

## *Setting the Thresholds of Potential Concern for Fish Assemblages*

### **Rationale**

Fish are considered to be a suitable component of the aquatic system to monitor because they integrate the effect of detrimental environmental changes as consumers and are relatively high in the aquatic food chain (Hellowell, 1978). Fish have been used as indicators of environmental conditions on the basis of individual organisms, populations and indicator species. The current emphasis is on the interpretation of the response of fish communities or assemblages to environmental disturbances (Kleynhans, 1997).

During a Water Research Commission workshop on fish TPC's in Pretoria (18 January 2000), it was decided to concentrate on the following indicators:

- The Fish Assemblage Integrity Index (FAII): This will embrace sensitivity, frequency of occurrence and % anomalies.
- Distribution and occurrence of individual species.
- Community composition shifts, including abundance models.
- Sensitive species as indicator of changes.

**Fish Assemblage Integrity Index (FAII):** The FAII commences with the compilation of attributes of the fish community in every segment to establish reference (baseline or near natural) characteristics. This involves the determination of the fish species historically present (i.e. before modern day disturbances) in each segment, followed by the assessment of the relative tolerance of every species. Next, the abundance and frequency of occurrence of species in a segment (again based on historical information for this river, or other rivers with comparable characteristics). Their health as expected under natural conditions is also used to derive expected fish community structure and function characteristics under unimpaired environmental conditions. This information is integrated in an index that is compared with the current situation in the river as was observed during fish surveys.

The FAII is able to compare historical data with present conditions and will be an indicator of:

- sensitivity, frequency of occurrence and % anomalies
- distribution and occurrence of individual species
- community composition shifts, including abundance models
- sensitive species as indicator of changes.

The FAII takes into account general intolerance, health and frequency of occurrence. It does not provide much insight into cause and effect relationships. It is based on the proportion of species observed: species expected for reference; expressed as % and linked to an integrity category (A-F; see Table 1):

A=natural

B=largely natural

C=moderately modified

D=largely modified

E=seriously modified

F=critically modified

The information and data input into the model are obtained as follow:

- Expected frequency of occurrence for fish under reference conditions in a defined river reach is derived based on expert judgment and available data.
- The present frequency of occurrence of these species are determined based on survey data and/or derived from habitat driver changes and their environmental preferences and intolerances.
- Frequency of occurrence information used to weight the indicator value of species for different habitat characteristics (metric groups) under reference conditions.
- Present frequency of occurrence as observed or derived from habitat changes is rated compared to the reference.

Based on species responses and their indicator value for different environmental characteristics, this provides an indication of the habitat changes, i.e., whether it is related to:

- Flow,
- Cover,
- Water quality
- Physical obstructions, or
- Introduced biota.

The methodology to the FAII is described in the unpublished reports by Kleynhans (1997) and Kleynhans (1999).

## Relation to KNP objectives

Objectives that this programme will address is:

### River health Objective:

- **migration patterns and movements** of fish between habitats based on connectivity
- restore natural river ecosystem health and functioning by rehabilitating **man-made structures** (implementing fishways)

### Functional processes Objective:

- **monitor** fish assemblage response against river TPCs and instigate strategic adaptive management processes when approaching thresholds

### Composition, Structure & Pattern Objective:

- **catalogue** riverine biodiversity
- establish **long-term fluctuations** in fish assemblages across multiple scales
- establish **TPC's** for fish diversity and river health
- implement a practical **monitoring programme** for fish

## *TPC*

The FAII will form the core of the fish TCP since it is based on the categorisation of the fish community according to an intolerance rating which takes into account trophic preference and specialisation, requirement for flowing water during different life-stages, and association with habitats with unmodified water quality. Results of the FAII are expressed as a ratio of observed conditions versus conditions that would have been expected in the absence of human impacts.

The proposed main TPC for fish assemblages is:

- **The fish present ecological state (PES) per river reach should not drop one biological condition class (Table 1) or show a continuous negative trend in the biological integrity categories (metrics) established for each river.**

This main TPC should be checked by taking the following points into account:

- A decrease (> 35% decline in number of localities collected in different surveys) in the

distribution of an indigenous fish species that is permanently resident in a river and where the reason for the decline is the consequence of man- induced changes in the aquatic environment

- An increase (>35% increase in number of localities collected in different surveys) in the distribution of permanently resident, indigenous fish species, where the reason for the increase is the consequence of man-induced changes in the aquatic environment and where the increased distribution of said species threatens the conservation status of any other species.
- The establishment or increase in the distribution of an alien fish species.

Alternatively, the following changes in the distribution of fish species would not indicate a decline in the conservation status of fish communities, and hence would not represent a departure from the National Parks Board’s conservation objectives:

- Either an increase or decrease in the distribution of an indigenous fish species resulting from natural changes in the aquatic environment; or where, after comprehensive study of the environmental preferences of the species and man- induced changes in the physical, chemical and biological environment, no obvious cause for the observed change in the distribution can be identified.
- A decline in the distribution of a widespread fish species whose widespread distribution is the consequence of man-induced changes in the aquatic environment.
- An increased in the distribution of an indigenous species, resulting from man-induced changes in the aquatic environment, where the increased distribution does not threaten the conservation status of any other species.
- A decrease in the distribution of an introduced or alien fish species.
- A decline in the distribution of occasional migrant fish species.

Table 1. FAII rating scale.

Class rating	Description of generally expected conditions for integrity classes	Relative FAII score (% of expected)
A	Unmodified, or approximate natural condition closely.	90 to 100
B	Largely natural with few modifications. A change in community characteristics may have taken place but species richness and presence of intolerant species indicate little modification.	80 to 89
C	Moderately modified. A lower than expected species richness and presence of most intolerant species. Some impairment of health may be evident at the lower limit of the class.	60 to 79
D	Largely modified. A clearly lower than expected species richness and absence or much lowered presence of intolerant and moderately intolerant species. Impairment of health may become more evident at the lower limit of the class.	40 to 59

E	Seriously modified. The striking lower than expected species richness and general absence of intolerant and moderately intolerant species. Impairment of health may become very evident.	20 to 39
F	Critically modified. Extremely lowered species richness and an absence of intolerant and moderately intolerant species. Only tolerant species may be present with a complete loss of species at the lower limit of the class. Impairment of health generally very evident.	0 to 19

***References.***

HELLAWELL, J.M. 1978. *Biological surveillance of rivers*. Water Research Centre, Stevenage, England.

Kleynhans, C. J. 1997. An exploratory investigation of the instream biological integrity of the Crocodile River, Mpumalanga, as based on the assessment of fish communities. Institute for Water Quality Studies, Department of Water Affairs and Forestry, Pretoria, South Africa.

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