



# THE AFRICAT FOUNDATION



**The assessment of leopard (*Panthera pardus*) density and population size via a capture – recapture framework in an island bound conservation area in Namibia.**

## **UPDATE AND PROGRESS REPORT**

After the initial and in-depth assessment of the leopard population in the Okonjima Nature Reserve via the use of remote camera traps that provided a detailed insight of their demography as well as temporal and spatial distribution patterns, a long-term monitoring program has been introduced. This aims to observe and monitor fluctuations in the composition of the population, as well as shifts and overlaps of home ranges and territories.

### **AIM OF THE STUDY**

To assess the density and population size of leopards (*Panthera pardus*) in the Okonjima Nature Reserve using photographic capture-recapture sampling and provide scientific data on their demography as well as spatial and temporal distribution patterns.



## STUDY OBJECTIVES

1. To determine leopard density and population size via a capture-recapture framework using remote camera traps.
2. To determine the demography of leopards within the Okonjima Nature Reserve.
3. To develop a dataset that can be applied as a baseline for comparisons to similar areas.
4. To develop a long - term population-monitoring programme.

## FIELD METHODS

A camera trap survey was conducted in the study area for 250 days from July 2015 – May 2016. The 20 000 ha Okonjima Nature Reserve was sub-divided into five approximately equally sized blocks of 40 km<sup>2</sup> (36.9 km<sup>2</sup> ± 5.1 km<sup>2</sup>). Each sub-block was sampled sequentially for 50 continuous days and was monitored by a set number of remotely triggered flash cameras (Cuddeback Triple Flash, model C123). The number of cameras used was proportional to the size of each sub-block resulting in 95 camera trap stations in an effectively sampled area of 184.6 km<sup>2</sup> over the entire study period.



A preliminary inspection of the study site was implemented in order to identify suitable camera trap locations. Geographic Position System (GPS) points were taken of every trap site and transferred onto a Google earth satellite map. To enhance accuracy of abundance estimates and to increase the number of leopards being photographed, camera traps were preferably placed in areas that suggested an elevated frequency of leopard occurrence such as dry riverbeds, riverbanks and/or frequently used roads and pathways.



An inter-trap distance of  $1.6 \text{ km} \pm 0.13 \text{ km}$  was maintained throughout all five blocks to ensure a complete and regular coverage of the study area and to maximize the capture frequency.

Baited camera stations were used to increase leopard capture frequency. Tall trees at each trap site were selected and baits positioned approximately 1.5 – 2.5 metres above the ground to prevent theft from other carnivores. A single camera trap was placed two to three metres perpendicular to the branch on which the leopard was expected to occur to access the bait. Cameras were housed in a protective case (CuddeSafe®) to prevent cameras from wildlife damage. Baits were fastened with double wound wire to ensure that leopards don't remove bait and feed out of sight. Once triggered, a single camera trap took a series of three consecutive photographs, followed by a delay of six seconds until it was able to trigger again. Cameras were serviced once a week in order to verify battery status, change of SD cards, renew bait and to ensure the correct functionality of each trap.

Photographs from each trap site were evaluated and leopards were identified via their unique spot patterns. Each individually identified leopard was assigned with a unique identification number and sex and age class were recorded.





## SUMMARY OF RESULTS OF LEOPARD POPULATION ASSESSMENT STUDY 2016 / 2017

Tab 1: Summary of study statistics “Leopard density study 2015/2016”

Survey period	24 July 2015 – 11 May 2016
Size of sampling area	184.6 km <sup>2</sup>
Number of camera trap stations	95
Number of sampling occasions	250
Sampling effort (trap nights)	4,566
Total number of leopard captures	457
Number of identified individuals	36

Leopards were present throughout the entire sampling area. The total sampling effort accumulated 4,566 trap nights and resulted in a total number of 36 captured leopards including 29 adult leopards (14 females, 15 males) and seven dependent juvenile leopards ( $\leq$  18 months). Leopards were captured a total of 457 times expanded over 250 trapping occasions. Capture frequencies ranged from 1 - 27 captures per individual leopard ( $12.1 \pm 8.1$ ). Female capture frequencies showed an overall higher capture frequency  $15.7 \pm 7.3$  within their demographic class when compared to male capture frequencies ( $12.0 \pm 8.5$ ). 14 of the captured 29 adults were fitted with radio collars at the time of capture; equivalent to the total number of collared leopards in the reserve, indicating a 100% detection rate for all collared individuals via the use of remote camera traps.

Leopards were photographed at 90 out of the 95 camera stations. Density was calculated 19.5 leopards/100km<sup>2</sup>.

Average male home range size was  $21.7 \text{ km}^2 \pm 10.1 \text{ km}^2$  compared to the average female home range size of  $8.9 \text{ km}^2 (\pm 4.3 \text{ km}^2)$ . Range overlap was observed between and within sexes. Overlap within sexes mainly occurred by dispersing sub-adults in search for territory or offspring that often remains within their natal range.





Home range size varies highly in Sub-Saharan Africa depending on resource availability ranging from 0.5 to 23.8 animals/100km<sup>2</sup> (Stander, 1997). High resource availability and the presence of a boundary fence surrounding the reserve are leading factors resulting in comparably smaller home ranges of the sampled population.

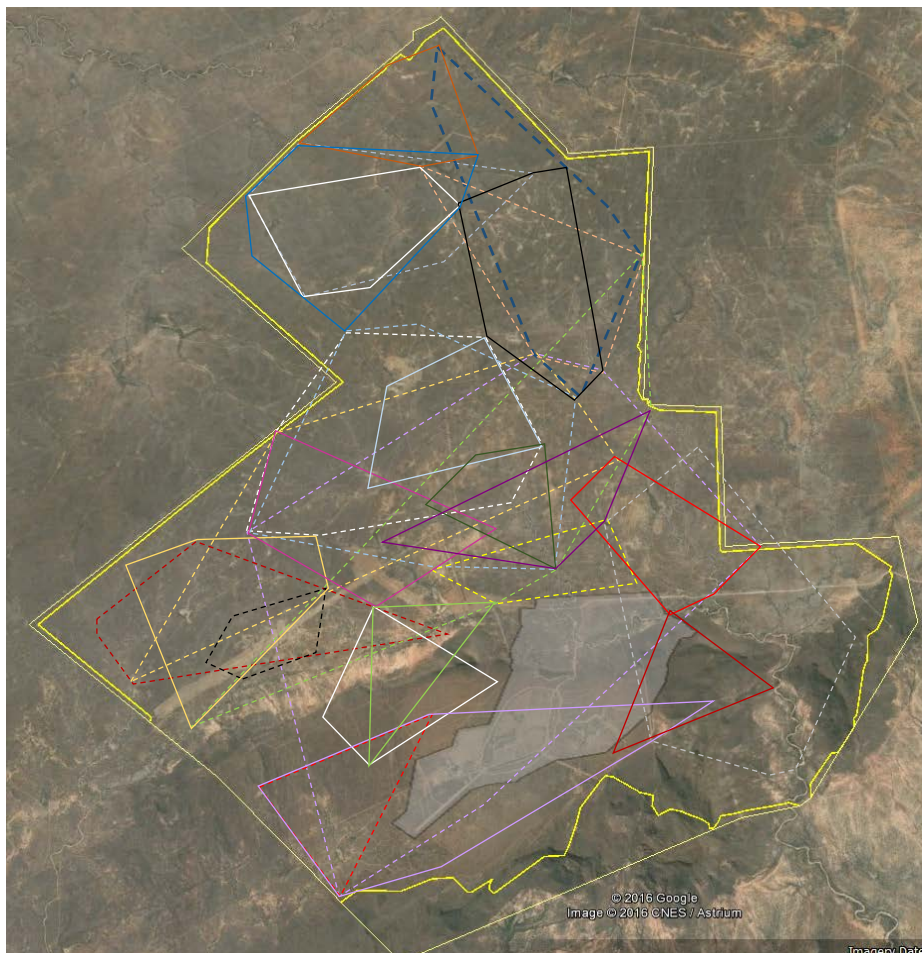
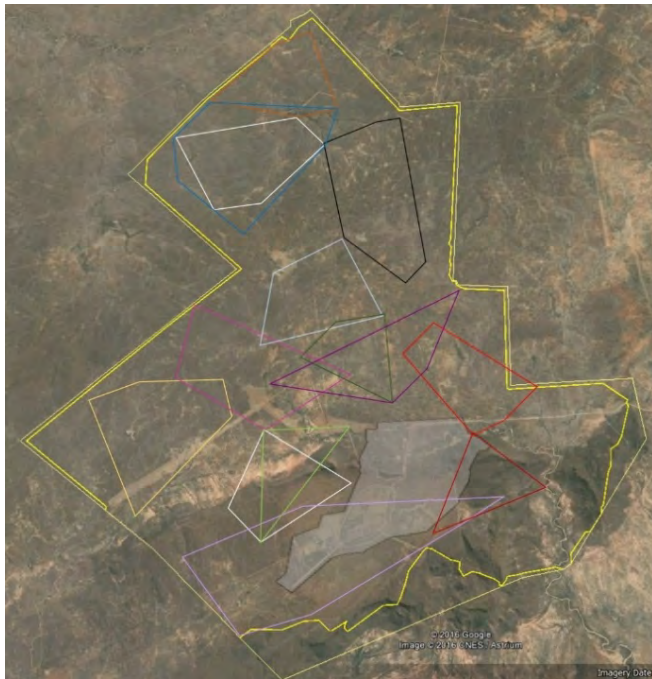


Fig. 1: Female (top left) and male home range overlap (top right). Overlap occurred within sexes and between sexes (bottom). Within sex overlap was mainly observed in dispersing sub-adult males in search for territory or offspring that often remains within their natal range. All male home ranges overlapped with at least one female home range.

Home range estimates were calculated using the 100% minimum convex polygon (MCP).

## ***The next phase: A leopard long-term monitoring programme***

In order to observe and monitor dynamics in the composition of the resident leopard population as well as shifts in home ranges and territories, a long-term monitoring programme has been established. For the correct management of an island-bound conservation area, it is fundamental to identify changes in the size and composition of population numbers and to evaluate population trends in terms of resource availability, competition and spatial organization. The Okonjima Nature Reserve (200 km<sup>2</sup>) is fully surrounded by an electrified predator proof fence, which creates an enclosed conservation area that protects resident carnivores from all-surrounding farmland on which they'd stand a high chance of human persecution. Fencing provides an important tool in conservation in limiting the loss of livestock due to carnivores and thus persecution, in response to livestock predation. However, effective fencing also restricts natural dispersal patterns of carnivores and causes differences in their ecology and behavior when compared to their free-ranging counterparts and ultimately might lead to inbreeding, a decline in genetic diversity and local extinction if not managed correctly. To effectively manage carnivores within a closed reserve, a thorough understanding of their altered ecology is needed to make informed and sustainable management decisions.

### **FIELD METHODS**

Camera traps (Cuddeback Color, Model 1279) are used as a non-invasive tool to observe and investigate the leopard population as well as to identify core areas of occurrence.

For the long-term monitoring programme, 24 cameras are currently arranged in a regular grid in order to cover the majority of the 200 km<sup>2</sup> Okonjima Nature Reserve. To enhance accuracy of abundance estimates, cameras are placed in locations that suggest an elevated frequency of leopard occurrence (e.g. riverbed, riverbanks and/or frequently used roads, paths, crossing, etc.). Camera positions are permanent, but will be changed if no or little leopard activity is recorded or if signs of familiarization with bait location are noticeable.

As with the previous survey, a baited approach is the preferred method to capture leopards. Cameras are installed in the same manner as described above. Because camera traps have the advantage to not only record the target species, data from camera traps set up for the detection and identification of brown hyenas (Sarah Edwards: Behavioural ecology and management-induced niche shift of brown hyena in a closed reserve; implications for conservation management.) are used additionally for data collection.

Cameras are serviced every one to two weeks to ensure the correct functionality of the camera, check of the battery status, change of SD-cards and the renewal of the bait.





Fig. 2: Current camera trap position in 200 km<sup>2</sup> Okonjima Nature Reserve.

### **PRELIMINARY RESULTS SEPTEMBER 2017 – JUNE 2018**

After 10 months of deployment, camera traps revealed the presence of 31 individuals including 15 males, 15 females and one individual of unknown gender resulting in a density of 16.8 individuals/100km<sup>2</sup>.

In a closed population, fluctuations in population numbers are resulting from deaths and births only.

Since the initial survey in 2015/2016, previously documented individuals have died and new cubs have been born. Leading cause of mortality was intraspecific competition (n=6), one female leopard died after being stabbed by a warthog and two leopards died due to indeterminable reasons.

Because inter-trap distances are larger than during the initial survey, chances are higher that individuals are moving in between traps sites without being captured; thus a current absence of previously captured animals does not inevitably imply that an individual has died or is actively absent.

All newly recorded animals are individuals that were born in the reserve. In total 12 juvenile and sub-adult leopards were recorded. During this stage of the study no new adult leopards have been captured on camera.

Tab. 2: Record of individually identified leopard captured on camera during the present survey (2017/2018) and previous survey (2015/2016).

ID	Gender	Leopard Density	
		2015/2016	2017/2018
Pp 1	F	x	x
Pp 2	F	x	
Pp 3	F	x	
Pp 4	F	x	x
Pp 5	F	x	x
Pp 6	F	x	x
Pp 7	M	x	x
Pp 8	M	x	
Pp 9	M	x	
Pp 10	M	x	x
Pp 11	M	x	
Pp 12	M	x	x
Pp 13	M	x	
Pp 14	F	x	
Pp 15	M	x	
Pp 16	F	x	x
Pp 17	F	x	
Pp 18	F	x	x
Pp 19	M	x	
Pp 20	M	x	
Pp 21	F	x	
Pp 22	M	x	
Pp 23	F	x	
Pp 24	M	x	
Pp 25	M	x	x
Pp 26	F	x	x
Pp 27	M	x	



Pp 28	M	x	x
Pp 29	F	x	x
Pp 30	M	x	x
Pp 31	M	x	
Pp 32	F	x	x
Pp 33	F	x	x
Pp 34	F	x	x
Pp 35	M	x	x
Pp 36	M	x	x
Pp 37	M		x
Pp 38	M		x
Pp 39	M		x
Pp 40	M		x
Pp 41	F		x
Pp 42	M		x
Pp 43	F		x
Pp 44	F		x
Pp 45	M		x
Pp 46	M		x
Pp 47	F		x
Pp 48	unknown		x



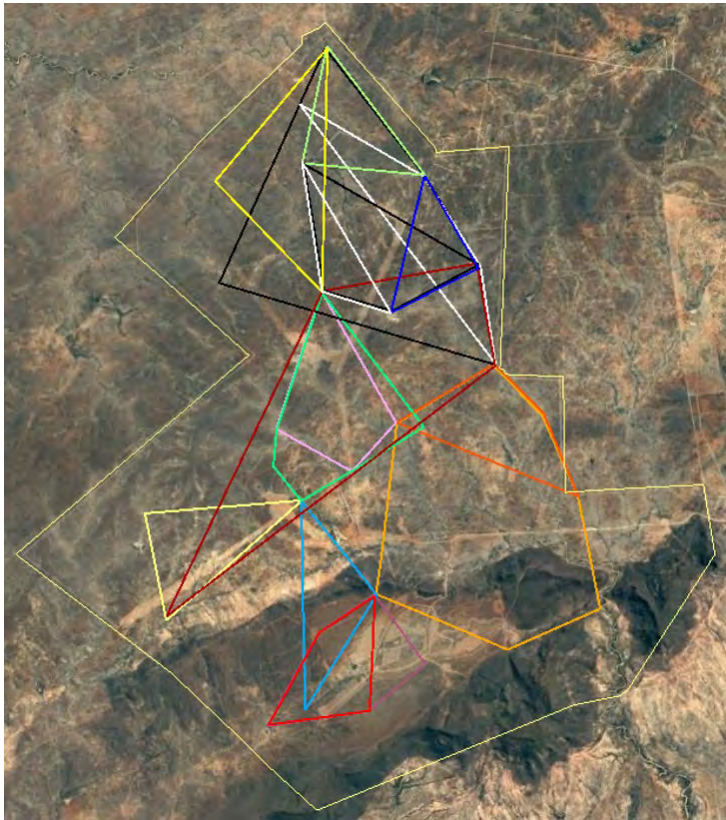
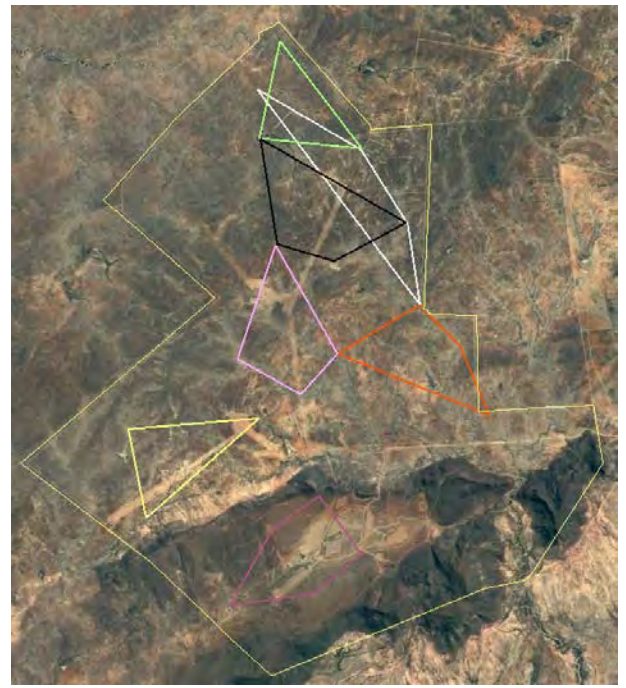
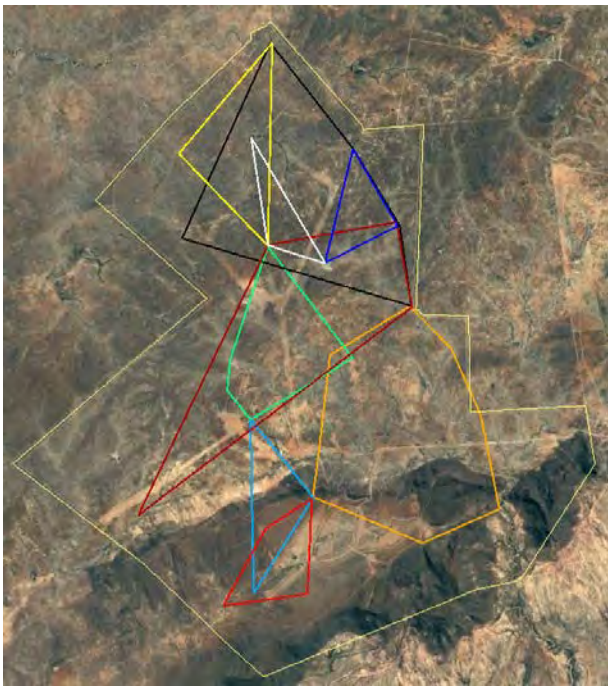


Fig 3: 100% MCP female (top left) and male (top right) leopard home ranges and overlap of male and female home ranges (bottom) based on camera trap data. Only individuals with  $\geq 3$  recorded locations were used for the analysis.



Male home ranges were found to be variable within their demographic class ( $15.6 \pm 13.4 \text{ km}^2$ ) and more than twice the size than female home range size ( $7.8 \pm 1.3 \text{ km}^2$ ). Home range size of male individuals has decreased by 28 % when compared to the initial study from 2015/2016. Possible explanations include a smaller sample size compared to the previous survey (2015/16:  $n = 14$ ; 2017/18:  $n = 9$ ), four out of the nine male individuals are sub-adult individuals who haven't migrated from the natal range in search of territory yet and a lesser number of cameras with a larger inter-trap not displaying the true extent of each individuals' home range size.

