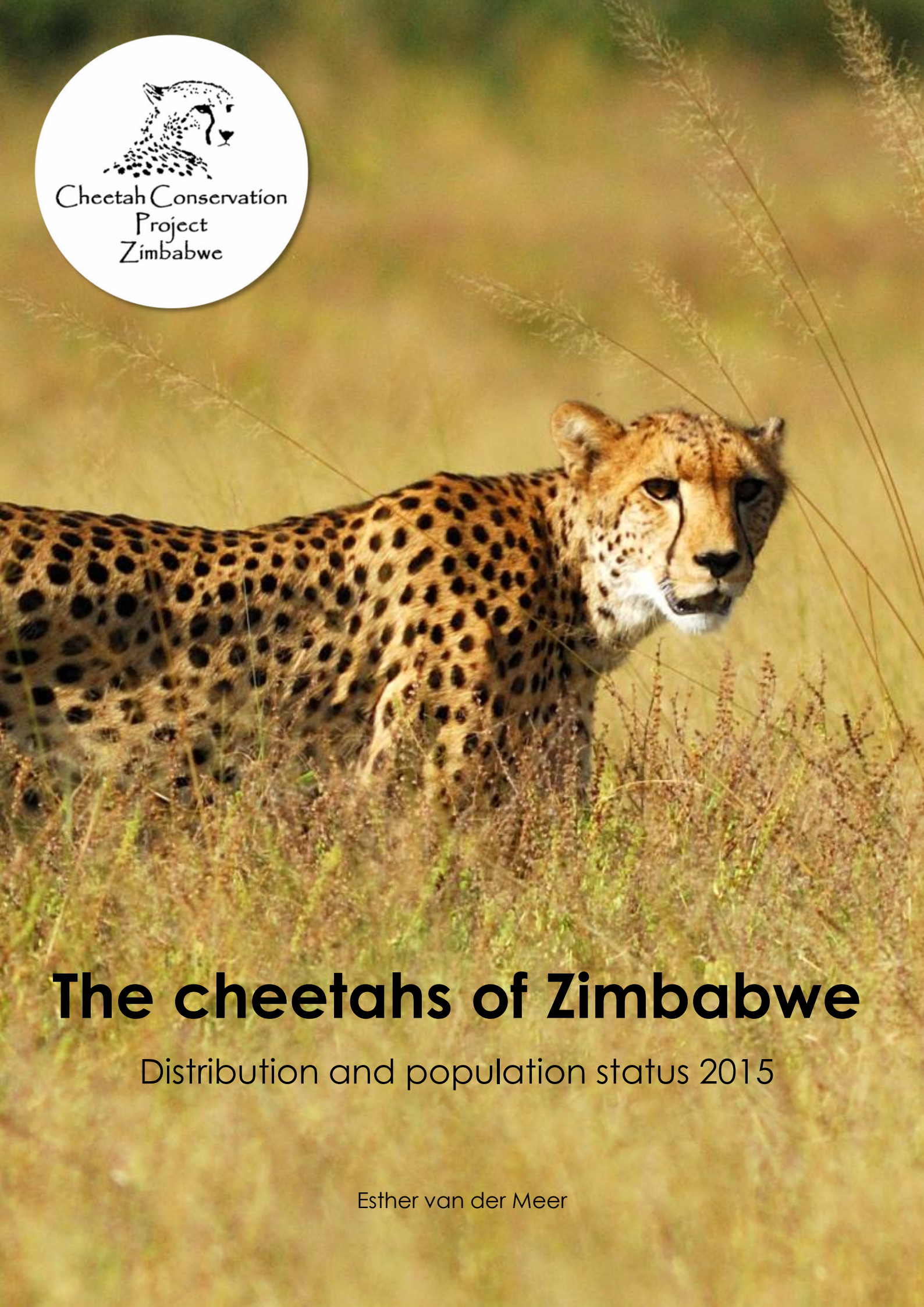


The cheetahs of Zimbabwe

Distribution and population status 2015

Esther van der Meer

Published September 2016 by Esther van der Meer – Cheetah Conservation Project Zimbabwe, Victoria Falls, Zimbabwe. Digital copy available from www.cheetahzimbabwe.org.

ISBN 978-90-817341-1-0

Citation - van der Meer, E. (2016) The cheetahs of Zimbabwe, distribution and population status 2015. Cheetah Conservation Project Zimbabwe, Victoria Falls, Zimbabwe.

Content

Acknowledgements

We would like to express our sincerest gratitude to the 1 209 respondents who kindly answered our cheetah questions and the numerous people who recorded and send us their cheetah sightings and photographs, without their assistance this survey would not have been possible. In addition, we would like to thank the many kind people who provided us with assistance and a place to camp during the survey. We thank our colleagues from Hwange Lion Research, Dambari Wildlife Trust, Bhejane Trust, Debshan Ranch, Nuanetsi Ranch, Malilangwe Private Wildlife Reserve, Bubye Valley Conservancy, the Darwin Initiative Leopard Project, Victoria Falls Wildlife Trust, Sango (Save Valley Conservancy), African Wildlife Conservation Fund for providing us with additional cheetah data. A special thank you to our students Muchaneta Badza, Simbarashe Mpansi, Aldwin Ndhlovu, Cynthia Mapendere, Honestly Ndlovu, Ashton Goronga and Samson Siakanoka for their assistance with the questionnaire based interview survey and the collection of cheetah sightings. We are grateful to Verity Bowman of the Dambari Wildlife Trust, Peter Blinston of Painted Dog Conservation, Pete and Judy Wienand and Richard Hoare and Sian Brown for providing us with a base in Bulawayo, Hwange and Harare. We are grateful to the Dambari Wildlife Trust, John Davison, Kevin Dunham, Ian Games, Sam Williams and the Zambezi Society for providing some of the referenced literature and would sincerely like to thank Richard Hoare and Sian Brown for reviewing earlier drafts of this report.

We would like to express our gratitude to Prof. Peter Mundy, Prof. Samson Sibanda and the late Prof. Lindela Ndlovu for facilitating our affiliation to the department of Forest Resources and Wildlife Management of the National University of Science and Technology.

We thank the Zimbabwe Parks and Wildlife Management Authority for supporting our survey and providing us with permits to carry out this research. We also thank the Research Council of Zimbabwe and the Ministry of Local Government, Urban and Rural Development for granting us the necessary research permits.

We gratefully acknowledge financial support from the following organisations:

Acronyms and definitions

CAMPFIRE	Communal Areas Management Programme for Indigenous Resources
CBD	Convention on Biological Diversity
CCPZ	Cheetah Conservation Project Zimbabwe
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals
IUCN	International Union for Conservation of Nature and Natural Resources
MNP	Matusadona National Park
NP	National Park
RDC	Rural District Council
RWCP	Range Wide Conservation Programme for Cheetah and African wild dog
SADC	Southern African Development Community
TFCA	Transfrontier Conservation Area
ZPWMA	Zimbabwe Parks and Wildlife Management Authority

Biodiversity - the variety of plant and animal species in an environment
Buffer zone - a neutral wildlife friendly area between a wildlife protected area and an area potentially hostile to wildlife
Carrying capacity - the maximum, equilibrium number of a particular species that can be supported indefinitely in a given environment without this environment deteriorating
Edge effect - anthropogenic mortality along the boundary of wildlife protected areas
Indicator species - a species whose abundance is an indication of the state of other species and the health of the ecosystem
Protected Area - according to the IUCN a protected areas is a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values
Sink - bad quality habitat in which population birth rates are lower than death rates and, a sink population can only exist when there is immigration
Source - good quality habitat in which population birth rates are larger than death rates, a source is a net producer of individuals
Transfrontier Conservation Area - large ecological regions that cover the boundaries of two or more countries and include one or more protected areas
Umbrella species - a species that requires such large tracts of habitat that conservation strategies aimed at this species will automatically benefit the conservation of other species
Wildlife corridor - an area in a landscape that facilitates the movement of species between wildlife habitats

Summary

Zimbabwe used to hold the world's third largest cheetah population (CITES, 1992). The species occurred throughout the country (ZPWMA, 2009) and population estimates ranged from 400 in 1975 (Meyers, 1975) to more than 1 500 cheetahs in 1999 (Davison, 1999a). By the late 90s the cheetah population had increased considerably in both range and density (Davison, 1999b). With cheetah populations in protected areas remaining stable or declining, this increase predominantly occurred on commercial farmlands and was partly attributed to the move of many Zimbabwean farmers towards stocking game in the 1980s (Davison, 1999b). By 1992 80% of Zimbabwe's cheetah population was found on commercial farmlands (CITES, 1992; Davison, 1999a). Although conflict with farmers had always been a major threat to Zimbabwe's cheetah population (Meyers, 1975), the population increase on commercial farmlands resulted in an escalation of this conflict and large numbers of cheetah were shot on sight (Heath, 1997).

The cheetah and its habitat are directly and indirectly part of numerous international and national laws, acts and policies. In Zimbabwe, it is a specially protected species under the 1975 Parks and Wildlife Act [Chapter 20:14]. Therefore, no person is allowed to hunt, possess or sell live cheetahs or parts of cheetahs, unless a permit is issued by the Zimbabwe Parks and Wildlife Management Authority (Parliament of Zimbabwe, 2001). As a result of this status and the cheetah's CITES Appendix I listing, farmers had to go through lengthy formalities to obtain permission to destroy problem cheetahs (Wilson, 1988). Instead, most farmers opted to illegally kill cheetahs and quietly dispose of their carcasses (Wilson, 1988). This situation was not unique to Zimbabwe and in 1992 the governments of Zimbabwe, Botswana and Namibia, proposed to promote the conservation of cheetah populations on farmland by allowing farmers to receive direct financial gain through the trophy hunting or live export of cheetahs (CITES, 1992). This proposal was approved and, since 1992, Zimbabwe annually receives 50 CITES tags for the export of live cheetahs or hunting trophies (CITES, 1992).

Since 1997, the cheetah has been the subject of various national management plans. Although conflict mitigation was a main topic in initial plans (Heath, 1997; Heath and Muchena, 1998), later cheetah management plans focussed more on research and, with the last country wide assessment being carried out in 1999, acknowledged the need to assess the cheetah population size in Zimbabwe (Davison, 1999b; ZPWMA, 2009). This need became more pressing after the government introduced phase II of their land reform programme in 2000. Land reform was initiated in 1980, however, this second phase aimed at fast tracking the process and fuelled rapid changes in land use from large scale commercial farming into indigenized small scale commercial and subsistence farming (du Toit, 2004). These changes in land use, the economic depression that followed and the increase of Zimbabwe's human population from 7.5 million people in 1982 to 13.1 million people in 2012, resulted in overexploitation of natural resources and degradation of wildlife populations and habitats (du Toit, 2004; AWF, 2011).

Between 2013 and 2015 Cheetah Conservation Project Zimbabwe carried out a nationwide questionnaire based cheetah population survey. This assessment shows the changes in land use have had a severe impact on Zimbabwe's cheetah population. Despite the special attention for this charismatic species and the high level of legal protection it receives in the country, resident cheetah range has declined by 61% (Fig.1), and the size of the population has been reduced with at least 85% to ca. 150-170 adult and independent adolescent cheetahs. The majority of this population (80%) is now found in wildlife protected areas (National Parks estates and wildlife conservancies), therefore, human-cheetah conflict is minimal and no longer considered a main conservation threat. With the current situation being the exact opposite of the historical situation, it is necessary to revise the cheetah management strategy in Zimbabwe.

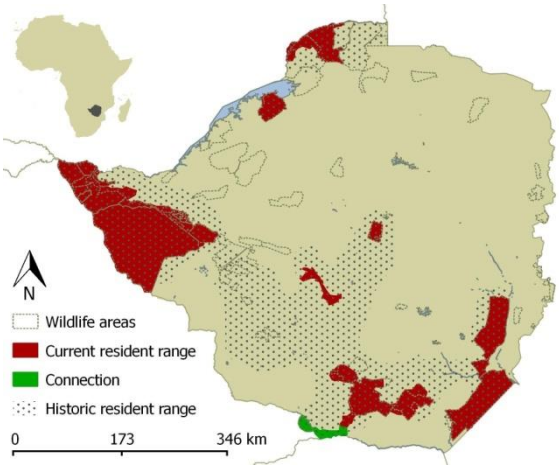


Figure 1. Historic and current cheetah range

Resource constraints have weakened wildlife management capacity and law enforcement in Zimbabwe, as a result, degradation of wildlife populations and habitats has also had its effect on protected areas (Shumba, 2001; du Toit, 2004; AWF, 2011; Ministry of Environment Water and Climate, 2015). Constraints in resources make it necessary to prioritise conservation action based on the species and habitats that provide the highest chance of generating conservation success (Ray et al., 2005; Dickman et al., 2015). Internationally it has been acknowledged that, of the African felids, the cheetah is most in need of conservation action (Ray et al., 2005; Dickman et al., 2015). The cheetah is a wide-ranging carnivore which requires more space than most other carnivore species (IUCN, 2007). This makes the cheetah a suitable umbrella species, which means the conservation of cheetah will benefit the conservation of many other species (Ray et al., 2005; Dickman et al., 2015).

Long term conservation success is affected by the effective size of a carnivore population (Winterbach et al., 2013) and particularly small fragmented populations are vulnerable to local extinction. Especially when conserving wide ranging large carnivores like cheetah, it is therefore more effective to conserve one large wildlife area rather than several small ones (Woodroffe and Ginsberg, 1998). Apart from securing relatively large conservation areas, in order to maintain population viability and genetic diversity, it is important to identify and create wildlife corridors which facilitate movement between populations (Rouget et al., 2006). **When setting priorities for cheetah conservation in Zimbabwe the aim should be to maintain relatively large cheetah populations that reside in functioning connected ecosystems which can sustain viable free ranging cheetah populations that are linked to or could be linked to larger transboundary populations.**

There are three cheetah populations which meet those criteria: the cheetah populations residing in the Hwange-Matetsi-Victoria Falls area, the Hurungwe-Mana Pools-Sapi area and the Malilangwe-Gonarezhou area. These relatively large free ranging cheetah populations should be prioritised for conservation, especially as they are linked to or can be linked to larger transboundary populations via Transfrontier Conservation Areas (TFCAs) and other transboundary agreements. It is also important to ensure off take of cheetahs is sustainable. In order to be sustainable, annual off take should be based on reliable population estimates and not exceed a populations growth rate (WWF, 1997). Taking into account that the cheetah populations in most areas are decreasing it would be appropriate to reduce the national quota and the number of export tags under CITES to a conservative 5 which, in order to secure key populations and facilitate dispersal, should not be hunted in and around the proposed priority areas. In addition, to secure the long term conservation of cheetahs and other carnivores, it is important to promote co-existence of people and carnivores in the buffer zones surrounding the priority areas, improve knowledge of carnivores within communities and wildlife authorities and continue to monitor remaining cheetah and carnivore populations.

Worldwide biodiversity is being lost at a dramatic range (Pimm et al., 2014; Ceballos et al., 2015). This loss has a direct impact on the functioning of ecosystems, affects human health and wellbeing, and is considered to be one of the most pressing environmental problems today (EU, 2014; Ceballos et al., 2015). The diversity of a complete carnivore guild is likely to provide an indication of overall biodiversity (Dalerum et al., 2008; Di Minin et al., 2006). Even though the cheetah was the main focus of our study, we also give an insight in the distribution of other carnivores in Zimbabwe which provides a starting point for future biodiversity monitoring. Land use change is a main driver behind range contractions and declines of carnivore populations (Ripple et al., 2014; Di Minin et al., 2016). Our study gives an empirical insight in the rate of decline in range and numbers of a low density, wide ranging, large carnivore under land use change, and highlights that in the face of poor governance and poverty, national and international laws, policies and conventions are unlikely to be sufficient to prevent biodiversity loss.

Although the land reform programme and the economic depression that followed have accelerated land use changes in Zimbabwe, it is likely that, with the increase in human population in Africa and the resulting demand for agricultural land and pressure on natural resources (EU, 2014), other African countries will face similar scenarios in the near future. The lessons learned in Zimbabwe can assist other countries to anticipate the effects of land use change on biodiversity and should be used to develop and implement integrated cross-sectoral land use plans that provide for the national and international conservation of biodiversity.

Chapter 1 - The cheetah

1.1. Species description

Cheetah male in Hwange National Park

The cheetah *(Acinonyx jubatus)* has a slender body with long thin legs, a small head with a short muzzle and short rounded ears set widely apart. The cheetah's shoulder height is 0.7-0.9 m, the total body length from the tip of the nose to the end of the tail is ca. 2.0 m, with a tail length of about 0.7 m. An adult cheetah weighs between 35 and 60 kg (Skinner and Smithers, 1990; Krausman and Morales, 2005). The cheetah has a distinct coat with a pale yellow-brown background covered with numerous small, round, black spots. Towards the tip of the tail these spots fuse into black rings. Its face is round with characteristic 'tear marks': black lines than run from the inside of the cheetah's eyes down to the corners of the mouth. The cheetah has a coarse coat with hair that is slightly longer on the nape of the neck, in young cubs this 'mane' is much more pronounced covering the head, neck and back (Skinner and Smithers, 1990; Krausman and Morales, 2005). The function of the cub's thick 'mane' of grey hair is most likely camouflage, it disappears when the cubs are about three months old (Caro, 1994). The cheetah's semi-retractable claws are blunt and slightly curved and show in the cheetahs spoor (Skinner and Smithers, 1990; Krausman and Morales, 2005). Cheetahs use high pitched chirps to communicate with each other, they are also able to purr (Bothma and Walker, 1999).

1.2. Taxonomic notes

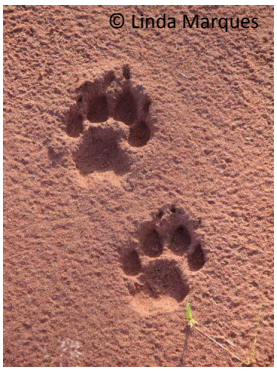
The cheetah is classified under the family Felidae, the subfamily Felinae, and part of the puma lineage (one of the eight lineages of Felidae), a lineage that also includes the cougar *(Puma concolor)* and jaguarundi *(Puma yagouaroundi)*. The cheetah diverged from the puma and jaguarundi ca. 4.92 million years ago and is placed in the genus *Acinonyx* of which there is only the one species *jubatus*. The cheetah originated in North America from where it migrated to central Asia and Africa (Johnson et al. 2006). This migration is believed to have resulted in a genetic bottleneck ~100 000 years ago, a second bottleneck ~12 000 years ago further lowered genetic diversity (Dobrynin et al., 2015). *Acinonyx jubatus* has five recognized subspecies: *A. j. hecki* (Northwest Africa), *A. j. fearsoni* (East Africa), *A. j. jubatus* (Southern Africa), *A. j. soemmerringi* (Northeast Africa) and *A. j. venaticus* (North Africa to Central India) (Krausman and Morales, 2005). The king cheetah, which has large blotchy spots and dark wide stripes extending from the neck to the tail, was first noted in Zimbabwe in 1926 by Major A. Cooper and initially described as a separate species (Hills and Smithers, 1980). However, genetic research confirmed it is in fact a colour variant of *Acinonyx jubatus* (Van Aarde and Van Dyk, 1986).

1.3. Hunting behaviour, habitat preference and territoriality

The cheetah *(Acinonyx jubatus)* is renowned for its speed and widely acknowledged as the fastest living terrestrial mammal. Its published top speed on a course is 103 km/h (64 miles/h) (Sharp, 1997), while during hunts in the wild the cheetah has been reported to reach a maximum speed of 93 km/h (58 miles/h) (Wilson et al., 2013). Reaching these speeds is possible through a range of physical adaptations, including: a slender body with long limbs, a highly flexible spine, a small skull with a

Cheetah chasing an impala

large nasal opening and semi-retractable claws (Hildebrand, 1959; Gonyea, 1976; Bryant et al., 1996; O'Regan, 2002). Cheetahs hunt by sight (Caro, 1994) and use a stalk and chase hunting technique (Hilborn et al., 2012), with sprints rarely lasting longer than 200-300 m (Nowell and Jackson, 1996; Mills et al., 2004; Wilson et al., 2013). During a sprint the cheetah tries to trip its prey with the use of the sharp dewclaw on its forepaws, if the cheetah succeeds the prey is grabbed by the throat and killed by strangulation (Schaller, 1968). Hunting success varies between 20-50% and is affected by age of the cheetah, size of the prey and habitat features (Schaller, 1968; Mills et al., 2004; Bissett and Bernard, 2007; Hilborn et al., 2012). Cheetahs generally predate on prey within a body mass range of 23-56 kg, with a significant preference for impala *(Aepyceros melampus)*, springbok *(Antidorcas marsupialis)*, Thomson's gazelles *(Gazella thomsoni)*, Grant's gazelles *(Gazella granti)* and blesbok *(Damaliscus dorcas phillipsi)* (Hayward et al., 2006). Although cheetahs are primarily active during the day, they have been observed to hunt during (moonlit) nights (Schaller, 1968; Cozzi et al., 2012; Wilson et al., 2013). Cheetah are habitat generalists that are able to successfully hunt in open grassland and a range of bush, scrub and woodland habitats (Mills et al., 2004; Bissett and Bernard, 2007; Wilson et al., 2013).



Cheetah spoor

Cheetahs select home ranges based on prey availability and vegetation characteristics (Caro, 1994; Broomhall et al., 2003; Marker et al., 2008). Some studies show they select home ranges that include grassland and mixed woodland (Broekhuis et al., 2013), while others found no marked effect of vegetation (Broomhall et al., 2003). Within their home range, cheetahs preferably utilise open savannah habitat (Broomhall et al., 2003; Broekhuis et al., 2013). There is great variability in territoriality and the sizes of territories and home ranges across various ecological systems. In Namibian farmlands home ranges of male and female cheetahs are of similar size and average 1 651 km^2, with considerable overlap (16%) and no effect of social grouping or seasonality (Marker et al., 2008). However, within this large home range Namibian cheetahs only make intensive use of a small core area (ca. 14% of the home range) (Marker et al., 2008). Size of both male and female cheetah home ranges within the Kruger National Park, South Africa, varied between 126-195 km^2 with no marked effect of social grouping (Broomhall et al., 2003). In the Serengeti National Park, Tanzania, males have been found to either hold small territories (37 km^2 on average) or roam over large ranges (777 km^2 on average), while female cheetahs have very large annual home ranges (833 km^2 on average) that overlap with the territories of several males (Caro, 1994). Whereas cheetah females tolerate each other and have overlapping home ranges, cheetah males actively defend their territories against male intruders and territorial fights can be an important source of male mortality (Caro, 1994). Territorial males mark their territories by scent-marking prominent land marks with urine (Caro, 1994), scratching trees is not common (Bothma and Walker, 1999).

Cheetah male scent-marking his territory

1.4. Social life, reproduction and survival

Female cheetahs live alone or with their dependent cubs, while male cheetahs live alone or in permanent coalitions of 2-4 males (Caro, 1994; Marker et al., 2003a). These male coalitions mostly consist of brothers, however, unrelated males have sometimes been found to join up and form coalitions as well (Caro, 1994). Male coalitions have competitive advantages over single males, i.e. better access to territories (Caro, 1994). Cheetahs generally start to reproduce in the third year of their life (Laurenson, 1993; Caro, 1994). Although seasonal peaks have been described, cheetahs do not have a strict breeding season and mating occurs throughout the year (Caro, 1994; Marker et al., 2003a; Bissett and Bernard, 2011). Breeding males and females stay in close proximity of each other, such an association may last 2-3 days and during this period they mate several times (Caro, 1994). If a female associates with a male coalition, all males within the coalition have a chance to mate (Caro, 1994). Cheetah females are

promiscuous and will also mate with unrelated males, resulting in cubs in the same litter frequently (43%) being fathered by more than one male (Gottelli et al., 2007).

After a gestation period of 90-95 days (Caro, 1994), the cheetah female gives birth to her cubs in a lair: a hiding place in tall vegetation, a rocky outcrop, gully or a marsh (Laurenson, 1993). Although litter sizes can range from 1-6 cubs, at birth a litter consists of an average of 3.1-3.5 cubs (Laurenson, 1994; Mills and Mills, 2014), with an equal sex ratio of male and female cubs (Caro, 1994; Marker et al., 2003a). The cubs are born blind and dependent (Caro, 1994; Bothma and Walker, 1999), their eyes open when they are ca. 10 days old (Bothma and Walker, 1999). The first 2 months of their lives they stay in the lair, during this period the cubs are regularly moved to different lairs (Laurenson, 1993). From the age of ca. 2 months, the cubs start accompanying their mother on hunts and begin to feed on solid food (Caro, 1994). The female will stop nursing the cubs when they are about 4 months old (Caro, 1994). From the age of 6 months, encouraged and assisted by their mother, the cheetah cubs will start practising their hunting skills (Caro, 1994). At the age of 13-20 months the cubs leave their mother, after which litter mates stay together for a variable period of time (Caro, 1994; Marker et al., 2003a). Sisters will leave their siblings when they become sexually mature at 23-27 months of age, brothers generally stay together for life in a male coalition (Caro, 1994).

Cheetah female with ca. 2 month old cubs

The cheetah mother gives birth to a next litter shortly (0-6 months) after the first litter has dispersed (Kelly et al., 1998; Marker et al., 2003a; Bissett and Bernard, 2011). Cub survival from birth to independence varies from 4.8% (Laurenson, 1994) to 35.7% (Mills and Mills, 2014), depending on the density of competing large carnivores, prey availability and cover (Durant, 2000a; Mills and Mills, 2014). The most common cause of cub mortality is predation by other carnivores, additional mortality causes include fire, bad weather, poor condition (due to injuries and starvation) and abandonment when prey is scarce (Laurenson, 1994; Mills and Mills, 2014). Up to the age of ca. 10 months avoidance of predators depends on the mother's vigilance as before this age cheetah cubs are rarely aware of passing predators (Caro, 1994). Average litter size when the cubs reach independence is 2.0-2.9 cubs in areas with lion presence (Kelly et al., 1998; Bisett and Bernard, 2011) and 2.4-3.2 in areas without lion presence (Marker et al., 2003a; Wachter et al., 2011) but can be as high as 4.7 in fenced reserves without lions (Bisett and Bernard, 2011). The likelihood that a female successfully raises cubs to independence increases with her age, with a peak when she is 6 years old and a decline as she grows older (Kelly et al., 1998). It has been suggested that the cheetah's low genetic diversity negatively affects reproduction and recruitment (O'Brien et al., 1985), however, recent studies show that low genetic diversity is unlikely to be a main factor reducing reproduction and recruitment in wild cheetah populations (Wachter et al., 2011).

Even though in the wild cheetahs can live up to 12-14 years old, they on average reach 5-7 years old (Caro, 1994; Kelly et al., 1998; Marker et al., 2003a). In the wild death is rarely witnessed and causes of natural death, especially of adults, therefore remain largely unknown (Caro, 1994; Kelly et al., 1998). It seems that predation by larger carnivores (Durant et al., 2004; Bissett and Bernard, 2011) and competition between cheetah males (Caro, 1994; Durant et al., 2004) are main causes of adult mortality, however, in human dominated landscapes adult mortality is predominantly caused by human persecution (Marker et al., 2003a).

Cheetahs can be affected by diseases such as anthrax, babesia canis, feline enteritis and tick fever (Bothma and Walker, 1999). Although due to its low genetic diversity, the cheetah has been considered to be more vulnerable to disease outbreaks (O'Brien et al., 1985), cheetahs have been found to respond effectively to viral challenges (Munson et al., 2004, 2005; Thalwitzer et al., 2010). Despite widespread exposure of wild cheetahs to common canine and feline viruses, there is limited to no clinical or pathological evidence of infectious diseases and disease does not seem to present a major mortality risk

(Munson et al., 2004, 2005; Thalwitzer et al., 2010). A possible exception is anthrax; this infectious disease caused by the bacterium *Bacillus anthracis* has causes cheetah mortalities during outbreaks (Lindeque et al., 1998; Good et al., 2008). Although cheetahs can naturally acquire antibodies to anthrax it is uncommon for cheetahs to develop natural immunity (Lindeque et al., 1998; Good et al., 2008), probably because their lack of scavenging behaviour prevents them from building up immunity through exposure to anthrax carcasses (Lindeque et al., 1998).

1.5. Competition with other predators

Cheetahs have low competitive ability and suffer kleptoparasitism (kill being stolen) from and are killed by lion *(Panthera leo)*, leopard *(Panthera pardus)* and spotted hyena *(Crocuta crocuta)* (Caro, 1994; Durant, 2000b; Mills et al., 2004; Hunter et al., 2007). Predation by these larger carnivores is the main cause of mortality for cheetah cubs (Laurenson, 1994; Mills and Mills, 2014). Especially within the first 4 months after birth, mortality due to predation can be as high as 56.9-88.9% (Laurenson, 1994; Mills et al., 2004). Reproductive success of cheetah females decreases with an increase in lion and spotted hyena densities (Durant, 2000a). Furthermore, between 3.3% and 13.1% of the cheetah's kills are stolen by lion and spotted hyena, the likelihood of the kill being stolen seems to be higher in open habitats (Mills et al., 2004; Bissett and Bernard, 2007). Despite these risks, cheetahs have been found to utilize areas with relatively high lion densities (Swanson et al., 2014) and do not consistently avoid areas with a high long term risk of encountering lion and spotted hyena (Broekhuis et al., 2013). In addition, cheetah home ranges have been shown to overlap with the home ranges of lion and leopard (Vanak et al., 2013).

In order to avoid encounters with larger competitors cheetahs have developed several behavioural adaptations. Cheetahs minimize overlap in their activity patterns with lion, leopard and spotted hyena and conduct approximately half of their activities (43.8%-55.0%) when these larger competitors are active (Hayward and Slotow, 2009; Cozzi et al., 2012). The nocturnal activity of cheetahs makes up only 25.6% of their total daily activity, is centred around full moon nights, and positively related to moonlight intensity (Cozzi et al., 2012). Cheetahs not only show temporal but also fine scaled spatial avoidance of larger predators (Durant, 1998; Vanak et al. 2013). In order to be able to co-exist with lions and spotted hyenas, cheetahs are highly mobile and concentrate their hunting in areas where the densities of these competing predators are low (Durant, 1998). Cheetahs actively move away from lion, leopard and spotted hyena (Durant, 2000b; Vanak et al. 2013). In addition, they maintain a minimum distance from lions which varies with vegetation type (Broekhuis et al., 2013; Vanak et al. 2013), and are less likely to go hunting when lions are in the vicinity (Cooper et al., 2007). In order to minimize encounters with larger carnivores at kill sites, cheetahs often move their kill to a safer area before feeding, they are vigilant (visually scanning the surrounding habitat) and leave their kill immediately after feeding (Hunter et al., 2007). It has also been suggested that one of the reasons why cheetahs prefer to catch medium sized prey is because this allows them to consume most of their kill before competitors arrive (Hayward et al., 2006).

Encounter between cheetahs and lion

Chapter 2 - Cheetah conservation

2.1. Global cheetah population

Cheetahs have vanished from most of their historic range across Africa and Asia (IUCN/SSC, 2007). Except for an isolated population in the central deserts of Iran, cheetahs are now extinct in Asia and have disappeared from 89% of their historic range in Africa (Durant et al., 2015). Today, the majority of the cheetahs are found in Southern and Eastern Africa. Since the first status survey for cheetah in 1975 (Myers, 1975), cheetah numbers have decreased substantially (Table 1). Currently the global cheetah population consists of ca. 6 700 adults and adolescents: 4 190 in Southern Africa, 1 960 in Eastern Africa, 440 in Western, Central and Northern Africa and 80 in Iran (Durant et al., 2015). Most of the cheetahs in the Southern African population are part of a transboundary population covering Angola, Botswana, Namibia, South-Africa, Zambia and Zimbabwe (IUCN/SSC, 2007). The main reasons for the drastic decline in global cheetah range and numbers are habitat loss and fragmentation, loss of prey and human persecution due to livestock depredation (IUCN/SSC, 2007). Illegal pet trade imposes an additional threat, especially for the cheetah population in the horn of Africa (Nowell, 2014). The cheetah is listed as vulnerable by the International Union for the Conservation of Nature (Durant et al., 2015), meaning the species faces a high risk of extinction in the wild (IUCN/SSC, 2012).

For wide ranging species with large home ranges, such as cheetah, habitat loss and fragmentation impose a major threat to their survival (IUCN/SSC, 2007). The human population in sub-Saharan Africa has increased from 220 million in 1950 to 800 million at the turn of the century and is expected to reach 2.1 billion by 2050 (EU, 2014). This increase in the human population is associated with habitat loss and fragmentation as new land is claimed for subsistence and commercial agriculture, and mining (EU, 2014). The erection of game fences further fragments existing habitats (EU, 2014). In addition, extreme poverty in rural areas results in overexploitation of wildlife and other natural resources, and increased levels of human-wildlife conflict (EU, 2014). As a result, wildlife is increasingly confined to isolated patches of protected habitat (EU, 2014). Most of Africa's protected areas are not large enough to maintain viable populations of cheetahs (IUCN/SSC, 2007) and wide ranging carnivores like cheetahs often get into conflict with people as soon as they range across the borders of protected areas (Woodroffe and Ginsberg, 2008). With the majority of the global cheetah population (ca. 80%) residing outside protected areas, the species has been subject to intense human persecution (IUCN/SSC, 2007). In an attempt to prevent or reduce livestock depredation communal and commercial farmers have indiscriminately killed and trapped large numbers of cheetahs (Marker et al., 1996). Although cheetahs can predate on young calves and smallstock (Marker et al., 1996; Ogada et al., 2003), the perceived losses of livestock are usually higher than the actual losses (Marker et al., 1996). Cheetahs predominantly prey on local native game and maintaining a sufficient natural prey population within livestock areas significantly reduces livestock losses (Marker, 2008; Winterbach et al., 2015; Boast et al., 2016). Effective livestock husbandry, i.e. herding livestock by day, the presence of watchdogs and enclosing livestock in dense walled bomas by night, further limits livestock depredation (Ogada et al., 2003; Woodroffe et al., 2007).

Table 1. Overview global cheetah population estimates.

Year	Cheetah numbers	Data source
1975[1]	14 000 (7 300 - 23 000)*	Over 2 000 direct interviews and 600 consultations through correspondence with wildlife professionals, farmers, government official and others in 28 African countries
1991[2]	9 000-12 000	Regular communication with researchers in range countries and literature review
2002[3]	≤ 10 000 adult cheetah	IUCN Red list assessment
2008[4]	7 500 adult cheetah	IUCN Red list assessment
2014[5]	6 700 adult and adolescent cheetah	IUCN Red list assessment

[1]Myers, 1975 [2]Marker, 1998 [3]Cat Specialist Group, 2002 [4]Durant et al., 2008 [5]Durant et al., 2015

*This survey covered sub-Saharan Africa

2.2. International policy and management

There are several international conventions, agreements and action plans that apply to the conservation of cheetah and/or their natural habitat, the ones that are most relevant to cheetah conservation and of which Zimbabwe is a party[1] are:

2.2.1. Convention on International Trade in Endangered Species of Wild Fauna and Flora

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments. The aim of this agreement is 'to ensure that international trade does not threaten the survival of wild animal and plant species'. Zimbabwe is one of the 181 governments that are party to the convention, the country joined CITES in 1981 (cites.org). CITES regulates the international import and export of species through a licensing system (CITES, 1973). The species that are protected under CITES are listed on three Appendices. Appendix I provides the highest degree of protection, it includes species that are threatened with extinction and only allows trade under exceptional circumstances (CITES, 1973). The cheetah has been listed on CITES Appendix I since 1975 (cites.org). In 1992, in an attempt to reduce human persecution of cheetah over livestock depredation, an annotation was added to allow Namibia, Zimbabwe and Botswana to export 150, 50 and 5 live cheetahs or hunting trophies respectively (CITES, 1992). Live cheetah can only be exported as long as they are not used for primarily commercial purposes and the importer or destination is a recognized breeding facility participating in an international breeding programme aimed at species recovery (CITES, 1992).

2.2.2. Convention on the Conservation of Migratory Species of Wild Animals

The Convention on the Conservation of Migratory Species of Wild Animals (CMS) is an international agreement between governments, supported under the United Nations Environment Programme. The aim of the agreement is to conserve terrestrial, aquatic and avian migratory species throughout their range by bringing together the states through which the species passes, and lay the foundation for internationally coordinated conservation efforts (CMS, 1979). CMS has 121 parties, Zimbabwe became party to the convention in 2012 (cms.int). CMS has two appendices, the appendices have different obligations and migratory species can be listed on both. Appendix I provides the highest level of protection and includes migratory species that are in danger of extinction throughout all or a significant part of their range. The cheetah is listed on Appendix I. Range states of Appendix I species are expected to endeavour to strictly protect this species by: 'conserving and, where feasible and appropriate, restoring habitats which are of importance to removing the species from danger of extinction; preventing, removing or mitigating obstacles to the species migration; preventing, reducing or controlling factors that are endangering or likely to further endanger the species; prohibiting the taking of animals belonging to the species (exceptions allowed for scientific purposes, purposes that enhance or propagate the survival of the species, traditional subsistence use and if extraordinary circumstances so require)' (CMS, 1979)

[1]Although Zimbabwe signed the Revised African Convention on the Conservation of Nature and Natural Resources (2003) in November 2003 they never ratified this convention (au.int/en/treaties/african-convention-conservation-nature-and-natural-resources-revised-version), also, Zimbabwe is neither a party nor a signatory to the Lusaka Agreement on Co-operative Enforcement Operations Directed at Illegal Trade in Wild Fauna and Flora (lusakaagreement.org).

2.2.3. Convention on Biological Diversity

The objective of the Convention on Biological Diversity (CBD) is to 'encourage the conservation of biodiversity and the sustainable use of its components with fair and equitable sharing of benefits out of the utilization of genetic resources' (CBD, 1992). CBD has 196 parties, Zimbabwe officially became a party in 1995 (cbd.int). By signing the Convention the parties, among other things: 'commit to monitor biodiversity; develop a national strategy for the conservation of biodiversity; integrate biodiversity conservation and sustainable use in plans and policies of relevant sectors; minimize adverse impacts on biodiversity; promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in their natural surroundings; develop and maintain necessary legislation protecting threatened species; where an adverse effect on biodiversity has been determined manage the relevant process and categories of activities' (CBD, 1992). In 2010, the Conference of the Parties adopted a revised and updated strategic plan for biodiversity that includes the Aichi Biodiversity Targets, herewith providing an overarching international framework for the conservation of biodiversity (CBD, 2010).

The parties agreed to translate this framework into revised and updated national biodiversity strategies and action plans. Zimbabwe's updated National Biodiversity Strategy and Action Plan 2014, among other things, states that by 2020: 'biodiversity is mainstreamed into all relevant sectors (mining, agriculture, health, manufacturing, transport, education) and incorporated into national accounting and reporting systems; at least 28% of Zimbabwe's terrestrial and inland water under protection is maintained and conserved and protected area connectivity enhanced through integrated resource management; the loss of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained; the loss of natural habitats, including, forests, is reduced by at least 50%; 60% of areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity and sustainable land use' (Ministry of Environment Water and Climate, 2014). The National Biodiversity Strategy and Action Plan acknowledges there is a significant information gap on the status of the mammalian population. Cheetahs are mentioned in the biodiversity assessment as a vulnerable species (Ministry of Environment Water and Climate, 2014).

2.2.4. SADC Protocol on Wildlife Conservation and Law Enforcement

In order to establish a common framework for conservation and sustainable use of wildlife in the region, the Southern African Development Community (SADC) developed a Protocol on Wildlife Conservation and Law Enforcement. The overall aim of this protocol is to 'establish regional common approaches to the conservation and sustainable use of wildlife resources and to assist with the effective enforcement of laws governing those resources' (SADC, 1999). Specific objectives include: promotion of the sustainable use of wildlife; facilitate the harmonisation and enforcement of wildlife laws; assist in building capacity and facilitate exchange of information concerning wildlife management and conservation and utilisation and enforcement of wildlife laws; promote the conservation of shared resources through the establishment of transfrontier conservation areas and facilitate community based management of natural resources (SADC, 1999). Under Article 7, State Parties agree, among other things, to: 'establish management programmes for the conservation and sustainable use of wildlife; avoid or minimise negative impacts on wildlife by assessing and controlling activities which may significantly affect the conservation or sustainable use of wildlife'. Measures which shall be taken by State Parties to ensure the conservation and sustainable use of wildlife include 'the protection of wildlife resources and wildlife habitats to ensure the maintenance of viable wildlife populations, prevention of overexploitation and extinction of wildlife species, restrictions on the taking of wildlife and restrictions on the trade in wildlife resources and products'. It is further mentioned that 'State Parties shall, as appropriate, develop programmes and mechanisms to educate the general public and raise awareness of the conservation and sustainable use of wildlife, build capacity for wildlife management and law enforcement, and promote research which contributes to and supports the conservation and sustainable use of wildlife' (SADC, 1999). SADC has 15 member states, Zimbabwe is one of those member states (sadc.int).

2.2.5. Transfrontier Conservation Treaties

The SADC Protocol on Wildlife Conservation and Law Enforcement aims to promote the conservation of shared wildlife resources through the establishment of Transfrontier Conservation Areas (TFCAs) which are defined as 'areas or component of a large ecological region that straddles the boundaries of two or more countries encompassing one or more protected areas as well as multiple resource use areas' (SADC, 1999). The objective of TFCAs is to 'facilitate and enhance the free movement of animals across international boundaries by joining fragmented wildlife habitats into a mosaic of protected areas and wildlife corridors through the provisioning of socio economic benefits to stakeholders and stakeholder involvement in planning, establishment and management of TFCAs' (Peace Parks Foundation, 2009). Socio economic benefits are derived through (cross border) tourism and the sustainable use of natural resources (Peace Parks Foundation, 2009). Although the content of the treaties between partner States can differ, the overall aim of TFCA agreements is to 'harmonize policies, strategies and practices for managing shared natural resources and derive equitable socioeconomic benefits through the sustainable use and development of natural and cultural heritage resources' (GLTFCA Treaty, 2002; KAZA-TFCA Treaty, 2011). In 2002 the government of Zimbabwe signed a TFCA treaty with the government of Mozambique and South Africa to establish the **Great Limpopo TFCA** which includes Gonarezhou National Park and the Malipati Safari Area. In 2011 the government of Zimbabwe signed a TFCA treaty with the government of Angola, Botswana, Namibia and Zambia to establish the **Kavango-Zambezi TFCA** which includes Hwange National Park, the Matetsi Safari Area and the Zambezi National Park. In 2006 the governments of Zimbabwe, Botswana and South Africa signed a memorandum of understanding towards the establishment of the **Greater Mapungubwe TFCA** which includes the Tuli Circle Safari Area. There are several proposed TFCAs that include a Zimbabwe component, one of them being the **Lower Zambezi-Mana Pools TFCA**, including Mana Pools National Park, for which preparatory work and a draft memorandum of understanding have already been finalised (peaceparks.org).

2.2.6. Range Wide Conservation Programme for Cheetah and African wild dog

In the past ten years it has been recognized that the maintenance of viable populations of wide ranging species like cheetah requires conservation planning at a scale that ranges beyond the boundaries of individual countries. The IUCN/SSC therefore introduced a process of conservation planning which starts at a range wide regional scale and moves down to a national level (IUCN/SSC, 2007). Between 2007 and 2012 planning workshops were held in Eastern, Southern and North, West and Central Africa resulting in Regional Conservation Strategies for cheetah and African wild dog in these respective regions (cheetahandwilddog.org).

After the regional workshops, planning workshops were organised in individual countries to establish national conservation action plans for the conservation of cheetah and African wild dog. The National Conservation Action Plan for Cheetah and African wild dogs in Zimbabwe was developed in 2009. In line with the Regional Conservation Strategy for Cheetah and African wild dog in Southern Africa, the Zimbabwe national conservation action plan recognises the need to; develop capacity in cheetah and African wild dog conservation; improve knowledge and expand research on the conservation biology of these species; 'ensure stakeholder involvement by making cheetah and African wild dog information available; minimise conflict and promote co-existence between cheetah, African wild dog and people; minimise the adverse effects of land development and promote best land use practice for cheetah and African wild dog; strengthen political commitment to the conservation of these species; review, and where necessary, revise, existing legislation and policy at international, national and local levels' (ZPWMA, 2009a).

2.3. Zimbabwe cheetah population

Estimates of cheetah numbers in Zimbabwe have ranged between 400 in 1975 (Myers, 1975) to more than 1 500 in 1999 (Davison, 1999a). The cheetah is believed to have once occurred throughout Zimbabwe (ZPWMA, 2009a). However, in the 2009 National Conservation Action plan for Cheetahs and African Wild Dogs in Zimbabwe it was noted the species was now largely absent from the north and east of the country, with the majority of the population residing in the south of the country (Matabeleland South Province) outside protected areas (ZPWMA, 2009a). Historically, the cheetahs in Zimbabwe have been in an anomalous position where at one hand the species was of scientific interest and was granted a high degree of legal protection under Zimbabwean law, while on the other hand the cheetah was perceived as a pest and suffered intense persecution by commercial farmers (Masulani, 1999). In the 70s the increase in commercial livestock farming resulted in increasing conflict between livestock owners and carnivores. In the late 1970s the first permits were issued to legally shoot problem cheetah (Heath, 1997). However, rather than going through the cumbersome formalities to acquire permits to shoot a cheetah, ranchers were using a so called 'shoot, shovel, and shut up' approach, illegally killing over a hundred cheetahs a year (Myers, 1975). Myers (1975) identified the indiscriminate killing of cheetahs as the main threat to the survival of the species in Zimbabwe and predicted that, with this rate of illegal off take, by 1980 the population would probably fall to 200 cheetahs confined to protected areas. In that same year the cheetah was declared a specially protected species under the Parks and Wildlife Act and listed on CITES Appendix I, herewith giving it a very high level of protection.

In the late 80s it was acknowledged that limited information was available on the status of the cheetah population in Zimbabwe and a country wide survey was undertaken. This survey highlighted that the cheetah was still heavily persecuted and viewed by farmers as a problem animal with no commercial benefit and therefore no place on their farms. Farmers showed antagonism to the authorities, especially the Zimbabwe Parks and Wildlife Management Authority and CITES, who work to protect the cheetah (Wilson, 1988). In the 90s the authorities developed several cheetah action plans focussing on reducing human-cheetah conflict, and various steps were taken to try and reduce this conflict. Firstly, a proposal was made to CITES to allow the legal off take of cheetah so that cheetah would have commercial value and the illegal off take by farmers would be reduced (CITES, 1992). As a result, Zimbabwe was allowed to legally export 50 cheetah trophies or live cheetah a year herewith enabling farmers to get economic returns. When the 50 export tags were exhausted, farmers were still able to apply for problem animal control permits (Davison, 1999b). Secondly, in 1994, the authorities translocated 21 problem cheetah from the Lowveld to Matusadona National Park, 7 of which died prior to or shortly after release (Zank, 1995). Although, to make it easier for farmers to acquire permits to control problem cheetahs, it was proposed to change the cheetah's status to restricted species (Wilson, 1989), these recommendations were not taken up and the cheetah remained a specially protected species (Davison, 1999b).

Chipangali cheetahs in a boma in Hwange National Park

While cheetah numbers on National Parks Estates declined, on commercial farmland, the population continued to increase (Heath, 1997). A survey of 37 ranches showed an increase from 220 cheetahs to 700 cheetahs in just one decade (Heath, 1997). A captive breeding programme was run at the Chipangali Wildlife Orphanage in Bulawayo, many of the initial breeders were cheetah captured as problem animal on commercial farmland. Because of the uncertainty of how they would survive in National Parks areas and the difficulty of training cheetahs to cope in the wild (Davison, 1999b), the Chipangali Wildlife Orphanage only released cheetah back into the wild in the early 2000s (2 in Matopos National Park, 6 on a game ranch in the Limpopo Valley, at least 6 in Hwange National Park) (Wilson, 2003; 2006a). In the late 90s the authorities carried out a country wide assessment which showed: cheetah densities had continued to increase on commercial farmland causing unacceptably high levels of stock loss; the status of the cheetah on communal farmlands was uncertain, numbers were probably low and the species was not commonly

reported as a pest; cheetah numbers in national park areas were low and not increasing, probably due to intra-carnivore competition; the cheetah population was estimated at a minimum of 1 200 cheetahs on commercial farmlands and 320 cheetah in National Parks areas (Davison, 1999a). Fifteen years later, Cheetah Conservation Project Zimbabwe carried out the next county wide cheetah population survey, the results of which are presented in this report.

2.4. National policy and management

There are several national acts and management plans that directly or indirectly apply to the conservation of cheetah and/or their natural habitat in Zimbabwe, the ones that are most relevant to cheetah conservation are:

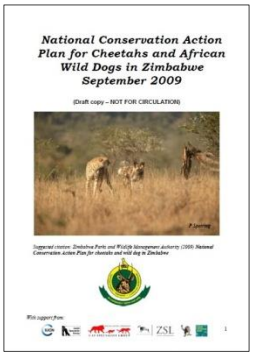
2.4.1. Parks and Wildlife Act and Trapping of Animals (Control) Act

The **Parks and Wildlife Act** [Chapter 20:14] provides for the establishment of national parks, botanical reserves, botanical gardens, sanctuaries, safari areas or recreational parks, and the protection, preservation and conservation of natural resources. The act gives the President the prerogative to establish a new national park, botanical reserve, botanical garden, sanctuary, safari area or recreational park, and add or subtract a new area to such park area, or abolish such park area. Under the Parks and Wildlife Act several species are declared specially protected. The cheetah has been a specially protected species in Zimbabwe since the Parks and Wildlife Act was proclaimed in 1975. In fact, the species enjoyed a similar status (Royal Game) right from the inception of the earlier version of this Act (the National Parks Act) in 1960 (Heath, 1997). 'No person is allowed to hunt, possess, sell or otherwise dispose of any live specially protected animal or the meat or trophy of such animal, unless a permit is issued by the Zimbabwe Parks and Wildlife Management Authority. Anyone who is found to hunt, possess, sell or otherwise disposes of a live specially protected animal or the meat or trophy of such animal without a lawful permit shall be guilty of an offense and liable to a fine or to imprisonment for a period not exceeding three years or to both such fine and imprisonment' (Parliament of Zimbabwe, 2001a).

The Zimbabwe Parks and Wildlife Management Authority, with the concurrence of the Minister may 'issue a permit to any person to hunt a specially protected animal on any land other than in a National Park or to keep, or to have in his possession or sell any live specially protected species or the meat or trophy of such species when the Authority is satisfied that the hunting is necessary for: scientific purposes; educational purposes; providing specimen for a museum, zoological garden or similar institution, the taking of animals live for the purposes of falconry, captive breeding export or restocking; the management and control of animal populations; the protection of human life or property; any other purpose which, in the opinion of the Authority, is of interest to the conservation of animals' (Parliament of Zimbabwe, 2001). Apart from fees for licenses to hunt and export the trophy, concession areas pay the authorities 2 500 USD trophy fee to legally hunt cheetah (ZPWMA, 2014).

In addition to the Parks and Wildlife Act, the **Trapping of Animals (Control) Act** restricts the use, possession and making of traps for the purpose of trapping animals and states that 'no person shall sell, or dispose of any animal or the whole or any part of the carcass thereof which he has trapped in contravention of any of the provisions of this Act' [Chapter 20:21] (Parliament of Zimbabwe, 2001b). In **Statutory Instrument 56** [CAP 20:14] Parks and Wildlife (Payment for Hunting of Animals and Fish) Notice, 2012 and **Statutory Instrument 57** [CAP 20:21] Parks and Wildlife (Payment for Trapping of Wild Animals) Notice, 2012, the fine for illegally hunting or trapping cheetah is set at 20 000 USD.

2.4.2. National Cheetah Action Plans

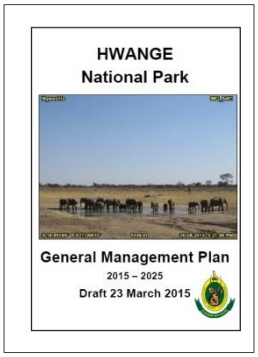


The initial management plans for cheetah in Zimbabwe were largely aimed at the management of an increasing conflict with livestock farmers and, in order to mitigate this conflict and reduce illegal killing of cheetah, facilitating legal commercial off take of (problem) cheetah. In 1997, the Zimbabwe Parks and Wildlife Management Authority wrote a combined management plan for leopard and cheetah in preparation for the CITES Cop 10 meeting, advising an increase in efficiency in the administration of the hunting of cheetah (Heath, 1997). In an attempt to reduce the number of cheetahs that were illegally killed by livestock farmers, this plan was revised in 1998 herewith facilitating a simplified procedure to receive permits to hunt or translocate cheetahs. The overall management goal of this revised plan was to have a secure free-ranging cheetah population of 5000 individual cheetahs in Zimbabwe (Heath and Muchena, 1998). Specific objectives in this plan were 'to secure the cheetah population outside Parks estates by allowing consumptive utilisation and translocation; secure existing populations in National Parks Estates and create new populations by research and translocation; involve landowners in surveying cheetah populations and aspects of human-cheetah conflict at a five year cycle'.

In the late 90s a Cheetah Working Group was established made up of researchers, National Parks staff and livestock producers to coordinate issues relating to cheetah management, conservation and research. As a result of the establishment of this working group, the authorities developed a more comprehensive cheetah management plan with the aim to manage the national cheetah population at least at minimum viable population level while mitigating famer-cheetah conflict. Specific objectives in the 1999 management plan were to: 'establish the actual or accurately estimated cheetah population size in the country and factors affecting population dynamics and minimal viable cheetah population; ensure that cheetahs are being conserved throughout their range in accordance with maintaining minimal viable population size; bring the conservation practises of cheetah in Zimbabwe to bear on the needs of the African cheetah meta-population' (Davison, 1999b).

A decade later, under the guidance of the Range Wide Conservation Programme for Cheetah and African wild dog, a new management plan was developed focussing on 'improving the status of cheetah and African wild dog and securing (additional) viable populations of cheetahs and African wild dogs across their range in Zimbabwe that successfully co-exist with and are valued by the people of Zimbabwe' (ZPWMA, 2009a) (see also section 2.2.6. Range Wide Conservation Programme for Cheetah and African wild dog, pp. 13).

2.4.3. National Park Management Plans



In the three main National Parks Estates where cheetahs occur, the species is taken into account in the Zimbabwe Parks and Wildlife Management Authorities management plans. In the management plan for **Hwange National Park** the cheetah is recognized as an exceptional resource. Within this National Park there are concerns regarding the low densities of cheetah and it is advised that research on rare and endangered species such as the cheetah should be expanded (ZPWMA, 2015a). In the **Mana Pools National Park** management plan the cheetah is identified as an exceptional resource and a rare and endangered species that requires special attention. It is acknowledged that there is a need to improve the understanding of predator dynamics in this National Park and specific studies need to be initiated to monitor cheetah (ZPWMA, 2009b). The management plan for **Gonarezhou National Park** mentions the cheetah as a species of special concern and aims to restore the National Park's carnivore populations including cheetah (ZPWMA, 2011).

2.4.4. Acts, policies and programmes related to land use

There are various acts and policies that apply to the conservation of the cheetah's habitat, including:

- **The Forest Act** [Chapter 19:05] which prevents illegal harvesting of or wrongful possession of forest produce (including wild animals) and gives the President the prerogative to declare a new demarcated forest, add or subtract any area to a demarcated forest, or abolish a demarcated forest (Parliament of Zimbabwe, 2002a)
- **The Environmental Management Act** [Chapter 20:27] which provides for the sustainable management of natural resources and protection of the environment and gives the President the prerogative to set aside State land or communal land for environmental purposes (Parliament of Zimbabwe, 2002b)
- **The Mines and Minerals Act** [Chapter 21:05] regulates the placement of mining locations and provides for reporting on the anticipated impact of mining operations on the environment and any measures to be taken to assess, prevent or minimize such impact (Parliament of Zimbabwe, 2001c)
- **The Rural District Council Act** [Chapter 29:13] which provides for the declaration of Intensive Conservation Areas in council areas or part of council areas and the establishment of natural resource committees and subcommittees at council and ward level to exercise functions related to natural resources (Parliament of Zimbabwe, 2002c)
- **The Rural Land Act** [Chapter 20:18] which provides for the acquisition and alienation of State Land (Parliament of Zimbabwe, 2002d)
- **The Traditional Leaders Act** [Chapter 29:17] which gives the traditional leaders the responsibility to prevent unauthorized settlements and use of land, ensure that the land and its natural resources are exploited according to the law and prevent the over-exploitation, degradation, abuse and misuse of land and natural resources in the area including the indiscriminate destruction of flora and fauna (Parliament of Zimbabwe, 2001d).

In 1980 the Government of Zimbabwe started a land reform programme, aimed at an equitable redistribution of land and the reduction of poverty and underdevelopment. During phase I and II of this process the Government purchased land from willing sellers. In 2000 the Government of Zimbabwe introduced phase III: the Fast Track Land Reform Programme. Under this programme the acquisition of land by the Government became compulsory, redistribution followed either an A1 (indigenized commercial farming) or A2 (subsistence farming) model (du Toit, 2004). In 2004 the Government revised its 1992 Policy for Wildlife into the **Wildlife Based Land Reform Policy** which aims to ensure profitable, equitable and sustainable use of wildlife resources (AWF, 2011). Specific objectives under this policy are: 'to facilitate the indigenisation of the wildlife sector and ensure equitable access to land and wildlife resources and the business opportunities related to those resources; maintain a proportion of land outside state protected areas under wildlife production; enhance diversity of land uses through wildlife production; promote secure and equitable tenure; develop and implement institutional arrangements for wildlife based land reform' (AWF, 2011).

The **Communal Areas Management Programme for Indigenous Resources** (CAMPFIRE) was introduced in 1988 with the aim to promote the sustainable use and management of wildlife on communal land (Alexander and McGregor, 2000; Frost and Bond, 2008). CAMPFIRE is a community based programme which, via the Rural District Councils, grants communities on communal land the authority to manage and profit from natural resources in their district by having market access to safari operators which in turn sell hunting and photographic safaris to tourists (Alexander and McGregor, 2000; Frost and Bond, 2008).

Chapter 3 - The nationwide cheetah survey

3.1. Background to the survey

When Cheetah Conservation Project Zimbabwe (CCPZ) was founded in 2012 (cheetahzimbabwe.org), there was limited up-to-date information available about the cheetah population of Zimbabwe. Estimates of the national cheetah population ranged from 400 to 1 500 and many of these figures were not based on reliable data (ZPWM, 2009a). With the last country wide estimate being made in 1999, there was no information available on the current population status of the cheetah (ZPWMA, 2009a). Between 1999 and 2012 Zimbabwe experienced drastic changes in land use, which has had its impact on the natural environment and its resources (Murombo, 2002; du Toit, 2004; AWF, 2011). CCPZ therefore decided that, in order to effectively conserve Zimbabwe's cheetahs, it was necessary to determine where cheetahs occur, what the current population estimate is and what conservation challenges the cheetah faces.

Interview and questionnaire surveys have historically been used to determine the abundance of cheetahs (Myers, 1975). Because estimates made by stakeholders can be subjective, later studies collected additional information about specific cheetah sightings which they used to estimate cheetah densities (Gros et al. 1996). This indirect survey method is considered the most accurate and appropriate method to collect cheetah data on a large geographic scale (Gros et al. 1996; IUCN/SSC, 2007). At a smaller scale, cheetah densities can also be measured directly by identifying individual cheetahs within a population (Gros et al. 1996) and the collection of photographs from tourists, safari guides and other stakeholders has been used to identify individual cheetahs and provide an estimate of minimum population sizes (Marnewick et al., 2014). In their nationwide cheetah survey CCPZ used a combination of these methods.

The survey consisted of a citizen science component (the collection of sightings and pictures from the public), a questionnaire based interview component, a data sharing component and an *in situ* education component. CCPZ is affiliated to the National University of Science and Technology, department of Forest Resources and Wildlife Management. Students on attachment assisted CCPZ with the questionnaire based interview component of the survey. Permits for the presented research were granted by the Research Council of Zimbabwe (Permit № 01197 (2012); № 01392 (2013); № 02336 (2014); № 02508 (2015)), Department of Immigration Zimbabwe (Ref. № 1372/07), the Zimbabwe Parks and Wildlife Management Authority (Permit № 23(1) (C) (II) 21/2013; № 23(1) (C) (II) 08/2014; № 23(1) (C) (II) 09/2015) and the Ministry of Local Government, Urban and Rural Development (Ref. ADM/23/8).

3.2. Citizen science

Tourists encountering a cheetah

In 2012 Cheetah Conservation Project Zimbabwe started the nationwide survey with the launch of a citizen science campaign to collect cheetah sightings and photographs from members of the public. By spreading posters and sighting sheets at National Parks estates, lodges and safari operator's offices, we encourage tourists, safari guides, rangers, professional hunters and others to provide cheetah sightings and photographs. In addition, we publish articles in the popular press, share our information via the Safari Operators Association Zimbabwe, give regular talks at events and use our website (with an online sighting form) and social media to promote the submission of sightings and photographs. During the questionnaire based survey we distributed 600 'help us find the cheetahs of Zimbabwe' posters and 3 000 sighting sheets. The citizen science component is part of a long term monitoring programme. All sightings and photographs are added to CCPZ's national cheetah database. The sightings provide information on cheetah occurrence and distribution. Photographs are used to identify individual cheetahs based on their unique spot pattern, herewith enabling us to estimate population sizes and collect information on demography and behaviour. The sightings and photographs are also used to derive information on dispersal patterns and the use of corridors. Since 2012, CCPZ has collected 1 605 sightings and 5 659 photographs from the general public, which has resulted in the identification of 104 individual cheetahs.

3.3. Questionnaire based interviews

Cheetah Conservation Project Zimbabwe used the existing administrative structure in Zimbabwe to carry out the nationwide cheetah population survey. Zimbabwe is divided in 8 provinces and two cities with provincial status (Harare and Bulawayo), each Province is subdivided in districts. The country has a total of 60 districts (two of which are the cities of Bulawayo and Harare) which are subdivided into 1 200 wards (ZimStat, 2015). Each district is headed by a District Administrator. There is also a Rural District Council which is headed by a Chief Executive Officer, and comprises of ward councillors and up to three chiefs from within the area. During the survey, we travelled through 58 districts (excluding Bulawayo and Harare). At each district, after authorisation from the relevant authorities, we visited the Rural District Council, National Parks offices and estates, Forestry Commission offices and estates, conservancies, hunting concessions, large commercial farms, communities adjacent to wildlife areas with cheetah presence and (upon the suggestion of the Rural District Councils) other areas of wildlife relevance (Fig. 2). At each interview location we interviewed the management and a minimum of 50% of the field staff in their preferred language (English, Shona or Ndebele). We made sure we were introduced as a carnivore project and did not wear clothing with the project's logo. We only interviewed respondents who had been working in the area for a minimum of one year. In the dry season of 2013, 2014 and 2015 we travelled from district to district to find the right informants. In 2013 we covered the districts in the northwest of the country, in 2014 the districts in the south of the country and in 2015 we covered the remaining districts in the northeast of Zimbabwe (Fig. 2).

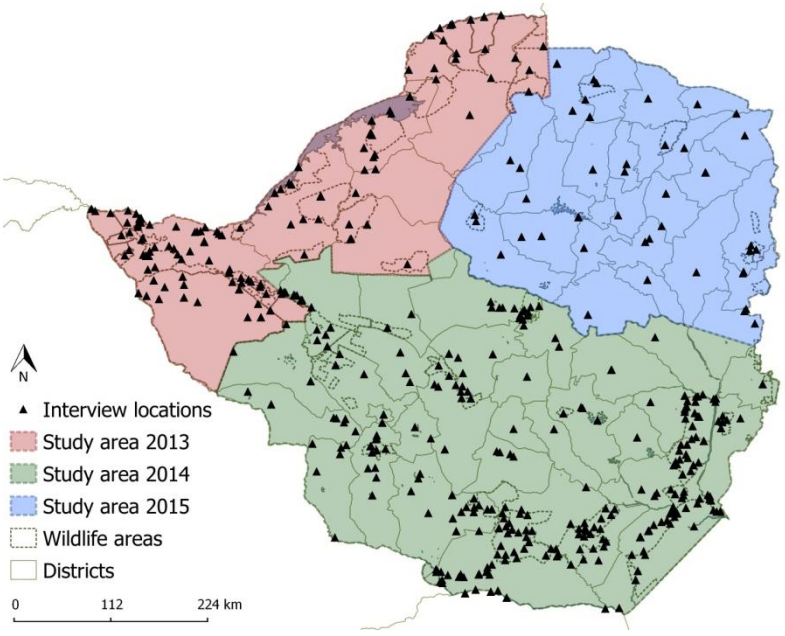


Figure 2. Interview locations and areas covered between 2013 and 2015 with the questionnaire based interview survey.

Interviews were based on a structured (pilot tested) questionnaire with a mix of open- and closed-ended questions (Appendix I). To allow for data comparison, we took the questionnaires previously used in cheetah/carnivore research in Zimbabwe into account in our questionnaire design. We started the interview with general questions about age, gender, nationality and profession, after which we showed informants photographs of 13 carnivores (including cheetah) (Fig. 3) and, for each photograph, asked them to identify the animal and give an indication of how often and where they saw it (Appendix II). We asked respondents to describe how they felt about living with predators in their area. In communal and commercial farming areas informants were asked to point out problem animals from the thirteen carnivore photographs, describe the type of conflict these animals were causing and the methods used to mitigate conflict. After these questions we made it clear to respondents we wanted to talk about cheetah and, in cases where respondents misidentified cheetah, explained the difference between cheetah and

other carnivores like leopard and serval. We proceeded to ask questions about cheetah, cheetah occurrence, cheetah population trends and threats to cheetah survival. Informants were also asked to recall their cheetah sightings and, where available, provide us with photographs of these sightings. In addition, we asked questions related to how the informant felt about the five large carnivore species, and how important he or she thought it is to conserve wildlife (Appendix I).

CCPZ on the road

At each district CCPZ interviewed the Natural Resource Officer at the Rural District Council (RDC) or, in cases where districts ran a CAMPFIRE programme, the CAMPFIRE manager. In addition, we interviewed the CAMPFIRE scouts and a minimum of one professional hunter trophy hunting in that particular CAMPFIRE area. CCPZ visited all the regional offices, Problem Animal Control stations, National Parks, Safari Areas and the relevant Sanctuaries and Recreational Parks of the Zimbabwe Parks and Wildlife Management Authority (ZPWMA) to interview their staff. In case of a Safari Area, we interviewed the professional hunters and trackers hunting in the area, and in case of a National Park, the safari guides and, where applicable, researchers working in the area. CCPZ visited relevant Forestry Commission Estates where we interviewed the Forester, estate ecologist or manager, the anti-poaching teams and other relevant informants. At conservancies and hunting estates we interviewed the estate managers, ecologists, anti-poaching teams, fence monitors, professional hunters, trackers and, where applicable, safari guides. On commercial farms we interviewed the farm managers, fence monitors, cattle managers and other relevant informants. CCPZ also visited communities adjacent to wildlife areas where cheetahs were confirmed to be present. Within each village we interviewed a minimum of three village heads, each village head has ca. 46.49 ± 6.22 (mean ± SE) households under his or her guardianship, these households report problems with wildlife to the village head. We interviewed village heads in villages that were within a maximum radius of 5 km of the wildlife area and a minimum of 10 km apart. If there was an indication that cheetah were seen within this 5 km radius we would expand this radius with 5 km and visit villages within a 10 km radius from the wildlife area. The interview area was expanded until cheetah sightings were no longer recorded.

Interview with a CAMPFIRE ranger

We conducted 1 292 interviews with 1 209 informants (Table 2), we asked informants who worked in more than one area to answer the questions specific to an area for each area of operation separately. For an overview of the number of respondents interviewed per industry or institute see Table 2. Because views of management staff and general staff can differ (Williams, 2011), respondents were subdivided into people working at management or senior positions (mgmt) (e.g. area or section manager, anti-poaching coordinator, wildlife officer, senior ranger, ecologist) and general staff (gen) (e.g. ranger, game scout, anti-poaching scout, fence monitor). The majority of our respondents were male (93.5%). We interviewed 79 females, most of which were employed as general staff by the Zimbabwe Parks and Wildlife Management Authority (63.3%). On average respondents were 40.08 ± 0.35 (mean ± SE) years old and had worked in the area for 11.45 ± 0.40 (mean ± SE) years (Table 2). Industries or institutes for which we interviewed ≤ 10 respondents (e.g. researchers, Environmental Management Agency employees, crop farmers) were grouped in the category others. On average respondents correctly identified 7.57 ± 0.08 (mean ± SE) of the carnivores in the 13 photographs, this average varied from a minimum of 4.76 ± 0.24 (mean ± SE) for subsistence farmers to a maximum of 12.51 ± 0.14 (mean ± SE) for professional hunters (Fig. 4). In the local languages there is no distinction between the different jackal and hyena species so this average includes respondents who identified black backed jackal and side striped jackal as jackal, and brown hyena and spotted hyena as hyena. Less than 50% of the respondents (45.2%) were able to identify more than 7 of the thirteen carnivores (Table 2). The majority of the respondents correctly identified cheetah (85.4%) from the

carnivore photographs, almost half of the respondents who correctly identified cheetah had seen a cheetah in the wild (47.7%) (Table 3). In addition to the interviews, CCPZ collected information on cheetah sightings and cheetah conflict from patrol reports and problem animal reports. With the questionnaire based interview survey we collected 949 verified cheetah sightings.

Figure 3. The thirteen carnivore species in the questionnaire based survey. For an overview of where these carnivores were sighted see Appendix II.

Aardwolf[1]
Proteles cristata

African wild cat[2]
Felis silvestris

African wild dog[1]
Lycaon pictus

Bat-eared fox[1]
Otocyon megalotis

Black backed jackal[2]
Canis mesomelas

Brown hyena[2]
Hyaena brunnea

Caracal[2]
Caracal caracal

Cheetah[1,2]
Acinonyx jubatus

Leopard[2]
Panthera pardus

Lion[2]
Panthera leo

Serval[2]
Leptailurus serval

Side-striped jackal[2]
Canis adustus

Spotted hyena[2]
Crocuta crocuta

[1]These species are specially protected in Zimbabwe under the sixth schedule (section 43) of the Parks and Wildlife Act [Chapter 20:14], African wild dogs have been granted a similar status under Statutory Instrument 80 [CAP 20:14]
[2]These species can be trophy hunted in Zimbabwe (ZPWMA, 2014)

Table 2. Number of respondents interviewed per industry or institute and department within this industry or institute and average age and number of years respondents had worked in the area.

Profession	n	Age		Years in area		Percentage who correctly identified > 7 of the 13 carnivores
		Mean	SE	Mean	SE	
Subsistence farmers	90	55.80	1.37	40.68	2.43	10.0%
Commercial livestock mgmt	41	50.98	2.04	27.44	3.03	73.2%
Commercial livestock gen	20	33.50	2.14	4.48	1.05	20.0%
Photographic safari guides	48	39.63	1.35	10.41	1.46	100%
Photographic mgmt	12	47.50	4.03	10.71	3.26	91.7%
Photographic gen	31	35.77	1.71	8.05	1.06	51.6%
Hunting professional hunters	70	44.43	1.39	12.01	1.12	97.1%
Hunting mgmt	40	45.08	2.48	14.30	2.51	72.5%
Hunting gen	158	36.79	0.75	6.29	0.43	41.1%
RDC natural resource officers	28	42.86	1.93	11.64	2.43	10.7%
CAMPFIRE mgmt	11	42.73	1.78	15.18	3.10	54.5%
CAMPFIRE gen	36	45.06	1.45	11.06	1.48	25.0%
Forestry Commission mgmt	29	37.24	1.84	7.28	1.47	20.7%
Forestry Commission gen	46	38.13	1.84	8.03	1.35	23.9%
ZPWMA mgmt	55	40.60	0.35	11.45	0.40	76.4%
ZPWMA gen	435	35.33	0.45	7.41	0.30	36.6%
Other	59	44.85	1.71	11.72	1.73	47.3%
Total	**1209**	**40.08**	**0.35**	**11.45**	**0.15**	**45.2%**

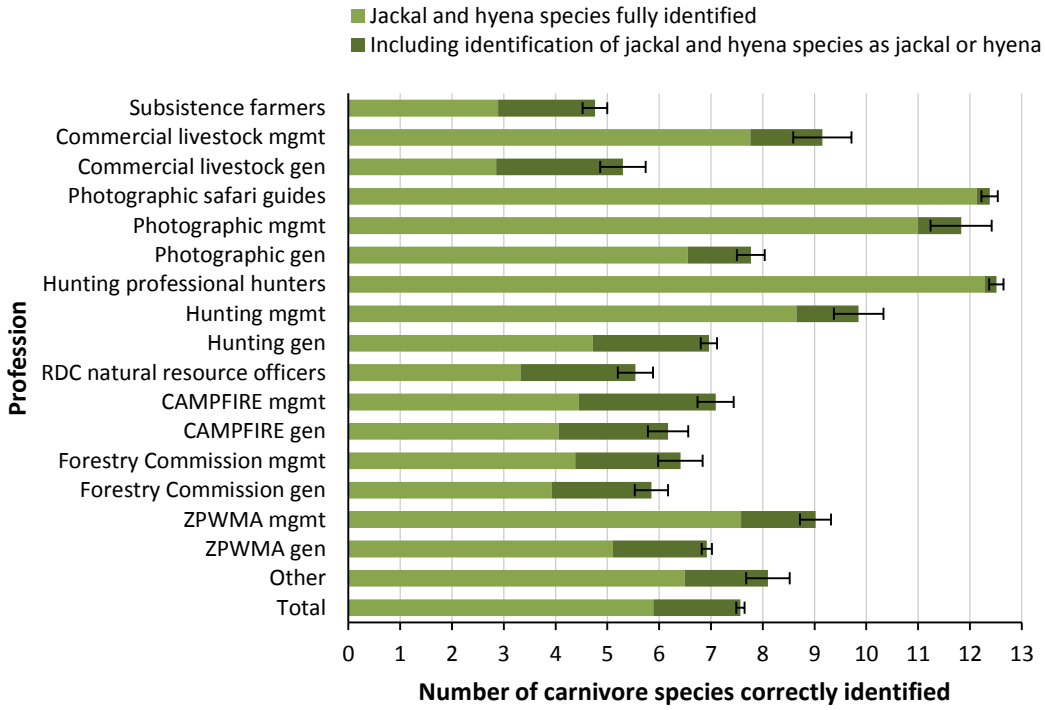


Figure 4. Mean number of carnivores species correctly identified from the thirteen photographs by respondents in various professions, in the local languages there is no difference between the jackal or hyena species so means are displayed for correct identification based on full species identification and based on identification as jackal or hyena.

Table 3. Percentage of respondents (n = 1 209) who correctly identified a carnivore species from the photograph and percentage of these respondents who saw the species in the wild.

Carnivore species	Correctly identified	Seen in the wild when correctly identified
Aardwolf	16.7%	38.6%
African wild cat	38.0%	75.2%
African wild dog	77.3%	62.1%
Bat-eared fox	23.8%	42.0%
Black backed jackal (including identification as jackal)*	73.2%	85.5%
Black backed jackal (identified with full species name)	*26.9%*	*86.2%*
Brown hyena (including identification as hyena)*	76.4%	41.6%
Brown hyena (identified with full species name)	*34.0%*	*41.8%*
Caracal	24.2%	45.9%
Cheetah	85.4%	47.7%
Leopard	87.1%	75.5%
Lion	96.6%	62.1%
Serval	19.4%	54.5%
Side striped jackal (including identification as jackal)*	45.5%	53.1%
Side striped jackal (identified with full species name)	*16.5%*	*65.8%*
Spotted hyena (including identification as hyena)*	93.3%	71.4%
Spotted hyena (identified with full species name)	*43.2%*	*80.5%*

*In the local languages there is no difference between the jackal or hyena species

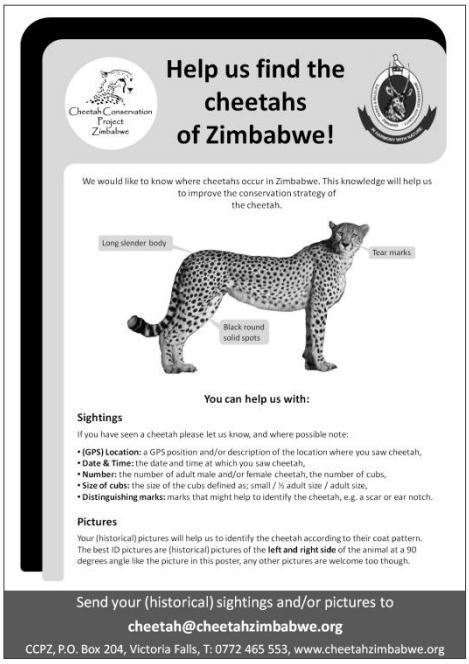
3.4. Data sharing

When carrying out research on one species, researchers inevitably collect information on other species, especially when carrying out spoor surveys or camera trap surveys. Various colleagues have kindly made their data bases available to provide us with additional cheetah information: Hwange Lion Research, Dambari Wildlife Trust, Bhejane Trust, Debshan Ranch, Nuanetsi Ranch, Malilangwe Private Wildlife Reserve, Bubye Valley Conservancy, the Darwin Initiative Leopard Project, Victoria Falls Wildlife Trust, Sango (Save Valley Conservancy), African Wildlife Conservation Fund.

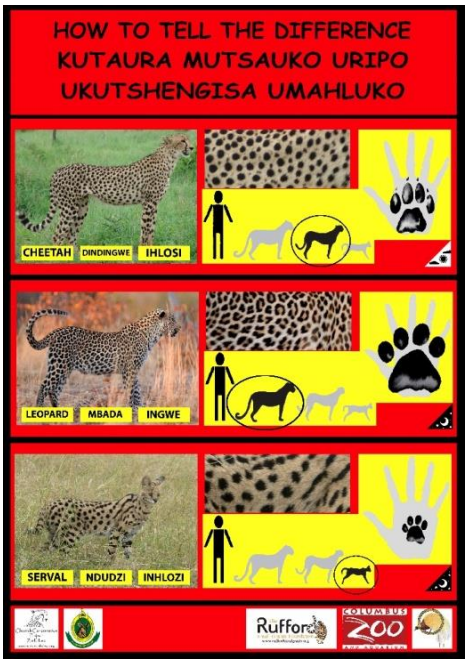
3.5. *In situ* education

Cheetah movie night

While travelling through the country to interview informants about cheetahs, Cheetah Conservation Project Zimbabwe tried to provide education about cheetahs, carnivores and human-carnivore conflict mitigation. Once we finished the interview we spent considerable time with the respondent to answer questions and provide the names of the carnivore species on the 13 photographs and basic information about their ecology and behaviour. In order to raise awareness, after the interview each respondent received a cheetah pen or sticker. In total we handed out 2 000 stickers and 1 000 pens. In addition to the 600 'Help us find the cheetahs of Zimbabwe' posters, we distributed 600 'how to tell the difference' posters which explain how to distinguish cheetah from leopard and serval, and 500 'I'm a cheetah posters' with information about the cheetahs adaptations to speed. At the various field stations, we distributed 500 spoor reference guides. These laminated field sheets assist with the identification of carnivores, herbivores and their spoor whilst on patrol. We left 50 'how to live with predator' booklets at Problem Animal Control stations and other offices dealing with human-carnivore conflict. The 'how to live with predator' booklets were developed by the Marwell Trust and explain how to identify problem carnivores and how to mitigate conflict with various carnivore species (Williams, 2011). Where possible, we organised 'cheetah movie nights' at field stations, showing rangers, scouts and their families a movie about the cheetah's behaviour and ecology.



Help us find the cheetahs of Zimbabwe poster (available at cheetahzimbabwe.org)



How to tell the difference posters developed by the RWCP (available at cheetahzimbabwe.org)

I'm a cheetah poster (available at cheetahzimbabwe.org)

Chapter 4 - Current cheetah population status

4.1. Background to the data on the cheetah population

We determined the cheetah population size and cheetah distribution in Zimbabwe from sighting reports of cheetahs collected via the questionnaire based interviews and citizen science. The respondents in the questionnaire based survey were asked to recall their cheetah sightings. We recorded all sightings the respondent could clearly remember. For each sighting respondents were asked to specify the date, time, location, total number of cheetahs, number of adults, sex of the adults, number of cubs and the size of the cubs (small, ½ adults size, adult size) (see Appendix I). In order to determine the location of the sighting we asked respondents to pinpoint sighting locations on a map of Zimbabwe (scale 1:250 000). We recorded the name of the location and the number of kilometres and direction (using the eight principal compass points as the reference) from this location to the interview location. In the few cases where respondents were interviewed on a location other than in their area of operation we used an obvious reference point in the area of operation like a camp or lodge. For additional information about the questionnaire based interview method see section 3.3. Questionnaire based interviews, pp. 19-23.

Based on the respondent's ability to identify carnivores from photographs, knowledge of the species, accuracy of the answers and willingness to participate, we classified respondents as reliable or unreliable sources of information. To estimate cheetah population size and cheetah distribution we only used recent sightings (≤ 3 years) from reliable respondents who correctly identified cheetah from the photograph and did not confuse cheetah with other carnivore species. If available, we collected photographs of the reported sightings. In total we used 796 sightings in the analyses[2] (Appendix II). In addition we used recent sightings collected via citizen science. In our analyses, we only used citizen science sightings that we were able to verify via photographs (n = 484)[2]. The photographs were used to identify individual cheetah based on their unique coat markings. Although tail and tear markings have been used to identify individual cheetah (Zank, 1995; Chelysheva, 2004), we found it most reliable to use a minimum of three different markings on front legs and shoulders and/or hind legs and hindquarters as these parts of the body have a relatively stable pattern visibility throughout different poses, body conditions (e.g. full versus empty belly) and weather conditions (e.g. rain, wind).

In addition to the cheetah sightings, we asked respondents to give an estimate for the number of cheetahs in their area of operation and Zimbabwe. In order to get an insight in population trends, respondents were asked if the number of cheetahs in their area of operation had increased, decreased or stayed the same, what the reasons for this trend could be and what threats the cheetah could be facing in the area. We also asked respondents to describe population trends and reasons for this trend for the total cheetah population in Zimbabwe. The information collected during the nationwide cheetah survey enabled us to map the distribution of cheetahs in Zimbabwe, give a cheetah population estimate, get an insight in cheetah demography, determine the level of co-existence between people and cheetah and map the distribution of twelve other carnivores (Appendix II). In line with common conservation practice (IUCN/SSC, 2007; Durant et al., 2015) the cheetah population estimates in this report includes adults and independent (i.e. dispersed) adolescents (referred to as adults throughout the document), and do not include cubs.

[2]The king cheetah, a colour variant of *Acinonyx jubatus*, was first described in Zimbabwe in 1926. The king cheetah has only been seen in the wild a handful of times and was last sighted in Zimbabwe in the seventies (Hills and Smithers, 1980). Within the nationwide survey we received no sightings of king cheetah.

4.2. Cheetah distribution

In the 2007 regional workshop to develop a southern African conservation strategy for cheetah and African wild dog it was estimated that the range within which cheetah were resident (known to exist and breed) in Zimbabwe was 132 931 km^2 (IUCN/SSC, 2007), this range was revised to 125 517 km^2 in the National planning workshops (ZPWMA, 2009a) (Fig. 5c). In addition, it was estimated there was a possible cheetah range of 100 699 km^2 in Zimbabwe within which the species might exist and be breeding but from which no reliable records were available. Connecting range, areas where the species does not reside but that are important for dispersal between resident populations, was estimated to be 17 463 km^2 and extirpated range, areas where the species no longer exist, to be 128 520 km^2 (ZPWMA 2009a). In the 2009 National workshop it was agreed that there was no recoverable range in Zimbabwe where cheetah did not exist but which could, naturally or artificially, be reconolized by the species as a result of improved management (ZPWMA, 2009a)(Fig. 5c). The present nationwide cheetah survey has enabled CCPZ to update the cheetah range map for Zimbabwe. As a result of this comprehensive survey we were able to reliably classify areas previously identified as possible range. In large parts of the range formerly classified as extirpated there are no available records of the species historical existence (Fig. 5a-c), we therefore decided to only use two classifications: resident range and connecting range. We defined resident range as habitat where cheetahs are regularly sighted over a period of several years and are known to breed (following IUCN/SSC, 2007). Connecting range was defined as habitat which provides a connection between resident populations and is used by cheetahs intermittently.

The current resident cheetah range covers ca. 49 134 km^2 (Fig. 5d), approximately 13% of the country (excluding lakes and water reservoirs). Compared to the resident range as described in the 2009 National Conservation Action Plan for Cheetahs and African wild dogs in Zimbabwe (ZPWMA, 2009a), the cheetah has experienced a 61% decline of its resident range in Zimbabwe. Globally ca. 80% of the cheetah's resident range covers land outside the protected area network (IUCN/SSC, 2007). Historically, in Zimbabwe, the majority of the cheetah population could indeed be found on commercial farmlands (CITES, 1992; Davison 1999a). However, with the start of the fast track land reform programme in 2000, much of the land used for large scale commercial farming was converted to smaller scale commercial and subsistence farming, which had serious environmental impact (Murombo, 2002; du Toit, 2004; AWF, 2011). It is therefore very likely that the decline in resident cheetah range started in the early 2000s but was not recognized in the 2007 and 2009 workshops due to a lack of up to date information on cheetah occurrence.

At present, 84% of the resident cheetah range in Zimbabwe falls within wildlife protected areas (Fig. 5d). We defined wildlife protected areas as areas managed with the aim to conserve nature, designated for sustainable consumptive or non-consumptive utilisation of wildlife, without human settlements and livestock, and protected by regulation of human activity and regular anti-poaching patrols. Although according to the IUCN criteria (Dudley, 2008), conservancies are not classified as protected areas we included those areas in our definition because in Zimbabwe conservancies consist of wildlife habitat with a high level of protection in which cheetah and other wildlife populations can thrive. The wildlife protected areas with resident cheetahs are either parastatal land (78%) (National Parks Estates and Forestry Commission Estates) or private land (22%) (conservancies). The non-protected areas with resident cheetahs are private land (commercial farms). Taking into account the increase in human population size (ZimStat, 2012) and the drastic changes in land use which have resulted in high human population densities and unsustainable exploitation of natural resources in former cheetah range (Murombo, 2002; du Toit, 2004; AWF, 2011), it is highly unlikely that the historical resident range which is no longer inhabited by cheetah can ever be naturally or artificially recolonized by the species. Recoverable cheetah range in Zimbabwe is therefore considered to be non-existent.

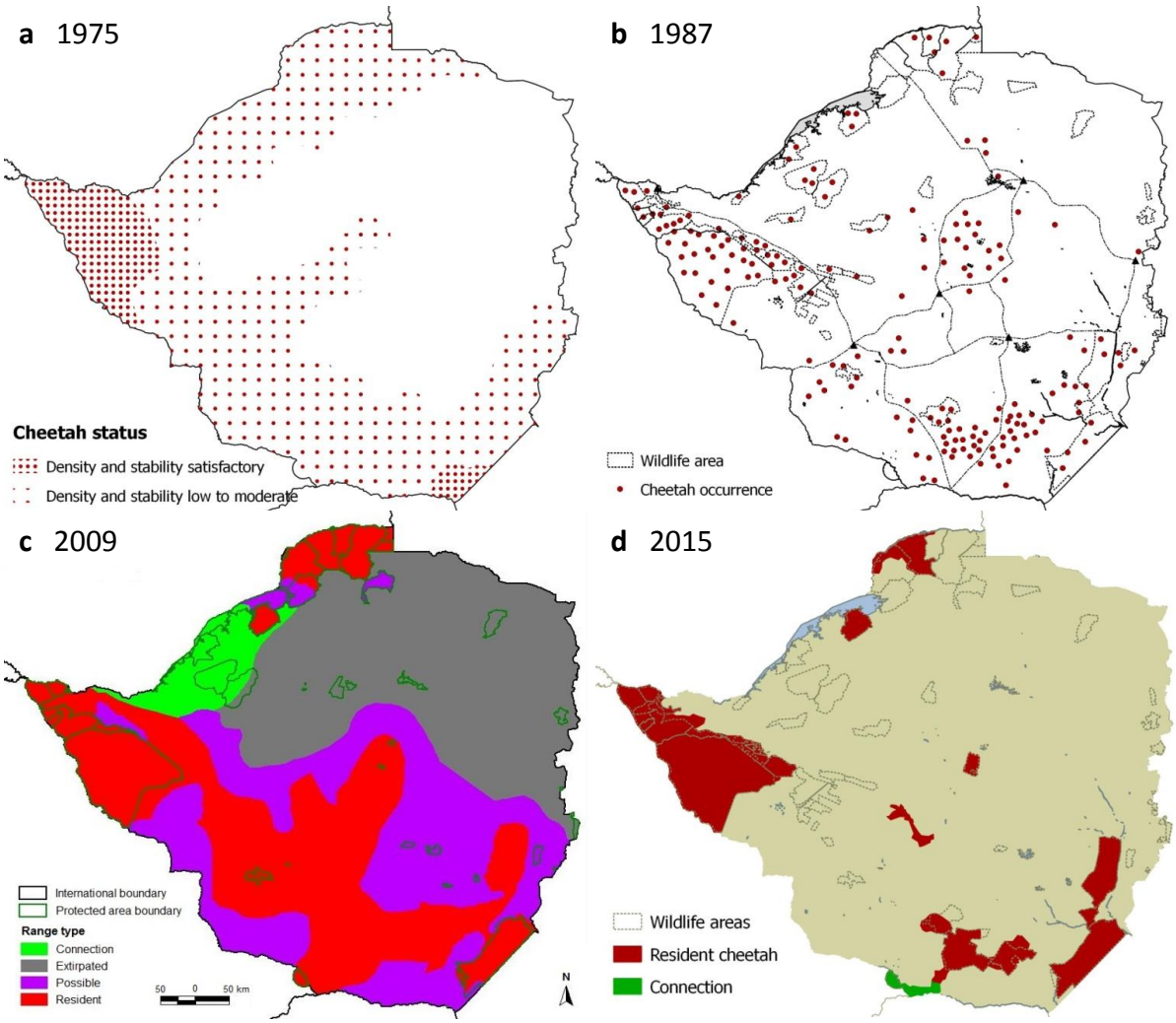


Figure 5. a. Cheetah distribution in 1975 (adapted from Myers, 1975) **b.** Cheetah distribution in 1987 (adapted from Wilson, 1988) **c.** Cheetah distribution in 2009 (ZPWMA, 2009) **d.** Cheetah distribution in 2015 as per the present study.

4.3. Cheetah population estimates and trends

In accordance with other studies (Williams, 2011; Gandiwa, 2012; Mohd-Azlan et al., 2013), the population estimates and trends based on opinions of participants in our questionnaire based interview survey varied greatly and in most cases did not result in a reliable insight in cheetah numbers and population trends for the respective areas of operation. Cheetah population estimates were therefore derived from the sightings reported during the questionnaire based survey, based on a method described and validated by Gros et al. (1996). For wild populations of large carnivores, this method is believed to provide the closest possible approximation to total counts (Gros et al., 1996). In our analysis we used sightings from reliable respondents who correctly identified cheetah from the carnivore photographs. For each year, we mapped the cheetah sightings in a given area using QGIS version 2.0.1. We eliminated redundant sightings by assuming that all similarly composed sightings describe the same animals if they were separated by a distance d. Following Williams (2011), distance d was defined as the maximum distance between two locations within the home range of a cheetah. Values for d were calculated from the literature or from known home ranges based on verified sightings of identified cheetahs (Table 4).

Table 4. Average home range sizes and d values for Hwange National Park, Malilangwe and Matusadona National Park calculated from sightings of identified cheetah and literature.

Area	Hwange NP	Malilangwe	Matusadona NP
Home range size based on minimum convex polygons (km^2) mean ± SE	229.73 ± 42.03	452.70	29.57 ± 12.63
Distance d (km) mean ± SE	41.06 ± 4.20	41.09	17.75 ± 1.78
N (number of cheetah)	11	1	3
Min number of point locations per cheetah for home range and d calculations	17	992	21
Source	Sightings of identified cheetah	Jaquier and Woodfine (2007)	Purchase and du Toit (2000)

When removing redundant sighting we also took mean home range sizes (Table 4) and an average daily distance travelled of 6 km into account (Wilson et al., 2013). In addition, for areas with enough sightings of identified individuals we were able to overlap known home ranges with sightings reported during the questionnaire based survey. Hwange values were used for calculations in the west of the country, Malilangwe values for calculations in the south of the country and Matusadona values for calculations in the north of the country. After elimination of redundant sightings, annual cheetah estimates for a given area were computed by adding up all cheetahs in the remaining sightings. The final estimate for each area is a mean value of the three most recent annual estimates prior to the interview date. For each area, population trends were determined based on a literature review and expert opinions (i.e. resident ecologist, area manager) (Table 5). As per common conservation practice (IUCN/SSC, 2007; Durant et al., 2015) the population estimates in this table include adults and independent (i.e. dispersed) adolescents (referred to as adults throughout the document), and excludes the ca. 60 cheetah cubs in the Zimbabwe cheetah population. According to our calculations the total cheetah population in Zimbabwe consists of ca. 150-170 adult cheetahs (Table 5). For an overview of cheetah estimates and population trends per province and cheetah range see Table 5, for the locations of those populations see Fig. 6.

Table 5. Overview of Zimbabwe's cheetah population estimates and population trends per province and cheetah range, population estimates are given as the number of adult (i.e. adult plus independent adolescents) cheetah. For the location of the various populations see map references in Fig. 6.

Map reference and area description	Number of adult cheetahs	Population trend	Reason for population trend
Matabeleland North	Ca. 40-42		
A Hwange National Park and buffer zone along eastern boundary (Gwaai ICA, Sikumi, Ngamo)	Ca. 25	↓ Decrease	Competition with other predators
Matetsi unit 1-5 and buffer zone along eastern boundary (Matetsi ICA, Deka)	Ca. 10	↕ Same	Competition with other predators, poaching of cheetah and their prey
Victoria Falls Area (Zambezi National Park, Matetsi unit 6-7, Panda Masuie, Kazuma, Kazuma Pan, Fuller)	Ca. 5-7	↕ Same	Poaching of cheetah and their prey
Matabeleland South	Ca. 34-42		
B Debshan Ranch/De Beers Cattle Section and neighbouring farms (Magholo Farm, Jabulani Safaris, Pezulu Ranch)	Ca. 3-5	↓ Decrease	Human encroachment, poaching of cheetah and their prey, habitat destruction by people
C Bubiana and farms West of Bubiana (Jonsyl Ranch, Chipize Ranch, Reata Farm, Pepeluza Farm, Inhlaba, Lucknow, Mashura Ranch, Rooiberg, Li farm, Mkashi, Muko Farm)	Ca. 3-5	↓ Decrease	Human encroachment, poaching of cheetah and their prey, habitat destruction by people
D Bubye Valley Conservancy	Ca. 20-22	↓ Decrease	Competition with lion (increase in lion population) and other large carnivores
E Farms and communal land southwest of Bubye Valley Conservancy (Den Linian Ranch, Bisshopstone Farm, Maramani Communal Land, River Ranch, Sentinel Ranch)	Ca. 5-7	↓ Decrease	Human encroachment, poaching of cheetah and their prey, habitat destruction by people
F Tuli Circle (part of a Botswana's Northern Tuli Game Reserve Population)	Transient population of 3	↕ Same	Competition with other predators, poaching of cheetah and their prey
Masvingo	Ca. 52-56		
G Nuanetsi Ranch cattle and wildlife section	Ca. 15-17	↑ Increase	No competition with lion
H Gonarezhou National Park	Ca. 15-17	↕ Same	Competition with other predators
I Malilangwe	Ca. 12	↑ Increase	Influx from surrounding areas as people encroached on the land, less competition with other carnivores (decrease in lion population)
J Save Valley Conservancy	Ca. 10	↓ Decrease	Competition with other predators, poaching of cheetah and their prey
Midlands	Ca. 3-5		
K Midland Rhino Conservancy (Sebakwe)	Ca. 3-5	↓ Decrease	Human encroachment, poaching of cheetah and their prey, habitat destruction by people
Mashonaland West	Ca. 15		
L Mana Pools National Park and shoreline along the northern boundary of Hurungwe and Sapi	Ca. 12	↓ Decrease	Unknown
M Matusadona National Park	3	↓ Decrease	Unknown
Mashonaland Central	0		
Mashonaland East	0		
Manicaland	0		
Additional single cheetah sightings outside resident cheetah range	Ca. 6-10		
Total	**Ca. 150-170 adult cheetahs**	**↓ Decrease**	**Habitat loss due to changes in land use and human encroachment**

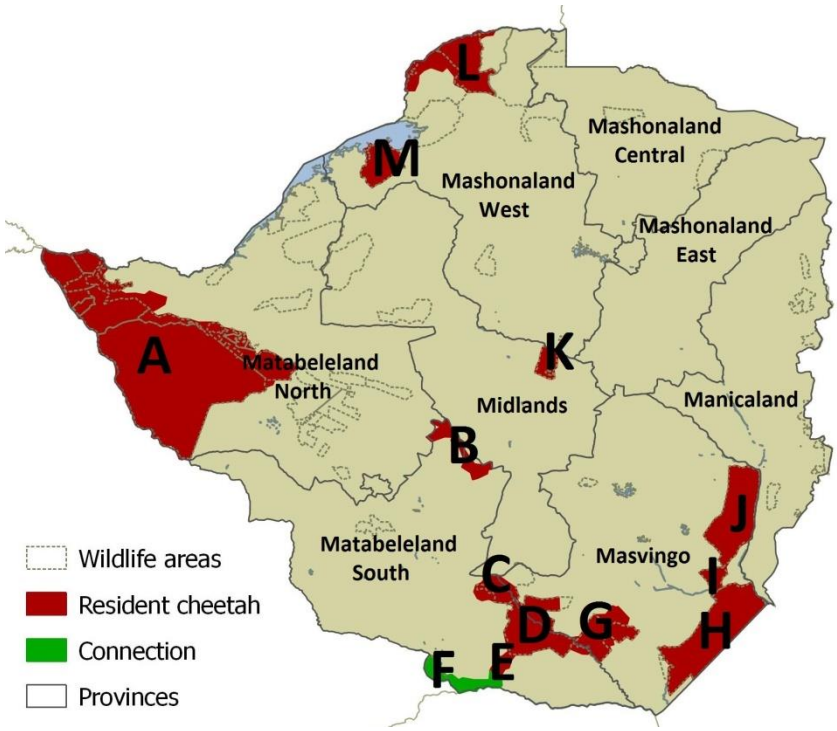


Figure 6. Resident and transient cheetah populations in Zimbabwe

4.3.1. Description of the cheetah populations in Zimbabwe

A. Hwange National Park up to Victoria Falls

Based on sightings of identified cheetah we know this cheetah population is connected and ranges from Hwange National Park up to Victoria Falls, including the Matetsi Safari Area, Matetsi ICA, Panda Masuie Forest, Fuller Forest, Kazuma Forest, Kazuma National Park and the Zambezi National Park. Cheetahs seen in the Victoria Falls region have for example been seen 70 km further at the northern boundary of Hwange National Park. Within Hwange National Park cheetahs are predominantly encountered in the north and east of the park, cheetah movement in the southwest of the park seems to be limited. The cheetahs out of Hwange National Park pass through the buffer zone and forests along the eastern boundary of Hwange National Park (Sikumi Forest, Ngamo Forest, Gwaai ICA) and are very occasionally seen in Ngamo communal land, Gwaai Forest and Inseze Forest. The cheetahs out of the Matetsi and Victoria Falls area pass through Breakfast Communal Land along the eastern boundary of the Matetsi Safari Area and occasionally Deka Safari Area and Deka Communal Land east of Victoria Falls. It is important to note that the cheetahs in the Hwange-Victoria Falls population have large home ranges (Table 4), therefore, the buffer zones around Hwange National Park and Matetsi (Sikumi Forest, Ngamo Forest, Gwaai ICA, Matetsi ICA) do not harbour separate cheetah populations. The cheetahs seen in the buffer zones are part of the core populations in the wildlife protected areas with territories of cheetahs at the periphery of these wildlife protected areas overlapping into the surrounding buffer zones. For an overview of this cheetah population's range and land use type within this range see Fig. 7 and Table 6.

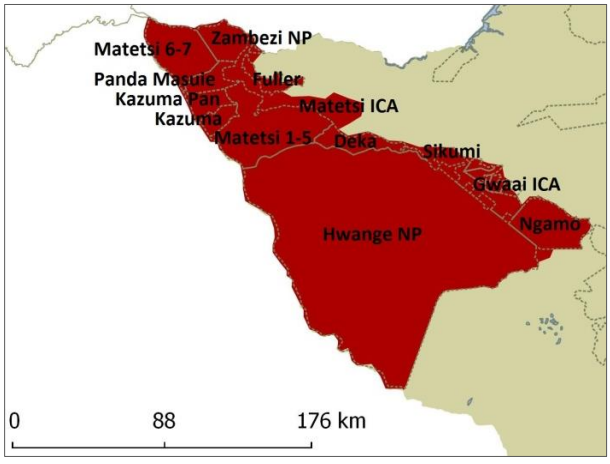


Figure 7. Resident range of cheetah population A.

Table 6. Area description, size and land use type in resident range of cheetah population A.

Area	Size	Land use
Hwange National Park and buffer zone along eastern boundary (Gwaai ICA, Sikumi, Ngamo)	Ca. 17 000 km^2	Photographic tourism/Trophy hunting in the buffer zone
Matetsi unit 1-5 and buffer zone along eastern boundary (Matetsi ICA, Deka)	Ca. 3 120 km^2	Trophy hunting
Victoria Falls Area (Zambezi National Park, Matetsi unit 6-7, Panda Masuie, Kazuma, Kazuma Pan, Fuller)	Ca. 3 220km^2	Photographic tourism/Trophy hunting

B. Debshan Ranch - De Beers Cattle Ranch and neighbouring farms

A very small population of cheetahs is found in and around Debshan Ranch, the De Beers Cattle Ranch and the farms between those two concessions: Magholo Farm, Jabulani Safaris, Pezulu Ranch. Cheetahs are seen in this area approximately once a year. In 2012 a single cheetah was seen once at Robins Farm 23 km West of Debshan Ranch. For an overview of this cheetah population's range and land use type within this range see Fig. 8 and Table 7.

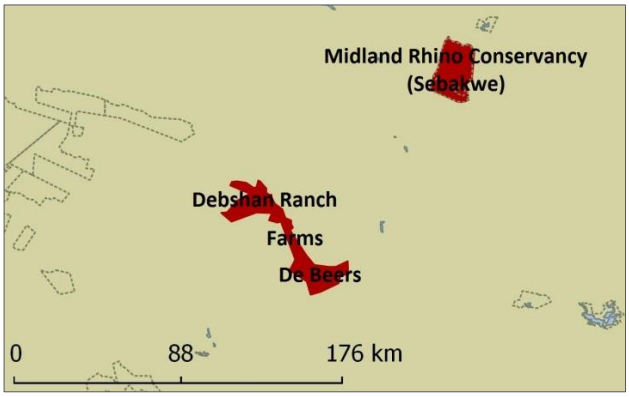


Figure 8. Resident range of cheetah population B and K.

Table 7. Area description, size and land use type in resident range of cheetah populations B.

Area	Size	Land use
Debshan Ranch	Ca. 1 100 km^2	Livestock farming/Trophy hunting
De Beers Cattle		Livestock farming
Neighbouring farms		Livestock farming/Crop farming/Photographic tourism/Trophy hunting

C. Bubiana and farms West of Bubiana

This area harbours a very small cheetah population which ranges from Bubiana Conservancy to the surrounding farms: Jonsyl Ranch, Chipize Ranch, Reata Farm, Pepeluza Farm, Inhlaba, Lucknow, Mashura Ranch, Rooiberg, Ladi farm, Mkashi, Mukado Farm. Cheetahs are seen in this area approximately once every six months. Cheetah sightings are clustered in the western part of the area, no cheetah sightings were recorded along the boundary between Bubiana Conservancy and Bubye Valley Conservancy. For an overview of this cheetah population's range and land use type within this range see Fig. 9 and Table 8.

D. Bubye Valley Conservancy

This double game fenced wildlife conservancy harbours a relatively large cheetah population. Cheetahs are very occasionally seen between the two fences, suggesting some cheetah movement in and out of the conservancy. For an overview of this cheetah population's range and land use type within its range see Fig. 9 and Table 8.

E. Farms and communal land southwest of Bubye Valley Conservancy

A small population of cheetahs is found on the farms and communal land southwest of Bubye Valley Conservancy up to the Botswana border south of Tuli Circle: Den Linian Ranch, Bisshopstone Farm, Maramani Communal Land, River Ranch and Sentinel Ranch. Cheetahs are seen in this area approximately once every 3-4 months. For an overview of this cheetah population's range and land use type within this range see Fig. 9 and Table 8.

F. Tuli Circle

Based on photographs it has been confirmed that a coalition of three cheetah males from the Northern Tuli Game Reserve in Botswana passes through the Tuli Safari Area on a regular basis (sightings approximately once every 4 months). For an overview of this cheetah population's range and land use type within this range see Fig. 9 and Table 8.

G. Nuanetsi Ranch

A relatively large population of cheetahs is found on Nuanetsi Ranch, this ranch consists of a cattle and wildlife section divided by a game fence. The cheetah population on the ranch is predominantly found in the wildlife section and the southwest of the cattle section along the border with the wildlife section. Cheetahs on the ranch occasionally move into Lot 21 and the Threeways Safari Area. After a fence was erected along the southwest border of the Nuanetsi wildlife section (the border with the Threeways Safari Area) in 2014 cheetah movement into the Threeways Safari Area has been minimal to non-existent. No cheetah sightings have been recorded in the communal land between the northwest boundary of Nuanetsi and the eastern boundary of Bubye Valley Conservancy. The Nuanetsi cattle section is one of the few areas in Zimbabwe where conflict with cheetahs occasionally occurs; in 2013 the section lost 3 head of cattle to cheetahs, in 2014 one head of cattle. For an overview of this cheetah population's range and land use type within this range see Fig. 9 and Table 8.

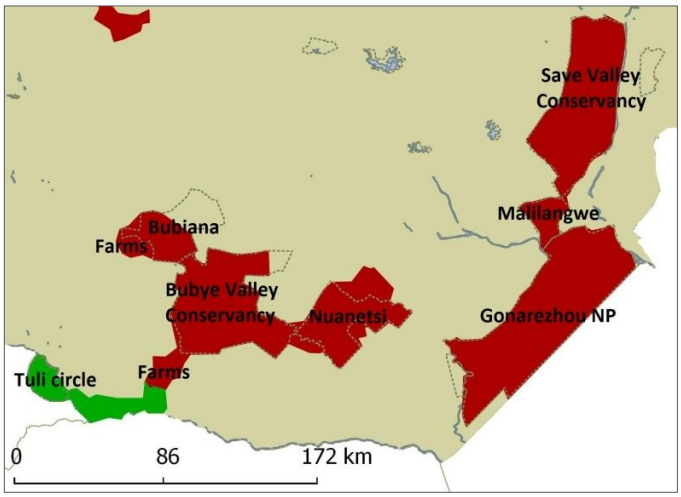


Figure 9. Resident range of cheetah population C-J.

Table 8. Area description, size and land use type in resident range of cheetah population C-G.

Area	Size	Land use
Bubiana Conservancy	Ca. 1 500 km^2	Crop farming/Livestock farming/Trophy hunting/Photographic tourism
Farms west of Bubiana		Crop farming/Livestock farming/Trophy hunting/Photographic tourism
Bubye Valley Conservancy	Ca. 3 740 km^2	Trophy hunting
Farms and communal land southwest of Bubye Valley Conservancy	Ca. 1 000 km^2	Crop farming/Livestock farming/Trophy hunting/Photographic tourism/Subsistence farming
Tuli Circle	Ca. 403 km^2	Trophy hunting
Nuanetsi	Ca. 2 500 km^2	Trophy hunting/Livestock farming

H. Gonarezhou National Park

Gonarezhou National Parks seems to harbour a relatively healthy and stable cheetah population. Cheetahs are predominantly encountered around Chipinda Pools, along the Runde River from Fishans up to Chamuluvati and in the southwest of the park between Gweni, Lion Pan, Red Hills and Chikombedzi with some movement along the Mozambique border (Sango, Guluweni). Cheetahs are occasionally seen in the Navaisha CAMPFIRE concession along the northern boundary with the park. No cheetah sightings have been recorded in the Malipati Safari Area. For an overview of this cheetah population's range and land use type within this range see Fig. 9 and Table 9.

I. Malilangwe

Malilangwe Private Wildlife Reserve harbours a relatively large cheetah population. The southern boundary of Malilangwe is fenced with a predator friendly game fence, facilitating connectivity with Gonarezhou National Park. Based on spoor records, there seems to be some cheetah movement between Malilangwe and Gonarezhou National Park. For an overview of this cheetah population's range and land use type within this range see Fig. 9 and Table 9.

J. Save Valley Conservancy

The majority of the cheetahs in the Save Valley Conservancy population are found in the northern part of the conservancy (north of the Turwi River). Based on the few cheetah sightings in the south of the conservancy and the high human population density (resettlements) between the southern boundary of Save Valley Conservancy and the northern boundary of Malilangwe, connectivity between this population and the Malilangwe/Gonarezhou population is likely to be limited. For an overview of this cheetah population's range and land use type within this range see Fig. 9 and Table 9.

Table 9. Area description, size and land use type in resident range of cheetah population H-J.

Area	Size	Land use
Gonarezhou National Park	Ca. 5 000 km^2	Photographic tourism
Malilangwe	Ca. 480 km^2	Photographic tourism
Save Valley Conservancy	Ca. 2 800 km^2	Trophy hunting/Photographic tourism

K. Midland Rhino Conservancy (Sebakwe)

The Midland Rhino Conservancy harbours a small isolated population of cheetahs. The area is surrounded by communal settlements and mining concessions herewith restricting cheetah movement outside the conservancy and no cheetah sightings have been recorded in the communal land surrounding the conservancy. For an overview of this population's range and land use type within its range see Fig. 8 and Table 10.

Table 10. Area description, size and land use type in resident range of cheetah population K.

Area	Size	Land use
Midland Rhino Conservancy	Ca. 585 km^2	Trophy hunting/Photographic tourism/Crop farming/Livestock farming

L. Mana Pools National Park and shoreline

The Mana Pools cheetahs are predominantly encountered in the north of the park along the shoreline and the Rukometchi riverbed. Cheetahs are also seen between Nyakasikana Gate and Chitaki Springs. Cheetah movement between those two areas has been confirmed based on identified individuals. This cheetah population ranges along the shoreline into Hurungwe (up to Old Buildings) and to a lesser extent the Sapi Safari Area (up to G-Camp). For an overview of this population's range and land use type within its range see Fig. 10 and Table 11.

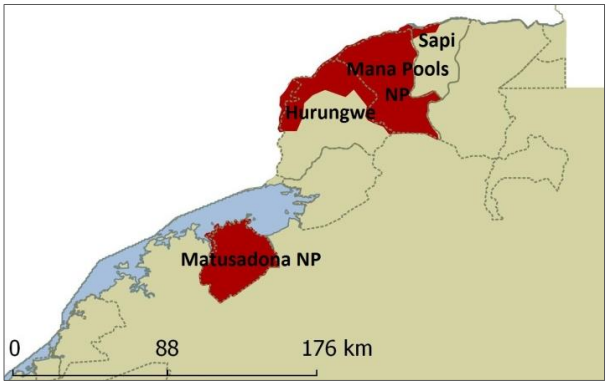


Figure 10. Resident range of cheetah population L-M.

M. Matusadona National Park

The Matusadona cheetah population seems to exist of not more than 3 individuals, a coalition of two adult males and one single adult female that reside on the Valley Floor. No cheetah sightings have been recorded in the areas surrounding Matusadona National Park. For an overview of this cheetah population's range and land use type within this range see Fig. 10 and Table 11. A detailed description about the history of the reintroduced Matusadona cheetah population can be found in Appendix III.

Table 11. Area description, size and land use type in resident range of cheetah population L and M.

Area	Size	Land use
Mana Pools National Park	Ca. 2 200 km^2	Photographic tourism
Hurungwe Safari Area	Ca. 2 900 km^2	Trophy hunting
Sapi Safari Area	Ca. 1 200 km^2	Trophy hunting
Matusadona National Park	Ca. 1 429 km^2	Photographic tourism

4.3.2. Overall cheetah population trend

The earliest cheetah population estimate in Zimbabwe was made in 1975 by Myers who, by direct interviews and consultations through correspondence, concluded there were between 250 and 400 cheetahs in the country (Myers, 1975). After this first survey it took more than a decade for these figures to be updated. Between the late 80s and 90s, various assessments were made resulting in cheetah population estimates ranging from 470 to 7 500 cheetah (Table 12). The last country wide survey in 1999, resulted in a minimum number of 1 520 cheetahs in Zimbabwe (Davison, 1999a). After the 1999 country wide assessment, cheetah estimates have either been based on historical estimates (Purchase et al., 2007) or extrapolations from data collected in a small part of Zimbabwe (Williams, 2011). Historically, the majority of the cheetah population in Zimbabwe was found on commercial farmlands (Table 12). During the 80s and 90s the cheetah population on these commercial farmlands increased with ca. 17% per annum (Davison 1999a). In 1999, a maximum of 20% of the cheetah population could be found in wildlife protected areas and at least 80% of the cheetah population resided on commercial farmlands (Davison 1999a). However, in 2007 it was suggested that the cheetah population in Zimbabwe may have been declining due to commercial farmland being converted to small scale resettlement farms, resulting in increased human activity and loss of prey (Purchase et al., 2007).

Cheetah Conservation Project Zimbabwe's current estimate shows the cheetah population in Zimbabwe has in fact declined dramatically. At present, the population consists of ca. 150-170 adult cheetahs, 80% of which reside in wildlife protected areas, and only 20% on commercial farmland. With wildlife protected areas being defined as areas managed with the aim to conserve nature, designated for sustainable consumptive or non-consumptive utilisation of wildlife, without human settlements and livestock, and protected by regulation of human activity and regular anti-poaching patrols (including conservancies, see 4.2). It is unclear whether the historical cheetah population estimates only include adult and independent adolescent cheetahs or also took the number of cubs into account. However, even if we would consider cubs (ca. 60) in our current population estimate, the cheetah population in Zimbabwe has declined by at least 85%.

When comparing the historical cheetah estimates for protected areas and commercial farmland with our current estimates it is evident the main decline in the cheetah population took place on the commercial farmlands and in the protected wildlife areas in the Zambezi Valley (Table 13, 14). In 1999, the cheetah population in the Zambezi Valley was estimated to consist of ca. 200 cheetahs (Table 13). However, the Hurungwe and Sapi estimate of 150 cheetahs seems to be exceptionally high compared to the estimate of only 5 cheetahs in the neighbouring Mana Pools National Park (Table 13). Especially as in the 1998 cheetah policy and management plan for Zimbabwe, it is stated that 'cheetahs within the parks estates are not doing well' because 'competition from lions and hyenas (which are largely absent from private land, being considerably easier to hunt than cheetah) has ensured that their population has remained small' (Heath and Muchena, 1998).

Although in our study cheetah population estimates by respondents in the questionnaire based interview survey varied greatly (min = 0, max = 5 million, median = 350), 25% of the respondents thought the number of cheetahs in Zimbabwe ranged between 100 and 200 individuals. More than half of the respondents (55%) felt that, in the past decade, the number of cheetahs in Zimbabwe had gone down (Fig. 11) mainly because of resettlements (28%), poaching (24%) habitat loss to people (18%), human persecution of cheetah (10%) and competition with other predators (13%) (Table 15).

Table 12. Overview of cheetah population estimates in Zimbabwe.

Year	Cheetah numbers	Commercial Farms	Protected Areas	Data source
1975[1]	400 (250-500)			Direct interviews and consultations through correspondence with 40 farmers and an unknown number of (governmental) wildlife professionals.
1987[2,3]	470	290 (62%)	180 (38%)	Questionnaires send to farmers and (governmental) wildlife professionals, field trips to interview people on site.
1991[4]	1 391		618 (44%)	Computer model predictions using an average density of 0.01 cheetahs/km^2 predicted 618 cheetahs on National Parks estates, 196 on communal land, 400 on alienated land and 177 on other state land. The model predicted 14 cheetahs in Matusadona National Park at a time when no cheetahs were present.
1992[5]	500-1 000	400-800 (Ca. 80%)	100-200 (Ca. 20%)	Convention on the International Trade of Endangered Species of Wild Fauna and Flora, 8th meeting of the convention of the parties, data source unknown.
1998[6]	6 000 (4 500-7 500)	4 450-7 425 (Ca. 99%)	50-75 (Ca. 1%)	Cheetah policy and management plan for Zimbabwe Parks and Wildlife Management Authority, data source unknown. It is noted that in 1985 cheetah range covered 15% of commercial farming areas but now covers over 50%. It is predicted that cheetah home ranges will cover 85% of the commercial farming areas which have suitable habitat and prey.
1999[7]	1 520	1 200 (79%)	320 (21%)	Questionnaires send to 900 members of the Wildlife Producers Association (210 responses) and 15 National Parks and Safari Areas. The authorities acknowledge these numbers should be considered as rough and not comprehensive as only 20% of the commercial farmlands and no communal areas were covered and therefore cheetah number could actually be higher.
2011[8]	100 (122-476)			Extrapolation from trends based on spoor survey and sighting data collected in and around Save Valley Conservancy.
2015[9]	Ca. 150-170 adult cheetahs	Ca. 25-38 adults cheetahs (Ca. 20%)	Ca. 125-132 adult cheetahs* (Ca. 80%)	Cheetah sightings collected through a nationwide questionnaire based field survey in which 1209 (governmental) wildlife professionals, commercial farmers, community spokespersons and other relevant stakeholders were interviewed on site, records in patrol and human-wildlife conflict reports, additional collection of cheetah sightings and photographs via citizen science.

[1]Myers, 1975 [2]Wilson, 1988 [3]Wilson, 2006b [4]Zank, 1995, [5]CITES, 1992 [6]Heath and Muchena, 1998 [7]Davison, 1999a [8]Williams, 2011 [9]Present study

*73-77 adult cheetahs on National Parks Estates (Ca. 47%), 52-55 adult cheetahs on Private Conservancies (Ca. 33%)

Table 13. Overview cheetah occurrence inside ZPWMA estates.

Area	ZPWMA estate	1973[1]	1975[2]	1986[3]	1987[4]	1989[5]	1997[1]	1999[5]	2015[6]
	Hwange	80	60		92*	80	50	50	25 adults
	Matetsi/Kazuma/Zambezi		60		60-100	20		20	15-17 adults
Middle Zambezi	Chizarira				10-20	5		5	0
	Chirisa							20	0
	Sengwa Research Area					5		2	0
	Matusadona					0		20	3 adults
Lower Zambezi	Mana Pools			15-20	< 20	30		5	12 adults
	Hurungwe and Sapi							150	
	Doma					0		0	0
	Matopos				≤ 5				0
Lowveld	Gonarezhou		40			20		20	15-17 adults
	Tuli								3 adults**

[1]Davison, 1998 [2]Myers, 1975 [3]Dunham, 1986 [4]Wilson 1988 [5]Davison, 1999a [6]Present study

*80 Hwange, 12 Sinamatella

**These cheetahs are part of a shared population with Botswana's Northern Tuli Game Reserve

Table 14. Overview cheetah occurrence outside ZPWMA Estates.

Province	1986[1]	1987[2]	1996[1,3]	2015[4]
Matabeleland North	165		474	0
Matabeleland South		250		31-39 adults
Masvingo	29		169	37-39 adults
Midlands	20	30	64	3-5 adults
Mashonaland West	2		12	0
Mashonaland East	0		9	0
Mashonaland Central	0		0	0
Manicaland	0		0	0

[1]Davison, 1999a [2]Wilson, 1988 [3]Wilson, 2006b [4]Present study

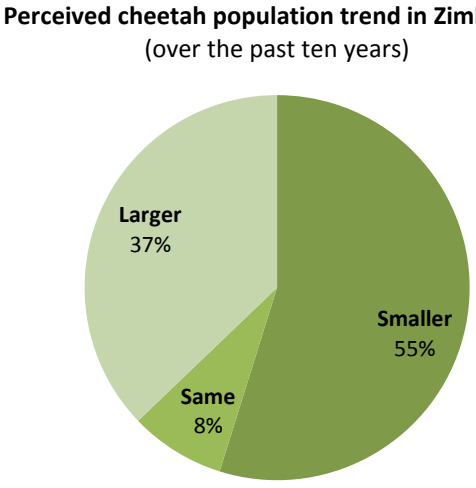


Figure 11. Perceived cheetah population trend in Zimbabwe (n = 985), excluding respondents who did not know whether the number of cheetahs in Zimbabwe had increased, stayed the same or decreased.

Table 15. Reasons given by respondents, why in the past ten years, the Zimbabwe cheetah population has increased, remained the same or decreased.

Reason for perceived population trend	All respondents
Cheetah numbers increased (n = 366)	
They reproduce, give birth to cubs	35.2%
Not (trophy) hunted	17.8%
More awareness and conservation, well protected in some areas	13.1%
No natural enemies, not killed by other animals	7.7%
Not poached	7.1%
More sightings, tracks	6.6%
Not killed by people	6.0%
Specially protected species so not (trophy) hunted or poached	4.6%
No carcasses found	3.3%
Enough prey	2.7%
Other	4.6%
Unknown	1.6%
Cheetah numbers remained the same (n = 79)	
Competition with other predators (lion, spotted hyena, leopard)	13.9%
No (change in) cheetah sightings, tracks or other indication of change in numbers	21.5%
No breeding, slow breeding, low cub survival	12.7%
Not poached, persecuted or trophy hunted	10.1%
Poached, persecuted or trophy hunted	15.2%
Well protected in some areas so numbers go up, in unprotected areas numbers go down	6.3%
Other	21.5%
Unknown	11.4%
Cheetah numbers declined (n = 540)	
Resettlement resulting in habitat loss, loss of prey and human persecution (poaching)	28.1%
Poaching of cheetahs and their prey	23.5%
Human encroachment and land loss to people (increase in human population) resulting in habitat loss, loss of prey and human persecution (poaching)	18.0%
Competition with other predators (lion, spotted hyena, leopard)	12.8%
Persecution of cheetah as a (perceived) problem animal	10.4%
Less or no cheetah sightings or tracks	8.5%
Trophy hunting	6.7%
Less or not enough prey	4.4%
No awareness, not properly conserved, not well protected in some areas	3.9%
Cheetahs don't breed well, slow breeders	3.5%
Killed for traditional use of the skin (traditional use by chief)	3.5%
Not the right natural environment (too mountainous, rocky, too hot)	2.4%
Drought (prey died)	1.7%
Diseases	1.3%
Not trophy hunted which means there are not enough cheetahs	1.3%
Chased and/or killed by domestic dogs	1.1%
Climate change	0.9%
Other	3.1%
Unknown	2.8%

4.4 Cheetah population demography

4.4.1. Sociality, female reproduction and cub survival

Based on the photographs collected via the citizen science component, Cheetah Conservation Project Zimbabwe has been able to identify 104 individual cheetahs: 30 females, 52 males and 22 unknown. Approximately half of the males were part of a male coalition of 2-3 individuals (Table 16). Average litter size when we received the first sightings was ca. 3 cubs, however, not all these cubs make it to independence (Table 17). Other studies show that cub mortality is highest in the lair and just after emergence from the lair, at the age of 16-18 weeks cubs are normally able to outrun larger predators and cub mortality is reduced (Caro, 1994). It has to be kept in mind we generally start receiving sightings of the cubs when they are past this most vulnerable age of ca. 4 months, which is why differences between litter size at first sighting and litter size at independence are relatively small (Table 17). The cheetah cubs disperse when they are ca. 19 months old (Table 17).

Table 16. Number of males in a male coalition in the Zimbabwe cheetah population.

Male coalitions	
Total number of males in coalitions	25
Percentage of males in coalitions	48.1%
Size male coalitions	
Mean ± SE	2.27 ± 0.14
Min	2
Max	3
Median	2
n	11

Male coalition in the Tuli Safari Area

Table 17. Litter sizes and age of the cubs when first sighted by a citizen scientist and at independence for the Zimbabwe cheetah population.

	Size litters when first sighted (nr)	**Age litters when first sighted (months)**	**Size litters when dispersed (nr)**	**Age when dispersed (months)**
Mean ± SE	2.83 ± 0.26	5.54 ± 0.99	2.56 ± 0.34	19.17 ± 0.95
Min	1	2	1	17
Max	5	12	4	23
Median	3	5	3	18
n	18	13	9	6

We annually receive the largest number of cheetah sightings and photographs from Hwange National Park and its buffer zone. This area therefore provides us with relatively reliable and detailed information about the demography of the cheetah population. At present, there are 25 adult and independent adolescent cheetahs active in the area, meaning they have been seen within the past 3 years. However, if we include historical photographs dating back as far as 2005, we have been able to identify 45 individual cheetahs. Of the 45 identified cheetahs, 14 were female, 26 were male, and 5 were unknown. Based on this information, the female to male ratio in the Hwange system is 1:2. A relatively large percentage of the males were part of a male coalition (Table 18). At any given time approximately 50% of the females are accompanied by cubs. Sample size of females we have been able to follow from cub to adulthood is only two, based on these cases females start reproducing when they are ca. 34-38 months old. The mean size of the litters when we receive the first sightings is ca. 2-3 cubs, because we generally start receiving the first sightings when the cubs are past their most vulnerable age, this is similar to litter size at independence (Table 19). Cheetah cubs disperse when they are ca. 19 months old (Table 19).

Cheetah with cubs in Hwange National Park

Table 18. Number of males in a male coalition in the Hwange cheetah population.

Male coalitions	
Total number of males in coalitions	11
Percentage of males in coalitions	42.3%
Size male coalitions	
Mean ± SE	2.20 ± 0.20
Min	2
Max	3
Median	2
n	5

Table 19. Litter sizes and age of the cubs when first sighted by a citizen scientist and at independence for the Hwange cheetah population.

	Size litters when first sighted (nr)	**Age litters when first sighted (months)**	**Size litters when dispersed (nr)**	**Age when dispersed (months)**
Mean ± SE	2.67 ± 0.29	6.57 ± 1.13	2.60 ± 0.40	19.40 ± 1.12
Min	1	3	1	17
Max	4	12	3	23
Median	3	7	3	18
n	9	7	5	5

4.4.2 Mortality causes, trophy hunting and (illegal) trade

The mortality data collected via citizen science and the questionnaire based interview survey are limited and causes of mortality remain largely unknown. However, from the available recent (< 5 years) records it seems that anthropogenic mortality and competition with other predators are the main cause of death for the cheetahs in Zimbabwe. We collected four reports of snared cheetahs (2 cheetahs killed, two snares removed), one cheetah stoned to death by the community, one road kill and three cheetahs killed on communal lands with the use of domestic dogs *(Canis familiaris)*. The natural mortalities consisted of 3 cheetahs killed by leopard and three cheetahs killed by lion.

In Zimbabwe, another mortality cause for cheetahs is trophy hunting. Since 1992, Zimbabwe yearly receives 50 CITES tags for the export of live cheetahs or hunting trophies (CITES, 1992). The 50 hunting quotas are allocated by the Zimbabwe Parks and Wildlife Management Authority based on estimates of cheetah abundance made by landowners and the authorities themselves (WWF, 1997; ZPWMA, 2012). In addition to the 50 cheetahs that can be trophy hunted or captured, the ZPWMA can issue permits for problem animal control (PAC) to landowners experiencing conflict with cheetahs (Masulani, 1999). No recent data are available on the annual cheetah off take in Zimbabwe. According to Masulani (1999) the requests for the allocation of cheetah hunting quotas from private land owners is usually higher than the maximum number of 50. However, cheetahs are not an easy species to hunt (Masulani, 1999) and since 1992 the number of cheetahs that are exported annually has not exceeded 50% of the CITES quota (Williams, 2007). Although the CITES trade statistics derived from the CITES Trade Database can be difficult to interpret (CITES, 2013), it seems that in the past five years the number of exported cheetahs has been less than 10 individuals a year (CITES.org). The majority of these exports are hunting trophies, the export of live cheetahs has been minimal (CITES.org). Concession areas pay the Zimbabwe Parks and Wildlife Management Authority a trophy fee of 2 500 USD to hunt cheetahs, plus various fees for licenses to hunt and export the trophy (ZPWMA, 2014). In addition to daily fees and costs related to processing the trophy, clients are charged a trophy fee of ranging between ca. 3 000-6 000 USD to hunt cheetahs (personal communication with landowners).

Globally, the illegal trade in live cheetahs and cheetah skins imposes an additional mortality threat for cheetah (Nowell, 2014). Although respondents did mention the trade in cheetah skins for use by traditional leaders as a threat to cheetah survival (Table 15), within the nationwide survey we did not come across any signs indicating this illegal trade exists. This certainly does not mean it does not exist, but it does indicate that the scale at which illegal trade takes place in Zimbabwe is likely to be limited.

Chapter 5 - co-existence of cheetah and people

5.1. Background to the data on co-existence of cheetah and people

Historically, the majority of the cheetah population in Zimbabwe resided on commercial farmlands, resulting in a high level of human-cheetah conflict over livestock depredation, a negative attitude towards the species and the illegal killing of many cheetahs (Myers, 1975; Wilson, 1988; Davison, 1999b). To assess the current level of human-cheetah conflict, we asked communal and commercial farmers participating in the questionnaire based interview survey to point out problem animals from the set of carnivore photographs, to describe the problems caused by these carnivores and the methods used to mitigate conflict with carnivores. We interviewed 23 commercial farmers and 90 subsistence farmers. The commercial farmers had on average been farming in the area for 28.80 ± 4.38 years (mean ± SE), the subsistence farmers for 40.68 ± 2.32 years (mean ± SE). All of the subsistence farmers were village heads with ca. 46.49 ± 6.22 (mean ± SE) households under his or her guardianship. Households report problems with carnivores and livestock losses to their village head.

In addition, we recorded all cases of human-cheetah conflict in conflict reports at the Zimbabwe Parks and Wildlife Management's Problem Animal Control (PAC) stations and the other (field) offices we visited during the survey. We also followed up on cheetah livestock depredation cases that were directly reported to Cheetah Conservation Project Zimbabwe. To cast light on the attitude the various stakeholders have towards cheetahs we asked respondents how they felt about living with predators in general and cheetahs and other carnivores in specific, and whether or not they thought it was important to conserve wildlife in their area (see Appendix I). Additionally, we asked respondents to explain why they felt positive, neutral or negative about carnivores and conservation. The explanations did not always match feelings, and especially respondents who felt positive about a carnivore species could still give a negative explanation (e.g. I like cheetahs even though they are dangerous). The percentages of respondents who gave a certain explanation are therefore based on the total number of respondents and not on the number of respondents within the positive, neutral or negative categories.

5.2. Conflict with cheetah and other carnivores

In the questionnaire based interview survey, 17 of the 113 farmers (23 commercial farmers, 90 subsistence farmers) selected the cheetah photograph when asked to point out which of the thirteen species in the carnivore photographs were causing them problems. However, only five of these farmers correctly identified cheetah, the other 12 farmers thought the cheetah in the photograph was a leopard. We could therefore only confirm five cases of livestock depredation by cheetahs. However, the fact that farmers could not correctly name the species in the photograph does not necessarily have to mean they are not talking about cheetahs when answering the livestock depredation questions based on the cheetah photograph. If, instead of using correct identification as a selection criterion, we based our assessment on whether or not cheetahs occurred in the area and the time of day and frequency at which livestock depredation took place, we could still only confirm the same five cases as livestock depredation by cheetahs. Apart from the cases recorded during the interviews, we came across four cases of recent (< 5 years) livestock depredation by cheetahs in conflict reports at (field) offices. In addition, since the start of Cheetah Conservation Project Zimbabwe in 2012, we followed up on and confirmed two reports of cheetahs killing smallstock. This gives us a total of eleven cases of livestock depredation by cheetahs within the last five years. The majority of these cases were reported by subsistence farmers in communal land, only one of the reports came from a commercial farm where they annually lose 1-3 calves and weaners to cheetahs.

Within the questionnaire based interview survey, only 4.4% of the farmers (who correctly identified the species) reported livestock depredation by cheetah. Some farmers experienced no problems with carnivores, 21.7% of the commercial and 1.1% of the subsistence farmers indicated none of the carnivores in the photographs ever caused them problems. The commercial and subsistence farmers who did experience conflict pointed out leopard, spotted hyena and black backed jackal as the main problem animals (Table 20). In addition, subsistence farmers frequently selected lion and to a lesser extent brown

hyena as problem animals (Table 20). The identification of the carnivore species came with its challenges, not only did the farmers mix up cheetah and leopard, the different jackal and hyena species have the same name in the local languages making it difficult to assess whether farmers actually distinguish between the species. None of the commercial and subsistence farmers who selected aardwolf, bat-eared fox, serval and caracal correctly identified these small nocturnal species. All of these four species were mistaken for jackal, hyena and lion and accused of killing calves, goats and sheep, which, based on their body size and diets, is extremely unlikely. More than half of the subsistence farmers who selected and correctly identified African wild cat (53.9%) mentioned this small carnivore occurs close to the homestead which likely means they have seen a domestic cat rather than an African wild cat.

Table 20. Number of times farmers selected a carnivore species from the photographs as a problem animal, location where conflict took place and type of problems caused (excluding farmers who did not experience problems), subsistence farmers (n = 89), commercial farmers (n = 18)

Species	Farming type	Nr times selected as problem animal	Selected and correctly identified	Location of confirmed (= selected and correctly identified) conflict			Reported problems
				Boma Coop	Field	Both	
Aardwolf	Commercial	5.6%	0				
	Subsistence	10.1%	0				
African wild cat	Commercial	0	0				
	Subsistence	16.9%	14.6%	69.2%	7.7%	23.1%	Kills chickens
African wild dog	Commercial	11.1%	11.1%		100%		Kills goats/sheep/calves
	Subsistence	20.2%	4.5%		100%		Kills goats/sheep/calves
Bat-eared fox	Commercial	0	0				
	Subsistence	5.6%	0				
Black backed jackal	Commercial	27.7%	22.2%		100%		Kills goats/sheep
	Subsistence	51.7%	38.2%		94.1%	5.9%	Kills goats/sheep
Brown hyena	Commercial	11.1%	11.1%	50.0%	50.0%		Kills calves
	Subsistence	31.5%	23.6%	23.8%	23.8%	52.4%	Kills goats/sheep/cattle
Caracal	Commercial	0	0				
	Subsistence	1.1%	0				
Cheetah	Commercial	11.1%	5.6%		100%		Kills all livestock
	Subsistence	16.9%	4.5%	50.0%	50.0%		Kills calves/weaners
Leopard	Commercial	55.6%	38.9%	42.9%	42.9%	14.3%	Kills all livestock
	Subsistence	58.4%	47.2%	11.9%	76.2%	11.9%	Kills calves/weaners
Lion	Commercial	5.6%	5.6%			100%	Kills all livestock
	Subsistence	70.8%	61.8%	10.9%	60.0%	29.1%	Kills adult cows
Serval	Commercial	5.6%	0				
	Subsistence	1.1%	0				
Side striped jackal	Commercial	5.6%	0				
	Subsistence	9.0%	4.5%	25.0%	75.0%		Kills goats
Spotted hyena	Commercial	38.9%	38.9%			100%	Kills all livestock
	Subsistence	75.3%	61.8%	32.7%	45.5%	21.8%	Kills and damages cattle

Although commercial farmers experienced livestock losses by leopard, spotted hyena and lion both in the field and in the boma, subsistence farmers predominantly lost livestock to these carnivores in the field (Table 20). Both commercial and subsistence farmers mostly experienced problems with black backed jackal in the field (Table 20). Subsistence farmers report conflict with carnivores to the Zimbabwe Parks and Wildlife Management Authorities (41.1%), local safari operators involved in trophy hunting (23.3%), CAMPFIRE (15.6%), the (Rural) District Council (14.4%) or other authorities like Forestry Commission, the Veterinary Department or the Zimbabwe Republic Police (6.7%). However, 18.9% of the subsistence farmers do not report problem animals and many (33.3%) indicated that if they do no or insufficient action is taken. Most commercial farmers did not report problem animals to the authorities (52.2%). If they did, they contacted the Zimbabwe Parks and Wildlife Management Authority (26.1%) and in some cases CAMPFIRE (4.3%), the (Rural) District Council (4.3%) or the Veterinary Department (4.3%). None of the commercial or subsistence farmers were part of an official compensation scheme for livestock losses.

Cattle in a boma in the communal lands

One subsistence farmer indicated the community sometimes pays other community members for livestock losses due to depredation by carnivores. In some cases commercial farmers received compensation by trophy hunting problem animals via the hunting quota allocated to their farm (17.4%).

Both commercial and subsistence farmers took various measures to protect their livestock against carnivores (Table 21), the most common ones being herding during the day and locking the livestock up in a strong boma at night. Farmers also tried to scare predators away, most commonly by lighting a fire around the boma (Table 21), but sometimes also by making noise or by building human shaped structures at the boma. A relatively large percentage of the farmers mentioned there is nothing they can do to reduce livestock losses to carnivores (Table 21). Most of the commercial farmers thought that over time the number of livestock lost to predators had gone down (Fig. 12), due to improved livestock husbandry and an overall reduction of wildlife because of poaching (Table 22). In contrast, the majority of the subsistence farmers thought livestock losses had gone up (Fig. 13), because game fences in the area had been destroyed, the authorities no longer controlled (problem) animals and the number of wildlife in the area had increased in general and because predators reproduce (Table 23).

Table 21. Methods used by commercial and subsistence farmers to reduce livestock losses to carnivores

Method used	Commercial farmers (n = 23)	Subsistence farmers (n = 90)
Herding during the day	30.4%	20.0%
Locking livestock up in a (strong) boma at night	30.4%	70.0%
Scare predators away with fire, noise or human shaped structures at the boma	13.0%	16.7%
Strengthening the boma with acacia	0	6.7%
Lock calves, goat kits and lambs up or keep them at the homestead	17.4%	3.3%
Keep domestic (guard) dogs	8.7%	1.1%
Synchronize breeding to reduce time frame of possible depredation of young animals	4.3%	0
Avoid areas with predators	0	2.2%
Make sure there is enough natural prey available	4.3%	0
Problem animal control	17.4%	2.2%
There is nothing we can do	13.0%	18.9%

Commercial farmers keep between 100-8 500 head of livestock, the majority of this livestock consists of cattle (Table 24). Subsistence farmers keep between 1-200 head of livestock, predominantly consisting of cattle and goats (Table 24). When asked how many head of livestock a farmer was willing to lose before wanting to eradicate a problem cheetah, 21.7% of the commercial farmers and 88.6% of the subsistence farmers indicated they would want to get rid of the cheetah either when they saw it or after it had made its first kill (Fig. 14). None of the subsistence farmers were willing to lose more than 5 head of livestock to cheetahs, whereas 39.1% of the commercial farmers were willing to lose more than 5 head of livestock (generally between 10-15 animals) (Fig. 14). Commercial farmers were willing to accept an average loss of 9.77 ± 4.40 (mean ± SE) head of livestock to cheetahs, whereas subsistence farmers were willing to accept a loss of 0.63 ± 0.12 (mean ± SE) head of livestock (Table 24). Overall, we found a positive correlation between the number of livestock a farmer keeps and the number of livestock this farmer is willing to lose; the more livestock the more tolerant to livestock losses (Pearson correlation: $P < 0.01$, $r = 0.85$). When a commercial livestock farmer with an exceptionally high number of livestock (> 8 500) was removed from the analyses, although less strong, this correlation remained significant ($P < 0.01$, $r = 0.27$).

Interview with a subsistence farmer

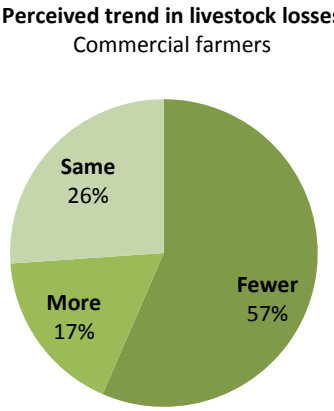


Figure 12. Perceived trends in livestock losses by commercial farmers (n = 23)

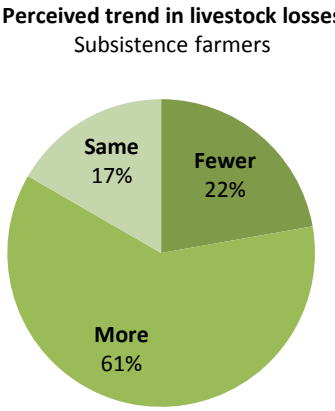


Figure 13. Perceived trends in livestock losses by subsistence farmers (n = 90)

Table 22. Reasons given by commercial farmers for perceived trends in livestock losses.

Reason for perceived trend in livestock losses	Commercial farmers
More livestock losses (n = 4)	
Influx of predators on the property due to resettlement of surrounding farms	75.0%
Not enough wild prey available	25.0%
Same number of livestock losses (n = 6)	
Improved livestock husbandry (herding, kraal at night)	33.3%
Less wildlife due to poaching	33.3%
Other	50.0%
Fewer livestock losses (n = 13)	
Improved livestock husbandry (herding, kraal at night)	53.8%
Less wildlife due to poaching	30.8%
Problem animal control	7.7%
Game fence	7.7%

Table 23. Reasons given by subsistence farmers for perceived trends in livestock losses.

Reason for perceived livestock losses	Subsistence farmers
More livestock losses (n = 55)	
No (more) game fence	16.4%
No more (problem) animal control by the authorities	20.0%
Predator numbers have increased, predators reproduce	25.5%
Predators were reintroduced by CAMPFIRE	5.5%
Predators are no longer trophy hunted	5.5%
Predators are no longer afraid of people	5.5%
More records of livestock losses	10.9%
Other	10.9%
Reason unknown	7.3%
Same number of livestock losses (n = 15)	
We don't see a change in livestock losses	53.3%
Other	26.7%
Reason unknown	26.7%
Fewer livestock losses (n = 20)	
Improved livestock husbandry (herding, in boma at night)	35.0%
Game fence	25.0%
More people so wildlife is scared to come into the community	20.0%
Problem animal control	5.0%
Other	20.0%

Table 24. Number of livestock, proportion of various species of livestock kept and number of livestock commercial and subsistence farmers were willing to lose to cheetahs before eradicating a problem cheetah.

Variable	Farming type	Mean	SE	Min	Max	Median
Number of livestock	Commercial	1 177.59	400.27	101	8 525	590
	Subsistence	31.54	4.07	1	206	20
Proportion of cattle	Commercial	0.92	0.02	0.60	1.00	1.00
	Subsistence	0.46	0.03	0.00	1.00	0.40
Proportion of donkeys	Commercial	0.01	0.01	0.00	0.10	0.00
	Subsistence	0.07	0.02	0.00	1.00	0.00
Proportion of goats	Commercial	0.05	0.02	0.00	0.40	0.00
	Subsistence	0.41	0.03	0.00	1.00	0.40
Proportion of sheep	Commercial	0.02	0.01	0.00	0.10	0.00
	Subsistence	0.05	0.01	0.00	0.50	0.00
Proportion of pigs	Commercial	0.01	0.01	0.00	0.10	0.00
	Subsistence	0.02	0.01	0.00	0.60	0.00
Acceptable livestock losses to cheetah	Commercial	9.77	4.40	0	100	5
	Subsistence	0.63	0.12	0	5	0

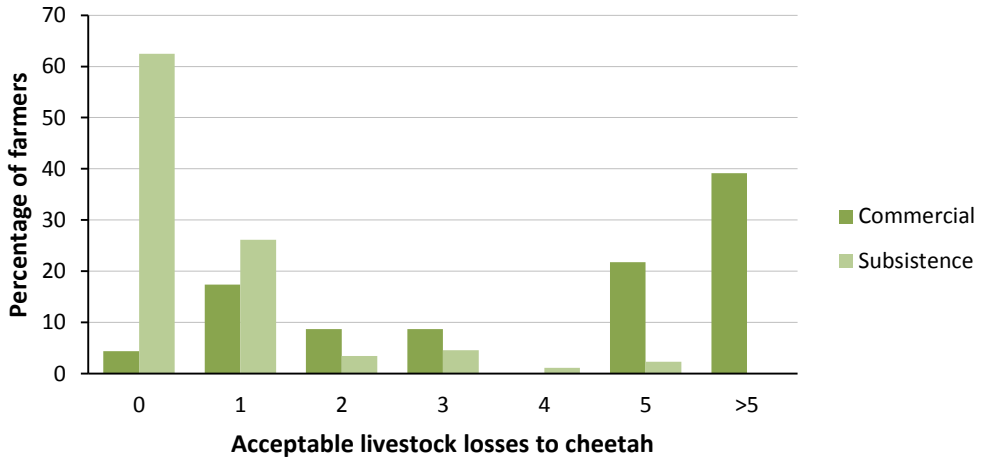


Figure 14. Acceptable livestock losses to cheetah before commercial or subsistence farmers want to eradicate a problem cheetah.

5.3. Attitude towards cheetah and other carnivores

5.3.1. Living with carnivores

The majority of the respondents working in the photographic tourism industry or at general positions for the ZPWMA felt positive about living with carnivores (≥ 74.2%) (Fig. 15). More than half of the respondents working in the trophy hunting industry or at management positions for the ZPWMA appreciated living with carnivores (≥ 65.5% ≤ 67.5%) (Fig. 15). Subsistence farmers, general and management staff at commercial livestock farms, RDC natural resource officers, general and management staff at CAMPFIRE offices and general Forestry Commission staff were less positive about living with carnivores (≥ 36.4% ≤ 57.8%) (Fig. 15). Natural resource officers at RDCs (17.8%), and especially subsistence farmers (2.2%) were least positive about living with carnivores (Fig. 15).

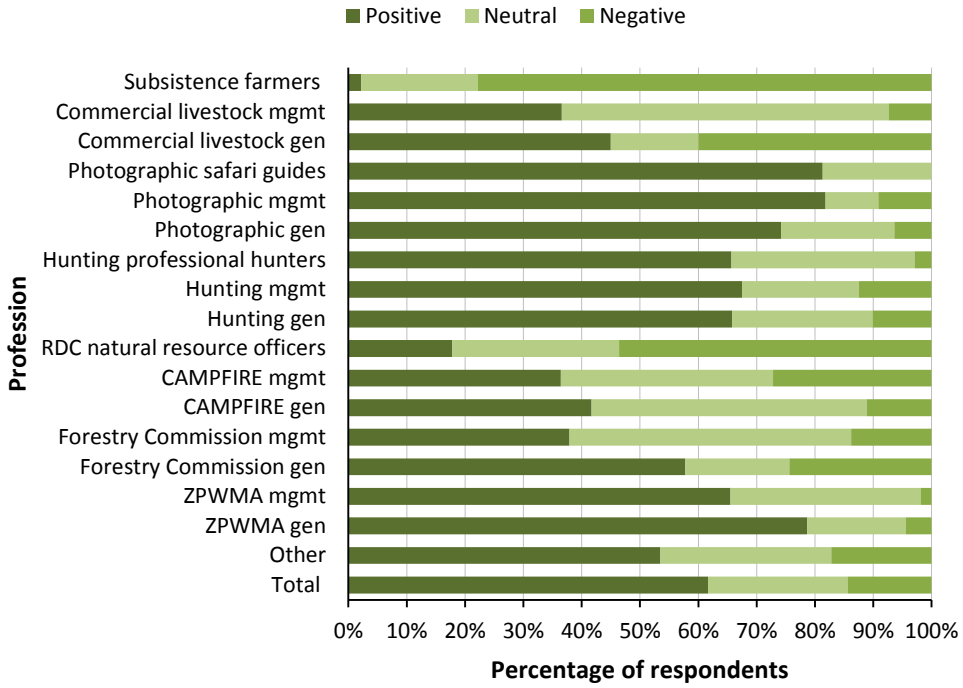


Figure 15. Percentage of respondents per profession who felt positive, neutral or negative about living with carnivores.

The majority of the respondents who felt positive about living with carnivores felt carnivores have a role in the ecosystem and provide revenue and benefits through photographic tourism and trophy hunting. Respondents in the photographic tourism industry emphasized the value of carnivores for photographic tourism, while respondents in the trophy hunting industry emphasized the value of carnivores for trophy hunting. Management staff at commercial livestock farms also mentioned the benefits carnivores give via trophy hunting. Only respondents working as general staff on commercial livestock farms mentioned the aesthetic value of carnivores and the fact that they add diversity as one of the main reasons to like carnivores. However, many respondents did mention they like living with carnivores because they would like to see them so they, their families and others can enjoy and learn about carnivores.

CAMPFIRE management staff and general staff at Forestry Commission and in the photographic tourism industry, felt positive about living with carnivores because they see them as a natural heritage which should be conserved for the future generation. Others felt positive about living with carnivores because it is part of their job (ZPWMA general and management staff, Forestry Commission management staff, general staff in the trophy hunting industry) or because they believed carnivores also have the right to live (CAMPFIRE management staff). Professional hunters and management staff in the photographic tourism and trophy hunting industry also liked living with carnivores because they love all wildlife, while general staff in those industries often felt positive because they learned how to live with carnivores.

Not everyone loved all wildlife, subsistence farmers and the management staff at commercial livestock farms relatively often mentioned they like the carnivores that do not cause problems but not the ones that kill livestock. With the exception of ZPWMA staff, respondents in the trophy hunting industry, general staff in the photographic tourism industry and safari guides, respondents felt negative about living with carnivores because they thought carnivores kill livestock. Especially subsistence farmers were afraid for livestock losses, more so than for the danger carnivores might present to humans. However, subsistence farmers, forestry commission management staff, natural resource officers at RDCs and general staff at commercial livestock farms did mention the danger for people as one of the main reasons to dislike carnivores. Professional hunters and respondents working at management positions in the photographic tourism industry that felt negative about living with carnivores often mentioned they thought there were too many[3] carnivores and it was important to keep a balance, while management staff in the trophy hunting industry felt carnivores kill too much prey[3].

For a detailed overview of the reasons given by respondents in different professions see Appendix IV.

5.3.2. Attitude towards large carnivores

African wild dog

The majority of the ZPWMA staff, management staff in the photographic tourism industry and safari guides felt positive about African wild dogs (≥ 73.5%) (Fig. 16). More than half of the respondents working in the trophy hunting industry, at general positions for CAMPFIRE, general positions in the photographic tourism industry or at management positions at commercial livestock farms liked African wild dogs (≥ 54.1%, ≤ 66.7%) (Fig. 16). Whereas, less than half of the Forestry Commission staff and the management staff at CAMPFIRE felt positive about African wild dogs (≥ 40.8%, ≤ 47.9%) (Fig. 16). Not many natural Resource officers at RDCs (21.4%), general staff at commercial livestock farms (30.0%) and subsistence farmers (19.3%) felt positive about African wild dogs (Fig. 16).

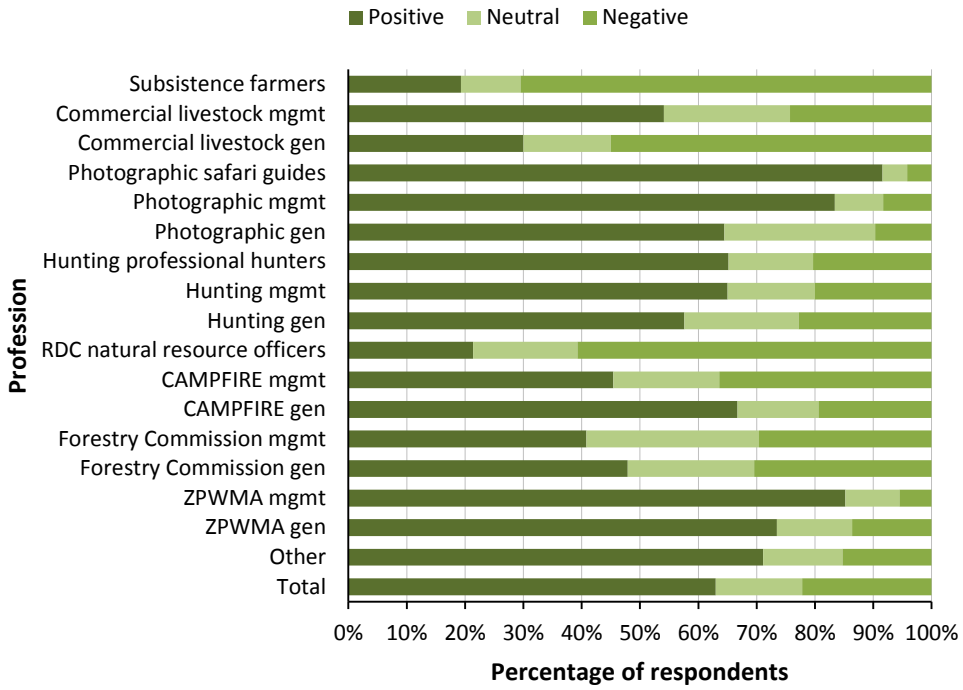


Figure 16. Percentage of respondents per profession who felt positive, neutral or negative about African wild dogs.

[3]It should be noted that reasons like 'too many carnivores' or 'kill too much prey' are personal perceptions which are generally not based on scientific assessments of the ecological carrying capacity of an area of operation.

Most respondents felt positive about the species because they perceive African wild dogs as a beautiful, nice and interesting species that adds diversity and is special to see. Respondents working at general and management positions at the ZPWMA, management positions in the photographic tourism and trophy hunting industry and safari guides also liked African wild dogs because they are rare, specially protected and should not go extinct . Many safari guides, professional hunters and respondents at management positions at the ZPWMA and management positions in the photographic tourism and trophy hunting industry felt positive about African wild dogs because of the role they play in the ecosystem.

Species specific traits like the African wild dog's social system and its high hunting success were most often mentioned as positive traits by respondents working in the photographic tourism industry and by respondents at management positions in the trophy hunting industry. ZPWMA staff but also the safari guides and general staff in the trophy hunting and photographic tourism industry felt African wild dogs are of value to the photographic tourism industry.

A general reason to like African wild dogs is because respondents liked all wildlife including African wild dogs (management staff in the photographic tourism industry). Management staff at CAMPFIRE offices, general and management staff in the photographic tourism industry and general staff at commercial livestock farms often felt positive about African wild dogs because they are not dangerous to people. General staff at CAMPFIRE also liked the species because it does not kill livestock.

African wild dog pack in Hwange National Park

However, many respondents working as general staff at commercial livestock farms, management staff at Forestry Commission and RDC natural resource officers did also perceive the species as dangerous to people and mentioned this as a reason to dislike African wild dogs. In addition, respondents often felt negative about the species because they thought African wild dogs kill livestock. Especially subsistence farmers were worried about African wild dogs killing livestock. ZPWMA management staff mentioned the species should be conserved in a fenced area, not in the community where it causes problems.

Natural resource officers at the RDCs were concerned African wild dogs carry and spread diseases like rabies[4]. Many respondents felt African wild dogs kill too much prey and especially professional hunters mentioned this as a reason to dislike the species. Management staff at Forestry Commission, CAMPFIRE offices and at commercial livestock farms also did not appreciate the way African wild dogs hunt and kill their prey.

For a detailed overview of the reasons given by respondents in different professions see Appendix V.

[4]Long term scientific studies have shown that domestic dog populations are in fact more likely to serve as rabies reservoirs than wild carnivore populations. Rabies persists in high density domestic dog populations but only sporadically occurs in wild carnivore populations (Lembo et al., 2008).

Cheetah

With the exception of subsistence farmers, the majority of respondents across all professions felt positive about cheetahs (≥ 74.0%) (Fig 17). Most respondents felt positive about the cheetah because they perceive it as a beautiful, nice and interesting species which adds diversity and is special to see. Respondents also appreciated the fact that cheetahs are not dangerous to people.

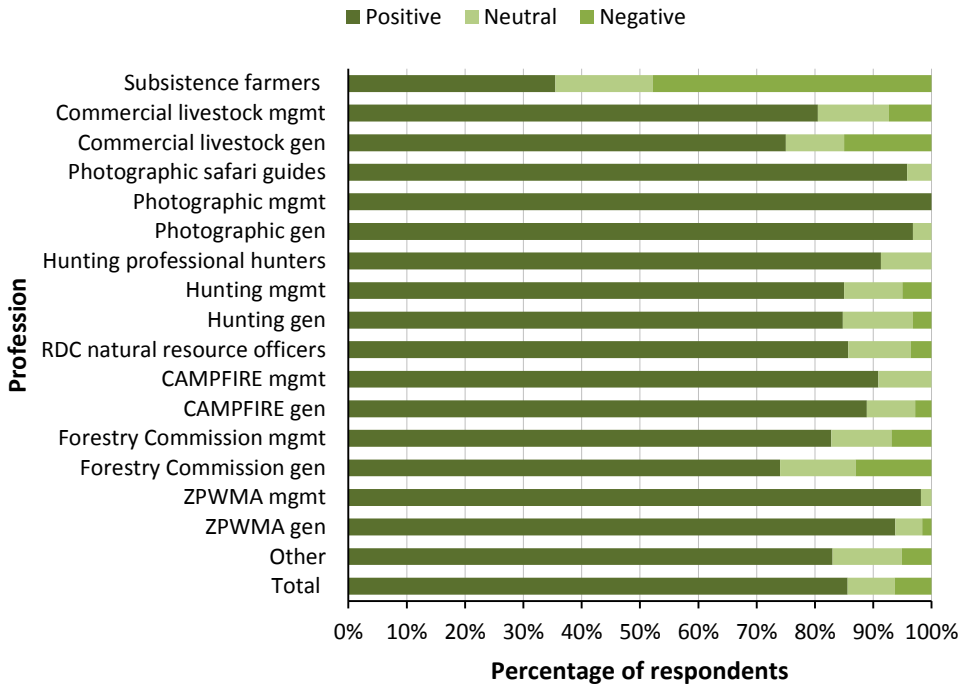


Figure 17. Percentage of respondents per profession who felt positive, neutral or negative about cheetahs.

General and management staff working for the ZPWMA, Forestry Commission and CAMPFIRE and general staff in the trophy hunting industry often felt positive about cheetahs because they provide revenue through photographic tourism. Although the management staff of CAMPFIRE mentioned the value of cheetahs for trophy hunting as a positive trait, this reason was not often mentioned by respondents working in the trophy hunting industry as a reason to like the species. Neither did respondents working in the photographic tourism industry often mention the cheetah's value for photographic tourism as a reason to feel positive about cheetahs.


© Gini Allen

Cheetah female in Hwange National Park

Apart from its aesthetic value, respondents working in the photographic tourism and trophy hunting industry felt positive about cheetahs because they have an ecological role to play and do not kill too much prey. Although natural resource officers at the RDCs were sometimes worried cheetahs might be dangerous to people, they did appreciate the way the cheetah hunts with speed. Management staff in the trophy hunting industry and safari guides also admired the cheetah's hunting technique. Both the general and management staff at commercial livestock farms felt positive about cheetahs because the species does not kill livestock, however, killing livestock was also mentioned by these respondents as a reason to dislike cheetahs.

The subsistence farmers that did not like cheetahs (47.8%), disliked the species because they thought it kills livestock and, to a lesser extent, because they perceive cheetahs as dangerous to people.

Subsistence farmers therefore relatively often mentioned that cheetahs should be conserved in a fenced area, not in the community where they cause problems with people and livestock. The 35.5% of the subsistence farmers that did feel positive about cheetahs predominantly liked the species because it is harmless and does not cause problems. This was also a reason for ZPWMA general staff, general and management CAMFIRE staff and management staff in the trophy hunting industry to like the species.

ZPWMA management staff often mentioned the cheetah's shy, elusive and peaceful nature as a reason to like the species. In addition, Respondents working at general and management positions at the ZPWMA, general positions at CAMPFIRE offices and safari guides felt positive about cheetahs because they are a rare species that is specially protected and should not go extinct.

Other, more general, reasons to like cheetahs were because respondents felt cheetahs have the right to live (safari guides, general staff at commercial livestock farms), respondents liked all wildlife including cheetahs (management staff in the trophy hunting industry, management and general staff in the photographic tourism industry) or because respondents wanted to see cheetahs (Forestry Commission management staff, general staff at commercial livestock farms).

For a detailed overview of the reasons given by respondents in different professions see Appendix V.

Leopard

Within most professions the majority of the respondents felt positive about leopards (≥ 71.0%) (Fig. 18). General and management staff at Forestry Commission, management staff at CAMPFIRE, natural resource officers at RDCs and general staff at commercial livestock farms were less unanimous about the likeability of leopards (≥ 50.0%, ≤ 63.6%) (Fig. 18). Few subsistence farmers felt positive about this carnivore species (24.4%) (Fig. 18).

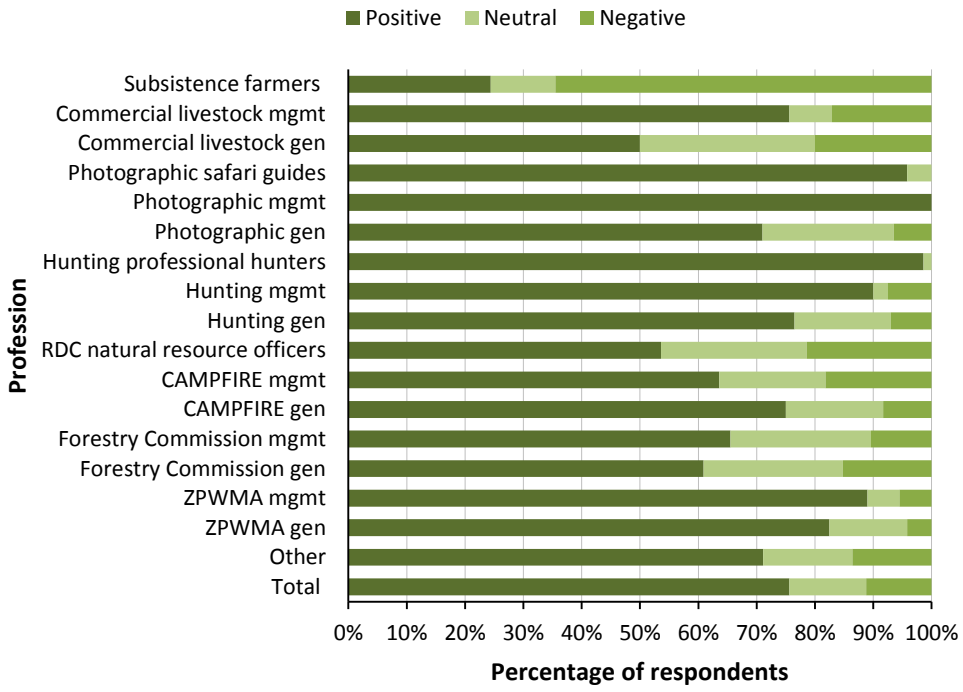


Figure 18. Percentage of respondents per profession who felt positive, neutral or negative about leopards.

Young leopard in Hwange National Park

Except for subsistence farmers, across all professions a main reason to like leopards is because they are regarded as a beautiful, nice and interesting species that adds diversity and is special to see. In addition, many respondents mentioned the leopard's value for photographic tourism and trophy hunting as a reason to like the species.

The fact that leopards are not dangerous to people unless provoked was often regarded as a positive trait. In addition, the management staff at Forestry Commission liked the species because they felt it is harmless, does not cause problems and does not kill livestock. The leopard's shy, elusive and calm nature was admired by safari guides and the management staff at Forestry Commission, while the natural resource officers at the RDCs liked the leopard's hunting technique.

Most respondents working as safari guides and at management functions in the trophy hunting, photographic tourism and commercial livestock industry also liked leopards because they play an ecological role and are part of a healthy ecosystem. Management staff in the trophy hunting industry appreciated leopards for not killing too much prey, while management staff in the photographic tourism industry liked the fact that leopards are adaptable and clever survivors.

Other reasons to like leopards were because respondents felt leopards have the right to live (safari guides) and because respondents simply liked all wildlife including leopards (management staff in the trophy hunting industry and photographic tourism industry and safari guides).

Respondents who did not like leopards mainly felt negative about the species because it is perceived as dangerous to people and a threat to livestock. Especially subsistence farmers were worried about leopards killing livestock. Subsistence farmers and Forestry Commission management staff therefore relatively often felt leopards should be conserved in a fenced area, not in the community.

For a detailed overview of the reasons given by respondents in different professions see Appendix V.

Lion

Compared to cheetahs and leopards, respondents were more divided in their opinion about lions. Most respondents working in the photographic tourism industry, on management positions in the ZPWMA and the trophy hunting industry or as professional hunters felt positive about lions (≥ 71.0%) (Fig. 19). More than half of the respondents working on management positions for Forestry Commission or at commercial livestock farms, at general positions in the ZPWMA, as general or management staff in the trophy hunting industry, or as RDC natural resource officers felt positive about lions (≥ 51.2%, ≤ 67.9%) (Fig. 19). Less than half of the respondents working for CAMPFIRE or as general staff for Forestry Commission liked lions (≥ 43.5%, ≤ 47.2%) (Fig. 19). Few subsistence farmers (16.7%) and respondents working as general staff at commercial livestock farms (15.0%) felt positive about lions (Fig. 19).

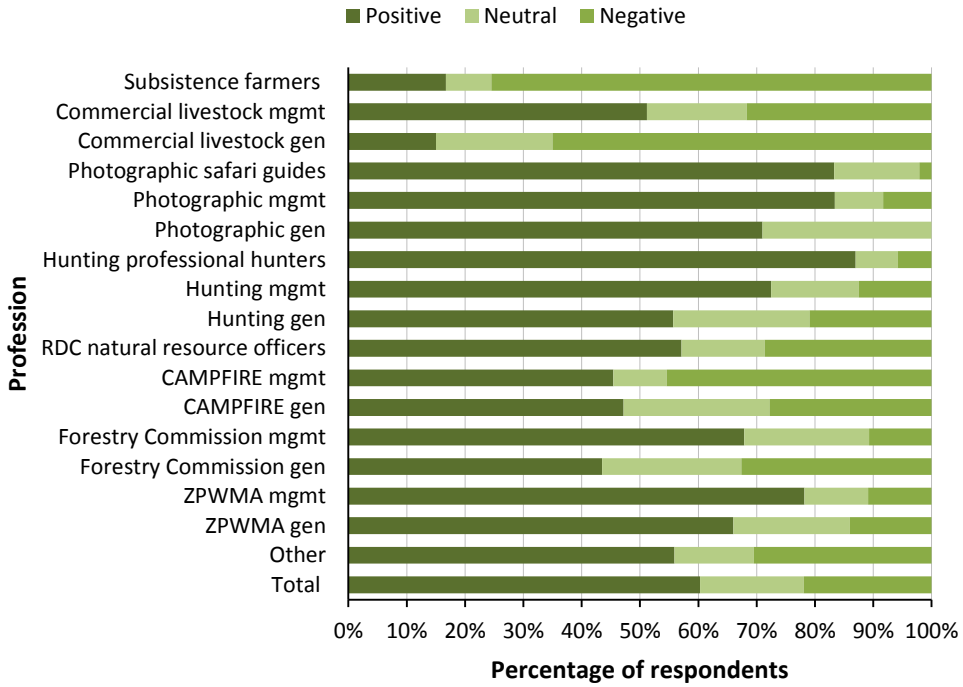


Figure 19. Percentage of respondents per profession who felt positive, neutral or negative about lions.

Most respondents felt positive about lions because they perceived the lion as a beautiful, nice and interesting species that adds diversity, is good to see and makes a nice noise. Some respondents specifically admired lions for their power and saw the lion as the king of the jungle. Especially professional hunters and management staff in the trophy hunting industry mentioned that lions are an intrinsic part of the bush, nature, Zimbabwe and/or Africa. Respondents also mentioned lions are a valuable species for the photographic tourism and trophy hunting industry.

Safari guides, professional hunters, respondents at management positions within the photographic tourism and trophy hunting industry, management staff at the ZPWMA and the RDC natural resource officers liked lions because of the role they play in the ecosystem. Especially the management staff of Forestry Commission and the general staff at commercial livestock farms appreciated the cultural value of lions and felt positive about the species because it is their totem. General reasons to like lions were because respondents liked all wildlife including lions (management staff in the photographic tourism industry, safari guides) or because they wanted to see lions (general staff at commercial livestock farms).

Except for professional hunters and general staff in the photographic tourism industry, a relatively large proportion of the respondents across all professions mentioned lions are dangerous to people. Respondents other than safari guides, management staff in the photographic tourism industry and professional hunters, felt negative about lions because they can kill livestock. CAMPFIRE management staff, RDC natural resource officers, general staff in the photographic tourism industry, management staff

at commercial livestock farms and subsistence farmers therefore often felt lions should be conserved in a fenced area, not in the community where they cause problems with people and livestock.

On the other hand general staff in the photographic tourism industry who liked lions perceived the species as harmless, and RDC natural resource officers also relatively often felt lions were not dangerous to people. Respondents at management positions in the trophy hunting industry and professional hunters who felt negative about lions thought there were too many lions and the lion population should be more balanced.

Pride of lions in Mana Pools National Park

For a detailed overview of the reasons given by respondents in different professions see Appendix V.

Spotted hyena

The majority of the professional hunters, management staff in the photographic tourism industry and safari guides felt positive about spotted hyenas (≥ 69.6%) (Fig. 20). More than half of the respondents working for the ZPWMA and at general or management positions in the trophy hunting industry liked spotted hyenas (≥ 52.7%, ≤ 60.0%) (Fig. 20). Whereas half or less than half of the respondents at general positions in the photographic tourism industry and CAMPFIRE felt positive about the species (≥ 48.4%, ≤ 50.0%) (Fig. 20). Not many respondents with general and management positions at Forestry Commission, management positions at CAMPFIRE or general and management positions at commercial livestock farms liked the species (≥ 13.8%, ≤ 31.7%) (Fig. 20). Very few subsistence farmers (7.8%) and natural resource officers at RDCs (10.7%) felt positive about spotted hyenas (Fig. 20).

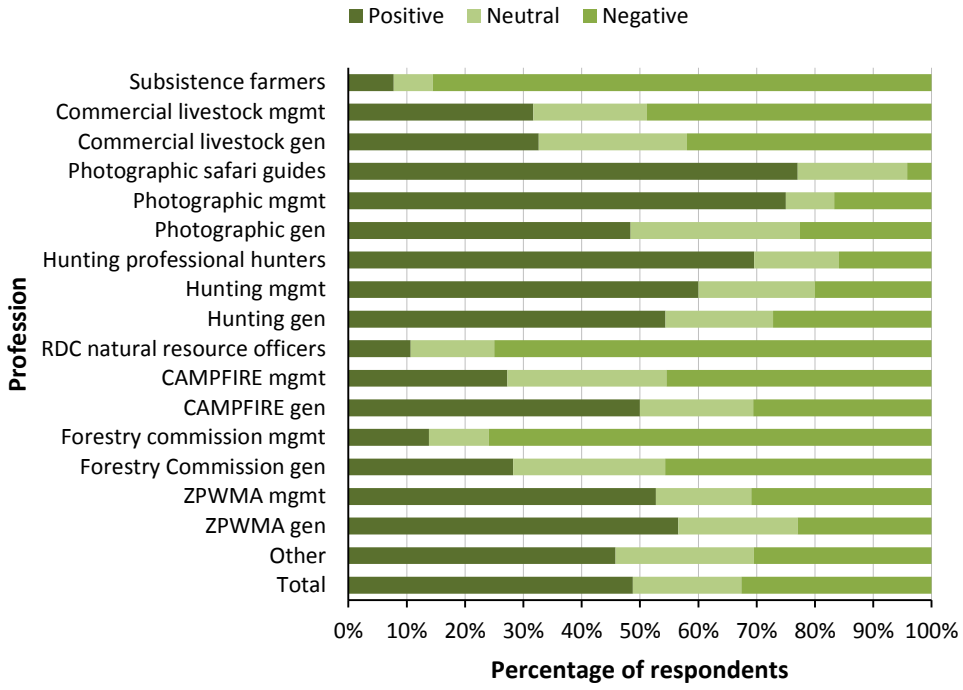


Figure 20. Percentage of respondents per profession who felt positive, neutral or negative about spotted hyenas.

Respondents often mentioned the species ecological role as a reason to like spotted hyenas. Especially in the trophy hunting and photographic tourism industry respondents perceived spotted hyenas as a beautiful, nice and interesting species which adds diversity, is special to see and makes a nice noise. General staff in the photographic tourism industry thought spotted hyenas are funny, naughty and clever animals. Whereas both the management staff in the photographic tourism industry and the trophy hunting industry felt the species is an intrinsic part of the bush, nature, Zimbabwe and/or Africa.

Only CAMPFIRE general staff, RDC natural resource officers, management staff in the trophy hunting industry and safari guides mentioned spotted hyenas are a valuable species for the trophy hunting and/or photographic tourism industry. General reasons to like spotted hyenas were because respondents felt it has the right to live (safari guides) and because respondents liked all wildlife including spotted hyenas (management staff in the photographic tourism industry.

Spotted hyenas scavenging on an elephant carcass

Especially subsistence farmers, but also most of the other respondent, felt negative about spotted hyenas because they are perceived as livestock killers. CAMPFIRE management staff, RDC natural resource officers, general staff at commercial livestock farms and subsistence farmers thought spotted hyenas are dangerous to people. CAMPFIRE management staff and RDC natural resource officers felt the species should be conserved in a fenced area not in the community where it causes problems. However, general staff at commercial livestock farms and management staff in the trophy hunting industry also perceived spotted hyenas as harmless, and general staff at commercial livestock farms often liked the species because it is not dangerous to people.

A relatively large proportion of the general staff at the ZPWMA, management staff at commercial livestock farms and respondents with general and management positions at Forestry Commission or in the photographic tourism industry disliked the behaviour and/or appearance of spotted hyenas. The association of spotted hyenas with witchcraft was regularly mentioned by RDC natural resource officers and respondents with management positions at the ZPWMA, CAMPFIRE and Forestry Commission as a reason to dislike the species.

Management staff in the trophy hunting industry and professional hunters who felt negative about spotted hyenas often thought there were too many spotted hyenas and there was a need to balance the population, whereas a relatively large proportion of the management staff in the photographic tourism industry felt spotted hyenas kill too much prey.

For a detailed overview of the reasons given by respondents in different professions see Appendix V.

Cheetah versus other carnivores

Compared to the other large carnivores, respondents relatively often felt positive about cheetahs and across the majority of the professions cheetah was liked the most (Table 25). Safari guides and respondents with management positions in the photographic industry felt as positive about cheetah as about leopard, while professional hunters and respondents at management positions in the hunting industry favoured leopard (Table 25). This high likeability of cheetah was largely related to the species appealing appearance and because, compared to other large carnivores, it is less often perceived as a problem animal. It should be kept in mind that, although precautions were taken to avoid bias in the respondents' answers it is possible that respondents felt overly positive about cheetah because they realized the interviewer was working in cheetah conservation and/or cheetah were the primary focus of the survey.

Table 25. Overview of the likability of African wild dog, cheetah, leopard, lion and spotted hyena among respondents within different professions.

	Most liked			Least liked	
Profession	**1**	**2**	**3**	**4**	**5**
Subsistence farmers	Cheetah (35.5%)	Leopard (24.4%)	African wild dog (19.3%)	Lion (16.7%)	Spotted hyena (7.8%)
Commercial livestock mgmt	Cheetah (80.5%)	Leopard (75.6%)	African wild dog (54.1%)	Lion (51.2%)	Spotted hyena (31.7%)
Commercial livestock gen	Cheetah (75.0%)	Leopard (50.0%)	Spotted hyena (35.0%)	African wild dog (30.0%)	Lion (15.0%)
Photographic safari guides	Cheetah/ Leopard (95.8%)	African wild dog (91.6%)	Lion (83.3%)	Spotted hyena (77.1%)	
Photographic mgmt	Cheetah/ Leopard (100%)	African wild dog/Lion (83.4%)	Spotted hyena (75.0%)		
Photographic gen	Cheetah (96.8%)	Leopard/Lion (71.0%)	African wild dog (64.5%)	Spotted hyena (48.4%)	
Hunting professional hunters	Leopard (98.6%)	Cheetah (91.3%)	Lion (87.0%)	Spotted hyena (69.%)	African wild dog (65.2%)
Hunting mgmt	Leopard (90.0%)	Cheetah (85.0%)	Lion (72.5%)	African wild dog (65.0%)	Spotted hyena (60.0%)
Hunting gen	Cheetah (84.8%)	Leopard (76.5%)	African wild dog (57.6%)	Lion (55.7%)	Spotted hyena (54.4%)
RDC natural resource officers	Cheetah (85.7%)	Lion (57.1%)	Leopard (53.6%)	African wild dog (21.4%)	Spotted hyena (10.7%)
CAMPFIRE mgmt	Cheetah (90.9%)	Leopard (63.6%)	Lion/African wild dog (45.5%)	Spotted hyena (27.3%)	
CAMPFIRE gen	Cheetah (88.9%)	Leopard (75.0%)	African wild dog (66.7%)	Spotted hyena (50.0%)	Lion (47.2%)
Forestry Commission mgmt	Cheetah (82.8%)	Lion (67.9%)	Leopard (65.5%)	African wild dog (40.8%)	Spotted hyena (13.8%)
Forestry Commission gen	Cheetah (74.0%)	Leopard (60.9%)	African wild dog (47.9%)	Lion (43.5%)	Spotted hyena (28.3%)
ZPWMA mgmt	Cheetah (98.2%)	Leopard (89.0%)	African wild dog (85.2%)	Lion (78.2%)	Spotted hyena (52.7%)
ZPWMA gen	Cheetah (93.8%)	Leopard (82.5%)	African wild dog (73.5%)	Lion (66.0%)	Spotted hyena (56.6%)
Other	Cheetah (83.1%)	African wild dog/Leopard (71.2%)	Lion (55.9%)	Spotted hyena (45.8%)	
Total	Cheetah (85.6%)	Leopard (75.6%)	African wild dog (63.0%)	Lion (60.3%)	Spotted hyena (48.8%)

5.3.3. Number of cheetahs wanted

Of the respondents who correctly identified cheetah, both general staff working at the ZPWMA and CAMPFIRE offices, general and management staff at Forestry Commission and respondents working in the photographic tourism or trophy hunting industry generally wanted more cheetahs in their area (≥ 75.0%) (Fig. 21). Respondents working as management staff at CAMPFIRE offices or at commercial livestock farms and natural resource officers at RDCs were more reluctant to see cheetah numbers increase (≥ 50.0% ≤ 60.0%) (Fig. 21). Whereas, less than half of the general staff at commercial livestock farms (41.7%) and very few subsistence farmers (23.7%) wanted a larger number of cheetahs in their area (Fig. 21).

Cheetah on the lookout on a fallen tree

Respondents who wanted the cheetah numbers in their area to increase, generally would like to have more cheetahs because it would be beneficial for photographic tourism but also because they wanted to see cheetahs and thought cheetahs are a beautiful, nice and interesting species. In addition, both the general and management staff of CAMPFIRE thought if cheetah numbers would increase, cheetahs would be able to provide revenue through hunting. General staff in the photographic tourism industry perceived cheetahs as a harmless species which is rare and should not go extinct. Respondents working at general or management positions at Forestry Commission, general positions at CAMPFIRE, as RDC natural resource officers or at management positions in the hunting industry also felt cheetah are part of a natural heritage which should be maintained for future generations.

Some respondents felt it would be appropriate to have more cheetahs because their area of operation is suitable for cheetah (management staff in the photographic tourism industry, safari guides), cheetahs do not kill too much prey (management staff in the photographic tourism industry) or because cheetahs have an ecological role to play (management staff at Forestry Commission, commercial livestock farms and in the trophy hunting industry, professional hunters and safari guides).

A relatively large proportion of the subsistence farmers, RDC natural resource officers and the general and management staff at commercial livestock farms preferred cheetah numbers to stay the same (which in most cases meant having no cheetahs) or, in some cases, even to go down (Fig. 21), because they were afraid cheetahs kill livestock. This was also a reason for management staff at CAMPFIRE offices and the ZPWMA to be reluctant to have more cheetahs. In addition, natural resource officers at RDCs and subsistence farmers relatively often felt cheetahs would impose a danger to people. A large proportion of the RDC natural resource officers and general staff at Forestry Commission offices mentioned cheetahs should be conserved in a fenced area, not in the community where they are a danger to people and livestock.

Some professional hunters and respondents working on management positions at the ZPWMA or in the photographic tourism or trophy hunting industry felt there should not be more cheetahs, or in some cases even less cheetahs, in their area because the area could not maintain a cheetah population, e.g. because the area was too small or because there was too much human activity. General staff in the photographic tourism industry also felt the cheetah numbers should be balanced so there would not be too many.

For a detailed overview of the reasons given by respondents in different professions see Appendix VI.

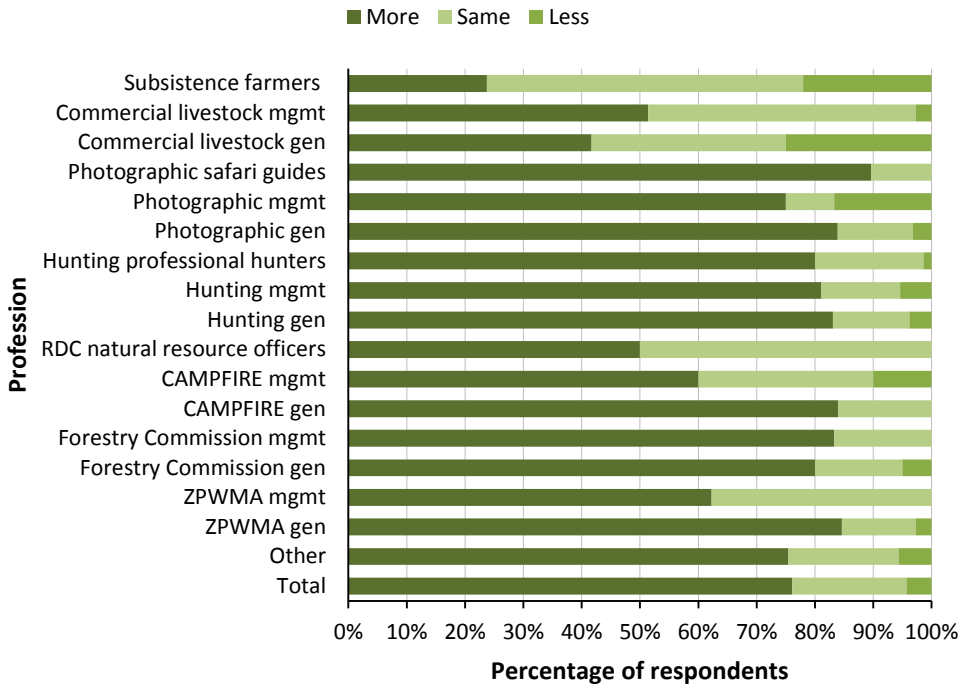


Figure 21. Percentage of respondents per profession who wanted more, the same or less cheetahs in their area.

5.4. Cheetah knowledge

Within most professions between 82.3% and 100% of the respondents correctly identified cheetah from the photograph used in the questionnaire based interview survey (Table 26). Subsistence farmers, general staff at commercial livestock farms and CAMPFIRE offices, and natural resource officers at RDCs less often correctly identified cheetah (≥ 60.0%, ≤ 71.4%) (Table 26).

Although the maximum speed at which a cheetah can run was topic of debate for professional hunters and respondents with management jobs at the commercial livestock farms or in the photographic tourism industry, the majority of the respondents in other professions agreed that cheetahs can run faster than 100 kilometres per hour (≥ 70.0%) (Table 27). Most respondents (≥ 83.8%) knew that cheetahs only eat meat (Table 27). With the exception of subsistence farmers and general Forestry Commission staff, ≥ 70.0% of the respondents knew cheetahs also occur in countries other than Zimbabwe (Table 27). Although whether or not cheetahs can breed with domestic cats was uncertain for the natural resource officers at RDCs and the management staff of Forestry Commission, most respondents correctly thought breeding between cheetahs and domestic cats would not be possible (≥ 70.0%) (Table 27).

A relatively large percentage of the subsistence farmers, RDC natural resource officers and the management and general staff of Forestry Commission thought cheetahs often kill people (≥ 34.8%). The majority of the respondents in other professions knew cheetahs are not dangerous to people (≥ 76.7%) (Table 27). Despite human-cheetah conflict in Zimbabwe being minimal, the historical perception of cheetahs as cattle killers still persists**.** Between 50.9% and 60.0% of the safari guides and management and general staff at the ZPWMA realized cheetahs do not often kill cattle. Half or more than half of the respondents in other professions incorrectly thought cheetahs often kill livestock (Table 27). Especially subsistence farmers, respondents with management or general positions at commercial livestock farms and management staff in the photographic tourism industry, more often than not thought cheetahs were regular cattle killers (≥ 73.3%) (Table 27).

Table 26. Percentage of respondents per profession who correctly identified cheetah from the photograph.

Profession	Respondents who correctly identified cheetah
Subsistence farmers	65.6%
Commercial livestock mgmt	90.2%
Commercial livestock gen	60.0%
Photographic safari guides	100%
Photographic mgmt	100%
Photographic gen	100%
Hunting professional hunters	100%
Hunting mgmt	92.5%
Hunting gen	82.3%
RDC natural resource officers	71.4%
CAMPFIRE mgmt	90.9%
CAMPFIRE gen	69.4%
Forestry Commission mgmt	82.8%
Forestry Commission gen	89.1%
ZPWMA mgmt	96.4%
ZPWMA gen	85.1%
Other	89.8%
Total	85.4%

Table 27. Number of cheetah questions correctly answered by respondents with various professions and percentage of respondents per profession who correctly answered each question.

Profession	Correctly answered questions (mean ± SE) max score = 6	Percentage of respondents (per profession) who correctly answered the question					
		Cheetahs can run faster than 100 km/h (True)	Cheetahs often kill people (False)	Cheetahs only eat meat (True)	Cheetahs only occur in Zimbabwe (False)	Cheetahs often kill livestock (False)	Cheetahs can breed with domestic cats (False)
Subsistence farmers	4.12 ± 0.13	86.7%	63.3%	95.6%	66.7%	26.7%	73.3%
Commercial livestock mgmt	4.22 ± 0.14	46.3%	90.2%	87.8%	87.8%	24.4%	85.4%
Commercial livestock gen	3.90 ± 0.27	70.0%	80.0%	90.0%	70.0%	5.0%	70.0%
Photographic safari guides	5.13 ± 0.14	89.6%	95.8%	87.5%	100%	52.1%	87.5%
Photographic mgmt	4.58 ± 0.23	66.7%	100%	83.8%	100%	16.7%	91.7%
Photographic gen	4.50 ± 0.18	77.4%	90.3%	96.8%	80.6%	41.9%	71.0%
Hunting professional hunters	4.84 ± 0.10	66.7%	100%	87.0%	98.6%	33.3%	98.6%
Hunting mgmt	4.68 ± 0.14	72.5%	95.0%	85.0%	92.5%	35.0%	87.5%
Hunting gen	4.52 ± 0.09	84.2%	82.9%	94.9%	71.5%	40.5%	77.8%
RDC natural resource officers	4.43 ± 0.20	71.4%	64.3%	89.3%	100%	50.0%	67.9%
CAMPFIRE mgmt	5.09 ± 0.25	100%	100%	100%	90.9%	36.4%	81.8%
CAMPFIRE gen	4.75 ± 0.19	91.7%	77.8%	94.4%	83.3%	44.4%	83.3%
Forestry Commission mgmt	4.03 ± 0.20	82.8%	55.2%	89.7%	93.1%	20.7%	62.1%
Forestry Commission gen	4.22 ± 0.20	76.1%	65.2%	97.8%	65.2%	45.7%	71.7%
ZPWMA mgmt	5.16 ± 0.10	85.5%	90.9%	98.2%	98.2%	60.0%	83.6%
ZPWMA gen	4.75 ± 0.05	86.2%	76.7%	94.9%	87.6%	50.9%	80.2%
Other	4.75 ± 0.15	78.0%	89.8%	93.2%	84.7%	44.1%	84.7%
Total	4.63 ± 0.03	81.5%	80.6%	93.5%	84.7%	42.8%	80.3%

5.5. Importance of conservation of wildlife

With the exception of subsistence farmers of which 73.3% thought wildlife should be conserved, between 91.7 and 100% of the respondents felt it is important to conserve wildlife (Fig. 22). All respondents mentioned benefits and economic growth through photographic tourism and trophy hunting, and the fact that wildlife is part of a natural and cultural heritage that should be conserved for future generations, as main reasons to conserve wildlife. In addition, especially staff at management positions thought wildlife plays an ecological role, is important to maintain biodiversity and should therefore not go extinct.

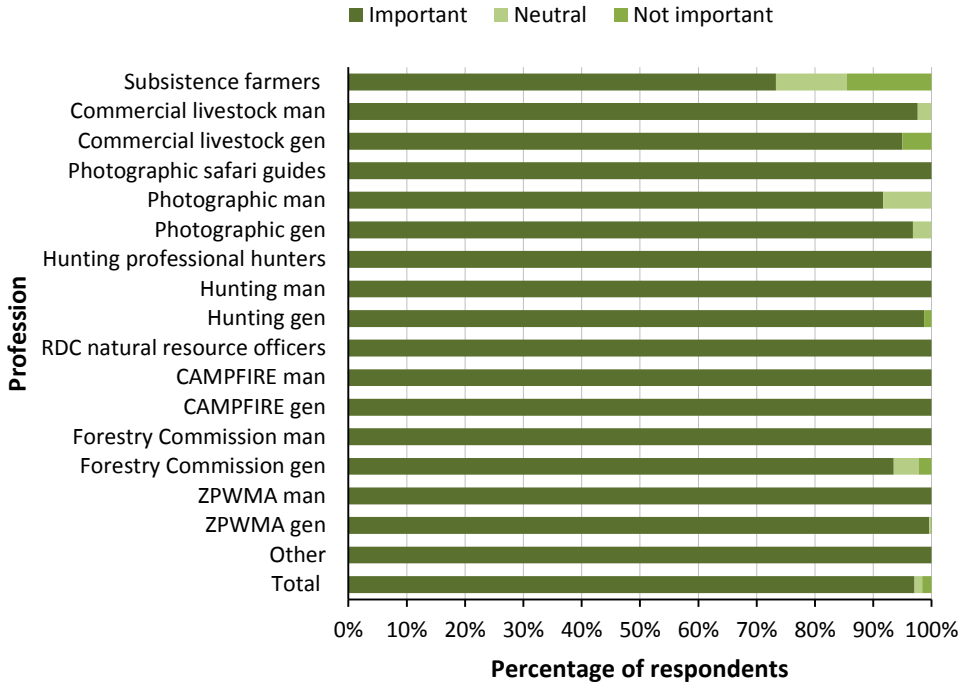


Figure 22. Percentage of respondents per profession who felt it is important, neutral or not important to conserve wildlife.

Professional hunters, safari guides and management staff at commercial livestock farms felt wildlife is an intrinsic part of the bush, nature, Zimbabwe and/or Africa. Management staff in the hunting industry and management staff of Forestry Commission, CAMPFIRE and the ZPWMA also value the aesthetic, emotional, cultural and spiritual role wildlife plays. However, the aesthetic value of wildlife was hardly mentioned by the photographic tourism industry. Especially general staff, relatively often wanted to conserve wildlife to see it.

Across most professions, respondents felt it is our duty as human beings to conserve wildlife because it has the right to live and/or it is created by God. Some respondent also realized they benefit directly from wildlife, professional hunters mentioned the fact that wildlife provides them with a livelihood as a main reason to conserve it, while subsistence farmers and management staff at Forestry Commission and commercial livestock farms often mentioned wildlife provides them with meat, skins and other products. Nevertheless, a large proportion of the subsistence farmers felt wildlife is dangerous, kills livestock and destroys crops and should be in a fenced area for all to see and learn from, not in the community where they cause problems.

'For our children to see in the wild not from pictures'

For a detailed overview of the reasons given by respondents in different professions see Appendix VII.

Chapter 6 - Discussion, recommendations and conclusion

6.1. Discussion and recommendations

The cheetah and its habitat are directly and indirectly part of numerous international and national laws, acts and policies (see chapter 2). Despite the special attention for this charismatic species and the high level of protection it receives in the country, Zimbabwe's cheetah population has declined dramatically. Over the past fifteen years cheetah numbers have been reduced by at least 85% and the cheetah has lost 61% of its resident range in Zimbabwe. Historically, the majority of Zimbabwe's cheetah population was found on commercial farmlands (CITES, 1992; Davison, 1999b). However, especially in the past two decades, much of this land has been converted to small scale commercial and subsistence farming under Zimbabwe's land reform policy (Murombo, 2002; du Toit, 2004; AWF, 2011). In addition to these changes in land use under the land reform policy, Zimbabwe's human population has increased from 7.5 million people in 1982 to 13.1 million people in 2012 and is expected to reach 19.3 million in 2032 (ZimStat, 2012, 2015b). The majority of this population (67.2%) lives in rural areas (ZimStat, 2012). Within the rural areas poverty is widespread, 76.0% of the rural households are considered poor (unable to attain a minimum level of wellbeing) while 30.4% of the rural people in Zimbabwe are extremely poor (unable to attain minimum food needs) (ZimStat, 2013, 2015a). According to the poverty analysis made by the Zimbabwe National Statistics Agency in 2011-2012 'a household whose head has communal or resettlement farming as a main activity is much more likely to be poor or extremely poor when compared to a household headed by a permanent or even casual employee' (ZimStat, 2013).

Bush clearing in resettlement area

Poverty, unemployment and food shortages are catalysts of illegal bush meat trade (Lindsey et al., 2011a). The changes in land use under the land reform policy and the economic depression that followed gave rise to unprecedented high levels of bush meat poaching (du Toit, 2004; AWF, 2011; Lindsey et al., 2011a) but also to high levels of deforestation (Shumba, 2001; du Toit, 2004; AWF, 2011). Nationwide 65.2% of the population uses wood as a source of energy for cooking, as many as 92.5% of the rural households cook on wood (ZimStat, 2014). Annually Zimbabwe loses 330 000 Ha of forest (-1.7%) (FAO, 2006), the highest rates of deforestation occur in communal and resettlement areas where trees are felled for housing, fencing, firewood and the cultivation of land, and uncontrolled veld fires are more common (Shumba, 2001; du Toit, 2004; AWF, 2011; Ministry of Environment Water and Climate, 2015). Resettlements in former wildlife habitat has resulted in an increase in human-wildlife conflict (AWF, 2011), depletion of the natural prey base due to poaching and habitat destruction is likely to have intensified this conflict (Woodroffe et al., 2005; Winterbach et al., 2015). Although Zimbabwe has many policies and laws in place to prevent overexploitation of natural resources and degradation of wildlife populations and habitats (see section 2.4. National policy and management, pp.15-17), financial constraints of wildlife and environmental management authorities have resulted in a lack of resources and manpower herewith weakening wildlife management capacity and the ability to effectively enforce the law (Zimbabwe, 2003, 2011; Ministry of Environment Water and Climate, 2015).

Cleared communal lands on the left and Mafungabusi Forestry on the right

Changes in land use, poverty and the increase in human population have resulted in drastic changes to the cheetah landscape in Zimbabwe. Although historically the commercial farmers saw cheetahs as a pest and (illegally) killed many cheetahs (Myers, 1975; Wilson, 1988; Davison, 1999a), they are willing to accept some livestock losses, especially if carnivores provide economic returns (Romañach et al., 2007; Stein et al., 2010; Lindsey et al., 2013). In accordance with other studies (Romañach et al., 2007), our survey shows commercial farmers had a more positive

attitude towards cheetah and other carnivores and a higher level of tolerance to livestock depredation by cheetah than subsistence farmers. In addition, subsistence farmers were more worried about livestock losses than commercial farmers and more often felt livestock losses had increased. We found a positive relationship between the number of livestock kept and the acceptable livestock losses to cheetah. Subsistence farmers generally keep small numbers of livestock which, based on informal conversation during the survey, are a source of food and, most importantly, provide financial security. It is therefore not surprising that subsistence farmers who live at high poverty levels in communal and resettlement areas (ZimStat, 2013) and only keep a small number of livestock which they depend on in case of financial emergencies are intolerant to livestock losses. Due to changes in land use, instead of one commercial farmer, the cheetah landscape now consist of a mosaic of many, less tolerant, subsistence farmers. In addition, subsistence farmers keep on average 1.89 ± 0.15 (mean ± SE) domestic dogs, which can be a cause of cheetah mortality (Laurenson, 1994; personal communication with respondents). These changes have increased the hostility of the landscape considerably which, in combination with a depletion of prey base and degradation of habitat, is likely to be the main driver behind the dramatic reduction of cheetah range and numbers as found in this study.

Community along the boundary of Chirisa National Park

After the previous countrywide assessment in 1999, Zimbabwe had more than 1 500 cheetahs, 80% of which resided outside wildlife protected areas and conflict between farmers and cheetahs was the main concern for cheetah conservation in Zimbabwe (Davison, 1999b). At present Zimbabwe is left with 150-170 adult and independent adolescent cheetahs, only 20% of which reside outside wildlife protected areas and human-cheetah conflict is extremely limited. With the majority of Zimbabwe's cheetah population now being found in wildlife protected areas, there is a need to adapt the country's cheetah management and conservation strategy. Especially as, due to human encroachment and the weakening of wildlife management capacity and law enforcement, the degradation of wildlife populations and habitats is also affecting many of Zimbabwe's wildlife protected areas (Shumba, 2001; du Toit, 2004; AWF, 2011; Ministry of Environment Water and Climate, 2015).

Resources to effectively secure those wildlife protected areas are limited, e.g. Hwange National Park, the largest wildlife protected area in Zimbabwe (ZPWMA, 2015a), makes approximately 1.3 million USD a year while in the current situation its annual running costs are estimated to be in excess of 1.6 million USD (ZPWMA, 2015b). However, to effectively manage this 14 651 km^2 National Park, the authorities would realistically require a minimal annual budget of ca. 2.6 million USD (calculations based on EU, 2014). Constraints in resource availability make it necessary to set conservation priorities based on the species and habitats that provide the highest chance to generate conservation success (Ray et al., 2005; Dickman et al., 2015). Of all the African felids the cheetah is most in need of conservation action (Ray et al., 2005; Dickman et al., 2015). Because of its wide ranging nature the cheetah is a suitable umbrella species (Simberloff, 1997; Dickman et al., 2015), which means the conservation of cheetah will benefit the conservation of many other species (Ray et al., 2005; Dickman et al., 2015).

Zebra in Masvingo town

Human population pressure is a limiting factor to conservation success (Dickman et al., 2015) and the relatively high human population density in former cheetah habitat is likely to make restoration of these degraded habitats increasingly difficult. Although habitat restoration can benefit local communities and reduce poverty, the restoration of degraded habitats takes considerable time, is more expensive than the conservation of existing habitats, requires broad stakeholder involvement and commitment plus true restoration to prior states is rarely possible at large scales (TEEB, 2009; Bullock et al., 2011). In Zimbabwe, the conservation priority should therefore be to secure remaining cheetah range rather than try to regenerate historic range. The same applies to the

cheetah populations itself. Zimbabwe has a long history with the translocation and reintroduction of cheetah (Zank, 1995; Wilson, 2003; 2006a), the best documented case being the reintroduction of cheetah into Matusadona National Park (see Appendix III). Although translocations have been widely used as a conservation tool in cheetah management, due to its low success rate and high economic costs, it is now commonly believed this tool should only be used when all other options have been exhausted (Weise et al., 2014, 2015; Boast et al., 2015). In order to generate the highest rate of conservation success, rather than trying to re-establish cheetah populations (e.g. the Matusadona population) conservation efforts in Zimbabwe should focus on securing existing healthy cheetah populations.

Small fragmented carnivore populations are vulnerable to local extinction therefore, especially when conserving wide ranging large carnivores like cheetah, it is more effective to have one large conservation area rather than several small ones (Woodroffe and Ginsberg, 1998). In addition, the long term viability of large carnivore populations is strongly affected by its effective population size (Winterbach et al., 2013). Apart from securing relatively large conservation areas, in order to maintain population viability and genetic diversity, it is important to identify and create wildlife corridors which facilitate movement between populations (Rouget et al., 2006). The largest cheetah population in the world is found in Southern Africa, the majority of which is part of a transboundary population covering Angola, Botswana, Namibia, South-Africa, Zambia and Zimbabwe (IUCN/SSC, 2007). **When setting priorities for cheetah conservation in Zimbabwe the aim should be to maintain relatively large cheetah populations that reside in functioning connected ecosystems which can sustain free ranging viable cheetah populations that are linked to or could be linked to larger transboundary populations.**

There are three cheetah populations which meet those criteria: the cheetah populations residing in the Hwange-Matetsi-Victoria Falls area, the Hurungwe-Mana Pools-Sapi area and the Malilangwe-Gonarezhou area. These relatively large free ranging cheetah populations are linked to or can be linked to larger transboundary populations via Transfrontier Conservation Areas (TFCAs): the Hwange-Matetsi-Victoria Falls area is part of the Kavango-Zambezi TFCA, the Hurungwe-Mana Pools-Sapi area is part of the future Lower Zambezi-Mana Pools TFCA and the Malilangwe-Gonarezhou area is part of the Great Limpopo TFCA (peaceparks.org). The cheetah population in Save Valley Conservancy used to be connected to the Malilangwe-Gonarezhou population, however, due to resettlements in the southern part of the conservancy this linkage has been disrupted (see also Williams, 2011). Although Bubye Valley Conservancy and Nuanetsi harbour large cheetah populations which could in theory be linked to the Southern African population via the Zimbabwe component of the Greater Mapungubwe TFCA, due to resettlements and to some extent game fencing, movement of cheetahs has been restricted and these population have become virtually isolated.

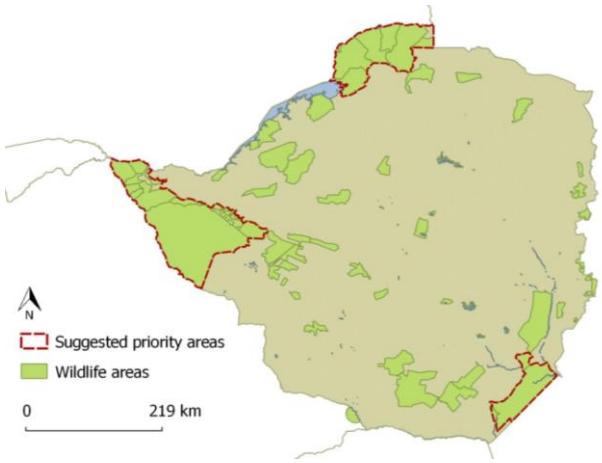


Figure 23. Suggested priority areas for the conservation of cheetahs and other large carnivores.

Recommendation 1: Prioritise the conservation of existing cheetah populations and their habitats in the Hwange-Matetsi-Victoria Falls Area, the Hurungwe-Mana Pools-Sapi area and the Malilangwe-Gonarezhou Area and secure connectivity to larger transboundary populations (Fig. 23).

Human induced mortality at the edges of wildlife protected areas negatively affects large carnivore populations inside protected areas and this 'edge effect' can create population sinks (Woodroffe and Ginsberg, 1998). In order to effectively conserve source populations of large carnivores in protected areas and facilitate dispersal it is therefore necessary to create buffer zones and dispersal corridors in which the impact of anthropogenic mortality is minimized by mitigating human-wildlife conflict and ensuring sustainable off take (Winterbach et al., 2013). In 1992, Zimbabwe was allowed to annually export 50 live

Human induced cheetah mortality

cheetahs or cheetah hunting trophies under CITES (CITES, 1992). This decision was based on the assumption that the national cheetah population consisted of between 500-1 000 cheetahs, 80% of which resided on commercial farmlands and were causing high levels of farmer-cheetah conflict which could be reduced by allowing farmers to receive economic returns from the species (CITES, 1992). The present situation, in which there are 150-170 adult and independent adolescent cheetahs, 80% of which reside in wildlife protected areas and hardly any human-cheetah conflict, asks for a revision of this quota.

In Zimbabwe hunting quotas are allocated by the Zimbabwe Parks and Wildlife Management Authority, however, these quotas are influenced by wildlife population estimates provided by landowners (WWF, 1997; ZPWMA, 2012). For a species like cheetah, unless based on sound scientific methods, landowner estimates are generally unreliable (see also Williams, 2011) especially as, due to the species large home ranges, neighbouring landowners will encounter the same individual cheetahs which results in an overestimation of the population (Marker et al., 2008). In order to be sustainable, annual off take should be based on reliable population estimates and not exceed a populations growth rate (WWF, 1997). For cheetah it has been recommended not to allocate hunting quotas for more than 5% of the population (WWF, 1997). Based on the current population estimate this would accumulate to an absolute maximum of 10 cheetahs. However, taking into account that the populations in most areas are decreasing it would be more appropriate to reduce the national quota and the number of export tags under CITES to a conservative 5 which, with the limited human-cheetah conflict, should be sufficient to encourage (commercial) farmers to tolerate the presence of cheetahs on their land. Densities of the three key free-roaming cheetah populations in Zimbabwe are relatively low (IUCN/SSC, 2007), in order to secure these key populations and facilitate dispersal cheetahs should not be hunted on land in the Hwange-Matetsi-Victoria Falls area, the Hurungwe-Mana Pools-Sapi area, the Malilangwe-Gonarezhou area or the buffer zones surrounding those areas.

Recommendation 2: Reduce the national quota and export tags under CITES to no more than 5 cheetahs annually which, in order to secure the remaining key cheetah populations and facilitate dispersal, are not to be hunted on land in the Hwange-Matetsi-Victoria Falls area, the Hurungwe-Mana Pools-Sapi area, the Malilangwe-Gonarezhou area or the buffer zones surrounding those areas.

Despite the limited human-cheetah conflict in Zimbabwe, anthropogenic mortality seems to be a main cause of death, with cheetahs being killed in wire snares and with the use of domestic dogs. To be able to secure large carnivore populations in protected areas and facilitate dispersal it is important to minimise bush meat poaching and promote non-lethal conflict mitigation methods in the buffer zones and dispersal corridors surrounding those protected areas (Balme et al., 2010; Winterbach et al., 2013; van der Meer et al., 2013). Human-wildlife conflict is frequently managed by removing the problem animal, either by killing it or by translocating it (Linnell et al., 1997; Fischer and Lindenmayer, 2000; Treves and Karanth, 2003). However, the removal of problem animals generally does not solve human-wildlife conflict: the problems continue as the vacant territories that are created are filled by other individuals, translocated individuals return to the capture area or resume their conflict behaviour at the release site plus, in most cases, survival of translocated animals is seriously reduced (Linnell et al., 1997; Fischer and Lindenmayer, 2000; Weilenmann et al., 2010; Boast et al., 2015). Conservation efforts should therefore focus on promoting co-existence between humans and carnivores by reducing the potential for conflict to occur (Weilenmann et al., 2010; Boast et al., 2015; Weise et al., 2015).

Piles of removed wire snares at Nuanetsi

Although the cheetah is a relatively popular carnivore species, most subsistence farmers felt negative about cheetah and other large carnivores, and did not want to live with predators because they were worried about livestock losses. Effective livestock husbandry significantly reduces the risk of livestock

depredation by large carnivores (Ogada et al., 2003; Woodroffe et al., 2007; Chardonnet et al., 2010). Livestock losses can be limited by letting small herds of cattle graze in open habitat accompanied by human herders and herd dogs during the day, and, at night, by locking livestock up in sufficiently high bomas with dense (non-transparent) walls and few gates, situated in areas with human activity and domestic dogs (Ogada et al., 2003; Woodroffe et al., 2007; Chardonnet et al., 2010). Both the commercial and subsistence farmers in our survey used several of those methods to prevent livestock losses and mentioned improved livestock husbandry as a main reason for lower livestock depredation rates. Some farmers mentioned the use of scarecrows, which according to a study by Woodroffe et al. (2007) can actually increase the risk of livestock depredation.

Livestock guarding dog

The effectiveness of the use of domestic dogs to deter carnivores (especially leopard and cheetah) can be increased by keeping them with livestock from birth as livestock-guarding dogs. If raised with livestock, domestic dogs will live with livestock herds and show protective behaviour to livestock when confronted with a predator (Marker et al., 2005; Chardonnet et al., 2010). Alternatively, having donkey mares or geldings (stallions can be aggressive to livestock) accompany livestock herds also reduces livestock losses (Marker et al., 1996; Chardonnet et al., 2010). Donkeys respond aggressive to predators and, as long as they are raised with livestock from birth, can protect livestock from carnivores (Marker et al., 1996; Chardonnet et al., 2010). In addition, maintaining a sufficient natural prey population within livestock areas further reduces livestock depredation (Woodroffe et al., 2005; Marker, 2008; Winterbach et al., 2015; Boast et al., 2016). Bush meat poaching is a severe threat to Zimbabwe's herbivore and carnivore populations (Lindsey et al., 2011a, b; Williams et al., 2016). A decrease of bush meat poaching in the buffer zones and dispersal corridors surrounding protected areas will not only reduce carnivore mortality, but will also improve the natural prey base herewith decreasing the potential for human-carnivore conflict.

Recommendation 3: Protect core population of cheetahs and other carnivores by securing buffer zones and dispersal corridors around the three key protected cheetah habitats in which bush meat poaching is minimized and human-carnivore conflict is limited through mitigation rather than the removal of problem carnivores.

A person's perception and attitude towards carnivores does not only depend on actual livestock losses but also on a combination of social factors like cultural believes, experiences of other community members and relationships between the authorities and local communities (Dickman, 2010). A relatively large proportion of the subsistence farmers did not report livestock depredation, felt there was nothing they could do to prevent livestock losses and no or inappropriate action was taken when conflict was reported to the authorities. Farmers who thought livestock losses to carnivores had increased often mentioned ineffective management by the authorities (i.e. no game fence, no problem animal control) as a reason for this trend. Additionally, although most subsistence farmers thought it was important to conserve wildlife for future generations and because it provides economic benefits, they often believed wildlife should be conserved in a designated wildlife area and not in the community where it can cause problems. This attitude points towards a perceived imbalance of power, with the authorities being the powerful party responsible for wildlife and the prevention of imposed problems with wildlife in the communities, which can fuel hostility to wildlife and the authorities protecting this wildlife (Alexander and McGregor, 2000; Dickman, 2010). Improving community-authority relationships and ensuring those relationships are based on trust is likely to assist with promoting co-existence in the buffer zones and dispersal corridors surrounding Zimbabwe's protected areas.

Recommendation 4: Appoint a community liaison and education officer within the authorities managing the three key protected cheetah habitats, to improve community-authority relationships and provide education about wildlife and conflict mitigation with the aim to reduce the potential for human-wildlife conflict to occur.

Especially subsistence farmers often felt wildlife should be conserved in fenced areas, not in the community where they may cause conflict with people. The effectiveness of fences in reducing human wildlife conflict has been mixed and varies per species (Ferguson and Hanks, 2010). In order to be effective, fences require continuous maintenance, yet, even well maintained fences are not a 100% predator proof (Ferguson et al., 2012). Although fences will not completely eliminate human-wildlife conflict, they can in some cases assist in reducing conflict (Ferguson and Hanks, 2010). Fencing comes with considerable economic costs but also with high ecological costs (Ferguson and Hanks, 2010). While some species thrive in fenced areas (Packer et al., 2013), especially (migratory) herbivores often experience reduced access to resources and an increase in predation risk which can results in population declines (Ferguson and Hanks, 2010).

Due to changes in herbivory, fences also affect vegetation composition and cover (Ferguson and Hanks, 2010). Furthermore, unless small spatially separated wildlife populations are actively managed, fencing can result in genetic isolation of species herewith increasing extinction risk (Ferguson and Hanks, 2010). Although in some cases fencing reduces poaching by excluding illegal hunters from wildlife areas, in other cases it exacerbates poaching by providing a limitless supply of wire for the construction of snares (Ferguson and Hanks, 2010). Fences deny communities access to natural and cultural resources, this can alienate communities from wildlife and fuel hostility towards wildlife authorities and conservation (Hoole and Berkes, 2010). It has therefore been argued that in order for conservation efforts to be effective in the long term, rather than separating people and wildlife, there is a need to involve communities in the management of natural resources and ensure they directly benefit from those resources (Hoole and Berkes, 2010).

The Bubye Valley Conservancy fence

Both commercial and subsistence farmers are more tolerant to carnivores and livestock losses to carnivores if the benefits of living with carnivores compensate or outweigh the costs (Romañach et al., 2007; Lindsey et al., 2013) and creating economic incentives to live with wildlife is a commonly used conservation strategy to promote co-existence (Inskip and Zimmermann, 2009; Winterbach et al., 2013). The Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) was introduced in Zimbabwe in 1988 to promote the sustainable use of natural resources by allowing communities to directly benefit from exploitation of wildlife and habitats in the communal lands (Alexander and McGregor, 2000; CAMPFIRE, 2013). To facilitate CAMPFIRE, Rural District Councils (RDCs) were given Appropriate Authority (AA) status herewith making them responsible for natural resource management in the communal lands within their district and allowing them to exploit those resources by marketing access to wildlife to safari operators (Alexander and McGregor, 2000; Frost and Bond, 2008; Taylor, 2009). By 2003, 37 of the 60 districts in Zimbabwe held AA status, of which 23 are considered fully participatory and 12 receive regular income through wildlife (CAMPFIRE, 2013). Communities participate in the CAMPFIRE programme at ward level (a sub-district administrative unit comprising several villages) via community-elected Ward Wildlife Committees to which the RDCs pay revenues which can be used for any purpose decided by the community (AWF, 2011; CAMPFIRE, 2013).

Payments to the wards are generally proportional to revenue, based on the assumption that wards with the largest wildlife populations (producer wards) generate the highest revenue but also bear the highest direct costs from wildlife damage (Frost and Bond, 2008). Although CAMPFIRE aims to alleviate poverty the benefits at household level are minimal and instead, wards use CAMPFIRE revenue to fund community development projects, e.g. clinics, boreholes and schools (Logan and Moseley, 2002; Frost and Bond, 2008; CAMPFIRE, 2013). Annually CAMPFIRE generates more than 2 million USD revenue, mostly via the lease of trophy hunting rights to commercial safari operators (Taylor, 2009; CAMPFIRE, 2013). Although according to the revised revenue sharing guidelines a minimum of 55% of this revenue should be devolved to ward level, RDCs are not legally obliged to pay the wards (Taylor, 2009). Underpayment and delays in payment are very common (Frost and Bond, 2008; Taylor, 2009; AWF, 2011) and undermine the incentive for communities to sustainably manage their natural resources (AWF, 2011;

CAMPFIRE, 2013). Although this problem has partly been resolved by endorsing a direct payment system in which communities receive their share of the revenue directly from the safari operator (CAMPFIRE, 2013), it is widely believed that, in order for CAMPFIRE to be truly effective, communities should be allowed to constitute themselves in legal entities which enable them to directly hold, manage, exploit and benefit from their natural resources (Logan and Moseley, 2002; Taylor, 2009; AWF, 2011). In addition, it has been pointed out that the 'producer wards' principle needs to be reviewed and adapted to the actual range and movement of wildlife in order to ensure that wards, communities and households that bear the costs of wildlife receive the appropriate benefits to offset those costs (Logan and Moseley, 2002). Although, especially under the current socio-economic conditions, CAMPFIRE faces many challenges (Taylor, 2009; AWF, 2011), the programme provides an important adaptable framework to create economic incentives for communities to live with wildlife.

Recommendation 5: Promote the co-existence between people and wildlife in the buffer zones and dispersal corridors surrounding the three key protected cheetah habitats by reviving, reviewing and adapting existing CAMPFIRE programmes.

In general, apart from their aesthetic and ecological value, the economic value of carnivores is a main reason for respondents to like carnivores. Dislike of carnivores was mostly based on the fear of losing livestock and the perceived danger carnivores present to human life. Even for species that do not impose a threat to humans, like cheetah, respondents mentioned its danger to people as a reason to dislike the species. In addition, for spotted hyena, fear and dislike of the species was affected by its cultural association to witchcraft. Such negative cultural associations seem to play a stronger role than positive cultural associations, e.g. the role of lion and leopard as totems. Hostility towards wildlife is often affected by misconceptions and fear and especially species which are large, highly visible and perceived as dangerous are met with antagonism regardless of the actual risk they impose (Chardonnet et al., 2010; Dickman, 2010).

In situ education during the survey

Knowledge of a species can positively affect a person's attitude towards a species (Lukas and Ross, 2005; Tisdell, Nantha and Wilson, 2007) and people living with wildlife are generally less afraid of wildlife (Ericsson and Heberlein, 2003; Røskaft et al., 2003). Respondents working as general staff in the photographic tourism and hunting industry relatively often mentioned they felt positive about living with carnivores because they got to know their behaviour and learned to live with them. Education and awareness programmes which provide information about carnivore identification, behaviour and actual risks as opposed to perceived risks, are an important conservation tool to reduce hostility and mitigate conflict (Marker et al., 2003b; Dickman, 2010). Respondents likely to be the first on the ground to identify conflict carnivores (subsistence farmers, general staff at commercial livestock farms, RDC natural resource officers and general staff at relevant authorities) and general staff of authorities patrolling wildlife areas or accompanying hunting parties (CAMPFIRE, Forestry Commission and the ZPWMA) struggled to identify all carnivores. Education programmes aimed at these groups will assist with effective conflict mitigation and management of carnivores. When developing education and awareness programmes it should be kept in mind that, in order for such programmes to have a long term impact, they need to be continuous (Gusset et al., 2008; Marker, 2008). It is also important to note that neither education, mitigation or economic incentives alone are likely to make a long term change to human behaviour and attitude (Dickman, 2010; Winterbach et al., 2013), conservation initiatives should therefore be based on an adaptable combination of those activities.

Recommendation 6: Promote and establish continuous education and mitigation programmes in communities surrounding the three key protected cheetah habitats and train general staff at the authorities in carnivore identification.

Cheetah on a camera trap

In order to effectively manage and conserve wildlife populations it is important to identify and understand the factors that impact on those wildlife populations both inside and outside wildlife protected areas (Ray et al., 2005; Inskip and Zimmermann, 2009; Winterbach et al., 2013), especially as failure to do so can result in rapid population declines (Balme et al., 2010; van der Meer et al., 2013). Scientific research is a crucial component of conservation management as it gives an insight in the ecological needs of wildlife populations, the threats and impact of threats these populations face and assists with the design and implementation of conservation interventions (Ray et al., 2005; Inskip and Zimmermann, 2009; Winterbach et al., 2013). Long-term population studies are particularly valuable to monitor the factors that affect population size and evaluate the effectiveness of conservation interventions (Kelly et al., 1998; Ray et al., 2005), such studies also assist in identifying and creating dispersal corridors and determining the effective size of buffer zones surrounding protected areas (e.g. Davidson, 2009; Elliot, 2013).The importance of research for conservation management has been acknowledged by, and is part of, various international and national agreements and policies, e.g. SADC Protocol on Wildlife Conservation and Law Enforcement (SADC, 1999), Range Wide Conservation Programme for Cheetah and African wild dog (IUCN/SSC, 2007; ZPWMA, 2009a). However, research on large carnivores does not always show a direct link to conservation management and there is a need for more applied research to inform management decisions and set conservation priorities (Ray et al., 2005).

Recommendation 7: Monitor remaining cheetah populations and promote long term applied research on cheetah and other carnivores to inform conservation management decisions.

Although traditionally most research is conducted by specialists, the involvement of non-specialists in the collection of scientific data is increasing (Dickinson et al., 2010). If trained and supervised by specialists, non-specialists can successfully assist with ecological monitoring (Ray et al., 2005; Dickinson et al., 2010). In most cases, knowledge levels of general staff were lower than knowledge levels of management staff, yet it is the general staff that goes on anti-poaching patrols, accompanies hunts and monitors fences and waterholes. These field activities provide unique opportunities to collect scientific data on e.g. species diversity, distribution and demography. If general staff is adequately trained and equipped with user friendly field manuals, they are in a position to make a valuable contribution to (long-term) ecological monitoring.

Recommendation 8: Educate and train field staff and involve field staff in the collection of baseline data which will assist the authorities and researchers with the monitoring of wildlife populations and their habitats.

Over the past decade Zimbabwe has experienced dramatic changes in land use (Shumba, 2001; du Toit, 2004; AWF, 2011; Ministry of Environment Water and Climate, 2015), this has had a severe impact on the cheetah population and within the current situation the conservation of cheetah and other wildlife depends on the wildlife protected areas and the political will to secure those areas from forms of land use that are not conducive to wildlife conservation, e.g. mining, resettlements, urban development. The socio-economic climate in the country has resulted in financial constraints which have undermined the effective management of wildlife protected areas (Shumba, 2001; du Toit, 2004; AWF, 2011; Ministry of Environment Water and Climate, 2015).

At a national as well as an international level there are relatively limited resources available to conserve wildlife, which makes it necessary to prioritize species and habitats that provide the highest chance to generate conservation success (Ray et al., 2005; Dickman et al., 2015). When setting those priorities it should be kept in mind that large connected conservation areas are the most effective way to conserve viable and genetically diverse wildlife populations (Woodroffe and Ginsberg, 1998; Rouget et al., 2006; Winterbach et al., 2013). The cheetah has a high national and international conservation priority and because of its role as an umbrella species (Dickman et al., 2015), the conservation of the main free roaming cheetah populations in the three largest connected wildlife areas in Zimbabwe (Hwange-

Matetsi-Victoria Falls area, the Hurungwe-Mana Pools-Sapi area and the Malilangwe-Gonarezhou area) will benefit the conservation of many other wildlife species, including the additional twelve carnivores that occur in those areas (Appendix II).

Competing land use types

Both the Hwange-Matetsi-Victoria Falls area, the Hurungwe-Mana Pools-Sapi area and the Malilangwe-Gonarezhou area predominantly consist of protected, relatively intact and connected wildlife habitat and are part of transfrontier agreements. However, each area consists of concessions with different land use practices and, especially in the Hwange-Matetsi-Victoria Falls area, different land tenure. In order to maintain connectivity and prevent land use changes that are detrimental to cheetah and other wildlife, in line with transfrontier agreements, the aim should be to manage each of these large connected wildlife areas as one and develop overall management and land use plans for those areas in which the cheetah is taken into account as a priority species. Managing large wildlife areas is more cost effective than managing small areas (EU, 2014), nevertheless, the effective management of these large connected wildlife areas would require considerable funds. With the current economic constraints, it is therefore necessary to further explore opportunities to receive financial and technical support from funding agencies and private donors through co-management contracts and public private partnerships.

Recommendation 9: Provide the Hwange-Matetsi-Victoria Falls area, the Hurungwe-Mana Pools-Sapi area and the Malilangwe-Gonarezhou area with the political and legal protection necessary to secure these areas from forms of land use that are not conducive to wildlife conservation and explore opportunities to receive financial and technical support to manage each of those areas as one.

The cheetahs of Zimbabwe are part of the Southern African cheetah population, especially considering the species global decline (IUCN/SSC, 2007), it is important to secure connectivity with this largest cheetah population in the world. Although more research is necessary to identify dispersal corridors and the factors affecting cheetah movement, at a national level, connectivity can be promoted by minimizing bush meat poaching and antagonism towards cheetah and other carnivores in communities surrounding wildlife protected areas. Internationally, especially within the Transfrontier Conservation Areas, the conservation of cheetah across international borders could be improved by harmonisation of laws, policies and (land use) practices. For example, by ensuring that the cheetah enjoys the same, highest possible, protected status across borders and the illegal off-take of cheetahs is discouraged to its fullest extent, but also by facilitating connectivity through synchronization of land use practices across international borders, especially along the borders of protected wildlife habitat. The political commitment to conserve transboundary cheetah and carnivore populations could be stimulated and strengthened under Transfrontier Conservation Treaties and other exiting legal frameworks (e.g. the Convention on the Conservation of Migratory Species of Wild Animals), by specifically signing memorandums of understanding with neighbouring countries for the joined management of transboundary cheetah and carnivore populations.

Recommendation 10: Promote connectivity and joined management of the Southern African cheetah population by harmonising laws, policies and (land use) practices across international boundaries of shared populations.

6.2. Conclusion

Worldwide species are going extinct at a dramatic rate (Pimm et al., 2014; Ceballos et al., 2015). This loss of biodiversity has a direct impact on the functioning of ecosystems, affects human health and wellbeing, and is considered to be one of the most pressing environmental problems today (EU, 2014; Ceballos et al., 2015). However, for many species, up to date detailed information on numbers and distribution is lacking, making it difficult to accurately assess rates of decline (Pimm et al., 2014). Even though the cheetah was the main focus of our study, we also provide an insight in the distribution of other carnivores in Zimbabwe. In most cases the current range of Zimbabwe's carnivores showed a substantial difference with historic (IUCN) range (Appendix II). Although especially for the small elusive carnivore species, our maps remain with considerable uncertainties related to the likelihood of respondents encountering the species, they provide a starting point for future biodiversity monitoring. Large carnivores are only considered suitable biodiversity indicators for large unfragmented landscapes (Dalerum et al., 2008), however, the diversity of a complete carnivore guild is likely to reflect overall prey diversity (Dalerum et al., 2008) and range loss of carnivores has been suggested to be linked to the loss of species in other taxonomic groups (Di Minin et al., 2016). Conserving carnivores could therefore prevent range declines of other threatened species herewith reducing biodiversity losses (Di Minin et al., 2016).

It has been widely acknowledged that land use change is a main driver behind range contractions and declines of carnivore populations (Ripple et al., 2014; Di Minin et al., 2016). Yet, empirical information is scarce and predictions of the implications of large scale land use change are often based on model projections (Pimm et al., 2014). The situation in Zimbabwe has provided us with a case study of the effects of large scale changes in land use, and our study gives an empirical insight in the rate of decline in range and numbers of a low density, wide ranging, large carnivore under land use change. Our study also highlights that in the face of poor governance and poverty, national and international laws, policies and conventions are unlikely to be sufficient to prevent biodiversity loss. Although the land reform programme and the economic depression that followed have accelerated land use changes in Zimbabwe, it is likely that, with the increase in human population in Africa and the resulting demand for agricultural land and pressure on natural resources (EU, 2014), other African countries will face similar scenarios in the near future. The lessons learned in Zimbabwe can assist other countries to anticipate the effects of land use change on biodiversity and should be used to develop and implement integrated cross-sectoral land use plans that provide for the national and international conservation of biodiversity.

Cheetah female and cubs in Hwange National Park

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Appendix I - Questionnaire used in the survey

QUESTIONNAIRE CCPZ - LONG P.O. Box 204, Victoria Falls, info@cheetahzimbabwe.org

Interviewer:	Date:	Language:
Communal area/Crop farm/Cattle farm/Hunting safaris/Photographic safaris/National Parks/Forestry/Other:		
Area:	Loc X:	Loc Y:
Name reserve/concession/farm:		Fenced: Yes/No
How many households are there in the area:	What is your position in the household:	
Name:	Age:	Sex: Male/Female
Occupation:	Organisation:	
How many years have you worked/lived in this area:		
Do you keep - Cattle: /Donkeys: /Goats: /Sheep: /Pigs: /Chickens: /Dogs: /Cats: /Other		
group survey nr: /individual survey		

Wildlife occurrence (use carnivore montage) & predation

1. What animal is this (show pictures carnivores in alphabetical order)**? How often do you see this animal in your area?**

English	Ndebele	Shona	Unknown/Other	Location/How far from here/in which direction
Aardwolf	Inthuhu/Isangci	Mbizimumwena	?	Where:
Seen	How often:			
African wild cat	Igola	Nhiriri/Gora	?	Where:
Seen	How often:			
African wild dog	Iganyana	Mhumi	?	Where:
Seen	How often:			
Bat-eared fox	Unga	Gava	?	Where:
Seen	How often:			
Black b. Jackal	Ikhanka/Igava	Gava	?	Where:
Seen	How often:			
Brown hyena	Impisi	Bere	?	Where:
Seen	How often:			
Caracal	Ithwane	Ntwana	?	Where:
Seen	How often:			
Cheetah	Ihlosi	Dindingwe	?	Where:
Seen	How often:			
Leopard	Ingwe	Mbada	?	Where:
Seen	How often:			
Lion	Isilwane	Shumba	?	Where:
Seen	How often:			
Serval	Inhlozi	Ndudzi	?	Where:
Seen	How often:			
Side str. Jackal	Ikhanka/Igava	Gava	?	Where:
Seen	How often:			
Spotted hyena	Impisi	Bere	?	Where:
Seen	How often:			

2a. How do you feel about having predators in your area, and why?

***** Additional questions commercial livestock farmers or subsistence farmers *****

2b. Have any of these animals ever caused you problems? Yes (continue with 2c)/No (skip 2c and go to 2d)

2c. Which ones? What kind of problems? How often (e.g. daily, weekly, monthly, yearly)**? Where** (e.g. boma, cage, field)**?**

Animal	Problem	How often	Where

2d. What do you do to prevent predators from killing your livestock?

2e. Who helps you when there is a problem with predators?

2f. Is there a compensation scheme for livestock losses in your area? Yes/No
2g. Who do you apply to?
2h. Compared to 10 years ago have you lost: more livestock to predation/the same/fewer livestock to predation
2i. What are the reasons for this?

****

Cheetah occurrence & attitude towards cheetah (Show the cheetah picture and explain how to identify cheetah) **We now have some more questions about this animal.**

3a. When did you last see cheetahs in Zimbabwe (make sure to note down all details of all memorable cheetah sightings)**?**

Tot nr	Date	Time	Nr Ad	Adult & sex	Nr cubs	Size Cubs (Ad=adult)	Use map to indentify area
				Male: Female:		small/½ Ad size/Ad size	Loc X:
Location:							Loc Y:
						Km from here:	Direction:
				Male: Female:		small/½ Ad size/Ad size	Loc X:
Location:							Loc Y:
						Km from here:	Direction:
				Male: Female:		small/½ Ad size/Ad size	Loc X:
Location:							Loc Y:
						Km from here:	Direction:

3b. How many cheetahs do you think there are in your area?
3c. Do you think the nr of cheetah that live in the area is larger/the same/smaller **than it was 10 years ago?**
3d. What are the reasons for this?
3e. What do you think are the biggest threats to the survival of cheetah in your area?
3f. In your area would you like to have fewer/the same number/more **cheetahs?**
3g. Why?
***** Additional question commercial livestock farmers or subsistence farmers *****
3h. How many livestock would you be willing to lose before you wanted to get rid of a cheetah?
****
3i. How many cheetahs do you think there are in Zimbabwe?
3j. Do you think the that the nr of cheetah in Zimbabwe is larger/the same/smaller **than it was 10 years ago?**
3k. What are the reasons for this?

3l. Are the following statements true or false?

A. Cheetahs can run over 100 km/h	True/False/?		**D.** Cheetahs only occur in Zimbabwe	True/False/?
B. Cheetahs often kill people	True/False/?		**E.** Cheetahs often kill livestock	True/False/?
C. Cheetahs only eat meat	True/False/?		**F.** Cheetahs can breed with domestic cats	True/False/?

4. Do you feel positive or negative about the following animal (use carnivore montage)**? Why?**

African wild dog	-	±	+	?	Why:
Cheetah	-	±	+	?	Why:
Leopard	-	±	+	?	Why:
Lion	-	±	+	?	Why:
Spotted hyena	-	±	+	?	Why:

5. How important do you feel it is to protect wildlife in your area and why?

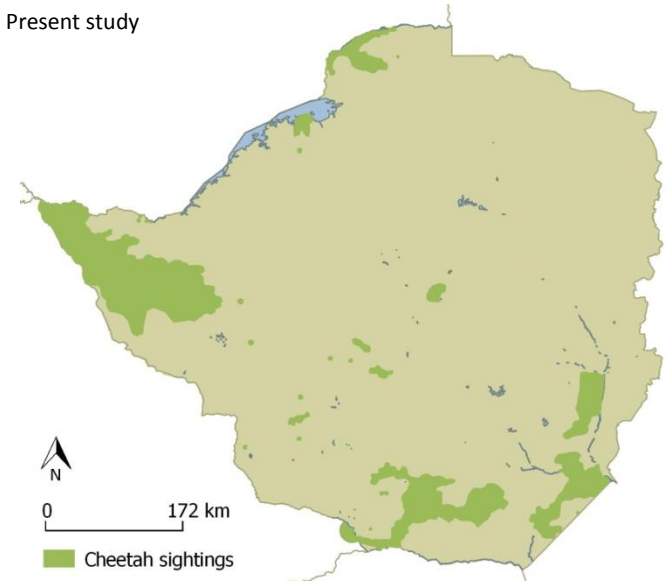
Appendix II - Maps occurrence of thirteen carnivores in Zimbabwe

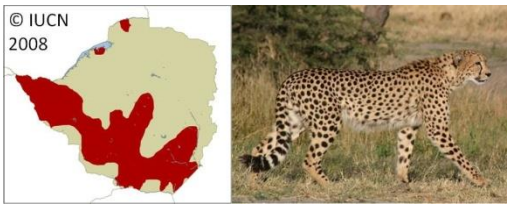
The maps show the areas in which cheetah, aardwolf, African wild cat, African wild dog, bat-eared fox, black backed jackal, brown hyena, caracal, leopard, lion, serval, side striped jackal and spotted hyena were sighted. They only include sightings which were dated ≤ 3 years prior to the interview date, from reliable respondents who correctly identified the carnivore species from the photograph. The cheetah map also includes verified sightings collected via the citizen science component of the study.

When interpreting these maps it should be kept in mind that respondents often struggled to identify small nocturnal species like aardwolf, bat eared fox, caracal and serval (see Table 3, pp. 23). However, misidentification does not necessarily have to mean respondents did not see the species. Therefore, in some areas these small nocturnal species might be underrepresented either because they were seen but not correctly identified or simply because they are difficult to see. Additionally, it was often hard for respondents to tell the difference between African wild cats and domestic cats, it is therefore possible that African wild cats are overrepresented.

Advances in technology have in some cases helped to get a better insight in species occurrence. These days, many professional hunters use camera traps at their baits, which has assisted in the collection of verified sightings of especially brown hyena, black backed jackal and side striped jackal. For lion, leopard and spotted hyena, there are several sightings outside their recognized resident range. For lion these sightings generally represent 'dead ends': animals that were shot as problem animals once they ventured out of their resident range. Nevertheless, the presented maps give an indication of the occurrence of the thirteen carnivores and provide a starting point for further studies.

The maps below show the sightings recorded in this study in green and provide inserts with the latest historical (IUCN) distribution in red, plus general information about the thirteen carnivores[5].



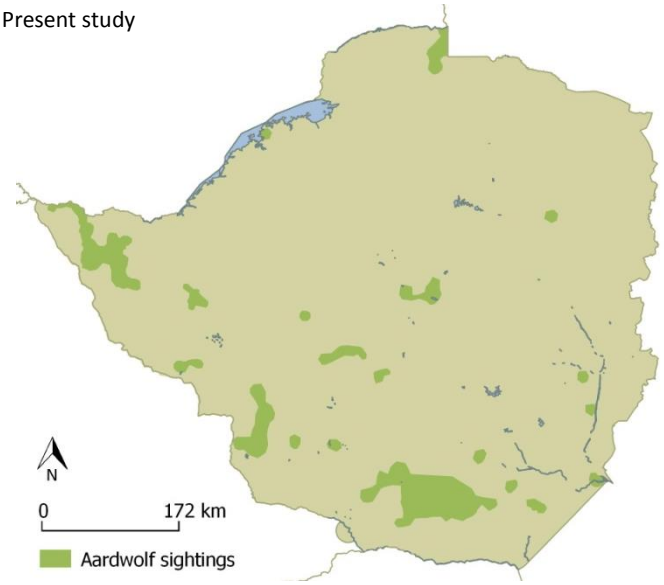


Cheetah

Shoulder height: 0.69-0.86 m
Weight: 36-60 kg
Diet: small to medium sized antelopes
Activity pattern: diurnal, moonlit nights
Social habits: females are solitary, males are solitary or live in male coalitions of 2-3 males (usually brothers)
Habitat: can be found in a wide range of habitats, from open grassland to a range of bush, scrub and woodland habitats
Territory size: 126-1 651 km^2

[5]Data source:
Burger, C. (2011) The mammal guide of Southern Africa. Briza Publications, Pretoria, South Africa.
Roodt, V. (2011) Mammals of Botswana and surrounding areas. Veronica Roodt Publications, Hartbeespoort, South African.
Skinner, J.D., Smithers, R.H.N. (1990) The mammals of the Southern African subregion, 2nd edition. University of Pretoria, Pretoria, South Africa.

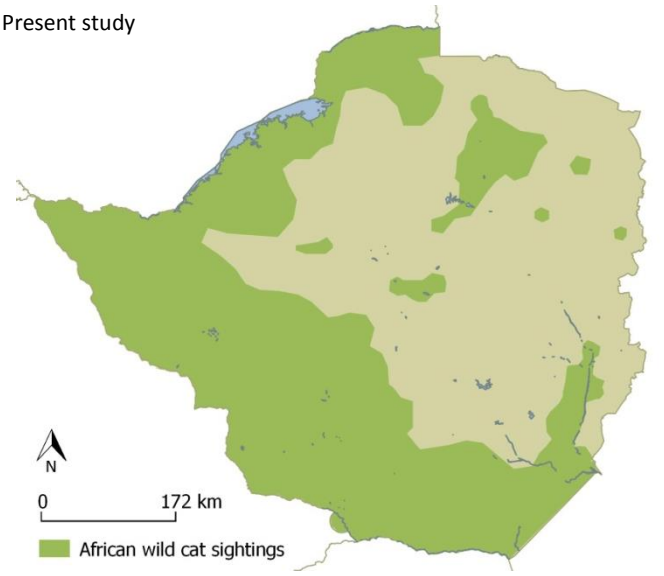
Present study



Aardwolf

Shoulder height: 0.47 m
Weight: 8-10 kg
Diet: termites but also feeds on larvae and other insects if termites are scarce
Activity pattern: nocturnal
Social habits: usually solitary but pairs and family groups are also seen
Habitat: dry open country, open patches around pans, grasslands and dry vleis with sufficient termite mounts
Territory size: 1-4 km^2

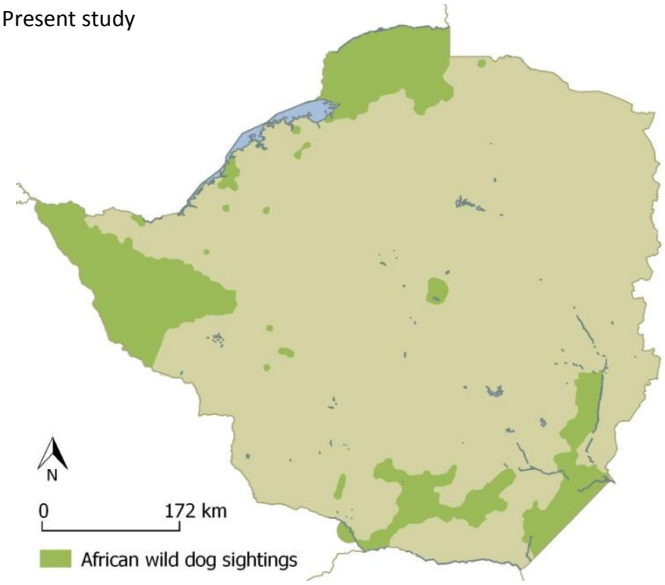
Present study



African wild cat

Shoulder height: 0.35 m
Weight: 3-7 kg
Diet: predominantly rats, mice and gerbils, but also birds, reptiles and insects
Activity pattern: nocturnal
Social habits: solitary, pairs in the mating season
Habitat: can be found everywhere provided there is enough dense thicket, tall grass and rocks for shelter
Territory size: 3-4 km^2

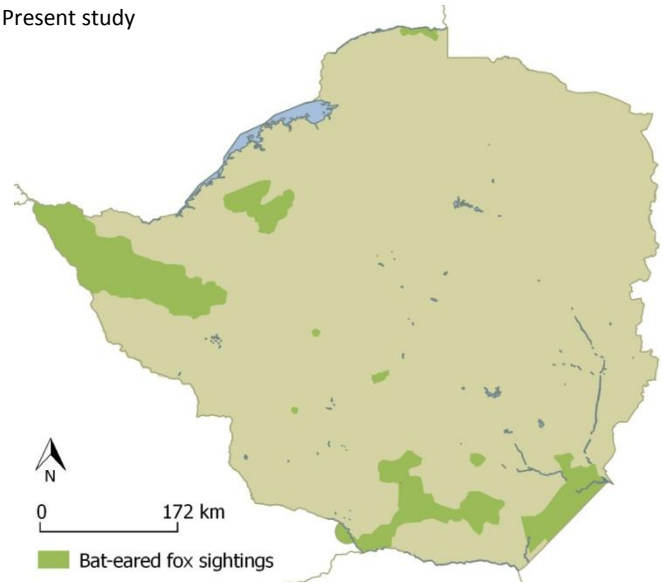
Present study



African wild dog

Shoulder height: 0.60-0.75 m
Weight: 20-32 kg
Diet: small to medium sized ungulates
Activity pattern: diurnal, moonlit nights
Social habits: live in packs of ca. 10-15 animals with an alpha male and female
Habitat: can be found in a wide range of habitats, from open grassland to a range of bush, scrub and woodland habitats
Territory size: 450-650 km^2

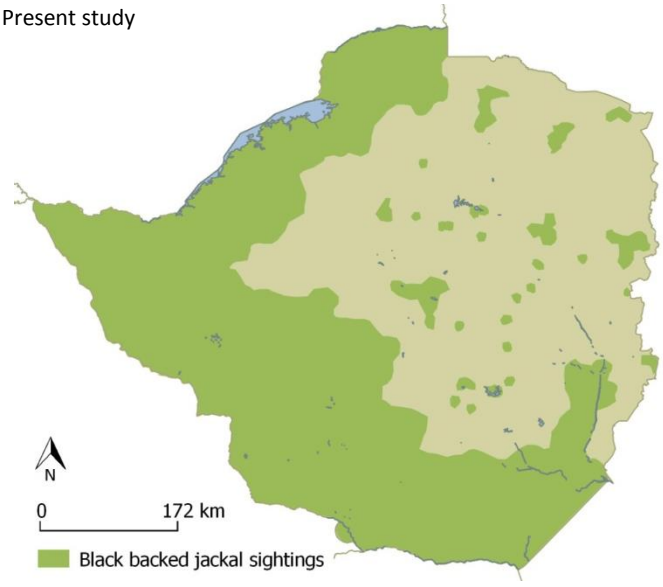
Present study



Bat-eared fox

Shoulder height: 0.30 m
Weight: 3-5 kg
Diet: mainly termites but also ants, insects, scorpions and larvae
Activity pattern: both diurnal and nocturnal
Social habits: pairs or family groups, often mate for life
Habitat: open areas in dry savanna or semi-arid areas, overgrazed areas
Territory size: 1-3 km^2

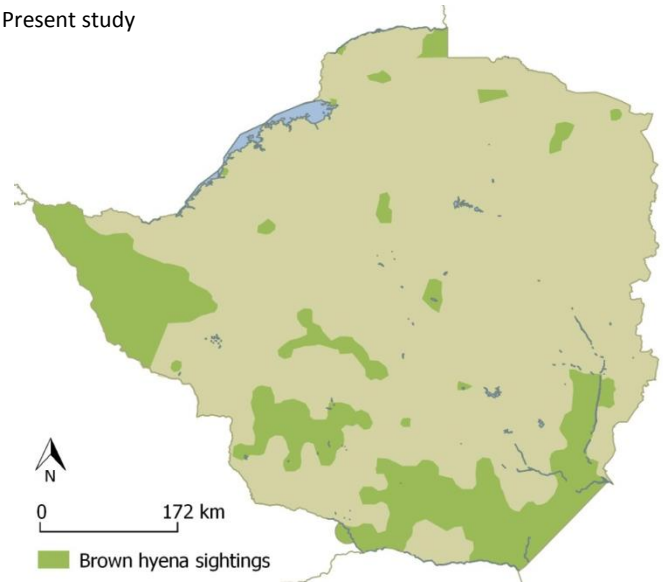
Present study



Black backed jackal

Shoulder height: 0.38 m
Weight: 5-11 kg
Diet: scavenge but also hunt small mammals and birds, known to eat wild fruits and insects
Activity pattern: primarily at dusk and dawn, also nocturnal
Social habits: forage alone but they live in pairs that mate for life
Habitat: they occur in most habitats but avoid well-watered areas
Territory size: 0.5-18 km^2

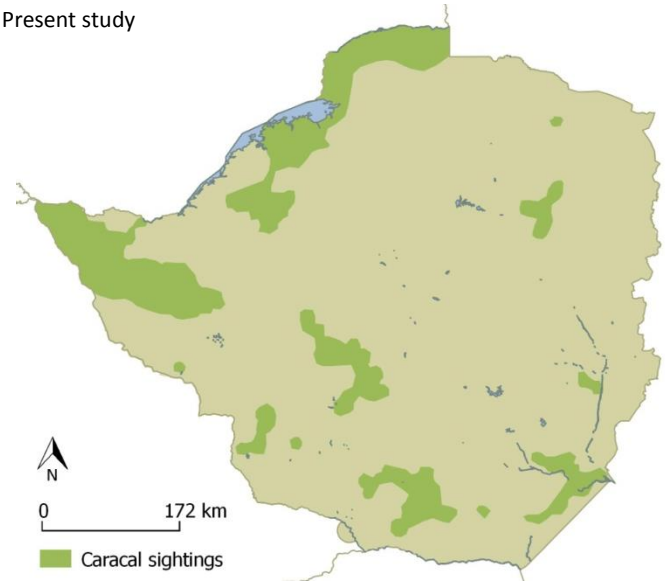
Present study



Brown hyena

Shoulder height: 0.70-0.79 m
Weight: 32-50 kg
Diet: Scavenge but also hunt birds and reptiles, also feed on tubers and melons
Activity pattern:
Social habits: gregarious (loosely organised social structures)
Habitat: dry open woodland or open shrubby areas for shelter
Territory size: 170-480 km^2

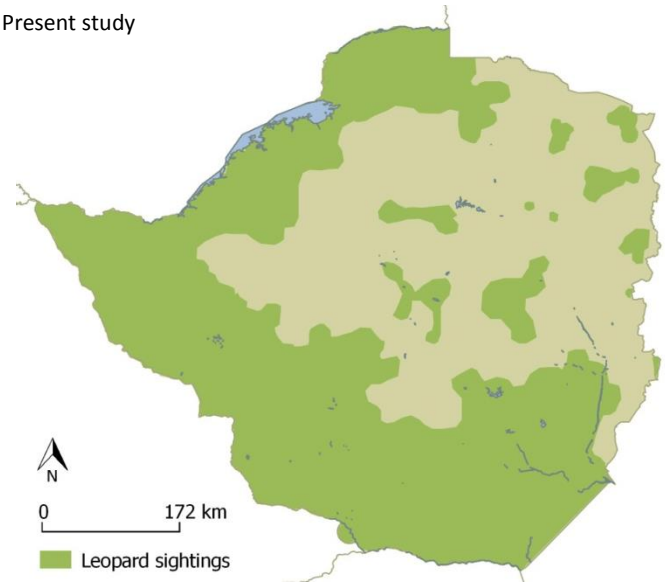
Present study



Caracal

Shoulder height: 0.41-0.44 m
Weight: 10-13 kg
Diet: predominantly birds but also small mammals and reptiles
Activity pattern: mainly nocturnal, active at dusk and dawn
Social habits: solitary, only pair up in the mating season
Habitat: very adaptable, prefer savanna or open patches in woody country
Territory size: 4-65 km^2

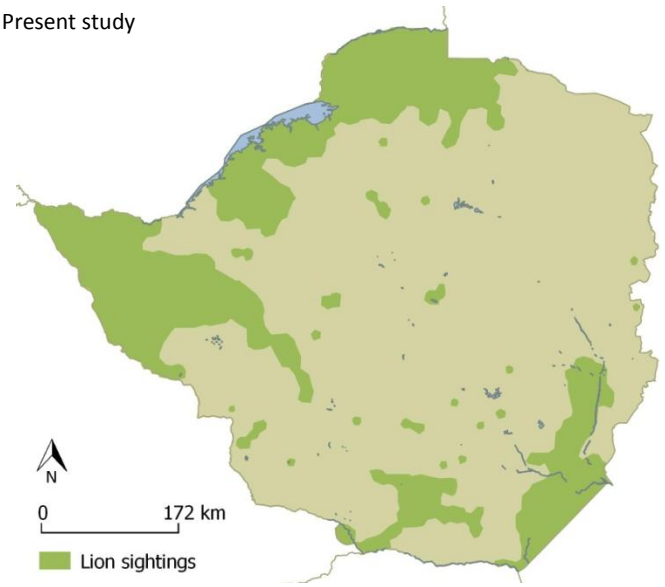
Present study

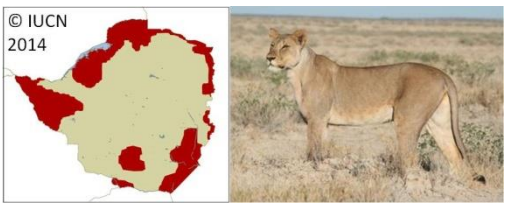


Leopard

Shoulder height: 0.70-0.80 m
Weight: 35-82 kg
Diet: opportunistic, small to medium sized antelopes but also mice, hyraxes and other small animals
Activity pattern: nocturnal
Social habits: solitary, only pair up during the mating season
Habitat: in or near thickets or mountain sides, riverine woodland, also arid areas
Territory size: 13-35 km^2

Present study

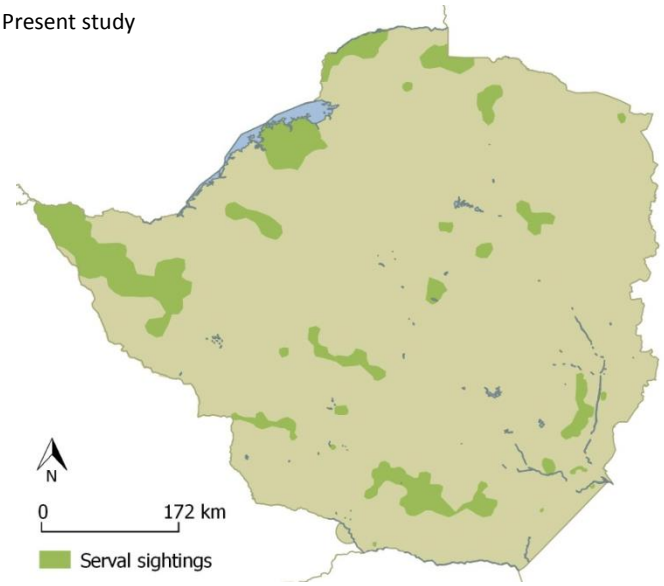




Lion

Shoulder height: 1.00-1.20 m
Weight: 120-250 kg
Diet: large antelopes, buffalo, giraffe but also smaller antelopes and sometimes elephant
Activity pattern: nocturnal
Social habits: prides of 5-30 with 1 or 2 dominant males
Habitat: most types of habitat, open woodland, dry floodplains and arid shrubby veld
Territory size: 20-400 km^2

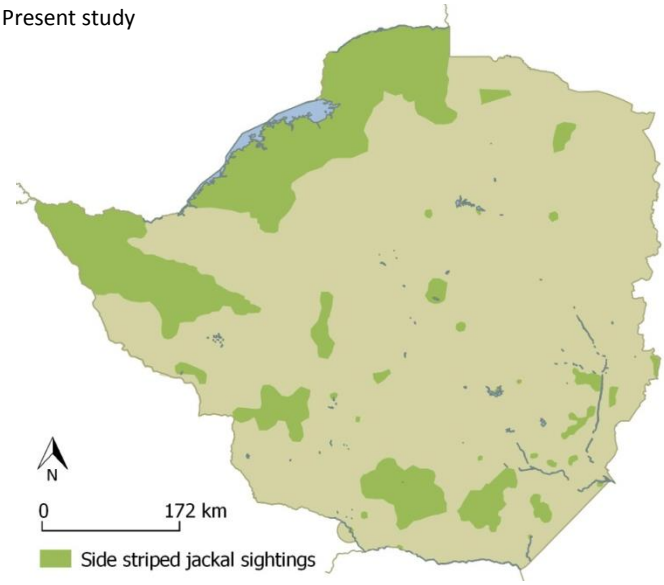
Present study



Serval

Shoulder height: 0.50 m
Weight: 9-14 kg
Diet: rodents, birds, insects and reptiles
Activity pattern: nocturnal, active at dusk and dawn
Social habits: solitary, pair up in the mating season but are sometimes found hunting together
Habitat: tall grass, humid woodlands with sufficient shelter and water
Territory size: 11-20 km^2

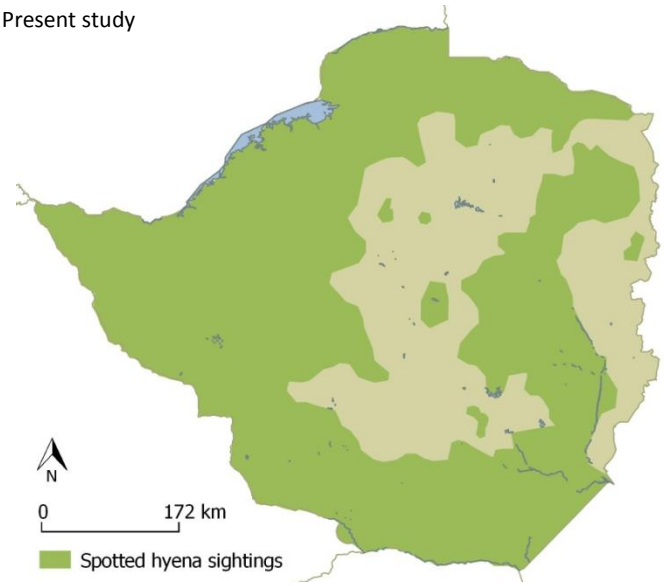
Present study

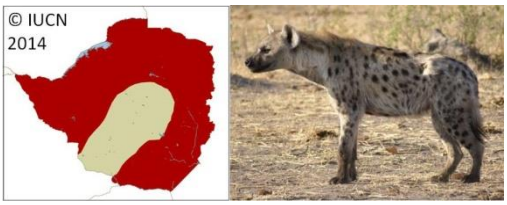


Side striped jackal

Shoulder height: 0.38 m
Weight: 7-12 kg
Diet: scavenge but also hunt small mammals, birds, reptiles and insects, eat wild fruits
Activity pattern: nocturnal, also active at dusk and dawn
Social habits: monogamous pairs and family groups
Habitat: well watered terrain, moist woodland
Territory size: 0.5-4 km^2

Present study





Spotted hyena

Shoulder height: 0.75-0.90 m
Weight: 46-85 kg
Diet: scavenge but also hunt medium sized ungulates
Activity pattern: mainly nocturnal
Social habits: gregarious forming matriarchal clans of 3-11 animals, often forage alone
Habitat: savanna, open plains and woodland
Territory size: 25-1 000 km^2

Appendix III - The Matusadona Cheetahs

Between 1980 and 1990 the then Zimbabwe Department of National Parks and Wildlife Management received an increasing number of requests from farmers in southern Zimbabwe for permits to shoot problem cheetahs (Zank, 1995). In addition, there was strong evidence that commercial farmers illegally killed large numbers of cheetahs (Zank, 1995). In the early 90s the Zimbabwe Department of National Parks and Wildlife Management therefore decided to translocate problem cheetahs from the southern part of the country to Matusadona National Park (MNP) (Zambezi Society, 1993). At that time no resident cheetahs were known to exist in MNP (Zank, 1995). It was assumed that there must once have been cheetahs in this part of the Zambezi Valley, but these cheetahs died out soon after the filling of Kariba Dam (Zambezi Society, 1993). Although no suitability assessment was conducted, the decline in lake level was thought to have resulted in sufficient suitable habitat and a large enough prey-base for a viable cheetah population to become established. It was proposed to reintroduce at least twelve mature individuals of an appropriate sex ratio to ensure a viable founder population (Zambezi Society, 1993).

Cheetahs on transport to Fothergill Island

Between 1993 and 1994, with the assistance of the Zambezi Society and the Matusadona Tour Operators Association, 21 cheetahs were captured opportunistically on commercial farmlands and transported to bomas on Fothergill Island, a peninsula on the northeast of MNP (Zank, 1995). Six individuals died shortly after capture, a total of 15 cheetahs (6 adult males, 5 adults females, 1 sub adult female, 2 juvenile males and 1 juvenile female) were released into the park of which one had to be put down because of a broken foot (Zank, 1995). Several of the MNP cheetahs were radio collared and between 1995 and 2005 the population was regularly monitored and subjected to ecological studies (Zank, 1995; Purchase, 1998; Purchase and Vhurumuku, 2005). An initial viability assessment revealed that, despite sufficient habitat and prey, the population was unlikely to be sustainable unless juvenile mortality was reduced by managing the lion population or a minimum of three cheetahs would be supplemented every three years (Zank, 1995). However, after an initial decline (Table 28), cheetah numbers increased and later studies considered the population viable (Purchase, 1998).

MNP covers 1 370 km^2 of land along the Zimbabwe shore of lake Kariba (028°35'E: 16°50'S), divided into a valley floor of ca. 388-450 km^2 and an escarpment of ca. 1 000 km^2 (Fig. 24). The size of the valley floor depends on the lake level. The foreshore consists of grassland while vegetation in the valley predominantly consists of woodland (*Colospermum mopane,* mixed with *Combretum* spp. and *Terminalia* spp.). The escarpment is characterized by steep valleys and is dominated by miombo woodland. During the dry season water availability in the escarpment is limited. The valley floor is inhabited by several suitable herbivores, including bushbuck *(Tragelaphus scriptus)*, common duiker *(Sylvicapra grimmia)*, impala *(Aepyceros melampus)*, kudu *(Tragelephus strepsiceros)*, warthog *(Phacochoerus africanus)* and waterbuck *(Kobus ellipsipyrmnus)* (Zank, 1995; Purchase, 1998). Both lion *(Panthera leo)*, leopard *(Panthera pardus)* and spotted hyena *(Crocuta crocuta)* occur in MNP (Zank, 1995; Purchase, 2005), all of which are natural enemies of cheetah (Laurenson, 1994; Mills et al., 2004; Hunter et al., 2007).

Since their reintroduction, the MNP cheetahs only utilised ca. 30% of the park: the foreshore was used for hunting while the woodlands in the valley were used for resting and moving, the escarpment was not utilised (Zank, 1995; Purchase, 1998). Within the first two years after release average female home range (n = 3) was 267 km^2 and average male home range (n = 2) 136 km^2 (Zank, 1995), later studies showed these home ranges had been reduced to 23.6 km^2 (n = 1 + cubs) and 53.8 km^2 (n = 2) respectively (Purchase, 1998). Home ranges of both male and female cheetahs showed substantial overlap (Zank, 1995; Purchase, 1998). The MNP cheetahs predominantly predated on impala (75.7-86.6%), but their diet also included waterbuck (6.7-7.3%) and smaller prey items like shrub hares (7.3%) and guinea fowls (6.4%) (Zank, 1995; Purchase, 1998). Although cheetahs showed limited diet overlap with lions, cheetahs showed considerable diet overlap with spotted hyenas (Purchase, 1998).

After an initial post release drop from 11 to 9 adult cheetahs, the number of adult cheetahs in MNP remained stable at 8-9 individuals (Table 28). However, in 2005, it was estimated that the MNP cheetah population had increased to as many as 20 adult cheetahs (Purchase and Vhurumuku, 2005). It was suggested this increase may have been the result of reduced interspecific competition due to a decrease in both the lion and spotted hyena population (Purchase and Vhurumuku, 2005). Because of a drop in tourism, the 2005 estimate was based on spoor surveys rather than the collection of sightings and photographs from tourists and safari operators. Nonetheless, safari operators reported 24 cheetah sightings (Purchase and Vhurumuku, 2005). Based on these sightings there were 17 individual cheetahs (adults, sub adults and cubs) in MNP (Purchase and Vhurumuku, 2005), which is similar to earlier estimates of the MNP cheetah population (Table 28). In the years that followed, the number of cheetahs in MNP decreased dramatically. According to the data collected during Cheetah Conservation Project Zimbabwe's (CCPZ) nationwide cheetah survey, since 2009, the cheetah population in MNP consists of three adult cheetahs: a single female and a coalition of two males (Table 28).

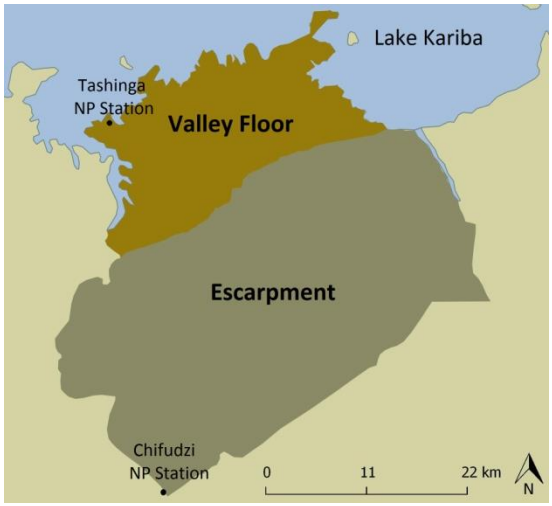


Figure 24. Matusadona National Park

After 2005 the cheetah population of MNP has not been intensively monitored, making it difficult to assess what caused this drastic population decline. Theoretically, in the presence of competing predators, it would require an area much larger than the valley floor (or even MNP) to support a cheetah population of ca. 15 individuals (ca. 2 424 ± 890 km^2 (mean ± SE), see Lindsey et al., 2011c). With the valley floor holding a relatively high density of cheetahs and competing predators it is likely that fluctuations in the size of this small area effect cheetah survival. The size of the foreshore of the valley floor, which is favoured hunting habitat for cheetah, fluctuates with the level of the lake (Purchase and Vhurumuku, 2005). Since 2005, the lake level has increased considerably (Fig. 25). However, this increase is comparable to the increase recorded between 1998 and 2000 (Fig. 25), a period during which the MNP cheetah population remained relatively stable (Table 28).

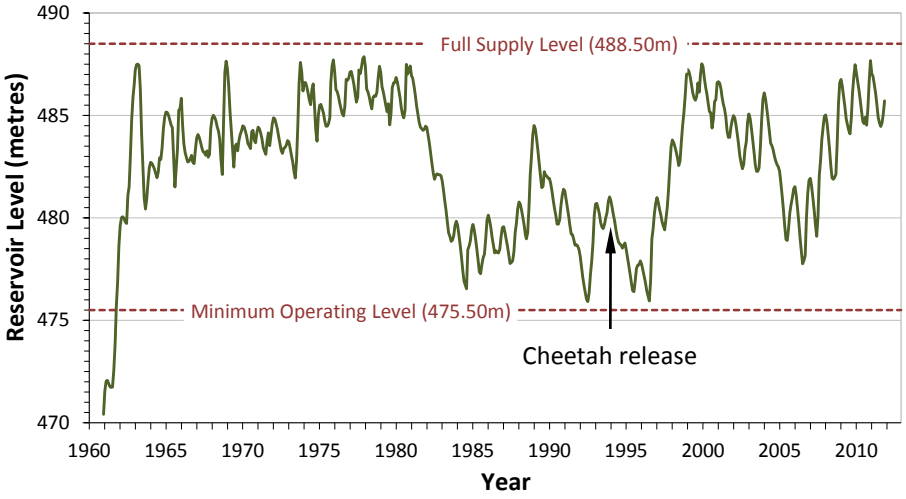


Figure 25. Recorded end of month levels of lake Kariba (data were kindly provided by the Kariba River Authority).

Table 28. Overview of the cheetah population of Matusadona National Park

	Adult			Sub adult			Unknown			Cubs	Total	Date source	Comments
	M	F	U	M	F	U	M	F	U	U			
Release 1993-1994[1]	6	5			1					3	15	Personal observations	One SAF broke a foot shortly after release and had to be put down
1995[1]	4	5								3	12	Personal observations	1 AM poached in the Omay, 1 AF gave birth to 3 cubs in May 1995, faith of 3 AM and one AF unknown
1998[2]	3	2	3				1	3	1	4	17	Personal observations and 28 sightings (some with identification via (tail) markings)	1 AM and 1AF founder population still alive, 12 cheetahs identified based on tail markings and collars (3 AM, 1 AF, 3 FU, 1 MU, 4 cubs), the remaining five cheetah based on non-identified sightings, one AM found dead in a tree by a tour operator
1999[3]			9			3					12	Personal observations and 34 sightings (some with identification via (tail) markings)	
2000[3]			8			8					16	Personal observations and 22 sightings (some with identification via (tail) markings)	
2005[3]											20 adults (±12)	Spoor survey	Based on 24 sightings there were 3AM, 1AF and a sub adult, 1AF and three sub adults, 8AU present in MNP
2009-2015[4]	2	1									3	78 sightings, 23 of which with photographs (identification via coat markings)	

[1]Zank, 1995 [2]Purchase, 1998, [3]Purchase and Vhurumuku, 2005, [4]Present study

Prey availability and competition with larger carnivores are limiting factors for cheetah populations (Lindsey et al., 2011c). Between 2005 and 2009 there have been no prey surveys other than aerial counts. During aerial surveys some herbivore species are not easily detected and might therefore be underestimated, however, aerial surveys provide indices of abundance which can be used to monitor population trends (Dunham, 2012). Since the release of cheetahs in MNP, impala numbers seem to have fluctuated (Table 29), but have not been reduced up to the point where it is likely to have caused the observed cheetah population crash (see Lindsey et al., 2011c). Besides, the 2014 impala estimates are comparable to the 2001 estimates, at which point the cheetah population was stable or even increasing (Table 28, 29). Although buffalo numbers increased, the lion population decreased (Table 30), which should have been beneficial for the cheetah population rather than detrimental (Purchase and Vhurumuku, 2005). There is limited information available on the population trends of the other large carnivores (Table 30), but spotted hyena densities in MNP have been found to decline with lion numbers (Purchase, 2004). Although the leopard population might have increased, a density of 2.30 leopards per 100 km^2 is not exceptionally high compared to other wildlife areas where cheetahs and leopards successfully co-exist (Loveridge, 2012).

Table 29. MNP Valley floor herbivore population estimates aerial surveys

Year	Buffalo	Impala	Kudu	Sable	Waterbuck	Warthog	Zebra
1996[1]	935	Unknown	87	0	182	Unknown	194
1997[2]	420	7 431	55	Unknown	159	Unknown	32
2001[3]	657	1 417	37	0	19	Unknown	15
2006[4]	0	2 745	113	0	114	56	80
2014[5]	430	1 134	6	0	65	0	0

[1]Mackie, 1997 [2]Mackie, 1998 [3]Mackie, 2002 [4]Dunham et al., 2006 [5]Dunham et al., 2015

Table 30. MNP Valley floor lion, spotted hyena and leopard densities (individuals/100 km^2)

Year	Lion	Spotted hyena	Leopard	Data source
1995	22.00	8.00	Unknown	Observations, sightings and call ups (Zank, 1995)
1998	31.70	13.00	Unknown	Observation, sightings and call ups (Purchase, 1998)
1999	23.00	4.00	Unknown	Observations, sightings and call ups (Purchase, 2004)
2005	7.00	Unknown	Unknown	Spoor survey (Purchase and Vhurumuku, 2005)
2011	2.10	Unknown	2.30	Spoor survey (personal communication A. Loveridge)

Disease related mortality of wild cheetahs is minimal, but cheetahs have been found to be susceptible to outbreaks of anthrax (Lindeque et al., 1998). There are no available records of anthrax outbreaks in MNP between 2005 and 2009. Although carnivore and herbivore densities declined, the number of buffalo, a species highly vulnerable to anthrax (Hugh-Jones and de Vos, 2002), increased, making an anthrax outbreak unlikely.

Anthropogenic mortality could have played a role in a reduction of cheetah numbers. Straight after release, several of the cheetahs moved into the neighbouring communal lands, resulting in at least one individual being killed in a wire snare (Zank, 1995). However, during later studies cheetah movement into communal areas seemed to be limited and although surrounding communities reported some livestock losses to cheetahs, these losses were minimal and subsistence farmers did not regard cheetah as a problem animal (Purchase and Vhurumuku, 2005). It is possible that rather than cheetahs moving out, communities moved into MNP to illegally hunt wildlife. Bush meat poaching with wire snares increased in the early 2000s but peaked in 2007 and 2008 when, due to price controls, groceries became less available (Lindsey et al., 2011b). Although poaching is likely to have contributed to the population decline of other species, it is unlikely to be the single cause of the crash of the MNP cheetah population. Since their release, the MNP cheetahs have predominantly utilised the valley floor, an area where due to its visibility and infrastructure, poaching is less likely to go unnoticed. Yet there are no available records of cheetahs being poached. In addition, poaching activity seemed to be most prevalent in the escarpment close to the surrounding communal areas (Dunham et al., 2006).

Although the MNP cheetah population has been relatively well studied, the reasons behind the post release decline and increase of the population are unclear (Purchase and Vhurumuku, 2005). Accordingly, there does not seem to be one single explanation for the drastic reduction in of MNP cheetah numbers as found in this study and it is likely that a combination of several (cascading) factors has resulted in the observed population crash. Because translocations of cheetahs generally have low success rates and come with substantial economic costs, it is not considered a preferred conservation tool (Weise et al., 2014, 2015; Boast et al., 2015). Especially with cheetahs only utilising the ca. 400 km^2 valley floor, the MNP is a very small wildlife protected area. MNP is surrounded by communal land, which severely restricts the dispersal abilities of the wide ranging cheetah. This limitation in dispersal abilities in combination with a lack of understanding of the ecological drivers behind fluctuations of the MNP cheetah population, make it unadvisable to consider future translocations of cheetah into MNP. In order to support cheetah conservation in Zimbabwe, the limited available conservation resources are best spend on securing existing healthy cheetah populations.

Coalition of two cheetah males MNP

Single cheetah female MNP

Appendix IV - Living with carnivores

Reasons for respondent in different professions to feel positive, negative or neutral about living with carnivores, reasons given by ≥ 10% of the respondents with a certain occupation are highlighted in light green, reasons given by ≥ 20% are highlighted in dark green. Respondents did not necessarily give a reason that matched their feeling, respondents who felt neutral generally gave a positive and a negative reason.

		Total	ZPWMA gen	ZPWMA mgmt	Forestry Commission gen	Forestry Commission mgmt	CAMPFIRE gen	CAMPFIRE mgmt	RDC natural resource officers	Hunting gen	Hunting mgmt	Hunting professional hunters	Photographic gen	Photographic mgmt	Photographic safari guides	Commercial livestock gen	Commercial livestock mgmt	Subsistence farmers	Other
Negative	As long as there is a balance, there are not too many	1.7	0.7	1.8							2.5	**15.7**		**16.7**	2.1				3.4
	Kill too much prey	1.4	1.1	1.8	4.3						**10.0**	4.3		8.3	2.1				
	Dangerous to people	7.4	4.4		8.7	**16.7**	2.8	9.1	**46.4**	8.9	5.0		6.5			**40.0**	7.3	**13.3**	8.5
	Kill livestock	**13.9**	2.8	5.5	**13.0**	**13.3**	**44.4**	**45.5**	**39.3**	6.3	5.0	7.1		**16.7**		**20.0**	**31.7**	**76.7**	**10.2**
	We like the carnivores that do not cause problems, not the ones that kill livestock	3.5	1.8	5.5	2.2	3.3	2.8		3.6	2.5			3.2				**17.1**	**11.1**	8.5
	Should be in a national park or fenced area for all to see and learn from, not in the community where they kill livestock and are dangerous to people	2.6	1.6	5.5	6.5	16.7	2.8	9.1	7.1	0.6			9.7		2.1			5.6	
Positive	Ecological role, sign of a healthy ecosystem, part of nature	**21.8**	**26.2**	**30.9**	**13.0**	**33.3**	**11.1**	**18.2**	7.1	5.7	**32.5**	**41.4**	9.7	**41.7**	**62.5**		**19.5**	1.1	**18.6**
	They have aesthetic value and add diversity	2.6	3.7	1.8	2.2					3.2	5.0	2.9			2.1	**15.0**			1.7
	I love wildlife, like all wildlife	5.8	7.6	7.3	4.3		2.8			0.6	**17.5**	**14.3**	9.7	**16.7**	4.2		9.8		1.7
	For myself, my family and others to see, enjoy and learn from	**12.6**	**13.1**	1.8	6.5	6.7	**16.7**	9.1		**19.6**	**10.0**	**17.1**	**38.7**	8.3	**14.6**	**15.0**	7.3	2.2	**11.9**
	Good for photographic tourism, provide revenue through tourism	7.0	9.9	5.5	**13.0**	3.3	2.8	9.1		1.9			**12.9**	**25.0**	**31.3**			2.2	5.1
	Good for trophy hunting, provide revenue through hunting	4.4	2.3		**13.0**	6.7	2.8		3.6	7.0	**10.0**	**12.9**				**20.0**	7.3	1.1	1.7
	Good for tourism, provide revenue, economic growth, jobs and development through hunting and photographic safaris	7.0	6.4	7.3			**27.8**	**36.4**	3.6	**13.9**	**10.0**	8.6							**10.2**
	They are part of our natural and cultural heritage which we have to conserve for future generations to see, learn and benefit from	6.6	8.7	7.3	**10.9**		8.3	**18.2**	3.6	7.6	5.0	2.9	**12.9**		4.2		4.9		5.1
	Proud to have these animals, other countries/areas don't	1.9	3.4	1.8				9.1	3.6	1.9		1.4							1.7
	They help me make a living, provide me with a job	2.7	2.3		2.2		5.6			7.0		7.1	3.2		2.1				3.4
	Assist me in my job by keeping poachers out of the area	1.1	0.9	3.6	4.3					2.5									1.7
	Part of my job to like, live with and conserve these animals	8.9	**12.2**	**16.4**	8.7	**10.0**	8.3			**12.0**	5.0	2.9	9.7		6.3	5.0			8.5
	We got to know their behaviour and learned to live with them	5.5	6.0	7.3	2.2	3.3			3.6	**11.4**			**25.8**			5.0	9.8		5.1
	Harmless, cause no problems	5.5	8.3	9.1	2.2	6.7	**11.1**		3.6	6.3	2.5	1.4				5.0	2.4		6.8
	It is our duty to protect wildlife, wildlife has the right to live, God's creation	2.2	2.5	3.6		6.7	2.8	**18.2**	3.6	1.3	7.5	2.9							1.7
	Other	2.8	2.1	9.1		6.7	5.6		3.6	2.5	7.5	2.9					4.9	3.3	1.7

Appendix V - African wild dog

Reasons for respondent to feel positive, neutral or negative about African wild dog, reasons given by ≥ 10% of the respondents with a certain occupation are highlighted in light green, reasons given by ≥ 20% are highlighted in dark green. Respondents did not necessarily give a reason that matched their feeling, respondents who felt neutral generally gave a positive and a negative reason.

		Total	ZPWMA gen	ZPWMA mgmt	Forestry Commission gen	Forestry Commission mgmt	CAMPFIRE gen	CAMPFIRE mgmt	RDC natural resource officers	Hunting gen	Hunting mgmt	Hunting professional hunters	Photographic gen	Photographic mgmt	Photographic safari guides	Commercial livestock gen	Commercial livestock mgmt	Subsistence farmers	Other
Negative	As long as there is a balance, there are not too many	1.8	2.1					9.1	7.1	0.6	7.5	4.3	3.2		2.1				1.7
	Kill too much prey	**11.7**	**10.8**	9.1	**17.4**	**10.0**	2.8			**12.7**	**17.5**	**41.4**	**16.1**	**16.7**	2.1	**10.0**	7.3		**15.3**
	Disturb prey, chase prey away	1.3	0.7		2.2					1.3	5.0	8.6					2.4		1.7
	I do not like the way they hunt and kill	3.2	3.4	3.6	4.3	**13.3**		**18.2**	3.6	1.9	2.5	1.4	3.2				**12.2**	1.1	1.7
	Carry diseases like rabies	1.3	0.5		4.3		2.8	9.1	**17.9**		5.0	1.4				5.0		1.1	
	Ugly, smelly, not nice or interesting	1.2	0.9			3.3		9.1	7.1	0.6		1.4				5.0	2.4	1.1	1.7
	Provides no benefits or revenue	1.3	0.5					9.1	3.6	1.9		7.1	3.2						5.1
	Dangerous to people	4.2	3.9	1.8		**20.0**	2.8		**10.7**	6.3						**15.0**	2.4	7.8	3.4
	Kill livestock	**13.5**	3.2	1.8	**30.4**	**26.7**	**13.9**	**18.2**	**35.7**	**13.9**	7.5	7.1	6.5	8.3	2.1	**30.0**	**14.6**	**63.3**	**10.2**
	Should be in the park not in communities where they are a problem	3.2	1.6	**10.9**	2.2	3.3	2.8		3.6	4.4	5.0	1.4	9.7				2.4	7.8	1.7
Positive	Ecological role, sign of a healthy ecosystem	8.2	6.7	**16.4**	2.2		8.3		7.1	1.9	**27.5**	**20.0**	3.2	**25.0**	**22.9**		9.8	1.1	**11.9**
	I like the way they hunt as a team, high hunting success	5.8	7.6	5.5		6.7	2.8		3.6	1.3	**12.5**	5.7	**12.9**		**14.6**		4.9		**10.2**
	I like their social system, like a family	4.6	4.4	9.1	2.2						**10.0**	4.3	6.5	**16.7**	**27.1**		4.9		8.5
	Chase lions and other carnivores away	0.7			2.2		8.3				2.5							3.3	1.7
	Beautiful, nice, interesting, add diversity, special to see	**20.4**	**24.6**	**25.5**	**17.4**	**13.3**	8.3	**18.2**	3.6	**15.8**	**17.5**	**32.9**	9.7	**41.7**	**37.5**	**10.0**	**31.7**	2.2	**16.9**
	Rare, endangered, specially protected, should not go extinct	9.5	**14.0**	**29.1**	2.2	3.3	5.6			3.2	**10.0**	2.9	6.5	**16.7**	**18.8**		4.9	1.1	**11.9**
	Part of the bush, nature, Zimbabwe, Africa	2.0	1.6		2.2			9.1		1.9	7.5	5.7		8.3			2.4		5.1
	I like all wildlife, want to conserve all wildlife	3.1	3.4	3.6	2.2	3.3	5.6		3.6	3.2		2.9		**16.7**	4.2		7.3		1.7
	For me, my family and others to see, enjoy and learn from	3.6	5.1	1.8						7.0	2.5	4.3	9.7						3.4
	For tourists to see, provide revenue through photographic tourism	8.5	**12.0**	**12.7**	4.3		5.6	9.1		**12.0**	5.0		**19.4**		**16.7**				6.8
	For trophy hunting, provide revenue through hunting	0.7	0.5				2.8	9.1		2.5		1.4							
	Natural heritage for future generations to see, learn and benefit from	2.3	2.5	1.8	2.2	6.7	5.6			4.4	2.5							1.1	3.4
	Has the right to live, God's creation	2.4	1.4	5.5	4.3	3.3				3.8		5.7			8.3		7.3		
	Harmless, cause no problems	3.8	4.1	5.5	2.2	3.3	5.6		3.6	1.9	2.5	1.4	3.2	8.3	2.1	5.0	2.4	5.6	8.5
	Not dangerous to people	5.7	6.4	1.8	6.5		8.3	**18.2**		9.5	5.0	1.4	**12.9**	**16.7**		**15.0**		3.3	3.4
	Does not kill livestock	2.3	0.9	1.8	4.3	3.3	**13.9**	9.1		2.5			6.5			5.0	2.4	5.6	1.7
	I am not familiar with it, do not know it	3.0	2.1	1.8	4.3	6.7	5.6	9.1	7.1	2.5						5.0	**17.1**	5.6	
	Other	5.5	8.0	1.8	6.5	6.7	8.3		**10.7**	4.4		1.4			4.2	5.0	7.3		8.5

Appendix V - Cheetah

Reasons for respondent to feel positive, neutral or negative about cheetah, reasons given by ≥ 10% of the respondents with a certain occupation are highlighted in light green, reasons given by ≥ 20% are highlighted in dark green. Respondents did not necessarily give a reason that matched their feeling, respondents who felt neutral generally gave a positive and a negative reason.

		Total	ZPWMA gen	ZPWMA mgmt	Forestry Commission gen	Forestry Commission mgmt	CAMPFIRE gen	CAMPFIRE mgmt	RDC natural resource officers	Hunting gen	Hunting mgmt	Hunting professional hunters	Photographic gen	Photographic mgmt	Photographic safari guides	Commercial livestock gen	Commercial livestock mgmt	Subsistence farmers	Other
Negative	As long as there is a balance, there are not too many	0.1					2.8											1.1	
	Kills too much prey	1.2	0.7		6.5					2.5	2.5	1.4				5.0			3.4
	Provides no benefits or revenue	0.6						9.1	3.6			1.4						3.3	1.7
	Dangerous to people	3.4	2.5	1.8	8.7	3.3	2.8		**10.7**	1.9	2.5					5.0	7.3	**12.2**	3.4
	Kill livestock	5.4	1.4	1.8	8.7		5.6		7.1	3.8		1.4				**10.0**	**12.2**	**40.0**	3.4
	Should be in the park not in communities where they are a problem	2.5	0.7	1.8	2.2	6.7			3.6	1.9	7.5		6.5		2.1		2.4	**12.2**	1.7
Positive	Ecological role, sign of a healthy ecosystem	5.1	3.4	7.3					7.1	0.6	**17.5**	**14.3**		**25.0**	**20.8**		9.8		**10.2**
	Does not kill much prey	4.9	3.7	3.6	4.3	6.7	2.8	9.1		3.8	**10.0**	**14.3**	**12.9**	**16.7**	6.3		4.9		8.5
	I like the way it hunts, its speed	7.4	9.0	**10.9**	2.2	6.7	2.8	9.1	**32.1**	3.2	**17.5**	2.9	6.5	**16.7**	8.3		9.8	1.1	8.5
	Shy, elusive, peaceful	2.8	1.6	**10.9**		3.3		9.1	7.1	1.9	2.5		3.2		4.2		4.9	3.3	8.5
	Beautiful, nice, interesting, add diversity, special to see	**32.0**	**35.9**	**41.8**	**26.1**	**43.3**	**27.8**	**45.5**	**57.1**	**26.6**	**27.5**	**44.3**	**38.7**	**33.3**	**33.3**	**20.0**	**48.8**	5.6	**28.8**
	Rare, endangered, specially protected, should not go extinct	7.1	**11.0**	**25.5**	2.2	**10.0**	5.6	9.1		1.9	5.0	2.9	3.2		**12.5**	5.0	7.3		1.7
	Part of the bush, nature, Zimbabwe, Africa	1.5	1.4							1.3	2.5	4.3		8.3	4.2				5.1
	I like all wildlife, want to conserve all wildlife	3.3	2.3	3.6	2.2		5.6			3.2	**10.0**	8.6		**16.7**	**10.4**		9.8		1.7
	For me, my family and others to see, enjoy and learn from	6.7	9.7	3.6	8.7	**10.0**	5.6			7.6	2.5	5.7	3.2		2.1	**15.0**	2.4	4.4	5.1
	For tourists to see, provide revenue through photographic tourism	**11.8**	**17.9**	**23.6**	**13.0**	**13.3**	**11.1**	**36.4**	7.1	**10.1**	5.0	4.3	6.5		8.3	5.0		4.4	6.8
	For trophy hunting, provide revenue through hunting	3.4	3.0		2.2	3.3	8.3	**36.4**	3.6	8.9	2.5	2.9				5.0		2.2	1.7
	Natural heritage for future generations to see, learn and benefit from	3.1	3.9	5.5	2.2		2.8	9.1		3.8	2.5		9.7				4.9	1.1	3.4
	Has the right to live, God's creation	2.2	0.5	3.6						1.9	5.0	8.6			**10.4**		**12.2**	1.1	
	Harmless, cause no problems	8.2	8.5	**16.4**	8.7		**13.9**	**18.2**		9.5	**10.0**	8.6	6.5		4.2		2.4	**12.2**	**10.2**
	Not dangerous to people	**13.0**	**12.9**	**20.0**	**15.2**	**16.7**	**22.2**	**36.4**	7.1	**20.3**	**17.5**	4.3	**25.8**	8.3	2.1	**25.0**	**12.2**	4.4	**10.2**
	Does not kill livestock	5.7	4.4	7.3	**13.0**	3.3	**19.4**	9.1	3.6	8.9	2.5	2.9	6.5			**20.0**	**14.6**	6.7	3.4
	Skin used for traditional purposes	0.2	0.2			3.3													
	Can be tamed	0.6	0.5			3.3						1.4			2.1				3.4
	I am not familiar with it, do not know it	1.7	1.4	1.8	2.2	6.7			3.6	3.2	2.5							3.3	1.7
	Other	5.0	6.4	1.8		3.3	5.6		3.6	3.8	5.0	8.6			**12.5**		2.4	3.3	**10.2**

Appendix V - Leopard

Reasons for respondent to feel positive, neutral or negative about leopard, reasons given by ≥ 10% of the respondents with a certain occupation are highlighted in light green, reasons given by ≥ 20% are highlighted in dark green. Respondents did not necessarily give a reason that matched their feeling, respondents who felt neutral generally gave a positive and a negative reason.

		Total	ZPWMA gen	ZPWMA mgmt	Forestry Commission gen	Forestry Commission mgmt	CAMPFIRE gen	CAMPFIRE mgmt	RDC natural resource officers	Hunting gen	Hunting mgmt	Hunting professional hunters	Photographic gen	Photographic mgmt	Photographic safari guides	Commercial livestock gen	Commercial livestock mgmt	Subsistence farmers	Other
Negative	As long as there is a balance, there are not too many	0.3	0.2		2.2								3.2						1.7
	Kill too much prey	0.7	0.7		4.3					1.3									3.4
	Dangerous to people	**12.2**	9.7	9.1	**26.1**	**16.7**	**11.1**	**18.2**	**32.1**	**15.8**	7.5		**16.1**		2.1	**25.0**	**12.2**	**25.6**	**10.2**
	Kill livestock	**12.0**	5.7	7.3	**10.9**	**13.3**	**13.9**	**18.2**	**14.3**	8.2	5.0	1.4	6.5		4.2	**20.0**	**34.1**	**58.9**	**16.9**
	Should be in the park not in communities where they are a problem	2.6	1.6	1.8		**10.0**		9.1	3.6	2.5	5.0		6.5				2.4	**10.0**	1.7
Positive	Ecological role, sign of a healthy ecosystem	5.6	3.7	9.1		3.3	5.6	9.1	3.6	0.6	**20.0**	7.1		**33.3**	**16.7**	5.0	**19.5**		**15.3**
	Does not kill too much prey	3.3	2.5	1.8	6.5	3.3	2.8	9.1		4.4	**20.0**	5.7	6.5	8.3					1.7
	I like the way it hunts	2.1	1.8	1.8		3.3	2.8		**14.3**	2.5	5.0	4.3					4.9		
	Shy, elusive, calm	4.3	5.1	7.3	2.2	**10.0**			7.1	1.3	7.5	1.4	6.5	8.3	**10.4**		4.9	1.1	5.1
	Adaptable, clever, survivor	3.3	3.0			3.3	2.8				2.5	**14.3**		**33.3**	8.3		7.3		6.8
	Beautiful, nice, interesting, add diversity, special to see	**28.1**	**30.6**	**27.3**	**17.4**	**26.7**	**27.8**	**27.3**	**39.3**	**20.9**	**37.5**	**42.9**	**32.3**	**25.0**	**47.9**	**15.0**	**51.2**	6.7	**30.5**
	Rare, endangered, should not go extinct	1.9	3.2	1.8		6.7				0.6	2.5				2.1		2.4		3.4
	Part of the bush, nature, Zimbabwe, Africa	1.4	0.9	1.8							5.0	4.3			4.2		4.9		5.1
	I like all wildlife, want to conserve all wildlife	3.3	2.3	7.3	2.2		5.6			3.8	**10.0**	5.7		**16.7**	**10.4**		7.3		1.7
	For me, my family and others to see, enjoy and learn from	3.3	4.6	5.5	4.3	3.3				3.2		1.4			2.1	5.0	2.4		8.5
	For tourists to see, provide revenue through photographic tourism	**13.8**	**20.7**	**29.1**	**10.9**	**13.3**	**19.4**	**36.4**	7.1	9.5	**15.0**	**10.0**	6.5		**12.5**			3.3	**11.9**
	For trophy hunting, provide revenue through hunting	**14.0**	**11.0**	**20.0**	**13.0**	**10.0**	**38.9**	**36.4**	3.6	**27.8**	**17.5**	**35.7**				**10.0**	**12.2**	4.4	**15.3**
	Natural heritage for future generations to see, learn and benefit from	2.6	3.2	3.6				9.1		2.5	2.5		9.7			5.0	2.4	2.2	3.4
	Has the right to live, God's creation	1.5	0.7	3.6						0.6	2.5	4.3			**10.4**		4.9		1.7
	Harmless, cause no problems	4.1	5.1	1.8	4.3		**11.1**	9.1	3.6	7.0	2.5	4.3	9.7			5.0		3.3	
	Not dangerous to people (unless provoked)	9.3	**11.5**	**10.9**	4.3	**20.0**	**16.7**	**18.2**	7.1	**12.7**	**10.0**	2.9	**12.9**	8.3	2.1	**25.0**	2.4	4.4	5.1
	Does not kill livestock	2.2	1.6	3.6	6.5		**11.1**			2.5	2.5	1.4				5.0	4.9	5.6	
	Scare away poachers	0.5	0.9							0.6									1.7
	Skin used for traditional purposes	0.3	0.7			3.3													
	It is my totem	0.3	0.5						3.6						2.1				
	I am not familiar with it, do not know it	1.1	1.4		4.3	3.3			7.1	0.6								1.1	
	Other	4.1	5.5	1.8	2.2		2.8		7.1	5.7	2.5	4.3	3.2		4.2		2.4		8.5

Appendix V - Lion

Reasons for respondent to feel positive, neutral or negative about lion, reasons given by ≥ 10% of the respondents with a certain occupation are highlighted in light green, reasons given by ≥ 20% are highlighted in dark green. Respondents did not necessarily give a reason that matched their feeling, respondents who felt neutral generally gave a positive and a negative reason.

		Total	ZPWMA gen	ZPWMA mgmt	Forestry Commission gen	Forestry Commission mgmt	CAMPFIRE gen	CAMPFIRE mgmt	RDC natural resource officers	Hunting gen	Hunting mgmt	Hunting professional hunters	Photographic gen	Photographic mgmt	Photographic safari guides	Commercial livestock gen	Commercial livestock mgmt	Subsistence farmers	Other
Negative	As long as there is a balance, there are not too many	2.9	1.6	1.8	2.2						**17.5**	**12.9**	6.5	8.3	6.3				6.8
	Kill too much prey	2.8	3.9				2.8			1.3	7.5	7.1	6.5	8.3	2.1		4.9		
	Negative impact on other carnivores, kill other carnivores	0.7	0.7	1.8	2.2						2.5		3.2		2.1				
	Boring, common	0.4			2.2										6.3		2.4		
	Dangerous to people	**28.5**	**26.2**	**14.5**	**43.5**	**43.3**	**30.6**	**54.5**	**42.9**	**39.2**	**10.0**		3.2	**25.0**	**10.4**	**70.0**	**39.0**	**44.4**	**25.4**
	Kill livestock	**19.0**	**12.9**	**12.7**	**21.7**	**13.3**	**41.7**	**27.3**	**10.7**	**13.9**	**12.5**	2.9	**12.9**		8.3	**40.0**	**31.7**	**73.3**	**13.6**
	Should be in the park not in communities where they are a problem	6.1	4.6	9.1	4.3	6.7	5.6	**27.3**	**10.7**	3.8	5.0	5.7	**16.1**		2.1		**14.6**	**11.1**	5.1
Positive	Ecological role, sign of a healthy ecosystem	6.2	4.1	**18.2**		3.3	2.8		**14.3**	1.3	**20.0**	**10.0**		**25.0**	**22.9**		9.8		**10.2**
	Does not kill too much prey	0.8	0.9						3.6	1.9	2.5						2.4		
	I like the way they hunt	1.6	2.5	1.8		3.3			3.6			1.4	3.2	8.3	2.1				1.7
	I like their social system, like a family	0.9	0.7	1.8		3.3			3.6				3.2		4.2		2.4		1.7
	King of the jungle, impressive, powerful	6.2	6.2	3.6	6.5	**10.0**	2.8		7.1	0.6	**10.0**	**12.9**		**33.3**	**12.5**		**19.5**		8.5
	Beautiful, nice, interesting, add diversity, good to see, nice noise	**13.1**	**14.9**	**12.7**	**17.4**	**10.0**		9.1	7.1	**15.2**	5.0	**28.6**	**12.9**	**16.7**	**10.4**	5.0	**12.2**	3.3	**10.2**
	Rare, endangered, should not go extinct	0.7	0.7				2.8			0.6	2.5				2.1		2.4		1.7
	Part of the bush, nature, Zimbabwe, Africa	1.6	0.5	1.8							**10.0**	**10.0**			4.2		2.4		3.4
	I like all wildlife, want to conserve all wildlife	3.1	1.8	5.5			2.8			4.4	7.5	7.1		**16.7**	**10.4**		4.9		1.7
	For me, my family and others to see, enjoy and learn from	3.7	6.4	1.8	2.2	3.3				1.3		1.4	6.5			**10.0**	7.3	2.2	3.4
	For tourists to see, provide revenue through photographic tourism	**18.9**	**26.2**	**38.2**	**15.2**	**13.3**	**16.7**		**14.3**	**15.8**	**20.0**	**11.4**	**22.6**		**31.3**			3.3	**11.9**
	For trophy hunting, provide revenue through hunting	**10.8**	9.2	**14.5**	**10.9**	**10.0**	**25.0**	9.1	3.6	**22.2**	**20.0**	**17.1**					4.9	2.2	8.5
	Natural heritage for future generations to see, learn and benefit from	2.3	2.8	3.6	2.2		2.8			3.2	5.0		9.7						3.4
	Has the right to live, God's creation	1.7	0.9	3.6	2.2		2.8			0.6	2.5	4.3	3.2		8.3		4.9		
	Harmless, cause no problems	1.8	1.6	1.8	2.2		2.8			1.3	2.5		**12.9**		2.1		2.4	3.3	
	Not dangerous to people	3.6	4.8	3.6	6.5		2.8	9.1	**14.3**	3.2	2.5		3.2				2.4	1.1	3.4
	Scare away poachers	1.5	2.5	3.6			2.8			1.3					2.1				1.7
	It is my totem	2.2	2.3	5.5		**10.0**			7.1		2.5		3.2			**15.0**			6.8
	Can be tamed	0.6	1.1						3.6								2.4		
	I am not familiar with it, do not know it	0.4	0.5							1.3						5.0			
	Other	4.2	5.7	3.6	2.2	6.7	5.6			4.4	2.5	7.1	6.5						6.8

Appendix V - Spotted hyena

Reasons for respondent to feel positive, neutral or negative about spotted hyena, reasons given by ≥ 10% of the respondents with a certain occupation are highlighted in light green, reasons given by ≥ 20% are highlighted in dark green. Respondents did not necessarily give a reason that matched their feeling, respondents who felt neutral generally gave a positive and a negative reason.

		Total	ZPWMA gen	ZPWMA mgmt	Forestry Commission gen	Forestry Commission mgmt	CAMPFIRE gen	CAMPFIRE mgmt	RDC natural resource officers	Hunting gen	Hunting mgmt	Hunting professional hunters	Photographic gen	Photographic mgmt	Photographic safari guides	Commercial livestock gen	Commercial livestock mgmt	Subsistence farmers	Other
Negative	As long as there is a balance, there are not too many	3.7	2.3	7.3	2.2	3.3	2.8		7.1		**17.5**	**14.3**			6.3		9.8		3.4
	Kill too much prey	1.1	0.9				2.8		3.6		2.5		3.2	**16.7**			2.4		3.4
	Compete with other carnivores, kill their young, steal their prey	2.3	2.5	**10.9**					3.6		2.5	2.9	9.7		6.3				1.7
	Scavenge, doesn't hunt (which is weird, lazy, useless)	1.0	0.9	1.8		6.7			7.1				6.5						1.7
	They steal from you (pots, shoes, raid camps)	1.3	2.1							0.6		2.9		**16.7**	2.1				1.7
	Ugly, not a nice appearance, dirty, scary noise	5.6	6.9	7.3	**13.0**	**13.3**			3.6	1.3			**16.1**		4.2		**17.1**	1.1	**10.2**
	They are associated with witchcraft	5.1	4.6	**14.5**		**10.0**		**18.2**	**25.0**	4.4	5.0	1.4			2.1	5.0	4.9	4.4	6.8
	Provides no benefits and revenue	1.7	1.4			6.7	5.6	9.1	3.6	1.3	2.5						2.4	4.4	
	Dangerous to people	5.9	3.2	9.1	4.3	**16.7**		**18.2**	**14.3**	5.7	2.5		9.7		2.1	**25.0**	9.8	**11.1**	**10.2**
	Kill livestock	**30.5**	**22.8**	**23.6**	**56.5**	**53.3**	**47.2**	**36.4**	**46.4**	**29.1**	**20.0**	**11.4**	**29.0**	8.3	6.3	**25.0**	**26.8**	**87.8**	**18.6**
	Should be in the park not in communities where they are a problem	4.8	3.7	9.1	2.2		2.8	**18.2**	**10.7**	5.1	5.0		9.7		4.2	5.0	7.3	7.8	6.8
Positive	Ecological role, sign of a healthy ecosystem	**16.5**	**19.3**	**23.6**		6.7	**11.1**	**27.3**	7.1	4.4	**30.0**	**40.0**	6.5	**33.3**	**39.6**		**19.5**	1.1	**18.6**
	Scavenge, doesn't hunt (so does not kill (much) prey or livestock)	2.4	3.7	1.8						2.5	7.5		3.2						6.8
	Funny, naughty, clever	2.2	1.8			6.7				0.6	7.5	2.9	**12.9**	8.3	2.1	5.0			6.8
	Beautiful, nice, interesting, add diversity, special to see, nice noise	**12.2**	**14.3**	3.6	8.7	3.3	5.6		3.6	**12.0**	**25.0**	**21.4**	**12.9**	**25.0**	**20.8**	5.0	**14.6**		**13.6**
	Part of the bush, nature, Zimbabwe, Africa	2.1	1.6	1.8					3.6	0.6	**10.0**	8.6		**16.7**	4.2				1.7
	I like all wildlife, want to conserve all wildlife	2.7	1.8	3.6	2.2		5.6			3.2	7.5	4.3		**16.7**	8.3		4.9		1.7
	For me, my family and others to see, enjoy and learn from	1.9	2.5		2.2					1.9		1.4	6.5			5.0	2.4	2.2	1.7
	For tourists to see, provide revenue through photographic tourism	6.5	7.4	7.3	6.5		**11.1**	9.1		9.5	**10.0**	5.7	3.2		**12.5**				6.8
	For trophy hunting, provide revenue through hunting	4.8	3.9	7.3	6.5		**13.9**	9.1		**12.0**	5.0	2.9				5.0	2.4		5.1
	Natural heritage for future generations to see, learn and benefit from	1.2	1.6	1.8	2.2		2.8			1.9					2.1				1.7
	Has the right to live, God's creation	2.2	0.9	3.6	2.2	3.3	5.6			0.6		5.7	3.2		**12.5**		2.4		5.1
	Harmless, cause no problems	4.9	4.1	5.5	4.3	3.3	8.3	9.1		**12.0**	5.0	1.4	6.5			**15.0**		1.1	5.1
	Not dangerous to people	3.6	5.5	1.8		3.3	5.6		7.1	5.7						**10.0**		1.1	3.4
	Show us carcasses, scare away poachers	0.8	1.4	1.8						0.6					2.1				1.7
	I am not familiar with it, do not know it	1.2	1.6		4.3		5.6									5.0	4.9		
	Other	6.0	8.3	5.5	2.2	**16.7**		9.1	3.6	5.7	2.5	8.6			2.1		7.3	1.1	8.5

Appendix VI - More, the same, or less cheetahs

Reasons for respondent to want more, less or the same number of cheetahs in their area and percentage of respondents per occupation who mentioned those reasons, reasons given by ≥ 10% of the respondents with a certain occupation are highlighted in light green, reasons given by ≥ 20% of the respondents with a certain occupation are highlighted in dark green.

		Total	ZPWMA gen	ZPWMA mgmt	Forestry Commission gen	Forestry Commission mgmt	CAMPFIRE gen	CAMPFIRE mgmt	RDC natural resource officers	Hunting gen	Hunting mgmt	Hunting professional hunters	Photographic gen	Photographic mgmt	Photographic safari guides	Commercial livestock gen	Commercial livestock mgmt	Subsistence farmers	Other
Negative	As long as there is a balance (not too many), we have the right balance	2.6	2.3	1.8	2.2		5.6			2.5	2.5	4.3	**12.9**				2.4	1.1	5.1
	Kill too much prey	3.6	3.9		4.3			9.1		7.0	5.0	2.9	6.5		6.3	4.5	4.9		1.7
	This is not the right area for them, too small, too much human activity, not enough prey, too many competing predators, wrong terrain	5.5	5.5	**16.4**	4.3	3.3	2.8	9.1	3.6		**10.0**	**11.4**		**25.0**	6.3	9.1	7.3	1.1	6.8
	Provides no benefits or revenue	0.7	0.2							1.3	2.5	1.4					2.4	3.3	
	Dangerous to people	3.7	2.3	3.6	6.5	6.7	2.8		**25.0**	1.3							4.9	**17.8**	
	Kill livestock	**10.4**	1.1	**12.7**	8.7	6.7	5.6	**18.2**	**17.9**	5.7	5.0	7.1				**36.4**	**41.5**	**58.9**	8.5
	Should be in a national park or fenced area for all to see and learn from, not in the community where they kill livestock and are dangerous to people	3.0	2.3	3.6		**16.7**			**32.1**								2.4	8.9	1.7
	People in the community would kill them, they would get poached	2.0	1.8	9.1		3.3	2.8		7.1					8.3			2.4		8.5
Positive	Ecological role, part of a healthy ecosystem	5.4	4.1	9.1	2.2	**10.0**	2.8		7.1	1.3	**17.5**	**10.0**	3.2	8.3	**18.8**		**12.2**		5.1
	Does not kill too much prey	1.9	1.6			3.3				1.3	5.0	5.7	9.7	**16.7**					3.4
	This is the right area for them, large enough, right terrain, enough prey, well protected	4.2	4.6	3.6						5.7	2.5	2.9	3.2	**25.0**	**18.8**		2.4		5.1
	Beautiful, nice, interesting, add diversity	**12.2**	**11.7**	9.1	**21.7**	**13.3**	**11.1**	**18.2**	3.6	8.2	**12.5**	**40.0**	**16.1**	**16.7**	4.2	9.1	**17.1**	1.1	8.5
	Part of the bush, nature, Zimbabwe, Africa	0.9	1.1				2.8					4.3			2.1		2.4		
	They are rare, endangered, specially protected, should not go extinct	5.0	5.3	5.5	4.3	6.7	5.6		7.1	8.9	7.5	1.4	**12.9**		2.1	9.1		1.1	1.7
	For me, my family and others to see, enjoy and learn from	**16.1**	**21.6**	**14.5**	**19.6**	**20.0**	**16.7**	**18.2**	3.6	**20.9**	**12.5**	**12.9**	**16.1**		**16.7**	9.1	2.4		**10.2**
	Good for photographic tourism, revenue via (photographic) tourism, for tourists and hunting clients to see and enjoy	**22.4**	**30.8**	**25.5**	**13.0**	**16.7**	**27.8**	**27.3**	**10.7**	**17.7**	**32.5**	**14.3**	**12.9**	**16.7**	**43.8**		7.3	2.2	**22.0**
	Good for trophy hunting, revenue via hunting, so we can hunt them	4.2	2.1			6.7	**11.1**	**27.3**		9.5	5.0	4.3				9.1		5.6	**10.2**
	It is our natural heritage which we have to maintain for future generations to see, learn and benefit from	6.8	5.5	3.6	**10.9**	**10.0**	**22.2**		**21.4**	9.5	**10.0**		6.5				4.9	8.9	5.1
	Harmless, cause no problems	1.7	1.4		4.3					2.5			3.2					3.3	6.8
	Not dangerous to people	2.9	2.1	5.5	2.2		2.8	9.1		5.1	5.0		**12.9**				7.3		5.1
	Does not kill livestock	1.4	0.7	1.8	4.3		2.8			0.6	2.5					4.5	4.9	3.3	3.4
	Other	6.0	6.0	3.6	4.3	6.7	2.8		3.6	8.2	5.0	7.1	3.2		**10.4**	9.1	4.9	1.1	**13.6**

Appendix VII - Importance of conservation

Reasons why respondents felt conservation is important or not so important and percentage of respondents per occupation who mentioned those reasons, reasons given by ≥ 10% of the respondents with a certain occupation are highlighted in light green, reasons given by ≥ 20% of the respondents with a certain occupation are highlighted in dark green.

		Total	ZPWMA gen	ZPWMA mgmt	Forestry Commission gen	Forestry Commission mgmt	CAMPFIRE gen	CAMPFIRE mgmt	RDC natural resource officers	Hunting gen	Hunting mgmt	Hunting professional hunters	Photographic gen	Photographic mgmt	Photographic safari guides	Commercial livestock gen	Commercial livestock mgmt	Subsistence farmers	Other
Negative	These animals are dangerous, destroy crops and kill our livestock	1.4	0.5		4.3					1.3						5.0		**11.1**	
	We want to conserve the wildlife that does not cause problems, not the ones that kill livestock, eat our crops and are dangerous	0.8	0.2														4.9	7.8	
	Should be in a national park or fenced area for all to see and learn from, not in the community where they kill livestock, destroy crops and are dangerous to people	3.9		1.8	4.3		2.8		3.6	1.3	2.5		3.2	8.3		5.0		**38.9**	1.7
Positive	To maintain a healthy ecosystem, biodiversity and prevent extinction	**13.5**	**12.4**	**25.5**	4.3	**20.0**	**11.1**	**27.3**	**39.3**	3.2	**22.5**	**12.9**	3.2	**33.3**	**18.8**		**29.3**	5.6	**25.4**
	Aesthetic, emotional, spiritual or cultural value	5.8	5.1	**14.5**	4.3	**23.3**	2.8	**18.2**	7.1	2.5	**20.0**	2.9	6.5	8.3		5.0	9.8	1.1	5.1
	Wildlife is part of the bush, nature, Zimbabwe, Africa	4.5	2.8	9.1			2.8	9.1		5.1	7.5	**10.0**	3.2		**10.4**	5.0	**12.2**	2.2	5.1
	For me, my family and others to see, enjoy and learn from	**11.3**	**11.5**	9.1	**17.4**	**10.0**	5.6	9.1	**14.3**	**12.0**	7.5	8.6	**32.3**		**12.5**	**15.0**	**12.2**	8.9	6.8
	Provides revenue, jobs, economic growth and development via photographic tourism and trophy hunting	**61.8**	**66.9**	**56.4**	**56.5**	**60.0**	**69.4**	**81.8**	**67.9**	**65.2**	**55.0**	**38.6**	**77.4**	**50.0**	**56.3**	**70.0**	**43.9**	**60.0**	**55.9**
	Important for research	1.3	2.5	5.5		3.3							3.2						
	It is a natural resource that provides meat, skins and other products	6.2	6.2	3.6	8.7	**13.3**	8.3	9.1	7.1	5.1	2.5		3.2		2.1	5.0	**17.1**	**11.1**	5.1
	It is our natural and cultural heritage which we have to conserve for future generations to see, learn and benefit from	**52.4**	**61.6**	**63.6**	**39.1**	**46.7**	**63.9**	**27.3**	**50.0**	**40.5**	**45.0**	**57.1**	**71.0**	**33.3**	**60.4**	**40.0**	**53.7**	**28.9**	**42.4**
	Wildlife provides me with a job, a livelihood	3.1	1.8	1.8	6.5					8.9	2.5	**10.0**		8.3	2.1	5.0			
	It makes us proud and the country look good if we are able to conserve our wildlife	2.0	3.0	5.5			2.8			1.9		2.9						1.1	1.7
	Assist me in my job by keeping poachers out of the area	0.4	0.2	1.8		3.3				1.3									
	Part of my job to conserve and protect these animals	1.8	2.8							4.4					2.1	**10.0**			
	It is our duty to protect wildlife, wildlife has the right to live, God's creation	**10.3**	5.3	**14.5**	6.5	**10.0**	**16.7**	**18.2**	7.1	3.8	**32.5**	**22.9**	**12.9**	8.3	**27.1**		**22.0**	1.1	**23.7**
	Other	1.5	1.1	5.5	4.3					1.3		4.3	3.2	8.3		5.0			

About the author

Dr. Esther van der Meer graduated from Utrecht University with an MSc in Ecology and an MSc in Environmental Education. After a five year career as a lobbyist and policy advisor for a Dutch non-profit organisation, she moved to Zimbabwe in 2006 to work on a PhD on the endangered African wild dog. Dr. van der Meer sees research as a tool to assist the authorities and other stakeholders in making informed management decisions and improve the conservation strategy of species at a regional, national and international scale. Her PhD focussed on several aspects of African wild dog ecology and conservation in and around Hwange National Park, the largest protected wildlife area in Zimbabwe. In 2012 she founded Cheetah Conservation Project Zimbabwe with the aim to contribute to the conservation of cheetahs through research, education, collaboration and capacity building. From 2013-2015 she carried out the presented nationwide cheetah population survey to determine where to set priorities for cheetah conservation in Zimbabwe. During this period she was affiliated to the department of Forest Resources and Wildlife Management of the National University of Science and Technology and supervised several graduate and undergraduate students. Dr. van der Meer is scientific advisor for Painted Dog Conservation and the Dambari Wildlife Trust. She has published various scientific papers in peer reviewed journals and, in addition to her column for a Dutch magazine, regularly writes articles for the popular press. She can be contacted at esthervdmeer@gmail.com.

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ISBN 978-90-817341-1-0