ECOSYSTEM SERVICES

Research project underlines the importance of South Africa's peatlands

A Water Research Commission (WRC)-funded study has shed new light on the distribution, characteristics and socio-economic value of peatlands in South Africa. Article By Sue Matthews.

The Malahlapanga wetland in the Kruger National Park contains a rare hot spring mire. A mire is a wetland that is actively accumulating peat.

It is the threat of climate change that has put peatlands on the global environmental agenda in recent years, because they store vast quantities of carbon that contribute to greenhouse gas emissions when these wetlands are damaged or destroyed. The Global Peatlands Initiative – launched at the 2016 United Nations Climate Change Conference (COP 22) – released a rapid response assessment report at COP 23 in November 2017 to raise awareness about the importance of the world's peatlands, and to encourage immediate action to protect them.

Previously, peatlands only garnered this level of international attention when the various 'bog bodies' were discovered. The most famous examples are the remarkably well-preserved Tollund Man, discovered in a peat bog in Denmark in 1950 and dated to 300–400 years BC, and Lindow Man – nicknamed Pete Marsh – discovered in England in 1984 and dated to 20–90 AD. Their existence perfectly illustrates what it is that sets peatlands apart from other wetland types, namely the extremely slow rate of decomposition of plant material and other organic matter. This is due to waterlogging that creates anaerobic conditions in the wetland, inhibiting bacterial decomposition processes.

Since waterlogging is a key feature of peatlands, they are primarily found in the 'wetter' parts of the world, such as the northern hemisphere's high latitudes and the tropics. As a semi-arid country, South Africa is not well-endowed with peatlands because most wetlands are seasonal, drying out during periods of lower rainfall and higher evapotranspiration. The peatlands that do exist are largely concentrated in the moist eastern and southern regions of the country.

The first national peatland ecoregion survey culminated in a report, published in 2001, and a database of likely peatland locations developed from a modelling exercise. This database

was recently updated and refined as part of a WRC-funded project entitled ***South African Peatlands: Ecohydrological characteristics and socio-economic value*** (**WRC Report No. 2346/1/17**). Project leader, Dr Piet-Louis Grundling, who was a co-author of the earlier report, headed up a team of five researchers from various organisations and consultancies. When the project was awarded he was employed at WetResT, but he is currently the Deputy Director: Programme Implementation for Working for Wetlands, and is also affiliated to the University of the Free State's Centre for Environmental Management.

The project team conducted a literature review to find new records of peatlands published since the previous survey, and also put out a call to the wetland and soil science community to contribute information. Using this expert knowledge and the existing model, a geographic information system (GIS) map depicting areas where peatlands potentially occur was produced. An accuracy assessment using known peatland distribution revealed that the greatest accuracy (87%) was attained when the old and new models were combined.

This exercise resulted in 990 additional data points being incorporated into the South African Hydrogeology Database. However, only 116 of these qualified as peatlands according to the criteria that they must contain >30% organic material (dry mass) or 15-29% carbon over a depth of at least 300 mm. Although just 10 of these 116 points have been verified infield, they have all been added to the South African Peatland Database, which is compatible with SANBI's National Wetland Inventory. The database is hosted and maintained by ARC-Soil, Climate and Water, where Dr Althea Grundling – Piet-Louis' wife and a fellow member of the project team – is employed as Senior Researcher: Wetlands.

The updated database now contains 635 peat points, but they add up to only about 1% of the country's total wetland area. So how important are South Africa's peatlands in terms of carbon sequestration – the capture and storage of atmospheric carbon dioxide? The project team evaluated this by estimating the annual carbon accumulation rates and the current levels of carbon stocks, using physical data pertaining to various peatlands countrywide and extrapolating to other peatlands where such data were lacking. Not surprisingly, the climate regulation ability of South African peatlands is rather paltry on a global scale, but the amount of carbon accumulated per year is nevertheless equivalent to the average annual greenhouse gas emissions produced by between 1 900 and 34 000 passenger vehicles! In Rand terms, the sequestration value is estimated to be at least R5.6 million per year, and possibly as much as R19.8 million.

More important for a water-stressed country like ours, though, is the ecosystem service provided by peatlands in the form of water quality regulation. Peatlands not only remove contaminants from water flowing through them, but also trap sediments, so they play a natural water purification role. And like other types of wetlands, they act as a sponge, absorbing water in times of plenty – providing they are not completely saturated already – and then gradually releasing it. In so doing, they help attenuate floods and sustain water flows for human use and aquatic health. The cumulative value of such ecological services was estimated by the project team to be as high as R174 billion, expressed as an ecological infrastructure value. This means that for every R1 of carbon storage value, approximately R12 can be added for other ecosystem services.

Clearly, peatlands are worth protecting, yet only 35% of the 635 peat points in the database are in formally protected areas, and even those are not immune to damage. Fortunately, commercial extraction of peat, which can be used as a fuel, horticultural soil amendment, filtration medium and construction material, has been halted in South Africa as it is unsustainable, and activities that might affect wetlands of any kind require authorisation in terms of the Environmental Impact Assessment Regulations. Nevertheless, water abstraction, alterations of watercourses, encroachment of infrastructure, urban and industrial effluent, and agricultural land transformation are all causing degradation of peatlands, with knock-on effects for aquatic ecosystems downstream.

"Forestry plantations in northern KwaZulu-Natal are having a particularly severe effect," says Piet-Louis. "Peatlands there are able to cope with natural dry and wet cycles to some extent due to the peat surface oscillation effect. In dry years, when the water table starts to drop, water flows out of the pores of the peat fibre, which causes it to collapse in upon itself, and the whole peat surface subsides, allowing it to stay close to the water table and remain moist. When the system wets again, the pores fill up with water and swell, so the surface raises. But these processes can't happen if the water table drops for a long period of time, as in plantations where the trees are pumping out the water through transpiration."

Elephants, buffalo and other animals visiting the Malahlapanga wetland for water have damaged a 4 000-year-old peat dome, but rehabilitation measures are underway.

Althea Grundling

Desiccation due to the forestry plantation surrounding Vasi Pan probably increased the peatland's vulnerability to fire.

"The amount of carbon accumulated per year in South Africa's peatlands is equivalent to the average annual greenhouse gas emissions produced by between 1 900 and 34 000 passenger vehicles."

One of the consequences of this inadvertent drainage by the plantations is that the peat is prone to burning as it dries out, so fires set for forestry management or livestock grazing purposes may result in underground fires that can burn for weeks or months. Between 2014 and 2016, the ***Zululand Observer*** regularly published articles about the impact of acrid smoke from plantation fires on the residents of Richards Bay, but more recently the problem has shifted further afield, where rural communities bear the brunt of the health effects. Fires like these are a feature of peatlands worldwide, hence the title of the Global Peatlands Initiative report mentioned earlier – 'Smoke on Water'. For example, peat fires in Indonesia in 2015 released more carbon dioxide than the total emissions of Japan for that year, and in August 2017 a massive wildfire attributed to burning peat was detected on Greenland's tundra via satellite imagery.

"At a peat seminar and workshop held in Pretoria on 2 February to mark this year's World Wetlands Day, the need for special training for firefighters likely to encounter subsurface peat fires was identified," says Althea. "We will also be starting a new WRC-funded project in April on the use of multi-platform remote-sensing tools for peat fire detection and monitoring."

Marvin Gabriel

In order to qualify as peatland, a wetland must contain more than 30% organic material (dry mass) or 15-29% carbon over a depth of at least 300 mm.

For the completed project, the researchers selected the following eight peatlands representing different geology, climatic conditions, hydrogeomorphic settings and land use to study the various processes and factors driving peat distribution and accumulation in South African wetlands.

Vazi North is a grass-sedge peatland forming part of the Vazi Pan within the Manzengwenya State Plantation in the Maputaland region of KwaZulu-Natal. The forestry plantation has probably contributed to the lowering of the water table during the drought, resulting in extensive peat fires and providing an environment favourable for invasive vegetation. Ownership of the plantation is being transferred to a trust representing the local community, who already use the pan and surrounds for livestock grazing and water supply purposes.

Malahlapanga wetland lies on the banks of a small tributary of the Mphongolo River in the north-eastern part of the Kruger National Park. It contains a globally rare hot spring mire – a mire being an active peat-accumulating wetland – with a number of small domes of reed-sedge peat. These have been damaged as a result of trampling by elephant, buffalo and other wildlife, so Working for Wetlands has begun assisting SANParks with rehabilitation measures.

Matlabas Mire, in the Marakele National Park, is situated in the headwaters of the Matlabas River, which flows into the Limpopo River. As such it plays a significant role in maintaining baseflows to ecosystems downstream. This is a high-altitude wetland in a steep-sided valley, and has a fast rate of peat formation – mostly grass-sedge peat – compared to other southern African peatlands. The system has been degraded from past land-use practices, but SANParks intends initiating rehabilitation measures with assistance from Working for Wetlands.

Lakenvlei, near Belfast in Mpumalanga, contains reed-sedge peat in the permanent zones of this valley-bottom wetland. The area supports high biodiversity, and in last year was declared the Greater Lakenvlei Protected Environment by the provincial government. Although it is in a healthy ecological state, it is affected by various impacts from mining, agriculture, forestry and infrastructure within the catchment.

Colbyn Valley peatland, located along the upper Hartbeesspruit in Pretoria East, is an urban open space providing opportunities for hiking, birding, environmental education and research. The reed-sedge peat is important for wetland filtration and flood attenuation, and thus helps improve the health of ecosystems downstream. Tshwane Metro and Working for Wetlands have supported the very active Friends of Colbyn Valley in undertaking erosion control work.

Gerhard Minnebron wetland, near Potchefstroom in the North West Province, is a karst wetland that formed as a result of dissolution of limestone in the dolomitic landscape. It is fed by several springs, including the Gerhard Minnebron Eye, from

Gamtoos Irrigation Board

In an effort to protect the last remaining peatlands and palmiet wetlands of the Kromme River in the Eastern Cape's Langkloof, Working for Wetlands has funded a number of costly erosion-control weirs.

which water is diverted for agricultural use. The wetland contains abundant reed-sedge peat that was extracted until recently, and this – together with the diversion of water – has caused dehydration and desiccation of large areas of the wetland, with some parts subsequently destroyed by fire.

Kromme peatland is part of the much larger Kromme wetland complex between Joubertina and Kareedouw in the Langkloof of the southern Cape. It is a rare peatland type in that it comprises palmiet-sedge peat, formed due to the growth behaviour of the palmiet plant, which is endemic to South Africa. By spreading across watercourses, palmiet blocks channels, traps sediment and slows the flow of water, creating conditions conducive to peat accumulation, but also causing back-flooding of agricultural land and infrastructure. As a result, palmiet wetlands were often destroyed by farmers in the past, but many were also lost to erosion exacerbated by roads and other infrastructure.

Vankervelsvlei, situated in a forestry plantation near Sedgefield on the southern Cape coast, contains what is thought to be the country's thickest peat system – up to 12 m thick in places. The lower layer is about 40 000 years old, with a younger layer of sphagnum peat above it. The vlei lies in an interdunal depression and its surface is dominated by reeds and rushes. The peatland is largely undisturbed, but it is unknown how it will respond to changes brought about by the extensive wildfires in the area in June 2017.

Water flow measurements and isotope analyses conducted for the study confirmed that peatlands in South Africa are mostly dependent on groundwater for maintaining their condition and productivity, but that they primarily formed during the past 15 000 years, with the period of about 5000 before present being most favourable for peat accumulation.

"For the majority of points in the peatland database, though, somebody must still travel there, put in an auger to see how deep it is, determine the carbon content and age of the peat, and properly describe the system," says Althea. "That's a big need – to take the database forward and validate it – but it would require significant funding."

The research report concludes with a list of management recommendations provided by the project team for all the case study sites, some of which are already being addressed.

"We held a workshop during the Wetlands Indaba in October 2017, and it was decided there that the government departments should get together and try to coordinate action," says Piet-Louis. "Hopefully, if we pool our resources we can make more of an impact in addressing peatland degradation."

To order the report, ***South African Peatlands: Ecohydrological characteristics and socio-economic value*** (**WRC Report No. 2346/1/17**) contact Publications at Tel: (012) 761-9300, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download an electronic copy.