

Quality control of biological indices: A first exercise for an index assessing ecological status of river phytobenthos in Flanders

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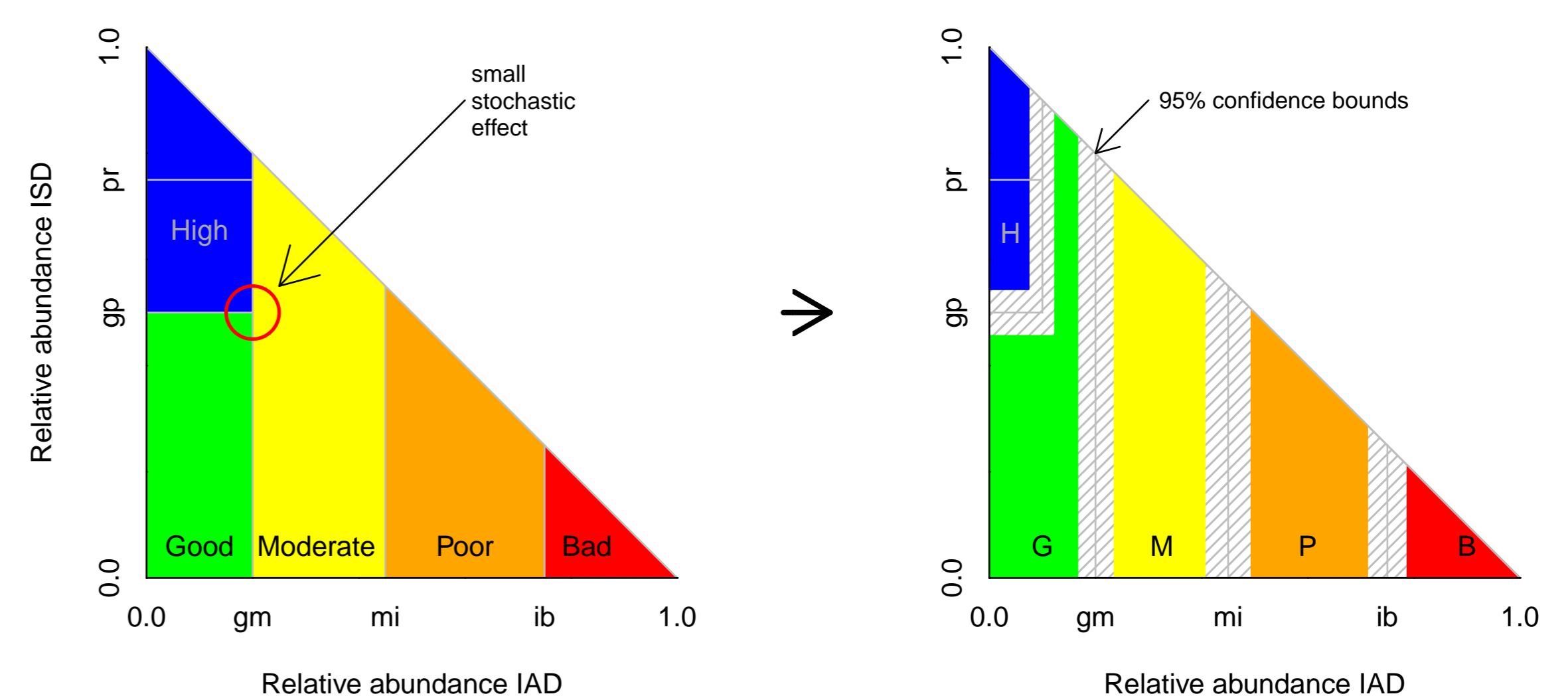
Introduction

- ▶ The European Water Framework Directive (WFD) requires that every member state assesses the ecological status of its waterbodies relative to near-pristine reference conditions, categorized in 5 classes, evaluating different biological quality elements (fish, macro-invertebrates, macrophytes and phytobenthos and phytoplankton) by means of Ecological Quality Ratios categorized in five classes. A quality lower than the second-highest class (good) implies that actions for improvement are required.
- ▶ A first evaluation is made of the current index for river phytobenthos in lower Belgium (Flanders):
 - ▶ firstly, some statistical properties of the index are analyzed;
 - ▶ secondly, an exploratory analysis of the data for the first three monitoring years is presented.

The PISIAD index

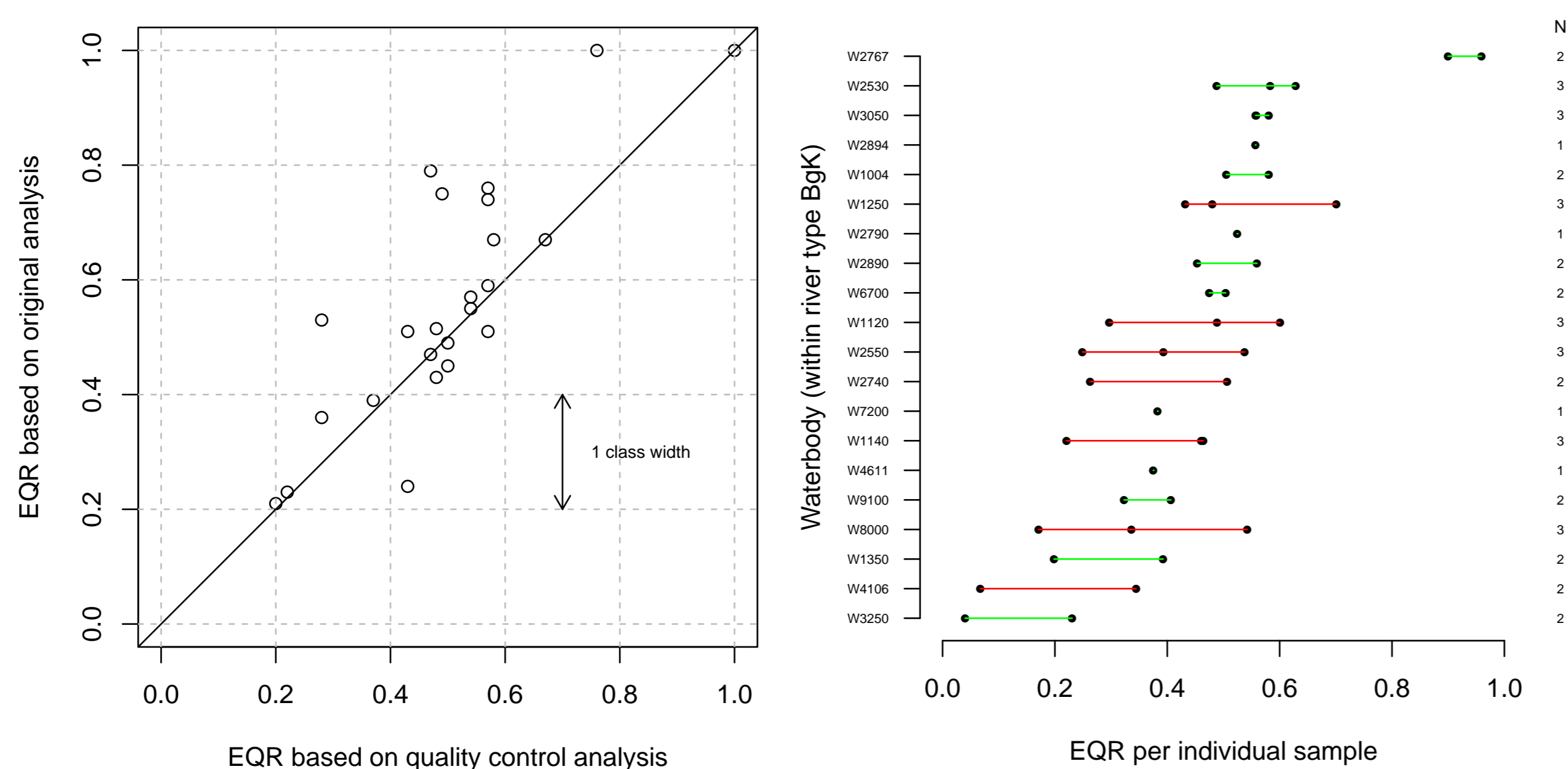
- ▶ Assemblages of diatoms, abundantly occurring unicellular algae with a cell wall including two silica valves, are chosen as proxy for phytobenthos evaluation.
- ▶ Assemblage composition is determined by identifying and counting a fixed number of individual valves under a microscope.
- ▶ For each river type, a reference list categorizes the numerous diatom species into impact sensitive (ISD), impact associated (IAD) or impact-indifferent (IID).
- ▶ The phytobenthos index (PISIAD) is calculated from the relative Proportions of both Impact Sensitive and Impact Associated Diatoms.
 - ▶ This index is a measure of increasing distance from natural conditions due to human impact.
 - ▶ For the lower three classes (bad, poor and moderate) only the percentage IAD is considered.
 - ▶ The two highest quality classes (good and high) are separated using only the percentage ISD.
 - ▶ For each water type thresholds of IAD and ISD are defined for class transitions.
- ▶ The values are rescaled to a continuous score between 0 and 1 (EQR).

Current and adjusted index



- ▶ Problem: because class "moderate" and "high" border, small stochastic variation can have serious impact on the classification.
- ▶ Adjustments
 - ▶ The problematic area is accounted for by expanding the "good" class
 - ▶ 95% Confidence around the class borders are introduced

Uncertainty: species identification and within waterbody variability



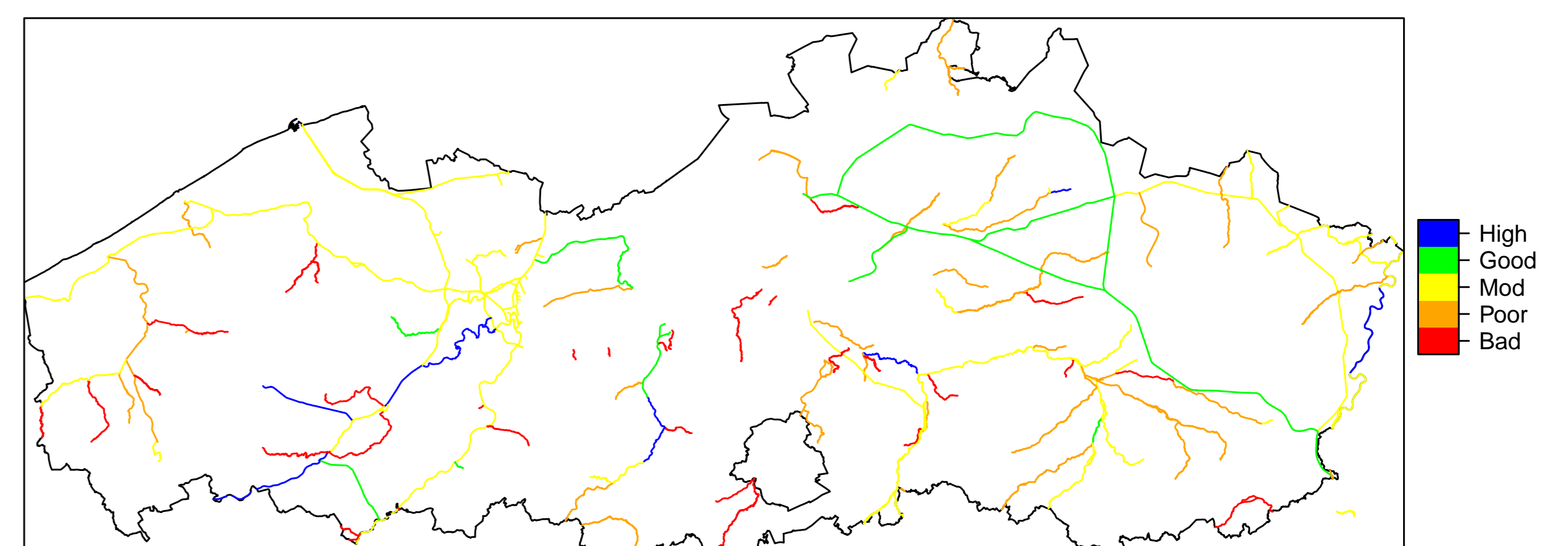
Sources of uncertainty on the index

- ▶ Species identification
 - ▶ 24 samples were recounted, leading to a different quality class for eight.
- ▶ Number of valves (confidence bounds)
 - ▶ The number of valves influences the confidence bounds around each class.
 - ▶ The figure above ('adjusted index') shows the 95% confidence bounds for 500 valves.
 - ▶ For the existing dataset, 27% of the measurements lie within these bounds.
 - ▶ Three samples are evaluated in each waterbody. If these are lumped, the count increases to 1500 valves, stabilizing the final result.
- ▶ Spatial variability within a waterbody
 - ▶ A waterbody should be a stretch of homogeneous quality; ecological quality was, however, largely unknown at the time of their delineation as no EQR values were available.
 - ▶ Three sites were sampled per waterbody.
 - ▶ The variability of index values within a waterbody is high.
 - ▶ On average, EQR variability was about 0.20, which amounts to a whole class width.

Results of the study

- ▶ The spatial distribution of the PISIAD scores in Flanders is shown on the right.
- ▶ Association with physical-chemical indications of human impact (not shown).
 - ▶ Associations were often not very strong
 - ▶ But a clear negative association with *EC*, *BOD*, *COD*, *N* and *O₂* was found
- ▶ Association with the other biological quality elements (not shown)
 - ▶ Association with macro-invertebrates was limited but slightly positive (correlation between 0.15 and 0.35); PISIAD was not correlated to the macrophyte EQR.
 - ▶ Study was not designed to compare the different indices.
 - ▶ The results suggest that the indices probably are complementary.
 - ▶ The quality element with the worst evaluation determines the integrated assessment.
 - ▶ ⇒ improvement of one of the elements will not often lead to a better overall quality.

Ecological quality for phytobenthos in Flanders



Conclusions

- ▶ When developing an index both ecological and statistical properties must be addressed.
- ▶ Aggregation of individual sampling points to waterbody level can lead to a more stable result.