

Acinonyx jubatus – Cheetah



Assessment Rationale

Cheetahs have been extirpated from over c. 90% of their former distribution range within the assessment region and currently occur only along the northern borders of South Africa and in several isolated protected areas. The population can be regarded as three groups assigned by differences in management intensity and land uses:

1. Free-roaming animals (population size estimated with low confidence at 400–800 individuals): occur unmanaged outside of fenced protected areas mostly on rangeland and are vulnerable to conflict-related killing and live removals;
2. Large protected areas of the Kruger National Park (KNP; population size assessed with high confidence at 412 individuals) and Kgalagadi Transfrontier Park (KTP; population size estimated with medium confidence at 80 individuals): these Cheetahs are well protected but are threatened by edge effects like snaring; and
3. Managed metapopulation: a network of fenced reserves into which Cheetahs have been reintroduced and are managed as one national population through assisted dispersals. While safe inside these fenced areas, these individuals are reliant on varying degrees of human management to ensure the population remains viable. Mortalities related to veterinary interventions and edge effects are the key threats in this group.

Regionally, key threats include: conflict-related killing, removal for captive trade and poorly regulated captive trade, habitat fragmentation and snaring. The full extent and impact of these threats are unknown. The regional population appears to be stable or perhaps increasing due to the conservation efforts of the managed metapopulation. However, the lack of reliable information on the free-roaming animals is prohibitive in making any reliable conclusions. We speculate a mature population structure of between 50 and 60% in Cheetah populations. Using a population range of between 1,166 and 1,742 (Table 2), and assuming a mature population structure of 50%, we speculate that there are between 583 and 871 mature individuals in the population. Whereas, assuming a mature population structure of 60%, we speculate there are between 700–1,045 mature individuals in the population. Thus, we retain the listing of Vulnerable D1 and urge further research on the free-roaming population. We also add the listing of Vulnerable C2a(i) given that the largest subpopulation (Kruger National Park) comprises 295–330 mature individuals and because there is potentially an inferred continuing decline in the free-roaming subpopulation given ongoing persecution, snaring and illegal removal for the captive industry (which is an emerging threat to wild Cheetahs within the assessment region). Key interventions include reducing human–wildlife conflict on rangelands, combatting the illegal trade in wild-caught Cheetah and promoting compatible land uses to connect protected areas, such as

Regional Red List status (2016)	Vulnerable C2a(i) + D1*†
National Red List status (2004)	Vulnerable D1
Reasons for change	No change
Global Red List status (2015)	Vulnerable A2acd + C1
TOPS listing (NEMBA) (2007)	Vulnerable
CITES listing (1975)	Appendix I
Endemic	No

*Watch-list Threat †Conservation Dependent

South Africa is the only country worldwide that has seen considerable growth in wild Cheetah numbers, with the national population increasing from an estimated 400 individuals in 1965 to almost 1,200 in 2016.

Taxonomy

Acinonyx jubatus (Schreber 1775)

ANIMALIA - CHORDATA - MAMMALIA - CARNIVORA - FELIDAE - *Acinonyx* - *jubatus*

Common names: Cheetah (English) Jagluiperd (Afrikaans), !Arub (Damara, Nama), Ihlosi (Ndebele, Shona, Xhosa, Zulu), Lengau (Sepedi, Setswana, Sotho, Tswana), Lepôgô (Sepedi), Dindingwe (Shona), Lihlosi, Sinkankanka (Swati), Didinngwe, Dagaladzhie (Tshivenda), Ndloti, Xinkankanka (Tsonga), Ingulule (Zulu)

Taxonomic status: Species

Taxonomic notes: *Acinonyx jubatus jubatus* (Schreber 1775) is the Southern and East African subspecies. The English name is derived from the Hindi *Chita*, meaning “spotted one”.

Recommended citation: van der Merwe V, Marnewick K, Bissett C, Groom R, Mills MGL, Durant SM. 2016. A conservation assessment of *Acinonyx jubatus*. In Child MF, Roxburgh L, Do Linh San E, Raimondo D, Davies-Mostert HT, editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

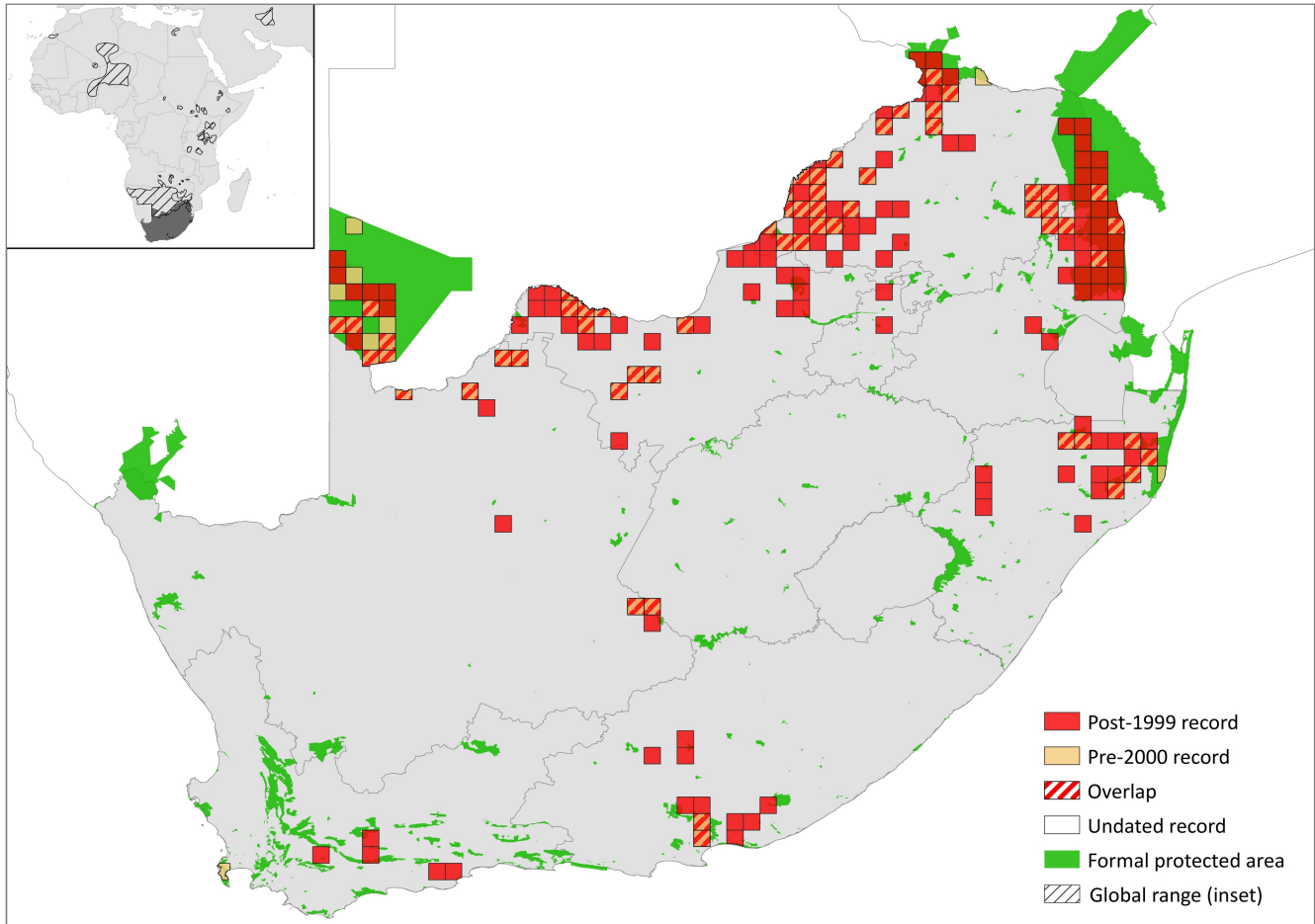


Figure 1. Distribution records for Cheetah (*Acinonyx jubatus*) within the assessment region

Table 1. Countries of occurrence within southern Africa

Country	Presence	Origin
Botswana	Extant	Native
Lesotho	Absent	-
Mozambique	Extant	Native
Namibia	Extant	Native
South Africa	Extant	Native
Swaziland	Extant	Reintroduced
Zimbabwe	Extant	Native

conservancies. This species requires active and ongoing conservation interventions to prevent it from slipping into a more threatened category.

Regional population effects: The free-roaming population in northern South Africa is connected through Botswana to Namibia and to a limited extent through Zimbabwe to the rest of southern Africa. Thus, the range within the assessment region is contiguous with the rest of the southern African range but it is unclear whether dispersal or movement actually occurs along these borders. Similarly, there are known Cheetah occurrences in the Mozambique side of the Great Limpopo Transfrontier Park (GLTP) (IUCN SSC 2007) (this population established following the dropping of fences with KNP in 2003), and there may be links through to Gonarezhou National Park in Zimbabwe which has resident Cheetah. Thus, there may be routes for dispersal into KNP from these two areas. However, due to uncertain

levels of dispersal and high rates of mortality from human-wildlife conflict in all areas, we assume no significant rescue effects are possible and retain the Vulnerable listing. We suspect that the South African Cheetah population is not a sink for immigrants, and is most likely a source (especially the KNP/GLTP).

Distribution

Cheetah historically occurred throughout most of southern Africa (Skinner & Chimimba 2005). For example, there are historical records from the Western Cape Province at Beaufort West in the 1860s, in the KwaZulu-Natal Province in the 1920s, in the Eastern Cape Province and south of the Orange River from the first quarter of the 20th century, as well as in the Northern Cape Province in Bushmanland and Kenhardt districts in 1942 and at the mouth of the Orange River in 1965 (see references within Skinner & Chimimba 2005). They have since been eliminated from 88% of their former range within southern Africa (Durant et al. 2015). Recently, efforts have been made to reintroduce Cheetah into areas of their former range. For example, while Cheetah became locally extinct in KwaZulu-Natal Province prior to 1930 (Pringle 1977), they were reintroduced when 142 Namibian Cheetahs were brought in by the former Natal Parks Board between 1965 and 1978 (Ezemvelo KwaZulu-Natal Wildlife unpubl. data). The managed metapopulation has also increased total Cheetah area of occupancy by 10,995 km² over the last 51 years (see below; V. van der Merwe unpubl. data). Similarly, the area available to the free-roaming subpopulation may have expanded over the last 30 years due to the proliferation of wildlife ranches and

conservancies in the area (and providing a prey base). In most of the Limpopo Province, ranchers have been reporting more frequent Cheetah sightings over the past decade (Marnewick 2016). During an earlier survey, Myers (1975) recorded a sighting of Cheetahs near the Brak River in the Zoutpansberg region of the Limpopo Province (formerly Northern Transvaal) in 1966. From the 1966 Cheetah sighting, until the survey of Myers was done in 1975, no further sightings were recorded until recent years. Similarly while they became locally extinct in Swaziland in the 1960s, they have been reintroduced into Mlawula Nature Reserve and Hlane Royal National Park in the 1980s (Monadjem 1998).

The population in South Africa can be divided into three different groups based on the land use of the area and the level of management implemented. These groups are not necessarily genetically isolated as dispersal does occur between the groups and some of the distribution area is contiguous with neighbouring countries.

Free-roaming: These Cheetahs are wild and unmanaged and occur naturally on privately owned stock and wildlife ranches as well as smaller reserves where fences are permeable (*sensu* Schumann et al. 2006; Weise et al. 2014). This group occurs along the northern borders of the country and on the western boundary of KNP and is contiguous with populations in Botswana, Zimbabwe and the KNP.

Large protected areas: Cheetahs occur naturally in the KNP and the KTP, and are unmanaged. The subpopulations are contiguous with those in neighbouring countries. These parks are the two conservation strongholds for the species.

Managed metapopulation: South Africa has a unique system of fenced reserves and Cheetahs from the Namibian and South African free-roaming populations were used as founder animals for reintroduction into these reserves for conservation and tourism purposes. Currently, there are 53 metapopulation reserves countrywide (V. van der Merwe unpubl. data). Each reserve on its own cannot sustain a viable population of Cheetahs, thus these animals have to be managed through a managed metapopulation approach using human-mediated translocations to ensure genetic and demographic integrity of the group as a whole (V. van der Merwe unpubl. data). Animals are no longer sourced from the free-roaming populations to stock these reserves. Cheetah have recently been reintroduced to reserves in the Western Cape, Eastern Cape, Gauteng and Free State provinces as part of the metapopulation expansion strategy (V. van der Merwe unpubl. data).

Population

Overall, the Cheetah population in South Africa appears to have remained stable or increased slightly since the previous assessment (Friedmann & Daly 2004), but the lack of confidence intervals (only the KNP contains upper and lower bounds; Marnewick et al. 2014), inconsistent survey methods/effort and the fact that Cheetah outside protected areas are difficult to survey preclude trend estimates. Overall, current subpopulation estimates (see below) are 600 (400–800) (outside protected areas; EWT unpubl. data), 412 (369–545) for KNP (Marnewick et al. 2014), 89 in KTP (Funston et al. 2001), and 308 for the metapopulation (Table 2). This yields a total current likely population size of 1,409 individuals, which could be as low

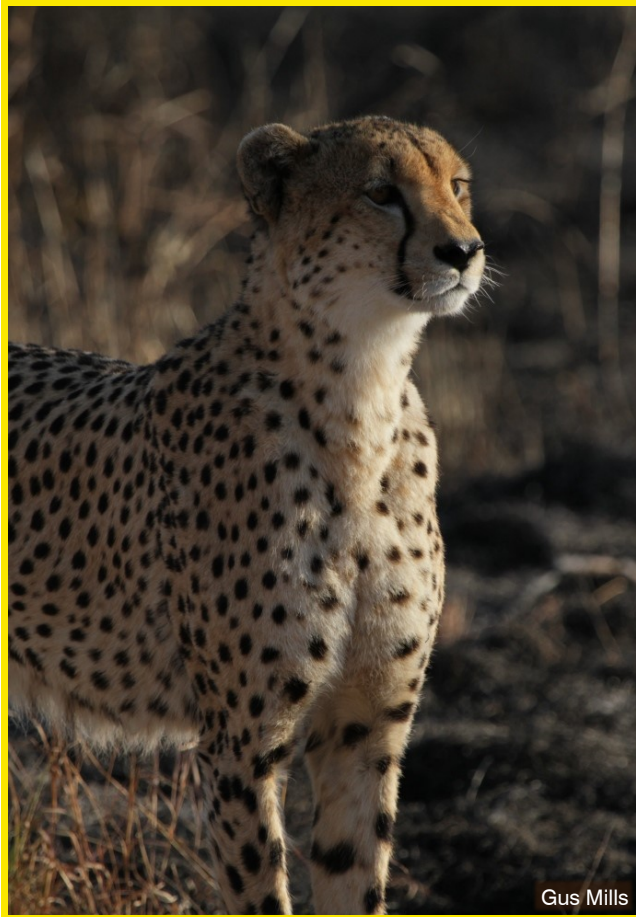
Table 2. Summary of Cheetah (*Acinonyx jubatus*) population sizes in South Africa, 2001–2015

Year	Free-roaming	KNP ¹	KTP ²	Meta-pop ^{3,e}	Total
2001	-	-	89 ^d	-	-
2003	300 ^a	175 ^a	65 ^a	117 ^a	657 ^a
2004	-	175 ^b	-	207	-
2005	-	-	-	206	-
2006	-	-	-	203	-
2007	-	-	-	241	-
2008	-	-	-	283	-
2009	-	412 ^c	-	329	-
2010	-	-	-	307	-
2011	-	-	-	278	-
2012	-	-	-	274	-
2013	-	-	-	283	-
2014	-	-	-	318	-
2015	400–800 ^e	412 (369–545)	89	308	1,166–1,742

¹Kruger National Park, ²Kgalagadi Transfrontier Park, ³Managed metapopulation. Sources: ^aFriedmann & Daly 2004, ^bKemp & Mills 2005, ^cMarnewick et al. 2014, ^dFunston et al. 2001, ^eEWT unpubl. data

as 1,166 if the lower KNP and free-roaming estimates are used and as high as 1,742 if both the upper KNP and free-roaming estimates are used. We speculate a mature population structure of between 50–60% in Cheetah populations. Using a population range of between 1,166–1,742 (Table 2), and assuming a mature population structure of 50%, we speculate that there are between 583–871 mature individuals in the population. Whereas, assuming a mature population structure of 60%, we speculate there are between 700–1,045 mature individuals in the population. However, given the inaccuracies inherent to Cheetah population estimates and the likely ongoing loss of mature individuals from both human–wildlife conflict and the intensifying threat from illegal international trade, we take a precautionary approach and assume there are fewer than 1,000 mature individuals. Additionally, it is unlikely that the population has been above 1,000 mature individuals for the past five years and thus a downlisting is not justified (IUCN Standards and Petitions Subcommittee 2014). The generation length for Cheetah is estimated as 4.9 years (Durant et al. 2015).

Free-roaming: The largest area of the Cheetah's distribution in the assessment region occurs outside protected areas, which means that ranchlands could support a substantial population. However, only localised population estimates have been obtained. In the Thabazimbi district of Limpopo, questionnaire surveys were used to obtain an estimated population size of 42–63 individuals with an estimated density of 0.6–0.9 individuals / 100 km² (Wilson 2006). This translated into a national estimate of 750–1,126 assuming that Cheetahs occur at uniform densities throughout their entire possible range. A camera trapping survey in a 240 km² section of the same study area used mark-recapture analyses to obtain a population estimate of 6–14 Cheetahs, however no density estimates were provided due to a lack of confidence in the size of the area surveyed (Marnewick et



Gus Mills

al. 2008). The size of the free-roaming population is thus probably in the region of 400–800 Cheetahs (EWT unpubl. data), although the confidence in these data is very low. Anecdotal information suggests an expanding range of free-roaming Cheetahs over the last 30–40 years with the increase in wildlife ranching providing a suitable prey base. Ranchers in Limpopo and North West provinces are under the impression that Cheetah numbers on ranchlands have increased during recent years (Marnewick et al. 2007; M. Thorn unpubl. data). However, these suggestions are not supported by reliable data. Furthermore, participants at a Population and Habitat Viability Assessment meeting suggested that this subpopulation appears to be static or even declining in Limpopo (Lindsay et al. 2009a). However, confidence in these data is also low.

Large protected areas: Cheetah have been monitored in the KNP using tourist photographic surveys in 1991 (Bowland 1994), 2005 (Kemp & Mills 2005) and 2009 (Marnewick & Davies-Mostert 2012). All surveys presented population estimates based on the minimum number of animals alive of 172 in 1991, 102 in 2005 and 172 in 2009. In 2009, mark-recapture analyses were applied to the data and resulted in an estimate of 412 Cheetahs (confidence intervals: 369–545) in the KNP (Marnewick et al. 2014). In the KTP spoor surveys were used to obtain an estimate of 89 Cheetahs (Funston et al. 2001). Although there are no accurate estimates for population trends in KTP and KNP, we suspect the transfrontier parks are contributing to large and resilient subpopulations by connecting adjacent subpopulations with each other.

Managed metapopulation: The Cheetah metapopulation increased from 207 to 329 between 2004 and 2009. This was largely due to supplementation from the free-roaming

population. Supplementation was halted in 2009 as it was felt that the continued removal from farmland was having a significant impact on this population (Lindsay et al. 2009a). The metapopulation then decreased from 329 in 2009 to 274 in 2012 (Table 2). This decrease was largely due to more than half of metapopulation reserves containing either single sex populations or contraception of their Cheetahs (7% of metapopulation reserves were experimenting with contraception, V. van der Merwe unpubl. data). Some breeding reserves were also selling surplus Cheetah to captive facilities who were offering higher prices than other metapopulation reserves. Reserve level management objectives were being met by holding only male coalitions (for example, prey number reductions and/or tourism). These reserves were effectively holding functionally extinct populations and were not contributing to national scale conservation objectives for the species. The Cheetah Metapopulation Project was officially launched in June 2011 to ensure the genetic and demographic integrity of the metapopulation. The project has managed to address some of these anthropogenic threats and the metapopulation has since recovered from 274 in December 2012 to 308 in January 2015 (EWT unpubl. data). Confidence in the latest estimates is high as they are obtained through intensive monitoring and counts. In most reserves all individual animals are known.

Current population trend: Unknown. While the metapopulation is increasing, the free-roaming subpopulation needs further research.

Continuing decline in mature individuals: Yes, from persecution, snaring and illegal removal for the captive-breeding trade.

Number of mature individuals in population: 583–871 individuals assuming a 50% mature population structure. 700–1,045 individuals assuming a 60% mature population structure.

Number of mature individuals in largest subpopulation: 184–273 individuals in KNP, assuming a 50% mature population structure.

Number of subpopulations: There are three primary subpopulations, which comprise the large reserves (KNP and KTP), the free-roaming individuals and the managed metapopulation. Within this, there are 51 isolated and fenced subpopulations in protected areas.

Severely fragmented: Yes. Most Cheetah are restricted to fenced and isolated reserves, necessitating active management.

Habitats and Ecology

Cheetahs are habitat generalists and as such can survive where sufficient food is available and threats are tolerable. In South Africa, the free-roaming population and the two largest protected populations (KNP and KTP) occur in the Savannah biome. Metapopulation reserves are located in the following biomes: Savannah (35); Thicket (6); Grasslands (4); Nama Karoo (3); Fynbos (2) and Succulent Karoo (1). Cheetahs are the fastest land mammals, and catch their prey, principally small- to mid-sized ungulates, in high speed chases up to 103 km / hour (29 m / s) (Wilson et al. 2013), over distances of hundreds of metres. Other prey range from ground-dwelling birds and small mammals, such as hares, up to large ungulates such as wildebeests, Greater Kudu (*Tragelaphus strepsiceros*) or Eland (*Tragelaphus oryx*) (see references

Table 3. Use and trade summary for the Cheetah (*Acinonyx jubatus*)

Category	Applicable?	Rationale	Proportion of total harvest	Trend
Subsistence use	No	-	-	-
Commercial use	Yes	Captive breeding.	Unknown	Increasing
Harvest from wild population	Yes	Damage causing animals and captive sale.	Unknown	Unknown, probably increasing (possibly due to the captive breeding industry).
Harvest from ranched population	No	-	-	-
Harvest from captive population	Yes	Captive-breeding facilities.	Unknown	Increasing

within Durant et al. 2015). Unlike other African predators, they rarely scavenge and do not remain long with their kills, some of which may be stolen by other carnivores, but they are energetically well adapted to cope with this (Scantlebury et al. 2014).

In comparison with other big cats, Cheetahs occur at relatively low densities (10–30% of typical densities for other large cat species in prime habitat; Durant 2007). Caro (1994) attributes lower Cheetah densities to interspecific competition, especially with larger species such as Lions (*Panthera leo*) and Spotted Hyaenas (*Crocuta crocuta*) that can kill cubs, but this assumption is increasingly disputed in the literature (Swanson et al. 2014; Mills & Mills 2014). Additionally, on Namibian farmlands, where Lions and Spotted Hyaenas have been eradicated, Cheetahs still occur at low densities of 0.2 individuals / 100 km² (Marker 2002).

Ecosystem and cultural services: The Cheetah is an umbrella species that requires large areas of natural or near-natural habitats. As such, by conserving Cheetah, many other species and habitats can be protected (Caro 2003). Furthermore, it is an indicator species of a functional ecosystem with medium-sized herbivores (Dalerum et al. 2008), and can be used to demonstrate good management and a healthy biodiverse area. Finally, they can play a key ecological role in sustaining biodiversity in the lower trophic levels, particularly in areas where it is the only large carnivore present. Cheetahs can also regulate herbivore numbers in reserves where hunting or live sale is not practical or desirable. Cheetah are a key tourist species wherever they occur, bringing in revenue to both state and private lands. As they are not a danger to people, and rarely take livestock where sufficient wild prey is available, Cheetah are a potentially

good species for community conservation and eco-tourism initiatives.

Use and Trade

The dominant threat to Cheetahs within the assessment region is poorly regulated and illegal national and international trade. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) allows legal trade in captive live animals and hunting trophies under an Appendix I quota system. This was accepted by CITES as a way to enhance the economic value of Cheetahs on private lands and provide an economic incentive for their conservation (Nowell & Jackson 1996). The global captive Cheetah population is not self-sustaining as they breed poorly in captivity and, in 2001, 30% of the captive population was wild-caught (Marker 2002). Cheetahs are highly sought after animals for captivity due to their financial value and ability to be tamed into exotic pets and the threat of trade has become an international concern for Cheetah conservation.

In South Africa, Cheetahs are protected by legislation and their international trade is governed under CITES Appendix I. South Africa is obliged as a member of CITES to show that any trade in CITES listed species is non-detrimental to wild populations. However, conservationists in South Africa have become increasingly concerned that this captive trade is impacting on the wild population through removals. During the last 10 years, 27% (N = 50) of wild Cheetahs removed from fenced metapopulation reserves have been sent to captive facilities (EWT unpubl. data). There are currently over 600 individuals in approximately 79 captive facilities in South Africa, yet a recent audit of 13 facilities showed only 36 cubs being born during the last year (Scientific Authority unpubl.

Table 4. Possible net effects of wildlife ranching on the Cheetah (*Acinonyx jubatus*) and subsequent management recommendations

Net effect	Unknown. Improvement in distribution of prey base, but increased conflict and habitat fragmentation due to formation of predator-proof camps.
Data quality	Suspected
Rationale	Historically, most of the current free-roaming Cheetah distribution area was under cattle farming. With a large-scale shift to wildlife ranching, cattle have been replaced with antelope that are more suitable prey for Cheetahs. With the increase in breeding of rare colour morphs of antelopes, ranchers have been constructing predator-proof camps to prevent predation. These camps effectively fragment habitat for Cheetahs as they are impermeable. Where these antelope are ranched outside of camps, conflict-related killing of Cheetahs has possibly increased due to the high economic value of the animals.
Management recommendation	Increased efforts in conflict mitigation. Conflict and habitat fragmentation related to game breeding currently have few effective solutions.

data), a figure far lower than the average annual number of live Cheetah exports of 80 animals (UNEP CITES Trade database). Most facilities cannot trace individual animals and the permitting system is ineffective in monitoring the movement of animals between facilities and out of the country. Additionally, there are irregularities in the CITES permitting system. For example, some hunting trophies were exported from South Africa despite there not being a hunting quota for Cheetahs and provincial data do not reconcile with CITES trade database data.

South Africa is the world's largest exporter of live Cheetah, and the only country to have registered two commercial captive-breeding operations with the CITES Secretariat. However, Nowell (2014) notes that most Cheetah exports have come from unregistered facilities and that provincial authorities cannot confidently say the exports are captive-bred rather than wild. South Africa may be a conduit for Cheetah from across the region because of the presence of captive breeding facilities and the relative ease of absorbing wild-caught individuals into the captive system. Thus, the free-roaming population may be increasingly threatened by questionable facilities harvesting wild Cheetah for the national and international trade.

Threats

Threats to Cheetahs in South Africa include conflict-related persecution, poorly regulated captive trade, veterinary complications from immobilisation, snaring and habitat fragmentation. Table 5 details the threats and which groups of Cheetahs are vulnerable to them.

1. Persecution remains a key threat to Cheetahs outside of protected areas (Thorn et al. 2012, 2013). Cheetahs are often killed or persecuted because they are a

perceived threat to livestock or game, despite research showing that Cheetahs were only responsible for 3% of livestock losses to predators (Marker 2002). One study in Thabazimbi (Limpopo Province) found that five of nine collared social groups died of anthropogenic causes (one road traffic accident, the rest were shot) (K. Marnewick unpubl. data). Inconsistencies in reporting rates and the illegal nature of the killing confound trend detection.

2. Increasing illegal (or poorly regulated) national and international trade is suspected to be an emerging threat within the assessment region, especially from "captive-breeding/keeping" facilities that may facilitate the capture of free-roaming individuals for live sale (see **Use and Trade**).
3. Poorly planned translocations and reintroductions can be a major source of Cheetah mortality. Former free-roaming and predator-naive Cheetahs suffered high mortalities in reserves with other large predators (Bissett & Bernard 2011). The release of problem Cheetahs into inadequately fenced reserves resulted in further farmer–Cheetah conflict. Within the metapopulation (between 1999 and 2009) many Cheetahs are being lost by reintroducing predator-naive Cheetahs into reserves with Lions or by allowing Lion densities to reach critical levels. Predator-related mortality is: Lions = 32% (N = 76), Leopards = 9% (N = 20), other Cheetahs = 7% (N = 17), and Spotted Hyaenas = 3% (N = 8). Humans directly caused 26% (N = 61) of Cheetah mortalities: 8% of all known mortalities occurred during immobilisation or transit to another reserve while an additional 4% of mortalities occurred in holding pens. Six metapopulation Cheetahs have been shot; four across fence lines

Table 5. Threats to the Cheetah (*Acinonyx jubatus*) ranked in order of severity with corresponding evidence (based on IUCN threat categories, with regional context)

Rank	Threat description	Evidence in the scientific literature	Data quality	Scale of study	Current trend
1	5.1.3 <i>Persecution/Control</i> : human–wildlife conflict over livestock or rare game species loss (all groups).	Thorn et al. 2012 Marnewick et al. 2007	Attitudinal Attitudinal	Regional Regional	Possibly increasing with settlement expansion and rare game breeding.
2	5.1.1 <i>Intentional Use</i> : removal of wild individuals for captive-breeding facilities (free-roaming and metapopulation).	Marker 2002 Nowell 2014	Empirical Indirect (based on permits)	Regional National	30% of the captive population wild-caught. Possibly increasing as trade continues to be lucrative.
3	12.1 <i>Other Threat</i> : mortalities in transit between protected areas as part of managed metapopulation (due to high management intensity required).	EWT unpubl. data	Empirical	National	Humans directly caused 26% (N = 61) of Cheetah mortalities in metapopulation.
4	5.1.2 <i>Intentional Use</i> : hunting and trapping: indirect mortalities in snares set out for other species (all groups).	-	Anecdotal	-	-
5	2.3 <i>Livestock Farming & Ranching</i> . Current stress 1.3 <i>Indirect Ecosystem Effects</i> : many ranchlands are increasingly erecting predator-proof game fencing leading to fragmentation of suitable habitat (free-roaming and possibly metapopulation).	-	Anecdotal	-	-
6	4.1 <i>Roads & Railroads</i> : individuals killed on roads, both inside and outside protected areas (all groups).	EWT unpubl. data	Empirical	National	Possibly increasing with infrastructure and human density pressure.

Table 6. Conservation interventions for the Cheetah (*Acinonyx jubatus*) ranked in order of effectiveness with corresponding evidence (based on IUCN action categories, with regional context)

Rank	Intervention description	Evidence in the scientific literature	Data quality	Scale of evidence	Demonstrated impact	Current conservation projects
1	2.1 <i>Site/Area Management</i> : the promotion of the “holistic” approach to the management of damage-causing animals(DCAs), such as the use of livestock guarding dogs.	Schumann et al. 2006	Empirical	Local	Swing gates may be effective in excluding predators from game camps.	Carnivore Conservation Programme, Endangered Wildlife Trust; Cheetah Outreach; Green Dogs Conservation
		McManus et al. 2014	Empirical	Regional	Predation rates decreased by 69%.	
2	5.4 <i>Compliance & Enforcement</i> : combat illegal trade by tighter inspections on captive breeding centres and better markers to track captive-bred individuals.	-	Anecdotal	-	-	-
3	5.3 <i>Private Sector Standards & Codes</i> : development of a metapopulation translocation strategy and guidelines.	-	Anecdotal	-	-	National Cheetah Metapopulation Project, Endangered Wildlife Trust
4	1.2 <i>Resource & Habitat Protection</i> : establish conservancies to improve habitat suitability between protected areas and allow dispersal.	-	Anecdotal	-	-	Cheetah Range Expansion Project, The Range Wide Conservation Program for Cheetah and African Wild Dogs and the EWT
5	2.1 <i>Site/Area Management</i> : establish habitat corridors and remove/modify fences to allow Cheetah passage.	Schumann et al. 2006	Empirical	Local	Cheetah used holes beneath fences or tyres inserted in fences to move between properties.	-
		Weise et al. 2014	Empirical	Local		
6	2.1 <i>Site/Area Management</i> : increase availability of natural prey through anti-poaching measures and snare removal.	-	Anecdotal	-	-	Green Dogs Conservation (anti-poaching)
7	4.3 <i>Awareness & Communications</i> : inform the public that captive Cheetah have no conservation value and there are better ways to promote Cheetah conservation.	-	Anecdotal	-	-	Cheetah Outreach

from roads adjacent to three different reserves and two after escaping and killing livestock on neighbouring farms. Three Cheetahs died consuming foreign objects including a football and an oily rag. There is often a trade-off of reserve-scale management objectives between Cheetah conservation and the cost of that conservation.

- Cheetahs are also vulnerable to being caught in snares set for other species (Ray et al. 2005).
- Roads and transport infrastructure are also a minor threat. Three metapopulation Cheetahs were killed on roads and one hunting male was struck by an aircraft on the runway of an air force base.

Current habitat trend: Stable. The majority of the population exists in well-protected savannah ecosystems, which are not projected to decline (Driver et al. 2012). Wildlife ranching may have provided a wider prey base for Cheetahs within the free-roaming range over the past 20–40 years. However, this is also often accompanied by conflict related killings. Both extent of occurrence and area of occupancy have increased for the managed metapopulation through the addition of new reserves.

Similarly, habitat expansion has occurred for the free-roaming population through the establishment of transfrontier parks (Marnewick et al. 2007). Cheetah can thrive in anthropogenically modified landscapes under the right circumstances; hence the landscapes that Cheetah require for their survival may be protected, unprotected, or a combination of the two (Durant et al. 2015). Cheetahs also have excellent dispersal abilities (Boast 2014), making it likely to be comparatively easy to maintain gene flow between populations, and to encourage re-colonisation of suitable unoccupied habitat by conserving connecting habitat.

Conservation

Conservation priorities for Cheetahs in South Africa are dependent on which group the Cheetahs occur in. This is due to the different land uses and threats in each of the different areas.

Free-roaming Cheetahs: Conservation priorities for the free-roaming Cheetahs include preventing persecution and live removals:

- Dealing with conflict between Cheetahs and livestock farmers is possible and very successful. Several mitigation measures work very effectively in South African farmlands including: livestock management regimes which minimise conflict with Cheetahs (for example, kraaling; Marnewick et al. 2007) and the use of herd protection measures like livestock guarding dogs (Marker et al. 2005, Boast 2014, McManus et al. 2015). Focussed and strategically implemented education and awareness campaigns should continue to teach farmers and ranchers that Cheetahs are not a threat to livestock and that holistic control methods can compete financially with lethal control (McManus et al. 2015), and that Cheetahs form a key component of functioning ecosystems and our natural heritage.
- The proliferation of wildlife ranching in South Africa has provided conservation opportunities for Cheetahs but the resulting human–carnivore conflict has become a key threat that is difficult to mitigate. Ongoing liaison with the ranching community to attempt to change attitudes is key.
- Incentives for Cheetah-friendly ranching and farming practices need to be developed. These incentives can be directly related to the farmer (for example tax breaks or tourism income), or more indirect like consumer pressure driving market change.
- Cheetahs require large areas to meet their energetic and social requirements. Thus conservation action on a landscape scale needs to be promoted. Conservation-friendly land uses need to be investigated and implemented where appropriate; for example, conservancy formation (Lindsey et al. 2009b), stewardship agreements, protected area expansion and development of safe dispersal corridors.
- Development and implementation of legislation that completely bans the movement of wild Cheetah into captivity. Legal requirements must include reliably marking, tracing and monitoring captive-bred Cheetahs, so as to counteract their removal from the wild (for example, genetic studbooks should be maintained to prove parentage). This is a key intervention for the metapopulation too.
- A better understanding of the free-roaming Cheetah population size within South Africa is required.
- A concerted effort needs to be made to ensure that the public are aware that captive Cheetah have no conservation value. The removal of wild Cheetah for reintroduction into captivity poses a serious threat to the persistence of wild functional Cheetahs in South Africa. There are serious ethical and welfare issues associated with such actions.

Large protected areas:

- Cheetahs are conserved well inside these areas. However, relevant edge effects need to be mitigated. Snaring and disease are the most important threats, however neither appear to have significant impacts on Cheetahs at present.
- When Cheetahs leave protected areas, they can come into conflict with people outside the parks. Clear and effective strategies need to be in place to deal with such incidents if the conflict level is significant.



Johan Wessels

- More regular monitoring of population sizes and trends needs to be done.

Managed metapopulation:

- Implementing a formal scientifically-based national metapopulation management plan. This will ensure that this group of Cheetahs grows in size and will ensure effective gene flow between reserves.
- Addressing veterinary mortalities through working with the relevant veterinary professional associations to raise awareness of the threat and to ensure that veterinarians are effectively trained. Working with reserves to promote the use of experienced veterinarians and keeping the amount of immobilisations to a minimum.
- Anthropogenic mortality should be further reduced by: 1) adhering to translocation protocols (IUCN SSC 2013); 2) improving husbandry and monitoring while in holding bomas; 3) maintaining fences; and 4) combating snaring.
- Finding ways to deal with the commercial value of Cheetahs in the metapopulation. On the one hand having a value means that reserves may be more willing to invest resources into reintroductions and the subsequent management of the Cheetahs. However, Cheetahs are often moved between reserves for financial gain rather than for genetic or conservation purposes. This complicates management of these reserves at a national level and can compromise the conservation potential of the metapopulation.
- Promote the expansion of the metapopulation where the financial and geographical scope exist. This scope has recently been limited by low Cheetah availability, primarily due to a high percentage of Cheetah moving into captivity (30% from 2009 until 2012), high anthropogenic mortality (26%) and low frequency of breeding reserves (48% in 2012).
- In the long-term, natural dispersal of Cheetahs between reserves in close proximity to each other needs to be promoted. This will minimise the management intensity required to ensure the population is sustainable. Mechanisms can include dropping fences or making fences permeable to Cheetahs while keeping larger animals inside (*sensu* Schumann et al. 2006; Weise et al. 2014). Proactive conflict mitigation and awareness work in dispersal areas will need to be done to ensure survival of transient animals.

Recommendations for land managers and practitioners:

- Conservation authorities must carefully consider the need for more captive facilities and captive breeding of Cheetahs before issuing permits for the practice.
- The captive-breeding fraternity is encouraged to develop a scientifically guided national level conservation breeding plan.
- Reserve owners and managers are encouraged to actively participate in the national Cheetah Metapopulation Project.
- Populations should be closely monitored in the two key protected areas. For example, tourism photographic surveys should be carried out every four years in the GLTP and the KTP (as has been done as a partnership between the Endangered Wildlife Trust and the South African National Parks).

Research priorities: Academics must focus research projects into: 1) understanding predator–prey dynamics on fenced reserves, 2) understanding the drivers and extent of conflict outside protected areas and 3) obtaining reliable population estimates and demographic data outside protected areas. Specifically, research can answer the following questions:

- Dispersal patterns across southern African borders including connectivity between key protected areas in southern Africa for Cheetahs, which includes measuring the effectiveness of the TFCAs/TFPs.
- Effectiveness of education and awareness in reducing human–wildlife conflict.
- The current population size, trend and demographic variables of the free-roaming group in South Africa.
- Regular surveys of the key protected populations including Kgalagadi Transfrontier Park, the KNP and important larger fenced reserves where data are not reliable (for example, Hluhluwe-iMfolozi Park).
- Testing and investigating livestock anti-predation measures for cost-efficiency and measuring effectiveness and identifying new or modified methods.
- Gathering more accurate life history data for the free-roaming population (for example, survival rates and litter sizes).
- Quantifying the levels of removal from the free-roaming group as a result of human-wildlife conflict and trade.
- Identifying suitable sites for Cheetah reintroduction to facilitate range expansion in southern Africa. For example, the Range Wide Conservation Program for Cheetah and African Wild Dogs (RWCP) and EWT are partnering on a project to identify suitable places for Cheetah reintroduction, identify suitable Cheetah (from the metapopulation reserves) for translocation, and developing guidelines and protocols for effective reintroduction and post-reintroduction monitoring.

Encouraged citizen actions:

- Consumers need to be sensitised to the impact of meat production on Cheetahs and pressurise retailers to stock meat that is Cheetah-friendly.
- Sport hunters must support hunting ranches that practise Cheetah-friendly management and request this when booking.

Data Sources and Quality

Table 7. Information and interpretation qualifiers for the Cheetah (*Acinonyx jubatus*) assessment

Data sources	Census (unpublished), field study (literature, unpublished)
Data quality (max)	Observed
Data quality (min)	Estimated
Uncertainty resolution	Confidence intervals and maximum/minimum values
Risk tolerance	Evidentiary

- Do not support commercial captive facilities, petting zoos, “walking with” initiatives or similar that, under the current legislative system, do not have any direct conservation value and often are harmful to the conservation of the species.
- Report sightings on virtual museum platforms (for example, iSpot and MammalMAP), especially outside protected areas. Cheetahs have unique coat patterns that allows the identification of individual animals. The KNP receives nearly one million visitors per year, most of whom carry cameras. Photographs obtained from tourists can be used to identify individual Cheetahs and thus provide a population estimate.

References

- Bissett C, Bernard RTF. 2011. Demography of cheetahs in fenced reserves in South Africa: implications for conservation. *South African Journal of Wildlife Research* **41**:181–191.
- Boast L. 2014. Exploring the causes of and mitigation options for human–predator conflict on game ranches in Botswana: How is coexistence possible? Ph.D Thesis. University of Cape Town, Cape Town, South Africa.
- Bowland A. 1994. The 1990/1991 cheetah photographic survey. Scientific Report, South African National Parks Board.
- Caro TM. 1994. Cheetahs of the Serengeti Plains: Group Living in an Asocial Species. University of Chicago Press, Chicago, USA and London, UK.
- Caro TM. 2003. Umbrella species: critique and lessons from East Africa. *Animal Conservation* **6**:171–181.
- Dalerum F, Somers M, Kunkel K, Cameron E. 2008. The potential for large carnivores to act as biodiversity surrogates in southern Africa. *Biodiversity and Conservation* **17**:2939–2949.
- Driver A, Sink KJ, Nel JN, Holness S, van Niekerk L, Daniels F, Jonas Z, Majiedt PA, Harris L, Maze K. 2012. National Biodiversity Assessment 2011: An assessment of South Africa’s biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria, South Africa.
- Durant S. 2007. Range-wide conservation planning for cheetah and wild dog. *Cat News* **46**:13.
- Durant S, Mitchell N, Ipavec A, Groom R. 2015. *Acinonyx jubatus*. The IUCN Red List of Threatened Species 2015: e.T219A50649567.
- Friedmann Y, Daly B, editors. 2004. Red Data Book of the Mammals of South Africa: A Conservation Assessment. IUCN SSC Conservation Breeding Specialist Group and Endangered Wildlife Trust, Johannesburg, South Africa.

Funston PJ, Herrmann E, Babupi P, Kruijper A, Kruijper H, Jagers H, Masule K, Kruijper K. 2001. Spoor Frequency Estimates as a Method of Determining Lion and Other Large Mammal Densities in the Kgalagadi Transfrontier Park. Unpublished research report to the management committee of the Kgalagadi Transfrontier Park.

IUCN Standards and Petitions Subcommittee. 2014. Guidelines for Using the IUCN Red List Categories and Criteria. Version 11. Prepared by the Standards and Petitions Subcommittee.

IUCN SSC. 2007. Regional Conservation Strategy for the Cheetah and African Wild Dog in Southern Africa. IUCN Species Survival Commission, Gland, Switzerland.

IUCN SSC. 2013. Guidelines for Reintroductions and Other Conservation Translocations. Version 1.0. IUCN Species Survival Commission, Gland, Switzerland.

Kemp L, Mills MGL. 2005. The 4th Wild Dog and 2nd Cheetah Photographic Census in the Kruger National Park. South African National Parks unpublished report, South African National Parks, Skukuza.

Lindsey PA, et al. 2009a. Cheetah (*Acinonyx jubatus*) Population Habitat Viability Assessment Workshop Report. CBSG Southern Africa, IUCN SSC Conservation Breeding Specialist Group, Endangered Wildlife Trust, South Africa.

Lindsey PA, Romanach SS, Davies-Mostert HT. 2009b. The importance of conservancies for enhancing the value of game ranch land for large mammal conservation in southern Africa. *Journal of Zoology* **277**:99–105.

Marker LL. 2002. Aspects of cheetah (*Acinonyx jubatus*) biology, ecology and conservation strategies on Namibian farmlands. Ph.D. Thesis. University of Oxford, Oxford, UK.

Marker L, Dickman A, Schumann M. 2005. Using livestock guarding dogs as a conflict resolution strategy on Namibian farms. *Carnivore Damage Prevention News* **8**:28–32.

Marnewick K. 2016. Conservation biology of cheetahs *Acinonyx jubatus* and African wild dogs *Lycaon pictus* in South Africa. Ph.D. Thesis, University of Pretoria, Pretoria, South Africa.

Marnewick K, Beckhelling A, Cilliers D, Lane E, Mills G, Herring K, Caldwell P, Hall R, Meintjes S. 2007. The status of the cheetah in South Africa. *Cat News* **3**:27–31.

Marnewick K, Davies-Mostert HT. 2012. Kruger National Park 2008/2009 5th Wild Dog and 2nd Cheetah Photographic Census. Unpublished Report to The Endangered Wildlife Trust and South African National Parks.

Marnewick K, Ferreira SM, Grange S, Watermeyer J, Maputla N, Davies-Mostert HT. 2014. Evaluating the status of African wild dogs *Lycaon pictus* and cheetahs *Acinonyx jubatus* through tourist-based photographic surveys in the Kruger National Park. *PLoS One* **9**:e86265.

Marnewick K, Funston PJ, Karanth KU. 2008. Evaluating camera trapping as a method for estimating cheetah abundance in ranching areas. *South African Journal of Wildlife Research* **38**:59.

McManus JS, Dickman AJ, Gaynor D, Smuts BH, Macdonald DW. 2015. Dead or alive? Comparing costs and benefits of lethal and non-lethal human–wildlife conflict mitigation on livestock farms. *Oryx* **49**:687–695.

Mills MGL, Mills MEJ. 2014. Cheetah cub survival revisited: a re-evaluation of the role of predation, especially by lions, and implications for conservation. *Journal of Zoology* **292**:136–141.

Monadjem A. 1998. The Mammals of Swaziland. Conservation Trust of Swaziland and Big Games Parks, Mbabane, Swaziland.

Myers N. 1975. The cheetah *Acinonyx jubatus* in Africa. Report of a Survey in Africa from the Sahara Southwards. IUCN/WWF joint project. IUCN Monograph No. 4. International Union for Conservation of Nature and Natural Resources, Morges, Switzerland.

Assessors and Reviewers

Vincent van der Merwe¹, Kelly Marnewick^{1†}, Charlene Bissett², Rosemary Groom³, Michael G.L. Mills^{4†}, Sarah M. Durant^{5†}

¹Endangered Wildlife Trust, ²South African National Parks, ³Range Wide Conservation Program for Cheetah and African Wild Dogs, ⁴Private Wildlife Researcher, ⁵Zoological Society of London

[†]IUCN SSC Cat Specialist Group

Contributors

Matthew F. Child¹, Jeanetta Selier², Kristin Nowell[†], Samantha Page-Nicholson¹

¹Endangered Wildlife Trust, ²South African National Biodiversity Institute,

[†]IUCN SSC Cat Specialist Group

Species Champions

Paco & Leandra Mendes

Details of the methods used to make this assessment can be found in *Mammal Red List 2016: Introduction and Methodology*.

Nowell K. 2014. An Assessment of Conservation Impacts of Legal and Illegal Trade in Cheetahs *Acinonyx jubatus*. Report to the 65th meeting of the CITES Standing Committee, Geneva, Switzerland.

Nowell K, Jackson P. 1996. Wild Cats. Status Survey and Conservation Action Plan. IUCN SSC Cat Specialist Group, Gland, Switzerland and Cambridge, UK.

Pringle JA. 1977. The distribution of mammals in Natal. Part 2. Carnivora. *Annals of the Natal Museum* **23**:93–115.

Ray JC, Hunter L, Zirgouris J. 2005. Setting Conservation and Research Priorities for Larger African Carnivores. WCS Working Paper No. 24. Wildlife Conservation Society, New York, USA.

Scantlebury DM, Mills MGL, Wilson RP, Wilson JW, Mills MEJ, Durant SM, Bennett NC, Bradford P, Marks NJ, Speakman JR. 2014. Flexible energetics of cheetah hunting strategies provide resistance against kleptoparasitism. *Science* **346**:79–81.

Schumann M, Schumann B, Dickman A, Watson LH, Marker L. 2006. Assessing the use of swing gates in game fences as a potential non-lethal predator exclusion technique. *South African Journal of Wildlife Research* **36**:173–181.

Skinner JD, Chimimba CT. 2005. The Mammals of the Southern African Subregion. Third edition. Cambridge University Press, Cambridge, England.

Swanson A, Caro T, Davies-Mostert H, Mills MGL, Macdonald DW, Borner M, Masenga E, Packer C. 2014. Cheetahs and wild dogs show contrasting patterns of suppression by lions. *Journal of Animal Ecology* **83**:1418–1427.

Thorn M, Green M, Dalerum F, Bateman PW, Scott DM. 2012. What drives human–carnivore conflict in the North West Province of South Africa? *Biological Conservation* **150**:23–32.

Thorn M, Green M, Scott D, Marnewick K. 2013. Characteristics and determinants of human–carnivore conflict in South African farmland. *Biodiversity and Conservation* **22**:1715–1730.

Weise FJ, Wessels Q, Munro S, Solberg M. 2014. Using artificial passageways to facilitate the movement of wildlife on Namibian farmland. *South African Journal of Wildlife Research* **44**:161–166.

Wilson JW, Mills MGL, Wilson RP, Peters G, Mills MEJ, Speakman JR, Durant SM, Bennett NC, Marks NJ, Scantlebury M. 2013. Cheetahs, *Acinonyx jubatus*, balance turn capacity with pace when chasing prey. *Biology Letters* **9**:20130620.

Wilson KA. 2006. Status and distribution of cheetah outside formal conservation areas in the Thabazimbi district, Limpopo province. M.Sc. Thesis. University of Pretoria, Pretoria, South Africa.