The Sperrgebiet Land Use Plan – An example of integrated Management of Natural Resources

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The Sperrgebiet is an area in southwestern Namibia, where extensive diamond mining has taken place since the early 20th century. For security reasons it has been an access-restricted area since that time. As part of the Namib Desert, it also boasts pristine landscapes and is part of an area of globally significant endemic biological diversity, the Succulent Karoo biome. Because of the restricted access, it has remained an undisturbed wilderness area with few parallels in the World. However, pressure from the mining industry to look for commodities other than diamonds is ever increasing, since the mineral potential is high. The tourism sector also has an increasing demand for the use of this national asset. The relevant Namibian ministries have therefore decided to produce a land use plan for the area, which contains recommendations for future land use options, and also provides for various zones within the Sperrgebiet with adequate protection and conservation status.

Introduction

The Sperrgebiet, or Diamond Area No. 1, covers some 26 000 km² between the Orange River in the south and latitude 26°S in the north, and extends 100 km inland from the coast (Fig. 1). After the first diamond had been discovered here early in 1908, the German Colonial Administration closed off the area, and exclusive mining rights were given to the Deutsche Kolonialgesellschaft für Südwestafrika. Diamond mining, however, concentrated in a narrow strip along the coast, and the rest of the area remained an untouched wilderness. This did not change when Namibia was no longer a German colony, and South Africa took over the administration after the First World War. Meanwhile the South African diamond concern DeBeers had taken over the German mining interests. The restricted status of the Sperrgebiet was confirmed by the Halbscheid Agreement of 1921, and any activities in the area were limited to diamond mining. Following Namibian Independence in 1990, negotiations between DeBeers and the new Namibian Government led to the formation of Namdeb Diamond Corporation, an entity jointly owned by DeBeers Centenary and the Namibian Government. The existing mining licence covering the entire Sperrgebiet was converted into a number of mining licences in accordance with the Minerals Act of 1992, which covered the diamondiferous parts of the area. The entire Sperrgebiet, however, is still retained as a security zone to protect Namibia's most valuable mineral commodity, the diamond. To this day, general public access has therefore been extremely limited. Almost 100 years of strict access control has provided for preservation and conservation, and today the Sperrgebiet is a pristine wilderness area throughout much of its extent.

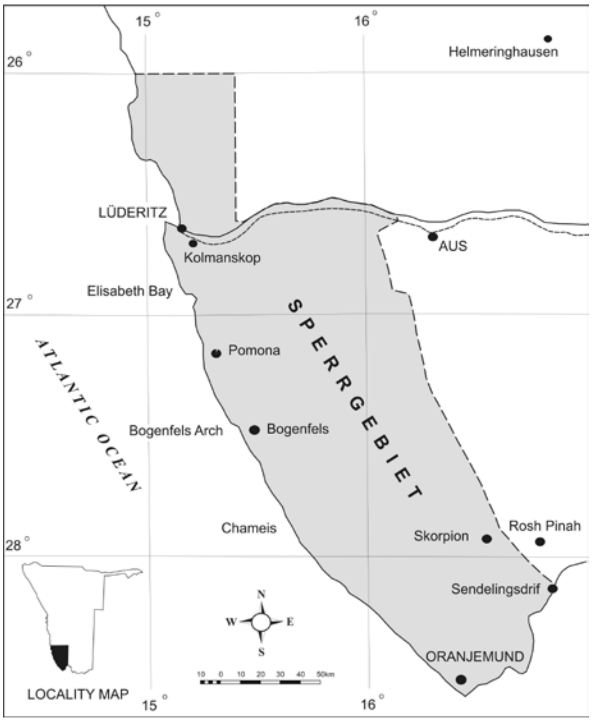

Figure 1: The Sperrgebiet in southwestern Namibia.

The Sperrgebiet has a complex geology spanning some 1900 million years of Earth's history. Lithologies comprise gneisses of the Namaqualand Metamorphic Complex, meta-sedimentary and meta-volcanic rocks of the Gariep Complex, sediments of the Nama Group, volcanics of the Klinghardt Igneous Province, as well as Cretaceous sediments and the extensive Cenozoic sedimentary sequence of the Namib Desert (Fig. 2).

Rocks of the Gariep Complex are associated with extensive base metal deposits, and one of the largest zinc mines in southern Africa is currently being opened up in the southeastern Sperrgebiet. The Orange River terraces, raised beaches along the coast and deflation surfaces in the northwestern Sperrgebiet host the world's largest and richest deposits of gem quality diamonds, and constitute the backbone of Namibia's economy. The diamond deposits extend out to sea on the seafloor. Since extensive exploration for minerals other than diamonds did not take place due to the restrictive status of the Sperrgebiet, potential for new discoveries is high.

The Sperrgebiet environment is fragile and characterised by its aridity. Landscapes range from inselbergs and mountain ranges to gravel plains and dune fields. The lower Orange River provides a linear oasis and is the only permanent source of fresh water. Soils are generally poorly developed, and often capped by biological crusts, which are extremely vulnerable to mechanical disturbance. The climate is characterised by strong winds and rainfall of less than 100mm. Evaporation is high. Despite this extreme environment, the Sperrgebiet has been listed as one of the world's top 25 global hotspots of biological diversity (Myers *et al.*, 2000). The Sperrgebiet has also an impressive fossil record, and archaeological evidence suggests that the area has been inhabited for at least the last 300 000 years (pers. Comm. D. Noli).

The Sperrgebiet is of extremely special scientific interest, due to its unique resources that have virtually been undisturbed by modern developments. Special conservation status should be considered for the area as a biodiversity hotspot, especially given the value of its cultural, historical, archaeological and palaeontological heritage resources. More scientific research is required on biota, as well as on geology, palaeontology and archaeology.

The Process of Land Use Planning

Following the Namdeb Agreement in 1994, the Sperrgebiet was retained as a security zone, but other land use options became available, as the exclusive rights previously held by the diamond mines in the non-diamondiferous areas were relinquished. Consequently, pressure from other stakeholders increased. The need for integrated development, with maximum protection of the environment, was realised by the relevant ministries, the Ministry of Mines and Energy, the Ministry of Environment and Tourism and the Ministry of Lands, Resettlement and Rehabilitation. An inter-ministerial steering committee was put in place in 1997, and funding for a Land Use Plan was secured from DANCED in 1999. In cooperation with a professional consultancy, such a Land Use Plan, addressing land capability, sensitivity assessment, integrated development scenarios, zonation proposals and management guidelines, was compiled and currently awaits submission to Cabinet.

The need for a Land Use Plan was driven by the necessity to protect the fragile desert, coastal and riverine environments within a development context; to allow sustainable development based on the inherent qualities of the area and within its carrying capacity; to ensure planned development according to agreed land use suitability criteria; to allow for the integration of multiple users where practical and possible; to prevent unsuitable land use and environmental degradation caused by a lack of proper planning; to develop the area so that it can ultimately be integrated into the vision of a Protected Area Network spanning three countries, namely South Africa, Namibia and Angola; and to ensure that the area has a long-term benefit for the whole of Namibia, and the southern regions in particular.

This land use plan has used an ecosystem-based approach. Under traditional multiple-use of areas, science was applied directly to specific resources. For example, geology focused almost exclusively on mineral and energy resources. Ecosystem-based planning considers all resources, living and non-living, within an ecosystem and evaluates their effects on each other in order to maintain a healthy ecosystem and provide for present and future needs. It is therefore also the fundamental basis for implementation of the Convention on Biological Diversity and related international conventions. A strong scientific foundation is critical to the success of ecosystem-based planning (Applegate, 2000).

Geology

The oldest rocks in the Sperrgebiet are gneisses of the Namaqualand Metamorphic Complex, which occur near Lüderitz and along the eastern margin of the Sperrgebiet. The Namaqualand Complex covers extensive areas in the south of Namibia. It can be subdivided into pre-tectonic meta-sediments, gneisses, amphibolites, charnockites, gabbros and ultramafic rocks; syn-tectonic granites and late- to post-tectonic granites. The pretectonic meta-sediments accumulated along the fringes of the Kaapvaal Craton and were metamorphosed about 1200 million years ago. Concomitantly, a magmatic arc formed, and the magmatic activity lasted for about 200 million years.

The Gariep Complex is subdivided into an eastern and a western part. In the eastern Port Nolloth Terrane, quartzite, arkose, argillite, carbonate, conglomerate, felsite and greenstone of the Rosh Pinah Formation are overlain by meta-sediment and limestone of the Hilda Formation, and meta-sediment, dolomite and iron formation of the Numees Formation. In the western Marmora Terrane, mafic lava, dolomite and schist of the Grootderm Suite are overlain by quartzite, dolomite and iron formation of the Oranjemund Suite and conglomerate, dolomite, arkose, quartzite, shale and limestone of the Bogenfels Formation. The Gariep Complex was intruded on a regional scale by granitic magma between 500 and 600 million years ago.

Rocks of the Nama Group are confined to the eastern part of the Sperrgebiet. Deposition of the Nama Group in a shallow syn-tectonic foreland basin resting on a stable platform commenced 600 million years ago and lasted for about 60 million years. It covers much of southeastern Namibia. Basal quartzites are overlain by limestones, shales and sandstones.

The opening of the South Atlantic Ocean was the first step in the development of the Namib Desert. Isostatic movements and extensive erosion led to the establishment of the Great Escarpment, and transported more than 4 km of sediments into the marine Orange Basin to the west between 120 and 65 million years ago. In the central Sperrgebiet, several approximately 130 million year old igneous complexes intruded during continental break-up. A temporary rise in sea level deposited some marine sediments near Bogenfels about 85 million years ago.

Towards the end of the Cretaceous some 65 million years ago, continental erosion slowed down and some Late Cretaceous land surfaces are preserved in the southern and central Sperrgebiet. Tertiary shorelines with an age of some 40 million years as determined by their fossil content occur in the central Sperrgebiet up to 160 m about the present day sea level. Over 100 small bodies of phonolite of the Klinghardt Igneous Province intruded some 37 million years ago.

The period between 18 and 20 million years ago is characterised by the deposition of terrestrial sediments in shallow streams and flood plains. Just slightly younger dunes with an age of 17 million years were deposited in the southern and central Sperrgebiet by southerly winds. The source of the aeolian sediments was an ancient course of the lower Orange River. They are overlain by coarse gravels indicating a temporarily wetter climate. This was again followed by drier conditions, and the extensive calcrete surfaces, which cover most of the Sperrgebiet, formed some 10 to 7 million years ago. This coincides with the full establishment of the Benguela Current. Strong southerly winds, which have prevailed during the last 5 million years, have produced dune fields and sand seas in and to the north of the Sperrgebiet. Relative changes in sea level over the last 3 million years have deposited marine terraces at various levels, which are best developed along the southern Sperrgebiet coast. The sedimentary settings led to the formation of the richest alluvial diamond deposits on Earth (Fig. 2).

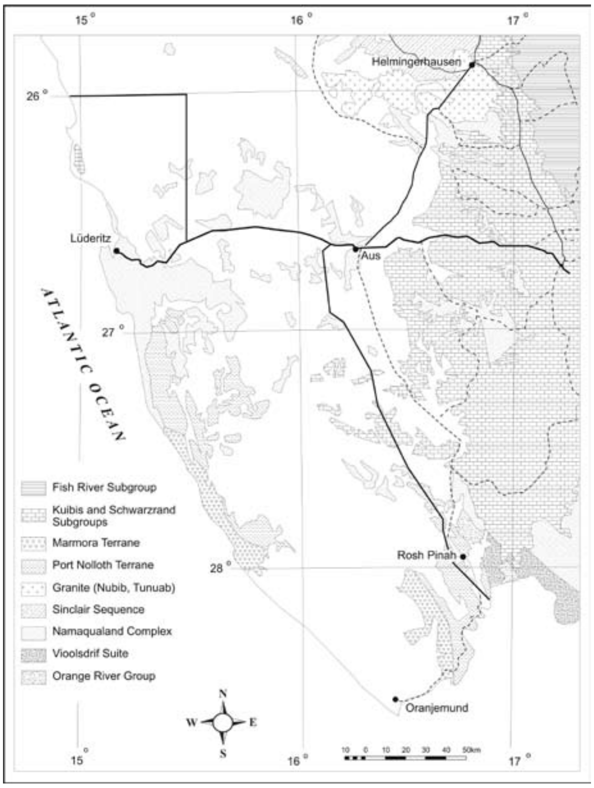

Figure 2: Geology of the Sperrgebiet and neighbouring areas (after Simplified Geological Map of Namibia 1:200 000).

Mining and Mineral Potential

The Orange River terraces, raised beaches along the Coast and deflation surfaces in the northwestern part of the Sperrgebiet host the world's largest and richest deposits of gem quality diamonds, and constitute the backbone of Namibia's economy. Littoral, deflational and deflational-depositional deposits, as well as occurrences in the terraces of the Orange River and offshore deposits can be distinguished.

The diamond mines are by far the most important mining operations in the country. The precious stones have accumulated in alluvial deposits along the Namibian coast, both onshore and offshore, as well as in old terraces of the Orange River. Since the beginning of mining in 1908, more than 70 million carats of diamonds have been recovered, 95% of which are of gemstone quality. Mining of the beach deposits north of Oranjemund involves exposure of the diamondiferous gravel by overburden stripping using earth-moving machines, which include two large bucket-wheel excavators. The overburden sand is used to construct sea-walls, which shift the beach up to 200 m seawards and thereby expose gravels up to 20 m below sea level. The gravel is then removed by hydraulic excavators, and industrial-sized vacuum machines are used for the final "clean-up" process. After treatment in a recovery plant, which includes crushing, screening, dense media separation and X-ray sorting, a concentrate is sent to a central sort-house.

Diamonds are also recovered at Elizabeth Bay south of Lüderitz, where mining is carried out with mechanical excavators. Pocket beaches have been test-mined in the Chameis area, while intermittent mining is taking place in the Bogenfels area. Diamondiferous gravels of the Orange River terraces are recovered and treated at Auchas and Daberas. The concentrates of all satellite mines are forwarded to the central sort-house at Oranjemund for final treatment. In addition, smaller operators are working the deflation deposits in the area between Pomona and Bogenfels.

Near-shore diamond mining operations in shallow water are carried out by divers, who operate either from the beach or from small vessels, often converted fishing boats, which can be seen mooring at Lüderitz harbour. Gravel is sucked with large hosepipes on board the vessels or onto the beach, where a concentrate is recovered by small plants. Final treatment takes place in a central recovery plant in Lüderitz.

Pioneering work to recover diamonds from the seabed offshore Namibia has been carried out since the mid-1960s. Today, a fleet of 10 purpose-built vessels belonging to 3 companies mines diamonds in water depths of up to 200 m, using drill bits and seabed crawlers. Some 50% of Namibia's total diamond production currently comes from the ocean floor, a figure which is set to increase, as the onshore deposits, mined since the early 20th century, become depleted.

The Rosh Pinah Formation of the Gariep Complex hosts the sedimentary-exhalative lead-zinc-silver-copper-barite deposit of Rosh Pinah, located some 20 km north of the Orange River on the eastern fringe of the Sperrgebiet. Rosh Pinah Zinc Corporation (Pty) Ltd is one of the major lead and zinc producers in southern Africa, and has been active since 1969. The ore grades 7% zinc and 2% lead, and is mined in an underground operation. Concentrates are transported by road to Aus, from where they reach the smelters by rail.

A second zinc mine, the Skorpion Mine, is has come into operation just west of Rosh Pinah, inside the Sperrgebiet. The Skorpion ore body is a shallow sub-horizontal body of secondary zinc minerals including carbonates, oxides and silicates. The deposit formed by the weathering and oxidation of primary sedimentary-exhalative ores of the type mined at Rosh Pinah. Skorpion has rich reserves of 21.4 million t grading 10.6% zinc, which can be mined in an open pit. The deposit cuts across deeply weathered Rosh Pinah Formation metavolcanics and Hilda Formation carbonate rocks. Development of the Skorpion Mine commenced in 2001, involving a total investment of 3.2 billion Namibian Dollars. The mine started production in 2003, and will produce 150 000 t of zinc per year over a mine life of at least 15 years. It will provide employment for some 400 people. During the development stage, approximately 4000 people were contracted. The open pit will have final dimensions of about 800 m in length by 600 m in width, and will be some 300 m deep. A refinery, utilising a process specially developed for the silicate and carbonate ore, and involving direct acid leach, solid-liquid separation, solvent extraction and electro-winning has been constructed next to the open pit.

The Rosh Pinah and Skorpion Mines, together with the zinc mines in northwestern South Africa, form one of the major zinc provinces in the world.

Since extensive exploration for minerals other than diamonds did not take place in the Sperrgebiet due to the restricted status of the area, the potential for new discoveries is high. This is even more so, since two world-class zinc deposits have already been found in strata that occur in abundance within the Sperrgebiet. The potential was therefore recognised by the international exploration community, which applied for numerous exclusive exploration licences, when the area was opened up for prospecting in 1999. More than 40 blocks covering large areas of the Sperrgebiet were awarded to various companies including Anglo American, Rio Algom, Cominco, Falconbridge, Anglovaal, Westport Resources and PE Minerals (Fig. 3).

The Geological Survey of Namibia stimulated exploration by covering the area with a high-resolution airborne geophysical survey that same year. This survey was flown at a ground clearance of 80 to 120 m, and a line spacing of 200 m (Fig. 4). The Sperrgebiet belongs

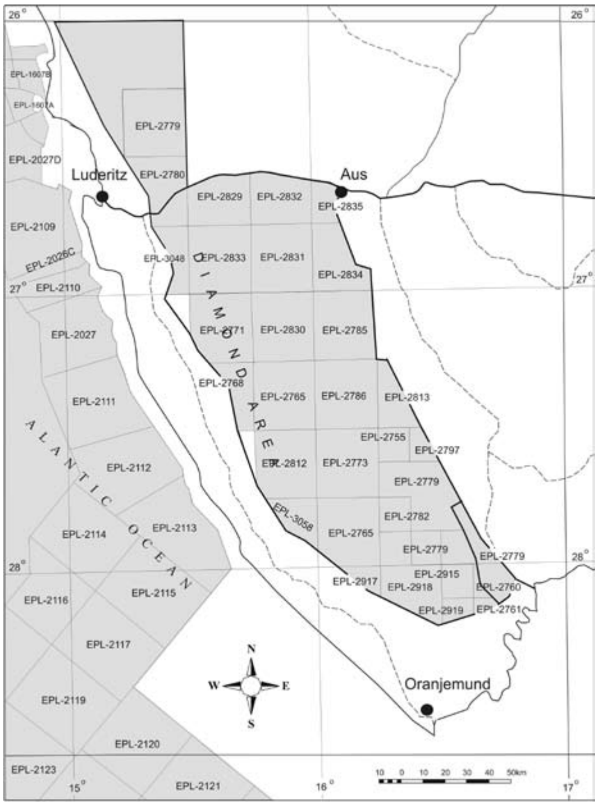

Figure 3: Exploration and Prospecting Licenses in the Sperrgebiet 2001-2003 (After Ministry of Mines and Energy).

to the tectono-stratigraphic domains of the Marmora Terrane, Port Nolloth Terrane and Namaqua Terrane. In the magnetic data, the Marmora and Port Nolloth Terranes present themselves as magnetic lows, while the Namaqua Terrane is a magnetic high. The Klinghardt intrusions also stand out as highs. The Chameis Bay Ring

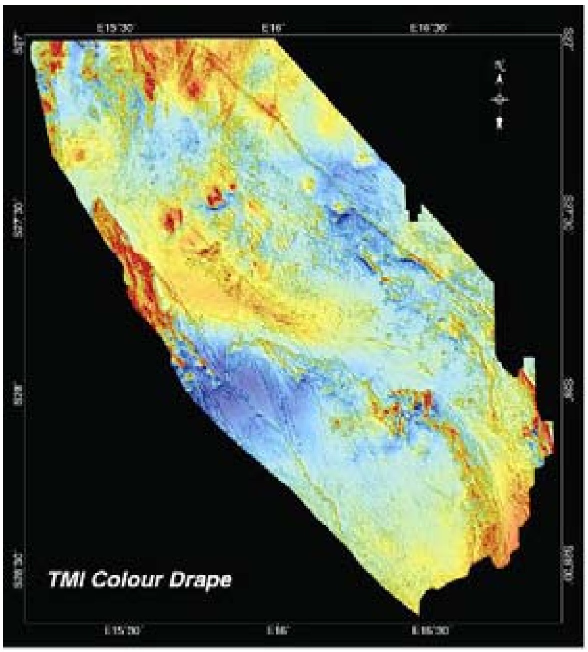

Figure 4: Total Magnetic Intensity Map

Structure encompasses parts of the Marmora and Port Nolloth Terranes and may have arisen from deep-seated plutonism. The Kudu Lineament Zone trends north-northeast, a direction which has proved to be important for mineralisation within Late Proterozoic rocks. It is noteworthy that the Kudu Gas Field offshore is situated close to both the Chameis Bay Ring Structure and the Kudu Lineament Zone; the Jakkalsberg Thrust can also be distinguished. The Poffadder Lineament presents itself with higher values.

Apart from the obvious base metal potential in lithologies of the Port Nolloth Terrane of the Gariep Complex, as evidenced by the Rosh Pinah and Skorpion deposits, massive syn-sedimentary volcano-exhalative lead-zinc sulphide deposits may occur in pre-tectonic terrigenous meta-sedimentary units such as magnetite quartzites of the Namaqualand Metamorphic Complex. Tungsten-bearing skarns within carbonates in granite-rich terrains are also known to occur within this unit. Potential for further discoveries of that nature therefore exists. The basal quartzite of the Nama Group is a target for unconformity uranium, while deep intra-Nama erosion suggests potential for palaeo-karsting of the Huns Member and hence Mississippi-Valley-Type lead-zinc mineralisation. The early Cretaceous complexes of syenite and foyaite are potential hosts for fluorite, apatite, rare earth elements, copper, tungsten, tin and semi-precious stones.

Environment

As part of the southern Namib Desert, the climate of the Sperrgebiet is characterised by strong southerly winds in summer and short-lived berg winds from inland in winter; by a very limited rainfall of less than 100 mm per year, which falls in winter in the south and in summer in the north; and by precipitation from fog, which forms along the coast and partially moves inland to provide moisture to animals and plants. Inland temperatures can well exceed 30°C, but are moderated by the coastal winds and fog. Evaporation increases from 2600 mm per year along the coast to 3200 mm per year further inland (Seely, 1995).

The Sperrgebiet has a wide variety of landscapes, ranging from inselbergs and low mountain ranges to gravel plains, red semi-stabilised dunes, pale-coloured mobile dunes and ephemeral watercourses. Along the lower Orange River a linear oasis transects the desert environment, and the Orange River mouth is a proclaimed Ramsar site. Closer to the coast there are bedrock-floored valleys eroded by the harshest wind regime on the subcontinent. This wind regime also drives up to 30m high barchan dunes northwards at a rate of up to 50m per year.

Immature desert soils are poorly developed in the Sperrgebiet, with gypsum profiles on stable gravel surfaces being the most common ones. Calcrete-covered palaeosoils, which formed some 10 million years ago, however, occur in abundance (Ward, 1995). Biotic soil crusts of the Sperrgebiet, like lichens and blue-green algal complexes, are extremely sensitive and likely to feature high endemism. They are poorly known so far, but, because of their significance, are at present the subject of a study (pers. comm. P. Barnard).

The only readily available fresh surface water in the Sperrgebiet is from the Orange River. This river is one of the most important ones in southern Africa and flows from its source in Lesotho some 2200 km to its mouth at Oranjemund. Water flow in the lower reaches is, however, affected significantly by developments upstream, where the river is extensively dammed, and water is abstracted for industrial, commercial agricultural and domestic use. Other surface water bodies in the Sperrgebiet are the Orange River Mouth Wetlands, the coastal saltpans, ephemeral wetlands, fountains, springs and seeps. Most of this water is, however, saline or brackish, and supports highly adapted and often endemic organisms.

Groundwater aquifers occur along the major drainage lines, where recharge occurs during good rainy seasons. Deep seated fossil water is found along geological structures. In general, the groundwater resources of the Sperrgebiet are limited.

Despite its extreme environment, the entire Sperrgebiet falls into a global hotspot of biological diversity, which is an internationally recognised global and national priority for conservation based on extreme richness, uniqueness of species and threats to the habitat. The vegetation of the Sperrgebiet is amazingly rich, with succulent plants dominating. Botanically, the area is the unique northwestern extension of the Succulent Karoo biome of southern Africa, the world's most biodiverse arid region. Four vegetation zones can be distinguished, namely the coastal zone, the central sand plains, rocky outcrops and inselbergs and the lower Orange River zone. The coastal zone is characterised by hummock vegetation, which receives its moisture from the coastal fog. Lichens and other highly diverse biological crusts also thrive in this zone. The central sand plains have a low vegetation density due to the low availability of water and wind erosion pressure. The rocky outcrops and inselbergs are richly vegetated compared to their surroundings, partly because more moisture from fog and rainfall is available, but also because of the difference in the underlying geology and the resulting availability of nutrients. They contain a variety of lichens, which harvest the coastal fog. In the summer rainfall area, the inselbergs host aloes, acacias and lithops, whereas in the winter rainfall area even mosses, ferns and orchids can be found. Most of the rare, endemic and protected species occur on the rocky outcrops and inselbergs due to the diversity of habitats found. The banks of the lower Orange River support large trees, such as rhus, tamarisks and willow. The floodplain close to the mouth is dominated by scrubby open woodland. Some low rocky outcrops within the zone have a very specialised and rare succulent flora (Williamson & Jacobson, 1995).

Because of limited biological research in the access-restricted Sperrgebiet, the full diversity of plant, animal, fungal and microbial species is poorly known. However, the fact that the Sperrgebiet represents a transitional zone between summer and winter rainfall and from the coast to a mountainous area in the east, has resulted in an extraordinary diversity of animal life adapted to the arid environment. To date, some 76 species of mammals, 145 species of birds, almost 100 species of reptiles, 16 species of frogs and a large number of insects and other invertebrates have been identified. The diversity and endemism of invertebrates is expected to be particularly high, given a high predicted rate of species-specific pollination, herbivory and dispersal associations with the endemic flora. In addition, there are 38 species of marine mammals living along the coast and in the Atlantic Ocean adjacent to the Sperrgebiet. Lion, elephant, black and white rhino, giraffe and hippo used to occur in the Sperrgebiet in the 18th and 19th century, but are now extinct. A number of today's inhabitants of the Sperrgebiet have been listed as Red Data Species (Griffin *et al.*, 1995).

Palaeontology

The Sperrgebiet has a very impressive fossil record going back to the Cretaceous, some 85 million years ago, but being particularly well represented in the Cenozoic, from 65 million years onwards. Marine sediments of Cretaceous age are extremely restricted in Namibia, the only fossiliferous deposit being near Bogenfels. At this site a thin and locally restricted deposit yielded abundant gastropods, oyster shells and some ammonites, which indicate a Cenomanian age.

In the Langental area shallow marine sediments have a rich and highly diverse fauna, which suggests an Early Eocene age and contains organisms such as corals, bivalves and gastropods, but also a high diversity of sharks.

The Neogene beach deposits have been subdivided into five zones on the basis of their palaeontology. The Kenyasus zone is of Early Miocene age, the Agnotherium zone follows with a Middle to Late Miocene age. The Donax haughtoni zone is of Latest Miocene to Basal Pliocene age, followed by the Early Pleistocene Donax rogersi zone and the Late Pleistocene Donax serra zone. The various zones contain a wealth of fossil mammals as well as abundant marine fossils, and age dating made possible through these fossils greatly aided diamond exploration.

The Sperrgebiet also has a network of ancient valleys that once drained into the Atlantic Ocean. They contain sediments of various ages and several richly fossiliferous sites. At Elizabeth Bay, fossil ostracods, molluscs, frogs and mammals have been exposed by the mining activity. At Fiskus, rodents, macroscelitids, ruminants, suids, carnivores and rhinocerotids were found. Thousands of fossil eggshells were found at Elisabethfeld, and allowed for biostratigraphic distinctions. Early Miocene mammals also occur at Grillental, as well as at Langental.

One of the most important fossil sites in Africa occurs at Arrisdrif on the north bank of the Orange River. This site has yielded more than 10 000 fossils belonging to more than 30 mammalian taxa, many of which are new to science. In addition, there are crocodiles, tortoises and other reptiles, birds and fishes, as well as a few plants, all indicating that the local environment must have been considerably more humid than it is at present, and the climate was subtropical rather than temperate (Pickford & Senut, 2000).

Archaeology

Archaeological evidence suggests that people have visited the Sperrgebiet for at least 300 000 years, although the archaeological record is not continuous. Permanent settlement by early man is unlikely, but it is believed that people moved into the area following good rains to gather bulbs and seeds, and hunt for game. Along the coast, fish, whale and seal meat, seabirds, eggs and shellfish provided a good source of nutrition.

During the Early Stone Stage, more than 150 000 years before present, human occupation clustered on a relict beach close to the Orange River mouth, some 4 m above the present sea level. Their presence has been traced through finds of Acheulian stone tools, made from quartzite beach cobbles, in the vicinity of Oranjemund, red jasper near Skilpadberg and green silcrete at Bogenfels. It is likely that they used the Orange River as a route of access to the interior.

Very interestingly, the Pleistocene fluvial terraces of the Orange River near Oranjemund have yielded the calotte of the so-called Orange River Man, an archaic Homo sapiens, who lived approximately 100 000 years before present. Artifacts also provide evidence that human occupation continued in the Sperrgebiet during the Middle Stone Age from 150 000 to 20 000 years ago in the vicinity of springs. The tools are made of silcrete, ferricrete and quartzite. There are very rich undisturbed sites on top of a series of hills in the Affenrücken and Chameis areas.

During the Late Stone Age between 20 000 and 500 years ago, the hunter-gatherer culture was widespread at the coast and inland, where occupation sites are associated with springs and waterholes. Near the coast shell midden sites contain stone tools, ostrich eggshells and pottery fragments. In the interior, rock shelters contain rock art, while grinding stones, probably used for grinding grass seeds for food, are a striking feature of most of them. Bowls fashioned from tortoise carapaces have also been found. More modern man eventually turned to pastoralism, but still relied partly on hunting and gathering (Kinahan & Kinahan, 1995).

History

The more recent history of the Sperrgebiet starts off with the visit of Bartholomeu Diaz at today's Lüderitz, in 1488. Much later, in the 1700s, adventurers, hunters and explorers crossed the Orange River into southern Namibia. Voyagers from the Cape of Good Hope during the 17th century made brief encounters with the local people. In 1780, a group of nomadic pastoralists coming from the south gradually occupied the area between the lower Fish River and the coast. A Khoi village existed at the same time at the mouth of the Orange River. The first missionaries were sent to the area in the early 1800s by the London Missionary Society, and in 1819 the Chief at Bethanie organised the building of a road to the coast.

The discovery of guano in 1828 led to the first occupation by foreigners of Namibia in the 1840s, when huge deposits of the valuable fertilizer were scraped from Ichaboe and the neighbouring islands. So great was the profit, that Britain annexed the islands in 1866. While mining guano on Pomona Island, a certain John Spence noticed mineralised rocks on the mainland comprising quartz veins with galena and chalcopyrite. In 1863 he obtained a mining licence for the entire area under control of the Nama Chief David Christiaan. Unfortunately, the Pomona Mine was never successful. Mining rights were later disregarded, and Spence only retained the right over the immediate Pomona area. He never did realise what wealth of diamonds he had been granted.

In 1882, businessman Adolf Lüderitz decided to establish a base somewhere at the coast north of the Orange River to search for minerals in the interior. His employee, Heinrich Vogelsang, arrived in 1883 at Angra Pequena, and subsequently purchased land for Germany from Chief Frederiks. The boundaries there and then demarcated what was to become the Sperrgebiet. In the course of the 19th century, San and the Damara people lived a highly marginal existence in the area. Consequently, they gradually moved and no more indigenous inhabitants have been reported after 1931.

A diamond rush started when Zacharias Lewala found the first diamond near Kolmanskuppe in April 1908. Two months later, after government geologist Dr Paul Range confirmed the stones to be diamonds, practically the whole coastal strip between Marmora and Lüderitz was pegged. Klinghardt discovered the diamond fields near Bogenfels and at the beginning of 1909, Stauch and Scheibe found the fabulously rich deflation deposits at Pomona. Some of the deflation surfaces were so enriched by wind action, that the workers could pick up diamonds while crawling on their stomachs. By 1913, 20% of the world's output of diamonds came from the area.

Conditions on the diamond fields were chaotic, and the German colonial government became concerned about overlapping mining rights, the security of the diamonds and illegal mining. On 22 September 1908, Secretary of State Bernhard Dernburg therefore proclaimed the Sperrgebiet. Sole mining rights were given to the Deutsche Kolonialgesellschaft für Südwestafrika. The desolate mining villages of Pomona, Bogenfels, Elisabeth Bay and Kolmanskuppe were established, and a railway line to connect the southern with the northern fields was built. Up to this day this is the most expensive private railway line built on the African continent.

The outbreak of World War I brought diamond mining operations to a standstill, however, only for a short while. Mining rights reverted to the administration for South West Africa after the war, and in 1920, Sir Ernest Oppenheimer amalgamated the various companies into Consolidated Diamond Mines of South West Africa (CDM). Extensive diamond deposits were found in marine terraces north of the Orange River mouth in 1928. Initially, mining was slow due to the world-wide depression, but started to pick up in the 1940s, and in 1943, CDM headquarters moved to Oranjemund from Kolmanskuppe, since the southern fields had gained more importance than the nearly mined-out northern fields. Mining in the northern areas stopped in 1950, and the last person left Kolmanskuppe in 1956. The town of Oranjemund has since grown into the major support structure for Namibian diamond mining.

In 1961, mining of shallow-water marine deposits for diamonds was initiated at Chameis. A fleet of four barges worked for several years before being replaced by the more modern barge “Pomona”. Today, a sophisticated fleet of mining and exploration vessels is concentrating on the deeper water areas, and some 50% of Namibia's total diamond production comes from the sea.

Conservation and Research

The Sperrgebiet is of special scientific interest, due to its globally significant and unique biological diversity, and its relative freedom from disturbance by modern developments. Stringent conservation status should be applied in areas of top biodiversity sensitivity, as well as those with cultural, historical, archaeological and palaeontological heritage resources. More scientific research is required on most of the areas's biota, and in particular on birds, seals, cetaceans, lichens and other biological crusts, arachnids and other invertebrates of the terrestrial, intertidal, and coastal island habitats. Palaeontology and archaeology also require additional research input. Environmental issues need urgent attention in already disturbed areas.

Equally important, from an economic point of view, is the thorough exploration for mineable mineral resources that can assist in the socio-economic development of the entire country. Detailed geological research is required to determine the mineral potential of the area, as well as options for its future exploitation, however, with full regard to the sensitivity and global uniqueness of the environment. Such options must integrate other land uses, and include rehabilitation measures that will allow for alternative uses once a mining operation has stopped.

Within the present core mining areas, the potential for rehabilitation and the establishment of alternative land uses after the closure of the current mining operations needs to be fully investigated. Areas of high biodiversity value, such as the mountainous areas, the inselbergs and the Orange River mouth and wetlands, need to be addressed by means of collecting sufficient scientific information to determine their environmental importance and potential for complementary land uses. The coastal islands are important breeding areas for a number of sea birds, while lobster breed in the adjacent shallow marine zone. As with the terrestrial environment, there is a severe lack of sufficient scientific information to determine the environmental importance of the islands

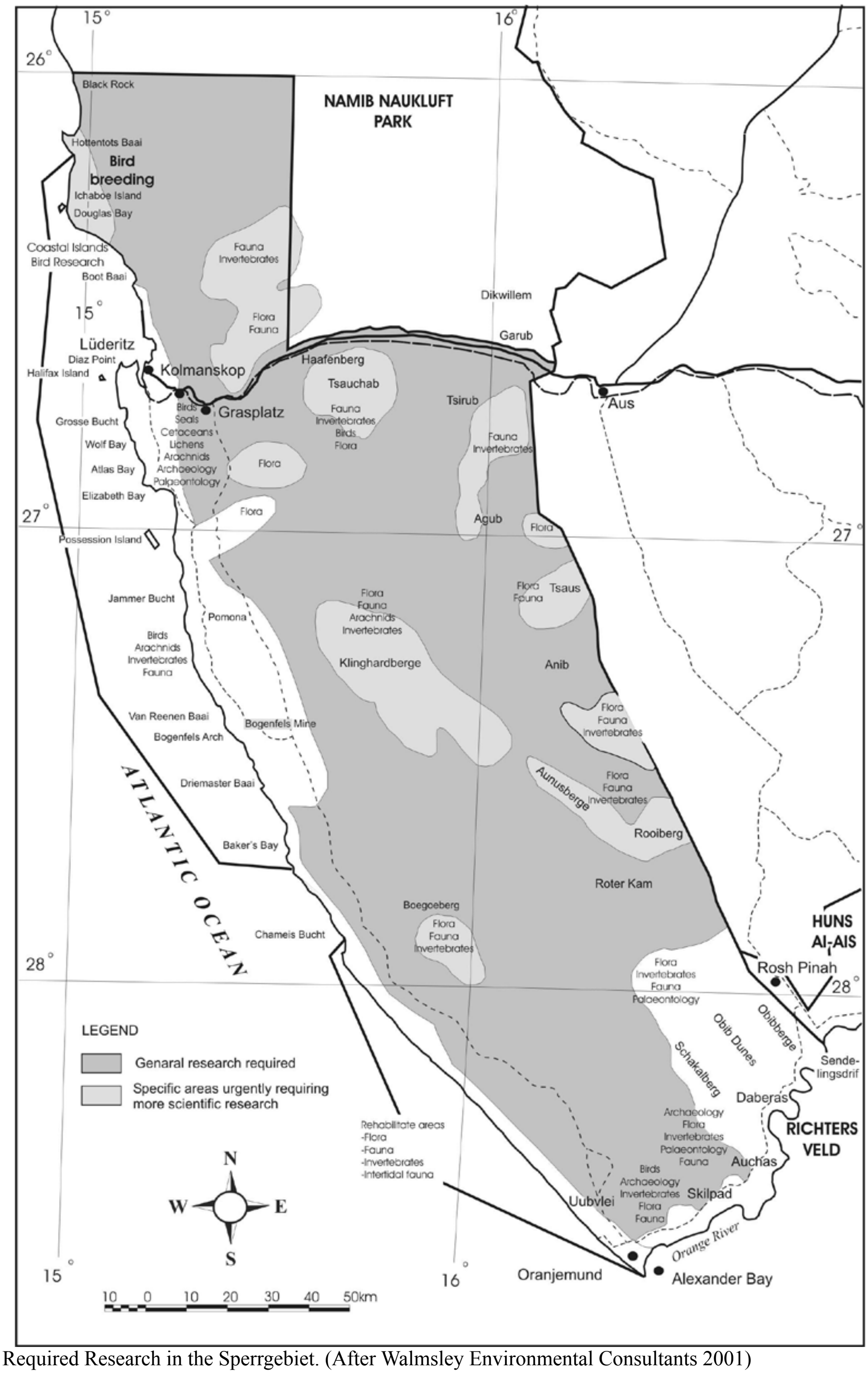

Figure 5: Required Research in the Sperrgebiet. (After Walmsley Environmental Consultants 2001)

and their potential for complementary land uses.

A map showing specific areas, which urgently need more research and areas that require general research is given in Fig. 5. A more detailed data analysis and conservation planning is currently undertaken in order to support the specific zoning of the area (pers. comm. P. Barnard).

The Recommendations of the Land Use Plan

The Land Use Plan gives land use options and guidelines for such options, including prospecting, mining, tourism, conservation, research, agriculture, mariculture, aquaculture, power generation and transmission, education and training. The plan provides a preliminary zoning for the Sperrgebiet, according to sensitivity, importance and development potential of individual areas (Fig. 6). The zoning includes strict nature reserves, national park areas, wilderness areas, natural monuments, habitat/species management areas, protected landscapes/seascapes and managed resource protected areas. The zoning of national park areas is an umbrella category, with the other zoning categories representing specialized areas within a national park area. It is further envisaged to put in place a management and integrated development plan for the southern Namib and the Rich-

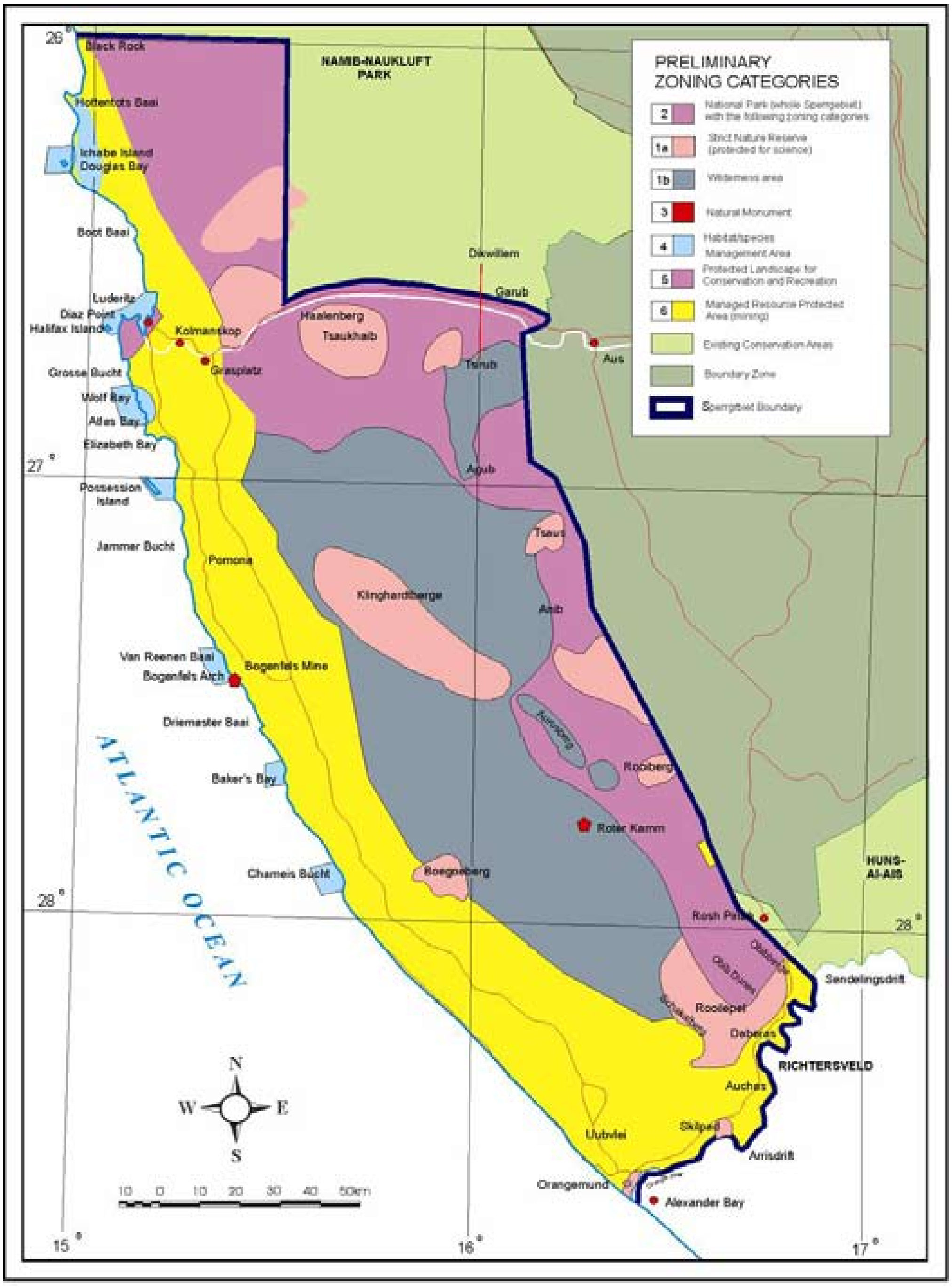

Figure 6: Recommended Zoning for the Sperrgebiet (After Walmsley Environmental Consultants, 2001)

tersveld Conservation Area, and eventually to have a trans-frontier conservation protocol between Namibia, Southern Africa and Angola to conserve and develop the entire Namib in a sustainable way.

It is therefore recommended that the entire Sperrgebiet be declared a Protected Area under the forthcoming Namibian Parks and Wildlife Act. This Act will adopt the International Union for the Conservation of Nature (IUCN) Guidelines for Protected Area Management Categories (IUCN, 1994). However, simply designating the Sperrgebiet as a Protected Area alone does not ensure its best utilisation and preservation. To recognize the importance of sustainable development, pristine wilderness, science, education and history without leaving negative imprints, is a challenge to which integrated management is the key.

Strict Nature Reserves are to be set aside for scientific studies until more is known about them and their environmental importance has been clarified, i.e. applying the precautionary principle. They include mainly mountainous areas, such as Klinghardt Mountains, Tsaukhaib, Rooiberg, Boegoeberg, Skilpadberg, Schakalberg and Rooilepel, where additional data on flora, fauna, palaeontology and archaeology need to be collected.

Wilderness Areas are low usage, core areas, which are managed mainly for conservation. It is recommended that there should be no or strictly minimal mechanised access. The entire central Sperrgebiet, including Aurusberg, falls within this zoning.

National Park Areas are designated mainly for conservation and ecotourism. There will be a slightly greater public usage, but still with controlled and limited access and always with a certified guide. This zoning will allow for vehicle access and wilderness camps. There should not be any permanent structures, and only some minor upgrading of tracks and development of hiking trails. The eastern and northeastern parts of the Sperrgebiet are included in this category.

The zonation of Natural Monument applies to the conservation of specific natural features. At present only the Bogenfels Arch and the Roter Kamm Meteorite Crater are included in this category.

Habitat/Species Management Areas comprise the Ramsar Site at the Orange River Mouth and the offshore islands. These are areas that should be managed mainly for conservation, and may require management interventions, for example manipulation of flows in the Orange River to ensure that minimum flow requirements are met.

The zonation Protected Landscape/Seascape applies to the Diamond Coast Recreation Area near Lüderitz and the recreation areas around Oranjemund, in which a broader spectrum of recreational activities occur and private vehicle access is allowed.

Managed Resource Protected Areas are to be managed for the sustainable use of natural ecosystems, including mining. This zoning includes the entire western part of the Sperrgebiet, as well as an area north of the Orange River. The area of the Skorpion Zinc Mine is also a Managed Resource Protected Area. It can be envisaged that future mineral discoveries will also be zoned accordingly, should it be agreed that in the national interest they should be exploited. Proper rehabilitation of these areas could mean that ultimately they would be available for some other type of land use in the future, consistent with the goals of the proposed National Park. By including these areas now in the National Park, it will allow Government some degree of environmental control both during, and on closing of the prospecting and mining activities. Once mining ceases and the areas are rehabilitated the zoning classification could be upgraded.

The Sperrgebiet Land Use Plan therefore represents a unique opportunity to show that conservation goals cannot be separated from economic development and that a balanced approach to sustainable development can be achieved given the cooperation of all stakeholders. It is an excellent basis for further detailed planning, on which to launch the future of an extraordinary partnership between conservation and economic activities, for the sustainable development of Namibia.

References

Applegate, D. 2000. Ruling the Range: Managing the Public's Resources. *In*: Schneidermann, J.S. (Ed.) *The Earth around us*, 453 pp., Freeman, New York.

Griffin, M., Williams, T., Ryan, P., Pallett, J., Marais, E. and Griffin, E. 1995. Animal Life. *In*: J. Pallett (Ed.) *The Sperrgebiet – Namibia's least known wilderness*, 47-58. NAMDEB, Windhoek.

IUCN 1994. *Guidelines for Protected Area Management Categories*. IUCN Commission on National Parks and Protected Areas.

Kinahan, J. and Kinahan, J. 1995. Archaeology. In: J. Pallett (Ed.) *The Sperrgebiet – Namibia's least known wilderness*, 69-71. NAMDEB, Windhoek.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., Da Fonseca, G.A.B. and Kent, J. 2000. Biodiversity hotspots for conservation priorities. *Nature*, **403**, 853-858.

Pickford, M. and Senut, B. 2000. Geology and Palaeobiology of the Namib Desert, Southwestern Africa. *Mem. Geol. Surv. Namibia*, **18**, 150 pp.

Seely, M. 1995. Climate. *In*: J. Pallett (Ed.) *The Sperrgebiet – Namibia's least known wilderness*, 37-39. NAMDEB, Windhoek.

Ward, J. 1995. Geology and Geomorphology. *In*: J. Pallett (Ed.) *The Sperrgebiet – Namibia's least known wilderness*, 27-32. NAMDEB, Windhoek.

Walmsley Environmental Consultants, 2001. The Sperrgebiet Landuse Plan. Unpubl. Rep., 175 pp.

Williamson, G. and Jacobson, K. 1995. Vegetation. *In*: J. Pallett (Ed.) *The Sperrgebiet – Namibia's least known wilderness*, 40-46. NAMDEB, Windhoek.