

The behavioural ecology of the Orange-Vaal River yellowfish in lentic and lotic ecosystems, North-West province, South Africa

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Dissertation submitted in fulfillment of the requirements for the degree *Magister Scientiae* in Zoology at the Potchefstroom Campus of the North-West University

Supervisor: Prof NJ Smit

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BY

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All men are equal before fish

Herbert Hoover

SUMMARY

Fishes are widely used by biologist as ecological indicators that measure key elements of complex systems, without having to capture the full complexity of a specific system. The Vaal River in South Africa is classified as Africa's hardest working river and is home to, two yellowfish species that are socially and economically important. Both these yellowfish species are considered to be sensitive to changes in water quantity and quality, habitat destruction and utilisation pressure and are often used as ecological indicators to manage aquatic ecosystems. Very little however, is known about their movement, response to changing environmental variables and interspecies habitat preferences. This study therefore aims to use radio telemetry as a method to characterise and evaluate how yellowfish behaviour is influenced by changing environmental variables.

To characterise the behavioural ecology of the Vaal-Orange River yellowfish species in lentic and lotic ecosystems, *Labeobarbus aeneus* (n=18) and *L. kimberleyensis* (n=3) were fitted with externally attached radio transmitters in Boskop Dam (*L. aeneus*, n=4) and the Vaal River (*L. aeneus*, n=14) (*L. kimberleyensis*, n=3). Various methods were used to collect yellowfish species including: gill nets, to target mobile individuals, in deep habitats, electro-fishing (electro-narcosis) to collect yellowfish in shallow habitats and angling techniques in a wide variety of habitats. Thereafter yellowfish species were sedated and tagged with externally attached radio transmitters, before being released back into the system. Yellowfish were monitored for eleven months using a remote monitoring system together with manual monitoring surveys.

Analyses of data collected showed that *L. aeneus* follows distinct behavioural patterns, with some individual variations in behaviour. *Labeobarbus aeneus* exhibited higher movement that are associated with deeper water during daylight hours (04:00-16:00). During nocturnal periods (20:00-04:00) *L. aeneus* showed a decrease in movement activity and preferred shallower water compared to daytime. However, *L. aeneus* in the Vaal River seems to be less influenced 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 were significantly higher ($P < 0.05$) with increased temperatures and shallower water in summer whereas movement significantly decreased ($P < 0.05$) with a decrease in temperature and increased depth in autumn and winter. Seasonal movement data were, however, limited.

This study confirms that radio telemetry methods can be used to characterise the behavioural ecology of yellowfish species. In addition, the study has improved the knowledge of how environmental variables may affect the behaviour of yellowfish species. However, due to limited data and our understanding of these species, it is still uncertain how behaviour of yellowfish species can be applied as an ecological indicator of aquatic ecosystems.

Keywords: ecological indicators; *Labeobarbus aeneus*; *Labeobarbus kimberleyensis*; radio telemetry; behaviour

OPSOMMING

Visse word tans algemeen deur bioloë as ekologiese indikaturs gebruik. Hierdie indikaturs meet die sleutelemente van komplekse stelsels sonder om die volle omvang en kompleksiteit van 'n spesifieke stelsel te bepaal. Die Vaalrivier, in Suid Afrika, word geklassifiseer as een van Afrika se hardwerkendste riviere en akkommodeer, onder meer, twee geelvisspesies wat van beide sosiale en ekonomiese belang is. Albei geelvisspesies word beskou as sensitief ten opsigte van veranderinge in waterkwantiteit, waterkwaliteit sowel as habitatverlies en oorbenutting. Alhoewel hierdie spesies dikwels gebruik word as ekologiese indikaturs, is daar min bekend aangaande hulle beweging, reaksie op omgewingsveranderlikes en interspesie habitatvoorkeure.

Om die gedragsekologie van die Vaal-Oranjerivier geelvisspesies in lentiese en lotiese ekostelsels te karakteriseer, is *Labeobarbus aeneus* (n=18) en *L. kimberleyensis* (n=3) in die Boskopdam (*L. aeneus*, n=4) en in die Vaalrivier (*L. aeneus*, n=14 en *L. kimberleyensis*, n=3) gevang en met eksterne radiosenders toegerus.

Verskeie metodes is gebruik om die geelvisspesies te versamel insluitend: nette om migrerende individue in diep water te teiken, elektriese-verdowing vir geelvisse in vlak-habitatte en hengeltegnieke vir 'n wye reeks habitatte. Gevolglik is die visse verdoof en die eksterne radiosenders is aangeheg voor die visse weer in die water vrygestel is. Die geelvis is vir elf maande gemonitor deur van 'n afstandbeheerde stelsel asook van fisiese moniteringsopnames, gebruik te maak.

Die ontleding van data wat ingesamel is, het getoon dat *L. aeneus* duidelike gedragspatrone volg, met slegs enkele individuele variasies in gedrag. *Labeobarbus aeneus* het meer beweging wat met dieper water gedurende die dag (4:00-16:00) geassosieer word, getoon. Tydens die nagtelike ure (20:00-04:00) het *L. aeneus* 'n afname in bewegingsaktiwiteit asook 'n voorkeur vir vlakker water, in vergelyking met die dag, getoon. Alhoewel *L. aeneus* in die Vaalrivier getoon het dat dit minder deur helder daglig beïnvloed word, mag dit moontlik aan die troebelheid van die rivierwater toe te skryf wees. *Labeobarbus aeneus*, in Boskopdam, het meer beweging tydens die volmaanfasies getoon, terwyl *L. aeneus* in die Vaalrivier, meer beweging in die nuwemaanfasies getoon het.

Al die gemerkte visse in beide Boskop Dam en in die Vaalrivier het in vergelyking met die nuwemaanfases, 'n voorkeur vir dieper water getoon tydens die volmaanfases. Beweging was betekenisvol meer ($P < 0.05$) met 'n toename in temperatuur en in vlakker water, tydens die somer, terwyl beweging betekenisvol verminder het met 'n afname in temperatuur en in dieper water, tydens herfs en winter. Data vir seisoenale beweging was egter beperk

Hierdie studie bevestig dat radiotelemetriese metodes gebruik kan word om die gedragsekologie van geelvisspesies te karakteriseer. Die kennis aangaande die effek van omgewingsveranderlikes op die gedrag van geelvisspesies is ook aangevul. As gevolg van beperkte data en kennis van die spesies, is daar egter steeds onsekerheid oor hoe die gedrag van geelvisspesies as ekologiese indikatortoe van akwatiese ekosisteme toegepas kan word.

Sleutelwoorde: ekologiese indikatortoe; *Labeobarbus aeneus*; *Labeobarbus kimberleyensis*; radio senders; gedrag