EUROPEAN COMMISSION
JOINT RESEARCH CENTRE
Directorate D – Sustainable Resources

ECOSTAT discussion paper: European surface water ecological assessment methods – an overview of their sensitivity to pressures

Wouter van de Bund, Sandra Poikane, Fuensanta Salas Herrero (European Commission DG Joint Research Centre)

Scope and purpose of this paper

One of the key activities for ECOSTAT in the CIS work programme 2016-2018 is "Best practice on the use of supporting elements for the assessment of ecological status (hydromorphology and physico-chemical parameters including river basin specific pollutants)", to be addressed in 2018. This activity will build on previous and ongoing ECOSTAT work including the intercalibration of good status for the BQEs, harmonization of nutrient standards, and the work on hydromorphological methods.

The recently completed intercalibration exercise has focused on good status boundaries for individual biological quality elements. In theory, the BQE classification methods should integrate the effects of all relevant pressures, and the classification of BQEs and supporting elements representing the key pressures should be in agreement. In this discussion paper we analyze to which degree the BQE methods used by the MS respond to pressures, based on the information in the intercalibration technical reports. The following questions are addressed:

- Which pressures are assessed /by ecological assessment systems currently in use in Europe?
- Which BQEs are used for detecting those pressures?
- Are there some pressures missing?
- How strong is the evidence provided to demonstrate pressure-response relationships for the different pressures and BQEs?
- Can we expect the classification for the different supporting elements to be in agreement with BQW classification?

Data used for the analysis:

For each of the methods included in the latest round of the intercalibration the following information was extracted from the IC technical report:

- Pressures to which the method responds according the MS (using the pressure categorization as they are reported)[1]
- Degree of evidence of pressure-impact relationships in the IC technical reports:
    - Any evidence (including regressions with R<0,1, multiple pressure index where the contribution of individual pressures is unknown, box plot comparison, pressure proxy based on expert judgment
    - Strong evidence (demonstrated by significant regressions with R>0,1)

Figure 1 and 2 show the number of biological quality elements that are sensitive to the main pressures in national classification methods for inland and coastal/transitional waters, respectively, shown as

[1] This information is only available for Rivers and Lakes. For Coastal and Transitional waters pressures were only included in the IC reports if there was at least some evidence for the BQE responding

percentages of the total number of Member States. Figure 3 and 4 show for each BQE the percentage of MS with methods sensitive for the various pressures.

Pressures addressed by BQE methods

Eutrophication and organic pollution

Eutrophication and organic pollution are the dominant pressures that are well covered by the BQE methods for all four water categories (Fig. 1 and 2. Strong evidence for pressure-impact relationships is reported in the intercalibration technical reports for most BQEs for all water categories (Fig. 2 and 3). For >30% of the countries these pressures are addressed by three BQEs or more, indicating a high level of redundancy in the classification systems. Some BQEs also respond very specifically to certain pressures (e.g. phytoplankton to nutrients, certain river invertebrate methods to organic pollution). It is reasonable to expect that effects of eutrophication and organic pollution are picked by the biological classification system, and that classifications of the relevant physicochemical supporting elements oxygenation and nutrient conditions are in agreement with BQE classifications.

Hydromorphological pressures

Member States report that hydromorphological pressures are addressed by at least one BQE in 90% of the countries for rivers, in ca. 80% of the countries for coastal and transitional waters, and in only ca. 50% of the countries for lakes. Fish and benthic fauna are the BQEs responding most strongly for rivers and lakes, angiosperms, macroalgae, and fish for coastal and transitional waters. For rivers, lakes and coastal waters, the evidence provided for the response to hydromorphological pressures is much weaker than for eutrophication/organic pollution, often based on proxy indicators such as land use. Methods rarely respond very specifically to hydromorphological pressures, with some exceptions (e.g., some countries have specific modules in their river benthic fauna methods designed to detect hydromorphological alterations).

From the intercalibration technical reports, there is not much evidence that the BQE methods currently in use reliably pick up the effects of hydromorphological alterations. To be sure that hydromorphological pressures and their effects do not remain undetected, it is therefore very important to use hymo classification methods alongside the BQEs. From the river hymo methods questionnaire it has become clear that most countries have developed classification methods for the hydromorphological supporting elements. However, P/I relationships between those methods and the BQEs need to be demonstrated.

Pressure by toxic substances

Few BQEs are reported to be sensitive for toxic substances (either priority substances or river basin specific substances) for rivers, lakes and coastal waters. For transitional waters the situation is different, here there is ample evidence that the AMBI based benthic fauna methods uses by many MS respond to contamination by heavy metals (but not to toxic substances in general). The conclusion can be drawn that one cannot expect the current BQE methods to reliably pick up effects of toxic substances. Targeted

methods (e.g. effect- based tools) could be developed to better integrate the effects of different toxicants in the environment.

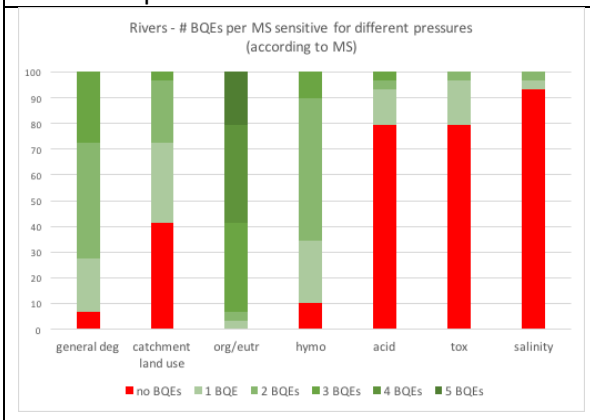
"General degradation" and "Land Use"

"General degradation" and "land use" are frequently mentioned as pressures affecting the BQEs, especially for rivers and coastal/transitional waters, and for many methods significant correlations have been demonstrated. There is no common definition of "general degradation", typically a composite pressure index is used combining single pressures such as nutrients, organic matter, various hydromorphological alterations, and others in a single pressure index. Problem with this kind of indexes is that it is not always clear which pressure is the one causing the response. "Land use" can be seen as proxy for a single or multiple pressures. The concept of "general degradation" has been used especially for rivers and coastal/transitional waters where it is often difficult to establish clean pressure-impact relationships. Multimetric benthic fauna and fish assessment methods typically show good relationships with such general pressure indices. In some cases, a multimetric index is a combination of different modules or metrics specifically designed to detect effects of different pressures. In any case, hydromorphological and physicochemical supporting elements can be very useful as diagnostic tools.

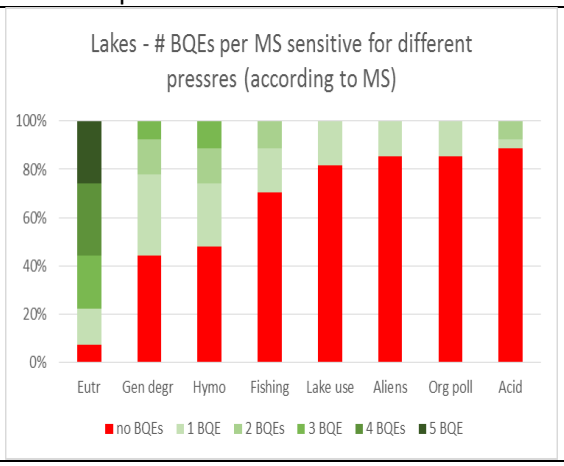
Acidification

Acidification is a problem occurring in rivers and lakes in the North of Europe; countries that are affected typically have separate fish and benthic fauna methods targeted to detect the effects of acidification, with strong evidence for pressure-impact relationships provided in the IC technical reports. It can therefore be concluded that acidification is well covered by the BQE methods.

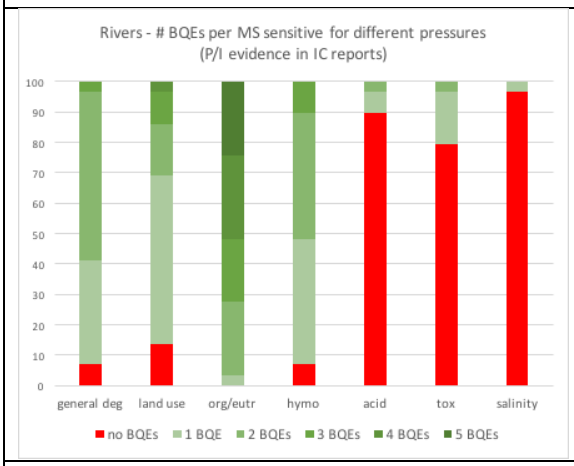
Rivers – reported



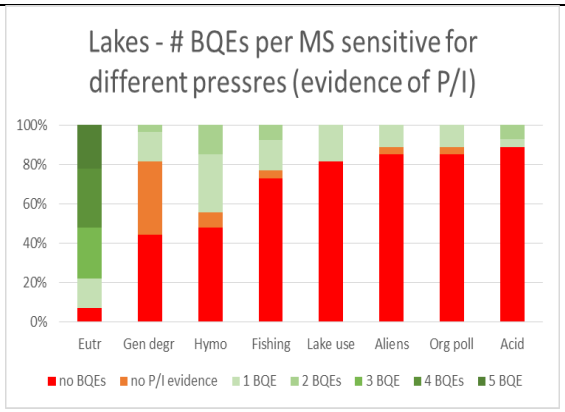
Lakes - reported



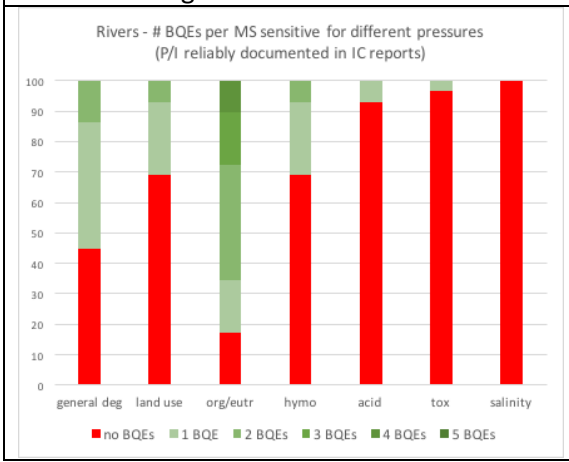
Rivers – evidence



Lakes - evidence



Rivers – strong evidence



Lakes – strong evidence

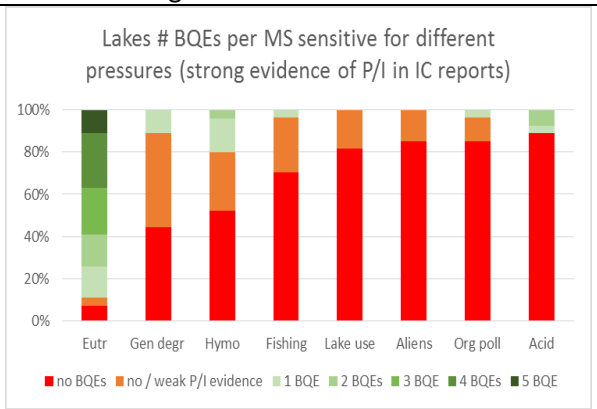


Figure 1 – Number of BQEs in national classification systems for lakes and rivers sensitive for different pressures (1) as reported by MS; (2) supported by some evidence; (3) supported by strong evidence (y-axis shows the percentage of the total number of countries)

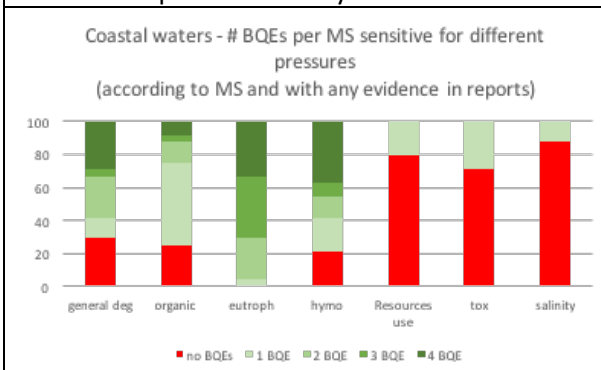
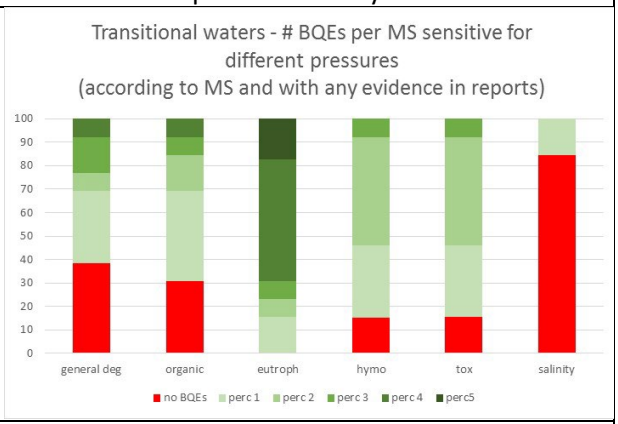
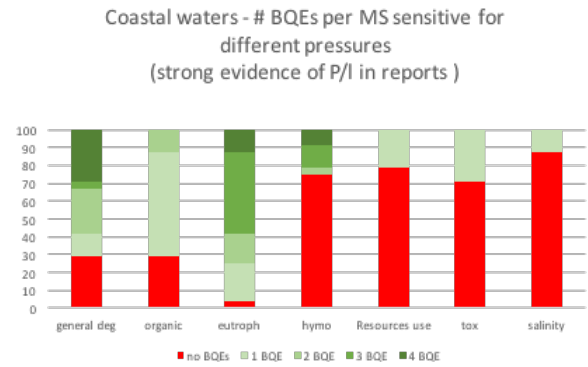
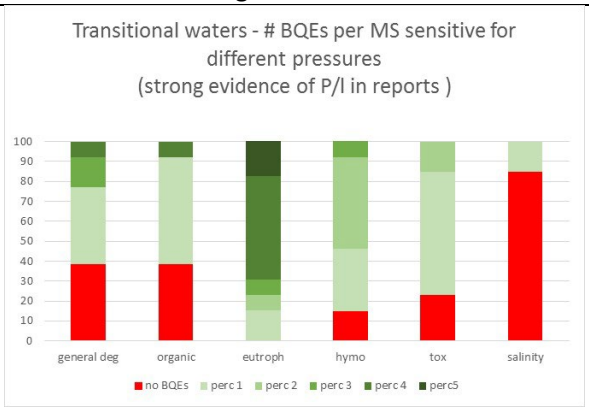
Coastal – reported with any evidence	Transitional - reported with any evidence
	
Coastal – strong evidence	**Transitional – strong evidence**
	

Figure 2 – Number of BQEs in national classification systems for coastal and transitional waters sensitive for different pressures (1) as reported by MS with any evidence; (3) supported by strong evidence (y-axis shows the percentage of the total number of countries)

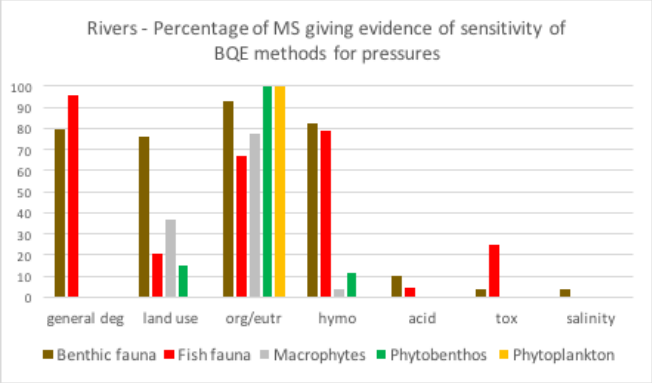
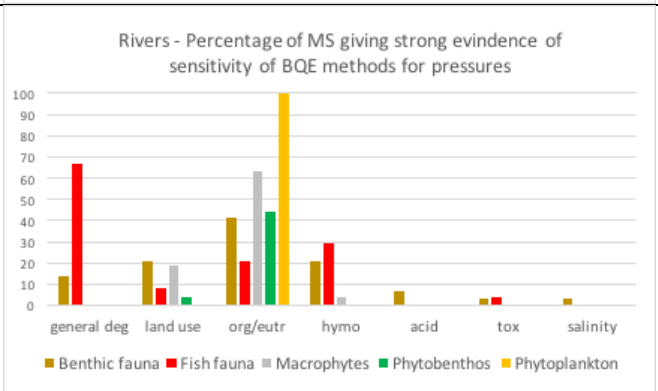
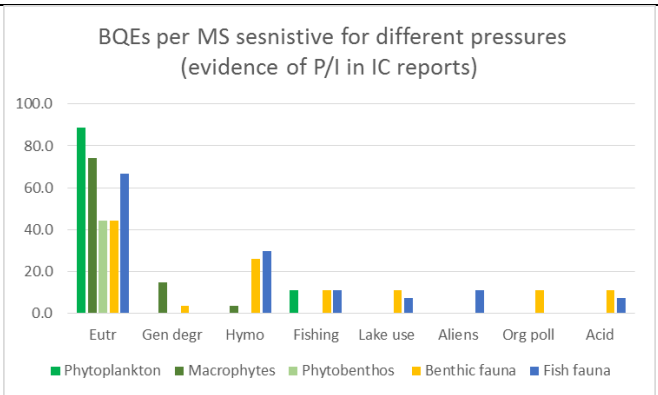
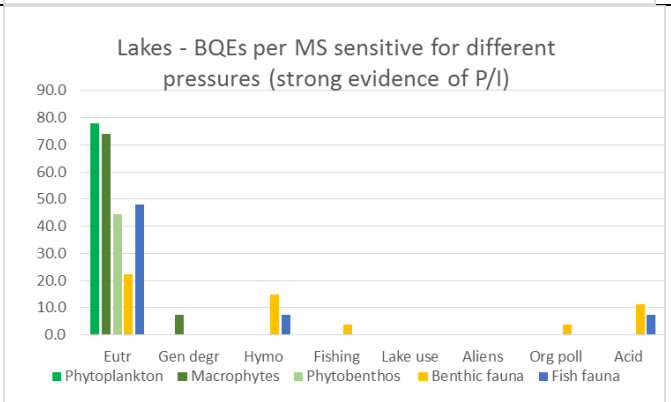
Rivers		
Rivers - strong evidence		
Lakes		
Lakes - strong evidence		

Figure 3 – Sensitivity of BQEs for reported pressures for rivers and lakes (1) some evidence in IC reports; (2) strong evidence in IC reports (y-axis shows the percentage of the total number of countries)

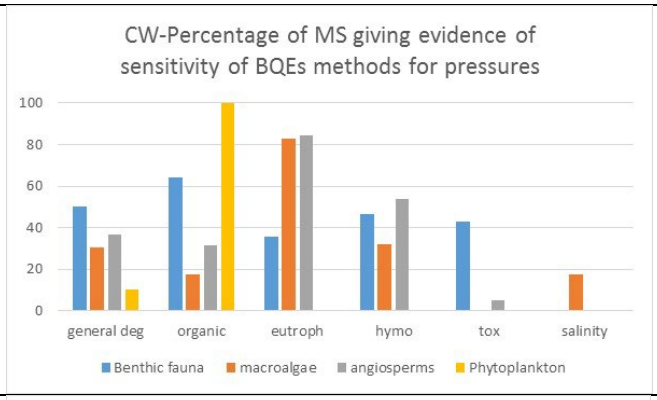
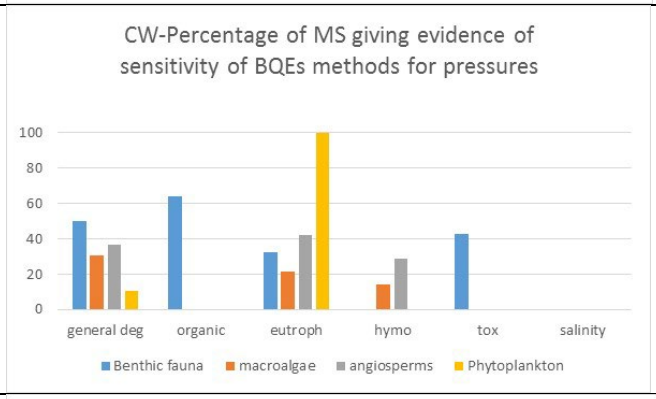
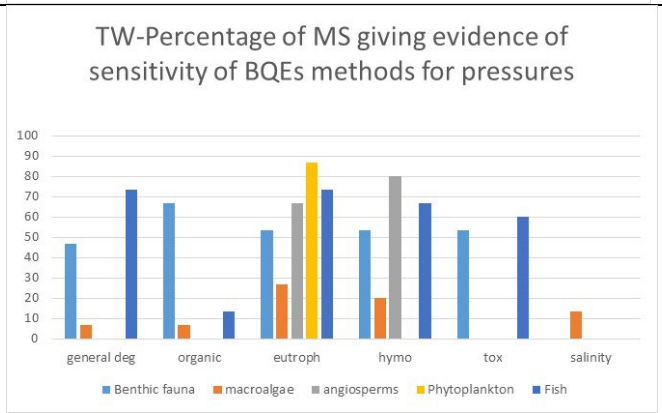
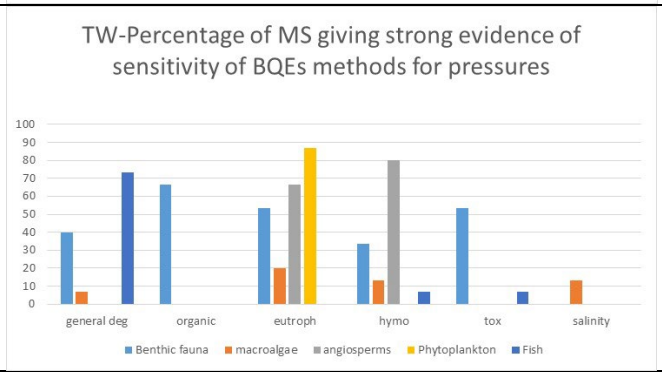
Coastal		
Coastal - strong evidence		
Transitional		
Transitional - strong evidence		

Figure 3 – Sensitivity of BQEs for reported pressures for coastal and transitional waters (1) some evidence in IC reports; (2) strong evidence in IC reports (y-axis shows the percentage of the total number of countries)