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DEPARTMENT OF FORESTRY, FISHERIES AND THE ENVIRONMENT

NO. 1532

26 November 2021

**NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004  
(ACT NO. 10 OF 2004)**

**NON-DETRIMENT FINDING FOR PUBLIC COMMENT**

I, Barbara Dallas Creecy, Minister of Forestry, Fisheries and the Environment, hereby publish the non-detriment finding for *Acinonyx jubatus (cheetah)* made by the Scientific Authority in terms of section 62 read with sections 99 and 100 of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) in the Schedule, for public comments.

Members of the public are invited to submit to the Scientific Authority, within 30 days from the date of the publication of this notice in the *Government Gazette* written representations relating to the cheetah non-detriment finding to the following addresses:

By post: Chair: Scientific Authority  
South African National Biodiversity Institute  
Attention: Ms M Pfab  
Private Bag X101  
**PRETORIA**  
0001

By hand: 2 Cussonia Avenue, Brummeria, Pretoria, 0001

By email: [secretariat.scientificauthority@sanbi.org.za](mailto:secretariat.scientificauthority@sanbi.org.za)

A copy of the non detrimental finding can be obtained from  
[https://www.environment.gov.za/legislation/gazetted\\_notices](https://www.environment.gov.za/legislation/gazetted_notices).

Enquiries must be directed to Mr Mpho Tjiane at Tel: 012 399 9596 or Cell: 083 980 6409 or Email:  
[MTjiane@environment.gov.za](mailto:MTjiane@environment.gov.za).

Comments received after the closing dates will not be considered.



**BARBARA DALLAS CREECY**  
**MINISTER OF FORESTRY, FISHERIES AND ENVIRONMENT**

## Non-detriment finding for *Acinonyx jubatus* (cheetah)

Reference Number: Aci\_jub\_Sep2020

Date: 24 September 2020

Issued by the Scientific Authority of South Africa

### Summary of findings

*Acinonyx jubatus* (cheetah) is included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the export of specimens for primarily commercial purposes is therefore prohibited. In terms of Article III of the Convention, an export permit shall only be granted for a specimen of an Appendix I species when a Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species. Specimens of Appendix I species bred in captivity (defined in Resolution Conf. 10.16 (Rev.)) for commercial purposes are deemed to be specimens of species included in Appendix II (Article VII) of CITES. In terms of Article IV of the Convention, an export permit shall only be granted for an Appendix II species when a Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species. This non-detriment finding (NDF) for *Acinonyx jubatus* (cheetah) was compiled through a review of the relevant literature and deliberations held at an NDF workshop convened by the South African National Biodiversity Institute on 27 February 2019 (workshop participants and references included at the end of this document), and amended through various further consultations. The information presented is current as of September 2020.

Cheetahs are long-lived and have low reproductive rates. Females can live up to 13 years, but male survival is much lower than that of females. Cheetahs start breeding at the age of 29-36 months and on average produce a litter every 20 months. Litter size ranges from 1 to 6 cubs. Data from Kruger National Park (KNP) show a cub mortality rate of 50% within the first year. The reproductive rate is considered low due to the time it takes for cubs to mature. However, cheetahs have the potential to display higher reproductive rates under certain conditions, including in small fenced reserves with ample prey populations, and particularly where competing predators are absent. From a trophic niche perspective, the cheetah is a specialist in that they are hyper-carnivorous, i.e. they only eat prey that they can catch. The species is however considered to be a habitat and prey generalist. Cheetahs are generally not limited by a particular habitat type for their survival, but prefer open habitat in which to hunt. Cheetahs use extremely large home ranges, indicating reasonably good dispersal ability. However, they are sensitive to human disturbance and are generally absent from areas with significant human activity.

Cheetahs were historically widely distributed throughout South Africa in all suitable habitats. Today they are restricted to the far northern reaches of the country, where an area of between 90 470 km<sup>2</sup> and 125 150 km<sup>2</sup> of suitable habitat for cheetah is available, of which approximately 55 654 km<sup>2</sup> is contained within formally protected areas. The wild cheetah population in South Africa is estimated at 1 409 (1 166 – 1 742) individuals, and can be divided into three different groups based on the land use of the area and the level of management implemented: i) naturally occurring populations in large protected areas (i.e. KNP and Kgalagadi Transfrontier Park (KTP)); ii) subpopulations that have been reintroduced into small and medium-sized fenced reserves; and iii) a naturally occurring, free-ranging population outside of protected areas. The size of the KNP population is estimated at 412 individuals, while the size of the South African KTP cheetah population is estimated at approximately 46 mature individuals (0.90 individuals/100km<sup>2</sup>). An estimated 419 cheetahs occur in 61 small to medium-sized state-owned and privately-owned fenced reserves, collectively comprising one managed wild population or

metapopulation. No reliable estimate for the free-ranging wild population is available, but is thought to be around 400 to 800 individuals. Estimates for the number of cheetahs in small and medium-sized reserves and in the KNP and KTP are reasonably accurate, whereas the estimates for cheetah outside of protected areas are outdated and at best a guesstimate. The captive cheetah population in South Africa is estimated to number more than 600 cheetahs in about 68 facilities in eight of the nine provinces.

There is little information to ascertain the trend in the size of the free-ranging population, but anecdotal evidence suggests that it may be in decline, the extent of which is unknown. Between 2009 and 2012 the cheetah population in fenced reserves was also in decline because animals were no longer being moved in from the free-ranging population, lions were killing cheetahs in fenced reserves, and cheetahs were being sold into captivity. The cheetah population in fenced reserves has been increasing since 2013/14 after management of the metapopulation was improved and movements to captivity were stopped through the implementation of stricter control measures at captive breeding facilities. Naturally occurring populations in large protected areas are considered to be stable. Overall, the national population is considered to be reduced but stable at present.

The primary threats facing free-ranging cheetahs in South Africa are persecution by landowners in an attempt to protect livestock or wildlife from predation, and the capture and the illegal removal of live animals for the captive trade. Additional threats include snaring, habitat destruction, and the increasing prevalence of predator-proof fencing around game farms in some areas. The main threat facing the metapopulation is capture-related mortalities linked to the translocation of cheetahs between reserves. Even though the major threat to the free-roaming population may be considered substantial, the threats facing the cheetah metapopulation are limited and reversible.

Harvesting of wild cheetah is opportunistic and/or unselective. This includes informal, illegal control of damage causing cheetah following losses of domestic stock or wildlife in order to reduce predation, and the illegal harvest of live free-ranging cheetahs for the captive trade. Limited information is available on the trends and extent of this harvest. Cheetahs are legally removed from the metapopulation in order to generate conservation benefits for the species and to manage surplus animals within the metapopulation. A metapopulation management plan is being developed to guide these activities. In 2009 a National Conservation Action Plan was compiled for cheetah in South Africa, and a Biodiversity Management Plan (BMP) is currently being developed in terms of the National Environmental Management: Biodiversity Act (NEMBA) of 2004, but is still in its infancy. Neither of these plans provide specific guidelines for the harvest of cheetahs perceived to be damage causing animals (DCAs), though legal DCA control is limited.

The number of cheetah specimens exported as hunting trophies is small to negligible, and South Africa does not currently have an export quota for cheetah hunting trophies. In accordance with the outcome of a population viability analysis (PVA), a small managed annual harvest of no more than 13 cheetahs from the metapopulation (comprising three females and 10 males) has only recently been allowed for the sole purpose of reintroducing cheetah to other range States as part of a conservation effort to expand the metapopulation. To date approximately eight cheetah have been reintroduced to reserves outside of South Africa. The majority of the legal harvest takes place on private land and to a lesser extent on protected areas that form part of the metapopulation. There is a high confidence in the management of the metapopulation and captive populations, but confidence in the recording and monitoring of illegal harvest is low.

Exports of live cheetah accounted for 91% (878 animals) of the total exports of cheetahs from South Africa for the period 2002 – 2012 (CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK). The majority of live cheetah exported were captive bred, with >80% sent to zoos and breeding facilities. The major import destinations of live cheetah include the United Arab Emirates, China, the United States of America and Japan. Despite cheetahs apparently being difficult to breed in captivity, an average of 80 live cheetahs/annum were exported each year from various captive facilities in South

Africa. A recent audit of 13 cheetah breeding facilities concluded that the potential for the movement of wild cheetahs into captive facilities was high due to weak management measures. In 2015 the Scientific Authority recommended specific measures to improve the management of captive-bred cheetahs and to prevent the laundering of wild specimens as captive-bred. The implementation of a number of these measures has already resulted in a significant reduction in the number of captive-bred cheetah exported from facilities not registered with the CITES Secretariat in accordance with Resolution Conf. 12.10 (Rev. CoP15), and exports of cheetah bred in South Africa's two CITES-registered captive breeding facilities now dominate exports.

Cheetah offtakes, including DCAs and translocation, are monitored through a permit system. Provinces record the numbers of DCA permits issued, though few actually note whether putative DCAs were successfully removed (translocated or killed). The Department of Environment, Forestry and Fisheries keeps a national database of CITES export permits issued by each province. All offtakes (both legal and illegal) from the cheetah metapopulation are monitored and detailed records are kept by the Endangered Wildlife Trust, although illegal harvest, by its nature, is difficult to monitor. There is a high confidence in monitoring harvest from the metapopulation, and the effects thereof. The effects of illegal harvest on the free-ranging wild population are not monitored.

Although harvest of free-ranging cheetahs for reintroductions into small reserves may have been beneficial for the species in the past, that might not be the case currently. This is because sufficient numbers of individuals already occur within the metapopulation of small reserves to provide founder individuals for reintroductions, and the capture of these animals is beneficial to the species overall. Sustainable hunting of excess male adults could potentially benefit the management and conservation of the species in the future. No data are however available to anticipate how utilization would affect tolerance of landowners towards the species. Conservation of cheetah or cheetah habitat is not incentivized under the current harvesting regime, and it is thus unlikely to yield any conservation incentives.

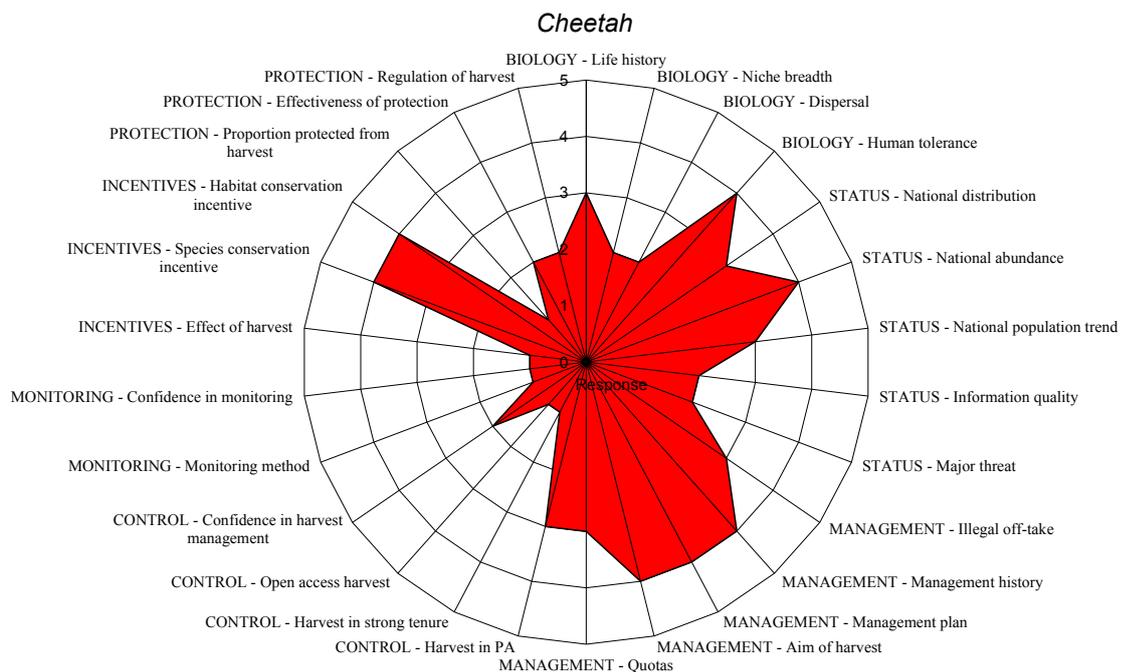
Approximately 44.5% of the natural range of cheetah is strictly protected from harvest such as trophy hunting or DCA control (approximately 55,654 km<sup>2</sup> is under formal protection, including both state-owned and private protected areas). There is a medium confidence in the effectiveness of these protected areas in protecting the species. Even though some animals living primarily in protected areas may be vulnerable to illegal hunting or snaring when ranging beyond the borders, the cores of larger protected areas such as the KNP and KTP likely constitute inviolate refuges for cheetahs. Harvest of wild cheetah for export purposes is restricted to excess animals within the metapopulation and to numbers shown to be sustainable by a PVA. These restrictions are considered to be effective. Capacity and resource constraints at a provincial level do however hamper the effective implementation of current regulations.

In conclusion, the evidence considered in this NDF for *Acinonyx jubatus* (cheetah) demonstrates that the export of cheetah sourced from the metapopulation for reintroduction purposes (CITES source code W) poses a low risk to this species in South Africa (Figures 1 and 2) and will not have a detrimental impact on the wild population provided that not more than 10% of the male population and 4% of the female population is removed per annum. A quota to allow for the export of hunting trophies sourced from the metapopulation can be considered once a formal metapopulation management plan has been developed and criteria for the trophy hunting of cheetah have been established.

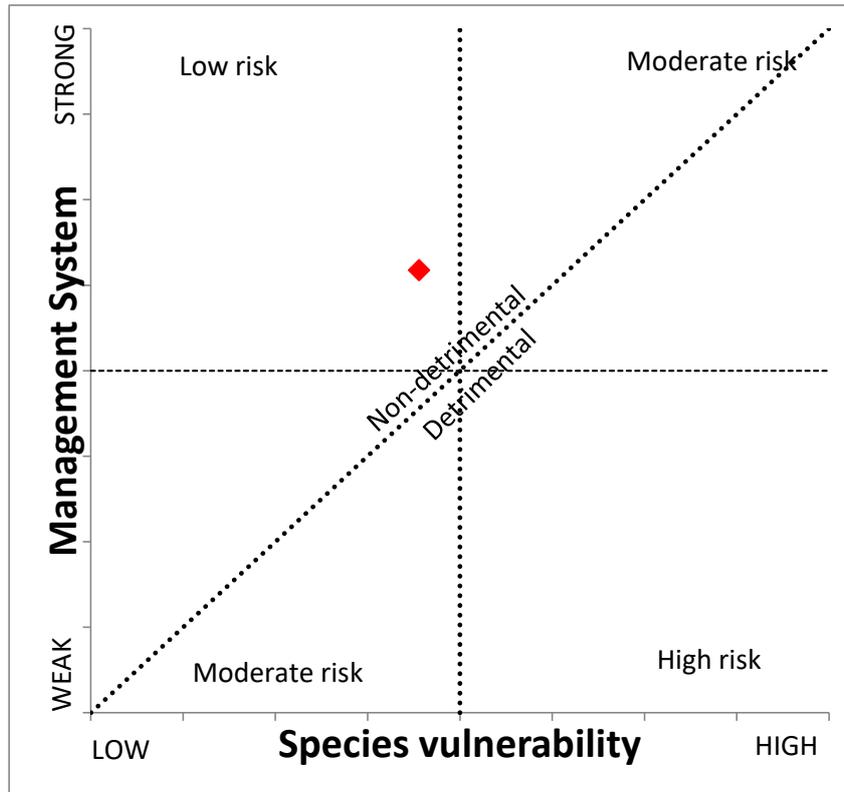
Harvest from the free-ranging cheetah population will likely be detrimental at present, and therefore a zero export quota for wild specimens sourced from the free-ranging population is recommended. Incentives for cheetah conservation outside of protected areas are needed, and a BMP for cheetah would improve the management of the free-ranging population. The distribution and size of the free-ranging population should also be established and the threats quantified.

The evidence presented in this NDF further shows that the export of captive-bred specimens will not have a detrimental impact on the wild population, provided that all specimens are verified as captive-bred (as defined in Resolution Conf. 10.16 (Rev.)) prior to export through DNA parentage analyses. All cheetah breeding facilities exporting internationally must also be registered with the Management Authority in compliance with the TOPS and CITES Regulations, and in accordance with criteria approved by the Scientific Authority, which should include at least the following.

- i) All cheetah must be recorded in a studbook that keeps records of dates of births and deaths, translocations and sales.
- ii) All cheetah must be individually identifiable through identification photographs, micro-chips and DNA fingerprints.



**Figure 1:** Radar chart summarizing the non-detriment finding (NDF) assessment undertaken for *Acinonyx jubatus* (cheetah) in accordance with the CITES NDF checklist. Explanations of scores given are detailed in Table 1. Higher scores are indicative of higher risks to the species. The limited area shaded in the radar chart demonstrates an overall low risk to the species.



**Figure 2:** The level of risk of harvesting for *Acinonyx jubatus* (cheetah), as represented by the relationship between species vulnerability (biology and status) and the management system to which the species is subjected (harvest management, control, monitoring, incentives and protection). The figure demonstrates that the species is assessed as at a low risk, and that the current export from the captive-bred population and metapopulation (conservation purposes only) is not detrimental to the survival of the species in the wild.

**Table 1:** Detailed NDF assessment for *Acinonyx jubatus* (cheetah) undertaken in accordance with the CITES NDF checklist. Scores assigned to each question are indicated (bold text in shaded blocks) along with detailed explanations/justifications where relevant. Higher scores are indicative of higher risks to the species.

<b>Biological characteristics</b>		
<b>1. Life history:</b> What is the species' life history?	High reproductive rate, long-lived	1
	High reproductive rate, short-lived	2
	<b>Low reproductive rate, long-lived</b>	<b>3</b>
	Low reproductive rate, short-lived	4
	Uncertain	5
<p>Cheetahs are deemed to have a low reproductive rate due to the time it takes for cubs to mature, though they have the potential to display higher reproductive rates under certain conditions, including in small fenced reserves with ample prey populations, and particularly where competing predators are absent. Estimates from the Serengeti suggest that cheetahs commence breeding at the age of 29-36 months for males and 29 months for females (Laurenson, <i>et al.</i>, 1992; Kelly, <i>et al.</i>, 1998; Durant, <i>et al.</i>, 2004). However, estimates from Kgalagadi Transfrontier Park (KTP) suggest that cheetahs only commence breeding at an average age of 37.2±3.42 months, while in fenced reserves cheetah start breeding as early as 27.4 months (Mills &amp; Mills, 2017). Litter size ranges from 1-6 cubs, but data from Kruger National Park (KNP) show a 50% mortality rate within the first 12 months (Broomhall, 2001). Studies in KTP found a mean litter size (on emergence) of 3.1±1.1, while within fenced reserves in South Africa the mean litter size was 4.0 (Mills &amp; Mills, 2017). Females mate again within three weeks of losing a litter, and conceive again within 18.7 (adult females) to 67.4 (young females) days (Laurenson, <i>et al.</i>, 1992). In the event of successfully rearing a litter, females often conceive again before the cubs have left, but don't give birth before the family splits (Laurenson, <i>et al.</i>, 1992; Laurenson, <i>et al.</i>, 1995). The birth interval between successfully reared litters is 15-24 months (Berry, <i>et al.</i>, 2002), with 23.4±3.91 months being the average for cheetahs in the southern Kalahari and 17.9 the average for cheetahs in fenced reserves (Mills &amp; Mills, 2017). Cheetahs reach senescence by the age of 12 years, though reproduction generally ceases by 10-11 years (Berry, <i>et al.</i>, 2002). In the Serengeti, most males die or disperse before the age of seven, whereas females can live up to 13 years or more (Kelly, <i>et al.</i>, 1998). Similarly, Durant, <i>et al.</i>, (2004), stressed that male survival was much lower than that of females (7.8 years for males, c.f. 11.8 for females), though in this study dispersal and mortality could not be separated, and thus it is likely that male mortality was overestimated.</p> <p>In the South African cheetah metapopulation, survival rate to 18 months in reserves with lions and high densities of leopards and spotted hyenas has been recorded at 45.1%, versus 62.5% in reserves without lions and with lower densities of other predators. Birth frequencies tend to be higher in reserves with high predator density, but this only partially compensates for higher mortality. Life expectancy has been observed to be significantly lower in reserves with lions and high densities of leopards and spotted hyenas (36.3±2.7 months versus 58.7±5.5 months), though there was no significant difference observed in life expectancy between the sexes (Buk, 2019).</p>		
<b>2. Ecological adaptability:</b> To what extent is the species adaptable (habitat, diet, environmental tolerance etc.)?	Extreme generalist	1
	<b>Generalist</b>	<b>2</b>
	Specialist	3
	Extreme specialist	4
	Uncertain	5
<p>Historically cheetahs occurred widely in sub-Saharan Africa in most habitats, excluding true desert and rainforests (Estes 1991). In South Africa, cheetahs occur primarily in savannahs, a biome that covers approximately one third of the country (Low &amp; Rebelo, 1998 in Marnewick <i>et al.</i>, 2007) and can exploit</p>		

grasslands, woodlands and even the fringes of deserts (Skinner & Smithers, 1990). Research on reintroduced cheetahs in the Eastern Cape highlights the ability of cheetahs to hunt successfully in dense thicket vegetation (Bisset & Bernard, 2007), though they do prefer open habitat to hunt – data from KNP show that cheetah tend to select open habitats (Broomhall *et al.*, 2003). Increased bush encroachment thus may limit the hunting success of cheetah. From a trophic niche perspective, cheetahs can be considered a specialist in that they are hyper-carnivorous (i.e. they only eat prey that they can catch). The species is however considered a habitat and prey generalist. They are generally not limited by a particular habitat type for survival, and are actually rather flexible in terms of their diet. Ninety percent of the cheetah's diet consists of small to medium-sized antelope species that are generally relatively abundant in fairly natural and protected areas. The recovery of the cheetah within the metapopulation has shown that once anthropogenic pressures are removed, the species has the ability to recover relatively quickly.

<b>3. Dispersal efficiency:</b> How efficient is the species' dispersal mechanism at key life stages?	Very good	1
	<b>Good</b>	<b>2</b>
	Medium	3
	Poor	4
	Uncertain	5

Cheetahs use extremely large home ranges, indicating that their ability to disperse is reasonably good. In KNP, males range between 126 km<sup>2</sup> and 191 km<sup>2</sup>, while the average female home range is 171 km<sup>2</sup> (Broomhall *et al.*, 2003). On South African game ranches, male home ranges (95% utilisation distribution) range from 122 km<sup>2</sup> to 607 km<sup>2</sup>, while female home ranges range from 15 km<sup>2</sup> to 703 km<sup>2</sup> (Marnewick & Somers, 2015). There are however few examples of cheetahs successfully re-colonizing areas that they have been extirpated from. The increase in predator-proof fencing across the cheetah range in South Africa may restrict their dispersal.

<b>4. Interaction with humans:</b> Is the species tolerant to human activity other than harvest?	No interaction	1
	Pest / Commensal	2
	Tolerant	3
	<b>Sensitive</b>	<b>4</b>
	Uncertain	5

Cheetahs are sensitive to human disturbance and are generally absent from areas with significant human activity such as predator-proof fencing, changing land-use and road networks. They are seldom seen around communal land settlements. The current distribution of cheetahs in South Africa is much smaller than the historic range and is smaller than the ranges of more versatile and/or smaller predator species such as black-backed jackals (*Canis mesomelas*), caracals (*Caracal caracal*) and leopards (*Panthera pardus*). However, cheetahs have managed to persist in the northern parts of the country despite intensive persecution, and their distribution is wider than larger and/or more sensitive predator species such as spotted hyaenas (*Crocuta crocuta*), lions (*Panthera leo*) and African wild dogs (*Lycaon pictus*) (Friedmann & Daly, 2004).

**National status**

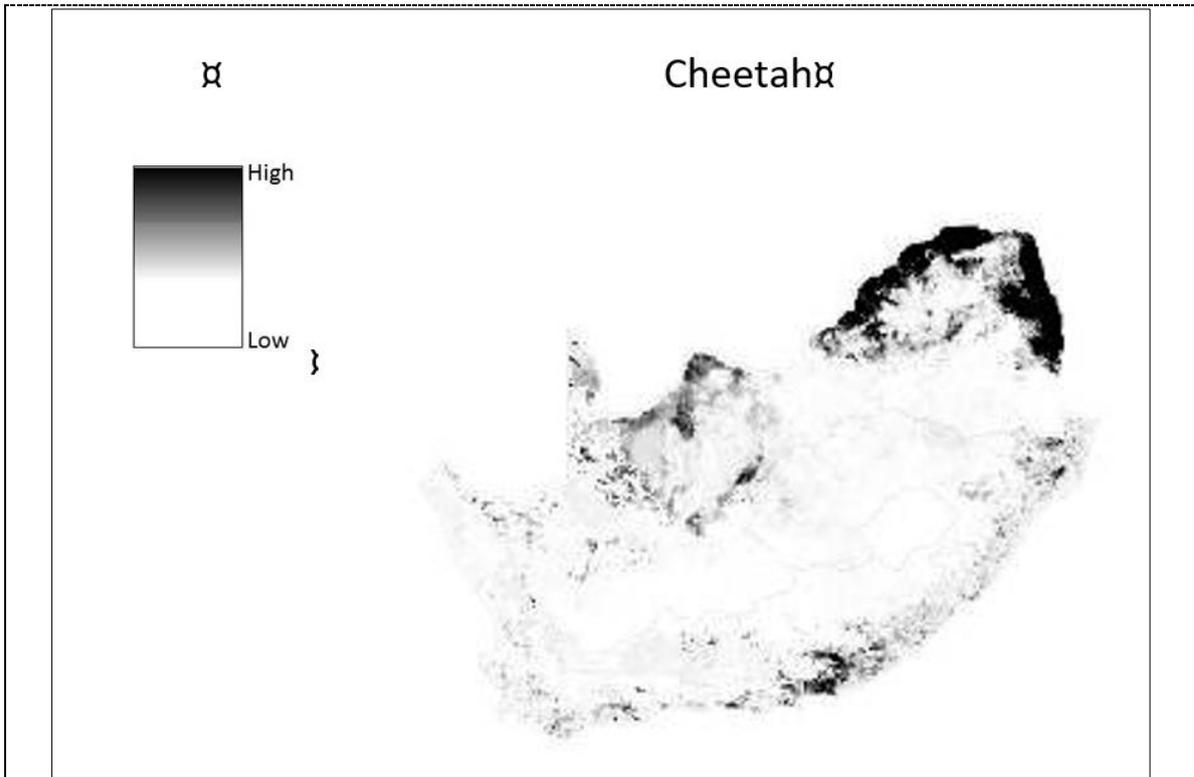
<b>5. National distribution:</b> How is the species distributed nationally?	Widespread, contiguous in country	1
	Widespread, fragmented in country	2
	<b>Restricted and fragmented</b>	<b>3</b>
	Localized	4
	Uncertain	5

In South Africa, cheetahs were historically widely distributed throughout the country in all suitable habitats (Marnewick *et al.*, 2007). Approximately 125 150 km<sup>2</sup> of land in South Africa (Boitani *et al.*, 1999) is

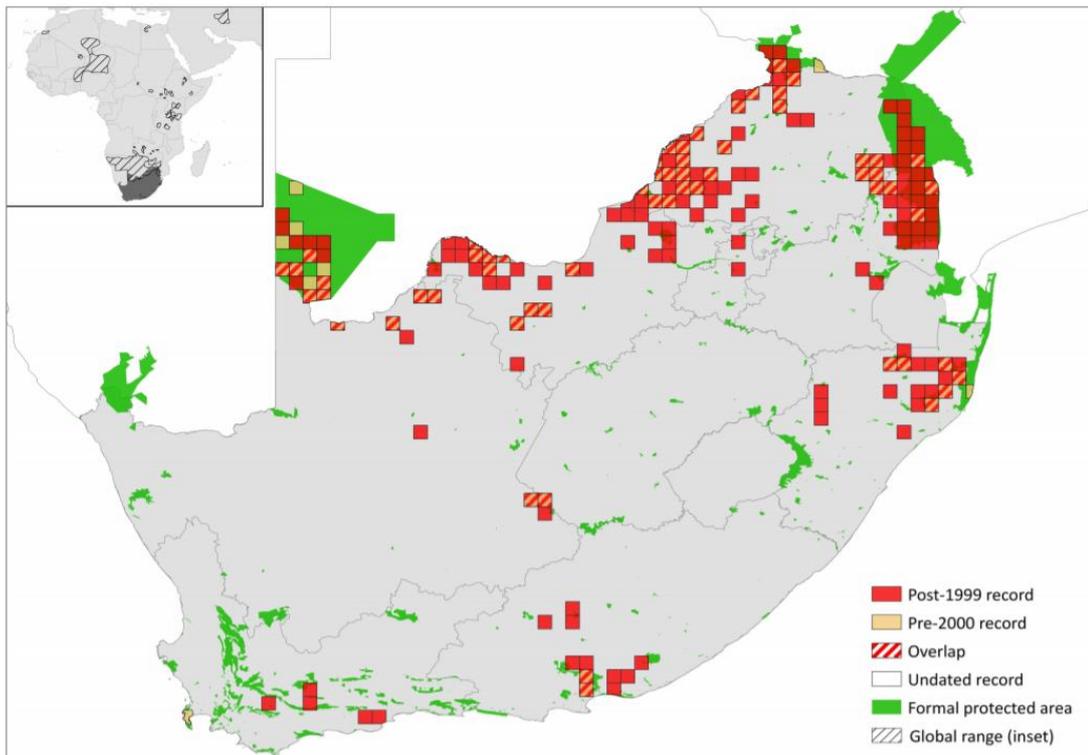
deemed to be suitable habitat for cheetah, of which approximately 44.5% (55 654 km<sup>2</sup>) is under formal conservation, including KNP and surrounding reserves, Pilanesberg National Park, Hluhluwe-Umfolozzi Park, Phinda Game Reserve and KTP (Friedmann & Daly 2004). A more recent assessment by Marnewick (2015) however concluded that only 90 470 km<sup>2</sup> of land in South Africa is suitable cheetah habitat (Figure 3) (the percentage of that habitat represented within State protected areas was not determined). While the KNP protects a large portion of suitable cheetah habitat in South Africa, the most suitable habitat, which is located in the Limpopo Province (altogether an area of 51 289 km<sup>2</sup> or approximately 56% of all suitable cheetah habitat), is insufficient in size and location to protect cheetah (Marnewick, 2015). Small fenced reserves across all nine provinces provide habitat for a managed metapopulation, with a total area size of between 11 721 km<sup>2</sup> and 13 000 km<sup>2</sup> (Wiese *et al.*, 2017).

The cheetah 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 namely i) a naturally occurring, free-ranging population occurring outside of protected areas, ii) naturally occurring populations in large protected areas (i.e. KNP and KTP) and iii) subpopulations that have been reintroduced into small and medium-sized fenced reserves that form part of the metapopulation (managed wild population)(van der Merwe *et al.*, 2016) (Figure 4). These groups are not necessarily genetically isolated as dispersal does occur between the groups (van der Merwe *et al.*, 2016). The distribution range of the free-ranging population is contiguous across four southern African countries, namely Botswana, Namibia, South Africa and Zimbabwe, and is estimated to be approximately 789 800 km<sup>2</sup>. However, within this range approximately 55% of the free-ranging population is concentrated within 400 000 km<sup>2</sup> (Wiese *et al.*, 2017).

The greater part of the South African cheetah population's distribution occurs outside of protected areas, the extent of which may have increased during the 1990s due to the shift from livestock to wildlife ranching and an increased tolerance to cheetahs among wildlife ranchers (van der Merwe *et al.*, 2016). Cheetah sightings are now a regular occurrence in the former Transvaal Province (notably in North West Province and Limpopo), where such sightings were rare during the 1960s and 1970s. Even so, cheetah range remains restricted to the far northern reaches of the country, and within that distribution, cheetah occurrence is likely to be patchy due to human habitation and habitat modification. The recent shift in the game ranching industry to high-value species and colour morphs may have decreased tolerance to cheetahs (and other carnivores) among pure game farmers, and so increased the levels of retaliatory killing (Thorn, *et al.*, 2013; Pitman *et al.*, 2016). An increase in predator proof fencing, associated with the intensification of game farming, have likely negatively affected the movement and distribution of cheetah throughout their distribution range.



**Figure 3:** Habitat suitability maps produced from MaxEnt modelling for cheetahs in South Africa. Darker colours indicate more suitable habitat and lighter colours indicate less suitable habitat. (Source: Marnewick, 2015). Note, model parameters excluded data from reintroduced / metapopulation cheetahs.



**Figure 4:** Distribution records for cheetah within South Africa, inclusive of reintroduced populations. Source: Van der Merwe, *et al.*, (2016).

<b>6. National abundance:</b> What is the abundance nationally?	Very abundant	1
	Common	2
	Uncommon	3
	<b>Rare</b>	<b>4</b>
	Uncertain	5

Currently, 61% (4 300 mature individuals) of the estimated global cheetah population of 7 100 adult cheetahs occurs in southern Africa, as opposed to approximately 2 300 adult cheetahs (32%) in eastern Africa (Durant, *et al.*, 2017).

Cheetahs are rare within South Africa. No reliable estimates are available for the free-ranging wild cheetah population, however Van der Merwe *et al.*, (2016) estimate the free-roaming population between 400 and 800 individuals.. Several estimates of the number of cheetahs in KNP have been published, including 219 (Pienaar 1963), 172 (Bowland & Mills 1994), and 103 (Kemp & Mills 2005). In 2009, a photographic survey using mark-recapture models, estimated the KNP cheetah population at 412 animals (329 – 495; SE 41.95) (Marnewick *et al.*, 2014). Capture-mark-recapture surveys between 2006 and 2012 estimate the cheetah density within the South African portion of the KTP at 0.90 individuals/100km<sup>2</sup>. On average 46±4.5 adult cheetahs were identified each year between 2006 and 2014, slightly lower than an earlier estimate that used tourist photographs (Mills & Mills, 2017). A total of 54 individual adult cheetah were identified during this 1-year survey between June 1998 and July 1999 (Knight, 1999). A small number of cheetah also occur naturally in the Marakele and Mapungubwe National Parks in Limpopo (Table 2). An estimated 419 cheetah occur in 61 small to medium-sized state-owned and privately-owned fenced reserves collectively, following reintroductions or the enclosure of free-roaming cheetahs through predator-proof fencing in newly established reserves e.g. Thaba Tholo (Endangered Wildlife Trust (EWT) unpublished data, August 2020). Under managed conditions, cheetah densities on small fenced reserves range from 0.11-15.0 individuals per 100 km<sup>2</sup> (Wiese *et al.*, 2017).

The total known cheetah population (including an estimate for the free-ranging population) is thus estimated at 1 409 (1 166 – 1 742) animals, of which approximately 553 (39%) individuals are strictly protected within four national parks and three provincial reserves (Table 2).

**Table 2:** Estimated number of cheetah occurring within state-owned (national parks and provincial reserves) and on private reserves. Data obtained from the EWT.

Province	National Parks	Provincial Reserves	Private Game Reserves	Total
Kruger National Park	412			412
Eastern Cape	5	0	79	84
Free State	0	0	4	4
Gauteng	0	8	0	8
KwaZulu-Natal	0	15	75	90
Limpopo	8	0	107	115
Mpumalanga	0	0	7	7
North West	0	14	30	44
Northern Cape	91	0	42	133
Western Cape	0	0	17	17
<b>Total</b>	<b>516</b>	<b>37</b>	<b>361</b>	<b>914</b>

According to data obtained from provincial Management Authorities, there are currently 68 cheetah breeding facilities of which 47 are registered in accordance with the National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA) Threatened or Protected Species Regulations (TOPS Regulations)

and only two (Hoedspruit Endangered Species Centre and De Wildt Cheetah Breeding Centre) are registered in accordance with Resolution Conf. 12.10 (Rev. CoP15) of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Table 3). While the number of captive facilities with cheetah have remained the same since 2014, the number of facilities that trade and breed cheetah locally have almost doubled over the same time period (Table 3). The captive cheetah population in South Africa is estimated to number more than 600 cheetahs.

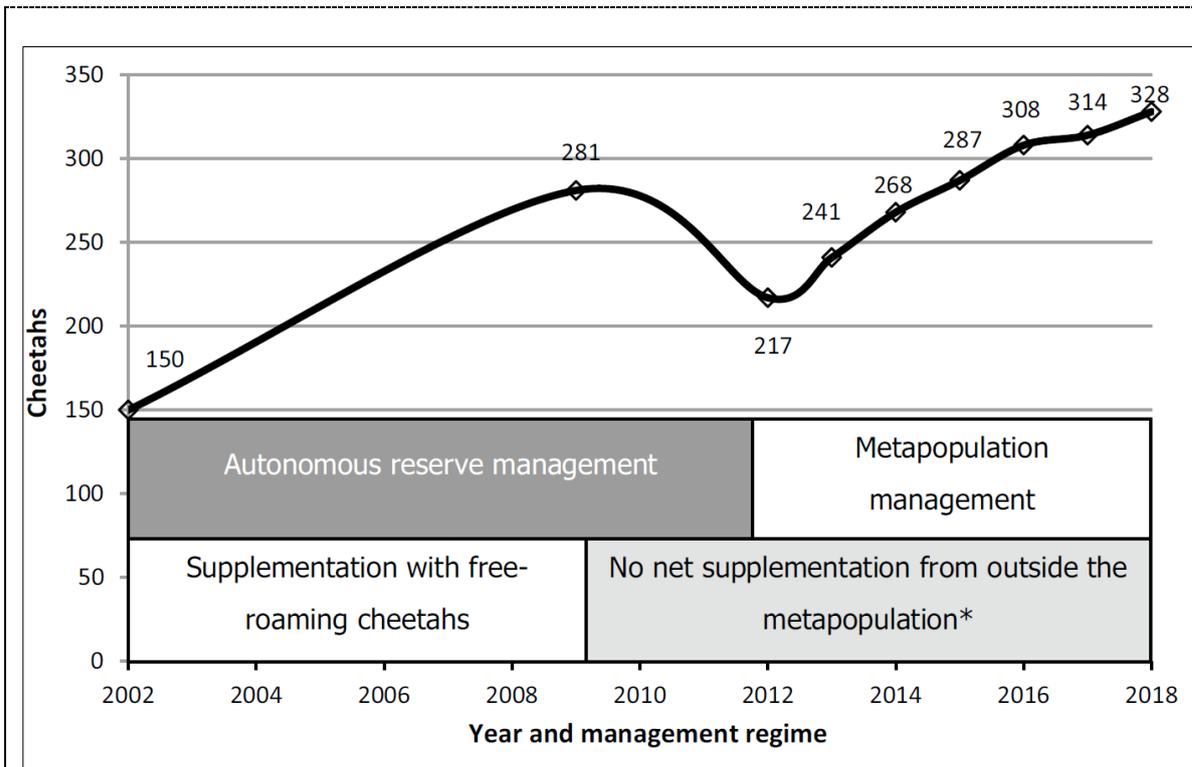
**Table 3:** A comparison of the number of cheetah breeding facilities within each of the provinces and the legal statuses of these facilities between 2014 and 2018. Data provided by the respective provincial Management Authorities.

	Eastern Cape		Free State		Gauteng		KwaZulu		Limpopo		Mpumalanga		North West		Northern Cape		Western Cape		Comparison	
	2014	2018	2014	2018	2014	2018	2014	2018	2014	2018	2014	2018	2014	2018	2014	2018	2014	2018	2014	2018
No of captive facilities with cheetahs	4	3	27	18	8	8	2	2	7	13	3	0	12	12	0		6	12	69	68
No of these facilities that breed & trade cheetahs locally	2	2	4	10	0	1	2	1	4	11	1	0	6	12	0		0	0	19	37
No of these facilities that breed & trade cheetahs internationally	0	0	2	2	8	0	0	0	3	9	0	0	6	4	0		0	0	19	15
No of ToPS registered cheetah breeding facilities	2	2	27	18	8	4	0	1	4	10	0	0	12	12	0		0	0	53	47
No of CITES registered cheetah breeding facilities	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0		0	0	2	2

<b>7. National population trend:</b> What is the recent national population trend?	Increasing	1
	Stable	2
	<b>Reduced, but stable</b>	<b>3</b>
	Reduced and still decreasing	4
	Uncertain	5

While population trends of naturally occurring populations in large protected areas, such as KNP and KTP, are considered stable, the population trend for the free-ranging wild population is unknown. Anecdotal data suggest a likely decline in the free-ranging population, but the extent of the decline is unknown. A 20% reduction in the range of the free-ranging population has been suggested based on the fact that cheetah has disappeared from the Lowveld as well as parts of the Northern Cape (Van Zyl's Rus area). An increase in predator proof fencing, associated with the intensification of game farming, has further negatively affected the movement and distribution of cheetah throughout their distribution range.

Cheetah populations in fenced reserves initially increased due to successful reintroductions and breeding. However, between 2009 and 2012 the cheetah population in fenced reserves was in decline, mostly due to a cessation in the input of animals sourced from the free-ranging population, the killing of cheetahs in fenced areas by lions, or cheetahs being sold into captivity. Sourcing of free-ranging cheetah for the metapopulation ceased in 2009 mainly due to concerns that the 157 recorded removals in addition to reported killings of cheetahs in response to conflict, could affect the long-term survival of South Africa's free-ranging cheetah population, and create a sink on Botswana's cheetah population (Lindsey *et al.*, 2009). The cheetah metapopulation has since recovered after management of the metapopulation was improved and movements to captivity ceased, increasing from 217 individuals in December 2012 to 328 in 2018 (Figure 5), and to 419 individuals at the end of August 2020. There is a high confidence in the latest estimates as they are obtained through intensive monitoring and counts. (In most small and medium sized reserves all individual animals are known.)



**Figure 5:** Total number of cheetahs in South Africa's fenced reserves and the concurrent cheetah management regimes from 2002 to January 2018. By August 2020 the number of cheetahs in fenced reserves have increased to 419 individuals. \*Exception: From July 2011 to December 2016 seven free-roaming cheetahs were relocated to metapopulation reserves, while 17 cheetahs were moved into captivity. Figure obtained from Buk *et al.*, (2018).

**8. Quality of information:** What type of information is available to describe abundance and trend in the national population?

Quantitative data, recent	1
<b>Good local knowledge</b>	<b>2</b>
Quantitative data, outdated	3
Anecdotal information	4
None	5

Population estimates for KNP and KTP are considered accurate as they are based on detailed photographic surveys. All individuals in the small and medium-sized reserves are known and regularly monitored by EWT. Outside of protected areas, a reasonable estimation of cheetah distribution has been obtained through questionnaire surveys, and the collation of sighting reports and damage causing animal (DCA) permit applications (Marnewick *et al.*, 2007). However, confidence in the estimates of the number of free-ranging wild cheetahs (and of trends in numbers) outside of protected areas is low.

**9. Major threats:** What major threat is the species facing (underline following: **overuse/ habitat loss and alteration/** invasive species/ other: ) and how severe is it?

None	1
<b>Limited/Reversible</b>	<b>2</b>
Substantial	3
Severe/Irreversible	4
Uncertain	5

The major threats facing free-ranging cheetahs in South Africa are believed to be persecution by landowners over perceived conflict with livestock or wildlife, and the capture and removal of live animals for the captive trade (van der Merwe *et al.*, 2016). However, data on the scale of both these threats are sparse. Persecution is among the leading world-wide threats to large predators (Treves & Karanth, 2003;

Graham *et al.*, 2005; Inskip & Zimmermann, 2009). Surveys undertaken in Limpopo indicated that African wild dogs are the least tolerated predators followed by cheetahs, although these species were only blamed for 6% and 3% of reported kills respectively (Thorn *et al.*, 2013). Thorn, *et al.*, (2012) found that farmers in North West Province killed 0.3 cheetahs/100 km<sup>2</sup> per year, resulting in estimated annual provincial removals of 137 cheetahs, approximately 34% of the estimated free-ranging cheetahs outside of protected areas (Lindsey *et al.*, 2009). From 2003 to 2009, four out of seven collared cheetahs were illegally killed by farmers within Limpopo (Marnewick & Somers, 2015). Data reported from provinces are however inconsistent with these findings and show that for the period 2002 – 2018 only six illegal killings of cheetahs were reported or investigated (Table 4). This is however to be expected as illegal activities are difficult to monitor. No data were available for several years for two of the four provinces in which the free-ranging cheetah population occurs. The free-ranging cheetah population occurs mainly on private land and it is very difficult to detect illegal activities on these properties, especially in under-resourced provinces. In addition, the recent shift in the game ranching industry to high-value species and colour morphs has likely decreased tolerance to cheetahs (and other carnivores) among pure game farmers, resulting in increased levels of retaliatory killing (Thorn, *et al.*, 2013; Pitman *et al.*, 2016).

**Table 4:** Number of cheetah legally killed as damage causing animals (DCAs) in the respective provinces (A) and the number of illegal killings of cheetah reported or investigated (B) from 2002 – 2018. Data provided by the respective provincial Management Authorities. ND = No data. Provincial Key: EC = Eastern Cape; FS = Free State; GP = Gauteng; KZN = KwaZulu-Natal; LIM = Limpopo; MP = Mpumalanga; NW = North West Province; NC = Northern Cape and WC = Western Cape.

A. No of cheetah killed as DCA																		
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
EC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GP	0	ND	ND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KZN	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
LIM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MP	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
NW	ND	ND	ND	ND	ND	0	0	0	0	0	0	0	0	0	0	0	0	0
NC	ND	ND	ND	ND	ND	ND	0	0	0	0	0	0	0	0	0	0	0	0
WC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>								

B. No of illegal killings of cheetah reported/investigated																		
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
EC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GP	0	ND	ND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KZN	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	3
LIM	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	2
MP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	ND	ND	ND	ND	ND	0	0	0	1	0	0	0	0	0	0	0	0	1
NC	ND	ND	ND	ND	ND	ND	0	0	0	0	0	0	0	0	0	0	0	0
WC	0	0	0	0	0	0	ND	0	0	0	0	0	0	0	0	0	0	0
<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>6</b>

Habitat destruction due to the development of urban areas and infrastructure, and the increasing prevalence of predator-proof fencing around ranches in some areas also constitute a significant threat to cheetahs by fragmenting available habitat (Thorn *et al.*, 2011).

Cheetahs are also vulnerable to being caught in snares, either purposefully set to kill cheetah for body parts or use as religious regalia or as bycatch of snares set for other species (Ray *et al.*, 2005). Increased incidences of snaring have been reported in several provinces including KwaZulu-Natal and Mpumalanga. In the Soutpansberg (Limpopo), the leading causes of leopard mortality have been found to be snaring, shooting and poisoning, either in response to the perceived risk of livestock predation or for bushmeat or animal parts (Williams, *et al.*, 2017). There is no reason to suspect that it would be any different for cheetah.

Data from an audit of cheetah breeding facilities conducted in 2014 by the South African National Biodiversity Institute (SANBI) showed that the potential for the movement of wild cheetahs into captive facilities was high and was facilitated by weak management measures. For example, cheetahs within captive facilities were seldom individually identifiable, with permits issued for the number of cheetahs within a facility and not for individual animals. Several facilities did not have containment areas or crushes in which an animal could be scanned for microchips during inspections, which meant that microchip numbers could only be checked when animals were exported. It was thus possible that once a cheetah in the facility died, it could easily be replaced by a wild cheetah. The implementation of strict management measures in 2015 appears to have significantly reduced this threat to the South African cheetah population, though some of the recommended measures have not yet been fully implemented (See Table 5). Owing to the stricter measures, especially with respect to facilities participating in international trade, the export of laundered wild cheetah from South Africa is now unlikely.

While the number of captive facilities with cheetah have remained the same since 2014, the number of facilities that trade and breed cheetah locally have almost doubled over the same time period (Table 3). The lack of full implementation of the recommended measures may thus allow for the laundering of free-ranging wild cheetah through captive facilities within South Africa, especially through those facilities that are not participating in the international trade.

**Table 5:** Management measures recommended by the Scientific Authority in 2015 and level of implementation.

Management measures	Fully implemented (Yes / No)
All captive-bred cheetah must be recorded in a studbook that keeps records of dates of births and deaths, translocations and sales (with blood or tissue samples taken from dead animals for DNA fingerprinting);	No. Only implemented for international trade
All cheetah in captivity must be individually identifiable through identification photographs and micro-chips and DNA fingerprints;	No. Only implemented for international trade
All specimens to be exported internationally must first be verified as offspring of captive-bred parents through DNA analyses;	Yes
Any facility exporting internationally must be registered with the Management Authority in compliance with the TOPS and CITES regulations;	Yes
Criteria for registered cheetah breeding facilities must be developed.	No, in progress

The biggest threat to the metapopulation is the deaths of individual animals through their capture and translocation. Braud *et al.*, (2019) suggested that free-ranging, rather than habituated captive cheetahs, are particularly at risk of dying during immobilization and transport. Since the inception of the cheetah metapopulation project in 2011, 23 capture-related deaths have been reported out of a total of 114 (20%) cheetahs that were immobilized. Although some mortalities are inevitable during the chemical capture and anaesthesia of wildlife species, rates exceeding 2% should be considered unacceptable in any large mammalian species (Arnemo *et al.*, 2006). Hyperthermia, likely to be associated with capture stress, was considered the primary complication observed during anaesthesia. Capture-associated hyperthermia is a common sequel of the capture of wild ungulates, and has been shown to largely be a stress response

rather than being associated with high environmental temperatures or physical exertion (Meyer *et al.*, 2008).

Even though the threat of persecution to the free-ranging population may be high, the threats facing the cheetah metapopulation are limited and reversible. In addition, management measures implemented with respect to cheetah breeding facilities have effectively reduced the laundering of wild cheetahs into captivity. The overall level of threat to the wild population is thus considered limited and reversible.

**Harvest management**

<b>10. Illegal off-take or trade:</b> How significant is the national problem of illegal or unmanaged off-take or trade?	None	1
	Small	2
	<b>Medium</b>	<b>3</b>
	Large	4
	Uncertain	5

The unregulated/illegal off-take of cheetahs due to perceived or real losses of domestic stock or wildlife is likely severe for the free-ranging wild cheetah population. It is likely that persecution within the Bray area, North West Province, South Africa is negatively affecting one of the biggest transboundary cheetah populations between Botswana, Namibia and South Africa. However, the extent of such off-takes is not known with any certainty. Based on surveys undertaken in Limpopo, the African wild dog is the least tolerated predator followed by the cheetah, although these species were only blamed for 6% and 3% of the reported kills respectively (Thorn *et al.*, 2013). Thorn *et al.*, (2012) found that farmers in North West Province killed 0.3 cheetahs/100 km<sup>2</sup> per year, resulting in estimated annual provincial removals of 137 cheetahs, about 34% of estimated free-ranging cheetahs outside of protected areas (Lindsey *et al.*, 2009). From 2003 to 2009, four out of seven collared cheetahs were illegally killed by farmers within Limpopo alone (Marnewick & Somers, 2015). Data reported from provinces are inconsistent with these findings and show that for the period 2002 – 2018 only six illegal killings of cheetahs were reported or investigated (Table 4). This is however to be expected as illegal activities are difficult to monitor. No data were available for several years for two of the four provinces in which the free-ranging cheetah population occurs (Table 4). The free-ranging cheetah population occurs mainly on private land and it is very difficult to detect illegal activities on these properties, especially in under-resourced provinces. KwaZulu-Natal, Limpopo, Mpumalanga and the Northern Cape allow for the lethal removal of problem cheetah under permit. Provincial data show that only three cheetahs have been legally killed as DCAs from 2002 to 2018 (Table 4).

Localized snaring within some protected areas can be considered a threat to the metapopulation as well as the KNP cheetah population. However, the extent of such off-takes is not known. According to the Ezemvelo KZN compliance database five cheetah incidences were recorded since April 2009. Three of these were for the possession of cheetah skins and two were animals snared in Mkhuze Game Reserve.

Poisoning of cheetah, leopard and other big cats is a recent threat recorded within KNP. Recently there has also been an increase in subsistence snaring specifically aimed at obtaining bushmeat. Snaring is non-specific and often carnivores such as wild dog and sometimes cheetah are affected. Small pieces of meat are poisoned and placed along game paths and around waterholes. Recently there has also been an incident where a cheetah was skinned and the pelt and body parts removed. A similar incident was recorded by the EWT where a cheetah was killed along a fence line and the entire skeleton expertly removed.

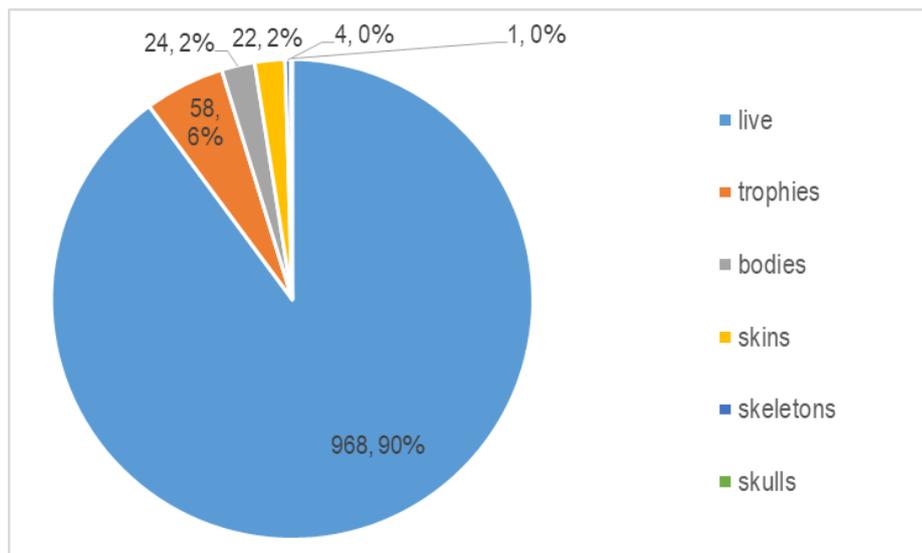
There have been some allegations of illegal cross border trade of cheetahs from Botswana and Namibia into South Africa, but the extent of this trade seems to be small.

<b>11. Management history:</b> What is the history of harvest?	Managed harvest: ongoing with adaptive framework	1
	Managed harvest: ongoing but informal	2
	Managed harvest: new	3
	<b>Unmanaged harvest: ongoing or new</b>	<b>4</b>
	Uncertain	5

The illegal killing of free-ranging cheetahs due to perceived or real losses of domestic stock or wildlife is currently considered to be the largest offtake from the national population and is unmanaged.

After the species was extirpated from 85% of South Africa, cheetahs were reintroduced from Namibian and South African ranches into fenced reserves. During the period 1965–2009, 343 cheetahs were reintroduced, yet in 2009 there were only 289 cheetah in fenced reserves. Then translocations of free-ranging cheetahs were halted, and numbers on fenced reserves dropped to 217 on 40 reserves by 2012. A metapopulation project was launched, and key conservation problems were identified from interviews and records (Buk *et al.*, 2018). Breeding cheetahs were absent from 35% percent of reserves, breeding was taking place in only 13% of reserves, fence quality was erratic, around 3% of cheetahs were being sold into captivity annually, and 28% of cheetah mortalities were anthropogenic in nature. Lion attacks accounted for 31% of cheetah mortalities, perhaps exacerbated by lion-inexperienced cheetahs and high lion densities. These problems were addressed, and cheetahs were translocated among reserves in accordance with metapopulation principles. Despite the median reserve size being only 125 km<sup>2</sup> with four cheetahs, and despite 80% of the reserves being privately owned, the cheetah metapopulation grew by 51% in six years to 328 cheetahs on 51 reserves (end of January 2018), during which time genetic diversity was managed and monitored (Buk *et al.*, 2018). Currently the number of adult females in the managed wild metapopulation limits the population’s reproductive potential, viability and expansion (Buk *et al.*, 2018).

An analysis of CITES trade data (CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK) showed that live exports accounted for 90% (968 animals) of the total exports of cheetah from South Africa for the period 2002 – 2017 (Figure 6). Six cheetah hunting trophies have apparently been exported from South Africa between 2002 and 2017 (CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK), though provincial data received in response to a questionnaire survey indicated that no permits have been issued for the trophy hunting of cheetah within South Africa over this time period.



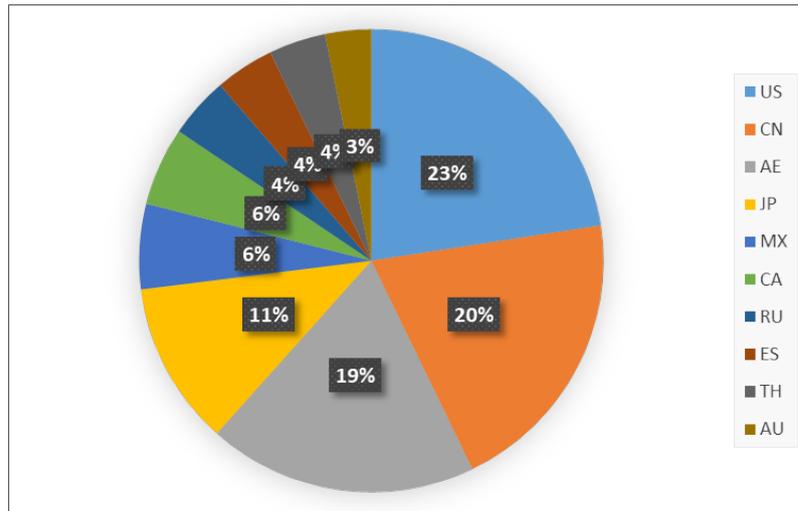
**Figure 6:** The number of cheetah exported from South Africa between 2002 and 2017, using the trade terms bodies, skeletons, skins, skulls, live and trophies under all purpose codes. Numbers exported as well as percentages per trade term are indicated. Note: trophies exported include re-exports from Namibia and Zimbabwe.

Exports of live cheetah accounted for 91% (878 animals) of the total exports of cheetahs from South Africa for the period 2002 – 2012 (CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK). More than 80% of the captive-bred live cheetahs were exported to zoos and breeding facilities. Up until 2015, the majority of live cheetah exported from South Africa originated from captive facilities, not all of which were registered with CITES for commercial trade in accordance with Resolution Conf. 12.10 (Rev. CoP15). Despite the fact that cheetahs are purportedly difficult to breed in captivity, an average of 80 live cheetahs were exported each year, this possibly lending support to the allegation that wild cheetahs were being moved or sold into captivity. This is also supported by data from the EWT that showed that 3% of cheetahs were moved from the metapopulation into captivity annually (Buk, *et al.*, 2018). An audit of cheetah breeding facilities conducted by SANBI in 2014 showed that weak management measures increased the potential for the movement of wild cheetahs into captive facilities. For example, cheetahs within captive facilities were seldom individually identifiable, with permits issued for the number of cheetahs within a facility and not for individual animals. Several facilities did not have containment areas or crushes in which an animal could be scanned for microchips during inspections, which meant that microchip numbers could only be checked when animals were exported. It was thus possible that once a cheetah in a facility died, it could easily be replaced by a wild cheetah without the knowledge of the provincial Management Authority.

Cheetahs are difficult to breed in captivity and thus there is an incentive for moving wild cheetahs into captivity. Only 36 cubs were produced collectively in the year preceding the audit conducted by SANBI, from six out of the 13 audited facilities (with a total of 76 breeding females). Similarly, of the 250 known international breeding facilities that keep cheetah, only 33 bred cheetah successfully in 2012 (Marker & Cunningham 2013). According to provincial permitting records, 19 wild cheetahs were legally translocated from reserves into captive environments between 2002 and 2013. There is also a case of a provincial Management Authority issuing a standing permit for the capture and removal of wild cheetah to a captive breeding facility. (A standing permit is a permit issued to authorize the continuous carrying out of a restricted activity, or a combination of restricted activities, involving one or more specimens of one or more listed threatened or protected species (Regulation 7 of the Threatened or Protected Species (TOPS) Regulations (2007))). Permit records further indicate that there are high numbers of translocations of cheetahs between provinces, with a total of 646 exports and 794 imports from provinces from 2002 – 2018 (Table 6). (Of concern, these data do not correspond with the CITES export data (provincial data include both provincial and international exports and should be higher than that recorded on the CITES trade database, though there were years where no data were available)).

An analysis of the CITES trade data for the period 2002 – 2017 (CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK) showed that 479 live cheetahs were exported from South Africa into the United States of America, China, United Arab Emirates (UAE) and Japan (Figure 7) (collectively 49% of all live cheetah exported). Results from an Internet search also highlighted the UAE as one of the top traders in live cheetahs, and dozens of recent news articles and social media images suggest that private ownership of cheetahs is popular throughout the Gulf region. Of the 140 live cheetah exported from South Africa to the UAE, between 2002 and 2012 (when the UAE was the top importing country), 98 were destined for breeding facilities, while six were exported to zoos and 36 as personal effects. Of the 36 live animals exported for personal effects, 26 were listed as captive-bred (source code C). This highlights that there is a high demand for cheetah in especially the Gulf States, and thus there is an incentive to capture wild cheetah for breeding and export purposes. Other countries that imported

more than 30 live cheetahs over the 16 year period (2002 – 2017) were Mexico (39), and Canada (36) (Figure 7).



**Figure 7:** The percentage of total live cheetah exports from South Africa for the top ten importing countries as determined by an analysis of CITES trade data for the period 2002 – 2017 (CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK). Country key: US = United States of America; CN = China; AE = United Arab Emirates; JP = Japan; MX = Mexico; CA = Canada; RU = Russian Federation; ES = Spain; TH = Thailand; AU = Australia.

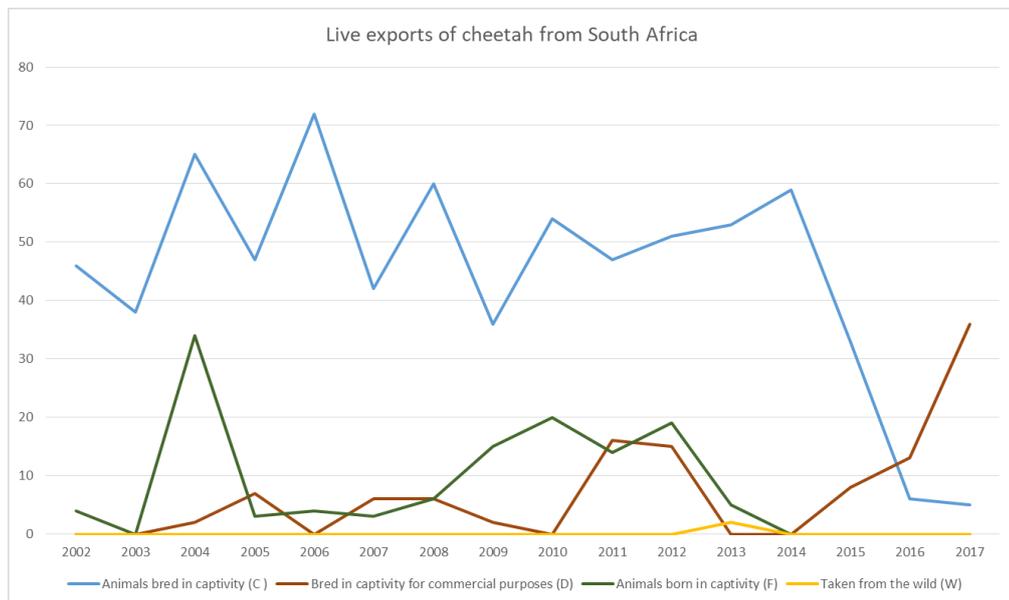
**Table 6:** The number of cheetahs imported into provinces (A) from 2002 to 2018 and the number of cheetahs exported from provinces for the same time period (B). Data were obtained from the respective provincial Management Authorities. (ND = No Data). Provincial key: EC = Eastern Cape; FS = Free State; GP = Gauteng; KZN = KwaZulu-Natal; LIM = Limpopo; MP = Mpumalanga; NW = North West Province; NC = Northern Cape and WC = Western Cape

A. No of cheetah imported into provinces from other provinces																		
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
EC	0	0	5	1	0	3	2	0	1	0	0	3	1	1	6	1	3	27
FS	0	0	0	0	0	0	0	4	23	4	ND	0	4	0	7	1	0	43
GP	0	ND	ND	11	10	7	15	17	22	8	4	3	0	0	0	0	11	108
KZN	7	5	13	17	12	7	8	23	3	6	6	42	5	6	3	15	5	183
LIM	0	0	0	0	0	0	0	2	3	4	10	16	6	14	32	19	17	123
MP	?	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	1	7
NW	0	0	0	0	0	0	0	0	0	0	6	0	2	1	0	3	2	14
NC	ND	ND	ND	ND	ND	ND	0	0	0	0	2	3	4	0	1	0	0	10
WC	ND	ND	14	17	18	10	19	38	15	19	24	6	27	14	9	37	12	279
<b>Total</b>	<b>7</b>	<b>5</b>	<b>32</b>	<b>46</b>	<b>40</b>	<b>27</b>	<b>44</b>	<b>84</b>	<b>69</b>	<b>43</b>	<b>54</b>	<b>73</b>	<b>49</b>	<b>36</b>	<b>58</b>	<b>76</b>	<b>51</b>	<b>794</b>
B. No of cheetah exported from province																		
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
EC	0	0	2	1	4	7	ND	ND	2	17	5	2	6	5	4	12	13	80
FS	0	0	0	2	18	14	8	6	7	5	5	3	14	4	6	0	2	94
GP	1	ND	ND	3	3	7	1	20	16	14	7	17	0	0	0	0	6	95
KZN	4	3	5	11	2	25	9	9	8	0	5	3	6	8	8	13	10	129
LIM	0	0	0	0	0	0	0	2	2	2	3	5	7	8	7	12	10	58
MP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4	5
NC	ND	ND	ND	ND	ND	ND	0	0	0	0	1	0	2	0	0	0	0	3
WC	ND	ND	13	2	10	10	2	8	14	23	16	9	27	18	16	3	11	182
<b>Total</b>	<b>5</b>	<b>3</b>	<b>20</b>	<b>19</b>	<b>37</b>	<b>63</b>	<b>21</b>	<b>45</b>	<b>49</b>	<b>61</b>	<b>42</b>	<b>39</b>	<b>62</b>	<b>43</b>	<b>41</b>	<b>40</b>	<b>56</b>	<b>646</b>

From 2015, in accordance with measures recommended by the Scientific Authority to improve the management of captive-bred cheetahs and to prevent the laundering of wild specimens as captive-bred, only cheetah verified through DNA analyses as offspring of captive-bred parents were allowed for

international export. Furthermore any facility exporting internationally had to be registered with the Management Authority in compliance with the TOPS and CITES Regulations.

The implementation of these recommendations significantly decreased the number of live cheetah exported as captive-bred from facilities not registered with the CITES Secretariat in accordance with Resolution Conf. 12.10 (Rev. CoP15) (source code C; Figure 8), and this trade was replaced over the same period with exports of live cheetah bred in South Africa's two CITES registered captive breeding facilities (source code D; Figure 8). A cheetah DNA database managed by SANBI currently stores 813 cheetah DNA profiles. A total of 52 cheetah breeding facilities have sent DNA samples for analysis according to an approved forensic protocol, and approximately 433 passports confirming parentage have been issued between 2016 and 2020 (end of August). Parentage could not be confirmed in only 23 cases, meaning that animals were confirmed as captive bred in 95% of cases. (It must be noted that not all DNA samples submitted were for the purpose of issuing DNA passports for international export.)



**Figure 8:** The number of live cheetah exported from South Africa annually under the various source codes (CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK).

<b>12. Management plan or equivalent:</b> Is there a management plan related to the harvest of the species?	Approved and co-ordinated local and national management plans	1
	Approved national/state/provincial management plan(s)	2
	Approved local management plan	3
	<b>No approved plan: informal unplanned management</b>	<b>4</b>
	Uncertain	5

In 2009, a National Conservation Action Plan was developed for cheetahs in South Africa (Lindsey *et al.*, 2009). A Biodiversity Management Plan (BMP) in terms of the National Environmental Management: Biodiversity Act (NEMBA) 2004 is currently being developed by EWT, but is still in its infancy. Neither of these plans provide specific guidelines for the harvest of cheetahs perceived to be damage causing animals (DCAs).

A protocol for the reintroduction of cheetah to reserves that form part of the metapopulation has also been developed by EWT (Cilliers & van der Merwe, 2016). Any new reintroduction is informed by a

predator management plan that is submitted to the relevant provincial Management Authority. In addition, a genetic management plan and code of ethics around the appropriate and responsible management of the cheetah population is signed by the reserves that constitute the cheetah metapopulation. Reintroductions are however still considered unmanaged and opportunistic as there are no set targets for numbers, areas, demographics etc.

South Africa's managed cheetah metapopulation meets several criteria for a successful reintroduction programme, as proposed by Seddon (1999) and Hayward *et al.*, (2007). Breeding by the first wild born generation was achieved already early on, a self-sustaining population has been accomplished through metapopulation management, and a 3-year breeding population with a natural growth rate has been passed twice during the 2012–2018 period. A wild population of  $\geq 500$  individuals before 2030 is a realistic target (Buk *et al.*, 2018). Currently the managed wild metapopulation is approaching 5% of the global cheetah population and may thus prevent a Red List up-listing from Vulnerable to Endangered (Buk *et al.*, 2018). Due to habitat fragmentation, the metapopulation will continue to require management in accordance with metapopulation principles (Buk *et al.*, 2018), and a formal metapopulation management plan is therefore being developed.

The management of genetic diversity was improved through identifying inbred cheetahs using existing reproduction records from each reserve, with the aim of preventing further inbreeding (Buk, *et al.*, 2018). In order to maintain genetic diversity, there is a need to complete and continuously update a single, digital metapopulation studbook in a standard format, and use it for systematic decisions on translocations (Buk, *et al.*, 2018). Even though it is too early to pronounce on the genetic viability of the metapopulation, the starting point is good, as Schoonover (2014) found when comparing 43 metapopulation cheetahs with 33 South African free-ranging cheetahs at 16 microsatellite loci. Metapopulation cheetahs were found to be on average more genetically diverse.

<b>13. Aim of harvest regime in management planning:</b> What is harvest aiming to achieve?	Generate conservation benefit	1
	Population management/control	2
	Maximize economic yield	3
	<b>Opportunistic, unselective harvest, or none</b>	<b>4</b>
	Uncertain	5

Legal DCA cheetah control is typically conducted to reduce predation and human-predator conflict. The aim of metapopulation harvest is to generate conservation benefit for the species and to manage surplus animals within the metapopulation. However, the largest part of the harvest is illegal which is considered opportunistic and unselective.

<b>14. Quotas:</b> Is the harvest based on a system of quotas?	Ongoing national quota: based on biologically derived local quotas	1
	Ongoing quotas: "cautious" national or local	2
	<b>Untried quota: recent and based on biologically derived local quotas</b>	<b>3</b>
	Market-driven quota(s), arbitrary quota(s), or no quotas	4
	Uncertain	5

Buk (2019) undertook a population viability analysis (PVA) to model the viability of the managed cheetah metapopulation. His model showed that the South African cheetah metapopulation should maintain 96% of its genetic diversity and predicted a growth from 314 animals to a metapopulation size of over 500 cheetahs in 20 years, and to over 1000 cheetahs in 100 years if an annual increase in carrying capacity of 0.7% is realised (equivalent to one average sized reserve added every second year, which is entirely

realistic as during the past 20 years two reserves were added each year on average) (Buk, *et al.*, 2018). The PVA further showed that up to 30% of males could be removed annually without any adverse effects on metapopulation viability, provided that only males are removed, whereas only 5% of females could be sustainably removed annually if only females are removed (Buk, 2019). If both sexes were to be removed in any one year, no more than 10% of the male population and 4% of the female population could be removed. These animals could be used for expanding the metapopulation by adding new breeding subpopulations or for restocking small non-breeding reserves with males only. Hunting of the male adults could even be considered, if there were no better options (Buk, 2019). Based on the outcome of this PVA, the Scientific Authority recommended an annual export quota of 13 cheetahs from the metapopulation (3 females and 10 males) for the sole purpose of reintroducing cheetah to other range States as part of the expanded metapopulation. To date approximately eight cheetah have been reintroduced to reserves outside of South Africa. This is considered to be a small managed harvest that has only recently been implemented. Whereas translocation of cheetahs between reserves within the metapopulation is not considered to be a harvest, translocation to other range countries for reintroduction purposes is considered to be a harvest.

**Control of harvest**

<b>15. Harvesting in Protected Areas:</b> What percentage of the legal national harvest occurs in State-controlled Protected Areas?	High	1
	Medium	2
	<b>Low</b>	<b>3</b>
	None	4
	Uncertain	5

Most cheetahs are harvested outside of protected areas. Some animals living primarily in protected areas may be subjected to persecution killings or captured when ranging beyond the borders of protected areas, however most protected areas are fenced, which limits such movements. There is the potential in future to sustainably harvest individuals from populations that have been reintroduced into small to medium-sized fenced reserves, in cases where management is required to reduce cheetah densities. Cheetahs translocated for reintroduction into other range countries may be removed from protected areas that form part of metapopulation. For example, cheetahs for a recent reintroduction to Malawi were sourced from Mountain Zebra National Park.

<b>16. Harvesting in areas with strong resource tenure or ownership:</b> What percentage of the legal national harvest occurs outside Protected Areas, in areas with strong local control over resource use?	<b>High</b>	<b>1</b>
	Medium	2
	Low	3
	None	4
	Uncertain	5

There is very little legal harvest of cheetahs, except for some DCA control (either lethally or through translocation). Such harvest occurs primarily on private land, where local control over resource use is high. According to provincial records, no permits have been issued for the trophy hunting of cheetah, and only three cheetahs have been legally killed as DCAs for the period 2002 – 2017 (Table 4). Whereas translocation of cheetahs between reserves within the metapopulation is not considered to be a harvest, translocation to other range countries for reintroduction purposes is considered to be a harvest. Cheetahs translocated for reintroduction into other range countries are mainly sourced from private land.

<b>17. Harvesting in areas with open access:</b> What percentage of the legal national harvest occurs in areas where there is no strong local	<b>None</b>	<b>1</b>
	Low	2
	Medium	3
	High	4

control, giving <i>de facto</i> or actual open access?	Uncertain	5
<p>The large majority of cheetahs occurring outside of protected areas occur on private land with strong local control over natural resource use.</p>		
<p><b>18. Confidence in harvest management:</b> Do budgetary and other factors allow effective implementation of management plan(s) and harvest controls?</p>	High confidence	1
	<b>Medium confidence</b>	<b>2</b>
	Low confidence	3
	No confidence	4
	Uncertain	5
<p>The current permitting system and stricter measures implemented in 2015 (Table 5) are believed to be effective in preventing the international export of wild cheetah laundered as captive-bred. There is thus a high confidence in management of captive populations to prevent/reduce the laundering of wild cheetah through captive facilities for international trade. However, the local trade in cheetahs is not as well managed. Confidence in the management of exports of live cheetah between provinces is thus low as not all the recommended measures have been effectively implemented and thus laundering of free-ranging cheetah through captive breeding facilities is still a possibility (Table 5).</p> <p>Capacity and resource constraints within provinces limit the effective implementation of management plans and harvest controls. There is no national management plan to control the harvest of cheetahs, and none of the provinces likely have the capacity to effectively curb illegal off-take.</p> <p>There is a high confidence in the management of the metapopulation and harvest controls. The only harvest currently allowed from the metapopulation is for the export of live cheetahs for reintroduction purposes, restricted to excess cheetah within the metapopulation and limited to a maximum of 13 animals per annum.</p>		
<p><b>Monitoring of harvest</b></p>		
<p><b>19. Methods used to monitor the harvest:</b> What is the principal method used to monitor the effects of the harvest?</p>	<b>Direct population estimates</b>	<b>1</b>
	Quantitative indices	2
	Qualitative indices	3
	National monitoring of exports	4
	No monitoring or uncertain	5
<p>Most of the legal harvest is from the cheetah metapopulation. All aspects of the metapopulation are monitored including illegal offtakes. Direct population estimates are available as all births and deaths (natural and anthropogenic) are recorded; translocations nationally and internationally are recorded and monitored.</p> <p>Cheetahs are currently listed as vulnerable in terms of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA), meaning that a permit is required if a person intends to carry out any restricted activity involving cheetahs such as keeping, hunting, catching, breeding, selling, conveying or exporting from the country. The permit system is regulated through the Threatened or Protected Species (TOPS) Regulations (2007), which have been promulgated in terms of NEMBA. Cheetahs are also protected under various provincial Ordinances / Acts. Records of permits issued provide useful data for monitoring. Some provinces record the numbers of DCA permits issued, but few actually note whether putative DCAs were successfully removed (translocated or killed). The Department of Environment, Forestry and Fisheries records the numbers of CITES export permits issued by each province.</p>		

The Scientific Authority has recommended that all cheetahs kept in captive breeding facilities must be individually identifiable through identification photographs, micro-chips and DNA fingerprints, and any live specimens to be exported internationally must first be verified as offspring of captive-bred parents through DNA analyses. A cheetah DNA database managed by SANBI currently stores 830 DNA profiles. A total of 52 facilities have sent samples, collected according to an approved forensic protocol, and approximately 433 passports confirming parentage have been issued. At present only some captive breeding facilities are maintaining a studbook. Though not yet fully implemented, these recommended measures provide a mechanism for monitoring the trade.

<b>20. Confidence in harvest monitoring:</b> Do budgetary and other factors allow effective harvest monitoring?	<b>High confidence</b>	<b>1</b>
	Medium confidence	2
	Low confidence	3
	No confidence	4
	Uncertain	5

Confidence in the monitoring of harvest from the metapopulation is high, as all cheetahs are individually identifiable and harvest for international reintroductions is strictly regulated.

Confidence in the monitoring of captive breeding facilities keeping cheetah has increased since the implementation of SANBI's cheetah DNA database, and the issuing of DNA passports for international cheetah exports. There is thus a high confidence in the monitoring of international exports of live cheetah.

Monitoring of illegal off-take of free-ranging wild cheetahs is poor. The free-ranging cheetah population occurs mainly on private land and it is difficult to detect illegal activities on these properties, especially in under-resourced provinces. From 2003 – 2009 four out of seven collared cheetahs were illegally killed by farmers within Limpopo (Marnewick & Somers, 2015). Yet data reported by provinces show that for the period 2002 – 2018 only six illegal killings of cheetahs were reported or investigated (Table 4). No data were available for several years for two of the four provinces in which the free-roaming cheetah population occurs. There is thus a low confidence in the monitoring of illegal off-takes from the free-ranging wild population.

Record keeping by provinces of permits issued for legal activities regulated through TOPS, though improved in recent years, has generally been poor.

**Incentives and benefits from harvesting**

<b>21. Utilization compared to other threats:</b> What is the effect of the harvest when taken together with the major threat that has been identified for this species?	<b>Beneficial</b>	<b>1</b>
	Neutral	2
	Harmful	3
	Highly negative	4
	Uncertain	5

The major threats facing free-ranging cheetahs in South Africa are believed to be persecution by landowners over perceived conflict with livestock or wildlife, and the capture and removal of live animals for the captive trade (van der Merwe, *et al.*, 2016). Initially, harvest of wild cheetahs for reintroductions into more secure small reserves may have been beneficial for the species. However, there are presently sufficient numbers of individuals within the metapopulation to provide founder individuals for future reintroductions, and so further harvest of cheetah from the free-ranging wild population is unlikely to yield conservation benefits for the species and would be detrimental to the source populations. At present the harvest of cheetah from the free-ranging population is not allowed as any harvest is likely to be detrimental.

Translocation of cheetah captured from the metapopulation to other range countries for conservation purposes is beneficial to the species.		
<b>22. Incentives for species conservation:</b> At the national level, how much conservation benefit to this species accrues from harvesting?	High	1
	Medium	2
	Low	3
	<b>None</b>	<b>4</b>
	Uncertain	5
The harvest of cheetahs as it currently occurs in South Africa is unlikely to incentivize the conservation of the species. Sustainable hunting of excess male adults could potentially benefit the management and conservation of the species in the future, though no data are available to show if or how utilization affects tolerance of landowners towards the species. A PVA (Buk, 2019) has shown that up to 30% of males could be removed annually without any adverse effects on metapopulation viability, provided that only males are removed.		
<b>23. Incentives for habitat conservation:</b> At the national level, how much habitat conservation benefit is derived from harvesting?	High	1
	Medium	2
	Low	3
	<b>None</b>	<b>4</b>
	Uncertain	5
The harvest of cheetahs as it currently occurs in South Africa is unlikely to incentivize the conservation of cheetah habitat, though no data are available to support such a supposition.		
<b>Protection from harvest</b>		
<b>24. Proportion strictly protected:</b> What percentage of the species' natural range or population is legally excluded from harvest?	<b>&gt;15%</b>	<b>1</b>
	5-15%	2
	<5%	3
	None	4
	Uncertain	5
The extent of the distribution of cheetahs outside of protected areas is not known with confidence. Boitani <i>et al.</i> , (1999) estimated that there is ~125 150 km <sup>2</sup> of suitable cheetah habitat in South Africa of which approximately 55 654 km <sup>2</sup> is under formal protection, including state-owned and private nature reserves. Because protected areas are fenced, 55 654 km <sup>2</sup> of the cheetah's distribution is effectively excluded from harvest. An estimated 553 cheetahs (39% of total population) occur within four national parks and three provincial reserves and are thus strictly protected. No trophy hunting or DCA control are allowed within any of the state-protected areas and these constitute approximately 44.5% of the suitable cheetah habitat within South Africa. However, cheetahs translocated for reintroduction into other range countries may be removed from protected areas that form part of metapopulation. For example, cheetahs for a recent reintroduction to Malawi were sourced from Mountain Zebra National Park.		
<b>25. Effectiveness of strict protection measures:</b> Do budgetary and other factors give confidence in the effectiveness of measures taken to afford strict protection?	High confidence	1
	<b>Medium confidence</b>	<b>2</b>
	Low confidence	3
	No confidence	4
	Uncertain	5
Even though cheetahs within some protected areas might be exposed to strong edge effects, the cores of larger protected areas such as the KNP and KTP likely constitute inviolate refuges for cheetahs. There is thus a medium confidence in the effectiveness of these strict protection measures.		

<b>26. Regulation of harvest effort:</b> How effective are any restrictions on harvesting (such as age or size, season or equipment) for preventing overuse?	Very effective	1
	<b>Effective</b>	<b>2</b>
	Ineffective	3
	None	4
	Uncertain	5
<p>There is good legislation in place both on a national (TOPS Regulations) as well as a provincial level, where all use activities relating to cheetah are regulated. This legislation is being effectively implemented in South Africa. Harvest of wild cheetah for export purposes has been restricted to excess animals within the metapopulation and to only 13 cheetah (3 females and 10 males) per annum. These restrictions are considered to be effective. In order to prevent laundering of wild cheetah through captive breeding facilities, all cheetah exported internationally must i) be recorded in a studbook that keeps records of dates of births and deaths, translocations and sales (with blood or tissue samples taken from dead animals for DNA fingerprinting); ii) be individually identifiable through identification photographs and micro-chips and DNA fingerprints; and iii) be verified as offspring of captive-bred parents through DNA analyses; and any facility exporting internationally must be registered with the Management Authority in compliance with the TOPS and CITES regulations. However, not all these recommendations have been fully implemented.</p>		

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## References

- Arnemo, J.M., Ahlqvist, P., Andersen, R., Berntsen, F., Ericsson, G., Odden, J., Brunberg, S., Segerström, P., & Swenson, J.E., 2006.** Risk of capture-related mortality in large free-ranging mammals: experiences from Scandinavia. *Wildlife Biology* 12, 109–395.
- Bartels, P., Bouwer, V., Crosier, A., Cilliers, D., Durant, S., Grisham, J., Marker, L., Mulama, M., Venter, L., Wildt, D., & Friedmann, Y., 2002.** Global cheetah action plan review final workshop report. Conservation Breeding Specialist Group SSC/IUCN, Pretoria
- Berry, H., Bartels, P., Cilliers, D., Dickman, A., Durant, S., Grisham, J., Marker, L., Munson, L., Mulama, M. Schoeman, B., Tubbesing, U., Venter, L., Wildt, D., Ellis, S. & Friedmann, Y., 2002.** Global Cheetah conservation action plan. Final report from the workshop held at Shumba Valley lodge in South Africa from the 27-30<sup>th</sup> of August 2001.
- Bissett, C. & Bernard, R.T.F., 2007.** Habitat selection and feeding ecology of the Cheetahs (*Acinonyx jubatus*) in thicket vegetation: is the Cheetahs a savanna specialist? *Journal of Zoology* 271: 310–317.
- Boitani, L., Corsi, F., De Biase, A., D'Inzillo Carranza, I., Ravagli, M., Reggiani, G., Sinibaldi, I. & Trapanese, P., 1999.** A Databank for the Conservation and Management of the African Mammals. Istituto Ecologia Applicata, Roma.
- Bowland, A.E. & Mills, M.G.L., 1994.** The 1990/1991 Cheetahs photographic survey. Scientific Report 6/94. SANParks, Skukuza.
- Braud, C., Mitchell, E.P., van der Merwe, V., & Tordiffe, A.S.W., 2019.** A veterinary survey of factors associated with capture-related mortalities in cheetahs (*Acinonyx jubatus*). *Journal of the South African Veterinary Association*.
- Broomhall, L.S., 2001.** Cheetah *Acinonyx jubatus* ecology in the Kruger National Park: a comparison with other studies across the grassland-woodland gradient in African savannas. MSc (Zoology) thesis, University of Pretoria, Pretoria.
- Broomhall, L.S., Mills, M.G.L. & du Toit, J.T., 2003.** Home range and habitat use by Cheetahs (*Acinonyx jubatus*) in the Kruger National Park. *Journal of Zoology*, London 261, 119-128.
- Buk, K.G., 2019.** Conservation ecology of the cheetah (*Acinonyx jubatus*) in the South African managed metapopulation. PhD thesis, Nature Conservation, Tshwane University of Technology.
- Buk, K.G., van der Merwe, V.C., Marnewick, K., & Funston, P.J., 2018.** Conservation of severely fragmented populations: lessons from the transformation of uncoordinated reintroductions of cheetahs (*Acinonyx jubatus*) into a managed metapopulation with self-sustained growth. *Biodiversity and Conservation*, 27(13), pp.3393-3423. <https://doi.org/10.1007/s10531-018-1606-y>
- Cilliers, D., & van der Merwe, V., 2016.** The reintroduction of cheetah (*Acinonyx jubatus*) into fenced reserves in South Africa. Unpublished EWT report.
- Durant, S.M., Kelly, M. & Caro, T.M., 2004.** Factors affecting life and death in Serengeti Cheetahs: environment, age, and sociality. *Behavioral Ecology* 15: 11–22.
- Durant, S.M., Mitchell, N., Groom, R., Pettorelli, N., Ipavec, A., Jacobson, A.P., Woodroffe, R., Böhm, M., Hunter, L.T., Becker, M.S. & Broekhuis, F., 2017.** The global decline of cheetah *Acinonyx jubatus* and what it means for conservation. *Proceedings of the National Academy of Sciences*, 114(3), pp.528-533.
- Estes, R., 1991.** *The behavior guide to African mammals* (Vol. 64). Berkeley: University of California Press.

**Friedmann, Y. & Daly, B., 2004.** Red Data Book of the Mammals of South Africa: A Conservation Assessment. CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust. South Africa.

**Global Eye 2015.** Analysis of cheetah trade databases. 28<sup>th</sup> October 2015. [www.countertraffic.org](http://www.countertraffic.org).

**Graham, K., Beckerman, A.P. & Thirgood S., 2005.** Human–predator–prey conflicts: ecological correlates, prey losses and patterns of management. *Biological Conservation* 122:159–171.

**Hayward, M.W., Adendorff, J., O'Brien, J., Sholto-Douglas, A., Bissett, C., Moolman, L.C., Bean, P., Fogarty, A., Howarth, D., Slater, R., & Kerley, G.I.H., 2007.** The reintroduction of large carnivores to the Eastern Cape, South Africa: an assessment. *Oryx* 41(2):205–214

**Inskip, C. & Zimmermann, A., 2009.** Human-felid conflict: a review of patterns and priorities worldwide. *Oryx* 43(01):18–34. doi:[10.1017/S003060530899030X](https://doi.org/10.1017/S003060530899030X)

**Kelly, M.J., Laurenson, M.K., FitzGibbon, C.D., Collins, D.A., Durant, S.M., Frame, G.W., Bertram, B.C.R. & Caro, T.M., 1998.** Demography of the Serengeti Cheetahs (*Acinonyx jubatus*) population: the first 25 years. *Journal of Zoology*, 244: 473-488.

**Kemp L. V. & Mills M. G. L., 2005.** The 4th wild dog and 2nd Cheetahs photographic census in the greater Kruger region September 2004 – April 2005. Unpublished report Endangered Wildlife Trust, Johannesburg.

**Knight, A., 1999.** Cheetah numbers in a changing environment: Kalahari Gemsbok National Park. Unpublished Report Endangered Wildlife Trust, Johannesburg.

**Laurenson, M.K., Caro, T. & Borner M., 1992.** Female Cheetahs Reproduction. Patterns of female reproduction in wild Cheetahs: Implications for conservation. *National Geographic Research and Exploration* 8(1): 64-75.

**Laurenson, M.K., Wielebnowski, N. & Caro, T.M., 1995.** Extrinsic factors and juvenile mortality in Cheetahs. *Conservation Biology* 47: 547-557.

**Lindsey, P. 2011.** A review of the consumptive utilization and trade of Cheetahs and leopards in South Africa. Unpublished report to the Carnivore Conservation Programme of the Endangered Wildlife Trust.

**Lindsey, P., Cilliers, D., Marnewick, K. & Davies-Mostert, H.T., 2009.** Draft Strategy for a Managed Metapopulation of Cheetahs *Acinonyx jubatus* in South Africa. Endangered Wildlife Trust Report, pp. 31. Lindsey PA, Davies-Mostert HT (eds.) 2009. South African action plan for the conservation of cheetahs and African wild dogs. Report from a National Conservation Action Planning Workshop, Bela Bela, Limpopo Province, South Africa, 17–19 June 2009.

**Lindsey, P., du Toit, J.T. & Mills, M.G., 2005.** Attitudes of ranchers towards African wild dogs *Lycaon pictus*: conservation implications for wild dogs on private land. *Biological Conservation*, 125: 113-121.

**Low A.B. & Rebelo A. G., 1996.** Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.

**Marker, L.L. & Cunningham, S., 2013.** International cheetah (*Acinonyx jubatus*) studbook 2012. Cheetah Conservation Fund, Otjiwarongo, Namibia.

**Marnewick, K., 2015.** Conservation biology of cheetahs *Acinonyx jubatus* (Schreber, 1775) and African wild dogs *Lycaon pictus* (Temminck, 1820) in South Africa. PhD Thesis, Centre for Wildlife Management, University of Pretoria.

**Marnewick, K., Ferreira, S.M., Grange, S., Watermeyer, J., Maputla, N., et al. 2014.** Evaluating the Status of and African Wild Dogs *Lycaon pictus* and Cheetahs *Acinonyx jubatus* through Tourist-based Photographic Surveys in the Kruger National Park. *PLoS ONE* 9(1): e86265. doi: [10.1371/journal.pone.0086265](https://doi.org/10.1371/journal.pone.0086265)

**Marnewick, K., Beckhelling, A., Cilliers, D., Lane, E., Mills, M.G.L., Herring, K., Caldwell, P., Hall, R. & Meintjes, S., 2007.** The status of the Cheetahs in South Africa. In: Breitenmoser, C. & Durant, S. (Eds.). The Status and Conservation Needs of the Cheetahs in Southern Africa. *Cat News Special Edition*, December 2007.

- Marnewick, K. & Cilliers, D., 2009.** Survival of Cheetahs relocated from ranchland to fenced protected areas in South Africa. Chapter 13 in *Reintroduction of Top-Order Predators*, 1st edition. M. Hayward and M. Somers (Eds.), Wiley-Blackwell, London.
- Marnewick, K. & Somers, M.J., 2015.** Home ranges of cheetahs (*Acinonyx jubatus*) outside protected areas in South Africa. *African Journal of Wildlife Research* 45(2): 223
- Meyer, L.C., Fick, L., Mathee, A., Mitchell, D., & Fuller, A., 2008.** Hyperthermia in captured 422 impala (*Aepyceros melampus*): a fright not flight response. *Journal of Wildlife Diseases* 42:344, 404–416.
- Mills, M.L., & Mills, M.E.J. Mills, 2017.** Kalahari cheetahs: Adaptations to an arid region. Oxford University Press, United Kingdom.
- Pienaar U. de V., 1963.** The large mammals of the Kruger National Park – their distribution and present-day status. *Koedoe*, 6: 1-37.
- Pitman, R.T., Fattebert, J., Williams, S.T., Williams, K.S., Hill, R.A., Hunter, L.T.B., Slotow, R., & Balme, G.A., 2016.** The conservation costs of game ranching. *Conservation Letters*; doi:10.1111/conl.12276
- Ray, J.C., Hunter, L. & Zigouris, J., 2005.** *Setting conservation and research priorities for larger African carnivores* (Vol. 24). New York: Wildlife Conservation Society.
- Schoonover R., 2014.** Evaluating the genetic and demographic integrity of South Africa's cheetah metapopulation. M.Sc. thesis, Duke University, 2014.
- Seddon P.J., 1999.** Persistence without intervention: assessing success in wildlife reintroductions. *Trends Res Ecology and Evolution* 14:503
- Skinner, J.D. & Smithers, R.H.N., 1990.** The mammals of the southern African subregion. University of Pretoria, Pretoria, South Africa.
- Thorn, M., Green, M., Dalerum, F., Bateman, P.W. & Scott, D.M., 2012.** What drives human–carnivore conflict in the North West Province of South Africa? *Biological Conservation*, 150(1), pp.23-32.
- Thorn, M., Green, M., Keith, M., Marnewick, K., Bateman, P.W., Cameron, E.Z., & Scott, D.M., 2011.** Large-scale distribution patterns of carnivores in northern South Africa: implications for conservation and monitoring. *Oryx*, 45(04), 579-586.
- 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.
- Treves, A. & Karanth, K.U., 2003.** Human-carnivore conflict and perspectives on carnivore management worldwide. *Conservation Biology* 17(6):1491–1499
- van der Merwe, V., Marnewick, K., Bissett, C., Groom, R., Mills, M.G.L., & Durant, S.M., 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.
- Weise, F.J., Vijay, V., Jacobson, A.P., Schoonover, R.F., Groom, R.J., Horgan, J., Keeping, D., Klein, R., Marnewick, K., Maude, G. & Melzheimer, J., 2017.** The distribution and numbers of cheetah (*Acinonyx jubatus*) in southern Africa. *PeerJ*, 5, p.e4096.
- Williams, S.T., Williams, K.S., Lewis, B.P., & Taylor R. 2017.** Population dynamics and threats to an apex predator outside protected areas: implications for carnivore management. *R. Soc. open sci.* 4: 161090. <http://dx.doi.org/10.1098/rsos.161090>