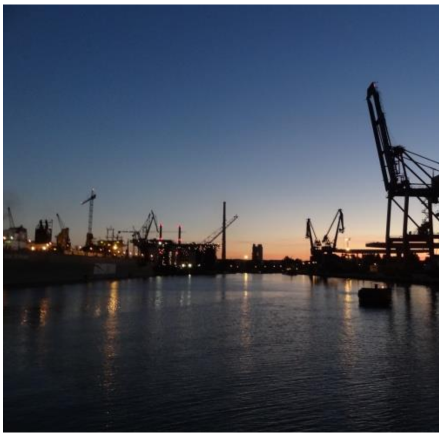
A comparison of European nutrient boundaries for transitional, coastal and marine waters



Fotos: W. Leujak

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On behalf of the Working Group on ecological Status ECOSTAT

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Abbreviations

MS abbreviations

BE: Belgium

BG: Bulgaria

CY: Cyprus

DE: Germany

DK: Denmark

EE: Estonia

EL: Greece

ES: Spain

F: France

FI: Finland

HR: Croatia

IE: Ireland

IT: Italy

LT: Lithuania

LV: Latvia

MT: Malta

NL: Netherlands

NO: Norway

PL: Poland

PT: Portugal

RO: Romania

SE: Sweden

SI: Slovenia

UK: United Kingdom

Others

BQEs: Biological quality elements

CW: Coastal waters

ECOSTAT: Working Group on Ecological Status

DIN: Dissolved inorganic nitrogen

G/M: Good/Moderate

MS: Member State

MSFD: Marine Strategy Framework Directive

MW: Marine waters

RC: reference conditions

TN: Total nitrogen

TP: Total phosphorus

TW: Transitional waters

WFD: Water Framework Directive

Summary and key conclusions

In general there was a large heterogeneity in the nutrient parameters assessed by MS, while some assessed the dissolved nutrients (inorganic nitrogen, phosphate) others assessed total nutrients (total nitrogen, total phosphorus). In addition, the assessment time (summer, winter or all year round) varied between MS. Lastly, there were also differences in the statistic used for the assessment (mean, median or 90th percentile). These described differences were observed between MS, as well as within the four marine ecoregions according to the MSFD and even within MS between transitional, coastal and marine waters.

The large heterogeneity seriously hampered a comparison of the nutrient boundaries for reference conditions and good/moderate status within a marine ecoregion. Comparison was also hampered by some MS providing no or incomplete nutrient boundaries or nutrient boundaries without units. In particular for reference conditions there is a considerable lack of information. No analysis could be carried out comparing the common types within the marine ecoregions because only very few MS reported these and it was not possible to assign these types based on the sparse information provided by MS.

In the Baltic Sea, Sweden assesses DIN in summer and winter using mean methods in all three water types; Germany assesses total nitrogen year round using median methods for coastal and marine waters (transitional were not defined). The rest of the MS either assess different parameters or monitor the parameters at different times of the year. The situation as regards phosphorus parameters is very similar. The N and P parameters used are consistent for 2 types of waters in LV (coastal and marine waters for N and P), LT and PL (transitional and coastal waters for P and N). For SE and DE, in a second step the ranges of G/M boundaries set from transitional to marine waters have been analysed.

In the Black Sea the situation is not clear as RO has just reported that they assess biannually but the metrics behind is unclear. BG has no common approach and the metrics for coastal waters is unclear.

In the Mediterranean Sea, while Croatia assesses DIN in transitional and coastal waters year-round using median methods, it assesses nitrate using maximum values based on multi-year data. Greece and Spain take the same approach for nitrate in transitional and coastal waters. For P-parameters, Croatia assesses TP and phosphate the same way for transitional and coastal waters, but only assesses phosphate in marine waters and uses different methods. Greece and Spain assess phosphate the same way in transitional and coastal waters. The N and P parameters used are consistent for 2 types of waters in ES and HR (coastal and marine waters for N and P). In a second step the ranges of G/M boundaries (transitional to marine waters) set in HR and SI for phosphate have been analysed.

In the North East Atlantic, only DE provides a consistent set of parameters for N and P in all three waters. The UK has a consistent set of parameters for N for all three saline water categories. The N and P parameters used are consistent for 2 categories of waters in BE (coastal and marine waters for N and P), IE (transitional and coastal waters for P; coastal and marine waters for N) and SE and PT (transitional waters and coastal waters for N and P). DE has set a specific “management target value” as a nitrogen concentration at the boundary of freshwater/marine (2,8mg/l for German rivers entering the North Sea and 2,6mg/l for rivers entering the Baltic Sea). This target value will enable the achievement of “good ecological status” of transitional and coastal waters under the WFD, of “good environmental status” of marine waters under the MSFD and for the Baltic Sea of the aims of the Baltic Sea Action Plan.

Most often a mixture of approaches was used to set nutrient reference conditions and G/M boundaries, and while expert judgment played an important role, it was predominantly used in combination with other, more quantitative approaches (use of existing sites with minor disturbance, historical data and information, modelling). As a basis for deriving reference conditions MS have predominantly used historic riverine nutrient inputs or historic nutrient concentrations. These have been interpolated along salinity gradients into the open sea using mixing diagrams. The further the historic nutrient concentrations go back in time the more they were derived by modelling rather than looking at time-series of in-situ data. With respect to the historic conditions, it is interesting that even within a region and between neighbouring MS there have been very different historic years used to base reference conditions upon (e.g. 1880, 1900, 1930, 1950s, 1960s). While this might be due to data availability, it

also appears that there are very different notions among MS of what constitutes water quality conditions not yet affected by eutrophication. Those MS that have not used the approach described above have mainly relied on deriving nutrient concentrations from recent sites considered to be unpolluted or have relied on pressure-response relationships between biological quality elements (predominantly chlorophyll-a) and nutrients.

G/M boundaries have often been derived by adding an “acceptable deviation” (mostly of 50%) to the reference conditions. In particular in the Baltic Sea and North-East Atlantic this approach was chosen.

Ideally the boundaries set for all three types of sea waters and the ones for inland waters should be related to each other, in a way that the nutrient concentrations in rivers and lakes allow for the achievement of “good status” in coastal and marine waters. However, most often MS have not chosen to compare the same parameters or use the same methods for all three saline water categories, so a relation is quite difficult to make.

In terms of the role of the general physico-chemical quality elements in the ecological classification of good and moderate status, Member States have largely developed different approaches to dealing with the inevitable differences between classifications derived from nutrient sensitive biological quality elements and the supporting physico-chemical nutrient standard. A key aspect here is how the assessment of nutrient concentrations affects the classification of the overall ecological status and how this factors into the consideration of measures if there is a mis-match of classification for biology and nutrients. Most MS apply the one out all out principle in a very strict way in that if any of the biological quality elements sensitive to nutrients are not in good status or nutrient concentrations are not good, the water body is classified as being not in good status. 6 MS (coastal waters) and 3 MS (transitional waters) allow a water body with nutrients in poor status but with good biological quality elements to be classified as good status.

Most MS have established a pressure-response relationship with biological QE. This analysis has mainly been carried out in coastal waters (17 MS), followed by transitional waters (8 MS) and marine waters (8 MS). The quality element (QE) mostly used for establishing a pressure-response relationship in transitional, coastal and marine water is phytoplankton. QE Fish is not used at all. Multiple QE have been used in analysing transitional waters in BG, IT and UK, the same for coastal waters in BG, IT, RO, UK, DK. In the case of marine waters none of the MS used more than one QE.

1 Introduction and background

Household wastewater and runoff from agricultural land contribute to large amounts of nutrients (especially phosphates and nitrates) entering EU waters, which accelerates the growth of aquatic plants and leads to eutrophication.

The EU Water Framework Directive (WFD) entered into force in 2000 and sets the environmental objectives for all European surface and ground waters. The objectives of the Directive are to protect waters, prevent deterioration and protect and improve the water balance of dependent terrestrial ecosystems and wetlands. The central element to achieving these goals is the definition of "good ecological status" (Art. 4 WFD). Nutrient concentrations are only used as supporting parameters in the assessment of the ecological status. They have therefore not been included in the intercalibration exercise. Coastal nutrient concentrations are, however, key parameters for the management of eutrophication, since they can be directly linked to nutrient inputs, which can be addressed by abatement measures. In this context it is important that EU Member States set consistent and comparable nutrient boundaries.

On 15 July 2008, the Marine Strategy Framework Directive of the European Union (MSFD) entered into force with the aim - analogous to the provisions of the WFD – to achieve or maintain "good environmental status" of the marine environment by 2020. In the course of implementation, each EU Member State must develop a strategy for its marine regions to achieve the objectives, starting with an initial assessment of the environmental status (Art. 8 MSFD), the determination of good environmental status (Art. 9 MSFD) and the establishment of environmental targets (Art. 10 MSFD) by 2012. According to the Commission Decision, nutrient concentrations under the MSFD are not just supportive parameters but indicators that are of equal importance as the biological indicators. Within the scope of the Marine Strategy Framework Directive, nutrient levels (nutrient concentrations in the water column and nutrient ratios for nitrogen, phosphorus and silica, where appropriate), are the relevant criteria and indicators in marine waters under Descriptor 5: "Human-induced eutrophication". The Commission's Article 12 assessment has shown that there is a lack of coherence between EU Member States in setting nutrient boundaries and in applying nutrients as an indicator in eutrophication assessments.

Nutrient boundaries set for the WFD and MSFD should ideally match, since the rivers represent a primary pathway of nutrients into the sea and nutrients entering via rivers are diluted along the salinity gradients. Setting consistent nutrient boundaries for the WFD and MSFD is therefore important for a consistent management approach of transitional, coastal and marine waters. Nevertheless, based on basic data on nutrients that MS reported to WISE in 2010, major differences have been identified.

The Working Group on Ecological Status (ECOSTAT), as part of the Common Implementation Strategy for the WFD and MSFD, agreed to address the topic of wide variations in the nutrient concentration boundaries set by the MS. In February 2013, a workshop in Birmingham was held to further explore these variations. At the working group meeting in Madrid, DE and the UK agreed to take the issue forward. To this end, in March 2014 two questionnaires, one for freshwater and one for saline waters were developed and sent to the Member States. The questionnaires covered three aspects:

1. High/good and good/moderate boundaries for nutrients
2. Methods used to derive reference conditions and good/moderate boundaries for nutrients
3. Use of nutrient classification in the assessment of ecological status / eutrophication status

In September 2014, an interim analysis was conducted. The objective of the analysis was to compare limits for nutrients within common types (broad types of freshwater and possible joint IC Types for the transition / coastal waters) and to check whether there is a correlation between the nutrients and the biological quality elements (BQEs) using the "pressure - response" relation.

For saline waters, as expected, a wide range of values and different metrics (mean, median, 95th percentile, maximum) are applied across the MS, as well as wide differences in reference conditions.

While most Member States reported that "pressure - response" relations were used to set class limits, mainly focussing on the biological quality element “phytoplankton”, the most common practice for the derivation of reference conditions seems to be the selection of, rather random, historic reference years.

As of December 2015, for saline waters 22 MS submitted questionnaires (excluding ES and MT) and 21 MS submitted Excel spreadsheets (excluding DK, NL[1] and MT) detailing information on boundaries set for total phosphorus, total nitrogen, DIN, phosphate and nitrate. In terms of methods used for determining boundaries, most MS use mean and median, with a few MS using percentiles and maximum. There are also a variety of methods to derive reference conditions and good/moderate boundaries for nutrients. The majority of MS use reference conditions based on expert judgement, historical data, modelling, or existing sites. Some MS use a combination of approaches. "Pressure - Response" relations with biological quality elements have also been considered in part.

This report details the full findings of the above mentioned questionnaire and spreadsheets. A previous version of this report was provided to ECOSTAT for commenting until 30 October. Further comments were collected and incorporated after the ECOSTAT nutrient workshop in Berlin in November 2015. The report was finalised in January 2016.

2 Methodological approach and challenges of the data analyses

When writing the report a logical sequence was used to analyse the data presented in chapter 3. This can be summarised as follows:

Step 1: The data were structured along the four regional seas and commonalities concerning “parameters assessed”, “methods used” and “time of the year applied” have been analysed. This was done for N and P separately for each water type as well as for reference conditions (RC) and good moderate (G/M) boundaries. As a result 6 tables per sea region have been produced.

Step 2: Under the second step, the G/M boundary threshold values that are assessed based on a common approach in more than 2 MS in a Sea Region have been compared. The figures show the variation among MS in the same water type, not considering different typologies.

Step 3: EU wide conclusions were drawn as to the methodologies used to assess reference conditions and G/M boundaries for all three water types.

Step 4: Assessment of G/M boundary threshold values along different water types within a MS. In an ideal case these values should drop from the inland to the open waters.

When applying this methodology a number of challenges have been faced. These are:

- Gaps in reported data. DK and MT have not set nutrient boundaries for coastal waters.
- The data reported were difficult to compare as MS often do not use common parameters, metrics and seasons of the year when they assess nutrients (see section 3). Comparisons were only carried out when the same parameters, metrics and seasons were used since comparability cannot be assumed if these differ.[2]
- Lack of information related to common types of waters. Not all MS have reported common types, but often only national types. This makes a comparison of boundaries within common types impossible.
- In many cases the values provided by MS where provided without units or other units than indicated in the template. This is a potential source of mistakes when converting the values to the same unit.
- In some cases information on salinity was lacking or the boundary values provided by MS are not based on the same salinity values/ranges.

[1] Nutrient standards were submitted only as a formula.

[2] While the questionnaire asked for “inorganic nitrogen” as a possible nutrient parameter some MS provided information on DIN. For this report it has been assumed that these two parameters are equivalent. Note that DIN = nitrite+nitrate+ammonia.

3 Comparison of nutrient boundary values within a regional sea

One of the challenges in comparing nutrient boundaries are the differences related to measurements among MS. These differences relate to:

- The parameters measured (TN, TP, phosphate, nitrate, DIN)
- The time of the year they are measured (summer, winter, annually, biannually)
- The variety of metrics used (mean, median, 90th percentile, maximum).
- The use of analytical methods

The tables below show the differences within the Sea Regions for the different types of water (transitional, coastal, marine) for those countries who have replied to the questionnaire[3].

3.1 Baltic Sea

3.1.1 Transitional waters

DE, EE, FI and DK have not designated transitional waters. The other four MS (LT, LV, PL and SE) of the Baltic Sea reported information on how they have set reference conditions and G/M boundaries in transitional waters.

Table 1 Metrics used and time of year measured for reference conditions in transitional waters in the Baltic Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
Lithuania	Northern part of the Curonian Lagoon	S			S											
Lithuania	Central part of the Curonian Lagoon	S			S											
Lithuania	Plume of the Curonian lagoon in the Baltic sea	S			S											
Latvia	LVT							W						W		
Poland	Internal Gulf of Gdańsk	S/Y			S/Y			W/Y						W/Y		
Poland	External (Outer) Puck Bay	S/Y			S/Y			W/Y						W/Y		
Poland	Vistula Outlet	S/Y			S/Y			W/Y						W/Y		
Poland	Świna - Outlet	S/Y			S/Y			W/Y						W/Y		
Poland	Dziwna - Outlet	S/Y			S/Y			W/Y						W/Y		
Poland	Vistula Lagoon	S/Y			S/Y			W/Y						W/Y		
Poland	Szczecin Lagoon	S/Y			S/Y			W/Y						W/Y		
Poland	Puck Lagoon	S/Y			S/Y			W/Y						W/Y		
Sweden	Stockholms inre skärgård och Hallsfjärden	W/S			W/S			W						W		

Legend: S=summer, W=winter, Y=year, ?=unclear

The information received shows most of the countries assess total nitrogen (except LV). LT, PL and SE assess total phosphorus, and LT, LV and SE assess phosphate and DIN.

There are only minor differences in the season the assessment takes place, even within countries. While in PL some transitional waters are assessed in the summer and year-round, SE assessed in the

[3] Please note that DE in the Baltic and CY, EE, FI and SI have not designated transitional waters.

winter and summer but LT only assesses in the summer. However, the figure above shows that for the same parameters the countries assess at the same time.

LT, LV and SE assess both N and P parameters; PL looks at multiple N parameters (TN and DIN).

Table 2 Metrics used and time of year measured for G/M boundaries in transitional waters in the Baltic Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
Lithuania	Northern part of the Curonian Lagoon	S			S											
Lithuania	Central part of the Curonian Lagoon	S			S											
Lithuania	Plume of the Curonian lagoon in the Baltic sea	S			S											
Latvia	LVT							W						W		
Poland	Internal Gulf of Gdańsk	S/Y			S			S/Y						W/Y		
Poland	External (Outer) Puck Bay	S/Y			S			S/Y						W/Y		
Poland	Vistula Outlet	S/Y			S/Y			W/Y						W/Y		
Poland	Świna - Outlet	S/Y			S/Y			W/Y						W/Y		
Poland	Dziwna - Outlet	S/Y			S/Y			W/Y						W/Y		
Poland	Vistula Lagoon	S/Y			S/Y			W/Y						W/Y		
Poland	Szczecin Lagoon	S/Y			S/Y			W/Y						W/Y		
Poland	Puck Lagoon	S/Y			S/Y			W/Y						W/Y		
Sweden	Stockholms inre skärgård och Hallsfjärden	S/W			S/W			W						W		

Legend: S=summer, W=winter, Y=year-round, ?=unclear

The same parameters as for reference conditions have been used to define G/M boundaries in transitional waters in the Baltic.

The figures below show the variation in G/M boundary values set for those countries that have designated transitional waters.

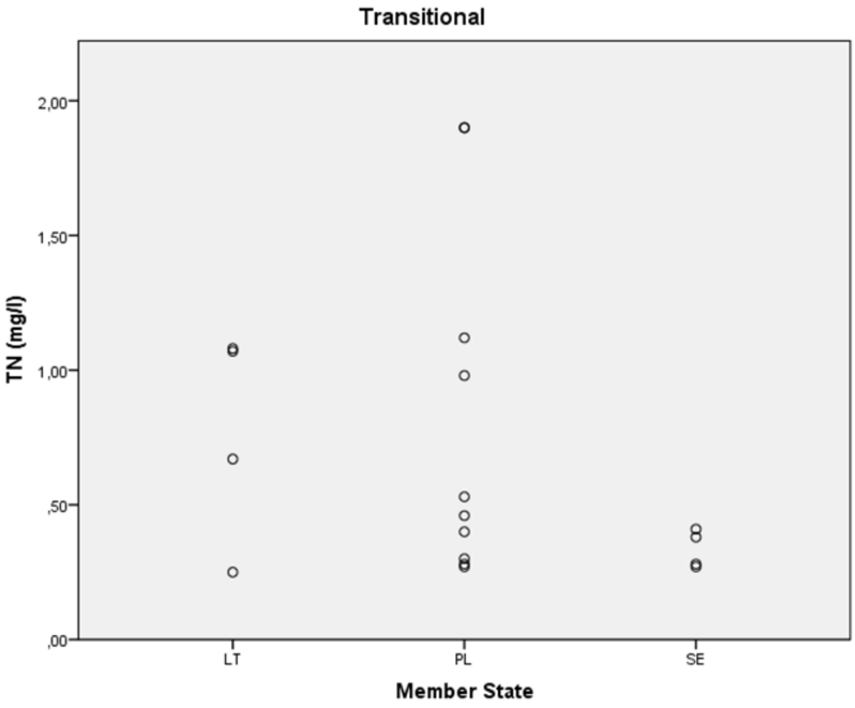

Figure 1 G/M boundary values for TN in transitional waters in the Baltic Sea

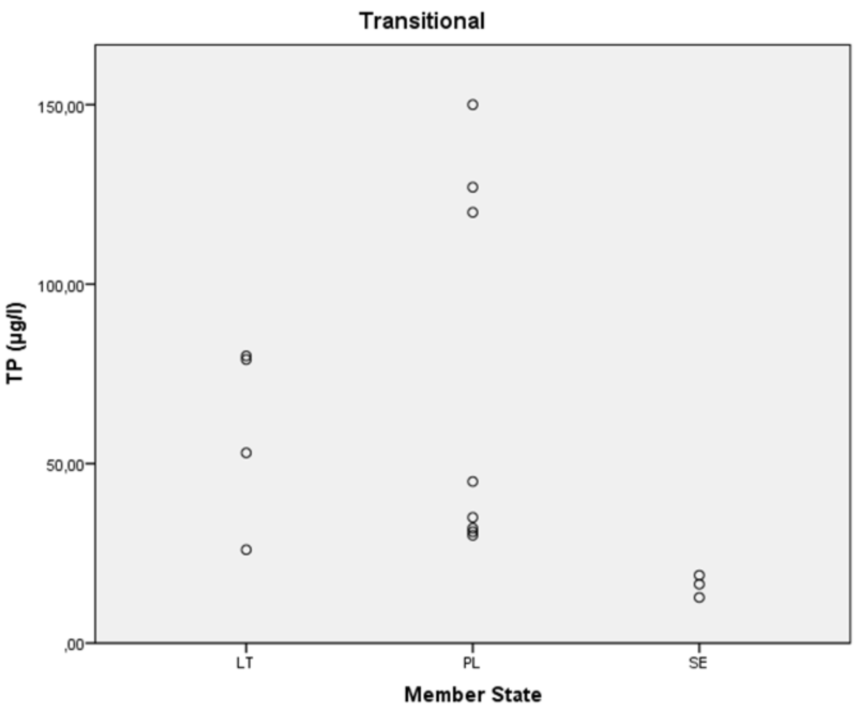

Figure 2 G/M boundary values for TP in transitional waters in the Baltic Sea

3.1.2 Coastal waters

All the Baltic MS reported information on how they define reference conditions for nutrient levels, with the exception of DK where nutrient boundaries have not yet been defined.

Table 3 Metrics used and time of year measured for reference conditions in coastal waters in the Baltic Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
Germany	B1-MV		Y			Y										
Germany	B2a-MV		Y			Y										
Germany	B2b-MV		Y			Y										
Germany	B3a-MV		Y			Y										
Germany	B3b-MV		Y			Y										
Germany	B2a-SH		Y			Y										
Germany	B2b-SH		Y			Y										
Germany	B3b-SH		Y			Y										
Germany	B4-SH		Y			Y										
Poland	Vistula Spit	S			S			W						W		
Poland	Pomeranian Bay	S			S			W						W		
Poland	Middle Coast	S			S			W						W		
Lithuania	Open Baltic sea sandy coast	S			S											
Lithuania	Open Baltic sea stony coast (northern coast)	S			S											
Latvia	LVA							W						W		
Latvia	LVB							W						W		
Latvia	LVCDE							W						W		
Latvia	LVF							W						W		
Estonia	I	S			S											
Estonia	II	S			S											
Estonia	III	S			S											
Estonia	IV	S			S											
Estonia	V	S			S											
Estonia	VI	S			S											
Finland	Ss	S			S											
Finland	Su	S			S											
Finland	Ls	S			S											
Finland	Lv	S			S											
Finland	Lu	S			S											
Finland	Ses	S			S											
Finland	Seu	S			S											
Finland	Ms	S			S											
Finland	Mu	S			S											
Finland	Ps	S			S											
Finland	Pu	S			S											
Sweden	7	S			S			W						W		
Sweden	8	S			S			W						W		
Sweden	9	S			S			W						W		
Sweden	10	S			S			W						W		
Sweden	11	S			S			W						W		
Sweden	12s	S			S			W						W		
Sweden	12n	S			S			W						W		
Sweden	13	S			S			W						W		
Sweden	14	S			S			W						W		
Sweden	15	S			S			W						W		
Sweden	16	S			S			W						W		
Sweden	17	S			S			W						W		
Sweden	18	S			S			W						W		
Sweden	19	S			S			W						W		
Sweden	20	S			S			W						W		
Sweden	21	S			S			W						W		
Sweden	22	S			S			W						W		
Sweden	23	S			S			W						W		

Legend: S=summer, W=winter, Y=year-round, ?=unclear

The most frequently used parameters for defining reference conditions in the Baltic Sea are total nitrogen and total phosphorus, assessed by all the reporting MS except LV. Out of the 6 MS reporting on both parameters, all assess in the summer and use mean methods, with the exception of DE, which assesses year-round; PL assesses in summer and year-round. DE is the only MS that measures its parameters using median, the rest all use mean.

PL, LV and SE assess phosphate using mean methods in winter. LV, PL and SE are the only MS to assess DIN; all use mean methods but assess during different times of the year.

A similar comparison can be made regarding G/M boundaries, as shown in the tables below.

Table 4 Metrics used and time of year measured for G/M boundaries in coastal waters in the Baltic Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
Germany	B1-MV		Y			Y										
Germany	B2a-MV		Y			Y										
Germany	B2b-MV		Y			Y										
Germany	B3a-MV		Y			Y										
Germany	B3b-MV		Y			Y										
Germany	B2a-SH		Y			Y										
Germany	B2b-SH		Y			Y										
Germany	B3b-SH		Y			Y										
Germany	B4-SH		Y			Y										
Poland	Vistula Spit	S			S			W						W		
Poland	Pomeranian Bay	S			S			W						W		
Poland	Middle Coast	S			S			W						W		
Lithuania	Open Baltic sea sandy coast	S			S											
Lithuania	Open Baltic sea stony coast (northern coast)	S			S											
Latvia	LVA							W						W		
Latvia	LVB							W						W		
Latvia	LVCDE							W						W		
Latvia	LVF							W						W		
Estonia	I	S			S											
Estonia	II	S			S											
Estonia	III	S			S											
Estonia	IV	S			S											
Estonia	V	S			S											
Estonia	VI	S			S											
Finland	Ss	S			S											
Finland	Su	S			S											
Finland	Ls	S			S											
Finland	Lv	S			S											
Finland	Lu	S			S											
Finland	Ses	S			S											
Finland	Seu	S			S											
Finland	Ms	S			S											
Finland	Mu	S			S											
Finland	Ps	S			S											
Finland	Pu	S			S											
Sweden	7	S/W			S/W			W						W		
Sweden	8	S/W			S/W			W						W		
Sweden	9	S/W			S/W			W						W		
Sweden	10	S/W			S/W			W						W		
Sweden	11	S/W			S/W			W						W		
Sweden	12s	S/W			S/W			W						W		
Sweden	12n	S/W			S/W			W						W		
Sweden	13	S/W			S/W			W						W		
Sweden	14	S/W			S/W			W						W		
Sweden	15	S/W			S/W			W						W		
Sweden	16	S/W			S/W			W						W		
Sweden	17	S/W			S/W			W						W		
Sweden	18	S/W			S/W			W						W		
Sweden	19	S/W			S/W			W						W		
Sweden	20	S/W			S/W			W						W		
Sweden	21	S/W			S/W			W						W		
Sweden	22	S/W			S/W			W						W		
Sweden	23	S/W			S/W			W						W		

Legend: S=summer, W=winter, Y=year-round, ?=unclear

The figures below show the range of G/M boundaries applied in the MS using TN and TP (using mean for the assessment).

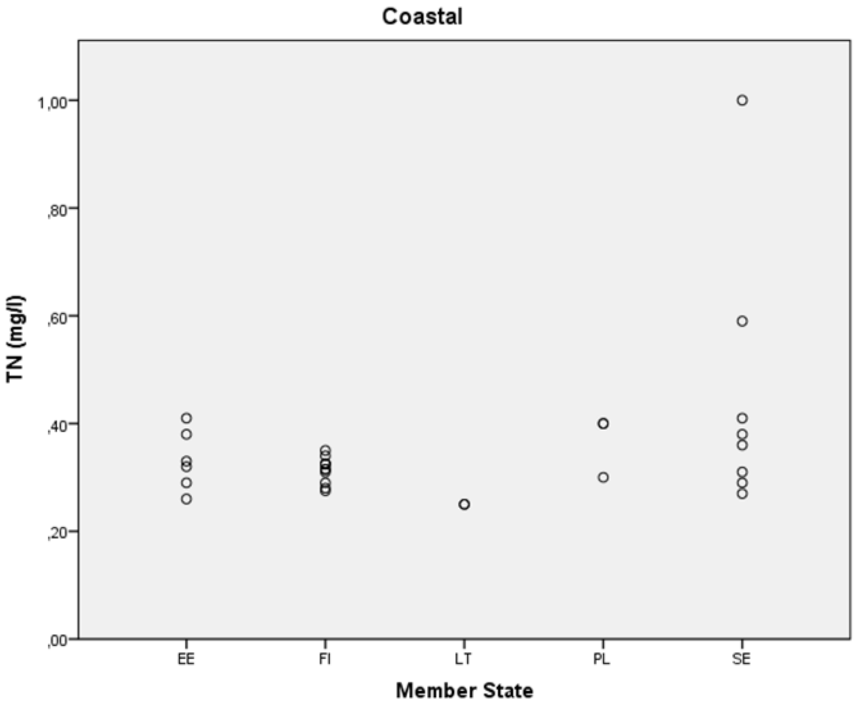

Figure 3 G/M boundary values for TN in coastal waters in the Baltic Sea

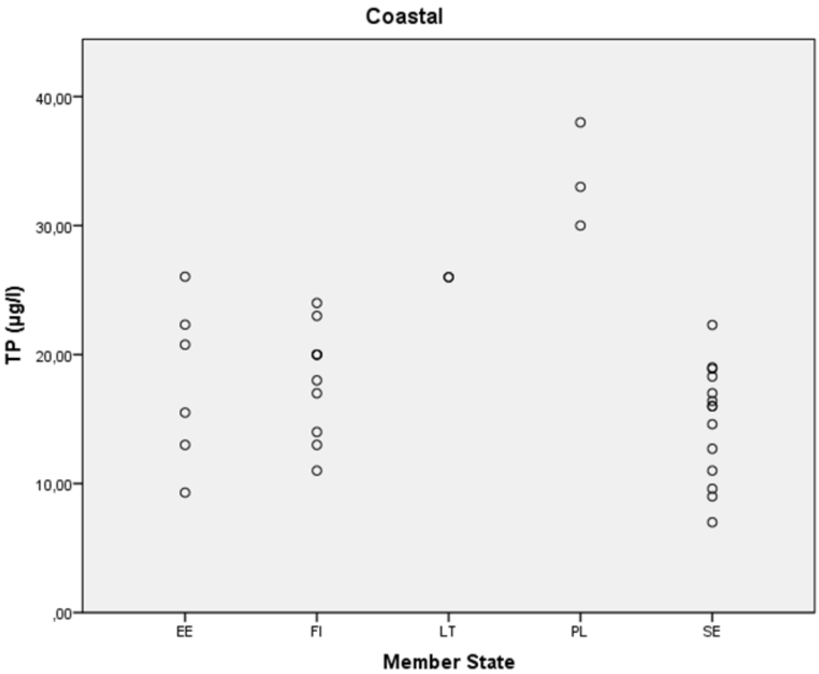

Figure 4 G/M boundary values for TP in coastal waters in the Baltic Sea

3.1.3 Marine waters

Only PL provided information regarding defining reference conditions for marine waters, the reason for this probably being that the other MS are using the HELCOM approach which has only defined G/M boundaries (“target values”) but no reference conditions.

Table 5 Metrics used and time of year measured for reference conditions in marine waters in the Baltic Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
Poland	Central (external) Gulf of Gdańsk	S/Y			S/Y			W/Y						W/Y		
Poland	Gdańsk Deep	S/Y			S/Y			W/Y						W/Y		
Poland	Shallow coastal zone along the central Polish coast - eastern part	S/Y			S/Y			W/Y						W/Y		
Poland	SE Gotland Basin	S/Y			S/Y			W/Y						W/Y		
Poland	Shallow coastal zone along the central Polish coast - western part	S/Y			S/Y			W/Y						W/Y		
Poland	Pomeranian Bay-open part	S/Y			S/Y			W/Y						W/Y		
Poland	Bornholm Deep	S/Y			S/Y			W/Y						W/Y		

Legend: S=summer, W=winter, Y=year-round, ?=unclear

Concerning the definition of G/M boundaries, 6 out of the 8 Baltic countries reported.

Table 6 Metrics used and time of year measured for G/M boundaries in marine waters in the Baltic Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
Germany	Kiel Bight		Y			Y		W						W		
Germany	Mecklenburg Bight		Y			Y		W						W		
Germany	Arkona Basin		Y			Y		W						W		
Germany	Bornholm Basin		Y			Y		W						W		
Finland	Northern Baltic Proper							W						W		
Finland	Gulf of Finland							W						W		
Finland	Åland Sea							W						W		
Finland	Bothnian Sea							W						W		
Finland	Quark							W						W		
Finland	Bothnian Bay							W						W		
Latvia	Baltic Proper							W						W		
Lativa	Gulf of Riga							W						W		
Lithuania	territorial and open wa	Y			Y			W						W		
Poland	Central (external) Gulf (	S/Y			S/Y			W/Y						W/Y		
Poland	Gdańsk Deep	S/Y			S/Y			W/Y						W/Y		
Poland	Shallow coastal zone al	S/Y			S/Y			W/Y						W/Y		
Poland	SE Gotland Basin	S/Y			S/Y			W/Y						W/Y		
Poland	Shallow coastal zone al	S/Y			S/Y			W/Y						W/Y		
Poland	Pomeranian Bay-open p	S/Y			S/Y			W/Y						W/Y		
Poland	Bornholm Deep	S/Y			S/Y			W/Y						W/Y		
Sweden	Arkonahavet och S Öresund							W						W		
Sweden	Bornholmshavet och Hanöbukten							W						W		
Sweden	Ö Gotlandshavet							W						W		
Sweden	V Gotlandshavet							W						W		
Sweden	N Gotlandshavet							W						W		
Sweden	Ålands hav							W						W		
Sweden	Bottenhavet							W						W		
Sweden	N Kvarken							W						W		
Sweden	Bottenviken							W						W		

Legend: S=summer, W=winter, Y=year-round, ?=unclear

All the MS except DE use mean as a method. DE assesses year-round, while the rest assess only in the winter time; PL does both. Phosphate is assessed by all the MS in the winter using mean methods, with the exception of Poland, which also assesses year-round. All the MS assess DIN in the winter using mean methods (DIN in winter with a mean metric was agreed within HELCOM). TN and TP are only assessed by DE, LT and PL.

The figures below show the G/M boundaries among MS measuring DIN and phosphorus. For DIN a comparison to the values agreed within HELCOM was made.

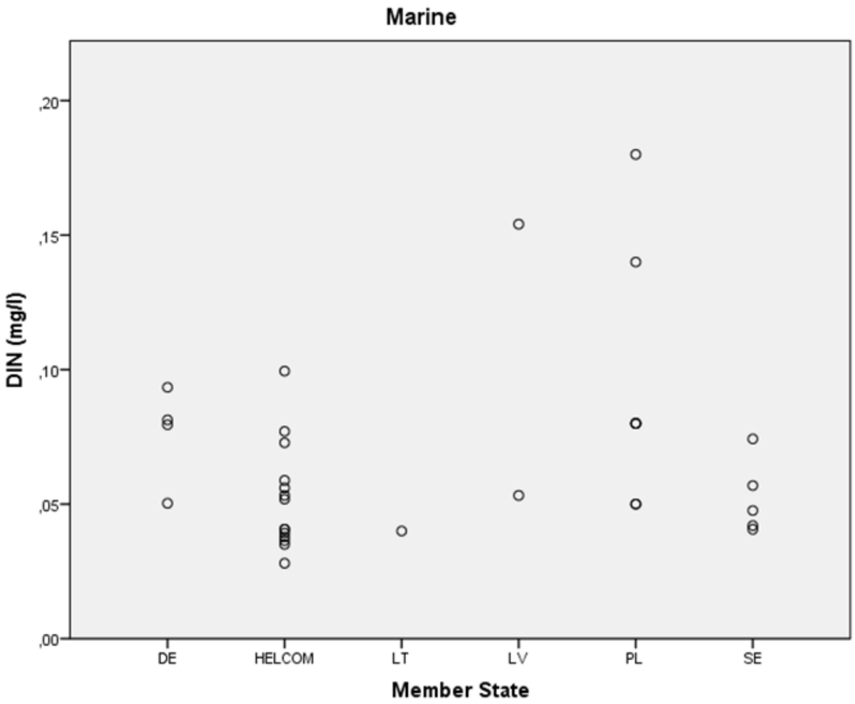

Figure 5 G/M Boundary values for DIN in marine waters in the Baltic Sea

The table below shows the G/M boundaries for DIN reported compared to the ones agreed in the HELCOM context.

Table 7 Comparison of reported DIN G/M boundaries and boundaries agreed upon under HELCOM

Country	HELCOM-region	DIN in mg/l	DIN HELCOM[4] in mg/l
		Mean	Mean
Germany[5]	Kiel Bight	0.081	0.077
Germany	Mecklenburg Bight	0.093	0.060
Germany	Arkona Basin	0.080	0.041
Germany	Bornholm Basin	0.050	0.035
Finland	Gulf of Finland		0.053
Latvia	Baltic Proper	0.053	0.073
Latvia	Gulf of Riga	0.154	0.036
Lithuania	HELCOM Eastern Gotland Basin	0.040	0.028
Poland	Central (external) Gulf of Gdańsk	0.140	
Poland	Gdańsk Deep	0.084	
Poland	Shallow coastal zone along the central Polish coast - eastern part	0.084	0.059
Poland	SE Gotland Basin	0.053	
Poland	Shallow coastal zone along the central Polish coast - western part	0.084	
Poland	Pomeranian Bay-open part	0.180	
Poland	Bornholm Deep	0.050	0.041
Sweden	HELCOM Arkona Basin	0.048	0.035
Sweden	HELCOM Bornholm basin	0.042	0.036
Sweden	HELCOM Eastern Gotland Basin	0.042	0.028
Sweden	HELCOM Western Gotland Basin	0.041	0.041
Sweden	HELCOM Northern Baltic Proper	0.042	0.042
Sweden	HELCOM Åland Sea	0.042	0.038
Sweden	HELCOM Bothnian Sea	0.042	0.039
Sweden	HELCOM The Quark	0.057	0.073
Sweden	HELCOM Bothnian Bay	0.074	0.059

As one can see the HELCOM values are always lower than the ones reported by MS.

[4] The values have been agreed by the Heads of Delegation in the 39th Meeting in Helsinki, Finland, 3-4 December 2012

[5] Note that Germany does not use DIN for the assessment of nutrient concentrations in coastal waters but only TN since DIN G/M boundaries were derived from a modelling approach and were found to be less trustworthy than the modelled TN-boundaries.

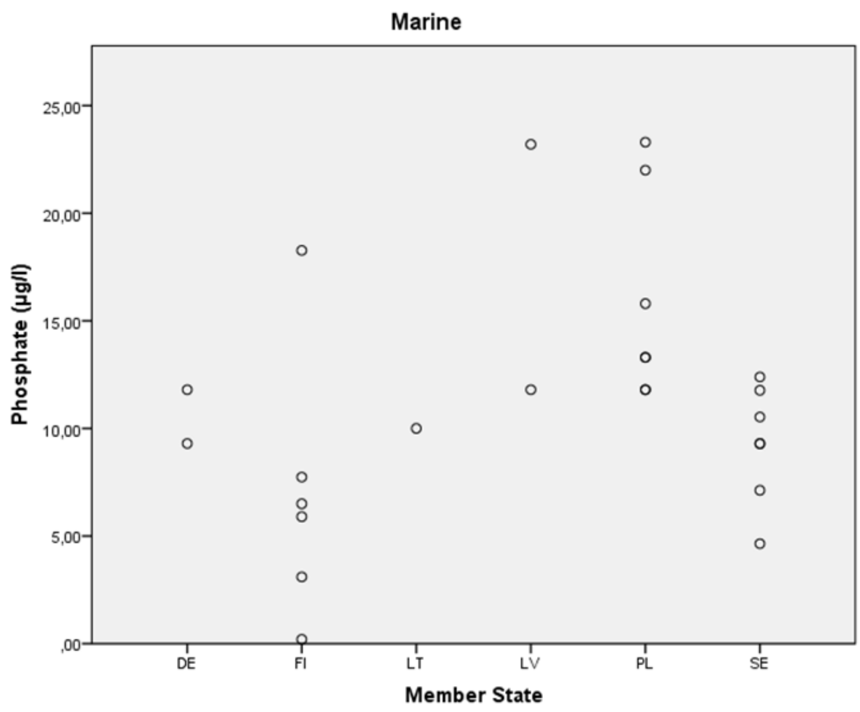

Figure 6 G/M boundary values for phosphate in marine waters in the Baltic Sea

3.2 Black Sea

3.2.1 Transitional waters

As the two tables below show, comparisons between BG and RO are difficult as they often use different parameters, methods and time periods for defining reference conditions and G/M boundaries for transitional waters. Both MS assess phosphate for reference conditions using mean methods but it is unclear what time of the year phosphate is assessed in Romania.

Table 8 Metrics used and time of year measured for reference conditions in transitional waters in the Black Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
Bulgaria	R16 Black sea firths	Y			Y			Y			Y					
Bulgaria	L7 Black sea freshwater coastal lakes	Y			Y			Y			Y					
Bulgaria	L8 Black sea oligohaline lakes	Y			Y			Y			Y					
Bulgaria	L9 Black sea mesohaline/polyhalie lakes	Y			Y			Y			Y					
Bulgaria	L10 Black sea euhaline and hyperhaline coastal lakes	Y			Y			Y			Y					
Romania	RO_TT03							?						?		

Legend: S=summer, W=winter, Y=year-round, ?=unclear

Both MS assess TP year-round using mean methods.

Table 9 Metrics used and time of year measured for G/M boundaries in transitional waters in the Black Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	National Type	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentil	Mean	Median	90% percentile	Mean	Median	90% percentile
Bulgaria	R16 Black sea firths	Y			Y											
Bulgaria	L7 Black sea freshwater coastal lakes	Y			Y											
Bulgaria	L8 Black sea oligohaline lakes	Y			Y											
Bulgaria	L9 Black sea mesohaline/polyhalie lakes	Y			Y											
Bulgaria	L10 Black sea euhaline and hyperhaline coastal lakes	Y			Y											
Romania	RO_TT03				Y						Y					

Legend: S=summer, W=winter, Y=year-round, ?=unclear

3.2.2 Coastal waters

Again, as the two tables below show, no comparison between BG and RO can be made in the Black Sea. Although both MS assess phosphate for reference conditions, BG did not indicate which method they use for assessing year-round and RO assesses using mean methods but doesn't indicate when they assess.

Table 10 Metrics used and time of year measured for reference conditions in coastal waters in the Black Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	National Type	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
Bulgaria	CW602210 (shallow, exposed, mixed substratum)								Y			Y				
Bulgaria	CW602220 (shallow, exposed, silt)								Y			Y				
Bulgaria	CW602230 (shallow, exposed, mixed substratum)								Y			Y				
Bulgaria	CW602310 (shallow, moderately exposed, mixed substratum)								Y			Y				
Bulgaria	CW602321 (deep, moderately exposed, silt)								Y			Y				
Romania	RO_CT01							?						?		
Romania	RO_CT02							?						?		

Legend: S=summer, W=winter, Y=year-round, ?=unclear

For defining G/M boundaries, comparisons are difficult: although both BG and RO assess phosphate, they use different methods and assess during different times.

Table 11 Metrics used and time of year measured for G/M boundaries in coastal waters in the Black Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN			Comments
Country	National Type	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	
Bulgaria	CW602210 (shallow, exposed, mixed substratum)																Maximum for phosphate and nitrate year round
	CW602220 (shallow, exposed, silt)																
	CW602230 (shallow, exposed, mixed substratum)																
	CW602310 (shallow, moderately exposed, mixed substratum)																
	CW602321 (deep, moderately exposed, silt)																
	CW602330 (shallow, moderately exposed, mixed substratum)																
Romania	RO_CT01				?			?									
	RO_CT02				?			?									

Legend: S=summer, W=winter, Y=year-round, ?=unclear

3.2.3 Marine waters

Only RO reported information on reference conditions for marine waters.

Table 12 Metrics used and time of year measured for reference conditions in marine waters in the Black Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN			Comments
Country	National Type	Mean	Median	90% percentil	Mean	Median	90% percentil	Mean	Median	90% percentil	Mean	Median	90% percentil	Mean	Median	90% percentil	
Romania	BLK-RO								x						x		x phosphate and DIN assessed bi-annually from 2004-2012

Legend: S=summer, W=winter, Y=year-round, ?=unclear

Comparisons on G/M boundaries are also difficult. RO and BG both assess phosphate with BG assessing in spring and summer (method is unknown) and RO assessing year-round. BG does not assess DIN.

Table 13 Metrics used and time of year measured for G/M boundaries in marine waters in the Black Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
Bulgaria	BLK-BG							Spring/Sum			Spring/Sum					
Romania	BLK-RO								Y						Y	

Legend: S=summer, W=winter, Y=year-round, ?=unclear

3.3 Mediterranean Sea

3.3.1 Transitional waters

CY, MT and SI did not designate transitional waters. EL, F and HR provided information regarding transitional waters in the Mediterranean. No comparisons are possible as the three countries use different methods to assess the parameters.

Table 14 Metrics used and time of year measured for reference conditions in transitional waters in the Mediterranean Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
Croatia	HR-P1_2					Y			Y						Y	
Croatia	HR-P1_3					Y			Y						Y	
Croatia	HR-P2_2					Y			Y						Y	
Croatia	HR-P2_3					Y			Y						Y	
France	T10			S			S			S						S
Greece	TW1							Y			Y					

Legend: S=summer, W=winter, Y=year-round, ?=unclear

However, 5 out of 8 abutting the Mediterranean provided information regarding G/M boundaries.

Table 15 Metrics used and time of year measured for G/M boundaries in transitional waters in the Mediterranean Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
Croatia	HR-P1_2					Y			Y						Y	
Croatia	HR-P1_3					Y			Y						Y	
Croatia	HR-P2_2					Y			Y						Y	
Croatia	HR-P2_3					Y			Y						Y	
France	T10			S			S			S						S
Greece	TW1							Y			Y					
Italy	TW-M-AT-1; TW-M-AT-3							Y						Y		
Italy	TW-M-AT-1; TW-M-AT-2							Y						Y		
Spain	AT-T01							Y			Y					
Spain	AT-T02							Y			Y					
Spain	AT-T04							Y			Y					
Spain	AT-T14	Y			Y											
Spain	AT-T15	Y			Y											
Spain	AT-T16	Y			Y											

Legend: S=summer, W=winter, Y=year-round, ?=unclear

Three MS (F, HR and IT) provided information regarding DIN. Two assess year-round (F in summer) but they all use different assessment methods. Four MS (F, HR, IT and ES) assess phosphate. And while 3 MS assess year-round (F in summer), F uses 90th percentile, HR looks at median data while IT and ES look at mean information. Two MS (F and ES) provided information regarding total nitrogen, but they assess at different times and use different methods. Overall, it is very difficult to draw any conclusions or to compare boundary values since the MS have taken such varied approaches.

3.3.2 Coastal waters

Five out of the 8 MS bordering the Mediterranean Sea reported information on reference conditions in coastal waters.

Table 16 Metrics used and time of year measured for reference conditions in coastal waters in the Mediterranean Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
Croatia	HR-O3_13					Y			Y						Y	
Croatia	HR-O4_12					Y			Y						Y	
Croatia	HR-O4_13					Y			Y						Y	
Croatia	HR-O4_22					Y			Y						Y	
Croatia	HR-O4_23					Y			Y						Y	
Cyprus	III-E							Y			Y					
Greece	III-E							Y			Y					
Italy	ITACE				Y											
Italy	ITACA-ITACB-ITACC-ITACE				Y											
Italy	ITACA-ITACB-ITACC-ITACE				Y											
Slovenia	CW M1, CW M3					Y			Y			Y				

Legend: S=summer, W=winter, Y=year-round, ?=unclear

Three of the MS that reported information use mean and 2 use median. All the MS assess year-round. Only HR assesses DIN, whereas 3 of the 5 MS (except CY and EL) assess total phosphorus. CY, EL, HR and SI assess phosphate year-round, but half use mean and half use median methods. Comparisons for nitrate are difficult since while CY and EL both use mean, SI uses median.

More MS reported data for defining G/M boundaries: 6 out of the 8 MS provided information (except F and MT).

Table 17 Metrics used and time of year measured for G/M boundaries in coastal waters in the Mediterranean Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN			Comments
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	
Croatia	HR-O3_13					Y			Y						Y		
Croatia	HR-O4_12					Y			Y						Y		
Croatia	HR-O4_13					Y			Y						Y		
Croatia	HR-O4_22					Y			Y						Y		
Croatia	HR-O4_23					Y			Y						Y		
Cyprus	III-E							Y			Y						
Greece	C1							Y			Y						
Italy	ITACE				Y												
Italy	ITACA-ITACB-ITACC-ITACE				Y												
Italy	ITACA-ITACB-ITACC-ITACE				Y												
Slovenia	CW M1, CW M3					Y				Y							N= maximum; Phosphate: expert judgement
Spain	AC-T01							Y			Y						values also available for ammonium, nitrite and FAN
Spain	AC-T02							Y			Y						
Spain	AC-T03							Y			Y						
Spain	AC-T04							Y			Y						
Spain	AC-T05							Y			Y						values also available for ammonium, nitrite and FAN
Spain	AC-T06							Y			Y						
Spain	AC-T07							Y			Y						values for ammonium, nitrite and FAN under discussion
Spain	AC-T08							Y			Y						
Spain	AC-T10							Y			Y						
Spain	AC-T11							Y			Y						
Spain	AC-T21							Y			Y						
Spain	AC-T22							Y			Y						
Spain	AC-T23							Y			Y						
Spain	AC-T24							Y			Y						

Legend: S=summer, W=winter, Y=year-round, ?=unclear, FAN = Free Amino Nitrogen

As with reference conditions, only HR assesses DIN. All the MS assess year-round. The most frequently used method is mean (4 out of the 6 MS); HR uses median and SI uses 90th percentile and expert judgement. The most frequently assessed parameter is phosphate (5 out of the 6 MS) but while 3 MS use mean the others used median and 90th percentile, making it difficult to draw parallels. Only HR and IT assess total phosphorus, but they use different methods. Three MS (CY, EL and ES) assess nitrate year-round and assess the data using mean methods.

3.3.3 Marine waters

EL, HR and SI reported information on reference conditions for marine waters.

Table 18 Metrics used and time of year measured for reference conditions in marine waters in the Mediterranean Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN			Comments
Country	National Type	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	
Croatia	NA					Y			Y			Y					for 2007-2012
Greece	IIIE							Y			Y						for 2012-2014
Slovenia	NA					Y			Y			Y					

Legend: S=summer, W=winter, Y=year-round, ?=unclear

While HR and SI take the same approach, Greece uses mean to assess phosphate and nitrate.

For defining G/M boundaries in marine waters, ES, HR and SI reported data.

Table 19 Metrics used and time of year measured for G/M boundaries in marine waters in the Mediterranean Sea

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN			Comments
Country	National Typ	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	
Croatia	NA									Y							N = Maximum
Greece	IIIE																
Slovenia	NA					Y				Y							N= maximum; Phosphate: expert judgement
Spain	ALB-O1							?			?						
Spain	ALB-O2							?			?						
Spain	LEV-OS							?			?						
Spain	LEV-ON							?			?						

Legend: S=summer, W=winter, Y=year-round, ?=unclear

All three MS assess phosphate but it is unknown at what time of year ES carries out its assessment. While HR and SI use 90[th] percentile as a method for assessing data, ES uses mean. All three MS assess nitrate but again, while HR and SI use maximum as the assessment method, ES uses mean.

3.4 North East Atlantic

3.4.1 Transitional waters

Six out of the 10 North East Atlantic countries reported information on reference conditions for transitional waters. It should be noted that Norway has not defined transitional waters.

Table 20 Metrics used and time of year measured for reference conditions in transitional waters in the North East Atlantic

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
France	all													W		
France	all													W		
Germany	T1, T2	Y			Y									W		
Ireland	TW2								W							
Ireland	TW2								W							
Portugal	A1									Y			Y			
Portugal	A1									Y			Y			
Sweden	Göta Älvs och Norde Älvs estuarie	W/S			W/S			W						W		
UK	TW1													W		
UK	TW2													W		
UK	TW3													W		
UK	TW4													W		
UK	TW5													W		

Legend: S=summer, W=winter, Y=year-round, ?=unclear

DE and SE both assess total nitrogen and total phosphorus using mean as a method and during similar times; DE assesses year-round including the winter and summer. DE, F, SE and the UK assess DIN during the winter using mean, but only PT assesses nitrate. Overall, with only ½ the MS reporting information and with much of the data being heterogeneous, it is difficult to make comparisons between the countries.

All the MS that have defined transitional waters in the North East Atlantic reported information on G/M boundaries.

Table 21 Metrics used and time of year measured for G/M boundaries in transitional waters in the North East Atlantic

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN			Comments
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	
Belgium	O1o	S			S			Y					Y			Y	
Belgium	O1b							S									
Belgium	O2zout							S									
France	all													W			
France	all													W			
Germany	T1, T2	Y			Y									W			
Ireland	TW2								W/S								
Ireland	TW2								W/S								
Ireland	TW2								W/S								
Netherlands														W			
Portugal	A1									Y			Y				
Portugal	A1									Y			Y				
Portugal	A1									Y			Y				
Portugal	A1									Y			Y				
Spain	AT-T07							Y			Y						
Spain	AT-T08							Y			Y						
Spain	AT-T09							Y			Y						
Spain	AT-T10							Y			Y						
Spain	AT-T11							Y			Y						
Spain	AT-T12							Y			Y						
Spain	AT-T13							Y			Y						
Sweden	Göta Älvs och Norde Älvs estuarie	W/S			W/S			W						W			
UK	TW1													W			additional boundary value for inorganic nitrogen depending on turbidity levels of waters. 99th precentile DIN - 70µM for intermediate waters SPM range
UK	TW2													W			
UK	TW3													W			
UK	TW4													W			
UK	TW5													W			

Legend: S=summer, W=winter, Y=year-round, ?=unclear

Despite all the countries reporting, comparisons remain challenging. The most frequent method is mean (7 MS). Median is only used by Ireland and 90th percentile is used by PT and sometimes by BE. The most frequently used parameters are phosphate (BE, ES, IE, PT, SE) and DIN (BE, F, NL and UK). No comparisons can be made, however, for phosphate as MS all use different methods and assess during different times of the year. On the other hand, all the MS reporting on total nitrogen and total phosphorus use mean, although during different times of the year.

BE, ES and PT are the only MS assessing nitrate, and while they all assess year-round, BE and PT use 90th percentile while ES uses mean. DE, F, NL, SE and the UK all assess DIN in winter using mean; BE uses 90th percentile.

3.4.2 Coastal waters

Five out of the 10 MS of the North East Atlantic reported data for defining reference conditions in coastal waters.

Table 22 Metrics used and time of year measured for reference conditions in coastal waters in the North East Atlantic

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
Belgium	CWSB1	W						W								
France	all													W		
France	all													W		
Germany	N1	Y			Y									W		
Germany	N2	Y			Y									W		
Germany	N3	Y			Y									W		
Germany	N4	Y			Y									W		
Germany	N5	Y			Y									W		
Ireland	CW2, CW5, CW6 and CW8														W	
Ireland	CW2, CW5, CW6 and CW8														W	
Sweden	1n	W/S			W/S			W						W		
Sweden	1s	W/S			W/S			W						W		
Sweden	2	W/S			W/S			W						W		
Sweden	3	W/S			W/S			W						W		
Sweden	4	W/S			W/S			W						W		
Sweden	5	W/S			W/S			W						W		
Sweden	6	W/S			W/S			W						W		
UK	CW1													W		
UK	CW2													W		
UK	CW3													W		
UK	CW4													W		
UK	CW5													W		
UK	CW6													W		
UK	CW7													W		
UK	CW8													W		
UK	CW11													W		
UK	CW12													W		

Legend: S=summer, W=winter, Y=year-round, ?=unclear

Mean is the only method used for assessing the parameters. Nitrate is the only parameter not assessed. Mostly, the parameters are assessed in winter, with DE assessing year-round and SE assessing TN and TP in the summer. These conditions make it easier to compare boundary values as common methods are used to assess data and parameters are assessed during similar times. The most frequently assessed parameters are total nitrogen (3 MS) and DIN (4 MS).

For defining G/M boundaries, all MS reported data.

Table 23 Metrics used and time of year measured for G/M boundaries in coastal waters in the North East Atlantic

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN			Comments
Country	National Type	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	
Belgium	CWSB1	W						W									
France	all													W			
France	all													W			
Germany	N1	Y			Y									W			
Germany	N2	Y			Y									W			
Germany	N3	Y			Y									W			
Germany	N4	Y			Y									W			
Germany	N5	Y			Y									W			
Ireland	CW2, CW5, CW6 and CW8														W/S		
Ireland	CW2, CW5, CW6 and CW8														W/S		
Ireland	CW2, CW5, CW6 and CW8														W/S		
Netherlands														W			
Norway	S1	W/S			W/S			W/S			W/S						
Norway	S2	W/S			W/S			W/S			W/S						
Norway	S3	W/S			W/S			W/S			W/S						
Norway	S5	W/S			W/S			W/S			W/S						
Norway	S6	W/S			W/S			W/S			W/S						
Norway	S7	W/S			W/S			W/S			W/S						
Norway	N1	W/S			W/S			W/S			W/S						
Norway	N2	W/S			W/S			W/S			W/S						
Norway	N3	W/S			W/S			W/S			W/S						
Norway	N4	W/S			W/S			W/S			W/S						
Norway	N5	W/S			W/S			W/S			W/S						
Norway	N6	W/S			W/S			W/S			W/S						
Norway	N7	W/S			W/S			W/S			W/S						
Norway	M1	W/S			W/S			W/S			W/S						
Norway	M2	W/S			W/S			W/S			W/S						
Norway	M3	W/S			W/S			W/S			W/S						
Norway	M4	W/S			W/S			W/S			W/S						
Norway	M5	W/S			W/S			W/S			W/S						
Norway	M6	W/S			W/S			W/S			W/S						
Norway	M7	W/S			W/S			W/S			W/S						
Norway	H1	W/S			W/S			W/S			W/S						
Norway	H2	W/S			W/S			W/S			W/S						
Norway	H3	W/S			W/S			W/S			W/S						
Norway	H4	W/S			W/S			W/S			W/S						
Norway	H5	W/S			W/S			W/S			W/S						
Norway	H6	W/S			W/S			W/S			W/S						
Norway	H7	W/S			W/S			W/S			W/S						
Norway	G1	W/S			W/S			W/S			W/S						
Norway	G2	W/S			W/S			W/S			W/S						
Norway	G3	W/S			W/S			W/S			W/S						
Norway	G4	W/S			W/S			W/S			W/S						
Norway	G5	W/S			W/S			W/S			W/S						
Norway	G6	W/S			W/S			W/S			W/S						
Norway	G7	W/S			W/S			W/S			W/S						
Norway	B1	W/S			W/S			W/S			W/S						
Norway	B2	W/S			W/S			W/S			W/S						
Norway	B3	W/S			W/S			W/S			W/S						
Norway	B4	W/S			W/S			W/S			W/S						
Norway	B5	W/S			W/S			W/S			W/S						
Norway	B6	W/S			W/S			W/S			W/S						
Norway	B7	W/S			W/S			W/S			W/S						
Portugal	A5	W/S								Y			Y				
Portugal	A7	W/S								Y			Y				
Spain	AC-T12							Y			Y						
Spain	AC-T13							Y			Y						
Spain	AC-T14							Y			Y						
Spain	AC-T15							Y			Y						
Spain	AC-T16							Y			Y						
Spain	AC-T17							Y			Y						
Spain	AC-T18							Y			Y						
Spain	AC-T19							Y			Y						
Spain	AC-T20							Y			Y						
Sweden	1n	W/S			S			W						W			
Sweden	1s	W/S			S			W						W			
Sweden	2	W/S			S			W						W			
Sweden	3	W/S			S			W						W			
Sweden	4	W/S			S			W						W			
Sweden	5	W/S			S			W						W			
Sweden	6	W/S			S			W						W			
UK	CW1													W			
UK	CW2													W			
UK	CW3													W			
UK	CW4													W			
UK	CW5													W			
UK	CW6													W			
UK	CW7													W			
UK	CW8													W			additional standards depending on turbidity of waters. 99th percentile DIN
UK	CW11													W			
UK	CW12													W			

Legend: S=summer, W=winter, Y=year-round, ?=unclear

Mean is the most common method used to assess data, with the exception of PT (90th percentile) and IE (median).

Again winter is the predominant time when the parameters are assessed (BE, DE, F, NL, UK), followed by winter and summer (IE, SE, NO). DE and PT also assess year-round and SE assesses TP in summer only. 3 MS (F, IE and UK) only assess one parameter. The most frequently assessed parameters are DIN (6 MS) and TN (5 MS). DIN is the easiest parameter to compare as 5 MS assess in the winter and use mean as a method; IE uses median and assesses in winter and summer.

The figure below shows the range of G/M boundaries for those countries measuring DIN.

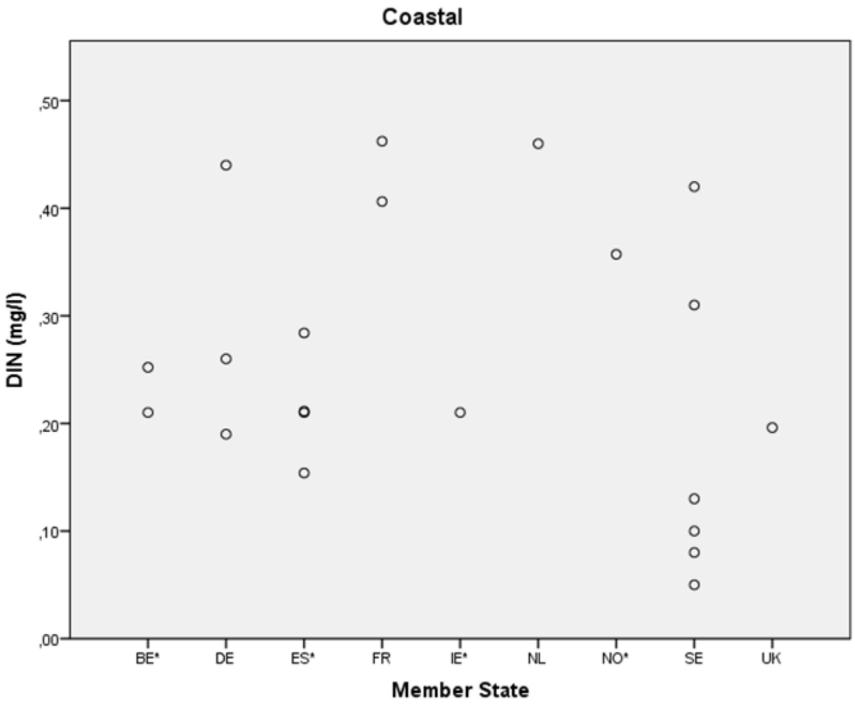

Figure 7: G/M Boundary values for winter DIN in coastal waters in the North East Atlantic * values for BE, IE, NO, ES are taken from Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area (Reference number: 2013-8). Please note that the metrics behind these values are not always clear.

3.4.3 Marine waters

Only 4 of the 10 MS in the North East Atlantic reported data on how they define reference conditions for marine waters.

Table 24 Metrics used and time of year measured for reference conditions in marine waters in the North East Atlantic

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
Belgium	Coastal waters	W						W								
Belgium	Offshore waters	W						W								
Germany	German Bight (coastal)	Y			Y									W		
Germany	German Bight (offshore)	Y			Y									W		
Germany	German Bight Marine Endmembers	Y			Y									W		
Ireland	Offshore Waters Irish and Celtic Seas	W						W							W	
Ireland	Offshore Waters Atlantic west Coast	W						W							W	
UK	UK													W		
UK	UK													W		

Legend: S=summer, W=winter, Y=year-round, ?=unclear

The most common method for analysing data is mean; IE also uses median. Three of the 4 MS assess in the winter; DE assesses year-round. All but the UK assess TN; only DE assesses TP. Both BE and IE assess phosphate in the winter and assess the data using mean methods. DE and the UK both assess DIN in the winter and assess the data using mean methods; IE also assesses DIN but uses median.

Six out of the 10 MS provided information on defining G/M boundaries for marine water.

Table 25 Metrics used and time of year measured for G/M boundaries in marine waters in the North East Atlantic

		TN in mg/l			TP in microg/l			Phosphate			Nitrate			DIN		
Country	**National Type**	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile
Belgium		W						W								
Belgium		W						W								
Germany	German Bight (coastal)	Y			Y									W		
Germany	German Bight (offshore)	Y			Y									W		
Germany	German Bight Marine Endmembers	Y			Y									W		
Ireland	Offshore Waters Irish and Celtic Seas	W						W							W	
Ireland	Offshore Waters Atlantic west Coast	W						W							W	
Netherlands														W		
Spain	Nor O1							?			?					
Spain	Plataforma							?			?					
Spain	SUR-OCEAN							?			?					
Spain	SUR-P1							?			?					
Sweden	Skagerrak							W						W		
Sweden	Kattegatt (N)							W						W		
Sweden	Kattegatt (S)							W						W		
UK	UK													W		
UK	UK													W		

Legend: S=summer, W=winter, Y=year-round, ?=unclear

Again, all MS use mean (except IE, which uses median) as the method for assessing data and all the MS assess in winter, except DE for some parameters. The most frequently used parameter is phosphate (4 MS) and TN (3 MS). All MS assess phosphate using mean methods and assess in the winter (for ES time is unknown). DE is the only MS to assess TP. DE, IE, SE and the UK assess DIN in the winter and assess the data using mean methods (except IE uses median).

3.5 Comparison along broad types

In this chapter the different G/M boundaries along the intercalibrated types have been analysed.

3.5.1 Baltic Sea

Table 26 Reported IC types for transitional and coastal waters

Type	DK	EE	FI	DE	LV	LT	PL	SE
BT1 (TW)						x		
BC1			x					x
BC3		x	x					
BC4		x			x			

BC5					x	x	x	
BC6								x
BC7				x			x	
BC8				x				
BC9			x	x				x
Other								

X= Type has been reported

Based on this information and a comparison with the information from the previous sections, the following picture can be drawn:

- For IC-Type BC1: SE and FI both assess TN and TP in the summer using mean methods. Boundary values for TN in FI are around 0.28 mg/l and in SE range from 0.29-0.41 mg/l. Boundary values for TP in FI are between 13-14 microg/l and in SE range from 11-17 microg/l.
- For IC-Type BC3: EE and FI both assess TN and TP in the summer using mean methods. Boundary values for TN range between 0.29 (FI) -0.32 (EE) mg/l and for TP range between 18 (FI) to 22.32 microg/l (EE).
- For IC-Type BC4 a comparison is not possible as there is no common assessment methodology between EE and LV
- For IC-Type BC5: LV, LT and PL can be compared, but not all together: LT and PL both assess TN and TP in the summer using mean methods. Values for TN range between 0.25 mg/l (LT) and 0.4 mg/l (PL). Values for TP range between 26 microg/l (LT) and 33 microg/l (PL). PL and LV both assess phosphate in the winter using mean methods. Phosphate ranges in LV from 18.5-23.23 microg/l) and values in PL range from 15-24 microg/l.
- IC-Type BC6 is only applied in SE.
- For IC-Type BC7 a comparison is not possible between DE and PL as there is no common assessment methodology for TN or TP.
- For IC-Type BC8 a comparison is not possible between DE and PL as there is no common assessment methodology for TN or TP.
- For IC-Type BC9: broad type is used in EE, DE and SE but only EE and SE can be compared as DE uses a different assessment methodology. EE and ES both assess TN and TP in the summer using mean methods. EE sets its boundary value for TN at 0.32 mg/l, SE ranges between 0.27-0.59 mg/l. EE sets its boundary value for TP at 22.32 microg/l, SE ranges between 13-19 microg/l.

3.5.2 Black Sea

Table 27 Reported IC types for coastal waters

Type	**BG**	**RO**
CW-BL1	x	

X= Type has been reported

In the Black Sea only Bulgaria reported on common types in coastal waters and no comparisons can be made. There are no common types for transitional waters.

3.5.3 Mediterranean Sea

Table 28 Reported IC types for coastal waters

Type	HR	CY	F	EL	IT	SI	ES	MT
Type I								
Type IIA, Type II A Thyreenian sea, IIA Adriatic						**x**	**x**	
Type IIIW							**x**	
Type IIIE		**x**		**x**				
Type Island-W							**x**	

X= Type has been reported

Based on this information and a comparison with the information from the previous sections, the following picture can be drawn:

- For IC IIA no comparison can be made as the assessment methodology for ES and SI are different.
- For IC IIIE both CY and EL assess phosphate year-round using mean methods. The values between the two range between 3.045 microg/l in EL to 4.34 microg/l in CY.

For transitional waters no responses were provided.

3.5.4 North East Atlantic

Table 29 Reported IC types for transitional and coastal waters

Type	**BE**	**ES**	**F**	**DE**	**IE**	**NL**	**NO**	**PT**	**SE**	**UK**
NEA1			x				x	x		x
NEA1/26a		x	x		x					
NEA1/26b	x		x			x				
NEA1/26c				x						
NEA1/26d										
NEA1/26e		x								
NEA3/4				x						
NEA7							x			x
NEA8a							x		x	
NEA8b									x	
NEA9							x		x	
NEA10							x		x	
NEA11	x				x			x		x

X= Type has been reported

Based on this information and a comparison with the information from the previous sections, the following picture can be drawn:

- For IC NEA 1: F, NO, PT and UK cannot be compared as the assessment methodologies are different.
- For IC NEA 1-26a IE, F and ES cannot be compared as the assessment methodologies are different.
- For IC NEA 1-26b BE and F cannot be compared as the assessment methodology are different; NL did not submit data via the excel sheet.
- For IC NEA 7 NO and UK cannot be compared as the assessment methodologies are different.
- For IC NEA 8a NO and SE both assess TN using mean methods in winter and summer. SE uses ranges between 0.13-0.45 mg/l and NO uses ranges between 0.33-0.38 mg/l. For TP and phosphate they assess during different times of the year.
- For IC NEA 9 NO and SE both assess TN using mean methods in winter and summer. SE uses ranges between 0.13-0.45 mg/l and NO uses ranges between 0.33-0.38 mg/l. For TP and phosphate they assess during different times of the year.
- For IC NEA 10 NO and SE both assess TN using mean methods in winter and summer. SE uses ranges between 0.13-0.45 mg/l and NO uses ranges between 0.33-0.38 mg/l. For TP and phosphate NO and SE assess during different times of the year.
- IC NEA 11 is only found in transitional waters in BE, IE, PT, ES and UK. They cannot be compared as the assessment methodologies are different.

3.5.4.1 Conclusions

Within the Baltic the comparison of nutrient values along broad types shows that in most cases the boundaries set by the MS are quite similar. The boundary values for TN do not vary much between the broad types. Most often values range between 0.28-0.4 mg/l; in Sweden the value jumps up to 0.59mg/l for IC-Type BC9. TP values are rather stable between 26-33 microg/l for most MS. Sweden reports lower values between 11-19 microg/l and FI reports values between 13-14 microg/l.

In the North East Atlantic, only Norway and Sweden are comparable. Their ranges for values are broader, with SE reporting values as low as 0.13 mg/l, whereas NO’s lowest value is 0.33 mg/l. Despite having different minimum and maximum values, the range of values for TN overlap.

3.6 Comparison of nutrient boundaries between regional seas

The range of good/moderate nutrient boundaries used for total nitrogen, total phosphorus, DIN and phosphate was compared between the four regional seas for transitional, coastal and marine waters. It was expected that there are regional differences, with the oligotrophic Mediterranean Sea having lower nutrient boundaries compared to the other regional seas. This was true for the parameters total phosphate and DIN for coastal waters and for phosphate for marine waters but it did not apply to transitional waters. For the Black Sea to few nutrient boundaries were available to come to a conclusion. For the Baltic Sea it was expected that the nutrient boundaries set are lower compared to the North East Atlantic since the Baltic Sea is much more susceptible to eutrophication. This assumption could mainly be confirmed but differences between the two regional seas were not large. There are cases were nutrient boundaries set in the Baltic Sea are higher than in the North East Atlantic but this was often due to one MS setting a particularly high nutrient boundary.

Table 30 Comparison of good/moderate nutrient boundaries for transitional, coastal and marine waters between the four regional seas. The range of values provided includes all metrics used (mean, median etc.) and all seasons (winter, summer, all year). The highest and lowest value reported for a respective regional sea was used. In cases where only one value is given only one MS has reported.

Regional Sea	**TN in mg/l**	**TP in µg//l**	**DIN in mg/l**	**Phosphate in µg/l**
Transitional Waters				
Baltic Sea	0,26-1,90	18,0-15,0	0,15-0,32	18,0-35,0
NE Atlantic	0,22-2,50	16,4-14,0	0,10-6,00	35,9-140,0
Mediterranean Sea	1,00-10,00	27,9-93,0	0,08-1,75	15,0-31,0
Black Sea	2,50	75,0	2,00	60,0
Coastal Waters				
Baltic Sea	0,25-0,59	9,3-26,0	0,053-0,73	5,0-23,2
NE Atlantic	0,18-0,40	16,4-36,0	0,05-2,60	3,5-24,8
Mediterranean Sea	--	13,0-19,0	0,14	3,1-23,5
Black Sea	--	--	0,04-0,14	13,0-20,0
Marine Waters				
Baltic Sea	0,20-0,37	18,6-27,9	0,04-0,18	4,7-22,0
NE Atlantic	0,16-0,29	19,0-23,0	0,05-0,46	3,1-24,8
Mediterranean Sea	--	13,0	--	2,2-4,6
Black Sea	--	--	--	--

3.7 EU wide conclusions

3.7.1 Conclusions transitional waters

The following conclusions as regards transitional waters can be made among the different regional seas:

3.7.1.1 Reference conditions

Total nitrogen is assessed by 7 MS (BG, DE, F LT, PL, RO and SE). It is assessed by all MS using mean methods, except for FR, which uses 90th percentile. It is assessed in the summer by 4 MS (F, LT, PL, and SE) and in winter by SE and year-round by BG, DE and PL.

Total phosphorus is assessed by 6 MS (BG, F, HR, DE, LT and SE). 4 MS use mean methods; HR uses median and F uses 90th percentile. It is assessed in all 4 RSCs. It is assessed either in the summer (F, LT), year-round (3 MS) or, in the case of SE, in summer and winter.

Phosphate is assessed by 9 MS (BG, EL, F, HR, IE, LV, PT, RO and SE) in all regional seas. Phosphate is assessed either in the winter (3 MS) or year-round (4 MS). Five MS apply mean as the

method for assessment; HR and IE use median and F and PT uses 90th percentile. Phosphate is the most frequently used parameter.

Nitrate is assessed by BG (Black sea), EL (Mediterranean), and PT (North East Atlantic) only. Nitrate is assessed in winter or year-round and is assessed using mean methods (BG, EL) or 90th percentile (PT).

DIN is assessed by 8 MS (DE (only North East Atlantic), F, HR, LV, PL, RO, SE and the UK). It is assessed in the winter by most of the MS using mean methods. F assesses in the summer using 90th percentile and HR uses median.

Only TN and TP are assessed in the summer by some MS (F, LT, PL, SE); the rest of the parameters are either assessed in the winter or year-round.

Whereas 13 MS reported information on reference conditions for transitional waters, 18 MS reported information on G/M boundaries.

3.7.1.2 G/M boundaries

Total nitrogen is assessed in 8 MS (BE, BG, F (Med), DE, LT, PL, ES, SE) in all regional seas with all MS assessing data using mean methods, except in FR, where the 90th percentile is used. SE assesses in summer and winter and Poland assesses in the summer or year-round depending on the water. BE, F and LT assess only in summer; the rest assess year-round (BG, DE, ES).

Total phosphorus is assessed in 8 MS (BE, BG, F, HR, DE (North East Atlantic), LT, PL, ES and SE). With the exception of HR and FT - which use median and 90th percentile, respectively – the rest of the MS assess the data using mean methods. TP is largely assessed in the summer or year-round with only SE also taking samples specifically in the winter (and also summer).

Phosphate is assessed in 12 MS (BE, EL, ES, HR, F, IE, IT, LV, PL, PT, RO and SE). Three different ways of analysing the data are used, with mean being used most frequently (7 MS), HR and IE using median and F and PT using 90th percentile. It is assessed at different times: 2 MS only in winter, 7 MS year-round, 1 MS in summer only, 1 MS year-round and summer and 1 MS winter and summer. Phosphate is the most frequently reported parameter.

Nitrate is only assessed by EL and ES (Mediterranean and North East Atlantic) and by BE and PT (North East Atlantic). It is only assessed year-round. While EL and ES assess the data using mean methods, both BE and PT use 90th percentile.

DIN is assessed by 10 MS (DE (North East Atlantic), F, HR, IT, LV, NL, PL, RO, SE and the UK). With the exception of RO (which assesses bi-annually) and F (which assess in summer), the rest assess in winter or year-round. HR uses median and F uses 90th percentile, the rest use mean methods.

TN, TP and phosphate are assessed by some MS in the summer, while nitrate and DIN are only assessed in the winter or year-round.

3.7.2 Conclusions coastal waters

The following conclusions as regards coastal waters can be made among the different regional seas:

3.7.2.1 Reference conditions

Total nitrogen is assessed by 7 MS (BE, EE, FI, DE, LT, PL and SE). BE assesses only in the winter, while SE assesses in the summer and winter. DE assesses year-round in both regional seas, the rest assess in the summer. TN is not assessed in the Black Sea or Mediterranean. All the MS use mean methods to assess data, except for DE, which uses median in the Baltic Sea but not the North East Atlantic.

Total phosphorus is assessed by 9 MS (HR, EE, FI, DE, IT, LT, PL, SI, and SE). It is not assessed in the Black Sea. The most frequent method for assessment is mean (6 MS) with 3 MS assessing data

using median methods (DE, HR and SI). Four MS (DE, HR, IT, SI) assess year-round, the rest during the summer; SE also assesses in the winter in the North East Atlantic.

Phosphate is assessed by 10 MS (BE, BG, CY, EL, HR, LV, PL, RO, SI and SE) with between 2-3 MS per regional sea. Median is applied in the Mediterranean by both HR and SI, while mean methods are by CY and EL. Mean methods are only used in the Baltic and North East Atlantic. Phosphate is assessed by 4 Mediterranean MS year-round, by 2 North East Atlantic MS in winter only. In the Baltic there is a mix between winter only, summer only (LV) and year-round. In the Black Sea there is no common approach. Phosphate is the most frequently used parameter.

Nitrate is assessed by only 4 MS (BG, CY, EL, and SI). All MS assess year-round. SI applies median methods while EL and CY use mean; BG did not report. Nitrate is not assessed in the North East Atlantic.

DIN is assessed by 9 MS (DE (North East Atlantic only), F, HR, IE, LV, PL, RO, SE and UK. It is assessed in all four regional seas. LV assess in summer, the rest of the MS assess in winter or year-round. Seven MS use mean methods, except IE and HR, which use median.

Overall, median methods are only used by HR, DE (Baltic), IE and SI. 90^{th} percentile is not used at all.

3.7.2.2 G/M boundaries

Total nitrogen is assessed by 10 MS (BE, EE, F, FI, DE, LT, PL, PT, NO and SE) in the Baltic Sea and the North East Atlantic. It is not assessed in the Black or Mediterranean Sea. All the MS use mean methods for assessing TN with the exception of DE in the Baltic, which uses median. In the Baltic, TN is most frequently assessed in the summer; DE assesses year-round and SE also assesses in the winter. In the North East Atlantic, the MS take a mixed approached: while BE and F assesses only in winter, PT, NO and SE assess both in summer and winter, while DE assesses year-round.

Total phosphorus is assessed by 10 MS (HR, EE, FI, DE, IT, LT, PL, NO, SI and SE). It is not assessed in the Black Sea. All the MS use mean methods for assessing TP with the exception of DE in the Baltic and HR, which use median, and SI, which uses maximum. TP is most frequently assessed in the summer, with SE also assessing the parameter in winter in the Baltic. HR, DE and IT assess year-round. The parameter is most frequently used in the Baltic.

Phosphate is assessed by 13 MS (BE, BG, HR, CY, EL, LV, NO, PL, PT, SI, ES, RO and SE). It is assessed in all 4 seas but it is most frequently assessed in the Mediterranean and both Black Sea countries. Only ¼ of Baltic countries assess phosphate and only 1/3 of North East Atlantic countries. It is most frequently assessed year-round with LV being the only country that assesses phosphate in the summer only. BE and SE are the only two MS that assess in winter only. Methods for assessing data vary greatly with 8 MS applying mean (BE, CY, EL, ES, LV, PL, NO, SE), HR applying median, PT and SI applying 90^{th} percentile, BG applying maximum and RO looking at data ranges from 2004-2012.

Nitrate is assessed by 8 MS (BG, CY, EL, ES, NO, PL, PT and SI). It is only assessed by one MS (PL) in the Baltic, 4 MS (CY, EL, ES and SI) in the Mediterranean and 3 MS (ES, NO, PT) in the North East Atlantic; BG is the only Black Sea country that assesses this parameter. Nitrate is assessed year-round by all the MS with the exception of NO (winter and summer). Five MS assess data using mean, while BG and SI use maximum and PT 90^{th} percentile.

DIN is assessed by 10 MS (DE (North East Atlantic), F, HR, IE, LV, NL, PL, SE, RO and UK). LV is the only MS that assesses in the summer; the rest assess in the winter. Nine MS assess data using mean methods. HR and IE use median. RO analyses data biannually from 2004-2012.

Overall, median methods are only used by DE in the Baltic, HR, and IE. PT is the only MS using 90^{th} percentile, and BG and SI are the only countries using maximum. RO takes a totally different approach and analyses data over an 8 year period. But most of the MS use mean methods. While TN and TP are most frequently assessed in the summer, phosphate and nitrates are mostly assessed year-round. DIN is mostly assessed in the winter.

3.7.3 Conclusions marine waters

Overall, very few MS provided any information regarding which parameters they assess for defining reference conditions or G/M boundaries, making it difficult to draw any meaningful conclusions.

The following conclusions as regards marine waters can be made among the different regional seas:

3.7.3.1 Reference conditions

Total nitrogen is assessed by 4 MS (BE, DE (North East Atlantic), IE and PL) in the Baltic and North East Atlantic. It is not assessed in the Black or Mediterranean Seas. Only PL assesses TN in the Baltic Sea. All 4 MS use mean methods for assessing data. PL and DE assess year-round and BE and IE assess in the winter. Only 3 out of 8 MS in the North East Atlantic reported assessing TN for marine waters.

Total phosphorus is assessed by 4 MS (DE (North East Atlantic), HR, SI and PL in three separate regional seas. It is not assessed in the Black Sea. All 4 MS assess year-round. DE and PL use mean methods and HR and SI use median.

Phosphate is assessed by 7 MS (BE, EL, HR, IE, PL, SI and RO). It is only assessed by 1 MS in the Baltic and three MS in the Mediterranean, making any comparisons difficult. Only 2 out of 8 North East Atlantic countries reported data. 4 MS (BE, EL, IE and PL) use mean methods, with HR, SI and RO using median methods. Assessments take place in the winter in the Baltic and North East Atlantic and year-round in the Black Sea and the Mediterranean.

Nitrate is assessed by EL, HR and SI in the Mediterranean Sea year-round and assessed using median methods (HR and SI) or mean methods (EL).

DIN is only assessed by PL in the Baltic, by RO in the Black Sea and by DE, IE and UK in the North East Atlantic. RO uses median methods, the rest use mean methods and assess in the winter. The parameter is not assessed in the Mediterranean Sea. No comparisons can really be made given the lack of application.

3.7.3.2 G/M boundaries

Total nitrogen is assessed by 5 MS (BE, DE, IE, LT and PL). It is not assessed in the Mediterranean or the Black Sea. All the MS assess the data using mean methods except for DE in the Baltic Sea, which uses median. 2 MS (BE and IE) assess only in the winter, while the rest assess year-round.

Total phosphorus is assessed by only 3 MS (DE, LT and PL). They all assess year-round and use mean methods for assessment, except that DE uses median in the Baltic. DE is the only MS that reported information in the North Sea. This parameter is not applied in the Black or Mediterranean Seas. Too little data is available for any conclusions.

Phosphate is assessed by 13 MS (BE, BG, FI, DE, ES, IE, HR, LV, LT, PL, RO, SE and SI). 11 assess in the winter using mean methods; this includes all the Baltic countries. HR and SI both use 90th percentile for assessing the data, but with only 3 out of 8 Mediterranean countries reporting a comparison is difficult. BG and RO do not have a common approach in the Black Sea.

Nitrate is only assessed in the Mediterranean by HR, ES and SI, by BG in the Black Sea and by ES in the North East Atlantic. HR and SI use maximum while ES uses mean; BG did not report which method they use.

DIN is assessed by 11 MS (BG, DE, IE, FI, LV, LT, NL, PL, RO, SE and the UK). It is not reported in the Mediterranean. All the Baltic MS (EE did not report marine data) assess DIN in the winter using mean as the method for analysis. RO assess year-round and uses median methods. DE, SE and UK assess in the winter using mean methods in the North East Atlantic, while IE uses median methods (winter).

3.7.4 Conclusion broad types

EU-wide conclusions on broad types are extremely difficult given varied assessment methodologies. For most broad types (BC4, BC7 BC8, BL1, IIA, NEA1, NEA 1-26a, NEA 1-26b, NEA7 and NEA

11) no comparisons can be drawn as the MS using these broad types use different assessment methodologies, whether it's looking at different parameters, using different methods for analysis or assessing during different times of the year. For other broad types (BL1, BT1 (TW), BC6, NEA 1/26e, IIIW) only one MS reported this type.

In the Baltic and North East Atlantic, comparisons could be made for TN and TP.

3.8 Comparison within a MS

3.8.1 Comparison of types and boundaries

As natural and background concentrations of nutrients vary between and within the regional seas, and between types of coastal water bodies, nutrient targets or thresholds for achieving good environmental status have to be determined while taking into account local conditions. So it can be assumed that for different national types of marine, coastal and transitional waters different boundaries have been set. The tables below show the relation between national types and number of boundaries (for N and P separate).

Table 31 Type – boundary relation for nitrogen

	Transitional		**Coastal**		**Marine**	
MS	Number of national Types	Number of boundaries	Number of national Types	Number of boundaries	Number of national Types	Number of boundaries
Baltic						
DE	Not applied		5	8	4	3
DK	Not applied		-	-	-	-
EE	Not applied		6	6	?	?
FI	Not applied		11	11	6	6
LT	3	5	2	1	1	1
LV	1	1	4	2	2	2
PL	8	6	3	3	7	5
SE	1	unclear[6]	18	unclear[7]	9	5
Black						
BG	4	2	6	4	1	4
RO	?	2	2	1	1	1
Mediterranean						
CY	Not applied		1	1	?	?

[6] SE does not provide a single value per type, but a range

[7] SE does not provide a single value per type, but a range

	Transitional		Coastal		Marine	
MS	Number of national Types	Number of boundaries	Number of national Types	Number of boundaries	Number of national Types	Number of boundaries
EL	1	1	1	1	?	?
ES	9	?[8]	15	?[9]	5	8
F	1	2	?	?	?	?
HR	2	4	5	2	?	?
IT	3	1	4	?	?	?
MT	Not applied		4	?	?	?
SI	Not applied		2	1	N/A	1
North East Atlantic						
BE	3	3	1	1	2	2
DE	2	1	5	3	2	6
ES	7	?[10]	9	?[11]	4	4
F	?	2	?	2	?	?
IE	1	?	4	3	2	2
NL	?	1	?	1	?	?
NO	Not applied		41	unclear[12]	?	?
SE	1	unclear[13]	7	unclear[14]	3	3
PT	1	4	2	1	?	?
UK	5	1	10	1	2	1

[8] Several values are under discussion
[9] Several values are under discussion
[10] Several values are under discussion
[11] Several values are under discussion
[12] NO does not provide a single value per type, but a range
[13] SE does not provide a single value per type, but a range
[14] SE does not provide a single value per type, but a range

Table 32 Type – boundary relation for Phosphorus

	Transitional		Coastal		Marine	
MS	Number of national Types	Number of boundaries	Number of national Types	Number of boundaries	Number of national Types	Number of boundaries
Baltic						
DE	Not applied		?	8	4	4
DK	Not applied		-	-	-	-
EE	Not applied		6	6	?	?
FI	Not applied		11	11	6	6
LT	3	5	2	1	1	1
LV	1	1	4	2	2	2
PL	8	6	3	3	7	6
SE	1	unclear[15]	18	unclear[16]	9	7
Black						
BG	4	2	6	4	1	4
RO	1	1	2	1	1	1
Mediterranean						
CY	Not applied		1	1	?	?
EL	1	1	1	1	?	?
ES	9	?[17]	15	?[18]	4	2
F	1	2	?	?	?	?
HR	2	2	5	1	?	2
IT	3	1	4	3	?	?

[15] SE does not provide a single value per type, but a range
[16] SE does not provide a single value per type, but a range
[17] Several values are under discussion
[18] Several values are under discussion

	Transitional		Coastal		Marine	
MS	Number of national Types	Number of boundaries	Number of national Types	Number of boundaries	Number of national Types	Number of boundaries
MT	Not applied		4	?	?	?
SI	Not applied		2	1	N/A	2
North East Atlantic						
BE	3	2	1	1	2	1
DE	2	1	5	2	2	4
ES	7	?[19]	9	?[20]	4	3
F	?	?	?	n.A	?	?
IE	1	2	4	?	2	1
NL	?	?	?	?	?	?
NO	Not applied		41	unclear[21]	?	?
SE	1	unclear[22]	7	unclear[23]	3	2
PT	1	4	2	1	?	?
UK	5	?	12	?	2	?

The question mark (?) means that no information was reported.

Even if the picture is incomplete due to the lack of reporting the following observations can be made:

- More boundaries are lacking for marine waters. This can be explained by the fact that WFD (which requires boundaries for transitional and coastal waters) is much longer in place than the MSFD, which requires also boundaries for marine waters.
- It seems that most MS have set type specific boundaries as the number of types matches or almost matches with the number of boundaries.
- Some MS (e.g. SE, LT) have set more than one boundary for one type as the boundaries are also related to different ranges of salinity
- From the reported information only the UK has set the same nutrient boundary for all types of waters.

[19] Several values are under discussion
[20] Several values are under discussion
[21] NO does not provide a single value per type, but a range
[22] SE does not provide a single value per type, but a range
[23] SE does not provide a single value per type, but a range

3.8.2 Boundaries from transitional to marine waters

Ideally the boundaries set for all three types of saline waters (and the ones for inland waters) should be related to each other, in a way that nutrient concentration in inland waters allow the achievement of the nutrient concentrations set for saline waters and that nutrient concentrations in transitional and coastal water set under the WFD allow the achievement of nutrient concentrations set for marine waters. Nutrient reduction efforts need to target the water type that demands the lowest nutrient concentrations.

The graphs below show to which extend an assessment along all three water types (transitional, coastal, marine) is possible based on the reported data.

3.8.2.1 Baltic Sea

Table 33 Assessment for nitrogen-parameters in the Baltic Sea

Country	Transitional									Coastal									Marine									Consistent Monitoring for all 3 types
	TN			Nitrate			DIN			TN			Nitrate			DIN			TN			Nitrate			DIN			
	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	
Denmark	N/A did not provide information for the Baltic																											
Estonia	N/A no transitional waters									S									N/A did not report									
Finland	N/A no transitional waters									S															W			
Germany	N/A no transitional waters										Y									Y					W			
Latvia							W									S									W			
Lithuania	S									S									Y						W			
Poland	S/Y						W/Y			S						W			S/Y						W/Y			
Sweden	S/W						W			S/W						W									W			

no commonality/no information

In 2 out of 3 waters the same approach (same parameter, same time of the year and same statistics) is used

In 3 out of 3 water using the same approach (same parameter, same time of the year and same statistics) is used or 2 out of 2 if no transitional waters have been applied

S=summer, W=winter, Y=year-round, ?=unclear

Table 34 Assessment for phosphorus parameters in the Baltic Sea

Country	Transitional						Coastal						Marine						Consistent monitoring for all 3 types
	TP			Phosphate			TP			Phosphate			TP			Phosphate			
	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	
Denmark	N/A did not provide information for the Baltic																		
Estonia	N/A no transitional waters						S						N/A did not report						[red]
Finland	N/A no transitional waters						S									W			[red]
Germany	N/A no transitional waters							Y						Y		W			[green]
Latvia				W						S						W			[yellow]
Lithuania	S						S						Y			W			[yellow]
Poland	S/Y			W/Y			S			W			S/Y			W/Y			[green]
Sweden	S/W			W			S/W			W						W			[green]

no commonality/no information

In 2 out of 3 waters the same approach (same parameter, same time of the year and same statistics) is used

In 3 out of 3 water using the same approach (same parameter, same time of the year and same statistics) is used or 2 out of 2 if no transitional waters have been applied

S=summer, W=winter, Y=year-round, ?=unclear

In the Baltic Sea DE, PL and SE provided a consistent set of parameters for N and P in all three waters. The N and P parameters used are consistent for 2 types of waters in LV (CW, MW for N and P) and LT (TW and CW for P and N). In a second step the ranges of G/M boundaries set for DE, PL and SE from TW to MW have been analysed as shown in the table below.

Table 3530 G/M boundaries for the three types of sea waters

	TN in µg/l			DIN in mg/l			TP in µg/l			Phosphate in µg/l		
	TW	CW	MW	TW	CW	MW	TW	CW	MW	TW	CW	MW
DE				Not designated	0.19-0.44	0.081	Not designated	16-44	12.7			
PL	0.026-1.9[24]	0.3-0.4	0.2-0.37	0.01-1.05[25]	0.1-0.23	0.01-0.18	30-150[26]	33-38-	18.6-37.2	3-90[27]	15-24	6.2-22.01
SE				0.05 – 0.13	0.05-0.72	0.04-0.07				9.6-11.7	5-12	4.6-11.7

[24] Some values have been derived under the process of MSFD Initial Assessment preparation and are not yet approved in the legal system, however they have been included in the Polish “target report” to the EC,

[25] ibid

[26] ibid

[27] ibid

From the table above it is apparent that boundaries are falling from CW to MW, as would be expected with increasing dilution of nutrients along salinity gradients.

3.8.2.2 Black Sea

Table 31 Assessment for nitrogen- parameters in the Black Sea

Country	Transitional									Coastal									Marine									Consistent Monitoring for all 3 types
	TN			Nitrate			DIN			TN			Nitrate			DIN			TN			Nitrate			DIN			
	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	
Bulgaria	Y												Maximum									Spring/Summer						(red)
Romania				Y									x												Y			(red)

no commonality/no information

In 2 out of 3 waters the same approach (same parameter, same time of the year and same statistics) is used (yellow)

In 3 out of 3 water using the same approach (same parameter, same time of the year and same statistics) is used or 2 out of 2 if no transitional waters have been applied (green)

S=summer, W=winter, Y=year-round, ?=unclear; x: assess bi-annually

Table 37 Assessment for phosphorus- parameters in the Black Sea

Country	Transitional						Coastal						Marine						Consistent monitoring for all 3 types
	TP			Phosphate			TP			Phosphate			TP			Phosphate			
	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	
Bulgaria	Y									Maximum						Spring/Summer			(red)
Romania	Y						x			x						Y			(yellow)

no commonality/no information

In 2 out of 3 waters the same approach (same parameter, same time of the year and same statistics) is used (yellow)

In 3 out of 3 water using the same approach (same parameter, same time of the year and same statistics) is used or 2 out of 2 if no transitional waters have been applied (green)

S=summer, W=winter, Y=year-round, ?=unclear; x: assess bi-annually

In the Black Sea the situation is not clear as RO has just reported that they assess biannually but the metrics behind is unclear. BG has no common approach and the metrics for coastal waters are unclear.

3.8.2.3 Mediterranean Sea

Table 38 Assessment for nitrogen- parameters in the Mediterranean Sea

Country	Transitional									Coastal									Marine									Consistent Monitoring for all 3 types
	TN			Nitrate			DIN			TN			Nitrate			DIN			TN			Nitrate			DIN			
	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	
Croatia								Y									Y					Maximum						[yellow]
Cyprus	N/A no transitional												Y						N/A No info provided									[red]
France			S						S	N/A No info provided																		[red]
Greece				Y									Y						N/A No info provided									[yellow]
Italy							Y												N/A No info provided									[red]
Malta	N/A No info provided																											
Slovenia	N/A no transitional												Maximum									Maximum						[green]
Spain	Y			Y									Y									?						[green]

no commonality/no information

In 2 out of 3 waters the same approach (same parameter, same time of the year and same statistics) is used

In 3 out of 3 water using the same approach (same parameter, same time of the year and same statistics) is used or 2 out of 2 if no transitional waters have been applied

S=summer, W=winter, Y=year-round, ?=unclear

Table 39 Assessment for phosphorus- parameters in the Mediterranean Sea

Country	Transitional						Coastal						Marine						Consistent monitoring for all 3 types
	TP			Phosphate			TP			Phosphate			TP			Phosphate			
	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	
Croatia		Y			Y			Y			Y							Y	[yellow]
Cyprus	N/A no transitional									Y			N/A No info provided						[red]
France			S			S	N/A did not provide information												[red]
Greece				Y						Y			N/A No info provided						[yellow]
Italy				Y			Y						N/A No info provided						[red]
Malta	N/A No info provided																		
Slovenia	N/A no transitional						Y					Y	Y					Y	[green]
Spain	Y			Y						Y						?			[green]

no commonality/no information

In 2 out of 3 waters the same approach (same parameter, same time of the year and same statistics) is used

In 3 out of 3 water using the same approach (same parameter, same time of the year and same statistics) is used or 2 out of 2 if no transitional waters have been applied

S=summer, W=winter, Y=year-round, ?=unclear

In the Mediterranean Sea both ES and SI provide a consistent set of parameter for P. The N and P parameters used are consistent for 2 types of waters in GR (TW and CW for N and P) and HR (CW, MW for N and P). SI also provided a consistent set of parameters for N. In a second step the ranges of G/M boundaries (TW to MW) set in SI for nitrate, TP and phosphate have been analysed. For ES such assessment was not possible as values are under discussion.

Table 40 G/M boundaries for the three types of saline waters

		Nitrate in µg/l		TP in in µg/l		phosphate in µg/l	
	TW	CW	MW	CW	MW	CW	MW
Slovenia	Not designated	,035	,035	13	13	4.6	4.6

3.8.2.4 North East Atlantic

Table 32 Assessment for nitrogen- parameters in the North East Atlantic

Country	Transitional									Coastal									Marine						Consistent Monitoring for all 3 types
	TN			Nitrate			DIN			TN			Nitrate			DIN			Nitrate			DIN			
	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	
Belgium	S					Y			Y	W															(yellow)
France							W									W									(yellow)
Germany	Y						W			Y						W						W			(green)
Ireland																	W/S						W		(yellow)
Netherlands							W									W						W			(green)
Norway	N/A no trans. defined									W/S			W/S						N/A No info reported						(red)
Portugal						Y									Y				N/A No info reported						(yellow)
Spain				Y									Y						?						(yellow)
Sweden	W/S						W			W/S						W									(yellow)
UK							W									W						W			(green)

no commonality/no information

In 2 out of 3 waters the same approach (same parameter, same time of the year and same statistics) is used

In 3 out of 3 water using the same approach (same parameter, same time of the year and same statistics) is used or 2 out of 2 if no transitional waters have been applied

S=summer, W=winter, Y=year-round, ?=unclear

Table 42 Assessment for phosphorus- parameters in the North East Atlantic

Country	Transitional						Coastal						Marine						Consistent monitoring for all 3 types
	TP			Phosphate			TP			Phosphate			TP			Phosphate			
	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	Mean	Median	90% percentile	
Belgium	S			Y/S						W						W			
France	N/A No info reported																		
Germany	Y						Y						Y						
Ireland					W/S											W			
Netherlands	N/A No info reported																		
Norway	N/A no trans. defined						W/S			W/S			N/A No info reported						
Portugal						Y						Y	N/A No info reported						
Spain				Y						Y						?			
Sweden	W/S			W			S			W			N/A No info reported						
UK	N/A No info reported																		

no commonality/no information

In 2 out of 3 waters the same approach (same parameter, same time of the year and same statistics) is used

In 3 out of 3 water using the same approach (same parameter, same time of the year and same statistics) is used or 2 out of 2 if no transitional waters have been applied

S=summer, W=winter, Y=year-round, ?=unclear

In the North East Atlantic only DE provides a consistent set of parameters for N and P in all three waters. The UK and NL[28] have a consistent set of parameters for N for all three waters. The N and P parameters used are consistent for 2 types of waters in BE (CW, MW for N and P), IE (TW and CW for P; CW and MW for N) and ES, SE and PT (TW and CW for N and P). In a second step the ranges of G/M boundaries set for DE and UK from TW to MW have been analysed.

Table 33 G/M boundaries for the three types of sea waters

	TP in µg/l			DIN in mg/l		
	TW	CW	MW	TW	CW	MW
DE	45	31-36	29-31	0,8	0,19-0,44	0,11-0,16
NL				0,46	0,46	0,46
UK				0,42	0,25	0,21

Table 42 above clearly shows that the boundary values are falling from the coastal waters to the marine waters as one would expect with increasing dilution of nutrients along salinity gradients.

4 Methods used to set nutrient boundary values

4.1 Methods to define Reference Conditions

According to the CIS Guidance No. 5 chapter 4.5, there are four options to derive reference conditions - the use of existing sites with minor disturbance, historical data and information, modelling or expert judgement. Figure 8 and Figure 9 show that for transitional, coastal and marine waters generally a

[28] Data reported to OSPAR.

combination of these different approaches was used to set reference conditions. While expert judgement is used quite often it is in most cases accompanied by more data-driven approaches. Existing sites are not often used, which might be explained by the fact that such sites are very rare to find considering the high anthropogenic pressures on coastal and marine zones.

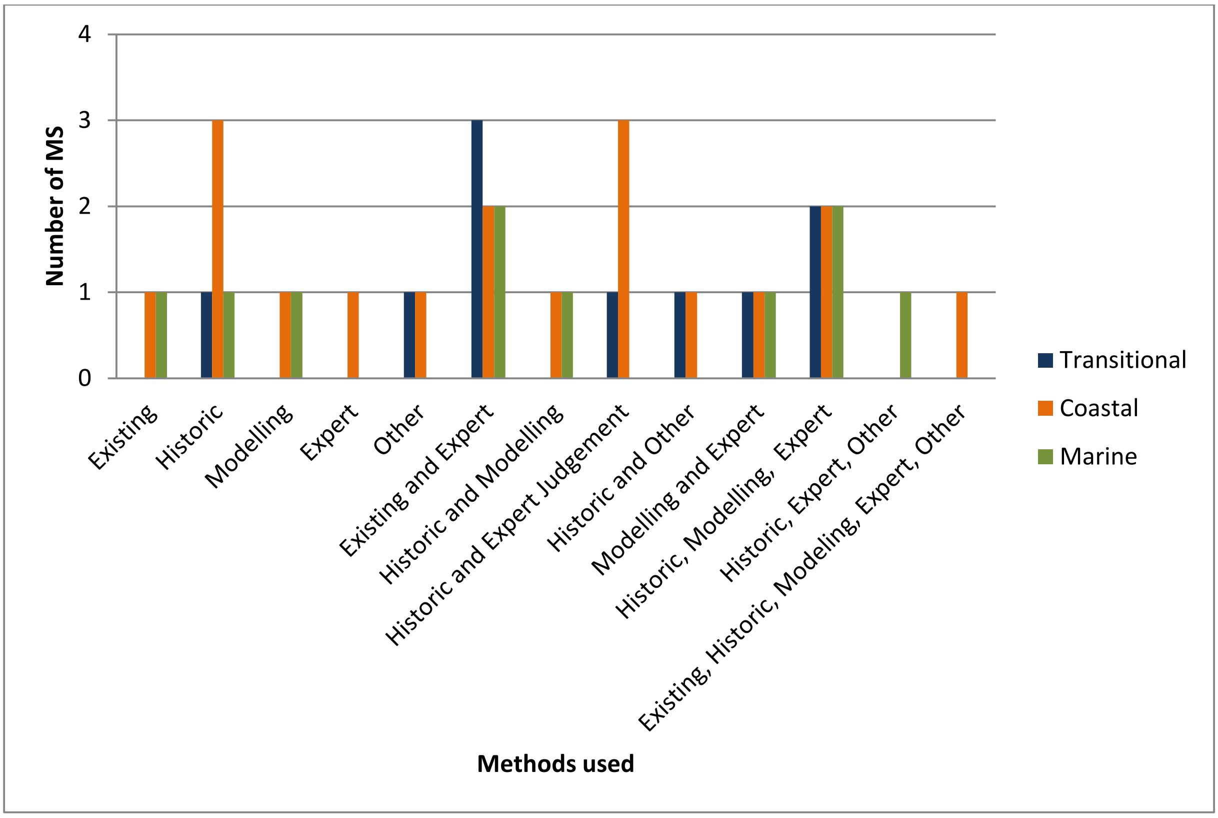

Figure 8 Methods used to define reference conditions for phosphorus

As regards transitional waters:

- 7 MS did not provide information as regards methods to define reference conditions: BE (Flanders), F, EL, NL[29], NO and the UK.
- Existing sites and expert judgement is the most common combination of methods used, reported by BG, HR and IT.
- 6 MS (BG, HR, IT, LV, RO, DE (North East Atlantic)) use two different methods.
- LT uses three different methods, namely historic data, modelling and expert judgement.
- Only SE and IE use one method: SE uses historic sites and IE uses 'other' defined as "For the freshwater endpoint of transitional waters, the range of nutrient concentration observed in rivers with benthic macroinvertebrates at high status was used".

As regards coastal waters:

- 4 MS did not provide information: F, EL, NL[30] and UK.
- Historic and expert judgement is the most common combination of methods used, reported by LV, PL and RO.
- IT uses all 5 methods, with other defined as "By using TRIX index as control metric, since TRIX is a linear combination of Chlorophyll, oxygen depletion, TP and DIN."

[29] According to the National Focal Point, NL did not deliver data on P standard due to slight differences in interpretation.
[30] ibid

- 6 MS only used one method: Ireland only uses existing sites; EE, NO and SE use historical data; DK consider how to derive NB from modelling as a technical possibility and CY uses expert judgement.

As regards marine water:

- 11 MS did not provide information: HR, CY, EE, F, EL, IT, LT, LV, NL[31], NO and the UK.
- The most commonly used approach is a combination of historical data and expert judgement (2 MS: BG and SI) and historical data, modelling and expert judgement (2MS: BG (Flanders), PL).
- RO uses three methods: historical data, expert judgement and other.
- 2 MS reported using only one method: IE only uses existing sites and SE only uses historical data.

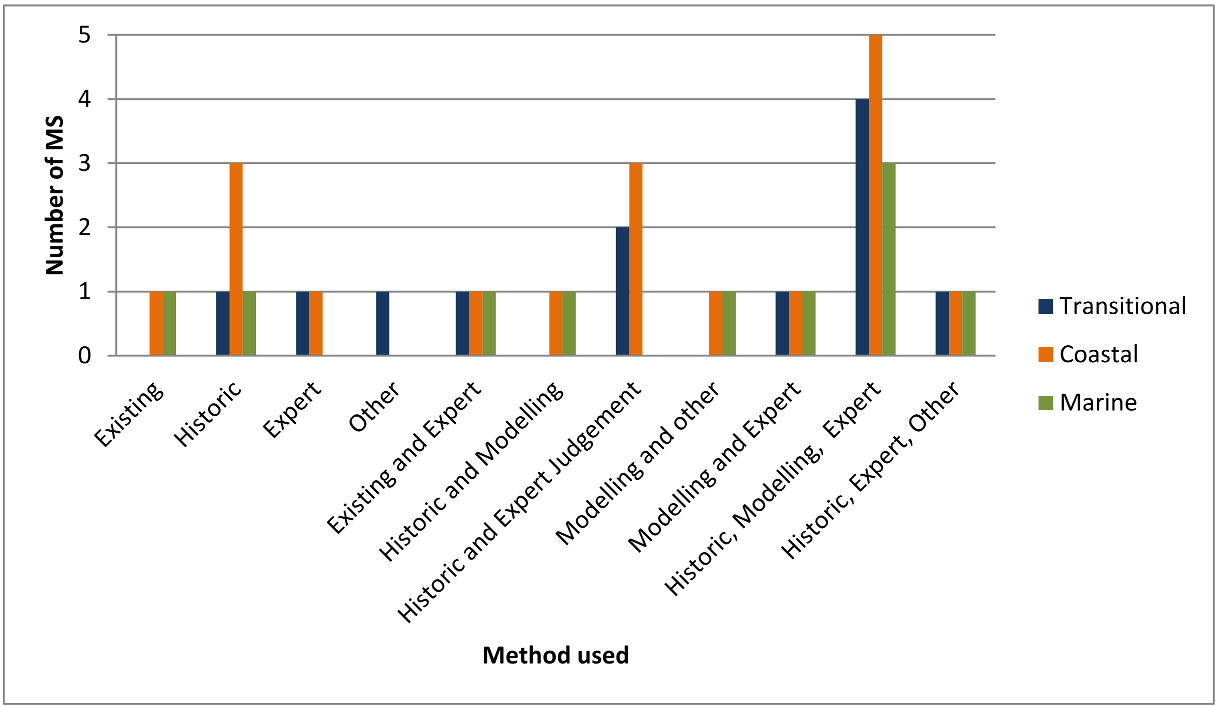

Figure 9 Methods used to define reference conditions for nitrogen

As regards transitional waters:

- 10 MS did not provide information: BE (Flanders), BG, CY, EE, FI, DE (Baltic), NO, SE and SI.
- The most commonly used approach is the combination of historical data, modelling and expert judgement, reported by 4 MS (LT, PL, NL and UK)
- 3 MS reported using only one approach
    - F uses only historical data
    - EL uses expert judgement
    - IE uses other, defined as "For the freshwater endpoint of transitional waters, the range of nutrient concentration observed in rivers with benthic macroinvertebrates at high status was used".

As regards coastal waters:

- 2 MS did not provide information: BG and IT
- The most frequently used method is historical data, modelling and expert judgement (5 MS: BE (Flanders), LT, NL, PL and UK)

[31] ibid

- 3 MS reported using only one approach:
  - IE uses only existing sites
  - F, SE and NO only use historical data
  - CY only uses expert judgement

As regards marine water:

- 11 MS did not provide information: BG, HR, CY, EE, F, EL, IT, LT, LV, NL and NO.
- The most frequently used method is historical data, modelling and expert judgement (3 MS: BE (Flanders), PL and UK).
- 2 MS reported using only one approach:
  - IE uses only existing sites
  - SE only uses historical data

The information provided by MS on how reference conditions were defined is not always detailed and makes a comparison challenging. Nevertheless, some conclusions can be drawn. MS have predominantly used historic riverine nutrient inputs or historic nutrient concentrations as a basis for deriving reference conditions, in particular in the North East Atlantic and Baltic Sea (table 43). These have been interpolated along salinity gradients into the open sea using mixing diagrams. The further the historic nutrient concentrations go back in time the more they were derived by modelling rather than looking at time-series of in-situ data. With respect to the historic conditions it is interesting that even within a region and between neighbouring MS there have been very different historic years used to base reference conditions upon.

Table 34 Historic years to base reference conditions upon

MS	Years
BE - FL	1950s
DE	1880
HR	1972-2010
DK	1900
FI	early 1900s
LV	1960s
PL	1950
RO	Assessment of data from 2004-2012 compared with 1959-2011(DIP), 1980-2011 (DIN) for CW and 1963-2011 (DIP) and 1980-2011(DIN)

While this might be due to data availability it also appears that there exit very different notions among MS of what constitutes water quality conditions not yet affected by eutrophication.

Those MS that have not used the approach described above have mainly relied on deriving nutrient concentrations from recent sites considered to be unpolluted. Few MS have derived reference conditions based on pressure-response relationships between biological quality elements (predominantly chlorophyll-a) and nutrients. For those that have it remained unclear how reference conditions for these respective quality elements were than derived.

Table 45 Method for assessing reference conditions

MS	**Description of the method**
BE_FL	The reference conditions (= background levels in OSPAR) cannot easily be objectively defined. A currently developing approach is using coastal ecosystem

	models with coupled river basin models to simulate historical “pristine” conditions prior to the significant increase in anthropogenic nutrient inputs, which is thought to have caused the most severe impacts from the 1960s onwards. Such models (Lancelot et al. 2007) are gradually being improved through several scientific projects and are providing valuable information for the further development of Belgian reference or “back-ground” levels. However, for the first application of the OSPAR Common Procedure (Belgium 2002), the background levels were chosen somewhat arbitrary, but have been validated by modelling to still be relevant for the WFD boundaries. In OSPAR, the background levels for DIN and DIP in Belgian waters were taken as 10.0 µMol/l and 0.6 µMol/l respectively, based on an analysis of monitoring data available (for the whole OSPAR area) in 2001 in the ICES database. In the second application of the Common Procedure a distinction has been made between coastal and offshore waters (waters with mean annual salinity of > 34,5), maintaining the same background levels for coastal waters as in the first application (Belgium 2007). The modelling results of four projects (financed by the Federal Science Policy of Belgium) have been taken into account to validate the natural background nutrient concentrations in Belgian coastal waters (Projects AMORE for 3 project periods, REFCOAST, TIMOTHY and EMoSEM). For COASTAL waters, containing both WFD coastal and part of MSFD marine waters (i.e. WFD coastal waters up to 1 nm and MSFD marine waters from 1 nm up to mean annual salinity up to 34,5): Historical reference year: no specific year, but range of data used as far as available back in history (1980 for nutrients?, 1988 for Phaeocystis and diatoms, copepod production) Type of modelling approach: The RIVERSTRAHLER model, an idealized biogeochemical model of the river system (Billen et al., 1994) was coupled with the marine ecological MIRO model (Lancelot et al., 2005) to reconstruct the interannual variations of nutrient loads, Phaeocystis colony blooms and primary and secondary production in the Belgian Continental Shelf. Results of the modelling in the AMORE projects: The 1950–1998 variations in winter nutrient concentrations and stoichiometry have been estimated from these coupled RIVERSTRAHLER–MIRO simulations for a station in the center of the Belgian marine waters with a reference salinity of 33.5. Modelling results have been validated with nutrient and phytoplankton concentrations, intensively assessed at this station (Rousseau, 2000; Breton et al., 2006) over the 1992–1998 period (Rousseau et al., 2004). Unfortunately such data are not detailed for the early seventies when both N and P loads increased (Billen et al., 2005). For modelled winter NO_3 concentrations, an increase from 15 µM in 1950 up to 40 µM in 1994 has been simulated, whereas R–MIRO winter NH_4 shows little variation around 5 µM (Lancelot et al., 2007a). This means that a winter concentration of about 20 µM of DIN was modelled for 1950. Winter PO_4 shows the most complex behaviour over the simulated period, being minimal in early 1950 at a value of about 1 µM (Lancelot et al., 2007a). However, the situation in the fifties reflected already a situation of enrichment of nutrients and cannot be considered as a pristine reference situation. Based on the outcome of the REFCOAST project (Van Damme et al., 2006) chlorophyll a modelling for a pristine scenario, values were about half (55%) the concentrations of the fifties. This means that roughly, the background winter DIN concentrations should be at least about half of the concentrations found in the fifties, this results in about 10 µM as background level. Results of the modelling for the retrospective scenarios of the pristine situation for nutrients earlier than the fifties: Preliminary historical MIRO model simulations of winter nutrient conditions at a station in the centre of the Belgian marine waters (reference salinity of 33,5), making use of RIVERSTRAHLER simulations as nutrient loads, showed a reference DIN concentration of 10 µMol/l and for DIP a concentration of 0.73 µMol/l for the pristine scenario, presented as a hypothetical state of the Scheldt basin before any human disturbance. More detailed model description: The trophic resolution of the mechanistic MlRO

model was chosen on the basis of the current mechanistic understanding of the eutrophication problem in the Belgian Continental Shelf. MIRO describes C, N, P and Si cycling through aggregated components of the planktonic and benthic realms of Phaeocystis-dominated eco-systems (see justification of chosen state variables in Lancelot et al., 2005). Its structure includes 38 state variables assembled in four modules describing the dynamics of phytoplankton (three groups: diatoms, nanoflagellates and Phaeocystis colonies), zooplankton (two groups: copepods and microzooplankton), dissolved and particulate organic matter (each with two classes of biodegradability) degradation and nutrients [NO_3, NH_4, PO_4 and $Si(OH)_4$], regeneration by bacteria in the water column and the sediment. Equations and parameters were formulated based on current knowledge of the kinetics and the factors controlling the main auto- and heterotrophic processes involved In the functioning of the coastal marine ecosystem. These are fully documented in Lancelot et al. (2005) and www.int-res.com/joumals/suppl/appendix_lancelot.pdf. MIRO was first calibrated in a multi-box frame (OD-MIRO) delineated on the basis of the hydrological regime and river inputs. ln order to take into account the cumulated nutrient enrichment of Atlantic waters by the Seine and Scheldt rivers, two successive boxes, assumed to be homogeneous, were chosen from the Seine Bight to the Belgian Continental Shelf. Each box has its own morphological characteristics and river inputs (Table 1 in Lancelot et al., 2005) and is treated as a well-mixed open system, receiving waters from the upward adjacent box and exporting water to the downward box. The boundary conditions were provided by the results of the calculations performed for the conditions existing in the Channel, considered to be a quasi-oceanic closed system. For the specific coupling application, an average meteorological year (global solar radiation, temperature and rainfall) is considered for the 1950-2000 period while changes in land use modifications and changes in annual urban and industrial wastewater discharges are documented by 10 year periods and by 5 year periods, respectively. Details on the coupling between RIVERSTRAHLER and MIRO (R-MIRO) are to be found in Lancelot et al. (2007b).

For OFFSHORE waters (waters with mean annual salinity of >34,5) being addressed as part of the marine waters in the MSFD:
Belgian DIN data were plotted against salinity in the form of a mixing diagram for the winters from 2000 to 2005. The measured values at different salinities along the outflow of the river give an indication how to define consistent different nutrient standards at different places along the mouth and the outflow of the river. For the Belgian coastal waters, the point of departure for the nutrient setting along a salinity gradient was the estimated and modelled background concentration of 10 µMol/l DIN at a station in the centre of the Belgian marine waters with reference salinity 33,5 (see model description above). An offshore endpoint value at a salinity of 34,5 was chosen in this way that, in connection with the value at salinity 33,5, the reference values’ trendline has a slope, leading to an acceptable freshwater end reference DIN value for salinity 0 = 77 µM. In this way the background value of 8 µMol/l DIN has been chosen for salinity 34,5. So far, linearity is assumed as a simple representation of the relationship between DIN and salinity. A background value of 17 µMol/l DIN for a reference salinity of 30 µMol/l fits perfectly on this trendline.

Biological quality element used: phytoplankton: chlorophyll a, as well as Phaeocystis and specific phytoplankton groups

Legal standards for nutrients and other general physical-chemical parameters (such as oxy-gen, pH and conductivity) already existed in Flanders before the WFD. These existing standards (although not type-specific) strongly influenced the standards finally adopted by the Flemish government for the WFD. The new WFD standards were mainly developed based on existing legislation, comparison with

	other countries, and expert advice (such as Schneiders, 2007). Schneiders, A. (2007). Aanzet tot het opstellen van richtwaarden voor nutriënten in oppervlaktewateren conform de Europese Kaderrichtlijn Water. Samenvatting. Report IN-BO.R.2007.27. Research Institute for Nature and Forest (INBO), Brussels. http://www.inbo.be/files/bibliotheek/55/182455.pdf
BG	Relationship with biological quality elements, various - usualy based on expert judgement. For BQE Phytoplankton the IC proces (Black Sea GIG) is successfuly finalized. For BQE`s Macroinvertebrates and Macroalgae the process is ongoing.
HR	The reference conditions for transitional and coastal waters were derived from a set of more than 30.000 nutrient data collected during the time period 1972-2010 at stations under different pressures. For reference conditions only stations with very minor anthropogenic impacts were chosen. Assessment of the significance of impacts were based on available date on oxygenation, transparency, Chl a concentrations, loss of biodiversity, introduction of invasive species etc. Median was used to derive reference conditions for each water type. Reference conditions for nutrients have been so far derived only for BQE Phytoplankton.
DK	The reference conditions of the biological elements in coastal waters are derived as follows: Macrophytes (eelgrass depth limit): Historical observations from a period around 1900. Phytoplnakton (chl-a): by use of ensample modelling (marine ecosystem models) using a nutrient pressures estimation of year 1900 (waterborne and airborne loads). It is considered if nutrient boundaries can be derived from the modelling set up in a scenario where macrophytes and phytoplankton are at a reference level.
EE	Reference conditions for were delivered by expert opinion at the basis of Ntot, Ptot and transparency data 1993-2008, presuming that ca 20% of data match to areas with low human impact. Reference values of Ntot and P tot were corrected against salinity, ref value of transparency was corrected taking account of the depth, openness and impact of river water.
F	The nutrients indicator is only based on the DIN concentration at this date (PO4 is measured but not take into account in the nutrient indicator). The nutrient indicator is not declared relevant for the Mediterranean waters. Nutrient indicator is only applied to TW and CW at this date (not MW). 1- Adjacent TW and CW are combined according to their catchment bassin to form "ecotypes" (31 "ecotypes" from the Belgian border to the Spanish border, Atlantic ocean and English channel) 2- The winter DIN (NO3 + NO2 +NH4) concentrations measured during 6 years (2006-2011) in each ecotype are normalized against salinity 33. 3- Chla EQR of each CW and TW is plotted against normalized winter DIN. 4- Six CW were chosen from expert advice to represent "low chla / low nutrients" and "high chla / high nutrients". A regression line, used as a mechanical tool, is drawn between these points.
FI	For the WFD coastal classification, reference conditions for summertime concentrations of total nutrients in surface waters were defined using (i) the frequency distribution of monitoring data, (iii) time series data and (iii) empirical modelling using the present monitoring data on nutrients and Secchi depth along with historical Secchi data from the early 1900s. Finally, the national reference values were compared with corresponding Swedish values in the common IC types to ensure harmony in the coastal waters of the northern Baltic Sea.

	In open marine waters, the assessment methodology for the implementation of the the MSFD was developed within HELCOM (HELCOM 2014). The method is actually not based on reference conditions (reflecting the boundary of high and good status), but on GES targets (reflecting the boundary between good and moderate status). However, reference conditions could be derived from the target values, if acceptable deviation of reference conditions was estimated and agreed upon. The Finnish coastal waters within the 1 nautical mile zone were included in the HELCOM assessment tool (HELCOM HEAT) to support the implementation of the MSFD. The reference values for wintertime concentrations of dissolved inorganic nutrients (DIN and DIP) in surface waters were defined using frequency distribution of monitoring data and time series data, the results of which were evaluated by review panel work. The dynamic models applied for open marine waters are not applicable in coastal water conditions. Reference: HELCOM 2014. Eutrophication status of the Baltic Sea 2007-2011. Baltic Sea Environment Proceedings No. 143.
DE_Baltic_Sea	In a first step the catchment area model MONERIS (MOdelling Nutrient Emissions in RIver Systems) was used to model historic riverine nutrient inputs of 1880. We have chosen this reference year because it represents the pre-industrial time for which historic data on macrophytes indicate that coastal waters were not yet eutrophic. In a second step the historic riverine nutrient inputs (including atmospheric nitrogen inputs) were used as input values for the baltic-wide ERGOM-MOM ecosystem model. The model was also run with current nutrient inputs (2001-2008) and the relative difference between the historic and the recent model simulation was analysed for the resulting nutrient concentrations. Background concentrations for nutrients were calculated by multiplying recent concentrations (2001-2012) with the factor gained from the 2 model simulations. Where the model had weaknesses (e.g. underestimation of nitrogen fixation) expert judgement was incorporated to set the nutrient background conditions. The approach has focussed on total nitrogen and total phosphorus, which were found to be more reliable indicators of eutrophication status in coastal waters than DIN and DIP. Besides nutrients, the model has also derived chlorophyll-a concentrations and secchi depth and can provide information on oxygen concentrations. See: Hirt, U., Mahnkopf, J., Gadegast, M., Czudowski, L., Mischke, U., Heidecke, C. et al. (2013): Refer-ence conditions for rivers of the German Baltic Sea catchment: reconstructing nutrient regimes us-ing the model MONERIS. Regional Environmental Change 14: 1123-1138, doi:10.1007/s10113-013-0559-7.
DE_North_Sea	In a first step the catchment area model MONERIS (MOdelling Nutrient Emissions in RIver Systems) was used to model historic riverine nutrient inputs of 1880. We have chosen this reference year because it represents the pre-industrial time for which historic data on macrophytes indicate that coastal waters were not yet eutrophic. The resulting riverine nutrient concentrations were then extrapolated into the marine waters considering retention processes in the estuaries (assuming a historic 50% retention of nitrogen and no retention of phosphorus), salinity gradients and linear mixing processes. As a result, nutrient background concentrations were obtained for transitional, coastal and marine waters. Furthermore, assuming a certain relationship between nutrient concentrations and chlorophyll-a concentrations, the results were also used to derive background concentrations for chlorophyll-a. In the near future it is planned to use a modelling approach to derive nutrient background concentrations based on nutrient inputs of 1880, since this provides a spatially more differentiated approach and allows the

	consideration of interactions between the different nutrients.
IE	For transitional waters reference conditions at the freshwater endpoint were based on the range of nutrient concentrations observed in rivers with benthic macroinvertebrates at high status. For coastal waters reference conditions where based on the analysis of data from water bodies which are considered to be unpolluted with respect to nutrient enrichment as classified by the EPA's trophic status assessment scheme. The TSAS scheme compares the compliance of individual parameters against a set of criteria indicative of trophic state. These criteria fall into three different categories which broadly capture the cause-effect relationship of the eutrophication process, namely nutrient enrichment, accelerated plant growth, and disturbance to the level of dissolved oxygen normally present. Eutrophic water bodies are those in which criteria in each of the categories are breached, whereas, unpolluted water bodies are those which do not breach any of the criteria in any category. There are two further trophic states, potentially eutrophic and intermediate which fall between the eutrophic and unpolluted states. For marine waters reference conditions were based on the analysis of data from oceanic waters considered to be not impacted by anthropogenic nutrient enrichment.
IT	During the 2nd phase of the IC exercise, both for transitional and coastal waters, stepwise regression techniques have been developed, using chlorophyll as dependent variable. For CW, TP always resulted the most important factor (with greater weight) in determining the variability of chlorophyll. For TW, no TP data were available for all the water bodies considered. P-PO4 has been therefore used. Similar results were obtained for Dissolved Phosphorus, instead of TP. In the case of CW, as reported in the Excel file, the reference conditions for phosphorus were derived from the regression line with chlorophyll (i.e. the P concentrations corresponding to Chl reference values for the related CW Macrotypes. For TW: reference conditions were not defined Instead. The good/moderate thresholds were defined from annual means of N-DIN and P-PO4 from sites classified as good or high for macrophyte. For Marine waters, the data available were not considered sufficient to derive reference conditions. The dataset used for the initial assessment (art. 8) of the MSFD in each of the assessment areas of Descriptor 5 'Eutrophication' was the following: in situ data collected at stations 3000 m off the coast from the National Monitoring Program (SidiMar database, years 2001-2009) and modelling data of surface concentration of N-NO3 from UE FP7 Program My Ocean 'Ocean Monitoring and Forecasting', from 2004 to 2009, with a spatial definition of 12 km. It is expected that the MSFD monitoring programmes will provide the data needed to derive reference conditions for marine waters.
LT	In the assessment of transitional waters biological quality element as mean summer (June-September) chlorophyll a concentrations were used to derive reference conditions for total nitrogen (TN). Expert judgment was used to derive total phosphorus (TP) reference conditions. For coastal waters were used algorithmic method basedon relationships between mean summer chlorophyll a concentrations and mean summer TP concentrations.
LV	There are no historical data on nutrients in coastal waters. However, there are data from open part since 1973 (national monitoring) and in the Gulf of Riga two

	surveys were made in sixties. The methods of that time are not exactly up to today's standard but it gave some estimate. Based on these values the expert judgement was made.
NL	No objective and reliable reference values could be determined using spatial data or historical reference data. For the 1st and 2nd application of the OSPAR Common Procedure, natural background levels were defined based on data for oceanic water. These values are somewhat arbitrary due to the large uncertainty in measured data. In the application of the Common Procedure the natural background level for winter means of DIN in coastal waters are set at 20 µM (normalized to a salinity of 30), and for winter means of orthophosphate at 0.6 µM (normalized to a salinity of 30). However, these values are not based on pressure-response relations between nutrient concentrations and phytoplankton.
NO	In the original description of the system there is not given much information regarding reference conditions for nutrients. The system is based on nutrient data from 120 stations at the coast. The system separate between winter and summer conditions. The system is based on the degree of deviation from «normal» conditions for an area. However, there is not given any description of "normal". If historical data exist this could be used or "normal" could be define based on "variation width of class 1" of the data from a location and setting the "natural condition" to median value.
PL	For 1950, winter phosphate-scarce historical data; DIN, TN, TP - extrapolation of temporal trends mainly for the data prior to 1985
PT	Reference conditions have not yet been determined for estuarine or coastal water bodies. Further work (in progress) must be done to enlarge the historical database and define nutrient reference conditions. Methods to differentiate natural values from human activities need to be developed (work in progress using a combination of data analysis+models+expert judgment).
RO	Assessment of data from 2004-2012 compared with 1959-2011(DIP), 1980-2011 (DIN) for CW and 1963-2011 (DIP) and 1980-2011(DIN)for water column and MW. Biological quality element-chlorophyll a - assessment done from WFD and GIG. The approach used the median value of the concentrations after the salinity corrections and comparison with the reference years ('60s). Values are not legally binding.
SE	Historical data and correlations with salinity were used to set reference conditions as a function of salinity. Correlation between Secchi depth and total nitrogen concentration was used to generate "historical" nutrient data.
SI	Concentrations of nutrients at a less disturbed site; time period for phosphate 1990-2012, for nitrate and total P 2007-2012; statistical analysis-median of annual geomeans, biological element used is phytoplankton
UK	The reference conditions in transitional and coastal waters and in marine waters are based on the salinity gradient approach developed for UK assessments under the OSPAR Common Procedure. Reference conditions (= background in OSPAR) were derived using a salinity

	gradient from the freshwater to the highest salinity water on the UK shelf. A reference value for zero salinity for the freshwater end of the mixing curve was obtained from a river considered to be unaffected by major inputs of nutrients from point or diffuse sources. The saline end of the mixing curve was derived from observations of Atlantic water concentrations on the shelf to the north west and south west of the UK. These end members provide the approximated linear relationship for dissolved inorganic nitrogen against salinity. References: Common Procedure for the identification of the Eutrophication Status of the OSPAR Maritime Area (Agreement 2013-8*). OSPAR Convention for the Protection of the Marine Environment of the North East Atlantic. UK ENVIRONMENTAL STANDARDS AND CONDITIONS (PHASE 2) www.wfduk.org *Supersedes agreements 1997-11 and 2002-20. Source: EUC 2005 Summary Record – EUC 05/13/1, Annex 5 as amended and endorsed by OSPAR 2005 Summary Record – OSPAR 05/21/1, §§ 6.2-6.5 and Annex 6

4.2 Methods to define Good/Moderate boundaries

The methods used to define G/M boundaries based on the reference conditions are listed in Table 44 below. The information provided is not always detailed and makes a comparison challenging. In summary the following can be said:

- For the Baltic Sea DE, FI, EE refer to the HELCOM approach. In LT, LV DK other approaches as listed below have been applied.
- For the North East Atlantic DE, SE, UK refer to the OSPAR approach[32]. In IE, FR, DK, NO, NL other approaches, as listed in table 44 below, have been applied. In the Mediterranean Sea and Black Sea no common approach was found. In the Mediterranean Sea several MS reported work in progress (ES, F, PT).

In general the most common approach seemed to be to add an “acceptable deviation” to the reference conditions to obtain the good/moderate boundaries. This deviation was suggested to be 50% by OSPAR and was subsequently also used by HELCOM. Interestingly, RO has also adopted this approach in the Black Sea while in the Mediterranean Sea it seems not to be applied. IE also used acceptable deviations but added two times 50% to the reference conditions to derive the G/M boundary. This approach is common practice in setting chlorophyll-a G/M boundaries for coastal waters already since the first intercalibration phase. The practice seems to stem from the confusion whether reference conditions actually are located at the very upper limit of the high status class or whether they denote the high/good boundary.

Few countries have not used “acceptable deviations” to derive G/M boundaries from reference conditions and have either used pressure-response relationships (e.g. IT) or existing sites (e.g. PL).

[32] Please see Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area (Reference number: 2013-8)

Table 46: Methods used to define G/M boundary for nutrients

MS	Description of the method
BE_FL	For the WFD as well as the MSFD, Belgium has followed the acceptable deviation as defined within OSPAR from the background or reference condition for DIN and DIP.
BG	Relationship with biological quality elements, usually based on expert judgement. For BQE Phytoplankton the IC process in Black Sea GIG (coastal waters) is finalized. For BQE`s Macroinvertebrates and Macroalgae the process is ongoing.
HR	The good/moderate boundary for nutrients for transitional waters were derived from the same data set used for deriving reference conditions, taking in consideration stations for which a good or moderate status were estimated. Median was used to derive reference conditions for each water type. This boundary has been so far derived only for BQE Phytoplankton.
DK	For coastal waters, modelling might be a possible technical tool to derive good/moderate boundaries conditions for nutrients based on good/moderate boundaries for ecological status
EE	For establishment of good/moderate class boundaries the method based on reference conditions and defining of acceptable deviation (in most cases 50 % from reference condition) was used.
F	5- The DIN threshold values (Very Good/Good and Good/Moderate) are obtained by plotting the corresponding chlorophyll EQR against the regression line. 6-The “good/moderate” threshold is moderated by the chlorophyll EQR value of the water body in order to take into account hydrodynamics and physical characteristics. If the chlorophyll EQR status is "very good" or “good”, the high nutrient input does not have too much effect on biology and the water body can be classified as “good status”. If the chlorophyll EQR is worse than “good status”, the water body is classified as “moderate status”. The work is still in progress for studying the relevancy of a phosphate indicator
FI	For the WFD coastal classification, the G/M boundaries of summertime TN and TP were presumed to deviate at maximum 50 percent from the reference values. The boundaries were checked against corresponding Swedish boundaries in the common IC types to ensure harmony. Additionally, the G/M boundaries have been tested against chlorophyll a, as well. For marine waters for the MSFD, methodology developed within HELCOM is used (HELCOM 2014). The GES targets have been set for winter time concentrations of dissolved inorganic nutrients (DIN & DIP) in surface waters to define the G/M boundaries using (i) historical data, (ii) dynamic simulation models (HELCOM 2013) along with (iii) the review panel work carried out by national experts from Finland, Sweden and Estonia (HELCOM 2014).
DE_Baltic_Sea	The same approach as for reference conditions was used. The good/moderate boundary for nutrients was derived by adding 50% to the nutrient background concentrations.

	The approach has also achieved full harmonisation with the approach used by the HELCOM TARGREV project, where nutrient good/moderate boundaries were derived by a data mining approach of historic data combined with modelling using the BALTSEM model. Results of BALTSEM and ERGOM-MOM have been cross-validated. Germany is now in the unique situation to have used a single approach for deriving good/moderate boundaries of nutrients across all saline waters.
DE_North_Sea	The same approach as for reference conditions was used. The good/moderate boundary for nutrients was derived by adding 50% to the nutrient background concentrations. The approach also considered nutrient retention processes in the estuaries. In the near future it is planned to use a modelling approach to derive nutrient background concentrations based on nutrient inputs of 1880, since this provides a spatially more differentiated approach and allows the consideration of interactions between the different nutrients.
IE	In relation to transitional waters the good/moderate boundary for P at the freshwater endpoint was set at 50% above the nutrient median concentration of P observed for rivers at moderate status (as determined by the macroinvertebrate QE). The good/moderate boundary for P at the seaward endpoint was set at approximately 50% above the high/good boundary, which in turn was set at 50% above the background concentration observed for marine waters. When applied the background concentration was set at 18.5 µg/l, the high/good boundary was set at 25 µg/l and the good moderate boundary was set at 40 µg/l. Only the good/moderate boundary value was established as an environmental quality standard for transitional waters in national regulations implementing the Water Framework Directive. In relation to coastal waters the high/good boundary for N at the seawater endpoint was set at approximately 50% above the background concentration observed for marine waters. In turn, the good/moderate boundary was set at approximately 50% above the value set for the high/good boundary. When applied the background concentration was set at 0.11 mg/l, the high/good boundary was set at 0.17mg/l and the good/moderate boundary was set at 0.25 mg/l. In relation to the freshwater endpoint the good/moderate boundary was set at 50% above the median concentration of N observed for rivers at moderate status (as determined by the macroinvertebrate QE).
IT	On the basis of historical data (from 2000 to 2009) a trophic classification was applied to the Italian coastal waters, using TRIX (as this Index was usually applied in ITALY, starting from 1999). Both G/M and H/G boundaries were determined for chlorophyll mean values (metric adopted in the IC exercise for the Phytoplankton BQE) and consequently we derived the same boundaries for Phosphorus, as already discussed above. For TW: annual means of N-DIN and P-PO4 from sites classified as good/high for macrophytes were used to define good/moderate boundaries. For marine waters, see answer above.
LT	Characterisation of water quality classes according to the TP ant TN for vegetation period from June to September is based on combination of historical data, ecological relevance of nutrient concentrations and phytoplankton parameters as well as expert judgment.
LV	The good/moderate boundary was derived by using principle of response curves and expert judgement. The response curves were used in areas where data pool was sufficient to construct them and are described in article Juris Aigars & Bärbel Müller-Karulis, Georg Martin & Vadims Jermakovs Ecological quality boundary-

	setting procedures: the Gulf of Riga case study. Environ Monit Assess DOI 10.1007/s10661-007-9800-5. They clearly showed nonlinearity of response to pressure. In areas where data pool was not sufficient to derive good/moderate boundary by use of response curves, expert judgement was used.
NL	G/M boundary is derived based on statistical relationship between phytoplankton (=chl-a + Phaeocystis) and winter DIN. In about 90% of the cases (on basis of yearly data) the achievement of the biology is ensured. This is also one of the reasons why nutrients mostly are not good while biology is good. The standard is precautionary.
NO	The boundary for the different classes is based on statistic analyses of historical data. Class 1 and 2 is based on median values for all observations. The boundary between 2 and 3 (Good/Moderate) is set to the highest value among the 75% of all observations, range from lowest to highest value.
PL	scarce historical data from the years 1938-1960 and the data collected in the oceanographic data-base of the IMWM in Gdynia between 1959 and 2004
PT	So far, Good/Moderate boundaries were established through statistical analysis of historical data and data collected in the scope of project EEMA (sampling in 2009, 2010, 2011), a project designed specifically to develop classification systems for transitional and coastal waters. In the case of nutrients, 90th percentile was used to determine the Good/Moderate boundary. In estuaries, these boundaries have been determined according to salinity classes: <10, 10-20, 20-30 and >30. Ecological Status was defined following the methodology described next: Step 1. statistical analysis of data for all estuaries and all coastal waters was performed (nitrate and phosphate were considered). 90th percentile was determined and considered the most representative value for the set of all estuaries or coastal areas. Step 2. statistical analysis for each estuarine and coastal water body was performed. 90th percentile was calculated for each water body for nitrate and phosphate. Step 3. RIM (RIM=90thpercentil for each water body calculated in step 2/ representative value for the all set of estuaries and coastal areas calculated in step 1) was determined. If RIM <0.7 and >1.2 MODERATE status was adopted. If RIM >= 0.7 and <=1.2 GOOD status was adopted. This methodology was used for all estuaries (all types) and all coastal waters except coastal lagoons. Classification system for coastal lagoons is still under development.
RO	Reference conditions as described + acceptable deviation (50%) for the increasing response of the parameter (nutrients and chlorophyll a) and - Acc.Dev (25%) for the decreasing response (dissolved oxygen, transparency) WFD: for TW and CW are available MAC in surface waters based on Ord.161/2006.
SE	The Good / moderate boundary was set as reference conditions plus 50% (c.f. OSPAR Common Procedure)
SI	Concentrations of nutrients at a disturbed site, time period for phosphate 1990-2012, for nitrate and total P 2007-2012; statistical analysis- 90 percentile for phosphate, maximum for nitrate, modified value of total phosphorous boundaries set on the

	level of the Adriatic sea during IC exercise of MED-GIG ; biological element used is phytoplankton
UK	The boundary between good and moderate is set as the assessment threshold for dissolved inorganic nitrogen which is used together with information on direct and indirect eutrophication effects to distinguish eutrophication problem areas from non-problem areas in the OSPAR Common Procedure. The assessment threshold reflects the natural variability in water quality, plus a "slight" disturbance. In practice this is usually the background concentration plus 50%. The UK nutrient standards for transitional and coastal waters derived from a nutrient-salinity mixing curve with end member concentrations raised as above. In certain waters where there is significant inorganic turbidity the standards are adjusted to reflect the effect this has on biology.

4.3 Use of pressure-response relationships

As shown in Table , only a few MS have established a pressure-response relationship with biological QEs. This analysis has mainly been carried out in coastal waters (17 MS), followed by transitional waters (7 MS) and marine waters (7 MS). The quality element (QE) mostly used for establishing a pressure-response relationship in transitional, coastal and marine water is phytoplankton. QE Fish is not used at all. Multiple QEs have been used in analysing transitional waters in BG, IT and UK, the same is the case for coastal waters in BG, CY, IT, UK. In the case of marine waters none of the MS used more than one QE.

Table 47 Use of pressure-response relationships

MS	**Transitional**				**Coastal**			**Marine**		
	Phytoplankton	**Macro-phytes**	**Macrozoobenthos**	**Fish**	**Phytoplankton**	**Macro-phytes**	**Macrozoobenthos**	**Phytoplankton**	**Macro-phytes**	**Mcrozoobenthos**
BE (FL)					x			x		
BG	x	x	x		x	x	x			
CY					x	x	x			
DE (Baltic)					x			x		
DE (North)					x			x		
DK					x	x				
EE					x					
EL										
F	x				x					

FI					x			x		
HR	x				x					
IE			x				x			
IT	x	x			x	x				
LT	x				x					
LV										
NL					x					
NO										
PL										
PT										
RO										
SE						x			x	
SI					x			x		
UK		x	x		x	x		x		

Legend: Red: no, Green: yes, Yellow: yes but no indication of BQE Grey: no response, White: pressure-response relationships with BQE have been taken into account but the details on which BQE are not provided.

5 Application rules for nutrient boundary values

The role of the general physio-chemical quality elements in the classification of good and moderate ecological status is set out in the EU CIS Guidance Document No. 13 Chapter 4, while the role of nutrients as supporting elements for the assessment of eutrophication is set out in the CIS Guidance Document No. 23. Discussion at a workshop held in Birmingham, UK, in 2013 indicated that Member States had developed different approaches to dealing with the inevitable differences between classifications derived from nutrient sensitive biological quality elements and the supporting physio-chemical nutrient standard.

One of the questions to be answered is how does the assessment of nutrient concentration affect the classification of the overall ecological status and how does this factor into the consideration of measures if there is a mis-match of classification for biology and nutrients.

As shown in the graph below, most MS apply the one out all out principle in a very strict way. In other words, if any of the biological quality elements sensitive to nutrients are not in good status or nutrient concentrations are not good, the water body is classified as being not in good status. This applies for transitional and coastal waters; it needs to be noted that for transitional waters far fewer answers have been provided.

6 MS (coastal waters) and 3 MS (transitional waters) allow a water body with nutrients in poor status but with good biological quality elements to be classified as good status.

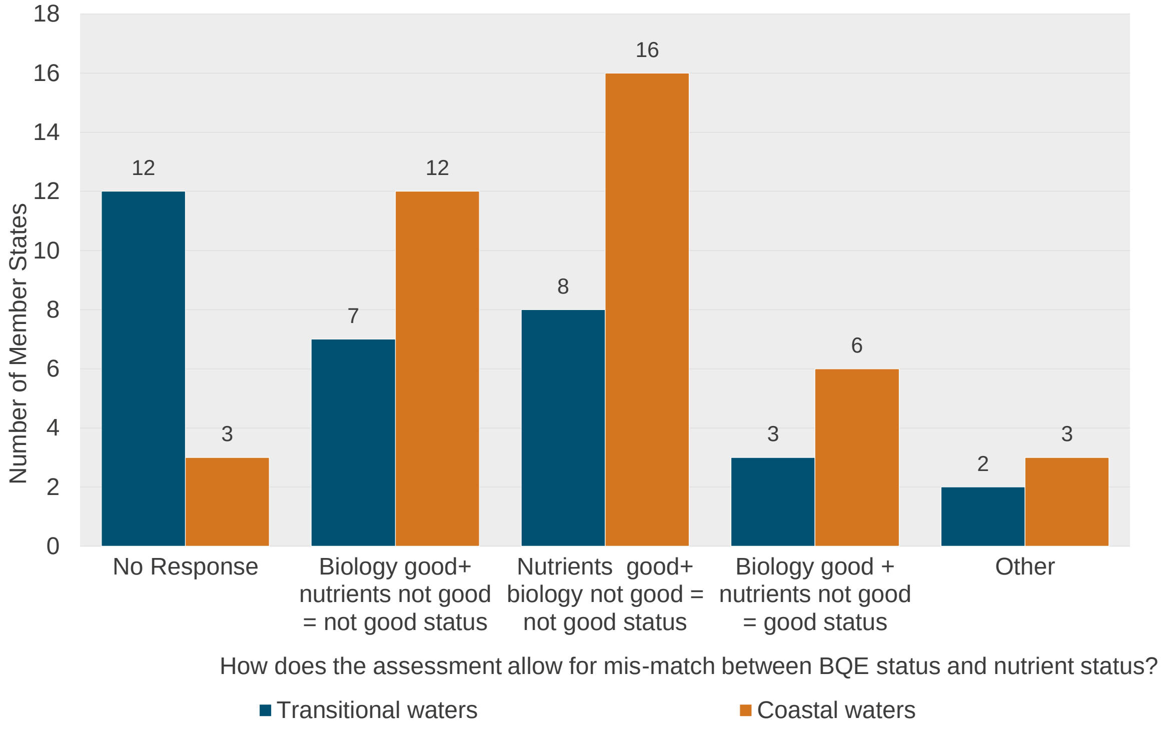

Figure 10 How the assessment allows for a mis-match between BQE status and nutrient status.

In the **UK**, consideration of measures in transitional waters is carried out through a 'Weight of Evidence' approach to eutrophication assessment in alignment with the OSPAR Common Procedure assessment.

For transitional waters in **IT**, if the BQEs are in good status but the nutrients exceed more than 75% of the standard, the water body is classified as not in good status. If the BQEs are in good status but the nutrients exceed less than 75% of the standard, additional assessments are requested to classify the water body in good status using monthly sampling of nutrients and additional assessments of the status of BQEs sensitive to nutrients (macroalgae, angiosperms and phytoplankton). The additional assessments should be carried out for a period of 1 year if nutrients exceed the standard <50%, and for 2 year if nutrients exceed the standard <75%. The water body could be classified in good ecological status if there are no evidence of impact on BQEs and no increase of nutrient concentrations. For coastal waters a similar approach has been adopted, but it is based on TRIX values.

In **DK** the coastal waters will be assessed according to the following: nutrients will not factor into the classification if the assessment of the ecological status of all the relevant biological quality elements either indicates that the condition is good, or if just one of the BQE's show moderate or poorer status. If not all relevant biological quality elements (due to missing data etc.) are involved in classification of ecological status, nutrients will play a factor in the status classification, if applicable, but not if just one BQE show moderate or poorer status. If the reviewed BQEs show good status but nutrients do not, status will initially be classified as moderate.

The questionnaire also asked for mismatches between the class derived from biological quality elements and the class derived from nutrient concentrations. According to WFD the nutrient boundaries established should ensure the achievement of biological quality required for the good status. Hence, if eutrophication is the predominant pressure in coastal and marine waters failure to achieve good status for nutrient concentrations should result in a failure in achieving good status for the biological quality elements. Chapter 4 of the CIS Classification Guidance proposes a checking procedure designed to ensure that the type-specific values established for the general physico-chemical quality elements are no more or no less stringent than required by the WFD. It applies if MS are confident that mismatches do not arise because of insufficient monitoring which usually requires evidence that there is a consistent mismatch from a significant number of water bodies. If there is evidence from a significant number of water bodies that the nutrient status is less than good but the

biological status is good it can be relaxed. The opposite situation, where the biology is not good and the nutrients are good, may follow a similar procedure to determine whether the type-specific nutrient standard is sufficiently tight.

Figure 11 below indicated that mis-matches do occur in coastal and transitional waters; however, many MS have not answered this question. For marine waters most MS did not provide an answer, probably because the WFD does not apply in these waters (but mismatches between nutrient and eutrophication parameters could still occur and are of relevance).

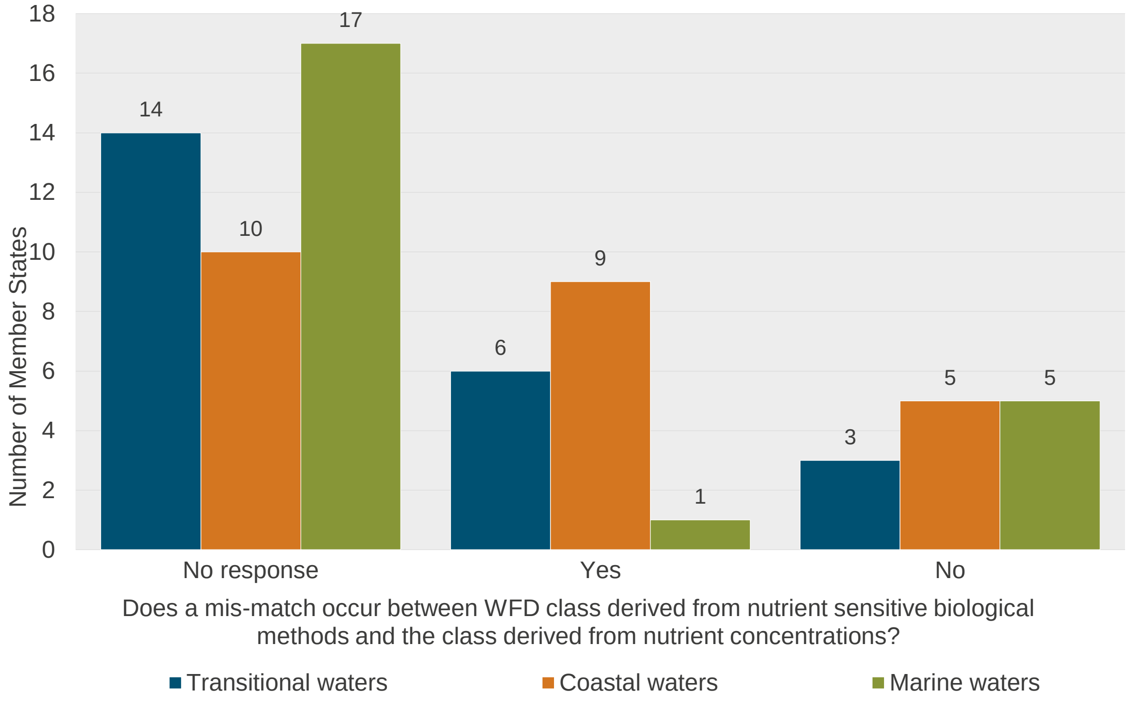

Figure 11 Does a mis-match occur between WFD class derived from nutrient sensitive biological methods and the class derived from nutrient concentrations?

The questionnaire went into further detail concerning the mis-matches, asking MS to detail how often such mis-matches occurred and what their character was (biology better or nutrients better, which biological quality element was predominantly affected). Unfortunately, few MS provided information on these issues (see Fig. 12 to 18 below) and answered cannot be interpreted in a meaningful way.

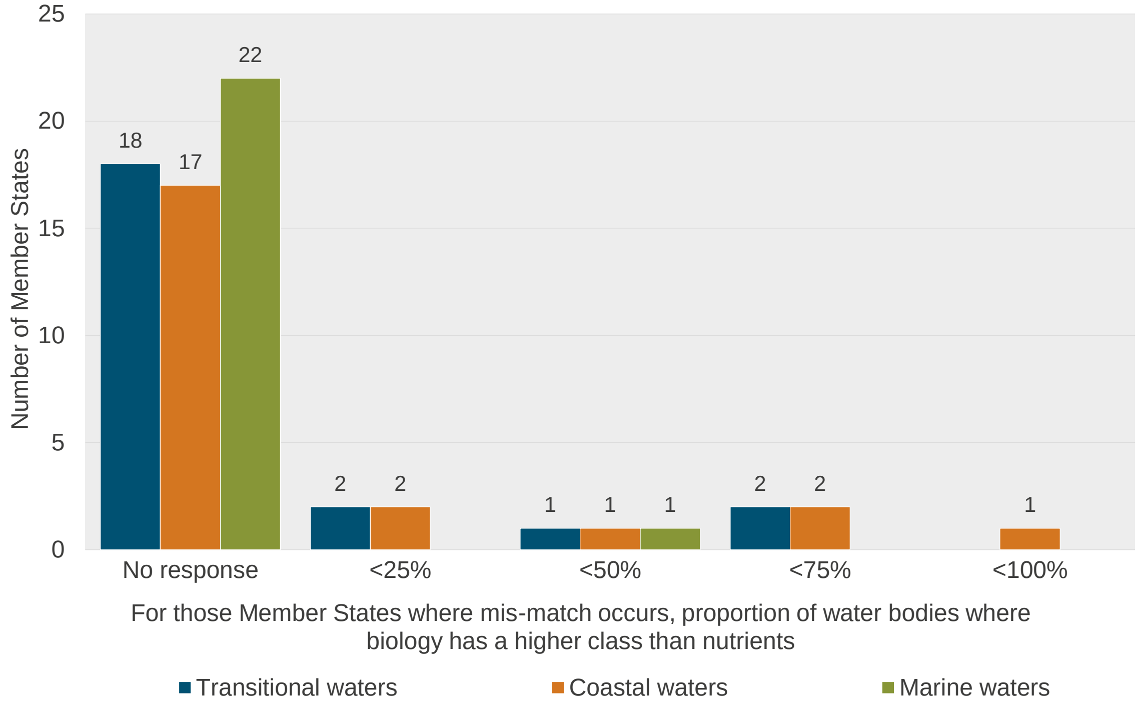

Figure 12 Proportion of water bodies (for marine waters: of areas/(sub-)regions) where biology has a higher class than nutrient class

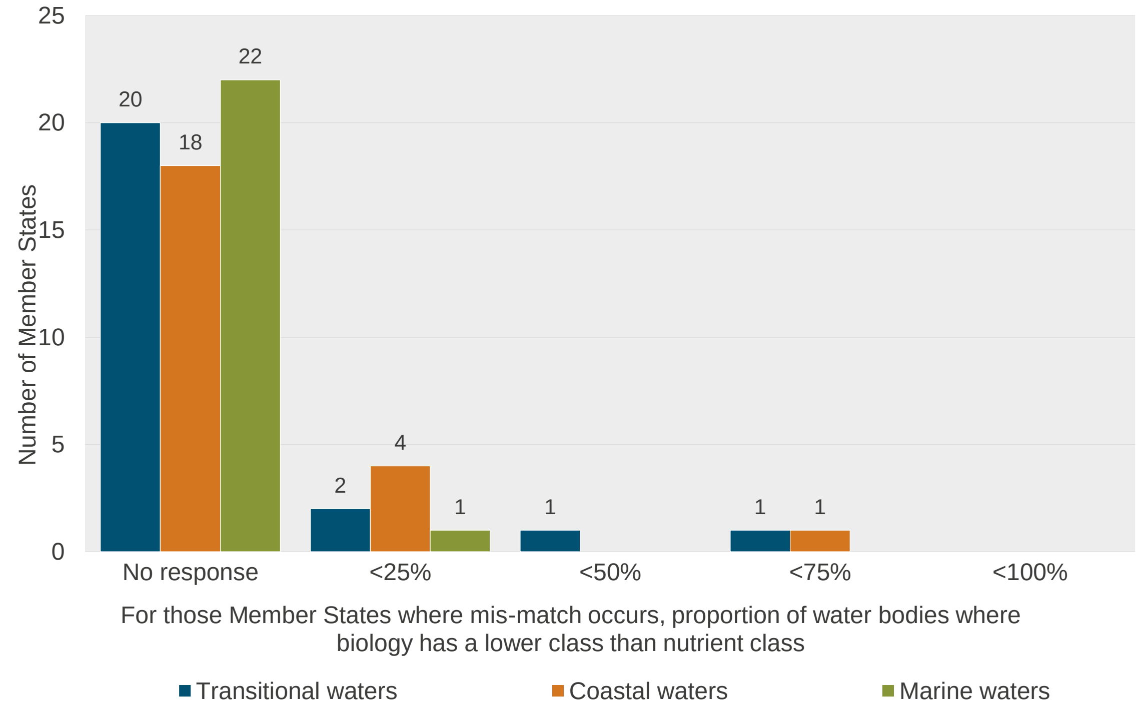

Figure 13 Proportion of water bodies (for marine waters: of areas/(sub-)regions) where biology has a lower class than nutrient class

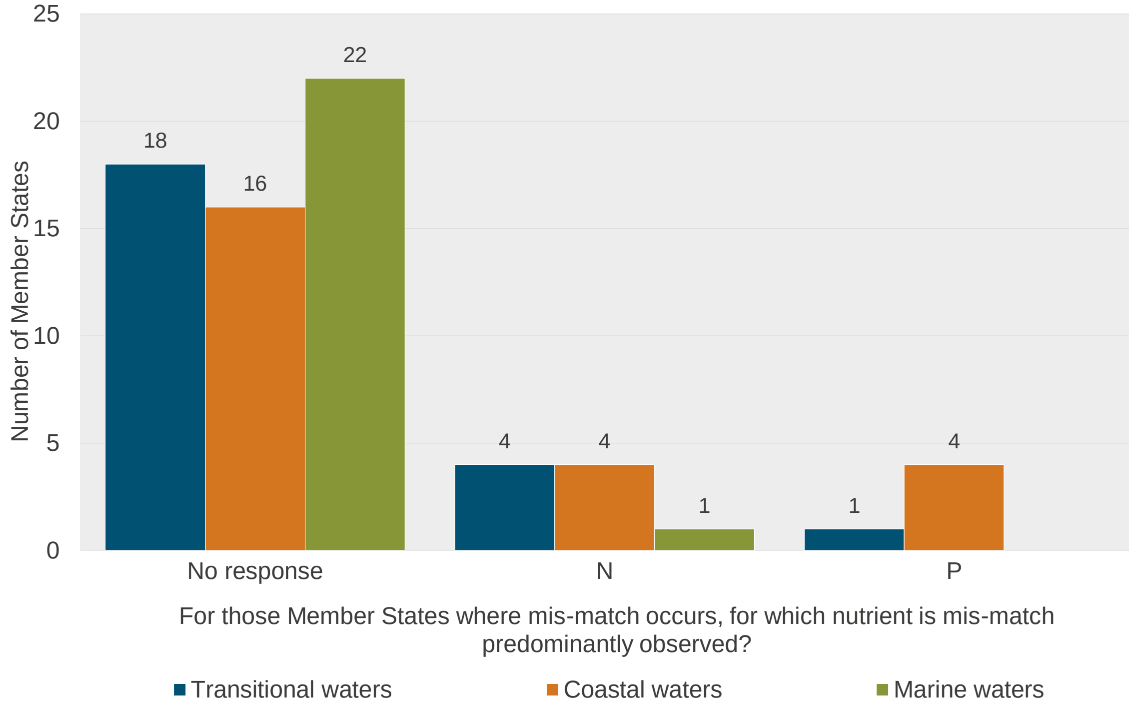

Figure 14 Indication of nutrients for which the mis-match was observed most

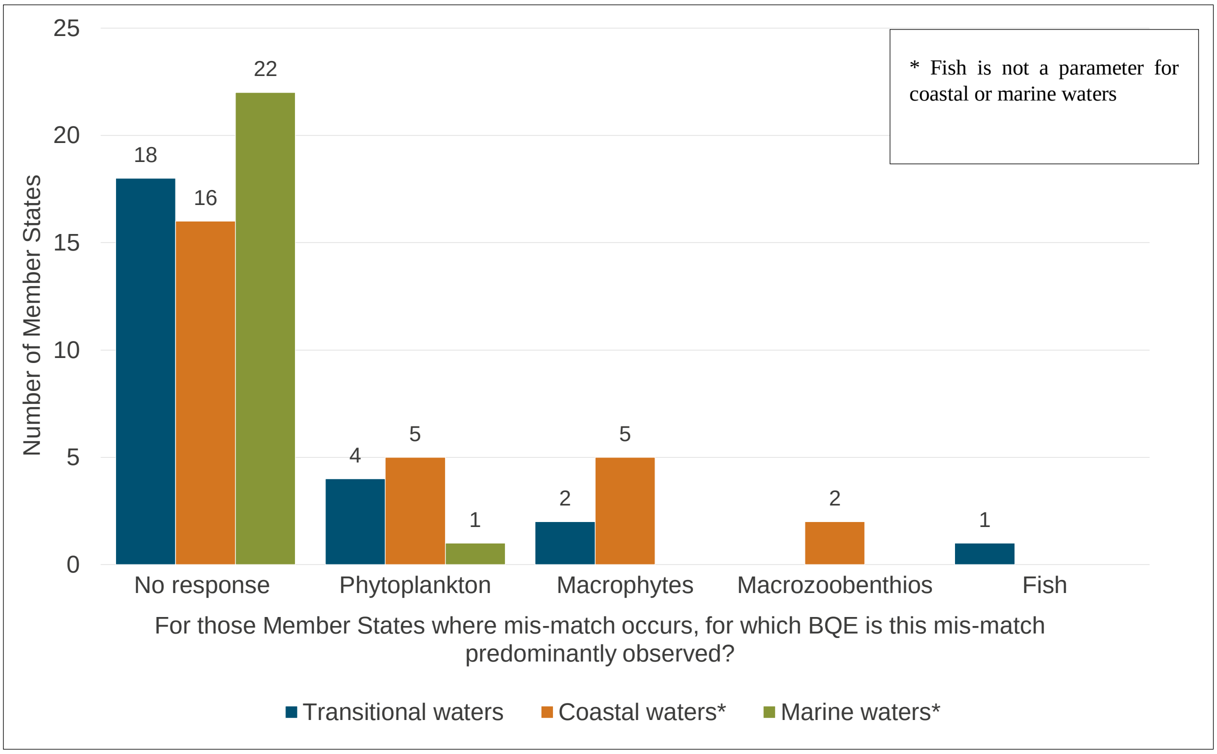

Figure 15 BQE or biological parameter this mismatch is predominantly observed

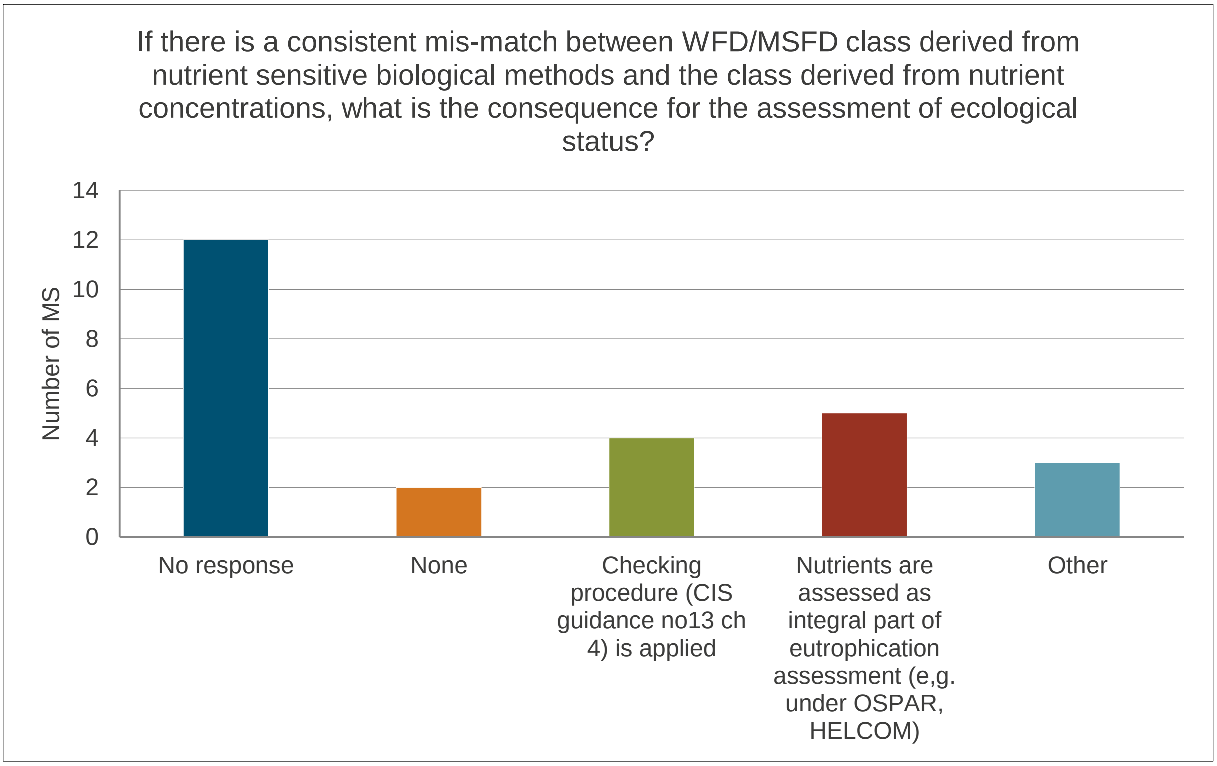

Figure 16: If there is a consistent mis-match (significant number of water bodies or assessment units from a type are affected) between WFD/MSFD class derived from nutrient sensitive biological methods and the class derived from nutrient concentrations, what is the consequence for the assessment of ecological status?

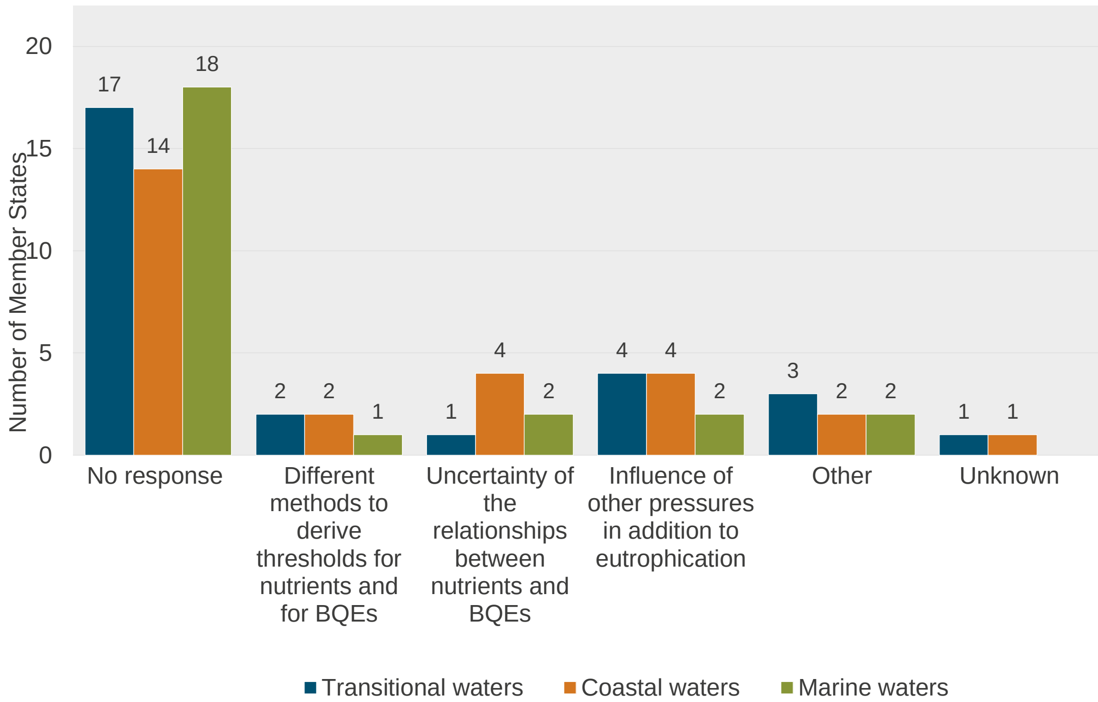

Figure 17 If there is a consistent mis-match between WFD/MSFD class derived from nutrient sensitive biological methods/effect indicators and the class derived from nutrient concentrations, please indicate possible reasons

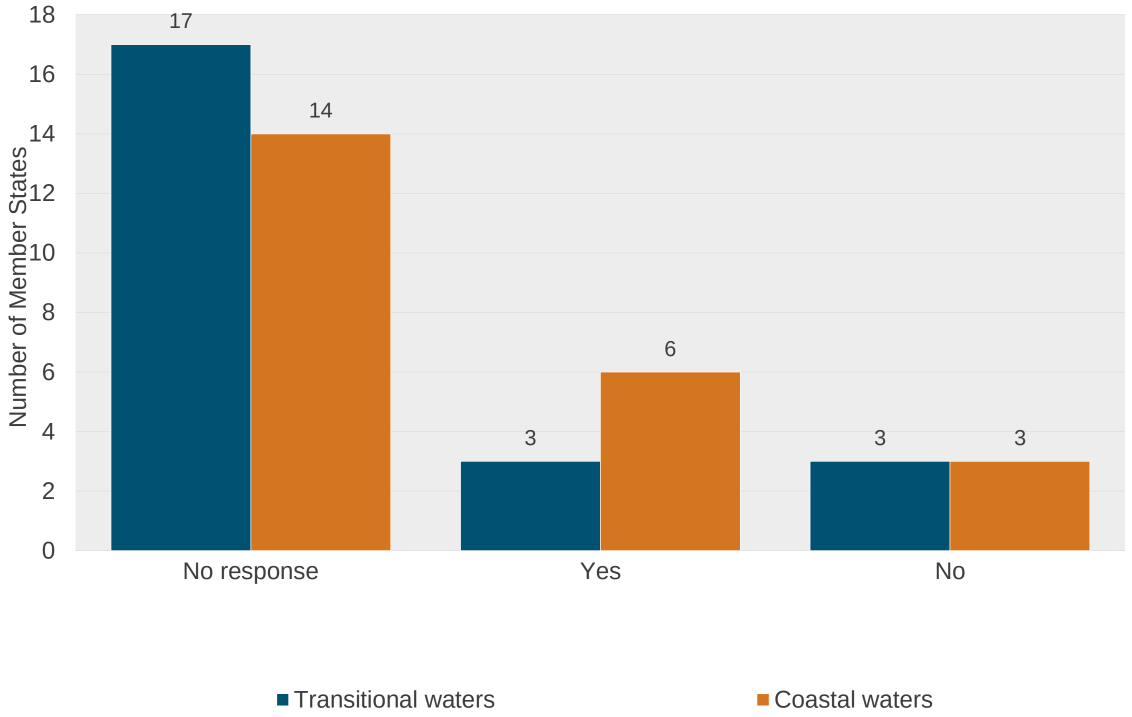

Figure 18 If there is a mis-match between WFD class derived from nutrient sensitive biological methods and class derived from nutrient concentrations for an individual water body, does this influence the actions taken under the Programme of Measures?

6 References

OSPAR (2013): Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area (Reference number: 2013-8)

Annex 1 Data Submission

MS	Date
BE_FL	December 2015
BG	September 2015
CY	September 2014
HR	August 2015
DK	September 2015
EE	November 2014
F	December 2015
FI	August 2015
DE_Baltic_Sea	July 2015
DE_North_Sea	July 2015
ES	December 2014
IE	August 2015
IT	September 2015
LT	July 2015
LV	July 2015
MT	N/A, information on coastal water types was provided
NL	December 2015
NO	October 2014
PL	December 2015
PT	July 2015
RO	December 2015
SE	December 2015
SI	December 2015
UK	December 2015