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Endangered and Threatened Wildlife and Plants; Listing the African Lion Subspecies as Threatened With a Rule Under Section 4(d) of the ESA; Proposed Rule

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–R9–ES–2012–0025; 450 003 0115]

RIN 1018–BA29

Endangered and Threatened Wildlife and Plants; Listing the African Lion Subspecies as Threatened With a Rule Under Section 4(d) of the ESA

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Proposed rule and 12-month finding.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), announce a proposed rule and a 12-month finding on a petition to list the African lion (*Panthera leo leo*) as endangered under the Endangered Species Act of 1973, as amended (Act). After review of the best available scientific and commercial information, we find that listing the subspecies *Panthera leo leo* as threatened is warranted, and we propose to list the subspecies as threatened. We are also proposing a rule under section 4(d) of the Act to provide for conservation measures for the African lion. To ensure that subsequent rulemaking resulting from this proposed rule is as accurate and effective as possible, we are soliciting information from the scientific community; other governmental agencies, including those within the range of the African lion; nongovernmental organizations; the public; and any other interested parties.

DATES: We will accept comments received or postmarked on or before January 27, 2015. We must receive requests for public hearings, in writing, at the address shown in **FOR FURTHER INFORMATION CONTACT** by December 15, 2014.

ADDRESSES: You may submit comments by one of the following methods:

(1) *Electronically:* Go to the Federal eRulemaking Portal: *http://www.regulations.gov.* In the Search field, enter FWS–R9–ES–2012–0025, which is the docket number for this rulemaking. Then, click the Search button. You may submit a comment by clicking on ''Comment Now!''

(2) *By hard copy:* Submit by U.S. mail or hand-delivery to: Public Comments Processing, Attn: FWS–R9–ES–2012–0025, Division of Policy and Directives Management; U.S. Fish and Wildlife Service; MS: BPHC, 5275 Leesburg Pike, Falls Church, VA 22041–3803.

FOR FURTHER INFORMATION CONTACT: Janine Van Norman, Chief, Branch of Foreign Species, Ecological Services, U.S. Fish and Wildlife Service, MS: ES, 5275 Leesburg Pike, Falls Church, VA 22041–3803; telephone, 703–358–2171; facsimile, 703–358–1735. If you use a telecommunications device for the deaf (TDD), call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Executive Summary

I. Purpose of the Regulatory Action

Under the Act, a species may warrant protection through listing if it is found to be an endangered or threatened species throughout all or a significant portion of its range. Under the Act, if a species is determined to be endangered or threatened we are required to publish in the **Federal Register** a proposed rule to list the species. The purpose of this proposed listing determination is to publish and seek comments on our 12-month finding on a petition to add the African lion to the list of threatened and endangered species.

II. Major Provision of the Regulatory Action

After review of the best available scientific and commercial information, we find that listing the African lion as threatened is warranted, and we announce a proposed rule to list the subspecies as threatened. We are also proposing a 4(d) rule to provide for conservation measures for the African lion.

III. Costs and Benefits

We have not analyzed the costs or benefits of this rulemaking action because the Act precludes consideration of such impacts on listing and delisting determinations. Instead, listing and delisting decisions are based solely on the best scientific and commercial information available regarding the status of the subject species.

Information Requested

Section 4(b)(1)(A) of the Act directs that determinations as to whether any species is an endangered or threatened species must be made solely on the basis of the best scientific and commercial data available. Therefore, we request comments or information from other concerned governmental agencies, the scientific community, industry, and any other interested parties concerning this proposed rule. We particularly seek comments concerning:

(1) The subspecies' biology, range, and population trends, including:

(a) Genetics and taxonomy;

(b) Historical and current range, including distribution;

(c) Historical and current population levels;

(d) Information pertaining to range countries' regulatory mechanisms, including specific laws and regulations pertaining to loss of habitat, loss of prey base, and human-lion conflict.

(e) Information pertaining to range countries' management plans, including information on management and implementation of hunting concessions, conservation measures in place for this subspecies and its habitat, community education and outreach programs that address lion conservation, revenue gained from trophy hunting and how it is allocated, and any information pertaining to long-term conservation of lions and their habitat and prey base; and

(f) Potential threats not already identified, such as extractive activities.

(2) The factors that are the basis for making a listing determination for a species or subspecies under section 4(a)(1) of the Act (16 U.S.C. 1531 *et seq.*), which are:

(A) The present or threatened destruction, modification, or curtailment of its habitat or range;

(B) Overutilization for commercial, recreational, scientific, or educational purposes;

(C) Disease or predation;

(D) The inadequacy of existing regulatory mechanisms; or

(E) Other natural or manmade factors affecting its continued existence.

(3) The potential effects of climate change on the subspecies and its habitat.

Please include sufficient information with your submission (such as scientific journal articles or other publications) to allow us to verify any scientific or commercial information you include. Submissions merely stating support for or opposition to the action under consideration without providing supporting information, although noted, will not be considered in making a determination.

We request that you send comments only by the methods described above in **ADDRESSES**. We will post all comments on *http://www.regulations.gov.* If you submit information via *http://www.regulations.gov,* your entire submission—including any personal identifying information—will be posted on the Web site. If your submission is made via a hardcopy that includes personal identifying information, you may request at the top of your document that we withhold this information from public review. However, we cannot

guarantee that we will be able to do so. Please include sufficient information with your comments to allow us to verify any scientific or commercial information you include.

Comments and materials we receive, as well as supporting documentation we used in preparing this proposed rule, will be available for public inspection on *http://www.regulations.gov,* or by appointment, during normal business hours, at the U.S. Fish and Wildlife Service, Ecological Services, Branch of Foreign Species (see **FOR FURTHER INFORMATION CONTACT**).

Public Hearing

At this time, we do not have a public hearing scheduled for this proposed rule. The main purpose of most public hearings is to obtain public testimony or comment. In most cases, it is sufficient to submit comments through the Federal eRulemaking Portal, described above in **ADDRESSES**. If you would like to request a public hearing for this proposed rule, you must submit your request, in writing, to the person listed in **FOR FURTHER INFORMATION CONTACT** by the date specified in **DATES**.

Peer Review

In accordance with our policy published on July 1, 1994 (59 FR 34270), we will solicit the expert opinions of at least three appropriate and independent specialists for peer review of this proposed rule. The purpose of such review is to ensure that decisions are based on scientifically sound data, assumptions, and analysis. We will send peer reviewers copies of this proposed rule immediately following publication in the **Federal Register**. We will invite peer reviewers to comment, during the public comment period, on the specific assumptions and conclusions regarding the proposed listing status of threatened for the African lion subspecies. We will summarize the opinions of these reviewers in the final decision document, and we will consider their input and any additional information we receive, as part of our process of making a final decision on the proposal.

Peer review is an important tool at our disposal to help evaluate the quality of the data and analyses we rely on in our decision making processes. The 1994 peer review policy commits us to soliciting the expert opinions of ''appropriate and independent specialists regarding pertinent scientific or commercial data and assumptions relating to taxonomy . . . for species under consideration for listing.'' The policy also requires that our final decision must document the opinions of all the independent peer reviewers, and that all information regarding peer review be included in the administrative record. All proposed listing rules must be peer reviewed according to this policy and to applicable standards under the Service's guidelines for implementing the Information Quality Act and the December 15, 2004, Office of Management and Budget Final Information Quality Bulletin for Peer Review.

Petition History and Previous Federal Action(s)

On March 1, 2011, we received a petition dated the same day from the International Fund for Animal Welfare, the Humane Society of the United States, Humane Society International, the Born Free Foundation/Born Free USA, Defenders of Wildlife, and the Fund for Animals requesting that the African lion subspecies be listed as endangered under the Act. The petition identified itself as such and included the information as required by 50 CFR 424.14(a). On November 27, 2012, we published a ''positive'' 90-day finding (77 FR 70727) indicating that we would initiate a status review of the African lion. This document consists of our proposed rule and our determination on the status review for the African lion and publishes our finding. Our status review may be obtained at *http://www.regulations.gov* under Docket No. FWS–R9–ES–2012–0025.

Conservation Status of the African Lion

U.S. Endangered Species Act

The African lion (*Panthera leo leo*) is currently not listed as either endangered or threatened under the Act, although the Asiatic lion (*Panthera leo persica*) has been listed as endangered since 1970 under the Act and its precursor, the Endangered Species Conservation Act of 1969.

International Union for the Conservation of Nature

In 2008, the International Union for the Conservation of Nature (IUCN) classified the African lion as vulnerable with a declining population trend, which means the species is considered to be facing a high risk of extinction in the wild (Bauer *et al.* 2008, unpaginated). This classification is based on a suspected reduction in its population of approximately 30 percent over the previous two decades (Bauer *et al.* 2008, unpaginated). Because the regional lion population in western Africa is isolated and estimated to number well below the IUCN endangered criterion level of 2,500 individuals, it is classified by the IUCN as regionally endangered (Bauer and Nowell 2004, entire). In the assessment for this classification, western Africa is defined as consisting of Benin, Burkina Faso, Cote d'Ivoire, Gambia (identified as ''Regionally Extinct'' (RE)), Ghana, Guinea, Guinea Bissau, Liberia (RE), Mali, Mauritania (RE), Niger, Nigeria, Senegal, Sierra Leone (RE), and Togo (Bauer and Nowell 2004, p. 35).

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

The African lion is listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES (see *http://www.cites.org*) is an international agreement through which member countries work together to protect against over-exploitation of animal and plant species found in international trade. Parties regulate and monitor international trade in CITES-listed species—that is, their import, export, and reexport, and introduction from the sea—through a system of permits and certificates. CITES lists species in one of three appendices—Appendix I, II, or III. Species such as the African lion that are listed in Appendix II of CITES may be commercially traded, subject to several restrictions. CITES Appendix II includes species that are less vulnerable to extinction than species listed in Appendix I, and ''although not necessarily now threatened with extinction, may become so unless trade in specimens of such species is subject to strict regulation in order to avoid utilization incompatible with their survival.'' The status of the African lion with respect to CITES and how it is affected by international trade is discussed in more detail below, in the section titled Import/Export of Lion Parts and Products.

Periodic Review Under CITES

In an attempt to increase CITES protections for the African lion, in 2004, Kenya submitted a proposal for consideration at the Thirteenth Meeting of the Conference of the Parties to CITES (CoP13) to change the listing of the African lion from Appendix II of CITES to Appendix I (CoP13 Prop. 6; *http://www.cites.org/eng/cop/13/prop/E13-P06.pdf*). An Appendix-I listing includes species threatened with extinction whose trade is permitted only under exceptional circumstances, which generally precludes commercial trade. The import of specimens (both live and dead, as well as parts and products) of an Appendix-I species generally

requires the issuance of both an import and export permit under CITES. Import permits are issued only if findings are made that the import would be for purposes that are not detrimental to the survival of the species in the wild and that the specimen will not be used for primarily commercial purposes. For live specimens, a finding must also be made that the recipient must be suitably equipped to house and care for the specimens (CITES Article III(3)). Export permits are issued only if findings are made that the specimen was legally acquired and the export is not detrimental to the survival of the species in the wild, and that a living specimen will be so prepared and shipped as to minimize the risk of injury, damage to health, or cruel treatment. (CITES Article III(2)).

Although Kenya had submitted its proposal to CoP13 for consideration, it withdrew its proposal due to the lack of regional consensus on the proposal. Furthermore, plans were under way at that time for convening a regional workshop on lion management in 2005, the results of which would be reported to the CITES Animals Committee (Animals Committee) (*http://www.cites.org/eng/cop/13/rep/E13-ComIRep13.pdf*).

Recognizing that lion workshops and other research had been completed, producing updated information on the conservation and status of this species, the Animals Committee, at its 25th Meeting (AC25) (Geneva, Switzerland, July 2011), agreed to include the African lion in the Periodic Review of Felidae [Decision 13.93 (Rev. CoP15)] (*http://www.cites.org/eng/dec/valid15/E15-Dec.pdf*) under the Animals Committee periodic review of the appendices. Kenya and Namibia offered to lead the review as a high priority with range country consultation (*http://www.cites.org/eng/com/ac/25/sum/E25-SumRec.pdf*). At CoP16 in March 2013, the Parties adopted a revised Decision [Decision 13.93 (Rev. CoP16); *http://www.cites.org/common/cop/16/sum/E-CoP16-Plen-06.pdf; http://www.cites.org/eng/dec/valid16/13_93_CoP16.php*], directing the Animals Committee to complete its Review of the Appendices for Felidae and to provide a report at CoP17 on the result of the review of all Felidae. Kenya and Namibia recently submitted a report of their work on the Periodic Review of the African lion for discussion at the 27th Meeting of the Animals Committee (AC27, Veracruz, Mexico, 28 April–3 May 2014) (CITES 2014a, entire). During discussion of this document at AC27, a representative of the IUCN informed the committee that the IUCN would be completing an updated Red List Assessment of the lion in 2015. In addition, she suggested potential nomenclature changes to lion subspecies (see Taxonomy). The Animals Committee took note of the upcoming Red List Assessment and requested Namibia and Kenya to incorporate this information into their Periodic Review and prepare a revised document for consideration at the 28th Meeting of the Animals Committee. Further, the Animals Committee made plans to continue seeking information from lion range states that had not yet responded to requests for information on the species. Finally, the Animals Committee took note of the recent information concerning changes in the nomenclature of lion subspecies and requested that the nomenclature expert of the Animals Committee review the information (CITES 2014b, p. 3).

Regions in Which African Lions Occur

The literature on African lion often includes reference to the following broad geographic regions: northern, western, central, southern, and eastern Africa. The boundaries of these regions vary somewhat among authors, based on the nature and result of the studies undertaken.

As reflected in the literature reviewed for this proposed rule, the lion conservation community generally works in the context of the regions of Africa as they are described in Table 1. The regions as described in Table 1 may vary somewhat from the descriptions of the regions that may be found in taxonomic and other research literature.

TABLE 1—DESCRIPTIONS OF THE DIFFERENT REGIONS OF AFRICA AS GENERALLY USED BY THE CONSERVATION COMMUNITY

[Information derived from Chardonnet 2012, IUCN 2006a and IUCN 2006b]

Regions	Countries
North of Saharan Desert:	
North Africa [1]	Algeria [1], Egypt [1], Libya [1], Morocco [1], Tunisia.[1]
Sub-Saharan Africa:	
Western Africa	Benin, Burkina Faso, Cote d'Ivoire [3], Gambia [1], Ghana [3], Guinea, Guinea-Bissau [3], Mali [3], Mauritania [1], Niger, Nigeria, Senegal, Sierra Leone [1], Togo.[2 3]
Central Africa	Cameroon, CAR, Chad, Congo, DRC, Gabon, Sudan/South Sudan.
Eastern Africa	Burundi [2], Djibouti [1], Eritrea [1], Ethiopia, Kenya, Rwanda, Somalia, Sudan/South Sudan, Tanzania, Uganda.
Southern Africa	Angola, Botswana, Lesotho [1], Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, Zimbabwe.

[1] Lions extirpated.
[2] Lions considered occasional or transient by Chardonnet 2002.
[3] Lions considered absent by Henschel *et al.* 2014.

Species Description

The lion is the second-largest extant cat species (second in size only to the tiger) and the largest carnivore in Africa. It has a broad geographical range, historically distributed throughout Africa (Ray *et al.* 2005, p. 67). As with other widely distributed large cats, there is considerable morphological variation within the species as a result of sexual selection, regional environmental adaptations, and gene flow (Mazak 2010, p. 194). These include, among others, variation in size, coat color and thickness, mane color and form, and skull characteristics (Mazak 2010, p. 194, citing several sources; Hollister 1917, in Dubach 2005, p. 15). They are described by CITES (2014, p. 3) as follows:

Characteristics include sharp, retractile claws, a short neck, a broad face with prominent whiskers, rounded ears and a muscular body. Lions are typically a tawny color with black on the backs of the ears and white on the abdomen and inner legs. Males usually have a mane around the head, neck and chest. Lions are sexually dimorphic, with males weighing about 20–27 percent more than females. Adult males, on average, weigh about 188 kg with the heaviest male

on record weighing 272 kg. Females are smaller, weighing, on average, 126 kg. The male body length, not including the tail, ranges from 1.7 m to 2.5 m with a tail from 0.9 m to 1 m (Nowell & Jackson, 1996).

Taxonomy

The lion (*Panthera leo*) was first described by Linnaeus (1758, in Haas *et al.* 2005, p. 1), who gave it the name *Felis leo.* It was later placed in the genus *Panthera* (Pocock 1930, in Haas *et al.* 2005, p. 1). Although the classification of the modern lion as *Panthera leo* is accepted within the scientific community, there is a lack of consensus regarding lion intraspecific taxonomy (Mazak 2010, p. 194; Barnett *et. al.* 2006b, p. 2,120).

Based on morphology, traditional classifications recognize anywhere from zero subspecies (classifying lions as one monotypic species) up to nine subspecies (Mazak 2010, p. 194, citing several sources). The most widely referenced of the morphology-based taxonomies is an eight-subspecies (six extant) classification provided by Hemmer (1974, in Nowell and Jackson 1996, p. 312; Barnett *et al.* 2006a, p. 507; Barnett *et al.* 2006b, p. 2,120), which is recognized by the Integrated Taxonomic Information System (ITIS) (ITIS 2013, *www.itis.gov,* accessed June 6, 2013). It divides the lion species into: *Panthera leo persica* (India); *P. l. leo,* commonly referred to as the Barbary lion (Morocco through Tunisia, extinct); *P. l. senegalensis* (West Africa east to the Central African Republic); *P. l. azandica* (northern Zaire); *P. l. bleyenberghi* (southern Zaire and presumably neighboring areas of Zambia and Angola); *P. l. nubica* (East Africa); *P. l. krugeri* (Kalahari region east to the Transvaal and Natal regions of South Africa), and *P. l. melanochaita,* also called the Cape lion (Cape region of South Africa, extinct) (Nowell and Jackson 1996, p. 312).

In 1987, O'Brien (1987a, entire; 1987b, entire) reported the first results of genetic studies conducted on lion samples from some, but not all, regions of the species' range using early genetic techniques. Results indicated that lions in India differed from lions in Africa, supporting a two-subspecies classification for extant lions: *P. leo leo* and *P. leo persica,* the African and Asian lion, respectively (Ellerman *et al.* 1953, Meester and Setzer 1971, O'Brien *et al.* 1987, in Dubach 2005, p. 16). According to Dubach (2005, p. 16), most taxonomic authorities recognize this two-subspecies taxonomy. This taxonomy is also recognized by the IUCN (Bauer *et al.* 2012, unpaginated) and, consequently, by several international organizations and governing bodies. As a result, this is the classification on which the conservation of the species is largely based. However, results of recent genetic research call into question this classification.

In recent years, several genetic studies have provided evidence of an evolutionary division within lions in Africa (see Barnett *et al.* 2014, p. 6; Dubach *et al.* 2013, p. 746; Bertola *et al.* 2011 (entire); Antunes *et al.* 2008 (entire); Barnett *et al.* 2006a, pp. 511–512). These studies include analysis of DNA samples from all major regions of the species' range, though some regions are represented by few samples. Results of analysis indicate that a major genetic subdivision among lions occurs in Africa, with lions in southern and eastern Africa being genetically distinct from and more genetically diverse than lions elsewhere (western and central western and central Africa and Asia). Evidence indicates that lions in western and central Africa (as well as now-extinct north African lions) are more closely related to lions in India than to lions in southern and eastern Africa (Barnett *et al.* 2014, pp. 4–8; Dubach *et al.* 2013, pp. 741, 746–747, 750–751; Bertola *et al.* 2011, entire). According to Dubach *et al.* (2013, p. 753) contemporary range collapse and fragmentation is too recent a phenomenon to explain the lower genetic variability in these regions. Rather, the low genetic diversity in and between western and central African lion populations suggests they have a shorter evolutionary history than the more genetically diverse lions in southern and eastern Africa (Bertola *et al.* 2011, p. 1362). Several authors argue that the origin of these genetically distinct groups may be the result of regional extinctions and recolonizations during major climate (and consequently biome) fluctuations during the Pleistocene Epoch (Barnett *et al.* 2014, pp. 5–8; Bertola *et al.* 2011, pp. 1,362–1,364).

These genetic studies on lion are based primarily on analysis of mitochondrial DNA (mtDNA), which is inherited only from the mother. Because lions display sex-biased dispersal, in which males leave their natal range and females tend to remain in their natal range, one would expect gene flow in females to be lower than in males, resulting in greater geographic differentiation in females (Mazak 2010, p. 204). Consequently, some authors state that results of mtDNA analyses should be backed up by studies on nuclear DNA (nDNA, inherited from both parents) and morphological traits before assigning taxonomic importance to them (Barnett *et al.* 2014, pp. 1, 8). Recently, Mazak (2010, entire) examined morphological characteristics of 255 skulls of wild lions and found considerable variation throughout the species' range, with variation being greater within populations than between them. However, according to Dubach *et al.* (2013, p. 742), the genetic distinction of lions in southern and eastern Africa from those elsewhere in the species' range is confirmed by results of studies by Antunes *et al.* (2008, entire) which, in addition to analysis of mtDNA, also included analysis of nDNA sequence and microsatellite variation.

The recent results of genetic research have renewed debate on lion taxonomy among the experts. For this reason, the IUCN Species Survival Commission Cat Specialist Group has commissioned a Cat Classification Task Force from among its expert members to determine a consensus taxonomy for the group. Until then, we conclude that the taxonomy of the species is currently unresolved. However, as required by the Act, we base this status review on the best available scientific and commercial information, which is the most recent taxonomy that is the most widely recognized by taxonomic experts: *P. leo leo* (Africa) and *P. leo persica* (India). Consequently, in this document we review the status of the petitioned entity, the African lion, *P. leo leo.*

Range

Historically, lions occupied most of the African continent except the West African coastal rainforest zone, the Congo Basin rainforest zone, and the inner Sahara Desert (Bauer 2003, in Ray *et al.* 2005, p. 67; IUCN 2006a, p. 10; IUCN 2006b, p. 10). Ray *et al.* (2005, p. 52) estimate lion historical range in Africa (at about 150 years prior to their study) to be roughly 22.2 million square kilometers (km^2), while IUCN (2006a, p. 12; 2006b, p. 13) estimates lion historical range in sub-Saharan Africa to be 19.3 million km^2 (Table 2). Depending on the study and methods used, the species' range is reported to currently cover between 3.0 million and 5.0 million km^2 (Table 2). The most recent range-wide study was based on a review of all of the most current available estimates of lion populations (up through 2012) (Riggio *et al,* p. 21), combined with satellite imagery of savannah habitat, and provided estimates of current lion range to be 3.4 million km^2 (Riggio *et al.* 2013, p. 26), or about 25 percent of the subspecies' historic range in savannah habitat. According to Chardonnet (2002, pp. 24–25), about half the range of the African lion falls within protected areas.

The African lion is now believed to be extirpated from between 75 and 83 percent of its former range (Table 2). The subspecies has been extirpated from all of its former range in northern Africa (Black *et al.* 2013, p. 1). In addition, according to IUCN (2006a,b; see Table 2), the species' range has declined by an estimated 91 percent in western Africa, 79 percent in central Africa, and 68 percent in eastern/southern Africa (Table 2), with lion occurrence unknown in an additional 38 percent of the historical range (Bauer *et al* 2008, p. 16). More recently, Henschel *et al.* (2014, p. 5) estimate the confirmed lion range in western Africa, based on data collected between 2006 and 2012, to be 49,000 km^2, or an estimated 1.1 percent of the species' former range in the region.

TABLE 2—ESTIMATES OF THE AFRICAN LION RANGE

Source	Region of Africa	Historic range (km^2)	Current range (km^2)	Current range as percent of historic range (percent of historic range w/unknown lion presence)
Ray *et al.* 2005:	Continent-wide	22,200,000	3,800,000	17 percent.
Chardonnet 2002:	Western	.....	121,980	
	Central	.....	651,970	
	Eastern	.....	1,137,205	
	Southern	.....	1,039,212	
	Total	.....	2,950,367	
IUCN 2006a, b: [1]	Western	3,814,576	331,749	9 percent.
	Central	3,392,241	715,482	21 percent.
	Western + Central	7,206,817	1,047,231	15 percent.
	Southern + Eastern	12,080,000	3,915,000	32 percent.
	Total	19,286,817	4,962,231	26 percent.
Bauer *et al.* 2008: [1 thnsp;2]	Western + Central	7,206,817	1,047,231	15 percent. (0 percent).
	Southern + Eastern	13,010,000	3,564,000	23 percent. (58 percent).
	Total	20,216,817	4,611,231	22 percent. (38 percent).
Riggio 2013 [3] (based on estimates of savannah habitat):.	Western	.....	133,784	
	Central		936,465	
	Eastern	.....	780,401	
	Southern	.....	1,540,171	
	Total	13,500,000	3,390,821	25 percent.
Henschel *et al.* 2014:	Western	.....	49,000	1 percent.

The historical range of the African lion included most current continental African countries (Chardonnet 2002, pp. 25–28). Currently, the subspecies occurs only in sub-Saharan Africa. Within this region, Chardonnet (2002, p. 27) described lions as present in 34 range states (35 with South Sudan, which gained its independence as a country in July 2011) and recently extirpated from 6 range countries (Chardonnet 2002, p. 27) (Table 1). The 34 sub-Saharan African range countries in which Chardonnet considered lions present included 10 in western Africa. More recently, during surveys of 21 large protected areas in western Africa, Henschel *et al.* (2014, p. 4) considered lions to be absent from protected areas in 5 of these 10 countries (Table 1).

Distribution and Abundance

The general distribution of lions in Africa is summarized by Ray *et al.* (2005, p. 67) as follows:

> Lions formerly occupied most of the African continent except for equatorial forest and the inner-Sahara. Today, they are extinct in North Africa and have undergone dramatic range retraction at the limits of their historical distribution. Currently, lions are restricted mainly to protected areas and surrounding conservancies or 'game management areas,' with the largest populations in East and southern Africa. Where protection is poor, particularly outside protected areas, range loss or population decreases can be significant. Declines have been most severe in West and Central Africa, with only small, isolated populations scattered chiefly through the Sahel. Lions in the region are declining in some protected areas and, with the exception of southern Chad and northern Central African Republic, are virtually absent from unprotected areas (Bauer 2003).

Estimates of lion abundance on a large geographical scale are few in number. For a variety of reasons—including low densities, large ranges, cryptic coloration, nocturnal and wary habits—lions are difficult to count (Bauer *et al.* 2005, p. 6; Riggio *et al.* 2013, p. 31). There are large areas of the species' range in which no data are available on lion occurrence or abundance (IUCN 2006b, pp. 12–13). Species experts recognize that estimating the size of the African lion population is an ambitious task, involving many uncertainties (IUCN 2012, p. 2). Estimates, particularly range-wide or broad region-wide estimates, tend to rely to a considerable extent on expert opinion or inference (Riggio *et al.* 2013, p. 21; Chardonnet 2002, p. 19). Consequently, there is a large degree of uncertainty in these estimates. In addition, to date all efforts to estimate the size of the African

[1] Current range includes occasional and probable range.

[2] Bauer *et al* (2008) provides a synthesis of the efforts from which the IUCN (2006a, b) estimates were generated, providing somewhat different numbers for southern and eastern Africa. Also, current range is range where lion occurrence is known, and in approximately 38 percent of historical range, the occurrence of lion is unknown.

[3] Riggio *et al.* (2013) calculate estimates for savannah habitat, defined as areas that receive between 300 and 1,500 mm of rain annually and which includes most of sub-Saharan Africa.

lion population have used different methods; the results of earlier estimates cannot be directly compared to those of later estimates to determine population trend. The earliest estimates of lion abundance in Africa were educated guesses made during the latter half of the 20th Century. Bauer *et al.* (2008, unpaginated) summarize the information as follows:

> There have been few efforts in the past to estimate the number of lions in Africa. Myers (1975) wrote, ''Since 1950, their [lion] numbers may well have been cut in half, perhaps to as low as 200,000 in all or even less.'' Later, Myers (1986) wrote, ''In light of evidence from all the main countries of its range, the lion has been undergoing decline in both range and numbers, often an accelerating decline, during the past two decades''. In the early 1990s, IUCN SSC Cat Specialist Group members made educated ''guesstimates'' of 30,000 to 100,000 for the African Lion population (Nowell and Jackson 1996).

Ferreras and Cousins (1996, entire) provided the first quantitatively derived estimate using a GIS-based model calibrated with information obtained from lion experts. Ferreras and Cousins predicted African lion abundance in 1980 to be 75,800. Later, four additional efforts—Chardonnet (2002), Bauer and Van Der Merwe (2004), IUCN (2006a, 2006b), and Riggio *et al.* 2013—estimated lion population sizes ranging from 23,000 to 40,000 (Table 3). Currently, about 90 percent of all African lions occur in southern and eastern Africa (Table 3). According to most studies, most African lions are in eastern Africa (Table 3). According to Riggio *et al.* (2013, p. 27), only nine countries contain resident populations of at least 1,000 free-ranging lions (Central African Republic, Kenya, Tanzania, Mozambique, Zambia, Zimbabwe, South Africa, Botswana, and possibly Angola). Approximately 40 percent of all lions are found in Tanzania (Riggio *et al.* 2013, p. 27). Only about 10 percent of all lions occur in western and central Africa (Table 3). According to the most recent survey effort, numbers in western Africa are extremely low. Henschel *et al.* (2014, p. 5) estimate that only 400 lions in the entire region, with most (about 350, or 88 percent) concentrated in a single population.

TABLE 3—ESTIMATES OF AFRICAN LION ABUNDANCE

[Rows may not tally due to rounding]

Source	Western Africa (percent of total)	Central Africa (percent of total)	Eastern Africa (percent of total)	Southern Africa (percent of total)	Total
Ferreras & Cousins 1996 (estimate for lion abundance in 1980).	.....	.....	.....	.....	75,800 (18,600 in protected areas).
Chardonnet 2002	1,163 (3 percent)	2,815 (7 percent)	15,744 (40 percent).	19,651 (50 percent).	39,373.
Bauer & Van Der Merwe 2004	850 (4 percent)	950 (4 percent)	11,000 (48 percent).	10,000 (44 percent).	23,000.
IUCN 2006[4] (as calculated by Riggio et al. 2013).	1,640 (5 percent)	2,410 (7 percent)	17,290 (52 percent).	11,820 (37 percent).	33,160.
Riggio 2013 (based on estimates of savannah habitat).	480 (1 percent)	2,419 (7 percent)	19,972 (57 percent).	12,036 (34 percent).	34,907.
Henschel *et al.* 2014	406 (n/a).				

In 2005–2006, in response to a growing concern that the African lion was in decline, IUCN and the Wildlife Conservation Society sponsored workshops to determine a lion conservation strategy. During these workshops, lion experts collectively assessed what they believed to be the then-current status of African lions based on a variety of information, including professional opinion. During the workshops, lion experts identified 86 African lion Conservation Units (LCUs). They defined LCUs as areas of known, occasional, or possible lion range that can be considered an ecological unit of importance for lion conservation (IUCN 2006a, p. 14; IUCN 2006b, p. 17). Of the 86 LCUs, 20 are in western and central Africa and 66 are in southern and eastern Africa (Table 4). Most (71 percent) have more than half their area under some form of legal protection (Bauer *et al.* 2008, p. 19). Few (16 percent) were estimated to contain large populations (Table 4). This was particularly the case for western and central Africa, where most (13, or 65 percent) of LCUs were estimated to contain fewer than 50 lions (Table 4). The majority of those with large populations were in southern and eastern Africa (Table 4). Only 23 of 86 LCUs (27 percent) were considered to contain viable populations, though more than half were thought to contain potentially viable populations (Table 4). Lion populations within 42 percent of the 86 LCUs were considered to be decreasing, whereas those in 9 percent were considered increasing. The remaining were considered stable or of unknown trend (Table 4).

TABLE 4—LION CONSERVATION UNITS (LCUS) AS IDENTIFIED AND CHARACTERIZED IN IUCN 2006a AND IUCN 2006b

Number of LCUs	Western & Central Africa	Eastern & Southern Africa	All regions (percent)
Total	20	66	86.
Estimated to contain:			
>500 lions	2	12	14 (16 percent).
50–500 lions	5	28	33 (38 percent).

[4] Estimates were made for individual Lion Conservation Units (defined management units), and were given as population size classes rather than specific figures. As calculated by Riggio *et al.* (2013, p. 27).

TABLE 4—LION CONSERVATION UNITS (LCUS) AS IDENTIFIED AND CHARACTERIZED IN IUCN 2006a AND IUCN 2006b—Continued

Number of LCUs	Western & Central Africa	Eastern & Southern Africa	All regions (percent)
<50 lions	13	26	39 (45 percent).
Considered:			
Viable	4	19	23 (27 percent).
Potentially Viable	12	34	46 (53 percent).
Doubtful Viability	4	13	17 (20 percent).
With Populations Considered to be:			
Increasing	3	5	8 (9 percent).
Stable	5	21	26 (30 percent).
Decreasing	12	24	36 (42 percent).
Unknown		16	16 (19 percent).

Riggio *et al.* (2013, entire) provide the most recent, most comprehensive estimates to date of free-ranging lion populations in Africa. They compiled all existing estimates of African lion populations since 2002, including data from Chardonnet (2002), Bauer and Van Der Merwe (2004), IUCN (2006a, 2006b), over 40 mainly country-specific reports, and their own experiences. They then combined these data with satellite imagery and information on habitat condition to estimate lion abundance and identify lion areas that they characterized as strongholds and potential strongholds. They conducted this within the context of savannah Africa, which they defined as areas that receive between 300 and 1,500 millimeters (mm) of rain annually, and within which most of the present range of the African lion occurs. Also, they used the LCUs identified in the 2005–2006 lion workshops as the general framework within which to identify lion areas, strongholds, and potential strongholds.

Riggio *et al.* (2013, p. 32) describe lion strongholds as areas meeting the necessary requirements for long-term viability; broadly, where management appears to be working. Potential strongholds are described, broadly, as areas where immediate interventions might create a viable population. Specifically defined, strongholds (1) contain at least 500 lions, (2) are within protected areas (including those that allow hunting), and (3) have stable or increasing lion numbers as assessed by IUCN (2006a, 2006b) (Riggio *et al.* 2013, p. 22). Potential strongholds contain at least 250 lions, but do not satisfy either requirement (2) or (3) above. The remaining lion areas—those not meeting the requirements of a stronghold or potential stronghold—are described as areas ''where present management clearly isn't working'' (Riggio *et al.* 2013, p. 32). Riggio *et al.* (2013, p. 32) derived the thresholds of 500 and 250 using information in Björklund (2003) on the number of prides needed to avoid the risk of inbreeding in lion populations, and information in Bauer *et al.* (2008) on the average size of lion prides. Björklund (in Riggio *et al.* 2013, p. 32) assessed the risk of inbreeding due to habitat loss and determined that, ''. . . to sustain a large out-bred population of lions, a continuous population of at least 50 prides, but preferably 100 prides, with no limits to dispersal is required.'' Bauer *et al.* 2008 (in Riggio *et al.* 2013, p. 32) indicate the average lion pride as containing approximately five adults.

The results of Riggio *et al.* indicate the size of the African lion population to be about 35,000, which falls within the range of the other recent estimates (Table 3). However, they state that ''Although these numbers are similar to previous estimates, they are geographically more comprehensive. There is abundant evidence of widespread declines and local extinctions'' (Riggio *et al.* 2013, p. 18).

Riggio *et al.* identified lions as occurring in 67 areas (Table 5). While a small portion (22 percent) of lion areas identified by Riggio *et al.* contain large populations, the majority are small and isolated (Riggio *et al.* 2013, p. 30; Table 5). Most (69 percent) contain fewer than 250 lions. A considerable portion (39 percent) contains very small populations of fewer than 50 lions. These include 63 percent of the lion areas in western and central Africa, and 31 percent of those in e/s Africa.

TABLE 5—NUMBER OF LION AREAS AND NUMBER OF AREAS CONTAINING LION POPULATION CLASSES ACCORDING TO RIGGIO ET AL. 2013

Number of lion areas	Western	Central	Eastern	Southern	All regions (percent)
Total	8	8	28	23	67.
# Estimated to contain:					
≥500 lions	0	1	7	7	15 (22 percent).
250–499 lions	1	2	1	2	6 (9 percent).
50–249 lions	0	2	12	6	20 (30 percent).
<50	7	3	8	8	26 (39 percent).

Riggio *et al.* identify 10 lion strongholds (viable populations) and 7 potential strongholds (Table 6). According to Riggio *et al.* (2013, p. 29), the 10 strongholds contain approximately 24,000 lions, or about 70 percent of the current African lion population. Of those, most (about 19,000 lions) are in protected areas. Potential strongholds contain about 4,000 lions. More than 6,000 lions are located in areas not considered strongholds or potential strongholds and have a very high risk of being extirpated (Riggio *et al.* 2013, p. 33).

TABLE 6—LION STRONGHOLDS AND POTENTIAL STRONGHOLDS IDENTIFIED BY RIGGIO ET AL. 2013

Lion area	Country	Area (km^2)	Stronghold	Lion population size	Population size in protected areas	IUCN (2006a, b) Trend
Western Africa						
W-Arly-Pendjari	Benin, Burkina Faso, Niger	29,403	Potential	350	350	Stable.
Central Africa						
SE Chad	Chad	133,408	Potential[5]	400	140	Stable.
E CAR	Central African Republic	328,721	Potential[6]	1,244	148	Stable.
Eastern Africa						
Boma-Gambella	Ethiopia, South Sudan	106,941	Potential	500	~500	Unknown.
Laikipia-Samburu	Kenya	35,511	Potential	271	46	Stable.
Tarangire	Tanzania	28,771	Potential	731	208	Decreasing.
Ruaha-Rungwa	Tanzania	195,993	Stronghold	3,779	2,235	Stable.
Selous	Tanzania	138,035	Stronghold	7,644	4,953	Stable.
Serengeti-Mara	Kenya, Tanzania	35,852	Stronghold	3,673	3,516	Increasing.
Tsavo-Mkomazi	Kenya, Tanzania	39,216	Stronghold	880	820	Decreasing.
Southern Africa						
Etosha-Kunene	Angola, Namibia	123,800	Potential	455	~315–595	Increasing.
Kafue	Zambia	58,898	Potential	386	386	Stable.
Great Limpopo	Mozambique, South Africa, Zimbabwe.	150,347	Stronghold	2,311	2,179	Increasing.
Kgalagadi	Botswana, South Africa	163,329	Stronghold	800	~800	Stable.
Luangwa	Malawi, Zambia	72,992	Stronghold	574	574	Stable.
Mid-Zambezi	Mozambique, Zambia, Zimbabwe.	64,672	Stronghold	755	~350–650	Stable.
Niassa	Mozambique, Tanzania	177,559	Stronghold	1,573	1,080	Increasing.
Okavango-Hwange	Botswana, Zimbabwe	99,552	Stronghold	2,300	~2,300	Stable.

Most of the strongholds and potential strongholds identified by Riggio *et al.* are trans-boundary areas. The vast majority, including all 10 strongholds, are located in southern and eastern Africa. Of the 17 strongholds and potential strongholds, only two potential strongholds are located in western and central Africa, one each in western Africa and central Africa. Only a small portion of the lions in the central Africa potential stronghold are within protected areas. The western Africa potential stronghold has one of the smallest lion populations of the 17 strongholds/potential strongholds and, according to Herschel *et al.* (2014, p. 5), contains 88–90 percent of all lions in the western Africa region.

By definition, all 10 strongholds identified by Riggio *et al.* include protected areas. Packer *et al.* (2013a, entire; 2013b, entire) looked at the relationship between lion densities, population trends, management practices, and several other variables (human population densities, governance, sport hunting, private management, and reserve size) from 42 sites in 11 countries in Africa. Results of modeling indicate that by 2050 about 43 percent of lion populations in unfenced reserves may decline to less than 10 percent of the carrying capacities of the unfenced reserves, including those in Botswana, Kenya, Cameroon, Ghana, Tanzania, and Uganda. According to the same modeling results lion populations in fenced reserves are expected to remain at or above the carrying capacity of the fenced reserves for the next 100 years, although most are small protected areas with small lion populations (Creel *et al.* 2013, entire).

Trends

Based on the best available information, as discussed above, African lion range and numbers have clearly declined over the past several decades. However, not all African lion populations have declined—some have increased or remained stable (see Distribution and Abundance), and some have been restored to areas from which they were previously extirpated (Packer *et al.* 2013, p. 636). Reports from the IUCN Species Survival Commission Cat Specialist Group (IUN 2006a, b) characterize the population as increasing in 3 of the lion strongholds identified by Riggio *et al.* (Table 6), as stable in 6 of the strongholds, and as decreasing in 1 stronghold. While four of the lion strongholds or potential strongholds identified by Riggio *et al.* (Table 6) are considered to be increasing, several African lion populations, containing a total of more than 6,000 individuals, have a very high risk of local extinction (Riggio *et al.* 2013, p. 33). During the 2005–2006 African lion workshops, lion experts characterized lion populations in 36 (42 percent) of the 86 LCUs as decreasing. In extensive surveys recently conducted within 15 of the 20 LCUs in western and central Africa, Henschel *et al.* (2010, entire) were able to confirm lion presence in only four. The work of Packer *et al.* (2013) suggests future declines within a number of protected areas. Craigie *et al.* (2010, entire) provide evidence of declining large

[5] Two lion areas in central Africa make up one potential stronghold.

[6] Riggio *et al.* make one exception to the requirement that lion strongholds contain populations that are stable or increasing. IUCN 2006 indicate lion numbers in the Tsavo/Mkomazi lion area are decreasing in numbers, but Riggio *et al.* believe that, while lion numbers are declining outside of protected areas, lions within the parks are usually well protected and in sufficient numbers to meet the criteria.

mammal populations in Africa's protected areas, indicating that protected areas in Africa have generally failed to mitigate threats to large mammal populations, including African lion. Although Craigie *et al.* (2010, p. 2,225) found large regional differences (from large declines in western Africa to positive rates of change in southern Africa), they found overall populations decreased steadily from 1970 to 2005.

Biology/Ecology

Habitat

Historically, the species occurred in all habitats in Africa, except rainforest and the hyper-arid interior of the Sahara (Ray *et al.* 2006, p. 66). Today they are found primarily in savannah, although there are some remnant populations in other habitat types (Riggio *et al.* 2013, p. 19). According to Nowell and Jackson (1996, p. 19), optimal habitat appears to be open woodlands and thick bush, scrub, and grass complexes, where sufficient cover is provided for hunting and denning. The highest lion densities are reached in savannah woodlands plains mosaics of eastern and southern Africa (Ray *et al.* 2005, p. 66). The species is intolerant of anthropogenic (human-caused) habitat conversion, such as farming or overgrazing by livestock (Ray *et al.* 2005, p. 66).

General Biology

Lions are well studied. Much information exists on African lion habits, behavior, and ecology. CITES (2014a, p. 3) provides a general overview as follows:

> Lions are generalist, cooperative hunters, with foraging preferences changing with season and with lion group size. Lions live in groups called ''prides'', which are ''fission-fusion'' social units with a stable membership that sometimes divide into small groups throughout the range. 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 short as 4–6 weeks if their litter is lost. Gestation lasts 110 days, litter size ranges 1–4 cubs, and sex ratio at birth is 1:1. At about four years of age, females will have their first litter and males will become resident in a pride. Pride takeovers by male lions and subsequent infanticide of cubs sired by the ousted male lions greatly influences reproductive success. Lionesses defending their cubs from the victorious males are sometimes killed during the takeover. Infanticide accounts for 27 percent of cub mortality. Adult mortality is typically caused by humans, starvation, disease or attacks from other lions. Injury and death can also occur during hunting attempts on some of their larger prey.

Haas *et al.* (2005, entire) provide a summary of information on lion, including the following:

> Prides vary in size and structure, but typically contain 5–9 adult females (range, 1–18), their dependent offspring, and a coalition of 2–6 immigrant males (Heinsohn and Packer 1995; Packer *et al.* 1991). . . . Pride sizes are smallest in arid environments with limited prey species (Elliott and Cowan 1977; Hanby and Bygott 1979; Ruggiero 1991; Schaller 1972; Stander 1992b; Wright 1960) . . . Males reside in a pride for [approximately] 2 years before being replaced by another group of males (Packer *et al.* 1988). . . . In the absence of a pride takeover, males generally leave their natal pride when 2–4 years old (Bertram 1975b; Pusey and Packer 1987). Most females are incorporated into their natal prides (Pusey and Packer 1987; Van Orsdol *et al.* 1985). . . . A small proportion of lions is nomadic, including young and adult males without a pride. Nomadic lions follow the migrations of prey and hunt and scavenge cooperatively (Bertram 1975a; Bygott *et al.* 1979; Schaller 1968, 1969; Van Orsdol *et al.* 1985).
>
> . . . Lion productivity (measured as number of surviving cubs) is limited by food. . . . Cub mortality is high in lions and is linked to periods of prey scarcity and infanticide by male lions during pride takeovers (Packer and Pusey 1983b; Schaller 1972; Van Orsdol *et al.* 1985; Whitman and Packer 1997).
>
> . . . Lions are mainly active at night . . . [They] usually hunt in groups; males hunt less frequently than do females, but males are stronger and can gain access to kills made by females (Bertram 1975a; Scheel and Packer 1991). Prey selection is related to seasonal weather patterns and the migration of large herbivores in some parts of Africa (Hanby *et al.* 1995). . . . Lions exhibit individual preferences in prey selection within and between prides in the same area (Rudnai 1973b; Van Orsdol 1984).

Diet and Prey

Lions are opportunistic hunters and scavengers. As scavengers, lions are dominant and can usually readily displace other predators from their kills (Packer 1986, Schaller 1972, in Haas *et al.* 2005, pp. 4–5). As hunters they are known to take a variety of prey. However, they are also the largest carnivore in Africa and, as a result, require large prey to survive. Ray *et al.* (2005, pp. 66–67) summarizes lion prey as follows:

> Lions are generalists and have been recorded to consume virtually every mammal species larger than 1 kg in their range, as well as a wide variety of larger reptiles and birds (Nowell & Jackson 1996; Sunquist & Sunquist 2002). The constraints of large physical size and extended social groups, however, bind them to large-bodied prey, and their diet is dominated by medium-large ungulates. In fact, only a few species of large ungulates comprise a majority of their diet wherever they occur (Schaller 1972; Stander 1992; Packer *et al.* 1995), and they are unable to persist in areas without large-bodied prey. The threshold of this requirement is perhaps represented at Etosha National Park, Namibia, where Stander (1992) showed that lions hunting in pairs met their minimum requirements hunting springboks which, at <50 kg, are the smallest preferred prey species recorded.

Prey availability affects the reproduction, recruitment, and foraging behavior of lions and, as a result, strongly influences lion movements, abundance, and population viability (Winterbach *et al.* 2012, p. 7, citing several sources). Lion densities are directly dependent on prey biomass (Van Orsdol *et al.* 1985, in Packer *et al.* 2013a, p. 636; Hayward *et al.* 2007, entire), and range from 0.08–0.13 adults and subadults per 100 km² in Selous Game Reserve up to 18 per km² in protected areas of eastern Africa and South Africa (Creel and Creel 1997, Nowell and Jackson 1996, in Haas *et al.* 2005, p. 4). Aside from human-related mortality, prey availability is likely the primary determinant of lion density (Fuller & Sievert 2001, in Winterbach *et al.* 2012, p. 7). In areas of low natural prey density, or high human contact, lions may prey on livestock (see Human-Lion Conflict).

Movements/Home Range

Availability of prey is perhaps the primary factor that determines the ranging behavior of large carnivores (Gittleman & Harvey 1982, Van Orsdol *et al.* 1985, Grant *et al.* 2005, Hayward *et al.* 2009, in Winterbach *et al.* 2012, p. 4). Home-range sizes of lion prides correlate with lean-season prey biomass (Van Orsdol *et al.* 1985, in Haas *et al.* 2005, p. 4) and, therefore, vary widely among habitats. Average range sizes of African lion prides are 26–226 km², but can be considerably larger (Stander 1992b; Van Orsdol *et al.* 1985; Viljoen 1993, in Haas *et al.* 2005, p. 4). In areas of low or variable prey biomass, annual range requirements for a single lion pride can exceed 1,000 km² (Packer *et al.* 2013, p. 636). Funston (2011, p. 5) found the home ranges of lion prides in the dune-savannah habitat of Kgalagadi Transfrontier Park to range from 1,762 to 4,532 km².

Because lion home ranges can be very large, many protected areas are not large enough to sustain them (Winterbach *et al.* 2014, p. 1; Funston 2011, p. 1, citing several sources). Where lion ranges approximate protected area size, lions roam near or beyond the protected area boundary, increasing human-lion contact and human-caused lion mortality. In these situations, local or regional extirpation probability is high due to the population sink created around the boundary of the protected area (Davidson *et al.* 2011, in Winterbach *et al.* 2012, p. 5; Funston

2011, p. 1, citing several sources; Brashares *et al.* 2001, entire). This ''edge effect'' is a major threat to carnivore populations inside protected areas throughout the world (Woodroffe 2001, in Winterbach *et al.* 2012, p. 5) (also see Human-Lion Conflict).

Habitat Loss

Habitat loss and degradation is reported to be among the main threats to African lions (IUCN 2006a, p. 18; Ray *et al.* 2005, pp. 68–69). The main cause of lion habitat loss and degradation is expansion of human settlements and activities, particularly agriculture and intensive livestock grazing in lion habitat (IUCN 2006a, p. 18; IUCN 2006b, p. 23; Ray *et al.* 2005, pp. 68–69; Chardonnet 2002, pp. 103–106). Expansion of human settlements and activities into lion habitat renders the habitat unsuitable for lions primarily because it results in reduced availability of the wild prey that lions depend on for survival (see Loss of Prey Base) and increased human-lion conflict resulting in lion mortality (see Human-Lion Conflict)—two of the main factors that influence the distribution and population viability of large carnivores such as lions (Winterbach *et al.* 2014, p. 1). Ray *et al.* (2005, p. 69) note that, although lions have a wide tolerance for habitats, they are generally incompatible with humans and human-caused habitat alteration and loss. Lions are sensitive to loss of cover or prey. Riggio *et al.* (2013, p. 18) state that dense human populations and widespread conversion of land to human use preclude use by lions.

Habitat destruction and degradation has been extensive throughout the range of the African lion, resulting in local and regional lion population extirpations, reduced lion densities, a dramatically reduced subspecies range (see Range), and small, fragmented, and isolated lion populations that are increasingly limited to protected areas (see Distribution and Abundance) (Ray *et al.* 2005, p. 69; Bauer and Van der Merwe 2004, pp. 29–30; Nowell and Jackson 1996, pp. 20–21). Lions appear to have one of the lowest levels of ecological resilience to human-caused habitat fragmentation; they are the least successful large African carnivore outside conservation areas (Woodroffe 2001, in Winterbach *et al.* 2012, p. 6). Large carnivores with low ecological resilience have a high risk of local extinction. In order to survive, they require larger contiguous habitats with lower negative human impacts than do more resilient species (Winterbach *et al.* 2012, p. 5). As human populations continue to rise in sub-Saharan Africa, the amount of land required to meet the needs of those populations is constantly increasing (Brink *et al.* 2014, entire; Brink and Eva 2009, entire; Eva *et al.* 2006, p. 4), a problem accentuated by slow rates of technological progress in food production and land degradation from both overuse and natural causes (United Nations Environment Programme (UNEP) 2012a, p. 3; Chardonnet *et al.* 2010a p. 19; International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) 2009, pp. 3–4, 8; United Nations Economic Commission for Africa 2008, pp. 3–5). The result of this process is accelerated transformation of natural landscapes at the expense of wilderness that sustains species such as lions and their prey (Chardonnet *et al.* 2010a p. 19). From 1970 to 2000, the human population in sub-Saharan Africa increased by 126 percent (from 282 million to 639 million) (United Nations (UN) 2013, p. 9), while at about the same time (1975 to 2000), there was a 57 percent increase in agriculture area (from just over 200 million ha to almost 340 million ha) and 21 percent decrease in natural vegetation in the region (Brink and Eva 2009, p. 507). In 2009, approximately 1.2 billion ha, or 40 percent, of Africa's land area was in permanent pasture or crops, with the vast majority (31 percent) in pasture (UNEP 2012b, p. 68).

Growing human populations have been associated with declines in large carnivore populations all over the world, and high human density is strongly associated with local extirpation of large carnivores (Linnell *et al.* 2001, Woodroffe 2001, in Woodroffe and Frank 2005, p. 91; Woodroffe 2000, entire). Chardonnet *et al.* (2002, p. 103) indicate that the distribution maps of lion subpopulations tend to confirm a direct inverse correlation of lion density and numbers with human activity and presence. Further, Packer *et al.* (2013, entire) found that lions in unfenced reserves are highly sensitive to human population densities in surrounding communities.

Based on a comparison of land-use and human population data, Riggio *et al.* (2013, p. 23) determined that a density of 25 or more people per km^2 served as a proxy for the extent of land-use conversion that would render habitat unsuitable for lions. Woodroffe (2000, p. 167) analyzed the impact of people on predators by relating local carnivore extinctions to past and projected human population densities and estimated 26 people per km^2 as the mean human density at which lions went locally or regionally extinct. Riggio *et al.* (2013, p. 29) estimate that there were originally approximately 13.5 million km^2 of savannah habitat in Africa. In 1960, 11.9 million km^2 of these habitats had fewer than 25 people per km^2, and in 2000 this number decreased to 9.7 million km^2. Based on analysis of land-use conversion using satellite imagery and human population densities, Riggio *et al.* (2013, p. 29) found current savannah habitat that is suitable for lions to be fragmented and to total about 3.4 million km^2 (or 25 percent of African savannah habitat). These data suggest a substantial decrease in lion habitat over the past 50 years.

Projections of future human population growth, area of conversion to agriculture, and livestock numbers in Africa suggest suitable lion habitat will continue to decrease into the foreseeable future. Africa has the fastest population growth rate in the world (UNEP 2012a, p. 2). Future population growth in sub-Saharan Africa is projected to be large and rapid (UN 2013, p. 9). Although urbanization is increasing in sub-Saharan Africa (UN 2014, p. 20), the majority of the population is rural, and about 60–70 percent of the population relies on agriculture and livestock for their livelihood (UNEP 2006, pp. 82, 100, 106; IAASTD 2009, p. 2). Much of the agriculture and livestock-raising is at subsistence level (IAASTD 2009, pp. 8, 28). As a result, a large portion of the growing population will depend directly on expansion of agriculture and livestock grazing to survive. Between 2010 and 2050 the population of sub-Saharan Africa is projected to more than double to more than 2 billion (from 831 million to 2.1 billion) (UN 2013, p. 9). During about this same time period (2005 to 2050), Alexandratos and Bruinsma (2012, p. 107) project the area of cultivated land to increase by 51 million ha (approximately 21 percent). However, this figure does not include range land, and the majority of agricultural land in Africa is devoted to grazing (UNEP 2012b, p. 68). The number of livestock (cattle, sheep, and goats) in sub-Saharan Africa is projected to increase about 73 percent, from 688 million to 1.2 billion, by 2050 (Alexandratos and Bruinsma 2012, p. 133).

Expansion of human settlements, agriculture, and/or livestock grazing are reported as occurring in or on the periphery of several of the areas identified by Riggio *et al.* (2013, suppl. 1) as lion strongholds (viable populations) and potential strongholds (IUCN 2006a, p. 16; IUCN 2006b, pp. 20–22), and are particularly a threat in western, central, and eastern Africa and

some parts of southern Africa. There are only two potential strongholds in western and central Africa (one in each region). Expansion of agriculture and livestock grazing are reported in or around both (Heschel *et al.* 2014, pp. 5–6; Houessou *et al.* 2013, entire; Chardonnet *et al.* 2010, pp. 24–26; IUCN 2008, pp. 8, 28–29), and management of protected areas in portions of both is reported as weak (Heschel *et al.* 2014, pp. 5–6; IUCN 2008, p. 8). Eastern Africa contains over half of all the lions in Africa (Table 3). Seven of the seventeen African lion strongholds and potential strongholds identified by Riggio *et al.* occur in eastern Africa, and six of those seven (all four strongholds and two of three potential strongholds) are located in Tanzania and Kenya (Table 6).

Between 1990 and 2010, Kenya's human population grew from 23 million (40/km^2) to 41 million (70/km^2), whereas Tanzania's grew from 25 million (27/km^2) to 45 million (48/km^2) (UN 2013, pp. 421, 798). Not unexpectedly, sources indicate that expansion of agriculture and livestock grazing is occurring in these countries (Brink *et al.* 2014, entire; UNEP 2009, p. 91; Mesochina *et al.* 2010, p. 74), including in or around lion strongholds and potential strongholds (Ogutu *et al.* 2011, entire; Mesochina *et al.* 2010, pp. 71–74, 76; Packer *et al.* 2010, pp. 8–9; UNEP 2009, pp. 98–99; Newmark 2008, pp. 322–324; IUCN 2006b, pp. 20–22; Ogutu *et al.* 2005, entire). Mesochina *et al.* (2010, p. 74) state that widespread destruction of wildlife habitat and human encroachment in wildlife corridors are major threats to lion conservation in Tanzania and consider loss of suitable habitat as a top threat to lion survival in the country. In Kenya, the Kenya Wildlife Service (2009, p. 21) indicates that habitat loss due to land-use changes and human encroachment into previously wild areas is having a major impact on lion range size. By 2050 the UN projects the human population of Tanzania to almost triple its 2010 population, reaching a density of 137 people per km^2, whereas Kenya's population is projected to more than double, reaching a density of 167 people per km^2 (Table 7).

The human populations of most other current and recent lion range countries are also expected to have very high growth rates (Table 7). It is important to note that the country-wide human population densities provided here (and in Table 7) are not directly comparable to the density thresholds determined by Riggio *et al.* (discussed above) due to the differences in scale at which they were made. However, country-wide population densities relate the number of humans to land area and, consequently, are indicative of the level of pressure that will exist to convert land to uses that will meet the needs of the human population. This is particularly the case given that much of sub-Saharan Africa is rural and locals depend on agriculture for their livelihood.

In southern Africa, the extent of current habitat destruction and degradation appears to vary widely. For example, according to the Zambia Wildlife Authority (2009 pp. 4–5), unplanned human settlement and other land-use activities in game management areas are a major threat to the long-term survival of the lion in Zambia. They note that conversion of natural habitat in game management areas for cropping and grazing of livestock has led to habitat destruction and indicate that elimination of tsetse flies and subsequent increase in pastoralist activities in game management areas places the lion under renewed direct conflict with humans. On the other hand, according to Funston (2008, pp. 123–126), in several areas of southern Africa where lions were recently extirpated, lions are reestablishing as a result of, among other factors, adequate protection of habitat and prey. Human population growth, and resulting pressures exerted on habitat, are also expected to vary widely in the region. Population increases from 2010 to 2050 are projected to range from about 23 percent (South Africa) to well over 200 percent (Zambia), with 2050 densities in the region ranging from 5 people per km^2 (Botswana and Namibia) to 348 people per km^2 (Malawi) (Table 7).

Summary of Habitat Loss

In the past several decades the human population has been expanding with concomitant large decreases in lion habitat and lion populations, resulting in an extremely large reduction in the species' range. Habitat for African lion continues to be threatened with destruction, modification, and curtailment. Human populations are projected to increase dramatically in sub-Saharan Africa in coming decades. As human populations continue to rise in sub-Saharan Africa, the amount of land required to meet the expanding human population's needs is constantly increasing. In addition, as indicated above, lions are increasingly limited to protected areas, and human population growth rates around protected areas in Africa tend to be higher than the average rural growth rate (Wittemyer *et al.* 2008, entire). Considering the majority of the human population in sub-Saharan Africa is rural, and land supports the livelihood of most of the population, loss and degradation of lion habitat can be expected to accompany the rapid growth in sub-Saharan Africa's human population. Therefore, overall, because (1) lion prides have vast ranges and the subspecies requires large areas of suitable habitat to survive, (2) the subspecies' range has already declined dramatically and is increasingly limited to protected areas, and (3) habitat loss and degradation is occurring in or around several of the remaining lion strongholds (viable populations) and potential strongholds, we conclude based on the best available scientific and commercial information that the continued destruction, modification, and curtailment of lion habitat is likely to become a significant threat to the African lion throughout its range.

Human-Lion Conflict

Human-lion conflict and associated retaliatory killing of lions has played a major role in the reduction of lion populations (Lion Guardians 2013, p. 1; Lion Guardians 2011, p. 2; Hazzah and Dolrenry 2007, p. 21; Frank *et al.* 2006, p. 1; Patterson *et al.* 2004, p. 508) and is the greatest threat to remaining lion populations (Hazzah *et al.* 2009, p. 2,428; Moghari 2009, p. 31; Kissui 2008, p. 422; Frank *et al.* 2006, pp. 1, 3, 10; Ray *et al.* 2005 in Hazzah 2006, p. 2; IUCN 2006b, p. 18). Conflict between humans and wildlife has been linked to population declines, reduction in range, impacts to small population demographics, and even species extinctions (Dickman 2013, p. 377; Begg and Begg 2010, p. 2; Hazzah *et al.* 2009, p. 2,428; Moghari 2009, p. 36; Kissui 2008, p. 422; Hazzah 2006, pp. 15, 23, 25).

Human-wildlife conflict stems from human population growth and the resulting overlap of humans and wildlife habitat (Chardonnet *et al.* 2010, p. 6; Hazzah 2006, pp. 14, 15). Lion populations are increasingly restricted to protected areas, due to human expansion and associated expansion of livestock husbandry and agricultural activities. However, despite being within protected areas, lions continue to be impacted by people living on adjacent land. Villages are established on the borders of protected areas, cattle herders enter the protected areas, and lions move beyond the borders of protected areas in search of food, increasing interactions between humans and lions and the risk of human-lion conflict (Hazzah *et al.* 2013, p. 1; Republic of Namibia 2013, p. 13; Chardonnet *et al.* 2010, pp. 11–12;

Mesochina *et al.* 2010a, p. 39; Mesochina *et al.* 2010b, p. 33; Packer *et al.* 2010, pp. 2, 6; Gebresenbet *et al.* 2009, p. 9; Moghari 2009, pp. 1, 14, 25, 26, 78; Kissui 2008, p. 422; Hazzah 2006, p. 2). The most significant cause of human-lion conflict is livestock depredation. Poor husbandry practices and grazing of livestock within or adjacent to protected areas increase exposure of livestock to lions and increase livestock loss (Uganda Wildlife Authority 2010, p. 27; Woodroffe and Frank 2005 in Moghari 2009, p. 35; Hazzah and Dolrenry 2007, pp. 22–23). Although lions generally avoid people, they will occasionally prey on humans, causing serious injury or death (Dickman 2013, pp. 380, 384; Chardonnet *et al.* 2010, pp. 11, 12, 13; Moghari 2009, pp. 14, 49, 26, 88; Bauer *et al.* 2001 in Moghari 2009, pp. 31, 78, 84; Frank *et al.* 2006, p. 1; Hazzah 2006, pp. 14, 17; Patterson *et al.* 2004, p. 507). Attacks on humans appears to be more frequent in southern and eastern Africa (Chardonnet *et al.* 2010, pp. 12, 13; Mesochina *et al.* 2010a, pp. 29–30; Frank *et al.* 2006, pp. 1, 10). Lion attacks can have various impacts on those communities that coexist with conflict-causing animals, generating resentment towards them. When lions cause or are perceived to cause damage to livestock, property, or people, the response is generally to kill them (Dickman 2013, pp. 378–379; Moghari 2009, p. 25; Frank *et al.* 2006, p. 1).

Loss of Prey Base

The lion's prey base has decreased in many parts of its range for various reasons, but a large factor is due to competition for meat by humans. Humans in Africa rely on protein obtained from bushmeat, resulting in direct competition for prey between humans and lions, and commercial poaching of wildlife is becoming a significant threat to many species, including those that lions rely upon for food. Historically, subsistence hunting with spears was traditionally used to hunt wildlife, which had minimal impact to wildlife populations. Spears have since been replaced by automatic weaponry (Chardonnet *et al.* 2010, p. 27), allowing for poaching of large numbers of animals for the bushmeat trade.

The human population in a majority of African countries within the range of the lion has quadrupled since the 1960s (Riggio *et al.* 2013, p. 29; IUCN 2009, p. 15), increasing the demand for bushmeat. Bushmeat comprises between 6 percent (southern Africa) and 55 percent (Central African Republic) of a human's diet within the African lion's range (Chardonnet *et al.* 2005, p. 9; IUCN 2006b, p. 19). In addition, the sale of bushmeat is an important livelihood in Africa, (Chardonnet *et al.* 2010, p. 27; Mesochina *et al.* 2010a, p. 38; Abwe and Morgan 2008, p. 26; Bennett *et al.* 2007, p. 885; Fa *et al.* 2006, p. 507). This growing demand and widely available modern weapons has led to increased poaching of native wildlife (Chardonnet *et al.* 2010, pp. 13–14, 27; Packer *et al.* 2010, p. 8). Because many wildlife species are being hunted at unsustainable levels to meet this demand within the range of the lion, its prey base is becoming depleted in many areas, which has led lions to seek out livestock (and in some cases, humans) for food (Hoppe-Dominik *et al.* 2011, p. 452; Chardonnet *et al.* 2010, pp. 6, 13–14; Frank *et al.* 2006, p. 12).

Further, the demand for agriculture to meet the increasing needs of a growing population has been met by intensified agricultural and livestock practices (Chardonnet *et al.* 2010, p. 19). As natural habitats are converted to agricultural or pastoral land, it removes the food and cover needed by wildlife, and the lion's natural prey base is reduced, causing them to prey on domestic livestock (Chardonnet *et al.* 2010, p. 27; Gebresenbet *et al.* 2009, p. 9).

In Tanzania, which is home to more than 40 percent of the African lion population, conversion of rangeland to agricultural use has blocked several migratory routes for wildebeest and zebra populations, both lion prey species, which likely forces lions to rely more on livestock (Packer *et al.* 2010, p. 9). Conditions worsen as livestock numbers and area under cultivation increase, leading to overgrazing, further habitat destruction, and greater depredation rates by lions (Gebresenbet *et al.* 2009, p. 9; Hazzah 2006, p. 61; Frank *et al.* 2005, Ntiati 2002, Mishra 1997, Meriggi and Lovari 1996, Rao 1996, Mech *et al.* 1988 in Hazzah 2006, p. 18). Additionally, the use of fences to subdivide group ranches interferes with traditional wet and dry season grazing schedules for livestock and wildlife (Hazzah 2006, pp. 58–59). Restricting wildlife movement reduces wild prey and, when combined with an increase in livestock numbers, increases the rate of human-lion conflict (Hazzah 2006, pp. 59, 61). Although well-built bomas can effectively constrain cattle and keep predators out (Frank et al. 2006, p. 8), they are traditionally built to keep livestock confined, but do not offer effective protection from predators (Moghari 2009, p. 35). In the absence of reliable methods for protecting livestock, some amount of depredation can be expected, and some lions can become habitual livestock killers (Frank *et al.* 2006, p. 9).

Studies have shown variation in rates of livestock depredation with regional rainfall that correlate with prey availability, including changes in herding strategies, movement of prey, and movement of lions (Lion Guardians 2011, p. 6; Moghari 2009, p. 32; Hazzah 2006, pp. 17, 18; Patterson *et al.* 2004, p. 514). For example, in some parts of Zimbabwe, Kenya, and Tanzania, livestock losses occur during the dry season. During this time, herders travel further for forage and water, they use temporary bomas (a livestock enclosure) that are typically weak, they are unfamiliar with carnivore movements in these new areas, and livestock are weak due to disease, which makes them more vulnerable to predator attacks by lions (Hazzah 2006, p. 17). Additionally, herders are dependent on resources within protected areas, and livestock may be left to wander for days or weeks during a prolonged drought to find forage, increasing opportunities for attacks on livestock by lions (Chardonnet *et al.* 2010, p. 24; Frank *et al.* 2006, p. 6). In other parts of Kenya, the Maasai Steppe region of Tanzania, and Queen Elizabeth National Park, Uganda, livestock losses were greater during or following the rainy season (Moghari 2009, p. 88; Kissui 2008, pp. 427, 428; Frank *et al.* 2006, p. 6; Patterson *et al.* 2004, pp. 510, 514). Weakened prey and readily available carcasses provide easy meals during times of drought, leading to fewer livestock attacks. However, when rains return, the abundant grass makes wild prey harder to catch and lions may turn to livestock. Migratory prey species, such as zebra and wildebeest, will move to other areas for forage and replenished water sources, leaving lions to turn to livestock as an alternate food source. Migratory prey may also move outside of protected areas. Opportunities for livestock predation on communal land increase when lions follow (Packer *et al.* 2010, p. 9; Kissui 2008, p. 427; Patterson *et al.* 2004, p. 514; Frank *et al.* 2006, p. 6). Similarly, environmental factors such as vegetative cover, habitat, climate, seasonality, and prey availability may affect the rate of attacks on humans. A certain amount of vegetative cover is crucial for hunting success; however, in some cases, the vegetative cover may make it more difficult to catch prey, leading to more attacks on humans. Additionally, dense cover near settlements allows lions to hide or stalk humans at a close distance

(Mesochina *et al.* 2010a, p. 39; Moghari 2009, p. 85; Frank *et al.* 2006, p. 12).

Attacks on Livestock

Traditional livestock husbandry practices are effective at reducing depredation of livestock by lions (Chardonnet *et al.* 2010, p. 35; Moghari 2009, p. 35; Frank *et al.* 2006, p. 2; Hazzah 2006, p. 22). These practices include livestock being closely herded by men and dogs during the day and being brought into bomas at night with people living in huts around them (Frank *et al.* 2006, p. 4). However, these traditional practices are being replaced by less diligent husbandry practices, which are increasing conflict (Woodroffe and Frank 2005 in Moghari 2009, p. 35; Frank *et al.* 2006, pp. 2, 10; Hazzah and Dolrenry 2007, p. 23). In Botswana, livestock are often left to wander outside bomas at night (Frank *et al.* 2006, p. 5). In Kenya and Tanzania, social changes are altering traditional Maasai pastoral livelihoods, reducing dependency on livestock, and reducing traditional livestock care and management, leaving livestock more vulnerable to predation (Chardonnet *et al.* 2010, p. 35; Hazzah and Dolrenry 2007, pp. 22–23). Young Maasai boys traditionally guarded herds at night; however, increased access to schools has left herds unattended to wander into predator areas at night (Chardonnet *et al.* 2010, p. 35).

Attacks on Humans

Provoked attacks on humans are usually associated with someone approaching a lion too closely or trying to injure or kill it and stealing a lion's prey for bushmeat (Chardonnet *et al.* 2010, p. 14; Uganda Wildlife Authority 2010, p. 27). Unprovoked attacks are usually associated with old, sick, or injured lions that turn to humans as easy prey. Additionally, there are risks of unprovoked attacks associated with certain human activities. These activities include walking alone at night, sleeping outside, and surprising a lion, particularly if it has cubs (Begg and Begg 2010, pp. 3, 21; Chardonnet *et al.* 2010, pp. 14, 15; Mesochina *et al.* 2010a, pp. 38, 39; Mesochina *et al.* 2010b, p. 32; Uganda Wildlife Authority 2010, p. 27; Moghari 2009, p. 85; Frank *et al.* 2006, pp. 11, 12). Inebriated people may walk in an altered manner that resembles sick or injured prey, attracting the attention of lions (Moghari 2009, p. 85). The most common context for attacks on humans occurs during harvest, due to prey dispersal during the wet season, bush pig attraction to crops, and because humans are particularly vulnerable in makeshift tents while protecting crops (Frank *et al.* 2006, p. 12).

Retaliatory Killing of Lions

Competition with humans, habitat changes, and regional climate variations can decrease availability of prey and increase human-lion conflict. When native prey are unavailable or difficult to find and kill, lions will target domestic livestock or humans (Chardonnet *et al.* 2010, p. 27; Moghari 2009, pp. 78, 83; Hazzah 2006, pp. 17–18; Patterson *et al.* 2004, pp. 507, 514). Lion attacks occur at the highest frequency in areas where natural prey abundance is lowest (Packer *et al.* 2010, p. 9; Frank *et al.* 2006, pp. 9, 12; Patterson *et al.* 2004, p. 507). Livestock provide an economic value to humans, particularly those in extreme poverty who rely solely on livestock for their protein source and livelihood. When lions have no economic value to local communities, and they kill or are perceived to kill livestock that do have an economic value to people, they are subject to retaliatory killing. This greatly impacts already-dwindling lion populations (Chardonnet *et al.* 2010, pp. 12–14; Mesochina *et al.* 2010a, p. 38; Mesochina *et al.* 2010b, p. 32; Gebresenbet *et al.* 2009, p. 9; Moghari 2009, pp. 4, 25, 49; Kissui 2008, pp. 423, 429; Hazzah 2006, p. 24; IUCN 2006a, pp. 23, 24; IUCN 2006b. pp. 18–19; Frank *et al.* 2006, p. 3). The availability of guns and poison makes killing suspected predators cheaper and easier than other control methods, such as reinforcing bomas (Hazzah *et al.* 2009, p. 2,429; Moghari 2009, p. 35; Frank *et al.* 2006, p. 14; Hazzah 2006, p. 3). Spearing, shooting, trapping, and poisoning of lions, as either a preventive measure or in retaliation for livestock and human attacks, occurs regularly (Government of Namibia 2013, pp. 12, 13–14; Begg and Begg 2010, p. 15; Chardonnet *et al.* 2010, pp. 41–42; Packer *et al.* 2010, pp. 9–10; Uganda Wildlife Authority 2010, pp. 13, 42; Gebrensenbet *et al.* 2009, p. 7; Hazzah *et al.* 2009, p. 2,429; Moghari 2009, pp. 52, 89, 91; Ikanda 2008, pp. 5–6; Hazzah and Dolrenry 2007, p. 21; Frank *et al.* 2006, pp. 2–4, 7; Hazzah 2006, p. 52; IUCN 2006b, p. 15). Studies have shown that lion populations are declining in areas where pastoralism persists (Hazzah *et al.* 2009, p. 2,428). Within protected areas, human-wildlife conflict is likely under-reported because cattle herders are within the protected areas illegally and, therefore, unlikely to report it (Chardonnet *et al.* 2010, p. 14; Mesochina *et al.* 2010b, p. 34). For example, Etosha National Park and Caprivi Game Park have the highest rates of lions killed per 100 km^2, yet it may be that just under half of the lions that are killed are reported (Republic of Namibia 2013, p. 14). Although most of the information on human-lion conflict comes from just a few areas of the lion's range (e.g., Kenya, Tanzania, and Uganda), it is reasonable to conclude that lions are being killed due to conflict in all major range countries, due to their depredation on livestock (Frank *et al.* 2006, p. 4).

In areas of high conflict, identifying the responsible animal is often difficult, and a token animal may be killed instead (Hazzah 2006, p. 25), leaving the problem lion to continue to attack and the potential for additional retaliatory killings. In Tanzania, game officers kill numerous lions each year in retaliation for attacks (Frank *et al.* 2006, p. 12). Whereas shooting or spearing target specific problem animals, poisoning is indiscriminate and is known to remove entire prides at once (Frank *et al.* 2006, pp. 2, 10, Living with Lions no date, unpaginated). In the absence of reliable methods for protecting livestock, rural people often turn to indiscriminant methods, like poisoning, to control livestock depredation. Poisoning is an easy method for lethal control since it is readily available, and reinforcing bomas or more carefully tending livestock requires time and effort. The use of Furadan, a widely available and cheap agricultural pesticide, is particularly lethal to wildlife and is increasingly being used to kill predators in small pastoralist areas of Kenya and Tanzania. Livestock carcasses are doused with the poison, killing predators and scavengers that feed on them (Frank *et al.* 2006, pp. 2, 10, Living with Lions no date, unpaginated). Poisoning of bush pig carcasses to kill lions is not uncommon after attacks on humans. These practices have serious negative impacts on lion populations (Frank *et al.* 2006, p. 9).

Factors That Drive Retaliation

Several anthropogenic factors drive the level of resentment towards lions and the extent of retaliatory killing (Dickman 2013, pp. 379, 385), including the extent of the loss caused by the lions, and the wealth and security of the people affected (Dickman 2013, p. 381; Mesochina *et al.* 2010b, p. 54; Moghari 2009, pp. 14, 25; Hazzah 2006, p. 81). Depending on alternative assets or incomes, the economic impact of lions killing livestock can be significant. Domestic livestock can provide manure, milk, and meat, and are the basis of many family incomes, savings, and social standing; losses can amount to a large proportion of a subsistence

herder's annual income. These losses are generally uncompensated, reinforcing negative community attitudes toward lions and causing retaliation (Dickman 2013, pp. 380, 381; Chardonnet *et al.* 2010, pp. 11, 12, 18, 29; Hazzah *et al.* 2009, p. 2,428; Moghari 2009, pp. 14, 25, 27, 36; Kissui 2008, pp. 422–423). Furthermore, a common perception among local communities is that lions are conserved at the cost of community safety and uncompensated financial losses. When the people who suffer significant costs from wildlife feel that the wildlife's needs are being put before their own needs, their frustration can lead to retaliatory killings (Dickman 2013, p. 382). This situation further contributes to negative attitudes toward lion conservation programs (Moghari 2009, p. 37).

Lions are particularly vulnerable to retributive killing because they are often driven by a perceived level of lion predation on livestock rather than actual levels of conflict. In some locations, other predators (e.g., baboons (*Papio ursinus*), spotted hyenas (*Crocuta crocuta*), and leopards (*Panthera pardus*)) as well as disease are responsible for the majority of livestock losses and human casualties, yet it is lions that are sought and killed more often. Negative perceptions of lions may be based on an over-estimated number of lions in a community or protected area and an over-estimated number of human-lion conflicts (Dickman 2013, p. 380; Begg and Begg 2010, p. 20; Chardonnet *et al.* 2010, pp. 12, 21–22; Hazzah *et al.* 2009, p. 2,436; Maclennan *et al.* 2009 in Hazzah *et al.* 2009, p. 2,429; Moghari 2009, pp. 77–78, 107, 150; Holmern *et al.* 2007 in Moghari 2009, p. 34; Butler 2001 in Moghari 2009, p. 34; Kissui 2008, pp. 426, 428, 429; Hazzah 2006, pp. 18–19, 83–85, 96, 98, 107, 111; Patterson *et al.* 2004, pp. 514, 515). One cause for the disproportionate blame put on lions is that the lion is a highly visible species. It is a large-bodied species that lives in groups and has cultural significance. Because of its physical presence, there is often a ''hyper-awareness'' of the potential risk for lion attacks and lions may be blamed simply because they have been seen in an area (Dickman 2013, pp. 380–381).

Cultural beliefs and traditions can have a negative impact on lions. Because cattle are of great cultural significance to Maasai, their loss can impose social or cultural costs and incite greater resentment and higher levels of retributive killing (Dickman 2013, p. 384; Kissui 2008, p. 429; Hazzah 2006, p. 99). In some areas of Africa, locals believe in ''spirit lions'', a lion whose body is overtaken by evil to kill rivals or their livestock (West 2001 in Dickman 2013, pp. 381–382). Because people believe spirit lions are created by their enemies, the number of perceived spirit lions, and killing of these lions, increases during times of social tension (Dickman 2013, p. 382. The prohibition of ritual lion hunts provides a greater incentive for participating in retaliatory hunts (Packer *et al.* 2010, p. 10; Moghari 2009, pp. 13–14, 28; Ikanda 2008, pp. 5, 6; Kissui 2008, p. 423; Frank *et al.* 2006, p. 10; Hazzah 2006, p. 99).

Social tensions within tribes and between local communities and other communities, the government, park officials, or tourists can lead to conflict and retributive killing of lions (Dickman 2013, p. 382; Hazzah 2006, p. 75). Locals often report that wildlife authorities do not react effectively when chronic livestock raiders are reported (Frank *et al.* 2006, p. 9). Significant numbers of lions have been killed when promised benefits were not received or adequate compensation was not provided for livestock and human losses (Dickman 2013, p. 383; Hazzah 2006, p. 45).

Summary of Human-Lion Conflict

Human-lion conflict and associated retaliatory killing of lions has played a major role in the reduction of lion populations and is the greatest threat to remaining lion populations. The most significant cause of human-lion conflict is livestock depredation and, to a lesser extent, attacks on humans. Expansion of human settlements and agricultural and pastoral activities into lion habitat, and even into protected areas, decreases prey availability and increases exposure of livestock and humans to lions.

The most common solution to lion attacks is retaliatory killing. Spearing, shooting, trapping, and poisoning of lions occur regularly. Although a majority of information on human-lion conflict comes from a few areas of the lion's range, we can reasonably conclude that lions are being killed due to conflict in all major range countries, because of their depredation on livestock (Frank *et al.* 2006, p. 4).

Impacts on victims of lion attacks create resentment towards lions and lion conservation, and a greater likelihood of retaliation. Even when lions are not the predators responsible for the majority of attacks, lions incite a greater response and are killed more often than other predators of livestock.

In areas of high human density and low lion density, mainly in smaller reserves and outside large protected areas, lion populations may not be sustainable. Attacks on humans can impact long-term viability for lions as people who fear for their lives or safety are unlikely to support conservation actions and are more likely to retaliate by killing any lions found near settlements (Frank *et al.* 2006, p. 12). Every year, human-lion conflicts intensify due to habitat loss, poor livestock management, and decreased availability of wild prey, further increasing the likelihood that the subspecies will be at risk of extinction within the foreseeable future (Lion Guardians 2013, p. 1).

Human population growth within the lion's range is projected to be 2.1 billion by 2050 (UN 2012, p. 2). The number of livestock within the lion's range is projected to increase by about 73 percent by 2050 (Food and Agriculture Organization of the United Nations 2012, p. 133). Given this expected increase in humans and livestock by 2050, we conclude the conditions described above will continue to worsen to the point that African lions will likely be at risk of extinction within the foreseeable future. As livestock numbers increase, expansion of agricultural and pastoral practices continue, and the lion's prey base is hunted at unsustainable levels to meet a growing demand for food, livestock depredation and retributive killing of lions will likely increase (Dickman 2013, p. 379; Hoppe-Dominik *et al.* 2011, p. 452; Chardonnet *et al.* 2010, p. 19; Gebresenbet *et al.* 2009, p. 9; Hazzah and Dolrenry 2007, p. 3). Furthermore, as the need for grazing land becomes more critical, expansion of livestock numbers may be partially supported by the network of protected areas, seen by herders as unused pastures (Chardonnet *et al.* 2010, p. 25).

Retaliatory killing of lions continue in many areas and this practice impacts the viability of lion populations throughout its range. The killing of lions due to human-lion conflict is enough to result in the local extirpation of lion populations, though at present does not place the subspecies in danger of extinction. Human-lion conflict is exacerbated by an increasing human population, the expansion of human settlements, loss of prey base due to the bushmeat trade and expanding agriculture, as well as increasing pressures on natural resources to meet the needs of the growing human population. We expect retaliatory killings due to human-lion conflict to continue to increase into the foreseeable future. We conclude based on the best available scientific and commercial information that the continuation of this

activity is a significant threat to the African lion throughout its range.

Disease

Wild lions are known to be infected with various pathogens (Hunter *et al.* 2012, p. 2; Craft 2008, p. 6; Michel *et al.* 2006, p. 92; Hofmann-Lehmann *et al.* 1996, pp. 559–561). The human population within the range of the lion is expanding into lion habitat, increasing the exposure of lions to diseases from domestic animals (IUCN 2006b, p. 26). Because lions are a top predator, they are at a particularly high risk of exposure to pathogens (Keet *et al.* 2009, p. 11). Some pathogens are endemic, meaning they are constantly present, but often do not cause disease. Others are epidemic and cause a sudden severe outbreak with the potential to cause high mortality (Craft 2008, pp. 5, 6). Although lions are known to be infected with certain pathogens, information on the extent of the subspecies' infections and impacts of these diseases on lion populations is limited, because few long-term studies have been conducted; for example, those lion populations found in Serengeti National Park, Ngorongoro Crater, and Kruger National Park.

Feline calicivirus, feline herpesvirus, feline parvovirus, feline coronavirus, and feline leukemia virus are endemic viruses known to occur in lions of Serengeti National Park, Ngorongoro Crater, Lake Manyara National Park, Kruger National Park, and Etosha National Park (but not all viruses are known in all parks). However, these diseases are not known to affect lion survival (Hunter *et al.* 2012, p. 2; Craft 2008, p. 6; Hofmann-Lehmann 1996, pp. 559, 561).

Lions within Kruger National Park and Hluhluwe-iMfolozi Park, South Africa, and Serengeti National Park, Tanzania, are known to be infected with *Mycobacterium bovis,* a pathogen that causes bovine tuberculosis (bTB). This pathogen is not endemic to African wildlife and was likely introduced from cattle imported from Europe. *M. bovis* is transmitted to ungulates, such as African buffalo (*Syncerus caffer*) and wildebeest (*Connochaetes taurinus*) from domestic cattle located on the periphery of the parks (Maas *et al.* 2012, p. 4,206; Keet *et al.* 2009, pp. 4, 11; Renwick *et al.* 2007, p. 532; Michel *et al.* 2006, pp. 92, 93; Cleaveland *et al.* 2005, pp. 446, 449, 450). Spillover of the disease from buffalo to other lion prey species, such as kudu (*Tragelaphus strepsiceros*) and warthog (*Phacochoerus africanus*), have also been documented (Keet *et al.* 2009, pp. 4, 11; Renwick *et al.* 2007, p. 535; Cleaveland *et al.* 2005, p. 450). Because the lion's primary prey are infected with bTB, they are frequently exposed to large amounts of infected tissue and are at risk of infection (Keet *et al.* 2009, pp. 4, 6; Renwick *et al.* 2007, pp. 532, 536; Michel *et al.* 2006, p. 93; Cleaveland *et al.* 2005, pp. 450, 451). Furthermore, predators prey on weak animals and scavenge on carcasses, increasing their likelihood of being exposed to *M. bovis* (Renwick *et al.* 2007, p. 536; Michel *et al.* 2006, p. 93). Transmission may also occur among lions via scratching and biting (Keet *et al.* 2009, p. 7; Renwick *et al.* 2007, pp. 532–533). *M. bovis* is a pathogen that causes the infected animal to remain infectious and, therefore, a source of infection, until it dies (Renwick *et al.* 2007, p. 531).

The social behavior of buffalo and lions allows *M. bovis* to spread to larger areas and facilitates the transmission within and between prides. Drought conditions may also encourage the spread of this pathogen as herds must move into new areas in search of forage, potentially putting them in contact with new, uninfected herds (Keet *et al.* 2009, pp. 4, 6; Renwick *et al.* 2007, p. 533; Michel *et al.* 2006, p. 93). In Kruger National Park, bTB was introduced in the southeastern corner of the park between 1950 and 1960. It gradually made a northern progress and reached the park's northern boundary in 2006. In 2009, the disease was found in buffalo across the river boundary in Zimbabwe (Keet *et al.* 2009, pp. 6, 11; Renwick *et al.* 2007, pp. 532, 533; Michel *et al.* 2006, pp. 92, 96, 98). In time it will likely spread to Mozambique (Keet *et al.* 2009, p. 6). In Serengeti National Park, infection may be widespread due to the large, migratory wildebeest population that ranges throughout the Serengeti ecosystem, including Maasai Mara National Reserve (Cleaveland *et al.* 2005, p. 450). Although an eradication program has been implemented for cattle in South Africa, once an infection is established in a free-ranging maintenance host, like buffalo, it is unlikely to be eradicated (Keet *et al.* 2009, p. 11; Renwick *et al.* 2007, pp. 537, 538; Michel *et al.* 2006, p. 96). In fact, modeling has predicted that prevalence could reach as high as 90 percent over the next 25 years, with similar consequences for predators (Renwick *et al.* 2007, p. 535).

Clinical signs of bTB in lions include: emaciation, respiratory complications, swollen lymph nodes, draining sinuses, ataxia, and lameness (Keet *et al.* 2009, p. 13; Renwick *et al.* 2007, pp. 533, 534; Cleaveland *et al.* 2005, p. 450), although some lions may be subclinically infected but remain asymptomatic until they experience another bTB infection, suffer from poor nutrition or advancing age, or become super-infected with other diseases that may exacerbate the infection (Renwick *et al.* 2007, p. 533). The impact of bTB on lions is largely unknown. Researchers suggest that bTB may lower breeding success, reduce resiliency, and may be a mortality factor based on data that indicate survival is shortened in infected lions, with death ranging between 2 and 5 years after infection (Maas *et al.* 2012, p. 4,212; Renwick *et al.* 2007, p. 536; Michel *et al.* 2006, p. 93; Cleaveland *et al.* 2005, pp. 450, 451). Thirty percent of the inbred populations in Hluhluwe-iMfolozi Park died due to a combination of bTB and malnutrition (Hunter *et al.* 2012, p. 3). A study from Kruger National Park indicated that bTB spreads quickly through lion populations; in an area with high herd prevalence of *M.* bovis, 90 percent of lions became infected (Cleaveland *et al.* 2005, p. 451). However, despite bTB infection and a high prevalence in prey species, the lion population in Kruger National Park has remained stable (Ferreira and Funston 2010, p. 201).

Epidemics of canine distemper virus (CDV) are known to have occurred in the Serengeti-Mara Ecosystem, an area that encompasses the Serengeti National Park, Ngorongoro Conservation Area, and Maasai Mara National Reserve (Craft 2008, pp. 13–14; Cleaveland *et al.* 2007, pp. 613, 616, 618). CDV is a common pathogen in the large population of domestic dogs around the Serengeti-Mara Ecosystem, which are believed to be the source of CDV (Cleaveland *et al.* 2007, pp. 613, 617). CDV is assumed to be transferred to lions by the sharing of food sources with spotted hyenas (*Crocuta crocuta*) or jackals (*Canis* spp.) that become infected by consuming the infected carcasses of domestic dogs (*Canis lupus familiaris*). Lions may also transmit CDV among themselves via sharing food, fights, and mating (Craft *et al.* 2009, pp. 1,778, 1,783; Craft 2008, pp. 13, 18, 71).

CDV generally lacks clinical signs or measurable mortality in lions, and most CDV events have been harmless. However, in 1994 and 2001, CDV epidemics in the Serengeti National Park/Maasai Mara National Reserve and Ngorongoro Crater, respectively, resulted in unusually high mortality rates (Hunter *et al.* 2012, p. 2; Craft 2008, p. 14; Munson *et al.* 2008, pp. 1, 2; Cleaveland *et al.* 2007, pp. 613, 618; Roelke-Parker *et al.* 1996, pp. 441, 443). These outbreaks coincided with climate extremes that resulted in a higher number of *Babesia,* a tick-borne

parasite, infections (Munson *et al.* 2008, pp. 2, 5). *Babesia* is common in lions, but typically at low levels with no measurable impacts on their health (Craft 2008, p. 14; Munson *et al.* 2008, p. 3). However, droughts in 1993 and 2000 in Serengeti National Park/Maasai Mara National Reserve and Ngorongoro Crater, respectively, led to large-scale starvation and widespread die-offs of buffalo. This situation combined with resumption of rains and fire suppression in Ngorongoro Crater favored propagation of ticks, vectors of *Babesia,* leading to unusually high tick burdens. The compromised health of buffalo allowed lions to feed on an inordinate number of tick-infested prey (Craft 2008, p. 14; Munson *et al.* 2008, pp. 2, 4, 5).

Exposure to either CDV or *Babesia* singly is not typically associated with a compromise in health or an increase in mortality (Craft 2008, p. 14; Munson *et al.* 2008, pp. 1, 2, 3). However, the *Babesia* infections were exacerbated by the immunosuppressive effects of CDV and led to the unusually high mortality rates (Craft 2008, p. 14; Munson *et al.* 2008, p. 5). The Serengeti National Park/Maasai Mara National Reserve lion population lost 30 percent of its population (approximately 1,000 lions), but has recovered to its pre-epidemic population levels (Craft 2008, pp. v, 14, 41; Munson *et al.* 2008, p. 1; Cleaveland *et al.* 2007, pp. 613, 617; Roelke-Parker *et al.* 1996, p. 444). Thirty-four percent of the Ngorongoro Crater lion population was killed, but frequent outbreaks of disease have prevented this population from recovering back to its carrying capacity (Craft 2008, p. 14; Munson *et al.* 2008, pp. 1, 2; Cleaveland *et al.* 2007, p. 617). The difference in recovery is likely due to the highly inbred nature of the Ngorongoro Crater lion population, compared to the Serengeti population, and its greater susceptibility to parasitic and viral infections (Hunter *et al.* 2012, p. 2; Munson *et al.* 2008, p. 5; Brown *et al.* 1994, pp. 5,953–5,954).

Feline immunodeficiency virus (FIV) is an endemic pathogen in many lion populations of southern and eastern Africa (Maas *et al.* 2012, p. 4,206; Adams *et al.* 2011, p. 173; Pecon-Slattery *et al.* 2008, p. 2; Hofmann-Lehmann *et al.* 1996, pp. 555, 558; Brown *et al.* 1994, p. 5,966). FIV is believed to have been present in lions since the late Pliocene (O'Brien *et al.* 2012, p. 243; Troyer *et al.* 2011, p. 2; Roelke *et al.* 2009, p. 3; Pecon-Slattery *et al.* 2008, p. 8). There are 6 subtypes of FIV, A through F, each with a distinct geographic area of endemnicity (Adams *et al.* 2011, p. 174; Troyer *et al.* 2011, p. 2; Roelke *et al.* 2009, p. 3; Pecon-Slattery *et al.* 2008, p. 4; O'Brien *et al.* 2006, p. 262). The social nature of lions allows for viral transmission within and between prides through saliva when biting (Maas *et al.* 2012, p. 4210; Pecon-Slattery *et al.* 2008, p. 5; Brown *et al.* 1994, p. 5,953). Prevalence of FIV in infected lion populations is high, often approaching 100 percent of adults (O'Brien *et al.* 2012, p. 243; Troyer *et al.* 2011, p. 2; Roelke *et al.* 2009, p. 3; O'Brien *et al.* 2006, p. 262; Hofmann-Lehmann *et al.* 1996, p. 559).

FIV causes immune deficiencies that allow for opportunistic infections in the host (Brown *et al.* 1994, p. 5,953). Chronic effects of FIV are important to long-term survival and differ according to subtype (Troyer *et al.* 2011, p. 6). Studies have indicated that lions may exhibit signs of opportunistic infection associated with AIDS, such as swollen lymph nodes, gingivitis, tongue papillomas, dehydration, poor coat condition, and abnormal red blood cell parameters, and in some cases death (Troyer *et al.* 2011, p. 2; Roelke *et al.* 2009, pp. 2, 3–6). Lions in Botswana and Tanzania have demonstrated multiple clinical features of chronic immune depletion similar to HIV and domestic cat AIDS (Troyer *et al.* 2011, pp. 2–3). However, there is no evidence that it poses a threat to wild populations (Frank *et al.* 2006, p. 1); FIV does not appear to be impacting lions in Kruger National Park (Maas *et al.* 2012, p. 4,212), and no evidence of AIDS-like illnesses or decreased lifespan has been found in FIV lion populations in the Serengeti (O'Brien *et al.* 2006, p. 263).

Infection with a single disease does not appear to have detrimental impacts on lions, although general body condition, health, and lifespan may be compromised. Co-infections, however, could have synergistic effects that lead to greater impacts on lions than a single infection. Lions impacted by the 1994 CDV outbreak in Serengeti National Park/Maasai Mara National Reserve may have been more susceptible to CDV due to depleted immunity caused by FIV (O'Brien *et al.* 2006, p. 263). Troyer *et al.* (2011, pp. 5–6) found that survival during the CDV/*Babesia* outbreak in Serengeti National Park/Maasai Mara National Reserve was significantly less for lions infected with FIV A and/or C than FIV B. This finding suggests that FIV A and C may predispose carriers to CDV pathogenesis and may increase the risk of mortality (O'Brien *et al.* 2012, p. 243). Additionally, certain environmental conditions may exacerbate the effects of an otherwise innocuous infection. For example, as discussed above, CDV and *Babesia* infections generally have no measurable impacts on lion health, but climatic conditions increased exposure of lions to *Babesia* infections, which were exacerbated by the immunosuppressive effects of CDV and led to unusually high mortality rates. Furthermore, species with reduced genetic variation may be less able to mount an effective immune response against an emerging pathogen (O'Brien *et al.* 2006, p. 255). Some lions infected with bTB may remain asymptomatic until conditions change and they suffer from poor nutrition due to low prey density, advancing age, or become super-infected with other diseases that may exacerbate the infection (Renwick *et al.* 2007, p. 533). Impacts of coinfections of FIV with FCV, FPV, FHV, and FCoV on individual lions are negligible and do not endanger the lion population, at least in the absence of other aggravating cofactors (Hofmann-Lehmann *et al.* 1996, p. 561). Pathogen–pathogen interactions may become more important when lions are under additional stress (e.g., increased parasite load or low prey density) (Maas *et al.* 2012, p. 4,212).

Although disease is known in several populations, the impacts are known in only a couple of populations where disease has been frequently studied. Disease can be a factor in the decline of lions when combined with other factors, including environmental changes, reduced prey density, and inbreeding depression. However, this type of impact has been observed in some small populations that are at a higher risk, but has not been observed at the species population level. Therefore, we conclude, based on the best scientific and commercial information available, that disease is not a significant threat to the species.

Deleterious Effects Due to Small Population Sizes

The risk of extinction is related to the moment when a declining population becomes a small population and is often estimated using minimum viable population (MVP) sizes (Traill *et al.* 2010, p. 28). The viability of a lion population is complex, but it partly depends on the number of prides and ability of males to disperse and interact with other prides, which affects exchange of genetic material (Bjorklund 2003, p. 518). Without genetic exchange, or variation, individual fitness is reduced and species are less able to adapt to environmental changes and stress, increasing the risk of extinction (Bijlsma and Loeschcke 2012, pp. 117, 119; Segelbacher *et al.* 2010, p. 2; Traill *et al.* 2010, p. 31; Bjorklund 2003, p. 515).

Some scientists believe that the minimum viable population size (MVP) to maintain genetic viability is between 500 and 5,000 individuals, although this estimate is not specific to lion (Bijlsma and Loeschcke 2012, p. 122; Traill *et al.* 2010, p. 30; Willi *et al.* 2006, p. 449). The MVP for the African lion has not been formally established and agreed upon by species experts (Riggio *et al.* 2011, p. 5; CITES 2004, p. 2; Bjorkland 2003, p. 521); however, it has been suggested that, to conserve genetic diversity populations of 50 to 100 prides (250 to 500 individuals), with no limits to dispersal, are necessary because inbreeding increases significantly when populations fall below 10 prides. If there are less than 10 prides, inbreeding will increase from an F-value of 0.0 in the initial state to an F-value 0.26–0.45 after 30 generations, while if the number of prides is 100 this F-value is only around 0.05 assuming no migration into the population (Bjorkland 2003, p. 515). F is the probability that the two alleles of a gene in an individual are identical by descent. Therefore, the Service considers the MVP to be 50 prides. Because the number of prides and male dispersal are the most important factors for maintaining viability, sufficient areas are needed to support 50 or more prides and allow unrestricted male dispersal. Unfortunately, few lion populations meet these criteria, and few protected areas are large enough to support viable populations (Bauer *et al.* 2008, unpaginated; Riggio 2011, p. 5; Hazzah 2006, p. 2; Bauer and Van Der Merwe 2004, pp. 28–30; Bjorklund 2003, p. 521). Even within large areas, inbreeding will increase if dispersal is limited, (Bjorklund 2003, pp. 521–522). More than 6,000 lions are in populations where their probability of survival is likely to be at risk of extinction within the foreseeable future (Riggio *et al.* 2013, p. 33). Furthermore, research indicates that there is a general lack of gene flow in most lion conservation units (Dubach *et al.* 2013, pp. 749, 750; Bertola *et al.* 2011, p. 1364; Chardonnet *et al.* 2009, p. 54). Small populations (e.g. fewer than 50 lions) can persist in the wild for some time; however, the lack of dispersal and genetic variation can negatively impact the reproductive fitness of lions in these populations and local extirpation is likely (Traill *et al.* 2010, p. 30; O'Brien 1994, p. 5,748).

Increasing human population growth between now and 2050 will continue to decrease and fragment large areas of habitat needed to support viable lion populations and disrupt dispersal routes for genetic exchange. Additionally, as the human population grows and lion populations decline, as discussed above, more lion populations could reach levels below the suggested minimum of 10 prides to maintain genetic diversity, putting more populations at risk of inbreeding and extirpation. Therefore, we conclude, based on the best scientific and commercial information available, that small population sizes currently pose a threat to the species.

Trophy Hunting

Trophy hunting (also known as sport hunting) has been identified by the petitioners as one of the factors contributing to the decline of African lions (Petition 2011, p. 24). Lions are a key species in sport hunting as they are considered one of the ''big five'' (lion, leopard, elephant, rhino, and cape buffalo), touted to be the most challenging species to hunt, due to their nimbleness, speed, and behavioral unpredictability (Lindsey *et al.* 2012a, p. 2). However, with the documented decline in lion population numbers throughout Africa, the sport hunting of lions for trophies has become a highly complex issue that has raised considerable controversy among stakeholders.

Range Countries

As of May 2014, approximately 18 countries in Africa permit lions to be hunted for trophies: Benin, Burkina Faso, Central African Republic (CAR), Democratic Republic of Congo (DRC), Ethiopia, Ivory Coast, Mali, Mozambique, Namibia, Senegal, Somalia, South Africa (RSA), Sudan, Tanzania, Togo, Uganda, Zambia, and Zimbabwe. However, in 2013 lion trophy hunting was only documented to occur in nine countries, specifically Benin, Burkina Faso, CAR, Mozambique, Namibia, RSA, Tanzania, Zambia, and Zimbabwe (Lindsey 2013, personal communication). Four countries, Burundi, Guinea Bissau, Lesotho, and Swaziland, provide no legal protection for lions (CITES 2014a, p. 14).

Hunting Moratoriums

In response to growing international recognition of reduced population numbers, many countries began implementing moratoriums banning the sport hunting of lions. In this document we use the terms moratorium and ban interchangeably. A ban or moratorium can be permanent, long term, or temporary, and can occur in countries that have hunting quotas in place. Having both a moratorium and a quota in place at the same time means that, although the country may have a hunting quota, the country has halted authorization of trophy hunting pursuant to that quota until some later date or until some further action is taken, as prescribed by that country. Therefore, you will see us refer to countries like Zambia and Botswana, each of which has hunting quotas and bans in place. Trophy hunting is currently banned in 12 countries: Angola, Botswana, Cameroon,[7] Congo, Gabon, Ghana, Kenya, Malawi, Mauritania, Niger, Nigeria, and Rwanda (CITES 2014a, p.14; Lindsey *et al.* 2013a, entire; Lindsey 2013, pers. comm.; Jackson 2013, pp. 7–8). Botswana banned lion hunting between 2001 and 2004, and then again from 2008 to the present (Davison *et al.* 2011, p. 114). Kenya banned all sport hunting in 1977 (African Wildlife Foundation 1998, p. 3). Trophy hunting is restricted to problem or dangerous animals in Ethiopia and Uganda (Lindsey 2008, p. 42). Zambia banned all sport hunting in January of 2013; while restrictions were lifted from other trophy species in August 2014, the ban on lions and leopards remains in place (ABC News 2014, unpaginated; Flocken 2013, unpaginated). In 2011, researchers in Cameroon suggested that there should be an immediate moratorium of at least 5 years on the hunting of lions in Cameroon, during which lions are allowed to recover and a management plan for lion hunting is established (Croes *et al.* 2011).

Quotas

A scientifically based ''quota'' is the maximum number of a given species that can be removed from a specific population without damaging the biological integrity and sustainability of that population (World Wildlife Fund (WWF) 1997, p. 9). For a quota to be scientifically based, it must be based upon available monitoring data of the species. Although varying by country and by economic resources, monitoring data used to determine quotas have included, but are not limited to, past hunting off-take records, trophy quality data, ground transect surveys, wildlife ranger and safari operator input, the species' reproductive biology, and aerial population census data, although usually aerial data is limited to species that can be easily observed from the air, such as elephants and buffalo (Barnett & Patterson 2005, p. 102). Generally, the conservation principle behind scientifically based quotas is to limit

[7] We found conflicting data on Cameroon, which was reported to prohibit trophy hunting (CITES 2014, p. 14), although other information provided by Lindsey (2013, pers. comm.) and Jackson (2013, p. 8) state that trophy hunting is legal in Cameroon.

offtake of the species to either equal or slightly lower than the growth rate of the target specimens (e.g., males vs. female), provided the offtake does not damage the integrity and sustainability of that population.

In order for scientifically based quotas to result in offtake less than the growth rate of target specimens, many factors are evaluated including the species' biological factors (reproductive rate, gender, age, and behavior), as well as community and client objectives (WWF 1997, pp. 14–19). Each quota should be then assigned to a geographical area and/or population based on this information. Thus, for lions, a scientifically based quota defines the specific number of lions that can be removed from a specific geographical area and population, for any purpose, within a particular year. Scientifically based quotas do not apply solely to sport hunting, but set the limits for all offtake for a particular year; other potential offtake includes problem-animal control (to reduce human-wildlife conflict), translocation (to expand conservation), culling (reducing population pressures), and local hunting (for protein/meat or employment) (WWF 1997, pp. 8–10).

While each of these uses offers advantages and disadvantages, quotas are typically utilized only for sport hunting, as it may provide the highest all-around benefits to local communities. For example, a portion of a quota could be used to kill a problem animal; the benefits to the community would then include the use of the animal parts for meat or trade and it would theoretically reduce the conflict. However, this provides a more limited economic benefit to the community than would selling the same quota for trophy hunting, which could potentially eliminate the problem animal, provide meat and parts for trade, and provide revenue for the community (WWF 1997, pp. 31–33).

There are two primary types of quotas, ''fixed'' and ''optional.'' Trophy fees for ''optional'' quotas are paid only when the lion is shot, whereas, ''fixed'' quotas require the payment of a portion (40–100 percent) of the lion trophy fee, regardless of whether the hunt is successful. Until 1999, male lions were typically on ''fixed'' quotas, whereas female lions were under ''optional'' quotas. Due to this approach, trophies collected in the 1990's were often of lower quality, younger, less desirable male lions, as operators and hunters had no incentive to be selective (e.g. the hunter had already paid for it). Therefore, current recommendation for all quotas is to be the ''optional'' type (Lindsey *et al.* 2013a, p. 9; Packer *et al.* 2006, pp. 5, 9).

Two primary concerns have been raised by the scientific and international community with regards to current lion quotas. Specifically, that existing quotas are set above sustainable levels and the data used for setting quotas is inconsistent and not scientifically based (Hunter *et al.* 2013, unpaginated; Lindsey *et al.* 2006, p. 284). For example, recent quotas appear rarely to address safeguards for sustainability or establish a systematic approach to setting lion quotas (Hunter *et al.* 2013, p. 2; Lindsey *et al.* 2013b, p. 8). Additionally, it has been noted that previous quotas in Namibia, Mozambique, and Zimbabwe may have been influenced by human-lion conflict, with higher quotas being allocated to locations with reportedly higher human-lion conflict levels (Lindsey *et al.* 2013b, p. 4). Apparently, in recognition of these inconsistencies, range countries and conservationists have been working to establish a set of best practices in order to create a more consistent, scientifically based approach to determining quotas. The recommended best practices include: (1) Establishing processes and procedures that are clearly outlined, transparent, and accountable; (2) establishing processes and procedures that are CITES compliant;(3) demonstrating management capacity; (4) standardizing information sources; (5) establishing monitoring systems for critical data; (6) recording and analyzing trophy hunting data; (7) conducting data collection and analysis for each hunting block and concession; and (8) establishing a primary body who will approve quotas (Burnett and Patterson 2005, p. 103). We have no information on whether these best practices have been implemented by the lion range states. However, most countries that allow trophy hunting of lions appear to be reviewing their trophy hunting practices (Jackson 2013, pp. 2–3; White 2013, pp. 12–13). Benin halved their quotas in 2002 after the first population census of lions was conducted and resulted in the current quota of six lions every 2 years in Pendjari and four lions every 2 years in western Benin or one lion annually in each of the five hunting zones. This was largely due to impacts to lions from habitat degradation and fragmentation (particularly exacerbated by the increase of human population), loss of prey by poaching, trade (both legal and illegal), and human-lion conflict. (CITES 2014a, p. 5; Sogbohossou 2014, p. 1).

Throughout the countries in Africa, most appear to have reduced their offtake considerably since the 1990's. According to Packer *et al.* (2006, pp. 2–3), regardless of population estimates, countries are allowing for only a small proportion of their lion populations to be hunted, with most countries ranging from 2–4 percent annually (excluding offtake from South Africa, where offtake has been increasing from the trophy hunting of primarily captive-born lions, and Zimbabwe, where offtake was 2–3 percent higher than other countries from 1998–2004.

Regardless of these reductions, many stakeholders consider the quota system to be outdated and ineffective because it does not address the biological and social impacts of trophy hunting on lion prides. Opponents also state that trophy hunting affects the social structure of the pride and results in increased infanticide of lion cubs. This supposition is inconclusive and not well supported (CITES 2014a, p. 14; Dagg 2000, pp. 831–835) (See Infanticide and Age-based Hunting Strategies). Regardless, since 2006, researchers have recommended the implementation of age-based hunting strategies; these are discussed below (Packer *et al.* 2006, pp. 6–8).

Five countries maintain quotas to allow for approximately 6–15 lion trophies to be taken per year: Benin, Burkina Faso, Cameroon,[7] Mozambique, and Namibia. Tanzania allows the take of approximately 50 lions annually, and Zimbabwe allows approximately 70 animals annually to be taken (Jackson 2013 pp. 7–8, CITES WCMC–UNEP trade database, accessed December 2013). In Ethiopia and Uganda, trophy hunting is restricted to problem or dangerous animals only (Lindsey 2008, p. 42), and Botswana and Zambia currently ban all trophy hunting (CITES 2014a, p.14). South Africa has not set a quota for the take of wild lions since 99 percent of the trophy-hunted lions are reportedly not of wild origin, but captive-born (Hunter *et al.* 2013, p. 2; RSA 2013, pp. 5, 7).

Below is a summary of estimated annual hunting quotas for the African lion:

TABLE 7—ANNUAL TROPHY QUOTAS (APPROXIMATE) AS OF 2013

Country	Annual lion trophy quotas (Jackson 2013, pp. 7–8)
Benin	6
Botswana (moratorium)	30
Burkina Faso	6
Cameroon[7]	6
Mozambique	15
Namibia	10
Tanzania (as of 2012)	50

TABLE 7—ANNUAL TROPHY QUOTAS (APPROXIMATE) AS OF 2013—Continued

Country	Annual lion trophy quotas (Jackson 2013, pp. 7–8)
Zambia (moratorium)	50
Zimbabwe	70

Import/Export of Lion Trophies

Although each country has its own method of regulating trophy hunting, international trade of lion trophies must adhere to CITES (see Conservation Status). International trade of lion parts and products (including trophies) are reported by both the exporting and importing countries and tracked by the United Nations Environment Programme World Conservation Monitoring Centre (UNEP–WCMC). The international trade data on the African lion that has been compiled in the CITES UNEP–WCMC Trade Database is extensive. Therefore, it is likely that the actual numbers of African lion parts and products in international trade is slightly smaller than what we have reported using the UNEP–WCMC ''gross exports'' report (CITES lion gross exports, *http://trade.cites.org,* accessed April 23, 2014).

In 2012, the most recent year for which CITES trade data are available, U.S. CITES Annual Report trade data indicated that the United States allowed the direct import of African lion trophies from eight African countries, as follows:

Central African Republic = 1 trophy
Ethiopia = 1 trophy
Mozambique = 5 trophies
Namibia = 5 trophies
South Africa = 413 trophies (the majority of which are reported to be of captive-born origin)
Tanzania = 42 trophies
Zambia = 32 trophies
Zimbabwe = 49 trophies

According to the CITES UNEP–WCMC database, between 2005 and 2012, exports of lion trophies have demonstrated a decreasing trend when exports of captive-born lions from South Africa are excluded (CITES lion gross exports, *http://trade.cites.org,* accessed April 23, 2014). For example, in 2005 there were 874 lion trophy exports reported in UNEP–WCMC, 521 if South Africa were excluded; whereas in 2012, there were 1,237 lion trophy exports reported in UNEP–WCMC, 336 if South Africa is excluded.

Here it should be noted that there are limitations to interpreting the above reported information. The 2004 guide to using the CITES Trade Database indicates that the outputs produced by the CITES Trade Database can be easily misinterpreted if one is not familiar with it (CITES 2004b, p. 5). The number of ''trophies'' reported does not necessarily equate to the number of lions hunted. Additionally, the number of trophies reported for a given year in the trade report does not equate directly to the number of animals hunted in that given year (CITES export permits may be valid for 6 months, and a trophy could in theory be exported the year after it was hunted). The second limitation to interpreting this information is, although many permits may indicate that an animal is of wild origin (source code ''W''), these permits may be incorrectly coded. This is true for South Africa, where during the period of 2000 to 2009, animals that were captive-born and released into private reserve systems were assigned an incorrect source code of ''wild.'' South Africa has since requested their provincial authorities to use the correct source code for ''captive bred'' in order to correctly reflect the source of sport-hunted lion trophies; however, some provinces are still not complying (RSA 2013, pp. 8–9). However, based on South African trade data, the bulk of the exports of lions and their parts and products (including trophies) from South Africa were from captive-born lions (RSA 2013, p. 7).

Tanzania, with the highest lion populations (Hamunyela *et al.* 2013, pp. 29, 283; Riggio *et al.* 2013, p. 32; Ikanda 2008, p. 4; Baldus 2004, pp. 5, 6), was the largest exporter of wild-origin lion trophies, but their exports have decreased significantly since 2006. In 2008, approximately 138 lions had been estimated to be killed in Tanzania as trophies. In 2010, Tanzania's numbers declined to 128 exports, 55 in 2011, and 42 in 2012 (CITES lion gross exports, *http://trade.cites.org/,* accessed April 25, 2014). In 2012, Tanzania established an annual quota to limit trophy hunting to no more than 50 animals (Jackson 2013, p. 7). Again, it should be noted that there may be discrepancies between the annual quota and the actual number of trophies exported in a given year (see *http://www.cites.org/common/resources/TradeDatabaseGuide.pdf* for additional information). Regardless, the numbers of lion trophies exported by Tanzania according to the UNEP–WCMC database suggest a decreasing trend.

In other areas within the range of the African lion, the number of lions hunted or authorized to be hunted annually has remained fairly consistent. In Burkina Faso, approximately 12 lions per year have been hunted over the past two decades (IUCN 2009, pp. 36–37; Bauer and Nowell 2004, p. 36), although their current annual quota is 6 animals. In Botswana, a quota of 30 lions per year was authorized for nearly two decades; however, Botswana has recently implemented a hunting moratorium (Jackson 2013, p. 8). (CITES lion gross exports, *http://trade.cites.org,* accessed April 23, 2014; CITES UNEP–WCMC database, accessed January 8, 2014, and August 16, 2013).

Potential Impacts of Trophy Hunting

Infanticide and Age-Based Hunting Strategies

Tourist safari hunting of males has been suggested by the petitioners to increase infanticide rates (when males kill young lion cubs sired by other males) (Petition 2011, p. 24; Whitman *et al.* 2004, p. 175), due in part to trophy hunters taking males under a certain age. Removing a younger male lion is purported to allow another male to take over the pride, and kill the former patriarch's cubs. This supposition is inconclusive and not well supported (CITES 2014a, p. 14; Dagg 2000, pp. 831–835). Infanticide is a common practice among many species, including lions (Hausfater *et al.* 1984, pp. 31, 145, 173, 487). When an adult male lion in a pride is killed, surviving males who form the pride's coalition become vulnerable to takeover by other male coalitions, and this often results in injury or death of the defeated males (Davidson *et al.* 2011, p. 115). In some cases, replacement males who take over the pride will kill all cubs less than 9 months of age in the pride (Whitman *et al.* 2004, p. 175). One range country specifically addressed this issue; the Republic of Namibia indicates that lion populations reproduce at similar rates in both harvested and non-harvested populations, but it is unclear whether cub survival is consistent in harvested vs. non-harvested lion populations.

While utilizing individual-based simulation models, Whitman *et al.* (2004, pp. 175–177) found that if offtake is restricted to males older than 6 years of age, then trophy hunting will likely have minimal impact on the pride's social structure and young (Packer *et al.* 2006, p. 6). This 6-year age restriction approach for lion trophies is in the process of being self-implemented, along with other best practices, by professional hunting guides, and is being adopted by certain range states (White 2013, p. 14; Davidson *et al.* 2011, p. 114; Whitman *et al.* 2004, p. 176). It involves conducting an age assessment of male lions using identification

techniques, such as mane development, facial markings, nose pigmentation and tooth-aging, to establish the relative age of male lions. Tooth wear on incisors, yellowing and chipping of teeth, coupled with scars, head size, mane length and color, and thinning hair on the face, as well as other factors can be an indicator of advanced age in lions (Whitman and Packer 2006, entire). Although these characteristics may be subjective, as regional differences may occur between lion populations, there are clear attempts by the trophy hunting community to establish and implement best practices. Promoting the removal of males 6 years of age or older, theoretically allows younger males the opportunity to remain resident long enough to rear a cohort of cubs (allowing their genes to enter the gene pool; increasing the overall genetic diversity). By removing males in a manner that promotes healthy population growth, the lion population could yield more males in the long term (Davidson *et al.* 2011, p. 114; Whitman *et al.* 2004, p. 176). The governments of Tanzania, western Zimbabwe, Mozambique in the Niassa National Reserve, Zambia, and most recently Benin have instituted or are in the process of instituting reforms such as 6-year age restrictions on lion trophies to increase the likelihood that trophy hunting of lion is sustainable in those countries (Van der Merwe 2013, p. 2; Jackson 2013, p. 3; White 2013, p. 14; Dallas Safari Club 2013, pp. 1–2; Hunter *et al.* 2013, p. 2).

In addition to quota-setting, moratoriums, and the 6 year age limit, it has been reported that more protective standards and guidelines are implemented, such as the best practices listed below (Jackson 2013, pp. 3, 8–10, Dallas Safari Club 2013, pp. 1–2).

- Minimum trophy quality, sizes, and standards;
- Wildlife hunting regulations enacted and enforced;
- Professional hunting associations formed;
- Professional hunting training courses;
- Professional hunter standards established;
- Quota-setting procedures;
- Compliance with CITES demonstrated;
- Monitoring; and
- Information and data collection and analysis.

While the supposition of increased infanticide due to the remove of established males from a pride is inconclusive and not well supported, it is clear that improved management practices are beneficial to maintaining viable lion populations. Developing and implementing best management practices, while not categorically establishing a direct correlation with increased population numbers and health, do appear to have practical impacts on lion populations. Based on the best available scientific and commercial information, infanticide, as a result of the removal of lions through hunting, is not a threat to African lions. Further, it is not likely to become a threat in the foreseeable future since the science is not well supported as to whether infanticide resulting from offtake due to trophy hunting is a significant threat to the subspecies (Whitman *et al.* 2004, pp. 175–176; CITES 2014a, p. 14).

Corruption

Corruption is common in some areas within the range of the African lion, particularly in areas with extreme poverty (Michler 2013, pp. 1–3; Kimati 2012, p. 1; Garnett *et al.* 2011, p. 1; IUCN 2009, p. 89; Leader-Williams *et al.* 2009, p. 296–298; Kideghesho 2008, pp. 16–17; *http://www.transparency.org*). Several of the range countries of African lion have experienced political instability for many years, which appears to be a contributing factor in intensifying levels of corruption. Political instability results in war and famine, which essentially halt conservation efforts and the enforcement of existing wildlife protection laws (Barnett & Patterson 2005, p. 82). Corruption manifests itself in several ways, including embezzlement of funds and acceptance of bribes to overlook illegal activities or for political influence (Garnett *et al.* 2011, p. 1). Given the financial aspects of sport hunting, it is reasonable to assume that corruption and the inability to control it could have a negative impact on decisions made in lion management by overriding biological rationales with financial concerns.

Corruption has complex roots and will not end immediately, but from all appearances, it is being addressed in many of the African lion range countries where it has occurred in the past. Countries throughout the range of the African lion are putting tools in place to combat corruption and create awareness (*http://www.transparency.org/cpi2012/results,* accessed June 20, 2013). In recent years, in several African lion range countries, leadership has taken steps to address corruption, or activities that facilitate corruption, associated with wildlife management. For example, in 2013, the Tourism Minister of Zambia banned hunting in 19 game management areas for 1 year due to corruption and malpractice among the hunting companies and various government departments. Some game management areas and privately owned game ranches were not included in the ban, but lion hunting appears to be currently prohibited throughout the country (Michler 2013, pp. 1–3). According to some authors (Martin 2012, pp. 4, 104; Kimati 2012, p. 1; Kideghesho 2008, pp. 16–17), corruption in the wildlife sector has often been one of the most discussed topics in Tanzania's National Assembly, which presumably would indicate the awareness of and willingness to address the corrupting factors in the wildlife sector.

Provided that countries continue to address corruption within the wildlife sector, we conclude, based on the best scientific and commercial information available, that corruption, in and of itself, does not currently pose a threat to the species. However, if efforts to address corruption do not continue, it could become a threat to African lions in the future.

Revenue From Trophy Hunting

The high value of lions makes them one of the most expensive large game species to hunt. The revenue derived from lion hunting is substantial. Lions are reported to generate the highest daily rate of any mammal hunted (USD $2,650 per day), the longest number of days that must be booked, and the highest trophy fee ($24,500) (Jackson 2013, p. 6; Lindsey *et al.* 2012a, p. 5). According to Groom (2013, p. 4), a 21-day lion hunt in Zimbabwe may be sold for approximately $2,500 per day, with an additional trophy fee of $10,000. Depending on the country in which a hunter visits, there may be several different fees required, including game fees, observer fees, conservation fees, permit fees, trophy handling fees, and government payments in terms of taxes, as well as safari operator fees (Barnett & Patterson 2005, p. 71). In the late 1990's, Tanzania reported annual revenue of $29.9 million from all trophy hunting, South Africa reported $28.4 million, Zimbabwe reported $23.9 million from all trophy hunting, Botswana reported $12.6 million, and Namibia reported $11.5 million; the revenue generated solely from lion hunting was not broken out (Barnett & Patterson 2005, p. iv). In the past, government and private land owners were the primary beneficiaries of the revenue gained; however, a portion of the revenue derived from hunting, in some countries, is now being distributed to local communities as well, which benefits the livelihoods of local people as well as contributes to

national economies of African range states (Barnett & Patterson 2005, p. vi).

Trophy Hunting as a Wildlife Management Tool

The concept of using trophy hunting to support lion conservation is complex and counterintuitive to many. Many range countries rely heavily on tourism (predominantly ecotourism and safari hunting) to provide funding for wildlife management (IUCN 2006a, p. 24). The countries that rely most on lion hunting are proportionally the highest in Mozambique, Tanzania, and Zambia (Lindsey *et al.* 2012a, pp. 7–8). The revenue generated from these industries provides jobs for locals, such as game guards, cooks, drivers, and security personnel, and often brings in revenue for local microbusinesses that sell art, jewelry, and other native crafts. Revenue generated from scientifically based management program is used to build and maintain fences, provide security personnel with weapons and vehicles, provide resources for anti-poaching activities, and provides resources for habitat acquisition and management (Chardonnet *et al.* 2010, pp. 33–34; Newmark 2008, p. 321). Revenue from trophy hunting increases the ability of many African countries to manage wildlife populations both within and adjacent to reserves; many of these hunting areas are geographically linked to national parks and reserves, providing wildlife corridors and buffer zones (Chardonnet *et al.* 2010, p. 34; Newmark 2008, p. 321).

Proponents and most species experts support trophy hunting as a conservation tool for the African lion (Hunter 2011, entire; van der Merwe 2013, entire; Hunter *et al.* 2013, entire) because it provides: (1) Incentives for the conservation of large tracts of prime habitat, and (2) funding for park and reserve management, anti-poaching, and security activities. As habitat loss has been identified as one of the primary threats to lion populations, it is notable that the total amount of land set aside for hunting throughout Africa, although not ameliorating the concerns about habitat loss, exceeds the total area of the national parks, accounting for approximately half of the amount of viable habitat currently available to lions (Chardonnet *et al.* 2010, p. 34; Packer *et al.* 2006, pp. 9–10). In Tanzania, 25–33 percent of the total area, encompassing 190 hunting units and over 247,000 km^2, has been set aside for sport hunting purposes; this has resulted in an area 5.1 times greater than Tanzania's fully protected and gazetted parks (Jackson 2013, p. 6; Barnett & Patterson 2005, p. 61).

In Botswana, despite the current ban on lion hunting, the country currently has over 128,000 km^2 of gazetted wildlife management areas and controlled hunting areas set aside for hunting purposes, which equates to 22.1 percent of the country's total area. This is in addition to 111,000 km^2 (or 19.1 percent) that has been set aside as habitat in the form of National Parks, Game Reserves, and Forest Reserves (Barnett & Patterson 2005, p. 7). Tanzania has land set aside for sport hunting in the form of safari areas, communal land, and privately owned properties that make up 23.9 percent of the total land base (Barnett & Patterson 2005, pp. 76–77). In 2000, five countries in southern Africa (Botswana, Namibia, South Africa, Tanzania, and Zimbabwe) had set aside a combined 420,000 km^2 of communal land, 188,000 km^2 of commercial land, and 420,089 km^2 of state land totaling over 1,028,000 km^2 for sport hunting purposes (Barnett & Patterson 2005, p. iii). As a species with a considerable range (up to 1,000 km^2) (Packer *et al.* 2013 p. 636; Haas *et al.* 2005, p. 4), suitable habitat is important to the survival of the species, and the marked decline in suitable habitat is a significant threat to the species (see Habitat Loss). The land currently designated for use in sport hunting has helped to reduce, but not eliminate, the impact of habitat loss for the African lion.

Cost estimates for maintaining lion populations range, from an annual budget of $500 per km^2 in smaller fenced reserves to $2,000 per km^2 annually for unfenced populations (Packer *et al.* 2013, p. 640; Lindsey *et al.* 2012a, p. 9). This includes but is not limited to costs associated with permanent and temporary staff, fencing installation and maintenance (fences can cost $3,000 per km to install), infrastructure maintenance, anti-poaching activities such as surveillance and snare/trap removal, wildlife restocking fees (both for lions killed by illegal poaching/snares as well as other trophy species killed by lions on the reserves), community outreach, and compensation for loss of livestock in surrounding communities (Packer *et al.* 2013, p. 640; Groom 2013, pp. 4–5; Lindsey *et al.* 2012a, p. 9; Barnett & Patterson 2005, p. 82). For example, in the past, the Savé Valley Conservancy in Zimbabwe invested $546,000 annually on anti-poaching activities and employed 186 permanent scouts, while operators in Coutada 16, Mozambique, spent $60,000 annually on anti-poaching (such as the removal of 5,000 gin traps) (Groom 2013, p. 5; Lindsey *et al.* 2012a, p. 9). According to Barnett and Patterson (2005, p. 82), in Zimbabwe:

> Land invasions, resettlement and political instability has had dire consequences for wildlife occurring in the commercial sector. Land invasions have affected all wildlife management activities, and resulted in severe habitat destruction, increased poaching and infrastructure damage with thousands of kilometers of fences being destroyed to make wire snares . . . A typical questionnaire response from an invaded 50,000 acre farm in Masvingo Province . . . indicates substantial poaching losses of up to $1,819,040, with over 3,400 snares recovered and 134 poachers arrested in just two months.

Niassa National Reserve, Mozambique, incurs annual costs of approximately $1.9–2 million to maintain a 42,000-km^2 area (Lindsey *et al.* 2012a, p. 9). As a single source of revenue, the trophy hunting of lions provides a substantial source of funds to pay for the management of lion habitat. According to Lindsey *et* al. (2012a, p. 5), with the exception of rhinoceros and exceptional elephant trophies, ''lions generate the highest revenue per hunt of any species in Africa.'' In Niassa National Reserve, lion trophy hunting has generated $380,000–400,000 annually (Lindsey *et al.* 2012a, p. 9). In the Savé Valley Conservancy, between 2005 and 2011, lion hunting in Zimbabwe provided an estimated net income (based on 26 lions) of approximately $1,365,000 in per-night charges and roughly $260,000 in trophy fees (Groom 2013, p. 4).

Trophy hunting of lions, if part of a scientifically based management program, can provide direct benefits to the species and its habitat, both at the national and local level (See: Role of Local Communities in Lion Conservation). Trophy hunting and the revenue generated from trophy hunting are tools that range countries can use to facilitate maintaining habitat to sustain large ungulates and other lion prey, protecting habitat for lions, supporting the management of lion habitat, and protecting both lions and their prey base through anti-poaching efforts. While hunting alone will not address all of the issues that are contributing to the declined status of the species, it can provide benefits to the species.

Role of Local Communities in Lion Conservation

Over the last few decades, conservationists and range countries have realized the integral role local communities play in the conservation of lions and their habitat; when communities benefit from a species,

they have incentive to protect it. Therefore, utilizing the wildlife sector as a land-use option and source of income for rural populations has increasingly been employed throughout the range countries of the African lion. Many of these countries are classified as 'developing' nations; specifically, seven of the ten countries (we include Cameroon here) where trophy hunting is permitted have 27–64 percent of their populations living in severe poverty (United Nations Development Programme's (UNDP) Human Development Report, *http://hdr.undp.org/en/data,* accessed July 7, 2014; Barnett & Patterson 2005, p. iii). These countries often have high population growth, high unemployment, limited industry, and a Gross Domestic Product (GDP) per capita lower than the poverty level (Barnett & Patterson 2005, p. iii). These combined challenges highlight the need for innovative solutions. Conservationists and range countries recognize the value of the wildlife sector; if managed sustainably, there is high potential to contribute to rural economic development while simultaneously protecting the unique ecological habitats and species contained therein (Chardonnet *et al.* 2010, p. 33; Kiss [editor] 1990, pp. 1, 5–15).

Studies have indicated that, in order for species such as the African lion to persist, the local communities must benefit from or receive a percentage of funds generated from tourism such as wildlife viewing, photography, or trophy hunting (White 2013, p. 21; Martin 2012, p. 57; Kiss [editor] 1990, pp. 1, 5–15). The economic value of a species, such as lion, can encourage range countries to develop management and conservation programs that involve local communities which would ultimately discourage indiscriminate killings by local communities (Groom 2013, pp. 3, 5; Hazzah *et al.* 2013, p. 1; White 2013, p. 21; Martin 2012, p. 49). If local communities see no beneficial value of lions being present in their communal areas, sustainable utilization of lions as a land-use becomes less competitive with other land-use options, such as grazing and livestock management, and local communities become unwilling and unable to manage their wildlife heritage (Barnett & Patterson 2005, p. iii). When the value of lions in areas outside of national parks is diminished, those areas are likely to be converted to forms of land use less suitable for lions, such as agriculture, livestock pastures, or areas of resource extraction, making them even more vulnerable to expanding human settlement (Van der Merwe 2013, p. 2).

Community conservancies that benefit from trophy hunting have specifically been formed as a way to protect wildlife and habitat. As an example, in Namibia, 160,000 km^2 (61,776 mi^2) of community conservancies were established in part due to revenue from trophy hunting. These conservancies benefit the local communities, which in turn protect lion habitat. For example, in 2012, the Savé Valley Conservancy (Zimbabwe) ''provided over US$100,000 worth of support to adjacent villages or farmers in the resettled areas. Assistance included drilling boreholes, maintaining boreholes, dredging of dams, building clinics and schools, assisting with repairs, maintenance and materials for schools, education initiatives, school field trips, provision of computer equipment in schools, and craft programs'' (Groom 2013, p. 5) Connecting conservation to community benefits can provide a value for wildlife, including lions, where there was previously resentment or indifference, helping to instill a sense of importance for lion conservation Additionally, an estimated 125,000 kg of game meat is provided annually to rural communities by trophy hunters at an estimated value of $250,000 per year, which is considerable for rural locations where severe poverty and malnutrition exists (White 2013, p. 21), further providing a value for wildlife, including lions. Lastly, local communities benefit from the trophy hunting industry by gaining employment as cooks, drivers, game guards, security, and anti-poaching personnel, and they also obtain revenue for items purchased by trophy hunters such as jewelry, art, and native handicrafts.

Trophy hunting as part of a scientifically based management program may provide direct economic benefits to the local communities and can create incentives for local communities to conserve lions, reduce the pressure on lion habitat, and end retaliatory killing, primarily because lions are viewed as having value. Conversely, lack of incentives could cause declines in lion populations because lions are viewed as lacking value and are perceived to kill livestock, which do have value to communities (see Human-lion Conflict).

Many range countries have realized local communities must benefit from the conservation of the species because [why?] and have revised their land management and ownership policies to reflect this. Of the ten countries where lion trophy hunting currently occurs (including Cameroon), seven have developed National Poverty Reduction Strategies in partnership with the International Monetary Fund (for a complete list, see *http://www.imf.org/external/np/prsp/prsp.aspx*); each of these has incorporated sustainable natural resource development as a main priority, and emphasized benefit distribution and management to rural communities (Benin 2000, unpaginated; Burkina Faso 2000, unpaginated; unpaginated; CAR 2000, p. 45; Mozambique 2000, unpaginated; Tanzania 2000, pp. 13, 21; Zambia 2000, unpaginated). As a result, an increase in participation by local communities in managing natural resources that are adjacent to reserves is occurring in several areas.

Captive Lions

In analyzing threats to a species, the Service focuses its analysis on threats acting upon wild specimens within the native range of the species, because the goal of the Act is survival and recovery of the species within its native ecosystem. We do not separately analyze ''threats'' to captive-held specimens because the statutory five factors under section 4 (16 U.S.C. 1533) are not well-suited to consideration of specimens in captivity and captive-held specimens are not eligible for separate consideration for listing. However, we do consider the extent to which specimens held in captivity create, contribute to, reduce, or remove threats to the species.

Captive-held African lions, including those that are managed for trophy hunting in South Africa and lions held in captivity in zoos, are believed to number between a few thousand and 5,000 worldwide (Republic of South Africa 2013, p. 5; Barnett *et al.* 2006a, p. 513). Captive lions in general are not suitable for reintroduction due to their uncertain origins (Barnett *et al.* 2006a, p. 513; Hunter *et al.* 2012, p. 3), potential maladaptive behaviors, and higher failure risk compared to translocated individuals (Hunter *et al.* 2012, pp. 2–3). There may be cases where captive specimens provide a benefit to the species under certain circumstances. For example, the display of Giant pandas in U.S. zoos has generated considerable revenue that is used for in-situ conservation of the species in China. It may be possible that captive lions could also serve a purpose of generating revenue for in-situ conservation.

Summary of Trophy Hunting

Although there is some indication that trophy hunting could contribute to

local declines in lion populations through unsustainable quotas, corruption, and possible disruption of pride structure through infanticide and take of males that are too young, we do not find that any of these activities rises to the level of a threat to the African lion subspecies at this time. It appears that most range countries that allow trophy hunting of African lions restrict offtake to approximately 2–4 percent of their lion populations for trophy hunting annually, excluding South Africa, where offtake is from predominantly captive-born animals, and Zimbabwe, where offtake is 2–3 percent higher than in other countries (Packer *et al.* (2006, pp. 2–3). Exports of lion trophies have demonstrated a decreasing trend when exports of likely captive-born lions from South Africa are excluded (CITES lion gross exports, *http://trade.cites.org,* accessed April 23, 2014), and lions from South Africa are likely captive-born (RSA 2013, p. 5). Most of the range countries that allow trophy hunting have quotas in place to limit take. Tanzania, with a population of approximately 16,000 lions, has a quota of 50 animals per year. Many other range countries have laws in effect that address trophy hunting, and several have moratoriums in place. The hunting community is taking the lead in developing best management practices to address take of males that are under 6 years of age, and they are guiding the development of scientifically based tools for minimizing the impact of trophy hunting on the social structure of lion populations. This 6-year age restriction on lion trophies is in the process of being self-implemented by professional hunting guides, and is being adopted by certain range states, such as Tanzania (White 2013, p. 14; Whitman *et al.* 2004, p. 176).

Currently, most countries that allow trophy hunting of lions appear to be reviewing their trophy hunting practices (Jackson 2013, pp. 2–3; White 2013, pp. 12–13). Range countries have recognized the need to incorporate best management practices, and have been progressively updating the policies and management systems in order to implement them (Lindsey *et al.* 2013a, pp. 4–10).

Finally, we found that, if trophy hunting of lions is part of a scientifically based management program, it could provide considerable benefits to the species, by reducing or removing incentives by locals to kill lions in retaliation for livestock losses, and by reducing the conversion of lion habitat to agriculture. Trophy hunting, if managed well and with local communities in mind, can bring in needed revenue, jobs, and a much-needed protein source to local people, demonstrating the value of lions to local communities (Groom 2013, pp. 1–3; Lindsey *et al.* 2006, pp. 283, 289). In addition, the amount of habitat that has been set aside by range countries specifically for trophy hunting has greatly increased the range and habitat of lions and their prey base, which is imperative given the current ongoing rate of habitat destruction occurring in Africa. The total amount of land set aside for trophy hunting throughout Africa exceeds the total area of the national parks, providing half the amount of viable lion habitat (Chardonnet *et al.* 2010, p. 34; Packer *et al.* 2006, pp. 9–10). However, expanding protected areas without taking the human population into consideration could lead to more resentment and retaliatory killing of lions (Nelson *et al.* 2009, p. 315).

Therefore, we conclude, based on the best scientific and commercial information available, that trophy hunting is not a significant threat to the species.

Traditional Use of Lion Parts and Products

CITES (2014, p. 8) reports that many African countries, including Somalia, Nigeria, Burkina Faso, Kenya, and Cameroon, maintain local markets in lion products, which include teeth, claws, fat, whiskers, bone, bile, testicles, meat, and tails for use as talismans, decorations, and in traditional African medicine. In Ghana, lion parts and products are used for ceremonial, medicinal, and nutritional purposes (Burton *et al.* 2010, p. 4). Skins and claws of lions were observed for sale in a market in Tamale, Ghana. Lions in and around Mole National Park in Ghana have been killed for traditional consumptive purposes (Burton *et al.* 2010, p. 4). In some cases, lions (either alive or dead) have been ''laundered'' through other countries so that their country of origin is unknown. As an example, lions have been found to be shot in Zimbabwe and Mozambique and declared as South African trophies (Lion Aid 2011, p. 20). In other cases, there have been reports of captive-born lions being smuggled between Botswana and South Africa and described as wild (Mouton 2013, pp. 1–2). Lion products, such as the trade in lion bone, seem to be primarily byproducts of trophy hunting; hunters are primarily interested in the trophy and skin and, therefore, the bones and other parts are sold separately (CITES 2014a, p. 10). However, since the reports of these types of activities are primarily anecdotal in nature, based on the best available scientific and commercial information, we find that the sale of these byproducts does not currently pose a threat to the species. Further, without a significant shift in the market, it is not likely to become a threat in the foreseeable future.

Conservation Measures in Place To Protect Lions

There has been awareness for several years that conservation strategies need to be implemented for the African lion due to the apparent decrease in its population numbers (Hamunyela *et al.* 2013, p. 1; Henschel *et al.* 2010, p. 34; Gebresenbet *et al.* 2009, p. 5; IUCN 2006a, b, entire). Prior to 2006, institutional inconsistencies throughout the African lion's range resulted in poor lion conservation policies and little to no enforcement of existing laws (IUCN 2006b, p. 18). As mentioned, in 2005 and 2006, nongovernmental organizations (NGOs) and several governments at various levels organized two regional lion conservation workshops. Species specialists, wildlife managers, and government officials attended these regional workshops in order to provide range country governments with frameworks for developing their own national action plans for the conservation of lions. Over 50 lion specialists, representing all lion range countries, participated in these workshops (Henschel *et al.* 2010, p. 34). During the workshops lion experts collectively assessed what they believed to be the then-current status of African lions based on a variety of information, and subsequently identified 86 African LCUs. This information was then used as a framework to identify lion areas, strongholds, and potential strongholds by Riggio *et al.* (2013, p. 32).

Many countries with very small lion populations have developed or updated their conservation plans for the African lion. Some of these include Benin, Cameroon, Uganda, and Malawi. Some range countries participate in transboundary conservation projects and are collaborating on transboundary lion conservation initiatives for shared lion populations. Most range countries have a national lion action plan or strategies in place, particularly if there are economic incentives for them to have viable lion populations (Groom 2013; Nghidinwa *et al.* 2013, pp. 11–12; Zambia Wildlife Authority 2012; Lion Aid 2011, pp. 1–2; Mesochina *et al.* 2010; Government of Tanzania 2010; Begg and Begg 2010). Range states have also implemented a number of conservation strategies designed to conserve habitat, reduce human-lion

conflict, and preserve the lion's prey-base.

Conservation Measures To Stem Habitat Loss

Habitat loss represents one of the main threats facing the African lion (Bauer *et al.* 2008, unpaginated). Attempts by range countries to address this decline in habitat are manifested in a number of ways, such as the creation of protected areas and the establishment of wildlife corridors to connect fragmented habitats.

Two conservation tools utilized by range countries for African lions include the establishment of protected areas and the enforcement of protections in these areas (Mesochina *et al.* 2010a and b; Treves *et al.* 2009, pp. 60, 64). Over the past few decades, the effectiveness of protected areas in protecting habitat has been studied, particularly in Africa (Pfeifer *et al.* 2012, p. 1; Craigie *et al.* 2010, pp. 2,221–2,222). A study conducted by the Wildlife Conservation Society in 2005 found that most lion populations in protected areas of southern and eastern Africa have been essentially stable over the previous three decades (Ray *et al.* 2005, p. 67). However, several problems have emerged. For example, certain land-tenure systems do not recognize community ownership of land and wildlife and undermine the extent to which benefits are converted into incentives for conservation. Protected-area ''boundaries'' are not always visible. Additionally, law enforcement in protected areas can be sporadic, and parks are often understaffed (Pfeifer *et al.* 2012, pp. 1, 7). Lastly, despite the Wildlife Conservation Society's findings, more recent evidence suggests that some protected areas are being more commonly encroached upon as human populations expand and search for resources.

Despite encroachment, protected areas are somewhat effective at protecting wildlife and habitat as rates of habitat loss tend to be lower in protected areas than outside them (Green *et al.* 2013, p. 70; Pfeifer *et al.* 2012, p. 2). African countries are realizing the benefits of managing their wildlife populations and parks for tourism; however, conservation of vast areas of land for megafauna such as the African lion is not only complex, but also expensive. As an example, the 28-km (17-mi) elephant corridor, completed in 2011 in Kenya, cost $1 million (The Nature Conservancy 2013, unpaginated). Additionally, the overall costs of anti-poaching and compensation is expected to increase in range states concurrently with growing human populations, declining purchasing power of external funds, and corruption (Garnett *et al.* 2011, pp. 1–2; Wittemyer *et al.* 2008, pp. 123, 125).

Another mechanism for protecting habitat is to reconnect fragmented habitat across national boundaries. Corridors are being restored, fences are being removed, and protected areas are being connected. Restoration of these corridors allows wildlife to travel between areas of suitable habitat (Jones *et al.* 2012, pp. 469–470). In some areas, fences have been constructed to protect grazing resources for domestic livestock as well as to provide barriers to disease (Gadd 2012, pp. 153, 176). One aspect of these fences is that they separate lions from their prey. In southern Africa, the trend now is to take down fences to increase the size of connected habitat and link it to reserves and national parks (IUCN 2009, p. 101; IUCN 2008, various). The Limpopo Transfrontier Park is another example of where this is being implemented (Newmark 2008, p. 327). Boundary fences along national borders that separate many reserves are being removed to form a 35,000-km^2 park. Limpopo National Park (formerly known as Coutada 16) in Mozambique; Kruger National Park in South Africa; Gonarezhou National Park, Manjinji Pan Sanctuary, and Malipati Safari Area in Zimbabwe will all be connected, as will be the area between Kruger and Gonarezhou, and the Sengwe communal land in Zimbabwe and the Makuleke region in South Africa (Newmark 2008, p. 327). However, in some locations, areas that have previously been designated as corridors have been encroached upon by human settlements and agriculture (Estes *et al.* 2012, pp. 258–261; Jones *et al.* 2012, p. 469).

Tanzania is an example of a country attempting to reconnect habitat. As of 2002, the Tanzanian Government, with donor and NGO support, was reconnecting the nine largest blocks of forest in the East Usambara Mountains using wildlife corridors (Newmark 2002, various). Additionally, the 2009 Wildlife Act of Tanzania allows the Minister, in consultation with relevant local authorities, to designate wildlife corridors, dispersal areas, buffer zones, and migratory routes. The 2010–2015 National Elephant Management Plan of Tanzania indicates that corridors are the primary objective of the plan, and although primarily designed for elephants, these corridors allow for continuity of populations of other large mammal species such as lions (Jones *et al.* 2012, p. 470).

In 2011, Kenya (which neighbors Tanzania to the North), completed a 28-km corridor through an area that had been heavily impacted by human-wildlife conflict. The purpose of the corridor was primarily to reduce human-elephant conflict and appears to have been successful (Mount Kenya Trust 2011, p. 1). The corridor also allows other wildlife such as lions to disperse through habitat that otherwise would have been unfavorable for wildlife to travel through (Mount Kenya Trust 2011, p. 1). It was an expensive project, but recent reports indicate that the effort has served its purpose: Elephants are using the corridor on a regular basis (particularly an underpass under a highway), and humans are reporting less human-wildlife conflict (Mount Kenya Trust 2011, p. 1).

However, connectivity alone does not ensure the dispersal of animals (Roever *et al.* 2013, pp. 19–21). The Tanzania Wildlife Research Institute (TAWIRI) is a parastatal organization under Tanzania's Ministry of Natural Resources and Tourism, and is responsible for conducting and coordinating wildlife research activities in Tanzania (*http://tawiri.or.tz/*). In this role, TAWIRI has been actively involved in promoting the development of and monitoring the use of wildlife corridors in Tanzania (*http://www.tzwildlifecorridors.org*). Surveys conducted in 2009 and 2010 suggest that the Nyanganje Corridor in Tanzania is no longer being used by elephants and other wildlife. This corridor is at a narrow passage in the Kilombero Valley and is the shortest distance for animals to cross between the Udzungwa and Selous ecosystems. Despite efforts in place, much of the corridor is being encroached upon by conversion of land to rice farming and cattle grazing (Jones *et al.* 2012, p. 469). Because these activities often deter wildlife from passing through, the corridor is ineffective (Jones *et al.* 2012, p. 469). TAWIRI reminds wildlife managers that they need to continue to implement steps to ensure that corridors are functioning properly.

Conservation Measures in Place To Stem the Loss of Prey Base

Lions, like most large carnivores, prey upon a variety of species including buffalo, plains zebra, wildebeest, giraffe, gemsbok, kob, and warthog (Kenya Wildlife Service 2013, p. 13; Niassa National Reserve Technical Report 2011, p. 4; Nowell and Jackson 1996, p. 18). Depletion of these prey species due to competition with humans represents a threat to the lion (Chardonnet *et al.* 2005, pp. 8–9). As noted, the increase in the human population in Africa is a major contributor to the increase in the

demand for bushmeat, which in turn increases human encroachment into wildlife lands (Lindsey *et al.* 2012b, p. 36). In addition to the increase in the human population, lack of an alternative livelihood, lack of alternate food sources, and lack of clear rights over land or wildlife are contributing factors toward the increase in demand for bushmeat (Lindsey *et al.* 2012b, pp. 36–41). The advent of automatic weapons in the bushmeat trade impacts the lion's prey base, which is being hunted at unsustainable levels.

Reconnecting fragmented habitat has the additive effects of not only conserving the biodiversity of the African lion's habitat, but also that of its prey base (Lindsey *et al.* 2012b, p. 43). These types of restoration practices enhance the health of species by allowing genetic interchange to occur and, thus, conserve the genetic diversity of all wildlife. Wildlife management entities are linking many of the major protected areas by removing boundary fences along national borders that separate many reserves in addition to creating or improving corridors to link good-quality habitat for wildlife (Gadd 2012, p. 179; Newmark 2008, pp. 323–324). To address the increasing consumption of bushmeat, host countries have employed a variety of different strategies, including the development of alternative industries for communities. Helping local communities develop alternate industries represents one of the ways range countries can reduce their dependence on bushmeat. Throughout Africa, several ideas have been attempted with varying levels of success. For example, the Anne Kent Taylor Fund (AKTF) helps local Maasai women to buy beads and other supplies to produce traditional items for the local tourist industry (AKTF 2012, p. 7; Lindsey *et al.* 2012b, p. 45; van Villet 2011, p. 17). In addition, AKTF helps organize local men into anti-poaching and de-snaring teams (AKTF 2012, p. 5; van Villet 2011, p. 17). By creating programs targeting both men and women, AKTF creates an environment that provides communities with financial stability as well as direct community interest in protecting local wildlife. With 13 years assisting local communities, the AKTF represents one of the more successful attempts to encourage locals to shift away from relying on bushmeat.

Studies compiled by Huzzah 2013 (pp. 1, 8) have shown that local communities who lived near protected areas with more lenient policies have a more positive attitude and relationship with both the manager and the protected area as a whole. This open approach to protected area management reflects a trend in recent years to bring in local communities to assist in the management of protected areas (Lindsey *et al.* 2012b, p. 53). Wildlife management programs run by local communities are defined by two goals: Conserving wildlife and providing economic aids to the community (Bandyopadhyay *et al.* 2010, p. 5). With regards to discouraging the consumption of bushmeat, this new approach is seen in the creation of community-based wildlife management programs (van Villet 2011, p. 26). The purpose of these programs is to give the local community a direct stake in the management of wildlife areas. One use for these areas is to turn them into game ranches. These areas are used both for legal bushmeat production as well as trophy hunting and ecotourism.

One such program is the Chivaraidze Game Ranch in Zimbabwe (van Villet 2011, pp. 28–29). The Chivaraidze Game Ranch started in 1996 with the stated goal of reducing poaching through providing bushmeat at a reduced price. However, internal infighting in the organization over the devolution of power to local communities, between those in favor of devolution and a powerful local interest group, limited the effectiveness of the organization. In the span of 8 years (between 2001 and 2009), the Chivaraidze Game Ranch has had six different boards of directors (Mombeshora and Le Bel 2010, p. 5). Furthermore, a power shake-up in local communities along party lines and kinship affiliation limited the abilities for communities to cooperate with each other (van Villet 2011, pp. 28–29; Mombeshora and Le Bel 2010, p. 7). The result was that the cost of maintaining the program exceeded the benefits to the local community. The decline in economic benefits to the local community coincided with a resurgence in poaching within areas of the park (Mombeshora and Le Bel 2010, p. 3). The result of the Chivaraidze Game Ranch project reflects the difficulty in shifting wildlife management from a centralized national government approach towards a more decentralized, community-based approach.

Unlike the difficulties encountered in Zimbabwe, Namibia has had greater success in setting up community-run conservancies. After gaining independence in 1990, Namibia began to turn over ownership of wildlife areas to local communities (van Vliet 2011, p. 29; Bandyopadhyay *et al.* 2010, p. 6). By 2011, Namibia had 64 communities that covered 17 percent of the country total area (van Vliet 2011, p. 29; Connif 2011, npn; NASCO 2010, p. 4). The majority of the incomes from these conservancies come from ecotourism, followed by trophy hunting (NASCO 2010, p. 22). These incomes are then used to support infrastructure improvement in the community. In addition, legal bushmeat acquired within conservancy lands is distributed to local families (NASCO 2010, p. 25). The success of the program in Namibia has been attributed to Namibia's unique characteristics, including low population density and favorable seasonal rain, which helps prey species recover (van Vliet 2011, p. 30). Despite the successes in Namibia, the country's unique characteristics mean that adapting Namibia's success to other, more densely populated countries will be difficult.

Conservation Measures To Stem Human-Lion Conflict

As the human population expands, the potential for conflict with wildlife increases. In Africa, conflict between villagers and lions, who prey upon livestock, represent a threat to the species (Chardonnet *et al.* 2010, p. 12; Moghari 2009, p. 14; IUCN 2006a, p. 23). In addition, habitat loss due to conversion of land increases the chance of villagers coming into direct contact with lions (Chardonnet *et al.* 2010, p. 24). In an attempt to address these problems, range countries have employed a variety of different strategies to help the lion. Such strategies involve education, an effective conservation plan, and interacting with the local community.

Historically, range countries seek to mitigate human-lion conflict through controlling rather than conserving the predator population. In countries such as Malawi, for example, the Department of Game, Fish and Tsetse Control would shoot large carnivores that prey upon livestock. The result of this policy was that, between 1948 and 1961, over 560 predators (which include lions and leopards) were killed in the country (Mesochina *et al.* 2010b, p. 35). While this department was disbanded in 1963 and jurisdiction shifted to the new Department of Forestry, crop and livestock protection still remains an important part of its function. Despite the department focusing on protecting crops and livestock, the number of lions killed in the country has declined. Between 1977 and 1982, eight lions were killed, whereas six lions were killed between 1998 and 2007 (Mesochina *et al.* 2010b, p. 35). While fewer lions are being killed than in the previous decades, problems remain, including lack of resources, lack of

manpower, and corruption within the range countries.

Current governmental management of lions in countries such as Malawi, Tanzania, and Zambia are managed by the Problem Animal Control units (Mesochina *et al.* 2010a, p. 41; Mesochina *et al.* 2010b, p. 36). When lion attack incidents occur, Problem Animal Control dispatches officials to investigate the problems. If the problem lion is located, it is either removed or eliminated. When properly funded, this program has helped in reducing not only conflicts between lions and humans but also has driven down the numbers of lions killed. Between 2005 and 2009, there were 116 reported cases of lions killed, with the number of lions killed being less than 50 per year in Tanzania (Mesochina *et al.* 2010a, p. 41). However, limitations of resources (including both manpower and funds) have hampered the effectiveness of these officials in responding to these incidents. In addition, many Problem Animal Control interventions resulted in the death of the lion (Mesochina *et al.* 2010a, p. 41; Chardonnet *et al.* 2009, p. 36). Even in cases of translocation, the lions that were being transported often end up injured or continue to pose problems to the community (Bauer *et al.* 2007, p. 91).

NGOs are also assisting in protecting lions. Intervention by NGOs often takes the form of interacting with the local community (Winterbach *et al.* 2010, p. 98). Lion Guardians, which operate in Kenya, recruits and educates local young men. These men then monitor and track lion movement and warn herders of lion presence in the area, thereby mitigating or preventing possible lion-human conflict (Hazzah *et al.* 2014, p. 853; Lion Guardians 2013, p. 7; Lion Guardians 2012, p. 3). In addition, Lion Guardians work with tribal elders to dissuade young men from killing lions for ceremonial purposes. Historically, the killing of lions through ritualized lion hunts called *ilmurran* is rewarded with gifting of cows and other rewards (Lion Guardians 2012, p. 5; Goldman *et al.* 2010, p. 334). After introducing village elders to the Lion Guardians program first hand, many return home to their village and give their blessings to the project. This education led to significant results; on August 11, 2013, two Lion Guardians stopped a group of hunters who were planning to hunt a lion in retaliation for the lion preying on their livestock. The local village elders fined the potential hunters two cattle each for going on a lion hunt, marking a gradual but significant shift in the cultural attitudes regarding the lion (Hazzah *et al.* 2014, p. 858; Lion Guardians 2013, p. 20). Since its establishment in 2007, only five lions had been killed in territories where Lion Guardians operates, in contrast to more than 100 lions killed in adjacent areas (Lion Guardians 2013, p. 5). Furthermore, reduced lion mortality was sustained across multiple years, resulting in the reserve having one of the highest lion densities in Africa (Hazzah *et al.* 2014, p. 857; Schuette et l. 2013, p. 149). Despite the success of this program, retaliatory as well as ceremonial killings of lions outside the program areas remain a threat to the species.

We found that many of the lion range states are trying to address lion conservation through the establishment of protected areas, wildlife management areas, wildlife corridors, and reconnecting habitat. In some areas, creating incentives for lion conservation is occurring through community conservation programs in range countries. In other cases, participatory strategies have been implemented to enhance local tolerance for large carnivores in Africa. An increasing number of programs encourage local communities to solve problems that arise from human-lion conflict without killing lions. However, the effectiveness of these measures still ranges from successful to unsuccessful, due in part to lack of resources, political will, and infighting. It is imperative that range countries continue to recognize and support the role that local communities play in lion conservation. Greater support by countries to address the needs of local communities, and thereby address the needs of lions, may be the single-most important role these countries can play in changing the trajectory of lion declines.

Regulatory Mechanisms

Regulatory mechanisms in place to provide protections to African lions vary substantially throughout Africa. As mentioned in the Conservation Status of African Lions CITES section, lions are listed in Appendix II under CITES, and with the exception of South Sudan, all of the lion range states are parties to CITES. According to the draft CITES Periodic Review of the Status of African Lions (CITES 2014a, pp. 14–15) outside of CITES, lions have no legal protections in four countries: Burundi, Guinea Bissau, Lesotho, and Swaziland. However, CITES 2014a (p. 15), states that most of the southern and eastern lion range states have regulatory mechanisms in place to protect lions. We found that most of the range states have national environmental legislation to establish national parks and conservation areas, and to conserve and regulate the take, hunting, and trade of wildlife, including parts and products, but could find no legislation specific to lions, nor to the main threats affecting lions: habitat loss, human-lion conflict, and loss of prey base (See: Appendix A, Ecolex information was accessed July 7–10, 2014, at *http://www.ecolex.org*.[8]).

Our status review did not reveal regulatory mechanisms in place that specifically address the main threats affecting lions. We are requesting comments or information from lion range states, other concerned governmental agencies, the scientific community, or any other interested parties concerning regulatory mechanisms that address the three main threats to lions: habitat loss, human-lion conflict, and loss of prey base.

Finding

Section 4 of the Act (16 U.S.C. 1533) and its implementing regulations at 50 CFR 424 set forth the procedures for adding a species to, and/or removing a species from, the Federal Lists of Endangered and Threatened Wildlife and Plants. As noted in the Information Requested section, a species may be determined to be an endangered or threatened species due to one or more of the five factors set forth in section 4(a)(1) of the Act:

(A) The present or threatened destruction, modification, or curtailment of its habitat or range;

(B) Overutilization for commercial, recreational, scientific, or educational purposes;

(C) Disease or predation;

(D) The inadequacy of existing regulatory mechanisms;

(E) Other natural or manmade factors affecting its continued existence.

In assessing whether the African lion meets the definition of an endangered or threatened species, we considered the five factors in section 4(a)(1) of the Act. A species is ''endangered'' for purposes of the Act if it is in danger of extinction throughout all or a significant portion of its range and is ''threatened'' if it is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. The ''foreseeable future'' is the period of time over which events or effects reasonably can or should be anticipated, or trends extrapolated.

[8] ECOLEX is a comprehensive database on environmental law, maintained by the International Union for Conservation of Nature (IUCN), the United Nations Environment Programme (UNEP), and the Food and Agriculture Organization of the United Nations (FAO). Our search terms used with respect to wildlife laws were ''African lion'' and ''country'', e.g., ''Angola'', ''Benin'', etc. See Appendix A.

When considering what factors might constitute threats to a species, we must look beyond the mere exposure of the species to a factor to evaluate whether the species may respond to the factor in a way that causes actual impacts to the species. If there is exposure to a factor and the species responds negatively, the factor may be a threat and we attempt to determine how significant a threat it is. The threat is significant if it drives, or contributes to, the risk of extinction of the species such that the species may warrant listing as endangered or threatened as those terms are defined in the Act. We conducted a review of the best scientific and commercial data available regarding the status of the African lion and assessed whether the African lion is endangered or threatened throughout all of its range.

There is consensus within the research community as well as lion range states that the African lion is impacted by a number of factors actively contributing to its population decline throughout Africa: habitat loss (fragmentation and degradation) (Factor A); decreased access to food prey sources (aka loss of prey base) (Factor B); retaliatory killing, snaring, and poaching (both intentional and unintentional), and deleterious effects in its viability due to small populations in some areas within its range (Factor E) (Nyanganji *et al.* 2012, p. 12; Seguya *et al.* 2010, p. 26).

We find three main threats, habitat loss, loss of prey base, and human-lion conflict, are impacting lions, alone and in combination, such that the subspecies is likely to become endangered within the foreseeable future throughout all of its range. In the past several decades, the human population has been expanding with concomitant large decreases in lion habitat and likely lion numbers, resulting in an extremely large reduction in the species' range. As human populations continue to rise in sub-Saharan Africa, the amount of land required to meet the expanding human population's needs is constantly increasing. Lions are increasingly limited to protected areas, and human population growth rates around protected areas in Africa tend to be higher than the average rural growth rate (Wittemyer *et al.* 2008, entire). Considering the majority of the human population in sub-Saharan Africa is rural, and land supports the livelihood of most of the population, loss and degradation of lion habitat, loss of prey base, and increased human-lion conflict can reasonably be expected to accompany the rapid growth in sub-Saharan Africa's human population into the foreseeable future.

Africa has the fastest population growth rate in the world (UNEP 2012a, p. 2). The majority of the population is rural, and about 60–70 percent of the population relies on agriculture and livestock for their livelihood (UNEP 2006, pp. 82, 100, 106; IAASTD 2009, p. 2). As a result, a large portion of the growing population will depend directly on expansion of agriculture and livestock grazing to survive in the future. Between 2010 and 2050, the population of sub-Saharan Africa is projected to more than double to more than 2 billion (from 831 million to 2.1 billion) (UN 2013, p. 9). During about this same time period (2005 to 2050), the area of cultivated land is projected to increase by 51 million ha (approximately 21 percent) (Alexandratos and Bruinsma 2012, p. 107). However, this figure does not include rangeland, and the majority of agricultural land in Africa is devoted to grazing (UNEP 2012b, p. 68), thus that figure may be much larger. The number of livestock (cattle, sheep, and goats) in sub-Saharan Africa is projected to increase about 73 percent, from 688 million to 1.2 billion, by 2050 (Alexandratos and Bruinsma 2012, p. 133). Therefore, in the case of African lion, the best available scientific and commercial data that we rely upon in projecting future conditions for the purpose of this listing determination establish the foreseeable future to be 2050.

Human settlements and agricultural and pastoral activities have expanded into lion habitat and protected areas, decreasing prey availability and increasing exposure of livestock and humans to lions. Human-lion conflict and associated retaliatory killing of lions will continue to play a major role in the reduction of lion populations and is the greatest current threat to remaining lion populations. The lion's prey base has decreased in many parts of its range in large part due to the bushmeat trade

Bushmeat is the primary source of protein for humans in much of the lion's range (Chardonnet *et al.* 2010, p. 27; Mesochina *et al.* 2010a, p. 38; Abwe and Morgan 2008, p. 26; Bennett *et al.* 2007, p. 885; Fa *et al.* 2006, p. 507), comprising between 6 percent (southern Africa) and 55 percent (Central African Republic) of a human's diet (Chardonnet *et al.* 2005, p. 9; IUCN 2006b, p. 19). This reliance by humans on protein obtained from bushmeat results in direct competition for prey species between humans and lions, and commercial poaching of wildlife through the use of automatic weapons is a significant threat to lion prey (Chardonnet et al. 2010, p. 27). Because many wildlife species are being hunted at unsustainable levels to meet this demand within the range of the lion, its prey base is becoming depleted in many areas and has led to lion attacks on livestock and humans (Hoppe-Dominik *et al.* 2011, p. 452; Chardonnet *et al.* 2010, pp. 6, 13–14; Frank *et al.* 2006, p. 12). Given the rapid increase in humans and livestock by 2050, we can reasonably expect the conditions described above to worsen. Also, as livestock numbers increase and as expansion of agricultural and pastoral practices continue to deplete and degrade the habitat that lion's prey rely on, the lion's prey base is expected to further decline. As the lion's prey base is hunted at unsustainable levels to meet a growing demand for food, livestock depredation and retributive killing of lions through spearing, shooting, trapping, and poisoning will continue to occur, and will likely increase (Dickman 2013, p. 379; Hoppe-Dominik *et al.* 2011, p. 452; Chardonnet *et al.* 2010, p. 19; Gebresenbet *et al.* 2009, p. 9; Hazzah and Dolrenry 2007, p. 3).

Lion range countries are aware of the threats affecting lions, and many are working to address them. NGOs and several governments at various levels have organized regional lion conservation workshops, which have helped them to identify Lion Conservation Units. Most range countries have a national lion action plan or strategy in place (Groom 2013; Nghidinwa *et al.* 2013, pp. 11–12; Zambia Wildlife Authority 2012; Lion Aid 2011, pp. 1–2; Mesochina *et al.* 2010; Government of Tanzania 2010; Begg and Begg 2010). Some range countries participate in transboundary conservation projects to create wildlife corridors and reconnect habitat, and are collaborating on transboundary lion conservation initiatives for shared lion populations. Reconnecting fragmented habitat has the additive effects of not only strengthening the biodiversity of the African lion but also that of its prey species (Lindsey *et al.* 2012b, p. 43). Wildlife management entities are linking many of the major protected areas by removing boundary fences along national borders that separate many reserves, in addition to creating or improving corridors to link good-quality habitat for wildlife (Gadd 2012, p. 179; Newmark 2008, pp. 323–324).

Range states have also implemented a number of conservation strategies designed to conserve habitat, reduce human-lion conflict, and preserve lion

prey-base. In order to address the increasing consumption of bushmeat, host countries have employed a variety of different strategies, including the development of alternative industries for communities, which can reduce their dependence on bushmeat. For example, the Anne Kent Taylor Fund (AKTF) helps local Maasai women to buy beads and other supplies to produce traditional items for the local tourist industry (AKTF 2012, p. 7; Lindsey *et al.* 2012b, p. 45; van Villet 2011, p. 17) and has organized local men to participate in anti-poaching and de-snaring teams (AKTF 2012, p. 5; van Villet 2011, p. 17). By targeting both men and women in the community, such programs provide communities with financial stability as well as direct community interest in protecting local wildlife. African countries are realizing the benefits of managing their wildlife populations and parks for tourism; however, conservation of vast areas of land for megafauna such as the African lion is expensive. The costs of anti-poaching and compensation is expected to increase in range states concurrently with growing human populations, declining purchasing power of external funds, and corruption (Garnett *et al.* 2011, pp. 1–2; Wittemyer *et al.* 2008, pp. 123, 125).

Studies have shown that local communities who live near protected areas (PAs) with community-based conservation policies have more positive attitudes and relationships with both the park manager and the PA as a whole (Huzzah 2013, pp. 1, 8). This open approach to PA management reflects a trend in recent years to bring in local communities to assist in the management of PAs (Lindsey *et al.* 2012b, p. 53). Wildlife management programs run by local communities are defined by two goals: conserving wildlife and providing economic aids to the community (Bandyopadhyay *et al.* 2010, p. 5). NGOs are also assisting in protecting lions. Intervention by NGOs often takes the form of interacting with the local community (Winterbach *et al.* 2010, p. 98). For example, Lion Guardians, which operates in Kenya, has shown great success with its Lion Guard program. Lion Guardians educates local young men who monitor and track lion movement and warn herders of lion presence in the area, thereby mitigating or preventing possible lion-yhuman conflict (Hazzah *et al.* 2014, p. 853; Lion Guardians 2013, p. 7; Lion Guardians 2012, p. 3). Outreach to tribal elders has successfully helped elders to dissuade young men from killing lions for ceremonial purposes. The result of such programs has been a gradual change in cultural attitudes towards lions (Hazzah *et al.* 2014, p. 858; Lion Guardians 2013, p. 20).

Finally, many range countries rely heavily on tourism (predominantly ecotourism and safari hunting) to provide funding for wildlife management (IUCN 2006a, p. 24). The revenue generated from these industries can be critical to fund wildlife management programs in range states. Tourism, through ecotourism and trophy hunting, can provide jobs to locals (such as game guards, cooks, drivers, security personnel) and often brings in revenue for local microbusinesses that sell art, jewelry, and other native crafts. Lions can generate the highest daily rate of any mammal hunted (USD $2,650 per day), the longest number of days that must be booked, and the highest trophy fee ($24,500) (Jackson 2013, p. 6; Lindsey *et al.* 2012a, p. 5), thus generating significant revenue for range countries. Creating community-based incentives to conserve lions from revenue derived from trophy hunting may ameliorate the human-lion conflict that arises from lions and humans coexisting in the same area.

Revenue from scientifically based management programs that include trophy hunting can increase the ability of many African countries to manage wildlife populations both within and adjacent to reserves; many of these hunting areas are geographically linked to national parks and reserves, providing wildlife corridors and buffer zones (Chardonnet *et al.* 2010, p. 34; Newmark 2008, p. 321). In the past, government and private land owners were the primary beneficiaries of the revenue gained; however, a portion of the revenue derived from hunting is reportedly now being distributed to local communities, creating a value for lions that encourages their conservation (Barnett & Patterson 2005, p. iv). Revenue from trophy hunting is purported to create: (1) Incentives for countries to conserve large tracts of prime habitat; and (2) funding for park and reserve management, anti-poaching, and security activities. Because habitat loss has been identified as one of the primary threats to lion populations, it is notable that trophy hunting has provided lion range states incentives to set land aside for hunting throughout Africa, and the land set aside exceeds the total area of the national parks, accounting for approximately half of the amount of viable lion habitat (Chardonnet *et al.* 2010, p. 34; Packer *et al.* 2006, pp. 9–10).

In Tanzania, which is home to 40 percent of all lions, land set aside for sport hunting purposes has resulted in an area 5.1 times greater than Tanzania's fully protected and gazetted parks (Jackson 2013, p. 6; Barnett & Patterson 2005, p. 61). In Botswana, despite the current ban on lion hunting, the country currently has more than 128,000 km^2 of gazetted wildlife management areas and controlled hunting areas set aside for hunting purposes, which equates to 22.1 percent of the country's total area; this is in addition to 111,000 km^2 (or 19.1 percent) that has been set aside as habitat in the form of National Parks, Game Reserves, and Forest Reserves (Barnett & Patterson 2005, p. 7). In 2000, five countries in southern Africa (Botswana, Namibia, South Africa, Tanzania, and Zimbabwe) had set aside a combined 420,000 km^2 of communal land, 188,000 km^2 of commercial land, and 420,089 km^2 of state land totaling more than 1,028,000 km^2 for sport hunting purposes (Barnett & Patterson 2005, p. iii). As a species with a considerable range (up to 1,000 km^2) (Packer *et al.* 2013 p. 636; Haas *et al.* 2005, p. 4), suitable habitat is important to the survival of the species, and the marked decline in suitable habitat is a significant threat to the species. The habitat currently preserved for use in sport hunting has helped to reduce the impact of habitat loss for the African lion, but as discussed previously, habitat loss remains a significant threat to the species.

Within its current range, the African lion exists in 10 stronghold populations containing approximately 24,000 lions (70 percent of the current African lion population), 19,000 of which are in protected areas, and in 7 potential stronghold populations containing another 4,000 lions. Reports from the IUCN Species Survival Commission Cat Specialist Group (IUN 2006a, b) characterize the population as increasing in 3 of those strongholds, as stable in 6 of the strongholds, and as decreasing in 1 stronghold. Most lion populations in protected areas of southern and eastern Africa have been essentially stable over the last three decades (Ray *et al.* 2005, p. 67). In contrast to the stronghold or potential stronghold populations, other African lion populations, containing a total of more than 6,000 individuals, have a very high risk of local extinction (Reggio *et al.* 2013, p. 33. During the 2005–2006 African lion workshops, lion experts characterized lion populations in 36 (42 percent) of the 86 LCUs as decreasing. In extensive surveys recently conducted within 15 of the 20 LCUs in western and

central Africa, Henschel *et al.* (2010, entire) were able to confirm lion presence in only four. The work of Packer *et al.* (2013) suggests future declines within a number of protected areas. Craigie *et al.* (2010, entire) provide evidence of declining large mammal populations in Africa's protected areas, indicating that protected areas in Africa have generally failed to mitigate threats to large mammal populations, including African lion. Although Craigie *et al.* (2010, p. 2,225) found large regional differences (from large declines in western Africa to positive rates of change in southern Africa), they found overall populations decreased steadily from 1970 to 2005.

The best available scientific and commercial information leads us to conclude that the African lion is in danger of extinction within the foreseeable future throughout all of its range. Accordingly, we find that listing is warranted and we propose to list it as a threatened species throughout its range, wherever found.

Significant Portion of Its Range

Under the Act and our implementing regulations, a species may warrant listing if it is endangered or threatened throughout all or a significant portion of its range. The term ''species'' includes ''any subspecies of fish or wildlife or plants, and any distinct population segment [DPS] of any species of vertebrate fish or wildlife which interbreeds when mature.'' We published a final policy interpreting the phrase ''Significant Portion of its Range'' (SPR) (79 FR 37578, July 1, 2014). The final policy states that (1) if a species is found to be endangered or threatened throughout a significant portion of its range, the entire species is listed as endangered or threatened, respectively, and the Act's protections apply to all individuals of the species wherever found; (2) a portion of the range of a species is ''significant'' if the species is not currently endangered or threatened throughout all of its range, but the portion's contribution to the viability of the species is so important that, without the members in that portion, the species would be in danger of extinction, or likely to become so in the foreseeable future, throughout all of its range; (3) the range of a species is considered to be the general geographical area within which that species can be found at the time FWS or NMFS makes any particular status determination; and (4) if a vertebrate species is endangered or threatened throughout an SPR, and the population in that significant portion is a valid DPS, we will list the DPS rather than the entire taxonomic species or subspecies.

We found the African lion to be in danger of extinction within the foreseeable future throughout all of its range. Therefore, no portions of the species' range are ''significant'' as defined in our SPR policy and no additional SPR analysis is required.

Proposed 4(d) Rule

The purposes of the ESA are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in the ESA. When a species is listed as endangered, certain actions are prohibited under section 9 of the ESA, as specified in 50 CFR 17.21. These include, among others, prohibitions on take within the United States, within the territorial seas of the United States, or upon the high seas; import; export; and shipment in interstate or foreign commerce in the course of a commercial activity.

The ESA does not specify particular prohibitions and exceptions to those prohibitions for threatened species. Instead, under section 4(d) of the ESA, the Secretary, as well as the Secretary of Commerce depending on the species, was given the discretion to issue such regulations as deemed necessary and advisable to provide for the conservation of such species. The Secretary also has the discretion to prohibit by regulation with respect to any threatened species any act prohibited under section 9(a)(1) of the ESA. Exercising this discretion, the Service has developed general prohibitions (50 CFR 17.31) and exceptions to those prohibitions (50 CFR 17.32) under the ESA that apply to most threatened species. Under 50 CFR 17.32, permits may be issued to allow persons to engage in otherwise prohibited acts for certain purposes.

Under section 4(d) of the ESA, the Secretary, who has delegated this authority to the Service, may also develop specific prohibitions and exceptions tailored to the particular conservation needs of a threatened species. In such cases, the Service issues a 4 (d) rule that may include some or all of the prohibitions and authorizations set out in 50 CFR 17.31 and 17.32 but which also may be more or less restrictive than the general provisions at 50 CFR 17.31 and 17.32. For the African lion, the Service has determined that a 4(d) rule is appropriate.

We propose to add a 4(d) (special) rule for the African lion (*Panthera leo leo*) at 50 CFR 17.40(n). This 4(d) rule would maintain all of the prohibitions and exceptions codified in 50 CFR 17.31 and 17.32 and would supersede with regard to African lion the import exemption found in 50 CFR 17.8 for threatened wildlife listed in Appendix II of CITES, such that a threatened species import permit under 50 CFR 17.32 would be required for the importation of all African lion specimens. Through the promulgation of the proposed 4(d) rule, the presumption of legality provided under Section 9(c)(2) of the Act for the otherwise lawful importation of wildlife listed in Appendix II of CITES that is not an endangered species listed pursuant to section 4 of the Act would not apply to this subspecies. Thus, under the proposed 4(d) rule, all otherwise prohibited activities, including all imports of African lion specimens, would require prior authorization or permits under the Act. Under our regulations, permits or authorization to carry out an otherwise prohibited activity could be issued for scientific purposes, the enhancement of propagation or survival of the species, economic hardship, zoological exhibitions, educational purposes, or special purposes consistent with the purposes of the Act. Applications for these activities are available from *http://www.fws.gov/forms/3-200-37.pdf.*

The intent of this proposed 4(d) rule is to provide for the conservation of the African lion consistent with the purposes of the Act. Under the proposed 4(d) rule, the prohibitions would, in part, make it illegal for any person subject to the jurisdiction of the United States to ''take'' (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or to attempt any of these) within the United States or upon the high seas; import or export; deliver, receive, carry, transport, or ship in interstate or foreign commerce, by any means whatsoever, in the course of commercial activity; or sell or offer for sale in interstate or foreign commerce any lion specimens. It would also be illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken in violation of the Act. We believe that these protections, including the requirement for an import permit for all African lion specimens, will support and encourage conservation actions for the African lion and require that permitted activities involving lions are carried out in a manner that is consistent with the purposes of the Act and our implementing regulations.

In connection with this proposed 4(d) rule, the Service notes that the African lion is listed in Appendix II of CITES, and thus can be imported into the U.S. pursuant to Section 9(c)(2) of the Act and upon presentation of a proper CITES export permit from the country of origin. Section 9(c)(2) of the Act provides that the otherwise lawful importation of wildlife that is not an endangered species listed pursuant to section 4 of the Act, but that is listed in Appendix II of CITES, shall be presumed to be in compliance with provisions of the Act and implementing regulations. While there has been question as to whether this provision of the Act might automatically require allowing the importation of a species that is both listed as threatened and in Appendix II, and preclude the issuance of more restrictive 4 (d) rules covering importation, the Service has concluded that such 4 (d) rules may be issued to provide for the conservation of the involved species. Section 9(c)(2) does not expressly refer to threatened species or prevent the issuance of appropriate 4 (d) rules and could not logically have been intended to allow the addition of a species to an appendix of an international convention to override the needs of U.S. law, where there is reliable evidence to affect the presumption of validity. Finally, the term ''presumed'' implies that the established presumption is rebuttable under certain circumstances, including through the promulgation of a protective regulation pursuant to section 4(d) of the Act.

In the case of the African lion, there are substantive grounds on which to challenge the presumption. For the import of sport-hunted trophies, while there is evidence that many of the range countries are implementing lion management plans, we want to encourage and support efforts by these countries to develop plans that are based on sound scientific information. As noted, the proposed 4(d) rule for African lion would provide for the importation into the United States of trophies taken legally in range countries upon the issuance of a threatened species import permit. While the Service cannot control hunting of foreign species such as African lion, we can regulate their importation and thereby require that U.S. imports of sport-hunted African lion trophy specimens are obtained in a manner that is consistent with the purposes of the Act and the conservation of the subspecies in the wild, by allowing importation from range countries that have management plans that are based on scientifically sound data and are being implemented to address the threats that are facing lions within that country.

Such management plans would be expected to address, but are not limited to, evaluating population levels and trends; the biological needs of the species; quotas; management practices; legal protection; local community involvement; and use of hunting fees for conservation. In evaluating these factors, we will work closely with the range countries and interested parties to obtain the best available scientific and commercial data. By allowing entry into the United States of African lion trophies from range countries that have scientifically based management plans, the range countries would be encouraged to adopt and financially support the sustainable management of lions that benefits both the species and local communities. In addition to addressing the biological needs of the subspecies, a scientifically based management plan would provide economic incentives for local communities to protect and expand African lion habitat.

As stated, anyone wishing to conduct any otherwise prohibited activity, such as interstate commerce or imports, must first obtain a permit under the current permitting regulations found at 50 CFR 13 and 50 CFR 17. As will all permits, the individual requesting authorization to carry out an otherwise prohibited activity under the Act must submit a permit application to the Service with specific information concerning the proposed activity and the benefits/impacts of the activity on the species. In some cases, such as imports of sport-hunted trophies, it is not always possible for the applicant to provide all of the necessary information needed by the Service to make a positive determination under the Act to authorize the activity. For the import of sport-hunted trophies, it is typical for the Service to consult with the range country and other interested parties to obtain the necessary information. To date, the Service typically has made the required findings on sport-hunted trophy imports on a country-wide basis, although individual import permits are issued for each applicant. While the Service encourages the submission of information from individual applicants, we would primarily rely on information from other sources when making a permitting decision.

Effects of This Rule

This rule, if made final, would revise 50 CFR 17.11(h) to add the African lion to the List of Endangered and Threatened Wildlife. This rule, if adopted, would also establish a 4(d) rule for the African lion, which implements all of the prohibitions and exceptions under 50 CFR 17.31 and 17.32 and requires a threatened species import permit under 50 CFR 17.32 for the importation of all African lion specimens. Under the proposed 4(d) rule, the import exemption found in 50 CFR 17.8 for threatened wildlife listed in Appendix II of CITES would not apply to this subspecies. Through the promulgation of the proposed 4(d) rule, the presumption of legality provided under Section 9(c)(2) of the Act for the otherwise lawful importation of wildlife listed in Appendix II of CITES that is not an endangered species listed pursuant to section 4 of the Act would not apply to this subspecies. (See: Proposed Special Rule section).

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Act include recognition of conservation status, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing encourages and results in public awareness and conservation actions by Federal and State governments in the United States, foreign governments, private agencies and groups, and individuals.

Section 7(a) of the Act, as amended, and as implemented by regulations at 50 CFR part 402, requires Federal agencies to evaluate their actions that are to be conducted within the United States or upon the high seas, with respect to any species that is proposed to be listed or is listed as endangered or threatened. Because the African lion is not native to the United States, no critical habitat is being proposed for designation with this rule. Regulations implementing the interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species or to destroy or adversely modify its critical habitat. If a proposed Federal action may adversely affect a listed species, the responsible Federal agency must enter into formal consultation with the Service. Currently, with respect to the African lion, no Federal activities are known that would require consultation.

Section 8(a) of the Act authorizes the provision of limited financial assistance for the development and management of programs that the Secretary of the Interior determines to be necessary or useful for the conservation of

endangered or threatened species in foreign countries. Sections 8(b) and 8(c) of the Act authorize the Secretary to encourage conservation programs for foreign listed species, and to provide assistance for such programs, in the form of personnel and the training of personnel.

Section 9 of the Act and its implementing regulations at 50 CFR 17.31 set forth a series of general prohibitions that apply to all threatened wildlife, except where a 4(d) rule applies, in which case the 4(d) rule will contain all the applicable prohibitions and exceptions. If the 4(d) rule is adopted as proposed, these prohibitions would apply to the African lion. These prohibitions, in part, make it illegal for any person subject to the jurisdiction of the United States to ''take'' (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or to attempt any of these) within the United States or upon the high seas; import or export; deliver, receive, carry, transport, or ship in interstate or foreign commerce, by any means whatsoever, in the course of commercial activity; or sell or offer for sale in interstate or foreign commerce any lion specimens. It also is illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken in violation of the Act. Permits may be issued to carry out otherwise prohibited activities involving threatened wildlife species under certain circumstances. Certain exceptions apply to agents of the Service and State conservation agencies.

Required Determinations

National Environmental Policy Act (42 U.S.C. 4321 et seq.)

We have determined that we do not need to prepare an environmental assessment, as defined under the authority of the National Environmental Policy Act of 1969, in connection with regulations adopted under section 4(a) of the Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

References Cited

A list of all references cited in this document is available at *http://www.regulations.gov* at Docket No. FWS–R9–ES–2012–0025, or upon request from the U.S. Fish and Wildlife Service, Endangered Species Program, Branch of Foreign Species (see **FOR FURTHER INFORMATION CONTACT**).

Authors

The primary authors of this proposed rule are staff of the Branch of Foreign Species, Ecological Services, U.S. Fish and Wildlife Service.

Proposed Regulation Promulgation

For the reasons described in the preamble, we propose to amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as follows:

PART 17—[AMENDED]

■ 1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 1531–1544; and 4201–4245; unless otherwise noted.

■ 2. In § 17.11(h), the List of Endangered and Threatened Wildlife, add an entry for ''Lion, African'' under Mammals to read as follows:

§ 17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
MAMMALS							
*	*	*	*	*	*		*
Lion, African	*Panthera leo leo*	Africa	Entire	T		NA	17.40(n)
*	*	*	*	*	*		*

* * * * *

■ 3. Amend § 17.40 by adding paragraph (n) to read as follows:

§ 17.40 Special rules—mammals.

* * * * *

(n) African lion (*Panthera leo leo*).

(1) *General requirements.* All prohibitions and provisions of §§ 17.31 and 17.32 of this part apply to this subspecies.

(2) The import exemption found in § 17.8 of this part for threatened wildlife listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) does not apply to this subspecies. A threatened species import permit under § 17.32 of this part is required for the importation of all African lion specimens.

(3) All applicable provisions of 50 CFR parts 13, 14, 17, and 23 must be met.

* * * * *

Dated: October 20, 2014.

Stephen Guertin,

Director, Fish and Wildlife Service.

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