

**AERIAL SURVEY OF
QUIRIMBAS NATIONAL PARK AND
ADJACENT AREAS, CABO DELGADO
*Mozambique, October 2011***

Prepared for

WWF Mozambique

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Thank you all

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1 INTRODUCTION

An aerial survey of wildlife and other environmental attributes in Cabo Delgado province in Northern Mozambique was undertaken from 19 to 27 October. The survey was carried out in sequence with the survey of Niassa Reserve which ended on the 19 October.

The Survey was done under the auspices of the Worldwide fund for Nature to cover Quirimbas National park, a corridor linking Niassa Reserve with Quirimbas NP (referred to here as WWF West or W) and a forest area on the Rovuma River (referred to here as WWF North or N). all wildlife, human impacts and other relevant environmental factors were to be estimated or evaluated.

Descriptions of methods are provided in Appendix I. Stratified systematic transect sampling was used (Norton Griffiths, 1978) in a light aircraft (a Cessna 206) flying at a nominal height of 300 feet above the ground. The nominal sampling intensity was 10%.

Quirimbas National Park was divided into 2 survey strata, Q1 and Q2, which included a buffer area around the park. The other areas were flown as single strata (Fig. 1). Some transects in stratum W were cut short for logistic reasons and the boundary adjusted accordingly. Transects in Q2 were extended to reach the coast.

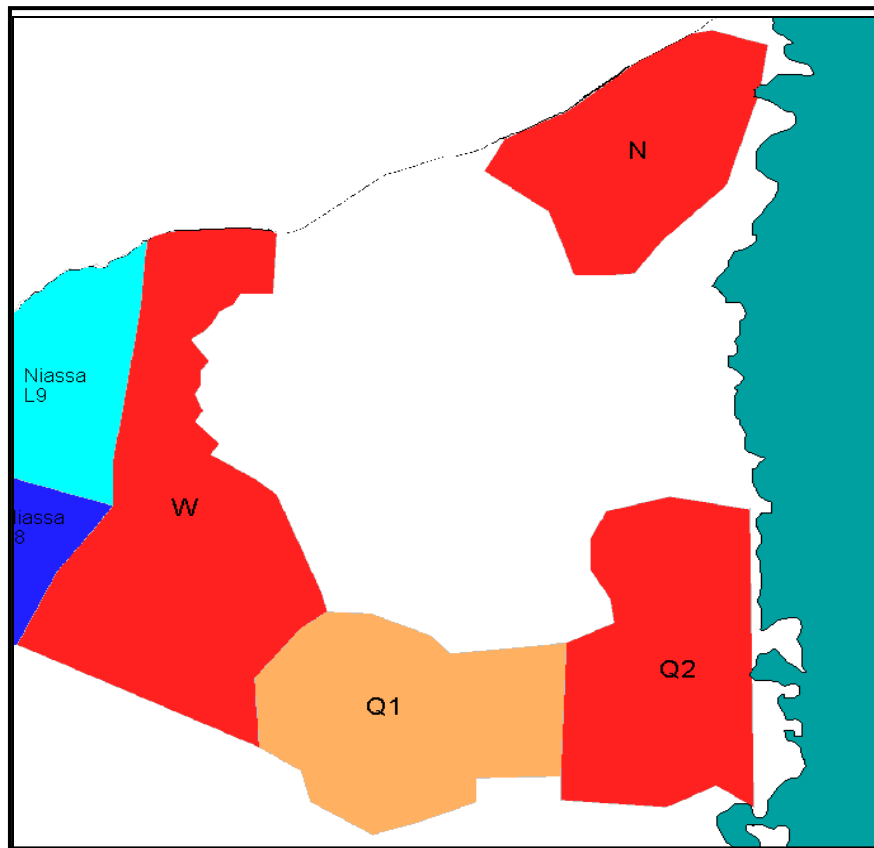


Figure 1: WWF Survey Strata 2011

This interim report covers wildlife populations and human activities. The results section describes estimates and distribution for all attributes. Full results by stratum are given in Appendix II.

2 RESULTS FOR WILDLIFE

For each wildlife species in this section a sighting map is provided along with a table of estimates for each management unit. In the table the “range” refers to the range within which there is a 95% probability that the true number falls (i.e. it is the 95% confidence interval). Strictly, for most species this is actually the range within which 95% of independent *estimates* made by the same method would fall. The true value is likely to be higher on average because of undercounting bias.

“No. seen” is the number of animals seen within sampling strips and “No. out” is the number seen outside of the sampling strips. Where animals were seen only outside of the sampling strips no estimate can be made by this method although the record shows that the species occurs.

Wildlife species in this section are arranged in alphabetical order of their common names with the exception of: Elephant, which are placed first; monkeys, which are put next to baboons; crocodiles, which are placed with hippos. At the end other carcasses seen are reported.

Under elephants, elephant carcasses are tabulated and carcass ratios are given in the table.

Locations of sightings in surveyed areas adjacent to the WWF survey are shown on the maps as well as sightings within the survey area for comparative purposes.

Full original results by stratum are given in Appendix II.

2.1 *Elephant*

All Elephants

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	232	49 <> 430	24	25	0.0319
WWF North	58	6 <> 171	6	0	0.0152
Quirimbas NP	517	84 <> 945	54	0	0.0529
Overall WWF Survey Area	807	326 <> 1289	84	25	0.0387

Elephant Bull

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	68	7 <> 148	7	0	0.0093
Quirimbas NP	124	13 <> 309	13	0	0.0127
Overall WWF Survey Area	192	20 <> 390	20	0	0.0092

Elephant in Family Groups

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	164	42 <> 346	17	25	0.0226
WWF North	58	6 <> 171	6	0	0.0152
Quirimbas NP	393	41 <> 785	41	0	0.0402
Overall WWF Survey Area	615	176 <> 1054	64	25	0.0295

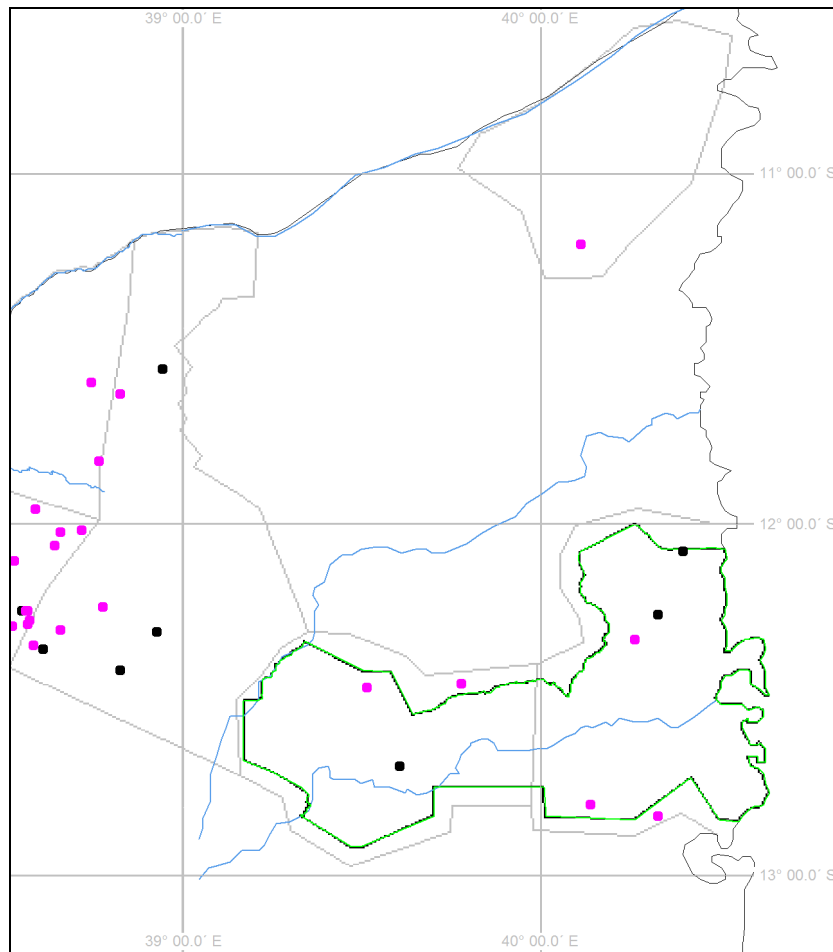


Figure 2: Elephant sightings: bulls black; family groups pink

All Elephant Carcasses

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²	Rat %
WWF West	49	10 <> 88	5	0	0.0066	17.44
WWF North	10	1 <> 29	1	0	0.0025	14.71
Quirimbas NP	86	29 <> 14	3	9	0.0088	14.26
Overall WWF Survey Area	144	73 <> 21	5	15	0.0069	15.14

Rat% = Carcass Ratio. Carcass ratio is 100*carcasses/(carcasses + live).

EleCarcass 3

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	10	1 \diamond 28	1	0	0.0013
Quirimbas NP	19	2 \diamond 45	2	0	0.002
Overall WWF Survey Area	29	3 \diamond 60	3	0	0.0014

EleCarcass 4

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	39	4 \diamond 73	4	0	0.0053
WWF North	10	1 \diamond 29	1	0	0.0025
Quirimbas NP	67	16 \diamond 118	7	0	0.0068
Overall WWF Survey Area	115	52 \diamond 179	12	0	0.0055

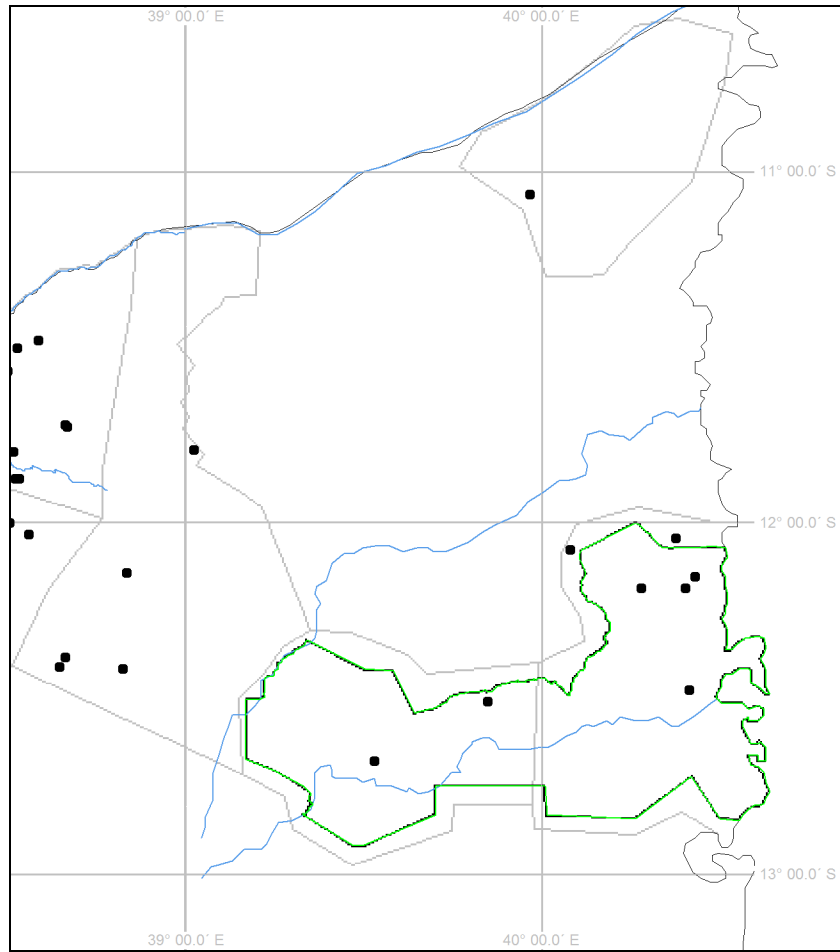


Figure 3: Carcass sightings: Fresh-recent (1+2) red; old-very old (3+4) black

2.2 Baboon

Baboon

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	126	13 \diamond 258	13	0	0.0173
WWF North	19	2 \diamond 58	2	0	0.0051
Quirimbas NP	1397	623 \diamond 2171	146	0	0.1429
Overall WWF Survey Area	1542	766 \diamond 2317	161	0	0.074

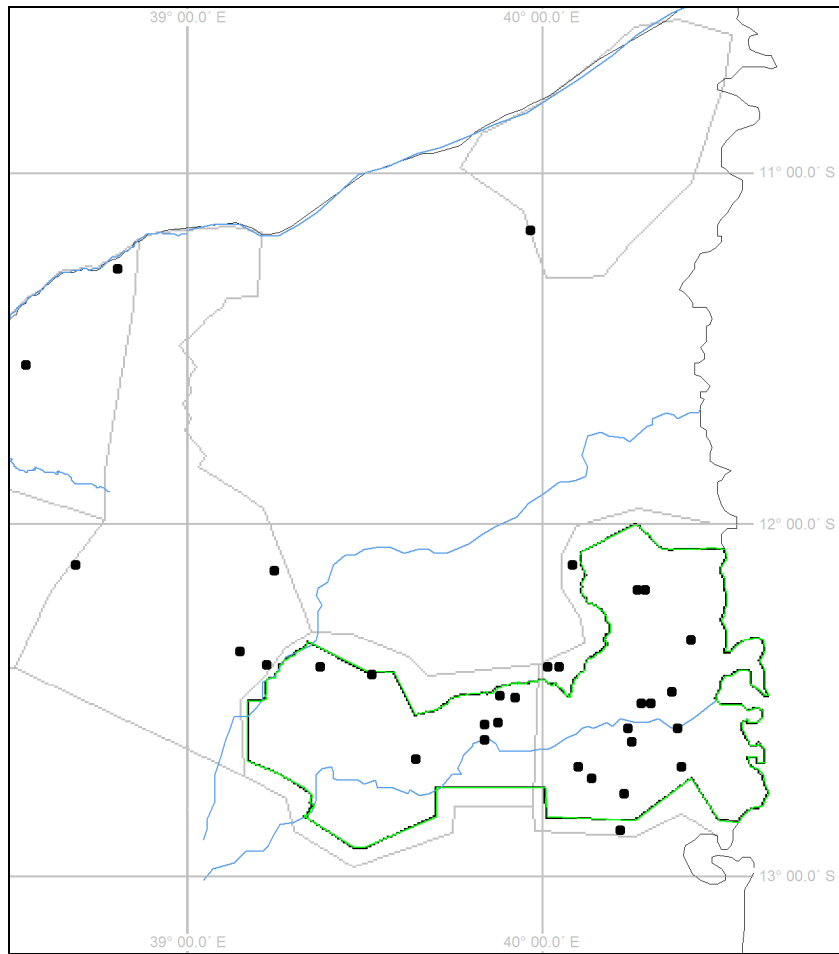


Figure 4: Baboons

Monkey

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	145	15 \diamond 290	15	0	0.02
Quirimbas NP	305	32 \diamond 614	32	0	0.0312
Overall WWF Survey Area	450	114 \diamond 786	47	0	0.0216

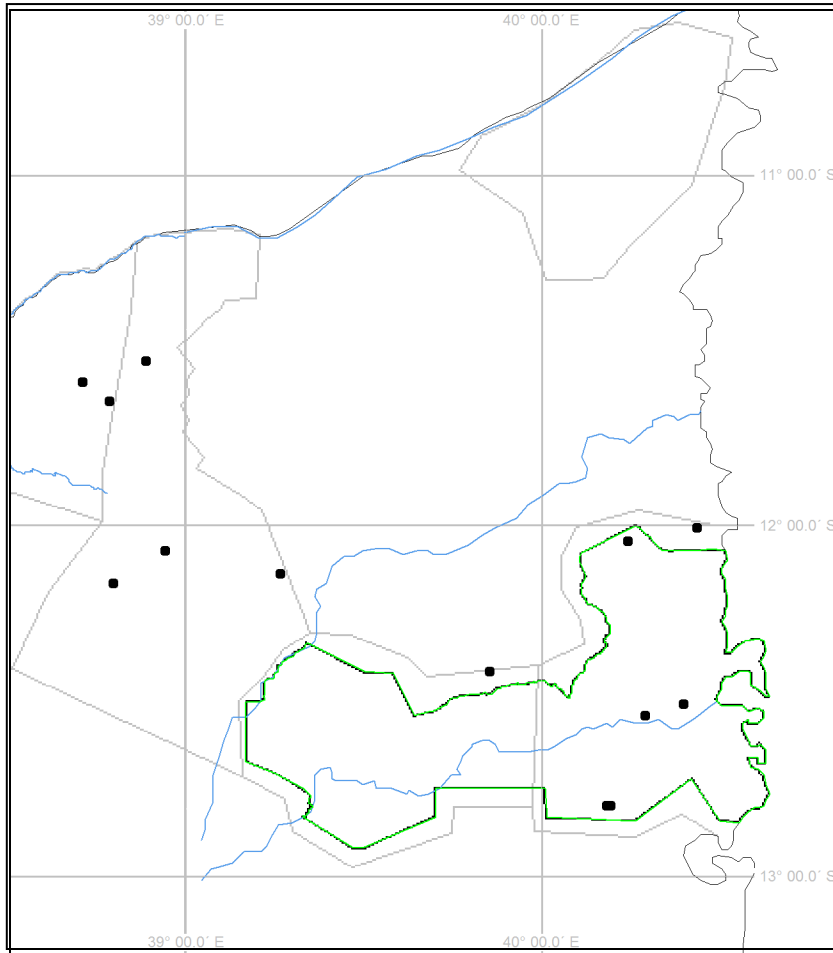


Figure 5: Monkeys

2.3 Bushbuck

Bushbuck

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km²
WWF West	19	2 \diamond 44	2	0	0.0027
WWF North	29	3 \diamond 70	3	0	0.0076
Quirimbas NP	153	64 \diamond 242	16	0	0.0157
Overall WWF Survey Area	201	102 \diamond 300	21	0	0.0097

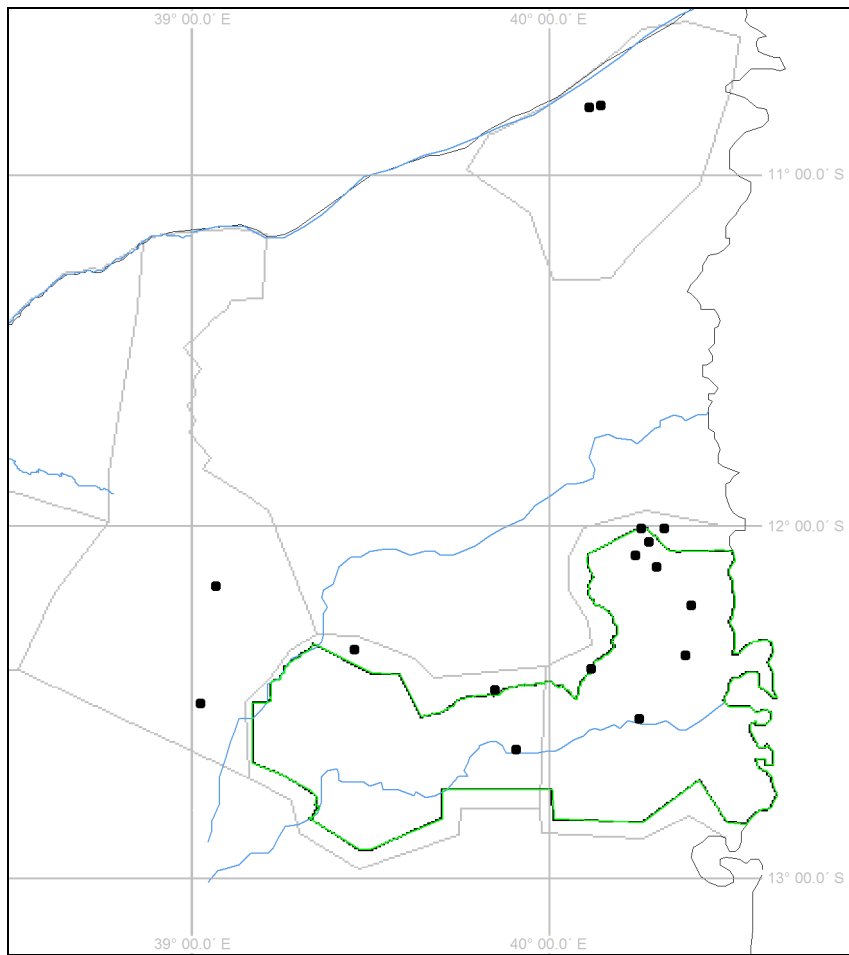


Figure 6: Bushbuck

2.4 Bushpig

Bushpig

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km²
WWF West	97	10 \diamond 225	10	0	0.0133
Quirimbas NP	48	5 \diamond 137	5	0	0.0049
Overall WWF Survey Area	144	15 \diamond 298	15	0	0.0069

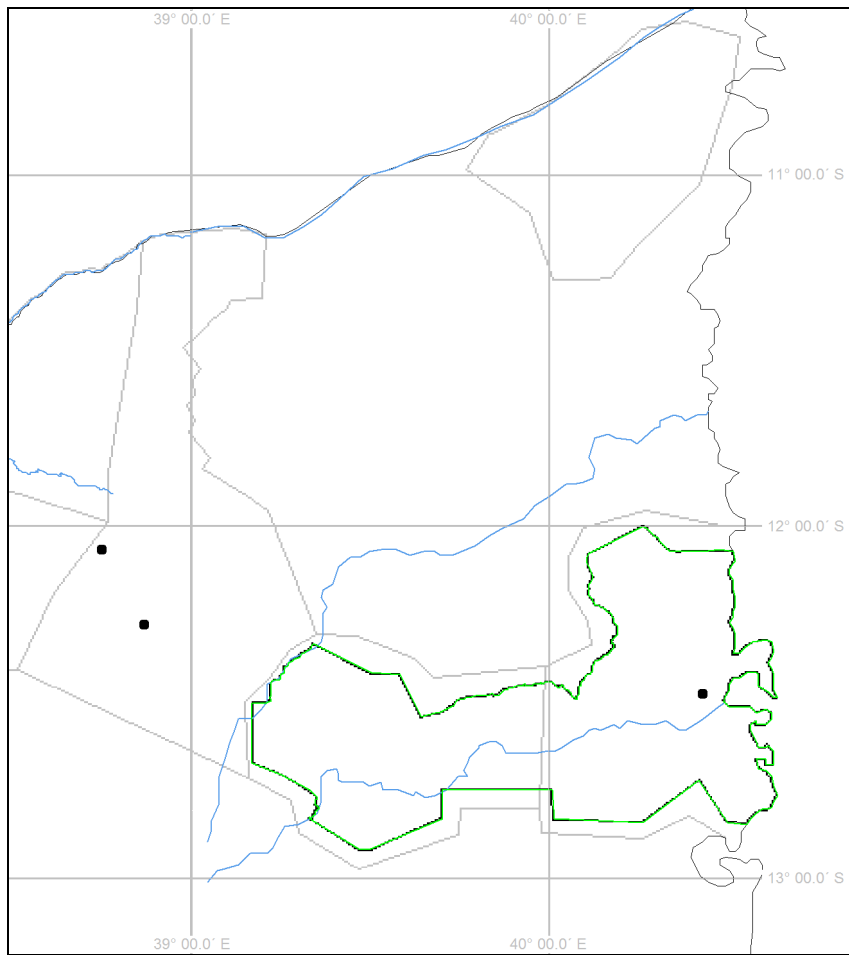


Figure 7: Bushpig

2.5 Duiker

Duiker

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km²
WWF West	3109	2401 \diamond 3817	322	0	0.429
WWF North	184	62 \diamond 306	19	1	0.0482
Quirimbas NP	938	634 \diamond 1242	98	1	0.096
Overall WWF Survey Area	4230	3466 \diamond 4995	439	2	0.2031

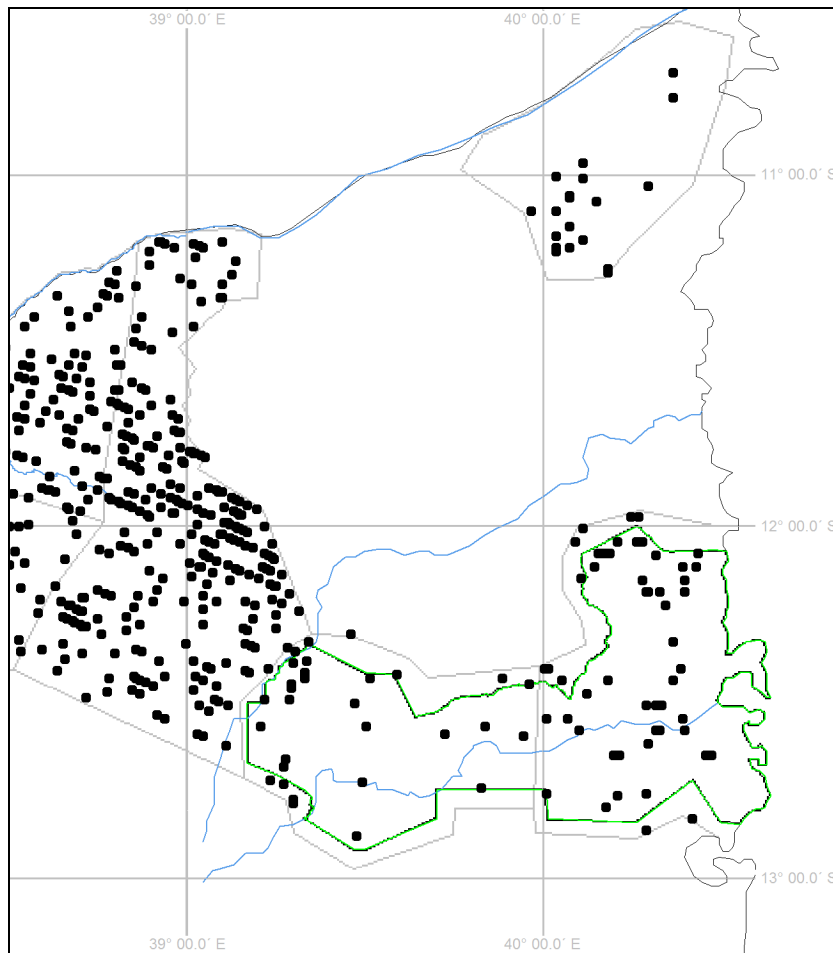


Figure 8: Duiker

2.6 Eland

Eland

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
Quirimbas NP	19	2 \diamond 44	2	0	0.002
Overall WWF Survey Area	19	2 \diamond 44	2	0	0.0009

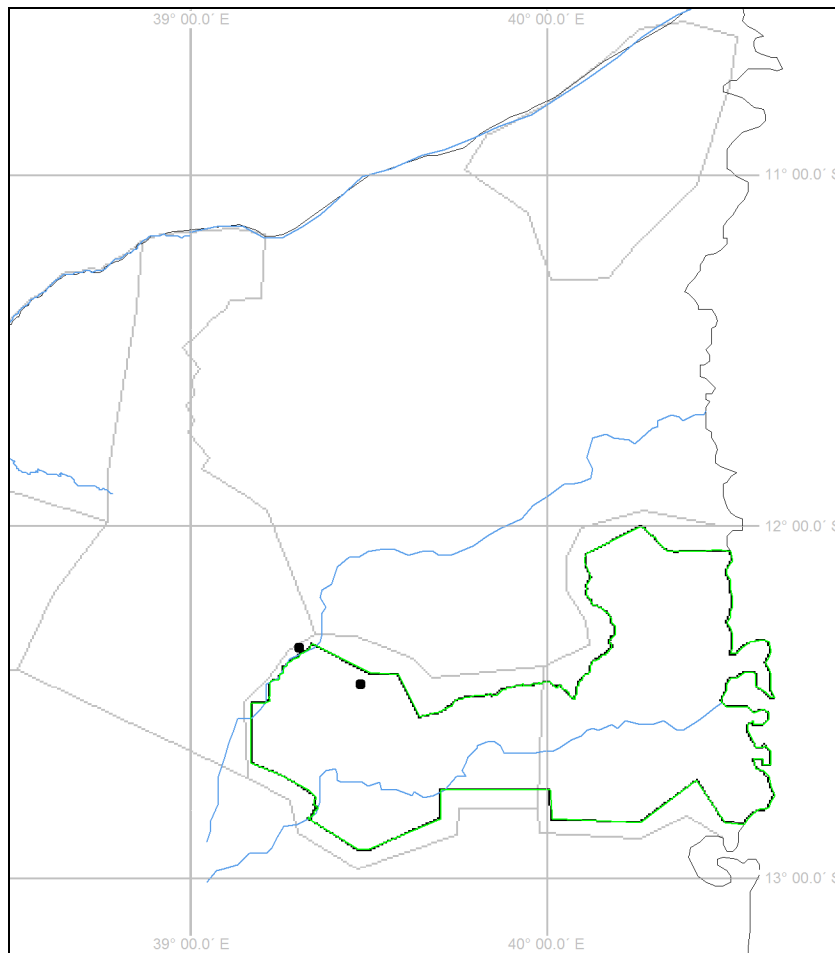


Figure 9: Eland

2.7 GroundHornbill

GroundHornbill

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km²
WWF West	965	655 \diamond 1275	100	0	0.1332
WWF North	77	8 \diamond 179	8	0	0.0203
Quirimbas NP	568	358 \diamond 777	59	4	0.0581
Overall WWF Survey Area	1610	1231 \diamond 1990	167	4	0.0773

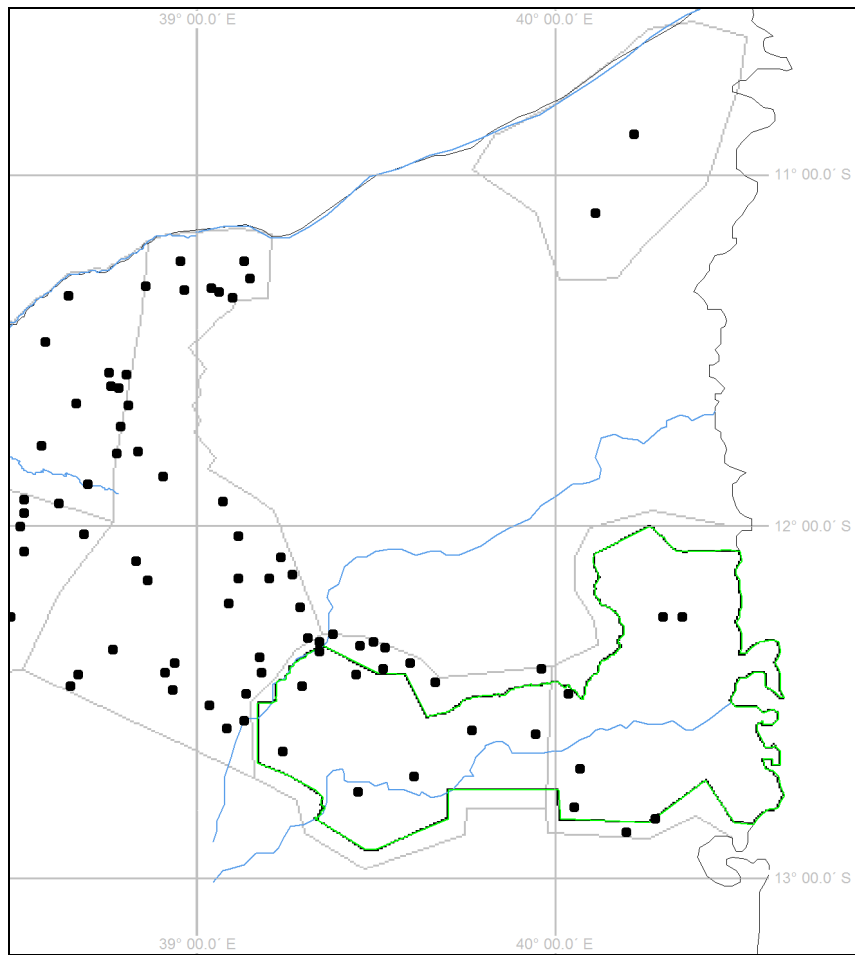


Figure 10: Ground Hornbill

2.8 Hartebeest

Hartebeest

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km²
WWF West	68	7 <> 160	7	0	0.0093
Overall WWF Survey Area	68	7 <> 158	7	0	0.0032

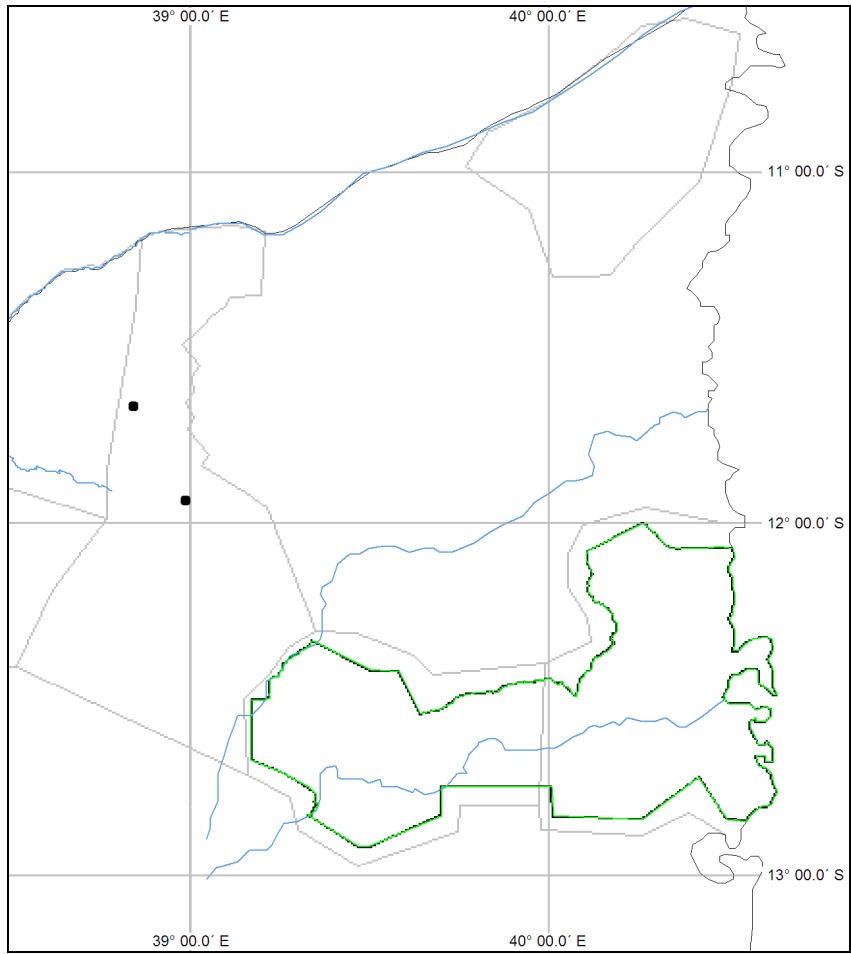


Figure 11: Hartebeest

2.9 Hippopotamus

Hippopotamus

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF North	262	27 \diamond 611	27	0	0.0685
Overall WWF Survey Area	262	27 \diamond 594	27	0	0.0126

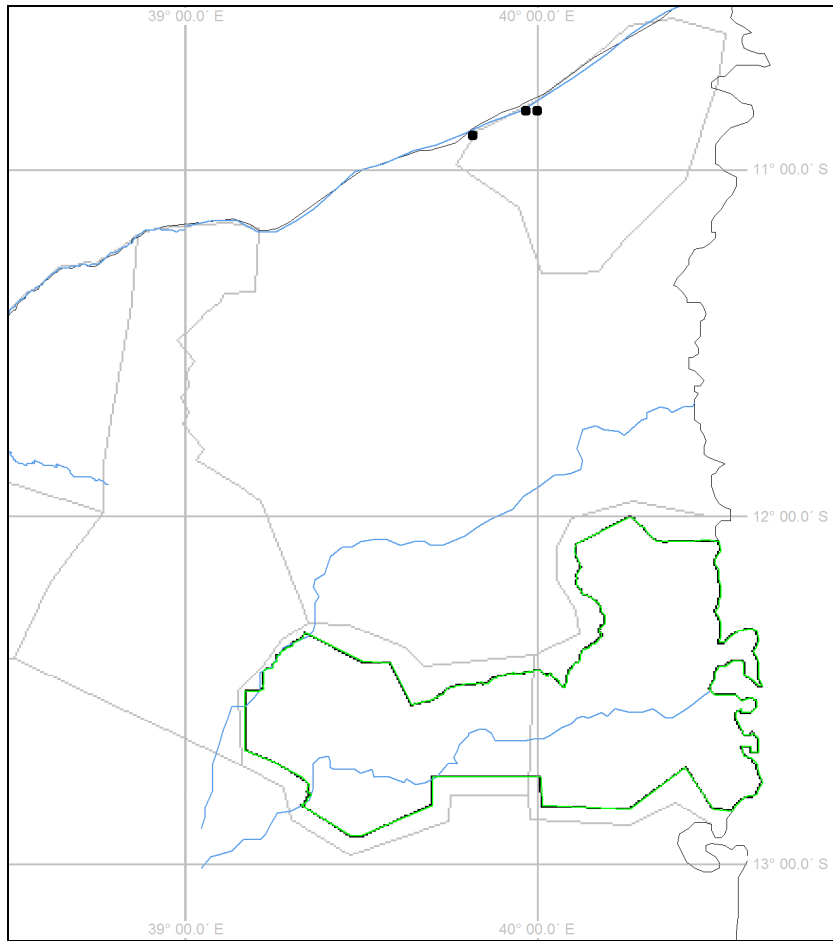


Figure 12: Hippopotamus

2.10 Crocodile

Crocodile

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km²
WWF West	19	2 \diamond 57	2	0	0.0027
Overall WWF Survey Area	19	2 \diamond 56	2	0	0.0009

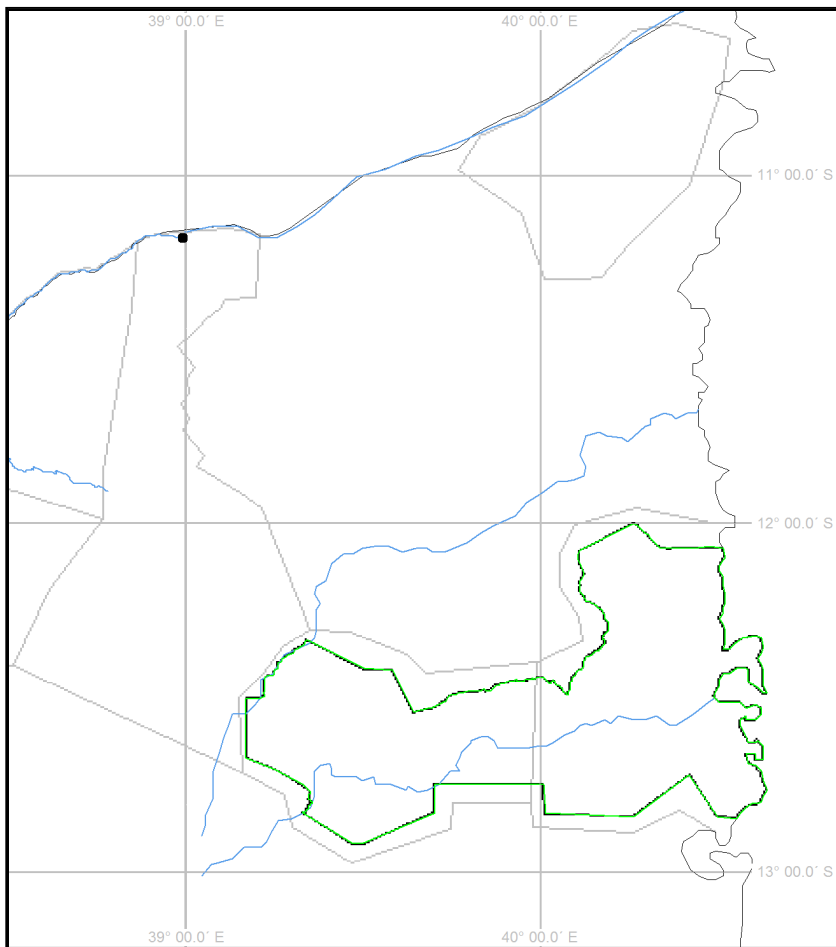


Figure 13: Crocodile

2.11 Kudu

Kudu

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km²
WWF West	251	65 \diamond 437	26	0	0.0346
Quirimbas NP	182	19 \diamond 349	19	0	0.0186
Overall WWF Survey Area	433	186 \diamond 679	45	0	0.0208

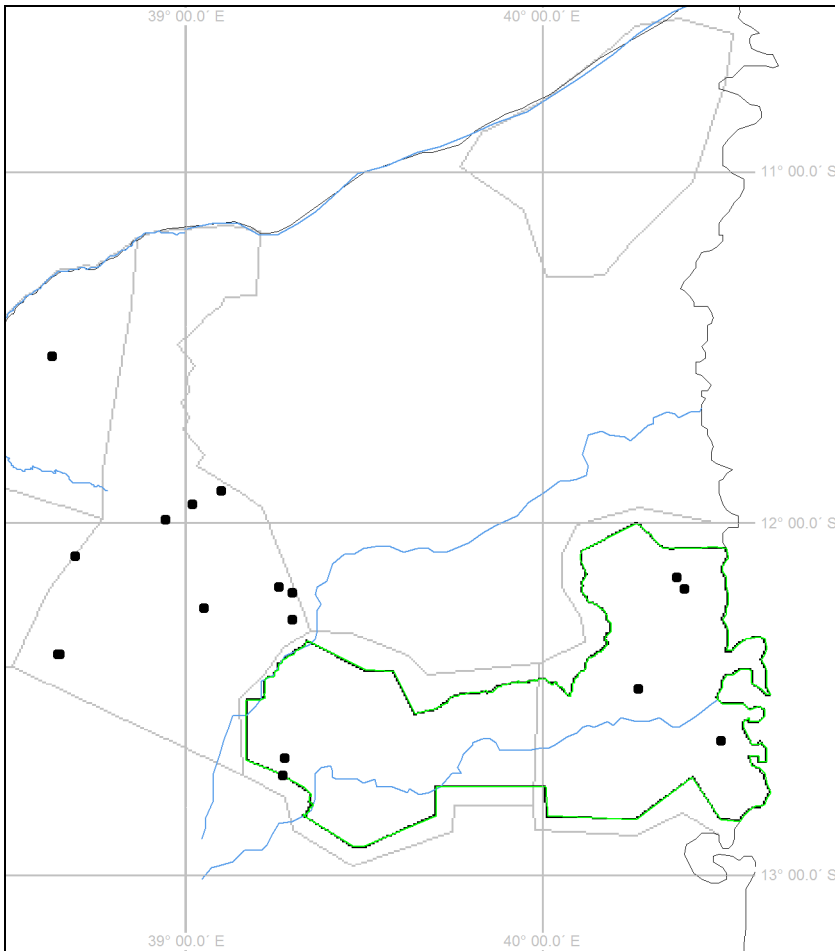


Figure 14: kudu

2.12 Reedbuck

Reedbuck

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km²
WWF North	19	2 \diamond 57	2	0	0.0051
Overall WWF Survey Area	19	2 \diamond 55	2	0	0.0009

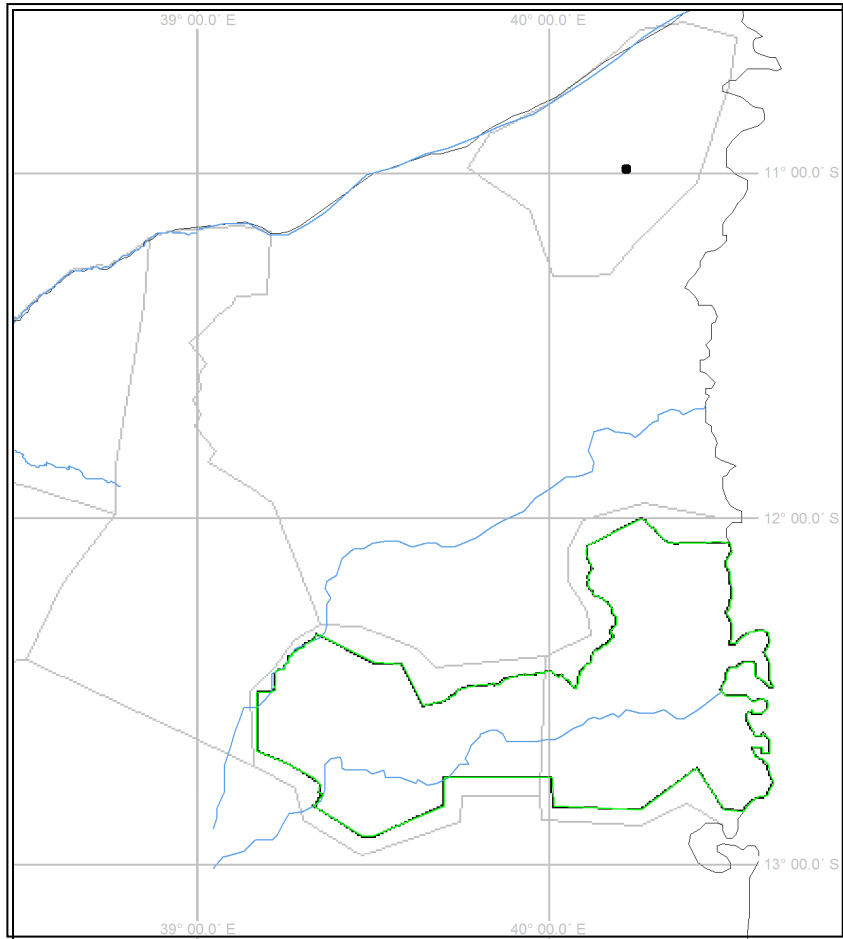


Figure 15: Reedbuck

2.13 Sable

Sable

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	29	3 \diamond 69	3	0	0.004
WWF North	300	31 \diamond 657	31	0	0.0787
Quirimbas NP	162	31 \diamond 417	17	14	0.0166
Overall WWF Survey Area	491	68 \diamond 915	51	14	0.0236

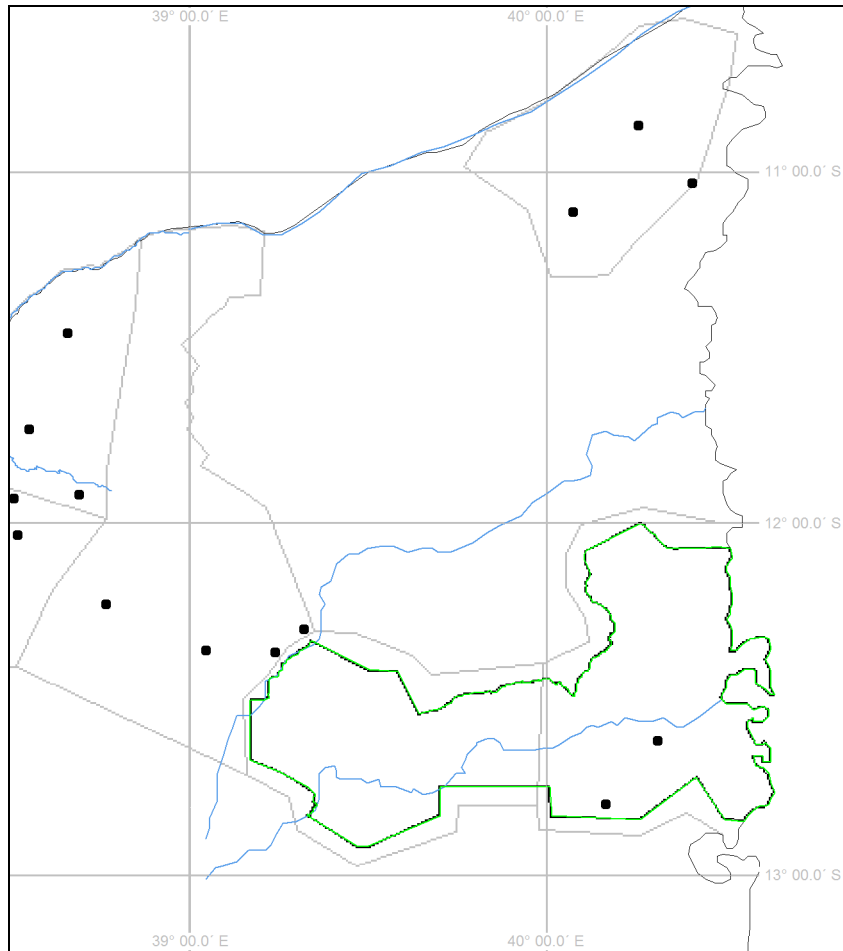


Figure 16: Sable

2.14 Warthog

Warthog

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	232	67 \diamond 396	24	0	0.032
WWF North	339	35 \diamond 662	35	0	0.0888
Quirimbas NP	555	290 \diamond 820	58	0	0.0568
Overall WWF Survey Area	1126	692 \diamond 1560	117	0	0.054

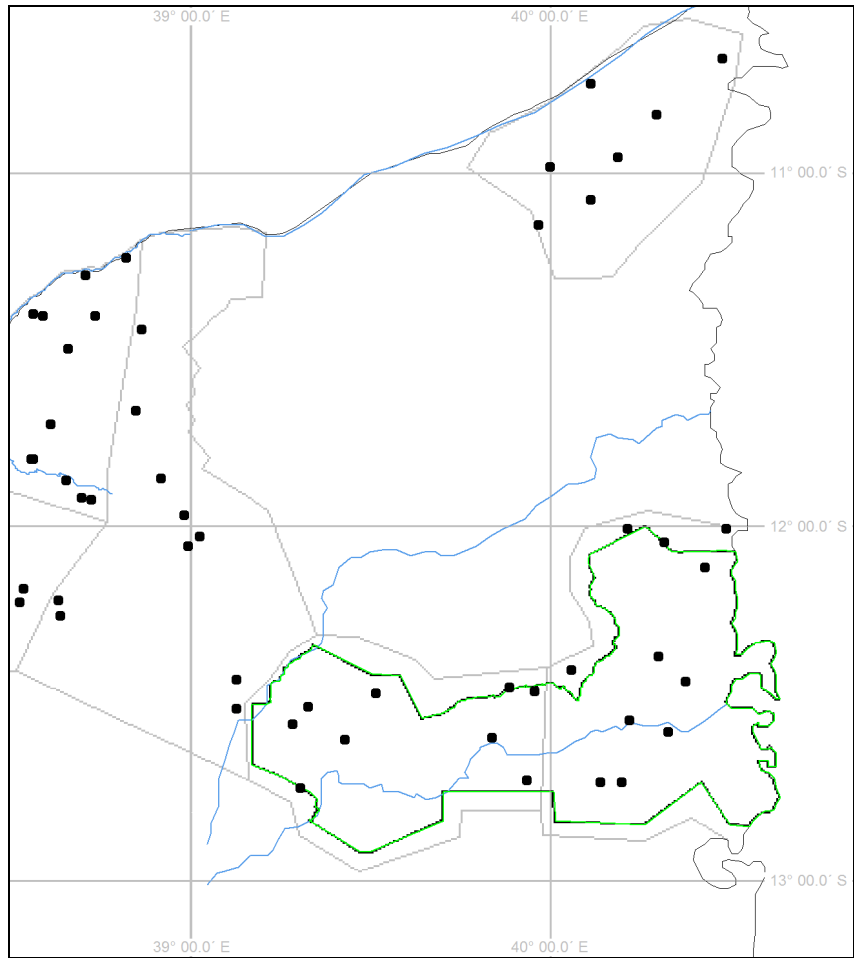


Figure 17: Warthog

2.15 Waterbuck

Waterbuck

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km²
WWF North	29	3 \diamond 86	3	0	0.0076
Overall WWF Survey Area	29	3 \diamond 83	3	0	0.0014

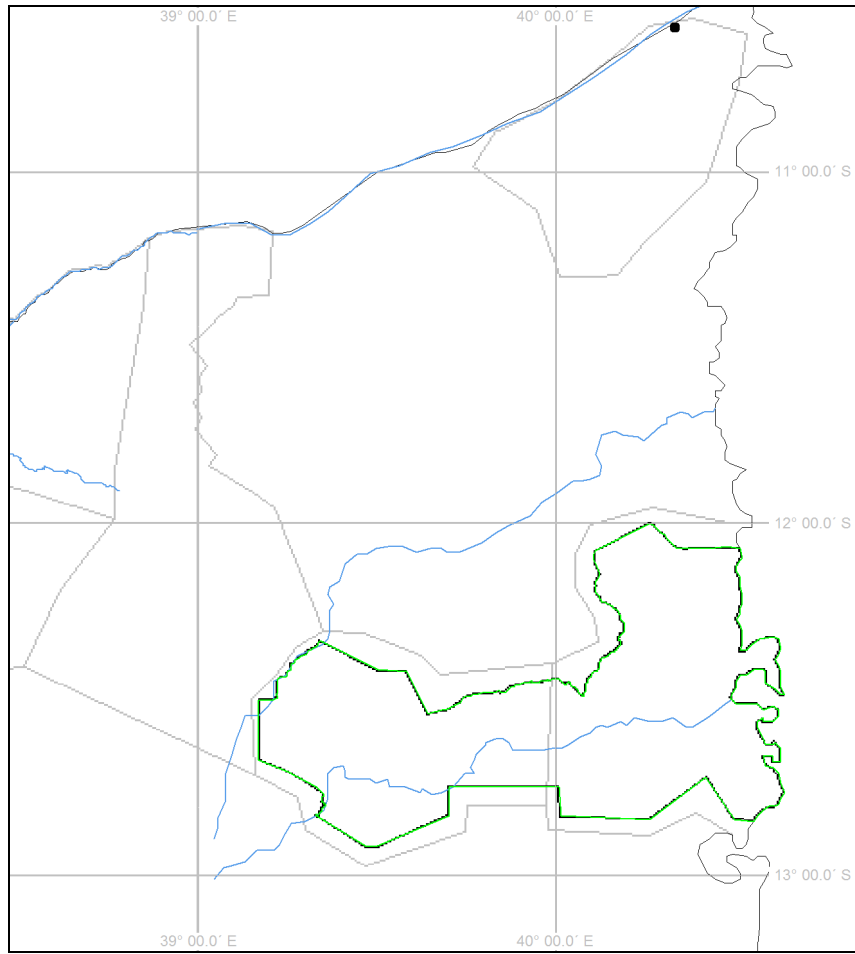


Figure 18: Waterbuck

2.16 Zebra

Zebra

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	87	9 <> 234	9	0	0.012
Overall WWF Survey Area	87	9 <> 231	9	0	0.0042

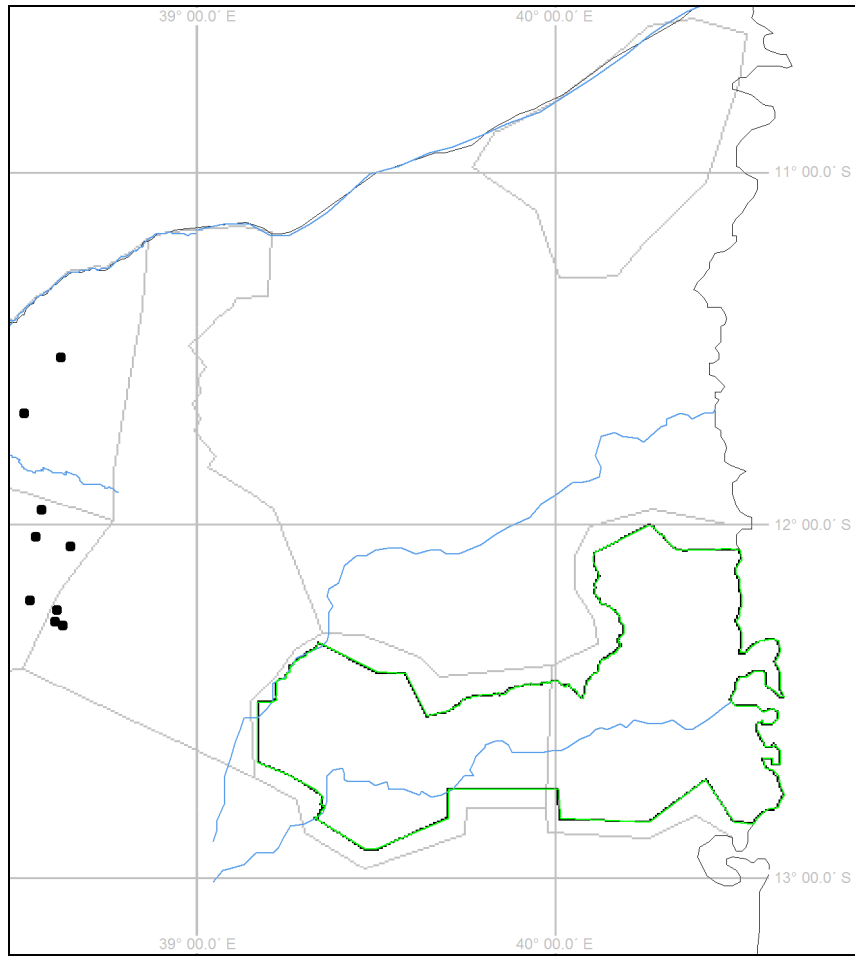


Figure 19: Zebra

2.17 Other Carcasses

OtherCarcass 4

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	10	1 \diamond 28	1	0	0.0013
Quirimbas NP	10	1 \diamond 28	1	0	0.001
Overall WWF Survey Area	19	2 \diamond 44	2	0	0.0009

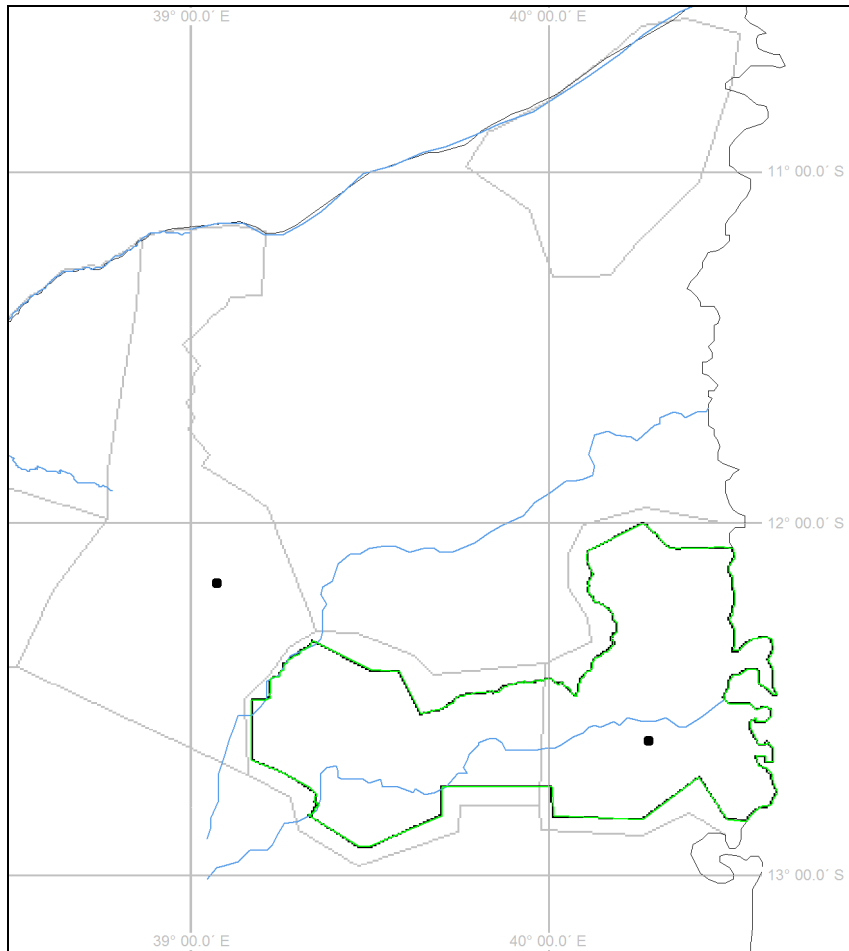


Figure 20: Other wildlife carcasses including unknown species

3 OTHER OBSERVATIONS

This section describes attributes other than wildlife recorded during the survey. “Estimates” are tabulated for several attributes, including density estimates. Such estimates only refer to observable instances and are not necessarily related to the true number of anything. For example: “villages” does not relate to the number of dwellings or people therein; fields extend beyond the sampling transect and the count does not reflect area; and snare lines also extend beyond the transect but are counted if only part is in. The counts may nevertheless serve as useful indices of occurrence and the estimates are given for so that comparisons can be made between areas. Livestock and logging represent discrete occurrences and these are true estimates. As above, data for surveys adjacent to the survey area are included on the maps.

3.1 Cattle

Cattle

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
Quirimbas NP	791	86 \diamond 2031	83	3	0.0809
Overall WWF Survey Area	791	86 \diamond 2014	83	3	0.038

3.2 Sheep/goats

Sheep/goats

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF North	155	16 \diamond 436	16	0	0.0406
Quirimbas NP	1062	391 \diamond 1732	111	0	0.1087
Overall WWF Survey Area	1217	504 \diamond 1930	127	0	0.0584

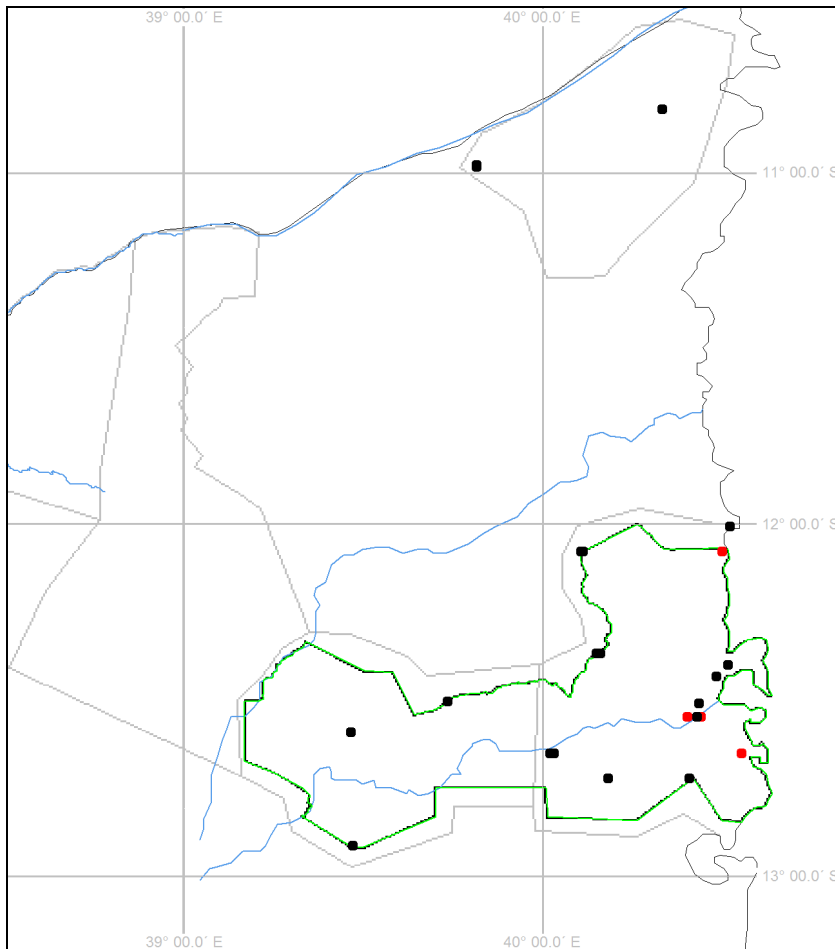


Figure 21: Livestock: Cattle red; Small stock black

3.3 Fishing camp

Fishing camp

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	77	8 \diamond 166	8	0	0.0107
WWF North	39	4 \diamond 74	4	0	0.0102
Quirimbas NP	76	20 \diamond 132	8	0	0.0078
Overall WWF Survey Area	192	83 \diamond 301	20	0	0.0092

3.4 Fishtrap/net

Fishtrap/net

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	154	16 \diamond 311	16	0	0.0213
WWF North	232	120 \diamond 345	24	0	0.0609
Quirimbas NP	76	17 \diamond 136	8	0	0.0078
Overall WWF Survey Area	463	268 \diamond 659	48	0	0.0222

3.5 Canoe

Canoe

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	77	8 \diamond 166	8	0	0.0107
WWF North	145	49 \diamond 241	15	0	0.0381
Quirimbas NP	619	144 \diamond 1094	65	9	0.0634
Overall WWF Survey Area	842	357 \diamond 1327	88	9	0.0404

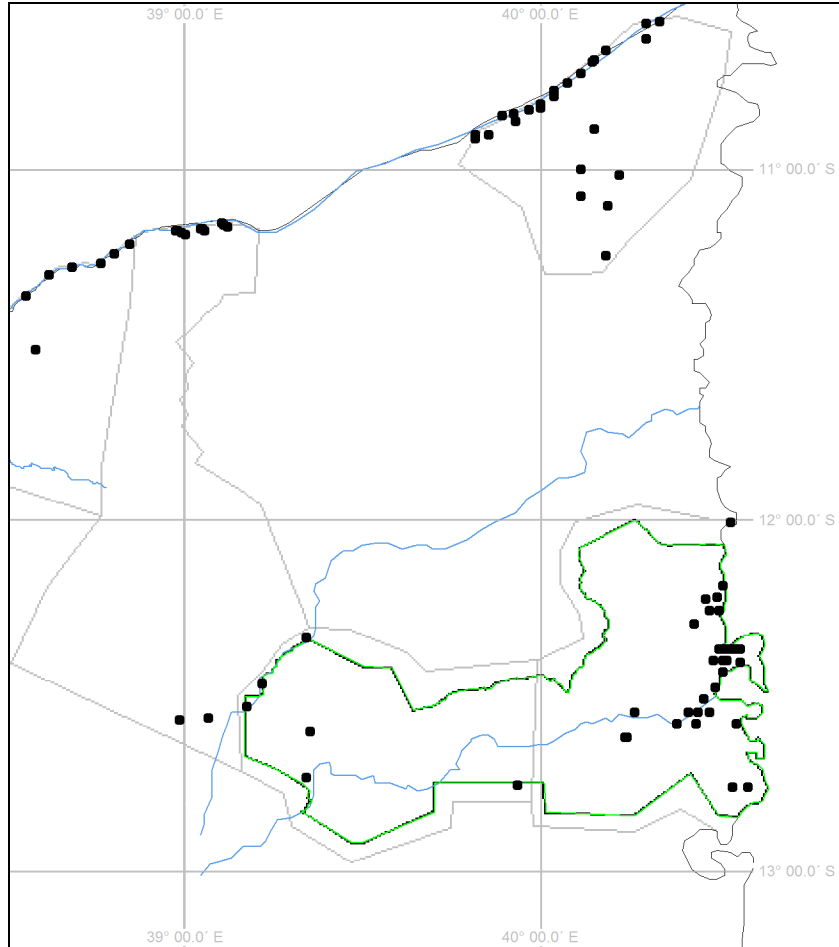


Figure 22: Undifferentiated fishing instances: camps, canoes, nets, traps

3.6 Snareline

Snareline

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	618	450 \diamond 785	64	0	0.0853
WWF North	87	35 \diamond 140	9	0	0.0228
Quirimbas NP	125	26 \diamond 224	13	0	0.0128
Overall WWF Survey Area	830	633 \diamond 1028	86	0	0.0398

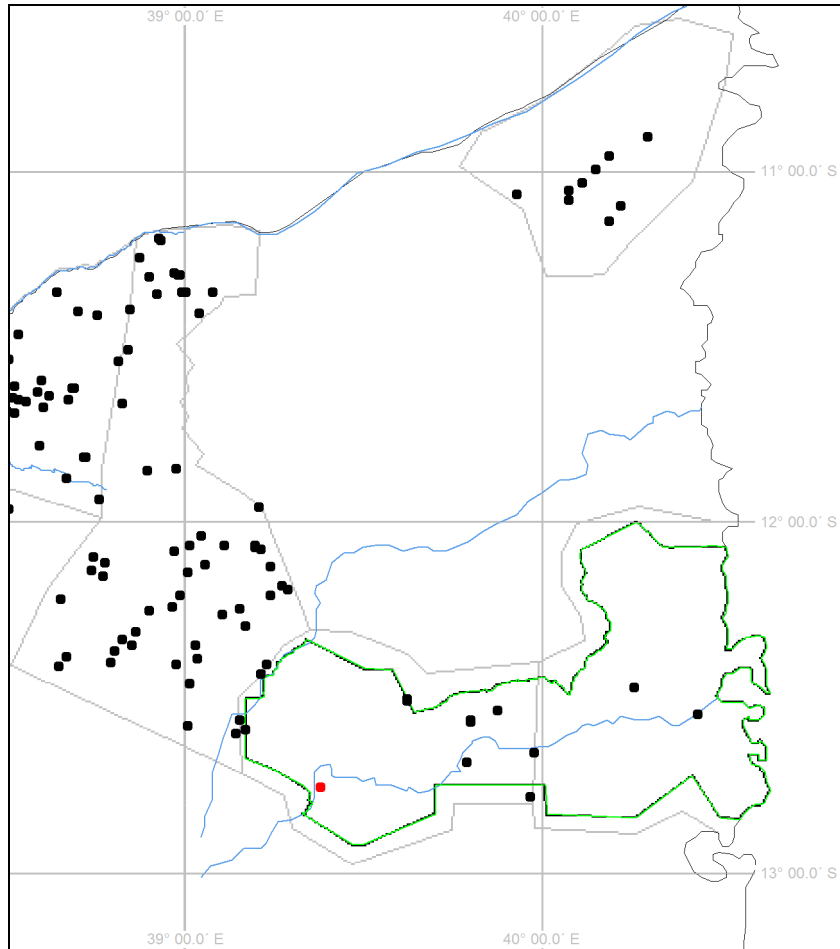


Figure 23: Illegal hunting: Snarelines black, Camps red

3.7 Gold panning

Gold panning

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km²
Quirimbas NP	48	5 \diamond 142	5	0	0.0049
Overall WWF Survey Area	48	5 \diamond 140	5	0	0.0023

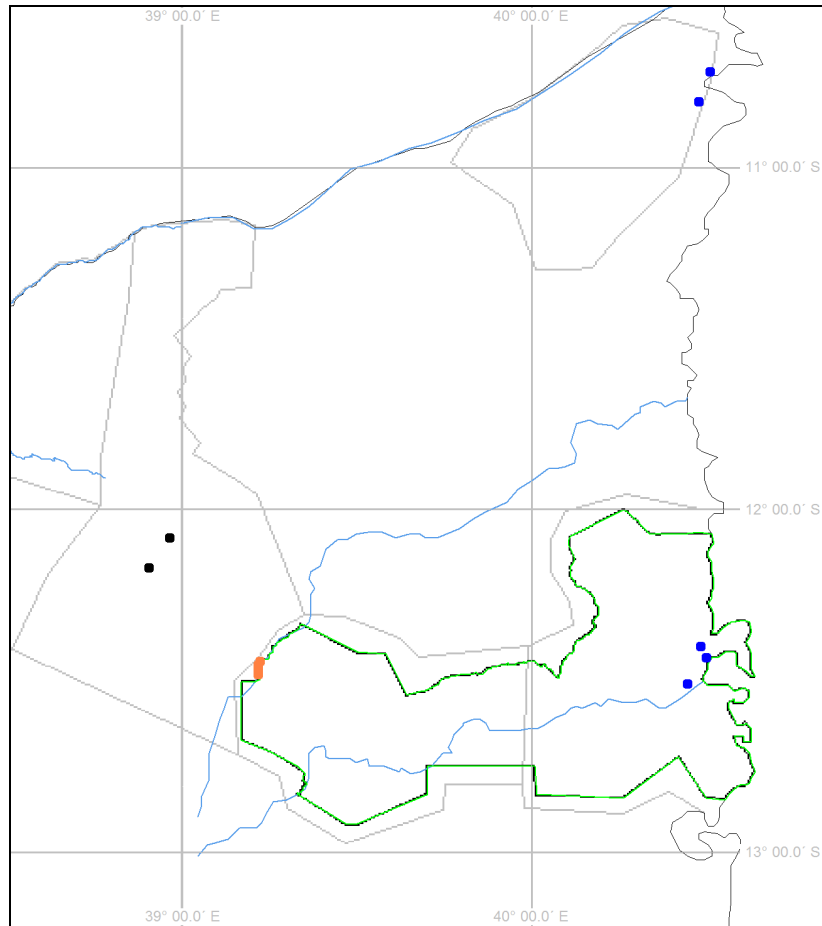


Figure 24: Mineral extraction: Gold panning orange; Prospecting black; Salt extraction blue

3.8 Logging

Logging

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	4596	3620 <> 5571	476	0	0.6342
WWF North	1918	1337 <> 2499	198	0	0.5025
Quirimbas NP	2196	1735 <> 2657	229	0	0.2248
Overall WWF Survey Area	8710	7516 <> 9903	903	0	0.4181

Timber yard

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	126	51 <> 200	13	1	0.0173
WWF North	77	19 <> 136	8	0	0.0203
Quirimbas NP	356	205 <> 506	37	1	0.0364
Overall WWF Survey Area	559	384 <> 733	58	2	0.0268

Bamboo harvesting

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF North	19	2 <> 45	2	0	0.0051
Quirimbas NP	105	11 <> 202	11	0	0.0107
Overall WWF Survey Area	124	26 <> 223	13	0	0.006
Total					

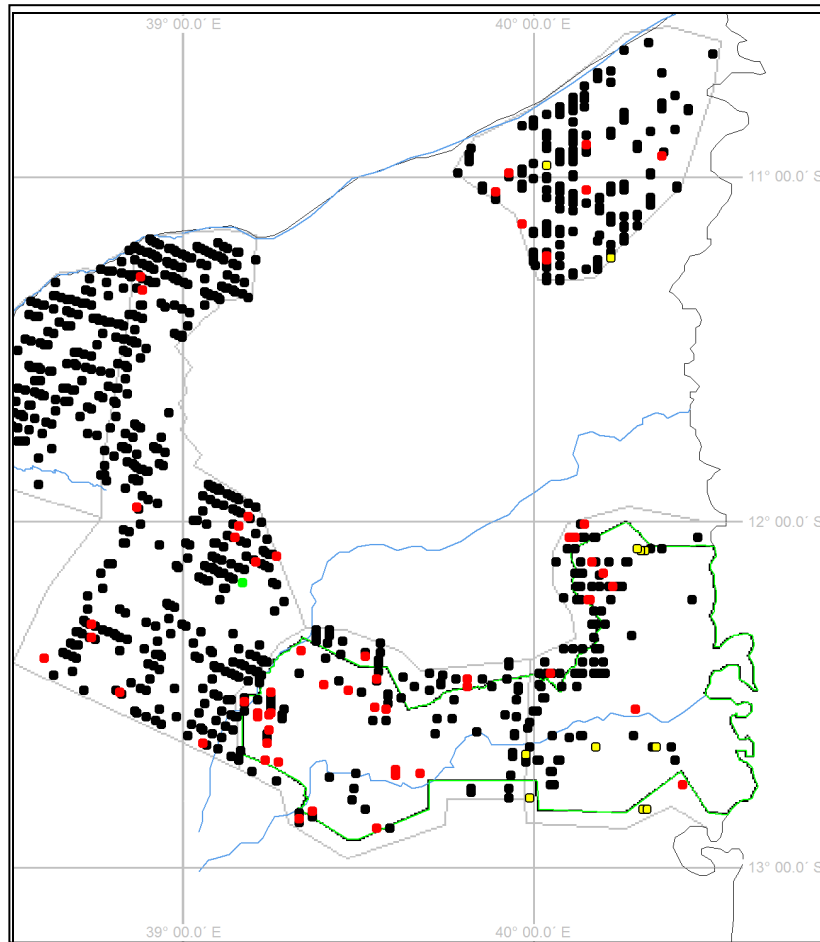


Figure 25: Wood extraction: Logging black; Timber stores red; Timber truck green; Bamboo cutting yellow

3.9 Cultivation

Cultivation

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	1072	597 <> 1546	111	3	0.1479
WWF North	4175	2526 <> 5824	431	5	1.0939
Quirimbas NP	6657	5448 <> 7866	695	8	0.6813
Overall WWF Survey Area	11903	9880 <> 13927	1237	16	0.5713

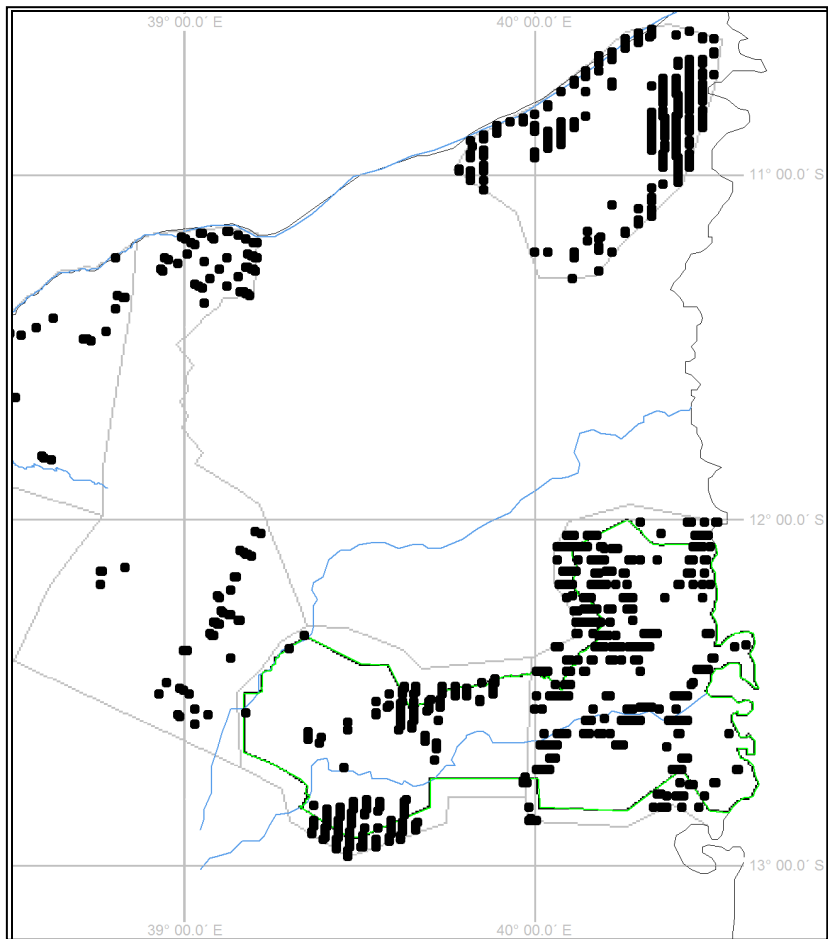


Figure 26: Cultivation

3.10 Village

Village

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	647	392 \diamond 901	67	7	0.0893
WWF North	1550	1090 \diamond 2010	160	12	0.4061
Quirimbas NP	2446	1941 \diamond 2951	255	22	0.2504
Overall WWF Survey Area	4643	3935 \diamond 5351	482	41	0.2229

Big Village

Stratum	Pop. est.	Range	No. seen	No. out	Dens/km ²
WWF West	29	7 \diamond 69	3	4	0.004
WWF North	48	8 \diamond 129	5	3	0.0127
Quirimbas NP	239	158 \diamond 320	25	16	0.0244
Overall WWF Survey Area	316	198 \diamond 434	33	23	0.0152

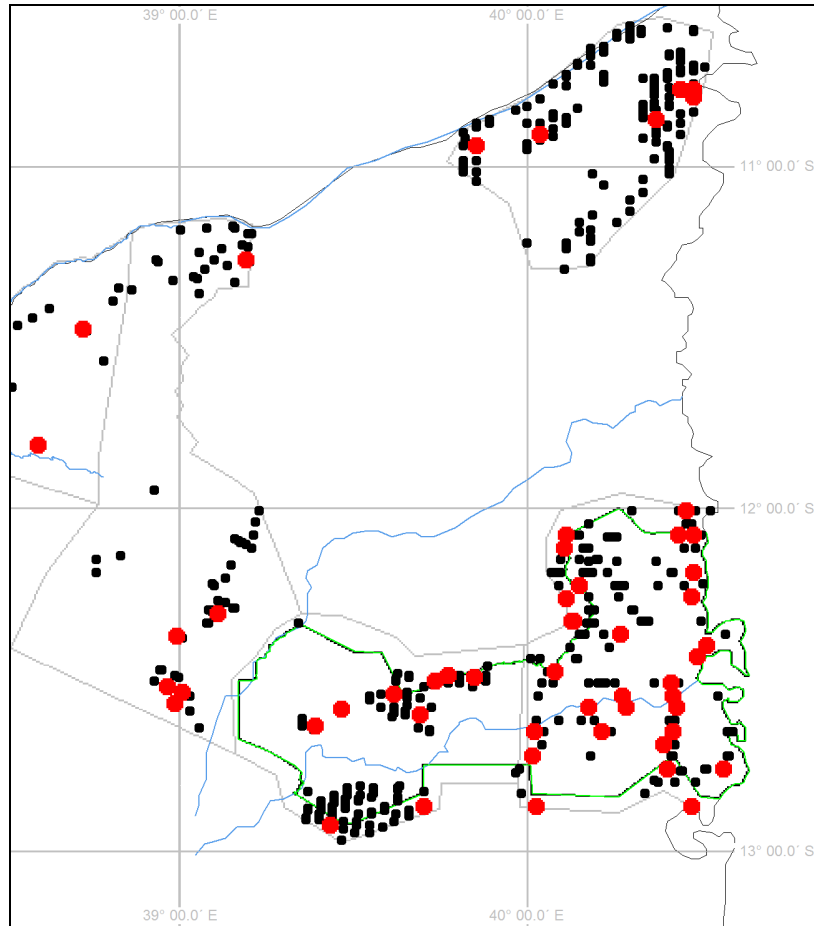


Figure 27: Habitation: Small settlements black; Major settlements and towns red

4 APPENDIX

4.1 APPENDIX I: METHODS

Methods were the same as in Niassa Surveys. Stratification was according to management units. Transects were orientated along presumed ecological gradients. Transect selection is shown in Fig. 28.

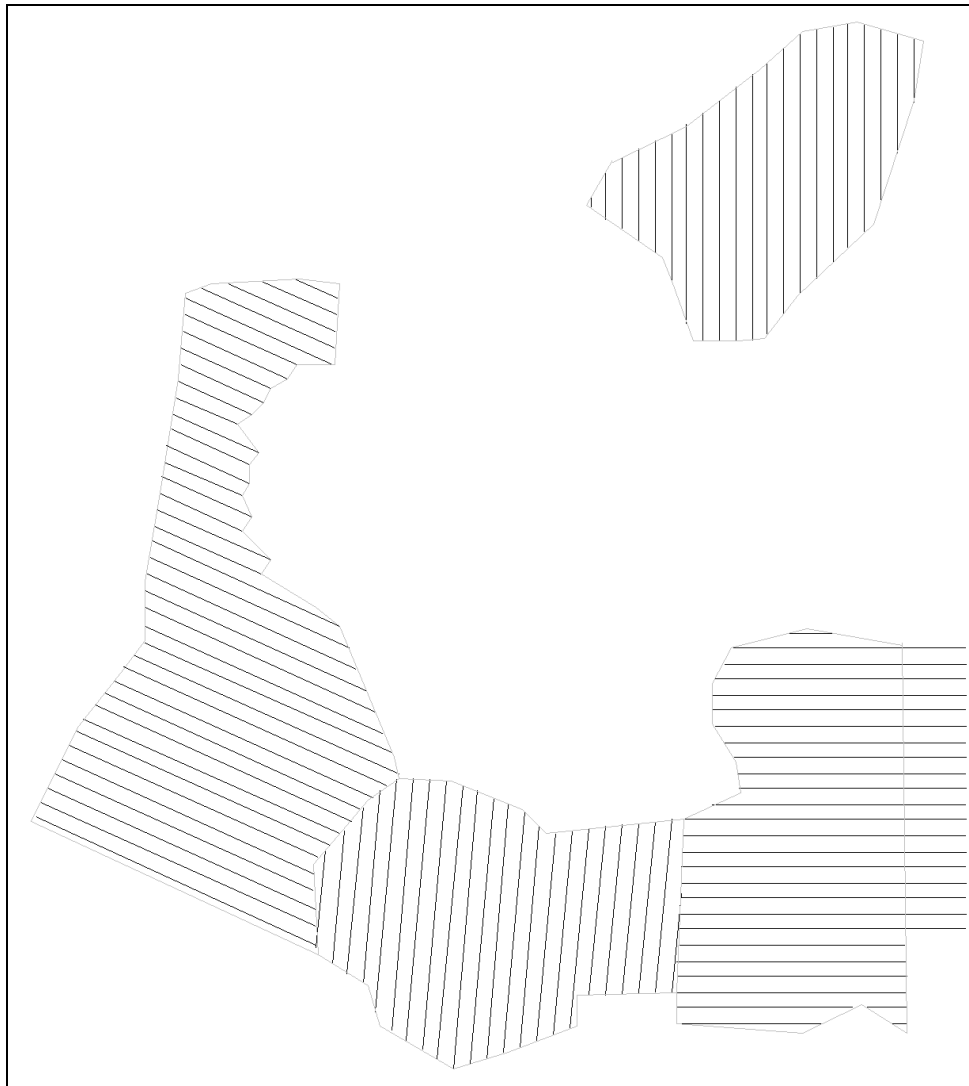


Figure 28: WWF Survey 2011 Transects

Survey crew comprised D. le Poidevin and C. Hertzler (Pilots), C. Craig (coordinator and front-seat observer), F. Muroki (left hand observer) and D Chipesi(right hand observer).

4.2 APPENDIX II: RESULTS

Supporting data indicating survey quality are given below.



Figure 29: Tracks flown on WWF survey

4.2.1 Stratum Statistics

Stratum	Area	SArea	SI	NSU	V(Knots)	Srate
Q1	4810.85	498.71	10.37	23	97.03	1.23
Q2	4959.66	520.47	10.49	28	86.66	1.11
WW	7246.5	750.58	10.36	39	97.06	1.24
WN	3816.7	394	10.32	21	95.69	1.22
All	20833.71	2163.77	10.39	111	94.1	1.2

SArea = Sample area; SI = Sampling intensity; NSU = No. of sampling units; V = groundspeed; Srate = Search rate in km² per minute. The target search rate was 1.1 km² per minute.

4.2.2 Calibration of strip widths

The results of the strip width calibration are given below. Messrs Muroki and Chipese were left and right observers respectively.

#	H	L		R		Width		Corrected		Tot W
		in	out	in	out	L	R	L	R	
1	280	9	28	7	22	200	160	214.2857	171.4286	385.7143
2	220	6	22	7	20	170	140	231.8182	190.9091	422.7273
3	240	1	19	13	27	190	150	237.5	187.5	425
4	250	9	27	5	19	190	150	228	180	408
5	250	5	23	8	23	190	160	228	192	420
6	250	10	26	4	19	170	160	204	192	396
7	220	11	28	2	14	180	130	245.4545	177.2727	422.7273
8	260	19	29	1	15	110	150	126.9231	173.0769	300
9	220	10	26	2	16	170	150	231.8182	204.5455	436.3636
10	250	10	27	4	17	180	140	216	168	384
11	250	11	29	2	14	190	130	228	156	384
12	220	10	29	3	16	200	140	272.7273	190.9091	463.6364
13	220	8	25	4	17	180	140	245.4545	190.9091	436.3636
14	240	9	25	4	20	170	170	212.5	212.5	425
15	250	9	24	5	20	160	160	192	192	384
16	250	12	28	2	17	170	160	204	192	396
17	250	8	24	7	23	170	170	204	204	408
18	250	9	25	5	22	170	180	204	216	420
19	260	8	25	6	21	180	160	207.6923	184.6154	392.3077
20	250	9	25	5	19	170	150	204	180	384
21	260	5	23	9	23	190	150	219.2308	173.0769	392.3077
22	240	10	29	4	19	200	160	250	200	450
								218.5184	187.6701	
									Mn	406.1885
									Var	1092.435
									SE Mn	7.582651
									%CL	3.733562

4.2.3 Maintenance of height

The target height was 300 feet above ground. The mean height flown was 305.3 feet. 95% of recorded heights were within 43.4 feet of this value.

4.2.4 Observer Bias

Species	No.of groups seen in + out		Chi ²	P%	
	Left	Right			
Baboon	5	56	42.639	6.58E-09	****
Buffalo	37	25	2.323	12.75084	
Bushbuck	6	31	16.892	0.00396	****
Bushpig	0	13	13	0.03115	***
Crocodile	5	7	0.333	56.37029	
Duiker	421	1012	243.741	6.01E-53	****
Eland	23	37	3.267	7.07012	
EleCarcass 1	2	2	0	100	
EleCarcass 2	9	15	1.5	22.06715	
EleCarcass 3	20	11	2.613	10.59976	
EleCarcass 4	86	141	13.326	0.02618	***
All Carc	117	169	9.455	0.21063	**
ElephantBull	39	39	0	100	
ElephantFamily	92	113	2.151	14.24567	
All Eles	131	152	1.558	21.19138	
GroundHornbill	93	110	1.424	23.28045	
Hartebeest	46	58	1.385	23.93167	
Hippopotamus	8	12	0.8	37.10934	
Honey Badger	1	1	0	100	
Hyaena	0	4	4	4.55003	*
Impala	8	18	3.846	4.98602	*
Kudu	24	43	5.388	2.0275	*
Lion	2	1	0.333	56.37029	
Leopard	0	1	1	31.73108	
Monkey	1	18	15.211	0.00962	**
Reedbuck	20	39	6.119	1.33763	*
Sable	150	195	5.87	1.54049	*
Warthog	73	153	28.319	1.03E-05	****
Waterbuck	23	34	2.123	14.51204	
Wildebeest	4	9	1.923	16.55179	
Zebra	46	65	3.252	7.13254	

The above shows that the left observer made significantly fewer sightings than the right when dealing with the more difficult-to-see species. These will be underestimated by the survey. There is no measure of the number of groups the right observer misses. All data from Niassa, Chipanje-Chetu and the WWF survey are included. **** indicates a probability of <1/10000, *** of <1/1000, ** of <1/100 and * of <1/20.

4.2.5 Estimates of numbers, densities and confidence limits

The following tables give the results for each stratum based on the numbers seen in the sample. Results for all species and attributes counted are given. Column 6 is the 95% confidence limit expressed as a percentage of the estimate.

Overall WWF Survey Area Area: 20833.71 km² Mean sampling intensity
10.4%

SPECIES	Pop. est.	No. seen	No. Out	Variance	95%cl %est.	95%Range	Dens /km ²
Baboon	1542	161	0	152946.2	50.3	766 < 2317	0.074
Bushbuck	201	21	0	2492.13	49.1	102 < 300	0.0097
Bushpig	144	15	0	6056.2	107	15 < 298	0.0069
Crocodile	19	2	0	342.67	190.1	2 < 56	0.0009
Duiker	4230	439	2	148700.61	18.1	3466 < 4995	0.2031
Eland	19	2	0	155.72	128.2	2 < 44	0.0009
ElephantBull	192	20	0	10022.5	103.6	20 < 390	0.0092
EleCarcass 3	29	3	0	243.98	107.4	3 < 60	0.0014
EleCarcass 4	115	12	0	1028.42	55.2	52 < 179	0.0055
ElephantFamily	615	64	25	48999.88	71.3	176 < 1054	0.0295
GroundHornbill	1610	167	4	36648.59	23.6	1231 < 1990	0.0773
Hartebeest	68	7	0	2097.09	134.3	7 < 158	0.0032
Hippopotamus	262	27	0	28117.99	127.1	27 < 594	0.0126
Kudu	433	45	0	15416.18	56.9	186 < 679	0.0208
Monkey	450	47	0	28767.32	74.7	114 < 786	0.0216
Reedbuck	19	2	0	322.05	183.6	2 < 55	0.0009
Sable	491	51	14	45675.4	86.2	68 < 915	0.0236
Warthog	1126	117	0	47970.2	38.6	692 < 1560	0.054
Waterbuck	29	3	0	734.06	184.8	3 < 83	0.0014
Zebra	87	9	0	5276.57	165.7	9 < 231	0.0042
Cattle	791	83	3	380836.06	154.7	86 < 2014	0.038
Sheep/goats	1217	127	0	129356.54	58.6	504 < 1930	0.0584
OtherCarcass 4	19	2	0	161.86	131.5	2 < 44	0.0009
Fishing camp	192	20	0	3008.85	56.6	83 < 301	0.0092
Fishtrap/net	463	48	0	9767.81	42.3	268 < 659	0.0222
Canoe	842	88	9	59904.59	57.6	357 < 1327	0.0404
Snareline	830	86	0	9922.93	23.8	633 < 1028	0.0398
Gold panning	48	5	0	2158.12	190.9	5 < 140	0.0023
Logging	8710	903	0	362365.78	13.7	7516 < 9903	0.4181
Timber yard	559	58	2	7766.14	31.3	384 < 733	0.0268
Bamboo harvesting	124	13	0	2463.8	79.2	26 < 223	0.006
Village	4643	482	41	127669.08	15.3	3935 < 5351	0.2229
Cultivation	11903	1237	16	1041755.9	17	9880 < 13927	0.5713
Big Village	316	33	23	3531.52	37.3	198 < 434	0.0152

Quirimbas NP Area: 9770.51 km² Mean sampling intensity; 10.4%

SPECIES	Pop. est.	No. seen	No. Out	Variance	95%cl %est.	95%Range	Mean	Dens /km ²
Baboon	1397	146	0	148326.13	55.4	623 < 2171		0.1429
Bushbuck	153	16	0	1958.32	58.1	64 < 242		0.0157
Bushpig	48	5	0	1998.91	188.6	5 < 137		0.0049
Duiker	938	98	1	22876.89	32.4	634 < 1242		0.096
Eland	19	2	0	155.72	130	2 < 44		0.002
ElephantBull	124	13	0	8458.96	149.1	13 < 309		0.0127
EleCarcass 3	19	2	0	162.62	133.6	2 < 45		0.002
EleCarcass 4	67	7	0	648.45	76.6	16 < 118		0.0068
ElephantFamily	393	41	0	38013.63	99.7	41 < 785		0.0402
GroundHornbill	568	59	4	10824.17	36.8	358 < 777		0.0581
Kudu	182	19	0	6951.73	92.3	19 < 349		0.0186
Monkey	305	32	0	23615.34	101.2	32 < 614		0.0312
Sable	162	17	14	16120.15	157.5	31 < 417		0.0166
Warthog	555	58	0	17348.32	47.7	290 < 820		0.0568
Cattle	791	83	3	380836.06	156.8	86 < 2031		0.0809
Sheep/goats	1062	111	0	111247.55	63.1	391 < 1732		0.1087
OtherCarcass 4	10	1	0	80.3	189	1 < 28		0.001
Fishing camp	76	8	0	783.83	73.8	20 < 132		0.0078
Fishtrap/net	76	8	0	864.51	77.3	17 < 136		0.0078
Canoe	619	65	9	55846.58	76.7	144 < 1094		0.0634
Snareline	125	13	0	2448.26	79.5	26 < 224		0.0128
Gold panning	48	5	0	2158.12	193.6	5 < 142		0.0049
Logging	2196	229	0	52548.07	21	1735 < 2657		0.2248
Timber yard	356	37	1	5610.66	42.3	205 < 506		0.0364
Bamboo harvesting	105	11	0	2313.4	92.1	11 < 202		0.0107
Village	2446	255	22	63226.48	20.7	1941 < 2951		0.2504
Cultivation	6657	695	8	361959.26	18.2	5448 < 7866		0.6813
Big Village	239	25	16	1634.02	34	158 < 320		0.0244

Stratum Q1 Area: 4811 km² Sampling intensity: 10.40%

SPECIES	Pop. est.	No. seen	No. Out	Variance	95%cl %est.	95%Range		Dens /km²
Baboon	444	46	0	41211.09	94.9	46	◇ 865	0.0922
Bushbuck	48	5	0	710.88	114.6	5	◇ 104	0.01
Duiker	309	32	1	12126.24	74	80	◇ 537	0.0642
Eland	19	2	0	155.72	134.1	2	◇ 45	0.004
ElephantBull	10	1	0	82.28	195	1	◇ 28	0.002
EleCarcass 3	10	1	0	81.48	194.1	1	◇ 28	0.002
EleCarcass 4	10	1	0	84.99	198.2	1	◇ 29	0.002
ElephantFamily	183	19	0	15973.55	143	19	◇ 445	0.0381
GroundHornbill	434	45	4	7926.58	42.5	249	◇ 619	0.0902
Kudu	39	4	0	1347.68	197.3	4	◇ 115	0.008
Monkey	19	2	0	339.97	198.2	2	◇ 58	0.004
Sable	0	0	14	0	0	14	◇ 0	0
Warthog	193	20	0	5348.23	78.6	41	◇ 345	0.0401
Sheep/goats	318	33	0	30669.66	114.1	33	◇ 682	0.0662
Fishtrap/net	19	2	0	166.27	138.6	2	◇ 46	0.004
Snareline	96	10	0	2065.94	97.7	10	◇ 191	0.0201
Gold panning	48	5	0	2158.12	199.7	5	◇ 145	0.01
Logging	1148	119	0	27883.69	30.2	802	◇ 1494	0.2386
Timber yard	251	26	1	4727.3	56.9	108	◇ 393	0.0521
Bamboo harvesting	10	1	0	87.41	201	1	◇ 29	0.002
Village	1331	138	2	50252.17	34.9	866	◇ 1796	0.2767
Cultivation	2778	288	2	261371.46	38.2	1718	◇ 3838	0.5775
Big Village	48	5	5	334.14	78.6	10	◇ 86	0.01

Stratum Q2 Area: 4960 km² Sampling intensity: 10.50%

SPECIES	Pop. est.	No. seen	No. Out	Variance	95%cl %est.	95%Range		Dens /km²
Baboon	953	100	0	107115.04	70.5	281	◇ 1624	0.1921
Bushbuck	105	11	0	1247.43	69.1	32	◇ 177	0.0211
Bushpig	48	5	0	1998.91	192.5	5	◇ 139	0.0096
Duiker	629	66	0	10750.65	33.8	416	◇ 842	0.1268
ElephantBull	114	12	0	8376.68	164.2	12	◇ 302	0.0231
EleCarcass 3	10	1	0	81.14	194	1	◇ 28	0.0019
EleCarcass 4	57	6	0	563.45	85.2	8	◇ 106	0.0115

ElephantFamily	210	22	0	22040.08	145.3	22	<	514	0.0423
GroundHornbill	133	14	0	2897.6	82.8	23	<	244	0.0269
Kudu	143	15	0	5604.05	107.5	15	<	297	0.0288
Monkey	286	30	0	23275.37	109.5	30	<	599	0.0576
Sable	162	17	0	16120.15	160.8	17	<	423	0.0327
Warthog	362	38	0	12000.09	62.1	137	<	587	0.073
Cattle	791	83	3	380836.07	160.1	86	<	2057	0.1595
Sheep/goats	743	78	0	80577.9	78.4	161	<	1326	0.1499
OtherCarcass 4	10	1	0	80.3	192.9	1	<	28	0.0019
Fishing camp	76	8	0	783.83	75.4	19	<	134	0.0154
Fishtrap/net	57	6	0	698.23	94.8	6	<	111	0.0115
Canoe	619	65	9	55846.58	78.3	135	<	1104	0.1249
Snareline	29	3	0	382.32	140.3	3	<	69	0.0058
Logging	1048	110	0	24664.39	30.7	726	<	1370	0.2113
Timber yard	105	11	0	883.36	58.2	44	<	166	0.0211
Bamboo harvesting	95	10	0	2225.99	101.6	10	<	192	0.0192
Village	1115	117	20	12974.31	21	881	<	1349	0.2248
Cultivation	3878	407	6	100587.79	16.8	3228	<	4529	0.782
Big Village	191	20	11	1299.88	38.8	117	<	265	0.0384

Stratum WW Area: 7246 km² Sampling intensity: 10.40%

SPECIES	Pop. est.	No. seen	No. Out	Variance	95%cl %est.	95%Range	Dens /km ²
Baboon	126	13	0	4273.26	105.4	13 < 258	0.0173
Bushbuck	19	2	0	154.7	130.4	2 < 44	0.0027
Bushpig	97	10	0	4057.29	133.6	10 < 225	0.0133
Crocodile	19	2	0	342.67	194.1	2 < 57	0.0027
Duiker	3109	322	0	122386.46	22.8	2401 < 3817	0.429
ElephantBull	68	7	0	1563.54	118.4	7 < 148	0.0093
EleCarcass 3	10	1	0	81.36	189.1	1 < 28	0.0013
EleCarcass 4	39	4	0	293.27	89.8	4 < 73	0.0053
ElephantFamily	164	17	25	8038.5	110.6	42 < 346	0.0226
GroundHornbill	965	100	0	23455.32	32.1	655 < 1275	0.1332
Hartebeest	68	7	0	2097.09	137.2	7 < 160	0.0093
Kudu	251	26	0	8464.45	74.2	65 < 437	0.0346
Monkey	145	15	0	5151.98	100.3	15 < 290	0.02
Sable	29	3	0	394.23	138.8	3 < 69	0.004
Warthog	232	24	0	6612.43	71	67 < 396	0.032
Zebra	87	9	0	5276.57	169.2	9 < 234	0.012
OtherCarcass 4	10	1	0	81.56	189.4	1 < 28	0.0013
Fishing camp	77	8	0	1939.74	115.4	8 < 166	0.0107
Fishtrap/net	154	16	0	6003.44	101.5	16 < 311	0.0213

Canoe	77	8	0	1933.56	115.3	8	◇ 166	0.0107
Snareline	618	64	0	6839.96	27.1	450	◇ 785	0.0853
Logging	4596	476	0	232138.75	21.2	3620	◇ 5571	0.6342
Timber yard	126	13	1	1356.86	59.4	51	◇ 200	0.0173
Village	647	67	7	15810.97	39.4	392	◇ 901	0.0893
Cultivation	1072	111	3	54863	44.2	597	◇ 1546	0.1479
Big Village	29	3	4	393.43	138.6	7	◇ 69	0.004

Stratum WN Area: 3817 km² Sampling intensity: 10.3%

SPECIES	Pop. est.	No. seen	No. Out	Variance	95%cl %est.	95%Range	Dens /km²
Baboon	19	2	0	346.81	200.5	2 ◇ 58	0.0051
Bushbuck	29	3	0	379.11	139.8	3 ◇ 70	0.0076
Duiker	184	19	1	3437.26	66.4	62 ◇ 306	0.0482
EleCarcass 4	10	1	0	86.7	200.5	1 ◇ 29	0.0025
ElephantFamily	58	6	0	2947.75	194.9	6 ◇ 171	0.0152
GroundHornbill	77	8	0	2369.1	131	8 ◇ 179	0.0203
Hippopotamus	262	27	0	28117.99	133.7	27 ◇ 611	0.0685
Reedbuck	19	2	0	322.05	193.2	2 ◇ 57	0.0051
Sable	300	31	0	29161.02	118.6	31 ◇ 657	0.0787
Warthog	339	35	0	24009.46	95.3	35 ◇ 662	0.0888
Waterbuck	29	3	0	734.06	194.5	3 ◇ 86	0.0076
Sheep/goats	155	16	0	18108.98	181.1	16 ◇ 436	0.0406
Fishing camp	39	4	0	285.28	90.9	4 ◇ 74	0.0102
Fishtrap/net	232	24	0	2899.86	48.3	120 ◇ 345	0.0609
Canoe	145	15	0	2124.45	66.2	49 ◇ 241	0.0381
Snareline	87	9	0	634.71	60.3	35 ◇ 140	0.0228
Logging	1918	198	0	77678.96	30.3	1337 ◇ 2499	0.5025
Timber yard	77	8	0	798.61	76.1	19 ◇ 136	0.0203
Bamboo harvesting	19	2	0	150.4	132	2 ◇ 45	0.0051
Village	1550	160	12	48631.63	29.7	1090 ◇ 2010	0.4061
Cultivation	4175	431	5	624933.68	39.5	2526 ◇ 5824	1.0939
Big Village	48	5	3	1504.08	167	8 ◇ 129	0.0127