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Expedition report

Population ecology and long-term monitoring of the Namibian cheetah

Expedition dates: **7 March – 2 April 2005**

Report published: **October 2005**

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Abstract

This expedition to Namibia, run by Biosphere Expeditions and Okatumba Wildlife Research from 07 March to 02 April 2005 was conducted to provide important baseline data on the world's largest free-ranging cheetah population. The expedition team consisted of two groups of seven and eight team members plus staff. Each group worked for two weeks and was divided daily into three research teams to conduct various research activities concurrently. Teams of two to three team members were guided by one local scientist or student. Additionally two groups were joined by local trackers. This expedition design led to a large amount of data being collected.

The difficulty of observation in the wild, especially in bushy areas, and the timidity of Namibian cheetahs necessitate the use of indirect sampling methods, rather than depending on direct observations. Therefore radio telemetry was used to locate study animals in order to determine space use (home range sizes, territories, habitat preferences, etc.) and activity rhythms.

Six box traps were set in the study area and capture activities took place on 24 days. Six cheetahs were caught - one radio-collared female with three juveniles (at the age of 10 month), one young adult female and one young adult male. All cheetahs were immobilised, examined, sampled and released. In addition to these study animals, six porcupines, six warthogs, one baboon (with infant) and one leopard tortoise were captured.

Aside from capture-recapture and radio telemetry, counting of cheetah tracks can be used to compute indices that reflect cheetah density. During the expedition spoor tracking took place daily. Seven cheetah tracks were detected around traps, 17 cheetah tracks were found on transects, and four cheetah tracks, as well as one leopard track were detected by chance.

Game counts using a line transect method and observations at waterholes were also conducted to obtain information on the cheetah's prey base.

By way of a summary of the expeditions from 2002 to 2005 (Omitara and Seeis study sites), an overview of results obtained is given in the conclusions and some conjectures on spoor density as a measure of true cheetah density, and cheetah space use patterns and home range sizes are made.

Diese Expedition wurde von Biosphere Expeditions und Okatumba Wildlife Research durchgeführt und fand in der Zeit vom 07. März bis zum 02. April 2005 in zentralen Landesteilen Namibias statt. Sie diente dazu, wichtige Basisdaten über den größten wild lebenden Gepardenbestand der Welt zu liefern. Das Expeditionsteam bestand aus zwei Gruppen mit sieben bzw. acht Teilnehmern plus Mitarbeitern, die jeweils für zwei Wochen vor Ort waren. Die Gruppen wurden jeden Tag in drei verschiedene Arbeitsteams unterteilt. Dadurch konnten verschiedene Forschungsaktivitäten parallel nebeneinander durchgeführt und eine große Menge an Daten gesammelt werden. Jedes Arbeitsteam von je zwei oder drei Teilnehmern wurde von einem Wissenschaftler oder Studenten geleitet. Außerdem wurden zwei Arbeitsteams von einheimischen Fährtenlesern begleitet.

Zum einen ist es schwierig, Beobachtungen in freier Natur, insbesondere in verbuschten Gebieten, durchzuführen, zum anderen sind Geparden auf Farmland in Namibia sehr scheu. Dies macht die Anwendung indirekter Beobachtungsmethoden erforderlich. Mit Hilfe der Radiotelemetrie können Tiere zu bestimmten Zeiten lokalisiert, ihre Raumnutzung (Größe der Streifgebiete, Territorien, Habitatpräferenzen, etc.) bestimmt und ihre Aktivitätsrhythmen ermittelt werden.

Das Studiengebiet war mit sechs Lebendfallen ausgerüstet, die an 24 Tagen scharf gestellt wurden. Es wurden sechs Geparden gefangen - ein besendertes Weibchen mit drei Jungtieren (10 Monate alt), ein junges erwachsenes Weibchen und ein junger erwachsener Kater. Alle Geparden wurden betäubt, untersucht, beprobt und wieder frei gelassen. Neben diesen Studientieren gingen sechs Stachelschweine, sechs Warzenschweine, ein Pavian (mit Jungtier) und eine Leopardenschildkröte in die Fallen.

Außer Fang- und Wiederfang sowie Radiotelemetrie kann das Zählen von Spuren genutzt werden, um Indikatoren für die Gepardendichte zu ermitteln. Deshalb wurden täglich Spuren gesucht. Während der Expedition wurden sieben Gepardenspuren um die Fallen herum sowie 17 Gepardenspuren auf Transekten gefunden. Vier Gepardenspuren und eine Leopardenspur wurden zufällig im Feld entdeckt.

Wildzählungen nach dem Line-Transekt-Verfahren und Beobachtungen an Wasserstellen wurden durchgeführt, um Informationen über das verfügbare Beutespektrum der Geparden zu erhalten.

Das Kapitel "Conclusions" enthält einen zusammenfassenden Überblick über die Ergebnisse der Jahre 2002 bis 2005 in den Studiengebieten Omitara und Seeis, sowie einige Grobaussagen über Spurendichte als Maß für Gepardendichte sowie Raumnutzungsverhalten und Reviergrößen.

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Contents

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1. Expedition Review

M. Hammer (editor) & David Moore
Biosphere Expeditions

1.1. Background

Biosphere Expeditions runs wildlife conservation research expeditions to all corners of the Earth. Our projects are not tours, photographic safaris or excursions, but genuine research expeditions placing ordinary people with no research experience alongside scientists who are at the forefront of conservation work. Our expeditions are open to all and there are no special skills (biological or otherwise) required to join. Our expedition team members are people from all walks of life, of all ages, looking for an adventure with a conscience and a sense of purpose. More information about Biosphere Expeditions and its research expeditions can be found at www.biosphere-expeditions.org.

This expedition report deals with an expedition to Namibia that ran from 7 March to 2 April 2005. The expedition was part of a long-term research project on the Namibian cheetah with an emphasis on locating cheetah marking trees, capture activities, radio-tracking, counting cheetah track frequencies and on recording cheetah prey animals.

Namibia harbours the world's largest population of cheetahs and is one of a few African countries that support six species of large carnivores. Lions, spotted hyaenas and wild dogs are mainly restricted to protected areas, but cheetahs, leopards and brown hyaenas still occur on areas with intensive livestock and/or game farming. Today, about 40% of Namibia is used for commercial livestock breeding and it is estimated that this land provides the habitat for 90% of the current Namibian cheetah population. Ensuing conflict with humans has resulted in large numbers of cheetahs being captured and/or shot. Cheetahs do kill livestock, but the extent of losses and financial damage to the farmers has to date not been properly quantified.

Although the Namibian cheetah is a fascinating flagship species, its ecology is poorly understood and this makes conservation of the species difficult. Hunting quotas are set without scientific basis, removal through human conflict is poorly monitored and no reliable population density estimates exist. (The frequently used and well-published figure of 2,000-3,000 individuals has been quoted for the past 15 years, but is very likely inaccurate as it is based on unscientific guesswork). Due to this lack of scientific data, the effectiveness of present conservation efforts are in doubt. New baseline data on population density, demography and ecology are thus urgently required. Data gathered during this expedition will be an essential ingredient to a new and effective conservation strategy for the Namibian cheetah.

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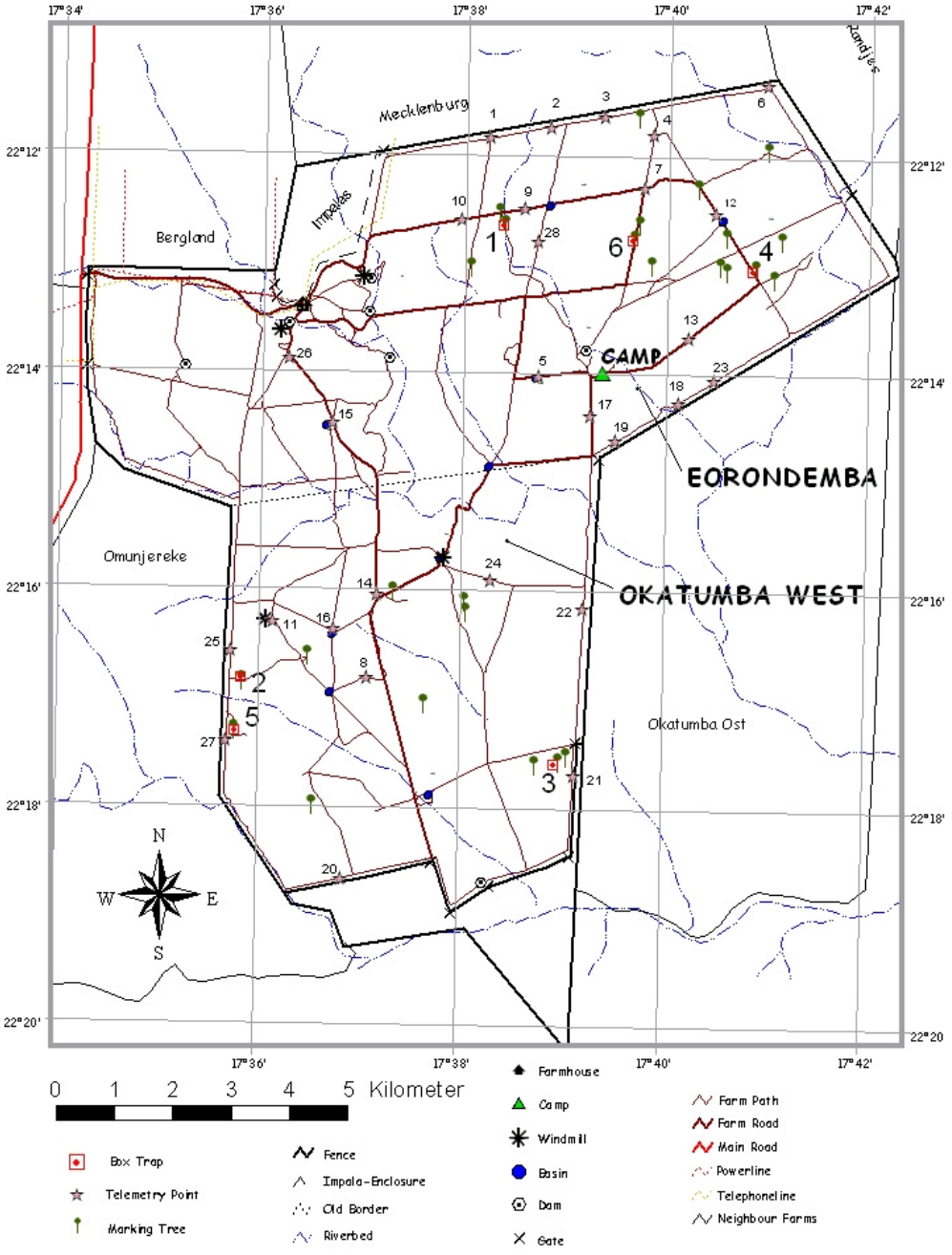
1.2. Research Area

With a small human population spread over a large area, Namibia is in better environmental shape than most African countries. Because Namibia lies mostly within an arid zone, much of the flora is typical African dryland vegetation. The research area covers about 40,000 hectares (400 km^2) on conservancy farmland savannah, as it is this farmland, not the national parks, which harbours 90% of the Namibian cheetah population. Conservancies are created by neighbouring farmers who agree to manage their land and livestock in a sustainable way and in return are granted ownership of the game on their land by the state. Within the research area was a core zone of 10,000 ha (outlined below by solid black lines) where counting of tracks, marking trees, prey density and cheetah capture took place, and a perimeter zone for radio-tracking.



Map showing the research area and expedition base ("camp"). See also appendix 1 for slightly larger version

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1.3. Dates

The expedition ran over a period of four weeks and was divided into two two-week slots, each composed of a team of international research assistants, guides, support personnel, local scientists and an expedition leader. Slot dates were 7 - 19 March and 21 March - 2 April.

1.4. Local Conditions & Support

On this expedition, Biosphere Expeditions was assisting Okatumba Wildlife Research (OWR) in its endeavours to provide important baseline data for a better understanding of the Namibian cheetah ecology. Three study sites in three different types of habitat were established, and the expedition camp with all essential supplies and equipment was situated in the western study site.

The climate is semi-arid with summer rainfalls, which peak from February to April. The dominating vegetation type is highland savannah in which various *Grewia* species occur. Large parts of the area also consist of camelthorn savannah on deep sandy soils. The characteristic plant species is camelthorn (*Acacia erioloba*), as well as some other types of acacia. Thickbush areas, which are mainly found on small hills, are dominated by *Acacia mellifera*.

Expedition base

The expedition team was based at a tented camp near Okatumba Wildlife Research, about 80 km East of Windhoek in a remote region of savannah farmland. Transport to and from base camp, and around the study site was by Land Rover Defenders.

The expedition base consisted of several safari tents for the expedition team, each with a shower, toilet and washing facilities. Team members were in pairs inside these tents. All meals were prepared for the team and served either outside or in an additional tent, which was also used as an office. Vegetarians were catered for. There was limited electricity at base camp.

Field communications

There was no telephone/fax/internet line at base. Two-way Motorola hand-held radios and vehicle-mounted portable radios were used for communication between teams around the study site. There was also irregular mobile phone coverage at base and around the study site.

Transport & vehicles

Team members made their own way to the Windhoek assembly point. For the expedition, the team had the use of two Land Rover Defender 110 Station Wagons, two Land Rover Defender 130 Double Cabs, and various other vehicles. The vehicles were provided by Land Rover as part of its Fragile Earth policy, which is the company's commitment to the environment through the sponsorship of leading environmental organisations such Biosphere Expeditions, the development of sustainable practices and technologies and the company's 'Off-Road Code'.

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Medical support & insurance

The expedition leader was a trained first aider, and the expedition carried a comprehensive medical kit. Namibia's healthcare system is of an excellent standard and the nearest doctor and hospital were in Windhoek. Emergency medical support was provided by SOS International. All team members were required to carry adequate travel insurance covering emergency medical evacuation and repatriation. The only medical incidents were one moderately severe case of stomach upset and vomiting, and minor cuts from thorn bushes.

1.5. Local Scientists

Birgit & Harald Förster, originally from Germany, now live and work in Namibia. Birgit Förster trained as a veterinary assistant and studied Biology. Harald Förster is a trained horticulturist and after his apprenticeship studied Forestry, specialising in tropical forestry and wildlife biology. The Försters founded Okatumba Wildlife Research (OWR) together with local farmers and a veterinarian in an effort, amongst other aims, to conduct fundamental and applied research on the farmland habitat, especially regarding complex ecological patterns and human influence on wildlife populations. Their main research interest is in developing strategies for the sustainable use of natural resources and all their projects are conducted in close co-operation with the Namibian Ministry of Environment and Tourism (MET). Various MET scientists provide the Försters with logistical support as well as scientific advice. OWR is also working with various universities and research institutes in Europe.

1.6. Expedition Leader

David Moore was born and educated in England and now lives in the UK and France. He graduated in French and German and studied Japanese while working for two years in Tokyo. His expedition/group leading experience began with Japanese educational trips in Australia and he has since worked in the Caribbean and throughout Europe for companies such as P&O, Explorica and Alyson Adventures. David joined Biosphere Expeditions in 2003 and has led expeditions to the Azores and Namibia. He also helps run the Biosphere Expeditions operations in France.

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1.7. Expedition Team

The expedition team was recruited by Biosphere Expeditions and consisted of a mixture of all ages, nationalities and backgrounds. They were:

7 - 19 March 2005

Dorothy Button (Australia), Gladis Cole (UK), Wendy Coley (UK), Jennifer Fry (UK), Heike Lange (Germany), Peter Rowley (UK), Philip Swift (UK).

21 March - 2 April 2005

Fiona Duthie (UK), Anna Gandola (UK), Ursula Hammer (Austria), Pauline Harris (UK), Wolfgang Ley (Germany), Sara McClelland (UK), Martina Miethig (Germany), Gerry Monaghan (UK), Sarah Stiff (UK).

Staff (throughout the above period):

Malte Schindler (scientific assistant), Markus Hammer (scientific assistant), Peter Shuette (scientific assistant), Wienke Ellerbeck (scientific assistant), and Nina Wessalowski (au pair and helper).

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1.8. Expedition Budget

Each team member paid towards expedition costs a contribution of £1250 per person per two week slot. The contribution covered accommodation and meals, supervision and induction, a permit to access and work in the area, all maps and special non-personal equipment, all transport from and to the team assembly point. It did not cover excess luggage charges, travel insurance, personal expenses like telephone bills, souvenirs etc., as well as visa and other travel expenses to and from the assembly point (e.g. international flights). Details on how this contribution was spent are given below.

Income	£
Expedition contributions	19,120
Expenditure	
Base camp and food includes all meals, base camp equipment, gas, wood	6,223
Transport includes fuel, car maintenance	1,237
Equipment and hardware includes research materials & gear etc purchased in UK & Namibia	851
Biosphere Expeditions staff includes salaries, travel and expenses to Namibia	1,761
Local staff includes salaries, travel and expenses, gifts	1,810
Administration includes permits, registration fees, sundries etc	884
Scientific services & logistics organisation Payment to Okatumba Wildlife	2,517
Team recruitment Namibia as estimated % of PR costs for Biosphere Expeditions	1,800
Income – Expenditure	2,037
Total percentage spent directly on project	89%

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1.9. Acknowledgements

This study was conducted by Biosphere Expeditions which runs wildlife conservation expeditions all over the globe. Without our expedition team members (listed above) who provided an expedition contribution and gave up their spare time to work as research assistants, none of this research would have been possible. The support team and staff (also mentioned above) were central to making it all work on the ground. Thank you to all of you, and the ones we have not managed to mention by name (you know who you are) for making it all come true. Biosphere Expeditions would also like to thank Land Rover, Cotswold Outdoor, Globetrotter Ausrüstung and Gerald Arnhold for their sponsorship and/or in-kind support.

1.10. Further Information & Enquiries

More background information on Biosphere Expeditions in general and on this expedition in particular including pictures, diary excerpts and a copy of this report can be found on the Biosphere Expeditions website www.biosphere-expeditions.org.

Copies of this and other expedition reports can be accessed via at www.biosphere-expeditions.org/reports.

Enquires should be addressed to Biosphere Expeditions at the address given below.

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2. Cheetah study

Birgit & Harald Förster
Okatumba Wildlife Research (OWR)

2.1. Introduction

This expedition report deals with an expedition to commercial farmland in central Namibia, which hosts the largest cheetah population in the world. The expedition assisted Okatumba Wildlife Research in their endeavours to increase knowledge about the Namibian cheetah and to contribute to a successful co-existence of this endangered species with Namibian people.

Aims and objectives

A large number of studies on free-ranging cheetahs have been published (for an overview see Caro 1994), but most of them were conducted in protected areas, mainly in East African countries. By contrast, only a handful of articles on Namibian cheetahs are published in the literature (Bartmann 1981, Gaerdes 1974, Joubert, 1984, Joubert & Mostert 1975, Kraus & Marker-Kraus 1991, Marker et al. 1996, Mc Vittie 1979, Morsbach 1987). The current project on cheetahs living on farmland in Namibia aims to provide important baseline data on population density, demography and behavioural ecology. Genetics and diseases are subsidiary objectives.

The habitat “Protected Area” differs from the habitat “Farmland” in various aspects (see table 2.1.1.a). It is expected that Namibian cheetah ecology differs from cheetahs in National Parks due to certain environmental conditions. For example, cheetahs on Namibian farmland exhibit unusually large group sizes (Gaerdes 1974, Joubert 1984, McVittie 1979). Furthermore, prey size expands, and litter sizes increase compared to East African cheetahs (McVittie 1979, Morsbach 1987). Durant (1998), Joubert and Mostert (1975) and McVittie (1979) have argued that lack of inter-specific competition might be one of the main factors in the success of the cheetah on farmland.

Table 2.1a Differences between protected areas and commercial farmland.

Protected areas	Commercial farmland
- no inhabitants	- presence of people (farmers)
- no livestock	- presence of livestock
- no hunting pressure	- persecution by man
- high inter-specific competition: lion, spotted hyena, leopard, wild dog	- low inter-specific competition: leopard, caracal, brown hyena
- migratory prey base	- permanent availability of prey
- low cheetah density	- high cheetah density

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Namibia and commercial farmland

Today about 40% of the total area in Namibia is used for commercial livestock farming, 40% are communal areas and 20% are National Parks and restricted areas (Berry 1990). It is estimated that commercial farmland provides the habitat for 90% of Namibia's cheetah population (Morsbach 1987) and about 80% of the commercially useable larger game species (Brown 1992). Thus Namibian farmland has a crucial role to play in the sustainable management and conservation of the country's wildlife.

The average farm size (commercial unit) in Namibia depends on the average annual rainfall and is about 5.000 ha in the North up to 30.000 ha in the South (Brown 1992). For reasons of efficient livestock management, farmers divide one farm into smaller units, so-called camps. In central parts of Namibia, where the study sites are situated, one camp is about 200 to 400 ha (own results, unpublished), and four to six camps are supplied with one watering place, usually of water pumped from the ground through wind power. One herd of livestock is rotated from camp to camp, dependent on season and quality of grass.

Commercial farmland in Namibia is fenced in, either with stock-proof fences on cattle farms, or with game-proof fences on game farms. Many farmers substitute their decreasing revenues from livestock breeding by consumptive and non-consumptive use of wildlife (Barnes & de Jager 1996). These farmers have a mixture of both types of fencing on their properties. Stock-proof fences are 1.40 m in height and consist of five wires that are stretched between wooden poles. These fences are no barrier for the local wildlife and only serve to keep cattle within a certain area. Game-proof fences are either 1.40 m in height and consist of eight to eleven wires, or 2.20 m in height and consist of 18 to more than 20 wires. The first type is game-proof for "crawling" game like hartebeest or oryx (who crawl under fences), but it can be crossed by "jumping" game like kudu or eland. The second fence type prevents movement of jumping species too. However, warthogs dig holes under all types of fences. Warthog holes are also used by some other species like steenbok, duiker and several carnivores, including the cheetah (personal observation).

Carnivores and population density

Namibia is one of the few African countries, which hosts six species of large carnivores. While lions, spotted hyenas and wild dogs are mainly restricted to protected areas, cheetahs, leopards and brown hyenas still occur on areas with intensive livestock and/or game farming (Berry et al. 1997). Kraus & Marker-Kraus (1991) and Morsbach (1987) have estimated that Namibia hosts the largest population of cheetahs in the world, but to date no reliable population density estimates exist and Namibian cheetah ecology is poorly understood. This lack of scientific data makes management and conservation of the species difficult. The frequently used and well published figure of 2000 to 3000 cheetahs for Namibia (Marker et al. 1996, Morsbach 1987) has been quoted for the past 15 years, but is probably inaccurate. More recent data from the *Large Carnivore Atlas Programme* indicate that cheetah numbers might be double or even more than this (Stander 2001).

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Direct assessments of population density depend on recognition of individuals and groups, and as such they are very expensive and time-consuming (Stander 1998). Indirect sampling methods (Becker et al. 1998, Martin & de Meulenaer 1988, Mills et al. 2001, Panwar 1979, Smallwood & Fitzhugh 1995) are cost-effective, objective and repeatable, but are questioned by some (Norton 1990). Stander (1998) criticises a general lack of understanding the results of indirect sampling, because only a few studies have combined both, direct and indirect measurements. In his study on lions, leopards and wild dogs he found a strong linear correlation between spoor density and true population density. The current cheetah project aims to provide reliable data on cheetah density in three different habitats.

Predation and conflict with farmers

Conflict between farmers and predators has resulted in large numbers of cheetahs being captured and sold, or shot (Marker et al. 1996, Morsbach 1987). Because of this, national and international conservationists tend to see farmers as a serious threat to the Namibian cheetah population (Marker 2000, Nowell et al. 1997), but the farmers' impact on the population will remain speculative until it is rigorously investigated.

Cheetahs do kill livestock, but the extent of losses and financial damage to farmers has to date not been quantified. One aim of the proposed study is to provide reliable information on the cheetah's diet and to quantify stock losses.

The phenonemon of marking trees

Some authors (Hanström 1949, Joubert 1984, McVittie 1979), as well as many Namibian farmers (personal communication) report on so-called play trees that are frequently used by cheetahs. Play trees appear to be a poorly understood, but very important means of communication, especially through scent-marking (Hanström 1949, McVittie 1979). Because of their importance as marking, rather than playing sites, the current study renamed 'play trees' into 'marking trees'.

Capture data indicate that marking trees are used more frequently by males than by females (McVittie 1979). Usually two thirds of cheetahs caught at marking trees are males. Females appear to visit marking trees in each and every reproductive status. In the current study they were already caught while being in estrus - either single or joining a male, while being pregnant or when they are accompanied by juveniles of different ages.

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2.2. Methodology

Study area

OWR established three study sites that differ in landscape types, geology and soils, annual rainfalls, composition of plant species, population densities of various game species as well as other carnivores (see table 2.2.1.a). Hunting pressure on prey base is similar in all study sites, and persecution of predators by humans is relatively low.

Table 2.2a Study sites and habitat differences.

	Hochberg	**SEEIS** *	**Omitara**
Climate	semi-arid	semi-arid	semi-arid
Annual rainfalls	400 - 450 mm	300 - 350 mm	350 - 400 mm
Landscape	very flat	hills and mountains	flat with hills
Geology and soils	sandstone, limestone	granite, quartzite, slate	sand, schist, quartzite
Vegetation	thornbush savannah (dense vegetation)	highland savannah (open habitat)	camelthorn savannah (open - dense)
Prey base	high density	medium density	medium density
Dominant species	hartebeest, kudu, springbok	oryx, springbok, hartebeest	kudu, hartebeest, oryx
Additional species	oryx, warthog, steenbok, duiker, hares, birds	warthog, kudu, zebra, hares, birds	warthog, steenbok, duiker, springbok, hares, birds
Competitors	low leopard density, few brown hyenas	high leopard density, low hyena density	medium leopard density, few brown hyenas

* In March 2005 Biosphere Expeditions assisted OWR at the Seeis study site.

Each study site has a core area of about 100 km² where most research activities like capture, mark and release, sample collection, telemetry, spoor tracking, investigation of marking trees and counting prey animals take place. The surrounding area where interviews with farmers, aerial radio tracking, post mortems etc. are conducted is much larger.

In March 2005 the expedition was conducted for the third and last time in the Seeis study site. Okatumba Wildlife Research (OWR) will move to Wilhelmstal (Okomitundu) in June 2005, where a new study site will be established that will enable OWR to extend the research project to leopard and brown hyaena.

Sampling Methods

Due to persecution by man, cheetahs on Namibian farmland live very secretive lives (Gaerdes 1974, McVittie 1979, personal observations). The difficulty of observation in the wild, especially bushy areas, and the wariness of Namibian cheetahs require employment of indirect sampling methods, rather than depending on direct observations.

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Study animals are live-trapped using capture cages with trap release doors at each end and a trigger plate in the middle. The cheetahs are radio-collared (adults only), marked with ear tags and transponders (all animals), investigated, sampled and released at the place of capture. Radio collars are fitted with activity sensors, and radio telemetry is used to locate study animals at will, to determine their space use (home range sizes, territories, dispersal of young adults) and activity rhythms.

Reliable data on population density can then be gleaned through a combination of mark-recapture (Caughley 1977, Cormack 1968, Otis 1978), radio telemetry (MacDonald & Amlaner 1980, Sargeant 1980) and counting spoor frequencies (Stander 1998). All these techniques were employed by the expedition.

Information on prey species was obtained by game counts using the line transect method (Buckland et al. 1993, Burnham et al., 1980). Continuous data collection by the expedition team led to large amounts of information on the cheetah's prey base, which will help to answer questions on prey availability and prey utilisation. In addition to this, some observations at water places were conducted.

The two expedition groups consisted of seven and eight team members and were divided into three research activity teams. Each team consisted of two or three team members and one local scientist or member of staff. Each team had the use of a Land Rover Defender 110 Station Wagon, or a Land Rover Defender 130 Double Cab (a pick-up model). Team members rotated through the various activities daily.

Table 2.2b Research activities and vehicles.

Team 1	Team 2	Team 3
Checking box traps Controlling marking trees	Spoor tracking along farm paths and boundaries	Radio telemetry
Data entry Waterhole observations	Follow-up	Game count
Land Rover Defender 110 Station Wagon	Land Rover Defender 130 Double Cab	Land Rover Defender 130 Double Cab

Every morning the **box trap team** drove a predetermined route to check box traps and to search for cheetah tracks around the traps. Box traps were either found open, or closed without animal, or closed with an animal inside. Captured animals others than cheetahs were released by the box trap team immediately. Captured cheetahs were moved from the trap into a smaller holding cage, which provides shade and water and descreases risk of injuries for the animal. They were immobilised, investigated, sampled and released either in the afternoon of the same day or early morning of the following day, with all expedition team members present. In the afternoon the box trap team **entered all data** collected by the expedition from the previous afternoon and from the morning into a laptop. Data were entered into a customized Excel database. Later data can be exported from that database to other programmes for further processing. After finishing data entry the team **observed animal movements at various water places** to

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obtain additional information on the cheetah's prey species. Two different water places were covered by two observers each. For successful data sampling it was important that observers placed themselves against the wind, wore clothes that blended in with their natural surroundings, remained totally quiet and moved as little as possible.

The **spoor tracking team** was joined by a local tracker (Bushman). During morning hours the Land Rover Defender 130, Double Cab was driven at low speed (<20 km/h) from telemetry point No. 14 direction south and then along southern and eastern parts of the farm boundary. The tracker and one expedition team member placed themselves on the mudguard of the Landrover to better detect spoors. Expedition team members took turns in sitting in front. Usually, tracks either ran along the path or cross the path, especially before/after crawling under the fence. If a cheetah or leopard track was found the GPS position was recorded using a Silva Multi-Navigator, as well as spoor data (species, number of animals, sex, age dass, description of spoor, etc.) were collected. In some cases tracks were followed, either back or forward, on foot. In the afternoon this team worked on **follow-ups**. Signals of study animals, which were located by the telemetry group during morning hours, were picked-up again, and the animals were followed either by vehicle or on foot. Usually, there is a good chance to see the focus animals during this research activity, but the group of observers should not be too large. If there was no signal in the morning, the follow-up team conducted standard telemetry again.

During morning hours the **telemetry team** drove along a predetermined route of about 30 km, covering central parts of the study area. To locate collared animals, the team would stop at vantage points and attempt to detect signals emanating from the surrounding area with the radio telemetry antenna. If a signal was detected, the GPS position was recorded using a Silva Multi-Navigator, as well as signal bearings using a Silva compass. These records had to be taken on three different locations (the more the better) to get reliable information on cheetah position and movements. In the afternoon this team conducted **game counts** by using the road strip method. With this method the predetermined counting route should be as random as possible, covering all types of habitat of the study site without going along farm boundaries. For data analysis it is important to cover various habitats and to record total km. Per 5.000 ha, 20 kilometres should be driven. The game count Land Rover was manned by one driver in the cab, and three observers and a tracker on the pick-up platform on the back. The driver then operated the Land Rover at very low speed (walking pace to about 20 km/h) and observers on the back counted all animals they detected on both sides of the road, no matter how far away they were detected. Observers also had to ensure that every single animal occurring on the transect line (angle = 0) was seen. When animals were detected, the observers signalled the driver who stopped the vehicle immediately. Observers then identified and counted all animals detected and recorded their distance to the Land Rover, their angle from the midline of the Land Rover, number of animals and, if possible, their sex and group composition. Every day the same route was covered. Regarding data processing one has to distinguish between a census, in which all objects in an area are counted, and a survey, where only some proportion of the objects in the area is detected and recorded. For that reason game densities were estimated using the Distance sampling Programme (see point 2.3.4.).

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2.3. Results

As part of the overall cheetah project 62 cheetahs and four leopards were caught between July 2002 and February 2005 (17 single male cheetahs, 18 male cheetahs in coalitions of 2-3 animals, 9 adult females, 7 male subadults, 6 female subadults, 2 male cubs and 3 female cubs). Some of these study animals were caught twice or even three times. In addition 10 cubs (sex unknown) were detected during aerial radio tracking. With a total of 8620 trap nights an average of 120 trap nights were needed to capture one cheetah. 41 of the captured cheetahs were fitted with radio-collars, 16 of these study animals are still alive, and six range within the Seeis study site.

Capture activities in the Seeis study site started in April 2003. Ten cheetahs and two leopards (1 male and 1 female with two cubs) were captured, sampled, marked and released. Among the captured cheetahs were two coalitions of two males (probably brothers) each, one single male, one female with two juveniles, one female that was in oestrus, and one female that was in the early stages of pregnancy. Subsequent aerial radio tracking showed that the former gave birth to four cubs, and the latter gave birth to three cubs. The single male cheetah was shot by a farmer. Additionally, one male of a coalition was found dead in the field (the reason of death remains unknown), but its brother is still alive within the core area of the Seeis study site.

Capture activities during the expedition

Six box traps were set throughout the study site. Each trap, which is set active, is counted as one trap night, so one night with six active box traps is counted as six trap nights. On several days some of the traps were not active due to cheetah captures (when a cheetah was caught, we disarmed all traps because there would have been no time to check them the next morning). During the expedition, box traps were active on 24 days with a total of 137 trap nights.

Table 2.3a Trapping effort and success during the expedition

	Group 1	Group 2	**Total**
Number of trap nights	70	67	**137**
- open traps	47	52	**99**
- closed but empty traps	10	8	**18**
- captures	13	7	**20**

During the four weeks of the expedition we were very successful and fortunate to capture six cheetahs - one female with three juveniles, one single female and one male. In addition to these study animals, six porcupines, six warthogs, one female baboon with baby and one leopard tortoise were captured.

The cheetah family was caught by the first expedition team on 11 and 12 March. The mother was already radio-collared. She was first captured at the end of February 2004, when she was pregnant. She gave birth to her cubs around 8 May 2004, thus the juveniles - one female and two males - were ten month old. First, the female cub was

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found in box trap 2 (for more details see below). By moving her into the holding cage and setting a total of four traps around the marking tree, we succeeded in capturing the mother and the siblings as well. All four animals were immobilised, investigated, sampled and released.

The two single cheetahs were caught by the second expedition group. On their first day at the study site the expedition team members were fortunate to surprise a cheetah feeding on a fresh springbok kill. Usually, it is not possible to bait a cheetah, because they do not return to a kill. However, in this case the cheetah was disturbed by the expedition team, and it did not manage to eat much of its prey. We decided to fetch a box trap and to put the carcass into the trap. The next morning the cheetah, a young adult female, was caught.

Three days before departure from the study site the expedition team caught a young adult male cheetah. This animal was in good condition, but had obviously been a victim of a snare some time ago. It appears that at the time, the animal managed to wriggle free of the snare, but the wire left a thin hairless scar all around the abdomen, and at the belly there was still a small bloody wound with a scab.

Spoor tracking

On 15 days spoor tracking was conducted in an effort to throw some light on cheetah density within the Seeis study site, and this method was considered to be successful.

During the expedition seven cheetah tracks were detected around the traps, 17 cheetah tracks were found during spoor tracking activities on a predetermined transect route, four cheetah tracks and one leopard track were detected just by chance somewhere in the field. On the basis of these tracks, and in connection with radio telemetry data, 13 individual cheetahs and three individual leopards were identified.

Table 2.3b Number of individuals identified on the basis of tracks found during the expedition.

	Adult Males	Adult Females	Juveniles	**Total**
Cheetah	4	3	6	**13**
Leopard	2	1	0	**3**

The results show that cheetah density on the farms *Eorondemba* and *Okatumba West*, the core area within the Seeis study site, is higher than estimated. This corresponds with the fact that 15 cheetahs were shot by a neighbouring farmer in 2002, which drastically reduced the local cheetah population. It appears, therefore, that we started with low cheetah density in 2003 (during the expedition conducted in October and November 2003 we identified seven individual cheetahs only). After the expedition in 2004 the number of cheetahs using the core area increased to nine, and during the expedition in March 2005 we identified 13 different cheetahs. In addition we found that one female with two juveniles was ranging out of the core area during the expedition (see radio telemetry below). In conclusion it appears that 16 cheetahs were using the study site.

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Spoor density and frequency for the Omitara and the Seeis study sites were calculated as below. For discussion on this see “Conclusions and Outlook” below.

Table 2.3c Sampling effort, spoor density and spoor frequency during expeditions from 2002 to 2005.

	2002 Omitara	2003 Seeis	2004 Seeis	2005 Seeis
Total number of counting days	34	33	27	15
Total number of kilometres driven	510	1254	406	201
Total number of tracks found	36	27	25	17
Spoor density (tracks per 100 km)	7.1	2.2	6.2	8.5
Spoor frequency (km per track)	14.2	46.4	16.2	11.8

Assuming that the spoor density of cheetahs show a strong linear correlation with true density, the above results confirm that cheetah density within the Seeis study site was low at the end of 2003, but increased continuously until March 2005. In October 2003 2.2 cheetah tracks per 100 km were found, or on average 46.4 km needed to be covered to find one cheetah spoor. In March 2005 spoor density within the Seeis study site was 8.5 cheetah tracks per 100 km (11.8 km per cheetah spoor). The figures indicate that spoor density, and therefore cheetah density, at Seeis in March 2005 was even higher than in the Omitara study site at the end of 2002.

Radio telemetry

Standard telemetry, i.e. location of study animals by use of triangulation, was conducted on 15 days, and radio-collared cheetahs and leopards were located on nine days. In total team members drove more than 700 km and spent 85 hours on this research activity.

Table 2.3d Radio telemetry: effort and success during the expedition.

	Group 1	Group 2	**Total**
No. of tracking days	8	7	**15**
No. of days with signals	6	3	**9**

Most of the study animals - the single male, the two brothers, the female cheetah with three cubs and the female leopard - were found within the core area of the study site on three different days. Signals from the female cheetah with four cubs and from the male leopard were received on one day only. During the entire expedition, the female cheetah with two cubs could not be located from the ground (but further away by aerial telemetry). We think this is because the mother was showing her two cubs, who were reaching independence, the periphery of their home range (which is outside the core area of our study site).

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Table 2.3e Radio telemetry: No. of days with signals of certain study animals during the expedition.

	Group 1	Group 2	**Total**
single male cheetah	2	1	**3**
two brothers	-	3	**3**
female cheetah with 2 cubs	-	-	**-**
female cheetah with 3 cubs	3	-	**3**
female cheetah with 4 cubs	-	1	**1**
female leopard with 2 cubs	3	-	**3**
male leopard	1	-	**1**

In addition to standard telemetry, so-called "ground follows" were conducted on four days. The aim of this research activity is to follow a study animal by vehicle and/or foot, to spot the animal and to observe as much as possible of its current situation, e.g. type of habitat, behaviour, etc.

Game counts

On 14 days game counts using the line transect method were conducted to assess availability of the cheetah's prey base. Measuring 20 km, the counting route covered different vegetation types. It usually took a research team up to three hours to conduct the survey. On several days game count activities started later than usual due to cheetah captures and relocation of box traps. In total 202 km were driven and 28 hours spent on this research activity. 2409 animals were detected during March 2005. Expedition group 1 (07 - 19 March) detected an average of 153 animals per counting day. In the second group (21 March - 02 April) this average was 191 animals per day.

Table 2.3f Effort in game counting during the expedition.

	Group 1	Group 2	**TOTAL**
Number of counting days	7	7	**14**
Number of hours spent on this activity	14	14	**28**
Total km driven	87	115	**202**
Total number of animals sighted	1069	1340	**2409**
Average number of animals per day	153	191	**172**

The most numerous species were hartebeest (948 animals), oryx (513 animals) and springbok (441 animals), followed by eland (141), kudu (116 animals) and warthog (96 animals).

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Table 2.3g Animals per species sighted by the two different expedition groups.

	Kudu	Oryx	Harteb	Warthog	Springb	Steenb	Waterb	Eland	Zebra	Giraffe	Jackal	**TOTAL**
Group 1	59	207	470	50	193	20	26	0	35	4	5	**1069**
Group 2	57	306	478	46	248	21	8	141	21	11	3	**1340**
TOTAL	**116**	**513**	**948**	**96**	**441**	**41**	**34**	**141**	**56**	**15**	**8**	**2409**

Game densities (number of animals per unit area) were estimated using the Distance Sampling Programme (Buckland et al. 1993). One of the major advantages of distance sampling is that some, or even many, of the objects may go undetected. Central to the concept of this method is the detection function. Generally, detectability decreases with increasing distance from the transect line.

Distance sampling theory considers certain variables like average group size, spatial distribution, etc. of the animals. These factors are different between species. This is the reason why for example springbok density is higher than the density of oryx although fewer springbok were detected during the expedition.

Table 2.3h Estimated game densities (number of animals per 10 km²) for the dominant prey species.

	Group 1	Group 2	**Entire expedition**
Kudu	34	22	**27**
Oryx	34	85	**63**
Hartebeest	206	150	**174**
Warthog	63	35	**47**
Springbok	158	43	**93**

Game densities were estimated for each expedition group, as well as for the entire expedition. It is thought that fluctuations from one group to the other in all species are mainly due to rainfalls and migratory patterns within the study site.

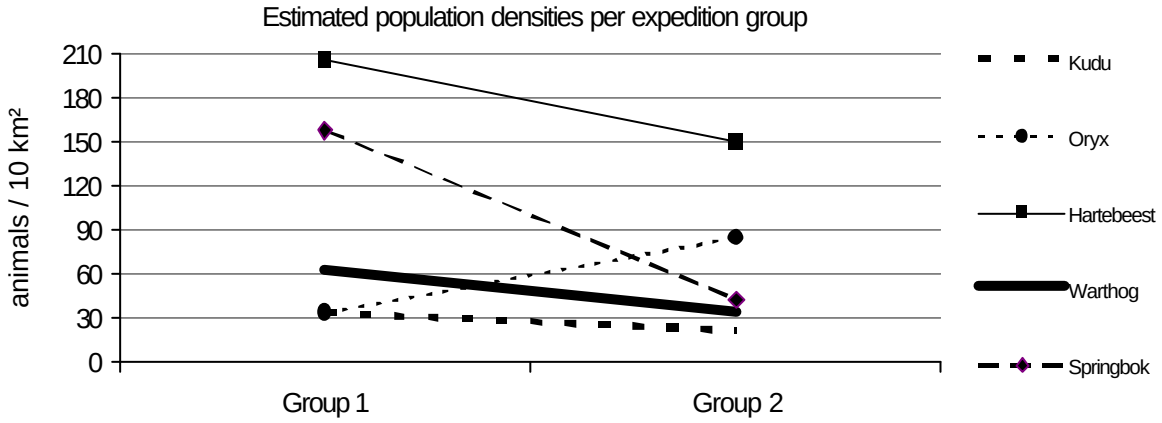

Figure 2.3a Estimated population densities (number of animals per 10 km²) of kudu, oryx, hartebeest, warthog and springbok per expedition group.

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Using average known population densities (number of animals per 10 km²), total numbers were calculated for the farms *Eorondemba* and *Okatumba West*, which together cover an area of 98 km². The calculations estimate that there are about 265 kudu, 617 oryx, 1705 hartebeest, 461 warthog and 911 springbok on the two farms.

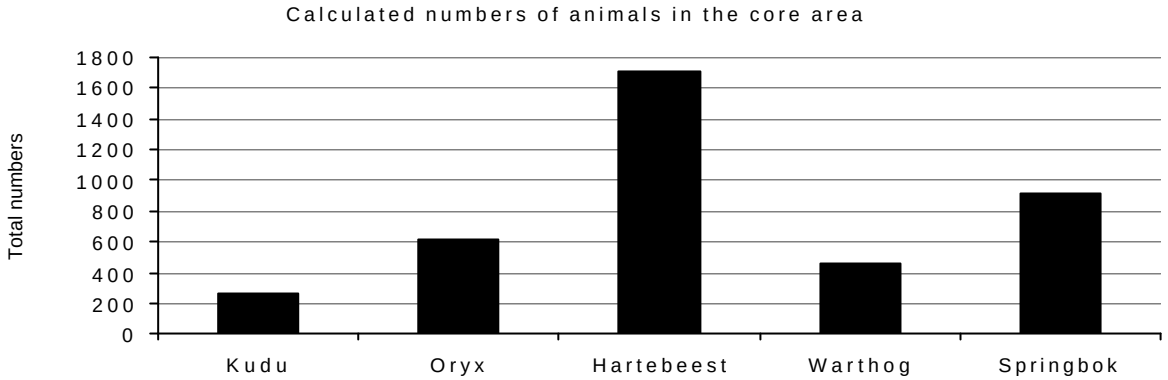

Figure 2.3b Total numbers of kudu, oryx, hartebeest, warthog and springbok on 98 km² (farms Eorondemba and Okatumba West). Numbers are calculated on the basis of estimated population densities during the expedition (22 counting days in six weeks).

Compared with the results that were obtained from the expeditions at the end of 2003 and 2004, game count data appear to reflect quite accurately what is known to have happened to populations, i.e. natural incidents, as well as game management activities:

Table 2.3i Changes in total numbers of the dominant prey species.

No. of animals	2003	2004	2005
Kudu	300	380	265
Oryx	1200	640	617
Hartebeest	550	725	1705
Warthog	430	420	461
Springbok	620	800	911

Although kudu were trophy hunted, as well as shot for own use (meat etc.), the total kudu population showed a growth rate of 27% from 2003 to 2004. The apparent population decline in March 2005 is thought to be due to data sampling error due to dense vegetation. This species does not flee from an approaching vehicle, but hides in the bush. Therefore, kudu are difficult to detect during the rainy season.

The oryx population declined from 1200 animals in 2003 to 640 animals in 2004, which is mainly due to capture activities that took place in August 2004. Additionally, this species was used for trophy hunting and meat production. Reduction of oryx numbers has been a management aim of the resident farmer. The calving season of oryx peaks in September, so oryx numbers in March 2005 were nearly the same as in November 2004.

Although hartebeest were used as trophy animals, as well as shot for meat, this population shows a growth rate of 32% from 2003 to 2004. In March 2005 more than twice as many hartebeest were counted than in October/November 2004. One reason for this immense increase is the calving season, which peaks in December and January. Another reason may be sampling error related to the animal's ecology: during the calving season, when hartebeest occur in very large herds, double counting errors are much more likely.

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From 2003 to 2004 the warthog population shows a small decline of 2.4%. As this species was not utilised by the farmer, except for a few individuals shot as trophy animals, it appears that warthogs are more vulnerable to natural influences like predation and diseases than other species. In addition to this, warthogs suffer from poaching and as such often die in snares. Nevertheless, from November 2004 to March 2005 the warthog population shows a small increase from 420 to 461 animals.

The springbok population was not influenced much by the farmer. It shows a natural growth rate of 29% from the end of 2003 to the end of 2004 and of 14% from November 2004 to March 2005 respectively. This corresponds with the fact that springbok have two calving seasons throughout the year. The figures indicate that factors like diseases or predation did not harm the springbok population within the Seeis study site.

Cheetah sightings

In total the expedition team had three cheetah sightings. During aerial radio tracking on 10 March the female cheetah with three cubs was located on a western neighbour farm. As Harald saw the radio-collared mother and one cub only, it was decided to conduct a ground follow on these study animals in the afternoon to check whether all three cubs were still alive. The entire expedition team went to the neighbour farm and managed to approach the cheetah family that was still resting under a bush at the same position as in the morning. Suddenly the mother's signal switched from inactive to active. Some of the team members also became very active (!), and they were able to observe the mother and her three cubs running away, passing the game-proof fence to *Okatumba West*, stopping at a hill and looking back.

The next morning the telemetry group picked up signals from the female with her cubs again. This time the family was located in the south-east of *Okatumba West* near the border fence where two box traps were situated. While approaching trap No. 2, the telemetry team spotted the mother and two juveniles. At the same time the cheetahs became aware of the vehicle and fled through the fence onto the neighbour farm. As the box trap was closed, the telemetry team went there to check the trap, and they found the third juvenile in the trap. An exciting and successful capture story began… ("see "Capture Activities" above).

On 21 March one part of the expedition team went to arm the box traps while the other part underwent their driver training. The trap setting team drove along the eastern border fence, and suddenly somebody spotted a springbok carcass that was lying very close to the path. At the same time another team member detected a cheetah about 20 metres away. The cheetah turned its head to look at the group before running into the bush. Investigation of the carcass showed that the springbok was killed by the cheetah some minutes ago. This cheetah was subsequently captured ("see "Capture Activities" above).

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2.4. Discussion & Conclusions

Expedition concept

Starting in 1998 OWR mainly worked with skilled biology students. The co-operation with Biosphere Expeditions starting in 2002 was our very first experience with largely untrained research assistants from all walks of life and of all ages. Before the start of the first expedition in 2002 we were sceptical, but after more than three years of co-operation with Biosphere Expeditions we consider the expedition concept to be an excellent one. Expeditions run by Biosphere Expeditions are a real asset for all concerned: local scientists gain important assistance for their conservation work, team members increase their knowledge about habitats and/or species and gain some real hands-on research experience.

Usually we do not have the manpower, time and money to conduct game counts, radio telemetry or spoor tracking on a daily basis, and we are very thankful for the additional data gained from four weeks of intensive research. Besides that we receive financial and in-kind support such as, for example, the Land Rovers and this allows us to purchase special research equipment or to employ specialised labour-intensive sampling methods, which would not be possible without Biosphere Expeditions.

Data quality

The expedition team consisted of highly motivated people who came in their holiday time to work with us on a research project. The work they put in and their expedition contribution helped us to gather large amounts of data, which would not have been collected without this expedition.

As regards data quality, one must be aware that data sampling was conducted by people with little or no training apart from that given during the expedition introduction period. Although all groups were assisted by a local scientist, student and/or tracker, it is very difficult to avoid problems associated with a large number of people collecting data. For example, the kind of standardisation whereby one person always samples the same data is impossible during an expedition, because all team members understandably want to take part in all research activities.

Some field techniques like checking box traps or searching for marking trees are easy to learn, whilst others like game counts, spoor tracking or radio telemetry require the acquisition of some specialised skills. For this reason some data are more vulnerable to errors and quality problems than others and each expedition data set needs to be assessed on a case-by-case basis.

In general, however, this is not a significant problem, since most of the key questions require continuous data collection over a time period of several month or even years by a multitude of helpers. Data gathered during the expedition(s) will be included in long-term data analyses, rather than being analysed as single data sets in this report.

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For example, it is not possible within the scope of this expedition report to determine home range sizes or territories out of four weeks of data collection (although some generalised conclusions based on our work with Biosphere Expeditions since 2002 are drawn below).

In general all data gathered during the expedition are important and useful. For example, telemetry data gathered during the expedition make a major contribution to interpretation of aerial radio tracking data and additional ground tracking conducted throughout the year. Game count data collected during the expedition will, over time, give us additional information on spatial distribution of various prey species, which is important for interpretation of the space use patterns of our study animals. Population densities estimated from data collected during the expedition correspond with results obtained from quaterly game counts conducted on Eorondemba and Okatumba West since November 1998.

Conclusions and Outlook

As stated above our experiences with Biosphere Expeditions since 2002 are entirely positive and we look forward to continuing the partnership. From our side we must ensure that:

- ✓ introduction to the project and research activities is conducted comprehensively,
- ✓ sampling methods are transparent and understandable for everybody,
- ✓ activities are not boring (or if so, it has to be very clear why they are as important as the more exciting ones),
- ✓ team members are kept highly motivated and thus continuously concentrate on the task in hand,
- ✓ data sampling is correct and continuous,
- ✓ data quality is as high as possible,
- ✓ data entry is transparent, intuitive and easy to understand and therefore works well.

The post-expedition questionnaires indicate that we reached most of these goals. Although everybody was informed that the probability of seeing or even capturing a cheetah during two weeks is very low, most of the expedition team members understandably hoped to get in contact with one of our study animals somehow. During this expedition we were fortunate in capturing six cheetahs, and hence everybody had the chance to witness immobilisation techniques and to touch a wild cheetah.

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Spoor density as an indicator for cheetah density:
overview of results 2002 – 2005 for Omitara and Seeis study sites

Team members worked successfully, and field data collected during the expeditions run by Biosphere Expeditions and Okatumba Wildlife Research in 2002, 2003, 2004 and 2005 increased our knowledge about:

a) cheetah density in two different study sites

b) availability of cheetah prey animals

c) space use of certain study animals

Effective conservation management of large carnivores requires reliable estimates of population densities. That is why the project aims to establish spoor density as an index for true cheetah density, following the methodology developed by Stander (1998) for lion, leopard and wild dog. The main requirement to reach this goal is knowledge of the true density through recognition of each cheetah that uses the study area. Then spoor counts can be conducted independently to asses the relationship between true population density and spoor density.

At our first study site (Omitara), we were unable to complete the data collection necessary, as we had to leave the study site early (see report of the expedition in 2002), During the eight weeks of expedition work at Omitara we found 75 cheetah tracks and identified more than 20 cheetahs that entered or left the farm *De Hoop*. Although 13 of these animals were captured, marked and released, we were still lacking crucial information on the remaining ones by the time we had to leave.

At our second study site (Seeis) working on the farms *Eorondemba* and *Okatumba West* from May 2003 to April 2005 we completed the data collection required. It took almost two years of intensive data collection and study, to which Biosphere Expeditions was essential, until we were certain that we had successfully identified all cheetahs ranging within the study site. The results showed that cheetah ecology on Namibian farmland makes it generally difficult to use spoor counts as an indirect sampling method to determine true population density. This is because some of the home ranges are extremely large, with great areas of overlap. Habitat use of the study animals is an important variable that influences spoor counts on roads. In a homogeneous habitat, cheetahs would use roads at random, but in a heterogeneous, natural habitat, such as the Seeis study site, cheetahs naturally prefer certain areas, and as a result spoor frequencies are not distributed randomly.

In both study sites, Omitara and Seeis, a large amount of natural prey like springbok, steenbok, warthog, (juvenile) kudu and hartebeest were available, and as a result our study animals were not forced to prey on livestock. Scat samples, which were collected to determine prey species taken by the cheetahs, are still waiting in the freezer to be analysed. Results on the cheetah's diet might be available by the end of 2006.

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Cheetah space use patterns and home range size
overview of results 2002 – 2005 for Omitara and Seeis study sites

As cheetahs need extensive amounts of space, aerial radio tracking is an important tool for determining space use patterns and home range sizes of our study animals. Location rate is high (about 85%) during tracking flights, but low (less than 20%) during radio tracking on the ground. Nevertheless telemetry activities by car or on foot are important to obtain additional or missing pieces of information.

Different methods may be used to analyse telemetry data and in this report we would like to look at two of them, the Minimum-Convex-Polygon (MCP) Method and the Kernel Method.

The MCP Method is one of the earliest (Hayne 1949) and still a widely used method for calculating home ranges (Harris et al. 1990). In this method the peripheral locations of a given data set are connected so that they form a polygon. The MCP method is very simple, and the resulting home ranges are comparable between different studies, but it has several disadvantages. For example, the home range is highly correlated to the number of locations, and it does not give any information on how the area is used. Evaluation of areas that are more important to the animal than others is not possible with the MCP method. Besides, occasional exploration trips of an animal may lead to home range sizes that are (much) too large. This is why researchers often take a certain percentage of the locations (e.g. 95%) for data analysis only.

An alternative method, the Kernel Method, is currently considered to be the most suitable for home range estimation (Powell 2000, Worton 1995). With this method a probability density function from the recorded locations is calculated to determine a utility distribution. Home ranges are then defined by drawing contours around areas with equal intensity of use. From a biological point of view the Kernel method is much more realistic than the MCP method (see below).

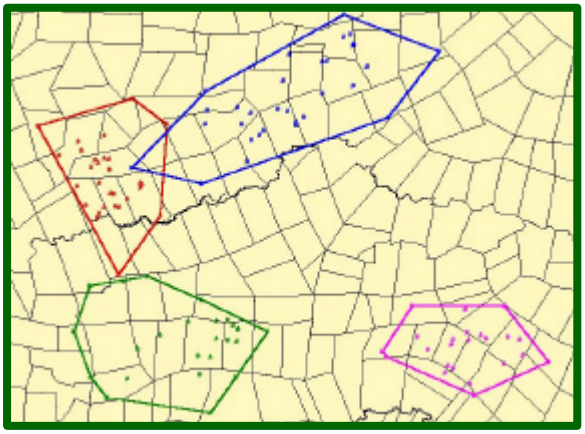

Figure 2.4a Home ranges of 4 different female cheetahs using the MCP Method Background: Farm boundaries.

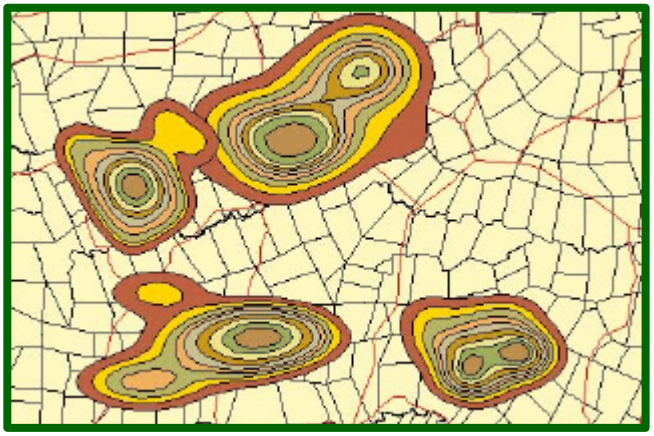

Figure 2.4b The same home ranges estimated with the Kernel Method.

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To visualize this method each location is covered by a three-dimensional bell-curve, the kernel. Directly at the data point the intensity of use is high. The further away from the location, the flatter the kernel becomes, and the smaller the intensity of use by the animal is. The resulting home range looks like a hilly surface. Hills resemble areas that are intensely used by the animal, valleys show areas that are less frequently used. The method itself selects occasional explorations of the animal, which are not part of the estimated home range.

Home range sizes of our study animals vary from 60 km² to 1580 km² (MCP method). Male coalitions of two or three cheetahs (that are considered to be brothers) use small home ranges and appear to hold territories, while single males roam over very large areas. Home range sizes of females are somewhere in between. We believe that space use patterns of female cheetahs depend on and vary with their reproductive status. When they are in oestrus, they use larger areas, but when they have cubs they range in small areas. The bigger the cubs, the larger the home range becomes.

This conjecture is supported by the patterns observed during the expedition, when expedition team members working in the Omitara study site often received signals from the male coalitions, but location of the single males was difficult. In the Seeis study site (2003) the male coalition ("Max and Moritz") was located most often. In 2004 all females were accompanied by cubs of different ages and used home ranges of different sizes. The female with the youngest cubs (5-6 months) could not be located, because she was known to stay about 40 km east of the core area. Team members managed to locate the mother of the elder cubs (7-8 months) on six days and the female with juveniles (almost one year) on three days. In March 2005 the latter one was assumed to be showing the periphery of her home range to the youngsters, which were about 17 months old and close to independence. That, we think, was the reason for not getting any signal of this study animal.

During ground follows we received information on where the animals were staying, what they were doing and how many cubs were still alive. Even if the cheetahs were not seen, we could search for their tracks and reconstruct the situation. Altogether this allowed us to draw a reasonably accurate picture of cheetah ecology and behaviour within the core area of our study site.

As mentioned above this expedition was the third and last one within the Seeis study site. In June 2005 Okatumba Wildlife Research moved from Seeis to Wilhelmstal where a new study site has now been established. The habitat at Wilhelmstal will allow us to extend our focus from cheetahs to include leopard and brown hyaena in future studies too. Research questions will stay the same and most of them require data of an additional study site in order to leave the regional level and to obtain reliable information on a more national scale.

We look forward to being assisted in our research and conservation work at Wilhelmstal by Biosphere Expeditions in the autumn of 2005 and beyond.

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2.5. Acknowledgements

We thank all expedition team members, as well as staff members for their amazing effort. This expedition made a major contribution to the cheetah project and really assisted us in increasing our knowledge about Namibian cheetah ecology.

We are grateful to Land Rover for supplying the expedition vehicles. We also thank Motorola for providing radios, as well as Silva for providing binoculars, GPSs and compasses.

Last, but not least our thanks goes to the farmers in and around our previous study area for giving us the permission to run the expedition on their properties and for their cooperation.

2.6. References

Altmann, J. (1979) Observational Study of behaviour: sampling methods. *Behaviour* 49: 227-267.

Bartmann, D.W. (1981) The cheetah problem in Namibia/South West Africa. *Zoologischer Garten* 51 (1): 52-64

Barnes, J.I. & J.V.L. de Jager (1996) Economic and financial incentives for wildlife use on private land in Namibia and the implications for policy. *South African Journal of Wildlife Research* 26 (2): 37-46

Becker, E.F, M.A. Spindler & T.O. Osborne (1998) A population estimator based on network sampling of tracks in the snow. *Journal of Wildlife Management* 62 (3): 968-977

Berry, H. (1990) Large-scale commercial wildlife utilization: Hunting, tourism and animal production in Namibia. In: *Wildlife Research for Sustainable Development*, 45-49. Ed. J.G. Brootenhuis, S.G. Njuguna and P.W. Kat. Proceedings of an International Conference held in Nairobi, April 1990.

Berry, H. M., M. Bush, B. Davidson, O. Forge, B. Fox, J. Grisham, M. Howe, S. Hurlbut, L. Marker-Kraus, J. Martenson, L. Munson, K. Nowell, N. Schumann, T. Shille, F. Stander, K. Venzke, T. Wagener, D. Wildt, S.E. Seal, U. Seal (1997) Population and habitat viability assessment for the Namibian cheetah (*Acinonyx jubatus*) and lion (*Panthera leo*). Workshop Report, February 1997.

Brown, C. J., ed. (1992) Namibia's Green Plan (Environment and Development). Ministry of Environment and Tourism, Windhoek, Namibia.

Buckland, S. T., D.R. Anderson, K.P. Burnham, J.L. Laake (1993) Distance sampling: Estimating abundance of biological populations. Chapman and Hall, London.

Burnham, K. P., D.R. Anderson, J.L. Laake (1980) Estimation of density from line transect sampling of biological populations. *Wildlife Monograph* Number 72.

Caro, T.M. (1994) Cheetahs of the Serengeti Plains. Group living in an asocial species. The University of Chicago Press, Chicago.

Caughley, G. (1977) Analyses of vertebrate populations. John Wiley and Sons, London.

Cormack, R.M. (1968) The statistics of capture-recapture methods. *Oceanogr. Mar. Biol. Annu. Rev.* 6: 455-506.

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Durant, S.M. (1998) Competition refuges and coexistence: an example from Serengeti carnivores. *Journal of Animal Ecology* 67: 370-386.

Gaerdes, J.H. (1974) Geparden in Südwestafrika. *Mitteilungen der SWA Wissenschaftliche Gesellschaft* 14 (9-12): 1-31.

Hanström, B. (1949) Cheetahs provide an unusual experience. *African Wildlife* 3 (3): 203-209.

Harris, S., W.J. Cresswell, P.G. Forde, W.J. Trewhella, T. Wollard, S. Wray (1990) Home-range Analysis using Radio-Tracking Data - A Review of Problems and Techniques particularly as applied to the Study of Mammals. *Mammal Review* 20: 97-123

Hayne, D.W. (1949) Calculation size of home range. *Journal of Mammalogy* 30: 1-18

Joubert, E. (1984) The cheetah: South West Africa's spotted enigma. *South West Africa*: 13-18.

Joubert, E., P.K.N. Mostert (1975) Distribution patterns and status of some mammals in South West Africa. *Madoqua* 9: 5-44.

Kraus, D., L. Marker-Kraus (1991) The status of the cheetah (*Acinonyx jubatus*). Report to the IUCN/SSC Cat Specialist Group.

MacDonald, D.W., C.J. Amlaner (1980) A practical guide to radio tracking. In: A Handbook on Biotelemetry and Radio Tracking, Ed.: C.J. Amlaner & D.W. MacDonald, Pergamon Press, Oxford.

Marker, L. (2000) Aspects of the ecology of the cheetah (*Acinonyx jubatus*) on north-central Namibian farmlands. Namibia Scientific Society, Journal No. 48: 40-48.

Marker, L., D. Kraus, D. Barnett, S. Hurlbut (1996) Cheetah survival on Namibian farmlands. Cheetah Conservation Fund.

Martin, R.B., T. de Meulenaer (1988) Survey of the status of the Leopard *Pandera pardus* in Sub-Saharan Africa. CITES, Switzerland.

McVittie, R. (1979) Changes in the social behaviour of South West African cheetah. *Madoqua* 11 (3): 171-184.

Mills, M.G.L., J.M. Juritz, W. Zucchini (2001) Estimating the size of spotted hyaena (*Crocuta crocuta*) populations through playback recordings allowing for non-response. *Animal Conservation* 4: 335-343.

Morsbach, D. (1987) Cheetahs in Namibia. *Cat News* 6: 26.

Norton, P.M. (1990) How many leopards? A critism of Martin and de Meulenaer's population estimates for Africa. *South African Journal of Science* 86: 218-220.

Nowell, K., W.C. Gasaway, T. Preisser, E.E.C. van Adrichem, O. Forge, L. Scheepers, B. Fox, W. Versfeld, C. Brain (1997) Factors relevant to the conservation management of cheetah in the Etosha National Park. Review draft, unpublished.

Otis, D.L., K.P. Burnham, G.C. White, D.R. Anderson (1978) Statistical inference from capture data on closed animal populations. *Wildlife Monographs* 62: 1-135.

Panwar, H.S. (1979) A note on the tiger census technique based on pugmark tracings. *Indian Forestry* (Special issue on International Symposium on Tiger), February: 70-77.

Powell, R.A. (2000) Animal Home Ranges and Territories and Home Range Estimators. In: Boitani, L. & T.K. Fuller (eds) Research Techniques in Animal Ecology - Controversies and Consequences: 65-110, Columbia University Press, New York.

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Sargeant, A.B. (1980) Approaches, field considerations and problems associated with radio tracking carnivores. In: *A Handbook on Biotelemetry and Radio Tracking*, Ed.: C.J. Amlaner & D.W. MacDonald. Pergamon Press, Oxford.

Smallwood, K.S., E.L. Fitzhugh (1995) A track count for estimating mountain lion *Felis concolor california* population trends. *Biological Conservation* 71: 251-259.

Stander, P.E. (1998) Spoor counts as indices of large carnivore populations: the relationship between spoor frequency, sampling effort and true density. *Journal of Applied Ecology* 35: 378-385.

Stander, P.E. (2001) Summary of range country overview presentations (Namibia). In: Global Cheetah Conservation Action Plan, Final Report from the Workshop held in South Africa from 27 to 30 August 2001, p. 8.

Worton, B.J. (1995) Using Monte Carlo simulation to evaluate Kernel-based home range estimators. *Journal of Wildlife Management* 59: 794-800.

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3. Expedition leaders' diary: Namibia 2004 (kept by David Moore)

5 March

With just a couple of days before the first expedition team members arrive, here's the first instalment of the diary for the spring 2005 cheetah expedition.

Having just arrived a couple of days ago myself from the freezing temperatures of Europe, the 26 degrees and clear blue skies make a pleasant change. But watch out for the evening chills - yesterday there were complaints when the temperature dropped to 22 degrees! Afternoon showers seem to be order of the day, however, as we're just approaching the end of the rainy season, so be prepared for the odd downpour.

Harald and Birgit, our scientists, have been busy with preparations for Monday's launch with a repositioning of the new cheetah box traps, along with the help of their band of assistants and helpers. The traps are unarmed at the moment as we don't have the time and manpower to check them on a daily basis, but from Monday onwards checking them will be part of the team members' daily activities - Birgit has already mentioned a large number of cheetah tracks found on the farm.

Today we'll spending most of the time down at the camp, stocking the kitchen and preparing the safari tents, as well as checking over our brand new Land Rovers and sorting out the expedition equipment.

Looking forward to meeting the first team on Monday!

10 March

A very enthusiastic start from the first team who are into the swing of expedition life here at basecamp in the Namibian bush. No sooner had we settled in to the camp on Monday than we were out in the field, one group following the 4-wheel driving training course and arming the traps in the north of the farm and the other heading down south to set the other box traps: it was a good day for spotting game with the giraffes and zebras located along with the more numerous oryx, kudu and springbok.

Now fully trained up, the research activities started for real yesterday with each group splitting up and undertaking their own tasks. The spoor tracking group had great success with cheetah spoor found in three different locations, while the telemetry team picked up signals from a leopard nearby on the neighbouring farm. Excitement for the box trap team came when they also found cheetah spoor leading towards box trap number three and noted through their binoculars that the trap was closed. Upon closer inspection, however, they discovered it did not contain our study species, but rather an angry warthog, which they immediately released. Two more warthogs were released by this morning's team.

Yesterday afternoon the follow-up team picked up signals from W007, a collared female cheetah with her cub from the neighbouring farm. This has now been confirmed with a precise location from Harald this morning: He took his once fortnightly aerial telemetry flight across the study area to test all the collared frequencies in the study area. The telemetry team then moved in to the border fence location and again picked up signals from her. With such a large number of spoor tracks located along with the telemetry readings there is clearly a lot of cheetah activity in the area.

Meanwhile everyone is enjoying time at base: Dee's star-lit cabaret performances around the camp fire are proving a popular evening option, and Rocky the Rabbit, Wendy's travelling mascot, has proved very cooperative in posing for suitable photo opportunities.

13 March

Having located cheetah W007 by aerial telemetry on Thursday morning, we were then successful at locating her on the neighbouring farm in the afternoon. About half of the team spotted her and her three cubs as she moved swiftly over the headland in the direction of our study site.

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Excitement mounted on Friday morning when the telemetry team radioed in with news of a sighting of the same animal spotted crossing the fence line. They also reported news of the capture of one of her cubs in the nearby box trap! Leaving our regular morning activities, we swung into action, transferring the captured cub to a holding cage and positioning three further traps around the marking tree in an attempt to capture the rest of the family (who will generally return to a capture site in search of a captured family member).

Sure enough, by Saturday morning we had a family of four cheetahs in the box traps and an intense morning's work for Harald, Birgit and their assistants. Although the cubs are too small to have collars fitted, each of the animals was sedated for an examination (numerous blood tests, eye/ear/nose/saliva smears, collection of parasites, measurement of body size and weight). The cubs took a little time to find their feet after the anaesthetic wore off, but they all recovered fine. With the procedures completed by late morning, we returned the box traps to their original locations in the afternoon and were able to pick up signals from the morning cheetah over on the neighbouring farm.

More routine activities now pretty much resumed, we're recovering from the excitement of this exceptional turn of events! The game count team this afternoon had to be satisfied with only (!) jackals, vultures, warthogs and steenbock. I don't think anything could really top the events of the last few days - although there is a leopard and cub regularly located by telemetry to the north of the farm. Perhaps we can persuade her to join the expedition next week!

18 March

The leopard made her appearance yesterday morning in the form of a leopard tortoise in one of the box traps. According to reports she was very obliging and happily posed for the team members.

The morning activities on Tuesday and Wednesday did not provide a lot of evidence of cheetah activity (although there were spoor by box trap number 6), so without any urgent follow-up to do, we were able to concentrate on some of the other research activities: the game count teams gathered over thirty observations on their route and saw a group of aardwolf and a pair of secretary birds. We've also undertaken waterhole observations: along with providing complimentary data for calculating game densities, they are also a good occasion for watching the warthogs who come down to drink with their young.

Yesterday we found several fresh cheetah spoor both entering and leaving the farm along the fence line and in the afternoon leopard spoor were discovered just a couple of kilometres from the camp. None of the spoor could be linked in with signals form the telemetry team, so they are presumably from uncollared animals.

The clear blue skies are back so we should be in for a good farewell sunset for the first team. The definitive song-list is pretty much finalised for tonight.

22 March

A lot has happened since the new team's arrival at base camp yesterday.

By mid-afternoon we were out in the field and I was accompanying one of the offroad training groups as we headed out towards the riverbed training ground. Harald came over the radio with news of a cheetah sighting by his box trap team as they drove down the eastern fence line. They had first come across a springbok kill by the roadside before a cheetah popped out from behind a small tree about 30 metres in front of them, gave the team a filthy look (according to Sara), and beat a hasty retreat in to the bush.

Upon returning from the box trap round they discovered the cheetah had since returned to its kill, moved it a few metres and eaten a bit more. At the end of the afternoon we all gathered at the site and assisted in the repositioning of one of the box traps with the kill inside. It was unsure if this technique would succeed in trapping the cheetah, but they are generally keen to return to their kills, as long as they made the kill themselves recently (you can’t bait cheetahs with just any kind of meat).

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This morning we began by checking the northern box traps (with appearances from the two giraffes, a few zebra, lots of lappet-faced vultures) before heading down to the trap containing the fresh kill, which was by now closed with the cheetah inside! By this time she had polished of three quarters of her springbok and wasn't too happy about being cooped up in the trap!

Harald and Birgit were keen to undertake the veterinary investigation, but did not want to retain her for long in case she had cubs waiting for her return. Yet given that she had recently eaten, it was impossible to sedate her immediately. As a compromise we left the procedure until late afternoon and darted and immobilised her around 5 o'clock today. Everything went well - a 40kg female without cubs, she recovered well from the intervention and was seen darting off in to the bush about an hour ago (too young to be collared, she was fitted with a microchip to assist with future identification).

A very surprising and overwhelming first day for the new team members (and a unique birthday present for Ursula). We'll catch up with the planned activities tomorrow and see what other surprises are in store!

27 March

By Wednesday afternoon we were able to begin with the routine activities, one team getting to grips with the data input while the other went out on the game count. The follow-up team had their introduction to telemetry (and came across a male cheetah spoor). One day before the full moon and a reasonably clear night, we walked along the dried-up river bed and up on to the damn wall in the evening to appreciate the night sounds and glowing animal eyes.

Thursday was quiet with a dramatic storm, making telemetry impossible, but Friday and Saturday brought new signs of considerable cheetah activity: signals were received from cheetah no. 2 as well as nos. 15 and 16, the brother coalition. Just to the east of the farm, perhaps they are responsible for spoors located next to the two northern box traps. Spoors were also discovered along the eastern fence line, presumably from uncollared animals.

Waterhole observations have brought a close encounter with a warthog family and yesterday we were able to observe bat-eared foxes. Though usually shy, this group seemed unperturbed by our presence. Now at the end of the rainy season there are lots of little waterholes amongst the greenery, many filled with turtles.

Meanwhile everyone has settled into the rhythm of life at base camp. The night time animal invasion much talked about over breakfast on Friday turned out to be donkeys. The horses have also chosen the camp as a grazing ground once we leave the camp fire at night.

30 March

On Sunday afternoon we had a session at camp where everybody had a chance to practise some of the techniques used in last week's cheetah capture, including darting our model cheetah. He still has a very broad grin despite being punctured by dart holes. Then Monday was a day off so we all drove in to Windhoek and most continued on to the Düsternbrook guest farm to experience their cheetah and leopard enclosures before meeting up at Joe's beer house in the evening. A very fun and entertaining day…

Yesterday was action-packed for the box trap team: Though no cheetahs, they did have to release a baboon and her baby, a warthog and a porcupine who took some encouragement to vacate the trap. The telemetry team was also busy, getting signals from cheetah no. 6 somewhere close to the farm as well as 15 and 16 to the north of the farm and the leopard with her two cubs.

Much to the frustration of the afternoon follow-up team, they were unable to gain any further signals in the afternoon. Though the game count team found only a low density of game, they got close to the giraffes and found warthogs wallowing by the central borehole.

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Now I'm up at the farm preparing the roof-tents for tonight's planned sleep-out: The nights are clear at the moment, so we're going to leave camp tonight to find an open spot in the bush. I've just heard the spoors team coming in over the radio. They've found cheetah spoor 0.4 km into their route so the telemetry team is on their way to follow it up…

2 April

Slot 2 brought the expedition to a climactic end with the capture of this year's sixth cheetah.

After Ursula's birthday cheetah last week, expectations were high for me to produce something exciting for the box-trap team in recognition of my 31 years. I thought the porcupine release from the penultimate trap would be enough to satisfy this demand, so I was more than a little surprised when we came across our big cat friend in the last trap. Josef picked up leopard spoor just by the trap, so we had a moment's hesitation establishing the cat's identity (!) ... but he is now known as cheetah W021, a 40kg male, captured once before in May 2004, and thought to be the son of the collared cheetah W014 who we follow on the telemetry.

Once we had succeeded persuading him to move to his holding cage, we placed a couple more traps around his tree on the off chance that he formed part of a coalition. With no further captures by Friday morning, we proceeded with the darting, anaesthetising and sampling procedures. It was discovered that he had quite a large wound where he had been caught in a snare, though this was healing well and his weight was normal for his age. A real show-biz cheetah, he was more than happy to pose for the group upon recovery before shooting off in to the bush.

With the weather remaining fine in the evening, we ended the afternoon activities a little early to rendez-vous up at telemetry point no. 2 from where we could get a great view of the surrounding plains and a last Namibian sunset.

The team members having just departed, this brings the expedition for spring 2004 to a close, so many thanks to everybody for contributing to making it a success. Thanks to the cheetahs too. I'm looking forward to helping Harald and Birgit with the establishment of their new study-site for autumn of this year. Apparently they actually have real leopards there…

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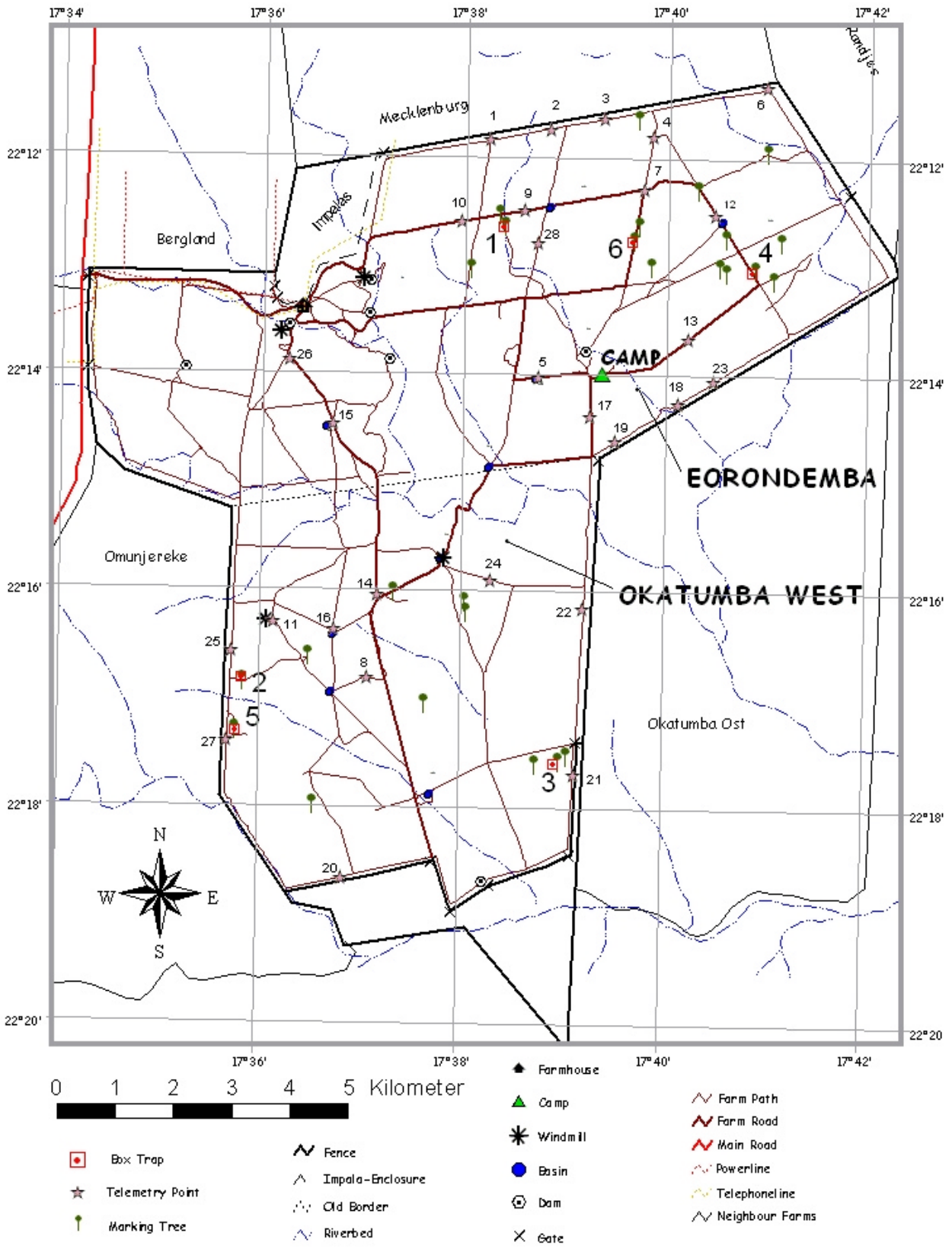
Appendix 1 – Map of study site



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