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Physico-chemical supporting elements: transitional and coastal waters:

a review of national standards to support good ecological status

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Contents

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Abstract

The task group on supporting physico-chemical elements has reviewed information reported by Member States to WISE on the standards for general physico-chemical quality elements, including nutrients. A wide range of supporting physico-chemical elements are used by Member States. This report provides a general introduction and then focusses on those elements that are ecologically most relevant for transitional and coastal waters and which are used by enough Member States to make realistic comparisons. These are:

- Transitional waters: Transparency, dissolved oxygen, total phosphorus, orthophosphate-P, total nitrogen, nitrate-N, total inorganic nitrogen;
- Coastal waters: Transparency, dissolved oxygen, total phosphorus, orthophosphate-P, total nitrogen, nitrate-N, total inorganic nitrogen.

Systematic variation between both types and countries is apparent for several of these, although comparisons are complicated by differences in the ways that data have been reported.

1 Introduction

1.1 Objectives.

If countries are to achieve good ecological status for all water bodies, then it is necessary to set thresholds for pressures that are consistent with this ambition. ECOSTAT recognized that nutrients were a key pressure across all water body types, noting that there was considerable variation in threshold values between countries but also between water body types within countries. It was also acknowledged that considerable uncertainty remained in estimates of threshold concentrations that needed to be considered when applying these thresholds to river basin management. The outcome of this work was the JRC Science for Policy report "Best practice in setting nutrient concentrations to support good ecological status" (Phillips et al., 2019) and a statistical toolkit to help countries review and revise their nutrient thresholds.

However, nutrients are not the only supporting physico-chemical quality elements (hereafter "supporting elements") likely to impede achievement of good ecological status and ECOSTAT's work programme has now been extended to other water quality variables. The key questions addressed in this report is to what extend standards reported by countries are likely to support good ecological status and whether or not there is potential for ECOSTAT members to work together to produce ecologically-meaningful standards when existing standards are unlikely to support good status. This, in turn, will generate further discussion on the use and relevance of supporting elements in the classification of ecological status, as well as on the use of these standards as a basis for deriving management targets to improve water quality and ecological status. As for the work on nutrients, the purpose of this work is not to impose a uniform approach on countries but, rather, to support them in the difficult task of achieving good ecological status across Europe's many and diverse water bodies. In brief, if a supporting element standard is not compatible with good status, then a large amount of effort and investment may be expended with little benefit to ecosystems. If, on the other hand, there are cases where supporting elements – nutrients or otherwise - are inhibiting the achievement of good status then setting appropriate thresholds should contribute to the long-term sustainability of Europe's water resources.

Standards for many supporting elements are reported to WISE; however, this report focusses only on those that are widely used and where there is good evidence of direct or indirect relationships with BQEs and ecosystem services. We have assumed that all national standards reported to WISE are used as part of formal assessments of ecological status but the manner in which each is used is beyond the scope of this report. Where there is a direct relationship with a BQE, then it may be possible to adapt approaches advocated in the statistical toolkit to review or revise existing standards. In some cases (e.g. oxygen conditions), there may be an indirect (and therefore weaker) relationship with the BQE, yet this indicates important secondary effects and may also increase in significance as global warming raises water temperatures. These and other supporting elements, such as transparency, may complement information on nutrients and thereby contribute to the decision-making process. It is also important to note that Member states apply different combination rules to supporting elements (e.g. average, worst case or more complex scoring systems, use of reference conditions and not quality standards, combination with impact on Biological Quality elements). The combination rule is very important, and will need further attention to when making detailed comparisons between Member states, as similar threshold values may give different classification depending on the combination rule applied.

It is also possible that standards currently in force around Europe are not tailored to the needs of the WFD but, rather, are historic standards set to fulfil requirements of earlier directives. In particular, we note that many countries use a standard of 6 mg L^{-1} dissolved oxygen, which is a value specified in the Freshwater Fish Directive (78/659/EEC) for salmonid waters. This standard despite derived from physiological considerations on the needs of some taxonomic groups, may not necessarily protect all organisms or life stages and might deserve further attention (but see discussion in section 4.2.1). A similar situation occurs for nitrates in freshwaters, where many countries use values derived from the Nitrates Directive (91/676/EEC). In such cases there is a need to revisit these standards with the particular requirements of the WFD in mind to ensure that they are also compatible with good ecological status.

1.2 Approach

The source data for this work were provided by Peter Kristensen (EEA) and were those used to produce a summary report (ETC ICM, 2019), which was presented to ECOSTAT in spring 2019. Following this, ECOSTAT representatives were invited to check the entries for their country and the revised database, incorporating these revisions, is the basis for the present report. As this work was started before the UK left the EU, their data has also been included. For transitional and coastal waters, in this present report, we have also considered salinity. However, it was not treated as an additional physico-chemical Quality Element on its own, with associated thresholds as in rivers, but rather as a factor often used by countries, particularly in transitional and some coastal waters, to adjust their QE boundaries reflecting the influence of this relevant natural gradient.

The data consisted of lists of physico-chemical quality element (PCQE) determinants with the values used for different national types for each water category, together with information on the units and summary metrics used. The data provided had been edited to harmonise the different formats used during reporting. However, further editing was necessary to convert text to numbers and enable a consistent approach to standardization of units, quality element names (see ETC/ITC, 2019) and national and intercalibration type codes.

In addition, some EU Member States may have set additional standards for physico-chemical supporting elements and not reported those elements to WISE; while these were not considered in the classification of ecological status as long as the biological quality elements are still classified to be in moderate or worse status. Nonetheless, where these standards were relevant and made available by MS (e.g. Secchi depth and Dissolved oxygen by Germany) they were also considered in this report.

1.2.1 Harmonisation of data

Standards are reported using a variety of units and to enable meaningful comparisons of standards we have harmonized to standard units wherever possible. This was carried out in two stages: initially a lookup table was used to make an initial conversion. For example, where a Member State reported units of mg P / L we converted this to µg P / L using a factor of 1000. The results of these conversions were checked for each different physico-chemical quality element using box plots arranged by country and this revealed further clear errors in the original reporting. Where these errors were obvious (e.g. a P standard of 20 mg/L is likely to be 20 µg/L, regardless of the units initially reported) further corrections were made. However, it was not always possible to make appropriate corrections and where this is the case, data were initially omitted but noted and the Member State concerned was given an opportunity to amend its data. Some results were reported as ranges; interpretation of these is discussed below.

This editing was carried out using R to provide an audit trail and avoid modifying the original source data.

1.2.2 Linking Trac data to intercalibration types

The data provided had already been matched to intercalibration (IC) type codes, but some corrections were made after comments from ECOSTAT representatives checking the entries for their country. The IC typology was often considered inadequate to support nutrient standard work due to strong within-type environmental differences (e.g. limiting nutrient; mixing conditions; residence time; salinity gradient; organic matter loading) that need to be reflected in the boundary setting process. To cope with this, some countries suggested splitting types into IC sub-types, while others removed the link to the IC type if this was considered inadequate for nutrient work. This has reduced considerably the number of comparable cases for obtaining an EU-wide overview of the consistency in standards between Member states using IC common typology.

In other cases, national type codes did not be match any common IC type. Where links to common types could not be established, they are shown in the plots in chapter 3 as “inapplicable” for both transitional and coastal waters. These links are summarised in Table 1.1.

Table 1.1 Number of national types per country with correspondence to a common intercalibration type (IC) in each water category.

	Coastal waters		Transitional waters	
Country	Match IC	No match	Match IC	No match
BE	1		3	
BG	1		1	
DE		9		4
EE	2	1		
ES		1		1
FI	6	3		
FR	6	6	6	6
GR	1			
HR	1		1	
IE	3		3	
IT			1	1
LT	2		2	2
LV	3			3
NL		1	1	
NO		1		
PL	2		1	2
PT	8	2	3	6
RO	1	1		1
SE	19	6		2
SI	1			
UK	10		10	

1.2.3 Values applied to "All" water types

Many standards were not linked to a specific national type, instead the entry for type was recorded as "All". These records were assumed to apply to all national types for that River Basin District (RBD). An "ALL" grouping category has been included, which can be used to assess which countries reported this approach and how the range of values compares to those in identified common IC type groups, where applicable.

1.2.4 Summarising data for presentation

The original data extracted from WISE was revised by ECOSTAT representatives of each country, with several changes reflecting either errors or misinterpretations from the original WISE database, but mostly changes updating boundary thresholds after country revised values since last official reporting.

In countries where national type specific boundary values existed, the same type specific boundary was replicated several times for each RBD. To avoid giving additional weight to these values only a single national type specific boundary value was used. Additionally, boundary values were not always the same for each national type, with some countries reporting different values for the same PCQE for different RBDs. As the number of national types also varied between countries, we show separate boundary values for all national types that fall within a given common IC type group. Similarly, where we present graphs showing the range of values within a common IC type, we present separate values for each national type that correspond to that IC type. Marine Region and Geographical Intercalibration Group (GIG) were also used to aggregate standards. Red and blue dots are used when a standard has upper and lower thresholds rather than a single value.

We have then calculated the median, 75th and 90th percentiles for all standards included in the comparison and plotted these values on the graphs to give a quick visual insight into how individual national standards compare to an EU-wide consensus. We would expect national standards that use mean values of the SE to cluster around the median whilst those based on higher quantiles should lie closer to the 75th and 90th percentile lines. Graphs show these results aggregated by both Member State and IC Type (although percentiles are only included where more than two Member States have contributed standards to the same IC Type) but these need to be interpreted with care. In some cases, a common IC type encompasses a wide range of national water body types and national decision-making processes use standards in different ways (see 1.1). It is, therefore, possible that a national standard that falls above the median value for a type does protect good ecological status in that territory whereas one that appears, at face-value, to be more stringent is, in fact, not protecting good status. We recommend readers focus on the big picture: a Member State that has national standards that are consistently more lenient than those of countries around them should regard this report as an opportunity to ask questions to ensure that its standards are sufficiently protective.

The relationship between these summary statistics (median, 75th and 90th percentiles) and concentrations at locations where the biota is at good or better status cannot yet be presented for transitional and coastal waters. This will however be done for phytoplankton, the BQE with the most data available in the EEA database so far for TRaC waters.

We have also included an analysis of variance to indicate the strength of the differences (country and typology) between supporting element good/moderate boundary concentrations. This is a type III analysis of variance, recommended for unbalanced designs (Fox et al., 2020) with “country” and sometimes “IC type” or “GIG” included as treatments. It was implemented using the “car” library within R.

2 Overview of reported physico-chemical quality elements and metrics

2.1 Which physico-chemical quality elements are used?

The other supporting elements used by the different countries for the different water categories are given in Table 2.1 and Table 2.2, based on revised data reported by countries to WISE with the 2nd RBMPs.

The principle used to select the most commonly used supporting elements for further analyses in this report was: those that are used by at least four countries and which are also most ecologically relevant (Figure 2.1). Based on these principles the supporting elements included in this report are: **Transitional waters:** Transparency, O_2, TP, PO_4-P, TN, NO_3-N, TIN; **Coastal waters:** Transparency, O_2, TP, PO_4-P, TN, NO_3-N, TIN.

Table 2.2 General physico-chemical quality elements reported to WISE and revised by countries, summarised by number of countries per water category. Quality elements selected for further analysis are highlighted. Data includes all EU MSs and Norway (n=21), except for DK, CY and MT, as their boundaries data were still not available

QE code	QE name	Parameter specifications	TW	CW
QE3-1-1-1	Secchi disk depth	Secchi disk depth	6	11
QE3-1-1-2	Other determinand for transparency	Turbidity		2
QE3-1-2-1	Water temperature (Celsius)	Temperature	1	2
QE3-1-3-1	Oxygen saturation (%)	% oxygen saturation	5	7
QE3-1-3-2	Dissolved oxygen (mg/l)	Dissolved oxygen	6	7
QE3-1-3-3	Other determinand for oxygen conditions	BOD5	1	
QE3-1-3-3	Other determinand for oxygen conditions	Total organic carbon (TOC)	1	1
QE3-1-5-2	pH	pH	1	
QE3-1-6-1-1	Nitrate	Nitrate as N	7	9
QE3-1-6-1-2	Nitrite	Nitrite as N	2	2
QE3-1-6-1-4	Ammonium	Ammonium N	2	2
QE3-1-6-1-5	Total Nitrogen	TN	9	7
QE3-1-6-2-1	Orthophosphate	Orthophosphate	11	12
QE3-1-6-2-2	Total Phosphorous	TP	10	12
QE3-1-6-4	Total Inorganic Nitrogen	TIN, DIN	9	10
QE3-1-6-4	Other determinand for nutrient conditions	NTK	1	1
QE3-1-6-4	Other determinand for nutrient conditions	Ratio N/P; ICO (Sediment organic quality index ICO=NTK+PT+COT); TRIX; FAN (Indice Fosfatos-Amonio-Nitritos); PCQI (Physico-Chemical Quality Index)	3	2
	Total hydrocarbons in surface (mg/L)	THC		1

TW	Secchi disk depth	% oxygen saturation	Dissolved oxygen	Nitrate as N	Total Inorganic N	TN	Orthophosphate	TP
BE			2	1	2	1	3	1
BG	4		4	4		4	4	4
DE					2	2		2
ES				2		3	2	3
FR			4		11	4	4	4
HR	1	3			4		2	2
IE		6					6	
IT			1		2		1	
LT						8		8
LV	3			3			3	
NL		1				1		
PL	5	5	5	5	5	5	5	5
PT	1			33			32	1
RO	2	2		2	1			1
SE					2	4	2	4
UK			29		57			
CW								
BE			1		1		1	
BG	9		9	36			36	
DE	18		8		5	11		11
EE	6			6		6	6	6
ES		4		18			19	6
FI	22					22		22
FR			7		5			
GR				1		1	1	1
HR	1	2			2		1	1
IE		3			3			
LT	2					2		2
LV	5			5			5	
NL		1			1			
NO	2	1	1	4		4	4	4
PL	4	4	4	4	4		4	4
PT	1			12			11	1
RO	2	2		2	2		2	2
SE					25	50	25	50
SI				1			1	1
UK			33		57			

Figure 2.1 Good/Moderate boundaries reported by different countries (except PT reporting reference values) for the supporting physico-chemical quality elements selected for transitional (top) and coastal (bottom) waters. Number of registers reported, not necessarily distinct boundaries

2.2 Metrics for most commonly used quality elements

The most commonly used means of aggregating data are annual averages (AA-EQS), seasonal averages or various high or low percentiles (Table 2.2).

Table 2.3 Overview of parameters and metrics. The number of countries using a particular parameter/metric combination in each water category is indicated. Metrics have been split into those that measure the central tendency (e.g. mean, median) and quantiles, including maximum and minimum

	Coastal waters					**Transitional waters**				
	Central tendency		Quantile		other	Central tendency		Quantile		other
PhysChem QE	annual	seasonal	annual	seasonal		annual	seasonal	annual	seasonal	
% oxygen saturation	2	1		1		2	1	1	1	
Dissolved oxygen	2	1	2	1		1		3	1	
BOD5								1		
TOC	1						1			
Temperature			1		1			1		
Secchi disk depth	2	2	1			2	1	1		
Turbidity	1		1							
pH						1				
Nitrate as N	2	4	2			1	1	2		
Nitrite as N	1					1				
TN	1	2				1	3		1	
Total Inorganic N	2	1	2		1	2	1	2	1	1
Ammonium N	1	2				1				
NTK	1							1		
Orthophosphate	3	4	2			2	1	1	1	
TP	3	2	1			2	3	2	1	
THC	1									
ICO	1									

More information on the actual seasons on which countries report can be consulted in more detail in Appendix 2 to this report, namely on Summary Table 9 (file: Appendix 2_TRACrevised_Summary.nb.html).

2.3 Challenges encountered whilst collating and comparing data

We recognize that countries are free to adopt their own approaches to implement the WFD and, as a result, this exercise has worked with the data that are supplied. Consistency in data collection within a country allows historical comparisons which may reveal trends in water quality and ecological status. However, this creates some challenges when attempting to compare national approaches.

Readers need to be aware of two principal challenges encountered whilst compiling this report. The first is where different assessment concepts were applied to the same supporting element and the second is ambiguity in data reporting. Most cases of the latter should have been picked up through our consultations with national experts; however, we encourage everyone to communicate any further changes that are needed in order to improve these outputs in the future.

2.3.1 Different assessment concepts

A good example of differences in assessment concept is the use of either concentration of dissolved oxygen or percent saturation as a measure. The two values are, in theory, interchangeable (if the temperature was recorded at the time that the measurement was made); however, this is rarely possible with the high-level aggregations of data used in this exercise. Both approaches are valid means of assessing the oxygenation state of water bodies but national standards can only be compared with others that use the same parameter.

We have not, at this stage, differentiated between standards set using samples collected from the top or bottom of the water column and those set using samples that integrate the entire water column; as not all countries have provided such details. Likewise, nor have we considered yet the salinity range at which samples were taken, an approach that is also responsible by a great deal of variation found among boundaries reported by the countries. Nonetheless, where salinity information was provided we have included it in the appendices to this report. These two aspects will need to be considered when making detailed comparisons of standards for individual variables.

Finally, a range of statistical summary metrics are used, including annual averages, seasonal averages, upper and lower percentiles (Table 2.2). There will be, in many cases, good reasons behind these choices, and the differing levels of precaution associated with particular approaches to aggregation may be reflected in the decision-making process.

2.3.2 Ambiguity with data reporting:

Many countries report ranges, which can mean different things:

- If reported for "All" types, the range can be for many national types (often spanning several IC types). There may, indeed, be no reason to expect variation between types for some supporting elements;
- If reported for one national type, the range can be site-specific limit values, for example in TW or in the Baltic Sea ranges often reflected variation related with strong natural gradients across water bodies (e.g. salinity). Whenever information was available, we analysed the reported standards accounting for such range variations to allow for meaningful comparisons;
- Some supporting elements (e.g. pH, oxygen) can have 'two-tailed' effects (e.g. both low and high values can impede good ecological status) and ranges may indicate the lower and upper thresholds. In TW and CW, ranges related with such two-tailed effects were mostly reported for oxygen, where a low value may directly influence ecological status whereas a high value indicates secondary effects. For these supporting elements we have attempted to split records into upper and lower standards to allow for more meaningful comparisons, although due to the original reporting format this was not always possible or had to be based on assumptions of whether a reported standard was a lower or upper threshold.

3 Boundary values for supporting elements within and between common types

This chapter presents a comparison of results for those quality elements (QEs) that are most commonly used and most ecologically important in transitional and coastal waters (chapter 2.1). We summarise the results for each, with further details given in the appendices. Where there were sufficient data, we also present analysis of variance tables to partition the variability of the reported standards between countries and water body IC types or geographical region, as deemed more adequate. For transitional and coastal waters, we have not included in this report a comparison of the reported standards with observed concentrations, which would show the range of mean concentration from water bodies categorised as Good or better and Moderate of worse quality overlain by quantiles summarising the range of the reported standards. Although this would not provide a reliable guide to the most appropriate standard they would still be a way of placing the current standards into context. This will be done in the near future, but boxplots illustrating this can be already consulted for freshwater categories in report (Kelly *et al.*, 2021).

3.1 Oxygen (both water categories)

Dissolved oxygen (DO) in waters are reported as either percentage saturation or as a concentration, which complicates the comparison of standards as it is not possible to convert between the two parameters without also having the temperature at the time of measurement. We thus compare standards for each parameter separately. Dissolved oxygen has "two tailed" effects, with low values indicating potential threats to fish and invertebrates, while high values indicate excess oxygen production from plant or algal growth. It could also be that the lower range values are standards for stratified water bodies while the upper range values are standards for non-stratified water bodies. Countries reported differences regarding depth zone sampling (surface, bottom, or mix waters), but this information was usually not available to further understand the reasons for standards presented as ranges. For this supporting element, where possible, we therefore compare upper and lower standards separately, and interpret good status to be at risk for values below the lower value and above the upper value, e.g. 80-120% oxygen saturation.

3.1.1 Oxygen (coastal waters)

For coastal waters, similar numbers of countries report DO using concentration (7) and percentage (7).

3.1.1.1 Dissolved oxygen concentration (coastal waters)

Data for Dissolved oxygen provided 63 records from 7 countries (Figure 3.1). Three countries use the annual mean ("AA-EQS") as a summary metric (Table 3.1); the seasonal quantile used by FR refers to Summer/Autumn. All countries (BE, BG, DE, FR, NO, PL, UK) use single values for each national type, with no country presenting standards as a range.

The data could be linked to 7 IC types (Figure 3.2 & Table 3.2). One of these (CW-NEA1/26) had type specific values from more than 2 countries allowing the range of standards in this type to be compared. Very few values are available to allow meaningful statistical comparison across grouping factor(s), so no analysis of variance was applied to test the significance of GIG, IC Type or other grouping factor effect on the boundaries reported.

The standards ranged from 3 mg/L (FR) to 8.9 mg/L (BG) with an interquartile range of 4 to 4.86 (Figure 3.2). Only the UK and NO reported adjusted salinity boundaries for this parameter, along with the respective salinity values.

More information in Annex A1.1.

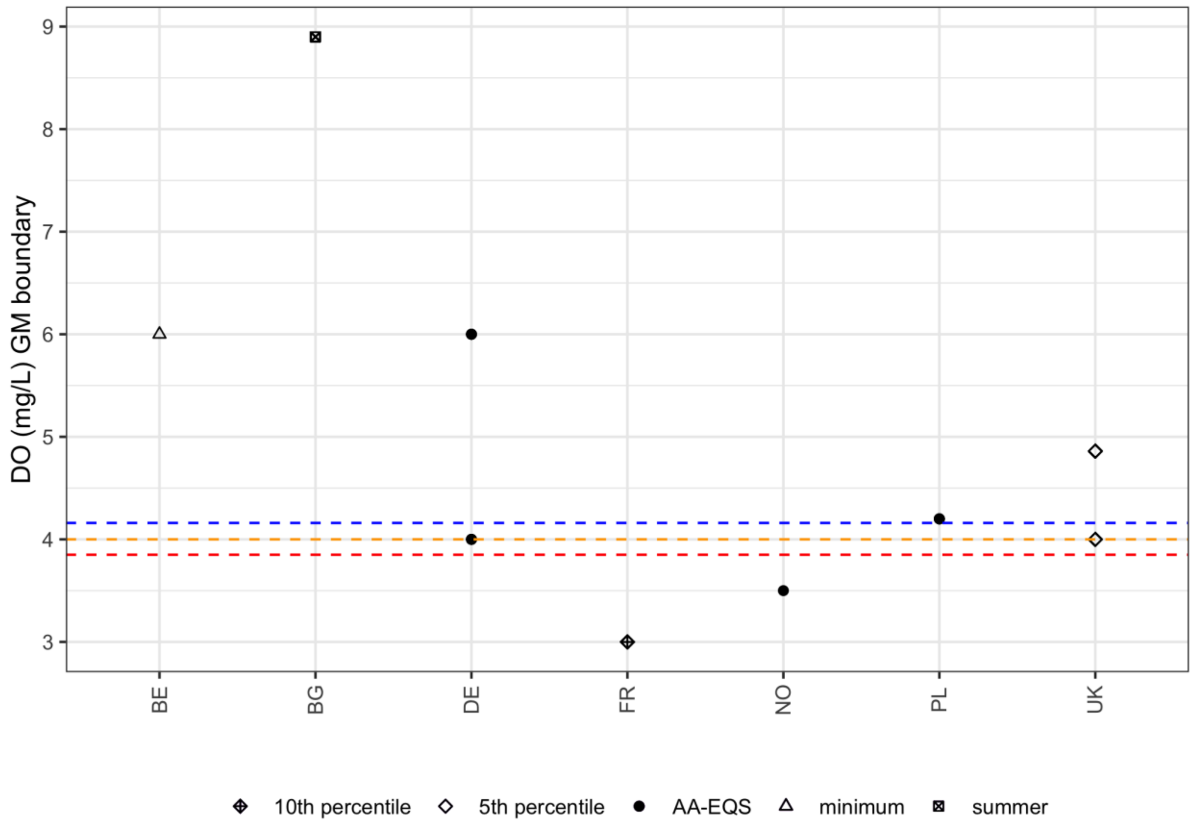


Figure 3.1: Dissolved oxygen standards by country (single value black, minimum blue, maximum red); dotted lines show interquartile range of mean or median values, (10th quantile=red, 25th quantile=orange, 50th quantile = blue).

Table 3.1 Overview of summary metric type and number of distinct standards for dissolved oxygen concentration in coastal waters.

Country	Metric Type	Summary Metric	n
BE	quantile annual	minimum	1
BG	central tendency seasonal	summer	1
DE	central tendency annual	AA-EQS	2
FR	quantile seasonal	10th percentile	1
NO	central tendency annual	AA-EQS	1
PL	central tendency annual	AA-EQS	1
UK	quantile annual	5th percentile	3

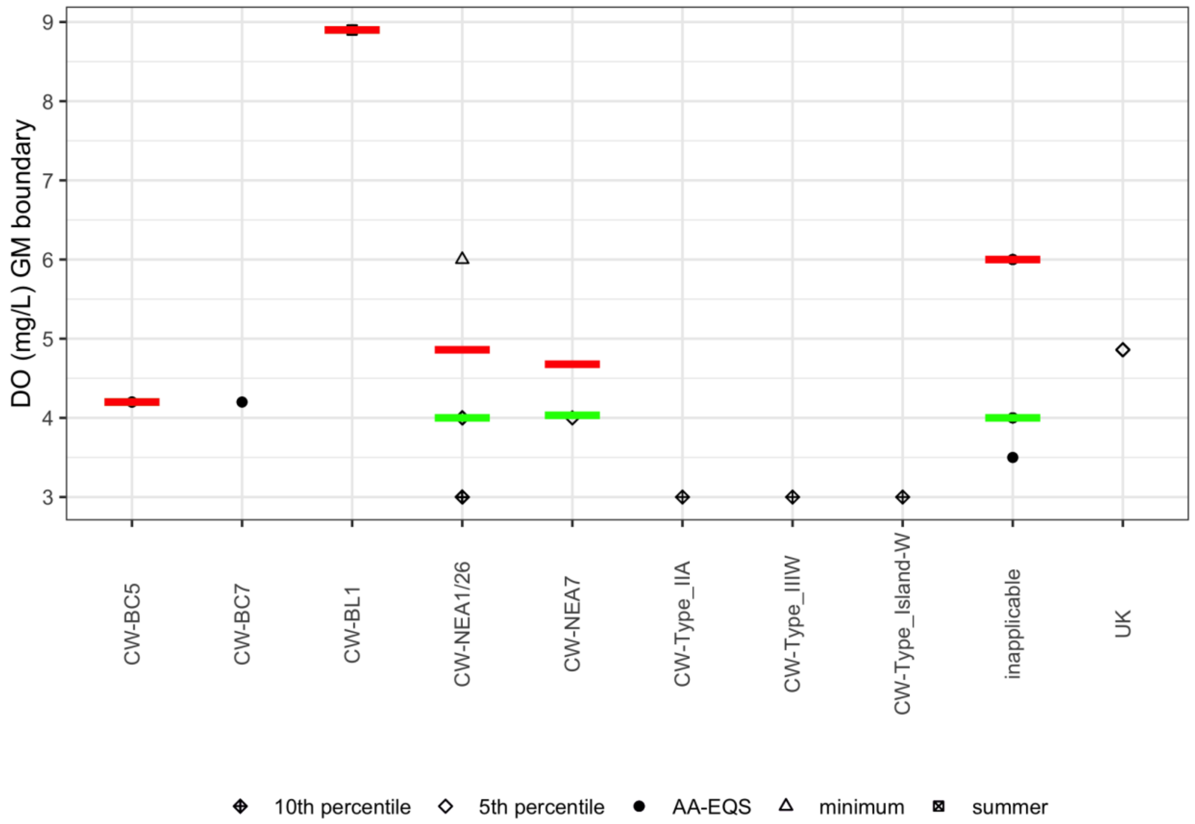


Figure 3.2: Dissolved oxygen standards by IC type (single value black, minimum blue, maximum red. Horizontal lines mark the 25th (green) and 75th (red) quantiles, (excluding standards based on quantiles).

Table 3.2 Overview of common intercalibration (IC) types showing the number of countries/ national types/ distinct standards for Dissolved Oxygen concentration in coastal waters.

IC code	IC Type	Cntry	NatType	ValueStd
CW-BC1	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days			
CW-BC3	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Sheltered, 90-150 ice days			
CW-BC4	Baltic Sea, surface water salinity 5-8 psu, bottom water salinity 5-8 psu, Exposed, < 90 ice days			
CW-BC5	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 6-12 psu, Exposed, <90 ice days	1	1	1
CW-BC6	Baltic Sea, surface water salinity 8-12 psu, bottom water salinity 8-12 psu, Sheltered, <90 ice days			
CW-BC7	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 8-11 psu, Exposed, <90 ice days	1	1	1
CW-BC9	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Moderately Exposed to exposed, 90-150 ice days			
CW-BL1	Black Sea, mesohaline, microtidal, shallow, moderately exposed, mixed substratum	1	1	1
CW-NEA1/26	North East Atlantic, open oceanic or enclosed seas, exposed or sheltered, euhaline, shallow (< 30 m), microtidal or mesotidal, fully mixed or partly stratified	3	8	5

IC code	IC Type	Cntry	NatType	ValueStd
CW-NEA10	Skagerrak Outer Arc Type, polyhaline, microtidal, exposed, deep			
CW-NEA7	North East Atlantic, deep fjordic and sea loch systems	1	1	2
CW-NEA8a	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (25-30), microtidal, moderately exposed, shallow, fully mixed			
CW-NEA8b	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (10-30), microtidal, moderately sheltered, shallow, partly stratified			
CW-NEA9	North East Atlantic, fjord with a shallow sill at the mouth with very deep maximum depth in the central basin with poor deepwater exchange			
CW-Type_IIA	Mediterranean Sea, moderately influenced by freshwater input (continent influence)	1	1	1
CW-Type_IIA_Adriatic	Mediterranean Adriatic coast, moderately influenced by freshwater input (continent influence), Adriatic coast			
CW-Type_IIIE	Mediterranean (Eastern Basin), not affected by freshwater input			
CW-Type_IIIW	Mediterranean (Western Basin), continental coast, not influenced by freshwater input	1	1	1
CW-Type_Island-W	Mediterranean (Western Basin), island coast	1	1	1
inapplicable	inapplicable	2	5	3

3.1.1.2 Percent oxygen saturation (coastal waters)

Data for % oxygen saturation provided 16 records from 7 countries (Figure 3.3). Four countries use the annual mean ("AA-EQS") as a summary metric (Table 3.3), only one country uses quantile measures (IE) and it refers to Summer. 3 countries (ES, NL, NO) use a single value for each national type while 4 countries (HR, IE, PL, RO) present standards as a range.

Of these none specify that the ranges represent sub-types or RBD specific boundaries and it is assumed that the range represents upper and lower boundary values, as % oxygen saturation is a supporting quality element that might be expected to have a two-tailed effect.

The standards ranged from 30 (ES) to 150 (HR), with an interquartile range of 60 to 120 (Figure 3.4). Given the bimodal distribution of the boundaries the data were split into two groups of upper and lower values, following countries revisions, and reported data. The lower threshold values ranged from 30 to 80 with a median value of 70. While the upper boundaries ranged from 80 to 150 with a median value of 120.

The data could be linked to 4 IC types (Figure 3.4 & Table 3.4). There are not values from more than 2 countries sharing the same IC types, not being possible the comparison between types. None of the countries apply the same standard to all national types found in one or more of their river basin districts.

Very few values are available to allow meaningful statistical comparison across grouping factor(s), so no analysis of variance was applied to test the significance of GIG, IC Type, Country or other grouping factor effect.

More information in Annex A1.2.

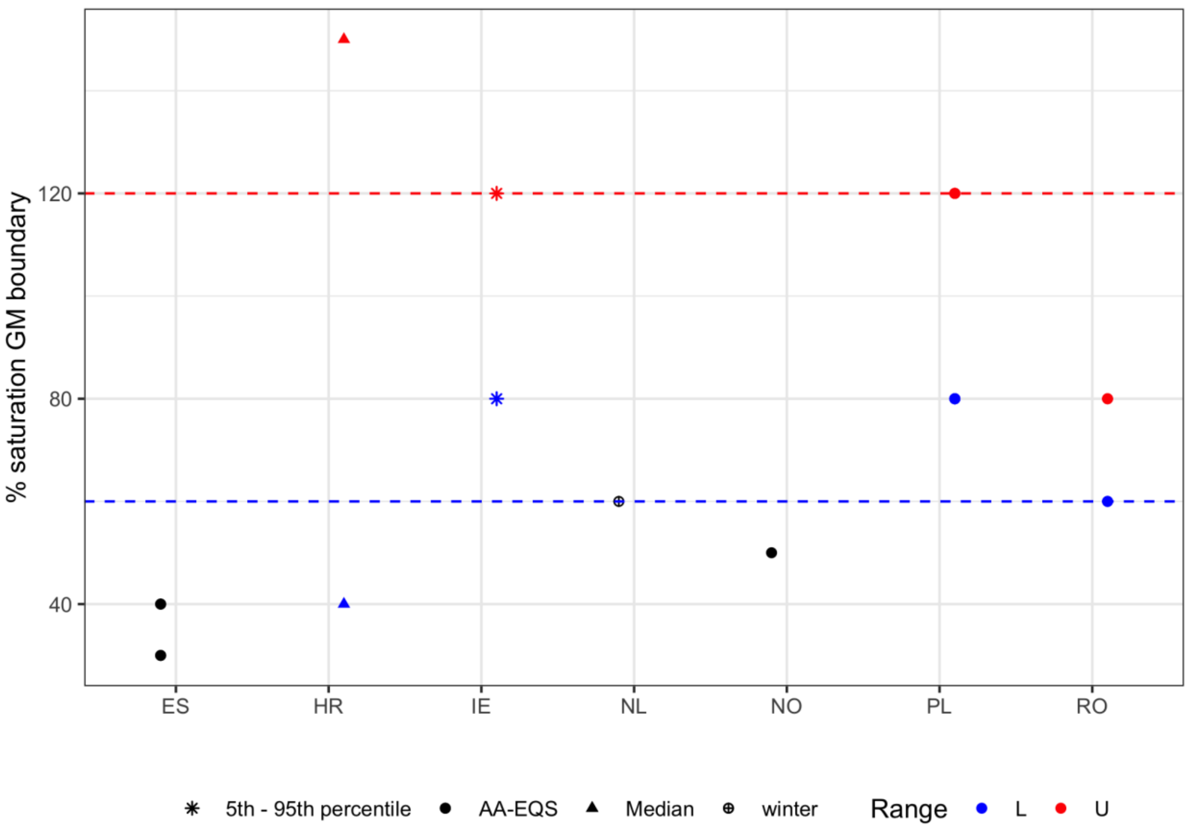


Figure 3.3: Comparison of coastal % oxygen saturation standards by country (single value black, minimum blue, maximum red symbols, dotted lines show median values for the upper (red) and lower (blue) groups.

Table 3.3 Overview of summary metric type and number of distinct standards for dissolved oxygen concentration in coastal waters

Country	Metric Type	Summary Metric	n
ES	central tendency annual	AA-EQS	2
HR	central tendency annual	Median	1
IE	quantile seasonal	5th - 95th percentile	1
NL	central tendency seasonal	winter	1
NO	central tendency annual	AA-EQS	1
PL	central tendency annual	AA-EQS	1
RO	central tendency annual	AA-EQS	1

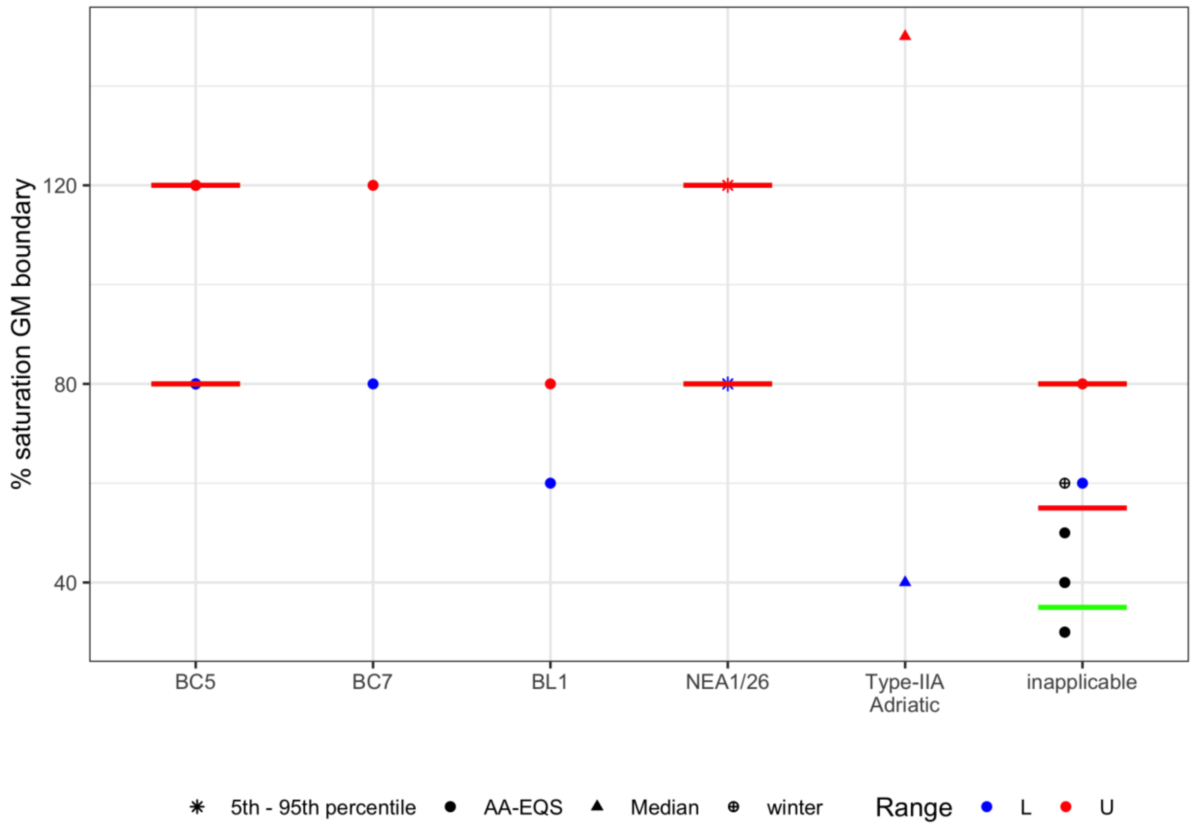


Figure 3.4: Coastal % oxygen saturation standards by IC type (single value black, minimum blue, maximum red, Horizontal lines mark the 25th (green) and 75th (red) quantiles for each group of standards).

Table 3.4 Overview of common intercalibration types (IC) showing the number of countries/ national types/ distinct standards for % oxygen saturation.

IC code	IC Type	Cntry	NatType	ValueStd
CW-BC1	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days			
CW-BC3	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Sheltered, 90-150 ice days			
CW-BC4	Baltic Sea, surface water salinity 5-8 psu, bottom water salinity 5-8 psu, Exposed, < 90 ice days			
CW-BC5	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 6-12 psu, Exposed, <90 ice days	1	1	1
CW-BC6	Baltic Sea, surface water salinity 8-12 psu, bottom water salinity 8-12 psu, Sheltered, <90 ice days			
CW-BC7	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 8-11 psu, Exposed, <90 ice days	1	1	1
CW-BC9	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Moderately Exposed to exposed, 90-150 ice days			
CW-BL1	Black Sea, mesohaline, microtidal, shallow, moderately exposed, mixed substratum	1	1	1
CW-NEA1/26	North East Atlantic, open oceanic or enclosed seas, exposed or sheltered, euhaline, shallow (< 30 m), microtidal or mesotidal, fully mixed or partly stratified	1	3	1
CW-NEA10	Skagerrak Outer Arc Type, polyhaline, microtidal,			

IC code	IC Type	Cntry	NatType	ValueStd
	exposed, deep			
CW-NEA7	North East Atlantic, deep fjordic and sea loch systems			
CW-NEA8a	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (25-30), microtidal, moderately exposed, shallow, fully mixed			
CW-NEA8b	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (10-30), microtidal, moderately sheltered, shallow, partly stratified			
CW-NEA9	North East Atlantic, fjord with a shallow sill at the mouth with very deep maximum depth in the central basin with poor deepwater exchange			
CW-Type_IIA	Mediterranean Sea, moderately influenced by freshwater input (continent influence)			
CW-Type_IIA_Adriatic	Mediterranean Adriatic coast, moderately influenced by freshwater input (continent influence), Adriatic coast	1	1	1
CW-Type_IIIE	Mediterranean (Eastern Basin), not affected by freshwater input			
CW-Type_IIIW	Mediterranean (Western Basin), continental coast, not influenced by freshwater input			
CW-Type_Island-W	Mediterranean (Western Basin), island coast			
inapplicable	inapplicable	4	2	4

3.1.2 Oxygen (transitional waters)

For transitional waters there are more countries reporting DO using concentration (6) than percentage (5).

3.1.2.1 Dissolved oxygen concentration (transitional waters)

Data for Dissolved oxygen provided 45 records from 6 countries (Figure 3.5). Most countries use quantile measures as summary metric (Table 3.5). All countries (BE, BG, FR, IT, PL, UK) use single values for each national type and none reported standards as a range.

The data could be linked to 3 IC types (Figure 3.6 & Table 3.2). Only the NEA11 had type specific values from 2 countries allowing the range of standards within type to be compared. Very few values are available to allow meaningful statistical comparison across grouping factor(s), so no analysis of variance was applied to test the significance of GIG, IC Type, Country or other grouping factor effect.

The standards ranged from 1 mg/L (IT) to 6 mg/L (BG) with an interquartile range of 4 to 4.86 (Figure 3.6).

More information in Annex A1.3.

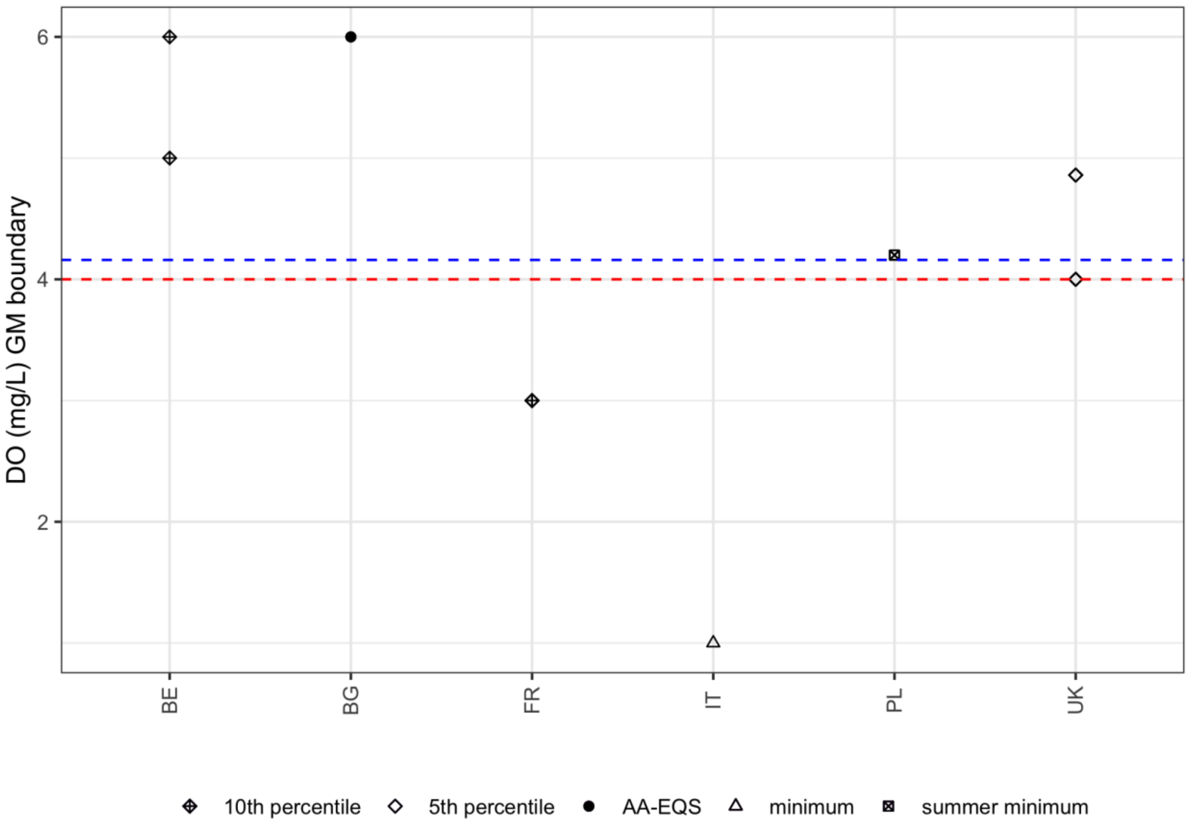


Figure 3.5: Comparison of transitional waters Dissolved oxygen standards by country (single value black, minimum blue, maximum red symbols, dotted lines show interquartile range of mean or median values, (10th quantile=red, 25th quantile=orange, 50th quantile = blue).

Table 3.5 Overview of summary metric type and number of distinct standards for dissolved oxygen concentration in transitional waters.

Country	Metric Type	Summary Metric	n
BE	quantile annual	10th percentile	2
BG	central tendency annual	AA-EQS	1
FR	quantile annual	10th percentile	1
IT	quantile annual	minimum	1
PL	quantile seasonal	summer minimum	1
UK	quantile annual	5th percentile	3

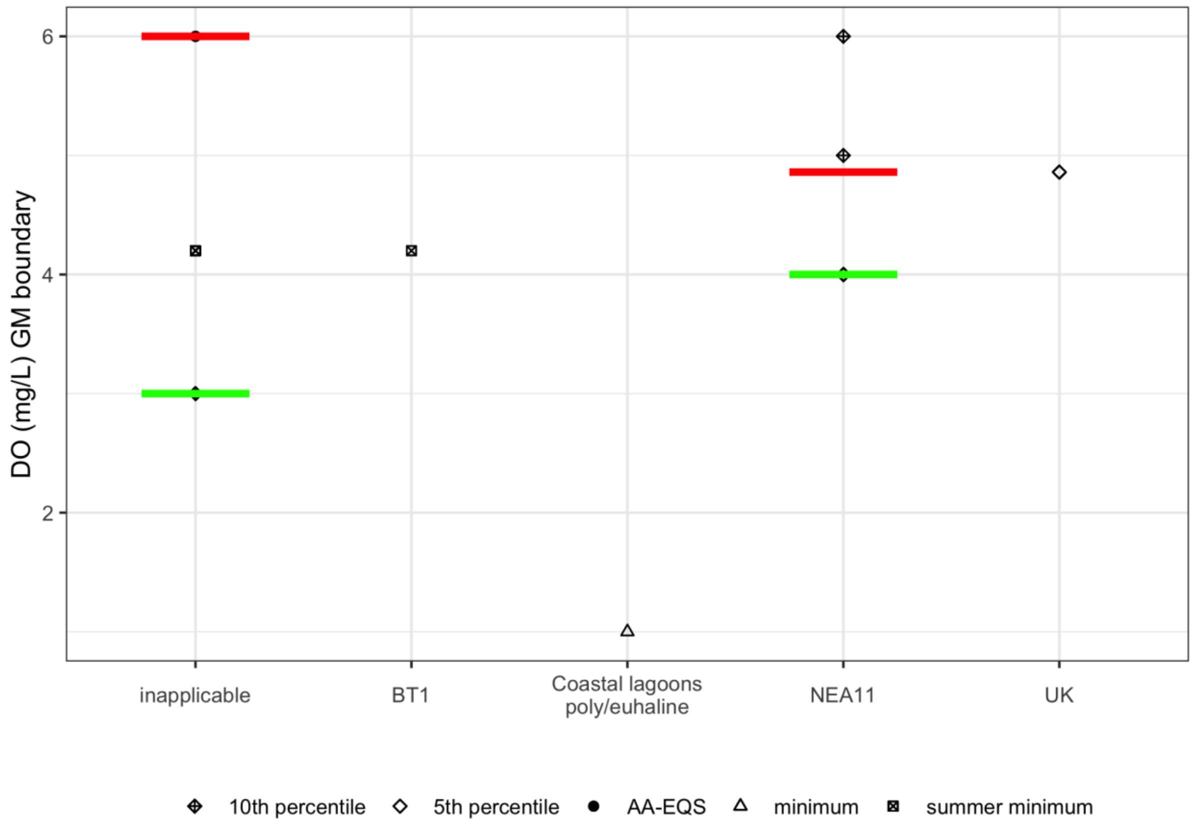


Figure 3.6: Transitional waters dissolved oxygen standards by IC type (single value black, minimum blue, maximum red. Horizontal lines mark the 25th (green) and 75th (red) quantiles, (excluding standards based on quantiles).

Table 3.6 Overview of common types showing the number of MS/national types/distinct standards for Dissolved oxygen concentration.

IC code	IC type	Cntry	NatType	ValueStd
inapplicable	inapplicable	3	7	3
TW-BT1	Baltic Sea, transitional waters, salinity surface 0-8 psu bottom 0-8 psu, very sheltered	1	1	1
TW-Coastal Lagoons Polyeuhaline	Mediterranean Sea, Coastal Lagoons, polyeuhaline salinity 18-40 psu	1	1	1
TW-Estuaries	Mediterranean Sea, Estuaries, salt wedge type			
TW-NEA11	North East Atlantic, transitional waters	2	5	5

3.1.2.2 Percent oxygen saturation (transitional waters)

Data for % oxygen saturation provided 17 records from 5 countries (Figure 3.7). Only two countries use a central tendency annual measure (HR, RO) as a summary metric. Two countries (HR, NL) use a single value for each national type and 3 countries (IE, PL, RO) present standards as a range. The data could be linked to 3 IC types (Figure 3.8 & Table 3.7). There are not values from more than 2 countries sharing the same IC type, not allowing the range of standards in these types to be compared. The standards ranged from 40 PC02 (HR) to 170 PC02 (HR) with an interquartile range of 80 to 120 (Figure 3.8). Very few values are available to allow meaningful statistical comparison across grouping factor(s), so no analysis of variance was applied to test the significance of GIG, IC Type, Country or other grouping factor effect.

More information in Annex A1.4.

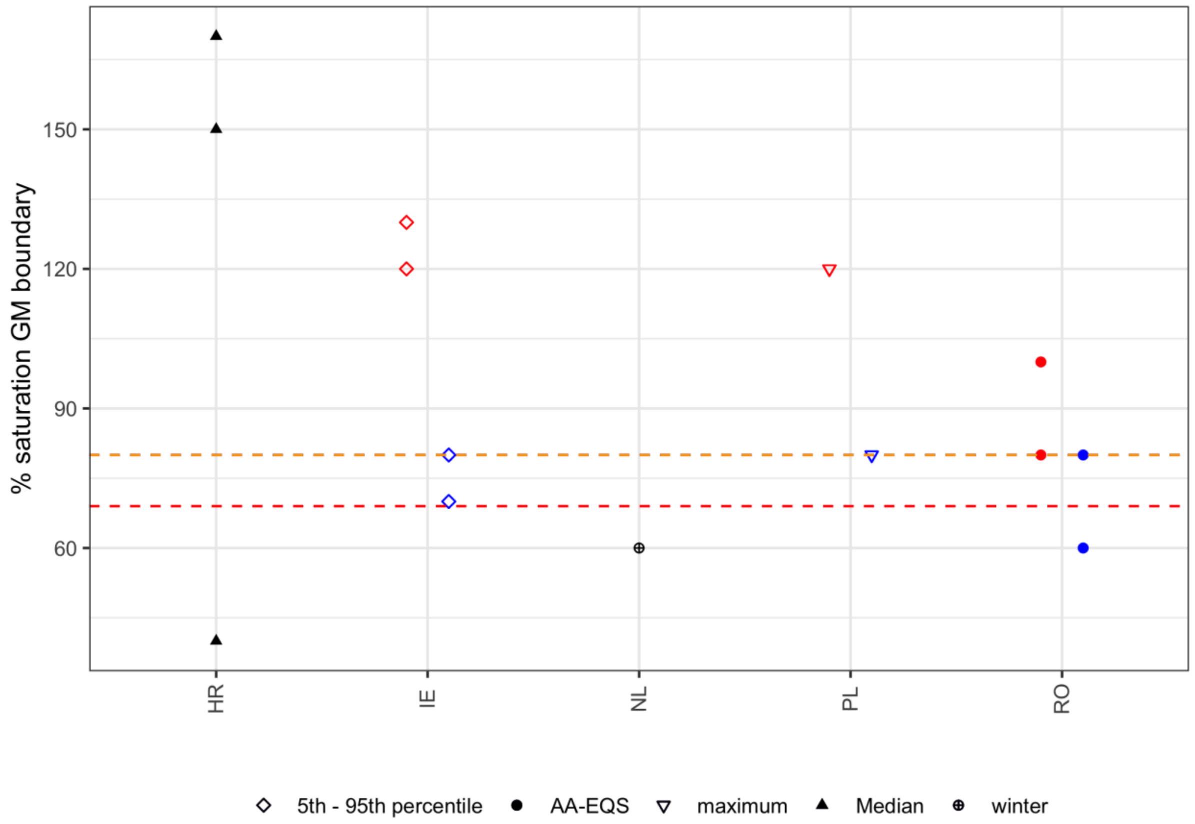


Figure 3.7: Comparison of transitional % oxygen saturation standards by country. (single value black, minimum blue, maximum red symbols, dotted lines show interquartile range of mean or median values, (10th quantile=red, 25th quantile=orange, 50th quantile = blue.)

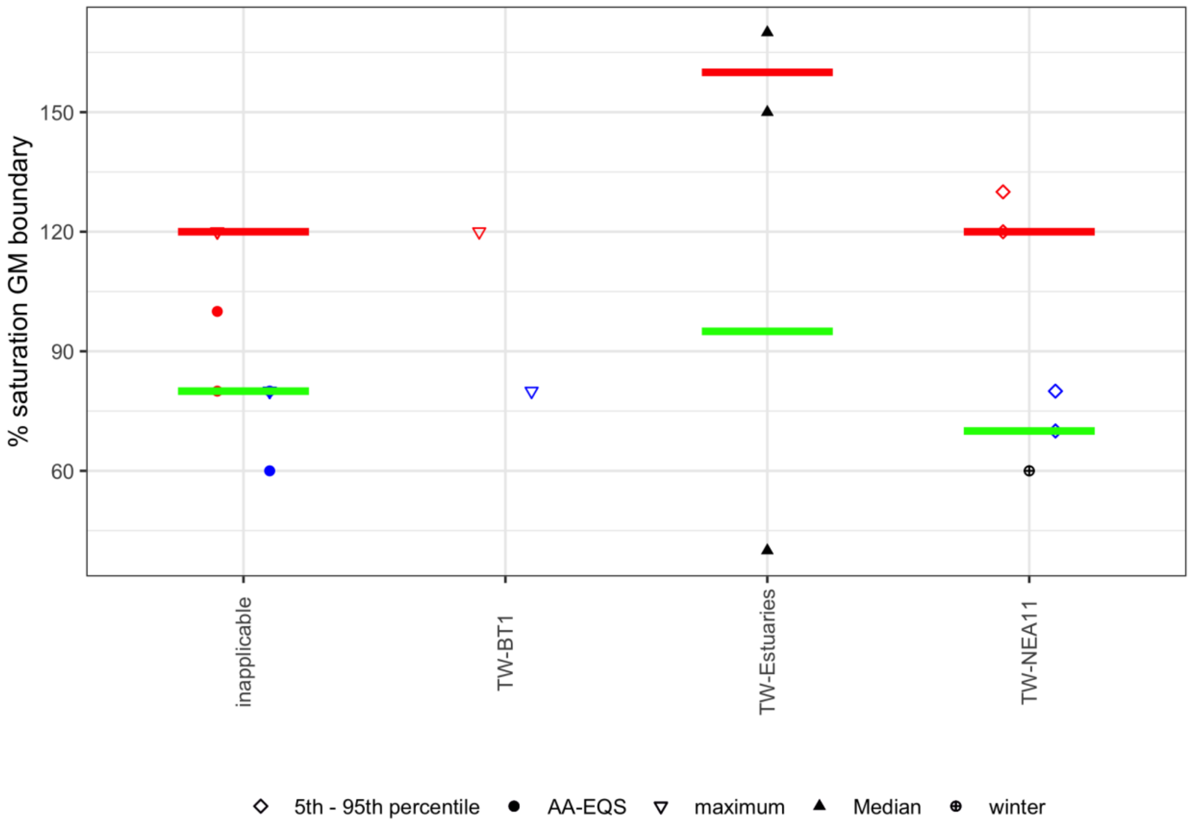


Figure 3.8: Transitional % oxygen saturation standards by IC type (single value black, minimum blue, maximum red. Horizontal lines mark the 25th (green) and 75th (red) quantiles, (excluding standards based on quantiles).

Table 3.7 Overview of common intercalibration types (IC) showing the number of countries/ national types/ distinct standards for % oxygen saturation.

IC code	IC type	Cntry	NatType	ValueStd
inapplicable	inapplicable	2	3	2
TW-BT1	Baltic Sea, transitional waters, salinity surface 0-8 psu bottom 0-8 psu, very sheltered	1	1	1
TW-Coastal Lagoons Polyeuhaline	Mediterranean Sea, Coastal Lagoons, polyeuhaline salinity 18-40 psu			
TW-Estuaries	Mediterranean Sea, Estuaries, salt wedge type	1	1	3
TW-NEA11	North East Atlantic, transitional waters	2	4	3

3.2 Transparency

3.2.1 Secchi depth (coastal waters)

Data for Secchi disk depth provided 72 records from 11 countries (Figure 3.9 and 3.10). Most countries use the summer mean as a summary metric (Table 3.8). Most countries use a single value for each national type, except RO and PT that present standards as a range, both related with sub-typology features.

The standards ranged from 1.3 (DE) to 7.5 (RO), with an interquartile range of 3.3 to 5.6 (Figure 3.11). Portugal values refer actually to reference conditions as no G/M boundaries had been established yet (Figure 3.10). A very high reference condition value for PT of 35 meters was removed to facilitate visualization of remaining standards and do not interfere with range of values summary, but it can be seen in (Figure 3.10).

The data could be linked to 7 IC types (Figure 3.10 & Table 3.9). Only the Baltic and the Black seas had IC types with two or more countries restricting comparisons within types (Figure 3.11).

In general, few values are available to allow meaningful statistical comparisons across grouping factor(s), so no analysis of variance was applied to test the significance of GIG, IC Type, Country or other grouping factor effect.

More information in Annex A2.1.

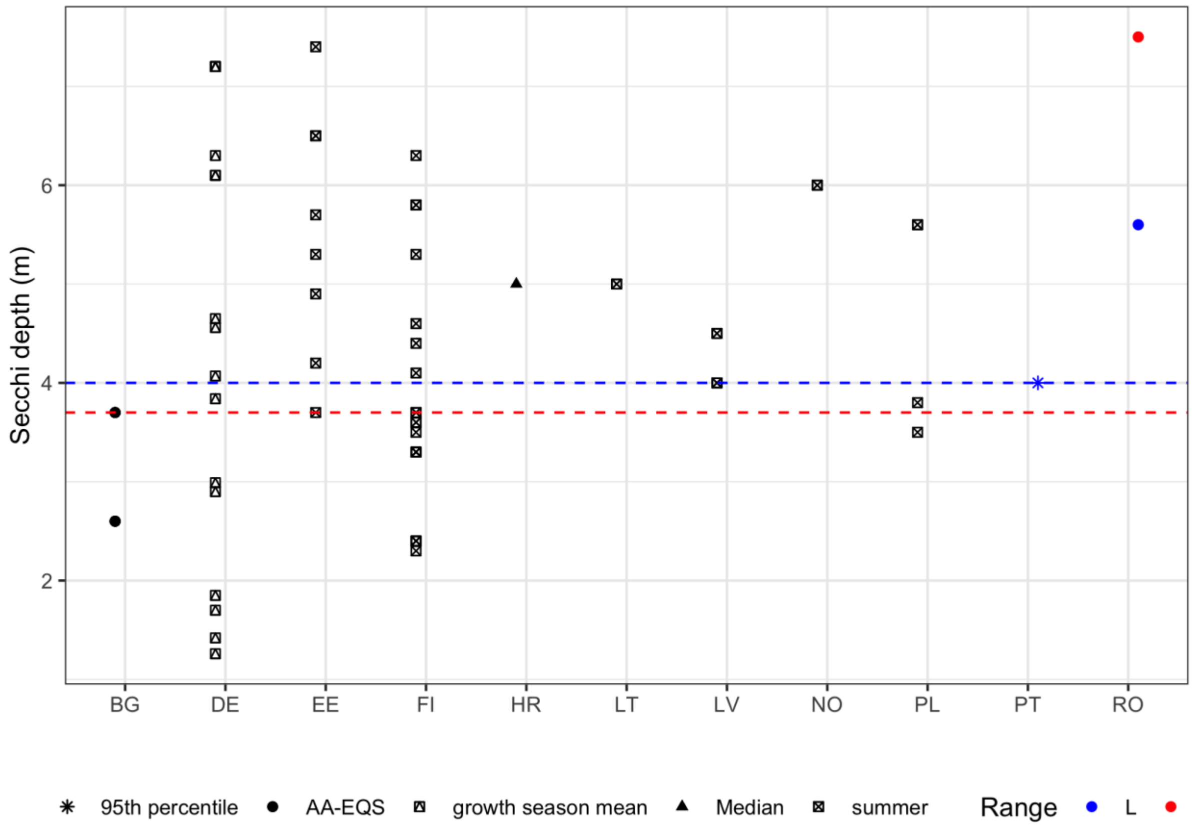


Figure 3.9: Comparison of coastal Secchi disk depth standards by country (single value black, minimum blue, maximum red symbols, dotted lines show median values for the upper (red) and lower (blue) groups.

Table 3.8 Overview of summary metric type and number of distinct standards for Secchi disk depth in coastal waters.

Country	Metric Type	Summary Metric	n
BG	central tendency annual	AA-EQS	1
DE	central tendency seasonal	growth season mean	13
EE	central tendency seasonal	summer	6
FI	central tendency seasonal	summer	12
HR	central tendency annual	Median	1
LT	central tendency seasonal	summer	1

Country	Metric Type	Summary Metric	n
LV	central tendency seasonal	summer	2
NO	central tendency seasonal	summer	1
PL	central tendency seasonal	summer	3
PT	quantile annual	95th percentile	1
RO	central tendency annual	AA-EQS	1

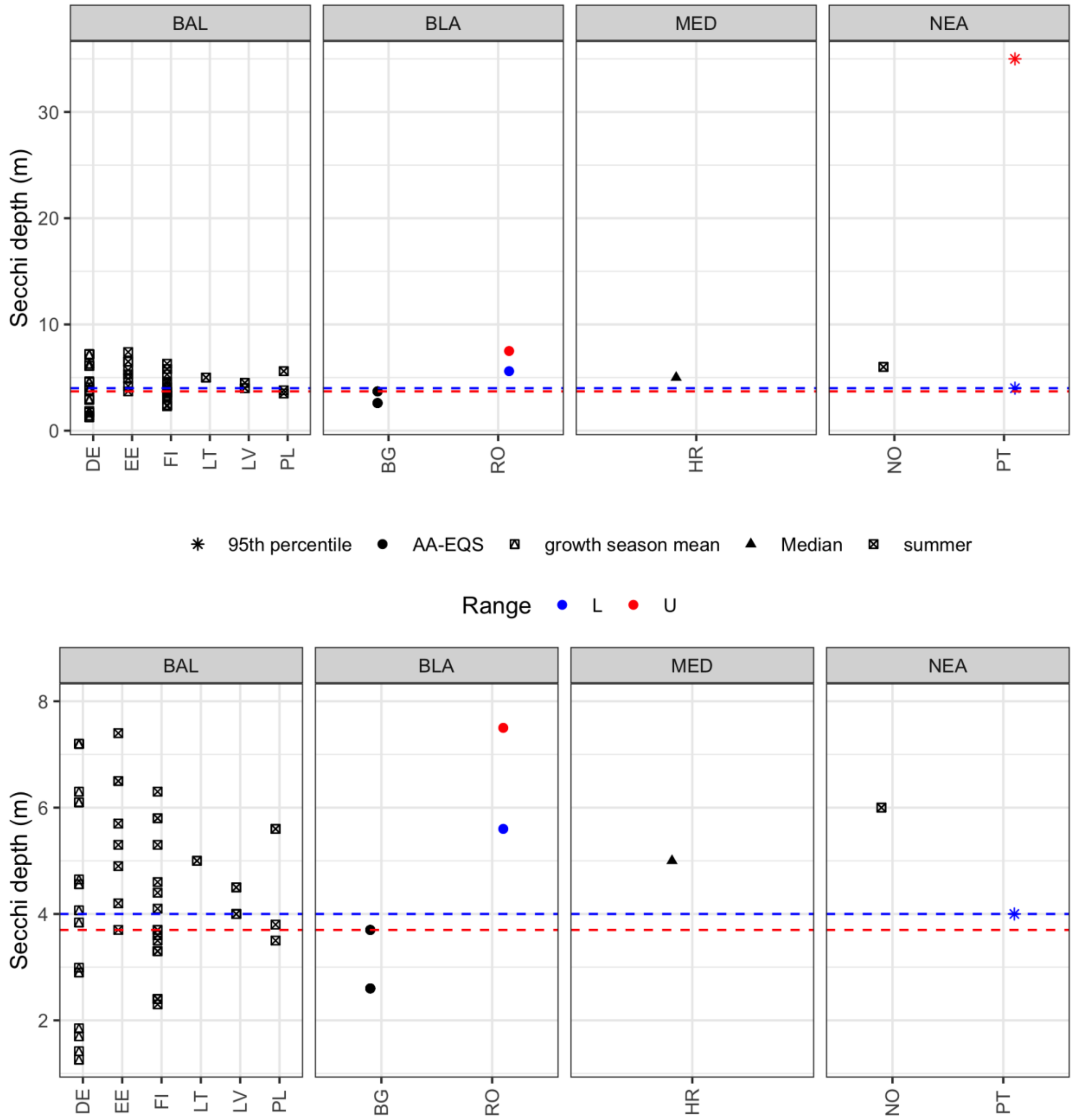


Figure 3.10: Coastal Secchi disk depth standards' comparing the range of Secchi disk depth boundaries when extreme PT standard of 35m (95th percentile) (top) is removed (bottom).

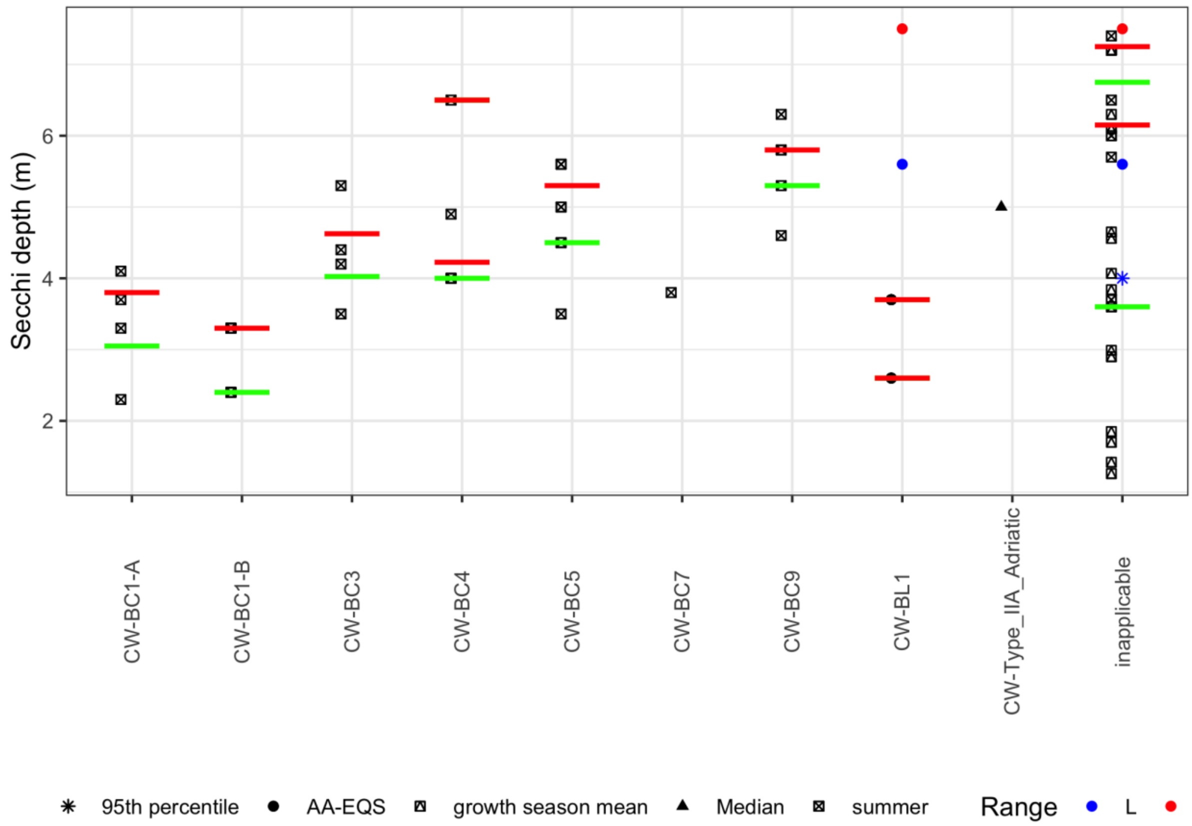


Figure 3.11: Coastal Secchi disk depth standards by IC type (single value black, minimum blue, maximum red). Horizontal lines mark the 25th (green) and 75th (red) quantiles for each group of standards.

Table 3.9 Overview of common types showing the number of countries/ national types/ distinct standards for coastal Secchi disk depth.

IC code	IC type	Cntry	NatType	ValueStd
CW-BC1	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days			
CW-BC1-A	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days	1	1	4
CW-BC1-B	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days	1	4	2
CW-BC3	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Sheltered, 90-150 ice days	2	3	4
CW-BC4	Baltic Sea, surface water salinity 5-8 psu, bottom water salinity 5-8 psu, Exposed, < 90 ice days	2	4	2
CW-BC5	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 6-12 psu, Exposed, <90 ice days	3	3	4
CW-BC6	Baltic Sea, surface water salinity 8-12 psu, bottom water salinity 8-12 psu, Sheltered, <90 ice days			
CW-BC7	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 8-11 psu, Exposed, <90 ice days	1	1	1
CW-BC9	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Moderately Exposed to exposed, 90-150 ice days	1	3	4
CW-BL1	Black Sea, mesohaline, microtidal, shallow, moderately exposed, mixed substratum	2	2	2
CW-NEA1/26	North East Atlantic, open oceanic or enclosed seas,			

IC code	IC type	Cntry	NatType	ValueStd
	exposed or sheltered, euhaline, shallow (< 30 m), microtidal or mesotidal, fully mixed or partly stratified			
CW-NEA10	Skagerrak Outer Arc Type, polyhaline, microtidal, exposed, deep			
CW-NEA7	North East Atlantic, deep fjordic and sea loch systems			
CW-NEA8a	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (25-30), microtidal, moderately exposed, shallow, fully mixed			
CW-NEA8b	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (10-30), microtidal, moderately sheltered, shallow, partly stratified			
CW-NEA9	North East Atlantic, fjord with a shallow sill at the mouth with very deep maximum depth in the central basin with poor deepwater exchange			
CW-Type_IIA	Mediterranean Sea, moderately influenced by freshwater input (continent influence)			
CW-Type_IIA_Adriatic	Mediterranean Adriatic coast, moderately influenced by freshwater input (continent influence), Adriatic coast	1	1	1
CW-Type_IIIE	Mediterranean (Eastern Basin), not affected by freshwater input			
CW-Type_IIIW	Mediterranean (Western Basin), continental coast, not influenced by freshwater input			
CW-Type_Island-W	Mediterranean (Western Basin), island coast			
inapplicable	inapplicable	6	11	20

3.2.2 Secchi disk depth (transitional waters)

Data for Secchi disk depth provided 15 records from 6 countries (Figure 3.12). Three countries use the annual mean ("AA-EQS") as a summary metric (Table 3.10). 4 countries (BG, HR, LV, PL) use a single value for each national type while (2) countries (PT, RO) present standards as a range. Both ranges of standards are related with sub-typology features. The standards ranged from 0.8 (PT) to 6 (PT), with an interquartile range of 2 to 3 (Figure 3.13). Given the bimodal distribution of the boundaries the data were split into two groups of upper and lower values, following countries revisions and reported data. The lower threshold values (which include single values reported) ranged from 0.8 to 3.6 with a median value of 2. While the upper boundaries ranged from 3 to 6 with a median value of 4.5. The data could only be linked to 2 IC types (Figure 3.13 & Table 3.11), although no country shared the same IC type, not allowing the range of standards within types to be compared. Very few values are available to allow meaningful statistical comparisons across grouping factor(s), so no analysis of variance was applied to test the significance of GIG, IC Type, Country or other grouping factor effect.

More information in Annex A2.2.

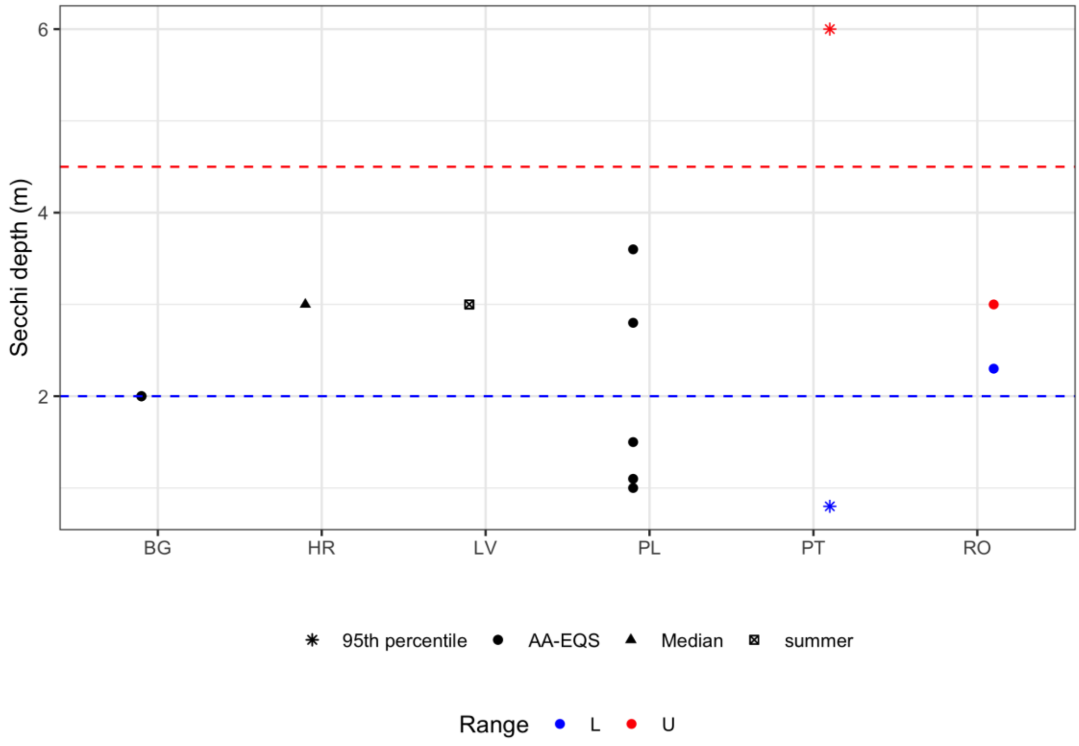


Figure 3.12: Comparison of transitional Secchi disk depth standards by country (single value black, minimum blue, maximum red symbols). Dotted lines show median values for the upper (red) and lower (blue) groups.

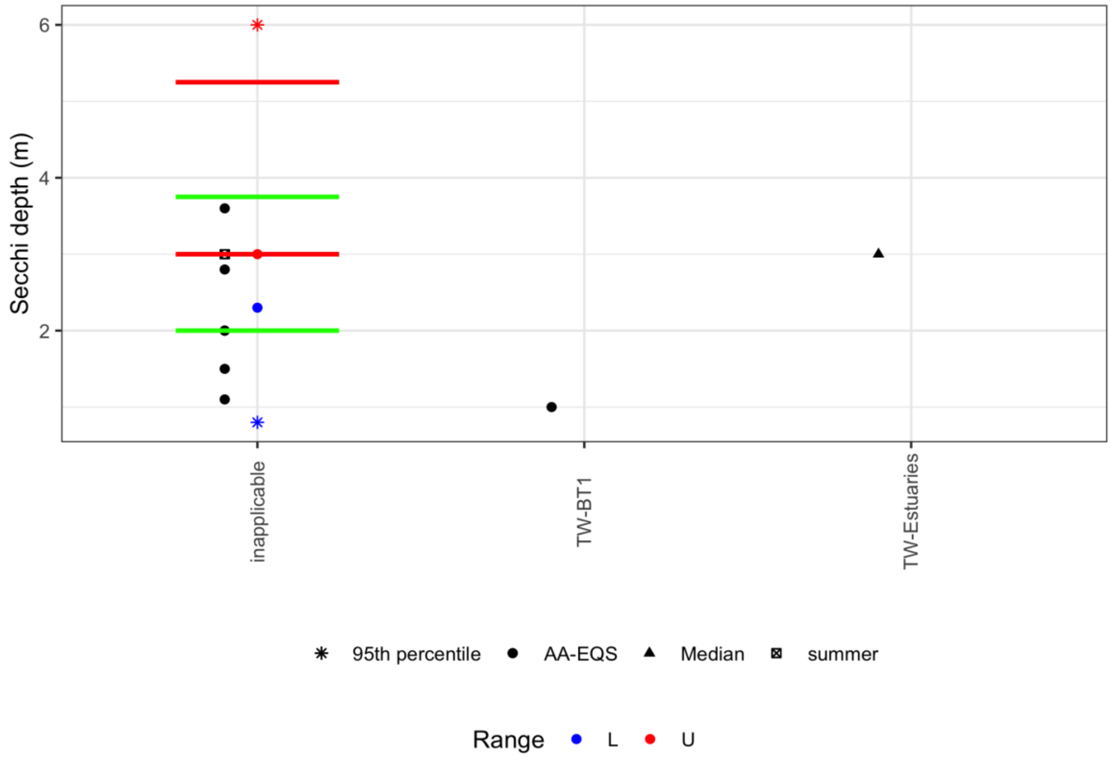


Figure 3.13: Transitional Secchi disk depth standards by IC type (single value black, minimum blue, maximum red). Horizontal lines mark the 25th (green) and 75th (red) quantiles for each group of standards.

Table 3.10 Overview of summary metric type and number of distinct standards for Secchi disk depth boundaries in transitional waters.

Country	Metric Type	Summary Metric	n
BG	central tendency annual	AA-EQS	1
HR	central tendency annual	Median	1
LV	central tendency seasonal	summer	1
PL	central tendency annual	AA-EQS	5
PT	quantile annual	95th percentile	1
RO	central tendency annual	AA-EQS	1

Table 3.11 Overview of common types showing the number of countries/national types/distinct standards for transitional Secchi disk depth.

IC code	**IC type**	**Cntry**	**NatType**	**ValueStd**
inapplicable	inapplicable	5	8	9
TW-BT1	Baltic Sea, transitional waters, salinity surface 0-8 psu bottom 0-8 psu, very sheltered	1	1	1
TW-CoastalLagoonsPolyeuhaline	Mediterranean Sea, Coastal Lagoons, polyeuhaline salinity 18-40 psu			
TW-Estuaries	Mediterranean Sea, Estuaries, salt wedge type	1	1	1
TW-NEA11	North East Atlantic, transitional waters			

3.3 Nitrate-N

3.3.1 Nitrate-N (coastal waters)

There were 83 records from 9 countries (Figure 3.14). The majority of countries use central tendency summary metrics, and these are split between those using annual and those using seasonal measures, with some countries (BG, NO, PT) referring the use of distinct summary metric types (Table 3.12). All countries (BG, ES, GR, LV, NO, PL, PT, RO, SI) use a single value for each national type and PT presents an additional standard as a range. The standards ranged from 0.01 mgN/L (GR) to 0.7 mgN/L (PT), with an interquartile range of 0.07 to 0.14 (Figure 3.15).

The data could be linked to 6 IC types (Figure 3.15 & Table 3.13). However, none of them had type specific values from more than 2 countries not allowing the range of standards in these types to be compared, (Black Sea BL1 and Baltic BC5 had values for 2 countries).

Few values are available to allow meaningful statistical comparisons across grouping factor(s), so no analysis of variance was applied to test the significance of GIG, IC Type, Country or other grouping factor effect.

More information in Annex A3.1.

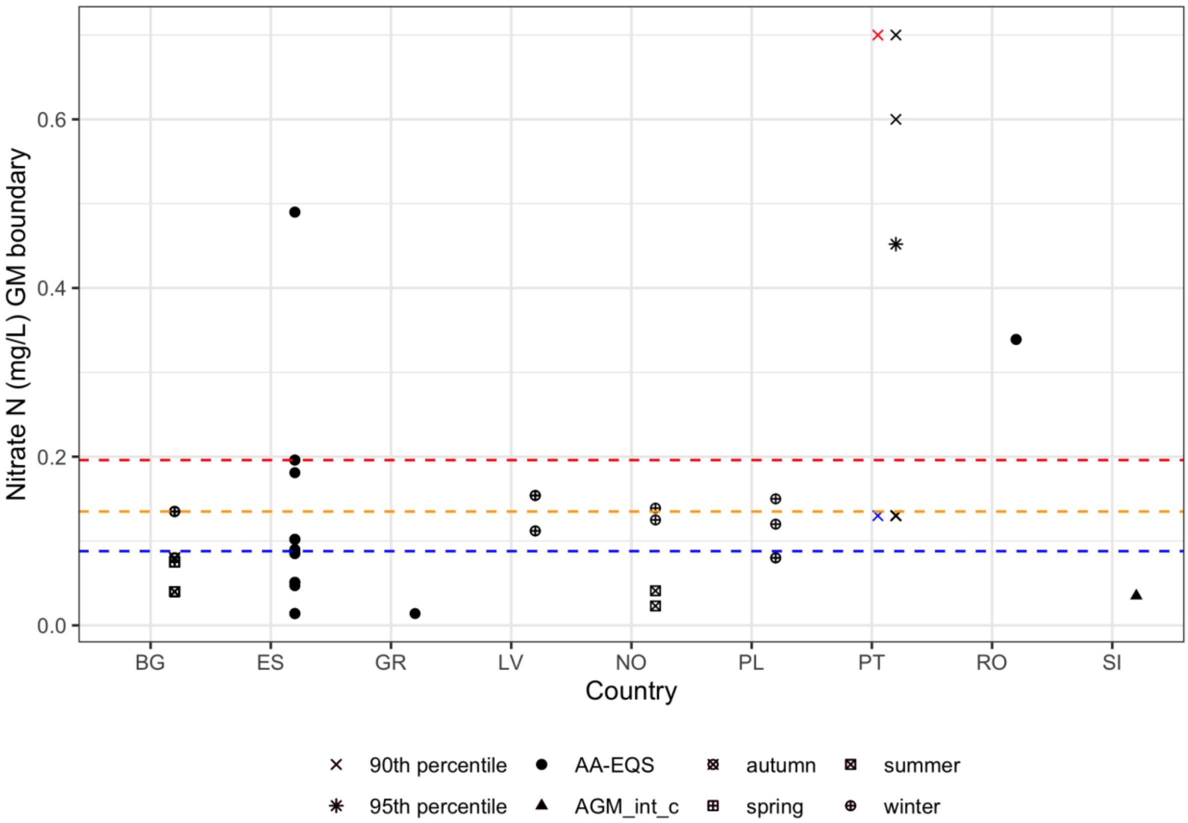


Figure 3.14: Comparison of coastal Nitrate as N standards by country (single value black, minimum blue, maximum red symbols).

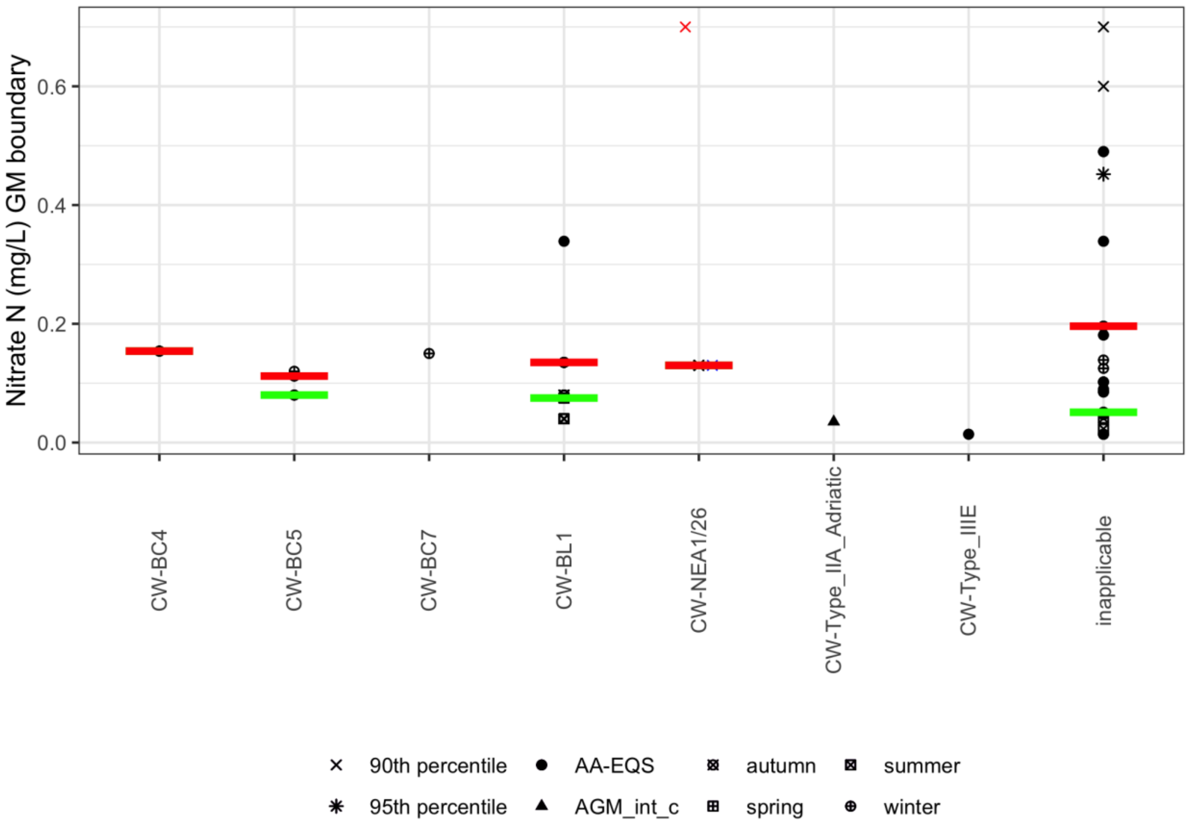


Figure 3.15: Coastal Nitrate as N standards by IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles, (excluding standards based on quantiles).

Table 3.12 Overview of summary metric type and number of distinct standards for Nitrate as N boundaries in coastal waters.

Country	Metric Type	Summary Metric	n
BG	central tendency seasonal	autumn	1
BG	central tendency seasonal	spring	1
BG	central tendency seasonal	summer	1
BG	central tendency seasonal	winter	1
ES	central tendency annual	AA-EQS	10
GR	central tendency annual	AA-EQS	1
LV	central tendency seasonal	winter	2
NO	central tendency seasonal	summer	2
NO	central tendency seasonal	winter	2
PL	central tendency seasonal	winter	3
PT	quantile annual	90th percentile	3
PT	quantile annual	95th percentile	1
RO	central tendency annual	AA-EQS	1
SI	central tendency annual	AGM_int_c	1

Table 3.13 Overview of common types showing the number of country/national types/distinct standards for coastal Nitrate as N.

IC code	IC type	Cntry	NatType	ValueStd
CW-BC1	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days			
CW-BC1-A	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days			
CW-BC1-B	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days			
CW-BC3	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Sheltered, 90-150 ice days			
CW-BC4	Baltic Sea, surface water salinity 5-8 psu, bottom water salinity 5-8 psu, Exposed, < 90 ice days	1	3	1
CW-BC5	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 6-12 psu, Exposed, <90 ice days	2	2	3
CW-BC6	Baltic Sea, surface water salinity 8-12 psu, bottom water salinity 8-12 psu, Sheltered, <90 ice days			
CW-BC7	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 8-11 psu, Exposed, <90 ice days	1	1	1
CW-BC9	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Moderately Exposed to exposed, 90-150 ice days			
CW-BL1	Black Sea, mesohaline, microtidal, shallow, moderately exposed, mixed substratum	2	2	5
CW-NEA1/26	North East Atlantic, open oceanic or enclosed seas, exposed or sheltered, euhaline, shallow (< 30 m), microtidal or mesotidal, fully mixed or partly stratified	1	8	1
CW-NEA10	Skagerrak Outer Arc Type, polyhaline, microtidal, exposed, deep			
CW-NEA7	North East Atlantic, deep fjordic and sea loch systems			
CW-NEA8a	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (25-30), microtidal, moderately exposed, shallow, fully mixed			
CW-NEA8b	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (10-30), microtidal, moderately sheltered, shallow, partly stratified			
CW-NEA9	North East Atlantic, fjord with a shallow sill at the mouth with very deep maximum depth in the central basin with poor deepwater exchange			
CW-Type_IIA	Mediterranean Sea, moderately influenced by freshwater input (continent influence)			
CW-Type_IIA_Adriatic	Mediterranean Adriatic coast, moderately influenced by freshwater input (continent influence), Adriatic coast	1	1	1
CW-Type_IIIE	Mediterranean (Eastern Basin), not affected by freshwater input	1	1	1
CW-Type_IIIW	Mediterranean (Western Basin), continental coast, not influenced by freshwater input			
CW-Type_Island-W	Mediterranean (Western Basin), island coast			
inapplicable	inapplicable	4	4	18

3.3.2 Nitrate-N (transitional waters)

There were 50 records from 7 countries (Figure 3.16). The majority of countries use central tendency measures as a summary metric, mostly annual measures (Table 3.14). All the 7 countries (BE, BG, ES, LV, PL, PT, RO) with standards use a single value for each national type instead of standards as a range. The standards ranged from 0.01 mgN/L (PL) to 5.65 mgN/L (BE), with an interquartile range of 0.3 to 1 (Figure 3.17).

Most of the standards were not assigned to any IC type (Figure 3.17 & Table 3.15). Common IC types with data reported, in the Baltic and in the Atlantic, had only type specific values from 2 countries. In general, few values are available to allow meaningful statistical comparisons across grouping factor(s), so no analysis of variance was applied to test the significance of GIG, IC Type, Country or other grouping factor effect.

More information in Annex A3.2.

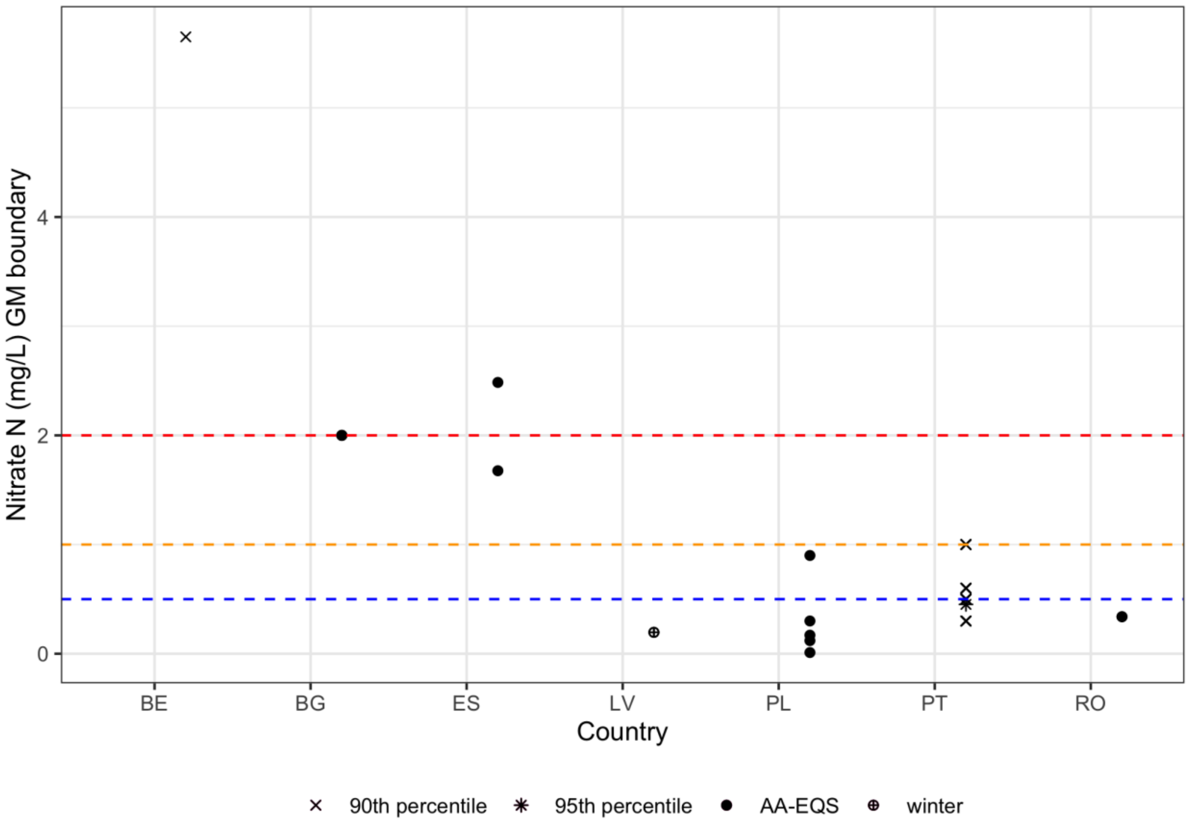


Figure 3.16: Comparison of transitional Nitrate as N standards by country (single value black, minimum blue, maximum red symbols).

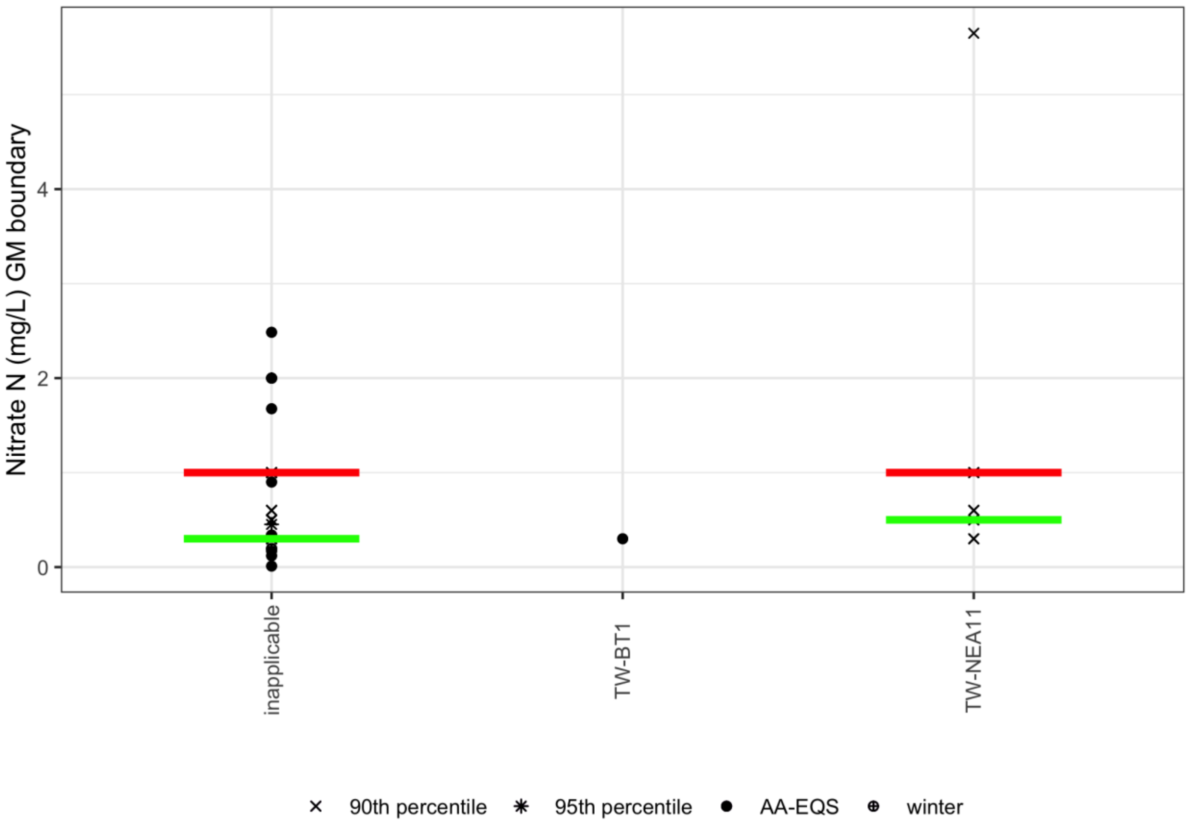


Figure 3.17: Transitional Nitrate as N standards by IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles, (excluding standards based on quantiles).

Table 3.14 Overview of summary metric type and number of distinct standards for Nitrate as N boundaries in transitional waters.

Country	Metric Type	Summary Metric	n
BE	quantile annual	90th percentile	1
BG	central tendency annual	AA-EQS	1
ES	central tendency annual	AA-EQS	2
LV	central tendency seasonal	winter	1
PL	central tendency annual	AA-EQS	5
PT	quantile annual	90th percentile	4
PT	quantile annual	95th percentile	1
RO	central tendency annual	AA-EQS	1

Table 3.15 Overview of common types showing the number of country/national types/distinct standards for transitional Nitrate as N.

IC code	IC type	Cntry	NatType	ValueStd
inapplicable	inapplicable	6	14	14
TW-BT1	Baltic Sea, transitional waters, salinity surface 0-8 psu bottom 0-8 psu, very sheltered	1	1	1
TW-CoastalLagoonsPolyeuhaline	Mediterranean Sea, Coastal Lagoons, polyeuhaline salinity 18-40 psu			
TW-Estuaries	Mediterranean Sea, Estuaries, salt wedge type			
TW-NEA11	North East Atlantic, transitional waters	2	4	5

3.4 Total Inorganic Nitrogen

3.4.1 Total Inorganic Nitrogen (Coastal waters)

There were 210 records from 10 countries (Figure 3.18). The majority of countries use central tendency measures as a summary metric, split between those using seasonal and those using annual measures (Table 3.16). 9 countries (BE, DE, FR, HR, IE, NL, PL, SE, UK) use a single value for each national type and 1 country (RO) presents standards as a range, which refer to subtype specific boundaries. The standards ranged from 0.04 mgN/L (SE) to 3.78 mgN/L (UK), with an interquartile range of 0.13 to 0.98 (Figure 3.19).

The data could be linked to 12 IC types (Figure 3.19 & Table 3.17), but only one of them (CW-NEA1/26) had type specific values from more than 2 countries allowing the range of standards within this type to be compared. Few values are available to allow meaningful statistical comparisons across grouping factor(s), so no analysis of variance was applied to test the significance of GIG, IC Type, Country or other grouping factor effect.

Five countries (BE, FR, IE, NL, SE) present G/M boundary or set of boundaries which refer salinity or reflect an adjustment to the salinity gradient (Figure A4.1-3).

More information in Annex A4.1.

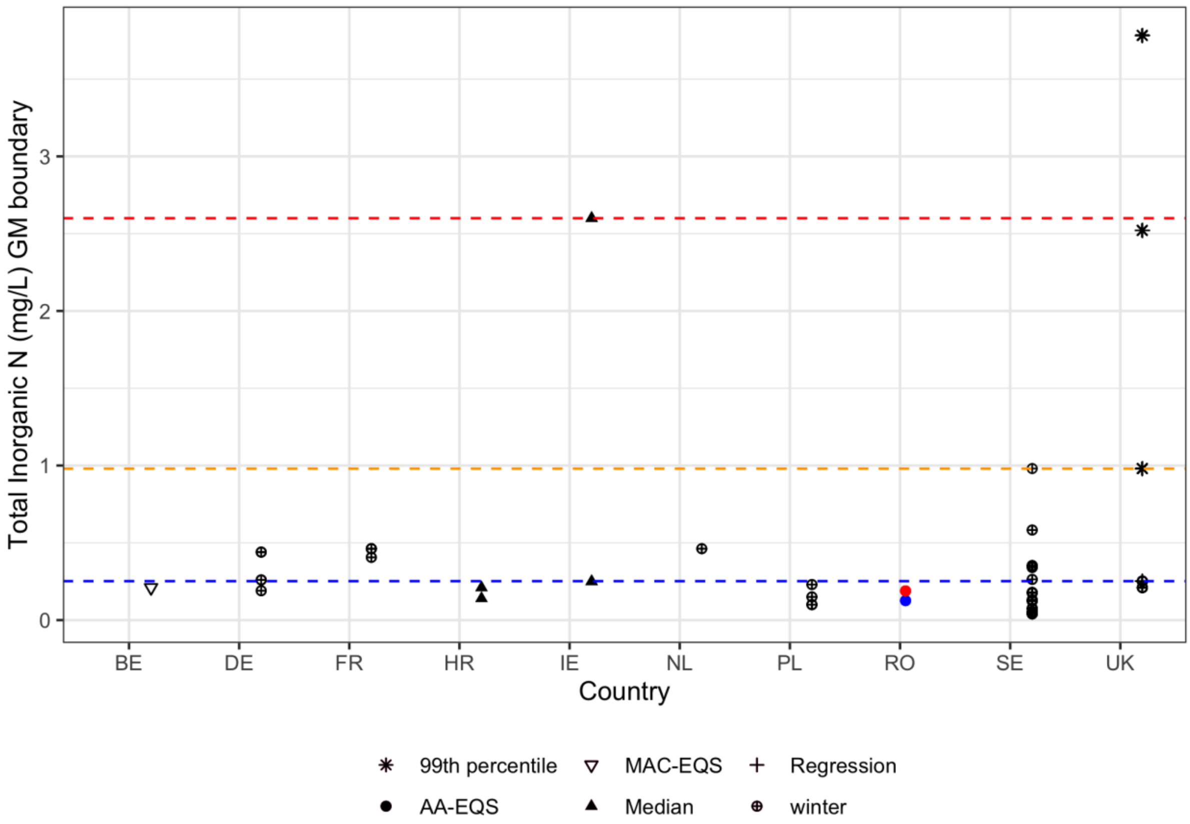


Figure 3.18: Comparison of coastal Total Inorganic N standards by country (single value black, minimum blue, maximum red symbols).

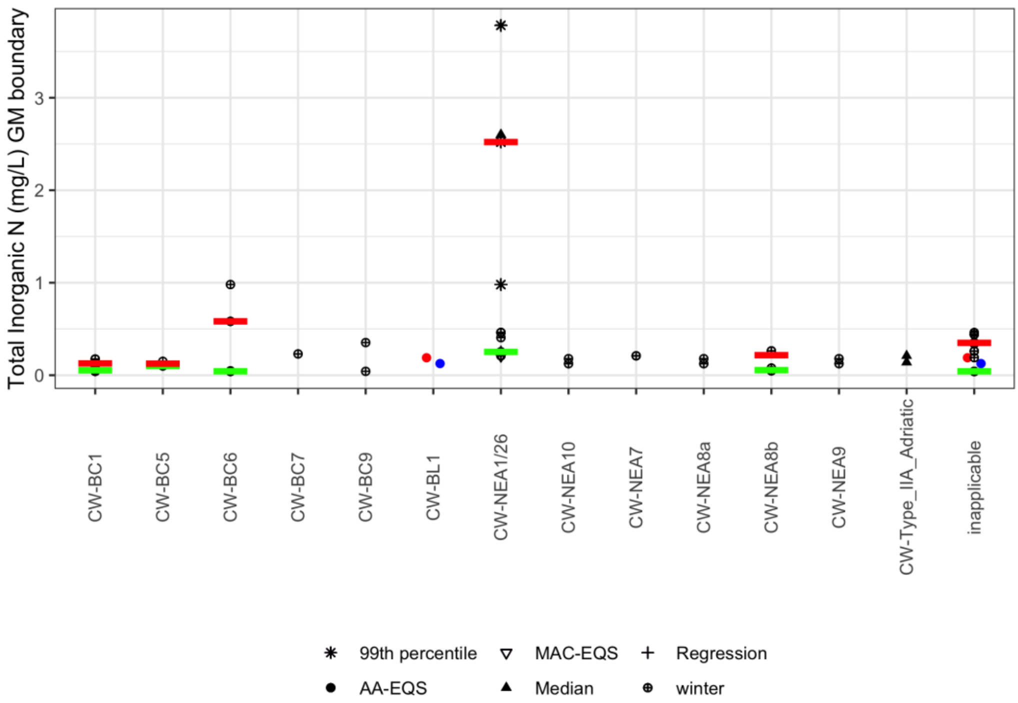


Figure 3.19. Coastal Total Inorganic N standards by IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles, (excluding standards based on quantiles).

Table 3.16 Overview of summary metric type and number of distinct standards for Total Inorganic N boundaries in coastal waters.

Country	Metric Type	Summary Metric	n
BE	quantile annual	MAC-EQS	1
DE	central tendency seasonal	winter	3
FR	central tendency seasonal	winter	2
HR	central tendency annual	Median	2
IE	central tendency annual	Median	2
NL	central tendency seasonal	winter	1
PL	central tendency seasonal	winter	3
RO	central tendency annual	AA-EQS	1
SE	central tendency seasonal	winter	19
UK	central tendency seasonal	winter	2
UK	other	Regression	1
UK	quantile annual	99th percentile	3

Table 3.17 Overview of common types showing the number of country/national types/distinct standards for coastal Total Inorganic N.

ICcode.TRAC	**ICType**	**Cntry**	**NatType**	**ValueStd**
CW-BC1	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days	1	8	7
CW-BC1-A	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days			
CW-BC1-B	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days			
CW-BC3	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Sheltered, 90-150 ice days			
CW-BC4	Baltic Sea, surface water salinity 5-8 psu, bottom water salinity 5-8 psu, Exposed, < 90 ice days			
CW-BC5	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 6-12 psu, Exposed, <90 ice days	1	1	2
CW-BC6	Baltic Sea, surface water salinity 8-12 psu, bottom water salinity 8-12 psu, Sheltered, <90 ice days	1	3	4
CW-BC7	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 8-11 psu, Exposed, <90 ice days	1	1	1
CW-BC9	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Moderately Exposed to exposed, 90-150 ice days	1	1	2
CW-BL1	Black Sea, mesohaline, microtidal, shallow, moderately exposed, mixed substratum	1	1	1
CW-NEA1/26	North East Atlantic, open oceanic or enclosed seas, exposed or sheltered, euhaline, shallow (< 30 m), microtidal or mesotidal, fully mixed or partly stratified	4	16	9
CW-NEA10	Skagerrak Outer Arc Type, polyhaline, microtidal, exposed, deep	1	1	2
CW-NEA7	North East Atlantic, deep fjordic and sea loch	1	1	1

ICcode.TRAC	ICType	Cntry	NatType	ValueStd
	systems			
CW-NEA8a	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (25-30), microtidal, moderately exposed, shallow, fully mixed	1	1	2
CW-NEA8b	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (10-30), microtidal, moderately sheltered, shallow, partly stratified	1	4	4
CW-NEA9	North East Atlantic, fjord with a shallow sill at the mouth with very deep maximum depth in the central basin with poor deepwater exchange	1	1	2
CW-Type_IIA	Mediterranean Sea, moderately influenced by freshwater input (continent influence)			
CW-Type_IIA_Adriatic	Mediterranean Adriatic coast, moderately influenced by freshwater input (continent influence), Adriatic coast	1	1	2
CW-Type_IIIE	Mediterranean (Eastern Basin), not affected by freshwater input			
CW-Type_IIIW	Mediterranean (Western Basin), continental coast, not influenced by freshwater input			
CW-Type_Island-W	Mediterranean (Western Basin), island coast			
inapplicable	inapplicable	4	13	10

3.4.2 Total Inorganic Nitrogen (Transitional waters)

There were 88 records from 9 countries (Figure 3.20). The majority of countries use central tendency measures as a summary metric, either annual ("AA-EQS") or seasonal ("winter") means (Table 3.18). All countries (BE, DE, FR, HR, IT, PL, SE, UK) use a single value for each national type and 1 country (RO) presents standards as a range related with subtype specific standards. Three countries (BE, FR, SE) reported a set of G/M adjusted to salinity gradient. The standards ranged from 0.03 mgN/L (PL) to 3.78 mgN/L (UK), with an interquartile range of 0.42 to 2.52 (Figure 3.21).

The data could be linked to 4 IC types (Figure 3.21 & Table 3.19). However, only one of these (TW-NEA11) had type specific values from more than 2 countries allowing the range of standards in this type to be compared. Few values are available to allow meaningful statistical comparisons across grouping factor(s), so no analysis of variance was applied to test the significance of GIG, IC Type, Country or other grouping factor effect.

More information in Annex A4.2.

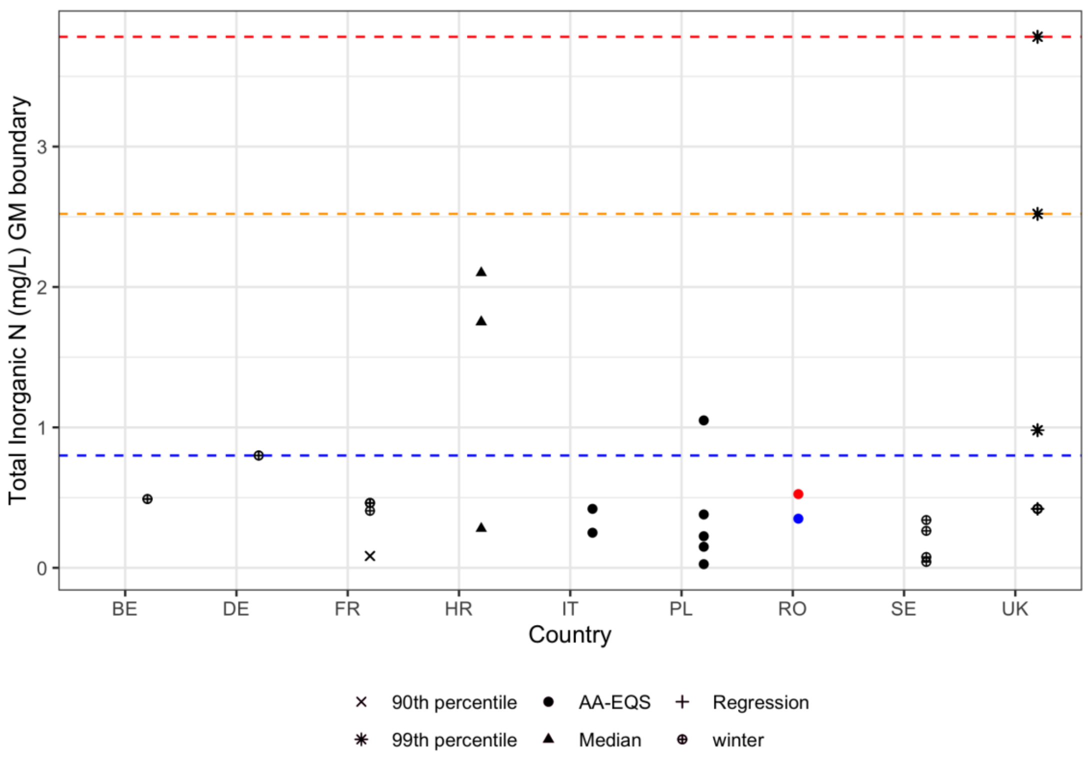


Figure 3.20. Comparison of transitional Total Inorganic N standards by country (single value black, minimum blue, maximum red symbols).

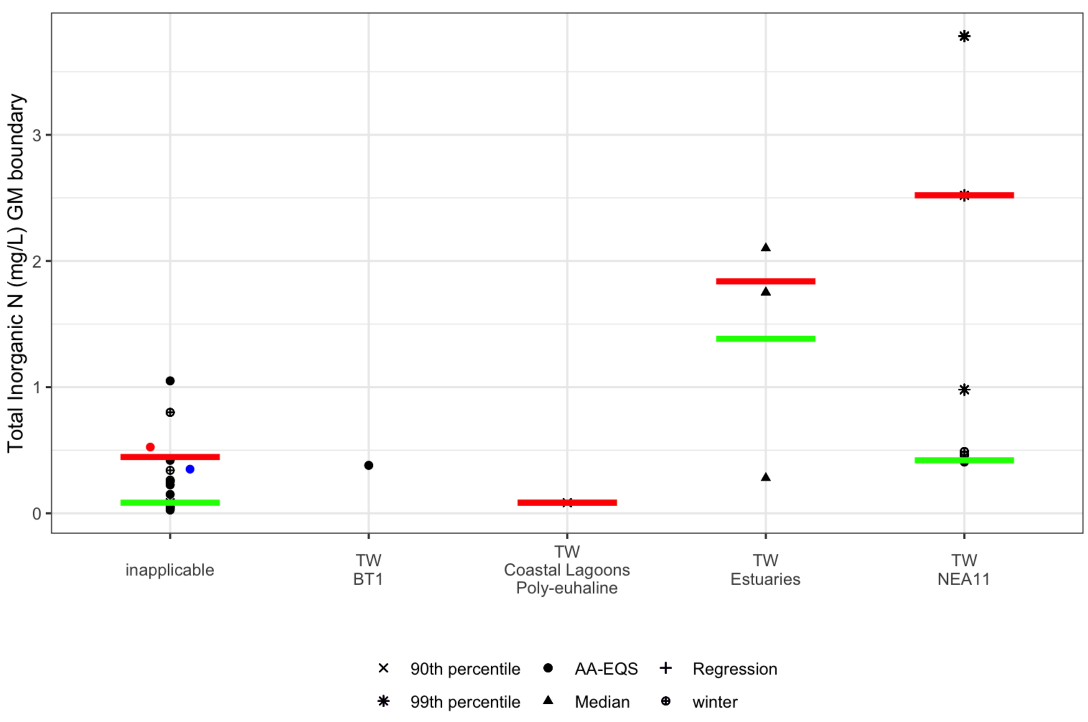


Figure 3.21: Transitional Total Inorganic N standards by IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles, (excluding standards based on quantiles).

Table 3.18 Overview of summary metric type and number of distinct standards for Total Inorganic N boundaries in transitional waters.

Country	Metric Type	Summary Metric	n
BE	central tendency seasonal	winter	1
DE	central tendency seasonal	winter	1
FR	central tendency seasonal	winter	2
FR	quantile annual	90th percentile	1
FR	quantile seasonal	90th percentile	1
HR	central tendency annual	Median	3
IT	central tendency annual	AA-EQS	2
PL	central tendency annual	AA-EQS	5
RO	central tendency annual	AA-EQS	1
SE	central tendency seasonal	winter	4
UK	central tendency seasonal	winter	1
UK	other	Regression	1
UK	quantile annual	99th percentile	3

Table 3.19 Overview of common types showing the number of country/national types/distinct standards for transitional Total Inorganic N.

IC code	IC type	Cntry	NatType	ValueStd
inapplicable	inapplicable	6	10	13
TW-BT1	Baltic Sea, transitional waters, salinity surface 0-8 psu bottom 0-8 psu, very sheltered	1	1	1
TW-CoastalLagoonsPolyeuhaline	Mediterranean Sea, Coastal Lagoons, polyeuhaline salinity 18-40 psu	1	2	1
TW-Estuaries	Mediterranean Sea, Estuaries, salt wedge type	1	1	3
TW-NEA11	North East Atlantic, transitional waters	3	14	7

3.5 Total Nitrogen

3.5.1 Total Nitrogen (coastal waters)

There were 148 records from 7 countries (Figure 3.22). All countries use central tendency measures as a summary metric, with many using the summer mean (Table 3.20). All countries (DE, EE, FI, GR, LT, NO, SE) use a single value for each national type and DE also presents additional standards as a range (reason for range not specified). Three countries (LT, SE, NO) present G/M boundary or set boundaries which refer salinity or reflect an adjustment to the salinity gradient.

The standards ranged from 0.11 mgN/L (GR) to 1.04 mgN/L (SE), with an interquartile range of 0.27 to 0.34 (Figure 3.23).

The data could be linked to 10 IC types (Figure 3.23 & Table 3.21). Only 2 of them (CW-BC3, CW-BC9) had type specific values from at least 2 countries allowing the range of standards within these types to be compared.

Few values are available to allow meaningful statistical comparisons across grouping factor(s), so no analysis of variance was applied to test the significance of GIG, IC Type, Country or other grouping factor effect.

More information in Annex A5.1

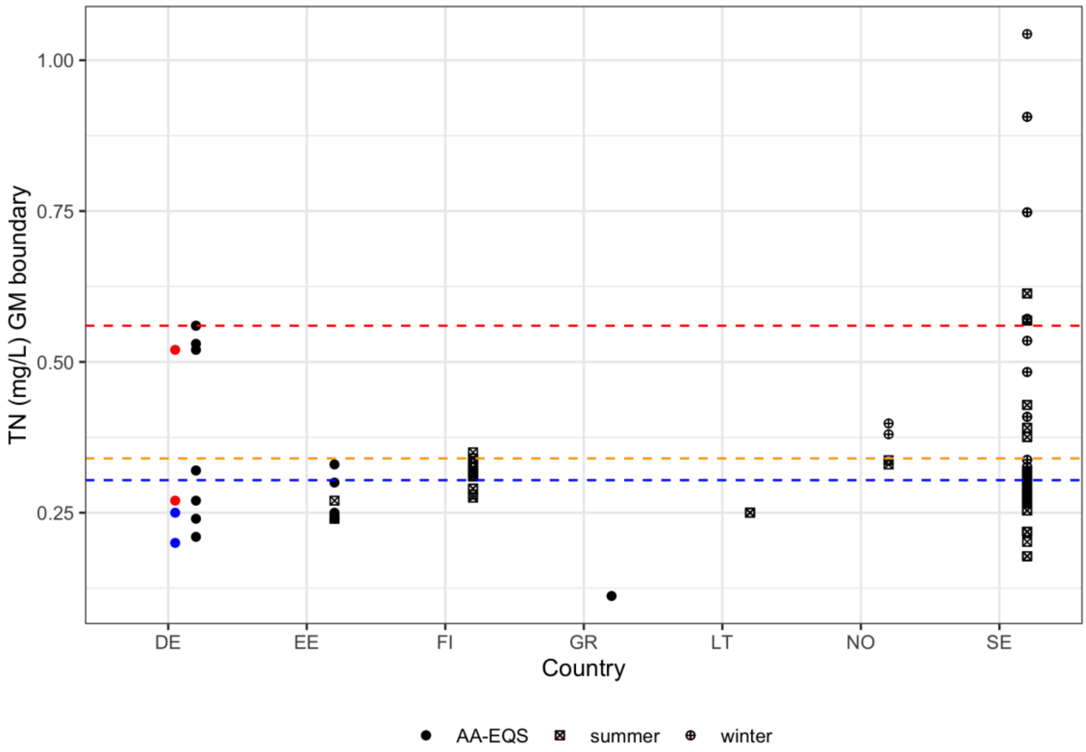


Figure 3.22: Comparison of coastal TN standards by country (single value black, minimum blue, maximum red symbols).

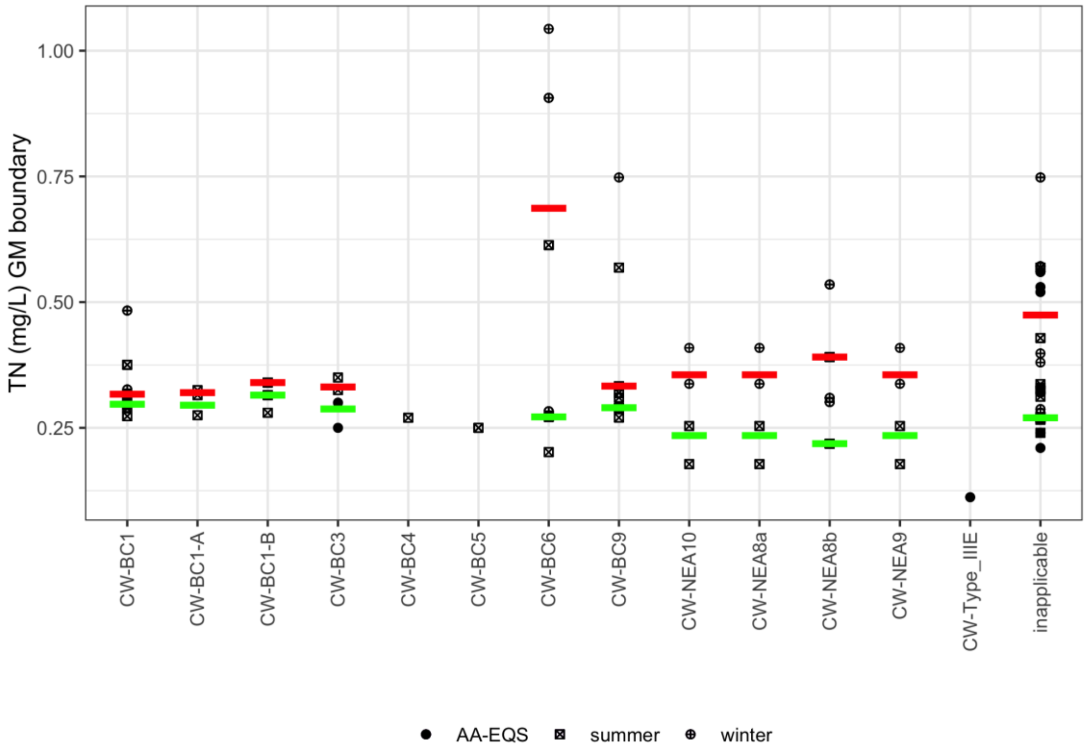


Figure 3.23: Coastal TN standards by IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles, (excluding standards based on quantiles).

Table 3.20 Overview of summary metric type and number of distinct standards for TN boundaries in coastal waters.

Country	Metric Type	Summary Metric	n
DE	central tendency annual	AA-EQS	9
EE	central tendency annual	AA-EQS	4
EE	central tendency seasonal	summer	2
FI	central tendency seasonal	summer	11
GR	central tendency annual	AA-EQS	1
LT	central tendency seasonal	summer	1
NO	central tendency seasonal	summer	2
NO	central tendency seasonal	winter	2
SE	central tendency seasonal	summer	20
SE	central tendency seasonal	winter	19

Table 3.21 Overview of common intercalibration types (IC) showing the number of country/national types/distinct standards for coastal TN.

IC code	IC type	Cntry	NatType	ValueStd
CW-BC1	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days	1	8	14
CW-BC1-A	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days	1	1	3
CW-BC1-B	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days	1	4	3
CW-BC3	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Sheltered, 90-150 ice days	2	3	4
CW-BC4	Baltic Sea, surface water salinity 5-8 psu, bottom water salinity 5-8 psu, Exposed, < 90 ice days	1	1	1
CW-BC5	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 6-12 psu, Exposed, <90 ice days	1	2	1
CW-BC6	Baltic Sea, surface water salinity 8-12 psu, bottom water salinity 8-12 psu, Sheltered, <90 ice days	1	3	6
CW-BC7	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 8-11 psu, Exposed, <90 ice days			
CW-BC9	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Moderately Exposed to exposed, 90-150 ice days	2	4	8
CW-BL1	Black Sea, mesohaline, microtidal, shallow, moderately exposed, mixed substratum			
CW-NEA1/26	North East Atlantic, open oceanic or enclosed seas, exposed or sheltered, euhaline, shallow (< 30 m), microtidal or mesotidal, fully mixed or partly stratified			
CW-NEA10	Skagerrak Outer Arc Type, polyhaline, microtidal, exposed, deep	1	1	4
CW-NEA7	North East Atlantic, deep fjordic and sea loch systems			
CW-NEA8a	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (25-30), microtidal, moderately exposed, shallow, fully mixed	1	1	4
CW-NEA8b	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (10-30), microtidal, moderately sheltered, shallow, partly stratified	1	4	5
CW-NEA9	North East Atlantic, fjord with a shallow sill at the mouth with very deep maximum depth in the central basin with poor deepwater exchange	1	1	4
CW-Type_IIA	Mediterranean Sea, moderately influenced by freshwater input (continent influence)			
CW-Type_IIA_Adriatic	Mediterranean Adriatic coast, moderately influenced by freshwater input (continent influence), Adriatic coast			
CW-Type_IIIE	Mediterranean (Eastern Basin), not affected by freshwater input	1	1	1
CW-Type_IIIW	Mediterranean (Western Basin), continental coast, not influenced by freshwater input			
CW-Type_Island-W	Mediterranean (Western Basin), island coast			
inapplicable	inapplicable	5	20	24

3.5.2 Total Nitrogen (transitional waters)

There were 46 records from 9 countries (Figure 3.24). The majority of countries use the annual mean ("AA-EQS") as a summary metric, but others also use seasonal means (Table 3.23). All countries (BE, BG, DE, ES, FR, LT, NL, PL, SE) use a single value for each national type. Four countries (BE, LT, NL, SE) present G/M boundary or set of boundaries which refer salinity or reflect an adjustment to the salinity gradient (Figure A5.2-1).

The standards ranged from 0.22 mgN/L (SE) to 10 mgN/L (ES), with an interquartile range of 0.4 to 1.29 (Figure 3.25).

The data could be linked to 3 IC types (Figure 3.25 & Table 3.24), but only 2 types had data from at least 2 countries allowing the range of standards in these types to be compared. Few values are available to allow meaningful statistical comparisons across grouping factor(s), so no analysis of variance was applied to test the significance of GIG, IC Type, Country or other grouping factor effect.

More information in Annex A5.2

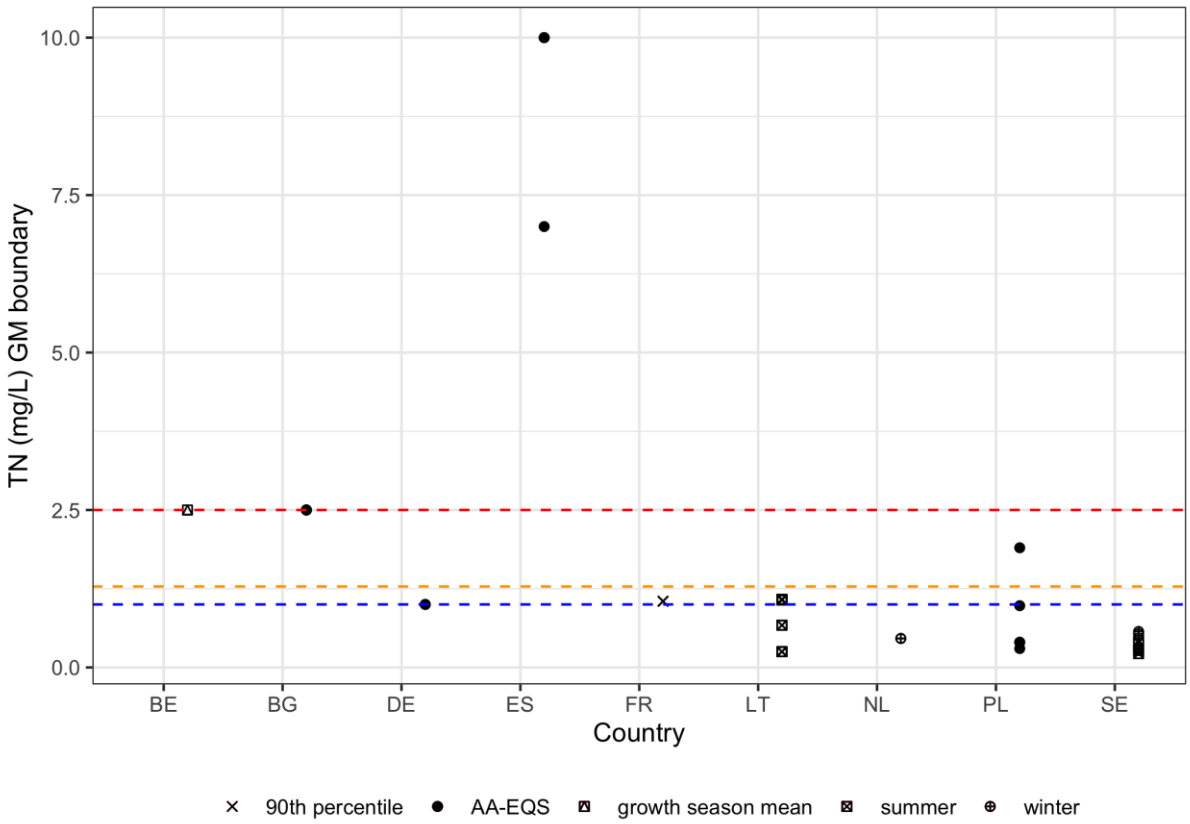


Figure 3.24: Comparison of transitional TN standards by country (single value black, minimum blue, maximum red symbols).

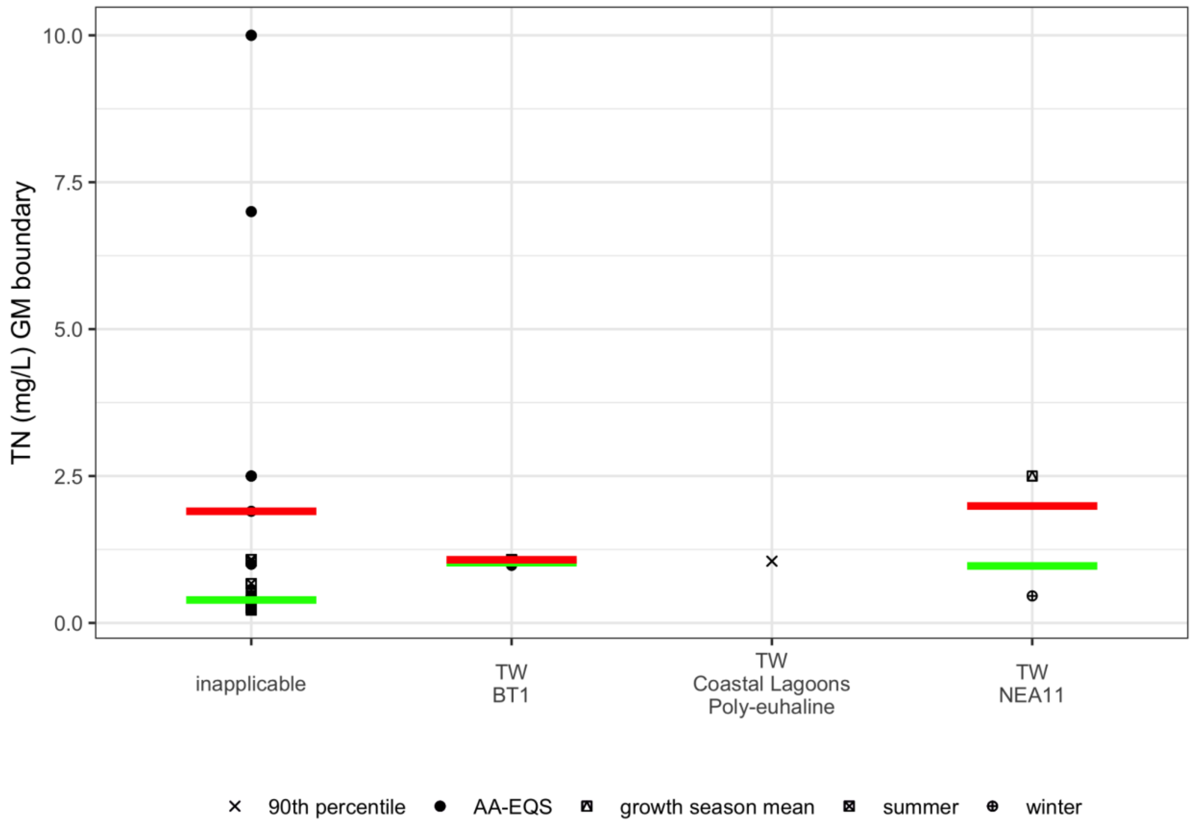


Figure 3.25: Transitional TN standards by IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles, (excluding standards based on quantiles).

Table 3.23 Overview of summary metric type and number of distinct standards for TN boundaries in transitional waters.

Country	Metric Type	Summary Metric	n
BE	central tendency seasonal	growth season mean	2
BG	central tendency annual	AA-EQS	1
DE	central tendency annual	AA-EQS	1
ES	central tendency annual	AA-EQS	2
FR	quantile seasonal	90th percentile	1
LT	central tendency seasonal	summer	5
NL	central tendency seasonal	winter	1
PL	central tendency annual	AA-EQS	4
SE	central tendency seasonal	summer	4
SE	central tendency seasonal	winter	4

Table 3.24 Overview of common types showing the number of country/national types/distinct standards for transitional TN.

IC code	IC type	Cntry	NatType	ValueStd
inapplicable	inapplicable	7	12	20
TW-BT1	Baltic Sea, transitional waters, salinity surface 0-8 psu bottom 0-8 psu, very sheltered	2	3	4
TW-CoastalLagoonsPolyeuhaline	Mediterranean Sea, Coastal Lagoons, polyeuhaline salinity 18-40 psu	1	2	1
TW-Estuaries	Mediterranean Sea, Estuaries, salt wedge type			
TW-NEA11	North East Atlantic, transitional waters	2	2	3

3.6 Orthophosphate

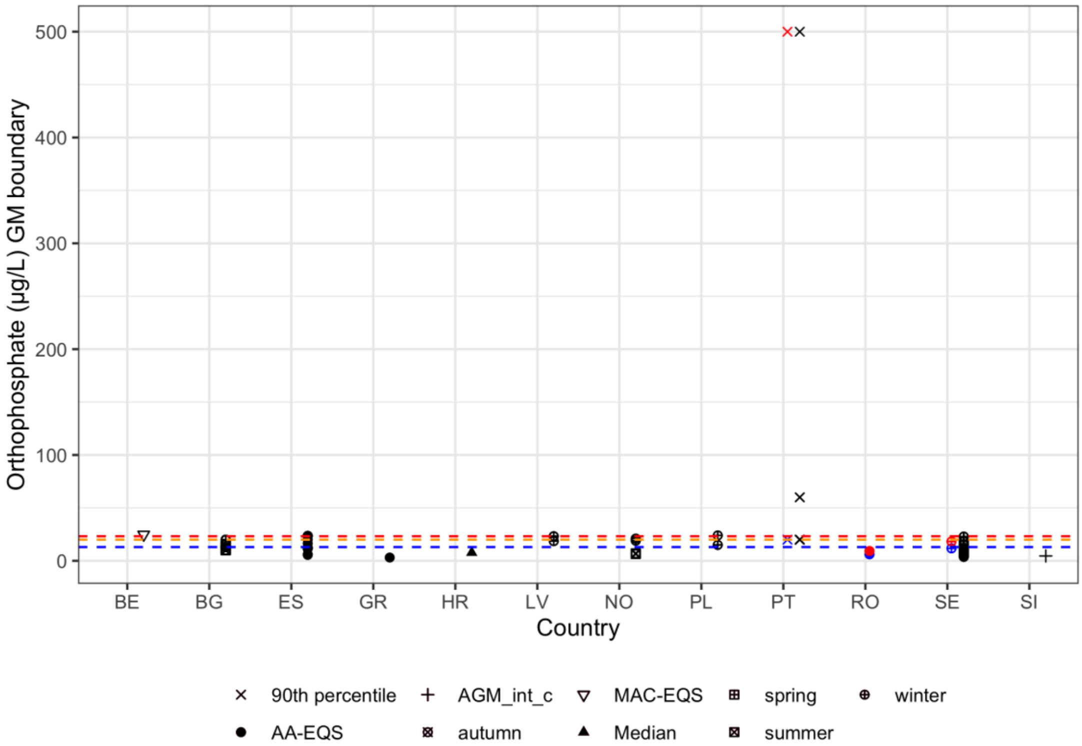
3.6.1 Orthophosphate (coastal waters)

There were 141 records from 12 countries (Figure 3.26). Most countries use a central tendency seasonal measure as a summary metric, often winter mean and by northern countries (Table 3.25). 11 countries (BE, BG, ES, GR, HR, LV, NO, PL, PT, SE, SI) use a single value for each national type and 2 countries (PT, RO) present standards as a range, which refer to subType specific boundaries.

The data could be linked to 13 IC types (Figure 3.27 & Table 3.25), 4 of which had type specific values from at least 2 countries allowing the range of standards within these types to be compared.

The standards ranged from 3.1 µgP/L (GR) to 60 µgP/L (PT) with a very extreme value of 500 µgP/L (PT), with an interquartile range of 10 to 20 (Figure 3.27). A few countries (SE, NO, PT) present G/M boundary or set of boundaries which refer salinity or reflect an adjustment to the salinity gradient (Figure 3.28).

More information in Annex A6.1



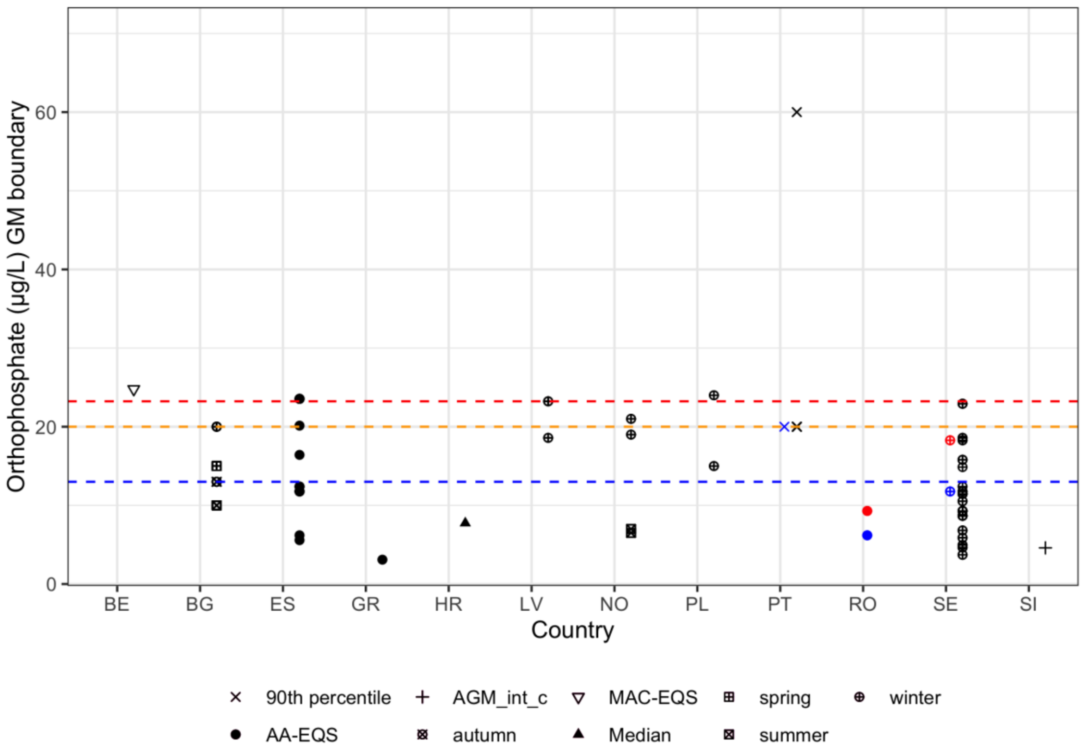


Figure 3.26: Comparison of coastal Orthophosphate standards by country (single value black, minimum blue, maximum red symbols). Top graph includes all values, bottom graph hides extreme values of 500 µg P/L (PT).

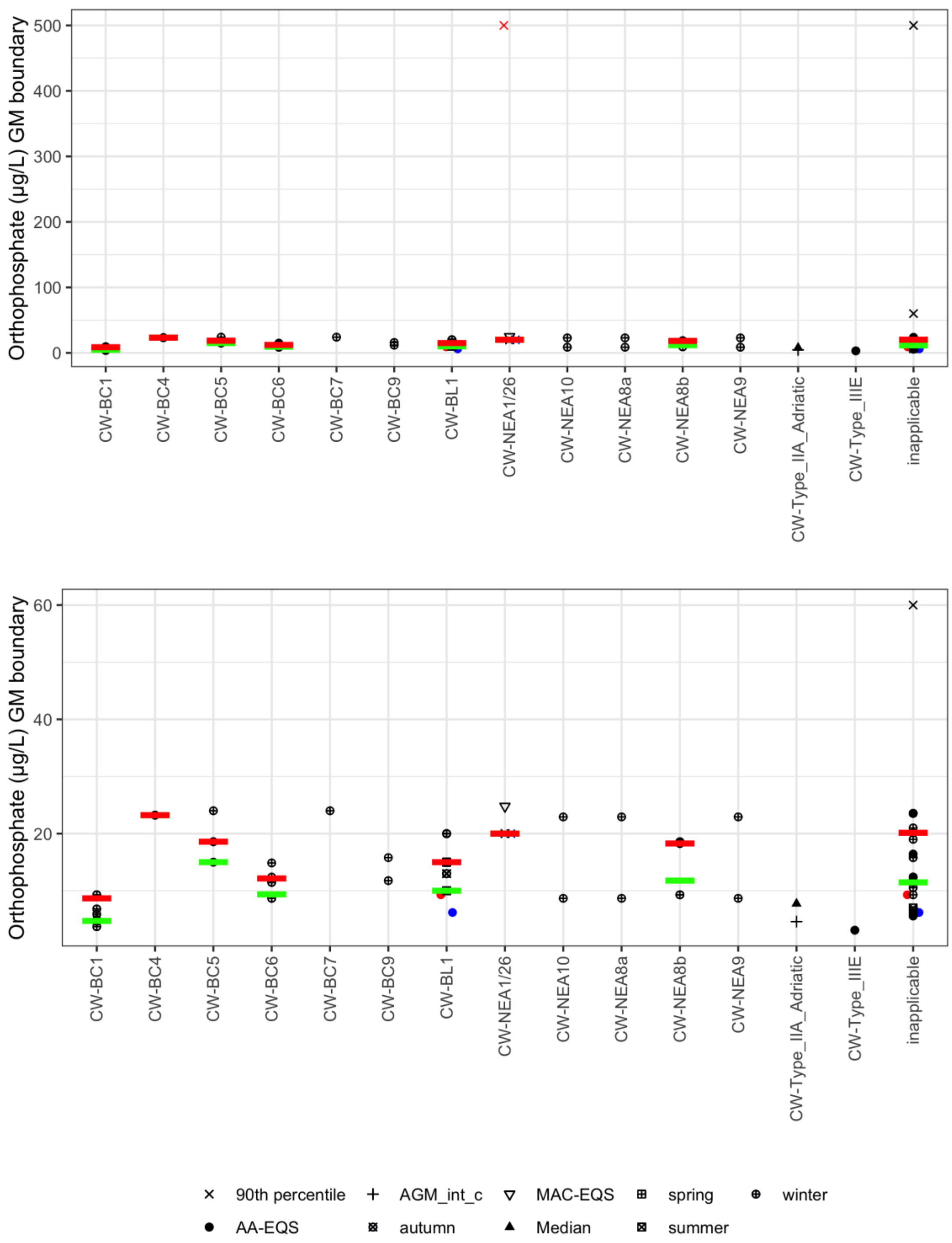


Figure 3.27: Orthophosphate standards by IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles, (excluding standards based on quantiles). Top graph includes all values, bottom graph hides extreme values of 500 µg P/L (PT).

Table 3.25 Overview of summary metric type and number of distinct standards for Orthophosphate boundaries in coastal waters.

Country	Metric Type	Summary Metric	n
BE	quantile annual	MAC-EQS	1
BG	central tendency seasonal	autumn	1
BG	central tendency seasonal	spring	1
BG	central tendency seasonal	summer	1
BG	central tendency seasonal	winter	1
ES	central tendency annual	AA-EQS	7
GR	central tendency annual	AA-EQS	1
HR	central tendency annual	Median	1
LV	central tendency seasonal	winter	2
NO	central tendency seasonal	summer	2
NO	central tendency seasonal	winter	2
PL	central tendency seasonal	winter	2
PT	quantile annual	90th percentile	4
RO	central tendency annual	AA-EQS	1
SE	central tendency seasonal	winter	17
SI	central tendency annual	AGM_int_c	1

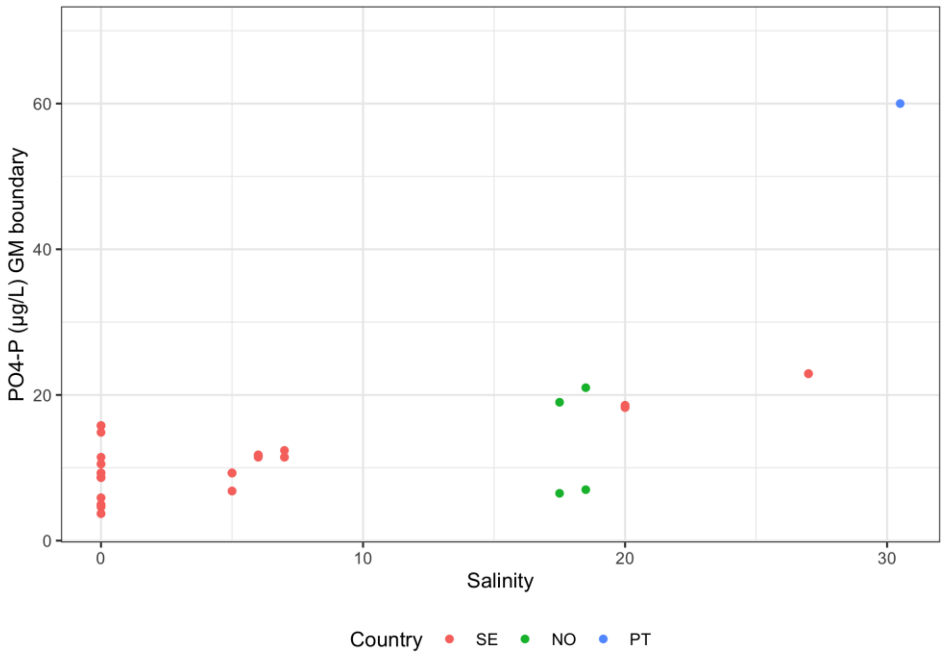


Figure 3.28: Orthophosphate standards for which a salinity value was associated. Extreme values of 500 µg P/L (PT) at salinities 20 and 30 not plotted.

Table 3.26 Overview of common types showing the number of country/national types/distinct standards for coastal Orthophosphate

IC code	IC type	Cntry	NatType	ValueStd
CW-BC1	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days	1	8	7
CW-BC1-A	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days			
CW-BC1-B	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days			
CW-BC3	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Sheltered, 90-150 ice days			
CW-BC4	Baltic Sea, surface water salinity 5-8 psu, bottom water salinity 5-8 psu, Exposed, < 90 ice days	1	3	1
CW-BC5	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 6-12 psu, Exposed, <90 ice days	2	2	3
CW-BC6	Baltic Sea, surface water salinity 8-12 psu, bottom water salinity 8-12 psu, Sheltered, <90 ice days	1	3	4
CW-BC7	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 8-11 psu, Exposed, <90 ice days	1	1	1
CW-BC9	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Moderately Exposed to exposed, 90-150 ice days	1	1	2
CW-BL1	Black Sea, mesohaline, microtidal, shallow, moderately exposed, mixed substratum	2	2	5
CW-NEA1/26	North East Atlantic, open oceanic or enclosed seas, exposed or sheltered, euhaline, shallow (< 30 m), microtidal or mesotidal, fully mixed or partly stratified	2	9	2
CW-NEA10	Skagerrak Outer Arc Type, polyhaline, microtidal, exposed, deep	1	1	2
CW-NEA7	North East Atlantic, deep fjordic and sea loch systems			
CW-NEA8a	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (25-30), microtidal, moderately exposed, shallow, fully mixed	1	1	2
CW-NEA8b	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (10-30), microtidal, moderately sheltered, shallow, partly stratified	1	4	4
CW-NEA9	North East Atlantic, fjord with a shallow sill at the mouth with very deep maximum depth in the central basin with poor deepwater exchange	1	1	2
CW-Type_IIA	Mediterranean Sea, moderately influenced by freshwater input (continent influence)			
CW-Type_IIA_Adriatic	Mediterranean Adriatic coast, moderately influenced by freshwater input (continent influence), Adriatic coast	2	2	2
CW-Type_IIIE	Mediterranean (Eastern Basin), not affected by freshwater input	1	1	1
CW-Type_IIIW	Mediterranean (Western Basin), continental coast, not influenced by freshwater input			
CW-Type_Island-W	Mediterranean (Western Basin), island coast			
inapplicable	inapplicable	5	9	20

3.6.2 Orthophosphate (transitional waters)

There were 107 records from 11 countries (Figure 3.29). Most countries use the annual mean ("AA-EQS") as a summary metric (Table 3.27). All countries (BE, BG, ES, FR, HR, IE, IT, LV, PL, PT, SE) use a single value for each national type with no standards as a range.

The data could be linked to 4 IC types (Figure 3.29 & Table 3.28), but only one (NEA11) had type specific values from at least 2 countries to allow the range of standards within type to be compared (Figure A6.2-1).

The standards ranged from 0.04 µgP/L (ES) to 140 µgP/L (BE), with an interquartile range of 30.98 to 90 (Figure 3.29). Other countries (BE, IE, PT, SE) present G/M boundary or set of boundaries which refer salinity or reflect an adjustment to the salinity gradient (Figure 3.30).

More information in Annex A6.2

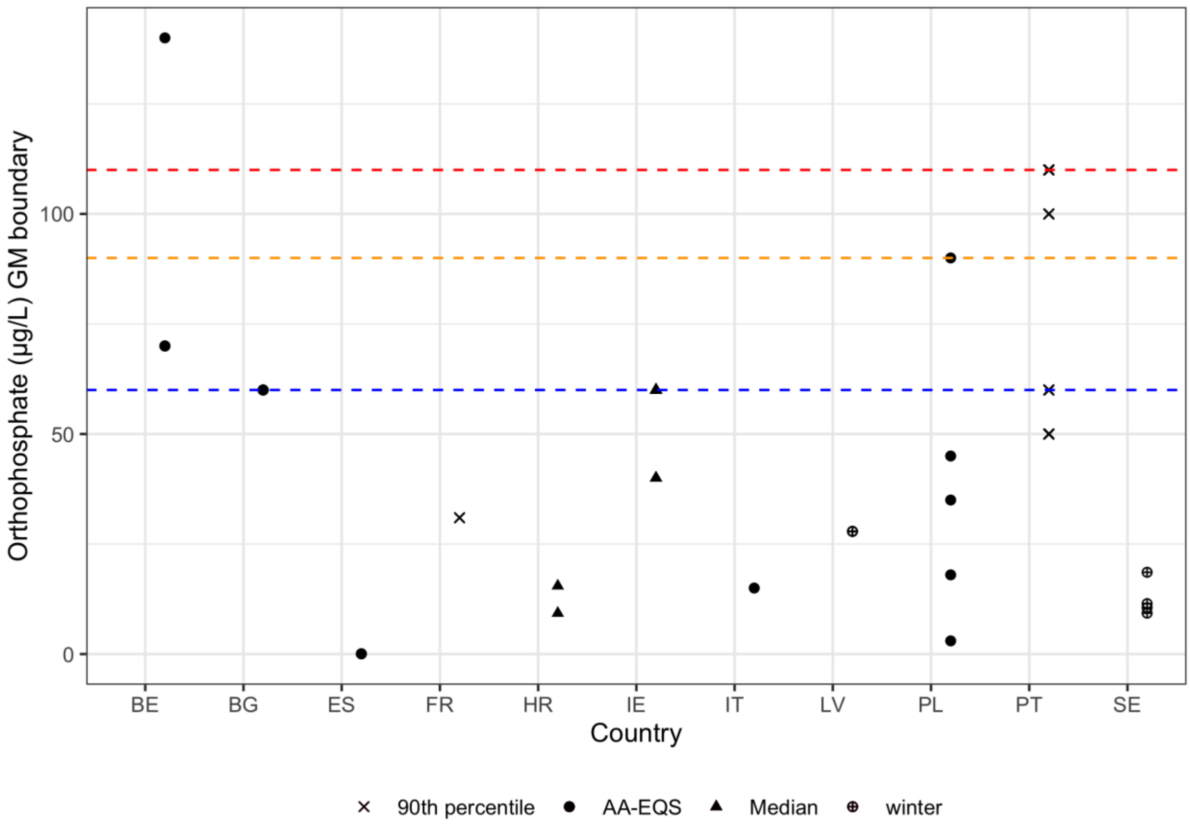


Figure 3.28: Comparison of transitional Orthophosphate standards by country (single value black, minimum blue, maximum red symbols).

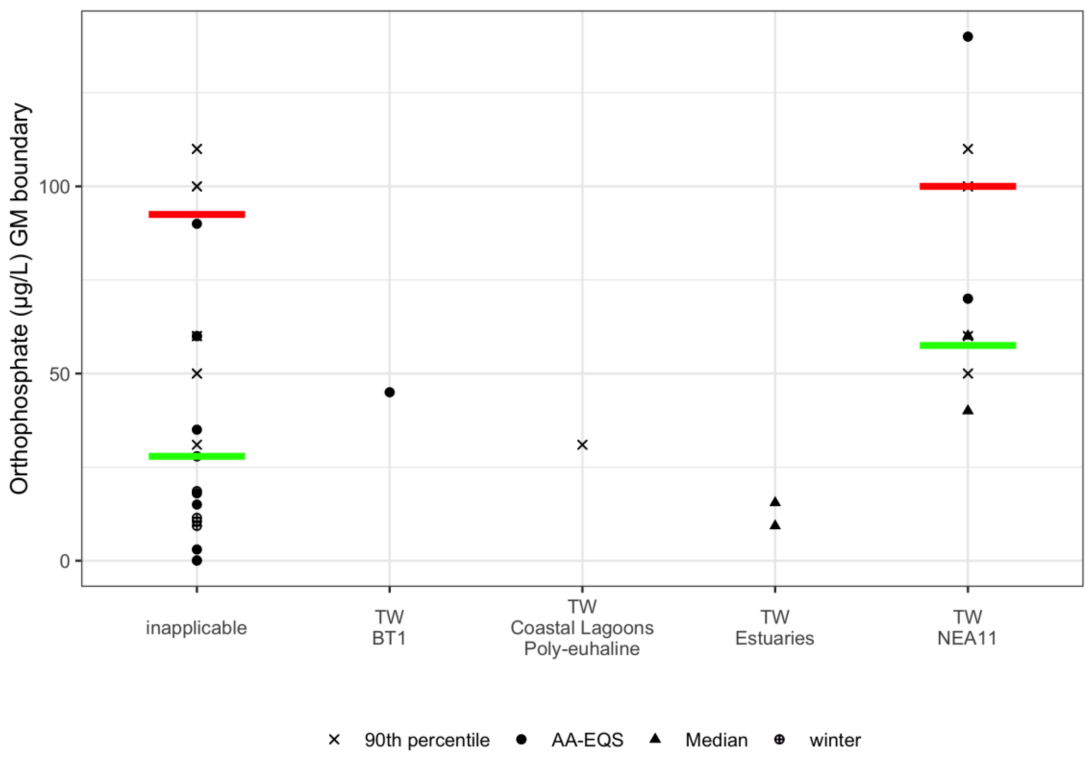


Figure 3.29 Transitional Orthophosphate standards by IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles, (excluding standards based on quantiles).

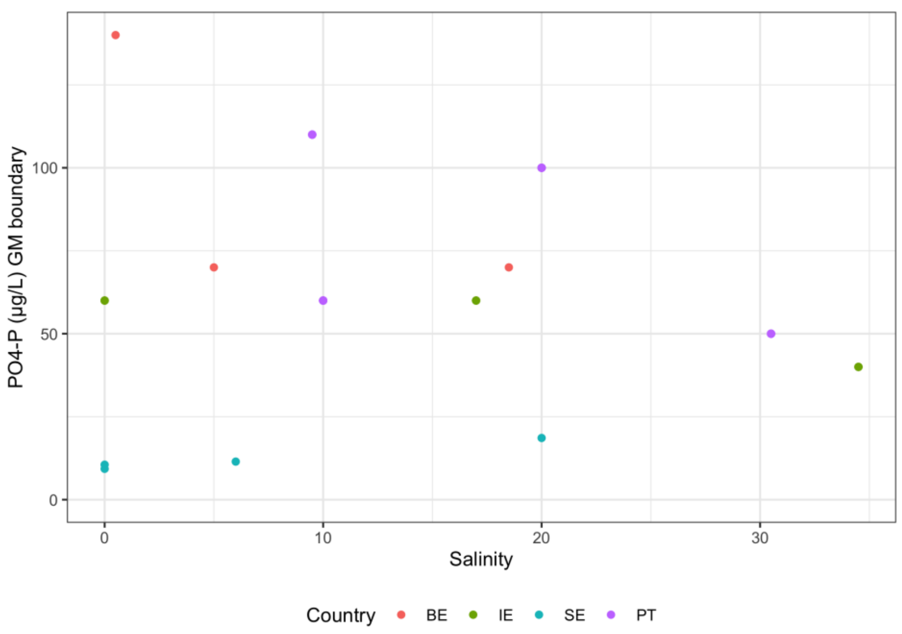


Figure 3.30 Orthophosphate standards for which a salinity value was associated.

Table 3.27 Overview of summary metric type and number of distinct standards for Orthophosphate boundaries in transitional waters.

Country	Metric Type	Summary Metric	n
BE	central tendency annual	AA-EQS	3
BG	central tendency annual	AA-EQS	1
ES	central tendency annual	AA-EQS	2
FR	quantile annual	90th percentile	1
FR	quantile seasonal	90th percentile	1
HR	central tendency annual	Median	2
IE	central tendency annual	Median	3
IT	central tendency annual	AA-EQS	1
LV	central tendency seasonal	winter	1
PL	central tendency annual	AA-EQS	5
PT	quantile annual	90th percentile	5
SE	central tendency seasonal	winter	4

Table 3.28 Overview of common types showing the number of country/national types/distinct standards for transitional Orthophosphate

IC code	**IC type**	**Cntry**	**NatType**	**ValueStd**
inapplicable	inapplicable	8	16	18
TW-BT1	Baltic Sea, transitional waters, salinity surface 0-8 psu bottom 0-8 psu, very sheltered	1	1	1
TW-CoastalLagoonsPolyeuhaline	Mediterranean Sea, Coastal Lagoons, polyeuhaline salinity 18-40 psu	1	2	1
TW-Estuaries	Mediterranean Sea, Estuaries, salt wedge type	1	1	2
TW-NEA11	North East Atlantic, transitional waters	3	9	8

3.7 Total Phosphorus

3.7.1 Total Phosphorus (coastal waters)

There were 161 records from 12 countries (Figure 3.31). Most countries use the summer mean ("summer") as a summary metric (Table 3.29). 11 countries (DE, EE, FI, GR, HR, LT, NO, PL, PT, SE, SI) use a single value for each national type and 1 country (RO) presents standards as a range, which refer to subType specific boundaries.

The standards ranged from 6.81 µg P/L (SE) to 100 µg P/L (EE), with an interquartile range of 13 to 25 (Figure 3.31). A few countries (LT, NO, SE) present G/M boundary or set of boundaries which refer salinity or reflect an adjustment to the salinity gradient (Figure 3.32).

The data could be linked to 14 IC types (Figure 3.33 & Table 3.30). 4 of these had type specific values from at least 2 countries allowing the range of standards within these types to be compared.

More information in Annex A7.1

Table 3.29 Overview of summary metric type and number of distinct standards for TP boundaries in coastal waters.

Country	Metric Type	Summary Metric	n
DE	central tendency annual	AA-EQS	9
EE	central tendency seasonal	summer	4
FI	central tendency seasonal	summer	10
GR	central tendency annual	AA-EQS	1
HR	central tendency annual	Median	1
LT	central tendency seasonal	summer	1
NO	central tendency seasonal	summer	2
NO	central tendency seasonal	winter	2
PL	central tendency seasonal	summer	3
PT	quantile annual	95th percentile	1
RO	central tendency annual	AA-EQS	1
SE	central tendency seasonal	summer	17
SE	central tendency seasonal	winter	21
SI	central tendency annual	AGM_int_c	1

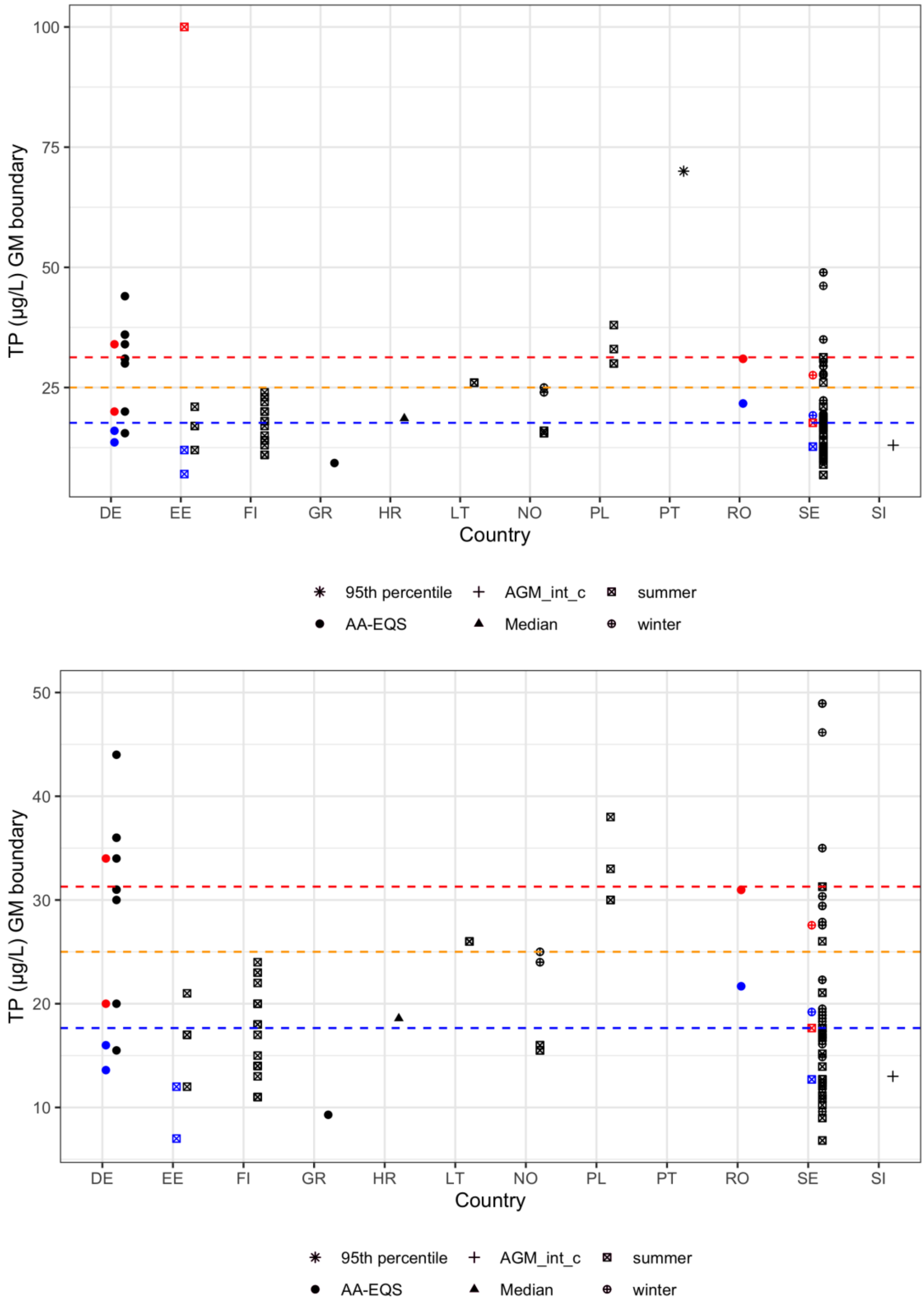


Figure 3.31 Comparison of coastal Total Phosphorus standards by country (single value black, minimum blue, maximum red symbols). Top graph shows all values, bottom graph hides values > 50 µg P/L.

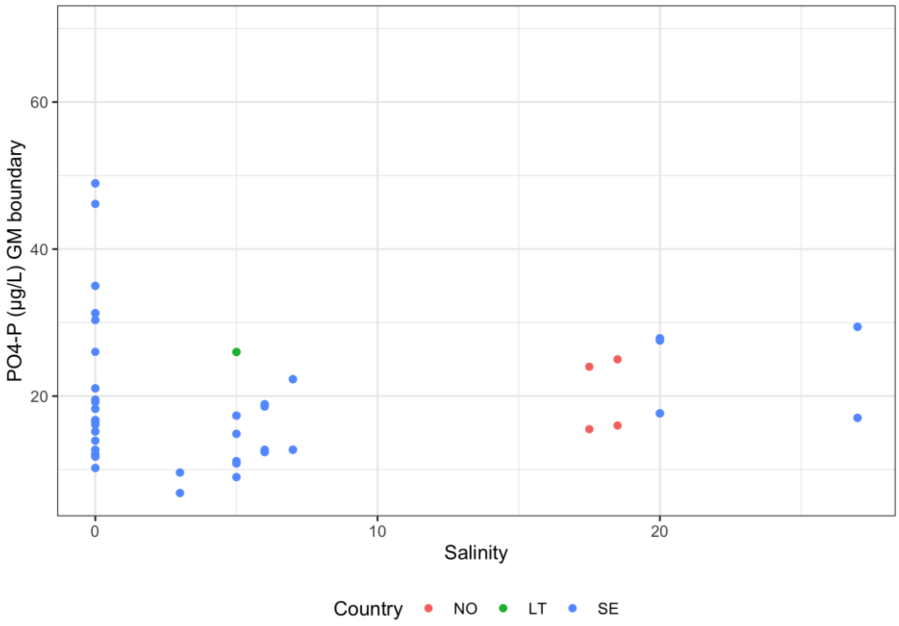


Figure 3.32 TP standards for which a salinity value was associated.

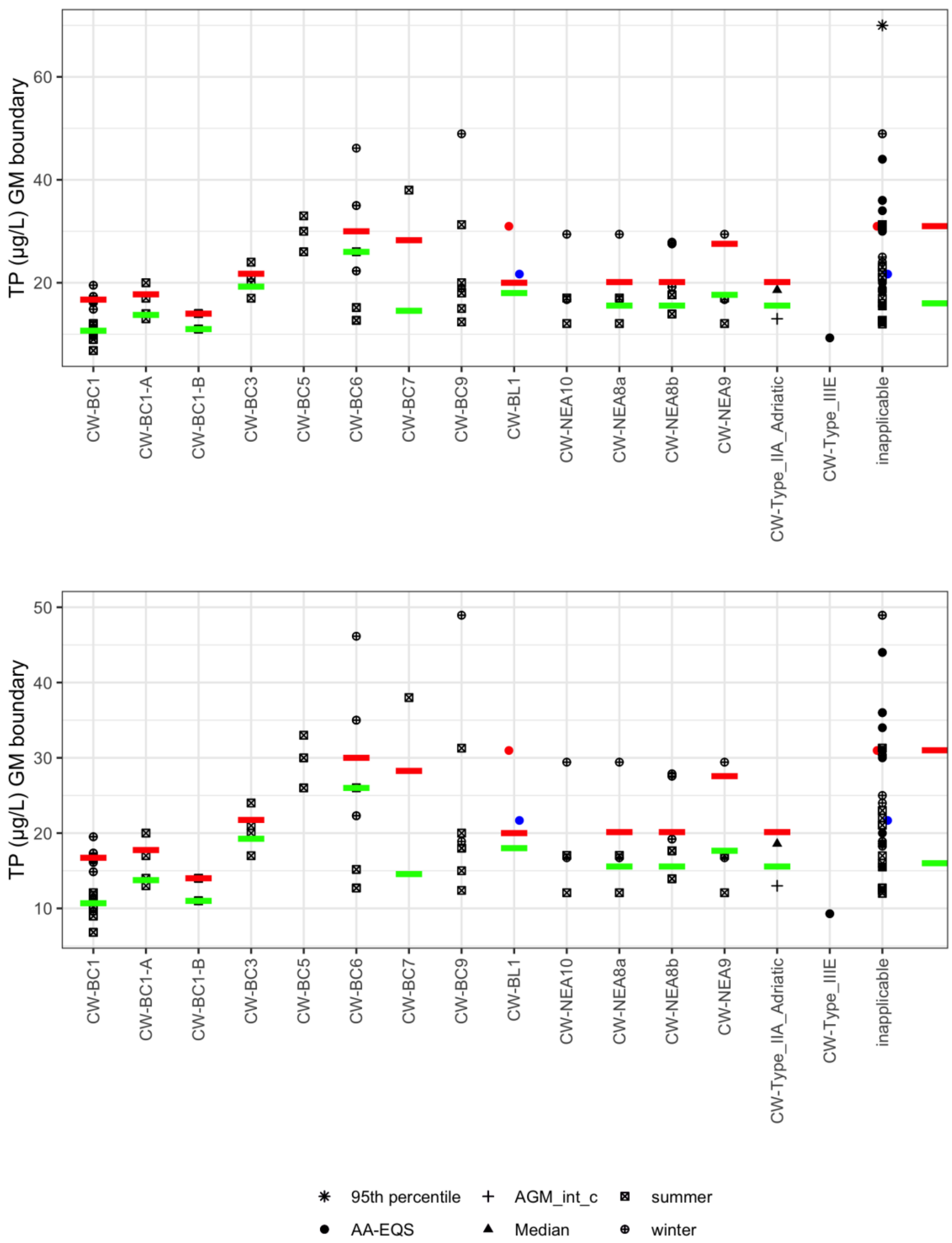


Figure 3.33 Coastal TP standards by IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles, (excluding standards based on quantiles). Top graph shows all values, bottom graph hides values > 50 µg P/L.

Table 3.30 Overview of common types showing the number of country/national types/distinct standards for coastal TP.

ICcode.TRAC	ICType	Cntry	NatType	ValueStd
CW-BC1	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days	1	8	14
CW-BC1-A	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days	1	1	4
CW-BC1-B	Baltic Sea, surface water salinity 0.5-6 psu, bottom water salinity 1-6 psu, Exposed, 90-150 ice days	1	4	2
CW-BC3	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Sheltered, 90-150 ice days	2	3	4
CW-BC4	Baltic Sea, surface water salinity 5-8 psu, bottom water salinity 5-8 psu, Exposed, < 90 ice days	1	1	1
CW-BC5	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 6-12 psu, Exposed, <90 ice days	2	2	3
CW-BC6	Baltic Sea, surface water salinity 8-12 psu, bottom water salinity 8-12 psu, Sheltered, <90 ice days	1	3	6
CW-BC7	Baltic Sea, surface water salinity 6-8 psu, bottom water salinity 8-11 psu, Exposed, <90 ice days	1	1	1
CW-BC9	Baltic Sea, surface water salinity 3-6 psu, bottom water salinity 3-6 psu, Moderately Exposed to exposed, 90-150 ice days	2	4	7
CW-BL1	Black Sea, mesohaline, microtidal, shallow, moderately exposed, mixed substratum	1	1	1
CW-NEA1/26	North East Atlantic, open oceanic or enclosed seas, exposed or sheltered, euhaline, shallow (< 30 m), microtidal or mesotidal, fully mixed or partly stratified			
CW-NEA10	Skagerrak Outer Arc Type, polyhaline, microtidal, exposed, deep	1	1	4
CW-NEA7	North East Atlantic, deep fjordic and sea loch systems			
CW-NEA8a	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (25-30), microtidal, moderately exposed, shallow, fully mixed	1	1	4
CW-NEA8b	North East Atlantic, Skagerrak Inner Arc Type, polyhaline (10-30), microtidal, moderately sheltered, shallow, partly stratified	1	4	6
CW-NEA9	North East Atlantic, fjord with a shallow sill at the mouth with very deep maximum depth in the central basin with poor deepwater exchange	1	1	4
CW-Type_IIA	Mediterranean Sea, moderately influenced by freshwater input (continent influence)			
CW-Type_IIA_Adriatic	Mediterranean Adriatic coast, moderately influenced by freshwater input (continent influence), Adriatic coast	2	2	2
CW-Type_IIIE	Mediterranean (Eastern Basin), not affected by freshwater input	1	1	1
CW-Type_IIIW	Mediterranean (Western Basin), continental coast, not influenced by freshwater input			
CW-Type_Island-W	Mediterranean (Western Basin), island coast			
inapplicable	inapplicable	7	22	28

3.7.2 Total Phosphorus (transitional waters)

There were 45 records from 10 countries (Figure 3.34), after removing extreme values of 1000 and 2000 μgP/L reported by ES from this overview (FigureA7.2-1). The annual mean ("AA-EQS") is the most used as summary metric, by three countries (Table. 3.31). 9 countries (BE, BG, DE, FR, HR, LT, PL, PT, SE) use a single value for each national type and 1 country (RO) presents standards as a range, which refer to subType specific boundaries (Figure 3.34). Other countries (BE, LT, SE) present G/M boundary or set of boundaries which refer salinity or reflect an adjustment to the salinity gradient (Figure 3.35).

The standards ranged from 12.7 μgP/L (SE) to 150 μgP/L (PL), with an interquartile range of 27.88 to 80 (Figure 3.34), excluding the extreme boundary values of 1000 and 2000 μg P/L (ES) excluded for this analysis due to the high discrepancy (but see Annex 3.3.5 for graphs).

The data could be linked to 4 IC types (Figure 3.36 & Table 3.32). Only 1 of these (BT1) had type specific values from at least 2 countries allowing the range of standards in these types to be compared.

More information in Annex A7.2

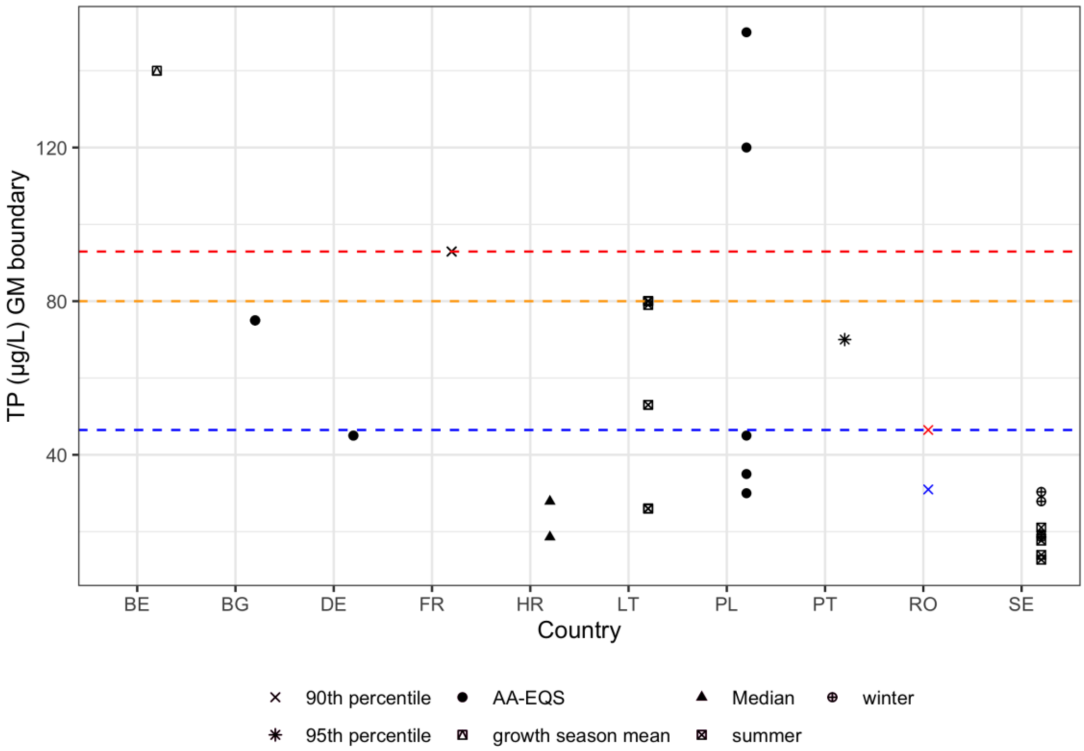


Figure 3.34 Comparison of transitional TP standards by country (single value black, minimum blue, maximum red symbols). (ES G/M boundaries of 1000 and 2000 μg P/L excluded).

Table 3.31 Overview of summary metric type and number of distinct standards for TP boundaries in transitional waters.

Country	Metric Type	Summary Metric	n
BE	central tendency seasonal	growth season mean	2
BG	central tendency annual	AA-EQS	1
DE	central tendency annual	AA-EQS	1
FR	quantile annual	90th percentile	1
FR	quantile seasonal	90th percentile	1

Country	Metric Type	Summary Metric	n
HR	central tendency annual	Median	2
LT	central tendency seasonal	summer	5
PL	central tendency annual	AA-EQS	5
PT	quantile annual	95th percentile	1
RO	quantile annual	90th percentile	1
SE	central tendency seasonal	summer	4
SE	central tendency seasonal	winter	4

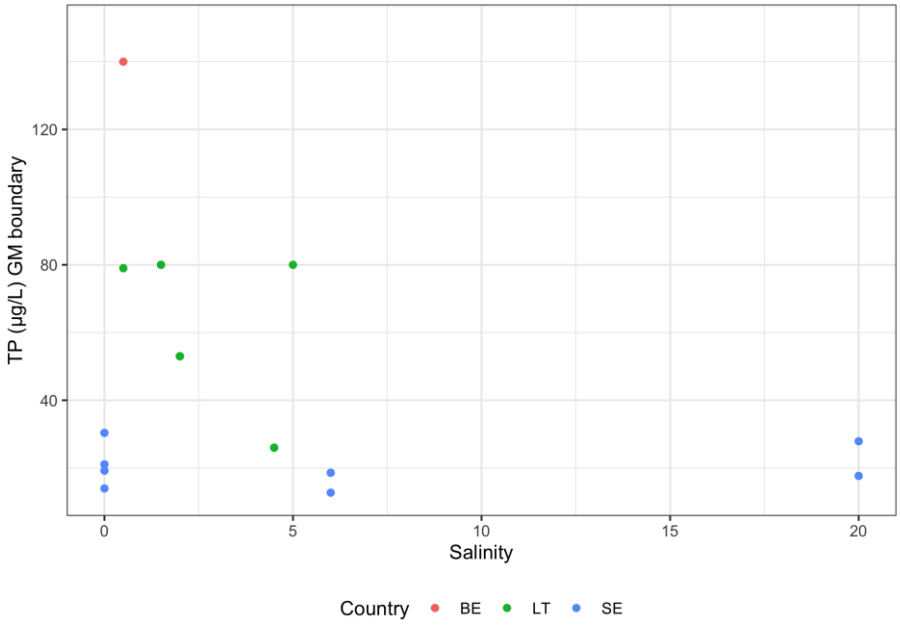


Figure 3.35 TP standards for which a salinity value was associated.

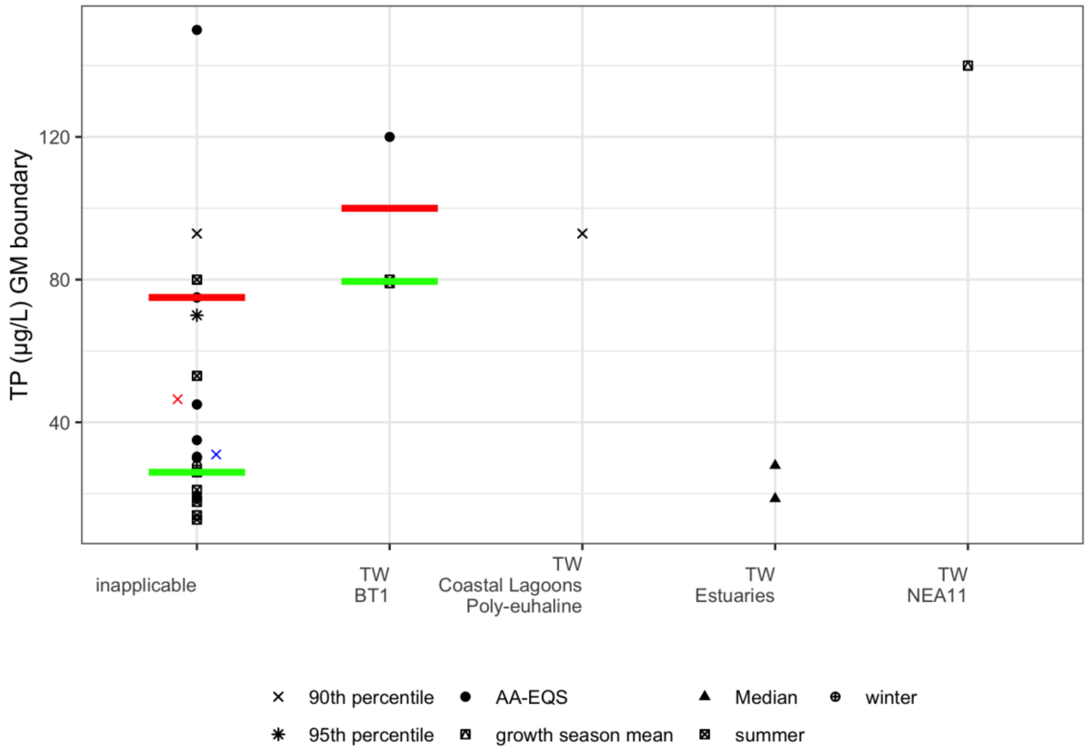


Figure 3.36 Transitional TP standards by IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles, (excluding standards based on quantiles). (ES G/M boundaries of 1000 and 2000 µg P/L excluded).

Table 3.32 Overview of common types showing the number of country/national types/distinct standards for transitional TP.

IC code	IC type	Cntry	NatType	ValueStd
inapplicable	inapplicable	8	13	20
TW-BT1	Baltic Sea, transitional waters, salinity surface 0-8 psu bottom 0-8 psu, very sheltered	2	3	4
TW-CoastalLagoonsPolyeuhaline	Mediterranean Sea, Coastal Lagoons, polyeuhaline salinity 18-40 psu	1	2	1
TW-Estuaries	Mediterranean Sea, Estuaries, salt wedge type	1	1	2
TW-NEA11	North East Atlantic, transitional waters	1	1	2

4 Discussion

4.1 General comments

The previous chapter catalogued standards used by Member states for different physico-chemical supporting elements and made some very tentative comparisons between countries. In some cases, there are clear differences between countries. These might be due to the way that the standard was set (e.g. expert judgment rather than derived empirically) but might also be due to differences in aggregation rules, assessment concept (which part of the water column was sampled, for example, in the case of oxygen), the summary statistics used, and boundaries adjustment to other factors (for example, salinity range, subtypes conditions). All of this will complicate direct comparisons of national standards.

In this chapter we first make some general comments on each of the physico-chemical supporting elements separately, with an evaluation of the desirability and practicality of future harmonisation of each. Note that the comments offer an EU-wide overview of the situation for each supporting element, in order to focus the work of ECOSTAT and should not be interpreted as endorsing any particular national standard. That responsibility remains with Member States.

Many of these supporting elements do not act in isolation: they may form part of a “cocktail” of stressors produced by a single pressure or they may, themselves, reflect the action of other stressors on one BQE whilst, simultaneously, exerting a direct effect on another BQE.

4.2 Comments on individual supporting elements

4.2.1 Dissolved oxygen

The fate and behaviour of dissolved oxygen is of critical importance to marine organisms in determining the severity of adverse impacts. Also important are the factors affecting the degree of fluctuations in dissolved oxygen levels. At some coastal sites, eutrophication from nearby rivers appears to be the main cause of hypoxia (Kemp et al.,2005; Rabalais et al.,2002). But at other sites on the continental shelf and in the deep ocean, changes in ocean circulation or in winter ventilation also play a role in lowering oxygen concentration (Gilbert et al., 2010).

The dissolved oxygen content in seawater is controlled by several unrelated processes including exchange with air, metabolism of plants and animals, microbial and chemical decomposition of organic matter, hydrodynamic features such as mixing, advection, convection, and up- or down-welling. The DO content is always the result of multifactorial influences and the reasons for changes may be difficult to assess (Helcom,2015).

In practical terms, the dissolved oxygen in sea waters ranges from 11,1 (0 °C) to 6,2 mg O2/L (30 °C) (Murray & Riley, 1962). In the open sea and shelf waters, O2 rarely drops to very low levels since a constant supply is maintained to the deeper layers of the sea by seasonal overturn and also by diffusion process. Exception to this rule occurs in certain areas of the sea such as the Baltic Sea, the Adriatic Sea, and the Black sea, where the total organic matter is so high in relation to water renewal that its degradation by bacteria at lower depths causes near complete depletion of dissolved O2 (<0,1 ml O2/L) (Topping, 1976; Capet et al., 2016).

Oxygen concentrations above 6 mg O2/L are considered to support marine life with minimal problems. In the marine environment chronic and acute oxygen deficiency occurs when levels fall between 2 and 6 mg O2/L and below 2 mg O2/L, respectively (OSPAR, 2013), while concentrations less than 2 mg O2/L (hypoxia, i.e. oxygen deficiency) are considered to cause severe problems (OSPAR, 2013). Most of the countries have provided threshold values in a range of 4-6 mg O2/L, indicating, according to OSPAR, a chronic oxygen deficiency. In fact, Vaquer-Sunyer and Duarte (2008) found strong global evidence that, in marine waters, the threshold of 4.6 mg O2/L could be taken as a precautionary limit to avoid catastrophic mortality events, but it would still not protect the most sensitive species (e.g., most fish and crustaceans, particularly early life-cycle stages). However, Best et al. (2006) established a range between 4 and 5 oxygen dissolved threshold values in UK coastal and transitional waters, as a function of the salinity, and considering that at these levels is assured the presence of salmonoids and transitional fish.

Low threshold value provided by Norway could be explained by important temporal variations in dissolved oxygen (significant decrease) observed during 1979-2018 period (Johansen et al., 2018).

Lowest value is provided by France for coastal waters, being necessary an explanation for this lenient boundary.

In the transitional waters, Italy (coastal lagoons) has provided very low values, explaining that when 0-1 mg O2/L values are observed for one or more days per year, the Water Body is classified as Moderate (no additional check is allowed);and 0-1 mg O2/L for less than 1 day, but repeated for several consecutive days and/or 1-2 mg O2/L for more than 1 day/year during 2 years of survey of Macroinvertebrates before classifying WB as Moderate. If no impact on Macroinvertebrates is observed, the WB is classified as Good.

The use of standards based on saturation, rather than concentration, has an added advantage in that the value of the standard does not have to be adjusted to take into account changes in salinity or temperature – which have a profound effect on oxygen solubility and hence concentration (Boyle et al., 2009).

However, it has been argued that saturation values should not be used as a standard as they can give a misleading interpretation of the amount of oxygen available for marine life (Best et al., 2007). For example, as water temperature increases, the amount of oxygen it is capable of holding decreases (i.e., its solubility decreases), which means at high water temperature fully saturated oxygen conditions can potentially occur at relatively low concentration levels (Boyle et al., 2009).

The lowest oxygen saturation threshold values are found in Spain, for national types located in the Mediterranean. These values are lower than those observed in Croatia, in the Adriatic Sea, theoretically more eutrophicated, and with more risk of oxygen deficiency that the Western Mediterranean.

Some countries considered, in addition, an upper boundary for oxygen concentration (CY, UK) or oxygen saturation (HR, IE, PL, RO) acknowledging a two tailed effect of this QE on biota. Strong diel oxygen dynamics resulting from ecosystems' strong primary activity (Schindler et al., 2017) might have an effect on biota due to nightime acute hypoxic episodes (Giomi et al. 2019). These countries' approach may reflect their own systems' specificities by setting thresholds to protect vulnerable biota in such situations.

4.2.2 Transparency

The estimation of water clarity in terms of Secchi disk transparency is important for assessing water quality in coastal and transitional waters.

Helcom (2009) establishes reference values for the 51 coastal areas included in its assessment report, with a range from 4.0 m to 13.7 m, reflecting the highly diverse nature of the coastal areas along the geographical expanse of the Baltic Sea. The median value for coastal reference conditions is 7.50 m, which is close to the open sea. Good moderate values are established considering a deviation of 25% from reference conditions (Helcom, 2006, 2009). Considering the range, the hydrological diversity on this area, the median value of reference conditions, and the 25% deviation, it seems the values reported by Baltic countries are in accordance to this approach. The low values of Finland could be explained by the presence of hummic substances characteristic of the Bothian Bay, affecting the Secchi depth.

In the Black sea, for water transparency (Secchi disk), the target is defined as "the physical, hydrological and chemical conditions are suitable for long term maintenance of the transparency of water at a level unaffected by human activity" (BalticBlack2 report (2010). Romanian coastal zone, influenced by of the flow of the Danube river, having the river runoff a significant impact on both formation of surface water masses, and biochemical features of the shelf. The reference condition and target values presented under the Black Sea Commission for coastal and transitional waters are the same than those provided for the WFD reporting as a range. Bulgaria has also provided a range for coastal waters. The up value is the same target value established in the BalticBlack report. But the low value (2.6m) of the range, is very lenient and it should be checked.

Croatia is the only Mediterranean country providing secchi depth threshold values. The median value provided (5 m) in coastal and transitional waters (3m) is similar with those presented in works on relationships between transparency and biological quality elements (i.e Nincevi c-Gladan et al., 2015; Ivesa et al., 2015).

Norway and Portugal are the only North Atlantic countries reporting threshold values for transparency in coastal waters. Portugal values refer to reference conditions though. Germany has justified the lack of values informing us that transparency is not regarded as a suitable indicator the North Sea coastal waters due to the high natural turbidity in the Wadden Sea.

Transitional waters, coastal lagoons and shallow estuaries have high sediment surface area to water volume ratios, frequent wave resuspension of sediments, and low pelagic and high benthic primary productivity because most of the sediment surface is in the photic zone (Sand-Jensen and Borum,1991). The transparency values provided by Poland for Vistula lagoon are in accordance to the current values found in this area (0.3-1m), although the low depth and the high, natural level of turbidity driven by winds led us to think that the Secchi depth is probably not the best indicator of its trophic status (Margoñski & Horwoba, 2003).

4.2.3 Nutrients

Eutrophication problems are related to enhanced and unbalanced nutrient conditions. In coastal ecosystems, N is generally believed to limit primary production (Howarth and Marino, 2006;Tyrrell, 1999)leading to the widespread use of N, rather than P for assessing the status of these eco-systems. This is not the case for the Mediterranean basin where phosphorus appears as the most important limiting nutrient, although it is closely followed by nitrogen in this limiting role (Krom et al., 1991; Estrada,1996; Pitta et al., 2005; Thingstad et al., 2005). Baltic countries, tend to use both N and P metrics, based on an understanding of eutrophication in this region (HELCOM,2015). In the Black Sea, both N and P play a role in the eutrophication pr-cesses (Black Sea Commission, 2008) so, consequently, both nutrients are used for classification by Romania and Bulgaria.

In estuarine and CWs, nitrogen vs. phosphorus limitation can change both temporally and seasonally, depending on the inputs from rivers, agriculture and sewage drainage (Painting et al., 2005). It is therefore important to consider local dynamics.

4.2.3.1 Nitrogen

Mediterranean Sea is probably the regional seas with fewest eutrophication problem areas. This is partly related to the fact that the offshore parts of the Mediterranean Sea are characterized by very low nutrient concentrations (EEA, 2018). However, the values presented by Spain for the national types located in the Mediterranean sea, except the islands types, at a distance of 200 meters of the coastal, are higher than those established for the Atlantic national types. An explanation for these differences should be provided.

The Eastern Mediterranean Sea (with high saline waters on the surface layer is one of the world's oligotrophic seas, and this is reflected by the low threshold values provided by Greece for TN and Nitrates. However, Cyprus, sharing the same common type, show less stringent values for nitrates, being necessary their revision. And Slovenia, in the Adriatic Sea, influenced by freshwaters inflows, shows threshold values similar to Greece, being too precautionary.

In transitional and coastal waters, strong salinity gradients exist between the freshwater end and the marine waters due to riverine influences and must be taken into account in any assessment of nutrient enrichment in coastal systems (Devlin et al., 2007). In this sense, the ranges values presented by Sweden and UK, for coastal and transitional waters for TIN (both countries) and TN (Sweden) are established according to the salinity gradient, not being possible the comparison with countries not taking into account this gradient. In the case of UK, boundaries values are established, by plotting the winter nutrient concentrations along the salinity gradient and calculating the mean winter value normalised to a specific salinity (Devlin et al., 2007).

In the case of Romania, the good/moderate boundaries provided for TIN in coastal and transitional waters are the same than the threshold values established in BalticBlack2 report (2014).

4.2.3.2 Phosphorus

Inorganic P compounds are present mainly as orthophosphate in sea water (Topping et al., 1976). But, Smith et a.l, (2006) considered the advantage of considering total nutrient in the eutrophication assessment, due to the significant correlation found between TN, TP and chlorophyll. In addition, total nutrients are essential for determining nutrient budgets, which have particular importance in coastal and marine waters that are influenced by transboundary nutrient transport and receive nutrient inputs from other countries. Furthermore, total nutrients are also essential parameters for establishing nutrient reduction targets (Poikane et al., 2019).

Most of the Baltic countries provides TP threshold values in coastal waters, and these Good/Moderate boundaries are, in most of the cases, within the range values reported by MS to HELCOM (2015, 2017) for the good environmental status in the different Baltic sub-regions. In transitional waters Poland establishes a range, where the upper value, is too lenient, compared with the Good/moderate boundaries proposed by Salas-Herrero et al., 2019.

In the Mediterranean Sea, Greece provides a lenient G/M boundary (9,29 µg/l) compared with the values (0,55-6,81 µg/l) showed by Simboura et al (2016) in Greek CW water bodies with moderate status.

On the other hand, Giovanardi et al. (2018), argued that the TP concentrations observed at sea are closely and functionally related to freshwater inputs from the continent, and then to be referred to the amount of nutrient loads generated and delivered from the basins burdening on the coastal areas. But the phosphorus associated with the freshwater inputs from the continent is a less "conservative" substance than inorganic parameters, since its decay in seawater must be related not only to physical dilution, but also to removal from the system due to sedimentation and/or chemical precipitation (Giovanardi and Tromellini, 1992).

Romania and Bulgaria show the same CW-TW boundaries (orthophosphate) than the threshold values established under the Black Sea Commission.

In national types of the Mediterranean Sea, in mesotrophic and oligotrophic areas vey high values of orthophosphates are provided by Spain, being necessary an explanation for these lenient values compared with other Mediterranean countries influenced by freswaters inputs (i.e Slovenia and Croatia).

4.3 Comparison of G/M boundaries between ECOSTAT 2014 questionnaires and WFD reporting

This chapter compares the Good/Moderate (G/M) boundary values reported for nutrients in the ECOSTAT 2014 questionnaires with those in the WFD reporting (as revised in 2020 – dat.TRACver2; the latest updates or changes made by countries in April 2021 - ver3, are not reflected here). Only the nutrients selected for this work and included in the ECOSTAT questionnaire are considered here, namely: Nitrate-Nitrogen (NO3-N), Total Inorganic Nitrogen (TIN or DIN), Total Nitrogen (TN), Orthophosphate (PO4-P or DIP or SRP) and Total Phosphorus (TP).

In general, there was an increase in the number of countries reporting Good/Moderate boundaries in each of the selected physico-chemical quality elements, both in coastal and transitional waters, sometimes up to 4 or 5 more countries. Very few cases occur where a country previously reporting on a given QE in the 2014 questionnaires does not report values for that QE in the WFD. In coastal waters, it was the case of DE for Nitrate-N; GR and LV for Total Inorganic N; PL for Total N; DE for Orthophosphate; and in transitional waters of LV for Total Inorganic N.

Where boundary values exist in both sets and are comparable, most countries presented almost no differences on the G/M boundaries reported. In a few cases the WFD reporting showed a larger set of values reported in relation to the 2014 questionnaires (e.g., Figures 4.3 SE and UK), which could be due to a more detailed typology associated reporting. In some cases, where a large range of values was reported, both sets are mostly within the same range, with only slightly deviations observed in both directions, i.e., some cases towards more restrictive boundaries (e.g., Figures 4.6, 4.7, 4.10) others towards more permissive G/M boundaries (e.g., Figures 4.1, 4.3, 4.4, 4.5 or 4.9).

Another point worth checking with ECOSTAT countries is the summary metric information (e.g., annuals or seasonal means, medians, etc). In a few cases, this information seems to have changed between the 2014 questionnaires and the WFD reporting although the G/M boundary values have not (e.g., Figure 4.1 BG and NO; Figure 4.4 BE). This could be due to countries corrections to information or an issue with our interpretation of the information associated with boundaries reporting for this work rather than an actual change in metric used by the country.

Finally, there were some extreme boundary values, beyond the 97.5%ile of the data distribution, both in the previous 2014 G/M boundaries and in the WFD reporting, which should also be checked with Countries. Note that for Portugal (PT), the values reported for WFD refer to Reference Conditions as no G/M boundaries were yet available.

Below we present detailed comparisons for each QE in the respective water category (coastal and transitional).

4.3.1 Nitrate-N

Coastal waters

Below we compare the Good/Moderate boundary values for Nitrate as N standards in coastal waters (Figure 4.1). There are 3 new countries (LV, PT, RO) reporting G/M boundary values for this QE, while 1 country (DE) no longer reports on this parameter.

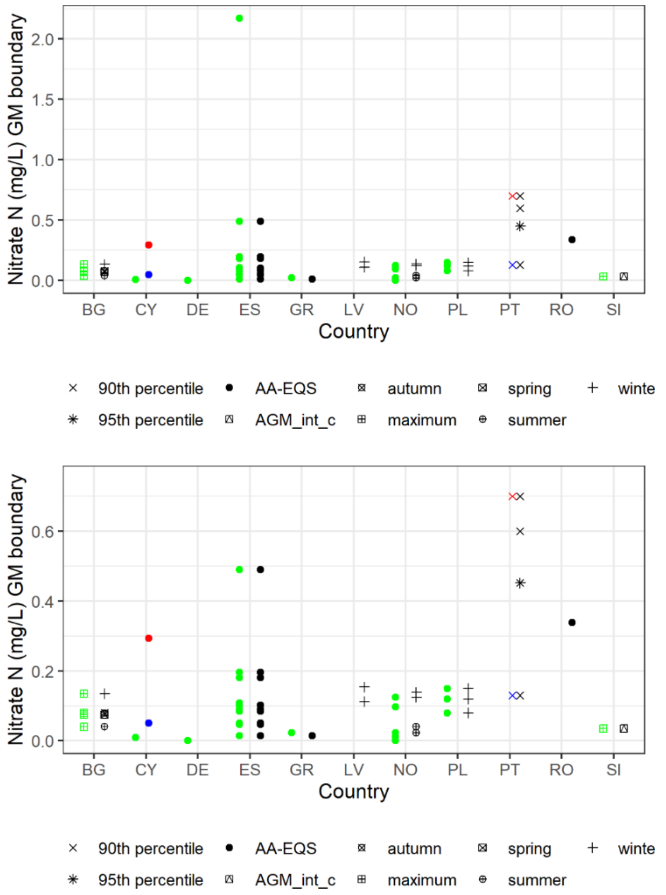


Figure 4.1: Comparison of coastal Nitrate as N standards by country. Graphs show all G/M boundaries reported (top) and bottom graph hides values > 0.75 mg/L for better comparison of remaining standards. Green symbols represent values reported in 2014, other colours are WFD boundaries revised in 2020 (single value black, minimum blue, maximum red symbols.)

Transitional waters

Below we compare the Good/Moderate boundary values for Nitrate as N standards in transitional waters (Figure 4.2). There are 3 new countries (LV, PT, RO) reporting G/M boundary values for this QE.

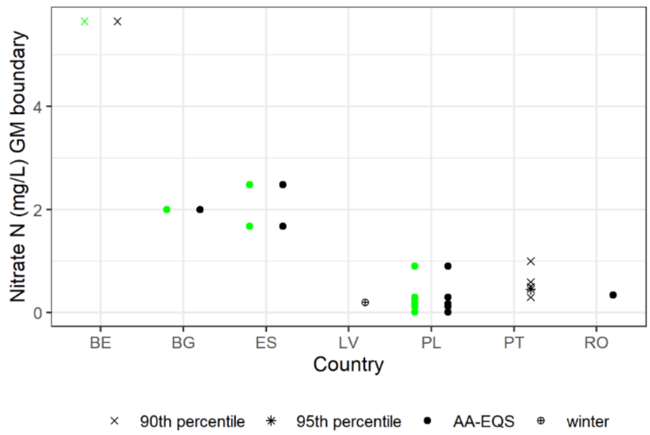


Figure 4.2: Comparison of coastal Nitrate as N standards by country. Green symbols represent values reported in 2014, other colours are WFD boundaries revised in 2020 (single value black, minimum blue, maximum red symbols.)

4.3.2 Total Inorganic Nitrogen

Coastal waters

Below we compare the Good/Moderate boundary values for Total Inorganic N standards in coastal waters (Figure 4.3). There are 2 new countries (BE, RO) reporting G/M boundary values for this QE, while 2 countries (GR, LV) no longer report on this parameter.

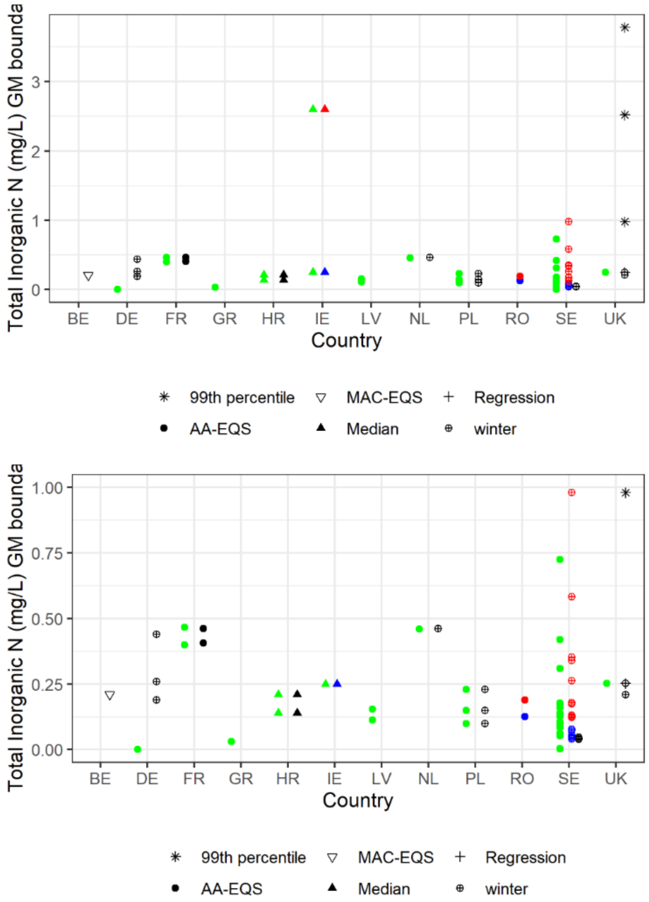


Figure 4.3: Comparison of coastal Total Inorganic N standards by country. Graphs show all G/M boundaries reported (top) and bottom graph hides values > 1 mg/L for better comparison of remaining standards. Green symbols represent values reported in 2014, other colours are WFD boundaries revised in 2020 (single value black, minimum blue, maximum red symbols.)

Transitional waters

Below we compare the Good/Moderate boundary values for Total Inorganic N standards in transitional waters (Figure 4.4). There are 4 new countries (DE, FR, RO, SE) reporting G/M boundary values for this QE, while 1 country (LV) no longer reports on this parameter.

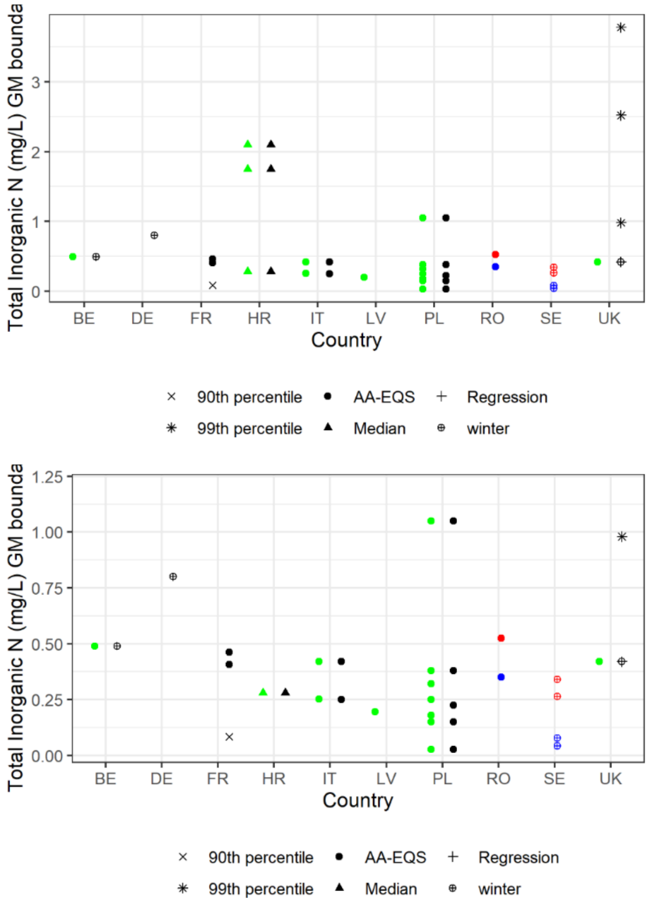


Figure 4.4: Comparison of transitional Total Inorganic N standards by country. Graphs show all G/M boundaries reported (top) and bottom graph hides values > 1.2 mg/L for better comparison of remaining standards. Green symbols represent values reported in 2014, other colours are WFD boundaries revised in 2020 (single value black, minimum blue, maximum red symbols.)

4.3.3 Total Nitrogen

Coastal waters

Below we compare the Good/Moderate boundary values for TN standards in coastal waters (Figure 4.5). There is 1 new country (GR) reporting G/M boundary values for this QE, while 1 country (PL) no longer reports on this parameter.

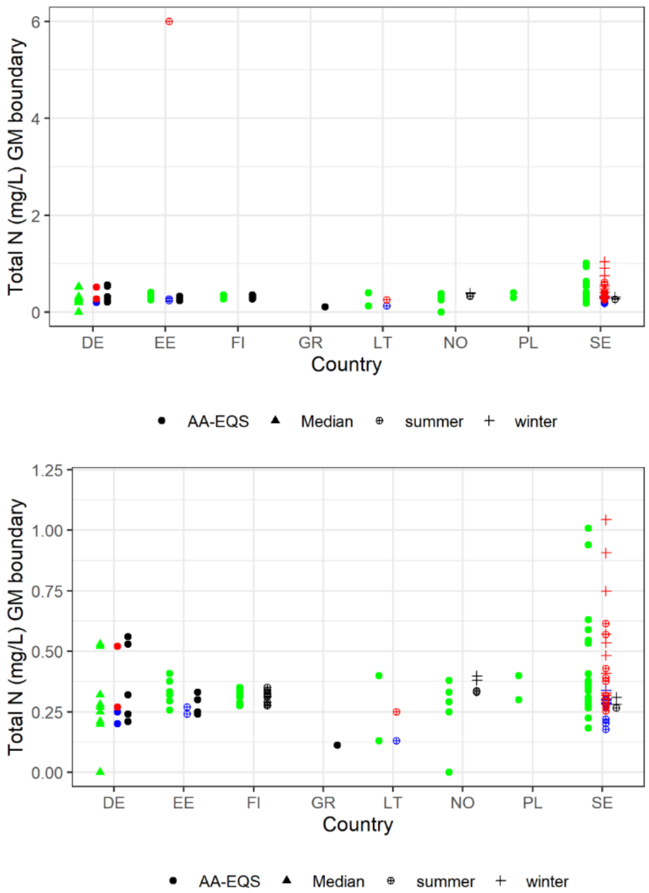
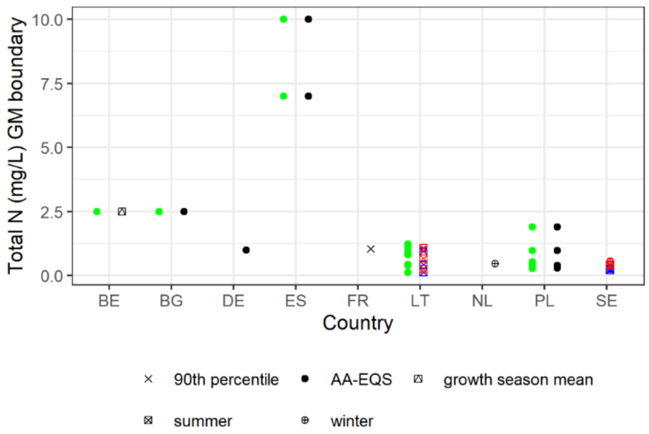


Figure 4.5: Comparison of coastal TN standards by country. Graphs show all G/M boundaries reported (top) and bottom graph hides values > 1.2 mg/L for better comparison of remaining standards. Green symbols represent values reported in 2014, other colours are WFD boundaries revised in 2020 (single value black, minimum blue, maximum red symbols.)

Transitional waters

Below we compare the Good/Moderate boundary values for TN standards in transitional waters (Figure 4.6). There are 4 new countries (DE, FR, NL, SE) reporting G/M boundary values for this QE.



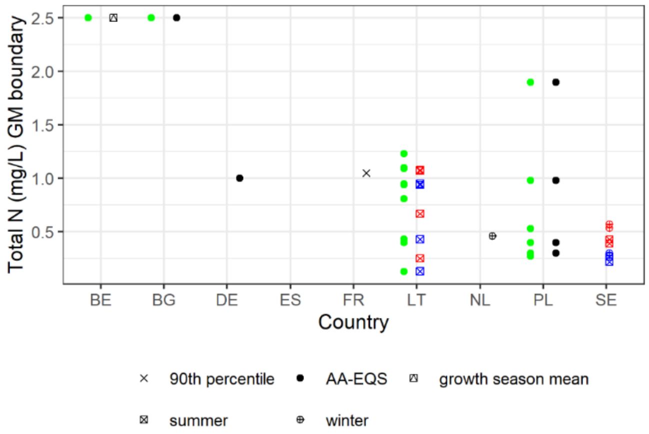


Figure 4.6: Comparison of transitional TN standards by country. Graphs show all G/M boundaries reported (top) and bottom graph hides values > 2.5 mg/L for better comparison of remaining standards. Green symbols represent values reported in 2014, other colours are WFD boundaries revised in 2020 (single value black, minimum blue, maximum red symbols.)

4.3.4 Orthophosphate

Coastal waters

Below we compare the Good/Moderate boundary values for Orthophosphate standards in coastal waters (Figure 4.7). There are 4 new countries (BE, GR, PT, RO) reporting G/M boundary values for this QE, while 1 country (DE) no longer reports on this parameter.

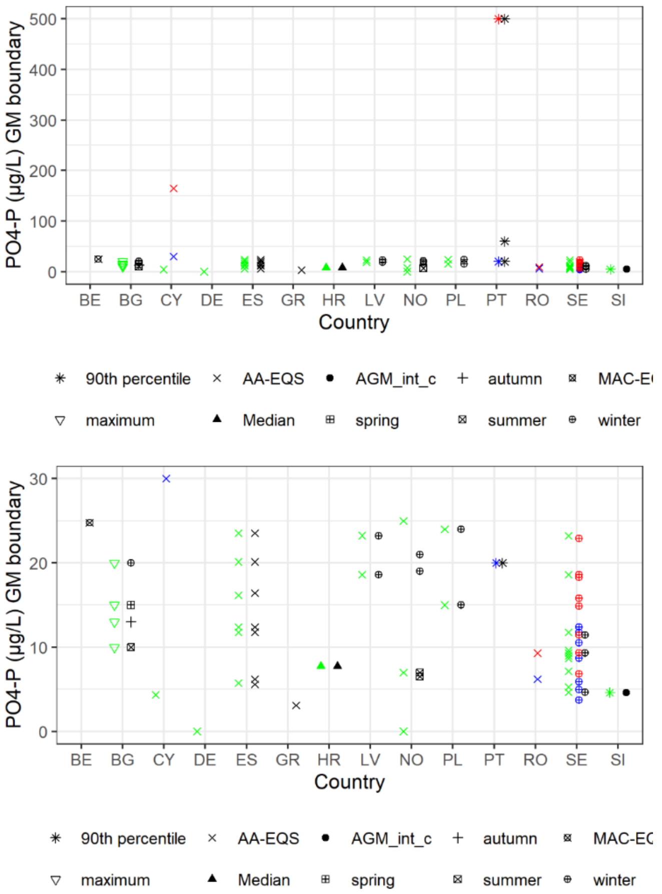
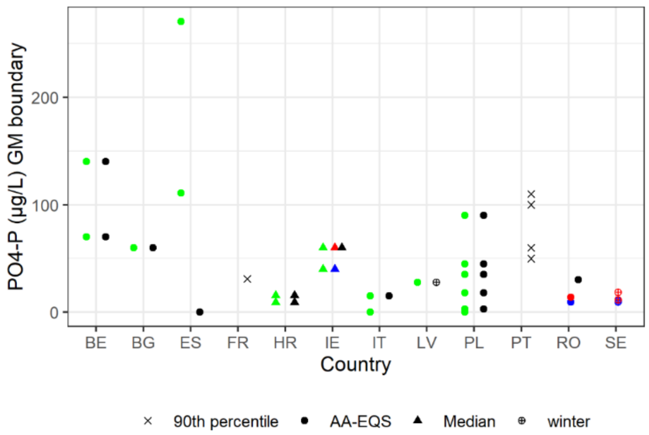


Figure 4.7: Comparison of coastal Orthophosphate standards by country. Graphs show all G/M boundaries reported (top) and bottom graph hides values > 30 µg/L for better comparison of remaining standards. Green symbols represent values reported in 2014, other colours are WFD boundaries revised in 2020 (single value black, minimum blue, maximum red symbols.)

Transitional waters

Below we compare the Good/Moderate boundary values for Orthophosphate standards in transitional waters (Figure 4.8). There are 4 new countries (FR, PT, RO, SE) reporting G/M boundary values for this QE.



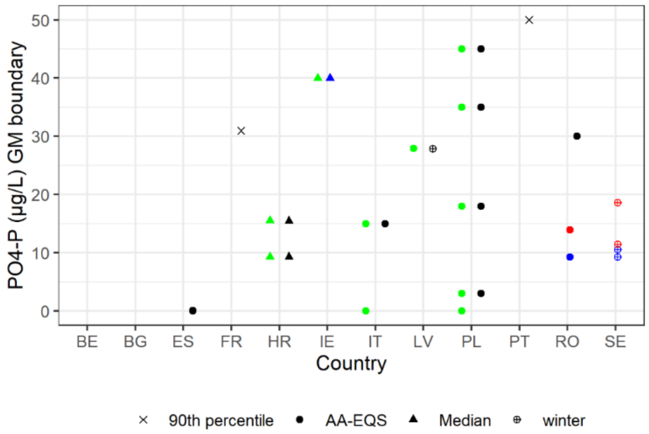
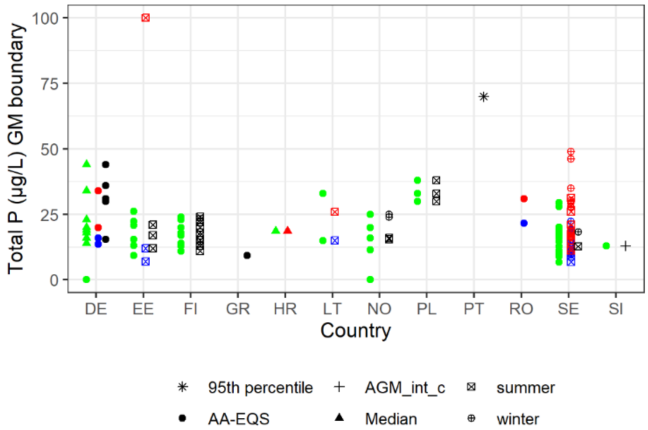


Figure 4.8: Comparison of transitional Orthophosphate standards by country. Graphs show all G/M boundaries reported (top) and bottom graph hides values > 50 µg/L for better comparison of remaining standards. Green symbols represent values reported in 2014, other colours are WFD boundaries revised in 2020 (single value black, minimum blue, maximum red symbols.)

4.3.5 Total Phosphorus

Coastal waters

Below we compare the Good/Moderate boundary values for TP standards in coastal waters (Figure 4.9). There are 3 new countries (Gr, PT, RO) reporting G/M boundary values for this QE.



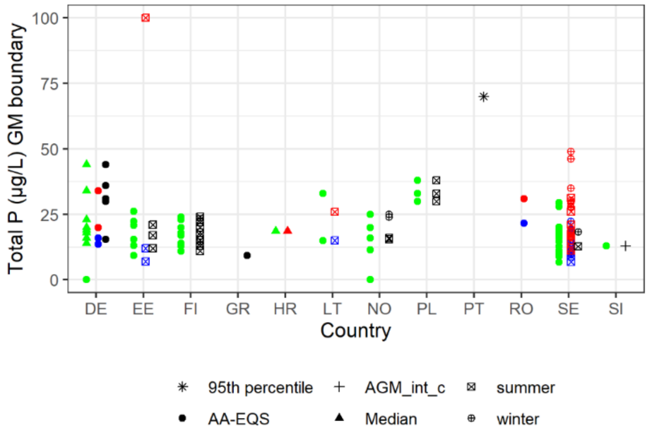


Figure 4.9: Comparison of coastal TP standards by country. Graphs show all G/M boundaries reported (top) and bottom graph hides values > 50 µg/L for better comparison of remaining standards. Green symbols represent values reported in 2014, other colours are WFD boundaries revised in 2020 (single value black, minimum blue, maximum red symbols.)

Transitional waters

Below we compare the Good/Moderate boundary values for TP standards in transitional waters (Figure 4.10). There are 5 new countries (DE, FR, PT, RO, SE) reporting G/M boundary values for this QE.

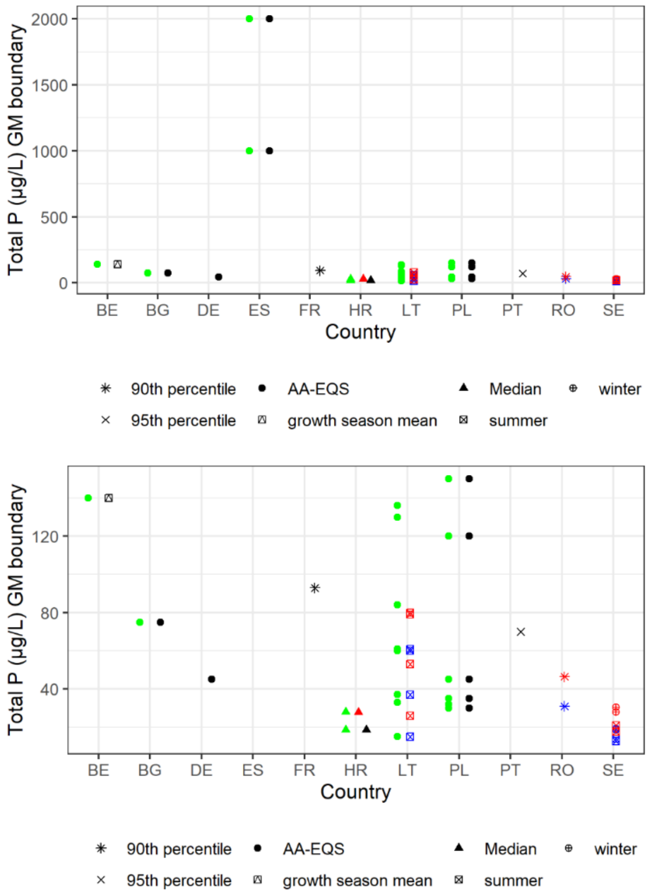


Figure 4.10: Comparison of transitional TP standards by country. Graphs show all G/M boundaries reported (top) and bottom graph hides values > 150 µg/L for better comparison of remaining standards. Green symbols represent values reported in 2014, other colours are WFD boundaries revised in 2020 (single value black, minimum blue, maximum red symbols.)

5 Conclusions

A recurring theme in the previous section is variation between countries overriding differences between common types. One key question, then, is the extent to which differences in national standards can be explained in terms of legitimate differences between efficient regulatory systems rather than as evidence that some countries have standards that are less effective at protecting good status. Some other general points that emerge are:

1. We recognise that PCSE should not be considered in isolation but rather as part of an integrated decision-making system that reflects both the requirements of the WFD and of national regulatory regimes.

2. Considerable effort has already been spent on promoting best practice for nutrients, but this has not yet been translated into more effective standards. Generally, the process is in place although some Member states may need support as they apply this to their own situations. ECOSTAT should also recognise that the democratic safeguards mean that the translation of science into policy may take some years to realise. We also recognise that setting effective N or P standards in situations where there are interactions from other stressors still needs additional work.

3. In some cases, comparisons between countries are complicated by different assessment concepts; in others, there are differences in how data are aggregated. Both of these were considered when individual supporting elements were discussed in more detail (section 4,2). There are situations where a measure of central tendency is most appropriate but also circumstances where an upper (or lower) quantile will be more relevant (e.g nutrients). Generally, those supporting elements that exert a lethal effect (e.g oxygen) should use upper/lower quantiles, reflecting the most extreme cases to which the biota is exposed. Questions about data aggregation lead naturally onto questions of appropriate sampling frequencies.

4. Following on from this, the role that combination rules play within individual countries will need to be considered. The present work cannot be considered in isolation from the broader process of classification. Whilst our mandate does not extend to formal interpretation of classification rules there is a need to make a scientific case for appropriate combinations of variables within a physico-chemical supporting element. Again, the work on nutrients has suggested that an apparently lenient threshold may be justified in situations where action requires both a BQE and SE trigger.

5. Although not discussed in this report, we recognise the importance of having a suite of variables that will permit a pan-European approach to detecting effects of climate change. This suggests a need for a co-ordinated approach to variables that are likely to change as a result and which in turn will impact the biota. Scientific evidence suggests that climate change (CC) due to increase temperature is likely to e.g. aggravate eutrophication problems (Ho et al. 2019); reduce oxygen solubility (Vaquer Dunyer and Duarte 2008), increase water column stratification (Capotondi et al., 2012), or lead to acidification problems (Koch et al., 2013). This highlights the importance of having a pan-European suite of PhCh QE that can detect effects of climate change. Some countries already assess parameters that may help detect CC effects while others do not yet routinely use them, and as such most of them were not included in this report for comparison. This interaction of PhCh QE raises a need to consider more protective nutrient standards as well as more effective mitigation and adaptation measures.

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List of abbreviations and definitions

CIS: Common Implementation Strategy

CW: Coastal waters

D.O: Dissolved Oxygen

ECOSTAT: WFD CIS working group dedicated to the ecological status of surface water bodies

MS: Member State

MSFD: Marine Strategy Framework Directive

PHC: Physico- Chemical

QE: Quality elemments

RBMP: River Basin Management Plan

TraC: Transitional and Coastal waters

TW: Transitional waters

WFD: Water Framework Directive

List of figures

Annexes

A1 Oxygen

A1.1. Dissolved oxygen concentration (coastal)

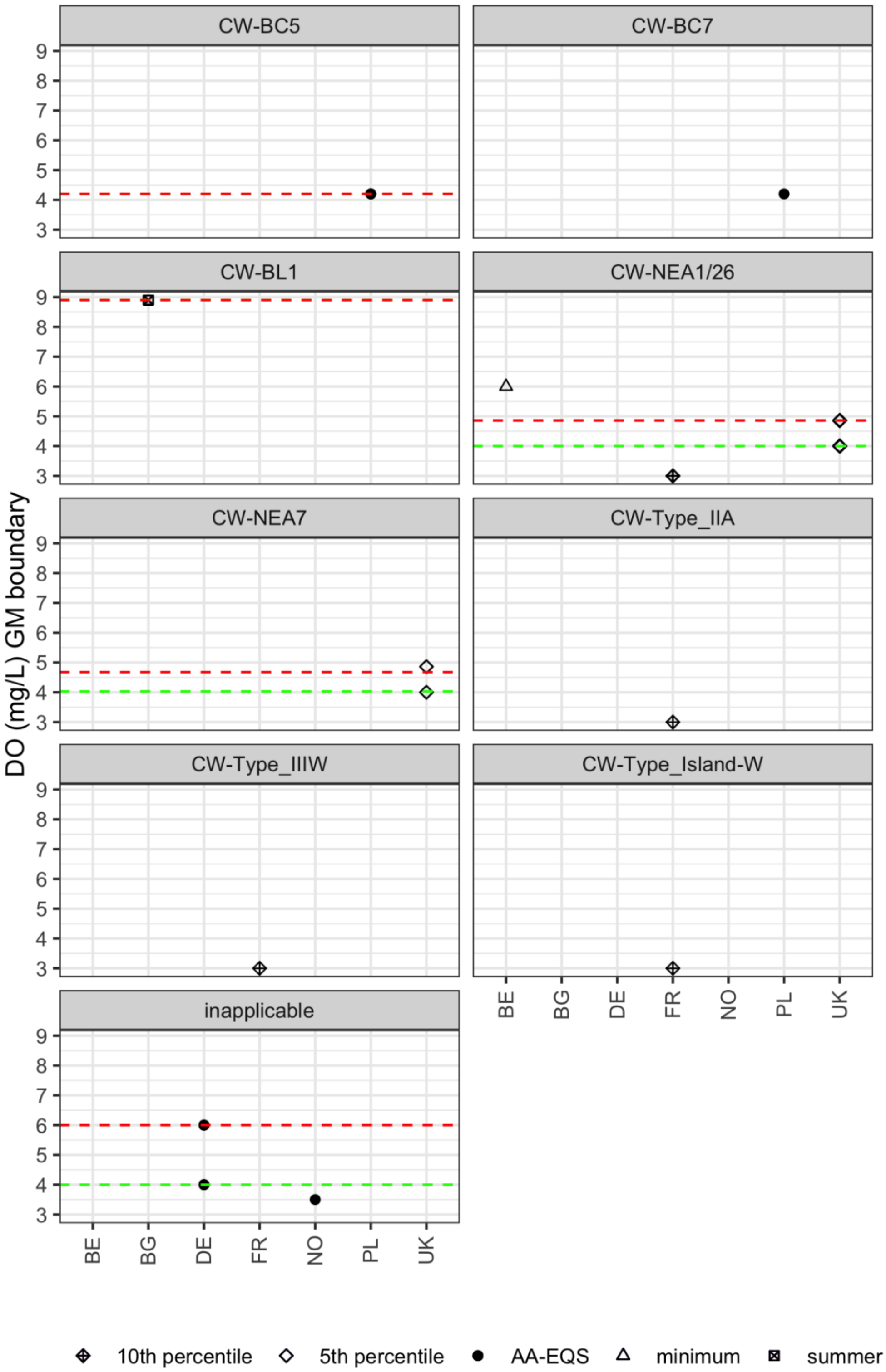

Figure A1.1-1: Dissolved oxygen standards by country and IC type (single value black, minimum blue, maximum red), horizontal lines mark 25th and 75th quantiles for types with 2 or more countries contributing to the type.

Table A1.1-1: Dissolved oxygen metrics used by country

	10th percentile	5th percentile	AA-EQS	minimum	summer
BE	0	0	0	1	0
BG	0	0	0	0	9
DE	0	0	8	0	0
FR	7	0	0	0	0
NO	0	0	1	0	0
PL	0	0	4	0	0
UK	0	33	0	0	0

Table A1.1-2: Records where Dissolved oxygen was reported as a value or a range

Country	value	range
BE	1	
BG	9	
DE	8	
FR	7	
NO	1	
PL	4	
UK	33	

Table A1.1-3: Number of different Dissolved oxygen standards by country and IC type

	BE	BG	DE	FR	NO	PL	UK	Sum
CW-BC5	0	0	0	0	0	3	0	3
CW-BC7	0	0	0	0	0	1	0	1
CW-BL1	0	9	0	0	0	0	0	9
CW-NEA1/26	1	0	0	4	0	0	29	34
CW-NEA7	0	0	0	0	0	0	4	4
CW-Type_IIA	0	0	0	1	0	0	0	1

	BE	BG	DE	FR	NO	PL	UK	Sum
CW-Type_IIIW	0	0	0	1	0	0	0	1
CW-Type_Island-W	0	0	0	1	0	0	0	1
inapplicable	0	0	8	0	1	0	0	9
Sum	1	9	8	7	1	4	33	63

A1.2 % oxygen saturation concentration (coastal)

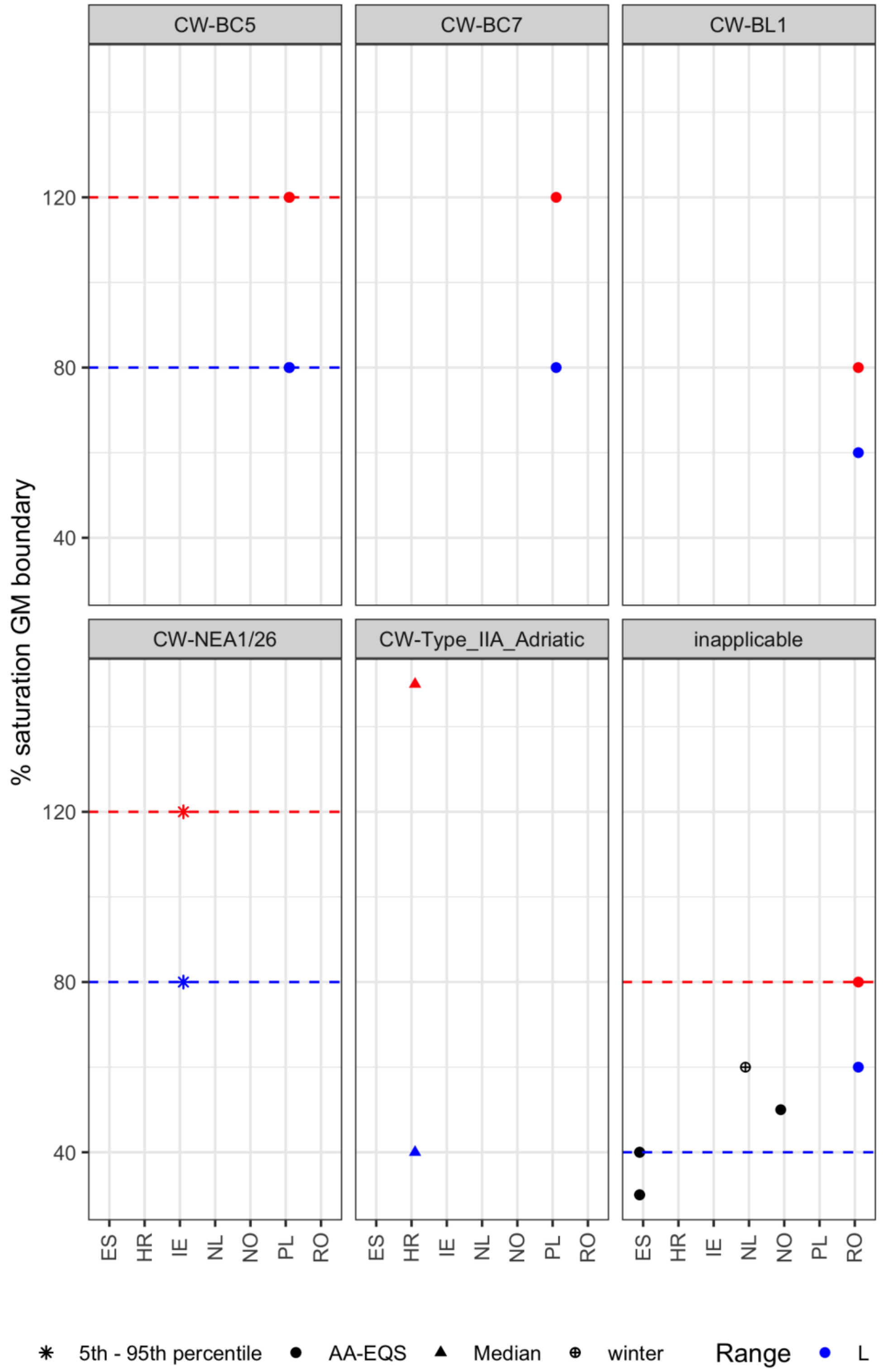

Figure A1.2-1: oxygen saturation standards by country and IC type (single value black, minimum blue, maximum red). Horizontal dotted lines show the median values for the upper (red) and lower (blue) groups of standards

Table A1.2-1: % oxygen saturation metrics used by country.

	5th - 95th percentile	AA-EQS	Median	winter
ES	0	4	0	0
HR	0	0	1	0
IE	3	0	0	0
NL	0	0	0	1
NO	0	1	0	0
PL	0	4	0	0
RO	0	2	0	0

Table A1.2-2: Records where % oxygen saturation was reported as a value or a range.

Country	value	range
ES	4	
NL	1	
NO	1	
HR		1
IE		3
PL		4
RO		2

Table A1.2-3: Number of different % oxygen saturation standards by country and IC type.

	ES	HR	IE	NL	NO	PL	RO	Sum
CW-BC5	0	0	0	0	0	3	0	3
CW-BC7	0	0	0	0	0	1	0	1
CW-BL1	0	0	0	0	0	0	1	1
CW-Type_IIA_Adriatic	0	0	3	0	0	0	0	3
inapplicable	0	1	0	0	0	0	0	1
Sum	4	0	0	1	1	0	1	7

A1.3 Dissolved oxygen concentration (transitional)

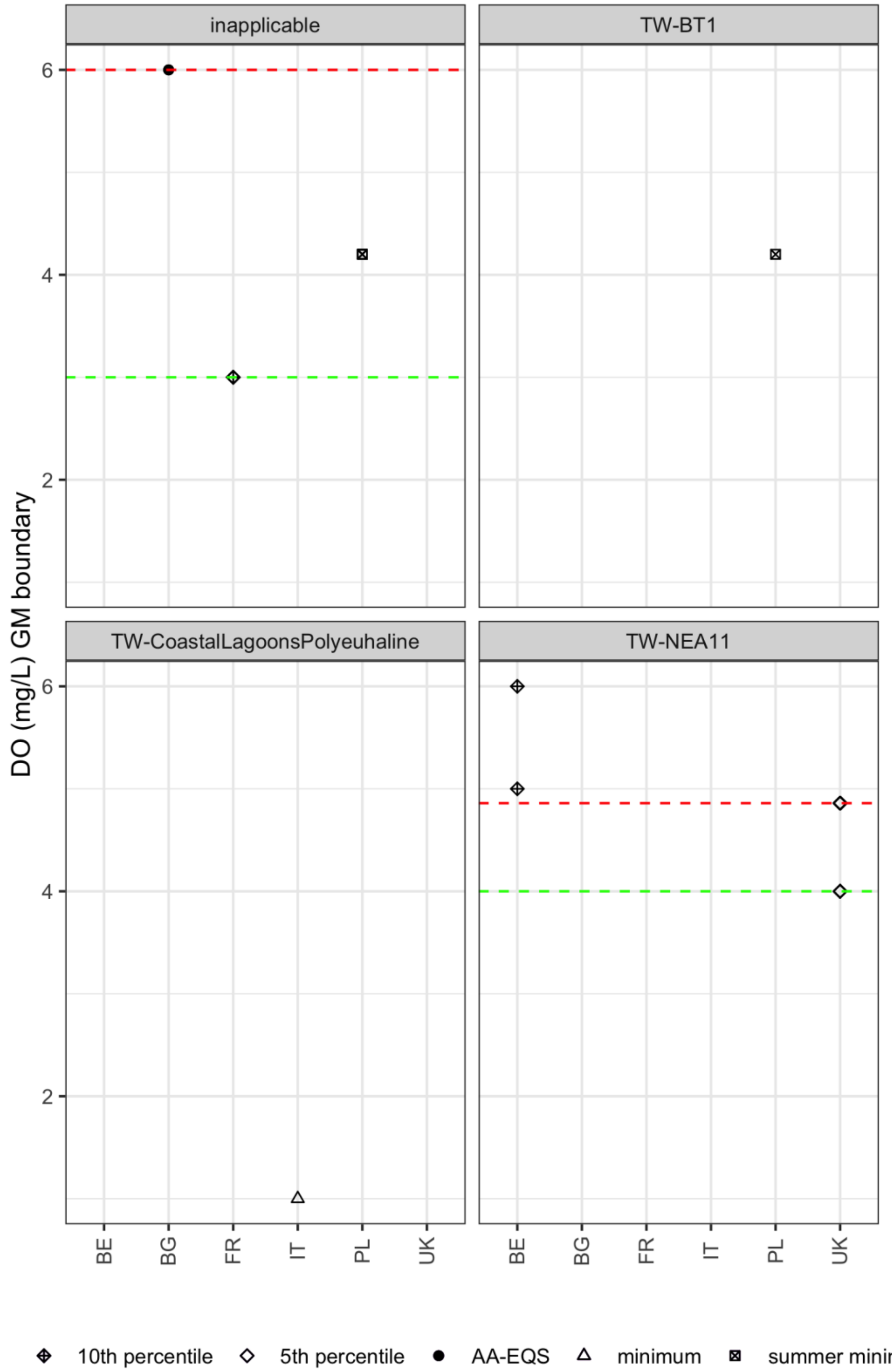

Figure A1.3-1. Dissolved oxygen standards by country and IC type (single value black, minimum blue, maximum red), horizontal lines mark 25th and 75th quantiles for types with 2 or more countries contributing to the type.

Table A1.3-1: Dissolved oxygen metrics used by country.

	10th percentile	5th percentile	AA-EQS	minimum	summer minimum
BE	2	0	0	0	0
BG	0	0	4	0	0
FR	4	0	0	0	0
IT	0	0	0	1	0
PL	0	0	0	0	5
UK	0	29	0	0	0

Table A1.3-2: Records where Dissolved oxygen was reported as a value or a range.

Country	value	range
BE	2	
BG	4	
FR	4	
IT	1	
PL	5	
UK	29	

Table A1.3-3: Number of different Dissolved oxygen standards by country and IC type

	BE	BG	FR	IT	PL	UK	Sum
inapplicable	0	4	4	0	4	0	12
TW-BT1	0	0	0	0	1	0	1
TW-CoastalLagoonsPolyeuhaline	0	0	0	1	0	0	1
TW-NEA11	2	0	0	0	0	29	31
Sum	2	4	4	1	5	29	45

A1.4 % oxygen saturation concentration (transitional)

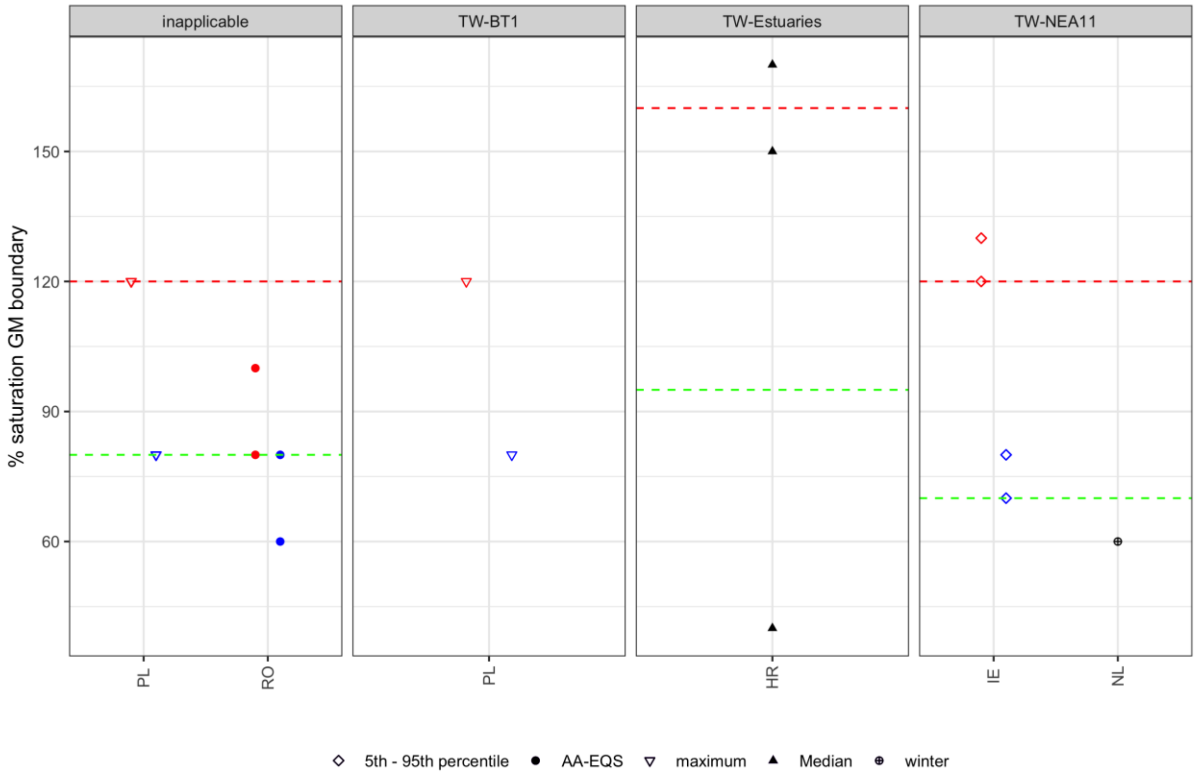

Figure A1.4-1: % oxygen saturation standards by country and IC type (single value black, minimum blue, maximum red), horizontal lines mark 25th and 75th quantiles for types with 2 or more countries contributing to the type.

Table A1.4-1:% oxygen saturation metrics used by country.

	5th percentile	95th percentile	AA-EQS	maximum	Median	winter
HR	0	0	0	0	3	0
IE	3	3	0	0	0	0
NL	0	0	0	0	0	1
PL	0	0	0	5	0	0
RO	0	0	2	0	0	0

Table A1.4-2: records where % oxygen saturation was reported as a value or a range.

Country	value	range
HR	3	
IE		6
NL	1	
PL		5
RO		2

Table A1.4-3: Number of different % oxygen saturation standards by country and IC type

	HR	IE	NL	PL	RO	Sum
inapplicable	0	0	0	4	2	6
TW-BT1	0	0	0	1	0	1
TW-Estuaries	3	0	0	0	0	3
TW-NEA11	0	6	1	0	0	7
Sum	3	6	1	5	2	17

Data set used *Rver2

A2. Transparency

A2.1 Secchi disk depth concentration (coastal)

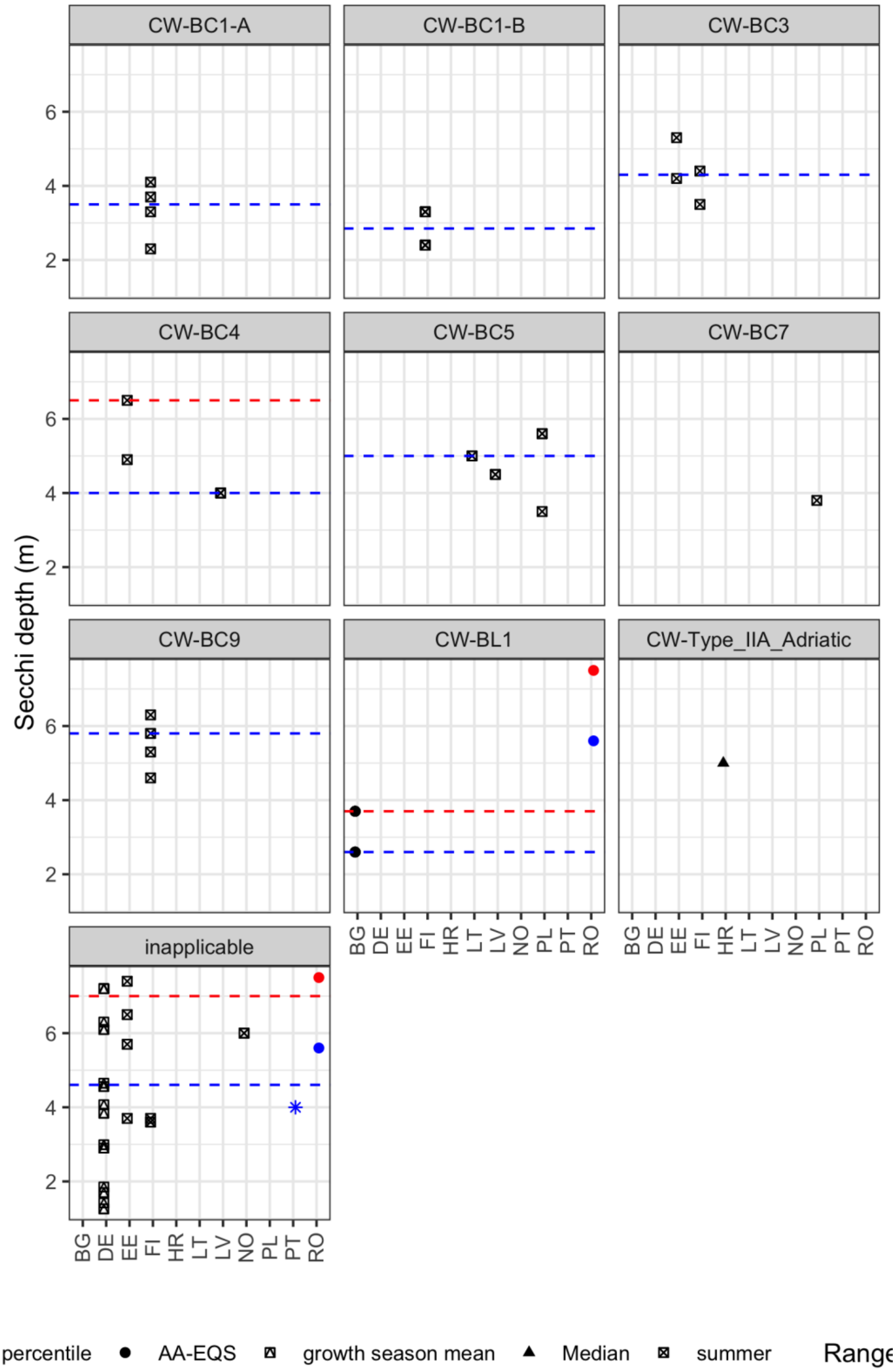

Figure A2.1-1: Secchi disk depth standards by country and IC type (single value black, minimum blue, maximum red). Horizontal dotted lines show the median values for the upper (red) and lower (blue) groups of standards.

Table A2.1-2: Secchi disk depth metrics used by country

	95th percentile	AA-EQS	growth season mean	Median	summer
BG	0	9	0	0	0
DE	0	0	18	0	0
EE	0	0	0	0	6
FI	0	0	0	0	22
HR	0	0	0	1	0
LT	0	0	0	0	2
LV	0	0	0	0	5
NO	0	0	0	0	2
PL	0	0	0	0	4
PT	1	0	0	0	0
RO	0	2	0	0	0

Table A2.1-3: Records where Secchi disk depth was reported as a value or a range.

Country	value	range
DE	18	
EE	4	
FI	22	
HR	1	
LV	5	
NO	2	
PL	4	
PT	1	
BG		9
LT		2
RO		2

Table A2.1-4: Number of different Secchi disk depth standards by country and IC type

	BG	DE	EE	FI	HR	LT	LV	NO	PL	PT	RO	Sum
CW-BC1-A	0	0	0	4	0	0	0	0	0	0	0	4
CW-BC1-B	0	0	0	8	0	0	0	0	0	0	0	8
CW-BC3	0	0	2	2	0	0	0	0	0	0	0	4
CW-BC4	0	0	1	0	0	0	3	0	0	0	0	4
CW-BC5	0	0	0	0	0	2	2	0	3	0	0	7
CW-BC7	0	0	0	0	0	0	0	0	1	0	0	1
CW-BC9	0	0	0	5	0	0	0	0	0	0	0	5
CW-BL1	9	0	0	0	0	0	0	0	0	0	1	10
CW-Type_IIA_Adriatic	0	0	0	0	1	0	0	0	0	0	0	1
inapplicable	0	18	3	3	0	0	0	2	0	1	1	28
Sum	9	18	6	22	1	2	5	2	4	1	2	72

A2.2 Secchi disk depth concentration (transitional)

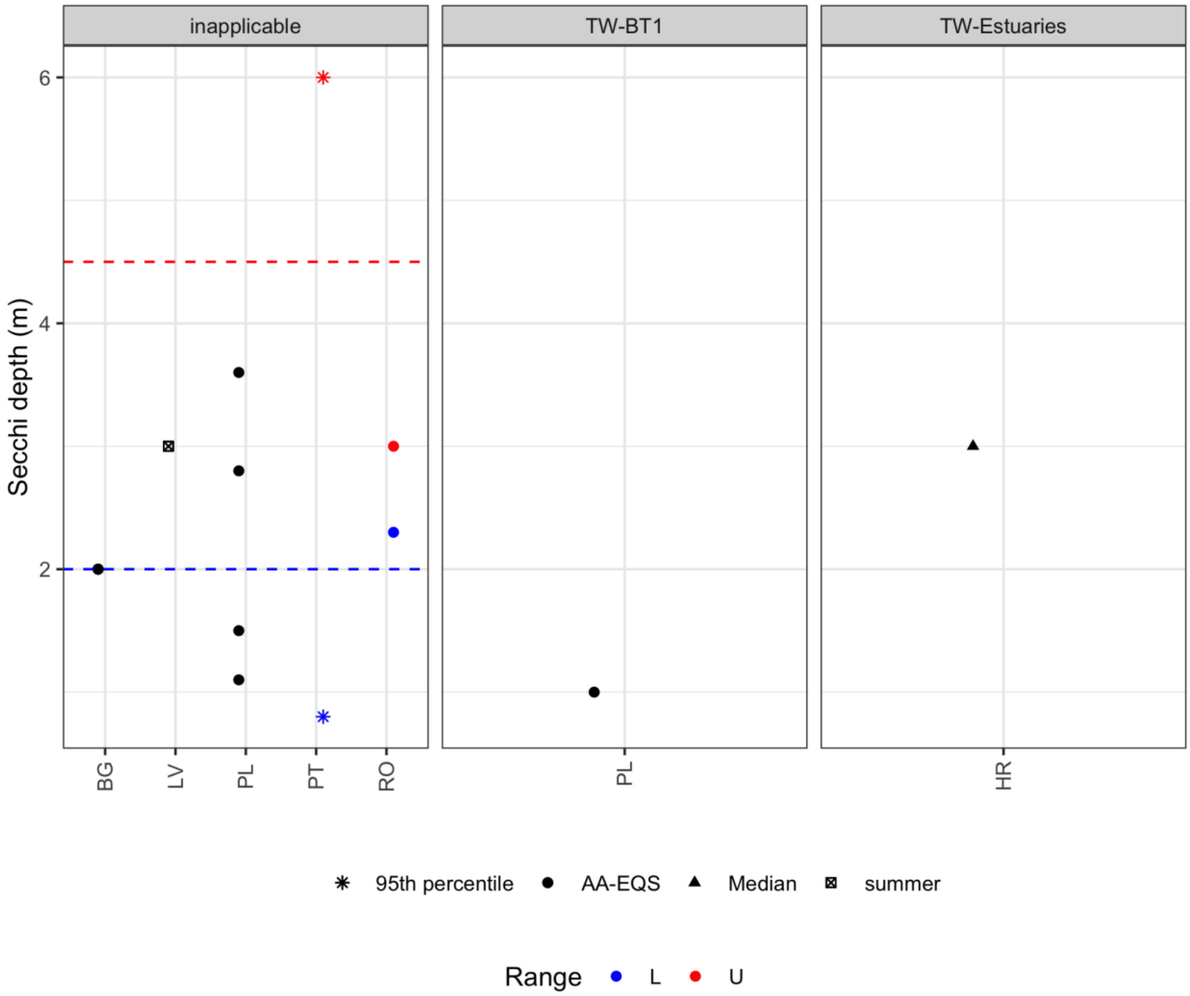

Figure A2.2-1: Secchi disk depth standards by country and IC type (single value black, minimum blue, maximum red). Horizontal dotted lines show the median values for the upper (red) and lower (blue) groups of standards.

Table A2.2-2: Secchi disk depth metrics used by country

	95th percentile	AA-EQS	Median	summer
BG	0	4	0	0
HR	0	0	1	0
LV	0	0	0	3
PL	0	5	0	0
PT	1	0	0	0
RO	0	1	0	0

Table A2.2-3: Records where Secchi disk depth was reported as a value or a range.

Country	value	range
BG	4	
HR	1	
LV	3	
PL	5	
PT		1
RO		1

Table A2.2-4: Number of different Secchi disk depth standards by country and IC type

	BG	HR	LV	PL	PT	RO	Sum
inapplicable	4	0	3	4	1	1	13
TW-BT1	0	0	0	1	0	0	1
TW-Estuaries	0	1	0	0	0	0	1
Sum	4	1	3	5	1	1	15

A3 Nitrate-N

A3.1 Nitrate-N (coastal waters)

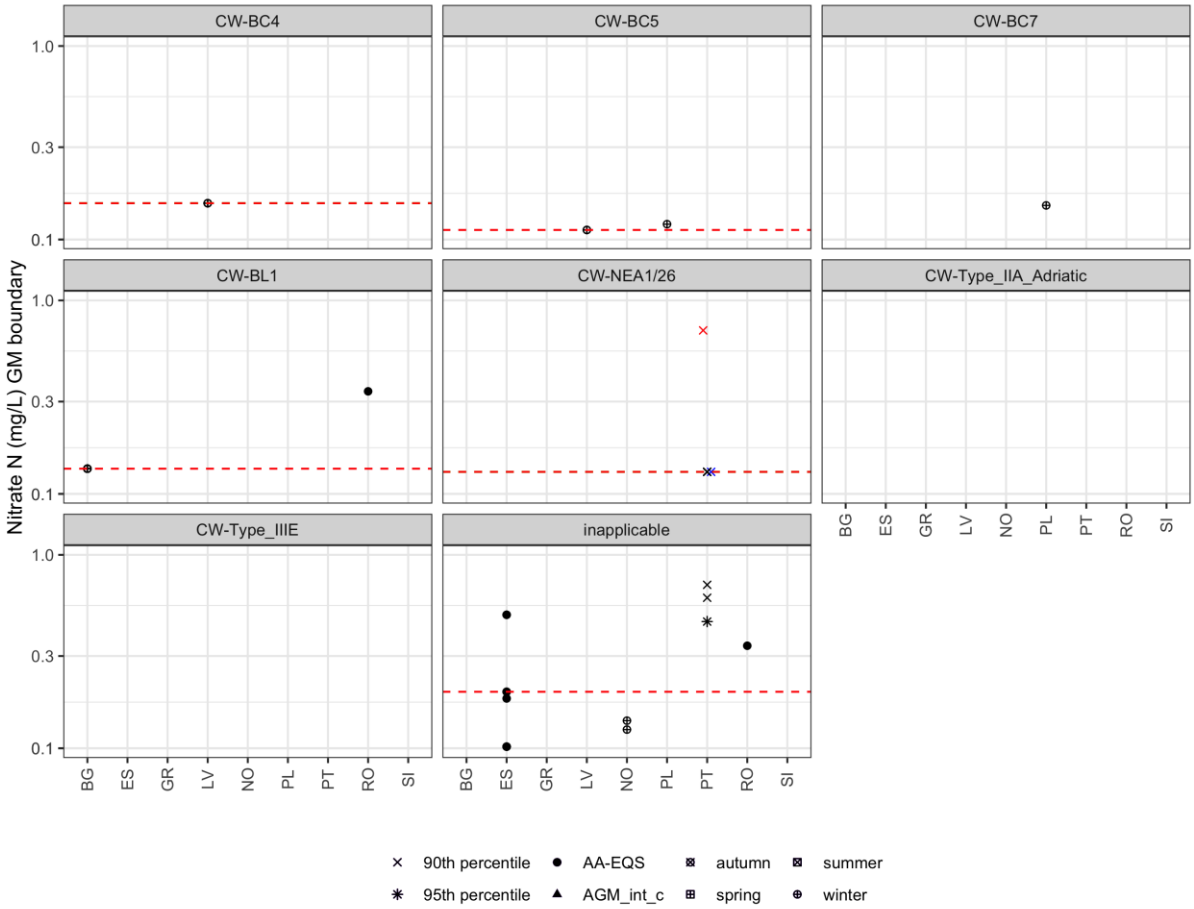

Figure A3.1-1: Nitrate as N standards by country and IC type (single value black, minimum blue, maximum red). Horizontal lines mark 75th (red) quantiles.

Table A3.1-1: Nitrate as N metrics used by country.

	90th percentile	95th percentile	AA-EQS	AGM_int_c	autumn	spring	summer	winter
BG	0	0	0	0	9	9	9	9
ES	0	0	18	0	0	0	0	0
GR	0	0	1	0	0	0	0	0
LV	0	0	0	0	0	0	0	5
NO	0	0	0	0	0	0	2	2
PL	0	0	0	0	0	0	0	4
PT	11	1	0	0	0	0	0	0

	90th percentile	95th percentile	AA-EQS	AGM_int_c	autumn	spring	summer	winter
RO	0	0	2	0	0	0	0	0
SI	0	0	0	1	0	0	0	0

Table A3.1-2. Nitrate as N number of records where standard was reported as a value or a range

Country	value	range
BG	36	
ES	18	
GR	1	
LV	5	
NO	4	
PL	4	
PT	11	1
RO	2	
SI	1	

Table A3.1-3: Number of different Nitrate as N standards by country and IC type.

	BG	ES	GR	LV	NO	PL	PT	RO	SI	Sum
CW-BC4	0	0	0	3	0	0	0	0	0	3
CW-BC5	0	0	0	2	0	3	0	0	0	5
CW-BC7	0	0	0	0	0	1	0	0	0	1
CW-BL1	36	0	0	0	0	0	0	1	0	37
CW-NEA1/26	0	0	0	0	0	0	9	0	0	9
CW-Type_IIA_Adriatic	0	0	0	0	0	0	0	0	1	1
CW-Type_IIIE	0	0	1	0	0	0	0	0	0	1
inapplicable	0	18	0	0	4	0	3	1	0	26
Sum	36	18	1	5	4	4	12	2	1	83

A3.2 Nitrate-N (transitional waters)

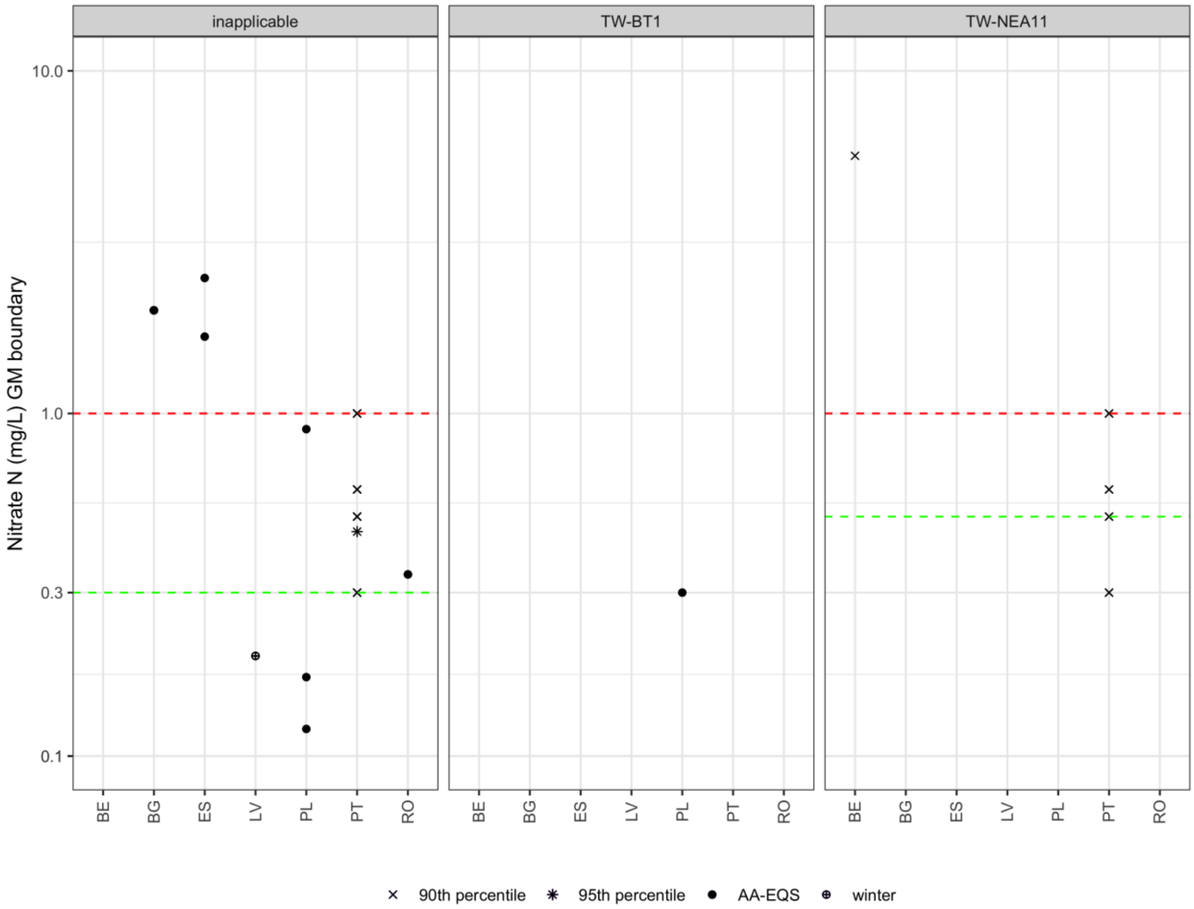

Figure A3.2-1: Nitrate as N standards by country and IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles.

Table A3.2-1: Nitrate as N metrics used by country.

	90th percentile	95th percentile	AA-EQS	winter
BE	1	0	0	0
BG	0	0	4	0
ES	0	0	2	0
LV	0	0	0	3
PL	0	0	5	0
PT	32	1	0	0
RO	0	0	2	0

Table A3.2-2: Nitrate as N number of records where standard was reported as a value or a range.

Country	value	range
BE	1	
BG	4	
ES	2	
LV	3	
PL	5	
PT	33	
RO	2	

Table A3.2-3: Number of different Nitrate as N standards by country and IC type.

	BE	BG	ES	LV	PL	PT	RO	Sum
inapplicable	0	4	2	3	4	21	2	36
TW-BT1	0	0	0	0	1	0	0	1
TW-NEA11	1	0	0	0	0	12	0	13
Sum	1	4	2	3	5	33	2	50

A4. Total Inorganic Nitrogen

A4.1 Total Inorganic Nitrogen (coastal waters)

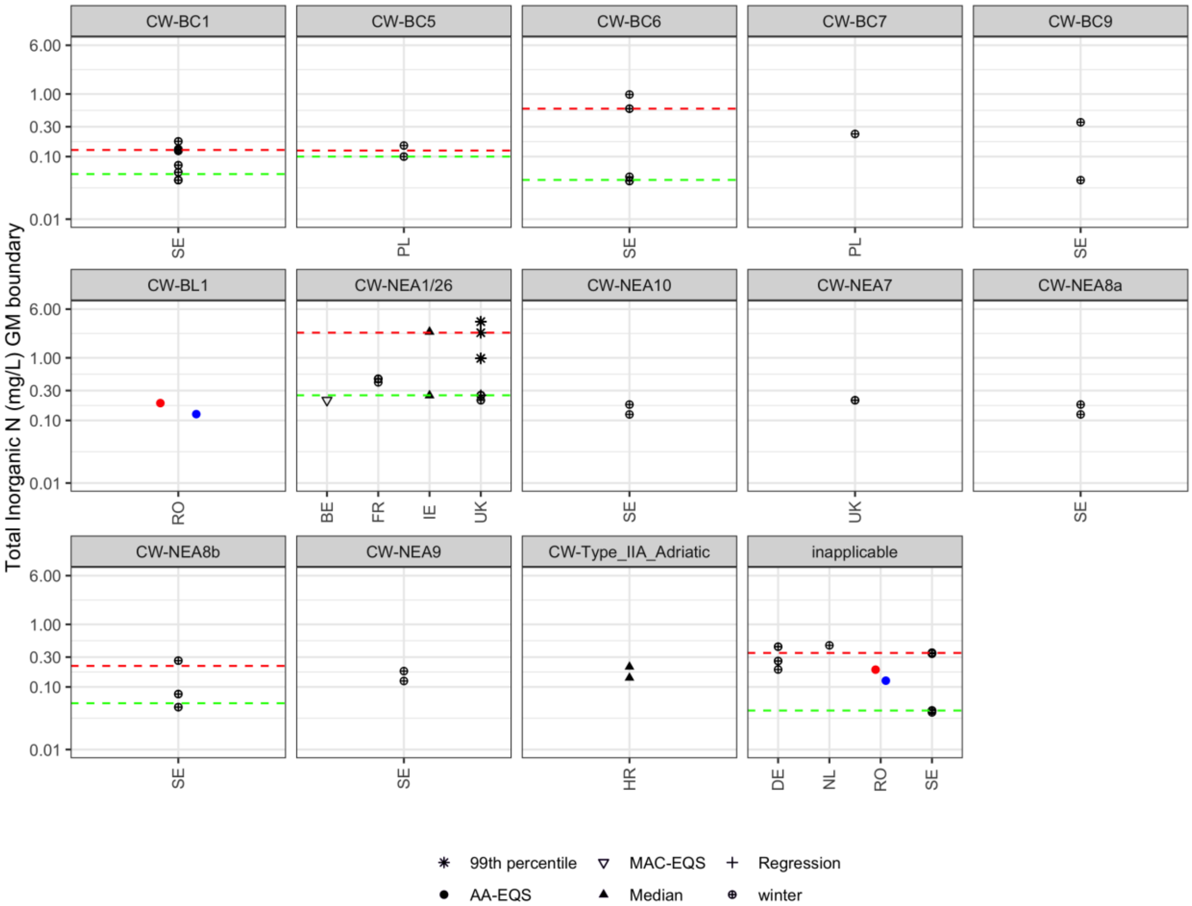

Figure A4.1-1: Total Inorganic N standards by country and IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles.

Table A4.1-1: Total Inorganic N metrics used by country.

	99th percentile	AA-EQS	MAC-EQS	Median	Regression	winter
BE	0	0	1	0	0	0
DE	0	0	0	0	0	5
FR	0	0	0	0	0	5
HR	0	0	0	2	0	0
IE	0	0	0	6	0	0
NL	0	0	0	0	0	1
PL	0	0	0	0	0	4
RO	0	2	0	0	0	0
SE	0	0	0	0	0	50
UK	39	0	0	0	3	15

Table A4.1-2: Total Inorganic N number of records where standard was reported as a value or a range.

Country	value	range
BE	2	
DE	10	
FR	10	
HR	4	
NL	2	
PL	8	
SE	50	
UK	114	
IE	6	
RO		4

Table A4.1-2: Number of different Total Inorganic N standards by country and IC type

	BE	DE	FR	HR	IE	NL	PL	RO	SE	UK	Sum
CW-BC1	0	0	0	0	0	0	0	0	16	0	16
CW-BC5	0	0	0	0	0	0	3	0	0	0	3
CW-BC6	0	0	0	0	0	0	0	0	6	0	6
CW-BC7	0	0	0	0	0	0	1	0	0	0	1
CW-BC9	0	0	0	0	0	0	0	0	2	0	2
CW-BL1	0	0	0	0	0	0	0	1	0	0	1
CW-NEA1/26	1	0	5	0	6	0	0	0	0	55	67
CW-NEA10	0	0	0	0	0	0	0	0	2	0	2
CW-NEA7	0	0	0	0	0	0	0	0	0	2	2
CW-NEA8a	0	0	0	0	0	0	0	0	2	0	2
CW-NEA8b	0	0	0	0	0	0	0	0	8	0	8
CW-NEA9	0	0	0	0	0	0	0	0	2	0	2
CW-Type_IIA_Adriatic	0	0	0	2	0	0	0	0	0	0	2
inapplicable	0	5	0	0	0	1	0	1	12	0	19
Sum	1	5	5	2	6	1	4	2	50	57	133

Extras plots for comparison of values without outliers and also salinity effect.

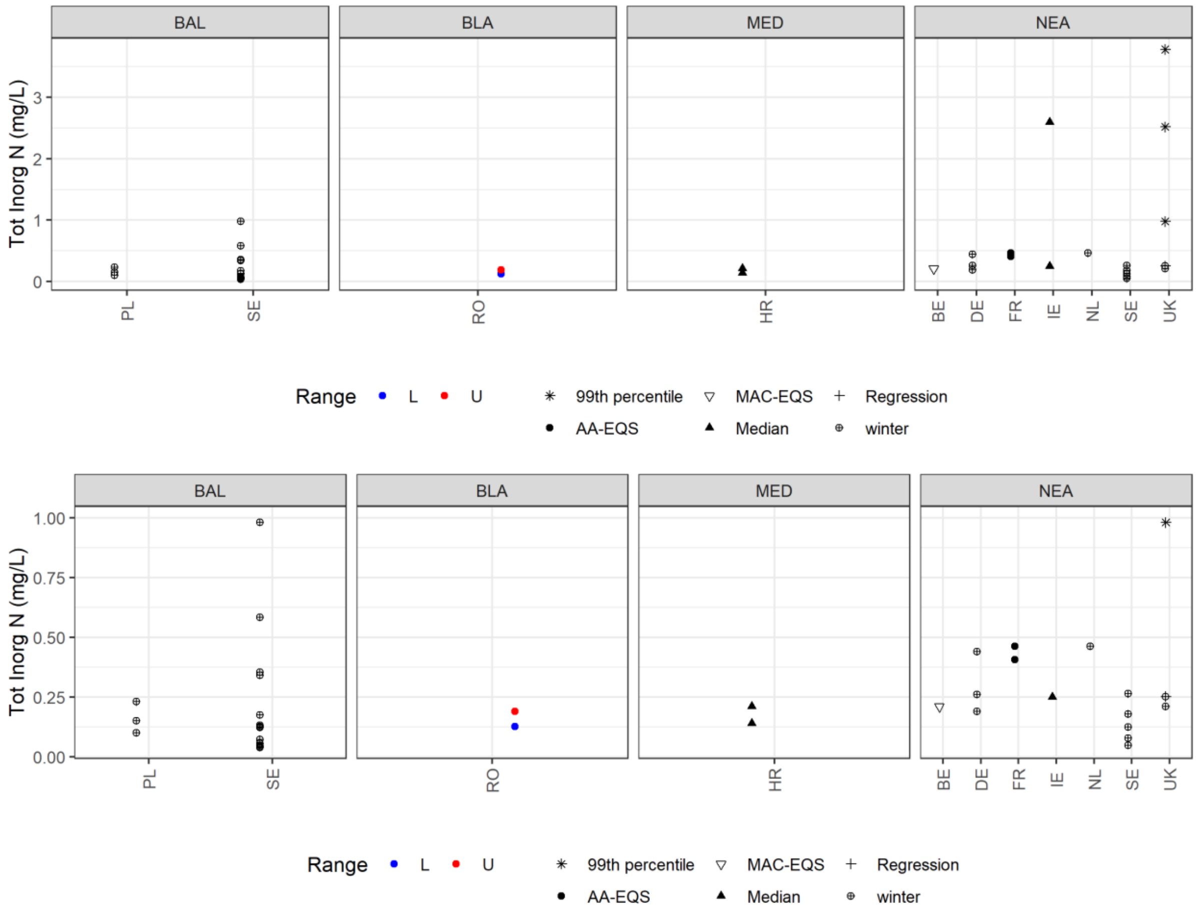

Figure A4-1-2: Total Inorganic N standards by country and GIG (single value black, minimum blue, maximum red), comparing G/M boundaries distribution with (top) and without (bottom) outliers (UK: 2.52 mg/L and 3.78 mg/L; IR: 2.6 mg/L).

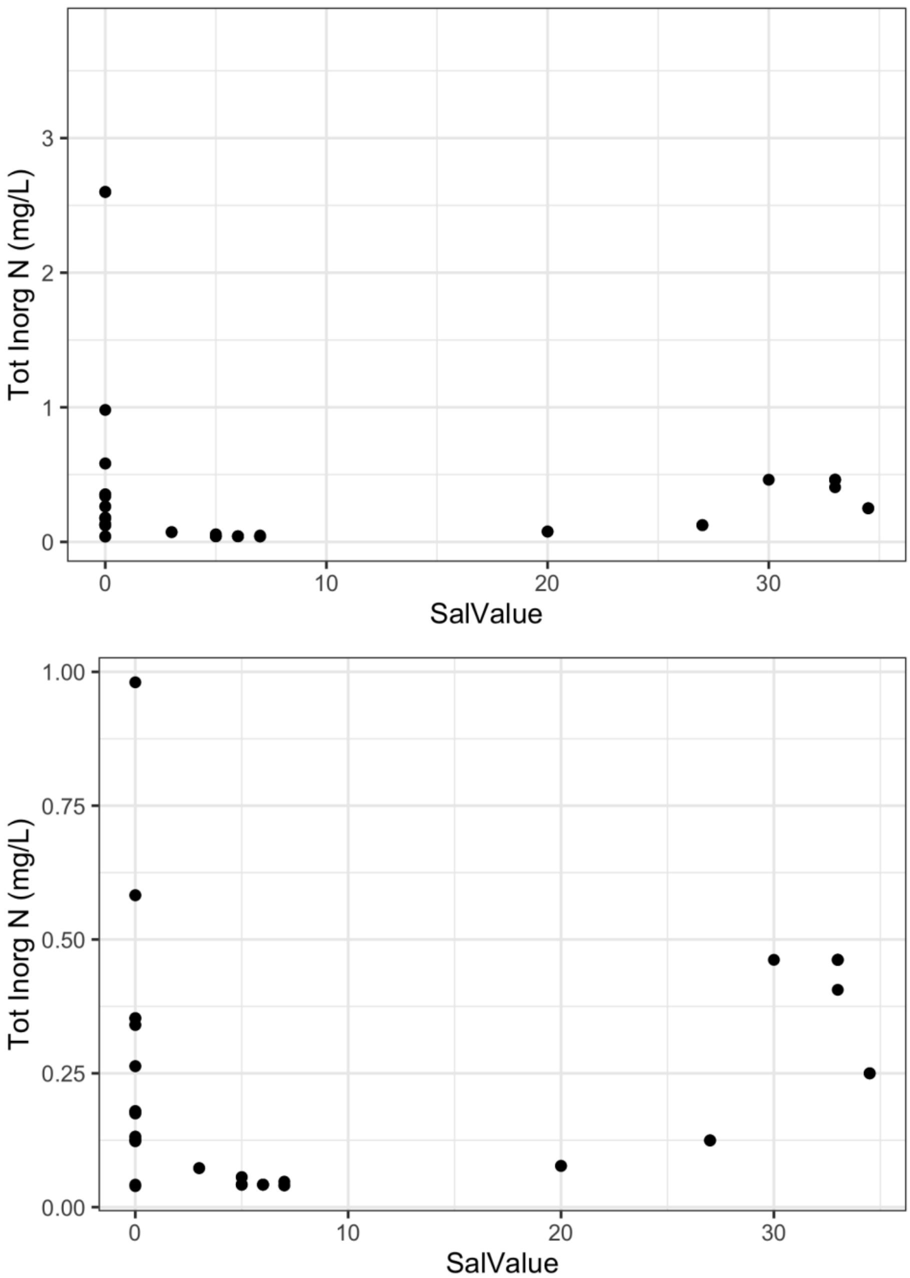

Figure A4.1-3: Total Inorganic N standards for which a salinity gradient was associated. Comparison of values distribution with (top) and without (bottom) the presence of outliers (IE: 2.6 mg/L).

A4.2 Total Inorganic Nitrogen (transitional waters)

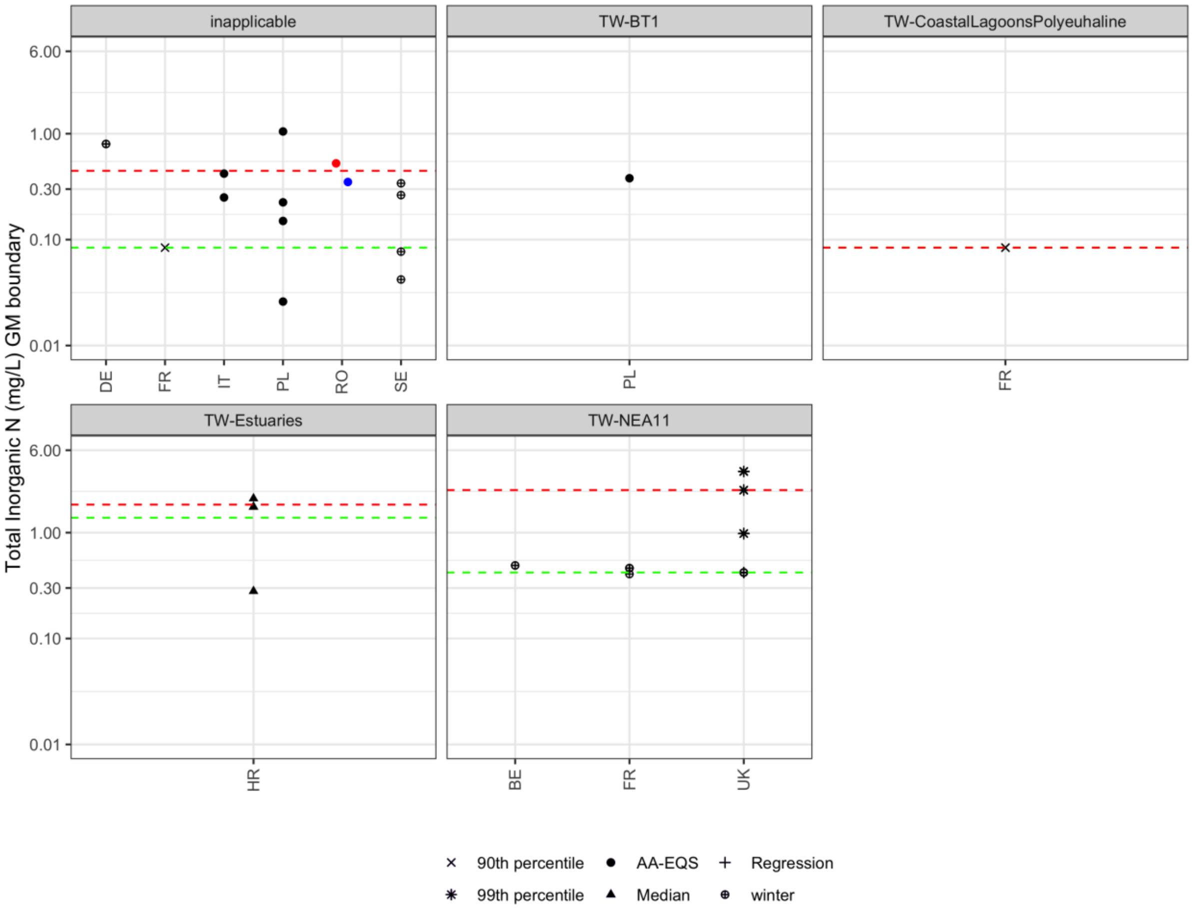

Figure A4.2-1: Total Inorganic N standards by country and IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles.

Table A4.2-1: Total Inorganic N metrics used by country.

	90th percentile	99th percentile	AA-EQS	Median	Regression	winter
BE	0	0	0	0	0	2
DE	0	0	0	0	0	2
FR	6	0	5	0	0	0
HR	0	0	0	4	0	0
IT	0	0	2	0	0	0
PL	0	0	5	0	0	0
RO	0	0	1	0	0	0
SE	0	0	0	0	0	4
UK	0	39	0	0	3	15

Table A4.2-2: Total Inorganic N number of records where standard was reported as a value or a range

Country	value	range
BE	2	
DE	2	
FR	11	
HR	4	
IT	2	
PL	5	
SE	4	
UK	57	
RO		1

Table A4.2-3: Number of different Total Inorganic N standards by country and IC type.

	BE	DE	FR	HR	IT	PL	RO	SE	UK	Sum
inapplicable	0	2	2	0	2	4	1	4	0	15
TW-BT1	0	0	0	0	0	1	0	0	0	1
TW-CoastalLagoonsPolyeuhaline	0	0	4	0	0	0	0	0	0	4
TW-Estuaries	0	0	0	4	0	0	0	0	0	4
TW-NEA11	2	0	5	0	0	0	0	0	57	64
Sum	2	2	11	4	2	5	1	4	57	88

A.5 Total Nitrogen

A5.1 Total Nitrogen (coastal waters)

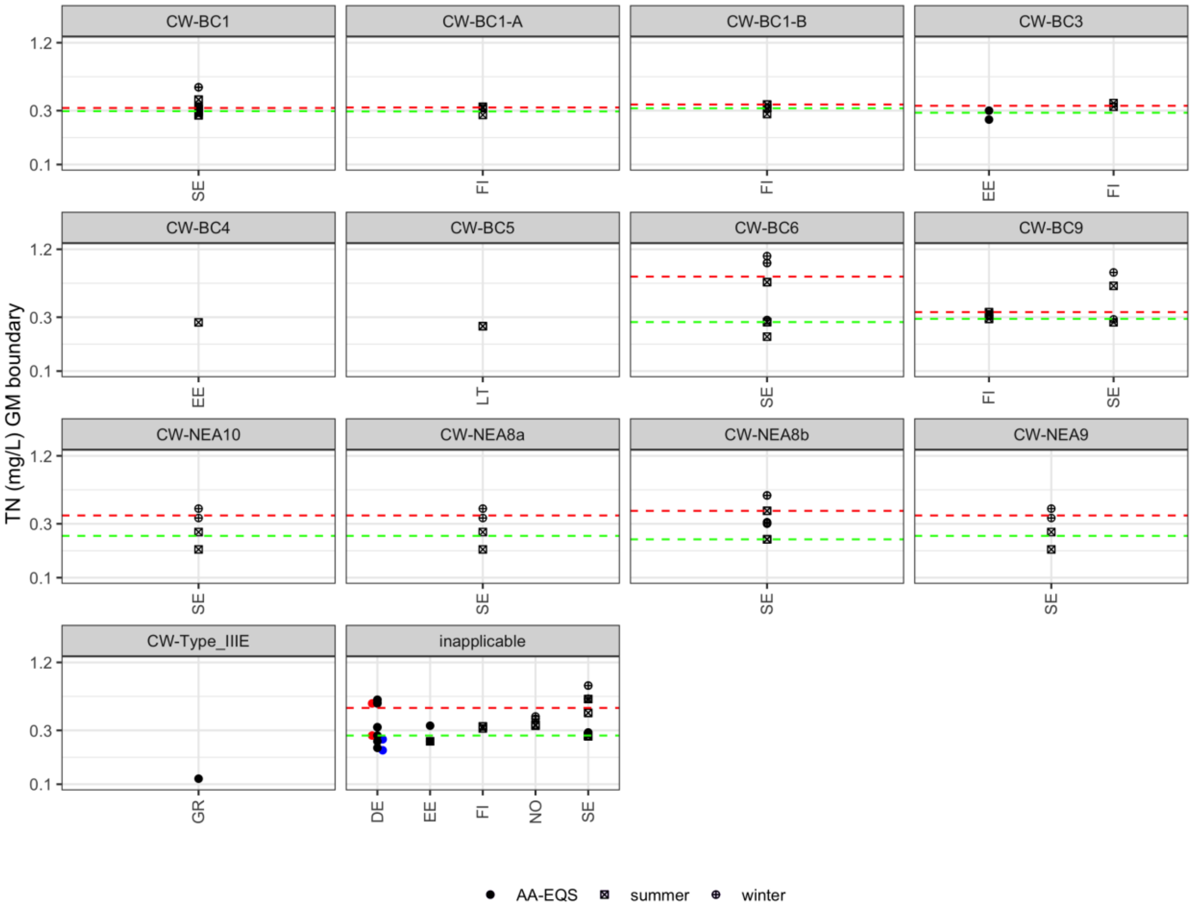

Figure A5.1-1: TN standards by country and IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles.

Table A5.1-1: TN metrics used by country.

	AA-EQS	summer	winter
DE	11	0	0
EE	4	2	0
FI	0	22	0
GR	1	0	0
LT	0	2	0
NO	0	2	2
SE	0	46	46

Table A5.1-2: TN number of records where standard was reported as a value or a range.

Country	value	range
DE	7	2
EE	6	
FI	22	
GR	1	
NO	4	
SE	100	
LT	4	

Table A5.1-3: Number of different TN standards by country and IC type.

	DE	EE	FI	GR	LT	NO	SE	Sum
CW-BC1	0	0	0	0	0	0	32	32
CW-BC1-A	0	0	3	0	0	0	0	3
CW-BC1-B	0	0	9	0	0	0	0	9
CW-BC3	0	2	2	0	0	0	0	4
CW-BC4	0	1	0	0	0	0	0	1
CW-BC5	0	0	0	0	2	0	0	2
CW-BC6	0	0	0	0	0	0	12	12
CW-BC9	0	0	5	0	0	0	4	9
CW-NEA10	0	0	0	0	0	0	4	4
CW-NEA8a	0	0	0	0	0	0	4	4
CW-NEA8b	0	0	0	0	0	0	12	14
CW-NEA9	0	0	0	0	0	0	4	4
CW-Type_IIIE	0	0	0	1	0	0	0	1
inapplicable	11	3	3	0	0	4	20	39
Sum	11	6	22	1	2	4	92	138

A5.2 Total Nitrogen (transitional waters)

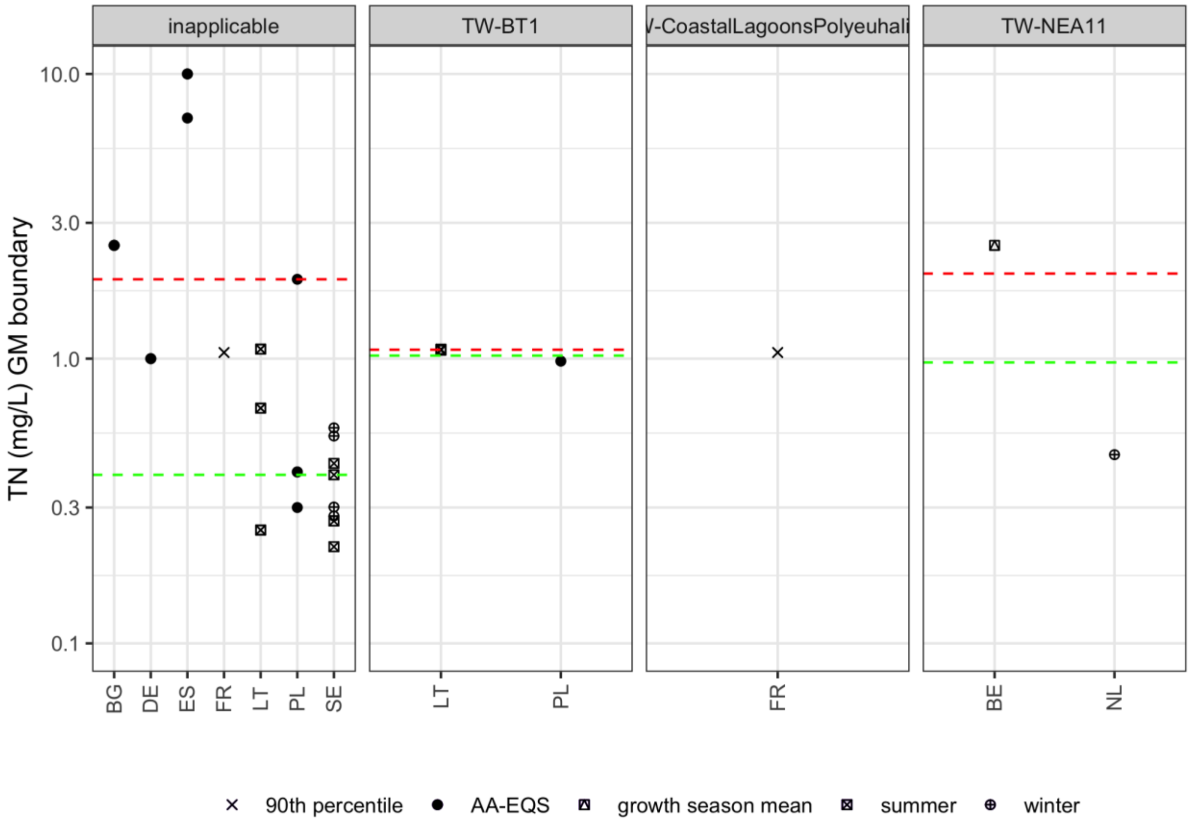

Figure A5.2-1: TN standards by country and IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles.

Table A5.2-1: TN metrics used by country

	90th percentile	AA-EQS	growth season mean	summer	winter
BE	0	0	2	0	0
BG	0	4	0	0	0
DE	0	2	0	0	0
ES	0	3	0	0	0
FR	4	0	0	0	0
LT	0	0	0	11	0
NL	0	0	0	0	1
PL	0	5	0	0	0
SE	0	0	0	4	4

Table A5.2-2: TN number of records where standard was reported as a value or a range.

Country	value	range
BE	2	
BG	4	
DE	2	
ES	3	
FR	4	
LT	16	
NL	2	
PL	5	
SE	8	

Table A5.2-3: Number of different TN standards by country and IC type

	BE	BG	DE	ES	FR	LT	NL	PL	SE	Sum
inapplicable	0	4	2	3	2	8	0	4	8	31
TW-BT1	0	0	0	0	0	3	0	1	0	4
TW-CoastalLagoonsPolyeuhaline	0	0	0	0	2	0	0	0	0	2
TW-NEA11	2	0	0	0	0	0	1	0	0	3
Sum	2	4	2	3	4	11	1	5	8	40

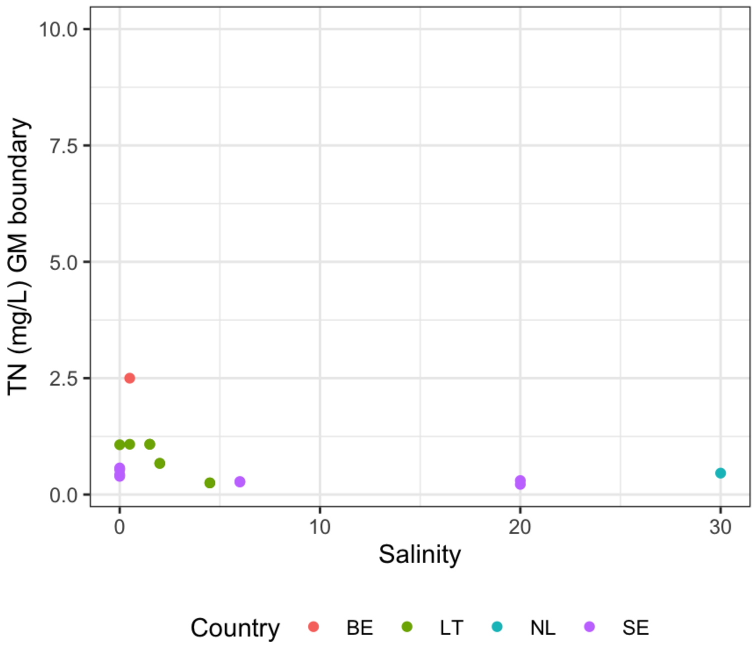

Figure A5.2-1: Total N standards for which a salinity gradient was associated.

A.6 Orthophosphate

A6.1 Orthophosphate (coastal waters)

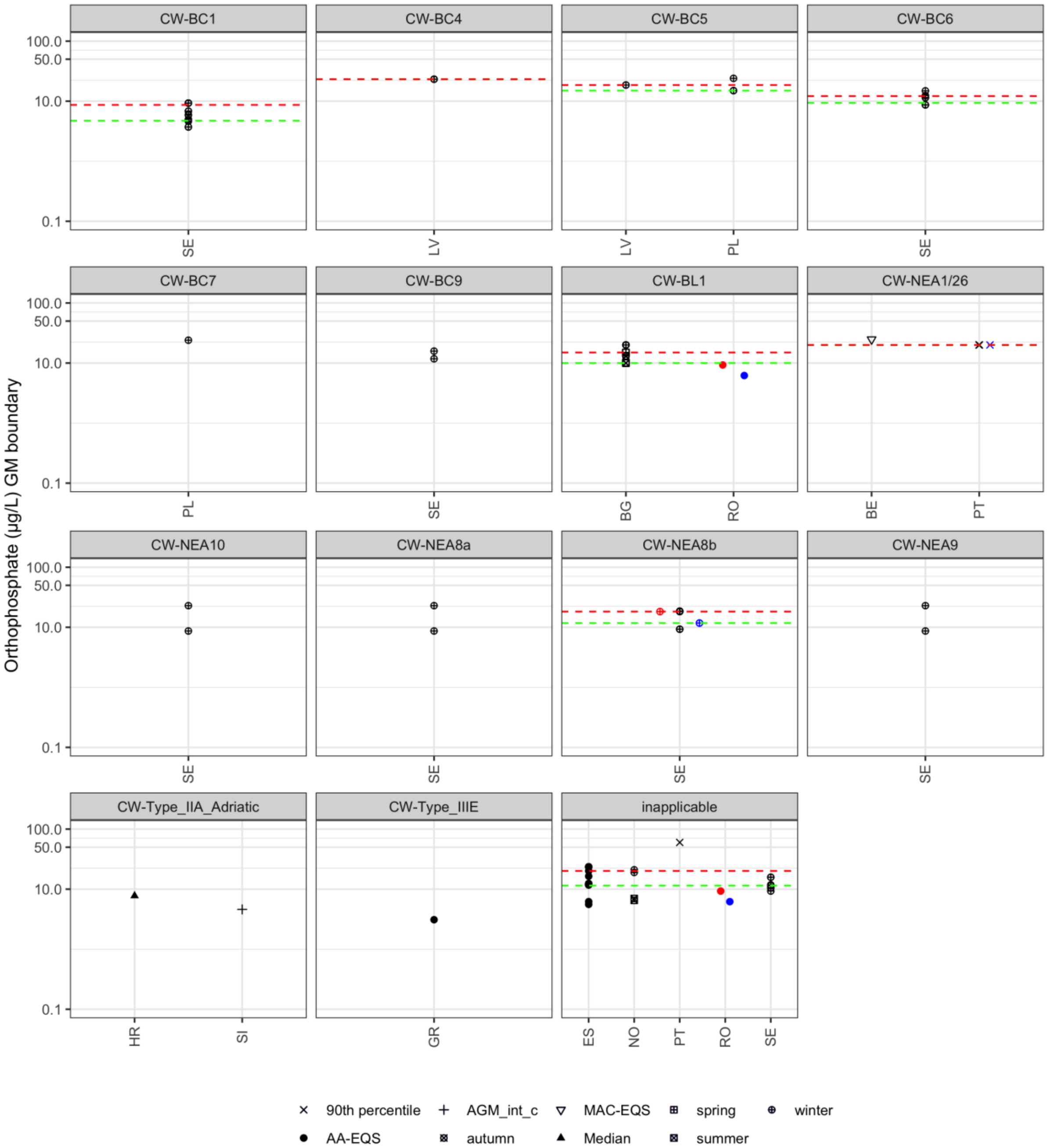

Figure A6.1-1: Orthophosphate standards by country and IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles.

Table A6.1-1: Orthophosphate metrics used by country

	90th percentile	AA-EQS	AGM_int_c	autumn	MAC-EQS	Median	spring	summer	winter
BE	0	0	0	0	1	0	0	0	0
BG	0	0	0	9	0	0	9	9	9
ES	0	19	0	0	0	0	0	0	0
GR	0	1	0	0	0	0	0	0	0
HR	0	0	0	0	0	1	0	0	0
LV	0	0	0	0	0	0	0	0	5
NO	0	0	0	0	0	0	0	2	2
PL	0	0	0	0	0	0	0	0	4
PT	12	0	0	0	0	0	0	0	0
RO	0	2	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0	0	50
SI	0	0	1	0	0	0	0	0	0

Table A6.1-2: Orthophosphate number of records where standard was reported as a value or a range.

Country	value	range
BE	1	
BG	36	
ES	19	
GR	1	
HR	1	
LV	5	
NO	8	
PL	4	
PT	12	1
SE	50	
SI	1	
RO		2

Table A6.1-3: Number of different Orthophosphate standards by country and IC type.

	BE	BG	ES	GR	HR	LV	NO	PL	PT	RO	SE	SI	Sum
CW-BC1	0	0	0	0	0	0	0	0	0	0	16	0	16
CW-BC4	0	0	0	0	0	3	0	0	0	0	0	0	3
CW-BC5	0	0	0	0	0	2	0	3	0	0	0	0	5
CW-BC6	0	0	0	0	0	0	0	0	0	0	6	0	6
CW-BC7	0	0	0	0	0	0	0	1	0	0	0	0	1
CW-BC9	0	0	0	0	0	0	0	0	0	0	2	0	2
CW-BL1	0	36	0	0	0	0	0	0	0	1	0	0	37
CW-NEA1/26	1	0	0	0	0	0	0	0	9	0	0	0	10
CW-NEA10	0	0	0	0	0	0	0	0	0	0	2	0	2
CW-NEA8a	0	0	0	0	0	0	0	0	0	0	2	0	2
CW-NEA8b	0	0	0	0	0	0	0	0	0	0	8	0	8
CW-NEA9	0	0	0	0	0	0	0	0	0	0	2	0	2
CW-Type_IIA_Adriatic	0	0	0	0	1	0	0	0	0	0	0	1	2
CW-Type_IIIE	0	0	0	1	0	0	0	0	0	0	0	0	1
inapplicable	0	0	19	0	0	0	4	0	3	1	12	0	39
Sum	1	36	19	1	1	5	4	4	12	2	50	1	136

A6.2 Orthophosphate (transitional waters)

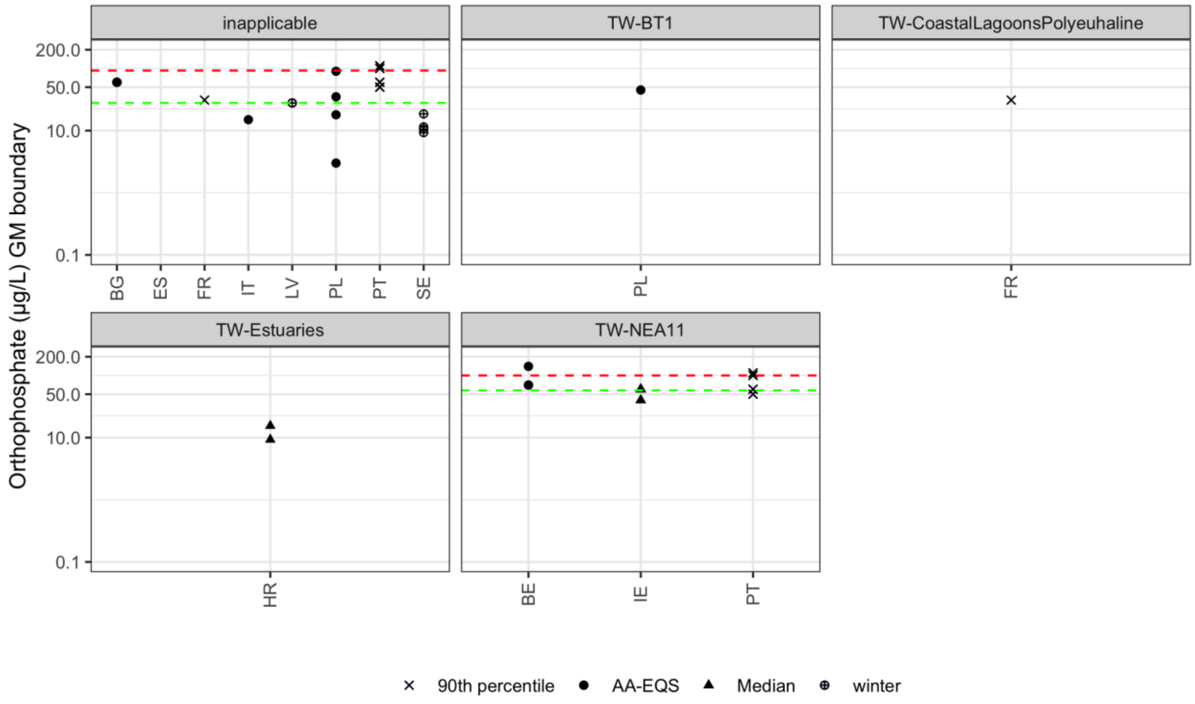

Figure A6.2-1: Orthophosphate standards by country and IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles.

Table A6.2-1: Orthophosphate metrics used by country.

	90th percentile	AA-EQS	Median	winter
BE	0	5	0	0
BG	0	4	0	0
ES	0	2	0	0
FR	4	0	0	0
HR	0	0	2	0
IE	0	0	12	0
IT	0	1	0	0
LV	0	0	0	3
PL	0	5	0	0
PT	48	0	0	0
SE	0	0	0	4

Table A6.2-2: Orthophosphate number of records where standard was reported as a value or a range.

Country	value	range
BE	6	
BG	4	
ES	2	
FR	4	
HR	2	
IE	12	
IT	1	
LV	3	
PL	5	
PT	64	
SE	4	

Table A6.2-3: Number of different Orthophosphate standards by country and IC type.

	BE	BG	ES	FR	HR	IE	IT	LV	PL	PT	SE	Sum
inapplicable	0	4	2	2	0	0	1	3	4	30	4	50
TW-BT1	0	0	0	0	0	0	0	0	1	0	0	1
TW-CoastalLagoonsPolyeuhaline	0	0	0	2	0	0	0	0	0	0	0	2
TW-Estuaries	0	0	0	0	2	0	0	0	0	0	0	2
TW-NEA11	5	0	0	0	0	12	0	0	0	18	0	35
Sum	5	4	2	4	2	12	1	3	5	48	4	90

A7. Total Phosphorus

A7.1Total phosphorus (coastal waters)

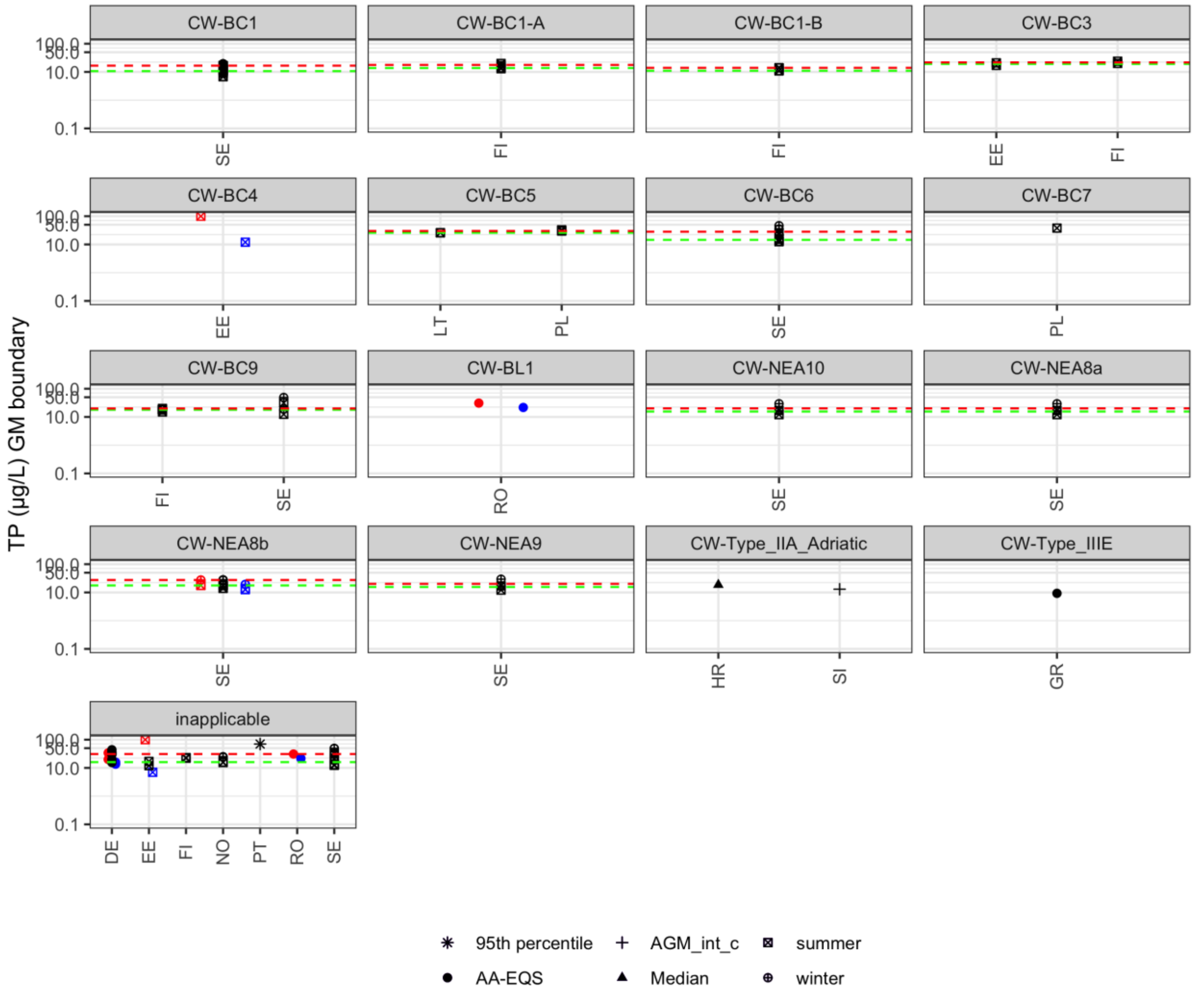

Figure A7.1-1: TP standards by country and IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles.

Table A7.1-1: TP metrics used by country.

	95th percentile	AA-EQS	AGM_int_c	Median	summer	winter
DE	0	11	0	0	0	0
EE	0	0	0	0	6	0
FI	0	0	0	0	22	0
GR	0	1	0	0	0	0
HR	0	0	0	1	0	0
LT	0	0	0	0	2	0
NO	0	0	0	0	2	2
PL	0	0	0	0	4	0
PT	1	0	0	0	0	0

	95th percentile	AA-EQS	AGM_int_c	Median	summer	winter
RO	0	2	0	0	0	0
SE	0	0	0	0	50	50
SI	0	0	1	0	0	0

Table A7.1-2: TP number of records where standard was reported as a value or a range.

Country	value	range
DE	9	
EE	4	
FI	22	
GR	1	
HR	1	
NO	8	
PL	4	
PT	1	
SE	100	
SI	1	
LT	4	
RO		2

Table A7.1-3: Number of different TP standards by country and IC type.

	DE	EE	FI	GR	HR	LT	NO	PL	PT	RO	SE	SI	Sum
CW-BC1	0	0	0	0	0	0	0	0	0	0	32	0	32
CW-BC1-A	0	0	4	0	0	0	0	0	0	0	0	0	4
CW-BC1-B	0	0	8	0	0	0	0	0	0	0	0	0	8
CW-BC3	0	2	2	0	0	0	0	0	0	0	0	0	4
CW-BC4	0	1	0	0	0	0	0	0	0	0	0	0	1
CW-BC5	0	0	0	0	0	2	0	3	0	0	0	0	5
CW-BC6	0	0	0	0	0	0	0	0	0	0	12	0	12
CW-BC7	0	0	0	0	0	0	0	1	0	0	0	0	1
CW-BC9	0	0	5	0	0	0	0	0	0	0	4	0	9
CW-BL1	0	0	0	0	0	0	0	0	0	1	0	0	1
CW-NEA10	0	0	0	0	0	0	0	0	0	0	4	0	4
CW-NEA8a	0	0	0	0	0	0	0	0	0	0	4	0	4
CW-NEA8b	0	0	0	0	0	0	0	0	0	0	16	0	16

	DE	EE	FI	GR	HR	LT	NO	PL	PT	RO	SE	SI	Sum
CW-NEA9	0	0	0	0	0	0	0	0	0	0	4	0	4
CW-Type_IIA_Adriatic	0	0	0	0	1	0	0	0	0	0	0	1	2
CW-Type_IIIE	0	0	0	1	0	0	0	0	0	0	0	0	1
inapplicable	9	3	3	0	0	0	4	0	1	1	20	0	41
Sum	9	6	22	1	1	2	4	4	1	2	96	1	149

A7.2 Total phosphorus (transitional waters)

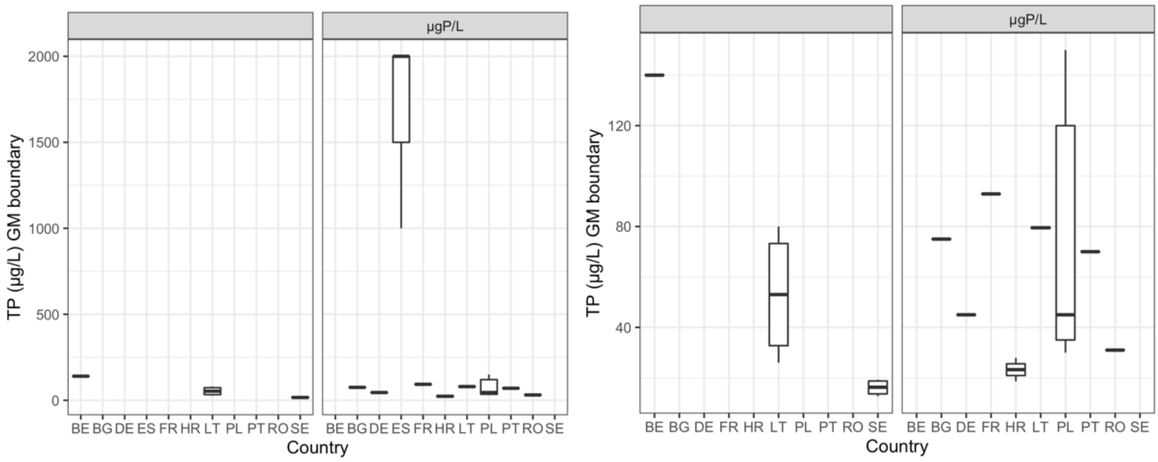

Figure A7.2-1: Comparison of G/M boundaries distribution reported by countries, with Spanish (ES) G/M boundaries of 1000 and 2000 µg P/L included (left) and excluded (right).

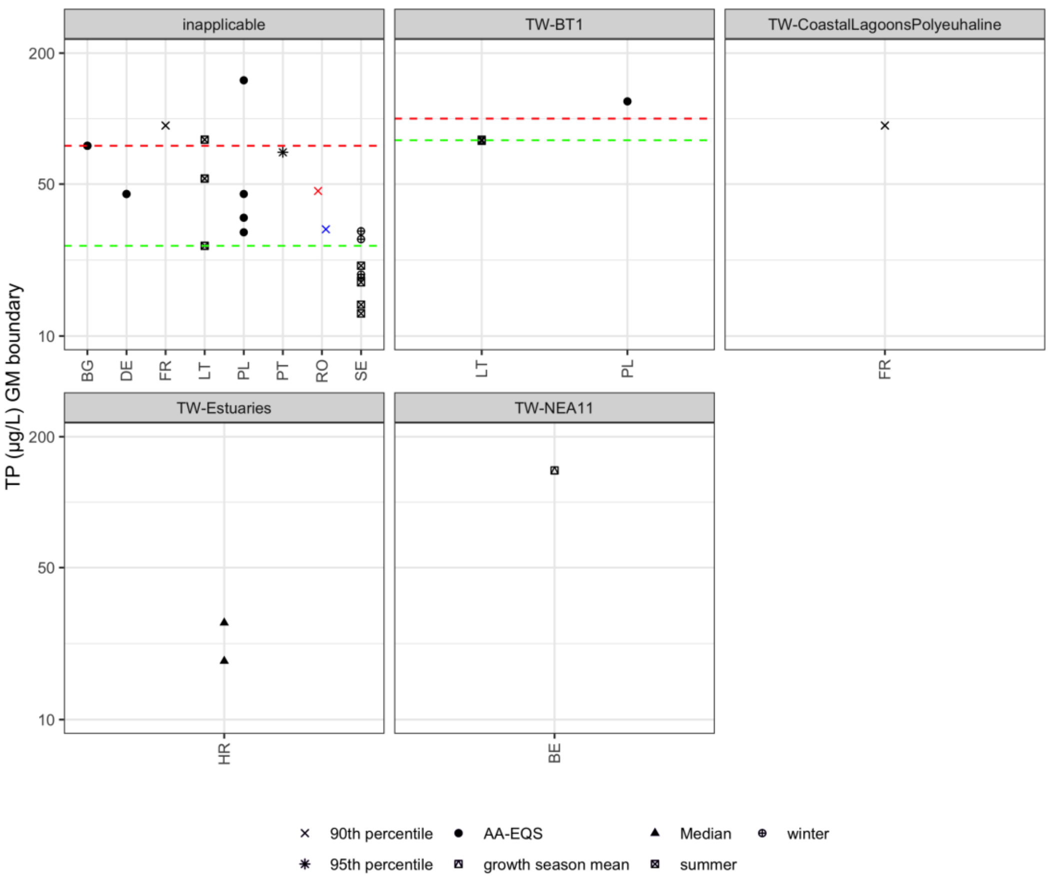

Figure A7.2-2: TP standards by country and IC type (single value black, minimum blue, maximum red). Horizontal lines mark 25th (green) and 75th (red) quantiles. (ES G/M boundaries of 1000 and 2000 µg P/L excluded).

Table A7.2-1: TP metrics used by country.

	90th percentile	95th percentile	AA-EQS	growth season mean	Median	summer	winter
BE	0	0	0	2	0	0	0
BG	0	0	4	0	0	0	0
DE	0	0	2	0	0	0	0
FR	4	0	0	0	0	0	0
HR	0	0	0	0	2	0	0
LT	0	0	0	0	0	11	0
PL	0	0	5	0	0	0	0
PT	0	1	0	0	0	0	0
RO	1	0	0	0	0	0	0
SE	0	0	0	0	0	4	4

Table A7.2-2: TP number of records where standard was reported as a value or a range.

Country	value	range
BE	2	
BG	4	
DE	2	
FR	4	
HR	2	
LT	16	
PL	5	
PT	1	
SE	8	
RO		1

Table A7.2-3: Number of different TP standards by country and IC type.

	BE	BG	DE	FR	HR	LT	PL	PT	RO	SE	Sum
inapplicable	0	4	2	2	0	8	4	1	1	8	30
TW-BT1	0	0	0	0	0	3	1	0	0	0	4
TW-CoastalLagoonsPolyeuhaline	0	0	0	2	0	0	0	0	0	0	2
TW-Estuaries	0	0	0	0	2	0	0	0	0	0	2
TW-NEA11	2	0	0	0	0	0	0	0	0	0	2
Sum	2	4	2	4	2	11	5	1	1	8	40

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