# A preliminary assessment of African lion demography, human-carnivore conflict and conservation education to village's adjacent Mkomazi National Park, Tanzania



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## Abstract

The overall purpose of the study was to understand lion demography, human-lion conflict hotspots and awareness of local community at Mkomazi National Park and the adjacent villages. Threats have been identified with bushmeat poaching being rife in the area, affecting lions both indirectly, through prey depletion, and directly, through snaring by-catch (but they do use lion's body parts for traditional medicine). Expanding communities are blocking migratory routes of prey and dispersal routes of lions. We visited the incident areas and received more information along with their views on the human lion's conflict. We used call ins, spoor count, opportunistic sightings and VHF collar to detect lions. Playback took place in areas where lion seen, as well as areas that had not closed bushes. The education and awareness program held, where various meetings detained with the villagers. Schoolchildren also received education about wildlife conservation. Very little was known about lions in the park and surrounding, but initial research has shown there is a breeding population present. For the past 11 month, our project has investigated four prides and location of an important lion population. One lioness in a pride fitted with VHF collar. The mean population of lion is 5.17 at Mkomazi National Park. A total of 31 (19 females and 12 males) individual lions has been sighted inside and outside the park. It is possible to sight three lion minimum to nine maximum at the park. We found that the difference between mean wild prey killed by lions (3 ± 2.5) and livestock killed by lions (9 ± 8.7) was not statistically significant (P<0.05). Considering our sample size (N=10) in average, livestock killed by lion (27) were higher than wild prey killed by lion (21). People's perception on wildlife conservation is negative; therefore, conservation education and community livelihood required.

## Introduction

Big cats face serious threats and are experiencing massive declines in their populations and geographical ranges across the world (*Ripple et al.*, 2014). To maintain biodiversity and ecosystem function in combination with the importance of resilient ecosystems, it is necessary to indicate that large carnivores and their habitats are maintained and restored (*Ripple et al.*, 2014). Tanzania contains about half of the continent's remaining lion population (*Riggio et al.*, 2013), but the IUCN found significant declines (*Bauer et al.,* 2016).

The Tsavo-Mkomazi ecosystem (TME) occupies an estimated 49,611 km2 of land and creates a key transboundary conservation area. The Tsavo-Mkomazi ecosystem is located in South-Eastern Kenya and North-Eastern Tanzania between latitude 1°33'S-4°36'S and longitude 37°34'E-39°36'E. The transboundary ecosystem is comprised of several wildlife ranches, Kitui National Reserve, Tsavo East, Tsavo West and Chyulu Hills National Parks in Kenya and Mkomazi National Park in Tanzania.

The African Lions are among the most symbolic species on the planet, yet there are significant decreases in population numbers and the habitat. Tanzania contains around half of the entire African lion population on the continent. The Mkomazi National Park is part of one of Tanzania's last lion stronghold population and is significant in linking other large lion population in Tsavo West National Park, Kenya. Therefore, an understanding of demography, home range, threats of African Lion and community perception provide vital data to inform management based on research evidence.

Consequently, this on-going research project intended to accomplish the following objectives

- To determine the location of African lion and understand ecological factors that influences its occurrence in Mkomazi National Park.
- To estimate abundance and population density of African lion in Mkomazi National Park.
- To assess of local community perception and attitudes towards lion conservation in Mkomazi National Park

The project is continuing therefore, this report mainly provides preliminary completion of the study; a further result will updated as more data collected.

## Material and method

*Study area*

Mkomazi was upgraded to the status of National Park in 2008, formerly a Game Reserve since 1951, and is located in Northern Tanzania (Fig. 1), covering an area of 3,245 km² *(Tanzania National Park, 2019)*. The Mkomazi National Park is part of the Tsavo ecosystem, which covers 40,000 km² and is adjacent to the Tsavo National Park 20,000 km² in the north and in the south is buffered by numerous Forest Reserves situated on the North and South Pare Mountains (*Sommerlatte*, 2001). The climate of Mkomazi National Park is semi-arid which has a bimodal rainfall of 500 mm per annum and mean annual temperature is 23.1°C. Altitude ranges from 230-800 m above sea level, but rising to 1356 m above sea level in the west (*Sommerlatte*, 2001). The park has no permanent water except the Umba River on its eastern boundary. Dry season is from June to October and wet season is from November to May (*Briggs*, 2019). The park is a wet season dispersal area with wildlife moving into the park from Tsavo National Park in Kenya and moving out again during the dry season as the pans and dams dry up (*Sommerlatte*, 2001). Wildlife biomass is on average 570 kg/km² during the dry season and increasing to 1,925 kg/km² during the wet season (*Sommerlatte*, 2001).



Map showing Mkomazi National Park, Tsavo West National Park, North and South Pare mountains, Eas and West Usambara Mountains
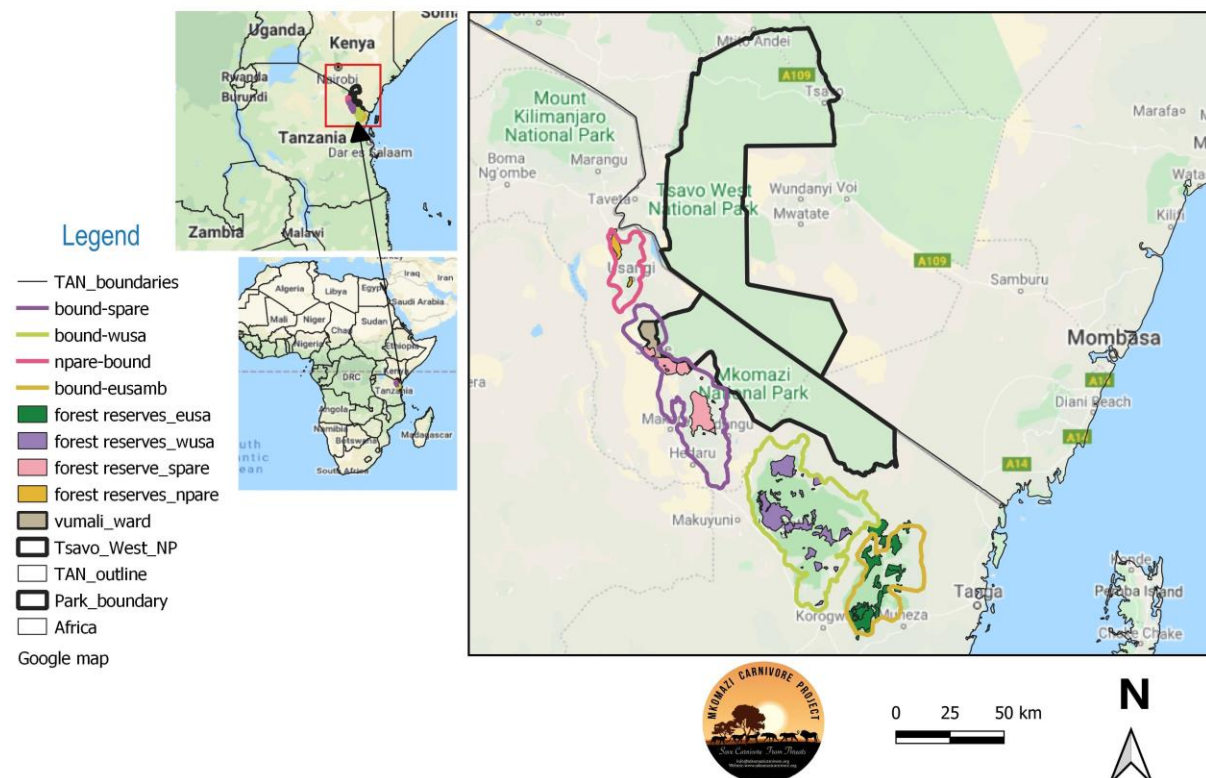
*Field data collection*

*Questionnaires*

Questionnaire studies of the local community within the Vumari ward used to collect information on lion in two key ways. Firstly, we used a simple presence/absence survey by gathering information from the community in Vumari on sightings. Secondly, used as an in-depth survey to not only gather information on distribution but also to assess levels of conflict with people, threats, and attitudes of local people to lions in their area.

*Call in playbacks*

In this method a sound of a kill – an animal dying or hyenas at a kill - is played at a loud volume, for a standardized time, usually one hour, and the numbers of individuals attracted to the sound are individually identified when possible and counted. Lions often scavenge kills from other predators, and hence can be attracted by the sound of kills.



*Different sites where playback was held early in the morning, late in the evening and at night*

*Radio collaring*

With this method, one VHF collar fitted to a lioness to enable relocation or recording of position. In order to fit the collar the lion has immobilized, usually by darting with veterinary officer from the park.

*Photo Identification*

Through photo identification, ID cards made for each individual encountered. Driving around the park lions located and sighting data sheet filled inn. Using the method described by

*Pennycuick & Rudnai* (1970) through the pattern of vibrissae sports, permanent scars and ear notches, it is possible to recognize each individual.



*Pictures of the lioness made for identifications shows right side sport pattern, face and left side.*



*Pictures of the male lion made for identifications shows right side sport pattern, face and left side.*

## Results

*Lion monitoring*

Collecting data for population studies has continued and encouraging, although there have befallen few difficulties, the work has maintained till momentarily. Thirty-one individual lions sighted in four prides, namely Zange, Dindira, Kavateta, and Maore. Other carnivores sighted in the Mkomazi National Park were Hyena, Golden jackal, Bat-eared fox, and Melanite serval cat. Table 1 shows the prides and average mean number of lions in different age-sex class within a particular period.

*Table 1:* *Average mean of prides and age-sex composition of lion sighted from August 19- March 20*

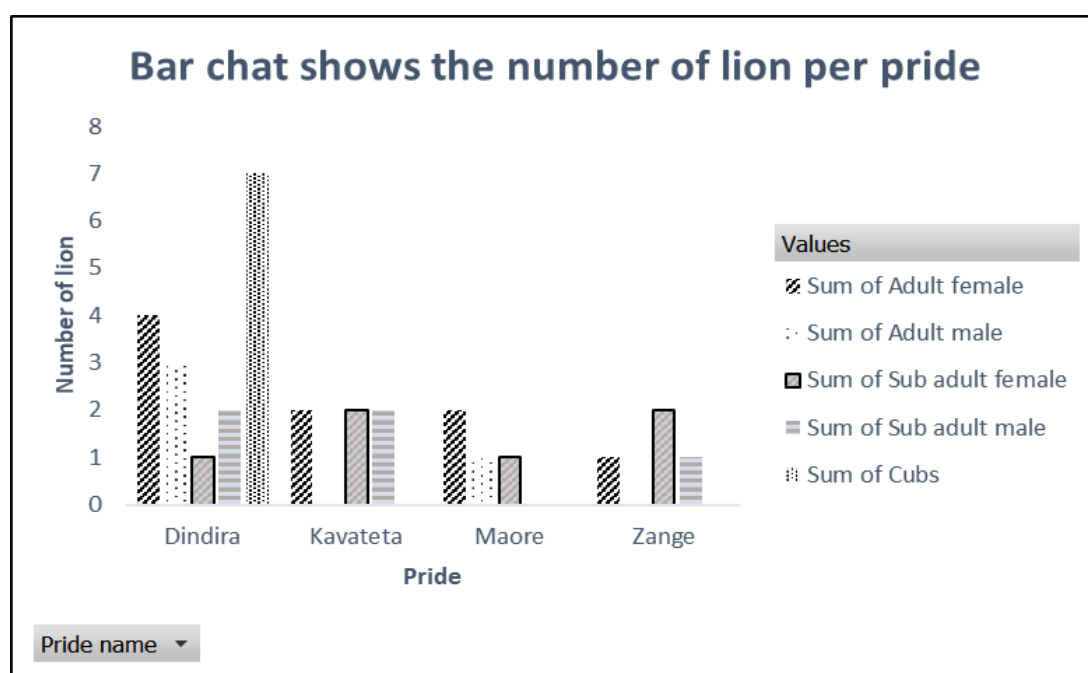| Pride | Adult | | Juvenile | | Cub | | Total |
|---|---|---|---|---|---|---|---|
| | F | M | F | M | F | M | |
| Zange | 1 | 0 | 2 | 1 | 0 | 0 | 4 |
| Dindira | 4 | 3 | 1 | 2 | 4 | 3 | 17 |
| Kavateta | 2 | 0 | 2 | 2 | 0 | 0 | 6 |
| Maore | 2 | 1 | 1 | 0 | 0 | 0 | 4 |
| Grand Total | 9 | 4 | 6 | 5 | 4 | 3 | 31 |



*Table 2: Bar chat shows the number of lion in each pride and their sex at Mkomazi National Park*
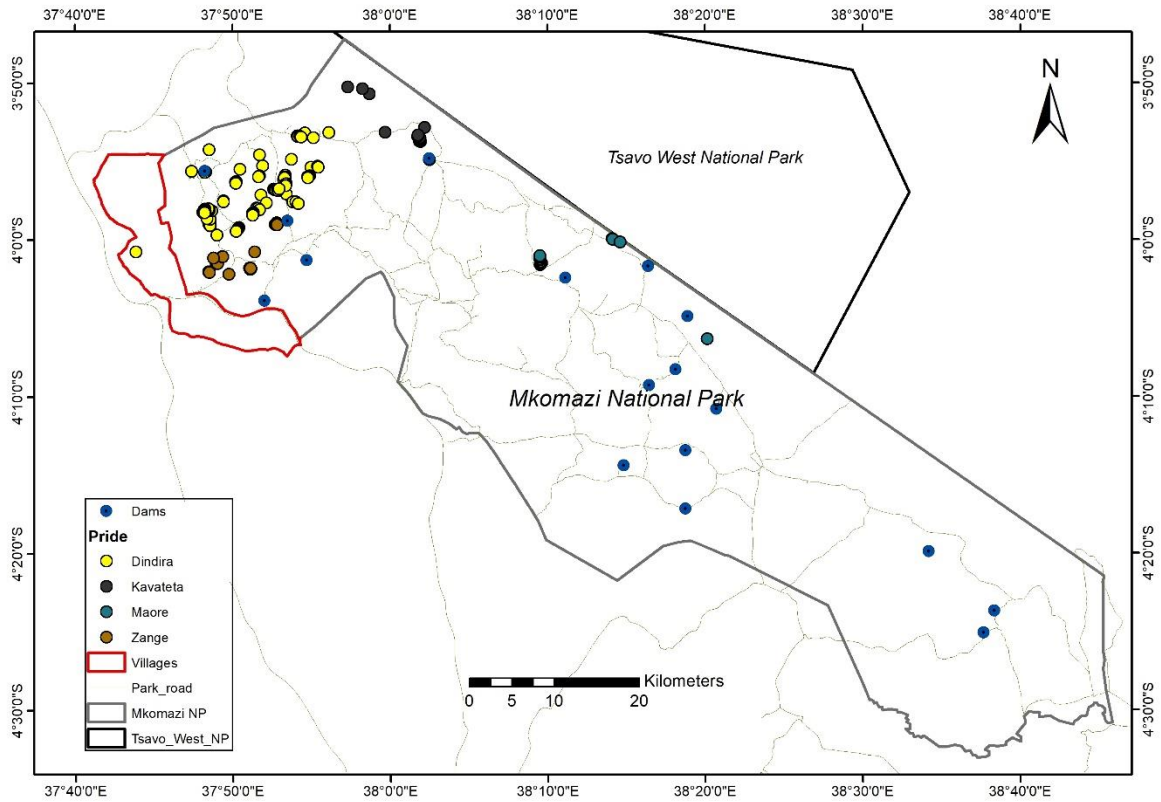
*Fig 2: Map showing the distribution of four pride at Mkomazi National park*



*Fig 3: Sub adult lion at Dindira pride killed Eland in Mkomazi National Park near Dindira dam*

*Fig 4: Lioness resting near Kavateta dam at Mkomazi National Park and three juvenile*



*During the dry season, all animals depend on drinking water in one dam, so access to lions becomes more accessible.*



*Fig 5: Shows type of prey and number killed by lion at Mkomazi National Park where buffalo mostly killed than other and followed by Eland.*

*Table 3: shows t-test two sample assuming unequal variance*

| t-Test: Two-Sample Assuming Unequal Variances | | |
| --- | --- | --- |
| | *Wild prey killed by lion (Carcass)* | *livestock Killed by lion* |
| Mean | 3 | 9 |
| Variance | 6.333333333 | 76 |
| Observations | 7 | 3 |
| Hypothesized Mean Difference | 0 | |
| df | 2 | |
| t Stat | -1.171345729 | |
| P(T<=t) one-tail | 0.181060692 | |
| t Critical one-tail | 2.91998558 | |
| P(T<=t) two-tail | 0.362121385 | |
| t Critical two-tail | 4.30265273 | |

We found that the difference between mean wild prey killed by lions (3 ± 2.5) and livestock killed by lions (9 ± 8.7) was not statistically significant (P<0.05). Considering our sample size (N=10) in average, livestock killed by lion were higher than wild prey killed by lion.

*Cub's recruitment*

There are seven cubs at Dindira pride. Three female gives birth as were found with cubs and their mammary gland looks lactating for both of them and the lionesses known D7, D8 and D9. We saw the tracks of cubs and adult lions and followed them until we spotted them sucking while other playing.
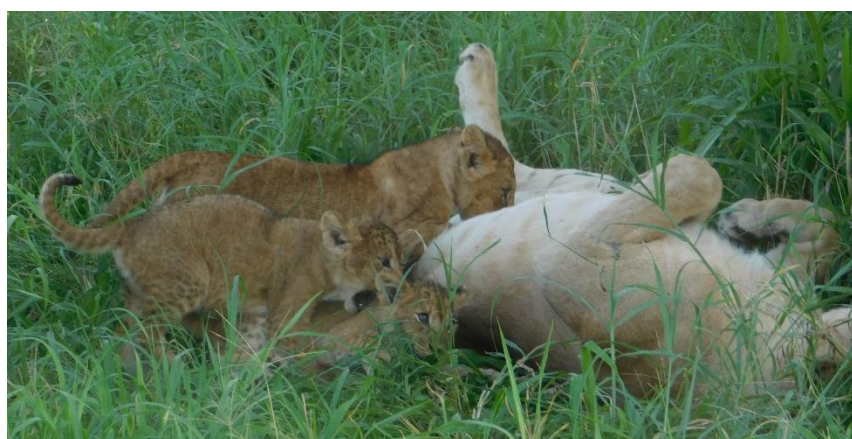


*Fig 6: Lioness lactating her three cubs at Mkomazi National Park, two are female and male.*

*Fig 7: Footprint of lion cubs at Mkomazi National Park*



*Fig 8: Two male lion cubs resting while the others playing with their mother at Mkomazi National Park*

*Collaring*

We have successfully installed one collar into one pride known as Dindira. Although there was a challenge in searching lions during the rainy season. As the animals move from the park to other areas, the lion's access becomes difficult. The lioness was spotted using playback. It was 21st January 2020 in the morning. After spending all night in the wild in search of lions without success, finally, the next morning, the lioness answered the playback. Park veterinary came early after a call, the time spent is two hours and a half until the lion woke up after immobilization.

*Fig 9: Collaring lioness at Mkomazi National Park with a VHF collar that enable to track lions.*



*Researcher assessing lion paw while the park veterinary Dr. Macha takes a blood sample of the collared lion.*



*Fig 10: Searching collared lion by using radio telemetry at Mkomazi National Park.*

*Fig 11: Collared lioness known as Nancy after we spot her, we follow to see whether we can sight her cubs, because mammary gland looks lactating*
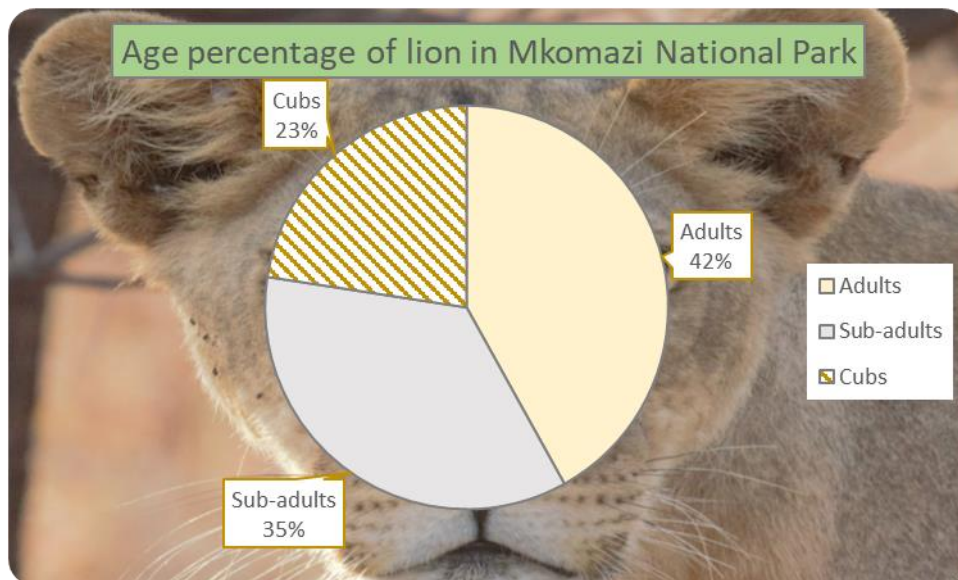


*Table 4: Pie chart shows there is high number of adult, followed by sub adult and finally cubs at Mkomazi National Park.*

*Human lion conflict*

So considerably, we have barely been able to collect data on the Lions' conflicts against livestock in the Same district only because of the scarcity of funds. In the beginning, it was deemed to encompass all five districts around the Mkomazi National Park, which are Same, Mwanga, Muheza, Korogwe, and Mkinga districts. In the Same district, there is only one ward that has conflicts between lions and humans. The ward is called Vumari, where it has an area

of 469 km² - Density: 12.58 / km² with 4 villages and a total population of 5908 people, both men, and women. These events have occurred and recorded from August 2019 to January 2020. Therefore, education and awareness programs have been held in the Vumari ward. We have successfully conducted seven meetings at Vumari, visiting livestock predation incidents in each villages, and educating secondary and primary school students. We have been investigating the incident to determine the wildlife involved. We have all seen lions' footprint and witnessed the remains of livestock killed.



*Fig 12: Researcher, Village Game Scout and villagers recording coordinates and take notes about the event of a lion invading and killing livestock in the village*

*Fig 13: Researcher, Village Game Scout and villagers recording coordinates and take notes about the event of a lion invading and killing livestock in the village*



*Fig 14: The pictures show fences where the animals are sleeping, which is too weak to stop the lion from attacking the herd*
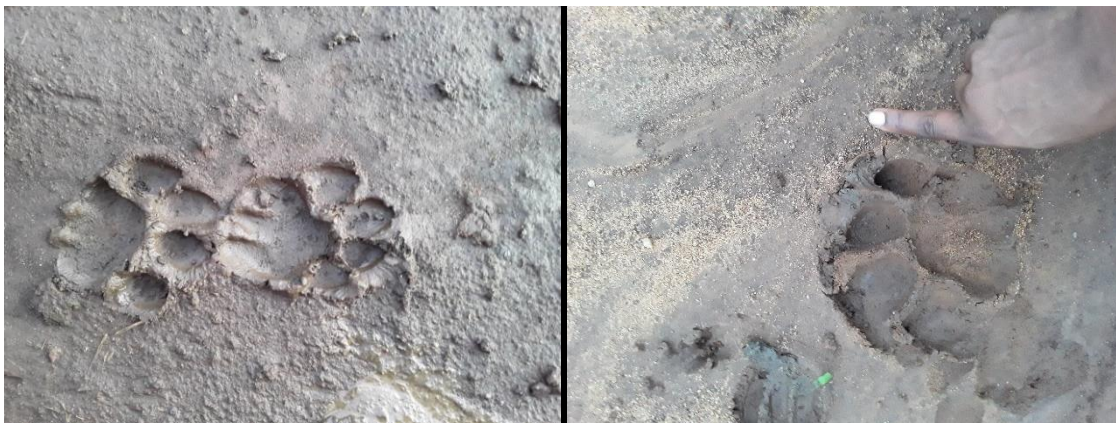


*Fig 15: Some of the lions' footprint had remained detected within the village nearby when they attacked livestock at night.*

*Fig 16: Researcher as well as village game scout recording and tracking the footprints of lions seen in the village*



*Fig 17: Remains of cow carcass discovered after lions attacked and killed livestock in the village at night. The researcher and district game officer witnesses the claws passage of lions on the skin*

In seven meetings with the villagers, we communicated the following things.

- To educate villagers to inform in advance whenever an incident occurred

- To educate on improving livestock fences as they use poor tree branches and thorns
- To explain the value of lions and other animals for them and their future generations.

At those gatherings, there were many inquiries where the most prominent was whether they would be awarded compensation for their loss. In our education team, we were working with the district wildlife officer, the Park community outreach officer, and the ward executive officer. The district wildlife officer was educating them on the importance of wildlife conservation and explaining compensation. Her office deals with compensation, where Tanzania has no compensation but consolation. Still, with consolation, villagers get a tiny percentage that does not match livestock value, and money does not come in time. The park community outreach also educates villagers about the changes brought to the village through the Mkomazi National park, such as school building, village offices, and roads. In terms of researchers, we discussed lion behaviour and how to protect themselves like building fences for livestock.

For the few questions we have been investigating about conflicts, it is clear that community perception is negative about wildlife. We propose to conduct studies in all villages around Mkomazi, to get a glimpse of their perspectives and the problems they encounter with the wildlife. It will avail us in obtaining the conflicts hotspot zone and discovering multiple threats to lions.
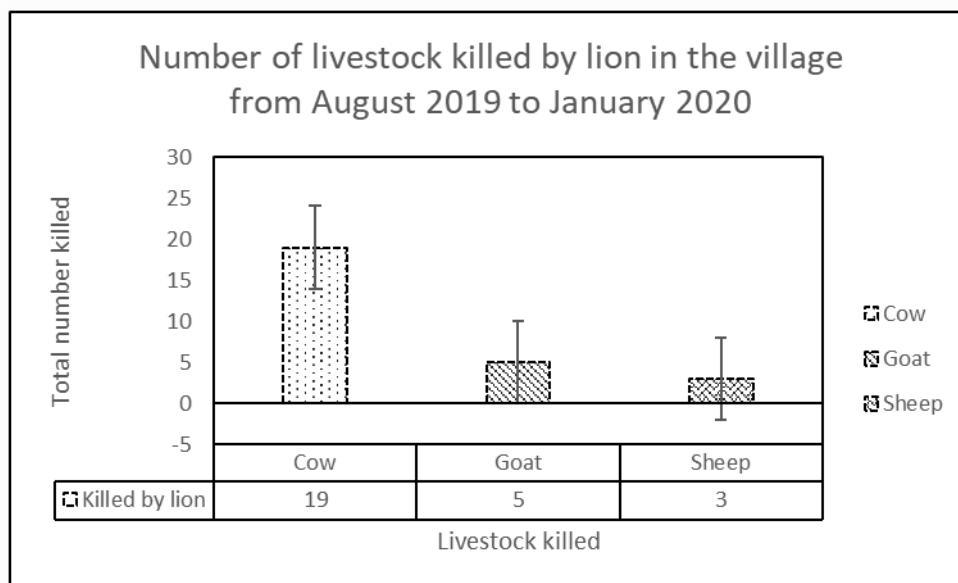


| | Cow | Goat | Sheep |
|---|---|---|---|
| Killed by lion | 19 | 5 | 3 |

*Table 6: Shows livestock killed by lion in the village where cow was more killed followed by goat and sheep because lion prefer larger prey.*

*Education and awareness*

We have also thrived in training pupils in Vumari primary and secondary schools. A total of 890 students earned knowledge about wildlife and environmental conservation. At each end of the month, we visit these schools and educate the students. We have developed a syllabus that we use. One of the tasks we have done in primary and secondary schools is wildlife videos shows. It is beneficial in educating children and making them more engaged in wildlife, but it also makes them more knowledgeable about wildlife behaviour. Through the wildlife video shows, many students have become ambassadors to educate parents and communities about wildlife and conservation. We understand this program will proceed to convey definite results to the community.



*Fig 18: Primary school children listening as they receive training on wildlife behaviours, as well as learning using various wildlife drawings and pictures.*

*Fig 19: The picture shows secondary and primary school students watching a wildlife video show, and after the video ended, they asked questions and received answers from the community wildlife officer*



*Fig 20: A village meeting where many villagers raised their complaints of not receiving compensation for their animals that were attacked and killed by lions in the village*



*Several discussions have been carried with the villagers in the Vumari ward to find out their views on conflict situations*

*Fig 21: A district game scout's leader assists victims who have lost their livestock from predation by lions to fill out a consolation form.*

## Discussion

Regarding the size of the park, it seems reasonable that there will be more than four pride. As during the dry season, the water completely dry, except for only one dam in Dindira. Thus, mammals arrive from distant to drink water in the dam, which often results in the presence of lions around. In addition, it seems that pride territory overlap. To get an overall result, we need enough (at least 6) collars for the entire park to track down all the lion's pride. Furthermore, sometime after night playback, it is challenging to make a lion's identification, as it is dark with dense shrubs. Merely before dawn, the lions leave and go deeper where it is hard to find them. Therefore, the number of lions is 31 due to individual identification, vocalization, playback response, and footprint at different locations within the park and in the community.



*Fig 22: Picture of male lion first day after doing play back at Mkomazi National park*

The Lions have shown to prefer more buffalo and Eland at Mkomazi National Park. There are large buffalo and Eland groups, so it becomes easier for lions to hunt. When lions fitted collar becomes more apparent to track them every day and understand what food they prefer. There have been cases in the village where much more cattle killed. From many studies, they explain that lions prefer larger prey.

Barely one collar tied to one pride. Before that, we relied on installing three collars. Due to the rainy season, it has been challenging to locate lions quickly, and many places are not suitable for driving since heavy mud impedes the car. The best time that lions are available is when the rain stops, for example, from May.



*Throughout the rainy season, it is challenging to find lions, and many roads are impassable.*

Human lion conflict information has collected in only one district. There has been a team that informs us of the event just in time. The team is under the District Game Officer, where has created a village game scout for each village. They help prevent and fight poaching in the village, as well as the presence of any predator. Four other districts around the Mkomazi National Park have not been reached due to a lack of funds to operate. If any other fund is available, it will help to investigate those areas. The problem we have discovered contributing to the conflict is the construction of poor fences for livestock. Moreover, we have seen that the people's perception of wildlife conservation is very negative; this could be due to the killing livestock by lions and crop raiding by other animals. Another reason could be the lack of education on wildlife conservation and its benefits to the community.

## Achievements of the project

- Successful Identification of few individual lions and four prides in the study area

- Successful mapping the location and distribution of lions in the study area

- Identifying few conflict hotspots and periods

- Identifying levels of threats and perception of the local community

- Creating a poster for presentation at Student Conference on Conservation Science Cambridge though cancelled due to COVID-19

- Preparing abstract for presentation for Human-Wildlife Conflict and Coexistence Conference 2020 at Oxford University, though it is scheduled due to COVID-19

## Recommendations/ Way forward

- Purchase at least four GPS collars that will help to understand the home range and movement of lions. This will help to identify current migratory routes of prey and dispersal corridors for lions to nearby other lion

- Collect data at all five districts around the park and Initiating / developing a survey to understand local communities' perceptions about the conflict situation and their needs in solving the human carnivore conflict issue villages adjacent Mkomazi National Park, Tanzania.

- Establish an education awareness program for student schools around the park in all five districts. Promoting children's understanding of large carnivore in schools near Mkomazi National Park, Tanzania. Conservation education programs directed toward children have proved to be crucial for not only acquiring personal knowledge but also influencing the attitudes and behaviour of their parents.

## Acknowledgment

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