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Econ@uj 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 4

Title:

Comprehensive survey reports based on the initial 2006 ecological state spring/summer surveys.

Prepared by:

Linda Nel and Gordon O'Brien

30-11-2006

Deliverable overview

The assessment of the ecological integrity state of the reach of the Vaal River where the Telemetry Study is being undertaken is aimed at providing information as to the ecological state of the segment which will facilitate an understanding of the movement of the Yellowfish in the system in relation to the species biological requirements.

This report describes the materials and methods and results of the survey implemented to carry out the RHP methodology on the system associated with the Telemetry Study on Yellowfish on the Vaal River System during spring (23rd to 25th September) and summer on the (22nd to the 24th November) of 2006.

The aim of this portion of the study is to identify current and monitor on the changes in the ecological integrity state of the reach of the Vaal River, in a manner which can be directly related to the findings of the Telemetry study. Based on the aim of this study the following objectives have been established:

1. Carry out a comprehensive biomonitoring survey of the reach of the Vaal River by implementing accredited methodologies and accredited personnel where applicable.
2. Carry out the surveys in a manner which will allow for direct comparison between the biomonitoring survey and the Telemetry study.

Survey information and materials and methods

The biomonitoring assessment of the aquatic ecosystems associated with the Yellowfish Telemetry Research study entailed the implementation of the National River Health Programme (RHP) of South Africa's approach to monitoring aquatic ecosystems.

The sampling regime of this study will be undertaken over a seasonal period (summer, autumn, winter and spring) thorough-out the duration of the study. This report documents the findings of the initial spring and summer (of 2006) surveys of the study. This report does not include an overview of the ecological state of the reach of the Vaal River as yet as that overview will be carried out once the work phase of the Telemetry project has reached completion. The research reach includes a section of Vaal River downstream of the Orkney weir and upstream of the Bloemhof dam. The main area where the research takes place is next to the R502 between

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Orkney and Leeudoringstad. GPS co-ordinates of the site assessed is 27° 07' 50.0" (South) 26° 29' 15.4" (East).

The RHP is a national monitoring program used to monitor and assess South Africa's freshwater resources. Application of the RHP methodology (Roux, 2001) initially entails the selection and use of reference as apposed to monitoring sites. Once the sites have been selected the monitoring focus of the RHP is based on the application of biological indicators and relevant non-biological indicators (indices), to assess the condition or "health" of the aquatic ecosystems. The abiotic driver assessment procedures include; the assessment of physico-chemical variables of the water and sediment, according to the Resource Directed Measures (RDM) methodology (DWAF, 1999) and the IWQS technique (1999), and the use of two abiotic driver indices the IHAS (Invertebrate Habitat Assessment System) and HQI (Habitat Quality Index) for habitat integrity (McMillan, 1999). The biotic response indicator methodologies are in the form of various indices relating to the health of the aquatic ecosystem. The indices include: SASS5 (South African Scoring System) for invertebrates (Dickens and Graham, 2002), FAII (Fish Assemblage Integrity Index by Kleynhans (1996)) and the RVI (Riparian Vegetation Index) by Kemper, (2001). The results of these indices are presented in the form of ecological state categories.

Results:

The following section presents the results of two ecological integrity survey assessments. The first survey was carried out between the 24th to the 25th of September 2006. Table 1 presents the SASS 5 score sheet showing results of the September 2006 invertebrate survey. Table 2 presents the Fish and related habitat data sheets. Table 3 presents the Fish habitat related velocity-depth classes and cover present at the site. Table 4 presents the Instream habitat use & surrounding area land use. Table 5 presents the fish habitat integrity at site: Estimated impact of modifications. Table 6 presents the fish habitats sampled and efforts. Table 7 presents the fish sampled in the slow deep habitat. Table 8 presents the fish sampled in the slow shallow habitat. Table 9 presents the fish sampled in the fast habitats. Table 10 presents the habitat integrity index results.

General remarks from survey 1 include:

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Sign of spawning (*C. carpio* and *C. gariepinus*) evident ➔ every few reports of Yellowfish spawning.

Sampled fish many eggs in SASS net and have seen eggs all over algae strands.

The second survey was carried out between the 22th to the 23rd of November 2006. Table 11 presents the SASS 5 score sheet showing results of the November 2006 invertebrate survey. Table 12 presents the fish habitat, velocity-depth classes and cover present at site. Table 13 Presents the instream habitat use & surrounding area land use. Table 14 presents the Fish habitat integrity at site: Estimated impact of modifications Table 15 presents the Fish habitats sampled and efforts used. Table 16 presents the fish sampled in the fast shallow habitat. Table 17 presents the fish sampled in the slow shallow habitat. Table 18 presents fish sampled in the fast deep habitat. Table 19 fish sampled in the fast deep habitat.

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Table 1 SASS 5 score sheet showing results of the September 2006 invertebrate survey.

Taxon		S	VG	GSM	TOT	Taxon		S	VG	GSM	TOT	Taxon		S	VG	GSM	TOT
PORIFERA	5					**HEMIPTERA**						**DIPTERA**					
COELENTERATA	1					Belostomatidae*	3		1		1	Athericidae	10				
TURBELLARIA	3	1	A	1	A	Corixidae*	3	1	A		A	Blepharoceridae	15				
ANNELIDA		B	1	A	B	Gerridae*	5					Ceratopogonidae	5	B	A	A	B
Oligochaeta	1					Hydrometridae*	6					Chironomidae	2	A	A	A	B
Leeches	3	B			B	Naucoridae*	7		1		1	Culicidae*	1		A		A
CRUSTACEA						Nepidae*	3					Dixidae*	10			1	1
Amphipoda	13					Notonectidae*	3		A		A	Empididae	6				
Potamonautidae*	3	1	B		B	Pleidae*	4					Ephydridae	3				
Atyidae	8					Veliidae/M...veliidae*	5		A		A	Muscidae	1				
Palaemonidae	10					**MEGALOPTERA**						Psychodidae	1				
HYDRACARINA	8					Corydalidae	8					Simuliidae	5	B	A	A	B
PLECOPTERA						Sialidae	6					Syrphidae*	1				
Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5				
Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
EPHEMEROPTERA						Ecnomidae	8			1	1	**GASTROPODA**					
Baetidae 1sp	4					Hydropsychidae 1 sp	4		A		A	Ancylidae	6	B			B
Baetidae 2 sp	6					Hydropsychidae 2 sp	6					Bulininae*	3				
Baetidae > 2 sp	12	B	B	A	C	Hydropsychidae > 2 sp	12	B			B	Hydrobiidae*	3				
Caenidae	6	B	B	B	C	Philopotamidae	10					Lymnaeidae*	3	1	A		A
Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
Heptageniidae	13					Psychomyiidae/Xiphoc	8					Planorbinae*	3				
Leptophlebiidae	9	B	A	1	B	**Cased caddis:**						Thiaridae*	3				
Oligoneuridae	15					Barbarochthonidae SW	13					Viviparidae* ST	5				
Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5	A			A
Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
Tricorythidae	9					Hydrosalpingidae SWC	15					Unionidae	6	1		1	
ODONATA						Lepidostomatidae	10					**Sass score**		175			
Calopterygidae ST,T	10					Leptoceridae	6	1			1	**No. of taxa**		31			
Chlorocyphidae	10	1	A		A	Petrothrincidae SWC	11					**ASPT**	43				
Chlorolestidae	8					Pisuliidae	10										
Coenagrionidae	4	1	A		A	Sericostomatidae SWC	13					**IHAS**					
Lestidae	8		A		A	**COLEOPTERA**											
Platycnemidae	10					Dytiscidae*	5		1		1	**Other biota:**					
Protoneuridae	8					Elmidae/Dryopidae*	8		1		1	Fish eggs, barble and Yellowfish spawning					
Zygoptera juvs.	6					Gyrinidae*	5	B	A		B						
Aeshnidae	8					Haliplidae*	5										
Corduliidae	8		1		1	Helodidae	12					**Comments:**					
Gomphidae	6					Hydraenidae*	8										
Libellulidae	4					Hydrophilidae*	5										
LEPIDOPTERA						Limnichidae	10										
Pyralidae	12					Psephenidae	10										

Table 2 Fish and related habitat data sheets

Assessor Name(s)	Andrew, Gordon, Linda		
Organisation	Econ@uj	Date	24-25 / 09 / 2006
Site information - assessed at the site			
Additional Comments:	Mixed flow conditions. Opaque and green water. Moderate to turbid turbidity		

Table 3 Fish habitat related velocity-depth classes and cover present at site.

SLOW-DEEP: 5	SLOW-SHALLOW: 3	FAST-DEEP: 2	FAST-SHALLOW: 5
Overhanging vegetation: 2	Overhanging vegetation: 3	Overhanging vegetation: 2	Overhanging vegetation: 1
Undercut banks & root wads: 1	Undercut banks & root wads: 1	Undercut banks & root wads: 1	Undercut banks & root wads: 1
Substrate: 3	Substrate: 4	Substrate: 5	Substrate: 5
Aquatic macrophytes: 2	Aquatic macrophytes: 3	Aquatic macrophytes: 3	Aquatic macrophytes: 2
Water Column: 5	Water Column:	Water Column:	Water Column:
Remarks: sufficient depth, good cover and turbid water	Remarks:	Remarks:	Remarks:

Note: Estimate abundance of each velocity-depth class and cover type using the scale: 0 – absent; 1 – rare; 2 – sparse; 3 – common; 4 - abundant; 5 – very abundant

Table 4 Instream use & surrounding area land use

Wiers: 0	Cultivated lands: 1	Grazing: 3	Plantations: 0
Impoundments: 0	Residential: 1	Mines: 0	Industries: 0
Roads: 1	Bridges/crossings: 0	Pumps: 0	Canals: 0
Exotic vegetation: 3	Aquaculture: 0	Fishing: 3	Recreation/conservation: 2

(0=absent; 1=rare; 3=moderate; 4=extensive/intensive)
Remarks: Area assessed = OVYCMA on controlled farm Wag 'n Bietjie

Table 5 Fish habitat integrity at site: Estimated impact of modifications

Water abstraction: 1	Flow modification: 2	Bed modification: 0	Channel modification: 0
Inundation: 0	Exotic macrophytes: 3	Solid waste disposal: 1	Indigenous vegetation removal: 1
Exotic vegetation encroachment: 3	Bank erosion: 1		

(Severity of impact: 0=none; 1=small; 3=moderate; 5=large)
Remarks: Segment below Orkney river. Slight flow modification indications of upstream impact:s suspected - mining activities, eutrophication and water quality modification.

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Table 6 Fish habitats sampled and efforts

Sample effort	Area 1	Area 2
Electro shocker (min)	45 min	45 min
Electro shocker: length sampled	40 m	30 m
Electro shocker: width sampled	30 m	20 m
Small seine (mesh size, length, depth, hauls)	X 1 + as base	As base

Table 7 Fish sampled in the slow deep habitat.

Habitat (velocity-depth class(es)	Slow deep
Sampling method:	Electroshock and seine net
Species	Number (J = juvenile, A = abnormality)
PPHI	3
TSPA	2
BPAL	8
C.Carpio	Exotic = 15 between 2-8kg
CGAR	20 +
BTRI	3

Table 8 Fish sampled in the slow shallow habitat.

Habitat (velocity-depth class(es)	Slow shallow
Sampling method:	
Species	Number (J = juvenile, A = abnormality)
PPHI	1
TSPA	2
BPAL	6
CGAR	3

Table 9 Fish sampled in the fast habitats.

Habitat (velocity-depth class(es)	Fast shallow / deep
Sampling method:	
Species	Number (J = juvenile, A = abnormality)
BANE	8
PPHI	1
BPAL	3
CGAR	2
BTRI	3
LCAP	4

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Table 10 Habitat integrity index

ASSESSOR/S NAME/S	
SYSTEM:	
RIVER:	
STREAM:	
QUATERNARY:	
DATE:	GPS
EVALUATION	
SECTOR/QUATERNARY/REACH/SITE	

INSTREAM HABITAT INTEGRITY		RIPARIAN ZONE HABITAT INTEGRITY	
PRIMARY			
WATER ABSTRACTION (IMPACT 1 - 25)	5	VEGETATION REMOVAL (IMPACT 1 - 25)	5
FLOW MODIFICATION ((IMPACT 1 - 25)	8	EXOTIC VEGETATION (IMPACT 1 - 25)	15
BED MODIFICATION (IMPACT 1 - 25)	0	BANK EROSION (IMPACT 1 - 25)	0
CHANNEL MODIFICATION (IMPACT 1 - 25)	0	CHANNEL MODIFICATION (IMPACT 1 - 25)	0
WATER QUALITY (IMPACT 1 - 25)	8?	WATER ABSTRACTION (IMPACT 1 - 25)	5
INUNDATION (IMPACT 1 - 25)	0	INUNDATION (IMPACT 1 - 25)	0
TOTAL (OUT OF 150)	21	FLOW MODIFICATION (IMPACT 1 - 25)	8
		WATER QUALITY (IMPACT 1 - 25)	5
SECONDARY		TOTAL (OUT OF 200)	38
EXOTIC MACROPHYTES (IMPACT 1 - 25)	10		
EXOTIC FAUNA (IMPACT 1 - 25)	10 carp!!	NB: Keep in mind that when you rate each variable (instream vs. riparian) ask yourself what the absloute worst case scenario of each variable whould be and what the refrence state would be for this particular site to conceptualise a scale. Then score. (	
RUBBISH DUMPING (IMPACT 1 - 25)	0		
TOTAL (OUT OF 75)	20		
INSTREAM HABITAT INTEGRITY SCORE INTEGRITY CLASS		RIPARIAN ZONE HABITAT INTEGRITY SCORE INTEGRITY CLASS	

RATING GUIDE	NONE	SMALL	MODERATE	LARGE	SERIOUS	CRITICAL
	(0)	(1-5)	(6-10)	(11-15)	(16-20)	(21-25)

Table 11 SASS 5 score sheet showing results of the November 2006 invertebrate survey.

Taxon		S	VG	GSM	TOT
PORIFERA	5				
COELENTERATA	1				
TURBELLARIA	3				
ANNELIDA					
Oligochaeta	1	B	A	B	C
Leeches	3	A			A
CRUSTACEA					
Amphipoda	13				
Potamonautidae*	3	A			A
Atyidae	8		A (C)		C
Palaemonidae	10				
HYDRACARINA	8				
PLECOPTERA					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA					
Baetidae 1sp	4				
Baetidae 2 sp	6			A	
Baetidae > 2 sp	12	C	B		C
Caenidae	6		A		
Ephemeridae	15				
Heptageniidae	13				
Leptophlebiidae	9	B			B
Oligoneuridae	15				
Polymitarcyidae	10				
Prosopistomatidae	15				
Teloganodidae SWC	12	A	1	A	B
Tricorythidae	9				
ODONATA					
Calopterygidae ST,T	10				
Chlorocyphidae	10				
Chlorolestidae	8				
Coenagrionidae	4		B	A	B
Lestidae	8				
Platycnemidae	10				
Protoneuridae	8				
Zygoptera juvs.	6				
Aeshnidae	8	-1	1		A
Corduliidae	8				
Gomphidae	6				
Libellulidae	4				
LEPIDOPTERA					
Pyralidae	12				

Taxon		S	VG	GSM	TOT
HEMIPTERA					
Belostomatidae*	3		B (1)		B
Corixidae*	3	1	A		A
Gerridae*	5		B(B)		B
Hydrometridae*	6				
Naucoridae*	7				
Nepidae*	3				
Notonectidae*	3				
Pleidae*	4				
Veliidae/M...veliidae*	5			1	1
MEGALOPTERA					
Corydalidae	8				
Sialidae	6				
TRICHOPTERA					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12	B	B		C
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphoc	8				
Cased caddis:					
Barbarochthonidae SW	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6				
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA					
Dytiscidae*	5	1	B	A	B
Elmidae/Dryopidae*	8				
Gyrinidae*	5	A	(C)B		C
Haliplidae*	5				
Helodidae	12				
Hydraenidae*	8				
Hydrophilidae*	5		A		A
Limnichidae	10				
Psephenidae	10				

Taxon		S	VG	GSM	TOT
DIPTERA					
Athericidae	10				
Blepharoceridae	15				
Ceratopogonidae	5				
Chironomidae	2			A	A
Culicidae*	1				
Dixidae*	10				
Empididae	6				
Ephydridae	3				
Muscidae	1				
Psychodidae	1				
Simuliidae	5	B	B	A	C
Syrphidae*	1				
Tabanidae	5				
Tipulidae	5				
GASTROPODA					
Ancylidae	6	B			B
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae*	3				
Physidae*	3				
Planorbinae*	3				
Thiaridae*	3				
Viviparidae* ST	5				
PELECYPODA					
Corbiculidae	5	B (B)			B
Sphaeriidae	3				
Unionidae	6				
Sass score					125
No. of taxa					22
ASPT					
IHAS					
Other biota:					
P phi (Fish)					
Tadpoles					
Comments:					

Rate invertebrate biotope sampled: 1=very poor (i.e. limited diversity),   5=highly suitable (i.e. wide diversity)

Table 12 Fish habitat. Velocity-depth classes and cover present at site.

SLOW-DEEP: 5	SLOW-SHALLOW: 1	FAST-DEEP: 4	FAST-SHALLOW: 2
Overhanging vegetation: 3	Overhanging vegetation: 4	Overhanging vegetation: 1	Overhanging vegetation: 3
Undercut banks & root wads: 2	Undercut banks & root wads: 1	Undercut banks & root wads: 1	Undercut banks & root wads: 2
Substrate: 4	Substrate: 3	Substrate: 4	Substrate: 4
Aquatic macrophytes: 2	Aquatic macrophytes: 3	Aquatic macrophytes: 2	Aquatic macrophytes: 1
Water Column: 4	Water Column: 1	Water Column: 2	Water Column: 1
Remarks: Difficult to sample. Need fyke net	Remarks:	Remarks:	Remarks:

Note: Estimate abundance of each velocity-depth class and cover type using the scale: 0 – absent; 1 – rare; 2 – sparse; 3 – common; 4 - abundant; 5 – very abundant

Table 13 Instream use & surrounding area land use

Wiers: 0	Cultivated lands: 1	Grazing: 3	Plantations: 0
Impoundments: 0	Residential: 1	Mines: 0	Industries: 0
Roads: 1	Bridges/crossings: 0	Pumps: 0	Canals: 0
Exotic vegetation: 3	Aquaculture: 0	Fishing: 1	Recreation/conservation: 1

(0=absent; 1=rare; 3=moderate; 4=extensive/intensive)
Remarks: Area assessed = OVYCMA on controlled farm Wag 'n Bietjie

Table 14 Fish habitat integrity at site: Estimated impact of modifications

Water abstraction: 0	Flow modification: 0	Bed modification: 0	Channel modification: 0
Inundation:	Exotic macrophytes: 3	Solid waste disposal: 0	Indigenous vegetation removal: 1
Exotic vegetation encroachment: 3	Bank erosion: 1		

(Severity of impact: 0=none; 1=small; 3=moderate; 5=large)

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Table 15 Fish habitats sampled and efforts

Sample effort	Slow shallow	Fast	Fast Deep	Slow Deep
Electro shocker (min)	10 min	50 min	15 min	
Electro shocker: length sampled	20 m	75 m	20 m	
Electro shocker: width sampled	2 m	50 m	20 m	
Small seine (mesh size, length, depth, hauls)				5 hauls

Table 16 Fish sampled in the fast shallow habitat.

Habitat (velocity-depth class(es)	Fast shallow
Sampling method:	Electroshock
Species	Number (J = juvenile, A = abnormality)
C.gar	Ax1 Jx11 = 12
B.tri	Ax3
B.pal	Ax14 Anx1 = 15
P.phi	Ax2 Jx5 = 7
B.aen	Ax1 jx3 = 4
L.cap	Ax2 Jx7 = 9
C.carpio(exotic)	Jx3 = 3

Table 17 Fish sampled in the slow shallow habitat.

Habitat (velocity-depth class(es)	Slow shallow
Sampling method:	Electroshocking
Species	Number (J = juvenile, A = abnormality)
B.pal	Jx1 Ax24 = 25
B.tri	Jx1 Ax5 = 6
B.aen	Jx1 = 1
C.carpio (exoctic)	Jx5 = 5
C.gar	Jx2 = 2
L.cap	Jx6 = 6
P.phi	Jx15 Ax3 = 18
G.affinis	Ax1 = 1

Table 18 Fish sampled in the fast deep habitat.

Habitat (velocity-depth class(es)	Fast deep
Sampling method:	Electroshock
Species	Number (J = juvenile, A = abnormality)
L.cap	Ax18 = 18
B.aen	Ax6 = 6

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Table 19 Fish sampled in the fast deep habitat.

Habitat (velocity-depth class(es)	Slow deep
Sampling method:	Large seine net (6 haules – very ineffective)
Species	Number (J = juvenile, A = abnormality)
C.carpio (exotic)	Ax1 = 1
C.gar	Ax1 = 1

Survey remarks

Focus of survey became to find missing but expected to occur 3x species including Austroglanis, B. anoplus and L. umbratus
All attempts were unsuccessful due to (believed) possible low abundance of x3 species and techniques used. Need to use a fyke net and boat shocker.

Concluding remarks

These surveys were carried out successfully. Some data is still being iterated but from the findings of these surveys a confident ecological state of the Vaal River in relation to the reach being studied in the Telemetry study will be established.

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