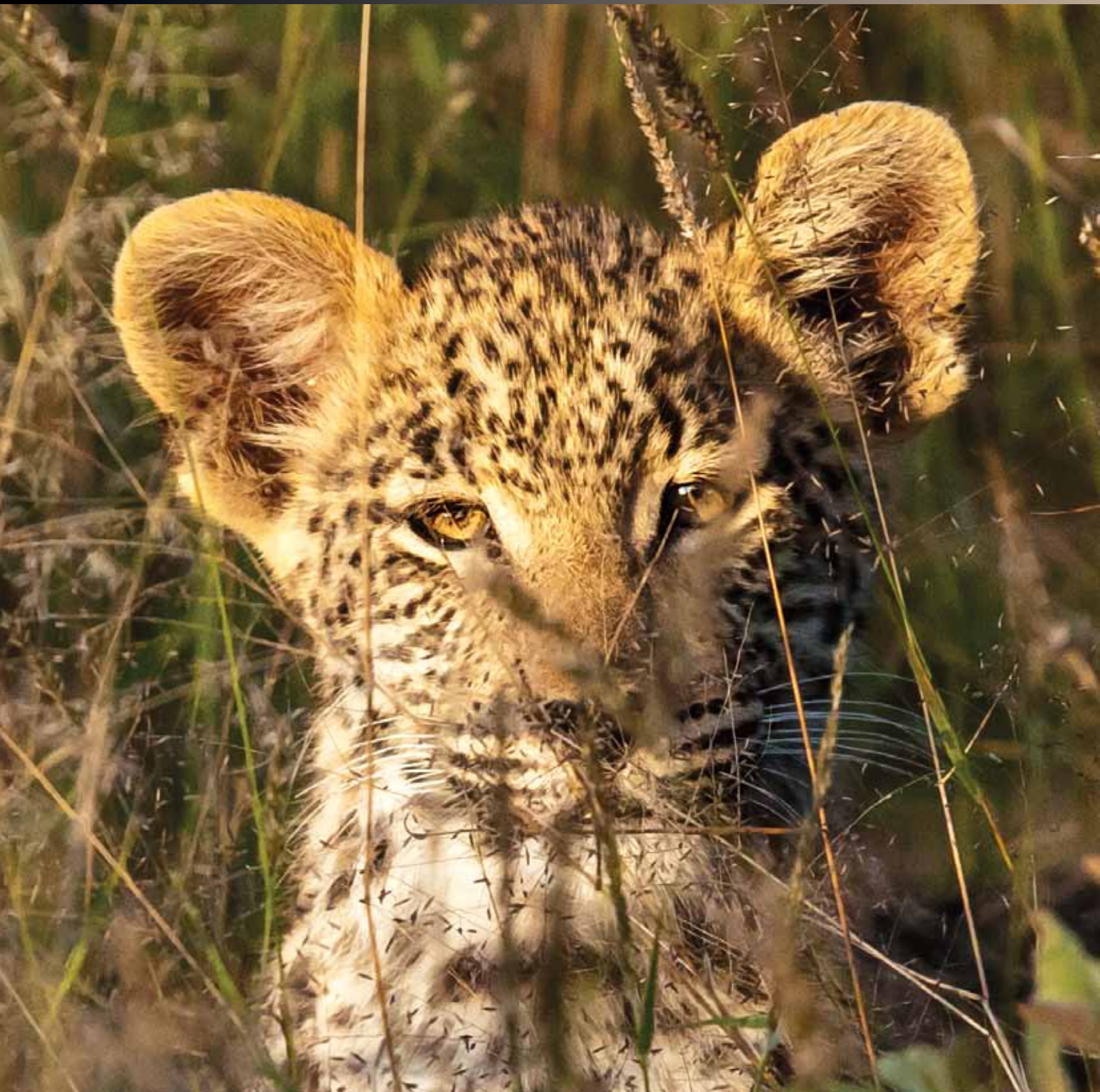




# Annual Report 2018





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We also sincerely thank our sponsors for their commitment to the conservation of leopards and lions in the Kalahari. We wish to express our appreciation to the members of

the African Cats & Conservation Foundation (ACACF), the Khutse Leopard Trust and the Act Now for Tomorrow Steering Board for their ongoing support and guidance. We also value the support provided by the Institute of Evolutionary Biology and Environmental Studies of the University of Zurich.

Finally, our success is a direct result of the dedication shown by all members of the Leopard Ecology & Conservation team, both in Botswana and Switzerland, as well as the numerous individuals associated with this project (see Appendix II).

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CKGR	Central Kalahari Game Reserve
DWNP	Department of Wildlife and National Parks, Botswana
GR	Game Reserve (as in Khutse GR)
LEC	Leopard Ecology & Conservation
BUAN	Botswana University of Agriculture and Natural Resources
UZH	University of Zurich

## BACKGROUND

LEC has been conducting research and community projects within the central Kalahari region of Botswana since 2000, focused on the ecology and conservation of leopards and lions. As apex predators, these large cats are dependent on interactions and conditions spanning the range of environmental conditions across all trophic levels. This is reflected in LEC's monitoring and research projects which range from rainfall and temperature data collection to ungulate demographics to predator behaviour.

From a conservation perspective, focusing on leopards and lions is effective in that these are charismatic species which draw the attention of people. They serve as "umbrella species", and their conservation ensures the conservation of many species and ecosystem processes. These "flagship species" encourage individuals and communities to engage in conservation projects. During our long years of research, many interesting insights were gained. The first leopard collared in 2001 was Boitumelo who was the likely mother of Ronja. A female leopard who the project followed for ten years and gave many insights into her life; including happy events such as giving birth to her cubs and very sad moments like this year when we learned that Ronja had died.

The central Kalahari region of Botswana is increasingly recognized as an area of

international conservation significance for large predators. The importance of which will increase in future. Effective conservation needs to be based on appropriate knowledge and reliable data. This is the motivation for LEC's research programme. In recent years, LEC has observed two biological phenomena of direct relevance to this conservation status:

- the dramatic decline in leopard density within the Protected Area and
- the apparent fragmentation of the lion social landscape.

These changes may be driven by natural cycles such as shifts between medium-term wet and dry periods. Response to these changes may be amplified by natural episodic events such as the recent establishment of a resident elephant population or fires. Alternatively, the observed demographic changes may be the consequence of local man-induced changes associated with the expanding human footprint, such as desertification and wildlife population fragmentation, as well global impacts such as shifting climatic conditions.

Conservation is essentially a human endeavor. Natural ecosystems have evolved to be inherently self-sustaining, and it is only when man intervenes that they become dysfunctional. It is up to man to manage his interaction with his environment to protect

Leopard. (Photo: Andrea Webster)

biological diversity. Consequently, in its community projects LEC has placed particular emphasis on education and capacity building. The Herder's Training course will teach local pastoralists how to effectively manage livestock and conserve biodiversity. The popular Kaudwane Horse Race seeks to achieve the same goal indirectly; by requiring all participating horses to be well managed and in good condition, and providing the owners with the opportunity to achieve this prior to the race.

Furthermore, two of LEC's three resident professional staff members are Batswana citizens and LEC has encouraged both to register for higher post-graduate degrees. Not only will this make them more effective members of the LEC team, it will also contribute to the ongoing development of knowledge and capacity within the local community, who are the long-term custodians of their ecosystems.

Conservation is both a human responsibility and long-term endeavor; and LEC continues to show a willingness to tackling this in situ and commitment to do so with a long-term vision. The importance of LEC's contribution toward the conservation of large predators and the ecosystem that sustains them grows with each year the project is sustained.



# RESEARCH PROGRAMME

## Predator Habitat Monitoring

### Weather

During the 2017–2018 austral year (July–June) we recorded 205 mm of rainfall at the LEC camp. This is less than half the average annual rainfall of 436 mm recorded at this location between February 2001 and June 2017. Not surprisingly, monthly rainfall values were low (Fig. 1). Each month, with the exception of September (mid–dry season) was below the average (Fig. 2). The monthly rainfall from January 2018 (latter half of the wet season) was particularly low. No rain was recorded in February 2018, despite an average rainfall for this month of 89 mm (Table 1). The start of the 2018–2019 wet season has been slow, with the first substantial rains falling in December 2018.

Reviewing the climate data recorded at the LEC camp, it was apparent that the weather station (type Davis) was measuring rainfall value that differed from the manually recorded rain gauges. Based on an analysis of these data by Prof. Zucchini, it was decided that the most reliable rainfall data were derived from an average of the rain gauges located at LEC and the DWNP office. Rainfall records have been adjusted accordingly. Since this time, we have been recording rainfall in at least two rain gauges within the LEC camp.

Elephants have continued to disturb the rain gauges placed at Khanke junction, Molose Pan and Moreswe Pan. To alleviate this problem, we placed an addition three rain gauges away from the pans and road junction, which are places frequented by elephants. In January 2018, gauges were placed in the vicinity of the fixed-point photograph sites closest to the existing rain gauges, namely B2, G2 and F1. As with the camp rain fall, we intend averaging the recording from Khanke/F2, Molose/B2 and Moreswe/F1 (Map Appendix) when values are available from both to provide a more reliable measure in the respective area. When elephants disturb one of the gauges, we will still have the measure from its adjacent station. Of the three new gauges, F1 was disturbed by elephants in January and December. Of the existing gauges, the Molose gauge has been disturbed every month, and has currently been removed. The Khanke gauge was disturbed every month except February, September and November. The Moreswe gauge was not disturbed. Consequently, we have a measure of monthly rainfall from at least one of the three paired rain gauges for each month of 2018.

Rainfall across the study area, was low during the 2017–2018 austral seasonal year.



Barn owl. (Photo: Walter Zucchini)

Values ranged from 205 mm recorded in camp to 252 mm recorded at Molose Pan. However, due to disturbance of rain gauges by elephants, rainfall was not recorded at Khanke in November 2017 and Molose in December 2017. On both occasions, rain was recorded at other stations and so it is assumed that the annual rainfall values for these is an under estimate.

## Vegetation

Monthly fixed-point vegetation photographs were taken at all 28 locations along the survey routes during the period of the extensive spoor and prey count (October

2017–October 2018), as well as the additional five pans. Images from sites along the routes may be compared with images collected at the same locations in 2008–2009 and 2013–2014. From November 2018, we reverted back to the five standard monitoring sites (A1, A2, B2, F1 and G2; Map Appendix) and the five pans (Khanke, Khutse 1, Mahurushele, Molose and Moreswe)

A fire started within the Khutse GR around the 5th September 2018, between Molose and Moreswe pans. It continued to burn until around the 15th September, despite DWNP efforts to control it. Over this period the fire affected a substantial proportion of the Khutse GR and part of the southern

Table 1. Monthly rainfall (mm) as recorded at the LEC research camp, Khutse GR from July 2017 to December 2018. Mean monthly rainfall is derived from data collected at camp between February 2001 and June 2017 (n = number of years included).

year	J	A	S	O	N	D	J	F	M	A	M	J
2017–2018	0.0	0.0	8.6	20.6	39.5	61.0	33.6	0.0	39.0	2.7	0.3	0.0
2018–2019	0.0	0.0	9.0	0.5	7.1	87.7						
mean	1.4	1.0	3.5	25.0	50.9	78.0	93.3	89.1	56.3	41.3	9.9	8.6
n	13	12	12	14	16	15	15	17	17	16	13	12



Elephants. (Photo: Fritz Schiess)

CKGR. Burning for a period of approximately 10 days, under differing weather conditions, the nature of the burn was highly variable. Being hottest during periods of daytime wind and coolest on still nights. Given the relatively homogenous nature of the topography within this area, it is assumed that fire is a particularly important determinant of the structure and to some degree composition of the vegetation in non-pan areas. This is the most extensive fire in a period of at least six years and given variable nature of the burn it is assumed that the fire will have a positive impact on landscape diversity within the study area. However, late and poor initial rains meant that a large part of the area had very little forage, particularly herbaceous forage, for most of the last quarter of 2018.

## Prey

In October 2017, LEC began an extensive spoor and prey survey, a repeat of similar surveys undertaken to a greater or lesser degree in 2001–2003, 2005, 2007–2010 and 2013–2014. It covers 171 km on road inside the Protected Area and 115 km across the adjacent livestock grazing lands, along which

predator spoor are counted and prey are counted within a 200 m road strip. Prey are also counted on 10 pans within the Protected Area and on one within in the grazing lands. This survey was completed in October 2018.

An earlier analysis of the spatial distribution of prey species was undertaken using data from the 2013–2014 extensive spoor and prey survey (qv. LEC Annual report 2016 Research Box: Prey Distribution). Now that the 2017–2018 survey has been completed, we plan to repeat this analysis in the coming year using data from all the extensive spoor and prey surveys.

A review of prey relative abundance was undertaken by Larissa Meyer, a student, following the completion of the extensive spoor and prey survey in 2018 (Research Box: Prey Density Over Time). This study revealed a decline in prey relative abundance over time within the Khutse GR and southern CKGR. Furthermore, it was observed that the proportional contribution of large prey individuals to the total prey density also decreased. This has a number potential implications for the large predators. Firstly, it implies that greater effort will be required to encounter prey animals. This may impact





Lions in Khutse. (Photo: Pogiso Ithuteng)

the energy budget of predators, requiring more effort to catch smaller prey. It may also influence home range or territory size, if a larger area need to be covered to encounter the same number of prey individuals. Secondly, it may impact on the opportunity of all individuals within a group to acquire sufficient food. If a pride of lions is able to compensate for the reduced number of large prey consumed by hunting more small prey animals, the alpha individuals within the group will still acquire sufficient food by dominating each kill. However, despite the fact the kill biomass may not have changed, smaller individuals within the group may have less access to food as the alpha individuals are less likely to be satiated by any one kill. This has potential implications for the production and recruitment of young animals into the pride. Thirdly, if lion have had to shift their diet to include more smaller sized prey items, it may bring them into more direct competition with leopards and other smaller predators.

Between the 25th September to mid-October, DWNP released approximately 120 blue wildebeest (*Connochaetes taurinus*) in the vicinity of Galalabadimo pan (air-strip). These animals were originally from

the Machidu area. This was a hard release and despite occasional sightings and kills by lions, very few of these wildebeest seem to have remained within the area.

For the second year, Khutse GR had a population of elephants (*Loxodonta africana*) that remained through the year. Their dry season distribution appears to have centered around Molose waterhole, however they moved widely throughout the study area. Ruth Gilchrist, a volunteer, developed a register of individuals based of distinctive nicks and tears in the ears. At the end of October, this register contained 15 known individuals. Given that the natural re-colonisation of an area by megaherbivores is a relatively rare occurrence, this may be a potentially useful source of demographic and behavioural data in future. A quick survey of elephant movements across part of the eastern Khutse GR fence (Route 1) found that of the 17 breaks in the fence along this 11 km stretch of the boundary, 13 (77%) were by animals moving from the grazing lands into the Protected Area. This implies that in this area the Protected Area serves to mitigate the human-wildlife conflict by providing a refuge for elephants, than being a source of conflict.

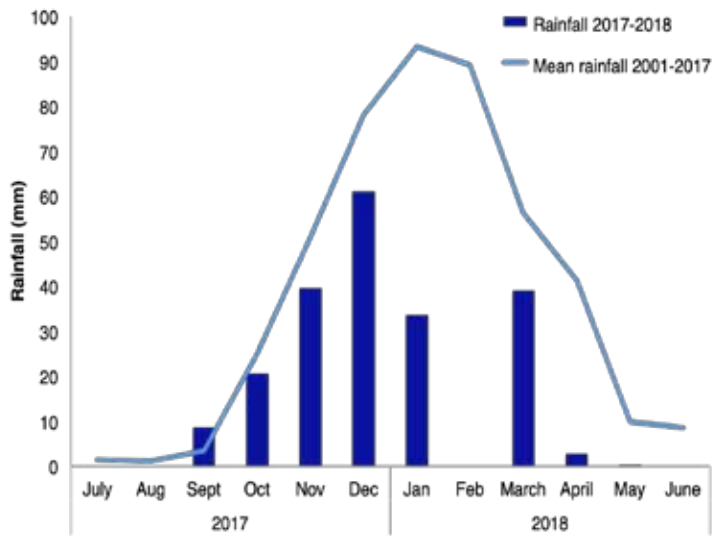


Figure 1. Monthly rainfall recorded at the LEC research camp, Khutse GR, for the 2017–2018 austral seasonal year and mean monthly rainfall recorded at the same location between 2001 and 2017.

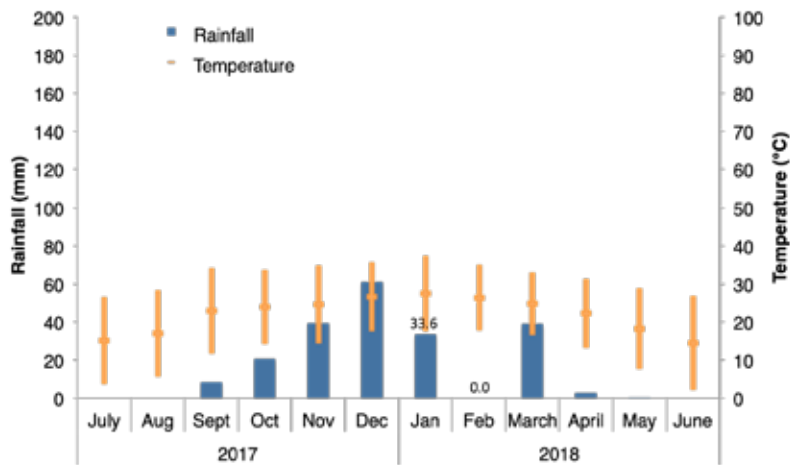


Figure 2. Monthly temperature and rainfall as recorded at the LEC research camp, Khutse GR, for the 2017–2018 seasonal year. The average median daily temperature is shown as a point, with the average daily minimum and maximums as bars.

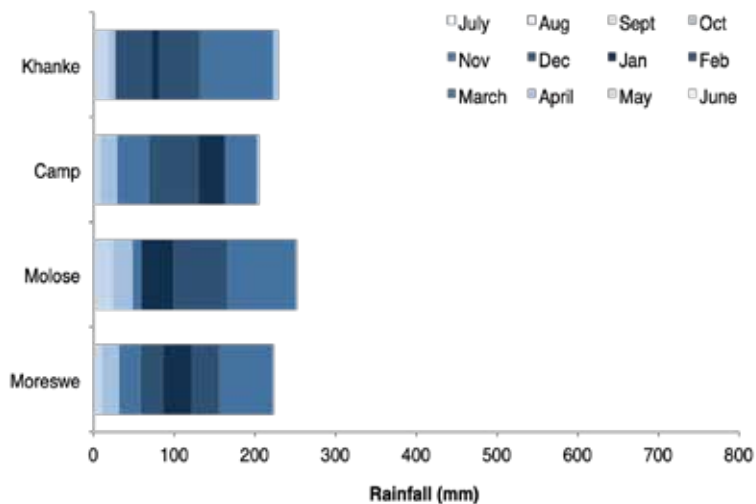


Figure 3. Accumulative monthly rainfall recorded at stations within the study area between July 2017 and June 2018. Rainfall for the months. Rainfall was not recorded at Khanke in November 2017 and Molose in December 2017.

Ronja as she will be remembered.  
(Photo: Monika Schiess-Meier)



## Leopard Research

### Study Animals – Leopard

At the beginning of 2018, we had one active collar on a female leopard, Ronja (PF007). During the course of the year collars were fitted to one other female and two male leopards. All of which were translocated problem animals. Despite a concerted effort to find, catch and collar leopards within the study area, including the employment of an experienced DWNP officer for a month, we were unsuccessful. We assume the lack of success is due to the low leopard density within our study area and their reluctance to enter a cage trap. On a number of occasions where we set a trap for a leopard, camera trap images show leopards approaching the trap, frequently on more than one occasion, but not entering the trap. We are still waiting for the completion of the remote-controlled dart gun, which we hope will increase the chance of catch trap-shy leopards. Having met with the engineers in Zurich designing and building the device in August, we expect it to be completed next year. At the end of 2018, we had one active collar on a female leopard, Tsholofelo (PF013) (Appendix I).

**Ronja (PF007):** Ronja has proven to be a remarkable study animal. It is believed that

she is the daughter of Boitumelo (PF001), the first leopard collared by LEC in July 2001. Ronja was initially collared in July 2008. She was then tracked almost continuously until her death in September 2018. Thus, through Ronja, we have an exceptional insight into the full life history of a wild leopard. When Ronja was free-darted in March, to replace her collar, we observed that although thin, she was in relatively good condition. Her teeth were worn, but given her age, not badly. Subsequent resightings of her confirmed that she was still capable of catching large prey, including juvenile gemsbok (*Oryx gazella*). The cause of her death is not known. Her carcass was found at a brown hyena (*Hyaena brunnea*) den. It is unlikely that the hyena killed the leopard within its den; it is more probable that she died there and the hyena dug out the carcass at a later stage.

**Tsholofelo (PF013):** On the 26th February, we were informed by the DWNP office in Kanye that a young female leopard was being translocated from Mabule village (south-east of Khutse GR), where it had been caught the previous day as a problem animal. Arrangements

## RESEARCH BOX: PREY DENSITY OVER TIME

This study sought to identify changes in prey relative abundance (density) within the Khutse GR and southern Central Kalahari GR using data from extensive spoor and prey surveys undertaken by LEC between 2001 and 2018, particularly changes in the relative abundance of large and medium sized prey species.

Prey were counted within strips 200 m either side of seven fixed routes and on 10 pans once a month. These accommodate the two primary biotopes within the study area, namely arid savanna (road strip counts) and pans (pan counts). The area covered by the seven road strip counts was 65 km<sup>2</sup>. The total area of the 10 pans counted was 9.5 km<sup>2</sup>. The data were analyzed for the nine most abundant ungulate species (eland *Taurotragus oryx*, gemsbok *Oryx gazella*, giraffe *Giraffa camelopardalis*, red hartebeest *Alcelaphus buselaphus*, kudu *Tragelaphus strepsiceros*, blue wildebeest *Connochaetes taurinus*, springbok *Antidorcas marsupialis*, steenbok *Raphicerus campestris* and warthog *Phacochœrus africanus*) and one bird species (ostrich *Struthio camelus*). Species were assigned a weight based on the mean mass of an individual within a typical social group of that species and the total number of animals per count. Where a route was counted more than once in a month the number of individuals per species was averaged for the month. Prey density was calculated for 1) total prey, 2) each species, and 3) medium (<100kg i.e. springbok, steenbok, warthog and ostrich) and large (>100kg i.e. wildebeest, gemsbok, hartebeest, kudu, eland and giraffe) prey species.

The data suggest that within the Protected Area, total prey density is typically an order of magnitude higher on the pans compared with the savanna matrix.

Total prey density was substantially higher, and more variable, during the 2001–2003 survey period, and declined until the 2013–2014 period (Figs. RB1a and RB1b). This is particularly true of the savanna area. While total prey density varied between seasons within the savanna area, there is no obvious pattern. However, total prey density on the pans was almost always greater in the wet season than the dry season.

Almost all species within the savanna biotope showed a decline in density over time. Warthog and ostrich were the only two species which showed an increase in density over time, however the trend for warthogs is driven by high density estimates in 2018, with a large standard error. Giraffe density was the lowest in 2008 but subsequently increased once again. The density of most species on the pans declined over the sampling period. Hartebeest were the only species with a trend towards higher densities on the pans over time.

While prey density (individuals per km<sup>2</sup>) appears to have declined, the data also suggest that there has been a shift from large prey to small prey over the study period both on the pans and within the savanna matrix (Figs. RB2a and RB2b). Prior to the 2007–2009 survey, large ungulate species accounted for more than 70% of the animals per unit area within the savanna. This then declined to around 50%.

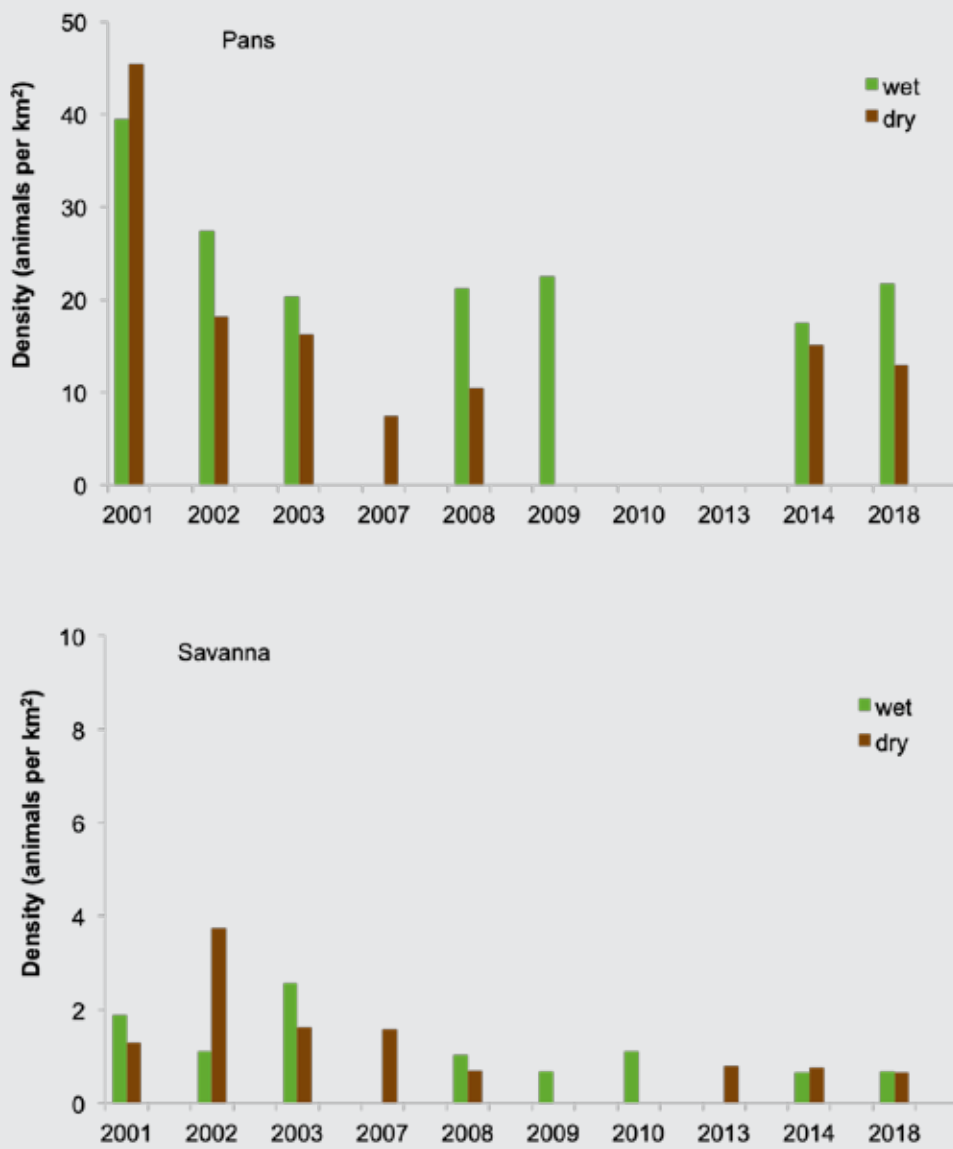


Fig. RB1a/b. Mean monthly prey density for all species combined, per season. Note the difference in scale of the Y axes.



Preparing the cage trap. (Photo: Pogiso Ithuteng)

were made to have the animal anesthetized at the DWNP office in Moloepolole so that she could be inspected by a veterinarian and collared. Tsholofelo (Hope) was released by LEC in the vicinity of Molose waterhole that evening. After a brief period of exploratory movement she established a new home range east of the southern CKGR, in an area of commercial livestock ranches (Fig. 4).

**Legadima (PM029):** Caught in a gin trap as a problem animal, Legadima (Lightning)

was then kept in a cage trap for five days before being translocated to Khutse GR from the Tuli Block area (east of Khutse GR). He was re-hydrated and his wounds treated by a veterinarian, and was fitted with a collar prior to his release in the vicinity of the Khutse 1 waterhole on the 6th February. He subsequently moved out of the Protected Area and was shot as a problem animal. His collar was retrieved by the DWNP office in Machaneng (east of Khutse GR) around the 14th October and returned to LEC.

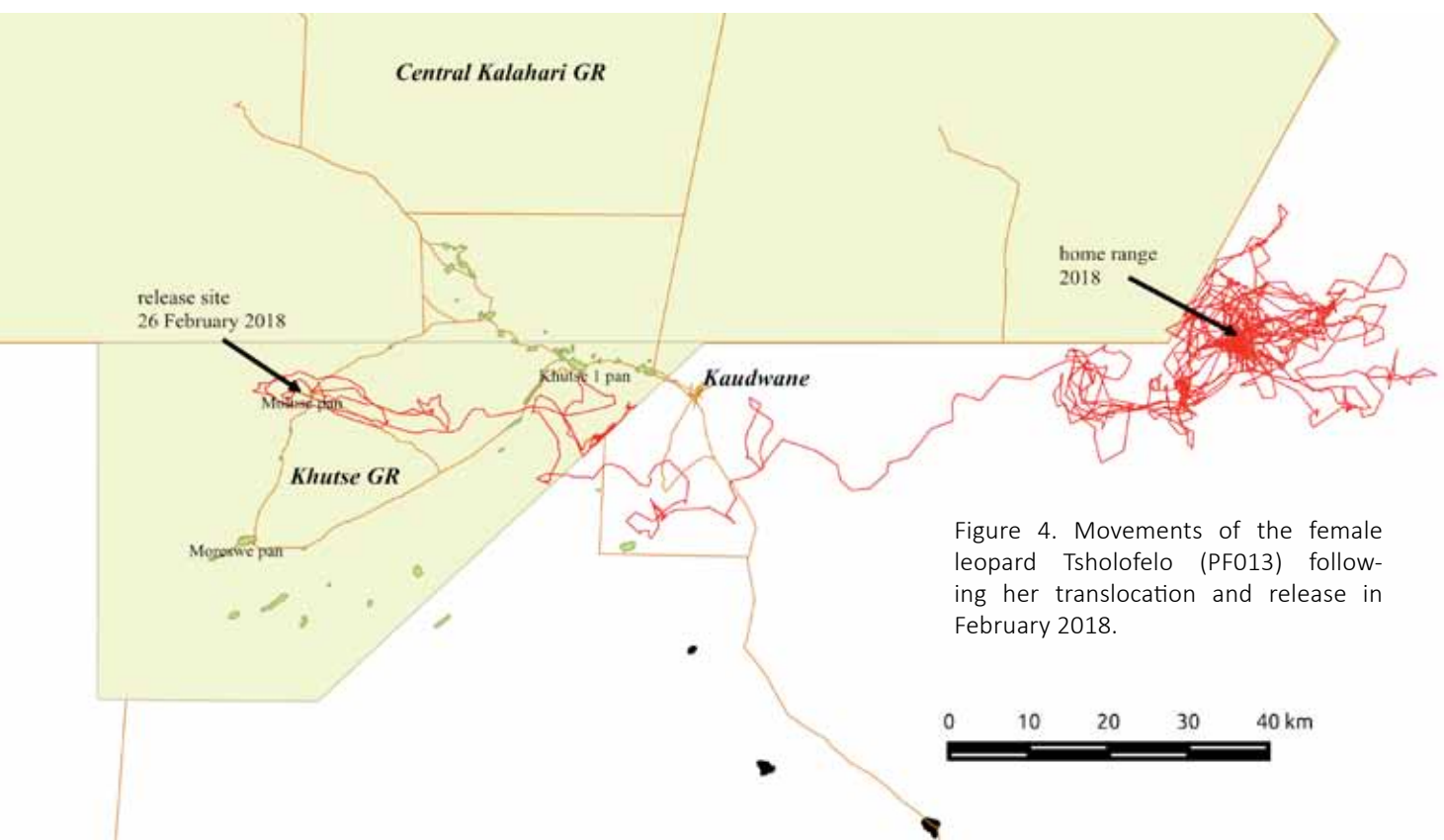


Figure 4. Movements of the female leopard Tsholofelo (PF013) following her translocation and release in February 2018.



Immobilised leopard. (Photo: Pogiso Ithuteng)

**Boiketo (PM030):** LEC received a report from DWNP on the 9th April that a male leopard had been trapped as a problem animal in the Machaneng area three days earlier (the area Tsholofelo was moved from six weeks earlier), and was to be translocated to Khutse GR. It was arranged to have the leopard immobilised and treated by a veterinarian at the DWNP regional Office, Molepolole. The leopard, Boiketo (Calm), was released later that day in the vicinity of Khutse 1 waterhole. Unfortunately, he left the Protected Area and was shot as a problem animal within a fortnight.

Four other leopards were translocated to Khutse GR in 2018, as part of DWNP's human-predator conflict mitigation strategy.

- On 8th September, a male leopard from Mabutsane area (south-west of Khutse GR) was released at the Ghukhama water hole.
- On 25th September, a leopard of unknown sex, caught three days earlier on Kombe Farms, Tuli Block area, and released near Khutse 2 pan.
- On 25th October, a young female leopard from Machwaneng area was released at Khutse 1 pan.
- On 3rd November, another male leopard

was translocated from the Machwaneng area to Khutse GR.

LEC was not informed prior to the arrival of these animals and so they were not collared. Where possible without unduly disturbing the animals, photographs were taken that may be used to identify them from spot and whisker patterns, but their movements subsequent to release are not known.

### Leopard Demographics

The extensive spoor counts, started in October 2017, continued until October 2018. These are a repeat of similar surveys carried out at intervals by LEC since starting the study of leopards in this area in 2001. Data from spoor counts undertaken in 2001–2002, 2007–2009, 2013–2014 and 2017–2018 reveal a substantial and sustained decline in leopard relative abundance over this period (Fig. 5). Leopard density inside the Protected Area declined from approximately 5 per 100 km surveyed in 2001–2002 to 1 per 100 km from 2013–2014. The 2017–2018 survey appears to suggest the population decline has slowed substantially, possibly stabilizing at a level comparable with that outside the Protected Area.



Vultures. (Photo: Pogiso Ithuteng)  
Leopard. (Photo Monika Schiess-Meier)

Another potentially interesting pattern to emerge from these data relates to seasonal relative abundance. When the Protected Area population was higher than outside (2001 to 2009), wet season population estimates were consistently higher than dry season estimates,

both inside and outside the Protected Area. However, from 2013, the pattern inside the Protected Area appears to have switched. Leopard abundance within the Protected Area is greatest in the dry season and decreases in the wet season. Furthermore, seasonal

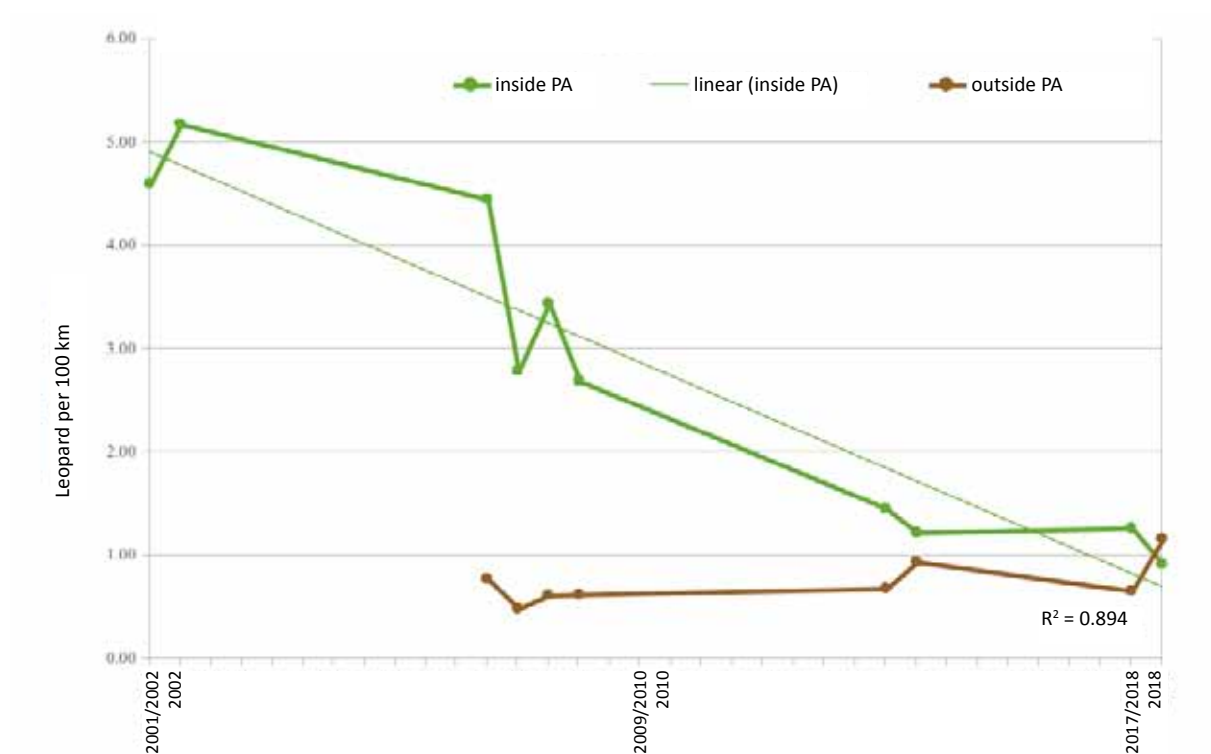


Figure 5. Leopard relative abundance as estimated through repeated spoor surveys within the Khutse GR – southern CKGR (PA = Protected Area) and adjacent livestock grazing lands (Outside PA). Data are averaged for wet season (year) and dry season (year-year) periods.





change in relative abundance inside and outside the Protected Area is similar. It is possible that there is a seasonal movement of leopards between the Protected Area and the adjacent grazing lands. This may reflect a changing relationship between the Protected Area and the grazing lands: previously Khutse GR was source population and the grazing lands a sink. However, since 2013 they are a shared population, with animals moving between them according to seasonal changes in resources. Given the growth in the human footprint, this has implications for the conservation of leopards in this region.

Using intensive spoor count data collected during the interval between the two extensive surveys (i.e. September 2014 to September 2017), Prof. Zucchini looked at the relationship between leopard relative abundance and rainfall (Research Box: Summary of LEC Spoor

Count Data). Unfortunately, the number of counts recording zero values was such that establishing reliable patterns in relative abundance was difficult and the relationship was ambiguous or weak.

### Leopard Predation

Based primarily on telemetry data from two collared individuals, Ronja and Tsholofelo, five leopard kills were recorded in 2018 (Table 2). Interestingly, despite Tsholofelo spending most of her time within the grazing lands, both of her kills were indigenous prey. The calf killed was attributed to an unknown male leopard. These predation data are separate from those collected through visits to the cattle posts, as these are heavily biased toward livestock predation report by herders.

Table 2. Leopard predation records for 2018. (A = adult)

Species	Total	A male	A female	A, sex unknown	Sub-adult	Juvenile
Cattle ( <i>Bos taurus</i> )	1				1	
Grey duiker ( <i>Sylvicapra grimmia</i> )	2		2			
Gemsbok ( <i>Oryx gazella</i> )	1					1
Black-backed jackal ( <i>Canis mesomelas</i> )	1	1				



Lion mating. (Photo: Pogiso Ithuteng)

## Lion Research

### Study Animals – Lion

Despite changes in the social landscape, LEC managed to continue monitoring the main groups by fitting collars to an adult female within each discrete group and the potential pride males or male coalitions. To this end, we collared three male lions as potential replacement pride males of the East Khutse and Molose prides. In 2018, we tracked three lionesses: Princess Fiona, an independent female, Notch from the East Khutse pride and Inca from the Molose pride; and seven adult males (Table 2 Appendix).

**Princess Fiona (LF009):** In April, Princess Fiona was found at a den with a litter of new born cubs. Three cubs later emerged and these are still alive at the end of the year. She continues to move independently of the two study area prides, although her home range overlaps to a degree with that of the Molose pride. In June–July, Princess Fiona was observed on kills with Snooks (LM073) and an uncollared male. In the past, she was regularly found with Mexico (LM007) when he was with the Molose group. Now that he has left, she is associating with the younger males from this group.

**Notch (LF018):** In the first half of 2018, Notch was seen with the four other adult

females of the East Khutse group, including Verity (LF012), and the 12 cubs born late in 2017. However, from August she was typically found with two cubs, apart from the rest of the group. If this fission of the group continues, we will need to collar another female to serve as the marker for the East Khutse pride. Notch’s collar failed prematurely in January, making it difficult to get resightings of her. We were able to replace the collar in August.

**Inca (LF043):** The Molose pride appears to have fragmented, and Inca, who was initially collared as a potentially dispersing female, has established a group with two other young adult females from the same age cohort as her. The older females from this pride have not been seen again, although there are occasional reports of other females in the Molose area. In September, Inca was found on a gemsbok kill with a young cub and the two other females of her group. They were displaced from this kill by Snooks (LM073) and his coalition partner. In December, she was found with the two other adult females and a juvenile between the game and stock fences that make up the eastern boundary of Khutse GR. They were being chased by an elephant. Snooks was nearby in the livestock grazing lands.

**Mexico (LM007):** Although having recovered from the injury that precipitated him leaving the Molose pride in 2016–2017, Mexico

Handling immobilised lion. (Photo: Pogiso Ithuteng)



did not return to his position as pride male. In February, he was shot as a problem animal at the Pelayaphokoje cattle post, south of Khutse GR.

**Orange (LM008):** Orange and his coalition partner Max (LM009) settled within the CKGR approximately 75 km north-west of the East Khutse pride home range. In March, following up on telemetry data, we found that the drop-off mechanism on his collar had fired prematurely. Given that he is in a well established coalition with another collared male, and they have moved north of our core study area, we decided not to invest time and finances in replacing the collar.

**Max (LM009):** Max and Orange (LM008) left the East Khutse pride and established a home range in the CKGR. Toward the end of the year, he suddenly abandoned this area and rapidly moved south, passing the area of his former home range. In late November, he was observed to be in poor condition. Within a fortnight he had died. There were no obvious signs of injury, disease or poisoning associated with the carcass.

**Innuity (LM033):** Telemetry data suggests that Innuity had dispersed from his natal pride area, Molose and settled in the south-western CKGR, and occasionally made forays out into the livestock grazing lands to the south.

Unfortunately, his collar failed prematurely in February. Given the remote location, he was last recorded in, we have not been able to resight him or his coalition partner Mathuba (LM039). We will continue looking for him and an opportunity to replace his collar.

**Snooks (LM073):** Snooks (named after Prof. Zucchini's son) was collared in February as one of a coalition of two young adult males expected to disperse from the Molose pride area. However, following the death of Mexico (LM007) and Patwa (LM011), these males have remained within their natal home range, and assumed the role of pride males. They were observed regularly associating with females from the Molose group and Princess Fiona (LF009). He is possibly a sibling of some of the Molose females. In addition to occupying a large part of the former Molose pride home range. Snooks frequently makes excursions into the livestock grazing lands east of Khutse GR, killing livestock before returning to the Protected Area.

**Peanut (LM074):** Peanut was collared in February when in our study area. We were aware of a young adult male that was occasionally encountered along the southern boundary of the CKGR. Subsequently, telemetry data confirm that his home range is centered in the south-eastern CKGR, in the vicinity of Sekaka. He is a potential replacement pride male for



Lion family. (Photo: Philipp Schiess)  
Lioness and African Wilddogs. (Photos: Pogiso Ithuteng)

the East Khutse pride, although to date he has not yet been observed in association with this group.

**Semariri (LM075):** Semariri (Hairy) was collared in August as a potential replacement pride male for Mexico, Max and Orange. However, he died two month later of an unknown cause.

### Lion Demographics

Despite the recent disruption to the Khutse lion society brought about by the departure of the males from both prides and the fission of the Molose group, the social landscape remains recognizable. Princess Fiona remains as an independent female in the south; Inca and her cohort of young adult females have established themselves in the central region; the East Khutse females remain in the northern part of the study area. The two independent prides remain centered on the perennial water sources at Molose and Khutse 1, while Princess Fiona's home range includes the Moreswe artificial waterhole. The Molose females were only known to have produced one cub in 2018, first seen in September. The East Khutse females have raised a large cohort of sub-adults: six males and two females. Princess Fiona produced three cubs in October. Three

study animals died in 2018, all of them older males. One was shot as a problem animal and the other two appear to have died of natural causes.

A review of the intensive spoor count data from September 2014 to September 2017 (Research Box: Summary of LEC Spoor Count Data) revealed no clear seasonal pattern in lion relative abundance. While rainfall clearly impacts on the quality and quantity of forage for herbivorous prey species, and consequently their distribution and behavior; apex predators appear to be responding more directly to other habitat drivers or population dynamics occur at a different temporal scale. Caroline Büttner, an MSc student at the University of Zurich, is studying the relationship between predators and key habitat variables, including rainfall, in greater detail.

### Lion Predation

We recorded 33 prey items in 2018 (Table 3). Two noticeable differences when compared to previous years are:

- the large number of wildebeest consumed (21% of prey items), such that wildebeest rank with hartebeest and gemsbok as the principle prey species, and



- the limited number of livestock consumed (3% of recorded prey items).

In the past, gemsbok have ranked as the principle prey, making up 38% of the diet in 2017 and 25% in 2016. Wildebeest were infrequent or absent from the list of prey items. Clearly, the translocation of wildebeest to Khutse GR was beneficial to the lion population.

The reduction in livestock consumed may be related to the loss of the older male lions

to our study population, and the dependence of the younger males on kills made by the females, who tends to be risk averse and not hunt within the grazing lands to the same degree as the males.

Two research projects were initiated in 2018 which will study predation in greater detail. Keitumetse Ngaka started his PhD study which will look at environmental correlates associated with lion predation and Dr Natalia Borrego began collecting data for her study of co-operative hunting behavior in lions.

Table 3. Lion predation records for 2018. (A = adult)

Species	Total	A male	A female	A, sex unknown	Sub-adult	Juvenile
Aardvark ( <i>Orycteropus afer</i> )	3	2		1		
Blue wildebeest ( <i>Connochaetes taurinus</i> )	7	3	2		2	
Cattle ( <i>Bos taurus</i> )	1	1				
Donkey ( <i>Equus africanus</i> )	2	2				
Eland ( <i>Taurotragus oryx</i> )	1	1				
Gemsbok ( <i>Oryx gazella</i> )	7	2	3	1	1	
Giraffe ( <i>Giraffa camelopardalis</i> )	1		1			
Horse ( <i>Equus ferus</i> )	1	1				
Kudu ( <i>Tragelaphus scriptus</i> )	2	2				
Red Hartebeest ( <i>Alcelaphus buselaphus</i> )	7	3	2	2		
Warthog ( <i>Phacochoerus africanus</i> )	1	1				



### Miscellaneous – Research

Genevieve Finerty's PhD programme is progressing and she is collecting data on trans-boundary movements of lion, predation and behaviour. As part of her research, Genevieve undertook a comparative study of the relative efficacy of trackers and camera traps in recording predator occurrence. She is currently collaborating with other biologists on a scientific publication on this topic. During this time, a serval (*Leptailurus serval*) was recorded on one camera trap. Khutse lies outside the known distribution and habitat range of serval. Genevieve has submitted this, along with other extralimital records to Cat News, the journal of the IUCN Cat Specialist Group. Furthermore, Genevieve is participating directly in LEC's research programme, and assisting with the processing of our data. With the support of her supervisors at the University of Oxford, she collated LEC's lion life history records, and developed a lion database during a three month internship.

Keitumetse Ngaka plans to submit his application to register for his PhD at the University of KwaZulu-Natal under the supervision of Prof. Craig Packer (University Minnesota), Prof. Rob Slotow (UKZN) and Dr Natalia Borrego (University Minnesota) in early 2019. Keitumetse's research will focus on lion and leopard predation patterns and associated

environmental drivers. The study is largely based on work undertaken by LEC and aligns with our research goals and aspirations.

After a visit to LEC by Prof. Craig Packer and Dr Natalia Borrego in July, Natalia began her field work in November to study co-operative hunting in lions. Natalia is the principle researcher in this collaborative project between LEC and the Lion Research Center, University Minnesota. Through funding from National Geographic, this project temporarily employed three additional San trackers to collect data. The study will complement Keitumetse's research project, so that resources and data can be shared.

In June, Larissa Meyer completed her MSc degree through the Department of Environmental System Science, ETH, Zurich. Her thesis, based on material provided by LEC and other collaborators was entitled "Occurrence of specific pathogens in free-ranging leopards (*Panthera pardus*) and lions (*Panthera leo*) in the Kalahari Game Reserves and farmland in Botswana". Larissa visited LEC's camp from October to December to work with our research team and to provide feedback on her study and its implications.

LEC is collaborating with Laura Perry, a post-graduate student from WildCRU, Oxford University. Laura is studying the impact of



livestock kraaling strategies on the predation across Africa. Her study integrates well with the MSc project of Tshepho Tsito (LEC staff member).

As part of her MSc project, Caroline Büttner visited LEC in December to familiarize herself with environmental conditions in this area and LEC data collection protocols. In collaboration with LEC, Caroline is studying the environmental correlates associated with lion and leopard movements in the CK region, through the University of Zurich.

In February and November, LEC undertook the annual BirdLife Botswana National Bird Population Monitoring survey. Two counts, one inside and one outside the Protected Area, were done each month as part of an ongoing countrywide monitoring programme. Ruth Gilchrist entered the data recorded by LEC member over the years into a digital database.

Two under-graduate students at the University of Zurich, Julia Frommelt and Isabel Flores Chemor, undertook a short study of giraffe behavior at Khutse GR waterholes using camera trap data provided by LEC.

Various requests for information and samples were submitted to LEC in 2018; including comment on patterns of intraspecific leopard

mortality recorded in Iran (Shadi Modares); a DWNP permit survey (Monika Morrison); the Lion Recovery Fund Conservation Footprint Survey (Ashley Robinson); sample material for a distribution-wide lion genome study being undertaken by the Program for Conservation Genomics, Stanford University.

LEC members attended various workshops and meetings:

- Botswana Biodiversity Symposium in Maun in February: Keitumetse Ngaka
- IUCN African Lion Working Group meeting in Skukuza, SA: Keitumetse Ngaka
- Workshop focused on the role of livestock guarding dogs in mitigating the human-predator conflict; hosted by Dr Gosiame Neo-Mahupeleng, from the Botswana University of Agriculture and Natural resources in August: LEC staff
- Meeting with staff and students from the University of Zurich to discuss current collaborative projects in August: Dr Steven Henley, Monika Schiess, Dr Nicole Gusset.
- Seminar on preliminary results at the University of Zurich in August: Genevieve Finerty.
- Workshop on modelling wildlife connectivity and the conservation implication thereof, co-hosted by WildCRU, Oxford University and DWNP in October: Genevieve Finerty and Dr Steve Henley

## RESEARCH BOX: SUMMARY OF LEC SPOOR COUNT DATA

Using data from intensive spoor counts, we sought to look for evidence of seasonal patterns in predator demographics and any relationship to rainfall.

Spoor counts were repeated monthly along one route (“A” 26 km) inside the Protected Area and another route (“3” 19 km) in the adjacent livestock grazing lands. In the period from 11 September 2014 to 28 September 2017 route A

was counted 102 times and route 3 96 times. Table RB1 lists the species detected along these routes during this period. To smooth the variable count data and account for the number of zero values, Generalized Additive Models for Location Scale and Shape (GAMLSS) (Rigby and Stasinopoulos 2005) were used, with a zero inflated Poisson (ZIP) distribution providing the best overall fit. To detect possible patterns the mean of the ZIP was modelled using a cubic smoothing spline.

Species	Route inside PA	Route outside PA
African wild cat ( <i>Felis lybica</i> )	13	7
Bat-eared fox ( <i>Octocyon megalotis</i> )	35	7
Black-backed jackal ( <i>Canis mesomelas</i> )	597	243
Brown hyena ( <i>Hyaena brunnea</i> )	198	163
Caracal ( <i>Caracal caracal</i> )	90	37
Cheetah ( <i>Acinonyx jubatus</i> )	66	2
Civet ( <i>Civettictis civetta</i> )	1	0
Honey badger ( <i>Mellivora capensis</i> )	36	5
Leopard ( <i>Panthera pardus</i> )	21	14
Lion ( <i>Panthera leo</i> )	51	0
Porcupine ( <i>Hystrix africaeaustralis</i> )	96	93
Wild dog ( <i>Lycaon pictus</i> )	10	11

Table RB1. The total number of individuals counted during the spoor counts from September 2014 to September 2017. PA = Protected Area

There were insufficient non-zero counts of leopard and lion along route 3 to establish a temporal pattern. Inside the Protected Area (route A) both species showed a fluctuation in relative abundance (Figures RB3a and b), but none clearly correlated with season or rainfall. Rainfall is an important

determinant of vegetation phenology and vigor, and consequently impact on habitat quality for most prey species, particularly in arid areas such as the Kalahari. Its relationship with predators appears to be less direct.



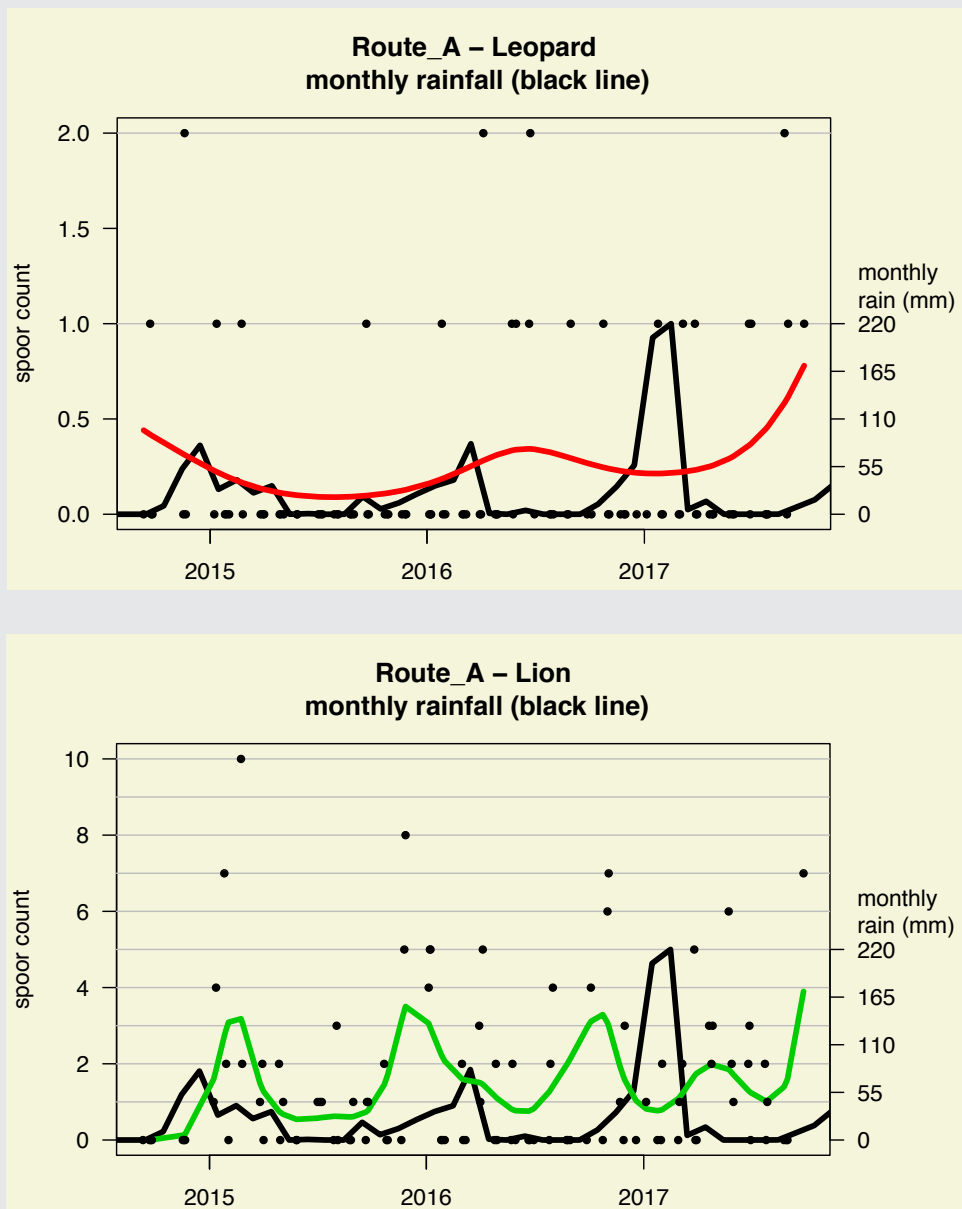


Fig. RB3a and b. Leopard and lion relative abundance within Khutse GR and its relationship with rainfall.

# EDUCATION AND COMMUNITY PROGRAMME

## Act Now for Tomorrow

The “Act Now For Tomorrow” education programme started in 2008 as a response to increasing human-carnivore conflict around the Khutse Game Reserve area. LEC selected seven cattle posts with the highest levels of conflict along Khutse GR and southern CKGR as its study area to implement the “Act Now For Tomorrow” Conservation education programme. The programme focused primarily on promoting co-existence of farmers with free ranging wild carnivores through improved livestock management, capacity building and conservation education. The programmes targeted at achieving two broad objectives:

- Develop an inclusive conservation education programme that promotes a balanced environment through sustainable and diversified land use.
- Empower participants through education and capacity building in the selected cattle posts so that they become knowledgeable and effective managers of all available resources.

For the purpose of identifying clear areas of focus, the “Act Now For Tomorrow”

education programme is sub-divided into two parts;

- the education projects and
- the community projects.

The education programme focuses on capacity building on animal husbandry and non-lethal predator management options in the selected seven cattle posts. The community programme focuses on conservation education through event based programs and small-scale projects in the villages of Kaudwane and Salajwe.

## Education Projects

The education projects in the seven cattle posts of LEC study area build capacity in herders and farmers in livestock management, non-lethal wildlife management and range management as a strategy to minimise the human-carnivore conflict in the area. Education projects such as the herders training course and the conservation horse race provide an alternative to reduce livestock predation opportunities, which is the basis of the conflict. In 2018, we continued to engage

Calves (Photo: Tshepho Tsito)



with farmers through weekly consultations to monitor livestock predation, to collect data on disease and livestock predation, and to monitor of implemented projects such as the hoof-trimming project. In collaboration with the local DWNP Problem Control office, we were involved in monitoring the presence of predators in the cattle posts through centralized reporting of spoor and sightings of predators to better understand the movement and abundance of problem carnivores in the area.

### Livestock predation

We collect livestock predation data to better understand how the human-carnivore conflict is evolving in the area and to give feedback to farmers, DWNP and other stakeholders to support informed decision-making. Patterns of livestock predation in LEC study area are shown in Figures 5 and 6.

Black-backed jackals (*Canis Mesomelas*), African lions (*Panthera leo*), leopards (*Panthera pardus*) and African wilddogs (*Lycaon pictus*) are primarily responsible for

the livestock losses over the last five years (2014–2018). A higher predation level by black-backed jackals was noted in 2015 when four leopards and one caracal were killed in the same area. Leopard predation is consistent over the 5-year period from 2014 to 2018.

Brown hyena (*Hyena brunnea*), Cheetah (*Acynonix jabatus*) and Caracal (*Caracal caracal*) predation patterns have been recorded as the lowest for the five-year period under study. In terms of livestock species, cow, calf and adult goat dominate the predated livestock species in LEC study area. In 2015, adult goat and goatling were higher than average of the entire predation level by all other livestock species. This was the same year when black backed jackal predation was at the highest. Heifer, adult horse and horse foal had least predation levels over the 5 years. We assume that the removal of large predators increases predation on small livestock by smaller carnivores such as jackal. Thus, we hypothesise that having a stable large carnivore population in an area might balance the impact of smaller carnivores which usually kill livestock in larger numbers.



Springbok and Oryx. (Photo: Pogiso Ithuteng)

### Livestock disease management

LEC sees livestock disease management as an important factor in the human-carnivore conflict around the Khutse area. We are interested in livestock diseases for three reasons:

- Sick livestock is more susceptible to predation than healthy livestock, so predation opportunities may increase when there is more unhealthy livestock.
- Carnivores scavenge on livestock that dies from disease and the dead livestock would be blamed on those carnivores, which perpetuates the conflict.
- We compare the livestock losses by carnivores with other causes of death.

In 2018, we recorded 30 cases of livestock that died from diseases. This is less than the recorded 34 cases from 2017 and the 42 losses in 2016. In comparison, we recorded 39 cases of livestock losses from carnivores in 2018. Although there is a reduction in the number of recorded cases in livestock losses from disease, we still encourage farmers to improve their disease management strategies during our weekly cattle post visits.

### Livestock management

LEC promotes sustainable livestock management as a predation mitigation measure. During weekly cattle post meetings with farmers, we encourage herders to herd livestock during the day, kraal livestock at night and build predator proof kraals to reduce predation opportunities.

### Herders Training Course

The herders training course project is a collaboration between LEC and BUAN. Its overall goal is to reduce human-carnivore conflict through capacity building (education and training) as a mean to assist farmers make informed decisions in managing available resources in their cattle posts.

The course trials and the accredited course will be delivered *in situ*. And it is categorised into three levels (basic, intermediate, advanced). So far, two course trials have been hosted at Kungwane cattle post as required by BQA. The last trial will be hosted during the first quarter of 2019. The accredited course is scheduled for October 2019.

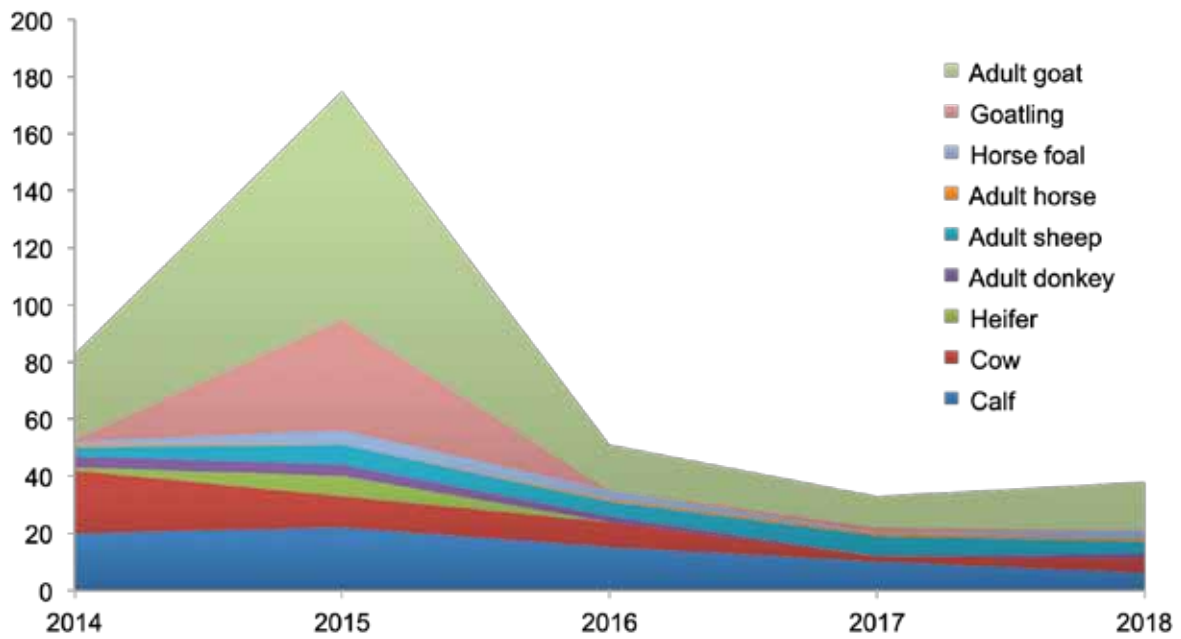


Figure 5. Livestock predation patterns from 2014 to 2018.

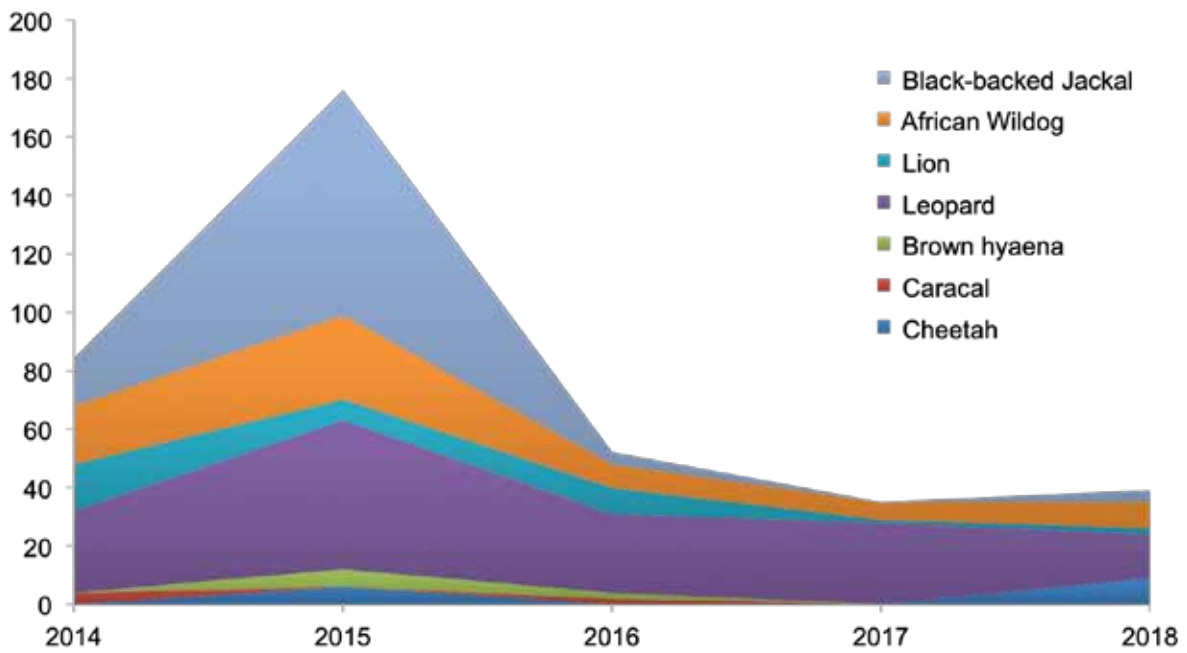


Figure 6. Number of kills by different predators from 2014 to 2018.



Participants Horse Race. (Photo: Pogiso Ithuteng)

## Community Projects

The Community programme helps LEC to consolidate its relationship with the community, while raising awareness about conservation issues affecting the community. In addition, the projects help to contribute to the improvement of livelihoods of community members through supporting various small-scale projects in the community such as commemoration of nationally recognized conservation related days.

Through these platforms, community members and farmers get an opportunity to interact and share ideas with LEC, and therefore, giving us the necessary feedback to customize our projects and improve success.

- **Horse race project**

Also the second LEC-Kaudwane horse race in September 2018, aimed to combine the event of a horse race with the promotion of good animal husbandry in the farming community. Good animal husbandry is a human-carnivore conflict mitigation measure, which promotes conservation as envisioned by LEC. We managed to achieve this aim as all the qualified horses had substantially

improved body condition certified by the farrier in his final assessment. In addition, farmers recorded no predation on registered horses throughout the entire period of livestock management. This is a positive development in our human-wildlife co-existence mission.

- **Kaudwane Primary School projects**

In 2018, the following projects were done by LEC at Kaudwane Primary School.

**Students city tour trip:** LEC organized a city tour for the most improved Kaudwane Primary School students. The objective of the trip was to motivate and reward students for the notable improvements in their studies and also to broaden the students understanding of life issues beyond Kaudwane village by exposing them to a different environment.

**Conservation club:** LEC started Kaudwane Primary School Conservation Club with the purpose of raising awareness on conservation issues in theory and in practice to children at a young age. During 2018, the club did activities such as litter

Students city tour trip. (Photo: Kefilwe Mokgwathi)



picking and creating items from waste material around the village. The students were taught topics covering different themes such as energy conservation and biodiversity conservation.

**School garden:** The school garden was built by LEC in 2002 to promote education with production and to help students get an opportunity to do agriculture practicals. LEC has been monitoring the progress on the garden in 2018. Feedback from the teachers about the performance of the garden and progress of students in their agriculture subject practicals was positive. However, occasionally, there are challenges with consistency in handing over the garden from one class to the next.

- **Hoof trimming project**

The Kaudwane hoof trimming project was started with the purpose of promoting healthy livestock herds as a way of minimising predation on livestock in the Kaudwane area. The project focuses on cutting overgrown hooves on livestock in Kaudwane and encourage farmers to

independently cut overgrown hooves on their livestock. The motivation behind this is to encourage farmers to kraal their livestock at night to minimise predation, as predators are mostly active during the night. Farmers also benefit from improved health condition of their livestock because of hoof trimming.

- **Itsoseng non-profit making shop**

Itsoseng non-profit making shop in Kaudwane has continued to support the welfare of Kaudwane residents by selling clothing to the residents of Kaudwane and use the proceeds from the shop to sponsor community projects in the village.

- **World Nature Conservation Day**

LEC commemorated the World Nature Conservation Day on the 29th of July 2018 at Kaudwane Kgotla. By commemorating the day, LEC aimed to open a platform to discuss conservation issues affecting the Kaudwane community and encourage co-existence with wildlife.

# MISCELLANEOUS

## Visitors

LEC hosted a number of visitors to camp in 2018, all of whom are contributing toward our research and conservation goals.

- Laura Perry from Oxford University visited camp in January to discuss our collaborative research and familiarise herself with local livestock management practices.
- Prof. Walter Zucchini returned to camp for two months in February-March to undertake statistical analyses of LEC data and assist our research staff and students.
- Tefo Gabanapelo, joined us in Khutse for the month of March. As a DWNP field officer and having worked with LEC previously, Tefo has extensive experience catching leopards. Despite investing a substantial effort, we were not successful.
- Prof. Craig Packer and Dr Natalia Borrego visited camp in July to discuss collaborative research and Keitumetse Ngaka's PhD project. Natalia returned in November to start data collection.
- Ruth Gilchrist joined LEC staff for two months from August to October. Given her experience in both research administration and field work, Ruth was well placed to assist with capacity building amongst our administrative staff. She also assisted with data collection and processing.
- Elicar Wagner, a long-term sponsor of LEC,

visited in September to be updated on our work and attend the Kaudwane Horse Race.

- Larissa Meyer, who recently completed her MSc degree based on material collected by LEC, visited camp for two months from October to December to transfer insights gained from her study of leopard and lion pathogens, interact with LEC staff and assist with our research programme.
- Caroline Büttner, a post-graduate student, visited camp in November to familiarise herself with environmental conditions and data collection protocols as part of her habitat modelling thesis.

## Administration

LEC continues to liaise closely with DWNP, Botswana's national conservation implementing agency to keep the Department informed of our research and conservation work and ensure that these remain relevant to the national conservation agenda. In particular, meetings were held regularly with Oganeditse Dintwa, the Manager of Khutse GR, and Johnson Lebotse, acting Manager during the period Ms. Dintwa was seconded to the Regional Head Office, as well as Phemelo Gadimang, the Head of Research and Statistics in the Department and Dr Michael Flyman who is now with the Ministry of Environment, Natural Resources Conservation and Tourism.





Night-time visitor. (Photo: Ruth Gilchrist)

## LEC Team

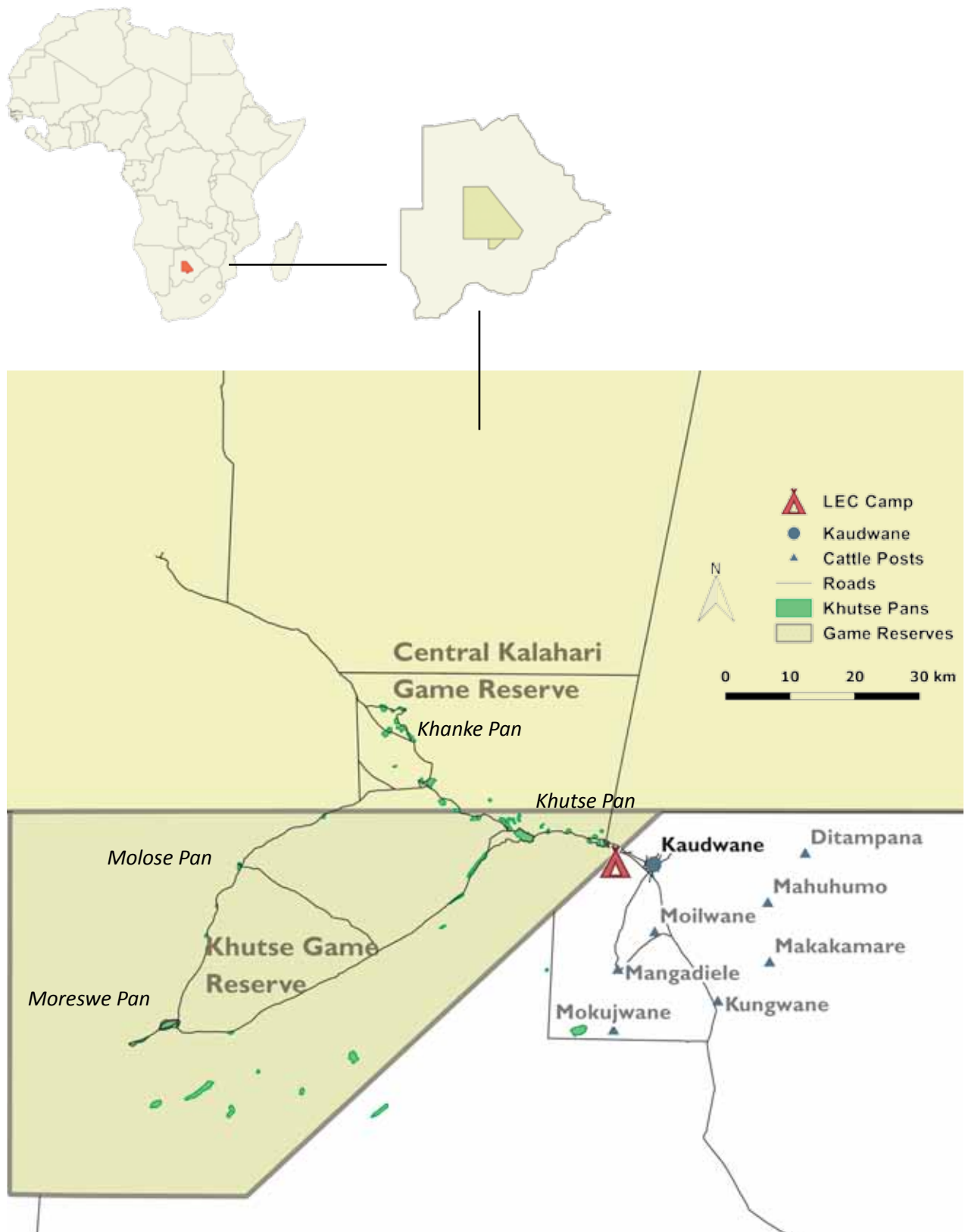
- Having recently retired from DWNP as a Senior Wildlife Warden, Tefo Gabanapelo joined LEC in May as the Community & Education Programme Coordinator. Tefo is a long-term contributor to LEC and a Trustee of the Khutse Leopard Trust. As an experienced conservationist who is familiar with LEC's vision and circumstances, we are grateful to have him join the team.
- Fabian Haas joined LEC in the second half of 2018. A former student collaborator with LEC and currently working with WWF. Fabian has joined LEC in Zurich on a part-time basis to assist managing the Community and Education Programme and establish a fundraising and datamanagement strategy.
- LEC sadly lost a member of staff in 2018. Having struggled with lymphatic cancer for some time, Bontle Raseme died on the 21st September. Joining LEC as tracker in 2011, Bontle showed interest and ability in working with vehicles and assumed responsibility for the maintenance of LEC's field vehicles. Sorely missed, he is remembered as an important and popular member of our team.
- In December, Sebakeng Gabotshwanelwe began maternity leave. Omponye Rabanya joined us as a temporary replacement.
- This year Pagiso Ithuteng (Africa) celebrated 15 years of employment with LEC. In

recognition of this anniversary, LEC hosted Africa and his family on a three day excursion to Gaborone in December.

## Infrastructure and Various

- Camp LEC developments in 2018 include:
  - the design and installation of a drip irrigation system in our vegetable garden by Kobe Majafe. The new system has worked well and experience suggests that it is substantially more efficient compared with watering by hand.
  - LEC acquired an additional research vehicle, a 2013 Land Cruiser double-cab, in March to be used by Keitumetse Ngaka and students.
- In February, Radio Botswana interviewed Tshepho Tsito and Keitumetse Ngaka about LEC's research and conservation efforts
- In August, we were visited by DWNP and a delegation of Ugandan Wildlife Officers they were hosting.
- In October, LEC was approached by two scholars from Westwood International School, Gaborone who wanted to undertake a conservation related IT project. LEC assisted with information and guidance. In return the scholars raised funds which they donated to LEC.

# APPENDIX I



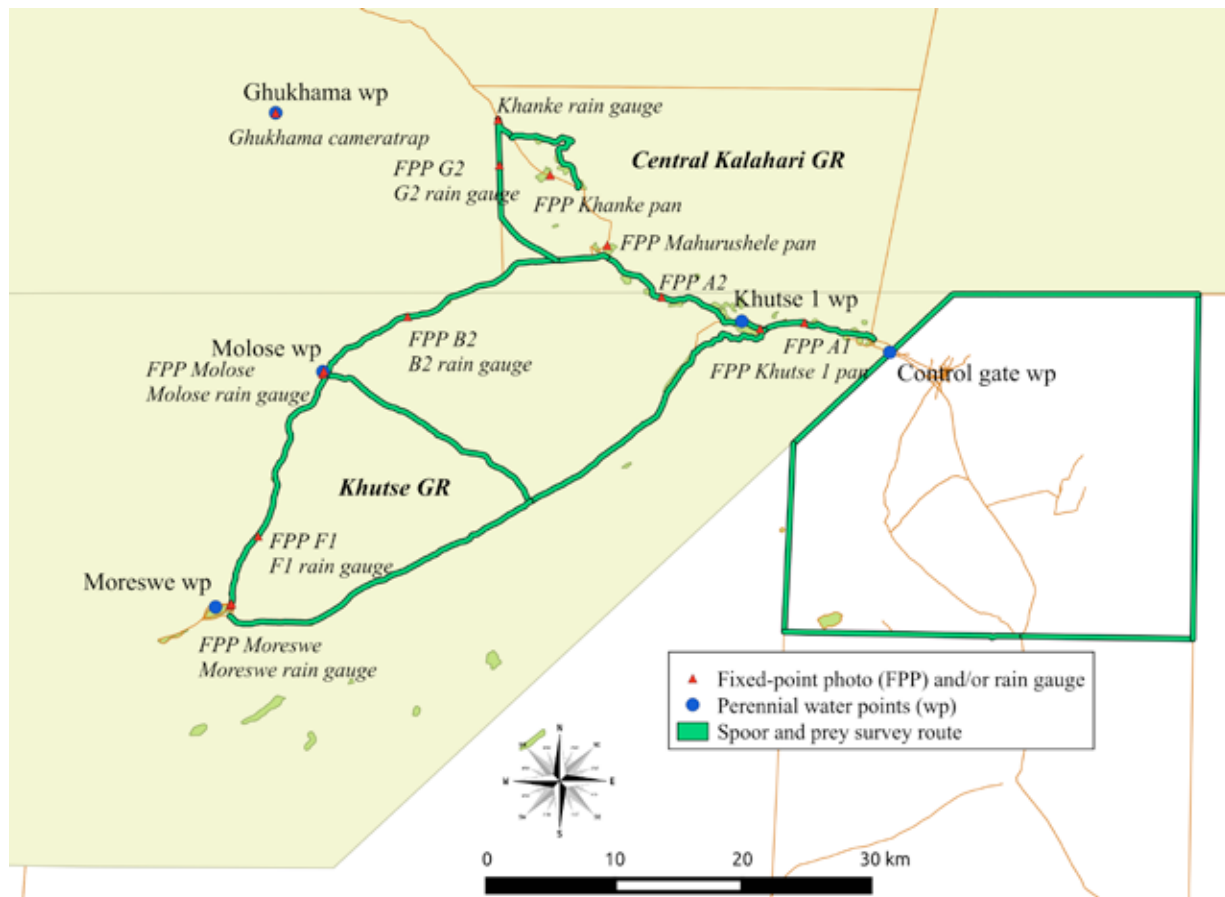
Map of Khutse Game Reserve, southern Central Kalahari Game Reserve and adjacent communal lands.

Table 1 Appendix. Leopard Telemetry. Animals monitored by LEC during 2018.

ID	name	first collared	status
PF007	Ronja	28 July 2008	collar replaced 20 March; died September
PF013	Tsholofelo	26 Feb 2018	
PM029	Legadima	2 June 2018	collar failed, recovered October
PM030	Boiketo	9 April 2018	shot April

Table 2 Appendix. Lion Telemetry. Animals monitored by LEC during 2018.

ID	name	first collared	status
LF009	Princess Fiona	18 April 2011	collar replaced 7 August
LF018	Notch	6 June 2013	collar replaced 7 August
LF043	Inca	17 March 2016	
LM007	Mexico	21 Sept 2012	shot 4 February
LM008	Orange	29 Nov 2012	collar recovered 5 March, not replaced
LM009	Max	15 Dec 2013	collar replaced 7 February; died December
LM033	Innuvit	17 March 2016	collar failed
LM073	Snooks	8 Feb 2018	collared 8 February
LM074	Peanut	8 Feb 2018	collared 8 February
LM075	Semariri	7 Aug 2018	collared 7 August; died October



Habitat monitoring map showing the locations of FPP and rain gauges and the route of spoor and prey survey.

## APPENDIX II

### The Leopard Ecology & Conservation Team

- Monika Schiess-Meier, MSc Zoology, founder and managing director, University of Zurich, Switzerland
- Dr Stephen Henley, PhD, field coordinator and researcher, South Africa
- Dr Nicole Gusset, PhD, project management, University of Zurich, Switzerland
- Phana Segametsi Kegakilwe, BAcc, administration, Botswana
- Tefo Gabanapelo, community and education programme coordinator, Botswana
- Fabian Haas, MSc, education programme and data management, Fundraising, Switzerland
- Tshepho Tsito, BBA, education and community programme officer, Botswana
- Kefilwe Mokgwathi, BBA, education assistant, Botswana
- Keitumetse Ngaka, MSc, researcher, Botswana
- Tshoganetso Ernest Gagosimologe, graphic designer, assistant camp and shop interim manager, Botswana
- Keolebetse Otukile, education & community liaison, Botswana
- Doris Barouk, MA Social Behavior Science, monitoring and evaluation, Germany
- Sylvia Senz, lic. phil.I, public relations, Switzerland
- Marianne Köpfler, administration, University of Zurich, Switzerland
- Pogiso Ithuteng, field research assistant, tracker supervisor, Botswana
- Phalatsa Nkadima, Supula Monnaanoka,

Mosepele Mamou, Sokwa Puridaroma: tracking, Botswana

- Bontle Raseme, vehicle maintenance, Botswana
- Kobe Majafe, camp maintenance, Botswana
- Goitseone Ithuteng, Sebakeng Gabotshwanelwe, Neo Mosikare: camp staff, Botswana
- Ngwanyana Kefeletswe, shop, Botswana
- Tebelelo Gabaikanye, camp administration and shop assistant, Botswana
- Onthusitse Kelatlhegile, Kelatlhegile Pulaekae: animal husbandry project, Botswana
- Masente Ithuteng, camp maintenance & vehicles assistant, Botswana
- Ditshupo Kegakilwe, housekeeping, Botswana
- Ronald Mpofu, garden maintenance, Botswana
- Genevieve Finerty, research biologist, UK
- Philipp Schiess, IT specialist, Zurich, Switzerland
- Joshua Pata, administrative assistant, Botswana

### The following people are involved in LEC

Research support and collaboration (leopard and lion behaviour, population genetics and health)

- Prof. Barbara König, Department of Evolutionary Biology and Environmental Studies, UZH, Switzerland
- Prof. Craig Packer, Department of Ecology, Evolution and Behavior, University of



Warthogs. (Photo: Pogiso Ithuteng)

- Minnesota, USA
- Prof. Regina Hofmann-Lehmann, Clinical Laboratory, Vetsuisse Faculty, UZH, Switzerland
- Prof. Robert Weibel, GIS, UZH, Switzerland
- Dr Natalia Borrego, Department of Biology, American University Cairo, AUC, Egypt
- Dr Rob Jackson, project veterinarian, Botswana
- Dr Gosiame Neo-Mahupeleng, Wildlife Ecology lecturer, Botswana University of Agriculture and Natural Resources, Botswana
- Prof. Walter Zucchini, Department of Economic Sciences, Georg August University Göttingen, Germany

Support in Botswana (permits, information and logistics)

- Hon. Kitso Mokaila, Minister of Environment, Natural Resources Conservation and Tourism
- Major General Otisitsew B. Tiroyamodimo, Director, DWNP
- Dr Cyril Taolo, Deputy Director, DWNP
- Dr Michael Flyman, Ministry of Environment, Natural Resources Conservation and Tourism
- Dr Phemelo Gadimang, Chief Wildlife Officer, DWNP
- Mrs Oganeditse Dintwa, Park Manager, Khutse Game Reserve
- Dr Mmadi Reuben, Principal Veterinary officer, DWNP
- Dr Mmolotsi Dikolobe, Veterinary Officer, DWNP

- Special Support Group (SSG), Khutse Base Camp, Botswana
- Regional Wildlife Officer Molepolole, Botswana
- Department of Veterinary Services, Letlhakeng

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- Christine Kämpf (chair) Switzerland
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Elefant family. (Photo: Pogiso Ithuteng)  
Starling. (Photo: Monika Schiess-Meier)

- Dieter Gutmann, Germany
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#### **Khutse Leopard Trust**

- Monika Schiess-Meier (Chair), Switzerland
- Doreen Khama, Botswana
- Tefo Gabanapelo, Botswana

#### **LEC Trust**

- Monika Schiess-Meier (Chair), Switzerland
- Dieter Gutmann, Germany
- Fritz Schiess, Switzerland
- Steve Henley, South Africa

#### **Educational Project (ANFT) Steering Board**

- Chief Scientific Officer (ruminants), Department of Animal Production, Botswana
- Chief Wildlife Officer, Community and Extension Services, Department of Wildlife and National Parks, Botswana
- Deputy Director, Department of Veterinary Services (disease control), Botswana
- Chief Forest Resources Officer, Department of Forestry and Range Resources, Botswana
- Kweneng Land Board Secretary, Botswana
- LEC, Education Programme Officer (Tshepho Tsito), Botswana
- Khutse Leopard Trust (Monika Schiess-Meier, Doreen Khama and Tefo Gabanapelo),

#### **Botswana**

- Farmer representatives (Pako Keokilwe and Boometswe Mokgothu), Botswana
- Edwin Dintle, former Land Registration Officer of Rolong Land Board (now with Botswana Housing Corporation), Botswana

#### **Collaborating Institutions from Botswana in 2018**

- Department of Wildlife and National Parks
- Community of Kaudwane
- Kaudwane Primary School
- Botswana University of Agriculture and Natural Resources
- University of Botswana, Botany Department
- Cheetah Conservation Botswana
- Kalahari Research and Conservation
- Tau Consultants
- BirdLife Botswana
- Village Extension Team and Village Development Committee (Kaudwane)
- Thapong Visual Arts Centre
- Kuanghoo Community Trust
- Letlhakeng Sub-District Council

#### **Scientific Publications, Workshops & Media**

- Zehnder, A., Henley S. and Weibel R. 2018. Home ranges of lions in the Kalahari, Botswana exhibit vast sizes and high temporal variability. *Zoology*, 128: 46-54.
- Haas, F., Schiess-Meier, M., Keller, L. and König, B. 2018. Genetic insights: diversity,



population structure and migration of Kalahari lions. 3rd Annual Meeting in Conservation Genetics, Vienna.

- Meyer, L. 2018. Occurrence of specific pathogens in free-ranging leopards (*Panthera pardus*) and lions (*Panthera leo*) in the Kalahari Game Reserves and farmland in Botswana. MSc thesis, Veterinary Faculty, UZH.
- Botswana Diversity Symposium, Maun
- IUCN African Lion Working Group, Skukusa, SA
- Radio Botswana 1: Herders Training Course
- Radio Botswana 1: Commemoration of World Nature Conservation Day
- Radio Botswana 1: Horse Race project
- "ANFT" Steering Committee meetings
- Schools Conservation Debates, Mochudi, Botswana

#### Workshops in Botswana:

- The role of livestock guarding dogs in mitigating the human-predator conflict
- Modelling wildlife connectivity and the conservation implications thereof
- Conservation and Education
- Farmers Training, Kaudwane
- Rhino Horn illegal Trading

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