

**AERIAL COUNT OF THE ROAN ANTELOPE  
AND OTHER WILDLIFE SPECIES IN KHAUDUM NATIONAL PARK**

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# KHAUDUM NATIONAL PARK

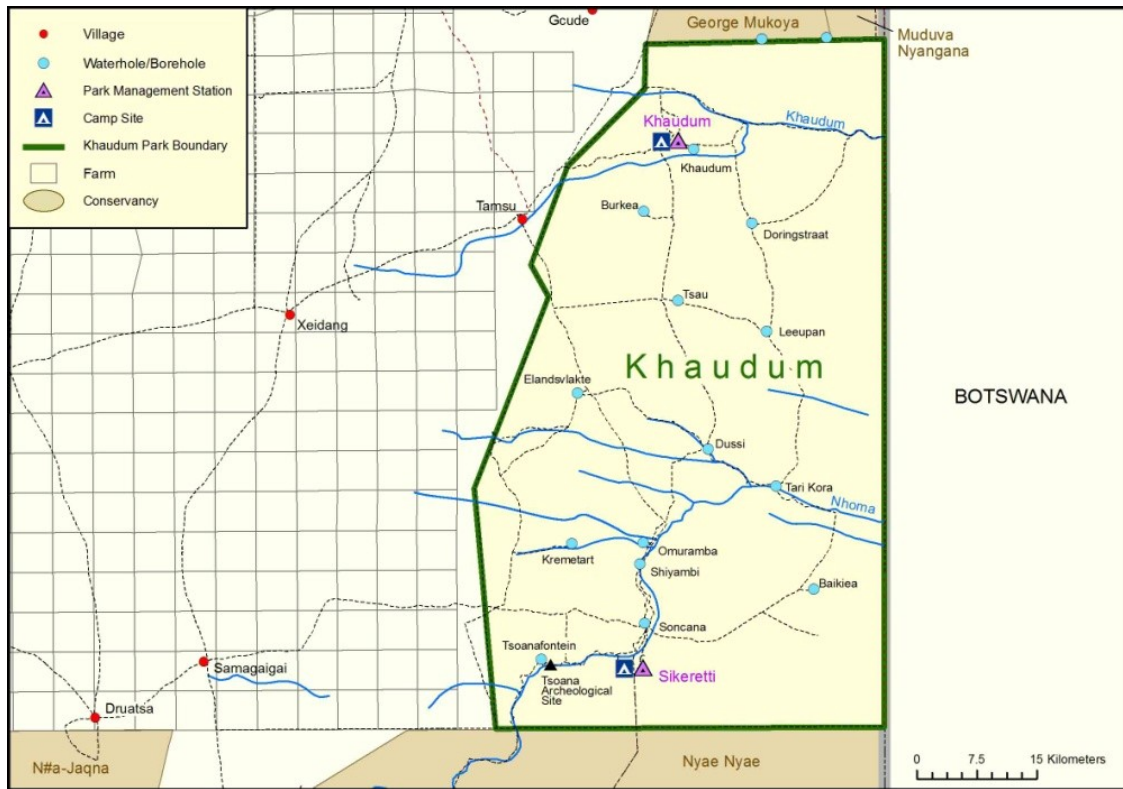
## INTRODUCTION

Khaudum National Park (KNP) covers some 385,000 ha of Kalahari Sandveld in the north-eastern part of Namibia. The reserve protects northern Kalahari Sandveld and provides refuge for threatened species such as roan, tsessebe, African wild dog as well as other species, including elephant.



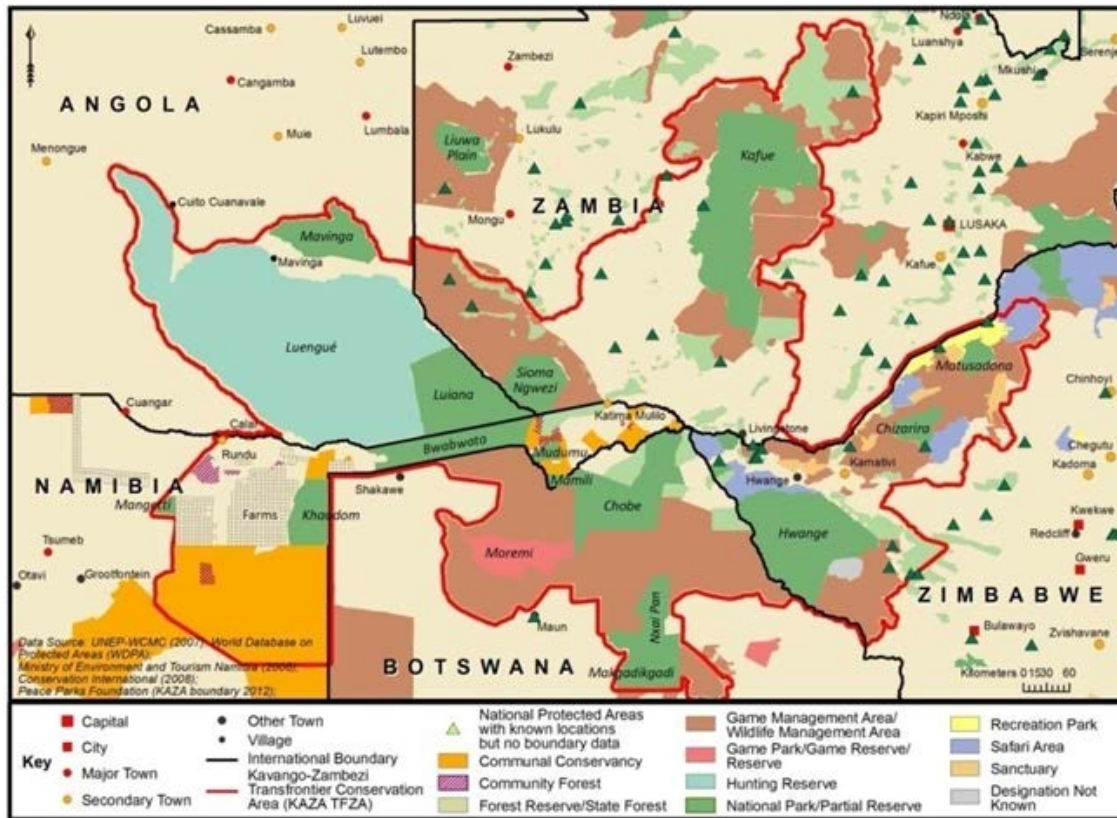
**Figure 1.** Khaudum National Park is located in the Kavango Region and is considered one of the North-East Parks.

Khaudum National Park is bordered by Botswana to the east, where a double game fence provides a barrier to free and large scale animal movement, although periodic breaks and subsequent movements of species such as elephant do occur (Figure 1 and 2).



**Figure 2.** Khaudum National Park covers 385,000 ha and shares its eastern border with Botswana.

Historically, movement of wildlife out of the Park, from east to west along omurambas during the wet season, is reported. KNP is one of the few refuges in which rare and endangered species such as roan antelope, tsessebe and African wild dog can roam freely, underlining the Park’s important conservation status. KNP forms part of a western corridor of KAZA (Figure 3).



**Figure 3.** The Kavango Zambezi Transfrontier Conservation Area (KAZA TFCA), a five-country initiative involving Angola, Botswana, Namibia, Zambia and Zimbabwe, encompassing an area of about 44,000,000 ha.

## KNP ROAN ANTELOPE CENSUS

In addition to infrequent multi-species transect sample counts, roan antelope numbers in KNP have been estimated ad hoc using full moon counts.

Roan antelope is the most valuable antelope species in KNP. The estimate for this species as recently as 2008/9 was close to 400 individuals with some staff members estimating as high as 800 individuals. An aerial survey of elephants was conducted in 2009 and covered the Khaudum/Nyae-Nyae system but very few roan were observed. This census was not designed to count roan antelope. The roan in KNP are the founder population for this species in Namibia, and all roan currently distributed across the country originate from this population.

In 1970, 74 roan were captured in the KNP and relocated to Etosha National Park (ENP) and some from there were taken to Waterberg Plateau Park (WPP) in 1975. From there they were sold to commercial game farms, where there are currently more than 500 roan. Except for the Mahango Core Area (200) and WPP (112), roan are only found in Mudumu National Park (80) and fewer than 30 in Kaross, the Rare Species Camp in ENP.

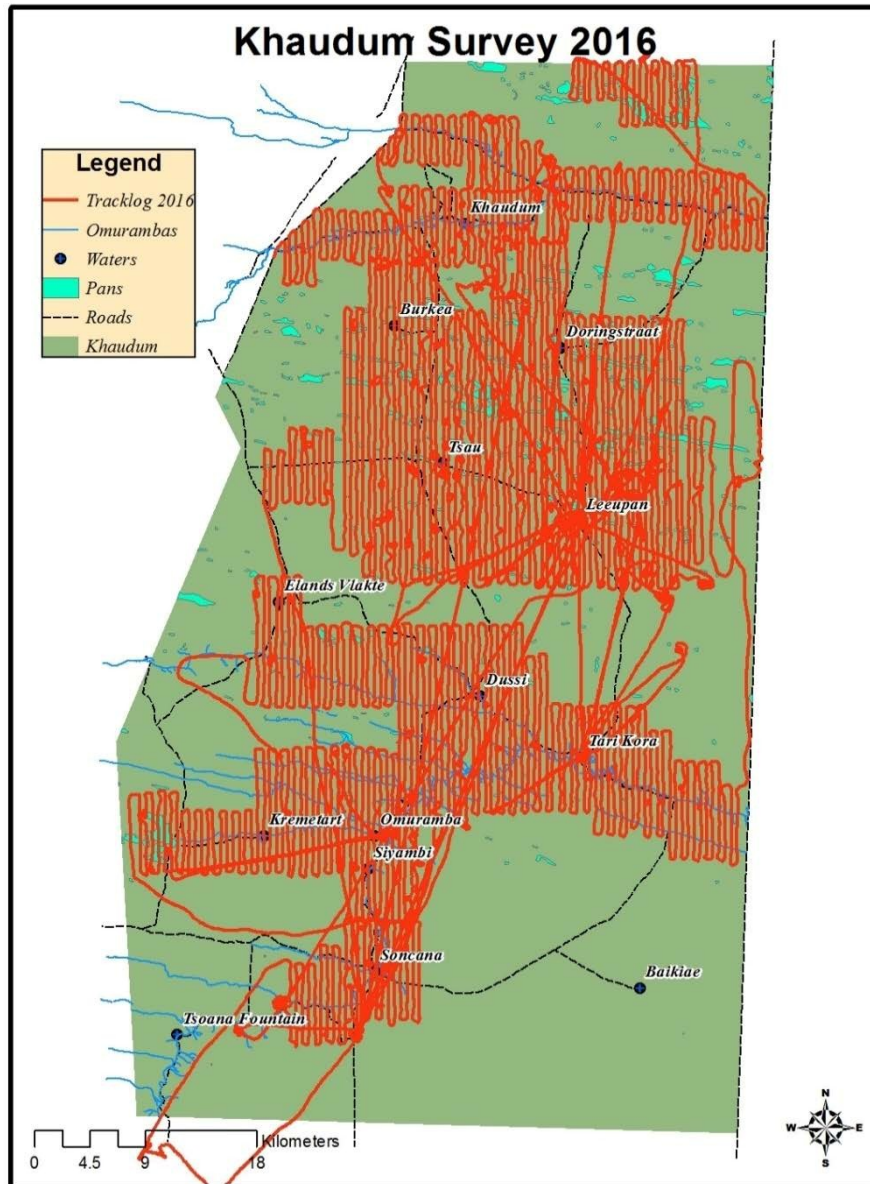
The roan population estimate in KNP needed to be confirmed using a well-designed and systematic survey and therefore a roan antelope specific census was developed in July 2012 and a follow-up survey was conducted in October 2013. The design of the 2013 and 2014 surveys changed from the 2012 survey through the incorporation of satellite collar data. Areas of high use were included and areas with little or no use were excluded. During both surveys, all species encountered were counted. However, it is important to note that the design targeted roan antelope and the stratification therefore might not be ideal for other wildlife species.

The 2014 design used unequal sized blocks and incorporated lessons learned in 2012 and 2013. The stratification was adapted and the area counted was also increased in 2014. The 2016 survey used the same stratification as the 2014 survey. The 2016 survey was fully funded by KfW through the NamParks III project.

## **METHODS**

The roan habitat in KNP was divided into eight (8) blocks in 2012 and 2013. In 2014 and 2016 some blocks were combined and KNP was only divided into five (5) blocks which were counted (total counts) as separate units. These blocks were chosen due to surface water availability and preferred roan habitat. The area around Baikiea was excluded from the survey, because the water point has not functioned for several years. Kremetart water point was counted, even though it is not functional, because of the large number of natural pans in the area.

## Stratification



**Figure 4.** The areas surveyed during the 2016 roan survey.

## Flight procedure

The roan survey was undertaken using a Bell Jet Ranger 206 turbine helicopter. The crew consisted of the pilot, two observers and a recorder. The responsibility of each member of the crew was specified and followed Standard Operating Procedures.



The grids to be flown were pre-drawn on the GPS's used by the pilot and recorder. This enabled accurate navigation, logging and plotting of the data. Transects were spaced 500m apart in a north-south direction. Height above ground level was kept at 200 – 300 feet (60 to 90m) and for all sightings the helicopter turned to ensure all roan were counted. Airspeed varied between 50 – 70 knots depending on the openness of the terrain and visibility. The GPS localities of all sightings in each block were recorded.

Where possible, the observer sitting behind the pilot used a Nikon D750 digital camera, and took digital images of roan seen (Figure 5). This was then used to verify totals during the analysis of the data. It is important to note, that due to their coloration, roan antelope are very difficult to spot from the air in the dry season.



**Figure 5.** Roan group of 18 photographed during 2016 survey (white dots depict individual roan).

### **Data management**

All data was recorded on a data sheet by the recorder noting the block number, detail of the sighting, search time in minutes etc. The recorded waypoint and track log data was downloaded from the GPS. The rough data are kept in hard copy and were also entered into an excel spreadsheet as an electronic record.

## RESULTS

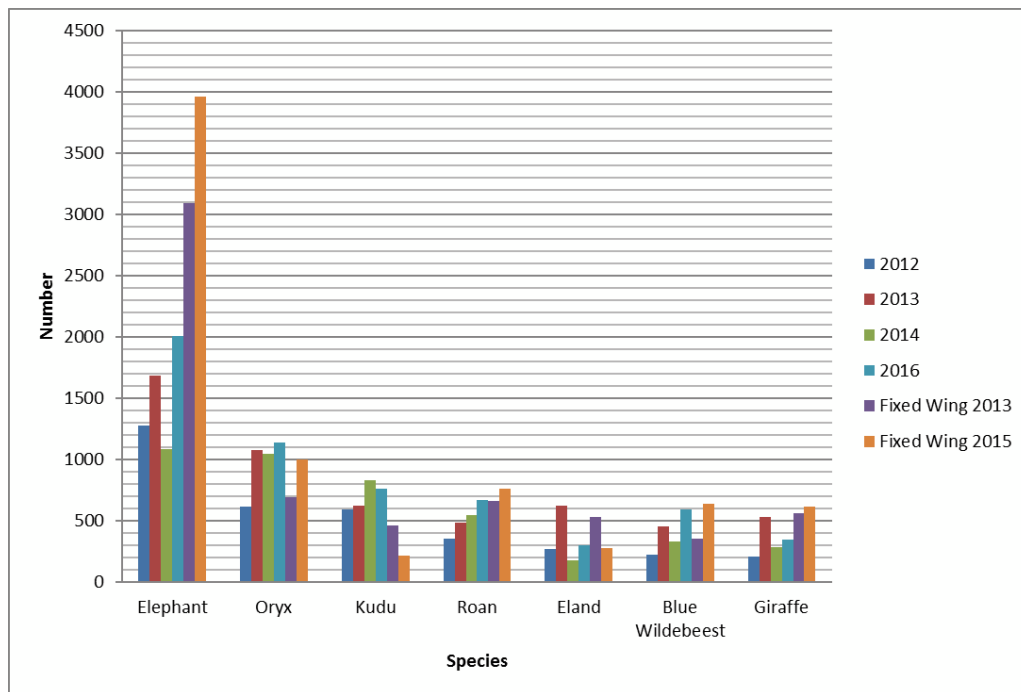
**Table 1.** Combined minimum estimate of all species in all blocks.

Species	Block 1	Block 2	Block 3	Block 4	Block 5	Totals 2016
Elephant	135	754	869	179	63	<b>2000</b>
Oryx/Gemsbok	18	176	692	239	14	<b>1139</b>
Kudu	17	465	193	66	19	<b>760</b>
Roan	48	79	470	66	1	<b>664</b>
Eland	5	95	107	94	0	<b>301</b>
Blue Wildebeest	14	18	421	136	0	<b>589</b>
Giraffe	8	137	190	9	0	<b>344</b>
Warthog	6	39	12	14	1	<b>72</b>
Steenbok	0	19	3	1	4	<b>27</b>
Duiker	0	8	0	4	0	<b>12</b>
Ostrich	1	14	41	8	1	<b>65</b>
Tsessebe	0	0	0	8	0	<b>8</b>
Red Hartebeest	0	0	3	1	0	<b>4</b>
Ground Hornbill	0	2	11	4	0	<b>17</b>
Lion	6	6	0	8	0	<b>20</b>
Leopard	0	1	0	0	0	<b>1</b>
Spotted Hyena	1	1	0	0	0	<b>2</b>
Porcupine	0	0	0	0	0	<b>0</b>
Honey Badger	0	2	0	0	0	<b>2</b>
Caracal	1	0	0	0	0	<b>1</b>
Wild Dog	0	12	0	0	0	<b>12</b>
Cheetah	0	0	5	0	0	<b>5</b>

It is important to note that this count was specifically designed for roan antelope and therefore all the other totals can only be used as minimum population estimates at best (Figure 6). A well-designed and executed all-species helicopter count of the whole park should give the best estimates with confidence intervals.

**Table 2.** Comparison of 2016 count with 2012, 2013, 2014 (helicopter rare species counts) and all species fixed wing counts 2013 & 2015.

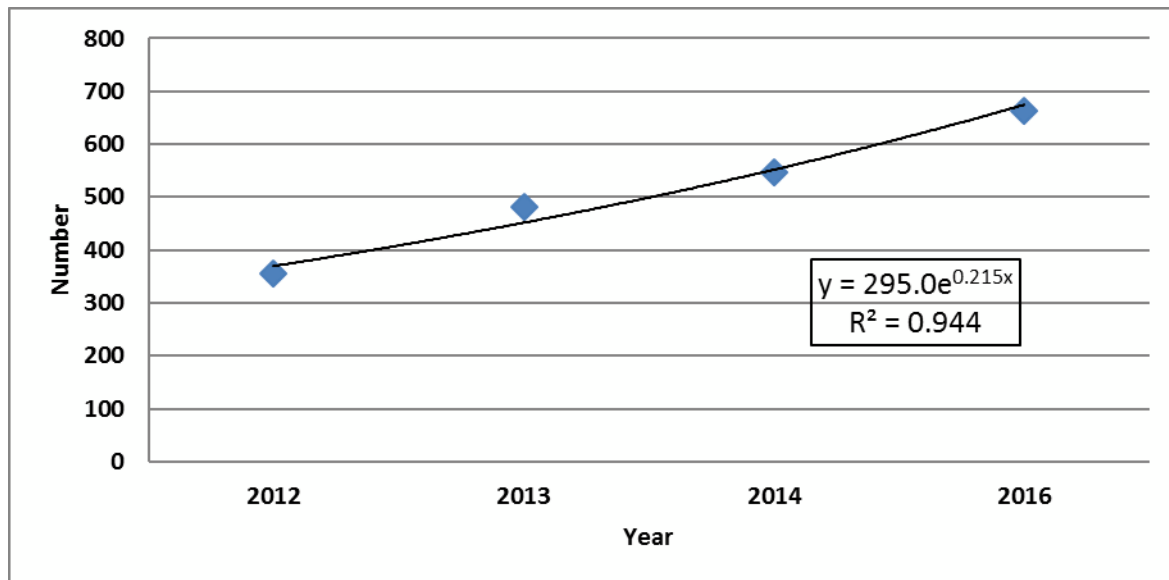
Species	Helicopter 2012	Helicopter 2013	Helicopter 2014	Helicopter 2016	Fixed wing 2013 (Craig and Gibson 2013)			Fixed wing 2015 (Craig and Gibson 2015)		
					Population Estimate	95% Confidence levels		Population Estimate	95% Confidence levels	
Elephant	1277	1680	1081	2000	3089	1998	4180	3959	2066	5851
Oryx	616	1078	1047	1139	690	347	1033	1001	546	1455
Kudu	592	619	832	760	457	213	701	213	36	391
Roan	355	482	546	664	657	254	1060	756	226	1285
Eland	267	618	178	301	531	91	1032	276	29	585
Blue Wildebeest	224	454	332	589	349	110	704	639	211	1067
Giraffe	208	528	284	344	557	264	851	613	289	937
Warthog	162	92	147	72	233	99	367	63	8	143
Steenbok	77	125	88	27	170	84	255	14	3	31
Duiker	54	139	55	12	161	95	228	101	41	162
Ostrich	27	52	52	65	96	20	180	56	10	106
Tsessebe	8	10	10	8	0	0	0	0	0	0
Red Hartebeest	8	12	6	4	22	4	62	0	0	0
Ground Hornbill	7	6	18	17	0	0	0	0	0	0
Lion	7	4	2	20	0	0	0	0	0	0
Leopard	4	1	2	1	0	0	0	0	0	0
Spotted Hyena	4	3	6	2	0	0	0	0	0	0
Porcupine	4	0	1	0	0	0	0	0	0	0
Bat Eared Fox	2	0	0	0	0	0	0	0	0	0
Honey Badger	2	1	1	2	0	0	0	0	0	0
Caracal	0	0	0	1	0	0	0	0	0	0
Wild Dog	0	0	0	12	0	0	0	0	0	0
Cheetah	0	0	0	5	0	0	0	0	0	0



**Figure 6.** Graph comparison of aerial surveys conducted over the last 5 years.

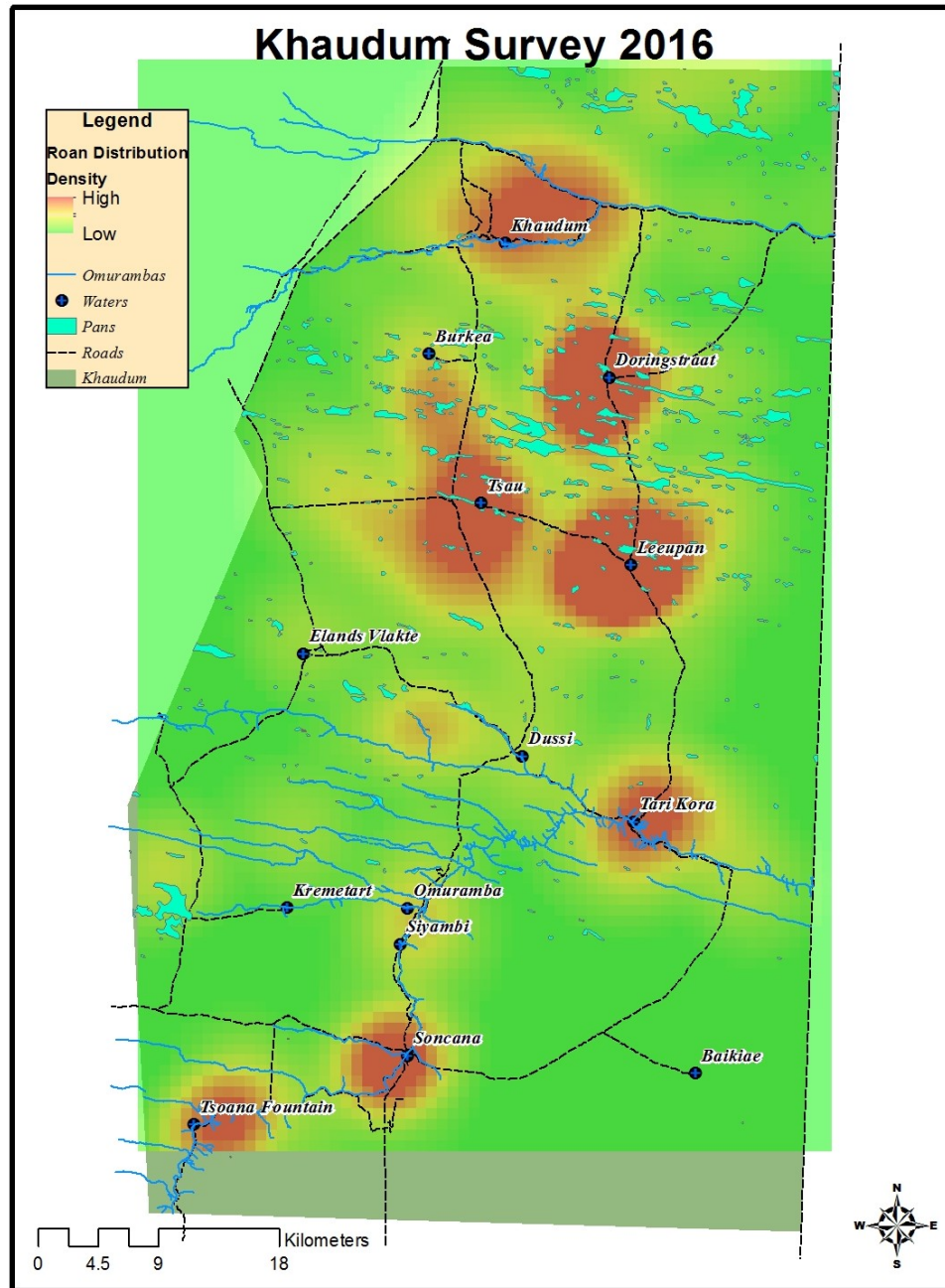
## Roan antelope

The estimate (minimum) for roan antelope is 664 which is a total count of the roan habitat of KNP. The drastic increase in roan numbers from the 2012 survey could possibly be attributed to the refinement of the stratification based on satellite collar data and the time of year that the count was undertaken.



**Figure 7.** Exponential trendline indicating growth of KNP roan population over the last 5 years.

The roan population in KNP has increased from 355 to 664 since the inception of the roan survey. This is mainly due to the adaptation of the survey to include roan habitat in the park. Satellite collar data was used to re-stratify the survey for optimal roan habitat selection. The second factor that possibly contributed to the significant increase in roan numbers is the maintenance of water points. In 2011, Wildlife Research conducted a feasibility study on the possible introduction of rhino into the park. During a field visit in November 2011 only 5 out of the 14 water points were functional. Since 2012, the maintenance of water points has increased significantly, especially during the hot summer months. The final factor that possibly contributed to the increase of roan could be the initiation of an early burning program. Early burning in the park greatly reduced the loss of grazing through veld fires in the hot dry months from August to November. The exponential growth rate of the roan population has been 21% over the last 5-year period, but longer term data is required to determine the actual performance of the population as the early increases can most likely be attributed to the refinement of the survey method. Figure 8 indicates the roan distribution in KNP.

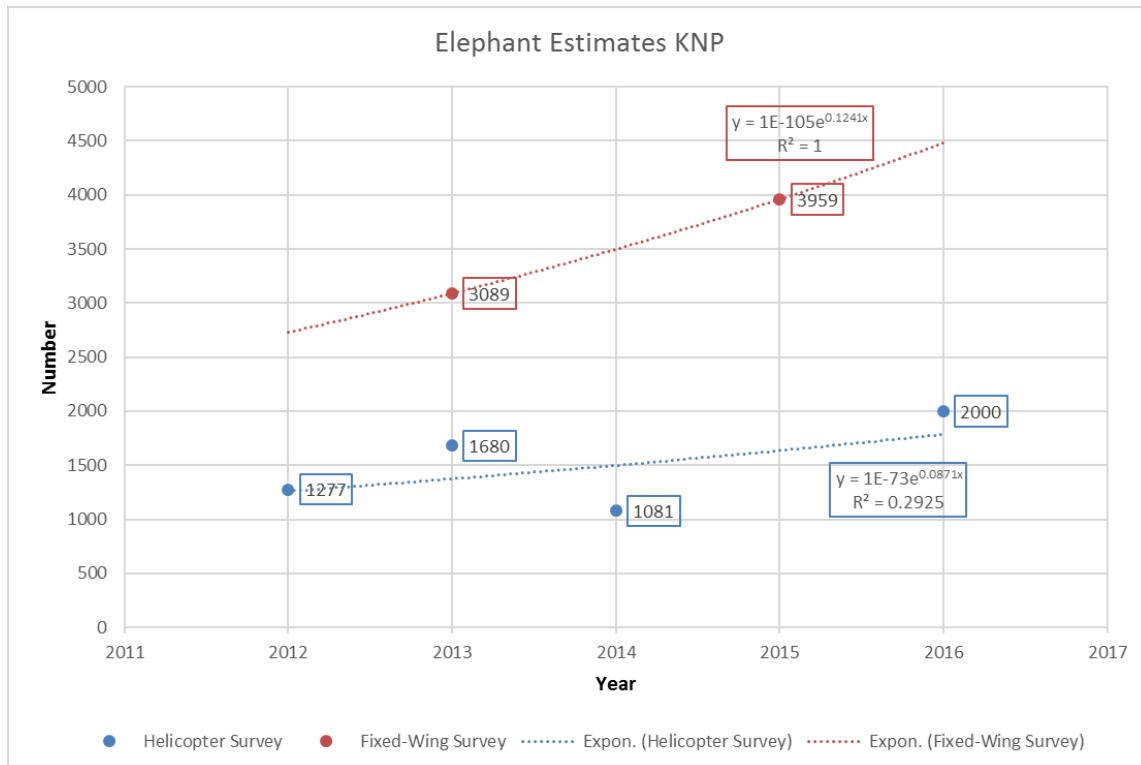


**Figure 8.** Roan distribution during 2016 survey.

Sightings of roan were concentrated around 4 main water points namely, Khaudum, Doringstraat, Leeupan and Tsau and this northern area seems to be the stronghold for roan. Other important areas are northern Nhoma omuramba and the southern Nhoma omuramba. It is important that the stratification should be expanded and refined for future counts. Additional satellite collar data could indicate more roan habitat. Areas that could be included in future counts might be Elands Vlakte and Baikieae, if the water point are functional. The Burkea water point was reinstalled shortly after the survey and should also be significant for roan as is indicated by the wet season roan collar data.

## Elephant

This count was not designed for elephant and not all the elephant range was counted. The 2000 elephant sighted should be regarded as a minimum count. Photographs of as many herds as possible were taken to enable the elephant specialist Mr. Kilian to determine population parameters for elephant and so this aspect will not be covered in this report. Figure 9 indicates the exponential growth rate of the elephant population in KNP.



**Figure 9.** Exponential trendlines indicating growth of elephant population in KNP from 2012 to 2016. Figure 9 compares survey results between the roan helicopter surveys and fixed wing all.

species sample counts. The 2014 roan helicopter survey produced a below expected result of 1080. This could have been caused by the Erindi elephant capture that took place directly before the survey was conducted. Erindi Private Game Reserve captured and translocated 100 elephants from KNP in July 2014. The capture operation probably caused major disturbance in the elephant population causing them to scatter. The trendlines of the two survey methods indicate that the elephant population in KNP is growing at a rate between 8% (helicopter survey) and 12% (fixed-wing survey). Elephant populations seldom grow at more than 5% per annum in the wild, therefore the helicopter survey results indicate a more realistic growth rate. A growth rate of 8% is exceptionally high and not sustainable for the elephant population in KNP.

An elephant specific helicopter survey should be conducted in KNP to ascertain a more realistic elephant population figure.

## **Oryx**

1139 Oryx were counted indicating that this population is healthy and due to the stratification not favouring all oryx habitat, this should be taken as a minimum estimate. Having said that, the 2013, 2014 and 2016 stratification for roan seem to be well suited for oryx with very little difference between the estimates of 1078 in 2013, 1047 in 2014 and 1139 in 2016 respectively.



**Figure 10.** Oryx herd of 46 sighted in the Khaudum omuramba.

## **Kudu**

760 Kudu were counted, indicating that this population is healthy. Kudu is a species which is, very difficult to count from the air due to its behaviour and so this estimate should be treated as a minimum and might be far higher with a different stratification.

## **Eland**

301 Eland were counted indicating that this estimate should be treated as a minimum estimate and should be far higher with a different stratification. The low eland numbers show that the stratification was not designed for eland and that during the 2016 survey most large herds were not encountered. The largest herd sighted in 2016 consisted of 40 animals whereas the largest herd in 2013 survey consisted of 130 animals.

## **Blue Wildebeest**

589 Blue wildebeest were counted and most were in a few big herds. This estimate should be treated as a minimum and might be far higher with a different stratification. Care should be taken with a sample count because of a few big groups on a population estimate. The blue wildebeest should be seen in the same light as the eland due to their concentrations in big herds.

## **Giraffe**

344 Giraffe were counted indicating that this population is healthy. The giraffe is a species which is very difficult to count from the air due to its colouring. This estimate should be treated as a minimum and might be far higher with a different stratification as the roan and the giraffe need significantly different habitats.



**Figure 11.** Group of 8 giraffes sighted during the 2016 survey.



## Tsessebe

Eight tsessebe were counted indicating that this population is almost absent from the survey area which might indicate extremely low numbers for this species in KNP. The results of this census indicated that tsessebe is still present in KNP however efforts should be made to get a more accurate estimate. This is a species which should be supplemented through introductions. A possible source population could be the Mahango Core Area of Bwabwata National Park as this population is doing extremely well and is less than 200km from KNP. A single red hartebeest bull was sighted with the tsessebe herd (Figure 12). Red hartebeest were introduced into Nyae Nyae Conservancy and a small population migrated to KNP. The red hartebeest in KNP are outside the normal distribution range for the species and there is a threat of cross breeding with the tsessebe. Red hartebeest should be eradicated from KNP to prevent possible cross breeding.



**Figure 12.** Tsessebe herd sighted with a red hartebeest bull (red circle) in KNP.

## Other species

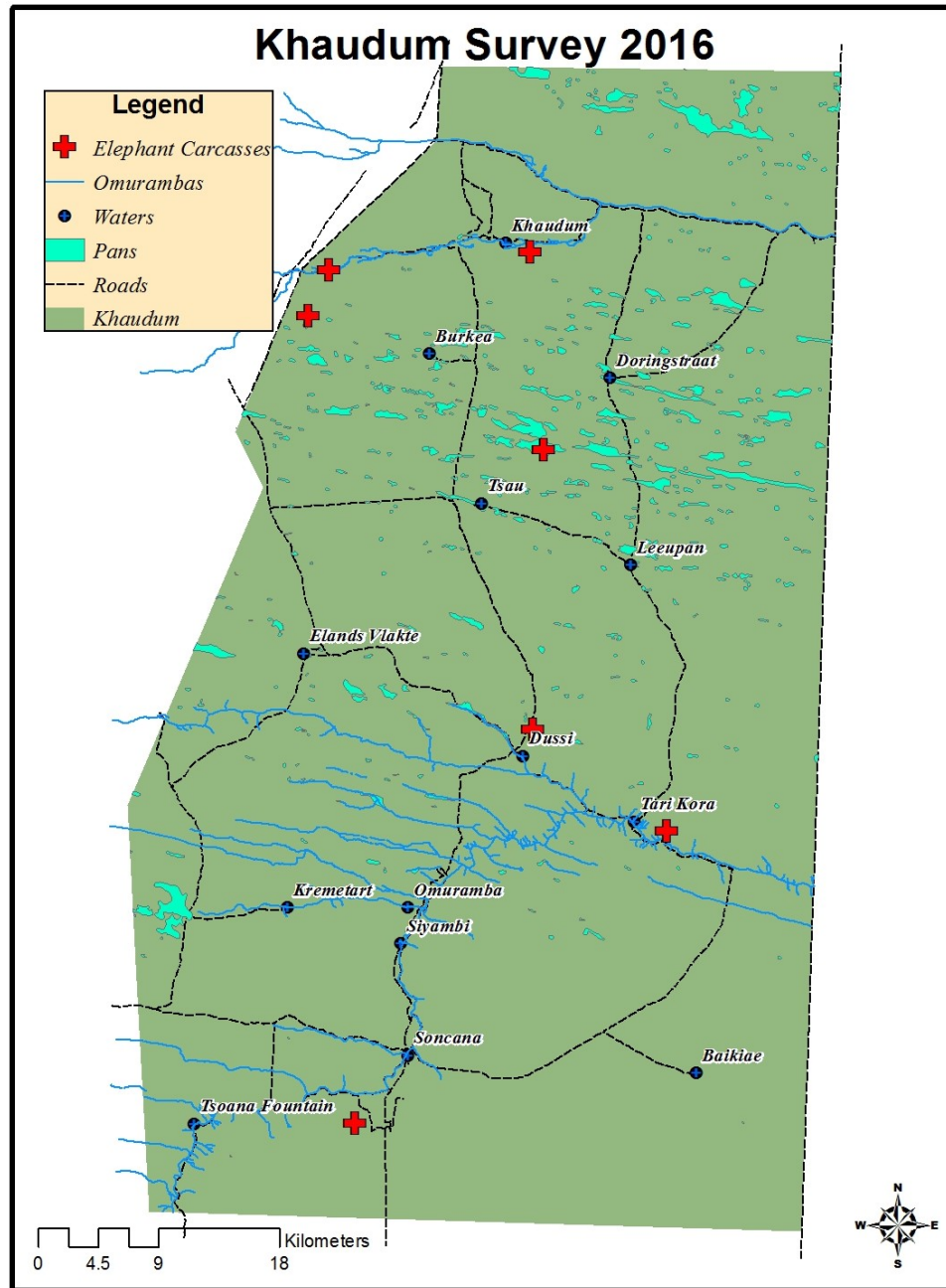
All other species totals should be used as presence data for the particular species as they were counted opportunistically and not targeted. During the survey 20 lions were counted. Lion are difficult to spot from the air but through the use of satellite collars all the lion prides were located and group compositions were recorded (Figure 13). Wildlife Research is currently conducting research on the large predators of KNP and investigating population dynamics and dispersal within the great KAZA TFCA area.



**Figure 13.** Khaudum omuramba pride sighting during the 2016 survey.

## Elephant carcasses detected

Figure 14 is a summary of all elephant carcasses detected. Seven elephant carcasses were sighted during the survey of which the majority was old.



**Figure 14.** Elephant carcasses detected in all blocks during 2016 survey.

No tusks were collected but all the waypoints were reported to KNP parks staff. The survey serves as an important tool to detect elephant carcasses in areas that are inaccessible by park staff on the ground. The freshest carcass was sighted in the Khaudum omuramba (Figure 15).



**Figure 15.** Elephant carcass with tusks sighted in Khaudum omuramba during survey.

## Search rates

The count was conducted for four days from the 28<sup>th</sup> to the 31<sup>st</sup> of August 2016, requiring 27.88 hours of actual counting time. The survey area was approximately 1811 km<sup>2</sup> and the average search rate was 1.08 km<sup>2</sup>/minute, based on the area size (1811 km<sup>2</sup>) and the actual time flown (27.88 hr). During the count the helicopter had to be refuelled, dividing the count into a number of transects. See Table 3.

**Table 3.** Summary of Search Rates.

Survey Blocks	Block Area km <sup>2</sup>	Start Time	End Time	Transect Time (hour)	Total Time (hour)	Total Area km <sup>2</sup>	Search Rate (km <sup>2</sup> /minute)
Block 1 (31/08/2016)	184	13:28	14:49	1:21	27.88	1811	1.08
Block 1 (31/08/2016)		14:30	15:24	0:54			
Block 2 (30/08/2016)	602	11:05	12:20	1:15			
Block 2 (30/08/2016)		13:14	15:06	1:52			
Block 2 (30/08/2016)		15:19	16:16	0:57			
Block 2 (31/08/2016)		6:42	9:07	2:25			
Block 2 (31/08/2016)		9:33	12:04	2:31			
Block 2 (31/08/2016)		12:58	13:17	0:19			
Block 3 (29/08/2016)	736	6:52	9:01	2:09			
Block 3 (29/08/2016)		9:31	11:42	2:11			
Block 3 (29/08/2016)		12:08	13:29	1:21			
Block 3 (29/08/2016)		13:33	14:06	0:33			
Block 3 (29/08/2016)		14:44	16:17	1:33			
Block 3 (30/08/2016)		7:07	9:18	2:11			
Block 3 (30/08/2016)		9:58	10:40	0:42			
Block 3 (30/08/2016)		8:02	9:04	1:02			
Block 4 (28/08/2016)	248	9:48	11:49	2:01			
Block 4 (28/08/2016)		12:53	14:40	1:47			
Block 5 (28/08/2016)		7:05	7:54	0:49			

## COSTS

The direct costs for the census was 27.88 hours of helicopter use at N\$ 10 350.00 /hr including VAT, total direct costs were N\$ 288 558.00. The direct costs for the entire operation (census + ferry) amounted to 48 hours at N\$ 10 350.00/hr including VAT totalling N\$ 496 800.00. Due to the inaccessibility of the terrain for fuel trucks, a large portion of the survey was made up of ferry time from survey sites to the fuel depot at Sikereti Station.

## CONCLUSIONS

Wildlife Research is developing a roan specific count methodology for KNP which will give a population estimate which is as precise as possible. This will therefore become a species-specific census which is repeatable and should routinely be applied by Ministry staff in a standard manner.

The 2012 count gave a baseline for roan antelope in KNP and due to a lack of scientific data this count produced a minimum population estimate for roan. This count was refined and modified, with the aid of satellite collar data, for the 2013 to 2016 surveys.

The stratification should be looked at again to include areas towards the Botswana border and Elands Vlake, Baikiea and Burkea water points, once they are functional, to improve the repeatability of the census and allow accurate population estimates with confidence limits. The area to the east of the roan "hotspot" (Tsau, Leeupan and Doringstraat) should be included in the next survey's stratification. It is very important that the census should be repeated to fine tune the method and if possible build in a correction factor for the areas not counted. The count should be done in the winter months, June-August, if possible.

## **RECOMMENDATIONS**

1. The count should be repeated after increasing the area to be counted especially the Doringstraat/Leeupan to Botswana border area and the Elands Vlake, Baikiea and Burkea areas. The stratification should be adapted as needed using all available sighting records and satellite collar data.
2. The count must be done at the same time each year to remove sighting bias.
3. All future counts must be done using a four-seater turbine helicopter with an experienced commercial pilot with a game and livestock culling/capture rating.
4. Waters (artificial) should all be upgraded to ensure they are accessibility for roan and other antelopes especially in the hot and dry season.
5. An all species transect count with a four-seater helicopter should be conducted in KNP to get reliable data on all other species especially elephant, eland, and blue wildebeest.
6. Management of waters by the Directorate of Wildlife and National Parks and should be done in consultation with DSS for their input as this might be detrimental to the roan population of KNP.
7. A controlled fire programme (early burns) should be maintained in the park to prevent catastrophic late fires.
8. Kremetart, Eland Vlake and Baikiea waterhole are crucial for the survival of wildlife in the hot dry period and should therefore be commissioned as a priority.
9. Species contributing to the biodiversity of the park that have become extinct or are in danger of becoming extinct in the park, e.g. common impala, reedbuck and tsessebe should be introduced/supplemented from Mahango Core Area or alternative available sources.
10. The red hartebeest should be removed from KNP to prevent cross breeding with the tsessebe.

## ACKNOWLEDGEMENTS

The pilot, recorder and observers are thanked for their contributions to making the 2016 Khaudum Roan census a success. Special thanks go out to Mr. Hans Rack for assisting with the photography and proving training on photography. The NamParks III Project funded the entire survey.

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# APPENDIX A: SURVEY BLOCKS

