

## WILDERNESS LAKES

1. COUNTRY

SOUTH AFRICA

2. DATE OF COMPILATION

JANUARY 1990

3. REFERENCE NUMBER 1 ZA 008

4. COMPILER

Dr. RM Randall  
National Parks Board  
P O Box 774  
GEORGE  
6530  
South Africa

TELEPHONE NUMBER: CODE: 04455 NUMBER: 31302

5. NAME OF WETLAND

Wilderness lakes

6. DATE OF RAMSAR DESIGNATION

1991/06/27

7. GEOGRAPHICAL CO-ORDINATES

33°59' S

22°40' E

8. GENERAL LOCATION

Wilderness : 0 km West  
George : 14 km West  
Sedgefield : 4 km East  
Knysna : 30 km East

North boundary : Approximately, railway line on edge of floodplain and lower reaches of Duiwe River

South boundary : Edge of the floodplain (c.5m contour)

East boundary : Swartvlei Lake

West boundary : Touw River mouth at town of Wilderness

9. AREA (ha)

1300 ha

## 10. WETLAND TYPE

F, J, Q

## 11. ALTITUDE

MIN: 1 m MAX: 200 m

## 12. OVERVIEW OF SITE

The Wilderness Lakes are a series of interconnected coastal lakes, parallel to the coastline, that are linked to an estuary and lagoon that opens periodically to the sea. Seawards of the wetland is an old consolidated dune which is vegetated with coastal fynbos and dune thicket, while inland of the wetland is a steep slope rising to a plateau. The slope is densely vegetated with coastal forest and bush.

## 13. PHYSICAL FEATURES

### 13.1 Geology and geomorphology

The lakes are situated on sands and alluvium of Pleistocene and Recent age against a back-drop of steep Tertiary-age sea cliffs on the north side and Pleistocene-age fossil dunes on the south side.

### 13.2 Origins

The system in its present form is thought to have formed about 7000 years ago. Between 45000 and 10000 years ago, during the periods of glaciation in the northern hemisphere, the sea alternately covered the entire area of the Wilderness Lakes to the base of the cliffs of the Tertiary-age uplands during warm periods, and then receded with the formation of the northern ice-caps. Then, with the end of the northern hemisphere glaciation, strong coastal winds associated with increased land temperatures led to the formation of coastal dunes. The dunes blocked the estuaries which resulted in basins forming inland of the dunes, and these lakes or barrier lagoons occasionally broke through to the sea. The Wilderness Lakes have been formed by the segmentation of an earlier lagoon.

### 13.3 Hydrology

The hydrology of the lakes is dominated by the flooding of the Touw and Duiwe Rivers when the mouth of the estuary is closed and by tidal influence when the mouth is open. The upper lakes are filled by reverse flow, where water from the Touw and to a lesser extent the Duiwe River flows back via the lower lakes and channels. This is especially the case when the mouth of the estuary is closed, and the process serves to ameliorate the effects of floods in the Touw River estuary. The sand sill at the mouth of the estuary has to be artificially maintained to

prevent flooding of properties in low lying areas near the mouth, and for the same reason the mouth has to be opened. The estuary closes naturally under the influence of longshore drift and deposition of marine sediments in the mouth.

#### 13.4 Soil type and chemistry

Most of the floodplain is covered in a dark alluvium which is rich in organic matter. The dunes and higherlying areas have a loose sandy soil with a low humus content.

#### 13.5 Water quality

Surface temperatures range between 10 and 27°C. Salinity in the lakes varies between 2 and 16 ppt, with the highest values in Rondevlei, whereas in the estuary it varies between 0 and 25 ppt. The variability in salinity depends on floods and whether the mouth is open. Approximate average values for parameters measured are as follows: salinity = 10 ppt, dissolved oxygen = 7 mg/l and pH = 8. Nitrate and phosphate levels are well below those associated with eutrophication. Inflowing streams are the most important sources of both inorganic nitrogen and phosphorus. Occasional elevated levels of soluble reactive phosphorus appeared to be associated with large numbers of water birds. Chlorophyll values follow the pattern of that for phosphate, occasionally reaching values as high as  $37 \times 10^{-6}$  g/l but decreasing to average levels ( $3 \times 10^{-6}$  g/l) soon after, unlike in true eutrophic waters.

#### 13.6 Depth, fluctuations and permanence

The maximum depths of the different waterbodies are as follows: Touw River = 3m, Eilandvlei = 4m, Langvlei = 3m and Rondevlei = 4m (See Figure 2). The waterbodies are permanent and fluctuations in levels are within narrow limits. The flood levels for 5 and 100 year floods for the different parts of the system are as follows: Touw River 1.7m and 3.15m, Eilandvlei 1.2m and 1.85m, and Langvlei/Rondevlei 0.5m and 1.35m respectively.

#### 13.7 Tidal variations

Highest Astronomical Tide	2,31
Lowest Astronomical Tide	0,11
Mean High Water Springs	1,96
Mean Low Water Springs	0,36
Mean High Water Neaps	1,43
Mean Low Water Neaps	0,90
Mean Level	1,16

#### 13.8 Catchment area

The catchment areas of the two rivers are as follows: Touw River =  $101 \text{ km}^2$  and Duiwe River =  $34 \text{ km}^2$ .

### 13.9 Downstream area

The Indian Ocean, but sometimes it is closed to the sea.

### 13.10 Climate

The lowest average temperature is 10,0° C and the highest average temperature is 22,9° C. The relative humidity varies from 41% - 93%. The average rainfall is 770 mm and is not in a specific season.

## 14. ECOLOGICAL FEATURES

About 320 species of plants have been identified from the Wilderness Lakes and immediate surroundings. Three easily identifiable vegetation components exist at the Wilderness lakes, and a fourth above the 5 m contour above mean sea level (a.m.s.l.) outside the area to the north. These four components are: 1. aquatic, 2. semi-aquatic, 3. coastal fynbos and 4. forest.

## 15. LAND TENURE

The National Parks Board manages the entire wetland on behalf of the state according to the provisions of the National Parks Act.

The surrounding areas are privately owned. In the catchments other state land is declared State Forest and administered by the Department of Water Affairs and Forestry.

## 16. CONSERVATION MEASURES TAKEN

### 16.1 Legal status

The entire area falls within the Wilderness National Park which was proclaimed on ..... The contiguous Lakes Nature Reserve, comprising Rondevlei and surrounding land (212 ha), was added in 1992. A conceptual master plan was devised in 1985 and is currently being updated and substantially enlarged.

### 16.2 Management category

National Park (IUCN Category II)

### 16.3 Management practices

Several of the management activities conducted elsewhere in the system indirectly have an impact on the Wilderness lakes area. An example of this is the manipulation of water levels that is undertaken at the estuary mouth.

Water levels:

The control of water levels is probably the most significant management practice in terms of impact on the ecology. Management actions in this field are based on recommendations contained in reports incorporating a hydrodynamic model of the entire Touw River system.

#### **Flood control:**

The Touw River mouth periodically closes and a sill then gradually builds up by deposition of sand with a marine origin transported by longshore drift. If left to function naturally water levels rise prior to breaking through the sill and this causes flooding of residential properties that were unwisely built in low-lying areas in the mouth area. (No further building in low-lying areas is permitted). In the interests of the ecology of the system water levels should be allowed to approximate the natural regime as closely as possible and extremes should not be dampened. Unfortunately the flooding of residential properties precludes this, so artificial manipulation of the mouth is necessary.

The small catchment of the Touw River results in peak discharge after about seven hours giving little reaction time in the event of major downpours. Through measurements and a hydrodynamic model, a 1:50 year flood was simulated which revealed that by keeping the sill at about 2.1 m a.m.s.l. flooding of these properties could be prevented. Consequently present policy is to skim the sill to a height of 2.1 m a.m.s.l. with a tractor (Figure 2).

#### **Dredging:**

Minor floods in the Touw River system are accommodated by reverse flow into the lakes system via the Serpentine. This is also the source of most of the water in the lakes. For both of these reasons the connecting channels between the lakes are of considerable significance and are therefore dredged to facilitate flow, but not so deep as to cause major dry-downs. The connections that are dredged are the Eilandvlei/Langvlei and Langvlei/Rondevlei channels.

An added reason for the maintenance of the channels is to facilitate the movements of fish, notably those with a marine phase in their lives.

#### **Clearing of macrophytes:**

The connecting channels become overgrown with both submerged and emergent macrophytes, which in turn exacerbates the siltation and flooding problems. Consequently it is management policy to cut macrophytes and clear them from the two channels.

#### **Sluice operation:**

The deepening and clearing of interconnecting channels increases inflow but also increases outflow when the mouth is open, thereby causing the system to drain. The upper lake levels are then determined by the levels of the interconnecting channels, and to prevent excessive draining a sluice was installed on the Serpentine. The theory behind the sluice operation is that it is kept open when the mouth is closed and is shut when the mouth is open. The sluice could seriously restrict recruitment of juvenile fish when it is shut so allowance is made some water to pass through, thereby enabling fish to move upstream.

#### **Invasive aliens:**

Over 35 alien (i.e. exotic) plant species have been identified in the WNP and immediate surroundings. The great majority are terrestrial plants occurring on the floodplain and fynbos areas.

Some (e.g. rooikrans *Acacia cyclops*, sesbania *Sesbania punicca*, and stinkbean *Albizia lophantha*) are invasive woody species that pose a threat to the indigenous flora. These plants are controlled by mechanical means at present and there is also the possibility of using biological control.

#### **17. CONSERVATION MEASURES PROPOSED**

Virtually all conservation measures proposed have been implemented and those suggested below will depend upon the results of research projects to determine their desirability and the extent of action that should be taken.

#### **Water levels:**

The continued manipulation of water levels is inevitable using the present approach. Based on experience gained over several years of operation there is evidence to indicate that the sluice has not functioned as expected and may in fact not be necessary, except under extreme circumstances. In view of its likely detrimental impact on fish migration and recruitment to the upper lakes it is important that the need for the sluice be reassessed. In the interim its operation should cease and the situation should be monitored.

There is an increasing realization that extremes and disturbances in ecological systems are desirable as part of the natural process. Presently there is a tendency in the WNP to manage the system to damp extremes in water levels. It is no longer possible to permit high water levels to develop but occasional dry-down may be ecologically desirable. This requires research and careful monitoring should it be implemented.

Whenever possible, artificial opening of the mouth should be restricted to the spring and summer months when maximum recruitment of fish stocks from the sea occurs. An added benefit

of this timing is that in the mouth-open phase the upper floodplain drains, exposing sand banks on which the summer migrant waders feed.

#### Alien organisms:

The removal of alien plants must be continued and expanded to include more species. Concern has been expressed about the invasion by alien grass species, such as *Paspalum vaginatum* and kikuyu *Pennisetum clandestinum*, on the sand- and mud-flats which are alleged to be rendered unsuitable for wading birds. The situation needs to be researched, and if desirable, measures devised and implemented for the removal of these grasses.

#### Enlargement of area

There is a dire need to enlarge the area, particularly those parts of the flood plain in private ownership, and that are being cultivated.

### 18. LAND USE

In the area immediately surrounding the Wilderness lakes the dominant form of land use is agriculture. This takes the form of low intensity cultivation on a few small-holdings and low intensity stock farming using cattle for meat production and dairying. The next most important forms of land use are exotic plantations of pines *Pinus pinaster* grown for timber. There is also a rapidly increasing number of cottages on small-holdings, some are occupied permanently and others only in the summer holiday season.

In a wider surrounding area the land use is basically similar except that there are several holiday resorts and more residential properties.

The constraints listed below apply specifically to the Wilderness lake area but several are also applicable to the wider WNP.

### 19. DISTURBANCES AND THREATS

#### 19.1 AGRICULTURE:

##### Abstraction:

The increasing use of pumps and dams in the catchment reduces the amount of water entering the lakes and poses the single greatest threat to the lakes.

##### Eutrophication:

The catchment of the Duiwe River which enters the eastern end of Eilandvlei near Langvlei is highly developed agriculturally. This appears to be an important source of nitrate and phosphate that could lead to eutrophication. Until recently eutrophic conditions have been of short duration, but increased inputs from the Duiwe River catchment could cause longer-term eutrophic conditions with consequent water quality problems.

#### Suspensoids:

A more serious problem is suspensoids carried down the Duiwe River during floods. The problem is a reflection of poor farming practices in the catchment and the degree of deforestation. Siltation of the channels and lakes is the primary threat at present but an adverse effect following floods is a reduction in water clarity.

#### Pesticides:

Tissue samples of fish and water birds from the lakes were found to have very low residue levels of chlorinated hydrocarbon insecticides (DDT and its metabolites and Dieldrin) and polychlorinated biphenyls (PCBs). A later study of African marsh harriers Circus ranivorus revealed residue levels of DDE and Dieldrin that could produce reproductive impairment. African marsh harriers are residents and although they hunt over a wider area than the floodplain it is apparent that there is a source of pesticides in the area.

#### Deforestation:

Deforestation in surrounding areas to provide agricultural land is leading to increasing fragmentation of the natural vegetation and thus indirectly to the fauna.

### 19.2 DEVELOPMENTS:

No further development on the floodplain below the 1:50 year and ideally 1:100 year floodline should occur. This relates to structures, notably permanent structures, but exceptions could be made for structures such as bird hides.

No further roads should be constructed on the floodplain and some existing roads could be deproclaimed to reduce traffic.

No further bridges across connecting channels should be permitted nor should existing ones be widened. Bridges should only be modified (e.g. changing the height of the bottom of the culvert) if research has indicated that changes are desirable.

The natural beauty of the area coupled with its uniqueness make it very attractive as a holiday destination and retirement centre. A result is escalating prices of real estate which in turn is making it increasingly difficult to acquire additional land for incorporation into the WNP.



Private housing developments and facilities for tourism are posing an increasing threat to the aesthetic beauty of the lakes and surroundings. This has led to calls for vetting the design of new structures to ensure they blend in.

#### Activities:

In the development of walking/hiking trails caution should be exercised to ensure that the siting of the trail is not ecologically and aesthetically detrimental.

Groups sizes and general carrying capacity of trails will have to be worked out with appropriate research. It may prove necessary to limit use of trails in certain areas or at certain times.

The ecological implications of a proposed canoe trail through Langvlei and Rondevlei should be thoroughly investigated before it is implemented. Of particular concern is the impact of disturbance on waterbirds, especially when they are breeding. It may be found desirable to limit activity to certain areas and to certain periods if the canoe trail is to proceed.

### 19.3 AQUACULTURE:

#### Alien organisms:

Alien organisms enter the system when they escape from farm dams or when dams break during floods. It is believed that Mozambique tilapia entered the lakes in this manner. There is concern that aquaculture on private land using the alien freshwater crayfish or marron *Cherax tenuimanus* could lead to contamination in this fashion.

### 20. HYDROLOGICAL AND BIOPHYSICAL VALUES

### 21. SOCIAL AND CULTURAL VALUES

#### Current

Principal social values are those of ecotourism, outdoor recreation, education, scientific research and flood control - presently none are significantly detrimental to ecological processes. In the immediate surroundings residential, retirement and holiday housing and small-scale agriculture - increasingly detrimental to aesthetic beauty, natural vegetation and fauna.

#### History

The history of the area is poorly documented and scattered in various narratives, often as anecdotal accounts. Prior to the arrival of the first westerners the area was inhabited by Khoisan peoples, some of whom possibly had cattle. It is known

that groups of Khoi at Mossel Bay (460 km west of the Lakes) had large herds of cattle and sheep. In the surrounding areas there were groups of San hunter-gatherers.

The first groups of people of negroid descent appear to have entered the area in about 1802.

The first westerners to see the area were Portuguese mariners on exploratory voyages and the first of these was Dias in 1488. They landed on the coast near the Lakes but did not venture inland. About 200 years later staff of the Dutch East India Company (VOC), carried out exploratory visits but only some 100 years later were outposts established, primarily for harvesting the indigenous woods. On account of inaccessibility the area remained largely isolated even into the 1800s when there was a gradual increase in settlement, primarily for the purposes of farming. Following the completion of the road in 1883 the Wilderness Lakes became more accessible. A railway line was completed in 1928 and a coastal tarred road was built in 1948.

The initial settlers were wood cutters, followed by farmers (cattle farmers and limited cultivation) and latterly the area has become as a holiday resort and retirement area.

#### Archaeology:

There are no archaeological sites known on the floodplain of the Wilderness lakes area, but there are two sites in the forest above the lakes. These are the Oakhurst shelter and the Glentyre shelter about 400 m from Eilandvlei. The sites are of similar age, extending from about 12 000 years B.P. to very recent. Remains of mammals like hippopotamus *Hippopotamus amphibius*, buffalo *Syncerus caffer*, bushpig *Potamochoerus porcus* and zebra *Equus* sp. amongst others were excavated at the Glentyre shelter.

There are also so called "Strandloper middens" in the area. These are essentially piles of molluscs, mostly bivalves, that accumulated where coastal Khoi people worked food collected in the intertidal zone of the seashore. The upper date of these middens is about A.C. 1 800.

#### Palaeontology:

There are no palaeontological deposits known within the area of the Wilderness lakes.

## 22. NOTEWORTHY FAUNA

For convenience the fauna is divided into two broad categories, viz. aquatic and terrestrial.

#### AQUATIC:

The aquatic component has received the bulk of the research effort and is better documented and understood.

## Invertebrates:

The zooplankton fauna is dominated by typical estuarine species that rely on a marine link and higher salinities for their existence. Copepods (eg. *Acartia natalensis* and *Pseudodiaptomus hessei*) and larvae of the bivalve *Musculus virgiliae* are the dominant species in the zooplankton. Freshwater organisms (eg. Cladocera) are washed down into the system following rainfall in the catchment area and marine species enter the estuary when the mouth is open to the sea. Measurements of standing crop in daytime showed that Langvlei had the greatest biomass, followed by Rondevlei and Eilandvlei.

Macrionvertebrates of the lakes are essentially estuarine and require a marine link. Dominant species are amphipods (*Corophium triaenonyx*, *Grandidierella lignorum* and *Melita zeylanica*), isopods (*Exosphaeroma hylecoetes*, *Cyathura estuaria*), bivalve (*Musculus virgiliae*), polychaete (*Ficopomatus enigmatica*), crab (*Hymenosoma orbiculare*) and prawn (*Callinassa kraussi*). Chironomidae are the most important freshwater group. All of these invertebrates feed predominantly on detritus, consequently submerged macrophytes are vital to them as a source of detritus and for some as attachment sites.

## Fish:

The fish fauna is dominated by euryhaline marine migratory species and the diversity is low (32 spp). The diversity is greatest near the Touw River mouth (23 spp) and decreases towards Rondevlei (12 spp). With nine exceptions fish species occurring in the Wilderness Lakes System have a marine phase in their life cycle. The most abundant of these exceptions are estuarine round herring *Gilchristella aesturius*, Cape silverside *Atherina breviceps*, both estuarine species, and Mozambique tilapia *Oreochromis mossambicus*, an introduced freshwater cichlid. The euryhaline marine species enter the estuary as juveniles. They migrate up into the lakes, which function as nursery areas, and mature, before they return to the sea again to spawn. The most abundant examples of this group are mullets (eg. *Liza richardsonii*, *L. dumerilii*, *Mugil cephalus*), sparids (*Rhabdosargus holubi*, *Lithognathus lithognathus*, *Pomadourys commersonnii*) and soles (*Heteromycteris capensis*).

Of the dominant fish fauna mullets and Mozambique tilapia are detritivores; estuarine round-herring, Cape silverside and white steenbras *L. lithognathus* feed on invertebrates; Cape stumpnose *R. holubi* feeds on invertebrates and aquatic plants; leervis *Lichia amia* is the only fish predator.

Most juvenile fish recruitment occurs during the austral summer. The extent of the recruitment was demonstrated in February 1984 during a mouth-open phase when 52 000 fish were estimated to have migrated up the Serpentine to the lakes.

## Avifauna:

Some 57 species of "waterfowl" (defined as any of the taxa Accipitriformes, Podicipedidae, Pelecanidae, Phalacrocoracidae, Ciconiiformes, Anatidae, Falconiformes, Sternidae, Charadriidae) or 72 species of "waterbirds" (defined by Boshoff & Palmer 1990 as non-passerines relying entirely on permanently or temporally inundated or semi-inundated areas) have been identified at the Wilderness lakes (Table 1).

The number of waterfowl fluctuates considerably from year to year on account of water conditions (eg. some species such as Cape shoveller *Anas smithii* and the other dabbling ducks prefer low water levels) and from season to season on account of migration (there is an influx of Palaearctic migrants in summer and local migrants at various times through the year). From counts in 1983 and 1984 maximum numbers counted and average numbers, which underestimate the migrants, yielded figures of about 23 000 and 10 500 waterbirds respectively.

There are two species of waterfowl occurring at the Wilderness lakes that are classified as Rare. One of these is the little bittern *Ixobrychus minutus payesii* which appears to be a resident as immatures have been seen at Rondevlei and these are records from all months of the year. There are thought to be less than 100 breeding pairs in South Africa.

The second Rare species is the Caspian tern *Hydroprogne caspia* that occurs as an irregular non-breeding visitor with less than five together at any one time. There are thought to be about 150 breeding pairs in South Africa.

There are significantly large populations of two duck species. At times 5 % of the total population of Cape shovellers and 3 % of the South African population of Yellowbilled duck *Anas undulata* occur at the Wilderness lakes. The Cape shoveller is a Southern African endemic that is regarded as potentially the most vulnerable of the waterfowl species on account of its restricted range, small population and specialized habitat and feeding requirements.

The lakes appear to function as a valuable refuge out of the breeding season for some species of waterfowl (eg. blacknecked grebe *Podiceps nigricollis*, darter *Anhinga melanogaster*) that breed inland at annual pans and small waterbodies which tend to dry up periodically. There is also evidence to suggest that the lakes are used by several species of the Anseriformes (eg. spurwinged goose *Plectropterus gambensis*, Egyptian goose *Alopochen aegypticus*, yellowbilled duck, Southern Pochard *Netta erythroptalma*) as a stopover point on their moult migration.

## TERRESTRIAL

Comparatively little research has been undertaken on the terrestrial fauna.

## Invertebrates:

Representatives of nine of the ten families of butterflies (Lepidoptera) that occur in Southern Africa have been identified on the floodplains and immediate surroundings. In all, 48 species have been identified from the area. None of these is recognized as Rare, Threatened or Endangered.

## Avifauna:

Apart from waterbirds about 170 species of birds have been recorded for the floodplain and the surrounding area. One of these, the grass owl *Tyto capensis*, is known to breed on the floodplain. The species is decreasing in number and the southern Cape population is becoming increasingly isolated. The status of the species is described as "Indeterminate" as there is insufficient information available, but it will probably rank as Rare.

## Mammals:

Bushbuck *Tragelaphus scriptus* still occur in the forest on the slopes just north of the lakes and bontebok *Damaliscus dorcas dorcas* have been introduced to the coastal fynbos near Rondevlei, but otherwise there are no large mammals in the area. A surprising variety of small carnivores are present: caracal *Caracal caracal*, large-spotted genet *Genetta tigrina*, white-tailed mongoose *Ichneumia albicauda*, large grey mongoose *Herpestes ichneumon*, Cape grey mongoose *H. pulverulentus*, water mongoose *Atilax paludinosus*, Cape clawless otter *Aonyx capensis*. Limited surveys of small mammals showed that there are vlei rats *Otomys irroratus*, striped mice *Rhabdomys pumilio*, red musk shrews *Crocidura flavescens* and forest shrews *Myosorex varius*, on the floodplain. Cape dune mole rats *Bathyergus suillus* occur on the coastal fynbos where they are regarded as important in maintaining the plant communities through their disturbance and activity.

## 23. NOTEWORTHY FLORA

The vegetation (aquatic and terrestrial) of the lakes and the surrounding area has been studied in some depth and there are a number of publications including annotated checklists, vegetation maps, biomass and production estimates.

About 320 species of plants have been identified from the Wilderness Lakes and immediate surroundings. Three easily identifiable vegetation components exist at the Wilderness lakes, and a fourth above the 5 m contour a.m.s.l. on the northern side.

### 23.1 Aquatic:

The surface waters of the Wilderness lakes have clear open water in the central areas and fringing beds of macrophytes in the littoral zone. For convenience the macrophytes can be separated into submerged and emergent units.

The dominant submerged macrophytes of the Wilderness lakes are *Ruppia cirrhosa*, *Potamogeton pectinatus* and Characeae (e.g. *Chara globularis*, *Lamprothamunium papulosum*). The biomass of submerged macrophytes varies greatly from year to year; for example virtually the entire lake bottom of Langvlei was covered by Characeae in 1975 but this died off almost completely by 1978 following a dinoflagellate bloom which dramatically reduced water clarity. The submerged macrophytes carry most of the zoobenthos and are vital to the system on account of their organic matter production, via particulate-feeding invertebrates, to the detritus food web. Furthermore the submerged macrophytes are important attachment sites for suspension-feeding invertebrates.

The dominant species of emergent macrophytes are reeds *Phragmites australis*, bulrushes *Typha latifolia* and sedges *Scirpus litoralis*. Reeds and bulrushes undergo seasonal fluctuations in biomass, but there is comparatively little year to year change. Emergent macrophytes produce over 80 % of the organic matter and, although only a portion of this enters the lakes as detritus, they are important to macroinvertebrates feeding on detritus.

### 23.2 Semi-aquatic:

This vegetation unit occurs on the low-lying areas of the floodplain adjacent to the lakes and channels, where it is subject to inundation at high water levels. Dominant species are rushes *Juncus kraussii* and sedges Cyperaceae. In slightly higher-lying areas the rushes and sedges are bordered by buffalo grass *Stenotaphrum secundatum*. Plants growing in this area are tolerant of short-term fluctuations in water levels, but sensitive to long-term alterations in water supply.

### 23.3 Coastal fynbos: (coastal macchia)

Coastal fynbos is confined to the slightly higher-lying areas bordering the floodplain. This vegetation unit grows on well-drained sandy soils and is regarded as a variant of dune fynbos. Relative to other fynbos types it contains a strong component of shrubs and trees which indicates that fires do not occur regularly. Dominant shrubs are *Metalasia muricata*, *Passerina* spp. and *Rhus* spp., and there is a large number and variety of fynbos annual herbs.

A mixture of coastal fynbos and dune forest is present on the old dunes to the south of the lakes.

### 23.4 Forest:

Evergreen forest with a closed canopy occurs immediately to the north of the lakes on the south-facing slopes of Tertiary-age sea cliffs and at places extend to within 300 m of Langvlei. These forests have a very high species diversity of woody plants in comparison with other forest types in the area, and also more creepers, geophytes, herbs and grass-like plants but fewer epiphytes and ferns.

There are as yet no recognized Rare, Threatened or Endangered plant species in the area, but there are some endemics in the coastal fynbos component that have very specialized habitat requirements. These include *Satyrium princeps*, *Gladiolus vaginatus* and two species that remain to be described, viz. *Silene* sp. nov. and *Herschelianthe* sp. nov. Further research on these plants is required but is likely that most, if not all of them, will be found to qualify for one of the three categories.

#### 24. SCIENTIFIC RESEARCH FACILITIES

The National Parks Board has an aquatic biologist stationed at the Regional Centre of the Scientific Services Section at Rondevlei whose main responsibility is conducting the monitoring programme for the Wilderness National Park. A further responsibility is to undertake research relevant to the management of the Wilderness National Park. Some of the research projects include the following:

1. Sedimentation in the lower estuary in relation to management activities.
2. Reassessment of the impact of the sluice, other constrictions and general management on fish populations.
3. Basic inventories of such faunal components as amphibians, reptiles and small mammals;
4. Investigate disturbance of waterbirds by boating activities, notably canoeing.

The Rondevlei Regional Centre has laboratories where water quality analyses are undertaken, as well as general laboratories, offices, computer facilities (including GIS). Vehicles, boats and sampling gear are also located at the centre. A university researcher is also working there while undertaking a study of trivers and streams in the catchment.

#### 25. CONSERVATION EDUCATION

The area is suitable for environment education programmes and low-key programmes during peak tourist periods are already in progress. These take the form of guided tours on foot by a fully qualified Information Officer of the National Parks Board.

Present facilities are inadequate for environmental education programmes but there is also a passive education programme in the form of displays, labelled plant samples, etc. Brochures incorporating maps and depicting the zoning are available.

Present facilities are inadequate for environmental education programmes but there are plans to establish an information centre in an old building which will be properly renovated. This will ensure continuity, more comprehensive displays and better information. Above all, it will then be possible to run environmental education programmes in situ.

The majority of conservation/ management staff of the National Parks Board responsible for law enforcement are required to have bachelor degrees, and preferably post graduate degrees. They are expected to perform the role of extension officers and to educate rather than prosecute.

## 26. RECREATION AND TOURISM

The WNP and surrounding area is a popular tourist destination. It experiences a short summer season of high activity but has the potential for a more extended period of activity. The major forms of recreational activity are water related. In view of the pressure from various interest groups the WNP has been zoned for different activities.

### Zoning:

Zoning of the WNP has been planned to accommodate high, medium and low intensities of activity. The high intensity areas are: the Touw River lagoon and most of the estuary as well as most of Eilandvlei. The medium intensity areas are the upper Touw river estuary and the Serpentine. The low intensity areas are the Eilandvlei/Langvlei channel, Langvlei/Rondevlei channel and Rondevlei. (Figure 1)

### Boating:

In the high intensity zone most forms of boating are permitted, whereas in the medium intensity zone only canoeing is allowed and in the low intensity zone no boating is permitted.

### Fishing:

Fishing with hook and line only is permitted, and then only in the high intensity zone.

### Swimming:

Swimming is permitted in demarcated areas only in the high intensity zone.

### Walking/hiking:



Hiking/walking trails have been laid out in the Touw River/Serpentine area on the floodplain, in the forest above Eilandvlei and in the fynbos area north of Rondevlei. A board walk of 1 km has been constructed in the north shore of the Touw River lagoon. There is a possibility of a further walking/hiking trail being laid out on the flood plain near Langvlei and Rondevlei.

#### Birding:

Birders have access to hides at Rondevlei and Langvlei and there are numerous points on the water between the Touw River and Langvlei for birding. The construction of more bird hides for Langvlei and Rondevlei is planned.

#### Picnicking:

Apart from the camping sites there are several points in the high intensity area where facilities exist for picnicking.

#### Camping and accommodation:

There are several resorts in the high intensity area, mostly concentrated on the Touw River estuary and lagoon. Two of them are operated by the National Parks Board.

#### 27. MANAGEMENT AUTHORITY

National Parks Board, PO Box 774, George, 6530, RSA

#### 28. JURISDICTION

National Parks Board

#### 29. REFERENCES

##### PUBLICATIONS

ALLANSON, B.R. & WHITFIELD A.K. 1983. The limnology of the Touw River Floodplain. South African national Scientific Programmes report no 79, 35 pp.

BIRCH, G.R., DU PLESSIS, A. and WILLIS J.P. 1978. Offshore and onland geological and geophysical investigations in the Wilderness lakes region. Trans. geol. Soc. S. Afr. 81: 339-352

BREYTENBACH, G.J. 1990. Masterplan: Wilderness National Park. Mammals. Unpublished presentation read at workshop on master plan vir Wilderness National Park, 6 pp.

DE KOCK, A.C. & BOSHOFF, A.F. 1987. PCBs and chlorinated hydrocarbon insecticide residues in birds and fish from the Wilderness lakes system. Mar. Poll. Bull. 18 413-416.

- FAGAN, B.M. 1960. The Glentyre Shelter and Oakhurst re-examined. S. Afr. arch. bull. 15: 80-94.
- HALL, C.M., WHITFIELD, A.K. & ALLANSON, B.R. 1987. Recruitment, diversity and the influence of constrictions on the distribution of fishes in the Wilderness lakes system, South Africa. S. Afr. J. Zool. 22: 163-169.
- JACOT GUILLARMOD, A. 1982. Checklist of the aquatic and floodplain vegetation of the Wilderness lakes, southern Cape. Bontebok 2: 41-51
- ODENDAL, A.W. & KRIGE I.M. 1988. Social science research projects in South African National Parks: introductory notes. Koedoe 31: 105-114.
- RUSSEL, I.A. 1991. Monitoring programme for the Wilderness National Park. Unpublished Internal report, National Parks Board.
- ROBINSON, G.A. 1985. Management of the Wilderness coastal lakes system. Unpublished paper presented 4th Symposium Coastal & Ocean Management, Baltimore, Maryland, USA. July/August 1985.
- TYSON, P.D. (Ed.) 1971. Outeniqualand: the George-Knysna area. The South African Landscape, monograph no 2. South African Geographical Society, 23 pp.
- VLOK, J. 1989. Masterplan - Wilderness National Park - the fynbos vegetation. Unpublished presentation read at workshop on master plan for Wilderness National Park, 4 pp.
- WEISSER, P.J. & Howard-Williams, C. 1982. The vegetation of the Wilderness lakes system and the macrophyte encroachment problem. Bontebok 2: 19-40.

#### OTHER REFERENCES:

- ALLANSON, B.R. 1981. The coastal lakes of southern Africa. In: Day, J.H. (Ed.) Estuarine Ecology with particular reference to southern Africa. Balkema, Cape Town. pp. 331-344
- BOSHOFF, A.F. & Palmer, N.G. 1989. Management recommendations for waterbirds in the Wilderness-Sedge- field lakes complex, southern Cape Province. C.P.A. Nature & Environmental Conservation, Int. rep. 1: 28 pp.
- BOSHOFF, A.F., Palmer, N.G. & Piper, S. 1990. Spatial and temporal abundance patterns of waterbirds in the Wilderness-Sedgefield lakes complex, southern Cape Province. Ostrich (in press).
- COETZEE, D.J. 1983. Zooplankton and environmental conditions in a southern Cape coastal lake system. J. Limnol. Soc. sth. Afr. 9: 1-11.

- COETZEE, D.J & Palmer, N.G. 1982. Algemene fisiese en chemiese toestande in Eilandvlei, Langvlei en Rondevlei gedurende 1978. Bontebok 2: 9-12.
- CSIR 1981. Wilderness Report no. 1. Evaluation of prototype data and the application of a numerical model to the Wilderness lakes and Touws River floodplain. CSIR rep. C/SEA 8113. National Research Institute Oceanology, CSIR, Stellenbosch, South Africa.
- CSIR 1982. Wilderness Report no. 2. Evaluation of prototype flood conditions and the application of the numerical model to conditions when the estuary mouth was opened. CSIR rep. C/SEA 8255. National Research Institute Oceanology, CSIR, Stellenbosch, South Africa.
- DAY, J.H., BLABER, S.J.M. & WALLACE, J.H. 1981. Estuarine fishes. In: Day, J.H. (Ed.) Estuarine Ecology with particular reference to southern Africa. Balkema, Cape Town. pp. 197-221.
- DAY, J.H. 1981. Summaries of current knowledge of 43 estuaries in southern Africa. In: Day, J.H. (Ed.) Estuarine Ecology with particular reference to southern Africa. Balkema, Cape Town. pp. 251-329.
- DE KOCK, A.C. & Simmons R. 1988. Chlorinated hydrocarbon residues in African marsh harrier eggs and concurrent reproductive trends. Ostrich 59: 180-181.
- GELDENHUYS, C.J. 1989. Conservation status of coastal and montane evergreen forest: In: Huntley, B.J. (Ed.). Biotic Diversity in southern Africa: concepts and conservation. Oxford University Press, Cape Town. pp. 224-238.
- GOODWING, A.J.H. 1937. Archaeology of the Oakhurst Shelter, George, Trans. Roy. Soc. S. Afr. 25: 229-324
- HALL, C.M. 1985. The limnology of the Touws River floodplain. Part II. Aspects of the ecological structure subject to floods, drought and human interference. Rhodes University, Institute Freshwater Studies, investigational rep. no. 85/1: 138 pp.
- HOWARD-WILLIAMS, C. 1980. Aquatic macrophyte communities of the Wilderness lakes: community structure and associated environmental conditions. J. Limnol. Soc. sth. Afr. 6: 85-92.
- HUGHES, D.A. & GORGENS, A.H.M. 1981. Hydrological investigations in the southern Cape coastal lakes region. Rhodes University, Dept Geography, Hydrological Research Unit, rep. no. 1/81.

- JACOT GUILLARMOD, A. 1979. Report to the Lakes Area Development Board, George, on invasive weed species in the area of the Wilderness lakes. Rhodes University, Institute Freshwater Studies, special rep. no. 79/3: 18 pp
- MARTIN, A.R.H. 1962. Evidence relating to the Quaternary history of the Wilderness lakes. Proc. Geol. Soc. S. Afr. 65: 19-42.
- SCHRIRE, C. 1962. Oakhurst: Re-examination and vindication. S. Afr. Archaeol. Bull. 17: 181-195.
- SIMMONS, R.E. & BARNARD, P.E. 1985. African marsh harriers: requirements for breeding and foraging habitat. Unpubl. rep., Dept. Zool., University Witwatersrand, 4 pp.
- UNDERHILL, L.G., COOPER, J. & Waltner, M. 1980. The status of waders (Charadrii) and other birds in the coastal region of the southern and eastern Cape, summer 1978/79. Western Cape Wader Study Group, Cape Town, 248 pp.

### 30. REASONS FOR INCLUSION

1.d The Wilderness lakes are one of the few coastal lake systems in southern Africa. Geomorphologically their closest counterparts in southern Africa are those on the coast of the Mozambique Plain.

Biogeographically three main biotic provinces are generally recognized for southern African estuaries: subtropical, warm-temperate and cold-temperate. The Wilderness lakes belong to the warm-temperate division and together with the nearby Swartvlei system are the only warm-temperate coastal lakes having a marine connection. An indication of the rarity of coastal lakes can be gauged by the fact that in the area there are only 2 coastal lake systems with a marine connection, whereas there are over 20 estuaries.

Of the Wilderness Lakes Langvlei and Rondevlei are in the most pristine condition.

2.c The Wilderness Lakes form an important wetland for several species of waterbird during the winter months as conditions deteriorate at the inland wetlands where they breed, usually because these wetlands dry up. These waterbirds are then compelled to move to the coast where wetlands like the Wilderness lakes form a valuable refuge. Three categories of waterbirds that use the wetland in this manner can be recognized: non-breeders, non-breeders with resident breeding populations and moult migrants.

The non-breeding category covers those species that visit the area seasonally but do not breed there. Examples are blacknecked grebe *Podiceps nigricollis*, spoonbill *Platalea alba* and threebanded plover *Charadrius tricollaris*.

The second category are those species of waterbirds that enter the Wilderness lakes seasonally, usually winter, where they join the resident population of the same species. It is believed that these migratory individuals breed elsewhere, probably at inland wetlands that dry up seasonally, thus compelling the waterbirds to move to more stable wetlands at the coast. Examples of these species are dabchick *Tachybaptus ruficollis*, whitebreasted cormorant *Phalacrocorax carbo*, reed cormorant *Rhalacrocorax africanus*, darter *Anhinga melanogaster*, redknobbed coot *Fulica cristata*, Kittlitz's plover *Charadrius pecuarius* and blackwinged stilt *Himantopus himantopus*.

The third category is based on the mounting evidence to indicate that the wetland is an important refuge for several species of Anseriformes during their moult migration. Examples of species that appear to use the wetland as a moult stopover point are spurwinged goose *Plectropterus gambensis*, Egyptian goose *Alopochen aegyptiacus*, yellowbilled duck *Anas undulata*, redbilled teal *Anas erythrorhynca*, Cape shoveller *Anas smithii*, southern pochard *Netta erythroptalma*, maccoa duck *Oxyura maccoa* and whitebacked duck *Thalassornis leuconotus*.

Several species of fish use the lakes as a nursery area. Examples are spotted grunter *Pomadasys commersonnii*, Cape stumpnose *Rhabdosargus holubi*, white steenbras *Lithognathus lithognathus*, Cape moony *Monodactylus falciformis*, leervis or garrick *Lichia amia*, Knysna halfbeak *Hyporhamphus capensis* and the mullets *Mugil cephalus*, *Myxus capensis*, *Liza dumerili*, *Liza tricuspidens* and *Liza richardsoni*. They enter the estuary as juveniles and migrate up interconnecting channels to the lakes where they mature, before migrating back to sea again to spawn. Three of these species (viz. spotted grunter, white steenbras and leervis) are prized angling fish.

3.b The Wilderness lakes regularly support a wide variety of waterbirds (max. = 72 species) or waterfowl (max. = 57 species). Particularly well-represented are the anatidae: 14 of the 17 species resident in southern Africa have been recorded and 10 of these use the area on a permanent or seasonal basis.

3.c Cape shovellers *Anas smithii* and yellowbilled duck *A. undulata* occur regularly at the Wilderness lakes in significantly large numbers. The Cape shoveler is a southern African endemic and at times 5 % of their world population occurs at the Wilderness lakes. Yellowbilled duck are more widespread but at times 3 % of their population in southern African occurs at the Wilderness lakes.

### 31. OUTLINE MAP OF SITE (To be appended)

## WILDERNESS LAKES

**Location** 33°59' - 34°00'S, 22°36'S - 22°43'E. 14 km East of George and 30 km West of Knysna on the South coast of the Cape Province.

**Area** 850 ha.

**Degree of Protection** All the area of the lakes, with the exception of Rondevlei form part of the Wilderness National Park. Rondevlei forms part of The Lakes Nature Reserve. Due to the pressure of recreation, the area has been zoned for different activities.

**Site Description** The Wilderness Lakes are one of the few coastal lake systems in Southern Africa. The lakes belong to the warm-temperate biotic province and together with the nearby Swartvlei system are the only warm-temperate coastal lakes having a marine connection. Geomorphologically, the lakes are regarded as an example of a barrier lake coast formed by high dunefields because they are coastal lakes connected to an estuary that periodically closes to form a lagoon.

**International and National Importance** The Wilderness Lakes form an important wetland for several species of waterbirds during the winter months as conditions deteriorate at the inland wetlands where they breed. The lakes support a wide variety of waterbirds (max. 72 species) or waterfowl (max. 47 species). Three categories of waterbirds can be recognised: non-breeders such as blacknecked grebe *Podiceps nigricollis*; non-breeders with resident breeding populations for example reed cormorant *Phalacrocorax africanus*; and moult migrants such as the yellowbilled duck *Anas undulata* and the Cape shoveller *Anas smithii*. Large numbers of the yellowbilled duck *Anas undulata* and the Cape shoveller *Anas smithii*, which is a Southern African endemic, occur on the lakes. There are two species of waterfowl occurring at the lakes that are classified as rare, namely the little bittern *Ixobrychus minutus payesii* and the Caspian tern *Hydroprogne caspia*. Several species of fish use the lakes as a nursery area. Examples are spotted grunter *Pomadasys commersonnii*, Cape stumpnose *Rhabdosargus holubi* and Knysna halfbeak *Hyporhamphus capensis*, besides many others. They enter the estuary as juveniles and migrate up inter-connecting channels to the lakes where they mature, before migrating back to sea again to spawn. The surface waters of the lakes have clear open

water in the central areas and fringing beds of macrophytes in the littoral zone. Coastal fynbos and evergreen forests border on the lakes.

There are no recognized rare, threatened or endangered plant species in the area but there are some endemics such as *Gladiolus vaginatus* and *Satyrium princeps*, among others.