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Comparison of ecological status between countries and river basin management plans (RBMP) cycles

Approaches used by countries for rivers and lakes, consequences for comparison for the 3rd RBMP assessment

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1 Executive summary

The Water Framework Directive (WFD) (EC, 2000) is founded on the concept of ecosystem-based management. The WFD therefore defines and specifies the concept of ecological status for surface waters (Annex V) and requires EU Member States and the EFTA-countries (e.g. Norway, Iceland) (MSs) to develop and intercalibrate methodologies for assessing ecological status for different biological quality elements (BQEs) in water bodies in common water body types. The WFD also requires MSs to develop methods for assessing the ecological status of supporting physico-chemical and hydromorphological quality elements (supporting QEs) and that these are in line with those of the BQEs for each status class. These requirements are fundamental to achieve comparable data for ecological status across MSs and from one cycle of river basin management plans (RBMPs) to the next.

The latest assessment of status and pressures in European waters (EEA 2018) presented the ecological status for different water categories, for different quality elements (BQEs and supporting QEs) and the change since the first assessment in 2012 (EEA 2012). The results showed that a large proportion of the water bodies were reported with unknown status for single BQEs and supporting QEs. As many MSs had not yet finalized the development of their assessment methods during the second cycle of RBMPs, the EEA 2018 report cautioned against detailed comparisons of BQE and supporting QE results between countries and between RBMPs. The changes in overall ecological status between the two cycles of RBMPs are even more difficult to interpret due to changes in monitoring and classification methods between the two cycles, as well as insufficient reporting of the reasons for changes in ecological status (whether the changes are real or methodological).

The variability of methodologies in assessing and reporting ecological status between MSs and RBMP cycles create comparability issues, which in turn compromise in-depth evaluations of WFD effectiveness at the European level. This situation raised the need to look deeper into the methodological differences to see how they affect comparisons of overall ecological status and QE status between MSs and RBMPs and how the data can best be used for the next assessment. We focus on ecological status in this report as it is central to the WFD and may support further similar analysis for chemical and quantitative status. Moreover, the outputs from this report on ecological status comparability could also support efforts to streamline biodiversity assessments relevant for the 2030 Biodiversity Strategy.

This technical report provides an overview of the comparability of ecological status for single BQEs and supporting QEs, as well as for overall ecological status. The main outputs present the major comparability issues and their consequences for cross-cutting assessments. Suggestions for the way forward are also provided for the next assessment at EU-level and for further work in the WFD-CIS-working groups WG-DIS and WG-ECOSTAT towards more harmonized approaches for the next RBMP cycles.

The major issues can be summarized as:

- There is a difference between the MSs and RBMPs concerning the number of BQEs used for classification. Some MSs classify a large proportion of their water bodies using only the supporting QEs or using no QEs at all. MSs using few quality elements may be more likely to get better overall ecological status than those using many due to the one-out-all-out principle.
- The standards (good/moderate boundaries) for the general Phys-Chem QEs vary a lot with wide ranges in standards between and within MSs. Some standards are probably not in line with the BQEs.
- The HyMo QE-status classification and downgrading practices applied for these QEs are different among MSs and RBMPs.
- Several MSs have a large proportion of water bodies with unknown QE-status for many BQEs and supporting QEs, making comparisons at QE-level of the small proportion of water bodies with known QE-status very uncertain.

- There is variability among MSs in the different approaches used to extrapolate ecological status for single QEs from monitored to non-monitored water bodies by grouping or expert judgement, and in whether (and what kind of) models have been used for this purpose.

Conclusions:

There are limitations in the comparability between countries and RBMP cycles due to differences and changes in monitoring and classification methods. Single BQE status is therefore better suited to compare between countries and to show progress between RBMP cycles.

However, the advantage in using overall ecological status in spite of all the comparability problems presented in this report is that it covers almost all the water bodies. The use of the overall ecological status versus using the BQE status for comparisons between countries and RBMP cycles, represents a trade-off for consideration by EEA when planning the assessment of the next RBMPs.

Suggestions for the way forward in the short term:

- It is encouraged to focus on changes between the 2nd and the 3rd RBMPs, due to more complete reporting and development of classification systems in those cycles than in the 1st RBMP cycle.
- Balancing the comparability on the one hand (using BQEs in monitored water bodies as the best option) and geographical representativity on the other hand (using overall ecological status, bearing in mind the major comparability issues).

Long-term actions for consideration by the relevant WFD-CIS working groups (ECOSTAT and WG-DIS-subgroup on indicators and/or possible new subgroup on comparability):

- Harmonisation of the combination rules for biological and supporting QEs, including criteria for excluding BQEs due to uncertainty. Compilation of best practice examples of the application of the one-out-all-out-principle.
- Using more BQEs in a larger proportion of water bodies to capture impacts of different pressures.
- Adjusting the standards for the physico-chemical elements to levels that are compatible with good status for the relevant BQEs. This can be encouraged by ECOSTAT through the existing and forthcoming best practice guide combined with training workshops.
- Comparing and validating the class boundaries for the hydromorphological QEs to improve the link to the relevant BQEs and agree on how to use them (only High and Good or also Moderate, downgrading or not) (ECOSTAT, HyMo Activity).
- Working towards harmonisation of the design of monitoring programmes to make them more representative in terms of status classes for all water bodies, types of water bodies, pressures and geographical distribution.
- A survey of the methods used for extrapolation from monitored to non-monitored water bodies is also encouraged. MSs replies can be used to draft a best practice guide, including modelling.

2 Introduction with rationale and objectives

2.1 Rationale

The latest EEA assessment of status and pressures in European waters (EEA 2018) presented the ecological status for different water categories (Figure 2.3 in EEA 2018), the ecological status reported for different quality elements (QEs) (Figures 2.4–2.5 in EEA 2018) and the change since the first assessment (Figures 2.6–2.7 in EEA 2018). The WISE visualisation tool provided numerous additional dashboards showing more detailed information at Member States (MSs) or River Basin District (RBD) level. The large proportion of water bodies with unknown QE-status, as well as the MS differences in the use of BQEs and supporting QEs and how they are combined create problems for comparison of current status between MSs. The changes in overall ecological status between the River Basin Management Plans (RBMPs) are even more difficult to interpret due to numerous changes in monitoring and classification methods between the two cycles, as well as insufficient reporting of the reason for changes in ecological status (being real or methodological).

The variability of methodologies in assessing and reporting ecological status between MSs and RBMP cycles create comparability problems also at European level, which in turn compromise realistic evaluations of WFD effectiveness (EC, 2019). This situation raised the need to look deeper into the methodological differences to see how they affect comparisons of overall ecological status and QE-status between MSs and RBMPs and how the data can best be used for the next assessment.

2.2 Objective and scope

The objective of this document is to explore and illustrate the different approaches used by the MSs to assess ecological status in the two RBMP cycles, and to assess the consequences of these differences for comparisons of overall ecological status and QE-status between MSs and RBMPs, as well as for the confidence in the results at EU-level. Another objective is to find the best way to show progress or change between the RBMPs.

The scope of this document is limited to ecological status in rivers and lakes and has a final synthesis chapter with conclusions, key messages and way forward.

The report includes the following chapters:

- Combination of QEs to overall ecological status aiming at answering the following questions: How are the different QEs combined to overall ecological status (one-out-all-out (OOAO) or other methods), and what is the impact of differences and changes in combination approaches for comparisons of overall ecological status? Does the OOAO principle hide progress, and can changes in status be shown in a better way by using BQE change? (Chapter 4)
- Use of different QEs: Which and how many QEs are used, and how do differences affect the comparison of ecological status results at QE-level between MSs and RBMPs? (Chapter 5)
- Differences and changes in standards (i.e. good-moderate boundaries) for physico-chemical QEs and the impacts on comparison of QE-status for these supporting QEs. In this chapter, we make a comparison between MSs based on water bodies having the same significant pressure (e.g. sign. diffuse pollution from agriculture) (Chapter 6)
- Differences and changes in classification methods for hydromorphological (HyMo) QEs (only as high and good or also less than good), and how does this affect comparisons of overall ecological status (Chapter 7)

- Unknowns: The large proportion of water bodies with unknown ecological status at QE-level and the implication for comparison of QE-status and overall ecological status between MSs and RBMPs (Chapter 8)
- Confidence in overall ecological status related to the basis for classification of QE-status (monitoring or grouping/expert judgement) and how different basis affects QE-status in different MSs (Chapter 9)
- The outputs from Chapters 4–9 are summarised and used to provide suggestions for the assessment of the 3rd RBMPs, addressing the question: How can the data best be used to compare status in time and space? (Chapter 10).

The outputs are relevant for further presentations and discussions with the MSs as a basis for further work in the WFD-CIS working groups to harmonise the approaches towards the next RBMP cycles.

3 Data sources used

The main data source used for analysing the different methodologies used by the countries for assessing and reporting status and pressures is the WISE-WFD database, version April 2019 (https://www.eea.europa.eu/data-and-maps/data/wise-wfd-3), including all countries except Greece and Lithuania, whose data from the 2nd RBMPs were only reported recently (Jan 2020).

The data for the different chapters are based on data reported according to the WFD reporting guidance (v. 6.0.6, from 26th April 2016, http://cdr.eionet.europa.eu/help/WFD/WFD_521_2016/Guidance/WFD_ReportingGuidance.pdf), Chapter 2 REPORTING AT Surface water body level (SCHEMA SWB), Sub-chapters 2.3. Pressures and impact, 2.4 Ecological status and 2.5 Chemical status, and Chapter 7 REPORTING AT RBD/SUB ‐ UNIT LEVEL FOR SURFACE WATER (SCHEMA SWMET), Sub-chapters 7.3 Methodologies classification ecological status and potential, 7.4 Methodologies classification chemical status and 7.6 Definition of significant pressures and impacts.

For all comparisons of change between RBMPs, the data selected are from MSs reporting in both cycles, meaning that the following MSs are excluded: Norway (did not report in 2010 due to later WFD implementation), Greece and Lithuania (had not reported data from 2nd RBMPs by April 2019).

For all comparisons the assessments are done for all water bodies including natural, heavily modified and artificial water bodies (HMWBs and AWBs). The figures represent both ecological status for natural water bodies and ecological potential for the HMWBs and AWBs but are labelled “Ecological status” or “Ecostatus” for simplicity.

4 Impacts of different combination rules (OOAO or other)

The key questions here are whether the MSs have used the one-out-all-out (OOAO) principle or not and whether they have changed their combination method between the two RBMP cycles. Below we illustrate these differences and show the consequences for the comparison of overall ecological status at EU-level and at MS-level. We also address the problem with the OOAO principle hiding progress of single QEs and suggest other ways to show progress, i.e. using changes in BQE-status between RBMPs.

In this chapter we use only the water bodies that are classified with respect to overall ecological status, while the issue with unknowns is addressed in Chapter 8.

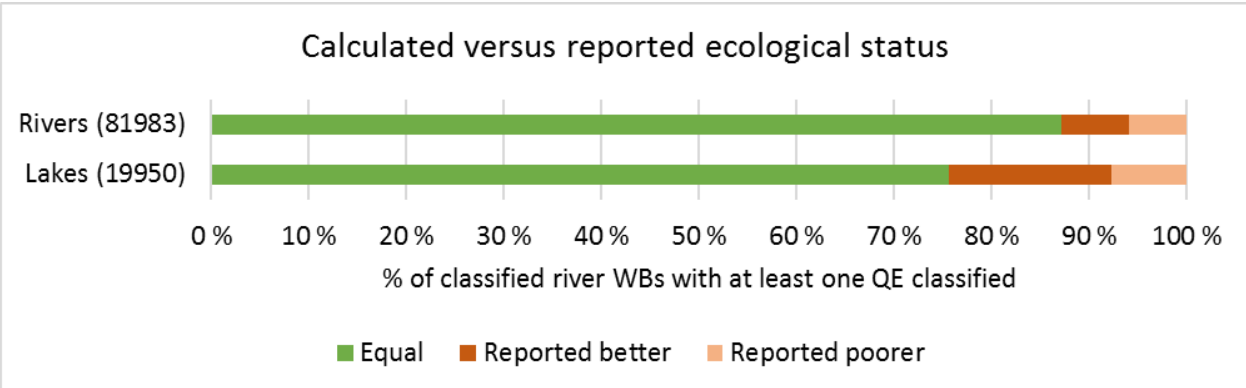
4.1 Comparison of reported versus calculated ecological status using the one-out-all-out principle (OOAO)

The use of the OOAO-principle can be assessed by comparing the reported overall ecological status with the theoretical ecological status that can be calculated based on the QE with the worst status in each water body. In this chapter and also the following chapters, this is what in meant with the term "Calculated status".

4.1.1 EU-level overview based on data reported with the 2nd RBMPs

For rivers, the OOAO based on the reported QEs has been used for 87 % of the classified water bodies, and there are few water bodies classified by other methods (Figure 1). The percentages are almost the same for water bodies classified in better and in worse status compared to the calculated status. Also for lakes, the OOAO has been used for most of the classified water bodies (76 %), but more water bodies than for rivers have been classified with other methods, and there are more lake water bodies classified in better status (17 %) than in worse status (8 %) compared to the calculated status.

Figure 1: Calculated versus reported overall ecological status of rivers (top) and lakes (bottom) at EU-level, based on the 2nd cycle data. Calculated status is based on the QE with the worst status



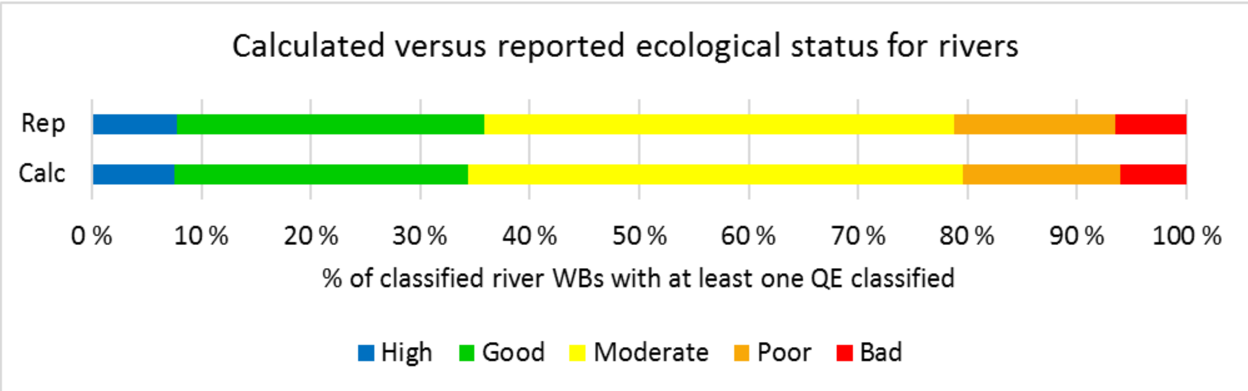
For those classified in better status than the calculated, the explanation can be that overall ecological status has been classified with other methods than the OOAO, such as averaging QE-status, using a weight-of-evidence approach (i.e. excluding one or more QEs with high uncertainty) or classifying overall ecological status without QEs by using expert judgement based on other information, e.g. pressures. The criteria for including or excluding a BQE for overall ecological status can be different in the different MSs. If some MSs apply stricter criteria and thereby exclude more BQEs and/or supporting QEs than other MSs, then this is likely to increase the uncertainty of overall ecological status comparisons between MSs.

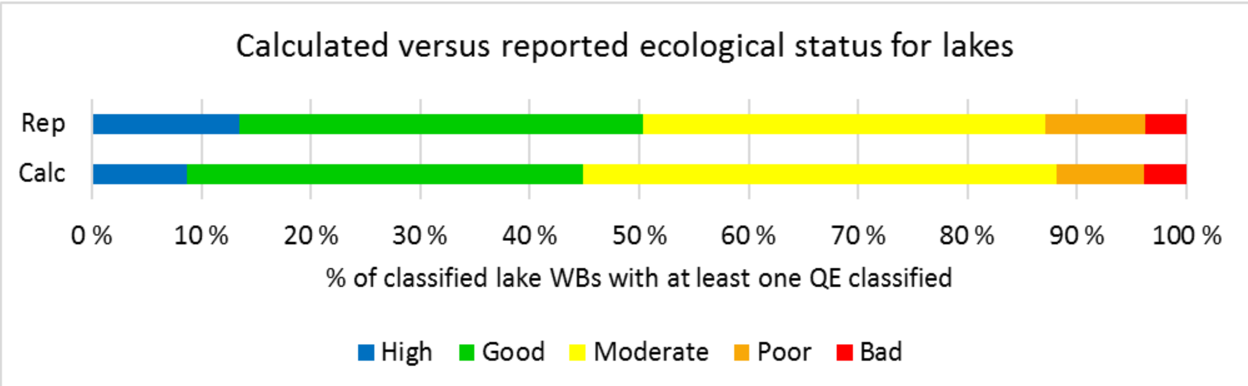
Water bodies classified in worse overall ecological status than the status for the worst QE can be due to some MSs classifying one or more supporting QEs as poor or bad and allowing these to decide overall ecological status, while the reporting did not allow reporting worse than moderate status for those QEs. Another possible reason can be that they have no BQEs responding to a significant pressure and use expert judgement to set overall ecological status.

Reporting mistakes can also contribute to the deviations shown above.

The consequences of these deviations from the OOAO principle for the distribution of status classes at EU-level is negligible for rivers, but clearly visible for lakes, showing a smaller proportion of water bodies in less than good status for the reported status than for the calculated status (55 % versus 50 %) (Figure 2). These small differences between reported and calculated ecological status are due to many countries showing no or only minor discrepancies between the reported and calculated ecological status, and that for the other countries the difference goes both ways (see section 4.1.3).

Figure 2: Calculated versus reported overall ecological status for rivers (top) and lakes (bottom) at EU-level (based on the 81,983 river WBs and 19,950 lake WBs with reported QEs in 2nd cycle)



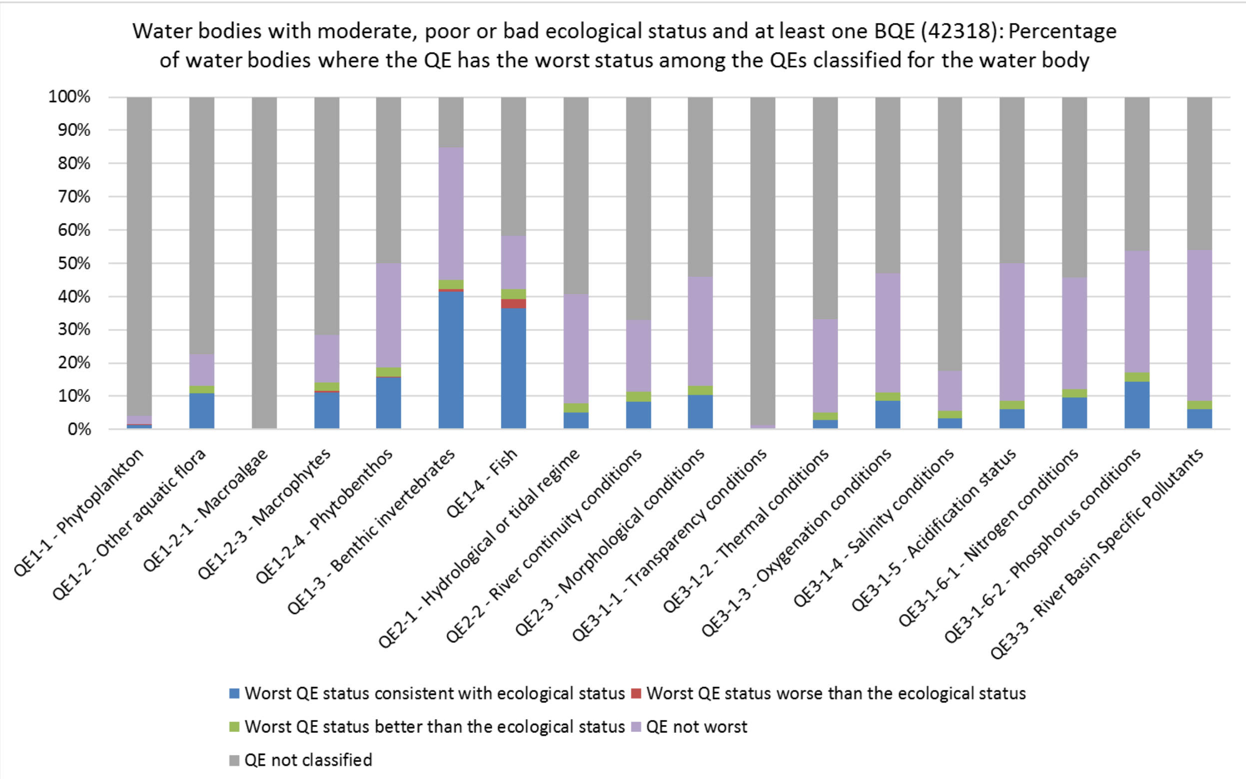


4.1.2 Which QE has the lowest status class in the 2nd RBMPs?

For water bodies in less than good ecological status, the QEs having the worst status at EU-level (across all countries) in rivers are benthic invertebrates and fish, followed by phytobenthos and phosphorus conditions (Figure 3), while in lakes, the worst QEs are phytoplankton and phosphorus conditions, followed by fish, macrophytes and benthic invertebrates (not shown). In both rivers and lakes, the HyMo QEs are less frequently reported as the worst QE in rivers with less than good status, but this may be partly due to several countries mainly classifying these as high or good QE-status (Chapter 7).

In both water categories, the worst QE is largely consistent with the use of the OOAO principle for overall ecological status classification, although there are a few deviations, indicating worse or better overall classification than the worst QE, e.g. fish, which has more deviations in both directions than any of the other QEs.

Figure 3: The frequency of different QEs having the lowest status class in rivers (being the worst QE) (EU-level)



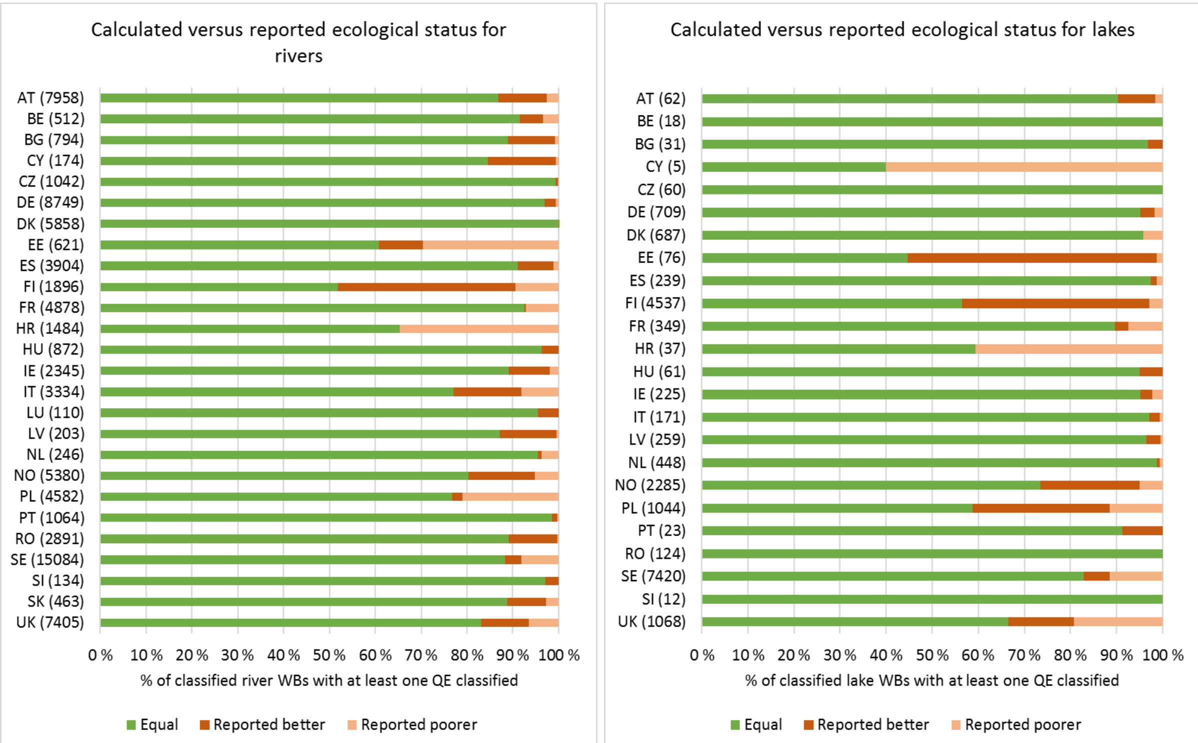
Notes:

- The 100 % is all water bodies with overall ecological status (Ecostatus) classified as less than good.
- The water bodies classified for each QE are shown by the coloured parts of each column (blue, red, green and violet), where the violet part is the percentage where the QE is not worst.
- Consistent (blue) is only possible for supporting QEs when Ecostatus is M (Moderate), worse is not possible for supporting QEs (since the lowest supporting QE class that can be reported is M).
- Worse (red) happens if the worst QE is poor (P) or bad (B), while the overall ecological status is moderate.
- Better (green) happens when the worst QE is good, while the overall ecological status is moderate, or if the worst QE is moderate, while the overall status is poor or bad.

4.1.3 MS overview based on data reported with the 2nd RBMPs

When looking more closely into the data at MS-level, almost all MSs have classified most of their water bodies for rivers and lakes in line with the OOAO principle, based on the reported QEs. However, for several MSs there are clear deviations from this for a significant proportion of water bodies, indicating that they use other approaches than the OOAO for classification (Figure 4). For rivers, Finland reports better overall ecological status than the status of the worst QEs for almost 40 % of their classified water bodies for both rivers and lakes. No other MSs report more than 20 % of their river water bodies in better overall ecological status compared to the calculated status. For lakes, also Estonia, Norway and Poland have reported better overall status compared to the calculated status for 20–50 % of the water bodies. Some MSs show an opposite pattern, reporting a substantial proportion of the water bodies in worse status compared to the calculated status, e.g. Cyprus (lakes, only 5 water bodies), Estonia (rivers), and Croatia (rivers and lakes).

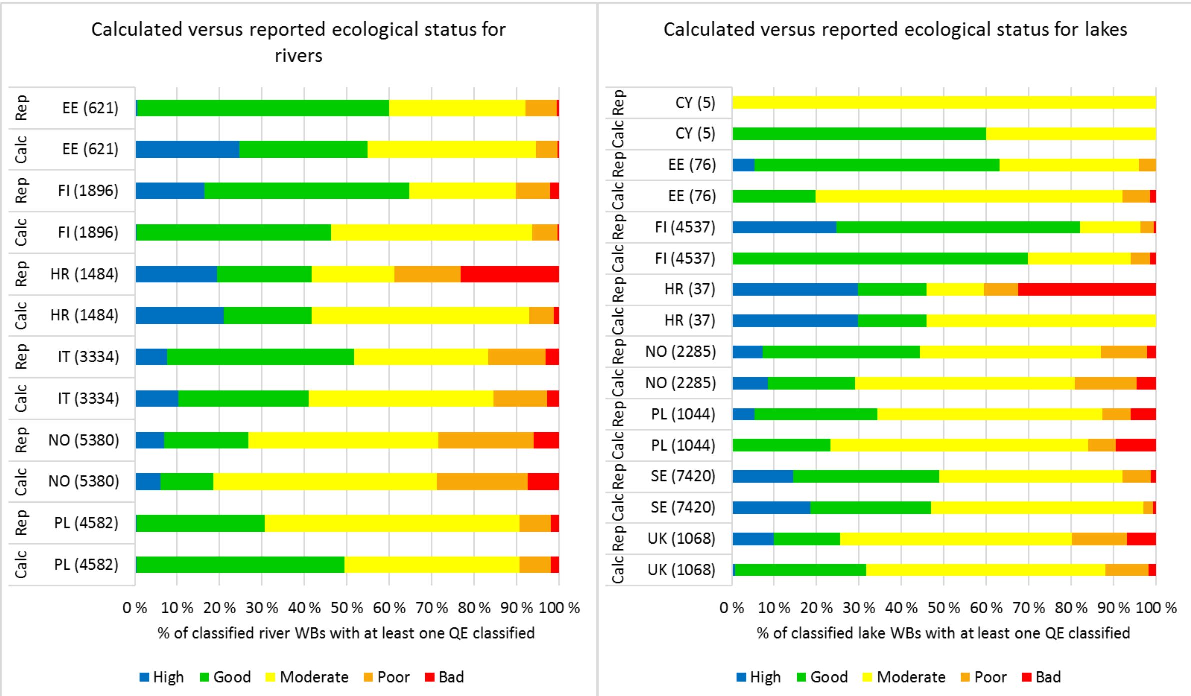
Figure 4: Calculated versus reported ecological status for rivers (left) and lakes (right) in different MSs based on the 2nd cycle data. Calculated status is based on the QE with the worst status



The consequences of these different combination rules for the distribution of ecological status classes (Figure 5) are that the MSs reporting better overall ecological status than the status for the worst QEs have a larger proportion of water bodies in good or better status than they would get if the OOAO had been applied. For rivers, one example is Finland, reporting 64 % of the water bodies to be in good and high status (64 %), while the calculated status indicates only 45 % in good status and close to zero in high status. Also, Italy and Norway reported more river water bodies in good or high status than what the calculated status suggests. For lakes, Estonia reported good or better status for > 60 % of their water bodies, while the use of OOAO gave only 20 % in good status and none in high status. Another example is Finland reporting 25 % of their lake water bodies in high status, while the calculated status indicates none in high status. Norway and Poland show the same pattern reporting more water bodies in good or better status and fewer in poor and bad status compared to the calculated status based on the worst QE (OOAO).

In contrast, the MSs reporting worse overall ecological status than the worst QE for rivers are Estonia, reporting almost no water bodies in high status, while the calculated status indicates 25 % in high status, and Poland, reporting 70 % in less than good status, while the calculated status indicates only 50 % less than good. Croatia reports 40 % of their rivers in poor or bad status, while the calculated status indicates only 7 % in those two worst status classes. For lakes, Cyprus, Croatia and UK show a higher proportion of water bodies in less than good status and more in poor and bad status than if the OOAO had been applied.

Figure 5: Calculated versus reported overall ecological status (using the OOAO) for selected MSs with significant differences between reported and calculated status (see Figure 3) based on data from the 2nd RBMP cycle



4.2 Comparison between RBMPs

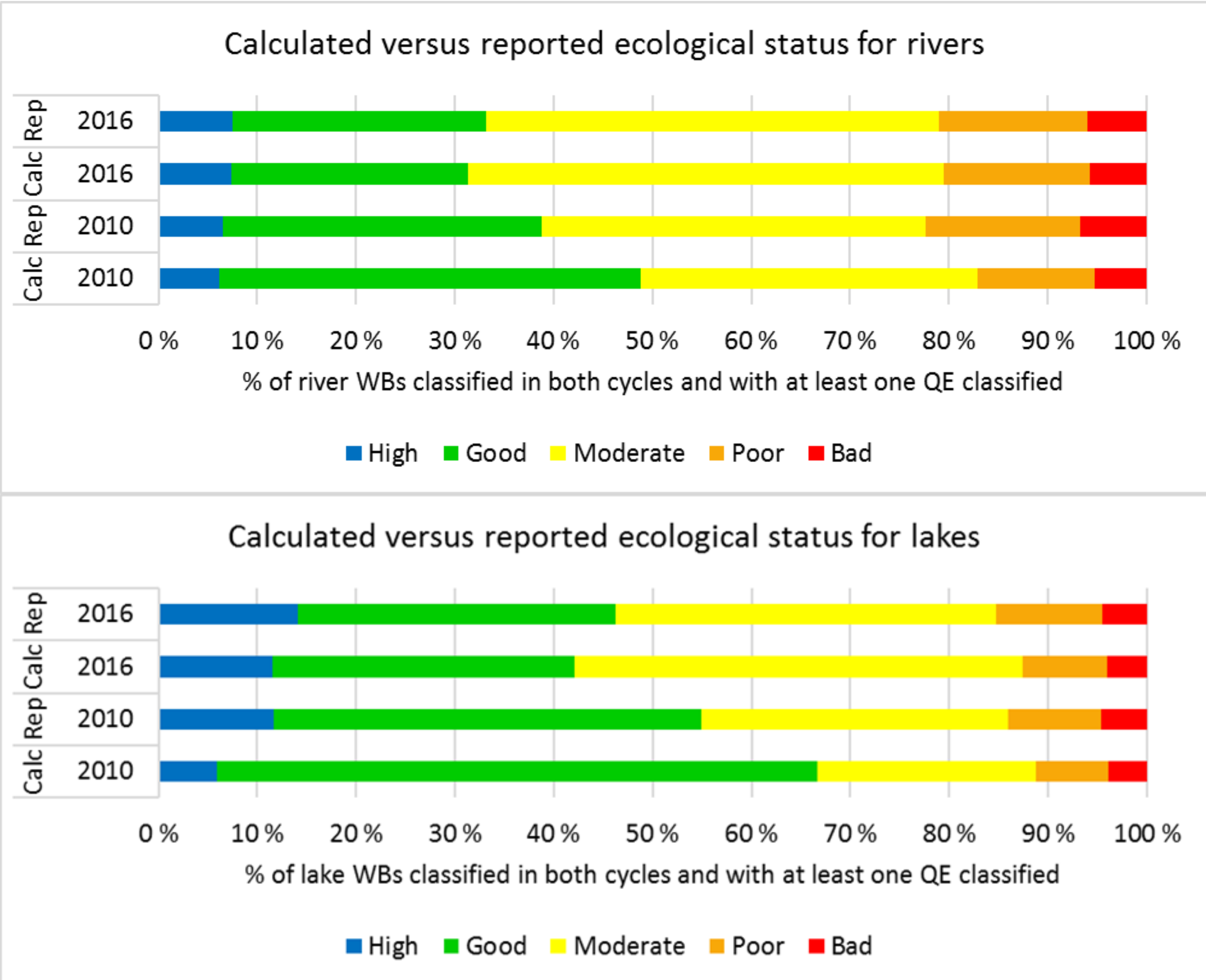
The improved methodologies for status assessment (more monitoring, more QEs, higher confidence) in the second RBMPs make it difficult to compare status in the first and second RBMPs. Caution is advised when drawing detailed conclusions regarding changes observed between the two cycles and also when comparing results between countries. The comparison is affected by:

- Re-delineation of water bodies;
- Differences in proportion of water bodies with known overall ecological status from the 1st to the 2nd RBMPs;
- Differences in the use of QEs;
- Differences in standards for physico-chemical QEs (good-moderate boundaries);
- Different approaches in status assessments (ecological status and QEs).

4.2.1 *Impact of the combination methods on change of overall ecological status at EU-level*

Calculation of overall ecological status based on the worst QE-status has been done also for the 1st RBMP cycle data to allow an assessment of the impact of the different combination rules on the change in overall ecological status from the 1st to the 2nd RBMP. This analysis shows whether the use of the OOAO principle has changed between the two cycles. The EU-level results (Figure 6) for reported status in rivers show only minor changes in the distribution of ecological status classes between the two cycles, with a slight increase in the proportion of water bodies in less than good status from 62 % to 68 %. The deterioration of ecological status becomes much larger when using the calculated status, showing the proportion of water bodies in less than good status increasing from 50 % in the 1st cycle to 70 % in the 2nd cycle. For lakes, the same analysis shows a small increase in the reported proportion of water bodies in less than good status from 45 % in the 1st cycle to 55 % in the 2nd cycle, while for calculated status the increase in this proportion is much larger changing from 35 % in the 1st cycle to 58 % in the 2nd cycle.

Figure 6: Calculated versus reported overall ecological status for rivers and lakes at EU-level for the two RBMP cycles based on 50 473 river WBs and 12 404 lake WBs classified in both cycles and that have reported QE-status in both cycles



Note: Norway did not report in the 1st cycle, while Greece and Lithuania had not reported data for the 2nd cycle, so are excluded.

Figure 6 also shows that the difference between the calculated and reported status for rivers was larger in the 1st cycle, when the proportion in less than good status was 62 % for reported status and only 50 % for calculated status. In the 2nd cycle, however, the difference between reported and calculated status is marginal, showing only a slightly larger proportion of water bodies in less than good status for the calculated status. For lakes, the picture is the same, but more pronounced, with a larger proportion less than good for reported status than for calculated status in the 1st cycle, and the opposite in the 2nd cycle. However, in the 1st cycle, the proportion of lake water bodies in high status was much larger for the reported (12 %) than for the calculated status (5 %).

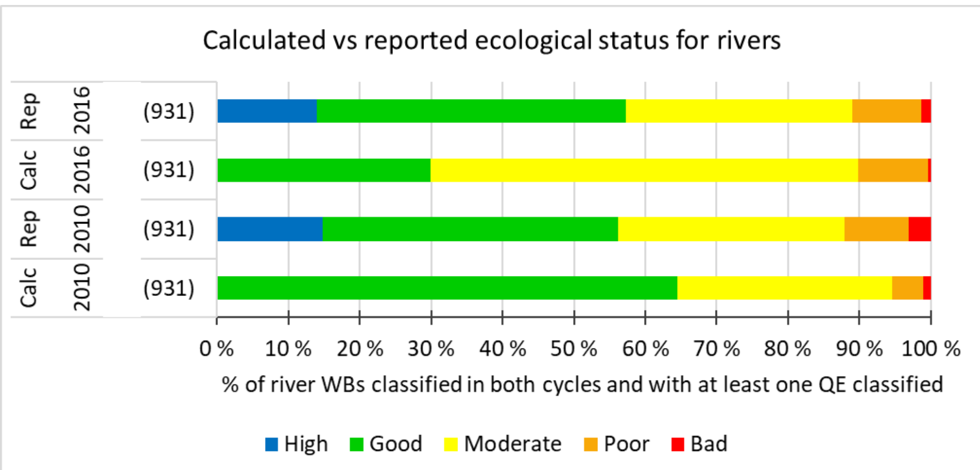
The results in Figure 6 for both rivers and lakes show a larger proportion of water bodies in less than good status for the reported status than for the calculated status, which may indicate that the status in the 1st cycle was based on expert judgement of pressures rather than on QEs due to incomplete classification systems. In the 2nd cycle, the pattern is opposite with a smaller proportion classified in less than good status for the reported status than for the calculated status, indicating that the OOAO has not been used in all MSs or all water bodies. These changes in combination rules from the 1st to the 2nd cycle create uncertainty concerning the validity of the reported overall ecological status change. If the OOAO had been used in both cycles to the same extent, the change in status would have been more pronounced with a larger deterioration from the 1st to the 2nd cycle than what the reported change in status indicates. Another possible reason for these discrepancies may be the more extensive use of BQEs in the 2nd cycle than in the 1st cycle (see Chapter 5.3).

Due to the changes in combination rules and classification methods between the two cycles, the changes in overall ecological status between the two cycles is hard to interpret, as the changes include both real changes and methodological ones. Moreover, the OOAO can hide progress for single QEs. In the section 4.2.3, we therefore assess whether ecological status for BQEs may be a more confident way to show changes between the RBMP cycles.

4.2.2 Change in combination rules in different MSs

MSs that have stopped using the OOAO and now use other rules (e.g. weight of evidence or other methods) are few. One example of a MS that seems to use other rules, reported worse status than that calculated from the OOAO in the 1st cycle and much better status than calculated in the 2nd cycle (Figure 7). The differences between the reported and calculated status are clearly bigger in the 2nd cycle than in the 1st cycle. The distribution of status classes is almost identical for the reported data in both cycles showing 15 % in high status, 45 % in less than good status and 10 % in poor or bad status, while the calculated status based on the worst QE-status is very different in the two cycles, showing only 36 % less than good in the 1st cycle, but 70 % less than good in the 2nd cycle. The possible contribution of changing the HyMo QE classification from only high and good in the 1st cycle to high, good and moderate in the 2nd

Figure 7: Example of effect of not using the OOAO on the status class distribution based on calculated versus reported overall ecological status for rivers for the two RBMP cycles

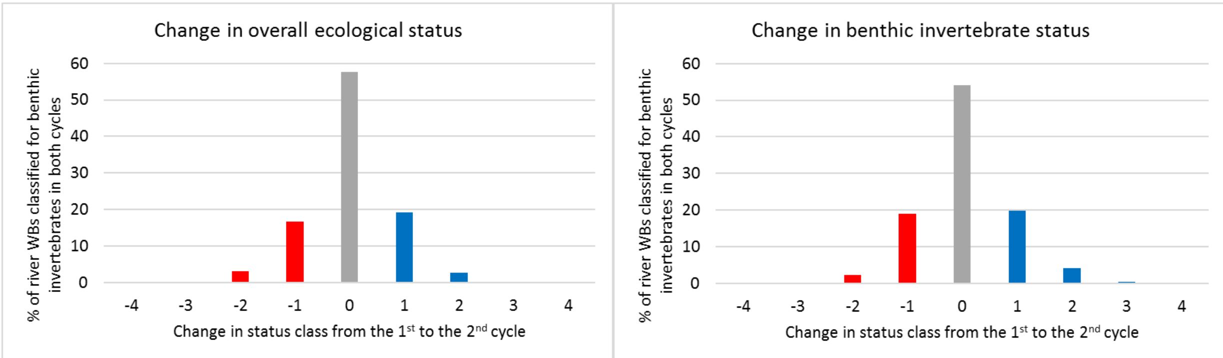


Notes: Based on 931 river WBs classified in both cycles and reporting QE-status in both cycles

4.2.3 Change in single BQEs between RBMP cycles – EU-level

Overall, the 2nd RBMPs show limited change in overall ecological status compared to the 1st RBMPs, as most water bodies have the same status in both cycles (left panel in Figure 8). For this selection of water bodies there are only slightly more water bodies in better than in worse status in the 2nd cycle. Improvements can sometimes be visible at the level of individual QEs but often do not translate into improved overall ecological status due to the OOAO principle. In the case of benthic invertebrates (right panel in Figure 8), the number of water bodies with improved QE-status is higher than that of improved overall ecological status. However, the number of water bodies with worse status is also higher for QE-status, so the ratio of improved to worse status is only marginally higher for QE-status than for overall ecological status. Hence, in this case the OOAO principle does not really hide any progress, with respect to benthic invertebrate status.

Figure 8: Change in overall ecological status for rivers (left panel) and QE-status for benthic invertebrates (right panel) at EU-level. The graphs show percentage of total number of river water bodies classified for benthic invertebrates in both cycles (26365 water bodies)



4.2.4 Alternative approach to show progress between RBMP cycles – EU-level

To assess the effect of implemented measures there are concerns that the overall ecological status will only show progress when the worst single QE has improved, due to the OOAO principle. To keep the motivation for continued implementation of measures to improve status, it is therefore vital to find other ways to show progress, such as assessing change at QE level. In this section, we therefore show change in ecological status at BQE-level between the two RBMP cycles (Table 1).

This analysis shows that only slightly more BQEs have improved than deteriorated from the 1st to the 2nd RBMP cycle and that the BQEs status class is unchanged for the majority of BQEs reported across all water bodies included in the analysis (see notes in Table 1). It also shows that there are changes in BQE-status for water bodies with no change in overall ecological status, but that the same proportion of BQEs have improved as deteriorated. The pattern is almost the same when excluding water bodies that were in high or good overall ecological status in both cycles, although there are slightly more BQEs deteriorating than improving (Table 1b). This approach is however limited to the proportion of water bodies with known BQE-status in both cycles to be compared (see Chapter 8 below).

Table 1 Change in status class (or no change) for BQEs in rivers compared to change in overall ecological status based on all BQE-status classes reported in both the 1st and the 2nd RBMP cycle (% of total BQE x water bodies)

a) All status classes

Overall ecological status class change	Worse BQE-status class	No change in BQE-status class	Better BQE-status class
Worse	9	9	2
No change	9	41	9
Better	2	9	10
Total (100 %)	20	59	21

b) Only water bodies that did not have high or good overall ecological status in both cycles

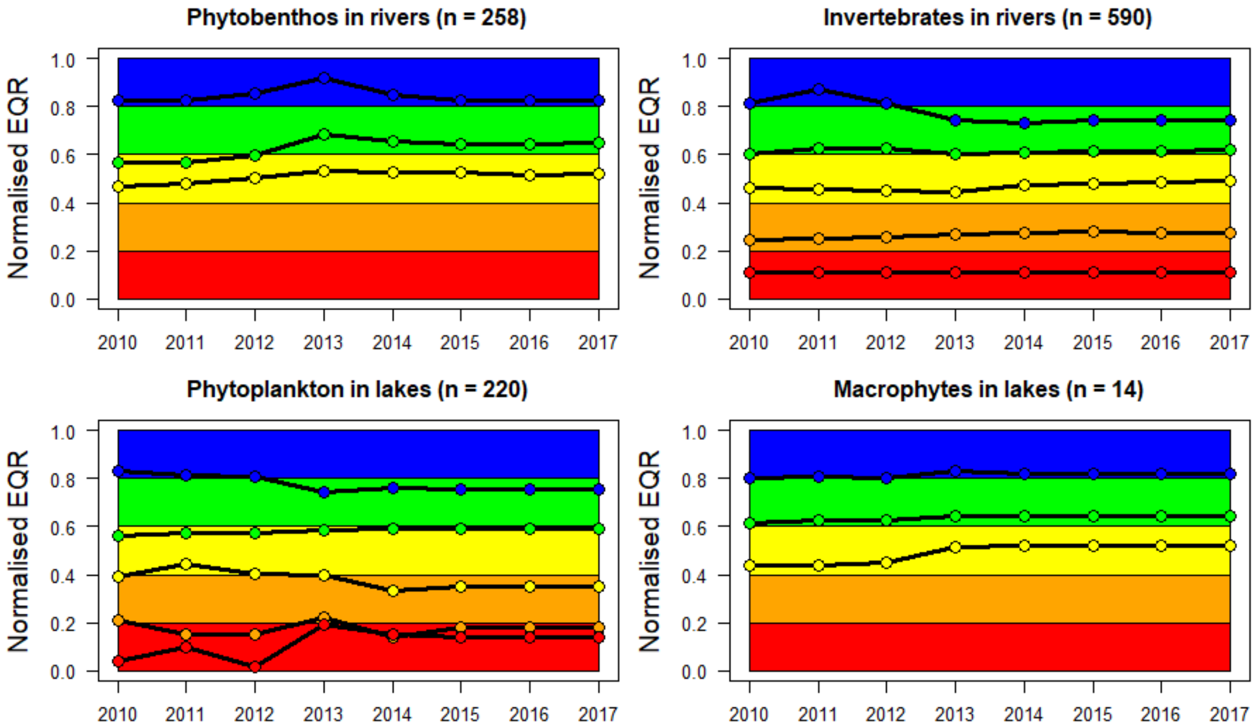
Overall ecological status class change	Worse BQE-status class	No change in BQE-status class	Better BQE-status class
Worse	11	11	2
No change	10	32	9
Better	2	10	13
Total (100 %)	23	53	24

Notes: Only WBs classified in both cycles are selected, and for these only BQEs that have been classified in both cycles. Other aquatic flora BQEs have not been combined, meaning that if they have reported the aggregated BQE other aquatic flora in addition to any of the sub-BQEs in both cycles, these will be counted twice.

The reasons why there are not more BQEs improving compared to the change in overall ecological status can be many, including using more BQEs in the 2nd cycle, BQEs not being sensitive to certain pressures, e.g. hydromorphology, delayed response to measures or insufficient planning or implementation of measures. Progress may still be seen in several MSs (see Section 4.2.5 below). However, also these changes may be difficult to interpret, because few MSs reported the reason for change in BQE-status (consistent change, real or methodological). This may improve in the next cycle if more MSs report this. In any case the BQE change is likely to be a more confident way to show progress than overall ecological status, because the BQE class boundaries have now been intercalibrated for most of the BQEs in most of the MSs.

Another option to assess BQE change is to look at changes in EQR values within a status class (Figure 9). This can be done using the WISE-SoE biological data.

Figure 9: Time series of nEQR aggregated by initial status class based on WISE-SoE biological data (from Moe et al., 2019)



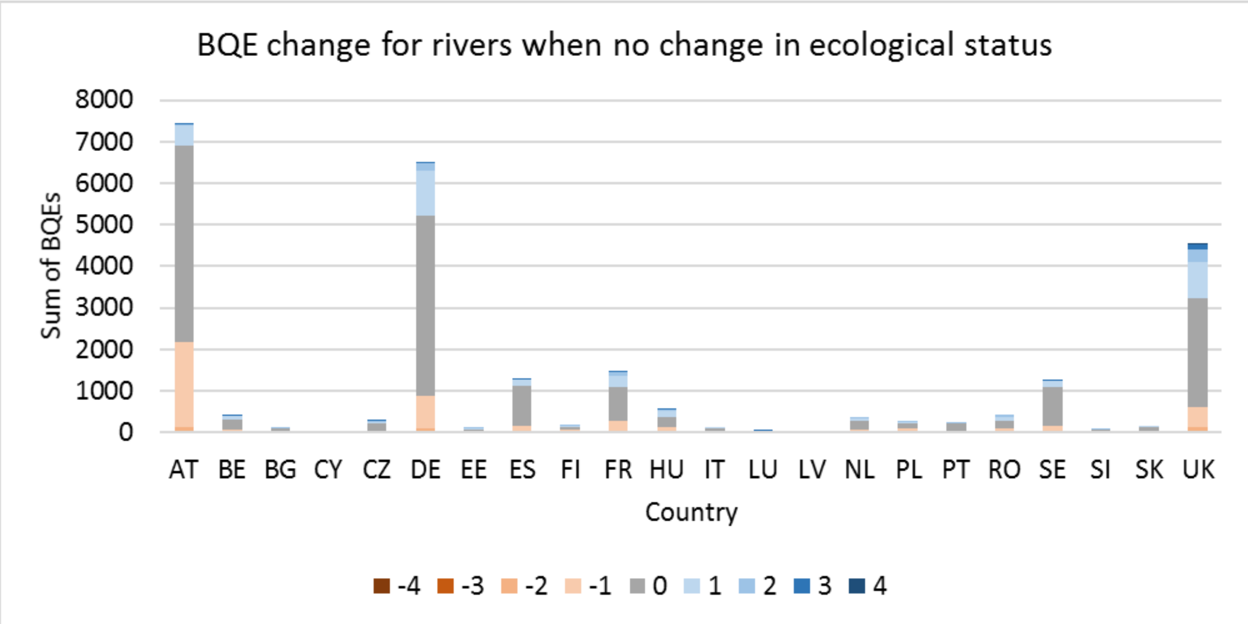
Notes: Time series of normalised EQR values for the years 2010–2017 aggregated by the initial status class. The numbers above the plots show the total number of water bodies for each BQE. The initial status class of each water body is set from the first year reported, which can be a year before 2010.

4.2.5 Change in BQE-status at MS-level

When looking at river water bodies in less than good status with no change in overall ecological status from the 1st to the 2nd RBMPs, many MSs have roughly the same proportion of positive and negative BQE-status changes (Figure 10).

However, Austria stands out with much more negative (red) than positive (blue) BQEs changes, and this pattern is also found in Latvia and Poland. MSs with the opposite pattern are DE, EE, LU and UK (although the differences are less). FI, HU, LU, LV, PL and RO all have more than 50 % change in BQE-status class (in contrast to no change), but for FI, HU, RO, these changes are evenly distributed among improvements and deterioration of BQE-status class.

Figure 10: BQE change (or no change) for MSs when there is no change in overall ecological status for river water bodies (water bodies with high or good overall ecological status in both cycles excluded). The y-axis shows the sum of all BQE changes across all the water bodies.



Notes: Based on the 25709 classified water bodies with at least one common BQE classified in both cycles. Only WBs classified in both cycles are selected, and for these only BQEs that have been classified in both cycles have been selected. Other aquatic flora BQEs have not been combined, meaning that if they have reported the aggregated BQE other aquatic flora in addition to any of the sub-BQEs in both cycles, these will be counted twice.

5 Use of quality elements (QEs)

In this chapter we show which QEs are used by the different MSs (as shown by which QEs they have reported status for), and how the differences affect the comparison of ecological status results at QE-level between MSs and RBMPs.

5.1 Use of groups of QEs to classify overall ecological status

Large differences between countries are seen in the use of different groups of QEs, i.e. BQEs, PhysChem QEs and HyMo QEs (Table 2 and Figure 11 with details in Table 3).

Most countries use all the major QE groups (BQEs, PhysChem QEs and HyMo QEs) and/or both BQEs and PhysChem QEs for a large proportion of their water bodies for both rivers and lakes, which is in line with the WFD Annex V. Most countries use different groups of QEs for different proportions of water bodies (appear in several rows in Table 2 and have various colours in Figure 11). Some countries deviate from the general pattern by excluding either the BQEs (EE, FI, HR, RO, SE, UK) or the supporting QEs (CY, DE, DK, IE) for a large proportion of their water bodies. There are also some countries classifying a large proportion of their river water bodies with no QEs (ES, FR, IE, IT, NO, PT, SK).

Table 2 Overview of the use of QE groups for classification of overall ecological status (excl. RBSPs)

Major QE groups	QE subgroups	Countries (Rivers)	Countries (Lakes)
BQEs with or without supporting QEs	BQEs only	**BE**, **DE**, **DK**, IE	AT, CY, **DE**, **DK**, **SI**
	BQEs, PhysChem QEs, HyMo QEs	BE, **CY,** EE, **ES, FI, HU, LU, LV, PL, RO, UK**	**ES**, **FI**, **HU**, **PL**, **RO**, **UK**
	BQEs, PhysChem QEs	**BG, CZ,** FR, **IE,** IT, **NL,** PT, **SI**	**BE, BG, CZ, EE,** ES, **FR,** HU, IE, **IT, LV, NL**, PL, **PT,**
	BQEs, HyMo QEs	**AT**, DE	**AT**
Supporting QEs only	PhysChem and HyMo QEs	FI, **HR**, **SE**	FI, **HR**, RO, **SE**,
	PhysChem QEs only	**EE**,	**CY**
	HyMo QEs only	SE	FI
No QEs		**FR**, **IT**, **NO**, **PT**, **SK**	**IE**, **NO**,

Notes: Colours on rows are the same as in Figure 11 for the various combinations of QE groups.
Some countries appear in several rows if they used several approaches for a large proportion (> 30 %) of their water bodies. **The most common approach in each country is given in bold font**. Countries without lakes: LU, MT, SK. Countries without rivers: MT

The use of hydromorphological QEs (HyMo QEs) is varying:

For rivers:

- 11 countries have classified HyMo QEs in more than 70 % of the water bodies
- 11 other countries are also using HyMo QE in classification (< 70 % of WBs)
- 4 countries have not reported HyMo QE-status.
- Of the 22 countries using HyMo QE-status:
    - 19 countries: report high, good, and less than good status
    - 3 countries (AT, FR, SI): report only high and good status

For lakes:

- 6 countries have classified HyMo QEs in more than 70 % of the water bodies
- 7 other countries are also using HyMo QE in classification (< 70 % of WBs)
- 11 countries have not reported HyMo QE-status
- Of the 13 countries using HyMo QE-status:
    - 12 countries: report high, good, and less than good status
    - 1 country (AT): reports only high and good status

The interpretation of the methodology used by the countries not reporting less than good for HyMo QEs can either be that no water body has less than good status for these QEs or that HyMo QEs are only used to classify water bodies as high or good in line with the Classification guidance (EC, 2003).

The use of the general PhysChem QEs (excl. RBSPs) is also varying:

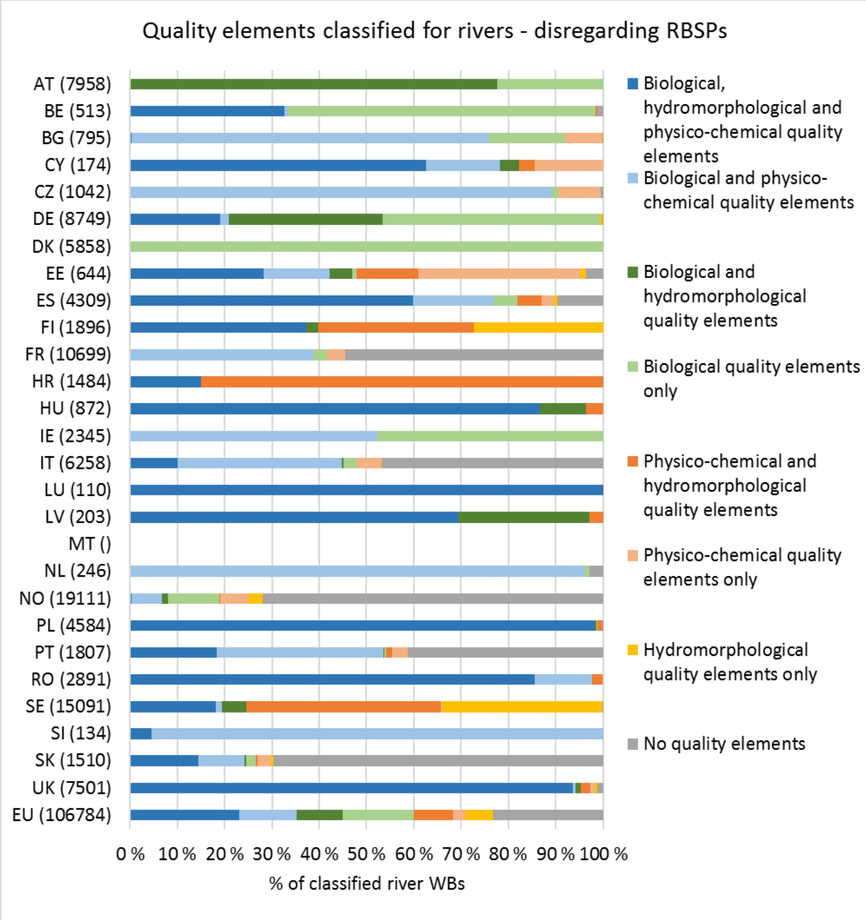
For rivers:

- 16 countries have classified PhysChem QEs in more than 70 % of the water bodies
- 8 other countries are also using PhysChem QEs in classification (< 70 % of WBs)
- 2 countries (AT, DK) have not reported PhysChem QE-status

For lakes:

- 16 countries have classified PhysChem QEs in more than 70 % of the water bodies
- 6 other countries are also using PhysChem QEs in classification (< 70 % of WBs)
- 2 countries (AT, DK) have not reported PhysChem QE-status

Figure 11: Use of different groups of QEs for classification (MS-level)



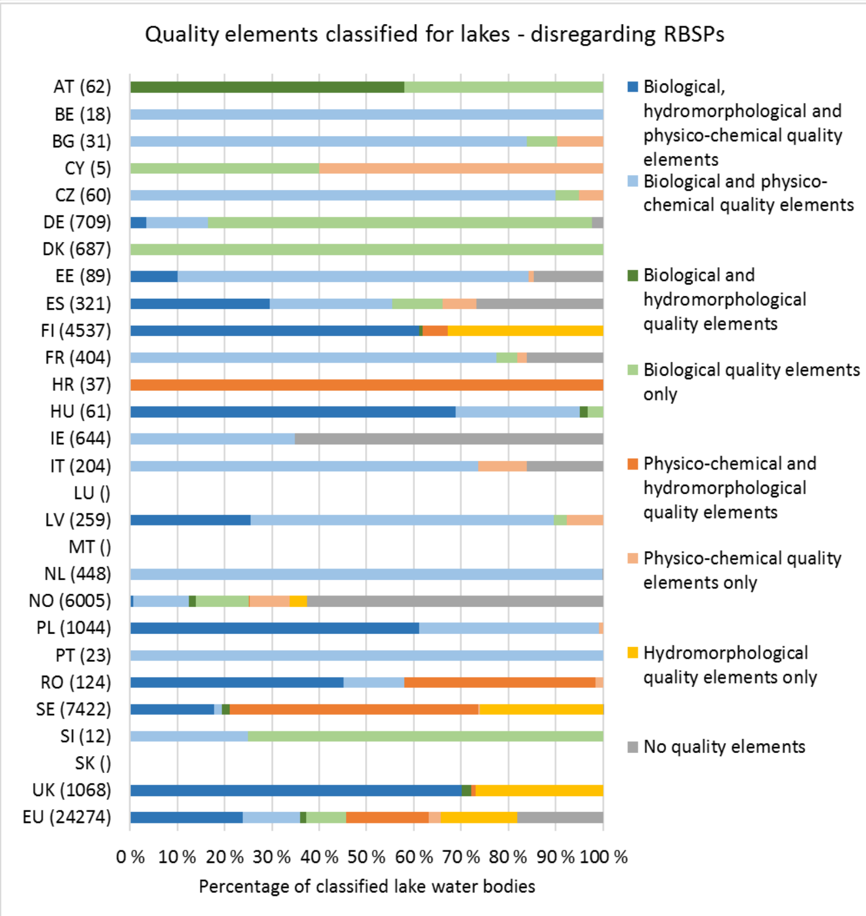


Table 3 Use of different groups of QEs by different countries: % of water bodies classified for different groups of QEs, and number (#) of QEs used in each group for at least 10 % of the WBs. The maximum number of QEs in each group is 4 BQEs (after merging the different benthic flora QEs), 3 HyMo QEs and 8 PhysChem QEs (incl. RBSPs as 1 QE).

a) Rivers

Country	%BQE	#BQE	%Hymo	#Hymo	%Phys-chem (never only) RBSPs	#Phys-chem (never only) RBSPs	%Phys-chem (RBSPs only)	#Phys-chem (RBSPs only)
AT	100	3	78	3	0	9	100	1
BE	98	4	33	3	34	5	54	1
BG	92	3	1	0	84	6	0	1
CY	82	2	70	1	96	4	0	1
CZ	90	3	0	0	98	6	1	1
DE	99	3	52	2	21	4	45	1
DK	100	2	0	0	0	0	0	0
EE	48	3	47	1	89	4	0	1
ES	82	2	66	3	84	6	3	1
FI	40	3	100	3	70	3	29	1
FR	42	3	0	0	43	5	0	1
HR	15	2	100	3	100	3	0	1
HU	96	4	100	3	90	5	0	1
IE	100	1	0	0	52	4	0	0
IT	48	2	11	1	50	3	1	1
LU	100	3	100	2	100	6	0	1
LV	97	3	100	3	72	3	0	1
NL	97	3	0	0	96	6	3	1
NO	19	0	5	0	13	0	0	0
PL	99	3	100	3	99	6	0	1
PT	54	2	20	3	58	6	0	1
RO	98	4	88	3	100	6	0	1
SE	25	2	98	3	61	2	0	0
SI	100	2	4	0	100	3	0	1
SK	27	3	16	1	27	5	1	1
UK	95	3	97	3	97	5	0	1
EU	60	3	47	3	46	6	12	1

Notes: The number of RBSPs only indicate whether they are used (1) or not (0) and does not say anything about the actual number of different single RBSPs that are used.

b) Lakes

Country	%BQE	#BQE	%Hymo	#Hymo	%Phys-chem (never only) RBSPs	#Phys-chem (never only) RBSPs	%Phys-chem (RBSPs only)	#Phys-chem (RBSPs only)
AT	100	3	58	2	0	0	100	1
BE	100	4	0	0	100	5	0	1
BG	90	4	0	0	94	7	0	1
CY	40	1	0	0	60	1	0	0
CZ	95	2	0	0	95	5	5	1
DE	98	2	4	0	17	2	48	1
DK	100	0	0	0	0	0	1	0
EE	84	3	10	1	85	4	0	0
ES	66	3	30	1	63	4	9	1
FI	62	2	100	3	66	2	33	1
FR	82	3	0	0	79	3	6	1
HR	0	0	100	3	100	1	0	1
HU	100	3	70	2	95	5	0	1
IE	35	3	0	0	35	5	0	1
IT	74	1	0	0	84	4	0	1
LV	92	3	35	2	97	3	0	1
NL	100	4	0	0	100	7	0	1
NO	25	1	6	0	21	2	1	0
PL	99	4	61	1	100	6	0	1
PT	100	3	0	0	100	7	0	1
RO	58	3	85	2	100	4	0	1
SE	21	2	98	3	72	2	0	0
SI	100	3	0	0	25	4	75	1
UK	72	3	100	3	71	4	1	1
EU	46	4	59	3	56	5	8	1

Notes: The number of RBSPs only indicate whether they are used (1) or not (0) and does not say anything about the actual number of different single RBSPs that are used.

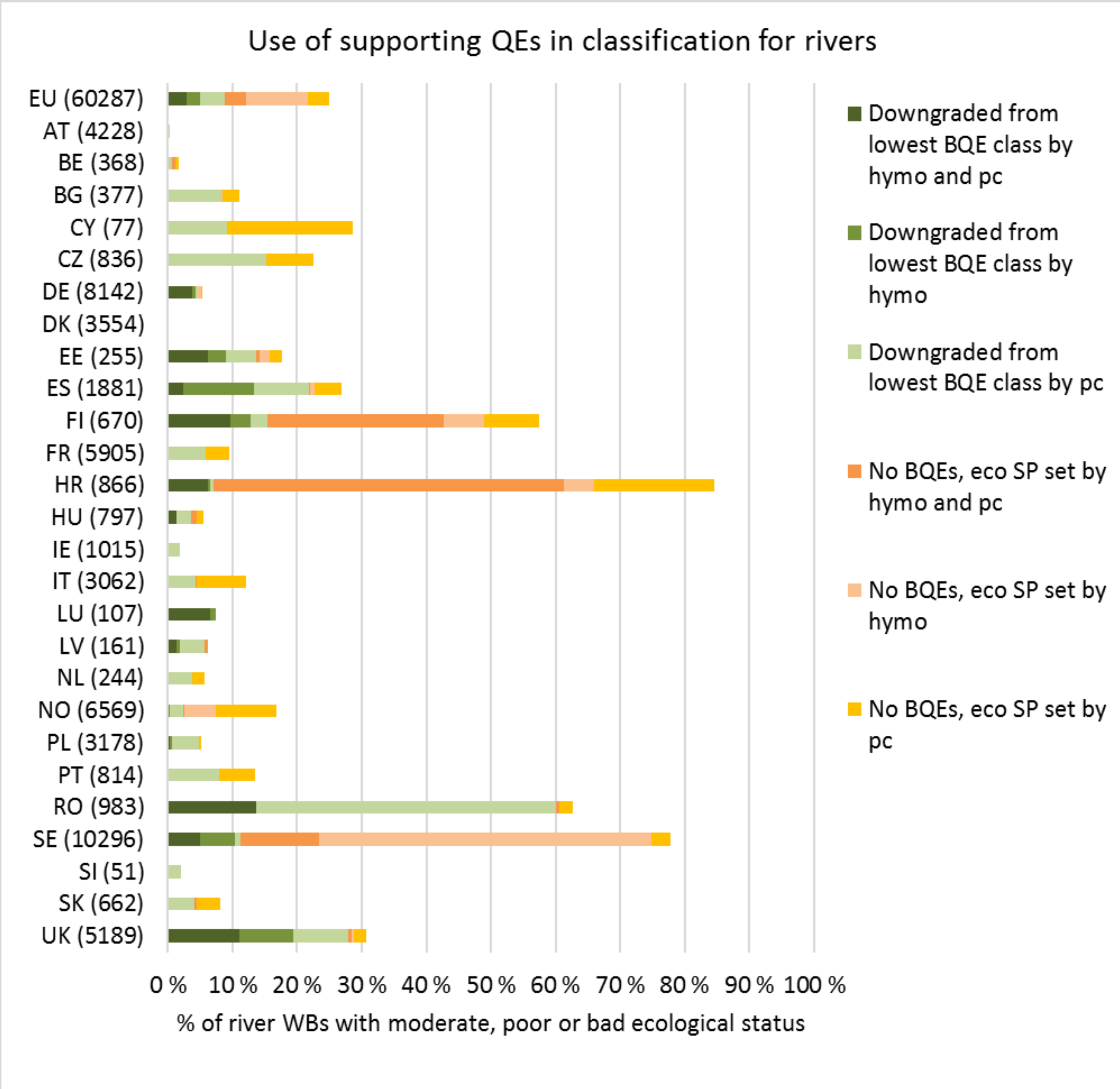
Concerning the RBSPs, these are used by most countries, except DK, IE, NO, SE for rivers and CY, DK, EE, NO, SE for lakes (Table 3).

At EU-level (bottom row in Table 3.a and b), the percentage of river water bodies that are classified based on the different QE groups are 60 % for BQEs, 47 % for the HyMo QEs and 46 % for the general PhysChem QEs, while for lakes, the percentages are only 46 % for BQEs and 59 % for HyMo and 56 % for the general PhysChem QEs. This shows a clear difference between rivers and lakes with BQEs being used to a larger extent for rivers than for lakes, and vice versa for the supporting QEs, reflecting old traditions of classification of the two water categories. The two major supporting QE groups have almost the same percentage in rivers (47 % and 46 %) and in lakes (59 % and 56 %). This is surprising, since the classification systems for PhysChem QEs have long traditions related to water quality classification preceding the WFD, while the methods for HyMo QEs have only been developed recently in most countries due to the WFD requirements.

5.2 Use of supporting QEs to downgrade overall ecological status in MSs

For water bodies in moderate status the classification can be based on one or more BQEs or on downgrading based on supporting QEs if all the BQEs are in good or better status, which would be in line with the WFD-CIS Classification guidance no. 13 (EC 2003) if the PhysChem QEs are used. According to this guidance, the HyMo QEs should only be allowed to downgrade from high to good status, if all the BQEs are in high status and the HyMo QEs are less than high. Most of the countries seem to follow this guidance for most of the water bodies in less than good status (dark green and green parts of the bars in Figure 12). However, AT and DK almost never use the supporting QEs to downgrade to less than good status. This is mainly due to the overall ecological status being less than good based on one or more BQEs.

Figure 12: Use of supporting quality elements in classification (MS-level) of river water bodies with less than good overall ecological status/potential

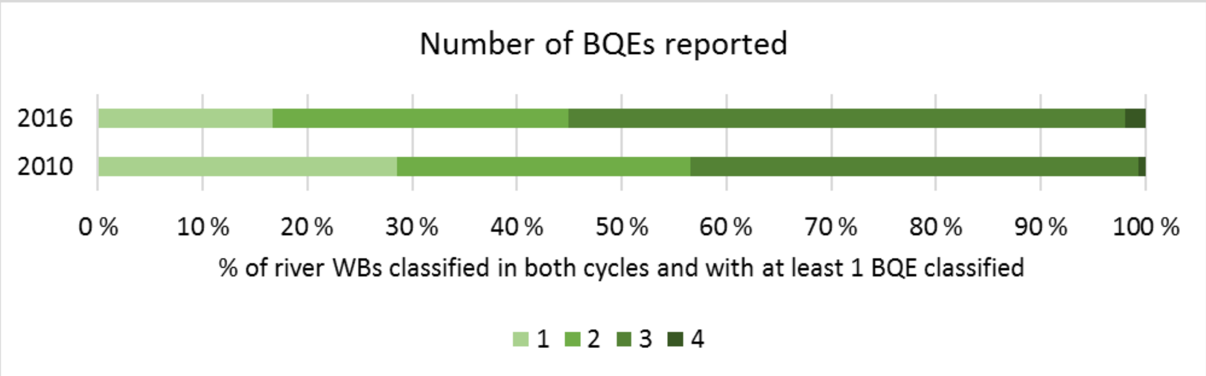


Some other countries use the supporting QEs to set the overall ecological status for water bodies in less than good status (even for poor or bad status) without any BQEs (orange parts of bars in Figure 12). This practice is used for a large proportion of river water bodies in less than good status for FI (40 %), SE (65 %) and HR (80 %), but only to a small extent in other countries. For HR, this practice is probably related to ongoing development of biological assessment methods (as they joined the EU as late as 2013).

5.3 Change in the use of BQEs between RBMP cycles

The reported data show that more BQEs were used in the 2nd than in the 1st RBMPs (Figure 13). The effect of an increase in the number of BQEs can be illustrated by calculating overall ecological status for the 2nd cycle based on the set of BQEs used in the 1st and 2nd cycle respectively. The results show that the impact of increasing the number of BQEs used for assessing overall ecological status is quite small at EU-level, but indicate slightly better status if only the BQEs used in the 1st cycle had been used also in the 2nd cycle (Figure 14). This shows that using more BQEs cause an apparent worsening of overall ecological status, but another interpretation is that using more BQEs provides as a more correct classification, suggesting that the status reported with fewer BQEs in 2010 could have been too good.

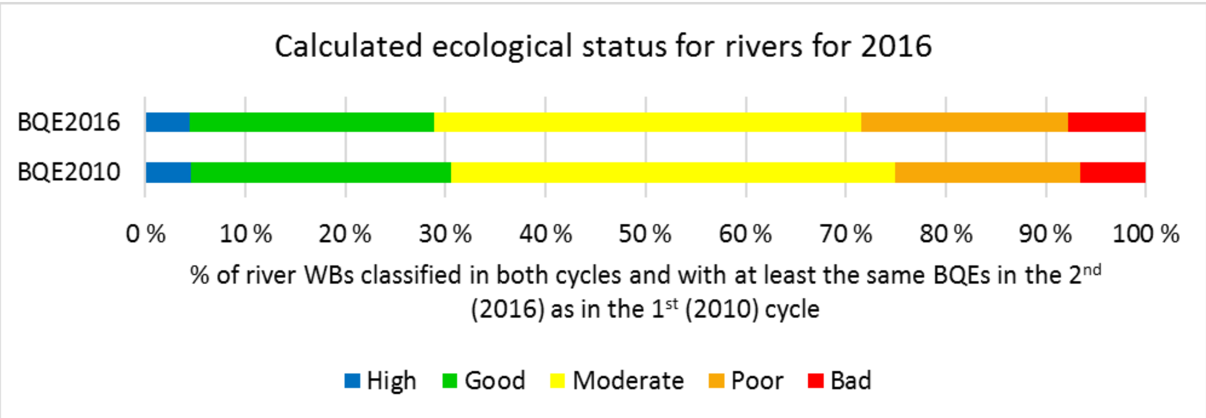
Figure 13: Change in the number of BQEs used for classification of rivers from the 1st (2010) to the 2nd (2016) RBMP cycle at EU-level



Notes: Same WBs in both cycles, at least 1 BQE reported both times. In total 31508 WBs. Other aquatic flora combined to one BQE.

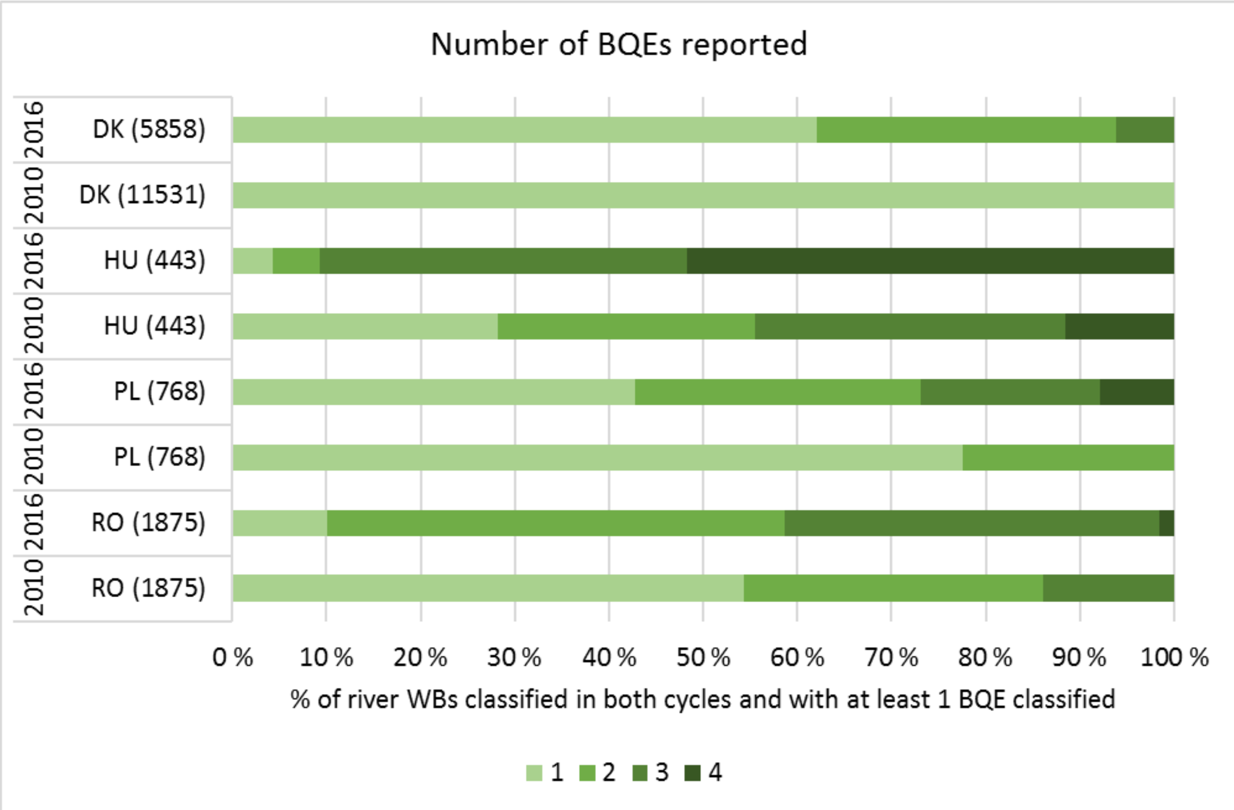
For some MSs, however, the impact of using more BQEs in the 2nd than in the 1st RBMPs on the calculated overall ecological status (using the worst BQE) is much larger than that shown for the EU overview, e.g. Denmark, which used only benthic invertebrates in the 1st RBMP, but also macrophytes and fish in the 2nd RBMP, Poland, using two BQEs in the 1st RBMP and up to four BQEs in the 2nd RBMP and Hungary, using only one BQE for almost all the water bodies in the 1st RBMP and up to four BQEs in the 2nd RBMP (Figure 15).

Figure 14: The effect of the change in number of BQEs used for overall ecological status of rivers at EU-level. BQE2016 is calculated status using all the BQEs reported in the 2nd RBMP cycle (2016), BQE2010 is calculated status using only the set of BQEs used in the 1st RBMP cycle (2010)



Notes: Same WBs in both cycles, WBs with at least 1 BQE in 2010 and (at least) the same BQEs in 2016 as in 2010. In total 30547 WBs. Other aquatic flora combined to one BQE.

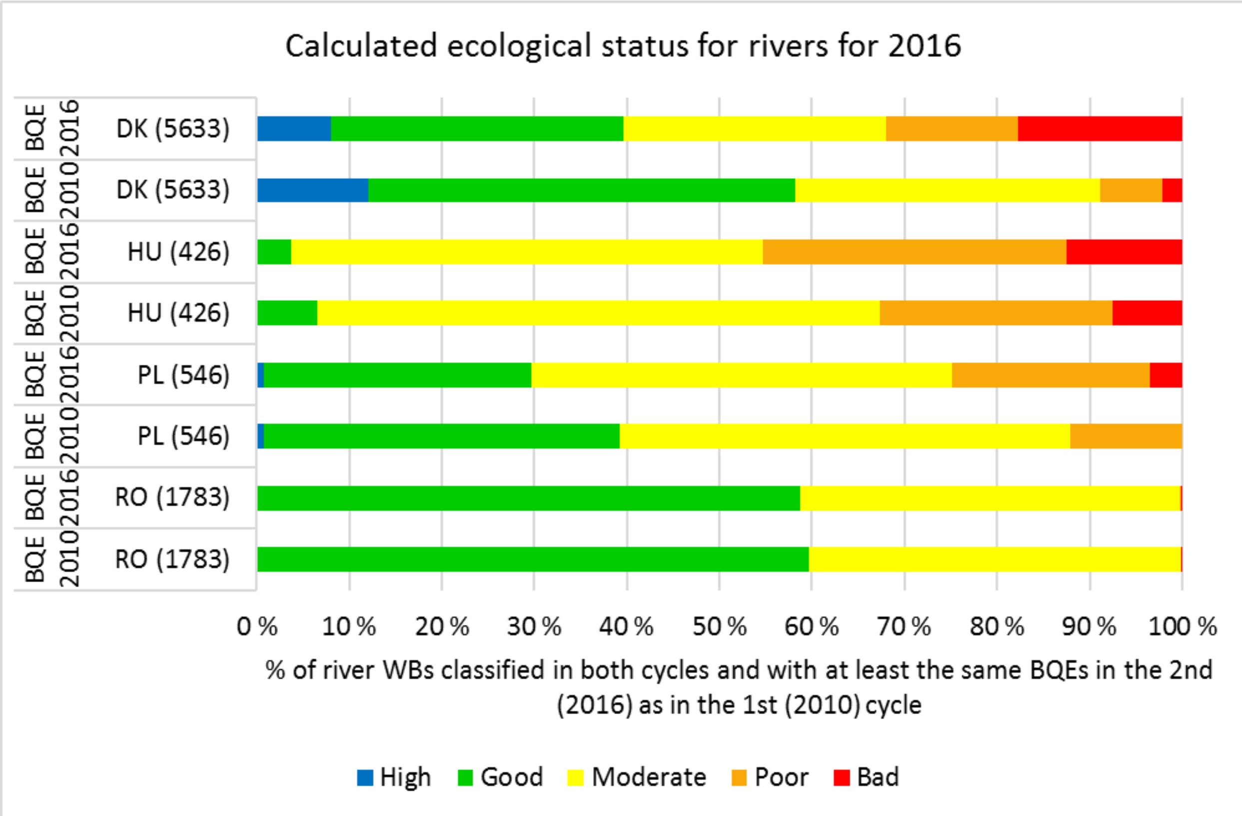
Figure 15: Change in the number of BQEs used for river classification between the two RBMP cycles (MS-level)



Note: For Denmark it was not possible to compare the same water bodies in both cycles because all WBs have been redefined in the 2nd cycle, partly involving re-delineation, reducing the total number of river water bodies from 11,531 in the 1st cycle to 5858 in the 2nd cycle. Denmark has still been included, but here the two bars to be compared do not represent the same set of WBs, in contrast to the other countries.

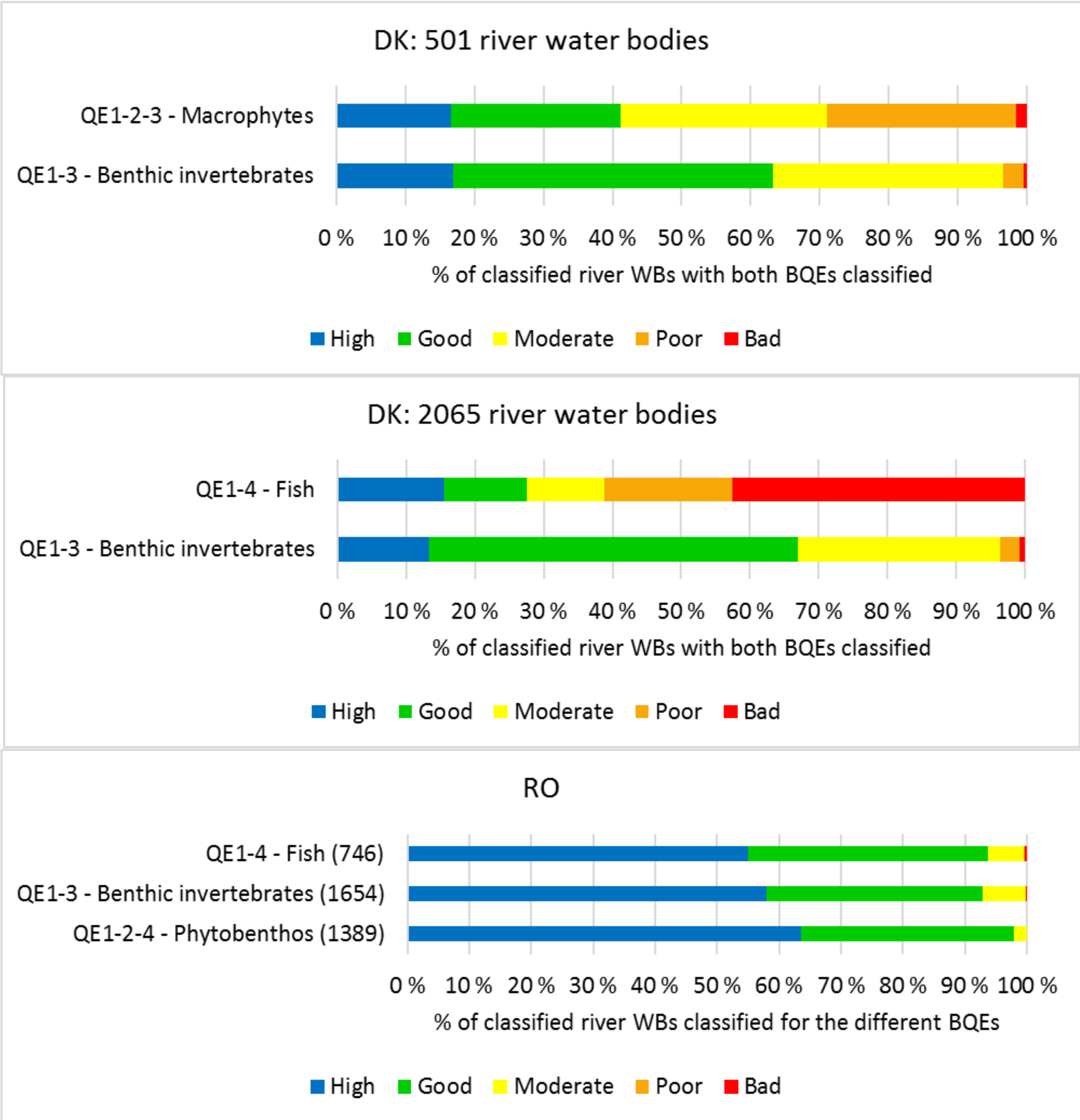
For these MSs, the results in Figure 16 show that the status obtained when using only one BQE is better than what would be expected if all BQEs had been used. For Denmark, the impact is quite substantial even if most of the water bodies are still classified with only one BQE in the 2nd cycle. This indicates that almost all the water bodies classified with more than one BQE in the 2nd cycle had worse status for those BQEs, which is confirmed by an in-depth analysis of status for the different BQEs, comparing benthic invertebrates with macrophytes and with fish respectively (Figure 17). In contrast to Denmark, Romania shows very little difference in overall ecological status between the two RBMPs in spite of having used more BQEs in the 2nd cycle. The reason can be that the status is quite similar for the different BQEs, so having more BQEs in the 2nd cycle does not change the status so much compared to using only one BQE (Figure 17).

Figure 16: The effect of the change in number of BQEs used for overall ecological status of rivers for countries using markedly more BQEs in the 2nd cycle (Denmark, Hungary, Poland and Romania, Figure 15). BQE2016 is calculated status using all the BQEs reported in the 2nd RBMP cycle (2016), BQE2010 is calculated status using only the set of BQEs used in the 1st RBMP cycle (2010).



Note: For Denmark, it was not possible to use the actual data on BQEs reported in the 1st cycle because all WBs have been redefined in the 2nd cycle, but as Denmark only used benthic invertebrates as BQE in the 1st cycle, BQE2010 ecological status was calculated using only benthic invertebrates as BQE.

Figure 17: Status for different BQEs in Danish and Romanian rivers



Notes: For DK the figure shows the same water bodies for both BQEs in each of the graphs, while for RO the figure shows all water bodies classified for each of the BQEs, so the three BQEs are not from the same set of water bodies. The number of water bodies shown for each BQE is given for each bar. The total number of river WBs for RO is 1,783, incl. unknowns. For DK benthic invertebrates represent the BQEs as used in the 1st cycle, while the other BQEs represent the addition in the 2nd cycle, making it easier to identify what has caused the change. For Romania different combinations of BQEs were used in the 1st cycle, making it impossible to show relevant comparisons of BQEs representing the two cycles.

5.4 Change in the use of supporting QEs between the two RBMP cycles

In contrast to the BQE-status, which was reported at the same level in both RBMPs, the supporting QE-status was reported aggregated for 1st RBMPs (e.g. QE2: hydromorphological status, QE3-1: general physico-chemical status) and by QEs (e.g. QE2-2: River continuity conditions, QE3-1-6-2: phosphorus conditions) for 2nd RBMPs and are therefore not directly comparable.

6 Physico-chemical standards, impact on QE-status, example for total phosphorus in rivers

6.1 Overview of physico-chemical standards reported by MSs

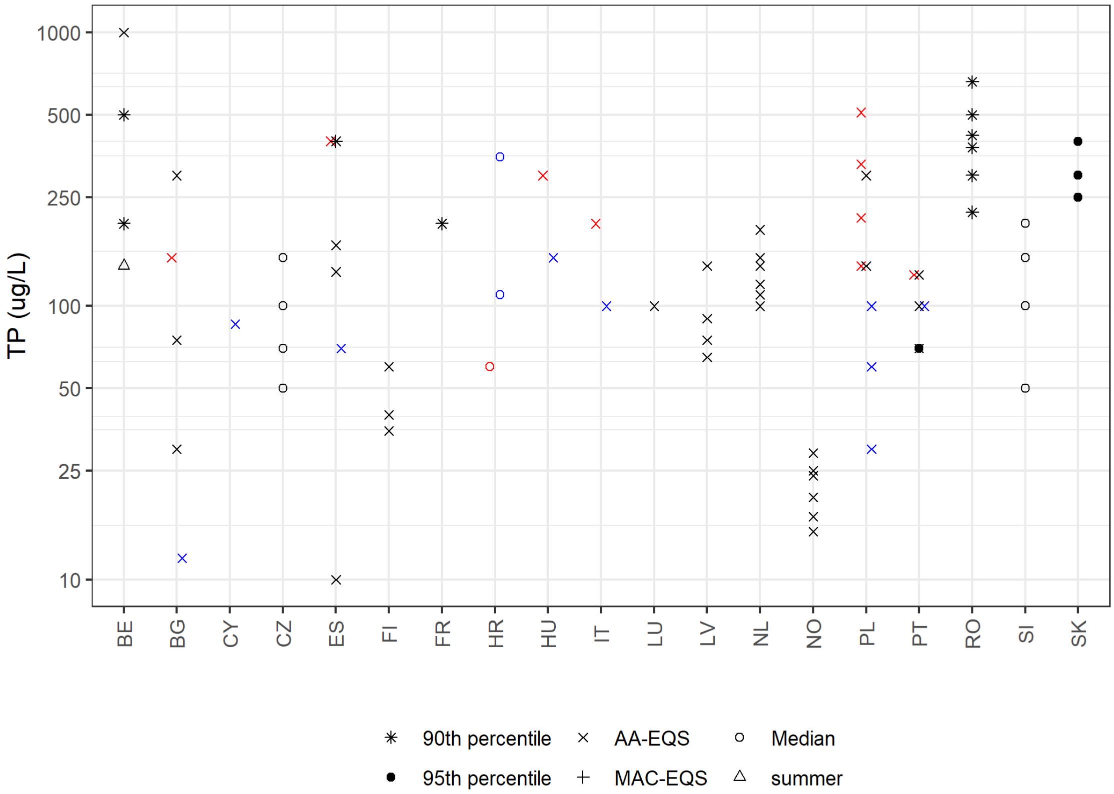
The standards reported by the countries to WISE with the 2nd RBMPs show very wide ranges for most of the PhysChem QEs (examples shown below). ECOSTAT work on aggregation of the standards reported for national types to the broad types (Lyche Solheim et al. 2019 and Table A.1 in the Annex) indicates that type-specific differences only explain a small part of the total variation for a few PhysChem QEs (e.g. Secchi depth and total phosphorus in lakes). The aggregation to broad type is however restricted to standards reported for national types that match one of the broad types. In many cases, the standards were reported for national types that do not match any of the broad types or overlap several broad types. Moreover, some countries reported a wide range of standards for "All" types. Such a range can either reflect standards used for different national types or for different water bodies. The results of this aggregation to broad types, as well as the standards reported for "All" types or for non-matching types are presented in a draft ECOSTAT report available on circa (Kelly et al., 2019: https://circabc.europa.eu/w/browse/491b7b0f-bbb7-4d4f-afdc-82da0a6df90f), and a few examples are shown in Annex 1: Figures A1.2 for rivers and A1.3 for lakes.

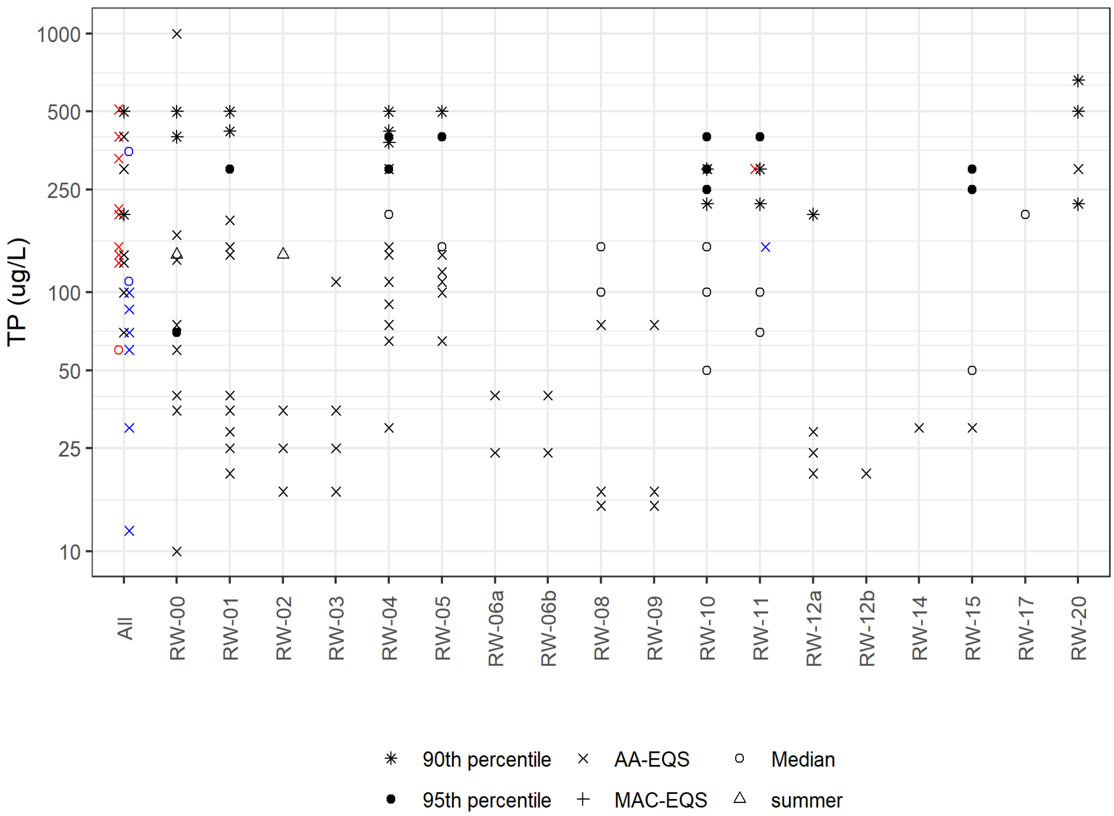
In summary, data reported for the PhysChem standards show that:

- For many of the physico-chemical QEs, the standards reported show very wide ranges, some spanning several orders of magnitude.
- Several of the standards reported are not likely to support good ecological status.
- Many countries only report generic standards valid for "All" types.
- Type-specific differences only explain a small part of the total variation in a few QEs, e.g. Secchi depth and total phosphorus (TP) in lakes and total nitrogen and TP in rivers.
- There is a lot of missing standards for many of the Phys-Chem QEs from many countries, e.g. DK for rivers and DE, DK for lakes have no general PhysChem standards.
- Systematic variation between countries is apparent for several elements.
- Comparisons are difficult due to differences in the ways data have been reported (esp. different statistical metrics).

Total phosphorus in rivers can be used as example to illustrate the comparability issues (Figure 18).

Figure 18: TP standards for rivers by country (upper figure) and aggregated to broad types (lower figure) (single value black, minimum blue, maximum red). "All" are standards that are not type-specific, but reported for all types in an RBD, while RW-00 are type-specific standards for national types that do not match any of the broad types.





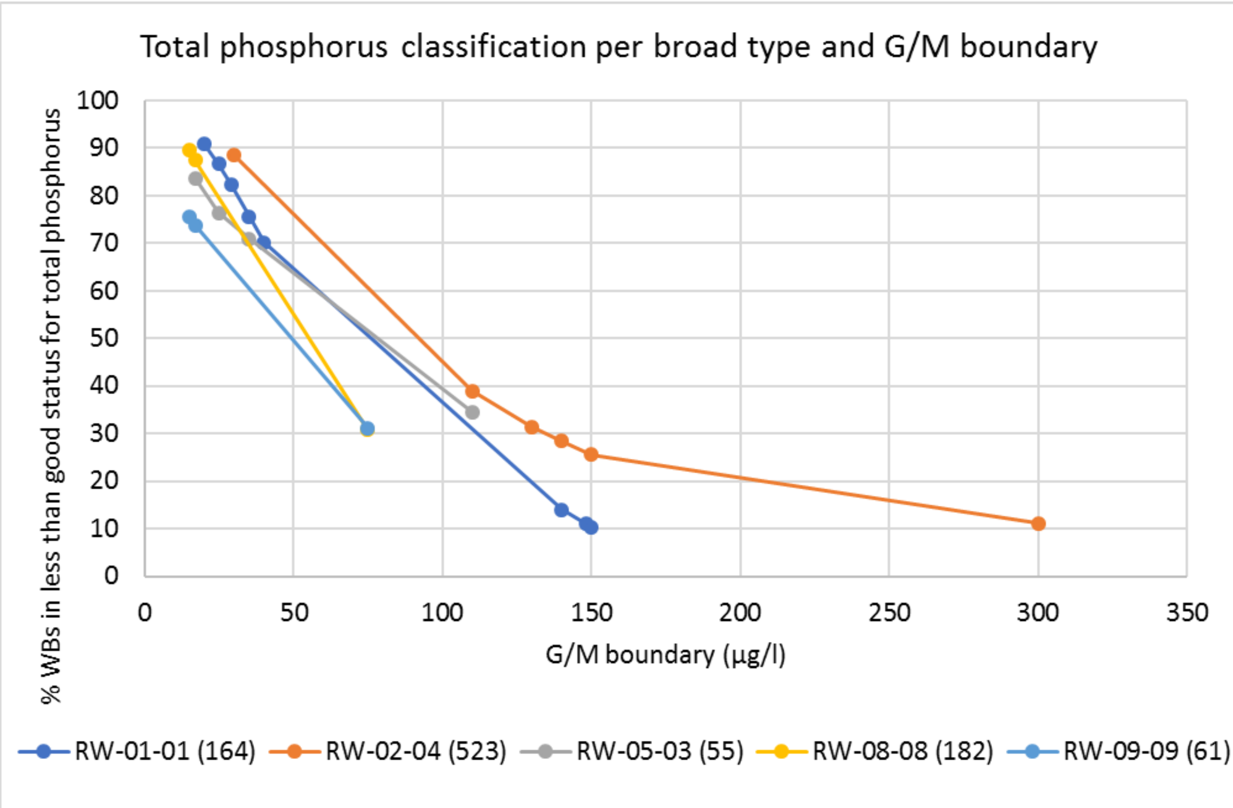
Notes: Source: Ecostat report available on circa:
https://circabc.europa.eu/w/browse/491b7b0f-bbb7-4d4f-afdc-82da0a6df90f

6.2 Using the EEA State-of-Environment (SoE) data to assess the impact of different standards aggregated to broad types on QE-status, example for total phosphorus in rivers

An overview of the range of physico-chemical standards (good-moderate boundaries) reported by MS for different types of rivers and lakes and how these are aggregated to broad types is given in Annex 1. The impact of these different standards on the proportion of water bodies failing to achieve good status for the relevant Phys-Chem QE (exceeding the standard) is illustrated below for TP in rivers, aggregated to different broad types (Figure 19). The classification is based on average TP per WB for 2015–2017 (SoE-data) and the different standards reported are AA-EQS for national types across MSs that have been aggregated to broad types to allow comparison of results. The broad types shown are those with most WBs and/or the largest range in boundaries.

The results clearly show that the proportion of water bodies failing to achieve good status for total phosphorus decreases with increasing standards, thereby causing problems with comparing Phys-Chem QE-status and maybe also overall ecological status between MSs, even for water bodies belonging to the same broad types. The problem is most pronounced when comparing MSs with standards above versus below 50 µg L^{-1}.

Figure 19: Impact of different standards (AA-EQS) for total phosphorus in rivers (dots) on the proportion of water bodies in less than good status for total phosphorus shown for different broad types (e.g. RW-01-01, see notes). The lines between the dots are linear interpolations. The number of water bodies is indicated in parenthesis for each broad type. See notes and text for further explanation.

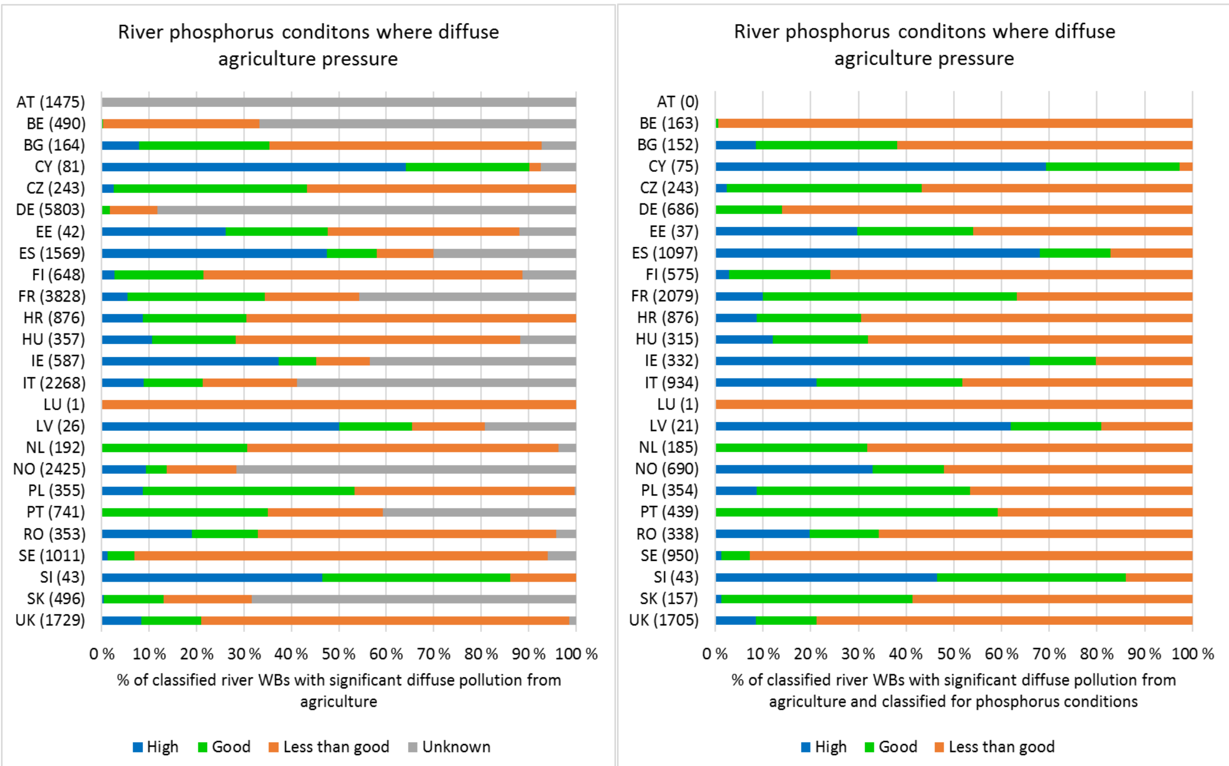


Notes: RW-01-01 is very large rivers, RW-02-04 is lowland, calcareous, medium-large rivers, RW-05-03 is lowland, calcareous, very small-small rivers, RW-08-08 is mid-altitude, siliceous, medium-large rivers, RW-09-09 is mid-altitude, siliceous, very small-small rivers. All WBs within a broad type have been classified according to all available G/M boundaries for that broad type. The classification is based on average total phosphorus values per WB for 2015–2017 for SoE monitoring stations.

6.3 MSs comparison of QE-status for phosphorus conditions in river water bodies having significant diffuse pollution from agriculture

In this section, we have harmonised the basis for the assessment, making a comparison between MSs for water bodies having the same significant pressure (e.g. sign. diffuse pollution from agriculture, classified by either one, two or three BQEs). Water bodies with significant diffuse pollution from agriculture (agri-pressure) could in theory be expected to have less than good status for nutrients, such as total phosphorus. However, the reported status class (H, G, M) for total phosphorus show that many of those river water bodies are reported to have good or even high status for this QE in most MSs (Figure 20), except in Belgium and Luxembourg (1 water body only), as well as for almost all the water bodies classified for this QE in Germany, Sweden and UK. The MSs with the highest proportion (> 70 %) in high or good status for phosphorus conditions in water bodies affected by significant diffuse pollution from agriculture and classified for this QE are Cyprus, Spain, Ireland, Latvia and Slovenia. This mismatch between the agri-pressure and the status for phosphorus conditions, can partly be explained by high standards for total phosphorus (Figure 18) and/or ortho-phosphate (AA-EQS > 50 µg/l, see Annex 1, Figure A1.2d, lower panel).

Figure 20: Status class for phosphorus conditions in rivers in river water bodies with significant diffuse pollution from agriculture (MS-level)



Note: Denmark did not report any river water bodies with significant diffuse pollution from agriculture (only lakes water bodies).

However, also for Norway, which has the lowest standards for total phosphorus (and no standards for orthophosphate), almost half of the river water bodies classified for this QE is reported to be in high or good status for total phosphorus. So, this indicates that there are other reasons for this mismatch, such as uncertainty related to the basis for reporting agri-pressure (e.g. pesticides and not nutrients, or overestimating the actual nutrient pressure). For other MSs with close to half of the classified water bodies in high or good status (e.g. CZ, EE, FR, IT, PL PT), another possible reason for the mismatch with the agri-pressure can be that the classification of phosphorus conditions is based on only orthophosphate, which is often attributed to other pressures (e.g. point source pollution from urban waste-water). Unfortunately, it is not possible to disentangle this mix of parameters, as the QE reported is phosphorus conditions regardless of the parameter.

7 Hydromorphological QE classification and impact on overall ecological status

7.1 Comparison between MSs of classifying HyMo QEs as less than good

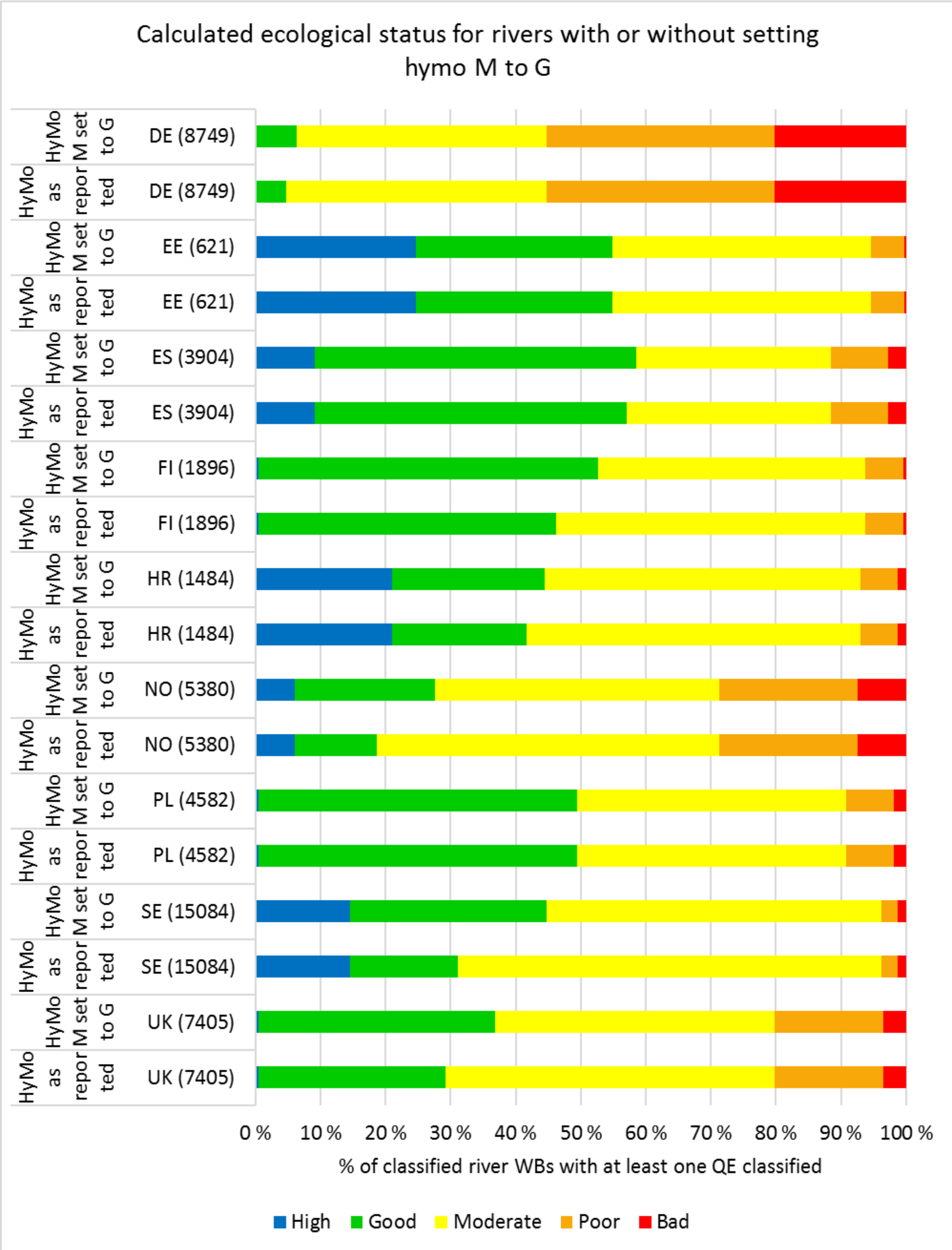
For hydromorphological (HyMo) QEs, the classification guidance (EC, 2003) recommends that these are used only to downgrade from high to good ecological status when combining them with the biological QEs. However, 19 MSs classify the QEs to less than good (reported as moderate) in the WISE-WFD database for rivers and 12 MSs do the same for lakes (Table 4).

Table 4 Use of HyMo QEs in rivers in different MSs reported with the 2nd RBMPs

Country Code	# of WBs with one or more HyMo QEs classified	# of WBs with all HyMo QEs classified as High or Good	# of WBs with at least one HyMo QEs classified as Moderate	% of WBs with at least one HyMo QE classified as Moderate
BE	170	4	166	98
BG	4		4	100
CY	122	121	1	1
DE	4552	287	4265	94
EE	305	178	127	42
ES	2840	2319	521	18
FI	1896	1223	673	35
HR	1484	1186	298	20
HU	872	581	291	33
IT	658	378	280	43
LU	110		110	100
LV	203	79	124	61
NO	899	63	836	93
PL	4574	4452	122	3
PT	359	352	7	2
RO	2536	1981	555	22
SE	14796	5267	9529	64
SK	239	205	34	14
UK	7286	4781	2505	34

Notes: MSs never classifying HyMo QEs as moderate status are not included

Figure 21: Impact on overall ecological status of allowing HyMo QEs to downgrade or set the overall ecological status to moderate (MS-level). This is done by comparing the calculated status using the reported status class for the HyMo QEs with the calculated status after changing the reported HyMo QE-status to good, if originally moderate (not allowing HyMo QEs to downgrade the overall status to moderate).



MSs that do not classify the HyMo QEs as less than good are AT, CZ, DK, FR, IE, NL, SI for rivers and the same MSs plus BE, BG, CY, IT, PT, SK for lakes. All countries in Table 4 classify the HyMo QEs as high, good or moderate, but the percentage in moderate status varies widely from < 5 % in CY, PL, PT to > 90 % in BE, BG, DE, LU, NO. Also, in LV and SE more than 60 % is classified as moderate. However, there can also be other QEs that are classified as moderate in those water bodies. We therefore assessed which MSs that have downgraded or set (when no BQEs) river water bodies to moderate status based only on the HyMo QEs (Figure 22). These are 9 MSs: DE, EE, ES, FI, HR, NO, PL, SE, UK (excluding MSs doing this only for one WB).

The impact on the calculated overall ecological status (using the worst QE to set status) of this practice of downgrading or setting river water bodies to moderate ecological status also using HyMo QEs in the 2nd RBMPs is illustrated in Figure 21 for the 9 MSs doing this. The results show that the impact is minor for many MSs (DE, EE, ES, HR, PL) probably because other QEs are already worse than the HyMo QEs. However, the impact is more pronounced for others (FI, NO, SE, UK). SE has the largest difference, showing an increase in the percentage less than good from 55 % to almost 70 %. This is mainly due to the large proportion of WBs classified without BQEs, and many also with HyMo QEs only (Figure 11). More than half the SE WBs classified to moderate ecological status were classified only using HyMo QEs.

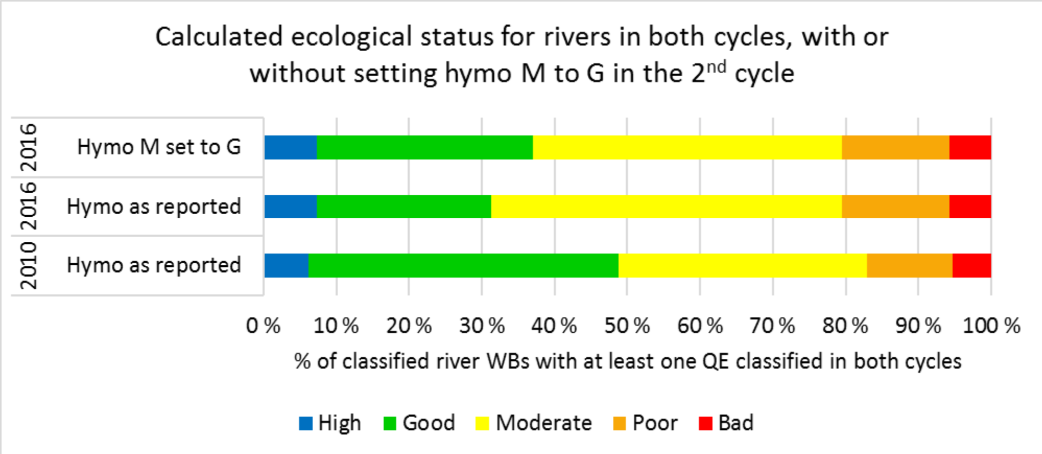
7.2 Comparison between RBMPs

The classification of the HyMo QEs as less than good has changed from the 1st to the 2nd cycle, which may have some impact on the change in the overall ecological status. However, we cannot know whether the changes are due to real changes in the classification systems of the MSs or are simply due to differences in the reporting guidance, which in 2010 only allowed reporting of HyMo QEs as high or good (or unknown) in contrast to the 2016 guidance allowing to report also moderate status for these QEs. The latter means that the MSs may have used HyMo QEs classified as M to downgrade the overall status also in the 1st cycle, but this is not evident from the reported HyMo QE-status. In case the reported overall ecological status might deviate from the OOAO, such downgrading by HyMo QEs could potentially contribute to the pattern for the 1st cycle seen in Figure 7.

The impact of the changes in reporting of HyMo QEs on overall ecological status can be considered by comparing the calculated overall ecological status in the two cycles with HyMo QEs as they are reported (HyMo QEs classified only as high or good in the 1st cycle and as high, good or moderate in the 2nd cycle), as well as if the reporting had been the same in both cycles (classifying HyMo QEs to high or good and none to moderate also in the 2nd cycle). The results (Figure 22) show that the proportion of river water bodies in less than good status increased from 52 % to 68 % from the 1st to the 2nd cycle when comparing the status as reported in both cycles (the two lower bars in Figure 22), whereas the increase is less going from 52 % to 64 % from the 1st to the 2nd cycle if the HyMo QEs classified as moderate in the 2nd cycle are set to good (lower versus upper bar in Figure 22). Thus, there is a small, but clear impact on the overall ecological status of these changes in the reporting of HyMo QEs from the 1st to the 2nd cycle.

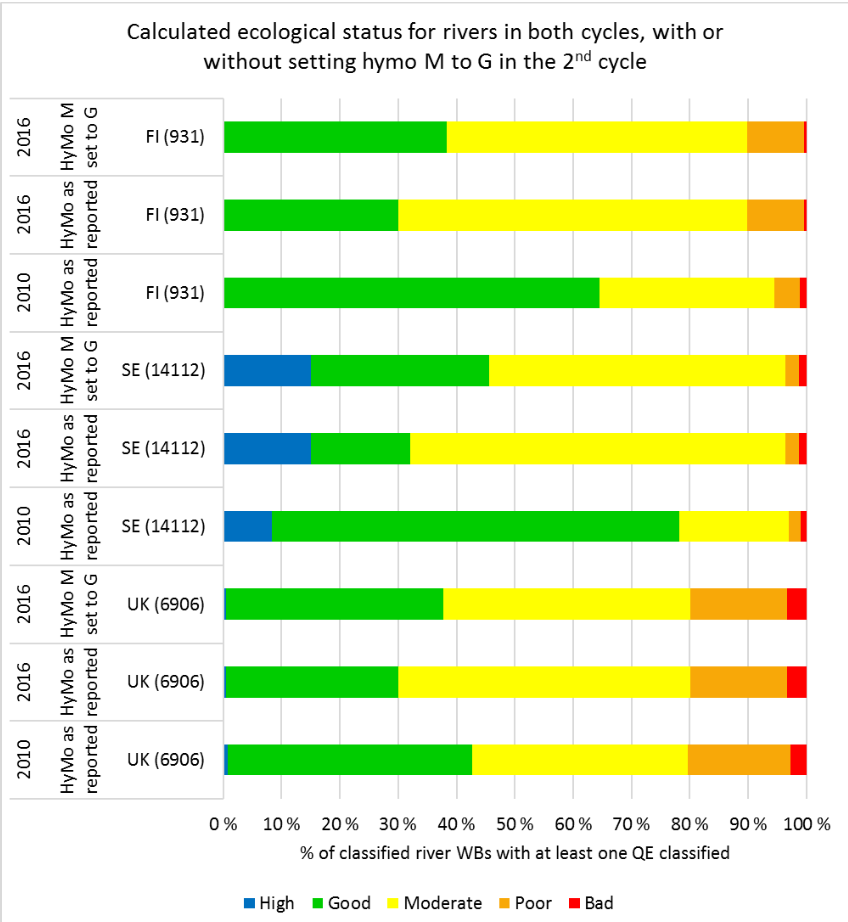
When looking at similar results for single MSs, Sweden, Finland and UK show the largest impact on overall ecological status due to these changes in classification methods for the HyMo QEs from the 1st to the 2nd cycle (Figure 23).

Figure 22: Impact on calculated overall ecological status (EU-level) of changing the reporting of HyMo QEs from High or Good in the 1st cycle to High, Good or Moderate in the 2nd cycle



Notes: Results shown by the calculated status using reported status for the HyMo QEs in the 1st cycle (lower bar) and the calculated status using reported status for the HyMo QEs (middle bar) versus the calculated status after changing the reported HyMo QE-status to Good, if originally Moderate, in the 2nd cycle (upper bar). Based on the 50,473 river WBs with reported QEs in the 1st (2010) and 2nd (2016) cycle.

Figure 23: Impact on calculated overall ecological status (MS-level) of changing the reporting of HyMo QEs from High or Good in the 1st cycle to High, Good or Moderate in the 2nd cycle



Notes: Shown by the calculated status using reported status for the HyMo QEs in the 1st cycle (lower bar) and the calculated status using reported status for the HyMoQEs (middle bar) versus the calculated status after changing the reported HyMo QE-status to Good, if originally Moderate, in the 2nd cycle (upper bar). The number of river WBs with reported QEs in the 1st cycle (2010) and 2nd cycle (2016) are given in for each MS.

8 Water bodies and QEs with unknown status and impacts on comparisons between MSs and RBMPs

The question to be addressed in this chapter is how water bodies in unknown ecological status affect the overall results and also the comparison between countries/RBMPs.

8.1 Unknowns and impact on comparison of ecological status and QE-status between MSs for the 2nd RBMP

In the 2nd cycle reporting, the overall ecological status was unknown for only 5 % of all water bodies (EEA 2018 report Chapter 2.1.2 and Figure 2.3 and updated WISE dashboard incl Norway and Ireland). Therefore, the unknowns only slightly affect the overall distribution of ecological status classes at EU-level. To estimate the potential effect, we can make some hypothetical examples: If all the unknown river water bodies were in moderate, poor or bad status, the proportion of river water bodies in less than good ecological status would be 58 %. By contrast, if all the unknown river water bodies were in high or good status, the proportion of river water bodies in less than good ecological status would be 53 %. In an extreme case, if all the unknowns were in bad status the proportion in bad status would double from 5 % to 10 %, while the other extreme if all the unknowns were in high status, the proportion in high status would increase from 11 % to 16 %.

At MS-level , however, there are more unknowns for certain MSs, e.g. for rivers in DK (25 %), IE (27 %), IT (16 %), and for lakes in BG (16 %), CY (39 %), CZ (22 %), DK (20 %), HU (47 %), IE (21 %), IT (41 %). Therefore, comparisons of the overall ecological status in those MSs with other MSs having almost no unknowns can be more problematic. The larger the proportion of unknowns, the larger is the uncertainty in the overall ecological status results. One solution is to compare ecological status between MSs after excluding the unknowns, but this introduces uncertainties because the classified water bodies are not necessarily representative for the unknowns. The unknowns can be worse or better than the knowns, depending on whether they are located in areas with more or less pressures than the classified water bodies. There are also other reasons why the percentage of WBs in each status class is not entirely comparable between MSs, which are use of different QEs and different combination methods (as shown in Chapters 4 and 5 above).

The problem with unknowns becomes much worse when comparing the status for different QEs, because the percentage of water bodies with unknown QE-status is much larger than for overall ecological status (Figure 2.4 in the EEA 2018 report and updated dashboards incl. Norway and Ireland), ranging from 42 % for benthic invertebrates to 64 % for fish in rivers, and from 54 % for phytoplankton to 84 % for fish in lakes (at EU-level). For most of the supporting QEs, the proportion of unknowns at EU-level is in the same range (40–80 %).

At MS-level, the proportion of river water bodies with unknown QE-status ranges from < 10 % to > 90 % for the same BQE (e.g. for benthic invertebrates in rivers shown in Figure 2.5 in the EEA 2018 report). As long as we don’t know whether the BQE-classified water bodies are representative also for the unknowns, such comparison is difficult. One option could be to only compare the BQE-classified water bodies in MSs having a low proportion of unknowns.

8.2 Impact of unknowns on comparison of overall and QE-status change between the 1st and 2nd RBMPs

The proportion of unknowns for overall ecological status was larger in the 1st than in the 2nd RBMP reporting, complicating the comparison of status change at EU-level (Section 2.4 in the EEA 2018 report). Such comparisons are even more difficult at MS-level for overall ecological status, as well as for single BQEs, due to changes in the proportion of unknowns between the two cycles for many MSs. Therefore, we can only analyse change for water bodies that have been classified in both cycles. The same is true for change in BQE-status. Change in status for supporting QEs cannot be done regardless of differences in proportion of unknowns, due to the different aggregation levels in the two reporting cycles, see Section 5.4.

9 Confidence in overall ecological status and QE-status, comparison across MSs and RBMP cycles

9.1 Confidence in classification in monitored versus non-monitored water bodies – EU-level – 2nd RBMPs

MSs report confidence in the classification of overall ecological status (high, medium, low), as well as the general method they have used for classification of each QE (monitoring, grouping, expert judgement).

As expected, for both rivers and lakes there is clearly better confidence in classification of monitored than non-monitored water bodies at EU-level, and there is also better confidence where BQEs are monitored than where only supporting QEs are monitored (Figure 24). The confidence is low for most non-monitored water bodies, but slightly better in water bodies where at least one QE has been classified (based on grouping or expert judgement) than where no QEs have been classified (bottom row for each water category in Figure 24). This pattern is seen for both water categories, but the confidence is generally better for rivers than for lakes for the equivalent groups of water bodies. The reason for the water category difference is unclear, but for water bodies with BQEs monitored, this difference in confidence may be related to more BQEs being used in rivers than in lakes.

The classification of the different QEs is based on monitoring for most of the QEs in both rivers and lakes, except HyMo QEs, which are mostly classified with expert judgement (Figure 25). Expert judgement is also used for > 25 % of the lake water bodies for most of the BQEs and PhysChem QEs, and for > 60 % of the lake water bodies for acidification and RBSPs. Grouping[1] is not much used in lakes but is used for a substantial part (15-35 %) of the river water bodies for most of the BQEs and PhysChem QEs.

It is not clear whether modelling (e.g. GIS data on pressures or land use, as well as typology data, such as altitude, catchment size, geology) is used for QE classification, nor in which of the methods expert judgement or grouping modelling may be embedded. This adds another complication to the interpretation of methodological differences. The WG-DIS has recently amended the WFD reporting guidance for the 3rd RBMPs by adding modelling as a separate reply option. However, modelling as a term may not be very informative as a basis for comparing confidence in classification, as that depends on the quality and type of the models used.

[1] Grouping means classification of water bodies without monitoring data, having the same type and pressures as other monitored water bodies

Figure 24: Confidence in classification of overall ecological status for rivers (upper graph) and lakes (lower graph) for monitored or non-monitored water bodies at EU-level. Number of water bodies given in parenthesis for each group of water bodies

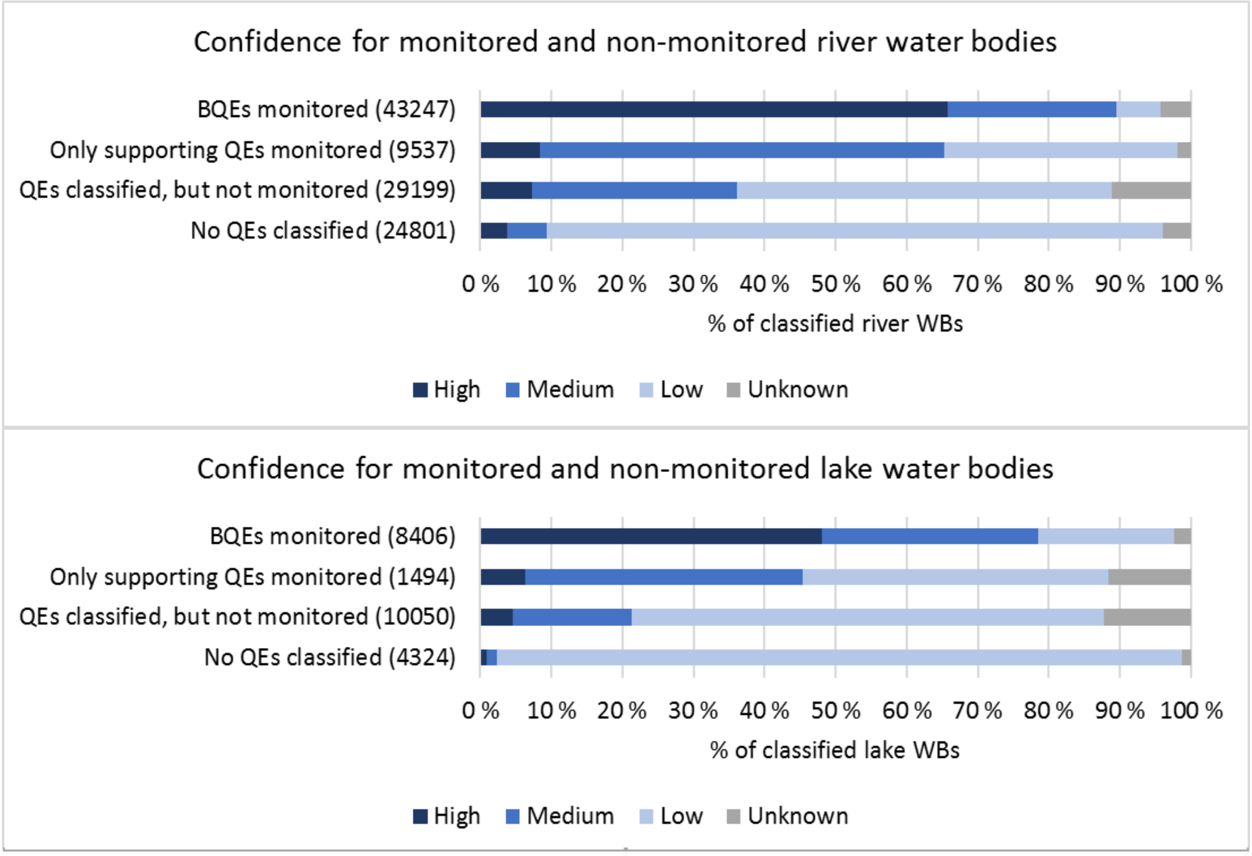
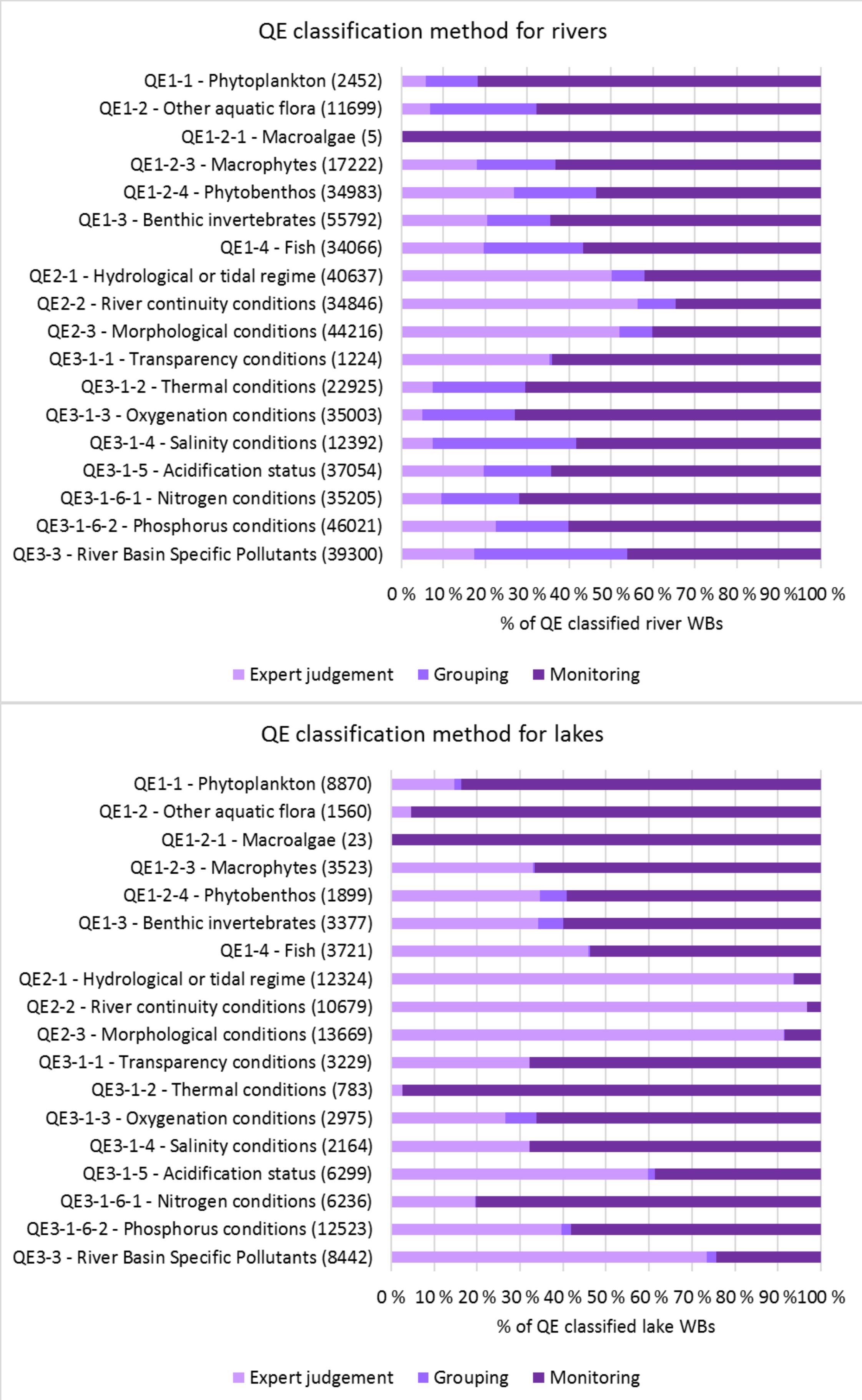


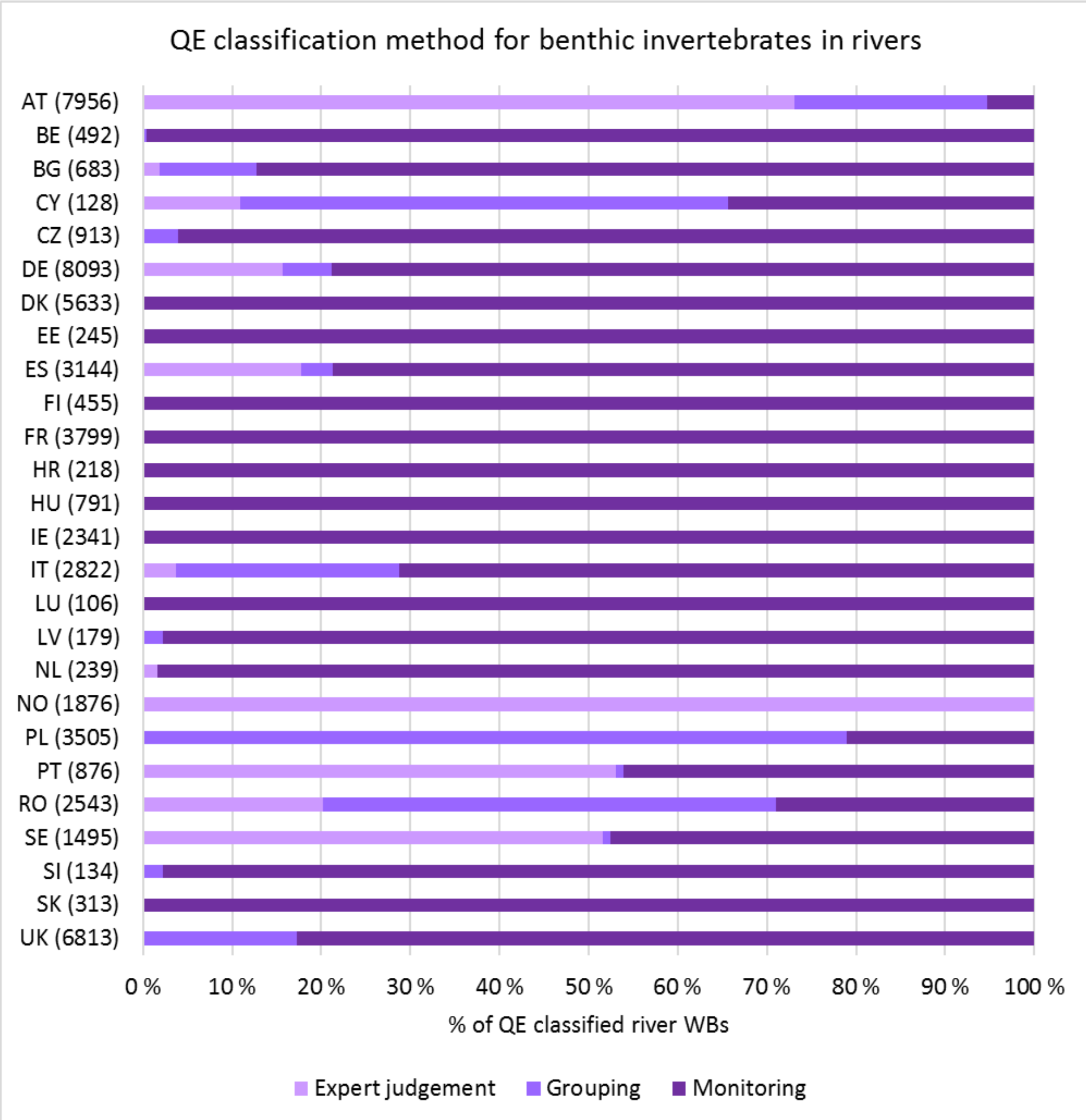
Figure 25: Basis for classification of QEs in rivers (top) and lakes (bottom) (EU-level)



9.2 Basis for classification of QEs, MS comparison

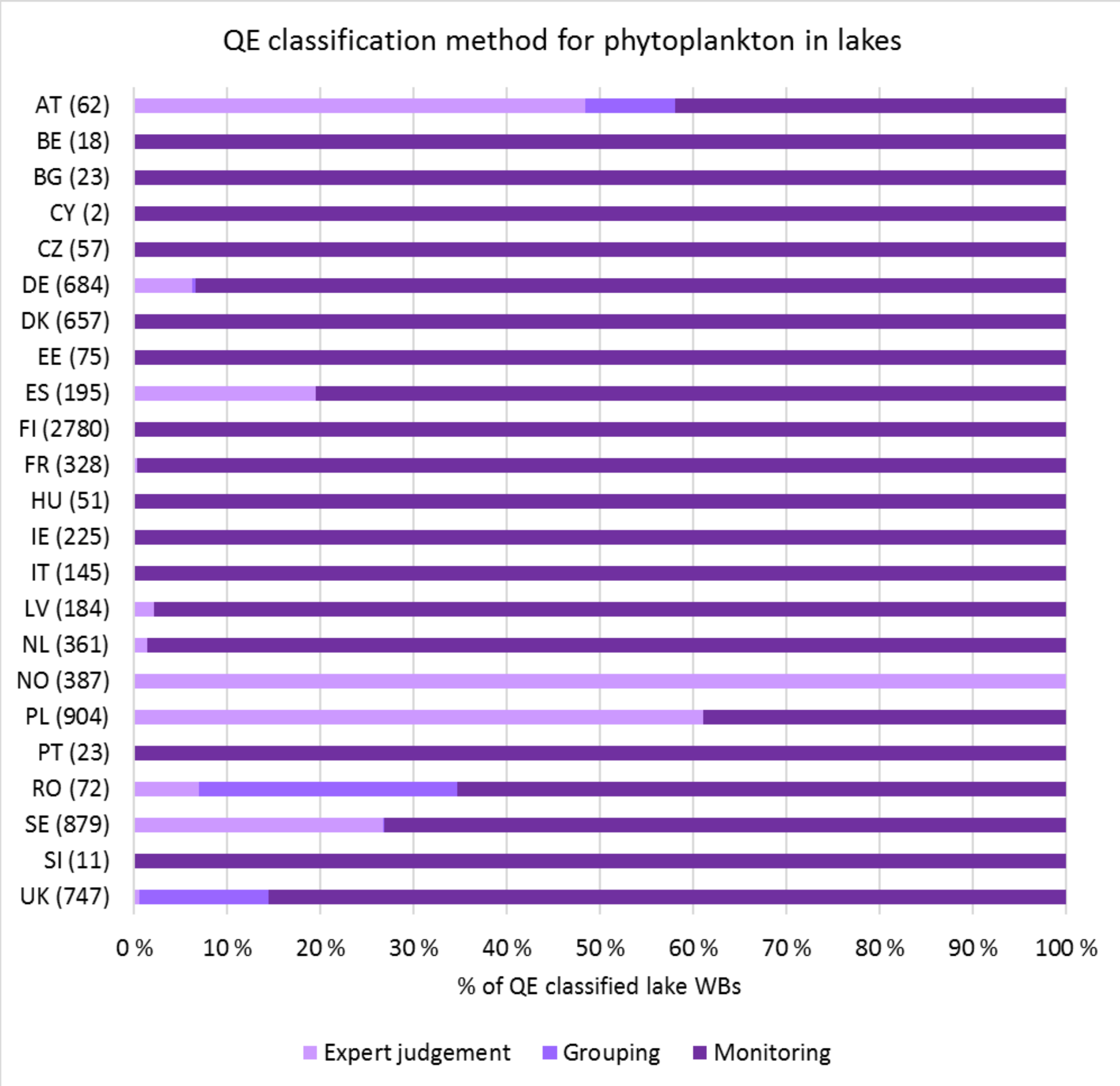
There are large differences between countries concerning the basis for classification of single QEs. Monitoring is the method used to classify most of the water bodies for the most commonly used BQEs in rivers. Figure 26 shows that monitoring is the dominant method used for classification of phytobenthos and benthic invertebrates in most of the countries, but expert judgement is used to a large extent in some countries (e.g. AT, NO, PT, SE), while grouping is mostly used by CY, PL and RO.

Figure 26: Basis for classification of benthic invertebrates in rivers (MS-level)



Phytoplankton classification in lakes is mainly based on monitoring in most countries, except in AT, NO and PL, where 50–100 % of the water bodies are classified based on expert judgement (Figure 27). For lake fish, monitoring is used by most countries for most water bodies, except AT, LV, NO, PL, who use expert judgement for 50–100 % of their water bodies. It is also worth mentioning that fish is classified by fewer countries and in fewer water bodies in most of the countries compared to phytoplankton.

Figure 27: Basis for classification of phytoplankton in lakes (MS-level)



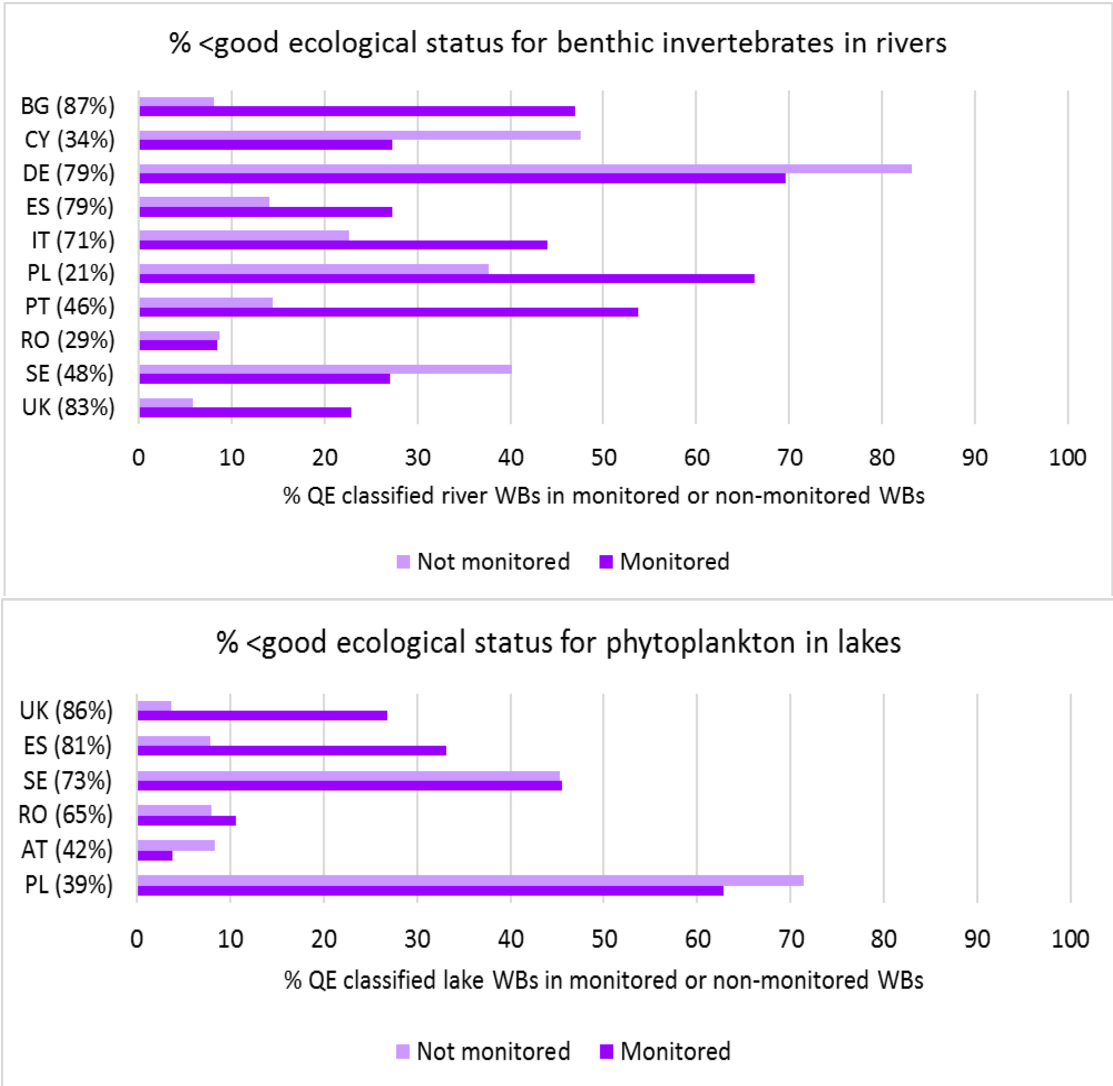
The consequences of different classification methods is that the ecological status results are less comparable due to different confidence (see Chapter 9.1).

9.3 Representativity of the monitored water bodies and impact on classification results in MSs

Classification based on monitoring provides higher confidence in the ecological status of different QEs than if the classification is based on grouping or expert judgement (Figure 24). Since the confidence is much lower for non-monitored water bodies, MSs comparisons become difficult, when the proportion monitored varies. Thus, a better option is to compare the status in only the monitored water bodies but only if these are representative, which is especially in MSs with low proportion of monitored water bodies (e.g. SE). Representative monitoring in terms of distribution of status classes is likely to give a better basis for grouping and expert judgement. An interesting question is therefore to which extent the QE-status in monitored water bodies is representative for the non-monitored ones.

The comparison of status in monitored versus non-monitored water bodies for benthic invertebrates in rivers and phytoplankton in lakes shows that the monitored water bodies are not representative for the other water bodies in several of the MSs included in the analysis (Figure 28). However, the deviation of status between the monitored and non-monitored water bodies differs between the MSs and goes in both directions in terms of which of the two groups of water bodies has the largest proportion in less than good status for the QE. The deviation of status between the monitored and non-monitored water bodies is quite small for benthic invertebrates in AT and RO and for phytoplankton in RO and SE. Larger deviations are found for the status of benthic invertebrates in BG, ES, IT, PL, PT, UK, and for phytoplankton in ES and UK, where the status is significantly worse in the monitored than in the non-monitored water bodies. In contrast, CY, DE, SE show better status in the monitored than in the non-monitored water bodies for benthic invertebrates in rivers, while AT and PL show the same pattern for phytoplankton in lakes.

Figure 28: Percentage of monitored versus non-monitored water bodies failing to achieve good status for benthic invertebrates in rivers and phytoplankton in lakes. The percentage after each MS code is the % monitored of all classified for the two BQEs respectively



Notes: Only shown for MSs with monitored water bodies between 10 % and 90 % of all water bodies classified for each BQE.

The interim conclusion on the impacts of the different methods shown in this chapter on the comparability between MSs is that MSs with a high proportion of monitored water bodies or with representative monitoring of BQEs would be more comparable than MSs with a low proportion of monitored water bodies or with non-representative monitoring of BQEs.

10 Synthesis, conclusions and way forward

10.1 Synthesis

This report illustrates differences between Member States (MSs) in methodologies used to classify the ecological status of rivers and lakes. These differences cause problems with comparing the status both between different MSs and between the different RBMP cycles, concerning which differences are actually real and which are simply artefacts cause by the variability in methodologies. For each of the comparability issues listed below, the consequences for comparison of overall ecological status and QE-status are illustrated and interpreted to the extent possible with the current datasets.

The major problems are related to the following issues:

- There is a difference between the MSs and RBMPs concerning the number of BQEs used for classification. Some MSs classify a large proportion of their water bodies using only the supporting QEs or using no QEs at all. MSs using few quality elements may be more likely to get better overall ecological status than those using many due to the one-out-all-out principle (Chapters 4 and 5).
- The standards for the general Phys-Chem QEs varies a lot with wide ranges of standards between and within MSs, some standards are probably not in line with the BQEs (Chapter 6)
- The HyMo QE-status classes and downgrading practices applied for these QEs are also different among MSs and RBMPs (Chapter 7).
- Several MSs have a large proportion of water bodies with unknown QE-status for many BQEs and supporting QEs, making comparisons at QE-level of the small proportion of water bodies with known QE-status very uncertain (Chapter 8).
- The variability among MSs in the approaches used to extrapolate ecological status for single QEs from monitored to non-monitored water bodies by grouping or expert judgement, and whether (and what kind of) models have been used for this purpose (Chapter 9).

Comparing status with pressures to check for consistency between the different pressures and the status of different sensitive QEs has not been done (except the attempt to assess the QE-status for phosphorus conditions in water bodies with significant diffuse pollution from agriculture in Chapter 6). There are also other comparability issues that have not been included in this report, e.g. differences in delineation of water bodies between MSs (many small versus few large), re-delineation of water bodies between the two RBMP cycles, designation and comparability of ecological potential of heavily modified water bodies (HMWBs) and widely different standards for the river basin specific pollutants.

10.2 Conclusions

The key question to be answered from this report is: How can we best use the reported data to compare ecological status in time and space? The answer to this question is the type of comparison that gives the best confidence. In this respect, confidence means how certain can we be that a comparison reflects real differences in ecological status and not simply artefacts of the different national methodologies to report the status, and the changes done in these methodologies between RBMP cycles. Below we have attempted to rank the various major ways to compare ecological status and QE-status from most confident to least confident (Table 5). Underlying assumptions for the ranking are:

- Water bodies classified with high confidence have lower uncertainty than the other confidence levels (i.e. medium and low).
- Water bodies classified with two BQEs or more are likely to more reliably reflect impacts of the major pressures (e.g. diffuse pollution and hydromorphological alterations) than water bodies classified with only one BQE or only supporting QEs.
- Water bodies belonging to the same broad type are likely to be more comparable than water bodies belonging to different broad types.
- The confidence in the classification is higher for monitored than non-monitored water bodies.
- MSs with a representative monitoring in terms of reflecting the status class distribution also for the non-monitored water bodies are more comparable than MSs with monitoring mainly water bodies in less than good status or mainly in good or better status.
- MSs using Phys-chem QEs are more comparable if their Phys-Chem standards support good status (are in line with the good-moderate boundaries) for the sensitive BQEs than if their standards are too high to support good BQE status.
- MSs using HyMo QEs are more comparable if these are applied in the same way concerning QE classification and downgrading to moderate status.
- BQE-status is more comparable than supporting QE-status, since the BQEs are intercalibrated (EC, 2018).
- BQE status change is more comparable between MSs than overall ecological status change for the same water bodies due to the large variability among MSs in combination methods from BQEs to overall ecological status (using supporting QEs or not, using the OOAO or not).

Table 5 Ranking of different comparisons of overall ecological status and QE-status between MSs and RBMPs according to confidence (1 is best)

Main topic	Current status and status change
Overall ecological status	1. WBs classified with high confidence and at least two BQEs based on representative monitoring (aggregated to broad types for EU-level) 2. WBs classified with medium confidence and at least one BQE based on representative monitoring (aggregated to broad types for EU-level) 3. WBs classified with the same combination rules (OOAO, downgrading with supporting QEs, or OOAO using only BQEs) 4. WBs classified with only supporting QEs 5. WBs classified with low confidence and without QEs
QE-status	1. BQE-status for monitored WBs aggregated to broad types for BQEs with few unknowns* 2. BQE-status for all (monitored and non-monitored) WBs aggregated to broad types for BQEs with few unknowns 3. BQE-status for all WBs regardless of proportion of unknowns 4. Physchem QE-status for QEs with few unknowns only for MSs with standards supporting good BQE-status 5. HyMo QE-status only for MSs classifying as HyMo QEs as High, Good or Moderate 6. QE-status for monitored WBs with different types 7. QE-status for all WBs with different types

*EQR-trends from SoE data can be used to show change in BQE-status between and within status class for consistent time series and more aggregated for geographic regions or broad types if representativity improves.

There are limitations in the comparability between countries and RBMP cycles due to differences and changes in monitoring and classification methods listed in Chapter 10.1. Single BQE status therefore seems better suited to compare between countries and to show progress between RBMP cycles. The qualitatively best comparisons of ecological status that can be done between countries and RBMP cycles would be the status for single BQEs in comparable types of monitored water bodies, as the good ecological status class boundaries have been intercalibrated for comparable water-body types. However, the advantage in using overall ecological status in spite of all the comparability problems presented in this report is that it covers almost all the water bodies. Therefore, the use of the overall ecological status versus using the BQE status for comparisons represents a trade-off for consideration by EEA when planning the assessment of the next RBMPs. If the monitoring improves and combination rules become more harmonised in the 3rd cycle, this will also strengthen the confidence in overall ecological status.

10.3 Way forward

Points for considerations by EEA in the short term are:

- Balancing comparability on the one hand (using BQEs in monitored water bodies as the best option) and geographical representativity on the other hand (using overall ecological status).
- Focusing on changes between the 2nd and the 3rd RBMPs, due to more complete reporting and development of classification systems in those cycles than in the 1st RBMP cycle.
- Comparing status for monitored (high confidence) versus non-monitored (low confidence) water bodies (with regard to overall ecological and QE-status).
- In order to better link status and pressures, the status for single BQEs and supporting QEs can be compared in water bodies having similar significant pressures. Examples can be e.g. phytoplankton, phytobenthos, phosphorus conditions and nitrogen conditions in water bodies with significant pressures from diffuse pollution from agriculture, or fish and HyMo QEs in water bodies with significant HyMo pressures.

We also suggest more long-terms actions towards further harmonisation of methodologies in the MSs to improve the comparability of ecological status in the coming RBMP cycles. Discussions with the countries are encouraged for the action points below, which can be further considered and elaborated by the relevant WFD-CIS working groups (ECOSTAT and WG-DIS subgroup on indicators and/or possible new subgroup on comparability) over the coming years:

- Harmonisation of the combination rules for biological and supporting QEs, including criteria for excluding BQEs due to uncertainty. Compilation of best practice examples of the application of the one-out-all-out-principle.
- Using more BQEs in a larger proportion of water bodies to capture impacts of different pressures.
- Adjusting the standards for the physico-chemical elements to levels that are compatible with good status for the relevant BQEs. This can be encouraged by ECOSTAT through the existing and forthcoming best practice guide combined with training workshops.
- Comparing and validating the class boundaries for the hydromorphological QEs to improve the link to the relevant BQEs and agree on how to use them (only HG or also M, downgrading or not) (ECOSTAT, HyMo Activity).
- Working towards harmonisation of the design of monitoring programmes to make them more representative in terms of status classes for all water bodies, types of water bodies, different pressures and geographical distribution.
- A survey of the methods used for extrapolation from monitored to non-monitored water bodies is also encouraged. MSs replies can be used to draft a best practice guide, including modelling.
- The use of modelling for classification has now been identified as a separate approach in the WFD reporting guidance (already implemented by the WG-DIS for the 3rd RBMP reporting). However, modelling as a term may not be very informative as a basis for comparing confidence in classification, as that depends on the type and quality of the models used. So further information may be needed on these aspects.

11 References

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Annex 1 Physico-chemical standards

The standards (GM boundaries) reported for the different physico-chemical QEs are given in Figure A.1.1 for rivers and lakes. The figure also shows many gaps in the standards reported. Ecostat is currently having a dialogue with the countries asking them to check and correct possible reporting mistakes and fill in some of the gaps for PhysChem QEs where standards exist in the national guidelines but were not reported.

Figure A1.1: Standards for rivers (left) and lakes (right) reported by different countries to WISE (from Lyche Solheim and Thrane 2019)

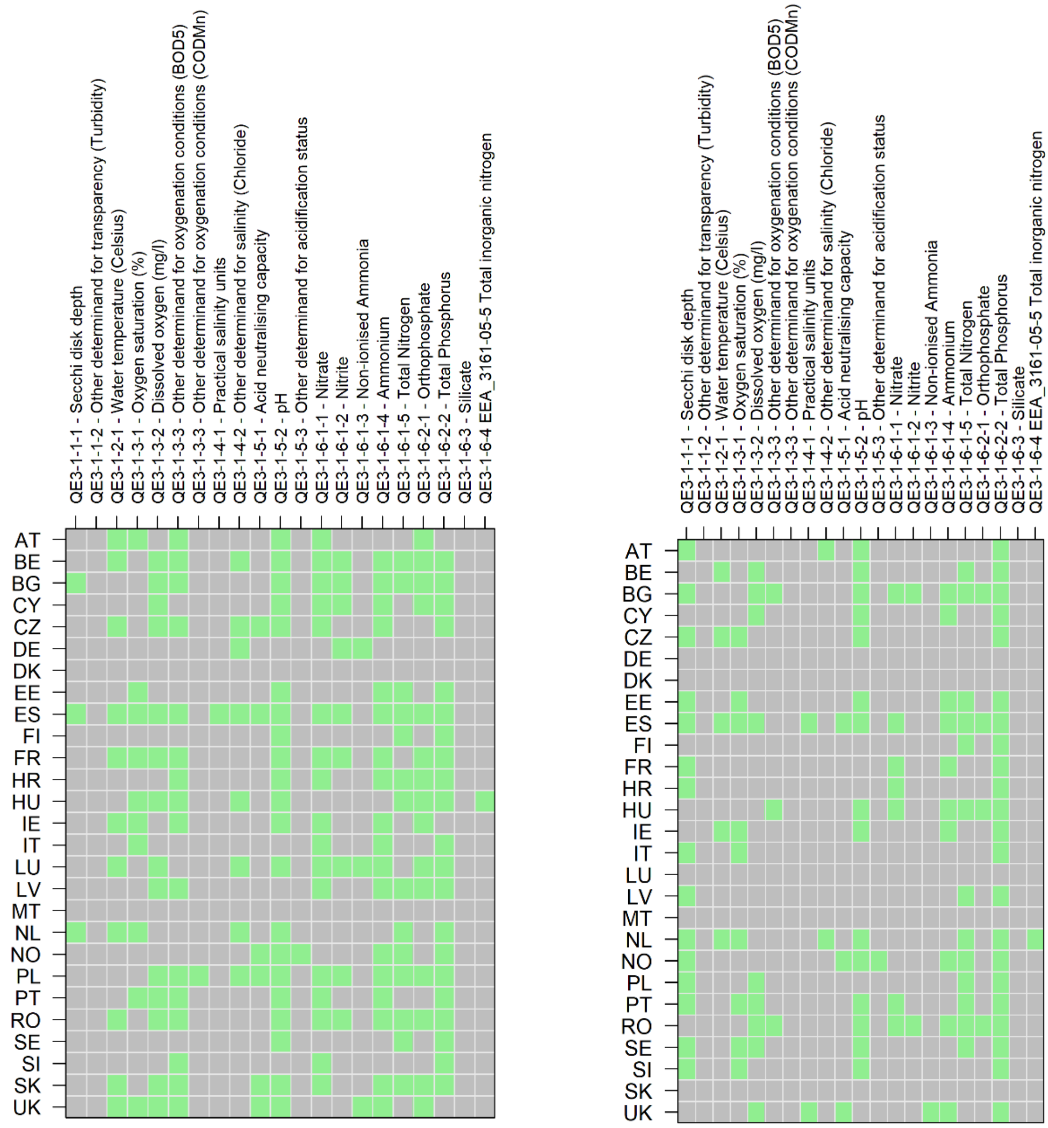


Table A.1 Broad types of rivers and lakes (Lyche Solheim et al. 2019)

R-01	Very large rivers
R-02 **R-03** **R-04** **R-05** **R-06a** **R-06b** **R-07**	Lowland, siliceous, medium-large Lowland, siliceous, very small-small Lowland, calcareous or mixed, medium-large Lowland, calcareous or mixed, very small-small Lowland, organic and siliceous, very small-small Lowland, organic and siliceous, medium-large Lowland, organic and calcareous/mixed
R-08 **R-09** **R-10** **R-11** **R-12a** **R-12b** **R-13**	Mid-altitude, siliceous, medium-large Mid-altitude, siliceous, very small-small Mid-altitude, calcareous or mixed, medium-large Mid-altitude, calcareous or mixed, very small-small Mid-altitude, organic and siliceous, very small-small Mid-altitude, organic and siliceous, medium-large Mid-altitude, organic and calcareous/mixed
R-14 **R-15** **R-16**	Highland (all Europe), siliceous, incl. organic (humic) Highland (all Europe), calcareous/mixed Glacial rivers (all Europe)
R-17 **R-18** **R-19** **R-20**	Mediterranean, lowland, medium-large, perennial Mediterranean, mid altitude, medium-large, perennial Mediterranean, very small-small, perennial Mediterranean, temporary/intermittent streams

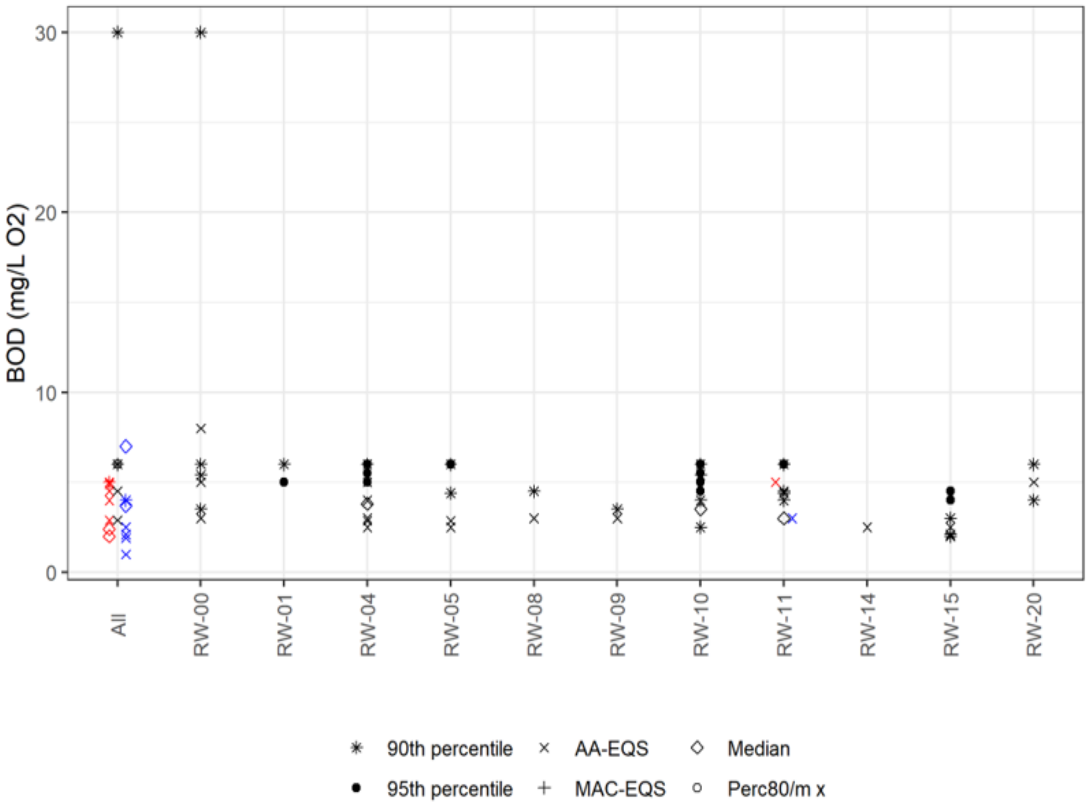
L-01	Very large lakes, shallow or deep and stratified (all Europe)
L-02 **L-03** **L-04** **L-05** **L-06**	Lowland, siliceous Lowland, calcareous/mixed, stratified Lowland, calcareous/mixed, very shallow/unstratified Lowland organic (humic) and siliceous Lowland organic (humic) and calcareous/mixed
L-07 **L-08** **L-09** **L-10**	Mid-altitude, siliceous Mid-altitude, calcareous/mixed Mid-altitude, organic (humic) and siliceous Mid-altitude, organic (humic) and calcareous/mixed
L-11 **L-12**	Highland, siliceous (all Europe), incl. organic (humic) Highland, calcareous/mixed (all Europe), incl. organic (humic)
L-13 **L-14** **L-15**	Mediterranean, small-large, siliceous Mediterranean, small-large, calcareous/mixed Mediterranean, very small

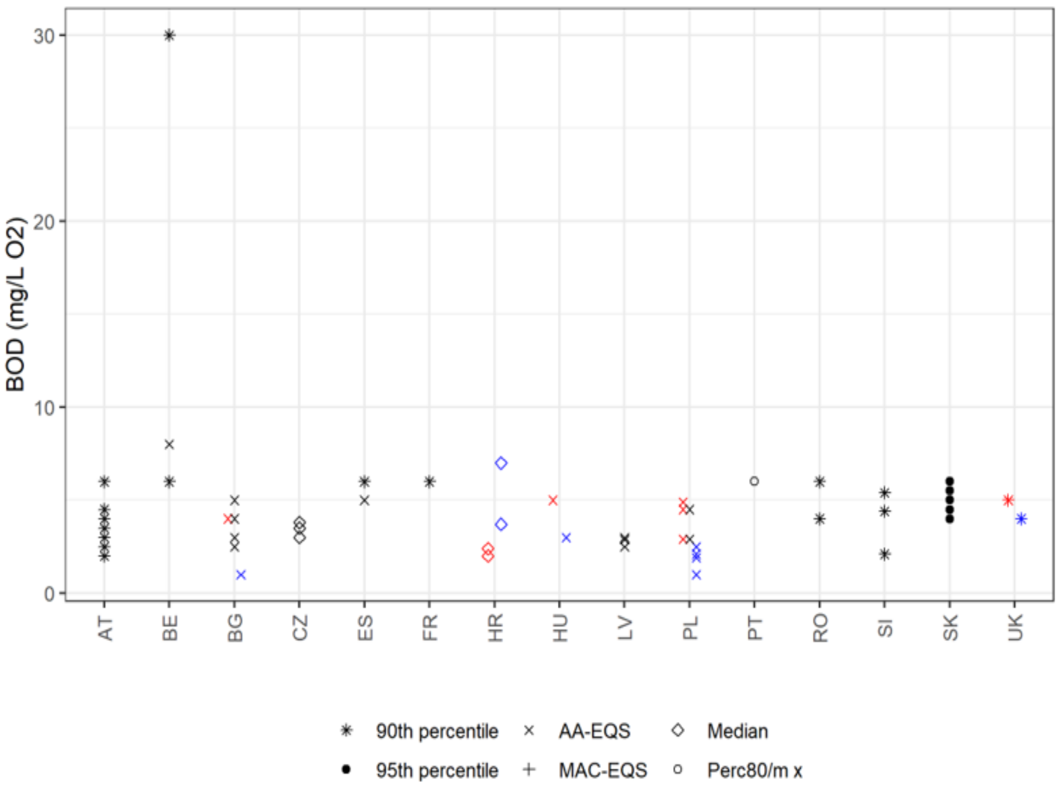
Figures A.1.2 and A.1.3 (Kelly et al. 2019) illustrate comparability issues for the reported standards that are due to the use of different statistical expressions (AA-EQS, MAC-EQS, high and low percentiles, seasonal means, medians etc.), and to different units, although the latter can mostly be eliminated after recalculation to similar units (mol to mg, µg to mg, NO_3 to NO_3-N, etc.). However, it is not always clear whether the unit is correct or correctly interpreted before the recalculation is done.

The often very wide range of standards spanning several orders of magnitude (Figures A1.2 and A.1.3) suggests that some of the standards may not support good ecological status for the relevant BQEs. This is particularly problematic for the very high standards reported by several countries for determinands increasing with human pressure, e.g. nutrients and BOD, as well as for some very low standards reported for other determinands decreasing with human pressures, e.g. Secchi depth, oxygen and pH. Although 80 % of all the standards are reported to support good status for the biology (EC 2019), this could certainly be a matter of further discussion with the countries according to the ECOSTAT workplan for 2020.

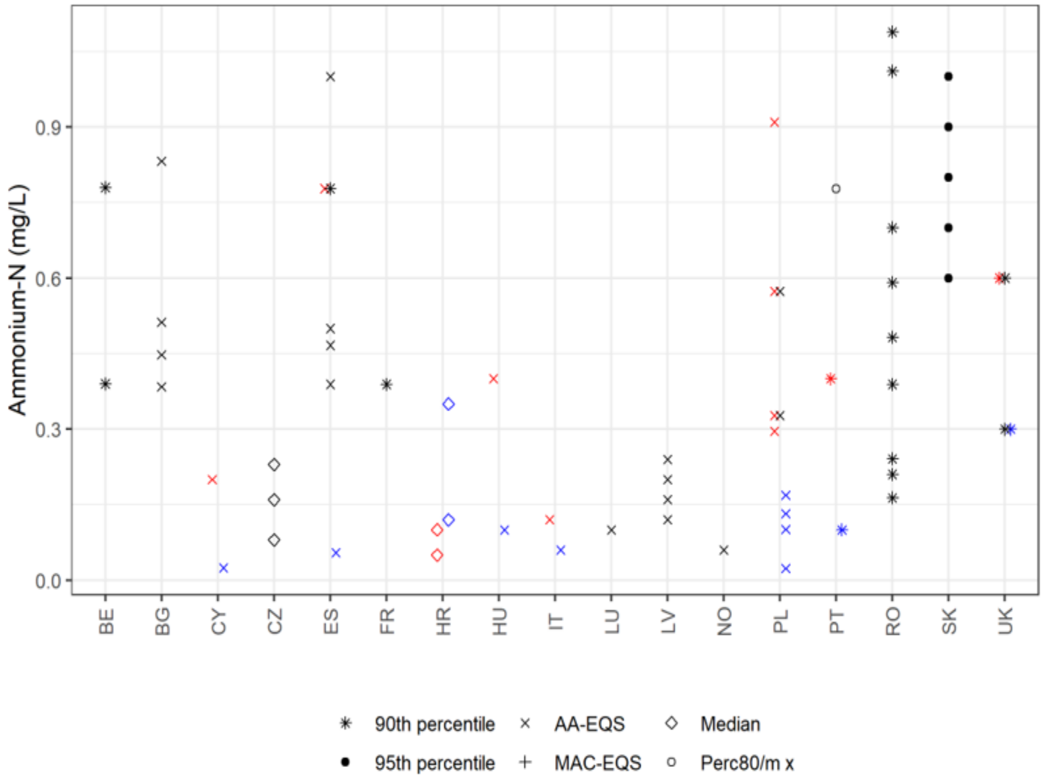
Figure A1.2: Standards reported for rivers by countries and aggregated to broad types. "All" (left column) are standards reported for "All" types. "RW-00" are standards reported for national types that do not match any broad type (from Kelly et al. 2019).

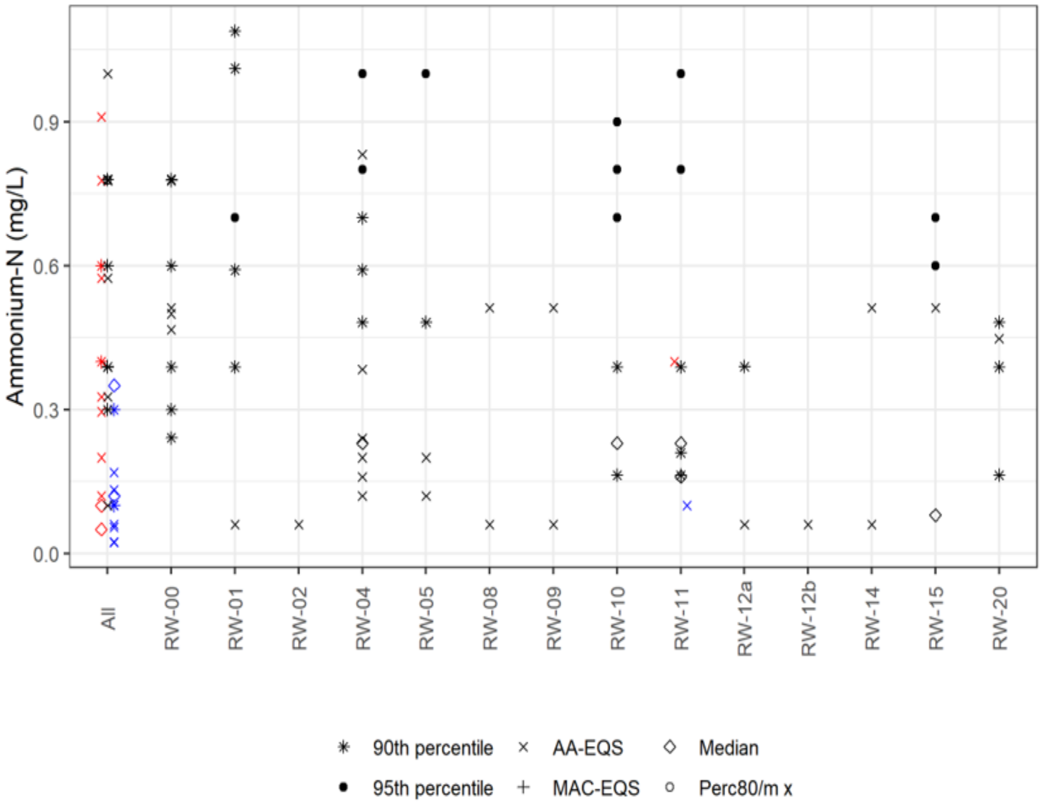
A) BOD



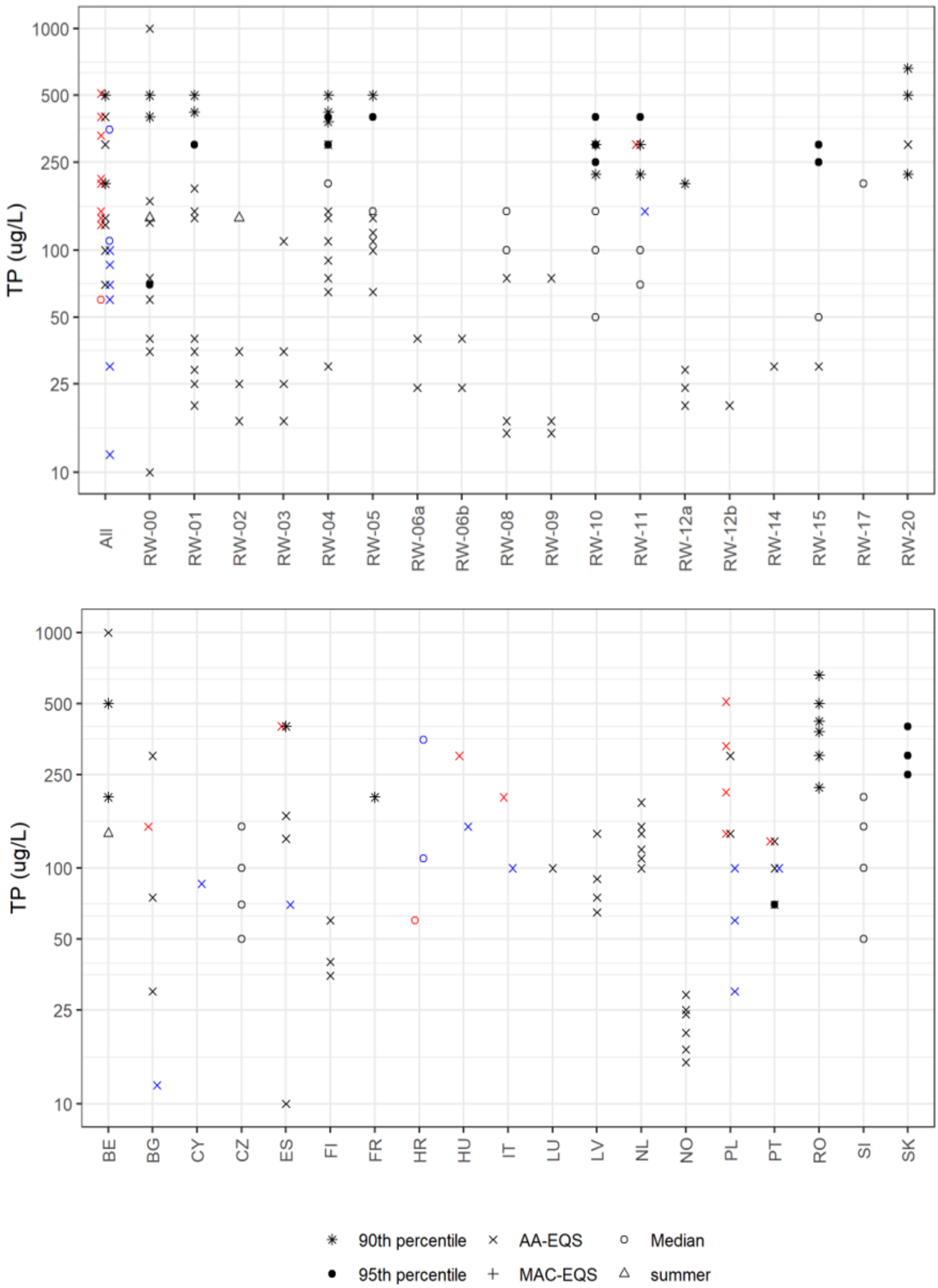


B) Ammonium

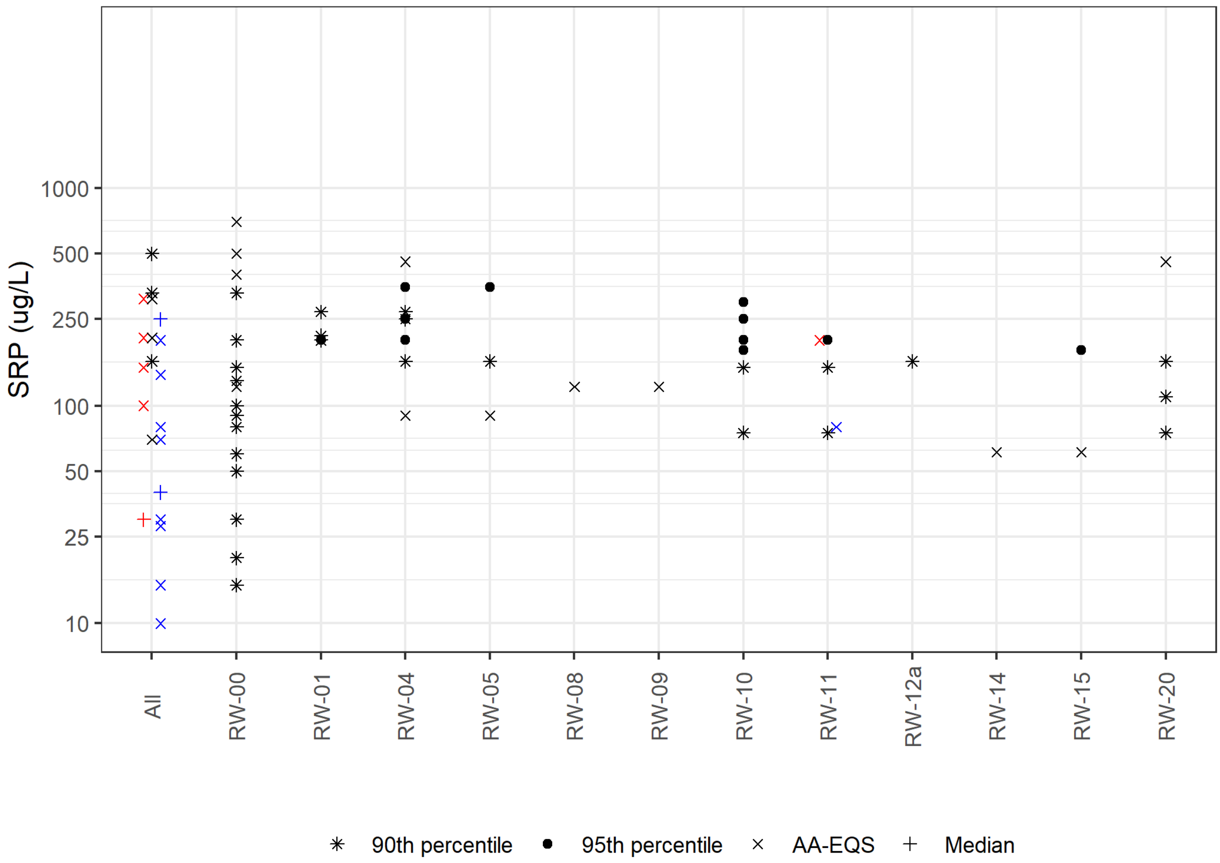

Ammonium-N (mg/L)
0.0
0.3
0.6
0.9
BE
BG
CY
CZ
ES
FR
HR
HU
IT
LU
LV
NO
PL
PT
RO
SK
UK
90th percentile
AA-EQS
Median
95th percentile
MAC-EQS
Perc80/m x

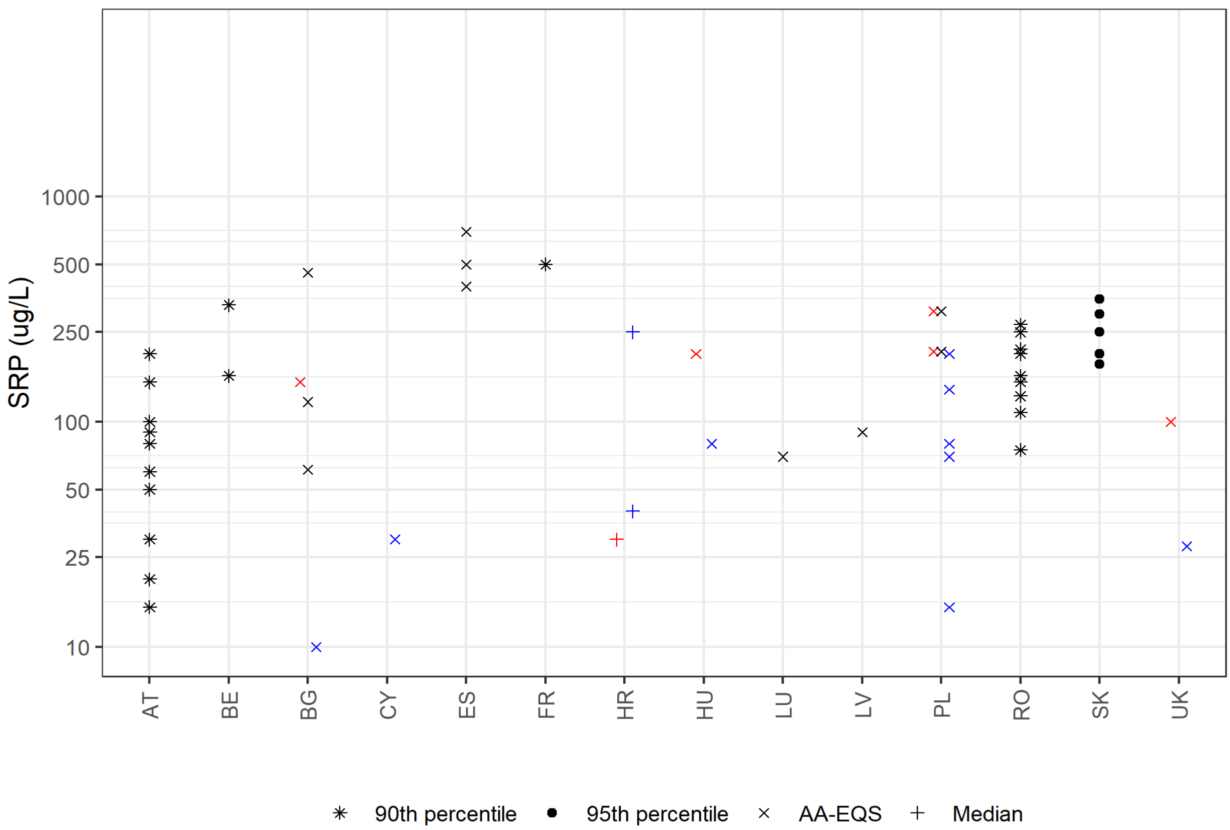

Ammonium-N (mg/L)
0.0
0.3
0.6
0.9
All
RW-00
RW-01
RW-02
RW-04
RW-05
RW-08
RW-09
RW-10
RW-11
RW-12a
RW-12b
RW-14
RW-15
RW-20
90th percentile
AA-EQS
Median
95th percentile
MAC-EQS
Perc80/m x

C) Total phosphorus

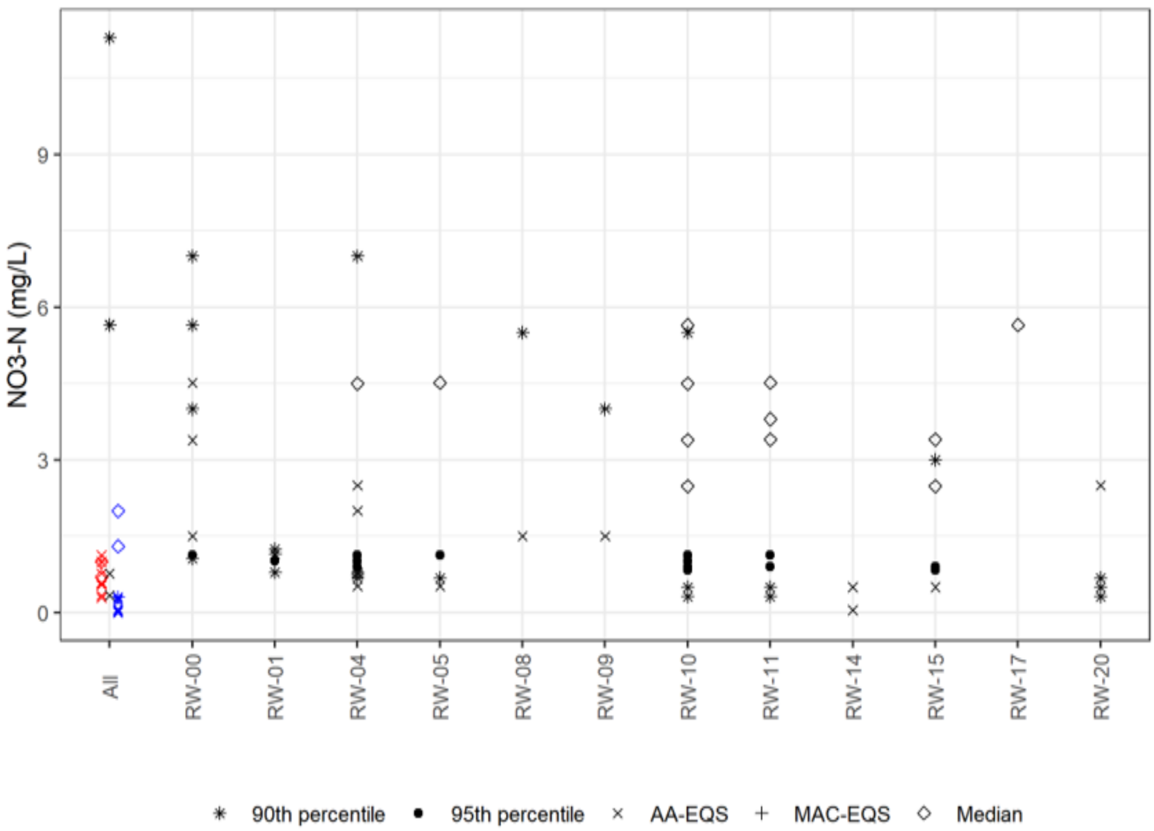


D) Orthophosphate

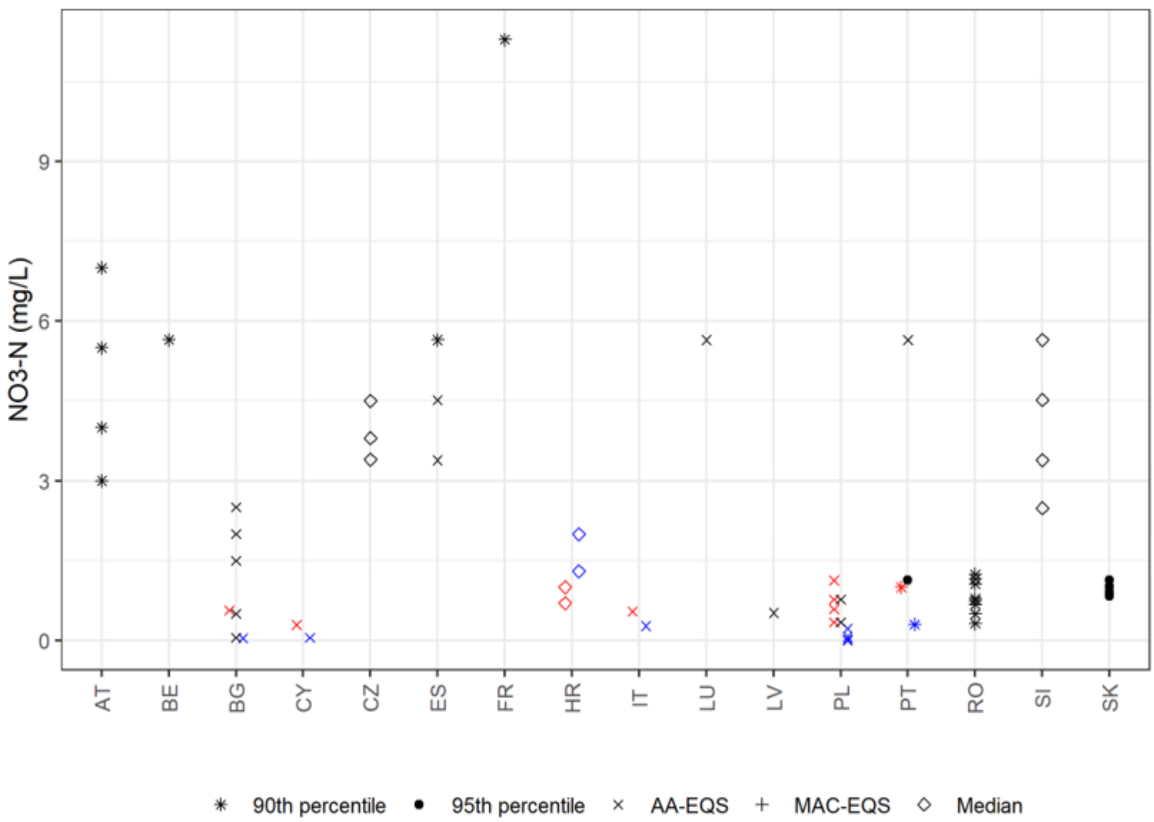




E) Nitrate



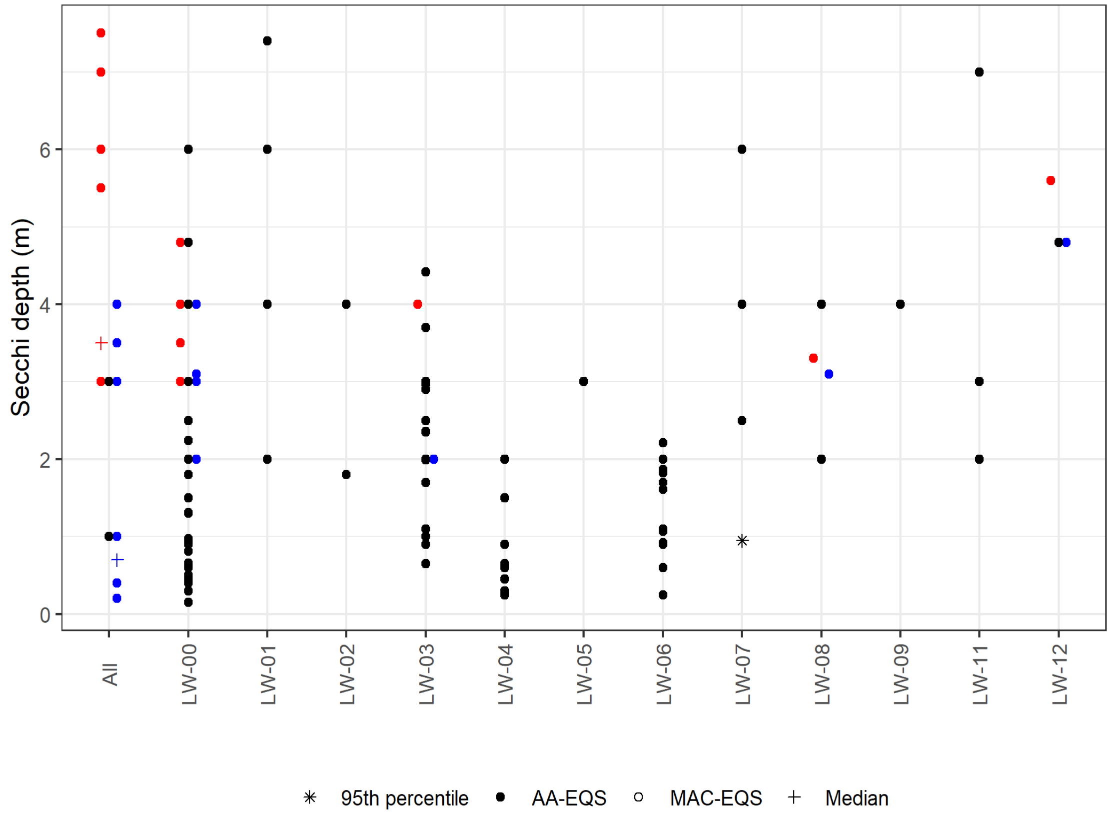
NO3-N (mg/L)
0
3
6
9
All
RW-00
RW-01
RW-04
RW-05
RW-08
RW-09
RW-10
RW-11
RW-14
RW-15
RW-17
RW-20
90th percentile
95th percentile
AA-EQS
MAC-EQS
Median

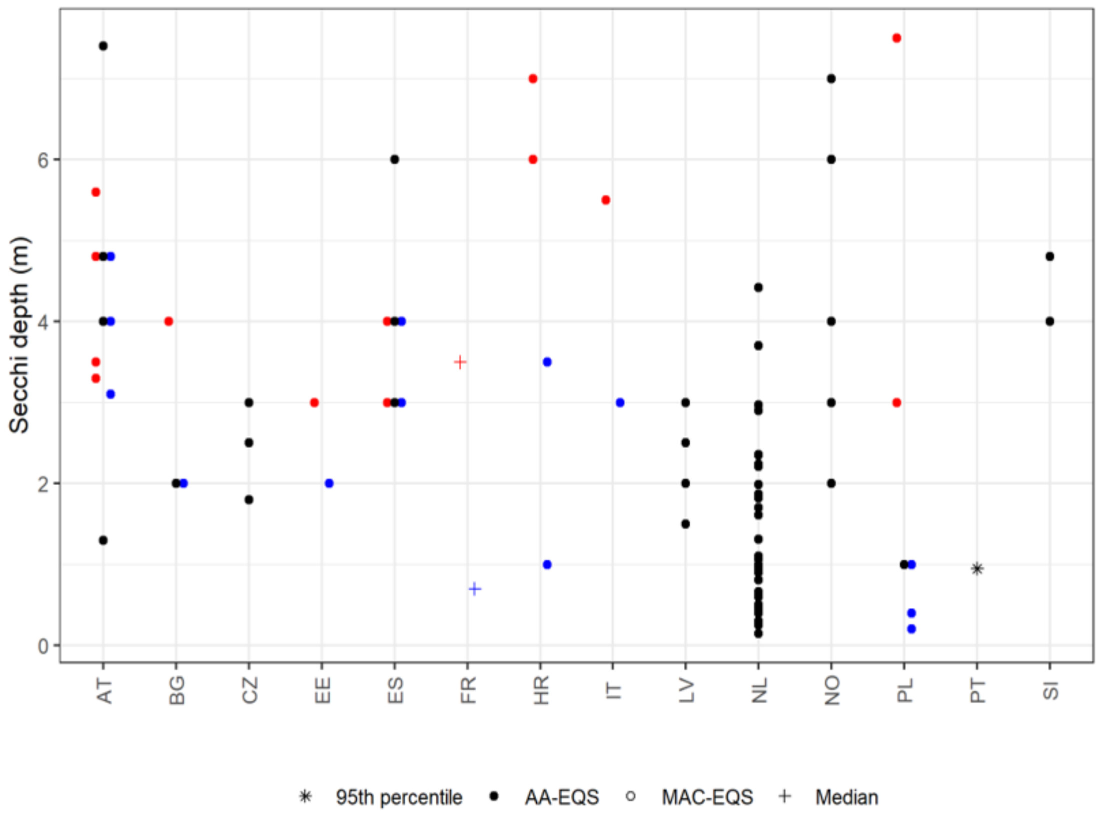


NO3-N (mg/L)
0
3
6
9
AT
BE
BG
CY
CZ
ES
FR
HR
IT
LU
LV
PL
PT
RO
SI
SK
90th percentile
95th percentile
AA-EQS
MAC-EQS
Median

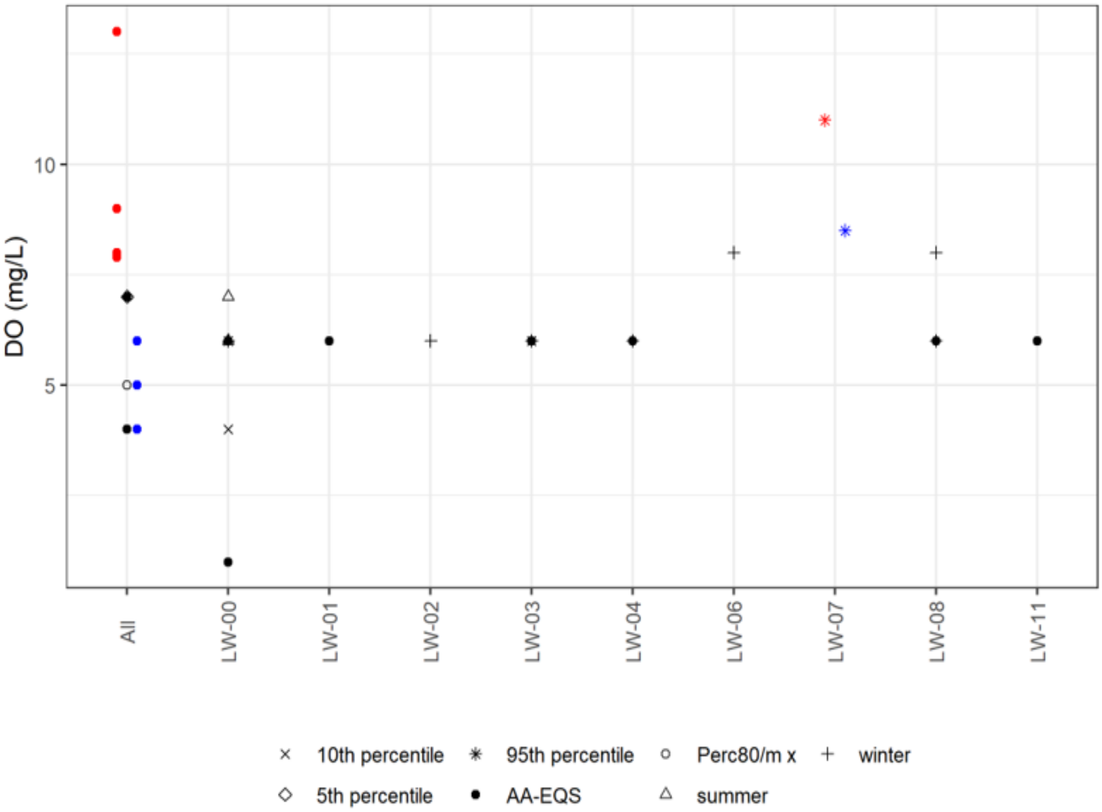
Figure A1.3. Standards reported for lakes and aggregated to broad types. "All" (left column) are standards reported for "All" types. "LW-00" are standards reported for national types that do not match any broad type (from Kelly et al. 2019).

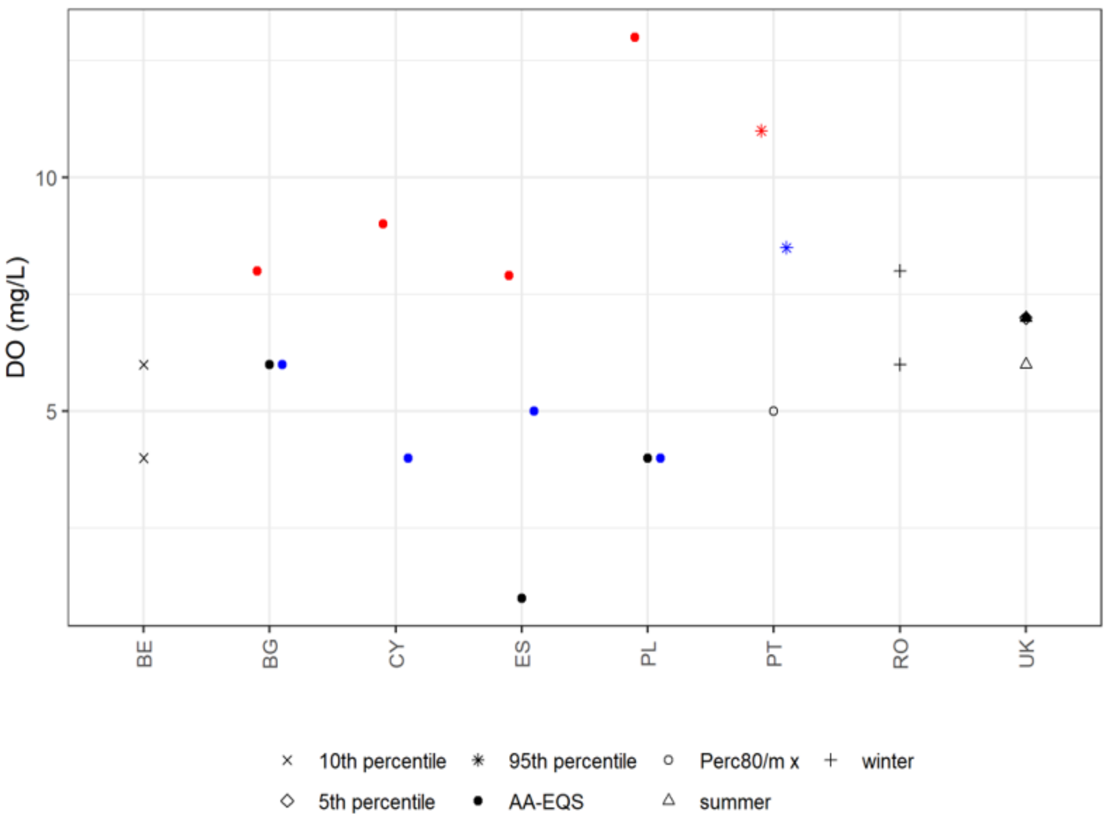
A) Secchi depth



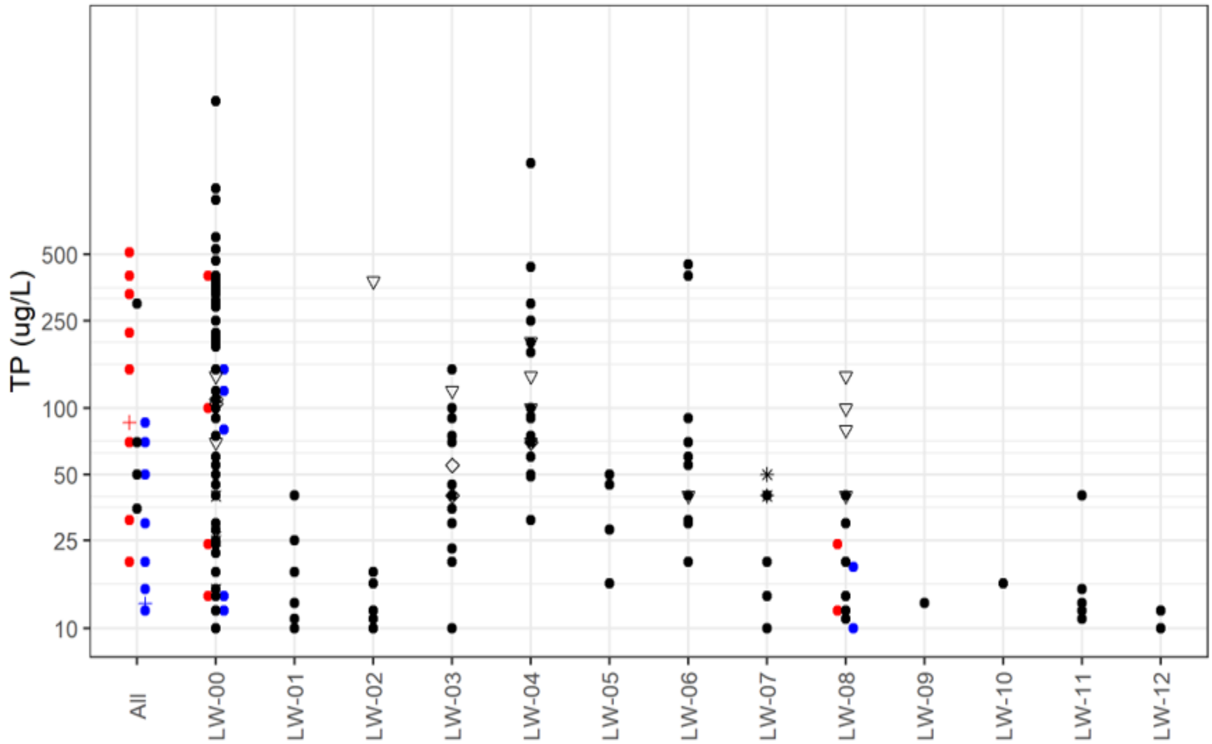


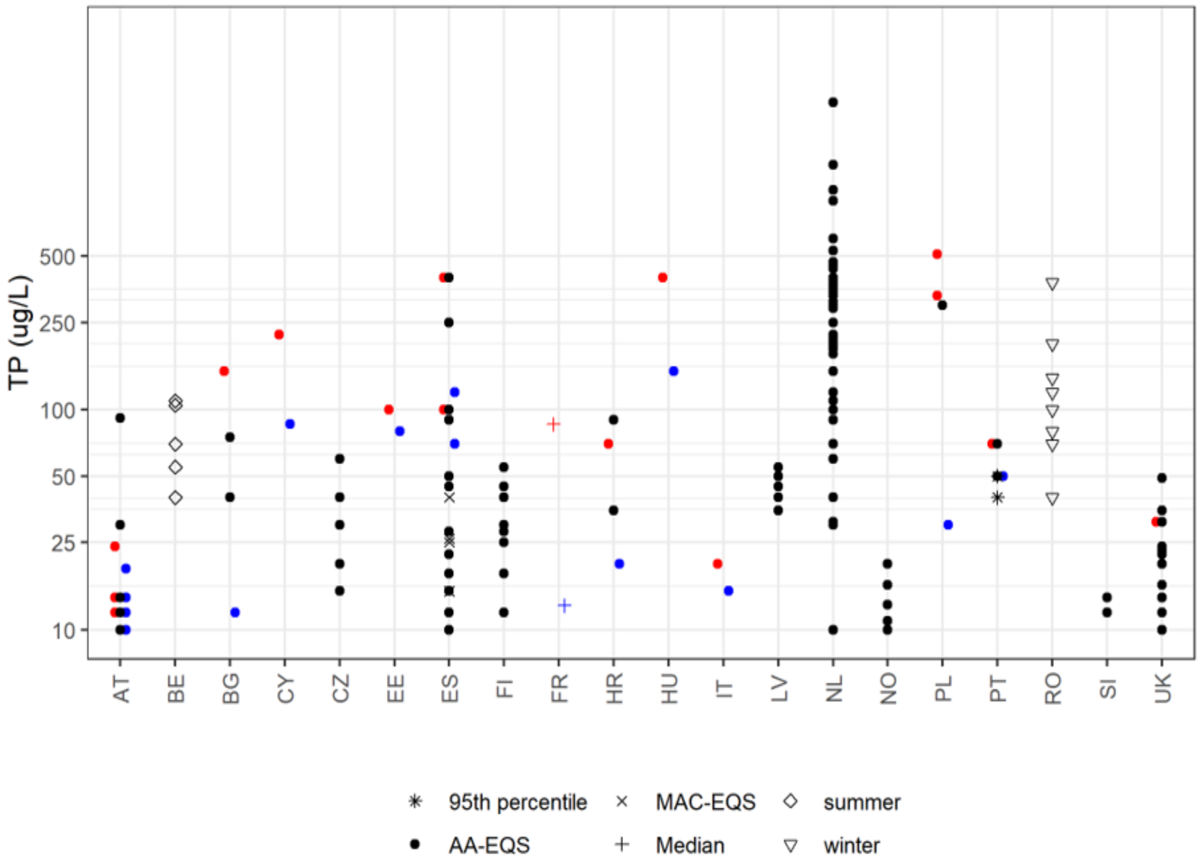
B) Dissolved oxygen in lakes (6 mg/L is the standard for the Freshwater Fish Directive).





C) Total phosphorus in lakes





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