Peatlands and Mires of South Africa

PIET-LOUIS GRUNDLING & RETIEF GROBLER

Abstract: South Africa is a country with a variety of landscapes ranging from tropical forests on the eastern Indian Ocean seaboard to deserts on the Atlantic Ocean, with the Highveld Plateau with its grasslands and savanna woodland dominating the interior. The country is in general an arid country and the average annual rainfall of 497 mm are well below the average of 860 mm for the world.
Peat accumulates mostly along the relatively well watered, eastern coastline: in the subtropical interdune mires of the Mozambique Coastal Plain (MCP), as well as on the central plateau: in the temperate highveld sponges and valleybottom fens. Peatlands in South Africa can mostly be classified as fens and are mostly derived from reeds, sedges and grasses. The majority of the peatlands, both on the coastline and interior, are of Holocene age, but a significant number of peatlands are of late Pleistocene age. The MCP is one of the most densely populated rural areas in Southern Africa and the Gauteng Province in the Highveld region is the most urbanised province and industrial heartland of South Africa. Water is a scarce commodity and urbanisation, industrial and agricultural development and population pressure in rural areas have put substantial pressure on wetlands. Many of these impacts have resulted in the erosion of peatlands and mires. The Working for Wetlands Programme of the South African National Biodiversity Institute (SANBI), focus on the restoration of degraded wetland eco-systems. Currently, 40% of the projects are associated with mires and peatlands.
Peatlands are a very rare and unique wetland type in Southern Africa and are very important ecosystems due to the biodiversity they support, their limited size, distribution and threats to them due to population pressure and development.

Key words: South Africa, Peat Eco-Regions, peat mining, subsistence farming, swamp forests, conservation.

Peatland Utilisation and Conservation: The South African Perspective

South Africa is a land with a variety of landscapes, dominated by a geological history dating back more than 3.8 billion years. This complex geology and associated diverse geomorphology has shaped the South African landscape and gave expression to different eco-regions (Fig. 1) where one unexpectedly discovers a diversity of mires and peatlands. Unexpectedly, because the country is in general located in an arid region where evaporation exceeds precipitation up to 200 % in places. Peat accumulates mostly along the relatively well watered regions of the country located on eastern (Fig. 2) and southern coastline (Fig. 3) and the eastern parts of the central plateau (Fig. 4). Peatlands are thus very rare and unique wetland types in Southern Africa. They are very important ecosystems due to the biodiversity they support, their limited size, distribution and threats to them due to population pressure and development.

Peatlands are important to three sectors of South African society, namely:

- The commercial nursery and mushroom industry
- Subsistence agriculture in peatlands by rural communities
- Conservation Institutions and certain government departments who are mandated to protect peatlands or at least ensure that peat resource use is controlled and sustainable.

There is also currently an interest in other peat derived products including using acids extracted from the peat in new technology pharmaceutical applications. This

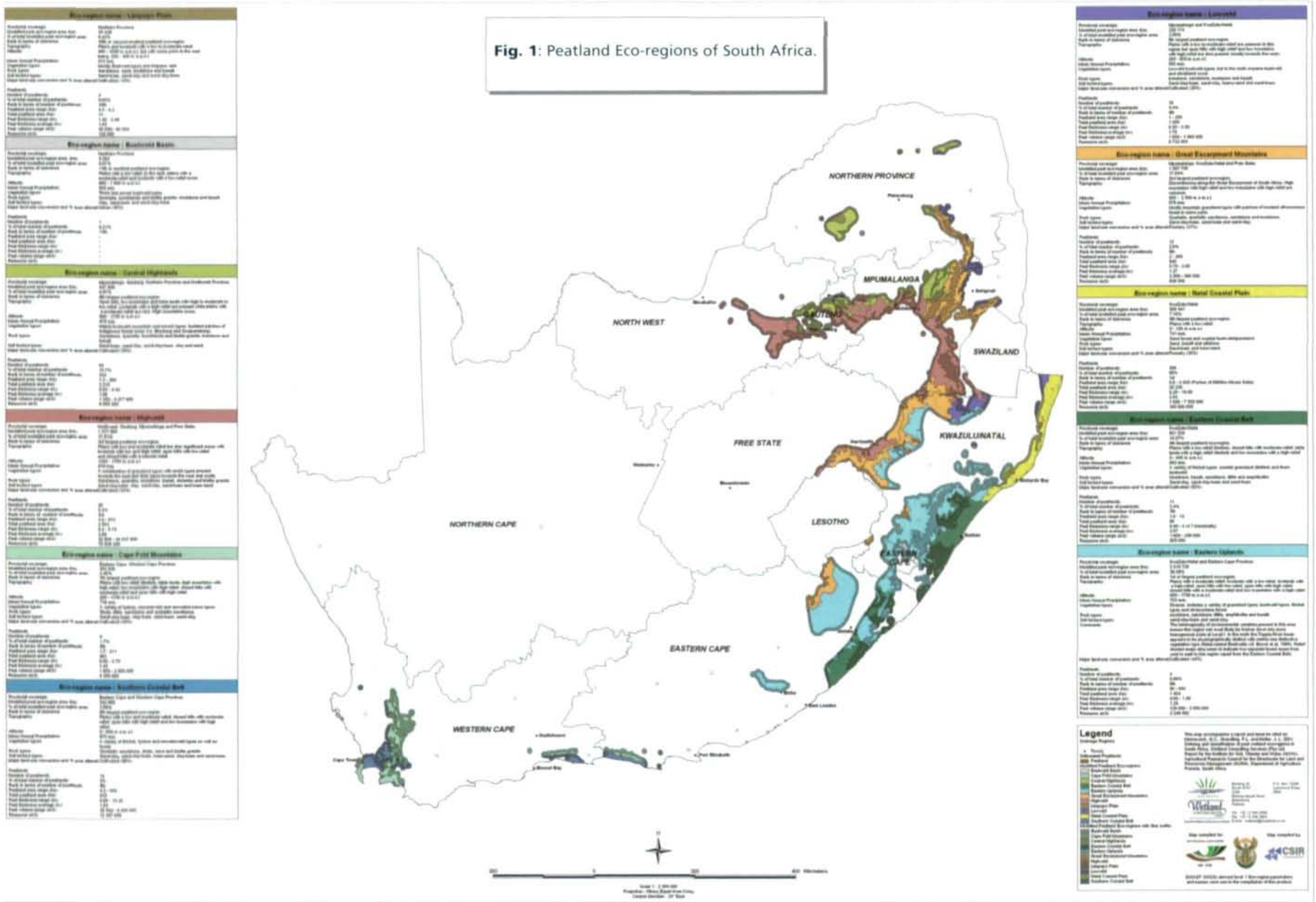

Fig. 1: Peatland Eco-regions of South Africa.

sector of the peat industry is however not well developed in South Africa at present. The potential for conflict between these three sectors are quite high and do exist. A lack of peatland policy, policing and a general apathetic attitude towards wetlands in general worsen this situation.

Commercial Utilisation

From a commercial perspective, peat is mainly used as a substrate for mushroom growing and as a potsoil mix in South Africa. It is extracted by draining the affected peatland and removing the peat by means of mini excavators or less destructively by means of the floatation peat mining method (Fig. 5). Most of the peat in South Africa is mined in the central part of the Highveld Peatland Eco-Region (Fig. 1). The mining of the peat is, with a few exceptions, in the hands of small scale landowners. Most of these are farmers who supplement their income by selling peat to mushroom growers or nurseries. The lack of planning of the extraction activities together with a lack of the understanding of the impacts associated with these has been of concern to those institutions responsible for protecting the resource, as well as for those authorizing and monitoring the peat mining operations. In addition, there has been very little pro-active rehabilitation of mined peatlands. The more recent legislative requirements together with the environmental and water related concerns, economic issues and constraints and lack of funds for rehabilitation have all raised the issue of the feasibility of peat mining in South Africa. Despite this, there remains a demand for local peat.

Mushroom growers in South Africa use peat as casing material, since no other cost effective alternative exists at present. Including both direct and indirectly related jobs, the mushroom growers are employing approximately 6.000 people (CAIRNS pers. comm.) while the nurseries support approximately 20.000 people (MCLACHLAN pers. comm.). Nurseries depend on peat to a lesser degree than the mushroom industry. This is because alternatives such as bark, compost and mushroom compost waste are available locally.

Fig. 2: The Mfabeni Mire in the Greater St Lucia World Heritage Site on the eastern coastline. Picture by JAN SLIVA.

The rising import cost of peat from abroad, particularly since the weakening of the Rand against the US$, have had an impact on the local resource. It has become more lucrative to mine peat locally than to import from abroad. More than 90 % of the peat utilized in the mushroom industry is now mined locally, mainly at two sites in the Highveld Peatland Eco-Region.

South African peat (mainly reed/sedge peat) is, in general, of an inferior quality compared to the moss (*Sphagnum*) based peats of the northern hemisphere. South

Fig. 3: The Kromme Mire in the Cape Fold Mountains on the southern coastline. Picture by Althea GRUNDLING.

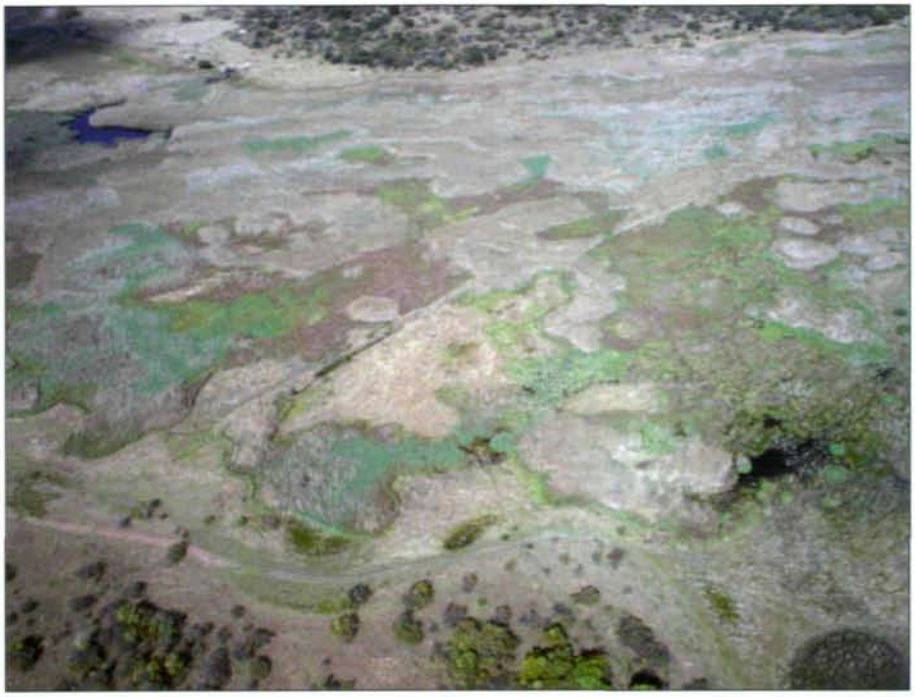

Fig. 4: The Schoonspruit Mire, a karst fen, in the highveld on the central plateau. Picture by Piet-Louis GRUNDLING.

African peat has lower moisture holding capacity, contains weeds and other impurities and is a more clayey and dirtier than the most of the imported or internationally available moss (*Sphagnum*) based peats.

Subsistence Farming

In the KwaZulu-Natal north (Mosambique/Natal Coastal Plain Peatland Eco-Region) and south coast (Southern Coastal Belt Peatland Eco-Region) peatlands are under pressure from the following:

- Local communities invading peatlands to plant vegetable gardens and banana plantations
- Peat represents a mineable commodity for which there is a growing demand in the horticulture and mushroom industries;
- Commercial afforestation and the planting of sugarcane; and
- Incorrect burning regimes and veld to management, particularly for domestic and wildlife grazing.

Maputaland in KwaZulu-Natal Province contains most of South Africa's peat resources. The inferred peat resource for Maputaland is estimated at 180 million m^3 moist peat. This represents about 60 % of the estimated peat resources in South Africa (GRUNDLING et al. 1998). At present these peatlands are mainly utilized for *in situ* horticulture by local subsistence farmers and as a water, biomass and fodder resource. Cash crops, thatching, weaving and braiding material and protein from the peatlands and other wetlands, are the only means of income, or even of survival, for many of the local communities in this area (GRUNDLING 1996).

At present, peat is not mined in Maputaland, but the possibility was investigated in the 1990's (SMUTS & KIRSTEIN 1995) to utilize the Maputaland peatlands as a commercial energy resource. The *in situ* utilization of the peatlands for horticultural purposes is impacting heavily on the cover vegetation and the hydrology of the peatlands. It is estimated that crops are grown on between 60 - 80 % of the peatlands (Fig. 6). A great deal of conflict is generated between local conservation bodies and local communities because of the destruction caused by subsistence farming. Draining and slash-and-burn practices of the swamp forests are severe, in some cases even within the boundaries of proclaimed conservation areas. Poverty, population pressure and a shortage of other viable agricultural land and resources leave the rural communities with few alternatives.

The importance of fresh water springs in Maputaland should not be underestimated particularly since many partially float on localised bodies of saline water (WIPPLINGER pers. comm.). If the peatlands are irreparably damaged or removed, this valuable

Fig. 5: Peat mining using the floatation peat mining method at Gerhard Minnebron in the Mooiriver Catchement, close to Potchefstroom. Picture by Piet-Louis GRUNDLING

source of fresh water will probably have to be replaced at high cost. A few peatlands in Mpumalanga (Lowveld and Great Escarpment Mountains Peatland Ecoi-regions) and along the south coast of KwaZulu-Natal are heavily utilized for the growing of Elephants ear (amadumbe's). At least one peatland along the south coast is intensively used for commercial tomato growing.

Conservation

Peatlands are recognised as important wetlands in terms of enhanced functional capacity such as water storage, filtering and carbon sequestration. They are also rare and unique features in the South African landscape. Most of the peatlands in South Africa fall outside areas with official conservation status except for a few areas in Maputaland (Mosambique/Natal Coastal Plain Peatland Eco-Region) which fall within proclaimed conservation areas, principally Kosi Bay, Lake Sibayi and the Greater St. Lucia Wetland Park. The significance of these peatlands, as an integral part of active wetland systems of which they form part, must be seen in the context of the international recognition of these areas as Wetlands of International Importance in terms of the Ramsar Convention and as part of the Greater St. Lucia Wetland Park World Heritage Site.

South African peatlands are at present still poorly studied as far as their distribution and the impact of exploitation on peatlands are concerned.

Under the Ramsar Convention South Africa has an obligation to:

- Maintain an inventory of its peatlands.
- Valuate and manage its peatlands according to guidelines to be drawn up.
- Support research programmes on peatland functioning and restoration of degrading peatlands.

The value of the peatlands in terms of natural functions could range between R 177 000 (US$ 29 437)/ha/year - R 233 000 (US$ 38 896)/ha/year (COSTANA et al. 1997) as has been reported for global wetlands, swamps and floodplains. These figures however will probably need to be verified and can only be seen to represent an estimated value based on the variables defined by those authors who derived them. Nevertheless, despite this, these figures serve to provide some indication of the potential value of these types of systems with respect to natural functions.

Fig. 6: Slash and burn agriculture in a Maputaland Peatland on the MCP close to Kosi Bay. Picture by Donovan KOTZE.

Working for Wetlands

The South African government has acknowledged that wetlands provide valuable ecosystem services, but that a high level of wetland loss and degradation occur in the country. These impacts vary from mine water pollution (Fig. 7), to draining and erosion (Fig. 8). It thus created a programme, that now falls within the Expanded Public Works Programme. This programme, Working for Wetlands, housed at SANBI, combines proactive preventative measures with remedial interventions focused on past degradation. It needs to raise awareness and influence behaviour and practices impacting on wetlands, rather than focusing exclusively on engineering solutions

It is the vision of Working for Wetlands to facilitates the conservation, rehabilitation and sustainable use of wetland ecosystems, in accordance with South Africa's national policy and commitment to international conventions and regional partnerships. In so doing, Working for Wetlands seeks to optimise opportunities with respect

Fig. 7: The effect of acid mine water from underground coal mine works decanting into a domed artisian fen: Minerals precipitates from this polluted water, encrusting the top peat layer and inhibits vegetation growth.
Picture by Piet-Louis GRUNDLING.

Fig. 8: The effect of erosion, as a result of catchment degradation and draining of the peatland, on the Goukou Peatland. Note the blocks of eroded peat in the gully.
Picture by Japie BUCKLE.

to ecological integrity, water and food security, human well-being and poverty alleviation.

Working for Wetlands combines the provision of work, training and opportunities (Fig. 9) to the poorest of the poor with the rehabilitation of wetlands (Fig. 10). The programme comprises of 5 key areas:

- Rehabilitation
- Partnerships
- Communication, education and public awareness
- Capacity building
- Research and planning

It is significant to note that 40% of the projects in Working for Wetlands are associated with mires and peatlands.

Government Policy

Mining of peat in South Africa is controlled through legislation by the Department of Agriculture's Directorate for Land Use and Soil Management (LUSM). A shortage of manpower, a shortage of information on the extent and distribution of peatlands and a lack of understanding regarding peatland ecocystems are, however, hampering monitoring and rehabilitation objectives.

Legislation

Peat is managed and regulated in terms of the Conservation of Agricultural Resources Act and is not a mineral in terms of the Minerals Act (Act no. 100 of 1991) even though it is a geological commodity, a precursor of coal and, as such, part of a geological process. Plans to mine a peat deposit must be accompanied by and Environmental Impact Assessment and must be approved by the relevant government departments as represented on the Peat Working Group. Permission to mine peat is granted by means of Article 7 of Act no. 43 of 1983. Violation of Article 7 is a criminal offence and can lead to legal prosecution. The latest amendments to South Africa's National Environmental Management Act (in 2005) resulted in the mining of peat being a listed activity in terms of the new amendments. The commissioning of an Environmental Impact assessment will thus be compulsory with any application to mine peat. The activities associated with the mining of peat, such altering the beds and banks of the wetland, diverting or impeding of flow also requires a water use license in terms of the National Water Act.

The South African Peat Working Group

The LUSM expressed its concern in August 1997 about the impact of unplanned and illegal peat mining in the Gauteng Province. The Council for Geoscience

(CGS) was approached and four peat mining sites were visited in the first half of September 1997. It was acknowledged during these field visits that the illegal as well as the legal peat mining operations were causing severe degradation of these sensitive wetland ecosystems and it was decided to form a South African Peat Working Group (PWG) to deal with what was perceived to be an unacceptable situation.

The PWG was established in November 1997 and the decisions were taken to:

- Extend representation and cooperation to include the Department of Water Affairs & Forestry and various relevant non-governmental organisations and research bodies, i.e.: Provincial conservation departments, Rennies Wetland Project, Water Research Council, Agricultural Research Council (ARC), etc.
- Re-evaluate existing legislation and policies,
- Encourage public interest in peatlands
- Step up monitoring and policing activities, depending on funds and manpower,
- Classify as a matter of urgency, sensitive, "no-go" peatland areas of high conservation value, e.g. mountain sponges; health risk areas, e.g. sewage, radioactive and heavy metal polluted peatlands and potential peat fire hazard areas in afforested and potential afforested areas, and
- Establish as a matter of urgency, the location of peat mining operations throughout the country.

The PWG identified a lack of research, and co-operation between relevant departments and industry, and a lack of funds and manpower as the main stumbling blocks in the way of effective evaluation and management of South African peatlands. The wetlands and peatlands of Gauteng were targeted earlier this year by the LUSM, ARC and the DEAT as a research priority.

Demand for Peat and Peat Related Products

Current demand and use (short-term needs)

The current volume of peat utilized in the country varies between 40.000 and 60.000 m^3 per annum. Mushroom growers in South Africa use about 44.000 m^3 of moist peat per annum as casing and nurseries use between 10.000–20.000 m^3. The value of 60.000 m^3 of peat at the time of extraction prior to transport (depending on the price per cubic metre) varies between R 4.0 million and R 6.0 million. The added value of

Fig. 9: A Working for Wetlands team discussing the construction of a gabion erosion control structure in a eroded gully in the Molopo peatland.
Picture by Piet-Louis GRUNDLING.

Fig. 10: Working for Wetlands staff evaluating the completed gabion structure and its positive effect on the eroded gully in the Molopo peatland.
Picture by Piet-Louis GRUNDLING.

Fig. 11: Mining of peat in the Schoonspruit Mire. Picture by Piet-Louis GRUNDLING.

the peat in terms of peat based horticultural products (such as pot soils), nursery pot-plants, mushrooms and other products might as high as be 20–50 times more. Certain peat deposits with very neutral pH might even increase this value added factor because of lower input costs.

The Mooi Rivier has been the catchment most affected in terms of the number of peat mining operations. Five of the 17 peatlands mined in the Highveld Peatland Eco-Region occur in the catchment of the Mooi Rivier. Only one of these peatlands are still actively being mined by 2 operators. Four of the 17 peatlands mined in the past occur in the Highveld Peatland Eco-Region occur in the catchment of the Klip River. Other peatlands were mined in the catchments of Harts River and the Schoonspruit. More operations are planned in the Schoonspruit Mire (Fig. 11). This means that almost 70 % of the peatlands that have been mined in the Highveld Peatland Eco-Region are located in the catchment of the Vaal River.

Two peatlands were previously mined in the Limpopo Plain Peatland Eco-Region. Two mined peatlands (including one operating peat mine) are located in the Rietspruit, a tributary of the Crocodile River. One mined peatland occurs in the Sesmylspruit, another tributary of the Crocodile River. A tributary of the Koffiespruit in the upper catchment of the Olifants River was mined until recently in 2004.

Future demand (Long-term needs)

The demand for peat has declined over the past 10–15 years. The mushroom and nursery industries used to utilize between 70.000–85.000 m^3 of peat per annum (GRUNDLING & MARNEWECK 1999). The current requirement for peat by this industry has therefore dropped and it is speculated that this is mainly due to the partial replacement of peat by decomposed pine and wattle bark and the recycling of mushroom compost waste. Peat utilization of the mushroom industry has also dropped from 52.000 m^3 per annum forty or so years ago to 42.000 m^3 in 1999. It has since risen slightly towards approximately 44.000 m^3 per annum, and the industry is expecting a growth rate of about 3–6 %. This is on par with the country's expected growth rate.

Peat related products (mainly mushrooms, potting soils and flower related products) are mainly in demand from the middle and higher income classes of the South African Society, as well as the entertainment sector (restaurants, floral shops, golf courses, etc). As the base of this sector grows and the Rand continues to devaluate against outside currencies, particularly those of Canada and the United Kingdom (main international suppliers of peat), the future demand for locally produced peat is expected to increase.

An unknown factor in future demand might be the use of peat in alternative and new technologies. These include the use of peat as a growing medium, fertilizer and fuel as well as a filter and purifier of industrial, municipal and domestic effluent and gas (BÉLANGER et al. 1988). Peat can be used in the treatment of radioactive waste and pesticides and as an absorbent in oil pollution. It is possible to use it as a colouring agent, and combined with bentonite as a binding agent for iron ore (BÉLANGER et al. 1988). Medical applications range from therapeutic peat baths to the treatment of skin ailments including leg and gastric ulcers and cancer. Various acids in the peat are extracted as a basis for such medicinal applications, some

of which are still in a research phase (BÉLANGER et al. 1988). This also includes potential application in veterinary medicines, pesticides and fertilisers used for organically grown food. Recently (1999), there has been an application for a permit to mine peat in the Schoonspruit Karst Fen (Highveld Peatland Eco-Region) at Ventersdorp to produce:

- A high yield, clean pathogen-free feedstock in the preparation of organic liquid fertiliser; and
- Organic acids.

The mushroom industries as well as some of the peat miners have expressed their concern about the rising cost of transport of peat from the Highveld where it is currently being mined to the coastal areas where there is a demand for peat. Areas such as Durban, Port Elizabeth and Cape Town are included as potential demand centres. As a result, a need has been identified to find peat resources closer to these centres. The following coastal or related peat Eco-Regions might therefore experience demands in future:

- Natal Coastal Plain Peatland Eco-Region
- Eastern Uplands Peatland Eco-Region
- Southern Coastal Belt Peatland Eco-Region
- Cape Fold Mountains Peatland Eco-Region

Peatland Eco-Regions Of South Africa

A GIS linked model (Peatland Eco-Regions) was developed using different parameters to determine where peatlands are likely to occur in South Africa (MARNEWECK et al. 2001). These parameters include:

- Precipitation
- Geology
- Geomorphology
- Slope
- Mean Annual Recharge to groundwater
- Groundwater component of River Flow (Base Flow)
- Depth to groundwater level
- Aspect
- Elevation
- Vegetation
- South African Eco-regions, and
- Springs

The final results of the peatland Eco-Region model are depicted in The Peatland Eco-Region map (Fig. 1). The Eco-Region names are the same as those given in the Institute of Water Quality Studies' (IWQS) level 1 Eco-Region classification (1998). The comparison of the modelled peatland Eco-Regions with the field data showed that while the modelled areas depicted where most of the peatlands occurred, there were outliers. Almost 85 % of the known peatlands fell within the modelled boundaries. Up to 94 % of these fell within 10km of the modelled boundaries.

Description of the Eco-Regions and of Selected Peatlands

The eleven modelled peatland Eco-Regions occur mainly in the eastern, central and southern parts of South Africa. Four hundred and sixty seven known peatlands occur in the 11 peatland Eco-Regions. Thirty nine of these (almost 10 %) are new records for South Africa. Three hundred and eight (66 %) of these peatlands occur in the Natal Coastal Plain Peatland Eco-Region. The Central Highlands and Highveld Peatland Eco-Regions contain the majority of the remaining known peatlands. The total area of known peatlands is 29.784 ha and the inferred peat resource volume for all the peatlands in all the Eco-Regions is 289 million m^3. The peatlands of the Eastern Coastal Belt Peatland Eco-Region have been heavily impacted upon and most of the known inferred peat resource from this Eco-Region has been lost (73 % or 1.75 million m^3 moist peat).

Limpopo Plain Peatland Eco-Region (Lppe)

The Limpopo Plain Peatland Eco-Region (Fig. 1) covers 0.4 % of the total peatland Eco-Region area and 3 known peatlands (0.6 % of the total recorded peatlands) occur in this Eco-Region. This region is the 2nd smallest Eco-Region and also contains the second smallest number (4) of known peatlands. All the known peatlands from this Eco-Region occur in the Soutpansberg Mountain range (Fig. 12). The major land-use in the Eco-Region is cultivation and approximately 14 % of the area has

Fig. 12: Lake Fududzi in the Soutpansberg Mountain Range, with the Fundudzi Peatland located in front of the water body. Picture by Piet-Louis GRUNDLING.

Fig. 13: The Waterkloof Spruit Mire in the Magaliesberg Mountain Range. Note the dense stands of reeds (*Phragmites australis*) in the middle ground. Picture by Piet-Louis GRUNDLING.

been altered from a natural state. The major land-use encroachment on the peatlands is forestry and also cultivation.

The peatlands in this region vary in extent from 3.3 ha to 9.2 ha, with a total area of 16 ha. Peat thicknesses vary from 1.4 m to 2.4 m with an average of 1.93 m and inferred peat volumes from 30.000 m^3 to 50.000 m^3 with a total inferred resource of 170.000 m^3. The largest peatland is the Fundudzi Peatland, a valley bottom fen, which is dominated by sedges and grasses, but which has burnt extensively in places. The majority of the peatlands are valleyhead fens with the dominating vegetation cover being grasses and sedges. The grass and sedge peats are mostly medium to fine grained peat. Peatland utilization and impacts include peat mining, water abstraction, agriculture, grazing, afforestation, draining, headcut and donga erosion, roads, fences and dams.

Bushveld Basin Peatland Eco-Region (Bbpe)

The Bushveld Basin Peatland Eco-Region (Fig. 1) is the smallest of all the peatland Eco-Regions and covers only approximately 0.1 % of the total peatland Eco-Region area. It has not been surveyed in particular and to date only one peatland with an area of 5 ha and average peat thickness of 5.5 m has been recorded in this Eco-Region despite the indications that conditions are favourable for the occurrence of more peatlands. The major land-use in the Eco-Region is extensive agriculture and approximately 45 % of the area has been altered from a natural state.

Central Highlands Peatland Eco-Region (Chpe)

The Central Highland Peatland Eco-Region (Fig. 1) covers approximately 7 % of the total peatland Eco-Region area and 64 known peatlands (approximately 14 % of the total recorded peatlands) occur in this Eco-Region. This Eco-Region, while only the 6th largest, contains the 2nd largest number of known peatlands (64), varying in size from 1.3 ha to 260 ha, with a total area of 2.215 ha. Peat thickness varies from 0.5 m to 4.5 m with an average of 1.3 m, while the inferred peat volumes range from 1.250 m^3 to 3.28 million m^3 with an total inferred resource of 9.07 million m^3.

The majority of the known peatlands in the Eco-Region are valley bottom fens with the dominant vegetation cover being reeds (*Phragmites australis*) and *Carex* species (Fig. 13) as well as grasses and other sedges to a lesser extent. The reed sedge peat tends to be a fibrous to medium fine peat. The grass and sedge peats are mostly medium to fine grained peat.

The largest peatland in this Eco-Region is the *Phragmites australis* and *Carex* species dominated Lakenvlei Wetland Complex, while the Verlorenvallei peatland has the greatest floristic diversity. Another significant mire in this Eco-Region is the Waterkloof Spruit Mire, located in the Magalies Mountain Range near Rustenburg (Fig. 13). It is important in terms of biodiversity and as an important water source.

Most of the known peatlands in this Eco-Region are concentrated on the Steenkampsberg Plateau, artesian springs (Fig. 14) are common in the upper sections of many of these wetlands.

The Lakenvlei peatland was dated at 5 080 ± 50 years before present (BP) at a peat depth of 1.95 m. During this period (the Holocene), peat accumulated at 0.36 mm/year. This peatland has subsequently been sampled up to a depth of 4.2 m and this thickness relates to a peat age of approximately 11.600 years

The Verloren Vallei Nature Reserve is located in the Mpumalanga Province, South Africa. It contains more than thirty wetlands, with the sizes of wetlands ranging between 2 and 250 ha. The primary wetland type is permanent freshwater marshes, with the emergent vegetation waterlogged for most of the season. Three wetlands contain peat and fit the description of a fen peat wetland (Fig. 15). The area is hydrologically important as the sponges in the upper catchment of important river systems occur here. It supports high botanical diversity, and is one of the last areas with suitable Wattled Crane breeding habitat. The area is furthermore of particular importance because a variety of wetlands characteristic of the region are represented, and because it is situated on a watershed, while the influence of external disturbances are limited.

The major land-use in the Eco-Region is cultivation and approximately 25 % of the area has been altered from a natural state. Peatland utilization and impacts include water abstraction, agriculture, grazing, afforestation, peat fires, draining, headcut and donga erosion, roads, fences and dams (particularly trout dams).

Fig. 14: A typical artesian spring on one of the Steenkampsberg Plateau mires. Picture by Anton LINSTRÖM.

Highveld Peatland Eco-Region (Hpe)

The Highveld Peatland Eco-Region (Fig. 1) covers 17.5 % of the total peatland Eco-Region area and 25 known peatlands (5.4 % of the total recorded peatlands) occur in this region. This region is the 3rd largest Eco-Region and also contains the 3rd largest number of known peatlands. The major land-use in the Eco-Region is cultivation and approximately 33 % of the area has been altered from a natural state.

The peatlands in this region vary in extent from 4.4 ha to 972 ha, with a total area of 2.554 ha. Peat thickness varies from 0.4 m to 5.75 m with an average of 2.88 m. The inferred peat volumes range from 32.000 m^3 to 34 million m^3 with a total inferred resource of 70.53 million m^3.

Fig. 15: The Verloren Vallei Mire during winter in the Verloren Vallei Ramsar site on the Sttenkampsberg Plateau. Picture by Anton LINSTRÖM.

Fig. 16: Fire damage to the Bodibe karst peatland near Lichtenburg. Picture Piet-Louis GRUNDLING.

The majority of the known peatlands are valley bottom fens with the dominant vegetation cover being reeds (*Phragmites australis*) and *Carex* species. Grasses and sedges occur to a lesser extent. The reed and sedge peat tends to be the more fibrous while the grass and sedge peats are mostly medium to fine grained.

Extensive peatlands have developed in the northwestern areas (mainly on dolomites) and to a lesser extent in the southeastern areas. Peatlands have developed over long periods of time across most of the region. The Witfontein South peatland was dated at 4.600 ± 60 BP at a peat depth of 2.35 m and has a peat accumulation rate of 0.51 mm/year. On the other hand, the Gerhard Minnebron was dated at 11.310 ± 110 BP at a peat depth of 4.7 m, with a peat accumulation rate of 0.49 mm/year.

Peatland utilization and impacts include peat mining (the majority of peat mining operations occur in the central and western parts of this region), water abstraction, agriculture, grazing, afforestation, draining, headcut and donga erosion, urbanization, roads, fences and dams. Peat fires have been severe on some of the karst peatlands, for example at Bodibe near Lichtenburg (Fig. 16). The effects of fire has been intensified by prolonged droughts and manmade hydrological modifications.

Lowveld Peatland Eco-Region

The Lowveld Peatland Eco-Region (Fig. 1) covers 2.9 % of the total peatland Eco-Region area and 16 known peatlands (3.4 % of the total recorded peatlands) occur in this region. This region is the 3rd smallest Eco-Region and contains the 4th largest number of known peatlands. The major land-use in the Eco-Region is cultivation and approximately 14 % of the area has been altered from a natural state. The major land-use encroachment on the peatlands is afforestation and agriculture.

The peatlands in this region vary in extent from 1 ha to 255 ha, with a total area of 1.059 ha. Peat thickness varies from 0.3 m to 3.5 m with an average of 1.78 m. The inferred peat volumes range from 1.000 m^3 to 1,980.000 m^3 with a total inferred resource of 8.7 million m^3.

Great Escarpment Mountains Peatland Eco-Region

The Great Escarpment Mountain Peatland Eco-Region (Fig. 1) covers 17.6 % of the total peatland Eco-Region area and 13 known peatlands (2.8 % of the total recorded peatlands) occur in this region. This region is the 2nd largest Eco-Region and contains the 6th largest number of known peatlands. The major land-use in the Eco-Region is forestry and approximately 21 % of the area has been altered from a natural state. The major land-use encroachment on the peatlands is also afforestation. This region is the 2nd largest Eco-Region and contains the 4th largest number of peatlands, but only 4 % of the total recorded peatlands. The peatlands in this region vary in extent from 2 ha to 480 ha, with a total area of 849 ha. Peat thickness varies from 0.75 m to 4.6 m with an average of 1.27 m. The inferred peat volumes range from 3.000 m^3 to 360.000 m^3 with a total inferred resource of 938.000 m^3.

The majority of the known peatlands are valley bottom fens with the dominant vegetation cover being grasses and sedges and to a lesser extent reeds (*Phragmites australis*) and *Carex* species (Fig. 17). The largest of the peatlands are reed and sedge dominated and these have developed the thickest peats. The reed and sedge peat

tends to be fibrous to medium fine peat. The grass and sedge peats are mostly medium to fine grained peat.

The peatlands in this Eco-Region are better developed in the south than in the north. However, this is not a clearly defined boundary. The Wakkerstroom peatland (a reed and sedge dominated peatland in the middle part of this Eco-Region) was dated at 780 ± 40 BP at a peat depth of 2.2 m, with a peat accumulation rate of 2.8 mm/year. In contrast, the Watervalvlei/Bedford peatland (a reed and sedge dominated peatland in the southern area) was dated at 10.745 ± 30 BP at a peat depth of 4.6 m. This peatland has a peat accumulation rate of 0.43 mm/year. The Bedford peatland (Fig. 18) falls within the Great Escarpment Mountain Peatland Eco-Region. This Highveld fen is unique in various ways, as it is:

One of 3 known valley bottom fens occurring in the Free State Province It is at 4.6 one of the thickest peatlands in the interior of South Africa and is the thickest and largest peatland in the Free State.

At 10.745 years Before Present (at 4.6 m) it is the oldest peatland in the Free State and the second oldest mire in the Highveld.

A stable environment since the last Ice Age 11.000 years ago and contains fossil pollen, fibre and other records of important scientifically concerning such matters as climatic change, ecological development of the Highveld, the Wilge River Catchment etc.

The only peatland in southern Africa (and for that matter possibly in the world) associated with a prominent waterfall (and indeed three in this instance) directly situated on its inflows.

It is the most important carbon store in the Wilge Catchment with an estimated peat volume of more than 10,000.000 m^3 of peat.

Peatland utilization and impacts include water abstraction, agriculture, grazing, afforestation, draining, headcut and donga erosion, roads, fences and dams. In a few areas within the region, siltation of peatlands is also a problem.

Fig. 17: The different plant communities that characterise the mire are clearly visible, with the *Carex cognata* dominated community in the front (with the soil auger), the *Phragmites australis* dominated community to its left and a *Typha capensis* dominated plant community at the back. Species present in all or most of these communities are a *Persicaria* sp. and *Leersia hexandra*. Picture by Nacelle Collins.

Eastern Uplands Peatland Eco-Region

The Eastern Upland Peatland Eco-Region (Fig. 1) covers 29.4 % of the total peatland Eco-Region area and 4 known peatlands (0.9 % of the total recorded peatlands) occur in this region. This region is the largest peatland Eco-Region, but it contains the 3rd least number of known peatlands. The major land-use in the Eco-Region is cultivation and approximately 44 % of the area has been altered from a natural state. The major land-use encroachment on the peatlands is cultivation.

The peatlands in this region vary in extent from 60 ha to 650 ha, with a total area of 1.404 ha of peatland occurring. Peat thickness varies from 0.6 m to 1.9 m with an average of 1.25 m. The inferred peat volumes range from 128.000 m^3 to 2.55 million m^3 with a total inferred resource of 3.25 million m^3.

The majority of the known peatlands in this Eco-Region are valley bottom fens with the dominant vegetation cover being bulrushes (*Typha capensis*) and sedges, as well as

Fig. 18: The Bedford valleybottom peatland is located at high altitude in the upper catchment of the Wilge River on Free State side of the Free State/KwaZulu-Natal escarpment. Picture by Nacelle Collins.

grasses to a lesser extent. Reed (*Phragmites australis*) and *Carex* species also occur. The reed/sedge peat tends to be a fibrous to medium fine peat. The bulrush /grass and sedge peats are mostly medium to fine grained.

The peatlands in this region are, in general, poorly developed with respect to peat thickness and most seem to have developed more recently. The Mvoti peatland was dated at 400 ± 50 years BP at a peat depth of 1.65 m. Over this period, peat accumulated at a rate of 4.1 mm/year.

Peatland utilization and impacts include water abstraction, agriculture, grazing, afforestation, draining, headcut and donga erosion, roads, fences and dams.

Natal Coastal Plain Peatland Eco-Region

The Natal Coastal Plain Eco-Region (Fig. 1) covers 7.1 % of the total peatland Eco-Region area and 308 known peatlands (approximately 66 % of the total recorded peatlands) occur in this region. This region is the 5th largest Eco-Region, but it contains the largest and highest density of peatlands of all the peat Eco-Regions. The geographical area enclosing the Natal Coastal Plain Eco-Region is known as Maputaland. Maputaland contains over 50 % of South Africa's peat resources, but is in comparison to its peat quantity quite small in size and consequently very unique. The major land-use in the Eco-Region is forestry and approximately 38 % of the area has been altered from a natural state. The major land-use encroachment on the peatlands is cultivation.

The peatlands in this region vary in extent from 0.8 ha to 3.925 ha, with a total area of 20.250 ha. Peat thickness varies from 0.2 m to 10 m with an average of 2.03 m. The inferred peat volumes range from 1.000 m^3 to 7.5 million m^3 with a total inferred resource of between 160 and 190 million m^3 (estimated at 180 million m^3). The largest peatland is the Mkuzi Delta dominated by *Pragmites australis*, a *Carex* species and *Cyperus papyrus*, swamp forests are also associated with this system.

The majority of the peatlands in this Eco-Region are interdune valleybottom fens with the dominant vegetation cover being reeds and sedges (*Cyperus papyrus*, *Phragmites australis* and *Carex* sp.) as well as swamp forests. Grasses and sedges occur to a lesser extent. The reed/sedge and swamp forest peat tends to be a coarse fibrous to medium fine peat. The grass and sedge peats are mostly medium fine fibrous to fine grained. The Mkuzi delta and Mbazwana swamp forest which occur in this peatland Eco-Region together form the largest mire complex in South Africa (approximately 8.800 ha in extent). Peatland utilization and impacts include intensive *in situ* horticulture (Fig. 19), water abstraction, agriculture, grazing, afforestation and draining.

Swamps forests are highly threatened ecosystems in South Africa, being the second rarest forest type in the whole country and only found in isolated patches from the Mozambique border to just south of the Msikaba River in the Eastern Cape (MOLL 1980; WESSELS 1997). Roughly 3.986 ha of peat swamp forest vegetation occur in Maputaland of which a great deal is still unclassified due to their remoteness and inaccessibility. Stands located on the eastern high rainfall section of Maputaland, form 75 % of all swamp forest found in South Africa, which makes it a very valuable entity for future conservation (LUBBE 1997).

Two distinct peat age trends are present in the peatlands of the Natal Coastal Plain. Most of the peatlands are younger than 7.000 years and are distributed across the Eco-Region. Two of the peatlands (Mfabeni and Mhlanga) are of Pleistocene age and are located in the southern area of the Natal Coastal Plain Eco-Region. Mfabeni (Fig. 2) is most probably one of the oldest active peat accumulating wetlands in the world. It was dated at 43.000 + 4.900 – 3.000 BP at a peat depth of 9.9 m. During the period 43.000–11.000 years BP (the late Pleistocene), peat accumulated at 0.23 mm/year, while during the period 11.000 years BP to present (Holocene), the peat accumulated at 0.43 mm/year (5.290 ± 70 BP at a depth of 2.5 m). The Nhlangu mire is an example of such a Holocene peatland (Fig. 20).

Eastern Coast Belt Peatland Eco-Region

The Eastern Coastal Belt Peatland Eco-Region (Fig. 1) covers 10.6 % of the total peatland Eco-Region area and 11 known peatlands (2.4 % of the total recorded peatlands) occur in this region. This region is the 4th largest Eco-Region, but it contains 7th largest number of peatlands. The major land-use in the Eco-Region is cultivation and approximately 52 % of the area has been altered from a natural state. The major land-use encroachment on the peatlands is also cultivation.

The peatlands in this region vary in extent from 1.6 ha to 13 ha, with a total area of 60 ha. Peat thickness varies from 0.4 m to 4.7 m with an average of 2.57 m. The inferred peat volumes range from 1.600 m^3 to 256.000 m^3 with a total inferred resource of 655.000 m^3.

The majority of the known peatlands in this Eco-Region are interdune valley bottom fens with the dominant vegetation cover being swamp forests as well as reeds and sedges to a lesser extent. The reed/sedge peat tends to be a medium to fine peat. The swamp forest peats are mostly fibrous to medium fine grained.

The oldest dated peatland in the Eastern Coastal Belt Peat Eco-Region is the Mpenyati Swamp forest peatland. It was dated at 9 730 ± 100 BP at a peat depth of 3.2 m. Over this period peat accumulated at a rate of 0.29 mm/year.

Peatland utilization and impacts include peat mining, water abstraction, agriculture, grazing, afforestation, draining, urban development, roads, fences and dams. The impacts on some of these peatlands have resulted in severe degradation and in some cases wetland and peatland loss.

Southern Coastal Belt Peatland Eco-Region

The Southern Coastal Belt Peatland Eco-Region (Fig. 1) covers approximately 3 % of the total peatland Eco-Region area and 14 known peatlands (3 % of the total recorded peatlands) occur in this region. This region is the 8th largest peatland Eco-Region, and it contains the 5th largest number of peatlands. The peatlands in this region vary in extent from 4.2 ha to 556 ha, with a total area of 919 ha. Peat thickness varies from 0.6 m to 10.2 m with an average of 1.9 m. The inferred peat volumes range from 25.000 m^3 to 6.3 million m^3 with an total inferred resource of 12.4 million m^3. The major land-use in the Eco-Region is cultivation and approximately 59 % of the area has been altered from a natural state. The major land-use encroachment on the peatlands is also cultivation.

Fig. 19: A swamp forest garden cultivated with amadumbes (*Colocasia esculenta*) next to the Siyadla River, Maputaland. Picture by Christoph Moning.

Fig. 20. The Nhlangu interdune valley bottom mire. Picture by Retief Grobler.

Fig. 21: The Vankersvelvlei mire is a emergent valley bottom fen, located in the fossil dune fields in the southern Cape within the Wilderness Lakes area, close to the town Sedgefield on the farm Rietlaagte. Picture by Japie Buckle.

The majority of the peatlands in this Eco-Region are valley bottom fens with the dominant vegetation cover being reeds (*Phragmites australis*) and a *Carex* species. Grasses and sedges occur to a lesser extent, as does palmiet (*Prionium serratum*). The reed and sedge peat tends to be a fibrous to medium fine peat. The grass and sedge peats are mostly medium to fine grained while the palmiet peat, unique to the Western-and Eastern Cape, is sandy fibrous to fine.

Peatland utilization and impacts in the Eco-Region include water abstraction, agriculture, grazing, afforestation, draining, urban development, roads, fences and dams.

The Vankersvelvlei (Fig 21), dominated by a moss (*Sphagnum* species) and sedges, is at 10.2 m the second deepest peatland that has been sampled in South Africa. The surface of this fen is covered with a mat of sedge and sphagnum vegetation to a depth of 2m below the surface. It is, along with Braamhoek (Watervalvlei), one of the few deep and active mires with very pronounced hummocks on its surface - up to 0.5 m high. The wetland is isolated in terms of surface hydrology with no visible outflow. This peatland was dated at 24.400 ± 450 BP at a peat depth of 10.2 m. During this period (Late Pleistocene and Holocene), peat accumulated at a rate of 0.42 mm/year.

Fig. 22: A valley bottom peatland in the Goukou River Catchment near Riversdale in the Western Cape in which up to 7 m of peat has been washed out of the landscape over an average width of approximately 20m, extending over a distance of hundreds of meters. Picture by Japie Buckle.

Cape Fold Mountains Peatland Eco-Region

The Cape Fold Mountain Peatland Eco-Region (Fig. 1) covers 4.49 % of the total peatland Eco-Region area and 8 known peatlands (1.7 % of the total recorded peatlands) occur in this region. This region is the 7th largest Eco-Region, and it contains the 8th largest number of peatlands. The major land-use in the Eco-Region is cultivation and approximately 24 % of the area has been altered from a natural state. The major land-use encroachment on the peatlands is also cultivation.

The peatlands in this region vary in extent from 1.7 ha to 211 ha, with a total area of 463 ha. Peat thickness varies from 0.5 m to 2.7 m with an average of 1.45 m. The inferred peat volume ranges from 10.000 m^3 to 3.5 million m^3 with a total inferred resource of 4.2 million m^3.

The majority of the peatlands are valley bottom fens with the dominant vegetation cover being palmiet (members of the Juncaceae or rush family of plants), as well as grass and other sedges to a lesser extent. The palmiet peat tends to be a sandy, medium fine to fibrous peat. The grass and sedge peats are mostly medium to fine grained peat.

Peatland utilization and impacts include water abstraction, agriculture, grazing, peat fires, draining, headcut and donga erosion, roads, fences, dams and alien invasive infestation, especially *Acacia mearnsii*. Agricultural activities leading to poor draining practices and infrastructure development, especially road building, have resulted in a canalization of water in the steep sloped valleys associated with the Cape Fold Moun-

tains. This lead to a state of increased flow concentration with a much higher erosion potential than normal, capable of eroding valley bottom peatlands up to 7 m deep after a single flooding event (BUCKLE pers. comm.) (Fig. 22).

Conclusion

South Africa's peatlands and mires are under pressure. Developers (peat miners) are at present engage in a land grab to secure the last remaining portions of mires being mined for peat, such as at the Gerhard Minnebron peatland. Even more devastating is the destruction of peatland swamp forests for the establishment of commercial banana and amdumbe plantations in the rural areas of Maputaland, many of these in the Greater St Lucia World Heritage and Ramsar sites.

This situation is compounded by the fact that South Africa lacks a national policy on the mining of peat and the management of peatlands in general. The inability of South Africa's government departments to coordinate, implement and enforce some of the most effective water and environmental legislation is contributing even more to chaos on the ground.

The question needs to be asked: Who is utilising peat related products? Is it the poorest of the poor, is it even the poorer broader based society of South Africa? Yes, perhaps to some extent in the case of the swamp forests in Maputaland. But, even here it is the more affluent in the local communities who control the trade in bananas in the region. It is, however, the mushroom and potting soil trade, whom is really contributing to one of the most unsustainable and unwise practices of wetlands in the world: to mine peat so that only less than 5 % of population can enjoy cheap mushrooms and potting soils while the rest of the country suffers under a shortage of readily available clean water.

Have we really measure the cost of our mushrooms or potting soils? Peatlands store and filter water, as well as mitigation global climatic impacts. Could we afford to undermine the filters and sponges of our rivers? Can we allow the destruction of our own life support systems so that a few individuals can enrich themselves to the determinant of most of the inhabitants of our country?

South Africa has a limited number of peatlands and mires, but they are unique in terms of their diversity and distribution over a variety of habitats. Conservation of these mires and peatlands should focus, in future, on defining and implementing sustainable management goals.

References

BÉLANGER A., POTVIN D., CLOUTIER R., CARON M. & G. THERIAULT (1988): Peat a resource of the future. Teaching manual. Le Centre Québécois de Valorisation de la Biomasse. Quebec.

COSTANZA R., D'ARGE R., DE GROOT R., FARBER S., GRASSO M., HANNON B., LIMBURG K., NAEEM S., O'NEILL R.V., PARUELO J., RASIN R.G., SUTTON P. & M. van den BELT (1998): The value of the world's ecosystem services and natural capital. Ecological Economics, 25: 3–15.

GRUNDLING P. (1996): Sustainable Utilisation of Peat in Maputaland, KwaZulu-Natal, South Africa. In LÜTTIG, G.W.(Ed.) Abstracts of the 10th International Peat Society Congress. May 1996, Bremen. 1. 6.

GRUNDLING P-L., MAZUS H. & L. BAARTMAN (1998): Peat resources in northern KwaZulu-Natal wetlands: Maputaland. Department of Environmental Affairs and Tourism Report no. A25/13/2/7. 102pp.

GRUNDLING P.L. & G.C. MARNEWECK (1999): Mapping and characterisation of Highveld peatland resources. Wetland Consulting Services. Report No. 28/99. Report for Agricultural Research Council and Directorate of Land and Resource Management, Department of Agriculture, Pretoria.

LUBBE R.A. (1997): Vegetation and flora of the Kosi Bay Coastal Forest Reserve in Maputaland, northen KwaZulu-Natal, South Africa. — M.Sc. dissertation. University of Pretoria, Pretoria.

MARNEWECK G.C., GRUNDLING P-L. & J.L. MULLER (2001). Defining and classification of peat wetland eco-regions in South Africa, Wetland Consulting Services (Pty) Ltd. Report to the Institute for Soil, Climate and Water (ISCW), Agricultural Research Council for the Directorate for Land and Resources Management (DLRM), Department of Agriculture, Pretoria, South Africa.

MOLL E.J. (1980): Terrestrial plant ecology. — In: BURTON M.N. & K.H. COOPER (Eds.): Studies on the ecology of Maputaland. Rhodes University & Wildlife, pp. 52-68.

WESSELS N.G. (1997): Aspects of the Ecology and Conservation of Swamp Forests in South Africa. — M.Sc. Dissertation Technikon Port Elizabeth; unpublished.

SMUTS W.J. & L.S. KIRSTEIN (1995): Peat and related biofuels as potential renewable alternative energy option in part of KwaZulu-Natal . DMEA Report no: EO9417

Address of authors:

Piet-Louis GRUNDLING
Working for Wetlands
South African National
Biodiversity Institute
Private Bag X101, Pretoria, 0001
South Africa
E-Mail: peatland@mweb.co.za

Retief GROBLER
Department of Botany
University of Pretoria
Pretoria, 0002
South Africa
E-Mail: retief@tuks.co.za