Results of the

Annual Game Count

for the NamibRand Nature Reserve

and Pro-Namib Conservancy

2 June 2012

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Title page photograph:
The magnificent red hartebeest continues to thrive on NamibRand (photo Morris Gosling)

1. Introduction

This report provides feedback and results of the annual game count held on NamibRand Nature Reserve and the Pro-Namib Conservancy on 2 June 2012 - for the eighth consecutive year since the counts were initiated in 2005. As usual, this event was combined with the Reserve's annual general meeting, which makes it an ideal opportunity to hold a game count with community participation.

In June 2009 a new area was added to the existing eight zones (Zone 9), in order to incorporate the Pro-Namib Conservancy. In June 2012 Zone 10 was added; this area forms part of NamibRand Nature Reserve, which now comprises Zone 1-8 and Zone 10. In order to facilitate comparisons among years, the data are listed separately for Zone 1-8, Zone 1-9 and Zone 1-10.

The results of the latest count are presented first, in relation to the data from the previous count (June 2011). This is followed by a broader analysis to compare trends in the data we have gathered over the past eight years; this information can then be used as a basis for effective management. Note, however, that management decisions are based on wildlife trends and distribution data obtained from actual sightings/counts, rather than on population estimates.

With rainfall being one of the main drivers of this complex desert system, mean annual rainfall figures provide interesting correlations with population estimates (including biomass) and wildlife distribution and density. The exceptional rainfall in 2010/11 (averaging 343 mm up to May, with a maximum of 464 mm at Wolwedans Reception) should provide some noteworthy results over the next years.

Kindly note that the game count method employed is ideal for estimating larger numbers of common plains game, but less suited to other species such as kudu and steenbok. No single census method is complete in itself, but needs to be supplemented and complemented on a dynamic basis by local knowledge and other sources of information, e.g. independent total counts of recently re-introduced species, incidental sightings and camera trap records.

2. Summary

Natural fluctuations in wildlife populations are driven primarily by rainfall, usually evidenced by seasonal migrations. Over the total count period, high mean rainfall (200-250 mm) was usually accompanied by an overall increase in estimated numbers, whereas lower mean rainfall was associated with a decrease in these numbers. Coupled with good rainfall, the area available to the game has increased with the gradual breaching of fences with neighbouring properties, and especially with the inclusion of the Pro-Namib Conservancy (Zone 9; 16 450 ha) in June 2009. In 2012 the count area was further increased by the addition of Springbokvlakte and Saffier (Zone 10; 23 510 ha) and with it, the area available to the game, now a total of 194 232 ha.

Data collected by participants in the June 2012 game count on NamibRand Nature Reserve and the Pro-Namib Conservancy (the combined "count area") were collated and analysed, bearing in mind our three core objectives:

Objective 1: Population estimates

Total numbers of game as estimated by the June 2012 game count are summarised below:

Species	Route 1-8	Route 1-9	Route 1-10
Oryx	6 054	6 913	7 296
Springbok	4 964	5 393	6 069
Kudu	41	41	41
P zebra*	464	470	470
Ostrich	448	615	765
Blesbok*	1	7	7
Hartebeest*	177	177	177
Total	**12 149**	**13 616**	**14 825**
Percentage change over previous year	**-17**	**-12**	*n/a*
*Giraffe***	*6**	*6**	*6**
*Ludwig's Bustard***	*109*	*109*	*117*

**Numbers are known*
***Not included in count*

This year, rainfall data were recalculated to cover a full season, namely from September to August (as opposted to January to December). Rainfall during the previous season (2010/11) was exceptional (343 mm from September to August), and overall estimated numbers increased by 13% (Zone 1-8) and 11% (Zone 1-9). However, the rainfall in 2011/12 was closer to the average (147 mm; September to May), and this was accompanied by a decrease in these numbers of 17% (Zone 1-8) and 12% (Zone 1-9). In June 2012 the overall population estimates are 12 149 (Zone 1-8), 13 610 (Zone 1-9) and, with the inclusion of Zone 10, a total of 14 825. It should be borne in mind, however, that these numbers are purely estimates.

With the lower rainfall in 2009/10, the biomass dropped accordingly, but this trend was reversed with the high rainfall in 2010/11 when biomass increased from 9.0 to 10.1 kg/ha (Route 1-8) and from 8.8 to 9.7 kg/ha (Zone 1-9). In 2011/12, despite drier conditions than the previous year that were accompanied by a decrease in overall estimated population numbers, the total biomass increased again to 11.0 kg/ha (Zone 1-8), 11.3 kg/ha (Zone 1-9)

and 10.6 kg/ha (Zone 1-10) by 9% for Zone 1-8, and 17% for Zone 1-9. The above figures are still well within the biomass of 15 kg/ha that is considered the maximum for our area.

Comparisons between the above biomass results and average annual rainfall figures indicate a "lag" of one year, reflecting good or poor breeding following good or poor rainfall.

Objective 2: Wildlife distribution

The highest densities of wildlife (Zone 1, 2, 5 and 6) were recorded in the northern parts including the foothills of the Nubib Mountains and Losberg, the Keerweder plains and the Chateau plains. The lowest densities (Zone 4, 7 and 9) were mainly in the dune areas north-west of Wolwedans; the Gorrasis area; and Excelsior/Dina. Densities in the remaining areas (Zones 3, 8 and 10), namely Kwessiegat, Aandstêr and Springbokvlakte/Saffier were also moderately low. These distribution patterns are likely to reflect the optimum grazing/browsing conditions in habitats such as the foothills at this time, compared to conditions on the dunes and in other parts.

Objective 3: Population change

The total population density in June 2011 rose to 693 individuals per 100 km, an increase of 9% compared to the previous year that appears to be directly related to the exceptionally high rainfall in 2010/11. In June 2012, the density dropped again to 339/100 km (Zone 1-9), a decrease of 51% compared to the previous count. This trend likewise appears to be related to the lower rainfall in 2011/12.

In June 2011 the extreme northern and central parts of the Reserve showed the highest increase in wildlife, with a decrease only in Zone 2 (36%). In marked contrast, the results for June 2012 showed a decrease for most zones, with up to 76% (in the extreme north), and only a slight increase (7%) in one count area (Zone 4, the dunes north-west of Wolwedans).

Dominant species

- **Oryx**

In June 2012 the total estimates for numbers of oryx are 6 054 (Zone 1-8) and 6 913 (Zone 1-9). This represents an increase of 24% (Zone 1-8) and 34% (Zone 1-9) over the previous year. With the inclusion of Zone 10, the total estimate for oryx is now 7 296. The overall trend is thus a slow but steady increase from about 2005, the present estimate being the highest on record since the game count was initiated.

The above increase in overall biomass in 2012 appears to be due largely to an increase of 33% in estimated numbers of oryx, resulting in an increase in biomass for the species from 6.7 to 8.9 kg/ha (Zone 1-9). Oryx now comprise 79% of the total biomass for the count area (Zone 1-9). In 2012, densities of oryx increased by 7% from 243/100 km in June 2011 to 259/100 km (Route 1-9), and overall from 146/100 km in June 2006. The steady increase in oryx biomass shows a good correlation with the increasing trend in rainfall averages.

The distribution of oryx was concentrated in Zone 6 (on the Keerweder plains), the Chateau plains and in most other parts of the Reserve, apart from the NUbib foothills (Draaihoek/ Keerweder), Gorrasis and Springbokvlakte/Saffier.

- **Springbok**

In contrast, estimated numbers of springbok have shown more variation over the long term. In 2011, a count of 8 878 (Zone 1-8) and 9 405 (Zone 1-9) represented a slight increase over the previous year, a trend that appears to be related to the good rainfall. In 2012, numbers of springbok are estimated at only 4 964 (Zone 1-8) and 5 393 (Zone 1-9), a decrease of 43-44% over 2011 for both data sets. With the inclusion of Zone 10, the total estimate for springbok is now 6 069. Percentage change greater than 30% per year is usually attributed to migration of animals in and out of the Reserve, normally in response to rainfall. Overall, the long term trend for estimated springbok numbers is a gradual decline from around 2005, the present totals being the lowest on record, and for the first time lower than those of oryx (Zone 1-10).

Springbok biomass has decreased by 43% (from 2.1 to 1.2 kg/ha; Zone 1-9) in 2012. The gradual decline in biomass shows a negative correlation with the increasing rainfall averages. Springbok densities have also decreased by 39% from 343/100 km to 227/100 km (Route 1-9) over the same period, and overall from a maximum of 785/100 km in June 2006. These densities were highest in the foothills of the Nubib Mountains (including Draaihoek/ Keerweder) and the Losberg, on the Keerweder plains and Chateau plains, and on Springbokvlakte/ Saffier.

Relationship between oryx and springbok

The long term increase in both estimated numbers and estimated biomass of oryx appears to be inverse to the decrease in springbok numbers. The present relationship in densities between these two species is also inverse. The reasons for this relationship are not known, and should be investigated further.

Oryx comprise 79% of the total biomass for the count area (Zone 1-9), compared to springbok (11%). However, both species are relatively independent of water and thus able to migrate in order to optimise changing foraging conditions. Their populations are therefore regarded as self-regulating over the long term.

- **Plains zebra**

Numbers of plains zebra were estimated at 350 in 2010 and have continued to increase again to 370 in 2011 and 470 in 2012. The biomass of this species has increased by 14% from 0.7 to 0.8 kg/ha in 2012. Although this biomass is only 6% of the total in 2012, the species is highly dependent on water and numbers are concentrated in the central parts of the Reserve. The situation is thus being monitored carefully with a view to regulation to a more sustainable level by means of game captures and translocation during the coming year (October 2012). The distribution of plains zebra was concentrated in the northern parts of the Reserve, especially on the Keerweder plains.

- **Ostrich**

In 2012, ostrich numbers showed an increase of 46% to 448 (Zone 1-8) and of 77% to 615 (Zone 1-9). The total estimate for Zone 1-10 is 765. Numbers, biomass and population densities appear to fluctuate widely, with no clear trend. Densities of ostrich were highest at Draaihoek/Keerweder, and on Aandstêr and Springbokvlakte/Saffier and lower in the dune areas.

- **Red hartebeest**

Numbers of hartebeest have gradually increased from 80 in 2007 to 125 in 2011 and 177 in 2012, thus doubling in the last five years. These numbers should be monitored carefully, due

to the species' dependence on water.

- **Blesbok**

In 2012 the number of blesbok was again reduced to six individuals in Zone 9 (Dina/ Excelsior), while one male remained in the Keerweder Pan area. As the species is alien to Namibia, efforts to eliminate it will continue.

- **Giraffe**

Two calves were born in 2011 (in January and April) bringing the total to six in June 2012 (and one more calf in July 2012). Due to the impacts of browsing by this species on the limited amount of vegetation in the area, the population will be further reduced by captures during the coming year.

- **Ludwig's Bustards**

Actual counts of these bustards dropped from 63 (an estimated 223) in 2010 to 39 (estimated 136) in 2011 and again to 28 (estimated 116; Zone 1-10) in 2012. These large terrestrial birds are highly nomadic, and these changes could be related to rainfall. Their distribution was concentrated in the north-eastern and central parts of the Reserve. Sightings were mainly on the open gravel plains in these zones. The species is threatened elsewhere, mainly by power line collisions, and was recently uplisted to *Endangered*. With its lack of overhead lines, NamibRand appears to provide a safe haven for this species, and ongoing monitoring is important.

- **Predators**

The ongoing increase in sightings of predators is considered to be a relection of a true population increase of species such as cheetah and leopard (both naturally occurring and re-introduced). The accompanying increase in predation is an important factor with regard to the long-term natural regulation of game numbers. Such predation is also accompained by increasing populations of scavengers, in particular spotted hyaena and vultures.

3. Methodology

3.1 Mean annual rainfall

For the June 2012 analysis, the "rainfall year" was recalculated to cover the full rain season, namely from 1 September to 31 August (as opposed to 1 January to 31 December). The former grouping captures both the summer and winter rainfall for a particular season and is especially important in years with early rains, in order to reflect the full rainfall as it relates to the growth cycle, veld productivity and thus to carrying capacity.

Two kinds of averages (means) were employed in order to explain the residual "carry-over effect" of rainfall from previous years, for example when comparing aspects such as biomass amongst years. Firstly, in order to "smooth' the data, a three-year running mean was calculated (i.e. the means of the present season, previous season and the season before were added together and divided by three). A weighted three-year running mean was also calculated in order to moderate the year-on-year rainfall (as well as the three-year running mean) and to reflect a closer "ecological effect of rainfall" on the biology and productivity of the land than the above two rainfall values, thus enabling a better comparison for wildlife biomass carrying capacity.

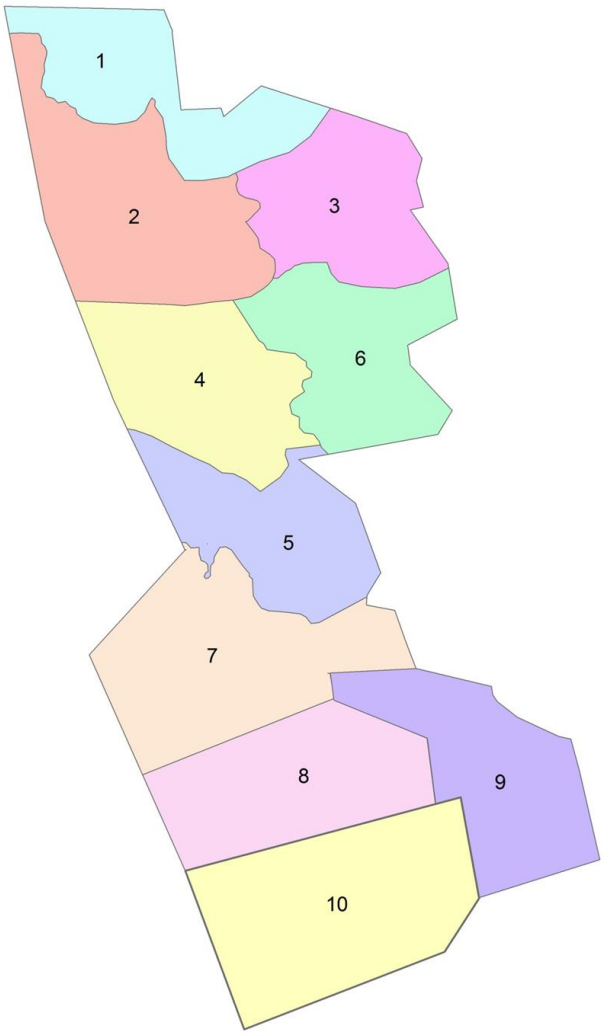
3.2 Count areas

For the purposes of the count, the total area is divided into ten game count zones, each with its own standardised route. The count zones used in June 2012 are shown in Figure 1. These include two relatively new zones: No. 9 that was added to the existing NamibRand zones in June 2009 in order to include the adjoining farms Excelsior and Dina, now part of the total area available to game through the establishment of the Pro-Namib Conservancy; and No. 10, added this year to include the farms Springbokvlakte and Saffier, which joined NamibRand officially in June 2012. The ten game count zones together are referred to as the "count area", which has now increased in size from 170 730 ha (Zone 1-9) to 194 232 ha (Zone 1-10; see Table 1). The total NamibRand count area (Zone 1-8 and Zone 10) is now 177 782 ha.

Table 1. Total areas for Zones 1-10; size of mountain areas (excluded); and remaining count area (ha)

Zones		Total area (ha)	Mountains (ha)	Count area (ha)
Zone 1-8	NRNR	172 208.63	17 928.63	154 280.00
Zone 10		30 079.53	6 578.00	23 501.53
TOTAL NRNR AREA		202 288.16	24 506.63	177 781.53
Zone 9 (Dina & Excelsior)		18 155.70	1 705.70	16 450.00
TOTAL COUNT AREA		**220 443.86**	**26 212.33**	**194 231.53**

Figure 1. The game count area, showing the ten zones used in June 2012 for NamibRand Nature Reserve (1-8, 10) and the Pro-Namib Conservancy (9).



3.3 Count methodology

The basic survey methodology used is a combination of the *Distance* and the *Strip-Count* census techniques. In layman's terms, these can be explained as follows:

Distance

All animals are counted and the distance to each animal, or group of animals, is recorded at right angles to the vehicle. This distance allows us to apply a *species' correction factor* for each type of animal counted. This is done in order to compensate for animals not seen.

For example, the chances of seeing large animals like zebra over a great distance are much higher than the probability or chances of seeing a smaller animal like a steenbok. Therefore a correction factor of 1.2 can be used for zebra (because one is likely to see most of them over a set distance). A much higher correction factor of 10 can be used for steenbok – over

the same set distance one is likely to see only a few steenbok while the rest will be hidden by "dead" ground or obstacles.

Strip-count

All animals are counted and the distance to each is recorded, at right angles to the vehicle. A strip-width is then determined – 1000m in our case, so that the area covered can then be multiplied into the overall area. This is known as an *area correction factor* (the number of times a 1000m wide strip will fit into the whole area). Only the animals inside the 1000m area (500m on either side of the road) are multiplied by the correction factor, in order to determine the population estimate for the given area.

Table 2 below lists the area correction factors and species' correction factors used for the game count in June 2012. Note that the area correction factors are based on the precise odometer readings for the route length.

Table 2

Correction factors (June 2012)					
Route no.	**Total count area per zone (ha)**	**Route distance (km)**	**Area correction factor (a.c.f)**	**Species**	**Species' correction factor (s.c.f)**
1	16 100	52.0	3.10	Oryx	1.4
2	16 330	52.1	3.13	Springbok	1.6
3	24 110	57.6	4.19	Kudu	2.6
4	18 780	47.0	4.00	Steenbok	10.0
5	16 120	71.0	2.27	Plains zebra	1.2
6	17 270	35.0	4.93	Ostrich	1.1
7	25 380	56.0	4.53	Red hartebeest	1.5
8	20 190	51.2	3.94	Ludwig's Bustard	1.0
9	16 450	51.0	3.23		
10	23 502	60.0	4.09		
Total	**194 232**	**532.9**			

Bearing in mind the objectives for counting, the results are thus calculated as follows:

Objective 1: Population estimates (*P*) – how many animals?

Actual number of animals seen* (*S*)
Area correction factor (*A*)
Species correction factor (*B*)

Formula for calculating population estimates*
(S x A) x B = P

**Known numbers:*
Note that where total numbers of species with small populations are known (e.g. for recently introduced species such as red hartebeest, plains zebra and giraffe, and the alien blesbok), these known totals are used for the final population estimates in preference to the above calculated estimates.

Biomass estimates (*B*)

Biomass estimates are important in terms of managing habitat conditions and inter-specific competition. These estimates are made by multiplying the estimated wildlife numbers with the mean mass per species, then dividing by the total number of hectares for the game count areas (i.e. 154 280 ha for Zone 1-8; 170 730 ha for Zone 1-9; 194 232 ha for Zone 1-10; and excluding 26 212 ha of mountainous habitat from the total number of hectares for the Reserve; see Table 1).

Note that agricultural Livestock Units (LSU) are not used for determining the biomass of wildlife species, due to differences between domestic and wild animals in aspects such as grazing/browsing patterns, and agricultural stocking according to a camps system as opposed to the open, unfenced system within the Reserve.

Estimated wildlife numbers (*E*)
Mean mass per species (*M*)
Total no. of hectares (*H*)

Formula for calculating biomass estimates*
(E x M) ÷ H = B

Biomass estimates were compared with average rainfall (see 3.1 for methods of determining rainfall averages), with a view to investigating the responses of the main plains species to rainfall and determining carrying capacity.

Objective 2: Wildlife distribution/density (*K*) – where are they?

Data from actual sightings (i.e. not estimates) for all count routes are "normalised" to animals counted per 100km. This is done in order to standardise the results to a value that is uniform for all count routes, thus enabling us to obtain accurate density and distribution figures for count zones.

Actual number of animals seen (*S*)
Length of route (*R*)
Animals seen per 100km driven (*K*)

Formula for calculating animals seen per 100 km driven
(S ÷ R) x 100 = K

Objective 3: Population change (*R*) – are numbers increasing or decreasing?

Data from actual sightings (i.e. not estimates) are also used to calculate the change in population over the previous year. As with distribution above, normalised or standardised data need to be used so that meaningful comparisons can be made. The data from each route are then compared to previous count data and the percentage change for each route and for the Reserve as a whole can be calculated. The percentage change for the total of each species can be calculated in the same way.

Previous value (*P*)
Current value (*C*)
Percentage change (*R*)

Formula for calculating percentage change
([C - P) ÷ P] x 100 = R

Population changes over the longer term are also investigated by means of a comparative data analysis, covering the full period since the inception of the game counts (June 2005).

4. Findings for the June 2012 count

4.1 Mean annual rainfall

The mean rainfall 0f 147 for 2011/12 (September to May) was closer to the average than the exceptional rainfall of the previous season, namely 343 mm (August 2010 to September 2011). As usual, this rainfall was widespread but patchy.

4.2 Population estimates

Counts per route and species estimates per zone

For each route, numbers of each species counted within the strip width (< 500m) were recorded. The total number counted per species per route was then multiplied first by the relevant area correction factor (a.c.f.; see Table 1) for each route, and then by the relevant species correction factor (s.c.f.) in order to produce a total estimate per species per zone. These data are shown in Tables 3.1 – 3.10 (see Appendix 1).

Total population estimates

The above total estimates per species per zone were then combined for all zones in order to determine the total population estimate for each plains game species in the count area. Total estimated numbers of game for the June 2012 count compared to those from the June 2011 count are shown in Table 4.1 (Zone 1-8), Table 4.2 (Zone 1-9) and Table 4.3 (Zone 1-10). Note that for this final estimate, known total numbers for certain species are used in preference to the above estimates (see 3.3 above).

Table 4.1

Total estimated numbers of game (Zone 1-8; Jun 11 – Jun 12)					
Species	**Jun-11**		**Jun-12**		**Percentage change**
	No. counted under 500m	**Total no. corrected for area + for species**	**No. counted under 500m**	**Total no. corrected for area + for species**	
Oryx	1 087	4 873	1 216	6 054	24
Springbok	1 521	8 878	998	4 964	-44
Kudu	3	38	4	41	8
Steenbok	0				
P zebra*	242	370*	273	464*	25
Ostrich	78	302	103	448	48
Blesbok*				1*	-
Hartebeest*	36	125*	177	177*	42
Total	**2 967**	**14 586**	**2 824**	**12 149**	**-17**
*Giraffe***	*3*	*6**		*6**	***0***
*Ludwig's Bustard***	*37*	*136*	*39*	*109*	***-20***

** Numbers are known*
*** Not included in count*

Table 4.2

Total estimated numbers of game (Zone 1-9; Jun 11 – Jun 12)					
Species	**Jun-11**		**Jun-12**		**Percentage change**
	No. seen under 500m	**Total no. corrected for area + for species**	**No. seen under 500m**	**Total no. corrected for area + for species**	
Oryx	1 151	5 162	1 297	6 913	34
Springbok	1 623	9 405	1 078	5 393	-43
Kudu	3	38	4	41	8
Steenbok					
P zebra	242	370*	273	470*	27
Ostrich	78	348	128	615	77
Blesbok		18*		7*	-61
Hartebeest	36	125*	177	177*	42
Total	**3 133**	**15 466**	**2 957**	**13 616**	**-12**
*Giraffe***	*3*	*6**		*6**	***0***
*Ludwig's Bustard***	*39*	*143*	*39*	*109*	***-24***

** Numbers are known*
*** Not included in count*

Table 4.3

Total estimated numbers of game (Zone 1-10; Jun 12)		
	No. seen under 500m	**Total no. corrected for area + for species**
Oryx	1 380	7 296
Springbok	1 208	6 069
Kudu	4	41
Steenbok		
P zebra*	273	470*
Ostrich	160	765
Blesbok*		7*
Hartebeest*	177	177*
Total	**3 255**	**14 825**
*Giraffe***		*6**
*Ludwig's Bustard***	*41*	*116*

** Numbers are known*
*** Not included in count*

Comments on population estimates for the June 2012 count (aso see No. 6 for discussion and conclusions)

In June 2012 the overall population estimate was 12 149 (Zone 1-8), a decrease of 17% over 2011. With the inclusion of the Pro-Namib Conservancy area (Zone 9) the estimate was 13 610, also a decrease of 12%, while with the recent inclusion of Springbokvlakte and Saffier (Zone 10), the estimate was 14 825.

- In June 2012 the total estimates for numbers of oryx are 6 054 (Zone 1-8) and 6 913 (Zone 1-9). This represents an increase of 24% (Zone 1-8) and 34% (Zone 1-9) over the previous year. With the inclusion of Zone 10, the total estimate for oryx is now 7 296.

- Numbers of springbok were estimated at 4 964 (Zone 1-8) and 5 393 (Zone 1-9), a decrease of 43-44% over 2011 for both data sets. With the inclusion of Zone 10, the total estimate for springbok is now 6 069.

- Ostrich numbers showed an increase of 46% to 448 (Zone 1-8) and of 77% to 615 (Zone 1-9). The total estimate for Zone 1-10 is 765.

- Numbers of kudu were estimated at 41, similar to the count for the previous year.

- Red hartebeest numbers have increased from 125 in 2011 to 177 in 2012.

- Plains zebra have increased again from 370 in 2011 to 470 in 2012.

- No steenbok were counted this year.

- Numbers of blesbok were reduced from 18 to six individuals by June 2012, while one more male remains in the Keerweder Pan area

- The giraffe population was six in June 2012 (and seven in July 2012).

- Actual counts of Ludwig's Bustards were 28 (an estimated 116; Zone 1-10) in 2012.

Biomass estimates

Biomass estimates are made for each game species by multiplying the above total population estimate for the species with the mean mass per species, then dividing by the total number of hectares for the game count areas (i.e. 154 280 ha for Zone 1-8; 170 730 ha for Zone 1-9; and 194 232 ha for Zone 1-10). The wildlife biomass in the count area for June 2012, in relation to that for June 2011, is shown in Table 5.1 (Zone 1-8), Table 5.2 (Zone 1-9) and Table 5.3 (Zone 1-10).

Table 5.1

Total wildlife numbers and wildlife biomass on NamibRand for June 2011 and June 2012 (Zone 1-8; 154 280 ha)

Species	Mean mass (kg)	Jun-11			Jun-12		
		Estimated wildlife numbers from June 11 game count	Species biomass (kg)	Biomass per ha (kg) TOTAL	Estimated wildlife numbers from June 12 game count	Species biomass (kg)	Biomass per ha (kg) TOTAL
Oryx	220	4 873	1 072 060	7.0	6 054	1 331 880	8.6
Springbok	38	8 878	337 364	2.2	4 964	188 632	1.2
Kudu	180	38	6 840	0.0	41	7 380	0.1
P zebra*	280	370	103 600	0.7	464	129 920	0.8
Ostrich	68	302	20 536	0.1	448	30 464	0.2
Hartebeest*	130	125	16 250	0.1	177	23 010	0.2
Steenbok	11	0	-	-		-	-
Blesbok*	100		-	-	1	100	0.001
Total		**14 586**	**1 556 650**	**10.1**	**12 148**	**1 711 386**	**11.1**

**Numbers are known*

Table 5.2

Total wildlife numbers and wildlife biomass on NamibRand for June 2011 and June 2012 (Zone 1-9; 170 730 ha)

Wildlife species	Mean mass (kg)	Jun-11			Jun-12		
		Estimated wildlife numbers from June 11 game count	Species biomass (kg)	Biomass per ha (kg) TOTAL	Estimated wildlife numbers from June 12 game count	Species biomass (kg)	Biomass per ha (kg) TOTAL
Oryx	220	5 162	1 135 640	6.7	6 913	1 520 860	8.9
Springbok	38	9 405	357 390	2.1	5 393	204 934	1.2
Kudu	180	39	7 020	0.0	41	7 380	0.04
P zebra*	280	370	103 600	0.7	470	122 080	0.7
Ostrich	68	348	23 664	0.1	615	41 820	0.3
Hartebeest*	130	125	16 250	0.1	177	29 900	0.2
Steenbok	11	0	-	-		-	-
Blesbok*	100	18	1 800	0.0	7	700	0.004
Total		**15 467**	**1 645 364**	**9.7**	**13,612**	**1 927 674**	**11.3**

**Numbers are known*

Table 5.3

Total wildlife numbers and wildlife biomass on NamibRand for June 2012 (Zone 1-10; 194 232 ha)				
Wildlife species	**Mean mass (kg)**	**Estimated wildlife numbers from June 12 game count**	**Species biomass (kg)**	**Biomass per ha (kg) TOTAL**
Oryx	220	7 296	1 605 120	8.3
Springbok	38	6 069	230 622	1.2
Kudu	180	41	7 380	0.04
P zebra*	280	470	122 080	0.6
Ostrich	68	765	52 020	0.3
Hartebeest*	130	177	29 900	0.15
Steenbok	11		-	
Blesbok*	100	7	700	0.004
Total		**14 825**	**2 047 822**	**10.6**

**Numbers are known*

Comments on biomass estimates for the June 2012 count (also see No. 6 for discussion and conclusions)

Despite drier conditions than the previous year, the total biomass estimate increased again this year to 11.0 kg/ha (Zone 1-8), 11.3 kg/ha (Zone 1-9) and 10.6 kg/ha (Zone 1-10). This represents an increase of 9% for Zone 1-8, and 17% for Zone 1-9.

These changes appear to be largely due to the good rainfall in 2010/11 and an increase of 33% in estimated numbers of oryx, resulting in an increase in estimated biomass for the species from 6.7 to 8.9 kg/ha (Zone 1-9).In contrast, the biomass of springbok has declined by 43% (from 2.1 to 1.2 kg/ha; Zone 1-9).

4.3 Wildlife distribution/density

Wildlife distribution is based on density: the actual number of animals per species counted (at a distance of <500m) per 100 km per route. The distribution and density of the major individual species (oryx, springbok, kudu, plains zebra, ostrich and Ludwig's Bustard) per count zone in June 2012 are presented below (Figure 2.1 – 2.6). The total distribution and density for the count area is shown in Figure 2.7. Note that the data are indicated on a gradient from dark (high values) to light (low values).

Figure 2.1 Distribution/density of oryx

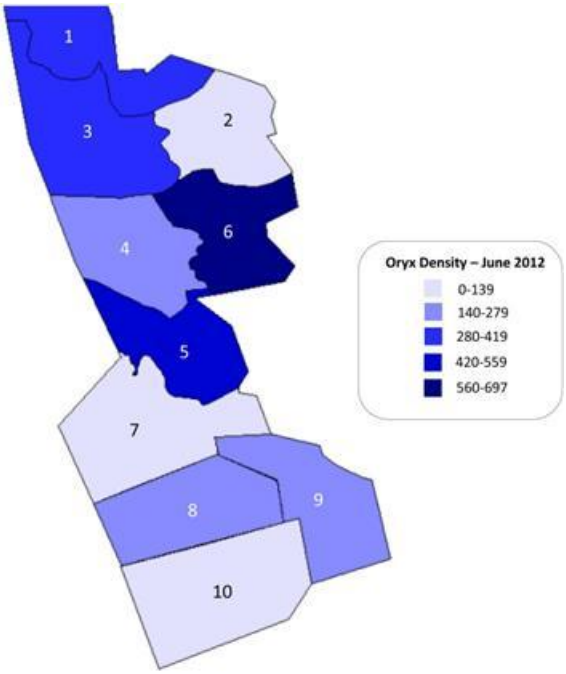


Figure 2.2 Distribution/density of springbok

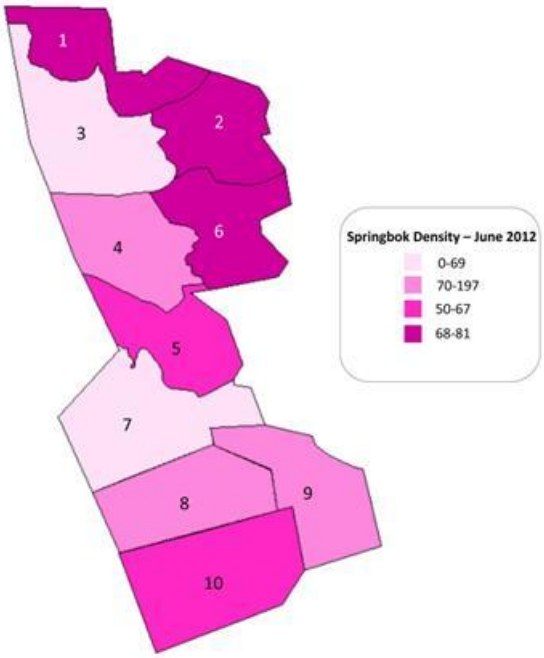


Figure 2.3 Distribution/density of kudu

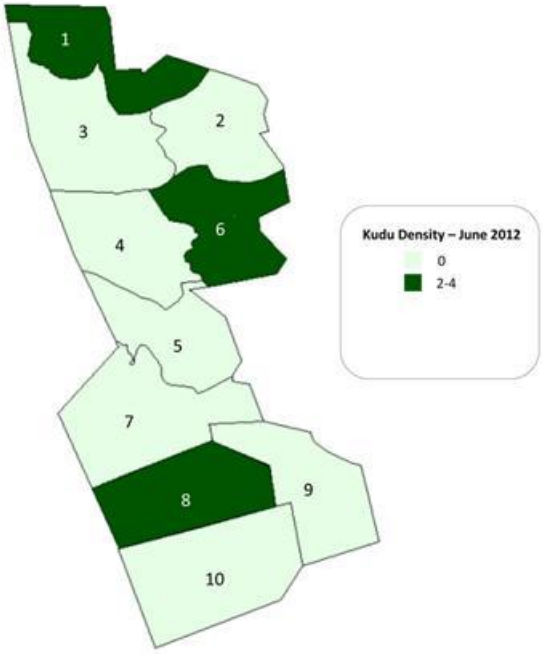


Figure 2.4 Distribution/density of plains zebra

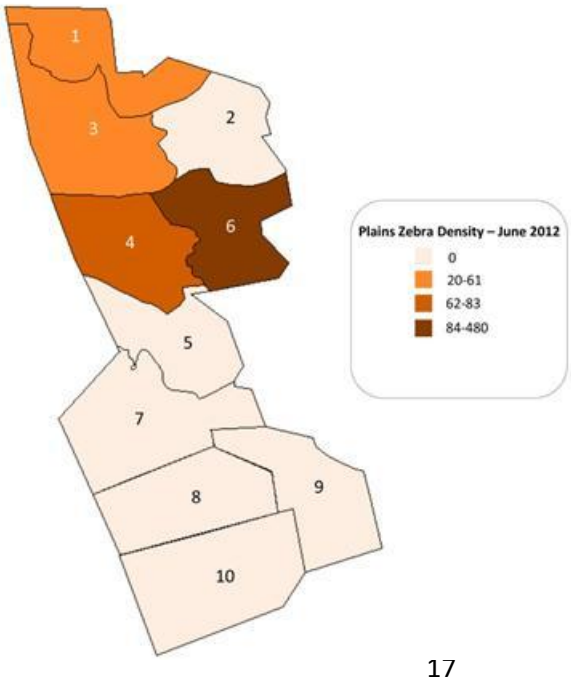


Figure 2.5 Distribution/density of Ostrich

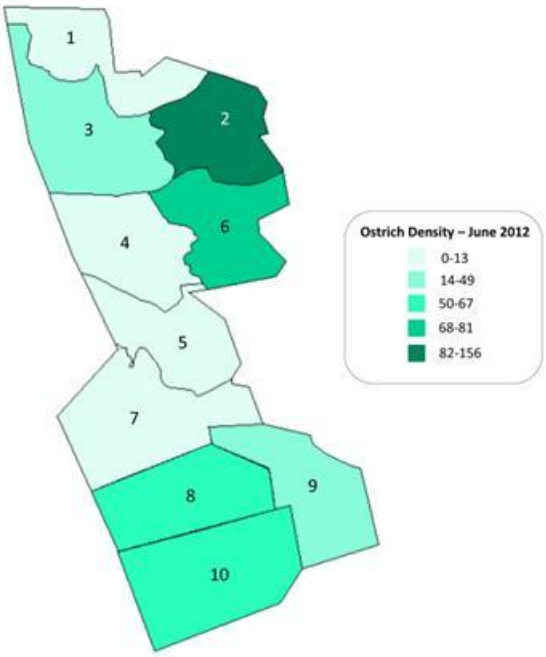


Figure 2.6 Distribution/density of Ludwig's Bustard

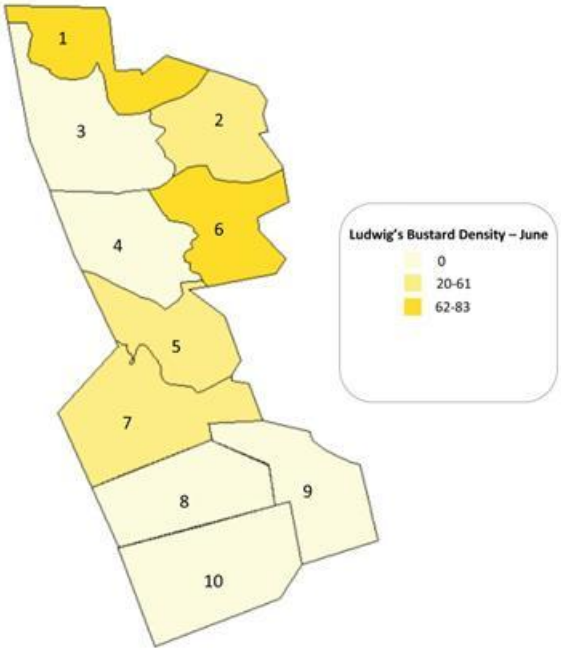
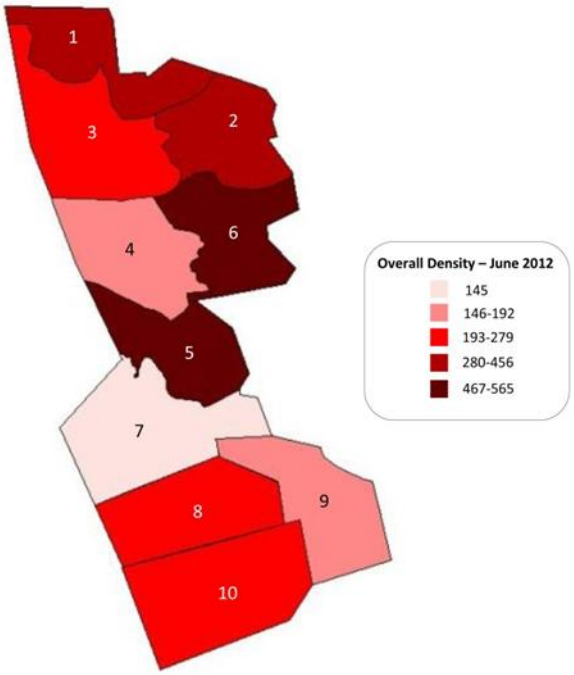


Figure 2.7 Total wildlife distribution/density

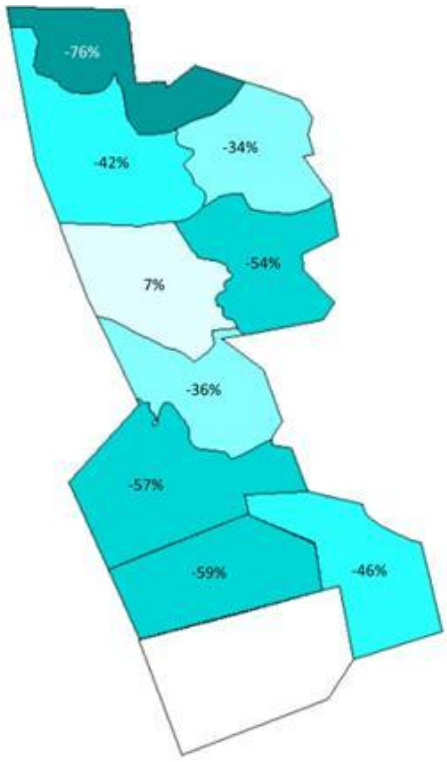


The total wildlife distribution/density for all species combined in the count area in June 2012, in relation to June 2011, is shown in Table 6. This includes the percentage change for each route/ zone, which is also illustrated in Figure 3 (below). Note that, apart from Route/ Zone 4 (which has a positive value: 7%), all the the other percentages represent a negative value or decrease (on average 56% per zone).

Table 6

Total no. of animals counted per 100 km per route (June 2011 – June 2012)			
Route	**Jun-11 (Route 1-9)**	**Jun-12 (Route 1-10)**	**% change (Jun-11 to Jun-12)**
1	1669	399	-76
2	684	455	-34
3	479	278	-42
4	178	191	7
5	830	530	-36
6	1215	564	-54
7	333	145	-57
8	503	209	-59
9	350	188	-46
10	-	243	-
Average per route: 1-9	**770.4**	**339.4**	**-56**
Average per route: 1-10	**-**	**330.9**	**-**

Figure 3. Changes in wildlife distribution between June 2011 and June 2012.



Comments on wildlife distribution/density for the June 2012 count (aso see No. 6 for discussion and conclusions)

As mentioned above, only actual sightings are used to analyse wildlife distribution/density (total number of animals counted per 100 km).

The distribution of oryx was concentrated in Zone 6 (on the Keerweder plains and around the foothills of the Losberg), the Chateau plains and in most other parts of the Reserve, apart from at Draaihoek/ Keerweder, Gorrasis and Springbokvlakte/Saffier. Springbok densities were highest in the foothills of the Nubib Mountains (including Draaihoek/ Keerweder) and the Losberg, the Keerweder plains and Chateau plains, and on Springbokvlakte/ Saffier. The distribution of plains zebra was concentrated in the northern parts of the Reserve, especially on the Keerweder plains. Densities of ostrich were highest at Draaihoek/Keerweder, Aandstêr and Springbokvlakte/Saffier and lower in the dune areas. The distribution of Ludwig's Bustard was concentrated in the north-eastern and central parts of the Reserve. Sightings were mainly on the open gravel plains in these zones. The highest overall densities were recordedin Zone 5 and 6.

The total density (number of sightings per 100 km per route) in June 2012 dropped to 339/100 km (Zone 1-9), a decrease of 51% compared to June 2011. This trend appears to be related to the lower rainfall in 2012. The results for June 2012 showed a decrease for most zones, with up to 76% (in the extreme north), and only a slight increase (7%) in one are (Zone 4).

5. Comparative data analysis/population change

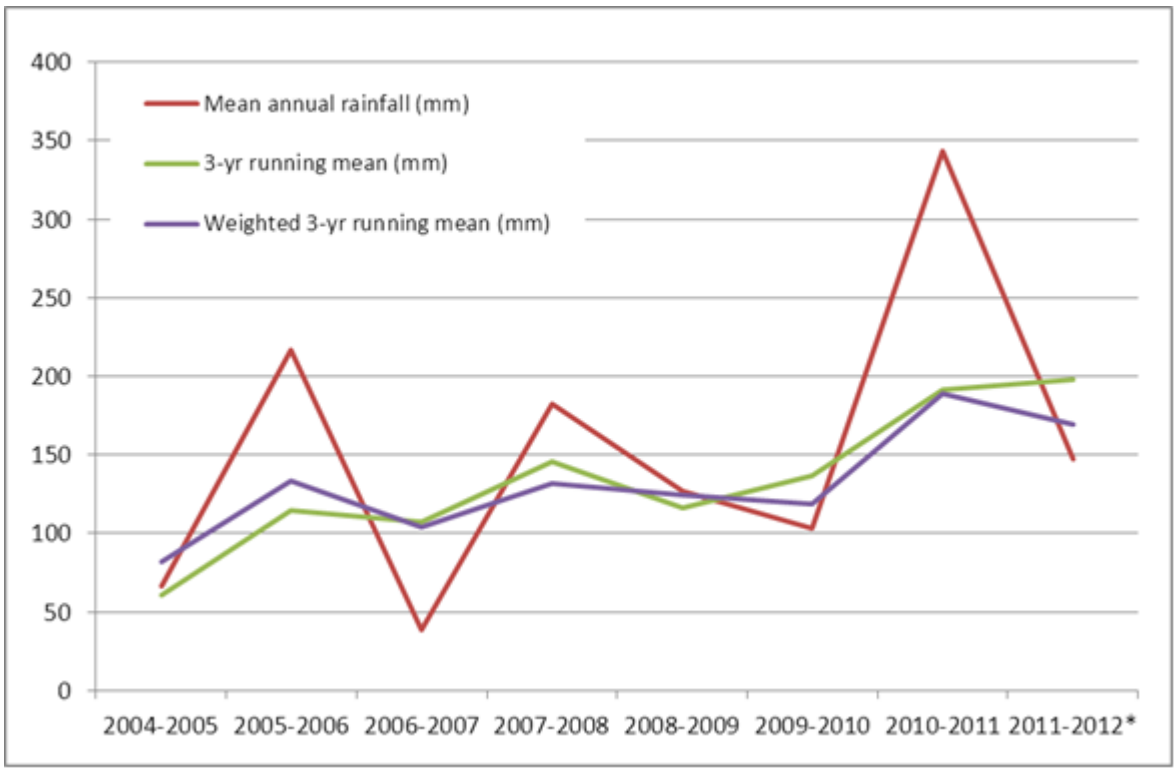
This section provides some further comparative analyses of the above data for June 2012 in relation to the long term data and to rainfall, in order to investigate population trends.

5.1 Mean annual rainfall

The mean seasonal rainfall (September to August) for the count period (2004/05 to 2011/12 [September to May]) is presented in Figure 4. These figures are calculated from available data for NamibRand Nature Reserve. Note that the mean annual rainfall figure for 2008/09 has been revised from that in the previous report, the figure now being closer to the average.

As mentioned above, the mean rainfall of 147 mm for 2011/12 was also closer to the average.

Figure 4. Mean annual rainfall ; three-year running mean; and weighted three-year running mean rainfall for NamibRand Nature Reserve, 2004/05 – 2011/12 (*September to May)*



5.2 Population estimates

Total population estimates

Changes in population estimates over the longer term (June 2005 – June 2012), in relation to average rainfall (see above; Figure 4) are presented in Table 7.1 and 7.2. The long term estimates for all species and total wildlife estimates are shown in Figure 5.1; estimates for oryx and springbok (only) are presented on a larger scale in Figure 5.2, and for plains species with lower numbers (i.e. excluding oryx and springbok) in Figure 5.3. For Ludwig's Bustard, actual counts in comparison to estimated numbers are shown in Figure 5.4.

Table 7.1

Total estimated numbers of game (Jun 05 - Jun 08)						
Species	**Jun 05**	**Summer Nov 05**	**Jun 06**	**Summer Dec 06**	**Jun 07**	**Jun 08**
Oryx	4 320	5 583	1 447	3 689	4 295	3 258
Springbok	7 733	9 207	17 900	13 127	9 013	12 451
Kudu	290	827	583	834	486	75
P zebra*	174	311	439	442	677	668
Ostrich	409	443	213	951	669	262
Hartebeest*	50	55	70	75	80	80
Steenbok	53	100	44	88	125	174
Blesbok*	10	11	15	18	20	20
Total	**13 039**	**16 538**	**20 710**	**19 224**	**15 366**	**16 988**
% change	-	**26.8**	**25.2**	**-7.2**	**-20.1**	**10.6**
Mean rain	**66**		**217**		**39**	**182**

** Numbers are known*

Table 7.2

Total estimated numbers of game (Jun 09 - Jun 12)									
Species	**Jun 09 (1-8)**	**Jun 09 (1-9)**	**Jun 10 (1-8)**	**Jun 10 (1-9)**	**Jun 11 (1-8)**	**Jun 11 (1-9)**	**Jun 12 (1-8)**	**Jun 12 (1-9)**	**Jun 12 (1-10)**
Oryx	4 700	5 415	4 262	4 683	4 873	5 162	6 054	6 913	7 296
Springbok	12 551	13 400	7 590	8 060	8 878	9 405	4 964	5 393	6 069
Kudu	79	79	24	24	38	38	41	41	41
P zebra*	318	318	350*	350*	370*	370*	464	470	470
Ostrich	829	935	550	644	302	348	448	615	765
Hartebeest*	80	80	110*	110*	125*	125*	177	177	177
Steenbok	0	32	0	0					
Blesbok*	7*	23*	1*	19*		18*	1	7	7
Total	**18 564**	**20 282**	**12 887**	**13 890**	**14 586**	**15 466**	**12 149**	**13 616**	**14 825**
% change	**9.3**	**19.4**	**-30.6**	**-31.5**	**13.2**	**11.4**	**-16.7**	**-12.0**	-
Mean rain	**127**		**103**		**343**		**147**		
Giraffe **			*8**	*8**	*6**	*6**	*6**	*6**	*6**
L Bustard **			*160*	*223*	*136*	*143*	*109*	*109*	*116*

** Numbers are known*

*** Not included in count*

Figure 5.1 Total estimated numbers for all plains species and total estimated wildlife numbers, June 2005 – June 2012

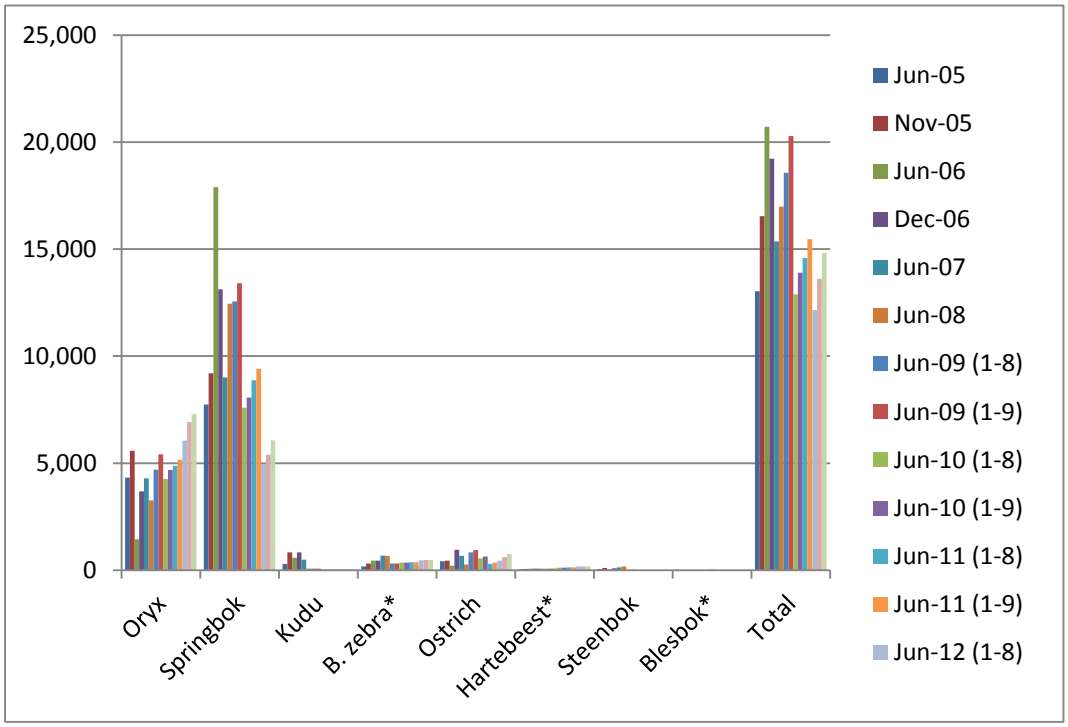


Figure 5.2 Total estimated numbers for oryx and springbok, June 2005 – June 2012

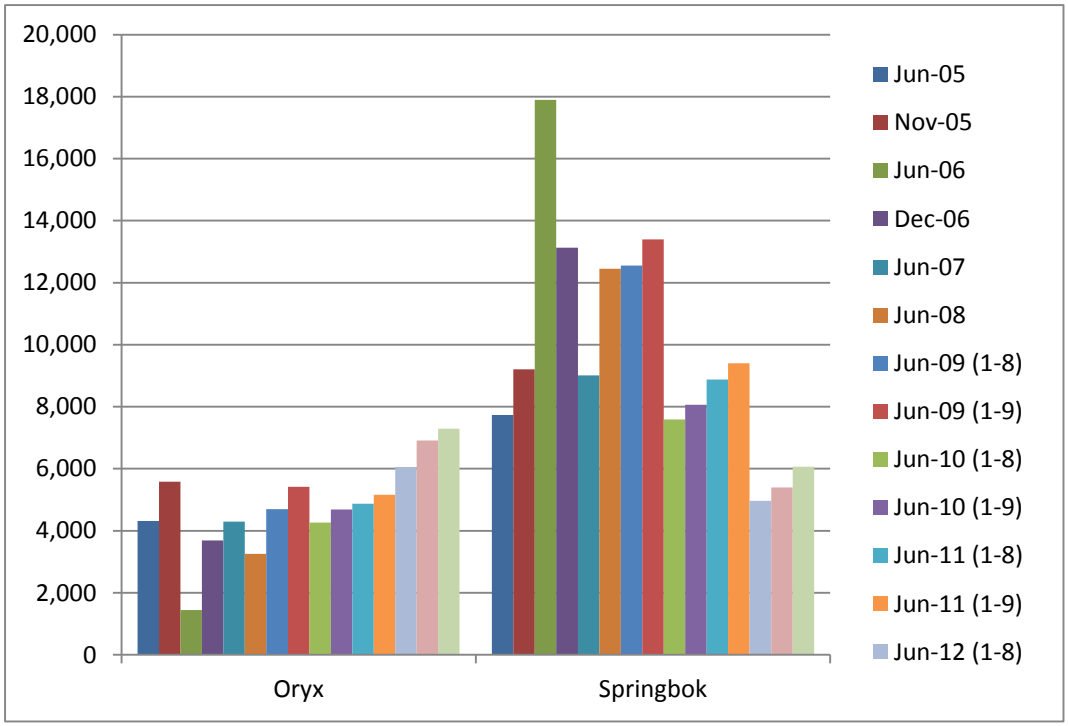


Figure 5.3 Total estimated numbers for all plains species other than oryx and springbok, June 2005 – June 2012

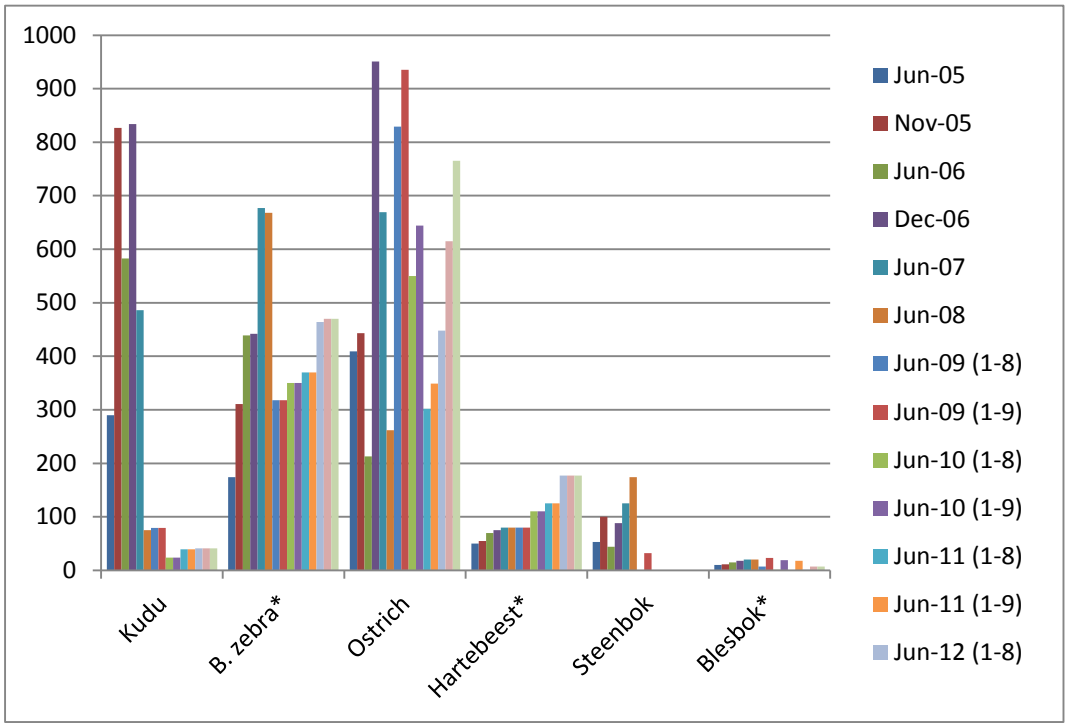
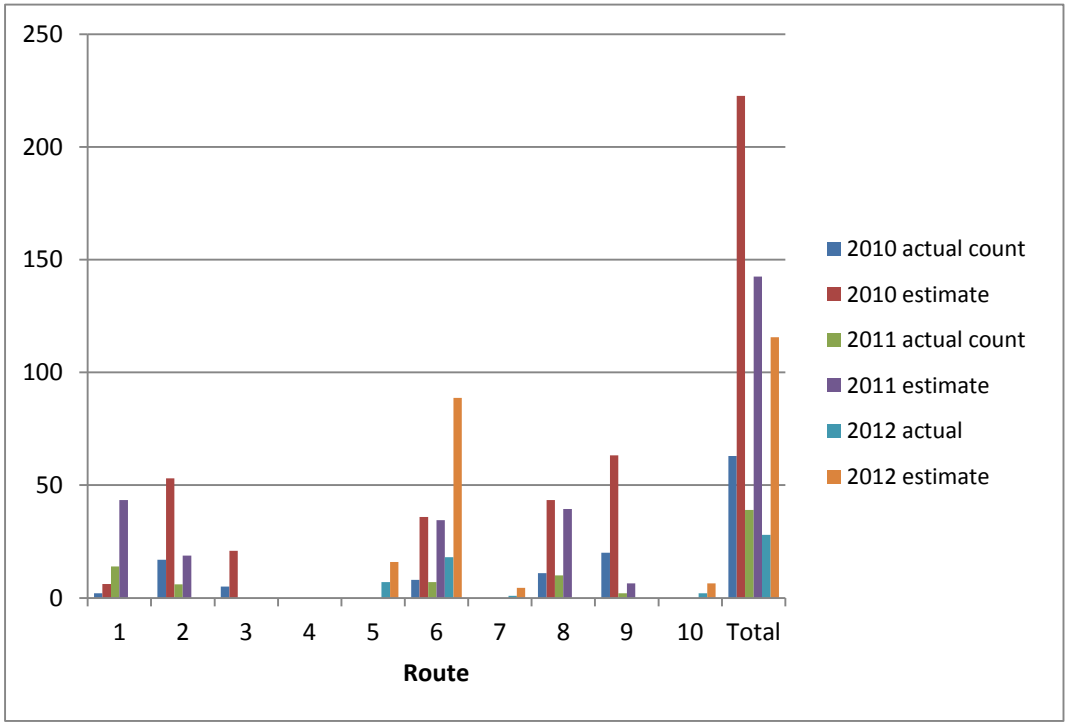


Figure 5.4 Actual counts and estimated numbers of Ludwig's Bustards, June 2010 - June 2012



Biomass estimates

The changes in total wildlife biomass estimates in the count area from June 2005 to June 2012 are shown in Table 8.1 and 8.2.

Total wildlife biomass (kg/hectare) for plains game species is shown in Figure 6.1, and for oryx and springbok in Figure 6.2. Total biomass in relation to rainfall means is shown in Figure 7.1; biomass of oryx compared to rainfall means in Figure 7.2; biomass of springbok compared to rainfall means in Figure 7.3; and biomass of both oryx and springbok in relation to rainfall means in Figure 7.4.

Table 8.1

Total wildlife biomass estimates (kg/ha) on NamibRand, June 2005 to June 2008						
Wildlife species	**Jun-05**	**Nov-05**	**Jun-06**	**Dec-06**	**Jun-07**	**Jun-08**
Oryx	6.2	8.0	2.1	5.3	6.1	4.7
Springbok	1.9	2.8	4.4	3.2	2.2	3.1
Kudu	0.3	1.0	0.7	1.0	0.6	0.1
P zebra	0.3	0.6	0.8	0.8	1.2	1.2
Ostrich	0.2	0.2	0.1	0.4	0.3	0.1
Hartebeest	0.0	0.1	0.1	0.1	0.1	0.1
Steenbok	0.0	0.0	0.0	0.0	0.0	0.0
Blesbok	0.0	0.0	0.0	0.0	0.0	0.0
Total	**9.0**	**12.6**	**8.1**	**10.8**	**10.6**	**9.2**

Table 8.2

Total wildlife biomass estimates (kg/ha) on NamibRand, June 2009 to June 2012											
Wildlife species	**Jun-09 (1-8)**	**Jun-09 (1-9)**	**Jun-10 (1-8)**	**Jun-10 (1-9)**	**Jun-11 (1-8)**	**Jun-11 (1-9)**	**Jun-12 (1-8)**	**% change from Jun-11**	**Jun-12 (1-9)**	**% change from Jun-11**	**Jun-12 (1-10)**
Oryx	6.7	7.0	6.1	6.0	7.0	6.7	8.6	22.9	8.9	32.8	8.3
Springbok	3.1	3.0	1.9	1.8	2.2	2.1	1.2	45.5	1.2	42.9	1.2
Kudu	0.1	0.1	0.0	0.0	0.0	0.0	0.02		0.02		0.02
P zebra	0.6	0.5	0.6	0.6	0.7	0.7	0.8	14.3	0.8	14.3	0.7
Ostrich	0.4	0.4	0.2	0.3	0.1	0.1	0.2		0.3		0.3
Hartebeest	0.1	0.1	0.1	0.1	0.1	0.1	0.15		0.13		0.12
Steenbok	0.0	0.0	0.0	0.0	-	-	-		-		-
Blesbok	0.0	0.1	0.0	0.0	-	0.0	-		0.003		0.002
Total	**10.9**	**11.1**	**9.0**	**8.8**	**10.1**	**9.7**	**11.0**	**8.9**	**11.3**	**16.5**	**10.6**

Figure 6.1 Total wildlife biomass estimates (kg per ha) for plains game species on NamibRand Nature Reserve, June 2005 - June 2012

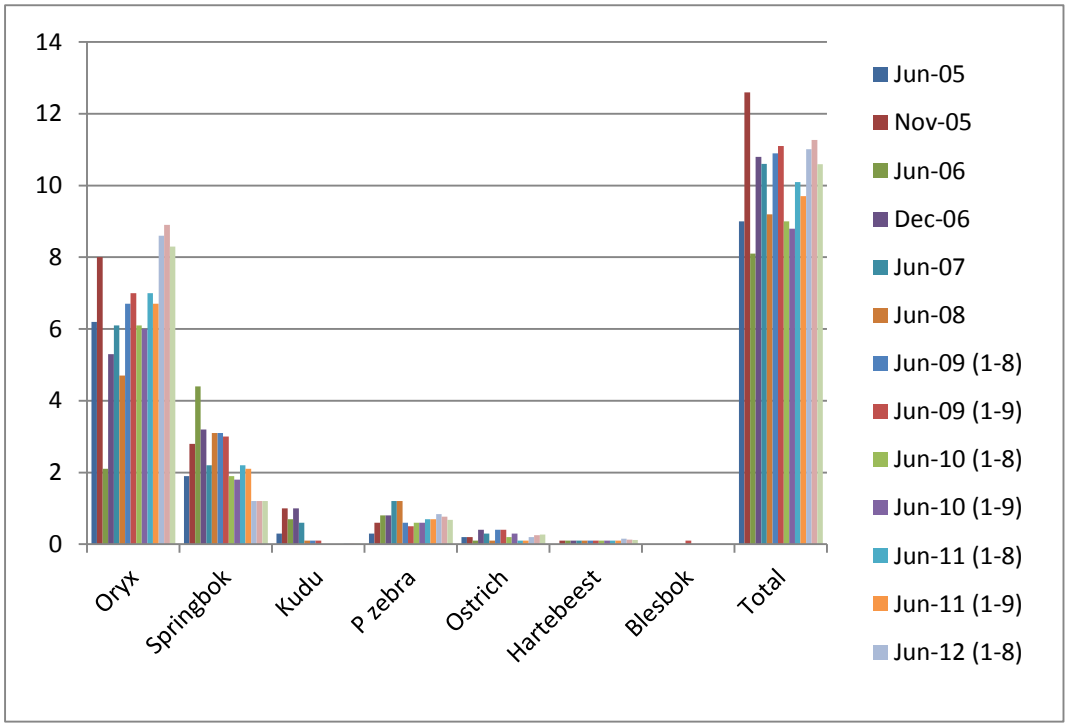


Figure 6.2 Total wildlife biomass estimates (kg per ha) for oryx and springbok on NamibRand Nature Reserve, June 2005 - June 2012

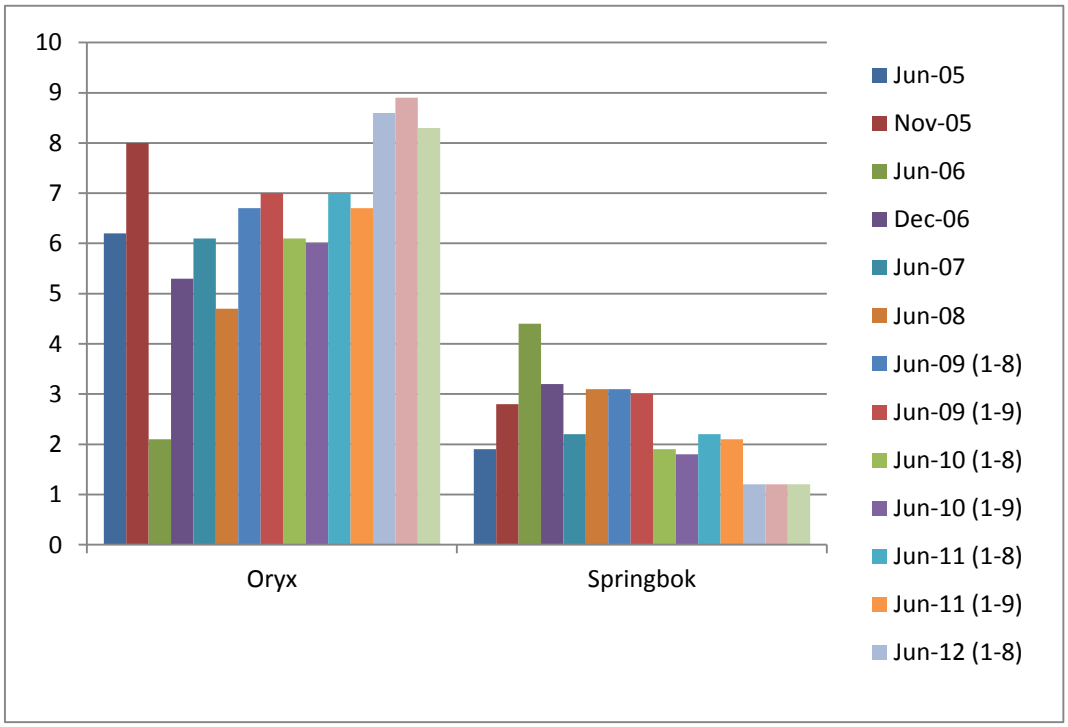


Figure 7.1 Total biomass compared to rainfall means

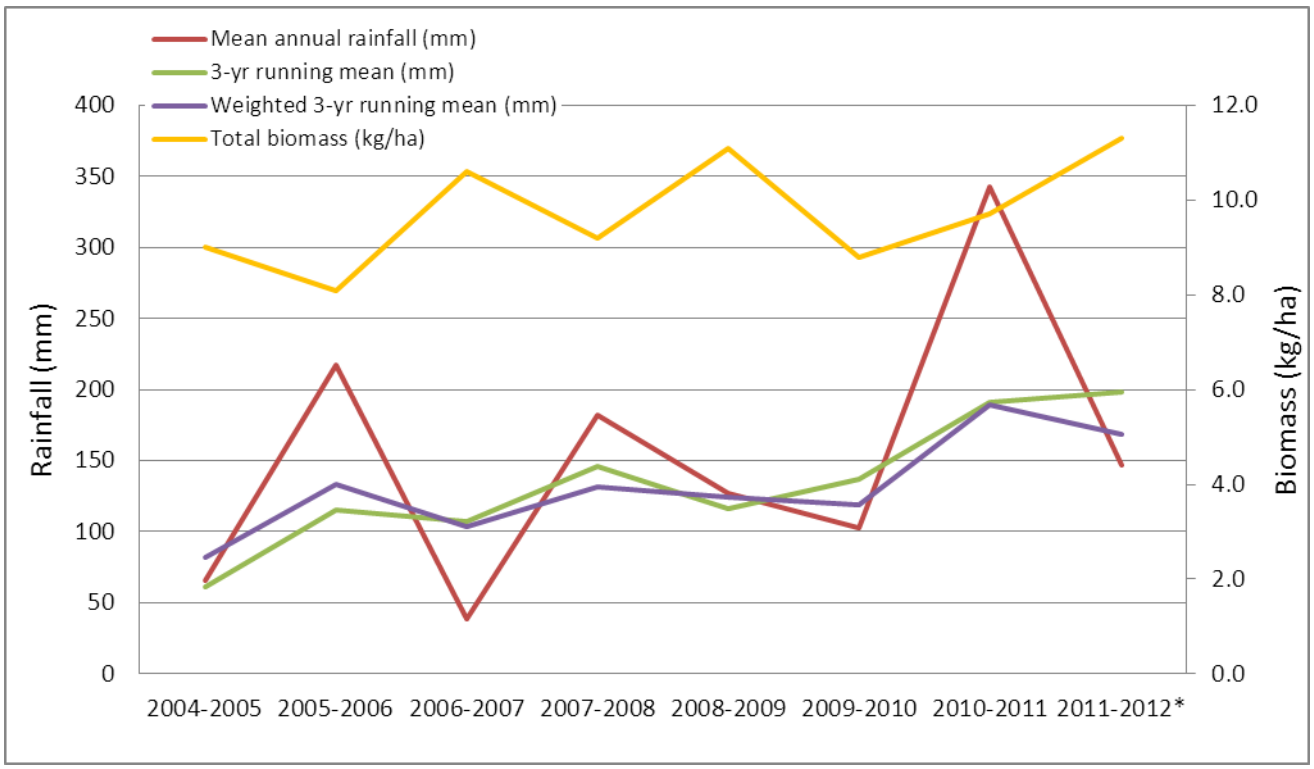


Figure 7.2 Biomass of oryx compared to rainfall means

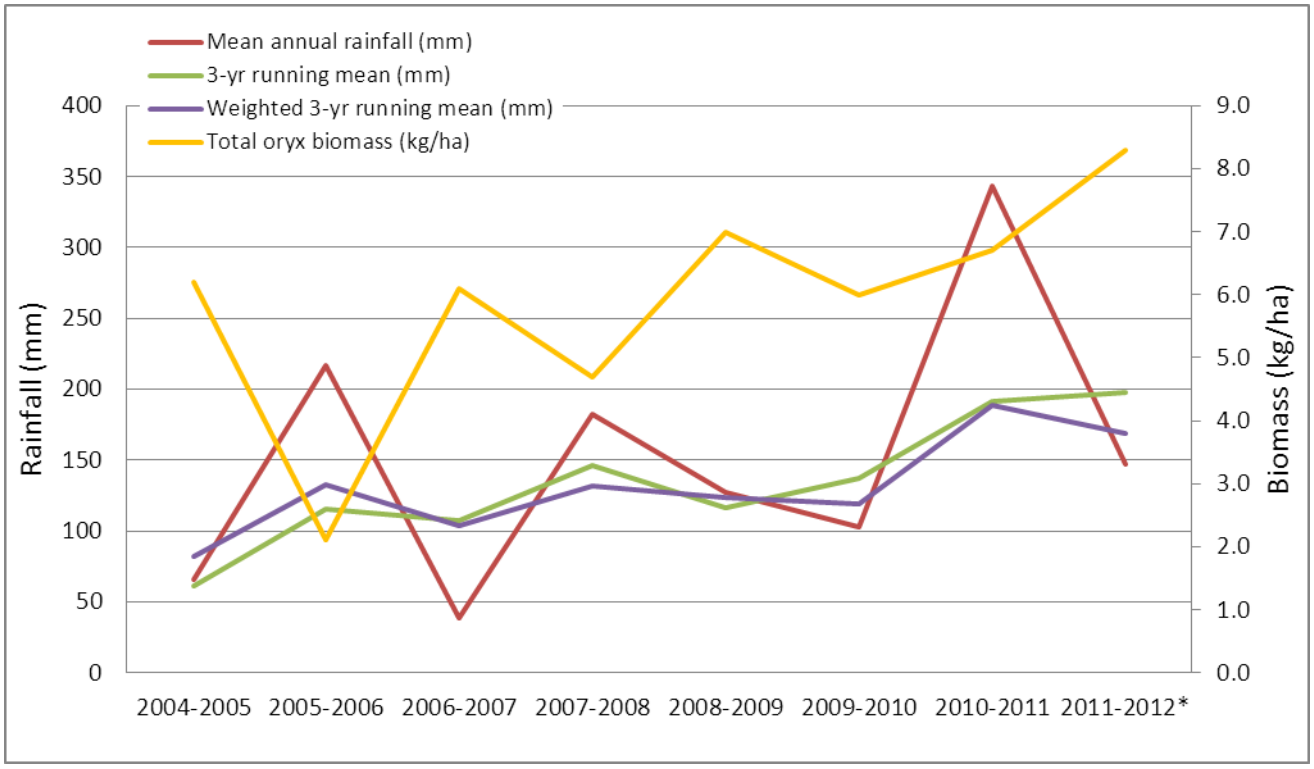


Figure 7.3 Biomass of springbok compared to rainfall means

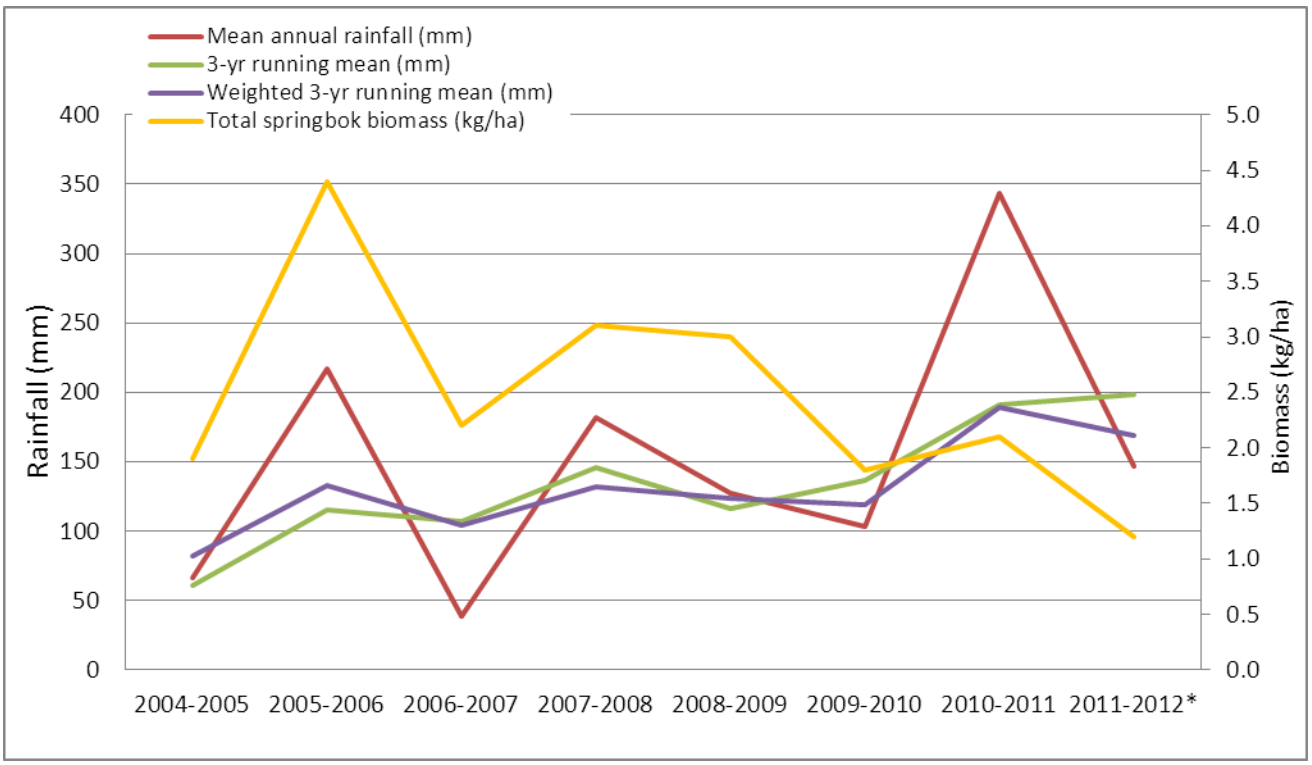
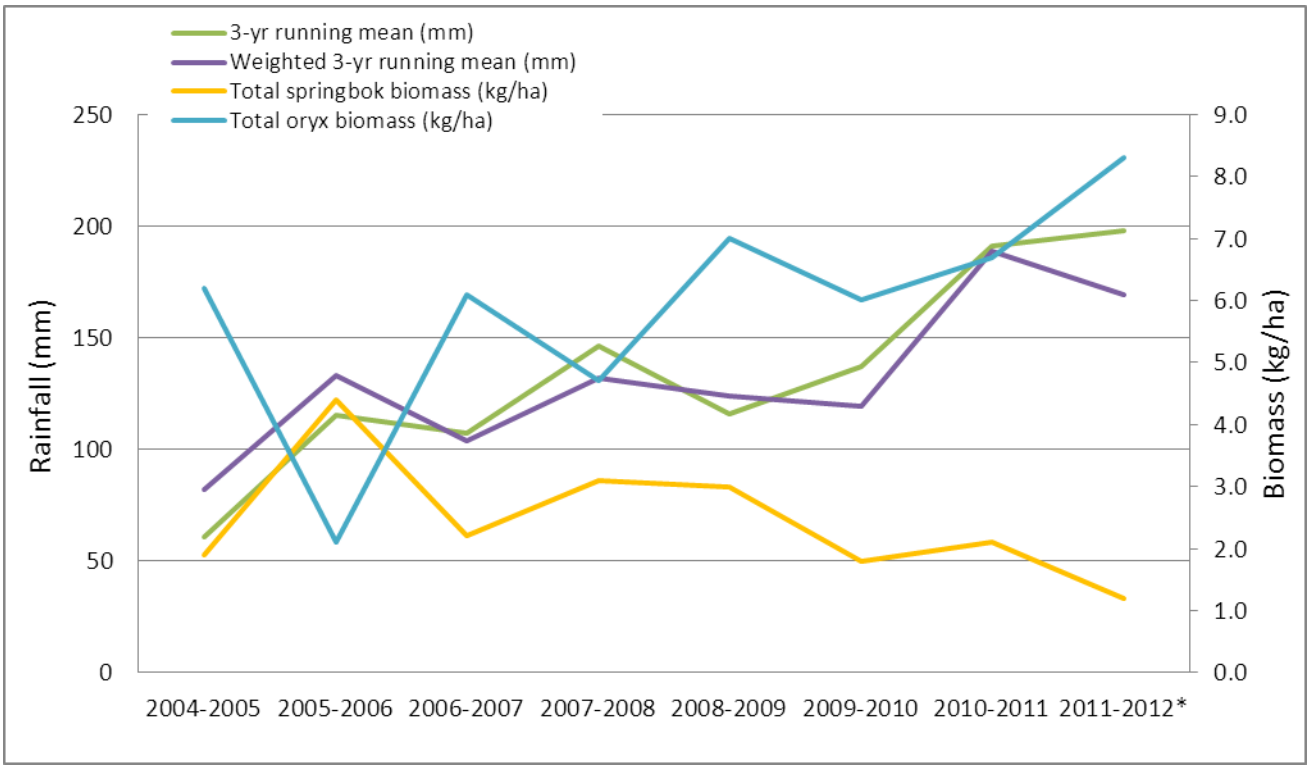


Figure 7.4 Biomass of oryx and springbok compared to rainfall means



5.3 Wildlife distribution/density

Wildlife distribution is based on density: the actual number of animals per species counted (at a distance of <500m) per 100 km per route. Note that wildlife densities are based on data that have been "normalised" in order to make more meaningful comparisons (see above).

The total densities (numbers of animals counted per 100km driven) per route for consecutive game counts from December 2004 to June 2012 are shown in Table 9.1 and 9.2, together with the percentage change for the latest count. The total densities (number of sightings per 100 km) for each species over the long term (December 2004 to June 2012) are shown in Table 9.3 and 9.4 (with the latest percentage change in the final column) and Figure 8. (The percentage change is also shown in Figure 3 above.)

Table 9.1

Total no. of animals counted per 100 km per route (June 2005 – June 2008)						
Route	**Jun-05**	**Nov-05**	**Jun-06**	**Dec-06**	**Jun-07**	**Jun-08**
1	608	500	1 094	581	1 117	460
2	1 491	1 491	1 407	683	1 709	806
3	387	387	247	1 342	635	454
4	239	239	237	424	350	275
5	480	480	416	776	324	633
6	875	875	1 423	2 159	1 127	978
7	714	714	596	1 238	516	704
8	822	822	1 943	944	1 487	858
9	-	-	-	-	-	-
Total	**579**	**794**	**1 037**	**816**	**716**	**715**

Table 9.2

Total no. of animals counted per 100 km per route (June 2009 – June 2012)					
Route	**Jun-09**	**Jun-10**	**Jun-11**	**Jun-12**	**% change (Jun-11 -Jun-12)**
1	1 981	811	1669	399	-76.0
2	670	1 064	684	455	-33.5
3	863	371	479	278	-42.0
4	129	271	178	191	7.3
5	687	439	830	530	-36.2
6	1 414	839	1215	564	-53.6
7	668	444	333	145	-56.5
8	996	883	503	209	-58.5
9	1 105	504	350	188	-46.3
10				243	-
Total	**953**	**625**	**693**	**339**	**-51.1**

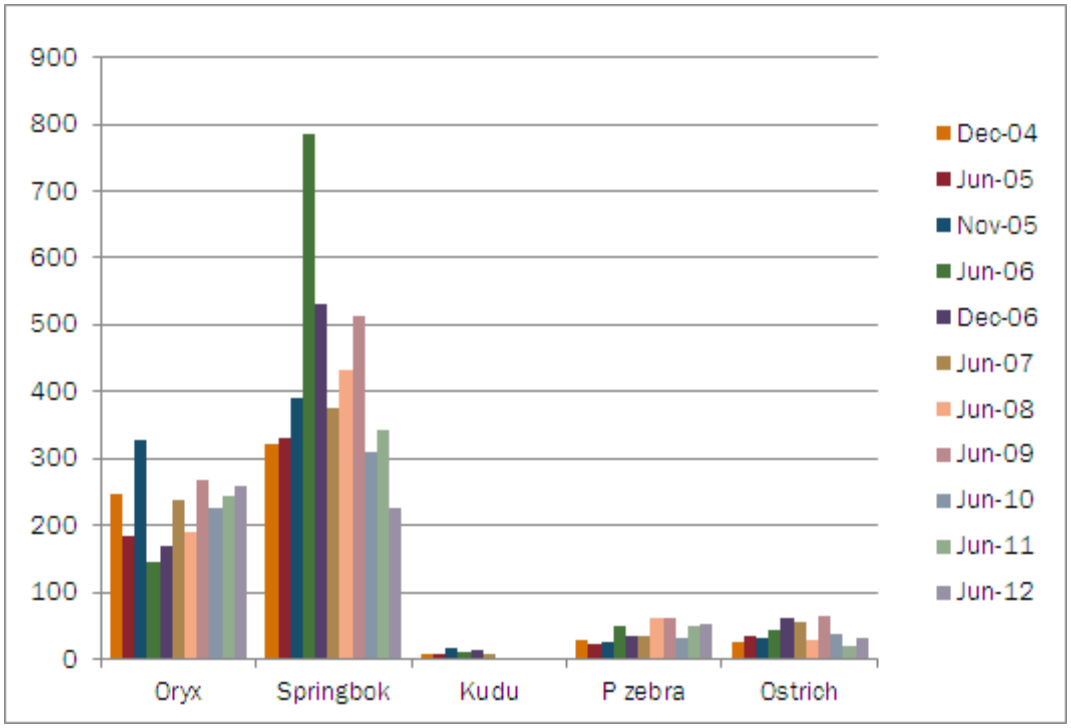
Table 9.3

Total number of sightings per 100 km for each species (December 2004 - June 2008)							
Species	**Dec-04**	**Jun-05**	**Nov-05**	**Jun-06**	**Dec-06**	**Jun-07**	**Jun-08**
Oryx	248	184	328	146	170	239	190
Springbok	321	330	390	785	532	375	433
Kudu	8	7	16	12	15	9	1
P zebra	29	23	27	51	36	36	60
Ostrich	27	35	33	43	62	56	30

Table 9.4

Total number of sightings per 100 km for each species (June 2009 - June 2012)					
Species	**Jun-09**	**Jun-10**	**Jun-11**	**Jun-12**	**% change (Jun 11 - Jun 12)**
Oryx	269	227	243	259	7
Springbok	514	311	343	227	-39
Kudu	2	1	1	1	0
P zebra	61	31	51	51	0
Ostrich	63	39	19	30	58

Figure 8. Total densities (number of animals counted per 100 km) for each species (December 2004 to June 2012)



6. Discussion and conclusions

Population estimates

Natural fluctuations in wildlife populations are driven primarily by rainfall, often evidenced by seasonal migrations. Over the total count period, high mean rainfall (200-250 mm) was usually accompanied by an overall increase in estimated numbers, e.g. comparisons of figures for Zone 1-8 in June show an increase of 25% in 2006, 11% in 2008 and 9% in 2009. In contrast, lower mean rainfall was associated with a decrease in these numbers , e.g. of 20% in 2007 and 31% in 2010. Rainfall during the previous season (2010/11, September to August) was exceptional (343 mm), and overall estimated numbers increased by 13% (Zone 1-8) and 11% (Zone 1-9).

However, the rainfall in 2011/12 (September to May) was closer to the average (147 mm), and this was accompanied by a decrease in estimated numbers of 17% (Zone 1-8) and 12% (Zone 1-9). In June 2012 the overall population estimates are 12 149 (Zone 1-8), 13 610 (Zone 1-9) and, with the inclusion of Zone 10 (Springbokvlakte and Saffier), a total of 14 825. It should be borne in mind, however, that these numbers are purely estimates.

The total estimated biomass of the Reserve increased slowly but steadily from 9.0 kg/ha in June 2005 to 10.9 (Zone 1-8) and 11.1 kg/ha (Zone 1-9) in June 2009. This trend can, in part, be related to good rainfall (see above). At the same time, the area available to the game has increased with the gradual breaching of fences with neighbouring properties, and especially with the inclusion of the Pro-Namib Conservancy (Zone 9; 16 450 ha) in June 2009. With the lower rainfall in 2009/10, the biomass dropped accordingly, but this trend was reversed with the high rainfall in 2010/11 when it increased from 9.0 to 10.1 kg/ha (Route 1-8) and from 8.8 to 9.7 kg/ha (Zone 1-9).

In 2012 the count area was further increased (Zone 10; 23 510 ha) and with it the area available to the game, now a total of 194 232 ha. Despite drier conditions than the previous year, with a decrease in overall estimated population numbers, the total biomass increased again this year to 11.0 kg/ha (Zone 1-8), 11.3 kg/ha (Zone 1-9) and 10.6 kg/ha (Zone 1-10). This represents an increase of 9% for Zone 1-8, and 17% for Zone 1-9. The above figures are still well within the biomass of 15 kg/ha that is considered the maximum for our area.

Comparisons between the above biomass results and average annual rainfall figures indicate a "lag" of one year, reflecting good or poor breeding following good or poor rainfall. Oryx biomass follows the inceasing rainfall trend over the past years, whereas that of springbok shows an inverse tendency (see below).

Wildlife distribution/density

The highest densities of wildlife (Zone 1, 2, 5 and 6) were recorded in the northern parts including the foothills of the Nubib Mountains and Losberg, the Keerweder plains and Chateau plains. The lowest densities (Zone 4, 7 and 9) were mainly in the dune areas north-west of Wolwedans; the Gorrasis area; and Excelsior/Dina. Densities in the remaining areas (Zones 3, 8 and 10), namely Kwessiegat, Aandstêr and Springbokvlakte/Saffier were also moderately low. These distribution patterns are likely to reflect the optimum grazing/browsing conditions in habitats such as the foothills at this time, compared to conditions on the dunes and in other parts.

The distribution of oryx was concentrated in Zone 6 (on the Keerweder plains and around the foothills of the Losberg), the Chateau plains and in most other parts of the Reserve, apart from at Draaihoek/ Keerweder, Gorrasis and Springbokvlakte/Saffier. Springbok densities were highest in the foothills of the Nubib Mountains (including Draaihoek/ Keerweder) and the Losberg, the Keerweder plains and Chateau plains, and on Springbokvlakte/ Saffier. Both species are regarded as mixed feeders,and are able to optimse available grass and browse species in terms of their requirements.

The distribution of plains zebra was concentrated in the northern parts of the Reserve, especially on the Keerweder plains. Densities of ostrich were highest at Draaihoek/ Keerweder, and on Aandstêr and Springbokvlakte/Saffier and lower in the dune areas. The distribution of Ludwig's Bustard was concentrated in the north-eastern and central parts of the Reserve. Sightings were mainly on the open gravel plains in these zones.

Population change

Note that management decisions are not based on estimates of population increases/ decreases, however, but rather on wildlife trends and distribution/density (number of sightings per 100 km per route) that are obtained from actual sightings/counts, rather than from population estimates. These results put the game count data into perspective and help us to equate the data in a more manageable or understandable format. We can, for example, determine that should we drive 100km, or from the top to the bottom of the Reserve, we will see 227 springbok in that distance.

The total population density in June 2011 rose to 693 individuals per 100 km, an increase of 9% compared to June 2010 that appears to be directly related to the exceptionally high rainfall in 2010/11. In June 2012, the density dropped again to 339/100 km (Zone 1-9), a decrease of 51% compared to the previous count. This trend likewise appears to be related to the lower rainfall in 2011/12. In June 2011 the extreme northern and central parts of the Reserve showed the highest increase in wildlife, with a decrease only in Zone 2 (36%). In marked contrast, the results for June 2012 showed a decrease for most zones, with up to 76% (in the extreme north), and only a slight increase (7%) in one count area (Zone 4).

Dominant species

- **Oryx**

In terms of the dominant species, estimated numbers of oryx initially remained fairly stable (apart from a minimum of 1 447 in June 2006), reaching 4 700 (Zone 1-8) and 5 415 (Zone 1-9) in 2009, and dropping slightly to 4 262 (Zone 1-8) and 4 683 (Zone 1-9) in 2010. The 2011 count showed a slight increase again to 4 873 (Zone 1-8) and 5 162 (Zone 9). In June 2012 the total estimates for numbers of oryx are 6 054 (Zone 1-8) and 6 913 (Zone 1-9). This represents an increase of 24% (Zone 1-8) and 34% (Zone 1-9) over the previous year. With the inclusion of Zone 10, the total estimate for oryx is 7 296. The overall trend is thus a slow but steady increase from about 2005, the present estimate being the highest on record since the game count was initiated.

The above increase in overall biomass in 2012 appears to be due largely to an increase of 33% in estimated numbers of oryx, resulting in an increase in biomass for the species from 6.7 to 8.9 kg/ha (Zone 1-9). Oryx now comprise 79% of the total biomass for the count area (Zone 1-9). The steady increase in oryx biomass shows a good correlation with the increasing trend in rainfall averages (with a lag of one year).

In 2012, densities of oryx increased by 7% from 243/100 km in June 2011 to 259/100 km (Route 1-9), and overall from 146/100 km in June 2006. Oryx were distributed mainly on the Keerweder plains and Chateau plains and in most other parts of the Reserve, apart from on the foothills of the Nubib mountains, Gorrasis and Springbokvlakte/Saffier.

- **Springbok**

In contrast, estimated numbers of springbok have shown more variation over the long term. The maximum of 17 900 in June 2006 has not been reached again. After this, numbers (in June) peaked at around 12 500 in 2008 and 2009 (a trend linked to good rains), showing an overall increase since the start of the counts (7 733 in June 2005). In June 2010, these numbers dropped to 7 590 (Zone 1-8) and 8 060 (Zone 1-9) when conditions became drier. In 2011, a count of 8 878 (Zone 1-8) and 9 405 (Zone 1-9) represented a slight increase over the previous count, a trend that appears to be related to the good rainfall. In 2012, numbers of springbok are estimated at only 4 964 (Zone 1-8) and 5 393 (Zone 1-9), a decrease of 43-44% over 2011 for both data sets. With the inclusion of Zone 10, the total estimate for springbok is now 6 069. Although it is possible that some individuals had moved closer to the foothills in search of better forage during the count period, percentage change greater than 30% per year is usually attributed to migration of animals in and out of the Reserve, normally in response to rainfall. It is likely that some of the springbok may not have returned from the adjoining Namib-Naukluft Park by the time of the count; this possibility is supported by the fact that 250-300 springbok were observed regularly on the plains between the Namib dune belt and west, north and east of Bushman Hill between 30 June 2012 and 8 August 2012 (Florian Weise and Stuart Munro, N/a'an ku sê pers. comm.). This may be a temporary situation; however, overall the trend for estimated springbok numbers is a gradual decline from around 2005, the present totals being the lowest on record, and for the first time lower than those of oryx (Zone 1-10).

Springbok biomass has decreased by 43% (from 2.1 to 1.2 kg/ha; Zone 1-9) in 2012. The gradual decline in springbok numbers shows a negative correlation with the increasing rainfall averages.

Springbok densities have also decreased by 39% from 343/100 km to 227/100 km (Route 1-9) over the same period, and overall from a maximum of 785/100 km in June 2006. Springbok densities were highest in thefoothills of the Nubib mountains (Draaihoek/ Keerweder) and the Losberg; Keerweder plains and Chateau plains, and Springbokvlakte/ Saffier.

Relationship between oryx and springbok

The long term increase in both estimated numbers and estimated biomass of oryx appears to be inverse to the decrease in springbok numbers. The present relationship in densities between these two species is also inverse. The reasons for this relationship are not known, and should be investigated further.

Oryx comprise 79% of the total biomass for the count area (Zone 1-9), compared to springbok (11%). However, both species are relatively independent of water and thus able to migrate in order to optimise changing habitat/foraging conditions. Their populations are therefore regarded as self-regulating over the long term.

- **Plains zebra**

Estimated numbers of plains zebra increased from 174 in 2005, to peak at around 670 in 2007 and 2008. The resident and non-migrating population was reduced by 150 animals during game capture operations in 2006 and 2008, in order to reduce grazing pressure on

the environment, resulting in a sharp decrease to 318 in 2009. Numbers were estimated at 350 in 2010 and have continued to increase again to 370 in 2011 and 470 in 2012.

The biomass of plains zebra has increased by 14% from 0.7 to 0.8 kg/ha in 2012. Although this biomass is only 6% of the total in 2012, the species is highly dependent on water and numbers are concentrated in the central parts of the Reserve. The situation is thus being monitored carefully with a view to regulation to a more sustainable level by means of game captures and translocation during the coming year.

Plains zebra are concentrated in the northern parts of the Reserve, on the Keerweder plains, although a few sightings of this species have been obtain in the south.

- **Ostrich**

Estimated numbers of ostrich appear to fluctuate widely, increasing from 2006 to a peak (829 for Zone 1-8 and 935 for Zone 1-9) in June 2009. In 2010, with the decrease in rainfall, numbers dropped again (550 for Zone 1-8 and 644 for Zone 1-9) and this trend was continued in 2011 (302 for Zone 1-8 and 348 for Zone 1-9). In 2012, ostrich numbers showed an increase of 46% to 448 (Zone 1-8) and of 77% to 615 (Zone 1-9). The total estimate for Zone 1-10 is 765. Numbers, biomass and population densities appear to fluctuate widely, with no clear trends. Ostrich densities were highest on Draaihoek/Keerweder, Aandstêr and Springbokvlakte/Saffier, but lower in the dune areas.

- **Kudu**

Numbers of kudu showed a marked decrease from a maximum of 834 (June 2006) to 75 in June 2008 and 79 in June 2009, dropped further to 24 in 2010 and then showed a slight increase to 38 in 2011, with 41 in 2012. It should be borne in mind, however, that this census method is not considered to be well suited for non-plains game such as kudu.

- **Red hartebeest**

Numbers of hartebeest have gradually increased from 80 in 2007 to 125 in 2011 and 177 in 2012, thus doubling in the last five years. In view of this species' dependence on water, it is essential that their numbers continue to be monitored.

- **Blesbok**

Culling operations in 2008 and 2010 reduced the core population of blesbok from an estimated 25 individuals to 18 on Dina/Excelsior (Zone 9). In 2012 this number was again reduced to six individuals, while one male remained in the Keerweder Pan area. As the species is alien to Namibia, efforts to eliminate it will continue.

- **Giraffe**

The population increased to nine with the birth of two calves in August and September 2008. One of the original females disappeared in February 2009. Another female gave birth to a calf early in November 2009, but both individuals died shortly afterwards. The total of eight, in June 2010, was reduced to two bulls and two cows during a successful capture operation in September 2010. Two calves were born in 2011 (in January and April) bringing the total to six in June 2012 (and one more calf in July 2012). Due to the impacts of browsing by this species on the limited amount of vegetation in the area, the population will be further reduced by captures dring the coming year.

- **Ludwig's Bustards**

Actual counts dropped from 63 (an estimated 223) in 2010 to 39 (estimated 136) in 2011 and again to 28 (estimated 116; Zone 1-10) in 2012. These large terrestrial birds are highly

nomadic, and these changes could be related to rainfall. They were distributed mainly on open gravel plains with sparse grass, in the north-eastern and central parts of the Reserve. The species is threatened elsewhere, mainly by power line collisions, and was recently uplisted to *Endangered*. With its lack of overhead lines, NamibRand appears to provide a safe haven for this species, and ongoing monitoring is important.

- **Predators**

The ongoing increase in sightings of predators is considered to be a relection of a true population increase of species such as cheetah and leopard (both naturally occurring and re-introduced). The accompanying increase in predation is an important factor with regard to the long-term natural regulation of game numbers. Such predation is also accompained by increasing populations of scavengers, in particular spotted hyaena and vultures.

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APPENDIX 1

Results per count route/zone

Tables 3.1 – 3.10 list the data collected on each route in June 2012, which were used as a basis for analysis. Numbers seen within the strip width (under 500m) have been multiplied first by the relevant area correction factor (a.c.f.) for each route, and then by the relevant species correction factor (s.c.f.; see Table 2).

Table 3.1

Route 1				
Species	**Number seen - total**	**Number seen under 500m**	**No. corrected for area (a.c.f. = 3.10)**	**No. corrected for area + species**
Oryx	302	210	651.0	911.4
Springbok	204	150	465.0	744.0
Kudu	1	1	3.1	8.1
Steenbok				
Plains zebra	31	31	96.1	115.3
Ostrich	17	7	21.7	23.9
Red hartebeest				
Blesbok				
Total	**555**	**399**	**1236.9**	**1802.7**
*Mountain zebra**	*17*	*5*		
*Ludwig's Bustard**				

**Not included in count*

Table 3.2

Route 2				
Species	**Number seen - total**	**Number seen under 500m**	**No. corrected for area (a.c.f. = 3.13)**	**No. corrected for area + species**
Oryx	32	32	100.2	140.2
Springbok	237	237	741.8	1186.9
Kudu				
Steenbok				
Plains zebra	22	22	68.9	82.6
Ostrich	16	11	34.4	37.9
Red hartebeest**	153	153	153	153
Blesbok				
*Giraffe***	6	6	6	6
Total	**466**	**461**	**951.3**	**1453.6**
*Ludwig's Bustard**				

**Not included in count*

***Correction factor exceeds known maximum*

Table 3.3

Route 3				
Species	**Number seen - total**	**Number seen under 500m**	**No. corrected for area (a.c.f. = 4.19)**	**No. corrected for area + species**
Oryx	540	216	905.0	1267.1
Springbok	44	40	167.6	268.2
Kudu				
Steenbok				
Plains zebra	63	13	54.5	65.4
Ostrich	18	9	37.7	41.5
Red hartebeest				
Blesbok				
Total	**665**	**278**	**1164.8**	**1642.2**
*Ludwig's Bustard**				

**Not included in count*

Table 3.4

Route 4				
Species	**Number seen - total**	**Number seen under 500m**	**No. corrected for area (a.c.f. = 4.00)**	**No. corrected for area + species**
Oryx	127	69	276.9	386.4
Springbok	80	80	320.0	512.0
Kudu				
Steenbok				
Plains zebra	39	39	156.0	187.2
Ostrich	54	3	12.0	13.2
Red hartebeest				
Blesbok				
Total	**300**	**191**	**764.9**	**1098.8**
*Ludwig's Bustard**				

**Not included in count*

Table 3.5

Route 5				
Species	**Number seen - total**	**Number seen under 500m**	**No. corrected for area (a.c.f. = 2.27)**	**No. corrected for area + species**
Oryx	347	347	787.7	1102.8
Springbok	174	174	395.0	632.0
Kudu				
Steenbok				
Plains zebra				
Ostrich	9	9	20.4	22.5
Red hartebeest				
Blesbok				
Total	**530**	**530**	**1203.1**	**1757.3**
*Ludwig's Bustard**	7	7	15.9	15.9

**Not included in count*

Table 3.6

Route 6				
Species	**Number seen - total**	**Number seen under 500m**	**No. corrected for area (a.c.f. = 4.93)**	**No. corrected for area + species**
Oryx	244	244	1202.9	1684.1
Springbok	99	99	488.1	780.9
Kudu	1	1	4.9	12.8
Steenbok				
Plains zebra	168	168	828.2	993.9
Ostrich	28	28	138.0	151.8
Red hartebeest***	24	24	24	24
Blesbok				
Total	**617**	**617**	**2739.1**	**3700.5**
*Ludwig's Bustard**	18	18	88.7	88.7

**Not included in count*

***Correction factor exceeds known maximum*

**** Corrected from 77, which represents a double count*

Table 3.7

Route 7				
Species	**Number seen - total**	**Number seen under 500m**	**No. corrected for area (a.c.f. = 4.53)**	**No. corrected for area + species**
Oryx	26	26	117.8	164.9
Springbok	117	117	126.8	202.9
Kudu				
Steenbok				
Plains zebra				
Ostrich	2	2	9.1	10.0
Red hartebeest				
Blesbok				
Total	**145**	**145**	**253.7**	**377.8**
*Ludwig's Bustard**	1	1	4.5	4.5

**Not included in count*

Table 3.8

Route 8				
Species	**Number seen - total**	**Number seen under 500m**	**No. corrected for area (a.c.f. = 3.94)**	**No. corrected for area + species**
Oryx	72	72	283.7	397.2
Springbok	101	101	397.9	636.7
Kudu	2	2	7.9	20.5
Steenbok				
Plains zebra				
Ostrich	34	34	134.0	147.4
Red hartebeest				
Blesbok				
Total	**209**	**209**	**823.5**	**1201.8**
*Ludwig's Bustard**				

**Not included in count*

Table 3.9

Route 9				
Species	**Number seen - total**	**Number seen under 500m**	**No. corrected for area (a.c.f. = 3.23)**	**No. corrected for area + species**
Oryx	190	81	613.7	859.2
Springbok	83	80	268.1	428.9
Kudu				
Steenbok				
Plains zebra				
Ostrich	47	25	151.8	167.0
Red hartebeest				
Blesbok				
Total	320	186	1033.6	1455.1
*Ludwig's Bustard**				

**Not included in count*

Table 3.10

Route 10				
Species	**Number seen - total**	**Number seen under 500m**	**No. corrected for area (a.c.f. = 4.09)**	**No. corrected for area + species**
Oryx	84	83	339.5	475.3
Springbok	130	130	531.7	850.7
Kudu				
Steenbok				
Plains zebra				
Ostrich	42	32	130.9	144.0
Red hartebeest				
Blesbok				
Total	**256**	**245**	**1002.1**	**1470.0**
*Ludwig's Bustard**	2	2	8.2	8.2

**Not included in count*