Conservation Status and Red List of the Terrestrial Carnivores of Namibia

Ministry of Environment, Forestry and Tourism
Large Carnivore Management Association of Namibia
Namibian Chamber of Environment

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Cover photos:

Front (left to right): leopard: R Portas; lion: R Portas; African wild dog: R Portas; black-footed cat: A Sliwa; spotted hyaena: R Portas; cheetah: R Portas.

Back (left to right, top to bottom): caracal: R Portas; rusty-spotted genet: CW Winterbach; Cape fox: S Périquet; suricate: A Denker; striped polecat: T Smith; southern African wild cat: E Do Linh San; banded mongoose: R Zaayman; dwarf mongoose: S Périquet; brown hyaena: E Verwey.

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Foreword from the Ministry of Environment, Forestry and Tourism

Since independence, Namibia has developed policies and processes that link human economic development with a clean, healthy environment. Environmental conservation is no longer viewed as a luxury that only a few can afford, but a necessary feature of sustainable development that benefits all Namibians. The importance of the environment for our citizens' well-being is encapsulated in the Constitution and reflected in Vision 2030.

One of the aspirational statements of Vision 2030 is: "farms and natural ecosystems are productive, efficient, diverse, stable and sustainable – socially, economically and ecologically". Our approach to conservation is therefore not confined to National Parks or the sole responsibility of government; it extends to farmlands and relies on partnerships with farmers and other key stakeholders. The policies and plans that my Ministry has developed that relate to species occurring both within and beyond our National Parks therefore require extensive collaboration with non-governmental organisations (NGOs), other line Ministries, conservancies, farmers unions and the private sector.

This Red Data Book fits within this broader collaborative approach, as scientists from the Ministry of Environment, Forestry and Tourism (MEFT) and their NGO colleagues combined their knowledge to produce the most accurate picture of Namibian carnivore conservation created to date. Developing a Red Data Book allows us to collectively reflect on the status and population trends of our carnivores, identify strengths and weaknesses in our current conservation efforts, and take these factors into account in our future plans and policies.

While I am pleased to note that the populations of many threatened carnivore species are considered stable within Namibia, this is no reason for complacency. Some of the species assessed here are considered more threatened in Namibia than globally, which highlights the need for continued conservation efforts. MEFT is open to learning and adapting our policies according to the latest scientific information, so we will scrutinise the recommended policy amendments and actions that require our leadership.

As indicated in this book, human-wildlife conflict remains a challenge both in terms of carnivore conservation and for the livelihoods of Namibian farmers. Our 2018 Revised National Policy on Human-Wildlife Conflict Management and the 2017 North-West Human-Lion Conflict Management Plan were developed as a means to proactively address this challenge. We therefore welcome further research and innovative ideas to address human-carnivore conflict from the partner organisations involved in producing this publication. Besides human-wildlife conflict, numerous other threats have been highlighted and conservation actions proposed in this book. This provides a useful starting point for directing our attention and collective resources towards specific measures that will improve the status of Namibian carnivore species.

Namibia prides itself in hosting extensive and ecologically important populations of large carnivores. Some of these species provide a major attraction for tourism, which will hopefully recover strongly in this post-COVID period. Nonetheless, developing more direct, positive links between carnivore presence and local livelihoods would be especially welcomed at this time. Notwithstanding the ecological value of carnivores, further unlocking their economic potential is in line with our overall conservation strategy and would provide greater impetus for Namibian citizens to become actively involved in carnivore conservation.

Further, I encourage the partner organisations involved with developing this Red Data Book to continue working together, and to ensure that the recommendations are turned into conservation actions. This may best be achieved by establishing a national Carnivore Working Group, which my Ministry would be happy to support.

I hereby congratulate the editors, authors, reviewers and data contributors for producing the first Red Data Book for Namibian Carnivores. This important work will be incorporated into the body of knowledge and information we can use to chart a way forward to conserve these species. I fully endorse this publication and encourage MEFT officials, conservation NGOs, universities and their students, and national and international donors to make full use of it to guide our research, build capacity within Namibia to address the challenges detailed herein, and implement actions on the ground that will make a positive difference for carnivores and our people.

Hon. Pohamba Shifeta
Minister of Environment, Forestry and Tourism

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Message from the Large Carnivore Management Association of Namibia (LCMAN)

LCMAN was established to promote and support the long-term management and conservation of healthy populations of free-ranging large carnivores in Namibia. We are a membership association comprising twelve non-governmental organisations (NGOs) that are involved in conservation and research efforts relating to large carnivores. MEFT, the Namibia Agricultural Union (NAU), and the Namibia Professional Hunting Association (NAPHA) are key partners for fulfilling our mission to conserve these species.

The main objectives of LCMAN are:

- To promote an understanding of large carnivores, their biology, ecology, roles and values in ecosystems, interactions with people (and their production systems), and conservation requirements.

- To serve as a national body of expertise and as a point of reference for all matters concerning large carnivores, including legal, policy, management, research and related issues.

- To advocate for and on behalf of large carnivore conservation, to ensure that sound research-based information and management is applied, as well as ethical practices in all aspects of large carnivore management, conservation, research, reintroductions, housing, utilisation and related issues.

Developing the Carnivore Red Data Book is therefore fully in line with our objectives. Although this publication is the first of its kind for Namibian carnivores, it builds on the Namibia Large Carnivore Atlas produced by Lise Hanssen and Philip Stander in 2004. This publication expands on that work to include small- to medium-sized carnivores and follows the processes set forth by the International Union for the Conservation of Nature (IUCN) that includes rigorous peer-review. The Red Data Book therefore marks a significant milestone for science-based carnivore conservation in Namibia.

As one can see from the author list, the current publication is the product of teamwork among numerous experts from within LCMAN membership and beyond. It also incorporated sightings from the general public through the Atlasing in Namibia project hosted by the Environmental Information Service (EIS) in Namibia. We would like to thank the Namibian Chamber of Environment (NCE) for initiating the process and providing financial and technical support to see the project to fruition. John Pallett deserves a special mention for his tireless coordination work over the years that it took from conception to publication. Finally, the external reviewers who found time to critically evaluate our assessments provided productive feedback and consequently improved the quality of this Red Data Book.

As an Association, we look forward to implementing the clear action plans detailed herein to ensure that the next Red Book assessment shows significant progress, especially for threatened species. Ultimately, we want to improve the status of each threatened carnivore species by working closely with MEFT, farmers who live with these species, and the private sector. As with this publication, conserving carnivores will take sustained teamwork and support from within and beyond Namibia's borders.

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Message from Dr Chris Brown, CEO of Namibian Chamber of Environment (NCE)

Red Data Books are essential tools for biodiversity management and conservation provided that the data on which they are based is sound, and the recommendations they make are effectively implemented.

The best way to ensure quality data is through collaboration by sector and species experts in a constructive setting, where everyone pools their data, information, ideas and expertise while retaining a questioning scientific attitude. And then to subject their work to critical independent review by other specialists.

And the best way to ensure that the recommendations are implemented is to set up an appropriate collaborative institutional mechanism for the contributors to the Red Data Book to continue working together and with other stakeholders to develop strategic action plans based on the key recommendations, to collectively implement the actions and to update the information, recommendations and plans from time to time.

I was therefore delighted when carnivore conservationists and scientists working in Namibia agreed to work together on this publication at our workshop in November 2017. All of the authors and contributors, the editors, John Pallett and Gail Thomson, and Alice Jarvis of the Environmental Information Service who produced all the maps, deserve a hearty congratulation now that their combined efforts over the intervening years have come to fruition in the form of the Red Data Book for Namibian Carnivores. The end result is a highly informative, detailed publication of which we can all be proud.

The Namibian Chamber of Environment (NCE) was established to facilitate just such collective actions by civil society in collaboration with the Namibian government and other partners. This project aligns closely with three of our aspirational objectives as a Chamber namely, to conserve the natural environment, protect indigenous biodiversity and endangered species, and promote best environmental practices. Red Data Books further provide baseline data, a focus for collaborative action, a means to engage with policy makers to improve our policy formulation and implementation, and facilitate wider access to environmental information, all of which are part of our operational objectives.

The widespread geographical ranges of carnivores across Namibia, as reported here, are a testament to environmental policies that support thriving wildlife-based industries well beyond the boundaries of protected areas. The relative success of Namibian wildlife management policies on formally unprotected lands presents opportunities to diversify our wildlife economy, but also creates challenges associated with living alongside carnivore species. The species assessments that reveal declining populations or heightened threats should therefore spur further action on the ground. It is up to us to now establish the institutional mechanisms that will facilitate the effective development of strategic action plans and the implementation thereof.

This project would not have been possible without our sponsors, especially B2Gold Namibia, which availed their Otjikoto Environmental Centre and provided funding for the initial workshop where this Red Data Book was first conceptualised. We are also grateful to our other sponsors shown on the imprint page of this book.

SUMMARY

Red Data Books provide information on the level of threat to the earth's biodiversity, identify the causes, and make recommendations on what can be done to address the problem.

As such, they are used to:

- Direct attention and resources to the greatest conservation priorities;
- Provide guidance for prioritised conservation action;
- Improve planning and environmental assessments;
- Monitor the status of species and groups of species over time; and
- Educate students, conservation scientists and managers, policy makers and the general public about the status of biodiversity, its threats and conservation needs.

Eleven of Namibia's 34 terrestrial carnivore species were found to be either *Threatened* (six species) or *Near Threatened* (five species). Of the Threatened species, one is considered to be **Critically Endangered** in Namibia, the African wild dog; one is **Endangered**, the cheetah, and four are **Vulnerable**, being the leopard, lion, black-footed cat and spotted hyaena. In Namibia, large carnivore species are generally more threatened than medium and small species, and the cats (Felidae) have a higher proportion of species threatened (four of seven) than other carnivore families.

The Near Threatened species are the serval, brown hyaena, Cape clawless otter, spotted-necked otter and African striped weasel.

One species is near-endemic to Namibia, the black mongoose which is listed as of Least Concern, i.e. no significant threats and conservation issues, but which warrants monitoring because of Namibia's special conservation responsibility to this species.

There are a number of common threats faced by the Threatened and Near Threatened carnivore species in Namibia, with most facing multiple threats. The most important of these are:

- Human-wildlife conflict (HWC) – when the species is deliberately killed in response to real or perceived damages caused by that species. A wide variety of methods are used, including poisons, trapping, shooting, digging out breeding dens and killing pups;
- Habitat loss, fragmentation or degradation. A particularly concerning trend is the expansion of game-proof fencing across the country resulting in habitat loss to carnivores, land fragmentation and the prevention of mobility for wildlife generally, one of their most important adaptations to arid conditions;
- Bycatch – when the species is killed in snares, gin traps or by poison aimed at other animals. Poisons are a particularly unselective and damaging form of predator control which has a devastating impact on non-target species, particularly birds of prey;
- Species killed or captured deliberately to use their parts, traffic their skin, bone or teeth, or sell them live (often as cubs) in the illegal wildlife trade;
- Accidental road mortalities.

By addressing these key root causes, the conservation status of the threatened carnivores can be significantly improved. The threats and recommended priority actions needed to address the threats are set out for each of the 11 Red Data species.

The next step is to develop these recommendations into strategic conservation actions plans. Where there is potential for synergy, this should be exploited. An appropriate institution, such as a national Carnivore Working Group should be established to (a) develop the action plans, (b) implement the plans, (c) monitor and assess their impact on carnivore populations, and (d) update the information on both threats and actions as may be relevant to each species.

This Carnivore Red Data Book is available in hard copy, and can be downloaded in electronic form at www.the-eis.com/elibrary.

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CHAPTER 1: INTRODUCTION

THE GLOBAL IUCN RED LIST AND NATIONAL RED DATA BOOKS

Despite international political commitments, biodiversity continues to decline and anthropogenic pressures on the natural world continue to increase (Butchart *et al.* 2010). The first step to addressing the biodiversity crisis is to understand its extent, severity and causes. Without this information it would be impossible to find effective solutions. To address this need, the International Union for the Conservation of Nature (IUCN) established the Red List, which since 1964 has grown to become the largest and most comprehensive global database of extinction risks to plants and animals (IUCN 2021).

National Red Data Books are an extension of this global effort that uses the same criteria for assessing threats for species at the national level following guidelines provided by the IUCN (2012b). Some species may be more or less threatened at the national level than the global level, depending on the availability of suitable habitat and the relative success of national conservation policies. Obtaining accurate information from local experts at this scale is essential for guiding nationally appropriate policies (Gärdenfors *et al.* 2001). This publication – covering mammalian terrestrial carnivore species – is the second Namibian Red Data Book on fauna following the 2015 publication *Birds to Watch in Namibia: Red, Rare and Endemic species* that covered threatened Namibian birds (Simmons *et al.* 2015).

The IUCN Red List approach and categories

IUCN Red List assessments combine science-based data with expert knowledge for each species. They are used for setting conservation priorities by identifying which species are at the greatest risk of extinction, and what steps can be taken to reduce the threats they face (Hoffmann *et al*. 2008). In this publication, each assessment takes into account the estimated population size and trend, geographical range and habitat, and lists the known threats to each species. Where known, the population size and geographical range is given for Namibia and globally.

These factors are taken into account when assigning a species into one of the following categories (from worst to best status): Critically Endangered, Endangered, Vulnerable, Near Threatened, and Least Concern. None of the Namibian carnivore species fall into the remaining IUCN categories: Extinct, Extinct in the Wild, Data Deficient or Not Evaluated (Figure 1). Species falling into the first three categories are threatened with extinction in the near or medium-term. Near Threatened species could become threatened in future if current threats are not addressed.

Globally, 28% of the species in Carnivora (including marine carnivores) are categorised as Vulnerable or worse by the IUCN, which is five percent higher than the proportion of threatened mammalian species in all Orders comprising 50 or more species (Figure 2, IUCN 2021).

History of the Namibian Carnivore Red Data Book

The concept of a Namibian Red Data Book for carnivore species was first discussed during a workshop on 8-10 November 2017 hosted by the Namibian Chamber of Environment (NCE) at the Otjikoto Environmental Centre, sponsored by B2Gold Namibia. This meeting brought together experts from non-governmental organisations under the umbrella of the Large Carnivore Management Association of Namibia (LCMAN) and those employed by the Ministry of Environment, Forestry and Tourism (MEFT). Since the workshop, groups of species experts from LCMAN and MEFT worked together on each species account, which were reviewed by external experts. John Pallett took on the role of the lead editor to guide the assessment and review processes, and Alice Jarvis of Namibia's Environmental Information Service (EIS; www.the-eis.com) collated information from the Carnivore Atlas and other sources to produce the distribution maps.

Procedures followed for Namibian carnivore assessments

This publication focuses on terrestrial mammalian carnivores in Namibia (Order Carnivora, excluding the Cape fur seal). Although LCMAN member organisations typically focus on large terrestrial carnivores, medium and small carnivores were included to highlight the current knowledge and status of these species.

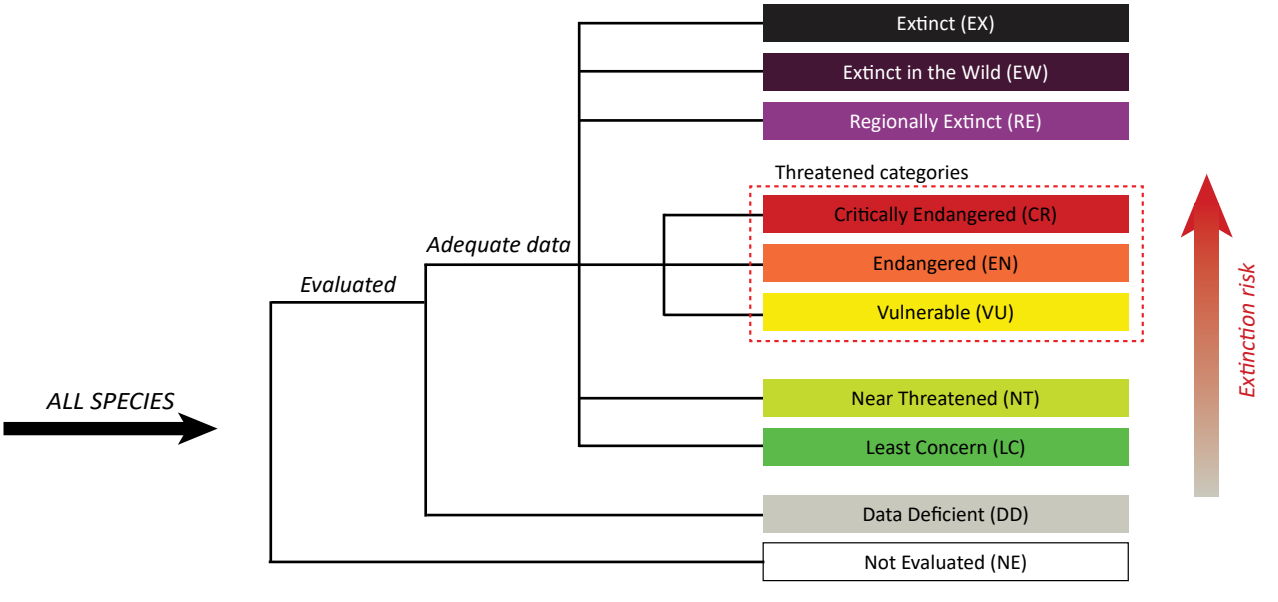

Figure 1: IUCN Red List categories of threat (IUCN 2021).

Where possible, Namibian experts with past or current research and conservation projects and working in collaborative teams were tasked with assessing each species falling within their area of expertise. For lesser-known species with no dedicated research programme, the assessor(s) conducted a scientific literature review to collate information about the species in Namibia and the southern African region. External reviewers were selected based on their scientific publication record for the species in question to ensure that they possessed the relevant expertise.

The geographical range for each species within Namibia was refined from the IUCN global range maps using verified records collected through the EIS's Atlasing in Namibia programme, historical records from other publications, and current data and expert knowledge. The range area, shown in green on the distribution maps, indicates where suitable habitat exists for the species. Individual records are plotted within Quarter Degree Squares and are differentiated between historical (1960-2008) and current (2008 to present) records.

The historical data are derived from previous atlases (notably, the Namibia Large Carnivore Atlas: Hanssen & Stander 2004), older datasets, information in the literature and museum specimen records. Current records are from datasets supplied by LCMAN member organisations, primarily through camera trapping and satellite collar data, or sightings records from farms and communal conservancies (the latter including human-wildlife conflict records), and citizen science records collected through the Carnivore Tracker and the Environmental Information Service's Atlasing in Namibia programme, including their mobile applications. Records which could not be verified and were located beyond the known range of the species were excluded.

Population estimates were possible only for better-studied species where intensive studies have been completed in different parts of the country to obtain density estimates that were then extrapolated to similar habitats. For species where such studies have not been done, experts stated whether it was common or rare in Namibia. Similarly, population trends were based on science-based data where possible, but also included general observations by researchers over time, e.g. range expansions or contractions combined with frequency of conflict incidents or reported sightings.

The threat assessment for each species is based on findings published in scientific literature for the species and the assessors' experience of the severity of these threats within Namibia. These are considered alongside the information about Namibian range and population size to decide whether the species' status in Namibia is the same, better or worse than the current global status. Finally, each assessment provides several action steps that can be taken to increase our understanding of the species and the threats they face, improve management for threatened species, and create public awareness of their status and importance.

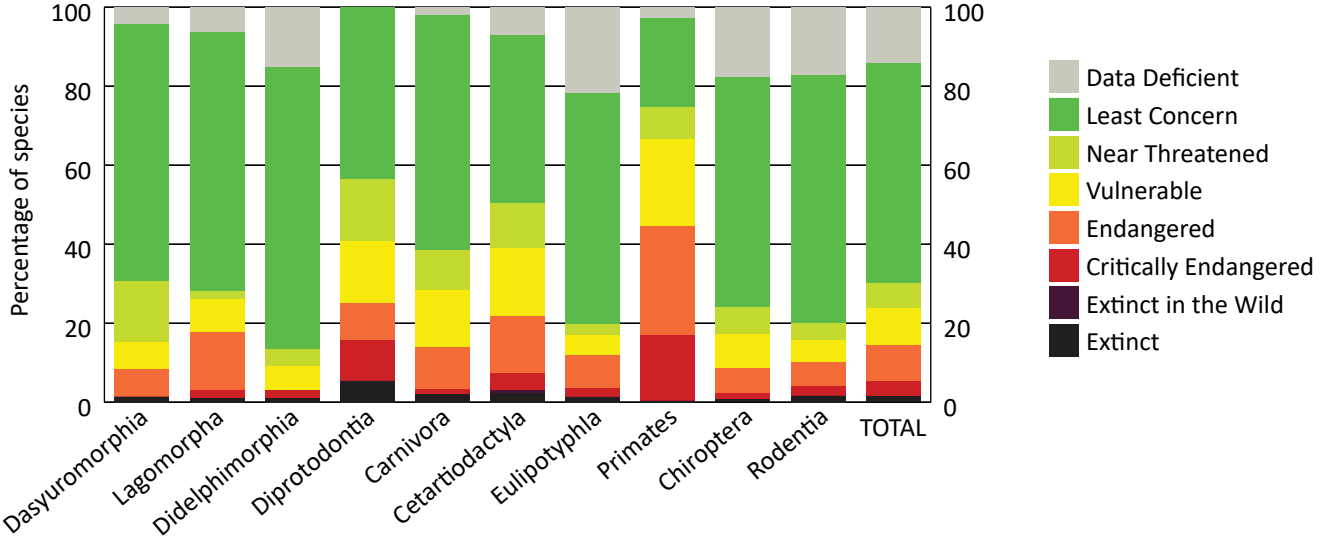

Figure 2: The percentage of species, globally, falling into each IUCN category for mammalian Orders comprising 50 or more species.

OVERVIEW OF NAMIBIA

The physical environment and available habitat combined with human factors of land use and policies largely dictate where carnivores can occur and at what density. This section provides a brief summary of some of the most important of these factors.

Climate and vegetation

Namibia covers 824,000 km² of land in the south-western corner of Africa and is characterised by a dry climate and low human population of 2.6 million (Atlas of Namibia Team, 2022). The arid to semi-arid Namib, Karoo and Kalahari ecosystems cover most of the country (Figure 3). The north-central and north-eastern parts of the country receive higher rainfall (Figure 4) and are characterised by savanna, woodland and floodplain ecosystems.

The aridity of Namibia's climate affects human land use and the natural density of wildlife in the country, which includes carnivores and their prey species. Crop farming is mainly restricted to the north-central and north-eastern parts of the country (and in the vicinity of a few permanent dams), while the remaining rural areas are used for livestock farming, wildlife ranching or a combination of the two (Figure 5). Sheep and goats are the primary livestock type in the southern and western parts of the country, while cattle predominate in the central and northern parts (Atlas of Namibia Team, 2022).

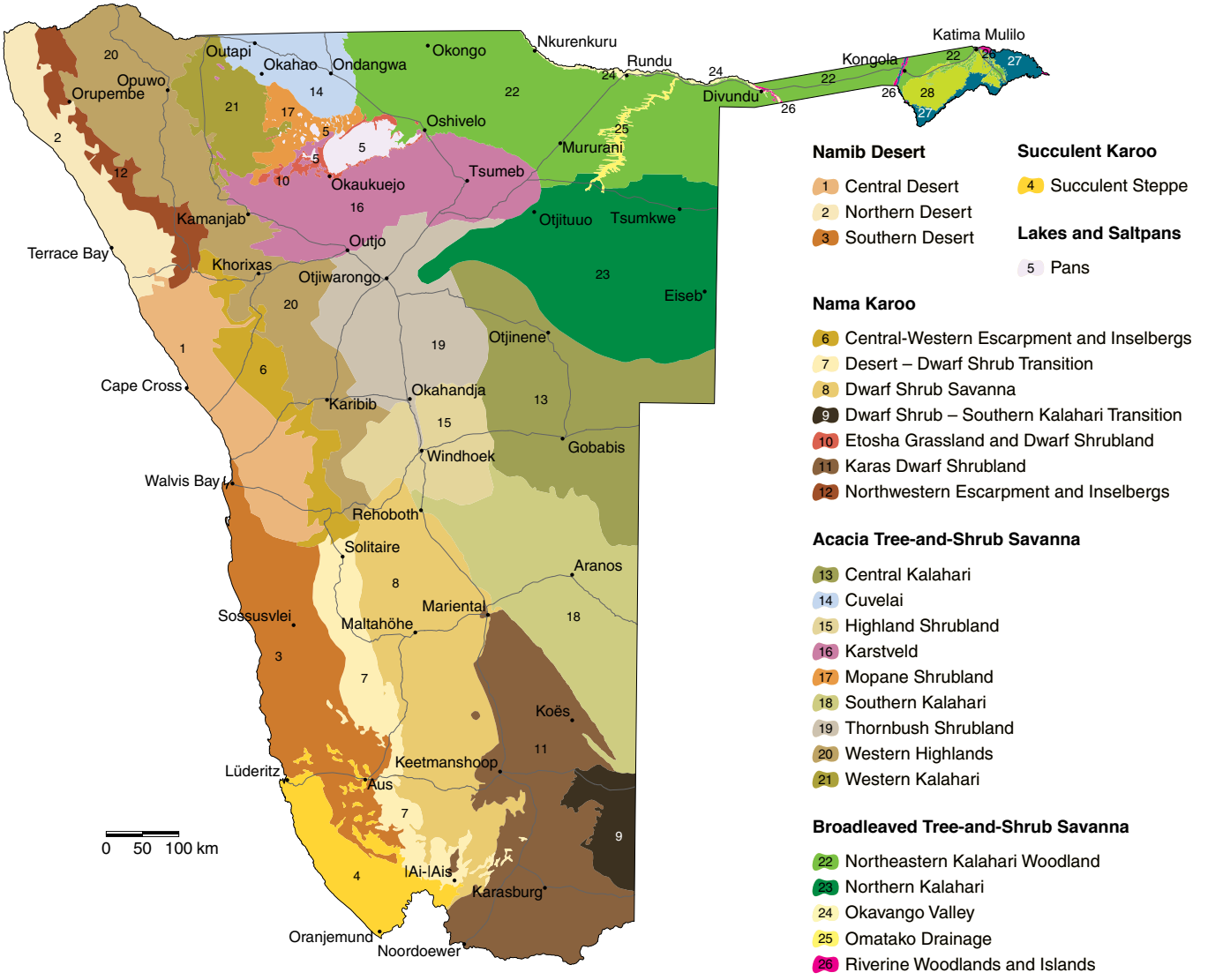

Figure 3: Vegetation types in Namibia (Atlas of Namibia Team, 2022).

Wildlife management policies and land use

Policies that allow Namibian people to benefit from wildlife through hunting and tourism encourage the maintenance of wild herbivore populations in unprotected areas (Barnes & Jones 2009, Weaver *et al*. 2011, Lindsey *et al*. 2013d), which in turn provides a prey base for carnivores. These conditions allow for greater human-carnivore coexistence outside formally protected areas than in most other countries, although it also creates competition between farmers and carnivores for valuable game species (Lindsey *et al*. 2013c). Because of the arid environment, prey and subsequent carnivore densities are nonetheless naturally low in most parts of Namibia, thus making populations more vulnerable than in countries where they occur at higher densities.

Land use patterns (Figure 5) further influence prey and subsequent carnivore densities. Outside of state protected areas and excluding urban areas, the remaining land can be broadly divided into freehold and communal farmlands. On freehold land, individual landowners hold a registered title deed, while communal lands legally belong to the state and their use is managed by recognised traditional authorities and state institutions – the people living there do not have secure land tenure (Atlas of Namibia Team, 2022). Freehold farms are fenced, either with low livestock fences (these can be porous multi-strand fences or 'jackal-proof' fencing that limits movement for non-jumping species; Cunningham 2019), or with game-proof fencing that limits the free movement of most large mammals (McGranahan 2011); fences of all heights may be electrified. Communal lands are largely unfenced, with exceptions where parts of the commons are fenced off – often illegally (Werner 2018).

Namibia's 21 National Parks cover 16.8% of the country, with the largest of these in the arid west, together covering the entire coastline. A relatively large proportion of land in the north-east falls within National Parks, where they form

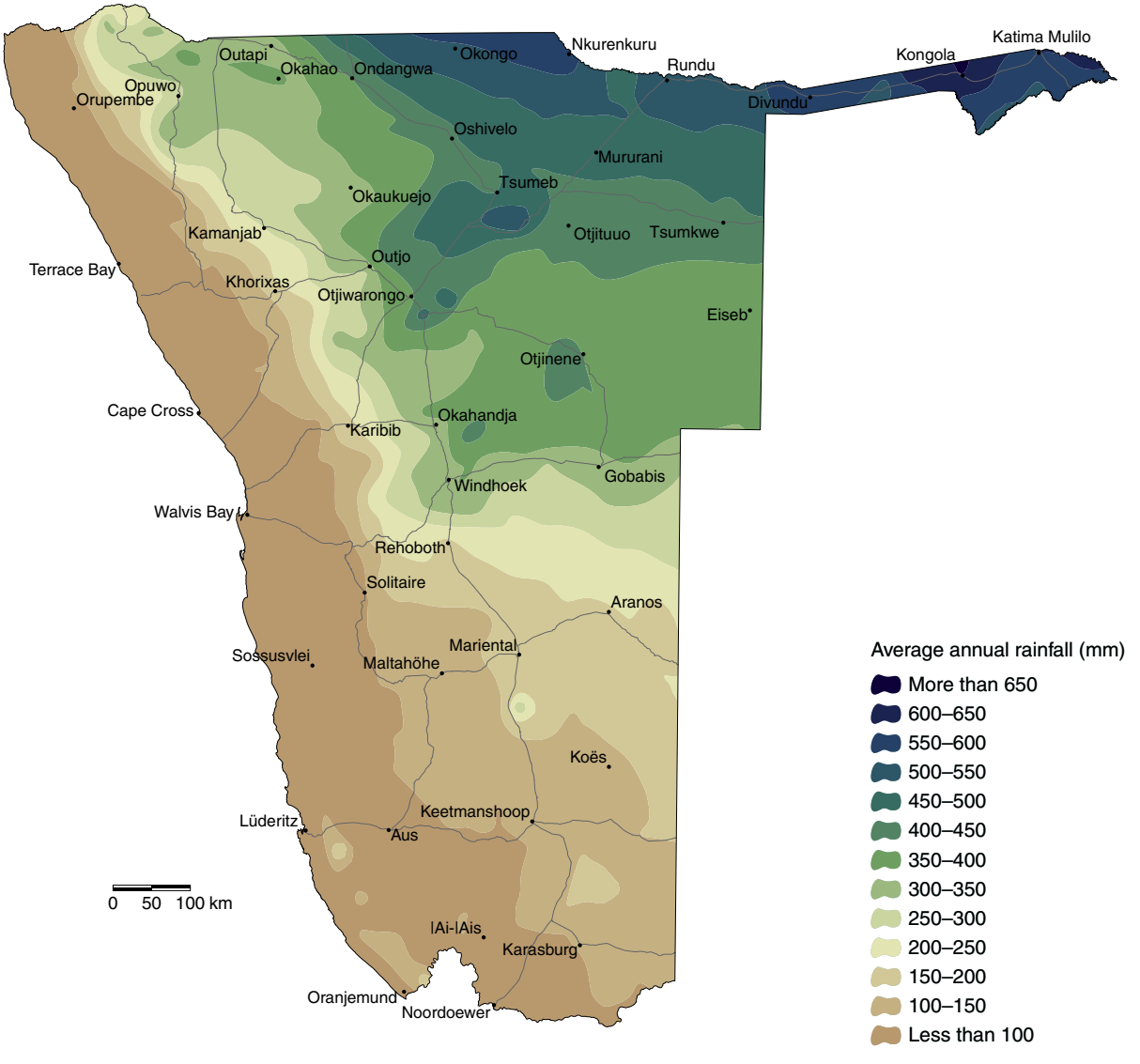

Figure 4: Average annual rainfall (Atlas of Namibia Team, 2022).

part of the Kavango-Zambezi Trans-Frontier Conservation Area (KAZA TFCA). Two other Namibian Parks form part of TFCAs: Skeleton Coast–Iona in the north-west with Angola, and |Ai-|Ais–Richtersveld in the south with South Africa (Figure 6, inset). Etosha National Park is the largest inland protected area, and is dominated by the Etosha Pan (Figure 6). National Parks offer the highest level of protection for carnivores, although the borders are relatively porous and allow movement of carnivores onto neighbouring lands in Namibia or into other countries (in TFCAs).

Outside National Parks on communal lands, communities have established communal conservancies and community forests (most of which overlap with conservancies- Figure 6) that cover 21.4% of Namibia's surface areas (Ministry of Environment, Forestry and Tourism & NACSO 2020). Communal conservancies were primarily established to provide people living on these lands with conditional ownership rights over wildlife, thus allowing them to generate income associated with sustainable wildlife use. Conservancies are granted hunting quotas for species occurring on their lands, including carnivores, and can thus enter into agreements with hunting outfitters to use these quotas for own use or trophy hunting (Ministry of Environment, Forestry and Tourism & NACSO 2020). Communal conservancies can enter similar agreements with lodge or campsite operators that use their lands for tourism purposes. Areas within each conservancy are zoned according to the main use of that land – e.g. exclusive wildlife zones (which may be further zoned for hunting and non-hunting uses), farming zones, and multiple use zones. Tourism concession areas on state lands (e.g. Palmwag, Etendeka, Hobatere) have revenue-sharing agreements with neighbouring conservancies, although they function more like National Parks since people do not live within these concession areas.

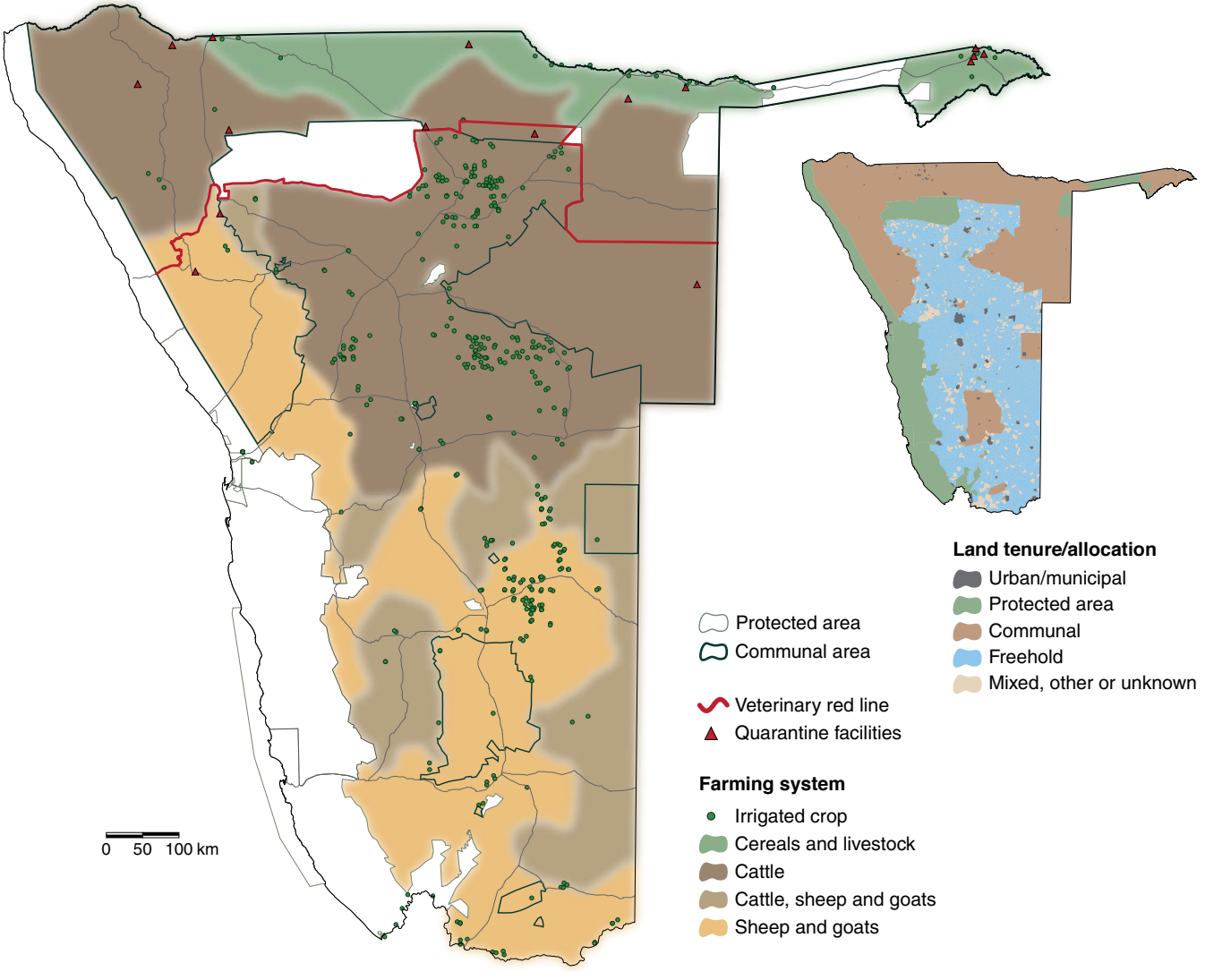

Figure 5: Land use in Namibia showing national parks; farming with large-stock, mixed, small-stock and game; irrigated cropping. Inset: land tenure. Both maps: Atlas of Namibia Team (2022).

On freehold lands outside National Parks, properties used primarily or exclusively for wildlife management (privately protected areas, wildlife ranches and hunting farms) are usually game-proof fenced on their borders, thus reducing connectivity in these areas. Individually fenced game farms pose a particular challenge for large carnivore conservation, especially where rare or valuable antelope species are stocked that fall within the prey range of large carnivores occurring on these properties (Marker *et al*. 2003). Freehold conservancies were established among some landowners as a means of jointly managing wildlife and enabling more economic opportunities through tourism development. Similar to communal conservancies, wildlife on these properties is used for hunting, photographic tourism and live sale of surplus high value species, and usually a combination of these. These private conservation and wildlife areas cover 7.2% of Namibia. Their significance to conservation is supported by government (Lindsey *et al*. 2013d) but insufficiently recognised.

Geographical orientation

Throughout this Red Data Book, authors refer to towns and regions in Namibia in the carnivore assessments. Namibia has 14 political regions with 29 smaller districts within the regions (Figure 7, inset). The locations of significant towns, roads, ephemeral rivers, perennial rivers and wetlands are provided in Figure 7 for geographical orientation purposes.

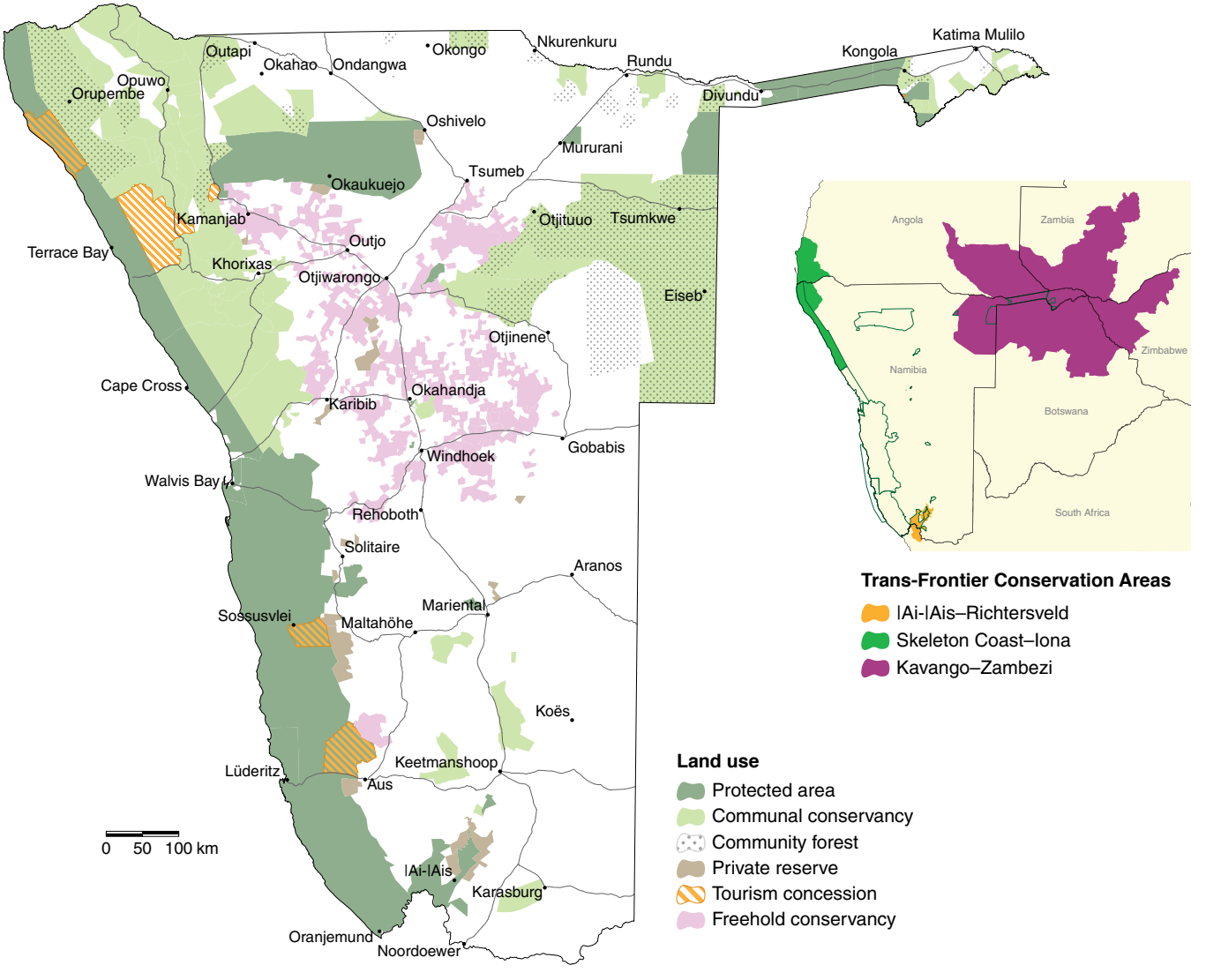

Figure 6: National parks, communal conservancies, community forests, privately protected areas. Inset: transboundary protected landscapes. Both maps: Atlas of Namibia Team (2022).

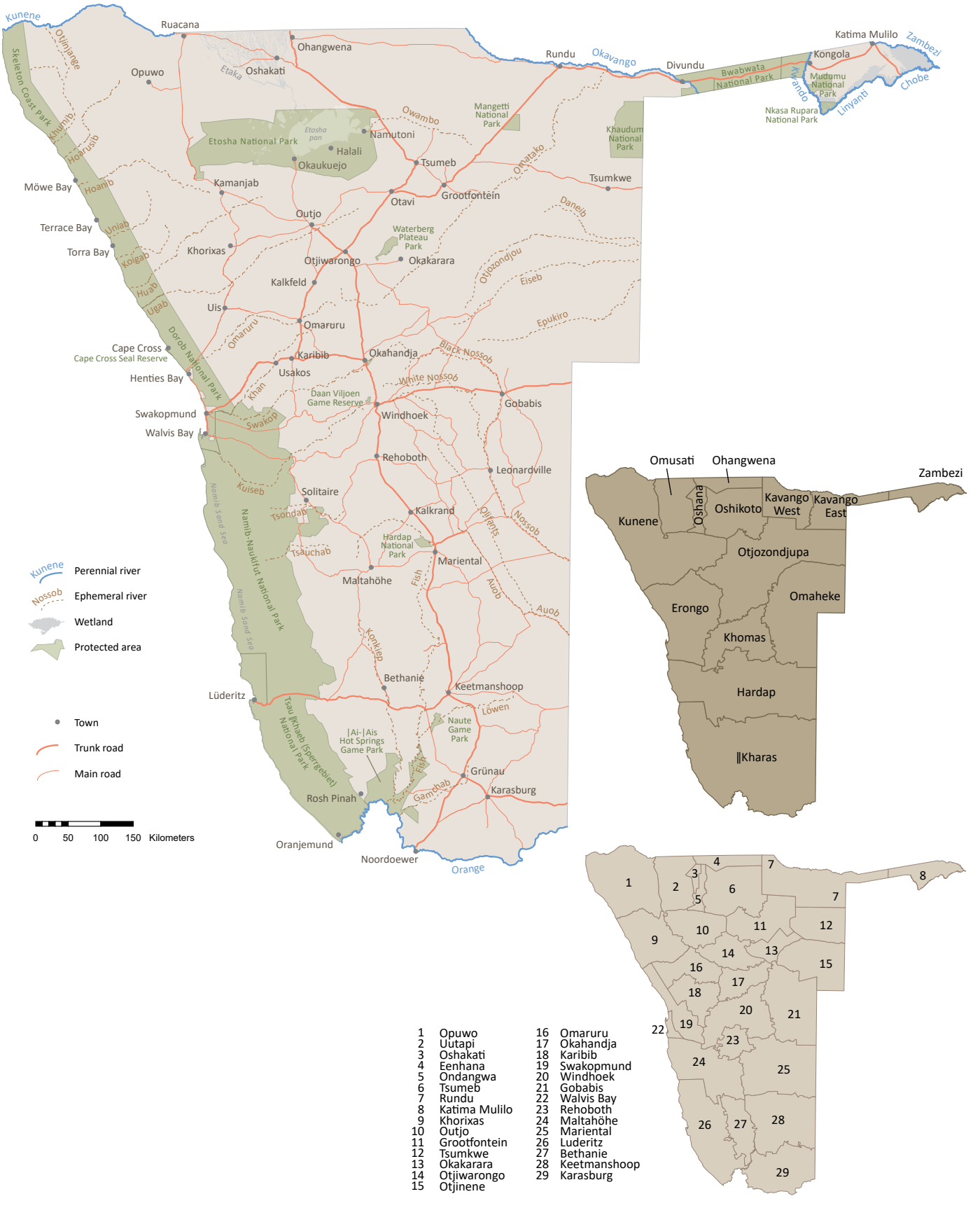

Figure 7: Parks, rivers, major towns, roads and some other orientation features.
Inset: Regions (top) and districts (bottom) of Namibia. All maps: Atlas of Namibia Team (2022).

THE STATUS OF NAMIBIAN CARNIVORES

There are 34 species of terrestrial mammalian carnivores (Order Carnivora) in Namibia, six of which fall into one of the threatened categories (Critically Endangered, Endangered or Vulnerable), five are Near Threatened and 23 are Least Concern (Table 1.1). This publication is divided into chapters that represent each of the five Carnivora families that are present in Namibia: Felidae (cat family – seven species), Hyaenidae (hyaena family – three species), Canidae (dog family – five species), Mustelidae (otters, badger and weasel – five species), Herpestidae (mongoose family – 11 species) and Viverridae (civet and genets – three species).

Table 1.1: Carnivore families in Namibia with the numbers of species in each status category as assessed in this Red Data Book.

Family	Critically Endangered	Endangered	Vulnerable	Near Threatened	Least Concern	No. of Species
Felidae	0	1	3	1	2	7
Hyaenidae	0	0	1	1	1	3
Canidae	1	0	0	0	4	5
Mustelidae	0	0	0	3	2	5
Herpestidae	0	0	0	0	11	11
Viverridae	0	0	0	0	3	3
Total	**1**	**1**	**4**	**5**	**23**	**34**

Status according to taxonomy and size

The Felidae has the highest proportion of threatened or Near Threatened species (5 out of 7 species) in Namibia, with one Endangered (cheetah, although Vulnerable globally) three Vulnerable (lion, leopard, black-footed cat) and one Near Threatened (serval, although Least Concern globally). Of the three Hyaenidae species in Namibia, the spotted hyaena is Vulnerable (although Least Concern globally) and the brown hyaena is Near Threatened. Namibia's only Critically Endangered carnivore species is the African wild dog (Canidae), while the remaining Canidae species are Least Concern. Three Mustelidae (two otter species and the African striped weasel) are considered Near Threatened in Namibia, primarily because they have highly limited areas of suitable habitat in the country, most of which falls outside protected areas. All of the Herpestidae (mongoose family) and Viverridae (genets and civet) occurring in Namibia are in the Least Concern category.

When categorised according to body size, small (defined here as <5 kg average body size) and medium-sized (5-20 kg) carnivores are generally less threatened than large carnivores (>20 kg) in Namibia (Figure 8). None of Namibia's large carnivores are considered Least Concern, whereas the majority of small and medium carnivores are considered Least Concern (23 species) or Near Threatened (four species). Only one species of small carnivore falls in a threatened category (black-footed cat, classified as Vulnerable).

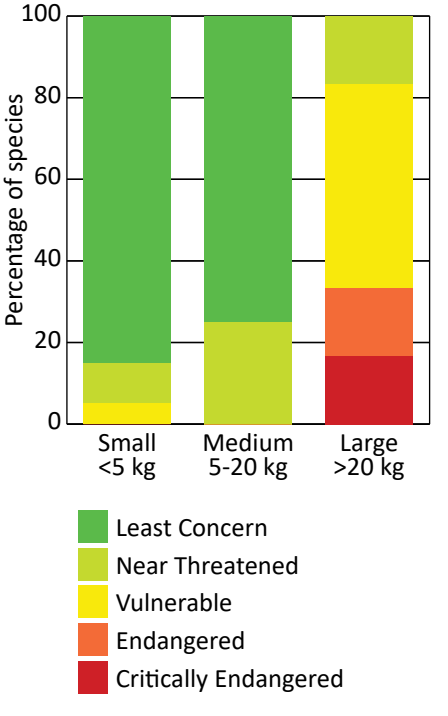

Figure 8: Namibian large carnivores disaggregated by body size and threat category, as assessed in this publication.


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While this cheetah (left) and black-footed cat (right) were caught for research purposes, cage traps are often used by farmers to catch and eliminate cheetahs and leopards either to prevent or in response to livestock or game losses.

Namibian contribution to global carnivore ranges

One carnivore species, the black mongoose, is near endemic to Namibia, with its range extending into southern parts of Angola. Namibia hosts a quarter and a third of the geographical range of the black-footed cat (Vulnerable) and brown hyaena (Near Threatened) respectively, which are endemic to southern Africa (Table 1.2). About 20% of the global cheetah population occurs in Namibia, which accounts for 14% of its geographical range. The Namibian ranges of African wild dog (10%), leopard (9%) and lion (6%) have some global significance (Table 1.2). Four mongoose species are endemic to southern Africa, while two Canidae species – bat-eared fox and black-backed jackal – have distinct sub-populations (and possibly sub-species, although this has yet to be determined) in the southern and East African regions (IUCN 2021).

Due to the semi-arid environment throughout most of Namibia, some species that are widespread and common elsewhere (notably, spotted hyaena, serval and African striped weasel) are relatively rare in Namibia. The two otter species, which rely on perennial rivers and wetlands, are marginal in Namibia and their populations are decreasing.

Despite hosting relatively small populations of African wild dog, lion and leopard, the population trend for these species is stable or variable (leopard) in Namibia, while they are declining globally. The national declines in black-footed cat and cheetah populations are of particular concern, however, given the large proportions of their global ranges that fall within Namibia.

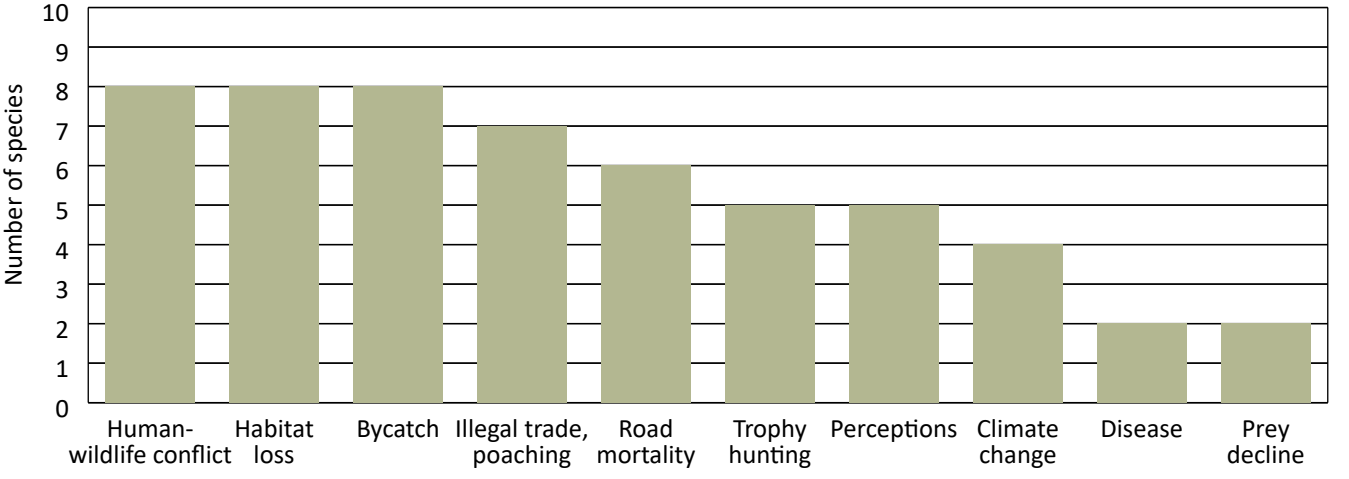
Table 1.2: Carnivore species of conservation concern in Namibia with their geographical ranges, proportion of their global ranges falling within Namibia, population estimates and trends.

Species	Global Status	Namibia Status	Namibian range (km²)	% Global range	Population estimate	Trend in Namibia
African wild dog	EN	CR	131,700	10.1	137-359	Stable
Cheetah	VU	EN	439,400	14.1	1,500	Decreasing
Black-footed cat	VU	VU	538,000	24.3	2,600	Decreasing
Leopard	VU	VU	776,800	9.1	<12,000	Variable
Lion	VU	VU	94,300	5.7	800	Stable
Spotted hyaena	LC	VU	399,800	2.7	615-715	Stable
Brown hyaena	NT	NT	685,600	28.0	<3,000	Stable
Serval	LC	NT	291,000	2.3	1,500-4,000	Stable
African clawless otter	NT	NT	±34,000	<1	Unknown	Decreasing
Spotted-necked otter	NT	NT	±23,000	<1	Unknown	Decreasing
African striped weasel	LC	NT	±46,000	<1	Unknown	Unknown

Threats faced by Namibian carnivores

Ten of the species in Table 1.2 (all except African striped weasel) face known threats to their populations. Several of these species face multiple threats simultaneously. The most common threats are human-wildlife conflict (HWC) i.e. when a species is deliberately killed in response to real or perceived damages caused by that species; habitat loss, fragmentation or degradation; and bycatch i.e. the species is killed in snares, gin traps or by poison used to kill other animals (Figure 9). Carnivores may also be killed or captured deliberately to use their parts or sell them live (in the case of cheetahs) in the illegal wildlife trade, or accidentally on the roads. Poorly regulated trophy hunting and negative perceptions (including lack of public awareness and suitable protective legislation) were considered significant threats to five species. The impact of climate change was considered an indirect threat, as more severe droughts could lead to prey declines for carnivore species, which is a current threat for two species.

Figure 9: Threats faced by the ten carnivore species in Namibia that are classified as Near Threatened or worse.



Road mortalities are considered a threat for six species of carnivores, including brown hyaena

Conservation Actions

The conservation actions suggested for Namibia's carnivores are divided into three categories in each assessment: management, awareness and research. While there is some overlap among these categories, management involves direct actions on the ground aimed at the target species, its habitat, prey etc.; awareness relates to changing human perceptions and policies that affect the target species; research relates to collecting and analysing data to inform or evaluate actions in the other two categories.

Although the actions relating to each species are often highly specific, several actions were recommended for multiple species (Table 1.3). The main cross-cutting awareness action was education aimed at increasing tolerance for carnivores (10 species), the most frequently recommended management action was livestock protection and other conflict mitigation methods (five species), while monitoring population trends in key areas was the most frequently highlighted research action (eight species). Note that these categories are not mutually exclusive and similar actions are categorised differently in the species assessments, depending on the authors' judgments.

While the actions in Table 1.3 were independently recommended for each species, they would be most cost-effectively implemented if they addressed several carnivore species at once. For example, education booklets on multiple carnivore species would be better than booklets focusing on one species. Further, some highly specific actions that only affect one species are not necessarily less important, as they may address significant threats facing that species.

It is therefore recommended that a national Carnivore Working Group be established, comprising the key stakeholder organisations that contributed to this Red Data Book, as well as other stakeholders such as farmer, conservancy and hunters' associations, and academia. The Ministry of Environment, Forestry and Tourism could chair the Working Group. The main functions of the Carnivore Working Group would be to turn the recommendations in this Red Data Book into strategic action plans, to collaboratively implement the action plans, to identify synergies and efficiencies in addressing carnivore management and conservation in Namibia, and to update the Carnivore Red Data Book from time to time.

Table 1.3: Management, awareness and research actions recommended in species assessments for Namibian carnivores that were assessed as Near Threatened or worse in this publication (n = the number of species for which the action is recommended).

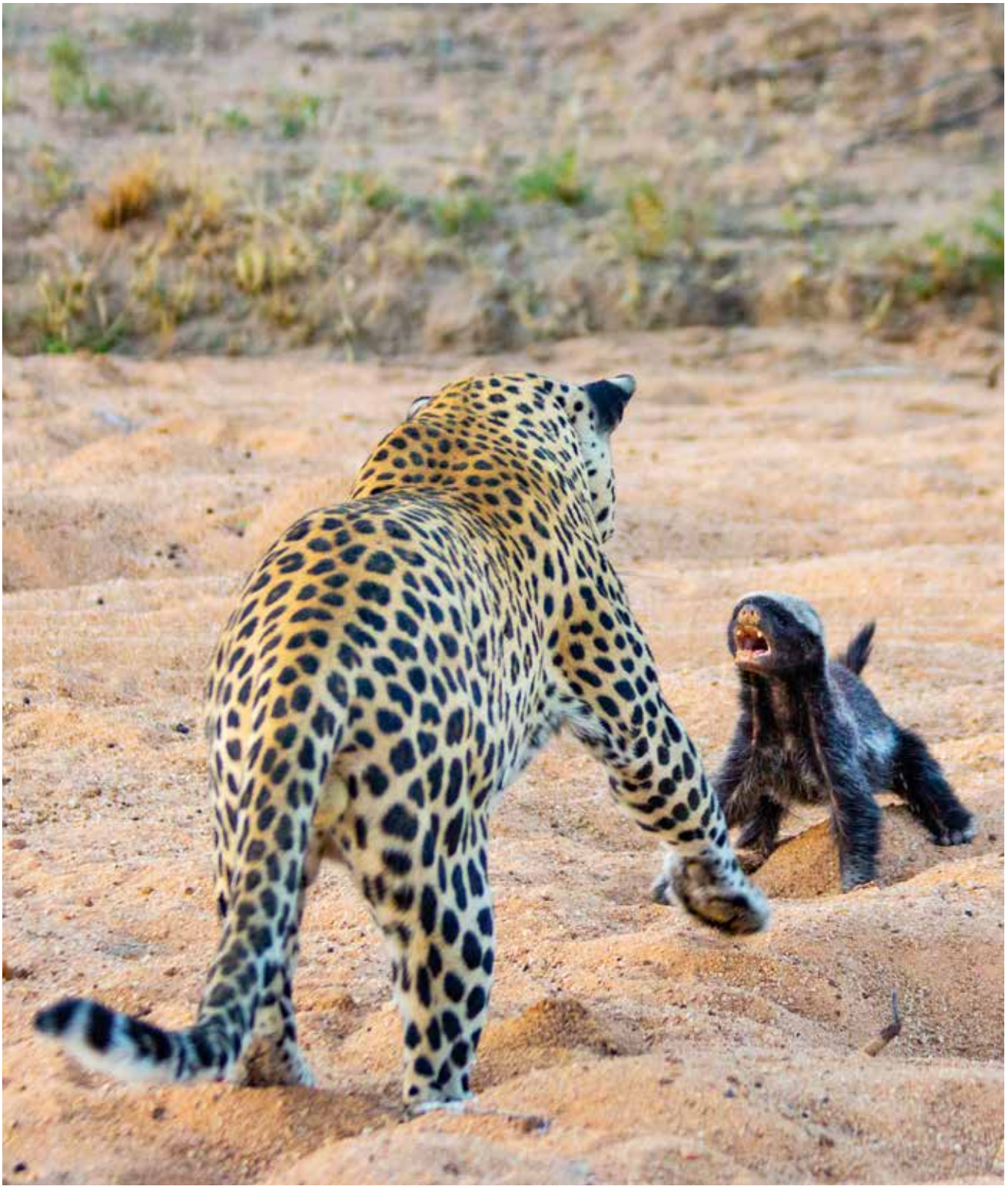
MANAGEMENT		
Sub-category	**Specific action**	**n**
Indirect	▸ Livestock protection/HWC mitigation	5
	▸ Reduce degradation/restore habitat	4
	▸ Increasing/maintaining wild prey	4
	▸ Land use planning	3
	▸ Road/infrastructure management	3
	▸ Range connectivity, reduce fragmentation	2
	▸ Farm/grazing management	2
Direct	▸ Translocation protocol/monitoring	4
	▸ Limit trophy hunting	2
	▸ Reintroduction	2

AWARENESS		
Sub-category	**Specific action**	**n**
Perceptions/ behaviour	▸ Education to improve tolerance	10
	▸ Recognition for predator-friendly farming	2
	▸ Discourage non-selective predator control	1
	▸ Better identification of problem species	1
	▸ Reduce hybrid serval/domestic cat demand	1
	▸ Employ community rangers	1
Policies	▸ Promote tourism	4
	▸ Create/improve economic incentives	4
	▸ Update species action plan	2
	▸ Improve HWC reporting and responses	2
	▸ Declare species as protected	1
	▸ Training on wildlife trade for officials	1

RESEARCH		
Sub-category	**Specific action**	**n**
Population/ distribution	▸ Monitor trends in specific areas	8
	▸ Collect more and/or better data	7
	▸ Obtain mortality data (all causes)	4
Threats	▸ Threat assessments for specific areas	2
	▸ Measure perceived vs. actual conflict	2
	▸ Risk analysis prior to reintroduction	1
	▸ Identify high-risk conflict areas	1
Other studies	▸ Establish DNA database	2
	▸ Economic cost/benefit studies	2
	▸ Dietary studies	2
	▸ Socio-ecological studies on communal lands	1

CHAPTER 2 – CHAPTER 7

SPECIES ACCOUNTS



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Cheetah *Acinonyx jubatus*

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Namibian conservation status	Endangered
Global IUCN status	Vulnerable (2015)
Namibian range	439,400 km^2
Global range	3,123,800 km^2
Population estimate	Widely distributed in central and western Namibia, less abundant in north-east Namibia. Very low densities in south-east and unknown status in north-central Namibia, except for its presence in Etosha National Park. The current population is estimated at 1,500 adult and subadult cheetahs
Population trend	Decreasing
Habitat	In Namibia cheetahs are found across a wide range of habitats from the evergreen tree savannas in the Zambezi Region to the open landscapes of the Namib
Threats	▸ Conflict with livestock and game farmers ▸ Inadequately regulated trophy hunting ▸ Decline of natural prey ▸ Illegal trade and keeping free-ranging animals in captivity ▸ Climate change ▸ Habitat loss and fragmentation (from game fences and main roads) ▸ Road mortalities

DISTRIBUTION

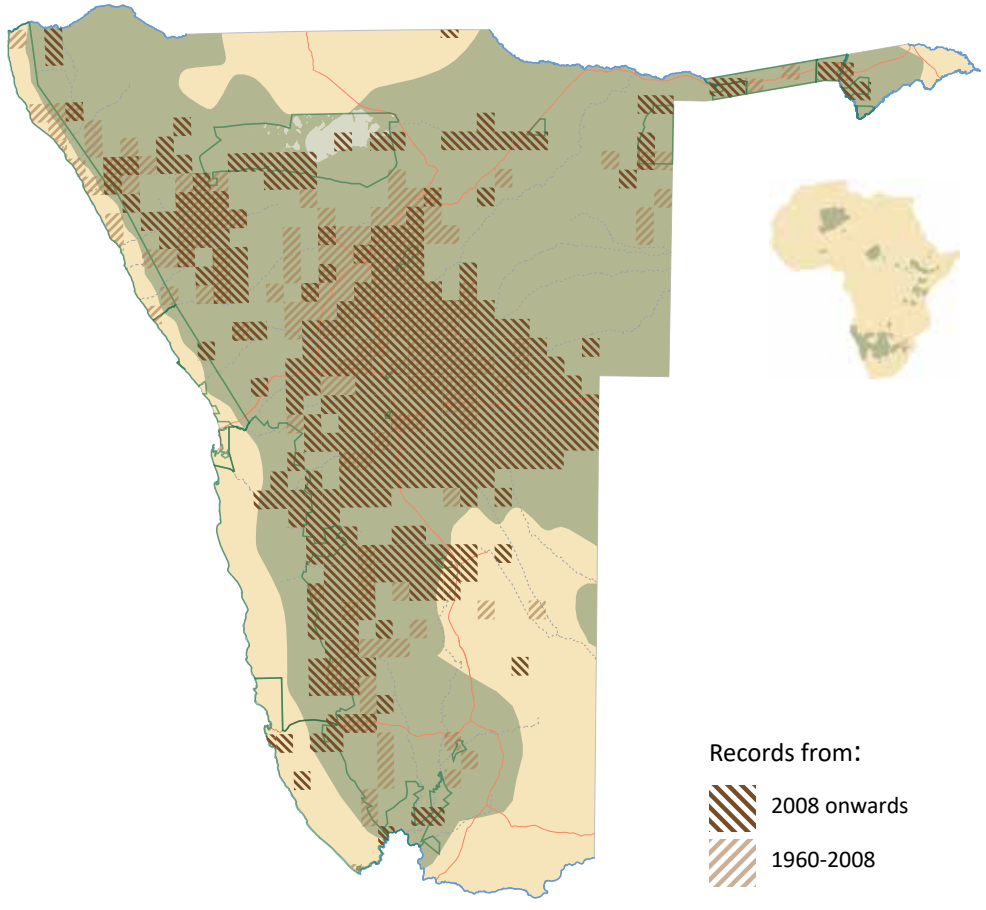
The global cheetah population is divided into 31 populations found in 20 African and Middle Eastern countries (Durant *et al*. 2017, Durant *et al*. 2018, Marker *et al*. 2018a). The largest populations are distributed in fragmented patches through southern and eastern Africa with the strongholds located in Namibia, Botswana, Tanzania and Kenya. Cheetahs also inhabit areas in Algeria, Mali, Niger, Benin, Burkina Faso, Chad, Central African Republic, South Sudan and Ethiopia along the southern margin of the Sahara. A few Asiatic cheetahs (approximately 70) live in Iran (*Acinonyx jubatus venaticus*). In most of the African countries, the status of the species is unknown and little information is available on the population size (Durant *et al*. 2015). The species is currently confined to 9% of its historical range covering 3,123,830 km^2 (Durant *et al*. 2017). The largest remaining viable populations of free-ranging cheetahs are located in southern Africa and are estimated to be approximately 4,000 individuals, of which fewer than 25% occur in protected areas (Durant *et al*. 2017, Weise *et al*. 2017).

Four subspecies of cheetah are formally recognised: *Acinonyx jubatus jubatus*, *A. j. venaticus*, *A. j. hecki* and *A. j.*

Distribution records of cheetah, and present estimated area of distribution in Namibia.

Inset: African distribution of cheetah according to IUCN (RWCP & IUCN/SSC 2015).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



soemmeringii. *A. j. hecki* occurs in the north-western African countries, whereas *A. j. soemmeringii* occurs in the north-eastern African countries. The Namibian cheetah is part of the southern African subspecies, *A. j. jubatus*. In the past, it was limited to southern African countries, but was recently expanded on taxonomic grounds to include the cheetahs found in eastern Africa (Kitchener *et al*. 2017).

Historically, cheetahs were distributed widely throughout Namibia (Shortridge 1934, Gaerdes 1973, Joubert & Mostert 1975, Marker-Kraus *et al*. 1996), with population densities presumably varying based on habitat, prey availability and density of competitors. Due to the mostly hostile attitude of small-stock farmers towards predators, cheetahs were extirpated from the southern part of the country, but they are still found widely throughout the central and north-western parts (Marker *et al*. 2018a). Most cheetahs live on privately owned farmland and community land rather than in protected areas (Durant *et al*. 2017). It was previously considered that cheetahs were absent from the desert regions on the western coast of Namibia (IUCN/SSC 2007, Purchase *et al*. 2007, Durant *et al*. 2017, Weise *et al*. 2017, Marker *et al*. 2018a) or that this area is a transient range for cheetahs (RWCP & IUCN/SSC 2015). During 2016 and 2017, intensive research in the arid environments of the Namib Desert and the Skeleton Coast confirmed a resident, reproducing population of desert-adapted cheetahs (Portas *et al*. 2017) and a monitoring programme was started. Despite this, there are still large areas where it is unknown whether cheetahs are transient or resident (Portas *et al*. 2017) and rapid declines might go unnoticed. Little is known about the distribution of cheetahs in the southern part of the country, in the north-western corner and in the communal land in north-eastern Namibia.

POPULATION ESTIMATE AND TREND

Previous population estimates for Namibia were vague and ranged from 2,000 to 8,000 animals (Myers 1975, Joubert & Mostert 1975, Morsbach 1987, Hanssen & Stander 2004, Purchase *et al*. 2007, Ministry of Environment and Tourism 2013b), with the latest estimate being only 1,498 adults and subadults (RWCP & IUCN/SSC 2015).

In the 1970s, the Namibian Department of Nature Conservation (DNC), later the Ministry of Environment and Tourism (MET) and now the Ministry of Environment, Forestry and Tourism (MEFT), conducted a nationwide farmland survey and estimated the cheetah population to be 2,500–3,500 adults and subadults (Nowell 1996). In the mid-1980s, the DNC carried out a radio-telemetry study on cheetahs on freehold farmland east of Windhoek, where

high levels of conflict with farmers were reported, and extrapolated the number of cheetahs for the entire country to be 2,000–3,000 (Morsbach 1987). The survey indicated that the population was declining due to the high level of cheetah removals by farmers. An assessment undertaken in the 1990s combined information provided from a farm survey with research projects in Etosha National Park and Bushmanland and determined a maximum population of 2,905 adult and sub-adult cheetahs (Nowell 1996).

Our current status assessment is based on a series of recent studies, which estimated the distribution and the population of adult and sub-adult cheetahs in Namibia (RWCP & IUCN/SSC 2015, Durant *et al*. 2017, Weise *et al*. 2017). The number of cheetahs was estimated at approximately 2,002 individuals (Weise *et al*. 2017) and 1,500 individuals (RWCP & IUCN/SSC 2015). Also, a variety of methods have been used to estimate the density of cheetahs within the last 10 years, including radio-telemetry and camera trap surveys (Marker *et al*. 2008a, 2008b, Portas *et al*. 2017). The density in central Namibia was estimated to be between 0.36 and 1.9 cheetahs/100 km² (Marker *et al*. 2008a). More recently (2015–2017), several sites across Namibia were surveyed, covering a total of 66,614 km², using a spatial-mark-recapture approach based on movement data of GPS-tracked individuals. This resulted in a set of regional density estimates ranging from 0.1 to 1.1 cheetahs/100 km², with the density in Kaokoland in north-western Namibia being 0.1–0.25 cheetahs/100 km², in the southern Namib Desert 0.2–0.4 cheetahs/100 km², in the Etosha Conservancy 0.6 cheetahs/100 km² and in east-central Namibia 1.1 cheetahs/100 km² (Portas *et al*. 2017).

In summary, central Namibia – largely the Khomas, Omaheke, Otjozondjupa and eastern parts of Erongo and Kunene Regions – have the highest cheetah densities of the country (Marker *et al*. 2008a, Portas *et al*. 2017, Weise *et al*. 2017), with the lowest densities reported in the south and the north-west (RWCP & IUCN/SSC 2015, Portas *et al*. 2017).

ECOLOGY AND BEHAVIOUR

The cheetah is the fastest land mammal, reaching speeds up to 93 km/h in the wild (Wilson *et al*. 2013). However, its lack of stamina requires the cheetah to catch its prey within the first 300 meters (Wilson *et al*. 2013). Cheetahs prefer small to medium-sized ungulates, but can take a wide variety of prey species (Hayward *et al*. 2006b, Wachter *et al*. 2006, Clements *et al*. 2014, Marker *et al*. 2018b). In Namibia, they prey predominantly on scrub hare, spring hare, common duiker, steenbok, warthog, springbok, hartebeest, gemsbok and kudu (Marker-Kraus *et al*. 1996, Marker *et al*. 2003a, Wachter *et al*. 2006). Adult male coalitions are able to take down large prey individuals, and have been observed to successfully hunt an adult kudu bull (J Melzheimer pers. obs. 2012), a juvenile giraffe (F Weise pers. obs. 2010) and a young adult eland bull (L Marker pers. obs. 1997). On Namibian farmlands, based on scat analyses, cheetahs prey primarily on wildlife, and livestock were only found in 4.0–6.4% of scat samples (Marker *et al*. 2003a, Wachter *et al*. 2006). The feeding ecology of cheetahs is influenced by the presence of other carnivore species. In areas where they coexist with lions, spotted hyaenas or leopards, they often lose their kills to these animals (Caro 1994).

Cheetahs have been considered primarily diurnal predators (Caro 1994), however, studies have shown that in areas with low interspecific competition, their activity pattern is shifted to night, early morning, and late afternoon (Marker 2002, Nghikembua *et al*. 2016, Marker *et al*. 2018b), and night activity is additionally favoured by moonlight (Cozzi *et al*. 2012, Broekhuis *et al*. 2014). Other studies hypothesise that this shift is driven by human activity (Belbachir *et al*. 2015).

In southern Africa, cheetahs are found primarily in the savanna biome (Low & Rebelo 1996, Marker *et al*. 2018b). Habitat selection of cheetahs has been linked to visibility, prey availability and large predator avoidance (Hayward *et al*. 2006b, Marker *et al*. 2008a, 2008b, Muntifering *et al*. 2006, Rostro-García *et al*. 2015, Marker *et al*. 2018b). In Namibia, bush encroachment has led to a reduction in preferred habitat (Muntifering *et al*. 2006, Nghikembua *et al*. 2016), but whether this has consequences for cheetah survival remains unknown.

Female cheetahs are either solitary or accompanied by their offspring, whereas males are either solitary or form coalitions of mostly two or three males (Caro 1994, Marker *et al*. 2008b, Wachter *et al*. 2018, Melzheimer *et al*. 2018). Genetic analysis has confirmed that in Namibia males within a coalition are usually related to each other (Marker *et al*. 2008c), similar to Tanzania and Botswana (Caro 1994, Gottelli *et al*. 2007, Dalton *et al*. 2013). Males exhibit two different spatial tactics (Caro 1994, Marker *et al*. 2018b, Wachter *et al*. 2018, Melzheimer *et al*. 2018) with non-territorial males ("floaters") roaming over vast areas and territory holders defending relatively small territories. In Namibia, a long-term study with more than 160 collared cheetah males revealed that the home range sizes of floaters were 1,595 km²±1,131 km², the ones of territory holders 379 km²±161 km² and of females 650±278 km² (Melzheimer *et al*. 2018). The territories are non-contiguous to each other but separated by a matrix of landscape (Melzheimer *et al*. 2020). Territorial males mark in the core areas of the territories at prominent landmarks such as big trees, rocks or termite mounts (Melzheimer *et al*. 2018). As they continuously patrol these marking sites, territorial males spend most of their time in the core area. Floaters encompass on average three territories and visit the respective core areas frequently, i.e. typically once or twice per 10 days. They do not mark these sites, but sniff the markings sites to check for opportunities to eventually take over the territory (Melzheimer *et al*. 2018, 2020). Females visit these areas rarely and sniff and mark (Melzheimer *et al*. 2018). These core areas function as communication hubs (CHs) of the cheetah population. The CHs cover only 5% to 10% of the area and are regularly distributed across the landscape with a mean distance of 23 km, thus functioning as a large communication network (Melzheimer *et al*. 2020). The high local cheetah activity in these CHs makes them hotspots for livestock depredation and thus are important areas concerning the cheetah-farmer conflict (Melzheimer *et al*. 2020). See below under "Actions" how the CHs can be used as a key to reduce livestock losses.

Young adult males typically disperse and cover large distances before settling down. They are not considered as floaters. Dispersers have been reported to move up to 200 km from their natal home range (Marker *et al*. 2008b).

Based on individuals known from birth, free-ranging female cheetahs in the Serengeti National Park (SNP) in Tanzania are reported to live up to 13.5 years, whereas males live up to 9.3 years (Kelly *et al*. 1998). Other studies reported that longevity in the SNP may reach up to 14 years 5 months for females and 11 years 10 months for males (Durant *et al*. 2010). Cheetahs give birth throughout the year and have litters of 1 to 6 cubs, with typical litter sizes of 3 or 4 cubs (Caro 1994, Marker *et al*. 2003b, Wachter *et al*. 2011, Mills & Mills 2014). On freehold farmlands in central Namibia, female cheetahs have several birth peaks distributed throughout the year; in the rainy season in February and March, in the cold dry season in June and July, and in the hot dry season in October and November (Marker-Kraus *et al*. 1996, Marker *et al*. 2003b). In the SNP, where cheetahs coexist with lions and spotted hyaenas, cub survival from birth to independence at 14 months of age is only 23% (Laurenson 1992, 1994), whereas on freehold farmland in east-central Namibia, an ecosystem without lions and spotted hyaenas, cub survival is 79% (Wachter *et al*. 2011). In central Namibia, average litter size at independence (14–18 months) has been recorded as 2.4 cubs (Marker *et al*. 2003b) and 3.2 cubs (Wachter *et al*. 2011), both higher than the 1.8 cubs reported in the SNP (Laurenson 1992, 1994).

THREATS

Across their entire range, cheetahs suffer from several threats, including conflict with livestock and game farmers, inadequately regulated trophy hunting, illegal trade, keeping free-ranging cheetahs in captivity, competition with other large carnivore species, decline of natural prey, climate change, habitat loss and habitat fragmentation. Human-wildlife conflict (HWC) is particularly pronounced in southern Africa due to perceived or actual predation on livestock and game (Durant *et al*. 2015, RWCP & IUCN/SSC 2015, Dickman *et al*. 2018, Durant *et al*. 2018, Marker *et al*. 2018a, 2018b, Schmidt-Küntzel *et al*. 2018, Tricorache *et al*. 2018).

In Namibia, cheetahs benefited from the removal of lions, leopards and spotted hyaenas from freehold farmlands, and from a subsequent reintroduction of prey species onto game farms (Marker-Kraus *et al*. 1996). Despite these apparently conducive conditions on farmlands, conflict with livestock and game farmers is the major threat to the cheetah population in Namibia, like elsewhere in southern Africa. Other factors such as landscape fragmentation due to the

erection of game fences, also poses an increasing threat to the cheetah population (Marker-Kraus *et al*. 1996, Marker *et al*. 2003c, Portas *et al*. 2017, Dickman *et al*. 2018).

Conflict with livestock and game farmers

Cheetah survival in the wild in Namibia is mostly threatened by human removal of cheetahs of prime breeding age, with males and females having an 80% and 86% chance, respectively, of dying between the age of independence and six years (Marker *et al*. 2003b). Since most cheetahs live on unprotected land (Durant *et al*. 2017), they are particularly vulnerable to indiscriminate removal by livestock and game farmers. Individual farmers have been reported to opportunistically kill cheetahs, mainly as a preventative measure (in 91% of cases) and not necessarily due to actual livestock depredation (Marker-Kraus *et al*. 1996, Marker *et al*. 2003c). Overall, a minority of intolerant farmers is responsible for >70% of all cheetah persecution on freehold farmlands, whereas the vast majority of farmers are tolerant or semi-tolerant towards the species (Weise *et al*. 2017). Between 1980 and 1991, 6,293 cheetahs were reported to have been killed or removed alive (CITES 1992). Between 1980 and 1993, an average of 26.1 cheetahs were removed per game farm, and 12.6 per livestock farm (n=157 total farms, Marker *et al*. 2003c). In addition, the proportion of

Table 2.1: The number of cheetahs reported taken into captivity or killed between 1960 and 2017, by district

District	Gaerdes[a] 1960-1973	DVS[b] 1986-1994	CCF[c] 1991-2017
Windhoek	296	146	26
Otjiwarongo	102	251	63
Okahandja	109	176	68
Outjo	45	118	16
Omaruru/Karibib	211	85	41
Grootfontein	54	87	20
Otavi	No removals reported	63	0
Keetmanshoop	No removals reported	24	0
Mariental/Maltahöhe	98	50	0
Gobabis	No removals reported	94	50
Unknown regions	No removals reported	No removals reported	127

[a] Gaerdes (1974), summarised in Marker-Kraus *et al*. (1996)
[b] Directorate of Veterinary Services in Marker-Kraus *et al*. (1996)
[c] Cheetah Conservation Fund, unpublished

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female cheetahs removed on game farms (42%) was higher than on livestock farms, where females only represented 26% of caught cheetahs (Marker *et al*. 2003c). Cheetah removals by district have been documented in Namibia from 1960 to 2017 (Table 2.1).

The MEFT has collected information on cheetah removals from the late 1970s to the mid-1990s and reported an average number of 553 cheetahs killed per year (Nowell 1996). The number decreased from 1986 to 1995, when an average number of 297 cheetahs per year was reported (Nowell 1996). More recently, the MEFT recorded that the total number of cheetahs killed from 1997 to 2004 was 1,679, which averages 240 animals per year. Of these, 1,088 were killed as "problem animals", whereas 591 were hunted as trophy animals. The actual number of cheetahs removed as "problem animals" is likely to be higher than the number reported to the MEFT (Marker-Kraus *et al*. 1996).

Weise *et al*. (2017) reported a removal rate of 0.3 adult cheetahs/100 km^2 per year on Namibian freehold farmland due to human-wildlife conflict (where removal refers to cheetahs killed or taken into captivity). This annual removal rate corresponds to approximately 27% of the total estimated population, using the density estimate from freehold farmland in central Namibia (Portas *et al*. 2017). Weise *et al*. (2017) infer that, considering the recruitment of cheetahs for this area, such a loss could only be compensated if densities are at a minimum of 0.67 adult cheetahs/100 km^2. For large parts of the country, lower cheetah densities are reported, which suggests that such a removal rate in those areas would not be sustainable.

Trophy hunting

Since 1992, Namibia has been allowed a limited trade of 150 cheetahs annually (CITES 1992), with almost 1,200 free-ranging cheetah trophies legally exported from Namibia between 2003 and 2013 (CITES trade database). Trophy hunting alone may not be a direct threat to the Namibian cheetah population, however when combined with removals (see Table 2.1), particularly removals of adult females, it is questionable whether the population is large enough to remain viable (Berry *et al*. 1997, Crooks *et al*. 1998, Cristescu *et al*. 2018). Typically, trophy hunting of cheetahs involves hunting from a hide at cheetah marking trees where territorial males are most likely to be encountered. This leads to a bias in the offtake towards territorial males, which entails a faster turnover in the territory tenure, with unknown implications on the mating system. In addition, females are sometimes hunted by mistake, potentially leaving orphan cubs.

Illegal trade

In addition to legal trade, there have also been reports of illegal trade of live captured wild cheetahs between Botswana, Namibia and South Africa, and of an illegal pet trade in which cheetahs are funneled through the Horn of Africa for sale into Middle Eastern markets (Tricorache *et al*. 2018). Even within Namibia, cheetah cubs are sometimes taken from the lairs and kept as pets (L Marker pers. obs. 2018) despite legislation prohibiting this (Ministry of Environment and Tourism 2012).

Competition with other large carnivore species

Cheetahs, particularly cubs, are vulnerable to predation by other large carnivores such as lions, spotted hyaenas and leopards (Laurenson 1994, Marker *et al*. 2018b). Several cases of leopards killing cheetahs have been reported in central Namibia (Krengel and B Wachter pers. obs. 2010, L Marker pers. obs. 2016), and such reports from farmers appear to be increasing. This rise is hypothesised to be linked to an increasing leopard population. While data to support this hypothesis is lacking, especially at the national level, farmers do report more leopard sightings.

Climate change

The majority of cheetahs are found in semi-arid environments, thus regions in southern Africa where temperature increases and changes in precipitation patterns are expected due to climate change (Nghikembua *et al*. 2018). With increasing temperatures, higher evapotranspiration is expected, causing more water stress, lack of surface water and possibly reducing primary productivity, which in turn would result in lowered grazing carrying capacity (Midgley *et al*. 2005, Ministry of Environment and Tourism 2008). This would lead to a loss of grassy savanna habitat in some parts of southern Africa where cheetahs are found. Consequently, cheetahs may suffer from reduced prey availability, and competition for available resources may be intensified. Ultimately, poor rangelands harbour more HWC as farmers become less tolerant towards any further economic losses. Varied precipitation patterns and rising temperatures also have the potential to change the ecology of vectors responsible for wildlife diseases such as fleas and ticks (Nghikembua *et al*. 2018, Roach 2008, Seijan *et al*. 2016).

Habitat loss and fragmentation, and human population growth

Pressure on cheetah populations is expected to grow in future as the human population grows, leading to greater competition for available resources and increased direct conflict. In addition, there is a current trend across the country to erect game fences, motivated by an increase of farmers that breed valuable game species, exotic species or different morphs of native antelope species. These game fences limit the movement of wildlife and aim to keep carnivores away. Some of these fences are electrified and even have mechanical methods to deter carnivores. Some game farmers have a lower tolerance for cheetahs than livestock farmers and induce higher mortality of cheetahs within their game-fenced areas, particularly of females and cubs (Marker *et al*. 2003c). Road mortalities have also been reported across the country (L Marker, J Melzheimer, B Wachter and F Weise pers. obs.).

Genetic variability

In addition to the main threats mentioned above, cheetahs have relatively low genetic diversity, which was assumed to have originated approximately ten thousand years ago (O'Brien *et al*. 1983, 1985). This low diversity has been apparent at several genetic markers over the past 35 years (reviewed in Schmidt-Küntzel *et al*. 2018), and was recently confirmed through a whole genome study (Dobrynin *et al*. 2015). Despite the low diversity levels, no major inheritable physical abnormalities are known to be an issue for the cheetah. Male cheetahs have poor sperm quality (Wildt *et al*. 1983, 1993) for which a genetic basis was found recently (Dobrynin *et al*. 2015), however this does obviously not hinder reproductive performance in the wild (Laurenson 1992, 1994, Wachter *et al*. 2011). Females have a high reproductive performance and resume quickly their oestrus cycle and become pregnant again, if they have lost their litter (Laurenson *et al*. 1992, Wachter *et al*. 2011). In contrast, captive females have a poor reproductive performance and only a few captive facilities successfully breed cheetahs (Marker-Kraus and Grisham 1993). It has been demonstrated that this is not due to stress levels in captivity but due to the phenomenon of asymmetric reproductive aging (Wachter *et al*. 2011, Ludwig *et al*. 2019). This phenomenon arises when first pregnancies of females are substantially delayed and their frequent oestrogen fluctuation induces pathologies of their reproductive tracts (Wachter *et al*. 2011, Ludwig *et al*. 2019).

Low levels of genetic diversity might impact the ability of the cheetah to adapt to changes in the environment or to newly emerging diseases (Castro-Prieto *et al*. 2011a, Schmidt-Küntzel *et al*. 2018). They are therefore at a potential disadvantage relative to species with more diversity, and it is important to preserve the current levels of diversity through viable population numbers and connectivity of populations (Schmidt-Küntzel *et al*. 2018). Currently the Namibian cheetah population is not showing signs of fragmentation at the genetic level (Marker *et al*. 2008c), however genetic data takes generations to show the effects of fragmentation, and fragmentation risk may thus be underestimated.

The adaptive immune system of cheetahs has limited potential because it is linked to immune genes for which only a few alleles have been detected (Castro-Prieto *et al*. 2011a). However, cheetahs have a strong constitutive innate immune system as shown with functional immune tests (Heinrich *et al*. 2016, 2017). Thus, it appears that cheetahs can compensate with their constitutive innate immunity for their limited adaptive immunity (Heinrich *et al*. 2016, 2017), which likely explains the good health status of the free-ranging Namibian cheetah population (Munson *et al*. 2005, Thalwitzer *et al*. 2010). Captive cheetahs, however, are known to be susceptible to diseases (Evermann *et al*. 1988), although this might be due to captive holding

conditions. Captive cheetahs are often kept together in groups that do not correspond to the composition in their natural social system, thus contact rates and stress levels, both factors increasing susceptibility to diseases, are higher compared to the wild (Wielebnowski *et al*. 2002, McEwen & Wingfield 2010). It is, therefore, possible that their immune system cannot always adequately cope with the unnatural conditions in captivity.

CONSERVATION STATUS

The cheetah is the most threatened large felid species in Africa. It is currently categorised as Vulnerable by the IUCN, with the global population estimated at approximately 7,100 adults and subadults, which are confined to less than 9% of their historical range (Durant *et al*. 2015). Durant *et al*. (2017) and Weise *et al*. (2017) recently called for the species to be uplisted to the Endangered status. While the number of mature individuals has not dropped below 2,500 individuals, which is a criterion for an Endangered status (IUCN 2012a), the cheetah is susceptible to dramatic changes over short periods of time. The species was predicted as being at risk of a population decline of 50% or more over three generations, which is another criterion for the Endangered status (IUCN 2012, Durant *et al*. 2017). This prediction is mainly based on the high percentage (77%) of the range-wide population occurring outside of protected areas (Durant *et al*. 2017). In Namibia, the situation is even more extreme, with over 90% of cheetahs residing outside of protected areas (Marker *et al*. 2018b). This exacerbated vulnerability in Namibia also supports the up-listing of Namibian cheetahs from Vulnerable to Endangered status.

ACTIONS

Because cheetahs have large range requirements and occur at low density, conservation planning is needed on a wide geographical scale (RWCP & IUCN/SSC 2015). Decreasing the conflict with humans, maintaining large contiguous areas of suitable habitat with healthy populations of ungulates, and establishing ecological corridors are priorities to conserve the cheetah population in Namibia. Overall, conserving the cheetah now and for future generations includes a complex web of governmental, social, economic and environmental challenges.

We consider the following actions, based on management, awareness and research, as key for the conservation of the cheetah population in Namibia. These correspond with the "Activities" in the logframe in Table 3.4. of the Namibian conservation action plan for cheetahs (Ministry of Environment and Tourism 2013b) developed during a national workshop in 2013 but not yet endorsed.

Management

- Maintain a large contiguous population of cheetahs within Namibia, connected to the populations in the other southern African countries.
- Ensure that all large-scale infrastructure development, including fencing and road building, allows the free and safe movement of cheetahs.
- Review policies to ensure the free movement of wildlife in Namibia and to revert the increasing trend of high and/or electrified game fences.
- Detect areas of high persecution of cheetahs (population sinks) and focus efforts to reduce the number of cheetahs killed.
- Reduce human-wildlife conflict by promoting methods of livestock protection such as herding, the use of kraals and guard dogs and assessing the effectiveness of livestock husbandry (Marker-Kraus *et al*. 1996, Dickman *et al*. 2018).
- Reduce human-wildlife conflict by identifying the communication hubs (CHs) of cheetahs on farmland and avoiding them as grazing areas for affected livestock (Melzheimer *et al*. 2020). CHs are characterised by high cheetah densities because they are constantly visited by the territorial males and often by the floaters. Thus, they represent areas of high livestock predation risk. Farmers can adapt their livestock grazing management according to the locations of CHs and shift the breeding herds away from the CHs into the surrounding matrix (Melzheimer *et al*. 2020). It was demonstrated that this shifting reduced the losses of cattle calves by more than 80% (Melzheimer *et al*. 2020). This is because cheetahs did not follow the breeding herds but preyed on the available game species in the CHs. Also, the location of the CHs remained stable when the corresponding territory changed ownership, thus the management adaptations of farmers have a long-lasting effect (Melzheimer *et al*. 2020). CHs are therefore "problem areas" rather than cheetahs in the CHs being "problem animals". CHs can be identified with the help of GPS-collared cheetahs or by finding the most actively used marking sites of the cheetahs.
- Focus efforts on improving tolerance towards cheetahs in livestock and game farming areas through awareness among the farming community, to reduce the number of indiscriminately trapped animals (Marker-Kraus *et al*. 1996, Marker *et al*. 2003c, Weise *et al*. 2015b, Dickman *et al*. 2018). In this sense, we recommend developing policies to ensure that cheetahs are not killed as a preventive measure and the practice of illegal and unselective killing methods is penalised.

- Improve the reporting to the MEFT of livestock and valuable game preyed on by cheetahs, and cheetahs killed by farmers, by working closely with the different Namibian Farmers' Associations, communal and freehold conservancies.

- Continue to develop a comprehensive protocol for translocations and reintroductions, and evaluate their efficacy (RWCP & IUCN/SSC 2015, Boast *et al*. 2018). Translocations of conflict-related cheetahs to reduce human-wildlife conflict have not proven successful to date. Weise *et al*. (2015b) showed that post-release survival and site fidelity of translocated cheetahs are low. Also, the significant financial costs of translocations and the failure to reduce stock losses both corroborate the ineffectiveness of the method (Weise *et al*. 2014, Boast *et al*. 2015, Melzheimer *et al*. 2020). The translocation of conflict-related cheetahs should be a last management option, whereas conflict mitigation methods focusing on techniques that promote coexistence of predators and humans should be prioritised (Weise *et al*. 2014, 2015b, Boast *et al*. 2015). However, translocation and reintroduction of perceived "non-problem" cheetahs on farmlands can be successful (Marker *et al*. 2008b). As a conservation management strategy, translocation of cheetahs might best be used to facilitate the structured reintroduction of the species into suitable patches of recovered historical range (Hayward & Somers 2009, Boast *et al*. 2018). However, given the scarcity of such areas in Namibia, and considering the large numbers of cheetahs trapped on Namibian farms annually, such reintroductions may have little potential for success.

- Develop economic benefits for coexisting with cheetahs on farmland through ecosystem stewardship and farmer certifications linked to programs such as predator-friendly farming management practices or subsidies related to the coexistence with large carnivores (Marker 2002, Wykstra *et al*. 2018).

- Update the 2013 Namibian conservation action plan for cheetahs, in line with the recently reviewed regional strategy for southern Africa, to put in place a comprehensive roadmap to secure the survival of cheetahs in Namibia (Ministry of Environment and Tourism 2013b).

Awareness

- Improve knowledge on the conservation of cheetahs across Namibia through media, education and capacity programs and transfer the relevant information within and between all involved parties (i.e. government, hunting industry, communal and freehold conservancies, farmers, NGOs and researchers).

- Promote continuous, healthy and diverse populations of ungulates across Namibia by ensuring the retention of wildlife-friendly land use.

- Promote predator-friendly livestock and game farming techniques.

Research

- Survey areas in the country that are data deficient in terms of cheetah distribution and local density. While there is a good overall understanding of the cheetah population in the country, specific information on distribution, local abundance and density of cheetahs in currently unsurveyed areas is still needed (Weise *et al*. 2017, Portas *et al*. 2017). In particular, the southern and north-western part of the country, and the north-eastern communal areas lack information.

- Conduct surveys every five years across Namibia to monitor the population and obtain research-based information on population trends.

- Continue to measure the perceived versus actual losses caused by cheetah and to identify the causes of livestock losses.

- Continue to identify communication hubs of cheetahs to determine areas of high predation risk for livestock.

- Obtain countrywide numbers of dead and killed cheetahs and the cause of death, i.e. road kill, shot on sight, shot after livestock predation, poaching, disease, inter- and intra-species competition.

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Black-footed Cat *Felis nigripes*

Namibian conservation status	Vulnerable
Global IUCN status	Vulnerable
Namibian range	538,000 km²; but area of occupancy estimated at 366,700 km²
Global range	2,214,300 km²
Population estimate	Global: 9,700 mature individuals Namibia: 2,600 mature individuals
Population trend	Regional population decline
Habitat	Dry, open grassy regions of southern Africa, specifically in the Nama Karoo, grassland and savanna biomes. Endemic to southern Africa
Threats	▸ Habitat loss and degradation through overgrazing, which negatively affects prey populations ▸ Unintentional mortality through predator control measures (e.g. shot and killed during night hunts; killed by hunting dogs; injury and mortality by gin traps and cage traps) ▸ Lack of legislative protection ▸ High natural mortality (predation and disease) of wild populations ▸ Possible decline in populations of springhare, aardvark or other animals that create shelter and dens for black-footed cats

IDENTIFYING FEATURES

The black-footed cat is the smallest wild cat species in Africa (Nowell & Jackson 1996c). This species is frequently confused with the similar southern African wild cat *Felis lybica cafra* or small-spotted genet *Genetta genetta*, but it is much smaller than the latter and has a shorter tail. The back of the ears is plain-coloured (not rusty as in southern African wild cat); the head is broad with prominent ears, and the body is boldly patterned with black spots and bands on a tawny or rusty-brown undercoat.

Black-footed cats have bright, reflective eyes and a characteristic blue eye-shine close to the ground at night. Important behaviours to help identification are that they are nocturnal, usually solitary, shy, move low to the ground (creeping gait) and rarely climb trees.

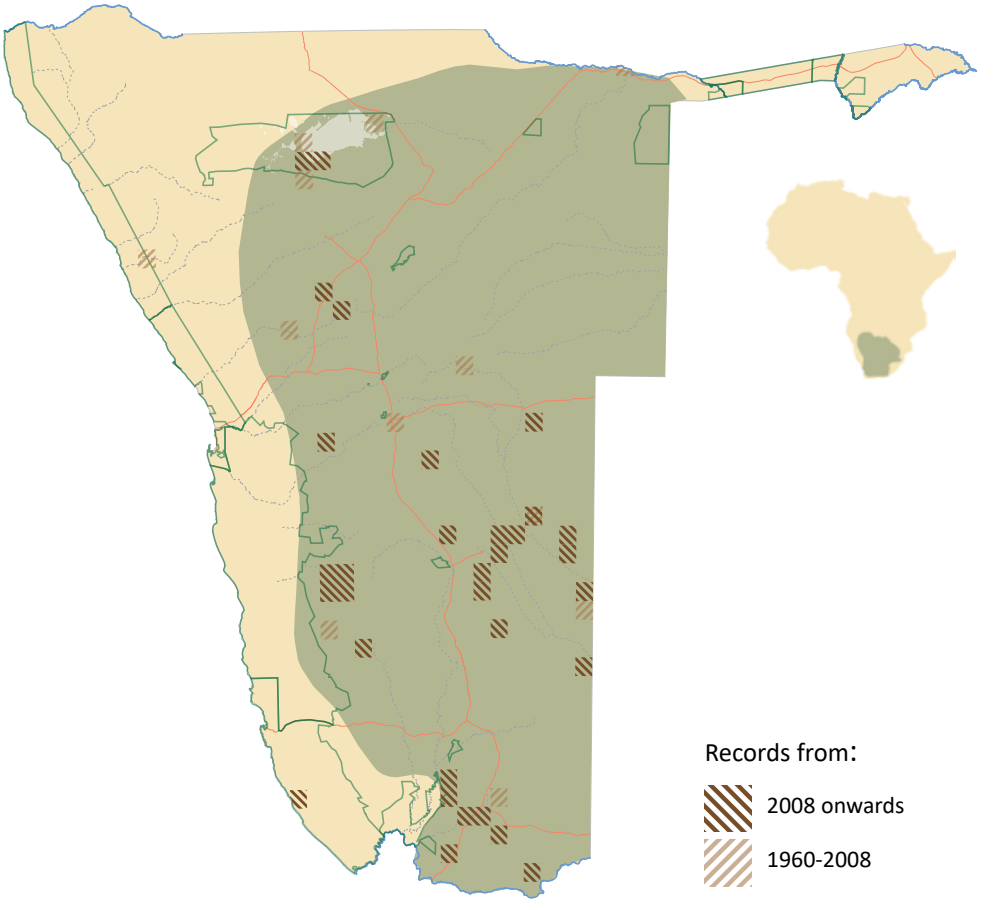
DISTRIBUTION AND ABUNDANCE

The black-footed cat is endemic to southern Africa. It occurs primarily in South Africa, Botswana and Namibia, and might marginally extend into southern Angola and Zimbabwe

Distribution records of black-footed cat, and present estimated area of distribution in Namibia.

Inset: African distribution of black-footed cat according to IUCN (Sliwa *et al*. 2016a).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



(Skinner & Smithers 1990, Sliwa *et al*. 2016a).

In Namibia, black-footed cats occur in the south from the Orange River around Noordoewer along the Great Escarpment and into areas of the Pro-Namib near Helmeringhausen and Maltahöhe (Küsters 2014). An isolated camera trap photo of *Felis nigripes*, taken 8.5 km east of the coastline in the Tsau||Khaeb National Park (Brown Hyena Research Project pers. comm. 2022) indicates they occur there (sporadically or resident) in suitable habitat. They are probably absent from the true Namib Desert. Camera trap records from Neuhof Reserve (Environmental Information Service 2021) and sightings on farms in the NamibRand area (Küsters 2013) extend the known range into the eastern fringes of the Namib.

Records suggest that farms around Grünau, Karasburg, Mariental and Stampriet may have viable populations of black-footed cats (Küsters 2014, Sliwa *et al.* 2019). The Nossob and Auob Rivers may be important corridors for linking subpopulations locally and into southern Botswana (D Joubert pers. comm. 2013, Küsters 2014). The species probably only occurs irregularly in the Khomas Hochland due to unfavourable habitat and mountainous terrain. Further north, its distribution ranges from Wilhelmstal towards Outjo and into the central and eastern parts of Etosha National Park. The short, dwarf scrubland habitat south of the pan is ideal habitat for black-footed cats. No records are documented from the Skeleton Coast National Park, except for an unverified sighting at Springbokwasser, near Möwe Bay (Environmental Information Service 2021) and one possible sighting in the Hoanib River (P Stander pers. comm. 2018).

Population densities are probably very low in the northern parts of Namibia (i.e. north of Etosha and eastwards) and subpopulations may be irregular in occurrence and isolated, such as the record of a road-kill on the B8 near Rundu (M Paxton pers. comm. 2018). Abundance and occurence in the arid western parts of Namibia may present isolated populations or sporadic distribution along corridors of suitable habitat, i.e. along drainage lines or rivers.

Considering the records described above, the estimated extent of occurrence in Namibia (i.e. encompassing all confirmed location records within the country) is 538,047 km². However, the species probably does not occur continuously throughout this area as not all of it is suitable habitat. The area of occupancy, defined as the area within its total range with suitable habitat and resident populations, is estimated as only 366,691 km². This area excludes the extreme outlier records, such as the records near Rundu, in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the Tsau||Khaeb National Park and Springbokwasser in the Skeleton Coast National Park (Environmental Information Service 2021).

Joubert *et al*. (1982) documented that the black-footed cat occurred on 304 farms throughout Namibia and that the species was more common in the northern districts of Tsumeb and Outjo and absent from the southern districts of Karasburg and Bethanie. The data collected during this survey should however be viewed with caution as the species can occur undetected or may be misidentified as the similar but larger southern African wild cat or small-spotted genet. Shortridge (1934) reported that the species was well known from the Gobabis District, became more numerous towards the Botswana border and was more associated with typical Kalahari sand-plain habitats. There are few location records from this area (Küsters 2014) and further east into Botswana (Wilson 2015, Sliwa *et al*. 2016a).

Although the distribution of *Felis nigripes* overlaps with seven formally protected areas in Namibia (Wilson 2015, Sliwa *et al*. 2016a), its presence has only been confirmed in the Etosha National Park (Stander 1991b, Küsters 2013). Overall, the distribution records are scarce and patchy, reflecting its status as a rare and under-reported species. The patterns of historic and recent distribution should not be regarded as range extensions but rather a reflection of insufficient confirmed records of black-footed cats in Namibia.

POPULATION ESTIMATE AND TREND

Due to their shy nature, nocturnal habits and small size, black-footed cats are rarely seen and hence less reported than larger wild felines. They are considered uncommon and rare throughout their range (Skinner & Smithers 1990, Nowell & Jackson 1996c). This makes population densities difficult to determine (Olbricht & Sliwa 1997, Sliwa 2013).

In South Africa, Wilson (2015) estimated population densities from long-term data collected by the Black-footed Cat Working Group (2004–2015) of between 1 to 3 cats/100 km², ranging from low to high density areas. High density areas were identified in the central Upper Karoo region, towards the north-western parts of the Eastern Cape and north-eastern parts of the Western Cape. The total population size of mature, adult black-footed cats in the sub-region is estimated at 9,707 (Wilson 2015, Wilson *et al*. 2016). Moreover, no subpopulations are suspected to have more than 1,000 adult individuals (Sliwa *et al*. 2016a). Total population size in Namibia is estimated at not more than 2,566 adult individuals, calculated as 70% of the population in suitable habitat (i.e. the area of occupancy) at a density of 0.01 cats/km² (Sliwa *et al*. 2016a). Estimating population size from the area of occupancy reflects a conservative estimate.

The species is considered rare in Namibia (Shortridge 1934, Joubert *et al*. 1982; Griffin 1998) and although its predicted range extends over large parts of central and southern Namibia, only a few confirmed locality records are documented (Küsters 2013, 2014, Wilson 2015). Reports suggest that some populations may have declined within the last 10 years or possibly no longer exist in other areas (Küsters unpublished data). Unfortunately, many records collected were of dead black-footed cats, i.e. shot, killed by hunting dogs or fatally trapped during predator control activities (Küsters 2013, 2014, unpublished 2017). Often farmers are not aware of the species occurring in their area until one is killed by hunting dogs, shot or trapped. Unpublished reports of kittens found in termite mounds or in agriculture fields being taken from the wild to be kept as pets (Küsters unpublished) could potentially affect reproductive success and recruitment if this occurs repeatedly. A decline throughout the regional population is suspected (Sliwa 2008, Wilson 2015, Sliwa *et al*. 2016a), especially when local populations are exposed to recurring persecution or have a high prevalence of disease (i.e. amyloidosis: Olbricht & Sliwa 1997, Terio *et al*. 2008).

ECOLOGY

They are strictly crepuscular and nocturnal and are active throughout the night, even in low temperatures (Olbricht & Sliwa 1997, Sliwa 2004). During the day they rest underground in dens or in hollow termite mounds. They do not dig their own dens, but depend on burrows dug by other species, such as springhare, yellow mongoose, ground squirrel, aardwolf and aardvark, for shelter and as a refuge for kittens, especially in habitat lacking termite mounds (Wilson 2015).

They occur in arid to semi-arid, grassy habitat with sparse cover in the form of trees and shrubs (Skinner & Smithers 1990, Nowell & Jackson 1996c), with average annual rainfall of between 100–500mm (Sliwa 2008). Although they can be described as habitat specialists, some reports suggest

that they may use modified land such as agricultural fields (Küsters 2013, Wilson 2015). A farmer from the Hardap Region reports black-footed cats occasionally foraging in tomato plantations, most likely hunting seasonally abundant rodents (K Bassingthwaighte pers. comm. 2013). Another sighting was from a kitten found in a maize field in South Africa (Anonymous pers. comm., Wilson 2015).

Although black-footed cats are opportunistic hunters taking a large variety of prey, small vertebrates are their main prey, with average prey size of 24.1± 47.4 g (Sliwa *et al*. 2010). Small mammals, such as the large-eared mouse and ground-roosting larks, constitute the most important prey classes (Sliwa 1994, 2006).

Sliwa (2004) studied the movements of 17 radio-collared black-footed cats in the Northern Cape and reports that annual home range sizes of adult female cats (n=7) were significantly smaller at 10 km² compared to adult male ranges at 20.7 km². The density on the 60 km² reserve was estimated at 0.17 adult black-footed cats/km² in the summer of 1998 (Sliwa 2004). The density of the same population had declined to 0.08 cats/km² in the years 2005–2015, estimated from long-term research in the area (Wilson *et al*. 2016). In more arid areas of the Upper Karoo, home ranges of female and male cats are larger (Sliwa *et al*. 2016a, 2017, Küsters *in prep*.) and population density of cats is lower (Sliwa *et al*. 2016b, Wilson *et al*. 2016, Küsters *in prep*.). Preliminary home range analysis of the first research on the species in Namibia suggests that the home range size of adult females is much larger (estimate ranges of 20-53 km², n=6, Küsters 2021) than those recorded on Benfontein Nature Reserve (10 km², Sliwa 2004) and on farmland near De Aar in South Africa (Sliwa *et al*. 2017; Küsters *in prep*.). In addition, there is high variation in home range size and shape between indivuduals and some females exhibit dramatic shifts in home range use (Küsters 2020; 2021).

THREATS

Habitat degradation and subsequent negative effect on habitat, vegetation cover and rodent prey densities may be the most important threats to populations of black-footed cats and affect the species' persistence regionally. Emerging threats may affect its subpopulations in the long-term include infectious diseases, genetic isolation and climate change (Schipper *et al*. 2008, Wilson 2015).

Mortality through predator control (i.e. shooting, gin- and cage traps, hunting dogs) poses a considerable direct threat to localised populations in Namibia (Küsters 2013, 2014). Black-footed cats are generally not perceived as a threat to livestock or poultry (Küsters 2013, Wilson 2015), but are killed by predator control methods either directly through accidental shooting or indirectly through gin and other traps deployed on farms. During a farm survey in 1981, Joubert *et al*. (1982) reported that 32 black-footed cats were killed on farms in the Karasburg area, yet only three (n=3) farms reported that the species caused any damage, illustrating the high mortality rate of non-selective control measures and indiscriminate eradication of all predators. Long-term persecution can lead to local extinction, especially in rare species that occur at low densities and have small litter sizes (Sliwa *et al*. 2010). Additionally, high rates (over 50%) of natural mortality (e.g. disease and predation) are recorded for radio-tracked black-footed cats in the wild (Sliwa *et al*. 2016b, Wilson *et al*. 2016).

Wilson (2015) suggests that declining springhare populations may negatively impact suitable habitat for black-footed cats by limiting the number of den sites for shelter. Also, the removal (i.e. the direct killing, trapping or poisoning)

or decline in populations of other fossorial species such as aardvark, Cape ground squirrel and mongooses, may affect the availability of dens and hence influence the long-term occurrence and survival of black-footed cats regionally (Wilson *et al*. 2016). Aardvarks, through their feeding habits, create protected shelters and refuges in termite mounds, especially for black-footed cat females with kittens (M Küsters pers. obs.). Aardvarks are also very important habitat creators for many other smaller animals (Haussmann *et al*. 2018).

A few road mortalities are documented in Namibia (Küsters unpublished data) and the extent and effect on local populations is not known (Wilson 2015).

In areas with a high density of medium-sized predators, predation by black-backed jackal and caracal may negatively affect survival of juveniles and females (Sliwa *et al*. 2010, Wilson *et al*. 2016). Predation is one of the main causes of mortality in radio-tracked free-ranging black-footed cats (Sliwa *et al*. in review).

Evidence suggests that wild black-footed cats were caught on farms in the Gobabis and Mariental Districts in the late 1970s and sold to overseas zoological gardens and safari parks (Küsters unpublished data). The exact number and sex of these cats is unknown, but one farmer caught at least 10 cats during the 1980s for sale to European zoos through a local game capture operator (Anonymous pers. comm. 2012). This could have severely compromised healthy, stable populations and may have resulted in local extinction, or fragmentation or a reduction of the local population, especially if adult females were caught. Several reports suggest that young and adult cats are caught in the wild and kept as pets (Küsters 2013, 2014). Sadly, these cats rarely survive in captivity. Black-footed cats are not suitable pets, cannot be tamed and need specialised care and nutrition (Olbricht & Sliwa 1997).

Captive breeding of black-footed cats is affected by poor reproductive success, high rates of mortality among kittens (<1 year old) and young adults of breeding age, and biased sex ratios (Olbricht & Sliwa 1997, Terio *et al*. 2008). Black-footed cats show a high prevalence for systemic (AA) amyloidosis (Olbricht & Sliwa 1997, Terio *et al*. 2008), a disease in which insoluble fibrillar protein deposits cause kidney failure. Both wild (Sliwa *et al*. 2016a, M Küsters pers. obs.) and particularly captive black-footed cats have succumbed to kidney failure due to this condition (Sliwa 2013). Evidence suggests that the species has a predisposition for this disease and that susceptibility to amyloidosis may be familial, i.e. it occurs in genetically related individuals (Terio *et al*. 2008). High prevalence of amyloidosis is a concern for the long-term viability of populations, not only in captivity but also in the wild, especially if ongoing threats further isolate subpopulations.

Hybridisation with domestic cats has not been documented in the wild or elsewhere and is not identified as a threat to wild populations (Wilson 2015).

The only confirmed hybrids were animals in captivity (Leyhausen 1979).

CONSERVATION STATUS

Black-footed cats are endemic to southern Africa and have the most restricted distribution of all the African felid species (Nowell & Jackson 1996c).

The density of black-footed cats in areas of suitable habitat in Namibia is suspected to be low (i.e. 1 cat/100 km^2) (Wilson 2015, Sliwa *et al*. 2016a, Sliwa *et al*. 2019) and subpopulations may be isolated and threatened by local extinction. Total population size over its entire range is estimated at less than 10,000 mature individuals, with subpopulations not expected to exceed 1,000 individuals, and the overall population is considered to be in decline (Sliwa *et al*. 2016a). Total population size in Namibia is estimated at not more than 3,666 individuals, of which only 2,566 are expected to be mature individuals of breeding age.

Therefore, the conservation status of black-footed cats in Namibia is Vulnerable due to a its small population size, fragmented subpopulations and continuing decline of populations regionally, coupled with a suspected risk of local extinction in certain areas. This is a precautionary assessment given the paucity of distribution records and limited data on survival rates of adults and dispersing subadults, causes of mortality, disease prevalence and status of suitable habitats.

The black-footed cat is not legally protected in Namibia and is only scheduled as a "wild animal" (Nature Conservation Ordinance 4 of 1974). Lack of legislative protection and general poor awareness of the species in the hunting and farming community causes unintentional prosecution and indirect mortality. In South Africa, *Felis nigripes* is listed as Vulnerable in the Regional Red List and formally protected under the Threatened or Protected Species List (Wilson *et al*. 2016). Hunting of the species is prohibited in South Africa and Botswana (Nowell & Jackson 1996c).

The species is listed as Vulnerable in the IUCN Red List of Threatened Species and Endangered in the US Federal list. It is included in the American Association of Zoos and Aquariums Species Survival Plan (Black-footed Cat Species Survival Plan) and listed in Appendix I of the Convention on International Trade in Endangered Species (CITES) of wild fauna and flora (Sliwa *et al*. 2016a).

ACTIONS

Species conservation efforts should be focused on farmland, as most of the black-footed cat's distribution range in Namibia falls on private or communal land outside formally protected areas. Arguably, this species should be seen as a flagship species for the conservation of biodiversity in central and southern Namibia. The Black-footed Cat Research Project Namibia, in partnership with the Black-footed Cat Working Group and the Namibian University of Science and Technology, is working on a study site to better understand the ecology and conservation status of this species in Namibia. The project aims to collect valuable data to assess the species' habitat requirements (e.g. home range sizes, social organisation), diet, health and diseases, causes of mortality, dispersal and survival in the arid south of Namibia.

Research

- Continue collecting distribution records for black-footed cats in Namibia and start field surveys to confirm presence in areas for future study sites.
- Undertake ecological studies to assess basic space and habitat requirements (e.g. home range sizes, population densities), status and health of populations, causes of mortality, dispersal and survival in new study sites to assess ecology across the distribution range.
- Collate available genetic material from various sources and compare to populations in South Africa, between geographical areas and subpopulations.

Management

- Collaborate with the Ministry of Environment, Forestry & Tourism on possible conservation action and declare the species as protected under the draft Protected Areas and Wildlife Management Bill.
- Investigate the extent of deliberate persecution and removal of black-footed cats from the wild and prosecute those people who illegally keep or trade in the species.
- Further develop the "black-footed cat custodian" programme in Namibia, similar to the programmes run by the Endangered Wildlife Trust in South Africa. Farmers who voluntarily strive and commit to conserve the black-footed cat and its habitat; and who practice selective species-specific methods of predator control and do not use poison, will be recognised. This will promote overall biodiversity conservation and awareness within the farming community.

Awareness

- Educational and awareness campaigns should be aimed at highlighting the arid ecosystem and animals of the Nama-Karoo biome, with special emphasis on the black-footed cat and its role in the natural environment. The campaigns should raise awareness about small carnivores and how they are beneficial at regulating rodent populations, which in turn has a positive impact in agricultural areas.
- Programmes need to be developed that promote biodiversity conservation and discourage farming methods and land uses which lead to habitat degradation and which impact negatively on biodiversity.
- Workshops and education are needed to encourage best practices in problem predator control. These should focus on species-specific control measures and should discourage the use of unselective methods such as poison and gin-traps (including 'nekslaaners' or home-made lethal traps).

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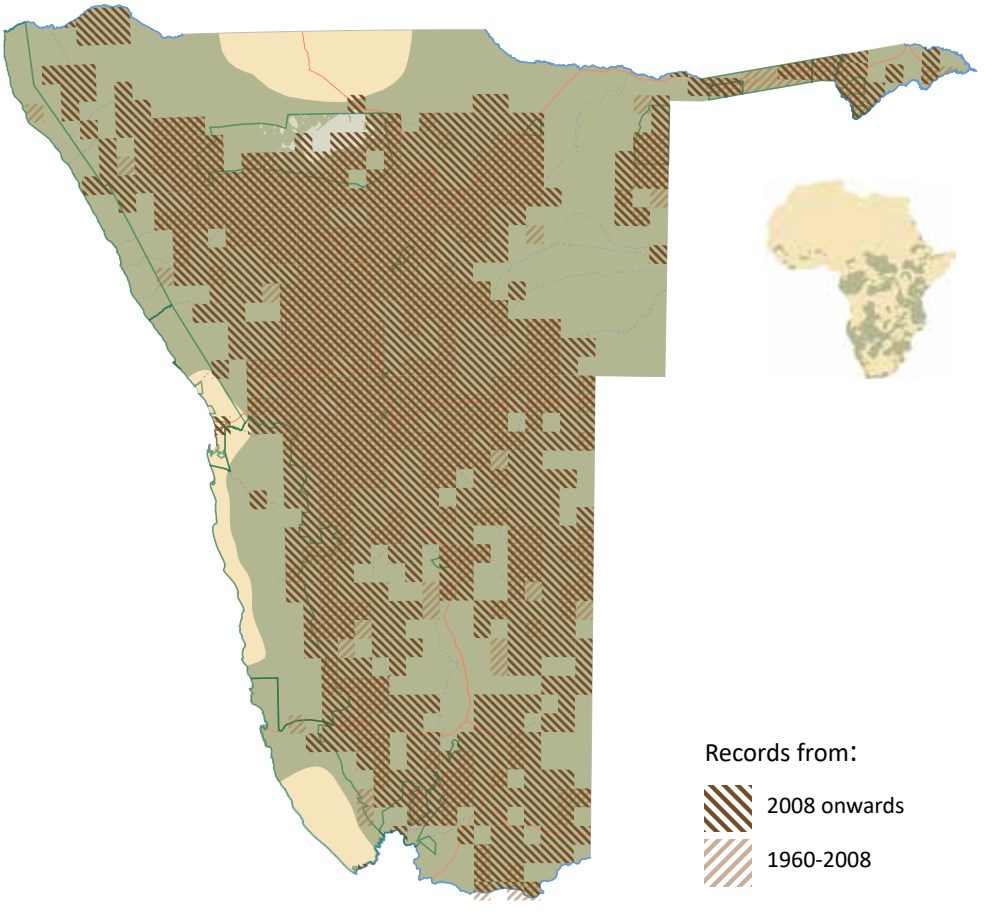
Leopard *Panthera pardus*

Namibian conservation status	Vulnerable
Global IUCN status	Vulnerable (2016)
Namibian range	Most of the country except the desert coast and far north-central parts
Global range	8,515,900 km² Widespread throughout sub-Saharan Africa and in smaller populations within the Middle East, south-west Asia, south-east Asia and north to the Amur peninsula of the Russian Far East
Population estimate	Namibia: <12,000 mature adults
Population trend	Variable: ▸ Increasing in central Namibia ▸ Decreasing in the north-east and south-west ▸ Data deficient in the north-west, east and south-east
Habitat	Ranges from tropical rainforest to arid savanna, and from alpine mountains to the edges of urban areas. Leopards reach their highest density in riparian zones
Threats	▸ Habitat loss and fragmentation ▸ Retribution killing for livestock predation ▸ Decline in prey ▸ Illegal wildlife trade and poaching ▸ Poorly managed trophy hunting

DISTRIBUTION

Based on genetic analyses, nine leopard subspecies are recognised which includes the African leopard *Panthera pardus pardus* (Linnaeus 1758; Miththapala *et al*. 1996; Uphyrkina *et al*. 2001). Leopards historically lived across approximately 35 million km² globally and 20 million km² in Africa, but are now only present in 25% of this area. Leopard distribution now covers 8,515,935 km² in 173 patches from sub-Saharan and North Africa to the Middle East and Asia



Distribution records of leopard, and present estimated area of distribution.

Inset: African distribution of leopard according to IUCN (Stein *et al*. 2016).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.

(Stein *et al*. 2020, Jacobson *et al*. 2016). The estimated regional range loss for leopards across Africa is 48–67% with regional variations (Stein *et al*. 2020, Jacobson *et al*. 2016). Despite these challenges, the African leopards have the widest distribution, with the least fragmentation and healthy connectivity between populations, of all the cats in sub-Saharan Africa (Henschel *et al*. 2008, Stein *et al*. 2020, Jacobson *et al*. 2016). It also shows the broadest range of genetic variation of all the leopard subspecies (Uphyrkina *et al*. 2001, Castro-Prieto *et al*. 2011b). Leopards inhabit most of Namibia except for the highly populated north-central region, the arid south-east farmlands and the desert coast, and were thought to be absent from 30% of their historic range (Hanssen & Stander 2004, Stein *et al*. 2011a, 2020).

The 2019 Namibian Leopard: National Census and Sustainable Hunting Practices study (Richmond-Coggan 2019) found that leopards were present in the north-central region and the south-east farmland (Richmond-Coggan 2019, map), where they were previously thought to be absent, or presence could not be confirmed. A proportion of these new presence records for the south-east are also outside the current IUCN Red List distribution for leopard in Namibia (Stein *et al*. 2020, map).

POPULATION ESTIMATE AND TREND

At the local scale, estimates of leopard population densities vary 300-fold (Jacobson *et al*. 2016). Martin and de Meulenaer (1988) estimated the Namibian population to be 7,745, while Hanssen and Stander (2004) in the Namibia Large Carnivore Atlas estimated it to range between 5,469 and 10,610 animals. The aim of the Atlas was to estimate distribution and population size using data from questionnaires. The 2011 Namibian leopard survey resulted in a national population estimate of 14,154 (CI 13,356–22,706) (Stein *et al*. 2011a).

In the last 20 years, several studies have provided leopard density estimates in Namibia using two main methods: spoor surveys and camera trap surveys. The lowest leopard density in Namibia was recently recorded in the Mudumu North Complex (Hanssen *et al*. 2019) (Table 2.2).

The regions of Erongo, Khomas, Kunene, Otjozondjupa and Omaheke were found to hold the core leopard population (Richmond-Coggan 2019). The density model predicted that Kunene and Khomas Regions have the highest leopard density overall. This was in part due to the Khomas Hochland Plateau and the recent leopard density determined for the Auas Mountains (Table 2.2). The density model predicted

that the highest leopard density in the Kunene Region would be in the Kaokoveld up on the Kamanjab Plateau and the escarpment that runs up to the Angolan border. The north-eastern parts of the Erongo Region around the Erongo Mountains and Mount Etjo were also identified as possible areas of high density and Omaruru was confirmed as high density (Table 2.2). The model highlighted that the Otjozondjupa Region has two distinct density areas; the higher density areas cover the freehold farms of the region, while the eastern communal conservancies, namely N#a-Jaqna, Nyae-Nyae and Ondjou Conservancies have lower density than the central and western areas of the region which was confirmed by leopard density studies (Table 2.2). In Omaheke, again, the highest leopard density was predicted by the model to be across the freehold farms in the centre and south of the region, and the lowest densities found in the communal conservancies. The regions of Omusati, Ohangwena, Oshana, Oshikoto, Kavango East and West, ǁKharas, Hardap and Zambezi were all categorised as low density areas by the model and density studies (Table 2.2). One potential variation was in Hardap on the border with Khomas Region where densities were predicted

Table 2.2: Estimates of leopard density from various parts of Namibia.

Location	*Survey Method	Density Estimate (leopards/100km²)	Reference
Khaudum National Park and Nyae Nyae Conservancy	SS	1.5	Stander *et al.* (1997)
Okonjima Farm, Otjiwarongo	RC	5.56	Hanssen & Stander (2000)
Hobatere Concession and West Etosha National Park	SS, GPS	3.85	Stander *et al.* (2001)
Waterberg National Park	CTS	1.0 (SE±0.7, 95% CI 0.8–1.5)	Stein *et al.* (2011b)
Central Namibia (freehold farmland- Waterberg)	CTS	3.6 (SE±3.6, 95% CI 3–8)	Stein *et al.* (2011b)
Northern Namibia (Omaruru)	CTS	3.1	Stein *et al.* (2011a)
Central Namibia (freehold farmland – Auas Mountains)	CTS	2.0	Stein *et al.* (2011a)
Southern Namibia (freehold farmland)	CTS	1.2	Stein *et al.* (2011a)
Bwabwata National Park	SS	1.18 (sand ridges); 2.40 (omurambas)	Funston *et al.* (2014)
Freehold farms bordering the Tsau ǁKhaeb (Sperrgebiet) and Namib-Naukluft National Parks	CTS	0.9 (SD±0.41) Northern Area; 0.59 (SD±1.15) Southern Area	Edwards *et al.* (2015)
Mudumu North Complex	CTS	0.6 (SD±0.54)	Hanssen *et al.* (2015)
Okonjima Nature Reserve (private)	CTS	14.5	Noack (2016)
Bwabwata National Park	SS	1.27	Hanssen *et al.* (2017)
Southern section of Khaudum National Park	CTS	1.8 (SD±0.40, 95% CI 1.11–2.50)	Portas *et al.* (2018)
Hoanib River	CTS	1 leopard detected (density not determined)	Portas *et al.* (2018)
Ongava Game Reserve (private)	CTS	2.6–4.6	Stratford *et al.* (2018)
Gondwana Canyon Park (private)	CTS	0.64 (SE±0.36, occupancy derived)	Edwards *et al.* (2018a)
Mudumu Landscape (Mudumu National Park and 3 conservancies)	CTS	0.25 (SD±0.06)	Hanssen *et al.* (2019)
Mudumu North Complex (Mayuni, Sobbe and Mashi Conservancies)	CTS	0.24 (SD±0.08)	Hanssen *et al.* (2019)
Bwabwata National Park (Kwando Core Area)	CTS	0.85 (SD±0.18)	Hanssen *et al.* (2019)
Bwabwata National Park (Multiple use area)	CTS	0.58 (SD±0.21)	Hanssen *et al.* (2019)
Khaudum National Park (North, 2017)	CTS	0.76 (SD±0.31)	Hanssen *et al.* (2019)
Khaudum National Park (South, 2018)	CTS	0.91 (SD±0.25)	Hanssen *et al.* (2019)
Nyae Nyae Conservancy (2017)	CTS	0.58 (SD±0.2)	Hanssen *et al.* (2019)
Nyae Nyae Conservancy (2018)	CTS	2.0 (SD±0.6)	Hanssen *et al.* (2019)
North East Omaruru (freehold farmland)	CTS	3.6 (95% CI 3.03–4.25)	Richmond-Coggan (2019)
Auas Mountains (freehold farmland)	CTS	2.8 (95% CI 1.97–3.68)	Richmond-Coggan (2019)

* CTS=Camera Trap Survey; RC=Radio collars; SS= spoor survey; GPS=GPS collars

by the model to be higher due to the Rehoboth Plateau and the Naukluft Mountains (part of Namib-Naukluft National Park).

In southern Namibia there are several large private reserves which were previously farmland with limited carnivore presence but due to their protected status, are now a refuge for multiple carnivores, including leopard. Leopards have been photographed along the western edge of the Nubib Mountains, in the sand and gravel plains further west and the dunes beyond (M Tindall pers. comm. 2018). The dune habitat is considered to be marginal due to its limited resources, however, the assumption is that the resource rich areas already have territorial males and therefore subadults are being pushed out to the margins (M Tindall pers. comm. 2018). Leopard presence is increasing in the southern, western and northern areas of Gondwana Canyon Park due to the mountainous habitat and the distance from the eastern farmland where they are persecuted (Q Hartung pers. comm. 2018). After 15 years the leopard population in the park is considered to be stable as a result of the increased game numbers and fence removal (Q Hartung pers. comm. 2018). A leopard population has recently been identified in the Oana Nature Reserve in the far south of Namibia (V Nesticky pers. comm. 2018).

Considering the density estimates of various studies (Table 2.2) the Namibian leopard population is estimated at 11,733 (RMSE 5,949) which is lower than the 2011 population estimate (Richmond-Coggan 2019). This is due to a combination of the re-classification of the density categories and changes in the leopard density in some areas of Namibia (Richmond-Coggan 2019). However, it is important to recognise that the leopard population varies countrywide: in the centre and north of Namibia across freehold farms, between 2011 and 2019, there has been an increase in leopard density by up to 40% (Richmond-Coggan 2019). Yet, leopard densities in the national parks and communal conservancies remain low (Table 2.2). Relative to other leopard densities recorded in South Africa, both inside (7.51–18.8 leopards/100 km², Balme *et al.* 2010, Owen *et al.* 2010) and outside (2.49 leopards/100 km², Balme *et al.* 2010) national parks, Namibia's leopard densities are still very low overall. However, it is important to recognise that Namibia when compared to South Africa is an arid and semi-arid country with low productivity which will impact both prey availability and distribution this in turn will influence leopard densities.

ECOLOGY

Leopards are highly adaptable and can be found across numerous habitats and climatic zones, including; mountains, rocks, bushveld, woodlands, desert and semi-desert, forest,

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from sea-level to 2,000 m, and in areas which receive less than 100 mm of rain to areas receiving above 1,200 mm (Stein *et al.* 2020). It has been determined that leopard resource use is governed by three key factors: avoidance of anthropogenic disturbance, such as roads and people; selection of prey-rich areas, such as river beds, protected areas and patches of recent rainfall; and selection of rocky areas with adequate vegetative cover to increase hunting success and minimise kleptoparasitism (theft of their kills by other carnivores) (Pitman *et al.* 2017a).

In Namibia leopards have been captured on camera in the Auas Mountains at an elevation of 2091m (Richmond-Coggan 2019) and in the Hoanib River north- east of the Skeleton Coast Park (Portas *et al.* 2018). The habitat suitability for leopard in Namibia showed that land ownership type (freehold, communal, national parks), the amount of rainfall during the wet season and landcover such as vegetation were some of the key variables that influenced leopard occurrence (Richmond-Coggan 2019). Their adaptability can be seen in the Namib Desert, where vegetation on the banks of watercourses provides cover, which is a contributing factor to leopard presence in the area (Mills & Hes 1997). Significantly sized dry river beds have been highlighted by the habitat and density models as potential areas of importance to leopards, for example the Omatako dry river bed, and other eastward-flowing river beds such as the Nossob (Richmond-Coggan 2019). In Hobatere and western Etosha, leopards showed a strong preference towards kopje (53%) and mountainous (25%) habitat (Stander *et al.* 2001). As opportunistic carnivores, they can be found in semi-urban and suburban environments, for example in Mumbai (Braczkowski *et al.* 2018) and Johannesburg (Kuhn 2014). In Namibia, multiple sightings of leopard have been recorded in suburban areas of Windhoek, such as Olympia and Avis.

Leopards are sexually dimorphic, solitary and territorial (Voigt *et al.* 2018). Male territories normally encompass two to five female territories (Mills & Hes 1997, Hayward *et al.* 2006a). The degree of range overlap both between and within sexes can vary substantially (Stander *et al.* 1997, Marker & Dickman 2005a, Devens *et al.* 2018). Males aged between 11–13 years start to become displaced when they lose territory to younger, neighbouring males and will then remain on the boundaries between territories (N de Woronin Britz pers. comm. 2018). Dispersing males can move into the territory of young territorial males which are still establishing themselves, kill and eat their cubs (N de Woronin Britz pers. comm. 2018).

Leopard territories in Namibia vary considerably in size and are directly related to prey abundance (Stander *et al.* 1997, Marker & Dickman 2005a). In Namibia adult male home ranges vary between 18.5 km² in a private reserve to 451.2 km² in the north-east; those of adult females range from 9.2 km² in a private reserve to 224 km² in the Hobatere Concession (Table 2.3). Overall, home ranges in the arid and semi-arid areas of Namibia's western-central region are substantially larger compared to those in the central and eastern regions of Namibia, as both prey and leopard density influence male and female home ranges sizes (Table 2.3).

Male territorial boundaries are defined by natural features such as rivers, hills, dams and man-made structures such as roads (Simcharoen *et al.* 2008, Steyn & Funston 2009, Naankuse Foundation 2018). A ten-year study using VHF/GPS collars has shown that over the course of a male's

Table 2.3: Home range size of leopards in various parts of Namibia

Location	Survey Method	Home Range Analysis Method	Home Range		Reference
			Adult Male	Adult Female	
North-eastern Namibia	Radio Collars	Convex Polygon and Grid Cell	451.2 km² (range 210–1,164 km², n=6)	188.4 km² (range 183–194 km², n=3)	Stander *et al.* (1997)
Okonjima Farm, Otjiwarongo	Radio Collars	Kernel (95%)	100.2 km² (range 71.4–221.5 km², n=6)	72 km² (range 70.8–73.2 km², n=2)	Hanssen & Stander (2000)
Hobatere Concession and West Etosha National Park	Radio Collars	Kernel (95%)	94.9 km² (n=1)	202 km² (range 84.5–339.8 km², n=5)	Stander *et al.* (2001)
Waterberg Conservancy	Radio Collars	Minimum Convex Polygon (95%)	229 km² (SD±95, n=3)	179 km² (SD±148, n=4)	Marker & Dickman (2005a)
Central Namibia	VHF/GPS Collars	Kernel (95%)	109 km² (n=1)	49.5 km² (range 46–53 km², n=2)	Stein *et al.* (2011b)
Okonjima Nature Reserve – closed private reserve	VHF Collars/ Camera Traps	Minimum Convex Polygon (100%)	18.3 km² (SD±10.1 km², n=11)	9.2 km² (SD±4.3 km², n=13)	Noack (2016)
Hardap, Khomas, Erongo, Otjozondjupa and Oshikoto	GPS Collars	Minimum Convex Polygon (100%)	150 km² (range 70–240 km², n=25)	110 km² (range 21–200 km², n=17)	Naankuse Foundation (2018)
Ongava Game Reserve	GPS Collars	Minimum Convex Polygon (100%)	190.6 km² (n=1)	96.9 km² (n=1)	Stratford *et al.* (2018)

lifespan, its territory size varied significantly (5–6 years 29 km², 6–7 years 60 km², 7–8 years 90 km², 8–10 years 120 km², 11 years 90 km², 12 years 60 km², 13 years 29 km²) (N de Woronin Britz pers. comm. 2018). During this time of expansion and contraction the number of females within the male's territory rose and fell, from one (male 5–6 years) to four (male 8–10 years) and then back to one (13 years) (N de Woronin Britz pers. comm. 2018).

Cubs are dependent on their mother from birth to 1.5–2 years (Bailey 1993). Female leopards become sexually mature between 2.5 to 3 years old, whilst males reach sexual maturity between 2.5 and 4 years old (Bailey 1993, Balme & Hunter 2004). The sex ratio at birth is assumed to be 50:50 (Clutton-Brock 2016), however, males seem to have a higher mortality rate than females once reaching adulthood, therefore, in the adult population there are usually more females than males (Nowell & Jackson 1996a, Portas *et al.* 2018). In central Namibia, there was found to be a two-year breeding cycle, which resulted in a temporary increase in the leopard density in the area every two to three years for a short duration. Of the 32 cubs born to 8 different female leopards over a ten-year period, only 25% of the cubs reached dispersal age (N de Woronin Britz pers. comm. 2018). The reasons for cub mortality were dispersing males (73%) followed by lions (9%), warthog (5%) and reasons unknown (13%) (N de Woronin Britz pers. comm. 2018).

Leopards are opportunistic ambush hunters that prefer ungulates with a body mass of between 10 and 40 kg (Hayward *et al.* 2006a; Clements *et al.* 2014). Leopards have one of the broadest diets and the highest number of prey species (92) of all the large African carnivores (Hayward *et al.* 2006a). However, leopards may select smaller bodied prey to balance the trade-offs between kleptoparasitic losses and the energy required to kill larger prey (Balme *et al.* 2017). Prey selection changes throughout the lifespan of an individual leopard, and they specialise in certain prey types depending on the habitat and density of prey species (N de Woronin Britz pers. comm. 2018). Livestock such as cattle calves, sheep and goats fall within the preferred weight range and are preyed on.

Leopards mostly hunt alone at night by stalking their prey then sprinting for a short distance to capture it (Bertram 1979, Bailey 1993). Leopards regularly kill other carnivores and prey on baboons when larger prey is scarce (Hayward *et al.* 2006a, Jooste *et al.* 2012). As an apex carnivore, they provide ecosystem services such as preying on smaller carnivores such as jackals, which would otherwise grow in numbers. On Namibian farmland, lions and spotted hyaenas have largely been eradicated so leopards mostly cache their carcasses by dragging them under thick bushes rather than up trees. In central Namibia, territorial males were regularly noted to share kills with the territorial females and their offspring in their range (N de Woronin Britz pers. comm. 2018).

THREATS

The major threats to leopard are habitat loss and fragmentation, human-wildlife conflict, prey loss, illegal trade and poaching, and unsustainable trophy hunting (Stein *et al.* 2020, Jacobson *et al.* 2016). Multiple studies in South Africa have found that the removal of problem animals can lead to a major decline in the leopard population, particularly for females with cubs (Ramesh *et al.* 2017b, Williams *et al.* 2017).

The decline in the leopard population across sub-Saharan Africa is the result of widespread habitat loss (21% in 25 years) and prey loss inside African protected areas (Stein *et al.* 2020). The conversion from livestock farming to game ranching, although it offers significant economic advantages, is increasing the level of conflict between valuable game species and carnivores (Lindsey *et al.* 2013c, Pitman *et al.* 2017b). Game ranching practices have become more intensive and involve activities such as removal of problem animals, particularly carnivores, to safeguard profitability. Leopards are generally not constrained by farm fences and move freely across the landscape (Balme & Hunter 2004, Balme *et al.* 2007, Swanepoel *et al.* 2013, Stratford

et al. 2018). However, a recent study (Ceia-Hasse *et al*. 2017) highlighted that 59% of the leopard's African range is affected by roads and their infrastructure which has a significant impact through direct mortality and by causing a barrier to movement.

Livestock predation by large carnivores is the most widespread cause of conflict and retaliatory killing by people (Woodroffe *et al*. 2005). The leopard exhibits an array of biological and behavioural traits such as opportunistic hunting behaviours, solitary living and a varied diet that renders it a high-impact conflict species (Kissui 2008). Globally, leopards are considered the leading carnivore conflict species, preying on livestock and threatening human safety (Seoraj-Pillai & Pillay 2017, Braczkowski *et al*. 2018). In southern Africa, leopards are shot, snared and poisoned mostly for their impact on livestock farming and less so for illegal wildlife trade (Skinner *et al*. 1977, Henschel *et al*. 2008, Stein *et al*. 2020, Jacobson *et al*. 2016, Ripple *et al*. 2017). Jacobson *et al*. (2016) showed that the retribution killing of leopard for real and perceived livestock loss is the second largest threat to the population today. Namibian freehold landowners echoed this finding, undertaking problem leopard removal based not only on actual loss of livestock and/or game but on the perceived threat to livestock and/or game along with the risk to human safety (Richmond-Coggan 2019).

In Namibia, the majority of the leopard population resides outside of national parks on freehold farmland and communal conservancies. Therefore, it is critically important to recognise that the majority of the national leopard population is under significant anthropogenic pressure, which will impact the population's long-term viability. Across Namibia, leopard removal rates vary depending on the density of the different carnivore species, farm management, type of livestock, landscape, vegetation cover, abundance of free-ranging prey and the level of poaching and livestock theft (Edwards 2015, Richmond-Coggan 2019).

When key prey species for leopard decline due to drought and high levels of poaching, leopards switch to catching livestock which can lead to increased levels of persecution and problem animal removal (Khorozyan *et al*. 2015, Jacobson *et al*. 2016, Rosenblatt *et al*. 2016). For example, when prey biomass drops below 812 kg/km², predation rates on cattle by leopard significantly increase (Khorozyan *et al*. 2015) furthermore, if prey biomass falls to 540 kg/km², cattle, sheep and goats will all be intensively preyed on to optimise a leopard's energy intake (Khorozyan *et al*. 2015). This pattern can be seen in the Hardap and ǁKharas Regions as they have two of the lowest game densities and highest livestock densities (sheep and goats) of all the regions and consequently suffer from the highest predation rates (Richmond-Coggan 2019).

In central Namibia retribution killing of leopards due to cattle loss led to 14% of the population being removed (killed or translocated) from the area over a five-year period (Stein *et al*. 2010). Conflict between leopards and small-stock farmers due to predation has recently been recorded along the Orange River in the far south of Namibia (V Nesticky pers. comm. 2018). The proportion of leopard-associated conflict has been rising since 2008, and from 2015 more than 50% of all carnivore conflict cases have been attributed to leopard (Naankuse Foundation 2018). Over 16 years (2001–2017) in ten regions, across 75 communal conservancies, 5,718 incidents (problem animal removed and/or livestock predation) of human-leopard conflict have been recorded, averaging 336 incidents per year (NACSO 2018). Freehold farmer's loss of 2,836 individual animals (cattle, sheep, goats, horses) between October 2016 and December 2018 led to the removal of 342 problem leopards (64% males, 28% females) (Richmond-Coggan 2019), an 87% increase from 2011 (Stein *et al*. 2011a). This increased removal of males can lead to destabilisation of the population (Balme *et al*. 2010, Davidson *et al*. 2011). The two main removal methods were live cage trapping and shooting however, other known removal methods are; snaring, poisoning, gin traps, hunting with dogs and call-ins using pre-recorded sounds (Richmond-Coggan 2019).

In Namibia, if a species is deemed to be causing damage to livestock or poses a threat to human life, a permit can be granted by MEFT which allows the hunting of any specially protected game at any time. The reporting structure relies on the accuracy of the kill identification information provided by the landowner, including which species was responsible for the livestock predation. It is important to recognise that when problem leopards are removed there can be misidentification of the specific problem animal at both the individual and species level (Grey *et al*. 2017). Between 2011 and 2019 there has been decline from 50% to 45% in the number of freehold farmers applying for a MEFT problem leopard removal permit. Interviewed freehold landowners who applied for a permit removed 60 leopards/year, whereas those who did not removed 90 leopards/year (Richmond-Coggan 2019). The lack of reporting is a cause for concern as the annual documented figures are not an accurate national representation.

Leopards that are responsible for livestock predation are generally specific individuals, often subadult males or old individuals, that prey at times on juvenile large stock and sometimes on small-stock and poultry (Kumar *et al*. 2017, L Hanssen pers. comm. 2018). Individual leopards can enter nighttime enclosures designed to keep livestock safe due to their climbing capability and agility which enables them to get through small gaps in mesh fencing (L Hanssen pers. comm. 2018). This can make it difficult to secure and protect livestock that is targeted (L Hanssen pers. comm. 2018).

The regions of Kunene, Khomas, Erongo and Otjozondjupa are conflict hot spots due to the level of livestock predation in the freehold farmland and total number of incidences recorded in the communal conservancies (NACSO 2018, Richmond-Coggan 2019). Given that the majority of the leopard population resides in these regions this level of human-leopard conflict is not unexpected.

Jacobson *et al*. (2016) identified the illegal trade in skins and parts across their African range as the fourth most important threat to the leopard. This is not a new threat; in 1977 Skinner *et al*. (1977) recognised that the skin trade was already a reason for the decline in the South African leopard population. In villages and cities in some African countries, skins and canines continue to be traded for use in traditional rituals (Stein *et al*. 2020; Jacobson *et al*. 2016). Preliminary data suggest that 4,500–7,000 leopards are harvested annually as part of the illegal trade in leopard skins for cultural regalia, a practice that is extensive throughout southern Africa (Stein *et al*. 2020).

A recent camera trapping survey in Omaruru, Namibia captured evidence of both brown and spotted hyaenas with wire snares around their necks and prior to the start of the survey a leopard was found dead in a snare (Richmond-Coggan 2019). This demonstrates the indiscriminate impact of the snares used in illegal poaching activities. Landowners in the Omaruru area engaged anti-poaching patrols to mitigate against the illegal activities, however, they report an ever-increasing number of snares being found. The concern is that this situation is indicative of a wider national issue.

Leopards are included in CITES Appendix I. Trade of Leopard Skins and Products (CITES resolution 10.14) is restricted to 2,483 individuals in 11 countries across sub-Saharan Africa (CITES 2018). Namibia has the 4th highest leopard quota within sub-Saharan Africa (CITES 2018). In 1997 the CITES export quota for Namibia was set at 100 individuals; in 2004 this was increased by 150% to 250 (CITES Resolution Conf. 10.14 (Rev.CoP13)). The quota was increased in 2004 as a result of the 7,745 population estimation by Martin and de Meulenaer (1988) from which an annual harvest of 332 animals (4.2% of the population) was calculated and determined to be a safe offtake level. The report by Stein *et al*. (2011a) recommended that the quota of 250, which represented 3–4% of the total adult male population, was to remain, along with the introduction of an intensive monitoring programme.

In Namibia, the highest number of leopard trophy hunts take place in the freehold farmland, followed by communal conservancies, and national parks. The areas shown to have higher leopard density, suitable habitat and prey availability had the greatest trophy hunting success rates (Erongo, Khomas, Kunene, Otjozondjupa) (Richmond-Coggan 2019). On average 39% of the trophy hunts undertaken were successful across Namibia, which is in line with other African countries, but information on why a hunt was unsuccessful is limited (Richmond-Coggan 2019). Since the implementation of Namibia's new TAG system in 2011 the quota of 250 leopards has never been reached, 2017 was the highest at 161 (-35.6%), the average between 2016–18 was 155 (Richmond-Coggan 2019). The implementation of the new regulations has had multiple impacts; firstly the size of the trophy has significantly increased post-2011, and secondly only male leopards can be hunted. The new regulations have resulted in a decline in hunted females from 32% to 0.7% which is a positive outcome. The remaining 0.7% is due to the misidentification by hunters (Richmond-Coggan 2019). Females are a key reproductive unit and are more difficult to replace than adult males (Daly *et al*. 2005), as such their removal can directly impact the population viability.

While the conservation value of regulated trophy hunting is recognised, it is important to note that there is a fine balance between sustainable and unsustainable offtake of leopards. For example, trophy hunting may selectively harvest large individuals with fitness-enhancing traits (Ripple *et al*. 2016). Poor management such as overharvesting, corruption, or lack of reinvestment in conservation and development of local communities, could undermine the rewards from trophy hunting and in turn threaten the species (Lindsey *et al*. 2007).

Therefore, it is critical to recognise a leopard's economic value and the need for careful management of the numbers that are utilised. The positive attitudes of some landowners towards leopards was based upon their potential economic value through either trophy hunting or tourism and this was why they tolerated having leopard on their property (Richmond-Coggan 2019). Landowners simply state that if the leopard loses its economic value, particularly through trophy hunting, then the rate of unreported and indiscriminate removals will rapidly increase in order to protect their livelihood (Swanepoel *et al*. 2015b, Richmond-Coggan 2019). When a territorial male is removed, by any means, from the territory it creates a "vacuum" which is immediately occupied by the dispersal males in the area (Davidson *et al*. 2011). As a male loses territory a female may then be sharing her territory with two males. This can result in infanticide and an unnatural ratio of males to females, causing females to mate with the new neighbouring dispersal male. Infanticide can also lead to females not raising young due to the incursion of new males (Balme *et al*. 2009, Balme *et al*. 2010, Balme & Hunter 2013). All of these interactions will have a significant impact on the long-term viability of the leopard population.

In terms of proactive population management, removals of problem animals are often uncontrolled, unreported and indiscriminate of age, sex and population density. On the other hand, regulated trophy hunting, if managed effectively,

is limited to areas which have a leopard population capable of sustainable controlled offtake. Therefore, it is necessary to improve the management of trophy hunting, in tandem with reducing the losses through other causes of mortality, particularly problem animal removal and its subsequent reporting.

CONSERVATION STATUS

Leopards are listed as a CITES Appendix I. species (Trade of Leopard Skins and Products, CITES resolution 10.14) with an allocated trophy hunting quota (CITES 2018). In 2008 the leopard was classified as Near Threatened on the IUCN Red List (Henschel *et al*. 2008). However, due to a global decline of the leopard populations by >30% over the last three leopard generations, the species was reclassified to Vulnerable in 2016 (Stein *et al*. 2020). The perceptions of Namibian landowners are that over the past five years there has been a 64% rise in the leopard population across the freehold farmland (Richmond-Coggan 2019). This rise has been recorded in some areas of the freehold farmland. However, lowering of densities have also occurred in parts of southern Namibia and communal conservancies in the north-east within the same timeframe. Leopard density varies significantly, particularly across different land use types, but overall is still low compared to other African countries (Richmond-Coggan 2019). The core leopard population resides in the freehold farmland and communal conservancies and is under substantial anthropogenic pressures; this is also the area where trophy hunting is at its highest. The scale and distribution of problem animal removal and the subsequent lack of reporting unequivocally represent the most significant pressure on the Namibian leopard population. Collectively these points justify retaining the conservation status as Vulnerable in Namibia.

ACTIONS

Awareness

It is critically important to recognise the role freehold farmers and communal conservancies have in the long-term survival of leopard in Namibia as these landowners are the custodians of the national population. Consequently, leopard conservation would be enhanced by increasing tolerance through education, implementation of conflict mitigation methods, improving financial aids and incentives such as utilising ecotourism, sustainable trophy hunting and wildlife credits schemes.

Management

Namibian landowners feel that they lack control over the official process of dealing with livestock losses, which frequently drives them to retaliatory killing to sort out the problem as quickly as possible, a sentiment shared by South African landowners (Grey *et al*. 2017). This has led to the disconnect between MEFT permit numbers and actual removal figures. As such reporting of problem leopard removal must be prioritised to determine and address conflict hotspots. To do this the official management of retaliatory killing needs to be effective and quick, data collection could be incorporated into regular MEFT management activities such as fence checks and game counts. An increase in efficiency in the system and a clear understanding of the data usage in relation to leopard management will further encourage farmers to report.

To improve coexistence with leopards bettering livestock husbandry should be the first step. Livestock management techniques, such as kraaling livestock in well-constructed enclosures at night and herding the livestock during the day, are some of the best methods to reduce livestock predation from leopards (Balme *et al*. 2009). In the Waterberg Conservancy, farmers who employed at least one out of six livestock husbandry techniques reported 85% less conflict with carnivores (Stein *et al*. 2010). To minimise risk of attacks on juvenile livestock at night, where juveniles are separated from their mothers, enclosures need to be as "leopard-proof" as possible. This would involve using small gauge wire mesh to prevent leopards from getting access, or using roofing sheets to prevent leopards from jumping into enclosures (L Hanssen pers. comm. 2018). Alternatively, juvenile livestock must be accompanied by an adult when in kraals as adults defend their young in cramped enclosures (L Hanssen pers. comm. 2018). On occasion, habitual stock-raiding leopards may need to be removed humanely (L Hanssen pers. comm. 2018). Lethal control strategies should be applied only if all other prevention methods have failed, and they should be careful to correctly target the identified problem individual, otherwise they will be counterproductive (Treves & Naughton-Treves 2005).

In some instances, farmers will trap leopards in metal cages in the hope that they can be translocated (L Hanssen pers. comm. 2018). In Namibia, of a sample of six confirmed conflict leopards that were translocated all six established new home ranges, four of them did not prey further on livestock and reproduced successfully (Weise *et al*. 2015a). Despite this apparent success, translocation is not a long-term solution as the number of suitable translocation sites is limited and information on the release sites must be available to improve chances of success.

Some farmers reduce their losses by keeping their livestock away from waterholes to avoid opportunistic predation when leopards go to drink and by synchronising calving periods with the wild game. For example, farmers in southern Namibia experienced lower losses of cattle in comparison to small-stock, partly because cattle show anti-predator behaviour by avoiding water points during peak carnivore activity times (Edwards 2015). The frequency and

severity of livestock predation by leopards depends on the availability of natural prey (Ray *et al*. 2005b). It therefore helps if a farm has a healthy density of free-ranging antelopes as available wild prey to diminish predation on livestock. Large guarding dogs (at least two animals) should be placed and always kept with the livestock as they can also dissuade leopards.

A landscape approach to leopard trophy hunting could be created through leopard management zones across freehold farms. The freehold conservancies have demonstrated that it is possible to establish landscape management zones of mixed farm types and it is recommended that these zones are re-established as part of a stratified monitoring system for Namibia's leopards, as called for by IUCN (2018). These management zones would be responsible for monitoring and management of their natural resources, including leopard and their prey species. Information gathered through the monitoring would include; population density and structure, environmental variables and problem animal removals. As these management zones would be spread across the known areas of leopard presence in Namibia they have the potential to acquire ongoing information on the local leopard population. This vital information would feed into the national adaptive management plan to inform effective decision making on the long-term conservation of the leopard.

Tourism can also provide an economically viable, non-consumptive use of leopards (Lindsey *et al*. 2007). In a survey out of all African wildlife the leopard came out as one of the highest ranked in terms of key species that tourists wanted to see (Di Minin *et al*. 2012). Income generation through tourism was stated as one of the key reasons that freehold landowners wanted to have leopard present on their property (Richmond-Coggan 2019). Since most leopards in Namibia live outside of national parks, such economic value is critical to ensure the long-term conservation of the species. For example, land use in the broader pro-Namib area is shifting away from farming and moving towards tourism, this change in land use has also led to a decline in human-leopard conflict (M Tindall pers. comm. 2018). However, areas of Namibia that are not easily accessible lack the opportunity to generate income from tourism, therefore legal consumptive use of leopards through trophy hunting could be a means of generating revenue in those areas (Balme *et al.* 2010).

Research

Since 2000, there have been 22 scientific journal articles containing data on the African leopard density across its geographical range (Jacobson *et al*. 2016). There is consensus within the conservation community that further research on leopards across Namibia is needed. As described above the density, territory size and distribution

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of leopard varies greatly across Namibia due to variations in habitat, persecution levels and prey availability. Acquiring further information on leopard densities regionally will also improve our ability to model the national population and its geographical variations. Understanding the impact of these variables on a national scale is critically important to understanding the leopard in Namibia as a whole. As problem leopard removal is a significant threat to the national population understanding which mitigation tools provide the most effective solution relative to cost in reducing the levels of leopard-livestock conflict and widely deploying these tools must be made a priority. The prolific use of snares in illegal bushmeat poaching highlights a real need for a more comprehensive understanding on the impact of this activity on leopards and other carnivores directly and indirectly due to the removal of wild prey, particularly in the freehold farmland.

It has already been identified that the core leopard population of Namibia, trophy hunting of leopard, and problem leopard removal predominantly occurs in the freehold farmland and the Kunene communal conservancies. Long-term leopard density monitoring across these areas must be made a priority as data is currently limited for this important leopard area. As well as farmers employing the most effective livestock husbandry techniques in order to significantly reduce the number of problem leopard removals nationally. Leopard presence records have now been established in the east and south-east of Namibia and therefore this area warrants further investigation to understand the structure of the resident population. Landowners on the south-east Botswana border have noted the transboundary movement of leopard and other carnivores onto their properties. Further research into the relationship between the Transfrontier Park and freehold farms is needed to understand leopard population dynamics in this area. Leopards in the Oana Nature Reserve and the broader area of the Orange River are also an understudied population; ongoing research there will provide valuable new information.

Building a Namibian leopard DNA database would provide multiple benefits for leopard conservation both nationally and internationally. DNA can provide useful data for answering questions on conservation and population genetics of wide-ranging species such as the leopard. DNA can also be used for DNA-based assignment tests, from which it is possible to infer geographic origins of DNA samples from seized illegal leopard products such as skins which helps to identify trade routes and poaching hotspots for leopards at a subcontinent scale, as has been the case in India (Mondol *et al.* 2015). The importance of understanding the genetic diversity of the Namibian leopard population has already been recognised. A genetic sample collection protocol was developed and incorporated into the post trophy hunt permit requirements which was implemented at the start of the 2019 hunt season (Richmond-Coggan 2019). The implementation of DNA collection as part of the trophy hunting permit requirements could be seen as phase 1. Phase 2 therefore, would be the inclusion of DNA collection as part of the problem animal removal permit requirements. This would substantially increase the sample size and geographical spread of leopard DNA collected on an annual basis.

Presence data recently collected for leopard across Namibia was, in part, was through a citizen science initiative which requested participants to submit their leopard photographs from private camera traps and key farm information. This initiative contributed to the expansion of the known leopard distribution as well as engaging people in leopard conservation efforts as such the continuation of this type of inclusive initiative is highly recommended.

The economic benefits that the leopard brings to Namibia, through both consumptive use and non-consumptive use, is important to multiple sectors. Incorporating this information into the long-term monitoring of the leopard population will enable pro-active management of the species to occur. This in turn will ensure the permanency of leopards across Namibia.

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Lion *Panthera leo*

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Namibian conservation status	Vulnerable
Global IUCN status	Vulnerable
Namibian range	94,300 km^2
Global range	~1,655,800 km^2 globally, including 1,400 km^2 in India
Population estimate	Namibia: ~800 Global: ~20,000
Population trend	Stable in Namibia, declining globally
Habitat	Moist sub-tropical savanna in the east, to arid and coastal areas in the west
Threats	▸ Persecution and retaliatory killing by farmers ▸ Excessive problem animal killing by MEFT and permitted farmers or hunters ▸ Management of trophy hunting ▸ Poaching for body parts ▸ Bycatch in bushmeat poaching

DISTRIBUTION

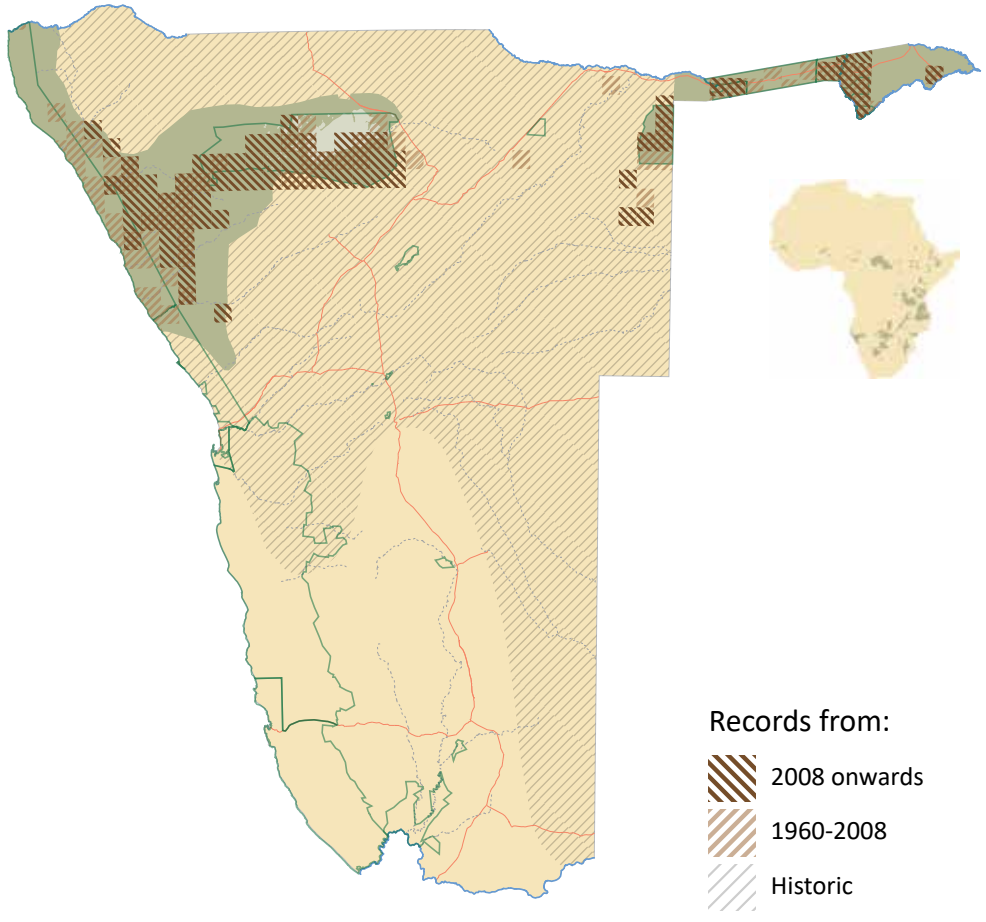
In Namibia lions occur in the north-western, north-central and north-eastern regions. They are found from the very arid Skeleton Coast National Park and in and around Etosha National Park, through to the relatively higher rainfall areas of Kavango East and Zambezi Regions. Africa-wide, lions are now mostly restricted to protected areas, and are currently restricted to only 8% of their former range (Bauer *et al.* 2016). In addition, as wild grazers have been replaced with domestic ones, lions have been increasingly persecuted. Until very recently little was known about the lions of Angola, South Sudan and the Central African Republic (Bauer *et al.* 2016). In the case of Angola, steep declines in range are now confirmed from recent surveys (unpublished data). For example, a survey carried out over 2015 and 2016 in Luengue-Luiana and Mavinga National Parks in Angola found that there were <50 lions left in the two parks, as compared to earlier estimates of up to 1,000 lions (Funston *et al.* 2017b).

"*Very occasionally a wandering lion may be still heard within a mile or two of Windhoek.*" This was written by Shortridge in 1934, and it shows the extent that lion range has

Distribution records of lion (1960 to present), and present estimated area of distribution.

Inset: African distribution of lion according to IUCN (Bauer *et al.* 2016). Historical distribution (hatched) from Shortridge (1934).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



diminished since then (Shortridge 1934). In the mid-1800s Andersson reported lion throughout Namibia (Andersson 1875), but they steadily retreated with the advance of European settlement, and the historic distribution shown in the map is as Shortridge recorded it in 1934.

POPULATION ESTIMATE AND TREND

Across Africa lions are estimated to have declined by more than 50% in the past 30 years, with approximately 20,000 individuals now thought to exist in the wild (Bauer *et al.* 2015). This downward trend has occurred Africa-wide with the exception of four southern African countries: Botswana, Namibia, South Africa and Zimbabwe, where lions are thought to have increased by about 11% over the last 20 years. The difference for these four countries is partly due to the establishment of fenced, intensively managed and relatively well-funded reserves to which lions have been reintroduced, as well as better-than-average conservation practices in non-fenced areas (Packer *et al.* 2013).

Regional lion population trends are closely mirrored by the trend of their main prey species, based on information from 78 herbivore populations monitored between 1970 and 2005 in western, eastern and southern Africa. While herbivore population sizes increased by 24% in southern Africa, they declined by 52% in eastern Africa and by 85% in West Africa (Craigie *et al.* 2010).

In Namibia the lion subpopulation in Etosha National Park is estimated to have been relatively stable at 400–450 lions for the last two decades, notwithstanding quite intense persecution rates along its boundaries (MEFT unpublished data). Over the same time period lions in the Kunene Region increased from only 20–25 individuals in 2000 to 130–180 (MEFT unpublished data). In Kunene the desert-adapted lions comprise three prides that occupy the harshest conditions in the Skeleton Coast National Park, with a further six prides in the conservancies that adjoin this area. These conservancy areas are sparsely populated by people but there is no shortage of livestock. Particularly in times of drought, lions and livestock interact more regularly near settlements in the Puros, Sesfontein, Anabeb, and Torra Conservancies. The desert-adapted lions of north-west Namibia are immensely valuable to the tourism industry, but poor livestock husbandry and range management practices, and a culture of killing conflict-causing lions, puts this population at risk.

Although lions occasionally move between Etosha and Kunene there are no resident prides in the more human- and livestock-populated places in between, although some

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lions occasionally reside outside western Etosha in the Etosha Heights area and along the southern boundary with Ongava. Beyond the Etosha-Kunene area, lions also occur on a number of fenced private properties including Kalahari Game Ranch, Erindi and Erongo. These animals likely form a fairly functional and stable meta-population although local crisis situations do occur, invariably resulting in a number of lions being killed.

In the north-east (Kavango East and Zambezi Regions) lions have declined to fewer than 100 individuals over the last three decades. Throughout the two regions lions are mainly restricted to protected areas, although the east Zambezi lions occasionally safely move into adjoining conservancy areas. Lions in this area remain highly vulnerable to persecution by livestock owners or MEFT officials. To minimise these threats, establishment of >150 lion-proof kraals has resulted in an 80% decline in lion attacks on cattle and a 95% decline in lion killing from 2012 to 2019 (Hanssen & Fwelimbi 2019). The initiation of a Wildlife Credit Scheme in the Mudumu South Complex, where communities receive payment for lion sightings by tourists, holds much promise, together with holistic rangeland management, as a suite of activities to foster greater tolerance towards lions and unlocking their potential value to society. Just as in the north-west, trophy hunting or killing of problem lions is a threat to the overall stability of the lion populations and can result in an increase in conflict outside parks. This is because when adult pride males are killed, females with cubs from that pride often move out of protected areas into communal areas in order to protect their cubs from incoming males, who may kill their cubs.

The eastern floodplain along the Chobe River does not have resident lions, although prides of lions from Chobe National Park in Botswana do cross over to the Namibian side of the river and are becoming increasingly valuable to tourism operators there. Whole prides do occasionally spend a few days at a time in the vicinity of lodges in Namibia. In this area these lions are extremely vulnerable to retaliatory killing by Namibian livestock owners, as large herds of cattle graze on the floodplain where 87% of all lion attacks on cattle take place (Hanssen & Fwelimbi 2019). In the five Chobe River conservancies, 227 cattle were killed by lions over a three-year period from 2016 to 2018, resulting in the retaliatory killing of between 35 and 40 lions (Hanssen & Fwelimbi 2019). These edge effects impact on the stability of lions of Chobe National Park in Botswana, which could possibly be in decline as adult females and cubs are often killed in retaliation for livestock losses. Once again, poor livestock and rangeland management practices underpin much of this preventable conflict.

Bwabwata National Park is relatively poorly populated

with lions, with only one pride in each of the core areas. In the Kwando Core Area, there are about twenty lions with recent sightings in the Mashambo area; in Buffalo there is a single adult lioness, two litters of cubs (two years apart) and a pair of adult males. In the multiple use area lions are vulnerable to changing land use practices and they are vulnerable to persecution both within the national park and in adjoining protected areas in both Angola and Botswana. The expansion of settlements from Omega 1 through to Omega 3, along with increasing numbers of illegal cattle and habitat destruction, are a threat to resident lions and an impediment to lion recovery in the park.

Road mortality of lions has increased in the Zambezi Region with three lions being killed by vehicles along the highways through Bwabwata and Mudumu in 2017/2018. Increasing human density along the Okavango River has led to the extirpation of lions from the Mahango Core Area. It is unlikely that lions will persist there even if reintroduced, as they are too vulnerable to edge effects in this small protected area.

Lions are struggling to recover their numbers in the Khaudum National Park and adjacent Nyae Nyae Conservancy, where historically there were stable prides (MEFT unpublished data). People and their livestock have now permanently settled south of Nyae Nyae, where there are indications of occasional incidents of poisoning. The development of small-scale commercial livestock farms along the western boundary of Khaudum is an impediment to the potential reintroduction of lions and the recovery of resident lions. Intensive monitoring of lions is being undertaken by MEFT that includes collaring with GPS/satellite collars and branding of individuals. This has revealed that the biggest threat to the recovery of lions in this area is persecution in neighbouring Botswana. The most important connectivity area for Namibia's north-eastern lion population (Khaudum to east Zambezi) is through northern Botswana. Although human and cattle numbers are not extensive in Ngamiland, tolerance of wildlife in general is low. Khaudum's lions are regularly killed in Botswana, with half a pride of females and cubs being shot during 2018. Since lion monitoring began, all but one adult male lion that have dispersed from the Khaudum population have been killed in Botswana (MEFT unpublished data).

The capture and removal from the system of the entire buffalo population in Nyae Nyae Conservancy during the 1990s, due to the perceived disease threat to livestock by Veterinary Services, is likely to have partly contributed to the decline in lion numbers. Lions no longer occur in Kavango West and are absent from the recently established Mangetti National Park.

We estimate the total lion population in Namibia at about 800 individuals when including the various private reserves. It would be possible for this number to increase to over 1,000 if the challenges to lion recovery in Kavango East and West, Kunene and Zambezi Regions of Namibia are overcome.

ECOLOGY

In Africa lions have a broad habitat tolerance, being absent only from tropical rainforests and the interior of the Sahara Desert (Nowell & Jackson 1996a).

Lions tend to live at higher densities than most other felids, but there are wide variations from <1 lion/100 km² in desert, to 40 lions/100 km² in the Ngorongoro Crater. In Namibia, desert-adapted lions exist at densities of 0.05–0.1 lion/100 km² (Stander 2006) but in Mudumu and Nkasa Rupara National Parks lions can occur at densities up to 6–8 individuals/100 km² (Hanssen & Funston unpublished data). In Etosha lions occur at densities of 2–3 lions/100 km² (Trinkel 2013, MEFT unpublished data).

Lions are the most social of the cats, with related females remaining together in prides, and related and unrelated males forming coalitions competing for tenure over prides. Average pride size (including males and females) is four to six adults (Schaller 1972, Stander 1991a). However, especially in arid areas such as Namibia, prides often split into smaller groups when hunting, sometimes for extended periods of time. Stander (1991a) found the average pride size in Etosha National Park to be 12.5 (range 9–20). This is probably the only area in Namibia where lions regularly occur at typical large pride sizes, with prides in most other areas experiencing some sort of social disruption induced by anthropogenic mortality. However, large prides of 15 to 20 lions have at times existed in Nkasa Rupara National Park and in Kunene Region. Pride males often venture over large distances looking for new females, making them vulnerable to persecution. Pride home ranges can vary widely even in the same region e.g. from 266–4,532 km² in the Kgalagadi Transfrontier Park of South Africa and Botswana (Funston 2011).

In Kunene Region the mean home range size of 18 male and female lions was 4,344 km² (range 618–12,642 km²) (Stander 2018). This declines to an average home range size of 600 km² (range 150–2,075 km²) in Etosha National Park (Stander 1991a). Even with the relatively higher prey densities of the Zambezi Region, lions still have quite large home ranges of about 200–500 km² (Moeller 2014).

Although lions drink regularly when water is available, they are capable of obtaining their moisture requirements from prey and even plants (such as the tsamma melon in the Kalahari Desert), and thus can survive in very arid environments (Stander 2006). Medium- to large-sized ungulates that typically weigh 150–300 kg, such as

antelopes, zebra and wildebeest, form the bulk of their prey, but lions will prey on large animals such as African buffalo and giraffe when the opportunity exists (Hayward & Kerley 2005). Smaller prey such as impala, springbok and warthog are killed more regularly than larger species, but do not constitute the bulk of meat eaten, which typically comes from medium-sized prey (Hayward & Kerley 2005). Lions tend to only hunt the young of very large prey such as elephant and rhino but will kill injured or debilitated subadults and adults of these species.

As the densities of elephants have increased in parts of lion range in the Kavango-Zambezi Trans-Frontier Conservation Area (KAZA TFCA), so there has been an increase in predation on elephant calves in recent years, occurring in the late dry season or droughts when elephants are nutritionally stressed (Power & Shem Compion 2009). Lions in the Zambezi Region are adept at hunting buffalo and readily scavenge on dead hippos. It is due to these large prey species that lions are able to persist in small parks surrounded by human settlements. They have been observed killing kudus, sable and waterbuck; lechwe and reedbuck have been identified in their scat (Hanssen unpublished data).

Lions also scavenge, displacing all other predators from their kills, but large groups of spotted hyaenas can drive groups of female lions from their kills, although spotted hyaenas in Etosha do not have large enough group sizes to achieve this (Trinkel & Kastberger 2008). Desert-adapted lions subsist mainly on gemsbok and zebra, but readily kill ostriches, giraffe, and even springbok. These hunts often occur near springs where wildlife visit for water, and in dry riverbeds (Stander 2018). Lions that live within the Skeleton Coast National Park kill seals and sea birds, and scavenge on whale carcasses when available (Stander 2019).

THREATS

Across Africa lions face numerous threats, including (in rough order of importance) prey depletion or direct mortality in snares and traps associated with bushmeat poaching (Lindsey *et al*. 2013a), human-lion conflict and persecution (Frank *et al*. 2006), habitat destruction (Henschel *et al*. 2014), invasion of protected areas by livestock, poorly managed trophy hunting (Packer *et al.* 2009, 2011, Rosenblatt *et al.* 2014) and trade in body parts (Williams *et al*. 2017).

Human-lion conflict

In Namibia the primary and most overarching threat to lions is persecution for livestock predation. Lions can be relatively easily tracked down and shot or speared, seldom moving far away from the carcass of an animal they have killed, and their scavenging behaviour makes them particularly vulnerable to poisoned carcasses put out to eliminate predators. Lions are thus very vulnerable to persecution and can suffer dramatic population declines when it intensifies (Kissui 2008).

Information on the exact numbers of lions killed throughout their range from human-lion conflict is lacking, but in Namibia the Event Book system allows fairly accurate monitoring of the numbers of lions killed. Along the boundaries of Etosha for the last 20 years about 40 lions are killed each year because of conflict, either by cattle farmers or MEFT officials (MEFT unpublished data). Other than killing regularly offending lions, which is the advocated policy (Stander 1991a), not much has been attempted at a national scale to actively prevent livestock depredation from occurring. Furthermore, data from the Kunene Region show that 37 lions were killed due to conflict in the period 2005–2015 (Ministry of Environment and Tourism 2016), while about 5–10 lions are killed per year in the Kavango and Zambezi Regions (Funston *et al*. 2017a, Hanssen & Fwelimbi 2019). Thus, the overwhelming anthropogenic mortality of lions in Namibia is due to persecution in retaliation to lion predation on livestock.

The hunting of "problem lions" for profit is acknowledged as a means of offsetting the costs incurred due to livestock lost to lions in communal conservancies (Ministry of Environment and Tourism 2018). Members of communal conservancies support trophy hunting generally, and view it as a key reason for supporting wildlife conservation in these areas (Angula *et al*. 2018, Störmer *et al*. 2019). However, the targeting of "problem lions" for trophy hunting is problematic in that it does not solve the real issue that causes conflict (poor livestock husbandry) and is open to flagrant abuse. Many lions shot as trophies to address conflict are not the offending lions; they tend to be the biggest, most impressively maned lions that hunters can bait into or find in an area (L Hanssen & P Funston pers. obs. 2018).

Furthermore, "problem lions" are often young dispersing lions that soon after transgressing and killing a few cows, might change their behaviour or move on to breed in a new area (Elliot *et al*. 2014). Killing these lions at this critical age of their lives is not advisable for maintaining genetic diversity.

Thus hunting "problem lions" as trophies is a flawed system that does not solve the problem. It should be re-evaluated, along with at times excessive trophy hunting of male lions. NGO and government-led initiatives should be developed to address the livestock husbandry practices that facilitate much of the conflict.

Evidence from several projects Africa-wide, and in parts of Namibia, suggests that human-lion conflict can be substantially minimised through the implementation of appropriate livestock management measures (Hazzah *et al*. 2014, Ministry of Environment and Tourism 2016, Hanssen & Fwelimbi 2019). These include creating an early warning system whereby livestock farmers are alerted when lions approach their homesteads (Weise *et al*. 2018), keeping cattle in lion-proof kraals (bomas) at night, and herding cattle during the day as part of a broader rangeland management strategy (Hanssen & Fwelimbi 2019).

Potentially, mechanisms for insuring against livestock losses and/or creating incentives to implement these measures are some of the primary responses to resolving human-lion conflict (Frank *et al*. 2006, Hazzah *et al*. 2014). Currently, the Ministry of Environment, Forestry and Tourism assists livestock farmers who lose animals to predators through the Human-Wildlife Self-Reliance Scheme, which partially offsets the costs of their livestock losses (Ministry of Environment and Tourism 2018).

However, new approaches to address human-lion conflict holistically need to incorporate many of the approaches above, along with solid principles of rangeland management. A further requirement is to unlock the value of (and thus appreciation for) lions to communities above those of conservancy membership and traditional agriculture. This can be achieved through performance payment schemes and more focused lion-related tourism offerings (e.g. lion monitoring guided safaris). One of these promising new plans is the Wildlife Credit Scheme, which provides a mechanism for tourists who view lions in conservancies to pay into a fund that the conservancy can use to mitigate human-lion conflict.

This is a form of payment for ecosystem services, which has been effective for conserving species elsewhere (Dickman *et al*. 2011), and is currently working with some effect in the Dzoti Conservancy, Zambezi Region. There is also a fledgling holistic rangeland management trial in the same area. A far more integrated and holistic approach is needed to replace the current "kraal and/or kill" approaches, which are limited in their effectiveness. Furthermore, human-lion conflict is a human development and an agricultural issue and should receive far greater interest from those sectors of society and government, and not just the under-resourced Ministry of Environment, Forestry and Tourism.

Management of trophy hunting

Lion trophy hunting is currently restricted to only ten sub-Saharan African countries and is considered an important management tool for conserving wild land, providing financial resources for lion conservation for both governments and local communities (Lindsey *et al*. 2012). However, there is concern that management regimes have not always been sufficient to deter unsustainable offtakes (Packer *et al*. 2011, Lindsey *et al*. 2013b). In Namibia the trophy hunting of lions is not practiced in any substantive way, with the total population of lions being about 100–150 individuals in the Kunene and Zambezi Regions predicating a low harvest of no more than about five lions per year. However, given that same pool of lions is exposed to substantive levels of mortality due to human-lion conflict that further reduces the opportunity to trophy hunt lions.

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There are many suggested approaches to achieving sustainable trophy hunting of lions such as area-based approaches (Whitman *et al*. 2004, Packer *et al.* 2011, Miller *et al*. 2016), or percentage of population (Creel & Creel 1997). However, all of these inherently require sufficient lions to hunt. With fewer than 100 individuals in any of the lion subpopulations in Namibia in which wild lions can be trophy hunted (<100 lions in Kunene conservancies, <20 in Nyae Nyae and surrounding conservancies, <30 in Bwabwata National Park and <50 in eastern Zambezi), it is questionable whether the option should exist to trophy hunt mature adult male lions in any of these subpopulations, especially as lions in all of these areas are already killed due to incidents of conflict.

Further evidence for this view is that there is currently not one male lion that is above six years of age in the entire Kunene subpopulation (Stander 2018). In the Kavango East and Zambezi Regions, fewer than three adult male lions are currently seven years or older (P Beytell, P Funston, L Hanssen pers. comm. 2019). The most recent scientific studies show that seven years old is the minimum age below which no lions should be hunted (Creel *et al.* 2016, Miller *et al*. 2016).

If the size of a subpopulation of lions is large enough to support limited lion trophy hunting, then an aged-based, known-individual-based lion trophy hunting system could be implemented. In such a system only older (8 years and above) male lions that are known to be relatively redundant (i.e. known to not have dependent cubs less than two years old) should be hunted as trophies. In Kunene, Kavango East and Zambezi various projects currently effectively monitor lion populations such that population trends can be assessed, and older lions identified. This information could inform trophy management systems once populations have recovered. Trophy hunting of lions (and all carnivores) should not be allowed in the core areas of National Parks such as Bwabwata, Mudumu, Nkasa Rupara, Mahango, Khaudum and Etosha.

Poaching for body parts

A new threat to lions is a rapidly growing international market for lion parts such as bones, skulls, skins and skeletons (Everatt *et al*. 2019). The killing of lions for body parts is not common in Namibia but is on the increase. For instance, the removal of the paws and the head in order to harvest teeth and claws from lions killed in conflict is a growing trend in Zambezi Region since 2016 (MEFT unpublished data). Although this has occurred mostly along the eastern Chobe floodplain, there are some isolated incidents in the conservancies of the Mudumu Landscape area.

Prey depletion and bushmeat poaching

There are not many areas in Namibia where prey depletion through illegal hunting is a major issue for lions. While poaching of wild ungulates is not currently a large issue in Namibia, there are parts of Zambezi Region where it is becoming increasingly problematic. At present it is barely controlled due to staff and operational budget constraints within MEFT. Furthermore, in that region bushmeat poaching is a significant problem in the neighbouring countries of especially Angola and Zambia, but also in Botswana (Rogan *et al.* 2018).

In these countries bushmeat is hunted in the adjoining protected areas using rifles, horses, dogs and spears, bow and arrows, wire snares and gin traps. These are very substantial threats to lion prey and indeed lions themselves. It is thus quite possible that, without joint transboundary anti-poaching efforts, Namibian lions, or lions that largely reside in Namibian protected areas, will be poached when they cross into the neighbouring countries. This is a serious issue for lions in the Zambezi Region and in areas bordering Botswana. Greater transboundary anti-poaching patrols and activities are needed to secure wildlife, which contributes to Namibian socio-economic development.

CONSERVATION STATUS

Since 1977 the African lion population has been included in CITES Appendix II (Bauer *et al.* 2018). Lions are considered to be Vulnerable on the IUCN Red List of Threatened Species (Bauer *et al*. 2016). But, the total population of the species is estimated to have declined 43% between 1993 and 2014, but this conceals a more severe decline across most of the range. Five countries (Botswana, India, Namibia, South Africa and Zimbabwe) comprising around 25% of the total population have stable/nearly stable or increasing populations which are collectively estimated to have increased 11% since 1993. These increases in a relatively small part of the range disguise the severity of the decline elsewhere in the African range, representing 75% of the population: this decline is collectively estimated at 60% since 1993 (Bauer *et al.* 2015). Accordingly, although the Lion is classified as Vulnerable on the IUCN Red List, it qualifies to be considered Endangered in most of its range (by the A2 criterion, with an inferred rate of decline over 50% in three generations; Bauer *et al*. 2016). Thus, the populations in West Africa are considered Critically Endangered, having lost nearly 99% of their historical range and with only approximately 400 lions remaining (Henschel *et al*. 2014, Bauer *et al*. 2016). The West and Central African lion is considered to be a separate subspecies (*Panthera leo leo*) from the East and southern African lion *(Panthera leo malenochaita*).

ACTIONS

Regional conservation strategies have been developed for lions in West and Central Africa (IUCN 2006a) and eastern and southern Africa (IUCN 2006b). By setting out common priorities to guide actions on both national, community and landscape levels, the regional conservation strategies have the potential for broad and significant improvement of lion status and management (Nowell *et al*. 2006). These regional strategies have been used in many countries to develop Lion Conservation Action Plans. Namibia drafted its Lion Conservation Strategy in 2007, but government has not endorsed that draft or more recent ones. To address more local challenges, MEFT has established a human-lion conflict management plan for communal conservancies in the Kunene and Erongo Regions (Ministry of Environment and Tourism 2016).

Management

- The Lion Conservation and Management Action Plan for Namibia needs to be updated and officially endorsed and a process developed to keep the plans ongoing and active. The national strategy should be reviewed at least every ten years.
- The National Lion Strategy needs to include a component on how to monitor the various subpopulations of lions over time, in ways that meet the management objectives of the strategy.
- Government needs to be actively approached and engaged to provide the financial support to implement lion management and conflict-avoidance strategies. The strategies should be fair to both people and lions, fostering the principle of co-existence.
- A human-lion conflict strategy needs to be developed for north-eastern Namibia.
- Political priority and funding for lion conservation management in Namibia needs to be developed. Human-wildlife conflict management has now become a national issue in Namibia, and lions carry much of the burden of hostility towards predators. Current approaches to conflict, particularly trophy hunting, are open to abuse and do not solve the problem in any lasting manner.
- Develop mechanisms to enhance the value of lions, especially in conservancies, by for example linking development aid/funding to lion tolerance (performance payments, etc.).
- The MEFT and private landowners managing reintroduced lion populations in private reserves should be encouraged to become members of the Lion Management Forum and manage their populations using best practice guidelines (Miller *et al*. 2013). The Forum is a body largely run for lion populations in South Africa but could easily be expanded to include other countries in the region. Indeed, that is the intention.
- As with other arid countries, lions in Namibia suffer the greatest threat from human-lion conflict and persecutory killing. Human-lion conflict has been dramatically improved in eastern Zambezi Region through the construction of lion-proof kraals and the employment of community members to address conflict. Although similar initiatives are being implemented in the Kunene Region, they need to be intensified and better managed to emulate these successes.
- New and innovative ways that truly foster coexistence need to be developed. The long-term solution for the relationship between Namibia's lions and its people lies not wholly in conflict-mitigation, but in fostering true coexistence; unlocking the value of lions and working towards a situation where lions are valued more alive than dead.

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Reviewers: Peter Lindsey and Luke Hunter

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Serval *Leptailurus serval*

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Namibian conservation status	Near-Threatened
Global IUCN status	Least Concern (2015)
Namibian range	Central and northern highlands, north-central and north-eastern Namibia (291,000 km^2, approximately 35% of Namibia)
Global range	Occurs widely through sub-Saharan Africa, with the exception of tropical rainforest. Few records north of the Sahara
Population estimate	1,500–4,000 in Namibia
Population trend	Stable; possibly declining
Habitat	A combination of permanent water sources with sufficient vegetation cover and opportunities to shelter
Threats	▸ Habitat loss and fragmentation ▸ Drought, Climate change ▸ Accidental mortality (snares and roads)

DISTRIBUTION

Shortridge (1934) describes the serval as occurring chiefly in the northern parts of Namibia, with records from Damaraland (now northern Erongo and southern Kunene), and eastwards to the Waterberg. He further noted that servals are rare south of these areas, and confirmed that they are generally found near permanent water sources. The IUCN's initial distribution map reflects this description (Breitenmoser-Wursten *et al.* 2008).

An apparent extension of the serval's range southwards as far as Windhoek and the central highlands has been noted (Thiel 2019, extended further by Stratford *et al.* 2016). Importantly, Stratford *et al*. (2016) report historical records from Gaerdes (1978), which demonstrate that servals have been present in the central highlands for an extended period. This suggests a permanent population, albeit at very low density. It also suggests that the IUCN's inference (see below) that servals are recolonising areas may not be completely correct. Monitoring techniques, especially camera trapping, have provided significant improvements in detection of nocturnal cryptic species such as the serval.

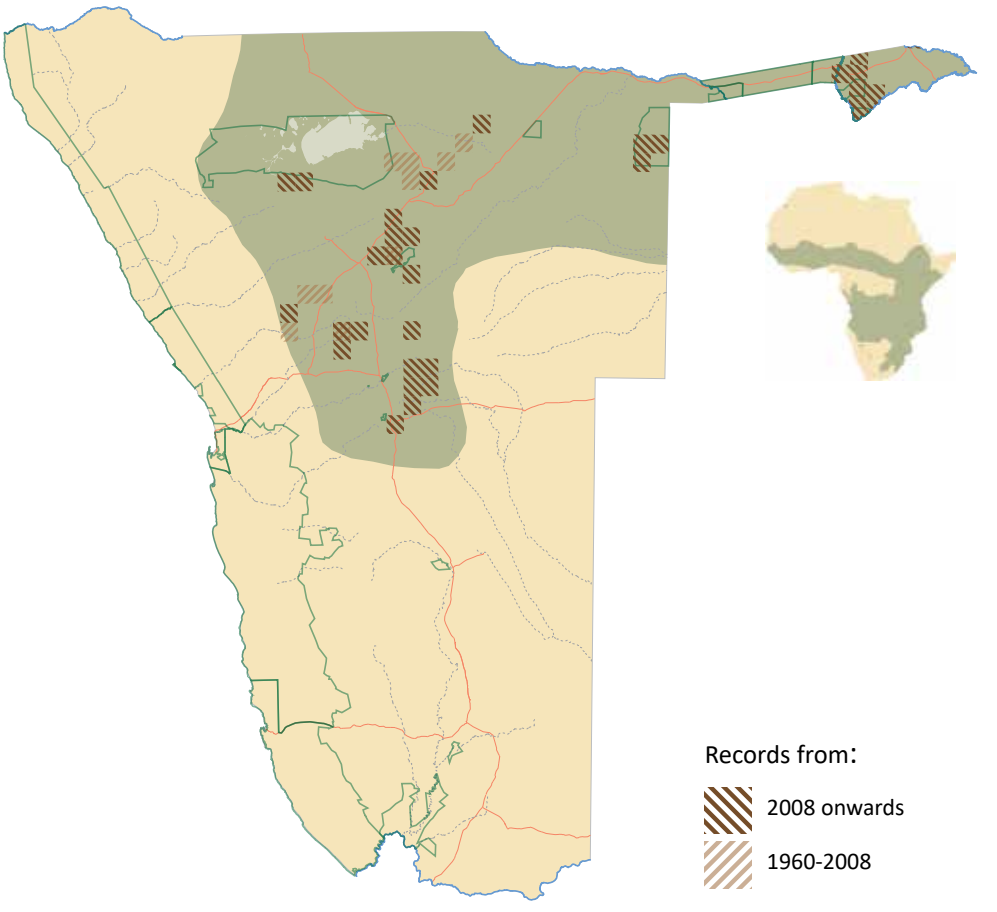
Some further range extensions have been reported: a sighting from 2015 in north-western Kunene might represent a population rather than a single dispersing individual. If this is the case, then it may be that in Namibia serval can extend their range by moving along waterways, as suggested in Thiel (2019). There is also a sighting from 2011 on the eastern edge of the Namib Sand Sea, at least 200 km south of what is thought to be the southernmost extent of the range. The status of this record is not known.

The serval occurs widely throughout sub-Saharan Africa, with the exception of tropical rainforests and deserts (Nowell & Jackson 1996a). In recent years there have been new records of servals in several areas such as Gabon,

Distribution records of serval, and present estimated area of distribution in Namibia.

Inset: African distribution of serval according to IUCN (Thiel 2019).

The Namibian distribution in the main map is more up to date, and expands the range of serval as shown by the IUCN.



eastern Central African Republic and south-western Uganda, implying an expanding population that is recolonising areas (Thiel 2019).

More recently, Finerty *et al.* (2019) have reported camera trap observations of servals in Botswana as far as 200 km south of the current IUCN range, suggesting that, where suitable conditions exist, servals may also occupy semi-arid landscapes. This would be consistent with Stratford *et al's* (2016) prediction that servals may occur in the central Kalahari savanna to the east of their southern range in Namibia.

POPULATION ESTIMATE AND TREND

Despite its status and wide range, the serval remains largely understudied (Ramesh & Downs 2013), and, until recently, density estimates have been limited to just five countries. Published density estimates for sub-Saharan Africa range widely: from 2.51–2.82 serval/100 km^2 in Senegal (Kane 2014) to 62.55–111.55 serval/100 km^2 in South Africa (Loock *et al.* 2018). However, such a high density estimate may be due to the industrialised nature of the study area (the Secunda Synfuels Operations Plant) attracting high densities of preferred prey species; in comparison Bohm and Hofer (2018) report a density of 10.37–11.81 serval/100 km^2 in the Republic of Congo's Odzala-Kokoua National Park, whilst Thiel (2011) reports a density of 9.9 serval/100 km^2 in Zambia's Luambe National Park.

Edwards *et al.* (2018b) present the first density estimates for Namibia, from two protected areas in the north-east. Density was estimated at 1.28 serval/100 km^2 (± 0.23, 0.82–1.56) in Khaudum National Park, and 0.63 serval/100 km^2 (± 0.51, 0.38–0.90) in the Mudumu North Complex. The latter is the lowest serval density published to date.

The projected distribution of servals in Namibia covers an area of approximately 291,000 km^2. The low density estimates from Edwards *et al.* (2018b) in the eastern areas, and the extremely low detection rate for servals in the central highlands (Stratford *et al.* 2016), suggest that servals in Namibia occur at densities that may well be as low as 0.50 serval/100 km^2. This would imply a population of as few as 1,500 individuals. Even if it is assumed that detection rates by the existing studies are compromised, and that the densities are as high as those recorded in Khaudum, the maximum population size is likely to be less than 4,000 adult individuals.

Given the paucity of information on this cryptic species, it is unknown whether the population is stable. However,

considering the threats (see below), it is unlikely that population numbers are increasing.

ECOLOGY

Servals are mostly found in and around marshland, well-watered savanna and long-grass environments, and are particularly associated with riparian vegetation types (Thiel 2019) that provide a high abundance of prey species, such as small mammals (especially rodents), birds and reptiles. These form their mainstay diet (Bowland 1990, Bowland & Perrin 1993, Geertsema 1984, Ramesh & Downs 2015b, Thiel 2011). Servals can tolerate agricultural areas provided there is available cover and prey, and can use features such as waterways to move between suitable patches (Hunter & Bowland 2013, Ramesh & Downs 2013), suggesting local populations may exist in smaller areas across their broad distribution range (Sunquist & Sunquist 2002). Stratford *et al*. (2016) show that servals can also exist in the semi-arid *Acacia*-dominated landscape of Namibia's central highlands – this provides patches of dense vegetation and suitable habitat for their preferred prey species.

Ramesh *et al*. (2016) suggest that the status of servals in mosaic agricultural landscapes is reduced, particularly their movement patterns in response to habitat fragmentation. This is supported for Namibian serval populations by the extremely low detection rates in the central highlands of Namibia (Stratford *et al.* 2016). Serval exhibit lower occupancy rates in cropland but increased occupancy with higher human abundance (Ramesh & Downs 2015b, and see the high densities recorded by Loock *et al.* 2018). However, serval are likely to be sensitive to fragmentation due to habitat specialisation (Ramesh *et al*. 2016). Ramesh & Downs (2013) found that they preferred native wetland with a higher percentage of less disturbed, large-sized patches and also avoided or used croplands less (Ramesh & Downs 2015a).

THREATS

The major threat to servals is the loss and degradation of wetland and associated grassland (Thiel 2011, Ramesh *et al.* 2016). Wetlands have high rodent densities when compared with other habitat types, and form the core areas of serval home ranges (Bowland 1990, Ramesh & Downs 2015a, Thiel 2019). Anthropogenic modification of grasslands through annual burning, overgrazing by livestock and intensive wildlife/livestock farming, can result in a significant reduction in prey species and suitable habitat. First-order anthropogenic sources are not the only drivers of loss of suitable habitat. The anticipated decline in rainfall, rise in temperatures and increased severity of droughts associated with climate change will also lead to a reduction in serval habitat.

Other threats include land-use change, increased anthropogenic structures (e.g. roads, buildings) and invasive alien plants. However, the very high densities found near an industrial plant (Loock *et al.* 2018) suggest that servals are able to take advantage of conditions in novel anthropogenic landscapes – as is being seen across many mammalian species (Fleming & Bateman 2018). Thus, while Ramesh and Downs (2013) found serval density to be similar across a

range of farmland management intensities, the continued degradation of core wetland areas may ultimately threaten viable serval populations, especially if they are reluctant to move through hostile habitat such as open cropland (Ramesh & Downs 2015a). Within agricultural landscapes, servals select areas with minimal disturbance and a high proportion of natural habitat (Ramesh & Downs 2015a), thus highlighting that only landscapes with a mosaic of modified to natural habitats will be suitable, and emphasising the importance of undisturbed habitats. In Namibia these habitats are under particular pressure as agricultural use increases.

Other threats within Namibia include road mortalities, accidental persecution by farmers intent on killing other carnivores (Power 2014), and incidental snaring as part of the bushmeat trade. Although servals are non-target animals (and are actually beneficial to crop farmers due to their predilection for rodents), many die in traps set out for carnivores such as black-backed jackals, which are perceived as a problem animal on many farms. Additionally, servals occasionally prey on poultry, which may lead to direct persecution. Similarly to leopards, the trade in South Africa for serval skins for use in ceremonial traditions is an important threat (Balme 2019), and also contributes to a suspected ongoing decline in mature individuals. Trade in serval pelts for ceremonial or medicinal purposes is widespread throughout Africa (Thiel 2019), and pelts are often worn as a substitute for leopard pelts. It is unknown whether this constitutes a significant threat for Namibia's servals.

Hunting of servals is not restricted in Namibia, although they may only be hunted with a permit in Angola. Hunting is prohibited in the neighbouring countries of Botswana and South Africa (Cape Province only). However, serval are not thought to be a common target for trophy hunting.

Hybridisation with feral cats may be a minor threat in Namibia, although this is not as severe as it is for other species, such as African wild cat. Hybridisation with the African wild cat has been documented in captivity (Skinner & Chimimba 2005). Deliberate hybridisation with the feral cat has resulted in a newly registered breed, the "Savanna Cat" (Eckermann-Ross 2014), which has been facilitated by the fact that many small felids are susceptible to domestication (Cameron-Beaumont *et al.* 2002). However, the males tend to become sterile after a few generations (Davis *et al.* 2015). There has, however, been no indication of a threat from this issue in Namibia.

CONSERVATION STATUS

Until now, the serval has been classified as Least Concern in Namibia. This document reports new information on population size and density, and therefore justifies a reassessment. While Namibia's serval population meets some of the criteria for a Vulnerable (VU) listing (e.g. population is fragmented and consists of less than 10,000 mature individuals), there is insufficient longitudinal data for an evaluation of the state of flux of the population. Given that the perceived threats are likely to increase, it would appear prudent to elevate the status of serval in Namibia to Near Threatened (NT).

The serval is listed in CITES Appendix II, although hunting of this species is not prohibited in Namibia. Indeed, there are no hunting regulations listed for serval in Namibia's Nature Conservation Ordinance Act (1975). Effective conservation of serval populations requires wide areas of native habitat,

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in particular well-preserved wetlands in mosaic landscapes (Ramesh & Downs 2013, 2015a, 2015b). Wetlands form islands of suitable habitat and provide reservoirs of small mammal populations that constitute the main prey of servals (Bowland 1990). Maintaining the quality of remaining natural wetland habitats, as well as artificial wetlands, will contribute to the persistence of serval subpopulations. For example, management actions such as retaining ground cover, reducing grazing pressure or keeping a buffer of natural vegetation intact around the wetland can reduce the impacts of damaging farming practices and contribute to the preservation of healthy population of rodents (Bowland & Perrin 1993, Driver *et al.* 2012). Restoration and maintenance of such habitat patches is the only means of improving functional connectivity in modified landscapes; these are especially relevant for a species that exists at very low densities (Ramesh & Downs 2015a). Additionally, artificial wetlands that provide protection, prey base and shelter can be integrated into landscape-scale conservation plans.

ACTIONS

Management

The impact of Namibia's small serval population on livestock is likely to be insignificant, therefore policy makers should work towards getting serval listed as a protected species under Namibian conservation legislation.

- Management should aim at conserving the prime habitat of serval, i.e. Namibia's wetland areas. Serval are known to forage away from wetlands and therefore such habitat management should also include conserving woodlands with good grass cover. Serval have been found to be abundant on South African farmlands; therefore maintaining good veld condition, especially in areas with riverine habitat, is identified as an important management practice.

- Monitoring serval should be introduced as a compliance measure in Environmental Impact Assessment reports of developments which affect wetlands.

Awareness

Report sightings, including road-kills and camera trap records from private individuals on virtual platforms (for example, the EIS), especially outside protected areas.

- Do not purchase or import hybrid "Savanna Cats" and ensure domestic cats are sterilised, especially in rural areas in which serval are known to occur.

- Report snaring or illegal hunting incidents to Ministry of Environment, Forestry and Tourism, Namibia's Intelligence Support Against Poaching (ISAP) and conservation NGOs.

Research

As yet no spatial data from free-ranging servals within Namibia has been collected. Edwards *et al*. (2018b) suggested Namibian serval might have relatively large home ranges which could explain the low densities recorded for the Mudumu North Complex and southern Khaudum National Park. The collection of spatial data from both sexes of serval in a variety of habitats using GPS/satellite collars will enhance the knowledge of serval ecology in Namibia.

- Across their range, serval should be monitored to determine density and population trends. Ramesh and Downs (2015b) suggested serval to be useful ecosystem indicators for the influence of habitat fragmentation within agricultural landscapes, therefore monitoring in such habitats, and in protected areas, is suggested as a high priority.

- Individuals translocated or released from rescue centres should be monitored using GPS/satellite telemetry, following their release. There is currently limited data on the success of such releases and obtaining relevant information would help guide future management decisions.

- Investigate the role of serval as a controller of agricultural pests and promote findings within local communities and the agricultural sector. At the same time, establish the degree of hunting pressure and persecution of serval in Namibia.

- Basic distribution data of serval across Namibia should be collected through structured questionnaire surveys. Results will highlight key areas that will need to be studied further.

- Obtain genetic samples from serval in Namibia to study connectivity across different populations.

Assessor: Ken Stratford
Contributors: Sarah Edwards, Rubén Portas, Lise Hanssen and Stéphanie Périquet

Suggested citation: Stratford K 2022. A conservation assessment of Serval *Leptailurus serval*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 49-53. MEFT, LCMAN & NCE, Windhoek, Namibia

Caracal *Caracal caracal*

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Namibian conservation status	Least Concern
Global IUCN status	Least Concern since 1996
Namibian range	~769,000 km^2
Global range	~17.2 million km^2 (IUCN 2014)
Population estimate	Widespread over its range and fairly common, although elusive
Population trend	Stable. Possibly increasing on some farms where black-backed jackal numbers have declined
Habitat	Dry savanna, dry woodlands, *Acacia* scrub, arid hilly and mountainous areas up to 2,500 m altitude
Threats	Caracals are heavily persecuted on game and small-stock farms as livestock killers. This results in a lack of experienced adult females which could pose a threat to their long-term survival. In addition, it can increase conflict due to the influx of young individuals- which defend smaller territories than mature animals- and thus a higher carnivore density

IDENTIFYING FEATURES

The caracal is the heaviest of Africa's small cats, ranging from 6–20 kg. The long black-tufted ears, rufous coat with spotted whitish underparts and relatively short tail, are distinctive. It has dark facial markings on the cheeks and over the eyes, and the backs of the ears are black.

DISTRIBUTION

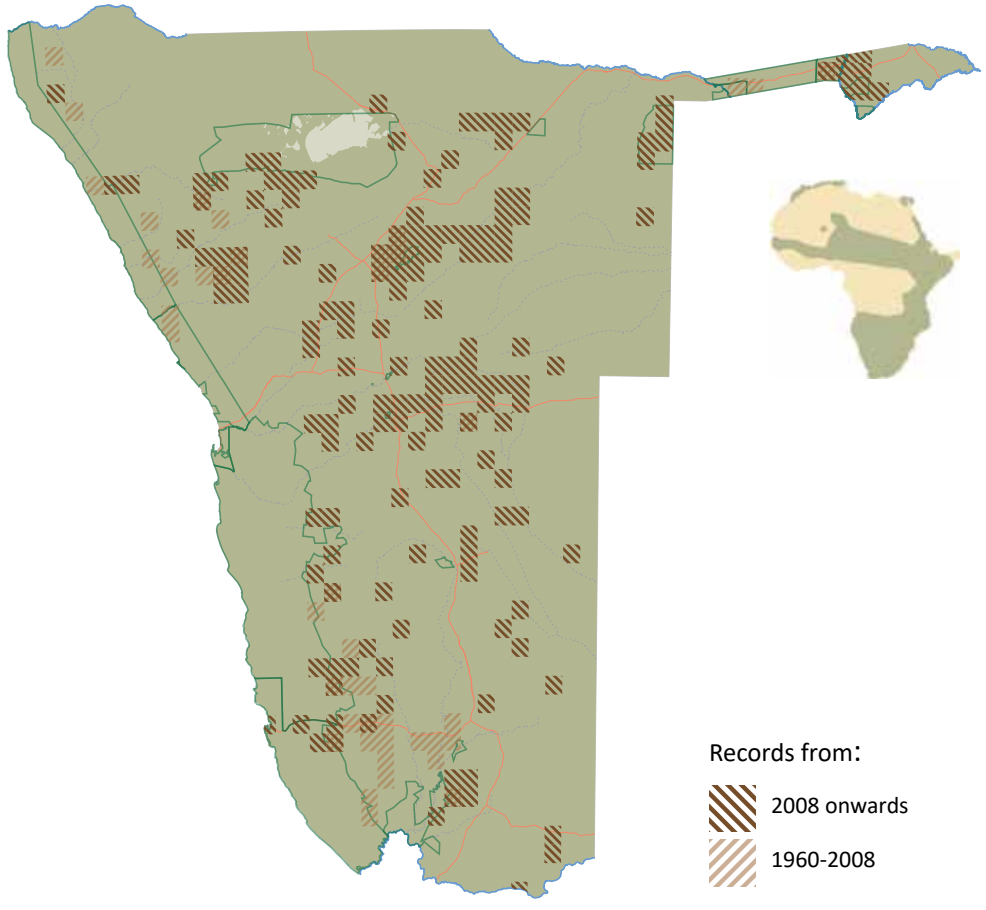
Caracals occur throughout the savannas of Africa and into the Middle East all the way to India and the Karakum Desert in Russia (Estes 1991). In Africa they occur over most of the continent with the exception of the central Sahara and the equatorial forest belt (Avgan *et al.* 2016).

In Namibia, their distribution does not seem to have

Distribution records of caracal, and present estimated area of distribution in Namibia.

Inset: African distribution of caracal according to IUCN (Avgan *et al.* 2016).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



changed much since the first written recordings by Shortridge (1934). Although Shortridge did not ascertain their occurrence on the coast, he recorded them as occurring throughout Namibia. The IUCN distribution map (Avgan *et al.* 2016) does not show their presence on the Namib coast, but caracals have been reliably recorded at various places on the southern and northern coast.

POPULATION ESTIMATE AND TREND

Throughout their range, the territory size (and thus also density) of caracals varies tremendously, from 5.5 km² for females in South Africa (Moolman 1986) to 1,116 km² for a male in Saudi Arabia (Van Heezik & Seddon 1998). In Namibia the one published study on north-central farmlands (Marker & Dickman 2005b) was done only on males and showed an average range size of 312.6 km² (range 79.3–439.8 km²). In 1975, Joubert & Mostert estimated the total number of caracals in Namibia at 16,481 based on a farmers survey, but that was a rather crude estimate and did not include any confidence intervals. Given the large territories of caracals found by Marker & Dickman (2005b), with the same caracal likely to be seen and counted on multiple farms, the 1975 figure was probably an overestimation. Nevertheless, caracal numbers are considered to be stable in Namibia and might even have increased in those areas where black-backed jackal numbers have been reduced (Neils 2018, Pringle & Pringle 1979). Population figures of caracal, and other carnivores with which it interacts, need to be properly substantiated to place more confidence on the above statements (see Actions below).

ECOLOGY

Caracals have a broad range of habitats and are found in dry woodlands, *Acacia* scrub, savanna, and arid hilly and mountain areas up to 2,500 m altitude. They are often associated with edge habitats where forests and grasslands meet, and although they may use open grasslands at night, they require access to rocks and bushes for daytime rest spots (Ray *et al.* 2005b). In better-watered areas where grasses are dominant throughout the year, the caracal can be replaced by the serval (Estes 1991).

Like many felid species, caracals are solitary and territorial. The males have territories 3–4 times larger than those of females, and one male's territory can overlap the territories of several females (Estes 1991). Both males and females mark and defend their territories against others of the same sex (Estes 1991). Caracals are primarily nocturnal (Estes 1991). They are polyoestrus and may have kittens at any time of the year, although there is an extended birth peak

during the summer (Sunquist & Sunquist 2009). The average number of kittens per litter is 2.2 (Estes 1991).

Caracals have a wide dietary range and can kill prey more than twice their own size. They generally subsist on prey that weighs less than 5 kg, such as hares, hyraxes, rodents and birds (Palmer & Fairall 1988, Drouilly *et al.* 2018b). However, they will take prey well over 15 kg, and have been recorded preying on adult impala, springbok, a sitting ostrich, and even young kudu, when such opportunities present themselves, including livestock (Drouilly *et al.* 2018b, Estes 1991, Grobler 1981). Large animals are killed using a throat bite, while smaller prey is typically killed by a bite to the nape of the neck.

Black-backed jackal and caracal may kill each other's young (Melville *et al.* 2004, Pringle & Pringle 1979) and there are suggestions that they might supress each other's numbers in overlapping areas (Tambling *et al.* 2018); however the level to which these two species influence each other in overlapping areas is still relatively unknown (Tambling *et al.* 2018). It is possible that there is some level of habitat niche partitioning, with caracals preferring thicker bush and mountainous areas, and black-backed jackals preferring more open and flat plains, but more research is needed on the interactions between the two species (Drouilly *et al.* 2018a, Drouilly *et al.* 2018b). Caracals will readily hunt other small carnivores such as the African wildcat, Cape fox and bat-eared fox, black-backed jackal, mongooses, suricate, genets, otters and polecat (Melville & Bothma 2006).

THREATS

Like black-backed jackals, caracals are commonly considered a problem species for small-livestock predation and are heavily persecuted in areas where small-stock is farmed. Ray *et al*. (2005b) reported that 2,800 caracals were killed in 1981 in Namibia. The effect on the population of such a level of offtake is not known, but it is possible that compensatory breeding and large dispersal distances make up for it to some extent. Neils (2018) found that most female individuals in southern Namibia only reproduce once before being killed and the resulting lack of experienced adult females could pose a threat to their long-term survival.

It is also possible that the effect of disruption of their social structure causes more livestock depredation following the removal of mature, settled caracals, and this probably contributes to a further increase in conflict (Conradie & Piesse 2013, Nattrass *et al.* 2020). This unexpected outcome is thought to occur as follows: when a mature adult is removed, his/her place is most often taken by a number of younger, newly established territorial individuals. Since they typically have less confidence to defend a large territory, their home ranges are smaller and therefore the density of carnivores is relatively higher (Neils 2018).

So killing predators can create a source-sink system, in which sink populations often have higher densities than the source population (Pulliam 1988). It is not that the young inexperienced caracals kill more livestock, but that the higher density of them results in higher livestock depredation (Conradie & Piesse 2013, Nattrass *et al.* 2020).

Meso-predator release, the term that describes the positive effect on populations of medium-sized predators when larger apex predators decline, probably also contributes to an increase in caracal numbers in some areas.

CONSERVATION STATUS

The caracal is listed as Least Concern on the global IUCN Red List and has been so since its first assessment in 1996 (Avgan *et al*. 2016). In South Africa it is also categorised as Least Concern (Avenant *et al*. 2016). The species is included in the CITES Appendix II for Africa (Avgan *et al*. 2016). Until recently, caracals were classified as "vermin" in Namibia and farmers were encouraged to eradicate all caracals on farmlands (Neils 2018). It is still permissible to kill caracals on farmland without a permit, as they are considered a threat to farmers' livelihoods.

ACTIONS

Livestock management techniques that reduce conflict between farmers and predators should be encouraged. This, and maintaining the natural prey of caracals, would allow caracal territorial structures to recover on farmlands, which is critical for the long-term stability of the species and a healthy ecosystem. The establishment of conservancies is one of the more effective ways to increase prey diversity on farmlands (McGranahan 2008). Reintroduction of or recolonisation by larger predators might also be important to stabilise numbers (Weise *et al.* 2015a). Farmers need to be made aware of the ecology of carnivore species and the results that improper carnivore management can have. Specific recommended actions are:

Management

Training for farmers and wildlife managers to identify the correct problem animal species involved in predation events.

The various methods available to prevent or minimise livestock depredation, and their relative cost-effectiveness, need to be more strongly studied and promoted, such as in Kerley *et al.* (2018), and the information needs to be made more readily available to farmers. Also, the practicalities of these methods and their outcomes should be evaluated as part of an adaptive management approach.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Awareness

- Small-stock farmers should be encouraged to maintain natural prey populations (including springbok) on their land as a buffer to reduce predation on small-stock. The focus should be on stock management and protection, instead of predator control. The establishment of conservancies should be encouraged and promoted to this end.

- The ecological role of caracals, and their benefits to land owners, needs to be further investigated and communicated to farmers and wildlife managers. There should be a focus on reducing counterproductive predator management, including the indiscriminate culling mentioned above.

- Guard dogs can virtually eliminate small-stock losses to caracals, and local breeds (or cross-breeds) of dogs suited to rural village life can be trained and used (Marker *et al*. 2005). Similarly, kraaling of livestock at night in predator-proof kraals (enclosures) may also reduce livestock losses significantly (Weise *et al*. 2018). Kraals need to be well maintained, since caracals can cause very high losses if they get into a kraal or corner a livestock flock against a fence.

- The draft Protected Areas and Wildlife Management Bill aims to change the notion that "problem species" exist. It recognises that there are problem individuals, but that no species should be labelled or managed as a problem. This concept should be built on and communicated to farmers and wildlife managers.

Participation in citizen science programmes should be encouraged, especially amongst private camera trap owners and farmers (e.g. via NAU). The information that can be gathered from these sources is important in both the national and global context. It is important to record all types of data, e.g. sightings, photos, human-carnivore-conflict, mortalities, carnivore signs (dens, marking posts). Ideally, information should be gathered in a coordinated manner, such as on the Environmental Information Service to better inform management and decision making.

Research

There is a need for more research to determine caracal density and home range sizes in different biomes and vegetation types, and in different land-uses.

Monitoring of caracal distribution should be carried out, using camera traps and complemented by questionnaires, citizen science participation and sign surveys. With persecution, they become incredibly secretive and, being largely water-independent, they are less often picked up on camera traps at waterholes. These two factors might give the impression that caracals are less abundant than they really are. Camera traps on game tracks / vehicle tracks may thus be a better indication of their abundance.

An ongoing estimate of the level of conflict involving caracals is needed from farmers, both to determine the numbers of caracals killed every year and the numbers of livestock losses attributed to caracals.

Interactions between the different carnivore species (especially between caracals and jackals) need to be studied. There is potential for this information on the boundaries between species to be used as a method to protect livestock from predation.

The effectiveness and ecological impact of various conflict management techniques on caracal should be studied in more detail.

Assessors: Chavoux Luyt and Gabriela Fleury
Reviewers: Jurie du Plessis and Marine Drouilly

Suggested citation: Luyt C & Fleury G 2022. A conservation assessment of Caracal *Caracal caracal*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 54-57. MEFT, LCMAN & NCE, Windhoek, Namibia

Southern African Wild Cat *Felis lybica cafra*

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Namibian conservation status	Least Concern
Global IUCN status	Least Concern
Namibian range	728,200 km²
Global range	Throughout southern Africa, extending north into the south-eastern parts of Tanzania and Mozambique
Population estimate	Unknown
Population trend	Unknown
Habitat	Wide habitat tolerance. Occurs in woodlands, savanna, grasslands and semi-desert
Threats	▸ Hybridisation with domestic cat ▸ Disease transmission between free-ranging wild cats and domestic cats could affect the health and status of wild populations ▸ Habitat degradation (e.g. overgrazing, bush encroachment), and subsequent effects on rodent prey density ▸ Direct or indirect killing through predator control measures ▸ Road mortalities

DISTINGUISHING FEATURES

Southern African wild cats have varied coat coloration and markings ranging from grey to red-brown, with light to dark vertical stripes mainly on the legs and dark rings towards the tail tip (Nowell & Jackson 1996b, Pocock 1951). In Namibia some specimens have light, sandy, ground-coloured coats with brown or rufous markings, others have iron-grey coats with black or whitish markings. The back of the hind legs is black, extending from the foot pad to the elbow. Diagnostic features are the red-brown colour of the back of the ears and proportionately longer legs than domestic cats (Pocock 1951). They look very similar in size, shape and colouring to some breeds of the domestic cat. They could possibly be confused with the much smaller black-footed cat (*Felis nigripes*), however southern African wild cats have a larger body size, and have comparatively smaller ears and less distinct body spotting and striping than black-footed cats.

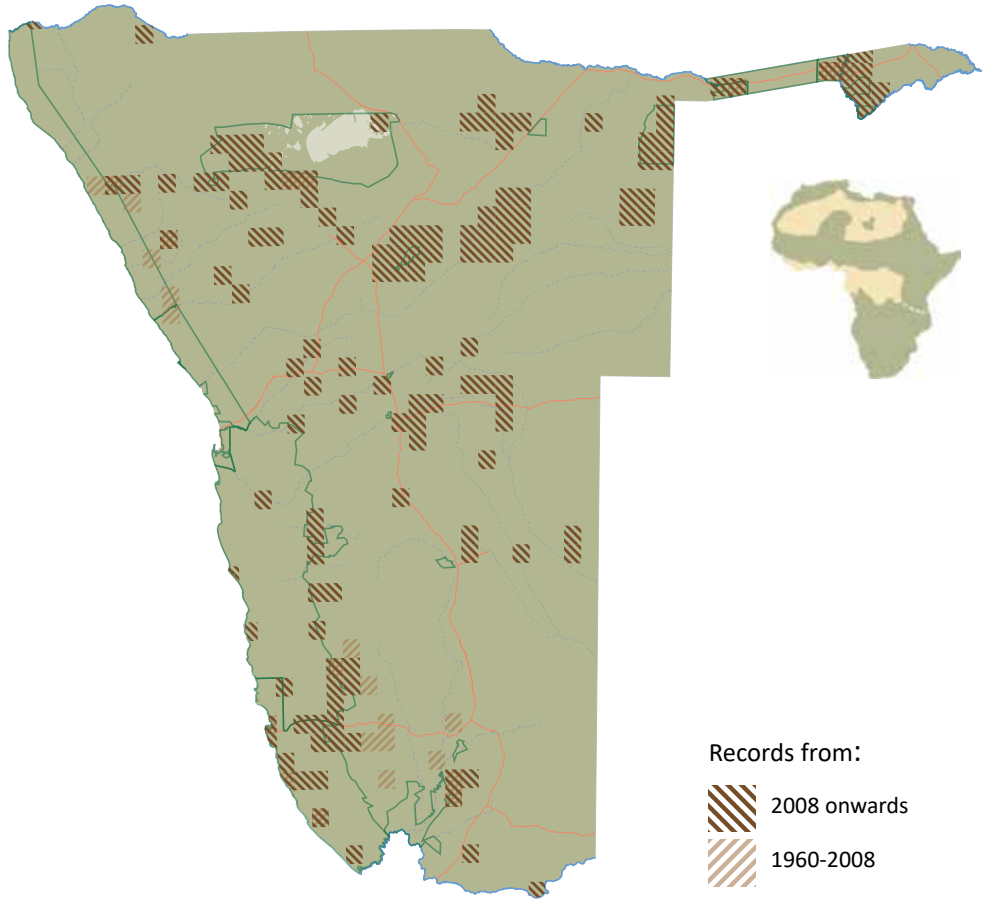
TAXONOMY AND DISTRIBUTION

There has been extensive debate about the taxonomy and relationship between the African *Felis lybica* and the European wild cat *Felis sylvestris* (Stuart *et al.* 2013), the origin of the domestic cat, and the classification and validity of their subspecies (Nowell & Jackson 1996b, Wiseman *et al.* 2000, Driscoll *et al.* 2007). The African wild cat *Felis lybica* has a very wide geographical range, occurring throughout West, East and North Africa, Middle East, central and south-west Asia into Afghanistan, Pakistan and India, China and

Distribution records of southern African wild cat, and present estimated area of distribution in Namibia.

Inset: African distribution of African wild cat according to IUCN (Yamaguchi *et al.* 2015); the rough northern limit of the southern African wild cat (*Felis lybica cafra*) is in southern Tanzania, as indicated.

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



Mongolia (Kitchener *et al*. 2017). Numerous subspecies of *Felis lybica* have been described throughout its extensive distribution (Pocock 1951, Wozencraft 2005). In this assessment we refer to the species as the southern African wild cat *Felis lybica cafra*, one of the three subspecies of *Felis lybica* as described by Kitchener *et al*. (2017).

In Namibia, *Felis lybica cafra* occurs throughout the country, except in the driest parts of the coastal desert belt (Skinner & Smithers 1990), but they are found along ephemeral rivers in the Namib Desert. They are regarded as a common species, with a broad ecological habitat tolerance and a wide distribution range (Herbst *et al*. 2016).

Shortridge (1934) documented that southern African wild cats occur from the woodlands of the Zambezi Region to the coastal desert belt, with higher population densities in the northern and eastern sandy areas of Namibia. A survey on farmland by Joubert *et al*. (1982) noted that these were more common in the southern districts and less so in the central and northern parts of Namibia. However this survey only considered private farmland, and large communal land in the northern districts of the country was excluded.

Data from camera trap surveys throughout north-eastern Namibia confirmed the presence of southern African wild cats in the Bwabwata National Park, Nyae Nyae Conservancy and northern Khaudom National Park (Institute für Zoo und Wildtierforschung camera trap data 2018; L Hanssen pers. comm. 2018).

POPULATION ESTIMATE

In the southern Kalahari, the density of wild cats was estimated at 25 cats/100 km² (Herbst 2009). Annual home range sizes of adult females were 6.1 km²±1.1 SE while males were 9.8 km²±3.4 SE, with males overlapping with up to four different females (Herbst *et al*. 2016). Home range size is affected by prey abundance and ranges may be larger when food resources are less abundant. The home range of a female African wild cat in the Sharjah Desert in the United Arab Emirates was 52.7 km² (Phelan & Sliwa 2005), however this could represent an exception rather than the norm.

During a survey to record nocturnal wildlife in the Gondwana Canyon Park, seventeen southern African wild cats were recorded on a 302 km route covering the road network (Sliwa *et al*. 2019). The estimated density was 18 cats/100 km, representing a viable population when compared to the density of 25 cats/100 km in the southern Kalahari (Herbst 2009), described as the area with the largest subpopulation (Herbst *et al*. 2016). No other attempt

has been made to estimate the population density in Namibia.

In the western part of Namibia they probably occur at relatively low densities where they are mainly found along vegetated dry river beds or on rocky outcrops (Shortridge 1934, Skinner & Smithers 1990). On farmland and rural areas, agricultural activities may result in seasonal increased abundance of rodent prey which would favour southern African wild cats as they are known to be associated with agricultural environments (Skinner & Chimimba 2005).

ECOLOGY

Southern African wild cats have a wide habitat tolerance but need vegetation cover such as on mountainous areas, along river banks and in reed beds, or stands of tall shrubs or dense grass (Skinner & Smithers 1990). They are often associated with humans, possibly attracted by the increased food supply of rodent prey. Some individuals may willingly associate with humans, especially in remote areas where they can become semi-tame, or where they are raised from kittens (M Küsters pers. obs.). It is uncertain if these cats are pure wild cats or have hybridised with the local population of domestic cats.

They are opportunistic hunters and take a wide range of prey items. Small mammals (<500 g) constitute the main food resource (both in biomass and season), followed by birds and reptiles (Herbst 2009). Seasonal prey availability probably determines the proportion of different prey consumed (Sliwa *et al*. 2010). Distances travelled and duration of activity is longer during the cold winter months (Herbst 2009), possibly a direct result of low density prey at that time of year. They are mainly nocturnal but hunt during the day as well.

THREATS

Throughout its distribution range, the primary threat to wild cats is hybridisation with the domestic cat (Skinner & Smithers 1990, Nowell & Jackson 1996b, Herbst *et al*. 2016). However, evidence suggests that hybridisation, at least in parts of South Africa and in isolated protected areas, may not be as extensive as previously thought (Wiseman *et al*. 2000, Le Roux *et al*. 2014). This is also reported for European wild cats (Steyer *et al*. 2018). Hybridisation mainly occurs on the periphery of protected areas (Le Roux *et al*. 2014). Unfortunately due to the uncertain taxonomy of *Felis lybica*, the distribution of its subspecies and morphological similarities, it is almost impossible to distinguish pure African wild cats from tabby-like domestic cats and in particular their hybrids (Herbst 2009).

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The extent of hybridisation in Namibia is not known and warrants investigation. Due to their relatedness, southern African wild cats are vulnerable to potential pathologies infecting domestic cats, such as feline immunodeficiency virus, feline leukaemia virus, feline calcivirus and feline foamy virus (Daniels *et al*. 1999). Disease prevalence needs urgent investigation.

Habitat loss, habitat degradation and persecution, are some of the leading causes threatening wild felid populations (Sliwa *et al*. 2010). In Namibia, poor rangeland management such as overstocking can lead to habitat degradation and in turn, affect small mammal abundances and potential prey numbers. This ultimately reduces the habitat suitability for southern African wild cats outside protected areas.

On farmland with small livestock, wild cats are considered a problem animal and are often shot during night hunts (M Küsters pers. obs.). The survey by Joubert *et al*. (1982) reported a high number of southern African wild cats killed in the Keetmanshoop District through predator control measures. Current numbers of mortalities through predator control are not known. Other non-selective predator control measures, including gin traps, cage traps and hunting dogs may cause significant mortalities, especially if measures are deployed in abundance and over a large area. The extent of road mortality and its effect on local populations is not known.

CONSERVATION STATUS

The southern African wild cat is not legally protected in Namibia, or over most of its distributional range (Nowell & Jackson 1996b, Herbst *et al*. 2016). They are listed as a "wild animal" (Nature Conservation Ordinance 4 of 1974) and therefore have reduced protection status from prosecution and indirect mortality. Although common and widespread, their abundance, status and health are not known throughout their range (Herbst 2009), including in Namibia.

Internationally, the species is listed as Least Concern in the IUCN Red List, and it is in Appendix II of the CITES Convention (Yamaguchi *et al*. 2015). In South Africa it is also listed as Least Concern in the Regional Red List

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and not protected under the Threatened or Protected Species regulations (National Environmental Management: Biodiversity Act 10/2004) (Herbst *et al.* 2016).

The geographical boundaries between the neighbouring subspecies of the African wild cat *Felis lybica* are speculative (Kitchener *et al.* 2017). This taxonomic uncertainty and lack of data on genetic and molecular differences between sub-species will hamper effective conservation measures.

ACTIONS

- Secure the genetic purity of southern African wild cats and prevent genetic introgression in protected areas by strictly prohibiting and removing domestic cats within national parks and other conservation areas.

- Implement protocols (i.e. the ethical capture and eradication) for the authorities to control feral domestic cats in all national parks and protected areas.

- Investigate the extent of potential introgression, hybridisation and disease prevalence of free-ranging southern African wild cats in and around protected areas (e.g. Bwabwata and Mudumu National Park in northern Namibia and in Hardap National Park and communal conservancies in southern Namibia). In specific, studies should focus on:

  - Sampling of wild-ranging wild cats in isolated areas with low introgression risk to define the genetic profile of "pure" wild cats (e.g. Etosha National Park, Gondwana Canyon Park), and also collecting of samples for disease prevalence.

  - Sampling of wild-ranging wild cats in areas with marginal introgression risk to determine the genetic profile of such individuals and disease prevalence (e.g. Von Bach and Naute Game Parks and Hardap National Park, specific farms of recorded "tame" wild cats).

  This could possibly be implemented through the veterinary outreach programme of the UNAM School of Veterinary Medicine. This should include a national campaign or awareness programme, addressing the issues of hybridisation and disease transmission.

- Identify a study site (e.g. Gondwana Canyon Park, Sliwa *et al.* 2019) in Namibia and conduct an ecological study on southern African wild cats with similar techniques to the work by Herbst & Mills (2010) to verify and assess the status of populations in the future.

Assessor: Martina Küsters
Contributors: Nick Buys and Lise Hanssen
Reviewers: Marna Herbst and Alexander Sliwa

Suggested citation: Küsters M 2022. A conservation assessment of Southern African Wild Cat *Felis lybica cafra*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 58-61. MEFT, LCMAN & NCE, Windhoek, Namibia

Spotted Hyaena *Crocuta crocuta*

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Namibian conservation status	Vulnerable
Global IUCN status	Least Concern
Namibian range	399,800 km^2
Global range	14,652,100 km^2
Population estimate	Namibia: 615–715 Total population: 27,000 to 47,000 individuals
Population trend	Namibia: Stable Globally: Decreasing with rapid decline outside protected areas
Habitat	Woodland, savanna, semi-desert and true desert, mountainous terrain. Wide habitat tolerance throughout its range south of the Sahara but not found in tropical rain forests in West and Central Africa
Threats	▸ Trophy hunting ▸ Retaliatory killing – snares, poisoning, gin traps ▸ Killed in snares intended for other animals ▸ Road mortality ▸ Negative public image leading to little conservation concern ▸ Body parts for traditional medicine and commercial trade

DISTRIBUTION

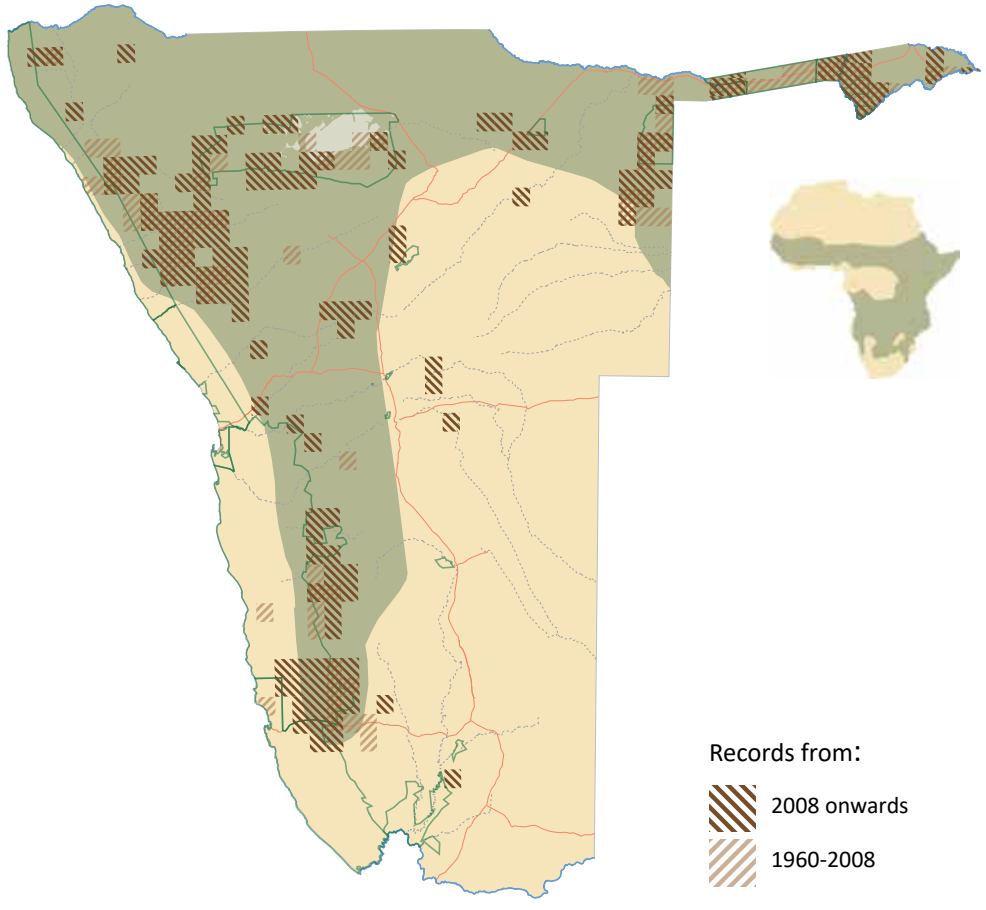
Spotted hyaenas generally occur at low densities in Namibia and are heavily persecuted outside protected areas. While the majority of the population is found in national parks and fenced-in private game reserves, they do also occur outside protected areas in the north-west and north-east but mostly in areas with few human settlements. Spotted hyaenas move into south-east Namibia from the Kgalagadi Transfrontier Park in Botswana, but are generally persecuted by farmers. It is unlikely that they are resident there.

Spotted hyaenas have a wide distribution south of the Sahara with the exception of tropical rain forests in West and Central Africa. They occur in a very wide array of habitats from semi-desert to montane forest up to 4,000 m elevation, through savannah, woodland and swamps. They are absent from lowland tropical rainforests, but can occur in very low densities in extreme deserts (East & Hofer 2013). Their presence in the southern Namib suggests that they can survive (with enormous home ranges, I Wiesel unpublished data) under these very marginal conditions.

Distribution records of spotted hyaena, and present estimated area of distribution in Namibia.

Inset: African distribution of spotted hyaena according to IUCN (Bohm & Höner 2015).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



POPULATION ESTIMATE AND TREND

The global spotted hyaena population is estimated between 27,000 and 47,000 individuals, with only a few populations in East and southern Africa exceeding 1,000 individuals (Bohm & Höner 2015). Even though they are classified as Least Concern by the IUCN (Bohm & Höner 2015), their population is decreasing across their range mainly because of habitat loss, natural prey shortages and conflict over livestock predation (Bohm & Höner 2015). Spotted hyaenas are rapidly disappearing from landscapes in West Africa including inside protected areas (Hofer & Mills 1998b). Their numbers are also declining inside some protected areas in southern Africa due to trophy hunting and snaring (Hunnicutt *et al*. 2016). Spotted hyaena numbers are stable in Namibia, however, the total estimated population does not exceed 715 individuals according to the estimations given below derived from field research and expert knowledge.

Like most predators, spotted hyaena densities are linked to prey availability (Périquet *et al*. 2015a). In the East African plains, where prey is plentiful, hyaena densities range from 0.1 to 1 individuals/km^2 (Kruuk 1972, Frank 1986, Hofer & East 1993a, Ogutu & Dublin 1998, Ogutu & Dublin 2002, Boydston *et al*. 2003a, Höner *et al*. 2005, Kolowski *et al*. 2007, Kolowski & Holekamp 2009, Watts & Holekamp 2009, Pangle & Holekamp 2010). In the wooded savannahs of Kruger National Park (South Africa) and Hwange National Park (Zimbabwe), densities range from 0.09 to 0.12 individuals/km^2 (Mills 1985, Henschel & Skinner 1990, 1991, Périquet 2014). In the Kalahari Desert, where prey occurs at low densities, spotted hyaena densities are also low, ranging from 0.056 to 0.09 individuals/km^2 (Mills 1990a). Spotted hyaena density in Namibia ranges widely from 0.056–0.09 individuals/km^2 in Etosha National Park (Trinkel *et al*. 2004, Trinkel & Kastberger 2008) to 0.008–0.02 individuals/km^2 in the protected areas and peripheral conservancies of the north-east (P Beytell, L Hanssen, J Robertson & M Roodbool unpublished data). In southern Namibia, clans range over extensive areas in order to forage, resulting in exceptionally low density (I Wiesel unpublished data).

The biggest population of spotted hyaenas occurs in the Etosha/Kunene system with an estimated 340 individuals (Trinkel 2009). The southern Namibia population is not likely to exceed 50 individuals (I Wiesel unpublished data). Five clans have been identified in southern Namibia including the privately owned NamibRand Nature Reserve (I Wiesel unpublished data, M Tindall & N Odendaal pers. comm.) with transient individuals moving as far north as the Khomas Hochland (I Wiesel unpublished data). This has led to the

misperception that spotted hyaenas are recovering in freehold farming areas and that numbers are increasing nationally.

In north-eastern Namibia, spotted hyaenas are mostly restricted to small protected areas or areas peripheral to parks where there is little interference from people. The north-east population estimate range of 225–325 spotted hyaenas is based on the following:

- 60-80 in Bwabwata National Park, 10–20 in Mudumu National Park, 10–20 in a maximum of two clans in the eastern State Forest (shared with the Wildlife Management Areas of Zambia) and the woodlands of the eastern Chobe Complex. Conflict with spotted hyaenas in the Lusese Conservancy is indicative of resident animals (L Hanssen unpublished data, Hanssen *et al*. 2017);
- 80–110 in Khaudum National Park, 10 in Mahango Core Area, 10 in Mangetti National Park (P Beytell pers. comm.);
- 30–60 in Nyae Nyae Conservancy (J Robertson & M Roodbool pers. comm.);
- Incidents of conflict in the eastern Otjozondjupa Region suggest that spotted hyaenas occur at low density ranging over extensive areas similar to southern Namibia, or there are transient individuals moving west and south from resident populations in Nyae Nyae Conservancy/ Khaudum National Park and Botswana. If resident, clan size is unlikely to exceed 15 individuals ranging over thousands of square kilometres (based on insight by researchers, expert opinion and Event Book records-monitoring records kept by Community Game Guards and Park Rangers).

Spotted hyaenas are currently non-resident in Nkasa Rupara National Park, as they require a system that supports medium-sized prey species (Purchase 2004). Nkasa Rupara is a wetland/floodplain system that is dominated by large animals such as elephant and buffalo.

Transient and dispersing spotted hyaenas occasionally move exceptionally far distances and have been observed in the freehold farming areas. Two images of spotted hyaenas were captured on camera trap in the Waterberg area in 2006 (A Stein pers. comm.), on commercial farmland in Otjiwarongo in 2017 (CCF pers. comm.) and on a freehold farm near Omaruru in 2018 (NAPHA & L Richmond-Coggan pers. comm.). A male spotted hyaena that was born into a clan near Garub, Aus was photographed by camera trap ~450 km away on a farm in the Khomas Hochland in 2018 (I Wiesel pers. comm.)

Spotted hyaena reproduction, population growth and recovery are extremely slow but the current population trend is stable. To maintain this situation, however, it is important that the population structure also remains stable. Clan disruptions due to the removal of individuals, especially dominant ones, are costly for all clan members, and could interfere with reproduction and possibly result in the disintegration of the entire clan (Holekamp *et al*. 2007, Silk 2019, K Stratford pers. comm.). This is of particular concern where spotted hyaenas are trophy hunted within the boundaries of protected areas or in areas adjacent to them.

ECOLOGY

In spotted hyaena, even though the skeletons of both sexes are of similar size, females are heavier than males, weighing on average 68.5 kg in southern African populations, while males average 61 kg (Skinner & Chimimba 2005). In north-eastern Namibia, adult males weigh over 50 kg and females 80–90 kg (P Beytell & K Stumphe pers. comm.).

They form large groups called clans, characterised by a strict matriarchal hierarchy where females are usually dominant over males (Kruuk 1972), and a dynamic group composition, expressed through frequent splitting and merging of groups (fission-fusion). All females in a clan reproduce, but the dominant individuals exhibit the highest reproductive success due to their privileged access to food and support (Kruuk 1972, Hofer & East 1993b, Frank *et al*. 1995, Vullioud *et al*. 2018). Clans usually consist of many related adult females and one to several breeding-age males, usually fewer than the females (Holekamp & Dloniak 2010). Young adult males emigrate from their natal clan and attempt to join other clans (Holekamp & Dloniak 2010, Höner *et al*. 2007). Immigrant males are responsible for most of the reproduction, although natal males also sire offspring when their fitness prospects in their natal clan are similar to the ones in another clan in East Africa (Davidian *et al*. 2015, Engh *et al*. 2002). Breeding occurs throughout the year and one or two, rarely three cubs per litter are born, with eyes open and teeth erupted. The cubs are dependent on their mother's milk (which has the highest protein content of all terrestrial carnivores) for the first year of their lives (Kruuk 1972). Mean litter size in the Namib and southern Namibia

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is 1.67 (range 1–3) where out of nine known litters, five had a single cub, three had two cubs and one had three cubs (M Lemerle & I Wiesel unpublished data). In the Zambezi Region's Mudumu National Park, two litters of one cub each were recorded (L Hanssen unpublished data). A litter of two cubs and a litter with a single cub were recorded in the Kwando Core Area in Bwabwata National Park. (L Hanssen unpublished data). Cubs are born in natal dens and when they are old enough they are moved to communal dens. As births are not synchronous and spotted hyaenas breed throughout the year, cubs of all ages can be found at the communal den. Spotted hyaena dens have wide entrances that are sometimes used by adults, but the tunnels narrow as they get deeper, which allows cubs to hide from all dangers including adult hyaenas from their own clan that could harm them (Holekamp & Dloniak 2010).

Clan members share the same home range, whose size and defence depends mainly on prey availability and movement patterns. In the rich plains of the Ngorongoro Crater (Tanzania) and Serengeti (Kenya), spotted hyaenas form large clans of 30–80 individuals and their home ranges are small (25–30 km^2; Kruuk 1972, Höner *et al*. 2005). Where prey is resident, the home range is fiercely defended from neighbouring clans but when prey is migratory, home range boundaries are loose, and spotted hyaenas commute between their dens and migratory herds (Kruuk 1972, Hofer & East 1993a). In the Kalahari Desert, where prey is scarce and dispersed, spotted hyaenas form smaller clans (~10 individuals) and roam over very large home ranges of more than 1,000 km^2 (Mills 1990a). In Etosha National Park, where prey is attracted to permanent waterholes, clans of 9–18 individuals use home ranges of 325 km^2 (Trinkel *et al*. 2004, Trinkel & Kastberger 2008). In the Namib Desert and southern Namibia, clan size ranges between 5 and 10 adults and sub-adults. Clan structure is dependent on birth, deaths, immigration and emigration. In one study clan, 8 cubs were born over two years, but 5 individuals emigrated from the clan during the same period of time (M Lemerle & I Wiesel unpublished data). These small clans have enormous home ranges resulting in exceptionally low density. One collared adult female moved over an area of 4,584 km^2 in just over a year. Another collared female moved over 1,052 km^2 in three weeks (M Lemerle & I Wiesel unpublished data). A collared male moved over 633 km^2 and was recently photographed in the Khomas Hochland, 450 km from his natal home range (I Wiesel unpublished data).

In north-eastern Namibia, clan size is similar and ranges between 5 and 15 adults and sub-adults. But home range sizes are much smaller than in the Namib, ranging from 580 to 710 km^2. Various clans are resident in the Mudumu and Bwabwata National Parks and adjoining conservancies, with some of them foraging into Angola. Their persistence in the parks depends as much on the surrounding conservancies as the parks themselves (L Hanssen unpublished data).

Collar data from a single spotted hyaena in the Multiple Use Area (MUA) of Bwabwata National Park showed that it moved over 1,000 km^2. This is likely due to its young age and the fact that spotted hyaenas were only just establishing themselves in the MUA at the time of the study (L Hanssen unpublished data). Two clans have now established themselves in the MUA (Hanssen *et al*. 2017).

Although clans appear to be of similar size throughout Namibia, i.e. 5 to 15 individuals, a clan of 23 individuals has been recorded in southern Khaudum National Park (P Beytell pers. comm.). This is likely due to higher productivity of this system along with permanent waterholes in the park, resulting in high numbers of elephant calves as well as other resident prey species. A clan of at least 30 adults has also been recorded on Ongava Game Reserve with a home range of ~370 km^2 extending over to Etosha National Park (Stratford & Stratford 2011, Stratford *et al*. 2019).

Spotted hyaenas are predominantly nocturnal and extremely vocal, especially around carcasses and during social interactions. They are opportunistic and highly flexible predators, capable of taking down large prey such as zebras and elephant calves (Salnicki *et al*. 2001), and are well adapted to scavenging due to their strong jaws and efficient digestive system (Kruuk 1972). About 90–95% of their daily energy requirement may comprise prey species that they kill themselves (L Hanssen unpublished data, Hayward 2006). However, this high proportion recorded by L Hanssen was carried out in a period when there were virtually no lions in the park. With recovering lion numbers, it is possible that left-over kills will provide more scavenging opportunities to spotted hyaenas. The proportion of own kills across their entire range can be as low as 43% (Holekamp & Dloniak 2010). They frequently steal kills from other predators (Kruuk 1972, Höner *et al*. 2002, Watts & Holekamp 2009). They readily scavenge on leftover kills, including elephant carcasses, and even consume elephant dung. They are able to digest all organic material except hairs, horns and hooves, and excrete mostly calcium carbonate from bones, making their faeces white (Kruuk 1972).

Spotted hyaenas take advantage of human refuse (Kolowski & Holekamp 2008, 2009, Cozzi *et al*. 2015, Yirga *et al*. 2015) and regularly visit dumpsites, as seen in the Kwando clan which pay nightly visits to the military base scavenging for left-over food. The presence of dumpsites has been known to temporarily impact on home range size and use in some areas (Plaza & Lambertucci 2017, Kolowski & Holekamp 2008), and the military base dumpsite was the second-most frequented location in their home range after their dens (L Hanssen unpublished data). Non-food items identified through scat analysis of the Kwando spotted hyaenas included wax wrap, nylon sacking, string and even a 50c coin (L Hanssen unpublished data).

In general, spotted hyaenas are considered to be generalist foragers, feeding on a wide range of available prey (Hayward 2006), and concentrating on the most abundant species of medium to large size. However, they do show some prey selectivity (Cooper 1990, Höner *et al*. 2002, Wentworth *et al*. 2011, Périquet *et al*. 2015b). Spotted hyaenas living on floodplains in the Zambezi Region have been found to prefer certain species above others and will actively seek them out (L Hanssen unpublished data). For instance, even though reedbuck occur in very low numbers due to habitat restrictions, they make up almost half the diet of floodplain spotted hyaenas. Other species that appear to be preferred are tsessebe, lechwe and buffalo calves. Impala, sable, steenbok, warthog and zebra are also taken, although probably in relation to their abundance. Surprisingly, kudu were not preyed on by spotted hyaenas in this area, possibly due to their inhabiting wooded dune areas making them harder to hunt. Wildebeest and roan are also abundant in the landscape, but appear to be avoided prey species for these spotted hyaenas (L Hanssen unpublished data).

THREATS

Spotted hyaenas are key components of healthy ecosystems and provide valuable ecosystem services as scavengers (Moleón & Sánchez-Zapata 2015, Sonowane *et al.* 2021). They are also exceptionally slow to reproduce and often do not readily recover their numbers, even under optimal conditions such as in protected areas. Their complex hierarchical clan structure and social organisation makes spotted hyaenas very sensitive to the removal of key individuals (Holecamp *et al*. 2007, Silk 2019, K Stratford unpublished data). Studies on spotted hyaena populations affected by human disturbance show increased vigilance, changes in home range use, and declines in local populations as a result of human-spotted hyaena interactions on the edges of protected areas (Pangle & Holekamp 2010, Boydston *et al*. 2003b).

Threats to spotted hyaenas in Namibia are wide ranging. In the north-east, they are killed in response to conflict with livestock farmers and trophy hunting is allowed inside protected areas such as in Bwabwata National Park and in mosaic landscapes such as the Mudumu North Complex, where conservancies surrounding the parks are vital for the persistence of spotted hyaenas inside parks. As most spotted hyaenas in the Zambezi Region are dependent on transboundary movements, the negative effects of hunting spotted hyaenas will impact on the protected areas of neighbouring countries too. Quotas for different conservancies all affect the same source population, which is a single clan in Mudumu National Park and a single clan in the State Forest.

Authorised “problem animal control” hunts are granted to hunting operators to mitigate human-spotted hyaena conflict and generate some money from the hunt for the local conservancies. There are severe shortcomings to hunting spotted hyaenas for either trophies or as “problem” animals, however. Firstly, it is extremely difficult to tell the sexes apart, often resulting in females being mistaken for males and shot. Any young cubs of a female that is killed

will also die, as they are not cared for by the rest of the clan (Mills 1985). Removing the alpha female may result in the disintegration of the entire clan. Secondly, targeting and killing any specific problem individual is difficult because they range widely and have learned to avoid human activity. Finally, spotted hyaenas are opportunistic hunters that will prey on unprotected livestock at night, so no one individual can be identified as a "problem animal"; killing one individual is therefore unlikely to reduce losses to hyaenas if livestock remain unprotected (L Hanssen pers. obs.). Consequently, there is no evidence to date that trophy hunting of spotted hyaenas reduces livestock depredation and lessens conflict with humans. We therefore argue that improving the safety of livestock is preferable to killing spotted hyaenas.

Besides ecological considerations, the trophy price of spotted hyaenas is so low that the income from these hunts for local communities is negligible. The seven spotted hyaenas hunted in communal conservancies throughout Namibia in 2017 generated N$44,100, which is only 10% of the revenue generated by hunting three lions and 6% of that generated from hunting 13 leopards in communal conservancies during the same year (MEFT 2020). Following MEFT's new quota-setting guidelines, no quotas for spotted hyaena trophy hunts have been granted for the current three-year quota cycle (2019-2021) in communal conservancies (R Fryer pers. comm.).

In the north-western Kunene and Erongo Regions, spotted hyaenas cause more conflict incidents than any other species (>700 incidents in 2018), yet they are rarely killed as problem animals (<0.1% of the incidents caused) by government authorities or trophy hunters (MEFT/NACSO 2020). It appears that communities in this part of Namibia are more tolerant towards this species than they are towards lions, which are killed in over 10% of the conflict incidents they cause (MEFT/NACSO 2020).

Road mortality is increasing due to increased traffic on main trade routes such as the Trans-Zambezi Highway that runs through Bwabwata National Park and the Mudumu North Complex. Spotted hyaenas have also been killed by vehicles on the C49 road that runs through Mudumu National Park. The recent tarring of the road with a speed limit of 120 km/h has resulted in vehicles driving at higher speeds. Up to three spotted hyaenas a year are killed by vehicles in the Zambezi Region (L Hanssen unpublished data).

Spotted hyaenas are killed on farms bordering Etosha National Park at an estimated rate of 45 individuals per year, representing >10% of the population in the park (Trinkel 2009). This population, although the largest in Namibia, may decline as a result of perceived and actual human-predator conflict on farms bordering the park (Trinkel 2009). Gin traps are set on freehold farms around the boundaries of Etosha to prevent spotted hyaenas from entering farms and killing livestock. Gin traps are also set at livestock carcasses killed by spotted hyaenas. How this impacts on spotted hyaenas is unknown as many incidents are not reported (L Hanssen pers. obs.).

Like other large carnivores, spotted hyaenas are susceptible to snaring as their territorial patrolling and foraging behaviour result in increased probability of encounters with snares (Woodroffe & Ginsberg 1998). Snaring has increased particularly on the northern boundary of Etosha National Park and the western boundary of Khaudum National Park as people and their cattle settle closer to park boundaries. Snaring by-catch of spotted hyaenas appears to be increasing in north-eastern Namibia. At least one snared spotted hyaena has been recorded in every recent camera trap survey in this part of the country. This includes the 2014 and 2017 camera trap surveys of the Mudumu Complexes and the 2017 camera trap survey of Khaudum National Park (P Beytell pers. comm., L Hanssen unpublished data). A spotted hyaena in Nyae Nyae had to be euthanised in 2017 due to extensive snare-related injuries (J Robertson pers. comm.) and two three-legged spotted hyaenas have been photographed in the Mudumu North Complex (L Hanssen unpublished data) including inside Mudumu National Park. As spotted hyaenas in the Zambezi Region regularly move across international boundaries, they are susceptible to snaring in the Game Management Areas of Zambia (Becker *et al*. 2013) and gin traps in Angola that are set for the extraction of bush meat (Funston *et al*. 2017b).

Spotted hyaenas are exceptionally intelligent making them difficult to shoot in retaliation for the killing of livestock. For this reason, they are occasionally poisoned by livestock farmers in retaliation for, or to prevent livestock losses (Ogada 2014). The extent of targeted hyaena poisoning is unknown as the practice is illegal, however there is one known case from 2011 where a spotted hyaena was poisoned near the settlement of Mutjiku inside the boundaries of Bwabwata National Park (F Alpers pers. comm.). Due to their willingness to scavenge, they are extremely vulnerable to poisoned carcasses where vultures have been targeted in recent years in the KAZA TFCA (O Aschenborn pers. obs., A Botha pers. comm.). It is therefore possible that the absence or only sporadic occurrence of spotted hyaenas in some landscapes is due to poisoning as well as snaring. As the demand for lion and leopard body parts for illegal markets increases (Everatt *et al*. 2019, United Nations Office on Drugs and Crime 2020; MEFT and MHAISS 2021), we can expect to see an increase in targeted poisoning/snaring of large carnivores that will have a big impact on spotted hyaenas.

In recent years, a small demand for spotted hyaena body parts has developed. In the north-east, road kills have been found with their paws cut off and two spotted hyaenas


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in the Buffalo Core Area were deliberately hit with a car and skinned (M Paxton pers. comm.). The skins were then offered for sale.

The negative public image of spotted hyaenas in Namibia contributes to the lack of conservation priority for this species. This was particularly evident in a recent series of events surrounding the protection of a feral horse population in the Namib-Naukluft National Park in southern Namibia (Brown 2019). Although horses are not native to Namibia, it has been argued that this particular population has cultural and historical value, as it has persisted in this desert region for about 100 years (mainly due to the artificial provisioning of water and supplementary feeding during drought). However, during the most recent drought, which started in 2013, the feral horses' condition severely weakened and spotted hyaena predation naturally increased. As a consequence, interest groups and certain sectors of the public viewed this predation negatively, and even tried to reduce the level of predation by providing the spotted hyaenas with supplementary food. However, the unstructured feeding regime led to increased human-spotted hyaena conflict, which resulted in the killing of 13 spotted hyaenas by local farmers and the government (Wiesel *et al*. 2018, Brown 2019). The government's killing of spotted hyaenas, after unsuccessful relocation attempts, was in response to a public outcry to the loss of new-born horse foals, born following the drought, to spotted hyaenas. Clearly, the feral horses were valued more highly than the native spotted hyaena population. By contrast, the lion population in Namibian arid areas is highly valued by the public as a unique subpopulation of lions that have adapted to this harsh environment (Stander 2019).

CONSERVATION STATUS

Spotted hyaenas provide valuable ecosystem services and are important for the healthy functioning of natural systems yet receive little conservation consideration, largely due to their negative public image. Their global conservation status is Least Concern, but due to the small population size in Namibia and the many and increasing threats, the national status of Vulnerable is justified.

ACTIONS

Management

- Spotted hyaenas are complex social carnivores and trophy hunting anywhere in their Namibian range, including for the removal of problem-causing individuals, should be avoided as much as possible. Only in exceptional cases where a specific recognisable individual is known to be causing a specific repeated problem, should it be dealt with by the authorities.

- Trophy hunting quotas should be set taking other anthropogenic mortalities such as vehicle accidents and retaliatory killing into account.

- Resources need to be directed towards livestock protection, preventing predation by spotted hyaenas and other large carnivores within mosaic landscapes, near park boundaries and within wildlife dispersal areas. This is an ecologically sound approach for co-existence with wildlife, and can bring other benefits to both local communities and the national economy, as fewer livestock are lost.

- Traffic slowing measures need to be implemented, particularly where transit routes bisect important spotted hyaena habitat such as where the Trans-Zambezi Highway runs through omurambas in Bwabwata National Park. In areas with high wildlife mortalities on the road, the speed limit should be reduced to 80 km/h. Speed trapping of vehicles needs to take place at these high-risk zones, with heavy penalties for non-compliance.

- Roads Authority should be approached to close Bwabwata National Park to transit traffic from sunset to sunrise. This would not impact on trucks as border posts to Zambia and Botswana close at 19h00 and open again in the morning.

- Park planning, zonation and wildlife corridors should include spatial requirements of large carnivores.

Awareness

- Awareness training for wildlife crime law enforcement

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and judiciary staff needs to include incidents of poaching for large carnivore body parts.

- Conservation authorities and the general public should be sensitised as to the value of spotted hyaenas and large carnivores in general, and in conservation landscapes specifically.

Research

- Dispersal patterns and connectivity of spotted hyaenas in north-east Namibia needs further attention. Recent results from Khaudum National Park indicate that spotted hyaenas are dependent on trans-boundary movement and traverse over enormous distances through landscapes (P Beytell & Z Mills unpublished data), making them increasingly vulnerable to persecution. Understanding dispersal routes would assist in implementing conservation steps and interventions for spotted hyaenas.

- Long-term monitoring through camera-trap surveys and spoor surveys is important particularly in north-east Namibia where spotted hyaenas are vulnerable to anthropogenic threats in neighbouring countries.

- The results of spoor surveys for spotted hyaenas need to be calibrated against camera-trap survey results, as spotted hyaenas cover large distances at night often resulting in an inflated population estimate derived from spoor frequency.

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Reviewers: Stephanie Dloniak and Kay Holecamp

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Brown Hyaena *Parahyaena brunnea*

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Namibian conservation status	Near Threatened
Global IUCN status	Near Threatened since 2000
Namibian range	~685,600 km^2
Global range	~2,450,000 km^2 (IUCN 2015)
Population estimate	Global: <10,000 mature individuals Namibia: <3,000 mature individuals
Population trend	Stable. Resettling or increasing in some parts of Namibia
Habitat	Desert, semi-desert, grassland, open shrub and woodland savanna with average annual rainfall up to 700 mm
Threats	▸ Human-carnivore conflict outside protected areas ▸ Non-selective persecution/control programmes (poisons, gin traps, snares) ▸ Habitat fragmentation through predator-proof fencing ▸ Traditional muti markets and illegal international commercial markets ▸ Road mortalities ▸ Trophy hunting, or any disruption to the social organisation (e.g. through removal of a breeding female); clan recovery can take many years

IDENTIFYING FEATURES

Brown hyaenas have the typical sloping body shape of hyaenas, with a strong, muscular neck, shoulders and front legs and less well developed hindlegs. Their body hair is dark to reddish brown and long. They have a brighter, yellowish to off-white mane and the legs are striped, which aids identification of individuals. The ears are pointed, as opposed to the round ears of spotted hyaenas. There is no pronounced sexual dimorphism.

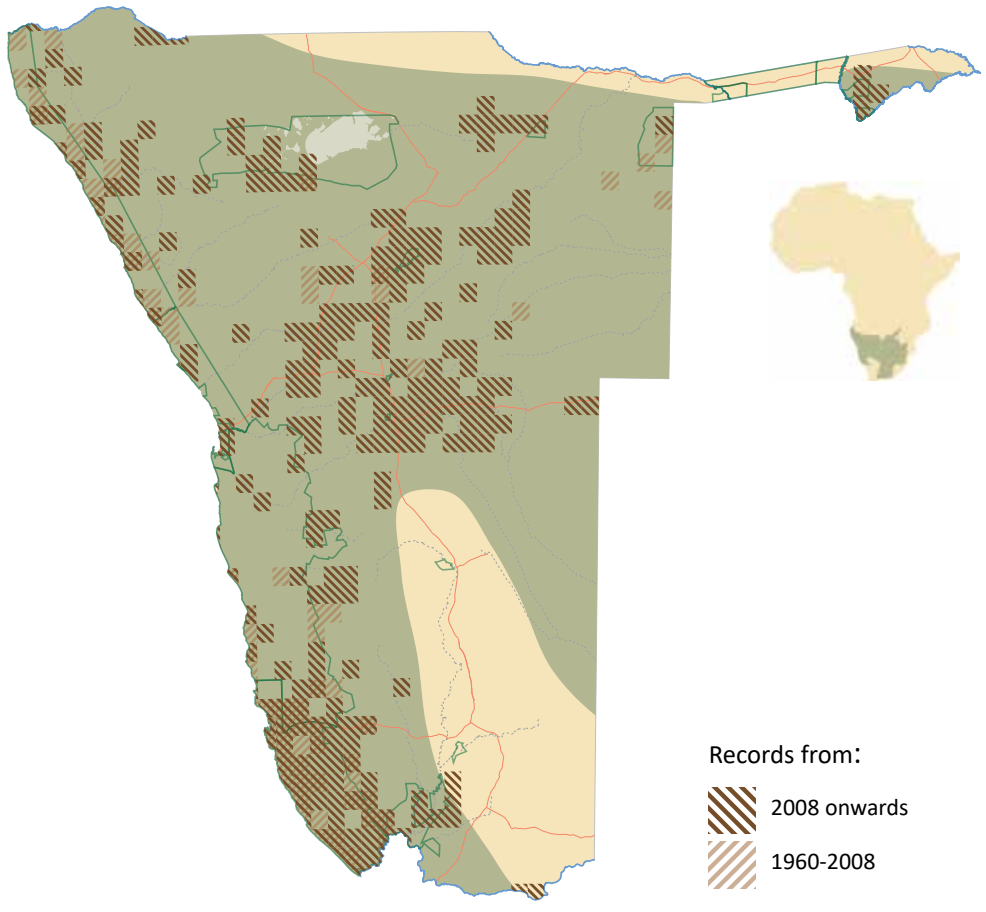
DISTRIBUTION

Brown hyaenas occur in the southern African subregion with a small, recently confirmed extension into the arid south-western parts of Angola (L Hanssen pers. comm.). They are widespread throughout Botswana (Winterbach *et al.* 2017) and most of Namibia (Wiesel 2015a). Historic distribution data show that they were absent or very rare in the eastern Zambezi Region and rare in areas of the south-eastern ǁKharas Region, where game densities were low (Shortridge 1934, Gaerdes 1977). The current distribution is similar

Distribution records of brown hyaena, and present estimated area of distribution in Namibia.

Inset: African distribution of brown hyaena according to IUCN (Wiesel 2015b).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



except that they also seem to be absent north of the Etosha National Park. This area is densely populated, which may contribute to their absence; however, brown hyaenas are known to survive well in urban areas (Kuhn 2014). Hyaena sightings have been reported from communal conservancies in the Omusati, Oshana, Ohangwena and Oshikoto Regions, but no distinctions have been made between hyaena species in the conservancy records (NACSO 2016), so it is impossible to ascribe these records to either spotted or brown hyaenas. The brown hyaena's occurrence in the eastern parts of Hardap Region and south-eastern areas of Omaheke Regions is uncertain. No recent records exist, but they occur across the border in the Kgalagadi and Ghanzi Districts of Botswana (Winterbach *et al.* 2017), which makes it likely they will also be found on the Namibian side. Small-stock farming, which is the predominant land use in eastern ǁKharas Region, may be the reason for the current absence of brown hyaenas there, due to increased conflict and less tolerance towards carnivores (Lindsey *et al.* 2013c).

POPULATION ESTIMATE AND TREND

According to the latest IUCN red data assessment, the global population estimate of brown hyaenas is less than 10,000 mature individuals (Wiesel 2015a). More recent estimates from Botswana show that it has the largest and probably the least fragmented brown hyaena population with an estimate of 3,133–5,933 animals (Winterbach *et al.* 2017), followed by Namibia with an estimated 1,662–2,870 animals (Wiesel 2015b). No recent estimates are available for South Africa, but population sizes (900–2,200 estimated by Hofer & Mills 1998a) have possibly been underestimated in the past (Yarnell *et al.* 2016).

Historic data to assess population trends for Namibian brown hyaenas are sparse and contradictory. Shortridge (1934) describes the brown hyaena as being an abundant large carnivore in the north-western regions, Omaheke Region and the eastern Otjozondjupa Region, as well as being the common hyaena species north of and around the Etosha Pan area. Contrary to this assessment, Gaerdes (1977) describes the brown hyaena as rare in his review of historic observation records. However, much of this information originates from farm questionnaire surveys, done by the Department of Nature Conservation in 1972 and 1982. Although brown hyaenas were not included in the questionnaire, the Namibian population was estimated as 50 individuals, classifying them as endangered (Joubert & Mostert 1975). Furthermore, brown hyaenas only seemed to occur on 7.3% of farms (Joubert *et al.* 1982). In general, brown hyaenas were described as being more common on farmland and in coastal areas of the Namib than spotted

hyaenas (Stuart 1975, Gaerdes 1977, Skinner & van Aarde 1981).

The past exclusion of brown hyaenas from surveys possibly contributed to its Red Data status classification of insufficiently known (possibly vulnerable) and peripheral (Griffin 2003). Fortunately, through advances in monitoring technologies, especially camera traps that enable citizens to monitor wildlife more easily, more detailed data are available today. The importance of non-protected areas for brown hyaena conservation has been established for Botswana, South Africa and north-central Namibia (Kaufman *et al.* 2007, Stein *et al.* 2008, Thorn *et al.* 2011, Kent & Hill 2013, Lindsey *et al.* 2013c). However, densities vary depending on land use. Brown hyaena density is higher on freehold rangelands than on more densely populated communal rangelands (Kaufman *et al.* 2007). In Botswana, densities on livestock farms are sometimes higher than on game farms (Kent & Hill 2013), and densities on agricultural land in South Africa are lower than in protected areas (Thorn *et al.* 2011).

Density estimates are available for a variety of different habitats, inside and outside of protected areas, using a variety of different methods. Density estimates on commercial farmland in western Botswana from camera trap surveys were 2.3 animals/100 km^2 (Kent & Hill 2013) and between 0 and 2.94 animals/100 km^2 from spoor and camera trap surveys across the entire country (Winterbach *et al.* 2017). The population size at Ongava Game Reserve in Namibia is estimated at between 7 and 10 animals (K Stratford pers. comm.), hence a density of 2.33–3.3 individuals/100 km^2. However, brown hyaenas are not confined to the reserve and regularly cross over from the Etosha National Park to forage. Acquah (2012) estimated a density of 4–10 animals/100 km^2 on Okomitundu, but true home range size was unknown and it can be assumed that these hyaenas were also not restricted to the farm. However, very high densities have been observed in Kwandwe Private Game Reserve in South Africa, where Welch & Parker (2016) estimated 14–19 individuals/100 km^2, and Edwards *et al*. (2019) estimate density at Okonjima at 24 animals/100 km^2. A full electric fence prevents free movement there. Most fences do not pose a barrier to brown hyaenas though, and therefore density estimates from single farms and some private reserves have to be interpreted with caution. For the southern coastal Namib Desert, long-term home range and population size estimates are available. Here, coastal densities are estimated as 0.43–0.8 animals/100 km^2 (I Wiesel unpublished data).

The current population trend is stable. However, there are numerous researchers and farmers that report a perceived increase in brown hyaena numbers, especially in the Khomas Hochland area. It is not entirely clear whether this is just a result of this cryptic species becoming more visible through the use of camera traps as a monitoring tool, highlighting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the importance of detailed monitoring studies necessary in these areas.

A recent genetic study has shown that there are potentially four subpopulations, one in South Africa, one in Botswana and two in Namibia (Westbury *et al.* 2018). In Namibia, there are indications of a northern and a southern subpopulation, possibly due to limited migration through the Namib Sand Sea and the eastern boundary of the Namib-Naukluft Park, where spotted hyaena density is higher (I Wiesel pers. obs., Stuart 1975).

ECOLOGY

Brown hyaenas are found in desert and semi-desert habitats with an annual average rainfall of less than 100 mm. They are also common in grassland, open shrub and open woodland savannas with rainfall up to 700 mm (Wiesel 2015a), and are known to survive close to urban areas (Kuhn 2014). In Namibia they occur along the entire Namib Desert coast and in high densities in the Khomas Hochland and central areas north of Windhoek (Wiesel 2015b). They are seldom recorded in wetlands, floodplains and densely forested areas.

Brown hyaenas live in mixed sex clans (Mills 1982) of what appear to be related females and males, and sometimes immigrant males. Clan sizes of up to 10 adult and subadult clan members have been recorded (Mills 1990b). In coastal areas of the southern Namib, clans consist on average of 2–3 adults and 1–2 subadult animals (I Wiesel unpublished data). Clans along the Skeleton Coast, also consisting of adult and subadult individuals, are on average 3–6 animals

(E Verwey pers. comm.). Subadult emigration is the main determinant of group size (Mills 1990b), with 33% of males becoming nomadic and forming an important component of the population (Mills 1982). After approximately 97 days of gestation (Shoemaker 1978), brown hyaenas give birth to a litter of 1–4 cubs (Mills 1983; average of 1.55 cubs coastal Namib, I Wiesel unpublished data; average of 2 cubs Skeleton Coast, E Verwey pers. comm.) in a natal den. The cubs are carried to the communal den when they are approximately 2 months old. These communal dens are the social meeting point of brown hyaenas. All clan members carry solid food back to the den to supplement the cubs' diet until they are completely weaned within 12–15 months (Mills 1990b, average of 11–12 months coastal Namib, Wiesel *et al*. 2019). Inter-litter intervals are irregular and range from 12–41 months in the southern Kalahari (Mills 1982) and 7–16 months in the southern coastal Namib (Wiesel *et al*. 2019).

Brown hyaenas are solitary, opportunistic foragers and most food is obtained through scavenging. Vertebrate remains are the most important food source, but reptiles and invertebrates are also consumed. Brown hyaenas on Namibian farmland predominately scavenge from leopard and cheetah kills (Stein *et al.* 2013), while coastal hyaenas' diets mainly comprises seals and seabirds (Avery *et al.* 1984, Siegfried 1984, Skinner *et al.* 1998, Kuhn *et al.* 2008). Hunting plays a minor role, although coastal brown hyaenas are successful hunters of Cape fur seal pups (Wiesel 2010). In urban areas refuse dumps can become major sources of food, and analysis of scat and stomach contents of road-killed hyaenas revealed non-food items such as tin foil, bottle tops, plastic and parts of shoes (I Wiesel pers. obs.). Brown hyaenas seem to be independent of permanent fresh water availability within their home range (e.g. Skinner & van Aarde 1981), and may complement their water intake by eating fruit, such as melons, when necessary (Mills 1978), or travel outside their territory to visit permanent water sources (I Wiesel unpublished data).

During the day, brown hyaenas seek shelter under bushes, holes or in mountainous areas under rocks. They are predominately nocturnal and cover average distances of 18 km/day in coastal areas and 42 km/day in inland areas of the Namib (I Wiesel unpublished data). Territories are marked at the boundaries and inside through defecating in latrines and pasting on vegetation and other landmarks (Mills & Mills 1980, Mills 1990b). Home ranges of adult male clan members are larger than those of adult females and often overlap with the home ranges of neighbouring clans. In the Southern Kalahari and Makgadikgadi in Botswana home ranges of 235–481 km^2 (100% Minimum Convex Polygon: MCP) and 135–221 km^2 (95% MCP) respectively have been recorded (Mills 1990b, Maude 2005). In Namibia home range sizes vary greatly, dependent on habitat type and distribution of food sources (Table 3.1). Nomads in the southern Namib Desert covered up to 11,690 km^2 over a period of one year and maximum dispersal distance was 240 km (I Wiesel unpublished data).

Brown hyaenas can be sympatric with spotted hyaenas but are sometimes displaced by them (Mills 1990b). Along the Namib Desert coast, black-backed jackals are considerable competitors for the coastal food resources and brown hyaenas may lose prey to jackals when outnumbered (I Wiesel unpublished data). Brown hyaenas scavenge carcasses from lions where they co-occur (Owens & Owens 1978, Mills 1990b, Yarnell *et al.* 2013) and they are dominant to cheetahs and sometimes leopard (Mills 1990b).

THREATS

Brown hyaenas are widespread across Namibia and a large proportion of the population lives outside of protected areas, where they may come into conflict with humans. They are often persecuted directly on farms, where they are shot or captured alive and subsequently killed or translocated. They are also indirect victims of predator control measures, such as snaring and poisoning, which may become a major threat for many carnivore species. Because of their scavenging nature, they are sometimes unfairly blamed for livestock losses; however, they can kill small-stock and incidents of calf attacks have increased in some parts of Namibia (I Wiesel pers. comm.). It is often suggested that "problem animals" are old animals that have problems of finding food elsewhere, or young subadults that start foraging on their own. When this is the case lethal or non-lethal removal of such animals mostly resolves the problem. In central Namibia, for instance, a subadult male that had injured several calves, was relocated, assimilated into the resident hyaena clan, and did not cause further conflict (Weise *et al*. 2015c). In dry southern Namibia, brown hyaenas also cause damage by gnawing on water pipes, resulting in losses of an important and limited resource on farms.

The tolerance of farmers towards carnivores in general, and the perceived predation risk posed by various carnivores, is a cause for concern. In Namibia a high proportion of farmers kill carnivores, and tolerance to large carnivores is often low. However, among the carnivore guild, brown hyaenas are mostly tolerated, especially among conservancy members (Schumann *et al.* 2008). Still, hyaenas in the central areas north of Windhoek are perceived to predominately prey on cattle and donkeys (Schumann *et al*. 2012) and 3.8% of land managers in Namibia reported significant livestock losses to brown hyaenas (Weise *et al*. 2015c). Studies in Botswana, however, show, that brown hyaenas do not hunt livestock (Maude & Mills 2005).

There is evidence that brown hyaenas are frequently killed by vehicles on tar roads. In southern Namibia, road mortalities on tarred roads have caused temporary local extinctions of clans (I Wiesel unpublished data). Upgrades from gravel to tar roads pose a real threat due to increased traffic volume, increased traffic after dark, and speeding. A conservatively calculated annual average of 1.5 brown hyaenas is killed on a 40 km stretch of tar road in southern Namibia (I Wiesel unpublished data).

Snares to poach birds and game pose a threat to brown hyaenas, especially around urban areas, settlements and refuse dumps, where hyaenas commonly forage. Evidence of snaring is often found at brown hyaena den sites, as clan members also carry snared animals, caught in snares, back to the den (I Wiesel pers. obs.). Brown hyaenas often get caught in bird snares and sometimes lose their feet trying to bite them off or when blood supply is disrupted. Some hyaenas caught in large snares have been able to escape from the capture site, but die of sepsis later (I Wiesel pers. obs.).

The impact of pathogens transmitted by domestic dogs is unknown, but several disease outbreaks, such as distemper and rabies, have been recorded in Namibia (Gowtage-Sequeira *et al.* 2009). Serologic screening shows that brown

Table 3.1: Home range sizes of Namibian brown hyaenas.

Area	Home range size (km²)	Age category	Sex	Home range estimate method	Source
East-central Namibia	127	adult		MCP (95%)	R Portas, J Melzheimer unpublished data
	297	adult		MCP (95%)	R Portas, J Melzheimer unpublished data
	44	subadult		MCP (95%)	R Portas, J Melzheimer unpublished data
Central area north of Windhoek	96	adult		MCP (100%)	L Hanssen unpublished data
Central Namibia	103	subadult		MCP (100%)	Weise *et al.* 2015
	134	subadult		MCP (100%)	Weise *et al.* 2015
Skeleton Coast Park	1286	adult	female	MCP (100%)	E Verwey unpublished data
	2108	adult	male	MCP (100%)	E Verwey unpublished data
Southern Namib Desert- coastal	368*	adult	females	MCP (100%)	I Wiesel unpublished data
	678*	adult	males	MCP (100%)	I Wiesel unpublished data
	375*	subadult	female	MCP (100%)	I Wiesel unpublished data
	305*	subadult	male	MCP (100%)	I Wiesel unpublished data
Southern Namib Desert- inland	3584	adult	male	MCP (100%)	I Wiesel unpublished data
	4,865	adult	male	MCP (100%)	I Wiesel unpublished data

*MCP= Minimum Convex Polygon; * = average*

hyaenas are exposed to a variety of pathogens (Wiesel *et al.* 2018), but the impact on the population is still unknown.

Brown hyaenas are not a valuable trophy hunting species. However, there seems to be an increase in demand for trophies of less frequently hunted species, possibly among collectors. Import restrictions on brown hyaenas in for instance the U.S. (Endangered Species Act), may limit demand, but photos of trophy hunted animals seem to be a popular substitute for actual trophies. Uninformed trophy hunting on brown hyaenas can have severe consequences for the population, because the risk of eliminating breeding females is so high, and it is these individuals which maintain the social clan structure. It is difficult to distinguish between sexes due to the long fur and small external sexual organs, as well as the penile pads that may be confused with testes. This makes the trophy hunting of brown hyaenas ill-advised. Furthermore, the low trophy price of brown hyaenas does not justify the risks.

Reintroductions and relocations should similarly not be encouraged, and should only be done with proper research into the clan structures of the source and recipient groups. Disruption of the social organisation of resident clans may cause stress and may have negative impacts on their reproductive output.

Restriction of natural migration and local movements due to, for example, predator-proof fencing around small private and public game reserves and parks may pose a threat. This should be monitored and possibly managed to avoid inbreeding.

Influences on the reproduction of a brown hyaena clan can have long-lasting population impacts. They are slow breeders with irregular, sometimes long inter-breeding intervals and low litter sizes (1–4 cubs,) and thus the recovery of populations may take many years. In southern Namibia, a prime territory including a mainland seal colony as a food source, became vacant in 2006, when the breeding female died and two adult males were killed on the tar road. The clan adjoining the vacant territory to the north only moved into the vacant territory in 2009, where they started denning in 2010. It took another 8 years until reproduction was recorded in the territory that the northern clan left behind (I Wiesel pers. obs.).

Although brown hyaena parts (glands, organs, hair, scats) are used in traditional medicine, collection is rather on an opportunistic basis from natural mortalities or road kills. In southern Namibia, many road kills disappear from the side of the road and of two recovered mortalities, one was skinned and the second had been hidden, presumably to be used for food (I Wiesel pers. comm.). However, emerging illegal commercial markets in Asia targeting teeth, bones and claws may become a serious threat in the future.

CONSERVATION STATUS

The brown hyaena is listed as Near Threatened in Namibia. It had previously been listed as insufficiently known due to paucity of data. The species' international conservation status has remained Near Threatened since 2008, after being uplisted in 2000 from Lower Risk/Least Concern to Lower Risk/Near Threatened (Wiesel 2015a). The lack of

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reliable density data together with the global population estimate of less than 10,000 mature individuals justifies this listing, despite the stable population trend assessments across its range. The brown hyaena was deleted from Appendix II of the CITES Appendices in 2000.

ACTIONS

Brown hyaenas, like many other large carnivores, are vulnerable to ecological and population stress due to their large area requirements, low reproductive rate and low densities (compare with Gittleman *et al.* 2001). Brown hyaena ecology is still widely misunderstood and misinterpreted by farmers. Several actions with regard to management recommendations, awareness programmes and research priorities are recommended for implementation in Namibia.

Management:

- Trophy hunting of brown hyaenas should be prohibited, due to the social clan structure and difficulties in differentiating between sexes.
- Uninformed reintroductions and relocations are not encouraged. The clan structure of both the source and recipient populations should first be studied, and decisions should be informed by the results and made after specialist consultations. Only subadult problem individuals may be relocated due to their submissive nature, that may enable assimilation into the recipient clan (e.g. Weise *et al*. 2015c). Such animals should be whenever feasible fitted with GPS collars to monitor relocation success.
- Standard methodologies should be developed for farmers to identify the correct problem animal species in predation events.
- Event Book reporting and conservancy reports should distinguish between spotted and brown hyaena.
- Tarred national roads that traverse through national parks should be closed from sunset to sunrise. This is especially relevant for newly upgraded roads, e.g. the Orange River road from Rosh Pinah to Oranjemund. There should be enforcement of speed restrictions, and penalties.

Awareness:

- Promote brown hyaenas for providing useful ecosystem services through their scavenging.
- Promote citizen science participation in online reporting platforms, such as the EIS. This could target especially private camera trap owners and farmers (e.g. via NAU), and should explain the importance of such data in the national and global context. It is important to record all types of data, e.g. sightings, photos, human-carnivore-conflict, mortalities, carnivore signs (dens, latrines, marking posts).
- Education with regard to brown hyaena sociality, foraging strategies and ecological needs.

- Provide detailed and correct information about brown hyaena ecology and social behaviour through video clips and popular articles in magazines, especially farmers' magazines.

- Promote farmer-to-farmer guidance on farming harmoniously with brown hyaenas.

Research:

- Assessment of livestock hunting abilities of brown hyaenas, especially in high density areas, such as the Khomas Hochland.

- Assessment of economic impacts of brown hyaenas to farmers in comparison to other predators, overall livestock losses and their benefits through e.g. scavenging.

- Collection and analysis of scats to determine diet composition on farmland to assess the use of livestock. Genetic population structure studies in Namibia. This should include genetic studies of enclosed subpopulations in small reserves and parks to assess management options.

- Standardised distribution monitoring through national multi-species carnivore monitoring programmes using camera traps, complemented by questionnaires, citizen science participation and sign surveys.

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Aardwolf *Proteles cristata*

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Namibian conservation status	Least Concern
Global IUCN status	Least Concern since 1996
Namibian range	760,500 km^2
Global Range	~6,665,900 km^2 in two distinct populations: ▸ ~3,505,400 km^2 in southern Africa ▸ ~3,160,500 km^2 in eastern Africa
Population estimate	Uncertain, as no density information is available for Namibia
Population trend	Likely stable but requires more data
Habitat	Open plains with short grass and open semi-desert environments, preference for overgrazed areas
Threats	▸ Indirect poisoning aimed at locust outbreaks ▸ Direct human persecution when hunting for black-backed jackal and caracal or due to suspected lamb predation, and from gin traps ▸ Incorrect information about their predatory abilities, and confusion with other predatory species ▸ Severe drought ▸ Road mortality ▸ Habitat loss and fragmentation

IDENTIFYING FEATURES

The aardwolf is the smallest member of the Hyaenidae family. Aardwolves have a slender build with a sloping back, a characteristic of hyaenas. The head is small with rather pointy ears, and the coat is buff to reddish brown with vertical black stipes on the body, becoming horizontal on the upper limbs. They also have a bushy tail and a long mane that can be erected in a threat display.

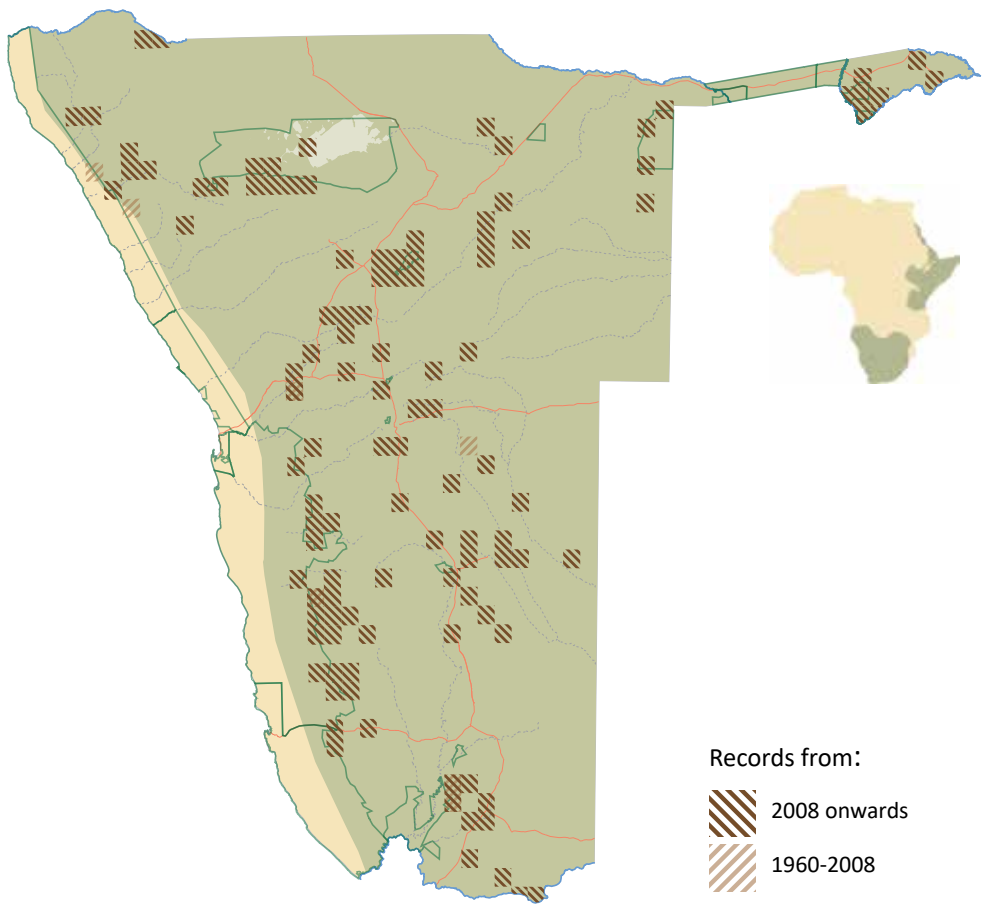
DISTRIBUTION

Aardwolves occur in two different subpopulations separated by 1,500 km: one in east and north-eastern Africa and one in southern Africa (Green 2015). Here, they are widespread in Zimbabwe except for the north-eastern regions, throughout South Africa except for the forests along the south coast, throughout Botswana and most of Namibia, and they extend into southern Angola and south-eastern Zambia.

Distribution records of aardwolf, and present estimated area of distribution in Namibia.

Inset: African distribution of aardwolf according to IUCN (Green 2015).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



They are widely distributed in Namibia except for the driest strip of the Namib Desert along the coast (Skinner & Smithers 1990). The current distribution of the aardwolf in this country is similar to its historic range. It was described by Shortridge (1934) as scarce along the Orange River and in the north-eastern regions, and absent from the Namib coastal belt, but widely distributed throughout the rest of the country. Their presence in the Zambezi and Okavango Regions, recently confirmed by sightings and camera trap records, confirm their occurrence there at probably low densities.

POPULATION ESTIMATE AND TREND

The aardwolf population is estimated to be stable across its range, but nowhere are these animals very common (Green 2015). The majority of the population occurs on farmland outside of conservation areas (Richardson 1998), but they can be displaced because of human disturbance (Kauffman *et al.* 2007). However, due to their shy, quiet and nocturnal nature, they are probably more common than usually believed (Holekamp & Kolowski 2009). A questionnaire survey conducted by the Department of Nature Conservation in 1982 showed that 41% of participating farmers reported the presence of aardwolf on their farms, with conflict reported on 2.3% of these, resulting in 372 aardwolves killed over the period of one year (Joubert *et al.* 1982), most possibly because they are perceived to kill sheep and goats or being confused with jackals.

Aardwolf density is dependent on the abundance of its major food source, nasute termites (*Trinervitermes spp.*; Nel & Bothma 1983). In areas with a high abundance of termites and no persecution, aardwolf can reach densities of 1 adult/km^2 (Anderson 2013). A camera trap study conducted in Kenya showed similar density estimates of 1.2 animals/km^2 (O'Brian & Kinnaird 2011).

The aardwolf's population size across southern African is currently unknown. In the 1998 IUCN assessment, most countries listed the aardwolf as data deficient, with the Namibian population regarded as stable (Hofer & Mills 1998a). Griffin (2003) listed the aardwolf as insufficiently known (possibly vulnerable) yet still no accurate survey data are available. The population appears stable, but future research into the aardwolf's distribution and population size is necessary.

ECOLOGY

Aardwolves occur in open grassland, dwarf shrub savanna, open savanna woodlands, and open semi-arid environments

with a mean annual rainfall of 100–800 mm (Nel & Bothma 1983, Skinner & Smithers 1990, de Vries *et al.* 2016). They seem to prefer open and dry country with short grass, especially overgrazed areas (Estes 1991).

Aardwolves are one of the most specialised carnivores, feeding almost exclusively on nasute termites of the genus *Trinervitermes* (Bothma & Nel 1980, de Vries *et al.* 2016). As an adaptation to their diet, their cheek teeth are very small and reduced to pegs, but the canines have been retained (Estes 1991, Holekamp & Kolowski 2009). Furthermore, their hairless muzzle prevents the terpene defence secretions of the nasute termite soldiers from sticking, so that it can be tolerated (Kruuk & Sands 1972).

Breeding pairs occupy a well-defined territory throughout the year. Territory sizes range from 1–6 km^2 (Sliwa 1996) and depend on termite density (Kruuk & Sands 1972, Richardson 1985). Minimum territory requirements are 3,000 termitaria with 55,000 termites per mound on average, and boundaries are aggressively defended (Richardson 1985) mainly through the deposition of pasted scent marks (Sliwa & Richardson 1998). Territoriality has been questioned in the Namib-Naukluft National Park, where individuals from different territories have been observed foraging together (Bothma & Nel 1980). However, data were collected during a period of food shortage, when food was widely distributed and did not seem to be defendable. Territory maintenance is done through defecation in latrines (Kruuk & Sands 1972, Bothma & Nel 1980, Richardson 1985) and pasting (Richardson 1987). Pastes in the Namib are dark brown in colour, which differs from the orange colour elsewhere (Nel & Bothma 1983). Apart from pastes that are used to intimidate intruders (Sliwa 1996), minute pastes that advertise areas that were visited while feeding have been observed only in the Namib (Nel & Bothma 1983).

Aardwolves are predominately nocturnal, although some diurnal activity may be observed in southern Africa during the cold winter months (Bothma *et al.* 1984, Richardson 1987). During the day, they usually rest in underground burrows to escape the heat and be protected from large predators. Their activity pattern reflects the activity of their prey. Nasute termites are nocturnal and when they become less active in the cold of winter, aardwolves become active earlier to supplement their diet with harvester termites (*Hodotermes spp*.; Richardson 1987, Anderson 1994). Diet also can become more varied in lean years or during the wet season (Kruuk & Sands 1972, Bothma *et al.* 1984). While foraging, aardwolves travel up to 1.7 km/h covering distances of up to 12 km per night (Richardson 1985). Prey is primarily located by sound, but olfactory detection may also play a role in some environments. In the Namib for instance, frequent downwind turns and movements have been recorded (Bothma & Nel 1980). Aardwolves forage solitarily (Bothma *et al.* 1984, Richardson 1998) except when young forage with their mother before dispersing. They usually stop foraging on termite patches, even when thousands of termites are still above ground, when the far less palatable soldiers outnumber the workers (Estes 1991). Because *Trinervitermes* are avoided by other termite-eaters, aardwolves suffer very little competition. Aardwolves are

largely independent of water (except during prolonged dry spells), satisfying their moisture requirements from termites (Skinner & Smithers 1990, Anderson 2013).

Most of the cubs are born during the rainy season, when termites and other insects are abundant. After a gestation period of about 90 days, aardwolves raise their young, usually from 1 to 4 cubs in underground burrows where they stay for the 4–6 weeks of their lives (Estes 1991). They will then forage outside in the company of an adult when they are 12–16 weeks old. Cubs reach their adult size at about 9 months and disperse from their natal territory when the next litter is born and can venture quite far away (Estes 1991).

De Vries *et al.* (2011) recorded sun spiders and scorpions in the aardwolf's diet and small rodents, carrion, eggs and birds were found in two aardwolf stomachs (Bothma & Nel 1980). Recently a single aardwolf was observed killing two geese at Mankwe Wildlife Reserve in South Africa (Yarnell & MacTavish 2013). These incidents are however very rare given the large amount of studies failing to detect other prey remains, and the species can still be regarded as an obligate insectivore (Cooper & Skinner 1979, Richardson 1987, de Vries *et al.* 2011).

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THREATS

According to the most recent IUCN assessment, there are no major threats to the aardwolf (Green 2015). However, as the majority of the aardwolf's population occurs outside of protected areas, conflicts do occur, although not all are intentional. Aardwolves are sometimes killed for food (Hofer & Mills 1998a, Richardson 1998, I Wiesel pers. comm.). Some body parts are even considered a delicacy. They are also sometimes persecuted due to incorrect information and the mistaken belief that they prey on livestock, chicken and eggs (Richardson 1998). They fall victim to collateral killing under jackal and caracal control programmes (e.g. gin traps, Skinner & Smithers 1990) or they are confused with other predator species (e.g. brown hyaena) and therefore persecuted. They are very occasionally hunted as trophies.

The primary threat, however, is possibly indirect poisoning aimed at locust outbreaks with poisoning events sometimes resulting in the death of half of the adults and all of the pups in a localised area (Richardson 1998, Anderson 2013). Richardson (1998) describes one such event where it took the population four years to recover and the remaining population became highly inbred due to lack of immigration of subadult animals.

Aardwolves can cover large distances, so that habitat fragments can be connected (Sliwa 1996). However, urbanisation and the conversion of open rangeland to crops (Holekamp & Kolowski 2009), involving the destruction of termitaria through poison and ploughs, could threaten aardwolf survival through habitat loss (Skinner & Smithers 1990), although this is not a common situation in Namibia where climate and soils make crop-growing marginal except in a few localised areas. Road kills contribute to mortality, as aardwolves tend to not move out of the way of approaching lights (Skinner & Smithers 1990, Périquet *et al.* 2018), but the extent of this problem in Namibia is unknown.

The main natural threats causing aardwolf mortalities are cub predation by black-backed jackals and severe droughts (Richardson 1998, Green 2015). In the current context of climate change, where droughts are likely to be more frequent and severe, aardwolf populations may be impacted (de Vries *et al.* 2016).

CONSERVATION STATUS

The aardwolf is listed as Least Concern in Namibia. It had previously been listed as insufficiently known (Griffin 2003), which is still the case, but the overall impression from scattered observations and records from farmers, camera traps and *ad hoc* sightings suggest that it is widely distributed at stable population sizes. The species' international conservation status has been Least Concern (Lower Risk/Least Concern) since 1996 (IUCN: Green 2015).

ACTIONS

Aardwolf ecology is still widely misunderstood and myths about their predatory habits persist. There are a variety of actions that should be implemented in Namibia.

Management

- Maintain open grassland ecosystems by grazing.
- Develop user-friendly materials to help farmers identify the correct problem animal species in predation events.
- Adjust Event Book reporting and conservancy reports to include aardwolf.
- Stop or minimise the use of pesticides for locust control.
- For farmers: Maintain termite density by not using poisons and not damaging termite mounds.
- Ban the use of gin traps and poisons for predator control.

Awareness

- Provide good information on aardwolf feeding ecology and their diet. Highlight the fact that they are not predators of livestock.
- Disseminate information through AgriForum and other publications aimed at farmers, as well as the production of short video clips.
- Promote farmer-to-farmer communications to spread accurate ecological information.

Promote citizen science participation in online reporting platforms (e.g. EIS), especially directed towards private camera trap owners and farmers (e.g. via NAU) and explain the importance of such data in the national and global context. It is important to record all types of data, e.g. sightings, photos, human-carnivore-conflict, mortalities, carnivore signs (dens, middens, pastes).

Research

- Undertake a country-wide survey of aardwolf presence and density, to generate reliable and factual data for a more accurate assessment of their conservation status.
- Standardise carnivore monitoring programmes so that information is captured from camera traps, questionnaires, citizen science projects and sign surveys.

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African Wild Dog *Lycaon pictus*

Namibian conservation status	Critically Endangered
Global IUCN status	Endangered
Namibian range	131,700 km^2
Global range	~963,000 km^2 resident range in Southern Africa ~1,303,500 km^2 area of occupancy in Africa
Namibian population estimate	137–359 adults and yearlings
Population trend	Stable in Namibia; decreasing globally
Habitat	Habitat generalists favouring wooded savanna, short grassland, montane and coastal forest and semi-desert
Threats	▸ Conflict with humans: direct persecution (especially during breeding time at dens) and negative perceptions of the species ▸ Habitat loss and subsequent fragmentation of the population ▸ Road mortality ▸ Diseases from domestic dogs ▸ Mortality in snares set for other wildlife ▸ Secondary poisoning

DISTRIBUTION

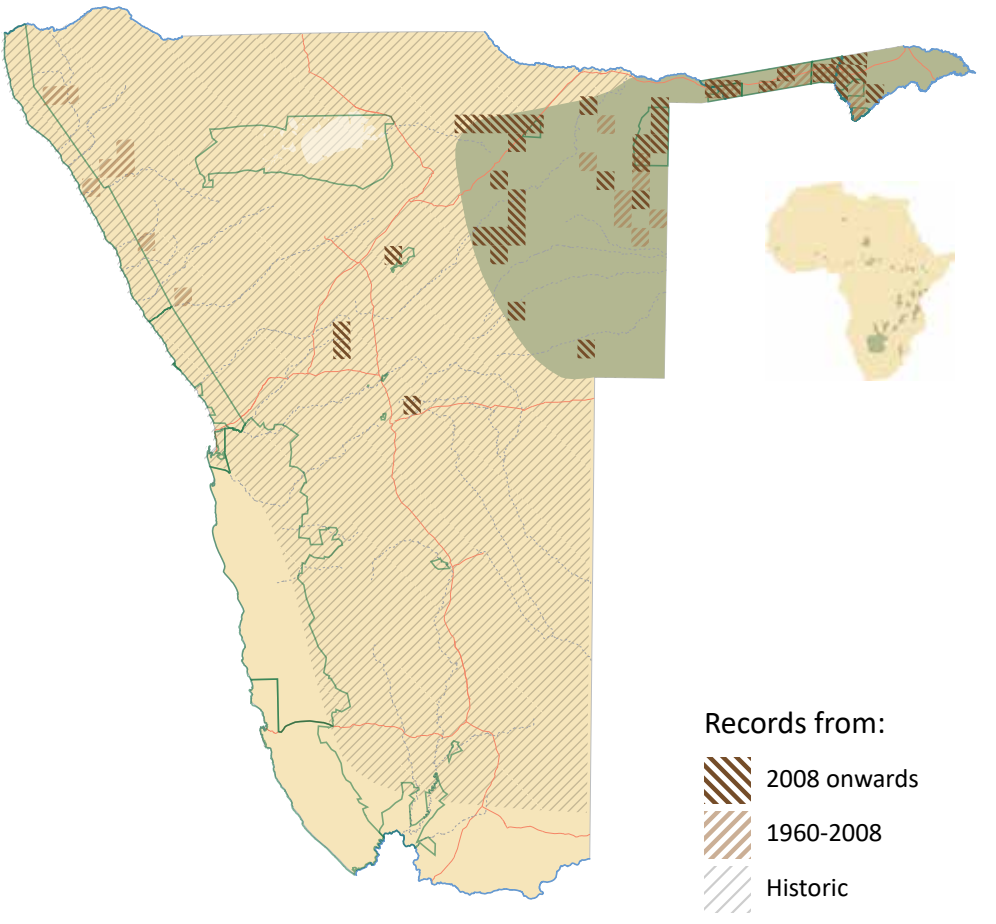
African wild dogs (or wild dogs) were historically distributed throughout Africa south of the Sahara, excluding the Congo basin (Creel & Creel 1998). They have been extirpated from 44% of their historical range, of which only 2% is thought to be possibly recoverable. African wild dogs are considered to still be resident in approximately 17% of their historical

Distribution records of African wild dog, and present estimated area of distribution in Namibia, including vagrant sightings in the west and managed populations in fenced reserves (Erindi and Zannier) further south of the free-ranging resident range.

The hatched area shows the estimated distribution in the 1940s (Shortridge 1934).

Inset: African distribution of African wild dog according to IUCN (IUCN/SSC 2015).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



range, highlighting the major contraction in geographic range that has occurred in this species over the last century (IUCN/SSC 2015). Studies from non-protected populations in Africa show continued widespread declines in population numbers (Woodroffe & Sillero-Zubiri 2012).

Wild dogs were widespread in Namibia historically, with records from as far south as 150 km north of the Orange River mouth (1967) and 65 km from Warmbad (1834), and from the Namib (1930s and 1940s) and former Kaokoland (1970s) in the west (Hines 1990). The populations in the south and west were, however, largely eradicated by the 1990s, with only the north and east remaining as strongholds for the species (Hines 1990).

In the 1920s the population in Etosha National Park (at that stage called Game Reserve No. 2, covering 99,526 km^2 – a much larger area than the present day Park) was estimated to be greater than 2,000 individuals (South West Africa Administrator report of 1923 quoted in Shortridge 1934). This population was depleted due to conflict with farmers on its borders, the treatment of this species as vermin by Game Wardens and other unknown factors, to the point that the species was no longer considered resident in Etosha by 1990 (Hines 1990, Scheepers & Venzke 1995, Fanshawe *et al*. 1991). Three attempts at reintroducing the species into Etosha have failed; the last attempt, in 1990, largely failed due to captive-bred wild dogs being introduced that were not experienced hunters and did not avoid larger predators such as lions (Scheepers & Venzke 1995). Etosha and communal conservancies to the west of it are still considered recoverable range (IUCN/SSC 2015).

The current wild dog population in Namibia is part of a dynamic transboundary population that falls over five countries that include Angola, Botswana, Zambia and Zimbabwe (IUCN/SSC 2015). In Namibia itself, their range is currently restricted to the Zambezi, East and West Kavango, eastern Otjozondjupa and northern Omaheke regions, an area of 181,441 km^2 (IUCN/SSC 2015). Some conservancies such as Nyae Nyae, Okamatapati and Otjituuo the Otjozondjupa Region have important wild dog habitat, despite not holding protected area status (IUCN/SSC 2015).

In the current distribution (see map), records from near Windhoek are packs within N/a'an ku sê's Zannier Reserve (with several dogs awaiting release), while the records north west of Okahandja are from packs reintroduced into Erindi Game Reserve. These are therefore not part of the naturally occurring resident range in the east. The sighting near the Waterberg National Park was likely a transient or vagrant individual or pack, rather than resident.

POPULATION ESTIMATE AND TREND

The Kavango-Zambezi (KAZA) Trans-Frontier Conservation Area (TFCA) is an important area for African wild dogs, where an estimated 2,300 individuals in 235 packs, or 25% of the world's population, is located. Of these, only 725 individuals are within protected areas (IUCN/SSC 2015).

In the 2015 Southern African Conservation Strategy for Cheetahs and Wild Dogs (IUCN/SSC 2015), population estimates for Namibia were based on an average density of 0.3/100 km^2 for the entire resident range. This gives an estimated population of 544 dogs in 45 packs (assuming an average of 12 dogs per pack). The experts at the IUCN strategy workshop also estimated the Namibian wild dog range to be 181,441 km^2, of which only 11,672 km^2 falls within protected areas in which an estimated 35 of 45 (77.8%) packs occur (IUCN/SSC 2015). Some recent work, presented here, provides finer details for specific areas that were studied within the Namibian wild dog range.

In a 2018 spoor survey of Nyae Nyae Conservancy, wild dog density was calculated as 0.62/100 km^2, which is likely to be valid for southern Khaudum National Park as the habitat is similar, although other factors like prey population and competing predator densities may influence that (P Beytell pers. comm., J Robinson & M Roodbool unpublished data). In Bwabwata National Park, two spoor surveys using the same methodology resulted in density estimates of 1 to 1.2/100 km^2 (Funston *et al.* 2014, Hanssen *et al.* 2017).

Based on these densities, population estimates for the study sites were calculated as follows:

- 75 individuals (range 51 to 100) in southern Khaudum National Park/northern Nyae Nyae Conservancy covering approximately 8,000 km^2 (J Robertson & M Roodbool unpublished data, P Beytell pers. comm.)

- 60 individuals (range 23 to 99) in four to six packs in Bwabwata National Park (Funston *et al.* 2014; Hanssen *et al.* 2015, 2017).

Based on insights from field researchers and anecdotal observations, further possible numbers of African wild dogs can be conservatively estimated as follows:

- Between 30 and 100 adults and yearlings in up to five packs in southern Nyae Nyae Conservancy and north-east Otjozondjupa.

- Between 10 and 30 African wild dogs in the less productive northern Khaudum National Park along with George Mukoya and Muduva Nyangana Conservancies to the north. This area covers approximately 3,000 km^2 with habitat that is similar to the woodlands of the Zambezi Region (P Beytell & L Hanssen unpublished data).

- Up to 15 adults and yearlings in and around the Mangetti National Park (C Luyt & N/a'an ku sê unpublished data). These animals are likely to move over enormous areas and even shift their home range to accommodate growing human settlement surrounding the park.

- Between 8 and 15 adults and yearlings in the Mudumu Complexes in two small packs in the Zambezi Region. A pack of three adults increased to nine after a breeding season in the Mudumu North Complex; they use Mayuni Conservancy and the State Forest as part of their home range, and probably move into the adjacent Sioma Ngwezi National Park in Zambia. A separate breeding pack was recorded in Mudumu National Park during the same period of time (L Hanssen unpublished data) and probably uses the woodlands in the surrounding conservancies as part of its home range. A pack of 12 wild dogs was observed in Mudumu National Park during the breeding season in 2020 (E Simataa pers. comm.).

Wild dogs have been recorded in Event Books in most conservancies that have woodland in the east Zambezi Region, but these are likely to be transient. They are not resident in Nkasa Rupara National Park, but transient groups have been recorded.

The total of these estimates ranges between 137–359 dogs, covering key areas of wild dog habitat in the north-east where some research and monitoring has been done. Spoor surveys are the most cost-effective way of determining wild dog density, and we suggest that more surveys are done in Otjozondjupa and Omaheke where little is currently known of their numbers. Spoor surveys are a first step for finding out more about this population, but they may produce imprecise and/or inaccurate population estimates for large carnivores (Balme *et al.* 2009, Stander 1998). These should ideally be combined with more intensive survey methods such as camera trapping in smaller study areas within these regions (Torrents-Ticó *et al.* 2017). The current IUCN estimate of 544 represents a best guess based on known range and a fixed expert-derived density estimate. The two spoor surveys reported above from protected areas and a conservancy with low human-wild dog conflict reveal higher densities than this estimate, although there are large areas of the range where the densities are lower and even decline to zero during some years due to conflict and other threats. Estimating long-term density in these areas is difficult as packs move in and occasionally breed, but are often destroyed by farmers.

Notwithstanding the above uncertainties, it appears that the wild dog population in Namibia is stable. The maintenance of wild prey in national parks and communal conservancies is likely to be responsible for allowing wild dogs to persist in

Namibia, although human-wild dog conflict is the greatest limiting factor for population growth in some parts of their range. In the eastern communal conservancies there are very limited numbers of natural prey for the wild dogs (Rust & Marker 2014, Verschueren *et al*. 2020). Outside protected areas, the numbers of lion and spotted hyaena are limited, which probably benefits wild dogs because they are subordinate competitors to these species (Creel & Creel 1998, Swanson *et al*. 2014).

ECOLOGY

African wild dogs are highly social and cooperative carnivores, hunting, breeding and rearing their young in a pack. Breeding is dominated by an alpha female and male; occasionally a beta female may breed although often unsuccessfully (Malcolm & Marten 1982). Breeding season often occurs in winter (Namibia Nature Foundation 2009), although in the fenced Erindi Private Game Reserve where packs were introduced as part of a managed population, breeding has occurred from as early as April through July (N de Woronin Britz pers. comm.). The suppression of subordinate breeding limits the growth rate of this species and has implications for conservation efforts. If either alpha individual is killed, then the pack is likely to disintegrate until unrelated individuals immigrate to form new packs (Woodroffe & Sillero-Zubiri 2012).

Pack size can range from 3 to 25 in different parts of Namibia and during different time periods, depending on environmental conditions and levels of persecution. The alpha female will only produce one litter of pups per year. The pups will stay in the den for three months and the mother will stay at the den for six weeks post-partum to protect them (Malcolm & Marten 1982). Individual pack sizes increase dramatically after denning seasons as the growing pups join the pack, provided a successful denning event and adequate pup survival. In Bwabwata National Park, litter sizes of 12 to 14 pups have been recorded (Hanssen *et al*. 2016). In the Otjituuo Conservancy in Otjozondjupa Region, Cheetah Cconservation Fund (CCF) recorded litter sizes of two, seven and nine in 2017–2018 (Marker *et al*. in revision). The first of these was rescued from being destroyed by farmers (CCF unpublished data). Long-term field studies have shown an average juvenile mortality of 56% in the wild without human interference (Creel & Creel 2002).

While their dietary range is wide, small to medium-sized ungulates make up the majority of wild dog prey (Hayward *et al*. 2006c). In the Zambezi and Kavango Regions, prey species include duiker, steenbok, impala, reedbuck, kudu, sable and buffalo calves with duiker, steenbok and bushbuck making up 65% of their diet in Bwabwata National Park (Ball 2019). In Nyae Nyae Conservancy and Khaudum National Park, kudu, roan (in Khaudum only), duiker and steenbok are the primary prey species (Lines 2008). Wild dogs occasionally scavenge on the kills of other carnivores and on road kills along the Trans-Zambezi Highway. Wild dogs use multiple short-distance hunting attempts and individuals have low successful kill rate but high group feeding from sharing of prey (Hubel *et al*. 2016). It has been suggested that simultaneous and opportunistic short chases by dogs pursuing multiple prey could be key to their hunting success in mixed woodland habitats (Hubel *et al*. 2016). In the Otjozondjupa Region, packs have been shown to hunt further away from their den sites than expected, likely due to low prey availability (Le Roux & Marker 2020).

African wild dogs generally avoid areas of high prey density due to competition with lions and spotted hyaenas that can kill adults and their pups, and steal their kills (Darnell *et al*. 2014, Swanson *et al*. 2014). Possibly as a result of this avoidance of other large predators, African wild dogs are found at low densities and range widely (Creel & Creel 1998), although this is less of a threat in Namibia (see Threats section). Wild dogs are not water dependent and in all the areas they frequent in Namibia, established packs live in areas where ephemeral pans provide the only water until they dry up in the late dry season.

Home ranges average 450–800 km^2 per pack in southern Africa (Woodroffe & Ginsberg 1998) but can exceed 2,000 km^2 (Woodroffe 2012) and have been recorded as large as 3,600 km^2 in Namibia (Ministry of Environment and Tourism 2013a). Home ranges in Kavango East (Nyae Nyae and Khaudum National Park) contract to as little as 150 km^2 during the denning season (P Beytell unpublished data), and 15 km^2 in the Eastern Otjituuo and Okamatapati packs, but home ranges increase dramatically once the pups and the pack are no longer bound to the den.

THREATS

Throughout Africa, the major threats to African wild dogs are habitat loss and fragmentation, prey loss, direct and indirect human persecution, disease, road mortality and poisoning (Woodroffe & Sillero-Zubiri 2012). Over 65% of Africa's wild dogs are found outside formally protected areas (IUCN/SSC 2015). Even where they occur in protected areas, their ranging behaviour means that few areas are large enough to fully protect them, and packs are likely to encounter the edges of all but the largest reserves (Woodroffe & Ginsberg 1999a). Packs ranging beyond the boundaries of protected areas commonly come into contact and conflict with farming communities over real or perceived threats to their livelihood, often driven by inherited prejudices and misunderstandings surrounding wild dogs' threats to livestock (Woodroffe & Ginsberg 1999a).

Within Namibia, conflict with humans is the primary direct threat to the population, which is exacerbated by lack

of wild prey (in some areas) that in turn is caused by a combination of habitat degradation through overgrazing and poaching. Human perceptions of the species are generally more negative than can be explained by livestock loss alone, and the ecological value of this species is underappreciated. Even in places where prey species are conserved on fenced game farms, this land use is (at least perceived to be) incompatible with wild dogs. Road mortalities and disease are localised threats that can be severe in some cases. Wild dogs being caught as by-catch in snares set for other wildlife and interspecific competition with lions and spotted hyaenas are less of a threat in Namibia than elsewhere.

Human-wildlife conflict and negative perceptions

In the Kavango, Otjozondjupa and Omaheke Regions, wild dogs are actively persecuted by humans targeting dens and either digging out the pups or killing them inside by filling in or setting fire to the dens. Farmers in Otjozondjupa will typically set gin traps around known dens to catch adults and then burn the den after capturing adult dogs with the most conflict occurring between April and September (Le Roux & Marker 2020). Although wild dogs have been shown to be responsible for only 15% of cattle depredation in these communal lands (Verschueren *et al*. 2020), they are still highly persecuted by farmers that suffer high losses in specific conflict hotspots.

The communal lands of Otjozondjupa and Omaheke, particularly, support very low densities of medium-sized herbivore species, which results in increased livestock losses to wild dog packs (Le Roux & Marker 2020). Farmers around the remote eastern farms of Otjituuo and Okamatapati in Otjozondjupa report that wild dogs cause most of their livestock losses and are frequently responsible for injuring livestock, as the packs in this region tend to be small (4-8 individuals) and thus not capable of killing cattle older than 18 months (Le Roux & Marker 2020).

Four dens from four different packs were found and mapped by researchers in this area in 2017 and 2018; farmers destroyed all four and killed numerous adults and subadults (13 confirmed mortalities) and all of the pups. In 2019, three known packs remained with two dens; in 2020 the three known packs using the same traditional denning sites were identified, although one pack consisted of a lone pair; the single male caused high levels of conflict (often injuring prey it could not take down) while trying to provision the female and pups (Le Roux & Marker 2020).

Human perceptions are influenced by culture, tradition and livelihoods (amongst other factors), and this is seen clearly with perceptions towards wild dogs. The conflict described above is mainly between the Herero people who rely heavily on traditional livestock farming and wild dogs. By contrast the San people living in the Tsumkwe District of Otjozondjupa see the dogs in a positive light as hunter-gatherers can use the meat from wild dog kills (Lines 2008). Similarly, wild dogs are not persecuted as a result of livestock depredation in the Zambezi Region, where livelihoods do not rely solely on livestock and different cultural norms prevail (L Hanssen pers. obs.).

Freehold farmers in Namibia also generally express negative attitudes towards this species. While the rise of game farming has led to an increase in wild dog prey species, game ranchers do not tolerate this species, particularly on smaller game-fenced farms (Lindsey *et al*. 2013c). The population of wild dogs within Erindi Private Game Reserve has been shown to predate on sick and weak animals, therefore effectively removing these individuals from the population (N de Woronin Britz pers. comm). This reflects a lack of awareness of the conservation value of the species and a lack of direct economic value attached to the species by game farmers, particularly those that rely entirely on hunting or antelope live sales rather than photographic tourism.

Habitat loss and fragmentation

Habitat connectivity is threatened in the Kavango and Zambezi Regions through excessive timber harvesting, slash-and-burn agriculture and expanding human settlement. Denning packs move over smaller areas than usual and have higher food requirements, so some of these may start targeting livestock, especially in the absence of wild prey (Woodroffe *et al*. 2005). In South Africa, the loss of habitat connectivity has not been shown to reduce genetic diversity but instead, Girman *et al*. (2001) showed a large admixture zone between populations from Botswana, Zimbabwe and south-eastern Tanzania.

Road mortality

Wild dogs are susceptible to road mortalities throughout Africa (Woodroffe *et al*. 2007a, IUCN/SSC 2015). In one

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extreme case in the Bwabwata National Park, which is bisected by the Trans-Zambezi Highway, motor vehicles were known to be responsible for deaths of over 10% of the park's population where ten wild dogs were killed in three incidents within two days (L Hanssen pers. obs.). Deliberate road mortalities have been reported for several cases in the Otjozondjupa Region (R Lines & CCF pers. comm.), which links back to human-wildlife conflict and negative perceptions of the species.

Disease

African wild dogs are susceptible to canine distemper and rabies which are often transmitted by unvaccinated domestic dogs (Woodroffe *et al.* 1997, Alexander & Appel 1994). In the eastern communal conservancies, domesticated dogs are not vaccinated for these diseases which are therefore a threat in this area (Le Roux & Marker 2020). Studies have shown it is possible to vaccinate wild dogs via oral immunisation with 100% vaccination coverage over two days (Knobel & du Toit 2003).

By-catch in snares and poisoning

Accidental snaring represents a major impact on African wild dog populations in southern Africa (Woodroffe *et al.* 2007a), but this has not been recorded as a major threat in Namibia. Bushmeat poaching is not as rampant here as elsewhere, and some livestock farmers are concerned about accidentally snaring livestock. There has been one confirmed case of a snare-related mortality in eastern Zambezi Region (L Hanssen pers. obs.).

Wild dogs do infrequently scavenge which makes them vulnerable to poisoning (Woodroffe *et al.* 2007a). Wild dogs from the protected areas of the north-east regularly cross into Angola and Botswana where poisoning happens more frequently. In Botswana, they have been known to succumb along with vultures at some of these carcasses (P Hancock & T McNutt pers. comm.).

Intraguild competition

In the core conservation areas of Bwabwata National Park, wild dogs share the landscape with lions and spotted hyaenas and have been known to den in areas frequented by both. Wild dogs have been observed mobbing spotted hyaenas and female lions in Bwabwata National Park (P Funston & A Cillier pers. comm.) and a pack of wild dogs, a clan of spotted hyaenas as well as three lions all responded to a calling station in the Kwando Core Area with little consequence. However, lion and spotted hyaena densities in wild dog range within Namibia are very low, so their competition with wild dogs is limited (Lines 2008). Lines (2008) found evidence of spotted hyaena presence for only 5% of wild dog kills in Nyae Nyae Conservancy.

CONSERVATION STATUS

Southern Africa supports a globally important population of African wild dogs. However, wild dogs have experienced major contractions in their geographic range, now inhabiting perhaps only 17% of their historic range in this region (IUCN/SSC 2015). The African wild dog is a Specially Protected Species in Namibia (Ministry of Environment and Tourism 1975), although illegal killing of this species is fairly common, as we report here. Given their ranging ecology and protected area coverage, it is unlikely any single pack is protected from direct or indirect human threats throughout their lifetime, and this is considered perhaps the greatest long term, large scale threat to the species survival (Lines 2008). Although they are classified as Endangered globally, Namibia's population is small and relies heavily on transboundary conservation actions, while very few wild dogs appear to range solely within Namibian borders. We therefore classify Namibian wild dogs as Critically Endangered, although the main population in north-eastern Namibia appears to be stable, as pack sizes have remained stable and pup survival is high (L Hanssen & P Beytell pers. obs.).

ACTIONS

Management

Although wild dogs are currently intensively managed in small- to medium-sized reserves in South Africa, this management system is unnatural, expensive to maintain and wild dog reintroductions from these reserves into large wild spaces is not always successful (Gusset *et al.* 2008b). In Namibia, there are still large areas of land outside protected areas that could host natural wild dog populations, so the key priority is keeping these populations stable and creating conditions where they could increase in numbers and/or expand their range. The mosaic of fully protected areas and conservancies in Namibia, along with similar areas in the broader KAZA landscape, is vital to their long-term persistence. In particular, the Khaudum National Park–George Mukoya–Muduva Nyangana Conservancies, the Mudumu Complexes, as well as the Bwabwata National Park–Luengue-Luiana National Park (in Angola) are vital for the persistence and connectivity of wild dogs.

There are large areas of Namibia where the wild dog population could potentially recover, given the right conditions (Ministry of Environment and Tourism 2013a). The key protected area for this recovery is Etosha National Park, where wild dogs occurred until the 1980s (Hines 1990). Previous reintroduction attempts using captive wild dogs were unsuccessful, as very little was known about reintroducing this species and several mistakes were made (Scheepers & Venzke 1995) that could be avoided in a new reintroduction attempt. For this purpose, much can be learned from the extensive wild dog metapopulation management programme in South Africa (Gusset *et al.* 2008b). A subpopulation in South Africa was established from reintroductions and now occurs across several small fenced and geographical isolated reserves (Nicholson *et al*. 2020). Nicholson *et al*. (2020) have shown that subpopulations can increase significantly – current average annual population size of 107 individuals – due to these intensive management strategies.

Erindi Private Game Reserve has been working to establish new packs since 2008 by releasing groups of males and females that are unrelated to each other onto the reserve. Since then, two packs have formed and they produced four litters of pups by 2020. One group of males has dispersed from their natal pack and will be merged with unrelated females in future. While these packs are self-sustaining, they cannot leave the fenced game reserve and must therefore be managed to avoid inbreeding (N de Woronin Britz pers. comm). A similarly managed population has been established on Zannier Reserve (managed by the N/a'an ku sê Foundation) since 2018 from wild dogs that were translocated due to conflict with livestock farmers in Otjozondjupa. There is currently one pack of seven wild dogs on this reserve that is self-sustaining, while a further six dogs are in bomas awaiting release (de Schepper pers. comm.).

The above reserves could form the basis of a wild dog metapopulation for Namibia, based on similar principles to those in South Africa, with the ultimate aim of reintroducing the progeny of this metapopulation into Etosha National Park. Other private reserves can be brought on board, including those that share a boundary with Etosha National Park. Once the population is established on private lands, it would be possible to soft-release packs into the park over time.

Although previous wild dog management recommendations suggested encouraging a natural repopulation of this species from the eastern population into Etosha National Park (IUCN/SSC 2015), the high levels of conflict and other barriers to dispersal are severe impediments for this option. Natural pack formation from dispersing groups is also highly unlikely, due to the small number of dogs ranging over a very large area which means that separate small groups of males and females may never find each other to form a pack (R Lines pers. obs.). Further, MEFT has committed to "improving the status of biodiversity by safeguarding ecosystems, species and genetic diversity" as Strategic Goal 3 in the Second National Biodiversity Strategy and Action Plan (NBSAP2; Ministry of Environment and Tourism 2014). Particularly, NBSAP2 aims to improve the status of "threatened and vulnerable species", which an active reintroduction programme is far more likely to achieve than a passive approach (Ministry of Environment and Tourism 2014).

In developing a plan to reintroduce wild dogs to Etosha National Park, the key threats mentioned in this status assessment (e.g. human-wild dog conflict, intraguild competition, disease) must be carefully considered and actions to mitigate them incorporated. A meta-analysis by one of the authors (R Lines) revealed that successful reintroductions elsewhere included the following features: combining wild-caught and captive-bred dogs; socially integrated packs; long periods spent in pre-release bomas (with pups born in boma); quality of fencing around the release site and low human population beyond the border; habitat quality and quantity; long-term funding available for post-release monitoring and management. We strongly recommend establishing an African Wild Dog Working Group comprising experts and key stakeholders from within Namibia and beyond (e.g. South African wild dog metapopulation managers, international reintroduction experts) as a necessary first step towards developing and implementing this plan.

Although competition with lions is known to suppress wild dog numbers in other protected areas, lion densities in Etosha National Park are lower than in these other areas

(Darnell *et al*. 2014, Swanson *et al*. 2014). Further, the lion population is highest around Etosha Pan and nearby permanent waterpoints, so there are large parts of the park where wild dogs could range with very little interference from lions. The potential for human-wild dog conflict around the border of Etosha National Park must be considered and addressed proactively, since this was one of the key contributing factors (along with disease) to the historical demise of wild dogs in the park (Hines 1990, Trinkel *et al*. 2016). Vaccinating the dogs against common diseases to which they are susceptible would further improve their chances of survival.

Outside protected areas, there remains a significant opportunity to re-establish or expand wild dog ranges. Perhaps the greatest opportunity is on commercial game ranches, which support large numbers of prey species for wild dogs. The key obstacles to overcome here, however, are farmer attitudes towards the species, which could be greatly improved if the full commercial value of this species is realised (Lindsey *et al*. 2013c). Wild dogs may not be trophy-hunted in Namibia, but they are highly valued by photographic tourists (Gusset *et al*. 2008a). Consequently, farms that are part of larger freehold and communal conservancies, without game-proof fencing between properties, and where ecotourism is the primary source of income would be ideal for future reintroductions of wild dogs (Lindsey *et al*. 2005b, 2013c). These conservancies' outer boundaries should nonetheless be fenced (unless bordering a protected area) to reduce conflict with neighbours and improve the chances of wild dog survival (Gusset *et al*. 2008b).

Similarly, communal conservancies where wild dogs occur currently realise no tangible value to hosting the species, due to the lack of tourism operations in conservancies in the Otjozondjupa and Omaheke Regions. Lines (2008) found that wild dog tracking activities with expert San trackers for tourists in Nyae Nyae Conservancy had some earning potential. Creating awareness among tour operators of the presence of these dogs and their potential value for photographic tourism could lead to establishing wild dog-specific tourism products that generate income for these currently under-funded conservancies (Le Roux & Marker 2020). The Wildlife Credits scheme that has been established to boost conservancy income by paying for the conservation of particular species (e.g. lions, rhinos and elephants) on a payment for ecosystem services model could be adapted for wild dogs (Le Roux & Marker 2020) to increase local tolerance. It seems that compensation for livestock losses does not necessarily increase tolerance for wild dogs (Gusset *et al*. 2009).

Ensuring connectivity between wild dog populations at national, transnational and regional scales is a priority for long term population viability, given that >90% of wild dogs live in populations spanning international boundaries (IUCN/SSC 2015). Research on wild dogs in Namibia has shown that they regularly move over a number of countries including Botswana, Angola and Zambia (O Aschenborn/MEFT unpublished data). Some dogs have been known to travel over all four countries and it is not unknown for Bwabwata wild dogs to move between Botswana, Namibia and Angola in a single day (O Aschenborn/MEFT unpublished data). A collared wild dog from the Buffalo Core Area of Bwabwata National Park travelled 400 km north into Angola and did not return (P Beytell unpublished data).

Controlling the expansion of human populations and adhering to land use plans and zonation will help maintain habitat integrity and reduce scope for conflict and persecution. Recent establishment of small-scale farms west of Khaudum National Park (formerly important wild dog habitat) has already resulted in retaliatory shooting, poisoning and snaring of other large carnivore species. Traffic slowing mechanisms on transit roads through protected areas will reduce road mortality.

There is some potential for improving the chances of wild dog survival on communal farmlands where wild prey has not been depleted. Wild dogs persist in Nyae Nyae Conservancy, but are frequently persecuted in other communal conservancies in Otjozondjupa Region; the difference between these areas is likely due to differences in wild prey densities and distribution and cultural attitudes towards wild dogs. Despite human threats to the species, African wild dogs can and do coexist with livestock farmers where wild prey populations persist (Woodroffe *et al*. 2007b). Improving the wild prey populations within communal conservancies in Otjozondjupa and Omaheke is therefore a key requirement for reducing livestock losses in the long-term.

Awareness

In addition to the availability of wild prey, herding livestock during the day and kraaling vulnerable livestock might be key to reducing livestock losses to wild dogs, thus allowing for coexistence with this species (Ogada *et al*. 2003, Woodroffe *et al*. 2005). Herding during the day is widely practiced in Kenya, where these studies were done, but two studies revealed that fewer than 50% of farmers in Namibia on freehold, resettled, and communal farmlands employ herders (Stein *et al*. 2010, Rust & Marker 2014). Improving coexistence between livestock farmers and wild dogs in Namibia would therefore require targeted education to improve attitudes towards the species, maintain healthy prey populations, and encourage more farmers to employ herders to protect their livestock. In South Africa, posters have been used to raise awareness about free-ranging packs of wild dogs and to encourage the public to report sightings (Nicholson *et al*. 2020). Educational programs have already

been suggested as a possible way to reduce wild dog conflict with livestock and game farmers in Botswana, where 80% of farmers surveyed show a negative attitude towards wild dogs (Fraser-Celin *et al*. 2017).

One option in the communal conservancies is to train selected community game guards as "wild dog rangers", similar to the lion and rhino rangers in the north-western conservancies, which can increase monitoring capacity and create awareness about the conservation value of the species (Le Roux & Marker 2020). These rangers could further assist by responding rapidly to cases of human-wild dog conflict in the region, which would signal to farmers that their concerns about wild dogs negatively affecting their livelihoods are taken seriously (Le Roux & Marker 2020). These actions may improve farmer tolerance for this species, with the overall goal of reducing den destruction by providing alternative solutions.

Since 2015, livestock and veterinary educational training has been conducted in the eastern communal conservancies to help prevent human-wild dog conflict in this area (Verschueren *et al*. 2020). Widening the access to environmental education in schools and training facilities, as well as amongst communities in and around the species' resident range will help combat misunderstanding and inherited prejudice towards African wild dogs and other large carnivores among the future generation of livestock owners. Younger farmers in southern Africa tend to show a more positive attitude towards having wild dogs on their farms compared to older farmers, suggesting traditional prejudices against the species are fading, however negative attitudes were typically linked to economic costs associated with wild dogs (Lindsey *et al*. 2005b). Over half of the 209 farmers surveyed indicated they would like to have wild dogs on their farms (Lindsey *et al*. 2005b).

Research

Reintroducing wild dogs into Etosha National Park will require research and extensive engagement with other stakeholders prior to a reintroduction attempt. A full risk analysis and population habitat viability analysis (PHVA) should guide decisions regarding where to establish the first packs and what steps must be taken before, during and after reintroduction to mitigate identified risks. All released packs should be monitored using GPS and VHF collars over a substantial period of time (several years) to evaluate success and feed into future reintroduction attempts.

The population in Otjozondjupa and Omaheke that occurs in the Okakarara and Otjinene Districts respectively is heavily persecuted and persists with little wild prey (Lines 2008, Le Roux & Marker 2020). While more needs to be known about the wild dog population through spoor and camera trap surveys, genetic studies, GPS collaring for key individuals and den monitoring (Le Roux & Marker 2020), research is also required on the broader socio-ecological system. The communal conservancies in these districts face multiple interlinked challenges – rangeland degradation, depletion of wild herbivore populations, poor livestock husbandry, little/no wildlife-based economic activity, and prevailing negative attitudes towards conservancies and especially towards wild dogs (Lines 2008, Le Roux & Marker 2020). Research in this area is therefore required on multiple fronts to address these complex challenges in a holistic manner. These studies should focus on identifying key interventions – e.g. conservancy income generation, land use planning and livestock management systems to improve rangeland condition – that will improve the state of the entire socio-ecological system, of which wild dogs are one part.

The wild dog population in the Zambezi Region is part of a larger transboundary population in the KAZA TFCA, so research questions must be framed within the context of this landscape. A more rigorous threat assessment is required for this population to identify "source" and "sink" areas, and to elucidate the specific reasons for particular locations being "sinks" for wild dogs. Wherever possible, lessons learned in one country (e.g. on mitigating conflict) should be shared with others for adaptation and implementation.

Assessors: Lise Hanssen, Robin Lines, Gail Thomson, Laurie Marker, Nadja LeRoux and Lauren Pfeiffer
Contributors: Natasha de Woronin Britz and Ulf Tubbesing
Reviewers: Rosemary Groom and Jessica Watermayer

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Bat-eared Fox *Otocyon megalotis*

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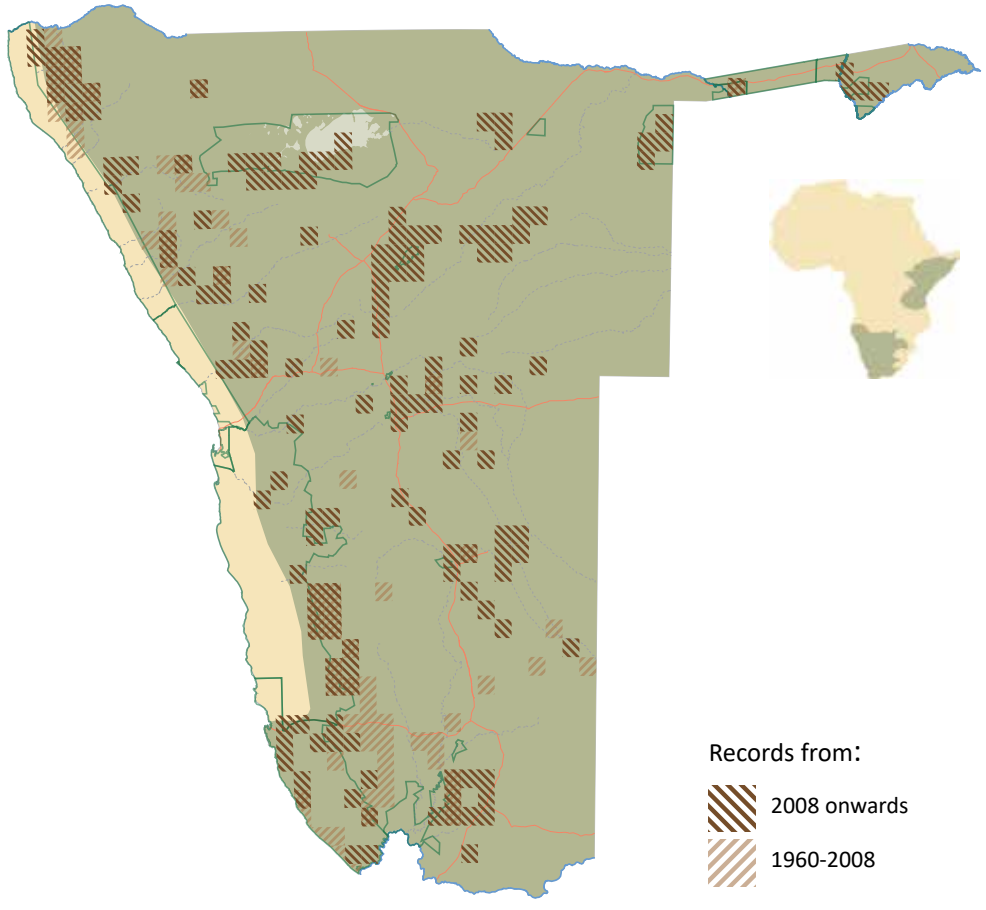
Namibian conservation status	Least Concern
Global IUCN status	Least Concern since 1996
Namibian range	Approximately 769,400 km^2, which is ~31% of the southern African range
Global range	~5,011,300 km^2 in two distinct populations: ~2,626,300 km^2 in southern Africa ~2,385,000 km^2 in eastern Africa
Population estimate	Namibia: unknown Global: approximately 1.3- 5.2 million individuals in southern Africa based on density estimates for a few populations
Population trend	Currently unknown, but likely stable based on general observations Common in protected areas, but becoming less common on small-stock farms where they are persecuted
Habitat	Short grassy habitat, open shrubby vegetation and semi-arid to arid savanna with bare ground, sandy areas of the Kalahari and Namib
Threats	▸ Under some pressure in small-stock farming areas because of persecution. This is mostly from hunting and poisoning where falsely perceived as a predator or where it is indirectly killed from anti-jackal measures ▸ Population fluctuations caused by diseases (rabies and canine distemper) ▸ Drought conditions, causing depressed insect populations. Extensive areas under jackal-proof fencing pose a threat, as the animals are prevented from moving in response to changing climate conditions ▸ Road mortalities

LEAST CONCERN

Distribution records of bat-eared fox, and present estimated area of distribution in Namibia.

Inset: African distribution of bat-eared fox according to IUCN (Hoffmann 2014b).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



IDENTIFYING FEATURES

Bat-eared foxes are small canids (~2–4kg, Estes 1991) with conspicuous large ears. The tail is bushy with a broad black stripe extending down to the black tip. They appear quite dark and "hunch-backed" when seen foraging at a distance, and are often in pairs or small family groups. They crouch low and hold their enormous ears horizontally when trying to avoid detection. These features separate them from similarly sized Cape fox which are lighter coloured, more slender and not at all hunched, and are usually solitary. When scared or threatened, bat-eared foxes curve their tail in a characteristic inverted U-shape and erect their fur to try to appear bigger than they are.

DISTRIBUTION

Bat-eared foxes occur in two different subpopulations corresponding to distinct sub-species: *Otocyon megalotis megalotis* in southern Africa and *O. m. virgatus* from East Africa (Nel & Maas 2013) and their distributions mirror that of their main prey, *Hodotermes mossambicus* (Mackie & Nel 1989).

In Namibia, bat-eared foxes occur throughout the country all the way into the Zambezi and Kavango Regions and to the south and Namib region. The current distribution also includes the southern coastal area as part of the range of this species, which is an extension from the IUCN distribution map (Hoffmann 2014b). It is not clear if this extension results from better observational data or reflects a real range expansion.

Bat-eared foxes are common within protected areas, but are becoming less common particularly on small-stock farmland where they are persecuted as part of efforts to kill jackals (Hoffmann 2014b). In the Waterberg area, bat-eared foxes were detected by camera trap only on freehold farms and never in communal land over the course of a 9-day survey period (Kauffman *et al*. 2007).

POPULATION ESTIMATE AND TREND

The current lack of data on bat-eared fox abundance precludes any estimation of population size and trend in Namibia. Through their range, local densities fluctuate depending on rainfall, food availability (Nel 1984), breeding season and disease (Maas 1993, Maas & Macdonald 2004). Diseases, particularly rabies and canine distemper, can cause short term but drastic declines in populations (Maas 1993, Hoffmann 2014b) from which they usually recover within 1–2 years (Dalerum *et al*. 2016).

Quantified densities in southern Africa range from 0.57 to 2.3 individuals/km^2 (Maas & MacDonald 2004, Kamler *et al.* 2012b, 2013). A small sample from the Kalahari went from 0.25 individuals/km^2 in 2016 to 1.75 a year later, possibly reflecting a rapid increase in the population when conditions were favourable (Brown pers. obs. 2017).

The above-mentioned density studies arrive at a total population of approximately 1.3–5.2 million individuals in southern Africa. The population trend is currently unknown, but is likely to be stable based on general observations. Bat-eared foxes are common in protected areas, but are becoming less common on small-stock farms where they are often persecuted (see below).

ECOLOGY

There is a lack of information about bat-eared fox ecology in Namibia but they are likely to have similar ecology as the neighbouring populations which is described below.

Bat-eared foxes are found in open grasslands, overgrazed rangelands and sparse *Acacia* woodland. They prefer short grass or extensive bare ground. Their habitat requirements and geographic range are nearly the same as the harvester termite (*Hodotermes mossambicus*) which is their primary food source in southern Africa (Mackie & Nel 1989, Nel 1990, Kurberg 2005, Sillero-Zuberi 2009a). In the Namib Desert, bat-eared foxes consume mainly *Hodotermes* and *Triniterves* species and seem to increase their use of *Triniterves* species in years with low rainfall and lower *Hodotermes* availability (Bothma *et al*. 1984). Their diet also contains other termites, other insects and invertebrates, mice and small reptiles, and wild fruits (Estes 1991, Jumbam *et al*. 2019).

Bat eared foxes are primarily nocturnal but are also active during daytime in winter months, mirroring the activity patterns of *Hodotermes* (Lourens & Nel 1990, Nel 1990).

Group size varies with the time of the year between monogamous pairs (occasional trios with one male and two females), and parents accompanied by their offspring prior to dispersal. They breed annually, whelping near the beginning of the rainy season during the period of peak insect abundance (Nel 1984). Pairs inhabit relatively small (0.43–5 km^2) and temporary home ranges (Mackie & Nel 1989, Kamler *et al.* 2012b). Contrary to the situation in East Africa (Maas 1993), these ranges overlap to a large extent in southern Africa and foraging family groups intermingle with little antagonism (Mackie & Nel 1989, Lourens & Nel 1990, de Bruin *et al.* 2018).

This species is characterised by a high involvement in pup rearing by the fathers who often spend more time with the pups than the mothers, guarding the den and playing, grooming and foraging with them (Wright 2006, Nel & Maas 2013).

The presence of other meso-carnivores such as black-backed jackals can negatively affect bat-eared foxes. While the presence of jackals doesn't suppress bat-eared fox density (Kamler *et al.* 2013), coexistence with them and other meso-carnivores can have negative effects on bat-eared foxes. Indeed, they tend to occur less than expected in habitat preferred by jackals and avoid denning in the core of jackals' home ranges (Kamler *et al.* 2012b). Evidence from areas where large predators and jackals have been extirpated for more than 50 years show that bat-eared foxes still display anti-predatory behaviour (Welch *et al.* 2017).

THREATS

In Namibia, the practice of putting extensive areas under mesh "jackal-proof" fencing in the south and west of the country poses a threat, as the animals are not able to move in response to changing climatic conditions. This threat is likely to become more severe as the impacts of climate change become more evident. In addition, intense droughts

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can depress insect populations, which may have an impact on bat-eared fox populations (Hoffmann 2014b).

Across southern Africa, bat-eared foxes are often falsely perceived as predators of small livestock, and they may be mistaken for black-backed jackals when dogs are used for hunting (Kurberg 2005, Hoffmann 2014b). In either case, they are often intentionally or accidentally persecuted by farmers. The combination of poisoning, gin traps and direct persecution have eradicated them on many farms. It takes typically at least a decade for populations to show signs of recovery, depending on recolonisation from adjacent areas. Where former small-stock properties border on national parks and well established privately protected areas, recolonisation is more rapid than in areas surrounded by small-stock farms.

Bat-eared foxes seem to be particularly susceptible to diseases such as rabies and distemper virus, and their numbers are known to fluctuate strongly in response to disease outbreaks that can almost wipe out local populations. In southern Africa, bat-eared foxes can act as a reservoir for rabies (Sabeta *et al.* 2007, Swanepoel *et al.* 2015a). Like many other diseases, rabies outbreaks usually follow periods of high stress, such as drought causing a significant decline in insect populations. Food deprivation could lead to impaired immune systems, creating opportunities for rabies infection. Vaccination of domestic dogs is therefore highly recommended in areas where they come into contact with bat-eared foxes, to prevent rabies transmission between species. Rabid bat-eared foxes do not usually show typical symptoms of frothing at the mouth and aggressiveness; most individuals develop the paralytic form of rabies. Behavioural signs range from violent convulsions and cramp-like seizures during which foxes frequently cry out, to lethargy and complete ataxia (Maas 1993, S Périquet pers. obs.). Rabies diagnosis requires examination of the brain from a freshly dead individual, which is rarely possible to obtain. An 11-year study in central Namibia revealed 16 cases of rabies in bat-eared foxes, and no long term trend in the disease prevalence (Courtin & Carpenter 2000). In Etosha, bat-eared foxes were also reported as being killed by rabies between 1975 and 1990 (Berry 1993). A more recent study (Hikufe *et al.* 2019) found that between 2011 and 2017, six cases of rabies were reported in bat-eared foxes.

While intense grazing can negatively affect bat-eared foxes, intermediate grazing pressure can be beneficial through increase of trampled vegetation and bare ground favouring *Hodotermes* (Kurberg 2005). In the current framework of climate change, drought periods are predicted to increase in length and severity, thus impacting insect species more severely. This will have a strong negative effect on bat-eared foxes, with increased food shortages making them more susceptible to disease. Erratic rains will also impact their breeding success and the pups might be born out of sync with the insect eruption after the first rains. The increased need for land for livestock production will likely have a negative impact on bat-eared fox populations as well. This effect will most probably manifest itself in the increase of direct and indirect killing as farmers increase their predator removal practises.

Bat-eared foxes are particularly vulnerable to road kills, and they are one of the carnivore species most reported killed on roads in South Africa (Périquet *et al.* 2018). With the increase of human population and thus traffic, it is also likely that road mortality of bat-eared foxes will increase in the future.

Commercial use (for pelts) is very limited, but they are sold as hunting trophies in South Africa (Hoffmann 2014b).

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CONSERVATION STATUS

The bat-eared fox is listed as Least Concern on the IUCN Red List (Hoffmann 2014b) and has been so since its first assessment in 1996. The species is not included in the CITES Appendices.

We have very little information on the bat-eared fox population in Namibia, but no reason to believe that it is declining as they are still seen very often across their range.

ACTIONS

There is still very little known about bat-eared fox populations and ecology in Namibia, and more research is needed in order to provide reliable recommendations. Promoting citizen science participation in online reporting platforms (e.g. EIS), and especially private camera trap owners and farmers (e.g. via NAU) would help in gathering data at a large scale.

Conservation actions for bat-eared foxes should focus on reducing their mistaken persecution on farmland and reducing their susceptibility to roadkill.

It is important for farmers to identify this species correctly in order to stop targeting them during predator control operations. Bat-eared foxes do not prey on livestock, even small goats and lambs, and scavenge on carcasses extremely rarely. Livestock dung attracts many insects, which in turn help to sustain this species. Therefore, by maintaining a healthy population of bat-eared foxes, farmland can benefit from the control of *Hodotermes*, which is implicated in rangeland degradation in Namibia (Mitchell 2002). Banning the use of gin traps and poisons for predator control, and stopping/minimising the use of pesticide to control termite populations, will greatly benefit bat-eared fox populations. Such information could be disseminated through AgriForum for instance.

People driving at night should be particularly vigilant when bat-eared foxes are spotted on or near the road. They are blinded by the lights and dart away, often changing direction very abruptly (S Périquet pers. obs.), ending up back on the road. When seeing bat-eared foxes, drivers should simply slow down and dim their lights to allow them to escape safely to the bush.

Assessor: Stéphanie Périquet
Reviewers: Fredrik Dalerum and Aliza le Roux

Suggested citation: Périquet S 2022. A conservation assessment of Bat-eared Fox *Otocyon megalotis*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 92-96. MEFT, LCMAN & NCE, Windhoek, Namibia

LEAST CONCERN

Cape Fox *Vulpes chama*

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Namibian conservation status	Least Concern
Global IUCN status	Least Concern since 1996
Namibian range	~614,000 km^2
Global range	~2,143,900 km^2 with range extension over recent decades
Population estimate	Common to fairly abundant across its range Namibian population not estimated
Population trend	Stable
Habitat	Open country including grassland with scattered thickets and lightly wooded areas Makes use of extensive agricultural lands
Threats	▸ No major threats ▸ Indiscriminate use of agricultural poisons

DISTINGUISHING FEATURES

Cape foxes are small canids with a slender build, a bushy black-tipped tail and a grizzled silver-grey coat. They are unlikely to be confused with other species; the small size, delicate appearance, pale colouration and ears (much smaller than a bat-eared fox's) are unlike other species in the same range.

DISTRIBUTION

The species is widespread in the central and western parts of southern Africa (Hoffmann 2014a, Dalerum *et al*. 2016). Cape foxes are found in grassland with scattered thickets and lightly wooded areas across Namibia, and occur in similar habitats as well as fynbos, *Acacia* scrubland and thorn bushveld in South Africa and Botswana (Sillero-Zuberi 2009b, Hoffmann 2014a, Kamler *et al*. 2016).

In Namibia, Cape foxes are distributed throughout the country except in the central Namib Sand Sea and the far north-east. There are many records from the southern Namib, including at the coast, and one from the Skeleton Coast, but none from the main sand sea except on its margins. Recent camera trap records from Khaudum National Park suggest they might also occupy other parts of the Kavango although it is likely that they avoid settled rural areas, where they would come into conflict with domestic dogs. There are distribution records from the eastern, southern and western sides of Etosha National Park, but none to the north of it.

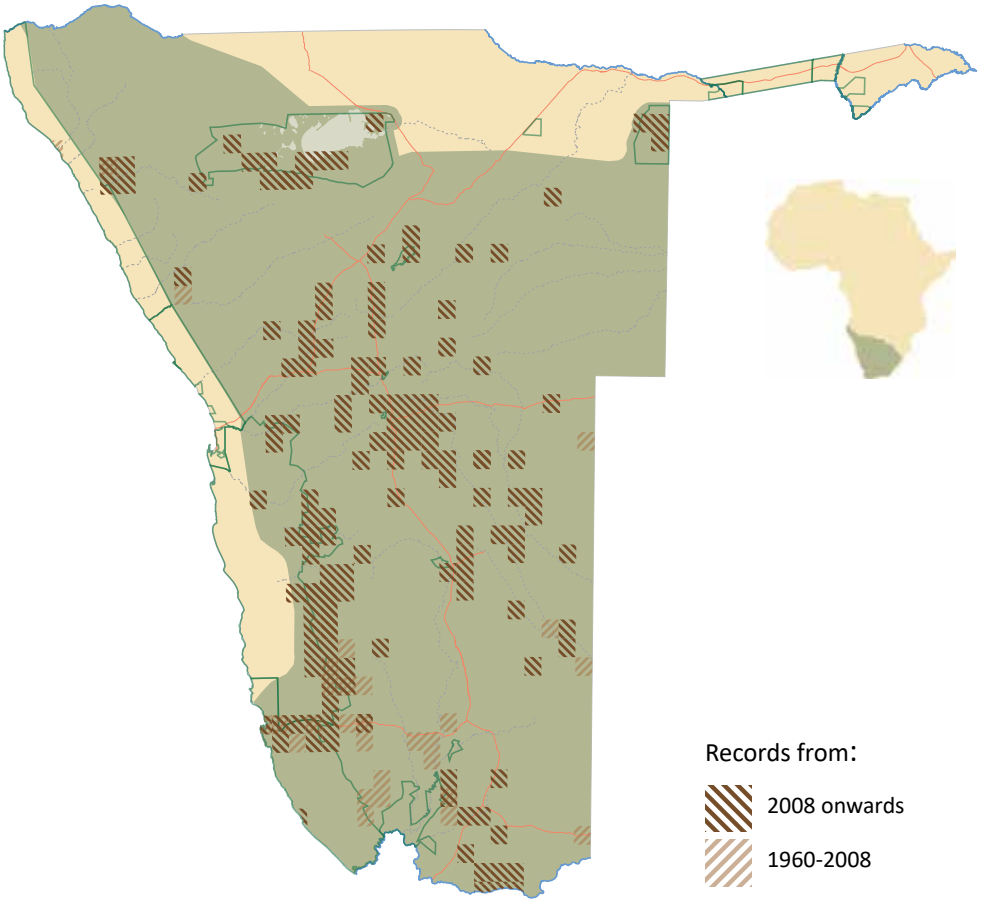
POPULATION ESTIMATE AND TREND

Cape foxes are common both within and outside protected areas. They have only been extensively studied in the Free State and Northern Cape provinces of South Africa where estimated densities of 3 to 14 foxes/100 km^2 (Kamler *et al*. 2012b, 2013) and 30 foxes/100 km^2 (Bester 1982) were recorded. In Namibia, this species is data-deficient and we cannot make reliable estimates of density and population size.

Distribution records of Cape fox, and present estimated area of distribution in Namibia.

Inset: African distribution of Cape fox according to IUCN (Hoffmann 2014a).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



ECOLOGY

The only detailed information about Cape foxes comes from a few studies in South Africa and further research is necessary to better understand their ecology and behaviour.

Cape foxes are almost exclusively nocturnal and live in monogamous pairs with occasional helpers (Bester 1982, Kamler & Macdonald 2014). Pairs share and defend their territories that are stable through the years (9–28 km^2, Kamler *et al.* 2012b, 2013). They breed annually, with the majority of births occurring between August and October (Kamler & Macdonald 2014).

Cape foxes forage alone and feed on a wide range of items including small rodents, reptiles, insects, birds, invertebrates and wild fruits (Kamler *et al.* 2012b, Klare *et al.* 2014). A single individual can consume nearly 4,000 rodents per year (Klare *et al.* 2014). They are also known to scavenge (Bester 1982, J Pallett pers. obs.).

Larger carnivores, especially black-backed jackals, seem to be responsible for the majority of recorded natural mortality (Kamler & Macdonald 2014, Kamler *et al.* 2016). Consequently, Cape foxes were found to spatially avoid areas of high black-backed jackal activity when foraging and establishing den sites.

THREATS

Although humans are probably their main cause of death on farmlands, heavy direct or indirect removal of Cape foxes does not seem to affect their populations (Hoffmann 2014a). However, the widespread use of agricultural poison to control rodents and insects populations poses the highest threats (Stuart & Stuart 2013b) and could probably cause local population decline.

The practice of putting extensive areas under mesh "jackal-proof" fencing in freehold small-stock farming areas also poses a threat, as the movements and dispersals of foxes could become restricted.

The growing need for land for livestock production might have a negative impact on Cape fox populations as well. This effect will most probably manifest itself in the increase of direct and indirect killing as farmers increase their predator removal practices. However, a local decrease of black-backed jackals through active removal could benefit Cape foxes (Blaum *et al.* 2009b, Kamler *et al.* 2013, Kamler & Macdonald 2014), so the overall impacts of livestock production on Cape fox populations are not clear, and probably are site specific.

LEAST CONCERN

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Desertification and changes in agricultural practises have resulted in some extensions of Cape fox range in South Africa, but it is not known if this has occurred in Namibia. Here, areas that have become desertified (particularly north-central Namibia) have also become more heavily settled, which would not facilitate expansion of Cape fox distribution.

CONSERVATION STATUS

Cape foxes are listed as Least Concern on the IUCN Red List (Hoffmann 2014a) and they have been so categorised since their first assessment in 1996. They are not included in the CITES Appendices.

ACTIONS

These small foxes prey minimally, if at all, on livestock and should therefore not be considered as a problem species. On the contrary, Cape foxes can be highly beneficial on farmlands as they help to control rodent populations (Klare *et al*. 2014).

The use of agricultural poisons (for insects and rodents) is likely to have a negative impact on Cape fox populations and should therefore be done sparingly and with careful targeting, paying attention to avoid unintended impacts on other species. Similarly, banning the use of gin traps would also help to decrease human-caused mortalities in Cape fox populations. Less harmful and more holistic approaches to dealing with damage-causing animals, such as using livestock-guarding dogs and bringing livestock in to kraals at night, would greatly reduce livestock losses, and would benefit Cape foxes and the farmers themselves.

It is important for farmers to identify this species correctly in order to stop targeting them during predator control operations. Such information could be disseminated through AgriForum for instance.

There is virtually no available data on Cape fox populations and ecology in Namibia and more research and monitoring is needed in order to provide reliable recommendations. Promoting citizen science participation in online reporting platforms (e.g. EIS), and targeting private camera trap owners and farmers (e.g. via NNFU, NECFU and NAU), would help with data gathering at a large scale.

Assessor: Stéphanie Périquet
Reviewer: Jan Kamler

Suggested citation: Périquet S 2022. A conservation assessment of Cape Fox *Vulpes chama*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 97-99. MEFT, LCMAN & NCE, Windhoek, Namibia

Black-backed Jackal *Canis mesomelas*

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Namibian conservation status	Least Concern
Global IUCN status	Least Concern since 1996
Namibian range	~809,700 km²
Global range	~6,453,500 km² in two distinct sub-species: ▸ ~3,150,400 km² in southern Africa ▸ ~3,303,100 km² in northeastern Africa
Population estimate	Common to fairly abundant across its range
Population trend	Stable. Possible increase on farmlands due to compensatory breeding where natural enemies have been removed
Habitat	Open country including grassland, scattered thickets and lightly wooded areas particularly in the Karoo, Kalahari and even in the Namib Desert. Makes extensive use of agricultural lands
Threats	▸ No major threats, even though they are heavily persecuted on game and small-stock farms as livestock killers. Depending on the situation, such activities might or might not have significant impact on jackal populations. However, the use of non-selective predator control methods against jackals, such as poisons and gin traps, have a significant impact on other species, including scavenging birds and many mammals that are highly beneficial to farmers and healthy ecosystems ▸ Rabies and canine distemper can cause local, short-lived population declines ▸ Persecuted for their role as rabies vectors

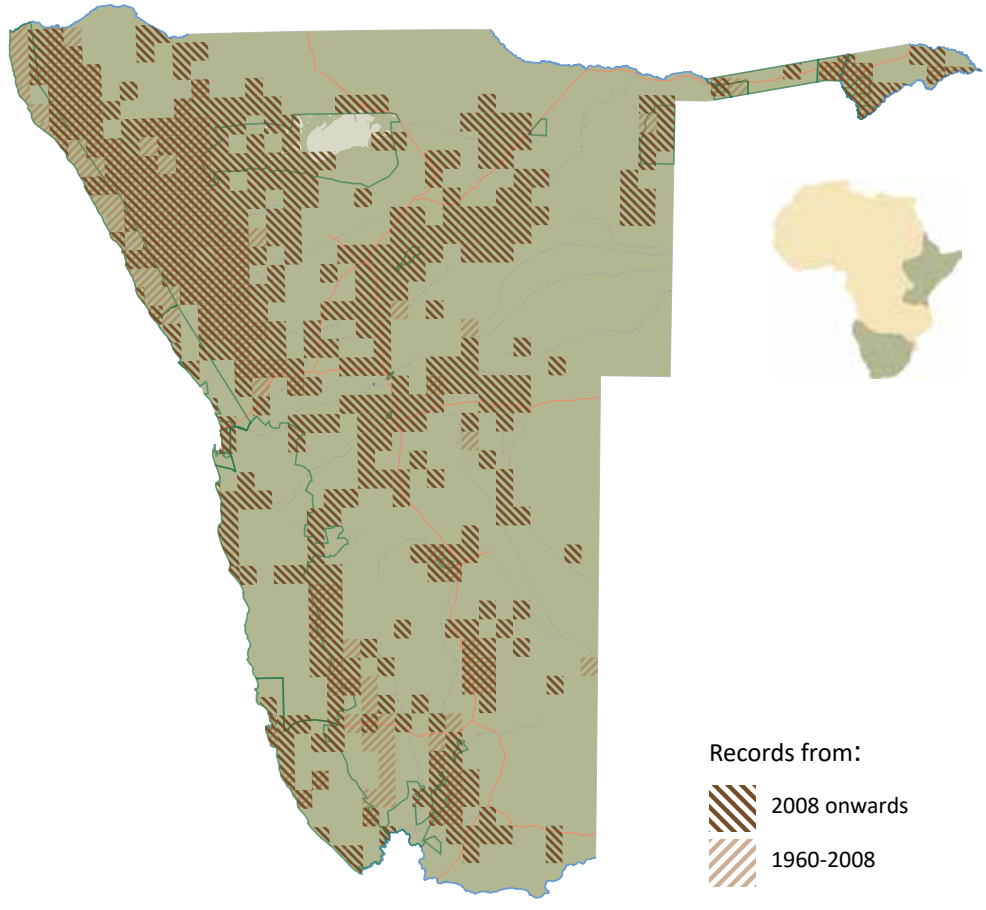
IDENTIFYING FEATURES

The black-backed jackal is a small- to medium-sized canine of 6–13 kg (Kingdon & Hoffmann 2013) with a distinctive dark saddle running from the nape of its neck to the tail. The coat is reddish brown to tan, with a black-tipped bushy tail, and the black of the saddle is intermixed with silvery hair. A black side stripe slopes up from behind the shoulders to the rump. The side and shoulder stripe, and tail markings, can be used for individual identification (Loveridge & Nel 2009, Murray & Merrifield pers. comm.).

Distribution records of black-backed jackal, and present estimated area of distribution in Namibia.

Inset: African distribution of black-backed jackal according to IUCN (Hoffmann 2014c).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



This jackal is similar in size to the side-striped jackal but the dark saddle should prevent any confusion. Individual black-backed jackals with a less distinct, paler saddle are found, which might be confused with side-striped, but in that species the stripe on the flank is white and there is little contrast in the pale-brown coat. The black tail tip of the black-backed jackal in contrast to the white tail tip of the side-striped jackal is another way to distinguish the species.

DISTRIBUTION

The black-backed jackal occurs in two discrete areas, separated by a distance of approximately 900 km. *Canis mesomelas schmidti* occurs in East Africa and *Canis mesomelas mesomelas* in southern Africa. The southern African subspecies is found in parts of South Africa, Botswana, Angola, Zimbabwe and Mozambique and throughout Namibia (Estes 1991, Hoffmann 2014c, Wilson & Reeder 1993). In Namibia, black-backed jackals occur both within and outside protected areas, and the species' overall current distribution is similar to that which occurred historically (Shortridge 1934). Hoffmann (2014c), in the most recent global assessment, regarded them as absent in the Zambezi Region, but occurrence has since been confirmed (L Hanssen pers. comm.).

POPULATION ESTIMATE AND TREND

Black-backed jackals are common in Namibia. Historically they were regarded as abundant except from Grootfontein to the northeast through Kavango and Zambezi Regions, where they were sympatric with side-striped jackal (Shortridge 1934). Prior to the 1970s, black-backed jackals were not considered an agricultural pest in Namibia, despite being widespread, because most small livestock were kraaled at night (Shortridge 1934). However, starting in the 1970s their numbers were severely decreased in southern sheep-farming districts due to (subsidised) jackal-proof fencing and hunting (Joubert & Mostert 1975). Numbers at that time were estimated at 51,325 black-backed jackals on Namibian freehold farmlands, mostly in the central to northern districts. Jackal numbers in the south seem to be recovering though, despite large numbers still being killed through organised hunting (C Luyt pers. obs.), poisoning and gin traps.

Black-backed jackal densities vary greatly and depend on prey diversity and abundance (Klare *et al.* 2010). In South Africa, for instance, densities of 34–40 individuals/100 km^2 have been recorded in the Drakensberg Mountains (Rowe-Rowe 1982), 33–43 individuals/100 km^2 on nature reserves in central South Africa (Klare *et al.* 2010), but

only 2 individuals/100 km² on small-livestock farms that actively managed black-backed jackals (Kamler *et al.* 2013). Along the Namib Desert coast, Nel *et al.* (2013) recorded jackal densities between 0.1 to 13.1 individuals per km of coastline, dependent on resource availability. Similarly, hourly counts carried out at a Cape fur seal colony, situated on a 1 km long beach in southern Namibia, revealed a maximum number of 33 and 76 jackals foraging at the same time during and after the seal pupping season respectively (I Wiesel pers. comm.). These extreme variations in abundance make it difficult to assess population densities for Namibia without further study. However, the population is regarded as stable.

ECOLOGY

Black-backed jackals occur in a wide range of habitats and occupy virtually all habitats within their distribution, including arid coastal desert, karoo, woodland, savanna and farmland (Ray *et al.* 2005b). They prefer open habitats and show a tendency to avoid denser vegetation (Loveridge & Nel 2009). Where they are sympatric with side-striped jackal, habitat is partitioned and black-backed jackals are found in more open areas, aggressively displacing side-striped jackals to woodland habitat (Loveridge & Macdonald 2002).

Black-backed jackals form monogamous territorial pairs, often with life-long pair bonds (Estes 1991). The pair forms the basis of the social structure that may also comprise their offspring and the previous year's offspring acting as helpers (Moehlman 1978, Loveridge & Macdonald 2001, Kamler *et al.* 2019). The breeding season is often synchronised with the main lambing season of their prey in spring (varying from August to December across southern Africa), enabling the jackals to provide high-quality food for the new pups (Estes 1991, Klare *et al.* 2010, Kamler *et al.* 2012a). An average of 4.6 pups (range 1–8) are born in dens after a gestation period of about 60 days. Food is regurgitated by the parents and alloparents, and also carried back to the den (Moehlman 1978, Estes 1991). Alloparents also guard the pups and their presence increases overall pup survival (Moehlman 1979). Pups are fully weaned by 8–9 weeks of age, when they start foraging together with their parents (Moehlman 1978, Ferguson *et al.* 1983). Subadults reach sexual maturity at 11 months, but typically start breeding at two years of age at the earliest (Ferguson *et al.* 1983). They usually disperse at one year of age when not staying as helpers (Moehlman 1987, Kamler *et al.* 2019) and dispersal distances of up to 135 km have been recorded (Ferguson *et al.* 1983). However, some dispersed offspring that have already set up a territory of their own, may occasionally return to their natal range to help their parents raise the next litter (Loveridge & Macdonald 2001). Black-backed jackals often go on extraterritorial forays, sometimes up to 8 km from their home-range boundaries, often to hunt or look for mating opportunities (Kamler *et al.* 2019).

The breeding pair is territorial and they aggressively defend their territory together with their helpers (Moehlman 1987). In South Africa they have been found to occupy territories of 1.3 to 27.7 km² (Ferguson *et al.* 1983), with home ranges being 14.7 km² per territorial pair in the Kalahari (Ferguson *et al.* 1983), 9.7 km² in Nama Karoo near Kimberley (Kamler *et al.* 2019), and up to 27.7 km² in Gauteng and Northwest Province (including farmland) (Ferguson *et al.* 1983). In south-eastern Botswana the average territory size was 15.9 km² (Kaunda 2001). In Namibia, territoriality has only been studied in coastal areas. For example, territory sizes

around Cape Cross, a mainland seal colony, vary from 0.2–11.1 km² during the breeding season and are positively correlated with the distance to the food source (Jenner *et al*. 2011). Along the coast away from mainland seal colonies, where food patches are mostly small and widely separated, jackal group sizes are small, and territories are narrow and extremely elongated. Where food patches are rich, fairly clumped and also heterogeneous, group sizes are large and territory sizes small (Nel *et al.* 2013). Larger group sizes can improve the black-backed jackals' efficiency as hunters (cf. Estes 1991, Jenner *et al*. 2011, Merrifield 2012, Murray *et al*. 2012) by allowing them to take larger prey such as adult springbok (Krofel 2007) or defensive prey such as seal pups (I Wiesel pers. obs.). Nevertheless, single black-backed jackals have been reported to kill impala and other medium sized ungulates (Kamler *et al*. 2010).

Black-backed jackals are predominately nocturnal, particularly on farmland where they are persecuted, but they may be active both during the day and night in undisturbed areas (Stuart 1981). At mainland seal colonies along the Namib Desert coast, activity is seen throughout the day, with weak individuals suffering from sarcoptic mange making use of the warmer daylight hours (I Wiesel pers. obs.).

Black-backed jackals are opportunistic and eat whatever is seasonally available from plants, invertebrates and reptiles to birds and mammals (Estes 1991, Stuart 1976, Stuart & Shaughnessy 1984, Kamler *et al.* 2012a). They readily scavenge, but when hunting they show a preference for "hider" ungulate species, rather than "followers" during ungulate birthing periods (Klare *et al.* 2010). Due to their opportunistic feeding behaviour, they may feed extensively on insects in years of good rainfall, which has for instance reduced predation on livestock in Namaqualand (C Luyt pers. obs., cf. Bothma 1966). When foraging, black-backed jackals respond to prey distress calls and are alert to large carnivore activities (Loveridge & Nel 2009). They will also often follow larger carnivores in order to scavenge (Bothma & Le Riche 1984, Estes 1991). They forage in pairs and family groups and can form large aggregations at large carcasses and at seal colonies (Kaunda 1998, Merrifield 2012, Murray *et al.* 2012). On small-livestock farms in South Africa, sheep were an important part of the black-backed jackal diet, although wild prey were preferred over sheep in most seasons (Kamler *et al*. 2012a).

While they do drink fresh water when available, and will even leave their territory in order to find water (Kaunda 2001), the widespread occurrence of black-backed jackals along the Namib Desert coast indicates that they can survive on the water they obtain from their food. The relatively high vegetation content in their diet (7.3–14.3% in the central Namib Desert) probably contributes a significant proportion of their water needs (Stuart 1976).

Black-backed jackals have been shown to have a negative impact on Cape foxes and bat-eared foxes, both by physically killing them and by restricting their available range and denning sites through aggressive behaviour and competition (Kamler *et al.* 2012b, Kamler *et al.* 2013). In turn, black-backed jackals are killed and preyed upon by larger carnivores, including African wild dogs, leopards, lions, cheetahs and brown hyaenas (Estes 1991, Stander 1992, Bothma & Le Riche 1994, Hayward *et al*. 2006b, Kamler *et al*. 2007, Stein *et al*. 2013). Consequently, the presence of large carnivores results in lower densities of black-backed

jackals (Yarnell *et al*. 2013), termed mesopredator release (Prugh *et al*. 2009). This would explain why jackals can attain relatively high densities in areas devoid of large carnivores. The relationship between black-backed jackals and caracals is more complex, because caracals may prey on black-backed jackals (Melville *et al.* 2004), yet jackals kill caracal kittens and therefore the removal of black-backed jackals may result in an increase of caracal numbers (Pringle & Pringle 1979).

There are aspects of the jackal's behaviour, particularly with respect to population control measures that are discussed under Threats below, that have unexpected consequences on their breeding and population. Firstly, a study has shown that anthropogenic mortality, that causes the breakdown of the jackal social structure, may be compensated for by breeding at an earlier age and increased litter size (Minnie *et al.* 2016b), resulting in the population control efforts being ineffective. Similarly, it has been shown that culling of carnivores can increase subsequent livestock losses (Conradie & Piesse 2013). This is best explained by a break-down in the territorial structure of black-backed jackals. Normally, mature breeding jackals allow some of their pups from previous years to stay on in their territory as helpers which help to raise the next generation of pups (Kamler *et al*. 2019). They will not allow any other jackals to breed in their territory, and youngsters need to have reached a certain level of maturity in order to set up a territory of their own. Minnie *et al.* (2016b) has shown that where jackals are persecuted on farms, the mature individuals are removed, allowing the younger individuals to pair and breed in their defunct territories. The net result can be a number of young breeding pairs in the same territory where there used to be only one mature breeding pair. Nevertheless, in some areas where predator-proof fences are used and maintained around small-livestock farms, and jackal hunting is intensive within the predator-proof fences, then jackal numbers can be suppressed and maintained at very low densities (Kamler *et al*. 2013).

Secondly, the use of gin traps and other nonselective traps may also affect the black-backed jackal's natural prey populations, (e.g. Namaqualand: Dreyer 2009) which may lead to increased conflict on farms. Eighty percent of the animals killed by trapping in the Namaqualand study were non-target species, including hares, bat-eared foxes, porcupines and mongooses. These can be a significant proportion of the black-backed jackal diet (Avenant & Du Plessis 2008), and removing these potential wild prey species might leave jackals with little choice but to kill more livestock to survive, leading to further conflict with livestock owners. The use of poisons has a similar effect, but can have the added disadvantage that vultures and scavenging birds of prey can also fall victim.

THREATS

Black-backed jackals are heavily persecuted in small-stock farming areas, with some farmers using jackal vocalisations and shooting at night (e.g. 30 jackals killed in two nights on one farm, C Luyt pers. obs.). Other indiscriminate predator control measures are also applied, such as the use of gin traps, and there is still widespread and possibly increasing use of poisons, despite the banning of the prescription and import of strychnine in 2003 (C Luyt pers. obs., Simmons *et al.* 2015, Santangeli *et al*. 2016).

Surprisingly, these activities do not currently seem to threaten the overall survival of black-backed jackals (Avenant & Du Plessis 2008). As explained above, jackal persecution measures may kill many jackals, but sometimes they are ineffective in controlling the local jackal population. Additionally, they can result in higher levels of carnivore-livestock conflict. This might be because unselective trapping and poisoning depletes the availability of jackal prey, so raising the likelihood that jackals will kill livestock. And due to the complex dynamics between jackals and caracals, where jackal numbers are reduced, the caracal population can grow, and these cats then inflict more damage on small-stock (Pringle & Pringle 1979). For instance, Conradie & Piesse (2013) showed that in the Ceres Karoo, those farms where most predators were killed in a certain year had the most livestock losses the following year, but they gave no explanation for this observation. The lack of knowledge about the black-backed jackal's ecology and the effect of extirpations needs to be addressed in order to maintain functioning ecosystems.

Jackals are susceptible to pathogens such as rabies, canine distemper and parvo virus (Loveridge & Macdonald 2001) and also act as vectors for these diseases (Bellan *et al.* 2012). Outbreaks of rabies and canine distemper can cause temporary local population crashes, and these often occur in areas where there are high numbers of dogs (Gowtage-Sequeira *et al.* 2009), or where population and territorial structure are disrupted by human persecution (Ray *et al.* 2005b). However, in Namibia, several outbreaks have been observed in protected areas along the coast, considerably reducing the black-backed jackal population (I Wiesel pers. obs.). Black-backed jackals are also persecuted for their role as vectors, as rabies poses a danger to humans and livestock.

There is very little trade with black-backed jackal skins and body parts (Minnie *et al.* 2016a).

CONSERVATION STATUS

The black-backed jackal is listed as a species of Least Concern on the IUCN Red List (Hoffmann 2014c) and has been so since its first assessment in 1996 (Lower Risk: Least Concern). It is not included in the CITES Appendices. Its conservation status in Namibia is Least Concern. Griffin (2003) listed the black-backed jackal as secure, and because of its wide habitat tolerance and stable population size, the current classification can be justified.

ACTIONS

Management

- Increasing the natural prey of jackals, as well as using livestock management techniques that reduce conflict with jackals, such as livestock guarding dogs, without the use of indiscriminate trapping and poisoning, are necessary for the long-term stability of the species (and a healthy ecosystem).
- Reintroduction of large predators such as leopards might even be important for stabilising jackal numbers. It is known that leopards kill and eat both jackals and caracals, so it is likely that their extirpation on farmlands has contributed to the reported increase in jackal and caracal numbers. Jackal territories in protected areas that they share with larger predators are also more stable than on adjoining farmlands (Minnie *et al*. 2016b). Thus areas where predators are persecuted act like a sink, with continuous immigration of young jackals moving in and never stabilising their territories.
- Adjust Event Book reporting and conservancy reports to distinguish between black-backed and side-striped jackal, to obtain sound distribution data.
- Develop standard methodologies for farmers to identify the correct problem animal species in predation events.

Awareness

- Farmers need to be made aware of the ecology of carnivore species and the undesirable results that improper carnivore management can have. Specifically, there should be greater effort to explain that the persecution and disruption of the social structure of black-backed jackals usually leads to more problems, as subadults come into the area. The ecological role that jackals play, and their benefits to land owners, needs to be explained and widely distributed.
- Make the public aware that black-backed jackals are no longer referred to as "problem species" in the draft Protected Area and Wildlife Management Bill. There are only problem individuals.
- Guard dogs can virtually eliminate small-stock losses to jackal, and local breeds (or cross-breeds) of dogs suited to rural village life can be trained and used. Similarly, just having livestock sleep in a predator-proof kraal can eliminate most livestock losses.
- Small-stock farmers should be encouraged to keep springbok on their land and to manage healthy ecosystems to reduce predation on small-stock. Farmers should focus on stock management and protection, not predator control.
- The public needs to be made aware that rabies in kudu is most probably not transmitted through black-backed jackals, but directly transmitted from kudu to kudu.
- Promote citizen science participation in online reporting platforms, especially amongst private camera trap owners and farmers (e.g. via NAU). Explain the importance of such data in the national and global context. It is important to record all type of data e.g. sightings, photos, human-carnivore conflict, mortalities, carnivore signs (dens, marking posts).

Research

- Standardise carnivore monitoring programmes so that information is captured from camera traps, questionnaires, citizen science projects and sign surveys.
- Research should be undertaken on black-backed jackals and their interactions with other carnivores and wild prey on farmlands, to better understand the dynamics of their populations.
- There is a need for applied research aimed to help farmers adopt the best strategy for reducing livestock predation impacts, while allowing coexistence with various other carnivores.

Assessors: Chavoux Luyt and Ingrid Wiesel
Reviewer: Jan Kamler

Suggested citation: Luyt C & Wiesel I 2022. A conservation assessment of Black-backed Jackal *Canis mesomelas*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 98-105. MEFT, LCMAN & NCE, Windhoek, Namibia

Side-striped Jackal *Canis adustus*

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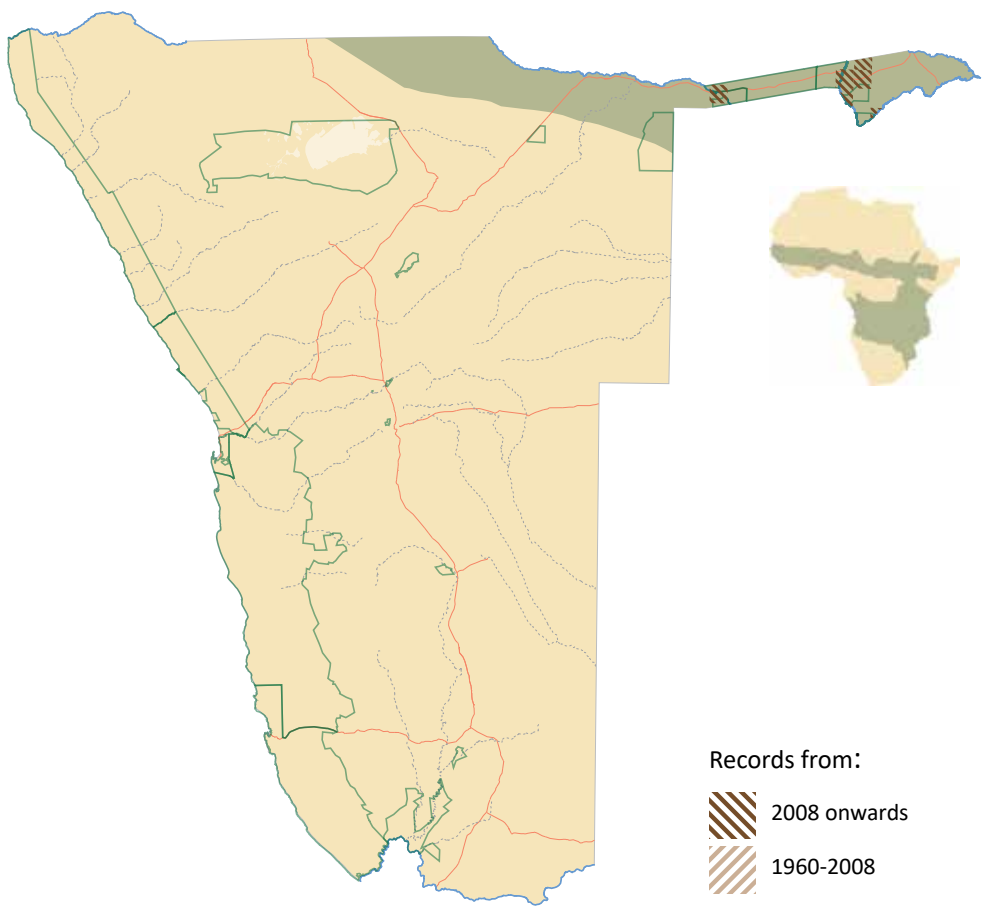
Namibian conservation status	Least Concern
Global IUCN status	Least Concern since 1996
Namibian range	56,000 km² in the north-eastern part of Namibia
Global range	~11,582,700 km² in sub-Saharan Africa
Population estimate	<4,500
Population trend	Stable
Habitat	Well-watered woodlands, relatively high rainfall areas. Absent from forests
Threats	▸ No major threats ▸ Minor threats are confusion with black-backed jackals and persecution as livestock predator, persecution for role in rabies transmission, disease outbreaks, snaring, road mortalities

IDENTIFYING FEATURES

Side-striped jackals are small- to medium-sized canids (6.5 to 14 kg), slightly larger on average than black-backed jackals, and overall grey or greyish-buff in colour with a light or off-white side stripe halfway up the flanks (Kingdon & Hoffmann 2013, Skinner & Chimimba 2005, Loveridge & Macdonald 2009). The tip of the tail is, with a few exceptions, white. Their ears are shorter and rounder than those of the black-backed jackal.

DISTRIBUTION

Side-striped jackals occur widely in sub-Saharan Africa but they are almost entirely replaced by the black-backed jackal in the south-west arid zone (Burnie & Wilson 2005, Skinner & Chimimba 2005, Loveridge & Macdonald 2009). They usually occur in better watered, higher rainfall areas; within the southern African sub-region they are found in northern Botswana, throughout Zimbabwe and Mozambique, except for drier regions, and marginally in the north eastern parts of South Africa and north-eastern Namibia. During the past two decades, the South African population has expanded westwards into areas where black-backed jackals have been suppressed (Camacho *et al*. 2016). In Namibia, the side-striped jackal as a species seems almost unknown to freehold commercial farmers (Joubert & Mostert 1975). They erroneously reported its occurrence throughout the country, despite the only evidence being from the Waterberg area, possibly confusing it with black-backed jackals. Shortridge (1934) reported the side-striped jackal from the northern Otjozondjupa Region from 19˚S latitude northwards, to the eastern Oshikoto and Ohangwena Regions and into the Zambezi Region. This distribution



Distribution records of side-striped jackal, and present estimated area of distribution in Namibia.

Inset: African distribution of side-striped jackal according to IUCN (Hoffmann 2014d).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.

was also suggested by Joubert & Mostert (1975). The current distribution seems to be similar and conforms with the latest IUCN distribution map, with side-striped jackal reported from Khaudum National Park (M Paxton pers. comm.), possibly at very low densities (L Hanssen pers. comm.), and confirmed by recent camera trap records from the Bwabwata National Park and the Zambezi Region. However, they seem to be absent from the State Forest in the northern part of the eastern Zambezi Region (L Hanssen pers. comm.). The Ministry of Environment, Forestry and Tourism also reports side-striped jackal occurrence for the Waterberg Plateau Park, but a camera trap study failed to confirm its occurrence (Stein *et al.* 2008).

POPULATION ESTIMATE AND TREND

The population size for side-striped jackal in Namibia is unknown. Historically they outnumbered black-backed jackal north-east of Grootfontein (Shortridge 1934). Two studies conducted in Zimbabwe show densities of 54–79 animals/100 km^2 and 20–30 animals/100 km^2 outside the breeding season, and almost double the number of animals during the breeding season (97–100 and 60–90 animals/100 km^2 respectively) (Rhodes *et al.* 1998, Loveridge & Macdonald 2009). Camacho *et al.* (2016) used a density estimate for South Africa of one breeding pair per 25 km^2 within the assessment area, as suggested by Friedmann & Daly (2004). Using the same density for the IUCN's extent of occurrence within Namibia (Hoffmann 2014d), population size would be below 4,500 animals.

ECOLOGY

The side-striped jackal occurs in open woodlands and scrub, and is predominately associated with well-watered habitat (Fuller *et al.* 1989, Loveridge & Macdonald 2002). It is absent from forests and avoids open dry savanna, a habitat favoured by black-backed jackals (Skinner & Chimimba 2005, Loveridge & Macdonald 2009). Habitat used depends greatly on the absence or presence of black-backed jackals. These aggressively displace side-striped jackals from grassland, and habitat is segregated wherever they are sympatric, with the side-striped jackal using denser vegetation and the black-backed jackal using open areas (Loveridge & Macdonald 2002).

Side-striped jackals form social groups consisting of a mated pair that is stable over several years, offspring that returns during the breeding season and sometimes immigrants (Loveridge & Macdonald 2001). A litter of 3–6 pups is born in a den after a gestation period of 57–70 days (Ginsberg & Macdonald 1990). Food is regurgitated by the male and after

weaning at 10 weeks also by the female (Skinner & Smithers 1990). Cubs reach maturity at 6–8 months of age and can breed in their first year (Ginsberg & Macdonald 1990, Bingham & Purchase 2003); however, subadult mortality is high (Rhodes *et al.* 1998). Age at dispersal varies from 11 months to 2 years. Average dispersal distances in Zimbabwe were 4.6 km, but distances of up to 20 km have been recorded (Loveridge & Macdonald 2001). Side-striped jackals either disperse into a vacant territory, join unrelated groups or remain in the vicinity of their parental home range, to which they return during the breeding season to help rear the cubs (Loveridge & Macdonald 2001).

Home range sizes vary and increase during the breeding season. Sizes from 0.2 km^2 (breeding season 1.2 km^2) in Zimbabwe to 4 km^2 on farmland, with a mosaic of suitable habitats, have been recorded (Rhodes *et al.* 1998, Loveridge & Macdonald 2001). Side-striped jackals are nocturnal and cover on average 10.3 km per night, walking at 1.4 km/h (Rhodes *et al.* 1998, Loveridge & Macdonald 2009).

They are omnivorous and their diet consists mainly of small mammals, reptiles, birds, insects, carrion and vegetable matter (Estes 1999) and they occasionally scavenge at kills. The side-striped jackal's diet shows strong seasonal and local variations, and in peri-urban and urban areas they are known to scavenge at rubbish dumps (Loveridge & Macdonald 2009).

THREATS

There are no major direct threats from humans in Namibia. However, side-striped jackals are sometimes confused with black-backed jackals and persecuted for killing livestock, despite little evidence for this (Shortridge 1934, Loveridge & Macdonald 2009). Snaring and road mortalities happen on occasion. Trade is only known from East Africa and does not seem to be a threat elsewhere (Loveridge & Macdonald 2009).

Side-striped jackals are heavily persecuted for their role in rabies transmission in some countries. Also, rabid dogs in Zimbabwe transmit rabies to side-striped jackals causing epidemics, which could become a concern with growing dog populations (Rhodes *et al.* 1998, Bingham *et al.* 1999). However, they show the potential for quick population recovery due to a high turnover rate (Bingham & Purchase 2003). Their unspecialised and opportunistic behaviour and their ability to occur in peri-urban and urban areas suggests that the side-striped jackal population is only vulnerable in cases of extreme habitat modification or intense disease outbreaks (Loveridge & Macdonald 2009). Side-striped jackals may also be susceptible to a variety of other pathogens, such as canine distemper virus, or diseases such as mange, making them a potential indicator species to monitor disease that can threaten other species' populations (Alexander *et al.* 1994).

CONSERVATION STATUS

The Namibian conservation status is Least Concern. The population seems stable and their range has most probably not decreased. Griffin (2003) also listed the side-striped jackal population as secure in Namibia without known local conservation problems. Internationally, it is listed as Least Concern on the IUCN Red List (Hoffmann 2014d) and has been so since its first assessment in 1996 (Lower Risk/ Least Concern). The species is not included in the CITES Appendices. However, it is the rarest of the three jackal species that occur in Africa (Ginsberg & Macdonald 1990).

ACTIONS

The side-striped jackal occurs only marginally in Namibia. Despite its different ecology and behaviour it may be mistaken for the black-backed jackal and therefore, some similar actions are recommended.

Management

- Adjust Event Book reporting and conservancy reports to distinguish between black-backed jackal and side-striped jackal.
- Develop standard methodologies for farmers to identify the correct problem animal species in predation events.

Awareness

- An educational campaign focused on predator identification, targeted at farmers in the north of the country, could help to reduce mistaken persecution of this species.
- Promote citizen science participation in online reporting platforms, especially private camera trap owners and farmers (e.g. via NAU) and explain the importance of such data in the national and global context. It is important to record all types of data, e.g. sightings, photos, human-carnivore conflict, mortalities, carnivore signs (dens, marking posts).
- The ecological differences between side-striped jackal and black-backed jackal, the role that they play, and their benefits to land owners need to be explained and widely distributed.
- Jackals are no longer referred to as “problem species” in the draft Protected Area and Wildlife Management Bill – there are only problem individuals. This information needs to be distributed once the Act is promulgated.

Research

- There should be standardised distribution monitoring through national multi-species carnivore monitoring programmes using camera traps, questionnaires, citizen science participation and sign surveys.
- Individuals and organisations likely to have data on side-striped jackals should be directly approached, for compilation of their data.
- Westwards range expansion has been noted for this species in South Africa, and there are possible records of side-striped jackals from central and western Namibia which might indicate a similar phenomenon. This aspect deserves attention.

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Contributors: Lise Hanssen, Mark Paxton, Piet Beytell and Rubén Portas
Reviewer: HO de Waal

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African Clawless Otter *Aonyx capensis*

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Namibian conservation status	Near-Threatened Nature Conservation Ordinance (1974) Schedule 4: Defined as "Protected Game" Listed on CITES Appendix II
Global IUCN status	Near-Threatened
Namibian range	Occurs in the perennial rivers in the north-east, and the Kunene and Orange Rivers, as well as in the ephemeral Fish River upstream from its confluence with the Orange, as far north as Neckartal Dam
Global range	Widespread in sub-Saharan Africa. Largely absent from Namibia, Botswana and the Karoo in South Africa, but found along some of the major ephemeral rivers
Population estimate	Insufficient data to make an estimate
Population trend	Thought to be decreasing
Habitat	Predominantly aquatic in fresh water systems, but also occurs in coastal habitats where there is access to fresh water
Threats	▸ Wetland degradation ▸ Suspected of being persecuted by fishermen who see it as a threat to fish resources ▸ Killed unintentionally and possibly intentionally in fish traps and nets ▸ Killed for bushmeat and possibly for other body parts ▸ Climate change, which will increase human pressure on wetlands, and might reduce continuity of surface pools in ephemeral rivers ▸ Lack of information on otters generally

DISTRIBUTION

Widely distributed in sub-Sahara where there is suitable aquatic habitat, in both coastal and fresh water settings, but largely absent from Namibia, Botswana and the Karoo in South Africa. In these drier parts, individuals are found along some ephemeral rivers where pools of fresh water persist (Nel & Somers 1998, van Niekerk *et al*. 1998).

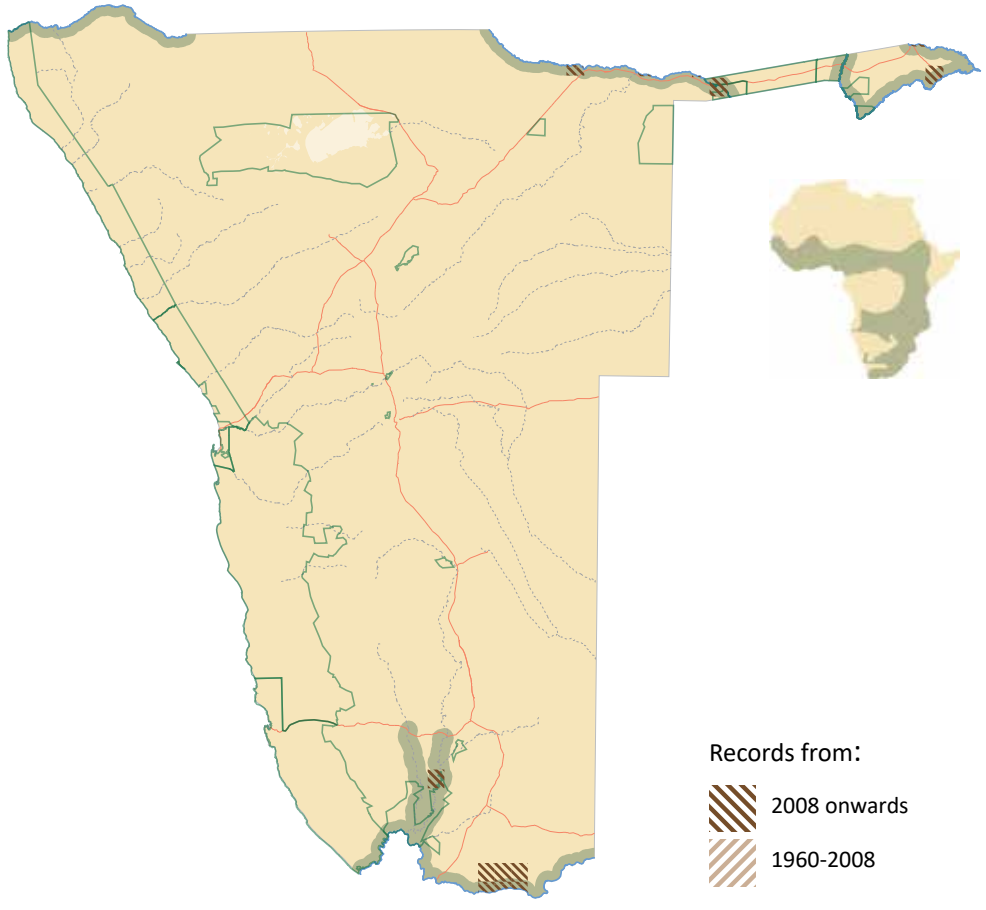
The African clawless otter is reported to have been quite common in the lagoons and swamps of what is now Zambezi Region, and in the Okavango, Kunene and Orange Rivers (Shortridge 1934, Smithers 1983). Shortridge (1934) recorded its occurrence in the ephemeral Fish River, the main tributary of the Orange in southern Namibia, extending almost up to Berseba.

The present distribution is still assumed to include all of Namibia's perennial rivers and wetlands, but there is very little data to confirm this. Its presence in the Fish River has

Distribution records of African clawless otter, and present estimated area of distribution in Namibia.

Inset: African distribution of African clawless otter according to IUCN (Jacques *et al.* 2015).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



been confirmed as far upstream as the site of Neckartal Dam (Palmer 2010), prior to the construction of the dam, as well as in the Löwen River (Nel & Somers 1998). Individuals can move long distances between pools in river beds.

POPULATION ESTIMATE AND TREND

There has been no attempt to estimate populations of either species of otters in Namibia. In keeping with the IUCN (Jacques *et al.* 2015), and South African assessments (Okes *et al.* 2016) of African clawless otter, we expect the population to be declining in Namibia due to increasing wetland degradation, and increased fishing activities by people which would cause increasing levels of disturbance.

ECOLOGY

This is the larger of the two otter species occurring in southern Africa, reaching up to 1,5 m long and up to 18 kg in weight (Smithers 1983). As its name implies, this species does not possess claws; the toes are finger-like, adapted for feeling and grasping their prey underwater (Smithers 1983).

The African clawless otter is predominantly aquatic, but also wanders widely in adjacent terrestrial habitat (Nel & Somers 1998). Preferred habitats in wetlands are areas of dense reed beds and rocky substrate, where their main food items are common. Unlike the spotted-necked otter, the African clawless can forage in both clear and turbid water (Somers & Nel 2007). Given suitable habitat, food availability is the single most important factor determining African clawless otter presence in any area (Nel & Somers 1998). In coastal habitats, they need access to fresh water for drinking and cleansing the fur.

The main prey is crabs and frogs (Smithers 1983, Rowe-Rowe 1992); other foods are fish, insects, and small mammals and birds (Stuart & Stuart 2015). There is some nocturnal as well as diurnal activity, but the African clawless otter is predominantly crepuscular, being most active for a few hours after sunrise and before sunset (Smithers 1983). This animal is generally solitary, but may be seen in pairs and small family parties up to five individuals.

Because otters feed on fish, they are often accused of competing with fishermen for fish. Studies in Zimbabwe (Butler 1994) and South Africa (Rowe-Rowe 1978) have shown this is not always true. African clawless otters in particular are unlikely culprits because fish are not their preferred prey (Carugati & Perrin 1998).

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THREATS

Degradation of river-bank vegetation due to clearing and burning of reed beds, and overgrazing and trampling of riverside vegetation by livestock, are common impacts of growing human pressure on Namibia's north-eastern wetlands. These are likely to reduce suitable habitat for otters. Agricultural intensification together with increased numbers of people, causing raised pollution levels, will also negatively impact otters (Kubheka *et al.* 2013).

Fishing may impact on African clawless otters because they are often perceived by fishermen as a threat to the resource, and persecuted as a result (Butler 1994, Rowe-Rowe 1978, Akpona *et al.* 2011). Fishing nets and traps have been recorded to cause otter mortalities in South Africa (Rowe-Rowe 1990); this situation probably also occurs widely elsewhere (Akpona *et al.* 2011).

In central Africa the Congo clawless otter, and the African clawless otter in other parts of Africa, is hunted for bushmeat, and otter body parts may also be used for traditional medicine (Cunningham & Zondi 1991, Nel & Somers 1998, Jacques *et al.* 2004, De Luca & Mpunga 2005b). We do not know whether these threats pertain in Namibia.

Climate change could negatively impact African clawless otters through its influence on river hydrology (van Niekerk *et al.* 1998). Reduced stream flow would have the effect of increasing human pressure on wetland resources, which would not suit otters. More frequent seasonal drying up of ephemeral pools could reduce their food sources, and reduce the continuity of pools enough to make the river beds unsuitable for these otters. This in turn would reduce the possibilities for dispersal and social interactions, thereby also limiting their populations. In the Fish River, this impact of reduced continuity between pools will be added to the reduction in downstream flows in the Fish River as a result of the Hardap and Neckartal Dams.

The lack of information on both otters in Namibia is, in itself, a threat as it renders them "invisible" to conservation authorities and interest groups. Without any people studying otters, they have lacked someone to speak out about their demise. Strategies to conserve these animals have been absent while they have probably experienced a steady decline.

CONSERVATION STATUS

The IUCN assessment of this species (Jacques *et al.* 2015) reports that otters in Africa are faced with habitat loss or degradation, polluted waters, and/or degraded aquatic ecosystems, as well as increasing human pressure on their prey base and reduction of resting and denning sites. These factors are expected to cause a 20% decline in the African clawless otter population over the next three generations (i.e. 13 years from 2015), which prompted the uplisting from Least Concern to Near-Threatened in 2015.

The decline in population of this species that is thought to be occurring throughout its range in Africa is based on the assessed threats and decreasing reports of signs and sightings (Nel & Somers 1998, Kubheka *et al.* 2013, Jacques *et al.* 2015, Reed-Smith *et al.* 2015a). Unfortunately there is very little solid information in Namibia to substantiate this, but there is no reason to expect the situation here to be any different.

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The continuing decline in habitat quality, the growing pressure on inland fisheries and harvesting of wetland resources, plus unintentional and possibly intended killing of otters from fishing activities, warrant concern for otter populations. These factors justify the status of Near-Threatened.

ACTIONS

Projects to monitor the presence and population density of both species of otters in Namibia's perennial rivers would help to estimate the African clawless otter population, giving confidence to the conservation status and possibly yielding new and valuable information. Camera trap monitoring, backed up with field observations and surveys, could be usefully applied here (Nel & Somers 1998, Stevens *et al.* 2004, Hönigsfeld Adamič 2011). An important aspect is correctly separating the two species and especially recognising their different tracks, so that the species are correctly identified (Rowe-Rowe 1992). (Tips for separating spoor and signs of African clawless otter, spotted-necked otter and water mongoose are given in the description of water mongoose).

Studies on the dietary preferences and impact of the African clawless otter on fisheries in north-eastern Namibia need to be undertaken, to inform the discussion around whether otters compete with local fishermen for fish. Conservation actions such as raising awareness, setting the record straight, should be implemented using this information.

Greater awareness of the presence of otters and their conservation status could help to stimulate interest and greater conservation efforts, using them as "flagship species" (but see Stevens *et al.* 2011). This should be done in collaboration with tourist and fishing lodges on Namibia's perennial rivers and wetlands. Otter-spotting and other tourist activities focussed on otters could possibly be an initiative for community-based tourism enterprises in the north-eastern wetlands. A survey of tourists on the Wild Coast in South Africa showed that most tourists were prepared to pay more for otter-centred activities (Dumalisile *et al.*2005).

Greater attention to wetland conservation and restoration is needed in developmental work, which can be achieved through rigorous environmental impact assessments, bringing attention to the importance of ecosystem services, and thorough implementation of the Ramsar Convention on Wetlands of International Importance (Foster-Turley 1990).

Assessors: John Pallett and Gail Thomson
Reviewer: Michael Somers

Suggested citation: Pallett J & Thomson G 2022. A conservation assessment of African Clawless Otter *Aonyx capensis*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 110-113. MEFT, LCMAN & NCE, Windhoek, Namibia

Spotted-necked Otter *Hydrictis maculicollis*

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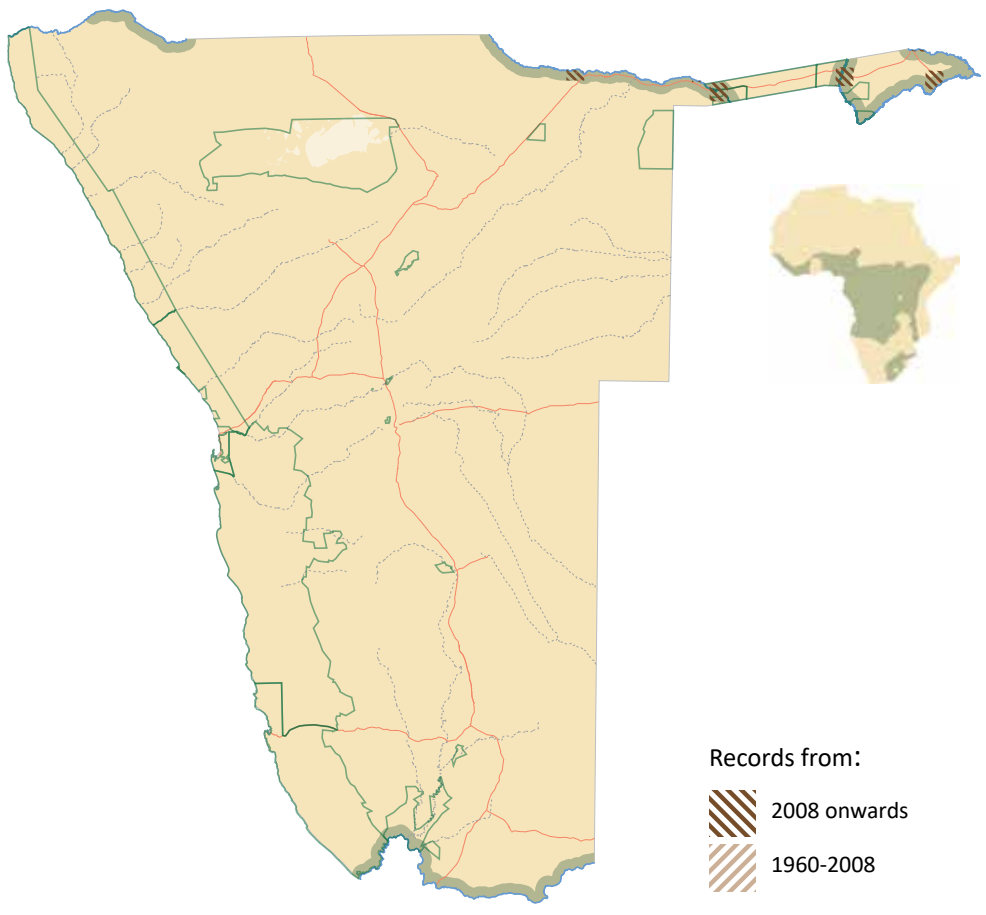
Namibian conservation status	Near-Threatened Nature Conservation Ordinance (1974) Schedule 4: Defined as "Protected Game"
Global IUCN status	Near Threatened Listed on CITES Appendix II
Namibian range	Confined to the perennial rivers in the north and north-east
Global range	Widespread in sub-Saharan Africa, but less so than the African clawless otter
Population estimate	Insufficient data to make an estimate
Population trend	Thought to be decreasing
Habitat	Perennial rivers and associated riverine vegetation
Threats	▸ Wetland degradation, including clearing and alteration of riparian vegetation ▸ Possibly persecuted by fishermen who see it as a threat to fish resources ▸ Killed unintentionally and possibly intentionally in fish traps and nets ▸ Killed for bushmeat and possibly for other body parts ▸ Climate change, which will increase human pressure on wetlands ▸ Lack of information on otters generally

DISTRIBUTION

The spotted-necked otter is less widely distributed in sub-Saharan Africa than the African clawless otter *Aonyx capensis*. While the overall distribution range is large, it only occupies larger rivers and lakes within this range (Reed-Smith *et al.* 2015b). It occurs only in fresh-water ecosystems and is more aquatic than the African clawless otter, which prevents it from moving over land to use ephemeral ponds or river systems (Nel & Somers 1998, Skinner & Chimimba 2005). It is absent from the eastern half of Tanzania, most of Zimbabwe, all but the northern portions of Botswana and Namibia, and the western half of South Africa (Rowe-Rowe 1990).



Distribution records of spotted-necked otter, and present estimated area of distribution in Namibia.

Inset: African distribution of spotted-necked otter according to IUCN (Reed-Smith *et al.* 2015b).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.

The confirmed range for this species in Namibia is limited to the northern perennial rivers and wetlands, where it is known mainly from rivers in the Zambezi Region and along the Kunene River (d'Inzillo Carranza & Rowe-Rowe 2013). There is one published sighting of an individual on the Orange River in the |Ai-|Ais–Richtersveld Trans-Frontier Conservation Area in August 2008, about 1,200 km west of its known range in South Africa (Power & Slater-Jones 2010).

POPULATION ESTIMATE AND TREND

Spotted-necked otters were recorded as rare in Namibia (Nel & Somers 1998), although this assessment is now 20 years old and no current or accurate population estimates are available. According to the global IUCN assessment (Reed-Smith *et al.* 2015b), this species is declining.

ECOLOGY

As the smaller of the two otter species, the spotted-necked otter weighs 3.8–6.6 kg, with males slightly bigger than females (Skinner & Chimimba 2005). Besides size, the white spotted or mottled upper chest distinguishes this species from the African clawless otter; the rest of the coat is chocolate to reddish-brown. The feet are webbed and have sharp claws, which helps differentiate their tracks from the other otter species (Skinner & Chimimba 2005).

These otters usually forage in pairs or groups of three (usually mother and pups), although groups of up to 12 individuals have been recorded in Tanzania (Reed-Smith *et al.* 2014). Home ranges within and between sexes overlap; male home ranges are about four times larger than female ranges, according to a radio telemetry study in the Drakensberg in South Africa (Perrin *et al.* 2000). They are largely diurnal, with activity peaks in the morning and afternoon, but do also forage at night (Perrin & D'Inzillo Carranza 2000, Jordaan 2017).

Spotted-necked otters are considered to be more piscivorous than African clawless otters, according to studies in South Africa where these species are sympatric (Somers & Purves 1996, Perrin & Carugati 2000, Jordaan *et al.* 2019). Their diet in the Drakensberg (Perrin & Carugati 2000) and the Eastern Cape (Somers & Purves 1996) includes fish, crabs and frogs, in that order of prevalence. The fish taken are usually small (≤20 cm, Rowe-Rowe 1977), although they can take larger individuals of introduced fish species in Tanzania (Kruuk & Goudswaard 1990).

The spotted-necked otter prefers riverbanks and oxbow lakes with sufficient cover near the water, in the form of dense

vegetation or boulders, particularly for holt sites (Rowe-Rowe 1992, Perrin & Carugati 2000). In Tanzania, signs of the species were found in undisturbed and disturbed (due to human or livestock activity) habitat close to the water edge, but not in cultivated fields adjacent to water (De Luca *et al*. 2018). This species also requires high prey visibility and thus clear, relatively unpolluted water in which to hunt (Larivière 2000).

THREATS

The key threats to spotted-necked otters throughout their range are habitat loss or degradation, depletion of freshwater fish stocks, human-otter conflict and water pollution (Reed-Smith *et al*. 2014). They may also be killed intentionally for food or traditional medicine (known from East Africa only) or unintentionally when entangled in fishing nets (Reed-Smith *et al*. 2010).

It is likely that clearing riparian vegetation for agriculture, burning reed beds, and overgrazing riparian vegetation threaten this species in north-eastern Namibia. Increased agricultural activities will likely lead to water pollution that will also negatively affect both otter species (Kubheka *et al.* 2013).

Fish stock depletion and conflict with fishermen are likely to threaten this species more than the African clawless otter, due to its greater dependence on fish. Whether or not fishermen kill otters due to this conflict is not yet known for Namibia, although fishing communities elsewhere kill otters due to damage to fishing equipment or direct competition for fish (Rowe-Rowe 1990, Reed-Smith *et al*. 2010, Akpona *et al.* 2011, De Vos 2018). The combination of increasing human populations and climate change are likely to exacerbate any existing human-otter conflict, with the twin impact of reduced river flows and declining fish stocks upon which both otters and local communities depend (Reed-Smith *et al*. 2015b).

Despite the potential threats to otters and suspected decline in this species, no conservation or research is being done on spotted-necked otters in Namibia. There is a general lack of awareness about otter conservation in the country, which may lead to otter declines going unnoticed and unmitigated.

CONSERVATION STATUS

As for the African clawless otter, the IUCN assessment of this species (Reed-Smith *et al*. 2015b) reports that otters in Africa are faced with habitat loss or degradation, polluted waters, and/or degraded aquatic ecosystems, as well as increasing human pressure on their prey base and reduction of resting and denning sites. These factors are expected to cause a 20% decline in the spotted-necked otter population over the next three generations (i.e. 23 years from 2015), which prompted the uplisting from Least Concern to Near Threatened in 2015.

Although the threats to spotted-necked otters have not been quantified in Namibia, it is likely that habitat degradation and human-otter conflict occur along the more densely populated areas in the Zambezi Region where people rely on subsistence agriculture and/or fishing. We therefore apply the Near Threatened global status to the Namibian spotted-necked otter population.

ACTIONS

More information is required on both otter species to inform conservation actions. In particular, otter populations must be monitored to detect trends over time and flag areas that currently host otters. See the African clawless otter assessment for suitable monitoring methods.

Protecting fish stocks is critical for spotted-necked otter conservation. The Ministry of Fisheries and Marine Resources published three Government Notices on the 15 December 2016: they prohibit the use of monofilament fishing nets (No. 296); establish a closed fishing season on the Chobe and Zambezi Rivers from December to February each year (No. 297); and declare a community-based Fisheries Reserve in Impalila Conservancy in the Zambezi Region (No. 298). Fisheries Reserves are no-fishing zones established by local communal conservancies to improve the health of their fish stocks. Ideally, these Fisheries Reserves would include suitable otter habitat and will support known otter populations. Further research is thus urgently needed to inform these plans.

Other key actions include regulating agricultural practices near rivers to limit otter habitat destruction and water pollution, and engaging with fishing communities to assess their attitudes towards and impacts on otter populations. Depending on these findings, it may be necessary to run awareness campaigns about the importance of otters to healthy freshwater ecosystems and/or create incentives for people to tolerate otter presence. Incentives could include developing and promoting otter-centred tourism activities that benefit local communities.

Assessors: John Pallett and Gail Thomson
Reviewer: Damian Ponsonby and Trevor McIntyre

Suggested citation: Pallett J & Thomson G 2022. A conservation assessment of Spotted-necked Otter *Hydrictis maculicollis*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 114-116. MEFT, LCMAN & NCE, Windhoek, Namibia

African Striped Weasel *Poecilogale albinucha*

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Namibian conservation status	Near Threatened
Global IUCN status	Least Concern
Namibian range	Marginal. Historic records show a small area of occurrence in south-eastern Namibia. Also recorded in Zambezi Region
Global range	Sub-Saharan Africa, excluding forests of the Congo basin and the southern coast of West Africa
Population estimate	Unknown
Population trend	Unknown
Habitat	Mainly savanna, but has been recorded in a wide range of other habitats from rainforest to semi-desert grasslands elsewhere in Africa
Threats	None

IDENTIFYING FEATURES

The African striped weasel is a very small carnivore with an elongated body, short legs and relatively bushy tail. The body is black with a white cap and tail, and four off-white or yellowish stripes run from the nape of the neck to the base of the tail. It is similar to the striped polecat, but this species is smaller and more slender with shorter fur.

DISTRIBUTION

African striped weasels are known to occur in a wide variety of habitats in central and southern Africa, but little is known of their distribution in Namibia. The latest IUCN assessment for the species shows a range extending only into a small area of south-eastern Namibia up to Leonardville in the Omaheke Region (Smithers 1983, Stuart *et al*. 2015b). Shortridge (1934) notes a specimen from the confluence of the Nossob and Molopo Rivers on the Botswana side of the border. These records explain the small area of expected range in south-eastern Namibia along the ephemeral Nossob and Olifants Rivers. Earlier range maps include the Zambezi Region (Larivière 2001). On the Atlasing in Namibia database (Environmental Information Service 2021), there are very few records.

POPULATION ESTIMATE AND TREND

Observation records are so few that a population estimate in Namibia is impossible (Do Linh San *et al*. 2013).

ECOLOGY

Little is known about African striped weasels in the wild, as they are not easily observed (Skinner & Chimimba 2005). Some observational studies of captive individuals revealed that they are proficient diggers but poor climbers, and they specialise on small mammal prey, particularly rodents (Rowe-Rowe 1972, Smithers 1983). Captive weasels usually became active at sundown and were chiefly nocturnal, but Smithers (1983) also recorded extensive diurnal activity in cool weather.

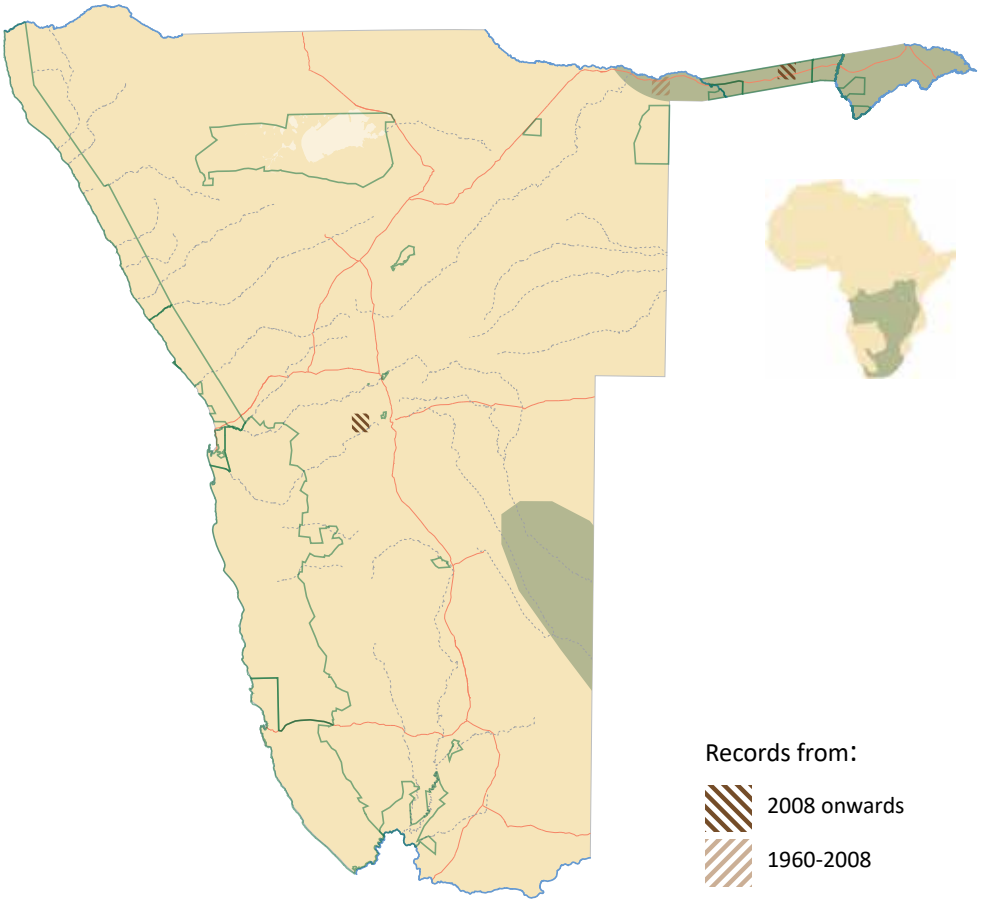
African striped weasels appear to be solitary, with females and males only coming together to mate during spring and summer (Skinner & Chimimba 2005). Females usually give birth to a litter of 1–3 naked young per season, which are fully grown at 20 weeks; a second litter may be produced if the first fails (Skinner & Chimimba 2005).

Although our knowledge of the striped weasel's ecological

Distribution records of African striped weasel, and present estimated area of distribution in Namibia.

Inset: African distribution of African striped weasel according to IUCN (Stuart *et al*. 2015b).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



role is scant, it is likely that they provide ecosystem services through burrowing (Rodgers *et al*. 2017) and preying on rodents. There is some evidence from South Africa that black-backed jackals prey on this species when other food sources are scarce (Do Linh San *et al*. 2009), and this may be true for other medium-sized carnivores.

THREATS

There are no known threats to this species in Namibia. Nonetheless, studies from South Africa indicate that this species is hunted for use in Zulu and Xhosa traditional medicine (Cunningham & Zondi 1991, Simelane & Kerley 1998). Whether or not striped weasels are used for traditional medicine in Namibia or other neighbouring countries is unknown.

CONSERVATION STATUS

Least Concern. The African striped weasel was listed as Least Concern in the IUCN international Red List in 2015 (Stuart *et al*. 2015b), which is the same listing as in previous assessments in 1996 and 2008 (Stuart *et al*. 2008b). It is considered Near Threatened in South Africa, Swaziland and Lesotho (Child *et al.* 2016), and Least Concern in Angola (Huntley *et al*. 2019).

ACTIONS

Our knowledge of this species is very limited in Namibia. In particular, whilst it is thought to prefer moist savanna and grasslands with >600 mm of rainfall per year in other countries (Skinner & Chimimba 2005), there are two records in Namibia from areas with <400 mm of rainfall per year. Research is therefore required to establish the distribution and habitat requirements for this species in Namibia.

Assessor: Gail Thomson
Reviewer: Emmanuel Do Linh San

Suggested citation: Thomson G 2022. A conservation assessment of African Striped Weasel *Poecilogale albinucha*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 117-118. MEFT, LCMAN & NCE, Windhoek, Namibia

Honey Badger *Mellivora capensis*

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Namibian conservation status	Least Concern
Global IUCN status	Least Concern
Namibian range	~789,700 km^2
Global range	Throughout Africa, the Middle East and south-west Asia, excluding hyper-arid dune deserts
Population estimate	15,900–31,800
Population trend	Stable. Uncommon but widespread
Habitat	As adaptable and versatile generalists, honey badgers occupy most habitats in Namibia except for the dunes of the Namib Sand Sea
Threats	Largely indiscriminate persecution by small-stock and poultry farmers

IDENTIFYING FEATURES

Honey badgers are low-slung, stocky carnivores which are jet-black below with a broad white-grey saddle running from above the eyes to the base of the tail. Although they are mostly unmistakable, the black-and-white markings may sometimes lead to confusion with striped polecats or striped weasels. Both of the latter are much smaller and have long tails.

DISTRIBUTION

Honey badgers are generalists and opportunists, occupying almost every habitat type in Namibia except for the Namib Sand Sea. Although previously thought to not occur along the Atlantic coast, there have been a number of recent sightings from the Skeleton Coast and coastal areas of Tsau ǁKhaeb National Park.

POPULATION ESTIMATE AND TREND

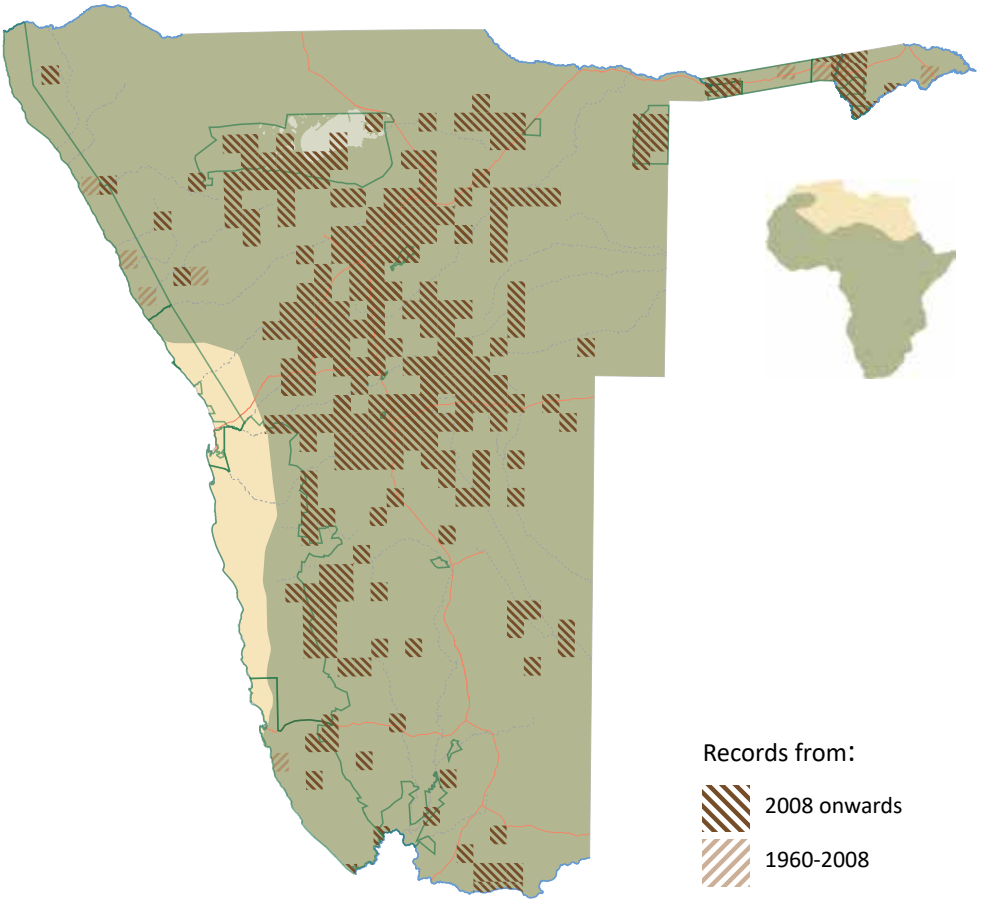
Density estimates for the species are limited to the Serengeti National Park (10 individuals/100 km^2) and the Kalahari Transfrontier Park (3 individuals/100 km^2) (Begg 2001a). Their home ranges are up to five times larger than any other carnivore of comparable body size (Begg *et al.* 2005a). In the only study on their movement ecology, in the Kalahari, males regularly occupied overlapping home ranges of up to 500 km^2, which would contain the home ranges of up to four females (Begg *et al.* 2005a).

Using information from the southern Kalahari study site of Begg (2001b), and assuming average ecosystem productivity in Namibia is comparable, we roughly estimate that the density of honey badgers in Namibia at 2–4 individuals/100 km^2. On this basis, the population estimate for the country would be 15,900 to 31,800 honey badgers.

Distribution records of honey badger, and present estimated area of distribution in Namibia.

Inset: African distribution of honey badger according to IUCN (Do Linh San *et al.* 2016).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



There are insufficient data to assess a population trend, but ongoing and low-frequency records from camera traps and occasional sightings suggest that the population is stable. The species is not considered by communal or freehold farmers as a major economic threat.

ECOLOGY

Honey badgers are cryptic carnivores with largely nocturnal activity patterns (Begg *et al.* 2016a). They are however not uncommonly observed during daytime, especially in the wet season when cover of grass and shrub foliage is sufficient (Allen *et al.* 2018), or where human activity is minimal (Begg *et al.* 2016a).

Honey badgers are the largest terrestrial African species of the family Mustelidae (Skinner & Chimimba 2005). This family also includes otters and weasels. They are solitary and do not move in pairs as was historically believed (Shortridge 1934). Females give birth to a single cub which remains with its mother for between 12 and 22 months (Begg *et al.* 2005b, Skinner & Chimimba 2005), a factor which probably led to the myth of them occurring in pairs.

They have only been studied intensively in the Kalahari biome (Begg 2001a, Begg *et al.* 2003a, 2003b, Begg *et al.* 2016b) and more recently in the mesic savannas of South Africa (Ramesh *et al.* 2017a, Kheswa *et al.* 2018). Honey badgers have always occupied a wide variety of habitats within all of Namibia's biomes (Shortridge 1934, Skinner & Chimimba 2005). The recorded sightings of the species in the Atlasing in Namibia Carnivore Records database (Environmental Information Service Namibia 2021) are distributed equally among privately owned farmland, communal rangeland and protected areas within all habitat types. They have been encountered in the peri-urban surroundings of Windhoek as well as the townlands of Oranjemund. This explains their highly variable diet which ranges from invertebrates to any bird, reptile or mammal smaller in size than themselves (Skinner & Chimimba 2005). In the Kalahari Transfrontier Park (Botswana and South Africa) reptiles and small mammals were found to dominate the diet, which was variable between sexes and seasons (Begg *et al.* 2003a). As their name suggests they actively seek out above- and below-ground beehives, consuming bee larvae and honey.

Honey badgers are prolific burrowers, digging for food, shelter and to escape climatic extremes. They will readily use the burrows of other animals such as aardvark, porcupine and springhare (Skinner & Chimimba 2005). Bioturbating mammals such as honey badgers are thought

to provide important ecosystem services for the productivity of rangelands in Namibia. Their burrowing activity aerates the soil and results in increased moisture infiltration and retention. Burrows are also found to trap seeds and detritus, resulting in better grass seed germination and growth (Rodgers *et al.* 2017).

THREATS

There are currently no serious threats to the species in Namibia. Conflict with apiculture is a common problem with honey badgers (Begg 2001b, Carter *et al.* 2017) but with low numbers of beekeepers in Namibia, this threat is minimal. Targeted and indiscriminate killings by poultry and small-stock owners with poisons and gin traps present a minor threat.

Honey badger paws, organs and skin are used in traditional medicine in neighbouring Zambia to harness the tenacious character of the animal (Do Linh San *et al.* 2016). An overall increase in illegal trade of wildlife products globally (Cooney *et al.* 2017) requires careful monitoring for increased demand in honey badger parts.

Rabies is regularly reported in honey badgers (Hassel 1982, Thomson & Meredith 1993) but the low population density of individuals probably keeps rabies incidents localised and number of incidents low.

CONSERVATION STATUS

Least Concern. Honey badgers were listed in the 2016 international IUCN Red List as Least Concern (Do Linh San *et al.* 2016), which is unchanged from the 2008 and 1996 assessments (IUCN 1998, Begg *et al.* 2008). They were also listed as Least Concern in South Africa, Lesotho and Swaziland (Begg *et al.* 2016c).

ACTIONS

There have been no studies on the ecology of the species in Namibia. Research should be encouraged to provide a more comprehensive account of the role honey badgers play in Namibian ecosystems. Honey badgers were listed as vermin in Namibia (Gordon *et al.* 2018) until an amendment to the Nature Conservation Ordinance (4 of 1975) in 2017 prohibited their persecution. This amendment is however not widely known, proving that awareness on this aspect and the need for their protection is required.

Assessor: Morgan Hauptfleisch
Contributor: Nicky Knox
Reviewer: Emmanuel Do Linh San

Suggested citation: Hauptfleisch M 2022. A conservation assessment of Honey Badger *Mellivora capensis*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 119-121. MEFT, LCMAN & NCE, Windhoek, Namibia

Striped Polecat or Zorilla *Ictonyx striatus*

© T Smith

Namibian conservation status	Least Concern
Global IUCN status	Least Concern
Namibian range	~750,000 km^2
Global range	Sub-Saharan Africa, excluding forests of the Congo basin and West Africa
Population estimate	~75,000
Population trend	Unknown
Habitat	Widespread throughout Namibia, from moist woodlands in the north-east to the Namib Desert in the west. Probably absent from dunes
Threats	No major threats, but road kills of this species are common

IDENTIFYING FEATURES

The striped polecat is a small carnivore with a black body and four white stripes extending from the head to the base of the tail. The head has three prominent white patches – one on the forehead and one at the base of each ear. The tail is bushy and mostly black but with varying amounts of white hair. This species can be distinguished from the African striped weasel by its larger, stockier body, longer fur and white facial markings that are absent in the weasel. The tail is often held upwards and fanned out, in an alarm gesture that gives a warning of its intention to spray a foul liquid over its opponents.

DISTRIBUTION

This species is widely distributed in Namibia, with past and recent records confirming a wide range of habitats from moist woodlands in the north-east through to the semi-arid and arid areas in the south and west (Coetzee 1969, Environmental Information Service 2021). In arid areas, it seems that they prefer drainage lines and areas with some scrub as cover (Smithers 1983). Absence of records from the Namib Sand Sea suggest that they do not occur in barren dune fields, probably due to lack of adequate vegetation cover. There are over 250 records of striped polecats in Namibia in the Atlasing in Namibia database (Environmental Information Service 2021), with verified records from all regions except Oshikoto, Oshana and Ohangwena. The lack of data in these areas is likely due to lack of recording effort, rather than absence of the species.

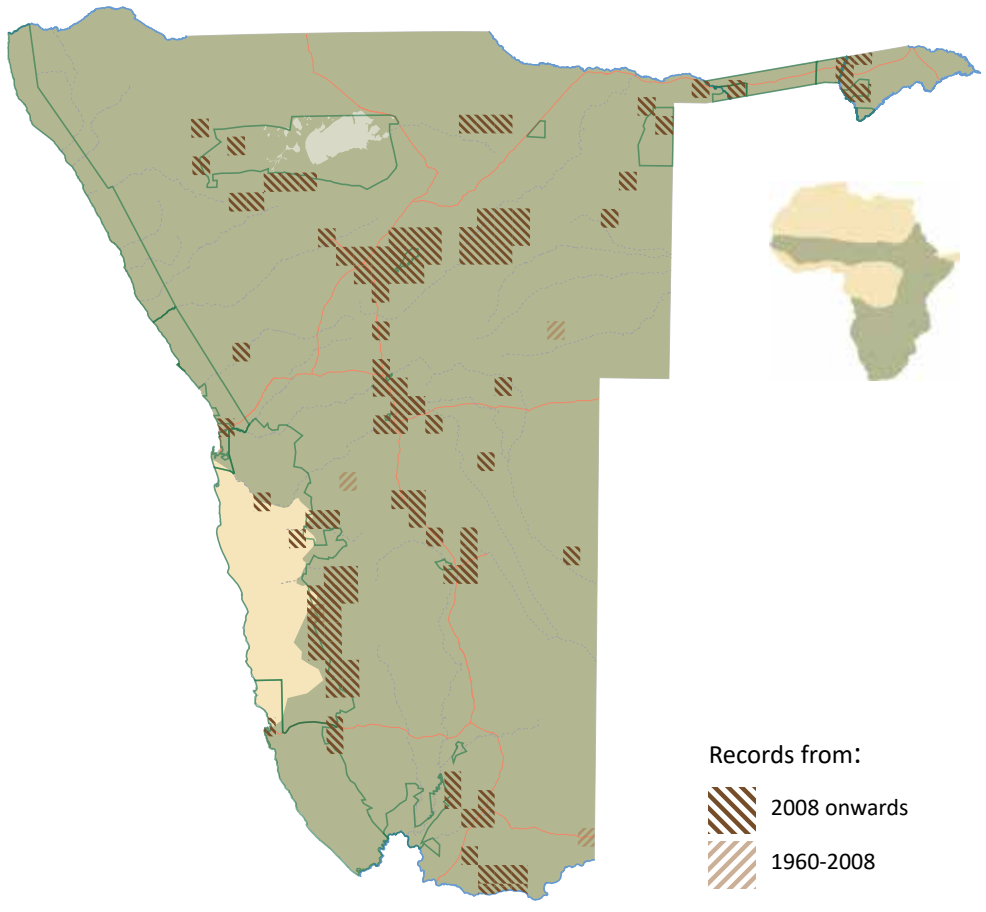
POPULATION ESTIMATE AND TREND

There are no population density estimates for striped polecats in Namibia. A study from East Africa estimated a density of 1–5 individuals per 10 km^2 (Hendrichs 1972 cited in Stuart *et al.* 2015a). If we assume that this species occurs throughout most of Namibia except the Namib Sand Sea (total area ca. 750,000 km^2) and use a conservative density estimate of 0.1 individuals per km^2, the national population of striped polecats is ~75,000 individuals. The population trend for this species is unknown, but is assumed to be stable due to lack of severe threats.

Distribution records of striped polecat, and present estimated area of distribution in Namibia.

Inset: African distribution of striped polecat according to IUCN (Stuart *et al*. 2015a).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



ECOLOGY

Striped polecats are strictly nocturnal and prefer to move on the ground rather than in trees, but they will climb trees when stressed. Although they can dig their own burrows, they often use burrows made by other species or natural crevices for shelter (Larivière 2002, Skinner & Chimimba 2005). They are generalist feeders. While small mammals and invertebrates feature predominantly in their diets, they are also known to prey on reptiles, amphibians, arachnids, birds and their eggs, and occasionally carrion (Larivière 2002, Skinner & Chimimba 2005). Reptiles, scorpions, and solifuges comprise an important part of the polecats' diet in drier regions like the Kalahari in Botswana (Smithers 1983), which may be indicative of their diet in much of Namibia. Due to their generalist diet, striped polecats are highly adaptable, and seem to thrive in agricultural croplands and pastures in South Africa, in addition to an array of natural habitats (Rowe-Rowe *et al*. 2016). It is therefore likely that they are widely distributed in Namibia, on farmlands and within protected areas.

They are solitary, with males and females only coming together to mate, and the altricial young will accompany females until they reach maturity. Females produce 1–3 young per litter, and will only produce a second litter in the season if the first fails (Skinner & Chimimba 2005). Little is known about the striped polecats' ecosystem services, although it is likely they reduce local rodent and insect populations (Rowe-Rowe *et al*. 2016). Although black-backed jackals occasionally prey on them (Do Linh San *et al*. 2009), polecats defend themselves by ejecting a pungent, unpleasant fluid from their anal glands, thus making them undesirable for potential predators (Skinner & Chimimba 2005).

THREATS

There are no major threats to this species in Namibia. However, there are 12 records of polecats that were killed on roads. Polecat road kills are a fairly common sight and it is likely that many suffer this fate, but the threat to the national population is probably insignificant. In South Africa, free-ranging domestic dogs kill polecats around urban areas (Rowe-Rowe *et al*. 2016), but this threat is likely to be lower in Namibia due to the low human population. Finally, there is some evidence that the species is used in South African traditional medicine on a small scale (Simelane & Kerley 1998, Rowe-Rowe *et al*. 2016), but nothing is written about this aspect in Namibia.

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CONSERVATION STATUS

Least Concern. This species is listed as Least Concern internationally (Stuart *et al*. 2015a) and in South Africa (Rowe-Rowe *et al*. 2016) and Angola (Huntley *et al*. 2019). Previous international assessments in 1996 and 2008 gave the same listing (Stuart *et al*. 2008a).

ACTIONS

No studies have been undertaken on this species in Namibia, which limits our understanding of their ecological role, distribution, habitats, and threats. The Atlasing in Namibia system has contributed greatly to revealing their distribution, but it could also help to understand the extent of road kill incidents for this species. Raising public awareness about reporting road kills using the Atlasing in Namibia application would expand our understanding of the impacts of road kills on this and other species.

Assessor: Gail Thomson
Reviewer: Emmanuel Do Linh San

Suggested citation: Thomson G 2022. A conservation assessment of Striped Polecat or Zorilla *Ictonyx striatus*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 122-124. MEFT, LCMAN & NCE, Windhoek, Namibia

Banded Mongoose *Mungos mungo*

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Namibian conservation status	Least Concern
Global IUCN status	Least Concern
Namibian range	North-eastern half of Namibia
Global range	Widespread in sub-Saharan Africa, excluding tropical forests and deserts
Population estimate	Unknown
Population trend	Common within its range, trend probably stable
Habitat	Wooded and bushy savanna
Threats	No major threats

IDENTIFYING FEATURES

The banded mongoose is distinguished, as its name suggests, by a series of transverse, distinct black bands running across the back from the shoulders to the base of the tail. It is medium-sized, a grizzled grey colour and has a bushy tail with a slightly darker tip (Gilchrist *et al.* 2009). Populations in drier savanna regions tend to be lighter in colour than those from more vegetated habitats.

DISTRIBUTION

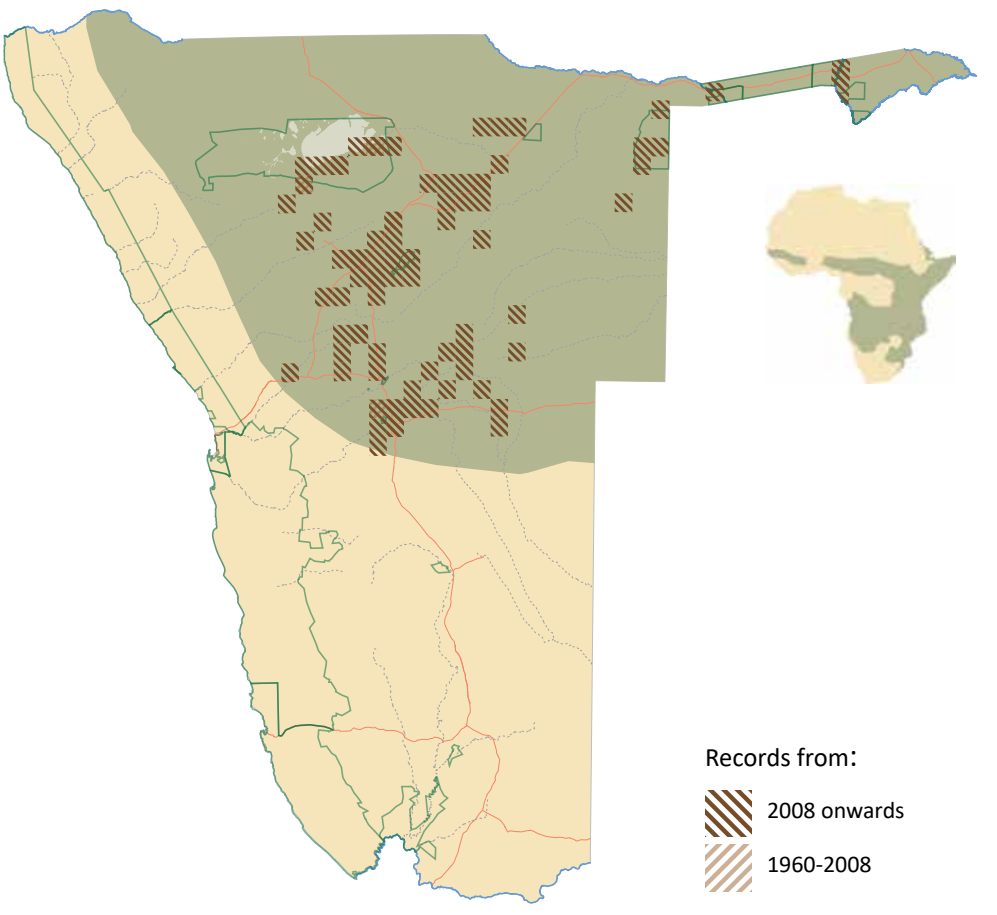
Banded mongooses are widespread in sub-Saharan Africa, but are absent from tropical forests, deserts and montane regions. In southern Africa the species is restricted to the eastern and northern parts, largely avoiding the dry southern and western parts of Namibia, the central Kalahari in Botswana, and most of South Africa and Zimbabwe (Gilchrist & Do Linh San 2016). Vegetation type (woodland or savanna preferred) and presence of termitaria, rather than water availability, appear to be the key habitat criteria for this species (Skinner & Chimimba 2005).

The recorded distribution in Namibia extends across the north-eastern half of the country, with the limit defined roughly by a line from just west of Ruacana in the north-west, to Karibib and Rehoboth in the central parts, and eastwards to Leonardville (Shortridge 1934). This is roughly the area of tree savanna and woodland in northern Namibia, and thorn and shrub savanna in the central parts of the country. This species prefers wooded habitat with adequate ground cover (Skinner & Chimimba 2005), and has possibly extended its range westwards into areas where trees and bushy growth have come to predominate from bush encroachment. The absence of Environmental Information Service (2021) records from northern Namibia (but excluding north-eastern Namibia) may be real or simply an absence of data, but possibly indicates that the species has disappeared

Distribution records of banded mongoose, and present estimated area of distribution in Namibia.

Inset: African distribution of banded mongoose according to IUCN (Gilchrist & Do Linh San 2016).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



from this area due to the density of human settlement and livestock, with associated deforestation (Mendelsohn *et al.* 2002).

POPULATION ESTIMATE AND TREND

Fairly dense records in central Namibia north of Windhoek suggest that this species is relatively common within its range, and there is nothing to suggest that this is changing. No population estimate has been attempted for this species. The global population is considered stable (Gilchrist & Do Linh San 2016).

ECOLOGY

This gregarious, diurnal mongoose lives in social groups from 4 to 49 (average ~15) individuals, comprising roughly equal numbers of males and females (Rood 1975, Cant 2000, Skinner & Chimimba 2005, Gilchrist *et al.* 2009). Termite mounds are commonly used for burrows; they may also use erosion gullies, aardvark holes and even man-made structures (Rood 1975, Hiscocks & Perrin 1991). Groups maintain a territory in which they forage and move about together, individuals foraging for themselves, not cooperatively, covering a daily foraging distance from 2 to 10 km (Rood 1975, Skinner & Chimimba 2005). They maintain contact with soft twittering calls. In relatively drier regions (South Africa), they occupy home ranges of >2 km^2 (Hiscocks & Perrin 1991), at a density of about 2.4 individuals/km^2 (Cant & Gilchrist 2013).

Banded mongooses breed cooperatively, with a number of females (up to 10) in the group giving birth at the same time (Gilchrist 2006). In the seasonal climate of Namibia, they are likely constrained in breeding season and number of births per year to the wet season, and likely 1–2 litters per year (as for Serengeti, Waser *et al.* 1995). Females suckle pups non-selectively, regardless of which ones are theirs. Adults in the group then help to feed and protect the offspring until independence at about 3 months (Hodge 2005, Nichols *et al.* 2012).

They feed primarily on invertebrates, particularly millipedes and beetles, while small vertebrates such as reptiles, amphibians, birds and their eggs, and small rodents are also eaten (Skinner & Chimimba 2005). They are known to feed from rubbish dumps (Gilchrist & Otali 2002, Otali & Gilchrist 2004), and have been seen picking dead insects off the grills of parked vehicles in Namutoni (G Thomson pers. obs. 2019).

Adult mongooses are preyed upon by raptors, large snakes

and large mammalian carnivores. Pups are taken by a wider diversity of predators, including monitor lizards, and marabou storks and warthogs at human waste dumps. They are recorded allogrooming and removing ectoparasites from warthogs. Banded mongooses do not pose any direct threat to humans, although they will steal food if accessible, and they can carry rabies. They can also carry human tuberculosis through a *Mycobacterium tuberculosis* complex pathogen, *M. mungi* sp. nov. (Alexander *et al.* 2002).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THREATS

There are no major threats from humans. They may be affected by fires via the burns themselves as well as habitat change. Tuberculosis infection rates in banded mongooses are likely increased by garbage feeding as shown by research in neighbouring Botswana (Fairbanks-Flint *et al.* 2016). Consumption of banded mongoose meat has been recorded in Botswana (Jobbins *et al.* 2013) and Mozambique (Fusari & Carpaneto 2006), but is not known within the assessment region.

CONSERVATION STATUS

Banded mongoose is listed as Least Concern internationally (Gilchrist & Do Linh San 2016), and it carries the same status in Namibia. There are no major threats to the species, it has a wide distribution, and adapts well to human habitation. The species is not included in CITES Appendices.

ACTIONS

Information on the ecosystem services provided by mongooses would help to raise awareness of their ecological role. This includes control of insects and other invertebrates, and the fact that they are harmless.

The capturing and keeping of baby mongooses as pets should be discouraged.

Assessors: John Pallett and Gail Thomson
Reviewer: Jason Gilchrist

Suggested citation: Pallett J & Thomson G 2022. A conservation assessment of Banded Mongoose *Mungos mungo*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 125-127. MEFT, LCMAN & NCE, Windhoek, Namibia

Black Mongoose *Galerella nigrata*

Namibian conservation status	Least Concern
Global IUCN status	Least Concern (since 1996)
Namibian range	North-western and north-central Namibia in appropriate habitat
Global range	Namibia and southern Angola
Population estimate	Unknown
Population trend	Unknown
Habitat	Restricted to habitats dominated by large granite boulders and the drainages and woodlands connecting them
Threats	▸ No major threats ▸ Hunting where perceived as a predator ▸ Hybridisation with the slender mongoose in farming community areas where these species encounter one another regularly as they are attracted to scavenging and easy (chicken) hunting opportunities

IDENTIFYING FEATURES

The black mongoose, also known as the Kaokoland slender mongoose, is similar in size and shape to the slender mongoose. Found in north-western and north-central Namibia, these mongooses have a very dark, nearly black pelage (hence *"nigrata"*)- yet with a distinctive rufous tinge in sunlight (Crawford-Cabral 1996, Tromp 2011, Taylor 2013a). A mongoose, *Herpestes flavescens*, with a tan or yellowish pelage (hence "flavescens") is confined to similar habitats in south-western Angola. It is currently unknown whether this mongoose is of the same species

The only other mongoose in Namibia that is as dark coloured is the dwarf mongoose. That is a much smaller animal (adults about half the total length of a black mongoose) and it has a less slender appearance and a less hairy tail. Dwarf mongooses are usually seen in social groups, whereas the black mongoose is mainly solitary.

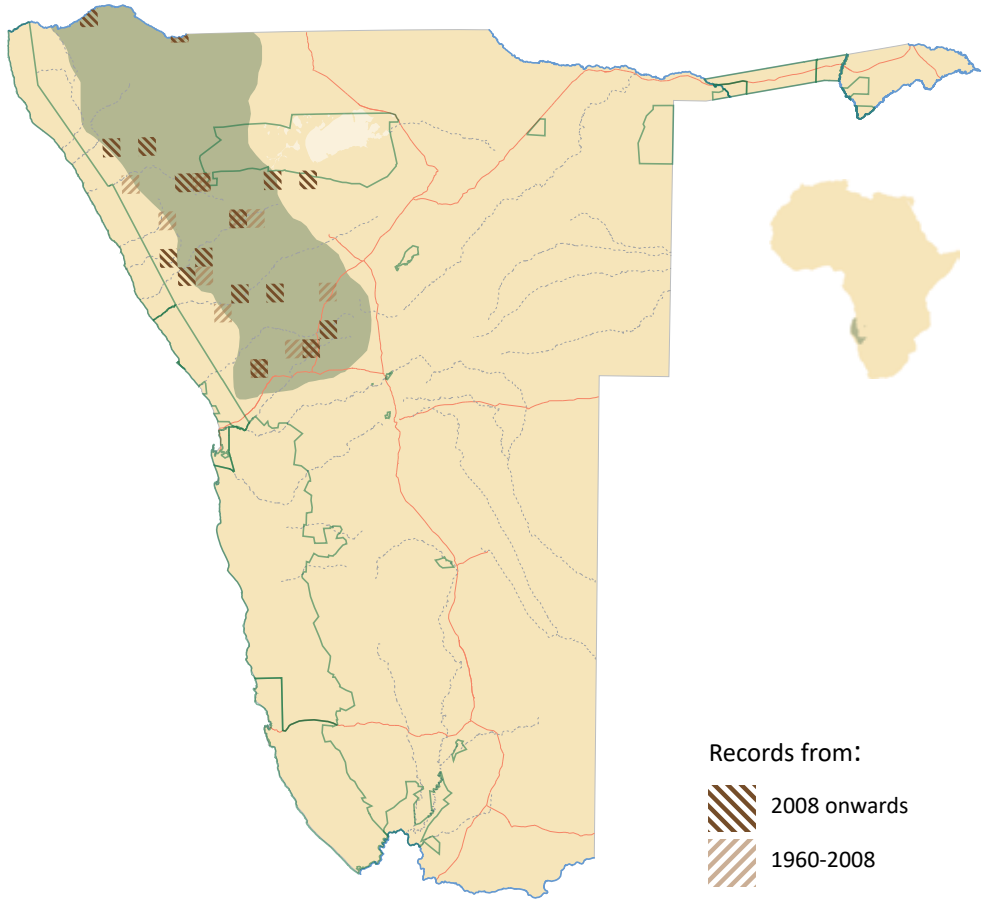
DISTRIBUTION

In north-western Namibia, this species is restricted to habitats dominated by large granitic boulders, and the drainages and woodlands connecting them. This results in a fragmented distribution (Shortridge 1934, Rathbun & Cowley 2008, Rapson *et al.* 2013). It is likely that Angolan populations have similar habitat preferences to their Namibian counterparts. In Namibia, genetic data suggest that populations of this mongoose are linked, despite the isolation of their preferred rocky habitats (Rapson *et al.* 2013).

Distribution records of black mongoose, and present estimated area of distribution in Namibia.

Inset: African distribution of black mongoose according to IUCN (Rapson & Rathbun 2015).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



POPULATION ESTIMATE AND TREND

Black mongooses are common within protected areas and appear to adapt well to low-intensity tourism activities, remaining elusive but relatively common. The encroachment of local communities with dogs and livestock has, however, led to the disappearance of this species from several areas in northern Namibia, such as the granite inselbergs adjacent to Twyfelfontein. Surveys conducted within these communities suggest that this could be a result of dog predation and trapping of mongooses by local communities in order to reduce chicken losses (Tromp 2011).

Densities appear to be highly variable depending on the terrain and land use in the area. Due to their elusive nature it is difficult to get robust density estimates and further research is needed before we can comment on population trends.

ECOLOGY

Studies of *G. nigrata* in Namibia have revealed that it is predominantly solitary. Home ranges are generally 0.12–1.5 km^2 (although they may be up to 4 km^2), often overlap to a large extent, and include multiple den sites (Rathbun & Cowley 2008, Tromp 2011). There is evidence to suggest that females occasionally forage in pairs for two to three consecutive days before resuming their solitary lifestyle (S Rapson unpublished data).

Primarily diurnal, the foraging behaviour of these mongooses in Namibia indicates that they are highly opportunistic (Rathbun *et al.* 2005). Prey items include insects, scorpions and solifuges, small mammals, birds, lizards and snakes (Rathbun & Cowley 2008, Nakwaya 2009, Warren *et al*. 2009), suggesting a very catholic diet.

THREATS

There are no known major threats.

High levels of hybridisation can occur with its sister species (slender mongoose, *H. sanguineus*) as documented at Spitzkoppe and Ruacana (Rapson *et al*. 2012). Unusually large populations of slender mongoose may be found in these areas due to local communities unintentionally providing food scraps and chickens. Thus, there is an increased probability of close contact between the two species of mongoose (Rapson *et al*. 2012).

In addition, dog predation and the trapping of mongooses by local communities who consider them a pest have

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the potential to pose a significant threat to this species. Indeed, the encroachment of local communities with dogs and livestock has led to the disappearance of the black mongoose from several areas in northern Namibia (Tromp 2011).

CONSERVATION STATUS

The black mongoose is listed as Least Concern on the IUCN Red List (Rapson & Rathbun 2015) and has been so since its first assessment in 1996. The species is not included in the CITES Appendices.

ACTIONS

An educational programme targeting communities in the north of the country could help to reduce the persecution of this species as well as that of other mongooses. Education of farmers and communities in the uniqueness of this species – as Namibia's largest endemic carnivore – and assistance with the adoption of effective waste disposal methods and secure confinement of chickens could potentially reduce both the mortality rate of black mongooses (due to the trapping of those considered pests) and the potential for hybridisation with the slender mongoose.

There is a need to address speculation about the genetic similarity of the Namibian *G. nigrata* and the Angolan *H. flavescens* populations. This speculation arises from both populations having similar habitat preferences and behaviours despite the differences in pelage colouration on either side of the Kunene River, which could indeed be a significant geographical barrier to dispersal. Acquisition of sufficient genetic data from the Angolan *H. flavescens* population would allow us to address any uncertainty as to its taxonomic classification in relation to what is recognised as *Galerella nigrata* in Namibia.

Assessor: Sara Rapson
Reviewer: Galen Rathbun

Suggested citation: Rapson S 2022. A conservation assessment of Black Mongoose *Galerella nigrata*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 128-130. MEFT, LCMAN & NCE, Windhoek, Namibia

Dwarf Mongoose *Helogale parvula*

© G Thomson

Namibian conservation status	Least Concern
Global IUCN status	Least Concern First assessed 1996: Least Concern, unchanged since then
Namibian range	Northern half of Namibia, from Okangwati through Etosha through to eastern tip of the Zambezi Region, with records from as far south as Okahandja
Global range	Continuous range from the horn of Africa to northern South Africa on the east, and from northern Angola to northern Namibia on the west. Centre of the range includes all of Zambia, most of Zimbabwe, and northern and western Botswana
Population estimate	Unknown
Population trend	Unknown, but probably stable
Habitat	In Namibia found in areas of savanna with termite mounds. Excluded from arid areas
Threats	No major threats

DISTINGUISHING FEATURES

This is the smallest mongoose in southern Africa. Dwarf mongooses are dark brown all over the body, although they can appear black; actually they are grizzled at close distance (Apps 2000). They are notably smaller than all other mongooses, with a stocky, muscular appearance, and are usually seen with other group members, which give high-pitched peeping contact calls.

DISTRIBUTION AND HABITAT

This is a savanna species associated with dry woodland and grassland. It prefers hard or stony ground where there is vegetation cover and termite mounds which are used as refuge holes (Apps 2000).

The dwarf mongoose occurs in the northern part of Namibia, with the southern limit approximately at the latitude of Okahandja, and extending westwards to the Opuwo area and probably to the escarpment, wherever there is adequate vegetation and rocky cover. Records are absent from far north-central Namibia, but it is known from Zambezi and the Kavango Regions.

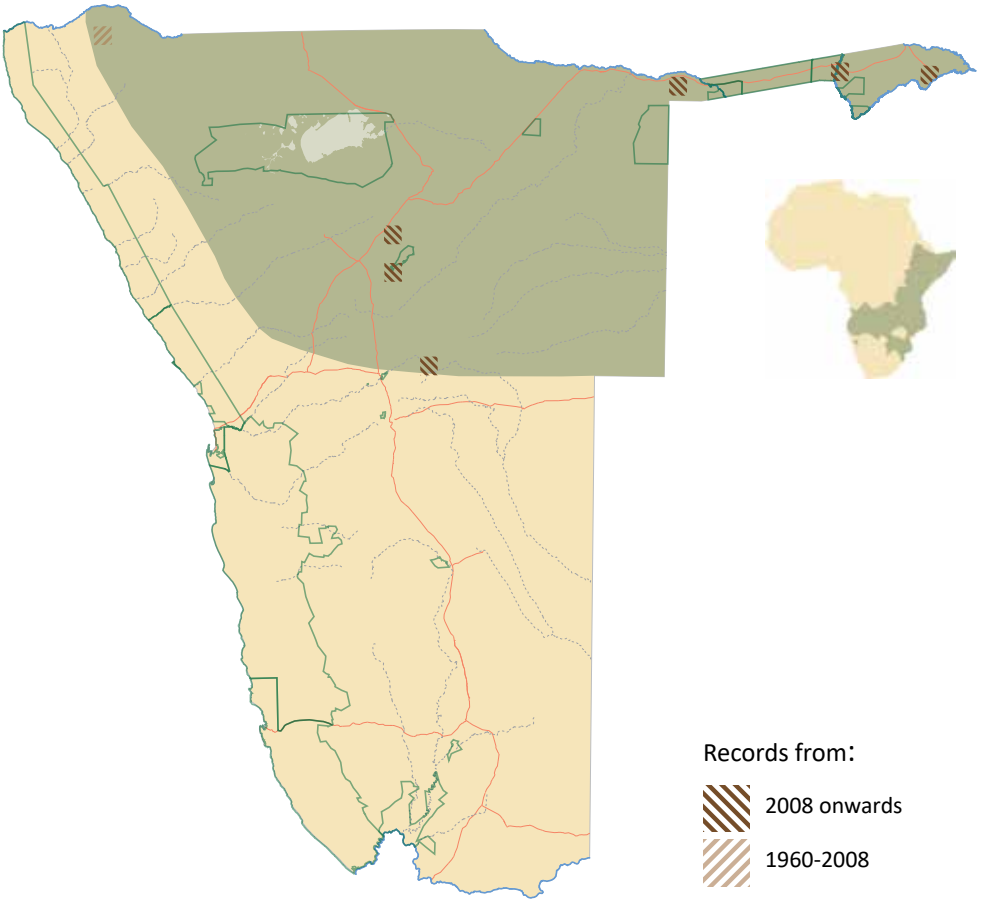
POPULATION ESTIMATE AND TREND

Population densities can be up to 31–42 individuals/km^2 in ideal habitats in Tanzania and South Africa (Rood 1983, Hoffmann *et al.* 2014), but 5/km^2 is more typical (Waser *et al.* 1995) and likely for Namibia where there are fewer den sites and less insect prey than wetter habitats. No estimate of the population in Namibia has been attempted.

Distribution records of dwarf mongoose, and present estimated area of distribution in Namibia.

Inset: African distribution of dwarf mongoose according to IUCN (Sharpe *et al.* 2015).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



ECOLOGY

This small diurnal mongoose lives in territorial groups of up to 30 individuals (average 12) (Apps 2000). Typically, only the dominant pair breeds, while subordinates help with raising young and acting as sentinels (Creel & Waser 1994). One or two sentries keep a lookout while the rest of the group forages; group members are always within earshot of each other and maintain constant contact with short soft calls (Kern & Radford 2013). They produce 11 different alarm calls which indicate the type of predator and degree of risk (Collier *et al*. 2017), and flee for cover in hollow logs, termitaria and shallow burrows when an alarm is raised. At night they withdraw to their main refuges, within the ventilation shafts of disused termite mounds (Hiscocks & Perrin 1991). Groups have up to 30 of these overnight refuges within their territories, staying in a different refuge every day or two (Sharpe *et al*. 2012). Although they forage as a group, each individual finds its own prey (Apps 2000). They spend considerable time in the morning sun-bathing, grooming, playing and scent-marking (using an unusual hand-stand posture) around the current residence, then move off as a group to forage (Sharpe *et al*. 2012). They defaecate in middens which are visible around the dens, and the droppings are predominantly made up of fine insect fragments (Apps 2000).

Dwarf mongooses are largely insectivorous, but will also take spiders, scorpions and centipedes, small vertebrates and the eggs of ground birds (Apps 2000). This species is preyed on by larger mongooses and other small carnivores, raptors such as snake eagles and pale chanting goshawks, snakes and monitor lizards (Kern & Radford 2014). To evade predators, groups prefer to forage in the company of birds, particularly mixed species flocks, so they can utilise the birds' warning calls. Some populations have developed mutualistic relationships with fork-tailed drongos or yellow-billed hornbills: the mongooses rely on the birds' predator warnings while the birds obtain additional prey flushed by the mongooses (Rasa 1983, Sharpe *et al.* 2010). Due to their small size, dwarf mongooses are very vulnerable to predation (especially the young) which appears to be the main driver for their cooperative behaviour and group living (Rasa 1987).

THREATS

No major threats are identified (Sharpe *et al.* 2015).

CONSERVATION STATUS

Least Concern in Namibia. The species is widely distributed elsewhere in Africa, and can reach high densities within the range, so its status appears secure (Sharpe *et al.* 2015).

ACTIONS

No specific actions are needed for the conservation of this species.

Assessors: John Pallett and Gail Thomson
Reviewer: Lynda Sharpe

Suggested citation: Pallett J & Thomson G 2022. A conservation assessment of Dwarf Mongoose *Helogale parvula*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 131-133. MEFT, LCMAN & NCE, Windhoek, Namibia

Large Grey Mongoose *Herpestes ichneumon*

By גיונגון - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=38012875

Namibian conservation status	Least Concern
Global IUCN status	Least Concern First assessed 1996: Least Concern, unchanged since then
Namibian range	Marginal in Namibia, only occurring in the mesic north-eastern areas
Global range	Occurs along the Mediterranean coast in North Africa and is widespread through the rest of sub-Saharan Africa, but absent from rainforest in Central Africa and semi-arid to arid parts of Botswana, Namibia and Zimbabwe Outside Africa, known from the Iberian and Arabian Peninsulas
Population estimate	Unknown
Population trend	Unknown, but thought to be stable
Habitat	In Namibia, prefers wetland vegetation and dense undergrowth on the fringes of rivers and swamps. Extralimitally also found in grassland and cultivated land
Threats	No major threats

IDENTIFYING FEATURES

The name accurately describes this species. It can be mistaken for the slender mongoose but is much larger and heavier in build, has short black legs, and a more pronounced black tassel at the end of the tail. The hair on the body is longer than on a slender mongoose, and on its hindquarters and flanks it forms a “skirt” partly hiding the hind legs.

DISTRIBUTION

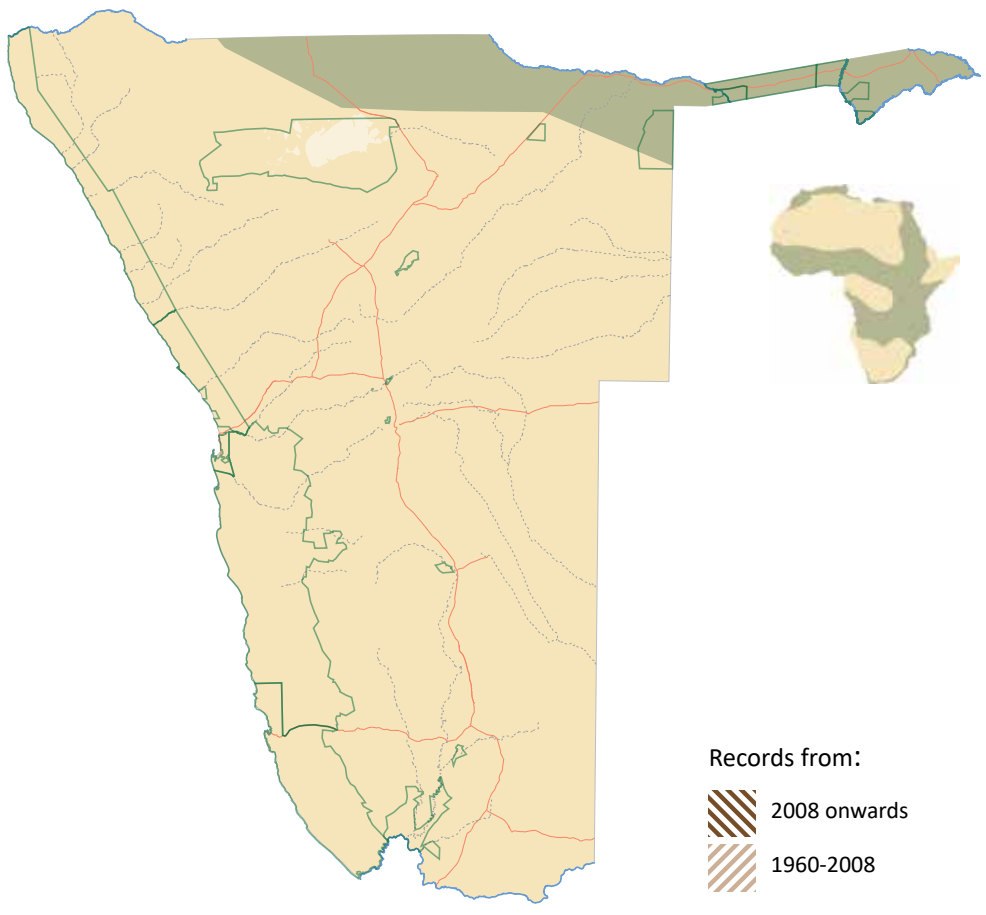
Large grey mongooses (also known as Egyptian mongoose) are closely associated with rivers and wetlands, but may also wander and forage in adjacent dry terrain where they have been recorded in grassland and cultivated land. They are widespread in Africa, frequenting moist habitats with understory cover in eastern South Africa and extending northwards over most of the continent except the central tropical areas and North African deserts. Their distribution extends into countries around the Mediterranean Sea including the Iberian Peninsula.

The species normally frequents reed beds and the fringes of rivers and swamps. This habitat preference confines them to the north-eastern parts of Namibia, where they are associated with the wetlands of the Okavango and the Kwando-Linyanti-Zambezi River systems.

Distribution records of large grey mongoose, and present estimated area of distribution in Namibia.

Inset: African distribution of large grey mongoose according to IUCN (Do Linh San *et al*. 2016).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



POPULATION ESTIMATE AND TREND

This species is marginal in Namibia and no population estimate has been attempted. The global population trend is stable (Do Linh San *et al*. 2016).

ECOLOGY

Large grey mongooses are mostly diurnal and are commonly seen singly or in pairs, occasionally in family groups (Skinner & Chimimba 2005). They forage in wet areas, hunting in dense undergrowth on the ground and sometimes venturing into shallow water. They take a variety of small vertebrates, especially rodents, birds and eggs, frogs and reptiles (including snakes such as puff adders), as well as crabs and insects (Stuart 1983, Skinner & Chimimba 2005).

THREATS

No major threats are identified (Do Linh San *et al*. 2016).

CONSERVATION STATUS

Least Concern as the species is widespread, occurring widely beyond Namibia's borders. It is common in parts of its range, and not threatened in any significant way (Do Linh San *et al*. 2016).

ACTIONS

No specific actions are needed for the conservation of this species although Do Linh San *et al*. (2016) suggested monitoring areas where water supply and or quality may be negatively affected.

Assessors: John Pallett and Gail Thomson
Reviewer: Anthony Maddock

Suggested citation: Pallett J & Thomson G 2022. A conservation assessment of Large Grey Mongoose *Herpestes ichneumon*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 134-135. MEFT, LCMAN & NCE, Windhoek, Namibia

Selous' Mongoose *Paracynictis selousi*

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Namibian conservation status	Least Concern
Global IUCN status	Least Concern First assessed 1996, unchanged since then
Namibian range	Restricted to northern and north-eastern Namibia
Global range	Occurs only in southern Africa, extending from Angola in the west through to Zambia and Malawi in the east, including most of Zimbabwe and the northern parts of Namibia, Botswana and South Africa
Population estimate	Unknown
Population trend	Unknown, but assumed to be stable
Habitat	Open scrub and woodlands on sandy soils
Threats	No major threats

DISTINGUISHING FEATURES

A medium-sized mongoose (weight 1–2 kg), identified by its greyish appearance with black legs and a fairly bushy tail with white at the tip (Apps 2000).

DISTRIBUTION AND HABITAT

The range of this species is restricted to woodland and savanna habitats in a band across southern Africa extending from Angola to Malawi through north-eastern Namibia, Zambia, northern Botswana and Zimbabwe; north-eastern South Africa is the southern-most part of its range (Stuart & Stuart 2013a). It is considered rare across its range, although the species is not well studied in any of these range states.

In Namibia, the known range for Selous' mongoose is restricted to the north-east. Their fairly common presence there has been confirmed by camera trap photos. They have also been sighted at and close to Swartbooisdrif on the Kunene River. The latter records are reliable and represent a range extension from their known range a bit further north in Angola. This species might be more widespread in Namibia than we currently recognise, but remains hidden due to its nocturnal and secretive habits.

POPULATION ESTIMATE AND TREND

This species is not well known in any of its range states, and no attempt has been made to estimate its population in Namibia. The global population trend for this species is also unknown (Mateke *et al*. 2016).

ECOLOGY

Selous' mongoose is rarely seen in the wild, as it is nocturnal and solitary. It feeds mainly on insects, but also takes other invertebrates, rodents, reptiles, amphibians and birds (Apps 2000). This species is understudied across its range.

THREATS

No major threats are identified.

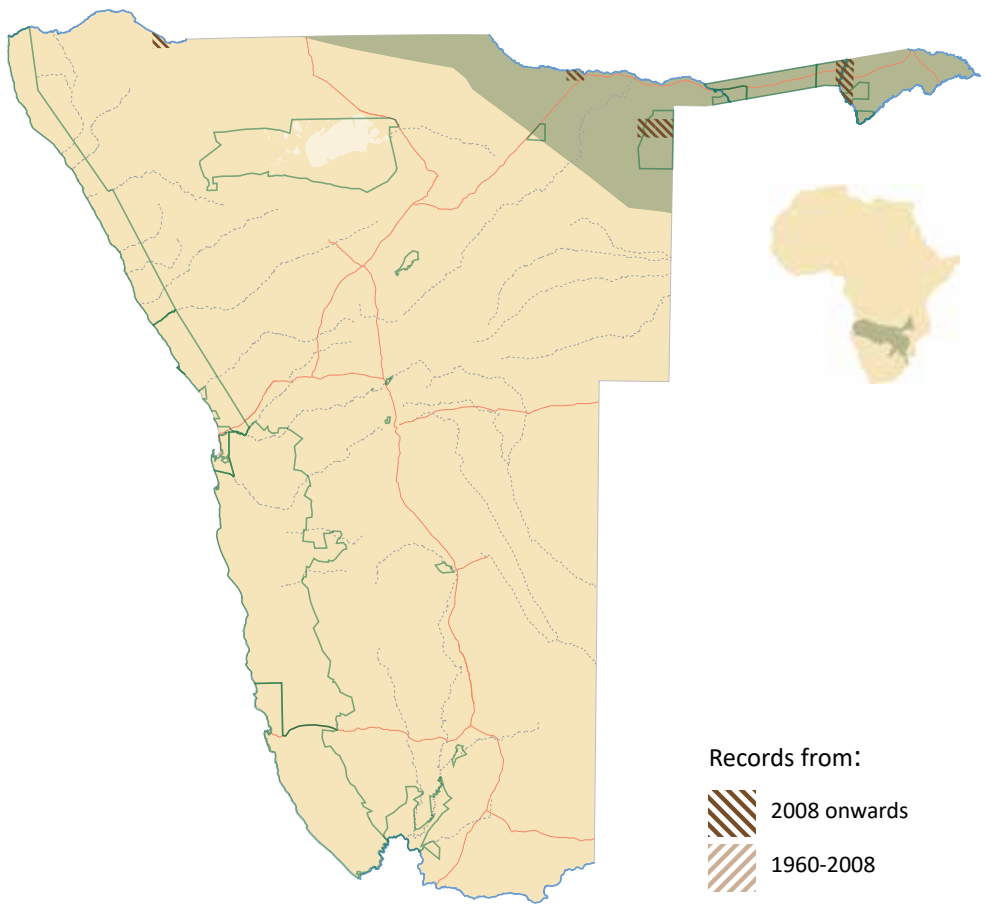
CONSERVATION STATUS

Least Concern in Namibia. Selous' mongoose is a rather marginal species in this country, confined to the far northern

Distribution records of Selous' mongoose, and present estimated area of distribution in Namibia.

Inset: African distribution of Selous' mongoose according to IUCN (Mateke *et al*. 2016).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



parts. Nevertheless, its frequent occurrence in camera trap photographs in the Zambezi and Kavango East Regions suggests that it is fairly common in the north-east. It is listed as Least Concern internationally, mainly because it occurs in a variety of habitats across its range and faces no known threats (Mateke *et al*. 2016).

ACTIONS

No specific actions are needed for the conservation of this species.

Assessors: John Pallett and Gail Thomson
Reviewer: Chris Stuart and Mathilde Stuart

Suggested citation: Pallett J & Thomson G 2022. A conservation assessment of Selous' Mongoose *Paracynictis selousi*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 136-137. MEFT, LCMAN & NCE, Windhoek, Namibia

Slender Mongoose *Herpestes sanguineus*

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Namibian conservation status	Least Concern
Global IUCN status	Least Concern First assessed 1996: Least Concern, unchanged since then
Namibian range	Occurs throughout Namibia except in the Namib Sand Sea and along the coast
Global range	Widespread throughout sub-Saharan Africa, absent only from forested areas in central Africa, the Karoo biome in South Africa and the most arid parts of the Namib Desert
Population estimate	Unknown
Population trend	Stable
Habitat	All woodland and savanna habitats, but also extends into sparsely vegetated, arid areas where there is either sufficient vegetation or rocky terrain which offers cover
Threats	No major threats

IDENTIFYING FEATURES

A small- to medium-sized mongoose, short-legged and slenderly built, with a sinuous body and a long tail with a black tip. When alert, the end of the tail is usually curled slightly upwards. Coat colour varies greatly, from charcoal grey (easily confused with black mongoose) to grizzled greyish-brown to reddish brown.

Dark slender mongooses can be distinguished from black mongooses by their brindled colouration – if present, it is a slender mongoose. This confers a more dull appearance to the coat, whereas black mongooses have a distinctive rufous shine (S Rapson pers. comm. 2020).

Slender mongooses are solitary and diurnal, but may be active at night if there is a good food source such as emerging flying termites (Apps 2000). This is a shy and restless animal, usually seen trotting in haste and darting into cover.

DISTRIBUTION

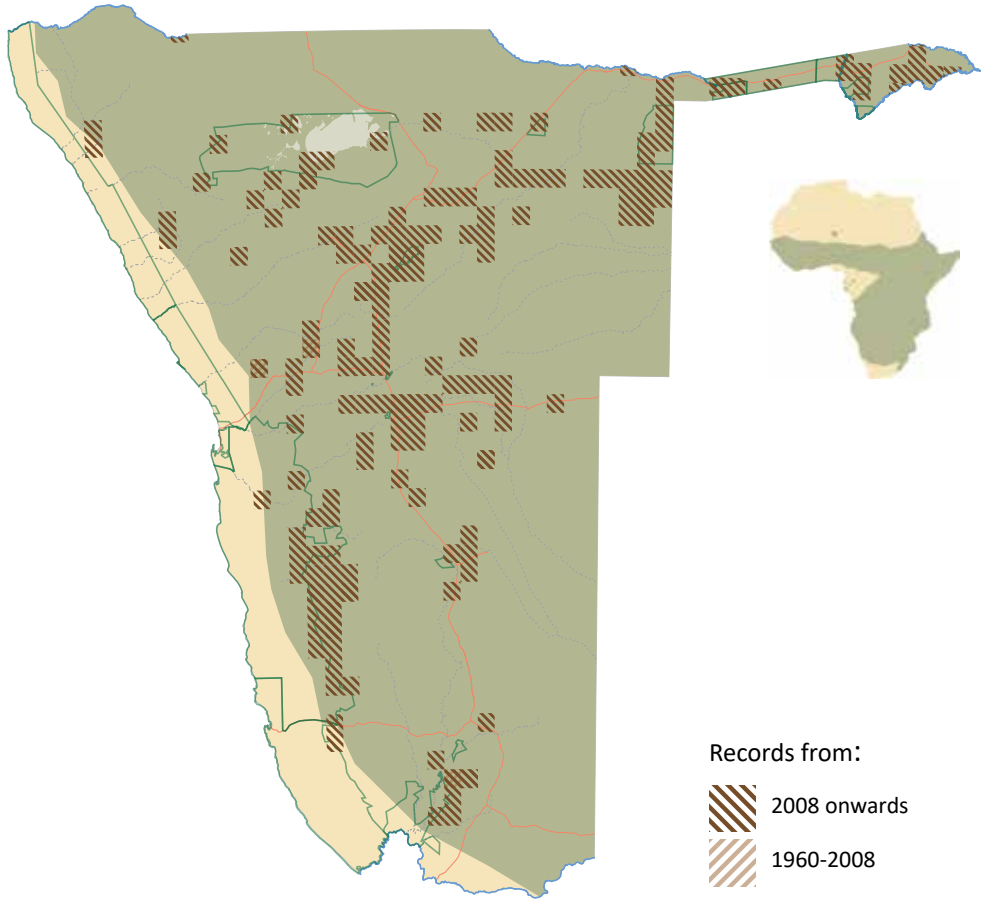
Widespread across sub-Saharan Africa, the slender mongoose occurs on the fringes of tropical forests (sometimes penetrating along roads) in West Africa, and is excluded from true desert (Hoffmann & Taylor 2013). In South Africa it is excluded from the Karoo regions; this may be due to competitive exclusion by the small grey mongoose (Skinner & Chimimba 2005).

In Namibia, it characteristically occurs in woodland and savanna habitats with reasonable vegetation cover, but also extends into the eastern margins of the Namib Desert and

Distribution records of slender mongoose, and present estimated area of distribution in Namibia.

Inset: African distribution of slender mongoose according to IUCN (Do Linh San & Maddock 2016).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



southern Namibia where there is either sufficient vegetation or rocky terrain which offers cover.

POPULATION ESTIMATE AND TREND

In the Serengeti National Park (Tanzania), population densities ranged from 3–6 individuals/km^2 (Waser *et al.* 1995). That is likely to be much higher than anywhere in Namibia, where prey density is probably lower. No population estimates have been attempted in this country. In the latest IUCN global assessment for this species, the population is considered stable (Do Linh San & Maddock 2016).

ECOLOGY

The slender mongoose is a generalist carnivore, eating a range of small vertebrates such as mice, small birds, lizards and snakes, invertebrates such as centipedes and insects, fruit such as *Grewia* berries and carrion when available (Graw & Manser 2016, Apps 2000). Males occupy large overlapping territories of usually related individuals, while adult females occupy ranges that are generally exclusive from one another, but overlap with those of one to a few males (Graw *et al.* 2019). This species is preyed on by raptors (Graw & Manser 2016) and probably other mammal carnivores. It may hybridise with the closely related black mongoose in areas where their distributions overlap in north-western Namibia (Rapson *et al.* 2012).

THREATS

No major threats are identified. Slender mongoose is listed in South Africa as a species used in traditional medicines (Cunningham & Zondi 1991); this has not been recorded in Namibia.

CONSERVATION STATUS

Least Concern in Namibia as the species is common and widespread. No major threats have been identified for this species globally (Do Linh San & Maddock 2016), and they appear to be largely unaffected by human presence in rural areas (Ramesh & Downs, 2014).

ACTIONS

No specific actions are needed for the conservation of this species.

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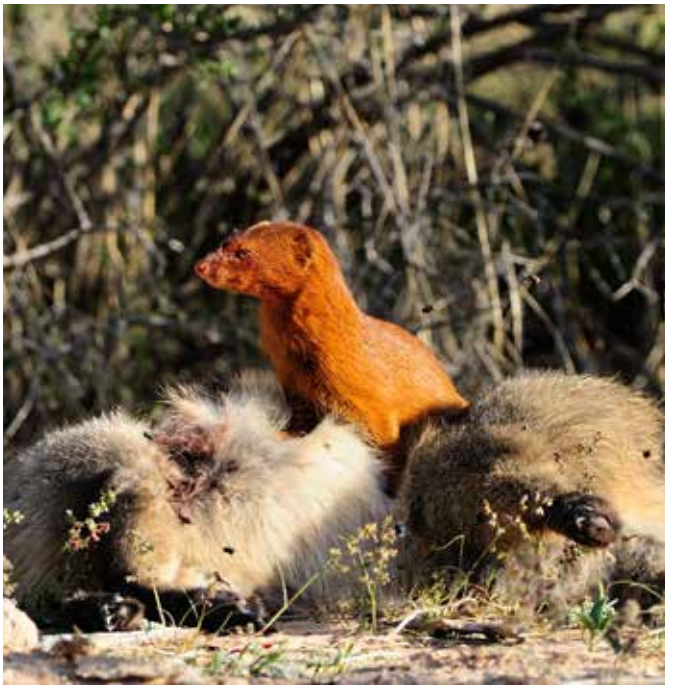

© S Périquet

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Assessors: John Pallett and Gail Thomson
Reviewer: Carolyn Baker

Suggested citation: Pallett J & Thomson G 2022. A conservation assessment of Slender Mongoose *Herpestes sanguineus*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 138-140. MEFT, LCMAN & NCE, Windhoek, Namibia

Small Grey Mongoose *Herpestes pulverulentus*

© C & M Stuart

Namibian conservation status	Least Concern
Global IUCN status	Least Concern First assessed 1996, unchanged since then
Namibian range	Along the Orange River and the Fish River Canyon
Global range	Endemic to southern Africa, where it is a species of the Karoo and extends southwards to the coast and eastwards across Lesotho
Population estimate	Unknown
Population trend	Stable
Habitat	In Namibia found in low scrub and rocky terrain
Threats	No major threats

IDENTIFYING FEATURES

A small, diurnal mongoose, grizzled dark grey all over the body with darker or black legs, and a tail that thins gradually to the tip without any black.

DISTRIBUTION AND HABITAT

The distribution of the small grey mongoose (also known as Cape grey mongoose) enters Namibia only in the far south. It has been recorded near the Fish River Canyon with verified sightings and a camera trap image submitted to the Environmental Information Service (2021).

In South Africa it extends southwards to the coast and eastwards across the Karoo and as far as Lesotho (Skinner & Chimimba 2005). The species has quite a wide habitat tolerance, occurring in fairly open scrubby country, fynbos and even forest in the south-eastern Cape (Cavallini 2013). It needs cover for protection so avoids completely open areas and is never far from dense bushes or rocky outcrops (Do Linh San *et al.* 2016). Knowing this habitat preference, and judging from the few records of its occurrence in Namibia, it might occur more widely in dwarf shrub vegetation of the Succulent Karoo and Nama Karoo.

POPULATION ESTIMATE AND TREND

No estimate of the population in Namibia has been attempted. The latest IUCN assessment considers the population to be stable (Do Linh San & Cavallini 2015).

ECOLOGY

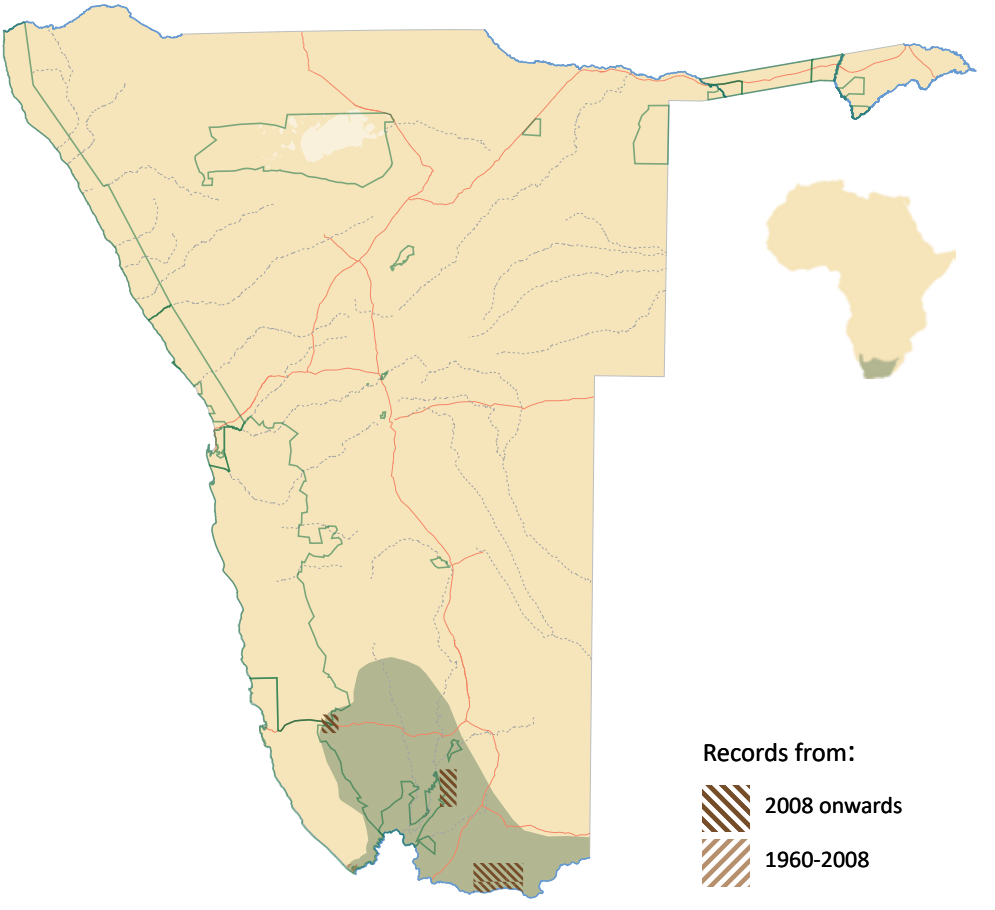
The small grey mongoose preys mainly on insects and rodents, although the diet may include other invertebrates, birds, reptiles and carrion or refuse; the relative percentage of rodent and insect prey differs according to habitat (Cavallini & Nel 1990b). It prefers bushy, rather than open, habitat (Cavallini & Nel 1990a).

Home ranges overlap between and within sexes; it is mostly solitary but is occasionally seen in pairs or family groups (Cavallini & Nel 1990a).

Distribution records of small grey mongoose, and present estimated area of distribution in Namibia.

Inset: African distribution of small grey mongoose according to IUCN (Do Linh San & Cavallini 2015).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



THREATS

No major threats are identified.

CONSERVATION STATUS

Least Concern in Namibia where it has only a limited range in the south. Across the rest of its range in South Africa and Lesotho it is common, there are no major threats, and it is present in a number of protected areas in its range (Do Linh San & Cavallini 2015, Do Linh San *et al.* 2016).

ACTIONS

No specific actions are needed for the conservation of this species.

Assessors: John Pallett and Gail Thomson
Reviewer: Chris Stuart and Mathilde Stuart

Suggested citation: Pallett J & Thomson G 2022. A conservation assessment of Small Grey Mongoose *Herpestes pulverulentus*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 141-142. MEFT, LCMAN & NCE, Windhoek, Namibia

Water Mongoose *Atilax paludinosus*

© D Keats

Namibian conservation status	Least Concern
Global IUCN status	Least Concern
Namibian range	Confined to the perennial rivers in the north-east, and the Kunene and Orange Rivers
Global range	Widespread in sub-Saharan Africa, but largely absent from Namibia, Botswana and the Karoo in South Africa
Population estimate	Unknown
Population trend	Thought to be declining internationally. Unknown in Namibia
Habitat	Perennial rivers and marshes
Threats	Wetland degradation

IDENTIFYING FEATURES

This is a fairly large mongoose that weighs between 3 and 5 kg and is unlikely to be mistaken for any other small mammal in wetland habitat. It varies in colour from reddish brown to black, and has a shaggy appearance with a distinctly tapered tail.

Water mongooses are generally solitary and crepuscular to nocturnal so are not often seen, but their presence is revealed from scats and other signs close to water. The scats are filled with crushed crab shells, but also contain fur from rodent prey (not eaten by otters) (Smithers 1983). Dry carapaces of crabs discarded on the river banks are a sure sign of their presence (Smithers 1983, Apps 2000). The toes are long and without webs; when walking on mud the digits tend to splay, making the tracks, with claw marks, easily separable from those of African clawless otter, which show just the five pads on each foot. Spotted-necked otter tracks show the webs between their clawed toes (Shortridge 1934, Smithers 1983).

DISTRIBUTION

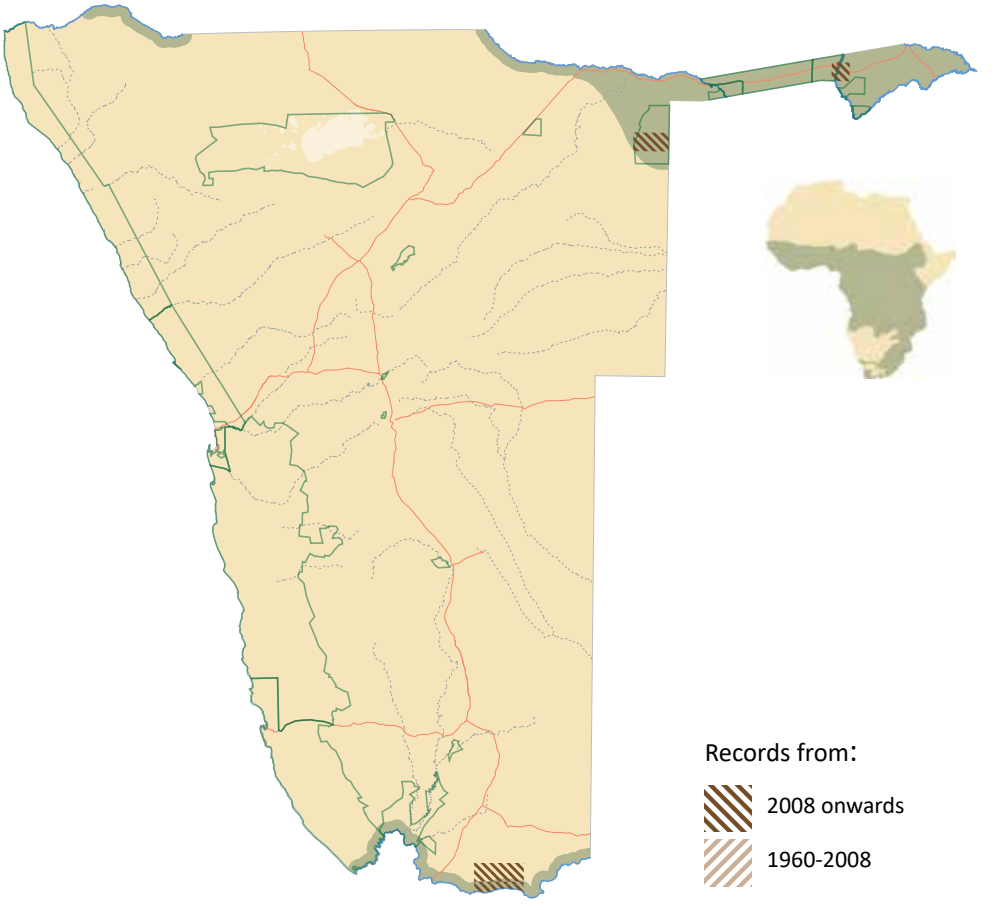
The water mongoose (also known as marsh mongoose) is widespread in sub-Saharan Africa, occurring in swamp or marsh habitats near freshwater bodies or coastal estuarine areas. It is absent from the dry south-western regions, including most of Namibia, Botswana and the Karoo in South Africa (Do Linh San *et al.* 2015a). Although semi-aquatic, it has a wide dietary niche that includes terrestrial species like small mammals and birds (Avenant & Nel 1997), and therefore occupies a broader dietary niche than the African clawless otter and spotted-necked otter.

In Namibia, it is known only from around the Kunene, Kavango and Zambezi River systems in the north, and the Orange River in the south. Hines (1993) recorded it in Khaudum National Park during seasonal flooding that created temporary wetlands along drainage lines linked to the Okavango River.

Distribution records of water mongoose, and present estimated area of distribution in Namibia.

Inset: African distribution of water mongoose according to IUCN (Do Linh San *et al.* 2015).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



POPULATION ESTIMATE AND TREND

There are insufficient data for this species to make a population estimate or to detect any trend in Namibia. They are thought to be declining globally (Do Linh San *et al.* 2015a).

ECOLOGY

The species is crepuscular and nocturnal, usually seen singly or in pairs (Louw & Nel 1986, Rowe-Rowe & Somers 1998). They are territorial, although their home ranges overlap slightly; males have smaller home ranges than females (Louw & Nel 1986, Skinner & Chimimba 2005).

Usually associated with well-watered areas along rivers and streams, and around dams where there are reeds or other thick vegetation cover (Baker & Ray 2013). May also be found along ephemeral rivers where there are pools and cover (Hines 1993), and sometimes ventures into open veld in the vicinity of water. Feeds on frogs, crabs, rodents, invertebrates and fish, and takes more terrestrial food when aquatic sources dry up or in habitats with less aquatic prey (Avenant & Nel 1997, Rowe-Rowe & Somers 1998). Tends to feed along banks and in shallow water where frogs and crabs are to be found, following regular pathways along the muddy fringes of water courses, and swimming when necessary (Rowe-Rowe & Somers 1998).

THREATS

Degradation of riverbank vegetation due to clearing and burning of reed beds, and overgrazing and trampling of riverside vegetation by livestock, are common impacts of growing human pressure on Namibia's north-eastern wetlands. These are likely to reduce the suitable habitat for water mongoose. The presence of fishing nets along riverbanks, especially the growing problem of discarded "sefa-sefa" monofilament nets, may entangle and trap individuals, thereby increasing mortality through drowning or starvation. While it is common in bushmeat markets in Nigeria, there is no evidence for bushmeat hunting of this species in Namibia (Angelici *et al.* 1999).

CONSERVATION STATUS

This species is considered Least Concern in the latest global IUCN assessment (Do Linh San *et al.* 2015a). Although the species is peripheral in Namibia, we see no reason to change the status for the country and therefore designate it as Least Concern.

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ACTIONS

Protection of wetland habitats in north-eastern Namibia is the most important conservation action for this species. This includes regulating agricultural practices and maintaining natural habitat along vegetated stretches of riverbank and swamps. The Namibian government's decision to ban monofilament fishing nets (Government Gazette December 2016, No. 296) should help reduce the problem of animals being entangled in these nets. Further research is needed to determine if the species is hunted for bushmeat in Namibia.

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Assessors: John Pallett and Gail Thomson
Reviewer: Peter Apps

Suggested citation: Pallett J & Thomson G 2022. A conservation assessment of Water Mongoose *Atilax paludinosus*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 143-145. MEFT, LCMAN & NCE, Windhoek, Namibia

White-tailed Mongoose *Ichneumia albicauda*

Namibian conservation status	Least Concern
Global IUCN status	Least Concern (2016)
Namibian range	Restricted to north-eastern Namibia
Global range	Beyond Africa, recorded in parts of the Arabian peninsula. Widespread in sub-Saharan Africa, absent from forest in central Africa
Population estimate	Unknown
Population trend	Unknown, thought to be stable
Habitat	Well-watered savanna, can adapt to areas with high human population density
Threats	No major threats

DISTINGUISHING FEATURES

This tall-standing mongoose with a bushy white tail is distinctive. Some individuals have black tails, but even they can be distinguished by their large size – this is the largest mongoose species in Namibia. The body is shaggy and dark grey to black, the legs are long and black and the tail is also shaggy and conspicuous with its white colour. Some Environmental Information Service (2021) records for this species are probably misidentifications of yellow mongoose, which also has white in the tail but only at the very tip, and that is a much smaller animal altogether.

DISTRIBUTION AND HABITAT

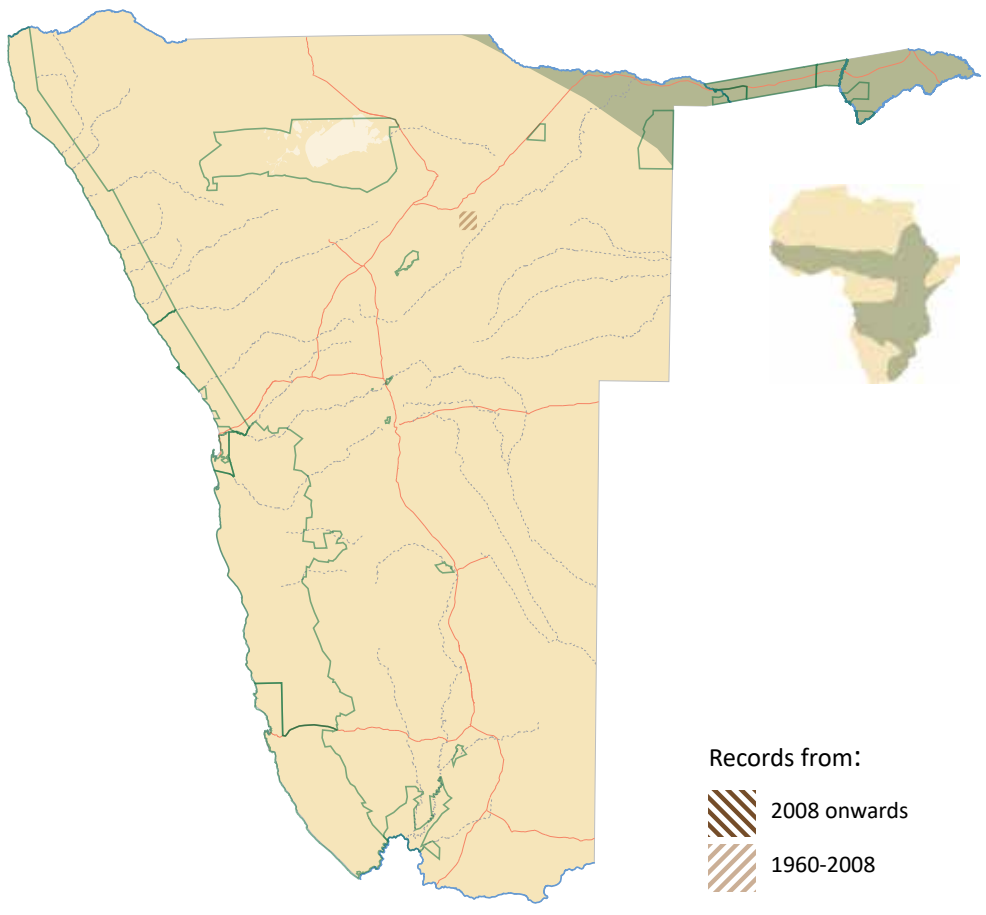
White-tailed mongooses are widespread in sub-Saharan Africa, occurring in well-watered savanna woodland. Known range in Namibia is restricted to the north-eastern woodlands of the Zambezi and Kavango Regions (Do Linh San 2015), although there is also a confirmed record from the Grootfontein area.

Although mainly found in wet savanna this is not always the case as it occurs in fairly arid areas in eastern and north-eastern Africa (C & M Stuart pers. comm. 2020). Confirmed records in Namibia have not extended into such habitat and our current information is that it is only present in north-eastern Namibia.

Distribution records of white-tailed mongoose, and present estimated area of distribution in Namibia.

Inset: African distribution of white-tailed mongoose according to IUCN (Do Linh San 2015).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



POPULATION ESTIMATE AND TREND

There are insufficient data to establish population estimates for this species, either globally or in Namibia. The population is considered stable globally (Do Linh San 2015).

ECOLOGY

The species is nocturnal and territorial, with minimal overlap between males, while female ranges overlap with males (Admasu *et al.* 2004b). They usually forage singly, but pairs and family groups are occasionally seen together (Skinner & Chimimba 2005).

The white-tailed mongoose is mainly insectivorous, but will also take other invertebrates, small vertebrates and carrion (Apps 2000). It is known to feed on garbage around towns and villages, and thus adapts to increased human presence and disturbance (Taylor 2013b).

THREATS

No major threats are identified. In South Africa, it is occasionally caught in traps set for jackals and caracals (Apps 2000), but this threat has not been recorded in Namibia.

CONSERVATION STATUS

Least Concern in Namibia. This species occurs only marginally in Namibia, and appears not to be hunted or threatened in any way in this country.

ACTIONS

No specific actions are needed for the conservation of this species.

Assessors: John Pallett and Gail Thomson
Reviewers: Chris Stuart and Mathilde Stuart

Suggested citation: Pallett J & Thomson G 2022. A conservation assessment of White-tailed Mongoose *Ichneumia albicauda*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 146-147. MEFT, LCMAN & NCE, Windhoek, Namibia

Yellow Mongoose *Cynictis penicillata*

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Namibian conservation status	Least Concern
Global IUCN status	Least Concern since 1996
Namibian range	~764,400 km^2 (30% of the global range)
Global range	~2,515,200 km^2, all in southern Africa
Population estimate	Approximately 10.1 to 65.4 million individuals in southern Africa
Population trend	Stable, but becoming less common in bush encroached areas
Habitat	Open grasslands with scattered shrubs and trees in semi-arid to arid savanna, and suburban areas
Threats	▸ No major threats ▸ Bush encroachment reduces their population density ▸ Road mortalities (unassessed) ▸ Occasionally hunted with dogs and shot when regarded as a pest species ▸ Drought conditions, causing decreased insect populations

IDENTIFYING FEATURES

This is a predominantly diurnal, small mongoose. It is distinctly yellower than other mongooses, and is usually distinguished from other species by the white tip at the end of the fairly bushy tail. In central and southern Namibia, fur is orange to yellow with less distinct white tip to tail compared to the redder individuals reported from South Africa. However, individuals from the north-eastern part of their range in Africa including north-eastern parts of Namibia are greyer and can lack the white tail-tip, so there they might be confused with Selous' mongoose, but that species has twice the mass of yellow mongooses and has dark-coloured legs whereas yellow mongoose are evenly coloured over the whole body. Also, the mostly diurnal habits separate it from Selous'.

DISTRIBUTION

Yellow mongooses are endemic to the southern African subregion, occurring apparently continuously across the western parts of southern Africa in Botswana, Namibia and South Africa. They are common in arid to semi-arid savannas and prefer open and sandy habitat with scattered shrubs and trees, and commonly inhabit suburban areas.

They are widespread in Namibia except for the Namib Desert and the most northern Zambezi and Kavango Regions (Do Linh San *et al.* 2015b).

POPULATION ESTIMATE AND TREND

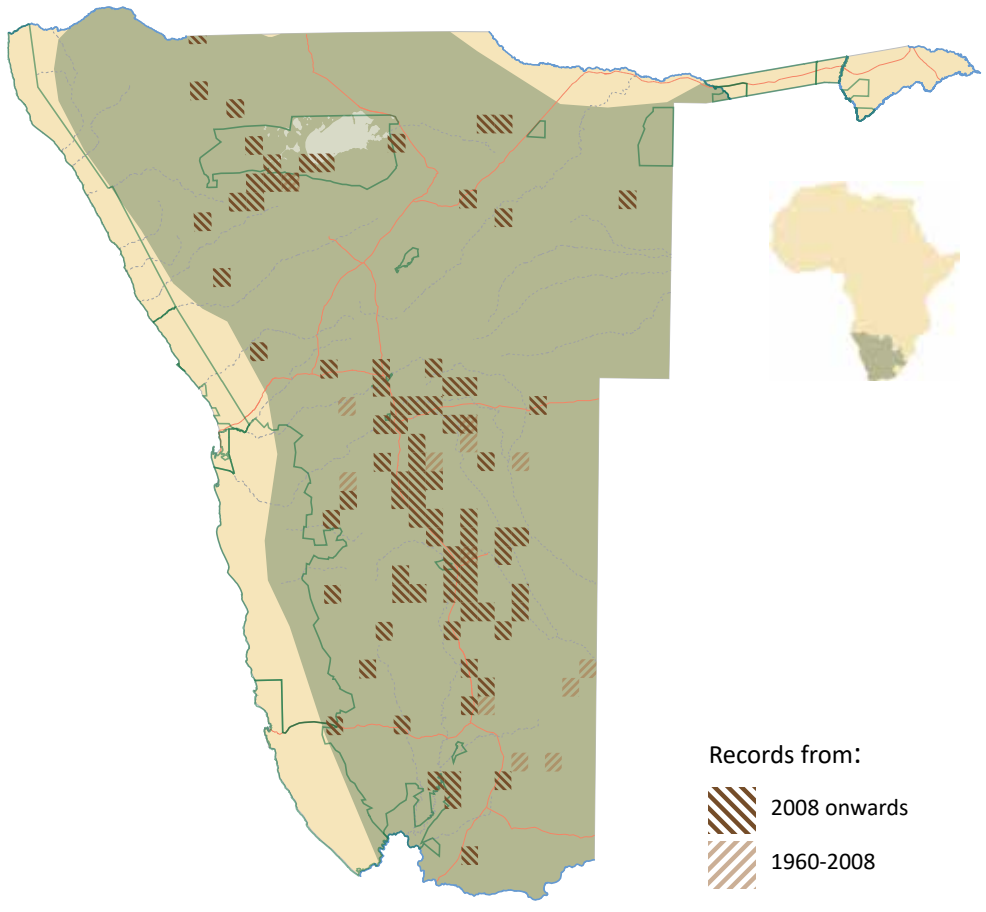
Yellow mongooses are common within protected areas and on farmland, but are becoming less common in rangelands where heavy grazing has led to bush encroachment (Blaum *et al.* 2007a, 2007b).

Local population density estimates vary between 4–200 individuals/km² depending on rainfall, food availability, level of shrub encroachment and probably interspecific competition and predation. The few studies estimating population densities were conducted in South Africa: in the

Distribution records of yellow mongoose, and present estimated area of distribution in Namibia.

Inset: African distribution of yellow mongoose according to IUCN (Do Linh San *et al.* 2015b).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



West Coast National Park, Western Cape, a density of 6–7 individuals/km^2 was estimated (Cavallini 1993, Cavallini & Nel 1995). Similar densities were observed by Do Linh San *et al.* (unpublished data) in the Great Fish River Reserve (Eastern Cape; 4–10 individuals/km^2) and by le Roux *et al.* (2008) in the Kuruman River Reserve (Northern Cape; 4–14 individuals/km^2). Higher densities of 23–26 individuals/km^2 were recorded in a population living in farmland near Heidelberg in the Western Cape (Balmforth 2004). The reported density of 133–200 individuals/km^2 by Earlé (1981) at the Vaal River is very likely an exception. This high density probably emerged since the study site was an island for much of the year.

Using the above density estimates, the population of yellow mongooses in southern Africa is estimated as 10.1 to 65.4 million individuals. This is based on the area of the global range (Do Linh San *et al.* 2015b) multiplied by the minimum and maximum estimated population densities in the various studies, excluding the abnormally high density estimated by Earle (1981).

In Kalahari savanna rangelands in the Northern Cape Province, South Africa, where local predator control (shooting, traps) reduced the density of black-backed jackal, caracal and African wild cat, the abundance of medium-sized carnivores (small spotted genet, bat-eared fox and Cape fox) increased (Blaum *et al.* 2009a). Such an effect was not recorded for yellow mongooses.

ECOLOGY

The feeding habits of yellow mongooses are opportunistic. They are primarily insectivores, eating termites, beetles and larvae, but they also feed on lizards, snakes and small mammals such as gerbils and mice (Avenant & Nel 1992, Taylor & Meester 1993, Nel & Kok 1999).

Yellow mongooses live in family groups of 4–13 individuals (du Toit 1980, Wenhold 1990, Rasa *et al.* 1992, Blaum *et al.* 2007a) and inhabit communal burrows as temporary shelters or for reproduction (Lynch 1980, Wenhold & Rasa 1994, Blaum *et al.* 2007a). Whilst they den communally and cooperative care of young occurs, they mainly forage alone. Although the yellow mongoose is a species of open habitats, it benefits from the protection of shrubs. Particularly during reproduction and nursing their young, they prefer burrows under the shelter of thorny *Acacia* bushes (e.g. *Acacia mellifera*) that successfully protect the young against avian predation at burrow exits (Blaum *et al.* 2007a). Burrows are sometimes shared with Cape ground squirrels and suricates (Skinner & Chimimba 2005, Waterman & Roth

2007). Yellow mongooses benefit from increased vigilance behaviour of squirrels (Waterman & Roth 2007, Makenbach *et al.* 2013). For example, in trials with a common predator, the puff adder (*Bitis arietans*), squirrels were most active in mobbing the snake (Waterman & Roth 2007). This interspecific association could be mutualistic, since the collective detection of common predators inducing hetero- and conspecific alarm calls elicits vigilance behaviour in both species (Makenbach *et al.* 2013).

In urban environments such as Windhoek, yellow mongooses are common and benefit from anthropogenic food resources and reduced predation pressure (Cronk & Pillay 2018, 2019). In cafeteria-style food choice experiments south of Johannesburg (South Africa), yellow mongooses preferred meat and insects over bread, dog kibble and chicken eggs in the more natural area, while they preferred bread to insects in the more urbanised area (Cronk & Pillay 2018). Particularly during cold winter months, when small mammals and invertebrates decrease in abundance, anthropogenic food items are found frequently in scats of yellow mongooses (Cronk & Pillay 2019).

The yellow mongoose is dioestrus – with potentially two litters per adult female per breeding season. In Namibia, the second oestrus occurs up to two months after birth of the first litter (in mid-December) with the second litter born in mid-February (Rasa *et al.* 1992).

Predators include large snakes, water monitor lizards, black-backed jackal, and large raptors including martial eagles, Wahlberg's eagles and tawny eagles (Taylor 2013c).

THREATS

There are no major direct threats from humans. In bush encroached areas, where abundance and diversity of insects is low (Blaum *et al.* 2009b, Hering *et al.* 2019), group size and reproductive success of yellow mongooses is lower compared to more open habitats (Blaum *et al.* 2007a, Popp *et al.* 2007). In Kalahari savanna rangelands where bush cover was below 15%, average group size during reproduction was 4.8 individuals caring for 2–3 young. Group size was lower with an average of 2.2 individuals without offspring above this threshold of bush cover. The presence of yellow mongooses in such bush dominated areas can be explained by emigration from neighbouring source populations.

The local impact of road mortality might be a concern but has not been studied.

There is one report indicating that yellow mongooses are sometimes regarded as a pest where they excavate burrows in crop fields (Western Cape, South Africa), and they are consequently hunted with dogs and shot (Balmforth 2004). This did not seem to have had any significant impact on the population, which still lives at a higher density than in natural areas (Balmforth 2004).

Extended drought periods predicted under climate change could depress insect populations such as termites (Davies *et al.* 2015), which may have an impact on yellow mongoose populations.

As a possible vector for rabies, attempts have often been made to regionally eradicate yellow mongooses, but these have not been successful because of rapid recolonisation from neighbouring populations (Zumpt & Hassel 1982).

CONSERVATION STATUS

The yellow mongoose is listed as Least Concern on the IUCN Red List (Do Linh San *et al.* 2015b) and has been so since its first assessment in 1996. The species is not included in the CITES Appendices.

ACTIONS

No actions are required.

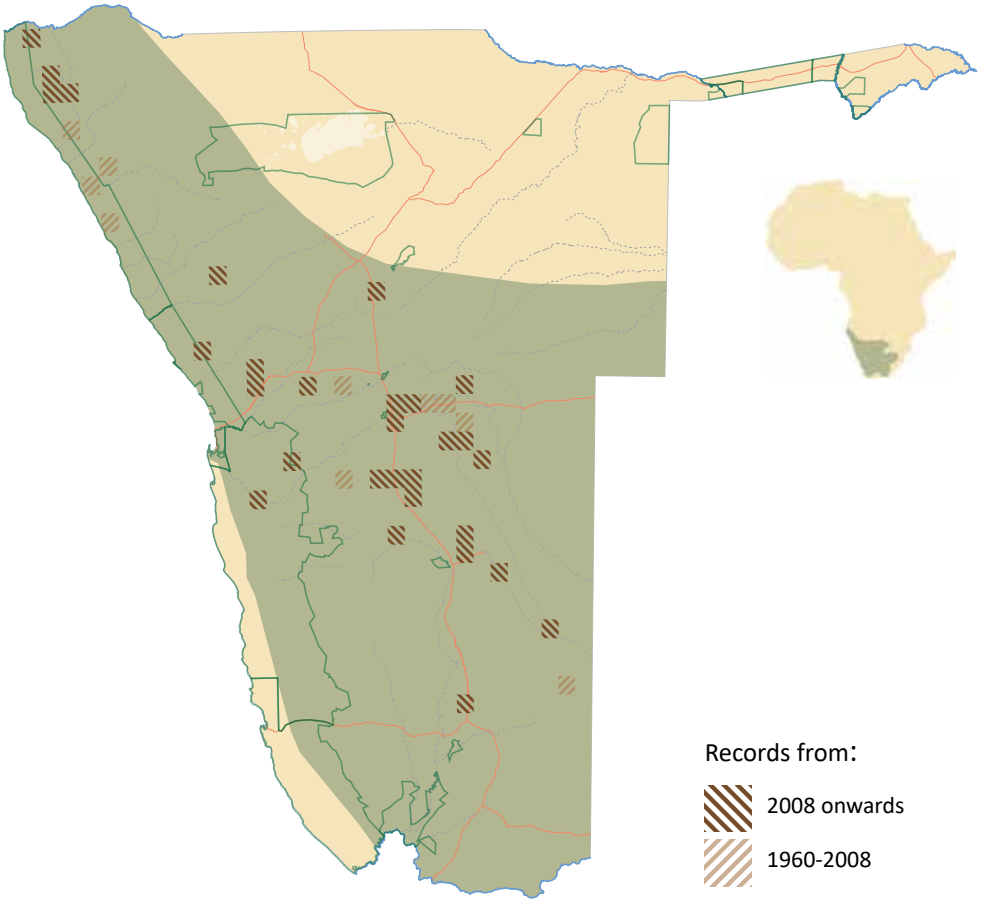
Assessor: Niels Blaum
Reviewer: Jason Gilchrist

Suggested citation: Blaum N 2022. A conservation assessment of Yellow Mongoose *Cynictis penicillata*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 148-150. MEFT, LCMAN & NCE, Windhoek, Namibia

Suricate *Suricata suricatta*

© K Finn

Namibian conservation status	Least Concern
Global IUCN status	Least Concern First assessed in 1996 as Least Concern/Lower Risk
Namibian range	Drier north-western, central and southern parts of the country, but absent from the Namib Sand Sea
Global range	Endemic to southern Africa, range includes semi-arid to arid areas in South Africa, Botswana and Namibia. Small extension into south-western corner of Angola
Population estimate	Unknown
Population trend	Unknown, but thought to be stable
Habitat	Arid, open grasslands or sparse scrubland/woodland. Absent from bare sand desert, thickly vegetated areas and forest
Threats	No major threats



Distribution records of suricate, and present estimated area of distribution in Namibia.

Inset: African distribution of ssuricate according to IUCN (Jordan & Do Linh San 2015).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.

IDENTIFYING FEATURES

A small mongoose that might be confused with the banded mongoose. The Afrikaans name "stokstertmeerkat" refers to the thin tail (not bushy) which is held vertically like a short whip when they are running. Features that identify this species are the light sandy-brown to silver-grey colouration on the body with indistinct, irregular transverse bars on the back, sharp pointed muzzle and dark "eye-shadow" in the eye sockets. They are always in groups, individuals usually seen huddled together while sitting upright on their haunches, or standing upright to look around.

DISTRIBUTION AND HABITAT

Suricates (also known as meerkats) occur throughout the drier parts of southern Africa, occupying open, lightly vegetated country characterised by short grasses and sparse woody growth, in Namibia, Botswana and South Africa (MacDonald 2013). They are found in areas of sandy substrate in the Kalahari, but dig their burrows (or share burrows with other species) in patches that are stony or made firm with calcrete in the soil (van Staaden 1994; Waterman & Roth 2007).

Within Namibia they are absent from the north-eastern part of the country, as they tend to avoid thick vegetation. They can survive in the driest parts of the Namib, even close to the coast, but they are always on gravel plains, not in sand dunes.

POPULATION ESTIMATE AND TREND

No estimate of the population in Namibia has been attempted. There is no evidence of an increase or decrease in numbers, therefore the population is assumed to be stable.

ECOLOGY

Suricates live in territorial colonies of 2–30 individuals (mean pack sizes 10 and 15 in South Africa and Botswana respectively), and are entirely diurnal (van Staaden 1994). They are very vulnerable to predators while foraging, especially juveniles whose vigilance and responses are not as sharp as the adults'. Raptors, snakes and mammalian carnivores (particularly jackals) are their main predators (Clutton-Brock *et al.* 1999, Apps 2012). A group of suricates, in turn, may attack and harass these animals, bunching together and chasing them off or killing those that they can, such as snakes (Apps 2012, Graw & Manser 2007). Larger groups are better able to defend against predators

than smaller groups through increased vigilance and pup protection (Clutton-Brock *et al.* 1999).

They emerge from the warren after sunrise and spend some time sun-bathing and grooming in their characteristic pose, sitting upright; they may retire to their burrow during the midday heat in summer (van Staaden 1994). In smaller groups only one female breeds, while two or three will breed in larger groups (Apps 2012). Burrows are often shared with ground squirrels or yellow mongooses; the squirrels benefit through increased vigilance provided by the mongoose species, while the mongooses benefit from the squirrels' burrowing activities (Waterman & Roth 2007).

Suricates eat a wide range of insects, especially larvae dug out of the ground, and other invertebrates such as scorpions, as well as small reptiles and birds (van Staaden 1994; Doolan & MacDonald 1996). They forage by scratching amongst vegetation, turning over objects and digging with their sharp claws to find their prey, all the time keeping in contact with soft grunts; food is not shared among adults, but youngsters up to 3 months old are fed by adults (Apps 2012). Non-breeding individuals take turns protecting young pups at the burrow, during which time they cannot forage; the length of time individuals spend babysitting increases with declining group size (Clutton-Brock *et al.* 1998). The group always posts a sentry who stands on an elevated rock or low bush to look out for predators; different alarm calls are given for aerial or terrestrial predators (Manser 2001). The group will either flee for the burrow, stand upright, or join the caller as part of a mob depending on the type and urgency of the call (Manser 2001).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THREATS

No major threats are identified. Bush encroachment in central Namibia may reduce habitat suitability for the species in the central part of the country (Blaum *et al.* 2007b), but this applies mainly to the northern edges of their range.

CONSERVATION STATUS

Least Concern in Namibia. The species is relatively widespread within southern Africa and there are no major direct or indirect threats (Jordan & Do Linh San 2015).

ACTIONS

The capturing and keeping of baby suricates as pets should be discouraged.

No other specific actions are needed for the conservation of this species.

Assessors: John Pallett and Gail Thomson
Reviewer: Peter Apps

Suggested citation: Pallett J & Thomson G 2022. A conservation assessment of Suricate *Suricata suricatta*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 151-153. MEFT, LCMAN & NCE, Windhoek, Namibia

African Civet *Civettictis civetta*

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Namibian conservation status	Least Concern
Global IUCN status	Least Concern
Namibian range	Unclear from the few reliable records that exist. Certainly occurs in northern and north-eastern Namibia. Probably much more widespread but extremely thinly distributed
Global range	Throughout Africa from Senegal and Ethiopia down to northern Namibia, northern and western Botswana and north-eastern South Africa
Population estimate	Unknown
Population trend	Unknown
Habitat	Generally wooded areas, but in Namibia also found in more arid regions
Threats	Poison use on farmlands

IDENTIFYING FEATURES

African civets are short, heavily-built carnivores. They are predominantly brown with black markings. A broad black stripe runs along the top of the spine and tail, with additional stripes on the neck, parallel bands on the tail, and black spots on the torso. Although superficially similar to genets, the African civet is much bigger, and generally darker.

DISTRIBUTION

African civets are typically restricted to wooded areas, and the existing IUCN distribution data limits them to the far north and north-east of Namibia. There have, however, been a number of confirmed sightings in the Outjo and Mariental Districts (Berry 1988) and these are backed up by numerous reports from farmers in the Otjozondjupa, Khomas, Erongo and Omaheke Regions who were surveyed as part of the national leopard census (Environmental Information Service 2021). There are also confirmed sightings from Ongava Research Centre on the southern border of Etosha and anecdotal sightings to the west of Etosha, with a few verified sightings on the Kunene River directly north of Opuwo. In the south, there are confirmed sightings from NamibRand in the east and anecdotal reports from farmers in the west on either side of the border between the Hardap and ǁKharas Regions. Considering these confirmed and anecdotal records, it is likely that civets occur throughout central Namibia, extending as far west as Opuwo in the north and the Namib-Naukluft in the south, and as far south as the Hardap-ǁKharas border.

POPULATION ESTIMATE AND TREND

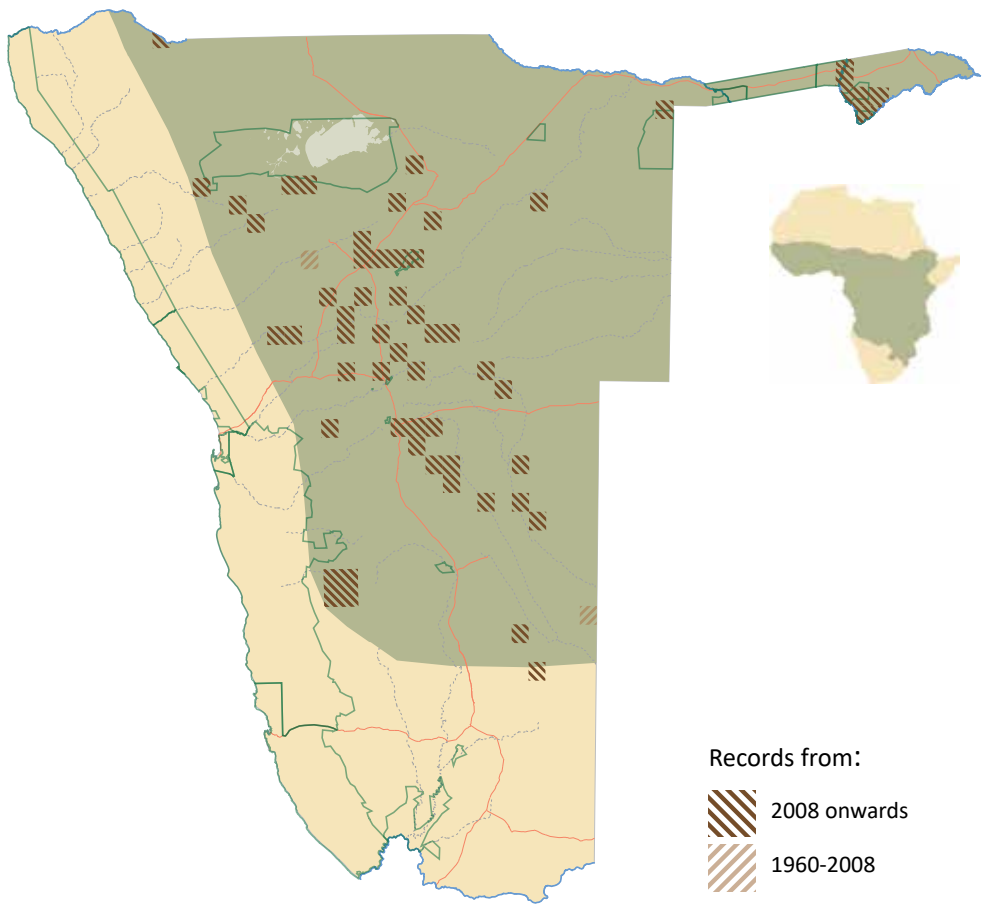
No density estimates have been made in Namibia. Studies in South Africa have indicated a range between 6.42±1.99 to 14.11±4.15 individuals per 100 km^2 depending on land-use, and the presence or absence of lions (Isaacs *et al*. 2021). As the Namibian distribution remains uncertain, we cannot estimate population numbers with current data.

The global population and current trend are unknown.

Distribution records of African civet, and present estimated area of distribution in Namibia.

Inset: African distribution of African civet according to IUCN (Do Linh San *et al.* 2015c).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



ECOLOGY

The African civet is omnivorous, with a diet that includes fruit, insects, invertebrates, small mammals, reptiles, birds, and carrion (Apps 2000, Bekele *et al.* 2008). Aside from the breeding season (June-November) they are solitary, with litter sizes of up to four cubs, and a two-month gestation period (Apps 2000).

Almost entirely nocturnal, they sleep in thick wooded areas, abandoned burrows or rock crevices (Apps 2000, Ray 2013). Although typically found in woodland regions, they also inhabit areas that have been partially cleared through logging or cultivation (Bahaa-el-din *et al.* 2013, Ray 2013).

In Ethiopia the home ranges of collared individuals range from 0.74 km^2 (Ayalew *et al.* 2013) to 11.1 km^2 (Admasu *et al.* 2004a).

The widely scattered but very sparse distribution records in Namibia suggest that these animals occur at an incredibly low density, and probably wander much more widely than others in wetter habitats elsewhere in Africa.

THREATS

There are currently no known threats to the species in Namibia. In Ethiopia male civets are removed from the wild and farmed for civet musk, which is used by the perfume industry (Swanepoel *et al.* 2016). In West Africa they are commonly found in bushmeat markets (Bahaa-el-din *et al.* 2013), and in South Africa they are often caught in snares or struck by vehicles (Collinson *et al.* 2015).

CONSERVATION STATUS

The African civet was listed in the 2015 global IUCN Red List as Least Concern (Do Linh San *et al.* 2015c), which is unchanged from the 1996 and 2008 assessments (Ray *et al.* 2008). A regional assessment for South Africa, Lesotho and Swaziland (Swanepoel *et al.* 2016) confirms this status. The Namibian situation for this species is very poorly understood but there is no evidence for a conservation status that differs from the other southern African countries. This species is therefore classified here as Least Concern.

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ACTIONS

There have been no studies of the ecology of the species in Namibia. Civets in Namibia appear to occur in much drier areas than they do elsewhere, so research should focus on establishing their distribution and studying their ecology in semi-arid and arid areas.

It is likely that there are sporadic records of civet caught on camera traps. Farmers, lodge owners, biologists and any others who set camera traps are urged to send in their animal observations to the EIS. Such records can help to build a stronger picture of the distribution and ecology of the country's carnivores, which in turn contributes to helping people co-exist with carnivores with reduced conflict.

Assessor: Morgan Hauptfleisch
Contributor: Nicky Knox
Reviewer: Filipe Carvalho

Suggested citation: Hauptfleisch M 2022. A conservation assessment of African Civet *Civettictis civetta*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 154-156. MEFT, LCMAN & NCE, Windhoek, Namibia

Rusty-spotted Genet *Genetta maculata*

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Namibian conservation status	Least Concern
Global IUCN status	Least Concern
Namibian range	~636,400 km^2 Mesic woodlands of north-east Namibia, possibly into parts of drier north-west Namibia. Often found in close proximity to the northern perennial rivers, especially the Okavango
Global range	Widely but sparsely distributed throughout most of sub-Saharan Africa, except for central and southern Namibia, Botswana and South Africa
Population estimate	~10,000–15,000
Population trend	Stable, possibly decreasing
Habitat	Evergreen or deciduous woodland. Relatively common in the mesic north-east, where they prefer the dense riparian forests of perennial rivers
Threats	▸ Deforestation ▸ Indiscriminate carnivore poisoning ▸ Frequent woodland fires in the Kavango and Zambezi Regions ▸ Poaching for meat and decorative pelts ▸ Roadkills

DISTINGUISHING CHARACTERISTICS

Rusty-spotted genets, also known as large-spotted genets, are similar in stature and size to small-spotted genets (*G. genetta*). They can be slightly heavier, but this is not a useful field feature. Coat patterns vary tremendously within the species, with the ground colour being off-white to buffy yellow. The spots along the body are quite large and separate from each other, and are black with brown or rusty-colouring in the centre of each spot. There is a mid-dorsal line, the same colour as the spots, the length of the body. They lack the raiseable crest of hairs along the back which is found in small-spotted genets. The legs are off-white, but the hind feet may be black below. The tail usually has a black tip (Stuart & Stuart 2001, Gaubert *et al.* 2005, Skinner & Chimimba 2005, Angelici & Gaubert 2013).

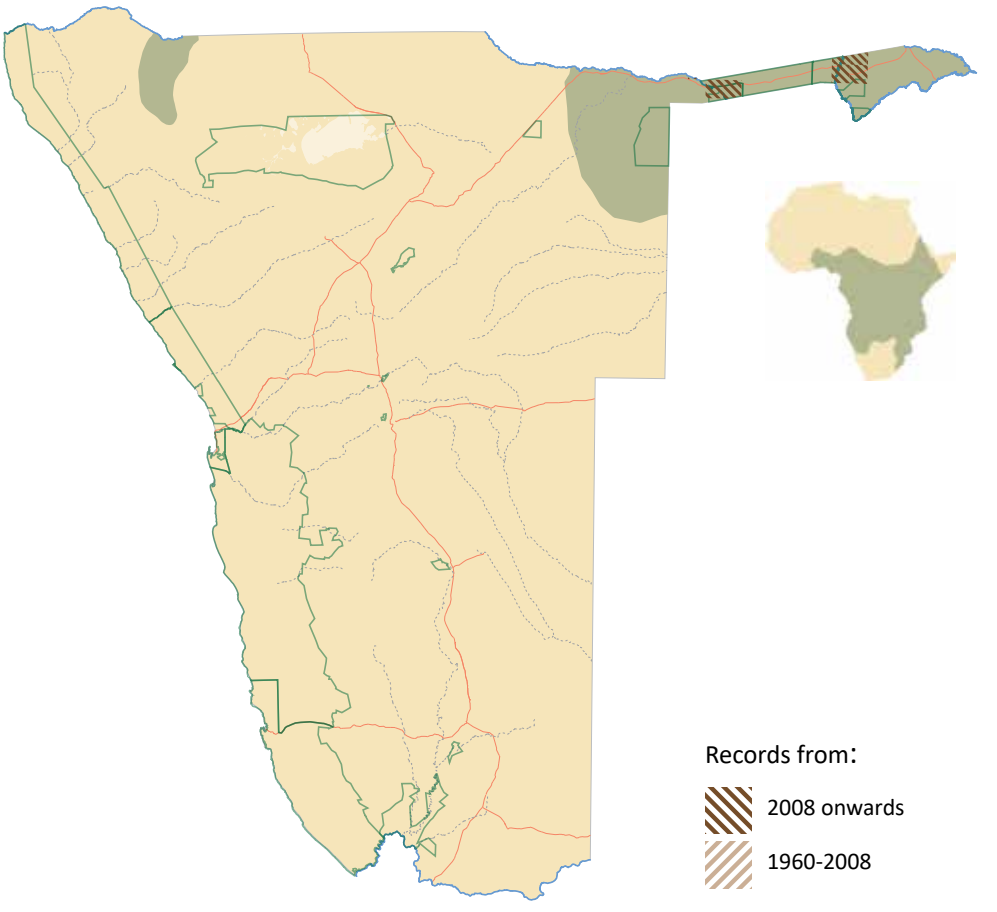
DISTRIBUTION

The phylogeny of the *Genetta* genus is complex and not fully resolved (Angelici *et al.* 2016). Here we follow the classification suggested by Gaubert *et al.* (2005), which separates rusty-spotted genet (*G. maculata*) from Cape genet (*G. tigrina*), both of which have large spots and have been lumped together as large-spotted genet before. The small-spotted genet (*G. genetta*) remains a separate

Distribution records of rusty-spotted genet, and present estimated area of distribution in Namibia.

Inset: African distribution of rusty-spotted genet according to IUCN (Angelici *et al.* 2016).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



species. There is a further school of thought which proposes *G. maculata* as a super-species, encompassing several other species across Africa, including *G. tigrina* (Gaubert *et al.* 2004).

Rusty-spotted genets occur irregularly across much of north-east Namibia's woodlands (Angelici *et al.* 2016) often in proximity to perennial rivers (Angelici & Gaubert 2013). There have been isolated sightings from the drier northern Kunene Region (Environmental Information Service 2021). Their distribution overlaps with small-spotted genets and the species are known to occur sympatrically (Roux *et al.* 2016, Carvalho *et al.* 2016). Northern Namibia represents the southern extent of the distribution of rusty-spotted genet, which stretches across most of central Africa between north-central Namibia and 10° north of the Equator (Skinner & Chimimba 2005, Angelici & Gaubert 2013, Environmental Information Service 2021). They mostly avoid the arid and semi-arid parts of the country where true woodland is either absent or too sparse, and water is scarce. They were previously thought to be restricted to areas along the perennial rivers of Kavango West, Kavango East and Zambezi Regions (Shortridge 1934, Skinner & Chimimba 2005), occurring there as a range extension, and possibly a sub-species, of the South African large-spotted genet (*G. tigrina*) (Skinner & Chimimba 2005) which is common in the mesic eastern parts of South Africa. However, since 2005, rusty-spotted genets have been recognised as a separate species to the Cape large-spotted genet which occurs in the southern and western part of South Africa (Gaubert *et al.* 2005).

POPULATION ESTIMATE AND TREND

Rusty-spotted genets are relatively common across their range, but are rarely encountered in relation to small-spotted genets. With no studies of the species in Namibia, the home-range sizes and densities are not known. A study in eastern South Africa found overlapping male and female home-ranges of approximately 3.3 km^2 (Roux 2017). A study in Kenya found similar female home-range sizes but male home-ranges were roughly double that size (Fuller *et al.* 1990). As an extrapolation of these studies and consideration of lower habitat productivity in Namibia, the population is estimated at approximately 10,000 to 15,000 individuals. Roux *et al.* (2016) estimated the South African population at 10,000.

Rusty-spotted genets are water-dependent and do not occur in arid or semi-arid habitats. With climate change likely leading to increased aridity across much of Namibia (Turpie *et al.* 2010), the range of this species is expected to shrink.

ECOLOGY

Rusty-spotted genets are almost exclusively nocturnal (Fuller *et al*. 1990, Skinner & Chimimba 2005, Roux *et al.* 2016). They are solitary or occasionally occur in pairs, using woodland thickets, aardvark burrows or rock shelters as cover during the day (Skinner & Chimimba 2005, Angelici & Gaubert 2013, Angelici *et al.* 2016). As a large proportion of their diet consists of rodents, they are often found in close proximity to cultivated fields (Widdows *et al.* 2015, Sogbohossou & Aglissi 2017) where gerbils and mice concentrate. They also feed on insects and occasionally fruit (Roux *et al.* 2016, Zemouche 2018).

THREATS

The reliance of rusty-spotted genets on healthy woodland and their preference for riparian forest makes them vulnerable to accelerated deforestation and frequent bush-fires, which are prevalent in the Kavango East and Zambezi Regions (Pröpper & Vollan 2013).

The Namibian population represents the southernmost extent of the species, making it vulnerable to changes in climate or habitat.

Roadkills are responsible for some mortalities in other countries (Roux *et al.* 2016), but none have been recorded to date in the Namibian Mammal Atlas (Environmental Information Service 2021). The inconsiderable road network in their Namibian range limits the effect of this factor on the population.

Rusty-spotted genets are sometimes used for meat and their pelts for decorative dress, but their shy habits make them difficult to capture or hunt.

CONSERVATION STATUS

Rusty-spotted genets have been classified globally as Least Concern in the 1996, 2008 and 2016 global red list assessments (Gaubert *et al.* 2008, Angelici *et al.* 2016). Without any clear indications of a population decrease, the Namibian status of Least Concern is retained, but if deforestation in the Kavango and Zambezi continue at current rates the species may be threatened in future.

ACTIONS

Protection of riparian forest and surrounding woodland will likely improve population numbers. Conducting nocturnal mammal surveys across the range of the species, similar to those by Hauptfleisch (2016) in Kavango East, will improve understanding of the species' distribution range and densities.

There have been no studies on the ecology, habits and behaviour of rusty-spotted genets in Namibia. Such studies could be usefully combined with population surveys of this and other small carnivores.

To prevent an increase in road mortalities, speed limits in the parks and communal conservancies across the range need to be enforced, and environmental assessments for roads and other developments within the range of the species need to include possible impacts on small carnivores. These include timber harvesting and road construction.

Assessor: Morgan Hauptfleisch
Contributor: Nicky Knox
Reviewer: Filipe Carvalho

Suggested citation: Hauptfleisch M 2022. A conservation assessment of Rusty-spotted Genet *Genetta maculata*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 157-159. MEFT, LCMAN & NCE, Windhoek, Namibia

Small-spotted Genet *Genetta genetta*

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Namibian conservation status	Least Concern
Global IUCN status	Least Concern
Namibian range	~812 500 km^2. Widespread except for the hyper-arid coastal zone, far north-central Namibia, and Namib Sand Sea
Global range	Three geographically separate zones: ▸ Southern Europe and North Africa ▸ A broad band across central Africa north of the Equator extending southwards to Kenya and Tanzania ▸ Western and southern Angola, Namibia, western Zambia, Zimbabwe and South Africa
Population estimate	~1.2 million in Namibia
Population trend	Stable
Habitat	Dense to open savanna, open woodland, also rocky areas with some tree cover. Less common in the mesic north-east. Often found close to human habitation
Threats	▸ Bush clearing ▸ Indiscriminate carnivore poisoning ▸ Roadkill ▸ Powerline electrocution ▸ Poaching for decorative pelts

DISTINGUISHING FEATURES

Small-spotted genets are sometimes difficult to distinguish as they vary phenotypically and may be confused with large-spotted genets in the higher rainfall parts of Namibia where both species occur (Skinner & Chimimba 2005, Carvalho *et al*. 2016). They have a dorsal crest of black hair along the spine, and the small spots along the body are often so close together that they may appear as stripes in poor light. They usually have a white tip to the tail and dark-coloured legs, compared to the dark tail tip and pale legs of the large-spotted genet (Stuart & Stuart 2001, Skinner & Chimimba 2005, Delibes & Gaubert 2013).

DISTRIBUTION

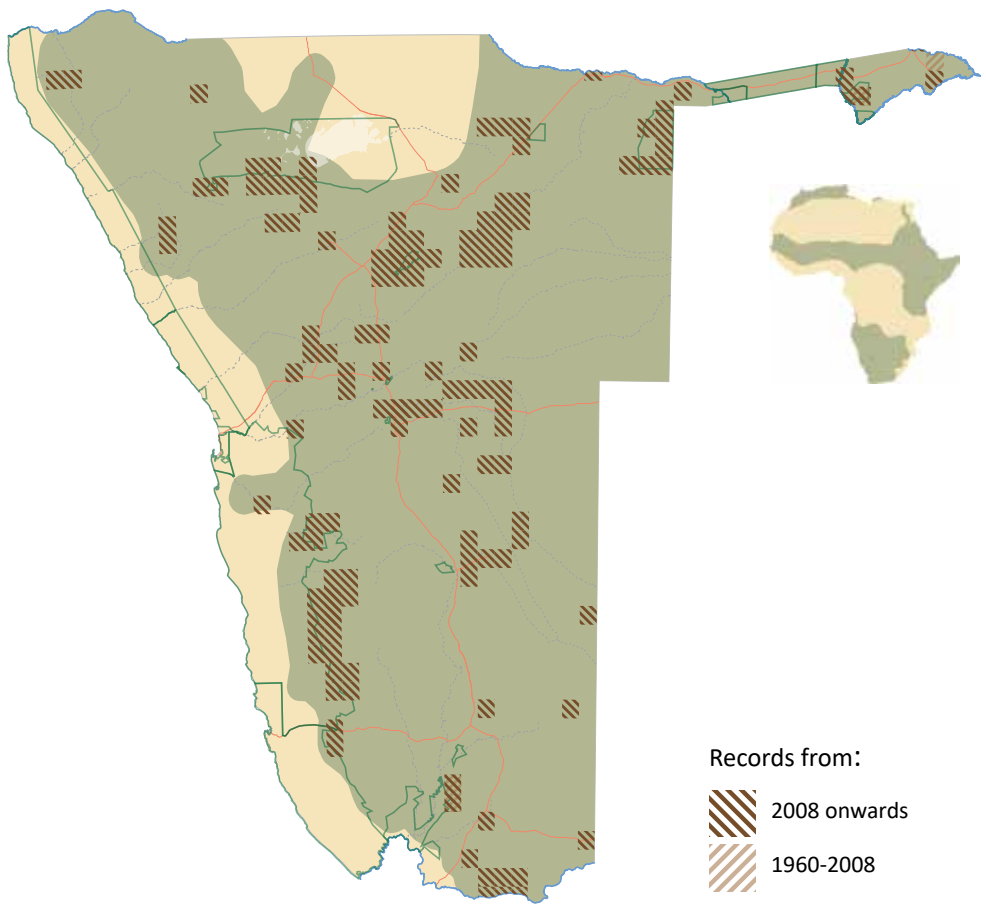
Small-spotted genets occur throughout Namibia, except for the Namib Sand Sea and far north-central Namibia (Skinner & Chimimba 2005, Gaubert *et al*. 2015, Environmental Information Service 2021). Increased deforestation, livestock density and crop farming in north-central Namibia (Klintenberg *et al.* 2007) has likely resulted in habitat not favoured by small-spotted genets. Although literature cites them to occur within a rainfall range of 100–800 mm, accounts from the early 20th century report them common even in the Rooibank area about 20 km inland from Walvis Bay in the hyper-arid coastal desert (Shortridge 1934) along the riparian woodland of the Kuiseb River. Records of the species span most of Namibia's vegetation biomes, with the highest density being in the central thornbush savanna (Environmental Information Service 2021). A number of sightings occur in arid areas with annual rainfall as low as 50 mm, where the riparian zone of ephemeral rivers provides sufficient prey and daytime cover.

Beyond Namibia they occur widely in South Africa,

Distribution records of small-spotted genet, and present estimated area of distribution in Namibia.

Inset: African distribution of small-spotted genet according to IUCN (Gaubert *et al*. 2015).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



Botswana, Zimbabwe and southern Angola, except for high rainfall areas (in excess of 800 mm). In central Africa they occur in a band from Liberia in the west to Somalia in the east, extending northwards into Ethiopia and southward into Kenya and Tanzania. They are also found along the Mediterranean coast of North Africa and into southern and western Europe (Larivière & Calzada 2001, Skinner & Chimimba 2005, Gaubert *et al*. 2015).

POPULATION ESTIMATE AND TREND

Small-spotted genets are one of the most common carnivores in their global range (Waser 1980, Carvalho *et al*. 2016) with a density estimate of 150 individuals per 100 km^2. This extrapolates to an estimate of over 1.2 million individuals across their Namibian range. There have been no studies on their population density in Namibia, although they were found to be less common than other carnivore species such as black-backed jackal, yellow mongoose and African wild cat in the Kalahari (Mills *et al*. 1984, Blaum *et al*. 2008). Since much of their habitat is similar in other parts of southern Africa, they are expected to be abundant (Carvalho *et al*. 2016, ADU 2020). Small-spotted genet numbers are expected to be stable throughout their range in Namibia, although no specific studies have been conducted to confirm this. In the more mesic north-east they seem to be gradually replaced by large-spotted genets (Environmental Information Service 2021), confirmed by a recent study which trapped both species in communal conservancies of the Kavango East Region (Hauptfleisch 2016).

ECOLOGY

Sufficient prey and day-time resting sites are important features for small-spotted genets (Carvalho *et al*. 2016). They are mostly nocturnal and rest in shrub thickets, large trees, tree cavities, rocky outcrops or burrows during the day (Mills *et al*. 1984, Skinner & Chimimba 2005, Camps 2011, Delibes & Gaubert 2013, Carvalho 2015). Associated with rivers and streams in more mesic countries, in Namibia they survive even in arid habitats as long as sufficient cover and fresh water is available, such as along some ephemeral rivers (Gaubert *et al*. 2015). They are commonly found near human habitation and on the fringes of urban areas as long as bush cover or woodland is nearby (Gaubert *et al*. 2015, Carvalho *et al*. 2016). They are socially solitary or less frequently in pairs and defend their territories (Carvalho *et al*. 2016). Females produce litters of two to five young during summer months, following approximately 10–11 weeks of gestation (Skinner & Chimimba 2005). Young are weaned by nine weeks, becoming fully grown and sexually mature by the age of 12 months.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Their wide carnivorous diet consists mostly of rodents, birds, reptiles and arthropods (Shortridge 1934, Virgós *et al*. 1999, Skinner & Chimimba 2005, Delibes & Gaubert 2013) while the remains of larger prey such as guineafowl and hares have been found at their burrows (Skinner & Chimimba 2005). In the central Namib plant material, mostly seeds of woody plants, were found to make up about 10% of their diet (Stuart 1977). They are often responsible for raiding domestic poultry coops and can cause substantial losses for poultry farmers (Larivière & Calzada 2001). They have been observed feeding on carrion, and raiding nests for eggs and young birds (Pienaar 1964).

THREATS

There are currently no serious threats to the species in Namibia.

Poisoning of carrion by livestock farmers may impact their numbers as they do scavenge when the opportunity arises. Although this indiscriminate persecution may reduce their numbers, the selective removal of larger carnivores such as jackal and cheetah by livestock farmers has been found to favour small-spotted genets through reduced inter-species competition (Blaum *et al*. 2007a, 2008, 2009b).

Genet road kills appear to be infrequent in Namibia (Environmental Information Service 2021), although in parts of their global range small-spotted genets, particularly subadults, are often killed on roads (Carvalho 2015). With increasing traffic volumes in Namibia, road kills may become a factor affecting the stability of the population.

Bush encroachment is prolific across much of Namibia's arid savannas (Bester 1998, Joubert *et al.* 2017), particularly the central savannas which form the core of small-spotted genet distribution. This factor may be a double-edged sword for the species. Although moderate bush densities may be beneficial to small-spotted genets, excessive shrub encroachment is found to reduce arthropod productivity (Hering *et al*. 2019) and this may similarly reduce other prey availability for genets. Indiscriminate debushing such as bulldozing or poisoning is however expected to reduce small-spotted genet habitat.

There have been a number of records of electrocutions along powerlines (Environmental Information Service 2021) although the effect on the viability of the overall population is small.

They are sometimes hunted for meat, medicine or decorative fur pelts (Gaubert *et al*. 2015, Carvalho *et al*. 2016), but the species does not appear to be targeted in Namibia.

CONSERVATION STATUS

Least Concern. The wide range of habitats they occupy, their common occurrence and adaptable behaviour make the small-spotted genet a species that is not directly threatened in Namibia.

ACTIONS

There have been no studies on the ecology, habits and behaviour of the species in Namibia. Namibian conservation biology largely ignores small carnivores, making it difficult to provide an accurate estimate of population size and trends. More studies on small carnivores such as those of Blaum *et al.* (2007b, 2008) and Mills *et al.* (1984) in Namibian habitats should be encouraged.

The number of road kills and electrocutions should be monitored, with the Mammal Atlas of the Environmental Information Service being an ideal mechanism to support such monitoring.

Assessor: Morgan Hauptfleisch
Contributor: Nicky Knox
Reviewer: Filipe Carvalho

Suggested citation: Hauptfleisch M 2022. A conservation assessment of Small-spotted Genet *Genetta genetta*. In: NCE, LCMAN, MEFT (eds) 2022. Conservation Status and Red List of the Terrestrial Carnivores of Namibia. Pp 160-162. MEFT, LCMAN & NCE, Windhoek, Namibia

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ABBREVIATIONS

CCF	Cheetah Conservation Fund
CH	Communication Hub
CI	Confidence Interval
CITES	Convention on International Trade in Endangered Species
DNC	Department of Nature Conservation
EIS	Environmental Information Service http://www.the-eis.com
GPS	Global Positioning System
HWC	Human-Wildlife Conflict
IUCN	International Union for Conservation of Nature
KAZA	Kavango–Zambezi Trans-Frontier Conservation Area
LCMAN	Large Carnivore Management Association of Namibia
MCP	Minimum Convex Polygon
MET	Ministry of Environment and Tourism
MEFT	Ministry of Environment, Forestry and Tourism
MUA	Multiple Use Area
NACSO	Namibian Association of CBNRM Support Organisations
NAPHA	Namibia Professional Hunting Association
NBSAP2	Second National Biodiversity Strategy and Action Plan
NECFU	Namibia Emerging Commercial Farmers' Union
NAU	Namibia Agricultural Union
NCE	Namibian Chamber of Environment
NGO	Non-Governmental Organisation
NNFU	Namibia National Farmers Union
PHVA	Population Habitat Viability Analysis
RMSE	Root Mean Square Error
RWCP	Rangewide Conservation Program
SNP	Serengeti National Park (Tanzania)
SSC	Species Survival Commission
TFCA	Trans-Frontier Conservation Area
VHF	Very High Frequency

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