WATER RESEARCH COMMISSION

October 2015
The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

Wetlands

A completed Water Research Commission (WRC) study looked to improve our knowledge of South African pans (endorheic wetlands).

A completed Water Research Commission (WRC) study looked to classify and analyse wetland vegetation types for conservation planning and monitoring

Background

Pans (endorheic wetlands) are more vulnerable to anthropogenic stress because of their isolated nature and hydrological regime. There are constant fluctuations in the duration and frequency of the inundation period.

Small changes in the natural hydrology can have significant impacts on the ecology of these wetlands. It is necessary to assess the ecology of these unique and fragile ecosystems to fully understand the impacts that anthropogenic activities will have.

It is also a necessity to find new ways of monitoring for such impacts in the shortest time possible with minimal efforts, for the benefit of both the environment and researchers involved. Studies have shown there is large variability within the physico-chemical parameters of pans.

This variability has a major influence on the presence and abundance of aquatic invertebrates and plants and the invertebrate fauna that inhabit these environments have various physiological, behavioural and structural adaptations enabling their survival in a constantly changing environment.

With many of the pans in South Africa occurring in areas where there has been an increase in mining activity, it has not been unexpected that the number of environmental impact assessments and monitoring programmes have also increased.

As is the case with most biotic indices and methods used in water resource management, studies on pans are also reliant on the selection of relevant reference conditions. The variability observed within these ecosystems also complicates the selection of appropriate reference conditions.

Methodology

As pans occur over a wide range of climates, three areas with a high density of pans were selected as study areas. These areas were the Lake Chrissie area in Mpumalanga, Wesselsbron in the Free State and Delareyville in North West.

These areas differ in climate and rainfall, but still contain perennial and ephemeral pans. An initial survey was undertaken during May 2012 to select appropriate study sites and to collect sediment for the hatching experiments as well as water samples for physico-chemical analyses.

Surveys were also undertaken between December 2012 and January 2013 and between March and April 2013. These surveys were undertaken to collect water samples for physico-chemical analyses.

Assessing the hatching success of egg banks in pans

The invertebrate fauna that inhabit pans are highly adapted to survive these constant changing environments. A particularly important group of fauna that inhabit these ecosystems are the Branchiopoda.

Branchiopod diversity and successional patterns could be determined from small amounts of sediment. Abundances obtained here are comparable to other studies assessing the hatching success of zooplankton communities.

The North West and Free State provinces, in particular, had high cumulative abundances. The Mpumalanga pans had the lowest abundance of hatchlings emerging from the sediment.

This was not an unusual result as pans sampled in the North West and Free State provinces were largely ephemeral in nature, while those sampled in Mpumalanga were of a perennial nature.

The patterns of hatching found in the study, throughout all three provinces, were similar to in-situ patterns of pan succession observed in other studies. Anostracans were generally the first group of crustaceans to be identified after inundation, followed by the Cladocera.

The diversity of pan communities was different between pans and between regions for the larger part of the pans studied. From this it seems that pans have their own unique communities, and each one contributes towards regional diversity.

Determining the impact of acid mine drainage (AMD) on pan fauna

The hatching of branchiopod crustaceans was found to be inhibited by the presence of AMD. It was also demonstrated that the recovery of these aquatic invertebrates after AMD exposure was low.

When compared to the diversity of aquatic invertebrates obtained from the controls it could clearly be seen that AMD altered the community structure of the branchiopods which recovered. The diversity of individuals was much lower as a result of the AMD. This shows how poorly the community will respond to the removal of this stressor.

Even though recovery did take place in a few pans, the number of individuals may be too low to replace the number of eggs affected by the AMD. The buffering capacity of the egg bank will be lost, and the egg bank will eventually deplete itself during future inundations.

Species extinctions as a result are inevitable, which raises the concern that wetlands impacted to such an extent by such a stressor may be beyond rehabilitation.

Testing the applicability of a trophic stated-based classification system for pans

Pan ecosystems are some of the most variable systems in South Africa. Their endorheic nature and the resultant variability make comparison to other wetlands and even other pans problematic.

To determine the spatial and temporal variation in the physico-chemical characteristics of the water from the various pans in the Mpumalanga, North West and Free State provinces, surface water samples were collected during each of the surveys.

All water quality analyses were carried out by Chemtech Laboratories (a SANAS accredited laboratory). The water analysis included nutrients, salts and metals.

The in situ physico-chemical variables that were sampled during the current survey included temperature, pH, dissolved oxygen concentration (DO) and saturation (DO%), total dissolved solids (TDS) and electrical conductivity (EC). The *in situ* analysis was undertaken using a pre-calibrated WTW 340i multi-parameter hand-held water quality meter.

Large variability was observed in the nutrient and salt concentrations of the selected study sites. This variability observed on a spatial scale was expected.

The climate and rainfall varies between the different provinces. The pans from Mpumalanga are generally more perennial in nature when compared to pans in the North West and Free State.

This was evident in this study as most of the pans in Mpumalanga had water during both surveys while only on the second survey water was present in North West. No water was present in the Free State although in previous seasons water was present throughout a whole year indicating the importance of rainfall in the pan catchment for filling of the pans.

The more perennial a pan is the more stable the physico-chemical variables will be and vice versa for pans that are more ephemeral. The Electrical Conductivity (EC), for example, ranged between 0.19 Ms/cm and 9.06 Ms/cm in Mpumalanga. In comparison the EC in the Free State and North West provinces ranged from 0.81 Ms/cm to 110.56 Ms/cm. In addition to the spatial variability, large temporal variability in water quality characteristics was also observed.

The current study did initially attempt to classify the pans from Mpumalanga, Free State and North West based on their salinity and nutrient data based on the Hutchinson et al. (1932). However, as was seen in the statistical analysis no real classification or different groups were identified based on the water quality.

The classification of pans based on their water quality variables were first attempted by Hutchinson et al. in 1932 on various pans in the Lake Chrissie area. Since then a few studies have attempted to classify pans based on their water quality as well as their biological communities. However, no one method has really been successful. This is due to the inherent variability within these pan systems.

Conclusions

It can be concluded that Branchiopoda can successfully be hatched from sediment collected in situ under controlled laboratory conditions. The hatching patterns are also closely related to patterns observed during *in situ* studies.

This clearly indicates that egg bank analysis can be used as a monitoring tool and can aid in the determination of diversity when pans are desiccated. This becomes essential in any impact assessment.

It is further concluded that AMD has a negative impact on the egg banks within pans and causes a loss of biodiversity. Ultimately this demonstrates how AMD will degrade these unique environments should its disposal not be properly managed and should mining activities continue to encroach upon the vicinity of these wetlands.

It is critical that the integrity of these ecosystems be maintained for all that depend on them. Due to the inherent variability within endorheic wetlands, attempts to classify these systems according to trophic state or salinities have been unsuccessful.

The variability observed in water quality was also observed in the invertebrate communities that inhabit these ecosystems. There was large spatial and temporal variation in biodiversity when comparing the communities from the various sites selected in the three provinces.

The water quality dataset collected throughout this project was used to determine ranges within the water quality variables for pans from Mpumalanga as well as from the North West and Free State provinces. These ranges can potentially be used to look if any variation out of this range has occurred and whether it is due to an anthropogenic impact.

Further reading:
To order the report, *The hatching success of eggs banks of selected endorheic wetland (pan) fauna and a suggest water quality classification of pans* (**Report No. 2190/1/14**) contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.