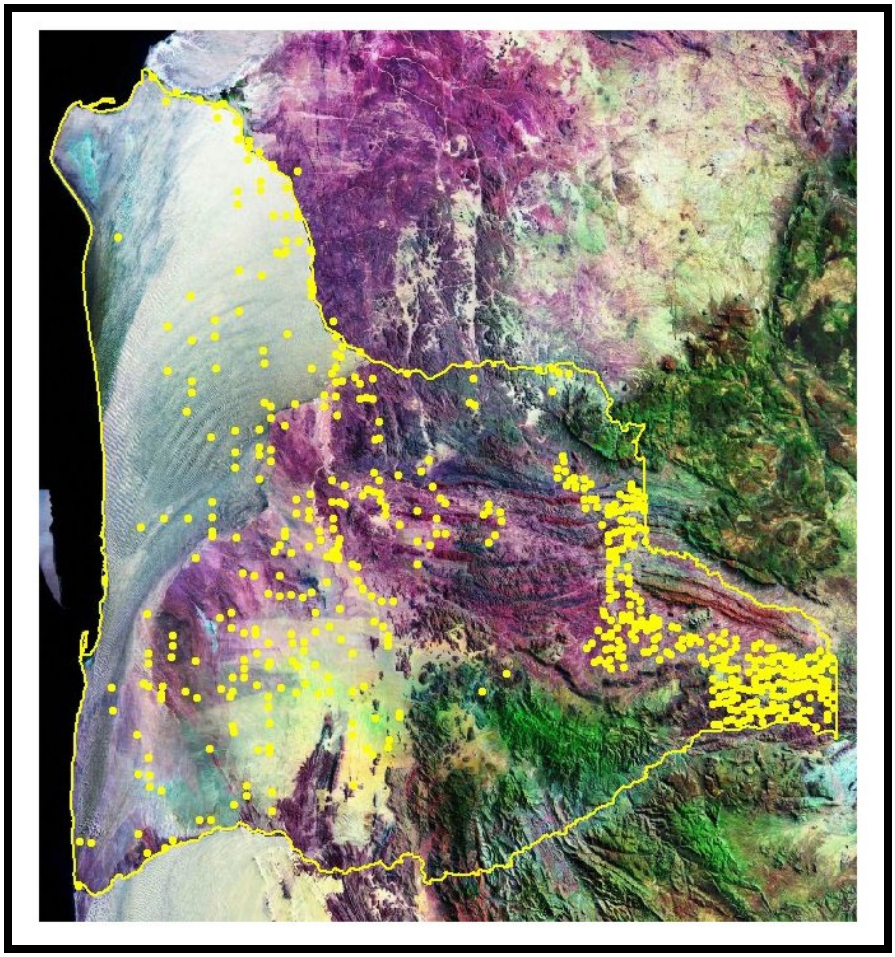
TECHNICAL REPORTS OF SCIENTIFIC SERVICES

Report on an Aerial Survey of Iona National Park, Angola, 6 to 14 June 2003

Holger Kolberg and Werner Kilian



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The following people contributed to this report:

Nad Brain, Chris Eyre, Martins Pinto, Joaquim Manuel, Willem Kubeb, Johannes Kapner, Markus Augumeb, Gotfried Tjiwethy

1. Introduction

Initiatives to create protected areas that span international boundaries have gained significant momentum over the past few years. The primary aim of these transfrontier conservation areas is to cooperatively manage large areas to the benefit of all parties involved. Namibia is involved in several such initiatives and the Iona Skeleton Coast TFCA is one of them.

Figure 1: Location of Iona National Park in Angola.

Angolan and Namibian officials visited Skeleton Coast Park and Iona National Park in May 2002 to familiarise themselves with the area. The difficulties experienced in accessing Iona by road, led to the recommendation that perhaps an aerial survey of the park should be undertaken in order to get a better understanding of the condition of the park's wildlife. This led to an aerial survey being conducted from 6 to 14 June 2003.

Iona National Park covers about 15000km² and is situated in the southwestern corner of Angola (Figure 1). It is bordered on the west by the Atlantic Ocean, the south by the Kunene River and the north and east by the Curoca and Ovipaca rivers. The western part of the park is flat, consisting of gravel plains in the south and sand dunes in the north. The eastern part is very rugged and mountainous with the highest peaks reaching well over 1500m above sea level (Figure 2).

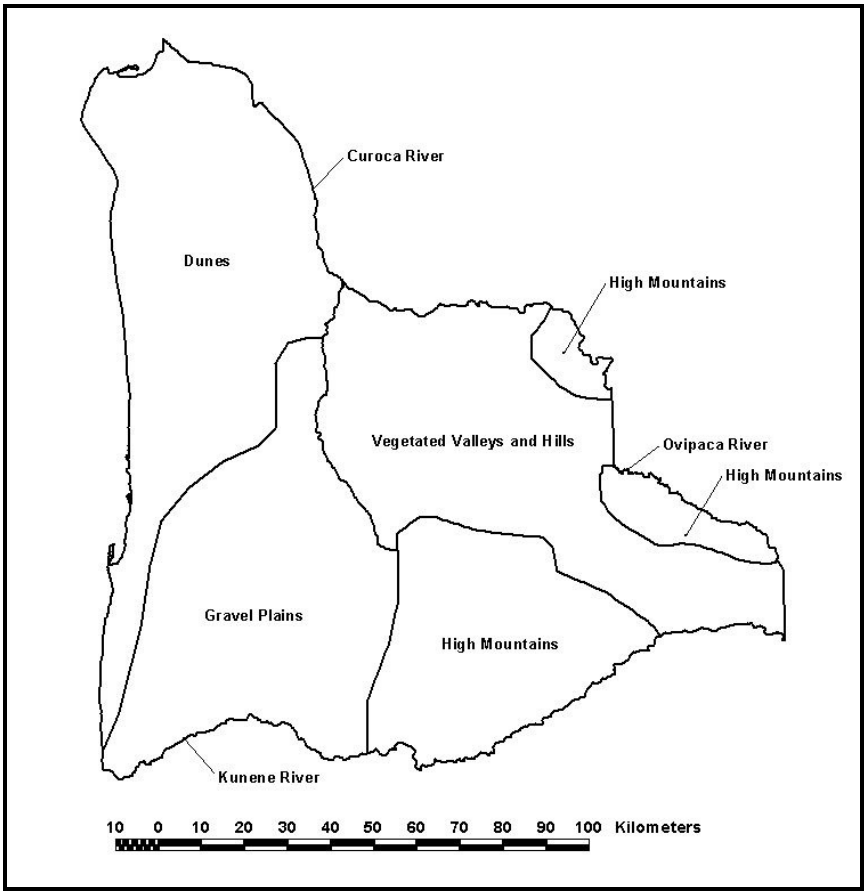

Figure 2: Map illustrating the different habitats found in Iona NP.

2. Methods

2.1 Stratification

The survey covered an area of 8022 km² or 53% of the total surface area of the park; the remaining area of the park was considered to be too mountainous and hence unsafe to fly with a fixed-wing aircraft. This survey was conducted using systematic transects following standard aerial survey sampling techniques (Norton-Griffiths 1978). To maximise efficiency and to improve the precision of estimates it is usual to stratify a survey area according to known or expected densities and distribution of the animals in question (Gasaway *et al* 1986).

There was however no *a priori* information available on animal distribution in Iona National Park on which the stratification could be based so the stratification was based purely on topography and habitat. There is a clear divide between the coastal dunes, vegetated dunes and gravel plains in the west and the mountainous terrain to the east. Iona was stratified into eleven blocks or strata (Figure 3). Since the western part of Iona NP is very similar to the southern Namib, 10 and 20% sampling intensities were chosen as an aerial survey conducted under similar conditions in the southern Namib showed these to be sufficient (Kilian 1999). Earlier experimental work in Etosha National Park had illustrated that 40% sampling intensity is optimal and cost-effective for that area (Lindeque 1997) and, as no other benchmark could be found, this intensity was chosen for the remainder of Iona NP.

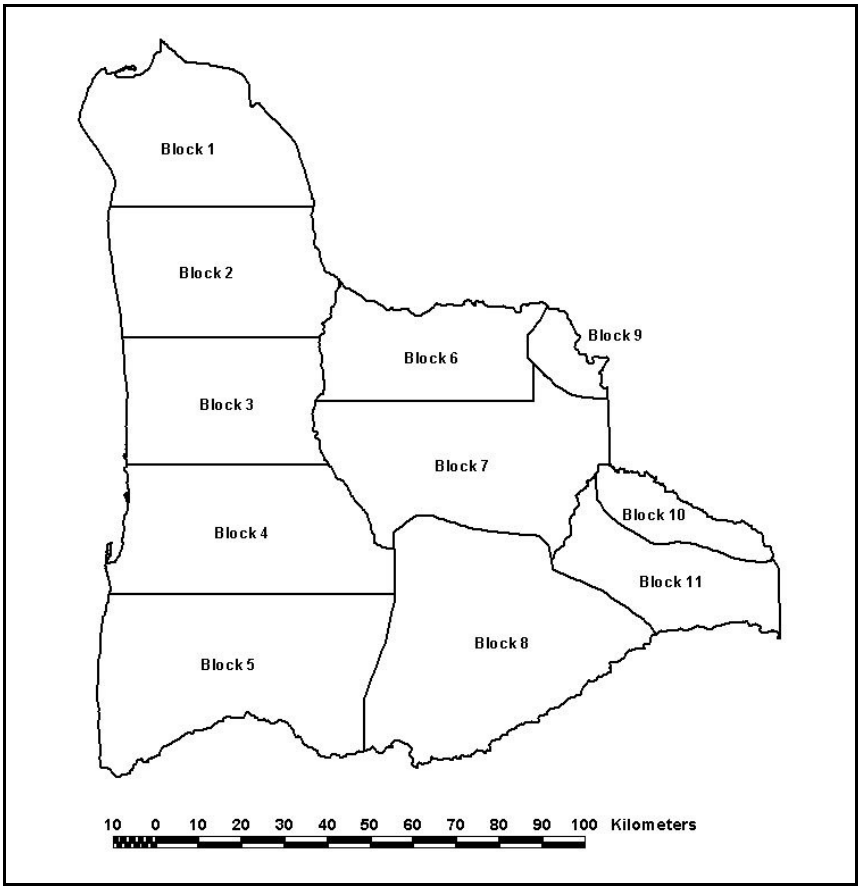

Figure 3: Original survey block design in Iona NP.

Blocks 8, 9 and 10 were omitted from sampling due to the extreme mountainous nature of the terrain in these blocks, which made it impractical and dangerous to attempt transect or block counts. Due to adverse weather conditions, blocks 3 and 4 had to be post-stratified, resulting in two additional blocks 3_1 and 4_1 with lower sampling intensities (Figure 4). Similarly, areas of block 2 and 5 close to the coast had to be left out because of fog. Part of block 1 around the town of Tombua was not flown because explicit permission to fly low over towns is required. Several areas in blocks 3, 4, 5, 6, 7 and 11 could not be flown due to the mountainous nature of the terrain, which would have made maintaining a constant flying height very difficult (the nature of the terrain was not obvious from the topographic sheets or the satellite image otherwise these areas would have been left out right away). Only the area actually flown was considered in the analysis.

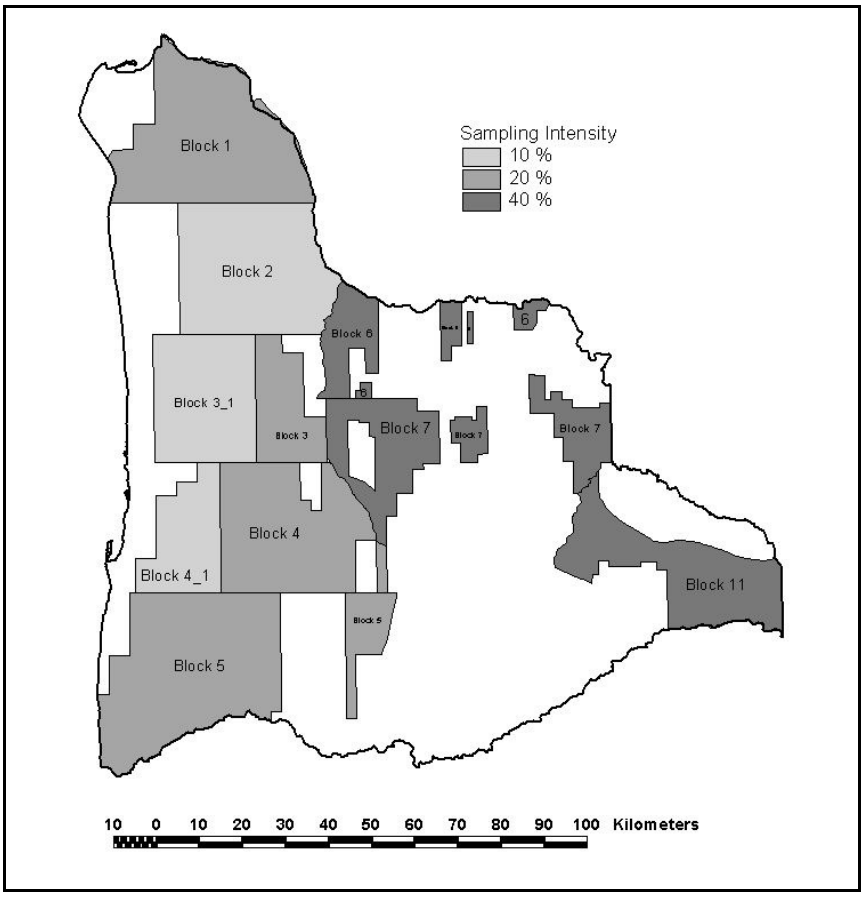

Figure 4: Map showing area of each block flown (darker colour = higher intensity) and the changes in block 3 and 4.

2.2 Calibration

A Cessna 206 was used in the survey. The observers were calibrated at a strip width of 250 meters on either side of the aircraft following standard procedures (Norton-Griffiths 1978). A pair of streamers fixed to the lift struts defined the boundaries of the strips on either side of the aircraft. The calculated strip widths for the two observers used in the survey are presented in Appendix 1.

2.3 Transect selection

The survey blocks were systematically divided into the required transect spacing (arbitrarily centred around 12°E) using ArcView® GIS software. The terrain generally slopes from east to west and hence transects were orientated in a north-south direction; this makes maintaining the required flying height easier. The layout of all transects flown is presented in Figure 5.

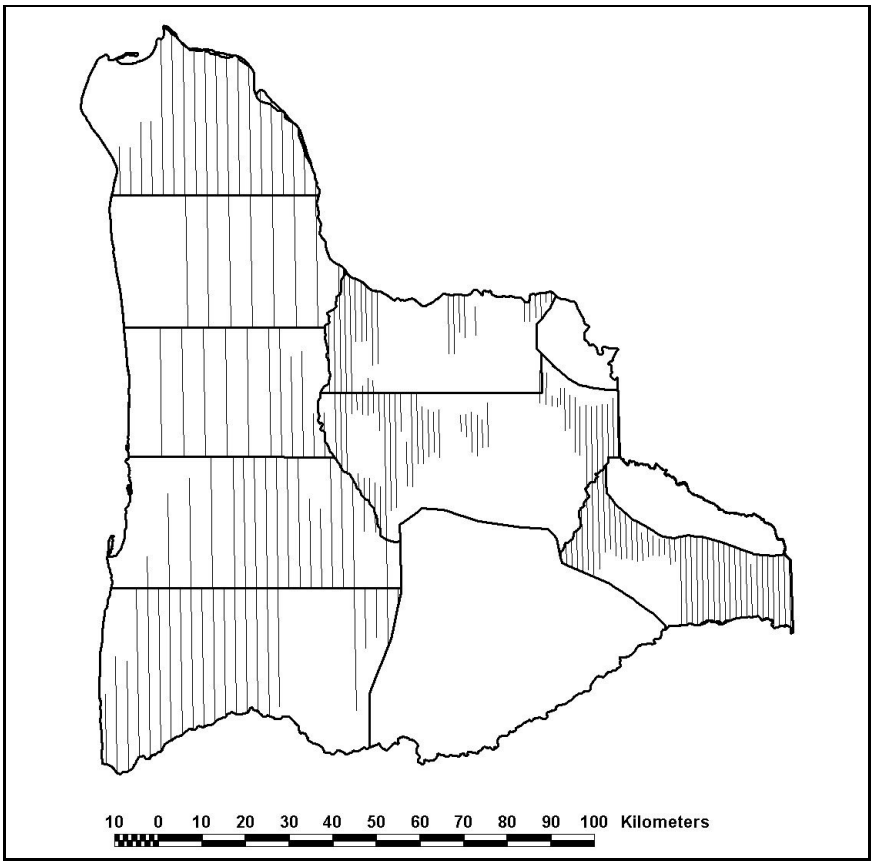

Figure 5: Transects flown in each survey block.

2.4 Data collection

The aircraft used in the survey was equipped with Garmin® 12 and 12XL global positioning systems (GPS). The transects were loaded onto the GPS and this ensured accurate navigation along each transect. A flying height of 300 feet above ground level was maintained. The two observers called out all sightings of animals but only those sightings within the demarcated strips were used for analyses. The data recorder noted waypoint data for each sighting which included the species and number seen and also noted the height above ground level (a.g.l.) from the radar altimeter for each waypoint to allow for the calculation of the mean flying height for each survey block, and the starting and end times for each transect. This enabled the calculation of search rate for each survey block. After each survey session, the observation and flight data were downloaded to a personal computer using Ozi Explorer® GPS software and all data were then transformed to a Microsoft Access® database. Summary data for all search blocks is shown in Table 1.

Table 1: Summary data for all blocks.

Block	*No of transects*	*Transect spacing (km)*	*Total area (km²)*	*Area sampled (km²)*	*Sampling (%)*	*Flying time (mins)*	*Search rate (km²/min)*
1	19	2.5	1150.78	208.24	18.1	117	1.78
2	8	5	1035.72	101.83	9.8	56	1.82
3	6	2.5	364.25	65.28	17.9	36	1.56
3_1	5	5	704.96	76.07	10.8	41	1.86
4	15	2.5	933.12	162.97	17.5	92	1.76
4_1	4	5	428.16	38.81	9.1	22	1.77
5	22	2.5	1487.91	275.47	18.5	153	1.80
6	21	1.25	363.33	157.2	43.3	76	2.07
7	42	1.25	799.09	323.36	40.5	154	2.10
11	42	1.25	754.99	340.14	45.1	153	2.22
Total			**8022.31**	**1749.37**	**21.8**		

2.5 Distribution mapping

The localities of each sighting were plotted on maps using ArcView® GIS linked to the database mentioned above. This enabled distribution mapping and calculation of densities.

2.6 Estimation of numbers and confidence limits

Jolly's method II for unequal-sized sampling blocks was applied to all sightings. A spreadsheet model was developed by R. Emslie (*pers. comm.*) to calculate population estimates and the variance of these estimates. This enabled the calculation of 90 and 95% confidence limits for each species per survey block. Where the lower 95% confidence interval was lower than the actual number seen, the actual number seen is given as the lower 95% confidence interval.

3. Results

3.1 Oryx (*Oryx gazella*)

The distribution of oryx is closely linked to the gravel plains and dunes in the western part of Iona. The groups were generally small (1-10 animals), the largest herd observed was 24 head[1], and no oryx were seen in the eastern blocks (Table 2).

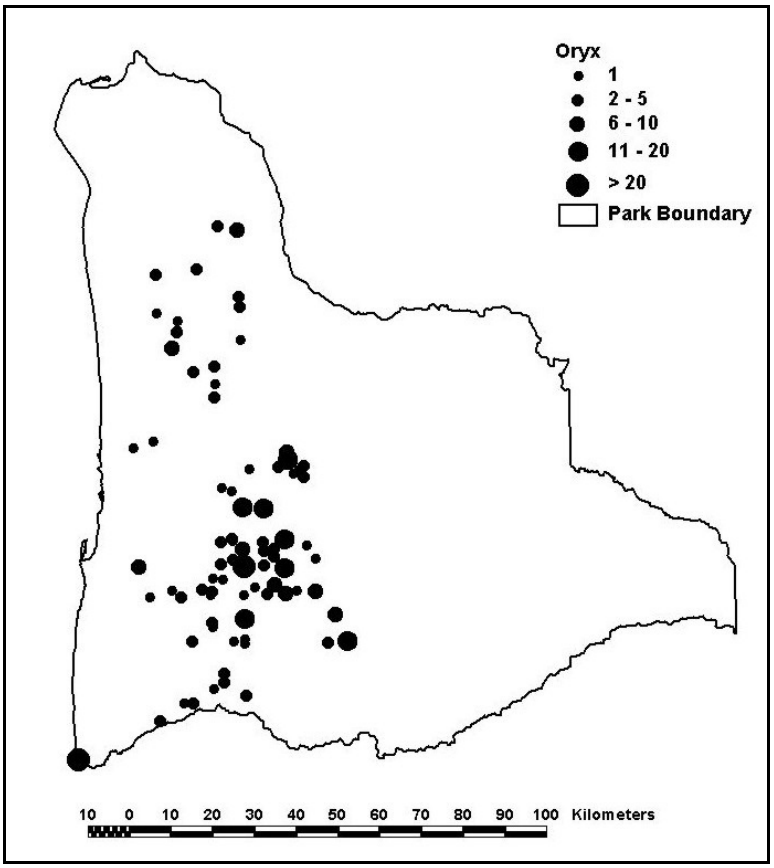

Figure 6: Distribution of oryx[2].

Table 2: Summary data for oryx.

Block	*Population estimate*	*Number seen*	*Variance*	*95% ci % estimate*	*95% range*	*Density (no/km²)*
1	0	0	0	0	0	0.00
2	285	28	24932.2	131.13	28-658	0.28
3	201	36	54147.8	297.85	36-799	0.55
3_1	83	9	1655.4	135.42	9-196	0.12
4	624	109	44595	72.58	109-1077	0.67
4_1	121	11	16492.3	336.75	11-530	0.28
5	302	56	15100.9	84.55	56-558	0.20

[1] A herd of 27 oryx was seen at the Kunene Mouth on 14 June but since this was not during the survey, these animals were not considered in the analysis.

[2] The map shows all sightings i.e. all animals seen both within and outside the transect. This applies to all distribution maps.

6	0	0	0	0	0	0.00
7	15	6	168.8	177.07	6-41	0.02
11	0	0	0	0		0.00
Total	**1631**	**255**	**157092.4**	**54.97**	**734-2528**	**0.20**

3.2 Hartmann's Zebra (*Equus zebra hartmannae*)

Very few mountain zebra were observed; all of these were on the central gravel plains. This is a reflection of the fact that none of the mountainous areas were surveyed. The largest herd comprised ten animals.

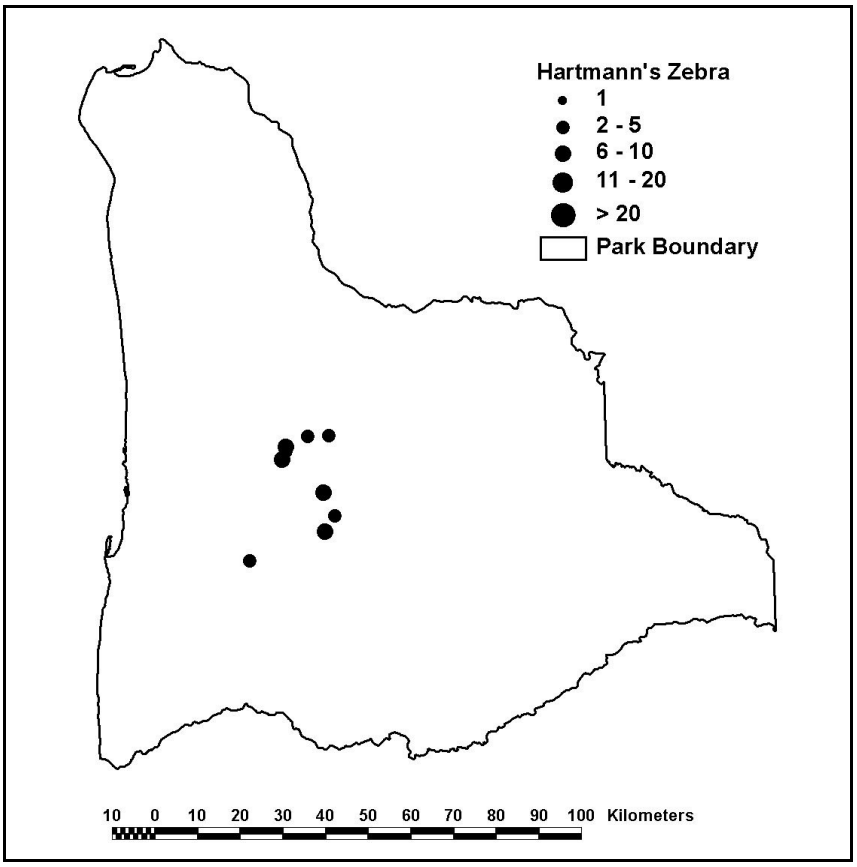

Figure 7: Distribution of Hartmann's zebra.

Table 3: Summary data for Hartmann's zebra.

Block	*Population estimate*	*Number seen*	*Variance*	*95% ci % estimate*	*95% range*	*Density (no/km²)*
1	0	0	0	0	0	0.00
2	0	0	0	0	0	0.00
3	67	12	2941	208.25	12-206	0.18
3_1	0	0	0	0	0	0.00
4	189	33	8410.2	104.11	33-386	0.20
4_1	0	0	0	0	0	0.00
5	0	0	0	0	0	0.00
6	0	0	0	0	0	0.00

7	7	3	87.7	255.22	3-26	0.01
11	0	0	0	0	0	0.00
Total	**263**	**48**	**11438.9**	**91.99**	**48-505**	**0.03**

3.3 Ostrich (*Struthio camelus*)

Ostrich were observed mainly on the gravel plains. Only in the extreme east no ostrich were seen and the largest group observed was 24.

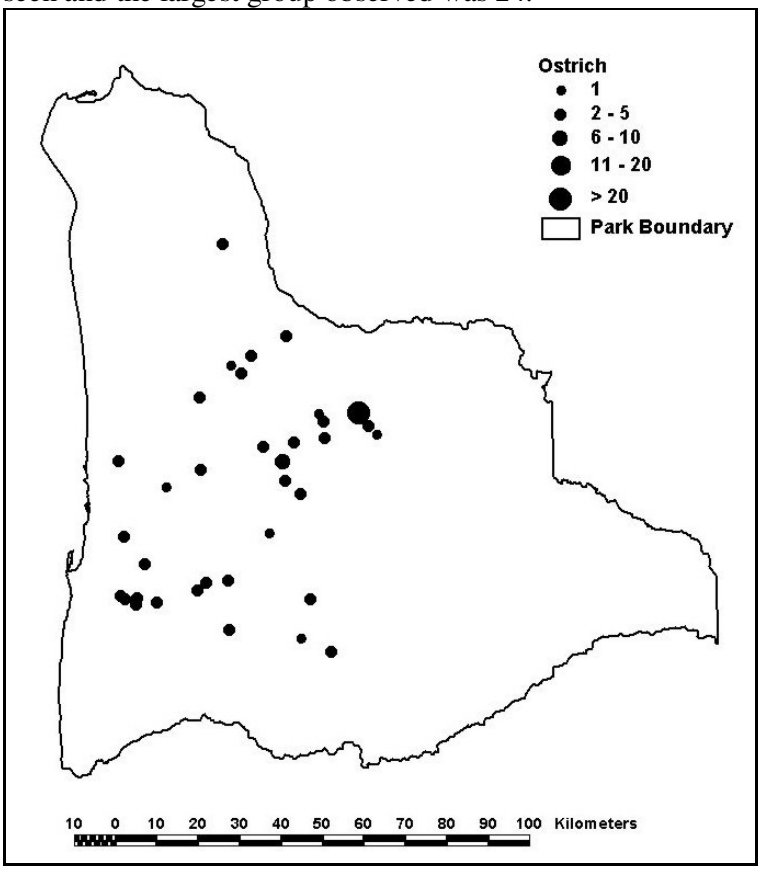

Figure 8: Distribution of ostrich.

Table 4: Summary data for ostrich.

Block	*Population estimate*	*Number seen*	*Variance*	*95% ci % estimate*	*95% range*	*Density (no/km²)*
1	0	0	0	0		0
2	41	4	1851.8	250.17	4-142	0.04
3	17	3	177.1	204.44	3-51	0.05
3_1	56	6	4420.4	331.94	6-240	0.08
4	46	8	726.6	126.23	8-104	0.05
4_1	77	7	849.4	120.09	7-107	0.18
5	32	6	371.9	123.77	6-73	0.02
6	5	2	29.4	244.52	2-16	0.01
7	124	50	7619.2	142.77	50-300	0.16
11	0	0	0	0	0	0.00
Total	**398**	**86**	**16045.8**	**71.99**	**111-685**	**0.05**

3.4 Springbok (*Antidorcas marsupialis*)

Distribution of springbok was similar to the distribution of oryx i.e. restricted to the gravel plains and dunes in the west. The largest herd was 60 head and springbok were seen in all blocks but one (Table 5).

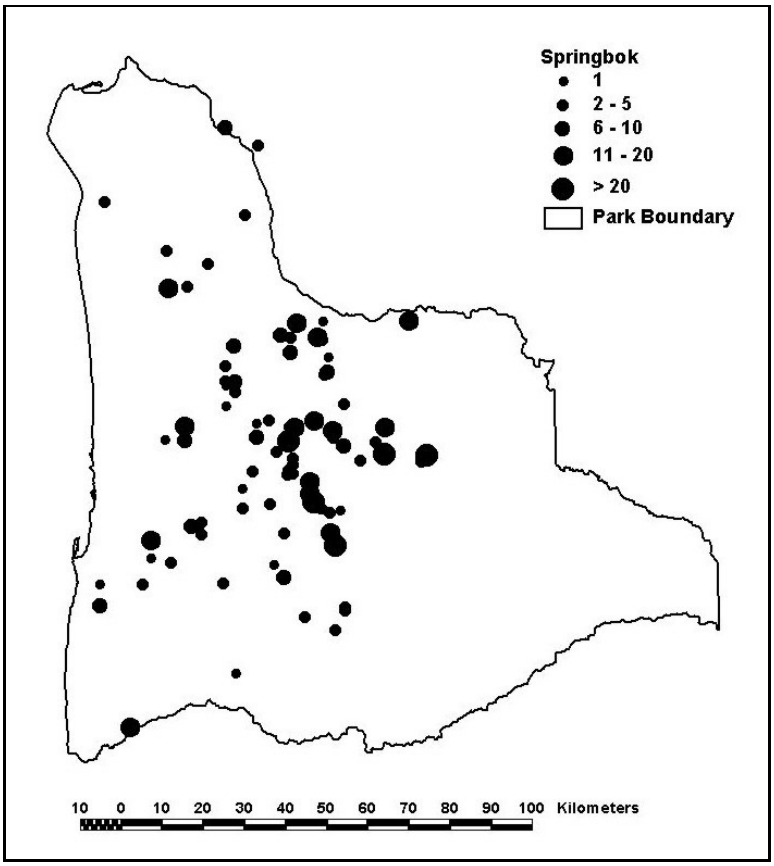

Figure 9: Distribution of springbok.

Table 5: Summary data for springbok.

Block	*Population estimate*	*Number seen*	*Variance*	*95% ci % estimate*	*95% range*	*Density (no/km²)*
1	44	8	1139.7	160.44	8-115	0.04
2	295	29	63348.8	201.82	29-890	0.28
3	145	26	1669.4	72.41	26-250	0.40
3_1	222	24	36099.6	237.15	24-750	0.31
4	378	66	39658.5	113.04	66-805	0.41
4_1	276	25	58838.6	279.87	25-1048	0.64
5	59	11	1262.2	124.44	11-133	0.04
6	171	74	4197.8	79.02	74-306	0.47
7	798	323	137453.2	93.87	323-1547	1.00
11	0	0	0	0	0	0.00
Total	**2388**	**586**	**343667.8**	**55.53**	**1062-3714**	**0.30**

3.5 Cattle

Distribution of cattle reflects the availability of water. In three blocks herds of over 100 cattle were observed, the largest being a herd of 600 in block 7 (Table 6). No cattle were observed in the southwestern areas.

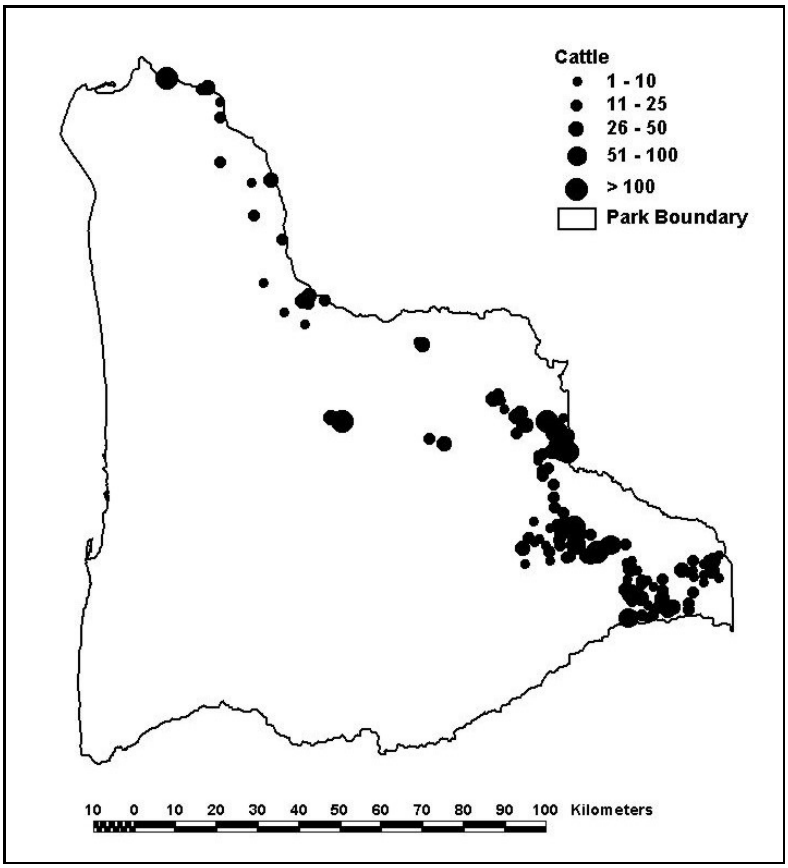

Figure 10: Distribution of cattle.

Table 6: Summary data for cattle.

Block	*Population estimate*	*Number seen*	*Variance*	*95% ci % estimate*	*95% range*	*Density (no/km²)*
1	2443	442	2218710	128.13	442-5572	2.12
2	633	56	234994.6	181.17	56-1779	0.61
3	0	0	0	0	0	0.00
3_1	0	0	0	0	0	0.00
4	0	0	0	0	0	0.00
4_1	0	0	0	0	0	0.00
5	0	0	0	0	0	0.00
6	254	110	25329.5	130.59	110-586	0.70
7	6650	2691	9698700	94.65	2691-12944	8.32
11	3982	1794	757527.6	44.17	1794-5741	5.27
Total	**13962**	**5093**	**12935261**	**58.27**	**5827-22097**	**1.74**

3.6 Donkeys

Very few donkeys were observed. A group of 21 donkeys was the largest group seen.

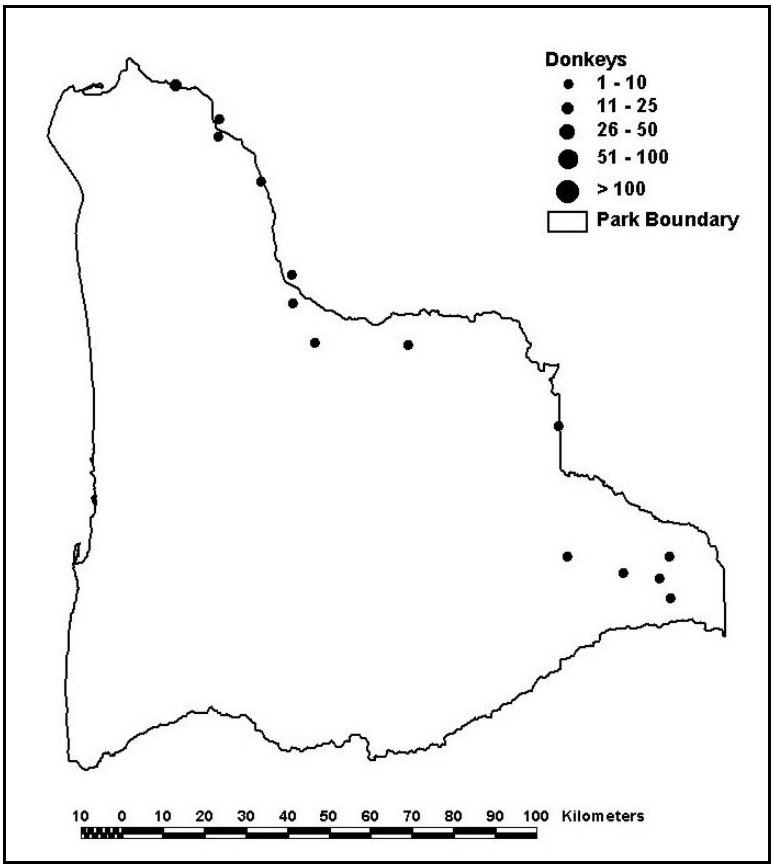

Figure 11: Distribution of donkeys.

Table 7: Summary data for donkeys.

Block	*Population estimate*	*Number seen*	*Variance*	*95% ci % estimate*	*95% range*	*Density (no/km²)*
1	249	45	42253.7	173.67	45-681	0.22
2	23	2	577.8	251.53	2-79	0.02
3	0	0	0	0	0	0.00
3_1	0	0	0	0	0	0.00
4	0	0	0	0	0	0.00
4_1	0	0	0	0	0	0.00
5	0	0	0	0	0	0.00
6	9	4	76.7	197.59	4-28	0.02
7	5	2	39.2	255.9	2-18	0.01
11	36	16	512.9	128.89	16-81	0.05
Total	**322**	**69**	**43460.3**	**146.45**	**69-794**	**0.04**

3.7 Goats

By far the largest numbers of animals observed were goats. Similar to the cattle, they are concentrated in the east and along the Curoca River. Three blocks had herds of over 100 animals with a herd of 1000 head being observed in block 7 (Table 8). Similar to the other livestock, no goats were observed in the southwestern blocks.

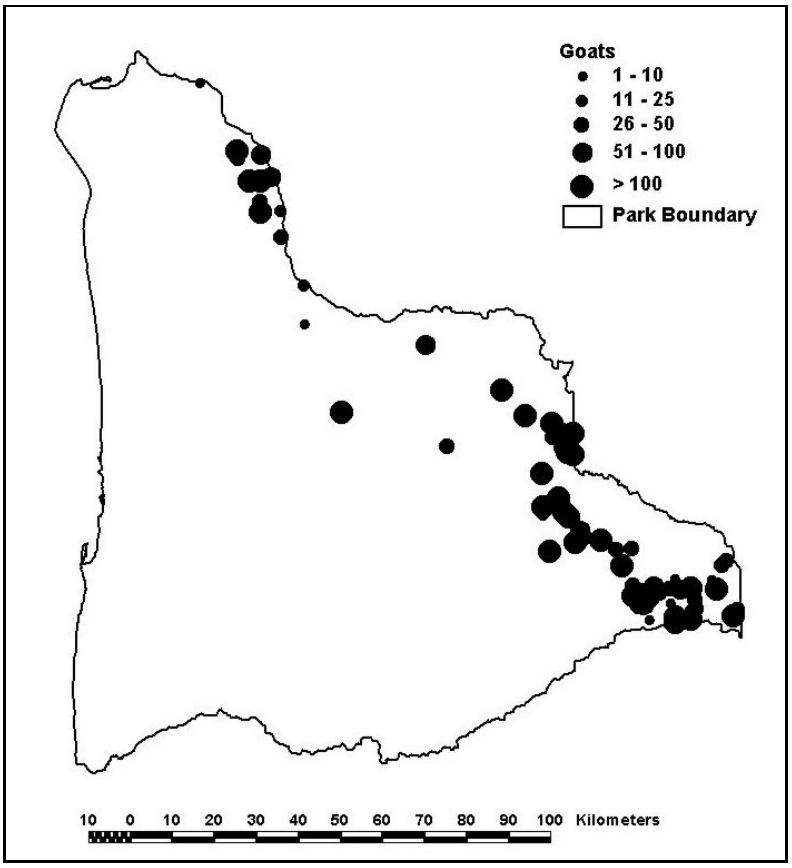

Figure 12: Distribution of goats.

Table 8: Summary data for goats.

Block	*Population estimate*	*Number seen*	*Variance*	*95% ci % estimate*	*95% range*	*Density (no/km²)*
1	4587	830	7437513	124.92	830-10316	3.99
2	576	51	177418.1	172.85	51-1572	0.56
3	0	0	0	0	0	0.00
3_1	0	0	0	0	0	0.00
4	0	0	0	0	0	0.00
4_1	0	0	0	0	0	0.00
5	0	0	0	0	0	0.00
6	171	74	39545.7	242.55	74-586	0.47
7	11170	4520	32207016	102.68	4520-22639	13.98
11	10998	4955	6719485	47.63	4955-16237	14.57

Total	**27502**	**10430**	**46580978**	**56.13**	**12064-42940**	**3.43**

3.8 Human Settlement

A large number of human settlements were observed. All settlements observed consisted of a number of huts surrounded by a wooden stockade i.e. similar to traditional Himba kraals. These were mainly concentrated in the eastern part of the park and along the Curoca River (Figure 13), reflecting the availability of water. The highest density of human settlement was observed in block 11 but no kraals were observed in five blocks (Table 9).

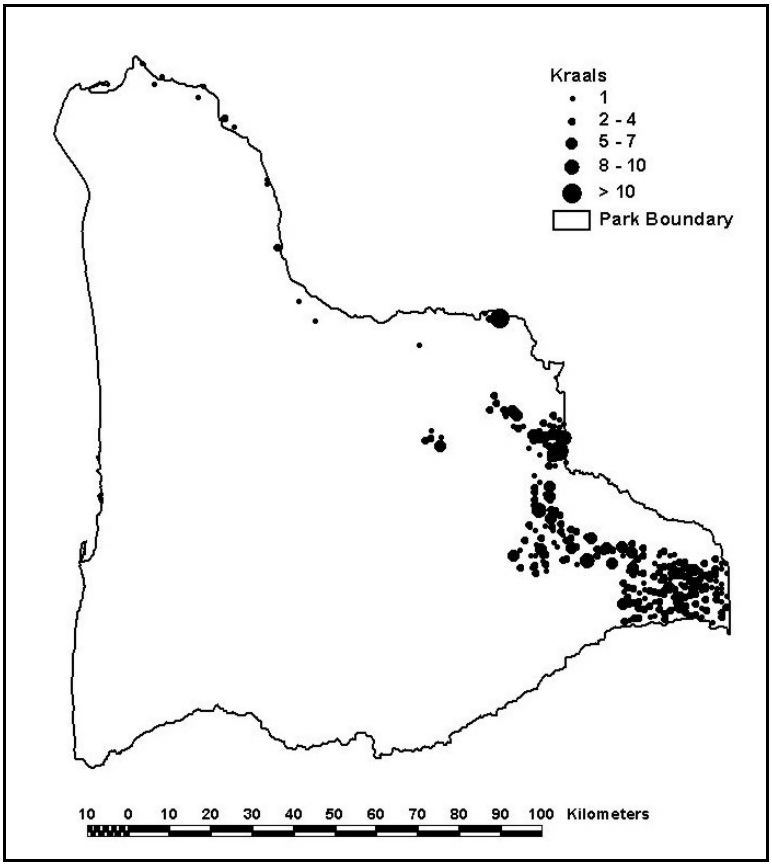

Figure 13: Distribution of kraals.

Table 9: Summary data for kraals.

Block	*Population estimate*	*Number seen*	*Variance*	*95% ci % estimate*	*95% range*	*Density (no/km²)*
1	55	10	225.4	57.08	10-87	0.05
2	23	2	250.7	165.69	2-60	0.02
3	0	0	0	0	0	0.00
3_1	0	0	0	0	0	0.00
4	0	0	0	0	0	0.00
4_1	0	0	0	0	0	0.00
5	0	0	0	0	0	0.00
6	12	5	42.5	117.61	5-25	0.03

7	124	50	1530.1	63.98	50-203	0.16
11	415	187	676.8	12.67	187-468	0.55
Total	**629**	**254**	**2725.5**	**18.77**	**511-747**	**0.08**

4. Discussion

Considering the fact that this was in essence a "cold" survey i.e. not much was known about the area to be surveyed beforehand, the results are nevertheless encouraging. Perhaps the high variances obtained for each species are a matter of concern but the low numbers and uneven distribution of species do, in part, account for that.

The presence of humans and livestock in any park is often a topic of heated discussion. Perhaps the high densities of goats and cattle observed in this survey are reason for concern and ways to address this issue need to be investigated. However, these densities are comparable to densities observed in northwestern Namibia (Mendelsohn *et al* 2002) and maybe an approach to conservation similar to that in Namibia is thus called for. Wildlife densities are virtually the same in Iona as in northwestern Namibia. Springbok average between 0.01 and 1 animal per km² in both areas and the figures for oryx are only slightly lower (max. 0.67/km² in Iona, max. over 1/km² in NW Namibia).

Table 10: Summary of data for all blocks.

Species	*Population estimate*	*Number seen*	*Variance*	*95% ci % estimate*	*95% range*	*Density (no/km²)*
Oryx	1631	255	157092.4	54.97	734-2528	0.20
Hartmann's Zebra	263	48	11438.9	91.99	48-505	0.03
Ostrich	398	86	16045.8	71.99	111-685	0.05
Springbok	2388	586	343667.8	55.53	1062-3714	0.30
Kraals	629	254	2725.5	18.77	511-747	0.08
Cattle	13962	5093	12935261	58.27	5827-22097	1.74
Donkeys	322	69	43460.3	146.45	69-794	0.04
Goats	27502	10430	46580978	56.13	12064-42940	3.43

The survey results show that despite considerable human presence and large numbers of livestock, there is still a reasonable wildlife resource in the park (Table 10). There is a clear division between areas occupied by humans and livestock, and areas occupied by wildlife (Figure 14). This split seems to be tied to the presence of permanent waters – the humans and livestock being restricted to the Curoca River and the mountainous valleys to the east and the wildlife inhabiting the dry gravel plains and sand dunes in the west.

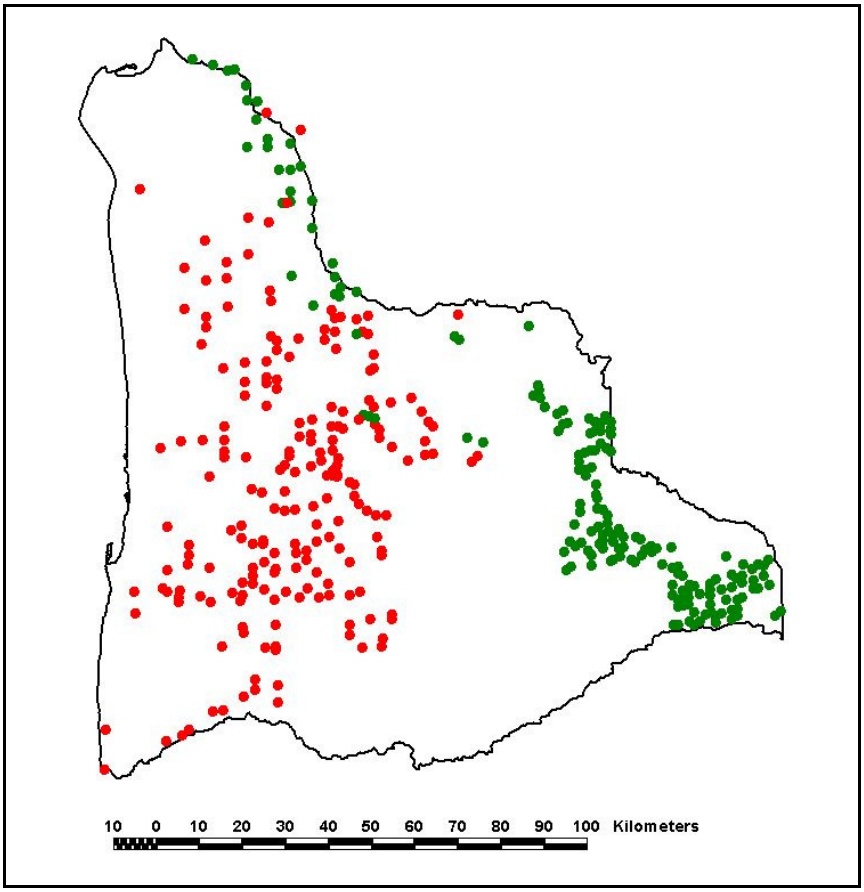

Figure 14: Distribution of livestock (green dots) and wildlife (red dots).

The presence of large predators (one leopard in block 7 and a cheetah in block 6), jackal (several observations) and vultures (four nests) indicates that the system is perhaps in good condition.

Due to a lack of historical data no estimates of population trends were possible. However, a report by Huntley (1974) makes some comparisons possible. During a visit to the park in February 1972, Huntley counted 561 oryx and 681 springbok and during a survey in January 1974 1050 springbok and 1650 oryx were seen[3]. If one assumes that both these counts were not comprehensive but rather opportunistic observations, then the numbers do appear to be drastically higher than the numbers observed during this survey.

All data referred to in this document are held in electronic copy at the offices of the Ministry of Environment and Tourism, Windhoek.

[3] Unfortunately no details are available on these surveys i.e. whether they were air or ground based, comprehensive or random etc.

5. References

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6. Acknowledgements

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Appendix 1

Calibration data and calculated strip widths for the two observers used during the survey.

Willem Kumub		Johannes Kapner	
Height (a.g.l.)	Strip width (m)	Height (a.g.l.)	Strip width (m)
310	250	310	210
300	210	300	220
300	230	300	240
300	210	300	240
300	200	300	230
300	210	300	200
290	220	290	220
290	200	290	200
240	170	240	160
300	200	300	220
300	210	300	220
310	190	310	220
Mean =295	Mean = 208	Mean = 295	Mean =215
	Calculated strip width = 212.8		Calculated strip width = 206.8