



Carnivore Densities in Gonarezhou National Park Results of the 2017 Spoor Survey

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(*Spoor survey carried out by Jessica Watermeyer, Rueben Boté and various students*)



AWCF head scout, Rueben Bote, tracking during the 2017 spoor survey in the Park

Introduction

Spoor surveys have been carried out annually in the Gonarezhou National Park (Gonarezhou/the Park/GNP) since 2009 in order to determine population trends of the five large carnivore species in the Park. A standardised method is followed each year, with the same tracker every time, to allow for consistency and comparability between surveys.

Where the substrate is suitable, spoor surveys have been shown to be an effective and efficient means to assess wildlife densities (Stander 1998; Funston et al. 2001; Davidson & Romañach 2007, Funston et al 2010) as there is a strong correlation between spoor density and true density.

Methods

We employed the same methods used in the Gonarezhou National Park every year since 2009, which were based on those used by Stander (1998) in Namibia. Similar methods have been used in Hwange (Davidson & Romañach 2007), the Savé Valley Conservancy (from 2008-2017; Watermeyer & Groom 2017) and Bubye Valley Conservancy (du Preez et al 2010).

The total area of the Gonarezhou National Park is 4963km². However, 1177km² of the area is north of the Runde River and is excluded from the survey because of the unsuitability of the substrate for seeing spoor (very rocky

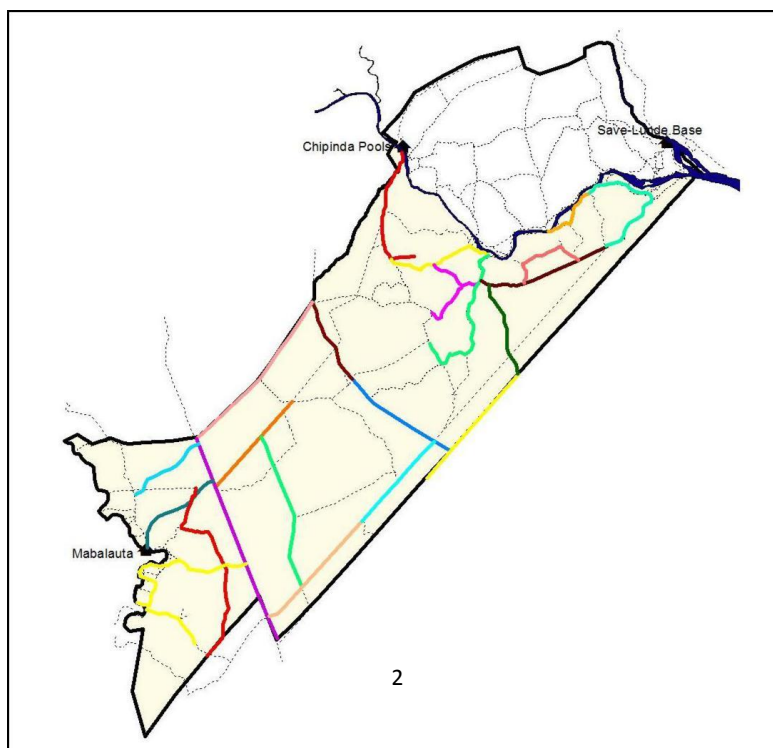
granite terrain). South of the Runde River however (3786km²), the ground substrate consists of alluvial sands and cretaceous sands which are ideal for spoor surveys. This total sample area was divided into two sections, representing the different management sections of the Park. The southern section (the Mabalauta subregion, comprising the Mabalauta tourist area and the Guluweni-Chefu Wilderness Area) comprised 2121km². The northern section (the Save-Runde subregion comprising the Chipinda Pools and southern Runde tourist areas) totaled 1665km².

The survey consists of driving along sandy roads in the Park, recording all fresh (<24hrs old) carnivore tracks observed along the route. A total of 524.3km were driven, representing a penetration ratio of 1:7.22 (total number of kilometres driven to total sample area). This is consistent with the penetration ratio in the SVC (between 1:6 and 1:7), and with the survey in Gonarezhou in 2009 -2016.

In the northern section, a total of 226.7km were driven as transects (penetration ratio 1:7.34) whilst in the southern section, a total of 297.6km were driven (penetration ratio 1:7.13). The transects driven in 2017 were largely the same as those driven in the previous years, except the Kundani Road (now closed) was replaced by the Kaputeni Road. Transect routes driven in 2017 are shown in Figure 1. Each transect was driven at a speed of between 10 and 20 km/hr with one observer (tracker Rueben Bote) sitting on the front of the car scanning the road. The driver or a student did the data recording. Transects ranged from 11.5km to 38.5km in length with a mean length of 22.8km.

Transects were driven mornings and evenings when the sun was at an angle to facilitate seeing spoor on the roads. Spoor was recorded for all mammalian carnivores equal in size to or larger than a genet. This included genet, African wild cat, bat-eared fox, jackal, porcupine, honey badger, civet, aardwolf, serval, brown hyena, African wild dog, cheetah, leopard, spotted hyena and lion. Only tracks less than 24 hours old were counted. Road conditions were generally sandy, such that spoor was relatively easy to see. Where possible, spoor of individual animals was followed to reduce the likelihood of that individual being counted twice on a given transect. The survey took 12 days to complete, and was carried out between the 12th and 23rd September 2017.

Figure 1: Map of the transects driven in Gonarezhou National Park– September 2017



Results

Table 1: Results summary for the four main large carnivores in Gonarezhou National Park in 2017 (density equations derived from graphs in Stander 1998). *Includes only the area south of the Runde River.*

Parameter	Northern GNP	Southern GNP	Total GNP
Area (km ²)	1665	2121	3786
Combined transect length (km)	226.7	297.6	524.3
Penetration ratio	1:7.34	1:7.13	1:7.22
Results – Lions			
Number of individual lion spoor seen	2	20	22
Lion spoor frequency (km/spoor)	113.35	14.88	23.83
Spoor density (spoor/100km)	0.88	6.72	4.20
Density of lions per 100km ² (Y=0.3049X)	0.3	2.0	1.3
Estimated number of lions	5	44	49
Results - Spotted Hyenas			
Number of individual hyena spoor seen	92	74	166
Hyena spoor frequency (km/spoor)	2.46	4.02	3.16
Spoor density (spoor/100km)	40.58	24.87	31.66
Density of hyenas per 100km ² (Y=0.3049X)	12.4	7.6	9.7
Estimated number of spotted hyenas	206	161	367
Results – Leopards			
Number of individual leopard spoor seen	29	42	71
Leopard spoor frequency (km/spoor)	7.82	7.09	7.38
Spoor density (spoor/100km)	12.79	14.11	13.54
Density of leopards per 100km ² (Y=0.6993X)	8.9	9.9	9.5
Estimated number of leopards	149	209	358
Results – Wild Dogs			
Number of individual wild dog spoor seen	40	60	100
Wild dog spoor frequency (km/spoor)	5.67	4.96	5.24
Spoor density (spoor/100km)	17.64	20.16	19.07
Density of wild dogs per 100km ² (Y=0.3049X)	5.4	6.1	5.8
Estimated number of wild dogs	90	130	220

Comparison with previous years

Table 2: Population estimates of the five large carnivore species in the **whole of Gonarezhou National Park including north of the Runde River** (extrapolated from survey area) from 2009 - 2017

Species	2009	2010	2011	2012	2013	2014	2015	2016	2017
Lion	31	45	72	64	77	116	125	54	63
Leopard	255	441	414	524	450	398	388	312	470
Spotted hyaena	407	489	553	585	760	671	642	419	479
Wild dog	31	81	160	223	138	208	279	181	289
Cheetah	22	30	66	113	108	75	90	37	43

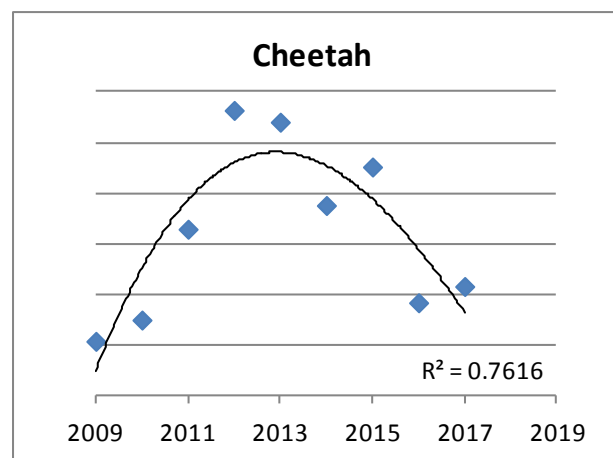
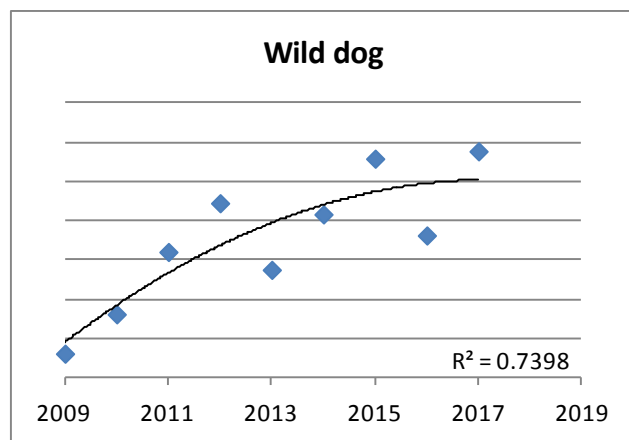
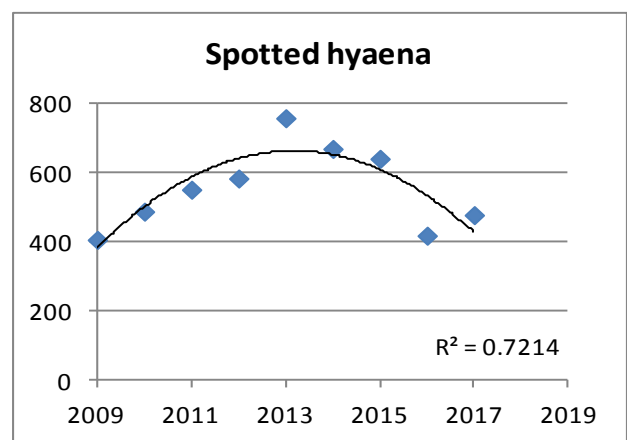
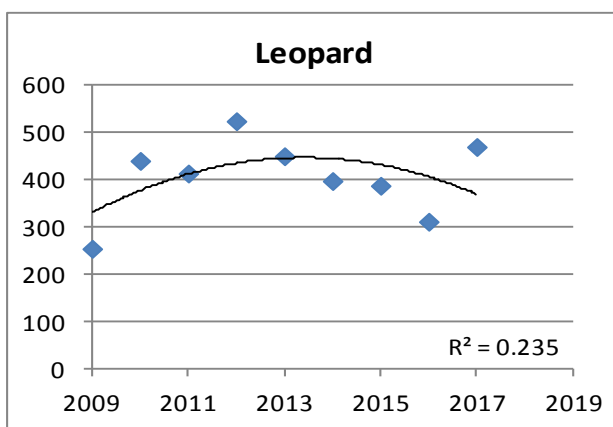
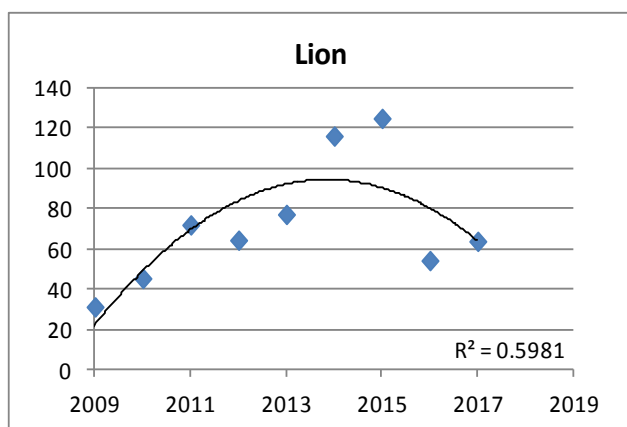


Figure 2: Graphs showing population trends of the five large carnivore species in Gonarezhou National Park as based on spoor survey estimates from 2009-2017. Y-axis represents total number of individuals estimated to occur **in the whole park**.

A breakdown of population estimates between the north and south of the park from 2009-2017 is given in Appendix 1

Interpretation of Results

Looking at the trend data it becomes clear that 2016 was most likely (as predicted) an anomalous under count from a drier year. However, it is of concern that the lion, spotted hyena and cheetah numbers appear to have remained low in the 2017 count too (various explanations discussed below). It will be particularly important to repeat the survey in 2018 and 2019 to ensure that these figures do not represent the start of a real decline for these species.

Lions:

The 2017 results estimate a population of **63 lions** in the whole of the Park, which is a slight increase from the 2016 estimate of **54 lions**, but significantly lower than the previous years' estimates. This number of lions equates to a **density of 1.3 lions/100km²**. Relative to other populations (average over Kruger, Hwange, Selous and Serengeti = 9.6 lions/100km²) this is very low. For example, the lion population in neighbouring Savé Valley Conservancy is 9.1 lions/100km² (Watermeyer & Groom 2017). Of the 22 lion tracks we encountered, 46% were adult males, with 36% identified as adult females, and we recorded tracks for only four cubs (18%).

We had a low encounter rate for the lions in 2017, particularly in the north of the Park, unfortunately producing unreliable results for the population estimate for the species in the Park. As such, we will need to monitor consecutive years of data before making any hard conclusions as to the status of the lion population in GNP. However, with anecdotal reports of lions and recorded lion sightings in the Park increasing, we are at this stage assuming the lower counts to be a result of sampling conditions and are moderately confident that there is not a problem with the Park's lion population.

One explanation for the low encounter rate and poor population estimate, could be that the lions in the north of the Park have shifted their space use to north of the Runde River. Indeed, 20 of the 22 tracks recorded were picked up in the south of the Park (see density estimates in Appendix 1), and anecdotal evidence recorded by the AWCF team whilst busy with the spoor survey suggests a greater presence of lions north of the Runde River. As such, suggestions to revise the methods and include transects north of the Runde River have been discussed.

Spotted hyenas:

The overall population estimate for spotted hyenas in the whole Park in 2017 was **479 individuals**, translating into a density of **9.7 hyenas/100km²**. Other populations have higher densities; 13.5/100km² in Kruger (Mills 1985); 17.0/100km² in Hwange (Bowler 1992); 32.0/100km² in Selous (Mills 1985); and 82/100km² in Serengeti (Hofer & East 1993)). Spotted hyena numbers in the Park are not of concern at the moment, however, the species has been declining slightly in the Park since 2013 so we need to monitor this trend moving forward.

Notably (as with lions), from expanding human-wildlife conflict work around the Park, we are starting to notice that hyenas are a noted conflict species. Illegal/retaliatory killings could thus also be responsible for the decreasing trend, although we have received no reports of this from our HWC monitors, so do not believe it to be a serious threat at this stage, at least on the Zimbabwean side of the Park.

Leopards:

The Park's leopard population seems to be making a recovery after a steady decline since 2012. There were an estimated **470 leopards** in GNP in 2017. At this stage we'd suggest the leopard numbers be treated with caution, and to wait for consecutive years of data before making any conclusions as to the status/trend of the leopard population in the Park. Importantly, derivation of population estimates from spoor densities is controversial for leopards since there are several different equations available which give different numbers.

Despite the above, the estimated leopard density in GNP is still reasonable. The current density is **9.5 leopards/100km²**, which is comparable to that recorded in Phinda and Mkhuze in South Africa (average 9.7/100km²; Balme et al 2009), and slightly lower than that in neighbouring Savé Valley Conservancy (14.7 leopards/100km²) (Watermeyer & Groom 2017).

Cheetahs:

Spoor surveys are not an appropriate techniques for monitoring cheetah because they use the roads a lot less than other large carnivores, and the species would be more accurately surveyed by a mark recapture camera trap survey using cheetah play trees and other key areas. They are valuable indicators of trend, but **numbers must be treated with caution.**

Results from this survey suggest a total population of **43 cheetahs** in the whole Park, which is significantly lower than estimates from previous years (excluding the undercount in 2016). This equates to a current density estimate of **0.9 cheetah/100km²**, which is average when one considers the range of cheetah densities elsewhere (excluding highly managed fenced reserves in South Africa); for example, 0.2 cheetah / 100km² on Namibian farmlands and in the Sahara, and up to 2.5 cheetah / 100km² in the Serengeti National Park (IUCN/SSC 2015). Since cheetah naturally occur at low densities and are a wide-ranging species (Mills 1997; Durant 1998; Wilson & Delahay 2001), an estimate of 0.9 cheetah/100km² is relatively realistic, particularly given the habitat.

At best, we can reliably say that cheetah are resident and breeding in the Park, but only present at low densities as is characteristic of the species.

Wild dogs:

Spoor surveys are also not good predictors of African wild dog numbers, and can overestimate population sizes by up to 200%, due to the large pack sizes which artificially inflate the calculations from spoor. However, they are a good indicator of trend, and generally the numbers estimated from the spoor survey are only slightly higher than those estimated from direct monitoring efforts.

Aside from an anomalously low count in 2013, and suspected undercount in 2016, the wild dog population has shown a steady increase. The current estimate from the spoor survey is of 289 wild dogs in the Park, which includes adults, yearlings and pups. By late September (when the spoor survey was conducted) many packs had finished denning and were moving around with pups, making this time of year the time of highest counts (if pups are included).

Nonetheless, from in depth direct monitoring efforts(which is much more accurate for wild dogs), we believe there to be about **107 adults and yearlings in the Park** across 11 packs, and about 70 pups by end 2017 (a total of 177 individuals). This equates to a density of **2.8 adult & yearling wild dogs/100km²** which is on par with the average wild dog densities in other protected areas (average 2.5 dogs/100km² across 5 populations; Pole 1999). In neighbouring Savé Valley Conservancy wild dogs occur at a density of 3.9 wild dogs/100km² (Watermeyer & Groom 2017).

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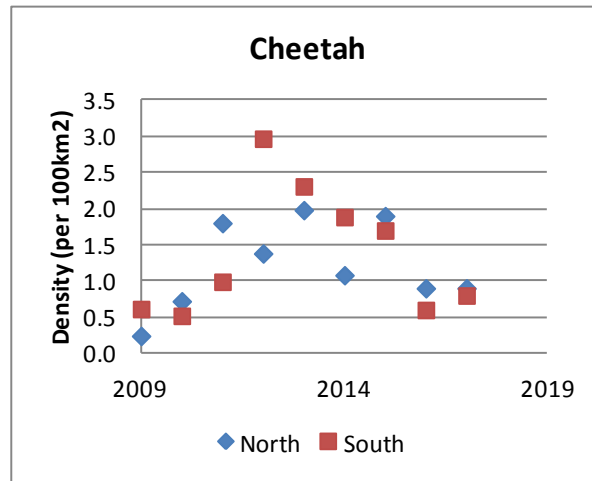
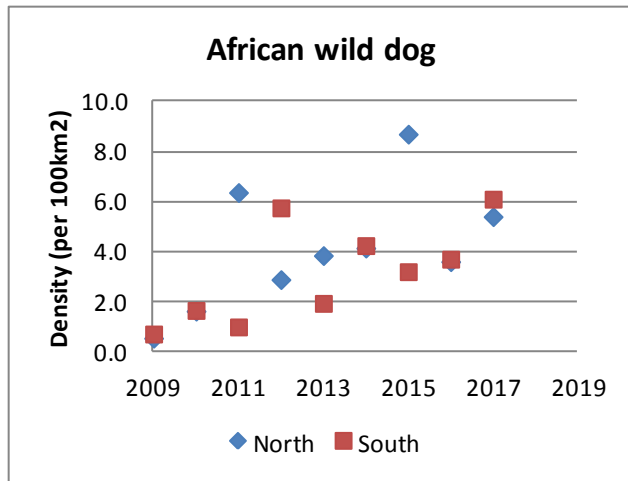
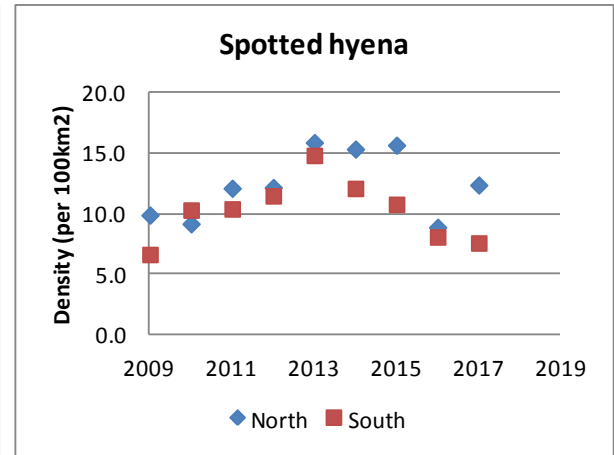
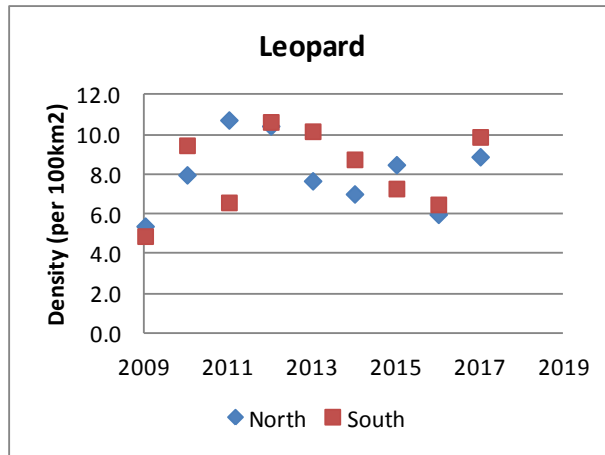
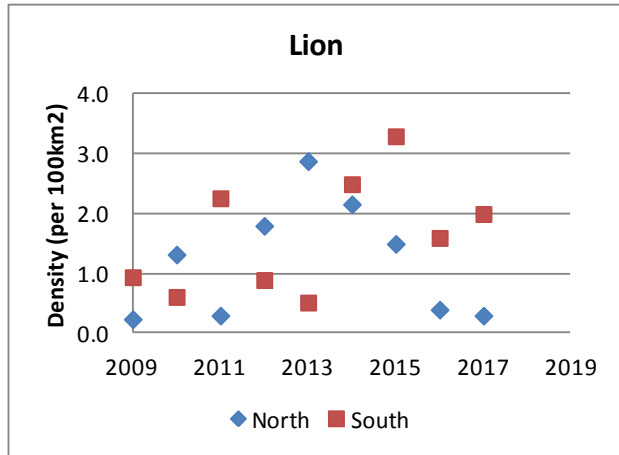
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Some of the rare and wonderful sites/activities enjoyed by the AWCF team whilst busy with the 2017 spoor survey (top to bottom, left to right); tracking a pack of wild dogs in the south of the Park, lion spoor sighted, one of the many beautiful camping spots the team enjoyed, and a rare sighting of the Smuggler Pack puppies along the Mozambique border road late one evening.

APPENDIX 1 DATA SPLIT INTO NORTH AND SOUTH

Graphs of population density estimates split between the North (between the Runde River and the Boundary Ridge Road) and the South (between the Boundary Ridge Road and the Mwenezi River / Southern Boundary of the Park). As densities, figures are directly comparable between the two areas.



APPENDIX 2 ALL SPOOR SURVEY RESULTS FOR ALL SPECIES COUNTED (2017)

NORTH GNP	Survey Area	Est. population	Equation Used	Est. density	Distance covered	No. of spoor	Spoor frequency	Transect length	Penetration	Spoor density
	North GNP	(Total area)	Stander1998	(Animals/100km ²)	(km)	counted	(km/spoor)	(km)	(Area/length)	(Spoor/100km)
Species	(Km ²)			Y=0.3049X Y=0.6993X	Sum of transects			Sum of routes		
Aardwolf	1665	36.0	Leopard (Y=0.6993X)	2.2	226.7	7	32.39	226.7	7.34	3.09
Brown hyena	1665	71.7	Lion (Y=0.3049X)	4.3	226.7	32	7.08	226.7	7.34	14.12
Cheetah	1665	15.7	Lion (Y=0.3049X)	0.9	226.7	7	32.39	226.7	7.34	3.09
Civet	1665	1016.9	Leopard (Y=0.6993X)	61.1	226.7	198	1.14	226.7	7.34	87.34
Genet	1665	179.8	Leopard (Y=0.6993X)	10.8	226.7	35	6.48	226.7	7.34	15.44
Jackal	1665	107.9	Leopard (Y=0.6993X)	6.5	226.7	21	10.80	226.7	7.34	9.26
Leopard	1665	148.9	Leopard (Y=0.6993X)	8.9	226.7	29	7.82	226.7	7.34	12.79
Lion	1665	4.5	Lion (Y=0.3049X)	0.3	226.7	2	113.35	226.7	7.34	0.88
Porcupine	1665	467.4	Leopard (Y=0.6993X)	28.1	226.7	91	2.49	226.7	7.34	40.14
Serval	1665	0.0	Leopard (Y=0.6993X)	0.0	226.7	0	0.00	226.7	7.34	0.00
Spotted hyaena	1665	206.0	Lion (Y=0.3049X)	12.4	226.7	92	2.46	226.7	7.34	40.58
Wild cat	1665	25.7	Leopard (Y=0.6993X)	1.5	226.7	5	45.34	226.7	7.34	2.21
Wild dog	1665	89.6	Lion (Y=0.3049X)	5.4	226.7	40	5.67	226.7	7.34	17.64

SOUTH GNP	Survey Area	Est. population	Equation Used	Est. density	Distance covered	No. of spoor	Spoor frequency	Transect length	Penetration	Spoor density
	South GNP	(Total area)	Stander1998	(Animals/100km ²)	(km)	counted	(km/spoor)	(km)	(Area/length)	(Spoor/100km)
Species	(Km ²)			Y=0.3049X Y=0.6993X	Sum of transects			Sum of routes		
Aardwolf	2121	39.9	Leopard (Y=0.6993X)	1.9	297.6	8	37.20	297.6	7.13	2.69
Brown hyena	2121	26.1	Lion (Y=0.3049X)	1.2	297.6	12	24.80	297.6	7.13	4.03
Cheetah	2121	17.4	Lion (Y=0.3049X)	0.8	297.6	8	37.20	297.6	7.13	2.69
Civet	2121	652.9	Leopard (Y=0.6993X)	30.8	297.6	131	2.27	297.6	7.13	44.02
Genet	2121	144.5	Leopard (Y=0.6993X)	6.8	297.6	29	10.26	297.6	7.13	9.74
Jackal	2121	84.7	Leopard (Y=0.6993X)	4.0	297.6	17	17.51	297.6	7.13	5.71
Leopard	2121	209.3	Leopard (Y=0.6993X)	9.9	297.6	42	7.09	297.6	7.13	14.11
Lion	2121	43.5	Lion (Y=0.3049X)	2.0	297.6	20	14.88	297.6	7.13	6.72
Porcupine	2121	358.8	Leopard (Y=0.6993X)	16.9	297.6	72	4.13	297.6	7.13	24.19
Serval	2121	5.0	Leopard (Y=0.6993X)	0.2	297.6	1	297.60	297.6	7.13	0.34
Spotted hyaena	2121	160.8	Lion (Y=0.3049X)	7.6	297.6	74	4.02	297.6	7.13	24.87

Wild cat	2121	0.0	Leopard (Y=0.6993X)	0.0	297.6	0	0.00	297.6	7.13	0.00
Wild dog	2121	130.4	Lion (Y=0.3049X)	6.1	297.6	60	4.96	297.6	7.13	20.16

TOTAL GNP	Survey Area	Est. population	Equation Used	Est. density	Distance covered	No. of spoor	Spoor frequency	Transect length	Penetration	Spoor density
	Total GNP	(Total area)	Stander1998	(Animals/100km ²)	(km)	counted	(km/spoor)	(km)	(Area/length)	(Spoor/100km)
Species	(Km ²)			Y=0.3049X Y=0.6993X	Sum of transects			Sum of routes		
Aardwolf	3786	75.7	Leopard (Y=0.6993X)	2.0	524.3	15	34.95	524.3	7.22	2.86
Brown hyena	3786	96.9	Lion (Y=0.3049X)	2.6	524.3	44	11.92	524.3	7.22	8.39
Cheetah	3786	33.0	Lion (Y=0.3049X)	0.9	524.3	15	34.95	524.3	7.22	2.86
Civet	3786	1661.3	Leopard (Y=0.6993X)	43.9	524.3	329	1.59	524.3	7.22	62.75
Genet	3786	323.2	Leopard (Y=0.6993X)	8.5	524.3	64	8.19	524.3	7.22	12.21
Jackal	3786	191.9	Leopard (Y=0.6993X)	5.1	524.3	38	13.80	524.3	7.22	7.25
Leopard	3786	358.5	Leopard (Y=0.6993X)	9.5	524.3	71	7.38	524.3	7.22	13.54
Lion	3786	48.4	Lion (Y=0.3049X)	1.3	524.3	22	23.83	524.3	7.22	4.20
Porcupine	3786	823.1	Leopard (Y=0.6993X)	21.7	524.3	163	3.22	524.3	7.22	31.09
Serval	3786	5.0	Leopard (Y=0.6993X)	0.1	524.3	1	524.30	524.3	7.22	0.19
Spotted hyaena	3786	365.5	Lion (Y=0.3049X)	9.7	524.3	166	3.16	524.3	7.22	31.66
Wild cat	3786	25.2	Leopard (Y=0.6993X)	0.7	524.3	5	104.86	524.3	7.22	0.95
Wild dog	3786	220.2	Lion (Y=0.3049X)	5.8	524.3	100	5.24	524.3	7.22	19.07

