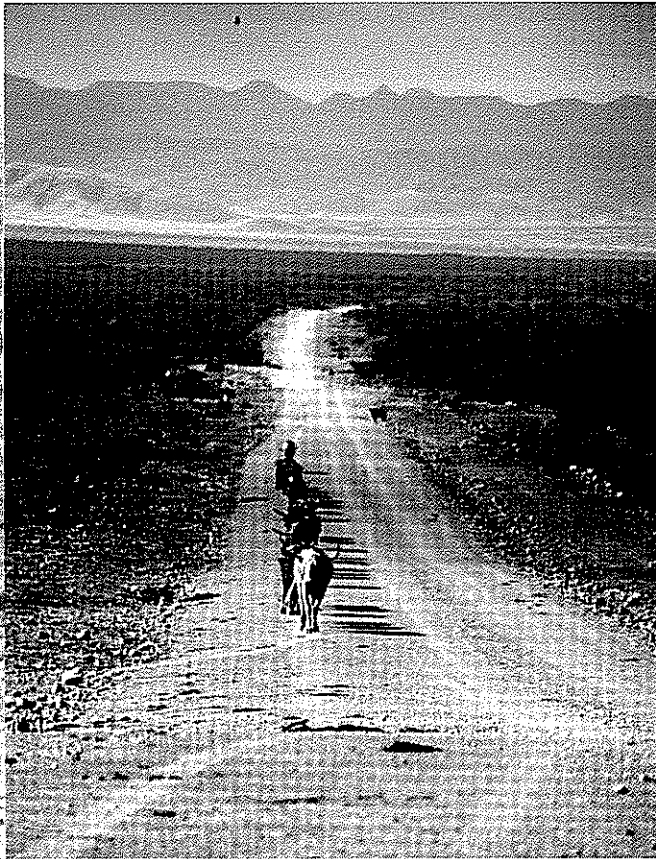


HOANIB RIVER *Catchment*



STEPHANIE AND
JULIAN FENNESSY

Acknowledgements

This booklet resulted from a three year project conducted on the Hoanib River Catchment by the Desert Research Foundation of Namibia in collaboration with government ministries and departments, communities and local NGOs, for which the Swedish International Developmental Cooperation Agency provided the funding. Dr Keith Leggett served as project coordinator and worked in collaboration with Julian and Stephanie Fennessy. Following completion of the Hoanib River Catchment Study, Leggett is pursuing further research on the elephants of the area with funding from Earthwatch, Denver Zoo, Wildlife Conservation Society and Bronx Zoo in addition to private donors. He has generously agreed to include new information gathered up to January 2004. This publication thus shares the most recent breadth of knowledge gained about elephants, a keystone species in the Hoanib River Catchment. Roger Swart is thanked for his contribution to the final draft of the chapter on Geology.

We are indebted to the Namibian Ministry of Agriculture, Water and Rural Development for their sponsorship of this project. We thank the chairman of our Steering Committee, Bernd Rottkegel, and the several members who met quarterly to advise us about the perspicacity of directions the investigation was taking. Members of the committee represented local communities, Government Ministries and NGOs working in the area. We are particularly pleased to acknowledge support received by the communities the project was associated with. In particular, we recognise the Community Researchers, Ms. Magdalena Eises (Erweë), Mr. German Muzuma (Otjokavare), Mr. Theodore Tjizembisa (Omuramba), Mr. Willy Ganaseb (Khowarib), Mr. Titus Hambo (Warmquella) and Ms. Flora !Haradoës (Sesfontein) for their support. The communities' ongoing observations, contributions to the veld assessment procedures we introduced, and their ensuing supportive response is deeply appreciated.



Sida



Editors: Bill Hamilton, Sharon Montgomery

Layout: Sharon Montgomery

Photographs: Hoanib River Catchment Study, DRFN (unless otherwise specified).

Foreword

This small booklet is designed to bring to short-term visitors to the Hoanib and to longer-term residents a brief overview of results of the three-year Hoanib River Catchment Study 1998-2000. It highlights some of the information gathered and approaches used during arduous months of fieldwork by community researchers and project staff. It is, however, neither a research report nor a field guide to the area. Instead it focuses on topics identified, early on during the project, as interesting or important to those living amongst, using and managing the varied natural resources of the catchment. For those who are strangers to this river basin, we hope it provides a bit of additional information to enhance your visit. For those of you who are long-term residents, perhaps it will provide a different perspective to your view of this fascinating landscape.

Although touching only a few points, this small booklet is based on a three-year research project focused on basic socio-economic and biophysical research illuminating environmental issues important for sustainable use and development of natural resources in the basin. Potential challenges in the area revolve around the dynamics of different discourses and include: escalating, uncontrolled tourism; increasing aspirations and expectations of local residents often based upon popular (mis)information; interactions amongst the various role players in the basin; limited water availability and a relatively fragile environment.

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Windhoek

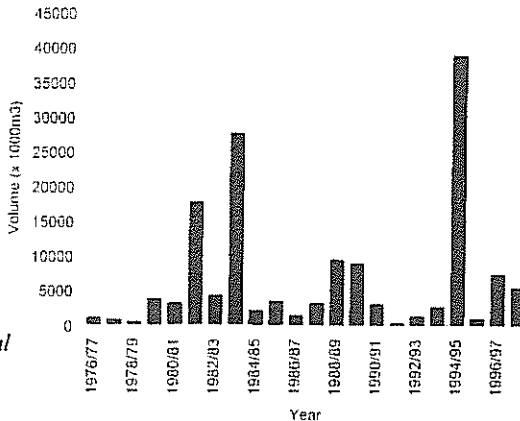
Namibia's Ephemeral Rivers

There are 12 major westward flowing ephemeral rivers in Namibia. The catchments of these rivers encompass 188 000 km², almost a quarter of Namibia's landmass. They range from 2 200km² (the Khumib River catchment) to approximately 30 100km² (the Swakop River catchment). Frequency of flooding varies from river to river and depends on the catchment size, the amount of annual rainfall and, in some areas, the water capacity of upstream dams. Flows of these rivers seldom reach the ocean, but occasionally a massive flood will reach a delta, as did the 1934 flood of the Kuiseb at Walvis Bay. In this study we noted that the greatest loss of a keystone plant species, the Ana Tree (*Faidherbia albida*), was due to the 2000 flood.

Eight of the 12 ephemeral rivers have their headwaters in private farmlands. Ten of them flow through communal farmlands. All 12 originate, drain through, or flow into proclaimed conservation and tourism areas and either end in the Namib Desert dune sea or flow directly into the Atlantic Ocean during significant flooding. Vegetation along the linear oases formed by these ephemeral rivers provides food resources essential to domestic stock and wildlife.

According to the long-term record from the weir at Sesfontein, the Hoanib River flowed every year from the 1976/77 season to the 1999/2000 season, when this study ended. In only 6 of these years were the annual flow rates above the average of approximately 6 million cubic meters per year. While the highest annual flood volume was approximately 38 million cubic meters, in 1994/1995, the greatest number of flood days was 52, in 1982/1983.

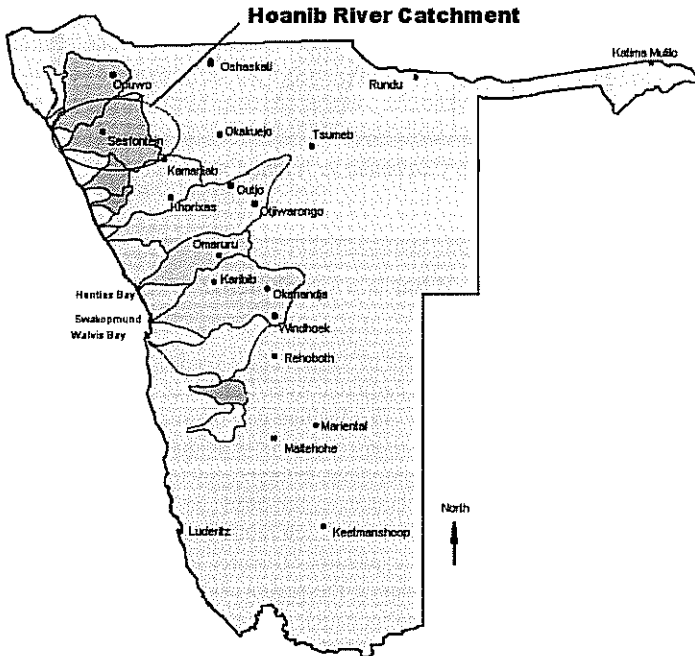
The Hoanib River flows westwards towards the coast through a steep climatic gradient. Mean annual rainfall at its origin may exceed 350mm but where the river reaches the floodplain and coast, this declines to less than 20mm.



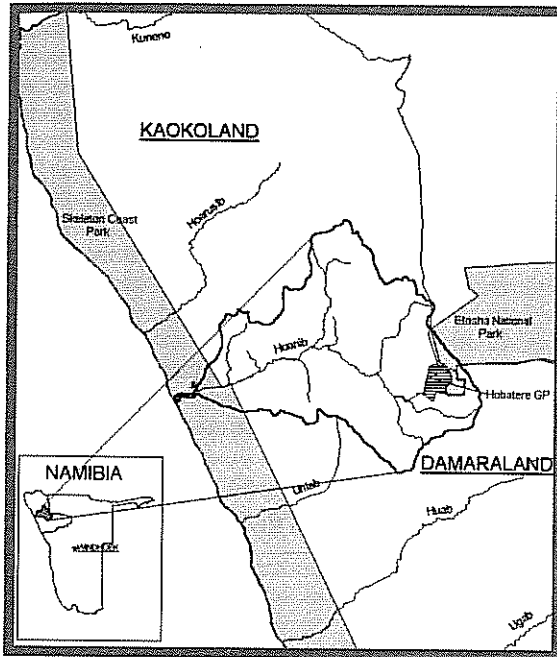
Historical annual flow rates at the Sesfontein Weir

What is an Ephemeral River?

While perennial rivers usually flow throughout the year, an ephemeral river flows rarely or intermittently and in some years not at all. In Namibia, ephemeral rivers flow only during the summer rainy season after unpredictable heavy rains. Flows rarely last more than a week. There are no perennial rivers with river courses entirely within Namibia. Perennial rivers in Namibia occur only along its borders (the Cunene, Zambezi and Orange Rivers) or where they cross the northeastern part of the country (the Okavango River). Factors such as surface flow, recharge into alluvial aquifers, and groundwater availability are closely linked in ephemeral rivers. People, domestic stock, wildlife and vegetation depend on this surface and underground water for their year-round water supply.



*Namibia's 12 Ephemeral
River Catchments*



The Hoanib Catchment in relation to Namibia

What is a Catchment?

A catchment (or basin or watershed) is the land area that drains rainfall into a particular river. Catchments are often separated from each other by high ground, such as ridges or mountains. Each river catchment is unique because of its geological, geographical, climatic, sociological and biological features. However, the overriding similarities of water flow from areas of high rainfall into the desert, coupled with similar patterns of water usage, support the concept of managing the region and its rivers as a single unit. In Namibia efficient management of river water in the several catchments is essential because they support three of the largest sectors of the Namibian economy – agriculture, tourism and fisheries.

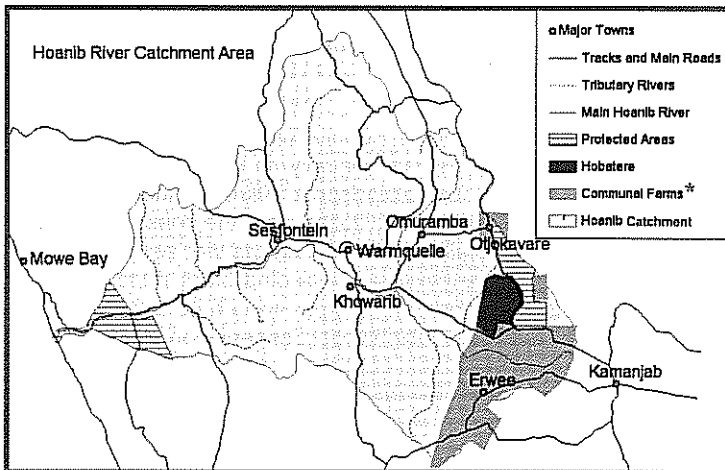
The Hoanib River

The Hoanib River Catchment is one of the westerly flowing ephemeral river catchments in semi-arid northwestern Namibia. The catchment occupies a total area of 17 200 km², 3% of which is private farmlands, 91% communal farmlands and 6% is protected in parks (Etosha National Park in the east and Skeleton Coast Park in the west).

The Hoanib River is the boundary between the former Damaraland and Kaokoland. Since independence in 1990 the catchment has been incorporated into the Kunene Region and can be divided into three broad geographic sections:

Eastern Section

East of the Khovarib Schlucht and on into Etosha National Park, this section is relatively well vegetated, with Mopane (*Colophospermum mopane*) dominating. The dominant land use here is pastoral grazing practised mainly by Otjiherero-speaking farmers. In the 1950s they were deprived of part of their traditional grazing and were forcibly removed from the area, which was incorporated into Etosha National Park. In the 1960s, in accordance with the homeland policy during the apartheid era, people had to move once again. Since independence in 1990 many people have returned to their traditional grazing areas. Mobility and new settlement is at present (2003) an active process. Expanding numbers of Otjiherero-speaking pastoralists are exerting an ever-increasing pressure on areas already heavily utilised in this section.

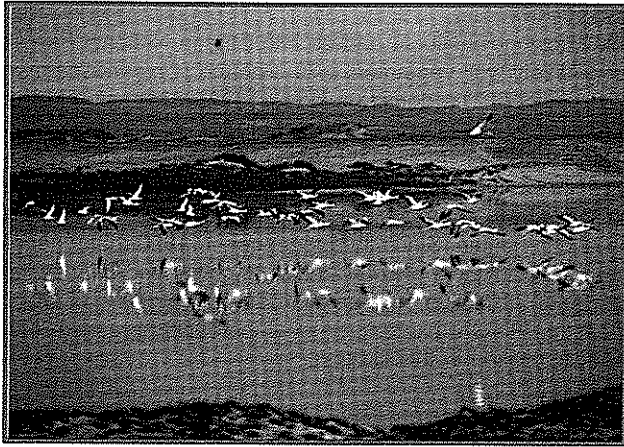


* Demarcated communal farms

The traditional authorities of Damaraland initially established Hobatere Game Park on the eastern edge of the catchment as a wildlife area in the early 1980s. It was originally used for hunting and is now run as a private tourism concession.

Central Section

The middle section, from the Khowarib Schlucht to Skeleton Coast Park's eastern boundary is sparsely vegetated. The main land use is nomadic pastoralism and irrigated agriculture (maize, wheat, melons, peppers and oriental tobacco). In the lower reaches of this area little human impact is evident and tourism remains the most valuable source of income. This area provides prime habitat for wildlife.



Flamingoes at the Hoanib River mouth

Western Section

The western and lower section of the Hoanib River, from the Skeleton Coast Park boundary to the coast, has virtually no vegetation outside the Hoanib River course. A broad floodplain (some 70km²) in the Skeleton Coast Park, located east of the moving dunes near the coast, provides substantial grazing for wildlife after floods during the wet season. Significant populations of large mammals including black rhinoceros and coastal elephants occur here. Several species living here are classified as rare or endangered by the IUCN (The World Conservation Union).

People have long been part of the landscape in the Kunene Region with old Damara settlements and rock engravings dating back thousands of years found throughout the catchment. Today there are approximately 7 000 people living in the catchment, the majority in the eastern section. Community-based conservation has changed traditional land use practices and attitudes in some places. Tolerance for wildlife and tourism is emerging.

Geological History

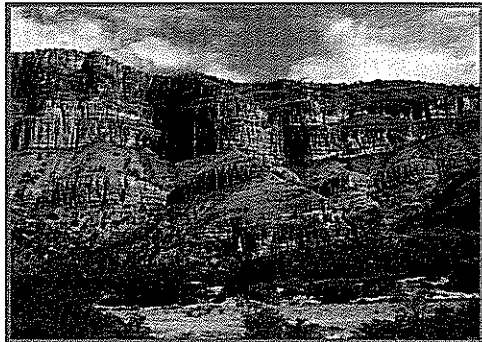
The dramatic land formations of the Hoanib River Catchment are the result of a long and complex geological history. The visible folds and whorls of the rock formations of the Khowarib Schlucht and the majestic Etendeka and Grootberg mountains were formed through millions of years of volcanic eruptions, earthquakes, continents colliding and being rent apart, oceans forming, receding and re-forming, floods, glaciers, deserts and more floods and then the ever-present wind that has scoured the land for centuries.

The earliest record of the geology of the area is from 2 700 million years ago when early mountain building processes formed what would become the core of the Congo Craton. These processes involved the collision and destruction of landmasses that we have no record of today. The Congo craton is one of two core mainland masses that survived later destruction (the other is the Kalahari Craton) and that form the basis of the southern African sub-continent as we know it today. At this stage they were still one land mass.

About 900 million years ago rifting started and two valleys developed, one splitting what is now the Congo and Kalahari Cratons along a belt several 100 km long from Walvis Bay to Zambia and another north-south, which separated these 2 cratons from the Sao Francisco craton in South America. Erosion of sediment from the adjacent highlands filled the rift valleys which slowly developed into substantial seas. The sediments laid down at this time are now known as the Damara Sequence

Within 190 million years reversal of the drift caused the three different cratons to collide with each other – in the Hoanib area the marine sediments from the west were thrust up and over onto the Congo craton. First evidence for the possibility of a "snowball" earth was discovered in the Damara sediments of this area.

About 300 million years ago at the beginning of the Karoo interval, large portions of northwestern Namibia were covered by the Gondwana ice age glaciers. These glaciers carved out many of the valleys that are present in this part of Namibia, including some of those in the Hoanib catchment (eg. The Ombonde).



The amphitheatre in the Khowarib Schlucht

The basalts and quartz latites of the Etendeka Plateau represent the initial stage of the break-up of the south west part of the Gondwana Continent about 135 million years ago. Undisputed similarities between the geology of South America and north-western Namibia provide fascinating proof of shared geological formations which moved thousands of miles away (in fact some of the first evidence in the world of plate tectonics).

Tectonics – (rock deformation)

The Hoanib River Catchment is interesting not only because of its great variety of rock types but also because of its tectonics. The dominating tectonic feature is the Sesfontein Thrust, which divides the Damaran shelf sediments to the east from the deep-water facies to the west. West of the thrust plane, rocks of the Epupa Complex (gneisses and amphibolites) are sheared and thrust over the much younger Damaran metasediments. Carbonates of the Damara sequence predominate east of the thrust. These carbonate rocks, formed about 500 million years ago around Khovarib, were also effected by tectonic processes which are visible in the large folded structures of the rocks.

Despite our knowledge of the processes forming the rocks and soils in the catchment, the formation of the Hoanib River course is still not fully understood. The geological map shows dominant north-south striking geological structures such as the Epupa and Damaran rock formations with the Hoanib cutting perpendicularly through some of the hardest rocks found in Namibia, forming the Khovarib gorge and the Ganamub poort. A change in the base level two to four million years ago led to this downcutting. Gravels and finer material associated with this and later events permit us to begin to interpret not only geologic materials but also climatic changes associated with them. Climate changes in the Hoanib Catchment and elsewhere in Namibia continue to the present. During the past millennium there have been wetter and dryer intervals associated with diagnostic sediment deposits including the Amspoor silts, believed to be a former Hoanib River delta now 50 km from the Atlantic.

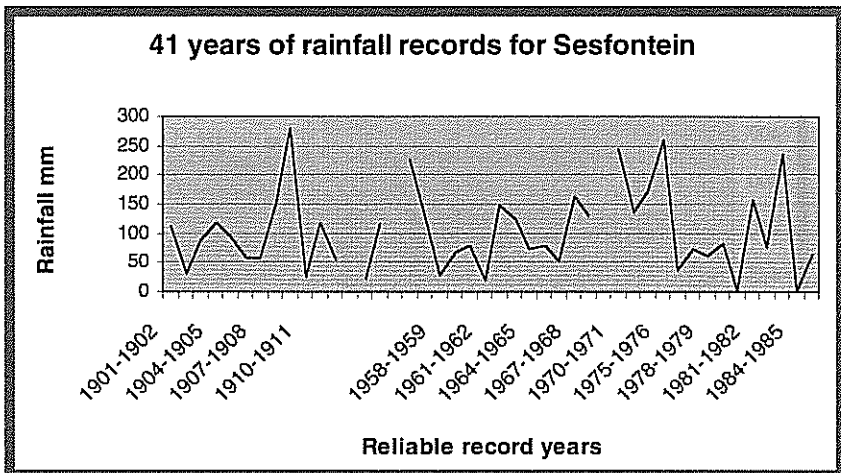
Climate

The defining feature of the Hoanib and the other westward-flowing ephemeral rivers is the climatic gradient, ranging from over 350mm rainfall in the mountains above the escarpment to an average of less than 20mm at the coast. Although no areas in the catchment are lush, seasonal rain in the mountains maintains open woodlands and, because it is spatially larger than the coastal part of the catchment, the inland area acts as a rainfall and runoff trap – when and if it rains. A further consequence of this gradient and its spatial configuration is that the rivers maintain riparian fringes of substantial trees, especially Ana Trees, throughout most of their course. At the expansive delta, where the sand sea usually blocks the river, abundant grassy and woody plant flora support antelope, elephants, oryx and other large mammals and a smattering of diverse bird species, an arrangement particularly attractive to the tourism companies and their clientele.

Throughout the catchment there are three distinct seasons:

- **Wet season** - from January through April
- **Cold-dry season** - from May through August
- **Hot-dry season** - from September through December.

The wet season is highly variable. Rainfall ranges from 0mm (1981) to 350mm (1995) at Sesfontein. Even if there is no rain in most of the catchment, rainfall in the upper end of the catchment may cause the Hoanib River and/or its tributaries to flow. Depending on how late in the season the first rains fall, temperatures may reach 40° C during the day and fall only to 30° C at night. However, once rain begins temperatures generally fall to around 30-33° C during the day and 20-23° C at night.



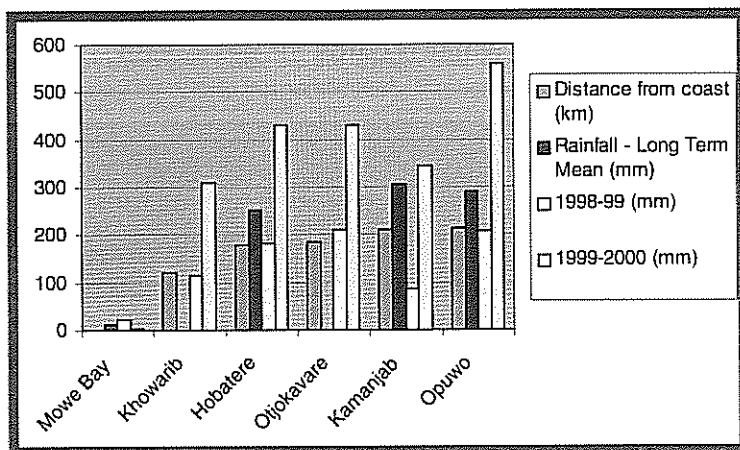
During the **cold-dry season** (winter) it is not uncommon for the overnight temperature to drop below 0°C. Days are clear and warm with average temperatures of 20°C. Rain falls very rarely during the cold-dry season.

The hot-dry season is exactly what its name implies. Although September can be mild, October warms up and phases in the hottest months of the year, November and December. Highest temperatures occur at the end of the calendar year just before the start of the wet season. Daily temperatures are generally between 35-40°C or more. Overnight temperatures fall to approximately 30°C.

In the western (Namib and pro-Namib) section of the catchment, rainfall is extremely sparse by any global standard. This is an extreme desert. Heading inland the rainfall increases, resulting in a steep rainfall gradient. Rainfall has a high degree of variability, up to 50% annually in the east and 90% in the west.

Mean potential evaporation from open water surfaces in the Hoanib Catchment can reach 2 500mm a year in the eastern section, i.e. more than eight times the mean annual rainfall in the inland headwaters, and more than two hundred times greater in the arid west. Thus water is lost from the ecosystem and is generally not available on the surface for most of the year. Where surface water is available in the form of springs and wetlands, the high rate of evaporation frequently produces highly saline soils.

While annual variation in rainfall patterns is common, the average variation may be minimal for several years, as was the case between the 1950s and 1980s. During the 1980s years of high aridity prevailed. These were lean times and large-scale die offs of domestic stock (up to 90%) and wildlife (up to 60%) occurred.



Rainfall gradient from the coast inland in the catchment

Vegetation

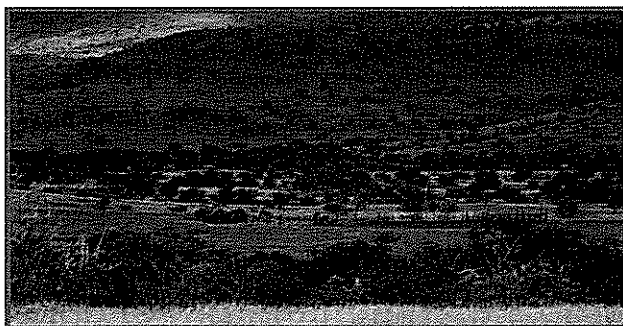
The variable rainfall across the Hoanib River Catchment is the primary determinant of the catchment's diverse vegetation structure. Coupled with temperature, soils and topography the vegetation structure changes across the east-west rainfall gradient, giving rise to a large variety of plant communities and productivity.

Mixed *Colophospermum mopane* woodlands, corresponding with the 200-350mm rainfall zone or isohyet, dominate the eastern catchment. Throughout the central catchment (100-200mm rainfall) the taller *Colophospermum mopane* woodlands give way to smaller or stunted mopane, while in the western reaches (50-100mm rainfall zone) larger stands of ephemeral grasses *Stipagrostis uniplumis* dominate the landscape forming permanent grasslands. Large trees are found only along the river courses namely *Faidherbia albida*, *Acacia tortilis*, *Acacia erioloba*, *Combretum imberbii* and *Combretum wattii*, as well as *Colophospermum mopane*.

The floristic communities, diversity, density, cover and population structure of vegetation across the catchment, vary markedly. Both annual and perennial grasses grow, flower and seed primarily during the wet season.

In the eastern and southern areas of the catchment, Omuramba, Otjokavare and Erwee, where the ranges of both domestic stock and wildlife are restricted by fencing or water availability, the impact on vegetation abundance and distribution is greatest. At Hobatere where wildlife exist in an 'open range' system and migrate seasonally both within and out of the area, their effect on distribution and abundance of vegetation is greatly reduced.

In the central area, particularly in the Sesfontein and Khowarib basins, the land has been grazed for centuries by local herders. Rangeland ecologists and sociologists have studied grazing and other livelihood practices of the local communities over the past decades with much reference to their negative impact on the land.



*Open Mopane
woodland at
Khowarib*

The best option, traditional nomadic grazing, is compromised by population growth and a national policy of encouraging settlement near water sources and in places where overstocking already exists.

Most importantly, the effect of intensive grazing and browsing of domestic stock and wildlife on plant species richness and diversity varies seasonally across the catchment. There are very few perennial grasses and little good quality browse in the catchment. An open range system, which allows herding of domestic stock and wildlife and free movement of wildlife during the wet and dry seasons, seems to hold most merit as an appropriate land management tool throughout the catchment. Although the 'high impact zone' appears to be limited to the vicinity of water sources and villages, increasing domestic stock numbers coupled with additional water sources would intensify competition for graze and browse. Further management options could include a better distribution of water sources, together with a coordinated grazing management system that is highly flexible and adaptive. Rapid Veld Assessment could support this approach.

Rapid Veld Assessment

Subsistence farming is the main livelihood of most people living in the Hoanib basin. As populations of people and livestock increase, active rangeland and livestock management becomes increasingly important. One key to successful subsistence farming is appropriate decision making based on adequate information. One tool for gaining this information, adapted and used in the Hoanib Catchment, is called Rapid Veld Assessment or RVA for short. This is a quick visual method used to assess rangeland grazing conditions and then aid farmers to make decisions as to where and when to move their livestock when conditions change. In days gone by, experienced farmers need only look at the grazing to make their decisions; today other grazers, other people and other activities such as tourism affect how people are able to manage the communal resources.

RVA does not attempt to identify different grass species but to assess overall abundance of vegetation cover in a particular area through the year. This tool requires only a small collection of photographs, depicting seasonal changes in grazing conditions. These conditions range, in 4-6 steps, from Bare Ground (no grass) through Poor Veld (small sections of bare ground, little grass) up to Excellent Veld (no bare ground, abundant grass).

Anyone can apply the RVA method after a short introduction with basic materials. A similar method has been incorporated into the Local Level Monitoring approach used by various farmers' associations and conservancies. The success of this method depends on its ongoing application and use in decision making. When it improves livelihoods of the farmers, then it has been worth the effort.

Erosion

Erosion affects more than 70% of southern Africa's surface area and has an immense impact at local and regional levels. Erosion is the most widespread of all environmental problems. Human activities such as agriculture, forestry, construction and land clearing are estimated to have degraded approximately 2 000 million ha throughout the world, with a little over half of it resulting from human-induced water erosion and a third of it due to wind erosion. In Namibia, the erosion of topsoil from rural areas, especially in the steeply sloped higher rainfall areas, is a significant factor increasingly limiting agricultural production and leading to land degradation, a process widely referred to as desertification by those investigating and attempting to ameliorate the process.

Ephemeral river flood events in the Hoanib and other rivers provide essential water in heavier rainfall years, from the mountains to the sea. But the same rainfall events, especially when they result from cloudbursts and short-term heavy rainfall, may not only cause erosion and denuding of slope soils but could also rearrange the configuration of the linear oases. As one area is affected by a loss of substrate, others downstream may benefit from sediment deposition, enriching soils and providing food and habitats. These newly formed environments have nutrient rich soils and promote growth of vegetation that otherwise would not colonize the arid Hoanib Catchment.

Within the catchment several erosion processes occur along the main riverbed and its tributaries, in the mountains and across the floodplains.

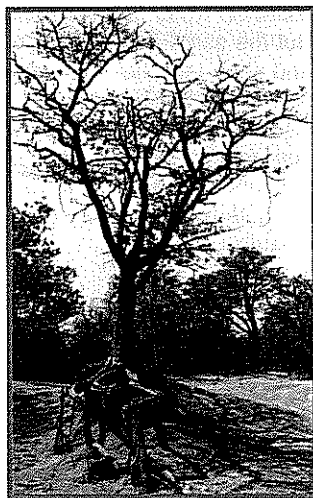
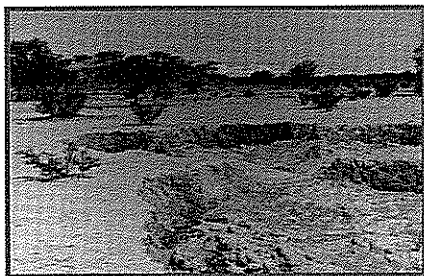
- Prevalent sheet, gully and wind erosion.
- In high rainfall years, large amounts of sediment are moved downstream along the riverbeds. The greater the volume of these floods, the greater the amount of suspended and river-borne sediment that is carried by the floodwaters.
- Significant amounts of organic materials are carried in and deposited by the floodwaters.
- The first floods carry more volatile organic compounds than later floods.
- Vehicle tracks persist and can be precursors to gullies in an otherwise stable substrate.

The suspended sediment recorded in Hoanib River flood events contain on average 14% carbon (organic) compounds and 86% inorganic compounds. Erosion occurring in the catchment is substantial. One study found erosion occurring at 70% of all sites, gully erosion at 50% of sites and wind erosion at 25% of them.

Erosion and associated processes alter the dynamics of a catchment system on an annual basis, whether through natural weathering or leaching or as a result of human activities such as over-grazing and compaction around villages.

Impacts of erosion caused by human activity are increasing in the catchment and are cumulative. These changes reduce the long-term productivity potential of the impacted areas. Erosion is a process that can be arrested by appropriate land use practices but one that cannot be reversed on a large scale. Irreversible losses in productivity are called desertification. Desertification impoverishes. Such effects with multi-generation consequences require the focused attention and remediation efforts of individual herdsmen, farmers and the government.

Examples of gully erosion caused by water



Vehicle Tracks

Sandy and gypsum soils are easily compacted by the heavy weight of vehicles travelling over them and the scars can last for decades. There is still evidence of the tracks of ox wagons made in the late 19th Century. These unsightly tracks are not only an eyesore, they compact the soil, which could cause erosion if there is a rare rainfall event. They also destroy the unique and delicate lichens that grow in the western section of the Hoanib River Catchment. Staying on existing tracks at all times limits potential damage to the environment and helps to preserve the aesthetic qualities of the near wilderness areas that attract visitors to this region. Engaging four wheel drive and driving slowly helps to prevent corrugations on tracks, making it less tempting for others to create new tracks.

People in the Hoanib River Catchment

With only 8 000 people living in the 17,200km² Hoanib River Catchment (an average of four people every 10km²) the area has one of the lowest population densities in Namibia where the average is 22 people every 10km². However, as in most parts of the country, the population is unevenly distributed due to environmental and climatic conditions, particularly availability of water.

As part of this project, a socio-economic baseline study was conducted in six different communities across the catchment; Khowarib, Warmquelle and Sesfontein, in the west, Omuramba and Otjokavare in the east, and Erwee in the southeast. The first two areas are divided by the Khowarib Schlucht, a narrow valley where the Ombonde River in the largely Otjiherero-speaking east becomes the Hoanib River in the largely Khoekhoegowab-speaking west. Erwee, the sixth focus community, is a Khoekhoegowab-speaking community in the southernmost part of the catchment, and the only one of the six communities that is located south of the veterinary cordon fence.

The Veterinary Cordon Fence, a game and stock proof barrier, was built during the 1960s to prevent the spread of Foot and Mouth disease from the north into the cattle producing areas of central Namibia. It stretches from the Springbok River in the Skeleton Coast Park in a northeasterly direction, skirting the southern boundary of the Etosha National Park and across Otzondjupa Region into Botswana. No traffic of cloven-hoofed animals or their products is allowed in a southerly direction and checkpoints are in place on all major access routes. The Red Line (as it is locally known) has had a major impact on migration patterns of wildlife and on the availability of markets for stock farmers living north of it. In recent times there have been proposals to move the Red Line to the northern borders of Namibia to allow for better marketing opportunities.

Rifts between some of the communities have limited planning and development of conservation, water and basic economic strategies. Community members, government and NGOs have held numerous community meetings to try to deal with these differences. The emergence of conservancies and a united wildlife policy have resulted from these discussions, however there are still many areas of conflict that need to be resolved. It is in the context of these rifts that progress, when it occurs, should be measured.

In the past, domestic stock production in the catchment was largely for local consumption due to the isolation of the area and the separatist policies of the colonial administrators. Since independence, a number of factors have dramatically changed the domestic stock-marketing

situation. The government has sought to integrate local stock producers into the formal market by extending marketing mechanisms to the area and by building the support structures necessary for market participation. Additionally, the end of the liberation war in northern Namibia has opened up a second market opportunity, particularly for cattle producers. With the end of hostilities, cattle producers in the northern catchment can safely travel to and from the north-central regions of Omusati, Oshana, Oshana, Oshana and Oshikoto (formerly Owamboland), and access the formal and informal meat markets in the Oshakati-Ondangwa-Oshikango triangle. Some producers insist that prices obtained in these informal markets rival (and even exceed) those available at formal markets.

By western standards the northern Hoanib Catchment is remote. Its natural beauty and wildlife attract tourists from around the world. Tourism is, however, a relatively new economic force in the area, and has only been felt in a major way since the end of apartheid. After 1990, both the willingness of international tourists to visit and the increase of investment opportunities have created a tourism boom for Namibia. Tourism and the wildlife that attract tourists may become the focus of economic activity in the catchment.

Sesfontein

Sesfontein is one of the oldest and certainly the largest community in the catchment with over 1000 residents. Oral and historical records indicate that human settlement has been on going since the early 1800s. The six springs at Sesfontein (the name means 'six springs' both in Afrikaans and Khoekhoegowab) provide ample water for irrigated crops, which have long been the economic base of the community. Wheat and maize are the staple crops followed by bananas, melons, squashes, and tobacco. Domestic stock is kept in and around the community, though many communal farmers with larger herds keep the bulk of their animals at posts more distant from developed areas.

Sesfontein serves as the effective capital of the area and in turn has the most highly developed infrastructure. Currently, the community has a clinic, a primary school, an Agricultural Development Centre, a Veterinary Resource Centre, a police station, administrative offices, auction facilities for domestic stock and a large airstrip. Infrastructure for direct FM radio transmission has been in place for some time and the introduction of telephone services has been a recent addition. The community will soon be connected to the national power grid and Sesfontein is to be declared a settlement area, the first step towards becoming a municipality.

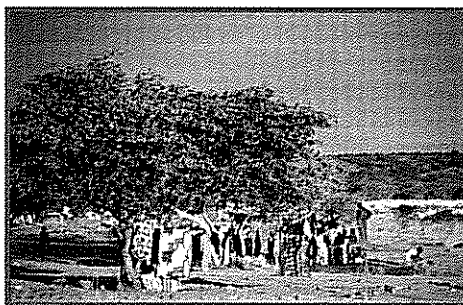
Grazing and family ties are the biggest attraction to this community and studies suggest that the gardens play a key role both in keeping people resident in the community as well as drawing young adults back to Sesfontein after brief jaunts into the market economy.

The settlement shows a relatively even generation distribution while educational levels are moderate with few gender imbalances.

Despite its lead in infrastructure development, Sesfontein has a low income structure, indeed the lowest in the catchment. Despite the extent and productivity of the gardens, the income derived from crops is low. Since pre-independence a number of programmes have tried to boost both agricultural production and income from marketing crops, the most recent an effort run by Agricultural Development NGOs on behalf of the government.

Warmquelle

Warmquelle is a largely Otjiherero speaking community located between Sesfontein and Khowarib on the main road to Palmwag. It has approximately 300 to 400 residents. Because of its ethnic make-up, there is a sense that this community is somehow different from its two neighbours. Like Sesfontein,



Warmquelle has a number of springs that irrigate large fields. The large gardens and the mix of crops are similar to those at Sesfontein. However, although low incomes are derived from crops, Warmquelle's income from vegetable marketing approaches that of Khowarib. Domestic stock farming is the main activity of the area and like their neighbours most of their stock is kept at posts outside the area.

The community benefits from its proximity to Sesfontein. The telephone service also serves this community and the same will be true for the FM radio service and electricity when the grid is extended to Sesfontein, as the power lines will pass close enough to benefit Warmquelle residents. There is also a junior primary school at the settlement.

There is an unusual demographic imbalance in the settlement. Unlike most other communities in the area, the number of grandchildren living with household heads is lower than the number of children. Possible explanations might be that youngest grandchildren are off on cattle posts scattered about the catchment or are at boarding school, as the local education facilities only cover the first three years of schooling. In general the education levels in Warmquelle are similar to those in Sesfontein.

Khowarib

Khowarib is the southernmost community in the western catchment and has a population of 350 to 400 residents most of whom rely on both farming and non-farming revenues. The number of people appears to have been declining since the mid-1980s, possibly due to problems with water

supply, particularly that for the gardening scheme, which was built by the colonial administration in the 1980s. The water system regularly silts up with river sand. The unreliable and low volumes of water delivered to the scheme have reduced its capacity. As a result many people have moved their gardens closer to their homes for easier access. These gardens are, however, not nearly as productive as those in the garden project.



Paprika farming project in Khowarib

Nevertheless, Khowarib residents report higher incomes from crop sales than those in Sesfontein.

Many residents of Khowarib are linked via kinship to Sesfontein residents. Indeed, there appears to be a steady movement of people between the two communities. Given the decline of the gardens over the past decade, as well as the growth of Sesfontein, it is not surprising that many residents of Khowarib are drawn to temporary or permanent residence there.

There are few formal work opportunities in Khowarib, and the decline of the gardening scheme has exacerbated this problem. This has led to a large proportion of 'missing generation' households, the middle generation being largely absent and grandparents are left to look after the children. The education level is slightly lower than in Sesfontein and Warmquelle.

Omuramba

Omuramba is a small farming community in the Beesvlakte, a broad plain in the north-east between the mountains bordering the western catchment area and the high ground that forms the Etosha National Park boundary. The Beesvlakte offers good opportunities for cattle production. Wildlife, in particular elephant and giraffe, occur throughout the area. Besides domestic stock production, the community has a series of rain-fed gardens. In most years the rainfall is sufficient to produce at least a crop of maize.

There is no infrastructure in Omuramba except for boreholes and a newly constructed conservancy office. The community is reached via tracks made in the soft alluvial deposits of the Beesvlakte. The closest school is approximately 7km away. There is one shop cum bar, run by a businessman from Rundu. All respondents noted that they came to the community (and remained there) because of grazing and/or water resources.

In Omuramba there are more adult children living in households than grandchildren. However, the percentage of children per household head is slightly lower than in the other communities, while the number of

grandchildren is much lower. Residents of Omuramba have the highest percentage of non-attendance in school. Over half the community has not attended school. Women are far more likely to have attended school than men.

Omuramba is the wealthiest community in the northern catchment. Income is mainly derived from cattle sales. Farmers not only sell their cattle to Meatco at auctions but also trek to the informal markets in the Oshakati-Ondangwa-Oshikango triangle. They point out that the advantage of informal markets is their constant availability.

Otjokavare

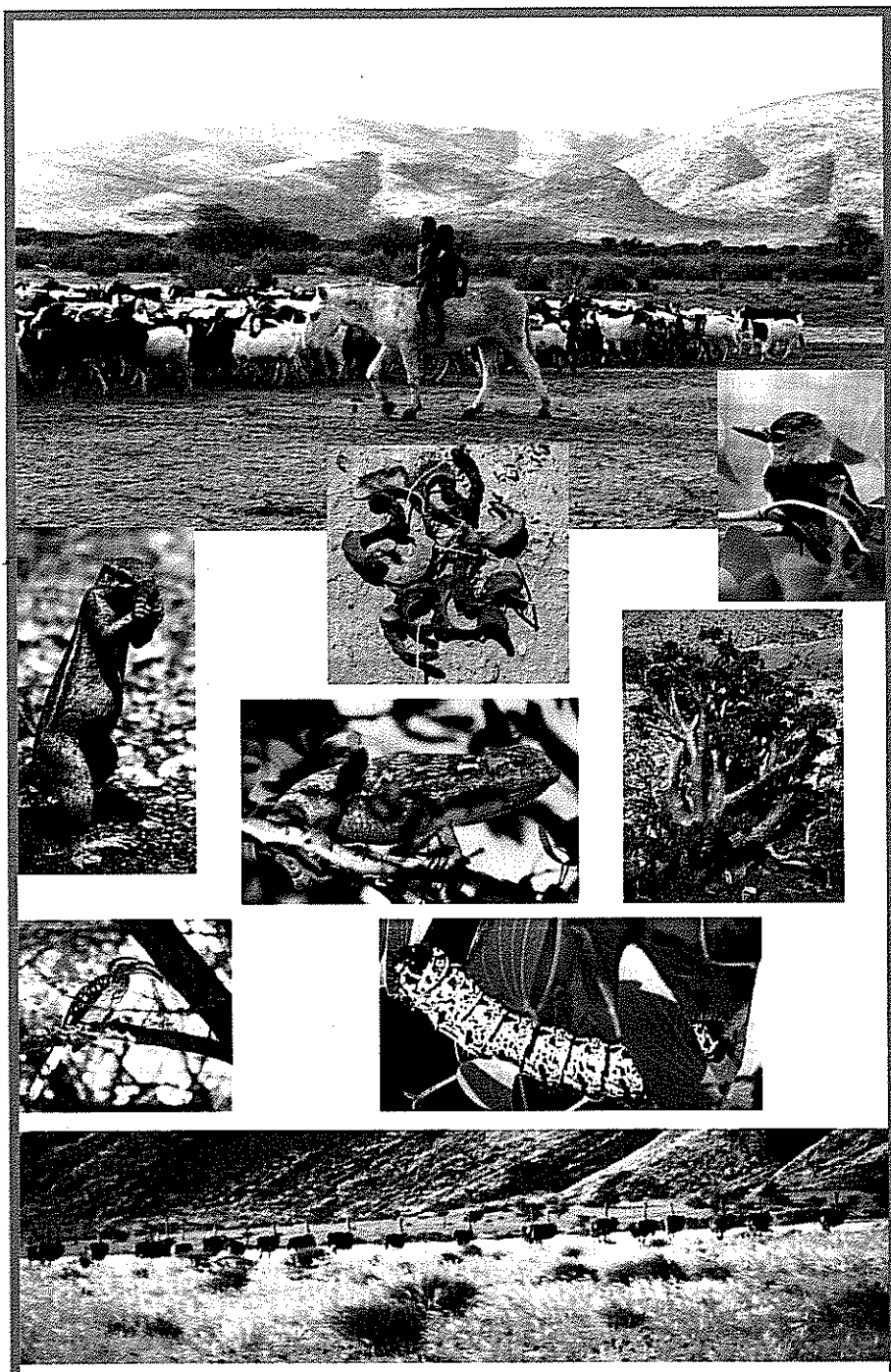
Otjokavare is adjacent to the Etosha National Park, and located on the main road between Kamanjab and Opuwo/Ruacana. The community is situated within what was once the Kowares Quarantine Camp, a camp where domestic stock was quarantined before being sold south of the Veterinary Quarantine Fence. The Werda Veterinary Fence Gate is approximately 20 kilometers south of Otjokavare. While no conclusive evidence is available, it is probable that the community developed in conjunction with development of the Quarantine Camp. The presence of the main road alongside the community ensures easy transport to and from Otjokavare. However, little has been done to take advantage of this traffic. Otjokavare has a school and a conservancy office. The closest clinic is in Werda. There are a few small shops in the community. There is no connection to the national electrical grid.

The households in Otjokavare have high numbers of children and grandchildren. One reason is the presence of the school that draws children from relatives living in neighbouring communities. In contrast to Omuramba, school attendance in Otjokavare is good, with relatively high education levels, exceeded only by Erwee. There are only marginal gender imbalances. Maximum incomes in Otjokavare are relatively high, with a moderate mean income.

Erwee

Erwee community is situated on the southern border of the catchment, south of the Veterinary Quarantine Fence. There are approximately 50 households in Erwee, housing some 500 people. Additionally, there is a primary school with 200 students, most of them boarders, a clinic and an Agricultural Development Centre. Erwee is located on the main road from Kamanjab to Palmwag and is therefore easily accessible. Erwee is also close to being declared a settlement. Telephone services have existed there for some time and it is already connected to the national power grid. Erwee's water supply is secured via a pipeline, which is fed by two boreholes north of the community.

Erwee shows the highest level of education in the catchment with no gender differentiation and has the second lowest average income in the catchment. Non-farming incomes of wages and pension are reported to be significantly higher than the farming income.



Water

Water in this arid environment is more of a miracle than the norm. The Hoanib River forms a "linear oasis" and wetlands along the river coincide with the most important biological and socio-economic areas in the catchment. They provide invaluable surface water for domestic stock and wildlife, as well as readily available sources of water for communities living in the area. The water is increasingly used in garden and irrigation projects, as well as for the expanding tourism industry.

The biophysical nature of the wetlands and other water sources such as seeps, springs, wells and seasonal water varies over time and is dependent on seasonal rainfall and water extraction. Rainfall is the only means by which the water table in the Hoanib River Catchment is replenished.

Numerous wetlands can be found throughout the catchment, either in the main riverbed or its tributaries. Springs, however, are located away from the river and are mainly concentrated around the Sesfontein and Khowarib basin.

Some of the individual springs and wetlands in the catchment are under pressure from humans to provide for an increasing population and thus water demand. However, the water quality of most of the springs and wetlands is of excellent quality for consumption by people, domestic stock and wildlife. There is a danger that negative examples of water 'mining', such as is currently happening in Palmfontein, will be duplicated in other parts of the catchment and in turn cause increased overuse and pollution of the limited and hence precious resource, water.

To ensure that the long-term impacts of people and their domestic stock on the water sources and their availability is minimised it should be attempted to use:

- an appropriate and catchment-wide approach to the positioning of additional water developments
- environmental impact assessment on any water development projects (including tourism development and town planning)
- monitoring and evaluation of any effect of the development on springs and wetlands.

The average water consumption in communities where water is available from taps in and around houses is approximately 60l of water per person per day. This is four times greater than in communities where water is fetched by hand from a single water source (approximately 15l per person per day). Consumption of water by domestic stock far outweighs that of people with the exception of Sesfontein, which is the only community in which human consumption of water exceeds that of domestic stock. Increased population and tourism coupled with a better infrastructure, accounts for this.

The biggest threat to the water resources is the increasing number of people, both local and tourists, domestic stock and wildlife. Existing water sources in the catchment have to be managed sustainably by local communities as main users. Conservancies are required to produce management plans for natural resource use in their areas and these will hopefully help to outline and in turn answer some of the key water-management questions. These issues should be given priority before any additional water development projects commence in the catchment, particularly as the miracle of these sensitive water sources is essential for life throughout the Hoanib River Catchment.

Erwee - a case for careful development

Erwee's water is supplied via a pipeline from two boreholes to the north of town, between Palmfontein Post 1 and the veterinary fence. Every month approximately 2 500 000 litres are extracted for use by Erwee residents.

People living in Palmfontein north of the veterinary fence rely on six springs and the flow of the ephemeral Palm River for water. The springs at Palmfontein used to flow all year every year, providing a secure water source for people, livestock and wildlife. However, since the mid-1990s, the springs began drying up early and people had to dig wells to enhance the water supply.

At present, the residents of Erwee enjoy increasing development and free water. However, the people at downstream Palmfontein have been excluded from these benefits and have an unreliable water supply. The short-term benefits of Erwee's intensified water abstraction are obvious but no one knows its long-term implications. In the future, other settlements, such as Khowarib and Sesfontein may also have less water due to high extraction rates upstream at Erwee and surroundings.

It is important to see the Hoanib River Catchment as one system. Appropriate water management and practices will help safeguard limited groundwater resources for future sustainable use. All stakeholders need to operate with less water than they have access to now to safeguard their current and future well being.

Arable Lands Agriculture

Water

Historically, arable agriculture was practised in small pockets throughout the Hoanib Catchment. The communities of Sesfontein, Khowarib and Warmquelle, located in the west, have strong springs used to grow crops. These ordinarily secure water sources provide sufficient water all year round, sustaining irrigation agriculture.

Since the last decades of the 1800s, crops such as maize, wheat, tobacco and fruits/vegetables have been cultivated, and thus have played an important role in local food security. Trade in crops, particularly wheat and tobacco, has also been extremely important. According to oral reports, this trade took place between local crop producers and communities of the surrounding Kunene Region, communities in Angola, as well as southwards into other areas of Namibia. Dates are obtained from existing palms at Sesfontein. Some naturalised tobacco is also grown and bartered for livestock with the Himba community.

Irrigation methods at these gardens are wasteful and water allocation among garden owners lacks coordination. There is a pressing need for appropriate water utilisation and its equitable distribution and allocation. As more farmers enter high-value cash crop production the need to tackle this question will become increasingly urgent.

Omuramba and Otjokavare in the eastern catchment lack secure natural water sources and rely on boreholes for their water supply. This limited water availability limits the area's potential for arable agriculture.

Climate

Summer temperatures in the range of 35-40°C in combination with extremely dry conditions limit the variety of agricultural and horticultural crops that can be produced successfully. Evaporation and evapotranspiration rates are high and rainfall is not adequate for crops. Strong, hot, east winds throughout the year pose an additional threat. However, frost-free nights, high diurnal temperatures and high levels of sunlight favour certain crops in the limited areas near springs where water is available.

Soils

The soils in the area are generally light and finely textured and thus easily worked. Despite being alkaline the soils are surprisingly productive even with minimal application of fertiliser, either artificial or kraal manure. Humus content is low due to the practice of allowing domestic stock access to crop residues.

Human Resources and Historical Practices

The potential for arable agricultural development in the western catchment may exceed current levels. Agricultural development projects introduced by Government or NGOs in the area have shown some limited success. One of the predominant limiting factors restricting agricultural development is sociological.

Leadership disputes and ethnic and political divisions disrupt the local society. These divisions seriously hamper development, which is manifested in the difficulties experienced in establishing appropriate agricultural co-operatives.

Access to and ownership of irrigated garden plots is limited. Most plot holdings are in the hands of older community members. Interested young people have little access to gardens.

New Initiatives and Potential

Agricultural development has in recent history been concentrated on the government owned garden in Warmquelle and the gardens in Khowarib. Community farmers are given individual allotments and marketing assistance and encouraged to take advantage of opportunities aimed at improving farming methods and the enhanced livelihoods. Positive results are emerging from this approach, which recognises the importance of combining development of human resources with production and marketing assistance.

The first crop introduced by this method was oriental tobacco. This is a labour intensive crop that, being an aromatic variety, thrives under hot, dry conditions on soils that are not fertile. Oriental tobacco has a low water requirement (approximately 25% that of maize or wheat) and the local farmers have produced some good quality offerings. In addition, due to warm frost-free winter conditions, up to three crops a year can be grown (each yielding an average of 1000kg/ha at N\$10/kg, thus giving farmers a possible income range of N\$10 000 to N\$30 000/ha/annum).

Trials are also underway on growing paprika for which there is high demand with an established market. It has the potential to become another economically lucrative crop.

Water resources for irrigation agriculture are limited and subject to long-term depletion if abstraction rates are not voluntarily curtailed. The exhaustion of aquifers on long-term and short-term bases will impose future hardships upon Hoanib catchment residents.

Domestic Stock Farming Practices

Crop production and domestic stock farming are the main economic activities in the Hoanib Catchment. In the early 19th century, when the first European explorers, settlers and hunters reached the Namibian interior, semi-nomadic pastoralism was the dominant socio-economic activity of the indigenous people. There are still large seasonal movements of domestic stock during times of grass and water shortages. Relatives in other areas may assist in providing family members with emergency grazing when fodder is unavailable in their area. It is common in periods of drought to see large herds of cattle being moved along the roads, sometimes to as far as 250km from their home grazing ranges.

Traditional pastoral farming practices in northwestern Namibia involved the continuing movement of stock (mainly cattle) from grazing area to grazing area, often over large areas depending on the spatial distribution of rainfall. Many cattle in the catchment are still farmed by this traditional pastoral practice.



Other pastoralists coped with the arid environment by dividing the cattle herds into smaller units and farming these smaller herds out to relatives in different areas (not necessarily at the same immediate location). This dispersal of herds was a way of 'spreading the risk' in times of arid climatic cycles, thus increasing the chances that some of the herd would survive a drought. Most small stock were traditionally not considered as valuable as cattle and were used for food. They were kept closer to villages and not herded like cattle. Today pastoralism is still the most prevalent form of land use, but movements are small scale.

The distribution of domestic stock in the catchment is limited by the seasonal availability of grazing and water. However, little difference exists in the distribution of domestic stock throughout the wet, cold-dry and hot-dry seasons, with the exception of the Khowarib plain and the Palmfontein area.

When grazing is depleted close to villages and near permanent water sources, domestic stock trek further each day in order to find sufficient grazing, before returning to drink. Domestic stock lose condition rapidly if they are forced to move long distances daily. Small stock (goats and sheep) graze to a maximum of 5-7km from water, cattle graze up to 6-7km from water. Cattle numbers decline in the catchment during the hot-dry season. This is probably due to the removal of some cattle as a strategy to avoid dry season overgrazing and crowding around permanent water sources.

When grazing is limited over the entire northwestern Kunene Region cattle are herded to areas that are not best suited for grazing. These areas are termed emergency grazing areas. In the Hoanib Catchment, the area in the southern section of the eastern catchment (Serengeti plains to Palmfontein) is used by the pastoralists of Otjokavare and Omuramba as an emergency grazing area. Pastoralists do not frequently use the area during relatively high rainfall years as, although grazing is available most of the year, there are only limited and widely spaced water sources coupled with very rugged terrain. Furthermore, extremely low rainfall years outside the catchment have resulted in cattle being moved into the catchment's southeastern corner from areas north of Opuwo.

Cattle are commonly used to create a cash economy in the eastern section while this practice is far less common in the west. Small stock are often bartered or sold within and between communities. In Erwee and its surrounding villages there is a thriving enhanced goat breeding programme supported by the Ministry of Agriculture which has enabled the greater Erwee area to become a regional centre for small stock management.

Improved breeding stock programme

In 1992 The Grootberg Farmers Integrated Livestock Improvement Scheme was introduced (just south of the Hoanib catchment) with 175 goats donated by the farmers themselves. The farmers take the lead in this project, the objectives of which are to improve their standard of living through improved quality of goats and to sell resultant good quality rams to community members at low prices. An additional benefit is that once they have donated goats, they receive double the original number in return.

Conservation and Development

Prior to independence, residents of communal areas in Namibia were subjected to a range of disempowering legislation affecting almost every facet of their lives, including education, health, agriculture and resource management practises. This legislative environment was one of the primary reasons for large-scale illegal hunting of wildlife, including black rhino and elephant, on communal land in the 1970s and 80s. The future of wildlife in these areas hung in the balance.

In the small village of Warmquelle, situated in the catchment, several key ingredients came together, consolidating a position that was to change the situation. One of these elements was an outspoken visionary and Traditional Leader, the late Headman Joshua Kangombe. Whilst he strongly opposed the involvement of his people in illegal hunting of wildlife, Kangombe felt unable to reverse the trend under the circumstances of the time. Equally concerned, local NGOs and members of the then Department of Wildlife were playing an active role in the arrest and conviction of poachers. It was once these entities collaborated that a new initiative took hold, marking the beginning of Community-based Natural Resource Management in Namibia.

Funding was raised through the NGO sector to provide support for the Community Game Guards, many of whom were ex-poachers. An increasing number of arrests and convictions were made with the active support and commitment of the local communities. Within a short interval many other traditional leaders, with the support of their constituents, requested assistance to facilitate the reestablishment of wildlife in their areas. The results were that wildlife populations increased dramatically.

Conservancies

A conservancy is a communally owned and managed area where people have pooled their resources in order to manage, utilise and benefit from their wildlife and other natural resources. Conservancies allow people to diversify their livelihoods beyond normal farming and provide a greater incentive for sound natural resource management. The Nature Conservation Amendment Act, 1996, which makes provision for Conservancies and Wildlife Councils, gives conservancies rights over non-consumptive use of wildlife, which includes use for recreational purposes. The new Tourism Act will specifically give conservancies tourism concession rights.

After independence the new Ministry of Environment and Tourism, together with NGOs, developed and introduced landmark legislation that paved the way for the establishment of Communal Area Conservancies which provides for a local social institution (committee) that together with

existing structures, can address some of past injustices and develop community-based solutions. The communities in the catchment have embraced the new legislation and several conservancies have been registered. Others are still emerging. Conflicts, different agendas, and border-disagreements have hampered and slowed this process. However, the conservancy legislation has provided the basic building blocks for local systems of decision making and natural resource management in a manner that is transparent, accountable and wise.

Several NGOs still actively support communities in the catchment. While they pursue different aims and objectives and employ different strategies, their common goal is sustainable development in combination with nature conservation.

Integrated Rural Development and Nature Conservation (IRDNC)

IRDNC seeks to link conservation and sustainable use of wildlife and other natural resources to the social and economic development of rural communities. The organisation grew from a small project that pioneered participation of communal area residents in nature conservation in the early 1980s to a community-based natural resource management-implementing agency. In recent years, IRDNC's primary role has been to provide technical support, training and interim financial and logistic assistance to registered and emerging communal area conservancies.

Loxtech

Loxtech is a subsidiary of Namibia Resource Consultants (NRC), which is a Namibian organisation undertaking local and regional consultancy and management services in both human and natural resource development. In Sesfontein, Warmquelle and Khowarib they support the Hoanib Farmers' Co-operative in agricultural production and subsequent marketing of crops, such as oriental tobacco and paprika.

Namibia Community Based Tourism Association (NACOBTA)

NACOBTA is a non-profit membership organisation that supports communities in their efforts to develop tourism enterprises in Namibia. NACOBTA's member organisations include campsites, restcamps, traditional villages, craft centres, open museums and tour guide associations. Tourism enterprises offer alternative livelihood strategies for local communities by providing employment opportunities and generating income in remote areas. This in turn gives rural communities more control and choice over their own development.

Desert-dwelling Elephant (*Loxodonta africana*)

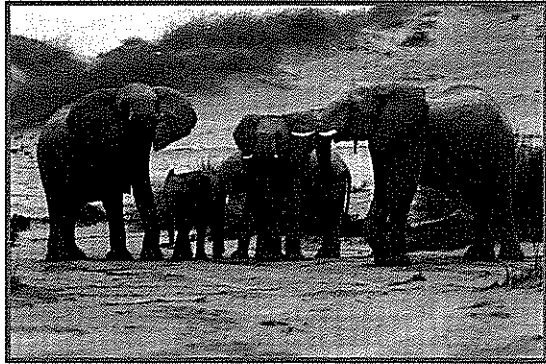
Namibia's desert-dwelling elephants are unique. They are a small but economically and culturally significant resource, particularly valuable to the tourism industry. Not considered to be genetically different from their savannah cousins, desert-dwelling elephants nevertheless possess unique behavioural characteristics adapting them to conditions in the arid northwest. Before the 1900s the elephant population in the northwest was estimated to be 2 500 to 3 500 animals. However, heavy hunting and poaching reduced the population in the latter part of the 19th Century and by the 1960s numbers had declined to 600-800. Expanding human settlements caused additional pressure. In the 1970s and '80s intensive poaching, war and drought further reduced their numbers. MET and NGO activities, which aimed to involve local communities closely in conservation programmes, have succeeded by giving local communities a sense of ownership of their natural resources, including wildlife. This effort, combined with effective law enforcement, has allowed elephant numbers to recover to approximately 800 individuals.

Elephant movement in the Hoanib Catchment shows seasonal patterns similar to those of other wildlife. However, recent satellite telemetry studies by Dr. Keith Leggett following completion of this study show that the western catchment elephants are not responding to rain but rather to ana pod production and that they move as much as 70km in a day from one water point to another. This research will resolve the issue of correlates of their long-distance movement, their expansion into new areas, and their return to previously occupied areas.

The social organisation of desert elephants appears to be unusual, with no apparent strong bonds within and between herds, though clan-like relationships are observed. Recently established artificial water points in the lower Hoanib River appear to have altered the seasonal movement pattern of some of the elephant herds. Elephants are now able to access a larger area for extended intervals because water points allow them to move west towards the Skeleton Coast Park. The impacts of these newly established water points upon elephant movement and distribution are not fully known, but competition with giraffe may be a consequence of breakage of large lower Ana Tree limbs. Furthermore, forage loss in such a fragile environment may have a long-term impact that could potentially affect the economic and social livelihoods of communities as elephants seek additional foraging areas.

Little is known about the numbers, range, residence time and age structure of the elephant population in the east of the catchment. Large flight distances of these animals when in contact with humans, possibly due to historical poaching incidents and the presence of larger human settlements in the area, make research difficult.

Recent studies emphasize the active role elephants play in avoiding settlements during their long-distance movements when searching for water, however they cannot avoid them altogether and are a problem near any garden and water system. Management of these problem



elephants is proceeding on a case-by-case basis and, when necessary, problem individuals are removed. Elephants are huge and inquisitive animals and, when they are aroused, they may attack vehicles and injure and kill people. When in the presence of elephants irresponsible and invasive behaviour can have lethal consequences.

With respect to appropriate conservation and management in the northwest, many questions remain unanswered. Current numbers suggest a healthy elephant population in the catchment. For this reason sustainable use (i.e. trophy hunting) has been introduced to the area, allowing local conservancies a source of high income. However, the effects of this reduction in numbers in combination with long periods of aridity (drought) are unclear and require more research. Additional questions that should be answered for improved elephant management in the future are:

- What sex and age of elephants cause the greatest amount of destruction to local communities?
- What is the tolerance of the communities for elephants in the context of emerging and established conservancies in the northwest?
- How would the communities and/or conservancies prefer to manage their elephant population?
- What information is required by the MET and/or conservancies to make informed management decisions about desert-dwelling elephants?
- What is the effect of removing adult males, either as problem animal control or for use as trophy animals, from a relatively small population?

In light of the growing economic and social importance of these elephants for emerging and established conservancies in the Hoanib Catchment, informed answers to these and other questions will become increasingly important.

Ana Tree (*Faidherbia albida*)

The Ana Tree is one of Africa's most important tree species in its arid and semi-arid regions. Its vast natural geographic distribution throughout Africa attests to its ecological adaptability, while its high numbers in the Hoanib Catchment (more than 4 000 individuals) makes it an extremely valuable resource. It is the dominant woody plant vegetation along the river and the most valuable food source for wildlife and domestic stock when grass is unavailable.

Large Ana Trees in the Hoanib River may be taller than 30m and 2m in diameter. Seasonal flooding of the river increases soil moisture availability in the riverbeds, sometimes enabling Ana Trees to prosper. Long-term studies of Ana Trees may provide a better understanding of the river's changing flow dynamics and its effect upon the production of forage. Ana Tree pods are an important food for goats, the main agricultural product along the middle reaches of the Hoanib Catchment. Nevertheless, in this area productivity of Ana Trees has declined. There is scant regeneration of young Ana Trees where goats are kept, including most riparian zones within the catchment. No recruitment was observed in the upper reaches of the river where goat browsing is active.

Throughout Namibia's arid northwest the Ana Tree is an important supplementary fodder source for domestic stock and wildlife. During the hot-dry season the leaves and pods of the Ana Tree provide up to double the amount of net energy per unit dry mass compared with grass and more digestible protein per unit dry mass than dry grass. Along many of the ephemeral rivers of Namibia local farmers collect Ana Tree pods and store them for use as supplementary fodder in times of need.

Ana Trees in the lower Hoanib River and perhaps throughout the river's course are a keystone species. If they were absent, either as a result of their loss or if they were never present, the characteristics of the local environment would be entirely different. Elephants and giraffe would have a different spatial distribution and far lower abundance. Wildlife species like gemsbok would be less numerous and more likely to starve *en masse* in times of food shortage. There would be other major differences in a landscape lacking Ana Trees.

Keystone species.

The presence or abundance of a keystone species can be used to assess the extent to which the resources of an area or habitat are being exploited. If either ana trees or elephants should disappear from the Hoanib Catchment the system would transform to another state.

For wildlife, particularly the desert-dwelling elephant *Loxodonta africana* and giraffe, *Giraffa camelopardalis angolensis*, Ana Trees provide essential year-round fodder. However, during



extended periods of high aridity, competition between people, domestic stock and wildlife may limit the availability of resources such as Ana Tree seedpods and browse except in the lower Hoanib and the SCP.

In the lower river, where the potential impact of elephants on Ana Trees has been assessed, a marked shift in the population dynamics of elephants was observed after the early 1980s. Elephants and giraffe have drastically reduced the availability of Ana Tree browse, elephants by not only browsing but also by breaking most large lower limbs within their reach. This has raised the lowest available browse to 3m, i.e. out of reach of all herbivorous mammals except elephants and adult giraffe on 80% of all Ana Trees.

Elephant damage to Ana Tree bark occurs throughout the reaches of the Hoanib River. Damage is greatest near water sources, approaching 100% at both the upper and lower floodplains. Bark damage has increased in recent years as water sources and elephants became more numerous. Nevertheless most trees survive being damaged. The ongoing expansion of the distribution of elephants in the catchment, as a result of their greater numbers and enhanced tolerance by communities, may alter pressure on Ana Trees and other forage plants within riparian refuges.

During this study flooding of the Hoanib in 1999-2000 uprooted 100 Ana Trees, 6% of the floodplain population, a greater loss than that imposed by elephants. There, in the alluvial sands, regeneration is operational and under current circumstances of elephant abundance and movements the Ana Tree resource may be self-sustaining. As a keystone species it deserves continued monitoring.

Desert-dwelling Giraffe (*Giraffa camelopardalis angolensis*)

Giraffe are one of the flagship African mammals and are a major tourist attraction of the Hoanib River Catchment and throughout Africa. Giraffe are specially protected in Namibia and the giraffe in the catchment, the Angolan giraffe (*Giraffa camelopardalis angolensis*), is one of nine subspecies found in Africa. Little is known about these Angolan giraffe and even less about the desert-dwelling population in the catchment.

The presence of a resident population of giraffe at the Hoanib River delta is surprising given their general absence from deserts. The only other desert giraffe population is in Niger. In the 1970s Eloff suggested that desert giraffe "represent a new dimension in the animal kingdom and deserve the highest priority". Since then there have been numerous conservation efforts including the translocation of giraffe throughout Hobatere. Throughout Africa, giraffe are considered vulnerable and peripheral, with an estimated population of 145 000 animals. Isolated populations like these are even more vulnerable due to their low numbers.

Giraffe have historically roamed the Hoanib Catchment for at least the past two to three thousand years with rock engravings in the region depicting them as sacred animals that the hunters deeply respected. Historically giraffe were a valuable resource for local communities who hunted them for their meat, marrow and skin for footwear and for sleeping mats. Today, the CBNRM programme in collaboration with the MET has allowed restricted hunting of giraffe to the east of the catchment, thus enabling communities to utilise this valuable resource again.

In the catchment giraffe are almost solely dependent on the riparian environment of the Hoanib River and its major tributaries. Giraffe numbers throughout the catchment vary across the rainfall gradient with the highest numbers recorded in the east at Hobatere (114) and the lowest in the arid west in the lower Hoanib River (38). Throughout the Kunene region numbers have increased markedly over the past two decades although the population density still matches the lowest in Africa – 1 giraffe/100km², similar to the desert population in Niger.

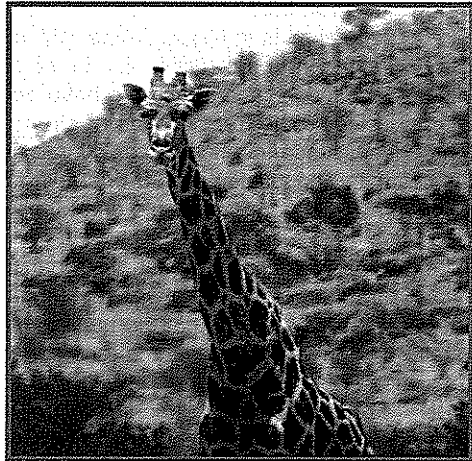
Giraffe in the catchment have the largest seasonal movements when compared with other African giraffe. It is quite common for giraffe of any age or sex to make the long and arduous trek 80km north from the lower Hoanib River to the Hoarusib River system in search of a mate or seasonal forage. During the wet and cold-dry seasons, giraffe in the lower Hoanib River make use of the tributaries to the north and south. However, the main riverbed acts as an important year-round refuge. Restricted food availability outside of the river courses plays a role in their low population growth and the carrying capacity of this area, although numbers are increasing marginally.

Along the length of the main Hoanib River bed giraffe numbers increase during the hot-dry season, which is a response to the availability of the nutrient-rich Ana Tree (*Faidherbia albida*) pods. Little other vegetation is available outside the river courses during this season, thus the Ana Tree and its fruit becomes an important refuge for forage and shade.

Further east in Hobatere, giraffe migrate in and out of the western boundary dependent on the seasons and food availability. Numbers have increased markedly over the past ten years since its establishment. Seasonal movement helps relieve grazing and browsing pressure in the area.

Higher densities are observed in the wet season, the opposite of what is seen in the riparian areas. This pattern of movement seems to be a response to seasonal availability of *Acacia*, *Combretum* and *Termanalia* species in Hobatere.

Giraffe in the Hoanib Catchment seem to have specially adapted to their life in their arid environment. The most marked difference to giraffe in other parts of Africa or even of Namibia is their ability to go without drinking regularly. Until late 2002



giraffe had only been observed drinking ten times in the past 70 years in the lower Hoanib River. This behaviour has sparked great interest in their adaptive abilities as large mammals surviving in such a harsh arid environment. Speculation about this behaviour is varied though nothing has been described regarding any specific adaptations of water retention and abstraction of water from forage. However, artificial water points erected in the lower Hoanib River in late 2002 have markedly altered both giraffe and other wildlife behaviour and movements and up to 15 giraffe have been observed drinking daily. In the short-term, giraffe have been displaced by elephant in areas in which they were previously dominant.

Giraffe in the catchment are a behaviourally distinctive population undifferentiated subspecifically from the Angolan form. They are most numerous in protected areas, notably Hobatere and in the SCP. The success of efforts to protect giraffe in the desert is confirmed by their flight distance in response to the presence of people. In 1992 this distance averaged 157m. At the time of this study (2000) flight distance in the lower Hoanib River had declined to less than 10 m! Many individuals made no response to intruders. Reduced flight distances are a clear measure of the success of efforts by the communities and others to protect giraffe.

Desert-dwelling Black Rhino

(Diceros bicornis bicornis)

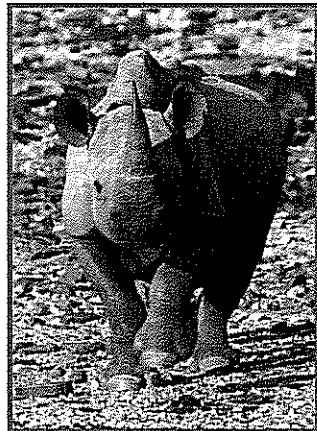
The black rhinoceros was severely threatened by poaching in the late 1970s throughout the Hoanib River Catchment, the Kunene Region and the rest of Africa where these large mammals occur. Today their numbers are recovering in the Kunene and their range is expanding following implementation of several conservation measures. The development of a community based conservation approach in the early 1980s was balanced by intensive field operations and strong law enforcement carried out by both government and NGOs (particularly Endangered Wildlife Trust, Save the Rhino Trust and Integrated Rural Development and Nature Conservation). This approach resulted in increasing numbers of black rhinoceros and other wildlife throughout northwestern Namibia.

Present Status

The western black rhinos are part of a unique population of desert-dwelling black rhino, the only desert ecotype so classified by the IUCN's African Rhino Specialist Group and the only black rhino population living outside a protected area. Their current range extends from the area near Purros, north of the catchment, to south of the Brandberg massif, and east along the 150mm isohyet, corresponding to where subsistence farming practices begin. A distinct rhino population occurs in the eastern section along the western border of the Etosha National Park.

Rhino density throughout northwest Namibia is the lowest recorded in Africa at approximately 1 rhino/100km². This density, their breeding performance and their ranging patterns are influenced by the variable geology and its impact on soil development, vegetation types and access to water. The complexity is compounded by low, variable and patchily distributed rainfall, as well as human disturbance, chance events and demographic consequences of small sub-populations. The most suitable habitat for rhino in the western section of the catchment is in the upper reaches of the Muderib River, a southern tributary of the Hoanib, where increased densities are observed.

Currently, few rhino occur north of the Hoanib River, while those that have been observed there have large ranging patterns. Breeding performance has been poor in this area, with no calves born in recent



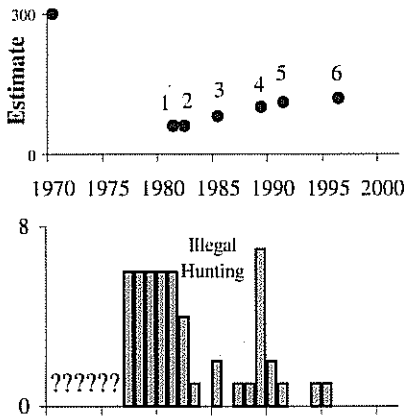
Picture: Save the Rhino Trust

years. The impact of trace metal build up (notably copper) in soil and vegetation and the subsequent ingestion by rhino may be a contributing factor, though no research has been conducted to support this theory.

Future Conservation

Government, NGOs, conservancies and community game guards presently undertake patrols and monitor desert-dwelling rhinos throughout the Hoanib Catchment. The efforts have a dual function. They obtain long-term data on individual rhino, their movement patterns and population performance. Patrols also act as a deterrent for and detection of illegal activities. Save the Rhino Trust operates a combination of vehicle, foot and camel patrols throughout rhino ranges and has been invaluable in the animals' recovery and ongoing conservation.

The current combination of ongoing research and monitoring programmes, legislative changes and land use plans, coupled with a CBNRM approach involving players from the grass roots level upwards, provides confidence and new hope for the future of this rare animal in such a special environment.



● Population status

Conservation Actions

1. First GRN conservation official based in Khorixas
2. Traditional leaders support, NGO activities initiated, monitoring and community game guards
3. Intensive monitoring by SRT teams – more accurate population estimates
- 4&5 Dehorning operations and APU (armed) operating in the area
6. Community participation formalised through Conservancy Legislation

Save the Rhino Trust (SRT)

SRT is a Namibian Trust that was founded in the early 1980s to stop the extermination of the endangered black rhino from communal land. This operation occurs in collaboration with government and local communities, with the aim of providing security for rhino, to monitor the rhino population in the region, and to bring benefit to local communities through conservation and tourism.

Wildlife

Ancient records in rock engravings indicate that a wide diversity of wild animals have roamed the mountains and plains of the Hoanib River Catchment for centuries. The richness of the fauna, from the tiny tenebrionid beetle to the tallest mammal of all, the giraffe, and the elephant have been familiar companions to the herders of the area for aeons.

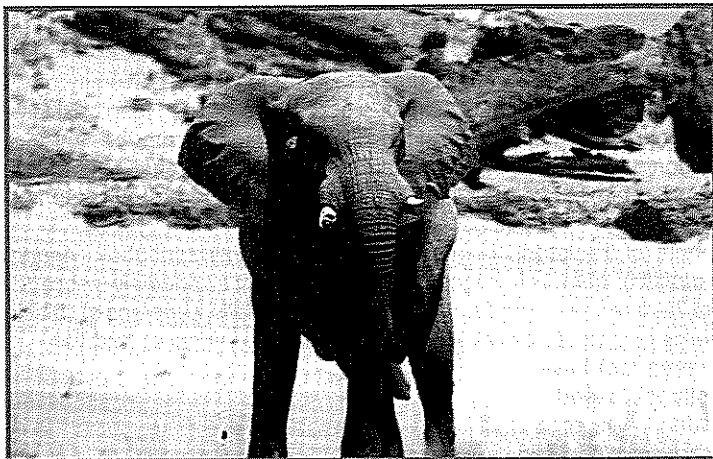
Numbers of the larger mammalian wildlife, notably springbok (*Antidorcas marsupialis*), gemsbok (*Oryx gazella*), Hartmann's mountain zebra (*Equus zebra hartmannae*), giraffe (*Giraffa camelopardalis angolensis*), black rhino (*Diceros bicornis bicornis*), elephant (*Loxodonta africana*) and lion (*Panthera leo*) have visually increased following years of decimation in the mid-20th Century.

Springbok, gemsbok and Hartmann's mountain zebra are spread throughout the catchment, ranging across the plains, along the riverbeds and up into the mountains. All wildlife in the catchment is dependent on the

seasonal availability of forage, while zebra and elephant are particularly dependent on water. Springbok are often observed around areas inhabited by humans or areas that have been grazed extensively by domestic stock, but are equally numerous in the core wildlife areas. However, in areas where there is a closer association with humans, springbok and other wildlife have much greater flight distances (movement away from disturbance) compared to animals elsewhere in the catchment. Gemsbok and Hartmann's mountain zebra appear to have little tolerance for humans and domestic stock and their distribution is generally restricted to areas where human settlement and domestic stock populations are low. As wildlife range much further than domestic stock, and need to drink less regularly, they have the advantage of being able to use alternative forage areas throughout the year.

Wildlife show distinct wet and dry season ranges, concentrating in the Hoanib River during the cold-dry and hot-dry seasons when grazing and browse is limited elsewhere but ranging widely throughout the catchment in the wet season. After good rains during the wet season, wildlife form feeding aggregations in the Khowarib and Serengeti Plains and around the Otiyapa springs (Etendeka Mountains). Seasonal aggregations are also





common in the western areas of the catchment as wildlife seek out available forage on the plains to the north and south of the main river. They continue feeding in these areas in large herds until seasonal vegetation is exhausted during the cold-dry season. By the end of the cold-dry season, herd sizes also decrease and plains game drift back to the rivers. During the hot-dry season wildlife are almost all concentrated in the main riverbed where they eat the maturing seedpods of the Ana Trees (*Faidherbia albida*), a valuable source of protein at a time when there is little nutrition in the veld. In addition to their value as food, mature Ana Trees have extensive canopies and offer welcome shelter and shade to wildlife and domestic stock year-round.

Wildlife species in this area vary widely in their water requirements. Elephants water near the mouth of the Hoanib range as far as 30km from water sources, but make the commute to and from these distant foraging areas in four days. These long distance movements emphasize the depletion of food resources near water sources. Dependence of mammals on surface water varies widely, in part dependent on the water content of their food. Hoanib giraffe browse succulent leaves and rarely drink. Gemsbok, sometimes said to be entirely independent of water, must drink or will die when their only food is dry grass or Ana Tree seed pods.

Wildlife – Water vs. Forage

Even during severe droughts water is not the most limiting factor for the survival of wildlife. Depletion of food sources, especially around villages, has the most detrimental effect – as water is almost always available from springs and seepages along the main riverbed.

Tourism in the Catchment

While tourism is an important alternative source of revenue for the inhabitants of the catchment, it is essential that some form of control be exercised in sensitive areas. Indiscriminate use of all-terrain vehicles in the Hoanib River bed disturbs the elephant population and there has been a decrease in the number of calves born in recent years. In parts of the river the cliff walls are high and as the river twists and turns the sounds of a vehicle are masked until it is almost on top of a herd of elephants. This has led to aggressive behaviour and several vehicles have been badly damaged by angry elephants. In certain places there is no way for the elephants to leave the riverbed and they are forced to flee from the disruption or turn to attack it.

In the Damara culture the river is a holy place. Traditionally they treat it with great respect and consult their ancestors on the correct routes to take and where to exit. It is strictly forbidden to make fires in the riverbed unless there is no other option.

In that case, all evidence of the fire is carefully removed the next morning so that the animals that use the river will not be frightened away from water by the smell. People are encouraged to camp 20 – 30m from the river itself to avoid disturbing the wildlife.



The conservancies are lobbying for legislation that would require visitors to the area to use local guides when travelling in the river. They know the river and its environs very well and are careful when they approach animals thus allowing better viewing without unnecessary disturbance. Quad bikes are also highly disturbing and there have been attempts to ban them from the riverbed altogether.



Tourists' tracks in the desert

The people of the area are enthusiastic about showing visitors their beautiful part of the country but are also concerned that they could be injured as a result of ignorance and that the wildlife of the area could become so disturbed that their behaviour and breeding patterns are disrupted.

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