



Government Gazette Staatskoerant

REPUBLIC OF SOUTH AFRICA
REPUBLIEK VAN SUID AFRIKA

Vol. 631

23 January
Januarie 2018

No. 41393

N.B. The Government Printing Works will not be held responsible for the quality of "Hard Copies" or "Electronic Files" submitted for publication purposes

ISSN 1682-5843



9 771682 584003

41393



AIDS HELPLINE: 0800-0123-22 Prevention is the cure

IMPORTANT NOTICE:

THE GOVERNMENT PRINTING WORKS WILL NOT BE HELD RESPONSIBLE FOR ANY ERRORS THAT MIGHT OCCUR DUE TO THE SUBMISSION OF INCOMPLETE / INCORRECT / ILLEGIBLE COPY.

No FUTURE QUERIES WILL BE HANDLED IN CONNECTION WITH THE ABOVE.

Contents

<i>No.</i>		<i>Gazette No.</i>	<i>Page No.</i>
GENERAL NOTICES • ALGEMENE KENNISGEWINGS			
Environmental Affairs, Department of/ Omgewingsake, Departement van			
19	Biodiversity Act (10/2004): National Environmental Management: Non-detriment Findings	41393	4

GENERAL NOTICES • ALGEMENE KENNISGEWINGS

DEPARTMENT OF ENVIRONMENTAL AFFAIRS

NOTICE 19 OF 2018

NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004

(ACT NO. 10 OF 2004)

NON-DETRIMENT FINDINGS

I, Bomo Edith Edna Molewa, Minister of Environmental Affairs, hereby publish the non-detriment findings made by the Scientific Authority in terms of section 62 of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) for implementation and set out in the Schedule hereto.



**BOMO EDITH EDNA MOLEWA
MINISTER OF ENVIRONMENTAL AFFAIRS**

Non-detriment finding assessment for *Panthera leo* (African lion)

Reference Number: Pan_leo_Sep2017

Date: 25 September 2017

Issued by the Scientific Authority of South Africa

Summary of findings

The South African population of *Panthera leo* (African lion) is included in Appendix II to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (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 document details the undertaking of a non-detriment finding (NDF) assessment (Figure 1) for the African lion and is based on the best available information, current as of September 2017.

African lions are long-lived with both sexes living longer than 12 years. The species has a low reproductive rate with females replacing themselves only every second year. The African lion is a generalist species that can utilize a wide range of habitats and prey species. Due to biological, social and anthropogenic constraints, dispersal ability of both sexes is relatively poor, although some long distance dispersal of males does occur. The species is sensitive to human activity and is conservation dependent in South Africa, occurring solely in state-protected areas and on a limited number of privately owned game reserves, all of which are fenced.

The African lion is considered an uncommon species within South Africa, with a restricted and fragmented distribution. The total national wild population is estimated at approximately 2876 individuals in an estimated land area of 41 745 km². Eighty-three percent of the population is well protected, primarily within the Kruger National Park, the Kgalagadi Transfrontier Park and the Hluhluwe iMfolozi Park, where recent quantitative data suggest that lion populations are stable to increasing. The remainder of the national population (approximately 500 individuals in a combined area of ca. 8500 km²) occurs in 45 small reserves where lions have been re-introduced and are intensively managed. This healthy wild lion population persists alongside a large captive population of approximately 7 000 lions kept in around 260 breeding/captive facilities in South Africa.

At present there are no major threats to the wild and managed lion populations within South Africa, although the management of re-introduced wild lion needs some improvement. Minor threats include overutilization, disease, poaching and conflict with communities around protected areas. Although there are no specific figures on the illegal trade of lions in South Africa, provincial conservation authorities indicate that illegal utilization of wild lion is generally small to negligible. The trophy hunting of captive-bred lions poses no threat to the wild lion population within South Africa, and it is thought that captive lions may in fact serve as a buffer to potential threats to wild lions by being the primary source of hunting trophies and derived products (such as bone). Up until early 2016 when the USA stopped the import of lion trophies from South Africa due to the listing of *Panthera leo* as threatened on the

Endangered Species Act, the bone in trade was primarily a by-product derived from captive lion trophy hunts.

As part of a comprehensive management approach for lion, a Biodiversity Management Plan (BMP), which includes a meta-population management plan and several actions relating to the management of captive lions, was developed in terms of the National Environmental Management: Biodiversity Act (NEMBA), 2004. However, since the BMP was published for implementation only recently (in December 2015), its effectiveness cannot yet be assessed. Local level management plans are however effectively implemented.

Hunting of lion is not allowed in any of the national parks and only limited hunting is allowed in some provincial state reserves, effectively ensuring strict protection of the majority of the wild population (>80% of the total lion population). Harvest of wild lion in the South African context is primarily for the control of damage causing (stock-raiding) lions and population management. Off-takes of lion (translocation and culling) within South African National Parks are associated with ecological management interventions and guided by a robust scientific framework. All re-introduced wild populations are at times managed through culling and translocation to mimic the population dynamics processes that are absent in small populations. This ecological harvesting benefits the conservation of the species.

Consumptive use of lion for commercial purposes is mostly restricted to private game reserves. In South Africa very few wild lions are trophy hunted each year (typically less than ten lion involving less than 5% of lion hunts on private property), and hunting trophies are largely sourced from captive populations. Off-takes from wild lion populations are managed on a local scale with ecologically based local quotas. In some cases there are local, informal management plans and approved local management plans for specific reserves that govern the type of lion that may be hunted, typically male lions over six years of age. Guidelines for the trophy hunting of wild lions in South Africa have been developed and now form part of permit conditions within the provinces. In most provinces, off-takes are effectively monitored through the attendance of lion hunts by provincial conservation officers. The economic benefits to the private sector of keeping and trading in wild lion may provide some incentive for conserving the species and its habitat.

In conclusion, the NDF assessment undertaken for the African lion (Figure 1) demonstrates that legal local and international trade poses a low to moderate, but non-detrimental risk to the species in South Africa (Figure 2). The species is well managed and the Scientific Authority does not have any current concerns relating to the export of wild lion in accordance with Article IV of CITES. It is recommended that hunting of lion from reserves smaller than 1000 km² be permitted only when in accordance with a meta-population management approach, and that guidelines be developed in this regard.

The Scientific Authority does not consider the export of captive-bred lion trophies or captive-bred live lion for zoological or breeding purposes to be detrimental to the wild lion population in South Africa. At present there is no evidence to suggest that the lion bone trade between South Africa and East-Southeast Asia is detrimental to South Africa's wild lion population. In accordance with the annotation to the Appendix II listing of the African lion that was adopted at the 17th Conference of the Parties to

CITES, a quota for the export of skeletons derived from captive breeding operations must be established and revised on an annual basis to ensure sustainability, and measures must be implemented to prevent any detrimental impact to wild lion populations.

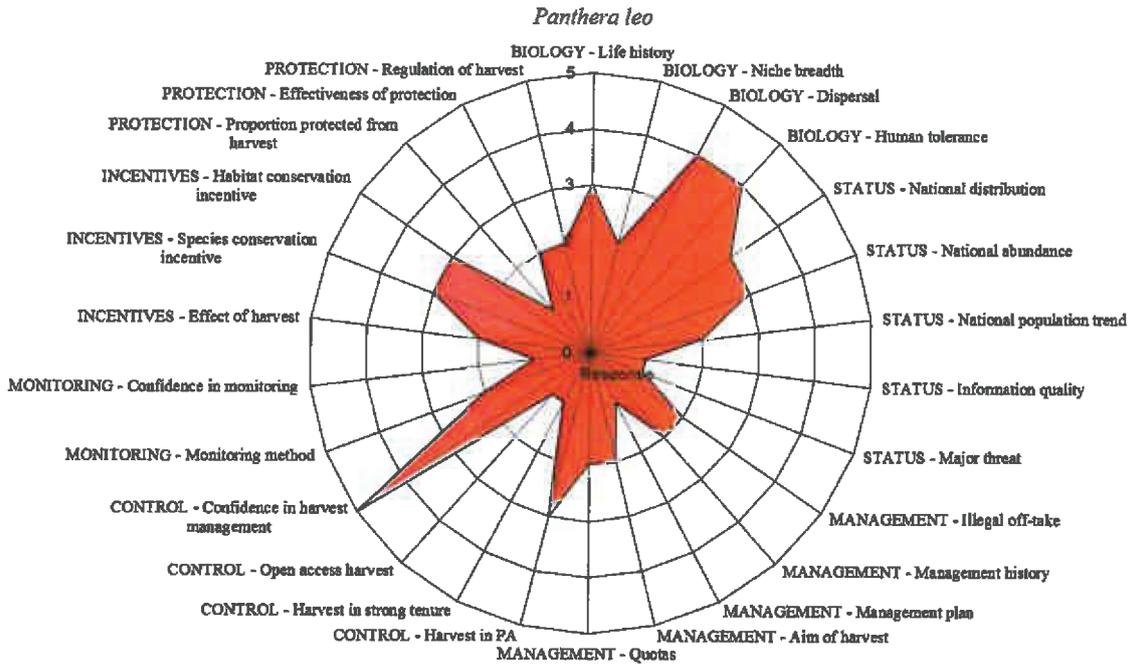


Figure 1: Radar chart summarizing the non-detriment finding assessment for *Panthera leo* (African lion) in accordance with the CITES NDF checklist. Explanations of scores given are detailed in Table 1. Higher scores are indicative of higher risks to the species. The limited area shaded in the radar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

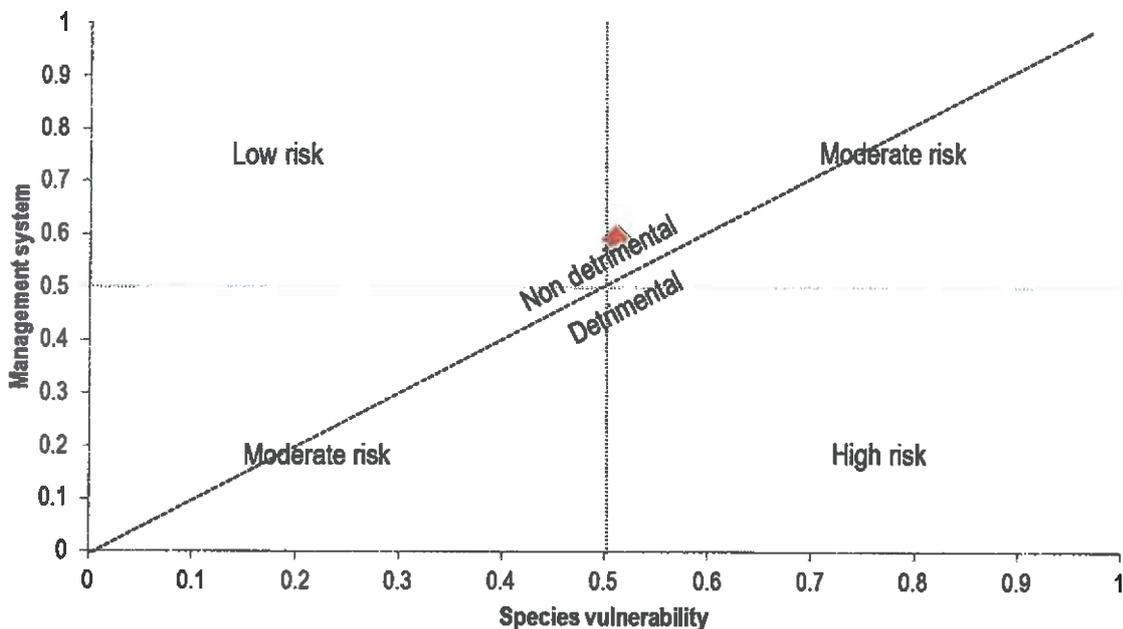


Figure 2: The level of risk of harvesting for *Panthera leo* (African lion) as represented by the relationship between species vulnerability (biology and status) (0 = low vulnerability; 1 = high vulnerability) and the management system to which the species is subjected (management, control, monitoring, incentives and protection) (0 = weak management system; 1 = strong management system). The figure shows that the species is at a low to moderate risk and trade is not detrimental.

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

Biological characteristics		
1. Life history: What is the species' life history?	High reproductive rate, long-lived	1
	High reproductive rate, short-lived	2
	Low reproductive rate, long-lived	3
	Low reproductive rate, short-lived	4
	Uncertain	5
<p><i>Lions are long-lived. Lionesses can live up to 14-16 years, while most males live up to 12-14 years in the wild (Packer et al. 1988). Litter size can range from one to six cubs, with 98% of litters containing 1-4 cubs (Packer & Pusey 1987). In general, there is high cub survival with >50% survival in the first year of life, which leads to longer birth intervals. At present the birth interval for Kruger National Park (KNP) is 2.3-2.4 years and ranges between 2.5-3.5 years within savannah woodland systems. If a female produces three cubs every 2.5-3 years, the net effect is approximately one cub per year. Fecundity is defined as the number of females that a female produces over her lifetime to replace her. Thus in the case of lions within South Africa, a female produces on average a female every second year if a 1:1 sex ratio is assumed, and lions therefore have a low reproductive rate.</i></p>		
2. Ecological adaptability: To what extent is the species adaptable (habitat, diet, environmental tolerance etc.)?	Extreme generalist	1
	Generalist	2
	Specialist	3
	Extreme specialist	4
	Uncertain	5
<p><i>Within South Africa the majority of lions occur in savannah, but they have also been successfully reintroduced to the subtropical thicket biome of the Eastern Cape and the semi-arid Nama Karoo biome (Karoo National Park). Lions readily adapt to hunting in varied habitats, generally having greater success when hunting in areas with longer grass (Funston et al. 2001) or greater cover (Hopcroft et al. 2005). Species at the top of the food chain, such as predators, are mostly considered specialists. However within the large carnivore guild, lions can be considered generalists when compared to other large mammals as they utilize a wider range of habitats and prey species.</i></p>		
3. Dispersal efficiency: How efficient is the species' dispersal mechanism at key life stages?	Very good	1
	Good	2
	Medium	3
	Poor	4
	Uncertain	5
<p><i>There are biological, social and anthropogenic constraints to dispersal in lions, and based on these cumulatively, lions can be classified as poor dispersers, although some long distance dispersal of males does occur. Male cubs are excluded from their maternal pride when they reach maturity at approximately three to four years of age, most of which then form coalitions with other males (Pusey & Packer 1987; Packer & Pusey 1993). Dispersing males face several challenges, for example dispersing into a high risk environment within which they have to hunt for themselves, and often obtain injuries as a result. Most young lionesses attempt to remain in the pride into which they were born, and those that do not remain typically do not disperse far and attempt to establish a territory adjacent to their natal territory. Lions dispersing out of protected areas are invariably killed, contributing further</i></p>		

to the poor dispersal ability of lions in the South African context.

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

In South Africa lions are conservation dependent, occurring solely in protected areas and on game farms, all of which are fenced. Across Africa, lion populations in fenced areas are significantly closer to their estimated carrying capacity than unfenced populations (Packer et al. 2013). Lions are sensitive to human modified landscapes.

National status

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

At present the lion distribution within South Africa is restricted and fragmented (Figure 3). Any change in the current distribution will be dependent on the establishment of new protected areas into which lions can be re-introduced. Lions originally roamed freely across most of South Africa but as a result of changes in land use (mostly for farming), free roaming lions were mostly extirpated from farmland and restricted to large national parks by the middle of the 20th century. The subsequent expansion of game reserves, especially since the early 1990s, has resulted in an increased range for lion and wild lions currently occur in isolated areas in all provinces of South Africa, except for the Free State. The estimated land area where lion occur is 41 745 km², with the largest proportion comprising a few large national or provincial protected areas (33 200 km², ca. 80%), and with the remainder made up of 45 small private or state reserves (Figure 3) with a combined area of ca. 8500 km² (Miller et al. 2016b).

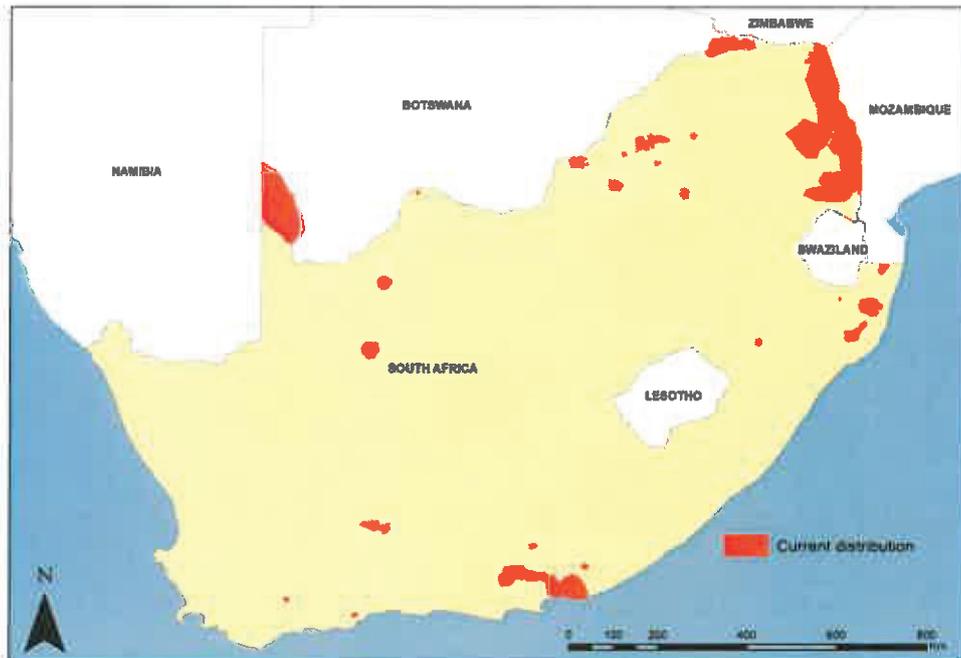


Figure 3: The current distribution of lions in South Africa including both original and re-introduced populations.

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

Wild and re-introduced lions in South Africa are estimated to total about 3490 individuals (Table 1), including those in transfrontier zones (Miller et al. 2016b). Altogether about 2376 lions (83% of the total South African population) are well protected within South Africa's national parks (Miller et al. 2016b). The total formally protected mature population of lions (1286) in South Africa represent 3–6% of the global mature population of 23 000–39 000 lions (Bauer et al. 2015; Riggio et al. 2013). The largest areas in the country with lion are the Kruger National Park, which straddles the provinces of Limpopo and Mpumalanga (part of the Greater Limpopo Transfrontier Park), and the Kalahari Gemsbok National Park in the Northern Cape (part of Kgalagadi Transfrontier Park). The Greater Limpopo Transfrontier Park subpopulation is estimated at c. 2000 individuals (South Africa only) if the private conservancies open to Kruger National Park on the western boundary are included (300 lions) and represents 70% of the wild lion population in South Africa.

During 2010, 500 lion were estimated to occur in the Kgalagadi Transfrontier Park (Ferreira et al. 2013). Recent mark-recapture estimates for the South African side of Kgalagadi Transfrontier Park may indicate an increasing subpopulation, where the total number of individuals is estimated to be 246 (95% confidence intervals 238-256), and the number of mature individuals (excluding cubs) is estimated to be 167 (95% confidence intervals 160-177) (Miller et al. 2016b). Fourteen lion occur in the Greater Addo Elephant National Park (2011) (Eastern Cape), 8 in the Karoo National Park (2011) (Western Cape), 13 in the Marakele National Park (2011) (Limpopo) and 120 in Hluhluwe-iMfolozi Park (KwaZulu-Natal).

Reintroduction of lion into small reserves (including national parks, provincial protected areas, conservancies and private reserves of <1000 km² in area) started in the early 1990s and there are currently about 500 lions on 45 small reserves (Miller et al. 2013; Miller & Funston 2014). All small reserve subpopulations are ecologically functional as, for example, they are large enough for social dynamics to continue unhindered, although some reserves may import prey stocks (Power 2002, 2003; Hayward et al. 2007).

Table 1: Current numbers of wild lion in South Africa and surrounding transfrontier areas. All counts were made between 2008 and 2015 (Miller et al. 2016b).

Location (sub-location)	Total lions (SA only)	Number mature lions (SA only)
Greater Limpopo TP (Kruger NP)	2000 (c. 1700)	1060 (c. 900)
Associated Private Nature Reserves (Greater Kruger NP)	300	160
Kgalagadi TP	520 (246)	255 (167)
Greater Mapungubwe TFCA	~50 (10)	25 (5)
Hluhluwe-iMfolozi Park	120	54
Total excl. small reserves	2990 (2376)	1554 (1286)
Small reserves	500	225
Total incl. small reserves	3490 (2876)	1779 (1511)

According to a study initiated in 2008 by the Department of Environmental Affairs (DEA) and conducted by the University of Free State, an estimated 3596 lions were kept in 174 breeding facilities in South Africa during 2008 (Taljaard 2009). It is estimated that at present between 3600 and 6000

lions are kept in at least 174 breeding/captive facilities in South Africa (Williams et al. 2015). According to recent data (2017) provided by DEA, this number is likely to be closer to 7 000 individuals kept in approximately 260 facilities.

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

When considering only the wild and re-introduced subpopulations in recent decades, lion numbers have increased and have probably been stable for the last thirty years in the two large wild subpopulations (Miller et al. 2016b). Recent surveys using 240 call-up stations distributed randomly throughout the Kruger National Park indicated the subpopulation has increased over the period 2000-2015 from 1684 (95% confidence intervals 1617-1751) to 1763 (95% confidence intervals 1680-1846) individuals and for adult females specifically, from 415 (95% confidence intervals 380-450) to 589 (95% confidence intervals 560-618) (Miller et al. 2016b). The lion population in the Kgalagadi Transfrontier Park has been fairly stable since the first population estimate in 1976 of 140 lion (range 108-181). In 1996/7 the population was estimated at 131 (range 106 – 156), and between 1998 and 2001 at 120 individuals (range 113-131). In 2010, 500 lion were estimated to occur in the Kgalagadi Transfrontier Park (Ferreira et al. 2013). Recent mark-recapture estimates for the South African side of Kgalagadi Transfrontier Park may indicate an increasing subpopulation, where the total number of individuals is estimated to be 246 (95% confidence intervals 238-256), and the number of mature individuals (excluding cubs) is estimated to be 167 (95% confidence intervals 160-177) (S. Ferreira unpubl. data). Since 2004 the number of lion on state-owned protected areas in KwaZulu-Natal has increased from 82 to 234, while the number of lion on private and communal land has increased from 33 to 82 during this same time period. Overall this represents an almost three-fold increase in the size of the lion population in the province, from 115 to 316, over a 7 year period (2004-2010). The remaining national parks have small numbers of lion that are intensively managed to maintain a single pride with 2-6 adult females. Lions also re-colonized the Mapungubwe National Park in about 2000, but fewer than 10 lions occur there.

8. Quality of information: What type of information is available to describe abundance and trend in the national population?	Quantitative data, recent	1
	Good local knowledge	2
	Quantitative data, outdated	3
	Anecdotal information	4
	None	5

Surveys in the Kruger National Park, and the Kgalagadi National Park are conducted regularly, which represent 68% of the total wild and managed population in South Africa. In the Kruger National Park, three park-wide surveys have been undertaken to date. In addition a 7-year study on the lions in Kruger National Park was recently completed. The lions within Hluhluwe iMfolozi Park are also monitored on a regular basis.

9. Major threats: What major threat is the species facing (underline following: overuse/ habitat loss and alteration/ invasive species/ other: disease; human wildlife conflict) and how severe is it?	None	1
	Limited/Reversible	2
	Substantial	3
	Severe/Irreversible	4
	Uncertain	5
<p><i>At present there are no major threats to the wild and managed lion populations within South Africa. Minor threats include overutilization, disease, poaching and conflict with communities around protected areas. Most lions currently in captivity originate from captive-bred stock and are utilised by the trophy hunting industry and, since 2008, the lion bone trade as well. In terms of the Threatened or Protected Species (TOPS) Regulations (2007), wild lions may not be introduced into captivity. This also does not seem necessary as lions breed well in captivity. Although captive lions are not considered to be of any conservation value to the wild lion population (Hunter et al. 2013), it is thought that they may serve as a buffer to potential threats to the wild population by being the primary source of hunting trophies and derived products (Lindsey et al. 2012a) (e.g. bones). A study conducted by TRAFFIC in 2013-2014 showed that the lion bone trade between South Africa and East-Southeast Asia is not detrimental to the wild lion population, and the bone in trade is primarily a by-product derived from captive lion trophy hunts (Williams et al. 2015), at least up until early 2016 when the USA stopped the import of lion trophies from South Africa due to the listing of Panthera leo as threatened on the Endangered Species Act. The male lions are sold to trophy hunters, and the skeletons to East-Southeast Asia. The females are used for breeding stock and are eventually sold into the bone trade once they have ceased to breed (Williams et al. 2015). Hunting of captive-bred lion differs from wild lion hunting in that lions are hunted in smaller areas ($49.9 \pm 8.4 \text{ km}^2$ compared to $843\text{-}5933 \text{ km}^2$ depending on the country), hunts are cheaper (US\$20 000-40 000 compared to US\$37 000-76 000), shorter (3.3 compared to 14-21 days), success rates are higher (99% compared to 51-96%), and trophy quality is higher (skull length + breath = 639 cm compared to 614-638 cm) (Lindsey et al. 2012a).</i></p>		
Harvest management		
10. Illegal off-take or trade: How significant is the national problem of illegal or unmanaged off-take or trade?	None	1
	Small	2
	Medium	3
	Large	4
	Uncertain	5
<p><i>Although there are no specific figures on the illegal trade of lions in South Africa, provincial conservation authorities indicated that illegal use or trade of wild lion is generally small to negligible. There is no recorded/known illegal trade in wild lion in Gauteng, KwaZulu-Natal or the Eastern Cape and illegal utilization of lion within South Africa's national parks is negligible. There are currently no statistics relating to cases involving lion in the National Environmental Compliance and Enforcement Report, although there are cases currently under investigation. Illegal trade in captive-bred lions within North West Province is suspected to take place, as this industry is large and a challenge to regulate. Lions along the Kgalagadi Transfrontier Park boundaries have been persecuted for decades (Mills et al. 1978; Van Vuuren, Herrmann & Funston 2005; Funston 2011).</i></p>		
11. Management history: What is the history of harvest?	Managed harvest: on-going with adaptive framework	1
	Managed harvest: on-going but informal	2
	Managed harvest: new	3
	Unmanaged harvest: on-going or new	4
	Uncertain	5

Lions are actively managed in most areas within South Africa. As part of a comprehensive management approach for lion, the Department of Environmental Affairs has developed a Biodiversity Management Plan (BMP) for lion in terms of the National Environmental Management: Biodiversity Act, 2004 (NEMBA 2004), which was published for implementation in December 2015.

Apart from the management of damage causing animals, the lion population within the Kgalagadi Transfrontier Park has never been managed (Mills et al. 1978; Van Vuuren, Herrmann & Funston 2005; Funston 2011). The lions that were established in the Hluhluwe-iMfolozi Park have been managed quite intensively, mainly to minimize conflict along the park boundary (Anderson 1980) and more recently to improve their genetic diversity and thereby reproductive potential (Trinkel 2008). Additional key management actions in KwaZulu-Natal for 2011 and 2012 included the determination of a provincial conservation target for lion, and the continuation with surveillance and monitoring of the provincial lion population and illegal hunting incidents. Utilisation and keeping of lion in the wild is closely managed in the province of Gauteng due to the dense human population in the province. Off-takes of lion (translocation and culling) within South African National Parks are associated with ecological management interventions and guided by a robust science framework.

In all the larger parks in South Africa, lions occasionally venture out of the park and kill livestock. In the Kruger National Park and Hluhluwe-iMfolozi (Anderson 1980) these lions are generally shot by rangers, whereas in the Kgalagadi rangers try and translocate them back into the park (Mills et al. 1978; Funston 2002). The reintroduction of lions into some 45 smaller fenced game reserves in South Africa has largely been for eco-tourism purposes rather than ecological reasons (Slotow & Hunter 2009). Reintroduced lions are currently micromanaged (Hayward et al. 2007a,b,c; Hunter et al. 2007; Kettles & Slotow 2009) primarily in isolation from each other, the net effect of which reduces their conservation value on a regional scale (Slotow & Hunter 2009). Ferreira & Hofmeyr (2014) advocate an approach where managers of small areas mimic natural social dynamics such as coalition tenure, density dependent changes in litter size, age at first birth and birth intervals, as well as sub-adult dispersal. This assists with achievement of population and evolutionary targets through a process-based approach mimicking drivers of variance in social groups. It is further suggested that these small populations be managed on a regional level as a single population with social groups spatially isolated over the region (Ferreira & Hofmyer 2014).

12. Management plan or equivalent: 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
	No approved plan: informal unplanned management	4
	Uncertain	5

A Biodiversity Management Plan for the African Lion (Panthera leo), which includes a meta-population management plan and several actions to assess and improve the management of captive lions (such as the development of national standards for the keeping and captive breeding of lions and an audit of all lion keeping facilities), was published for implementation in December 2015 (Government Gazette vol. 606 no. 39468). Lions are protected under various provincial Ordinances / Acts, and provincial conservation authorities often require ecological management plans when lion is re-introduced to a property. There are also local, informal management plans and approved local management plans for specific reserves that specify the type of lion that may be hunted, typically male lions above six years of age (Miller et al. 2016a).

13. Aim of harvest regime in management planning: What is harvest aiming to achieve?	Generate conservation benefit	1
	Population management/control	2
	Maximize economic yield	3
	Opportunistic, unselective harvest, or none	4
	Uncertain	5
<i>Only wild and managed populations were considered in the scoring of this question since trophy lions are predominantly sourced from captive-bred populations (Sinovas et al. 2016) with less than 5% of lion hunts conducted on private property between 2008 and 2010 having targeted wild lions. Consumptive use of lion for commercial purposes is mostly restricted to private game reserves. Private landowners that conduct legal hunts of wild lions have an interest in ensuring the stability of their lion populations. In addition to the limited trophy hunting of wild lion, other kinds of harvesting are undertaken as a management tool to regulate populations, such as culling and live removals. These harvests aim to mimic population dynamics that are absent in managed prides (Ferreira & Hofmeyr 2014; Miller et al. 2015).</i>		
14. Quotas: Is the harvest based on a system of quotas?	On-going national quota: based on biologically derived local quotas	1
	On-going quotas: "cautious" national or local	2
	Untried quota: recent and based on biologically derived local quotas	3
	Market-driven quota(s), arbitrary quota(s), or no quotas	4
	Uncertain	5
<i>Current harvest is not based on a national quota system. Harvest is however managed on a local scale with ecologically based local quotas. Permits for wild lion hunts in South Africa are issued by the relevant provincial conservation authority, as are permits for hunting captive-bred lions. Off-takes of lion within South African National Parks are guided by a strict utilization strategy.</i>		
Control of harvest		
15. Harvesting in Protected Areas: What percentage of the legal national harvest occurs in State-controlled Protected Areas?	High	1
	Medium	2
	Low	3
	None	4
	Uncertain	5
<i>Hunting of lion is not allowed in national parks, which collectively represents the majority of the wild population (>80% of the total lion population), but there is limited legal hunting in some provincial state protected areas. In KwaZulu-Natal damage-causing animals can be hunted by local hunters on the borders of protected areas. The number of damage causing lions removed annually in the Kruger National Park is relatively low (<1% of the population). In smaller reserves this off-take is slightly higher at 10-20%. Removals of lion from the Kgalagadi Transfrontier Park are much higher.</i>		
16. Harvesting in areas with strong resource tenure or ownership: What percentage of the legal national harvest occurs outside Protected Areas, in areas with strong local control over resource use?	High	1
	Medium	2
	Low	3
	None	4
	Uncertain	5
<i>Utilization of lion for commercial purposes is mostly restricted to private game reserves. Trophy hunting of lions is popular in South Africa, although trophies are predominantly sourced from captive-</i>		

bred populations (Sinovas et al. 2016). Hunting of wild lion on private property is limited, with less than 5% of lion hunts conducted over the 2008 to 2010 reporting period having targeted wild lions. Wild lions are hunted in the Associated Private Nature Reserves (APNR) bordering the Kruger National Park and open to the park. The APNR has a very strict hunting protocol that is strictly enforced. There is also a general memorandum of understanding between the Kruger National Park and the APNR. Aspects with regards to trophy hunts are handled on a case by case basis.

17. Harvesting in areas with open access: What percentage of the legal national harvest occurs in areas where there is no strong local control, giving <i>de facto</i> or actual open access?	None	1
	Low	2
	Medium	3
	High	4
	Uncertain	5

No lions occur within open access areas. Damage causing animals within these areas originate from protected areas and the number of animals removed on average is low.

18. Confidence in harvest management: Do budgetary and other factors allow effective implementation of management plan(s) and harvest controls?	High confidence	1
	Medium confidence	2
	Low confidence	3
	No confidence	4
	Uncertain	5

Local level management plans and harvest controls are effectively implemented. On a national scale however there is no budget or capacity to fund a national coordinated system that can be implemented for all re-introduced lion populations. Thus budget and legal restrictions are hampering the scaling up of local management to enhance a larger management framework for lion conservation. The biodiversity management plan for lion, that includes a meta-population management plan, has only recently (December 2015) been published for implementation. Confidence in the effective implementation of this management plan is thus still uncertain.

Monitoring of harvest

19. Methods used to monitor the harvest: What is the principal method used to monitor the effects of the harvest?	Direct population estimates	1
	Quantitative indices	2
	Qualitative indices	3
	National monitoring of exports	4
	No monitoring or uncertain	5

Lion is 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 lion 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. Lion is also protected under various provincial Ordinances / Acts. Within the Free State, Limpopo and Northern Cape, all lion hunts are attended by a provincial officer, while Mpumalanga's legislation does not require a conservation official to be present at lion hunts. Due to capacity constraints within KwaZulu-Natal, North West and the Eastern Cape, only some of the lion hunts are attended by a conservation officer. Lion hunts are not offered in Gauteng and the Western Cape. Data obtained from the provinces are used to calculate statistics on the trends in lion populations within the provinces and nationally. Any negative consequences of the harvest of lion will thus be detectable through the current permit monitoring system.

According to the CITES trade database that is administered by UNEP-WCMC, just over half (53%) of the lion (3508) exported from South Africa between 2000 and 2009 are wild sourced, but this is due to a reporting error. Lions bred in captivity, then released in extensive systems for a period of time before being hunted have in the past been incorrectly reported as source code "W" (i.e. wild). Delegated provincial management authorities have subsequently been requested to ensure the correct use of source codes so that the CITES trade records correctly reflect the trade in wild specimens. There is also a major discrepancy between reported exports and reported imports, with reported exports of captive sourced specimens greater than reported imports and conversely the reported exports of wild sourced specimens less than the reported imports. This would have contributed to inflated export figures overall and of wild sourced specimens in particular.

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

There is a high confidence in the quantitative indices used to monitor the harvest of wild lions. Most reserves monitor their lion populations well and are well-resourced on a local level.

Incentives and benefits from harvesting

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

There is currently no major threat facing wild lions within South Africa. Trophy hunting of wild lions is limited, with the number of wild lion hunted over the period 1999-2008 never exceeding 10 lion per annum. Trophy lions are predominantly sourced from captive-bred populations. Harvesting as a tool for science-based population management of fragmented populations is beneficial to the population.

22. Incentives for species conservation: At the national level, how much conservation benefit to this species accrues from harvesting?	High	1
	Medium	2
	Low	3
	None	4
	Uncertain	5

Currently wild lion hunts are less than 10 per year and the majority of income originates from non-consumptive tourism. However, where lion trophy hunting occurs (e.g. APNR) it contributes directly to the conservation of the species. The economic benefits to the private sector of keeping and trading in wild lion may provide some incentive for conserving the species and its habitat. However, in some cases benefits do not filter down to directly affected stakeholders and thereby affect conservation outcomes. Ecological harvesting of lions is practiced in some managed populations in order to mimic population dynamics that are absent (Ferreira & Hofmeyr 2014). These removals benefit the conservation of the species.

23. Incentives for habitat conservation: At the national level, how much habitat conservation benefit is derived from harvesting?	High	1
	Medium	2
	Low	3
	None	4
	Uncertain	5
<i>Hunting of wild lion on private property is limited, with less than 5% of lion hunts conducted over the 2008 to 2010 reporting period having targeted wild lions. The revenue generated through hunting contributes to the maintenance of areas where these lion populations can continue to exist. The economic benefits to the private sector of keeping and trading in wild lion may provide some incentive for conserving the species and its habitat.</i>		
Protection from harvest		
24. Proportion strictly protected: What percentage of the species' natural range or population is legally excluded from harvest?	>15%	1
	5-15%	2
	<5%	3
	None	4
	Uncertain	5
<i>Hunting of lion is not allowed in any of the national parks and only limited trophy hunting is allowed on some provincial state reserves, this collectively representing the majority of the wild population (>80% of the total lion population). The scoring is based on the population size and not on the range of the species.</i>		
25. Effectiveness of strict protection measures: Do budgetary and other factors give confidence in the effectiveness of measures taken to afford strict protection?	High confidence	1
	Medium confidence	2
	Low confidence	3
	No confidence	4
	Uncertain	5
<i>The national and provincial permitting systems are effective.</i>		
26. Regulation of harvest effort: How effective are any restrictions on harvesting (such as age or size, season or equipment) for preventing overuse?	Very effective	1
	Effective	2
	Ineffective	3
	None	4
	Uncertain	5
<i>Regulation of harvest effort is effective. On a local scale specific individuals are selected for ecological harvesting, trophy hunting or removal of damage causing animals. Guidelines for the trophy hunting of wild lions in South Africa have been developed and form part of permit conditions within the provinces (Miller et al. 2016a).</i>		

List of participants:

1. Dr Sam Ferreira (SANParks)
2. Dr Paul Funston (Panthera)
3. Michele Pfab (SANBI)
4. Thea Carroll (DEA)
5. Dr Jeanetta Selier (SANBI)

References:

- Anderson, J.L. (1980).** The re-establishment and management of a lion *Panthera leo* population in Zululand, South Africa. *Biological Conservation* 19: 107-117.
- Bauer, H., Packer, C., Funston, P.F., Henschel, P., and Nowell, K. (2015).** *Panthera leo*. The IUCN Red List of Threatened Species 2015.
- Creel, S. & Creel, N.M. (1997).** Lion density and population structure in the Selous Game Reserve: Evaluation of hunting quotas and offtake. *African Journal of Ecology* 35: 83–93.
- De Boer, W.F., Vis, M.J.P, De Knegt, H. J., Rowles, C., Kohi, E. M., et al. (2010).** Spatial distribution of lion kills determined by the water dependency of prey species. *Journal of Mammalogy* 91: 1280–1286.
- Druce, D., Genis, H., Braak, J., Greatwood, S., Delsink, A., Kettles, R., Hunter, L. & Slotow, R. (2004a).** Prey selection by a reintroduced lion population in the Greater Makalali Conservancy, South Africa. *African Zoology* 39: 273-284.
- Druce, D., Genis, H., Braak, J., Greatwood, S., Delsink, A., Kettles, R., Hunter, L. & Slotow, R. (2004b).** Population demography and spatial ecology of a reintroduced lion population in the Greater Makalali Conservancy, South Africa. *Koedoe* 47: 103–118.
- Elliot, J.P. & Cowan, I. Mc T. (1978).** Territoriality, density and prey of the lion in Ngorongoro Crater, Tanzania. *Canadian Journal of Zoology* 56: 1726-1734.
- Ferreira, S.M. & Funston, P.J. (2010a).** Estimating lion population variables: Prey and disease effects in Kruger National Park, South Africa. *Wildlife Research* 37: 194-206.
- Ferreira, S.M. & Funston, P.J. (2010b).** Age assignment to individual African lions. *South African Journal of Wildlife Research* 40: 1-9.
- Ferreira, S.M., Govender, D., & Herbst, M. (2013).** Conservation implications of Kalahari lion population dynamics. *African Journal of Ecology* 51:176–179.
- Ferreira, S.M. & Hofmeyr, M. (2014).** Managing charismatic carnivores in small areas: large felids in South Africa. *South African Journal of Wildlife Research* 44(1): 32-42.
- Funston, P.J. (2002).** Kgalagadi Transfrontier Lion Project – Final Report. Submitted to the Green Trust and the Endangered Wildlife Trust.
- Funston, P.J. (2004).** Specialist study: Lion utilization plan for the Associated Private Nature Reserves (APNR). Management Consultancy.
- Funston, P.J. & Mills, M.G.L. (2006).** The influence of lion predation on the population dynamics of common large ungulates in the Kruger National Park. *South African Journal of Wildlife Research* 36: 9-22.
- Funston, P.J. (2008).** Conservation and management of lions in Southern Africa: Status, threats, utilization and the restoration option. In: B. Croes, H.H. Delongh, & H. Bauer (Eds.), *Management and Conservation of Large Carnivores in West and Central Africa*. (pp. 109-131). Institute of Environmental Sciences, Leiden.

- Funston, P.J. (2011).** Population characteristics of lions (*Panthera leo*) in the Kgalagadi Transfrontier Park. *South African Journal of Wildlife Research* 41: 1-12.
- Funston, P.J., Mills, M.G.L., Biggs, H.C. & Richardson, P.R.K. (1998).** Hunting by male lions: ecological influences and socioecological implications. *Animal Behavior* 56: 1333–1345.
- Funston, P. J., Mills, M. G. L. & Biggs, H. C. (2001).** Factors affecting the hunting success of male and female lions in the Kruger National Park. *Journal of Zoology, London* 253: 419–431.
- Funston, P.J., Mills, M.G.L., Richardson, P.R.K. & van Jaarsveld, A.S. (2003).** Reduced dispersal and opportunistic territory acquisition in male lions (*Panthera leo*). *Journal of Zoology, London* 259: 1-12.
- Funston, P.J., Groom, R.J. & Lindsey, P.A. (2013).** Insights into the management of large carnivores for profitable wildlife-based land uses in African savannas. *PLoS ONE* 8(3): e59044. doi:10.1371/journal.pone.0059044
- Hanby, J. & Bygott, J. (1987).** Emigration of subadult lions. *Animal Behavior* 35: 161–169.
- Hanby, J.P., Bygott, J. & Packer, C. (1995).** Ecology, demography, and behavior of lions in two contrasting habitats: Ngorongoro Crater and the Serengeti plains. In: Sinclair, A. R. E. and Arcese, P. (eds), *Serengeti II: dynamics, management, and conservation of an ecosystem*. Univ. of Chicago Press, pp. 315-331.
- Hayward, M.W. & Kerley, G.I.H. (2005).** Prey preferences of the lion (*Panthera leo*). *Journal of Zoology, London* 267: 309–322.
- Hayward, M.W. & Hayward, G.J. (2007).** Activity patterns of reintroduced lion *Panthera leo* and spotted hyaena *Crocuta crocuta* in Addo Elephant National Park, South Africa. *African Journal of Ecology* 45: 135–141.
- Hayward, M., O'Brien, J. & Kerley, G. (2007a).** Carrying capacity of large African predators: Predictions and tests. *Biological Conservation* 139: 219-229.
- Hayward, M.W., Adendorff, J., O'Brien, J., Sholto-Douglas, A., Bissett, C., et al. (2007b).** Practical considerations for the reintroduction of large, terrestrial, mammalian predators based on reintroductions to South Africa's Eastern Cape Province. *Open Conservation Biology Journal* 11:1-11.
- Hayward, M.W., Adendorff, J., O'Brien, J., Sholto-Douglas, A., Bissett, C., et al. (2007c).** The reintroduction of large carnivores to the Eastern Cape, South Africa: an assessment. *Oryx* 41: 205-214.
- Hayward, M.W & Kerley, G.I.H (2009a).** Fencing for conservation: Restriction of evolutionary potential or a riposte to threatening processes? *Biological Conservation*. 142: 1-13.
- Hayward, M.W, Hayward, G.J., Druce, D.J. & Kerley, G.I.H. (2009b).** Do fences constrain predator movements on an evolutionary scale? Home range, food intake and movement patterns of large predators reintroduced to Addo Elephant National Park, South Africa. *Biodiversity and Conservation* 18: 887–904.
- Hayward, M.W., Hayward, G.I, Tambling, C.J. & Kerley, G.I.H. (2011).** Do lions *Panthera leo* actively select prey or do prey preferences simply reflect chance responses via evolutionary adaptations to optimal foraging? *PLoS ONE* 6(9): e23607. doi:10.1371/journal.pone.0023607.
- Hopcraft, J. G. C., Sinclair, A. R. E. & Packer, C. (2005).** Planning for success: Serengeti lions seek prey accessibility rather than abundance. *Journal of Animal Ecology* 74: 559–566.
- Hunter, L.T.B., Pretorius, K., Carlisle, L.C., Rickelton, M., Walker, C., Slotow, R. & Skinner, J. D. (2007).** Restoring lions *Panthera leo* to northern KwaZulu-Natal, South Africa: short-term biological and technical success but equivocal long-term conservation. *Oryx* 41: 196-204.

- Hunter, L.T., White, P., Henschel, P., Frank, L., Burton, C., Loveridge, A., Balme, G., Breitenmoser, C., and Breitenmoser, U. (2013). Walking with lions: why there is no role for captive-origin lions *Panthera leo* in species restoration. *Oryx* 47:19-24.
- Kettles, R. & Slotow, R. (2009). Management of free-ranging lions on an enclosed game reserve. *South African Journal of Wildlife Research* 39: 23-33.
- Lindsey, P.A., Alexander, R., Balme, G., Midlane, N. & Craig, J. (2012a). Possible relationships between the South African captive-bred lion hunting industry and the hunting and conservation of lions elsewhere in Africa. *South African Journal of Wildlife Research* 42: 11–22.
- Lindsey, P.A., Balme, G.A., Booth, V.R. & Midlane, N. (2012b). The significance of African lions for the financial viability of trophy hunting and the maintenance of wild land. *PLoS One* 7(1): e29332.
- Lindsey, P.A., Havemann, C.P., Lines, R.M., Price, A.E., Retief, T.A., Rhebergen, T., Van der Waal, T. & Romañach, S.T. (2013). Benefits of wildlife-based land uses on private lands in Namibia and limitations affecting their development. *Oryx* 47: 41–53.
- Lindsey, P.A., Balme, G.A., Funston, P.J., Henschel, P., Hunter, L., Madzikanda, H., Midlane, N. & Nyirenda, V. (2013). The trophy hunting of African lions: scale, current practices and factors undermining sustainability. *PLoS One* 9(8), e73808.
- Miller, J.R.B., Balme, G., Lindsey, P.A., Loveridge, A.J., Becker, M.S., Begg, C., Brink, H., Dolrenry, S., Hunt, J.E., Jansson, I. (2016a). Aging traits and sustainable trophy hunting of African lions. *Biological Conservation* 201, 160.
- Miller, S.M., Riggio, J., Funston, P., Power, J., Williams, V., and Child, M. (2016b). A Conservation Assessment of *Panthera leo*. In: M.F. Child, L. Roxburgh, D. Raimondo, E. Do Linh San, J. Selier and H. Davies-Mostert (eds), *The Red List of Mammals of South Africa, Swaziland and Lesotho*. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.
- Miller, S.M., Bissett, C., Burger, A., Courtney, B. & Dickerson, T. (2013). Management of reintroduced lions in small, fenced reserves in South Africa: an assessment and best practice guidelines. *South African Journal of Wildlife Research* 43: 138-154.
- Miller, S.M. & Funston, P.J. (2014). Population growth rates of lions (*Panthera leo*) on small, fenced reserves in South Africa: a management dilemma. *South African Journal of Wildlife Research* 44: 43-55.
- Mills, M.G.L., Wolf, P., Le Riche, E.A.N. & Meyer, I.J. (1978). Some population characteristics of the lion (*Panthera leo*) in the Kalahari National Park. *Koedoe* 21: 163–171.
- Mills, M.G.L. & Shenk, T.M. (1992). Predator-prey relationships: the impact of lion predation on wildebeest and zebra populations. *Journal of Animal Ecology* 61: 693-702.
- Mills, M. G. L. & Biggs, H. C. (1993). Prey apportionment and related ecological relationships between large carnivores in Kruger National Park. Symposium of the Zoological Society of London 65: 256–268.
- Mills, M.G.L., Biggs, H.C. & Whyte, I.J. (1995). The relationship between rainfall lion predation and population trends in African herbivores. *Wildlife Research* 22: 75-88.
- Mosser, A. & Packer, C. (2009). Group territoriality and the benefits of sociality in the African lion, *Panthera leo*. *Animal Behaviour* 78: 359–370.
- Owen-Smith, N. (2008). Changing vulnerability to predation related to season and sex in an African ungulate assemblage. *Oikos* 117: 602-610.
- Owen-Smith, N. & Mills, M.G.L. (2008a). Predator-prey size relationships in an African large-mammal food web. *Journal of Animal Ecology* 77: 173-183.

- Owen-Smith, N. & Mills, M.G.L. (2008b). Shifting prey selection generates contrasting herbivore dynamics within a large-mammal predator–prey web. *Ecology* 89: 1120–1133.
- Packer, C. & Pusey, A. E. (1993). Dispersal, kinship, and inbreeding in African lions. In: N. Thornhill (Ed.), *Natural History of Inbreeding and Outbreeding: Theoretical and Empirical Perspectives*. (pp. 375–391). University of Chicago Press, Chicago.
- Packer, C. & Pusey, A.E. (1987). Intrasexual cooperation and the sex ratio in African lions. *American Naturalist* 130: 636–642.
- Packer, C., Herbst, L., Pusey, A. E., Bygott, J. D., Hanby, J. P., Cairns, S. J. & Bergerhoff-Mulder, M. (1988). Reproductive success in lions. In: *Reproductive Success* (Ed. by T. H. Clutton-Brock), pp. 363–383. Chicago: University of Chicago Press.
- Packer, C., Scheel, D. & Pusey, A. E. (1990). Why lions from groups: food is not enough. *American Naturalist* 136: 1–19.
- Packer, C., Pusey, A.E., Rowley, H., Gilbert, D.A., Martenson, J. & O'Brian, S.J. (1991). Case study of a population bottleneck: lions of the Ngorongoro crater. *Conservation Biology* 5: 219–230.
- Packer, C., Gilbert, A., Pusey, A.E. & O'Brien, S. J. (1991). A molecular genetic analysis of kinship and cooperation in African lions. *Nature* 351: 562–565.
- Packer, C., Pusey, A.E. & Eberly, L. E. (2001). Egalitarianism in female African lions. *Science* 293: 690–693.
- Packer, C., Altizer, S., Appel, M., Brown, E., Martenson, J., O'Brien, S.J., et al. (1999). Viruses of the Serengeti: patterns of infection and mortality in African lions. *Journal of Animal Ecology* 68: 1161–1178.
- Packer, C., Pusey, A.E., & Eberly, L.E. (2001). Egalitarianism in female African lions. *Science* 293: 690–693.
- Packer, C., Hilborn, R., Mosser, A., Kissui, B., Borner, M., Hopcraft, G., Wilmshurst, J., Mduma, S. & Sinclair, A.R.E. (2005). Ecological change, group territoriality, and population dynamics in Serengeti lions. *Science* 307: 390–393.
- Packer, C., Kosmala, M., Cooley, H.S., Brink, H., Pintea, L., Garshelis, D., et al. (2009). Sport hunting, predator control and conservation of large carnivores. *Plos ONE* 4: e5491.
- Packer, C., Brink, H., Kissui, B.M., Maliti, H., Kushnir, H., & Caro, T. (2011). Effects of trophy hunting on lion and leopard populations in Tanzania. *Conservation Biology* 25: 142–153.
- Packer, C., S. Canney, A. Loveridge, S.T. Garnett, M. Pfeifer, K.K. Zander, A. Swanson, D. MacNulty, G. Balme, P.J. Funston et al. (2013). Conserving Large Carnivores: Dollars and Fence. *Ecology Letters* doi: 10.1111/ele.12091
- Power R.J. (2002). Prey selection of lions *Panthera leo* in a small, enclosed reserve. *Koedoe* 45:67–75.
- Power R.J. (2003). Evaluating how many lions a small reserve can sustain. *South African Journal of Wildlife Research* 33:3–11.
- Pusey, A. E. & Packer, C. (1987). Evolution of sex-biased dispersal in lions. *Behaviour* 101: 275–309.
- Radloff, F.G.T. & du Toit J.T. (2004). Large predators and their prey in a southern African savanna: a predator's size determines its prey size range. *Journal of Animal Ecology* 73: 410–423.
- Riggio, J., Jacobson, A., Dollar, L., Bauer, H., Becker, M., Dickman, A., Funston, P., Groom, R., Henschel, P., and de longh, H. (2013). The size of savannah Africa: a lion's (*Panthera leo*) view. *Biodiversity and Conservation* 22:17–35.
- Schaller, G.B. (1972). *The Serengeti Lion: A Study of Predator Prey Relations*. University of Chicago Press, Chicago.

- Sinovas, P., Price, B., King, E., Davis, F., Hinsley, Pavitt, A., and Pfab, M. (2016).** Southern Africa's wildlife trade: an analysis of CITES trade in SADC countries. Technical report prepared for the South African National Biodiversity Institute (SANBI). UNEP-WCMC, Cambridge, UK.
- Slotow, R. & Hunter, L.T.B. (2009).** Reintroduction decisions taken at the incorrect social scale devalue their conservation contribution: the African lion in South Africa. In: M.W. Hayward & M.J. Somers (Eds.), *Reintroduction of Top-Order Predators*. (pp. 41-73). Wiley-Blackwell, Oxford.
- Smuts, G.L. (1978b).** Effects of population reduction on the travels and reproduction of lions in Kruger National Park. *Carnivore* 1: 61-72.
- Spong, G. & Creel, S. (2001).** Deriving dispersal distances from genetic data. *Proceedings of the Royal Society of London* 268: 2571-2574.
- Stander, P.E. (1990).** A suggested management strategy for stock-raiding lions in Namibia. *South African Journal of Wildlife Research* 20: 53-60.
- Stander, P. E. (1991).** Demography of lions in the Etosha National Park, Namibia. *Madoqua* 18: 1-9.
- Taljaard, P.R. (2009).** Report on the captive lion breeding industry in South Africa. Unit for Livestock and Wildlife Economics Department of Agricultural Economics, University of the Free State, Bloemfontein.
- Trinkel, M., Ferguson, N., Reid, A, Reid, C., Somers, M., et al. (2008).** Translocating lions into an inbred lion population in the Hluhluwe-iMfolozi Park, South Africa. *Animal Conservation* 11: 138-143.
- Valeix, M., Loveridge, A.J., Davidson, Z., Madzikanda, H., Fritz, H. & Macdonald, D.W. (2010).** How key habitat features influence large terrestrial carnivore movements: waterholes and African lions in a semi-arid savanna of north-western Zimbabwe. *Landscape Ecology* 25:337-351.
- Van der Waal, K.L., Mosser, A. & Packer, C. (2009).** Optimal group size, dispersal decisions and postdispersal relationships in female African lions. *Animal Behaviour* 77: 949-954.
- Van Orsdol, K.G., Hanby, J.P. & Bygott, J.D. (1985).** Ecological correlates of lion social organization (*Panthera leo*). *Journal of Zoology, London* 206: 97-112.
- Van Vuuren, J.H., Herrmann, E. & Funston, P.J. (2005).** Lions in the Kgalagadi Transfrontier Park: modelling the effect of human-caused mortality. *International Transactions in Operational Research* 12: 145-171.
- Williams, V.L., Newton, D.J., Loveridge, A.J., Macdonald, D.W. (2015).** Bones of contention: an assessment of the South African trade in African Lion *Panthera leo* bones and other body parts. TRAFFIC, Cambridge, UK & WildCRU, Oxford, UK. Available from http://www.traffic.org/species-reports/traffic_species_mammals83.pdf.

Printed by and obtainable from the Government Printer, Bosman Street, Private Bag X85, Pretoria, 0001
Contact Centre Tel: 012-748 6200. eMail: info.egazette@gpw.gov.za
Publications: Tel: (012) 748 6053, 748 6061, 748 6065