Text **Mathew Ross**
EnviRoss CC
Cell +27-82-293-5752
matross@telkomsa.net

Fish climbing
the ladders back to survival

HAVE YOU EVER wondered why you don't see as many fish today as you did in the past in our river systems and where they have gone to? Have you ever wondered what the possible reasons were causing them to disappear slowly but surely from our rivers and if we will ever see the numbers of fish in the rivers as we did in the past? A recent research initiative is trying to answer all of these questions.

Fish have always had to bear the brunt of industrial, agricultural and domestic effluents that get pumped continuously into our rivers. As if this were not enough, they also need to contend with their freedom of movement being limited by various barriers along the river systems in the form of gauging and abstraction weirs, dam walls, low level bridge crossings, etc. This fragmentation of the riverine habitat means that they are not able to undergo seasonal breeding migrations that many species (such as yellowfish, mudfish and many others) have to undergo to find suitable breeding and spawning areas upstream. More and more of these upstream spawning areas are being limited to these fish to support increased development and the need to gauge the flows of our rivers. This means that these fish are not being able to reach their natural breeding potential. By fragmenting the riverine habitats, many populations of the same species of fish are also being isolated to the extent that the general gene pool is being depleted, with the eventual consequence being the loss of species throughout the country.

A project was set up during 2004 that collaborates of the efforts of the Water Research Commission (WRC), the University of Johannesburg (UJ), various professional ecological (biologists) and hydrological (engineers) consultants, and with the support of the Department of Water Affairs and Forestry (DWAF) to determine the feasibility of new and innovative fishway designs. To date, many fishways that have been built based on international designs because of the lack of sufficient local research being undertaken on the subject. However, fishways overseas have largely been aimed at facilitating the salmon industry due to their commercial value and have therefore largely ignored the weaker swimming species. It is only recently that the importance of a balanced aquatic ecosystem has come under the spotlight. This means that there is an increased need to determine what the swimming abilities and limitations of these weaker swimmers

1 A 1:1 scale prototype double fishway channel was built and tested under various flow conditions at the Hydrometrics Laboratories, DWAF, Pretoria. Various fish species were used during the testing to determine the success rate of such a channel

2 Fish congregate en masse at migratory barriers during the high-flow summer season (Kruger Gate weir, Sabie River, KNP, November, 2004). Only a relatively small percentage of these individuals will successfully negotiate the barrier to utilise upstream habitats for reproduction, genetic dispersal and habitat exploitation. Many of these fish therefore will not reproduce to their full potential, limiting the reproductive output for the season

3 The swimming abilities of different fish species need to be determined before a fishway channel can be designed that will cater for all the species applicable to a river system. Some fish species have anatomical adaptations that help them to adhere to wetted surfaces. Chiloglanis sp can be seen here successfully negotiating a vertical rock surface. Other species rely on their swimming and jumping abilities to negotiate barriers. It is these specific biological requirements that need to be addressed before an ecologically sound fishway channel can be constructed.

4 A mobile prototype fishway channel was built that could be transported to various localities where migratory barriers were identified. This channel was placed into the water where migrating fish had congregated and water was pumped through it at various flow rates. This allowed for testing of various channel conditions and designs in the field

5 Migratory barriers such as this flow gauging weir (Vaal River) inhibit the upstream migrations of many fish. Very few individuals are able to successfully negotiate a barrier such as this. This effectively isolates populations, leading to the eventual decline of species composition and community structures due to genetic isolation and the reduction of reproductive outputs

6 A housing system was constructed within an environmentally controlled room at the aquarium facility at the Auckland Park Campus of the University of Johannesburg. This allowed for the testing of various channel designs with various fish species under controlled and repeatable conditions

species are to promote a healthy and balanced aquatic ecosystem.

Fishways (or fish ladders) have been around since the 1800s, when the importance of upstream migrations for trout and salmon was realised. Since then, many designs of fishways have been explored, including pool-and-weir (with many variations), Denil, and even a 'fish lift' system that traps fish downstream and transports them to above the barrier. This is a system that is specifically designed for large dams, with the exorbitant cost implication being an indication of the importance of the continuity of riverine habitats to the overall health of an aquatic ecosystem. An economical but ecologically sound fishway design that has been implemented overseas has been the 'vertical slot' type. This project therefore primarily aimed at testing various forms of this fishway type to determine if it is a viable alternative to the many largely ineffective local fishways to date. One important advantage that the vertical slot type has over the pool-and-weir types is that it caters for a much wider variation in flows that is typical of South African rivers.

An experimental prototype vertical slot fishway channel model was built that was mobile enough to transport to various fish migration barriers along the Vaal and Sabie rivers. This channel was placed over the barrier and the fish that were congregating at the base of the barrier were allowed to use it to overcome the barrier. By placing the channel at different gradients and subjecting it to differing flow rates, the data collected from the fish that were successful in negotiating upstream passage through it were used to 'fine tune' the design to make it as ecologically sound as possible. An experimental system was also built at the aquarium research facility at UJ that allowed for the continued undertaking of 'out of season' research.

It was found that the vertical slot channel (as it stood) could not adequately cater for the diversity of fish species of southern African rivers, therefore the innovative 'double channel vertical slot' was designed. This design allows for both weaker and stronger swimming species to utilise the same fishway. A full-scale model of this design was built by DWAF and tested, with very promising results. The results of this research will soon be available as a WRC publication, with the data being synthesised into a PhD thesis through UJ. Plans are also under way to implement the double channel vertical slot on a local river system. ◻

Source:
http://www.saice.org.za/downloads/monthly_publications/2007/CivilEngAug2007/#/0