Non-detriment finding for *Panthera pardus* (Leopard)

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Summary of findings

Panthera pardus (leopard) is included on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In terms of Article III of the Convention, an export permit shall only be granted for an Appendix I species (e.g. in the case of a hunting trophy) when a Scientific Authority of a State of export has advised that such export will not be detrimental to the survival of that species. This document summarises the details of a non-detriment finding (NDF) assessment (Figure 1) undertaken for *Panthera pardus* at an NDF workshop convened by the Endangered Wildlife Trust in December 2010 and subsequent expert consultations, and is based primarily on data published in the refereed scientific literature. This information is current as of May 2015.

Leopards are long-lived with low reproductive rates. They are tolerant of a wide range of habitats and climatic conditions, including mountains, bushveld, woodlands, desert and semi-desert, and forests. However, like most felids, leopards are relatively poor dispersers and the degree of connectivity between populations, within and outside of South Africa, is unknown. Although more resilient than many other large carnivores, leopards are still sensitive to human disturbance and have been eradicated from at least 37% of their historic African range.

Approximately 20% (248,770 km^2) of South Africa comprises suitable leopard habitat, although much of this is highly fragmented due to agricultural development, persecution and human encroachment. Today leopards are found in the remote mountainous regions of the Western Cape, parts of North West, Limpopo, Mpumalanga, KwaZulu-Natal, the Eastern Cape, and the semi-desert areas of the Northern Cape bordering on Botswana. There is no rigorous estimate for the size of the South African leopard population, nor reliable estimates of leopard population trends at national or provincial scales.

In addition to habitat loss, key documented threats to leopards include: excessive off-takes (legal and illegal) of putative damage-causing-animals (DCAs); poorly managed trophy hunting; the illegal trade in leopard skins for cultural and religious attire; incidental snaring; and the unethical radio-collaring of leopards for research and tourism. However, the relative severity of these threats and their impact on the national or provincial leopard populations remain unknown. Trophy hunting (practised to maximize economic returns) and legal DCA control (practised to minimize economic losses) are formally though often poorly managed, while other forms of harvest are illegal and therefore unregulated. There are almost no reliable estimates for the extent of illegal off-take of leopards, though data from a few intensive studies in South Africa suggest that levels of illegal off-take exceed levels of legal off-take.

The majority of leopard trophy hunting occurs on private land. Harvest of leopards is not managed consistently throughout the country; some provinces implement effective controls, others do not. Legal off-takes are poorly documented in many provinces. There is an urgent need for a coordinated national strategy which provides standardized guidelines to all provinces for the management of leopards.

South Africa is permitted under CITES to export 150 leopard trophies annually. The national hunting trophy quota was informed by two separate Population and Habitat Viability Analyses (PHVA), but the data used for the analyses (population estimates, number of DCA's and illegal removals) were poor, even though they were the best available information at the time. The national and provincial quotas are therefore arbitrary, based on speculative population estimates. Recent research suggests that trophy hunting may be unsustainable in Limpopo, KwaZulu-Natal and possibly North West. This is due mainly to excessive quotas, clumping of hunting effort, poor trophy selection, and the additive effects of DCA control combined with other forms of illegal off-take.

Nationally, monitoring of trophy hunting is limited to records of the numbers of leopards removed each year, and for legal DCA off-take the numbers of permits awarded annually. There is little to no monitoring of illegal off-take of leopards. KwaZulu-Natal and Limpopo recently instituted frameworks that combine intensive and extensive monitoring to reliably track leopard population trends at a provincial scale, but elsewhere confidence in monitoring is low.

There are likely no effective incentives for habitat conservation arising from the harvest of leopards, although trophy hunting can potentially foster tolerance towards the species. The detrimental impacts arising from the poor management of leopard hunting and DCA control likely compound rather than offset the illegal off-take of leopards.

Only a relatively small proportion of the species range is excluded from harvest as most (68%) leopard habitat in South Africa is found outside protected areas, and even protected populations may suffer strong edge effects. The cores of larger protected areas such as the Kruger National and Kgalagadi Transfrontier Parks likely constitute inviolate refuges for leopards. The imposition of a CITES quota limits the numbers of leopards trophy hunted each year, and individuals require a permit to remove a putative DCA. However, there are no restrictions on the sex, age or size of leopards that can be hunted. Illegal off-take is typically indiscriminate. South Africa is the only country of the 12 range states permitted by CITES to export leopard trophies procured through trophy hunting that allows the hunting of female leopards. Almost half of the leopards trophy hunted in KwaZulu-Natal between 2000 and 2005 were female. Research has shown that polygynous felids such as leopards are resilient to disturbance if the prime reproductive female life-stage remains intact. Hunting female leopards carries the additional risk of dependent cubs dying when their mother is killed. A population viability analysis conducted for the South African leopard population demonstrated that the risk of extinction almost doubled when females were included on quota.

In conclusion, the non-detriment finding assessment (Figure 1) undertaken for *Panthera pardus* (leopard), as summarized in the analysis of the key considerations above, demonstrates that legal local and international trade in live animals and the export of hunting trophies at present poses a high risk to the survival of this species in South Africa (Figure 2A). This is mostly due to poor management of

harvest practices and a lack of reliable monitoring of leopard populations. National norms and standards (section 9 of the National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA)) are required to address current shortcomings in the management of leopard trophy hunting and putative DCAs. Similarly, monitoring frameworks that reliably track leopard population trends should be implemented by all provinces. This will facilitate adaptive management of the harvest of the species, as well as provide insight on the effects of the illegal off-take of leopards.

The following is recommended:

1) Guidelines for the allocation of leopard trophy quotas must be developed and provided to all provinces by the end of January 2015.
2) A conditional leopard trophy quota allocation must be issued for 2015, whereby provinces must indicate compliance with the guidelines recommended in (1) above. Provinces showing non-compliance with these guidelines must not be allocated a quota for 2016.
3) National norms and standards for the management and monitoring of leopard trophy hunting and putative DCAs in South Africa must be developed in terms of section 9 of NEMBA and published by the end of 2016.
4) The norms and standards recommended in (3) above must be fully implemented by the end of 2019.

By implementing the above mentioned recommendations, a moderate to low harvest risk for the species and trade that is not detrimental (Figure 2B) can potentially be achieved.

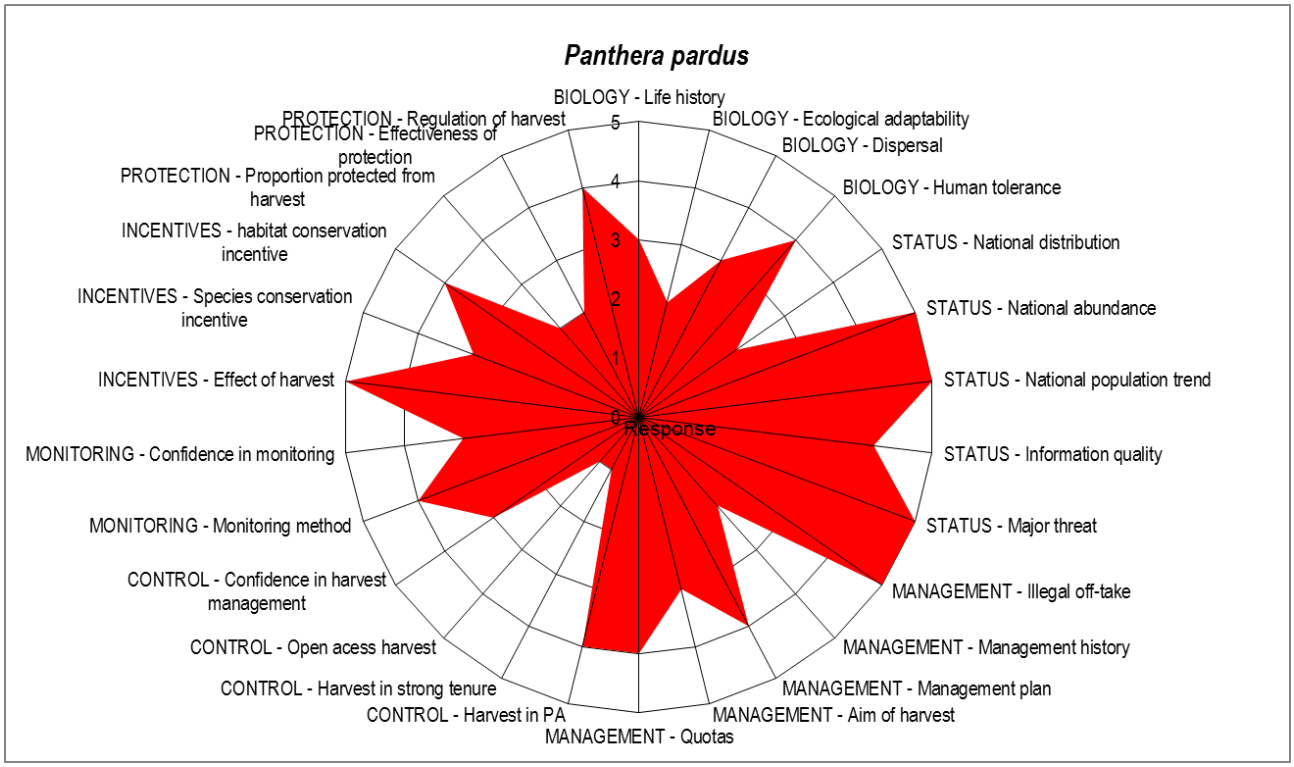

Figure 1: Radar chart summarizing the non-detriment finding assessment for *Panthera pardus* (leopard) in accordance with the CITES NDF checklist. Higher scores are indicative of higher risks. The extensive shaded area in the radar chart demonstrates an overall high risk to the species.

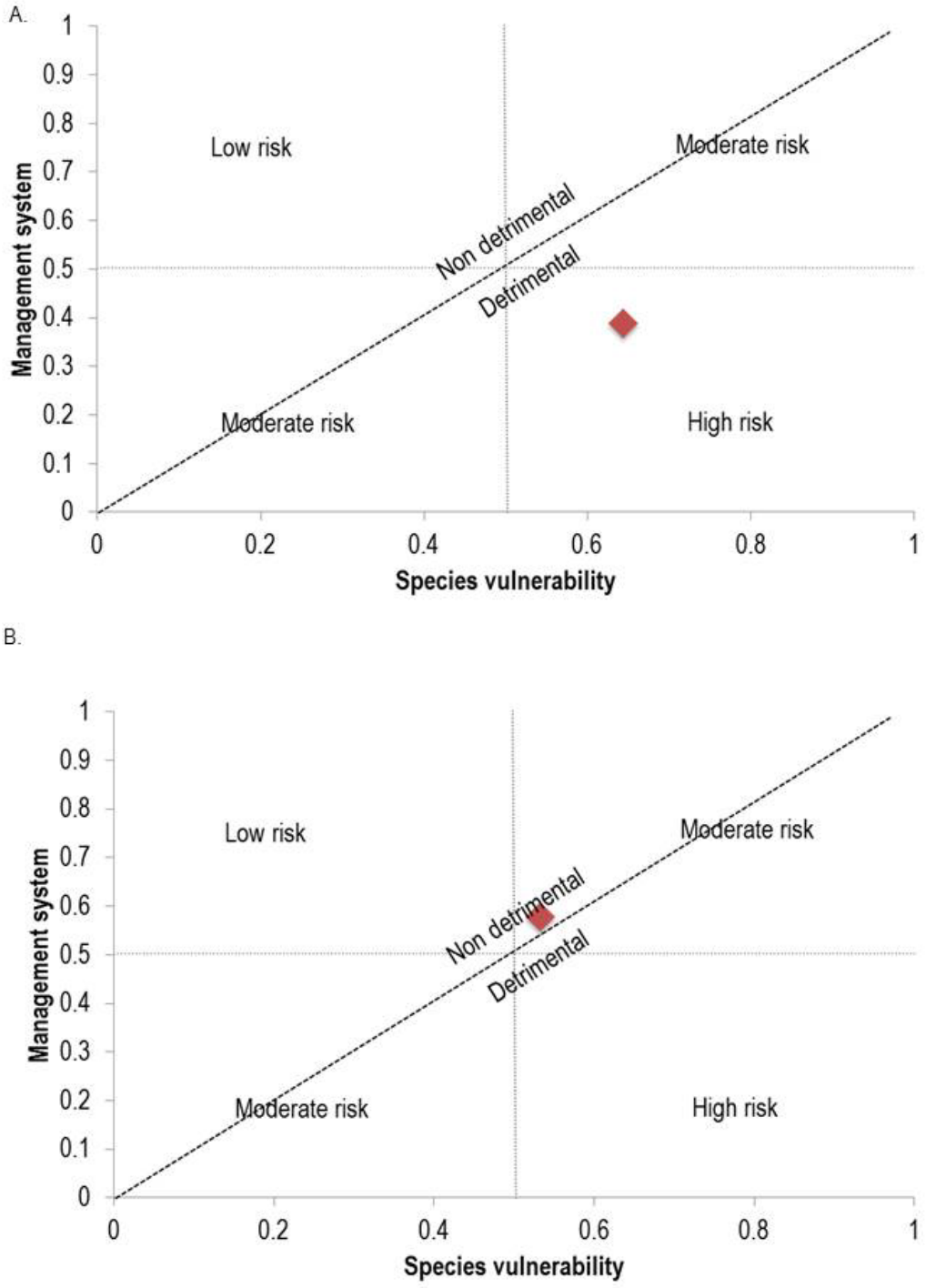

Figure 2: The level of risk of harvesting for *Panthera pardus* (leopard) as represented by the relationship between species vulnerability (biology and status) and the management system to which the species is subjected (management, control, monitoring, incentives and protection). Figure 2A is an indication of the current situation where the species is at high risk and trade is detrimental, while 2B indicates the potential risk to the species after improved monitoring of the species and harvest, and the development of national norms and standards for the management and monitoring of leopard trophy hunting and putative DCAs in South Africa. In this scenario the species is at moderate risk and trade is not detrimental.

Table 1: Detailed Non-detriment finding (NDF) assessment for *Panthera pardus* (leopard) conducted in accordance with the CITES NDF checklist. Scores assigned to each question are indicated (bold text in shaded blocks) along with detailed explanations/justifications. 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
Leopards of both sexes reach sexual maturity at 24-28 months though they rarely breed before 3-4 years (Balme et al*. 2009, 2013). Cubs are born after a gestation period of 90-106 days and litter size at emergence varies from 1-3 cubs (Hunter* et al*. 2013). In South Africa, cubs reach independence from 10-18 months, and the interval between successfully raised litters varies from 16-24 months (Owen* et al*. 2010, Balme* et al*. 2009, 2013). Average mortality of leopard cubs prior to independence varies from 50-90% (Hunter et al. 2013). Even populations fully insulated from human disturbance suffer juvenile mortality as high as 62% (Balme* et al*. 2013). Mean lifetime reproductive success for female leopards is 4.1 ± 0.8 (Balme* et al*. 2013). Survival rates among sub adults (1-3 years old) varies between protected (males – 82%, females – 93%) and unprotected (males – 67%, females – 21%) areas (Swanepoel* et al*. 2014a). Similarly, survival of adults (>3 years) varies between protected (males - 91%, females - 85%) and unprotected (males – 72%, females – 66%) areas (Swanepoel* et al*. 2014b). Longevity of wild leopards is poorly known, but females in protected areas have been recorded living to 19 years and males to 14 years (Balme* et al*. 2013).*		
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
Leopards have the widest distribution of any felid and are tolerant of a wide range of habitats and climatic conditions, including mountains, bushveld, woodlands, desert and semi-desert, and forests (Hunter et al*. 2013). They occur from sea-level to 4600 m above sea-level, in areas receiving <50 mm of rain to areas receiving >1200 mm (Hunter* et al*. 2013). Their wide habitat tolerance is partly due to the breadth of their diet, which also explains their ability to persist close to urban areas (Hayward* et al*. 2006). Prey items range from beetles to ungulates the size of eland (*Tragelaphus oryx*). Leopards are also not particularly water-dependent; in the Kalahari, leopards have been known to drink only once in ten days (Sunquist & Sunquist 2002). Leopards reach their highest densities in woodland savannahs (Hunter* et al*. 2013).*		
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
Large felids are typically considered poor dispersers, especially in comparison to canids or ursids which are far more effective colonisers of distant, vacant habitat (Zimmerman et al*. 2005). Dispersal*		

success among a nominally protected leopard population in KwaZulu-Natal was low (only 19 of 35 radio-collared sub adult leopards survived to establish home ranges) and mean dispersal distance was <10 km (Fattebert 2014). Only two of these 35 sub adults successfully dispersed between adjacent source populations, even though these were less than 20 km apart. Genetic data are required to further assess connectivity between core leopard populations in South Africa.

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

Although leopards appear more capable of persisting in anthropogenically-modified environments than other large carnivores, they have still disappeared from an estimated 37% of their historic African range, due mainly to pressure from humans (Ray et al*. 2005).*

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

Based on maximum entropy models, Swanepoel et al*. (2013) estimated that approximately 20% (248 770 km^2) of South Africa is suitable leopard habitat (Fig. 3). Suitable habitat is fragmented into four general regions: one stretching along the southeast coast, one occurring in the interior of KwaZulu-Natal, one encompassing the Kruger National Park and interior of Limpopo, and one in the northern region where the Kgalagadi Transfrontier National Park is located (Fig. 3). Although vegetation and physical variables were the most influential determinants of habitat suitability in the models, livestock farming primarily seemed to underlie fragmentation. Approximately, 32% of suitable leopard habitat is situated in protected areas.*

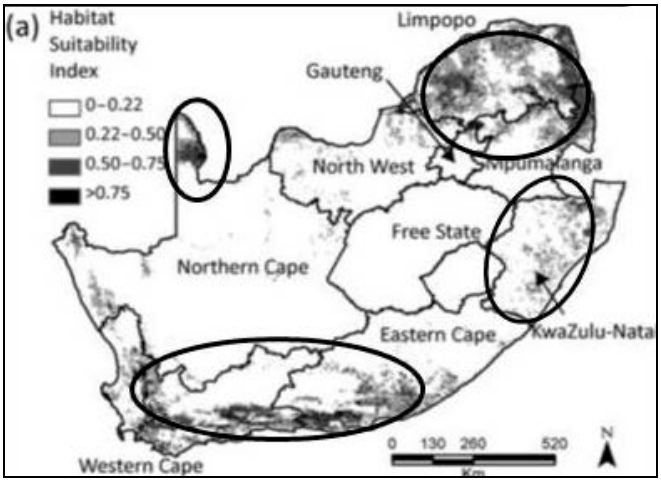

Figure 3: *Suitable leopard habitat in South Africa predicted from a model containing the full set of environmental variables (land cover; NDVI, gazing capacity, elevation, surface ruggedness, distance to nearest river, human density, distance to roads, distance to villages, cattle density, and small ruminant density). The habitat suitability index represents logistic probabilities of occurrences. We regarded logistic probabilities of above 0.22 to indicate suitable leopard habitat, which corresponds to the 10th percentile training presence threshold. (Copied from Swanepoel* et al*. 2013).*

6. National abundance: What is the abundance nationally?	Very abundant	1
	Common	2
	Uncommon	3
	Rare	4
	Uncertain	5
Estimates of the South African leopard population vary from 2,185-23,400 (Martin & De Meulenaer 1988; Friedmann & Traylor-Holzer 2005; Swanepoel et al*. 2014b). However, none of these estimates are based on rigorous population counts at regional scales, and their confidence intervals are so wide as to make them meaningless (e.g. 2,813- 11,632 Leopards; Swanepoel* et al*. 2014b). As such, national leopard population abundance remains uncertain.*		
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
Published longitudinal data exist only for one localised leopard population in KwaZulu-Natal (Balme et al*. 2009). This population declined until the introduction of conservation interventions, after which it increased and then stabilised at capacity set by prey availability (Balme* et al*. 2010a). Leopard population trends elsewhere in South Africa are unknown. Populations in large protected areas are probably stable, but this is pure speculation. Similarly, anecdotal information suggests leopard numbers in the Western Cape are increasing. Leopard range has likely increased with the growth of the commercial game ranching industry (Thorn* et al*. 2011). Questionnaire surveys suggest that pure game ranchers are more tolerant of leopards than livestock farmers, but that mixed farmers (i.e. those that farm both livestock and game) are the least tolerant (Lindsey* et al*. 2005; Thorn* et al*. 2013). However, the recent shift in the game ranching industry to high-value species and colour morphs has likely decreased tolerance of leopards (and other carnivores) among pure game farmers and increased levels of retaliatory killing (Thorn* et al*. 2013). Furthermore, high rates of illegal off-take to fuel the demand for leopard skins for cultural and religious regalia are likely driving population declines in many parts of the country, and more widely across southern Africa (Hunter* et al*. 2013). Indications from site-specific projects (e.g. Balme* et al*. 2009) and modelling exercises (Swanepoel* et al*. 2014b, Pitman* et al*. submitted) show that trophy hunting in some areas is unsustainable.*		
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
Reliable information on leopard population sizes and trends at a national scale is poor or non-existent. Detailed estimates of abundance are available for only a very small fraction of the species' range (e.g. Balme et al*. 2010, Chapman & Balme 2010, Chase-Grey* et al*. 2013, Maputla* et al*. 2013), and data on population trends from only one population in South Africa (Balme* et al*. 2009). KwaZulu-Natal and Limpopo provinces recently established monitoring frameworks that will provide quantitative data to track leopard population trends at a provincial level.*		

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
	Limited/Reversible	2
	Substantial	3
	Severe/Irreversible	4
	Uncertain	5
Key documented threats to leopard populations in South Africa include: excessive off-takes (legal and illegal) of putative damage-causing-animals (DCAs; Balme et al*. 2009, St John* et al*. 2011, Thorn* et al*. 2013, Swanepoel* et al*. 2014b); poorly managed trophy hunting (Balme* et al*. 2010b, Swanepoel* et al*. 2014b); the illegal hunting of leopards for skins and other body parts for traditional ceremonies and medicines (Hunter* et al*. 2013); and the unethical radio-collaring of leopards for research and tourism (Balme* et al*. In review). Habitat loss and fragmentation is also an increasing problem in some parts of South Africa, due to the development of urban areas, mines and agriculture (Di Minin* et al*. 2013, Swanepoel* et al*. 2013). In the Western Cape, the loss of wilderness areas is resulting in reduced habitat for leopard prey such as hyrax and small antelopes, increasing the likelihood of leopards relying on livestock for food (Martins & Martins 2006). However, at this stage, the relative severity of threats is unknown, due mainly to lack of reliable data on the extent of illegal off-take of leopards (Balme* et al*. 2014).*		
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
Little is known about the extent of illegal off-take and trade of leopards and their body parts in South Africa, although anecdotal information suggests it is large (particularly the illegal trade in leopard skins for cultural and religious regalia; Hunter et al*. 2013).*		
11. Management history: What is the history of harvest?	Managed harvest: ongoing with adaptive framework	1
	Managed harvest: ongoing but informal	2
	Managed harvest: new	3
	Unmanaged harvest: ongoing or new	4
	Uncertain	5
Trophy hunting and legal DCA control is formally (though often poorly; Balme et al*. 2009, Pitman* et al*. In review) managed at the provincial level, but most forms of harvest are illegal and therefore not regulated (e.g. illegal retaliatory killing, off-take for skins, incidental snaring, road kills).*		
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
Some provinces have management plans which address particular aspects of leopard management		

(e.g. the Eastern and Western Cape have guidelines for the management of DCAs; KwaZulu-Natal (Balme et al*. 2010b) and Mpumalanga have specific plans that guide the allocation of hunting quotas); however, there is no coordinated national approach or holistic management plan for the species. A national management plan which provides standardized guidelines to provinces for the management of the species - particularly for managing trophy hunting and monitoring of leopard populations - is required.*

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

Trophy hunting is practised to maximize economic returns, while DCA control (legal and illegal) is practised to minimise economic losses. The local trade in leopard skins is mainly for cultural and religious purposes; however, it still has a commercial component (e.g. traders sell leopard skins to followers of the Shembe Church).

14. Quotas: 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
	Untried quota: recent and based on biologically derived local quotas	3
	Market-driven quota(s), arbitrary quota(s), or no quotas	4
	Uncertain	5

Under CITES South Africa is allowed to export 150 leopards annually as trophies (though on average only 117 leopards have been exported annually as trophies over the period 2002 - 2012 (CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK).
Two separate Population and Habitat Viability Analyses (PHVA) were conducted (2005 and 2011) to inform the CITES trophy hunting quota. Even though slightly more reliable data were used in the second modelling exercise (2011) both exercises suffered from a lack of reliable data on population estimates, and illegal offtakes. For the model scenarios tested (ranging from 0 -150 leopard hunted) an increase in the CITES quota from 75 to 150 did not increase the risk of extinction of leopards throughout South Africa over the next 100 years, but did decrease the overall meta-population size from a projected 4,631 with no trophy hunting, to 3,844 with a quota of 75 to 3,196 with the 150 quota, representing a decline from 93% to 64% of the carrying capacity. These results suggested that the effects of the increased quota will depend in part on the areas from which leopards are taken and can lead to local extinctions and reduced population size. Both the national and provincial quotas are thus based on unreliable population estimates, and are therefore relatively arbitrary. Recent research suggests hunting quotas in Limpopo – which accounts for >60% of leopards trophy hunted in South Africa – are unsustainable, particularly if the removal of putative DCAs is taken into account (Pitman et al*. in review). Anecdotal information from North West similarly suggests that quotas are too high (Power 2014). A further concern with the current hunting trophy allocation is the clumping of trophy hunts, leading to increased pressure on specific populations. Historically, clumping of trophy hunting effort in KwaZulu-Natal resulted in localised leopard population declines, although this has ameliorated to some extent by the formation of specific Leopard Hunting Zones (Balme* et al*. 2010b). No quotas are*

applied to the removal of DCAs or the illegal off-take of leopards, which is likely to significantly exceed off-take from trophy hunting (St John et al*. 2011, Thorn* et al*. 2013).*		
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
No trophy hunting or DCA control of leopards is allowed in state protected areas.		
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
Most trophy hunting of leopards occurs on private land (Balme et al*. 2010b; Pitman* et al*. in review). Due to poor record keeping, there are few data which illustrate where most legal DCA control occurs, but it also likely takes place mainly on private land.*		
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 *de facto* or actual open access?	None	1
	Low	2
	Medium	3
	High	4
	Uncertain	5
Some trophy hunting and DCA control of leopard occurs on communal lands, but access is still generally controlled by communal authorities.		
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
Some provinces (e.g. KwaZulu-Natal, Western Cape) have the resources to implement management plans and effective controls over the legal harvest of leopard (i.e. trophy hunting and DCA control); other provinces less so. However, none of the provinces likely have the capacity to curb the illegal off-take of leopards effectively.		
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
The Department of Environmental Affairs records the numbers of CITES export permits allocated to, and the numbers of leopard hunting trophies exported from, each province. Some provinces record the numbers of DCA permits awarded, but few actually note whether putative DCAs were successfully removed (translocated or killed). Record keeping is generally poor among the provinces. KwaZulu-		

Natal and Limpopo provinces recently established a monitoring framework to track provincial leopard population trends using a combination of intensive (i.e. direct population estimates) and extensive (i.e. quantitative indices) monitoring approaches. A similar framework should be adopted by all the provinces.		
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
Confidence in monitoring the impacts of legal leopard off-take (trophy hunting and DCA control) at a national level is generally low, although KwaZulu-Natal and Limpopo provinces have recently taken steps to improve this. Monitoring of illegal off-take of leopards is poor or non-existent.		
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
Evidence suggests that legal off-take of leopards through trophy hunting and DCA control likely compounds rather than offsets illegal off-take, but more research is required. Although questionnaire data suggest that landowners are more tolerant of leopards as they can benefit financially from hunting the species (Lindsey et al*. 2005), empirical data from northern KwaZulu-Natal show that landowners that hunted the most leopards also removed (legally and illegally) the highest numbers of putative DCAs (Balme* et al*. 2009). Research also suggests that, even in isolation, poorly managed trophy hunting can drive leopard population declines (Balme* et al*. 2009; Swanepoel* et al*. 2014b; Pitman* et al*. In review). The illegal off-take of leopards to fuel the local skin trade is unlikely to be affected by legal harvesting of the species, nor will incidental snaring of leopards.*		
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
Trophy hunting has the potential to increase tolerance towards leopards. Questionnaire surveys suggest that the attitudes of landowners to leopards is better than for other predator species which cannot be hunted, such as cheetahs and wild dogs (Lindsey et al*. 2005). However, in northern KwaZulu-Natal, landowners that hunted the most leopards also removed (legally and illegally) the highest numbers of putative DCAs (Balme* et al*. 2009). Similar patterns have been observed more widely. Tolerance for wolves in Wisconsin declined following the first-ever regulated harvest of the species (Treves & Bruskotter 2014), while the numbers of cougar DCA complaints was positively related to harvest levels (Peebles* et al*. 2013). Clearly, more research is required to understand the complex relationship between trophy hunting and tolerance of landowners towards predators.*		
23. Incentives for habitat conservation: At the national level, how much habitat conservation benefit is derived from	High	1
	Medium	2
	Low	3
	None	4

harvesting?	Uncertain	5
Leopards, on their own, are unlikely to influence land-use decisions by landowners.		
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
Swanepoel et al*. (2013) estimate that 12% of suitable leopard habitat in South Africa falls within national parks where hunting of leopard is not allowed. A further 20% falls inside other conservation areas but harvesting is permitted in some of these reserves. Some protected leopard populations are also likely to be exposed to strong edge effects. For example, in the Phinda-Mkhuze complex in northern KwaZulu-Natal, the density of leopards declined from 11.1/100 km² in the centre of the protected area, to 7.2/100 km² at its periphery due to harvesting in adjacent non-protected areas (Balme* et al*. 2010a). Nevertheless, the cores of larger protected areas such as the Kruger National and Kgalagadi Transfrontier Parks likely constitute inviolate refuges for leopards.*		
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
There is a medium confidence in the effectiveness of strict protection measures implemented. Even though leopards within some protected areas might be exposed to strong edge effects, the cores of larger protected areas such as the Kruger National and Kgalagadi Transfrontier Parks likely constitute inviolate refuges for leopards. The imposition of a CITES quota on the number of trophies that can be exported limits the number of leopards legally hunted in South Africa each year. No trophy hunting or DCA control are allowed within any of the state protected areas and these constitute approximately12% of the suitable leopard habitat within South Africa.		
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
The numbers of leopards trophy hunted in South Africa each year is regulated and individuals require a permit to remove a putative DCA; however, there are no restrictions on the age, sex or size of leopards that can be killed (Balme et al*. 2012). Illegal offtake is typically indiscriminate. South Africa is the only country of the 12 range states permitted by CITES to export leopard trophies procured through trophy hunting that allows the hunting of female leopards. Almost half of the leopards trophy hunted in KwaZulu-Natal between 2000 and 2005 were female (Balme* et al*. 2010b). Research has shown that polygynous felids such as leopards are resilient to disturbance if the prime reproductive female life-stage remains intact (Crookes* et al*. 1998, Goana* et al*. 1998). Since one male can mate with numerous females, fewer males are required to maintain the same levels of reproduction. Hunting female leopards carries the additional risk of dependent cubs dying when their mother is killed (Robinson* et al*. 2014). Male leopards also disperse over greater distances than females (Bailey 2005), enabling more*		

efficient replacement of hunted individuals. A population viability analysis conducted for the South African leopard population demonstrated that the risk of extinction almost doubled when females were included on quota (Daly et al*. 2005).*

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Martins, Quinton	Cape Leopard Trust
Newton, David	TRAFFIC
Pfab, Michele	SANBI
Physick, Jamie	EKZN Wildlife
Power, John	EWT
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