

Kunene Regional Ecological Analyses: Assisting Conservancies with Seasonal Wildlife Monitoring

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Dr. Kimberly S. Heinemeyer¹, Lead Scientist

Contributing authors: R. Karimi, V. Kasupi, R. Tingey

¹ Contact: Round River Conservation Studies, 284 West 400 North Suite, Salt Lake City, UT 84103;
kim@roundriver.org

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ABSTRACT

From November 2011 to April 2013, Round River Conservation Studies worked with Anabeb, Ehrovipuka, Omatendeka, Sesfontein and Torra conservancies and the Namibia Ministry of Environment and Tourism conducted wildlife surveys to support wildlife monitoring in the Kunene Region. The surveys are designed to complement the North-West Annual Game Counts by providing wildlife count data during other times of the year or in areas not being sampled during the Annual Game Count. The methods employed a sampling design and standardized data collection protocols similar and compatible to the Annual Game Count. Over the course of 4 surveys completed between October 2011 and April 2013, we completed 7,335 km of vehicular game count surveys with 493 hours of observation time; 90 foot-accessed timed point count surveys with 180 hours of observation; and exploratory use of remote-triggered cameras as an approach to survey nocturnal or rare mammal species. Conservancy Game Guards and Round River staff and students completed surveys in the five Kunene conservancies in Oct-Nov 2011, Mar-Apr 2012, Oct-Nov 2012 and Mar-Apr 2013; Palmwag concession was added to the study area and surveyed in Oct-Nov 2012 and Mar-Apr 2013. Thirty different wildlife species were observed during the vehicular surveys, of which 15 of these species were also observed during point count surveys. Two species were observed solely on the point count surveys. The most common wildlife observed were gemsbok, springbok and Hartmann's mountain zebra. Two test camera stations captured leopards, lion, cape fox, honey badger, and porcupine, as well as a diversity of more common species. Gemsbok, Hartmann's mountain zebra, kudu and springbok locations were attributed information about major structural habitat types and livestock grazing intensity to compare the relative proportion of observations with in these habitat types to the relative survey effort in these habitats. The analyses showed that each species is found proportionately more than expected by survey effort in some kinds of habitats. Additionally most species also exhibited a higher relative use of selected habitats that are not grazed by livestock with possible avoidance of the same habitat classes if grazed by livestock. The avoidance is particularly notable for some species if livestock grazing is more intensive such as areas classified as wet season grazing where livestock use may actually be nearly year-around. Population densities and abundances are calculated for 6 species: gemsbok, giraffe, Hartmann's mountain zebra, kudu, ostrich and springbok using distance analyses approaches. The population estimates are presented for each of the 4 seasonal surveys completed; including regional population estimates and trends through time and conservancy-level population densities and abundances. Trends through time are non-significant but some species populations suggest a possible declining trend. This trend could be a response to the drought conditions being experienced in the region, though more data is needed to see if the trend continues. These survey efforts will continue to be repeated each March-April and October-November, and will provide additional species abundance and seasonal distribution information for the conservancies and the Ministry of Environment and Tourism.

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INTRODUCTION

Wildlife monitoring in the Kunene Region of Namibia is primarily through a region-wide annual game count each June jointly conducted by MET, conservancies and the World Wildlife Fund (WWF). The annual North-West Game Count is the largest road-based game count in the world, covering approximately 6.6 million hectares and over 7,000 km of survey routes (NACSO 2010). For the last ten years, conservancy, MET and WWF staffs have jointly carried out these game counts in the conservancies and concessions of the Kunene region, as well as in Skeleton Coast National Park (NACSO 2010).

Within each conservancy, conservancy staff and members also undertake periodic foot and vehicle wildlife surveys to supplement the regional census. In addition, game guards monitor wildlife-related events (e.g. fire, poaching, problem animal incidents, wildlife mortalities, etc.) and wildlife sightings using the Event Book System that provides a consistent record-keeping approach across conservancies (NACSO 2010). The annual North-West Game Count and the Event Book System help determine annual quotas for wildlife utilization that are summarized in the conservancy's *Annual Natural Resource Report* (NACSO 2013; Stuart-Hill 2005).

To complement and supplement the information on wildlife populations in the Kunene region, Round River Conservation Studies works with MET and 5 conservancies to complete additional wildlife surveys in October-November and March-April of each year. These surveys are completed within Anabeb, Ehrovipuka, Omatendeka, Sesfontein and Torra conservancies and Palmwag Concession and are conducted using methods consistent with the annual road-based game counts. The data collection protocols allow for both distance sampling and strip count analyses (Buckland et al. 2001). In addition, we are conducting point count surveys in more remote and roadless areas to improve information in these regions and we are exploring methods to surveys of more rare or nocturnal mammals. Conservancy staff and Game Guards are being trained in all survey methods and are present on all surveys, to enhance and expand their skills and experiences. Game guards are increasingly able to also participate and assist with data processing and management, with capacity building continuing each season.

Round River Conservation Studies in the Kunene Region of Namibia

In 2001, Round River began working in the Kunene Region of Namibia in support of the Namibian organization, Save the Rhino Trust. In 2006, Round River, initiated the Kunene Regional Ecological Assessment (KREA) to provide ecological and capacity building support for regional conservation. Endorsed by MET, the KREA was also supported by the Kunene Regional Governor and Council, and the 15 Conservancy Management Committees and Traditional Authorities. The KREA was founded on field-based research, scientific and technological analysis and support, the development of strong local working relationships through outreach and training, and community-based land management planning. The ecological outputs of the KREA include improvements in the mapping of both natural and man-made water sources, human use and livestock grazing patterns, a regional connectivity model, regional quantitative habitat models for desert elephant, lion and black rhino; and identification of areas of high regional conservation value (Muntifering et al. 2009). KREA reports and maps are available on the [Round River](#) web site. The KREA has

been used to inform community-based land planning for 15 conservancies in the Kunene region.

Since 2011, Round River has focused on developing and implementing wildlife surveys two times each year in Anabeb, Ehirovipuka, Omatendeka, Sesfontein, and Torra conservancies, with Palmwag concession added in 2012. Four surveys have now been completed across the 5 conservancies and 2 surveys have been completed in the Palmwag concession. The surveys include road-based surveys, foot-accessed point count surveys, and remote camera trap stations. Game guards have assisted each survey completed within their conservancies and concession area and have been trained in the use of necessary equipment.



FIELD METHODS

Wildlife surveys within each conservancy and concession area were a combination of road-based transects, foot-accessed point counts and remote camera stations completed in October-November and March-April each year from October 2011 through April 2013. Surveys were conducted in 5 Kunene Region conservancies in northwest Namibia: Anabeb, Ehrovipuka, Omatendeka, Sesfontein and Torra, and in the Palmwag concession (Figure 1). This arid region is sparsely populated with scattered villages and farms (Table 1, NACSO 2013). The landscapes of these conservancies are comprised of hills, plains and wooded river valleys, with vegetated communities of sparse savannah and semi-desert (Muntifer et al 2009).

Vehicular Wildlife Transect Survey Methods

Transects across the study area were based upon MET's Annual Game Count routes (Figure 1). Survey design parameters including daily timing, driving speed and observer numbers also were consistent with the Annual Game Count methods. Detailed description of the methods can be found in Heinemeyer et al (2012). Routes were surveyed in the morning, beginning no earlier than half an hour before sunrise (0630 hours) and ending no later than 1100 hours even if the route was not completed. This window focused survey efforts during the highest visibility times and avoided surveying when animals are more likely to have bedded down to avoid the heat. Each survey route was recorded using a GPS unit.

Surveys used at least 4 people: 1-2 conservancy game guard or community members who had participated in the Annual Game Count, a Round River biologist and 2 or more Round River students. The driver did not exceed 30 km/hour. After the initial survey in Oct-Nov 2011, we assigned one observer to scan behind the vehicle 180° from their left to right. The other two observers scanned 90° to their right or left in the direction of the moving vehicle. The driver functioned as the main observer of wildlife on or near the road. The rear-faced observer increased the visual field to observe wildlife hidden from forward seated observers by hills and vegetation. Additionally, observers recorded data, entered a GPS waypoint for each observation, determined the distance between the vehicle and the animals using a laser range finder (Nikon Laser 1200 Monarch Gold) and recorded the compass angle to the center animal of the group (equipment details and operating instructions are in Heinemeyer et al. 2012).

The distance was recorded between the vehicle and the location of the animal or group of animals where it was originally spotted. For groups of animals, the original center of the group was used to calculate this distance. If the rangefinder distance appeared inaccurate, the observer made a visual distance estimate to the location of the animal and it was noted that the distance was a visual estimation. This occurred most frequently at distances greater than 500m. Prior to the surveys, all observers practiced visual distance estimation to minimize errors in data collected without the aid of a laser range finder.

Each observer had a compass set to the regional declination (10 degrees west) and obtained the angle (from true north) to the location where the animal was first sighted to the closest degree. The species, group size and if possible the sex and age class (adult, sub-adult, young

of year) of individual animals were recorded. When possible the vehicle was moved closer to the spotted animal to record a more accurate recording of group size, ages and sexes.

Data were collected for all encountered wild mammals (excluding rodents) and for ostrich (*Struthio camelus*). When livestock were spotted, the vehicle was not stopped but a GPS waypoint was taken and species, group size and visual estimated distance from the survey route were recorded. Our original research permit (#1621/2011) does not allow us to collect data on black rhino (*Diceros bicornis*), and any incidental sighting information was provided to employees of Save the Rhino Trust (SRT).

Point Count Survey Methods

Road-based vehicular surveys are limited to regions with existing roads and do not collect animal abundance information in potentially important regions of limited access and low human use and disturbance. Therefore, we conducted point counts to collect data in the more remote areas of each conservancy. Point counts were conducted in areas more than 2 km from transect survey routes (Figure 1). The location of point count surveys considered several local environmental variables, including topography and our ability to find a high vantage point for effective viewing (Figure 2). The location of point count survey sites were recorded with a GPS. At least two sites in each of the 5 conservancies and the concession were surveyed each season with additional sites surveyed when time allowed.

Point count surveys consisted of at least three observers typically including a conservancy game guard, a Round River biologist or lead staff and 1-2 students. Point counts began no later than 0900 hours to ensure the survey was completed by 1100 hours. The observers searched for animals for 2 hour observation periods with sampling occurring at 5 minute intervals. Once an animal was counted, its location was monitored to ensure it was not counted again. The observers approached the point of observation on foot taking care to remain hidden by topography and upwind of the sampling field of view (Lee & Marsden 2008). The field of view or view-shed was established using the right and left most compass angles. There was minimal activity by the observers during the two-hour observation period. Each observer had a compass set to the correct declination (10 degrees west). The observer took a compass angle (from true north) to the location where the animal was first seen, as well as a distance measurement, using a laser range finder when possible. If the range finder appeared to be inaccurate, the observer made a visual estimate to the original location of the animal sighting. The location of animals was described to fellow observers so as to ensure that it was not counted twice. Characteristics and behaviors of previously sighted animals were observed to track an animal as it may have changed location during the two-hour observation period. Key survey design parameters and a detailed manual for equipment use may be reviewed in Heinemeyer et al. 2012.

Game Count Data Processing

Data collected during vehicular game counts and point count survey efforts were entered into a Microsoft excel data file and trigonometric equations were used to calculate the estimated UTM locations of the wildlife observed (see Heinemeyer et al. 2012 for details). Summary statistics including total count of each species, the average and range of group sizes and counts by sex and age class were calculated for each conservancy. The group

composition data (age class and sex) were summarized only if all individuals in a group were accounted for.

Remote Camera Survey Methods

Remote cameras were used to gather information on the presence of less commonly observed species such as predators and other nocturnal species (Heinemeyer et al. 2012). When the memory cards were replaced and the photos were reviewed, the observer would identify species and record pertinent information regarding the 'sightings' in an Excel spreadsheet. Commonly observed species were disregarded in the photo review process, as the purpose of the remote camera stations was to observe elusive and nocturnal species that would not commonly be seen during other survey methods. Species were recorded in the data sheet only if there was 30 minutes of inactivity between photos taken to minimize recording the same animal or group of animals consecutively during one long visit to the camera site.

Table 1. Summary of information about conservancies and the Palmwag concession surveyed as part of wildlife census efforts in the Kunene region of northern Namibia between October 2011 and April 2013.

Conservancy/ Concession	Area (km²)	Population	Annual Rainfall (mm)	Main River(s)
Anabeb	1570	2000	150-250	Hoanib/Ombonde
Ehrovipuka	1980	2500	200-350	Hoanib/Ombonde
Omatendeka	1619	2500	150-300	Hoanib/Ombonde
Palmwag	5500	No permanent residents	<150	Uniab, Achab, Khawahab, Hoanib/Ombonde
Sesfontein	2465	2500	50-150	Hoanib/Ombonde
Torra	3493	1200	50-150	Huab, Springbok

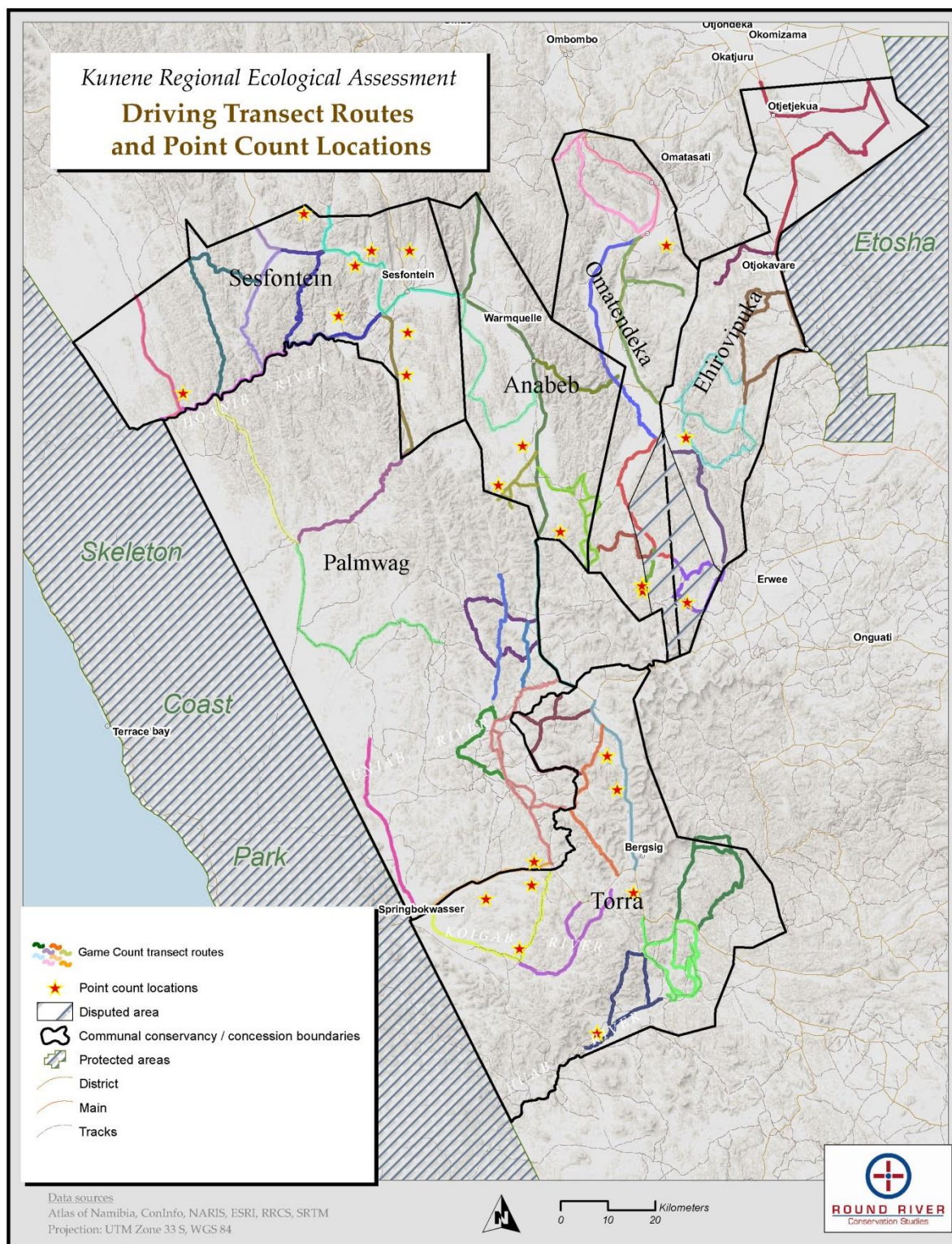


Figure 1. Map showing the road-based game count transect routes and the point count sites surveyed between October 2011 and April 2013 in the Kunene region of northern Namibia.

FIELD EFFORT AND DATA SUMMARY

This report summarizes the data collected across 4 seasons of surveys (Oct-Nov 2011, Mar-Apr 2012, Oct-Nov 2012, Mar-Apr 2013) including data from road-based transect surveys, point count surveys and camera surveys.

Vehicular Game Count Surveys

Summary of Effort. Vehicular surveys were repeated four times between October 2011 and April 2013 along established survey routes (Figure 1) for a cumulative total of 104 survey days. Surveys were completed in Oct/Nov 2011, Mar/Apr 2012, Oct/Nov 2012 and Mar/Apr 2013 for the 5 conservancies. Palmwag Concession was added to our survey area in Oct-Nov 2012 and two seasons of surveys have been completed in the Concession. We attempted to complete each transect route once each survey period. In some cases, we repeated transect routes within a season to collect information regarding in-season variability of counts. Repeat surveys have been completed along some transects in Anabeb, Ehirovipuka, and Palmwag. Over the four seasons, a total of 6227.5 km of routes were surveyed with 1138.9 km of these being surveyed twice during one field season for a total survey effort of 7,366.4 km and 493 hours of observation time. Within conservancies, the average survey effort ranged from 223 km to 388 km, with an average total survey time ranging between 14 and 30 hours to complete a single set of transect routes (Table 2). Details of each survey are provided in Appendix I. The average transect route was 44.2 km, but was variable (range: 8 - 89 km) and took an average of 2.93 hours to complete (range 0.7 – 4.3 hrs). As per protocol, surveys started in the morning (average start time 7:07) and ended before 11:00 (average end time 10:21) to minimize the potential effects of hot weather on wildlife behavior influencing sightability. The average temperature at the end of surveys was 29°C (range: 12-43°C).

Summary of Data. Thirty wildlife species were counted during the vehicular game count surveys (Table 3). The most prevalent species included springbok, Hartmann's mountain zebra, and gemsbok (Table 4); these species were relatively common across most conservancies and abundant in some conservancies (Figure 3, Appendix II). Other species found in lower numbers in most conservancies including giraffe and ostrich. Several species were found in lower numbers but some of these were more abundant locally in some conservancies (e.g., kudu in Torra, eland in Ehirovipuka). Noteworthy sightings included a caracal in Anabeb, a herd of 17 red hartebeest in Torra, 3 bat-eared foxes and a leopard in Sesfontein.

Group composition data including age class and sex was analyzed for common species (Table 5). However, group compositions were only calculated for groups in which all individuals were accounted for. The identification of age class/sex was difficult to obtain for larger groups so group composition data are biased toward smaller groups. Age structure can be an important indicator of population, particularly if the proportional age structure of the population changes through time. Additional data and additional analyses are required before interpreting the data collected to date as part of the game count surveys.

Instances where binoculars were used to first observe a group and instances where groups were first observed fleeing from observers were minimal (Table 6). Fleeing groups accounted for less than 27% of data collected, excluding baboons, with the majority of species being observed fleeing in less than 20% of observations. Groups viewed through binoculars accounted for less than 10% of observations, excluding giraffe during the Mar-Apr 2012 season. Evaluation of the distribution of recorded distances indicates that the dataset has minimal biases that could affect analyses due to these influences and all observations were included in population analyses.



Figure 2. Photograph showing the typical type of point count observation site used to survey wildlife in roadless portions of 5 conservancies and the Palmwag concession between Oct 2011 and Apr 2013 in the Kunene region of northern Namibia; this site is in the Anabeb conservancy.

Table 2. Summary of vehicular survey efforts completed in 5 conservancies and the Palmwag concession in the Kunene region of northern Namibia during 4 seasonal surveys between October 2011 and April 2013.

Conservancy/ Concession	Total Survey Routes	Average (Range) Survey Distance/Field Season (Km)	Average Survey Time/Field Season (Hours)
Anabeb*	6	222.8 (201-234)	13.6 (12.5-14.9)
Ehirovipuka*	6	306.0 (234-293)	17.8 (16.4-19.4)
Omatendeka	6	254.6 (214-324)	17.0 (15.8-18.1)
Palmwag*	12	437.7 (337-449)	41.8 (27.2-31.6)
Sesfontein	6	243.8 (337-449)	14.0 (13.0-16.1)
Torra	9	387.5 (201-288)	30.5 (16.7-27.7)

*A portion of routes in this conservancy/concession were repeated more than once during at least one field season, which is not accounted for in this table: Anabeb 6 routes; Ehirovipuka 2 routes,; Palmwag 7 routes on the first repeated circuit, 9 routes on the second

Table 3. Total counts of species recorded during vehicular game counts in 5 conservancies and Palmwag concession in the Kunene region of northern Namibia from October 2011 through April 2013.

Species	Latin Name	Oct- Nov 2011	Mar-Apr 2012	Oct-Nov 2012	Mar-Apr 2013
Aardwolf	<i>Proteles cristatus</i>	2			1
African wildcat	<i>Felis libyca</i>				3
Bat-eared fox	<i>Otocyon megalotis</i>		3	5	6
Black-backed jackal	<i>Canis mesomelas</i>	21	28	40	57
Black rhino	<i>Diceros bicornis</i>		2	5	10
Brown hyena	<i>Hyaena brunnea</i>				1
Caracal	<i>Caracal caracal</i>		1		1
Chacma baboon	<i>Papio ursinus</i>	141	72	153	121
Cheetah	<i>Acinonyx jubatus</i>		4		2
Dik-dik	<i>Madoqua kirkii</i>	4			
Duiker	<i>Sylvicapra grimmia</i>				2
Eland	<i>Taurotragus oryx</i>	17	4		
Elephant	<i>Loxodonta africana</i>	10	2	21	53
Gemsbok	<i>Oryx gazelle</i>	942	1079	1361	1106
Giraffe	<i>Giraffa camelopardalis</i>	159	195	253	282
Zebra	<i>Equus zebra hartmannae</i>	1251	1920	1952	2009
Honey badger	<i>Mellivora capensis</i>	1			1
Klipspringer	<i>Oreotragus oreotragus</i>		4		7
Kudu	<i>Tragelaphus strepsicerus</i>	141	60	175	111
Leopard	<i>Panthera pardis</i>		1		
Lion	<i>Panthera leo</i>			5	10
Ostrich	<i>Struthio camelus</i>	116	294	262	331
Red hartebeest	<i>Alcelaphus caama</i>		17		14
Rock hyrax	<i>Procavia capensis</i>	11	4		23
Spotted hyena	<i>Crocuta crocuta</i>	2	1	3	4
Steenbok	<i>Raphicercus campestris</i>	19	22	59	39
Warthog	<i>Phacochoerus africanus</i>		6		6

Table 4. Average counts of seven common species per kilometer travelled during four field seasons in Anabeb, Ehirovipuka, Omatendeka, Sesfontein, and Torra conservancies Oct 2011- Apr 2013, including Palmwag concession Oct 2012- Apr 2013.

Species	Latin Name	Oct- Nov 2011	Mar-Apr 2012	Oct-Nov 2012	Mar-Apr 2013	Average	Standard deviation
Chacma baboon	<i>Papio ursinus</i>	0.0922	0.0458	0.0765	0.0497	0.0660	0.0221
Gemsbok	<i>Oryx gazella</i>	0.6189	0.6864	0.6810	0.4953	0.6204	0.0888
Giraffe	<i>Giraffa camelopardalis</i>	0.1046	0.1240	0.1265	0.1263	0.1203	0.0106
Zebra	<i>Equus zebra hartmannae</i>	0.8176	1.2214	0.9755	0.9000	0.9785	0.1743
Kudu	<i>Tragelaphus strepsicerus</i>	0.0922	0.0382	0.0875	0.0497	0.0669	0.0270
Ostrich	<i>Struthio camelus</i>	0.0758	0.1870	0.1310	0.1482	0.1355	0.0462
Springbok	<i>Antidorcas marsupialis</i>	0.9052	1.8804	1.6085	1.5615	1.4889	0.4138

Table 5. Age class/sex composition for identified groups of the seven most common species in Anabeb, Ehrovipuka, Omatendeka, Sesfontein, Torra conservancies and Palmwag concession in the Kunene region. Percentages describe the total number of groups counted which were included in the composition numbers; n= number of groups in which ages and sex were recorded, A = Adult, SA = Subadult, YoY = Young of Year.

Field Season	Species	Groups Counted	Mean Group Size	Range Group Size	Age Class Composition				Sex Ratio		
					A	SA	YoY	N	Male	Female	N
Oct-Nov 2011	Chacma baboon	13	10.9	1-23	3.60	1.83	1.33	6 (46%)	-	-	1 (8%)
	Gemsbok	232	4.08	1-40	2.87	0.08	0.15	131 (56%)	1	1.2	86 (37%)
	Giraffe	50	3.20	1-13	2.39	0.34	0.39	40 (80%)	1	1.0	24 (48%)
	HM Zebra	168	7.45	1-40	5.59	0.45	0.30	71 (42%)	1	1.8	22 (13%)
	Kudu	30	4.70	1-20	3.82	0.59	0.06	17 (57%)	1	1.4	23 (77%)
	Ostrich	54	2.15	1-13	1.73	0.04	0	48 (77%)	1	0.5	47 (87%)
	Springbok	194	7.14	1-64	3.60	0.33	0.50	98 (51%)	1	1.2	61 (31%)
Mar-Apr 2012	Chacma baboon	7	10.3	2-30	5.33	2.00	4.00	3 (43%)	-	-	0
	Gemsbok	211	5.11	1-103	2.54	0.38	0.28	112 (53%)	1	1.0	60 (28%)
	Giraffe	53	3.68	1-16	2.00	0.38	0.15	13 (25%)	1	0.2	21 (40%)
	HM Zebra	258	7.44	1-150	4.88	0.69	0.47	65 (25%)	1	2.3	8 (3%)
	Kudu	27	2.22	1-7	1.92	0.04	0.08	24 (89%)	1	1.2	26 (96%)
	Ostrich	46	6.39	1-49	3.5	0.35	0.24	34 (74%)	1	0.7	29 (63%)
	Springbok	190	15.4	1-208	3.58	0.68	0.31	77 (41%)	1	1.3	45 (24%)
Oct-Nov 2012	Chacma baboon	8	19.1	1-40	9.00	2.75	2.25	4 (50%)	-	-	0
	Gemsbok	308	3.63	1-33	2.31	0.22	0.17	193 (63%)	1	0.9	119 (39%)
	Giraffe	73	3.14	1-15	2.23	0.52	0.38	64 (88%)	1	1.1	27 (37%)
	HM Zebra	210	8.13	1-45	4.26	0.75	0.69	88 (42%)	1	1.4	22 (10%)
	Kudu	36	4.02	1-12	2.91	0.63	0.22	32 (89%)	1	2.1	28 (78%)
	Ostrich	73	3.10	1-21	2.56	0.11	0	66 (90%)	1	0.7	59 (81%)
	Springbok	111	7.40	1-62	4.47	0.91	0.15	211 (55%)	1	1.5	111 (29%)
Mar-Apr 2013	Chacma baboon	10	7.50	1-17	3.67	2.33	1.11	9 (90%)	1	0	3 (30%)
	Gemsbok	298	2.65	1-23	2.33	0.19	0.03	296 (99%)	1	0.8	226 (76%)
	Giraffe	67	3.34	1-14	2.43	0.51	0.24	63 (94%)	1	0.8	48 (72%)
	HM Zebra	168	5.56	1-27	4.23	0.84	0.16	159 (95%)	1	1.6	35 (21%)
	Kudu	39	2.85	1-10	2.23	0.51	0.13	39 (100%)	1	1.3	36 (92%)
	Ostrich	71	4.15	1-14	3.89	0	0.27	71 (100%)	1	0.8	66 (93%)
	Springbok	264	3.77	1-34	3.10	0.25	0.31	258 (98%)	1	0.9	141 (53%)

Table 6. Instances where animals were first observed fleeing or with the assistance of binoculars during vehicular game counts in the Kunene region of northern Namibia (n= total number of animal groups by species and field season).

Field Season	Species	Groups fleeing upon observation	Groups sighted with binoculars	N
Oct-Nov 2011	Chacma baboon	5 (38%)	1 (8%)	13
	Gemsbok	55 (24%)	5 (2%)	232
	Giraffe	10 (20%)	0	50
	HM Zebra	28 (17%)	6 (4%)	168
	Kudu	4 (13%)	1 (3%)	30
	Ostrich	14 (26%)	3 (6%)	54
	Springbok	33 (17%)	6 (3%)	194
Mar-Apr 2012	Chacma baboon	1 (14%)	0	7
	Gemsbok	57 (27%)	21 (10%)	211
	Giraffe	5 (9%)	13 (25%)	53
	HM Zebra	59 (23%)	23 (9%)	258
	Kudu	5 (19%)	2 (7%)	27
	Ostrich	8 (17%)	4 (9%)	46
	Springbok	32 (17%)	14 (7%)	190
Oct-Nov 2012	Chacma baboon	2 (25%)	0	8
	Gemsbok	31 (10%)	14 (5%)	308
	Giraffe	0	1 (1%)	73
	HM Zebra	20 (10%)	6 (3%)	210
	Kudu	5 (14%)	1 (3%)	36
	Ostrich	6 (8%)	3 (4%)	73
	Springbok	28 (7%)	3 (1%)	384
Mar-Apr 2013	Chacma baboon	1 (10%)	0	10
	Gemsbok	13 (4%)	1 (<1%)	298
	Giraffe	1 (1%)	1 (1%)	67
	HM Zebra	15 (9%)	1 (1%)	168
	Kudu	0	0	39
	Ostrich	0	1 (1%)	71
	Springbok	16 (6%)	1 (<1%)	264

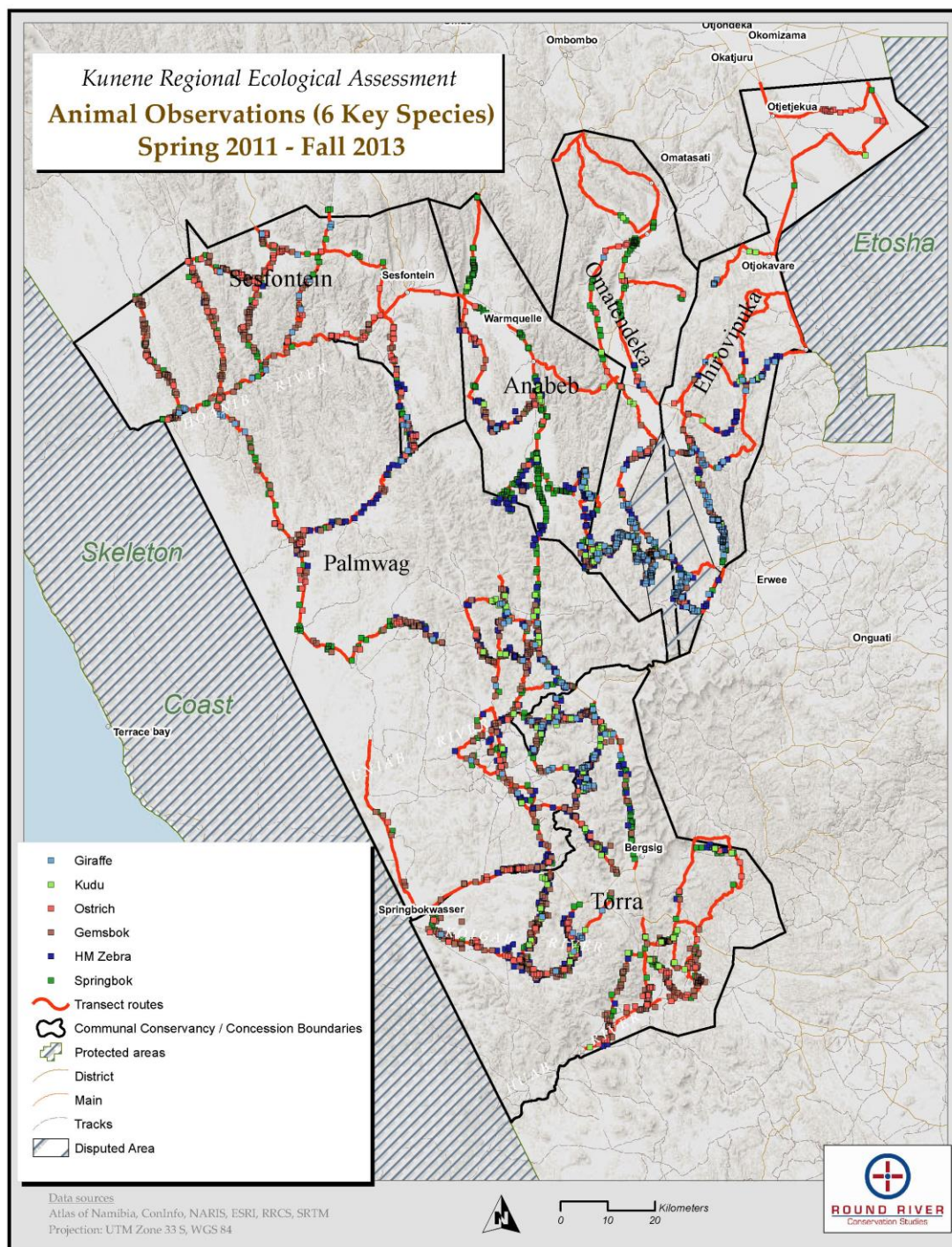


Figure 3. Map showing the road-based transects and the observations of 6 common species across the study area of 5 conservancies and the Palmwag concession in the Kunene region of northern Namibia; observations are compiled from 4 surveys completed between October 2011 and April 2013.

Point Count Surveys

Summary of Effort. Point count surveys were conducted in each of the 4 surveys seasons for a total of 91 point counts sites surveyed in 71 survey days with some days employing 2 teams to conduct 2 surveys in different areas. A total of 46 point count sites were sampled at least once over the 4 season period. Of these, 21 have been selected for repeated sampling and surveys completed at least twice during the study period (Table 7). A total of 180 hours of survey effort were devoted to point count surveys. Point count sample site locations and characteristics were recorded and survey information for each point count is provided in Appendix I (Table I-2). As per protocol, surveys started in the morning (average start time 7:59) and ended before 11:00 (average end time 9:59). This is intended to minimize the potential effects of hot weather influencing wildlife behavior and sightability. The average temperature at the end of the survey was 32°C (range: 21 – 46°C).

Summary of Data. We observed seventeen different species during the point count surveys (Table 8). Noteworthy sightings included black-faced impala in Ehirovipuka, 3 cheetahs in Torra, and a lion in Palmwag concession. Hartmann's mountain zebra, gemsbok, and giraffe were seen across all five conservancies and in the concession. In addition to these species, kudu, springbok, and ostrich were also commonly observed species. At this time, we have not conducted additional analyses on the point count survey information, as the within season sample size and cumulative information is limited. We anticipate additional analyses will be possible in the future to supplement transect-based population monitoring efforts.

Table 7. Point count field effort from Oct 2011 to Apr 2013 across 5 conservancies and Palmwag concession in the Kunene region of northern Namibia; Palmwag concession surveys from Oct 2012 – April 2013.

Conservancy/ Concession	Identified PC locations	# of locations repeated	Total Time of PC effort (hours)
Anabeb	5	3	24
Ehirovipuka	7	2	20
Omatendeka	7	2	20
Palmwag	5	1	12
Sesfontein	10	7	46
Torra	12	6	56

Table 8. Summary of point count survey results for surveys completed in 5 conservancies and Palmwag concession in the Kunene region of northern Namibia between October 2011 and April 2013; information provides includes total counts and sighting rates listed as total count/sighting rate; hours of survey effort are listed after each conservancy name.

Species	Latin Name	Anabeb (24 hrs)	Ehrovipuka (20 hrs)	Omatendeka (20 hrs)	Palmwag (12 hrs)	Sesfontein (46 hrs)	Torra (58 hrs)
Black-backed jackal	<i>Canis mesomelas</i>	1/0.04	0	0	0	0	0
Black mongoose	<i>Galerella nigrata</i>	0	0	0	1/0.08	0	0
Black rhino	<i>Diceros bicornis</i>	0	0	0	0	0	11/0.19
Black-faced impala	<i>Aepyceros melampus petersi</i>	0	10/0.50	0	0	0	0
Chacma baboon	<i>Papio ursinus</i>	0	0	0	0	0	20/0.34
Cheetah	<i>Acinonyx jubatus</i>	0	0	0	0	0	3/0.05
Eland	<i>Taurotragus oryx</i>	0	9/0.45	3/0.15	0	0	0
Gemsbok	<i>Oryx gazella</i>	17/0.71	57/2.85	50/2.50	34/2.83	71/1.54	373/6.43
Giraffe	<i>Giraffa camelopardalis</i>	4/0.17	31/1.55	27/1.35	0	14/0.30	18/0.31
Zebra	<i>Equus zebra hartmannae</i>	594/24.8	287/14.4	199/9.95	479/39.9	64/1.39	828/14.3
Kudu	<i>Tragelaphus strepsicerus</i>	12/0.50	7/0.35	10/0.50	0	1/0.02	66/1.14
Lion	<i>Panthera leo</i>	0	0	0	1/0.08	0	0
Ostrich	<i>Struthio camelus</i>	14/0.58	20/1.00	0	7/0.58	65/1.41	29/0.50
Rock hyrax	<i>Procavia capensis</i>	0	0	0	0	3/0.07	0
Spotted hyena	<i>Crocuta crocuta</i>	0	0	0	2/0.17	0	3/0.05
Springbok	<i>Antidorcas marsupialis</i>	151/6.29	254/12.7	137/6.85	343/28.6	519/11.3	191/3.30
Steenbok	<i>Raphicerus campestris</i>	0	0	0	0	2/0.04	0

¹ Sighting rate is the total count/total observation hours in each conservancy

Remote Camera Surveys

Summary of Effort. Infra-red remote triggered cameras were placed at Collin's Spring (117 trap days), Jebico Spring (136 trap days) and Zebra Spring (11 trap days) in Torra and two locations within the concession: a remote location nearby Wereldsend camp (7 trap days) and Wereldsend Spring (112 trap days) for a total of 383 trap days (Table 9).

Summary of Data. Twelve nocturnal or elusive species were photographed at the remote camera trap stations. Leopards were identified at Collin's Spring, Jebico Spring, and Wereldsend Spring. Lions were photographed at Jebico Spring and Wereldsend Spring. Brown hyenas were photographed at Collin's Spring and Jebico Spring. The camera station at Jebico Spring appeared to have the highest diversity of elusive species (Table 10).

Table 9. Camera trap locations and field effort in Torra Conservancy and Palmwag Concession from November 2011 to April 2013.

Conservancy/ Concession	Site Name	Camera trap days	Photos reviewed
Palmwag	Wereldsend Spring	112	8959
Palmwag	Wereldsend 2	7	449
Torra	Collin's Spring	117	14087
Torra	Jebico Spring	136	7673
Torra	Zebra Spring	11	18

Table 10. Camera trap photographs of species identified at five sites in Torra conservancy and Palmwag concession. Photographs of elusive species and predators were counted when a period of 30 minutes had passed without a photo being taken. numbers are not indicative of number of unique individuals as same animals could visit the camera station multiple times.

Identified Species	Scientific Name	Collin's Spring	Jebico Spring	Zebra Spring	Wereldsend Spring	Wereldsend 2
African wildcat	<i>Felis libyca</i>	1	1			
Black rhino	<i>Diceros bicornis</i>	22			1	
Black-backed Jackal	<i>Canis mesomelas</i>		9	1	65	1
Brown Hyena	<i>Hyaena brunnea</i>	5	3			
Cape Fox	<i>Vulpes chama</i>		1			
Caracal	<i>Felis caracal</i>		1			
Honey Badger	<i>Mellivora capensis</i>		1		1	
Leopard	<i>Panthera pardis</i>	3	13		4	
Lion	<i>Panthera leo</i>		1		1	
Porcupine	<i>Hystrix cristata</i>		16		7	
Slender Mongoose	<i>Galerella sanguine</i>		14			
Spotted Hyena	<i>Crocuta crocuta</i>		14	2	5	
Unknown carnivore	-		1			



WILDLIFE DISTRIBUTION BY HABITAT AND LIVESTOCK GRAZING

The distribution of wildlife across the study area may be influenced by a number of variables including the distribution of quality habitats, access to water and responses to human infrastructure and uses. Understanding how animals respond to human uses is important if these responses result in displacement from preferred habitats or attraction to areas that cause increases in human-wildlife interactions. We completed a preliminary analysis examining the relative abundance of selected wildlife species within major habitat types and livestock grazing areas to index habitat preferences in areas with and without livestock grazing.

Analysis Methods

Locations of 4 wildlife species (Hartmann's mountain zebra, kudu, gemsbok, springbok) collected during transect-based game counts were attributed by major vegetation structure classes (Atlas of Namibia Project 2002; Figure 4) and type of mapped livestock grazing (classes: wet season grazing, dry season grazing and no grazing; Muntifer et al. 2009). The wet season grazing classification actually indicates year-around grazing as these areas typically continue to have livestock use during the dry season; wet season grazing has the highest grazing pressure. We calculated the length of game count transects travelled within each major ecosystem type, each grazing type and the combination of these two (livestock – habitat) to provide an index of relative effort within each class. The proportion of locations of each species within each of the habitat, livestock grazing and habitat-livestock classes was calculated across the study area (all conservancies and seasons combined). The proportion of animal locations relative to the survey effort within each class was calculated as a relative use index (RUI):

$$RUI = \text{Proportion of animal locations in class } x / \text{proportion of transect length in class } x$$

If the proportion of animal locations seen in class x is the same as the proportion of survey effort within that class, the index is 1 and might be expected if animal locations were randomly distributed relative to the class. Values falling below 1 indicate that proportionately fewer animals were seen in the class relative to the level of effort spent searching for animals in that class and values above 1 indicate that the species was found more frequently in the class than may be expected based on the effort to survey within that class.

Results and Discussion

The RUI across most species indicates that they are not found in all habitats equally with some habitats used more than expected while others are used less than may be expected based on the relative amounts of each habitat surveyed (Table 11). All 4 species tended to be sighted more in the sparse shrubland habitat and less in the grassland and Namib

grassland habitat types. Neither gemsbok nor zebra were sighted in woodland and the use of this habitat was less than expected by kudu and springbok. Both gemsbok and kudu were sighted more than expected in ephemeral riverine woodland with kudu having 4x as many sightings in this habitat than may be expected based on the survey effort in this habitat type. Springbok was the only species found in all habitat types.

When habitat types were subdivided into types of livestock grazing (none, wet season, dry season), responses to relative grazing intensity can be identified. In almost all cases, species were found in each habitat type relatively more frequently if it did not have livestock grazing compared to areas with livestock grazing and the difference is most notable if compared with the most intensely grazed wet season grazed areas (Figure 5). For example, the RUI suggests that zebra strongly selected for sparse shrubland without grazing but strongly avoided sparse shrubland with wet season grazing. In some cases, habitat preferences not suggested by examining simply the habitat types are suggested when accounting for livestock grazing. For example, the gemsbok RUI for grassland is <1 (Table 11) indicating non-preference for this habitat. When grassland is divided into areas based on livestock grazing, the gemsbok RUI for ungrazed grassland is >1 while the gemsbok RUI for livestock grazed grasslands are <1 (Figure 5). The strong kudu RUI for ephemeral riverine grasslands can be fully attributed to ungrazed areas of this habitat as kudu were not observed in this habitat where it is grazed. Kudu also may prefer sparse shrubland habitats that ungrazed or areas only seasonally grazed by livestock and avoid the more intensely wet season grazed areas. Springbok RUI suggests that this species may prefer sparse shrubland over other habitat types regardless of the level of grazing with the highest RUI for ungrazed sparse shrublands.

The RUI does not account for several factors that could change the patterns seen in these preliminary analyses. For example, it does not account for potential differences in sightability across the different major habitat types. If animals are more difficult to see due to thick vegetation in some habitats, this could result in lower than expected counts in this habitat relative to the level of effort; we would not expect this factor to affect within habitat type patterns such as differences in habitat use based on livestock grazing intensity. Generally, sightability is high across this region given the desert ecology and overall sparseness of vegetation at landscape scales. Importantly, the RUI is not a statistical analysis of habitat use, selection or preference and should be viewed only as a preliminary evaluation of the data collected to date.

With the above cautions in mind, there are still some patterns that are notable in the data. Species do tend to be found proportionately more in some habitats than others indicating a potential preference for these habitats. This is not surprising as most species have habitat preferences. More importantly, these habitats and the potential preferences for these habitats may be affected by the intensity or duration of livestock grazing in some areas. All species examined show some level of potential avoidance of otherwise preferred habitats in the presence of grazing with the strongest indication of avoidance often of the wet season

grazing areas. As discussed previously, areas indicated as wet season grazing are likely grazed year-around and these areas are typically closer to settlements or farm infrastructure.

The results suggest that livestock grazing may be an important influence on the distribution of wildlife species locally and across the study area and that it may affect the quality of wildlife habitats where it occurs. Habitat degradation and loss are the leading causes of wildlife declines worldwide. Additional data and analyses are warranted to understand how the patterns of habitat responses to livestock grazing may affect wildlife populations. These insights should provide guidance for wildlife population management as well as habitat and land use management that ensure the sustainability of both the livestock and the wildlife of the Kunene region.

Table 11. The relative use index of 4 species in major structural habitat classes as calculated by the proportion of sightings in that habitat divided by the proportion of survey effort (km driven) in that habitat across 5 conservancies and Palmwag concession over 4 seasonal surveys between Oct 2011 and Apr 2013 in the Kunene region of Northern Namibia.

Species	N	Ephemeral riverine woodland	Grassland	Namib grassland	Sparse shrubland	Woodland
Gemsbok	702	1.99	0.76	0.8	1.22	
Kudu	58	4.16	0.84	0.18	1.43	0.34
Zebra	1398		0.29	0.79	1.41	
Springbok	2747	0.56	0.58	0.49	1.33	0.37

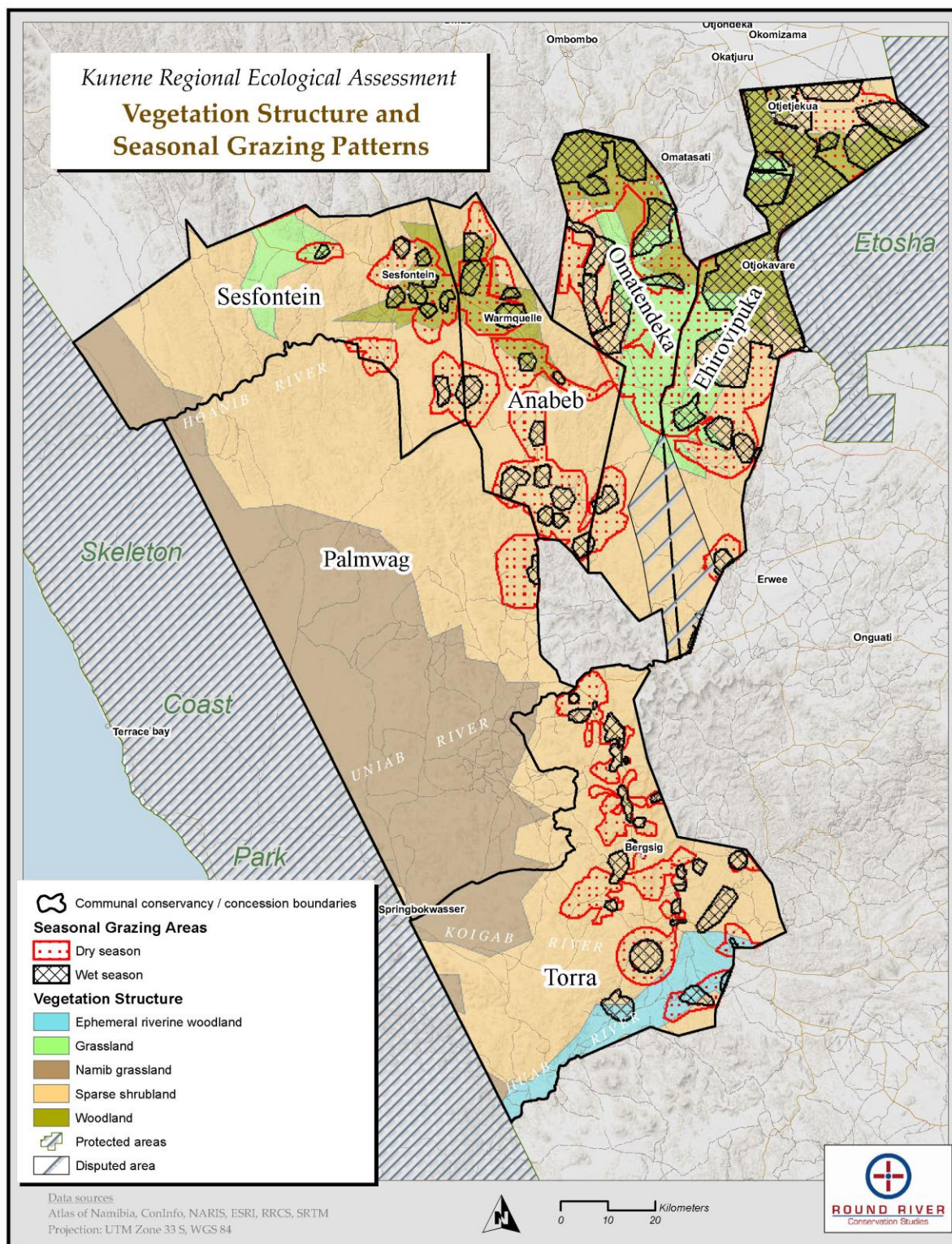


Figure 4. Structural vegetation types and classes of livestock grazing used to attribute wildlife observations and calculate relative use indexes in the Kunene region of northern Namibia.

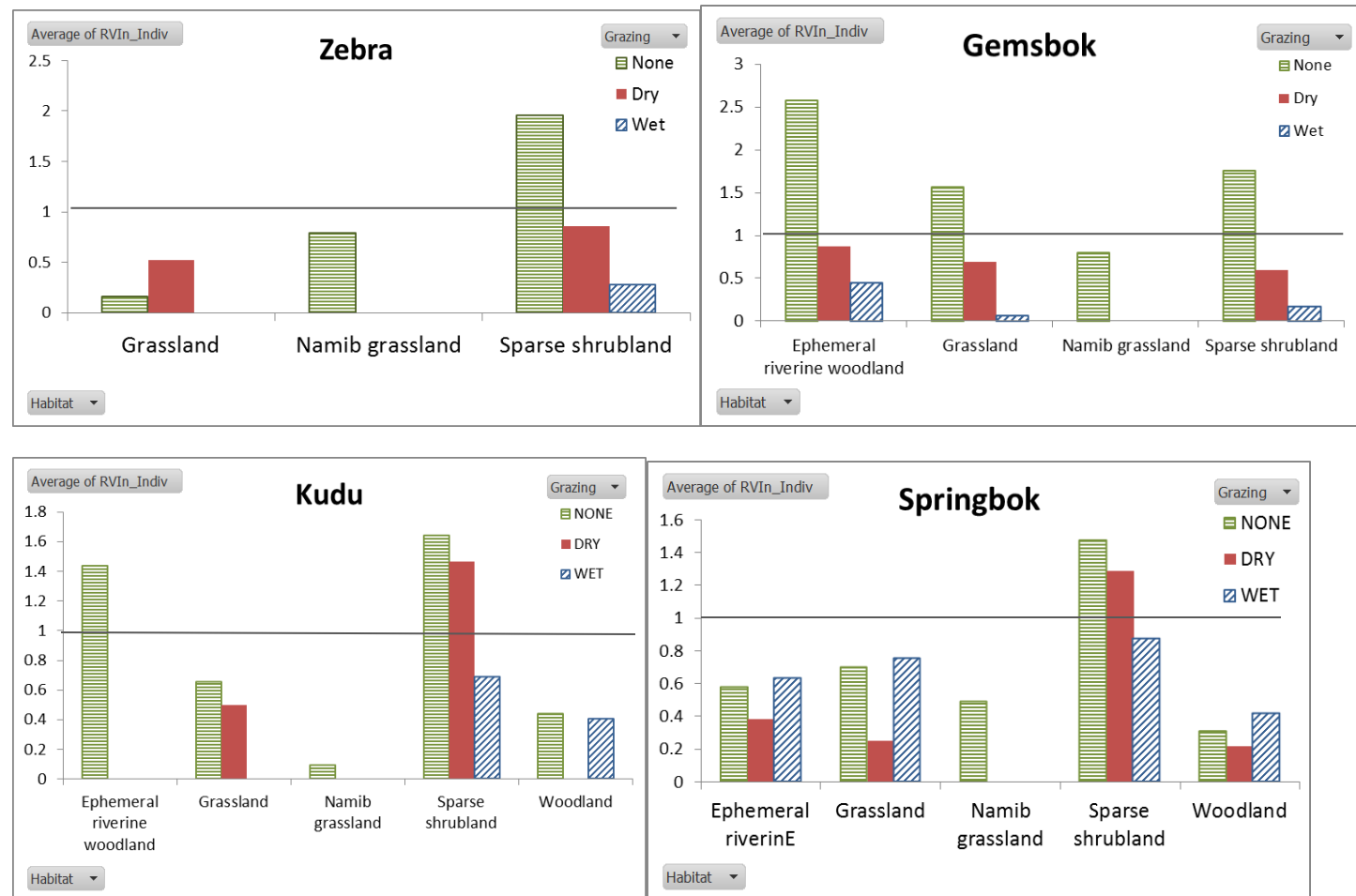


Figure 5. The relative use index (RUI) of 4 wildlife species in major habitat classes and livestock grazing classes in the Kunene region of northern Namibia; RUI is calculated by the proportion of sightings in a habitat-livestock class divided by the proportion of survey effort (km surveyed) in that class across 5 conservancies and Palmwag concession with data combined over 4 surveys completed between Oct 2011 and Apr 2013.

POPULATION ESTIMATES

A primary goal of the game count survey efforts is to obtain data sufficient to estimate seasonal population sizes for key wildlife species across the region and within conservancy areas. In this section, we report on analyses to obtain these seasonal population estimates.

Methods

We used distance sampling models to estimate regional and conservancy-level population sizes for Hartmann's mountain zebra, kudu, gemsbok, springbok, giraffe and ostrich. Distance Program 6.0 (Thomas et al. 2009) conventional distance sampling engine was used to evaluate data and select key functions for population estimates for each of the seasonal surveys completed (4 different seasons). These estimates were developed for the entire study area and separately within each of the 5 participating conservancies and the Palmwag concession.

For each species and season, we evaluated the data for outliers and for violations of major assumptions regarding the expected shape of the data distribution. Model selection included evaluating the best fitting key function across recommended options (Table 12; Buckland et al. 2004). The model with the lowest AICc was selected; if 2 models tied then one model was selected at random. The fit of the selected model to the data was evaluated using Kolmogorov-Smirnov (K-S) tests and 2 Cramer-von Mises tests, visual evaluation of quantile-quantile plots and visual evaluation of the predicted model probabilities against histograms of the data plotted by the distance of observations from the transect (Buckland et al 2001). In the case of the K-S test and the Cramer-von Mises tests, high p-values indicate that it is highly probable that the 2 compared distributions are the same.

All species data were collected as observations of groups or clusters of animals and the number of individuals within each group was recorded. Thus, number of groups and the average group size were key parameters in the modeling and analyses. Group or cluster sizes may be biased with distance (e.g., at larger distances, there may be a higher probability of missing smaller groups). We used regression modeling to test for size bias by distance in the detection function, and if there was significant bias (slope >0.15), we used the regression to adjust expected cluster size.

Sightability of species is likely to decline with increasing distance from the transect line and may result in unreliable data at far distances. We evaluated model fit to subsamples of the data removing more distance observations and established truncation rules to subsample data for the best fitting model. In all cases, data were truncated to remove the most distant observations (e.g., $>1000\text{m}$ or farthest 5% of observations). In most cases the data were used as exact distance inputs, but in one season, zebra data were grouped into classes to better fit modeling assumptions and increase model fit.

The best fit model and the global detection function were based on the full data from each season (all transects pooled) and the study area-wide density, population size and

confidence intervals were estimated. Population density estimates for each Conservancy used the global detection function combined with Conservancy-specific encounter rates and effort.

Population sizes and confidence intervals for the study area as a whole and for each conservancy are calculated from the population density estimates and confidence intervals. We multiplied the density estimate by the estimated area for the study region and each conservancy using the area estimates that are used in the Annual Game Count analyses. These estimates remove areas from each conservancy that are far from transect routes to avoid extrapolating far into areas that are not surveyed. We chose to use these same area estimates so these analyses will be consistent and comparable with the Annual Game Count. Area included within each conservancy varies from 49 - 75% with 63% of our study area assumed to support animals in our regional population estimates (Table 13). The resulting Conservancy population estimates and the global population estimate assume these remote areas do not support the species under consideration. This is a conservative measure due to the under sampling of these areas and does not suggest the excluded areas do not support wildlife but that these areas are not sufficiently sampled.

Population density and size estimates calculated for individual conservancies have high uncertainty due to the smaller samples sizes within any conservancy. We provide the average of the 4 seasonal population estimates for conservancy estimates to increase the reliability of the information.

While we are collecting point count data for eventual analyses, the sample size is insufficient to complete these analyses and point count data are not analyzed in this report. See the Field Methods and Data Summary sections of this report for further information on these point counts.

Table 12. Models evaluated for potential use to model the detection function for each species, limiting the potential adjustment factors to 3 or less.

Model	Series Expansion
Uniform	Cosine
Half-Normal	Cosine
Half-Normal	Hermite polynomial
Hazard Rate	Simple polynomial

Table 13. Conservancy and concession area estimates for estimate total hectares and hectares used to calculate population sizes for selected wildlife species in the Kunene region of Namibia.

	Total area (ha)	Area (ha) included in population estimate	Proportion of area included in estimates
Anabeb	156936	76899	0.49
Ehrovipuka	222015	159851	0.72
Omatendeka	185966	96702	0.52
Palmwag	577735	329309	0.57
Sesfontein	246510	135581	0.55
Torra	349097	261823	0.75
Region including Palmwag	1738259	1060164	0.61
Region excluding Palmwag	1160524	730855	0.63

Results and Discussion

Samples sizes were sufficient to marginally sufficient to allow us to calculate population estimates for 6 species (gemsbok, zebra, springbok, kudu, giraffe, ostrich) across the study area, with estimates calculated for each of 4 seasons. Because sampling area expanded in the second year of the effort, we provide population estimates for the following: Oct-Nov 2011 and Mar-Apr 2012 include the 5 conservancies; Oct-Nov 2012 and Mar-Apr 2013 included the 5 conservancies and Palmwag concession. To allow for comparisons across the 4 seasons, we also present analyses results for Oct-Nov 2012 and Mar-Apr 2013 limited to the 5 concessions.

In addition to the study area-wide population estimates, we completed analyses of each species for each season within each conservancy. Because of sample size issues when subsampling at the conservancy level, we encourage caution be used when interpreting these results. We provide an average population estimate across the 4 seasons for each conservancy as a potentially more reliable population estimate than any single season may provide.

The distance surveyed across conservancies each season varied between 1,313 and 1,483 km, and with the addition of the Palmwag concession the total distance surveyed increased to over 1,700 km (Table 2). Between 29 and 32 transect samples were completed across the

5 conservancies each season, with the sampling increasing to 39-40 transects with the inclusion of the concession starting in Oct-Nov 2012.

GEMSBOK

Examination of the data distributions and statistics indicated truncating data to those groups identified within 1000m of the transect line increased the fit of the key function. With this subsample of for modeling, the number of gemsbok groups during seasonal surveys varied between 133 and 215 groups across the conservancies, increasing to a max of 285 groups with the inclusion of the concession (Table 14). Total numbers of individuals seen ranged from a 951 in Mar-Apr 2011 to 436 in Mar-Apr 2012 across the 5 conservancies. Including the Palmwag concession increased total number of individuals to a maximum of 1,044 within a 1,000m of transects (Table 14).

Gemsbok density across the region ranged from a high of 0.0106 in Mar-Apr 2012 to a low of 0.0041 in the Mar-Apr 2013 and population sizes ranged from a high of 7719 in Mar-Apr 2012 to a low of 2991 in Mar-Apr 2013 (Table 14). The difference between seasons is not statistically significant but there is potential of a declining trend over the 3 most recent surveys (Figure 6). Further monitoring is needed to see if the downward trend continues, and may be particularly important given the drought conditions experienced over the period of surveys is on-going.

Gemsbok were found in every conservancy and in the Palmwag concession during each seasonal survey. Population size estimates were lowest in Anabeb and highest in the Palmwag concession, mirroring estimated densities in these areas (Figure 7, Table 15).

Evaluation of the source of variation in the modeling results shows the predomination of variation in the encounter rates over variation in cluster size or detection probability. Encounter rates cause between 72% and 83% of the identified variation in results. It is common that encounter rates are identified as the highest source of variation (Msoffe et al. 2010), and may suggests that habitat selection or other spatially-driven processes may underlie the distribution and thus variability (in detection rates) in the analyses.

Table 14. Summary of data and distance sampling analyses of gemsbok across 4 seasonal surveys completed in the Kunene region of northern Namibia.

Variable	Oct-Nov 2011 ¹	Mar-Apr 2012 ¹	Oct-Nov 2012 ¹	Mar-Apr 2013 ¹	Oct-Nov 2012 ²	Mar-Apr 2013 ²
Truncation	1000m	1000m	1000m	1000m	1000m	1000m
# Groups	215	175	186	133	285	251
Total Count	888	951	666	382	1044	790
Key Function, adjustment	Hazard Rate	Half-normal, 2 cosine orders	Uniform, 3 cosine orders	Half-normal	Half-normal, 2 cosine orders	Hazard rate, 4 polynomial orders
K-S p-value	0.76	-	0.87	0.999	-	0.56
Ave. Cluster Size + SE³	4.1 + 0.38	5.43 + 0.77	3.67 + 0.32	3.23 + 0.44	3.66 + 0.26	3.15 + 0.29
ESW³	360	336	280	389	310	272
Regional Density	0.0083	0.0106	0.0093	0.0041	0.0097	0.0081
Density CI³	0.0051 - 0.0136	0.0059 - 0.0190	0.0057 - 0.0152	0.0024 - 0.0071	0.0067 - 0.0140	0.0051 - 0.0128
Density %CV³	25	30.0	24.9	28.2	18.8	23.8
Abundance	6070	7719	6787	2991	10257	8547
Abundance CI³	3702 - 13789	4294 - 14506	4133 - 11143	1718 - 5205	7066 - 14888	5379 - 13582

¹Estimates for the 5 conservancies and does not include the Palmwag Concession

²Estimates for the 5 conservancies and the Palmwag Concession

³CI = Confidence intervals; %CV = % Coefficient of Variation; SE = Standard error; ESW = Effective strip width; K-S = Kolmogorov-Smirnov

Table 15. Average population density and population size of gemsbok in each of 5 conservancies and the Palmwag concession based on the average (Range) across 4 seasonal estimates between Oct 2011 and Apr 2013.

Conservancy or Concession Name	Average population density (Range)	Average population size (Range)
Anabeb	0.0035 (0.0032 - 0.004)	271 (244 - 308)
Ehirovipuka	0.0028 (0.0006 - 0.0044)	446 (96 - 705)
Omatendeka	0.0087 (0.0032 - 0.0151)	846 (309 - 1462)
Palmwag	0.0147 (0.0137 - 0.0158)	4845 (4502 - 5188)
Sesfontein	0.0103 (0.0094 - 0.0112)	1399 (1268 - 1515)
Torra	0.0127 (0.0091 - 0.0165)	3325 (2393 - 4326)

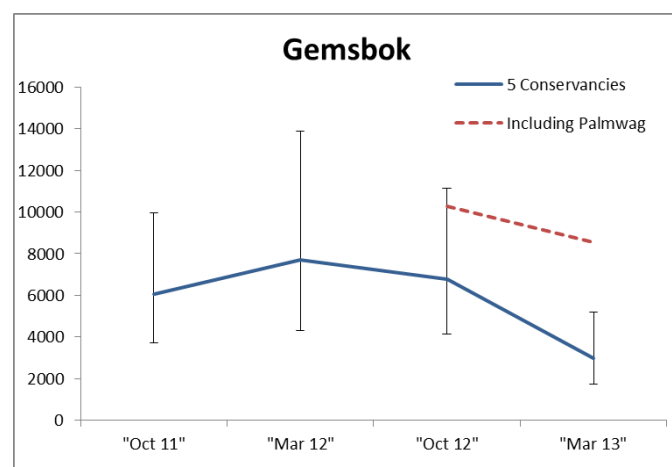


Figure 6. Estimated population size of gemsbok based on 4 seasonal surveys across 5 conservancies in the Kunene region of northern Namibia; population estimates including the Palmwag concession in the latter 2 surveys is shown.

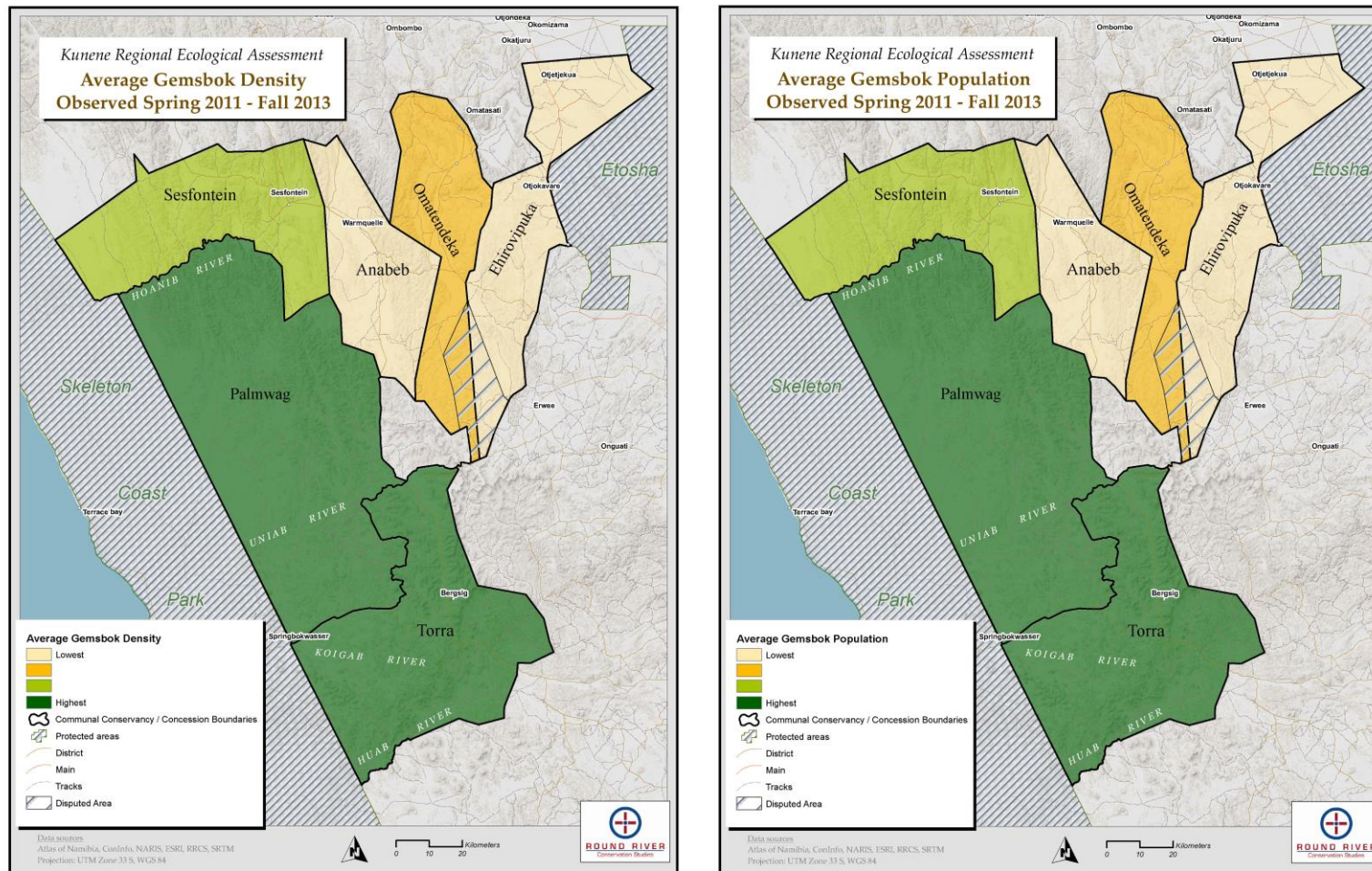


Figure 7. Maps showing the average population density and population size of gemsbok estimated by on 4 seasonal estimates calculated from game count surveys completed between Oct 2011 and Apr 2013.

HARTMANN'S MOUNTAIN ZEBRA

Examination of the data distributions and statistics indicated the best fit model was supported by subsampling the data within each season (Table 16). For Mar-Apr 2012 and Oct-Nov 2012 seasons, the model fit was further improved by transforming the data into 200m intervals. The number of zebra groups included in the analyses during seasonal surveys varied between 86 and 208 groups across the conservancies, increasing to a max of 227 groups with the inclusion of the concession (Table 16). Total numbers of individuals included in the analyses ranged from a 566 to 1,189 across the 5 conservancies. Including the Palmwag concession increased total number of individuals to a maximum of 1,597 included in the analyses (Table 16).

The seasonal models fit reasonably well, the low K-S p-values for the Mar-Apr 2013 analyses should be flagged but visual examination of the model predictions over the histogram of data showed a very reasonable approximation of the raw data values. Given the generally low sample size, we present the analyses results emphasizing caution in interpretation and suggest careful attention be given the confidence intervals and coefficient of variation values (Table 16).

Zebra density across the region ranged from a high of 0.0134 in Mar-Apr 2013 to a low of 0.0073 in the Oct-Nov 2011 with some suggestion of a seasonal pattern in highs and lows (Figure 8; Table 16). The difference in densities is not statistically significant, but suggest that differences in seasonal either distribution or sightability may be affecting the sampling. Further monitoring is needed to see if the seasonal trends continues.

Zebra were found in every conservancy and in the Palmwag concession during each seasonal survey. Population estimates tended to be lowest in Sesfontein and highest in the Palmwag concession, due primarily to estimated densities in these areas though the amount of area used to estimate population sizes influenced the population size estimates for specific conservancies (Figure 9, Table 17).

Evaluation of the source of variation in the modeling results shows the predomination of variation in the encounter rates over variation in cluster size or detection probability. It is common that encounter rates are identified as the highest source of variation (Msoffe et al.2010), and may suggests that habitat selection or other spatially-driven processes may underlie the distribution and thus variability (in detection rates) in the analyses.

Table 16. Summary of data and distance sampling analyses of Hartmann's mountain zebra across 4 seasonal surveys completed in the Kunene region of northern Namibia.

Variable	Oct-Nov 2011¹	Mar-Apr 2012¹	Oct-Nov 2012¹	Mar-Apr 2013¹	Oct-Nov 2012²	Mar-Apr 2013²
Width	1500m	1200m	1200m	1200m	1000m	1200m
# Groups	159	208	86	133	184	227
Total Count	1229	1669	647	950	1545	1597
Key Function, adjustments	Half-normal, 2 cosine	Half-normal, 2 cosine	Half-normal	Hazard rate, 4 poly	Half-normal, 2 cosine	Half-normal, 2 cosine
Group Size + SE³	7.04* + 0.46	7.79 + 0.85	7.59 + 0.64	6.91 + 0.54	8.88 + 0.53	6.91 + 0.43
ESW³	516	463	375	259	377	382
K-S³ p-value	0.761	n/a	0.87	0.999	n/a	0.56
Regional Density	0.00731	0.0131	0.0066	0.0134	0.0117	0.0116
Density CI³	0.0041 - 0.0129	0.0070 - 0.0243	0.0034 - 0.0128	0.0074 - 0.0242	0.0068 - 0.0200	0.0077 - 0.0176
Density %CV³	28.7	31.8	34	30.2	27.3	21
Regional Abundance	5341	9538	4798	9808	12387	12332
Abundance CI³	3022 – 9440	5111 – 17801	2452 – 9387	5432 - 17709	7225 - 21237	8127 - 18712

¹Data and analyses across 5 conservancies; does not include Palmwag concession

² Data and analyses across 5 conservancies and Palmwag concession

³CI = Confidence intervals; %CV = % Coefficient of Variation; SE = Standard error; ESW = Effective strip width; K-S = Kolmogorov-Smirnov

Table 17. Average population density and population size of Hartmann's mountain zebra in each of 5 conservancies and the Palmwag concession based on the average (Range) across 4 seasonal estimates between Oct 2011 and Apr 2013.

Conservancy or Concession Name	Average population density (range)	Average population size (range)
Anabeb	0.0142 (0.0024 - 0.0266)	1091 (186 - 2048)
Ehrovipuka	0.0092 (0.0045 - 0.0202)	1467 (724 - 3223)
Omatendeka	0.0126 (0.0044 - 0.0281)	1217 (421 - 2717)
Palmwag	0.0226 (0.0198 - 0.0253)	7430 (6523 - 8336)
Sesfontein	0.0039 (0.0022 - 0.0076)	530 (298 - 1034)
Torra	0.0129 (0.0111 - 0.0171)	3389 (2909 - 4486)

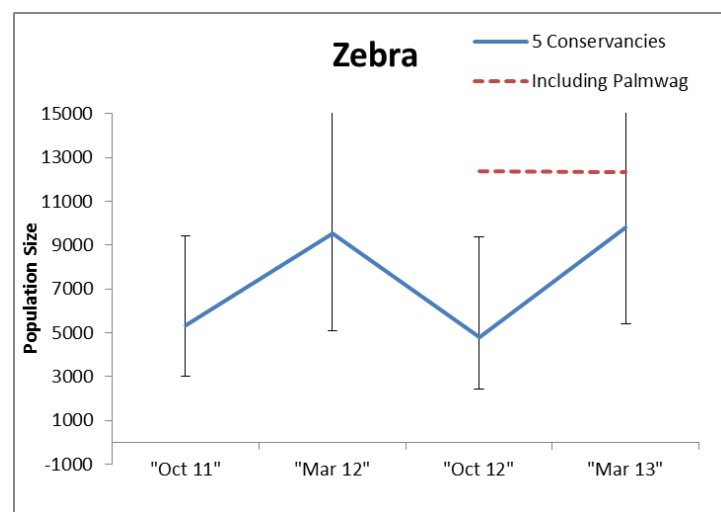


Figure 8. Estimated population size of Hartmann's mountain zebra based on 4 seasonal surveys across 5 conservancies in the Kunene region of northern Namibia; population estimates including the Palmwag concession in the latter 2 surveys is shown.

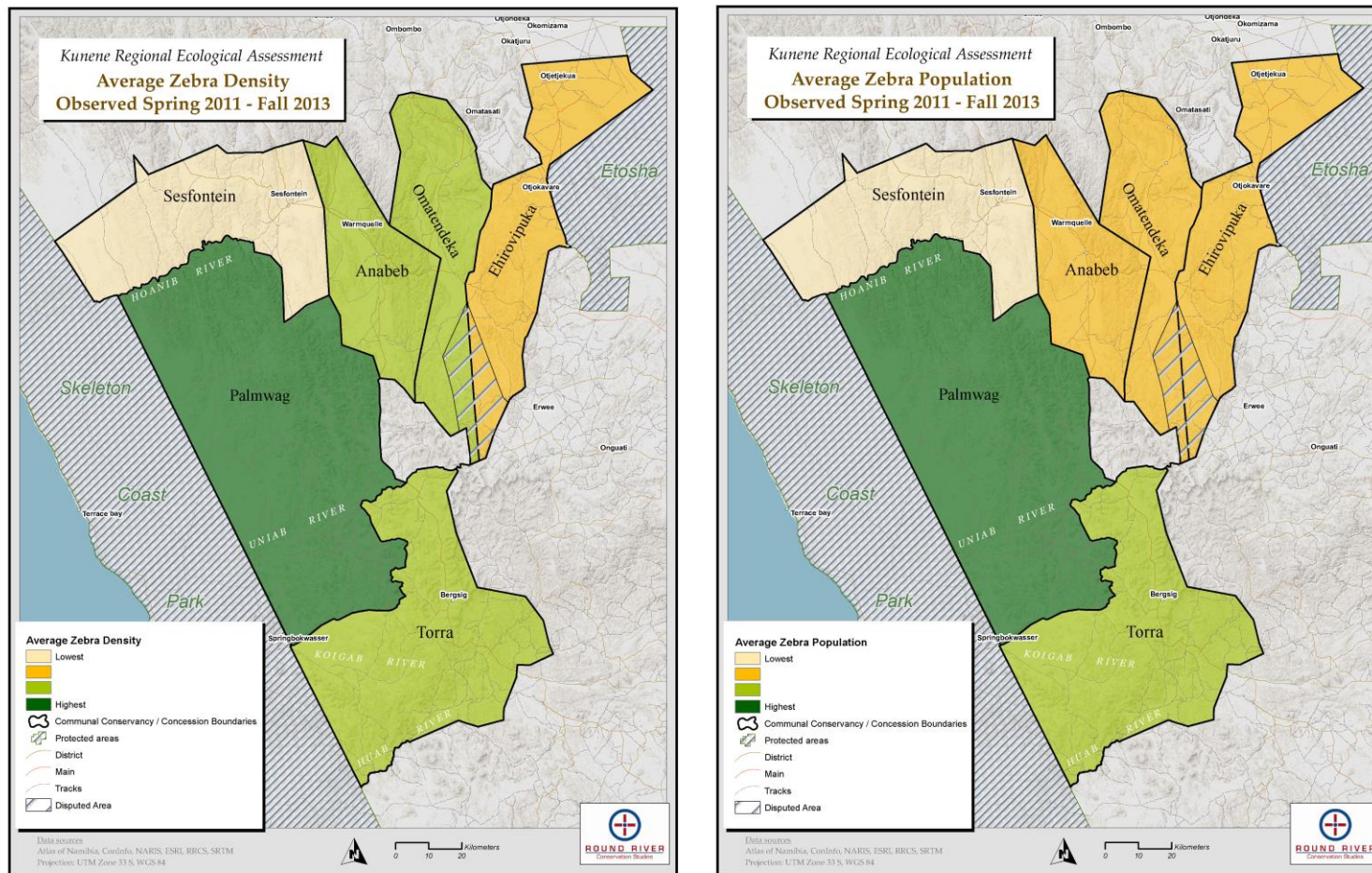


Figure 9. Maps showing the average population density and population size of Hartmann's mountain zebra estimated by on 4 seasonal estimates calculated from game count surveys completed between Oct 2011 and Apr 2013.

SPRINGBOK

Examination of the data distributions and statistics indicated the best fit model was obtained by adjusting the truncation values each season (Table 18). The number of springbok groups included in the analyses during seasonal surveys varied between 132 and 257 groups across the conservancies, increasing to a max of 360 groups with the inclusion of the concession (Table 18). Total numbers of individuals included in the analyses ranged from a 1294 to 2404 across the 5 conservancies. Including the Palmwag concession increased total number of individuals to a maximum of 2810 included in the analyses (Table 18).

The seasonal models fit well based on the K-S p-values (Table 18) as well as visual examination of the model predictions over histograms of raw data by distance from the transect. Still, we present the analyses results emphasizing caution in interpretation and suggest careful attention be given the confidence intervals and coefficient of variation values (Table 18).

Springbok density across the region ranged from a high of 0.99 animals/ha in Mar-Apr 2012 to a low of 0.69 animals/ha in Mar-Apr 2013 across the 5 conservancies. The difference in densities is not statistically significant, but suggest a possible declining trend that is also seen when the Palmwag concession is added to the analyses (Figure 10). Further monitoring is needed to see if the seasonal trends continues and is particularly important given the drought conditions present during the seasonal surveys is on-going.

Springbok were found in every conservancy and in the Palmwag concession during each seasonal survey. Population density estimates were lowest in the Ehrovipuka conservancy and highest in the Anabeb while population size estimate was highest in the Palmwag concession, reflecting differences in the amount of area used to estimate population sizes for specific conservancies (Figure 11, Table 19).

Evaluation of the source of variation in the modeling results shows the predomination of variation in the encounter rates over variation in cluster size or detection probability. It is common that encounter rates are identified as the highest source of variation (Msoffe et al.2010), and may suggests that habitat selection or other spatially-driven processes may underlie the distribution and thus variability (in detection rates) in the analyses.

Table 18. Summary of data and distance sampling analyses of springbok across 4 seasonal surveys completed in the Kunene region of northern Namibia.

Variable	Oct-Nov 2011¹	Mar-Apr 2012¹	Oct-Nov 2012¹	Mar-Apr 2013¹	Oct-Nov 2012²	Mar-Apr 2013²
Width	>5%	1000	1000	1000	1000	1000
# Groups	180	132	257	189	360	284
Total Count	1294	2404	1743	2039	2615	2810
Key Function, adjustments	Hazard Rate	Hazard Rate, 4 polynomial orders	Hazard Rate, 4 poly orders	Hazard Rate, 4 polynomial orders	Half-normal, 3 cosine orders	Hazard Rate, 4 polynomial orders
K-S³ test p-value	0.87	0.99	0.84	0.69	0.91	0.79
Group Size + SE³	7.2 + 0.80	18.2 + 2.81	6.8 + 0.38	6.7 + 0.80*	7.3 + -.39	6.85 + 2.0
ESW³	266	203	189	169	206	189
Regional Density	0.0164	0.0441	0.0353	0.0275	0.0365	0.0286
Density CI³	0.0105 - 0.0259	0.0243 - 0.0800	0.0245 - 0.0508	0.0168 - 0.0451	0.0271 - 0.0492	0.0193 - 0.0422
Density %CV³	22.9	30.7	18.3	25.2	15	19.9
Regional Abundance	12001	32245	25781	20128	38683	30269
Abundance CI³	7643 - 18843	17775 - 58493	17909 - 37113	12288 - 32973	28709 - 52122	20482 - 44733

¹Data and analyses across 5 conservancies; does not include Palmwag concession

² Data and analyses across 5 conservancies and Palmwag concession

³CI = Confidence intervals; %CV = % Coefficient of Variation; SE = Standard error; ESW = Effective strip width; K-S = Kolmogorov-Smirnov

Table 19. Average population density and population size of springbok in each of 5 conservancies and the Palmwag concession based on the average (Range) across 4 seasonal estimates between Oct 2011 and Apr 2013.

Conservancy or Concession Name	Average population density (range)	Average population size (range)
Anabeb	0.0571 (0.0193 - 0.0935)	4391 (1487 - 7193)
Ehirovipuka	0.0088 (0.0012 - 0.0211)	1408 (185 - 3369)
Omatendeka	0.0335 (0.0117 - 0.0628)	3243 (1129 - 6073)
Palmwag	0.0411 (0.0397 - 0.0425)	13529 (13073 - 13984)
Sesfontein	0.0217 (0.0188 - 0.0285)	2936 (2548 - 3866)

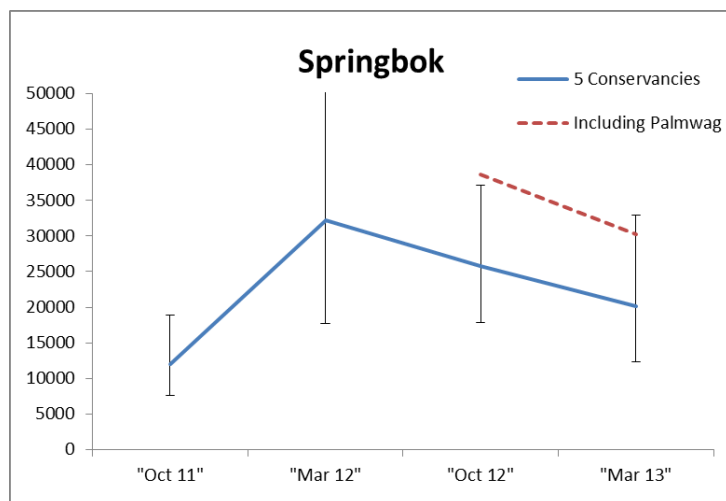


Figure 10. Estimated population size of springbok based on 4 seasonal surveys across 5 conservancies in the Kunene region of northern Namibia; population estimates including the Palmwag concession in the latter 2 surveys is shown.

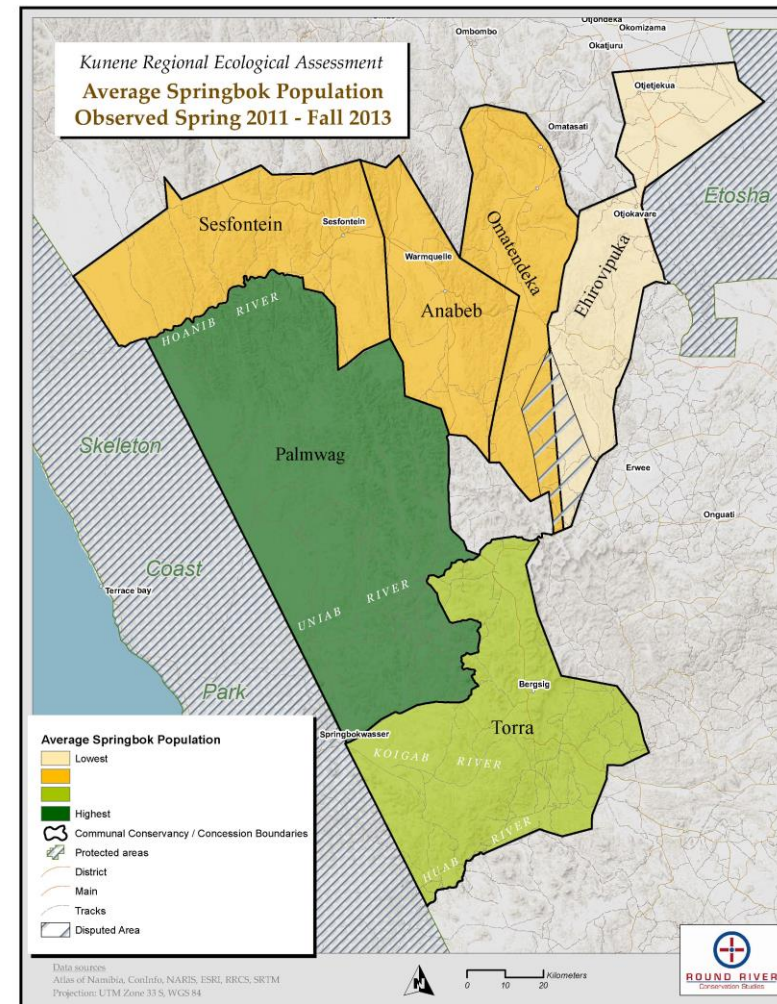
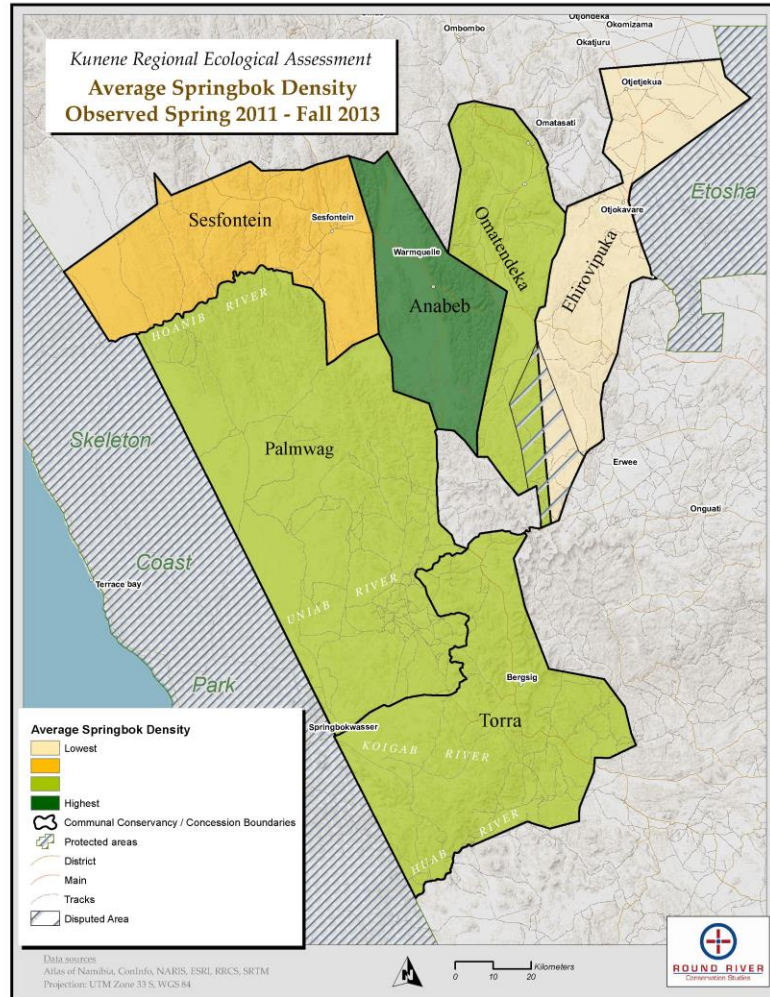


Figure 11. Maps showing the average population density and population size of springbok estimated by on 4 seasonal estimates calculated from game count surveys completed between Oct 2011 and Apr 2013.

KUDU

Examination of the data distributions and statistics indicated the best models in each season were fit by limiting the data to those group sighted within 1000m of the transect line (Table 20). Total numbers of individuals included in the analyses is low and ranged from a 42 to 133 across the 5 conservancies. Including the Palmwag concession increased total number of individuals to a maximum of 144 included in the analyses (Table 20). The number of kudu groups is insufficient for robust analyses, ranging from 17 to 28 groups across the conservancies, increasing to a max of 36 groups with the inclusion of the concession (Table 20). Still, the models fit reasonably well and we present the analyses results again strongly emphasizing caution in interpretation particularly given the confidence intervals and coefficient of variation values (Table 20). The intent of the analyses is to provide information and insights that may assist managing a relatively rare species.

As indicated by the low counts obtained in the surveys, kudu density and populations across the region is low compared to other more common species included in the analyses. Kudu density across the region ranged 0.0005 in Mar-Apr 2013 to a high of 0.0019 in the Oct-Nov 2011 with some suggestion of a seasonal pattern in highs and lows in both estimated density and population size (Table 20, Figure X). Confidence intervals are broad around the estimates, reflecting the low sample size indicative of monitoring a low density species. Thus, the difference in densities is not statistically significant, but suggest that seasonal differences in either distribution or sightability may be affecting the sampling. Further monitoring is needed to see if the seasonal fluctuations continue.

Kudu were found in 4 of the 5 conservancies and in the Palmwag concession during each seasonal survey except Mar-Apr 2013 survey when they were not sighted in the Ehrovipuka conservancy. They were not found in the in the Sesfontein conservancy during any survey. Where kudu were present, population estimates tended to be lowest in the Ehrovipuka and Anabeb conservancies and highest in the Torra conservancy and the Palmwag concession; translating these densities into population sizes changes the relative abundance across conservancies due to the amount of area used in calculating population sizes (Figure 13, Table 21).

Evaluation of the source of variation in the modeling results shows the predomination cause of variation in the analyses is the detection probability, with relatively lower amounts of variation due to cluster size or encounter rate in most of the analyses of Kudu. This is likely caused by the low sample sizes used to develop the models, and suggests a need to explore alternative approaches to more powerfully use the limited information on kudu populations in the region.

Table 20. Summary of data and distance sampling analyses of kudu across 4 seasonal surveys completed in the Kunene region of northern Namibia.

Variable	Oct-Nov 2011¹	Mar-Apr 2012¹	Oct-Nov 2012¹	Mar-Apr 2013¹	Oct-Nov 2012²	Mar-Apr 2013²
Width	1000	1000	1000	1000	1000	1000
# Groups	28	23	28	17	36	27
Total Count	133	54	112	17	144	34
Key Function, adjustments	Half-normal	Hazard Rate	Hazard Rate, poly 4	Half-normal	Hazard Rate, poly 4	Hazard Rate
K-S test p-value³	0.97	0.99	0.998	0.31	0.997	0.82
Group Size + SE³	4.75 + 0.88	1.56 + 0.26*	4.0 + 0.61	2.5 + 0.35	4.0 + 0.51	2.2 + 0.25
ESW³	240	168	138	129	114	256
Regional Density	0.0019	0.0008	0.0031	0.0005	0.0031	0.0006
Density CI³	0.0008 - 0.0046	0.0003 - 0.0020	0.0011 - 0.0089	0.0003 - 0.0012	0.0013 - 0.0100	0.0003 - 0.0015
Density %CV³	47.3	49.3	55.2	40.2	53.6	44.7
Regional Abundance	1361	582	1335	402	3860	676
Abundance CI³	552 - 3355	228 - 1484	862 - 9083	184 - 875	1411 - 10562	287 - 1588

¹Data and analyses across 5 conservancies; does not include Palmwag concession

² Data and analyses across 5 conservancies and Palmwag concession

³CI = Confidence intervals; %CV = % Coefficient of Variation; SE = Standard error; ESW = Effective strip width; K-S = Kolmogorov-Smirnov

Table 21. Average population density and population size of kudu in each of 5 conservancies and the Palmwag concession based on the average (Range) across 4 seasonal estimates between Oct 2011 and Apr 2013.

Conservancy or Concession Name	Average population density (range)	Average population size (range)
Anabeb	0.002 (0.0003 - 0.0038)	158 (20 - 296)
Ehrovipuka	0.0014 (0.0004 - 0.003)	165 (0 - 480)
Omatendeka	0.0016 (0.0002 - 0.0039)	152 (16 - 377)
Palmwag	0.0021 (0.001 - 0.0033)	704 (323 - 1084)
Sesfontein	0 (0 - 0)	0 (0 - 0)
Torra	0.0032 (0.0011 - 0.0063)	842 (283 - 1647)

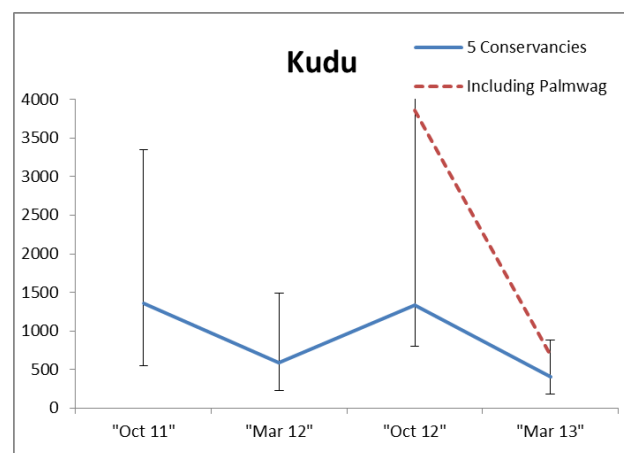


Figure 12. Estimated population size of kudu based on 4 seasonal surveys across 5 conservancies in the Kunene region of northern Namibia; population estimates including the Palmwag concession in the latter 2 surveys is shown.

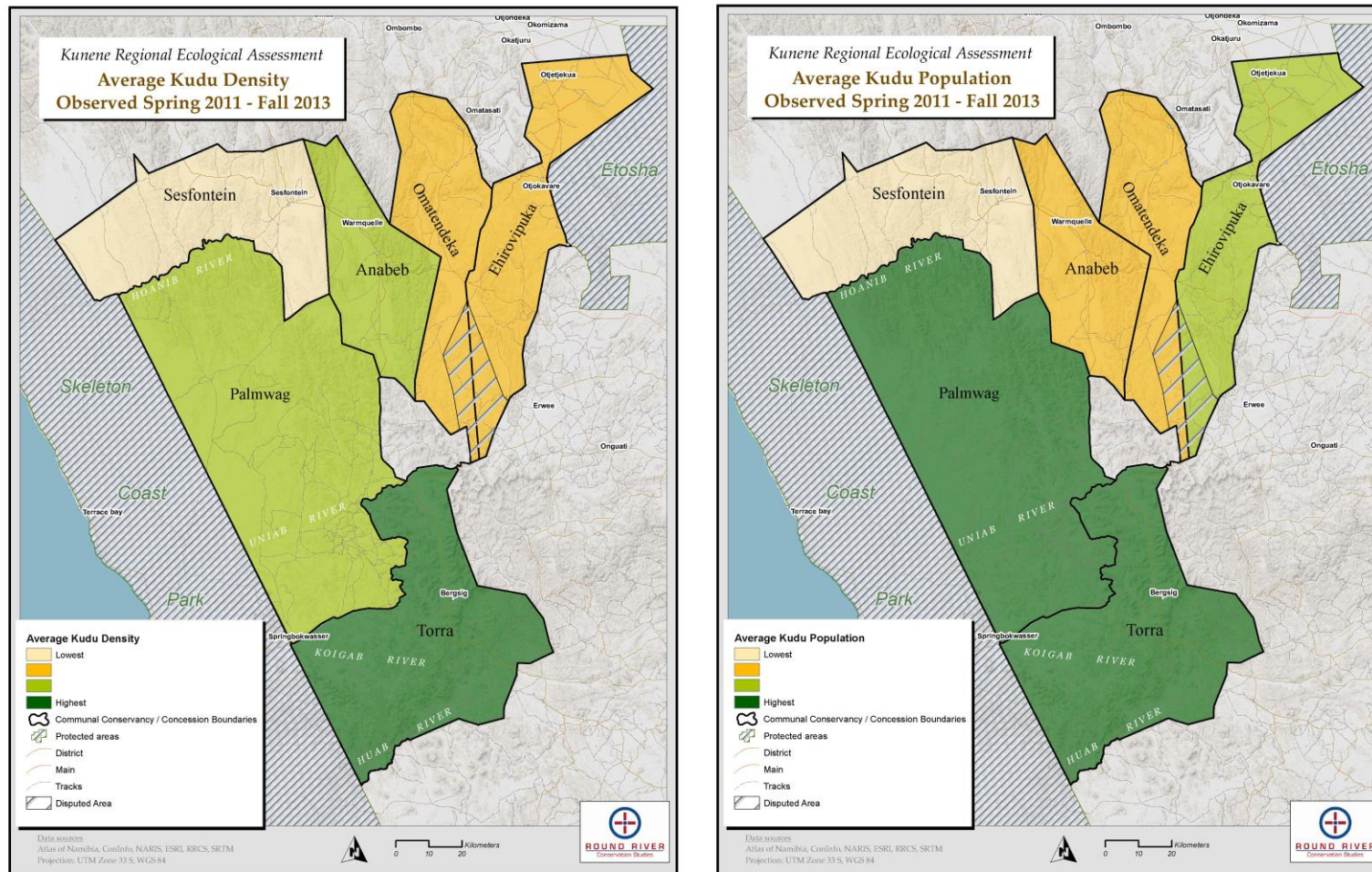


Figure 13. Maps showing the average population density and population size of kudu estimated by on 4 seasonal estimates calculated from game count surveys completed between Oct 2011 and Apr 2013.

GIRAFFE

Examination of the data distributions and statistics indicated the best fit model was fit limiting observations within 1000m of the transect line (Table 22). Total numbers of individuals included in the analyses ranged from a 129 to 206 across the 5 conservancies. Including the Palmwag concession increased total number of individuals to a maximum of 234 included in the analyses (Table 22). The number of giraffe groups included in the analyses ranging from 43 to 53 groups across the conservancies, increasing to a max of 70 groups with the inclusion of the concession (Table 22). The seasonal models fit reasonably well, the low K-S p-values for the Mar-Apr 2013 analyses should be flagged but visual examination of the model predictions over the histogram of data showed a very reasonable approximation of the raw data values. Given the generally low sample size, we present the analyses results emphasizing caution in interpretation and suggest careful attention be given the confidence intervals and coefficient of variation values (Table 22).

Giraffe population density and sizes across the region appear to be relatively consistent across the different season though the wide confidence intervals suggests very low power in detecting any change if it had occurred (Figure 14). Giraffe density ranged 0.0015 to 0.0018 and population size estimates ranged from 1233 to 1296 for the area of the 5 conservancies and up to 2260 when also including the Palmwag concession. Confidence intervals are broad around the estimates, reflecting the low sample size indicative of monitoring a low density species. Further monitoring is needed to see if the apparent stability in the giraffe population continues over additional seasons of monitoring, particularly if the drought present during these surveys continues.

Giraffe were found in all 5 conservancies and in the Palmwag concession during each seasonal survey (Table 23, Figure 15). Average population density and size estimates were lowest in the Anabeb conservancies and highest in the Ehrovipuka conservancy.

Evaluation of the source of variation in the modeling results shows the predominate cause of variation in the analyses is the encounter rate, with relatively lower amounts of variation due to cluster size or the detection probability in most of the analyses of Giraffe. It is common that encounter rates are identified as the highest source of variation (Msoffe et al.2010), and may suggests that habitat selection or other spatially-driven processes may underlie the distribution and thus variability (in detection rates) in the analyses.

Table 22. Modeling parameters and summary results for regional Giraffe population estimates across 4 seasonal surveys in Kunene region of northern Namibia

Variable	Oct-Nov 2011 ¹	Mar-Apr 2012 ¹	Oct-Nov 2012 ¹	Mar-Apr 2013 ¹	Oct-Nov 2012 ²	Mar-Apr 2013 ²
Width	1000	1000	1000	1000	1000	1000
# Groups	43	50	53	50	70	60
Total Count	129	192	147	206	214	234
Key Function, adjustments	Hazard Rate	Hazard Rate	Half-normal, 2 cosine orders	Half-normal	Hazard Rate	Half-normal
K-S³ test p-value	0.96	0.69	0.43	0.09	0.87	0.06
Group Size + SE³	3.0 + 0.39	3.8 + 0.47	2.3 + 0.22*	4.1 + 0.53	2.5 + 0.22*	3.9 + 0.46
ESW³	245	424	263	432	235	428
Regional Density	0.0018	0.0017	0.0018	0.0017	0.0021	0.0015
Density CI³	0.0008 - 0.0042	0.0006 - 0.0047	0.0009 - 0.0034	0.0009 - 0.0034	0.0012 - 0.0039	0.0008 - 0.0027
Density %CV³	44.9	54.8	33.3	34.7	31.5	30.2
Regional Abundance	1296	1233	1284	1272	2260	1605
Abundance CI³	553 - 3042	444 - 3421	667 - 2472	645 - 2507	1227 - 4165	889 - 2897

Data and analyses across 5 conservancies; does not include Palmwag concession

² Data and analyses across 5 conservancies and Palmwag concession

³CI = Confidence intervals; %CV = % Coefficient of Variation; SE = Standard error; ESW = Effective strip width; K-S = Kolmogorov-Smirnov

Table 23. Average population density and population size of giraffe in each of 5 conservancies and the Palmwag concession based on the average (Range) across 4 seasonal estimates between Oct 2011 and Apr 2013.

Conservancy or Concession Name	Average population density (range)	Average population size (range)
Anabeb	0.0005 (0.0002 - 0.0011)	42 (18 - 87)
Ehrovipuka	0.0036 (0.0028 - 0.0044)	577 (455 - 704)
Omatendeka	0.0031 (0.0017 - 0.0049)	296 (164 - 476)
Palmwag	0.0016 (0.001 - 0.0021)	519 (345 - 694)
Sesfontein	0.0009 (0.0002 - 0.0013)	117 (24 - 179)
Torra	0.0011 (0.0008 - 0.0016)	298 (222 - 429)

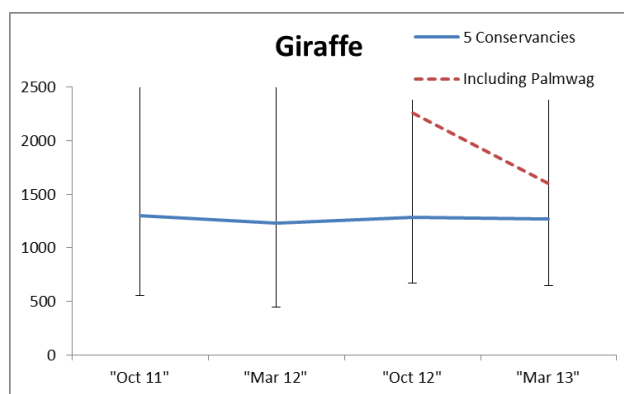
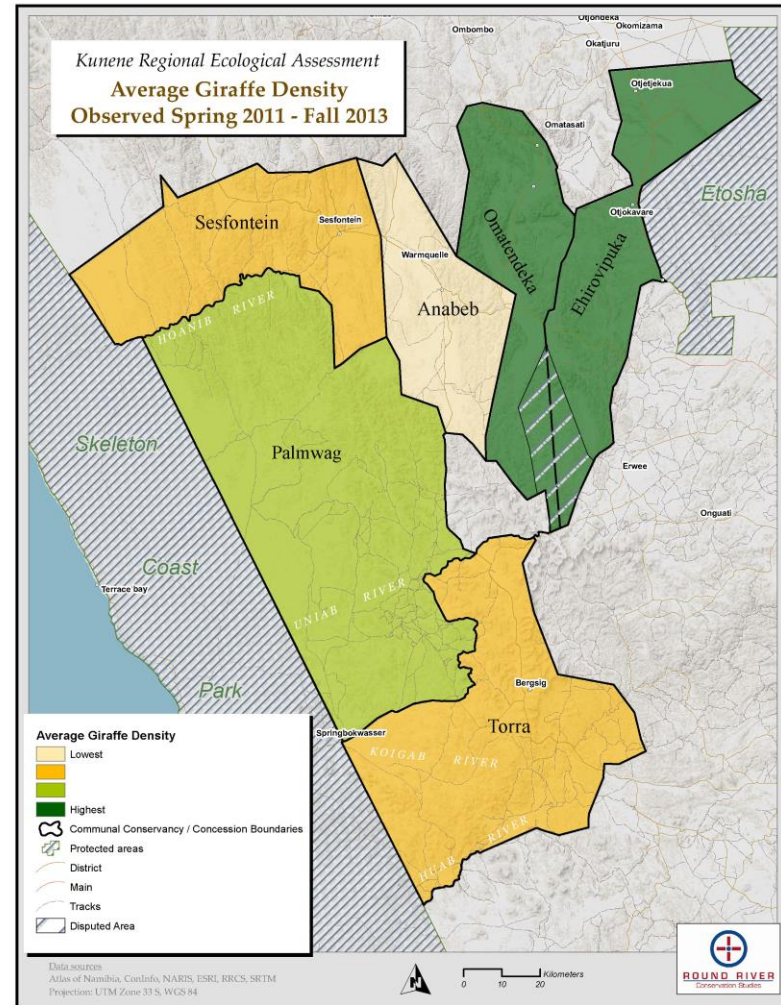


Figure 14. Estimated population size of giraffe based on 4 seasonal surveys across 5 conservancies in the Kunene region of northern Namibia; population estimates including the Palmwag concession in the latter 2 surveys is shown.



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OSTRICH

Examination of the data distributions and statistics indicated the best model was fit limiting observations within 1000m of the transect line (Table 24). Total numbers of individuals included in the analyses ranged from a 113 to 264 across the 5 conservancies. The number of ostrich groups included in the analyses ranging from 32 to 52 groups across the conservancies, increasing to a max of 69 groups with the inclusion of the Palmwag concession (Table 24). The seasonal models fit reasonably well, with K-S values ranging from 0.36 – 0.91 and visual examination of the model predictions over the histograms of data indicating a reasonable approximation of the raw data values. Given the generally low sample size, we present the analyses results emphasizing caution in interpretation and suggest careful attention be given the confidence intervals and coefficient of variation values (Table 24).

Predicted ostrich density and population appears significantly low during the Oct-Nov 2011 survey compared to the following survey completed in Mar-Apr 2012 (Table 24, Figure 16). While not statistically significant, there is a potential pattern of declining population numbers between Mar-Apr 2012 and Mar – Apr 2013, though the population estimates that include the Palmwag concession are notably stable. Confidence intervals are broad around the estimates, reflecting the low sample size indicative of monitoring a low density species. Further monitoring is needed to see if the potential trend in the population continues over additional seasons of monitoring, particularly if the drought conditions present during these surveys continues.

Ostrich were found in all 5 conservancies and in the Palmwag concession during each seasonal survey (Table 25). Population densities estimates tended to be lowest in the Ehirovipuka conservancy and highest in the Torra and Sesfontein conservancies. Due to the amount of area included in the population size estimates, the relative abundance of ostrich across the difference conservancies and the concession is different than the relative density patterns (Table 25, Figure 17).

Evaluation of the source of variation in the modeling results shows the predominate cause of variation in the analyses is the encounter rate, with relatively lower amounts of variation due to cluster size or the detection probability in most of the analyses of Giraffe. It is common that encounter rates are identified as the highest source of variation (Msoffe et al.2010), and may suggests that habitat selection or other spatially-driven processes may underlie the distribution and thus variability (in detection rates) in the analyses.

Table 24. Summary of data and distance sampling analyses of ostrich across 4 seasonal surveys completed in the Kunene region of northern Namibia.

Variable	Oct-Nov 2011¹	Mar-Apr 2012¹	Oct-Nov 2012¹	Mar-Apr 2013¹	Oct-Nov 2012²	Mar-Apr 2013²
Width	1000	1000	1000	1000	1000	1000
# Groups	52	39	48	32	69	52
Total Count	113	264	159	173	210	254
Key Function, adjustments	Uniform, 1 cosine order	Half-normal, 2 cosine orders	Half-normal	Half-normal	Half-normal	Half-normal
K-S³ test p-value	0.44	0.73	0.67	0.91	0.66	0.36
Group Size + SE³	2.2 + 0.34	6.8 + 1.36	3.3 + 0.51	5.4 + 0.76	3.0 + 0.37	4.9 + 0.51
ESW³	550	287	305	433	390	473
Regional Density	0.0007	0.0034	0.002	0.0015	0.0015	0.0015
Density CI³	0.0004 - 0.0013	0.0018 - 0.0066	0.0011 - 0.0037	0.0008 - 0.0027	0.00097 - 0.0024	0.0009 - 0.0023
Density %CV³	31.5	34.1	31.2	31.3	23.6	23.3
Regional Abundance	506	2512	1451	1066	1638	1578
Abundance CI³	274 - 937	1300 - 4851	788 - 2673	579 - 1963	1032 - 2600	1001 - 2489

¹Data and analyses across 5 conservancies; does not include Palmwag concession

² Data and analyses across 5 conservancies and Palmwag concession

³CI = Confidence intervals; %CV = % Coefficient of Variation; SE = Standard error; ESW = Effective strip width; K-S = Kolmogorov-Smirnov

Table 25. Average population density and population size of ostrich in each of 5 conservancies and the Palmwag concession based on the average (Range) across 4 seasonal estimates between Oct 2011 and Apr 2013.

Conservancy or Concession Name	Average population density (range)	Average population size (range)
Anabeb	0.0015 (0.0003 - 0.0045)	117 (26 - 349)
Ehrovipuka	0.0007 (0.0003 - 0.0013)	111 (41 - 212)
Omatendeka	0.0015 (0.0001 - 0.005)	145 (12 - 480)
Palmwag	0.0021 (0.0019 - 0.0024)	707 (630 - 784)
Sesfontein	0.0024 (0.0009 - 0.0043)	324 (129 - 579)
Torra	0.0023 (0.0006 - 0.0042)	606 (162 - 1089)

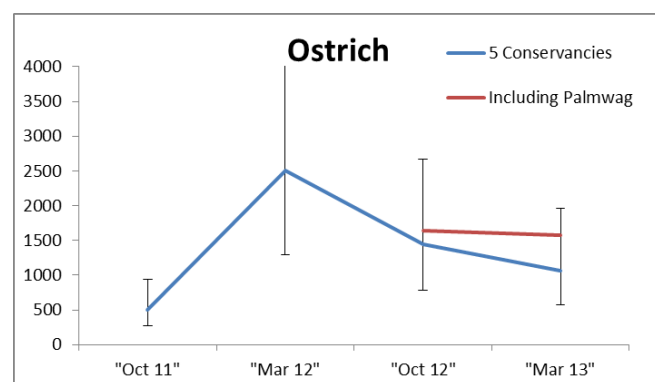


Figure 16. Estimated population size of ostrich based on 4 seasonal surveys across 5 conservancies in the Kunene region of northern Namibia; population estimates including the Palmwag concession in the latter 2 surveys is shown.

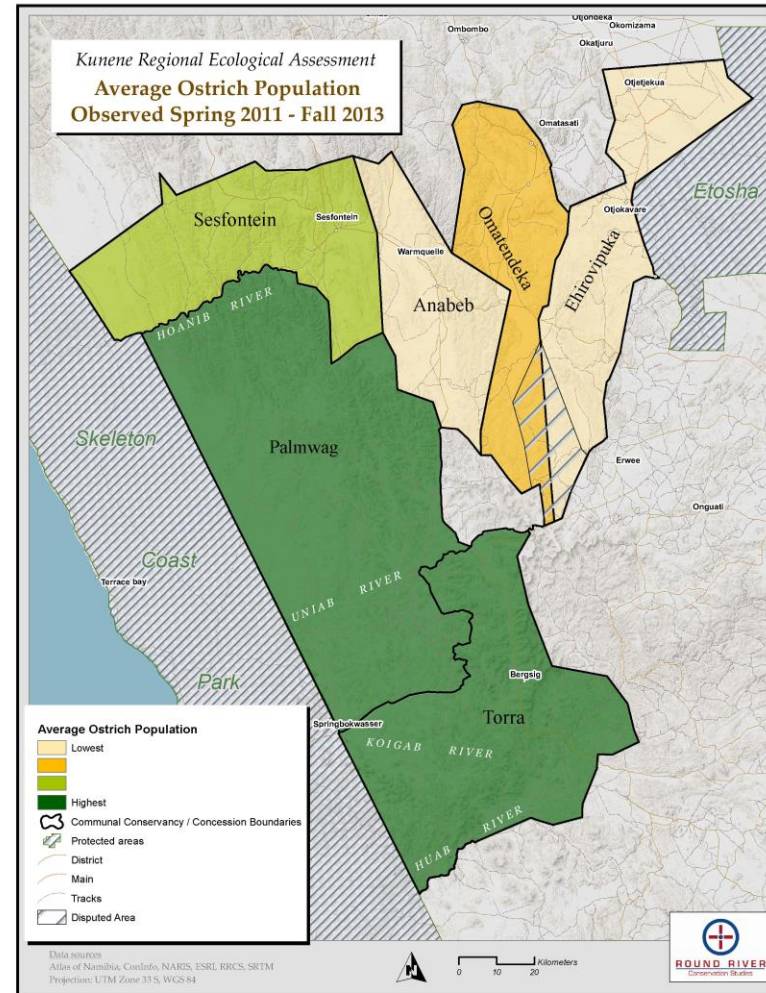
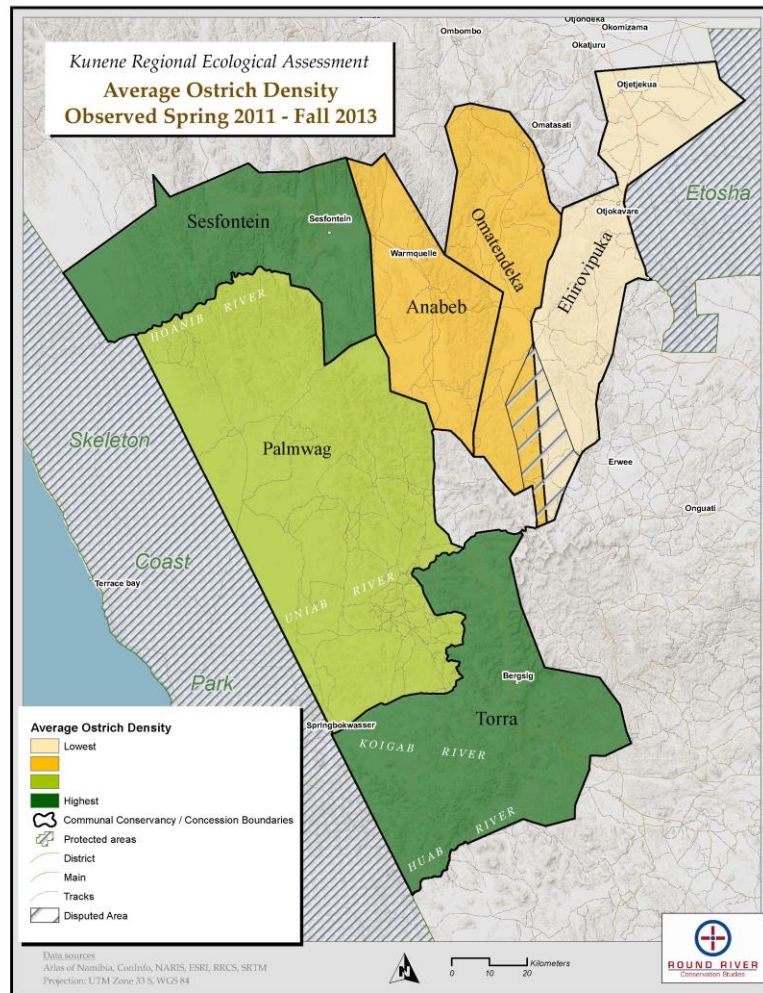


Figure 17. Maps showing the average population density and population size of ostrich estimated by on 4 seasonal estimates calculated from game count surveys completed between Oct 2011 and Apr 2013.

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APPENDIX I. SUMMARY OF VEHICULAR AND POINT COUNT SURVEY EFFORTS

Table I- 1. Summary of vehicular game count survey effort completed march-april 2012 in the Kunene region of Namibia.

Conservancy/ Concession	Rt ID	Date	Start Time	Start Temp	End Time	End Temp	Distance Travelled (km)	Survey Time (HR:MIN)
Ehrovipuka	1	8-Oct-2011	7:13	26	11:00	31	58.0	3:47
Ehrovipuka	2	9-Oct-2011	7:05	15	10:20	34	50.0	3:15
Ehrovipuka	3	9-Oct-2011	7:17	17	10:49	34	56.0	3:32
Ehrovipuka	4	11-Oct-2011	7:18	24	10:20	NA	35.0	3:02
Ehrovipuka	5	11-Oct-2011	7:11	24	11:00	NA	35.0	3:49
Torra	5	15-Oct-2011	6:40	NA	11:00	NA	55.0	4:20
Torra	7	16-Oct-2011	7:04	20	9:51	32.2	36.0	2:47
Torra	8	17-Oct-2011	6:56	20	11:01	NA	55.0	4:05
Torra	1	17-Oct-2011	6:42	13	10:45	27	62.0	4:03
Torra	3	19-Oct-2011	7:13	13	9:55	18	34.0	2:42
Torra	2	21-Oct-2011	7:00	12	11:00	38	48.0	4:00
Torra	6	21-Oct-2011	7:03	15	10:59	38	43.0	3:56
Torra	4	23-Oct-2011	7:16	20	9:02	25	36.0	1:46
Anabeb	6	25-Oct-2011	6:57	22	8:44	24	45.0	1:47
Anabeb	5	25-Oct-2011	6:57	22	8:09	24	25.0	1:12
Anabeb	2	26-Oct-2011	7:04	20	10:00	31	51.0	2:56
Anabeb	1	26-Oct-2011	6:56	20	9:16	31	41.0	2:20
Anabeb	3	28-Oct-2011	7:06	19.5	9:30	26.5	32.0	2:24
Anabeb	4	28-Oct-2011	7:05	21	10:34	38	40.0	3:29
Sesfontein	6	30-Oct-2011	7:12	16.7	9:26	30.5	55.0	2:14
Sesfontein	5	31-Oct-2011	7:12	18	9:59	24.4	33.0	2:47
Sesfontein	4	31-Oct-2011	7:16	21	10:37	34	70.0	3:21
Sesfontein	3	1-Nov-2011	7:00	16.5	9:00	32	37.0	2:00
Sesfontein	2	2-Nov-2011	7:21	15	10:28	44	53.0	3:07
Sesfontein	1	2-Nov-2011	7:18	15.82	9:54	44	40.0	2:36
Omatendeka	3	14-Nov-2011	7:05	19	11:05	40	89.0	4:00
Omatendeka	2	15-Nov-2011	6:59	15	10:30	38.9	78.0	3:31
Omatendeka	4	16-Nov-2011	7:03	16	9:32	26	45.0	2:29
Omatendeka	1	16-Nov-2011	7:29	14	10:18	28	78.0	2:49
Omatendeka	5	18-Nov-2011	7:12	27	10:27	27	26.5	3:15
Omatendeka	6	18-Nov-2011	7:13	23.75	8:12	28.8	7.95	0:59
Ehrovipuka	5	20-Nov-2011	7:08	20.3	9:40	23.3	45.6	2:32
Ehrovipuka	4	20-Nov-2011	7:28	22.1	10:12	26.7	35.04	2:44
Torra	1	4-Mar-2012	7:15	17	10:40		55.0	3:25
Torra	8	4-Mar-2012	7:11	19	11:00		55.0	3:49

Torra	4	5-Mar-2012	7:12	18	11:03		49.0	3:51
Torra	7	7-Mar-2012	7:00	18	9:13	26	42.0	2:13
Torra	6	7-Mar-2012	7:02	21	11:02	40	36.0	4:00
Torra	2	8-Mar-2012	6:54	26	10:58	28	42.0	4:04
Torra	7	12-Mar-2012	7:11	16	11:00	34	51.0	3:49
Torra	5	13-Mar-2012	7:16	22	10:56	30	47.0	3:40
Anabeb	1	17-Mar-2012	7:07	18	8:57	26	40.0	1:50
Anabeb	5	17-Mar-2012	7:10	21	8:44	22	32.0	1:34
Anabeb	2	18-Mar-2012	7:19	20	10:27	30	42.0	3:08
Anabeb	6	18-Mar-2012	7:11	25	9:01	27	45.0	1:50
Anabeb	4	19-Mar-2012	7:04	24	10:59	35	42.0	3:55
Anabeb	3	20-Mar-2012	7:05	26	9:39	32	26.0	2:34
Sesfontein	5	22-Mar-2012	7:15	24	9:19	29	33.0	2:04
Sesfontein	4	24-Mar-2012	7:16	26	9:41	34	54.0	2:25
Sesfontein	6	22-Mar-2012	7:15	24	8:30	NA	NA	1:15
Sesfontein	1	29-Mar-2012	7:30	20	9:47	27	45.0	2:17
Sesfontein	2	30-Mar-2012	7:10	18	10:00	23	53.0	2:50
Sesfontein	3	30-Mar-2012	7:20	19	9:29	16	29.0	2:09
Ehrovipuka	6	5-Apr-2012	6:35	11	8:05	25	17.0	1:30
Ehrovipuka	1	5-Apr-2012	6:42	18	10:08	29	81.0	3:26
Ehrovipuka	2	6-Apr-2012	7:05	18	10:58	32	60.0	3:53
Ehrovipuka	3	6-Apr-2012	7:05	20	9:56	32	48.0	2:51
Ehrovipuka	4	8-Apr-2012	7:05	18	9:44	35	33.0	2:39
Ehrovipuka	5	8-Apr-2012	7:04	16	9:36	33	28.0	2:32
Omatendeka	3	11-Apr-2012	7:06	22	11:00	34	45.0	3:54
Omatendeka	2	12-Apr-2012	7:04	21	10:27	37	34.0	3:23
Omatendeka	1	13-Apr-2012	7:05	19	9:35	32	54.0	2:30
Omatendeka	4	13-Apr-2012	7:04	21	9:55	32	37.0	2:51
Omatendeka	5	14-Apr-2012	7:08	21	10:42	40	27.0	3:34
Omatendeka	6	14-Apr-2012	7:00	19	7:40	20	17.0	0:40
Anabeb	5	16-Apr-2012	7:02	22	8:13	26	24.0	1:11
Anabeb	1	16-Apr-2012	7:00	21	8:46	26	39.0	1:46
Anabeb	6	17-Apr-2012	7:01	26	9:10	33	43.0	2:09
Anabeb	2	17-Apr-2012	7:10	23	9:52	33	46.0	2:42
Anabeb	4	19-Apr-2012	7:05	26	10:19	28	43.0	3:14
Anabeb	3	20-Apr-2012	7:00	24	9:15	36	26.0	2:15
Torra	5	4-Oct-2012	7:00	19	10:40	12	47.0	3:40
Torra	7	5-Oct-2012	7:07	22	11:00	33	48.0	3:53
Torra	8	6-Oct-2012	6:59	15	10:02	19	53.0	3:03
Torra	1	6-Oct-2012	7:00	11	11:00	24	55.0	4:00
Torra	3	7-Oct-2012	7:00	15	9:43	20	35.0	2:43
Torra	6	8-Oct-2012	7:00	16	11:00	29	42.0	4:00
Torra	2	8-Oct-2012	6:59	9	11:00	24	44.0	4:01
Torra	4	9-Oct-2012	7:01	15	9:03	22	40.0	2:02

Anabeb	1	12-Oct-2012	6:57	19	10:55	28	85.0	3:58
Anabeb	2	12-Oct-2012	7:04	14	10:08	30	51.0	3:04
Anabeb	3	13-Oct-2012	7:28	23	10:28	33	43.0	3:00
Anabeb	3	14-Oct-2012	7:10	14	9:51	30	50.0	2:41
Sesfontein	5	15-Oct-2012	7:00	18	9:17	30	14.0	2:17
Sesfontein	4	17-Oct-2012	7:00	16	10:42	30	63.0	3:42
Sesfontein	4	17-Oct-2012	7:00	16	10:42	30	63.0	3:42
Sesfontein	2	18-Oct-2012	7:06	19	9:53	19	52.0	2:47
Sesfontein	1	18-Oct-2012	7:01	15	9:00	19	40.0	1:59
Sesfontein	3	19-Oct-2012	7:02	13	9:33	17	32.0	2:31
Sesfontein	3	19-Oct-2012	7:02	13	9:33	17	32.0	2:31
Ehrovipuka	6	24-Oct-2012	7:03	23	8:11	28	18.0	1:08
Ehrovipuka	1	24-Oct-2012	7:06	20	10:59	31	74.0	3:53
Ehrovipuka	3	25-Oct-2012	6:57	11	11:00	33	70.0	4:03
Ehrovipuka	2	25-Oct-2012	7:05	20	10:27	33	59.0	3:22
Ehrovipuka	5	26-Oct-2012	7:00	15	10:50	31	39.0	3:50
Ehrovipuka	4	26-Oct-2012	7:07	22	10:14	33	33.0	3:07
Omatendeka	2	29-Oct-2012	7:02	22.5	10:26	33	55.0	3:24
Omatendeka	3	29-Oct-2012	7:06	26	11:08	38	41.0	4:02
Omatendeka	1	30-Oct-2012	7:00	16	9:58	27	58.0	2:58
Omatendeka	4	31-Oct-2012	7:10	17	10:18	40	36.0	3:08
Omatendeka	5	31-Oct-2012	7:25	17	10:45	35	27.0	3:20
Omatendeka	6	31-Oct-2012	7:18	20	8:34	28	9.0	1:16
Palmwag	10	9-Nov-2012	7:46	19	11:00	40	27.0	3:14
Palmwag	11	9-Nov-2012	7:00	17	10:10	28	39.0	3:10
Palmwag	5	9-Nov-2012	8:16	21	10:12	28	14.0	1:56
Palmwag	9	10-Nov-2012	7:25	19	10:12	29	34.0	2:47
Palmwag	3	10-Nov-2012	7:06	17	11:00	26	50.0	3:54
Palmwag	7b, 8	11-Nov-2012	7:03	19	11:00	32	59.0	3:57
Palmwag	7a	11-Nov-2012	7:07	17	9:35	25	32.0	2:28
Palmwag	1	12-Nov-2012	7:00	22	10:10	30	40.0	3:10
Palmwag	8	12-Nov-2012	7:00	20	9:33	35	42.0	2:33
Palmwag	2, 4	16-Nov-2012	7:11	17	11:00	25	60.0	3:49
Palmwag	3	21-Nov-2012	7:03	22	11:00	30	45.0	3:57
Palmwag	9	21-Nov-2012	7:23	21	9:20	22	33.0	1:57
Palmwag	10	22-Nov-2012	7:10	23	10:58	30	53.0	3:48
Palmwag	5	22-Nov-2012	7:28	24	10:20	34	30.0	2:52
Palmwag	11	22-Nov-2012	7:00	24	9:20	30	37.0	2:20
Palmwag	2	28-Nov-2012	7:15	21	9:31	31	34.0	2:16
Palmwag	4	28-Nov-2012	7:16	21	10:27	33	58.0	3:11
Torra	6	3-Mar-2013	7:00	27	10:50	37	42.0	3:50
Torra	2	3-Mar-2013	7:03	20	10:58	35	39.0	3:55
Torra	5	5-Mar-2013	7:00	27	10:37	30	49.0	3:37
Torra	7	5-Mar-2013	7:03	22	11:00	32	37.0	3:57

Torra	8	6-Mar-2013	7:00	28	10:28	32	45.0	3:28
Torra	4	8-Mar-2013	7:00	14	9:26	33	39.0	2:26
Palmwag	3	10-Mar-2013	7:00	15	11:00	38	45.0	4:00
Palmwag	4	10-Mar-2013	7:10	25	9:51	33	52.0	2:41
Anabeb	2	13-Mar-2013	7:00	26	9:44	33	49.0	2:44
Anabeb	1	13-Mar-2013	7:10	25	11:01	33	85.0	3:51
Anabeb	3	14-Mar-2013	7:06	26	9:07	33	28.0	2:01
Anabeb	4	14-Mar-2013	7:04	20	11:00	32	39.0	3:56
Sesfontein	5	16-Mar-2013	7:00	23	9:21	34	32.0	2:21
Sesfontein	4	16-Mar-2013	7:02	19	10:04	31	62.0	3:02
Sesfontein	2	17-Mar-2013	7:04	24	10:03	30	51.0	2:59
Sesfontein	1	17-Mar-2013	7:16	11	9:15	26	39.0	1:59
Sesfontein	3	18-Mar-2013	7:00	16	8:50	20	34.0	1:50
Sesfontein	6	19-Mar-2013	7:01	19	9:54	29	54.0	2:53
Ehrovipuka	6	26-Mar-2013	7:04	21	8:06	23	18.0	1:02
Ehrovipuka	1	26-Mar-2013	7:02	18	10:17	27	83.0	3:15
Ehrovipuka	2	27-Mar-2013	7:07	21	10:58	34	62.0	3:51
Ehrovipuka	3	28-Mar-2013	7:08	23	10:01	31	54.0	2:53
Ehrovipuka	5	29-Mar-2013	7:13	18	10:04	24	37.0	2:51
Ehrovipuka	4	29-Mar-2013	7:04	18	9:33	30	34.0	2:29
Omatendeka	3	31-Mar-2013	7:06	19	11:00	27	70.0	3:54
Omatendeka	2	31-Mar-2013	7:17	15	10:35	22	56.0	3:18
Omatendeka	1	1-Apr-2013	7:17	14	9:40	17	56.0	2:23
Omatendeka	4	2-Apr-2013	7:00	16	9:39	25	38.0	2:39
Omatendeka	5	2-Apr-2013	7:00	11	9:40	24	26.0	2:40
Omatendeka	6	3-Apr-2013	7:00	14	7:55	18	8.0	0:55
Palmwag	10	8-Apr-2013	7:36	19	11:00	33	56.0	3:24
Palmwag	5	8-Apr-2013	7:33	23	10:45	36	33.0	3:12
Palmwag	11	9-Apr-2013	7:00	15	9:31	30	35.0	2:31
Palmwag	1	10-Apr-2013	7:06	12	10:03	26	39.0	2:57
Palmwag	7	10-Apr-2013	7:03	16	11:00	33	62.0	3:57
Palmwag	8	11-Apr-2013	7:05	10	9:23	28	41.0	2:18
Palmwag	6	11-Apr-2013	7:07	15	10:40	34	53.0	3:33
Torra	1	15-Apr-2013	7:08	20	10:00	31	51.0	2:52
Torra	3	15-Apr-2013	7:00	27	10:51	43	53.0	3:51
Palmwag	2	17-Apr-2013	7:14	21	10:14	28	33.0	3:00
Palmwag	4	17-Apr-2013	7:16	23	9:13	27	59.0	1:57
Palmwag	5	21-Apr-2013	7:11	16	10:12	28	35.0	3:01
Palmwag	10	21-Apr-2013	7:02	17	11:00	35	60.0	3:58
Palmwag	12	22-Apr-2013	7:03	21	9:31	33	33.0	2:28
Palmwag	11	22-Apr-2013	7:00	13	9:18	28	45.0	2:18
Palmwag	1	23-Apr-2013	7:04	24	10:02	34	31.2	2:58
Palmwag	7	23-Apr-2013	7:03	15	10:35	30	62.9	3:32
Palmwag	8	24-Apr-2013	7:05	19	9:03	35	38.0	1:58

Palmwag	6	24-Apr-2013	7:00	12	10:33	35	50.0	3:33
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TABLE I- 2. SUMMARY OF POINT COUNT GAME SURVEY SITES ESTABLISHED DURING OCTOBER 2011 TO APRIL 2013 IN THE KUNENE REGION OF NAMIBIA

Conservancy	Site ID	Site Quality ¹	Field of View ²	Location UTM E	Location UTM N	Replications
Anabeb	A1	2	170	374493	7871254	1
	A2	2	182	372805	7885144	1
	A3	2	204	378647	7852010	5
	A4	1	187	373585	7843743	3
	A5	2	221	386664	7833928	2
Ehrovipuka	E1	1	212	413408	7818975	2
	E2	3	78	414640	7821517	1
	E3	2	141	411280	7816944	1
	E4-39	1	122	413196	7853766	3
	E5	2	184	413403	7818954	1
	E6	1	136	415061	7842701	1
	E56	2	143	429616	7858721	1
	O1	2	91	409018	7894377	2
	O2	2	126	403866	7872101	1
	O3	3	114	402338	7854837	1
Omatendeka	O4-20	1	147	404000	7821332	3
	O5	2	224	408810	7894560	1
	O6	2	NA	395915	7901220	1
	O57	1	181	403869	7821285	1
Palmwag	P1	1	199	381145	7764250	2
	P2	2	171	381791	7764588	1
	P3	2	205	384143	7768218	1
	P4	3	169	339631	7801785	1
	P5	1	169	326184	7835024	1
Sesfontein	S1	2	160	355472	7888926	1
	S2-7	1	124	307004	7863127	3
	S3-12	1	215	354440	7875962	4
	S4-17	1	158	354182	7866999	2
	S5-21	1	202	339782	7879512	3
	S6	2	219	332495	7901025	2
	S7	3	230	343323	7890099	2
	S8-27	1	182	346818	7893255	4
	S9	1	184	353158	7877927	1
	S10	2	177	323706	7895955	1
Torra	T1-4	1	227	380591	7759376	4
	T2-8	1	177	370977	7756368	4
	T3	2	120	423052	7746294	1
	T4-19	1	181	394488	7728042	4
	T5	1	148	377268	7719164	1
	T6	3	127	377651	7723718	1

T7	1	292	391683	7794906	1
T8-28	1	164	396521	7786559	4
T9-1	1	281	398660	7779495	4
T10	2	137	402061	7757769	2
T12	1	206	392058	7789070	1
T13	2	130	383578	7749732	1

¹ Subjective rating from 'High Quality' = 1 to 'Limited Quality' = 3 as an indication of quality of view scape and access restrictions

² Field of view is the degree of the angle of view shed

Shaded cells sites indicate more than one repeat and are sites RRCS will focus efforts to replicate in the future.

TABLE I- 3. SUMMARY OF POINT COUNT GAME SURVEY EFFORT COMPLETED OCTOBER 2011-APRIL 2013 IN THE KUNENE REGION OF NAMIBIA.

Conservancy	Date	Point ID	Temp Start (°C)	Wind Direction ¹	Wind Speed (km/hour)	Time Start	Time End	Temp End (°C)
Ehrovipuka	12-Oct-2011	E1	NA	E	0-5	7:33	9:33	NA
Ehrovipuka	12-Oct-2011	E2	NA	SE	0-5	8:40	10:40	NA
Torra	15-Oct-2011	T1-4	25.0	S/SE	0-5	8:16	10:16	NA
Torra	16-Oct-2011	T2-8	16.7	W	0-5	8:09	10:09	32.2
Torra	18-Oct-2011	T3	18.0	SW	0-5	7:16	9:16	24.0
Torra	19-Oct-2011	T4-19	17.9	SW	0-5	8:42	10:42	36.8
Torra	20-Oct-2011	T5	21.0	NE	10-15	7:31	9:31	31.0
Torra	20-Oct-2011	T6	21.0	NE	10-15	8:15	10:15	31.0
Torra	22-Oct-2011	T7	24.0	W	5-10	7:41	9:41	32.8
Torra	22-Oct-2011	T8-28	14.8	E	0-5	8:04	10:04	32.8
Torra	23-Oct-2011	T9-1	22.0	None	0	8:03	10:03	34.0
Anabeb	27-Oct-2011	A1	26.0	NE	0-5	7:50	9:50	32.0
Anabeb	27-Oct-2011	A2	26.0	NE	0-5	7:46	9:46	32.0
Anabeb	29-Oct-2011	A3	23.0	W/NW	0-5	7:50	9:50	36.0
Anabeb	29-Oct-2011	A4	26.4	NE	0-5	8:00	10:00	33.7
Sesfontein	30-Oct-2011	S1	23.0	SW	0-5	7:37	9:37	NA
Sesfontein	1-Nov-2011	S2-7	21.3	W	0-5	8:29	10:29	34.4
Sesfontein	3-Nov-2011	S3-12	NA	None	0	7:51	9:51	46.0
Sesfontein	3-Nov-2011	S4-17	36.7	N	0-5	7:54	9:54	43.3
Sesfontein	4-Nov-2011	S5-21	24.0	N	0-5	7:25	9:25	33.0
Sesfontein	4-Nov-2011	S6	27.0	S/SE	0-5	7:08	9:08	34.0
Sesfontein	5-Nov-2011	S7	25.0	None	0	7:20	9:20	37.0
Sesfontein	5-Nov-2011	S8-27	25.0	W	0-5	7:15	9:15	37.0
Omatendeka	15-Nov-2011	O1	NA	None	0	8:00	10:00	NA
Omatendeka	17-Nov-2011	O2	30.5	None	0	8:20	10:20	43.6

Omatendeka	17-Nov-2011	O3	25.0	None	0	7:56	9:56	40.0
Omatendeka	18-Nov-2011	O4-20	30.1	NW	0-5	8:37	10:37	34.5
Ehrovipuka	19-Nov-2011	E1	26.1	None	0	7:27	9:27	41.7
Ehrovipuka	19-Nov-2011	E3	26.1	None	0	7:30	9:30	41.7
Torra	5-Mar-2012	T10	20.0	S	0-5	7:54	9:54	24.0
Torra	6-Mar-2012	T4-19	20.0	SE	0-5	7:51	9:51	25.0
Torra	8-Mar-2012	T8-28	21.0	SE	0-5	7:50	9:50	25.0
Torra	9-Mar-2012	T12	24.0	W	0-5	8:59	10:59	35.0
Torra	9-Mar-2012	T9-1	21.0	None	0	8:04	10:04	24.0
Torra	10-Mar-2012	T13	24.0	E	0-5	7:50	9:50	34.0
Torra	10-Mar-2012	T11	23.0	N	0-5	7:34	9:34	29.0
Torra	12-Mar-2012	T1-4	26.0	None	0-5	8:00	10:00	31.0
Torra	13-Mar-2012	T2-8	22.0	SW	0-5	8:07	10:07	30.0
Anabeb	19-Mar-2012	A4b	30.0	S	0-5	8:44	10:44	37.0
Anabeb	20-Mar-2012	A3	26.0	S	0-5	8:26	10:26	41.0
Sesfontein	24-Mar-2012	S8-27	28.0	SE	0-5	7:39	9:39	38.0
Sesfontein	25-Mar-2012	S3-12	25.0	S	0-5	7:50	9:50	28.0
Sesfontein	25-Mar-2012	S9	26.0	W	0-5	8:11	10:11	33.0
Sesfontein	26-Mar-2012	S5-21	26.0	NA	0-5	7:54	9:54	29.0
Sesfontein	26-Mar-2012	S10	25.0	NA	0-5	7:31	9:31	34.0
Sesfontein	27-Mar-2012	S7	21.0	NA	0-5	7:55	9:55	25.0
Ehrovipuka	7-Apr-2012	E4-39	22.0	W	0-5	8:25	10:25	32.0
Ehrovipuka	9-Apr-2012	E6	20.0	SW	0-5	8:20	10:20	32.0
Ehrovipuka	9-Apr-2012	E5	23.0	NA	0-5	7:53	9:53	37.0
Omatendeka	11-Apr-2012	O5	25.0	E	0-5	7:50	9:50	38.0
Omatendeka	12-Apr-2012	O6	33.0	N	0-5	8:40	10:40	35.0
Omatendeka	14-Apr-2012	O4-20	26.0	NW	5-10	8:31	10:31	38.0
Anabeb	19-Apr-2012	A3	28.0	SE	0-5	7:45	9:45	28.0

Anabeb	20-Apr-2012	A4	30.0	S	0-5	8:42	10:42	37.0
Torra	4-Oct-2012	T1-4	24.0	E	0-5	7:55	9:55	28.0
Torra	5-Oct-2012	T2-8	16.0	W	0-5	8:10	10:10	21.0
Torra	6-Oct-2012	T10	19.0	NA	0	8:01	10:01	26.0
Torra	7-Oct-2012	T4-19	14.0	N	5-10	7:42	9:42	22.0
Torra	8-Oct-2012	T8-28	20.0	NA	0-5	8:00	10:00	27.0
Torra	9-Oct-2012	T9-1	23.5	E	0-5	8:20	10:20	25.0
Anabeb	13-Oct-2012	A3	20.0	N	0-5	7:50	9:50	24.0
Anabeb	14-Oct-2012	A5	24.0	E	0-5	7:54	9:54	36.0
Sesfontein	15-Oct-2012	S3-12	24.0	NE	0-5	8:07	10:07	38.0
Sesfontein	16-Oct-2012	S8-27	18.0	None	0	7:25	9:25	23.0
Sesfontein	16-Oct-2012	S8-27	18.0	None	0	7:25	9:25	23.0
Sesfontein	17-Oct-2012	S6	23.0	E	0-5	7:46	9:46	37.0
Sesfontein	17-Oct-2012	S5-21	18.0	S	0-5	8:05	10:05	23.0
Sesfontein	19-Oct-2012	S2-7	24.0	E	0-5	8:35	10:35	32.0
Ehrovipuka	25-Oct-2012	E4-39	22.0	S	0-5	8:54	10:54	25.0
Omatendeka	29-Oct-2012	O1	27.0	N	0-5	7:53	9:53	33.0
Omatendeka	31-Oct-2012	O4-20	28.0	S	0-5	9:07	11:07	33.0
Palmwag	11-Nov-2012	P4	27.0	E	0-5	8:27	10:27	37.0
Palmwag	12-Nov-2012	P5	24.0	S	5-10	8:03	10:03	33.0
Palmwag	16-Nov-2012	P3	24.0	S	0-5	8:41	10:41	28.0
Palmwag	16-Nov-2012	P2	24.0	S	0-5	8:32	10:32	28.0
Palmwag	28-Nov-2012	P1	28.0	E	5-10	8:07	10:07	33.0
Torra	1-Mar-2013	T2-8	21.0	SE	5	8:02	10:02	29.0
Torra	4-Mar-2013	T8-28	27.0	NE	5	8:00	10:00	30.0
Torra	5-Mar-2013	T1-4	27.0	N	10	8:05	10:05	35.0
Torra	9-Mar-2013	T9-1	20.0	NW	5	8:24	10:24	33.0
Anabeb	15-Mar-2013	A5	25.0	NW	5	7:29	9:29	32.0

Anabeb	15-Mar-2013	A3	17.0	NW	5	7:18	9:18	36.0
Sesfontein	18-Mar-2013	S2-7	18.0	NE	0-5	7:45	9:45	25.0
Sesfontein	19-Mar-2013	S8-27	23.0	SW	0-5	7:28	9:29	34.0
Sesfontein	20-Mar-2013	S3-12	25.0	SE	0-5	7:19	9:19	29.0
Sesfontein	20-Mar-2013	S4-17	28.0	N	0-5	7:50	9:10	35.0
Ehrovipuka	27-Mar-2013	E4-39	21.0	W	0-5	8:15	10:15	26.0
Ehrovipuka	28-Mar-2013	E56	18.0	NE	0-5	7:39	9:39	25.0
Omatendeka	3-Apr-2013	O57	24.0	S	0-5	8:50	10:50	30.0
Torra	16-Apr-2013	T4-19	23.0	NE	5-10	7:45	9:45	31.0
Palmwag	18-Apr-2013	P1	21.0	E	0-5	7:15	9:15	25.0

[†]Wind information at time of sampling; provided for future planning to avoid disturbing animals as approach site on foot

APPENDIX II. TOTAL COUNTS OF COMMON SPECIES BY SEASON.

Table II-1. Total counts of common species observed on vehicular game routes during Oct/Nov 2011.

Common Name	Latin Name	Conservancy (transect distance (km))				
		Anabeb (234)	Ehrovipuka (234)	Omatendeka (324)	Sesfontein (288)	Torra (369)
Chacma baboon	<i>Papio ursinus</i>	29	36	0	30	46
Gemsbok	<i>Oryx gazella</i>	69	80	266	140	392
Giraffe	<i>Giraffa camelopardalis</i>	7	81	22	9	41
HM Zebra	<i>Equus zebra hartmannae</i>	207	96	227	85	636
Kudu	<i>Tragelaphus strepsicerus</i>	19	4	7	0	111
Ostrich	<i>Struthio camelus</i>	10	7	4	51	44
Springbok	<i>Antidorcas marsupialis</i>	226	4	257	257	641

Table II-2. Total counts of common species observed on vehicular game routes during Mar/Apr 2012.

Common Name	Latin Name	Conservancy (transect distance (km))				
		Anabeb (227)	Ehrovipuka (281)	Omatendeka (214)	Sesfontein (251)	Torra (415)
Chacma baboon	<i>Papio ursinus</i>	32	5	0	0	35
Gemsbok	<i>Oryx gazella</i>	68	66	261	244	440
Giraffe	<i>Giraffa camelopardalis</i>	16	109	46	4	20
HM Zebra	<i>Equus zebra hartmannae</i>	578	251	615	38	438
Kudu	<i>Tragelaphus strepsicerus</i>	7	6	13	0	34
Ostrich	<i>Struthio camelus</i>	44	13	122	34	81
Springbok	<i>Antidorcas marsupialis</i>	1259	102	374	151	1070

Table II-3. Total counts of common species observed on vehicular game routes during Oct/Nov 2012.

Common Name	Latin Name	Conservancy/Concession (transect distance (km))					
		Anabeb (229)	Ehrovipuka (293)	Omatendeka (226)	Palmwag (337)	Sesfontein (201)	Torra (364)
Chacma baboon	<i>Papio ursinus</i>	40	0	0	29	29	55
Gemsbok	<i>Oryx gazella</i>	23	94	107	663	143	332
Giraffe	<i>Giraffa camelopardalis</i>	2	46	64	91	11	39
HM Zebra	<i>Equus zebra hartmannae</i>	44	76	210	1241	15	365
Kudu	<i>Tragelaphus strepsicerus</i>	21	23	32	62	0	37
Ostrich	<i>Struthio camelus</i>	5	10	7	102	46	92
Springbok	<i>Antidorcas marsupialis</i>	457	292	505	1410	136	417

Table II-4. Total counts of common species observed on vehicular game routes during Mar/Apr 2013.

Common Name	Latin Name	Conservancy/Concession (transect distance (km))					
		Anabeb (201)	Ehrovipuka (288)	Omatendeka (254)	Palmwag (449)	Sesfontein (272)	Torra (355)
Chacma baboon	<i>Papio ursinus</i>	2		65		15	29
Gemsbok	<i>Oryx gazella</i>	18	3	42	670	117	256
Giraffe	<i>Giraffa camelopardalis</i>	19	92	70	75	8	18
HM Zebra	<i>Equus zebra hartmannae</i>	167	217	41	1059	120	405
Kudu	<i>Tragelaphus strepsicerus</i>	10	0	5	69	0	27
Ostrich	<i>Struthio camelus</i>	13	13	26	153	20	106
Springbok	<i>Antidorcas marsupialis</i>	386	171	901	1448	133	448

