

EXECUTIVE SUMMARY

This report documents the outcomes of three Water Research Commission consultancy studies that were carried out between 2006 and 2010 by the University of Johannesburg and River of Life Aquatic Health Services CC. The titles of the consultancies were:

- An assessment of selected biology aspects of the two yellowfish species *Labeobarbus kimberleyensis* and *L. aeneus* from the Orange-Vaal River system, South Africa (K8/678).
- Effects of flow and temperature on spawning and recruitment of Largemouth (*Labeobarbus kimberleyensis*) and Smallmouth (*L. aeneus*) yellowfish (K8/803).
- Assessment of selected biological features associated with the breeding biology of the threatened Orange-Vaal River Largemouth yellowfish and the Orange-Vaal River Smallmouth yellowfish from the Orange-Vaal River system (K8/818).

The combined aims of the study included:

1. Successfully develop the technology to implant radio telemetry tags and to track the two yellowfish species in the Orange-Vaal River system (K8/678).
2. Determine the home range of *L. aeneus* and *L. kimberleyensis* (K8/678).
3. Determine how environmental variables (flooding, drawdown and temperature) affect the movement and biological requirements of *L. aeneus* and *L. kimberleyensis* to changing environmental variables (K8/678).
4. Establish age-length relationships for larval and early juveniles of both species (K8/803).
5. Use hatch date analysis to determine the timing, duration and frequency of spawning by *L. aeneus* and *L. kimberleyensis* over a single season (K8/803).
6. Link the above information to the prevailing environmental conditions (temperature and flow) and to identify environmental cues and optimal conditions that promote spawning by the two species (K8/803).
7. Link the findings of this study to the movement of *L. aeneus* and *L. kimberleyensis* prior to, during and after spawning events (K8/803).
8. Use this knowledge to guide management and conservation frameworks and provide input to EWR studies currently underway in the Orange/Vaal River system (K8/803).
9. The aim of this study is to characterise selected biological features associated with the breeding biology of the threatened Orange-Vaal River Largemouth Yellowfish and the Orange-Vaal River Smallmouth Yellowfish in the Vaal River and to produce yellowfish offspring for further scientific studies' (K8/818).

In the study, eight of the nine original aims established were achieved. Aims number six and seven required wild caught Largemouth yellowfish larvae and or fingerlings (>6 months old). Attempts were made to collect Largemouth yellowfish larvae and

fingerlings within study areas unsuccessfully. Recent anecdotal observations show that the Largemouth yellowfish populations in the study area may be dominated by different age class cohorts. This suggests that successful recruitments of this species into the Vaal River do not occur annually. More research on the recruitment of this species into the Vaal River is required. In addition to these aims, some new aims were established for the study and achieved included:

10. Assess selected behavioural ecology and biology features of the Vaal River yellowfishes including the daily, seasonal and annual movements, habitat use, migrations and possible territoriality behaviour of species.
11. Assess selected components of the conservation and management approaches adopted for the Vaal River yellowfishes by the Orange Vaal River Yellowfish Conservation and Management Association.
12. Finally, an aim of the study was developed to carry out a regional scale risk assessment of threats to the sustainability of the Largemouth yellowfish populations in the study area making use of the data obtained in this study.

The report itself presents a broad review of the known biology and ecology of the Vaal yellowfishes, including dedicated sections on species identification, taxonomy and notes on the evolutionary and phylogenetic development of the species, as well as the taxonomic history of the yellowfishes. The study then addresses the approaches adopted and the outcomes of three complementary reproduction, early development and growth studies of the Vaal River yellowfishes. These studies included assessments of the artificial reproduction, early development of and age validation of larval and juvenile Vaal River yellowfish. This includes the first documented findings of any formal early development and growth study of a yellowfish in southern Africa. The early development study has allowed for the characterisation of numerous developmental stages that yellowfish undergo which will contribute towards the life-cycle biology and conservation of these species. The work also presents some evidence of new ecological requirements and previously unknown behavioural features of yellowfish in the Vaal River. Finally, the study shows that distinct morphological features of the larvae and juveniles of each species occur. These features can be used to identify wild larvae and juvenile yellowfish. The age validation study showed that both species deposit daily growth rings that can be counted to accurately determine the age of wild caught yellowfish. This can be used to evaluate the importance of the volume, timing and durations of natural flows and other related ecosystem conditions, to ensure that good recruitment of yellowfish into the Vaal River occurs.

The next section of the report presents the outcomes of the first ecological behavioural assessment, carried out on Vaal River yellowfish using biotelemetry methods. This section details previously unknown behavioural biology and ecology features of the Vaal River yellowfishes. Specific findings include features of the daily, seasonal and annual movements, home ranges, habitat use, migrations and possible territoriality behaviour of Vaal River yellowfishes. In this part of the study, a database of information has been generated that can be used in the future to evaluate the consequences of changing environmental conditions in the Vaal River.

The study is completed with an assessment of components of the conservation and management of Vaal River yellowfishes. This includes a review of a socio-economic value assessment of Yellowfish in the Vaal River, and a study to address the possible impacts of angling on yellowfish populations in the Vaal River. This information, along with the historically known biology and ecology of the Vaal River yellowfishes and new information generated in this study was used to carry out a simplified regional scale risk

assessment of the threats to Largemouth yellowfish in the Vaal River. This risk assessment shows that the excessive current use of the resources of the Vaal River is threatening the continued viability of these species. In addition, if management plans are not developed and implemented to balance between the use and protection of the resources of the Vaal River, there is a high probability that the conservation status of the Largemouth yellowfish will increase to endangered status.

This study has successfully developed our understanding of these three areas of the biology and ecology of the Vaal River yellowfishes, and demonstrates the value of this information in the conservation and management fishes in southern Africa. In consideration of the outcomes of this study the following recommendations are made:

- The reproduction experiments showed that both of the Vaal River yellowfishes can relatively easily be cultured under artificial conditions. Outcomes show however that it is difficult to condition Largemouth Yellowfish in artificial environments. We recommend that a monitoring exercise be carried out in an artificial environment where the conditioning process and behavioural changes of both Largemouth and Smallmouth yellowfishes can be assessed.
- The study shows that distinct morphological features of the larvae and juvenile yellowfish from a set of adult broodstock of each species occur. If consistent, these features can be used to identify wild larvae and juvenile yellowfish. We recommend that an evaluation study be carried out to confirm that these morphological features are consistent and can be used to identify wild yellowfish in the Vaal River.
- The role that that flow plays in the recruitment of *L. aeneus* and *L. kimberleyensis* in the Vaal River is not well understood, but there is evidence that both species depend on optimal flow and temperature conditions for successful reproduction. Following from this study, which is an important preliminary step to aging wild-caught larval *L. aeneus* and *L. kimberleyensis*, a dedicated study that addresses the recruitment of yellowfishes into the Vaal River should be carried out.
- The behavioural monitoring study showed that biotelemetry methods can effectively be implemented to monitor the behaviour of yellowfishes in riverine ecosystems in South Africa. The study produced a range of new behavioural biology and ecology features of both of the Vaal River yellowfishes. Although valuable a lot of behavioural events are still unexplainable. We recommend that the biotelemetry monitoring work on yellowfish in the Vaal River be continued, and expanded on into the Orange System and lentic ecosystems in the catchment.
- The outcomes of the simplified regional scale risk assessment show that some of the Largemouth yellowfish populations in the Vaal River may currently be unsustainable. In addition, this assessment suggests that the population structures and recruitment of juveniles into populations can be good indicators of the health of populations. In accordance, we recommend that an assessment of the Largemouth yellowfish population structures and recruitment of juvenile yellowfish into the populations should be carried out.