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Livestock Losses and Predation Crisis in Communal Areas around Sengwa Wildlife Research Area (SWRA), Zimbabwe

Spencer Matindike[1], Gladman Chibememe[1], Innocent Mahakata[2*]

[1]Department of Wildlife Ecology and Conservation, Chinhoyi University of Technology, Chinhoyi, Zimbabwe
[2]Zimbabwe Parks and Wildlife Management Authority, Scientific Services Section, Chimanimani National Park, Chimanimani, Zimbabwe
Email: *innocentmahakata@gmail.com

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Abstract

Livestock losses as a result of depredation by large wild carnivores are still of major concern globally. The study sought to establish current problematic predators, targeted livestock and to quantify in monetary value losses incurred by affected farmers from January, 2021 to December, 2021 in the communal area adjacent to Sengwa Wildlife Research Area (SWRA). Four villages were purposively sampled (*i.e.* Chirevereve, Dungwa, Nhidza and Siamwanja). Data were collected through face-to-face interviews with randomly selected households. Mann-Whitney U-test was used to compare livestock losses between dry and wet season in Minitab-17 Statistical Software. Leopard, hyena, black-backed-jackal, baboon, bat-eared-fox and crocodile were the recorded problem predators while cattle, hen, sheep, pig, donkey, goat and turkey were the targeted livestock. There was no significant difference between number of livestock killed in dry and wet season from the study area (p-value = 0.962, where $\alpha = 0.05$). Livestock losses were net USD 7615.00. Depredation by hyena contributed 54.8% losses with a value of USD 6275.00 while crocodile and leopard related livestock losses were the least, contributing only 0.9% with a value of USD 50.00. Local community held different views on the possible causes of livestock losses by predators. However, absence of a game fence was mentioned as the major factor facilitating predators moving outside the SWRA to target livestock. Further researches to quantify loss due to livestock depredation at household level are recommended.

Subject Areas

Wildlife Management

Keywords

Livestock, Predation, Loss, Sengwa Wildlife Research Area, Sai Communal Area

1. Introduction

Predation of livestock by carnivores is a historical issue that agricultural farmers all over the world still deal with today (Ugarte, 2019) [1]. Agro-pastoralists in Zimbabwe experience cattle losses by wild carnivores mostly in areas bordering wildlife protected areas (PAs). Rural communities, whose livelihood totally depends on agricultural and livestock production, regularly experience financial losses as a result of wild animals preying on their livestock (Ray *et al.*, 2022) [2] Losing livestock to predators invites problems to farmers, and has an impact to their livelihood.

Livestock losses due to predation in communal areas that share same boundary with PAs had been in existence for centuries around the world (Oliveira *et al.*, 2021) [3]. Community surround PAs are always on the receiving end and suffering consequences of livestock losses (Woodhouse *et al.*, 2018) [4]. Wild predators such as lions, leopards and hyenas attack mainly goats, donkeys and cattle (Radford, 2022) [5]. Most livestock in communities are in global decline due to predation resulting in communities experiencing economic losses (Mahajan *et al.*, 2022) [6].

Factors accelerating predation crisis are driven by loss of habitats, human population increase, and growing wildlife populations (Estrada *et al.*, 2020) [7]. Kissui *et al.*, (2019) [8] highlighted that predation rates by lions, leopards, cheetahs and spotted hyenas are high in livestock attacks when predators' population boom followed by habitat loss. Farmers tend to kill a lot of lions, leopards, and spotted-hyenas in cases where these predators kill more livestock.

According to Pimenta *et al.*, (2017) [9] livestock husbandry had a clear impact on the rates of predation and the number of livestock losses. Goats, cattle and sheep have the least predation rates when herded by daylight and enclosed in kraals at night (Kokole, 2019) [10]. Socio-economic impact of livestock depredation is mostly brutal in economically marginal communities nearest to PAs that are to a greater extent dependent on pastoralism. Cattle, donkeys and goats are important to the economies of several communities (Geiger *et al.*, 2020) [11]. Revenues from sales of livestock are used for different purposes such as paying fees, buying food and farming. Predator attacks represent a significant cost to agricultural producers (Kaumbata *et al.*, 2020) [12]. Reports of livestock losses had been constantly increasing, however, researches to establish the related losses had not been explored in areas surrounding the SWRA.

The potential for continued predation of livestock by predators is high in communities adjacent to SWRA. Quantifying losses incurred by local communi-

ties due to predation, determining common problem predator and targeted livestock by predation to local communities is important to give baseline information for planning purposes. Research to focus on the actual loss incurred and the level of predation as a result of the conflict gives an insight in terms of monetary value losses. Quantifying livestock losses in monetary value give baseline information on losses incurred by local communities hence help to establish possible solutions towards mitigating further losses.

2. Materials and Methods

Study Area

Sai Communal area, our study site, lies at the Southern side of the SWRA, Gokwe South, Zimbabwe (**Figure 1**). It is part of the Mid-Zambezi Valley Basin. Sai Communal area has four villages (*i.e.* Chirevereve, Dungwa, Nhidza and Siamwanja) which share unfenced boundary with SWRA making it easy for wildlife to straddle the boundary in search of food. The reports were received within a distance of 23 km from the park boundary into the communal area. The area under study makes an arc that stretch from the Lutope River towards the eastern side up to Manyoni, about 10 km along the boundary, with a total study area covering 230 km^2.

The Sai communal area is a characteristic of three climatic seasons: hot-wet period from November to April, a cool-dry period from May to July and a hot-dry period from August to October. Mean annual rainfall averaged over 55 years of the area is 612 mm (Mahakata and Mapaure, 2021) [13] while mean annual temperature is 22˚C (Mhiripiri and Mlambo, 2021) [14]. The hottest month is October and July is the coldest. The study area is located in agro-ecological region IV with livestock rearing at subsistence level very effective.

Adjacent to the Sai communal area on the northern side is the SWRA, a home to a diversity of large mammal species of herbivore and carnivore. Known carnivore species in SWRA are lion, leopard, spotted hyena, brown hyena, genet, baboon (Mahakata, 2021) [15]. In the Sai communal area, farming and livestock rearing are the major practices. Sai communal area is a human dominated communal area with an estimated population density of 27 people per square kilometer. The communal land is occupied by smallholder farmers who keep cattle (*Bos-taurus*), goats (*Capra-aegagrus hircus*), sheep (*Ovis-aries*) and donkeys (*Equus-asinus*), with densities per km^2 of 20.4, 16.7, 9.5 and 4.5, respectively (Mhiripiri and Mlambo, 2021) [14]. The grazing system is uncontrolled on shared land which is heavily grazed throughout the year forcing some domestic animals to encroach into the SWRA in search of water and forage. Livestock is an integral part of almost all farming systems, with cattle and goats constituting the bulk of domesticated animals.

3. Data Collection

The target communities are located on the southern boundary of SWRA within

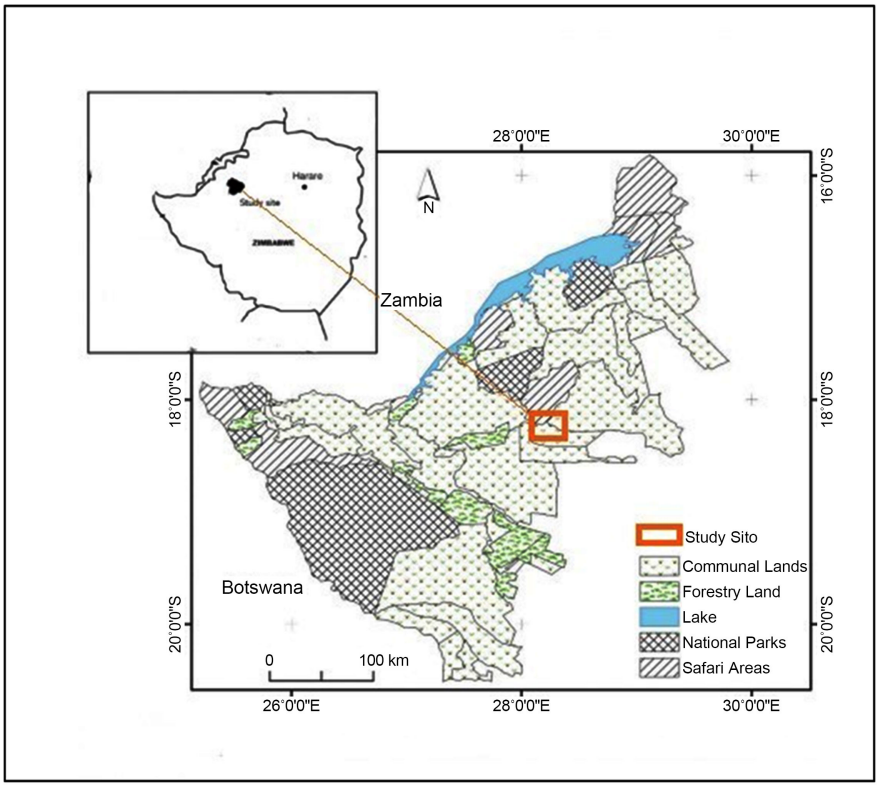

Figure 1. Location of the study site (Sai Community) on the Southern part of the SWRA.

a distance of 23 km from the park boundary and approximately 10 km along the park boundary. The study employed qualitative and quantitative techniques. Both primary and secondary data were used. Data related to livestock losses due to wildlife predation from January, 2021 to December, 2021, around SWRA was retrieved from Human Wildlife Conflict Report Database (HWCD) maintained at the Sengwa Wildlife Research Area (SWRA). Face-to-face interviews were conducted with randomly selected households in the selected villages and the responses were captured in audio formats which were recorded using Sound Recorder Device. A total of 233 reports on livestock losses as a result of predation covering four villages in ward Three (3) and Four (4) in Gokwe South under Chief Sai were retrieved from the HWCD. A total of 40 people were interviewed to determine community views on predation crisis, causes and losses being experienced from four selected villages (Chirevereve, Dungwa, Nhidza and Siamwanja). The following information was collected during face-to-face interviews with the randomly selected house-hold owners; number of domestic animals killed, corresponding problem predator, area, date and community views on predation crisis in their area. To determine actual losses in monetary value for each species killed by predator, a national approved market value of each species of livestock was used.

4. Data Analysis

Data on livestock losses from predation by wild carnivores was analyzed in Mi-

nitab statistical software version 17. A Minitab Statistical Software is used for statistical research and statistical analysis. It uses the data in the active worksheet to run the analysis. A non-parametric Mann-Whitney U-test was used to compare seasonal variation in number of livestock losses from predators using data retrieved from HWCD recorded at the SWRI. The Mann-Whitney U test is used to determine whether the median of two groups differs when the data for both groups have similarly shaped distribution. It compares whether the distribution of the dependent variable is the same for the two groups and therefore from the same population. Comparison data between wet and dry season, number of livestock and predators involved were displayed in tables and graphs. To calculate total livestock losses (USD) caused by predators during the selected period (January to December, 2021), data were grouped for each livestock species (*i.e.* goat, pig, cattle, donkey, hen, sheep and turkey) and mathematically calculated manually using the formula;

$$\left(TL/S\right)=\left(n\right)\times\left(mv\right).$$

where TL/S = Total Loss for each livestock species,

n = Number of animals killed for each livestock species, and

mv = Market Value of each livestock species in USD.

Total loss for all livestock species recorded was then added together using derivative formula;

$$TL/A=TL/S_1+TL/S_2+TL/S_3+TL/S_n^{th}$$

where TL/A = Total Loss for all livestock species.

5. Results

A total number of 40 people (n = 40) from different households were interviewed from the four purposely selected villages which share boundary with the SWRA. All the respondents were selected within a predefined study area of 230 km^2. Total number of households from the two wards (3 and 4) was 221. Equal number of households representatives (n = 10 people/village) were selected. Of the 40 response, 75% (n = 30) were males while 25% (n = 10) were females. The participants had different age groups ranging between 26 and 70 years and were all adult house-heads and had been staying in the area for at least 5 years.

5.1. Participant Views to Livestock Losses and Depredation Crisis

Responses varied among the 40 participants interviewed. Clear evidence point to some livestock attacks by predators were not recorded or reported to relevant authorities by affected farmers. Hyena, black backed jackal and bat eared fox were the species mentioned as major problem predators causing many losses. Existence of SWRA contributed to livestock losses as the predators were coming from the PA. There was a variation in respondents' views on seasonal attacks by

predators with 76% mentioning the predators as problematic throughout the year in the adjacent community around SWRA while the remaining 24% mention varies with species and season.

From the interviews done, highest losses were recorded in Nhidza village and the least in Dungwa village (Figure 2).

5.2. Predators and the Target Livestock Recorded

Hyena, black backed jackal, bat eared fox and baboon were the most problematic predators targeting killing livestock. Losses due to these predators contribute 98.3% while the most targeted livestock were goats (Table 1).

Bat eared fox, black backed jackal and baboon targeted young and sub-adult goats mostly and this was linked to ability to carry their prey.

5.3. Seasonal Variation in Livestock Predation

Comparison on livestock losses due to predation between wet and dry season were done using the Man-Whitney-U-Test (Table 2).

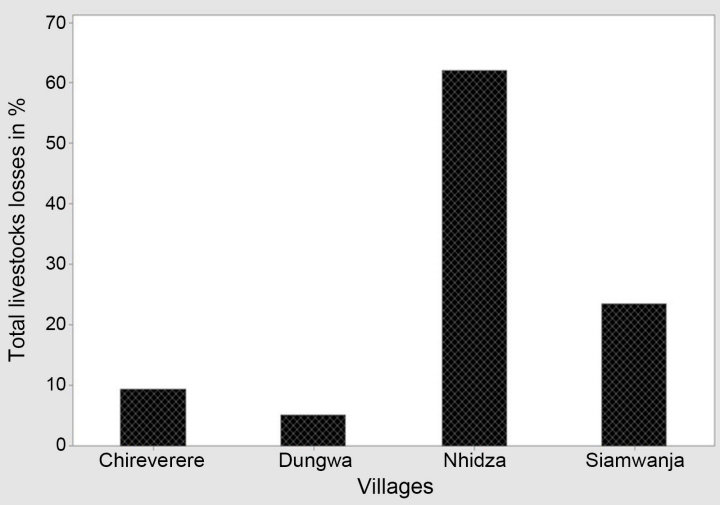

Figure 2. Percentage predation levels recorded at village level within the study area between January-December, 2021.

Table 1. Number of reports on livestock predation received (January-December, 2021).

Predators	Livestock							
	Goat	Pig	Cattle	Donkey	Hen	Sheep	Turkey	Total
Baboon	6	0	0	0	21	0	0	27
Bat-eared fox	5	0	0	0	34	0	11	50
Black backed jackal	15	0	0	0	7	0	3	25
Crocodile	2	0	0	0	0	0	0	2
Hyena	107	3	5	8	0	6	0	129
Leopard	2	0	0	0	0	0	0	2

Table 2. Overall seasonal variation on number of livestock losses between dry and wet season around SWRA in 2021.

		Mann-Whitney U-test for comparison on overall livestock losses due to predation between wet and dry season					
	Season	n	median	n_1-n_2	95% CI	w	*p-value*
Predation	Dry Wet	6 6	13 13	0.50	(−24.01, 26.00)	40	0.9362

Mann-Whitney U-test at α 0.05 showed no significant difference on number of livestock losses due to predation between dry and wet season (*p-value* = 0.9362). Since the *p-value* (0.9362) is above 5 percent (0.05), the null hypothesis cannot be rejected.

Number of reports received on livestock killed by predators varied for each species between dry and wet season (**Figure 3**).

Value of livestock losses were calculated at village level for all livestock attacked and reported to the SWRI and totalled USD 7615.00. Loss for each species of livestock varied considerably (**Table 3**).

Number of losses include all livestock that were killed and or seriously injured. It was calculated at village level and not household level. Market value were based on national market price of the specific livestock species and are valued in USD in Zimbabwe.

6. Discussion

6.1. Participant Views on Livestock Predation Crisis in Communities around SWRA

Responses aired during face-to-face interviews showed that total estimated value that is lost through livestock depredation in communities around SWRA were more than the estimated amount from reports made annually. Most of the reports involving some small predator species such as bat-eared fox and black backed jackal were not recorded while some farmers ignore to make such reports as they were viewed as harmless to humankind on their safety. The observation supports similar sentiments by Chetri *et al.*, (2019) [16] who highlighted that different people have different views and consider impacts of livestock depredation differently.

It was noted that when the park fence was still maintained, reports of livestock losses were very minimal especially those related to hyenas, bat eared foxes and black backed jackals. The boundary fence acted as the major deterrent in controlling wild animal movement from the park into the adjacent communities. Concerns on poor livestock husbandry are one factor that was raised by communities especially where livestock attacks by nocturnal predators occur. It was noted livestock depredation was high during the night by hyena and leopard and common to livestock that could have been lost and spend a night out of boma. However, farmers expressed concern for failure by authorities to find lasting solutions to reduce the predation crisis despite reports being done to the PA Authorities among other key stakeholders.

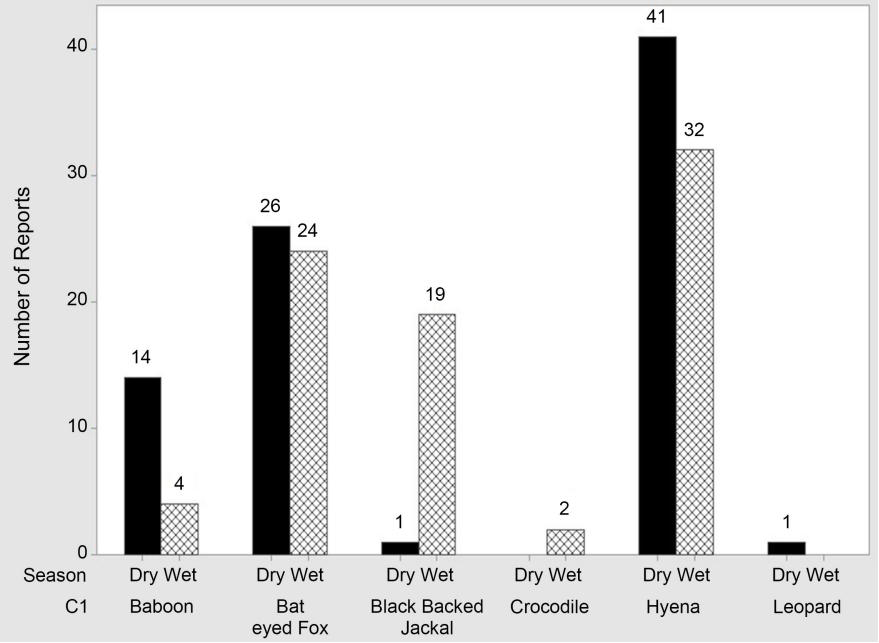

Figure 3. Seasonal variation on number of reports received for each predator species (January-December, 2021).

Table 3. Total cost lost to predators in 2021 around SWRA.

Livestock	Monetary value/species		
	Number of losses	Market value (USD)	Total value/Village (USD)
Cattle	5	350	1750.00
Donkey	8	100	800.00
Sheep	6	50	300.00
Goat	137	25	3425.00
Pig	3	250	750.00
Tuckey	14	20	280.00
Hen	62	5	310.00
Total Cost			**7615.00**

Some respondents also highlighted increase in predator population in the SWRA coupled with low prey abundance which could be the major driving force for livestock depredation in the adjacent communities around SWRA. This view of low prey abundance in the PA is supported by aerial survey results done in the area in 2020 where it was reported a general decline in population status of major herbivores (Dunham and Nyaguse, 2021) [17].

6.2. Targeted Livestock and Problem Predators in Communities around SWRA

Leopard, hyena, Bat-eared fox, black backed jackal, crocodile and baboon were the main problem predators listed from the reports received (Table 1). Hyena

dominated the group and claimed highest percentage (54.6%) of livestock lost due to predation. Both species of hyena (Brown and Stripped) were involved but the incidence was not recorded separately.

The targeted livestocks were cattle, donkey, sheep, goat, pig, turkey and hen (Table 1). Goats recorded the highest number of victims to predators which totaled 137 while sheep and pig were the least affected with a total of 6 and 3 respectively. Many reports of goats, cattle and donkeys being killed by hyenas were recorded when they are left outside of the kraals during the night while kills by bat-eared foxes, black backed jackals, baboons and crocodiles were related to day time attack while headsmen were safekeeping and monitoring their livestock in grazing areas and or when the livestock are lost.

While hyenas were noted to attack large livestock such as donkeys, cattle and adult goats mostly. Bat eared fox, black backed jackal and baboon targeted small livestock such as hen, turkey and small goats. For example, bat eared fox recorded highest number of hen and turkey depredation of 34 and 11 respectively, while hyena recorded the highest number of donkeys, cattle, goats, pigs and sheep with records indicating 8, 5, 107, 4 and 6 respectively (Table 1). On the other hand, even though SWRA had other predators such as lion and the migrating cheetah, no reports were received.

While leopard are the most feared predators in the area which expected higher density as well, however, predation on livestock were recorded low. The study findings support views by Athreya *et al.*, (2020) [18] in Kenya on a ranch, who found that high densities of leopard have less impact on livestock than might be expected. On the other hand, species of hyena were found to kill cattle that are both in and outside kraals. Conversely, other small predators such as jackal are likely to prefer smaller livestock prey than large types. Elsewhere in South Africa, the black backed jackal was noted to bear a detrimental effect on South Africa's livestock business particularly with sheep and goat (Drouilly *et al.*, 2021) [19].

6.3. Seasonal Variation in Livestock Attack by Predators

Seasonal variation on number of livestock attacks from recorded predators varies with species. The variation in number may be attributed to different factors such as cover, food availability and livestock security by headsmen. Number of attacks on livestock by hyena between dry season and wet season were within the same range, *i.e.* 41, 32 reports respectively (Figure 1). While for bat eared fox the margin was of two reports (*i.e.* 26 and 24 reports respectively. Baboon related attacks were high in dry season. Suggestion from people interviewed pointed to scarce food. Baboon in the study area were believed to move out of the PA into the community area looking for food hence targeting small livestock such as young goats and hen which they are able to carry. Bat eared fox also are very active during the late dry season especially in September and October, as shown from records, when cover is looming while at the same time livestock will be moving freely without headmen. At the same time, it was noted, hen and turkey among

other poultry will be moving a distance away from homestead searching for food.

While all reports on crocodile were reported in the wet season, leopard attacks were recorded during the dry season. Black backed jackal reports were also higher in wet season than in dry season. Black backed jackal cases were reported more between November and April. During the time, it is believed, black backed jackal utilise cover to raid young goats and other livestock as well snatching targeted prey lost from headsmen. Variation in seasonal livestock movements was also raised by Valls-Fox *et al.*, (2018) [20] who mentioned that movement patterns of livestock on a PA boundary are related to seasonal crop growing. In the growing season livestock graze further from villages and closer to PAs which may increase chances of livestock depredation by wild predators. In the dry months, cattle grazing close to villages benefit from the close proximity of people, resulting in few incidence of depredation.

6.4. Livestock Losses in Monetary Value as a Result of Predation around SWRA

A total of USD 7615.00 was lost as a result of livestock attacks by predators in the Sai community area around the SWRA. The total amount was calculated at village level for the period between January and December, 2021. Goats were the most affected livestock contributing 58.3% (USD 3425.00), hen 26.4% (USD 310) while cattle and donkey contributed 2.1% and 3.4% respectively which translate to USD 1750.00 and USD 800.00 respectively. Other livestock species such as hen and turkey had lowest monetary value lost but the number of animals lost was high especially from baboons and bat eared fox. Obviously, this is affected by market value of each species which varies with size of the livestock and its value for example market value for hen is USD 5.00 while for goats is USD 25.00.

Elsewhere, Megaze *et al.*, (2017) [21] noted that adjacent communities around PAs have suffered similar losses from livestock predation in many areas of the world in 2017. Large predators such as lion, leopard, wild dog, and spotted hyena, cause the greatest losses. Szopa-Comley *et al.*, (2020) [22] mentioned that livestock predation by carnivores is noticeable and the annual mean livestock loss faced by farmers is almost 1.29 head of stock leading to an economic loss amounting to USD 12,252 of which leopard and tiger kills accounted for 82% (USD 10,047). A study undertaken in Web Valley, Bale Mountains National Park in Ethiopia showed that a total number of 704 livestock were killed by wild carnivores over a 3-year period, causing a loss of potential revenue of USD 12 per year per household in a compounded interest. Deneke *et al.*, (2022) [23] also mentioned that community reports high economic loss from livestock killed by predators.

In Zimbabwe, recorded economic loss averaging $13% or 12% of each household's net annual income as a result of livestock predation according to Kusi *et al.*, (2020) [24]. This shows the impact of livestock predation is huge and expe-

rienced. In Ethiopia as well, in the year 2005 to 2009, livestock losses due to predation amounted to 492 heads over 5 years; an annual mean of 0.6% worth US$7042 (Van Niekerk *et al.*, 2021) [25].

A number of studies have been done to estimate losses due to predators according to Van Eeden *et al.*, (2018) [26]. Local producer organisations estimated a loss of 8% of small livestock per year in countries in the Sub-Sahara Africa. Predation of livestock, for example, in South Africa has been estimated to cost in excess of ZAR1 billion in losses per year and has complex social, economic and ecological drivers and consequences (Kerly *et al.*, 2017) [27].

7. Conclusion

In sum, livestock losses as a result of depredation are high in the adjacent SWRA. This research sheds light on the severity of livestock losses and the predation situation in the SWRA area. The study revealed that a number of wild predators are causing significant losses to livestock, for example hyena, bat eared fox and black backed jackal. Cattle, donkey, sheep, goat, pig, turkey and hen are the most targeted livestock by wild predators. Depredation by hyena contributed 54.8% losses with a value of USD 6275.00 while crocodile and leopard related livestock losses were the least contributing only 0.9% respectively with value of USD 50. In a nutshell, further research to quantify loss due to livestock depredation at household level is recommended. To reduce livestock depredation, knowledge about predator behaviour is also recommended to minimise predation on livestock.

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Conflicts of Interest

The authors declare no conflicts of interest.

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