C/O Zoology Department
University of Johannesburg
P.O.Box 524
Auckland Park
2006
Tel: +27 (0) 11 489 3820
Fax: +27 (0) 11 489 2286
Email: gob@rau.ac.za
gordono@uj.ac.

Econ@uj
UNIVERSITY OF JOHANNESBURG
a consortium of ecological scientists

Econ@uj Investigational Report

WRC PROJECT K8/678

AN ASSESSMENT OF SELECTED BIOLOGY ASPECTS OF THE TWO YELLOWFISH SPECIES *LABEOBARBUS KIMBERLEYENSIS* AND *L. AENEUS* FROM THE ORANGE-VAAL RIVER SYSTEM, SOUTH AFRICA.

DELIVERABLE 5

Title:

Initial report on the movement of fish as a response to changing environmental parameters

Prepared by:

Gordon O'Brien and Linda Nel

08-12-2006

Background

This study entails the use of tagged Largemouth and Smallmouth Yellowfish (*Labeobarbus kimberleyensis* and *L. aeneus)* individuals in the Orange-Vaal River system to assess selected biological requirements of these fish species. The study focuses initially on the habitat selection of the tagged individuals and then indirectly addresses ecological aspects of and the state of the aquatic ecosystem in which these tagged individuals occur.

As the dominant migratory species of the Orange-Vaal River system, the flow related requirements of both Yellowfish species are important to characterise. A clear understanding of these requirements if related to methodologies incorporated to assess environmental flows of the Orange-Vaal River system will facilitate the development of a management strategy for the system. Therefore specific biological flow related requirement questions of these species are going to be addressed in this study.

This project entails the use of telemetry tracking technology to research flow related biological aspects of the two species and there by addressing the following questions:

1. Where do Yellowfish take refuge during periods of high and low flow? What environmental conditions stimulate this survival mechanism?
2. What is the home range of largemouth and smallmouth yellowfish in the Vaal River?
3. What environmental variables (water temperature and flow) influence movement in yellowfish?
4. How is movement influenced at the onset of the spawning season.
5. Do individual fish frequent the same areas in subsequent spawning seasons.
6. Do the two species favour/require different habitats?

This study is being undertaken primarily by specialists from **Econ@uj** (Zoology Department of the University of Johannesburg) and by skilled and unskilled specialists from the Orange-Vaal Yellowfish Conservation and Management Association. Finally this study is being supported by the department of Ichthyology and Fisheries Science, Rhodes University.

This report which is a follow on report to deliverable #2 documents the movement of 3 fish that were tagged during winter of 2006 where sufficient data exists to provide some indication as to the habitual patterns of the fish. Mr. Andre Hoffmann of the Orange-Vaal Yellowfish Conservation and Management Association and Miss. Linda Nel of **Econ@uj** carried out the tagging on the Vaal River, on the Farm called Doodsdrif (Wag-'n-bietjie) in the Northern Freestate.

Materials and Methods

The experiment was undertaken during the 9th of September to the 5th of November 2006. The 10km reach selected for this tracking survey is owned by members of the Orange-Vaal Yellowfish Conservation and Management Association. This reach is easily accessible to the tacking team and is under a certain level of protection as the riparian owners of this reach can control access to this reach.

The tagging methodology implemented is based on the telemetry study, successfully carried out by Mpumalanga Parks Board in the Inkomati River and the approach adopted by Mr. Andre Hoffman presented in Deliverable #2. Although there are 10 Yellowfish bearing tags at this time, seven of the 10 have only recently been tagged and as a result are not included in this report.

The tagging procedure includes the following steps:

- Five Smallmouth Yellowfish of approximately 45cm (forklength) were caught using standard Fly-fishing techniques.
- Three Largemouth and two Smallmouth Yellowfish larger than 56 to 76cm (forklenght) were sampled using electro-shocking techniques.
- The telemetry tag was surgically attached to the fish following standard attachment techniques (refer to Deliverable #2).
- The tracking device was set and the fish subsequently released.

The tracking methods involved the routine determination of the location of the tagged fish from a small inflatable boat to an accuracy of about 1m. The location of the fish and general habitat variables of the position were recorded during the tracking period.

Results and Discussions

The following section describes the results obtained from the tracking survey carried out. The fish were not all tagged at the same time and as such the amount of data collected for each individual varies. In this report only the movement of three fish will be discussed since the other seven were only tagged two weeks ago and insufficient data is available for these individuals. Figure 1 illustrates the capture point and movement information of tagged fish no 322. Collection information includes (Figure 1 point #1):

a. Date captured: 09/08/2006
b. Time caught: 16:30
c. Location of capture: 27° 09' 05.6" (S) 26° 25' 42.0" (E).
d. Fish information: Species: Smallmouth Yellowfish (*Labeobarbus aeneus)*
   Sex: Female
   Total length: 66 cm
   Girth: 35 cm
e. Habitat information: Local habitat represented by a pool with smooth turbulent water of about 1m deep. Individual captured in the pool close to the edge of the pool in shallow water of about 0.5 m deep.

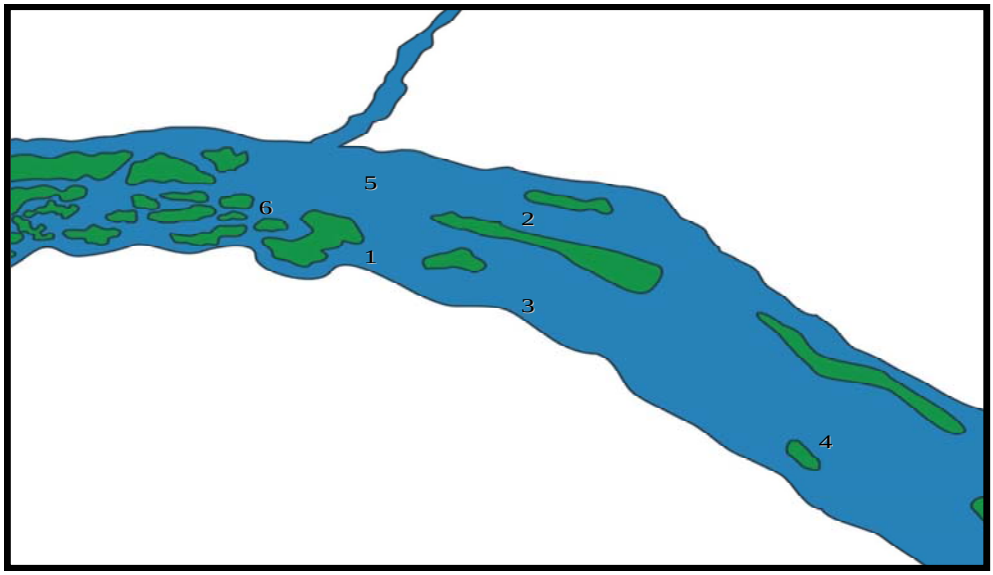

Figure 1. Vaal River on the farm Koedoesdraai with the Maaitjies spruit entering it from the top. This site is also referred to as the Kampplek. Figure indicates movement of tagged fish no 322.

Initial observation in the first two weeks after tagging (Figure 1, point #2):

a. Date observed: 09/08/2006 to 16/08/2006
b. Location of fish: The fish was not located in the first two weeks because the tracking equipment used requires direct line of site. Tracking was initially done from the river bank on foot. An area of 10 km was searched, after two weeks a boat was used to search behind the island etc, and during one of these surveys fish no 322 was found behind an island.

Observation no. 3 (Figure 1, point #2):

a. Date observed: 17/08/2006 to 05/09/2006
b. Location of fish: 50m from capture point. But only 30m upstream
c. Habitat information: Deep pool, overhanging trees on the side of the island.
d. Fish activity: Moving up and down the side of the island underneath the overhanging vegetation.

Observation no. 4 (Figure 1, point #3):

a. Date observed: 06/09/2006
b. Location of fish: Moved out from behind the island to the bank of the river upstream from where it was caught to an overhanging tree.
c. Habitat information: Pool (1m deep) with abundant overhanging marginal vegetation.
d. Fish activity: Patrolling the edges of the riverbank but staying under the overhanging marginal vegetation.

Observation no. 5 (Figure 1, point #2):

a. Date observed: 07/09/2006 to 27/09/2006
b. Location of fish: Behind the island beneath overhanging vegetation.
c. Habitat information: Deep pool, smooth turbulent flow and overhanging vegetation in the stream on the bank of the island.

d. Fish activity: Fish was in the middle of the stream then moved beneath overhanging vegetation on the side of the island.

Observation no. 6 (Figure 1, point #4):

a. Date observed: 28/09/2006
b. Location of fish: 100m upstream of location 1
c. Habitat information: Strong rapid, 0.5m deep bordered by a small island.
d. Fish activity: The water temperature increased to 16.5 ºC. Fish feeding on the side of the small island. Moving slowly downstream

Observation no. 7 (Figure 1, point #2):

a. Date observed: 29/09/2006 to 18/10/2006
b. Location of fish: From the rapids upstream fish #322 moved back to the area behind the island beneath overhanging vegetation.
c. Habitat information: Deep pool with smooth turbulent water and overhanging vegetation in the stream on the bank of the island.
d. Fish activity: During these observations fish #322 moved out of its holding location next to the island (Figure 1, point #2) into the pooled area adjacent to the island occasionally. At no stage was fish #322 observed outside of this pooled area.

Observation no. 8 (Figure 1, point #5):

a. Date observed: 19/10/2006 to 23/10/2006
b. Location of fish: Just downstream of point #2 (Figure 1) in a pool which is fed by a tributary of the Vaal River.
c. Habitat information: Large pool average depth 1 m, surface flow type is smooth turbulent.

d. Fish activity: Fish moves around in this pool, occasionally moving back behind the island (Point #2). The fish would adopt feeding behaviour in a glide of stronger flowing water entering the Vaal River by the tributary.

Observation no. 9 (Figure 1, point #6):

a. Date observed: 24/10/2006 to 02/11/2006
b. Location of fish: The water lever increased and the fish moved into the rapids of the bottom of the pool.
c. Habitat information: Strong rapid, 1m deep bordered by small islands.
d. Fish activity: Feeding activity where fish #322 would feed along the banks of the small islands moving up and down the islands. Air temperature were very hot above 30 ºC.

Observation no. 10 (Figure 1, point #1):

a. Date observed: 06/11/2006 to 14/11/2006
b. Location of fish: Capture point.
c. Habitat information: Local habitat represented by a pool with smooth turbulent water of about 1m deep. Individual captured in the pool close to the edge of the pool in shallow water of about 0.5 m deep.
d. Fish activity: Circular pattern of feeding activity: From the bottom of the pool individual no #322 would move to the left bank of the Vaal migrate upstream beneath overhanging vegetation and then move into a stream of faster flowing water where the fish would move back down to the base of the pool.

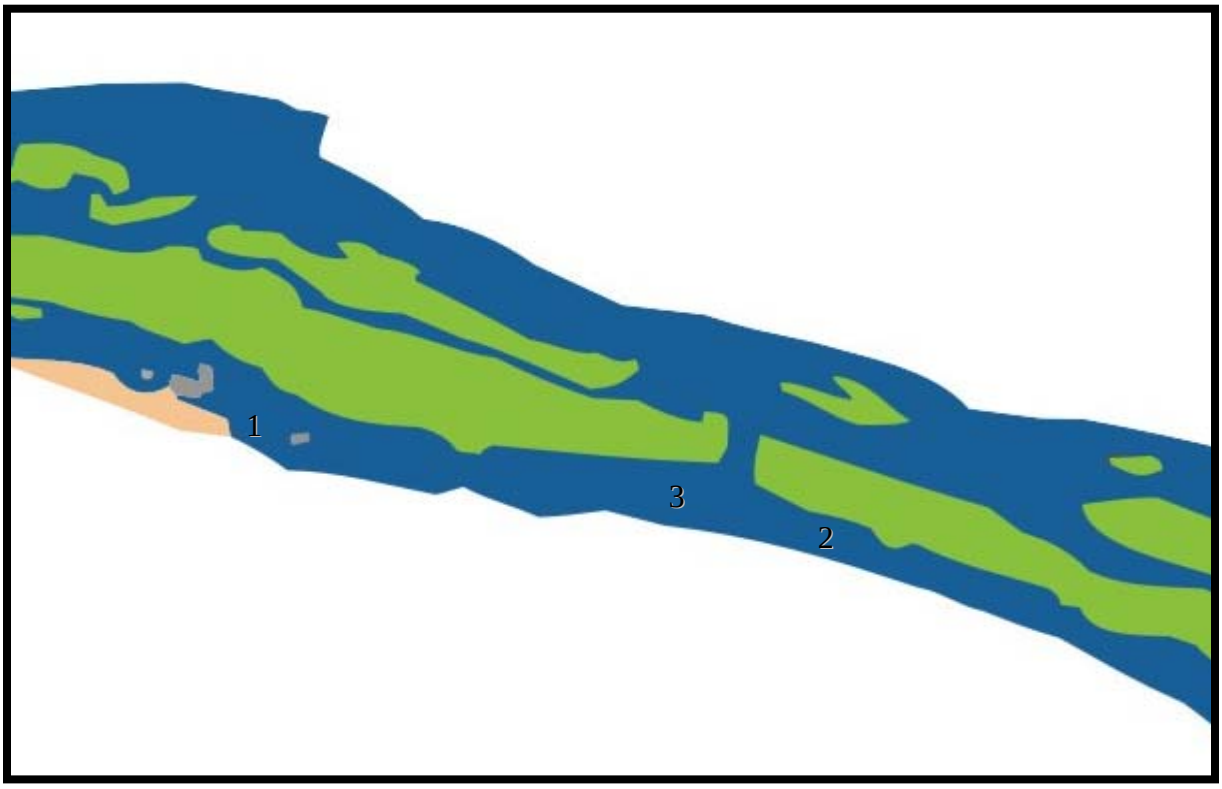

Figure 2. The Vaalriver on the farm Doodsdrif, site is known as “Otterbaai”. This is upstream from Figure 1. Movements of fish no 083 is presented on this figure.

Refer to Figure 2, which illustrates the capture point (1) of the second tagged individual (fish no 083) and the movement of this fish.

Collection information (Figure 2, point #1):

a.	Date captured:	02/09/2006
b.	Time caught:	16:30
c.	Location of capture:	27° 09' 05.6” (S) 26° 25' 42.0” (E).
d.	Fish information:	Species: Smallmouth Yellowfish (*Labeobarbus aeneus)* Sex: Male Total length: 58 cm Fork length: 52 cm Girth: 31 cm
e.	Habitat information:	Local habitat represented by strong flowing rapids about 1m deep. Individual captured

in a pool with barely perceptible flow (slack water). Depth approximately 1m.

Initial observation (#1) was the next day after tagging (Figure 2, point #2):

a. Date observed: 03/09/2006 to 06/09/2006
b. Time: 12:00
c. Location of fish: The fish was observed in a deep pool about 200 m upstream of the capture point. It remained in this pool for the next few days.
d. Habitat information: The pool is about 1m deep, flow type was smooth turbulent. Overhanging vegetation was abundant on the margins of the channel. Substrate included boulders of which many protruded above the surface of the water.
e. Fish activity Feeding activity: feeding along the edge of the stream.

Observation no. 2 (Figure 2, point #3):

a. Date observed: 07/09/2006 – 25/09/2006
b. Time observed: 10:00
c. Location of fish: The fish moved downstream into the pool just below point #2. Remained for two days before returning to point #2.
d. Habitat information: Deep pool about 1.5m, overhanging trees on the banks of the channel, fast to medium flowing water.

No observations from the 26/09/2006.

Following the final observation of fish #083 on the 25/09/2006 no more observations were made. The fish may possibly have vacated the area, but no significant environmental change was observed and as a result the working order of the tag is questioned.

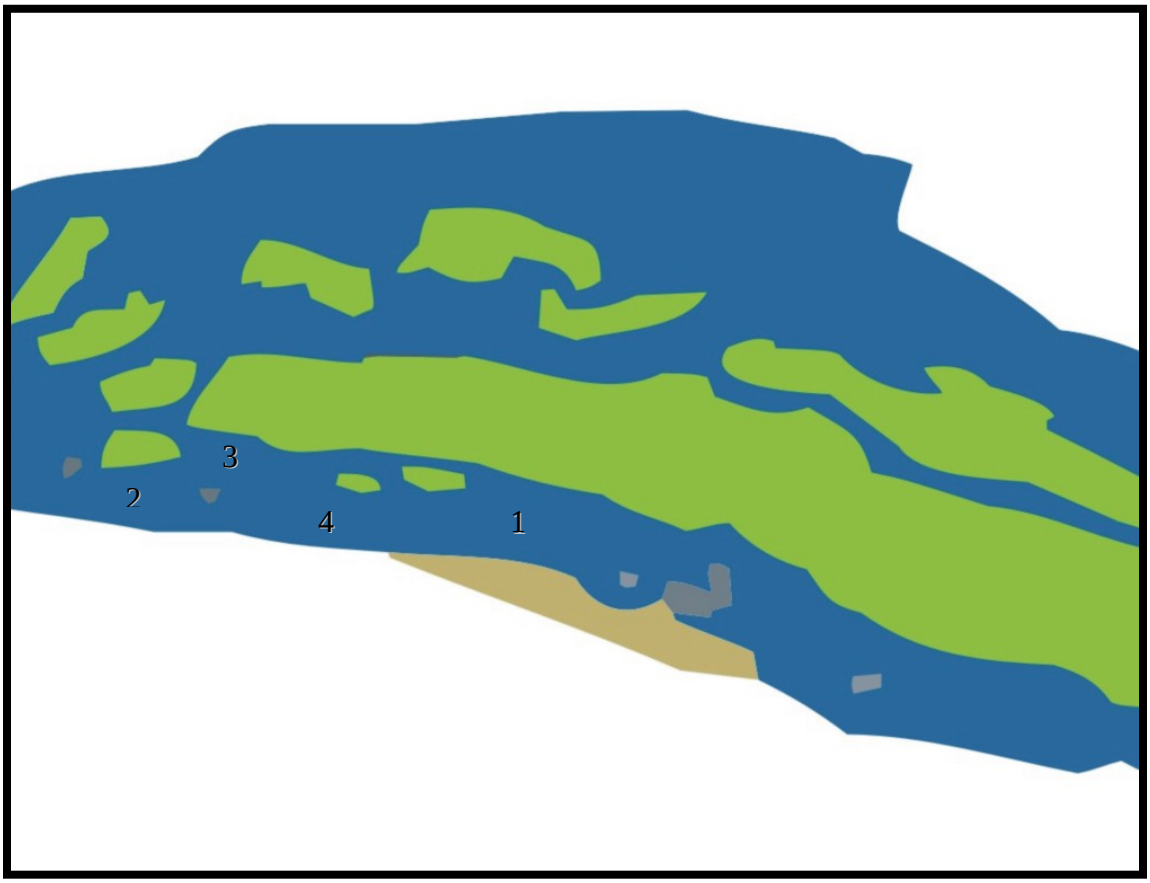

Figure 3. The Vaalriver on the farm Doodsdrif, site is known as “Otterbaai”. This is upstream from Figure 1. Movements of fish no 017 is presented on this figure.

Refer to Figure 3, which illustrates the capture point (1) of the third individual (tagged fish no 017) and the movement of this fish.

Collection information

a.	Date captured:	23/09/2006
b.	Time caught:	13:30
c.	Location of capture:	27° 09' 05.6” (S) 26° 25' 42.0” (E).
d.	Fish information:	Species: Smallmouth Yellowfish (*Labeobarbus aeneus)*
		Sex: Male
		Total length: 59 cm
		Fork length: 55 cm
		Girth: 30 cm

e. Habitat information: Local habitat represented by strong flowing rapids about 0.5m deep. Individual captured in rapids with fasts flowing water.

Initial observation was the next day after tagging (Figure 3, point #2):

a. Date observed: 24/09/2006 to 03/10/2006
b. Time: 12:00
c. Location of fish: The fish was observed in a channel of a glide between a boulder and a small island. It remained in this location for about nine days.
d. Habitat information: Flow type was smooth turbulent, depth about a 1m deep. Substrate included large protruding (occasionally) boulders. Aquatic macrophytes in the form of green algae, attached to this substrate dominated this habitat.

Observation no 3 (Figure 3, point #3):

a. Date observed: 04/10/2006 to 17/10/2006
b. Location of fish: The fish moved upstream into a deep pool and stayed there for a few days moving along the bank of the island but remaining in the deep water.
c. Habitat information: Deep pool about 1.5m deep, overhanging vegetation again dominated this habitat. Flow type ranged from a mixture of ripple surface to undulating or broken standing waves.

Observation no 4 (Figure 3, point #4):

a. Date observed: 17/10/2006 to 17/11/2006.
b. Location of fish: Upstream of point #3 on the shallower left hand bank of the river. This habitat had a

dominance of cobbles and some boulders. For the next month this individual was observed between this point and the point #3.

c. Habitat information: Cobble beds with fast flowing water that is about 0.5 m deep. There is also a lot of boulder that are visible and vegetation like reeds in the water.

This information reveals that these individuals have very limited ranges (approximately 100m) and show very specific habitual patterns. This leads us to conclude that these fishes are territorial and do respond to changing environmental conditions.

Additional findings: The initial spawning of the Yellowfish (*L. aeneus*) began in this reach when the temperature of the water increased above 16^{o}C. There was no significant increase in the flow of the river during this early spawning period. Following an initial massive spawning, periodic spawning activities were observed during the late spring / summer period. For a water activity event on the Vaal River water was released from the Vaal barrage for this event. The resulting increase in water (inundated dry cobble bed area's – Figure 4) for a period of a few days resulted in an artificial environmental cue for the Yellowfish to initiate another massive spawning cycle. This spawning activity was focused on the newly inundated area's where new spawning conditions (rapids dominated with cobble beds) were created. These conditions were maintained for approximately three days before the water subsided. After investigating now isolated pools in these area's, a massive abundance of fish eggs were found in the pools between the cobbles (Figure 5). This simple observation leads to promote better management of the artificial regulating of the river to ensure sufficient time for the spawned eggs to hatch and vacate these newly formed spawning area's.

Figure 4. Gravel beds of the spawning areas where spawning activities commenced following the release of water from the Vaal Barrage which inundated these areas.

Figure 5. One of the small pools with eggs found in them after the spawining activities were consluded.

Concluding remarks

In conclusion the findings obtained from these tracking experiments are providing information related to the habitat preferences of these Yellowfish in the Vaal River. By considering the methods implemented and the information generated from these experiments we are confident that the required information regarding the establishment of the environmental habitat preferences of the Largemouth and Smallmouth Yellowfishes in the Orange-Vaal System will be determined.