WATER AND THE ENVIRONMENT

New mayfly species discovered in Kruger adding bricks to conservation foundation

Discovery of new mayfly species in the rivers of the Kruger National Parks illustrates how much South Africans still need to learn about their freshwater ecosystems. Article by Petro Kotzé.

All photographs supplied

Project leader, Dr Lizaan de Necker, with fellow postdoctoral fellow Dr Hannes Erasmus and Honours students Nobukhosi Sithole and Herman le Roux conducting field work for the bilharzia research project.

"Mayfly taxonomy is not considered to be a sexy science," Dr Helen Barber-James says. Though not the most popular choice of study field, it is very important. Barber-James would know. A freshwater biologist, she has dedicated much of her career to exactly that – the biodiversity, systematics and biogeography of freshwater invertebrates, especially the Ephemeroptera (mayflies).

Nevertheless, there is still much work to be done. Last year, Barber-James led a team that identified two new mayfly species, and at least seven caddisfly species from the Kruger National Park's rivers. "It's amazing that we are still finding all these new species in such well-studied rivers," she says. The specimens are tiny; the mayflies only 3 to 4 mm long but, in addition to being exceptional finds, they are also an important part of a very large picture. Key to unlocking the messages from the mayflies, is calling each by their name.

An important aquatic inhabitant

The name mayfly refers to the time of year they emerge in the Northern Hemisphere (in spring, typically starting in the month of May). The tiny critters are perhaps commonly best known for the short lifespan of the adults (in many cases not even a day, sometimes only a few hours) and for occasionally emerging in large swarms depending on the species, but there is much more to them.

Mayflies are one of the oldest groups of insects, and date back to the late Carboniferous or early Permian periods, some 290 million years ago, says Barber-James, who co-published the findings on the two mayflies with international mayfly expert, Dr Peter Malzacher.

They spend the bulk of their lifetimes unseen under water, where, in their developing nymphal stage, they cling to rocks and aquatic plants, feeding on microscopic plants and bacterial growth (periphyton). A few of them burrow in river banks under the water surface and in the sediments. They play an important role in nutrient cycling through the aquatic ecosystem and are a rich source of food to many other species.

All of these functions make them essential to the ecosystem, but they are also very sensitive to changes within it. As such, mayflies are indicators of ecosystem health. Several mayfly families are included as indicators in the South African Scoring System (SASS5) biomonitoring system, which forms the backbone of South Africa's River Health Programme.

Different mayflies have different sensitivities, so their presence or absence can tell a lot about the quality of a freshwater system. "Every single one of them has a slightly different ecological role to play, is adapted to live in a particular area, and has a different sensitivity to change," Barber-James says. Researchers count on them to indicate the state of the rivers, and in this case, the rivers of the Kruger National Park.

KNP game guard, Moffat Mambane, with Lyndall Pereira da Conceicoa and Helen Barber-James.

Counting critters in the water

The researchers conducted detailed surveys of the freshwater macro-invertebrate fauna of selected rivers within the park. With funding from the National Research Foundation (FBIP programme), Rhodes University and the South African Institute of Aquatic Biodiversity (SAIAB), Barber-James led the project in her capacity as head of the Department Freshwater Invertebrates at the Albany Museum, with the help of post-doctoral fellow, Dr Alexandra Holland and several post-graduate students.

It is common practice to record the presence of families of freshwater macro-invertebrates when scoring the health of aquatic ecosystems but, uniquely, this study dug down to species level. Only looking at family level is far too shallow for a biodiversity study, Barber-James says.

So, with the Kruger rivers survey project, they look at species within families of aquatic macro-invertebrates. Documented species richness and distribution is then compared to a similar study carried out in the 1980s (by Moore and Chutter, see reference below), to see how the species complement and abundance has changed.

However, for the species to be documented, they have to be known. "We have to know whether it's a Caenidae mayfly or a Baetidae mayfly and within those families what the species are," she says. "Species identification is the foundation of all ecological studies."

Helen Barber-James finding the best site for sampling.

Walking to a site with some of the KNP colleagues and game guards.

What's in a name?

All living things are named according to a classification system that dates back a long time ago, developed by a Swedish botanist from the 17th century, Linnaeus. With some modifications, this system is still in use today. There are now eight taxonomic ranks, which broadly group similar organisms, starting with the broadest categorisation and going down to the finest (species) level. The levels are domain, kingdom, phylum, class, order, family, genus and species.

To put this in context, the two newly discovered mayflies from Kruger are from the kingdom Animalia, in the phylum Arthropoda (joint-legged animals), in the insect class and part of the order Ephemeroptera, meaning they are winged creatures with a short life (ephemeral wings). More specifically, they belong to the family Caenidae, and are part of the genus ***Caenis***, which is widely distributed in Africa (yet still poorly studied). The adult ***Caenis*** males are characterised by forceps with a tuft of long spines, while the nymphs typically have square gills covering the rest of the gills on the body (hence the common name square-gill mayfly). The two new species have been named ***Caenis albicans*** (referring to the white body) and ***Caenis letabanensis*** (from the Letaba River)**.**

For the sake of comparison, lions and leopards are also part of the Animalia Kingdom, the phylum Chordata, class Mammalia, order Carnivora, the family Felidae and the genus ***Panthera***. It's only at species level that they are classified as lion and leopard. In the aquatic world, ***Caenis albicans*** and ***Caenis letabanensis*** are thus as different and significant as lions and leopards.

However, the classification of the specimens is difficult and time-consuming. Often there's not enough literature or reference papers published as far back as the 1930s or earlier, sometimes written in foreign languages, need to be referenced. "It's a tremendous task," says SANParks aquatic ecologist, Robin Petersen, which is why SANParks needs the help of outside researchers to do it.

Unfortunately, the pool of researchers to fish from, is small. This is work for specialists, Petersen says, of which there are only a small handful with limited networks to call on. Plus, the pool is not growing substantially. "It's totally not seen as trendy," Barber-James says.

A further challenge is ongoing funding for foundational biodiversity research. We are very grateful to the NRF Foundational Biodiversity Information Funding (FBIP) programme for supporting this project for three years, she says. The study happened to coincide with a period of extreme drought and, ideally, should have continued into the period of renewed rainfall after the drought broke. But since their funding came to an end, they have had to move on to other projects.

This challenge is not new. A 2001 Technical Report (Herbert et al. 2001) written to bring critical issues relating to taxonomy and systematics research in South Africa to the attention of the then-Department of Arts, Culture, Science and Technology (DACST) and the NRF, highlighted that much of South Africa's unique and diverse biological heritage remains undocumented, and until it is made known and studied, cannot be conserved or utilised.

The authors warned that capacity for taxonomy and systematics

Caenis albicans larva

Caenis albicans male

Caenis breviceps larva

Caenis breviceps male

research in South Africa was already in danger of falling below critical mass levels, if it had not already done so. The lack of systematics research has management implications, up to national governmental level and impacts on our country's international commitments.

In Kruger, for example, the project results can advise management strategies. According to the project proposal, "monitoring of the environmental conditions affecting the invertebrate species living in these rivers, and looking beyond the broad family level used in regular biomonitoring, will allow recommendations to be made for reducing the pollution levels from external land use".

Furthermore, if rare species are found these can be placed on the IUCN Red List of Threatened Species, which can help put pressure on organisations responsible for causing pollution. The benefits of creating a suitable freshwater environment to aquatic fauna will also spillover to other megafauna.

Already, the aquatic vertebrate species are telling researchers much about the state of the Kruger rivers.

What the mayflies say

So far, they have sorted, identified and catalogued the samples collected over the three-year period and identified some of the groups to species level, Barber-James says. They focused on Ephemeroptera, Trichoptera and Plecoptera (the so-called EPT indicator species) and Odonata (dragonflies and damselflies). There are two reasons for this, she says. This first is that these groups are well recognised as ecologically sensitive. The second is the expertise available. For some of the other groups, they need additional experts for accurate species-level identification.

While the paper on ***Caenis albicans*** and ***Caenis letabanensis*** was published earlier this year, Dr Alexandra Holland (under the guidance of (retired) caddis expert at the Albany Museum, Dr Ferdy de Moor) is still at work on the mentioned caddisfly species, as part of her post-doc research.

Regardless of the exciting new findings, early results from the surveys also indicated a decline in total mayfly abundance and species diversity over time at some sites. The researchers concluded that this is possibly due to increased effects of mining and other upstream land-use activities affecting some of the rivers, or coinciding with drought periods. Another serious concern is the presence of the alien freshwater snail, ***Tarebia granifera***. This native to Southeast Asia is outcompeting some of the indigenous aquatic macroinvertebrate fauna and could be part of the cause of decline in diversity of the indigenous freshwater macroinvertebrate species.

There is still much more work to be done in these rivers, Petersen says, with different aquatic species in the park that have been studied more than others. Fish and riverine areas in general are well defined, and comprehensive inventories on reptilians and frogs were conducted in the seventies and eighties though few resurveys have been conducted since.

"There's endless work," Barber-James says, "but it's hampered by inadequate expertise to really assess the biodiversity of our systems." Considering the global realisation of massive decline in species diversity and numbers over recent years, this work is timely. What we really need is more people to do this kind of work. Across the continent, she says, we run the risk of losing species quicker than we can record them. Without an efficient baseline of species in place, we cannot measure change effectively. Without this foundation in place, she says, any knowledge is built on shaky ground. We might never know the price that we pay for this gap.

References

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