

*Full Length Research Paper*

# **Review of the status of African lion (*Panthera leo*) in Ethiopia**

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Received 9 May, 2022; Accepted 17 June, 2022

**African lion (*Panthera leo*), is an important species in the Ethiopian ecosystems. However, significant lion populations and their suitable habitats in many of their former ranges in Ethiopia have declined over time due to socioeconomic uncertainty and the resulting ecological imbalances. Despite this general trend, it is equally noted that there is a lack of verifiable data which depicts the past and current status of African lions. Thus, very little is known about the species in question in most of its ranges. Available published and unpublished reports and manuscripts on the target species were reviewed in order to examine and document the status of the African lion in Ethiopia. From our review, we concluded that the lion numbers are still low and declining whilst considerable ranges have been identified through the field assessments conducted in the last two decades. African lions in Ethiopia have been under serious threat from various anthropogenic activities and it is therefore recommended to effectively implement the national conservation action plan for lion and undertake further field assessment on its habitats. This study suggests the establishment of a national Red list category for the threatened species based on the final reports of our assessments.**

**Key words:** Trends, abundance, distribution, threats, conservation.

## **INTRODUCTION**

The populations of African lion (*Panthera leo*, Linnaeus, 1758), which are key stone species in a given ecosystem require large tracts of undisturbed land with ample prey, permanent water and sufficient cover for raising their cubs. Since they inhabit areas where a relatively large natural habitat and herds of prey population occur, lions are usually considered indicators of a stable ecosystem and self-sustaining community of larger grazers (Nowell and Jackson, 1996; Kingdon, 1997; Yirga et al., 2017).

Ethiopia is believed to play an important role in the African lions' distribution pattern as they were distributed

throughout most of its areas. Lions have been an important element in the Ethiopian ecosystems that range from evergreen montane forests to open savannah grassland, to semi-arid and arid lowland areas (Gebretensae et al., 2007; Gebresenbet et al., 2009; Riggio et al., 2013; Yirga et al., 2017). However, the ever-increasing human population, economic uncertainty, social and cultural disruption and the resulting ecological imbalance have adversely affected the wildlands of the country and even the formerly established protected areas are under increased anthropogenic pressure

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(Gebretensae et al., 2007; Gebresenbet et al., 2009; Yirga et al., 2017). As a result, significant lion populations and their suitable habitats in many of their former ranges in Ethiopia have declined over time (Bauer et al., 2016; Kebede and Gebretensae, 2018; Yirga et al., 2021).

Despite this fact, it is equally important to note that there is a lack of reliable and justifiable data as well as up-to-date information which depict the past and current status of lions and other carnivores for various reasons. From the perspective of Ethiopia, very little is known about larger carnivores in most of their ranges including the designated protected areas. In areas where there is little information, long-term population data are not available and most of the information gathered so far has been dependent on guess works (Riggio et al., 2013; Kebede and Gebretensae, 2018).

Therefore, this review aims at examining and documenting the past and present status of distribution, population and conservation of African lions in Ethiopia based on the available reports and relatively reliable information.

### Taxonomic status of African lion in Ethiopia

Even though all African lion (*P. leo*, Linnaeus, 1758) is currently considered monotypic (Kingdon, 1997; Bauer et al., 2013), the genetic status of their population is still unknown and needs to be examined. Some studies explain that there are phenotypically and genetically distinct African lions. For example, Bruche et al. (2013) reported that the Addis Ababa Zoo lions are distinct from Asian lions as well as all African lion populations for which comparative data were available. However, recent finding that based on the genetic analysis of samples collected from various parts of Ethiopia shows that the existing lions are admixture of the northern and southern subspecies and it has been hypothesized that the existing patterns have arisen as a result of a naturally occurring hybridization zones (Bertola et al., 2019).

## METHODS

### Study area

This review was conducted to examine the status distribution, population and conservation of African lions in Ethiopia. Ethiopia's relatively vast land area of some 1.12 million km<sup>2</sup>, boasts huge variation in topography and climate. Indeed her lands soar from the heights of 4543 m *asl* on the peak Ras Dajen down to the hot baking plains of the Danakil depression, some 116 m below sea level. In between Ethiopia's Great Plains sit atop two massive highland plateaus cloven by the Great Rift Valley. These highland plateaux, cut by deep gorges and 12 major river valleys, dominate much of the interior of Ethiopia. The differences in altitude, topography and distance from the ocean cause massive variation in rainfall, humidity and temperature and have created the ten ecosystem types of Ethiopia, from cool afro-alpine to evergreen montane forests, to dry desert scrubland.

Ethiopia is consequently endowed with a diverse suite of biological resources and the isolation of its mountain and desert areas has given rise to numerous endemic species of flora and fauna found nowhere else on Earth (Biodiversity Indicators Development National Task Force, 2010). To support the conservation of this rich wildlife resource, over 77 Protected Areas (PAs) of different categories have been created over the last six decades (EWCA, 2020; IUCN ESARO, 2020).

### Literature sources

This status review is based on survey of various scholarly sources, published and unpublished reports and conservation strategy documents related to the target species. The National Action Plan for the conservation of the African Lion in Ethiopia (Gebresenbet et al., 2009; EWCA, 2012) and the corporate plans of wildlife sector (EWCA, 2020) are the strategy documents that were considered to undertake this review. Google's search engine, Google Scholar (<http://scholar.google.com>) and Science Direct (<https://www.sciencedirect.com>) were used to get the review materials that are not found in local libraries and archives.

For the review, a total of 29 articles and books published in the past 25 years have been reviewed. Besides, 15 unpublished reports of assessment on wildlife resources and human-wildlife conflict, which were submitted since 2007 to different departments of the Ethiopian Wildlife Conservation Authority (EWCA) were used for the review.

In order to assess the habitats of the extant populations of lions, various census reports on wild fauna (Ewnetu et al., 2010; Yadeta and Hailu, 2013; Wendim et al., 2015; Yadeta and Getachew, 2016; Kebede et al., 2017; Wendim, 2018) and assessment reports on human-wildlife conflict (Gebretensae et al., 2007, 2008; Wendim and Yadeta, 2013; Siege et al., 2016; Assefa and Teklu, 2017; Zerfu et al., 2019) were used as key sources and these were supplemented by direct field observation, publications, previous reports of IUCN SSC Cat Specialist Group (Bauer et al., 2016; IUCN SSC Cat Specialist Group, 2018) and other documents related to conservation of African lion.

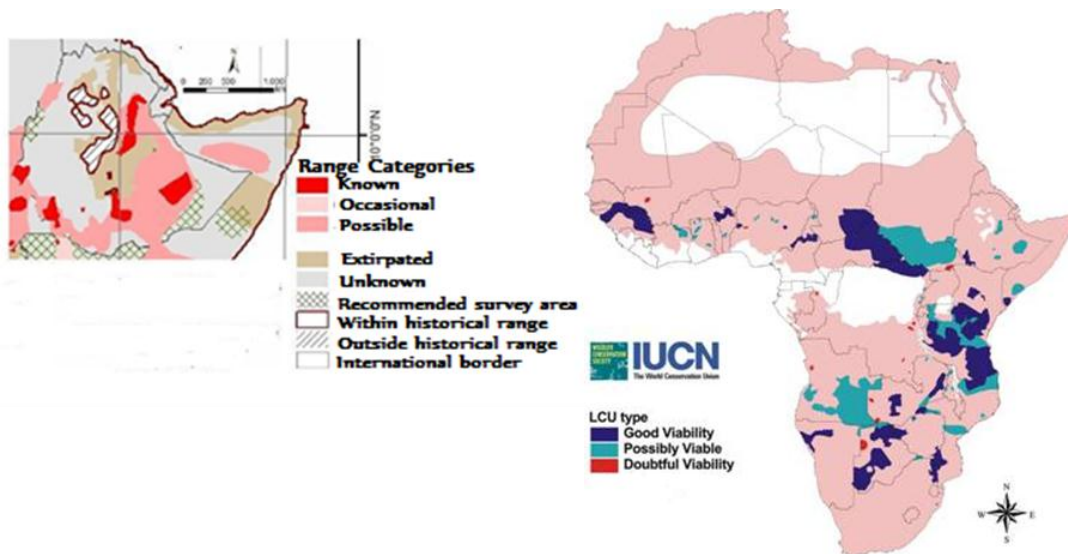
According to most census reports, line transects were used for sample counts and the wild animals were counted along randomly placed line transects where counting was done between 200 and 300 m width in either side of each transect based on the sampling protocol adopted by Norton-Griffiths (1978), Sutherland (1996) and Wilson et al. (1996).

However, most of the populations are believed to be overestimated since the methods depend on simplistic approaches of extrapolations that rely on suitable habitats without taking into consideration the prey-predator relationships and other key ecological aspects. For this reason, most of the results from the field surveys were not considered to determine population estimate but they were vital in defining the distribution of the lions. Therefore, in most cases extrapolations derived from conservative assumptions were used to estimate the populations of the species in question. The assumptions were the lion densities in most ranges are likely to be low since prey densities are low. In this regard, it is conservatively assumed a density of 1 to 2 lions/100 km<sup>2</sup> as adopted by Bauer and Van Der Merwe (2004).

The maps and Global Positioning System (GPS) readings indicated in the published and unpublished reports were used to determine the distributions of African lions and their potential threats.

### Review of experts' opinion

In 2006, the IUCN organized a lion conservation workshop for wildlife authorities from all lion range countries within Eastern and Southern Africa (IUCN, 2006). The workshop consisted of a



**Figure 1.** Range of African Lion (2006) (R) and African Lion Distribution and Population Viability (LCU-Lion Conservation Unit) (L).

Sources: IUCN Lion Conservation Strategy (2006).

technical session to map current lion range and status, followed by a strategic planning session to develop lion conservation strategies. The technical session was modeled after the range wide priority setting process developed by WCS for jaguars (Sanderson et al., 2002). Accordingly, experts were guided to produce maps of current lion range and delimit areas harboring known or suspected populations called Lion Conservation Units (LCUs) (IUCN, 2006). LCU delimitation relied on evidence of lion presence within the preceding 10 years and for each LCU participants assigned lion population trends and approximate lion population size. Although the data presented at the 2006 workshop date from 1990s onwards, it was the first expert-based comprehensive dataset on lion distribution in Eastern and Southern Africa and this was used as baseline for this review.

## RESULTS AND DISCUSSION

### Trend in distribution of African lion in Ethiopia

Even though it is generally believed that Ethiopia plays an important role in the African lion distribution pattern (Kebede and Gebretensae, 2018), it is true that it has been difficult to get up-to-date and reliable data on large carnivores. As a result, there is limited information on the distribution of large carnivores in Ethiopia and most of the information gathered so far has been dependent on assumptions and unverifiable sources (Riggio et al., 2013). For instance, there was a considerable concern about the consistency of the information on which the LCU had based to find out the then existing and former ranges of African lion in 2006 (Figure 1).

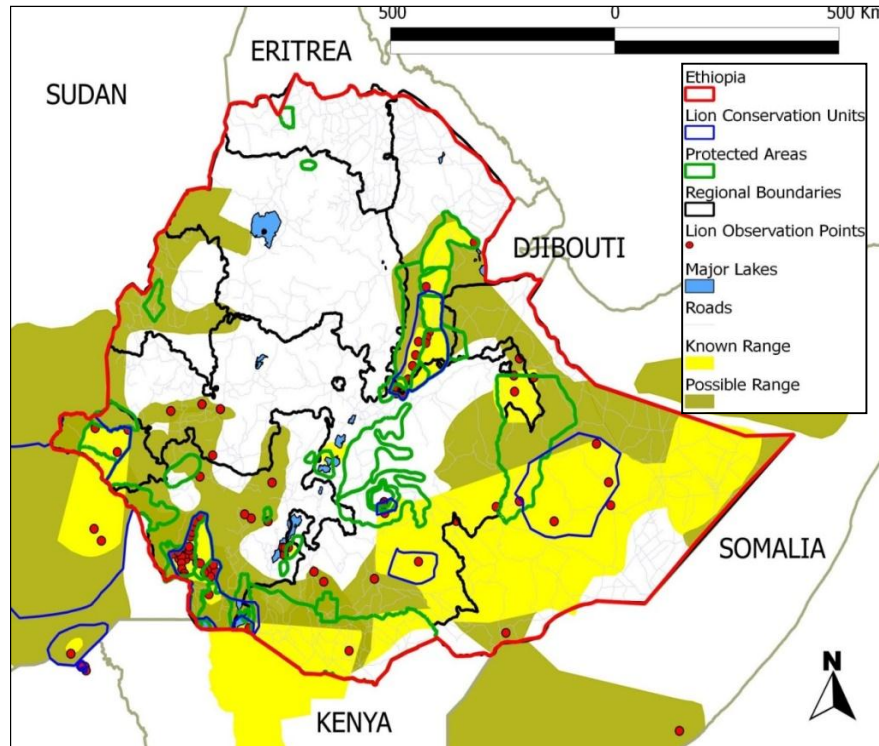
As pointed out earlier, efforts were made to assess the status of African lion in its possible ranges in order to update the distribution of this flagship species. During the

workshop held in Addis Ababa, in 2009 to develop National Action Plan for conservation of the lion in Ethiopia, some additional information about the then status of lion was obtained and based on this the following map was produced (Figure 2).

The recent published extrapolations indicate that the major lion populations that are found within Ethiopia include Boma-Gambella, South Omo, Welmel-Genale, Ogaden, Awash basin, Bale and Nechisar areas, the largest-Boma Gambella, being shared with areas in South Sudan (Riggio et al., 2013). The IUCN Red list assessment (Bauer et al., 2016) updated the former ranges and extrapolated the locations for extant and possibly extinct populations in Ethiopia in which additional ranges in the north western part, specifically, Alitash areas were considered.

As part of implementation of the National Action Plan, field assessments of possible lion range habitats have been undertaken and reports of the assessments of wildlife potential areas in various parts of the country reveal that many areas indicated as possible extinct ranges on the updated map indicated in Bauer et al. (2016) are still the locations for considerable populations of lion.

Accordingly, reports on assessments conducted since 2007 indicate that there are considerable populations of lion at Gara-Gumbi Open Hunting Area which also further extends to Chercher/Arsi-Harerge massifs (Gebretensae et al., 2008). The human-lion conflict incidences around Hadiya zone show that there is remnant population of African lion which occasionally moves to the upper part of Gibe Valley (Gebretensae et al., 2007). Recent reports also depict that considerable populations are present in



**Figure 2.** African lion distribution map produced based on information obtained from the national workshop participants (2009). Some of the Regional and PA boundaries may not be placed properly.

the Shebelle-Genale-Dawa (Afer, Liben and Dawa zones) and Dabus-Mao-Komo-Begimiz areas in the southern and western part of the country, respectively (Yadeta and Hailu, 2013; Wendim et al., 2015; Yadeta and Getachew, 2016; Wendim, 2018; Bauer et al., 2019). The report of the rapid assessment in the north western part of Ethiopia, which was supported by camera traps confirms that a trans-boundary population of African lion exists in Alitash National Park of Ethiopia and Dinder National Park and Biosphere Reserve of Sudan (Bauer and Rksay, 2016; Bauer et al., 2017) and this finding reveals also that Sudan is one of the Range States for Africa lion. Yabello (Borena) National park and Chelbi Wildlife Reserve of the extreme southern areas as well as Nechisar and Maze National Parks in the middle south are also the present locations for some populations of the species in question (Pers. Comm).

Therefore, based on the up-to-date information obtained so far, substantial amount of areas in the north-western, western and southern part of Ethiopia are considered as present ranges for African lion (Figures 3 and 4).

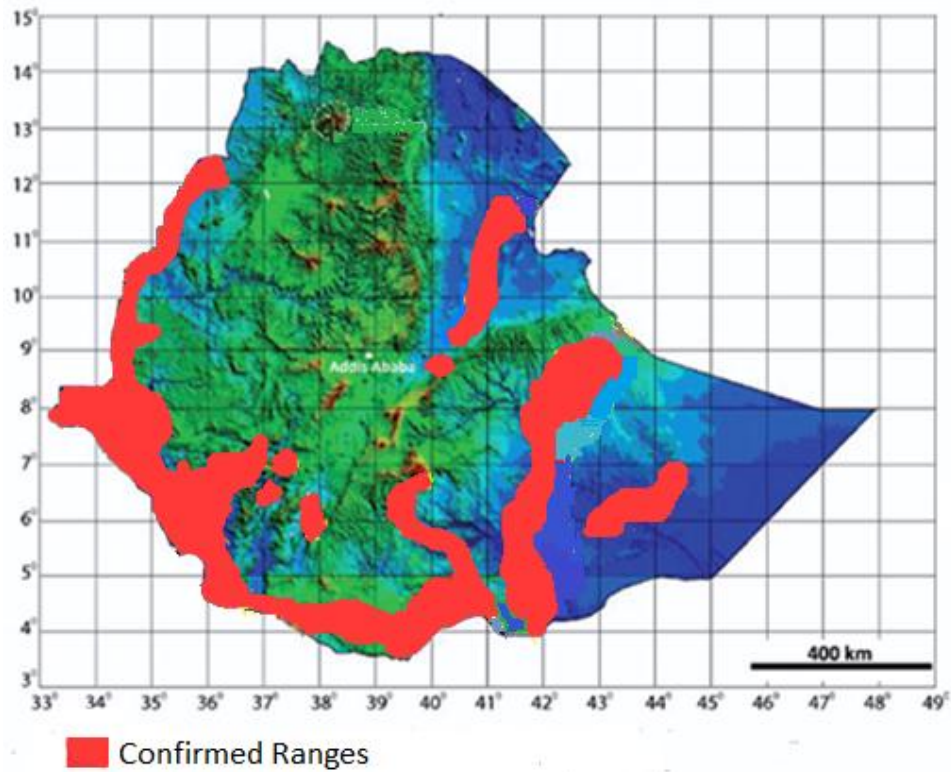
#### **Trend in abundance of African lion in Ethiopia**

As explained earlier, endeavors have been made by

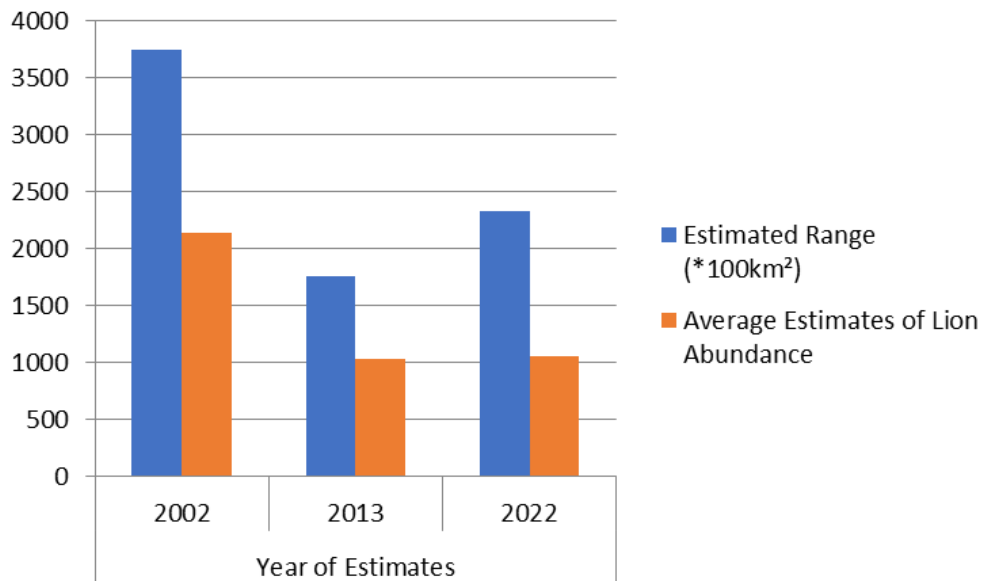
experts in the field to collect a relatively reliable data and associated information on African lions over the last decade so as to depend on a relatively justifiable approach and gather reliable information on lion population that reflect the current situation on the ground thereby establish database which in turn can be used as inputs in devising sound lion conservation mechanisms. Riggio et al. (2013), which is one of the recent published reports indicates that seven lion populations exist within Ethiopia as indicated in Table 1.

Following this, various field assessments were conducted and these surveys have clearly indicated that there are still more populations of African lion. Recent reports depict that some populations are present in Shebelle-Genale-Dawa (Afer, Liben and Dawa zones) and Dabus-Mao-Komo-Begimiz areas in the southern and western part of the country, respectively (Yadeta and Hailu, 2013; Wendim et al., 2015; Yadeta and Getachew, 2016; Wendim, 2018; Bauer et al., 2019). The report of the rapid assessment in the north western part of Ethiopia, which was supported by trapping cameras confirms that a transboundary population of African lion exists in Alitash National Park of Ethiopia and Dinder National Park and Biosphere Reserve of Sudan (Bauer and Rskay, 2016; Bauer et al., 2017).

Therefore, the population assessments mentioned earlier conform that there are additional LCUs that may



**Figure 3.** Present confirmed distribution of Africa lion in Ethiopia (based on the result of this review).



**Figure 4.** Estimates of African lion range and abundance by Chardonnet (2002), Riggio et al. (2013) and the current estimate.

be taken into consideration. In the north western, Bauer and Rskay (2016) conservatively assumed a density in

the range of 1 to 2 lions per 100 km<sup>2</sup>. On a total surface area of about 10,000 km<sup>2</sup>, this would mean a population

**Table 1.** Lion areas, habitat size and population estimates for Ethiopia.

Lion area	Size (km <sup>2</sup> )	Population
Boma-Gambella*	106,941	500
South Omo	22,483	200
Welmel-Genale	6,649	100
Ogaden	35,405	100
Awash	25,302	50
Bale	2,373	50
Nechisar	1,030	10

The greater proportion (82,541 km<sup>2</sup>) is included in the South Sudan region and the population estimate for Gambella is 150.  
Source: Riggio et al. (2013).

of 100 to 200 lions for the entire ecosystem, of which 27 to 54 would be in Alitash National Park. Wendim et al. (2015) recorded 53 lions in all of the six line transects of the proposed Mao-Komo National Park and extrapolated a population estimate of 413 considering 1000 km<sup>2</sup> (43% of the total area) as a suitable habitat. This population is believed to be overestimated since the extrapolation solely bases on suitable habitat and does not take the prey-predator relationship as well as associated ecological conditions. However, given the availability of prey, coupled with the intactness of the habitat in Mao-Komo, it is logical to assume the area is one of the lion strongholds in Ethiopia. Considering the direct sighting of 53 lions in the total sampled area (128.4 km<sup>2</sup>) and significant number of prey populations, the area is believed to harbor sizeable lion population and thus it has to be exceptionally treated. Consequently, it can be conservatively proposed that density in the Mao-Komo ranges between 4 and 5 per 100 km<sup>2</sup> while the remaining adjacent ranges of Bejemiz, Dedessa and Dabus fall in the density 1-2 per 100 km<sup>2</sup>.

The recent reports in the other side of LCU, Awash Valley also show dense distribution of some populations. For example, Siege et al. (2016) reported that 10-15 lions were estimated to inhabit in the 102.35 km<sup>2</sup> of Metehara sugarcane plantation. The dense distribution of the lions within the sugarcane plantation may be attributed to prey scarcity, fragmentation and associated perturbations of the surrounding natural habitat since larger carnivores are attracted by the prey populations of warthogs and wild pigs of agricultural areas as the prey diminishes in the natural ecosystem (Gebretensae et al., 2008). The abundance of lions in Bilen-Hertele Controlled Hunting Area (with 825 km<sup>2</sup> of an area), as estimated by Kebede et al. (2017) and Ewnetu et al. (2010) is 43 ( $\pm 2$ ) and 20 ( $\pm 1$ ), respectively; and this shows that 5.21 and 2.4 lions per 100 km<sup>2</sup>, which largely exceeds the conservative assumption (1-2 lions per 100 km<sup>2</sup>). This overestimation also stems from the simplistic approach of extrapolation that relies on crude assumption of suitable habitat without taking key ecological aspects into consideration.

Generally, efforts were made to assess some potential areas through which new locations for resident populations have been identified. It is however equally important to note that some of the populations in the former ranges especially in the protected areas are in deteriorating situation as their habitats are under increased anthropogenic pressure. For example, recent surveys in the Awash Valley and Gambella areas have indicated increased incidence of human-lion conflict and retaliatory killings by the local community and there is also significant fragmentation of habitats due to the ever-expanding cultivation areas (Wendim and Yadeta, 2013; Siege et al., 2016; Assefa and Teklu, 2017; Zerfu et al., 2019). Therefore, the present estimation of population needs to take into account the facts discussed earlier and the current population estimate of African lion in Ethiopia is summarized in Table 2.

Despite of the increase in the area coverage of ranges following the recent explorations, the current population estimate (915-1190 lions) does not show substantial difference with number of lions reported by Bauer and Van Der Merwe (2004) and Riggio et al. (2013) which estimated total of 1000 and 1030 lions, respectively. There is however significant decline (45-57%) as compared to the estimation made by Chardonnet (2002), in which 2144 lions were considered to occur in Ethiopia.

### Potential threats to African lion

There are several threats and problems for lion conservation in Ethiopia. A problem analysis undertaken 12 years ago shows that habitat loss (mainly due to development that is incompatible with lion conservation), poaching, lack of prey and human-lion conflict all pose major threats for conservation of lions (Gebresenbet et al., 2009). The lion is classified as vulnerable on the IUCN Red List of Threatened species, with their range reduced by 8% of historical range (Bauer et al., 2015). The leading causes of their continent-wide decline are indiscriminate killing (often related to conflict), habitat

**Table 2.** The present lion areas, habitat size and population estimates for Ethiopia.

Lion area/Habitat patch	Size (km <sup>2</sup> )	Population	Year of estimate	Associated IUCN LCU
Alitash National Park	2666	27-54*	2016, 2022	N/A
Mao-Komo, Bejemis and Dedessa Areas and their surroundings	29,000	162-255**	2015, 2018, 2022	N/A
Gambella	24,400	150*	2013, 2022	Boma-Gambella
South Omo and Gibe Valley	20,000	170-200*	2013, 2022	South Omo
Borana	15,000	50-100*	2021, 2022	N/A
Gerale-Dawa	4,000	40-80*	2021, 2022	N/A
Welmel-Genale	6,649	100*	2013, 2022	Welmel-Genale
Ogaden and Shebelle	100,000	100*	2013, 2022	Ogaden
Awash	25,000	50*	2013, 2022	Awash
Bale	3,000	30*	2013, 2022	Bale
Eastern Hararghe	3,500	35-70*	2021, 2022	N/A
Total population estimate	-	914-1189	-	-
	-	~915-1190	-	-

\*Population extrapolated from the density 1-2 lions per 100 km<sup>2</sup> (current estimates made using the extrapolation adopted by Bauer and Van Der Merwe (2004), estimates made by Riggio et al. (2013), Bauer and Rskay (2016) and Yirga et al. (2021)). \*\*Population extrapolated from medium density of 4-5 lions per 100 km<sup>2</sup> (Maokomo) and low density 1-2 lions per 100 km<sup>2</sup> (Bejemis and Dedessa) (based on reports of Yadeta and Hailu (2013), Wendim et al. (2015) and Wendim (2018)).

loss, prey base depletion and trade (Bauer et al. 2015; Riggio et al., 2013; Yirga et al., 2017).

Like the case of other countries of Africa, suitable lion habitats in many of its former ranges in Ethiopia have declined. Human and livestock population growth, settlement and agricultural expansion and the ramifications of economic development have had cumulative negative impacts on the natural habitat and populations of lions and their prey. Furthermore, poaching of the wild prey population and the existing expansion of livestock where the wild grazers progressively are being replaced by domestic ones has largely affected the roles of lions in the ecosystem. Besides, increased fragmentation of wildlands results in lack of habitat segregation and inter-specific competition among the larger carnivores and this in turn, brings about considerable lion population losses (Gebretensae et al., 2007).

Human-lion conflict has worsened over time and thus threatened the usual co-existence between people and lion populations. The conflict has escalated and reached its maximum and devastating stage in the process of retaliatory attack. These have resulted in tremendous socio-economic and ecological losses. The human-lion conflict in Soro district of Hadiya zone, Zone 3 of the Afar Region and Liben zone of the Somali region is the best example where depredation cases of hundreds of livestock of various types and significant number of people by lions were reported (Gebretensae et al., 2007). Similar incidences have been encountered recently in the middle and lower Awash Valley (Wendim and Yadeta, 2013; Siege et al., 2016; Assefa and Teklu, 2017; Yirga

et al., 2017) and in some cases reduction of the vermin animals could not reduce the prevalence of the problem. The underlying causes for the conflict are believed to be habitat loss and fragmentation, prey scarcity and erosion of the traditional systems among others (Gebretensae et al., 2007; IUCN SSC Cat Specialist Group, 2018).

Illegal captivity and trade is also considered as potential threat to the lion population in the horn of Africa. The case of illegal trade of larger carnivores including cheetahs and lions has been well-publicized. For instance, Amir (2006) has pointed out that lion is one of the illegal trade-affected species through the Somali smuggling route and export destinations where many hunters adopted new hunting and trapping techniques, and learned to care and handle live animals bound to be sold in foreign counties. Since the recent past, Ethiopia appears to be facing an escalating poaching and trafficking threat linked to organized crime and cross-border trafficking networks (Gebretensae and Gebremicael, 2018) and lion is one of the victims of the ever-increasing threat (Tessema et al., 2021).

### Conservation status

One of the recommendations from the regional lion conservation workshops (IUCN, 2006) was that National Action Plans should be developed, in order to guide the implementation of conservation measures at a national level. In 2012, Ethiopia endorsed a National Action Plan to conserve its lion population and this species specific conservation strategy was developed using logical

framework methodology, based on the information on potential threats and associated problems. After defining the vision and goal, lion conservation objectives were defined for each threat. These objectives were further operationalized by setting targets and by defining the activities needed to achieve them. Time frames and responsibilities for these activities were also identified (EWCA, 2012).

The goal of the strategy is: “*To secure, and where possible restore, sustainable lion populations throughout their present and potential range in Ethiopia, recognizing their potential to provide substantial social, cultural, ecological and economic benefits*” and under this goal, there are objectives that deal with five thematic areas, namely: management, mitigation, socio-economic, policy-land use and trade (Gebresenbet et al., 2009; EWCA, 2012).

Generally, there have been considerable limitations in delivering the outputs that meet the aforementioned objectives even though considerations were given to specific components of the lion conservation strategy. One of the reasons for this is the conservation approaches in Ethiopia are ecosystem focused ones since there is a need to save the key biodiversity areas using the limited resources (Kebede and Gebretensae, 2018).

## CONCLUSION AND RECOMMENDATIONS

It is generally true that there is limited information on the status of lions in Ethiopia. However, the existing data from the field assessments conducted over the past two decades show that there are more ranges for African lions and these areas include the wildlands that were assumed as extirpated in the previous reports. Despite this fact, the lion numbers are still low and declining. It is generally assumed that African lions in Ethiopia have been under serious threat from various anthropogenic activities like habitat destruction, indiscriminate killing and illegal captivity. It is therefore recommended that there is a need to:

- (1) Effectively implement the developed national action plan for lion conservation;
- (2) Strengthen partnership and trans boundary protected area systems in order to enhance ecological connectivity between the major habitats of lions;
- (3) Undertake field assessment to examine the status of existing populations in the conformed ranges in general and in the possible stronghold areas of Mao-Komo, Bejimez, Dedessa, Dawa-Genalle and Wabe-Shebelle areas in general;
- (4) Establish national Red list category for the threatened species based on the final reports of the assessments; and
- (5) Conduct a countrywide census to ascertain the current population of lions in Ethiopia.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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