Kwando Carnivore Project

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Human-Lion Conflict mitigation in the Mudumu Complexes, Zambezi Region, Namibia

Report March 2017

Cub from Lupala Pride, Nkasa Rupara National Park *Photo:Simone Micheletti*

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With input from Balyerwa, Dzoti, Mashi, Sobbe and Wuparo Conservancies

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Background

The Mudumu-South Complex, Zambezi Region, Namibia, is made up of protected areas, conservancies and community forests and lies adjacent to the Kwando River in the southernmost tip of the eastern part of the region. This area lies at the heart of the Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA), within the Kwando Wildlife Dispersal Area (WDA), and is one of six identified as imperative for wildlife connectivity within KAZA. The Kwando WDA is an important area for transboundary movement of many wildlife species including all of the larger carnivores, and is pivotal to the success of KAZA as a wildlife landscape, and an especially important area of connectivity of lions between Angola, Botswana and Zambia.

During 2012 and 2013, predation on cattle by lions in the East Zambezi Region of Namibia increased dramatically, seemingly in response to lion populations in Nkasa Rupara and Mudumu national parks reaching their ecological thresholds. In 2012/13 a total of 135 cattle were reported killed by lions, followed by 61 in 2014. In response 17 lions were killed in retaliation in late 2012/2013. This precipitated the Lion-Farmer Conflict Mitigation Project, spearheaded by testing a design for lion-proof kraals at two locations. Lions were mainly killing cattle in the farming and village areas of the Balyerwa, Wuparo and Dzoti conservancies, which lie between the two parks (Figure 1). One pride was particularly heavily culled, the Lupala Pride, which was 15 individuals strong in early 2012, and by the end of 2013 had been reduced to 3 individuals. By the end of 2014, only a single adult female remained of this pride leaving a vacant territory and severely impacting tourism activities in the area.

The program really took off in 2014. With funding from Big Cat Initiative, Panthera and the Millennium Challenge Account (MCA) in partnership with IRDNC, a further 27 lion-proof kraals were built and a human-lion conflict mitigation coordinator, Hans Fwelimbi, a resident of the Samudono village in the Wuparo Conservancy, was appointed. Immediate successes included a reduction in the numbers of cattle killed in 2014, 61 in total, and only three lions were killed in retaliation.

To get the program started the lion-proof kraals we built were donated to farmers that had lost livestock to lions. This was an attempt to sharply reduce the number of cattle killed and as quickly as possible change people's perceptions towards the lions and allow the lion population to recover. Selection was done in collaboration with the management of the affected conservancies using the event book system, which is a community run wildlife monitoring system. Each record of human-wildlife conflict is investigated by community game guards (CGG), who respond to reports of conflict and record all pertinent information in their event books. These data are used to guide our efforts, identify hotspots of conflict, and to measure the effectiveness of our mitigation methods. Nowadays the

lion conflict coordinator facilitates much of this and investigates all incidences with the CGGs and assists in transporting the game guards to rapidly respond to conflict.

During 2015 conflict with lions erupted in the Mudumu North Complex (MNC). Mashi and Sobbe conservancies (Figure 5) were affected as they lie to the north and east of Mudumu National Park. During 2016 we expanded our focus area to include these two conservancies and replicated our efforts from the MSC by reinforcing kraals where cattle had been attacked by lions and constructing lion-proof kraals in conflict "hotspots". The intervention in the MNC has made a positive impact in a very short space of time reinforcing the growing tolerance for lions in this mosaic landscape.

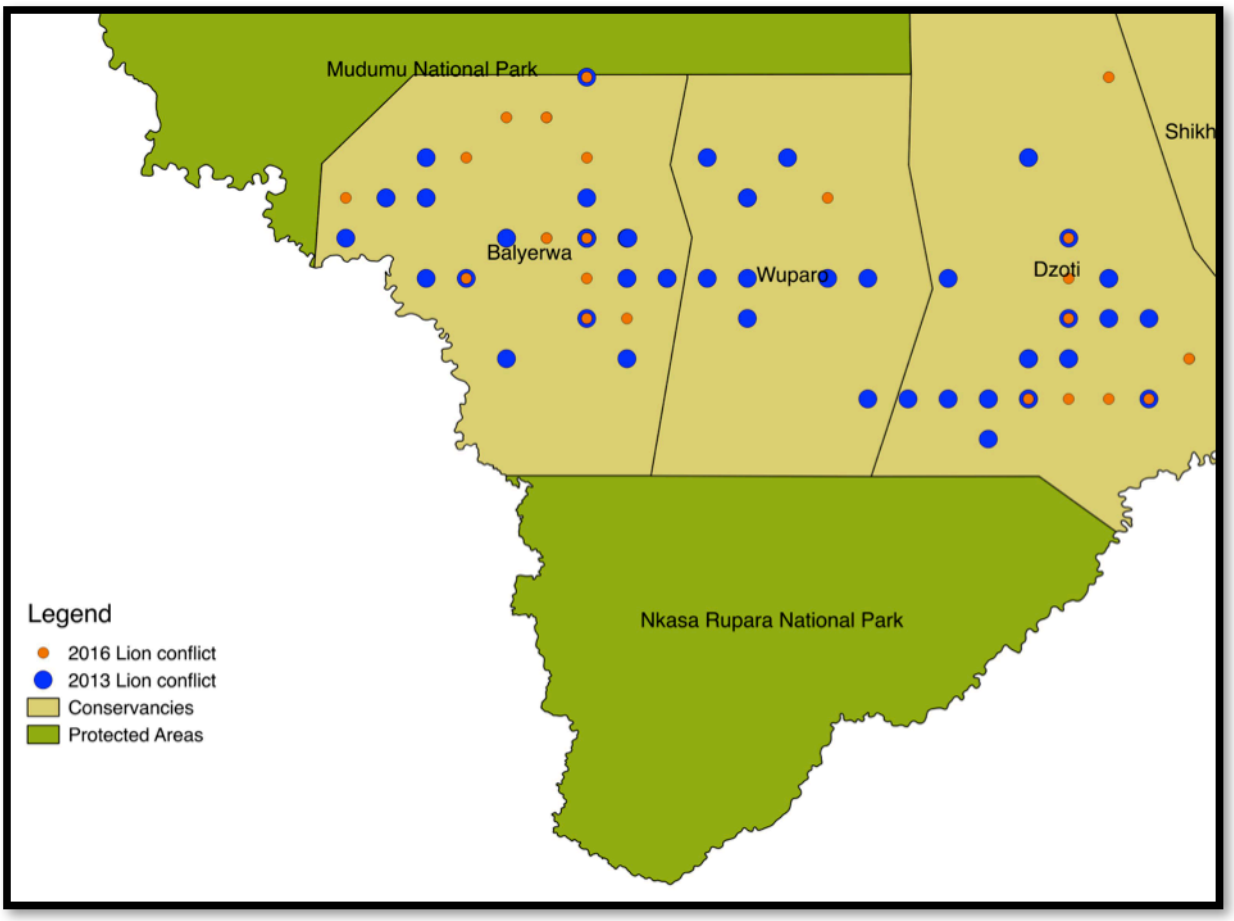

Figure 1: Lion attacks on cattle in the MSC in 2016 compared to 2013 when the project was initiated.

Cattle predation statistics in the Mudumu South Complex

There was a steady decline in the number of livestock killed by lions in the MSC from 2012/2013 until early 2016. During 2014, 61 cattle were killed (69% decline), and during 2015 this figure dropped to 28 cattle (a further 67% decline); a combined decline of 73%. During 2016, 41 cattle were killed by lions.

The number of cattle killed by lions while grazing increased by 13 to a total of 37 grazing cattle during 2016 compared to 24 in 2016. The Zambezi Region has undergone drought conditions over the past few years, with 2016 being exceptionally dry. It is likely that cattle were left to graze for extended periods of time to maximise grazing opportunities and minimise the energy required for them to walk to and from their kraals every day. Twenty-one of the cattle that were killed while unattended included the following:

- Seven cattle belonging to six different farmers were left outside their lion-proof kraals overnight.

- Fourteen cattle belonged to three different farmers who had been offered help with upgrading their kraals to lion-proof. Two of the farmers did not supply the promised poles and the third farmer could not be helped after he insisted that the kraal be constructed on the boundary of Mudumu National Park.

The overall number of cattle killed by lions in the MSC has declined dramatically since 2012/2013 despite the slight increase during 2016. There is little doubt that kraal improvements in areas of conflict and "hotspots" of conflict is a big contributor to this overall decline. Only two incidents involving four cattle took place in kraals during 2016 throughout the MSC.

The numbers of cattle killed by lions per year and per conservancy in the Mudumu-South Complex are presented in Table 1.

Table 1. *Cattle losses to lions per conservancy in the Mudumu-South Complex from 2013 to 2016 (Event Book data from Balyerwa, Dzoti and Wuparo Conservancies).*

Conservancy	Balyerwa	Dzoti	Wuparo	Total (%)
No of cattle killed in 2013:				
While kraaled	21	17	15	**53 (39%)**
While grazing	31	31	20	**82 (61%)**
No of cattle killed in 2014:				
While kraaled	0	5	3	**8 (13%)**
While grazing	22	23	8	**53 (87%)**
No of cattle killed in 2015:				
While kraaled	0	4	2	**6 (20%)**
While grazing	14	8	2	**24 (80%)**
No of cattle killed in 2016:				
While kraaled	1	3	0	**4 (10%)**
While grazing	19	17	1	**37 (90%)**
Total	**108**	**108**	**51**	**267**

From the data it is clear that irrespective of the decline in predation levels and the building of the kraals that nevertheless the majority (73%, n = 196) of cows are actually killed while grazing unattended by herders. However, the total number of cattle killed since the project was initiated during 2014 suggests that the high numbers of lion-proof kraals makes this area less attractive to lions. The number of cattle killed in kraals has declined even further since 2015 when six cattle were

killed. During 2016, four cattle in only two incidents took place at kraals. Since 2012/2013, the number of cattle killed inside kraals has declined by 93%. To date not a single cow has been killed by lions, or any other large carnivore, inside the reinforced lion-proof kraals.

Figure 2 illustrates the shift in cattle depredation. During 2012/2013 cattle predation that took place in kraals made up almost half of all cattle predation. Over the past three years as the number of lion-proof kraals have increased, this has shifted to approximately 10%. This strongly suggests that lion-proof kraals have played a significant role in reducing livestock depredation in MSC

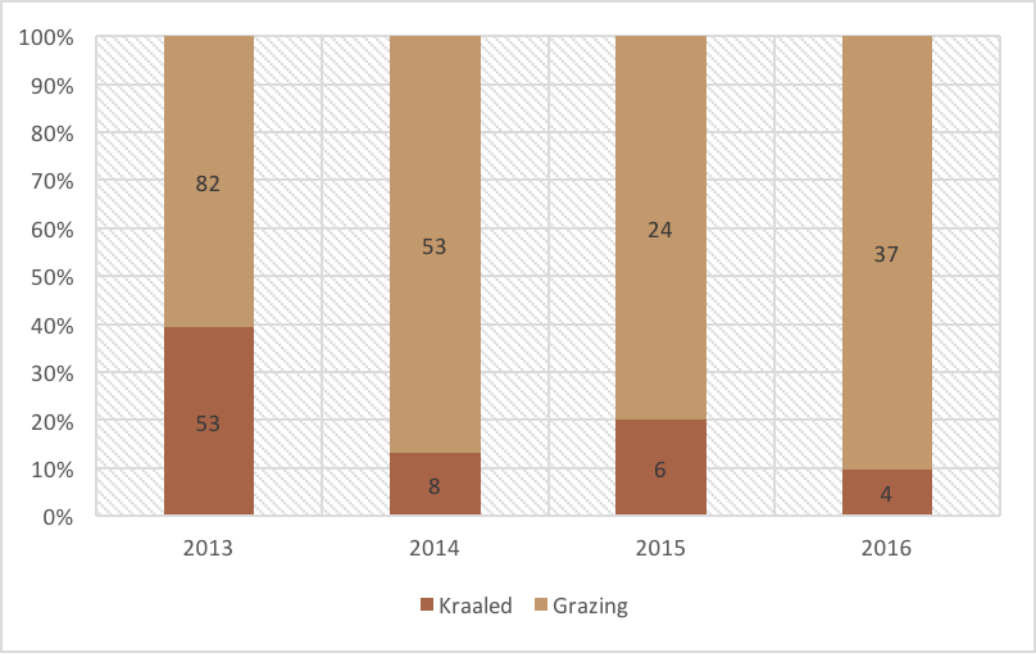

Figure 2. *Percentage of cattle killed grazing vs in kraals in the Mudumu-South Complex from 2013 to 2016.*

Seasonality of conflict

When all the data from 2013 to 2016 is compiled (Figure 3), it is clear that predation on cattle occurs throughout the year, with two clear periods of greater activity. There is an increase during the wet season from October until March, which is likely partly due to prey dispersing with the onset of the rains resulting in the lions having to work harder for food.

Of importance for farmers is that the wet and dry season patterns (Figure 4) of cattle predation also correspond with certain agricultural practices.

1. The sharp spike in May/June (dry season) would seem to be in response to cattle being left out at night unattended in order to graze on the remaining corn and mahango plants after the crops have been harvested during May. This is done to help fatten the cattle before the winter months but is clearly a cause of much of the cattle depredation by lions.
2. The increase in predation over October and November (early wet season) could be in response to farmers and herders focusing their efforts on ploughing of fields in readiness for planting crops during the early wet season. Plough oxen are left unprotected in close proximity of fields during ploughing periods rather than herding them back to kraals every day.
3. Often cattle are left to roam for long periods of time unherded during the wet season to make the most of the green forage.
4. Cattle are left out of kraals in the late wet season when the dung build-up inside the kraals become very wet from prolonged wet conditions.
5. The extended period of lion depredation during 2016 would seem to be in response to cattle being left out to graze throughout the dry season due to drought conditions.

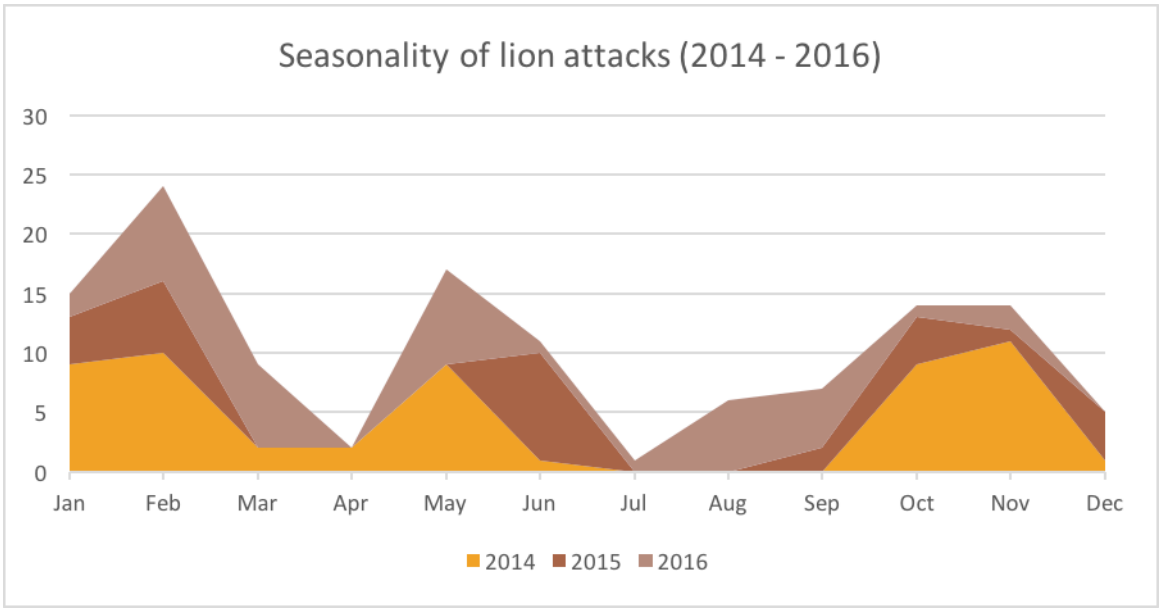

Figure 3. *Seasonality of lion predation on cattle in the Mudumu-South Complex, Zambezi Region, from 2013 to 2016.*

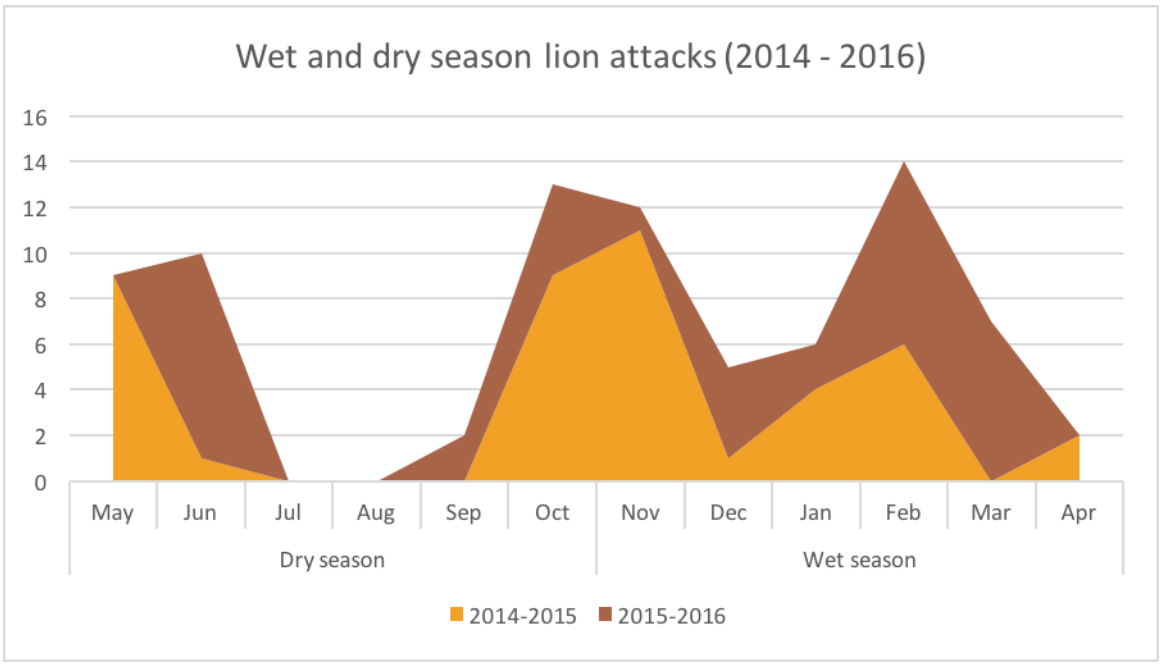

Figure 4. *Patterns of lion predation on cattle in the Mudumu-South Complex, Zambezi Region, for mid 2014 until mid 2016, representing two full wet and two full dry seasons.*

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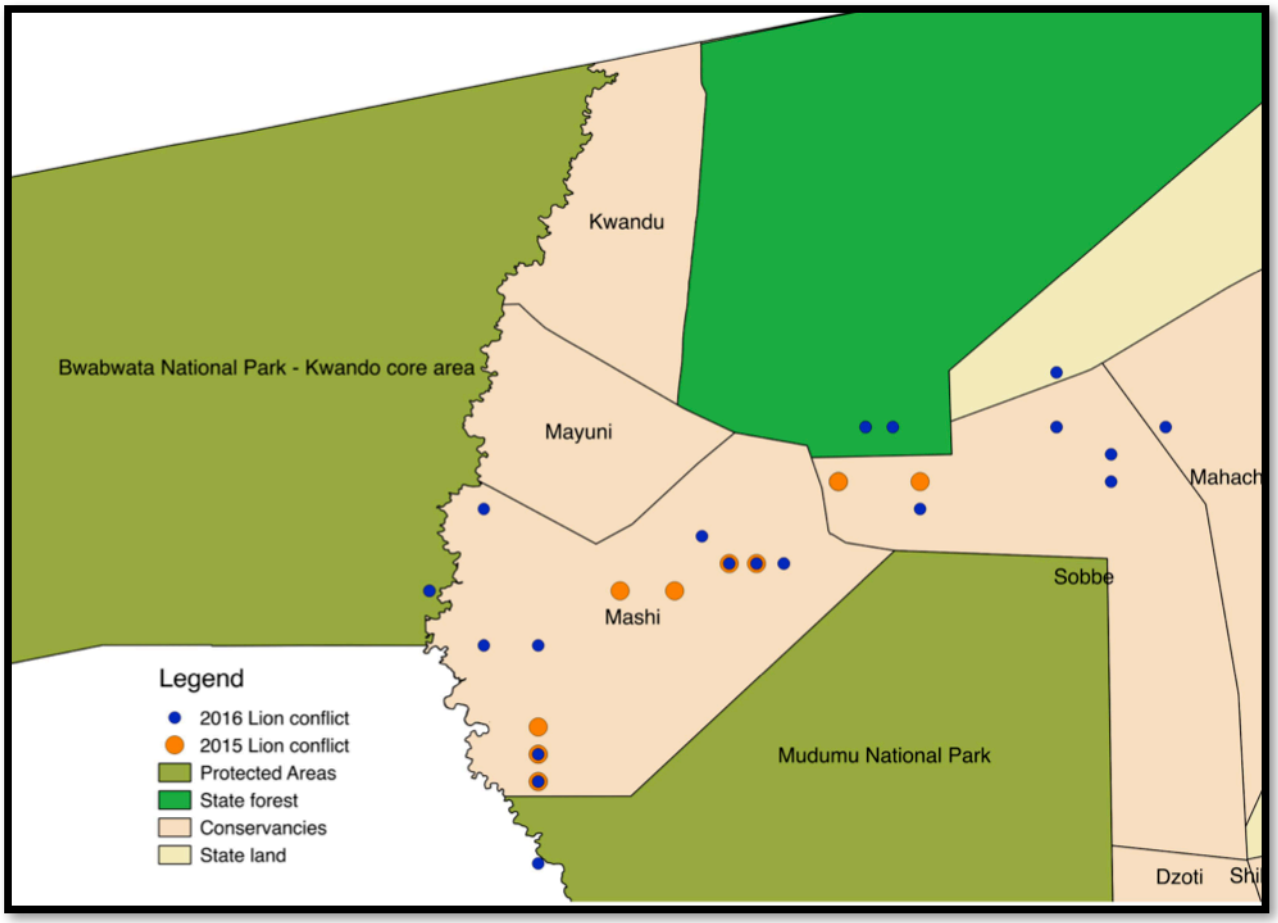

***Figure 5**: Lion attacks on cattle in the MNC in 2016 compared to 2015 when the project was initiated.*

Cattle predation statistics in the Mudumu North Complex

The number of cattle killed by lions in the MNC increased during 2016. This is possibly due to the drought conditions already described resulting in cattle left to graze for long periods of time. The shift in the percentage of cattle killed while grazing from 50% in 2015 to 97% in 2016 appears to support this. Three of the cattle that were left outside overnight belong to farmers whose kraals had been upgraded to lion-proof during 2016.

The numbers of cattle killed by lions per year and per conservancy in the MNC are presented in Table 2.

Table 2. *Cattle losses to lions per conservancy in the Mudumu North Complex from 2015 to 2016 (Event Book data from Mashi and Sobbe Conservancies).*

Conservancy	Mashi	Sobbe	Total (%)
No of cattle killed in 2015:			
While kraaled	5	2	**7 (41%)**
While grazing	7	3	**10 (59%)**
No of cattle killed in 2016:			
While kraaled	0	1	**1 (3%)**
While grazing	18	10	**28 (97%)**
Total	**30**	**16**	**46**

Figure 6. illustrates the shift in cattle depredation. During 2015 cattle predation that took place in kraals made up almost half of all cattle predation. During 2016, nine lion-proof kraals were constructed in the MNC, which appears to have had a significant impact with attacks on cattle in kraals making up only 3% of the total number of attacks. This strongly suggests that lion-proof kraals have made an impact on lion depredation even after only one year.

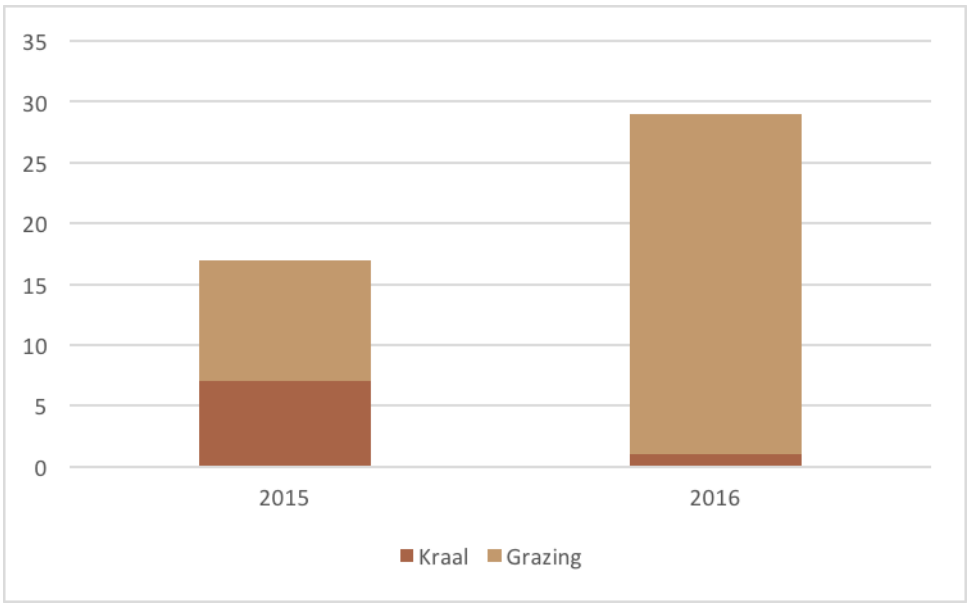

Figure 6. *Percentage of cattle killed grazing vs in kraals in the Mudumu North Complex from 2015 to 2016.*

Seasonality of conflict

When all the data from 2015 and 2016 is compiled (Figure 6), it is clear that predation on cattle in MNC occurs throughout the year. There are definite peaks in cattle attacks including the second half of the wet season similar to the MSC. Interestingly, the behaviour of the Mudumu pride of lions differs from the three prides in the Nkasa Rupara NP. The adult females spend most of their time inside the park boundaries. The sex (mostly male) and group size of lions reported to have killed livestock correspond to the group of three-year-old lions in the Mudumu pride. Dispersal-age males often kill more livestock than older established resident lions. The Mudumu pride are notoriously shy so direct observation is rare.

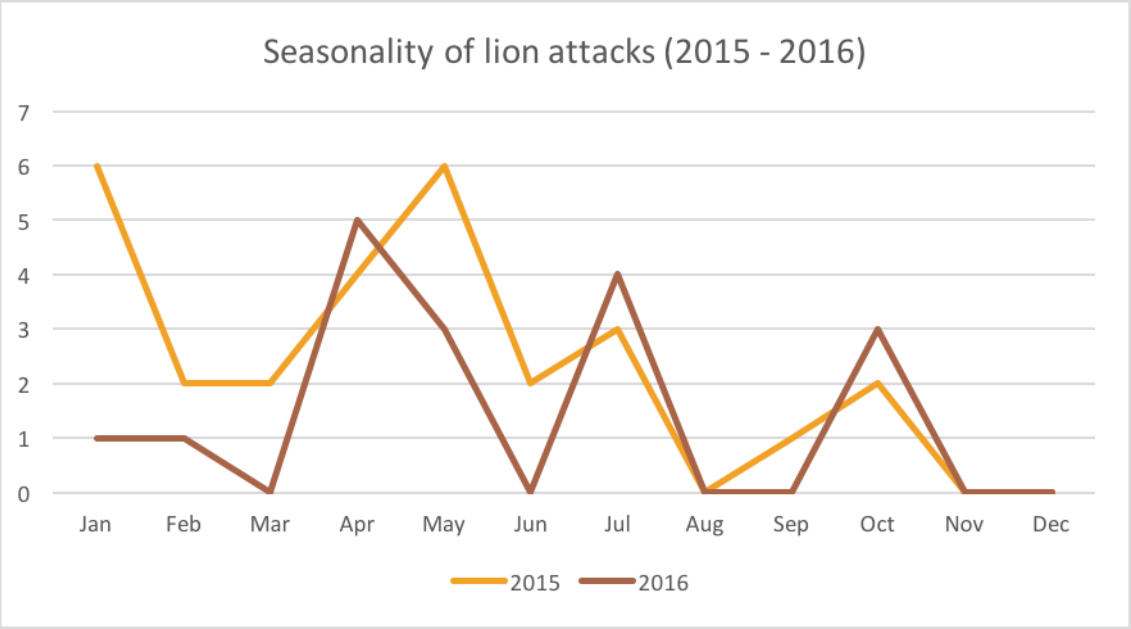

Figure 7. *Seasonality of lion predation on cattle in the Mudumu North Complex, Zambezi Region, from 2015 to 2016*

Lion statistics (2013 – 2016)

- The Lupala Pride (17 lions) that was killed during 2013 and early 2014 was replaced in early 2014 by the Mparamure Pride (8 lions in total).
- The single surviving female of the Lupala pride had a litter of two cubs in early 2015 and spends most of her time in the extreme west of the MSC.

- In late 2015 the small Liadura Pride (three lionesses) moved into the area seemingly from Botswana.
- During 2016, three young adult male lions from the Mudumu Pride successfully dispersed through the Mudumu North Complex, crossed the Kwando River and moved into Luiana National Park in Angola.
- During 2016, three young adult male lions from the Horse Shoe Pride moved north into Luiana National Park in Angola. They move between Angola and Namibia.
- The Horseshoe Pride males moved south into Botswana and took over the Kwando Lagoon pride. They move between the Kwando Lagoon and the Horse Shoe prides.
- The Horseshoe Pride has successfully raised the third litter of cubs since 2010. Fourteen Horseshoe lions have reached dispersal age over that time.
- There has been zero conflict/human-related lion mortality in the Mudumu Complexes (north and south) since between 2014 and the end of 2016.

Pilot project: Conservation Agriculture through mobile kraaling of livestock

Mobile bomas were implemented during 2016. Mobile kraals are constructed using PVC/canvas sheets and are erected on fields where crops are grown. Cattle housed in mobile kraals during the night trample dung into the substrate. This results in the field being fertilized contributing to improved crop yields. Mobile bomas in mosaic landscapes contribute to conservation as well as human livelihoods in the following ways:

1. Implementing an adaptable method of protection for cattle at night near the fields where they graze, which is 100% effective if properly carried out.
2. Improved fertilization of cropping areas which result in increased yields of staple food crops for food security.
3. A reduction in loss of habitat as nutrified fields provide sufficient space for food production. Clearing of new cropping areas when old fields are depleted of nutrients (slash and burn agriculture) is a growing threat to connectivity for all wildlife.
4. Adherence to zonation of land-use, which discourages settlement and cropping in wildlife corridors.

Field work

Farmer network and cattle protection

Farmers that took part in the project were chosen for their willingness to adhere to the necessary steps in the methodology. These included the following:

1. Cattle had to be kraaled every night in the mobile kraals in order to trample their dung into the substrate and protect them from lions.
2. Farmers had to be willing to participate in moving the mobile kraals every week. Due to the sandy substrate, we extended the period of nutrification to two weeks before moving bomas. Extending the length of time for nutrification essentially reduced the size of the area that could be nutrified in the first season.

Farmers and cattle numbers that participated.

Nine farmers with a collective total of 779 cattle participated in the project. Farmers were located around the Sobbe corridor as well as within the more expansive Mudumu Complexes.

***Table 3**. Participating farmers and cattle numbers*

Name of participating farmer	*Number of cattle*
Calvin Shozi	46
Hans Fwelimbi	68
Kenest Mudzo	87
Coster Mayumbelo	22
Albert Lingeza	101
Davis Mwezi	31
Obicious Siyanga	25
Clement Kutelo	74
Robinson Simasiku	325
Total	**779**

Results

There were no incidents of lions or any other large carnivore or predator breaching the sides of the mobile kraals or even attempting to do so. There were no reports of large carnivores approaching the sides of the mobile kraals. The

mobile kraals resulted in 100% protection of almost 800 head of cattle with a collective value of approximately N$4 million.

Field nutrification for growing of crops

As a project of this nature has never been attempted in the Zambezi Region, we had no baseline for comparison or guidance. We initially based our methodology on the successes of soil nutrification in Zimbabwe, both from the African Centre for Holistic Rangeland Management and from the Hwange Lion Project (Brent Stapelkamp – Project Coordinator). Soils in Zimbabwe have high clay content, which helps to retain the dung near the surface of the soil making it available to growing crops. For this reason, the optimal result for the nutrification of fields is dependent on the very specific density of cattle and kraaling period. Stocking capacity for clay soils is 2.5 square metres per head of cattle (one square metre for calves) for one week only before the kraal is moved to the adjacent plot.

In our area, we realized that one week of treating plots in sandy soils is insufficient. We decided on a period of two weeks and used the appearance of the soil after two weeks of nutrification to guide us. It is possible that an even longer period might be optimal, but this can only be established with further experimentation over time.

Nutrification of fields

Due to the extended period of kraaling, the size of the area that was nutrified was smaller than originally anticipated. Our field time for treating fields was also reduced due to the late arrival of the mobile bomas and other equipment. We were only able to start in September, but ideally the process should start in June or July, straight after crops have been harvested. Some farmers did not use a square shape for their bomas. When all sides are equal in length then more surface area is enclosed. The oblong shape of some of the kraals resulted in smaller areas being nutrified, but with the same amount of effort. The plots that were treated only made up parts of each farmer's entire field although whole fields have been used to plant crops. This would allow us to compare plants and crop yields.

***Table 4**. Kraaling period and total nutrified area for each farmer*

Name of participating farmer	*Kraaling period*	*Total area (m^2)*
Calvin Shozi	7 weeks	625
Hans Fwelimbi	9 weeks	625
Kenest Mudzo	6 weeks	3168
Coster Mayumbelo	3 weeks	312.5
Albert Lingeza	6 weeks	972
Davis Mwezi	6 weeks	468.75
Obicious Siyanga	9 weeks	625
Clement Kutelo	8 weeks	2500
Robinson Simasiku	8 weeks	5000

Monitoring of nutrified fields

Due to rainfall patterns, farmers waited until mid December 2016 before planting their crops. Two farmers only started ploughing in January 2017. Plants on treated plots are greener and longer and there is a higher density of plants on treated plots.

Monitoring of plant health and growth rate for treated and untreated plots will be carried out through the periodic measurement of thirty randomly chosen plants in each plot for each farmer throughout the growing season.

Challenges and lessons

- The unexpected length of time for the ordering process as well as delays in delivery resulted in the field work being considerably delayed.
- The extended length of time needed for soil nutrification in sandy soil resulted in smaller plots being treated.
- Boma layouts were not optimised for maximum area for nutrification. Bomas need to be square rather than oblong in shape.

- Communities are still hesitant to kraal their cattle communally in order to nutrify larger areas.
- Stocking capacity of cattle in mobile bomas does not have to be as precise in sandy soils as it is in clay soils.
- Mobile bomas can be used as emergency fixed bomas in "hotspots" of lion and livestock conflict.

Benefits

- The Zambezi Region has had substantial and consistent rainfall which has benefitted the early results of this project.
- The appearance of healthier plants and denser crops has resulted in much enthusiasm from the community and happy participant farmers.
- Visible results has created much interest from members of the community with more farmers willing to participate next year.

Next steps

- Continue the monitoring of crops
- Procure a scale with the capacity to weigh harvests
- Encourage communal kraaling of cattle in mobile bomas for a village or small community in order to plant bigger communal fields.
- Identify new participants
- Order additional mobile boma material in order to expand the project.

Conclusion

Even with delays and challenges, early results are promising. Interest by the community is driven by food security with cattle protection being secondary. This project is worth building on taking on a few farmers annually and learning from mistakes made during the pilot phase. Changing agricultural practices takes years and it will only be with consistent good results and food production that mobile kraaling will become common practice

Activities in 2016

1. Kraal building

Data from the conservancy game guard event book system is collated annually in order to identify farmers who have lost the most cattle to lion attack (see Tables 1 and 2). An important distinction is made between farmers whose

cattle had been killed while in a kraal at night, and those killed grazing in the day. No amelioration was offered to farmers whose cattle were killed grazing if they were unattended (no herder present). During 2016, a total of twenty-two lion-proof kraals were built bringing the total number of lion-proof kraals in the Mudumu-South Complex to 71. Farmers provided their own poles which resulted in eight additional lion-proof kraals being constructed with the left over funds. In total, these kraals protect over 6000 head of cattle.

Our trial with "living wall" kraals pioneered by Laly Lichtenfeld was carried out on a small scale only. Commiphora may only be chopped with a permit from the Directorate of Forestry so we used a method called pollarding, where smaller branches were taken from trees. Two small experimental kraals were erected and produced green shoots during December when the ground was sufficiently moist. We have been advised by Laly that these kraals could take up to two years before they are viable.

2. *Holistic Rangeland Management pilot project*

Grazing cattle on old crop fields after harvesting and leaving them out at night is a practice that results in significant losses of cattle to lion attacks. With funding from WWF Germany we purchased material for mobile kraals. Nine farmers took part in erecting mobile kraals around their crop fields. These mobile kraals provide safe housing for cattle at night time. We are currently analysing the data from this experiment, but the 778 collectively owned cattle all survived the night time housing in mobile kraals while fertilizing some hectares of crop fields. This project will be expanded and using the concept of food security, we hope to encourage communal kraaling in mobile bomas. We have approached the University of Namibia to collaborate on the monitoring of this pilot project.

3. *Farmer workshops and community awareness*

We held a number of farmer information days regarding protecting cattle as well as field nutrification in order to promote the mobile kraals. The expansion of the fixed lion-kraals has resulted in many farmers approaching our team to assist them in erecting their own kraals. Many have offered to purchase all their own material only asking for guidance and training. These farmers will be included in our kraal construction plans for 2017.

4. *Expand our focus area*

During 2016 we expanded our efforts to include the Mudumu North Complex (Mashi and Sobbe Conservancy) and we have started with stakeholder meetings along the Chobe River floodplains. Seventeen lions were killed in the

Chobe floodplain conservancies during 2016. BCI have become project partners with KCP on lion conflict mitigation in the eastern floodplains. Our introduction to the Traditional Authority at Bukalo and the first exchange visit of Chobe farmers to the MSC project is planned for March/April.

5. *Develop the concept of a joint MET/Game Guard lion patrol team*

This idea has been shelved for now. The lion-proof kraals are proving so effective that if used correctly lions do not cause problems. The Kwando/Mudumu Complexes are a wildlife dispersal area within KAZA and its value to lion conservation in the broader KAZA landscape is the movement of dispersing lions facilitated by a tolerant community. For the past two years there has been no lion mortality in the Mudumu Complexes even though the Nkasa Rupara lions regularly move outside of the park.

6. *Benefits – performance payments*

WWF in Namibia are carrying out the first pilot performance payment project in the Zambezi Region. The area to be protected is known as the Sobbe Corridor and falls within the Sobbe and Dzoti Conservancies. This corridor has been identified as important for wildlife connectivity between Botswana, Namibia and Zambia. WWF Namibia has the capacity to develop a funding/payment system using their WWF network. KCP will be responsible for monitoring the use of the corridor by carnivores, cattle and people using camera traps. Lion dispersal is particularly important as a criterion for payment to the community. WWF will use camera trap photos of lions and other large carnivores as one of their connectivity metrics. The first stakeholder meetings have already taken place with camera trapping design starting in May.

Activities planned for 2017

1. *Kraal building and monitoring*

For 2017 we would like to train more farmers in kraal construction and invite more partnerships from farmers who are willing to contribute poles or even wire and fencing in hotspots of conflict. We will also be exploring the possibility of a different kraal design that uses less wooden poles and requires less maintenance.

2. *Expand on the Holistic Rangeland Management/Conservation Agriculture project*

After only a few months of field nutrification, early results are promising. The first participant farmers were picked for their willingness to stick to the necessary steps for mobile kraaling, but for 2017, we will visit the conflict hotspots where grazing cattle were killed by lions and promote mobile kraaling on a larger scale.

3. *Farmer workshops and community awareness*

Our first exchange visit of farmers from the Chobe floodplains to the MSC will take place in March/April. We are participating in agricultural stakeholder meetings throughout the year as well as visiting farmers in each conservancy over the next few months. We would like to use the Kwando Thematic Working Group of the KAZA large carnivore coalition to bring together farmers from the Mudumu Complexes, the Sioma area in Zambia and from Botswana to engage on community projects and conservation steps to promote tolerance for lions throughout the dispersal area and promote a landscape level concept for lion conservation in the region.

4. *Expand our focus area*

We will investigate the impediments to adhering to the land-uses and zonation within conservancies.

5. *Benefits – performance payments*

We will implement a permanent camera-trapping grid in the Sobbe corridor to monitor use of the landscape and contribute to the measures on which to build a fund for performance based payments to the community for lion tolerance.

6. Surveys and monitoring

We will repeat the Mudumu Complex – wide camera trapping survey and the Bwabwata National Park spoor survey that were carried out during 2014 in order to establish whether lions have established themselves in new areas. The camera trapping survey will be extended into Sioma Ngwezi National Park in Zambia in order to identify where pockets of lions occur. We are also putting GPS/satellite collars on dispersing male lions in order to establish how they move through the mosaic landscape of the Kwando WDA and to identify future challenges and conflict areas.

Acknowledgments:

Our gratitude goes to National Geographic's Big Cat Initiative and Panthera for financial support for kraal building and project expenses since these efforts were implemented. We thank WWF Germany for their financial support for the implementation of the mobile kraal pilot project. In Namibia, we thank the Ministry of Environment and Tourism, IRDNC, WWF in Namibia, NACSO and all members of the conservancies for their willing participation and guidance. A special thank you to Hans Fwelimbi, Coster Sililo, Luscious Kakuwe, Paul Funston and Obicious Siyanga, without whom this project could not have succeeded. Thank you also to Carol Murphy and the Directorate of Forestry, Simone Micheletti for his input on lion activity in the Nkasa Rupara National Park, Laly Lichtenfeld for input on the living wall kraals and Brent Stapelkamp for guidance and advice on mobile kraaling.