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Annual Report
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Brown Hyena Feeding Ecology at the Wolf Bay Seal Colony

1. Introduction

Mortality of newborn Cape fur seal pups is highest during the first months of their lives (De Villiers & Roux 1992). Factors such as starvation, heat stress and stillbirth are the main causes of newborn pup mortality. Additionally brown hyena and jackal predation contributes to seal pup mortality during the first 12 months of the pups' lives (Wiesel 2006). Non-violent mortality of seal pups decreases to almost zero towards the end of January, except in years with weather anomalies that influence the ocean's primary productivity, so that pups can hence die throughout the year of starvation. Brown hyenas kill and scavenge seal pups at mainland seal colonies. Data regarding factors that influence brown hyena feeding ecology around the Wolf Bay seal colony were collected during the seal pupping season in November and December 2009 and were compared with data from previous years (Wiesel 2006).

2. Results

Data from 1120 seal pups that died of non-violent causes (any cause of mortality other than predation) and from 60 pups that were killed by brown hyenas were collected in 2009.

a) Non-violent seal pup mortality (NVM)

Cumulative non-violent seal pup mortality was 8.2% in 1999, 8.1% in 2000, 10.7 % in 2004 and 9.3% in 2009 (Figure 1). The daily non-violent mortality rate in 2000 was significantly different to the daily mortality rates of all other years (Friedman Test, $p < 0.0001$).

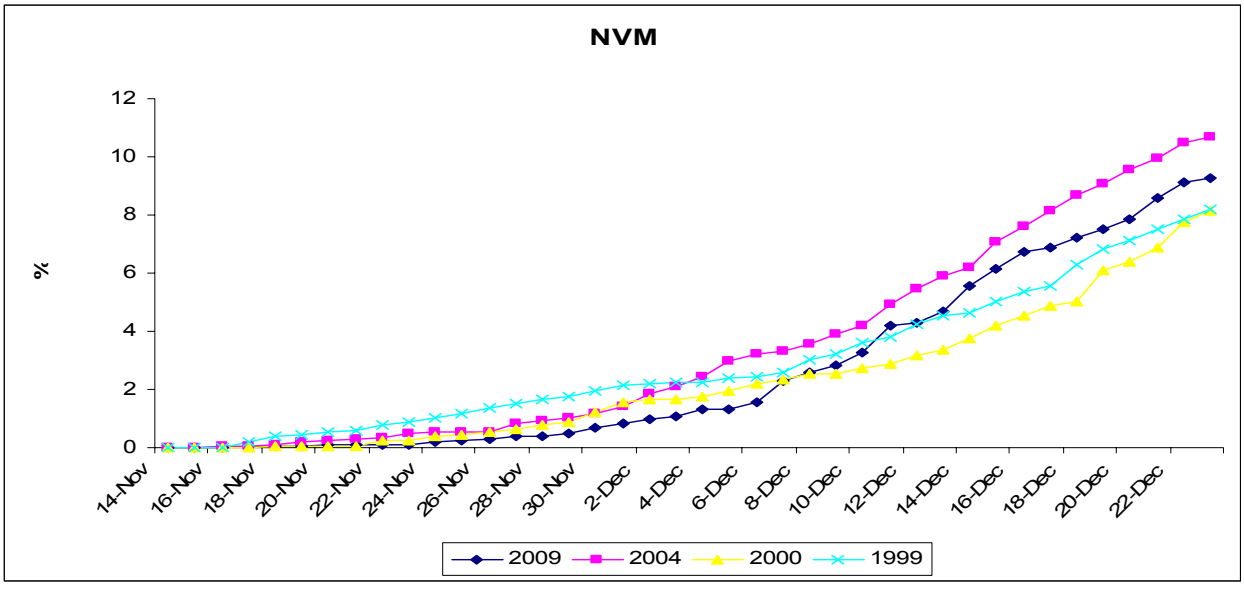


Figure 1: Cumulative non-violent mortality of newborn seal pups at the Wolf Bay seal colony from the beginning of the seal pupping season in November until the end of the peak pupping season in December

b) Carcass availability

Seal pup carcasses wash up along the coast and hence serve as a food source for scavengers. Occasional seal pup carcass counts were done at Wolf Bay throughout seven seal pupping seasons. Most carcasses were washed up along the bay during the peak pupping season in the middle of December (Figure 2).

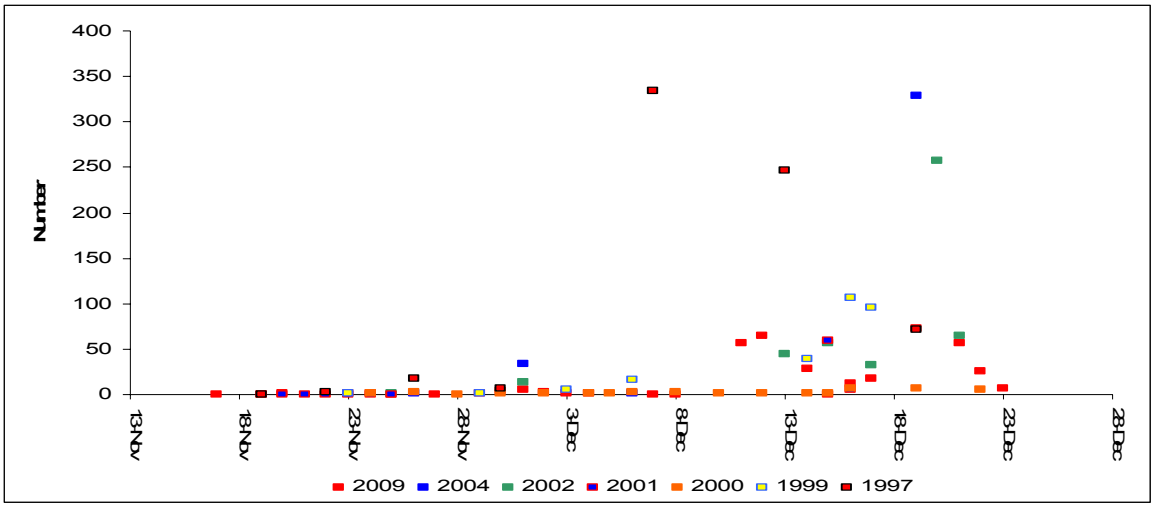


Figure 2: Seal pup carcass counts at Wolf Bay during seven seal pupping seasons.

c) Predation

The cumulative predation rate at the Wolf Bay seal colony from November to the end of December was 2.7% in 1999, 2.3% in 2000, 1% in 2004 and 0.5% in 2010 (Figure 3). The predation rate in 2010 was significantly lower than those of the other three years (Friedman Test, $p < 0.001$).

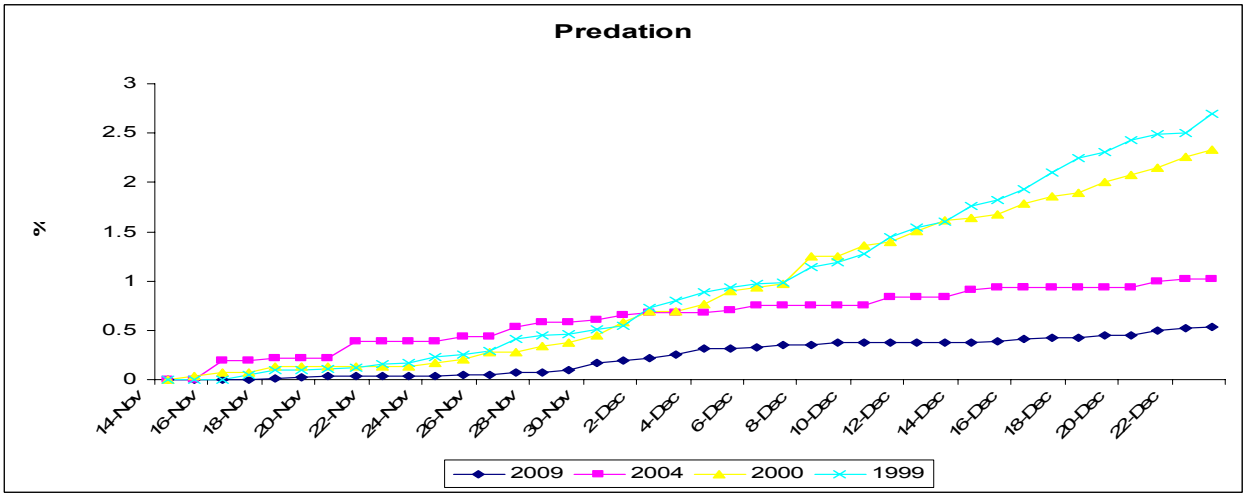


Figure 3: Cumulative predation rate at the Wolf Bay seal colony from the beginning of the seal pupping season in November until the end of the peak pupping season in December

d) Cause of death

i. Mass of seal pups

Seal pups that died of starvation were significantly smaller than pups that died of other causes (Figure 4) (Kruskal Wallis Test, $p < 0.01$). Although the weights of all other seal carcass classes (predation, heat stress (OHS) and stillbirth) did not differ significantly, the elevations of the regression lines were significantly different.

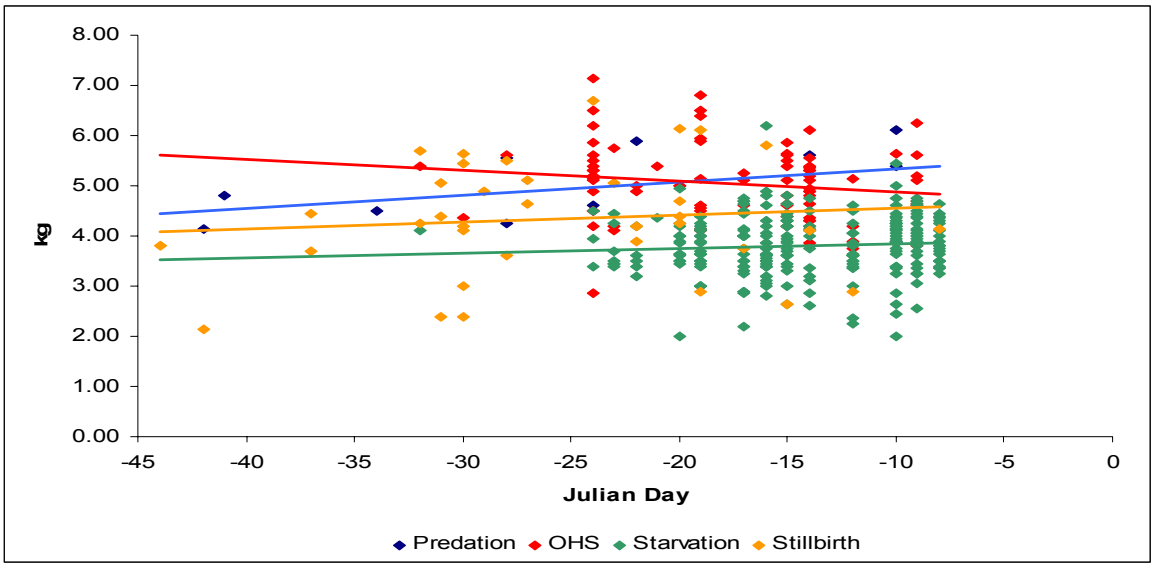


Figure 4: Mass of dead seal pups that died of different causes between the middle of November (Julian Day -45) until 23 December (Julian Day -8)

ii. Age of dead pups

Pups that were younger than three days predominately died of heat stress (OHS), whereas older seal pups predominately starved to death (Figure 5). Seal pups that died of heat stress were significantly younger than pups that died of starvation (χ^2 Test, $p < 0.0001$).

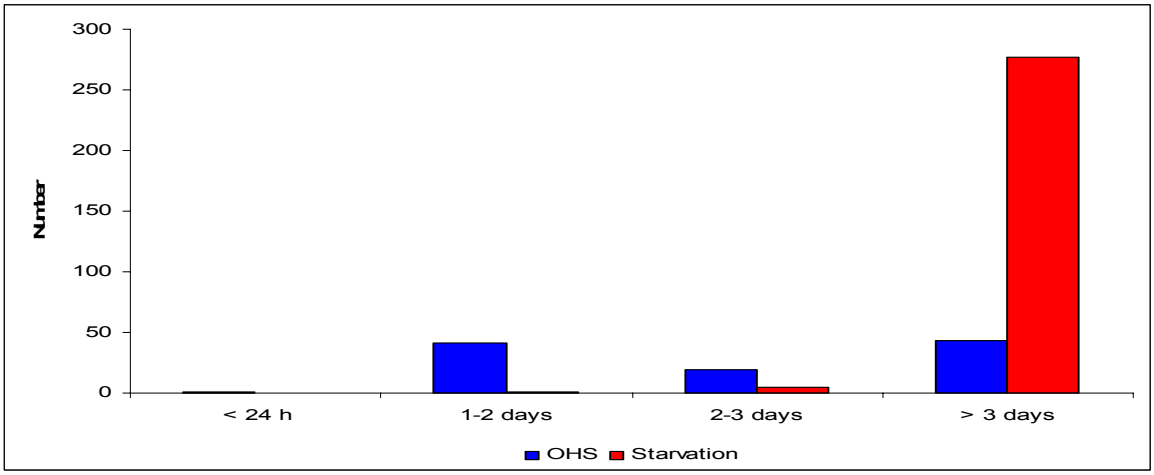


Figure 5: Age distribution of pups dying of heat stress and off starvation

iii. Non-violent mortalities

Seal pups died predominately of starvation and heat stress (OHS), except for in 2000 when stillbirth was also a major cause of mortality (Figure 6). However, the difference of mortality causes between years was only significantly different between 2000 and 2009 (Friedmann Test, $p < 0.05$).

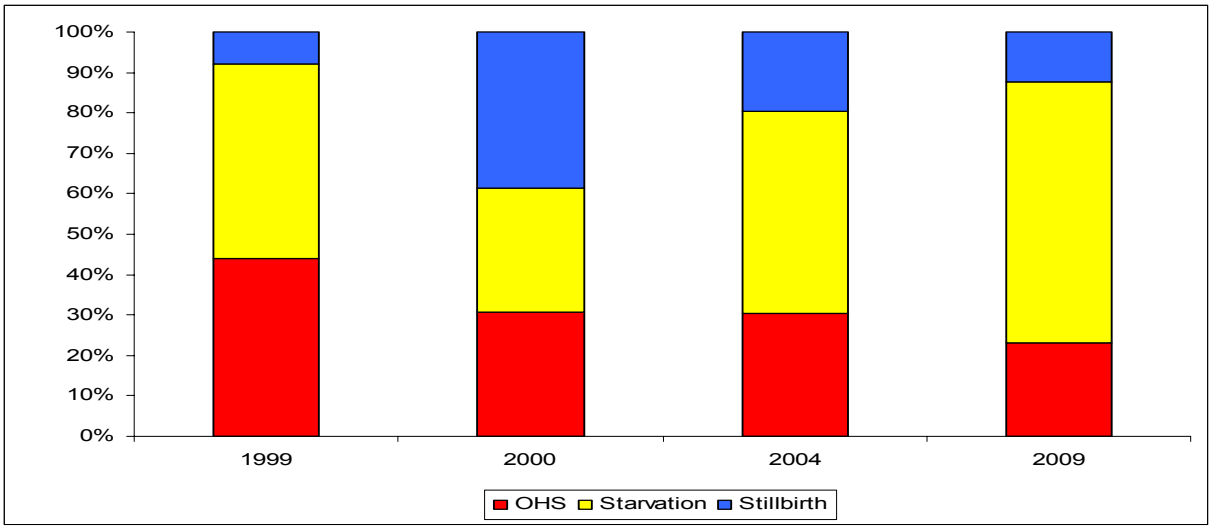


Figure 6: Non-violent mortality causes of seal pups at the Wolf Bay seal colony

e) Prey choice

There was not enough data to determine prey choice by brown hyenas regarding age, sex and condition of seal pups for the pupping season in 2009. However, the amount of carrion scavenged by hyenas did not differ between years (Wilcoxon Test, $p > 0.05$). The majority of available carrion was not consumed by brown hyenas or black-backed jackals (Figure 7, χ^2 Test, $p < 0.0001$).

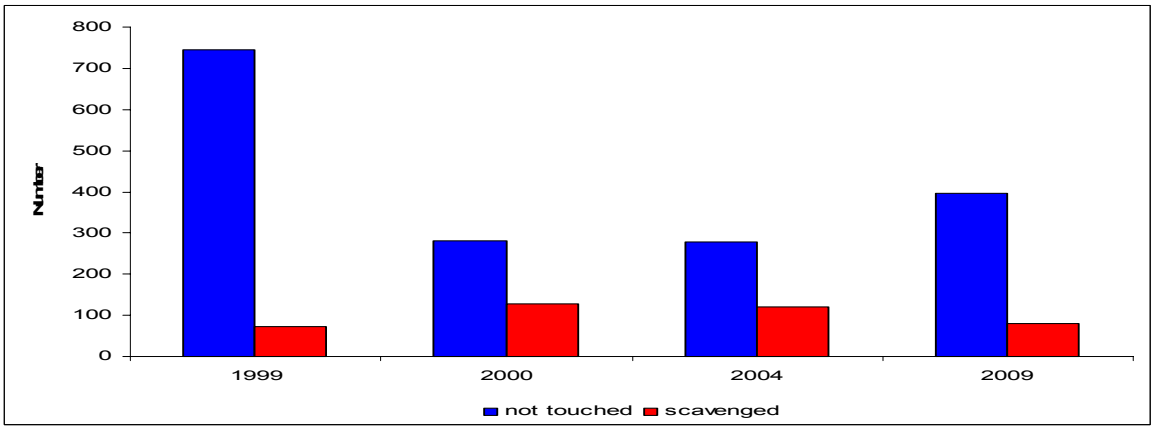


Figure 7: Use of seal pup carcasses by brown hyenas at the Wolf Bay seal colony

f) Brown hyena abundance

Brown hyena abundance fluctuated over the years. The most reliable estimates were calculated for the periods 1997/1998, 2002/2003 and 2004 from monitoring data and incidental sightings and for 2009/2010 from camera trap data (Table 1). Brown hyena abundance decreased to a quarter of the hyenas present in the Wolf Bay area between 2003 and 2004 and the population only recovered after 2007.

Table 1: Brown hyena abundance estimates for the Wolf Bay area from 1997 to 2010

Period	95% min	95% max	N	PRP
1997/1998	9	11	10	12.70
1999/2000	9	33	13	90.11
2000/2001	11	33	16	69.61
2002/2003	10	14	12	17.17
2004	2	4	3	26.67
2006/2007	2	6	3	66.67
2009/2010	8	10	9	12.70

A miminum of six brown hyenas of the Wolf Bay area were killed by vehicles on the tar road between Luderitz and Aus from 1997 to 2005 and a further two between 2005 and 2009.

4. Summary

- Non-violent mortality of seal pups in 2009 was not different to that of other regular years. Seals during the pupping season in 2000 were in an extremely bad condition and this may have influenced seal pup production and their non-violent mortality rate.
- A large amount of seal pup carcasses is available for scavengers during the seal pupping season.
- Young seal pups predominately died of heat stress, as they are very immobile and hence susceptible to overheating. Older seal pups predominately died of starvation. Their mass was significantly lower than that of pups dying of other causes.
- Many pups were stillborn in 2000. Seals were in an extremely bad condition and this may have contributed to an increased number of stillborn pups.
- Only a small proportion of seal carcasses was scavenged by brown hyenas and black-backed jackals.
- Brown hyenas killed seal pups throughout the pupping season, but the predation rate decreased in 2004 and was significantly lower in 2010 compared to the other three years.

- At the same time, brown hyena abundance decreased substantially in the Wolf Bay area. A large proportion of adult brown hyenas of this area was killed by vehicles on the road, which contributed to the observed decrease.
- The decrease in abundance seems to have had an influence on the predation rate at the Wolf Bay seal colony.
- Brown hyena abundance recovered from the low number of individuals in 2004 after 2007.

5. References

De Villiers, D. J. & J.-P. Roux (1992). "Mortality of newborn pups of the South African fur seal *Arctocephalus pusillus pusillus* in Namibia." South African Journal of marine Science 12: 881 - 889.

Wiesel, I. (2006)." Predatory and foraging behaviour of brown hyenas (*Parahyaena brunnea* Thunberg, 1820) at Cape fur seal (*Arctocephalus pusillus pusillus* Schreber, 1776) colonies." PhD Thesis, University of Hamburg, Hamburg. Germany.

Carnivore Activity Pattern from Camera Trap Data

1. Introduction

Camera traps were set up at different locations within brown hyena home ranges. Four camera traps were set up near den sites, one at a territory boundary marking area, three at access routes to seal colonies and two at randomly chosen areas inside the home ranges. The aims were to establish an identification catalogue of brown hyenas to do abundance estimates (see above), to determine differences in activity in different areas of the home ranges and to detect differences in activity between brown hyenas and black-backed jackals.

2. Study area

The study area included the home ranges of the Wolf Bay Clan and the Van Reenen Bay Clan (Figure 8). There are two large mainland Cape fur seal breeding colonies within the Wolf Bay Clan's home range (annual pup production around 60 000 pups) and a small breeding colony within the Van Reenen Bay Clan's home range (annual pup production around 2000 pups).

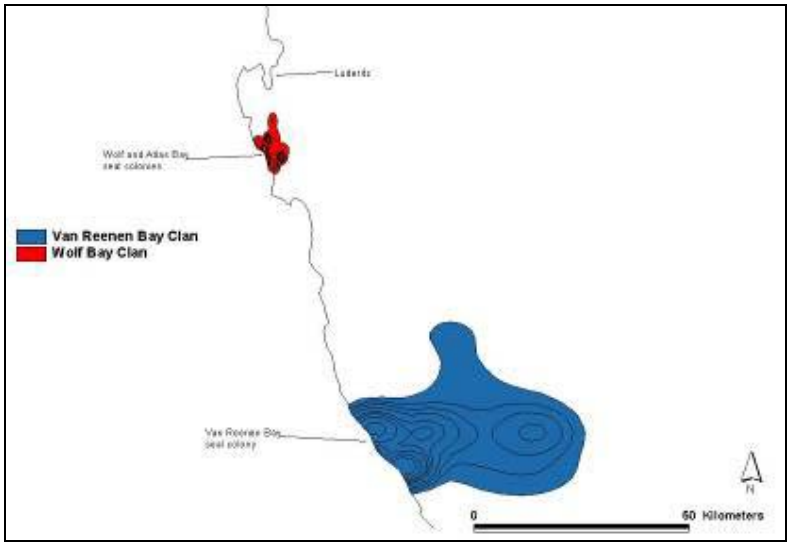


Figure 8: Location of the Wolf Bay and Van Reenen Bay study sites.

3. Material and Methods

Three different kinds of camera traps were used. Camtrakker camera traps work with regular flashlight, which may disturb the animals and influence the results. The Stealthcam and Bushnell camera trap models work with infrared flashlight. Night-time images of the latter two models are of moderate quality compared to images taken by the Camtrakker model. Camera traps were either set up next to a trail or road or opposite latrines, feeding sites or paste marks. Traps were checked throughout the year. Camera traps near den sites had to be checked more regularly to change batteries due to the large amount of images taken.

4. Results

a) Frequency of sightings

The proportion of brown hyena images taken by camera traps was highest at or near the den site and at the territory boundary. The proportion of images taken on access routes to the seal colony did not differ to the proportion of images taken at randomly chosen areas within the home range (Table 2). However trapping success was higher at these access routes and similar to the trapping success at the territory boundary. Camera trap trapping success was highest at the den site and lowest at randomly chosen areas within the home range.

Table 2: Proportion of images taken and trapping success of camera traps at different locations within brown hyena home ranges

Trap	Location	Camera type	Proportion wildlife images	Proportion brown hyena images	Hyena images/wildlife images	Trapping days	Trapping success
AB Valley	Den access	Camtrakker	0.67	0.19	0.29	258	0.50
Jungle Den	Den area	Stealthcam	0.48	0.14	0.29	172	1.97
D-SPG 27 latrine	Den area	Stealthcam	0.59	0.31	0.52	4	3.75
D-SPG 27 feeding site	Den entrance	Stealthcam	0.73	0.55	0.75	10	11.20
Bain's Bay den	Inside territory	Stealthcam	0.29	0.07	0.26	169	0.04
Bogenfels Arch	Inside territory	Stealthcam	0.34	0.10	0.30	81	0.04
Greenhouse Gully	Seal colony	Camtrakker/Bushnell	0.64	0.08	0.12	174	0.13
Van Reenen Bay south	Seal colony	Stealthcam	0.34	0.05	0.14	125	0.18
Van Reenen Bay north	Seal colony	Bushnell	0.69	0.10	0.14	100	0.13
Hangar 2	Territory boundary	Stealthcam	0.81	0.23	0.28	166	0.14

b) Activity patterns

Most activity was recorded at the den site just before sunrise and around sunset (Figure 9). Activity at the seal colonies peaked at sunrise and in the late afternoon, whereas activity at the territory boundary was greatest around midnight.

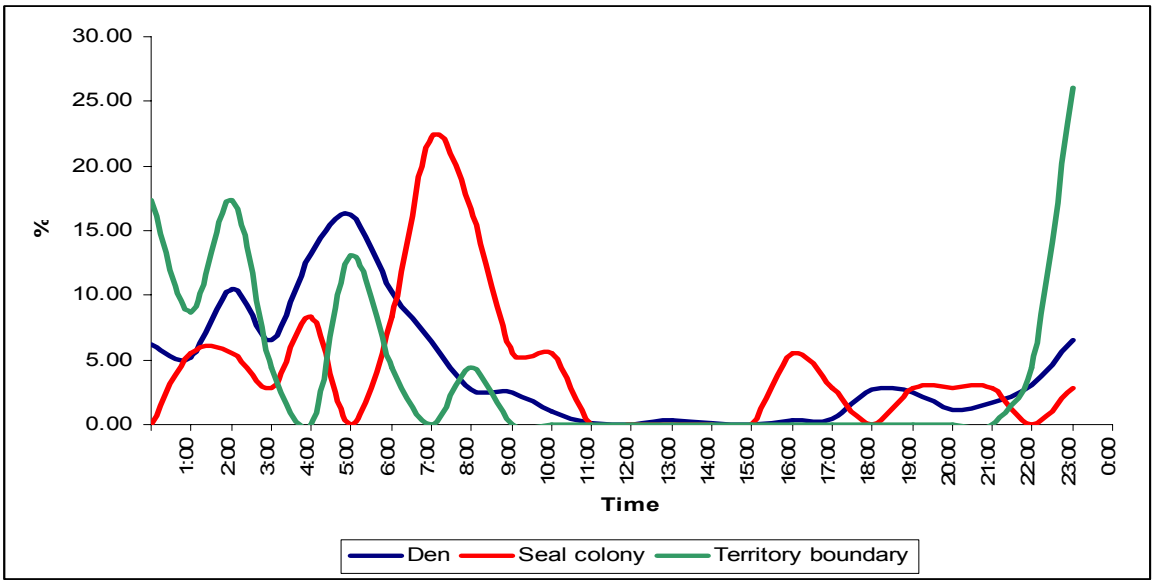


Figure 9: Activity pattern recorded by camera traps at different locations within brown hyena home ranges

The activity pattern of brown hyenas and black-backed jackals was significantly different. Jackals were more diurnal and more active outside the brown hyenas' peaks of activity (Wilcoxon signed rank test, Den: $p = 0.002$, Seal colony: $p = 0.0002$, territory boundary: $p = 0.04$).

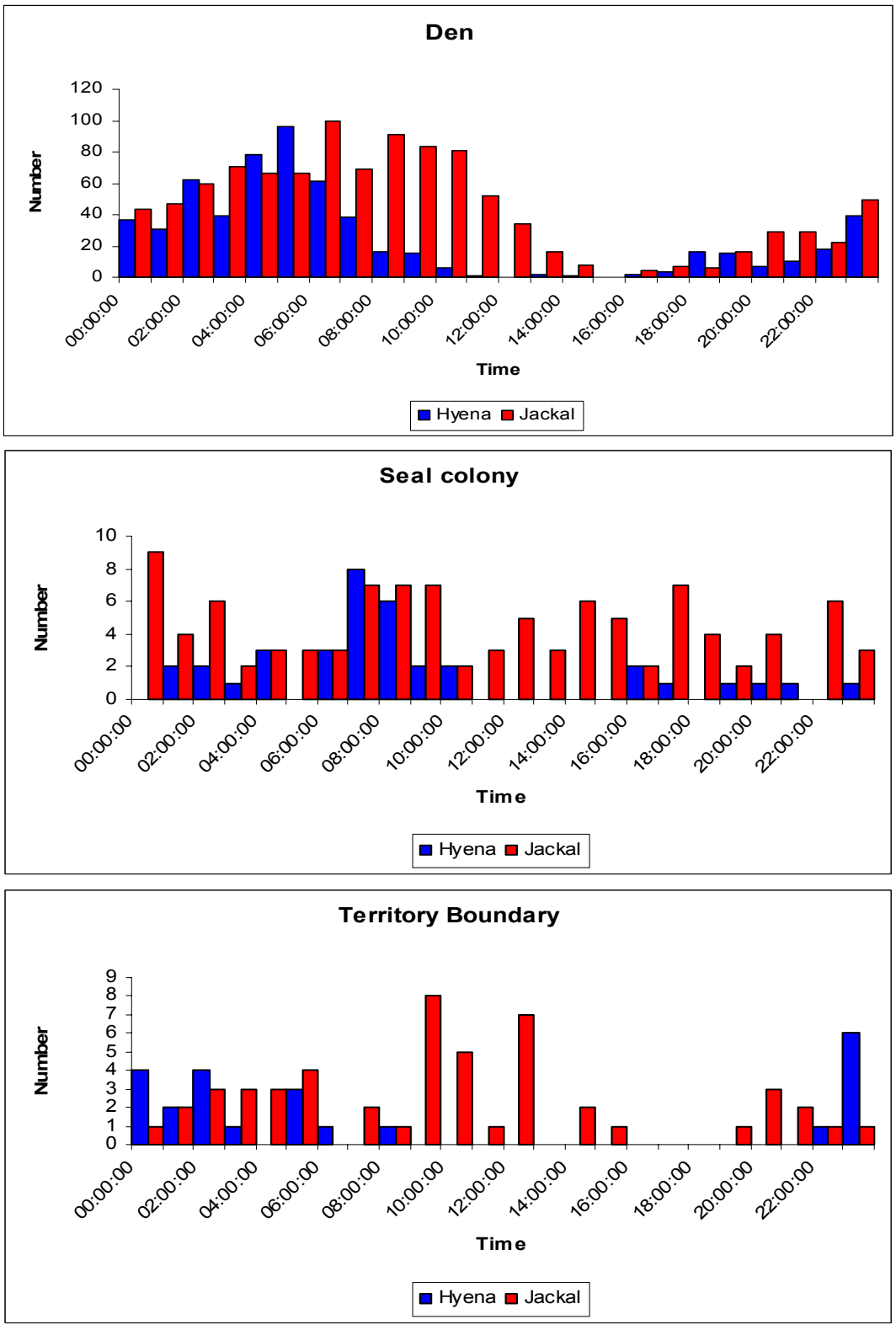


Figure 10: Activity pattern of brown hyenas and black-backed jackals in different areas within brown hyena home ranges

5. Summary

- Camera traps can be used as a tool to detect differences in activity within home ranges.
- Trapping success results can be used to indicate the importance of specific areas within brown hyena home ranges.
- Brown hyena activity patterns at dens, seal colonies and territory boundaries differ. A typical sequence is as follows: foraging – visit to den site – territory boundary maintenance – visit to den site – foraging – resting.
- Brown hyenas and black-backed jackals have different activity patterns. Jackals may avoid brown hyena activity peaks around den sites, at seal colonies and along territory boundaries.

Changes of Brown Hyena Home Ranges around Luderitz – Historical and Recent Location

1. Introduction

Brown hyenas in the Luderitz area have been studied in the 1980's (Skinner et al. 1995). Furthermore some baseline data about brown hyena movement is available for 1990-1992 (Wolhuter, pers. comm..). The Brown Hyena Research Project has been studying the brown hyena population around Luderitz since 1995. Detailed movement data is available from 1998 to present. According to Skinner et al. (1995) there were two brown hyena clans in the area in 1982 (Figure11). Clan A (Peninsula Clan) comprised of nine individuals and Clan B (Wolf Bay Clan) of three individuals. The area in that brown hyenas moved in 1992 encompassed both territories that were determined in 1982. Home ranges for individual brown hyenas could not be determined due to a low sample size. However, it can be assumed that the territory boundary locations were similar to those in 1982.

Detailed brown hyena home range size estimates are available from 2003 to present and these data are compared with the historical location and distribution of those in 1982 and 1992.

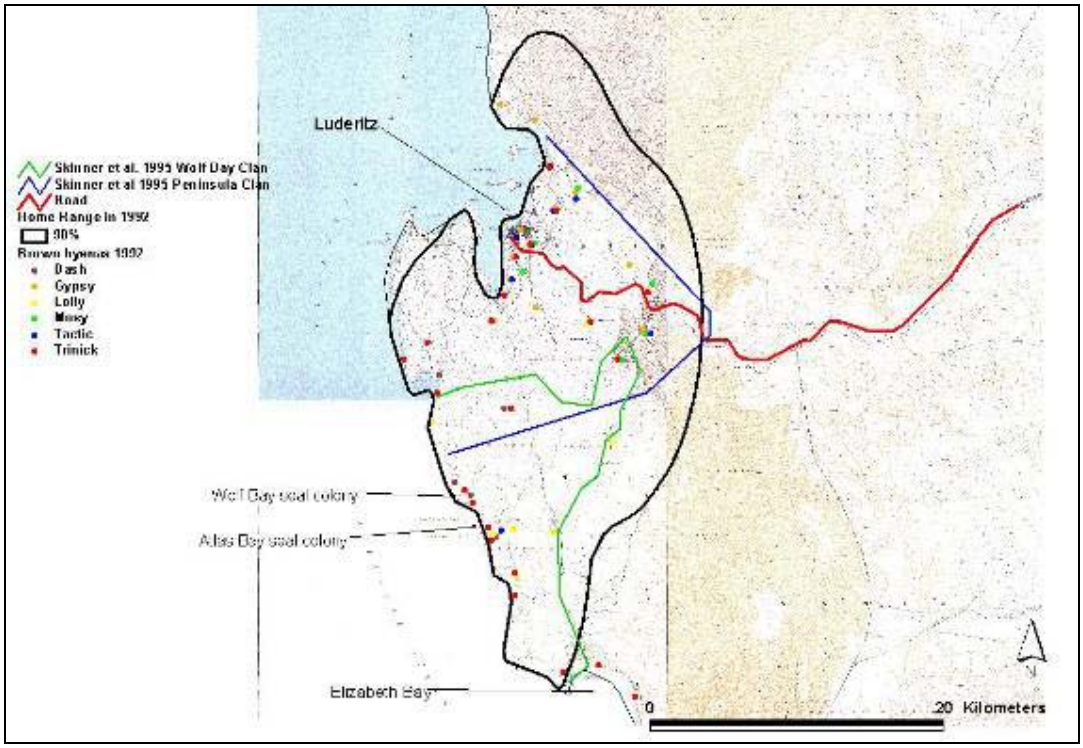


Figure 11: Brown hyena territory boundaries in 1982 (Skinner et al. 1995) and in 1992 and GPS locations of individual brown hyenas in 1992

2. Material and Methods

Five brown hyenas of four different clans were collared with GPS collars between 2003 and 2009:

- Agate Beach Clan: 1 breeding female (Minerva)
- Peninsula Clan: 2 breeding females (Gypsy II,Tosca)
- Wolf Bay Clan: 1 resident male (Dollar)
- E-Bay Clan: 1 breeding female (Obelixa)

3. Results

Home ranges of all five brown hyenas fell within the home range outline that was determined in 1992 (Figure 12) and hence all animals could be regarded to be of the same study unit than the animals studied in 1982 and 1992. However, these hyenas were members of four clans and not two clans as in 1982.

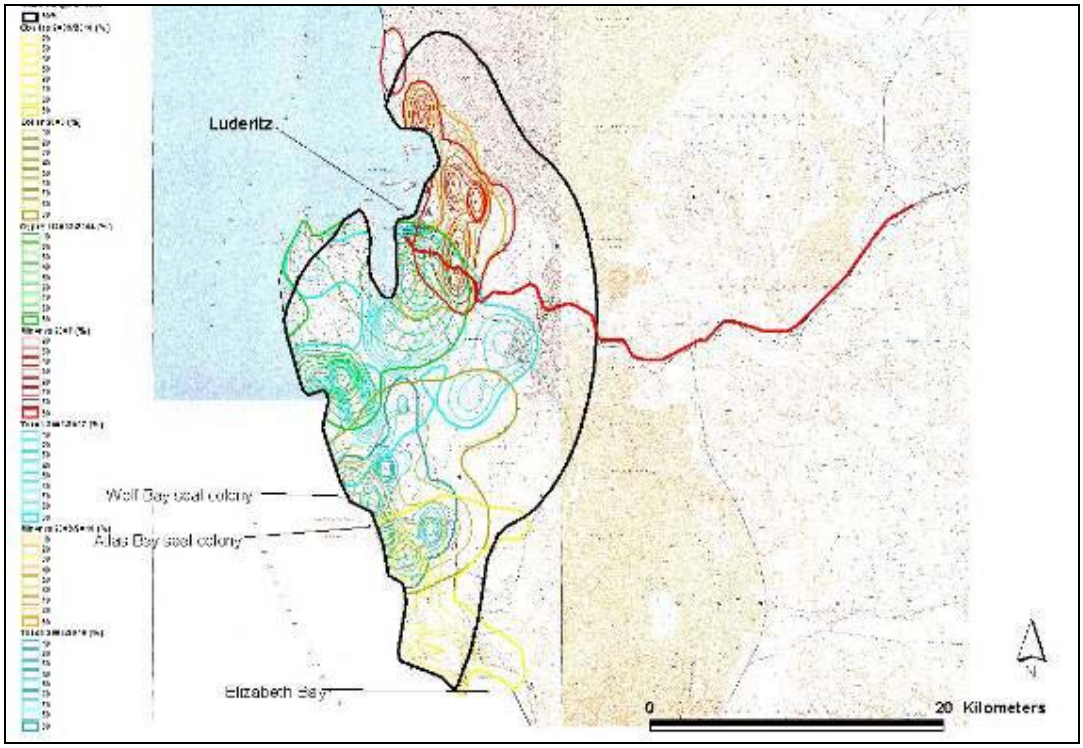


Figure 12: Brown hyena home range boundaries between 2003 and 2010

a) Agate Beach Clan brown hyenas

The breeding female of the Agate Beach Clan, Minerva, has been collared since 2003.

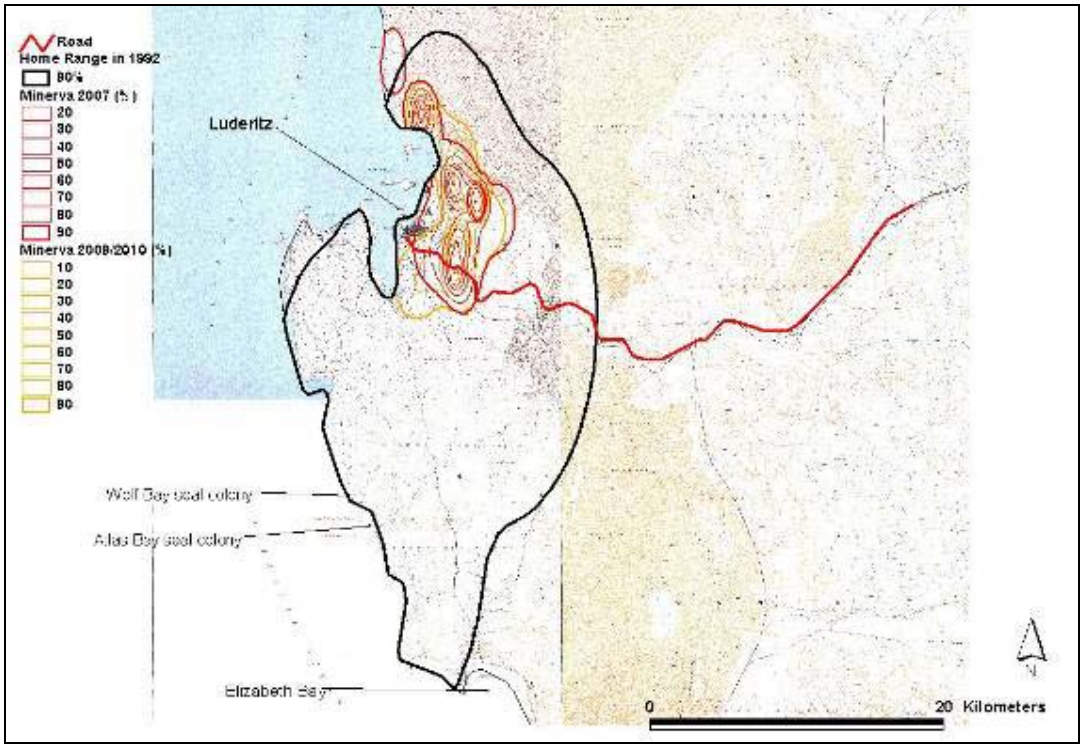


Figure 13: Home ranges of Minerva in 2007 and in 2009/2010

Her southern home range boundary changed from 2007 to 2009/2010 by shifting further south towards the second lagoon (Figure 13). Other than that, her home range location stayed mostly the same.

b) Peninsula Clan brown hyenas

Tosca's home range substantially changed between 2006/2007 and 2009/2010 (Figure 14). The majority of the original area is not visited at all any more and the entire home range shifted south, only slightly overlapping with the old range's south-western boundary.

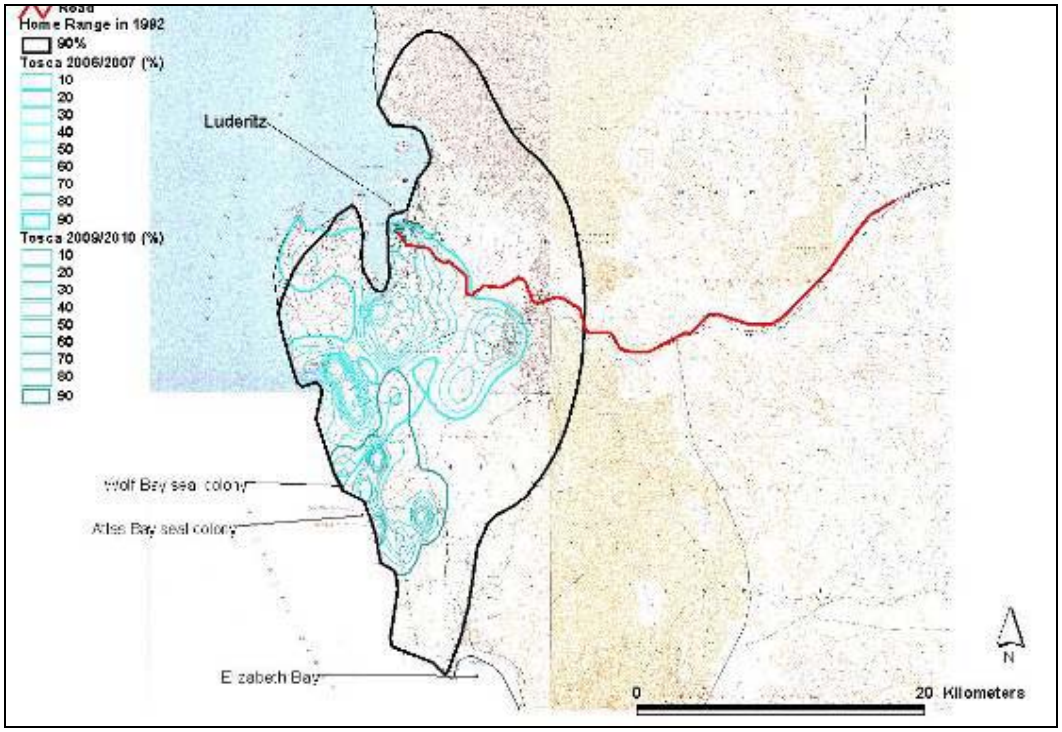


Figure 14: Home ranges of Tosca in 2006/2007 and 2009/2010

The home range of Alaika, a female of the Peninsula Clan that was collared in 2009 had an 80% overlap with Tosca's home range and both visited the same core areas.

c) Peninsula Clan and Wolf Bay Clan

The home range of Gypsy II, an older relative of Tosca of the same clan, in fell completely within Tosca's original home range in 2003/2004 (Figure 15). Dollar, a resident male hyena of the Wolf Bay Clan, shared a clear territory boundary with Gypsy II and his home range overlaps greatly with that of Tosca's today (compare Figures 13 & 14).

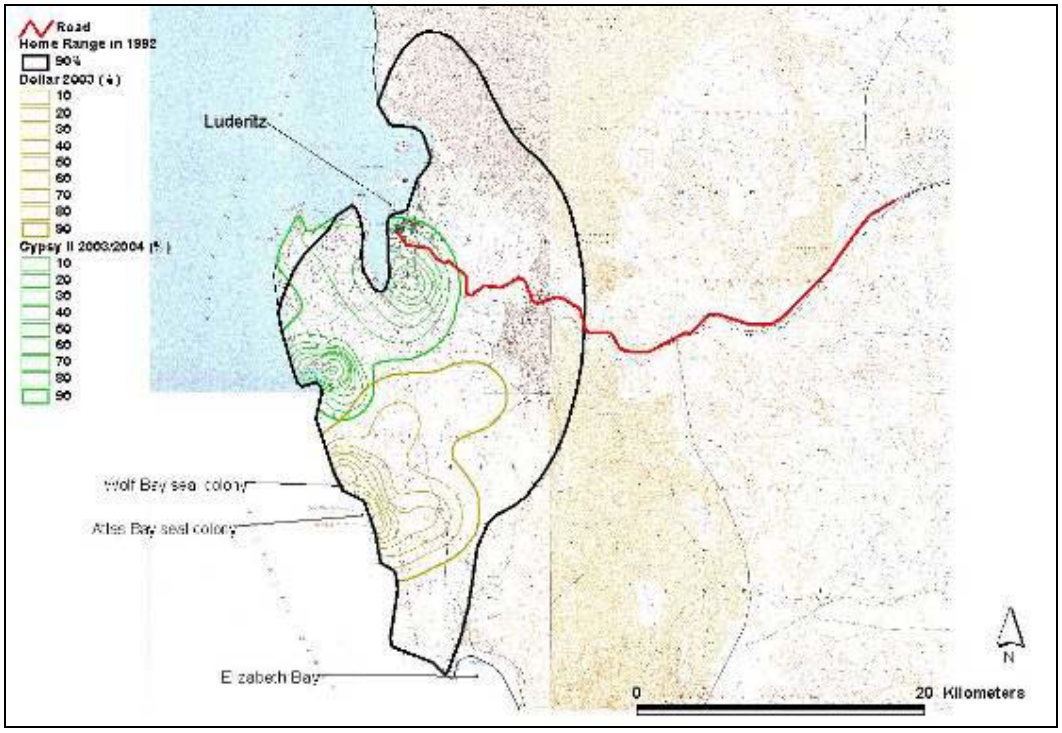


Figure 14: Home ranges of Gypsy II in 2003/2004 and of Dollar in 2003

d) Peninsula Clan and Agate Beach Clan

Tosca's northern and Minerva's southern home range boundaries overlapped in the area along the main tar road from Luderitz to Aus in 2006/2007 (Figure 15).

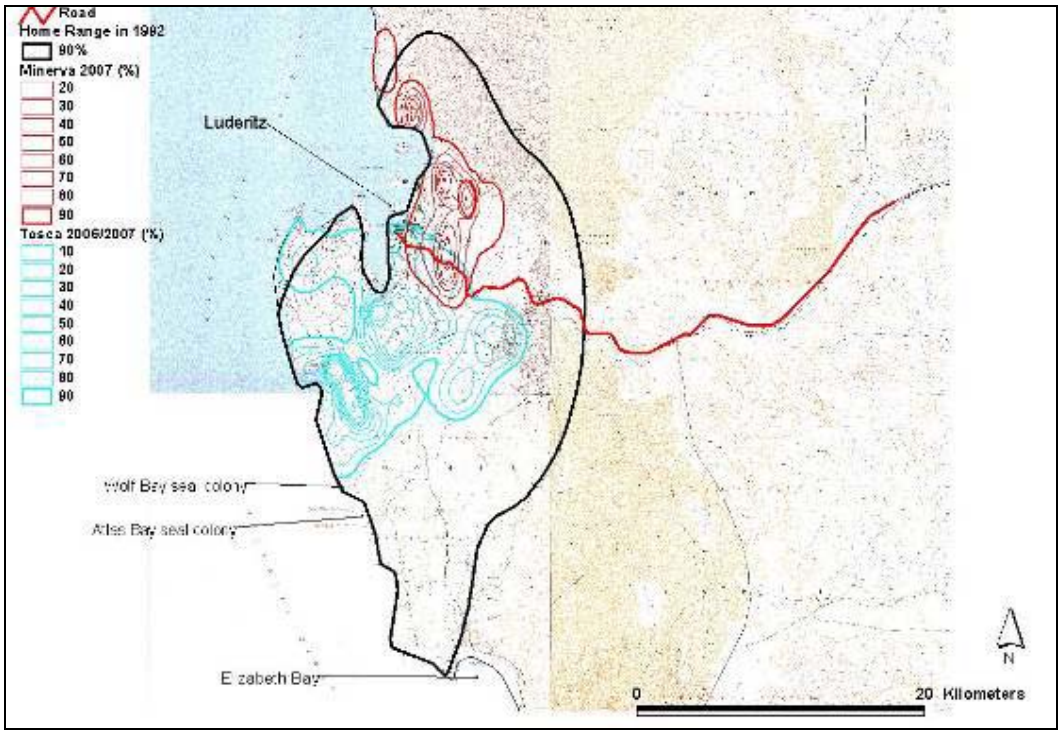


Figure 15: Tosca's and Minerva's home ranges in 2006/2007

Mapping of the area around the tar road revealed several latrines and many paste marks along the road indicating that the tar road was a heavily marked territory boundary.

Both hyenas' home ranges did not overlap any more in 2009/2010 (Figure 16). Minerva's boundary shifted slightly south towards the Second Lagoon and Tosca's home range shifted into the area that was formerly the home range of Dollar of the Wolf Bay Clan.

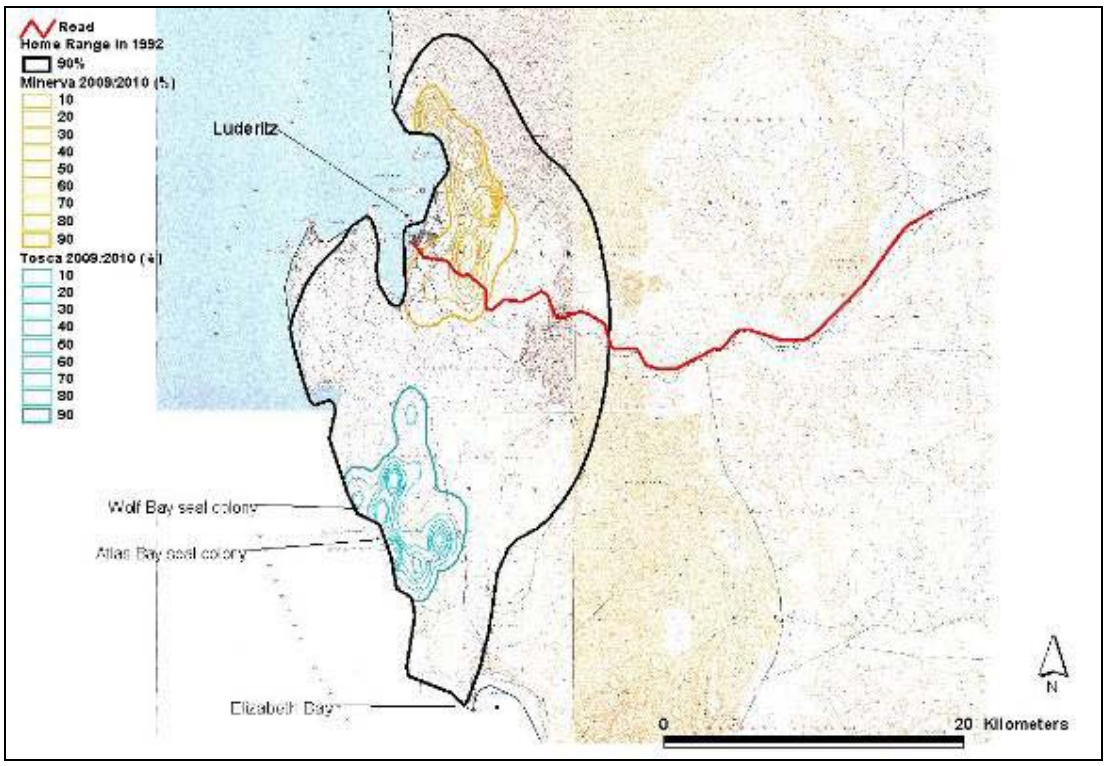


Figure 16: Tosca's and Minerva's home ranges in 2009/2010

e) Elizabeth Bay Clan brown hyenas

Three animals of the Elizabeth Bay Clan had been fitted with radio collars before 2004. The first GPS data of a clan member, Obelixa, became available in 2009. The comparison of the data collected from the radio collared animals and the GPS collar showed a great overlap of home ranges. However, home ranges in 2004 were considerably larger than today's, extending beyond the dune belt in the east, but their location along the coast is the same.

Obelixa's home range overlaps with Tosca's home range in the area around the Atlas Bay seal colony (Figure 17).

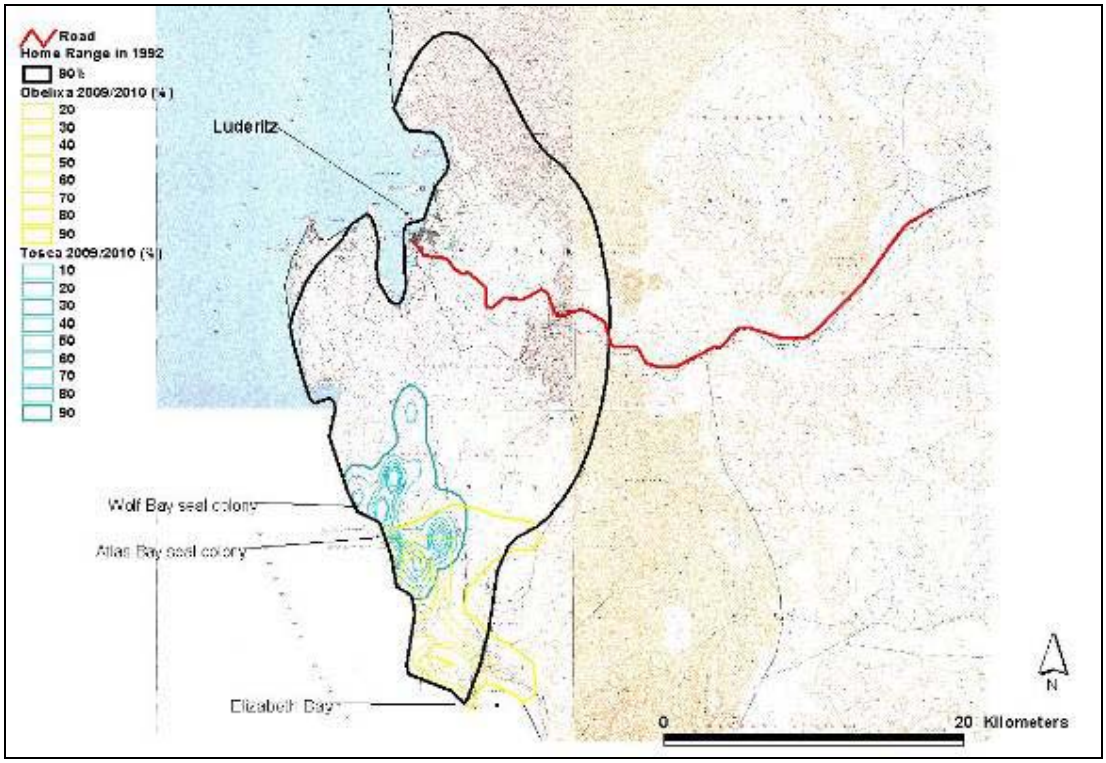


Figure 17: Tosca's and Obelixa's home ranges in 2009/2010

4. Summary

- Skinner et al. (1995) determined two territories in the Luderitz area.
- Clan A's territory encompasses the Brown Hyena Research Project's original home ranges of the Agate Beach and Peninsula Clans.
- Clan B's territory encompasses the original home ranges of the Wolf Bay and Elizabeth Bay Clans.
- Clan A may have split or shifted its territory boundary either to the north or to the south of today's tar road after the road had been upgraded from a gravel road to a tar road and when traffic and vehicle speed increased, resulting in the new home ranges of Gypsy II and Tosca and Minerva.
- Eight hyenas of the Wolf Bay Clan had been hit and killed on the tar road until 2009 including all known study animals. It seems as if the Clan became extinct and that their territory became vacant.
- The Peninsula Clan hyenas moved into the vacant territory and their own former territory became vacant.
- The Agate Beach Clan animals are in the process of moving further south into the Peninsula Clan's former territory.

- The coastal part of the home range of Elizabeth Bay Clan hyenas seems to be stable.

5. References

Skinner, J. D., R. J. van Aarde & R. A. Goss (1995). “Space and resource use by brown hyenas (*Hyaena brunnea*) in the Namib Desert.” Journal of Zoology, London 237(1): 123 - 131.

Pocket Beach Monitoring: Predicting Wildlife-Vehicle-Collision Hotspots through GPS Telemetry

1. Introduction

This progress report concentrates on the analysis of GPS data with regard to the determination of wildlife-vehicle-collision (wvc) hotspots and the prediction of wvc hotspots in the greater mining area.

A total of 28 brown hyena road kills have been recorded by the Brown Hyena Research Project, approximately ¼ of these occurred in Mining areas (two at Elizabeth Bay between 2001 and 2003; five in Mining Area 1). Increased traffic due to mining poses a real risk to brown hyena survival.

2. Study area

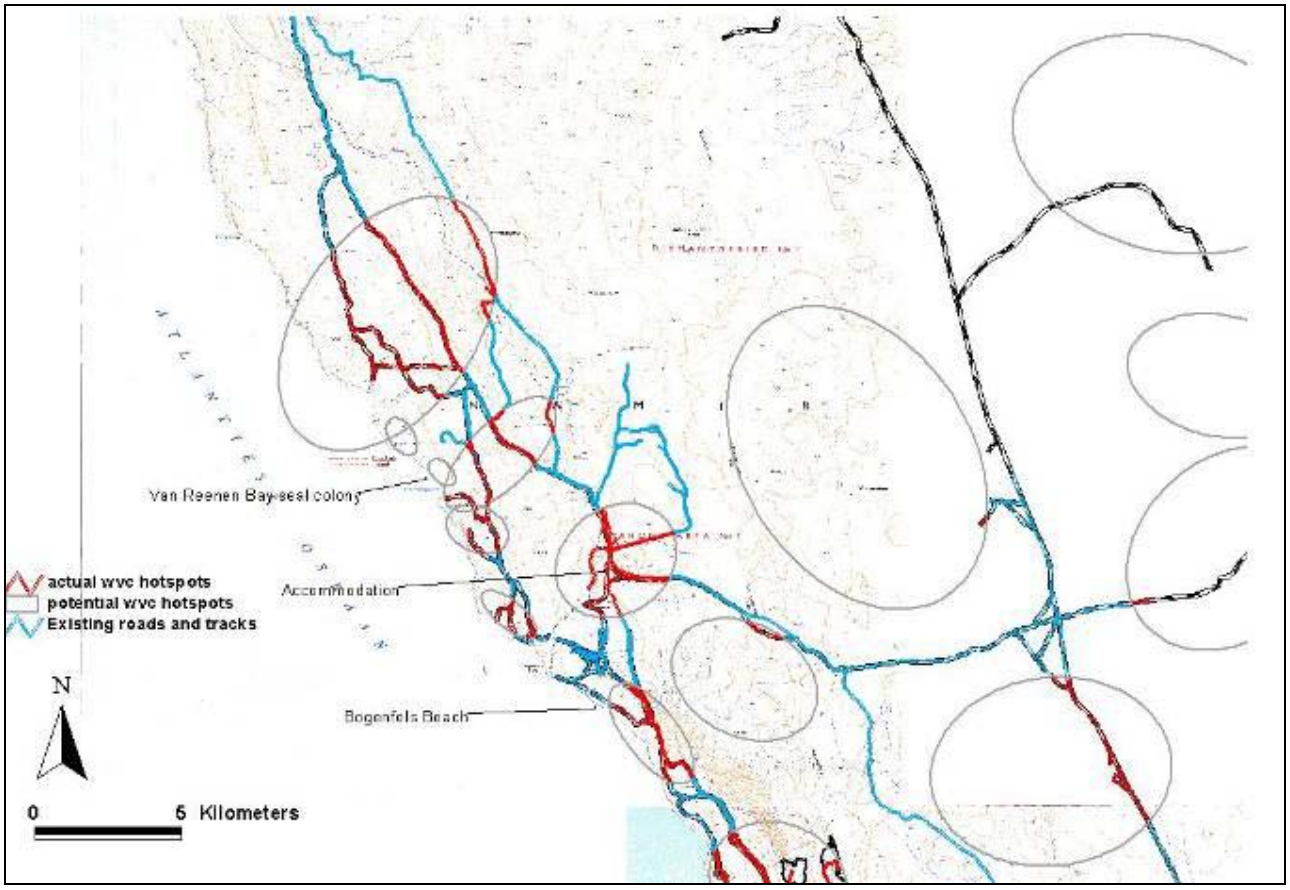
The study area lies in the central coastal part of the Sperrgebiet. The mining deposits stretch from Chamais Bay in the south to Bogenfels in the north. Construction at Site 11&12 (Bogenfels) commenced in March 2005 and mining started in February 2007 and is still on-going.

3. Material and Methods

Movement data of brown hyenas was plotted in ArcView 3.3 and road crossings on existing roads were marked. Hotspots were determined by using CRIME STAT III Spatial Statistics Programme.

4. Results

Several wvc hotspots were identified in the Bogenfels mining area (Figure 18). The most sensitive area is found around the accommodation site, where a network of roads exists.



18: Actual and potential wildlife-vehicle-collision (wvc) hotspots in the Bogenfels mining area

The analysis of all available GPS data revealed a number of potential wvc hotspots in the greater mining area. Coastal areas have a dense network of roads with many potential wvc hotspots.

Pocket Beach Monitoring: Brown Hyena Activity and Abundance in the Mining Area

1. Introduction

Last year's results showed that mining activity has a significant influence on brown hyena movement and behaviour. Avoidance of disturbed areas can lead to a significant reduction of home range size through habitat fragmentation and could lead to a reduction in survival success if prime resources become inaccessible (e. g. seal colonies, water sources).

The Bogenfels brown hyena population was monitored with the help of camera traps in 2010 and data was compared with data from camera traps retrieved in 2007/2008.

2. Material and Methods

Three camera traps were set-up in the Bogenfels area in 2010. Two cameras were placed at the seal colony at Van Reenen Bay to establish an ID catalogue and one camera trap was set up near Bogenfels beach to monitor changes in brown hyena activity in the mining area. Additionally incidental brown hyena sightings that were reported and data from the brown hyena monitoring programme at the Van Reenen Bay seal colony were analysed to determine changes in brown hyena abundance.

3. Results

a) Sighting data

The number of incidental sightings that were reported to the Brown Hyena Research Project from the Bogenfels mining area decreased from 1999 to 2010 (Figure 19). However only 17% of the variation in the data was explained by the linear trend curve that was fitted to the data. Nevertheless, brown hyena monitoring success at the Van Reenen Bay seal colony clearly decreased during the same time.

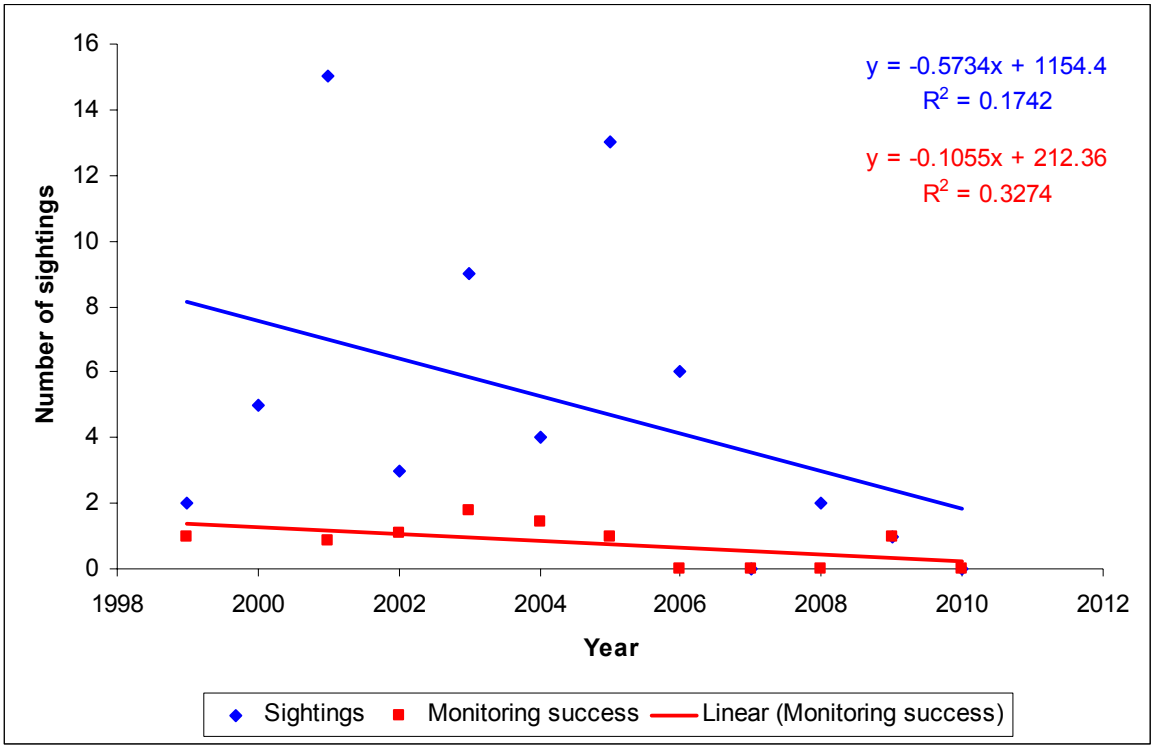


Figure 19: Number of incidental sightings reported from the Bogenfels mining area and monitoring success at the Van Reenen Bay seal colony

b) Camera trap data

Trapping success in the Bogenfels area decreased by half from 2007/2008 to 2010 (Table 3). Trapping success at the northern and southern end of the seal colony was much higher than trapping success near Bogenfels beach, indicating that the beach is not used as a regular foraging area by brown hyenas.

There is not enough data available yet for a reliable abundance estimate. The first estimate will be available in the middle of 2011.

Table 3: Trapping success of camera traps near the Bogenfels mining site and at the Van Reenen Bay seal colony

Camera trap	Period	Location	Trapping days	No sightings	Trapping success
Bogenfels Sewage 1	22 December 2007 - 6 February 2008	Inside Territory	47	2	0.04
Bogenfels Sewage 2	22 December 2007 - 29 December 2007	Inside Territory	7	1	0.14
Bogenfels Sewage Fence	17 March 2007 - 20 March 2007	Inside Territory	4	2	0.50
Bogenfels Arch	18 August 2010 - 17 September 2010	Inside Territory	30	1	0.03
Bogenfels Arch	21 September 2010 - 28 September 2010	Inside Territory	7	0	0.00
Bogenfels Arch	12 December 2010 - 29 December 2010	Inside Territory	18	1	0.06
Van Reenen Bay south	18 August 2010 - 24 November 2010	Seal colony	67	9	0.13
Van Reenen Bay south	12 December 2010 - 29 December 2010	Seal colony	18	8	0.44
Van Reenen Bay north	9 September 2010 - 21 November 2010	Seal colony	43	10	0.23
Van Reenen Bay north	12 December 2010 - 29 December 2010	Seal colony	18	3	0.17
Combined					
Bogenfels	2007-2008	Inside Territory	58	5	0.09
Bogenfels	2010	Inside Territory	55	2	0.04
Van Reenen Bay	2010	Seal colony	146	30	0.21

4. Summary

- Brown hyena daytime activity decreased in the mining area revealed through incidental sightings and monitoring at the seal colony.
- Brown hyena activity in general decreased in the mining area revealed through trapping success of camera trap data.

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