

July 31, 2013

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Re: Comments to the US Fish and Wildlife Service to Follow Up on the African Lion Workshop on 26 June 2013.

## INTRODUCTION

Safari Club International Foundation (SCIF) thanks the Fish and Wildlife Service (the Service) for inviting them to participate in the June 26, 2012 workshop (the Workshop) on the conservation status of the African lion (*Panthera leo leo*). The workshop was held as part of the status review that the Service is conducting in response to the March 2011 “Petition to List the African Lion (*Panthera leo leo*) as Endangered Pursuant to the U.S. Endangered Species Act” (the Petition) submitted by five animal rights organizations. The workshop was designed to ensure that the Service has before it the best scientific and commercial information available to support a listing decision. In light of the information presented at the workshop and further research into some of the claims made by the petition, SCIF offers the following additional comments to the Service that challenge the petition’s claims and demonstrates that there is no scientific basis for an endangered finding.

Specifically, the following comments summarize some key discussion points and opinions of the three lion experts attending the Workshop. Using the Service’s explanation of “in danger of extinction”, the comments explain how the African lion does not fit into the Service’s own definition. Lastly, the paper explains why the petition’s arguments that the African lion is

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“on the brink of extinction” from 1) overutilization of the species for commercial, recreational, scientific, or educational purposes and an 2) inadequacy of existing protection are invalid.

## STATUS OF THE AFRICAN LION

The Petition portrays the African lion as being on the brink of extinction and claims the global population of African lion has experienced an alarming and precipitous decline over the past two decades. The Petition relies on information that is not scientifically robust to conclude that the global African lion population has demonstrated an alarming and precipitous decline. The Petition not only incorrectly references sources of information to support this claim, but it compares poorly developed historical lion population estimates to more current estimates to calculate rate of decline. In addition, three of the world’s leading lion experts attending the Workshop portrayed the status of the African lion much differently than the petition and do not agree that the lion is on the brink of extinction.

### A. Expert Opinions

The workshop featured presentations by three of the world’s leading experts on the conservation status of the African lion. Their comments brought the true status of the African lion into focus. Significantly, the experts were unanimous in their view that the lion is not “endangered,” which the Service has defined as being “currently on the brink of extinction in the wild.”

Dr. Paula White, who is the Director of the Zambia Lion Project, stated at the workshop that there is “no scientific support that the lion is on the brink of extinction.”

Jason Riggio discussed his recent study of the extent of lion habitat in Africa. The study concludes, among other things, that there are at least ten lion “strongholds” that “span eight countries, [and] contain roughly 19,000 lions in protected areas alone (more than 50% of the remaining lions in Africa), and over 24,000 lions in the entire lion areas as delineated.” A lion “stronghold,” explained Riggio, is an area that meets the “necessary requirements for long-term viability” of the lions living there. To qualify as a “stronghold,” an area must be: 1) a protected or hunting area; 2) with a population of at least 500 lions; and 3) the population must be either stable or increasing. According to his study, lions in these “strongholds,” are “likely to persist into the foreseeable future.”

Dr. Craig Packer of the University of Minnesota, when asked whether, in his professional opinion, the lion was on the brink of extinction, answered simply, “No.” Dr. Packer’s presentation clearly demonstrated key areas, such as Kruger National Park, where lions are secure. His presentation clearly demonstrated that diseases, such as canine distemper virus, feline immunodeficiency virus, and bovine tuberculosis are not a threat to lion populations, which refutes claims made in the Petition.

**B. Lack of Evidence in the Petition to Claim a Decline in the African Lion Population**

**1. Lack of Evidence to Claim 30-50% Decline**

The Petition characterizes the status of the African lion as vulnerable, based upon the ‘Red List’ classification by the International Union for the Conservation of Nature (IUCN). Specifically, the petition states “the most recent IUCN Red List analysis identifies the African lion population trend as ‘decreasing’ with a suspected population reduction of at least 30 percent

over the last 20 years (Bauer et al., 2008)” (p. 12). The provided citation, Bauer et al., 2008, is a reference to the IUCN website and not a primary source.

The IUCN website references a different publication by the same author, Bauer 2008, for the 30% population reduction statistic. However, this publication (“Synthesis of threats, distribution and status of the Lion from the two Lion Conservation Strategies” In: B. Croes, R. Buij, H. de Iongh and H. Bauer (eds), *Management and conservation of large carnivores in west and central Africa*, pp. 13-28. Institute of Environmental Sciences (CML), Leiden University, Leiden) is also not the primary source of this information. The Bauer 2008 publication states “the IUCN Red List classification (IUCN SSC Cat SG, 2004) speculatively proposes a suspected continental decline of 30-50% over two decades.”

The trail leading to the primary source of information ends when the IUCN SSC Cat SG 2004 reference cites the IUCN Red List website from 2004, which is an older version of the same website referenced by Bauer et al., 2008 and the Petition. This circular reference never reveals the primary source of information that estimated or discussed a 30-50% decline. Without a primary reference and justification, the Petition’s referenced publication and argument that lions have declined by 30% over twenty years have no scientific credibility.

## 2. The Comparison between Estimates is Based on an Untested Model

The Petition supports its argument that lion populations are declining precipitously by “comparing the 1980 estimate of 75,800 to the higher 2002 estimate of 39,000 lions (Chardonnet, 2002) [which] yields a suspected decline of 48.5 percent over 22 years (Bauer, et al. 2008)” (p. 12). The Bauer et al. 2008 reference does not make this determination; therefore,

the citation is incorrectly used. The Petition appears to be the source of the 48.5 percent statistic, which was calculated by comparing two separate population estimates almost 20 years apart that were derived from completely different methodologies. Trends and statistics should not be derived from such comparisons, especially when there is no understanding of precision in the estimates, such as standard error, standard deviations, or confidence intervals.

The 75,800 lion population estimate from 1980 resulted from a modeling exercise by Ferreras and Cousins 1996. The petition provides little explanation on the details about the Ferreras and Cousins estimate to validate its accuracy, possibly by design. The Ferreras and Cousins study was an early GIS exercise to attempt to quantify the number of African lions based upon habitat characteristics, while including factors that might influence the density of lions in a particular area. All modeling exercises are only as good as the data and information used to create it. Ferreras and Cousins used 37 published studies on 19 African lion populations inside National Parks. The 37 studies referenced were published between 1964 and 1996, which collectively reference lion population information from 1959 to 1993. More than 30 years of information was included in their model, which introduces high temporal variability, and is likely not representative of lion abundance in 1980 (For a full analysis of Ferreras and Cousins 1996 see Appendix 1).

In summary, the Petition incorrectly characterizes the status of the African lion. The petitioners makes assumptions by incorrectly and inaccurately citing references, and draws conclusions from unreliable information which could mislead the U.S. Fish and Wildlife Service into making an erroneous listing decision for the African lion. The Petition does not present substantial scientific and commercial information indicating that the African lion is on the brink

of extinction or that” the African lion warrants listing as “endangered” on the ESA. Furthermore, this information is not corroborated by lion experts working in the field; three of which agree that the African lion is not on the “brink of extinction.”

#### LISTING PRECEDENTS OF THE US FISH AND WILDLIFE SERVICE

Under the ESA, a species is “endangered” only if it “is in danger of extinction throughout all or a significant portion of its range.” The ESA, however, does not define what it means to be “in danger of extinction.” Accordingly, the Service has given meaning to that phrase through its species-specific listing decisions.

In 2008, the Service prepared, for use in the polar bear litigation, a “Supplemental Explanation” (Explanation) of “the meaning [it has given to] the statutory phrase ‘in danger of extinction.’” In the Explanation, the Service states that in all of its listing decisions is a general understanding that “in danger of extinction” means “currently on the brink of extinction in the wild,” but that there is “no single metric for determining if a species” is in that condition (Explanation, p. 3). Instead, the Service notes that the species “determined [by it] to be in danger of extinction...[have] generally fall[en] into [one of] four basic categories” (Explanation, p. 3). Each of those categories describes a condition which the Service has determined may be indicative of the fact that the species is “currently on the brink of extinction in the wild,” depending, of course, on “the life history and ecology of the [particular] species” under review, “the nature of the threats” that it is facing, and “the species’ response to those threats.” It is helpful to examine the status of the African lion with reference to each of those four categories.

#### Category 1

Category 1 consists of species that face a catastrophic threat from which the risk of extinction is imminent and certain. The Service considers a catastrophic threat to be an event or condition, natural or man-caused, that is both imminent and certain and that will result in the complete extinction of a species. In such situations, due to the severity, certainty, and imminence of the threat, other considerations are largely irrelevant. Neither the Petition nor any of the presentations at the workshop identified a catastrophic event that is imminent and certain and that would completely destroy the African lion. Therefore, the lion does not fall into Category 1.

#### Category 2

Category 2 consists of species that are narrowly restricted endemics that, as a result of their limited range or population size, are vulnerable to extinction from elevated threats. For purposes of this category, an endemic is a species that is rare in its natural state. For example, a category 2 species would be a species that in its natural state consists of a very small population and/or inhabits a very small range. Due to its rarity, or the restricted limit of its range, such a species can be vulnerable to extinction as a result of exposure to even a small increase or change in the nature of the threats it is facing.

The African lion in its natural state was not a narrowly restricted endemic. The Petition states that it “has been estimated that a million lions existed in Africa in pre-colonial times,” and that the lion “once lived throughout the African continent, except for the interior of the Sahara Desert and dense coastal and central rainforests” (p. 12, 15). Moreover, Riggio’s study shows that currently there are approximately 34,000 lions inhabiting 3.4 million square kilometers of a

range that spans 27 countries. Therefore, the African lion does not fall into Category 2 because it is not restricted to a very small range and does not have a limited population.

### Category 3

Category 3 consists of species that were formerly widespread in their distribution, but they have been reduced to such critically low numbers or restricted ranges that they are at a high risk of extinction due to threats that would not otherwise have imperiled the species. This category applies to species that were at one time quite abundant in their natural state across a large range, but that have been reduced to such small numbers, or such a limited range, that they now face a high risk of extinction from threats that would not normally have imperiled their existence in their former state. Put another way, this category applies to species that have become, in effect, “narrowly restricted endemics.” The Service describes the species that fall into this category as species that have “suffered [such] catastrophic range reductions and population crashes that ... their extinction seems all but certain,” or as species whose “distributions and populations have been so severely curtailed that on-going threats and chance events have resulted in them being currently on the brink of extinction” (Explanation, p. 5).

The Petition references “a suspected decline of 48.5 percent over 22 years” (p. 12). However, as shown in the previous section this is based on comparing population estimates that lack statistical precision with completely different methodologies over several decades. But, it also notes that “African lion experts have agreed” that there are still at least 23,000 (and perhaps as many as 39,000) African lions living in the wild, and that those lions inhabit a 4,500,000 square kilometer range spread across 27 countries (p. 11-12). Significantly, the Petition also states that there are at least 5,569 (and as many as 8,535) African lions living in population

groups that are both viable and that inhabit “mostly Protected Areas” (p. 13-14). Or, as the Petition puts it, “one-third of all lions on the Continent could be considered secure under present conservation measures.” Consequently, even on the face of the Petition, it is clear that the lion has not reached the point where it would fall into Category 3.

#### Category 4

Category 4 consists of species with relatively widespread distribution that have nevertheless suffered, or are suffering, major reductions in their numbers, range, or both, as a result of factors that have not been abated. This category applies to species that still inhabit a relatively wide range, and may still consist of a large population, but which have suffered such significant reductions in their numbers or range from conditions that still persist that it is likely that if those conditions go unchanged, the species will become extinct.

The Petition asserts that “the African lion has suffered a major reduction in population size across the continent” (p. 5) and the study by Riggio (2012) reaches a similar conclusion. But, the Petition then makes an assertion that is not supported by the best available science, or even by the petition itself. For example, that the “threats to the [lion] continue unabated.” The petition establishes that the principal threat to the survival of the African lion, which they claim is loss of habitat, has been and is being addressed through the creation and management of protected areas. By the Petition’s own estimate, “[b]ased on the number of African lions that are [living in populations large enough to be considered] viable and inhabiting mostly Protected Areas...about one-third of all lions on the Continent could be considered secure under present conservation measures” (p. 14). Moreover, Riggio 2012, which the petitioners endorsed at the workshop, and which was published after the listing Petition was filed, found that

“approximately 24,000 [not 5,569] lions are in strongholds,” which, are areas that meet Riggio’s criteria for insuring the long-term viability of the lions that inhabit them. This represents between 68% and 73% of the total lion population estimated by Riggio. This is not the profile of a species “on the brink of extinction.”

This is further confirmed by a comparison of a Category 4 species that was found to be “endangered” with the African lion. In its explanation, the Service cites the red-cockaded woodpecker as an example of a species that fell into Category 4. It notes that by the time the bird was listed, “the species had declined to fewer than 10,000 individuals in widely scattered, isolated, and declining populations,” and that its decline had been “caused by an almost complete loss of its primary...habitat,” which “resulted in the species being currently on the brink of extinction due to reproductive isolation, and demographic threats due to only small, isolated populations remaining” (Explanation, page 6). As noted above, unlike the red-cockaded woodpecker, the African lion is not living “in widely scattered, isolated, and declining populations” as a result of “an almost complete loss of its primary habitat.” Instead, more than half of the African lions are living in populations and in areas that meet the criteria for insuring their long-term viability.

Based on the opinions of the experts given at the workshop, the other evidence in the record, and the Service’s own precedents, it is now clear that a listing of the African lion is not warranted. Due to the ongoing efforts of many organizations, individual people, and governments, the lion, while facing several significant challenges, is not “endangered” as that term has been interpreted and applied by the Service under the Endangered Species Act.

### OVER-UTILIZATION OF THE AFRICAN LION

The Petition lists five main reasons that the African lion is “on the brink of extinction”. They put the most emphasis on the “over-utilization” of the lion, especially demonizing hunting as the main culprit of causing decline.

#### A. CITES Trade Database cannot be used to Determine Lion Harvest or Total Lions in Trade.

The Petition blames the decline of the African lion on overutilization, pointing to hunting and commercial use as the culprits. Specifically, the petition states “the African lion is clearly over-utilized” and supports this claim with data extracted from the World Conservation Monitoring Center trade database (UNEP-WCMC database), available through the CITES website.

The UNEP-WCMC database is the best available information on international wildlife trade and is utilized in many ways by the CITES Secretariat, the CITES Animals and Plants Committees, CITES Party countries, and the public. However, the database is subject to inaccuracies due to inconsistent use of coding in the trade of wildlife and plants. In some cases, the database is erroneous and does not provide an accurate representation of the number of wildlife or plants in trade.

For example, the UNEP-WCMC database provides an inaccurate number of total lions harvested or in trade in any given year. This is clearly shown when comparing lion harvest and trade data provided by the Tanzania Wildlife Division with the CITES-WCMC database. Table A68 (below) from the Petition gives the gross imports from Tanzania from all sources between 1999 and 2008. The Petition claims that a minimum of 2,186 lions were traded between 1999

and 2008. The Petition obtains this number by adding the gross exports of trophies (2083), skins (102) and live lions (1); which matches the information from the database (See Table A68).

Moreover, the Petition claims that a minimum of 2,131 wild lions in trade were hunted between 1999 and 2008. This number discounts live lions, captive bred lions, and duplicative items in trade (imports and re-exports) from the total lions in trade (2,186).

Table A68. International trade in lions and lion parts from Tanzania, all sources and purposes. (Source: Petition)

Term	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Totals
claws	1	15	0	0	0	0	0	0	0	0	16
hair	0	0	0	0	0	0	0	1	0	51	52
leather products	1	0	0	0	0	0	0	0	0	0	1
live	1	0	0	0	0	0	0	0	0	0	1
skins	32	28	13	6	2	7	3	11	0	0	102
skulls	35	23	10	6	1	6	5	9	0	0	95
specimens	0	0	0	0	84	43	992	1326	90	29	2564
teeth	12	0	0	0	0	0	0	0	0	0	12
trophies	272	317	230	228	216	141	210	223	108	138	2083
Grand Total	354	383	253	240	303	197	1210	1570	198	218	4926

Source: UNEP-WCMC CITES Trade Database searched by “gross imports” from “Tanzania”, all sources and purposes, on 21 July 2010.

In contrast, the Tanzania Wildlife Division reports that a total of 1,396 lions were hunted in Tanzania between 1999 and 2008 (Table 1). This shows a major discrepancy between the database and the Tanzanian Wildlife Division’s figures. The actual number of hunted lions in Tanzania is 36% lower than the claim made in the Petition and 33% lower than the number of trophies in trade reported by CITES between 1999 and 2008. Data in the CITES database cannot be used to determine numbers of lions harvested and misrepresents the total number of trophy hunted lions. This error is likely a result of a discrepancy in the number of animal parts in trade and the number of animals harvested.

**Table 1: Number of African lions hunted by year in Tanzania.**

Year	Number of lions
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	taken by Hunters
1999	104
2000	162
2001	88
2002	210
2003	173
2004	94
2005	128
2006	133
2007	146
2008	158
<b>TOTAL</b>	<b>1396</b>

Source: Tanzanian Wildlife Division

While this specific example is from Tanzania, it is not the only country where this disparity exists. The difference between what the UNEP-WCMC database reports and the actual number of lions taken by hunters can be in the thousands. It is recommended that the US Fish and Wildlife Service collect the total number of lions harvested directly from the Scientific and Management authorities of each range state to perform further analysis. This will give the USFWS a more valid number of lions that are removed each year.

**B. Recreational Hunting is done in a Sustainable Manner**

The Petition points to “recreational trophy hunting” as contributing to the decline of the African lion and supports this claim by using the UNEP-WCMC database. They show that from 1999 through 2008 7,090 lion specimens were traded for recreational trophy hunting. Using their formula for determining the number of lions (trophies, skins and live lions) they equate that to 5,663 lions being removed from wild populations. This would equate to an average of approximately 566 lions per year from all countries.

If we use the most recent lion population estimate from Riggio 2012, which estimates approximately 32,000 African lions currently, and a total harvest of 566 wild lions per year,

hunters are only removing 1.7% of the population annually. The majority of lions harvested are adult males, which do not contribute directly to recruitment of the species. Although lions, unlike other big cats, are social animals, females still have most of the burden for cub survival. Also, African lions have high reproductive rates, with an average of 3-4 cubs per litter, and can breed throughout their adult lives. 1.7% is not a significant total of the overall population of lions, and is sustainable based up on their biology.

#### ADEQUATE EXISTING REGULATORY MECHANISMS

##### A. Local Conservation Measures in place to Protect Lion Populations.

The petition fails to recognize that the African lion range states are invested in lion conservation. Lion range states continue to develop conservation and management strategies for African lions. Benin, Botswana, Ethiopia, Guinea, Kenya, Mozambique, Namibia, Nigeria, Senegal, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe all are conducting lion monitoring and research projects. Most of these governments have adopted regional and national level lion management plans; however, not all of these countries have the financial resources to fully implement their plans.

In Tanzania and most of southern Africa, the wildlife management authorities are improving their capacity to manage lion populations. The governments and their management authorities are making progress with the implementation of their management plans. However, the government funded conservation efforts would be impaired by a loss of revenue from U.S. hunters (11<sup>th</sup> Meeting of the African Wildlife Consultative Forum, 2012).

The lion range states and lion researchers are exploring new ways of managing lion populations. In some countries they are using an age-based harvest, where only males past their breeding prime can be removed from the population. This encourages breeding by younger males. Furthermore, most range states have management plans that have reporting and monitoring programs built in to ensure that lion populations remain viable.

The ESA requires the Service to take into account all conservation efforts that are being made to protect a species in conservation agreements, conservation plans, management plans, or similar documents developed by federal agencies, state and local governments, tribal governments, businesses, organizations, and individuals. Since many of the African lion range states have adopted conservation or management plans, the service should consider those before making a listing decision. Furthermore, many local programs have been put in place to aid in the conservation of the African lion. For example, in Kenya, Maasai warriors are trained to protect lions in the “Lion Guardian” program.

A. Legal and Legislative Polices

African lion range states have enacted a number of regulatory mechanisms that ensure the health of their lion population, as well as other wildlife species. For example, Tanzania has the Tanzania Wildlife Policy (2007), Wildlife Conservation Act (2009), Wildlife Conservation (Hunting Regulations) (2010), and the National Lion and Leopard Action Plan (TAWIRI 2009) that specify regulatory mechanisms. Specifically, the Tanzania Wildlife Policy’s (2007) main purpose is to be able to manage and utilize their wildlife sustainably while accounting for the needs of people. It also lays out regulatory mechanisms for the Wildlife Division to follow. Other range states have similar policies in place.

## CONCLUSION

In conclusion, the three experts, Dr. Paula White, John Riggio, and Dr. Craig Packer, at the workshop all had the same opinion on the status of the African lion; it is not on the “brink of extinction.” The status of the African lion, as characterized by the Petition makes assumptions by incorrectly and inaccurately citing references and draws conclusions from unreliable information. This information could mislead the US Fish and Wildlife Service to making an erroneous listing decision for the African lion. The Petition does not present substantial scientific and commercial information indicating that the African lion is “over-utilized” and is therefore, on the brink of extinction. Or that the African lion warrants listing as “endangered” under the ESA. Furthermore, based upon this evidence and the precedent set by the Service, there is no option but to find that the African lion is not “in danger of extinction” and not warranted for listing.

## References

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## APPENDIX 1

### The Basis for the 1980 Estimate is based on a Speculative Conclusions and Warrants Further Discussion.

The petition provides little detail on the Ferreras and Cousins estimate by saying “the most quantitative estimate of the recent historic size of the African lion population, which was based on a modeling exercise, predicted that there were 75,800 African lions in 1980 (Ferreras and Cousins, 1996; Bauer et al., 2008).” They never divulge the details of the Ferreras and Cousins study. The modeling exercise performed by Ferreras and Cousins warrants explanation and a closer examination of their methodology, as it provides speculative conclusions on lion population numbers as a function of lion habitat modeling. Moreover, their estimate is often used as a basis for the suspected decline in the African lion population. Continually, the petition does not recognize the speculative nature of this estimate, and instead, treats it as if it is fact.

Looking into the methods used by Ferreras and Cousins gives insight into what their abundance estimate, 75,800 African lions in 1980, represents. First, Ferreras and Cousins used the potential range map from Nowell and Jackson 1996 as a base for their modeling exercise (Nowell, K. and Jackson, P. 1996. *Wild cats: Status survey and conservation action plan*. IUCN Publications, Cambridge, UK, 382 pp.). *Wild cats: Status survey and conservation action plan* is a book that provides species accounts of all members of the Felidae family. Species accounts detail the general species description, behavior, biology and habitat requirements, while giving a map of the range of a species. These are common in biology. The “Habitat and Distribution” section within each species account provides “habitat preference and association” and the

“distribution is illustrated in range maps”. Each species distribution map shows a number of points that represent protected areas; this information was “gathered from a wide variety of sources” and may have excluded areas that are known to have the species.

Ferreras and Cousins combined Nowell and Jackson’s map with geo-referenced lion occurrences. They used 37 published studies on 19 African lion populations inside National Parks. The 37 studies referenced were published between 1964 and 1996, and reference information from 1959 to 1993. This means more than 30 years of information was included in their model, which introduces temporal variability, and is likely not representative of lion abundance in 1980.

The 37 studies vary in their stated purpose. Some studies used, like Stander 1991 (Stander, P.E. 1991 Demography of lions in the Etosha National Park, Namibia. *Madoqua* 18(1): 1-9), determined the abundance of lions within a specific area. Stander 1991 identified lions in Etosha National Park with specific features and by branding lions to track them over time. Stander’s study estimated the abundance of lions within the national park. Other studies used, like Packer, Scheel and Pusey 1990 (Packer, C., Scheel, D. and Pusey, A.E. (1990). Why lions form groups: food is not enough. *Am.Nat.* 136: 1-19), give no measure of lion abundance within an area and instead look at facets of lion behavior or prey availability. Particularly, Packer, Scheel and Pusey 1990 looks into lion pride dynamics and group hunting behaviors. They do not specifically reference lion abundance within the study area.

In addition to the geo-referenced map, Ferreras and Cousins used a model from Woodward et al. 1995 (Woodward, F. I., T. M. Smith, *and* W. R. Emanuel (1995), A global land primary productivity and phytogeography model, *Global Biogeochem. Cycles*, 9(4), 471–490) to

obtain a measure of potential vegetation at each geo-referenced point. Specifically, they used leaf area index (LAI). LAI is a dimensionless measure that characterizes plant canopies, while taking into account temperature and rainfall in an area. LAI is used to measure primary productivity; the amount of energy put into an ecosystem by plants, the primary producers. Ferreras and Cousins determined the LAI for each of the areas used in the 37 referenced studies and extrapolated to estimate LAI for the entire lion range.

Ferreras and Cousins combined their geo-referenced map of lion occurrence and LAI to build a relationship between primary productivity and African lion density. Using that relationship, they created a map to illustrate African lion abundance throughout the lion's range. Ferreras and Cousins made an assumption as to what the abundance of lions would be without the presence of human activity; 784,700 African lions. Essentially, through this modeling exercise Ferreras and Cousins extrapolated lion abundance throughout the African lions range as a function of "lion habitat" estimated by leaf area index.

While habitat is an important factor that will determine African lion abundance, there are other factors that influence density and abundance of animals. Ferreras and Cousins needed a way to refine their estimate of abundance. They used the Delphi Method which is a structured way of collecting and filtering information from a group of experts using a series of questionnaires (Adler and Ziglio 1996). Generally, this process is used for social issues where there is a lot of uncertainty. However, it will sometimes be used in ecology to get expert opinion to be used in further analysis. Ferreras and Cousins used the Delphi Method to get lion experts' opinions on the uncertainty of the distribution of the lion, information about undocumented populations, and factors that might be impacting populations outside of protected areas.

Participation was limited to experts who published primary literature on lions or synthesized abundance or distribution information. Using two rounds of questions they asked experts to rank the factors, in order of importance, that are impacting lions outside of protected areas. Ferreras and Cousins needed a way to quantify what was impacting lion densities throughout their range. They had 14 participants in the first round and 8 in the second. Through these two rounds of questions they determined four main categories to be factors that reduce lion densities; human population, cattle, distance from protected area, and an agricultural effect.

Using the opinions gathered Ferreras and Cousins quantified the impact of these factors on lion densities outside of the known populations in protected areas. Their map to illustrate abundance of African lions in 1980 now included “map layers” from the geo-referenced populations, the relationship between lions and LAI (habitat), and the derived factors that would reduce density. This gives a final population size of 75,800 lions in 1980, the average year of publication of their 37 studies.

Ferreras and Cousins study was a GIS exercise to attempt to quantify the number of African lions based upon habitat characteristics, while including factors that change the density of lions in a particular area. However, any model is only as good as the data and information used to create it. At the time of their study GIS technology was not as robust as it is now, and quantifying the experts’ opinions to show factors influencing lion densities holds little statistical significance. Furthermore, this modeling exercise was never validated with ground-truthing. Ferreras and Cousins state “validation of densities outside parks will be needed. The present distribution estimates...can provide a framework for prioritizing data collection”. They show the need for further study into the abundance of African lions through on the ground studies.

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