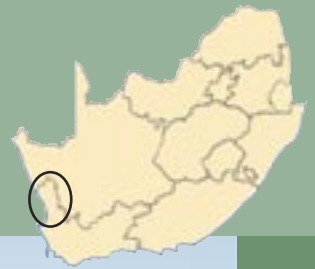


STATE OF RIVERS REPORT

OLIFANTS/DORING AND SANDVELD RIVERS 2006



RIVER HEALTH PROGRAMME

OLIFANTS/DORING AND SANDVELD RIVERS

2006: SUMMARY

The Olifants/Doring Water Management Area comprises the Olifants, Doring, Kouebokkeveld, Knersvlakte and Sandveld areas.

The Olifants River is the main river within the Water Management Area. It flows to the north-west, through a deep, narrow valley that widens and flattens into a wide floodplain below Clanwilliam. The Doring and Sout rivers are major tributaries. The Sandveld comprises the seasonal Verlorelei, Langylei and Jakkals rivers, which flow westwards of the Olifants River towards the Atlantic Ocean.

Land-use in the area consists largely of livestock farming (sheep and goats), with small areas being used for dryland farming. Citrus, grapes, deciduous fruit and potato farming is intensive in the south-west. Urban and rural areas are relatively small, with the main towns being Calvinia, Citrusdal, Clanwilliam, Lamberts Bay, Niewoudtville, Vanrhynsdorp and Vredendal.



OVERALL STATE

Generally, only the upper reaches of the main rivers and their tributaries in the Water Management Area are still in a natural or good ecological state. Portions of the area are protected through conservation initiatives such as the Greater Cederberg Biodiversity Corridor and the Knersvlakte Centre of the Succulent Karoo. The middle and lower reaches of many rivers are in poor ecological condition as a result of alien plant and fish infestation, as well as intensive agricultural development. Alien fish have severely impacted indigenous fish populations.

IMPACTS

Flow is severely modified in the lower Olifants River as a result of two large instream dams (Clanwilliam and Bulshoek). No environmental releases are made from these dams. A large number of instream and off-channel farm dams in the Kouebokkeveld have severely modified flows (low flow and floods) in the Houdenbek and Winkelhaak rivers.

Water abstraction from surface and groundwater resources throughout the Water Management Area has further modified flow. Major impacted rivers are the Sandveld rivers and the lower Olifants River.

Modified flows are impacting negatively on the functioning of the river, as well as the overall ecological integrity, which in turn affects the ability of the system to deliver certain goods and services provided by the rivers (water supply, breakdown of pollutants).

Instream dams on the Brandewyn River



River Health Indices (p. 4)

Index of Habitat Integrity



Geomorphology Index



Riparian Vegetation Index



Fish Index



South African Scoring System



Water Quality



EcoStatus/River Health Categories (p. 5)

Natural (N)

Good (G)

Fair (F)

Poor (P)

EIS Categories (p. 4)

Very High (VH)

High (H)

Moderate (M)

Low (L)

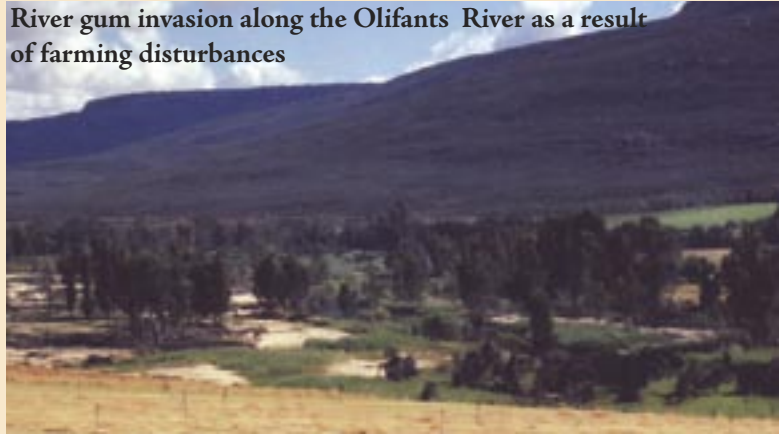
WHAT IS RIVER HEALTH?

Healthy rivers provide **goods and services** (water supply, natural products, breakdown of pollutants, conservation, flood attenuation, recreation and spiritual value) which contribute to human welfare and economic growth. When people use rivers, they impact on river health. The National River Health Programme assesses the health of rivers by measuring selected ecological indicator groups that represent the condition of the larger ecosystem. The data are simplified and represented as indices.

The overall ecological status of a river reach is expressed as the EcoStatus, which provides an integrated value of all the ecological indices assessed for that particular reach. The ecological importance and sensitivity rating (EIS) provides an indication of the level of protection that a river should receive.

Many of the Olifants/Doring and Sandveld rivers suffer from habitat loss due to *farming disturbances* in the riparian zone (construction of levees, bulldozing, clearing of indigenous riparian vegetation, overgrazing, crops within the floodplain). This has resulted in invasion by alien plants, a loss of cover and food for aquatic animals, a reduction in water quality and increased sedimentation of the river bed.

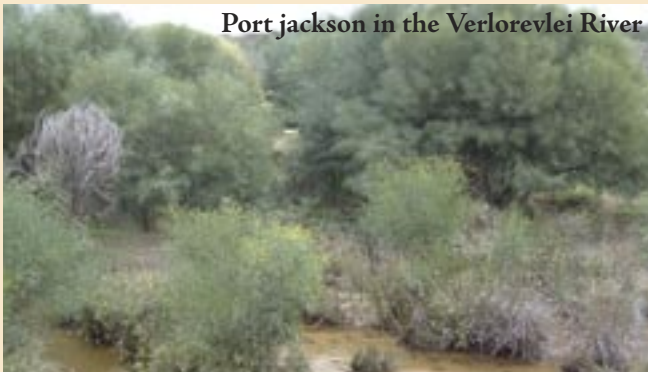
River gum invasion along the Olifants River as a result of farming disturbances



Oleander in the Groot River



Port jackson in the Verlorevelei River



Alien fish (banded tilapia, bluegill sunfish, bass, carp) occur mostly in the mainstem of the Olifants and Doring rivers, as well as the lower reaches of the tributaries. Predation by alien fish (bass) has resulted in localised extinctions of indigenous fish, particularly in the Olifants and Doring rivers and many of their tributaries.

A variety of *invasive alien plants* occur throughout the Water Management Area. In the wetter Olifants and Kouebokkeveld areas, black wattle and red river gum are common on river banks where indigenous riparian plants have been removed. Mesquite dominates the riparian zone of the arid Doring and Sout catchments, while oleander completely blocks the channel in parts of the Doring and Groot rivers. Disturbance of the riparian zone has resulted in infestation of port jackson throughout the Sandveld. These alien plants modify the river channel, and reduce habitat integrity and baseflows in rivers.

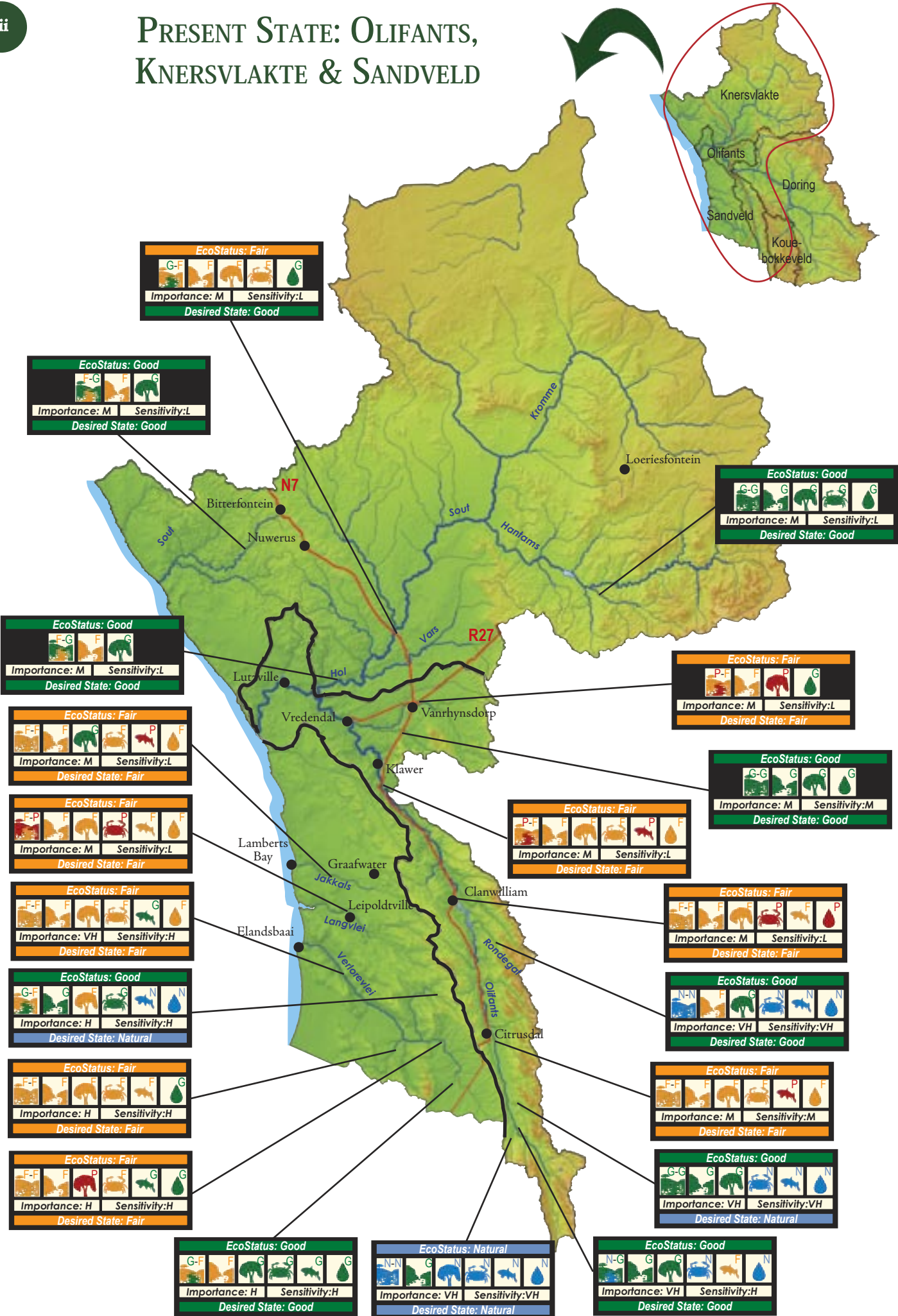
Smallmouth bass



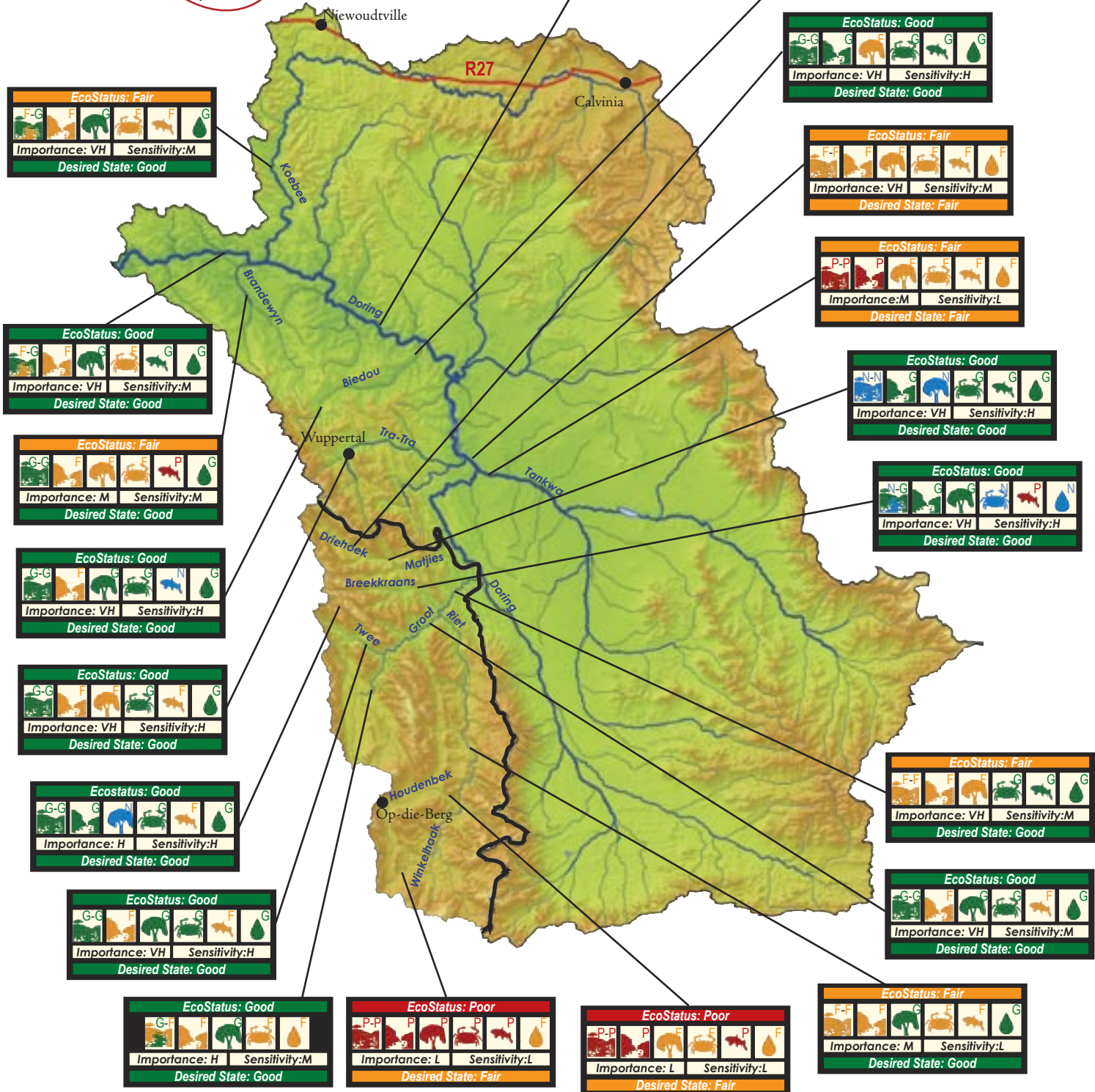
MANAGEMENT ACTIONS

- ✈ Encourage efficient water-use throughout the Water Management Area
- ✈ No further instream dams should be built in the Olifants, Doring and Verlorevelei rivers
- ✈ Investigate environmental flow release options for all existing instream dams
- ✈ Discourage groundwater abstraction within the riparian zone in the Sandveld
- ✈ Use environmentally acceptable farming practices (prevent overgrazing, limit livestock in riparian zones) and maintain a buffer area (10 - 20 m) along river banks
- ✈ Clear alien vegetation from riparian buffer areas and the surrounding catchment. Maintain cleared areas
- ✈ Investigate the removal of alien fish from certain key river reaches to allow the creation and management of sanctuaries/refuge areas for indigenous fish

PRESENT STATE: OLIFANTS, KNERSVLAKTE & SANDVELD



PRESENT STATE: DORING & KOUEBOKKEVELD



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Department of Environmental Affairs and Tourism

Water Research Commission

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City of Cape Town

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FOREWORD

The availability and locality of water has shaped the Olifants/Doring and Sandveld catchment areas as we see them today. Access to water has determined the location of towns and enabled the growth of the agricultural sector. This area is, however, also subjected to extreme dry conditions, during summer months. Combined with the scenario that this is a winter rainfall area, there are many challenges that this area is faced with when water demand is at its peak during the dry summer months.



To continue providing water for all users at the optimum assurance of supply, we need to use water more efficiently and develop a more sustainable approach to agriculture, and at the same time restore and maintain the health of the environment. This means changing our entire approach and our mind-set to the management of water. We need to build an ethic of water conservation, to cut water use and recycle or reuse water wherever possible, to put our water to the highest value use, where we do use it, and to restore our rivers to safeguard our water systems in the future.

To achieve sustainable use of water resources, they need to be monitored, assessed and reported on. This State of Rivers Report, the product of a variety of organisations, researchers and scientists, attempts to inform decision makers, interested parties and the public on fundamental issues impacting on river systems, in an easy to understand format. It aims to raise awareness and understanding on the current state of our rivers, the impacts on them and what management actions can be taken by all to improve them. As increasing development, especially by the agricultural sector, places pressure on these water resources, it becomes increasingly important that both water resource managers and users of these resources understand the current state of the rivers and their ecological importance.

Through this report, all who live in the Olifants/Doring and Sandveld river catchments are encouraged to use these water resources sustainably and where possible restore or conserve the rivers to uphold the goods and services that they provide.

Abdulla Parker

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Suggested Citation:

River Health Programme (2006). State of Rivers Report: Olifants/Doring and Sandveld Rivers.

Department of Water Affairs and Forestry, Pretoria

ISBN No: 0-620-36021-6

Acknowledgements

Roger Bills (SAIAB), Charlie Boucher (US), Cate Brown (Southern Waters), Atherton de Villiers (CapeNature), Brian Dyason (DWAF), A. Fanfoni, Liesl Hill (CSIR), Neels Kleynhans (DWAF), Sean Marr (UCT), Bonani Madikizela (DWAF), Rembu Magoba (Southern Waters), Steve Mitchell (WRC), Rudi Pretorius (DEAT), Wilma Strydom (CSIR), Colleen Todd (DWAF), Henk van Kleef (DWAF)

STATE OF RIVERS REPORT: OLIFANTS/ DORING AND SANDVELD RIVERS

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CONTEXT

The current state of the aquatic ecosystems presented in this report is based on the findings of river surveys that were conducted in the Olifants/Doring and Sandveld Rivers as part of the River Health Programme, Western Cape. These surveys took place between 2002 and 2005.



'River health' refers to the overall condition of a river. The term can be compared to a person or an economy's health. Healthy rivers are essential to our well-being and is central to social and economic development.

MANAGING HEALTHY RIVERS FOR PEOPLE

Access to a sufficient supply of freshwater is critical for human survival. However, only 0.01% of the earth's water is available as freshwater in rivers and lakes. Rivers and lakes supply a vast array of goods and services, such as the supply of water for drinking, irrigation and manufacture of products, the breakdown or dilution of waste and provide places of recreational, aesthetic, spiritual or religious value. Freshwater resources also support approximately 12% of all species, which depend on the physical, chemical and hydrological processes and biological interactions within rivers to complete all or part of their life stages. All terrestrial organisms also need freshwater for their survival. The high dependency of all life on freshwater, highlights the importance of managing our rivers.



Today our rivers face a crisis, as the health of the world's freshwater ecosystems has declined by 50% in the last 30 years. Up to 35% of the world's freshwater fish have become endangered, threatened or extinct. The deterioration of rivers not only results in a loss of freshwater species but also degrades the ability of the systems to provide the goods and services that people depend on. Estimates are that freshwater use is growing at 2.5 times the rate of the human population growth rate, with water demand in developing countries increasing by 50% in the next 25 years. Water resource managers and water users alike must alter their practices to ensure that rivers continue to support both freshwater biodiversity and human life.

WATER POLICY, LEGISLATION & MANAGEMENT

The need for sustainable, equitable and efficient water use is central to South Africa's water resource management policy and legislation. The National Water Act (Act 36 of 1998) is the principle legal instrument for the protection, use, development, conservation, management and control of our water resources.

The National Water Resources Strategy (2004) provides a long term plan of how the National Water Act is to be implemented. A protective approach to water resource management has been adopted where water use activities are allowed according to a desired water resource state. This means that water resources are "looked after and used wisely", not "kept separate and preserved".



WHAT IS THE RIVER HEALTH PROGRAMME?

The River Health Programme assesses the biological and habitat integrity of rivers (through evaluation of, for example, fish, aquatic invertebrates and riparian vegetation). This assessment enables reports on the ecological state of river systems to be produced in an objective and scientifically sound manner. Information from the River Health Programme assists with identification of those areas where unacceptable ecological deterioration is taking place. In addition, this programme reflects the effectiveness of existing river management policies, strategies and actions.

Monitoring aquatic ecosystem health is a requirement in terms of the National Water Act and the results are important for the application of the National Environmental Management Act (1998).

The River Health Programme is a collaborative venture and partnerships are vital for its success. The national organisations leading the River Health Programme are the Department of Water Affairs and Forestry, Department of Environmental Affairs and Tourism and the Water Research Commission. A variety of organisations within each province implement the River Health Programme at a local level.

The Department of Water Affairs and Forestry, custodian of South Africa's water resources, protects the health of aquatic ecosystems and ensures the sustainable use of water. The River Health Programme, operational since 1994, is a key part of this responsibility. For more information visit www.csir.co.za/rhp.

WHAT ARE STATE OF RIVERS REPORTS?

Reports and posters of the River Health Programme will eventually cover all major river systems in South Africa. These will be updated on a regular basis.

State of Rivers reporting is a spin-off of State of the Environment (SoE) reporting, which has become a recognised form of communication on environmental issues over the past decade. The aim is to provide better information for environmental decision-making. The national SoE uses the Driving Force-Pressure-State-Impact-Response framework to explain what causes environmental change, the wider implication of that change and what we can do to manage the change. State of Rivers reporting uses the same approach, but often with slightly different terminology.

State of Rivers reporting disseminates information on river health to:

- ✦ assist in ecologically sound management of rivers;
- ✦ inform and educate people regarding the condition of our rivers; and
- ✦ encourage wide participation by all stakeholders.

HOW TO READ THIS REPORT

This introductory section deals with the overall aims of the River Health Programme. The next few pages provide general information on the methods and the study area, followed by five sections dealing with the Olifants/Doring and Sandveld rivers in detail. Each section outlines catchment activities, ecological importance and sensitivity, present and desired health, ecostatus, pressures on the river and key management actions required.





HOW DO WE MEASURE RIVER HEALTH?

Many physical, chemical and biological factors influence river ecosystem health. The River Health Programme focuses on selected ecological indicator groups that represent the larger ecosystem and are feasible to measure. State of river reporting uses *RIVER HEALTH INDICES* (see below) to present data in a format that is easy to understand.

The *PRESENT HEALTH* of a river is a measure of the present ecological state of the river during the time of the survey and is presented in terms of the *RIVER HEALTH CATEGORIES* given below.

| River Health Category | Ecological Perspective | Management Perspective |
|-----------------------|--|---|
| Natural N | No or negligible modification from natural | Relatively little human impact |
| Good G | Biodiversity and integrity largely intact | Some human-related disturbance but ecosystems essentially in good state |
| Fair F | Sensitive species may be lost; tolerant or opportunistic species dominate | Multiple disturbances associated with the need for socio-economic development |
| Poor P | Mostly tolerant species; alien invasion, disrupted population dynamics; organisms often diseased | High human densities or extensive resource exploitation |

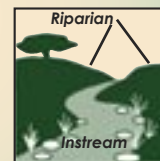
Riparian Vegetation Index

Healthy riparian zones help to maintain the form of river channels and serve as filters for sediment, nutrients and light. Plant material from the riparian zone is an important source of food for aquatic fauna. The index is a measure of modification of riparian vegetation from its natural state.



Index of Habitat Integrity

The availability and diversity of habitats are major determinants of aquatic biota that are present. The index assesses the impact of human disturbance on the riparian and instream habitats.



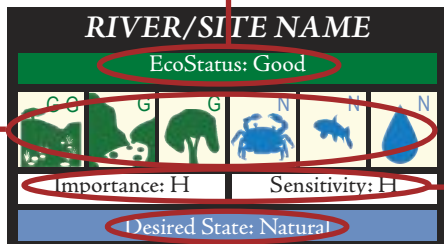
South African Scoring System

Aquatic invertebrates (crabs, insects, snails) require specific aquatic habitats and water quality conditions. They are good indicators of recent localised conditions in a river. The index is relatively simple and based on invertebrate families found at a site.





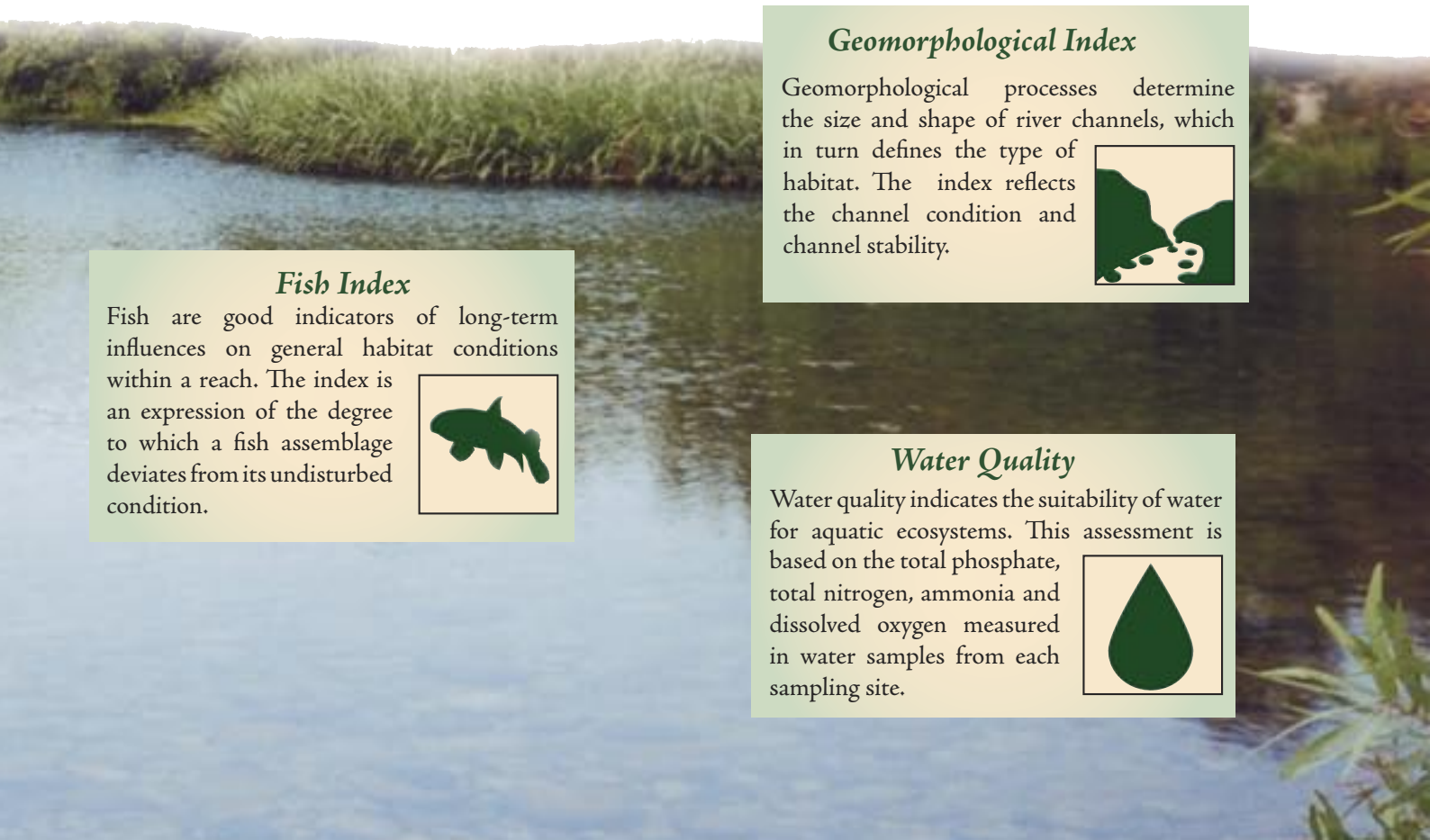
The outcome of the overall assessment is the ecological status (*ECOSTATUS*), which is an integrated index value that indicates the ecological state of a river site or reach in a simple but ecologically relevant way. The EcoStatus indicates the ability of a river to support an array of indigenous species and a variety of goods and services.



The *ECOLOGICAL IMPORTANCE AND SENSITIVITY* (EIS) rating provides an indication of the level of protection that a river should receive. The following EIS categories can be assigned to a river:

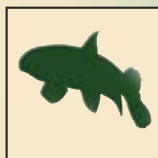
| EIS Category | Description |
|------------------|--|
| Very High (VH) | A very high or high EIS indicates a strong ecological motivation for awarding a high level of protection to the associated river. |
| High (H) | Such rivers should be maintained in a natural or good river health category. |
| Moderate (M) | A moderate or low/marginal EIS is representative of a river with a relatively lower conservation value. Such river catchments are more impacted and thus more suited to development. |
| Low/Marginal (L) | |

The *DESIRED HEALTH* of a river is the envisioned future ecological state of the river. It is based on ecological considerations, the need for sustainable development and management actions (rehabilitation) concerning the river environment.



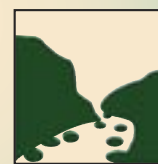
Fish Index

Fish are good indicators of long-term influences on general habitat conditions within a reach. The index is an expression of the degree to which a fish assemblage deviates from its undisturbed condition.



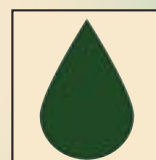
Geomorphological Index

Geomorphological processes determine the size and shape of river channels, which in turn defines the type of habitat. The index reflects the channel condition and channel stability.



Water Quality

Water quality indicates the suitability of water for aquatic ecosystems. This assessment is based on the total phosphate, total nitrogen, ammonia and dissolved oxygen measured in water samples from each sampling site.



The study area consists of five management areas: the Olifants, Doring, Kouebokkeveld, Knersvlakte and Sandveld. The main river is the Olifants River, with the Doring and Sout rivers being major tributaries.

The Olifants River flows to the north-west, through a deep, narrow valley that widens and flattens into a wide floodplain below Clanwilliam. This naturally perennial river lies in the winter rainfall area and has a distinctly seasonal flow pattern. The Doring River lies to the east of the Olifants River and has a large number of contributing tributaries rising in the Cederberg and Kouebokkeveld. The Sout River drains the Knersvlakte in the north and flows into the Olifants River near Lutzville. The Doring and Sout rivers are naturally seasonal rivers.

The Sandveld comprises the seasonal Verlorevlei, Langvlei and Jakkals rivers that flow westwards of the Olifants River towards the Atlantic Ocean.

POPULATION

Approximately 104 000 people live in the area. Almost half of the population live in urban and peri-urban areas. The average population growth rate is about 0.5% per year. However, Vredendal is growing at a rate of about 7% per annum due to migration of people from rural areas.

ECONOMY

The area contributes approximately 0.3% to the gross domestic product of South Africa, with nearly half (R2 billion) contributed by the agricultural sector. Activities in this sector include the production of wine, table grapes, citrus, rooibos tea, fresh fruit, dried fruit, potatoes, wheat, livestock and fisheries. Trade and industry linked to agriculture is the next most important economic sector. Half of the labour force is employed by the agricultural sector, while 8% are unemployed. Nature-based tourism is an important and growing industry in this area, with most of the towns experiencing a growth in this sector. Mining (diamond, gypsum, limestone and marble) occur on a small-scale.





Urban areas (<1%)

Land-use in the Olifants/Doring and Sandveld river catchments consists largely of livestock farming (sheep and goats), with small areas being used for dryland farming. Citrus, grapes, deciduous fruit and potato farming are intensive in the south-west. Urban and rural areas are small. Most of the area is still covered by natural vegetation, although this has been disturbed by over-grazing.

Water-use is highest in the Olifants management area, representing over 65% of the total water requirement for the Water Management Area. Close to 20% is used in the Kouebokkeveld, about 10% in the Sandveld and smaller quantities in the Doring and Knersvlakte management areas.



Forest plantations (<1%)



Dryland crops (6%)



Irrigated crops (2%)



Natural vegetation (89%)



| Management Area | Olifants | Doring | Kouebokkeveld | Knersvlakte | Sandveld |
|--------------------------------|--|--------------------------------|---|--------------------------------|----------------------------------|
| Main land-use | Irrigated agriculture (citrus and grapes), urban | Livestock, dryland agriculture | Irrigated agriculture (deciduous fruit) | Livestock, dryland agriculture | Irrigated agriculture (potatoes) |
| Population | 52600 | 15800 | 9700 | 8500 | 26400 |
| Inadequate water services (%)* | 3% | 2% | 2% | 1% | 2% |

* Water supply and sanitation services that are below the Reconstruction and Development Plan standards

CATCHMENT CHARACTERISTICS

Areas of similar ecological characteristics (e.g. climate, geology and vegetation) are grouped together in ecoregions. Ecological characteristics are important in influencing the distribution and different types of fauna and flora. Rivers in the same ecoregion are ecologically more similar to one another than rivers in different ecoregions.

ECOREGIONS

The ecoregions in the Olifants/Doring and Sandveld river catchments are the Western and South-Western Coastal belts, the Western and Southern Folded Mountains, Nama and Greater Karoo, and Namaqua Highlands.

South Western Coastal Belt

| | |
|--------------------------------|-------------------------|
| Landscape | Moderate relief plains |
| Vegetation | West Coast Renosterveld |
| Altitude (m) | 0 - 300 |
| Rainfall pattern | Winter |
| Mean Annual Precipitation (mm) | 100 - 1000 |
| Mean Annual Runoff (mm) | 20 to 250 |
| Average Daily Temperature (°C) | 14 - 20 |

Western Coastal Belt

| | |
|--------------------------------|-------------------|
| Landscape | Low relief plains |
| Vegetation | Succulent Karoo |
| Altitude (m) | 0 - 700 |
| Rainfall pattern | Winter |
| Mean Annual Precipitation (mm) | 0 - 300 |
| Mean Annual Runoff (mm) | less than 5 |
| Average Daily Temperature (°C) | 16 - 22 |



| Management Area | Olifants | Doring | Kouebokkeveld | Knersvlakte | Sandveld |
|-----------------------------------|--|--|--|---|--|
| River & main tributaries | Olifants, Ratel, Thee, Noordhoek, Boontjies, Rondegat, Jan Dissels, Seekoeivlei, Troe-Troe | Doring, Tankwa, Oorlogskloof/Koebee, Tra-Tra, Biedouw, Brandewyn | Groot, Riet, Leeu, Twee, Matjies, Breekkrans | Hol, Kromme, Hantams, Sout, Vars | Verlorevlei, Langvlei/Wadrif, Jakkals |
| Catchment size (km ²) | 4501 | 18248 | 3072 | 23245 | 4827 |
| Geology | Table Mountain Group (quartzitic sandstones), | Table Mountain Group (quartzitic sandstones), Bokkeveld Group (shales), Witzenberg Group (quartzites and shales) | Table Mountain Group (quartzitic sandstones), Witzenberg Group (quartzites and shales) | Dwyka Formation (tillites and shales), Ecca Group, Vanrhynsdorp Group | Sandveld Group (alluvial sediments) |
| Vegetation | Sandstone Fynbos | Sandstone Fynbos, Succulent Karoo, Tankwa Karoo | Sandstone Fynbos | Succulent Karoo | Strandveld Succulent Karoo and Sand Fynbos |
| Mean Annual Precipitation (mm) | 460 | 220 | 413 | 179 | 295 |
| Mean Annual Evaporation (mm) | 1656 | 1814 | 1675 | 1977 | 1582 |



Nama Karoo

| | |
|--------------------------------|--|
| Landscape | Moderate to high relief plains & hills |
| Vegetation | Bushmanland Nama Karoo |
| Altitude (m) | 300 - 1700 |
| Rainfall pattern | Very late summer to winter |
| Mean Annual Precipitation(mm) | 0 - 500 |
| Mean Annual Runoff (mm) | 5 - 60 |
| Average Daily Temperature (°C) | 12 - 20 |



Namaqua Highlands

| | |
|--------------------------------|-------------------------|
| Landscape | Moderate to high relief |
| Vegetation | Succulent Karoo |
| Altitude (m) | 100 - 1300 |
| Rainfall pattern | Winter |
| Mean Annual Precipitation (mm) | 0 - 200 |
| Mean Annual Runoff (mm) | 20 - 40 |
| Average Daily Temperature (°C) | 12 - 22 |



Greater Karoo

| | |
|--------------------------------|-------------------------------|
| Landscape | Low, moderate and high relief |
| Vegetation | Central and Great Nama Karoo |
| Altitude (m) | 300 - 1700 |
| Rainfall pattern | Very late summer to winter |
| Mean Annual Precipitation (mm) | 0 - 500 |
| Mean Annual Runoff (mm) | 5 - 40 |
| Average Daily Temperature (°C) | 10 - 20 |



Western Folded Mountains

| | |
|--------------------------------|--|
| Landscape | Moderate/high relief mountains & hills |
| Vegetation | Sandstone Fynbos |
| Altitude (m) | 300 - 1700 |
| Rainfall pattern | Winter |
| Mean Annual Precipitation (mm) | 200 - 1500 |
| Mean Annual Runoff (mm) | 5 to more than 250 |
| Average Daily Temperature (°C) | 10 - 20 |



Southern Folded Mountains

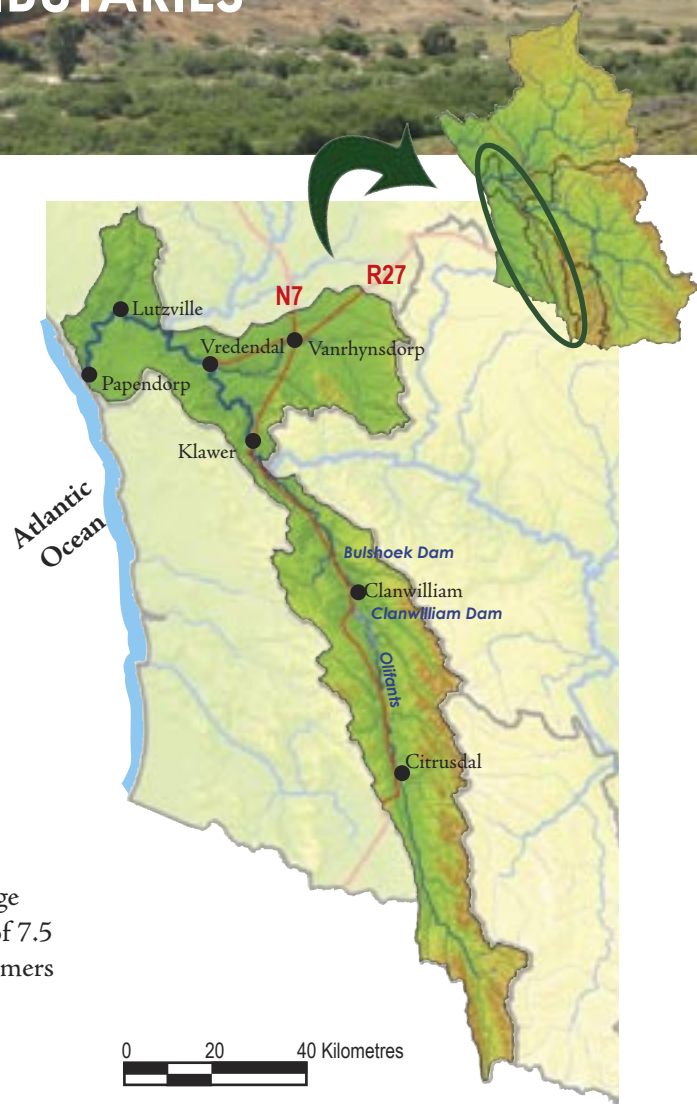
| | |
|--------------------------------|---|
| Landscape | Moderate/high relief mountains & hills |
| Vegetation | Sandstone Fynbos, Succulent Karoo |
| Altitude (m) | 300 - 1900 |
| Rainfall pattern | Very late summer to winter, to all year |
| Mean Annual Precipitation (mm) | 200 - 1500 |
| Mean Annual Runoff (mm) | less than 5 to more than 250 |
| Average Daily Temperature (°C) | 10 - 20 |

OLIFANTS RIVER AND TRIBUTARIES

The Olifants River rises in the Agter Witzenberg Mountains north of Ceres. The mainstem is about 250 km long. The river flows to the north-west through a deep, narrow valley that widens and flattens into a wide floodplain below Clanwilliam. In its upper reaches it drains Table Mountain Group quartzitic sandstone and is fed by a number of high-quality acidic streams. The tributaries flowing from the east (Ratel, Thee, Noordhoek, Boontjies, Rondegat, Jan Dissels) are typically perennial, while those flowing from the west (Seekoeivlei) are seasonal and do not contribute much to the flow in the system. The river eventually drains into the Atlantic Ocean near Papendorp.

The main land-use in the upper reaches is commercial agriculture (deciduous fruit, vegetables and citrus). This gives way to viticulture, rooibos tea, vegetables and livestock farming in the middle and lower reaches. The main towns are Citrusdal, Clanwilliam, Klawer, Vredendal, Vanrhynsdorp and Lutzville.

Two major instream dams of the mainstem are the Clanwilliam (storage capacity of 127 million cubic metres) and Bulshoek (storage capacity of 7.5 million cubic metres) dams. A system of canals distributes water to farmers downstream of the Bulshoek Dam.



Vineyards on the banks of the middle reaches of the Olifants River



Oxalis sp.



GOODS AND SERVICES

Citrus industry: The Western Cape produces 15 - 20% of South Africa's citrus crop (R1.8 billion in 2001). The Citrusdal area is particularly well suited to soft citrus and has seen a growth of nearly 10% per annum. This crop is irrigated, either from the Olifants River or from groundwater.

Grape / wine industry: The region produces 170 000 tons of grapes annually. By 2000, approximately 27 million vines had been planted in the region, representing almost 9% of all wine grape vineyards in South Africa. Approximately 10% of the region's production is exported to Europe, America and the Far East.

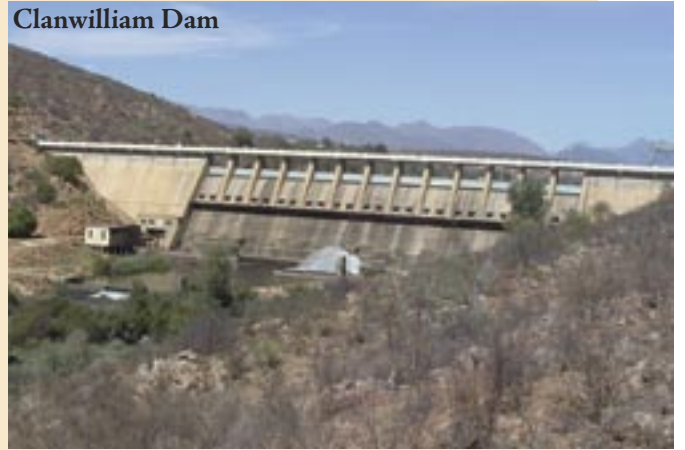
Tourism: Significant investment in the marketing of the region's natural beauty and its wines has generated an enormous interest from local and foreign visitors. Tourists have a choice of visiting nature reserves, various co-operative or private cellars, or the mineral spa resort, with its campsites and chalets near Citrusdal. The area offers a variety of flowers and historical routes, hiking trails and rock art viewing.

WATER SUPPLY SCHEMES

Clanwilliam and Bulshoek dams are state owned dams of the Olifants River Government Water Scheme. These dams play an important role in the development of the lower Olifants River valley. Water is released from Clanwilliam Dam into the Olifants River to flow to Bulshoek Dam some 30 km downstream. Bulshoek Dam has 261 km of main canal and another 60 km of distribution canals.

Water is mainly utilised for agriculture (11 500 ha of grapes), for domestic and industrial use in major towns in the area, and distributed to several wine cellars and mines. Both dams are also used for recreation (water sports and fishing).

Clanwilliam Dam



Bulshoek Dam



Canal system near Klawer



GROUNDWATER

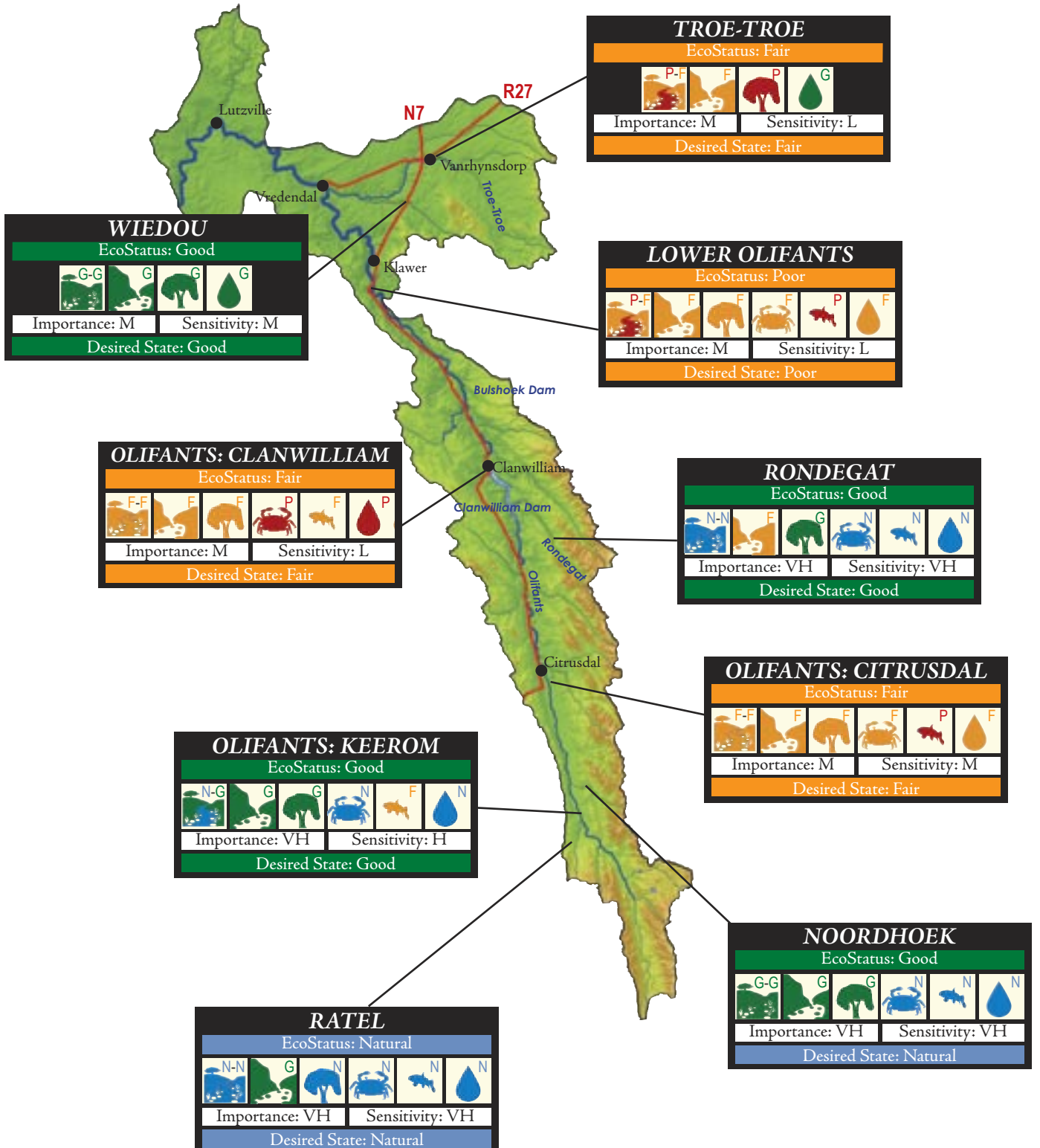
Aquifers in the Table Mountain Group (TMG) Peninsula Formations of the Cape Folded Mountains ecoregion contain substantial supplies of water that have not been widely exploited to date. Conservative estimates of the yields from the TMG aquifer indicate that the aquifer could be developed to supply approximately 45 million cubic metres of water per year to this area. However, concerns about the effect of the development of this water resource on aquifer-dependent ecosystems, such as wetlands and rivers, require that a precautionary approach be taken to the aquifers' development. It is essential that any bulk abstractions are monitored and regulated.

In the Olifants River, the Peninsula Formation quartzites are overlain by Cedarberg Formation shale. The shale prevents water from entering the rivers or other aquifers, except at particular discharge sites, such as the hot springs near Citrusdal, that yield 43°C water flowing at 30 l/s.

Ministerial visit to Citrusdal groundwater development



OLIFANTS RIVER & TRIBUTARIES: PRESENT STATE



MAJOR IMPACTS & MANAGEMENT ACTIONS

Large amounts of *water are abstracted*, mostly for agriculture, in the middle reaches of the Olifants River. This results in severely depressed summer low flows, usually causing the river to dry up entirely along sections.

Irrigation releases made from Clanwilliam Dam increase natural summer flows above Bulshoek Dam. This water is usually released from the bottom of the dam, where water quality is poor and potentially harmful to aquatic life.

No flow releases are made from Bulshoek Dam, although summer flow in the river is augmented by leaks from the supply system. This has resulted in a severely *modified flow* in the lower Olifants River, and consequently, a narrowing of the river channel and vegetation encroachment (palmiet). As a result, only less sensitive biota occur.

Dry riverbed of the Olifants River



MANAGEMENT ACTIONS

- ✂ Reduce the cumulative effect of small farm dams in the catchment, particularly during summer. Encourage farmers to use water from the existing water supply scheme in the Olifants River (see p. 11)
- ✂ Investigate environmental flow release options from the water supply scheme
- ✂ No further instream dams should be built in this catchment

Farming activities (bulldozing, vineyards and orchards within the floodplain) have modified the river channel and bed, reduced water quality and increased sedimentation. This impacts severely on the goods and services provided by the river.

Abundant river gum along the middle reaches of the Olifants River



Alien invasive plants are found along the river banks where agricultural development has taken place. While black wattle dominates in the upper reaches, much of the area near Citrusdal has been cleared of alien plants, and the river already shows signs of recovery (improved habitat). Red river gum dominates the banks of the middle to lower reaches, which further modifies the river channel, uses more water than indigenous vegetation and reduces habitat integrity.

MANAGEMENT ACTIONS

- ✂ Continue clearing alien vegetation from the riparian zones and surrounding catchment and maintain cleared areas
- ✂ Improve the condition of riparian zones by leaving this area undisturbed or rehabilitating it, where necessary
- ✂ Stop all bulldozing in the river channel

Clanwilliam yellowfish



Invasive alien fish (small-mouth bass, banded tilapia, Mozambique tilapia, carp, catfish) dominate the mainstem of the Olifants River. They prey on and compete with indigenous fish for habitat and food, resulting in reduced numbers and localised extinctions of indigenous fish (see p. 43).

MANAGEMENT ACTIONS

- ✂ Identify and manage sanctuaries/refuge areas for indigenous fish, similar to the Clanwilliam Yellowfish Sanctuary

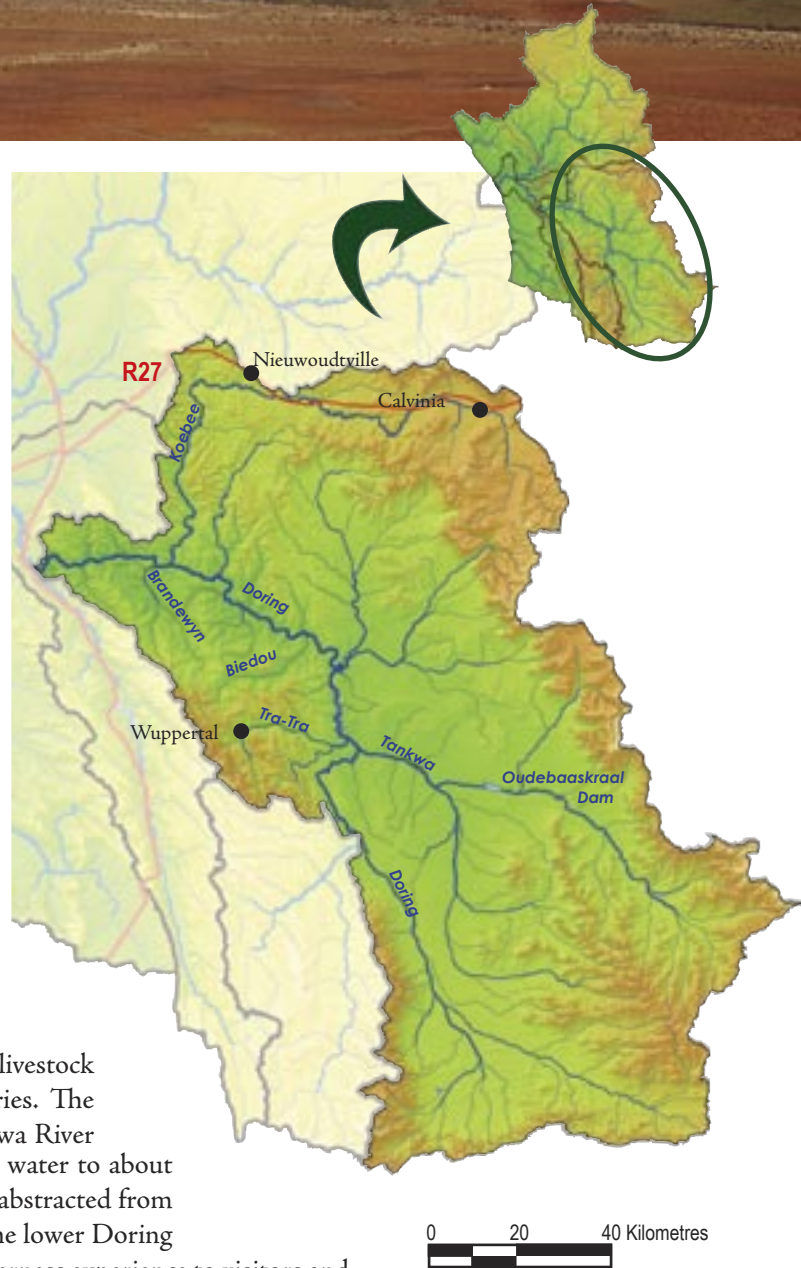
DORING RIVER AND TRIBUTARIES

The Doring River rises in the Hex River Mountains and flows in a north-easterly direction through Karooport to the dry region to the east of the Cederberg Mountains. Much of the first 150 km of river is naturally seasonal, with the upper section receiving water via an interbasin transfer from Lakenvallei Dam in the Hex River Mountains.

Downstream of the river's confluence with the Groot River, it becomes a wide braided river, flowing through a series of spectacular gorges. It flows for most of the year. Other major tributaries joining the Doring River are the Tankwa, Tra-tra, Biedou, Brandewyn and Koebee rivers. Approximately 310 km from its source, the Doring River enters the Olifants River just upstream of Klawer.

The Doring River has a natural bi-modal flow pattern. The tributaries draining the sandstone mountains contribute low salinity water during winter, whereas the tributaries draining the shales contribute saline water in summer. The contrasting water qualities and flow duration provide a unique habitat for nine indigenous fish species, including seven species that are endemic to the Olifants-Doring system (see p. 40).

Land-use in the Doring management area consists of cultivation (lucerne and vegetables) on the hillslopes and livestock farming in the flatter areas adjacent to the major tributaries. The Oudebaaskraal Dam (34 million cubic metres) on the Tankwa River is the largest privately owned dam in the country, supplying water to about 350 ha of land. An additional 350 ha is irrigated from water abstracted from the Doring River at its confluence with the Tankwa River. The lower Doring River supports significant landforms and offers a unique wilderness experience to visitors and commercial river-rafters. Towns in the area are Calvinia, Wuppertal and Nieuwoudtville.



Fly-fishing



Bushmanskloof Private Nature Reserve



GOODS AND SERVICES

Tourism and Recreational Activities: White-water rafting and canoeing opportunities exist in the Doring River during winter and spring, while hiking and fishing can be done throughout the year. The Biedouw Valley is visited annually for its spring-flower viewing.

Conservation: There are many nature reserves and conservancies, as well as the Tankwa Karoo National Park, in this area that are aimed at conserving the biodiversity of the region (see p.15).

SAN ROCK ART

Over 2500 San rock art sites have been discovered in the Cederberg region, making it one of the best areas for viewing ancient San rock art in the world. Paints used are a mixture of ochre pigments, blood, egg-white, bird droppings and clays. What we see today are essentially stains where some of the original pigments have been absorbed into the rock surface. It is accepted that most of the paintings can be associated with religious beliefs of the San. The paintings provide a record of activities and dress of the San, as well as animals (elephant and rhinoceros) previously found in the area.

Painting of elephants near Stadsaal Caves, Cederberg



TANKWA KAROO NATIONAL PARK

The Tankwa Karoo National Park (proclaimed in 1986) conserves about 80 000 ha of Succulent Karoo and is managed by South African National Parks. The Park is an accessible and strikingly beautiful protected area north of the Tankwa River. The Tankwa Karoo is one of the most arid parts of the Karoo, with a mean annual rainfall of less than 100 mm (25% falls in summer). Vegetation in the Park is still recovering from the impact of years of over-grazing.

Conservation of the Tankwa Karoo is considered important because:

- ✈ it has a unique environment gradient from Roggeveld in the east to Cederberg in the west;
- ✈ it is an important area in terms of endemism and diversity of Succulent Karoo flora; and
- ✈ it is an important area for birdlife.

The Tankwa Karoo



MAJOR IMPACTS & MANAGEMENT ACTIONS

Weir on the Brandewyn River



Water abstraction from the Doring River is limited and mostly occurs in winter, however, many tributaries (Biedou, Brandewyn, Koebee) are subjected to large scale abstraction. The lower sections of the Doring River and tributaries cease to flow in summer for periods lasting longer than would have occurred naturally.

Diversion of flow and impounding of water (Oudebaaskraal Dam) in the tributaries (Tankwa, Brandewyn) have further *modified flow* and impacted the goods and services provided by the river.

MANAGEMENT ACTIONS

- ✂ No further instream dams should be built in this catchment
- ✂ Improve regulation of abstractions in the Doring River tributaries

Invasive alien fish (bass, banded tilapia and bluegill sunfish) occur mostly in the mainstem of the Doring River and the lower reaches of the tributaries. As a result, small species have disappeared and only adults of the larger species of indigenous fish remain.

Farming disturbances (clearing of indigenous riparian vegetation, overgrazing) have resulted in the *invasion of alien plants* (red river gum, black wattle, oleander, mesquite, grasses) throughout the catchment. In the arid areas of this catchment, oleander and mesquite are a severe problem (see p. 42).

Mesquite is widespread along rivers in arid areas



Oleander is abundant in many river beds

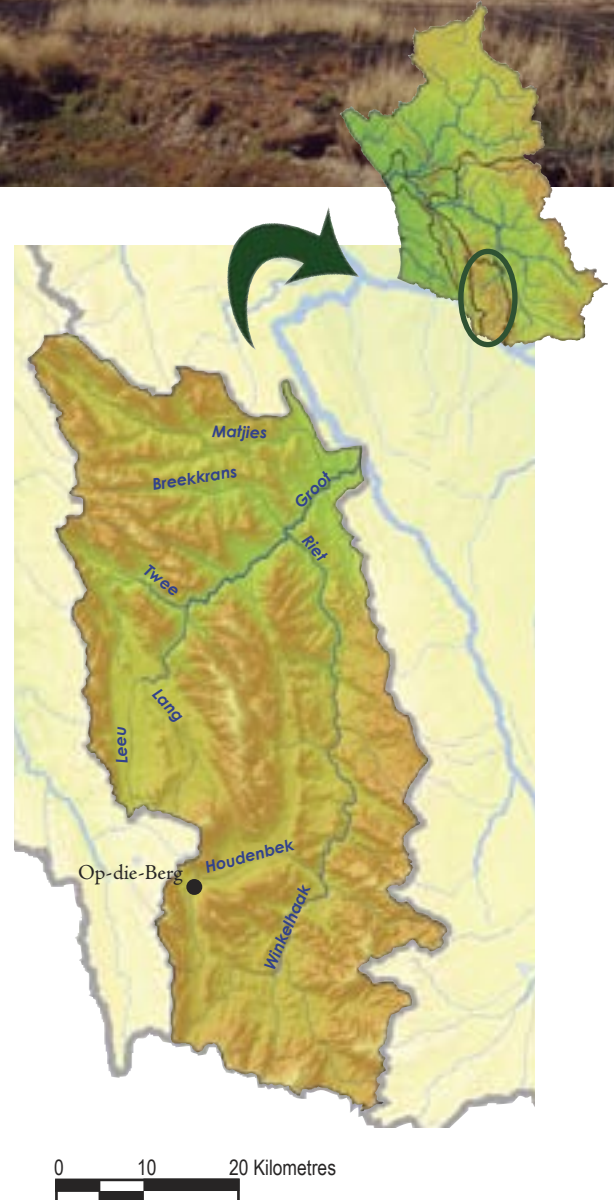


MANAGEMENT ACTIONS

- ✂ Continue clearing alien vegetation along the Doring River tributaries. Maintain cleared areas
- ✂ Establish and maintain sanctuaries for indigenous fish
- ✂ Improve the condition of riparian zones by leaving this area undisturbed or rehabilitating it, where necessary

The Groot River, formed by a number of small tributaries including the Twee and Lang rivers, flows off the eastern slopes of the Cederberg Mountains, south-east of Citrusdal. The river flows in an easterly direction through the Skurweberge Mountains where it joins the Riet River that rises as the Winkelhaak and Houdenbeks rivers north of Ceres. Below this confluence, the Groot River is joined by the Brandkraals and Matjies rivers, after which it flows into the Doring River.

Land-use in the catchment comprises mainly agriculture, with extensive areas under cultivation of deciduous fruit and vegetables. Irrigation water is stored in numerous farm dams. Pine plantations occur on the high rainfall mountainous slopes of the catchment. Much of the north-eastern portion of the catchment is undeveloped and falls within the Cederberg Wilderness Reserve (see p. 19). The only urban development in the area is at Op-die-Berg.



GOODS AND SERVICES

Fruit and Vegetable Industry: This industry is supported by water from the rivers of this region. About 25 000 tons of fruit and vegetables are produced annually at Kromfontein in the Kouebokkeveld. Apples are the main crop, but pears, nectarines, peaches and plums are also grown. The majority of fruit is for export, mainly to Europe and the UK, except for peaches, which are used for canning. Onions are also grown for the export market, while potatoes are cultivated for local markets.

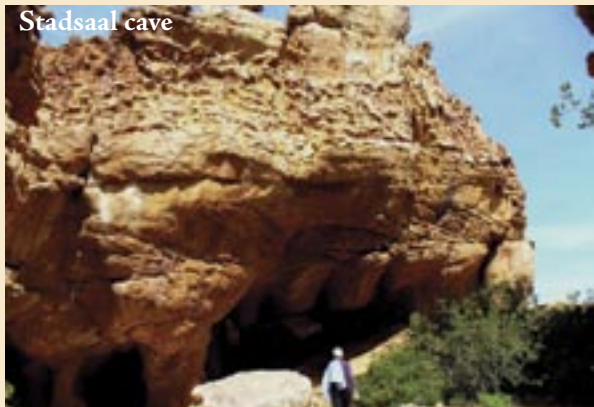


Harvesting of onions at Leurivier farm



CEDERBERG WILDERNESS RESERVE

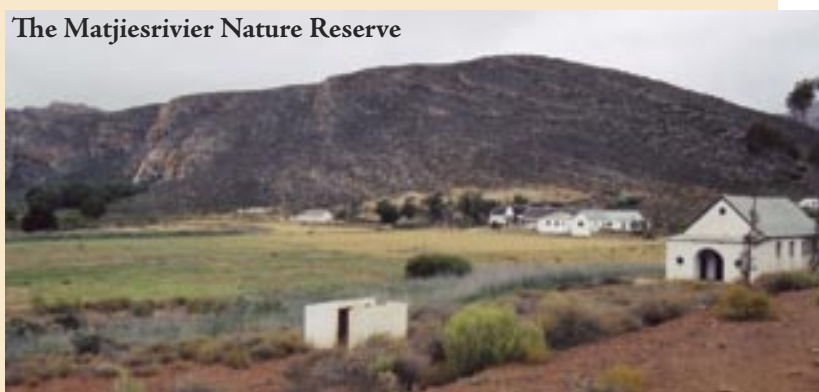
Stadsaal cave



The nearby Matjiesrivier Nature Reserve (12 000 ha) is part of the greater Cederberg conservancy. It includes the famous Stadsaal cave, San rock art and spectacular rock formations. These Reserves are managed by CapeNature.

The scenic Cederberg Wilderness Reserve comprises 71 000 ha of mountainous terrain. This area is a proclaimed wilderness area and World Heritage Site and enjoys a high conservation status. With its weathered sandstone formations, most notably the Wolfberg Arch and the Maltese Cross, this area offers excellent hiking and mountaineering activities.

The Matjiesrivier Nature Reserve



Matjiesrivier wetland



GROUNDWATER USE IN THE KOUEBOKKEVELD

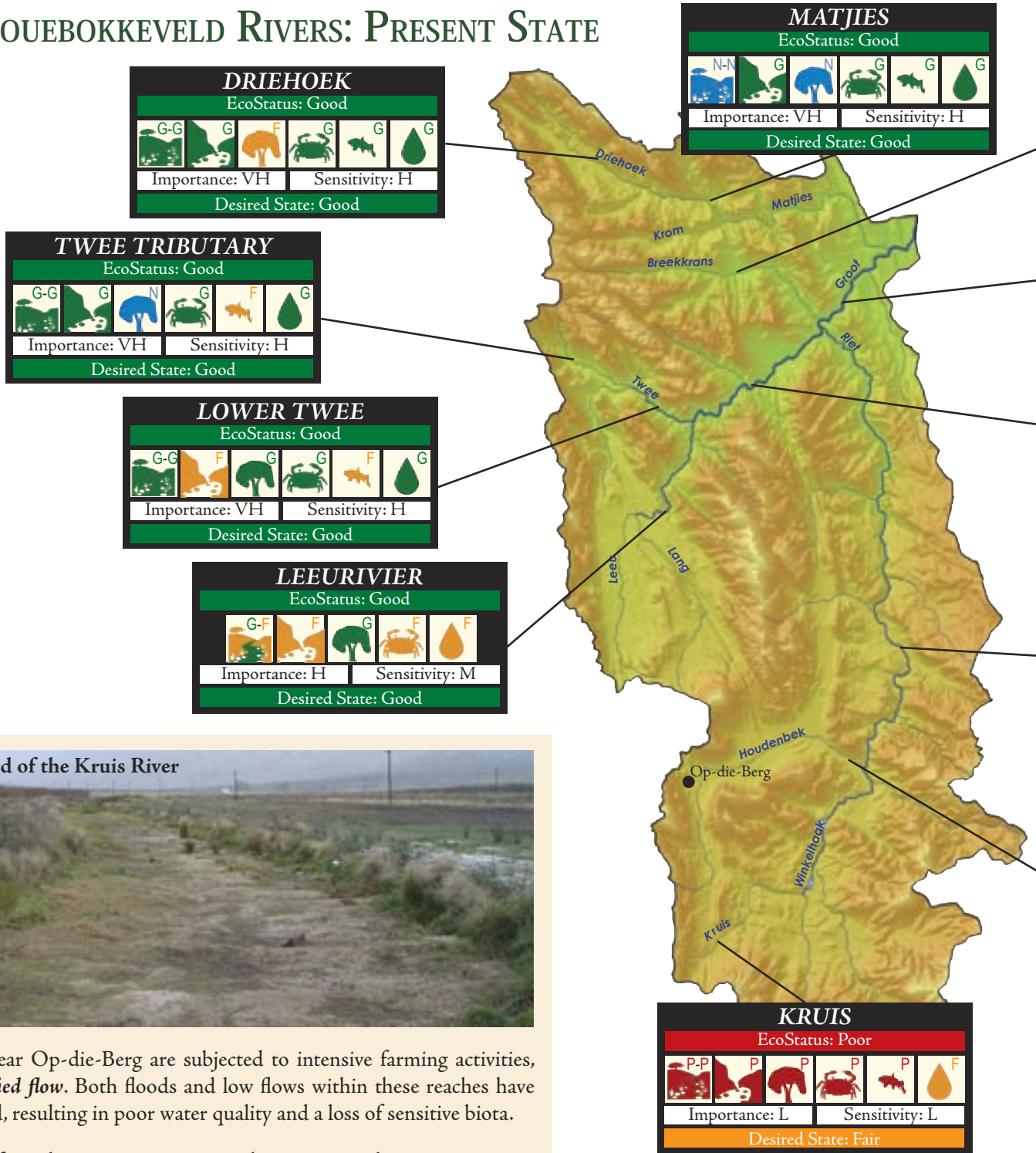
A localised concentration of boreholes in the Kouebokkeveld and the relatively high level of summer-season groundwater dependence reflect the good groundwater sources of the area. This is in spite of arid to semi-arid climatic conditions.

Currently, the groundwater resource is not being systematically explored and developed, and groundwater monitoring is limited. Recharge distribution and groundwater yields (0.5 to more than 5 l/s) indicate that the Table Mountain Group fractured-rock aquifers is likely to be the main groundwater exploration target in the region. Recharge to the Table Mountain Group aquifer is highest in the mountains around the Kouebokkeveld, with the exposed Peninsula Aquifer as the most sustainable source.

Groundwater exploration



KOUEBOKKEVELD RIVERS: PRESENT STATE



Dry river bed of the Kruis River



The rivers near Op-die-Berg are subjected to intensive farming activities, which *modified flow*. Both floods and low flows within these reaches have been reduced, resulting in poor water quality and a loss of sensitive biota.

Removal of indigenous vegetation has increased sedimentation, which has led to *modification of the river bed*. The presence of a large number of weirs, instream dams and some channelisation has further reduced the health of these rivers. Farm dams and channel modification have reduced the extent of wetlands in the Kouebokkeveld.

- ### MANAGEMENT ACTIONS
- ✦ Implement environmental flows for the Houdenbek and Kruis rivers
 - ✦ Use environmentally acceptable farming practices and maintain a buffer area along river banks
 - ✦ Encourage efficient water use throughout the catchment

MAJOR IMPACTS & MANAGEMENT ACTIONS

Encroachment by *alien invasive vegetation* (red river gum, grasses) is common on river banks where farming activities have removed indigenous riparian vegetation. Oleander is a serious invader of riparian zones in the arid reaches of the Groot and Breekkrans rivers.

Nutrient enrichment due to the application of fertilisers for agricultural purposes throughout the catchment and flow reduction through abstraction, has resulted in the proliferation of indigenous riparian vegetation (palmiet and fluitjiesriet). This has reduced habitat integrity and the goods and services that rivers can provide.

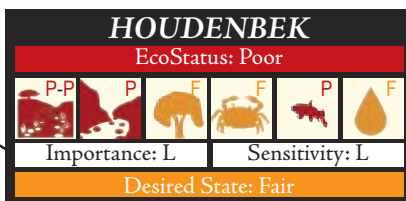
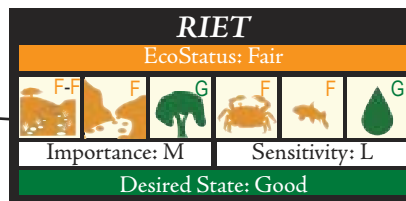
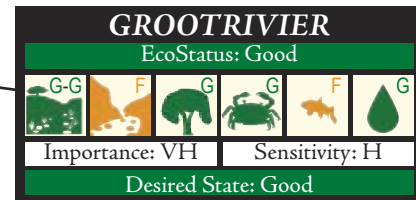
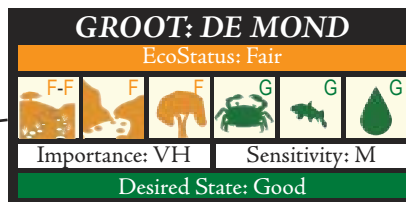
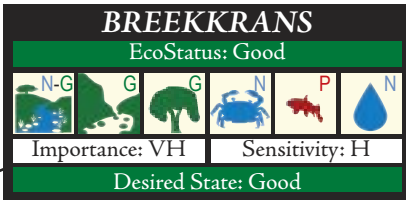
MANAGEMENT ACTIONS

- ✂️ Rehabilitate riparian zones to act as a buffer between the river and surrounding agricultural areas
- ✂️ Remove alien invasive plants where necessary to improve biodiversity and waer supply
- ✂️ Reinstate wetlands to improve water quality and continuity of water supply

River gum along the Kruis River



Prolific fluitjiesriet growth in the Riet River



Predation by *alien fish* (bass and bluegill sunfish) has reduced the numbers of indigenous fish, particularly the unique fiery redfin (see p. 40), which has become very scarce in the Breekkrans and Driehoeks river.

The bluegill sunfish, which is found in many rivers and farm dams throughout the catchment, competes with indigenous fish for food. They are regarded as a pest species and have limited angling value (see p. 43).

Bluegill sunfish



MANAGEMENT ACTIONS

- ✂️ Investigate the removal of alien fish from certain key river reaches where sanctuaries/refuge areas need to be created and managed for indigenous fish (see p. 40)

Two species of indigenous fish (Cape kurper and Clanwilliam yellowfish) were unwisely introduced into the Twee River catchment and threaten the critically endangered Twee River redfin (see p. 40).



The Knersvlakte comprises catchments of the Kromme, Hantams, lower Olifants/Sout and Goerap rivers in the far north. The catchment is located in a dry climate with very low rainfall. The area is typified by low rolling hills with isolated patches of white quartz pebbles and very saline soils. As a result, the rivers are ephemeral and very saline.

Opportunities for economic development are limited or non-existent and agriculture only takes place on a small local scale as a poverty relief initiative. Mining activities occur at Namakwa Sands (heavy mineral sands) and along the coast (marine diamonds). Small-scale mining for gypsum, diamonds, limestone and marble also takes place.

Towns in the area are Bitterfontein, Nuwerus and Loeriesfontein, which rely on groundwater as their primary water source. At Bitterfontein, groundwater needs to be desalinated before it can be used for human consumption.



Bababoudjies



GOODS AND SERVICES

Tourism: The world renowned natural display of spring flowers after good winter rains offers a viable non-consumptive land-use in the form of tourism to the area in spring (daisies, succulents and bulbous plants).

Heavy mineral sand mining: Although mining requires only 3 million cubic metres water per year, this represents nearly 50% of the total water availability in the Knersvlakte sub-area. Anglo American's Namakwa Sands is South Africa's second largest producer of heavy minerals (228 000 tonnes).

Gypsum mining



WESTERN CAPE PROVINCIAL GOVERNMENT OLIFANTS/DORING RIVER IRRIGATION STUDY (WODRIS)

Agricultural development provides opportunities for enhancing regional income and improving the welfare of local communities in the Olifants/Doring catchment. In 2001, the Western Cape Provincial Government commissioned a study to investigate agricultural development scenarios in the Aties Karoo and Coastal Region, which are proposed to receive water from a proposed Melkboom Dam on the Doring River and/or from groundwater. The study was a follow-up of the Olifants/Doring Basin Study, which investigated the most economic and beneficial development of the Olifants and Doring rivers, where it was recognised that water availability was paramount to any further agricultural and more specifically, irrigation development.

The investigation assessed aspects such as economic viability, ecological impact, employment creation, establishment of new farms and empowerment of previously disadvantaged communities, as well as the overall sustainability of the scenarios. Key elements of the study for the proposed development included:

- investigation of groundwater potential;
- identification of potential irrigation areas;
- feasibility of developing surface water, the impacts and mitigatory measures;
- investigation into the technical and agronomic aspects;
- assessment of the socio-economic feasibility; and
- environmental impact assessments.

Groundwater is a major source of water in the Knersvlakte

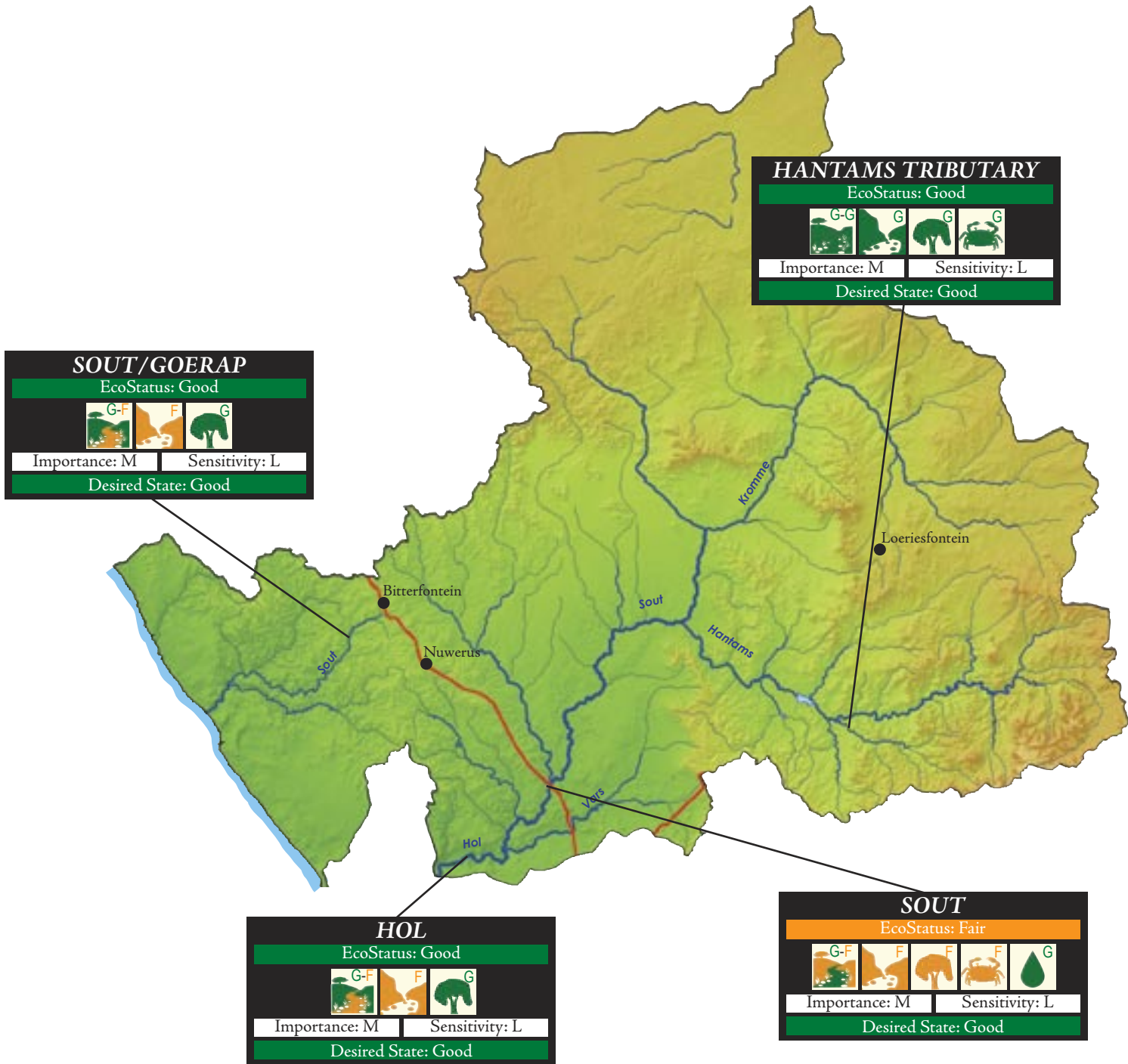


The lower Doring River at Melkboom



Recommendations from the assessment was that all of the proposed dam sites in the Doring and Brandewyn rivers would result in impacts of high significance from a riverine, botanical and archaeological point of view. Portions of the identified development areas should also not be developed but should be part of the proposed Knersvlakte and Cederberg Biosphere Reserves. Groundwater development and the likely impacts of large-scale groundwater abstraction on surface ecosystems should be investigated further.

KNERSVLAKTE RIVERS: PRESENT STATE



MAJOR IMPACTS & MANAGEMENT ACTIONS

Overgrazing by livestock (goats and sheep) has *modified river beds and banks*, which consequently resulted in erosion and sedimentation. Due to the low rainfall pattern, re-establishment of vegetation and recovery of habitat integrity is very slow.

Erosion in this area occurs naturally due to low densities of riparian vegetation. As a result naturally occurring incised channels are common throughout the area. Wind erosion is prevalent during dry periods and results in sand dune formation.

Livestock in the riparian zone of the Hantams River



Gypsum mining activities along the river banks also contribute to *erosion and sedimentation*. The only other impact on rivers is as a result of infrastructure development (roads, fences, bridges). This has modified the river bed.

MANAGEMENT ACTIONS

- ✂️ Protect the riparian zone by preventing overgrazing
- ✂️ Keep goats and sheep out of riparian zones
- ✂️ Rehabilitate riparian zones where mining has occurred
- ✂️ Limit mining activities and infrastructural development within the riparian zone and river bed

Disturbance of the Sout River banks



Alien vegetation in the riparian zone comprises mostly mesquite (see p. 42) that was introduced by farmers for fodder. It is likely that these large trees reduce the baseflows in the rivers. This, together with groundwater use, is extending the no-flow period in these rivers.

Drilling for groundwater in the Namaqualand



Mesquite dominates the riparian zone of the lower Hantams River



MANAGEMENT ACTIONS

- ✂️ Initiate an alien plant clearing initiative in the area, particularly on the Hantams River
- ✂️ Regulate groundwater abstraction adjacent to river beds

The Sandveld is located between the Olifants River Mountains in the east, the Atlantic Ocean in the west, the Olifants River in the north and the Berg River in the south. It is a sandy area underlain by granular primary aquifers and deeper fractured rock secondary aquifers.

The Verlorelei system originates as a multitude of streams in the eastern and northern Piketberg. These streams collectively form the Kruis River, which drain the low relief, sandy coastal plain. The river exhibits a seasonally variable flow, feeding the Verlorelei wetland (see p. 27). The Langvlei and Jakkals rivers are both small seasonal rivers that originate on the mountain slopes west of Clanwilliam and terminate in Wadrif and Jakkalsvlei pans, respectively. All the rivers eventually drain into the Atlantic Ocean.

The Sandveld is a characteristic rural area with extensive farming, a few towns (Lamberts Bay, Elands Bay, Graafwater, Strandfontein and Doringbaai), fishing and tourism development along the coast. Most of the towns, as well as all irrigation development in the region are supported by groundwater, the exceptions being Strandfontein and Doringbaai, which receive water from the Olifants River canal at Ebenhaezer. Crops (potatoes) are irrigated mainly from groundwater. The only significant dams in the region are farm dams that occur in the mountainous areas.



Vygies near Lamberts Bay



GOODS AND SERVICES

Agriculture: In 2004, the Sandveld produced 26 million 10kg pockets of potatoes (15% of the national production). The industry depends on groundwater supplies.

Conservation: Verlorelei, Wadrif Pan and Jakkalsvlei support populations of pan-coastal migrant birds.

Domestic water use: Groundwater from Wadrif wetland is abstracted for supply to Lambert's Bay.

Tourism: The tourist trade flourishes during the spring and summer months (birding at Verlorelei and Wadrif, wild flowers and seafood).

Gannets at Bird Island, Lamberts Bay



Irrigation of potatoes



VERLOREVLEI

Verlorevlei is one of the most important estuarine systems in the Western Cape and one of the largest natural wetlands along southern Africa's west coast. This coastal lake is an important feeding ground for several rare and threatened bird species and has been classified as a RAMSAR site. It is regarded as one of the ten most important wetlands for wading birds in the south-western Cape and is a particularly important feeding area for the white pelican (see p. 39).

Indigenous freshwater fish species occurring in the wetland are the Cape galaxias, the rare Verlorevlei redbfin (see p. 41) and flathead mullet. Rare and threatened mammals such as the Cape clawless otter, *Aonyx capensis*, have also been recorded.

Several causeways near the mouth disrupt hydrological fluctuations and interaction with the sea, cause siltation and prevent fish migration. Land surrounding the wetland is privately owned and intensive farming practices (grazing, invasive alien vegetation and drawdown of groundwater) threaten the surrounding vegetation. The vlei is also dominated by alien fish (carp and Mozambique tilapia).

Verlorevlei in winter



Flamingos on Wadrif Pan



Wadrif Pan during dry periods



WADRIF WETLAND AND PAN

Wadrif wetland and pan lies north of Verlorevlei and south of Jakkalsvlei. The brackish to saline pan is seasonal, usually filling during late winter from the Langvlei River. In summer, water recedes and shallow exposed mudflats support a number of bird species (lesser and greater flamingo, Cape shoveller, black oystercatcher and chestnutbanded plover).

Wadrif wetland previously was a lush palmiet wetland but extensive groundwater abstraction in the late 1970's for water supply to Lambert's Bay resulted in the dessication of the peat layers. Much of the peat vegetation in the wetland was destroyed by a fire, which burnt for many years, leaving little hope of regeneration. The Berg River redbfin has subsequently disappeared from the system.

Preliminary determinations of the Ecological Water Requirements for the Sandveld indicate that unsustainable over-allocation of groundwater is taking place. This region has minimal surplus water for allocation and in certain areas groundwater abstraction will need to be reduced.

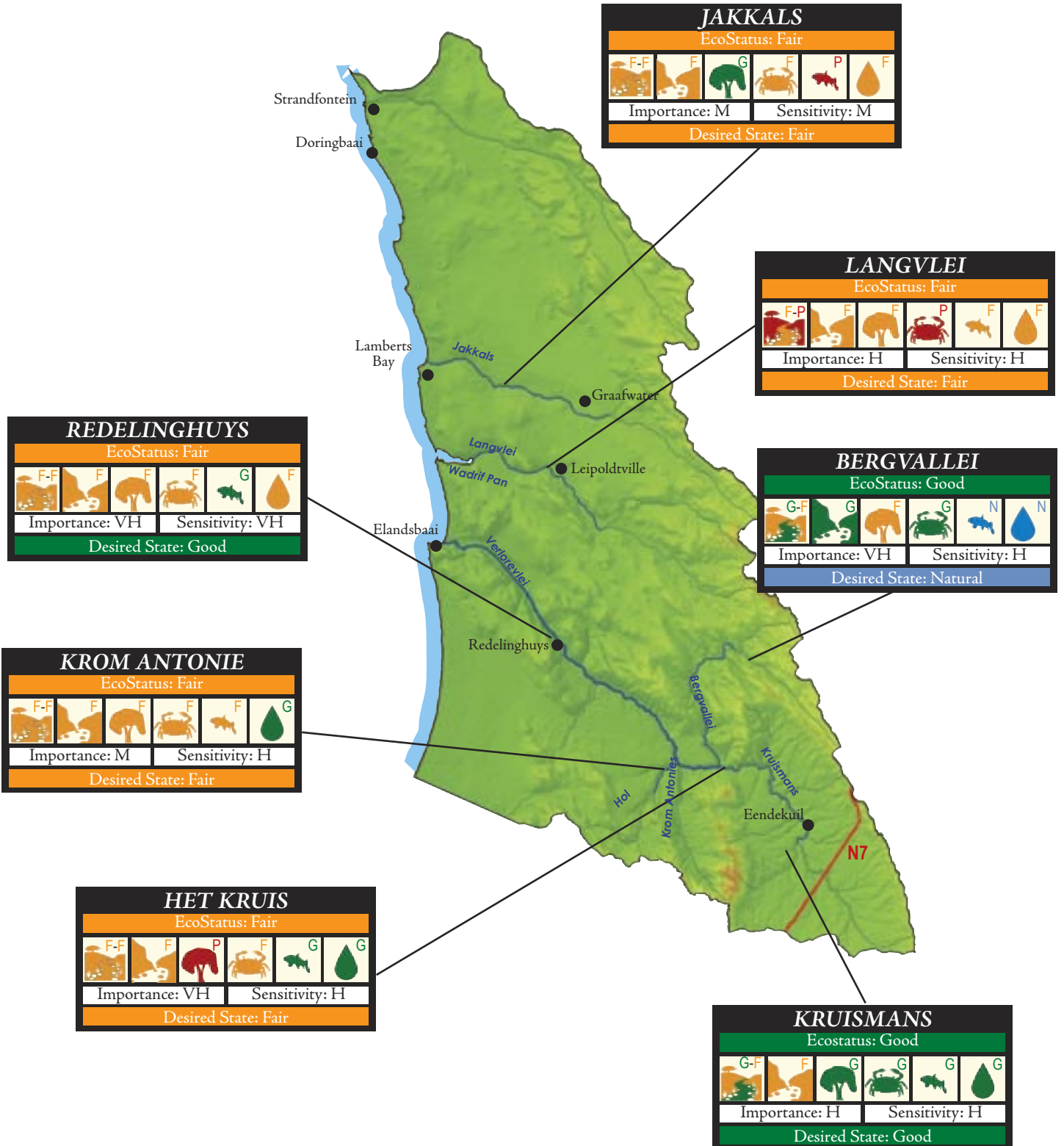
Wadrif Pan in flood



Burnt Wadrif wetlands



SANDVELD RIVERS: PRESENT STATE



JAKKALS
EcoStatus: Fair

| | | | | | |
|-----|---|---|---|---|---|
| F-F | F | G | F | P | F |
|-----|---|---|---|---|---|

Importance: M Sensitivity: M

Desired State: Fair

LANGVLEI
EcoStatus: Fair

| | | | | | |
|-----|---|---|---|---|---|
| F-P | F | F | P | F | F |
|-----|---|---|---|---|---|

Importance: H Sensitivity: H

Desired State: Fair

BERGVALLEI
EcoStatus: Good

| | | | | | |
|-----|---|---|---|---|---|
| G-F | G | F | G | N | N |
|-----|---|---|---|---|---|

Importance: VH Sensitivity: H

Desired State: Natural

REDELINGHUYNS
EcoStatus: Fair

| | | | | | |
|-----|---|---|---|---|---|
| F-F | F | F | F | G | F |
|-----|---|---|---|---|---|

Importance: VH Sensitivity: VH

Desired State: Good

KROM ANTONIE
EcoStatus: Fair

| | | | | | |
|-----|---|---|---|---|---|
| F-F | F | F | F | F | G |
|-----|---|---|---|---|---|

Importance: M Sensitivity: H

Desired State: Fair

HET KRUIS
EcoStatus: Fair

| | | | | | |
|-----|---|---|---|---|---|
| F-F | F | P | F | G | G |
|-----|---|---|---|---|---|

Importance: VH Sensitivity: H

Desired State: Fair

KRUISMANS
EcoStatus: Good

| | | | | | |
|-----|---|---|---|---|---|
| G-F | F | G | G | G | G |
|-----|---|---|---|---|---|

Importance: H Sensitivity: H

Desired State: Good

MAJOR IMPACTS & MANAGEMENT ACTIONS

Potato farmers rely on irrigation from groundwater and on large amounts of fertilisers and pesticides that contaminate the rivers. Groundwater *abstraction* has had a significant detrimental impact on the low flows throughout the catchment. Instream farm dams and run-of-river abstraction in the Verlorevlei River and tributaries has also *modified river flows*. This has resulted in the loss of wetlands and naturally occurring pans, and reduced river health.

Groundwater abstraction points in the Langvlei River



Intensive potato farming in the Verlorevlei catchment



Channel modification due to roads and farming activities (removal of indigenous riparian vegetation) is particularly evident in the Langvlei River. As a result, large-scale loss of unique wetland vegetation has occurred.

MANAGEMENT ACTIONS

- ✂ Discourage groundwater abstraction within the riparian zone
- ✂ No further instream dams should be built in the Verlorevlei River
- ✂ No further run-of-river abstraction should take place during the low flow period (summer)

Eendekos



Removal of indigenous riparian vegetation has resulted in *alien vegetation* (Port Jackson) infestation throughout the catchment. This further reduces low flows in the rivers.

Prolific growth of *aquatic weed* (eendekos, *Coltula coronopifolia*) in the Langvlei and upper Verlorevlei rivers clogs the water surface, depletes oxygen and smothers indigenous plants and biota that live in the river.

MANAGEMENT ACTIONS

- ✂ Clear invasive alien plants from riparian zones and the surrounding catchment, particularly in the upper Verlorevlei River. Maintain cleared areas

Alien fish (banded tilapia and large-mouth bass) occurring in the lower Verlorevlei River have reduced numbers of indigenous fish (Verlorevlei redbfin, Cape galaxias and Cape kurper).

Cape kurper



Cape kurper and Verlorevlei redbfin have become extinct in the Langvlei River and Cape galaxias seem to have disappeared from the Jakkalsvlei River. This is most likely due to a lack of flow and the associated habitat destruction in these systems.

Movement of mullet species in the vlei is restricted by the railway line and lack of culverts.

MANAGEMENT ACTIONS

- ✂ Increase awareness of unique and threatened fish species amongst riparian land-owners

OLIFANTS ESTUARY

The Olifants Estuary is a permanently open system. The mouth is situated between a large sandbar to the south and a rocky bluff and reef to the north. The estuary widens just upstream of the mouth to a width of about 400 m and depth of three to five metres. About 15 km from the mouth, the estuary narrows to between 20 and 50 m and depths of two to three metres. Tides intrude into the estuary for approximately 36 km, where a low water bridge prevents tides from extending further upstream.



Low water bridge near Lutzville

The Olifants Estuary has the largest supratidal/floodplain salt marsh in South Africa (~900 ha). The salt marsh areas are located in the lower and middle reaches of the estuary. From about 9 km upstream of the mouth the estuary is fringed by reeds beds (*Phragmites australis*). Submerged macrophytes, e.g. pond weed (*Potamogeton pectinatus*), about 20 km upstream, provide additional water column habitat, particularly during summer when flows are at their lowest.

Salt marsh areas in the lower reaches of the estuary



Water quality characteristics in the estuary are often strongly seasonal. For example, during summer when river flow is at its lowest, the system becomes more saline, while during the rainy season (winter) salinities are usually much lower when stronger river flows limit the intrusion of seawater to the lower reaches.

Conservation Importance

The Olifants Estuary is ranked third in terms of conservation importance of all South African estuaries. It is one of only two permanently open estuaries on the West Coast, the other being the Berg River Estuary. The estuary is also one of the largest in the country (1140 ha) and is one of the most important in terms of the amount and diversity of habitats it contains.

The estuary is ranked among the top ten estuaries in the country for avifauna and is an identified 'Important Bird Area'. In addition to having a high diversity and number of birds (72 species, of which 21 are long-distance migrants), it regularly supports important and red data species such as African black oystercatcher, Caspian tern, chestnutbanded plover and African marsh harrier.

Due to its high conservation importance, the Olifants Estuary is listed as a desired protected area.

Olifants Estuary mouth



Importance of the Olifants Estuary to Fish

A total of 38 fish species from 30 families have been recorded in the Olifants Estuary, 12 of which are endemic to South Africa.

Six fish species caught in the estuary are entirely dependent on estuaries to complete their life-cycle (white steenbras), eight breed in estuaries (estuarine round-herring, Cape silverside, prison goby, commafin goby and longsnout pipefish) and four depend on estuaries as nursery areas (white steenbras, leervis, freshwater mullet and flathead mullet). Another seven species are partially dependent on estuaries (elf, blackhand sole, white stumpnose), seven are freshwater species (Clanwilliam yellowfish, sawfin, Cape galaxias) and remaining six species are mostly marine (silver cob, pilchard, bluntnose guitarfish).

Almost half of the species occurring in the Olifants Estuary are estuarine dependent, indicating a high reliance of local fish on the estuary. Given that the estuary is permanently open and one of the few available warm water refuges during the summer upwelling season on the west coast, any degradation of estuarine habitat will have worse consequences for fish on the West Coast than elsewhere in the country.



Freshwater mullet



Estuarine roundherring

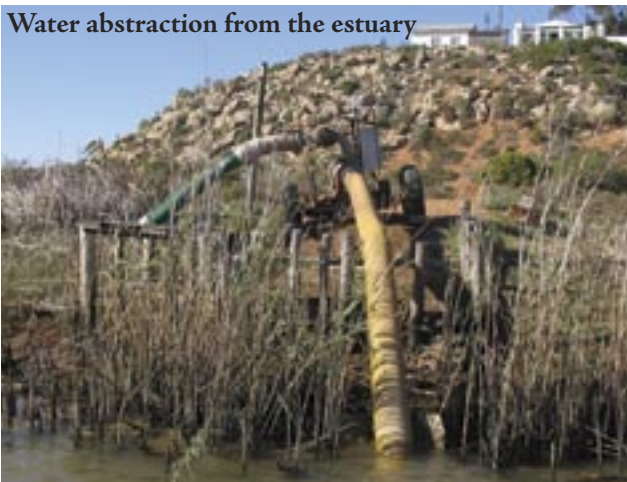


The Olifants Estuary is vital to inshore fisheries along the West coast. The value of this estuary's fisheries, as well as its contribution to marine fisheries on the West Coast is estimated to be about R2 million per year. Commercial and recreational fisheries in the estuary catch approximately 121 tonnes of fish per year. Much of this can be attributed to the gillnet fishery, which targets mullet (approx. 100 tonnes per year). There are currently 45 (reduced from 120) commercial gillnet permit holders in the estuary, comprising mostly of fishermen from the Ebenhaezer and Papendorp communities. Recreational anglers catch an additional one to two tonnes of fish from the estuary annually.

Gillnet fishing in the estuary



Water abstraction from the estuary



Water from the estuary is also used for irrigation of agricultural areas along the upper reaches. This, together with a marked reduction in river inflows, has resulted in the estuary becoming increasingly marine dominated.

Tourism is increasing in the region and is linked to the provision of accommodation in scenic areas adjacent to the estuary. Bird watching and recreational fishing are major tourist attractions to the estuary.

Diamond mining concessions occur along the coast to the north and south of the estuary. Smaller mining vessels sometimes utilise the estuary as a safe harbour.



OLIFANTS ESTUARY: PRESENT STATE



The overall ecological health of the Olifants Estuary is fair. The desired health state for the estuary is good given the high ecological importance of the estuary. This can be achieved through the implementation of the recommended management actions (see p. 33).

OLIFANTS ESTUARY

Habitat Health: Fair

Biotic Health: Fair

Importance: High

Desired State: Good



WHAT IS ESTUARINE HEALTH?

Estuaries provide many goods and services (food and bait collection, nurseries and refugia for fauna, tourism and recreation, cultural and spiritual activities), which contribute to human welfare and economic growth.

A formal monitoring programme for estuarine health still needs to be developed. Such a programme would possibly resemble and compliment the River Health Programme.

This assessment of the present state of Olifants Estuary is based on the results of the Olifants/Doring Ecological Water Requirements Study: Estuarine Components. It highlights the characteristics, benefits and environmental pressures relating to the estuary. The indices used on this page represent the habitat and biotic health of the larger estuarine ecosystem. 'Ecological importance' is an expression of the importance of an estuary to maintaining ecological diversity and functioning on local and wider spatial scales.

| Estuarine Health Indices | | Estuarine Health Categories | |
|-----------------------------|--|--|--|
| Hydrodynamics and Hydrology | | Natural (N) | |
| Water Quality | | Good (G) | |
| Physical habitat | | Fair (F) | |
| Microalgae | | Poor (P) | |
| Macrophytes | | | |
| Invertebrates | | | |
| Fish | | | |
| Birds | | | |
| | | Estuarine Ecological Importance Categories | |
| | | Very High (VH) | |
| | | High (H) | |
| | | Moderate (M) | |
| | | Low (L) | |

MAJOR IMPACTS & MANAGEMENT ACTIONS

Water abstraction in the Olifants/Doring catchment has a marked impact on the estuary, altering it from a freshwater dominated to a marine dominated system. This impact is most severe during summer, when the estuary is at its most productive with high levels of fish recruitment.

A large off-channel dam on the Olifants Estuary



MANAGEMENT ACTIONS

- ✈ Increase base flows during summer to limit seawater penetration into the upper reaches
- ✈ No further river abstraction should take place during summer (low flow period)
- ✈ Reduce water abstraction by implementing water conservation and demand management measures

Excessive macrophyte growth on the Olifants Estuary



Agriculture is extensive on the banks of the upper estuary and lower Olifants River, often extending down to the water's edge. **Return flows** degrade water quality, where nitrophosphates and other fertilisers accumulated in soils are flushed out during winter, resulting in high dissolved inorganic nutrient concentrations in the upper estuary. This causes excessive macrophyte growth (pond weed) in the upper reaches during summer and impacts on water intake systems, recreational use and aesthetics.

MANAGEMENT ACTIONS

- ✈ Minimise fertiliser and pesticide use along the upper estuary and lower Olifants River to prevent excessive nutrient input to the estuary
- ✈ Reintroduce or maintain a riparian buffer zone to minimize the inflow of fertilisers and pesticides

Over-exploitation of fish in the Olifants Estuary has had a major impact on the occurrence and abundance of estuarine fish. The commercial fishery catches approximately 120 tonnes of mullet (*Liza richardsonii*) and 20 tonnes of bycatch, mostly elf (*Pomatomus saltatrix*), annually.

MANAGEMENT ACTIONS

- ✈ Reduce or eliminate the number of permit holders for gill net fishing in the estuary to protect nursery grounds

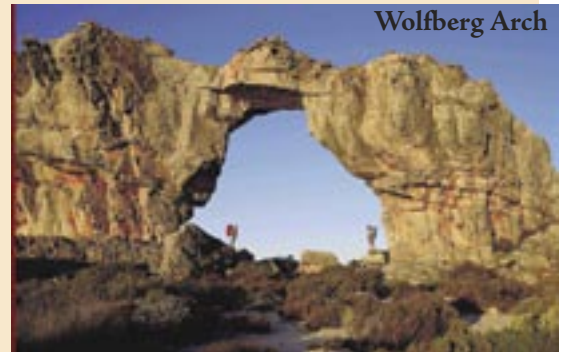


CONSERVING OUR NATURAL RESOURCES

A number of initiatives that have a primary aim of conserving biodiversity and promoting sustainable development are taking place in the Olifants/Doring Water Management Area. Through the following initiatives, rivers in the area are being conserved.

CAPE ACTION FOR PEOPLE AND THE ENVIRONMENT & GREATER CEDERBERG BIODIVERSITY CORRIDOR

The Cape Action for People and the Environment (CAPE) is a programme of the South African Government, with support from international donors, to protect the rich biological heritage of the Cape Floristic Region. The programme seeks to unleash the economic potential of the region's resources through focused investment in sustainable development, while conserving nature and ensuring that all people benefit. A broad-scale spatial plan targets over 60% of the remaining natural vegetation of the region for conservation.



The Greater Cederberg Biodiversity Corridor (GCBC), one of the five key CAPE landscape initiatives, comprises mainly natural habitat. It conserves an area of greater than 500 000 ha. CapeNature is the lead agent for the implementation phase of this partnership initiative between communities, landowners, local authorities, non-governmental organisations and conservation agencies. The primary aim is to conserve the rich and unique biodiversity of the greater Cederberg Region.

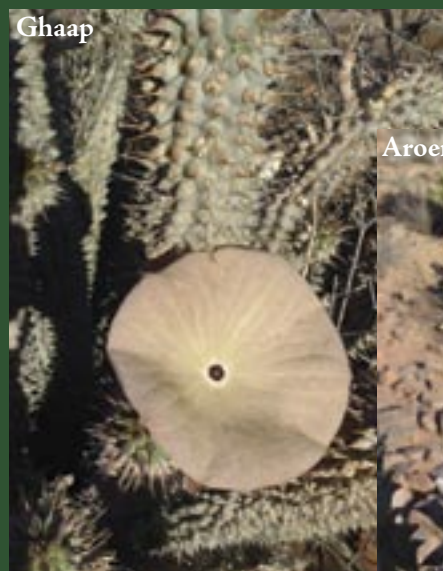
The GCBC protects the unique flora and highly adaptive animal life of the Cape Floristic Region and includes part of the Succulent Karoo, which is an internationally recognised biodiversity hot-spot. The Succulent Karoo covers an area of approximately 116 000 km². It is the only arid region in the world to be declared a biodiversity hot-spot and includes an array of 6356 succulent species, 40% of which are endemic. However, only 30 000 km² of the area exists in a relatively pristine state

Ghaap (*Hoodia gordonii*)

Hoodia cactii are succulent plants that were traditionally used by the San as an appetite suppressant, thirst quencher and as a cure for severe abdominal cramps, haemorrhoids, tuberculosis, indigestion, hypertension and diabetes. *Hoodia* are protected species in southern Africa, with *H. gordonii* only occurring in South Africa and Namibia. Permits are required for harvesting, collecting seeds, trade or their transport.

CSIR isolated an active compound (P57) from the cactii for appetite suppression and licensed the rights for its further development. An agreement was reached between CSIR and the San towards a mutual benefit from the development of P57.

The aroena (*Quaqua*) usually occurs together with *Hoodia* and is also eaten as an appetite suppressant.



Aroena



SUCCULENT KAROO ECOSYSTEM PROGRAMME

The Succulent Karoo Ecosystem Programme (SKEP) was formed to make all land-users aware of the need to conserve biodiversity in the Succulent Karoo Region and to view conservation as a land-use that promotes sustainable development. SKEP has a 20 year strategy which aims to:

- ✦ create a co-ordinated conservation and land-use programme throughout the Succulent Karoo;
- ✦ secure 100 % of conservation targets for Succulent Karoo vegetation types being conserved;
- ✦ maintain populations of key indicator and flagship species within priority geographic areas; and
- ✦ conserve important ecological processes (sand corridor movements, river corridors and climatic gradients).



Knersvlakte/Vanrhynsdorp Centre of the Succulent Karoo

The unique Knersvlakte flora represents one of six endemic centers of the Succulent Karoo vegetation type and is known as the 'Vanrhynsdorp Centre'. The Knersvlakte Basin encompasses flora of about 1300 species and is exceptionally rich in endemic plant species (more than 260 endemic species). The area is also home to the highest number of threatened plant species (128 species) in the Succulent Karoo. Vegetation is dominated by dwarf succulent shrubs (vygies). Mass displays of flowering annuals (daisies) occur on degraded or fallow lands in spring.

Due to its limited extent (522 000 ha) and uniqueness of its vegetation, the Knersvlakte is considered to be of immense conservation importance nationally and internationally. Not only is the flora unique for its high incidence of endemic species, it is also unique in its ability to adapt to the extremely harsh Knersvlakte environment.

Threats to the area are overgrazing and small-scale mining, illegal harvesting of rare and spectacular plant species for private collections.



INTEGRATED WATER RESOURCE MANAGEMENT

Integrated water resource management “promotes the co-ordinated development and management of water, land and related resources order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of ecosystems” (Global Water Partnership, 2000).

Rivers, wetlands, estuaries and groundwater are all linked within the water cycle. They are also linked to the surrounding land and the human activities that impact on them. To address the inter-related nature of water resources and ensure sustainable, equitable and efficient water use, these water bodies need to be managed in an integrated manner. This means that water availability, quality and use, as well as environmental and socio-economic issues must be taken into account. Co-ordination and co-operation between decision-makers and water users should take place at all levels.

Informed decision-making that is critical to integrated water resource management, relies on reliable data and information. The River Health Programme (see p. 4) is one of many monitoring programmes that provides information on the ecological status and trends of water resources.



CATCHMENT MANAGEMENT AGENCIES

The National Water Act provides for formal structures and processes for integrated water resource management at a catchment and local level, through the establishment of catchment management agencies and a strong user representation. These agencies provide a forum for government authorities and stakeholders to work towards a consensus on the management and development objectives for a catchment, which plays an important role in integrating land-use and water management. Partnerships and community involvement are of utmost importance in maintaining a healthy environment.

A formal process was started in 2001 to establish a Catchment Management Agency in the Olifants/Doring Water Management Area. Eleven water forums were formed in 2002 for the Lower Olifants, Middle Olifants, Upper Olifants, Ceres Karoo, Kouebokkeveld, Witzenberg, South Namakwaland, Nama-Karoo, Ceder-Doorn, Hantam and Sandveld sub-catchment areas. These forums support the Olifants-Doring Catchment Management Agency Reference Group which is the main vehicle for public participation in the process. A proposal for the establishment of the catchment management agency has been drafted and needs to be accepted by the Department of Water Affairs and Forestry. The intent to establish the agency has been published in the Government Gazette. This final approval process is expected to take up to one year.

ENVIRONMENTAL WATER REQUIREMENTS

Environmental water requirements refer to the quality and quantity of water that needs to be left in a river system, or released into it, for the specific purpose of managing aspects of the health of the ecosystem. Past water abstractions, or other flow manipulations, made without thought for the impacts on the river ecosystem or on people depending on that ecosystem, have resulted in a wide range of economic, social and ecological repercussions. Water developments can be expected to continue, however, water shortages will become a major and growing threat to national and global security. If both present and planned developments include informed management of river flows and water quality, then water resources can be used whilst holding negative impacts at a level that is acceptable to society. Such managed flows, usually called Environmental Water Requirements, can be used to achieve conservation or recreational aims, ensure continued subsistence use of river resources, or to ensure a better functioning and healthier ecosystem.

In the National Water Act, the highest priority is afforded to provision of water for the purposes of the Reserve. The first objective is to ensure that sufficient quantities of water of appropriate quality are reliably available to provide for basic human needs. In terms of current policy, a quantity of 25 litres per person per day has been incorporated for this purpose. The second priority is the provision of water for safeguarding and sustaining healthy ecosystems, including fauna and flora. Owing to the complex interdependence amongst species in nature, and our extremely limited knowledge of the wide spectrum of habitat and water requirements, for many water resources only provisional estimates of the ecological water requirements exist. In the Olifants/Doring Water Management Area improved determinations of the Reserve exist, where more comprehensive studies have been carried out for the Olifants/Doring River System and Estuary, as well as for groundwater in the Sandveld.

Olifants River at Keerom



River Conservation Planning

Living landscapes, waters and seascapes are ones that are able to support all forms of life, now and in the future. The aim of conservation planning is to identify which areas of land, water and sea are crucial to focus conservation action on. Systematic conservation planning is founded upon three fundamental principles: the principle of representation, persistence and quantitative target setting. In order to assess how severely river ecosystems have been impacted and to design a conservation plan that selects the most suitable rivers for conservation, it is important to map river integrity across South Africa. Rivers that are largely natural should be the first choice for meeting biodiversity targets. If the targets cannot be met in rivers with a high ecological integrity, then rivers with a moderate integrity would be the next best option. River integrity is mapped based on the present ecological status. The results from State of River assessments such as in this report are critical to the successful implementation of fine-scale conservation planning initiatives.

Waterfall on the Twee River



The Importance of Healthy Riparian Vegetation

The vegetation that grows along river banks is extremely important because of the function it serves. Indigenous riparian plants:

- ✦ help bind riverbanks with their roots and prevent erosion;
- ✦ trap sediment and pollutants, helping to protect water quality;
- ✦ provide habitat and food for animals, fish and aquatic insects;
- ✦ reduce the effects of floodwaters;
- ✦ provide cover to rivers exposed to extreme temperatures;
- ✦ slow runoff in the groundcover, increasing absorption of water;
- ✦ provide an aesthetically pleasing environment; and
- ✦ contribute to species richness.

Indigenous riparian plants are particularly well adapted to the conditions along our river banks. Their deep and extensive root structure is particularly well adapted to the erosive forces of water and preventing the undercutting of banks. The diversity of indigenous plants provides a diversity of habitats for aquatic and terrestrial life.

Alien plant encroachment in the riparian zone tends to be dominated by one plant species, substantially reducing habitat quality and ecological functioning.

Generally, only perennial and seasonal streams have sufficient water to support riparian vegetation. Ephemeral streams do not have a water table sufficiently close to the soil surface to provide for typical water-loving riparian vegetation. Vegetation growing along ephemeral streams may occur in greater densities or grow more vigorously than the surrounding terrestrial vegetation, and the plant composition is generally different to that in the surrounding areas.

Healthy riparian vegetation in the Twee River



Seekoraal



Seekoraal (*Sarcocornia* sp.)

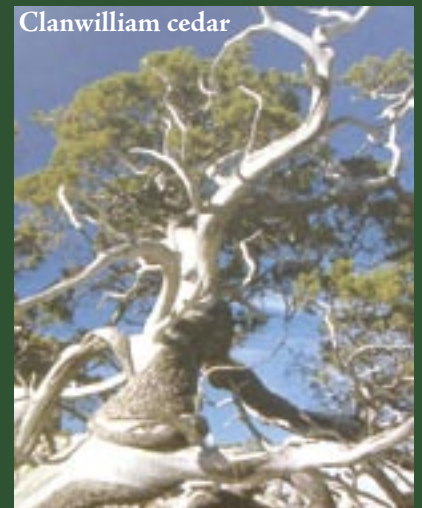
This edible succulent grows in saline marshes and in moist sand close to the sea. They are adapted to withstand high levels of salt. Seekoraal was eaten as a salad to prevent scurvy. These plants have a potential as commercial crops, using seawater irrigation.

Clanwillian Cedar (*Widdringtonia cedarbergensis*)

Clanwillian cedar trees are unique to the Cederberg Mountains near Clanwilliam. These magnificent trees are endangered and are one of 43 conifer species worldwide facing extinction. Although fire damages or even kills cedar trees, it is important for germination of their seeds.

A cedar reserve (5250 ha) was created in an attempt to prevent the extinction of these trees. A cedar nursery was established at Matjiesrivier Nature Reserve (see p. 19) to produce seedlings. The cedar, a flagship species, ensures that the broader community becomes involved and shares the responsibility of taking care of the Cederberg environment.

Clanwilliam cedar



Riparian Habitat and its Importance for Wildlife

Riparian zones provide important habitat for land-based plants and animals. These areas occupy only a small percentage of the catchment but contain a high diversity of living organisms, and play a crucial role as a corridor for the movement of plants and animals. For some species this habitat is critical. Some animals rely on riparian habitats for their entire lifetime, whereas others may only need them at particular times during the day, in certain seasons, or during specific life stages. The components of habitat that are important for animals include food, water, shelter from predators and from harsh physical conditions, and safe sites for nesting and roosting.

Cape Sand Frog (*Tomopterna delalandii*)

This small burrowing frog is widespread in sandy flat areas between the Cape Peninsula and St. Francis Bay in the east and Springbok in the north. Breeding takes place in the rainy season in pans, vleis, dams and rivers. Breeding males are known to form large choruses and are very vocal. They call at night, generally from exposed positions in shallow water, and breeding choruses can be heard over a distance of several hundred metres.

A detailed survey of amphibians and reptiles in the greater Cederberg area is currently being undertaken to better inform conservation management of the Greater Cederberg Biodiversity Corridor (see p. 34).

Cape Sand Frog



White Pelican (*Pelecanus onocrotalus*)

The white pelican frequents large estuaries, coastal waters and lakes, as well as large inland stretches of open water throughout Africa, south-eastern Europe and eastwards to Asia. The bird is a resident breeder but subject to substantial movement in response to food sources. They feed on marine and freshwater fish and often fish cooperatively, forming a semi-circle to drive fish together. There are only a few breeding colonies in southern Africa. They nest in large colonies on the ground and are very susceptible to disturbance at their breeding sites. As a result they have been classified as 'rare' on the Red Data list for birds in South Africa.

White pelican



Leopard

Leopard (*Panthera pardus*)

The leopard is the second largest of Africa's cats, with leopards from the mountains of the Cape being generally much smaller than those from further north. They can tolerate a variety of climatic conditions and habitats and are found from coastal areas up to elevations of greater than 2000 m. Livestock farmers have long been in conflict with leopards in the Cape, resulting in diminished numbers of leopard over the years. In 1974, the leopard was declared a protected species. This, however, did not resolve the conflict with farmers. In the Cederberg Wilderness Area and surrounding farmland much attention has been given to leopard conservation and a leopard management policy has been implemented to meet the needs of both the farmer and the Cape leopard.

Freshwater Fish of the Olifants/Doring System

No other river system in South Africa has as many endemic fish as the Olifants/Doring River System and its tributaries. This, arguably, makes it South Africa's most important river system for freshwater fish conservation. Eight of its ten indigenous fish species are endemic to the system, all of which are threatened (see table below).

The most common family is the Cyprinidae (redfin, sandfish and yellowfish). Ongoing genetic and morphological research on the fiery redfin and Cape galaxias indicate that the system may be home to two new species (see p. 41).

Currently, most indigenous fish are found in mountain streams that are inaccessible to farming activities, dam construction and invasive alien fish (smallmouth bass).

| Species | Scientific name | Conservation status |
|---------------------------|--------------------------------|-----------------------|
| Cape galaxias | <i>Galaxias zebratus</i> | Near threatened |
| Chubbyhead barb | <i>Barbus anoplus</i> | Not threatened |
| Clanwilliam redfin* | <i>B. calidus</i> | Endangered |
| Clanwilliam rock catfish* | <i>Austroglanis gilli</i> | Vulnerable |
| Clanwilliam sandfish* | <i>Labeo seeberi</i> | Critically endangered |
| Clanwilliam sawfin* | <i>B. serra</i> | Endangered |
| Clanwilliam yellowfish* | <i>Labeobarbus capensis</i> | Vulnerable |
| Fiery redfin* | <i>Pseudobarbus phlegethon</i> | Endangered |
| Spotted rock catfish* | <i>A. barnardi</i> | Critically endangered |
| Twee River redfin* | <i>B. erubescens</i> | Critically endangered |

* endemic species



Several actions are being taken to improve fish conservation and address the decline in threatened fish numbers. The Cape Action for People and the Environment (see p. 34) involves a number of important interventions, such as the Greater Cederberg Biodiversity Corridor and a dedicated Alien Fish Control project. The latter project has identified Rondegat, Suurvlei and Krom rivers as priorities for alien fish eradication and is supported by the Cape Piscatorial Society and Western Cape Bass Anglers Association. None of these rivers are notable angling waters for the alien species present.

CapeNature has identified the following rivers as focal areas for freshwater fish conservation: Biedou, Boschklouf, Breekkrans, Driehoeks-Matjies, Doring, Groot, Jan Dissels, Noordhoek, Olifants River (Visgat to Keerom), Oorlogskloof-Koebee, Ratels, Rondegat, Noordhoek, Thee and Twee. These rivers have reasonable to high numbers of indigenous fish, as well as good habitat, flow and water quality.

MANAGEMENT ACTIONS

- ✂ Ensure that any future water resource developments do not reduce the ecological status of the rivers
- ✂ Ensure that no further stocking of alien fish into dams and rivers takes place in sensitive catchments

Freshwater Fish of the Sandveld Rivers

The non-perennial Verlorevlei River is home to the endemic Berg River “Verlorevlei” redfin, unique populations of Cape kurper and probably two species of Cape galaxias. This river is critically important for freshwater fish conservation due to the ecological collapse of the nearby Langvlei River. CapeNature has identified the Verlorevlei River as a priority for freshwater fish conservation purposes.

| Species | Scientific name | Conservation status |
|---------------------------------|---------------------------|---------------------|
| Cape galaxias | <i>Galaxias zebratus</i> | Near threatened |
| Cape kurper | <i>Sandelia capensis</i> | Near threatened |
| Berg River “Verlorevlei” redfin | <i>Pseudobarbus burgi</i> | Endangered |



Cape kurper



Berg River redfin

Unfortunately, the Verlorevlei River is under growing threat from agricultural activities and invasion by alien plants and fish (banded tilapia). Flows are reduced by increasing groundwater abstraction and invasive alien plants in the riparian zone that causes the river to dry out. In the dry season, indigenous fish are confined to small shallow pools that have poor water quality.

Cape galaxias in the Driehoeks River



Cape galaxias in the Rondegat River



Cape galaxias in the Noordhoeks River



Cape galaxias in the Middeldeur River



Genetic Diversity of Fish

Many of the rivers and tributaries in the Water Management Area are home to populations of Cape galaxias, some of which may be a genetically distinct and a completely new species.

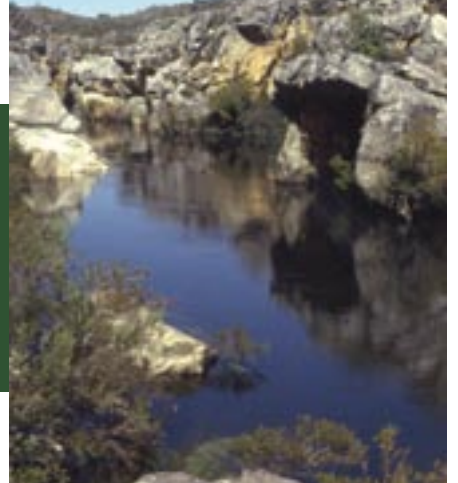
Studies indicate a genetic separation of Berg River redfin originating from the Verlorevlei and Berg rivers. These two populations may have remained isolated since the Pleistocene.

Taxonomic studies have been undertaken by scientists at the University of Pretoria’s Department of Genetics to determine the status of these species. Confirmation of the genetic differences of the Cape galaxias and Berg River redfin populations imply that these populations should be managed as distinct conservation units. Alternative and innovative conservation strategies involving private landowners will need to be investigated to preserve genetic diversity within the different species.

Olifants River Gorge

The upper Olifants River is characterised by a spectacular and near pristine gorge almost 30 km long. The gorge is home to high numbers of Clanwilliam yellowfish and sawfin, and is the only mainstream area remaining in the whole catchment where natural recruitment takes place. A waterfall at Visgat at the top of the gorge is a natural barrier to the indigenous fish.

Olifants River gorge



ALIEN FLORA AND FAUNA

Working for Water Programme in the Olifants/Doring WMA

The Working for Water (WfW) Programme's main objective is to remove and control alien invasive plants. The programme creates employment for previously disadvantaged communities as part of the Expanded Public Works Programme (EPWP). The Western Cape focus is on removing alien invasive plants from riparian zones and mountain catchments. The Programme also assists land-users with an initial clearing of alien invasive plants, as well as two follow-up treatments. After this the land-user is held responsible for keeping cleared areas free from alien invasive plants in terms of the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983).

WfW projects in the Olifants/Doring WMA take place at Calvinia, Citrusdal and Wuppertal. The project in Calvinia to clear the Oorlogskloof River catchment is managed by the Namaqua District Municipality. Alien invasive plants (mesquite, river gum, oleander) are being cleared in the Dwars and Toring rivers. Clearing in the Soetwater River is planned for 2006. Since this project's inception in January 2005, 1640 ha have been cleared, at a cost of R1.5 million. Land-users can contact the project office in Calvinia (Tel: 027-3418114) for further information.

The Citrusdal Water User Association (CWUA) manages the project in Citrusdal which takes place along the Olifants River, between Agterwitzenberg and Clanwilliam, as well as in Wuppertal. An estimated R5.8 million has been allocated to the project since 2001. Problematic plants such as black wattle are being cleared in the upper reaches of the Olifants River, while long leaf wattle and gum trees are being cleared in the middle and lower reaches between Citrusdal and Clanwilliam. To date, 3412 ha have been cleared along the Olifants River and 7955 ha of follow-up work undertaken. The participation of land-users at Clanwilliam and Citrusdal has been the key to the project's success. Most land-users in Clanwilliam have taken full responsibility for ongoing maintenance of cleared areas. Land-users can contact the project office in Citrusdal (Tel: 022-9212678) for further information.

Oleander (*Nerium oleander*)

Oleander is an ornamental shrub that originates from the Mediterranean and is used mostly as a hedge. This shrub is declared as a Category 1* weed and invades watercourses, particularly rocky river beds in semi-arid mountain valleys. All parts of the oleander plant are poisonous and can result in paralysis or even cardiac arrest.



Mesquite



Mesquite (*Prosopis glandulosa*)

This Acacia-like tree is cultivated for fodder, shade, fuel or a honey source. It originates from northern and central America (south-west USA and northern Mexico). It invades riverbeds and banks in semi-arid to arid areas and has been declared a Category 2* weed. The pods of the plant can become poisonous if consumed in large quantities and the pollen is a respiratory irritant. The plant is controlled biologically through seed feeders.

*The National Department of Agriculture has divided alien invader plants into categories. Category 1 invader plants must be removed and destroyed immediately, while Category 2 plants must be retained in specially demarcated areas but controlled outside of these areas (Conservation of Agricultural Resources Act, 1983).

Invasive Alien Fish

The Olifants/Doring River System is home to the Western Cape's finest freshwater angling fish, the indigenous Clanwilliam yellowfish (maximum size 11 kg). This fish is present in small numbers due to widespread and often illegal introductions of fish alien to the system for angling purposes. Alien fish can be grouped into legal introductions by the authorities prior to 1960 and illegal introductions thereafter (i.e. without a permit from CapeNature).

| Species | Scientific name | Approx. date introduced | Legal introduction? | Impact on indigenous biota |
|--------------------|--------------------------------|-------------------------|---------------------|------------------------------|
| Banded tilapia | <i>Tilapia sparrmani</i> | 1960 | yes | primarily competitor |
| Bluegill | <i>Lepomis macrochirus</i> | 1950 | yes | predator and competitor |
| Brown trout | <i>Salmo trutta</i> | 1910 | yes | predator |
| Carp | <i>Cyprinus carpio</i> | 2000 | no | competitor, degrades habitat |
| Largemouth bass | <i>Micropterus salmoides</i> | 1940 | yes | predator |
| Mosquitofish | <i>Gambusia affinis</i> | 1950 | yes | competitor |
| Mozambique tilapia | <i>Oreochromis mossambicus</i> | 2000 | no | primarily competitor |
| Rainbow trout | <i>Oncorhynchus mykiss</i> | 1910 | yes | predator |
| Sharptooth catfish | <i>Clarias gariepinus</i> | 2000 | no | predator and competitor |
| Smallmouth bass | <i>Micropterus dolomieu</i> | 1940 | yes | predator |

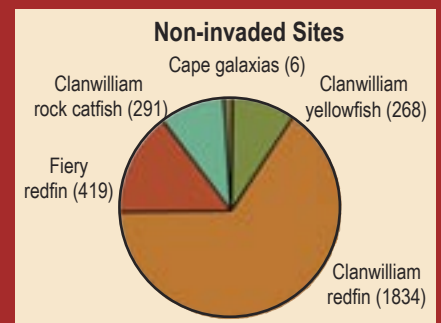
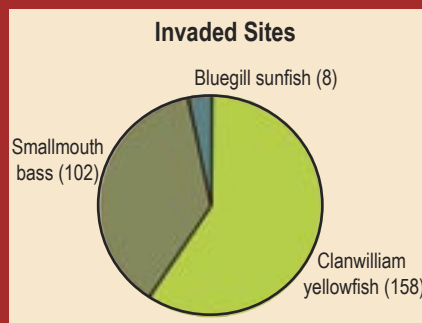


Invasive alien fish have had a huge impact on the biodiversity and ecological functioning of rivers in this Water Management Area and are the principal reason for the threatened status of all endemic species. Alien fish impact on indigenous fish in three ways:

- ✂ they prey on them (smallmouth bass);
- ✂ they compete with them for food (sharptooth catfish, Mozambique tilapia); or
- ✂ they degrade their habitat (carp).

Research on the Rondegat River has quantified the severe predatory impact of smallmouth bass (see diagrams). Where this species occurs, very few indigenous fish remain.

Smallmouth bass are a prized angling fish and bass tournaments are held annually in Clanwilliam Dam. Trophy Rainbow trout (over 4 kg) are targeted by fly-fisherman in the nutrient rich dams of the Kouebokkeveld. Through CAPE, the system has been identified as a priority for alien fish control (see p. 40).



Numbers of fish caught at non-invaded versus invaded sites

Alien species are fauna and flora introduced intentionally or by accident from other countries.

Aquatic biota is the community of plants and animals that live in rivers and wetlands.

Biodiversity is the variety and variability of living organisms and their ecological complexes.

Buffer zone is a strip on the outer edge of the riparian zone, which is required to protect the habitat and the water resource.

Ecological importance is the diversity, rarity or uniqueness of habitats and biota and the importance of protecting these ecological attributes.

Ecological sensitivity is to the ability of a specific ecosystem to tolerate disturbances and to recover from certain impacts.

Ecological water requirements the quality and quantity of water needed to maintain a river in a pre-determined state of health.

Endemic species is a species which is only found in a given region or location and nowhere else in the world.

Environmental flow releases are the quantity and variability of water released from impoundments to ensure long-term maintenance and conservation of riparian vegetation and to ensure sustainable resource utilisation.

Ephemeral rivers have intermittent or periodic flow.

Fauna is the collective term for animals living in a particular area.

Flora is the collective term for plants growing in a particular area.

Goods and services refer to the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life.

Gross Domestic Product is the total market value of all final goods and services produced in a country for a given period.

Indigenous species are the fauna and flora occurring naturally in an area.

Instream refers to “within the river channel”.

Mean Annual Evaporation is the average evaporation over a year.

Mean Annual Precipitation is the average rainfall (including snow, hail and fog condensation) over a year.

Mean Annual Runoff is the average yearly available stream flow at a point in the river which has been calculated over a long period of time (usually 50 years or more), assuming a constant level of development.

RAMSAR sites are wetlands of international importance. The Ramsar Convention on Wetlands provides a framework for national action and international co-operation for the conservation and wise use of wetlands and their resources.

Recharge is the process where water is added to an aquifer, for example, from rainfall.

Red Data species are plants or animals that are under threat. The Red Data categorisation of species helps to determine their conservation status. The categorisation follows the IUCN guidelines and includes categories such as extinct, endangered, vulnerable and rare.

Reserve is the quality and quantity of water that is required to provide for basic human needs and to protect the aquatic ecosystems of a water resource.

Riparian habitat refers to the habitat on the river bank.

Riparian zone is the area adjacent to a river or water body that forms part of the river ecosystem.

Runoff is water that is not absorbed by the soil and flows to lower ground, eventually draining into a stream, river or other water body.

FURTHER READING

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Web pages to explore are:

CAPE: capeaction.org.za

CapeNature: www.capenature.org.za

City of Cape Town: www.capetown.gov.za

Department of Environmental Affairs and Tourism: www.deat.gov.za

Department of Water Affairs and Forestry: www.dwaf.gov.za

South African National Parks: www.sanparks.org

Water Research Commission: www.wrc.org.za

Working for Water: www.dwaf.gov.za/wfw

River Health Programme: www.csir.co.za/rhp





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