A fish-based assessment tool for the ecological quality of the brackish Schelde estuary in Flanders (Belgium)

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Extended abstract

1. The basic rationale of a fish-based Estuarine Index of Biotic Integrity (EBI)

An EBI should predict the ecological quality of an estuary based on fish assemblage data. A new approach was developed to find an optimal subset from a series of candidate metrics extracting possible relevant ecological information from the catch data. A powerful EBI should minimise two prediction errors simultaneously: falsely declaring a site as disturbed when it is pristine (type I error) and the reverse, declaring a disturbed site as undisturbed (type II error) (Table 1).

Table 1: The type I and II error (extended definition + results for EBI)

R: reference **M: moderate** **D: disturbed**	Biotic Index **R**	Biotic Index **M**	Biotic Index **D**
Independent classification: **R**		(small) type I 6 %	(severe) type I 4 %
Independent classification: **M**	(small) type II 41 %		(small) type I 9 %
Independent classification: **D**	(severe) type II 0 %	(small) type II 20 %	

For a given index a one-to-one relationship between both errors exists: decreasing one error is at the expense of the other. For instance, decreasing the type I error implies being more conservative to declare a site as disturbed and as a consequence the type II error will increase. The error curve shows this trade-off between type I and type II error and gives a picture of the overall discriminative power of a certain metric or index (Fig. 1).

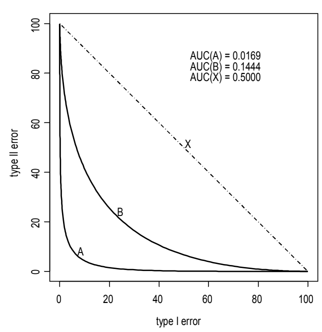

Figure 1: Error curves for two fictitious indices

A lower error curve implies a better balance between the two types of error. For instance, the curve for index A is systematically below B: for each choice of the type I error, the type II error is smaller. A is uniformly more powerful than B.
A way to summarize the closeness to the origin is the area under the (error) curve (AUC). The AUC expresses numerically the quality of an index (smaller = better: $AUC_A < AUC_B < 0.5$ = no discrimination).
This criterion was applied to search for the optimal set of metrics for the estuarine fish-based index of biotic integrity (EBI) for the brackish Schelde estuary in Flanders.

2. The EBI development

From 1995 to 2004, fish data from 5 sites belonging to the brackish estuary of the River Schelde in Flanders were used to calibrate the EBI. Fish assemblages were surveyed using fyke nets. Since no undisturbed sites were available it was only possible to develop an EBI for class 3 (moderate quality) to 5 (very disturbed).
Candidate metrics were chosen based on their ecological information and on the data availability. Their response to pressure was screened by boxplots with respect to a predefined habitat quality class. Only monotonous metrics (i.e. having a uniform relation with disturbance) were kept and scored from 0 to 1. The quintiles of the distribution of the metric values in the best condition (moderate) were used as thresholds to score in steps of ¼. Values above the highest threshold get 1, then 0.75 until 0.25. Below the lowest threshold 0 is given (Fig. 2).

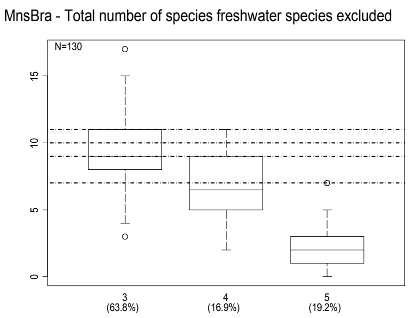

Figure 2: Boxplot of one of the metrics (total number of species, excluding the freshwater species); dotted lines are the quintile thresholds to score.

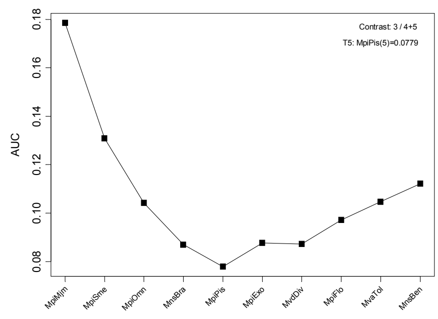

Figure 3: The stepwise minimization of AUC by stepwise metric introduction

From the screened list of metrics an optimal subset was composed by a process similar to stepwise regression. First the metric with lowest AUC or highest discriminating power was selected. Then the metric decreasing most AUC is introduced. And so on, until AUC starts to increase (Fig. 3). In this way five metrics turned out to be optimal. Their average is the ecological quality ratio (Fig. 4) and it is the basis for the final EBI. Thresholds were chosen to fix the type I error for each level at 10%. Then the other errors can be calculated to evaluate (Table 1). They were small (< 9%) with exception of the poor status (4) where there is a tendency to underestimate disturbance (small type error II = 41%). However, none of the fishing occasions in class five was misclassified in class four.

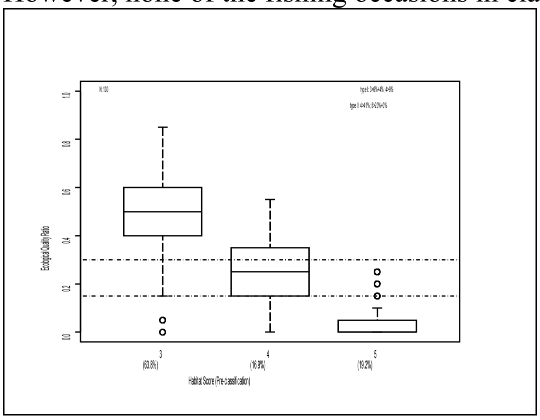

Figure 4: The EBI distribution and thresholds

The obtained results are logical and the EBI adequately assesses the sites (internal validation). More data are needed for an external validation. The new method to select metrics and attribute scores is a transparent and general system that can be applied to the calibration of any other biotic index.