THE WATERBERG COALFIELD was discovered in the 1920s, but was too far from the economic heartland of the country to develop. However, faced with the current and growing electricity crisis, and with enough coal for the next 150 to 200 years to fire eight power stations, the region is set for dramatic change.

The Medupi Power Station is the biggest coal-fired power plant ordered by Eskom for the past 80 years. Because the region is so water-stressed, it will operate with air-cooled condensers. Exxaro’s Grootegeluk coal mine, also at Lephalala, will be expanded to accommodate the increased demand for coal.

The Waterberg forms a wide basin in which four of the main rivers in Limpopo originate – the Lephalala, Mokolo, Matlabas and Mogalakwena rivers. Funded by a parliamentary grant, the three-year CSIR research project is focusing on the current state of the aquatic ecosystems of the upper and middle reaches of the Mokolo and Lephalala rivers.

LIMPOPO RIVER BASIN UNDER STRESS

Dr Pete Ashton, principal researcher and unit Fellow at the CSIR, says the Limpopo River basin is particularly water-stressed. “Every tributary river in the basin has been exploited to the limits possible by conventional engineering approaches. Efforts to meet society’s demands for water for domestic, irrigation, mining and industrial uses have caused a progressive deterioration of the aquatic ecosystems.”

Additional atmospheric depositions from the planned new coal mines and power stations in the area, combined with increasing agricultural activities and the development of new towns to house the employees of mines and power stations, “will only exacerbate the already poor water quality situation and accelerate the rate at which aquatic ecosystems deteriorate.”

There is simply too little water available in the basin to support projected developments and new supplies of water will have to be brought in via inter-catchment transfers,” explains Ashton.

DEVELOPING ECOLOGICAL INDICATORS FOR THE WATERBERG

Contextualising the research in the Waterberg, CSIR principal researcher and project leader, Dr Paul Oberholster, draws a comparison with the Olifants River. “It is nearly impossible to determine what the ecological status of the Olifants River was before mining started a hundred years ago. Today it is one of the most polluted rivers in South Africa. While we cannot keep nature in a glass cage, maybe this time we can do it differently.”

The likely adverse consequences in the Waterberg could be minimised if managers and decision-makers base their decisions, plans and actions on a sound scientific under-
standing of the current ecological situation in the basin, as well as an understanding of the cause-effect relationships that link atmospheric deposition and land-use patterns to water quality changes and their ecological consequences.

In this regard, the CSIR is already partnering with the Department of Water and Environmental Affairs (DWAF), and is discussing collaboration with industrial stakeholders such as Eskom.

The CSIR’s Waterberg study area aims to develop a set of ecological indicators that provide an accurate estimate of the ecological status of the river and wetland ecosystems in the study areas. These will then be used to detect existing processes of change in the aquatic ecosystem and to estimate the likely future direction and extent of changes that increased atmospheric deposition, water pollution and water transfers will cause.

“The results will provide the basis for management guidelines designed to inform and direct management actions aimed at ensuring the long-term sustainable use of the Waterberg rivers and their aquatic ecosystems,” Oberholster says.

During a field trip in 2008 the researchers discovered an extremely rare organism never before recorded in Africa, or in a river. This rare species of colonial protozoa is extremely sensitive to heavy metals in water and occurs only in unpolluted water with very high light penetration. The researchers have also confirmed earlier DWAF reports of new species of fish that still need to be formally classified.

“It is extremely important for us to be out there in the field, seeing for ourselves the structure and composition of the aquatic ecosystems in these rivers and also the changes in the rivers and their surroundings. One cannot get the bigger picture sitting in front of a computer in one’s office, and, without a clear overview, decisions that are taken in isolation are seldom based on reliable or useful evidence,” says Oberholster.

The researchers have started to engage local conservation groups and land owners in the area in a programme to collect rainfall samples, which will be analysed to check for atmospheric deposits.

In addition, the project is building scientific and technical capacity by taking young CSIR interns on the field trips where they are exposed to terrain analysis, catching fish and habitat assessment. Staff members from the Directorate Resource Quality Services of the then DWAF also accompanied the team on the third sampling visit last year. — Wido Bason


FIELD TRIPS PROVIDE THE BIGGER PICTURE

Since last year a team of specialists have made four field trips to six different sampling sites in the two rivers. Some of the ecological indicators sampled are chemical water quality, isotope studies to determine the structure and importance of aquatic foodwebs, sampling of phytoplankton and benthic algae, protozoa, insects and fish.

During a field trip, researchers first deploy sampling equipment and pre-rinsed, polyethylene bottles, which are kept on ice in the dark during transit back to the CSIR’s laboratory where their chemical composition will be analysed. The phytoplankton samples will be examined under the microscope to determine which species of phytoplankton are present.

At each site, duplicate water samples are collected for standard chemical analysis and assessment of the phytoplankton species that are present. Here MSc student Arno de Klehr helps Paul Oberholster to collect the samples and store them in pre-iced, polyethylene bottles. These samples are kept on ice in the dark during transit back to the CSIR’s chemical analytical laboratory where their chemical composition will be analysed. The phytoplankton samples will be examined under the microscope to determine which species of phytoplankton are present.

CSIR senior researcher Dr James Dabrowski measures the water flow velocity at each site using a paraplex flow-meter at 50 cm intervals along a cross-section transect of the river. This provides an estimate of streamflow velocity on each visit to understand the specific flow features that characterise each sampling site.

MSc student Leanne Graham helps CSIR researchers Peter Woodhill (specialist on invertebrates) and Grant Hall (isotope techniques) to identify the invertebrates and algae. After these have been identified, the invertebrates are returned to the water, while a small sample is held back for isotopic analysis. This is important to establish a baseline for the isotopic signature of the aquatic foodwebs of the Waterberg and provides scientifically sound information on where specific isotopes come from.

CSIR researcher Klaudia Schicklothuneder uses a plant press to preserve samples taken from the riparian vegetation along the river banks at the different sampling sites. She identified the Waterberg saxifrage (Saxifraga cordata) as the one tree species that is present at all of the different sampling sites. The health and vigour of this species could be used as an indicator of changes in water quality and water availability.

On arrival at each sampling site, the dissolved oxygen, water temperature, pH and electrical conductivity values are measured in situ at the water surface using a portable multiparameter. This information provides an immediate picture of the general conditions at each sampling site.

On arrival at each sampling site, the fish are stunned by electrical shock, collected in bins, identified and returned to the water. Here James Dabrowski is geared up with the electrical shocker while Oberholster and MacMillan collect the fish.

For a standard period of time and at the same place with each sampling trip, the research team uses an electrical shocking machine to temporarily stun the fish. The fish are then collected in bins, identified and returned to the water. Here James Dabrowski is geared up with the electrical shocker while Oberholster and MacMillan collect the fish.

Six different ecological indicators are used to create a holistic picture of the different trophic levels in the foodweb and possible impacts of pollution at that specific site. Pollution is difficult to measure as it quickly moves through the river and becomes dissolved. However, traces of how pollution has affected an area can be found and analysed by looking at indicators such as phytoplankton and benthic algae, macro-invertebrates and fish, while isotope studies will give an indication of the possible accumulation of heavy-metals in the fish and invertebrates.

When these tests are standardised and done on a regular basis, it gives scientists a better understanding of the ecological processes that characterise rivers and dams and also how outside influences — such as pollution — alter these processes.

ON A R R I V A L at each sampling site, the team immediately gears up for the different field measurements and sample collection procedures.

The results will provide the basis for management guidelines designed to inform and direct management actions aimed at ensuring the long-term sustainable use of the Waterberg rivers and their aquatic ecosystems, Oberholster says.

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