Chapter Five:

Conclusions and Recommendations

5 Conclusions and recommendations

5.1 Conclusion

The original aims proposed to test the established hypothesis for this study (Chapter 1) were to: (Chapter 2) establish biotelemetry methods that will be used to monitor the behavioural ecology of yellowfish in one lentic and one lotic system in the North West Province, South Africa: assess the availability of yellowfish in Boskop Dam to carry out the behavioural study: capture, tag, release and monitor yellowfish species in Boskop Dam and the Vaal River to characterise their behaviour: monitor changes in selected environmental variables (water quantity, habitat and selected atmospheric variables) in Boskop Dam and the Vaal River: (Chapter 3) statistically characterise the habitat use, movement and activity of the yellowfish species in these systems: and (Chapter 4) evaluate possible links between yellowfish behaviour and changing environmental variables. By achieving all these aims we can revisit the hypotheses in order to reject or accept them.

Hypothesis 1:

> Biotelemetry methods can be used in lentic and lotic environments of the Vaal River catchment to characterise the habitat use, movement and activity of yellowfish species.

Biotelemetry methods have successfully been used in Boskop Dam and the Vaal River to characterise habitat use, movement and activity of yellowfish species. The remote monitoring aspect of the study worked very well, although some investigation needs to be done on the radio tags that resulted in limited data being recorded. This hypothesis is therefore accepted.

Hypothesis 2:

> Behaviour of Orange-Vaal River yellowfish species is influenced by changes in environmental variables.

The behaviour of Orange-Vaal River yellowfish species is influenced by specific environmental variables such as temperature, flow, time of day, seasons and moon phases. This hypothesis is therefore accepted.

Hypothesis 3:

1. Behaviour of Orange-Vaal River yellowfish species can be used as an ecological indicator of changing environmental conditions.

It has been shown that environmental conditions do influence the behaviour of yellowfish species; however, the use of behaviour as an ecological indicator of changing environmental conditions has not been achieved in this study. The outcome has been that more and new behavioural information that was previously unknown is now available. This hypothesis is therefore rejected.

5.2 Concluding remarks

The behaviour of *L. aeneus* has been shown to be influenced by changing environmental variables. By using biotelemetry methods these changes have been characterised and some previously unknown behaviour is described. *Labeobarbus aeneus* follows distinct behavioural patterns, with some individual variations in behaviour. *Labeobarbus aeneus* exhibited higher movement counts that are associated with deeper water during daylight hours (04:00-16:00). During nocturnal periods *L. aeneus* showed a decrease in movement activity and preferred shallower water compared to daytime. However, *Labeobarbus aeneus* in the Vaal River seems to be influenced less by bright daylight and this might be due to the turbidity of the river water. *Labeobarbus aeneus* in Boskop Dam showed higher movement counts during full moon phases whereas *L. aeneus* in the Vaal River showed higher movement counts during new moon phases. All tagged fishes in Boskop Dam and in the Vaal River preferred deeper water during full moon phases than during new moon phases.

Movement counts were significantly higher ($P<0.05$) with increased temperatures and shallower water in summer whereas movement significantly decreased ($P<0.05$) with decreased temperatures and increased depth in autumn and winter. Seasonal movement data were, however, limited.

Labeobarbus aeneus in the Vaal River showed a significant decrease ($P<0.05$) in movement with increasing flows, and significantly increased ($P<0.05$) movement during stable flows. Movement counts of all individuals were higher when

temperatures increased in spring and summer whereas individuals' movement counts significantly ($P<0.05$) decreased with decreased temperatures and increased depth in autumn and winter.

5.3 Limitations and recommendations

There are variations in behaviour of the same species and continual studies need to be carried out to gain a better understanding of the yellowfish species. This study being part of a developmental project gave us the opportunity to identify many shortcomings that can be eliminated in the future. One of the greatest limitations for the Boskop Dam study area was the radio telemetry tags. These tags can transmit data down to a depth of 2 500 mm over a distance of approximately 500 m. The depth and size of the study area may have been too large for this type of radio telemetry study and this could possibly have resulted in limited data being recorded. In addition, no manual monitoring could be successfully carried out on Boskop Dam as tagged fishes could not be located. Furthermore, the high number of defective tags in the Vaal River study area may be as a result of the rougher water and submerged obstacles such as rocks or sandbars in the river environment compared to Boskop Dam. Radio tags might have been damaged by chafing and abrasion, and constant friction between the fish and the substrate while fishes were feeding, or by rubbing themselves ('flashing') against rocks or substrate due to irritation.

It is therefore recommended that these radio tags be tested for rigidity before applying to other projects. The amount of data collected from fishes tagged in the Vaal River by remote monitoring stations was sufficient for the purpose of this study. Our understanding of the behaviour of *Labeobarbus species* has been improved, this being only the second radio telemetry study on the species; however, it is strongly suggested that further more focused studies be carried out on these highly important indigenous species.

Possible further studies may include:

1. testing yellowfish behaviour to light intensity in a controlled environment
2. determine swim performance of yellowfish in a controlled environment and calibrate movement with activity readings on radio tags

3. apply the biotelemetry approach at a source point pollution area to test if yellowfish behaviour can be used as an ecological indicator

One of the most valuable projects that can be carried out to classify yellowfish behaviour is to observe yellowfish in an aquarium like manner as they have done on pike and bass in the Americas to visually learn about their behaviour in induced environmental changes.