

RESEARCH ARTICLE

Large carnivore distribution, conflicts and threats in the east of the Somali region, Ethiopia

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Abstract

Large carnivore distribution in Ethiopia is not well documented; we did 108 interviews and 12 focus group discussions in six districts of the Somali Region to gather basic information. The Region is not listed as resident range for big cats, but our results indicate widespread presence of cheetah, and possible remnants of lion and leopard occurrence. Spotted and striped hyaena, plus many smaller species, are frequently encountered. In contrast to positive attitudes towards wild grazers, all carnivores are persecuted in response to frequent conflict leading to injuries and deaths among people and livestock. Lion and cheetah cubs were regularly captured and trafficked, and this may have contributed to lion declines especially. Cheetah cubs are still regularly caught and we mapped how they are smuggled to Somalia/Somaliland from where they enter the pet trade.

KEYWORDS

cheetah, hyaena, leopard, lion, wild dog

Résumé

La répartition des grands carnivores en Éthiopie n'est pas bien documentée; nous avons réalisé 108 entretiens et 12 discussions de groupe dans six districts de la région de Somali afin de recueillir des informations de base. La région n'est pas répertoriée comme une zone de résidence pour les grands félins, mais nos résultats indiquent une présence généralisée de guépards et des vestiges possibles de lions et de léopards. La hyène tachetée et la hyène rayée, ainsi que de nombreuses espèces plus petites, sont fréquemment rencontrées. Contrairement aux attitudes positives à l'égard des herbivores sauvages, tous les carnivores sont persécutés en raison des conflits fréquents qui entraînent des blessures et des décès parmi les personnes et le bétail. Les lionceaux et les petits guépards étaient régulièrement capturés et faisaient l'objet d'un trafic, ce qui pourrait avoir contribué au déclin des lions en particulier. Les petits guépards sont encore régulièrement capturés et nous avons cartographié la façon dont ils sont introduits clandestinement en Somalie/Somaliland, d'où ils entrent dans le commerce des animaux de compagnie.

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1 | INTRODUCTION

Carnivore species tend to be more threatened than other taxa, mostly due to their low densities and propensity for conflict with livestock (Ripple et al., 2014). Ethiopia has a complete carnivore guild, but for most species little has been published internationally on the current status of their populations. Notable exceptions are the work on the Ethiopian wolf *Canis simensis* (Haydon et al., 2006; Sillero-Zubiri et al., 2016), spotted hyaena *Crocuta crocuta* (Yirga et al., 2017; Yirga, Ersino, et al., 2012) and lion *Panthera leo* (Gebresenbet et al., 2018; Gebretensae & Kebede, 2022; Yirga et al., 2021). The ecology of cheetah *Acinonyx jubatus*, leopard *Panthera pardus* and wild dog *Lycaon pictus* have not been investigated in Ethiopia, but savannah habitats in the South of Ethiopia are considered suitable habitat (EWCA, 2012). There is sufficient information to suspect that these species are threatened and that cheetahs face an additional threat that is less common across the rest of Africa; commercial trade in cubs (Durant et al., 2017; Tricorache et al., 2021).

Within Ethiopia, the Somali Regional National State (henceforth Somali Region) is thought to be the principal source of cheetah cubs for the Middle Eastern pet trade (EWCA, 2012). Information from the area is scarce as it is remote, weather conditions are harsh and in the past insecurity was endemic. The population of 6.5 million people (CSA, 2013) is almost entirely (95.6%) ethnic Somali and Muslim (Temin, 2006). Human densities are below 20 inhabitants per km⁻², mostly pastoralists (60%) and agro-pastoralists (25%) (Bank, 2020). Regional livestock estimates are 6.5 million camels, 6 million cattle, 11 million sheep and 16.5 million goats (CSA, 2018).

Wildlife is hardly the object of study or policy in the Somali Region; Geraile NP is the only protected area but is not entirely characteristic of the mostly arid lowland region; it is at higher altitude and has higher rainfall. On the IUCN red List (www.redlist.org), only Geraile NP is mapped as part of the resident range of the three big cats. The rest of the Region is mapped as a range only for spotted and striped hyaena *Hyaena hyaena*. Medium-sized carnivores in the Region include caracal *Caracal caracal*, serval *Leptailurus serval*, black-backed jackal *Canis mesomelas*, African wolf *Canis lupaster* and African wild cat *Felis lybica*. Natural prey species include gerenuk *Litocranius walleri*, East African oryx *Oryx beisa*, lesser kudu *Tragelaphus imberbis*, dibatag *Ammodorcias clarkei* and Salt's dik dik *Madoqua saltiana*. Densities of prey and carnivores are so low that camera trapping is not a viable option across most of the Region due to both low detection probabilities and inaccessible terrain. It is unlikely therefore, that robust estimates of abundance will be available in the foreseeable future. Until new technologies (e.g. environmental DNA analysis) are available in Ethiopia, anecdotal information and local expert opinion are all that is available to guide conservation policy.

In this study, we build on previous work in Adadle district of Somali Region that was oriented towards 'one health', but which also showed that livestock depredation and livestock disease were ranked as the two biggest problems for local people, far ahead of drought (Ibrahim et al., 2022). We visited six different districts in November and December 2021 to interview people about their knowledge and experience of wild carnivores. Our key questions were oriented towards

local knowledge of carnivore distribution, the status of human carnivore conflict and information related to the cheetah cub trade. We tested hypotheses concerning differences between carnivore species, and between geographic locations. People were informed about our purpose and all respondents readily consented to participate, all villagers were hospitable and collaborative. Since we report partly on illegal activity, all information was anonymised before leaving the area and some data are presented only in aggregated form.

2 | METHODS

We selected three zones (an administrative level between region and district) across a North-South belt straddling Ethiopia's arid eastern extremity, towards the Republic of Somalia (Figure 1). In each zone, we selected two districts and in each district three villages. The 18 villages are thus geographically representative, even if they were not selected randomly. In each village, we conducted six semi-structured key informant interviews (total respondents $n=108$); and in 12 villages, we conducted focus group discussions. All respondents were male, partly not only by cultural constraint but also because all matters related to livestock and landscape are the domains of men. Our questions focused on perceived wildlife abundance and trends, on human carnivore conflict and on determinants of threats with particular reference to the cheetah cub trade. The focus group discussions revolved around the same topics.

Respondents were asked to score carnivore abundance on a scale of +3 for the most abundant to -3 for the rarest species in their village. They were also asked to give their most recent observation of each species, which we categorised into intervals of 6 months for last year and of 5 years for the last 20 years. Respondents also gave the most recent incidents of people and livestock they recalled as having been either killed or injured by carnivores in their vicinity (defined as the area that can be covered in 1 day's walk), and we used the same time intervals. To test hypotheses concerning trends in these numbers and if they differed between species, we fitted general linear models (GLMs) to data aggregated across the survey area for human attack incidents (Table 2) with a Poisson family error structure and using the different lengths of time intervals as an offset. Significant overdispersion was accommodated by applying a correction factor (using the 'family=quasipoisson' option with 'glm' in base R, version 3.5.0). Hypothesis tests were affected with the 'drop1' option, applying a deviance test for individual terms. Because the models were adjusted for overdispersion, F ratios were appropriate for these tests.

Respondents were asked about carnivore killing and cub trafficking, and differences between districts were compared using Chi-square contingency tables and Wilcoxon sign rank test. All tests were performed in R (Fox & Weisberg, 2018; R Core Team, 2018).

3 | RESULTS

All respondents were familiar with all the species mentioned in our introduction. Table 1 presents the abundance scores for large

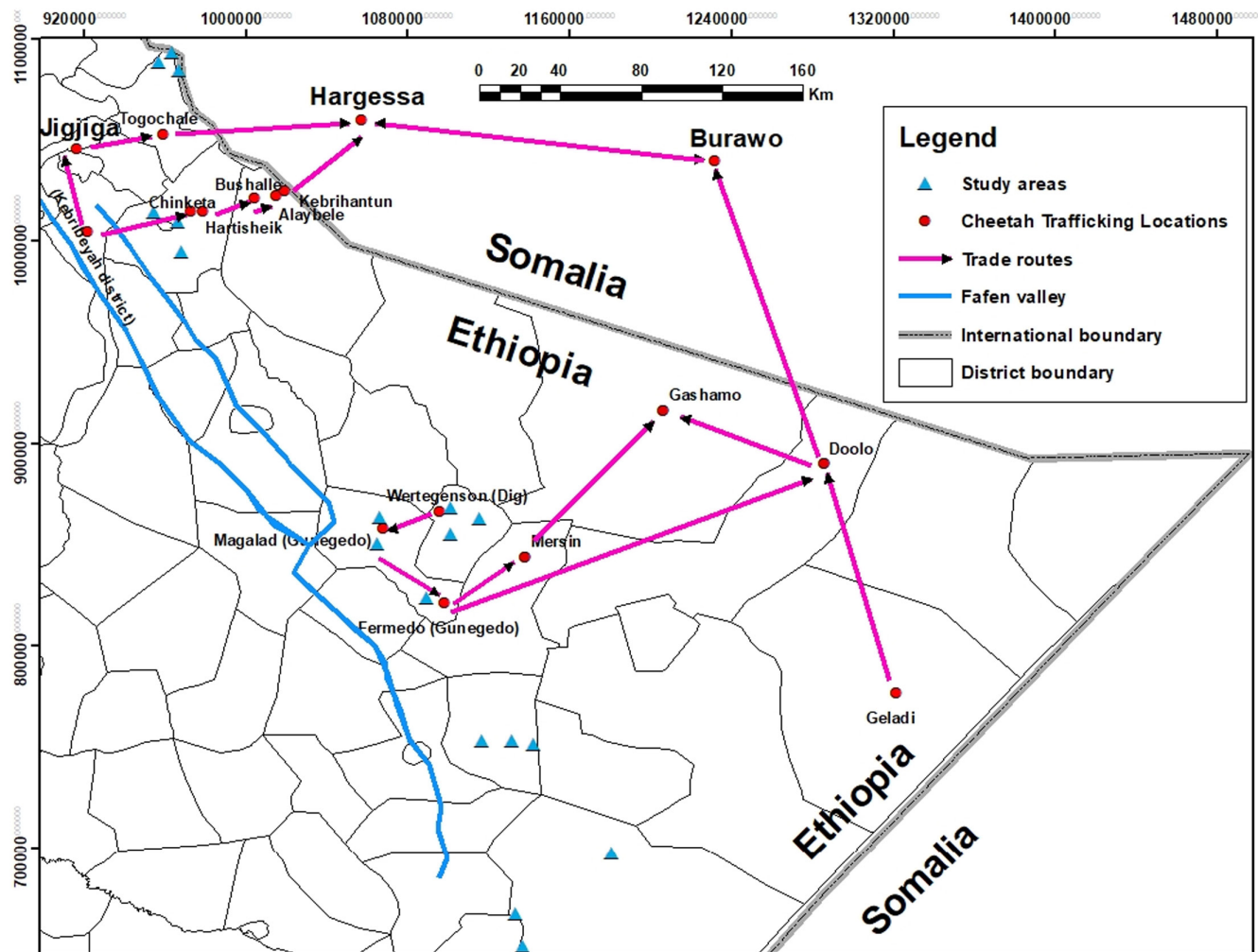


FIGURE 1 Map of the study area showing interview locations and showing the nodes in the cheetah cub trafficking routes from the rural source areas into Somalia.

TABLE 1 Mean perceived abundance scores on a scale of +3 (most abundant) to -3 (most rare) aggregated across $n = 18$ respondents per district.

Zone	Korahye		Jarar		Fafen		
District	Shila-Bo	Kudu-mbur	Gune-gedo	Dig	Kebri-Beya	Awba-re	Total
Lion	-37	-46	-41	-30	-30	-10	-194
Leopard	-24	-36	-25	-4	-24	-33	-146
Wild dog	-19	-12	-1	0	-9	0	-41
Cheetah	11	28	21	-2	3	-33	28
Spotted hyaena	41	39	49	46	48	54	277
Striped hyaena	-3	3	-4	-24	3	-6	-31
Caracal	0	-4	-11	-3	-14	7	-25
Serval	-5	-7	-25	-27	-10	-3	-77
Black-backed jackal	37	34	38	35	36	19	199
Common jackal	2	0	0	9	0	11	22
Wild cat	-3	2	0	0	-3	-6	-10

carnivores, showing that lion, leopard, wild dog and serval were ranked as rare, whereas spotted hyaena, Black-backed jackal and cheetah were ranked as abundant. There was not much spatial

variation but we note as an outlier that cheetahs were ranked as rare in the district in the North of the study area, close to the regional capital Jijiga. None of the respondents reported observing

wild dogs over the last year or decade, while cheetah and spotted hyaena sightings have been increasingly common. People have been killed or injured by large carnivores (Table 2); over a decade ago this was mainly due to lions but over the last 5 years most incidents have involved cheetahs and hyaenas. This shift was statistically significant over the last 20 years: trends differed among species in the GLM model ($F_{5,24}=10.53$, $p<0.001$), with significant upward trends for cheetah and both hyaena species ($F_{4,4}\geq 9.3$, $p\leq 0.03$). There was no evidence of a trend for lions ($F_{4,4}=0.1$, $p=0.82$). Data were too sparse to fit models for leopard and wild dog. In focus group discussions, people indicated that conflicts with lion and leopard have decreased progressively in past years while that of cheetahs and hyaena increased in recent years and they linked this to corresponding trends in species abundance.

Respondents recognised the following commercial forms of carnivore use; trade in lion and cheetah cubs for export, trade in leopard skins for ornamental use and trade in spotted hyaena body parts for traditional practices. Lion cubs reportedly used to fetch much higher prices than cheetah cubs, reflecting higher rarity and risk, but lion cubs are hardly captured nowadays. Leopard skin trade used to be very common but none are available in local markets nowadays. Cheetah cub trade is common in the districts in the central part of the study area, but not in the North where cheetahs have become rare. A majority of respondents from Dig (72.0%) and Gunegedo (67.0%) reported awareness of cheetah being captured, while the rates were much lower elsewhere (Shilabo: 16.7%, Kudumbur: 33.3%, Kebri Beya: 33.3%, Awbare: 0.0%). These differences are statistically significant (contingency table $\chi^2_5=29.5$, $p<0.001$). Similarly, where respondents were asked to rank the importance of the trade on a three point scales from 1='low' importance to 3='high' importance, the highest mean rank was observed at Dig (mean=2.66) and Gunegedo (mean=2.55). The mean rank

for the cheetah trade was significantly higher than that for the lion trade (Wilcoxon sign rank test, $p=0.03$).

Through focus group discussions, we identified the network and the routes used in cub trade. Figure 1 shows these routes, whereby the nodes are exact but not the arrows; there is no established road network, rather a labyrinth of tracks in the landscape that are easily navigated by locals but not by outsiders. Cubs are given fresh cow and camel milk during capture and on the way.

All respondents replied that they kept livestock in protective enclosures at night and ensured herding of livestock during the day, but still most respondents ($n=87$) reported livestock loss. Where incidents of all kinds are considered, including injuries to stock, almost all respondents ($n=107$, 99.1%) reported incidents involving spotted hyaenas at some time in the past compared with 20 (18.5%) for leopards, 56 for lions (52.3%), and 90.7% for cheetahs.

Most recent Livestock losses are shown in Table 2, showing a gradual shift from lions and leopards to cheetahs and hyaenas. For lions, there was a negative correlation between time elapsed since the last incident was recorded and the number of respondents (Figure 2). The most recent incidents involving lions were more often reported to have been some time in the past by more respondents. The opposite tendency was recorded for the other species; hence, temporal trends for lions and other species were negatively correlated. Most attacks on cattle were by lion, whereas most attacks on shoats were by leopard, cheetah and hyaena, whereas spotted hyaena also attacked camels.

Overall, a majority (56.5%) of respondents said they had ever killed a predator, and there was no evidence that this varied among communities (Contingency Table $\chi^2_5=0.42$, $p=0.98$). Of the 61 respondents who said they had killed a carnivore, $n=33$ (54.1%) said they had killed only hyaena. Only five respondents said they had killed cheetahs, and three lions alone. Five respondents said they had killed multiple carnivores; spotted hyaena and, respectively,

TABLE 2 Most recent/Last one incidents of people killed (K) or injured (I) by carnivores over different time spans going back from the time of interview, as reported by $n=108$ respondents.

People	Lion		Leopard		Wild dog		Cheetah		Spotted hyaena		Striped hyaena		Total	
	K	I	K	I	K	I	K	I	K	I	K	I	K	I
≤6 months	0	0	0	0	0	0	1	3	4	9	0	2	5	14
>6 months ≤1 year	1	0	0	0	0	0	0	0	0	10	0	1	1	11
>1 year ≤5 years	0	0	0	0	0	0	0	3	1	10	0	1	1	14
>5 years ≤10 years	2	1	0	0	0	0	0	3	0	0	0	2	2	6
>10 years ≤15 years	5	2	0	2	1	1	0	0	0	0	0	0	6	5
>15 years ≤20 years	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Livestock														
≤6 months	13	4	2	1	0	0	149	36	154	29	80	7	433	82
>6 months ≤1 year	6	8	5	1	0	0	24	10	32	11	15	2	118	33
>1 year ≤5 years	17	4	19	7	0	0	30	3	114	3	57	0	279	21
>5 years ≤10 years	9	3	3	0	0	0	17	0	4	0	0	0	50	2
>10 years ≤15 years	11	0	0	0	0	0	15	0	1	0	4	0	17	0
>15 years ≤20 years	7	2	0	0	0	0	0	0	0	0	0	0	19	0
>20 years	39	0	0	0	0	0	4	0	0	0	0	0	0	0

lion ($n=3$), common jackal ($n=1$) or Black-backed jackal ($n=3$). Approximately, half the respondents (50.8%) said they had killed predators in the 12 months before the survey.

In the course of the focus group discussions and key informant interviews, we realised that perceptions about wild herbivores are positive, but that carnivores are generally detested. There is awareness across the area about the existence of lion and cheetah cub trade, although the importance varies (Table 3). We cannot quantify this with our interviews, but we quote statements which attracted no dissent from other participants (Table 4). The focus group discussions further confirmed that lions are virtually extirpated due to retaliatory killing, whereas the threat to cheetahs is primarily the cub trade.

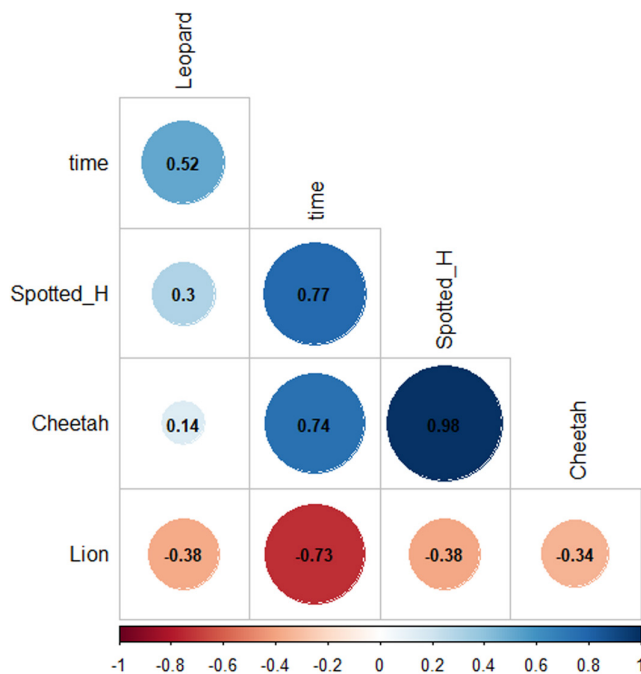


FIGURE 2 Correlation matrix for trends in reported incidents of livestock attacks (of all types where fatalities, injuries or both were recorded) involving different species. Positive correlation with 'time' indicates that respondents tend to report that the last incident occurred recently. Positive correlation between species indicates trends in the same direction, negative correlation indicates trends in opposite direction. Critical value for $p=0.05$ with 5 dof is 0.75.

TABLE 3 Cheetah and lion cub trade awareness and importance (ranked as 1=low importance, 2=medium importance, 3=high importance).

	% Aware of cub trade (n respondents)	Cheetah trade mean importance rank	Lion trade mean importance rank
Shilabo	17.0 (3/18)	1.22	1.00
Kudumbur	33.0 (6/18)	1.44	1.00
Gunegedo	67.7 (12/18)	2.55	1.44
Dig	72.0 (13/28)	2.66	1.44
Kebri Beya	33.3 (6/18)	1.67	1.00
Awbare	0.0 (0/18)	1.11	1.00
Total	37.7 (40/108)	1.76	1.15

4 | DISCUSSION

Even though the interviewers were affiliated with the national wildlife authority, this institution has very limited law enforcement capacity on the ground and is not locally associated with positive (e.g. compensation payments) or negative (e.g. anti-poaching patrol) expectations. People considered the issues we discussed as uncontroversial and statements showed a great degree of overlap, if not consensus. The reliability of responses to direct questions about wildlife abundance and trends can be disputed, but there is little reason to doubt people's ability to assess which carnivore species was responsible for attacks. Triangulation between responses about carnivore abundance, frequency of carnivore attacks on people and most recent carnivore observations over time corroborate each other and support the following conclusions. Firstly, cheetahs persist across the study area at unknown but probably low densities, despite retaliatory killing and cub trade. Lions, leopards and especially wild dogs appear to have all but disappeared but were present throughout the area and remnant pockets with lion and leopard may persist. With reported decreases in lion, leopard and wild dog densities, the relative importance of conflicts with cheetahs and their associated persecution appears to be increasing. It is possible that the decline of dominant predators led to increases in cheetah, hyaena and jackal numbers. While interviews are no substitute for biological surveys, our results provide convincing evidence to extend range polygons for several species, most importantly cheetah. Our findings are mirrored by similar work on the other side of the border using similar methods, which suggests that the range of cheetah extends into Somaliland (Evangelista et al., 2018).

Ethiopia is no exception to the general problem of livestock damage wherever lions and leopards share a landscape with livestock (Gebresenbet et al., 2018), so the fact that damage by lions and leopards is reported to be low is likely due to their low abundance. Attacks by other large carnivores are usually rare, and the relatively frequent attacks by cheetahs and hyaenas are noteworthy. Also remarkable is the frequent reporting of spotted hyaena attacks, whereas in other parts of Ethiopia this species is mainly dependent on scavenging, leading to much less conflict (Yirga et al., 2015, 2017; Yirga, De Longh, et al., 2012). Carnivore attacks are traumatic experiences and victims are often confident as to which predator species was responsible, if not by direct observation then by tracks and signs; misidentification is unlikely. Attacks by carnivores are

Locality	Phrase
Kebri Beya	We have never seen any benefit from carnivores except harm; they are our number one enemy. They expose us to loss, poverty and dismay as they take our beloved wealth, livestock – our source of livelihood, pride and dignity
Shilabo	If they are important as most of you say, let the government do something to keep us and our livestock safe, otherwise please convince the government to give us poison to eradicate them from our land
Kebri Beya	Herbivores are signs of good rain and pasture, signs of good luck. Carnivores are enemies, signs of bad luck. We see wild herbivores as our livestock, camels, cows and goats. When there are plenty, it is a sign for us that the year will be affluent. It also signifies that our environment is peaceful and people are happier than ever. We also used to use them as sources of food, though we do not do so these days. On the contrary, carnivores are signs of deficit, loss and disturbed environment. They are of no use, rather a source of harm and discomfort to our community in which livestock is our source of everything; food, clothes, security and what not
Gunegedo	I want to see them (carnivores) completely destroyed
Gunegedo	Herbivores are our family members
Kudumbur	Lion cubs have a bigger price than cheetah cubs, if you get a lion cub and sell it you will buy a car and a good house. However, nowadays getting a lion cub is much more difficult

TABLE 4 Phrases quoted from group discussions.

obviously a serious issue for the people involved, and whereas this is common across Africa for livestock, we note that, here, attacks on people are also frequent. Apart from the impact on human welfare, this can have a disproportionate effect on perceptions of coexistence with carnivores (Packer et al., 2005) and should be the topic of immediate further investigation and mitigation.

Livestock loss mitigation measures such as the use of enclosures at night and herders during the day, the two most commonly recommended measures are already widely used in the area. We do not know much depredation is thereby prevented, but where livestock are free-ranging and abundant, and carnivores are present, some degree of depredation is expected despite this mitigation. Although we have no data on respondents' livestock numbers and cannot calculate percentage losses, depredation reported by our respondents appears to be in the range of what has been reported elsewhere (Gebresenbet et al., 2017; Yirga et al., 2021). However, the quotes from our interviews clearly illustrate a distinction between positive attitudes towards wild herbivores and negative attitudes towards large carnivores, linked to losses that are considered intolerable. Tolerance levels were earlier reported to vary between regions in Ethiopia as a result of cultural differences, here we can add that the attacks on people, reported less frequently in those other regions, may play an important role in reducing tolerance (Gebresenbet et al., 2018).

The cheetah cub trade appears to take its source within the Somali Region and most notably in the central zone of our study area, not a single informant suggested that cubs were sourced further inland. Despite what appear to be substantial offtakes, cheetahs persist across the Region, albeit at low densities and with recent signs of possible declines in the North of our study area. Informants know that cub trafficking is illegal but with low levels of law enforcement they were not afraid to talk about it. It

is a well-organised trade, with brokers and middlemen on established routes across the Region and into Somalia/Somaliland, not hidden to the majority of the community as reflected in the map in Figure 1. As to lion cub trade, this may have played an important role that has always been underrepresented in discussions on lion trafficking; its importance has diminished but further investigations may be informative for lion conservation elsewhere and for the study of wildlife trafficking generally.

Due to our survey design, covering a North–South band across the Somali Region, we were able to identify the main trafficking routes and the villages that act as hubs. Cheetahs are regularly confiscated here, but confiscation is unpractical and insufficient as a deterrent at scale, as the potential for cheetah reintroduction or life-long care is limited. The area is too vast and remote for conventional law enforcement to be effective within the current limits of government capacity. The information presented here can be useful to design other interventions aimed at actors on strategic points along the chain, such as middlemen in trade hubs, customs posts on the national border and authorities in Somalia/Somaliland. An essential part will be international cooperation with transit and destination states (Tricorache et al., 2018).

Our work corroborates work across the border, both in terms of cheetah presence and trafficking in Somaliland (Marker et al., 2023). The Somali Region used to have low densities of wildlife, but because of the enormous habitat size, populations of many species may have been viable in the past. At present, viability is doubtful for some species, but the area is still of major importance for the conservation of cheetahs, hyaenas, smaller carnivores and prey species. We therefore recommend increased attention to biodiversity values in this Region and action-research aimed at deploying further mitigating measures for both livestock conflicts and wildlife trafficking.

AUTHOR CONTRIBUTIONS

PJJ and HB were not involved in the preparatory and field phase of this project.

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CONFLICT OF INTEREST STATEMENT

We declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

CONSENT

All respondents gave prior informed consent and participated voluntarily in this study.

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