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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

Invasive alien species

Guidelines for the management of alien and invasive fish species

A completed Water Research Commission (WRC) project has improved understanding of the unintended spread and impact of alien and invasive fish species and developed management guidelines for their control in South African inland water.

Background

Invasive alien species are recognised globally as direct drivers of biodiversity and ecosystem service loss that pose substantial threats to fragile ecosystems and threatened and endangered species.

In South Africa, this recognition led to the promulgation of the National Environmental Management: Biodiversity Act (Nr 10 of 2004) and the subsequent supporting Alien Invasive Species Regulations. These regulations provide a legal framework for the future management of alien species, including freshwater fishes, within the borders of South Africa.

Largemouth bass

Rationale for WRC study

In South Africa, some invasive alien fish species, such as bass, carp and trout threaten biodiversity and sensitive ecosystems in some areas, but are important contributors to the national economy elsewhere. It is also recognised that in many cases alien species are so well established that their eradication would not be feasible.

Instead, these alien fishes should be actively managed to limit further impacts on biodiversity, as well as to maximise social and economic benefits from the resource in areas where they are already established.

This will require a national management plan that will guide eradication in areas of biodiversity concern and permit their use in others.

The WRC project used case studies that exemplify the issues surrounding the understanding of alien fish invasion processes and impacts to collate key lessons learned that would inform a management decision framework.

Case study 1: Assessing impacts of largemouth bass in a near-pristine ecosystem

The catchment of the Groot Marico River is characterised by deeply incised gorges that are fairly inaccessible and unsuitable for large-scale agriculture or development. Therefore the catchment is uniquely un-impacted compared to most other rivers in South Africa.

The Groot Marico is also relatively unique in the South African context in that it originates from a series of dolomitic eyes. This ecosystem is therefore prioritised in the provincial conservation plan and the entire upper catchment is classified as a freshwater priority area and fish support area.

This study aimed to assess the impact of Largemouth bass (***Micropterus salmoides***), an invasive alien fish species, on the relatively un-impacted fish community in the Groot Marico catchment.

Based on this assessment the endemic Marico barb (***Barbus motebensis***) was the only species that was strongly negatively correlated with the presence of ***M. salmoides***. The density of ***B. motebensis*** showed significant differences between invaded and uninvaded pools.

Four priority areas for conservation were identified based on the current conservation status of the species (Vulnerable), the number of evolutionary significant units for each species as well as the overall genetic diversity of the species.

Case study 2: Understanding the role of water-transfer infrastructure in enabling invasion

This case study assessed the processes of invasion using a natural experiment provided by the irrigation water transfer scheme of the Sundays River Valley, a citrus-growing area with a complex canal network that supplies water from an inter-basin water transfer scheme to approximately 400 small off-channel impoundments.

A year-long study linked the number of immigrating fish or propagules being supplied by the irrigation network to 30 water storage ponds of varying ages, to assess the patterns and processes of fish invasion through water transfer infrastructure.

The project showed that high propagule size in the canals corresponds to rapid colonisation of the ponds, provided the introduced fish species is capable of reproducing within the environment of the pond.

Although the team set out to assess what management strategies could mediate the transport of fish through the canals, they determined that this was impossible, as no change in management strategy or modification of water-transfer infrastructure was likely to result in decreased transfer of fish propagules or meaningful improvements to the conservation status of the freshwater ecosystems.

They did, however, identify an ongoing invasion of the adjacent Addo Elephant Park, which was likely enabled through water discharges from the irrigation network. While prevention of this invasion is no longer possible, the final WRC report describes how an assessment of the risk of invasion and subsequent investment into infrastructure to prevent it may have historically prevented the invasion.

This case study is concluded by emphasising the importance of considering the implications of organism transfers when designing inter-basin or intra-basin transfer schemes, and in investing in preventative measures prior to water transfer infrastructure becoming operational.

Decision support tool for managing invasive fish in South Africa

In addition to the above investigations, the project team used three case studies to explore other aspects of fish invasions, impacts and management.

It was found that the aquarium trade and illegal movement of fish by angler are the major pathways for fish invasions in South Africa today and it is recommended that these actions are more carefully regulated in future.

The options available for mitigating the impacts on invasive fish on native biota were assessed. These are realistically limited to targeted eradications in logistically feasible habitats with high conservation priority.

The lessons learned during the successful Rondegat rehabilitation project were also studied. These included choosing a river that is logistically feasible to treat, ensuring that barriers to re-invasion by the alien fish are breach-proof and not affecting other biota.

With these general principles in place, the final report then describes a decision support framework for managing invasive fish in South Africa. The framework is written in the form of a decision tree that enables systematic prioritisation of discreet populations of invasive fish for active management or eradication. The framework asks the following questions in sequence:

- Is the population established?
- Is the population invasive?
- Does the population have socio-economic value?
- Is eradication feasible?

A positive response to question 4 results in a recommendation to 'eradicate' the target population, while a positive response to question 3 results in a recommendation to 'manage against impacts and further spread'. Negative responses to Questions 2 and 4 also result in the recommendation to 'manage against impacts and further spread'.

The report then illustrates the use of the framework with examples from the Sundays, Marico, Nseleni and Swartkops case studies.

The report is concluded with the emphasis that the framework can only be an effective tool for invasive fish management if there are conservation practitioners available to pursue the management goals it suggests. This will require increased employment of aquatic conservation issues at a national scale. The report also highlights the need for improved engagement between government and the users of invasive alien species, as only through dialogue and cooperation can the desired management outcomes for invasive fishes be achieved within South Africa.

Further reading:
To order the reports, *Understanding the unintended spread and impact of alien and invasive fish species – development of management guidelines for South African inland water* (**Report No. 2039/1/14**) contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.