WATER RESEARCH COMMISSION

January 2014

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

Aquatic environment

Monitoring fish behaviour using radio telemetry

In a project, funded by the WRC, a new radio telemetry tracking system has been designed and produced to monitor freshwater species.

Background

In South Africa, the excessive use of aquatic ecosystem services is resulting in the depletion of fish stocks and pollution of inland waters. At present, at much as 80% of South Africa's inland ecosystems (lakes, rivers and estuaries) may be threatened.

Technology developments are increasingly empowering scientists with the ability to evaluate the biological requirements of fish, and characterise the effects of altered ecosystem states to populations of fish.

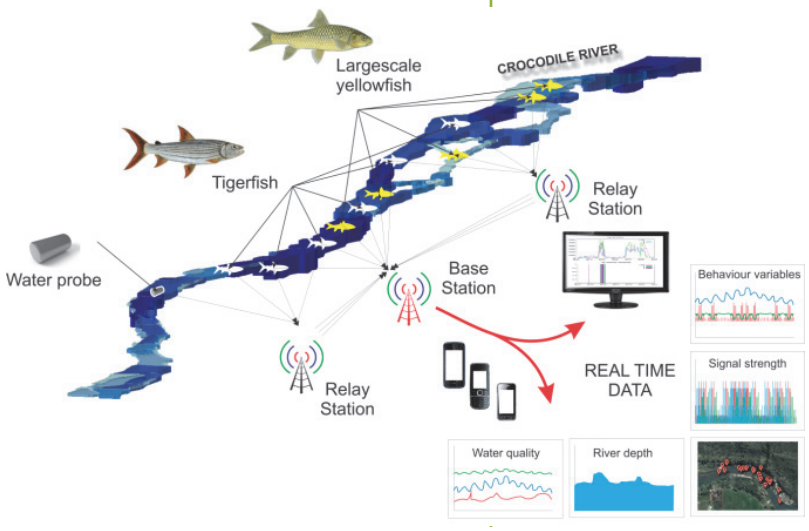
Only recently, primarily due to the development of radio telemetry monitoring techniques, have scientists had the ability to characterise the behaviour of fish in inland aquatic ecosystems. Radio telemetry techniques allow researchers to document, for long uninterrupted periods, how undisturbed fish interact with each other and their environment in real time.

Remote and manual monitoring techniques are internationally recognised as an effective way of acquiring a wide range of behavioural information of freshwater fishes and other aquatic animals over extended periods within their natural environments.

Improving biotelemetry methods for aquatic research

Wireless Wildlife (WW) is a commercial radio tracking and monitoring system provider. Although the WW radio tracking and monitoring system has been designed for use on terrestrial animals, the systems had the potential to be adapted for use on aquatic animals, such as fish.

This WRC-funded study was established to develop remote and manual radio telemetry methods to monitor and use fish behaviour in South Africa's inland waters.



Schematic representation of the remote monitoring system.

Locally-produced system

The new locally-produced biotelemetry system makes use of remote and manual tracking or monitoring systems as well as smart tags or receivers. The latter is attached to the organism being monitored.

Once tagged, the animals (in the case of this 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 system includes the use of 'listening stations' or receivers that are deployed in 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(s). 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.

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.

While the WW radio telemetry approach is unique, biotelemetry methods are not, so ecologists have access to a wide range of very useful data analyses methods that allow for the graphical and statistical analysis of the behavioural data collected.

The system has been designed to allow for the monitoring of the location of fish, the movement and activity as well as some environmental variables, including depth of the fish in the water and temperature in the water. In addition, by monitoring the location, movement and activity of the fish over extended periods, scientists are able to evaluate the response of the animal to changing habitat variables, flows, water quality components and weather variables, such as atmospheric pressure.

Case studies

The final report of this study presents four case studies that used the WW radio telemetry system. In the first case study, the system was used to evaluate the habitat preferences of adult Lowveld large-scale yellowfish (***Labeobarbus marequensis***) and tigerfish (***Hydrocynus vittatus***) in the Crocodile River, Kruger National Park (KNP).

In the second case study the system was used to evaluate the behavioural response of ***L.marequensis*** to flow and other ecosystem variable changes in the KNP. The system was also used to evaluate the habitat use and the effect of diurnal, lunar and seasonal cycles on the movement of adult Vaal-Orange smallmouth yellowfish (***L. aeneus***) in Boskop Lake, North West.

In the last case study, the system was used to evaluate the effect of diurnal, lunar and seasonal cycles on the movement of adult Orange-Vaal yellowfishes in the Vaal River.

Conclusion

In all of the cases the WW radio telemetry system developed was shown to be robust, easy to implement, informative and suitable to answer a host of fish behavioural ecology and associate ecosystem conservation and management questions. In addition, the approach was shown to not only compare with international fish behavioural monitoring systems, but has many advantages that make the approach more suitable for application in South Africa.

In particular, the advances made in remote behavioural monitoring systems, which include the use of a range of peripheral sensory components and the availability of local technical support makes the use of the radio telemetry system ideal for application in South Africa.

With this technology South Africans now have access to a relatively cost-effective fish behavioural monitoring tool locally, with local technical and scientific support that can contribute to the conservation and management of fishes and the ecosystems they occur in.

Further reading:
To order the report, *Remote and manual radio telemetry methods to monitor and use fish behaviour in South Africa's inland waters* (**Report No. 2111/1/13**) contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za, or Visit: www.wrc.org.za to download a free copy.