Panthera leo – Lion


Susan Miller

Regional Red List status (2016)	Least Concern*
National Red List status (2004)	Vulnerable D1
Reasons for change	Genuine change: Increased population
Global Red List status (2016)	Vulnerable A2abcd
TOPS listing (NEMBA) (2007)	Vulnerable
CITES listing (1977)	Appendix II
Endemic	No

*Conservation Dependent

Although Lions formerly occurred widely over sub-Saharan Africa, today there are only 10 Lion strongholds remaining, of which six occur in southern Africa (Riggio et al. 2013).

Taxonomy

Panthera leo (Linnaeus 1758)

ANIMALIA - CHORDATA - MAMMALIA - CARNIVORA - FELIDAE - *Panthera* - *leo*

Synonyms: *Felis leo* (Linnaeus 1758)

Common names: Lion, African Lion (English), Leeu (Afrikaans), Isilwane (Ndebele), Tau (Sepedi, Sesotho, Setswana), Ndau (Tshivenda), isiGidi, iNgwenyama (Xhosa), iNgonyama (Xhosa, Zulu), Nghala (Xitsonga), iBhubesi (Zulu)

Taxonomic status: Species

Taxonomic notes: The latest published phylogeographical study of Lions shows that the traditional split between Asian and African Lions as distinct subspecies is untenable (Barnett et al. 2014). Based on these results, the Cat Classification Task Force of the IUCN SSC Cat Specialist Group has provisionally proposed a different split into two subspecies, *P. l. leo* of Asia and West, Central and North Africa; and *P. l. melanochaita* from South and East Africa, with several regional management units identified as well (Haas et al. 2005; Bertola et al. 2011, 2015; Bauer et al. 2015).

Assessment Rationale

The Lion populations in South Africa declined substantially in the 19th century but have been stable or increasing over the past 20–30 years. The number of free-roaming mature Lions in South African large protected areas has increased from an estimated 800 in 2002–2004 to an estimated 1,286 in 2015. Furthermore, by including the entire area of transfrontier parks as interconnected and functional landscapes (over which South African conservation authorities have shared management jurisdiction), the total number of mature, free-roaming Lions within the assessment region is estimated to be 1,550. The number of small reserves containing Lions has increased from one in 1990 to at least 45 in 2013, which corresponds to an increase in Lion numbers from about 10 in 1990 to 500 (225 mature individuals) in 2013. Including Lions on small reserves yields a total mature population size of 1,775 individuals. Thus, Lion numbers in the assessment region comfortably exceed the threshold for D1 and the species does not qualify as threatened using the A or C criteria because the two major free roaming subpopulations have not declined over the past 20 years (3 generations). In Kruger National Park (KNP) alone, the number of Lionesses is estimated to have increased by 45% between 2005 and 2015. Thus we list the species as Least Concern.

This species would technically qualify for Near Threatened D1 if we exclude the managed subpopulations in small reserves and assess only the South African portions of the transfrontier parks (1,286 mature individuals). However, because the overall population is stable or increasing with no severe threats that could cause rapid decline, and because the reintroduced subpopulations on small reserves qualify as wild and free roaming, a Least Concern listing is most appropriate. Similarly, the regional criterion could be applied as the two major Lion subpopulations are connected to conservation areas in Botswana, Zimbabwe and Mozambique through transfrontier conservation areas. Thus, there has been a genuine increase in Lion numbers due to the success of

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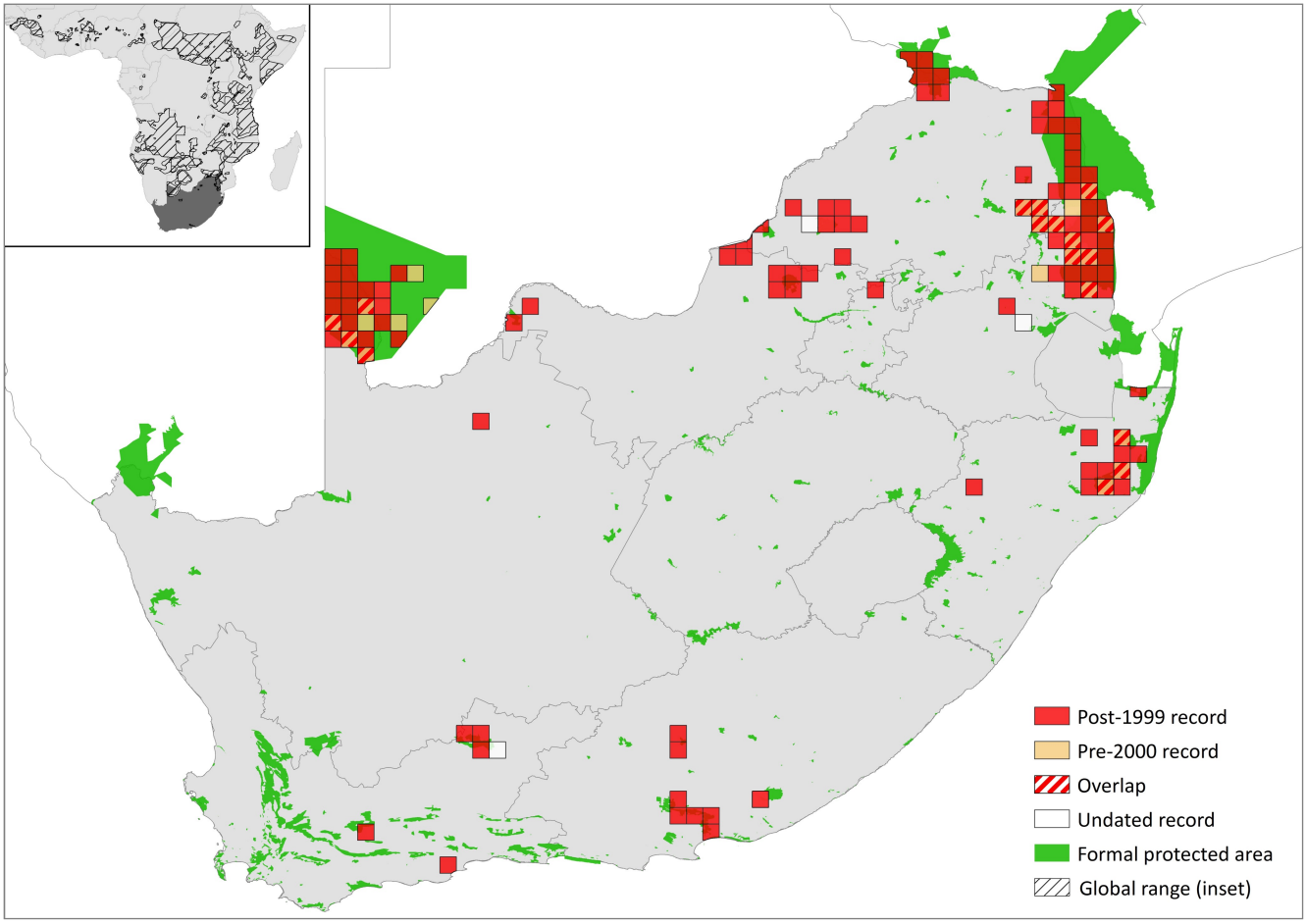

Figure 1. Distribution records for Lion (*Panthera leo*) within the assessment region

Table 1. Countries of occurrence within southern Africa

Country	Presence	Origin
Botswana	Extant	Native
Lesotho	Regionally extinct	Native
Mozambique	Extant	Native
Namibia	Extant	Native
South Africa	Extant	Native and reintroduced
Swaziland	Extant	Reintroduced
Zimbabwe	Extant	Native

transfrontier conservation areas and private protected area expansion.

There are no major current threats to Lions in the assessment region. While the trade in Lion bones to East–Southeast Asia has been cited as a potential threat in South Africa, evidence suggests that the trade is not adversely impacting on wild Lion subpopulations in South Africa because the skeletons are almost all a by-product of the sizeable trophy hunting industry, and Lions that are hunted in South Africa are almost exclusively captive-bred (which are excluded from this assessment). However, this situation needs to be closely monitored (especially elsewhere in Africa where the scale of the bone trade is largely unknown) and the assessment re-evaluated if new data become available that indicates that the bone trade is a threat to wild Lions. Currently, key interventions include the formulation and adoption of a metapopulation plan (small, fenced subpopulations require greater management input and coordination) and protected area expansion (especially transfrontier conservation areas).

Regional population effects: Although the range is mostly fragmented within the assessment region, there is connectivity and dispersal between subpopulations within Kgalagadi Transfrontier Park and Great Limpopo Transfrontier Park. There is also dispersal across the Botswana and South African border at the Greater Mapungubwe Transfrontier Park. Thus, there is potential for immigration.

Distribution

Lions originally roamed freely across most of South Africa but hunting and changes in land use (particularly farming) devastated Lions between the late 1800s and early 1900s and restricted them to large national parks by the middle of the 20th century (Nowell & Jackson 1996). For example, Lion became regionally extinct in the Eastern Cape by 1879 (Skead 2007). The fate of Lions in the Northern Cape is typical of many parts of the country: based on the average pride size of 11 individuals recorded in the dune-savannah of Kgalagadi Transfrontier Park (KTP) (Funston 2011), at least 1,492 Lions may have resided in the Northern Cape before the species was hunted to near local extinction in the 1800s. Lion disappeared from regions such as Namaqualand, Bushmanland, Karoo, Tankwa-Karoo, the Kimberley region and north of the Orange River. At one point, Lions survived only in the national park that now forms part of the KTP (*viz* Kalahari Gemsbok National Park), where they have been protected since 1931. Since the 1990s, however, Lion prides have been established on three

private properties in the Kalahari region of the Northern Cape (north of the Orange River). Lions have also been reintroduced into Swaziland: Swaziland's last resident Lion was reputedly seen by King Sobhuza II in the late 1950s at Hunter's Rock in Hlane National Park (Monadjem 1998). Subsequently, a male and two females were introduced from KNP to Hlane National Park in 1994 (Monadjem 1998).

Generally, the expansion of private game reserves, especially since the early 1990s, has reclaimed lost ranges for Lions and they currently occur in isolated subpopulations in all provinces of South Africa, except for the Free State (Hayward et al. 2007; Hunter et al. 2007; Slotow & Hunter 2009; Miller et al. 2013; Williams et al. 2015a). However, these subpopulations are highly fragmented, with over 45 "small" (< 1,000 km^2) reserves having reintroduced Lion (Miller et al. 2013). There is currently a push to develop a metapopulation management plan to reduce the effects of fragmentation (Miller et al. 2013). Although the subpopulations on private reserves occur in fenced areas, some of which are smaller than the average range that would be required under natural conditions (but see Hayward et al. 2009), these subpopulations are all considered free-roaming and have access to large and varied prey populations (for example, Power 2002, 2003; Slotow & Hunter 2009).

This species still occupies only a small part of its former range in South Africa and they now persist on *c*. 40,000 km^2 as compared to 1.22 million km^2 historically. Lions are almost exclusively found in fenced areas in South Africa (there is only a very small free-roaming subpopulation in northern Limpopo bordering Botswana and Zimbabwe – this probably accounts for fewer than 20 animals). The current area of occupancy (41,745 km^2) has been determined by summing the areas of the fenced reserves where Lions occur. The largest proportion comprises a few large transnational or provincial protected areas (33,200 km^2, *c*. 80%), with the remainder made up of 45 small fenced private or state reserves with a combined area of *c*. 8,500 km^2. The transnational protected areas are all fenced on the South Africa side, but open to neighbouring countries which have varying levels of fencing. Some reserves may have dropped internal fences since the last data were collected and so have increased their individual size and there may be one or two new reserves that have not been included, but this number should be reasonably representative. The smaller reserves (< 1,000 km^2) complement the conservation value of larger reserves and have greatly helped to expand the area of occupancy for Lions. However, the small, fenced populations (many of which support fewer than 20 individuals), require greater management input and coordination than those populations in transfrontier parks (Miller et al. 2013).

Population

Lion numbers have been dropping dramatically across the African continent (Bauer et al. 2015). However, in South Africa, the Lion population is stable or increasing in major reserves and increasing through the addition of small reserves or through the formation of conservancies (Table 2). There are an estimated 3,490 free-roaming Lions in South Africa, including transfrontier zones; and 2,876 in South African conservation areas alone. Of these, there are 1,775 mature Lions, using a 50% mature population structure evident in large reserves (Smuts 1976; Mills et al. 1978); and 1,511 in South African conservation areas alone. If we use the total formally protected mature population of Lions (1,775), it represents 5–9% of the global mature population of 23,000–39,000 Lions (Riggio et al. 2013; Bauer et al. 2015).

The conservation success of the formally protected population is due largely to the transfrontier parks (established in the early 2000s) that have created resilient and self-sustaining Lion subpopulations. The Great Limpopo Transfrontier Park subpopulation (estimated at *c*. 2,000 individuals in 2013; 2,311 individuals if the private conservancies open to KNP on the western boundary are included), which represents 50% of the free-roaming Lion population, has remained stable or has slightly increased over the past 30 years (Ferreira & Funston 2010), where the KNP numbers have reached *c.* 1,700 individuals. Recent surveys, using 240 call-up stations distributed randomly throughout KNP, indicate the subpopulation has increased over the past decade from 1,684 (95% confidence intervals 1,617–1,751) in 2005 to 1,803 (95% confidence intervals 1,715–1,891) individuals in 2015 and,

Table 2. Current subpopulation numbers of Lion (*Panthera leo*) in South Africa and surrounding transfrontier areas. All counts were made between 2008 and 2013.

Location (sub-location)	Total Lions (South Africa only)	Number mature Lions (South Africa only)	Reference
Great Limpopo Transfrontier Park (Kruger National Park)	2,000 (*c*. 1,700)	1,060 (*c*. 900)	Ferreira & Funston 2010; Smuts 1976
Associated Private Nature Reserves (Greater Kruger National Park)	300	160	Funston 2004; Smuts 1976
Kgalagadi Transfrontier Park Total (South Africa only)	520 (246)	255 (167)	Ferreira et al. 2013; Funston 2011; S. Ferreira unpubl. data
Greater Mapungubwe Transfrontier Conservation Area (South Africa only)	~50 (10)	25 (5)	Funston 2010
Hluhluwe–iMfolozi Park	120	54	D. Druce pers comm. Feb 2014; 45% from small reserve data for mature Lions
Total excluding small reserves	**2,990 (2,376)**	**1,550 (1,286)**	
Small reserves	500	225	Miller et al. 2013
Total including small reserves	**3,490 (2,876)**	**1,775 (1,511)**	

for adult females specifically, from 415 (95% confidence intervals 380–450) to 604 (95% confidence intervals 515–693) (S. Ferreira unpubl. data).

Similarly, the South African side of the KTP has been fairly stable since the first population estimate in 1976 of 140 Lion, ranging between 108 and 181 (Funston 2001, 2011), and KTP overall reached over 500 individuals in 2010 (Ferreira et al. 2013). Recent mark-recapture estimates for the South African side of KTP 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 is estimated to be 167 (95% confidence intervals 160–177) (S. Ferreira unpubl. data). The subpopulation in the Greater Mapungubwe Transfrontier Conservation Area (GMTFCA) contains Lions on the De Beers Venetia Limpopo Nature Reserve, which does require active management as they are enclosed. However, the rest of the Lions in the GMTFCA are completely free-roaming (not contained by fences) and so are not managed, although they are constantly under threat from human–wildlife conflict. The subpopulation in Hluluwe-iMfolozi Park (HiP) has increased from two founders in 1956 and 60 mature individuals in 1986 to a stable population of approximately 120 in 2014 (D. Druce unpubl. data), with new individuals being reintroduced in the late 1990s to mitigate potential inbreeding (Trinkel et al. 2008).

Lions have also been extensively reintroduced onto small reserves (including national, provincial and privately protected areas), having increased from one in 1990 to 45 in 2013, with a corresponding increase in numbers from 10 to *c*. 500 (Miller et al. 2013; Miller & Funston 2014). Around 45% of these Lions are mature (225 individuals), as opposed to 50% of Lions in large national parks or transfrontier parks (1,400 individuals). All small reserve subpopulations are ecologically functional as, for example, they are large enough for social dynamics and hunting to continue unhindered, although some reserves may import prey stocks (Power 2002, 2003; Hayward et al. 2007). Thus, they may occasionally receive supplementary prey but are not fed and are not captive-bred Lions. Such subpopulations continue to grow and generally increase to the extent that management has become a necessity (Power 2003; Hayward et al. 2009; Slotow & Hunter 2009), although the addition of new reserves has slowed in the past five years (Miller & Funston 2014). The reasons for this are varying: for example, in Mpumalanga, development and infrastructure conflict with protecting more land for conservation, while in the Northern Cape high costs of land and predator-proof fencing inhibit further conservation efforts. This highlights the need to consolidate existing private reserves into conservancies and create larger, more ecologically-resilient populations (Di Minin et al. 2013). Secondly, the management of small reserve subpopulations requires a metapopulation plan to ensure they do not become a threat to genetic integrity through inbreeding (Miller et al. 2013; Miller et al. 2015). Genetic studies indicate that the southern African Lion would originally have constituted one large panmictic population (Barnett et al. 2006). However, there is very limited “free” movement of Lion between separate subpopulations today, which necessitates metapopulation management. This managed population may need to be occasionally supplemented with Lions from the larger protected areas (for example, KNP).

The total current (2013) mature population size ranges from 1,286 to 1,775 depending on the inclusion on the entire transfrontier conservation areas and small reserves (Table 2). Generation length is calculated as 6.5 years (Bauer et al. 2015), and the core population in the largest protected areas have remained stable or have increased over three generations. In southern Africa overall (Botswana, Namibia, South Africa and Zimbabwe), the population is inferred to have increased by 12% over three generations, whereas outside these countries the population has declined by 43% over the past 21 years (Bauer et al. 2015). The strongholds for Lions (Great Limpopo Transfrontier Park, KTP and HiP) provide enough mature individuals to exceed the D threshold alone.

In addition to wild Lions, there are many captive-bred Lions in most provinces, especially the Free State and North West provinces (Lindsey et al. 2012; Power 2014; Williams et al. 2015a). According to a study by Williams et al. (2015a), there are close to 6,000 Lions in captivity in approximately 70 breeding facilities. Although such Lions do not contribute to the wild and free-roaming population, they may serve as a significant buffer to threats facing the wild population by being the primary source of trophy hunting and derived products (SANBI 2012; Lindsey et al. 2012; Williams et al. 2015a).

Current population trend: Increasing

Continuing decline in mature individuals: No

Number of mature individuals in population: 1,511–1,775

Number of mature individuals in largest subpopulation: > 500

Number of subpopulations: 49

Severely fragmented: Yes. Most subpopulations are in small fenced reserves that require active metapopulation management.

Habitats and Ecology

Lions have a broad habitat tolerance and are only absent from tropical rainforest and the interior of the Sahara Desert (Nowell & Jackson 1996). They once lived across Eurasia, but now only a remnant population of a different subspecies (*Panthera leo persica*) survives in India. Lions are largely found in the savannah biome of Africa, which is broadly defined as those areas that receive between 300 and 1500 mm of rain annually, and encompass a wide variety of habitats including grasslands, wetlands, dry woodlands and mosaics of all of these (Riggio et al. 2013). They do locally exist in the Namib Desert in Namibia (Bauer & van Der Merwe 2004). Once extirpated from the

tropical thicket biome of the Eastern Cape in South Africa, Lions have recently been successfully reintroduced (Hayward et al. 2007).

Although Lions drink regularly when water is available, they are capable of obtaining their moisture requirements from their prey and even plants (such as the tsama melon in the Kalahari Desert), and thus can survive in very arid environments as they are water-independent (Green et al. 1984). Medium- to large-sized ungulates (190–550 kg, including antelopes, zebra and wildebeest) are the bulk of their prey (Hayward & Kerley 2005), but depending on circumstances, Lions will take almost any animal, from rodents to a rhinoceros. They also scavenge, displacing other predators (such as the Spotted Hyaena *Crocuta crocuta*) from their kills (Hayward 2006). Lions can only exist in areas with sufficient wild prey, and seldom co-exist closely with man. Within their home ranges, Lions require habitats or locations that are suitable for hunting, resting, and breeding. They readily adapt to hunting in varied habitats generally having greater success when hunting in areas with longer grass or cover (Funston et al. 2001). Although landscape features may vary from area to area, Lions tend to select areas where prey is easier to catch, rather than areas where prey densities are highest.

Lions are the most social of the cats, with related females remaining together in prides, and related and unrelated males forming coalitions competing for tenure over prides (West & Packer 2013). Average pride size (including males and females) is four to six adults; prides generally break into smaller groups when hunting (Smuts 1976). Lions tend to live at higher densities than most other felids, but with a wide variation from 1.5 adults / 100 km^2 in southern African semi-desert to 55 adults / 100 km^2 in parts of the Serengeti. Small fenced reserves in South Africa had average densities below 10 adults / 100 km^2 (Miller & Funston 2014). Pride home ranges can vary widely even in the same region: for example, from 266 to 4,532 km^2 in the South African part of the KTP (Funston 2001), and 45 km^2 in the Ngorongoro Crater, Tanzania (Hanby et al. 1995). Home ranges also vary widely within South Africa and do not appear to be linked to reserve size (Lehmann et al. 2008). For example, home ranges can vary hugely within a reserve, as evidenced on Makalali where Lions had home ranges from 25 km^2 to 107 km^2 (Druce et al. 2004).

Key habitat for Lions is directly driven by the presence or density of preferred prey species rather than any particular vegetation types – other than those associated with their preferred prey. As such, the vegetation communities that support the preferred prey of Lions range from semi-desert (Kalahari) through savannah (Kruger/Okavango) and subtropical thicket (Addo). In South Africa, however, the predominant subpopulations all occur within the savannah biome in the northern parts of the country.

Ecosystem and cultural services:

- This species is a keystone species and an apex predator. For example, Lions were reintroduced to Addo Elephant National Park in part to substitute the need to cull overabundant herbivores (Hayward et al. 2007), thus performing an ecosystem service of top-down population control.
- Lions are extensively used for ecotourism and are a prominent member of the “Big 5” (Di Minin et al. 2012; Maciejewski & Kerley 2014).
- Lions have huge commercial value in the trophy hunting industry, though there is controversy over such practices.

Use and Trade

South Africa’s international trade in Lion products is sizeable. Besides trophies and live Lions, South Africa has issued CITES permits to export 19 categories of Lion products since 1977 ranging from hair to handbags, feet, leather items and tails (Williams et al. 2015a). Since 1992, South Africa has issued CITES permits to export at least 7,474 trophies, with an average of 351 ± 303 per year. However, from 2002 that average has increased to 565 ± 275 trophies per year. The trophies are primarily derived from legally hunted captive-bred Lions, and hunting predominantly occurs in the North West (77% of hunts from 2004 to 2010), Eastern Cape (10% of hunts) and Free State (6% of hunts) provinces (Williams et al. 2015a). Exports of trophies originating in South Africa increased markedly from *c*. 2006.

Despite the sizeable trade of Lions in South Africa, trophy hunting and trade is a negligible threat as utilization appears to be sustainable and wild populations are either stable or increasing. No hunting is allowed in national or provincial parks, which collectively represent > 75% of the total wild Lion population. Furthermore, less than 5% of trophy hunts are sourced from wild populations (CITES Scientific Authority South Africa 2013). For example, Lindsey et al. (2012) reported that the South African hunting operators estimated the proportion of wild Lions hunted annually to be only 0.9 and 1.1% of the totals for 2009 and 2010 respectively. The majority of trophy hunting is performed on private wildlife ranches (53%) or on properties with captive-breeding facilities (42%), where there are at least 6,000 Lions kept in captivity in at least 149 facilities across South Africa (Williams et al. 2015a). Although this population does not contribute to the wild population under assessment, it may act as a buffer to the wild population (Lindsey et al. 2012), as well as contributing to the South African economy. Besides trophies, CITES permits have been issued to export large numbers of live Lions across the world, as well as skeletons and bones to east-southeast Asia. From 1992 to 2012, CITES permits to export almost 1,400 live Lions (predominantly captive origin from the North West Province) were issued, 16% of these were destined for southeast Asia (mostly Thailand), and reached a peak of > 280 Lions in 2010 (Williams et al. 2015a).

In 2005, the process to develop stricter regulations relating to the hunting of captive-bred Lions was initiated and the provisions came into effect in 2007. These stricter regulations in terms of the National Environmental Management: Biodiversity Act (NEMBA), 2004 (Act No 10 of 2004) and, more specifically, the Threatened or Protected Species (ToPS) regulations, proposed that captive-bred Lions could only be hunted if they were released into an extensive self-sustaining (or ‘free-roaming’) system for a 2-year period. This regulation was challenged twice in court by the South African Predator Breeders Association (SAPBA) and, in 2010, SAPBA were successful in having the two-year period declared invalid for Lions (Williams et al. 2015a). Consequently, provinces apply regulations as per their provincial ordinances or guidelines, and this self-sustaining period varies across the provinces (for example, 96 hours in the North West, 30 days in the Eastern Cape, and 24 months in the Limpopo Province) (Williams et al. 2015a).

Table 3. Use and trade summary for the Lion (*Panthera leo*)

Category	Applicable?	Rationale	Proportion of total harvest	Trend
Subsistence use	Yes	Low-scale traditional medicine use.	Minority	Stable
Commercial use	Yes	Trophy hunting and export of skeletons.	Majority	Increasing
Harvest from wild population	Yes	Low incidences of poaching or illegal hunting.	< 5%	Stable
Harvest from ranched population	Yes	Occasional trophy hunting.	< 5%	Stable
Harvest from captive population	Yes	Extensive trophy hunting and exportation of parts for international markets.	95%	Increasing

In 2006 the IUCN SSC African Lion Working Group cautioned against allowing a legal trade in Lion bones based on a concern that a legal trade would be unable to meet the substantial demand for Lion bones in China. This demand was allegedly to replace tiger bones in Asian traditional medicines and tonics. According to Williams et al. (2015a), there is evidence that the legal trade in Lion bones had started by 2008. Before 2008, the only record of South Africa issuing CITES permits to export Lion skeletons was for three units to Denmark in 2001. However, Lion bone exports from South Africa have increased dramatically since 2008. From 2008 to 2011, the official number of skeletons legally exported with CITES permits totalled 1,160 skeletons (about 10.8 tonnes of bones), 573 of them in 2011 alone, with 91% of them destined for Lao People's Democratic Republic. The North West, Free State and Eastern Cape provinces, all home almost exclusively to captive-bred Lions, were the only provinces to issue export permits. Sixty-seven percent of the skeletons recorded on the export permits were from the North West and 25% from the Free State (Williams et al. 2015a). Lion bones are a sustainable by-product of the trophy industry and there was no evidence that any of these skeletons were obtained from wild Lions (Williams et al. 2015a). However, the longer-term sustainability of this practice is questionable, particularly if Asian consumers begin demanding wild rather than farmed or captive-bred products as consumer surveys indicate they prefer (Gratwicke et al. 2008).

Although there are no specific figures on illegal trade of Lions in South Africa, provincial conservation authorities indicate that illegal use or trade in Lion body parts and products is generally limited to negligible or non-existent. Furthermore, any illegal trade in Lions and their body parts usually involves restricted activities for which offenders are not in possession of a permit to breed, keep, hunt, catch, sell or export a live Lion or part thereof (Williams et al. 2015a). There is no known illegal trade in Lion in Gauteng, KwaZulu-Natal or the Eastern Cape and illegal utilisation of Lion within South Africa's national parks is negligible. Illegal trade in captive-bred Lions within North West Province is suspected to take place, as this province has the most facilities and is quite difficult to regulate. There are no reported records of illegal hunting of Lions in the Northern Cape. Any illegal hunting or trade in wild Lions is only likely to occur along the border between the Northern Cape and Botswana between Askham in the west and McCarthy's Rest in the east, a stretch of approximately 200 km, while Lions do also enter into the North West Province across the Molopo River (Power 2014).

Lions are used for traditional medicine and various trade studies conducted in Gauteng and KwaZulu-Natal urban traditional medicine markets have documented their body parts (usually bones and 'fat') for sale, but the quantities are small and the incidences sporadic (Whiting et al. 2011; Williams et al. 2015a). The expansion of human settlements on the western boundary of the KNP in Mpumalanga has been cited as a reason for the recent increase in Lion poaching for African traditional medicine (CITES Scientific Authority South Africa 2013), but these incidences too are sporadic. There have been anecdotal reports, however, that traditional healers living in areas adjacent to KNP acquire Lion body parts from healers working for SANParks – especially when dead animals become available (Williams et al. 2015a).

Overall, the private sector has been positive for the wild population. Some Lions have been removed from KTP to stock small reserves (for example, 6 in 2003 for Addo Elephant National Park), but this was not detrimental to the population. No Lions have been moved from KNP to small reserves. New reserves currently source their Lions from within the metapopulation. Some excess Lions from the metapopulation have ended up in captive facilities, but not vice versa. Thus, the system is self-contained and there is little leakage between the captive-bred, metapopulation and wild populations. The exception is the Mapungubwe area subpopulation where Lions get through the fences and onto managed properties (where legal hunting occurs) and are free-roaming on farmland (where they are occasionally killed by farmers) and cross international borders. There have not been extensive studies on whether this has any impact on the overall subpopulation in that area. The private sector too has greatly increased the commercial value of this species through trophy hunting. However, Lions are being increasingly reared in captivity for captive-bred hunting (*sensu* canned hunting), which negates the conservation value of these subpopulations. The majority of private wildlife ranches that contain subpopulations of conservation value are those large private nature reserves or conservancies who use Lions as an ecotourism drawcard.

Threats

There are no major threats to Lions in the assessment region. However, human-wildlife conflict and associated persecution may threaten local subpopulations, especially in the Mapungubwe region, and along protected area edges (*sensu* Wittemyer et al. 2008). Conflict on the borders of the KNP is relatively minor. For example, over the past 11 years, *c*. 135 complaints relating to wild animals killing livestock in the Nsikazi district adjacent to KNP have been received by Mpumalanga Tourism and Parks Agency (G. Camacho unpubl. data). Similarly, the conservation authority in North West Province reported two Lions shot for killing cattle in 2009 and one female

Lion shot in 2011, but it was never confirmed if these were wild or escapees from a captive facility, though these occurrences are rare in this province (Power 2014). In Gauteng, there is limited human–Lion conflict, which is closely managed by the authorities of the Dinokeng Game Reserve. As all Lions in the Eastern Cape are kept in areas that are protected with adequate fencing, there have been no human-Lion conflicts reported nor any livestock killed by Lion.

Lions are also accidentally killed in snares laid by bushmeat poachers. Poaching, snaring and poisoning of Lions remain a threat to free-roaming Lions in the Limpopo and Mpumalanga provinces. According to the IUCN SSC African Lion Working Group, Lions are lured from KNP into Mozambique and also across the Crocodile River by farmers for trophy hunting purposes. The illegal killing of problem animals and the illegal hunting of Lion for their skins are thought to be minor threats in KwaZulu-Natal Province.

Disease has also been a threat to free-roaming Lion population, especially Bovine Tuberculosis in KNP and HiP. This is especially prevalent for inbred subpopulations (Trinkel et al. 2011), which is exacerbated by the fragmented and isolated nature of most subpopulations within the region. Bovine Tuberculosis is not spread within Lion subpopulations through intraspecific interactions, it can only be sustained in the population through infected prey, particularly buffalo (Maruping-Mzileni 2015). The high numbers of domestic and feral dogs and cats associated with the expanding human population bordering the western side of KNP also enhances the possibility of transmission of diseases such as canine distemper and rabies. Within KNP, Bovine Tuberculosis has not had any detectable impacts on the Lion population and disease threats within this national park are minimal (Ferreira & Funston 2010) and research demonstrates that infections of Bovine Tuberculosis and Feline Immunodeficiency Virus do not co-vary (Maas et al. 2012). Future threats to Lions in KwaZulu-Natal Province are speculated to be disease, primarily Bovine Tuberculosis and Canine Distemper Virus.

Although prey-base depletion and habitat loss is listed as a major threat to the global Lion population (Bauer et al. 2015), the expansion of small, private protected areas with high prey numbers has counteracted this threat on a local scale in South Africa (Miller et al. 2013). Conversely, artificially high Lion numbers negatively impact the abundance of other predators and need to be managed so as not to affect overall diversity.

The popular media emphasises the threat of trophy hunting on Lions in South Africa, but the overwhelming majority of trophy hunts are taken from the captive-bred population, which leaves the wild and free-roaming population largely unscathed (SANBI 2012). Lindsey et al.

Table 4. Threats to the Lion (*Panthera leo*) ranked in order of severity with corresponding evidence (based on IUCN threat categories, with regional context)

Rank	Threat description	Evidence in the scientific literature	Data quality	Scale of study	Current trend
1	*5.1.3 Persecution/Control*: indiscriminate killing to protect livestock.	-	Anecdotal	-	Stable, but minimal impact on overall population.
2	*2.1 Annual & Perennial Non-Timber Crops*, *2.3 Livestock Farming & Ranching* and *1.1 Housing & Urban Areas*: loss of habitat from agricultural and residential expansion. Current stresses *2.3.5 Inbreeding* and *2.1 Species Mortality*: inbreeding due to fragmented subpopulations and increased persecution rates.	Trinkel et al. 2011	Empirical	Local	Fragmentation: increasing with new reserves, but minimal in last 5 years. Inbreeding: potential to increase with more small reserves, but metapopulation plans are addressing this.
3	*8.1 Invasive Non-Native/Alien Species/ Diseases*: Bovine Tuberculosis and Feline Immunodeficiency Virus outbreaks / epidemics.	Ferreira & Funston 2010	Empirical	Local	Stable in Kruger National Park; controlled on small reserves.
		Trinkel et al. 2010	Empirical	Local	
		Trinkel et al. 2011	Empirical	Local	
		Maas et al. 2012	Empirical	Local	
4	*5.1.2 Hunting & Collecting Terrestrial Animals*: incidental mortality from snaring during bushmeat hunting.	-	Anecdotal	-	Increasing, but minimal impact on overall population.
5	*5.1.1 Hunting & Collecting Terrestrial Animals*: trade in Lion bones which are sourced predominantly from captive-bred population.	Williams et al. 2015a	Empirical	National	Increasing, but no discernible impact on wild population yet.

(2012) warn that if the captive-bred Lion industry were to become increasingly regulated, in part due to pressure from animal welfare activists, the demand for wild Lion trophies would increase and thus the management of wild Lions would need increased regulation, stricter penalties and greater enforcement. Thus, the captive-bred population effectively buffers the wild population and reduces the associated conservation costs (Lindsey et al. 2012). Similarly, while the trade in Lion bones to east–southeast Asia has been cited as a potential threat in South Africa, evidence suggests that the trade is not adversely impacting wild Lion subpopulations in South Africa because the skeletons are almost all a by-product of the sizeable trophy hunting industry, and Lions that are hunted in South Africa are almost exclusively captive-bred (Williams et al. 2015a). In addition to wild-hunting, there are few records of Lion poaching – especially at a level that could supply the sizeable bone trade (Williams et al. 2015a). There are concerns, however, that the trade in Lion bones to China and southeast Asia could stimulate demand for wild Lion bones and other felids (Lindsey et al. 2012), and thus this situation needs to be closely monitored (especially elsewhere in Africa where too little is known of the bone trade) and the assessment re-evaluated if new data become available that indicates that the bone trade is a threat to wild Lions within the assessment region.

Current habitat trend: Stable/increasing. The savannah biome is well protected and the current area of occupancy is expanding through private protected areas.

Conservation

While there are no pressing interventions necessary for large, formally protected areas, developing a management plan for reintroduced Lions on small reserves (< 1,000 km^2) is the primary conservation intervention (Miller et al. 2013). The Lion Management Forum (LiMF) was formed in 2010 to develop such management guidelines. LiMF bases its recommendations on the premise that managers should try to mimic natural processes that have broken down in reserves, using proactive rather than reactive methods. Specifically, managers should attempt to reduce Lion subpopulation growth and thus reduce the number of excess Lions in the metapopulation; disease threats should be reduced through vaccination whenever animals are translocated; and genetic integrity should be monitored throughout the metapopulation (Miller et al. 2013). As part of the metapopulation strategy, new sites for reintroduction should be identified. Founder groups to new areas should be as large and genetically diverse as possible (Trinkel et al. 2010). Research demonstrates that inbred Lions are more susceptible to Bovine Tuberculosis and that translocating outbred Lions into the area can mitigate losses (Trinkel et al. 2011). However, care must be taken not to introduce new diseases into subpopulations through translocation. An adaptive management framework is thus needed to implement the guidelines developed by LiMF on reserves across the country. Ongoing monitoring of subpopulation responses to the management actions should improve management of Lions on small reserves in South Africa. This approach will provide a template for evidence-based conservation management of other threatened carnivores.

The second most important conservation strategy for all Lions, both within small reserves and those within transfrontier parks or large national parks, is protected area expansion. Plans for expanding the protected area system are underway in a number of provinces. Through the development of privately owned nature reserves in Gauteng, it is hoped that available habitat will expand in the near future and the Lion population will increase. A process has been initiated in North West Province to identify critical biodiversity areas for the expansion of the protected area system, which will also possibly involve reintroductions of further free-roaming Lion subpopulations. Similarly, a Park Expansion Strategy is currently being implemented by the Mpumalanga Parks and Tourism Agency and as the area of available habitat

Table 5. Conservation interventions for the Lion (*Panthera leo*) ranked in order of effectiveness with corresponding evidence (based on IUCN action categories, with regional context)

Rank	Intervention description	Evidence in the scientific literature	Data quality	Scale of evidence	Demonstrated impact	Current conservation projects
1	*3.3.1 Reintroduction*: further translocation and reintroduction under a metapopulation plan to increase occupancy and reduce the effects of inbreeding.	Trinkel et al. 2011	Empirical	Local	> 30% of inbred Lions died from Bovine Tuberculosis or malnutrition compared with < 2% of the translocated Lions and their offspring.	Lion Management Forum
2	*1.1 Site/Area Protection*: protected area expansion, especially transfrontier areas, to increase subpopulation resilience.	Miller et al. 2013	Review	National	30% increase in Lion numbers over 10 years.	Lion Management Forum
3	*3.1.3 Limiting Population Growth*: sustaining Lion numbers at ecological densities.	Trinkel et al. 2010	Empirical	Local	Saturated subpopulations show lower growth rates.	Lion Management Forum
4	*3.2 Species Recovery*: pre-emptive vaccination prior to translocation/ reintroduction.	-	Anecdotal	-	-	Lion Management Forum
5	*2.1 Site/Area Management*: site-specific conflict mitigation measures, including the use of livestock guarding dogs.	Rust et al. 2013	Indirect	Local	Livestock depredation rates reduced.	-
		McManus et al. 2015	Indirect	Local		

for Lion is secured, reintroduction of Lion will be possible. There are currently four areas that could support healthy Lion populations in Mpumalanga, including the Loskop Dam Nature Reserve area, the Nkomazi Wilderness area, the Lydenburg/Burgersfort/Steelpoort area and the Andover area in the Lowveld. Although, in order to realize this, current development trends in these areas will need to be managed. While fencing has been shown to be effective in reducing conflict and increasing Lion subpopulation size (Packer et al. 2013), it also increases isolation, and thus, while small fenced reserves are necessary, continued transfrontier protected area expansion is necessary to create more resilient and self-sustaining subpopulations.

The use of livestock guarding dogs and improved livestock husbandry should be trialled in the Mapungubwe region to reduce conflict between the small free-roaming subpopulation and local communities (Marker et al. 2005). While various pilot projects have been established in Limpopo, North West, Northern and Western Cape provinces, little research has been done about their overall effectiveness within the assessment region, especially for Lions. Preliminary findings suggest that livestock guarding dogs can decrease depredation by 69% (McManus et al. 2015).

Recommendations for land managers and practitioners: The lack of a sound metapopulation management plan for these small reserves undermines the conservation value of the privately protected subpopulations and increases the risk of inbreeding (Björklund 2003). To redress this, the LiMF was established to draft a metapopulation management strategy for Lions (Miller et al. 2013). LiMF is run by independent individuals interested in Lion management on small reserves and has been very successful in providing a forum for managers, scientists and, more recently, government organisations, to discuss Lion management issues unique to small reserves. Landowners and interested stakeholders are encouraged to participate.

Similarly, the Department of Environmental Affairs has developed a Biodiversity Management Plan (BMP) for Lions in terms of the National Environmental Management: Biodiversity Act, 2004. The BMP is aimed at ensuring the long-term survival of the species in nature and will contribute towards the achievement of the recommendations of the Eastern and Southern African Lion Conservation Strategy (the regional conservation strategy compiled by the IUCN SSC Cat Specialist Group, 2006).

Research priorities:

- Comprehensive contraception study to test the efficacy and effects (physiological and behavioural) of chemical and surgical contraception of Lionesses to reduce growth rates on small reserves.
- Effects of Bovine Tuberculosis on tenure and male take over in Lions of KNP.
- Quantifying and monitoring the effects of Lion bone trade on the wild Lion population within the assessment region.
- Exploring interventions to reduce human–Lion conflict.

Encouraged citizen actions:

- Contribute to citizen science projects within protected areas (by reporting sightings locations and pride numbers), and report sighting data on virtual museum platforms (for example, iSpot and MammalMAP) outside of protected areas.
- Support protected areas and nature reserves over Lion parks or captive centres, as the latter institutions do not have conservation value for Lions (Hunter et al. 2013).

Data Sources and Quality

Table 6. Information and interpretation qualifiers for the Lion (*Panthera leo*) assessment

Data sources	Census (literature), field study (literature, unpublished)
Data quality (max)	Observed
Data quality (min)	Estimated
Uncertainty resolution	Total count, confidence intervals
Risk tolerance	Evidentiary

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Assessors and Reviewers

Susan Miller[1,2], Jason Riggio[3], Paul Funston[4], John Power[5], Vivienne Williams[6], Matthew F. Child[7]

[1]Tshwane University of Technology, [2]University of Pretoria, [3]University of California, Davis, [4]Panthera, [5]North West Provincial Government, [6]University of the Witwatersrand, [7]Endangered Wildlife Trust

Contributors

Matt W. Hayward[1], Sam Ferreira[2], Nkabeng Maruping[3], Gerrie Camacho[4], Michael Hoffmann[5]

[1]Bangor University, [2]South African National Parks, [3]Tshwane University of Technology, [4]Mpumalanga Parks and Tourism Board, [5]International Union for the Conservation of Nature

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