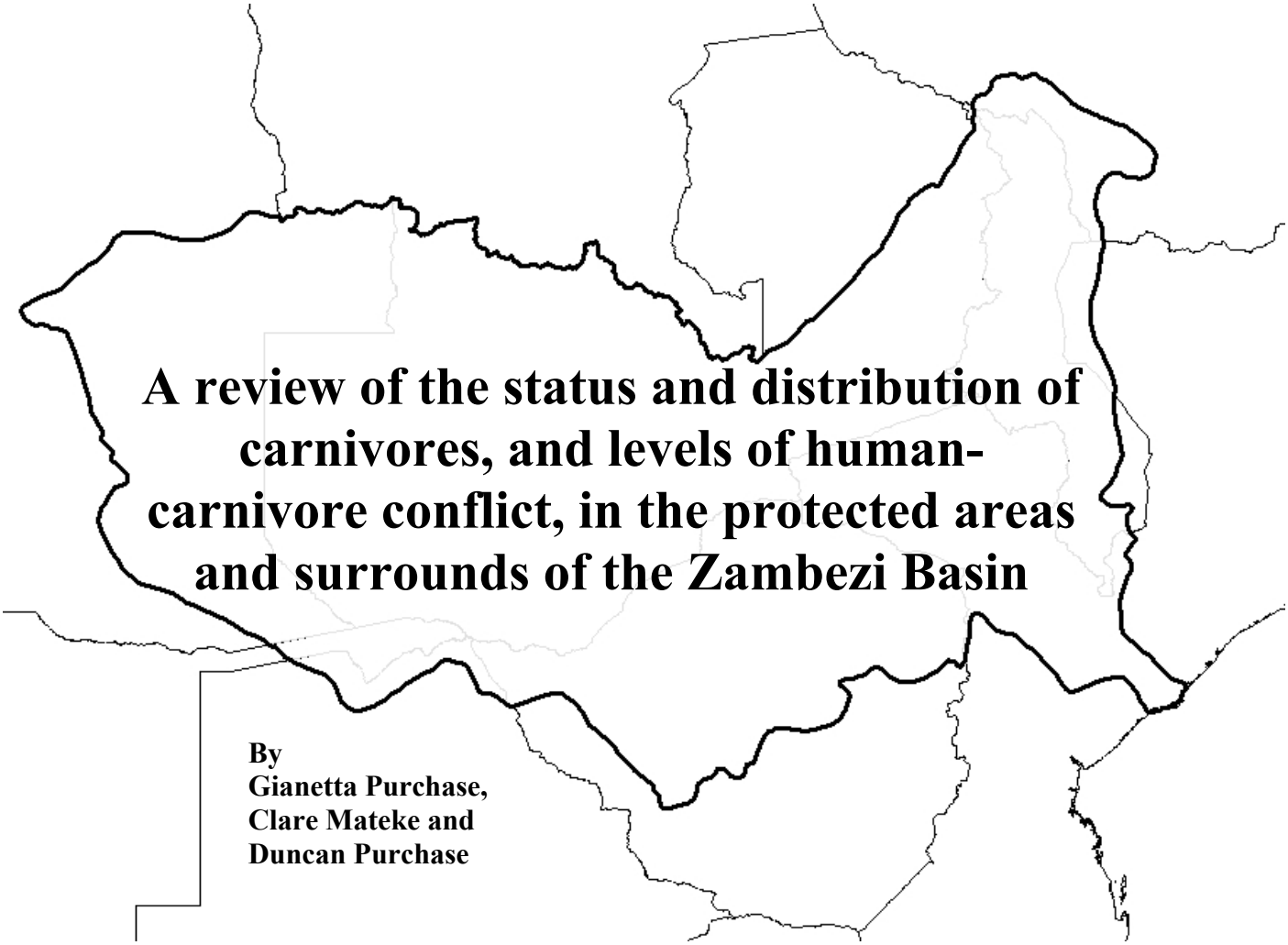
Aardwolf *Common genet* *Selous' mongoose*

African Wild Cat *Dwarf mongoose*

Serval *Banded mongoose* *Honey badger*

Side striped jackal *Bat-eared fox*



A review of the status and distribution of carnivores, and levels of human-carnivore conflict, in the protected areas and surrounds of the Zambezi Basin

By
Gianetta Purchase,
Clare Mateke and
Duncan Purchase

Large grey mongoose *Slender mongoose* *Black backed jackal*

Large spotted genet *Spotted hyaena*

Brown hyaena *Leopard* *Spotted necked otter*

Caracal

Lion

Striped polecat *Cape clawless otter* *Marsh/Water mongoose*

Striped weasel *Bushy tailed mongoose*

Meller's mongoose

Tree/Palm Civet *Cheetah*

White tailed mongoose *Wild dog* *Yellow mongoose*

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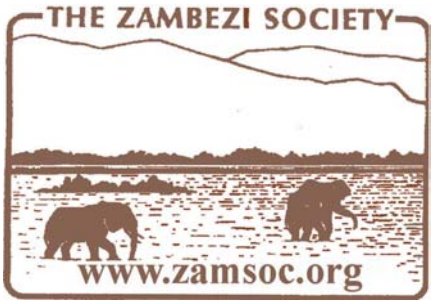

Mission Statement

To promote the conservation and environmentally sound management of the Zambezi Basin for the benefit of its biological and human communities

THE ZAMBEZI SOCIETY was established in 1982. Its goals include the conservation of biological diversity and wilderness in the Zambezi Basin through the application of sustainable, scientifically sound natural resource management strategies. Through its skills and experience in advocacy and information dissemination, it interprets biodiversity information collected by specialists, and uses it to implement technically sound conservation projects within the Zambezi Basin.

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Executive summary

Carnivores represent an important component of global biodiversity, the Order Carnivora being made up of a diversity of species that vary in all aspects of their biology. Conversely in many parts of the world, they also represent a threat to human survival and can have significant adverse effects on human livelihoods through depredation of livestock. The conservation of carnivores is therefore, both an important undertaking, and also one with many challenges.

Conservation of carnivores in Africa is important as many species occur here and nowhere else. Effective conservation relies on accurate and recent data regarding status and distribution, as well as an understanding of the impacts of carnivore population on human populations, both positive and negative. Carnivores are argued to be keystone species, as the presence of a viable population suggests a large amount of biodiversity, given that they are at the top of the food chain. Many carnivore species are among the charismatic group of animals that attract tourists and sustain an important economy in many African countries

However, there is a concern over the paucity of data for much of the African continent regarding the status and distribution of carnivore species, and their impact on the human communities with whom they co-exist. A number of conservation workshops for various carnivore species in Africa have indicated that the highest priority for conservation and management is surveys in the numerous areas where little or no data exists.

The Zambezi River Basin is a large ecologically distinct area within Africa, where a number of carnivore species are known to have historically existed. The Basin has an impressive network of protected areas, and other areas suitable for wildlife management. There is a history of transboundary, regional conservation management in this area, with three Transfrontier Conservation Areas declared in the last 5 years. All these factors make this region potentially important for carnivore conservation but there is still a lack of information regarding priorities for conservation.

This review determined the current state of knowledge regarding the status, distribution and conflict with humans of all carnivore species known to have occurred historically within the Zambezi Basin. The review was carried out to start the process of determining what conservation priorities there are for this ecological region, to assist governments and other management institutions to more effectively conserve the overall biodiversity of the Basin.

The review found that there were large areas within the protected area network where there was either no recent data, or limited data regarding the status, distribution and conflict with humans of carnivore species. There is an urgent need for these areas to be surveyed as the review found that there is likely to be important populations of carnivores present, when extrapolating from available data.

Given the information that was available, three key areas for management were identified on the basis of overall species diversity for the Basin as a whole. The Hwange-Chobe-Caprivi-Luiana-Liuwa Plains complex of protected areas was found to be the area with the most potential for conservation of carnivores at present, based on recorded species diversity, connectivity and human-carnivore conflict mitigation. The Lower Zambezi-Mana Pools complex was also found to be relatively diverse, but human-carnivore conflict in this area is of concern and more work needs to be carried out. South Luangwa, and the Luangwa complex was found to be important due to the present of two rare species of carnivores, and overall species diversity, and Liwonde National Park in Malawi is a key area for management being the only protected area where the African Palm Civet was recorded.

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Section 1: Carnivore Conservation in the Zambezi Basin

Introduction

The Order Carnivora is the fourth largest group of species in the Class Mammalia (Gittleman et al, 2001), and use of the word "carnivore" conjures up images of charismatic, dangerous (and therefore, exciting) animals that kill other animals for food. In fact the Order Carnivora species range from being almost exclusively meat eating to exclusively insectivorous (Skinner and Chimimba, 2005). Many members of this Order have attracted a great deal of interest and some would argue an unfair proportion of conservation effort.

Carnivores are extremely varied in a number of characteristics such as size, reproductive rates, habitat use, home range and social structure (Gittleman et al, 2001). A single protected area may have resident species ranging from 250kgs (an adult male lion, *Panthera leo*), to 300g (an adult male Dwarf Mongoose, *Helogale parvula*). This variability makes this Order a priority for conservation, as efforts to conserve all carnivores species will effectively preserve a large degree of biological diversity as the habitat and resource requirements of member species cover a great deal of all habitats and resources available (Gittleman et al, 2001).

Many carnivore species are the most vulnerable species in the world given their requirements, and conservation of such species is a priority if they are not to disappear. Many species require large areas to sustain viable populations and as such can be argued to be keystone species.

Conversely, the challenge faced when conserving carnivores is that they are often also potentially very destructive, and can have large negative impacts on the livelihoods of the human communities they interact with. With increasing human populations, and the fact that some carnivore species require large areas to sustain viable populations, interactions between humans and carnivores are only likely to increase. The other side of the coin is that some species provide income to the human communities they interact with, through either consumptive or non-consumptive use, and many carnivore conservation programmes today are dedicated towards finding the correct balance between the cost of living with a carnivore species, and the benefit realized.

Much conservation effort to date has focused on conserving single species, although more recently attention is being paid to identifying areas with diverse communities of carnivore species, and then working towards conserving these areas. However, there is still a great deal unknown about the status, distribution, requirements and human-carnivore conflict. Until these knowledge gaps are filled, it will be difficult to identify these areas effectively, and resources may be wasted on duplicated effort throughout the range of each carnivore species.

The status and distributions of many carnivore species in Africa is no exception, especially when looked at from the global and continental perspective. Local information may be very accurate and detailed, but such information does not assist management in determining priorities and maintaining links between populations. This makes assessing conservation priorities difficult, and focus to date has tended to be on the large charismatic species in isolated populations. However, the distribution and status of even these larger species could be better understood.

One large and ecologically distinct area of Africa, the Zambezi Basin, is known to have important carnivore species present, but detailed information regarding their distributions, status and vulnerability is lacking for most of the Basin. Areas of the Zambezi Basin have been highlighted as important for the global conservation of mammals (Rodrigues et al, 2003) and for carnivores (Mills, Freitag and van Jaarsveld, 2001) given the nature of the vegetation, the diversity of species and the presence of species of global importance. Due to the very large spatial extent of the Basin, there is a high probability that populations of carnivores that fall within this area are important to the overall survival of the species in question and that the populations are already linked or have the potential to be linked to ensure their survival. The distribution and status of wild dogs (*Lycaon pictus*), one of the Africa's most endangered carnivores in the Zambezi Basin is not clear and yet indications are that the Basin could hold important populations of this species. The Global Cheetah Forum (Bashir, 2004) and the African Lion Working Group (Bauer and van de Merwe, 2004) have both argued that the Basin area could hold important populations of cheetahs (*Acinonyx jubatus*) and lions (*Panthera leo*) respectively, and that there is an urgent need for more detailed information. In their assessment of areas of geographic importance in conserving carnivores, Mills *et al* (2001) ranked species according to various conservation criteria. Out of those species ranked highest, where there is great concern for their survival, the following occur in the Zambezi Basin: wild dog, spotted hyaena (*Crocuta crocuta*), cheetah, aardwolf (*Proteles cristatus*), lion, serval (*Leptailurus serval*) and the bushy tailed mongoose (*Bdeogale crassicauta*). There is also concern about the lack of data for some carnivore species, and although they are not yet considered vulnerable or threatened, this may be a result of a paucity of data regarding their status and distribution. Meller's mongoose (*Rhynchogale melleri*) and the spotted necked otter (*Lutra maculicollis*) are two such species that are known to occur within the Zambezi Basin (Mills, pers. comm.) but we only have limited knowledge regarding their distribution.

Carnivore populations are likely to be linked within the Basin area given the large areas needed to sustain viable populations, especially the larger species (Bennett, 2003). Determining the current distribution of carnivores will assist management in identifying possible corridors for movement, to ensure long-term viability. Knowledge of the distribution of carnivore species within the Basin area will also highlight areas where cross-border management may be required to ensure their survival. Meta-population management of vulnerable species is costly, and it is preferable to conserve links that are already present, or work towards creating effective links after assessing the current situation on the ground. Identifying the current distribution and status of key carnivore species that require large tracts of land will be an important starting point for the establishment of suitable corridors.

Carnivores, especially the larger species, can be argued to be indicators of ecosystem health as they depend on the presence of prey animals, which in turn depend on productive vegetation. It can be argued that the presence of a community of large carnivores, such as the lion, cheetah, spotted hyaena, leopard (*Panthera pardus*) and wild dog, indicates a greater overall biodiversity as they feed on different species and sizes of prey. An assessment of the presence, distribution and status of the large carnivore community within the Protected Area (PA) network of the Zambezi Basin will also assist in identifying areas of importance with regard to biodiversity.

Tourism is being promoted in many areas of Africa as an industry that will assist local communities to develop. Many of the carnivore species are important keystone

species for the tourist industry, and determining their distribution with the PA network of the Zambezi Basin will provide information that can help the relevant authorities to improve revenue from tourists.

This report presents the results of a review of available information from the literature and from information obtained from individuals working in protected areas of the Zambezi Basin. The results presented here are preliminary in nature and include the following:

- Maps indicating where carnivore species are known to be present as of the year 2000, where species should be present according to previous records and where species are no longer present, ie they have been extirpated. It does not include population estimates or other measures of population abundance as there was no enough data available for all the areas included in the survey. Any reliable abundance measures available are referred to in the text accompanying the maps.
- Records of conflict between each carnivore species, and where possible the nature of this conflict and steps being taken to mitigate this conflict
- Maps indicating possible corridors of movement and areas where transboundary management of populations may be necessary.

It is anticipated that this report will assist in identifying gaps in our knowledge, and as a result will help inform management as to where resources should be spent collecting data.

Given the knowledge available, the report will also assist in identifying protected areas of current importance based on the known diversity of the carnivore communities present, connectivity with other protected areas and mitigation of human-carnivore conflict.

Zambezi Basin

The Zambezi Basin, which is the fourth largest drainage system in Africa, flows over a distance of 2650km from its source in the Kalene Hills of Zambia's northwest province to its mouth in the Indian Ocean in Mozambique. The total catchment area (Basin) of the river is almost 1.4 million km^2 and is home to approximately 40 million people (Munjoma, 2006) who are dependant on its natural environment's diverse resources. The Basin constitutes the most shared transboundary resource in the Southern African Development Cooperation (SADC) region and is, therefore, subject to exploitation by a diverse range of interests

The Basin is shared by eight countries (Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe, Figure 1) and incorporates a number of important ecoregions (Figure 2a) and wetlands (Figure 2b). The Basin encompasses a

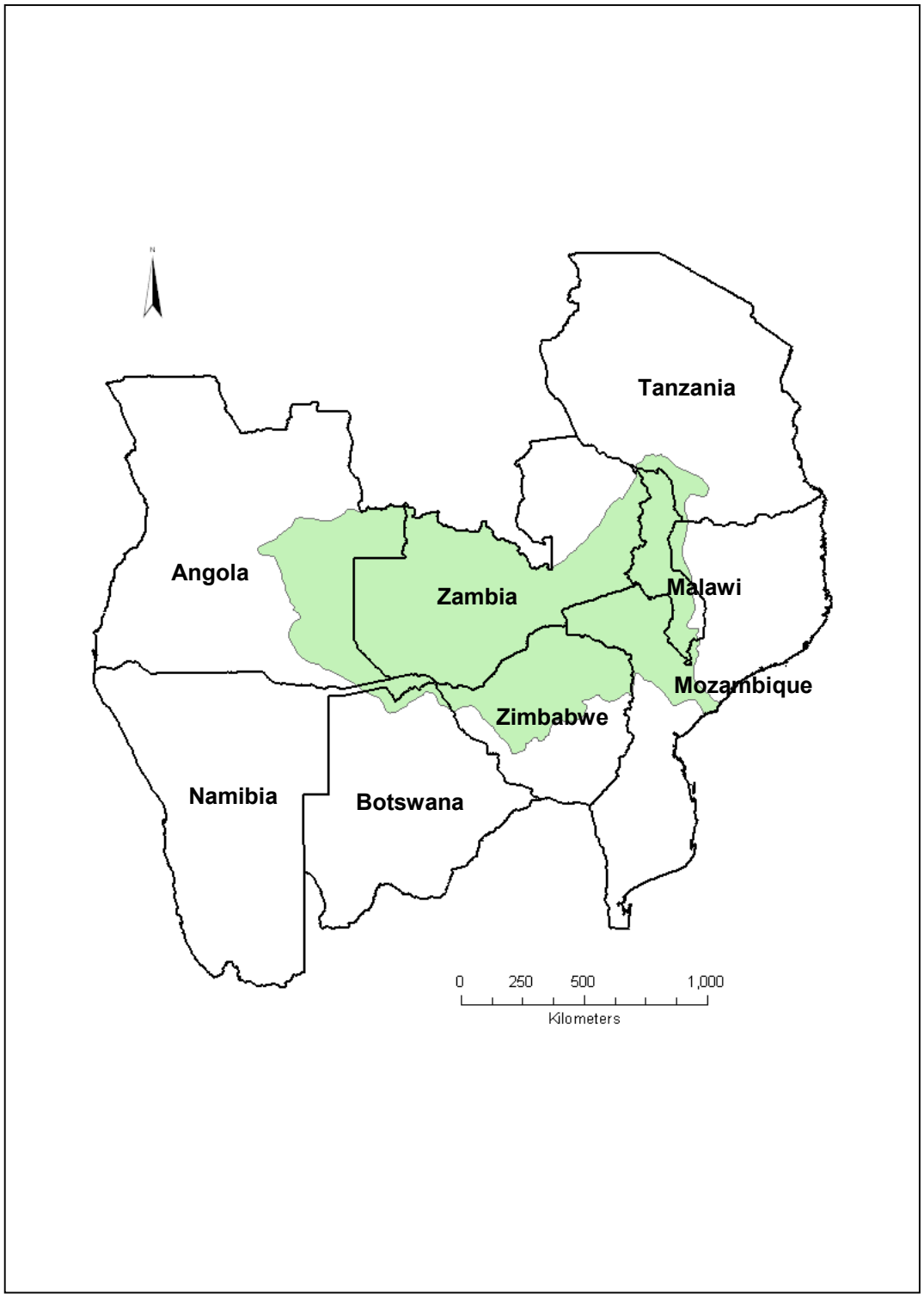
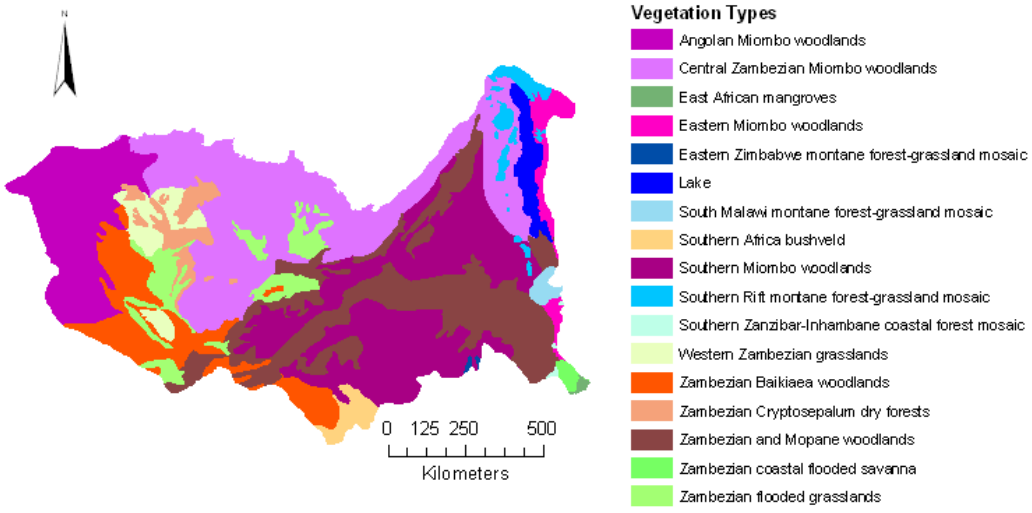
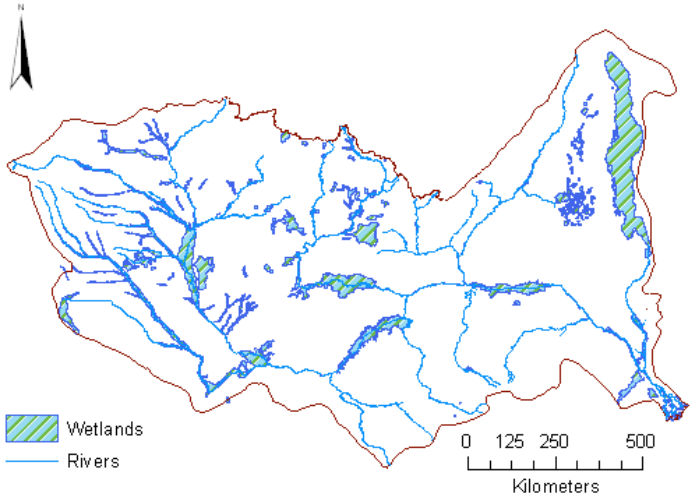


Figure 1: An illustration of the relative proportions of the Zambezi River Basin that fall within the eight countries (states) that share the Basin.



a) Main vegetation types of the Zambezi Basin



b) The Zambezi river with its main tributaries and wetlands

Figure 2: a) The main vegetation types of the Zambezi River Basin (based on WWF Ecoregions) and b) the major rivers and wetlands (Source: Biodiversity Foundation for Africa)

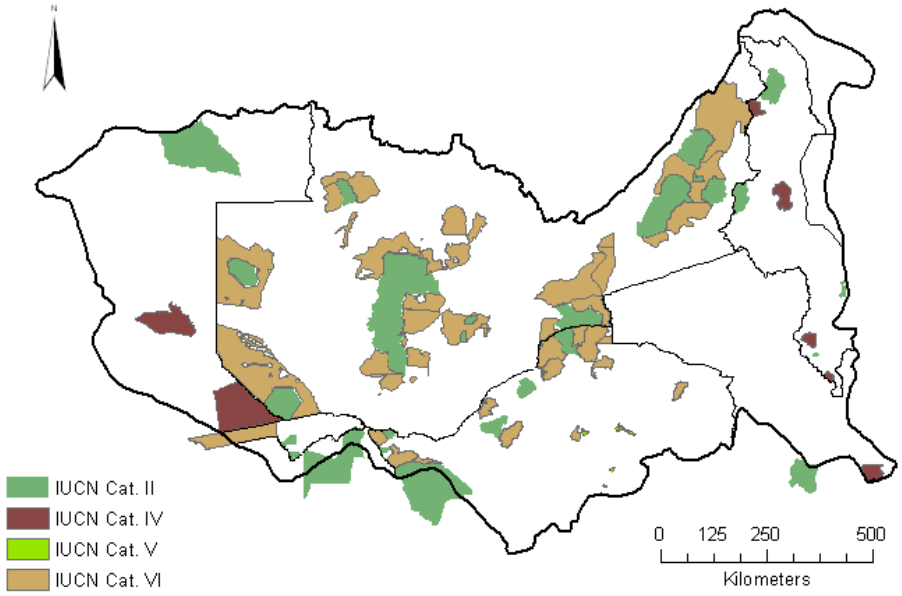
large proportion of the Miombo Ecoregion (Figure 2a) and includes the Barotse floodplains, the Kafue Flats, Lake Malawi and the Zambezi delta wetlands which have been shown to be critical to both the provision of fresh water, and the survival of large diverse herbivore (and hence carnivore) communities (WWF SARPO, 2007, Figure 2b).

The protected area network of the Basin is extensive (Figure 3a) and there is enormous potential for the conservation of substantial populations of wildlife, including fish, birds and mammals. However, the human population of the Basin is increasing, and as can be seen is not evenly distributed throughout the region (Figure 3b). Malawi is the most populated state within the Basin, and in many of the states human populations are resident legally within the protected area network (Figure 3b). This has the potential to result in increasing conflict between the wildlife of the Basin, through competition over available resources.

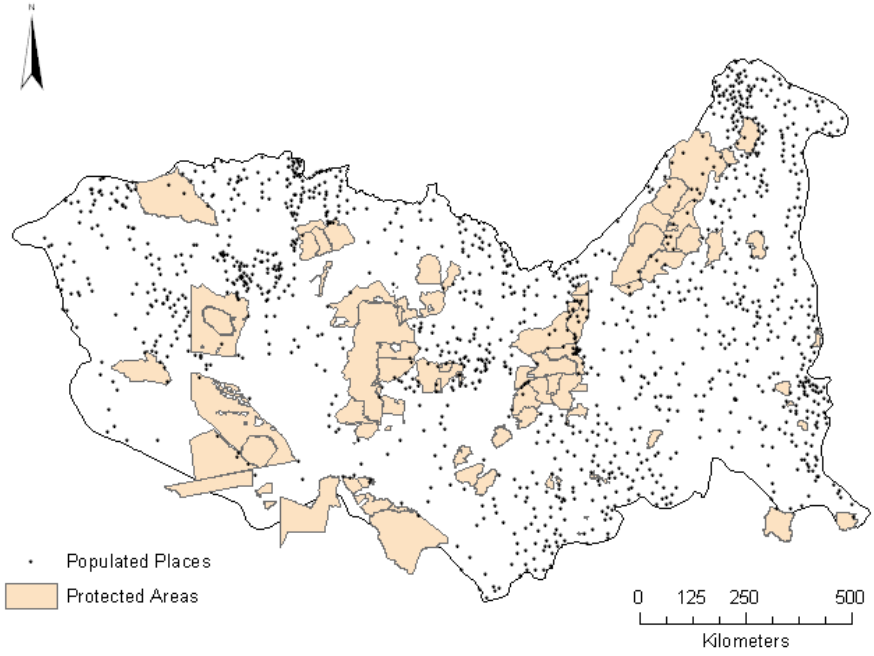
However, given the history of wildlife utilisation in many of the Basin states, there exist a number of areas which are not gazetted as wildlife areas, but which function as wildlife areas through sustainable utilisation programmes, where wildlife corridors could be developed to ensure sustainability of the wildlife communities (Figure 4). In many of these "other" areas for wildlife protection human communities are benefiting from the presence of wildlife (Holden, *et al*, 2006) and there is potential for wildlife populations to increase.

If found to be necessary, complexes protected areas within the Basin could be connected by biological corridors though such areas where, although land use is more intensive, wildlife movement is still possible. The end result could be a series of biological conservation corridors where large scale conservation planning can take place without being confined to protected areas and their buffer zones (Sanderson *et al*, 2003).

Given the requirements of large carnivores for large areas, with adequate populations of prey, they can be argued to be keystone species whose conservation will act to conserve a significant proportion of the overall biodiversity of the Basin. The carnivore community of the Basin includes 6 large species (lion, leopard, spotted and brown hyaena, cheetah and wild dog) and species that depend on large connected expanses of water with adequate stocks of fish (the spotted and cape clawless otters). An assessment of their current status and distribution within the Basin will assist greatly in identifying key areas for management of water and other natural resources in this important ecological region.



a) Protected area network of the Zambezi Basin



a) Distribution of human population centres within the Zambezi Basin and its protected areas

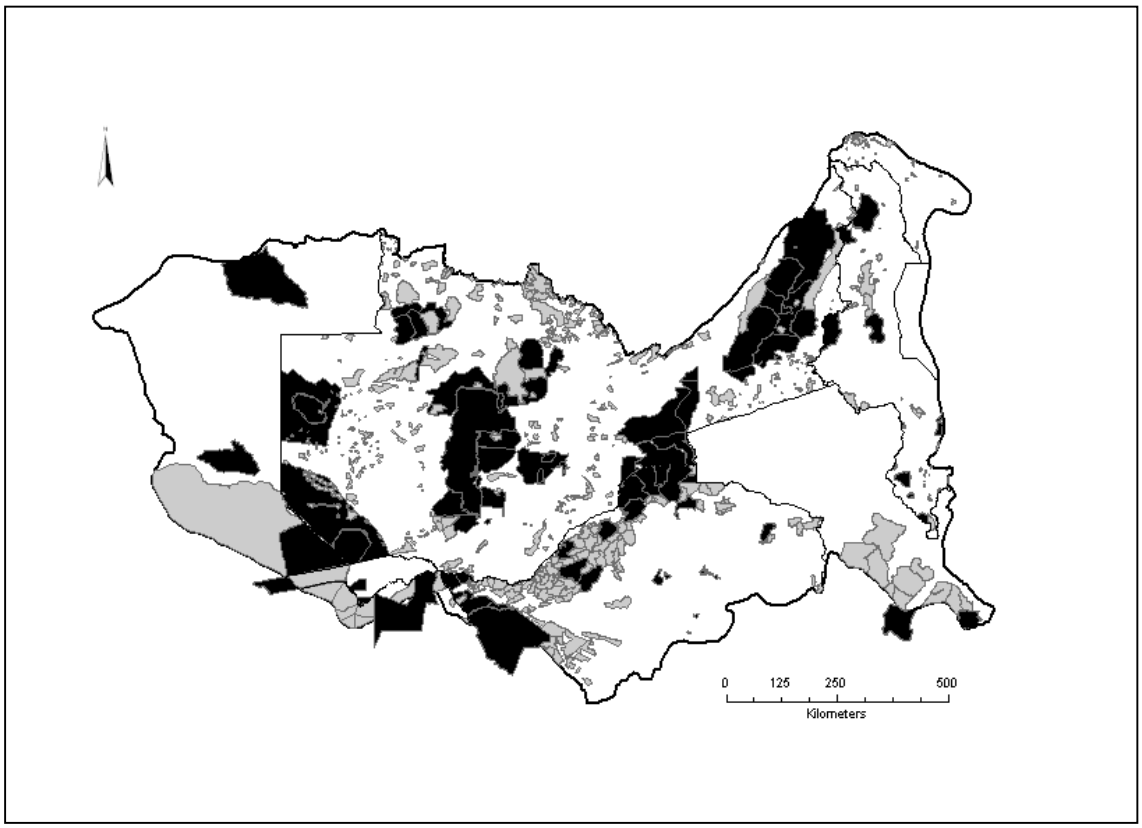


Figure 4: The network of other wildlife land use areas (grey polygons; WPDA, 2006) illustrating potential areas for corridors between the protected area network of the Zambezi River Basin (black polygons; WPDA, 2006)

The Review

As the number of carnivore species that have been present historically in the Zambezi Basin is large (See Appendix I for more detail), and many of them are difficult to identify by the layperson, the review divided the species into two groups. The first group (**Priority species**) comprises species considered to be of conservation importance, determined using the following criteira:

- the species is considered to be endangered or vulnerable according the IUCN Red Data Book,
- the species is regarded as a keystone species, or a member of the large carnivore community
- in conservation literature, a specific conservation need has already been identified

Using these criteria, the priority species group includes wild dog, cheetah, lion, spotted hyaena, leopard, aardwolf, serval, spotted necked otter and the bushy tailed mongoose.

All the other carnivore species historically present in the Basin were included in the review under the group, **Other species**.

Only protected areas were included in the review as the Zambezi Basin covers an immensely large geographic area, and to determine presence/absence of carnivores throughout the entire area would be costly in terms of both time and resources. Protected areas are by their very nature areas that have the most potential for carnivore conservation and it is logical to start with determining carnivore distribution and status in these areas.

The review was carried out by reviewing all available literature, including published papers, unpublished reports (and other forms of grey literature) and where possible databases that included records of carnivore presence (eg Zimbabwe Parks and Wildlife Authority Quota records; CAMPFIRE Association Problem Animal Control Records, Widlife and Environment Zimbabwe Game Count records, Museum records). Where possible, individuals known to be working or have worked since 2000, in protected areas within the Basin were contacted and requested to fill in a questionnaire (See Appendix II). If the information available was not detailed enough to fill in the questionnaire, these same individuals were requested to list species they had seen since 2000. Individuals in Angola and Mozambique were contacted in person to overcome the problems of differences in language and in some cases in Zambia respondents were contacted by telephone.

Human carnivore conflict was recorded when

- carnivores impacted negatively on resident human populations, such as human deaths and/or depredation of livestock and
- humans impacted negatively on carnivores either
    - directly such as retaliatory killing or killing for skins
    - indirectly such as snaring, reduction in prey base and road kills

When compiling the maps, all available information was collated and six categories were used to map the current distribution of all the species:

- **Confirmed present** by reliable source since year 2000
- **Unconfirmed present** (information received was not detailed enough for verification. Record since year 2000)
- **Expected** (using the two authoritative texts Skinner and Chimimba (2005) and Ansell (1978) to determine where species should occur from historical records, but were not recorded during the survey)
- **Out of range** (as per Skinner and Chimimba (2005) and Ansell (1978))
- **Extirpated** (species were present historically but are confirmed to have disappeared from the area)
- **Transient** (species have been seen in the area periodically but are known to move in and out of the boundary, with no resident populations)

A black and white colour scheme was adopted to ensure that information would not be lost should end users receive a photocopied report. Many of the decision makers in this region do not have access to computers and may only receive a photocopied of this report.

Maps were compiled using the software ARCMAP V8, and the World Database on Protected Areas (IUCN, 2006) was used to generate the base line map of protected areas. All other information was accessed from GeoComm.

Species' conservation concerns

Priority species

Wild dog

The African Wild Dog (*Lycaon pictus*) once existed in great numbers in most parts of sub-Saharan Africa. Today it is one of Africa's most endangered carnivores (Leigh, 2005) and is red listed as an endangered species by the International Union for the Conservation of Nature (Woodroffe, *et al*, 2004). In an assessment of geographic priorities for carnivore conservation in Africa, Mills *et al* (2001) gave the wild dog the second highest priority score for conservation using five criteria (taxonomic distinctiveness, endemism, extent occurrence, Red Data Book status and size). It is estimated that only 3,000 - 5,000 wild dogs remain in Africa today, with most populations occurring in Angola, Zambia, Malawi, Mozambique and southwards (Skinner and Chimimba, 2005; Woodroffe et. al., 1997). Given current knowledge, the largest populations in the southern and central African region exist in northeast Namibia, Northern Botswana and Western Zimbabwe (likely to be one contiguous population), the Zambezi Valley and in Kruger National Park (Skinner and Chimimba, 2005). However, there are still question marks as to the status of this species in many areas of the Basin, especially Angola, much of Zambia and Mozambique. It is likely that where there is still a wild prey base, and protected areas large enough to buffer wild dog populations for the adverse effects of interaction with humans, viable wild dog populations will be present. There is an urgent need to determine the status and distribution of wild dogs in an area such as the Basin to fill in some of the gaps in the knowledge base.

Cheetah

Historically cheetah ranged widely throughout Africa and Asia (Skinner and Chimimba, 2005; Nowell and Jackson, 1996, Barthels et al., 2002). They have undergone significant declines in distribution over much of their range, mainly due to persecution by humans for their skins and retaliatory killings by farmers (Nowell and Jackson, 1996). They have become extinct in at least 13 countries in the past 50 years. They still occur in the Middle East and parts of Asia and the drier parts of sub-Saharan Africa. Their distribution has become much fragmented and large contiguous populations are now restricted to the woodland savannas of eastern and southern Africa.

The total number of cheetahs in sub-Saharan Africa has been variously estimated at 15,000 in 1975, 25,000 in 1984 and 9,000 – 12,000 in 1991 (Nowell & Jackson, 1996). The cheetah is listed as Vulnerable by the IUCN

In 2001 the first ever Global Cheetah Action Plan Workshop was held in South Africa, facilitated by the IUCN/Conservation Breeding Specialist Group (CBSG). This was followed by a Global Cheetah Forum Review Workshop in 2002. The Forum voted completing a census of free-ranging cheetahs the highest priority of all projects. In December 2005, at the third meeting of the Global Cheetah Forum (Southern African members) status reports were commissioned for all southern and central African states by the Forum in conjunction with the IUCN Cat Specialist Group. Purchase (in press) determined that little was known about cheetah in Zambia, but that the species has always been regarded as rare, except for Kafue National Park, and was apparently restricted to Protected areas, having disappeared from much of the country. In Mozambique Purchase (in press) reported that cheetah had disappeared from much of their former range, and were only confirmed as present in one area of the country (Tete province in the north west) and unconfirmed present in the areas adjacent to Kruger National Park and Gona-re-Zhou National Park. No information was available for Angola. There is an urgent need to determine if the status of cheetah is as reported by Purchase (in press) and Purchase (in press) is still accurate, or whether populations exist that have previously been unrecorded.

Lion

Lions once occurred widely in Europe, Asia and Africa, but their distributional range has shrunk considerably in recent times. Historically, the lion ranged across most of Africa, with the exception of the rainforests of the Congo Basin and the interior of the Sahara Desert. The lion has now disappeared from over 80% of its former range (IUCN/SSC Cat Specialist Group, 2006). At least 7 African countries have witnessed the recent disappearance of lions from their territory.

Currently lions occur either permanently or occasionally in 34 African countries. There is disagreement as to what proportion of the remaining African lion population is in protected areas. Chardonnet (2002) estimated that about half the African lion population occurs outside protected areas, this being more so in West and Central Africa. Meanwhile Bauer & Van Der Merwe (2004) stated that due to increased human pressure lions had virtually disappeared from non-protected areas. This was supported by Ray, et al. (2005), who stated that lions were currently restricted mainly to protected areas and surrounding conservancies or game management areas.

Two recent surveys have provided the first current estimates of the African lion population. The African Lion Working Group (ALWG), a network of lion specialists affiliated with the IUCN/SSC Cat Specialist Group, conducted a survey and compiled estimates of 100 known African lion populations. Lion populations of unknown or unestimated size were not included. The ALWG African lion population estimation is 23,000, with a range of 16,500 – 30,000 (Bauer and Van Der Merwe 2004). The second survey was carried out by Philippe Chardonnet (2002). He compiled estimates for 144 individual lion populations grouped into 36 isolated subpopulations. His methodology included extrapolation of estimates of known populations into areas where lion status was unknown, and his total figure is larger: 39,000 lions in Africa, with a range of 29,000-47,000. Approximately 30% of the individual population estimates compiled by the ALWG were based on scientific surveys. The other 70% were derived from expert opinion or guesstimates. In the other survey 63% of Chardonnet's individual population estimates were based on expert opinions or guesstimates, while 12% were based on scientific surveys and a further 25% derived from extrapolation variables from nearby populations and catch-per-unit effort-estimates based on lion trophy hunting (Bauer & Nowell, 2004).

In 2004 the IUCN SSC Cat Specialist Group carried out an assessment of the African lion for the IUCN Red List of Threatened Species. Using two important sources (Ferreras and Cousins, 1996; Chardonnet, 2002), the lion was assessed as Vulnerable due to an estimated species population reduction of 30-50% over the past two decades (three lion generations)

It was agreed at the 13th Conference of the Parties to CITES (Bangkok, November 2004), that there was a need to better understand the status of lion and to develop a management strategy for its long-term survival. With the assistance of IUCN, a pan-African workshop on East and Southern African lion conservation was convened in Johannesburg, South Africa in January 2006, to determine lion status and develop conservation recommendations.

One of the objectives of the strategy developed at the workshop was to ensure effective conservation management of lions, their habitat and prey by developing monitoring and survey programmes throughout their ranges states (IUCN/SSC Cat Specialist Group, 2006) Given the lack of data in many areas of the Basin it is important that surveys are conducted in line with the Conservation Strategy for Lion in Eastern and Southern Africa, to determine current status, distribution and threats. As lion populations are likely to cross national boundaries, adopting a regional approach to surveying is advisable.

The strategy also recognised the need to address human-lion conflict and set a target of developing databases documenting such conflict in each range state. The results of this review will assist in this process, as it will involve determining recorded levels of human-carnivore conflict.

Finally, the Conservation strategy set a target to develop a new integrated land use plan to secure existing and establish lion populations. This target cannot be met without understanding the current situation i.e where lions occur, and where lions have been extirpated. The results of this review will also assist with achieving this target.

Spotted hyaena

Spotted hyaenas (*Crocuta crocuta*) used to be widespread throughout sub-Saharan Africa. Their range has shrunk considerably in recent times (Skinner & Chimimba, 2005). The current distribution of spotted hyaena is patchy in many places, with populations concentrated in protected areas and surrounding land (Mills & Hofer, 1998). Continuous distribution over large areas is now restricted to Ethiopia, Kenya, Tanzania, Botswana, Namibia and eastern South Africa (Ray et al., 2005).

Spotted hyaenas are listed as "Lower risk: conservation dependent" in the IUCN Red List of Threatened Species, based on an assessment carried out in 1996 (Hyaena Specialist Group, 1996a). However, Mills *et al* (2001) listed this species as the third highest priority for conservation based on the following five criteria; taxonomic distinctiveness, endemism, extent of occurrence, Red Data Book status and size. Spotted hyaenas are often reported as problem animals and may have a considerable adverse effect on human populations in terms of livestock losses and as a threat to human life. As a result they can suffer high level of persecution. It is important to determine their status and where they are reported to be in conflict with humans within the Basin.

Aardwolf

The Aardwolf (*Proteles cristatus*) occurs in two distinct populations in eastern and southern Africa, separated by a 1,500km gap of relatively unsuitable wetter woodland habitat. The aardwolf's range has not changed much in recent times (Ray et al., 2005). The southern population extends into southern Zambia from Namibia and Botswana. Records collected over the last 20 years indicate it still occurs over much of its former range in southern Africa (Mills & Hofer, 1998).

Although the aardwolf population is not apparently threatened (Lower Risk status, IUCN; Hyaena Specialist Group), it was given a high conservation priority score by Mills *et al* (2001) and given this knowledge it is important to determine its current status and distribution within the Basin.

Serval

Servals (*Leptailurus serval*) have a wide distribution in Africa south of the Sahara (Skinner & Chimimba, 2005). They are widely distributed within historical limits, but have suffered range loss at the north, west and extreme south of their range. Meanwhile, they have expanded their range in a few places, such as in South Africa. Servals are strongly associated with permanent water sources (Ray, et al., 2005), and the Zambezi Basin is likely then to be an important stronghold for the species given the large expanses of wetland and large river systems (Figure 2b). Very few studies of serval in Africa have been carried out, but this species was also given a high conservation priority score by Mills *et al* (2001) mainly due to its size (and therefore potential for conflict with humans) and taxonomic distinctiveness.

Leopard

The Leopard (*Panthera pardus*) has a wide distribution in sub-Saharan Africa and also occurs widely in the Middle East and Asia. Remnant populations remain in North Africa and South Africa (Stuart & Stuart, 1997). The leopard has a wider distributional range than any of the larger wild cats, given its greater habitat tolerance and broader prey base (Skinner and Chimimba, 2005). Historically, the leopard has experienced a marked range loss in Asia, North Africa, West Africa and South Africa.

The status of the leopard has been a matter of controversy since 1973, when it was first listed on the CITES Appendix I (Nowell & Jackson, 1996). Several attempts have since been made to determine the leopard's status but many of them have been criticised. Despite the controversy there appears to be general agreement that it is not currently endangered in sub-Saharan Africa, but is subject to local depletion. There is a growing body of evidence that the combined effect of killing of leopards as problem animals (livestock depredation and threat to human life) and trophy animals can have a adverse effect on populations, reducing recruitment by disrupting the social system of the species (Balme and Hunter, 2004). If such exploited populations are not linked to an unutilised source population they can become extinct. Given the large number of areas within the southern and central African region where leopards are exploited as trophy animals, but also killed as problem animals, there is an urgent need to assess the status of the species in the Basin, a large geographic area which has the potential to hold an important regional population of leopard.

Bushy tailed mongoose

The Bushy-tailed Mongoose (*Bdeogale crassicauda*) is confined in distribution to the eastern parts of Africa, from south eastern Kenya, southwards to central Mozambique, south eastern Congo DR, and eastern Zimbabwe. It is not common anywhere throughout its range. The species' distribution is not clear, as it is based on the collection of only a few specimens (Skinner & Chimimba, 2005. Schreiber, et al. (1989) stated that the species was, in general, rare, nowhere occurring at great densities, although the reasons for this were unknown. Taylor (1987) stated that the mongoose was rare and there were relatively few records of its distribution. The species is not considered endangered, except as *B.c.omnivora* (Sokoke bushy-tailed mongoose), which occurs in a few coastal areas of Kenya and Tanzania (Schreiber, et al., 1989).

However, given the lack of information regarding its current status and distribution, this conservation status may change. A large proportion of its range falls within the Basin, and it is imperative that this review determines how much is currently known about the species.

Meller's mongoose

Meller's mongoose (*Rhynchogale melleri*) appears to be confined to the more eastern parts of Africa (Skinner and Chimimba, 2005). Ansell (1978) noted that its' precise distribution in Zambia was not known. Nowhere is it common throughout its patchy range. But its apparent discontinuous distribution may be due to a lack of knowledge of its presence, rather than its absence (Skinner & Chimimba, 2005). As much of its' known range falls within the Basin, it was felt that the review should focus on determining the current knowledge base about this species.

Spotted necked otter

The Spotted-necked Otter (*Lutra maculicolis*) has a wide distribution in Africa south of the Sahara, although it is confined to larger rivers, streams, dams and swamps (Skinner & Chimimba, 2005). Its distributional range is thought to be declining, particularly in southern Africa. Mason & Macdonald (1990) identified a need for field studies to determine its current distribution and status throughout its range. They classified it as a "species of local conservation concern."

Accurate data are mostly lacking, but it is thought to have disappeared from some rivers in South Africa, possibly due to siltation or over-fishing. This species appears

to be dependent on clear, unsilted, unpolluted, permanent fresh water (Ray, et al., 2005), and can, therefore, be argued to be an indicator of water quality. Given the changes that have occurred in the Basin since many of the historical records were recorded, there is concern that the species may have declined, and there is a need to determine its current status and distribution in a geographic area which should have a large population of the species, given the large expanses of wetlands, large rivers and lakes.

Other species

Hyaenidae

The other species of hyaena that occurs within the Basin is the brown hyaena (*Parahyaena brunnei*). Historically this species has only been recorded in the extreme southwestern area of the Basin, at the northern most part of its range. It is for this reason that it was not included as a priority species for this review, although its priority conservation score (Mills *et al*, 2001) is higher than some of the other species included in the priority group. Its' impact on human populations is generally small as it is predominantly a scavenging species, but it has been reported in some countries as a problem animal, preying on small livestock such as sheep and goats (Mills and Hofer, 1998)

Canidae

The Side-striped Jackal (*Canis adustus*) has a wide distribution in Africa south of the Sahara (Stuart & Stuart, 1988). It occurs in West, Central and southern Africa, excluding the southernmost part (Atkinson and Loveridge, 2004). There is no significant change from its historical distribution (Ray, et al., 2005). Regional estimates of abundance are not available, but it is assumed common and stable. The total population is estimated at over 3 million (Atkinson & Loveridge, 2004).

Black backed jackals (*Canis mesomelas*) have a similar distribution in the Basin to that of the brown hyaena, occurring only in the southwestern area of the Basin. It is an important species to consider as it is known to outcompete the brown hyaena and the side striped jackal (Mills and Hofer, 1998; Loveridge and Macdonald, 2001; Loveridge and Macdonald, 2002).

The bat-eared fox (*Otocyon megalotis*)occurs within two discrete distributional ranges in Africa. The northern range in East Africa from Tanzania to Ethiopia and Somalia is separated by about 1,200 km from the southern range in southern Africa. They occur widely in southwestern Angola, Namibia and Botswana and the distribution extends narrowly into Zimbabwe and Mozambique and into western South Africa (Skinner and Chimimba, 2005). The disjunctive distribution is similar to that of the aardwolf and the black-backed jackal (Nel & Maas, 2004), and only a small proportion of its southern range falls within the Basin.

However, the southern part of the range has expanded considerably in recent decades (Stuart & Stuart, 1997). Until 1965 bat-eared foxes had not been recorded in the extreme northeast of Botswana along the Chobe River. After this date they were seen on several occasions near Kasane, where they seemed to have settled (Smithers,

1971). In 1970 they were recorded for the first time in Victoria Falls, Zimbabwe, suggesting that the species was in the process of extending its range.

Although there have been various reports of the bat-eared fox in Zambia over the years (Ansell, 1960 & 1978), none of these have ever been confirmed and are thought to have been mistaken identities, probably for side-striped jackal. The species does, however occur close to the Zambian border at Kasane in Botswana and near Victoria Falls in Zimbabwe (Ansell, 1978). The inclusion of this species in the review may lead to new confirmed locations of the species, indicating that its range is still expanding.

Felidae

The Wild Cat (*Felis silvestris*) is widespread in Africa except in tropical and montane forest and most of the Sahara Desert. It also occurs in Europe, the Middle East and Western Asia (Stuart & Stuart, 1997; Skinner & Chimimba, 2005). It is generally common, but threatened in some areas by hybridising with domestic and feral cats (Stuart & Stuart, 1997).

Caracal (*Caracal caracal*) are still widely distributed through their historical range (Ray, et al., 2005), comprising parts of central and south western Asia, and most of Africa, excluding the Sahara and equatorial rainforest. They inhabit the drier savanna woodland regions of sub-Saharan Africa (Nowell & Jackson, 1996). They have experienced loss at the peripheries of their former range in North & West Africa, but are still common, especially in livestock lands, in southern and eastern Africa. They have even expanded their range in some farming areas in southern Africa (Ray, et al., 2005).

In some places, such as in South Africa and Namibia, caracal are common and have become problem animals, while in other places they are considered sparse, but this may be on account of their being nocturnal and secretive (Skinner & Chimimba, 2005 Nowell & Jackson, 1996). Caracal are listed under species of Least Concern by IUCN, the total population size being estimated as more than 50,000, but with declining trend.

Mustelidae

The Cape Clawless Otter (*Aonyx capensis*) is distributed widely in Africa south of the Sahara where there is suitable aquatic habitat (Skinner & Chimimba, 2005). There are few accurate distribution data for the species, but it is thought to be still widely distributed throughout its historical range, though nowhere common (Ray, et al., 2005). There is a need to determine its current status and distribution within the Basin given the increase in human population, and the potential negative consequences of this increase.

The Honey Badger (*Mellivora capensis*) has a wide distribution in Africa but is absent from true desert (Stuart & Stuart, 1997). It also extends to the Middle East, eastward to India and Nepal (Vanderhaar & Hwang, 2003). It still occurs widely throughout its historical range and appears to naturally occur at relatively low densities and is nowhere abundant. Distribution trends are poorly known (Ray, et al., 2005). Its status

in most parts of its extensive range (particularly West and Central Africa) remains uncertain, but there is little doubt that the honey badger is now absent from many areas where it previously occurred and populations may be becoming increasingly fragmented throughout its range. Little information is available from other areas, and as it should occur throughout the protected area network of the Basin there is a need to establish the current knowledge of its status and distribution.

The Striped Polecat (*Ictonyx striatus*) has a widespread distribution in Africa south of the Sahara, being absent only in the Congo Basin, the forests of West Africa and the arid regions of north-eastern Somalia (Larivière, 2002). However, little is known about its current status and distribution, except that it should occur in all the protected areas of the Basin

The Striped Weasel (*Poecilogale albinucha*) has a limited range in southern and central Africa (Stuart & Stuart, 1997). As it has always been apparently rare in most of its range (Skinner & Chimimba, 2005), there is a need to assess how much is currently known about its status and distribution.

Viverridae

Civets (*Civettictis civetta*) occur in sub-Saharan Africa from 15^{o}N to 24^{o}S latitude and from Senegal to the east coast (Ray, 1995). They remain widely distributed throughout their historical range (Ray, et al., 2005) and should occur in all the protected areas of the Basin.

The Genet species have been grouped together for several reasons. The species are very difficult to distinguish in the field, this being further complicated by the fact that scientists are not yet clear on how many species there are, and studies have shown that hybridisation between the species occurs in some areas (Gaubert, et al., 2004). Ansell (1978) recognised three species of genet from Zambia, the Large-spotted or Pardine Genet *(Genetta pardina [tigrina])*, Small-spotted Genet *(G. genetta)* and Angolan Genet *(G. angolensis)*. More recently, both *G. tigrina* and *G. genetta* have been found to comprise at least two species each (P. Taylor, pers. com.). *G. tigrina* is divided into *G. tigrina* and *G. pardina*, while *G. genetta* is split into *G. genetta* and G. felina. Gaubert, et al. (2004), after recent morphological and molecular studies, found *G. maculata* to be widespread in Zambia and *G. angolensis* widespread except east of the Muchinga and Zambezi escarpments. *G. genetta* was identified from two places, one in north-western Zambia and one in northern Zambia. Meanwhile, there was one possible case of *G. felina*, also in north-western Zambia.

From this evidence it seems likely that there is more than one species present in most parts of Zambia, except for the Luangwa Valley and Middle Zambezi to Lower Zambezi Valleys, where only *G. maculata* has been recorded. The review felt that is was suitable to group all the species, given that at present none of them are considered to be endangered or vulnerable according to the IUCN (Schreiber *et al*, 1989). Recording the presence of "genets" will assist managers in determing protected areas that have a diversity of carnivore species, as genets occupy a specific niche in the carnivore world.

Nandiniidae

The African Palm Civet, (*Nandinia binotata*) occurs only marginally in the Basin (in Malawi and some areas of Mozambique; Skinner and Chimimba, 2005) but as its specific habitat requirements for forest habitat make it an important indicator species, it was felt that the review should determine the current status and distribution. It should occur in all protected areas of Malawi, and possibly in Gorongosa National Park in Mozambique.

Herpestidae

The two rare species of mongoose have been covered in detail under the section "priority species". The other species of mongoose that should occur in all, or some of the protected areas of the Basin include the slender mongoose (*Galerella sanguinea*), the white tailed mongoose (*Ichneumia albicauda*), the marsh (or water) mongoose (*Atilax paludinosus*), the dwarf mongoose (*Helogale parvula*), the banded mongoose (*Mungos mungo*), the large grey (or Egyptian) mongoose (*Herpestes ichneumon*) and the Selous mongoose (*Paracynictis selousi*). As the presence of these species in a protected area would add to the biodiversity of the carnivore community, all these species were included in the review.

Section 2: Status, distribution and levels of human-carnivore conflict in protected areas and surround of the Zambezi Basin

Published literature regarding the status and distribution of carnivores, and records of human-carnivore conflict were limited for this region, with most information being available for Protected areas in Botswana, Namibia and Zimbabwe. In addition most grey literature reviewed also contained more information about these three countries than the other countries that share the Basin, namely Angola, Malawi, Mozambique and Zambia. The number of databases available was limited, and it is of concern that none of the countries that share the Basin keep detailed records at the national level of records of conflict between humans and carnivores, the CAMPFIRE database from Zimbabwe being one of the exceptions, and even this database only includes records of the larger carnivore species.

However, there were a number of respondents to the questionnaire from six of the seven countries, which in addition to the information gained from the literature, enabled a preliminary assessment of the status and distribution of carnivores to be made, although it must be acknowledged that the report is biased towards the Protected areas well represented in both the published and grey literature. Apart from data regarding the presence of lions from the Conservation Strategy for the Lion in Eastern and Southern Africa (IUCN Cat Specialist Group, 2006), there is no recent information available from Angola, and all data presented in this report for this country come from Skinner and Chimimba (2005). Only information regarding the status and distribution of the large carnivores was available for Namibia, and there was limited information for the smaller species from Malawi and Mozambique. More detailed data was collected from Zambia and Zimbabwe, mainly due to a greater number of respondents, who had spent considerable time in the Protected areas in these countries.

Broken down by country there were 33 respondents in Zambia, 13 in Zimbabwe, 3 in Malawi, 3 in Botswana, 2 in Namibia and 1 in Mozambique, giving a total of 55.

There was very limited data regarding conflict between humans and carnivores, the most detailed being available for the larger species. There were few respondents who reported conflict in Zambia, and most of these reports were for the larger species. In Malawi there is little conflict reported for any species other than the spotted hyaena, mainly because it appears that most of the larger species have been extirpated from the Protected areas. No information on conflict was available for Mozambique or Angola.

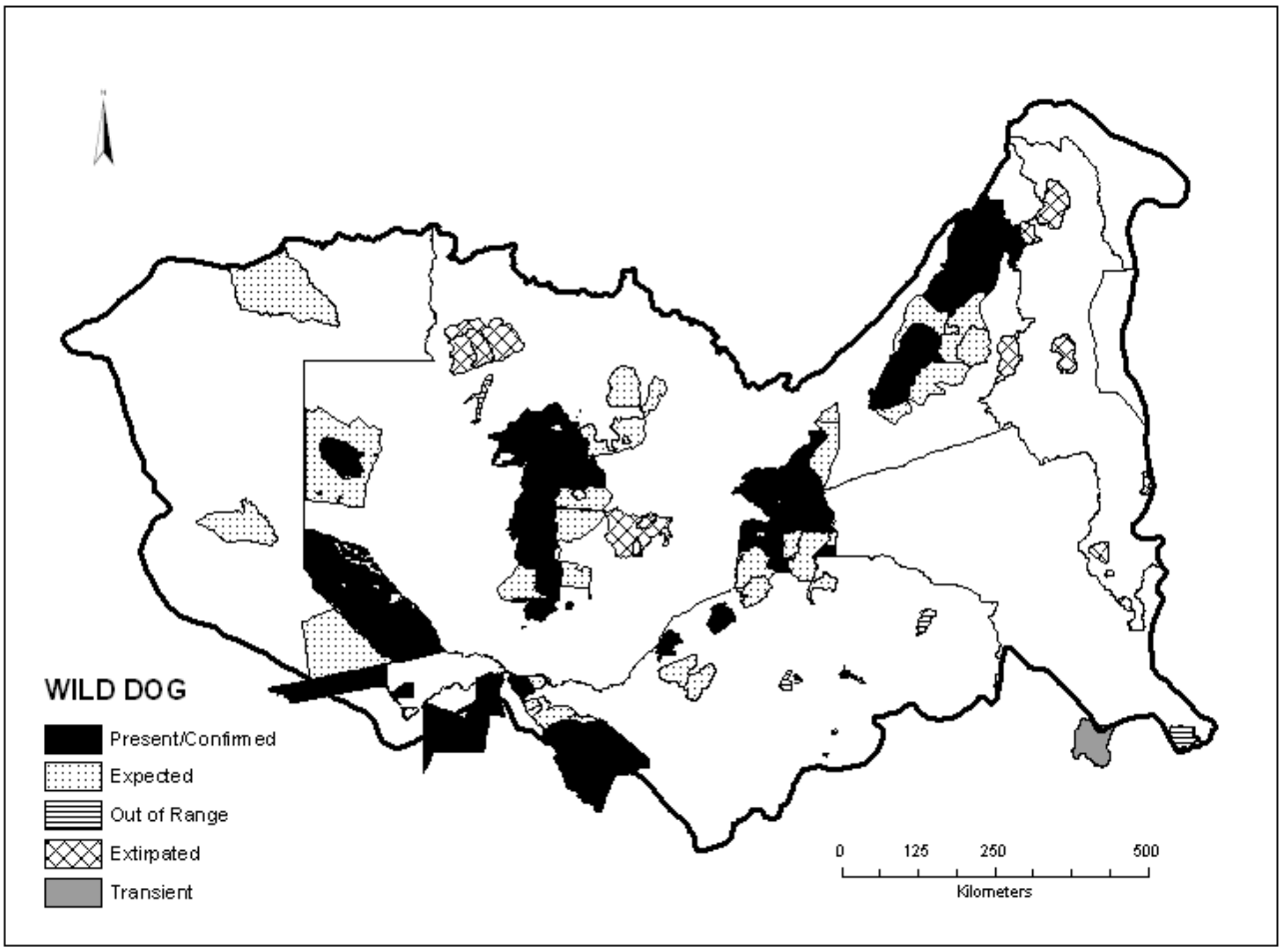
The following sections present the data collected during the survey.

Status and distribution of carnivore species

Priority species

NOTE: Present/Confirmed = species recorded by a reliable source since 2000; Present/Unconfirmed = species recorded since 2000 but details not verified; Expected = historical records indicate that species should be present but was not recorded during this survey; Extirpated = species known to no longer be present; Transient = species present but not resident

Wild dog



The results of the survey indicate that wild dogs are widely distribution in the protected areas of the Zambezi Basin, occurring in six distinct geographic areas (the Liuwa Plains-Caprivi-Chobe-Hwange complex of protected areas, the Kafue complex, the Lower Zambezi-Mana Pools complex, the Luangwa complex and in Mozambique;). In five of these areas, wild dogs appear to be resident and permanent, whereas in Gorongosa National Park they are reported to be transient and are only seen sporadically. Given the lack of data for many of the protected areas of the Basin the species may be more widely distributed that shown here, and may be present in many of the areas currently listed under the "expected" category. Certainly the presence of lions in the protected areas of Angola (see below) indicate that wild dog may also still be present in these areas. The distribution of the species was not found

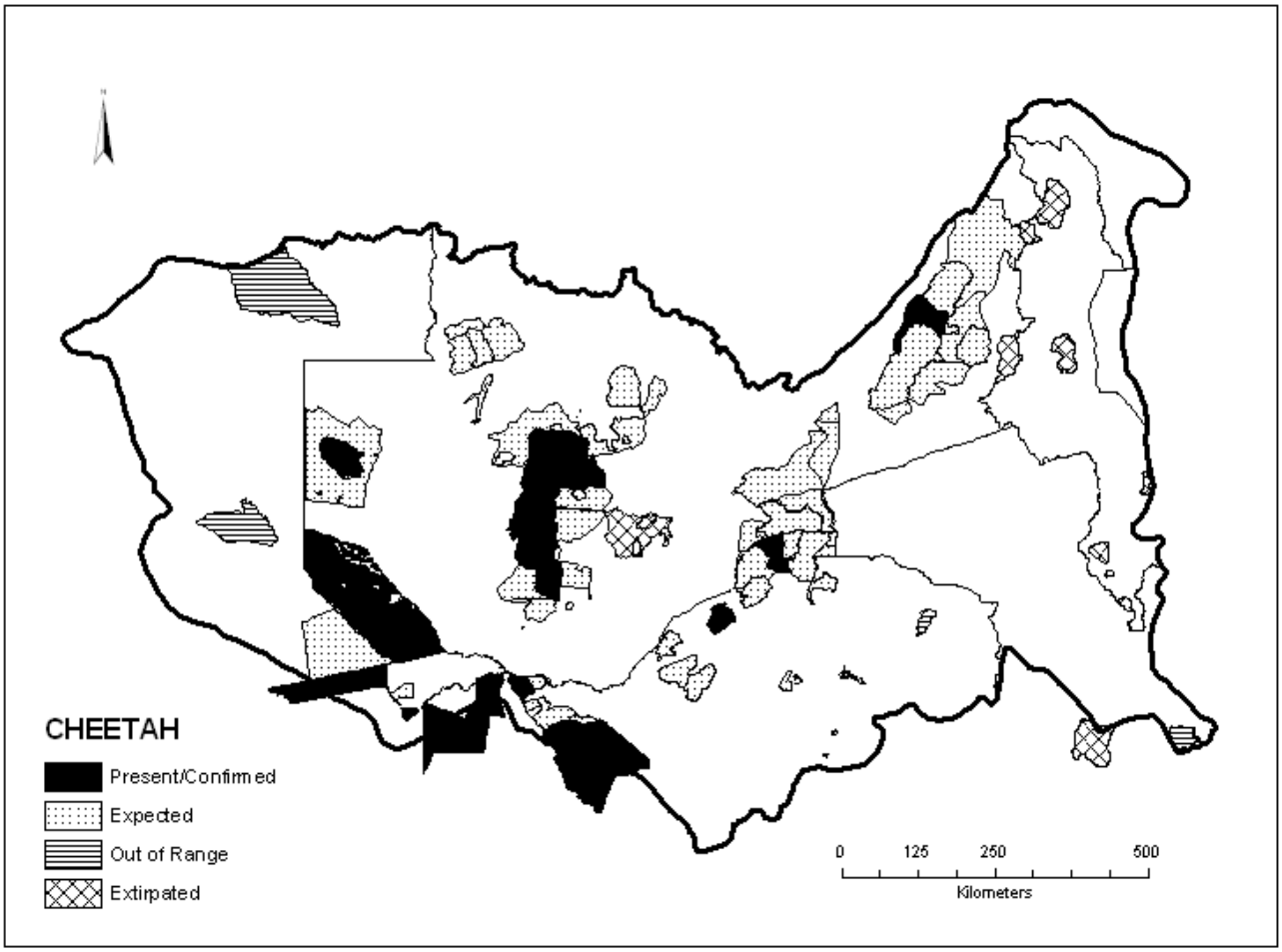
to differ significantly from that recorded in Skinner and Chimimba (2005) with the exception of the record of wild dogs in Gorongosa, an area excluded from Skinner and Chimimba (2005).

Of concern is the extirpation of wild dogs from the West Lunga National Park and surrounding game management areas (GMAs), all protected areas in Malawi and the Kafue Flats GMA/Blue Lagoon National Park/Lochinvar National Park. In all these cases it appears that high human populations and the resultant direct and indirect persecution of wild dogs led to their decline. As many of the protected areas in the Basin have resident human populations, especially the GMAs in Zambia and Angola, this finding is of concern.

Table 1: Summary of recent (2000 – 2006) sightings of wild dogs in Zambia

Protected area	Minimum no. of packs recorded	No. of dogs seen	Estimated density	Mean pack size	Date	Month	Source of information
Liuwa plain	2 packs	11			2001	Nov/ Dec	Kamweneshe & Morrison (2003)
Liuwa plain		1			2002		P. Johnson, pers. comm.
Sioma Ngwezi	2 packs	about 10			2004	Feb.	F. Corry, pers. comm.
Kafue (northern)	9-10 packs		1.8/100sq. km	11.6	2004		Carlson, et al. (2005)
Kafue (southern)	6 packs				2004		Carlson, et al. (2005)
Sichifulo		1			2000	Sept.	S. Norman, pers. comm.
Kasonso-Busanga	1 pack	17			2006	Oct.	A. MacDonald, pers. comm.
Lower Zambezi/Chiawa		about 31	1.7/100sq. km	7.2			Leigh (2005)
Lower Zambezi		3			2007	March	G. Hovell, pers. comm.
Rufunsa	1 pack	8			2000		H. Erfmann, pers. comm.
South Luangwa		4 (northern end)			2004		R. Pope, pers. comm.
South Luangwa	3 packs regular around Mfuwe				2007	March	R. Pope, pers. comm.

Cheetah



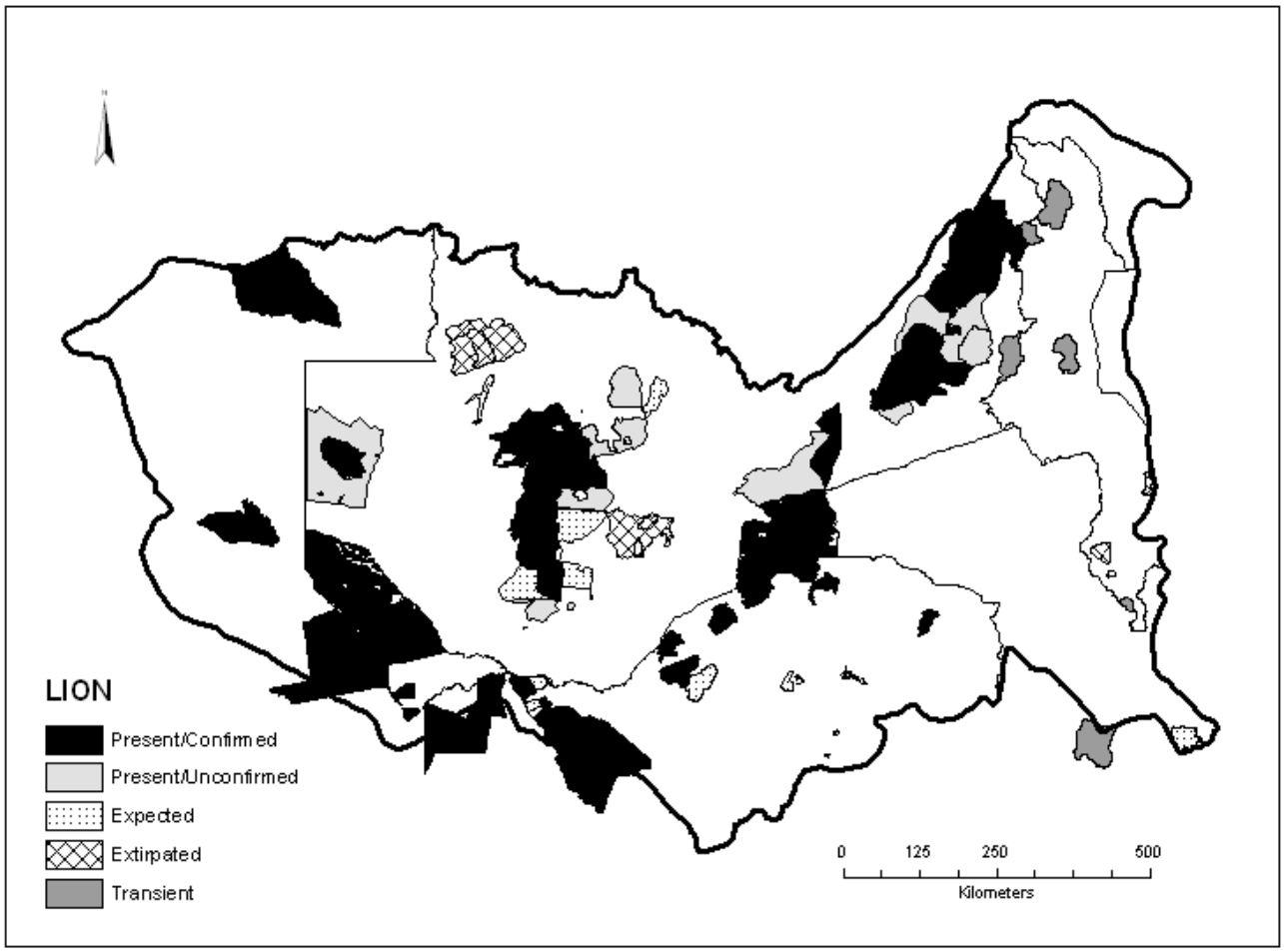
Compared with many regions of Southern and East Africa it appears that the Zambezi Basin has a relatively low population of cheetahs. With the exception of Kafue National Park, respondents who reported seeing cheetah all indicated that sightings were infrequent and that populations appeared to be low. Historically cheetah were reported as rare in Zambia (Ansell, 1978) and Mozambique (Smithers and Labao Tello, 1976), and sightings in the northern areas of Zimbabwe have always been sporadic.

The results of this survey suggest that cheetahs are more common in the western area of the Basin with resident populations in the Liuwa Plains-Caprivi-Chobe-Hwange complex although even here numbers appears to be low, and sightings infrequent. The Kafue complex may hold the largest population of cheetahs in the Basin, but data is limited. They are infrequent in the Mana Pools National Park and have not been seen in the other protected areas in this complex. An experimental release of three male cheetah in the Lower Zambezi National Park was carried out in the mid 1990's but all three animals have not survived.

In Hwange National Park they are also seen infrequently and in Chobe National Park only one out the three respondents reported seeing cheetah. They have been seen relatively recently in the Munyamadzi corridor GMA (year 2000) between South and North Luangwa National Parks, but were not recorded as present in this survey in either Park. Interestingly, cheetah were reported as infrequent in Nyika and Kasunga

National Parks until recently, and it was assumed that the animals seen were dispersers from the Luangwa complex. However, they are now considered extirpated in all the protected areas of Malawi, and have not been recorded in North Luangwa National Park since the late 1980's or in South Luangwa since the mid 1990s.

Lion



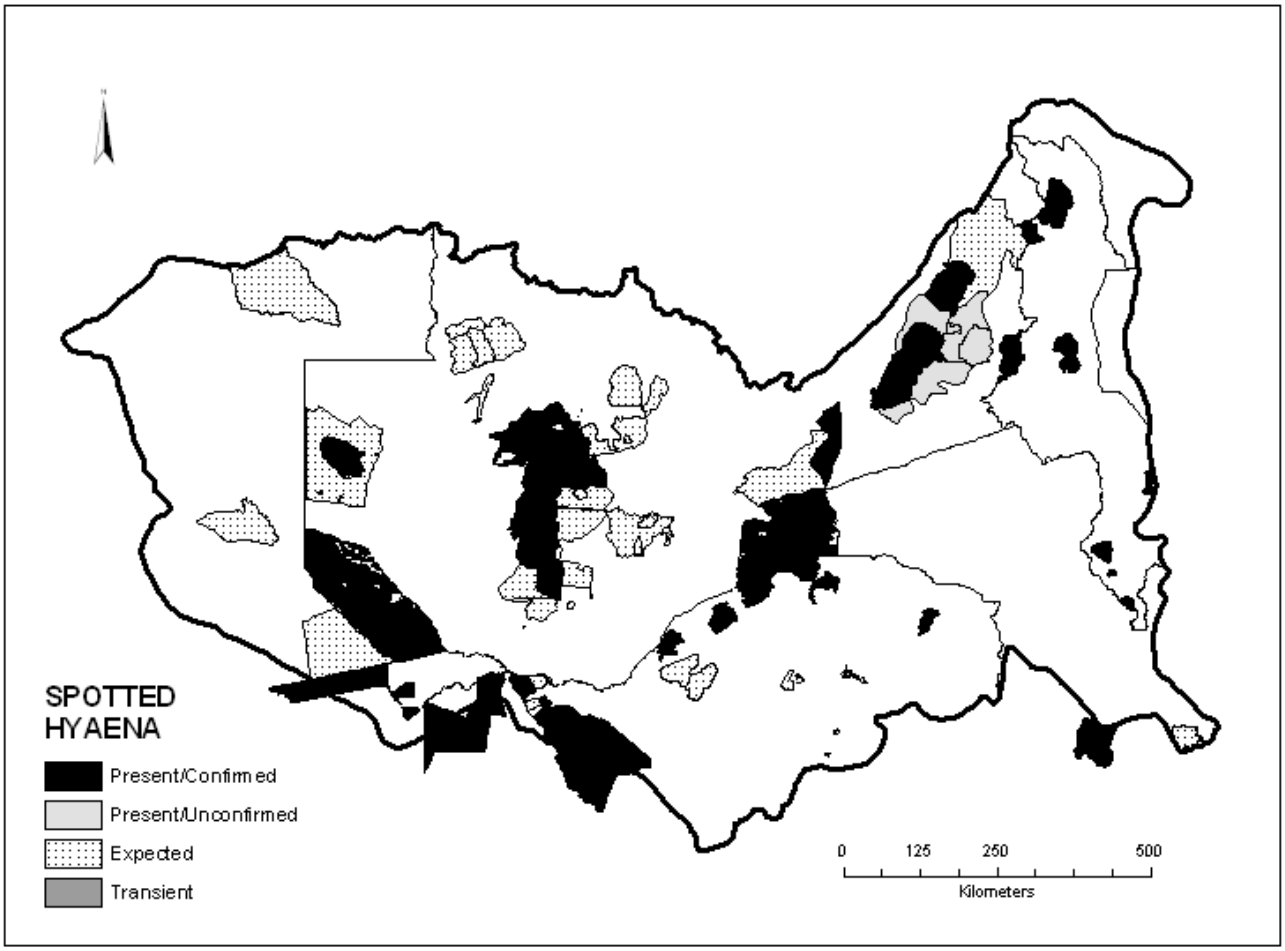
According to the two authoritative texts (Skinner and Chimimba, 2005; Ansell, 1978) used in the survey to determine where species should be present, lion should have been recorded as present in all the protected areas of the Basin. However, data from this survey show that they are no longer present in the following protected areas: the West Lunga National Park and surrounding GMAs, the Kafue Flats GMA and the Blue Lagoon and Lochinvar National Parks, and the Liwonde, Lengwe and Majete Protected areas of Malawi. In addition they were only recorded as transient in the other protected areas of Malawi and in Gorongosa National Park in Mozambique.

The survey results suggests that other than these above areas, lions are widely distributed within the Basin occurring in Angola, the Liuwa-Caprivi-Chobe-Hwange complex, the Kafue complex, the Mana Pools-Lower Zambezi complex and the Luangwa complex. However, within these areas number vary. In Liuwa and Sioma Ngwezi National Parks and the surrouding West Zambezi GMA numbers are considered to be low, bordering on extinction in Liuwa Plains. The little data from Angola indicates that lion populations are large in the Angola protected areas but this needs to be verified. Numbers in Kafue and the surrounding areas are also relatively low, depending on the source of information, with some data indicating that lions are rare in the southern section of Kafue. Carlson *et al* (pers. comm) reported a density of 1.5 lions per 100km^2 in the northern section of Kafue. Lion numbers in the Lower Zambezi National Park and surrounds and in the Luangwa complex suggest that the population here are viable (a density of 7.1 lions per 100km^2; Leigh 2005), and it is

known that lions from Mana Pools cross into the Lower Zambezi and that the two population could be considered as one.

Lions in protected areas of Zimbabwe are potentially under threat from hunting in the surrounding areas although at present numbers are relatively high. The survey was not able to determine the status of lions in Chobe National Park and the protected areas of the Caprivi Strip, only that they were present. However this area had been included as in the Conservation Strategy for Lion in Eastern and Southern Africa as an important area (Lion Conservation Unit, Type I) for lion conservation (IUCN, 2006)

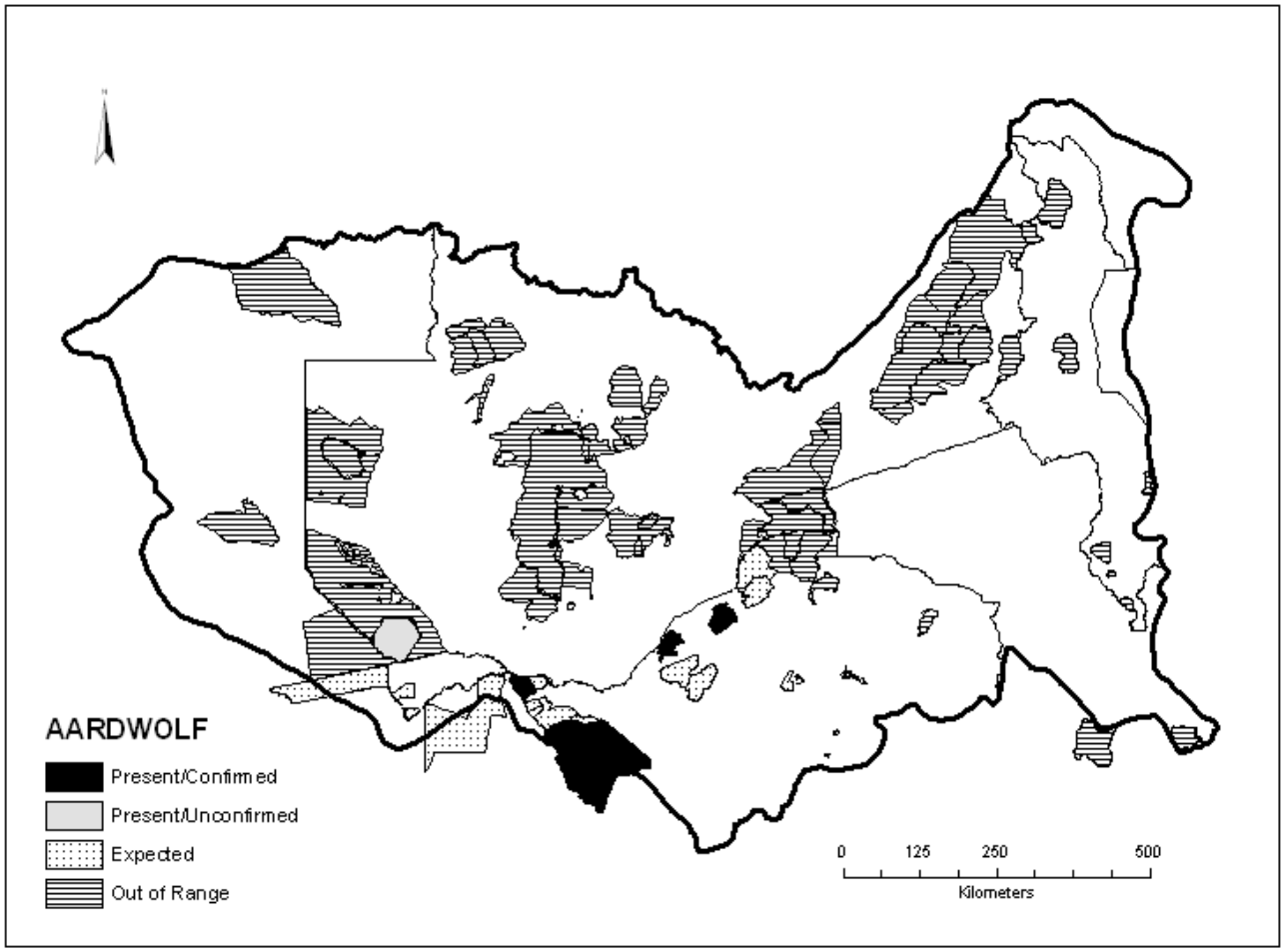
Spotted hyaena



Off all the species included as "priority species" in the survey, the spotted hyaena appears to be the most widely distributed and the least under threat, although no recent data was available for protected areas in Angola. The distribution recorded during this survey mirrors that included in Skinner and Chimimba (2005) and it has not been extirpated from any protected area in the Basin.

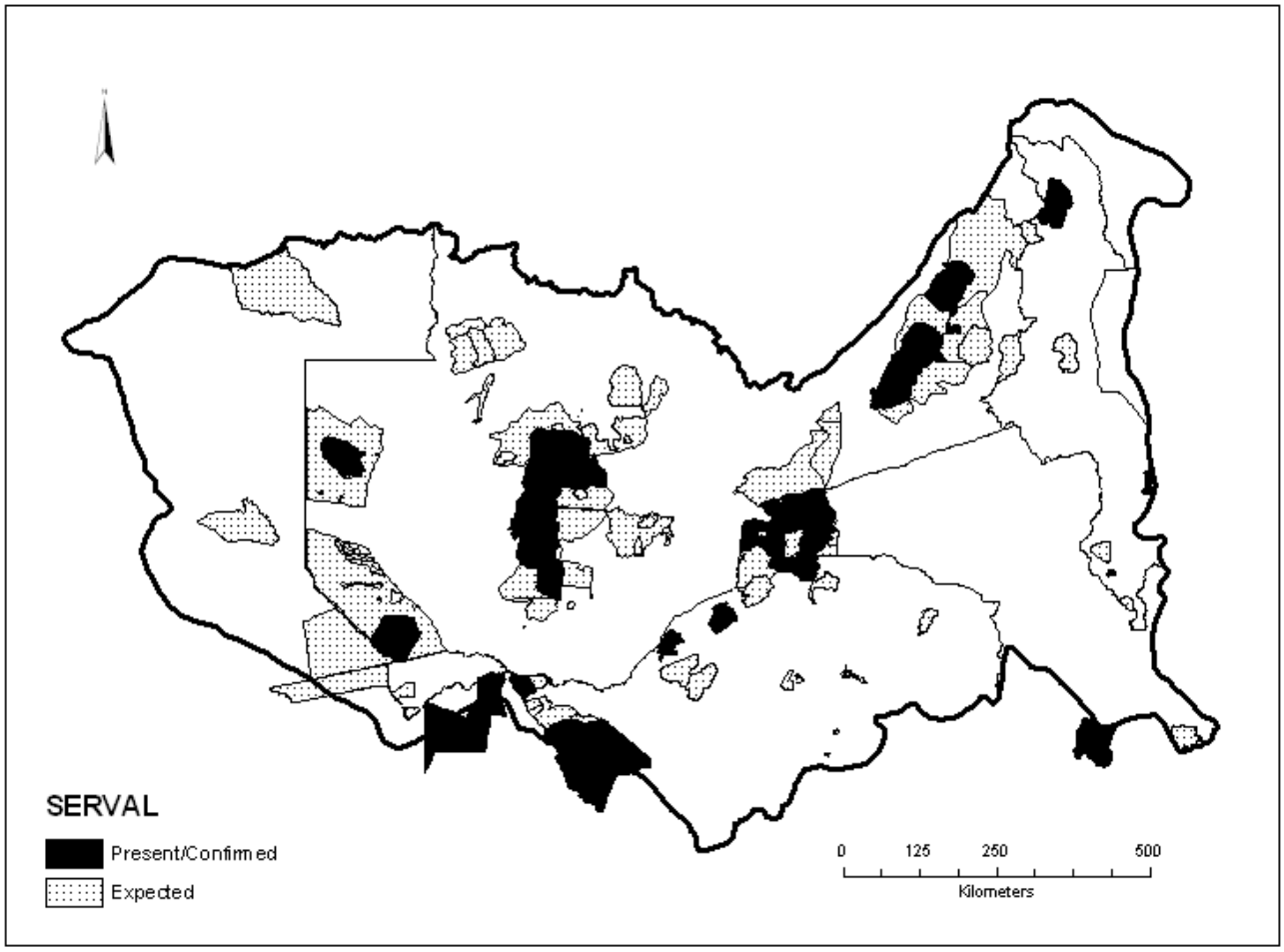
However, in Malawi the species is reported as a major problem animal, and there are indications that numbers may be declining in protected areas of the Lower Shire region.

Aardwolf



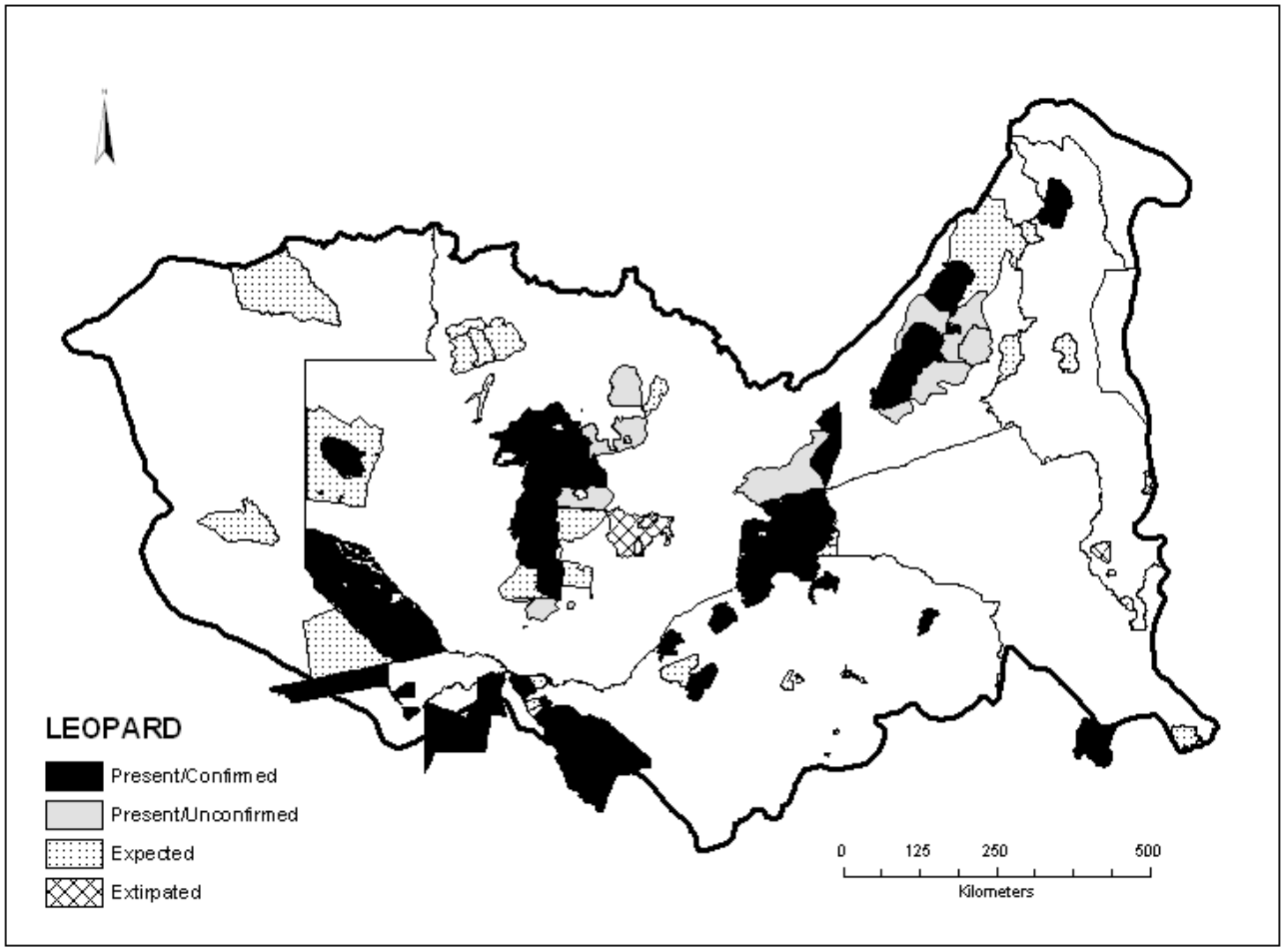
According to the expected distribution, aardwolves should have been reported from 25 protected areas of the Basin. Confirmed sightings were only recorded from four protected areas, raising some concern about their status. However, given their nocturnal nature, the lack of records may simply reflect a lack of observations rather than absence. Certainly the distribution determined during this survey indicates that it is still wide spread within its expected range.

Serval



This species should have been recorded in all protected areas in the Basin if there has been no change from the expected distribution as determined by Skinner and Chimimba (2005) and Ansell (1978). Encouragingly, it was not reported as extirpated from any protected area and confirmed sightings indicate that it is still widely distributed within the Basin. Respondents from Zambia reported it as being rare and infrequent in protected areas other than in Kafue National Park and Luambe National Park, but this may be an artefact of its noctural and secretive behaviour. Such behaviour means that the species is easily overlooked, and a lack of records probably indicates a lack of observations rather than absence. Serval are one of the few carnivore species that can benefit from increases in human habitation as the latter is normally associated with an increase in the rodent population. However, conflict with humans can arise over depredation of livestock, especially domestic fowls, and more information is needed.

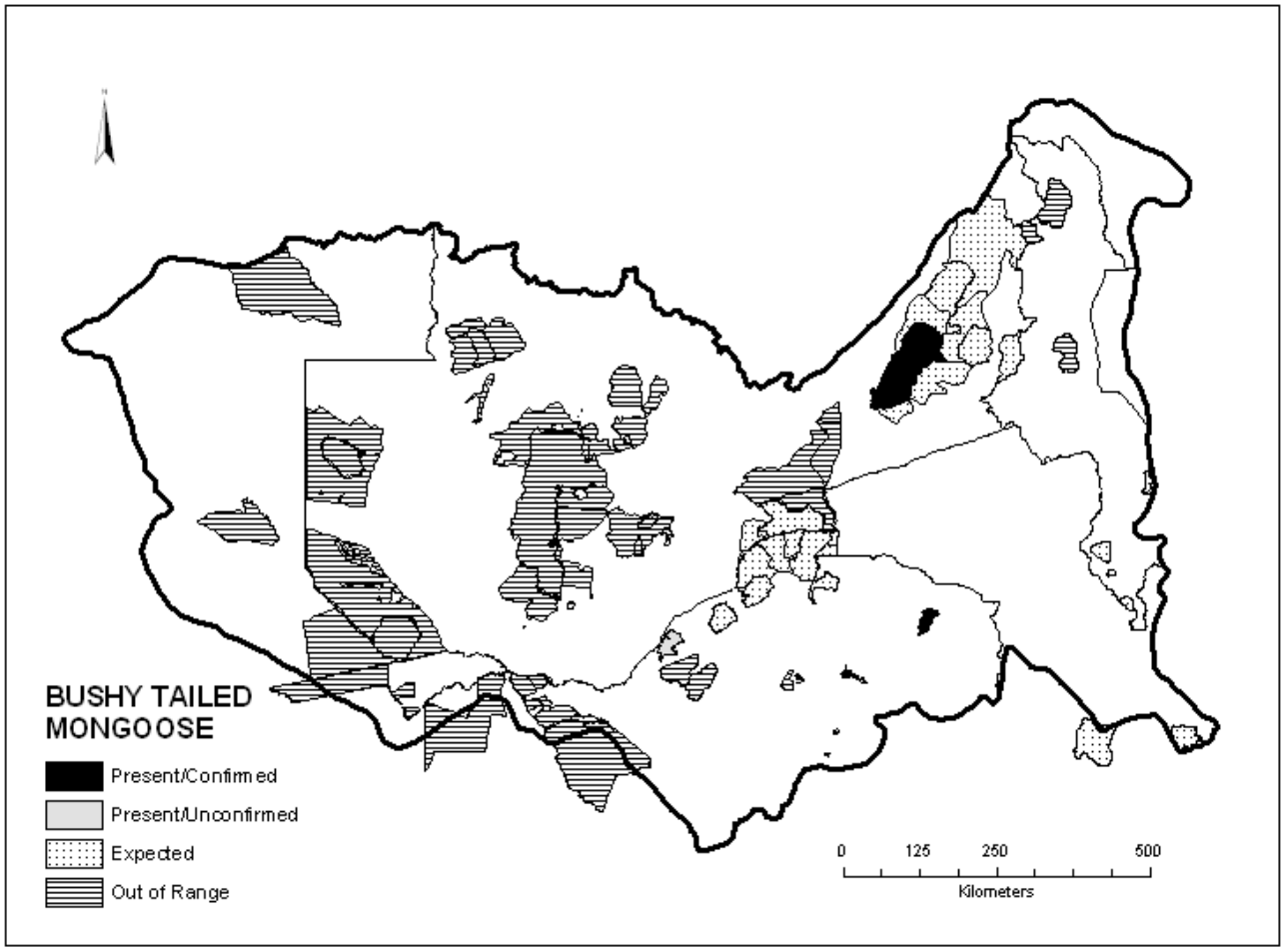
Leopard



Although the distribution of leopard determine by this survey indicates that they are widespread throughout the Basin, there is some concern over their status. In the Lower Shire region of Malawi they have disappeared from three protected areas, and numbers are reported to be very low in the fourth. In addition, numbers appear to have declined in Nyika National Park in the north of Malawi, which historically was always a stronghold of leopard in the country. Similarly in Liuwa Plains National Park leopard numbers are low enough to have raised the concern that they may become locally extinct. In all these areas, high human populations and direct persecution of leopards for skins appears to be the reason for decline.

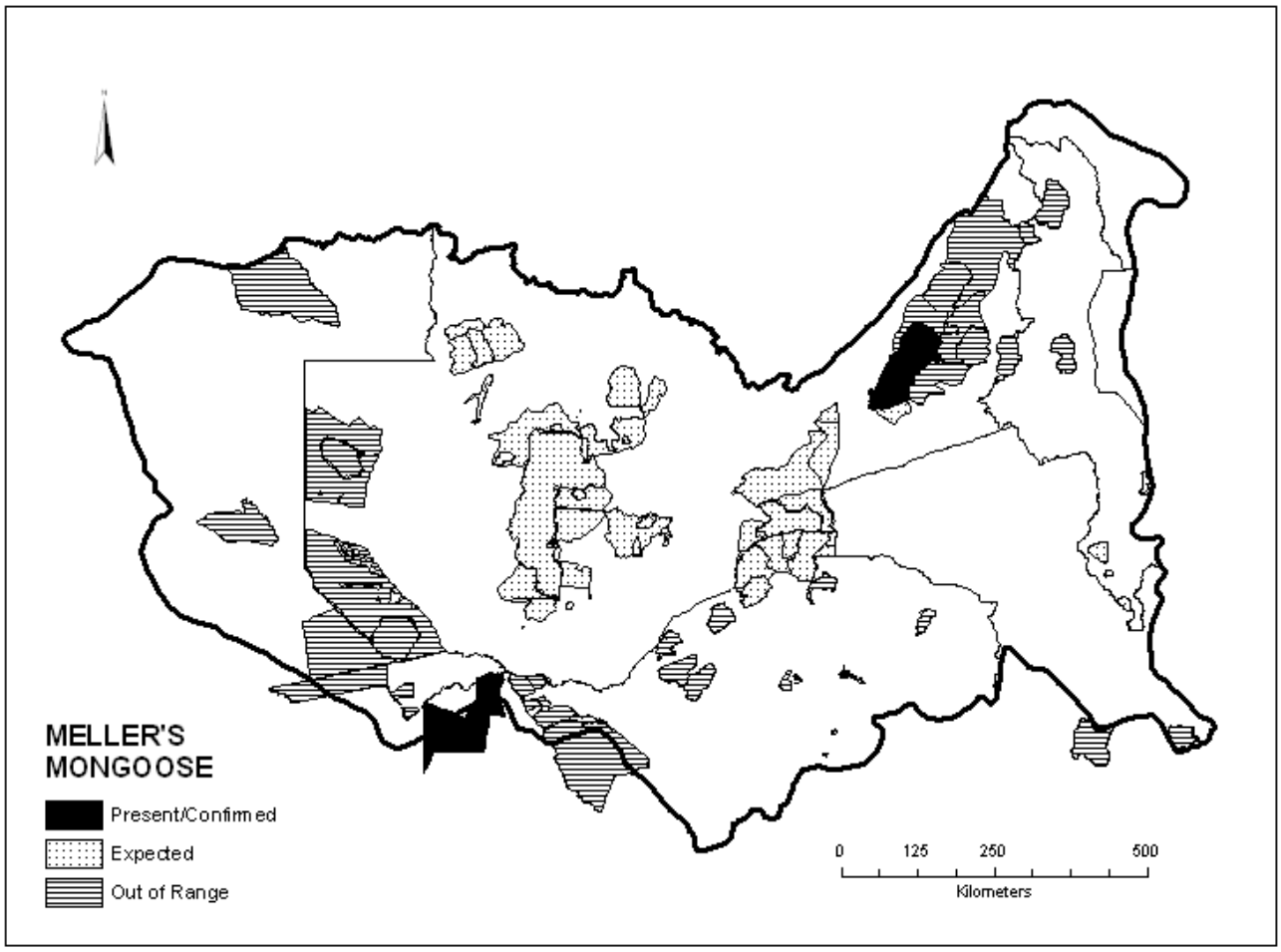
Given the above, in all other protected areas where leopard were confirmed as present, respondents reported that numbers were high. Given the lack of data for many of the protected areas of the Basin, it can be argued that leopard distribution is greater than presented in this report. However, detailed information regarding persecution is also lacking, and it is not clear what the status of leopard is in many of the protected areas, especially as leopards are known to be killed as both problem animals and trophy animals in Botswana, Zambia and Zimbabwe.

Bushy tailed mongoose



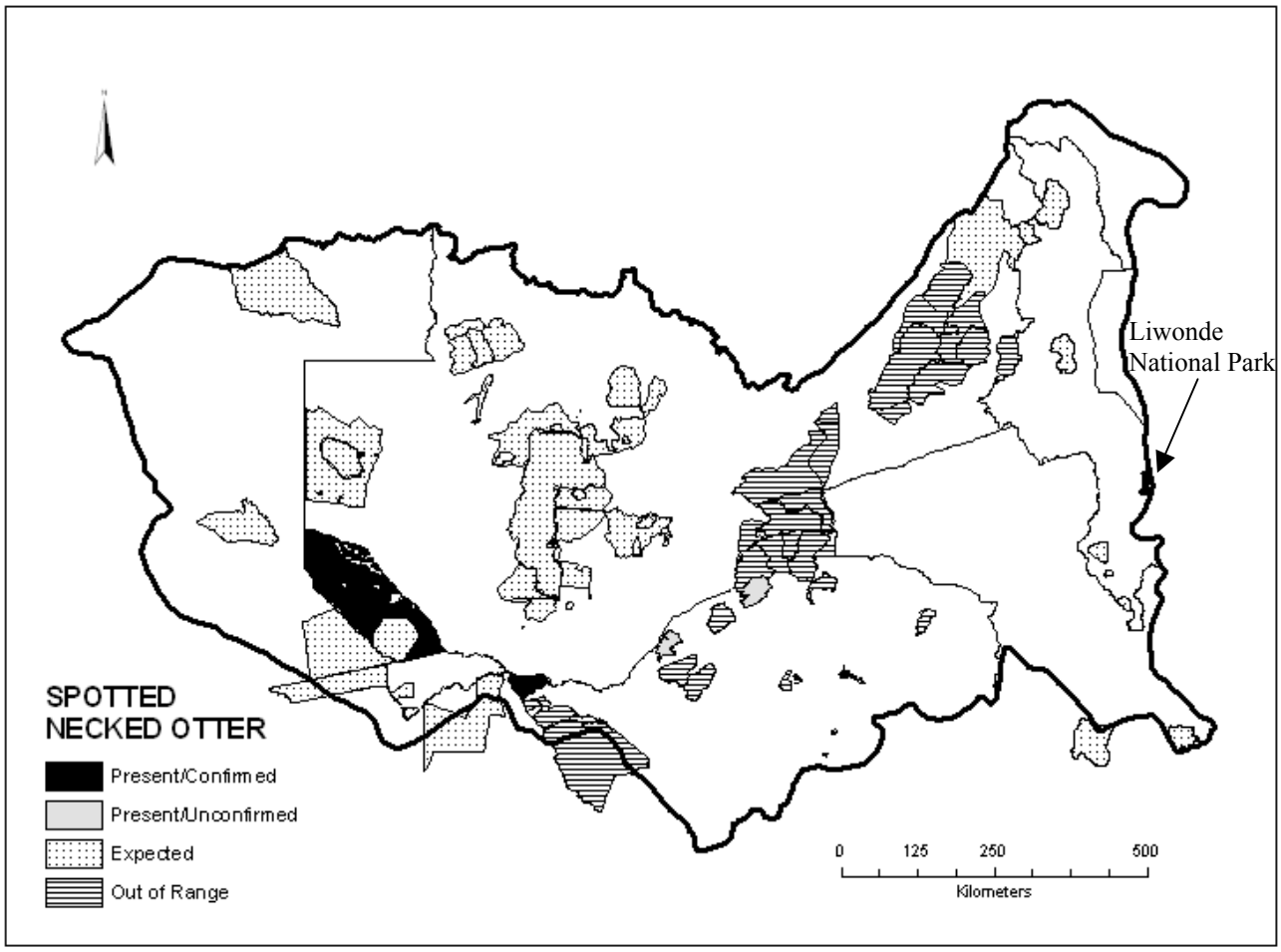
The results of this survey are important as they show that this rare and relatively unknown species is still present in two protected areas of the Basin, and unconfirmed as present in a third. Given the locations of the two recent records in comparison to the historical distribution of the species, the results indicate that it is likely to still be present in much of its previous range, but the lack of records is more likely to indicate a lack observations rather than absence

Meller's mongoose



Interestingly the confirmed sightings recorded during this survey of this rare species were from two protected areas at the opposite ends of its the historical distribution , namely Chobe National Park and South Luangwa National Park This current distribution patterns suggest that it may still occur within a large proportion of its historical range but is overlooked due to its nocturnal nature and rarity.

Spotted necked otter



There is concern that only three confirmed sightings of this species were recorded during the survey (only 5% of its expected range) compared with a 14% confirmed presence of the African Clawless Otter. The presence of this species can be argued to be an indicator of the quality of the water or a river (and hence the catchment) or lake system, and it is of concern that only two geographic areas within the Basin reported the species as resident.

The survey also recorded two sightings of otters in areas where neither the spotted necked, nor the African clawless otter have been recorded (according to the published literature). The two areas are at the same place, on the shores of the artificial lake, Kariba, and the habitat is therefore suitable for both species. Unfortunately the information recorded during these two sightings was not sufficient to determine which species of otter had been seen.

Priority species: Conflict with humans

Conflict with humans was reported for 4 priority species during the survey, with wild dog, lion, spotted hyaena, and leopard either negatively impacting on human populations, or being adversely affected by human populations (and a combination of the two) Interestingly in comparison with other southern African regions, there were no reports of cheetahs as problem animals, or much interaction between cheetah and human populations. This corresponds to the findings of the review that cheetahs are either absent or present in low numbers in protected areas of the Basin.

Data was not available for either Angola or Mozambique. No data was available for the smaller priority species from any of the countries that share the basin.

Wild dogs were reported as problem animals in Botswana, Namibia, Zambia and Zimbabwe, although only details of the conflict were available for Zambia and Zimbabwe, where the cause of conflict was depredation of livestock (Table 2). There were also a number of records of adverse effects of the human population on wild dogs either deliberate (poaching and retaliatory killings; Table 2) or indirect (snaring, road kills and poaching of wild prey; Table 2). In the protected areas of Namibia and Botswana projects are ongoing to mitigate this conflict between wild dogs and human populations. In Zimbabwe in the Hwange National Park and surrounding areas there is an ongoing project to mitigate conflict, and in Zambia work is ongoing in the Lower Zambezi National Park and surrounds, and the Liuwa Plains National Park and surrounds to reduce snaring and poaching of prey.

Lions were reported as negatively impacting of human populations by threatening human life and preying on livestock (Table 2). However, the impact of humans on lions appear to be potentially very large given the number of reports of lions killed by snaring, poisoning, deliberate retaliatory killing and excessive trophy hunting (Table 2). Interestingly, unlike the wild dog, there were no reports of poaching of prey affecting lions and emphasis was placed on the direct interaction, rather than the indirect. This direct interaction has been so severe in some protected areas that lion numbers have reduced to critical levels (Liuwa Plains National Park, Kasungu National Park and Nkhota Kota National Park). In the West Lunga National Park and surrounds, direct persecution of lions has caused local depletion, and reduced the chances of recolonisation even though dispersing lions still pass through this protected area (Table 2). Some projects are ongoing to mitigate conflict through improved husbandry, increasing economic returns to local communities from the revenue generated by the presence of lions, community driven compensation schemes and improved education (Table 2).

Spotted hyaenas were reported as problem animals in all five countries for which data was available due to killing of livestock, especially sheep and goats (Table 2). In most of the protected areas and surrounds of Malawi spotted hyaenas are also a major threat to human life, especially in the hot season when many villagers sleep outside their huts (Table 2). Likewise in Liuwa Plains National Park in Zambia, spotted hyaenas have also been reported to kill humans (Table 2). In Botswana hyaenas were reported as problem animals but no details of the conflict were available (Table 2). Likewise, although the hyaena was the most commonly reported problem carnivore in the protected areas and surrounds of the Caprivi strip in Namibia, details of the conflict were not available, except an indication from the Human Animal Conflict

Compensation Scheme Project (HACCIS) brochure, that hyaenas prey on livestock (Table 2)

Conversely humans have negatively impacted on spotted hyaenas in the Kafue National Park where hyaenas are often caught in snares set for other species (Table 2).

The main conflict with leopard in protected areas of the Basin is depredation of livestock and subsequent retaliatory killing (Table 2). Leopards were reported as problem animals in Botswana and the Namibia protected areas and surrounds, as well as in some protected areas of Zambia, Malawi and Zimbabwe (Table 2). The conflict in Zambia and Zimbabwe should be offset to some degree by the benefits received by the local communities from trophy hunting and photographic tourism under programmes such as CAMPFIRE in Zimbabwe.

Poaching of leopards in Liuwa Plains National Park in Zambia, and many of the National Parks in Malawi has caused a decline in leopard populations, in Malawi this is exacerbated by the poaching of prey populations as well. In addition there is concern in Zimbabwe that the current level of trophy hunting of leopards in Safari areas may be unsustainable (Table 2). Snaring is reported as having a negative effect on leopards in South Luangwa National Park in Zambia (Table 2)

As can been seen from Table 2, it is encouraging to note the number of projects that are ongoing in all countries (including Gorongosa National Park in Mozambique), to work with the human communities interacting with these priority species to try and mitigate conflict. However, there are still many areas of the Basin where there is no data on whether conflict is occurring and impacting on carnivore species population, and the nature of this conflict. A more thorough survey is urgently required.

For lion and leopard there is also concern that trophy hunting at current levels may be having a long term negative impact on population viability of some populations within the Basin, and as offtakes are not known for these protected areas, it is imperative that this is investigated as soon as possible. Additional concern lies in the knowledge that in areas where these two species are hunted as trophy animals, they are often also killed as problem animals either legally or illegally.

In all protected areas in Zambia (with the exception on South Luangwa National Park) and Malawi there is a concern that prey population are being depleted and this will have a long term negative effect on carnivore populations. Efforts are underway in Kafue, Lower Zambezi, Liuwa Plains, Sioma Ngwezi, Majete, Nyika and Lengwe National Parks to reverse this trend, but the surrounding game management areas are not part of the process as yet.

Table 2: Summary of reports of human carnivore conflict (priority species) in Protected areas and their surrounds within the Zambezi Basin from 2000 to 2006. Included in the summary are projects aimed at mitigating conflict. (NP National Park; GMA = Game management area; SA = Safari area)

Species	Country	Protected area	Nature of Conflict	Mitigation projects
Wild dog	Zambia	Lower Zambezi complex	Livestock depredation	
		Kafue NP	Livestock depredation and road kills	
		Liuwa Plain NP	Livestock depredation, poaching of predators and prey and road kills	African Parks Foundation
		Sioma Ngwezi NP	Poaching of predators and prey	
		Luano GMA	Livestock depredation and road kills	
		Sichifulo GMA	Livestock depredation and retaliatory killings	
		Lunga Luswishi GMA	Poaching of prey	
		Lower Zambezi NP	Snaring	Lower Zambezi Conservation Trust
		Chiawa GMA	Snaring	Lower Zambezi Conservation Trust
	Botswana	Chobe NP	No details, reported as a problem animal	CARACAL project
	Zimbabwe	Hwange NP	Livestock depredation, snaring, retaliatory killings and road kills	Painted Hunting Dog Project
		Matetsi Unit 7	Road kills	
Cheetah		NO REPORTS OF CONFLICT RECORDED DURING THE SURVEY		
Lion	Zambia	Sioma Ngwezi NP	Livestock depredation	
		Lower West Zambezi GMA	Livestock depredation	
		Kafue NP	Snaring and road kills	
		Rufunsa GMA	Illegal trophy hunting and livestock depredation	
		South Luangwa NP	Poisoning, snaring and livestock depredation	South Luangwa Conservation Society
		West Lunga NP and surrounds	Trapping and shooting	West Lunga Trust
	Namibia	Conservancies surrounding Mamili, Mudumu and Caprivi protected areas	No details given, but lion recorded as problem animal 69 times in 2005, and 113 times in 2006	Human Animal Conflict Compensation Insurance Scheme (HACCIS) under the guidance of the Integrated Rural Development and Nature Conservation organisation
	Botswana	Chobe NP	No details given, lion recorded as problem animal	CARACAL project
	Zimbabwe	Hurungwe SA and surrounds	Threat to human life, livestock depredation, one report in 2004	CAMPFIRE Programme
		Hwange	Between 2002 and 2006 a total of 55 reports of lions as problem animals in terms of threat to human life and livestock depredation	CAMPFIRE Programme, Hwange Lion Project
		Matetsi	Snaring and trophy hunting Over harvesting as trophy animals	

Species	Country	Protected area	Nature of Conflict	Mitigation projects
		Mfunrudzi NP	Livestock depredation and retaliatory killings	
		All Safari areas	Trophy hunting	
	Malawi	Kasungu NP and Nkhota-Kota NP	Threat to human life, livestock depredation	
Spotted hyaena	Zambia	Kafue NP	Snaring	
		Sioma Ngwezi NP	Livestock depredation	
		Liuwa Plains NP	Threat to human life, livestock depredation	African Parks Foundation
	Namibia	Conservancies surrounding Mamili, Mudumu and Caprivi protected areas	No details given, but hyaena recorded as problem animal 263 times in 2005, and 169 times in 2006	Human Animal Conflict Compensation Insurance Scheme (HACCIS) under the guidance of the Integrated Rural Development and Nature Conservation organisation
	Botswana	Chobe NP	No details but spotted hyaena recorded as problem animal	CARACAL Project
	Malawi	Nyika NP	Livestock depredation and threat to human life	
		Lengwe, Majete, Mwabvi and Liwonde protected areas	Threat to human life and livestock depredation	African Parks Foundation in Majete NP
	Zimbabwe	Matusadona	Livestock depredation	
Aardwolf		NO REPORTS OF CONFLICT RECORDED DURING THE SURVEY		
Serval		NO REPORTS OF CONFLICT RECORDED DURING THE SURVEY		
Leopard	Zambia	Liuwa Plains	Poaching	
		Sioma Ngwezi	Livestock depredation	
		South Luangwa	Snaring	South Luangwa Conservation Society
	Namibia	Conservancies surrounding Mamili, Mudumu and Caprivi protected areas	No details given, but leopard recorded as problem animal 20 times in 2005, and 27 times in 2006	Human Animal Conflict Compensation Insurance Scheme (HACCIS) under the guidance of the Integrated Rural Development and Nature Conservation organisation
	Botswana	Chobe NP	No details but leopard recorded as problem animal	CARACAL Project
	Zimbabwe	All Safari areas	Trophy hunting	
		Hurungwe SA and surrounds	Livestock depredation	CAMPFIRE Programme
		Hwange NP surrounds	Livestock depredation	CAMPFIRE Programme
		Matusadona	Livestock depredation	CAMPFIRE Programme
	Malawi	Nyika	Poaching of prey Threat to human life and livestock depredation	Nyika TFCA Programme; Biosearch Nyika

Table 3: Priority areas for future work to mitigate human-carnivore conflict: Category 1 = Conflict known to be occurring and negatively impacting on at least one focal carnivore species but mitigation possible through partnerships with local institutions already in place; Category 2 = Conflict known to be occurring and negatively impacting on at least one focal carnivore species but no known local institution to implement mitigation strategy. Category 3: No information regarding conflict available

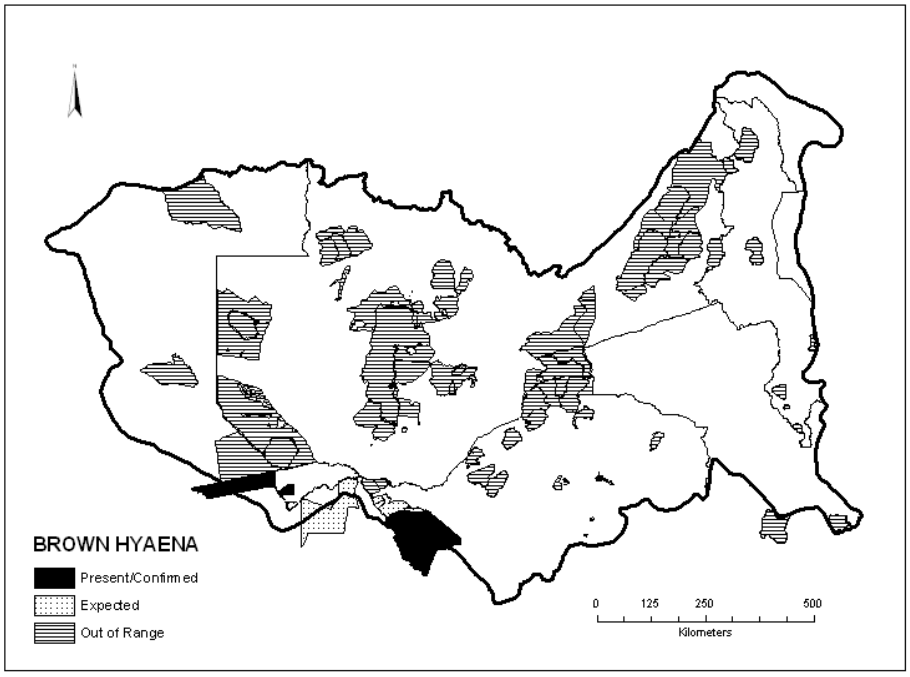
Protected area	Type of conflict known to be occurring	Priority for future work
Transboundary areas and complexes		
Hwange-Chobe-Caprivi-Luiana-Sioma Ngwezi-Liuwa complex	Livestock depredation, threat to human life, loss of prey, excessive trophy hunting	Category 1
Luangwa – Nyika complex	Snaring, poisoning, livestock depredation	Categories 2 and 3
Lower Zambezi-Mana Pools complex	Livestock depredation, retaliatory killing, snaring, poaching of prey, road kills and illegal/excessive trophy hunting	Category 1
West Lunga complex	Retaliatory killings, loss of prey	Category 2 and 3
Individual Protected areas		
Angola		
Kameia		Category 3
Mavinga		Category 3
Malawi		
Mwabvi	Poaching of prey, threat to human life, livestock depredation	Category 2 and 3
Lengwe	Poaching of prey, threat to human life, livestock depredation	Category 2 and 3
Majete	Poaching of prey, threat to human life, livestock depredation	Category 2 and 3
Liwonde	Poaching of prey, threat to human life, livestock depredation	Category 2 and 3
Nkhota-Kota	Poaching of prey, threat to human life, livestock depredation	Category 2 and 3

Protected area	Type of conflict known to be occurring	Priority for future work
Kasungu	Poaching of prey, threat to human life, livestock depredation	Category 2 and 3
Mozambique		
Marromeu		Category 3
Gorongosa		Category 3
Zambia		
Mosi-oa tunya		Category 3
Chitzera		Category3
Zimbabwe		
Sebakwe		Category 3
Ngezi		Category 3
Robert McIlwaine		Category 3
Umfuli		Category 3
Chegutu		Category 3
Lake Robertson		Category 3
Chirisa		Category 3
Chizarira		Category 3
Chete		Category 3
Mfundrundzi	Livestock depredation and retaliatory killing	Category 1
Matusadona	Livestock depredation, threat to human life, excessive trophy hunting	Category 1

Other species

Hyaenidae

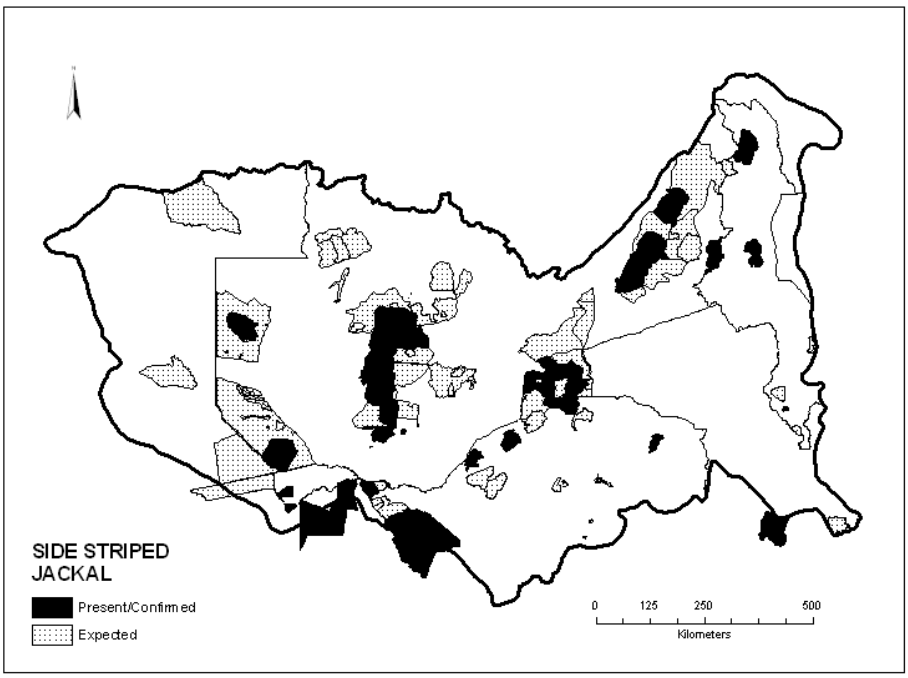
Brown hyaena



Brown hyaena were confirmed to be present in Hwange National Park , Mudumu National Park and the Caprivi wildlife management area. However, in all these areas numbers were reported to be low, and the species regarded almost as a vagrant. This distribution is as would be expected given that the south west corner of the Zambezi Basin is at the extreme northern end of the species distribution.

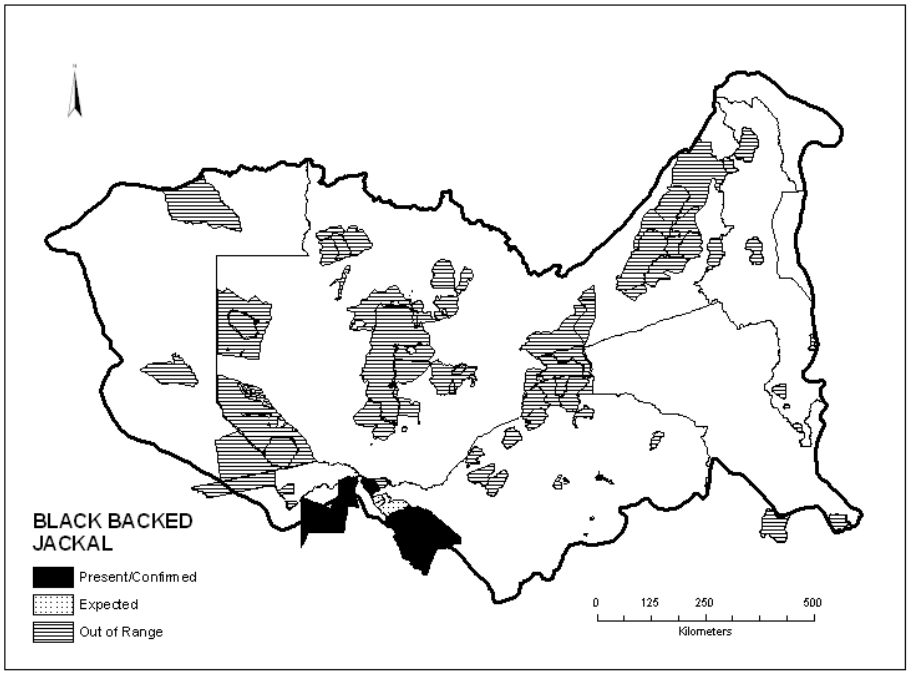
Canidae

Side striped jackal



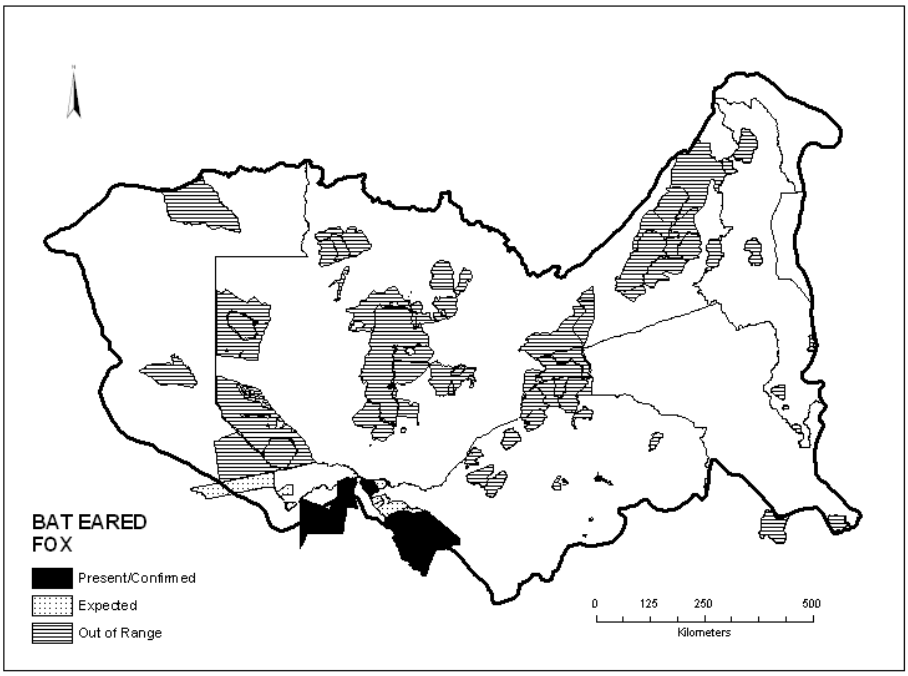
The review found that side striped jackals were widely distributed in the protected areas of the Basin and in most protected areas were reported as common. It is still commonly seen in Nyika and Kasungu National Parks in Malawi, but is rarely sighted now in the protected areas of the Lower Shire region of the country (Liwonde, Lengwe, Majete and Mwabvi). It was reported as rare in South Luangwa, Lower Zambezi, Chiawa and Matusadona protected areas. There were few records of conflict. In the protected areas and surrounds of the Caprivi strip jackals were recorded as problem animals only 8 times between 2005 and 2006, a minimal number of reports compared to the larger species (See Table 2). In Zambia and Zimbabwe the main conflict appears to be road kills.

Black backed jackal



Black backed jackals were confirmed as present in Hwange and Chobe National Parks and in Matetsi North (Unit 7) Safari area. This distribution agrees with its historical distribution, as the south west corner of the Zambezi Basin is at the northern most extreme of its southern African range. In Hwange and Matetsi the species was recorded as more common than the side striped jackal. There were no records of conflict.

Bat-eared fox



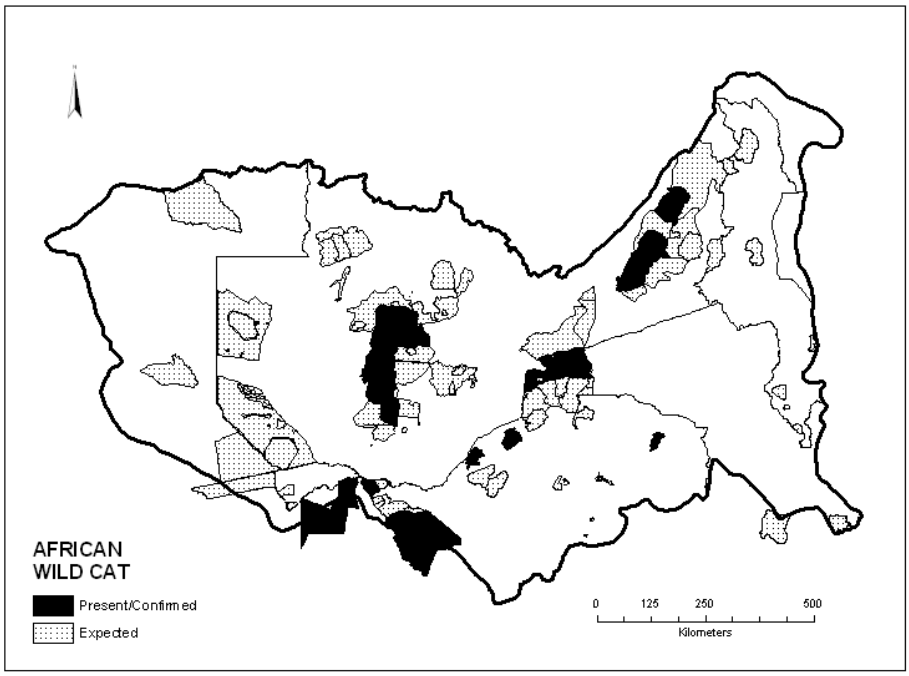
As with the black backed jackal, the historical range of this species only extends marginally into the southwest corner of the Zambezi Basin. Although there have been various reports of the bat-eared fox in Zambia over the years (Ansell, 1960 & 1978), none of these have ever been confirmed and are thought to have been mistaken identities, probably for side-striped jackal.

The distribution recorded during this reviews mirrors the historical distribution of the species. A report was received from a camp in Lower West Zambezi National Park that it had been heard near the camp, however, it was eventually decided that this was probably side-striped jackal. There is some concern in Hwange that the species has declined but the lack of sightings probably reflects its nocturnal habits.

The review found no records of conflict

Felidae

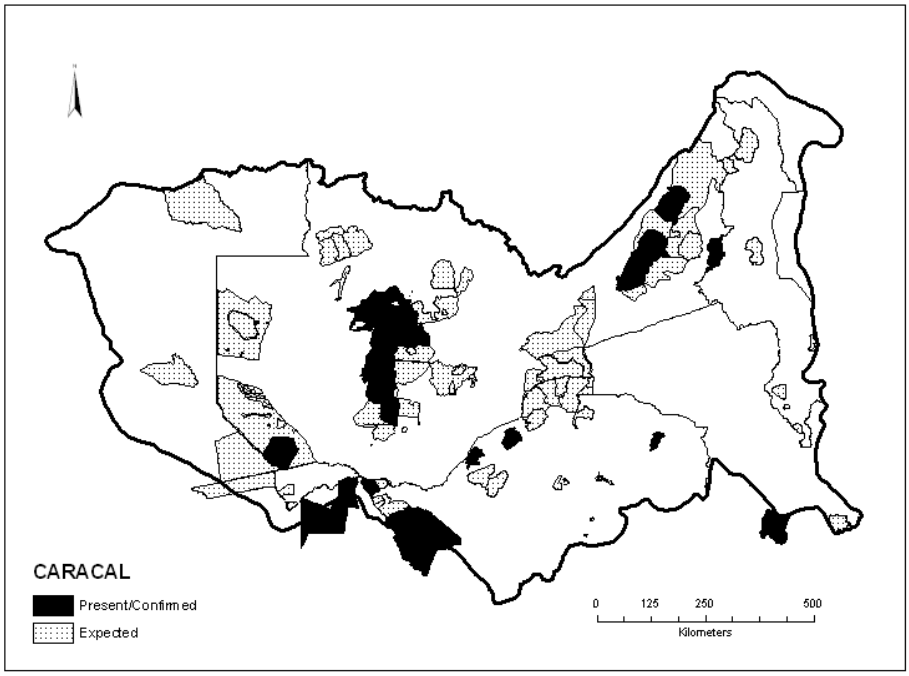
African wild cat



The available information for this species was disappointing, and considering that it should have been recorded as present in all the protected areas of the Zambezi Basin, the paucity of sightings is of concern. It was reported as common in Rufunsa Game Management Area, and Chobe National Park, but only one sighting was reported in Hwange during the annual water hole counts. However, the limited data collected indicate that it probably still has a wide distribution within the Basin, and may be overlooked in many areas due to its nocturnal and secretive habits

The review found no records of conflict with this species

Caracal

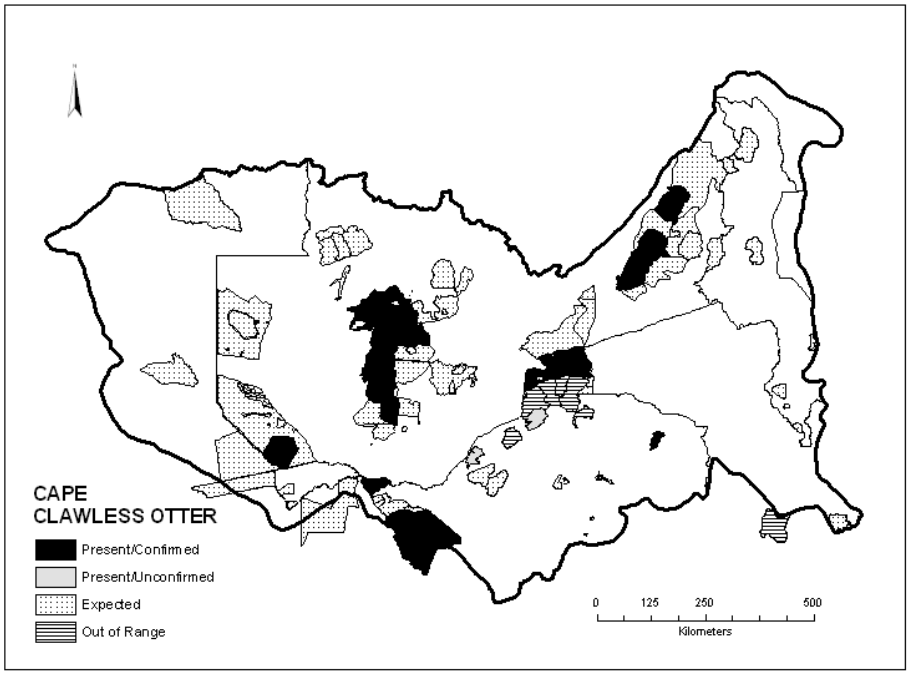


This species should have been recorded from all protected areas of the Basin, and the lack of recent records from the well-documented Lower Zambezi and Mana Pools protected areas is of concern. In addition it was reported as rare from all protected areas it currently occurs. In Malawi it is regarded as a rare species with no recorded recent sightings. The density of the species in both Chobe and Hwange National Parks was also reported to be low, similarly in Matusadona National Park. All the protected areas in Zambia that reported it as present mentioned that sightings were rare. However, it appears to still be widely distributed in the Basin but more information is required regarding its status and distribution.

The only report of conflict was that of the sale of live animals in Zambia.

Mustelidae

Cape clawless otter

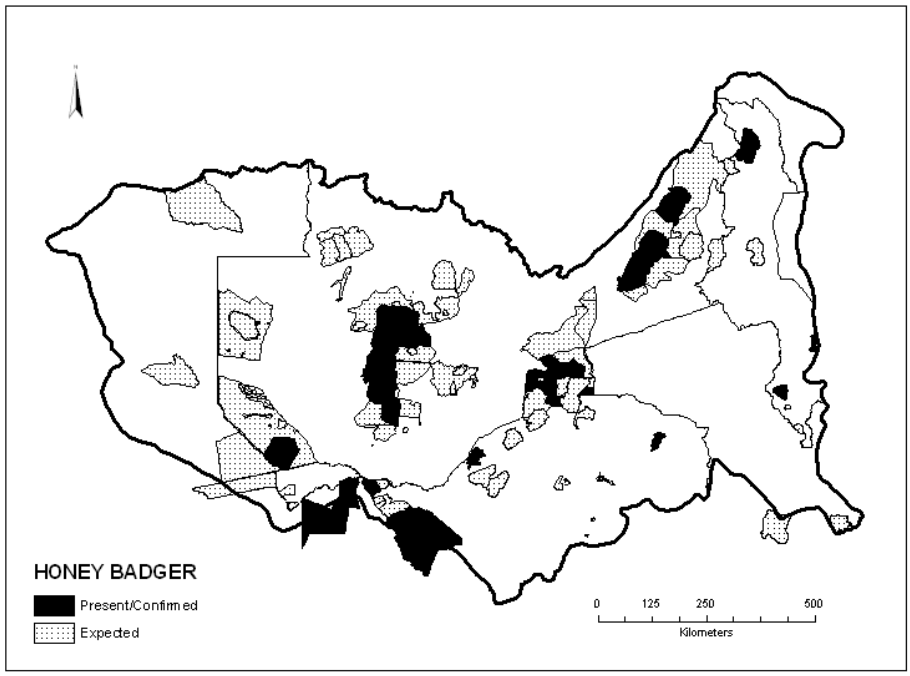


The review found that this species is widely distributed within the protected areas of the Zambezi Basin, although sightings were rare. It was reported as present in three areas where it has not previously been recorded, namely the Lower Zambezi National Park, Chiawa and Rufunsa Game Management Areas. There are also two sightings of otters in areas outside ranges of both this species and the spotted necked otter, and it was not possible to determine which species was seen (Chete Safari Area and Charara Safari Area in Zimbabwe). Both these sightings were recorded in Lake Kariba, a large open expanse of water.

It is known to be present in Lake Malawi, but it was not known if this included Liwonde National Park. The lack of other recent sightings in Malawi is of concern as all the protected areas have suitable habitat for the species. The species was only recorded once in Hwange during 6 years of annual game counts. It was reported as rare in both North and South Luangwa National Parks. Although common both sides of the river up stream from the Victoria Falls, in Matetsi it was reported that the burning of islands by fisherman and hunting of the species by local communities was adversely affecting the species. There was also a report of fisherman downstream of the Victoria Falls attempting to capture individuals.

The review found no other reports of conflict.

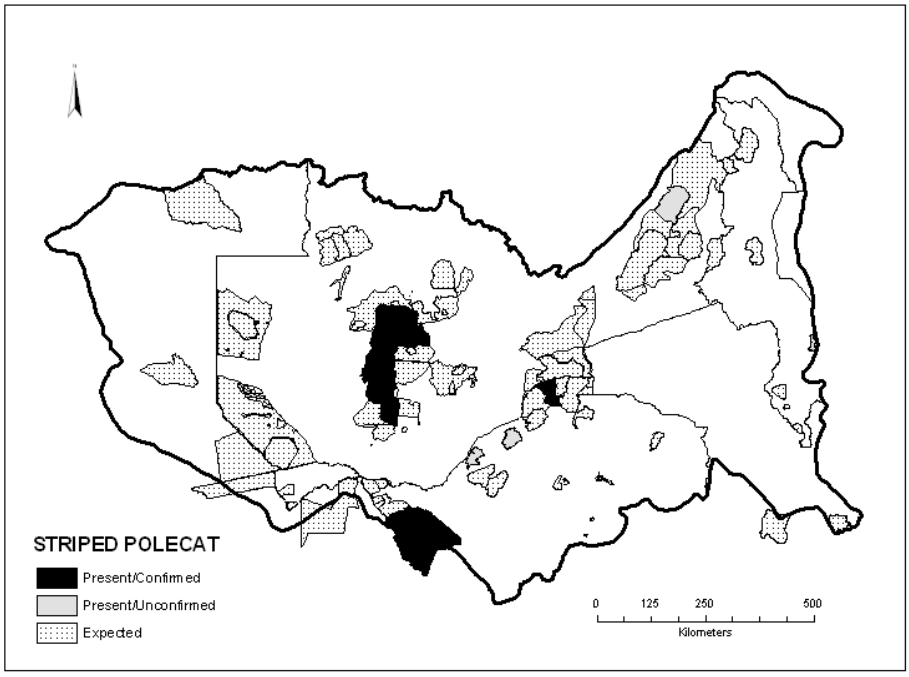
Honey badger



This species should have been recorded as present in all the protected areas of the Zambezi Basin, but the review found large gaps in the knowledge of its status and distribution. However, the information that was available suggested that it is still widely distributed in the protected areas of the Basin. It was reported as common in Sioma Ngwezi, Kafue, Lower Zambezi and Mana Pools National Parks, and the Game Management Areas surrounding the Lower Zambezi National Park. It was also reported as common in Hwange National Park. It is seen often in Nyika and Majete protected areas of Malawi.

In Zambia it has been reported that the species is hunted for meat in areas where wildlife populations have declined to very low levels, and the species often becomes a problem animal around campsites in protected areas. However, no reports of conflict in protected areas and surrounds was recorded during this survey

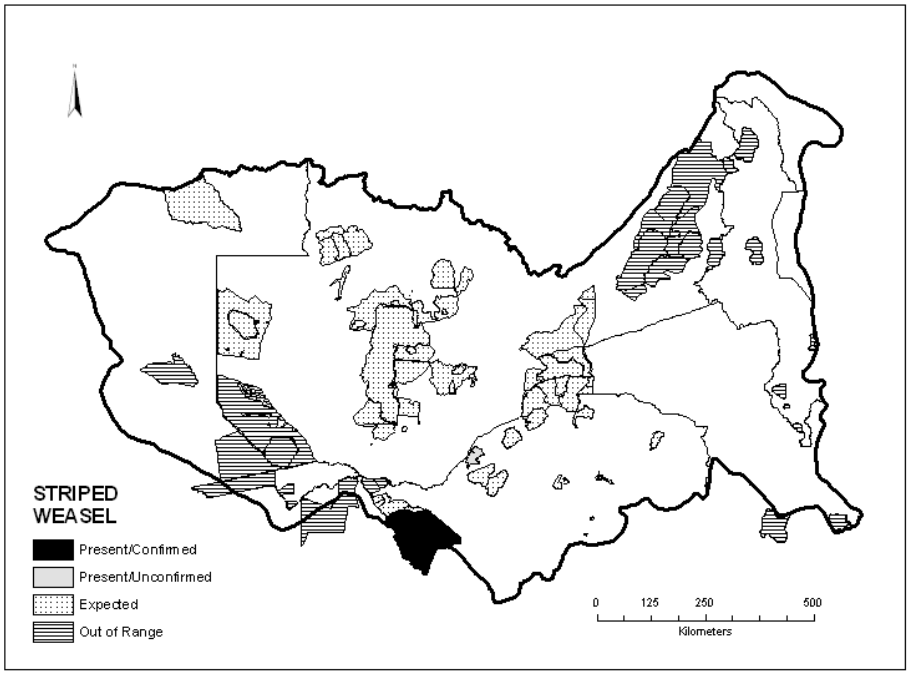
Striped polecat



This is another species that should have been recorded as present in all the protected areas of the Zambezi Basin, but was only confirmed as present from four; Kafue, Hwange, Mosi-oa-Tunya and Mana Pools National Parks. There were four records of a black and white striped animal from protected areas; Chete Safari Area and Matusadona National Park in Zimbabwe, North Luangwa National Park in Zambia and Liwonde National Park in Malawi but these could not be verified. However, if these sightings were of the polecat it would indicate a wide distribution within the Basin.

No records of conflict were found during the review.

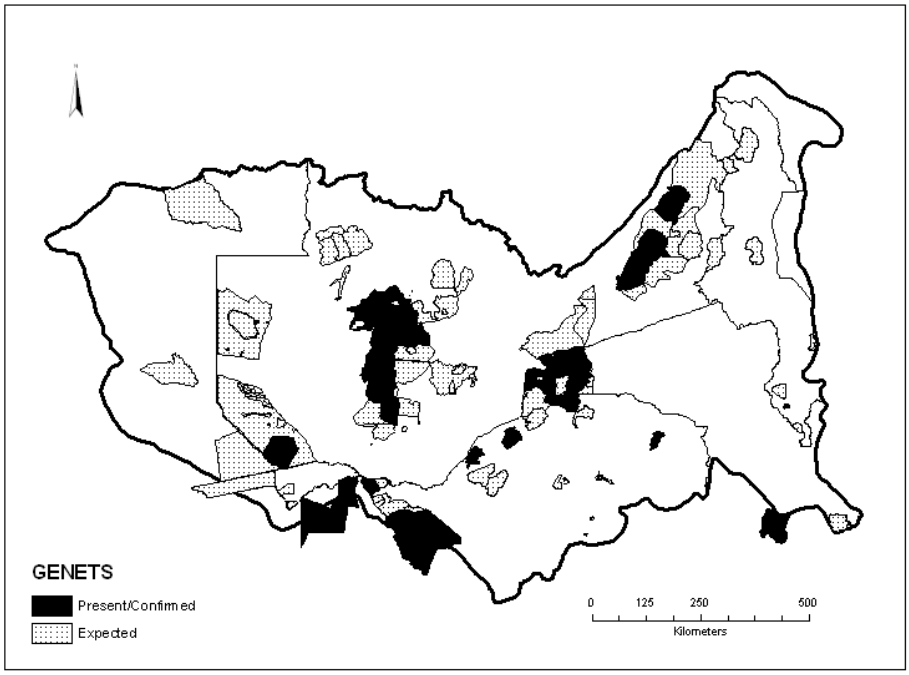
Striped weasel



This species historically was recorded as rare, and this status has not changed as a result of this review. Only two confirmed records were found both in the same geographic area: Mosi-oa-Tunya National Park and Hwange National Park. The historical distribution covers a large proportion of the protected areas in the Basin and the lack of information is of concern.

Viverridae

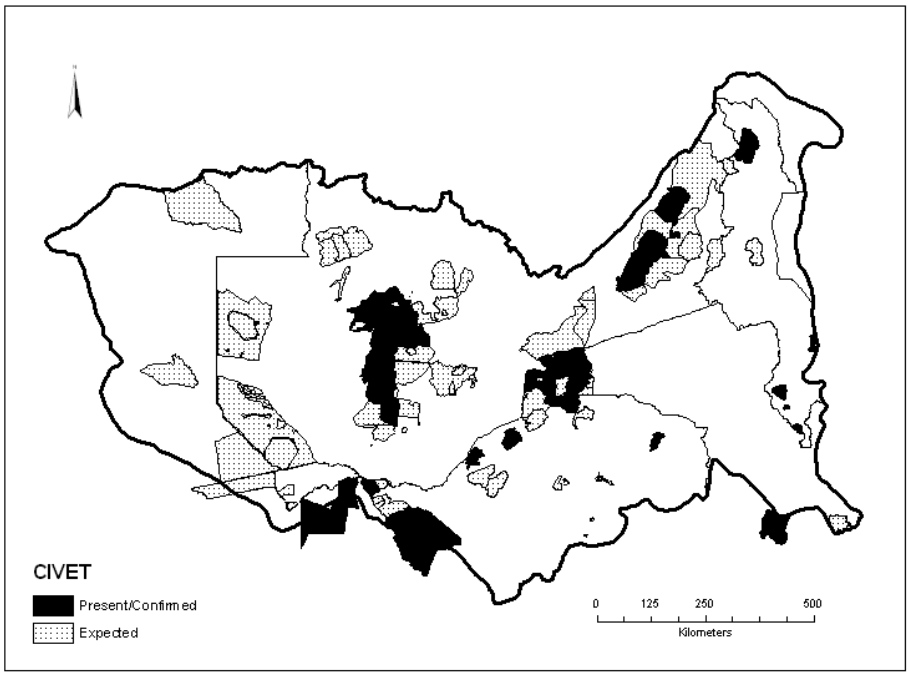
Genets



As mentioned in Section 1, all genet species were grouped together for the purposes of this review, given the continuing debates regarding their taxonomy and the difficulties of differentiating between species. This map therefore, illustrates protected areas within the Basin where a genet species was reported as being present. As can be seen, genets have a wide distribution within protected areas of the Basin and were reported as common for all areas where they were confirmed to be present.

They were reported as problem animals in the areas surrounding Chobe National Park although details of the conflict were not available. They were reported as killing chickens on a farm near Mosi-oa-Tunya National Park. In Malawi they are killed for their skins, although this practice is not aimed at genets in particular but all small species of carnivores.

Civet

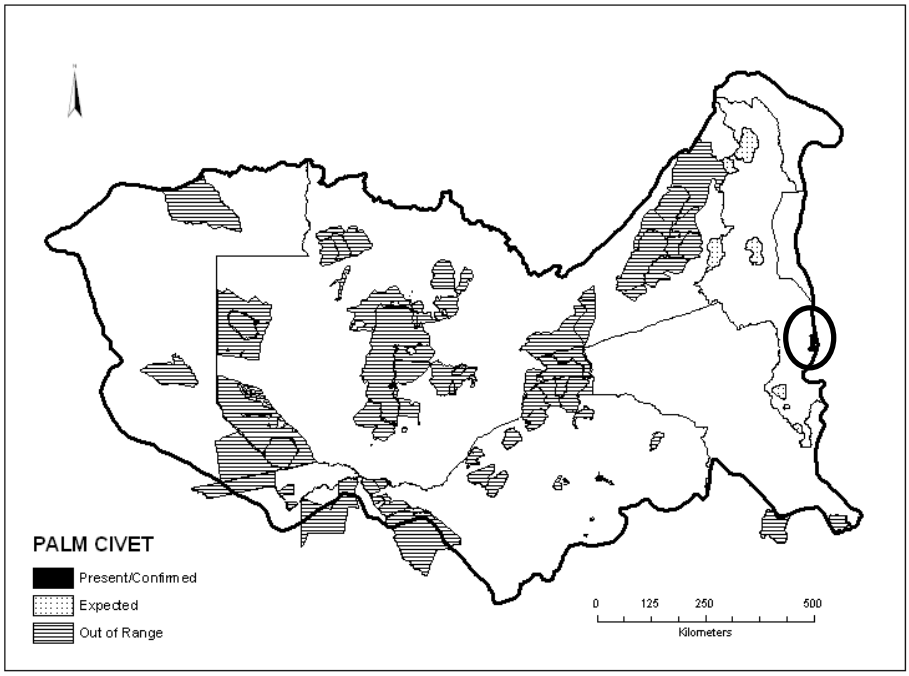


Civets were found to have a wide distribution in the protected areas of the Zambezi Basin, and were reported from almost all the protected areas where recent information was available. They were also reported as common in all areas where they currently exist.

There were no reports of conflict recorded during the survey.

Nandiniidae

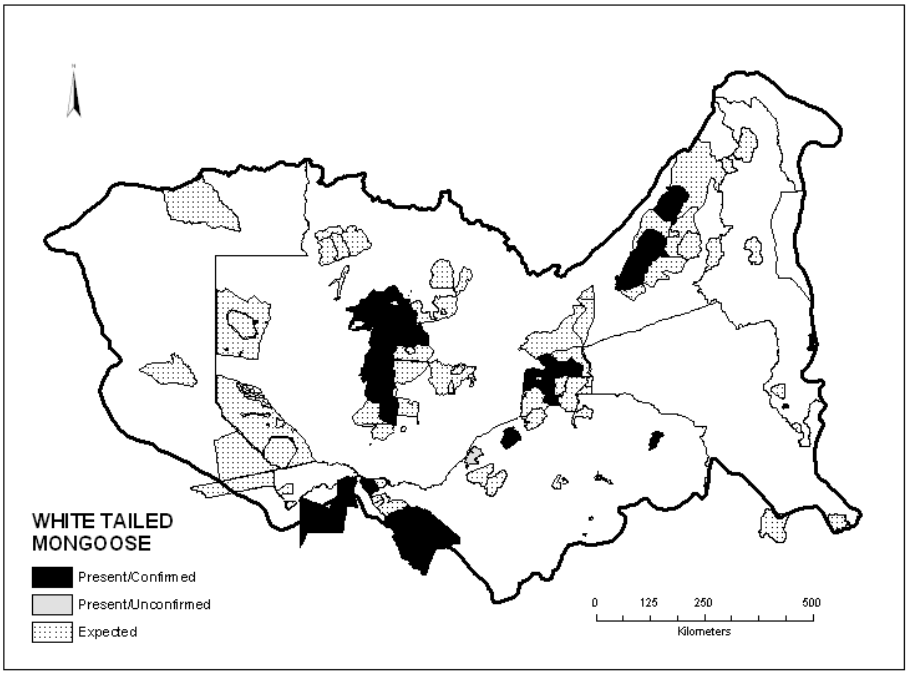
Tree/Palm Civet



This species only occurs historically in the protected areas of Malawi and possibly Gorongosa National Park. During this survey only one confirmed sighting was reported in Liwonde National Park (the circled area in on the map). Given that information was available for other protected areas in Malawi that gave details of other carnivore species, there is some concern over the status of this species, especially given its habitat requirements. More information is needed.

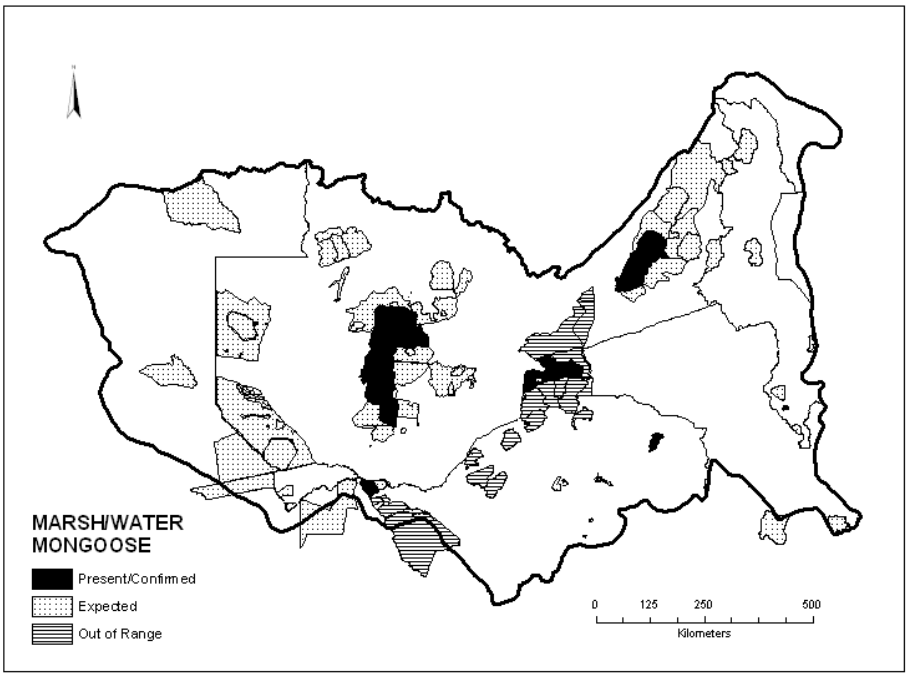
Herpestidae

White tailed mongoose



This is one of the more common species of mongoose and the largest of the mongoose species that occur in the Zambezi Basin. The review found that it has a wide distribution in the Basin, occurring in nearly all areas for which information was available. In all the National Parks where it was reported to be present, it was recorded as common, except for Chobe National Park. There were no records of conflict found during the survey.

Marsh/Water mongoose

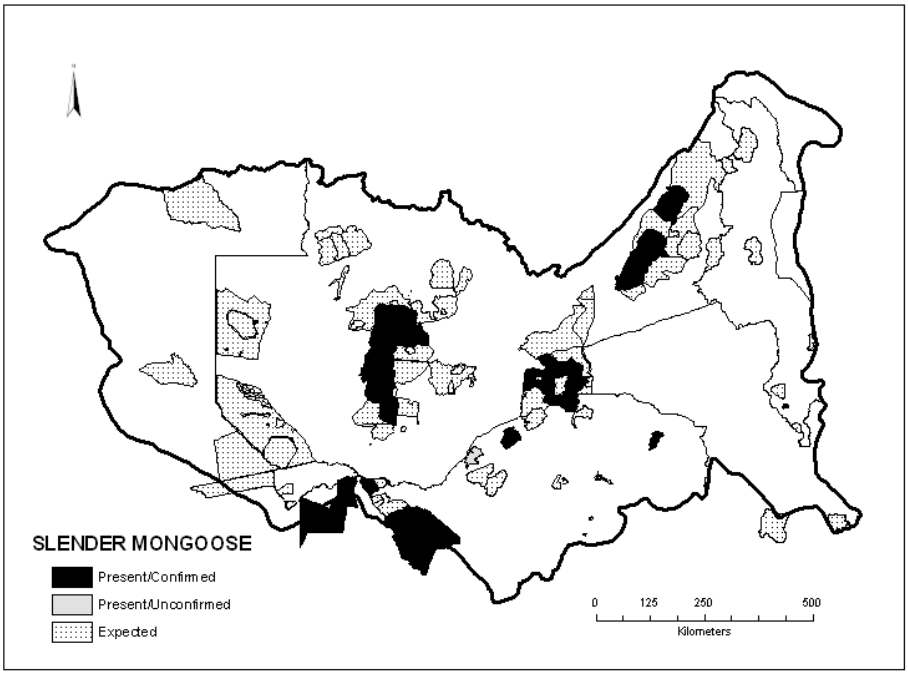


This species was found to have a distribution similar to that reported by Skinner and Chimimba (2005) and Ansell (1978) except that confirmed sightings were reported for the Lower Zambezi National Park, an area not previously included in its range. Interestingly, this National Park also recorded the Cape clawless otter where previously there had been no records. These two species both utilise riverine habitats, although the mongoose does not swim to catch its prey, but forages on the edge of water (Skinner and Chimimba, 2005). Their diet overlaps considerably, and resource partitioning seems to occur more along the time of activity, the mongoose being mainly nocturnal and the otter having a wider activity period (Skinner and Chimimba, 2005). It is possible that habitat changes and or prey changes have occurred in the Lower Zambezi National Park area, and the two species have expanded their historic range. Alternatively it may be that the species were previously overlooked, and no specimens were captured.

It has been acknowledged that this species in not rare, but often overlooked so the lack of records from protected areas where information was available for other carnivore species probably indicates a lack of sightings rather than absence.

There were no records of conflict with humans.

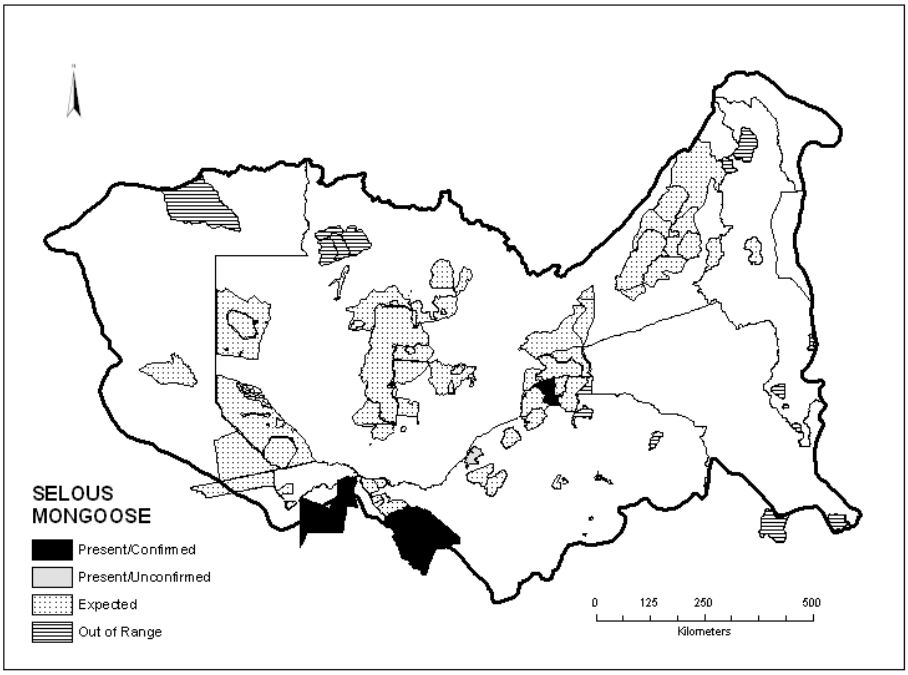
Slender mongoose



Given the fact that historically this species has been recorded as common throughout its range, the number of confirmed sightings reported during this survey was less than would be expected. The species still appears to have a wide distribution within the Basin, but more information is needed from Malawi (where there was only one recent confirmed sighting) and the western area of the Basin including Angola. In areas where it was confirmed as present it was also reported to be common.

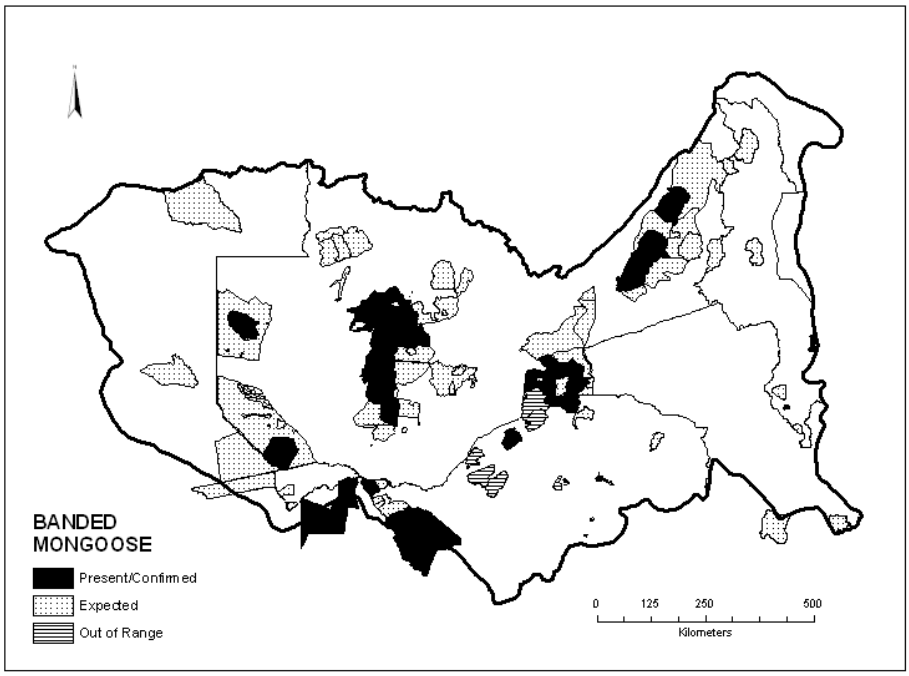
Only one record of conflict was found during the review, where an individual was caught killing chickens on a farm near the Mosi-oa-Tunya National Park. However, there is anecdotal evidence that it can cause considerable damage to poultry farmers by eating eggs and killing chickens and other domestic fowl

Selous' mongoose



This species was only confirmed as present in four of the protected areas of the Zambezi Basin, a small proportion of its expected range. There were no recent records from Zambia or Namibia, where the species should occur. Historically they were reported to be an uncommon species (Skinner and Chimimba, 2005) and this review reinforces that status.

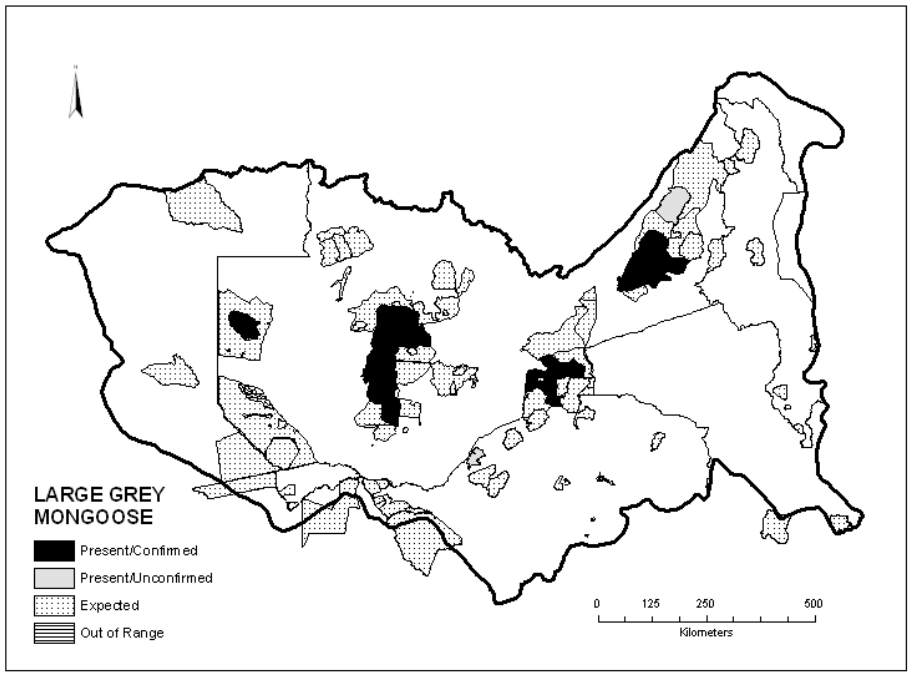
Banded mongoose



This species was found to be widely spread within the protected areas of the Zambezi Basin, and was confirmed present in one new location, Matusadona National Park. . In all protected areas from which information was available the species was recorded as common.

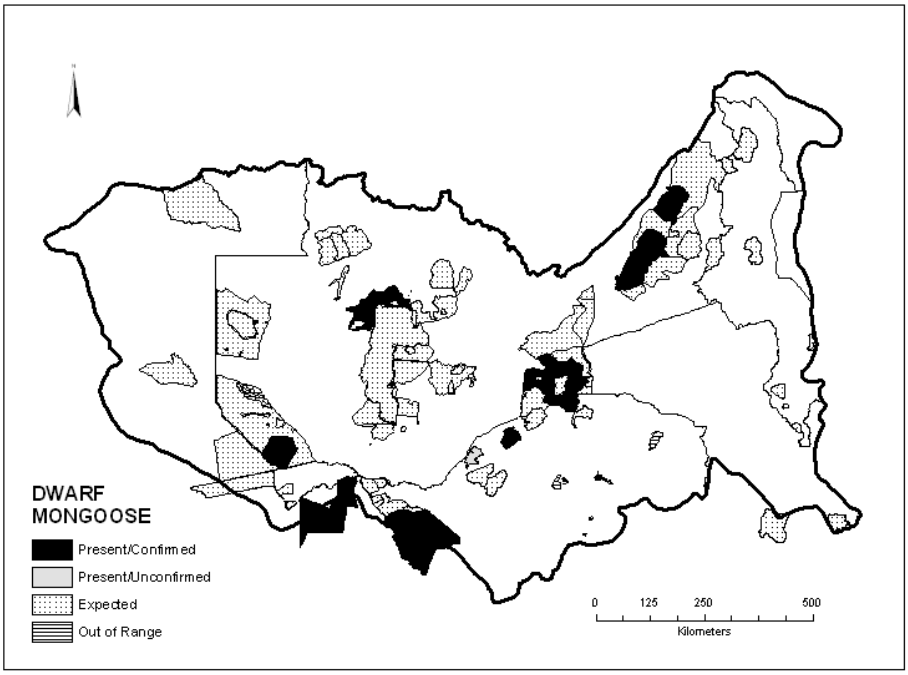
There were no reports of conflict found during the review.

Large grey mongoose



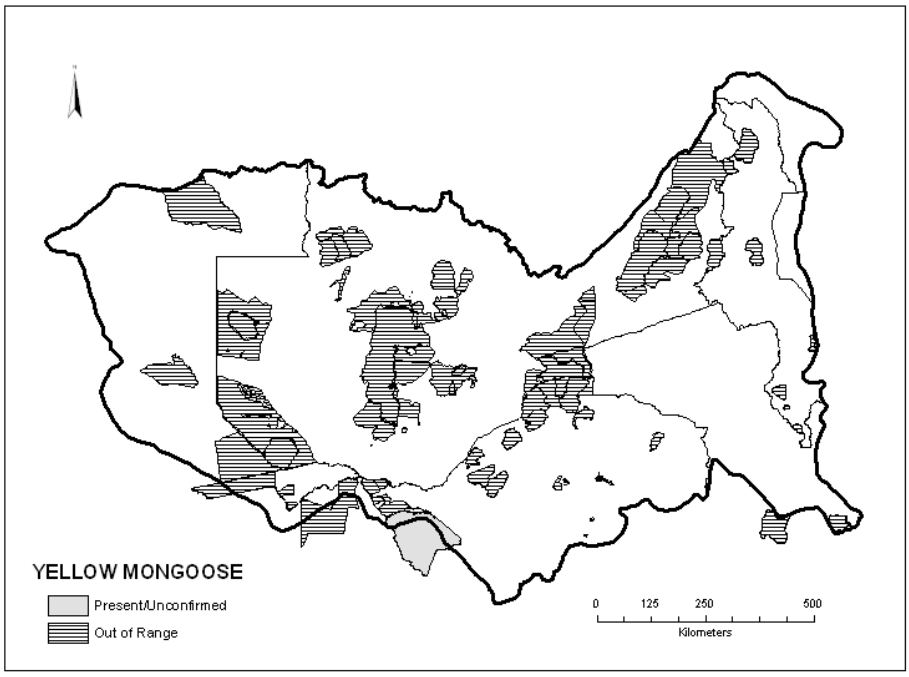
Given that this species should have been recorded in all protected areas of the Zambezi Basin, and is less likely to be overlooked given its size, and diurnal activity, the lack of records is surprising. It was confirmed as present only in protected areas of Zambia, although in Malawi it was thought to be present in all protected areas but no detailed recent records were available. There were two unconfirmed records of this species, one in South Luangwa National Park and Chete Safari area. They have a broad habitat tolerance and should still be relatively common in this region. More information is required about this species.

Dwarf mongoose



This species was found to have a distribution very similar to that of the banded mongoose with the exception of not being recorded in Kafue National Park, or Liwonde National Park. It should be present in all protected areas of the Basin, and being active in the day, and a social species it is relatively conspicuous. The lack of records suggests its population is lower than that of the banded mongoose. Respondents to the questionnaire indicated that it was not as common as the banded mongoose in protected areas where they occurred together.

Yellow mongoose



This species was not originally included in the review as its historic range did not extend into the Zambezi Basin. However, during the review an unconfirmed sighting of the species was recorded for Hwange National Park, and as one purpose of the review was to look at overall carnivore diversity in protected areas it was felt that the potential presence of a new species for the region was important to consider.

Section 3: Conclusions and recommendations:

Gaps in knowledge

The review found that there was limited published literature regarding the status and distribution of carnivores within protected areas of the Zambezi Basin, and that most of this literature focussed on the larger more charismatic species. Much of the literature was also found to be more that 10 years old, and given the rapid changes in human population and land use that have occurred in the Basin area it is likely that carnivore populations have changed in response.

As can be seen from Tables 3 and 4, other than information about lion taken from the Conservation Strategy for Lion in Eastern and Southern Africa, there was no current information available for Angola. Information was also not available for many of the protected areas of Zambia, especially the Game Management Areas, which form important buffers to the main protected areas (Table 3 and 4). Information in Malawi was mainly confined to the larger species, and this is of concern given that the protected areas in this country should have viable populations of the African palm civet and the spotted necked otter (Tables 3 and 4). Likewise accurate and detailed information in Namibia was available for the larger species, but no information about the smaller species (Table 3 and 4). Information for the two protected areas in Mozambique was also limited.

The exceptions in the review were Hwange National Park, Chobe National Park, Matetsi Unit 7 Safari Area, Matusadona National Park and Mana Pools National Park where sightings have been systematically recorded since 2000 (Table 3 and 4). Some tourist operators in South Luangwa have kept records of sightings, as has Chiawa camp in the Lower Zambezi National Park allowing an assessment of distribution in these areas (Table 3 and 4). The main tour operator in Mfunrundzi National Park has also kept detailed records of sightings since beginning operations in the Park (Table 3 and 4).

Databases were available for Hwange National Park and Chobe National Park for all species seen. The Zimbabwe Parks and Management Authority keeps a relatively accurate record of species killed as trophy species in the Safari Areas of Zimbabwe, and the CAMPFIRE Association of Zimbabwe keeps some records of problem animal reports although these vary greatly in accuracy between areas. The Zambia Wildlife Authority keeps no record of carnivore species in their protected area network and limited information about species killed as trophy animals. It was not possible to determine what information was available from the government in Mozambique, and although Botswana has a unit within its Department of National Parks that deals with problem animals, access to this information was not possible.

The lack of information and databases urgently needs to be reversed if carnivore conservation is to be successful in this region. The recommendations from this review are as follows:

It is strongly recommended that detailed ground surveys be carried out in all protected areas where data was found to be lacking, especially the National parks (Kameia National Park in Angola; Liuwa Plains, Sioma Ngwezi, West Lunga, Kafue, North Luangwa, Luambe and Lukusuzi National Parks in Zambia and all protected areas in Malawi and Mozambique). If this is not

Table 4: Summary of data collected during the review indicating presence/absence of priority species in protected areas of the Zambezi Basin 2000 – 2006. Protected areas have been grouped into "complexes" in line with recommendations from Sanderson *et al* (2003) according to geographic proximity and potential biological corridors

WD = Wild dog; CH = Cheetah; LI = Lion; SH = Spotted hyaena; AW = Aarwolf; SE = Serval; LE = Leopard; BTM = Bushy tailed mongoose; MM = Meller's mongoose; SNO = Spotted necked otter
1 = Present (Confirmed); 2 = Present (Unconfirmed); 3 = Expected but not recorded; 4 = Out of range; 5 = Extirpated; 6 = Transient . See text for more detail.
TC = Total Present (Confirmed); TE = Total Extirpated.

Protected area	IUCN	Presence/Absence Carnivore species											
	Status	WD	CH	LI	SH	AW	SE	LE	BTM	MM	SNO	TC	TE
Hwange-Chobe-Caprivi-Luiana-Zambia complex													
Hwange	II	1	1	1	1	1	1	1	4	4	4	7	0
Deka	VI	3	3	1	1	3	3	1	4	4	4	3	0
Mamili	II	3	1	1	1	3	3	1	4	4	3	4	0
Kazuma Pan	II	3	3	3	3	3	3	3	4	4	4	0	0
Matetsi	VI	3	3	3	3	3	3	3	4	4	4	0	0
Mudumu	II	1	3	1	1	3	3	1	4	4	3	4	0
Zambezi	II	3	3	3	3	3	3	3	4	4	1	1	0
Matetsi Unit 7	VI	1	1	1	1	1	1	1	4	4	1	8	0
Caprivi	VI	1	1	1	1	3	3	1	4	4	3	5	0
Sioma Ngwezi	II	1	1	1	1	2	1	1	4	4	3	6	0
Luiana	IV	3	3	1	3	4	3	3	4	4	3	1	0
Chobe	II	1	1	1	1	3	1	1	4	1	3	7	0
Lower West Zambezi	VI	1	1	1	1	4	3	1	4	4	1	6	0
Kafue Complex													
Sichifula	VI	1	3	2	3	4	3	2	4	3	3	1	0
Kafue	II	1	1	1	1	4	1	1	4	3	3	6	0
Mulobezi	VI	3	3	3	3	4	3	3	4	3	3	0	0
Bilili Springs	VI	3	3	3	3	4	3	3	4	3	3	0	0
Nkala	VI	3	3	3	3	4	3	3	4	3	3	0	0
Lochinvar	II	5	5	5	3	4	3	5	4	3	3	0	4
Kafue Flats	VI	5	5	5	3	4	3	5	4	3	3	0	4
Namwala	VI	3	3	3	3	4	3	3	4	3	3	0	0
Mumbwa	VI	3	3	2	3	4	3	2	4	3	3	0	0
Lunga-Luswishi	VI	3	3	2	3	4	3	2	4	3	3	0	0
Kansonso-Busanga	VI	1	3	1	1	4	3	1	4	3	3	4	0
Machiya-Fungulwe	VI	5	3	3	3	4	3	3	4	3	3	0	1
Blue Lagoon	II	5	5	5	3	4	3	5	4	3	3	0	4
Luangwa-Nyika complex													
Sandwe	VI	3	3	2	2	4	3	2	3	3	4	0	0
Lupande	VI	3	3	1	2	4	3	2	3	4	4	1	0
Lukusuzi	II	3	3	2	2	4	3	2	3	4	4	0	0
South Luangwa	II	1	3	1	1	4	1	1	1	1	4	7	0
Luambe	II	3	3	1	2	4	1	1	3	4	4	3	0
Munyamadzi	VI	3	1	2	2	4	3	2	3	4	4	1	0
Lumimba	VI	3	3	2	2	4	3	2	3	4	4	0	0
North Luangwa	II	1	3	1	1	4	1	1	3	4	4	5	0
Musalangu	VI	1	3	1	3	4	3	3	3	4	3	2	0
Vwaza Marsh	IV	5	5	6	1	4	3	3	4	4	3	1	2

Protected area	IUCN Status	Presence/Absence Carnivore species											
		WD	CH	LI	SH	AW	SE	LE	BTM	MM	SNO	TC	TE
Nyika	II	5	5	6	1	4	1	1	4	4	3	2	2
Lower Zambezi-Mana Pools complex													
Charara	VI	3	3	3	3	3	3	3	3	3	2	0	0
Doma	VI	3	3	3	3	4	3	3	3	4	4	0	0
Hurungwe	VI	3	3	3	3	3	3	3	3	3	4	0	0
Dande	VI	1	3	1	1	4	3	3	3	3	4	3	0
Mana Pools	II	1	1	1	1	4	1	1	3	3	4	6	0
Chewore	VI	3	3	3	3	4	1	1	3	3	4	2	0
Rufunsa	VI	1	3	1	1	4	1	1	4	3	4	5	0
Sapi	VI	3	3	3	3	4	3	3	3	3	4	0	0
Lower Zambezi	II	1	3	1	1	4	1	1	3	3	4	5	0
Chiawa	VI	1	3	1	1	4	1	1	3	3	4	5	0
Luano	VI	1	3	2	3	4	3	2	4	3	4	1	0
West Petauke	VI	3	3	1	1	4	3	1	4	3	4	3	0
Chisomo	VI	3	3	1	1	4	3	1	4	3	4	3	0
West Lunga Complex													
Lukwakwa	VI	5	3	5	3	4	3	3	4	3	3	0	2
West Lunga	II	5	3	5	3	4	3	3	4	3	3	0	2
Musele-Matebo	VI	5	3	5	3	4	3	3	4	3	3	0	2
Chibwika-Ntambu	VI	5	3	5	3	4	3	3	4	3	3	0	2
Angola													
Mavinga	IV	3	4	1	3	4	3	3	4	4	3	1	0
Kameia	II	3	4	1	3	4	3	3	4	4	3	1	0
Malawi													
Mwabvi	IV	5	5	6	1	4	3	3	3	3	3	1	2
Lengwe	II	5	5	5	1	4	1	5	3	3	3	4	2
Majete	IV	5	5	5	1	4	3	5	3	3	3	1	4
Liwonde	II	5	5	5	1	4	1	5	3	3	1	4	3
Nkhota-Kota	IV	5	5	6	1	4	3	3	4	4	3	1	2
Kasungu	II	5	5	6	1	4	3	3	3	4	4	1	2
Mozambique													
Marromeu	IV	4	4	3	3	4	3	3	3	4	3	0	0
Gorongosa	II	6	5	6	1	4	1	1	3	4	3	3	1
Zambia													
Mosi-Oa-Tunya	II	6	3	3	6	3	1	1	3	3	2	2	0
Liuwa Plain	II	1	1	1	1	4	1	1	4	4	3	6	0
Upper West Zambezi	VI	3	3	2	3	4	3	3	4	4	3	0	0
Chizera	VI	4	3	3	3	4	3	3	4	3	3	0	0
Zimbabwe													
Sebakwe	V	4	3	3	3	3	3	3	4	3	4	0	0
Ngezi	V	4	3	3	3	3	3	3	4	3	4	0	0
Robert McIlwaine	V	4	3	3	3	3	3	3	4	4	4	0	0
Umfuli	V	4	3	3	3	3	3	3	4	4	4	0	0
Chegutu	VI	4	3	3	3	3	3	3	4	4	4	0	0
Lake Robertson	V	4	3	3	3	3	3	3	4	4	4	0	0
Chirisa	VI	3	3	3	3	3	3	1	4	4	4	1	0
Chizarira	II	3	3	1	3	3	3	3	4	4	4	1	0
Chete	VI	1	3	1	1	1	1	1	2	4	2	6	0
Mfundrundzi	VI	4	4	1	1	4	3	1	1	4	4	4	0
Matusadona	II	1	1	1	1	1	1	1	3	4	4	7	0

Table 5: Summary of data collected during the review indicating presence/absence of remaining carnivore species in protected areas of the Zambezi Basin 2000 – 2006. Protected areas have been grouped in line with recommendations from Sanderson *et al* (2003) according to geographic proximity and potential biological corridors

BH = Brown hyaena; SSJ = Side striped jackal; BBJ = Black backed jackal; BEF = Bat eared fox; CA = Caracal; AWC = African Wild Cat; CCO = Cape Clawless Otter; HB = Honey Badger; SP = Striped polecate; SW = Striped weasel; G = Genet species; CI = Civet; APC = African Palm Civet; WTM = White tailed mongoose; MWM = Marsh/Water mongoose; SM = Slender mongoose; SeM = Selous Mongoose; BM = Banded mongoose; LGM = Large grey mongoose; DM = Dwarf Mongoose; YeM = Yellow mongoose

1 = Present (Confirmed); 2 = Present (Unconfirmed); 3 = Expected but not recorded; 4 = Out of range; 5 = Extirpated; 6 = Transient . See text for more detail.
TC = Total Present (Confirmed); TE = Total Extirpated.

Protected area	IUCN Status	Presence/Absence Carnivore species																					TC
		BH	SSJ	BBJ	BEF	CA	AWC	CCO	HB	SP	SW	G	CI	APC	WTM	MWM	SM	SeM	BM	LGM	DM	YeM	
Hwange-Chobe-Caprivi-Luiana-Zambia complex																							
Hwange	II	1	1	1	1	1	1	1	1	1	1	1	1	4	1	4	1	1	1	3	1	2	16
Deka	VI	4	1	1	3	1	3	3	1	1	3	3	1	4	1	4	1	1	1	3	3	4	10
Mamili	II	3	1	4	3	3	3	3	3	3	4	3	3	4	3	3	3	3	3	3	3	4	1
Kazuma Pan	II	3	3	3	3	3	3	3	3	3	3	3	3	4	3	4	3	3	3	3	3	4	0
Matetsi	VI	3	3	3	3	3	3	3	3	3	3	3	3	4	3	4	3	3	3	3	3	4	0
Mudumu	II	1	1	4	3	3	3	3	3	3	4	3	3	4	3	3	3	3	3	3	3	4	2
Mosi-Oa-Tunya	II	4	1	4	4	3	1	1	3	3	1	1	3	4	1	3	1	3	1	3	3	4	8
Zambezi	II	4	3	4	3	3	3	1	3	3	4	3	3	4	3	3	3	3	3	3	3	4	1
Matetsi Unit 7	VI	4	1	1	1	1	1	1	1	3	4	1	1	4	1	1	1	3	1	3	3	4	13
Caprivi	VI	1	3	4	3	3	3	3	3	3	4	3	3	4	3	3	3	3	3	3	3	4	0
Lower West Zambezi	VI	4	3	4	4	3	3	3	3	3	4	3	3	4	3	3	3	3	3	3	3	4	0
Sioma Ngwezi	II	4	1	4	4	1	3	1	1	3	4	1	3	4	3	3	3	3	1	3	1	4	7
Luiana	IV	4	3	4	4	3	3	3	3	3	4	3	3	4	3	3	3	3	3	3	3	4	0
Chobe	II	3	1	1	1	1	1	3	1	3	4	1	1	4	1	3	1	1	1	3	1	4	13
Kafue Complex																							
Sichifula	VI	4	1	4	4	3	3	3	3	3	3	4	3	4	3	3	3	3	3	3	3	4	0

Protected area	IUCN	Presence/Absence Carnivore species																					
	Status	BH	SSJ	BBJ	BEF	CA	AWC	CCO	HB	SP	SW	G	CI	APC	WTM	MWM	SM	SeM	BM	LGM	DM	YeM	TC
Kafue	II	4	1	4	4	1	1	1	1	1	3	1	1	4	1	1	1	3	1	1	3	4	13
Mulobezi	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	3	3	3	3	4	0
Bilili Springs	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	3	3	3	3	4	0
Nkala	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	3	3	3	3	4	0
Lochinvar	II	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	3	3	3	3	4	0
Kafue Flats	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	3	3	3	3	4	0
Namwala	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	3	3	3	3	4	0
Blue Lagoon	II	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	3	3	3	3	4	0
Mumbwa	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	3	3	3	3	4	0
Lunga-Luswishi	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	3	3	3	3	4	0
Kansonso-Busanga	VI	4	3	4	4	1	3	1	3	3	3	1	1	4	1	3	3	3	1	3	1	4	7
Machiya-Fungulwe	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	3	3	3	3	4	0
Luangwa-Nyika complex																							
Sandwe	VI	4	3	4	4	3	3	3	3	3	4	4	3	4	3	3	3	3	3	3	3	4	0
Lupande	VI	4	3	4	4	3	3	3	3	3	4	4	3	4	3	3	3	3	3	1	3	4	1
Lukusuzi	II	4	3	4	4	3	3	3	3	3	4	4	3	4	3	3	3	3	3	3	3	4	0
South Luangwa	II	4	1	4	4	1	1	1	1	3	4	1	1	4	1	1	1	3	1	1	1	4	13
Luambe	II	4	3	4	4	3	3	3	3	3	4	4	1	4	3	3	3	3	3	3	3	4	1
Munyamadzi	VI	4	3	4	4	3	3	3	3	3	4	4	3	4	3	3	3	3	3	3	3	4	0
Lumimba	VI	4	3	4	4	3	3	3	3	3	4	4	3	4	3	3	3	3	3	3	3	4	0
North Luangwa	II	4	1	4	4	1	1	1	1	2	4	1	1	4	1	3	1	3	1	2	1	4	11
Vwaza Marsh	IV	4	3	4	4	3	3	3	3	3	4	4	3	3	3	3	3	4	3	3	3	4	0
Musalangu	VI	4	3	4	4	3	3	3	3	3	4	4	3	4	3	3	3	3	3	3	3	4	0
Nyika	II	4	1	4	4	3	3	3	1	3	4	4	1	3	3	3	3	4	3	3	3	4	3
Lower Zambezi-Mana Pools complex																							
Charara	VI	4	3	4	4	3	3	2	3	3	3	4	3	4	3	4	3	3	4	3	3	4	0
Doma	VI	4	3	4	4	3	3	4	3	3	3	4	3	4	3	4	3	3	3	3	3	4	0

Protected area	IUCN	Presence/Absence Carnivore species																					
	Status	BH	SSJ	BBJ	BEF	CA	AWC	CCO	HB	SP	SW	G	CI	APC	WTM	MWM	SM	SeM	BM	LGM	DM	YeM	TC
Hurungwe	VI	4	3	4	4	3	3	4	3	3	3	4	3	4	3	4	3	3	3	3	3	4	0
Dande	VI	4	3	4	4	3	3	3	1	3	3	4	3	4	3	4	3	3	3	3	3	4	1
Mana Pools	II	4	1	4	4	3	3	4	1	1	3	1	1	4	1	4	1	1	1	1	1	4	11
Chewore	VI	4	1	4	4	3	3	4	3	3	3	1	1	4	3	4	1	3	1	3	1	4	6
Rufunsa	VI	4	3	4	4	3	1	1	3	3	3	1	1	4	3	4	3	3	3	3	3	4	4
Sapi	VI	4	3	4	4	3	3	4	3	3	3	4	3	4	3	4	3	3	3	3	3	4	0
Lower Zambezi	II	4	1	4	4	3	1	1	1	3	3	1	1	4	1	1	1	3	1	1	1	4	12
Chiawa	VI	4	1	4	4	3	1	1	1	3	3	1	1	4	1	1	1	3	1	1	1	4	12
Luano	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	4	3	3	3	3	3	4	0
West Petauke	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	4	3	3	3	3	3	4	0
Chisomo	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	4	3	3	3	3	3	4	0
West Lunga Complex																							
Lukwakwa	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	4	3	3	3	4	0
West Lunga	II	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	4	3	3	3	4	0
Musele-Matebo	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	4	3	3	3	4	0
Chibwika-Ntambu	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	4	3	3	3	4	0
Angola																							
Mavinga	IV	4	3	4	4	3	3	3	3	3	4	3	3	4	3	3	3	3	3	3	3	4	0
Kameia	II	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	4	3	3	3	4	0
Malawi																							
Mwabvi	IV	4	3	4	4	3	3	3	3	3	4	4	1	3	3	3	3	4	3	3	3	4	1
Lengwe	II	4	1	4	4	3	3	3	3	3	4	1	1	3	1	1	1	4	1	3	3	4	7
Majete	IV	4	3	4	4	3	3	3	1	3	4	4	1	3	3	3	3	4	3	3	3	4	2
Liwonde	II	4	3	4	4	3	3	3	1	2	4	4	1	1	1	3	3	4	1	3	3	4	5
Nkhota-Kota	IV	4	1	4	4	3	3	3	3	3	4	4	3	3	3	3	3	3	3	3	3	4	1
Kasungu	II	4	1	4	4	1	3	3	3	3	4	4	3	3	3	3	3	3	3	3	3	4	2

Protected area	IUCN	Presence/Absence Carnivore species																					
	Status	BH	SSJ	BBJ	BEF	CA	AWC	CCO	HB	SP	SW	G	CI	APC	WTM	MWM	SM	SeM	BM	LGM	DM	YeM	TC
Mozambique																							
Marromeu	IV	4	3	4	4	3	3	3	3	3	4	4	3	4	3	3	3	4	3	3	3	4	0
Gorongosa	II	4	1	4	4	1	3	4	3	3	4	1	1	4	3	3	3	4	3	3	3	4	4
Zambia																							
Liuwa Plain	II	4	1	4	4	3	3	3	3	3	3	3	3	4	3	3	3	3	1	1	3	4	3
Upper West Zambezi	VI	4	3	4	4	3	3	3	3	3	3	3	3	4	3	3	3	3	3	3	3	4	0
Chizera	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	3	3	3	3	4	0
Zimbabwe																							
Sebakwe	V	4	3	4	4	3	3	3	3	3	3	3	3	4	3	3	3	3	4	4	4	4	0
Ngezi	V	4	3	4	4	3	3	3	3	3	3	3	3	4	3	3	3	3	4	4	4	4	0
Robert McIlwaine	V	4	3	4	4	3	3	3	3	3	3	3	3	4	3	3	3	3	4	3	4	4	0
Umfuli	V	4	3	4	4	3	3	3	3	3	3	3	3	4	3	3	3	3	4	3	4	4	0
Chegutu	VI	4	3	4	4	3	3	3	3	3	3	3	3	4	3	3	3	3	4	3	4	4	0
Lake Robertson	V	4	3	4	4	3	3	3	3	3	3	3	3	4	3	3	3	3	4	3	4	4	0
Chirisa	VI	4	3	4	4	3	3	3	3	3	3	4	3	4	3	4	3	3	4	3	3	4	0
Chizarira	II	4	3	4	4	3	3	3	3	3	3	4	3	4	3	4	3	3	4	3	3	4	0
Chete	VI	4	1	4	4	1	1	2	1	2	2	1	1	4	2	4	2	2	4	2	2	4	6
Mfunrundzi	VI	4	1	4	4	1	1	1	1	3	3	1	1	4	1	1	1	4	3	3	4	4	10
Matusadona	II	4	1	4	4	1	1	4	3	2	3	1	1	4	1	4	1	3	1	3	1	4	9

done soon, then conservation efforts may be focussed on other areas already known to be diverse and have priority species present, despite that fact that key populations of carnivore species may exist in these undocumented protected areas. Given the opportunities for connectivity between protected areas within the Basin it is recommended that survey be carried out in a similar manner, during a similar time frame in all the above protected areas, perhaps adopting an atlas approach.

At present it is known that there is a national survey planned to determine lion population size and offtakes in Zambia (White, 2007), and a carnivore atlas project ongoing in Zimbabwe (Wilson, pers comm.) but the review was not able to ascertain if any other carnivore surveys are planned for protected areas within the Basin

- It is strongly recommended that all countries that share the Basin are encouraged to keep similar, detailed databases of reports of human-carnivore conflict to enable mitigation to be carried out effectively. This is especially important in the areas identified where carnivore populations are found across national borders
- .It is recommended that where possible regional policies for problem animal control develop along similar lines (eg the procedure developed by the African Lion Working Group for control of problem lions)

Key areas for management

Given the available information collected during this survey, and as a guide for management, the area within the Basin that is currently known to have the greatest number of priority species present and the highest diversity of carnivore species in terms of species number, is the geographic area (protected area "complex") incorporating the Hwange-Chobe-Caprivi-Luiana-Sioma Ngwezi protected areas, and their surrounds (Table 3 and 4, Figure 5).This complex is also important as the land between the gazetted protected areas is also suitable for carnivores and dispersal of individual animals (Figure 5). Between Hwange National Park and the Matetsi Unit 7 Safari area, and Chobe National Park are wildlife management areas and hunting concessions where human habitation and livestock numbers are limited. Likewise between Chobe and the protected areas of the Caprivi strip in Namibia there are also wildlife management areas and community conservancies, where corridors of movement for carnivores would be present (Figure 5). Finally, the protected areas of Angola and Zambia in this geographic region juxtapose, and although humans are present in these areas, the emphasis, *de jure,* is on wildlife management, and there is potential to secure these areas for carnivore conservation (Figure 5).

There are already five projects working towards mitigation of human-carnivore conflict in this complex (The HACCIS project in Namibia, CARACAL Programme in Botswana, The Hwange Lion Project in Hwange, the Painted Hunting Dog Project in Hwange and the CAMPFIRE programme around the periphery of the protected areas in Zimbabwe; Table 2), which means that there already a greater potential for long term carnivore conservation.

The results of this review agree with the recommendation of Mills *et al* (2001) that this geographic area is a key area for carnivore management.

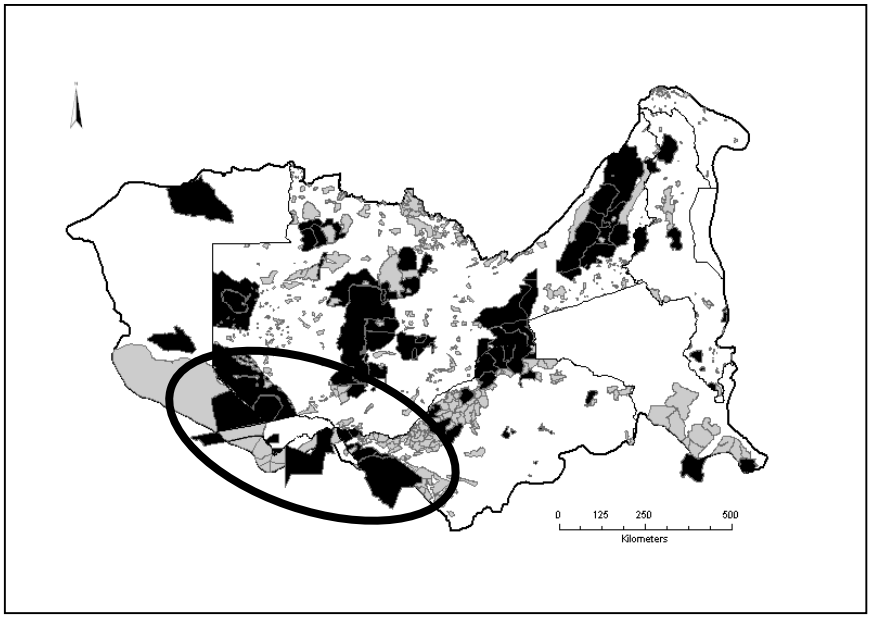


Figure 5: Illustration of the potential for one contiguous area for carnivore conservation between Liuana in Angola, and Hwange National Park in Zimbabwe. Given the current knowledge base this area incorporates the highest number of carnivore species, and the greatest number of priority species in the Zambezi Basin.

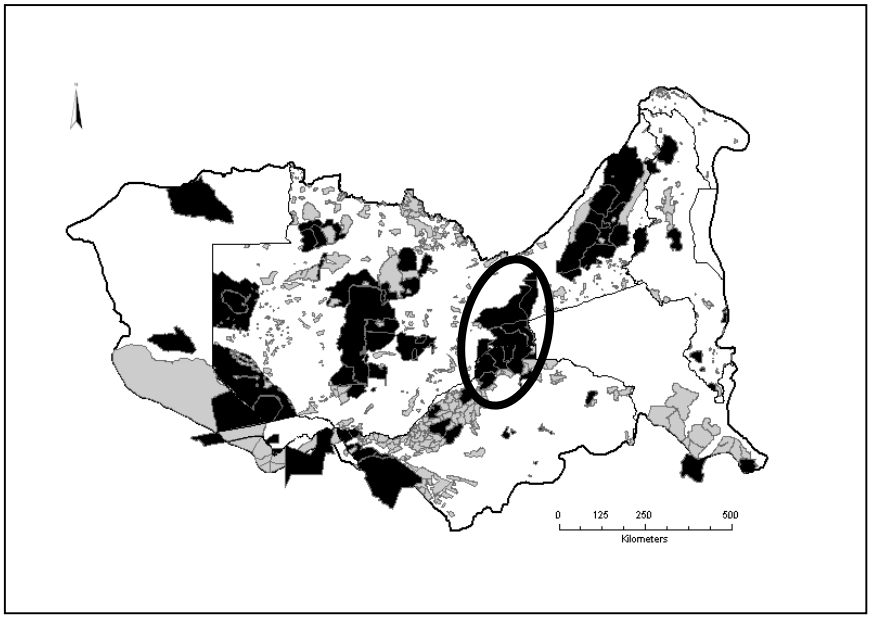


Figure 6: Mana Pools-Lower Zambezi complex of protected areas within the Zambezi Basin, the second highest priority area for carnivore conservation given the current knowledge about status and distribution of carnivores, and levels of human carnivore conflict.

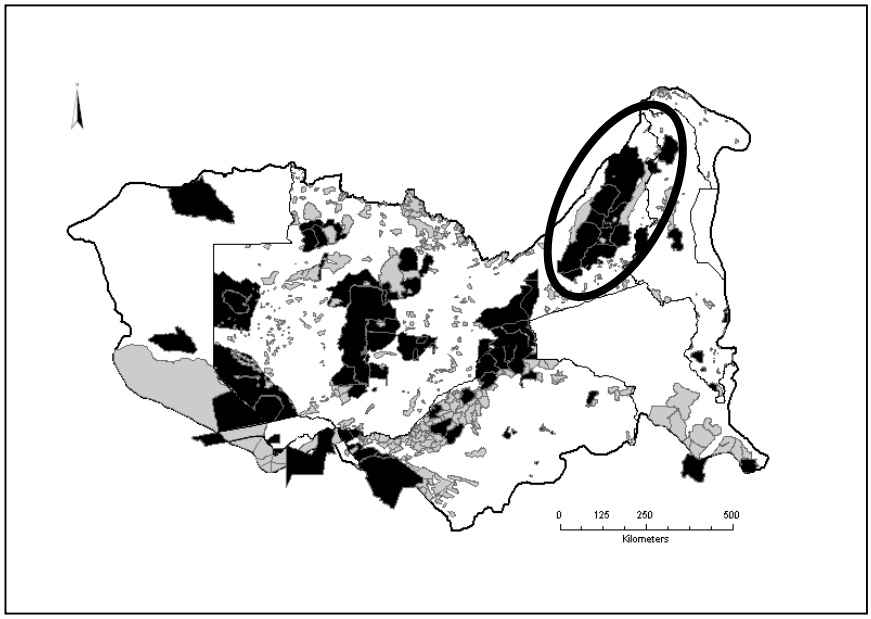


Figure 7: The Luangwa-Nyika complex of protected areas that is currently known to have populations of the two rare priority species, the bushy tailed mongoose and the Meller's mongoose. However, the status of cheetah and wild dog within this complex is of concern.

The next most diverse and important area for overall carnivore conservation given the current knowledge base is the Lower Zambezi- Mana Pools and surrounding game management/safari areas complex (Table 3 and 4, Figure 6). This complex is also contiguous in terms of carnivore populations and dispersal, although some of the Game Management areas in the Zambia section of this complex have relatively high human population densities, and the review recorded a number of conflicts between the larger carnivores and humans (Table 2). The Lower Zambezi Conservation Trust is already working towards mitigating human-carnivore conflict in this area, which will assist with long term carnivore conflict. However, there is a need for more data on conflict in this conflict and what is the most appropriate mitigation method(s).

The review also identified the South Luangwa National Park as an important protected area for overall carnivore conservation given that current knowledge shows that it has populations of the two rare priority species, the bushy tailed mongoose and the Meller's mongoose (Table 2). It also has viable populations of all the large carnivore species except for cheetah and it is likely that cheetah do occur in this protected area but at low densities. South Luangwa is also part of a complex of connected protected areas that extends into Nyika National Park in Malawi with potential for the entire area to be managed for carnivore conservation (Figure 7). More information, however, is needed about the status and distribution of carnivores in the other protected areas of this complex, especially given the recorded extirpation of wild dog and cheetah in the Malawi component, and the apparent decline in cheetah in North Luangwa and Musalangu Game Management Area.

All these important complexes of protected areas would require transboundary management Two of them are already part of established Transfrontier Conservation Areas (TFCAs) and the third is in the process of being declared a TFCA. The Hwange-Chobe-Caprivi-Luiana-Zambia complex falls almost entirely within the recently established Kavango-Zambezi TFCA. The Luangwa-Nyika complex is

partially covered by the Nyika TFCA, and the Mana Pools-Lower Zambezi complex will fall entirely under the proposed Lower Zambezi-Mana Pools TFCA.

The protected areas in Malawi were found to no longer have cheetahs and wild dogs, limited populations of lions and leopards, and there was little information about the status and distribution of many of the smaller carnivore species (Table 3 and 4). However, the Liwonde National Park was found to be important in terms of overall conservation of the diversity of carnivores in the Basin, as it was the only protected area to confirm the presence of the African palm civet, a species with a restricted range and specific habitat requirements. Liwonde also confirmed the presence of the spotted necked otter, one of the priority species where little is still known about its current status and distribution.

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List of participants in the survey

Name of source	Locality of data	Organisation/ Company	Person type	Information type
Aaskov, Hans	West Zambezi, Sioma Ngwezi	Royal Danish Embassy	Potential tour operator	personal observation, reports from scouts
Alexander Kathy	Chobe	CARACAL Project	Coordinator	Personal observation
Amanda	Mosi-o-tunya surrounds	Taita Falcon Lodge	Tour operator	personal observation
Andre Marc Jean	Marromeu Game Reserve		Researcher	Personal observation
Arnold, Neil	South Luangwa NP	Travelling Naturalist	Tourist	website - trip report
Biodiversity Foundation for Africa				Map data
Bolton, Andrew 'Sven'	Mosi-o-tunya surrounds	The Zambezi.com	Tour operator	personal observation
Burmeister Garth	Charara	KPMG	Risk Advisor	Personal observation
Burns, Cathy	Kafue National Park	Munda Wanga/ Greenforce	Researcher	Personal observation
Chibge Charles	Matetsi/Chete	Parks and Wildlife Management Authority	Senior Warden	Reports from Scouts
Chomba, Andrew	North Luangwa National Park	Zambia Wildlife Authority	Ranger	Personal observation, reports from scouts
Corry, Fynn	Sioma Ngwezi & Liuwa Plains NPs	University of Cape Town	Former park manager	personal observation
Erfmann, Hugo	Lower Zambezi	Redcliff Zambezi Lodge	Tour operator	personal observation
Gava Peter	Matetsi Unit 7	CC Africa	Manager	Personal observations and reports from scouts
Greeff, Nick	Luambe, Lower Zambezi, Chiawa		Former park manager	personal observation
Grobellaar Charl	Dande Safari Area/Chewore	Ingwe Safaris	Professional hunter	Personal observations
Hansson Lise	Mamili, Mudumu and Caprivi and surrounding areas	Predator Conservation Trust	Director	Personal observations
Henson, Ruth	Martindale Farm	Martindale Farm	Farmer	personal observation
Hind Sean	Matusadona	Spurwing island	Guide	Personal observations

Hockly, Jock	Mosi-o-tunya surrounds		Farmer	personal observation
Hovell, Garth	Lower Zambezi NP & Chiawa GMA	Chongwe Safari House	Tour operator	personal observation
Jarvis Ian	Mfunrudzi National Park	Hippo Pools	Owner/guide	Personal observations
Johnson, Penny	Sioma Ngwezi NP	Royal Barotse Safaris	Tour operator	personal observation
Labuschagne Lucille	Nyika National Park	Nyika TFCA		Personal observation and reports from scouts
Leigh, Kellie	South Luangwa NP	African Wild Dog Conservation Zambia	Researcher	personal observation
Livingstone Museum	Zambia	Livingstone Museum		museum collection records
Macdonald, Allisdair	Shinganda-Lunda Conservancy		Tour operator	personal observation/guide records
Manning, Ian	West Petauke, Luano		Professional hunter	personal observation
Masonde, Jones	Mosi-o-tunya surrounds	ZAWA	Ecologist	personal observation
Mateke Clare	Mosi-oa-Tunya National Park and Zambezi river between Victoria Falls and Kazungula	Livingstone Musuem	Keeper of Mammals	Personal observation and results of biodiversity survey
McRobb, Rachel	South Luangwa NP	South Luangwa Conservation Society	Conservationist	personal observation, reports from scouts
Michael Stewart	Lengwe, Majete and Mwabvi National Parks			Personal observation and reports from scouts
Monks, Norman	Mana Pools National Pak	Parks and Wildlife Management Authority	Senior Warden	Personal observations
Mpumba, Rebecca	West Lunga and surrounding GMAs	West Lunga Trust	Park trust co-ordinator	personal observation, transect census records
Natural History Museum, Bulawyo	Zambia	National Museums of Zimbabwe		museum collection records
Ndhlovu Beks	Chobe/Hwange	African Bush Camps	Owner/Guide	Personal observation
Ndoro Onias	Zimbabwe protected area surrounds	CAMPFIRE	Information officer	Records of PAC from Rural District Councils
Norman, Stuart	South western Zambia	North-West Naturalist Society	Naturalist	personal observation
Orr, Tony	Muchenji Farm	Muchenji Farm	Farmer	personal observation
Pope, Robin	South Luangwa NP	Robin Pope Safaris	Tour operator	personal observation
Purchase, Gianetta	Liuwa Plains NP		Researcher	personal observation
Rea, Charles	West Lunga and surrounding GMAs	West Lunga Trust	Park trust member	personal observation
Salnicki Julia	Hwange	Hyaena Project	Former Project coordinator	Personal observations
Schultz Jo Ann	Mana Pools/Matusadona	Wilderness Safaris	Guide	Personal observations

Shenton, Ali			Conservationist	personal observation
Simakando, Chambwa	Mosi-o-tunya surrounds	ZAWA	game scout	personal observation
Smith, Steve	Kafue NP	Mochaba Developments	Tour operator	personal observation
Solomon, Derek	South Luangwa NP		Tour operator	personal observation
Sparrow, Alan	Kafue NP		Researcher	personal observation
Stjernstedt, Robert	Mosi-o-tunya surrounds	Birding with Bob	Tour operator/ Researcher	personal observation
Stokke, Sigbjorn	Chobe	NINA	Researcher	Research records
Taylor Paul	Malawi Protected areas	Wildlife and Environment Society, Malawi		Records from the Society and personal observations
Ward David	Mamili, Mudumu, Caprivi and surrounding areas	WWF Namibia		Reports from scouts and PAC records
Whitefield, Rebecca	Chundukwa	African Horizons	Tour operator	personal observation
Wildlife and Environment Zimbabwe (Mashonaland Branch)	Mana Pools	Annual Game Counts		Recorded observations
Wildlife and Environment Zimbabwe (Matebeland Branch)	Hwange	Annual Game Counts		Recorded observations
Zumla, Wardasha	Lower Zambezi	Ana Tree Lodge	Tour operator	personal observation

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Appendices

Appendix I: List of species included in the survey.

Species have been divided into two groups depending on their conservation priority (see Section 1: The Review, for more detail)

A: High Priority

Scientific name	Common name
Lycaon pictus	Wild dog/Painted hunting dog
Acinonyx jubatus	Cheetah
Panthera leo	Lion
Crocuta crocuta	Spotted hyaena
Proteles cristatus	Aardwolf
Leptailurus serval	Serval
Panthera pardus	Leopard
Bdeogale crassicauta	Bushy tailed mongoose
Rhynchogale melleri	Meller's mongoose
Lutra maculicollis	Spotted necked otter

B: Lower priority

Scientific name	Common name
Felis silvestris	African wild cat
Caracal caracal	Caracal
Canis adustus	Side striped jackal
Canis mesomelas	Black backed jackal
Otocyon megalotis	Bat-eared fox
Aonyx capensis	Cape clawless otter
Mellivora capensis	Honey badger
Ictonyx striatus	Striped polecat
Galerella sanguinea	Slender mongoose
Ichneumia albicauda	White tailed mongoose
Atilax paludinosus	Marsh/Water mongoose
Helogale parvula	Dwarf mongoose
Mungos mungo	Banded mongoose
Genetta genetta	Common genet
Genetta tigrina	Large spotted genet
Paracynictus selousi	Selous' mongoose
Poecilogale albinucha	Striped weasel
Herpestes ichneumon	Large grey mongoose
Nandinia binotata	Tree/Palm Civet
Parahyaena brunnea	Brown hyaena
Cynictis penicillata	Yellow mongoose

Appendix II: Questionnaire used in the survey (except for Angola and Mozambique)

QUESTIONNAIRE

Name of protected area	
Resident human population (Y/N)*	
Name of respondent	
Contact details	
Address	
Tel No	
Email	

* Excluding Wildlife Authority, Tourist camps and Hunting camps

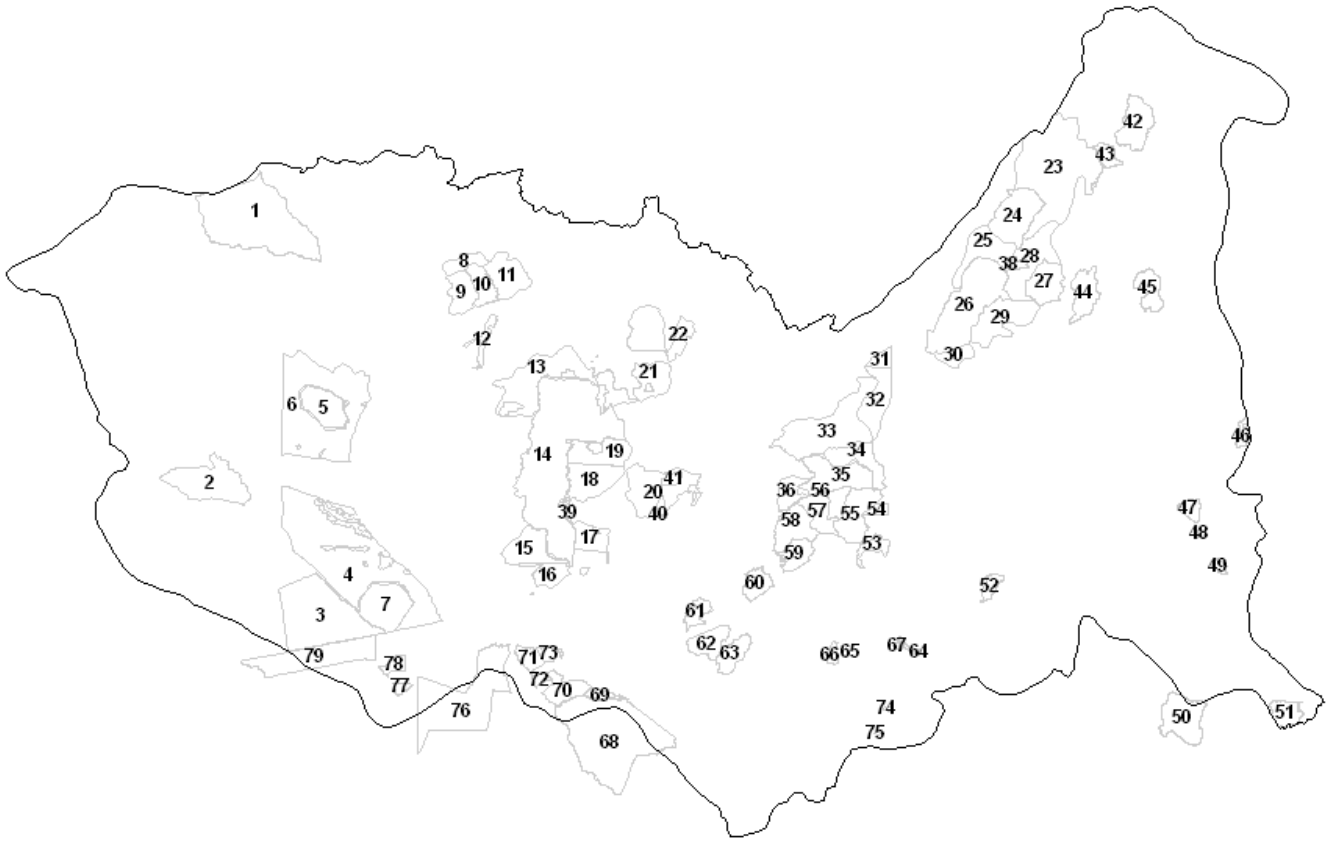
Species List		Information from most recent sighting								Conflict with humans reported			
Common name	**Scientific name**	**Date**			**Location**	**Type of sighting**			**Pop Est**	**Y**	**DK***	**N**	**Details (including location)**
		Year	**(M)**	**(D)**		**Visual**	**Spoor**	**Other**					
Wild dog	*Lycaon pictus*												
Cheetah	*Acinonyx jubatus*												
Lion	*Panthera leo*												
Spotted hyaena	*Crocuta crocuta*												
Aardwolf	*Proteles cristatus*												
Serval	*Leptailurus serval*												
Leopard	*Panthera pardus*												
Bushy Tailed Mongoose	*Bdeogale crassicauta*												

Species List		Information from most recent sighting								Conflict with humans reported			
Common name	Scientific name	Date			Location	Type of sighting			Pop Est	Y	DK*	N	Details (including location)
		Year	(M)	(D)		Visual	Spoor	Other					
Meller's mongoose	*Rhynchogale melleri*												
Spotted necked otter	*Lutra maculicollis*												
Caracal	*Caracal caracal*												
African Wild Cat	*Felis silvestris*												
Side striped jackal	*Canis adustus*												
Black Backed Jackal	*Canis mesomelas*												
Bat Eared Fox	*Otocyon megalotis*												
Cape Clawless Otter	*Aonyx capensis*												
Honey Badger	*Mellivora capensis*												
Striped Polecat	*Ictonyx striatus*												
Slender Mongoose	*Galerella sanguinea*												
White tailed Mongoose	*Ichneumia albicauda*												
Marsh/Water Mongoose	*Atilax paludinosus*												
Dwarf Mongoose	*Helogale parvula*												
Banded Mongoose	*Mungos mungo*												
Common genet	*Genetta genetta*												
Large Spotted Genet	*Genetta tigrina*												
African Palm Civet	*Nandinia binotata*												
Civet	*Civettictus civetta*												
Large grey mongoose	*Herpestes ichneumon*												
Striped Weasel	*Poecilogale albinucha*												
Selous Mongoose	*Paracynictus selousi*												

**DK = Don't know*

Appendix III: List of Protected areas(PA) including IUCN status and total area.

(Source: World Database on Protected Areas, 2006)



IUCN Categories (Source: Chape *et al*, 2003)

Category II: National Park:
Protected area managed mainly for ecosystem protection and recreation
Category IV: Habitat/Species Management Area:
Protected area managed mainly for conservation through management intervention
Category V: Protected Landscape/Seascape:
Protected area managed mainly for landscape/seascape conservation and recreation
Category VI: Managed Resource Protected Area:
Protected area managed mainly for the sustainable use of Natural Resources

Map Reference	PA Name	Country	IUCN Category	Area (Km²)
1	Kameia	Angola	II	14450
2	Mavinga	Angola	IV	5950
3	Luiana	Angola	IV	8900

Map Reference	PA Name	Country	IUCN Category	Area (Km²)
4	Lower West Zambezi	Zambia	VI	38070
5	Luiwa Plains	Zambia	II	36600
6	Upper West Zambezi	Zambia	VI	38070
7	Sioma Ngwezi	Zambia	II	5276
8	Chibwika_Ntambu	Zambia	VI	1550
9	Lukwakwa	Zambia	VI	2540
10	West Lunga	Zambia	II	1500
11	Musele Matebo	Zambia	VI	3700
12	Chizera	Zambia	VI	2280
13	Kasonso_Busanga	Zambia	VI	7780
14	Kafue	Zambia	II	22400
15	Mulobezi	Zambia	VI	3420
16	Sichifula	Zambia	VI	3600
17	Bilili Springs	Zambia	VI	3080
18	Namwala	Zambia	VI	3600
19	Mumbwa	Zambia	VI	3370
20	Kafue Flats	Zambia	VI	5175
21	Lunga Luswishi	Zambia	VI	13340
22	Machiya Fungulwe	Zambia	VI	1530
23	Musalangu	Zambia	VI	17350
24	North Luangwa	Zambia	II	4636
25	Munyamadzi	Zambia	VI	3300
26	South Luangwa	Zambia	VI	9050
27	Lukusuzi	Zambia	II	2720
28	Lumimba	Zambia	VI	4500
29	Lupande	Zambia	VI	4840
30	Sandwe	Zambia	VI	1530
31	Chisomo	Zambia	VI	3390
32	West Petuake	Zambia	VI	4140
33	Luano	Zambia	VI	8930
34	Rufunsa	Zambia	VI	3179
35	Lower Zambezi	Zambia	II	4092
36	Chiawa	Zambia	VI	2344
37	Mosi O Tunya	Zambia	II	66
38	Luambe	Zambia	II	328
39	Nkala	Zambia	VI	204
40	Lochinvar	Zambia	II	344
41	Blue Lagoon	Zambia	II	468
42	Nyika	Malawi	II	3134
43	Vwaza Marsh	Malawi	IV	986
44	Kasungu	Malawi	II	2316
45	Nhkota Kota	Malawi	IV	1802
46	Liwonde	Malawi	II	538
47	Majete	Malawi	IV	700
48	Lengwe	Malawi	II	887
49	Mwabvi	Malawi	IV	135
50	Gorongosa	Mozambique	II	3750
51	Maromeu	Mozambique	IV	1561

Map Reference	PA Name	Country	IUCN Category	Area (Km²)
52	Mfunrundzi	Zimbabwe	VI	760
53	Doma	Zimbabwe	VI	945
54	Dande	Zimbabwe	VI	523
55	Chewore	Zimbabwe	VI	3390
56	Sapi	Zimbabwe	VI	1180
57	Mana Pools	Zimbabwe	II	2196
58	Hurungwe	Zimbabwe	VI	2894
59	Charara	Zimbabwe	VI	1692
60	Matusadona	Zimbabwe	II	1407
61	Chete	Zimbabwe	VI	1081
62	Chizarira	Zimbabwe	II	1910
63	Chirisa	Zimbabwe	VI	1713
64	Macliwane	Zimbabwe	V	70
65	Umfuli	Zimbabwe	V	115
66	Chegutu	Zimbabwe	VI	442
67	Lake Robertson	Zimbabwe	V	196
68	Hwange	Zimbabwe	II	14651
69	Deka	Zimbabwe	VI	510
70	Matetsi South	Zimbabwe	VI	1478
71	Matetsi North	Zimbabwe	VI	1477
72	Kazuma Pan	Zimbabwe	II	313
73	Zambezi	Zimbabwe	II	560
74	Ngezi	Zimbabwe	V	56
75	Sebakwe	Zimbabwe	V	27
76	Chobe	Botswana	II	10570
77	Mamili	Namibia	II	320
78	Mudumu	Namibia	II	1010
79	Caprivi	Namibia	II	5848