



Smart technology helps brings researchers closer to SA's aquatic life

South Africa might be water scarce but its rivers nevertheless support a vast array of wildlife both on the surface and underwater. A new locally developed biotelemetry system is helping us understand what is rolling in the deep. Lani van Vuuren reports.

Biotlemetry involves the use of transmitting devices to monitor the behaviour and physiology of animals in their natural environment. This monitoring technique is proving to be increasingly useful to researchers around the world. Biotlemetry devices allow researchers to document, for long uninterrupted periods, how undisturbed organisms interact with each other and their environment in real time.

For the last four years the Water Research Commission (WRC) has been funding a series of studies which have led to the development of a locally produced biotlemetry system to monitor the behaviour of aquatic organisms in South Africa. Through collaborative efforts between the Water Research Group at North West University (WRG-NWU), the Centre for Aquatic Research at the University of Johannesburg, Scientific Services at South African National Parks, E Oppenheimer and Son and biotlemetry system specialists Wireless Wildlife International, the technology has now been successfully developed and tested in the field.

Project leader Dr Gordon O'Brien, of the WRG-NWU, explains that biotlemetry methods are internationally recognised as one of the most effective ways of acquiring behavioural information of fishes and other aquatic animals over extended periods within their natural environments. "We are particularly interested in using the behaviour of these organisms to develop our understanding of their biology and ecology and then to evaluate the impact of changing environmental variables such as water quality, quantity or flows and habitat on their behaviour. This will allow us to establish management guidelines for these environmental variables which will contribute to the conservation of species."

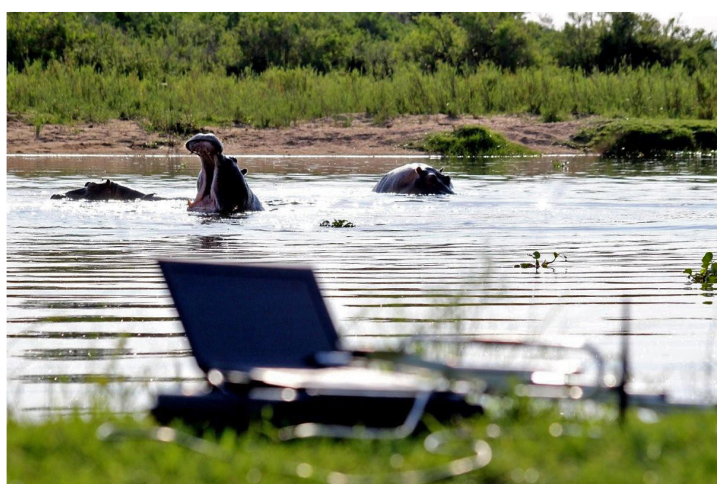
REMOTE MONITORING

So how does it all work? The locally-produced biotlemetry system makes use of remote and manual tracking or monitoring systems as well as smart tags or transceivers. The latter is attached to the organism being monitored. Once tagged the animals (in the case of the study fish and crocodiles) are released to re-establish their normal behavioural patterns. With remote and manual monitoring systems researchers now monitor the continuous behaviour of the animal for at least a year.

The remote monitoring systems include the use of 'listening stations' or receivers that are deployed

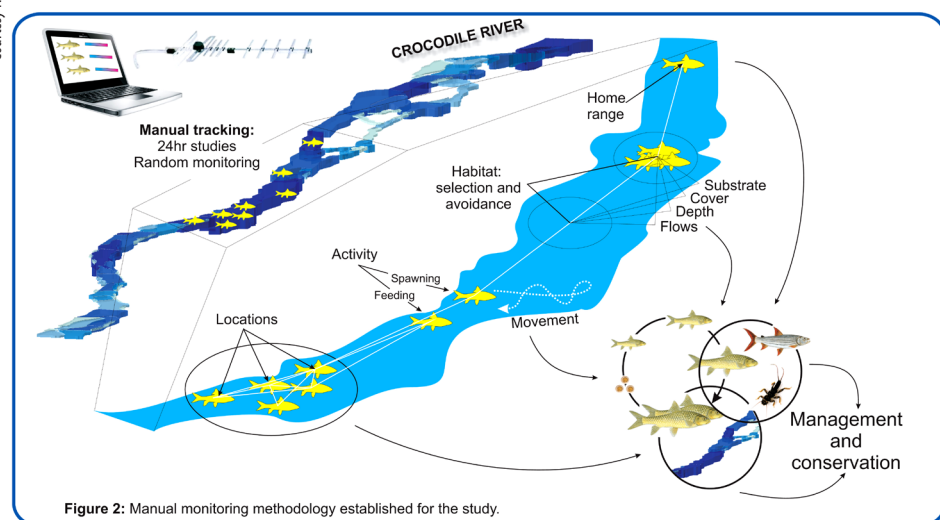
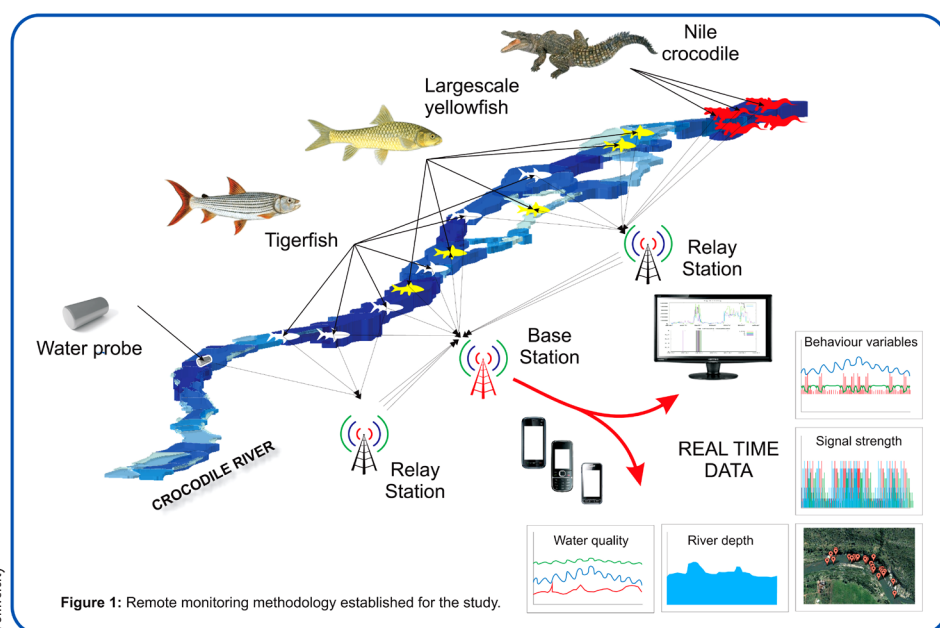
"We have already had a few close encounters with crocodiles, hippopotami, pythons and pathogens."

into the study area. These record and transmit information from the tags at a ten-minute interval to an Internet-based data management system. The researchers can log onto the data management system at any time from any computer with Internet access and download real-time behavioural data from the tagged animal. In turn, manual monitoring systems involve the use of directional antennae and hand-held receivers which are used to locate and download behavioural data from any tagged animal in the field.



Courtesy North West University

Monitoring South African wildlife can be a dangerous occupation.



According to Dr O'Brien, the benefits of combining remote and manual monitoring methods are that scientists can manually monitor the behaviour of the tagged animals and important environmental variables whenever they choose, as well as get additional information from the remote systems when they are not in the field. "Fortunately although the approach we have developed is unique, biotelemetry methods are not, and we have access to a wide range of very useful data analyses methods that allow us to graphically and statistically analyse the behavioural data we collect."

The type of behavioural aspects of the aquatic organisms that can be monitored include the location of the animal, the movement and activity as well as some environmental variables, including the depth of the animal in the water, as well as the temperature in the water. In addition, by monitoring the location, movement and activity of the animal over extended periods of time, the team is able to evaluate the response of the animal to changing habitat variables, flows, water quality components and weather variables, such as atmospheric pressure.

Data collected on a monthly basis can miss the short-term water resource quality changes that can affect aquatic life, making real-time data monitoring all the more important, explains Bonani Madikizela, Research Manager at the WRC. "The kind of technology developed through this research allows authorities to react more quickly, not only protecting our biodiversity but also affording a greater chance to apprehend polluters."

Unfortunately the size of the tag is largely limited by the battery needed to power the tags. This means that the smallest tags that last one year are currently the size of an AA battery and weigh about 18 g. Due to the size of the tags the WRC studies have focused on adult aquatic animals that grow larger than 1 500 g. Smaller tags (10 g) are available for fish, however, they last only for three months. The smaller tags have been designed to address specific conservation or management questions for smaller fish species which can be answered with a limited amount of behavioural information.

TESTING THE WATERS

The Crocodile River, which forms the southern boundary of the Kruger National Park, was recently selected to carry out an experimental behavioural ecology study to test the locally manufactured biotelemetry equipment. Seven Lowveld large-scale yellowfish (*Labeobarbus marequensis*), twelve tigerfish (*Hydrocynus vittatus*) and one Nile crocodile (*Crocodylus niloticus*) were captured and tagged. The animals were then released and monitored for eight months between July 2011 and February 2012.

Behavioural data, including home range, habitat use, daily and seasonal movement patterns, daily activity patterns, as well as the response of the animals to changing environmental variables (flows, water quality and habitat availability) were described and statistically analysed.

Despite some early challenges with regards to the development of the local biotelemetry system, it has proven itself to work well in the field.

In addition to the KNP project, team members have already made noticeable contributions to the conservation of threatened or protected yellowfish in the Vaal River and tigerfish in man-made dams in southern Africa through the use of biotelemetry. “We are increasing our understanding of the behaviour of aquatic organisms in southern Africa and how to conserve and manage the systems they occur in,” notes Dr O’Brien.

The findings of some of the studies the team has carried out to date have generated new, interesting and useful lifecycle biology and ecology information. Among others, the team has discovered how important refuge areas for Largemouth yellowfish are; how small the home range of Smallmouth yellowfishes can be (less than 500 m of the Vaal); how sensitive fish are to alternations in flows and water quality; how different species not only use different habitats but avoid habitat types; new predation strategies of tigerfish; the migration requirements of fish species; how often crocodiles feed in relation to the temperature of their gut; how the activity of crocodiles change when they guard nests, and how yellowfish and tigerfish use different parts of the water column in the same habitats.

The researchers are not deterred from working in South Africa’s ‘wild’ environment. “While scientists from abroad refer to aquatic ecosystems as hostile environments because of the difficulty to see what is happening below the surface, we Africans base the hostilities of the system on the amount of animals that want to bite, eat or chase us,” says Dr O’Brien. “We have already had a few close encounters with crocodiles, hippopotami, pythons and pathogens.”

Wireless Wildlife together with the WRG-NWU now offers biotelemetry monitoring services using



Top left: Water Research Group MSc student, Francois Jacobs, holding a tigerfish carrying a transmitter.



Bottom left: Team member Matthew Burnett with a yellowfish.

Courtesy North West University

the locally-developed technology. Dr O’Brien sees a long and prosperous future ahead for biotelemetry in South Africa. “The use of the behaviour of aquatic organisms is not only going to help us improve our understanding of the biology and ecology of aquatic animals, but make better use of these indicator species to manage ecosystems.”

“The WRC is excited about the outcomes and strongly believes that the results from the studies will find immediate uptake by water resource managers in many uses,” adds Madikizela. “In the near future this approach is expected to allow ecosystem managers to make real-time management decisions based on the immediate response of organisms to changing environmental variables.”

This means that when the behaviour of species indicates that environmental thresholds have been reached, for example, through reduced flows or a chemical spill into a river, managers will be able to respond accordingly. “We may even be able to use fish behaviour in real time to release ecological flows at the start of migration. This will all result in a better ability of decision-makers to manage and conserve our precious ecosystems,” explains Dr O’Brien.

Further developments in remote and manual biotelemetry monitoring methods and analyses techniques are continuing. It is hoped that this technology will go a long way towards the conservation of South Africa’s rich aquatic biodiversity. ■