Voelvlei Dam

Voëlvlei Dam was commissioned in 1952 and was the first large water supply scheme in the Berg River catchment. It was constructed by impounding the natural Vogelvlei lake near Gouda. As the catchment of the lake was only 31 km², additional water was obtained via a canal from the Klein Berg River (max 1.3 million cubic metres per day). The dam supplied water to Riebeek-Kasteel, Riebeek-Wes, Malmesbury, Darling, Moorreesburg and farms along the supply route. Water was released into the Berg River for riparian farmers downstream of Zonkwasdrif and for abstraction at Misverstand Dam (see p. 30).

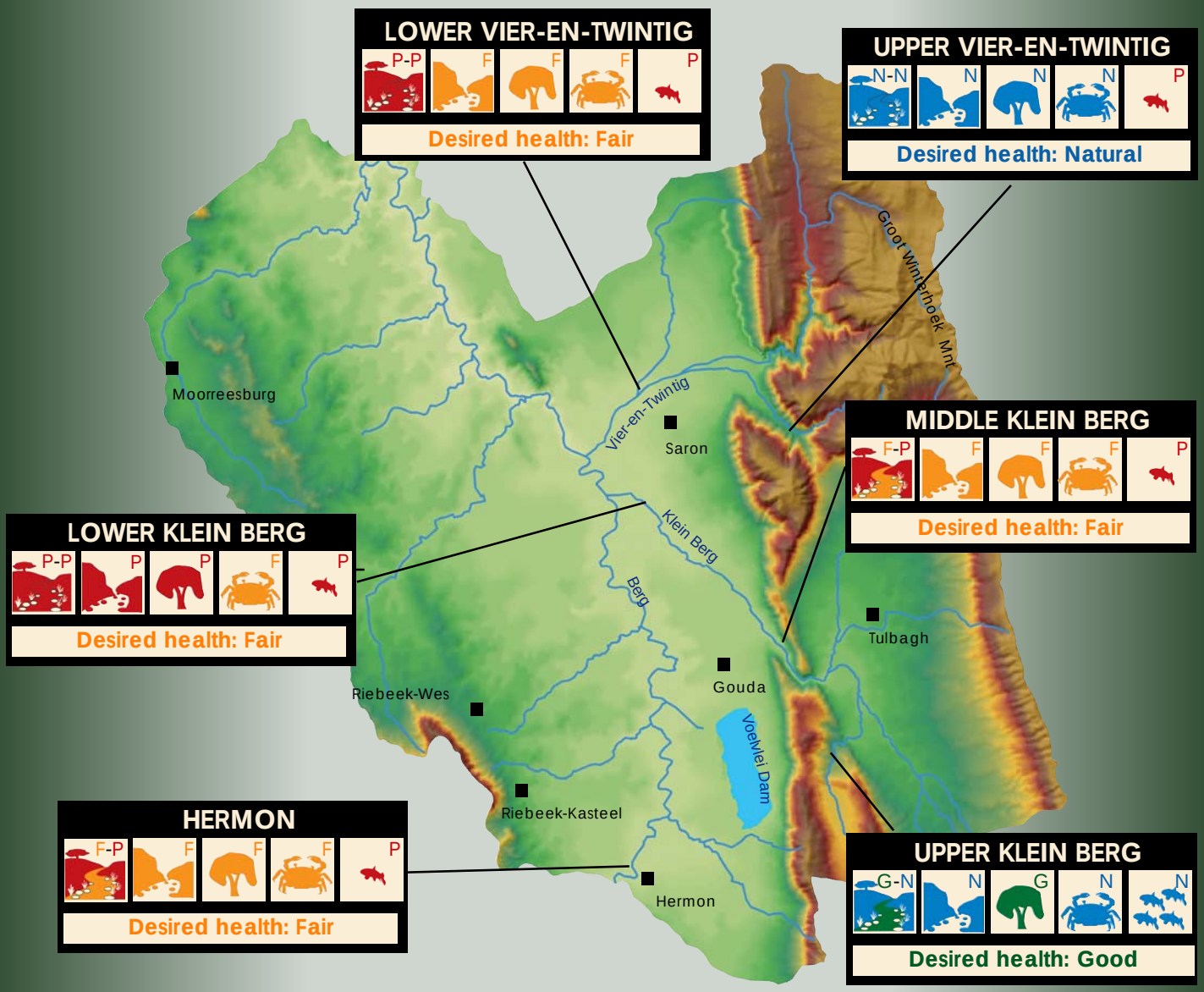
In 1969, Cape Town's increasing water demand resulted in the dam wall being raised and more water being abstracted from the Klein Berg River (max. 1.7 million cubic metres per day). This supply to Cape Town was increased in 1971 to 1.8 million cubic metres per day by constructing an additional canal to divert water from the Vier-en-Twintig and Leeu rivers (max. 2.9 million cubic metres per day).

Groot Winterhoek Wilderness Area

The Groot Winterhoek Wilderness area (30 608 ha) is situated north of Tulbagh and east of Porterville. This is an important catchment area for Voëlvlei Dam and is popular amongst eco-tourists. The Wilderness is an important wildlife area for the conservation of Sandstone Fynbos and associated fauna (e.g. klipspringer, grey rhebok, leopard and grysbok).

Various rare, threatened and endangered species occur here, e.g. threatened flat-leaf clusterhead protea *Sorocephalus scabridus*. The red disa *Disa uniflora* grows in abundance along streams in this area, while the rare yellow form also occurs here. The beautiful 2 m tall *Ixianthes retzioides* shrub is endemic to mountain streams in this wilderness area.

Lower Middle Berg River & Tributaries - Present State



Major Impacts and Management Actions

RIVER AND FLOW MODIFICATION

Diversion weirs in the Klein Berg and Vier-en-Twintig rivers divert much of the flow, including the entire summer flow, from these tributaries to the Voëlvlei Dam (see p. 26). This results in greatly reduced river health scores in the lower reaches.

Inappropriate farming practices along the river banks has resulted in a need to construct levees to prevent flood damage. Levees intensify flood flow, reduce the natural ability of the floodplain to absorb flood water and result in increased levels of siltation.

ALIEN VEGETATION AND FORESTRY

An improvement in the state of the Klein Berg River is evident where alien trees are being cleared. However, the lower reaches of the tributary, as well as the main stem of the Berg River, are still infested with river gum and black wattle. These trees destabilise river banks resulting in increased erosion and deposition of sediments in pools and riffles.

URBAN AND AGRICULTURAL DEVELOPMENT

Wastewater discharges in the Tulbagh area reduce water quality in the Berg River. Pesticides are used to control pests in vineyards and orchards near Tulbagh and Porterville. Pesticide residues that are washed off into surface waters result in low levels of contamination in the area. This has resulted in a loss of pollution-sensitive aquatic invertebrates.

ALIEN FISH

With the exception of the upper Klein Berg River, all the other rivers are infested with alien fish (carp, sharptooth catfish, smallmouth bass, Mozambique tilapia, rainbow trout). These fish, together with habitat degradation, have caused the localised extinction of Berg River redfin, Cape kurper and witvis.

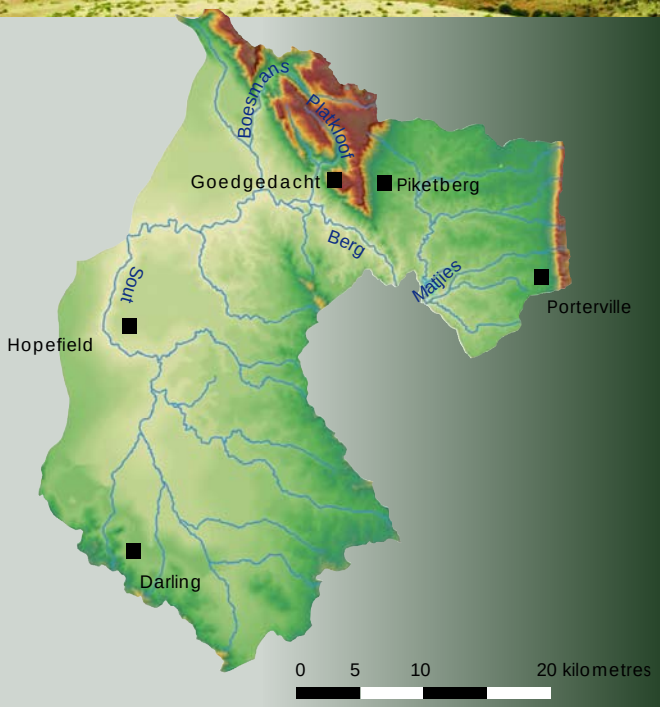
Management Actions

- **Ensure that environmental flow releases are made from diversion weirs (e.g. Vier-en-Twintig River)**
- **Continue clearing of invasive alien vegetation and maintain cleared areas**
- **Improve land-use practices (e.g. farming) to reduce sedimentation and water quality problems**
- **Improve monitoring and management of runoff and discharges from urban and agricultural areas**
- **Stock farm dams with indigenous fish rather than alien fish**

Lower Berg River & Tributaries

The Matjies, Boesmans and Platkloof rivers originate on the north-eastern portion of the catchment in the Olifantsrivier and Piketberg mountains. The Sout River drains the south-western portion, which has a very low gradient, near Malmesbury. These rivers feed the lower Berg River, with the Matjies River being the only historically perennial tributary. Although this section of the Berg River constitutes over 40 % of the total catchment area, it contributes only 10 % of the runoff (97 million cubic metres per annum) due to significantly lower annual rainfall.

Major towns in this part of the catchment are Porterville, Piketberg, Hopefield and Darling. Water supply to most of these towns is from Voëlvlei and Misverstand dams. Porterville obtains its water from a local mountain spring.



Wastewater treatment works at Porterville (0.2 million cubic metres per annum) and Darling (0.1 million cubic metres per annum) discharge treated wastewater into minor tributaries of the Berg and Sout rivers, respectively. Hopefield (0.1 million cubic metres per annum) and Piketberg (0.5 million cubic metres per annum) wastewater treatment works use their wastewater for irrigation purposes.

Dominant land-use in this region is grain farming, together with limited cultivation of table and wine grapes. The underlying geology of the lower Berg River comprises the Malmesbury Shales that have a high salt content. Irrigation results in an increase in inorganic salt concentrations and turbidity. Due to these factors, the water quality of the Berg River deteriorates downstream, with the Sandspruit River near Riebeek-Wes and the Matjies River being major contributors to this deterioration.

Misverstand Dam

The old Berg River pump station was located about 60 km from the river mouth and supplied water to the Saldanha Bay – Vredenburg area from 1942. This scheme was dependent on river flow to minimize seawater intrusion. Increased demand for water resulted in the construction of a weir higher up in the Berg River at Misverstand in 1977 to improve water supply to the area.

Saldanha skull

Sea Level and Climate Change

Over the last 2 million years, sea level changes have been frequent due to freezing and thawing of the polar ice caps. These changes in sea level affect not only the area of exposed land, but also the underlying rocks and soils. Under these changing conditions, lowland fauna and flora have evolved, adapted and either colonised or become extinct. At Elandsfontein, 13 km south west of Hopefield, rich fossil remains give a picture of the animal life of the past. Fossils found here indicate that this area was originally a swampy region where the Berg River met the sea. It also had dense vegetation and was rich in animal life. The Saldanha skull is one of the earliest remains of the Stone Age Man found in southern Africa.

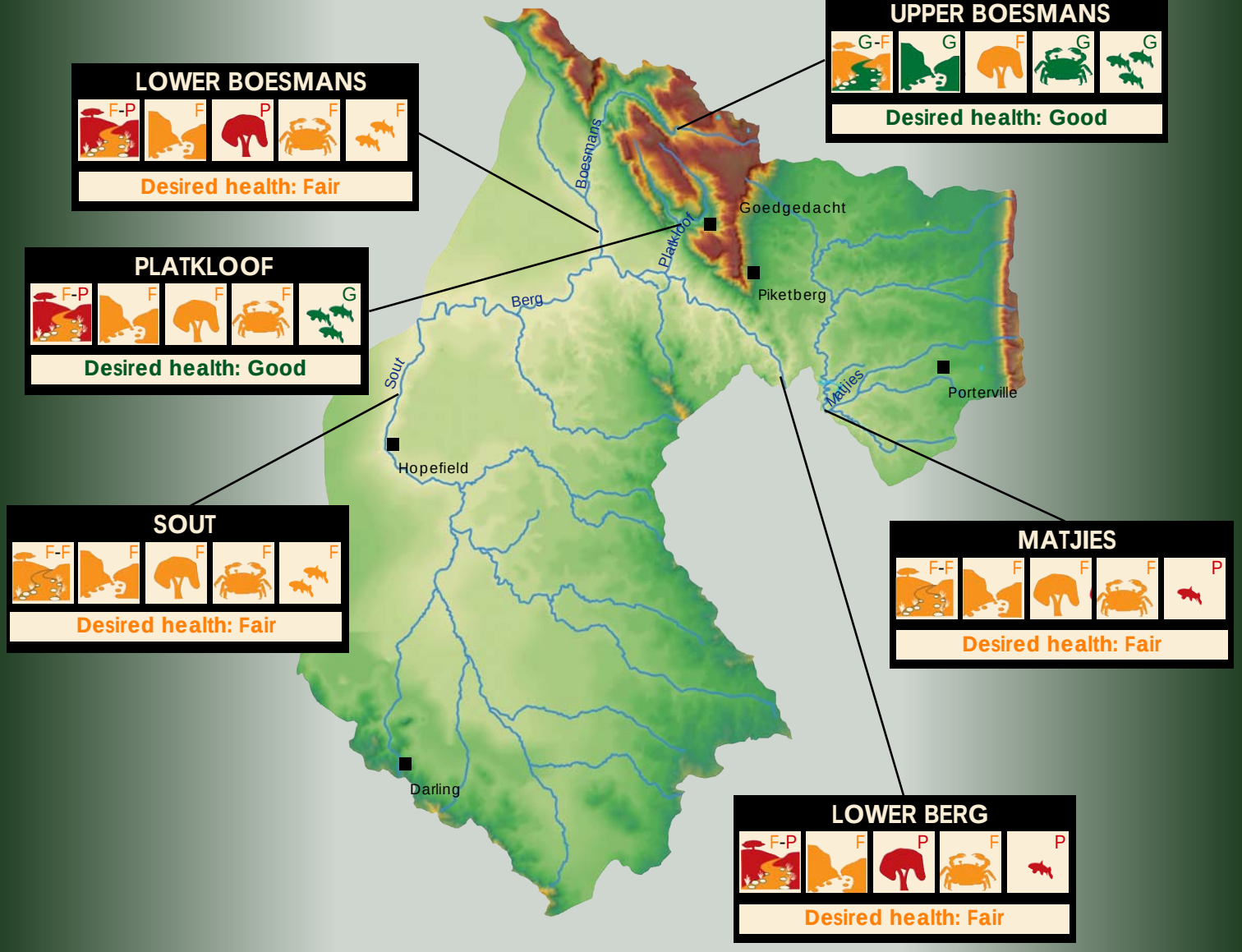
Climate change, as a result of Global Warming, is expected to have a significant impact on the West Coast, which is likely to become hotter and drier. This will place a greater stress on the already stressed water resources of this region, as well as its fauna and flora, with many species likely to become endangered or possibly extinct.

Extinct giant pig lower jaw

Extinct rhino jaw

Early elephant species jaw

Lower Berg River - Present State



Major Impacts and Management Actions


Water hyacinth

ALIEN VEGETATION & REMOVAL OF INDIGENOUS VEGETATION

Farming practices along the river banks have resulted in the removal of natural vegetation and subsequent alien vegetation infestation. Where infestation by alien trees does not occur denuded river banks are subject to erosion and cause sedimentation problems in the river.

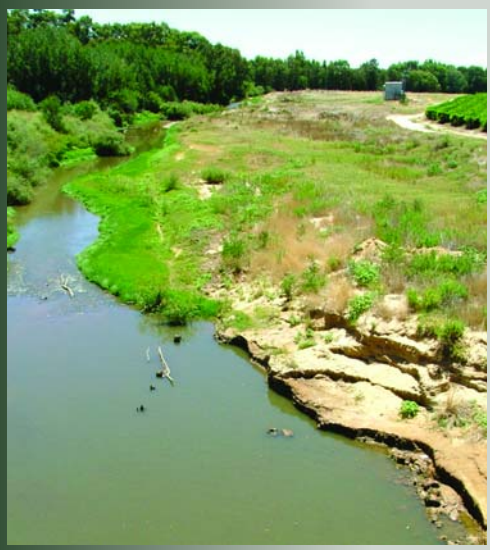
Alien trees (e.g. black wattle) use large amounts of water throughout this catchment. Water hyacinth clog the water surface of the lower Berg River and reduce water quality and habitat integrity (see p. 45).

ALIEN FISH

The lower Berg River is dominated by invasive alien fish (e.g. carp and Mozambique tilapia). Estuarine fish (e.g. mullet and round herring) often penetrate the freshwater zone of the river. Indigenous fish are confined to the upper reaches of the Boesmans, Platkloof and Sout rivers.

Management Actions

- **Clear alien vegetation along the banks of the Berg, Boesmans and the Platkloof Rivers**
- **Re-introduce indigenous riparian vegetation to reduce sedimentation problems**
- **Manage flows in the Platkloof River at Goedverwacht and the upper reaches of the Boesmans River to ensure sufficient water in summer for threatened indigenous fish**
- **Obtain support of the Goedverwacht community to become caretakers of the highly sensitive Platkloof River**
- **Improve management and monitoring of water abstraction, particularly during summer**



RIVER MODIFICATION

Farming activities within the river banks and bed lead to erosion and increased sedimentation. Deposition of sediments in rivers reduces habitat quality and diversity.

WATER ABSTRACTION

Water abstraction in the tributaries, particularly in the Boesmans River, decreases the low flows during summer. In addition, no environmental flow releases are made from most of the dams in these tributaries.

Releases for irrigation from Misverstand Dam create water quality problems below the weir. These releases are made from the bottom waters, which are of poor quality.

WATER QUALITY

The WATER QUALITY in the Berg River has changed considerably over time, with the major impactors being agricultural return flows, irrigation releases, urban and industrial runoff and wastewater discharges. Temporal trends in water quality in the Berg River catchment can be summarised as follows:

PRE-DEVELOPMENT

There are no water quality records for the Berg River in its unimpacted state (see box on p. 9). Naturally, the upper reaches of the river could be described as having freshwater with a low pH and nutrient concentration. These characteristics change with distance downstream, depending on the underlying geology and flow conditions. Different tributaries assert different degrees of influence on the Berg River at different times of the year. During summer, river flow is dominated by low conductivity waters from the upper reaches and perennial tributaries. The saline ephemeral tributaries generally impact on the Berg River for a short period at the onset of winter.

PRE-1960

Generally, the upper reaches remained in a near natural state, while conductivity and total dissolved salts increased with distance downstream. Localised impacts were organic enrichment downstream of the Franschhoek River, possibly as a result of Franschhoek and neighbouring farms. Runoff from Pniel, local farms and a cannery reduced the water quality in the Dwars River, while domestic and industrial pollution occurred in the Paarl and Wellington areas. Increased levels of abstraction from tributaries caused the elevation of pollutant concentrations in summer and the disappearance of pollution-sensitive species.

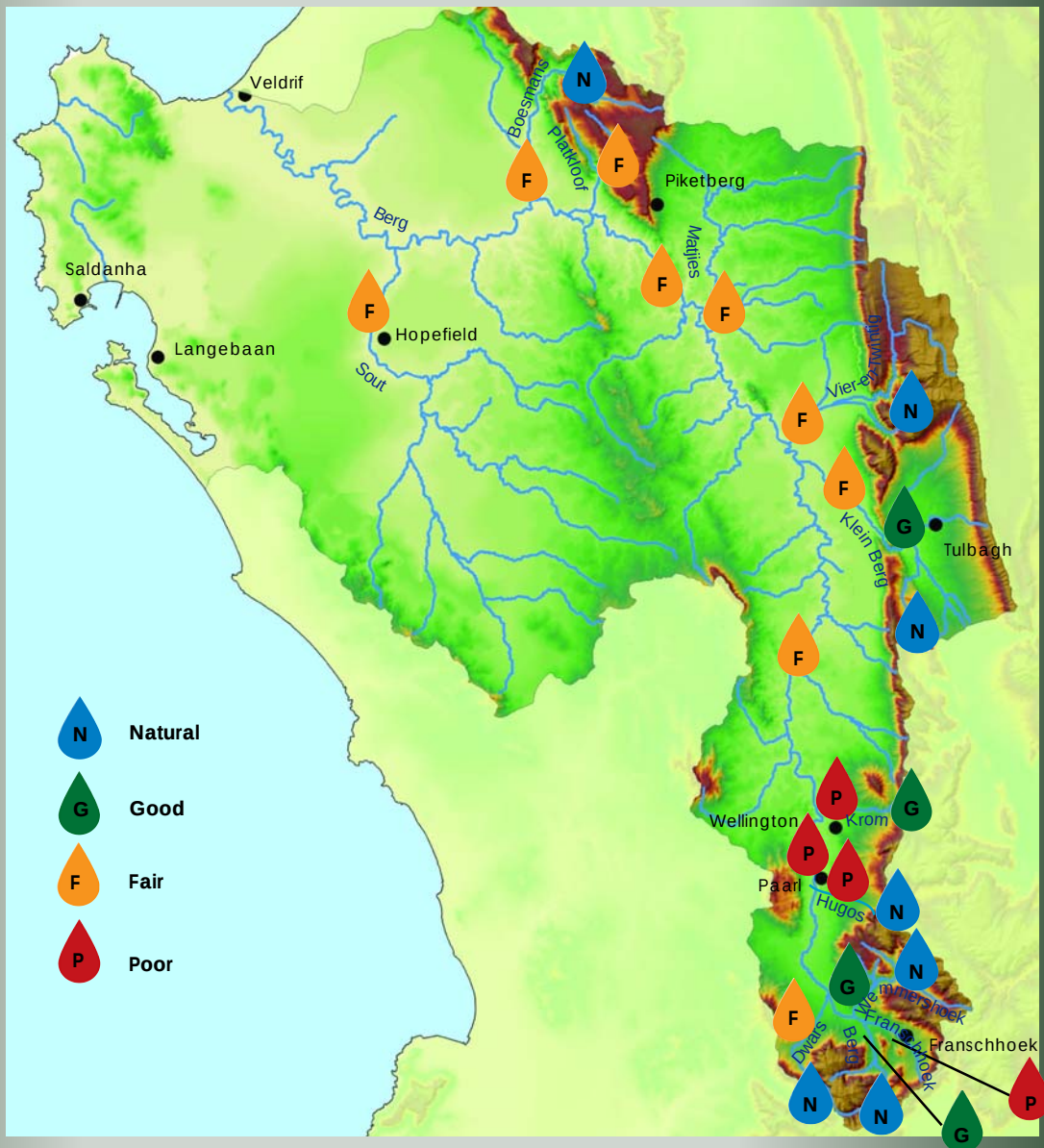
1960 – 1980

The upper reaches remained unpolluted. Water quality deteriorated downstream as a result of increased organic loading (wastewater discharges) to the river between Paarl and Wellington. Irrigation releases from Voëlvlei Dam during summer resulted in a sharp increase in conductivity during these months. Overall, the Berg River showed a substantial increase in mineralisation along its course. Many lower reaches of tributaries were now showing substantial declines in water quality due to excessive rates of water abstraction and use of fertilisers.

1980 – 2004

The interbasin transfer (see p. 18) into the upper reaches of the Berg River increased conductivity, pH and suspended solids and transformed the river downstream during the dry summer months. Conductivity continued to increase with distance downstream, with a marked increase below Voëlvlei Dam as a result of irrigation return flows. Major point sources of nutrients into the river occurred in the Paarl and Wellington areas, associated with wastewater discharges. The major source of phosphorus into the river was from non-point sources.

The PRESENT WATER QUALITY is indicated according to its **suitability for aquatic biota**. This assessment is based on the phosphate, nitrate, nitrite, ammonia, suspended solids, dissolved oxygen, pH and conductivity measured in water samples from each sampling site.



Pollution from Pesticides and Fertilisers

Fertilisers and pesticides are heavily utilised to optimise production of grapes, deciduous and citrus fruits. Typically these chemicals can reach rivers via vapour/spray drift, surface runoff, spills or through leaching into groundwater. These chemicals, many of which are copper-based, adversely affect aquatic biota (e.g. reduce reproduction or cause mortality) resulting in the disappearance of important pollution-sensitive species.

Environmentally-friendly chemicals, applied appropriately, will reduce the above-mentioned effects. It is also essential that riparian land-owners leave a 10 – 20 m buffer strip of natural vegetation between the planted crops and the river. This buffer zone protects the river from runoff, spray drift and siltation and plays an important role in maintaining the habitat integrity in the riparian zone.

FLOODPLAIN

FLOODPLAINS are broad and relatively flat areas on either side of a stream or river that are inundated by water during floods. They are integral parts of a river ecosystem and are as dynamic as the rivers that create them.

The well developed **floodplain of the Berg River**, above the estuary, is unique in the south-western Cape.

Evaporation on the floodplain is three times more than the rainfall. Thus, the floodplain and the surrounding communities rely on floods originating higher up in the catchment for their existence. It is thus essential that environmental flow releases are made to ensure the future existence and viability of this locally unique ecosystem.

The floodplain vegetation provides food and shelter for many bird species (see p. 39). The floodplain is also important as a fish nursery (e.g. flathead mullet).

Floodplains act as flood buffers, water filters, fish nurseries and are generally major centres of biological activity in the river ecosystem. During periods of high water, floodplains act as natural sponges, which store and release floodwaters slowly. They improve water quality by providing fresh water to wetlands and backwaters, diluting salts and nutrients and generally improving the overall habitat health. In addition to filtering out pollutants, floodplain trees and plants also prevent bank erosion and provide shade, which reduces water temperatures.

Many floodplain species are dependent on flooding for survival. For example, floods trigger breeding in water birds and fish as food availability increases, while seedlings of a number of floodplain plants establish during flood events. Terrestrial grazers and browsers are attracted to the floodplain at the end of the wet season when rich alluvium deposits activate new growth. Lack of flushing during floods gradually results in increased salinity levels in floodplain soils.

Water abstraction and dams reduce the frequency and intensity of flooding of the Berg River floodplain, while agricultural and urban encroachment further damage the floodplain.

MANAGEMENT ACTIONS

- **Ensure that environmental flow releases allow for sufficient water to fill the floodplain during average rainfall years**
- **Take “after-flood” snapshots to show the importance of the braided river for floodplain functioning**

GROUNDWATER

Groundwater in the Berg River catchment is stored mainly in the Table Mountain Group and Malmesbury Group aquifers. The Table Mountain Group Aquifer is the dominant aquifer in the upper catchment and along the eastern and northern fringes of the catchment, while the Malmesbury Group Aquifer underlies most of the central and lower catchment. This groundwater does not exist in isolation and plays a vital role in ensuring the baseflow of rivers during the dry season.

The total harvest potential for the Berg River basin is about 325 million cubic metres per annum. High yielding aquifers are the Table Mountain Group Aquifer and one near Langebaan. Aquifers associated with the Malmesbury Group, Cape Granite Suite and Klipheuwel Group are considered to be of low harvesting potential.

Total groundwater use in the catchment is about 8.5% of the harvest potential, with agriculture being the largest user. Most of the groundwater in the catchment is used in the western and southern parts, with little being used in the central region where dryland crops predominate. Poor groundwater quality, particularly in the Malmesbury Group Aquifer, and the availability of surface water supplies have limited the use of groundwater as a resource. It is essential that groundwater use does not result in the ecological collapse of surface waters, such as wetlands and rivers.

The Table Mountain Group Aquifer contains substantial supplies of groundwater. The City of Cape Town is investigating this groundwater resource for additional water supply in certain areas, for example the Watervalsberge near Voëlvlei Dam.

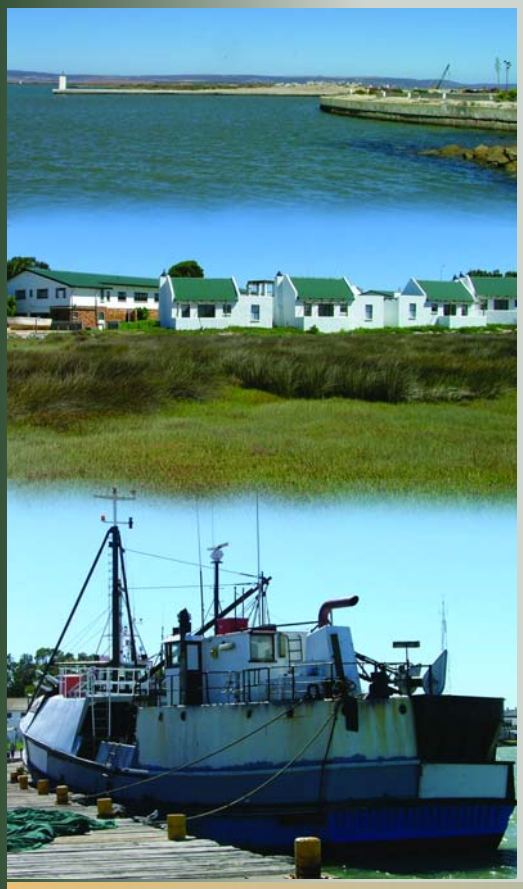
The Berg River Estuary

ESTUARIES are unique habitats where rivers interact with the sea to varying degrees. The extent of seawater penetration and whether an estuary mouth will be open or closed depends strongly on river flow. The salinity regime and mouth status of an estuary in turn, govern the nature of the habitats on which most estuarine biota depend.

The mouth of the BERG RIVER ESTUARY is kept permanently open by a constructed channel and dredging.

The estuary reflects strong seasonal patterns. River inflow during winter creates more turbid, freshwater-dominated conditions, with limited saline intrusion near the mouth. During summer, the estuary becomes marine-dominated with less turbid saline waters penetrating up to about 40 km from the mouth. Upwelling during these summer months is a typical feature along the West Coast when colder, nutrient-rich seawater is introduced into the estuary. This seasonal variability drives the ecology of the estuary.

Length: 70 km
Area: 3 615 ha
Depth: ~ 5 m below mean sea level



IMPORTANCE OF THE BERG RIVER ESTUARY

The Berg River Estuary is South Africa's second most important estuary in terms of national conservation importance for estuarine birds, fish, invertebrates and vegetation (see p. 39-40). Despite extensive human activity, the system is still particularly important for birds because it supports large populations of both resident species and Palaearctic migrants.

DAMS AND WATER ABSTRACTION

Storage and abstraction of water in the catchment have reduced fresh-water inflow to the Berg River Estuary by 30%. This results in:

- extensive upstream intrusion of seawater into the estuary, particularly during summer,
- reduction in frequency and extent of floodplain inundation, and
- a decrease in the scouring of sediment within the estuary.

The extensive upstream intrusion is also exacerbated by the stabilisation of the mouth which keeps it permanently open via a constructed channel.

EROSION IN THE CATCHMENT

Increased silt supply from agriculture may contribute to the siltation of sensitive areas (e.g. Die Plaat) in the estuary.

LOSS AND DESTRUCTION OF NATURAL HABITAT

Livestock grazing and the construction of salt works and Port Owen Marina have resulted in extensive loss of natural habitat, mainly saltmarsh. Although the salt works has destroyed this habitat, the area now provides rich feeding grounds for flamingos and waders.

Power boating activities, as well as the stabilisation and regular dredging of the mouth have resulted in increased bank erosion in the estuary, with the associated loss of saltmarsh habitat and a decline in floodplain vegetation.

OVEREXPLOITATION OF LIVING RESOURCES

Overexploitation of estuarine fish is a serious concern in the Berg River Estuary. As a result, Marine and Coastal Management withdrew all gillnet permits for 2003 to protect the nursery function of the estuary and allow for stock recovery. Preliminary surveys already show a strong recovery of flathead mullet and elf stocks in the estuary.

DETERIORATION IN WATER QUALITY

Potential threats to water quality include wastewater discharges from a fish processing plant, seepage from the salt works, harbour activities (e.g. dumping of fish offal and petroleum oils). Agricultural return flow is another potential source of pollutants (nutrients and pesticides) to the system.

MANAGEMENT ACTIONS

- **Determine the ecological Reserve for the Berg River Estuary before any further reduction in river inflow is approved** **(see p. 49)**
- **Register the Berg River Estuary as a wetland of international importance under the Ramsar Convention to ensure a high level of bird habitat protection**
- **Ensure that prescribed environmental flow releases are made from large dams in the catchment**
- **Clear the alien vegetation, especially river gum and water hyacinth**

The Floodplain & Berg River Estuary Fauna & Flora

Birds

The floodplain and the Berg River Estuary are known collectively as the Lower Berg River Wetlands and are listed as an Important Bird Area (Ramsar Convention). In addition to the estuary, winter flooding of the Berg River inundates an extensive floodplain of about 5 500 ha. Although this floodplain is known to support large numbers of breeding birds, the distribution and abundance of these floodplain species and their conservation status has never been quantified.

The floodplain supports at least 127 species of water birds, of which 85 are observed regularly, 31 are of regional significance, 25 are of national importance and 5 are listed as red data species. Migratory birds from Europe and northern Asia use the floodplain as feeding grounds during summer.

A number of large heronries occur within the Berg River floodplain. Riparian reedbeds also provide breeding habitat for large water birds, colonies of red bishops, various weaver species and populations of small warblers and cisticolas. Ducks, coots and blackwinged stilts breed in the sedge pans and South African shelducks breed in burrows near open pans.

The breeding season of water birds in the Western Cape is closely linked to the winter rainfall regime. Peak breeding activity is restricted and mirrors the seasonal pattern of flooding with a time lag of approximately two months. Any development that alters the seasonal flow pattern (e.g. construction of large in-streams dams on the Berg River) would severely impact on the breeding behaviour and performance of water birds.

The estuary is one of the few suitable habitats along the west coast for migratory birds. Migratory waders on the East Atlantic, Mediterranean and Middle East flyways (with South Africa as the southerly end-point) use the estuary as a feeding ground. In addition, the estuary supports approximately 250 resident bird species, representing 50 % of the species of the South-Western Cape in the area. These include white pelican *Pelecanus onocrotalus*, african spoonbill *Platalea alba*, greater flamingo *Phoenicopterus ruber* and lesser flamingo *P. minor*. Little blue heron *Egretta caerulea* (1st ever recorded outside the Americas) have also been recorded in the estuary.

Estuarine Fish

Nearly 80 % of the Western Cape coastal fish species have been recorded in the Berg River Estuary and floodplain. Of these fish, some are entirely estuarine or partially dependent on the estuary and floodplain. Over 30 fish species have been recorded, including six estuarine residents (e.g. estuarine roundherring *Gilchristela aestuaria*), eleven euryhaline migrants (e.g. flathead mullet *Mugil cephalus*), seven marine migrants (e.g. elf *Pomatomus saltatrix* and leervis *Lichia amia*) and six freshwater species (e.g. Mozambique tilapia *Oreochromis mossambicus*). The southern mullet *Liza richardsonii*, is the most abundant species making up more than 80% of total catches.

Due to the scarcity of suitable sheltered habitats along this stretch of coast, west coast floodplains and estuaries are of tremendous local importance to fish, particularly as nursery areas.


Flathead mullet

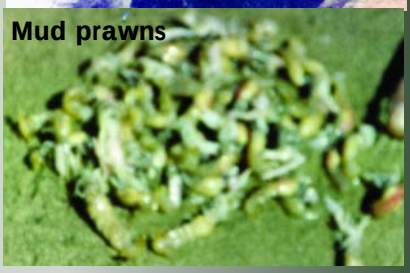

Estuarine roundherring


Elf

Estuarine Invertebrates

Invertebrates are an important food source for bird and fish in the estuary. The system supports an extremely high abundance of invertebrates, including polychaete worms *Ceratonereis erythraeensis*, mud prawns *Upogebia africana* and sand prawns *Callianassa kraussi*.


Polychaete worm


Mud prawns

Estuarine Vegetation

Dense stands of the indigenous reed *Phragmites australis* line the upper reaches of the Berg River Estuary. Sedgeland (*Juncus kraussi* with *Scirpus maritimus* and *S. triqueter*) and reed beds (*Phragmites australis*) occur along the floodplain and banks of the middle reaches of the estuary.

The lower reaches of the estuary include the third largest saltmarsh in the Cape. Sea grass *Zostera capensis* occurs on tidally exposed and subtidal mudflats. The sago pondweed *Potamogeton pectinatus* occurs in brackish pools (10 - 15%) along the edge of the main channel. These plants provide food and habitat for estuarine fauna.


Zostera


Phragmites


Sarcocornia

Flora of the Berg River Catchment

Indigenous Flora

The natural vegetation of the area includes Sandstone Fynbos, Sand Fynbos, Fynbos Thicket Mosaic and Renosterveld.

SANDSTONE FYNBOS

The dominant vegetation type in the Berg River catchment is mountain fynbos. Some 70 % of the remaining Sandstone Fynbos is on privately owned land, while the remainder is protected in water catchment areas by national legislation (Forest and Mountain Catchment Areas Acts). This fynbos occurs on acidic, nutrient-poor sands. The Piketberg Mountain Fynbos complex is one of the centres of endemism in the fynbos vegetation.

Erica mammosa

SANDPLAIN FYNBOS

The lower Berg River region is extensively covered by Strandveld and Sand Fynbos which occur on alkaline, sandy soils. The vegetation is typically Asteraceous and Proteoid Fynbos and is characterised by the presence of ninepin heath *Erica mammosa*, starface *Phyllica cephalantha* and sandveld thatching reed *Thamnochortus punctatus*. Only 1.4 % of the remaining Sand Fynbos is protected in a single private nature reserve. About 40 % of the Strandveld is undeveloped, with only 1 % occurring in conservation areas.

FYNBOS THICKET MOSAIC

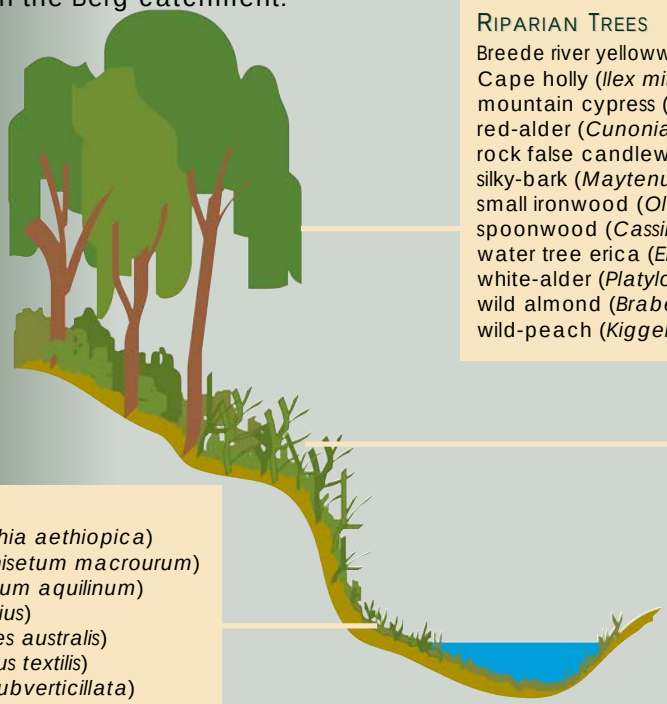
Dune fynbos and thicket patches occur along the Langebaan coastline. Dominant trees and shrubs include: cherrywood *Pterocelastrus tricuspidatus*, common spike-thorn *Gymnosporia buxifolia* and sea guarri *Eulea racemosa*. A majot threat is the removal of thicket for coastal resorts and invasion by alien vegetation.

Felicia filifolia

RENOSTERVELD

Renosterveld occurs on the fertile clay soils of the Western Cape where renosterbos is the dominant shrub. Less than 3 % of the original renosterveld remains, with less than 1 % being found in nature reserves. The largest remaining tract of renosterveld in the Berg River catchment is in the Elandsberg Private Nature Reserve between Wellington and Voëlvlei Dam. Dominant species include renosterbos *Elytropappus rhinocerotis*, kouterbos *Anthanasia trifurcata*, draaibossie *Felicia filifolia* and slangbos *Stoebe spiralis*. Bush clumps, associated with termitaria, are dominated by wild olive *Olea europaea* and dune taaibos *Rhus laevigata*.

The diagram below shows indigenous riparian species commonly found within the Berg catchment:



Riparian Trees

Breede river yellowwood (*Podocarpus elongatus*)
Cape holly (*Ilex mitis*)
mountain cypress (*Widdringtonia nodiflora*)
red-alder (*Cunonia capensis*)
rock false candlewood (*Maytenus oleoides*)
silky-bark (*Maytenus acuminata*)
small ironwood (*Olea capensis*)
spoonwood (*Cassine schinoides*)
water tree erica (*Erica caffra*)
white-alder (*Platylophus trifoliatus*)
wild almond (*Brabejum stellatifolium*)
wild-peach (*Kiggelaria africana*)

Riparian Shrubs

blue laurel (*Cryptocarya angustifolia*)
bog rice-bush (*Cliffortia strobilifera*)
bush willow (*Salix mucronata*)
fly bush (*Myrsine africana*)
fynbos star-apple (*Diospyros glabra*)
honey-bells (*Freylinia lanceolata*)
lance-leaved waxberry (*Morella serrata*)
notsung (*Halleria elliptica*)
palmiet (*Prionium serratum*)
river currant bush (*Rhus angustifolia*)
slangbessie (*Lycium ferrocissimum*)
smalblaar (*Metrosideros angustifolia*)
vleiknopbos (*Berzelia lanuginosa*)
water white alder (*Brachylaena neriifolia*)

Herbaceous Flora

arum lily (*Zantedeschia aethiopica*)
bedding grass (*Pennisetum macrourum*)
bracken fern (*Pteridium aquilinum*)
bulrush (*Typha latifolius*)
fluitjiesriet (*Phragmites australis*)
matjiesgoed (*Cyperus textilis*)
restios (*Ischyrolepis subverticillata*)
rush (*Juncus lomatophyllus*)
sedge (*Isolepis prolifer*)
sundew (*Drosera trinervia*)
wire grass (*Aristida junciformis*)

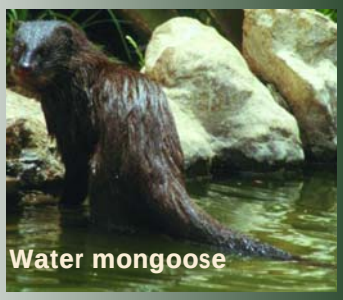
Other Flora of Interest in the Catchment

DAGGER-LEAF SUGARBUSH (*Protea mucronifolia*)
This protea is one of only two shale sugerbushes that occur on the shale soils of the lower Berg Catchment. Both proteas have ivory coloured flowers with pink tips and a sweet scent and are pollinated by wasps. In the Berg catchment, the *P. mucronifolia* occurs from Hermon to Saron, east of the Berg River. They are listed as vulnerable in the Red data book as they have been reduced by agriculture to one population of a few thousand plants. Most occur on a private nature reserve south of Voëlvlei Dam.

BLUSHING BRIDE (*Serruria florida*)
Courting young men during early settler days wore these flowers in their buttonholes to express an intent of honour and matrimony, causing the maiden to blush prettily. During these times the plant was rare and grew only in the Franschhoek Mountains. For 100 years it was thought to be extinct after a devastating fire. Later some plants were found in the high mountains and were cultivated and preserved in Kirstenbosch National Botanical Gardens. This plant is currently listed as vulnerable due to invasion of its habitat by pines and hakeas. A single population of about 1000 plants remains, in 6 to 8 stands of a few hundred plants each. This species has shown the important role of fire in fynbos ecology.

Fauna of the Berg River Catchment

Rivers and their riparian zones provide habitat and migration routes for many animals. Examples of animals that migrate along the rivers include: Cape clawless otter, water mongoose and bushpig. Plant seeds and propagules (e.g. mosses) are transported downstream on the flowing waters.


Water mongoose

WATER MONGOOSE (*Atilax paludinosus*)
The water mongoose is the only mammal to display a preference for open freshwater, as opposed to seeps and marshes. Water mongooses live amongst bulrushes and create runs and tunnels through thick vegetation along the river. Their droppings and prey remains indicate a liking for frogs, birds' eggs and small mammals.


Hippopotamus

HIPPOPOTAMUS (*Hippopotamus amphibius*)
Hippopotami were once widespread along the Berg River (see p. 12). They prefer open stretches of permanent water which are deep enough to allow them to submerge totally. Highly selective grazers, they can eat about 130 kg of green grass at a feed. Their food includes short grass, fallen fruits and other plants, as well as occasional aquatic vegetation.

SPECIALISED AQUATIC FAUNA OF THE BERG RIVER


Hydroptilid

The Berg River falls within the Cape Floristic Kingdom. Winter rainfall, fynbos and the underlying geology result in unique riverine fauna, particularly in the upper reaches which are poorly mineralised and acidic. These conditions have resulted in a highly specialised aquatic fauna, many of which are only found in the Western Cape. The uniqueness of the conditions and riverine fauna in the Berg River have led some scientists to propose that the Berg River should be considered a "living museum".

Recently a new genus of hydroptillid caddisfly, thought to be a Gondwanaland relic, was recorded in the Berg River.

FROGS AND TOADS

About 28 % of southern African frogs and toads occur in the fynbos biome. Some of the frogs in the Berg River include the giant rain frog (*Breviceps gibbosus*)and the montane marsh frog (*Poyntonia paludicola*).

The giant rain frog (top right) lives in the sandy flats between Stellenbosch, Cape Town and Piketberg. This species is listed as near endangered.

The recently discovered montane marsh frog (below right) is a very small, very warty fynbos endemic with attractive white or red stripes on its snout and is found at high altitudes in seeps and shallow water bodies.


Giant rain frog

Montane marsh frog


Cape galaxias


Cape kurper


Berg-Breede witvis


Berg River redfin

Freshwater Fish

Cape Floral Kingdom rivers have few fish species (19 indigenous fish species), of which 16 are endemic. Four indigenous fish species have been recorded in the Berg River system, the Berg River redfin (*Pseudobarbus burgi*), Cape galaxias (*Galaxias zebratus*), Cape kurper (*Sandelia capensis*) and Berg-Breede witvis (*Barbus andrewi*).

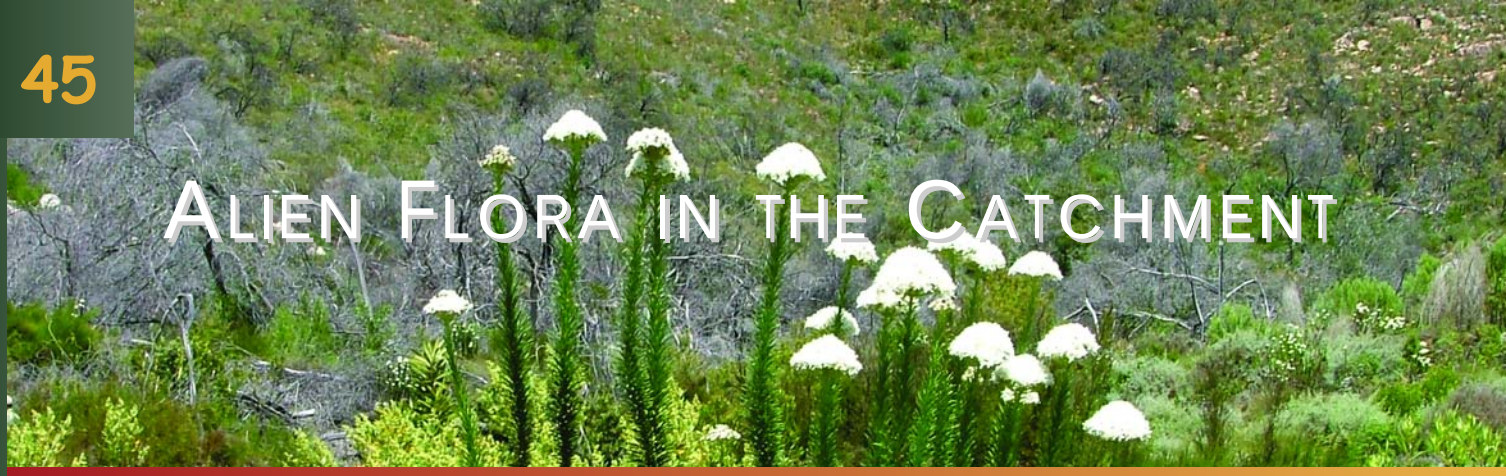
Indigenous fish in the Berg River mainstream and perennial tributaries were once naturally abundant. Historical descriptions provide a glimpse of the river near Groot Drakenstein: "Clean stony runs alternated with basins of large water-worn stones and long deep pools, fringed with palmiet rushes and overhanging trees and bush, silt beds being confined to the backwater. The bed was in splendid condition and the dire effect of soil erosion had not begun to appear. There was a large population of indigenous fishes. Shoals of witvis up to about 4 lb in weight, and rooivlerk minnows amounted to thousands of individuals. The Cape kurper lurked under all favourable stones or swam boldly in the open water, and the little galaxias haunted the marginal weedy areas" (Piscator,1934).

Today, witvis are extinct in the Berg River, the Berg River redfin is critically endangered, and the other two species mentioned above are near threatened. The upper reaches of the Berg River and a handful of tributaries are the last refuge areas where indigenous fish are still relatively abundant. A project to re-establish the witvis has recently been implemented by the WCNCB and conservation-minded farmers.

MAJOR IMPACTS & MANAGEMENT ACTIONS

Invasive alien fish, as well as reduced water quality, degraded riparian zones and extensive rates of abstraction have impacted severely on the indigenous fish populations in the Berg River system. Farming activities (levees, bulldozing) have destroyed much of the riparian zone of the mainstream and lower reaches of tributaries which provides shade, shelter and food for fish. Inappropriate use of fertilisers, pesticides and the transfer of inferior quality water from Theewaterskloof Dam into the Berg River (see p. 14) in summer have reduced water quality and negatively impact on indigenous fish. Excessive water abstraction from certain tributaries (e.g. Boesmans, Hugos, Dwars and Vier-en-Twintig rivers) further reduce habitat quality and diversity for smaller species. This results in repeated recruitment failure and the eventual localised extinction of indigenous fish.

The most important areas remaining for indigenous fish conservation are the upper Berg, Boesmans, Krom, Platkloof, Waterval and Wemmershoek rivers. Development in these catchments should ensure that habitat is retained, sufficient flow is provided and good water quality is maintained. No further stocking of alien fish into such areas should be allowed.



Alien Flora in the Catchment

Alien Flora

Invasion by alien plants poses one of the largest threats to the survival of the Fynbos Biome. At least 109 terrestrial alien plant species have been found in the fynbos. Rooikrans (*Acacia cyclops*) is the most extensive in the Strandveld while eucalypts (*Eucalyptus camaldulensis*), long-leafed wattle (*Acacia longifolia*) and black wattle (*Acacia mearnsii*) prevail along river courses. About 17 % of the natural vegetation between the Berg River catchment and False Bay is infested, with hakeas and pines infesting the mountains, and thicket forming aliens (e.g. black wattle) infesting the lowland areas.

In 1998, alien vegetation infestation in the Berg River catchment was estimated to be 101 882 ha, or 11.5 % of the total catchment area. Working for Water has cleared a "condensed area" of about 6 507 ha of alien vegetation within the Berg Water Management Area (surface area of 1.3 million ha, including the Berg River catchment and Cape Town). This clearing is calculated to provide an additional 5 million cubic metres per annum of water to the environment and potentially to water users.

There remains an urgent need to clear the extensive stands of eucalypts lining the Berg River near Paarl. Each mature plant has been calculated to utilise 250 litres of water per day. Its control would increase the water in the Berg River considerably.

Rooikrans

black wattle

black wattle

WATER HYACINTH (*Eichornia crassipes*)

Water hyacinth grows in dense mats in dams and slow-flowing rivers. Imported from tropical South America as an ornamental plant, this weed has found its way into many of our rivers where it can double its mass every four days under ideal warm and eutrophic conditions. Dense mats prevent recreational activities (e.g. Berg River Canoe marathon), disrupt water flow, block water infrastructure, reduce water availability and reduce habitat suitability for aquatic biota. Dense mats can also smother indigenous vegetation leaving bare patches which are highly prone to erosion. The recommended method of removal of this weed is mechanically or by hand, although herbicides or biocontrol methods are generally used.

Water hyacinth

Alien Fauna in the Catchment

Alien Fish

Rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) were introduced into the Berg River mainstream during the early 1900's by anglers. Other invasive alien species stocked into the river later were largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieu*), carp (*Cyprinus carpio*), banded tilapia (*Tilapia sparrmanii*), Mozambique tilapia (*Oreochromis mossambicus*) and bluegill sunfish (*Lepomis macrochirus*).

During recent years, anglers illegally stocked sharptooth catfish (*Clarias gariepinus*) into the river. These now dominate the fish community of the mainstem and may be replacing the alien basses. Alien fish impact on indigenous fish in three ways,

- they prey on them (e.g. smallmouth bass),
- they compete with them for food (e.g. banded and Mozambique tilapia), or
- they degrade their habitat (e.g. carp).

GREY SQUIRREL (*Sciurus carolinensis*)

The grey squirrel, originally from North America, was introduced to the Western Cape around 1900 via England by Cecil John Rhodes. The squirrel spread rapidly from Cape Town and are now common throughout the Boland and the Peninsula. Acorns and pine seeds form their staple diet, followed by pine nuts, vegetables and deciduous fruits (almonds, grapes, peaches). The squirrel is invasive, especially in alien tree plantations and urban areas, where the invasion of riparian vegetation by the oak (*Quercus robur*) is positively correlated with the distribution range of the grey squirrel. The squirrel is, however, not considered a serious ecological or agricultural problem.

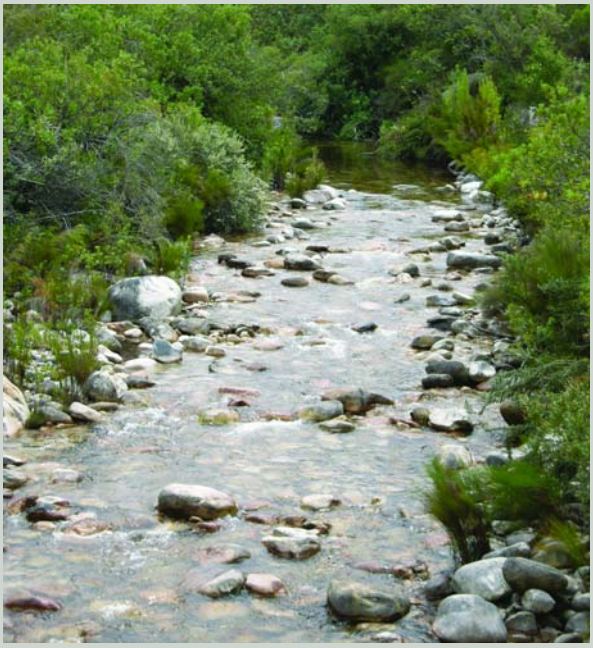
Protecting Indigenous Fauna & Flora

What Can We Do to Protect & Conserve our Rivers?

Join a clearing or hack group and encourage others to become involved

Remove alien plants from rivers and their catchment in co-operation with local authorities

Buy products made by alien clearing programmes (firewood, crafts, furniture, mulch)



Inform authorities about the location of invasive alien plants and fish

Protect natural species by not buying and introducing alien fauna and flora into rivers

Obtain permission from conservation authorities before stocking rivers and dams with fish

Protect best areas for river and fish conservation by establishing conservancies

Plant indigenous vegetation to control erosion of river banks and improve biodiversity

How to Get Involved

New legislation 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 of objectives for a catchment. The active cooperation of water users is of the utmost importance in maintaining a healthy environment.

Remove alien plant material from river banks as this could clog up the river

Minimize disturbance to the river

Improve agricultural and forestry practices, prevent erosion & reduce fertilizer and pesticide usage

Request permission to modify river banks, sink boreholes in riparian zones or to build dams on rivers

Avoid straightening river channels and smoothing riverbeds

Water is precious - use it sparingly and wisely!

Avoid dumping litter, garbage, pesticides or building rubble on river banks and in rivers

Who to Consult

Consult local offices at Cape Nature (Tel: 021-866 8000), Department of Water Affairs and Forestry (Tel: 021-950 7100, Regional Office: Bellville), Department of Environmental Affairs and Development Planning (Tel: 021-483 4282) and where applicable the City of Cape Town (Tel: 021-487 2205) or other District Municipalities for guidance regarding river and catchment issues. They are there to help you.

GLOSSARY

Alien species Fauna and flora introduced intentionally or by accident from other countries. Not all alien species are invasive.

Biodiversity The variety and variability among living organisms and the ecological complexes in which they occur.

Biota refers to the community of plants and animals .

Desired health An indication of the envisioned ecological state of the river and is determined by considering the ecological importance and sensitivity of the specific river ecosystems.

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

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

Ecological Reserve The quality and quantity of water that is required to protect the aquatic ecosystems of a water resource.

Environmental Impact Assessment Investigates the actual and potential impacts of the proposed action or development on an area.

Euryhaline Able to tolerate a wide range of degrees of salinity.

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

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

Gross Geographic Product (GGP) The total value of all final goods and services produced within the economy in a geographic area for a given period.

Gross Domestic Product (GDP) The total market value of all final goods and services produced in a country for a given period.

Harvest potential is the maximum volume of groundwater that can be abstracted per square kilometre per annum, without depleting an aquifer.

Indigenous species Fauna and flora occurring naturally in an area.

Instream refers to “within the river channel”.

MAP (Mean Annual Precipitation) Average rainfall (including snow, hail and fog condensation) over a year.

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

nMAR (natural Mean Annual Runoff) Average yearly available stream flow at a point in the river, calculated over a long period of time (usually 50 years or more), in undeveloped conditions.

Marginal vegetation refers to plants growing at the edge of the river.

Present health A measure of the present ecological state of the river during the time of the survey. This is expressed as a river health category which reflects how much the river has changed from its natural state.

Riparian habitat refers to the habitat on the river bank.

Riparian zone The area adjacent to a river or water body that forms part of the river ecosystem. The riparian zone plays an essential role in the functioning of the river ecosystem. It is characterized by frequent inundation or sufficient flooding to support vegetation distinct from the surrounding area.

Runoff Runoff is water flowing over the surface of a catchment.

spp. Abbreviation after a genus name denoting that several species belonging to the genus are being referred to. Species (sp.) refers to the unit of biological classification and diversity.

Further Reading

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Web pages to explore are:
City of Cape Town: www.capetown.gov.za
Department of Water Affairs and Forestry: www.dwaf.gov.za
Department of Environment Affairs and Tourism: www.environment.gov.za
Cape Nature: www.capenature.org.za
TCTA: www.tcta-metsi.com
Working for Water: www-dwaf.pwv.gov.za/wfw
Berg River Baseline Monitoring: www.dwaf.gov.za/Projects/BergRiver

Department of Water Affairs and Forestry
Department of Environmental Affairs and Tourism

Water Research Commission

CapeNature

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http://www.csir.co.za/rhp/