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PROPOSAL FOR THE INCLUSION OF THE LION (*Panthera leo*) IN CMS APPENDIX II

Summary

The Government of Kenya has submitted a proposal for the inclusion of the Asiatic lion (*Panthera leo persica*) in CMS Appendix I and the inclusion of all other subspecies of the lion (*Panthera leo*) in CMS Appendix II for the consideration of the 11th Meeting of the Conference of the Parties (COP11), 4-9 November 2014, Quito, Ecuador.

A revised proposal for the inclusion of the lion (*Panthera leo*) in CMS Appendix II was subsequently submitted by Kenya pursuant to Rule 11 of the COP Rules of Procedure.

The proposal is reproduced under this cover for a decision on its approval or rejection by the Conference of the Parties.

**PROPOSAL FOR INCLUSION OF SPECIES ON THE APPENDICES OF THE
CONVENTION ON THE CONSERVATION OF MIGRATORY SPECIES OF
WILD ANIMALS**

Panthera leo

**Proposal to add *Panthera leo*
in Appendix II**

This listing proposal is for the species *Panthera leo* in the sense of Wilson & Reeder (2005). It is thus for the species that migratory status under CMS must be argued, not for any of its constituents.

Article 1, paragraph 1, of the Convention states that

" For the purpose of this Convention:

a) "Migratory species" means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries". Thus it is enough for some populations within a species to be migratory under CMS criteria for the whole species to be (numerous examples in present Appendices). In the case of the Lion, the criteria happen to apply, as shown below, to all significant, diagnosable, components of the Wilson & Reeder species, but it is not a necessary condition.

The migratory status of a species under CMS is not affected when loss of range and local extinctions have led to the discontinuation of trans-border migrations (**4th CMS COP, Nairobi 1994**). It is thus on the historical range of a species that the criterion of "crossing one or more [present] national jurisdictional boundaries" must be evaluated. The Nairobi decision was taken following a discussion on *Oryx dammah*, then believed to be restricted to Chad [although it was probably already extinct in the wild]. It is however of general application and concerns, for instance, the Asiatic cheetah, now restricted to Iran, but formerly widespread, some of the equids in CMS appendices, the Mongolian Saiga etc.

Resolution 2.2 further affirms that

"In the interpretation of the term "migratory species" in Article 1, paragraph 1 (a):

(i) The word "cyclically" in the phrase "cyclically and predictably" relates to a cycle of any nature, such as astronomical (circadian, annual, etc.), life or climatic, and of any frequency;
(ii) The word "predictably" in the phrase "cyclically and predictably" implies that a phenomenon can be anticipated to recur in a given set of circumstances, though not necessarily regularly in time;"

In conclusion:

1. There is no doubt that *Panthera leo*, in the sense of Wilson & Reeder (2005), and all its evolutionarily significant constituents, including *Panthera leo persica* in the sense of Wilson & Reeder (2005), are migratory under CMS definitions.

2. Of these evolutionarily significant constituents, two *Panthera leo persica* and *Panthera leo senegalensis*, have a conservation status, that, if IUCN guidelines were followed, would require their listing in Appendix I rather than Appendix II. However, the Terrestrial Mammal Working Group of the CMS Scientific Council, making full use of Resolution 5.3, has already indicated that following the IUCN guidelines was not desirable for *Panthera leo senegalensis*. The Working Group saw no reason to take similar action for *Panthera leo persica*. Nevertheless, since the Working Group also indicated that the only motivation for listing the Lion was to focus Concerted Actions on its constituents (Central Eurasian CA for *persica*, Sahelo-Saharan CA for *leo*, new actions for *senegalensis* and the Eastern-Southern populations), and since, if the dispositions agreed upon at the ScC are adopted, Concerted Actions will now be extended to Appendix II species, the WG sees no objection, if this facilitates the debate, to simply listing the entire Wilson & Reeder species in Appendix II. This may have the advantage of not conveying the impression that the status of *senegalensis* is less preoccupying than that of *persica*, which is certainly not true.

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1. TAXONOMY, EVOLUTIONARY STATUS AND NOMENCLATURE

- 1.1 **Classis:** Mammalia
 1.2 **Ordo:** Carnivora
 1.3 **Familia:** Felidae
 1.4 **Genus and Species:** *Panthera Leo* (Linnaeus, 1758)
 1.5 **Common Names:** English – LION
 French – LION
 German – LION
 Italian – LEONE
 Spanish – - LEON

Treatment in WILSON & REEDER (2005)

Polytypic species, *Panthera leo* (Linnaeus, 1758), with 11 recognized subspecies.

Evolutionary status

The 11 subspecies recognized by Wozencraft (2005) form two major clades, one composed of Asian, North African, West African and central Sahelian populations, the other of Eastern and Southern African populations (Burger et al., 2004; Barnett et al., 2006a, 2006b; Barnett et al., 2007; Autunes et al., 2008; Barnett et al., 2009; Mazák, 2010; Bertola et al., 2011; Bruche et al., 2012; Dubach et al., 2013; Riggio et al., 2013); the first clade further divides into Asian (*P. l. persica*), North African (*P. l. leo*, extinct in the wild) and West-Central African (*P. l. senegalensis*) clusters. The four clusters are presently isolated from each one another and are genetically diagnosable (Barnett et al., 2006a,b; Autunes et al., 2008; Bertola et al., 2011; Dubach et al., 2013; Riggio et al., 2013). Taken together, *persica* and *leo* are morphologically diagnosable against all sub-Saharan populations in skull morphology (Barnett et al., 2006a, 2006b; Barnett et al., 2007; Mazák, 2010; Bertola et al., 2011; Dubach et al., 2013). The two northern taxa are themselves diagnosable against each other on perhaps somewhat more tenuous morphological characters (Pocock, 1930; O'Brien, Joslin et al., 1987; O'Brien, Martenson et al., 1987; Haas et al., 2005; Dubach et al., 2013).

Thus on currently available evidence, the *Panthera leo* s.l. complex is best divided into four phylogenetic species, as follows:

- *Panthera [leo] persica* (Linnaeus, 1758), monotypic, (EN), formerly distributed from south-eastern Europe, through Anatolia and the Near- and Middle-East to India, now restricted to the Gujarat peninsula.
- *Panthera [leo] leo* (Linnaeus, 1758), known as the Barbary lion, monotypic, formerly distributed throughout north Africa, north of the Sahara, now extinct in the wild. It appears to be more closely related to the Asiatic rather than sub-Saharan lions. A number of animals in captivity are likely to be Barbary lions, particularly the 90 animals descended from the Moroccan Royal collection at Rabat Zoo.
- *Panthera [leo] senegalensis* (von Meyer, 1826), known as the West African lion, monotypic, (CR), formerly distributed widely in West Africa and the central Sahelian belt, now restricted to mostly very small populations scattered throughout the former range, from Senegal to the Central African Republic.
- *Panthera [leo] melanochaita* (Smith, 1858), distributed in eastern and southern Africa, polytypic, (VU), with eight subspecies (*azandica*, *bleyenbeghi*, *hollisteri*, *kamptzi*, *krugeri*, *massaica*, *melanochaita*, *nyanzae*) recognized by Wozencraft (2005). One of these described subspecies, formerly occupying the Cape district (nominate *melanochaita*, syn. *capensis*) is extinct. *Panthera melanochaita* is likely to include several Evolutionarily

Significant Units, which do not necessarily correspond to the presently recognized subspecies.

2. Biological data

Species description

The lion is the second largest species of *Felidae* (the largest being the tiger *Panthera tigris*). Lions are typically a tawny colour with black on the backs of the ears, white on the abdomen and a black tuft at the end of the tail. Lions are the only members of the cat family to display obvious sexual dimorphism, with males weighing between 20 and 27% more than females. On average an adult male weighs 188kg while an adult female weighs 126kg. Adult male lions have a distinctive mane around the head, neck and chest, however there is regional variation in the colour and development of the mane, from blond to black and from thick to patchy. Lions have sharp, retractile claws, a short neck and prominent whiskers.

Asian lions, despite recent shared ancestry (Dubach et al., 2013), tend to differ morphologically from those in North, West, and Central Africa. Characteristically, Asian lions have a longitudinal belly fold, less inflated auditory bullae, and more frequently divided infra-orbital foramina (Pocock, 1931).

Lions live for 10–14 years in the wild. Their primary habitats are savannah and grassland, although they can sometimes be found inhabiting bush and forest.

Lions are social. A lion pride includes related females, their offspring, and a small number of adult males. Lions have no fixed breeding season. Females give birth every 20 months if they raise their cubs to maturity, but the interval can be as few as 4-6 weeks if they lose their cubs. Gestation lasts 110 days, average litter size is 1-4 cubs, and the sex ratio at birth is 1:1.

Groups of female lions typically hunt together, preying mostly on large ungulates. Lions are apex predators and primarily nocturnal.

2.1 Distribution

Historical distribution:

Historically, lions were found across Africa, Europe, the Middle East and Southwest Asia, occurring in all habitat types, except very dry deserts and very wet forests (IUCN SSC Cat Specialist Group, 2006b) (Fig.2). Its range extended from the Cape of Good Hope to the Mediterranean, from Senegal to Somalia, and from Greece and Yemen to central India (Barnett et al., 2009). Range collapse from persecution by humans has been rapid and continual. Lions were extirpated from the Cape Region of South Africa in the mid-19th century, from Turkey, Syria, Tunisia, and Algeria by the end of the 19th century, and from Morocco, Pakistan, and Iran between 1922 and 1942 (Guggisberg, 1961).

Current distribution in Asia:

The Asiatic lion (*Panthera leo persica*) is now only represented by a single population found in and around the Gir Forest in the State of Gujarat, India (Nowell and Jackson, 1996; Bauer et al., 2012).

Current distribution in Africa:

In Africa, lions are mainly restricted to larger parks, reserves, and the remaining wilderness areas in savannas, covering no more than 20–25 % of the species historic distribution in the continent (IUCN SSC Cat Specialist Group, 2006b; Riggio et al., 2012, 2013; Bauer et al., 2012). The following distribution map is from Riggio et. (2013).

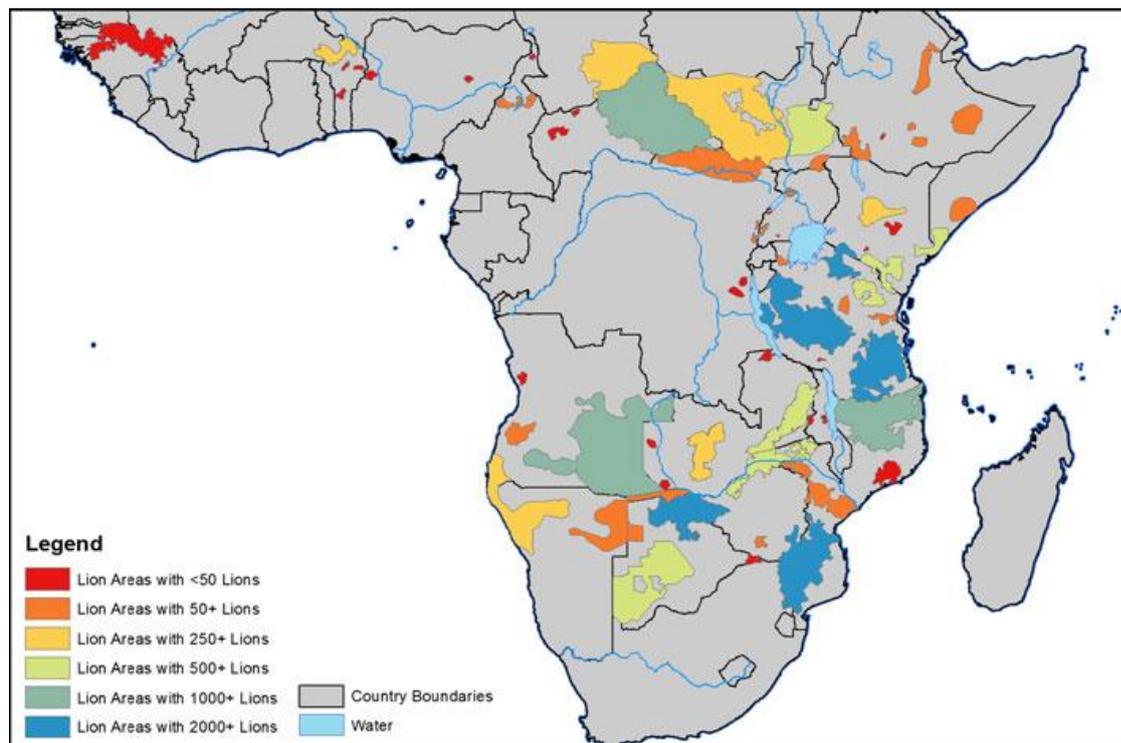


Fig. 1: Range Map (source: Riggio et al., 2013)

The definition of a lion stronghold, according to Riggio et al. (2012), is as follows:

- i) It must contain at least 500 individuals;
- ii) It must be within protected areas including hunting areas;
- iii) The lion population must be stable or increasing as assessed by the IUCN Cat Specialist Group (IUCN 2006, a,b).

Riggio et al. (2012) also described a potential lion stronghold as an area with at least 250 individuals but which does not satisfy either requirement ii or iii.

Using these criteria, Riggio et al. (2012) identified 10 lion strongholds. Among these, four are in East Africa and six in Southern Africa. In total these areas contain an estimated 24,000 lions. A further seven areas were identified as potential strongholds, with a total population of around 4,400 lions.

2.2 Population estimates and trends

In Africa:

African lions have undergone a severe decline in the past few decades. Numbers have dropped accordingly from a speculative number of 100,000 (Myers, 1975) at the turn of the 20th century to less than 40,000 today, and their numbers continue to fall. The most quantitative estimate of the historic size of the African lion population resulted from a modelling exercise based on experts' estimates, which predicted there were 75,800 African lions in 1980 (Ferrerias & Cousins, 1996).

The most recent overview of lion numbers and distribution for the African continent is Riggio et al. (2013) in which they estimate lion numbers at approximately 32,000. Note that Riggio et al. added only a few new estimates, their database was largely drawn from (IUCN 2006a,b), and those databases were in turn updates from Bauer and Van Der Merwe (2014) and Chardonnet (2002). By quoting the figures of Riggio et al. (2013) the estimates from the other references are thus selectively and implicitly included.

Panthera [leo] senegalensis: A study conducted by Henschel et al. (2010) across West and Central Africa, between 2006 and 2010, surveyed 15 Lion Conservation Units - areas of known or probable lion range - and found concrete evidence of lions in only two LCUs visited in West Africa, and none in Central Africa. As few as 450-1,300 lions may remain in West Africa, and 550-1,500 in Central Africa, with many populations declining or having disappeared altogether (Henschel et al., 2010; Henschel et al., 2014). *Panthera [leo] senegalensis* is now restricted to very small scattered populations and considered by experts to be critically endangered (Henschel et al., 2014).

Other areas elsewhere are also experiencing dramatic declines. For example, in Queen Elizabeth National Park, Uganda, a 50 percent decline has been reported over 10 years (Dricuru, as cited in Treves et al., 2009).

One can argue about the reliability, accuracy and comparability of various sources; academically it is difficult to assess the true extent of decline, but from the above it is clear that lions are in serious decline and merit conservation attention and action. African lions are currently classified by the IUCN as Vulnerable with a declining population trend (Bauer, Nowell, & Packer, 2008), based on a suspected reduction in population of approximately 30 percent over the past two decades (Bauer & van der Merwe, 2002; Bauer et al., 2008). There is a continuingly decreasing population trend (IUCN, 2013).

In Asia:

Panthera [leo] persica

The Asiatic lion exists as a single isolated population in India's Gujarat State, numbering approximately 175 mature individuals, all occurring within one subpopulation (but in four separate areas, three of which are outside of the Gir Forest protected area). Since the population now extends beyond the boundary of the lion sanctuary, and the numbers are stable, the subspecies is listed as Endangered based simply on the population size (none of the other criteria are met). The subpopulation was in fact increasing for a time but is now considered stable (IUCN Cats Red List Workshop, 2007). Constant monitoring is required to ensure poaching levels do not increase; 34 animals were reported killed in 2007 (Jackson, 2008). For more information see full *Panthera leo* species account. Current total population size is about 350 animals. It was increasing, but is now stable as has reached its expansion

limits and there are now increasing poaching incidents. At least 100 animals are outside the Gir Forest Protected Area. Total number of mature animals is about 175.

2.3 Habitat

In Africa:

Lions have broad habitat tolerance. They are absent only from tropical rainforest and the interior of the Sahara desert (Nowell and Jackson, 1996). Lions have been recorded at elevations of more than 4,000 m in the Bale Mountains and on Kilimanjaro (West and Packer, in press).

Lions can meet their moisture requirements from both prey and plants (e.g. the tsama melon in the Kalahari desert). Lions are therefore capable of surviving in very arid environments. Medium- to large-sized ungulates (including antelopes, zebra and wildebeest) are the bulk of their prey, but lions will take almost any animal, from rodents to a rhino. They also scavenge, displacing other predators (such as the spotted hyaena) from their kills.

In Asia:

The Gir is dry deciduous forest dominated by teak, the predominance of which is partially due to the silvicultural practices of the Gujarat State Forest Department, which permits logging and replants clear-cut areas with teak (Nowell and Jackson, 1996). The forest, which covered about 2,600 km² at the turn of the century, has since shrunk to less than half this size. Most of the remaining forest is included in the Gir National Park and Wildlife Sanctuary (Nowell and Jackson, 1996).

2.4 Migratory status of the Lion under CMS definitions

2.4.1 Migratory behavior

For large Felidae, the cycles concerned are predominantly the circadian cycles, the life cycles and the climatic cycles, more rarely the annual cycles. This was previously acknowledged at an ad hoc meeting of cat specialists held in the framework of the Rome COP meeting, in the decision to list the Cheetah in the appendices, and in the preparation of proposals for the Tiger and the Leopard.

Circadian cycle

Daily activities of Lions take place within a large home range. Pride home ranges vary between 25 and 200 km² in high prey-density areas, and can reach up to 2000 km² in low prey-density areas, notably in arid areas. Distances of up to 35 km, are travelled by individuals in one day in unproductive areas, in particular in the arid areas where the species has been studied (Mills et al., 1978; Sunquist and Sunquist, 2009; Tuqa et al., 2014). With such home ranges and daily movements Lions pertaining to trans-border populations, known to exist in all parts of the historical range, have to cross state boundaries as part of their circadian cycles. This is particularly, and observed where the species persists in trans-national areas such as the Kalahari, of the lions occupying very arid zones. These zones constitute a very substantial part of the historical range of the Asiatic Lion, of the extinct North African Lion and of the south-western and eastern populations of the Sub-Saharan Lion.

Annual Cycle

Predictable annual movements of fairly large amplitude are documented for some East-Southern African Lion populations in response to annual precipitation cycles (Tuqa et al., 2014) or the migrations of ungulates (Sunquist and Sunquist, 2009: 137). Such movements are highly likely to have also occurred within the range of the Asian lion, an area for which massive, long-distance migrations of ungulates is well documented in historical times, and where severe monsoon-controlled annual climate variation have existed throughout post-glacial times. .

Life-cycle

Large dispersal distances, usually of more than 100 km, have been recorded in all parts of the present range of the Lion (e.g. Stander, 2004; Divyabhanushin, 2004; VanderWaal et al., 2009; Sing & Gibson, 2011; Dubach et al. 2013). Dispersal is an essential element in the conservation of the species. It is evident that for populations that occupy trans-national ranges or even ranges that come close to borders, those vital dispersal movements will take place across national borders, if a continuity of habitat is preserved or restored.

2.4.2 Crossing of national boundaries

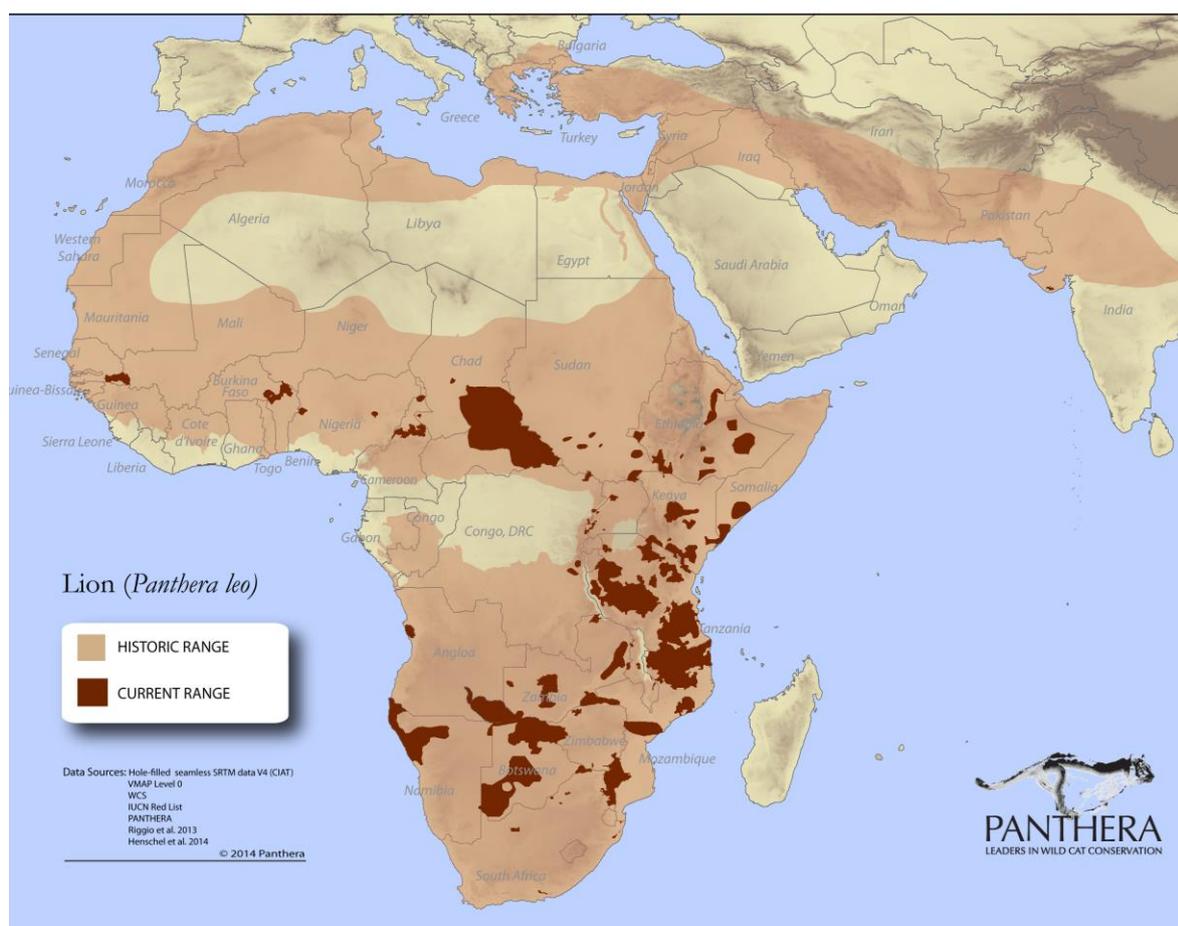


Fig 2 Historic and current range of the Lion (Panthera, 2014)

The historical range of the Lion (Fig 2) extended over numerous present-day national boundaries, with a continuity of habitats. It is thus certain that circadian cycle and life cycle movements occurred in all parts of the range, Asian, North African, West-Central African and East-Southern African. Annual cycle movements may have been limited to the Asian and East-Southern African parts of the range. Nowadays, clearly trans-national movements can only occur in the Sub-Saharan and, very locally, in the West-Central African part of the range. However, if the Asian lion is to be restored in parts of its original range, and if, a more remote possibility, but one that is nevertheless envisaged and advocated, is to be reintroduced in the wild, trans-border dispersal will be indispensable, within the Palaearctic range as well.

Given the above information, there is an urgent requirement for greater international recognition and protection of these cross-border populations. Lion populations believed to be currently connected across international boundaries include, loosely from South to North:

Botswana - South Africa

Mozambique – South Africa: Kruger NP and Limpopo NP (Chardonnet et al., 2009).

Mozambique – Zimbabwe: Gairezi Wildlife Management Area and Nyangui State Forest and Manica Province (Chardonnet et al., 2009).

Mozambique – Zimbabwe: Gonarezhou NP and Gaza Province (Chardonnet et al., 2009).

Angola - Namibia - Botswana: South Angola, Caprivi, Okavango

Mozambique – Zambia: all along the Zambia border with Tete Province (Chardonnet et al., 2009; Jacobson et al. 2013)

Malawi – Mozambique : between Liwonde National Park / Namizimu FR and Mangochi FR and Niassa Province (Mésochina et al., 2010 a, b).

Malawi – Zambia: (Mésochina et al., 2010b).

Mozambique - Tanzania: between Niassa National Reserve, Mozambique and southern Tanzania with protected linkages from Niassa Reserve to Selous Game Reserve, Tanzania through the Selous Niassa Wildlife Corridor (Mésochina et al., 2010a).

Tanzania – Zambia: suspected but not confirmed (Mésochina et al., 2010a)

Malawi - Tanzania (Mésochina et al., 2010a)

Rwanda -Tanzania: Akagera NP and Kimisi GR (Mésochina et al., 2010a).

Kenya – Tanzania: Tsavo NP and Mkomazi NP

Kenya - Tanzania: Serengeti Complex and Mara Complex (Frank et al., 2006a).

Ethiopia – South Sudan: Gambella NP (National Action Plan for the Conservation of the African lion in Ethiopia, 2010).

Ethiopia - Kenya: Northern East Kenya – South East Ethiopia (National Action Plan for the Conservation of the African lion in Ethiopia, 2010).

Cameroon-Nigeria: (Tumenta et al, 2009).

Cameroon – Chad: Yamoussa Transfrontier Reserve, includes Bouba Njidda and Sena Oura NPs

Chad – CAR: Salamat Hunting Areas in Chad; Bamingui-Bangoran NP and Manovo-Gounda-Saint Floris NP in CAR (Mésochina et al., 2010c)

CAR-South Sudan: Eastern CAR Hunting Areas in CAR and South Sudan NP in South Sudan (Mésochina et al., 2010c)

Benin – Burkina Faso - Niger: WAP Ecosystem (W-Arly-Pendjari)

Guinea - Senegal: Niokolo-Koba NP - Badiar NP (Sillero-Zubiri et al., 1997).

Guinea – Guinea Bissau: Boé area in Guinea Bissau and contiguous area in Guinea (Brugiere et al., 2005).

There is no doubt that *Panthera leo*, in the sense of Wilson & Reeder (2005), and all its evolutionarily significant constituents, including *Panthera leo persica* in the sense of Wilson & Reeder (2005), are migratory under CMS definitions.

3 Threat data

Asian lion (IUCN Red List): Endangered

African lion (IUCN Red list): Vulnerable A2abcd (ver 3.1)

West African lion (expert evaluation 2014): Critically endangered (Henschel et al., 2014)

3.1 Actual and potential threats

Africa:

Major direct threats to African lions include indiscriminate killing (including retaliatory killing and inadvertent snaring in bushmeat snares), disease, loss of prey base, habitat loss and degradation and trophy hunting (Bauer et al., 2013).

The main threats to Lions are indiscriminate killing (primarily as a result of retaliatory or pre-emptive killing to protect life and livestock) and prey base depletion. Habitat loss and conversion has led to a number of populations becoming small and isolated (Bauer 2008).

The most significant cause of these threats stem from the linked issues of human population growth and poverty. An expanding poor human population leads to increasing expansion of human settlement into lion habitat and the resultant growth of livestock and agricultural activities necessary to sustain people in both rural and urban areas (Ray et al., 2005). For lions, this results in habitat loss, population fragmentation, and reduction in the wild prey base. As human-lion contact increases, so does human-lion conflict, resulting in reductions in

lion numbers (through poisoning, trapping and shooting) and lack of support for lion conservation among local communities. It is therefore of concern that the human population of sub-Saharan Africa, which was 518 million in 1990, is predicted to rise to 1.75 billion people by 2050 (UN DESA, 2009).

Land degradation through desertification is predicted to lead to the loss of two-thirds of arable land in Africa by 2025 (Bied-Charreton, 2008), which will undoubtedly further increase competition between humans and African lions.

Livestock depredation and attacks on humans are a significant problem (Chardonnet et al., 2010). As a result, retaliatory killing, as a consequence of livestock losses and threat to human life, is common throughout all of sub-Saharan Africa (Frank et al., 2006; Bauer et al., 2010).

Trophy hunting is carried out in a number of sub-Saharan African countries and is considered an important management tool for providing financial resource for Lion conservation for both governments and local communities. However, there is concern that current management regimes can lead to unsustainable off takes (Packer *et al.* 2006). Recent analysis has shown that trophy hunting has likely contributed to the decline of lion populations in many areas (Packer et al., 2009).—Some authors such as Packer et al. (2009) state that trophy hunting has likely contributed to the decline of lion populations in several areas, while some others such as Chardonnet et al. (2010) or Lindsey et al. (2013) consider that Hunting Areas are critical lion ranges acting as buffer zones around National Parks and ecological corridors between National Parks.

A further threat to lions is armed conflict. Beyond its greater costs to people and their society and economy, in relation to lions and wildlife, conflict prevents tourism and enables wildlife poaching and illegal trade, exacerbated by the spread of firearms and anarchy. Civil unrest within sub-Saharan Africa degrades otherwise suitable lion habitat through the overharvesting of wildlife and vegetation (Dudley et al., 2002). Even once conflicts have stopped, the spread of weapons enhances the capacity of pastoralists to harass lions in retaliation and prevention of human-lion conflicts.

Asia:

The Asiatic lion currently exists as a single subpopulation, and is thus vulnerable to extinction from unpredictable events, such as an epidemic or large forest fire. There are indications of poaching incidents in recent years (there are reports that organised gangs have switched attention from tigers to these lions). There have also been a number of drowning incidents after lions fell into wells.

3.2 Exploitation

The trophy hunting of lions is contentious due to uncertainty concerning conservation impacts and because of highly polarised opinions about the practice. African lions are hunted across 27– 32% of the lion range in countries where trophy hunting of the species is permitted, and at least 16% of the total lion distribution in Africa (Lindsey *et al.*, 2013). Consequently, trophy hunting, if it is well regulated, it may have a rather positive impact; if poorly regulated, it has the potential to impart significant positive or negative impacts on lions. The fate of lions depends on how well user communities manage them and how well there are managed and protected in non-using areas, such as NPs.

Several studies have demonstrated that excessive trophy harvests have driven lion population declines. Problems include: unscientific bases for quota setting; excessive quotas and off-takes in some countries; fixed quotas which encourage over-harvesting; the fact that hunting companies are compelled to pre-pay these quotas; and the lack of restrictions on the age of lions that can be hunted. Reforms are needed to ensure sustainability and reduce conservation problems associated with the practice while allowing retention of associated financial incentives for conservation (Lindsey et al., 2013).

However, many authors, even some who are not in favour of hunting, underline the crucial importance of the officially gazetted Hunting Areas which are both very numerous across the lion range and very extensive in size, sometimes much larger than National Parks such as e.g. in Tanzania where Hunting Areas are 5.1 times larger than NPs (Mésochina et al., 2010a). These Hunting Areas (i) preserve natural ecosystems which are suitable lion habitats, (ii) conserve the whole biodiversity including the lion prey base, (iii) deter land conversion to other non-environment friendly land uses. Obviously, suppressing lion hunting would jeopardize Hunting Areas, thus ultimately the existence of lions there. The negative impact of hunting through the loss of a few male lions is greatly overtaken by the positive impact of hunting through conservation of large populations of lions in suitable habitats with thriving lion prey base.

3.3 Other threats

Illegal trade in lion cubs has been flagged as a locally important threat in some areas, especially remote zones in the Horn of Africa. It is essential that any trade complies with regional and international agreements such as CITES. The persistence of illegal cub trade is largely due to ineffective law enforcement, which results from a lack of knowledge, weak capacity and low motivation within law enforcement agencies (EWCA, 2012). Recently, a suspected lion bone trade has been regarded as a new possible threat.

4 **Protection status and needs**

In Africa:

Threats to lions in Africa are exacerbated by insufficient regulatory mechanisms throughout their range (IUCN SSC Cat Specialist Group, 2006a; IUCN SSC Cat Specialist Group, 2006b). Existing protection is inadequate to protect African lions from ongoing and rapid decline in population and range.

The long-term viability of many African lion populations is a significant cause for concern. Escalating rates of habitat loss, reduction in available prey-base, conflict with humans, incidental snaring in bushmeat snares, international trade of body parts and, in some part of the range, excessive pressure from trophy-hunting, have led to population reduction, fragmentation and loss. There is, therefore, an increasingly urgent need for tangible conservation actions and heightened levels of protection for African lions across their range.

Regional lion conservation and management plans should consider historic records that document lion range and movement patterns, emphasizing the protection or restoration of landscape connectivity between LCUs. Results from Dubach et al.'s (2013) study may serve

as guidelines in identifying and prioritizing potential movement corridors thereby maintaining naturally occurring genetic diversity

Panthera [leo] senegalensis : Considering the seriously depleted conservation status of the taxa, with no large population remaining, and lions absent from many of the region's national parks, Henschel and colleagues (2014) call for the mobilization of substantial and urgent investment by the international community to assist these countries in improving management effectiveness of PAs containing lions: “Lions persist in some of the largest and most intact protected landscapes in West Africa, where they co-occur with some of the last remaining populations of critically endangered mammals including Northwest African cheetahs, Western giant elands and African wild dogs. Further deterioration of those last wilderness areas in West Africa will likely cause the loss of genetically distinct populations of charismatic megafauna and further preclude already tenuous, potential future revenue streams from photographic tourism for West African nations. Without immediate action, we believe the opportunity to save both will be lost”.

Riggio and colleagues (2012) made the following conclusions and recommendations:

Independently verified census data, using statistically repeatable techniques are the rare exception, not the rule, across even relatively well-studied East and Southern Africa. The situation is particularly acute for Tanzania, which holds a large fraction of the world's lions.

Hunting areas are extensive, so the fate of lions depends on how well user communities manage them. The same principle applies to lions within protected areas, with responsibility falling on protected area managers to secure these populations. Finally, lions also occur well beyond protected areas, and how well one manages lion-human conflict will determine persistence there. Yet, conflict outside protected areas can affect lion persistence within (Woodroffe and Ginsberg, 1998). Good protection within a protected area is not sufficient if there is unrelenting killing of lions outside it.

Central Africa may have sizable lion and prey populations, but they are poorly known.

Repeated mapping of areas, which have at least the potential for lions because of their low human impacts may provide the only quantifiable measures of how savannah Africa is shrinking from the lion's viewpoint. This is necessary, but definitely not sufficient. The lack of repeated, statistically credible lion counts, for well-defined areas is a striking omission, one that must be rectified if we are to assess not only the trends in lion numbers, but our success in reversing their declines.

In Asia:

Establishment of at least one other wild population is advisable for population safety, for maximizing genetic diversity, and in terms of ecology (re-establishing the lion as a component of the fauna in its former range). However, there are problems in attempting this: a previous attempt to establish a second subpopulation in the Chandraprabha Wildlife Sanctuary in eastern Uttar Pradesh appeared to be succeeding, as the population grew from three to 11 animals, but then the lions disappeared, presumably shot or poisoned (Nowell and Jackson, 1996). Palpur-Kuno Wildlife Sanctuary in northern Madhya Pradesh has now been selected as the best candidate area. Communities will require resettlement to make room for

lions, but this time great care is being taken to make the process participatory and to attempt to satisfy local needs, and not engender hostility toward Lion conservation.

4.1 National protection status: to be completed by Range States

Angola: Protected
Benin:
Botswana:
Burkina Faso:
Cameroon:
Central African Republic:
Chad:
Congo, The Democratic Republic of the:
Côte d'Ivoire:
Ethiopia:
Ghana:
Guinea:
Guinea-Bissau:
India: Fully protected
Kenya:
Malawi:
Mali:
Mozambique:
Namibia:
Niger:
Nigeria:
Rwanda:
Senegal:
Somalia:
South Africa:
Sudan:
Swaziland:
Tanzania, United Republic of:
Uganda:
Zambia:
Zimbabwe:

4.2 International protection status

Lions drew international attention at the 13th meeting of the Conference of the Parties to CITES (CoP13) in October 2004. A Proposal to transfer the African lion to CITES Appendix I, thereby restricting commercial trade in lions, sparked extensive debate among African Range States, and highlighted the need to achieve pan-African consensus on the way forward for lion conservation.

The proposal was withdrawn, and Range States agreed that a series of regional lion conservation workshops should be held. IUCN - The World Conservation Union - was asked to organize workshops, which would bring together stakeholders to develop regional lion conservation strategies using a participatory approach based on a logical framework (IUCN, 2006a,b).

The IUCN conservation strategies have not been sufficiently implemented and have not led to a reversal of trends so far. The lion is therefore not off the CITES agenda. The CITES Animals Committee is currently performing a Periodic Review of African lions, to ascertain whether their current listing on CITES Appendix II is appropriate, or whether lions should be uplisted to Appendix I. Kenya and Namibia are jointly co-ordinating this process.

The US Government is currently reviewing a petition to list African lions as Endangered on the US Endangered Species Act (ESA). If the US Government adopts this Proposal, imports of lion trophies into the US will be severely restricted.

4.3 Additional protection needs

It has been argued that a landscape approach to lion conservation would benefit the long-term management of the species. However, others believe that physical separation between lions and human communities is the only sustainable long-term solution. Regardless of the approach adopted, the conservation of lions on a large-scale will require significant financial resources. For example, it has been estimated that a 10 – 100 fold increase in management budget could be needed to support areas that aren't yet fenced (Packer et al., 2013). Managing unfenced lion populations can be even more costly – with \$2,000 per km² per year required to maintain an unfenced population at 50% of its potential density (Packer et al., 2013).

Lion Conservation Action Plans have been or are being developed for the following countries:

- Senegal
- Benin
- WAP-ecosystem (Burkina Faso / Niger / Benin)
- Cameroon
- Ethiopia
- Kenya
- Tanzania
- Namibia
- Mozambique

5 **Range States**

In Africa:

Angola; Benin; Botswana; Burkina Faso; Cameroon; Central African Republic; Chad; Congo, The Democratic Republic of the; Côte d'Ivoire; Ethiopia; Ghana; Guinea; Guinea-Bissau; Kenya; Malawi; Mali; Mozambique; Namibia; Niger; Nigeria; Rwanda; Senegal; Somalia; South Africa; Sudan; Swaziland; Tanzania, United Republic of; Uganda; Zambia; Zimbabwe.

In Asia:

India, State of Gudjarat

6 **Comments from Range States**

7 **Additional Remarks**

8 References

- Antunes, A., J.L. Troyer, M.E. Roelke, J. Pecon-Slattery, C. Packer, Ch. Winterbach, H. Winterbach, G. Hemson, L. Frank, Ph. Stander, L. Siefert, M. Driciru, P.J. Funston, K.A. Alexander, K.C. Prager, G. Mills, D. Wildt, M. Bush, S.J. O'Brien, W.E. Johnson. 2008. The evolutionary dynamics of the lion *Panthera leo* revealed by host and viral population genomics. *Genomics*. *PLoS Genet* 4(11): e1000251. doi:10.1371/journal.pgen.1000251 (Editor: Arnaud Estoup, INRA, France).
- Baillie, J. and Groombridge, B. (compilers and editors) 1996. 1996 IUCN Red List of Threatened Animals. IUCN, Gland, Switzerland.
- Barnett, R., N. Yamaguchi, I. Barnes and A. Cooper. 2006. The origin, current diversity and future conservation of the modern lion (*Panthera leo*). *Proc. R. Soc. B* 273: 2119-2125
- Barnett, R., N. Yamaguchi, I. Barnes and A. Cooper. 2006. The origin, current diversity and future conservation of the modern lion (*Panthera leo*). *Proc. R. Soc. B* 273: 2119-2125.
- Barnett, R., N. Yamaguchi, I. Barnes and A. Cooper. 2006. Lost populations and preserving genetic diversity in the lion *Panthera leo*: Implications for its ex situ conservation. *Conservation Genetics* (2006). DOI 10.1007/s10592-005-9062-0.
- Barnett, R., N. Yamaguchi, B. Shapiro and V. Nijman. 2007. Using ancient DNA techniques to identify the origin of unprovenanced museum specimens, as illustrated by the identification of a 19th century lion from Amsterdam. *Contributions to Zoology* 76 (2): 87-94.
- Barnett, R., B. Shapiro, I. Barnes, S.Y.W. Ho, J. Burger, N. Yamaguchi, T.F.G. Higham, H.T. Wheeler, W. Rosendahl, A.V. Sher, M. Sotnikova, T. Kuznetsova, G.F. Baryshnikov, L.D. Martin, C.R. Harington, J.A. Burns and A. Cooper. 2009. Phylogeography of lions (*Panthera leo* ssp.) reveals three distinct taxa and a late Pleistocene reduction in genetic diversity. *Molecular Ecology* (2009) doi: 10.1111/j.1365-294X.2009.04134.x.
- Bauer, H. & de Iongh, H.H. (2005). Lion (*Panthera leo*) home ranges and livestock conflicts in Waza National Park, Cameroon. *African Journal of Ecology* 43: 208-214.
- Bauer, H., H.H. De Iongh, E. Sogbohossou (2010) Human lion conflict mitigation in West and Central Africa. *Mammalia* 74, 363-367.
- Bauer, H. & Van der Merwe, S. (2004) Inventory of free-ranging lions *Panthera leo* in Africa. *Oryx*, 38, 26–31.
- Bauer, H., Nowell, K. & Packer, C. 2012. *Panthera leo*. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1. <www.iucnredlist.org>. Downloaded on 03 October 2013.
- Bauer, H., Nowell, K. & Packer, C. 2013. *Panthera leo*. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.2. <www.iucnredlist.org>.
- Bied-Charreton, M. (2008). Integrating the combat against desertification and land degradation into negotiations on climate change: a winning strategy. November 2008. (www.csf-desertification.org).
- Bartosiewicz, L. 2009. A lion's share of attention: archaeozoology and the historical record. *Acta Archaeologica Academiae Scientiarum Hungaricae* 60: 275 - 289.
- Bertola, L.D., W.F. van Hooft, K. Vrieling, D.R. Uit de Weerd, D. S. York, H. Bauer, H.H.T. Prins, P.J. Funston, H.A. Udo de Haes, H. Leirs, W.A. van Haeringen, E. Sogbohossou, P.N. Tumenta and H.H. de Iongh. 2011. Genetic diversity, evolutionary history and implications for conservation of the lion (*Panthera leo*) in West and Central Africa. *J. Biogeogr.* 38, 1356–1367.
- Bruche, S., M. Gusset, S. Lippold, R. Barnett, K. Eulenberger, J. Junhold, C.A. Driscoll, M. Hofreiter. 2012. A genetically distinct lion (*Panthera leo*) population from Ethiopia. *Eur J Wildl Res.* DOI 10.1007/s10344-012-0668-5.
- Brugiere, D., Badjinca, I., Silva, C., Serra, A., Barry, M. (2005). Distribution and status of lion and leopards in Southern Guinea Bissau and Western Guinea, West Africa. *CATnews* 43 (Autumn), 14-18.
- Breitenmoser, U., Mallon, D.P., Ahmad Khan, J. & Driscoll, C. 2008. *Panthera leo* ssp. *persica*. The IUCN Red List of Threatened Species. Version 2014.2. <www.iucnredlist.org>.
- Burger, J, W. Rosendahl, O. Loreille, H. Hemmer, T. Eriksson, A. Götherström, J. Hiller, M.J. Collins, T. Wess and K.W. Alta. 2004. Molecular phylogeny of the extinct cave lion *Panthera leo spelaea*. *Molecular Phylogenetics and Evolution* 30: 841–849.

- Chardonnet, P., Mésochina, P., Cyril-Renaud, P., Bento, C., Conjo, D., Fusari, Begg, C., A., Foloma, M., Pariela, F. (2009). Conservation status of the lion (*Panthera leo* Linnaeus, 1758) in Mozambique. DNAC/MITUR, Maputo.
- Chardonnet, P., Soto, B., Fritz, H., Crossmary, W., Drouet-Hoguet, N., Mesochina, P., Lamarque, F. (2010). *Managing the conflicts between people and lion: Review and insights from the literature and field experience* (Wildlife Management Working Paper 13). Rome, Italy: Food and Agriculture Organization of the United Nations.
- Corbet, G. B. 1978. The mammals of the Palaearctic region: A taxonomic review. London, British Museum (Natural History).
- de Queiroz, K. 2005. A unified species concept and its consequences for the future of taxonomy. *Proceedings of the California Academy of Sciences* 56 (suppl. 1) (18): 196-215.
- Divyabhanusinh. 2004. The story of Asia's lions. Mumbai, Marg publications.
- Driscoll, C.A. M. Menotti-Raymond, G. Nelson, *et al.* 2002. Genomic microsatellites as evolutionary chronometers: A test in wild cats. *Genome Res.* 12: 414-423.
- Dubach, J.M., Brigg, M.B., White, P.A., Ament, B.A., and Patterson B.D. (2013). Genetic perspectives on “Lion Conservation Units” in Eastern and Southern Africa. *Conservation Genetics*, 14(4). Pp 741-755.
- Dudley, J.P., Ginsberg, J.R., Plumptre, A.J., Hart, J.A. & Campos, L.C. (2002). Effects of war and civil strife on wildlife and wildlife habitats. *Conservation Biology*, 16(2), 319-329.
- Ellerman, J. R., and T. C. S. Morrison-Scott. 1951. Checklist of Palaearctic and Indian mammals 1758 to 1946. London, Trustees of the British Museum (Natural History).
- EWCA (2012) National Action Plan for the conservation of the African Lion *Panthera leo* in Ethiopia. Ethiopian Wildlife Conservation Authority, Addis Abeba.
- Frank, L., Hemson, G., Kushnir, H., & Packer, C. (2006). Lions, conflict and conservation in Eastern and Southern Africa. In *The Eastern and Southern African Lion Conservation Workshop*, 11–13.
- Groves, C. and P. Grubb. 2011. *Ungulate taxonomy*. Baltimore, John Hopkins University Press.
- Haas, S.K., V. Hayssen and P. R. Krausman. 2005. *Panthera leo*. *Mammalian Species* 762: 1–11 + 3 figs. (American Society of Mammalogists, 15 July 2005).
- Henschel, P., Azani, D., Burton, C., Malanda, G., Saidu, Y., Sam, M., Hunter, L. (2010). Lion status updates from five range countries in West and Central Africa. *CatNews* 52, Spring 2010, 34-39.
- Henschel P., De Iongh H., Lichtenfeld L., Pimm S. 2013. The size of savannah Africa: a lion's (*Panthera leo*) view. *Biodiversity and Conservation* 22, 17-35
- Henschel P, Coad L, Burton C, Chataigner B, Dunn A, et al. (2014) The Lion in West Africa Is Critically Endangered. *PLoS ONE* 9(1): e83500. doi:10.1371/journal.pone.0083500
- Hilton-Taylor, C. (compiler). 2000. 2000 IUCN Red List of Threatened Species. IUCN, Gland, Switzerland and Cambridge, UK.
- IUCN SSC Cat Specialist Group. (2006a). Regional conservation strategy for the lion *Panthera Leo* in Eastern and Southern Africa. Retrieved from <http://www.catsg.org>
- IUCN SSC Cat Specialist Group. (2006b). Conservation strategy for the lion in West and Central Africa. Retrieved from <http://www.catsg.org>
- IUCN. 2003. 2003 IUCN Red List of Threatened Species. www.iucnredlist.org. Downloaded on 18 November 2003.
- Jacobson, A., Cattau, M., Riggio, J., Petracca, L., Fedak, D. (2013) Distribution and abundance of lions in northwest tete Province, Mozambique. *Tropical Conservation Science* Vol.6 (1):87-107, 2013.
- Lindsey PA, Balme GA, Funston P, Henschel P, Hunter L, et al. (2013) The Trophy Hunting of African Lions: Scale, Current Management Practices and Factors Undermining Sustainability. *PLoS ONE* 8(9): e73808. Doi
- Mazák, J.H. 2010. Geographical variation and phylogenetics of modern lions based on craniometric data. *Journal of Zoology* 281, 3: 194-209, DOI: 10.1111/j.1469-7998.2010.00694.x.
- Mésochina, P., Mbangwa, O., Chardonnet, P., Moshia, R., Mtui, B., Drouet, N., ... Kissui, B. (2010). Conservation status of the lion (*Panthera leo* Linnaeus, 1758) in Tanzania. Paris, France: SCI Foundation, MNRT-WD, TAWISA & IGF Foundation.

- Mésochina, P., Sefu, L., Sichali, E., Chardonnet, P., Ngalande, J., Lipita, W. (2010). Conservation status of the lion (*Panthera leo* Linnaeus, 1758) in Malawi. Paris, France: SCI Foundation, DNPW & IGF Foundation.
- Mésochina, P. Mamang-Kanga J.B., Chardonnet, P., Mandjo, Y., Yaguémé, M. (2010). Statut de conservation du lion (*Panthera leo*) en République Centrafricaine. MEFCP, MDRA, Fondation IGF.
- Mills, M.G.L., P. Wolff, E.A.N. le Riche, I.J. Meyer. 1978. Some population characteristics of the Lion Panthera Leo in the Kalahari Gemsbok National Park. Koedoe 21: 163-171
- Nowel, K. & P. Jackson. 1996. Wild Cats: Status Survey and Conservation Action Plan. Gland, IUCN.
- Packer, C., Kosmala, M., Cooley, H.S., Brink, H., Pintea, L., Garshelis, D., ... Nowel, K. (2009). Sport hunting, predator control and conservation of large carnivores. *Plos One*, 4(6), e5491.
- Panthera, 2014. Lion Current and Historic Range
- Parliamentary Office of Science and Technology. Postnote. (2005). *The bushmeat trade, February 2005, number 236*. Millbank, London.
- Patterson, B.D. 2007. On the nature and significance of variability in lions (*Panthera leo*). *Evol Biol* 34:55–60, DOI 10.1007/s11692-007-9003-6.
- Ray, J.C., Hunter, L. & Zigouris, J. (2005). Setting Conservation and Research Priorities for Larger African Carnivores. WCS Working Paper No. 24. Wildlife Conservation Society, New York. http://www.carnivoreconservation.org/files/issues/wcs_working_paper_24.pdf
- Riggio, J., A. Jacobson, L. Dollar, H. Bauer, M. Becker, A. Dickman, P. Funston, R. Groom, P. Henschel, H. de Iongh, L. Lichtenfeld, S. Pimm (2013) The size of savannah Africa: a lion's (*Panthera leo*) view. *Biodiversity and Conservation* 22, 17-35
- Packer, C., S. Canney, A. Loveridge, S.T. Garnett, K.K. Zander, G. Balme, H. Bauer, C. Begg, K. Begg, S. Bhalla, R. Bonham, H. Brink, C. Burton, T.M. Caro, B. Clegg, S. Dloniak, L. Frank, P. Funston, R. Groom, B. Heath, T. Hill, L. Hunter, H. DeJonghe, D. Joubert, B. Kissui, W. Kocker, B. Leatham, P.A. Lindsey, S.D. MacLennan, T. MacNutt, K. Nicholls, B. Patterson, A. Plumptre, J. Salerno, R. Slotow, E. Sogbohossou, K. Stratford, C. Winterbach, H. Winterbach (2013) Conserving large carnivores: dollars and fence. *Ecology Letters*, online early view doi: 10.1111/ele.12091
- Pocock, R. I. 1930c. The lions of Asia. *Journal of the Bombay Natural History Society*, 34(3):638-665.
- Riggio, J., A. Jacobson, L. Dollar, H. Bauer, M. Becker, A. Dickman, P. Funston, R. Groom, P. Henschel, H. de Iongh, L. Lichtenfeld and S. Pimm. 2012. The size of savannah Africa: a lion's (*Panthera leo*) view. *Biodivers. Conserv.* DOI 10.1007/s10531-012-0381-4.
- Schnitzler, A.E. 2011. Past and present distribution of the North African-Asian lion subgroup: a review. *Mammal Review*(Mammal Society) 41, 3:220-243.
- Sillero-Zubiri, C., Di Silvestre, I., Marino, J., Massaly, S., Novelli, O. (1997). La distribution et l'état des carnivores dans le Niokolo-Badiar. Rapport No 17, Projet Niokolo Badiar, Communauté Europeene, Senegal. 27 pp.
- Singh, H.S. & L. Gibson. 2011. A conservation success story in the otherwise dire megafauna extinction crisis: The Asiatic lion (*Panthera leo persica*) of Gir forest Biological Conservation 144: 1753–1757
- Stander, P. 2004. Population ecology and distribution of lions in the Kunene and Erongo Regions, Namibia.
- Sunquist, M.E. and Sunquist, F.C. 2009. Family Felidae. Pp. 54-168 in Wilson, D.E. & R.A. Mittermeyer (editors). *Handbook of the mammals of the world. Vol. 1. Carnivores*. Barcelona, Lynx
- Tende, T., S. Bensch, U. Ottoson & B. Hansson. 2014. Dual phylogenetic origins of Nigerian lions (*Panthera leo*). *Ecology and Evolution* 4: 2668– 2674
- Treves, A., Plumptre, A.J., Hunter, L.T.B., & Ziwa, J. (2009). Identifying a potential lion *Panthera leo* stronghold in Queen Elizabeth National Park, Uganda, and Parc National Des Virunga, Democratic Republic of Congo. *Oryx*, 43(01), 60-66.
- Tumenta et al, 2009, Threat of rapid extermination of the lion in Waza NP, northern Cameroon. *African Journal of Ecology* 48: 888-894
- Tuqa, J.H., P. Funston, C. Musyokib, G.O. Ojwangh, N.N. Gichuki, H. Bauer, W. Tamisa, S. Dolrenry, M. Van't Zelfde, G.R. de Snoo & H.H. de Iongh. 2014. Impact of severe climate

- variability on lion home range and movement patterns in the Amboseli ecosystem, Kenya. *Global Ecology and Conservation* 2: 1–10
- UN DESA. (2009). *World population prospects: The 2008 revision population database*. Retrieved from <http://esa.un.org/unpp>
- VanderWaal, K. L., A. Mosser & C. Packer. 2009. Optimal group size, dispersal decisions and postdispersal relationships in female African lions. *Animal Behaviour* 77: 949–954
- Wilson, D.E. & D.M. Reeder (editors). 2005. *Mammal species of the world. A taxonomic and geographic reference* (3rd ed.). Baltimore, Johns Hopkins University Press.
- Wozencraft, W.C. 2005. Order Carnivora. Pp. 532-628 *in* Wilson, D.E. & D.M. Reeder (editors). 2005. *Mammal species of the world. A taxonomic and geographic reference* (3rd ed.). Baltimore, Johns Hopkins University Press