Nutrient meeting of the ECOSTAT working group

18-19 November, Berlin

All presentations and related papers can be found at: https://www.fresh-thoughts.eu/FreshEvents-80-Material

Welcome

Following a short introduction into the workshop's location – the Center of Excellence for Safety in Chemistry and Technology, Mr. Claussen (UBA) and Ms. Poikane (JRC) introduced the workshop, providing a brief overview of the objectives of the workshop and work done to prepare for the meeting.

The objectives were:

1. To discuss the comparison of the nutrient boundaries and the methods to derive and apply nutrient boundaries and to understand the reasons for the current range of nutrient boundary values that are used by different countries to support "good ecological status" under the Water Framework Directive (WFD) and the "good environmental status" under the Marine Strategy Framework Directive (MSFD);

2. To discuss / agree on approaches how to set nutrient boundaries using pressure-response relationships. These approaches can be used also to check whether MS nutrient boundaries support "good" biology according to the pressure-response relationships. The work on pressure – response relationships has provided first results (proposal of approaches to boundary setting and their correspondence checking) which will be discussed during the workshop.

3. To draw conclusion and to decide on the way forward how to reach the objectives stated in the work programme

Ms Leujak (UBA) presented the results of the ISPRA MSFD D5 workshop, which took place in September 2015, followed by a presentation by Ms. Pitt (EA, UK) on the legal background of nutrient work in the Working Group on Ecological Status. It was also stressed that the work is not only important for the implementation of the WFD and MSFD, but also other Directives such as the Nitrate Directive or Habitats Directives.

Session 1: Comparison of European freshwater and saline water nutrient boundaries and their application

Three presentations set the scene for Session 1, presenting the results of the two reports on nutrient boundaries prepared in advance of the meeting, one about freshwater and one on saline waters, as well as a presentation on the use of nutrient boundaries.

"Comparison of freshwater nutrient boundary values". Presented by Geoff Phillips, University College, London

Nutrient boundaries for lakes and rivers have partially been derived based on pressure-response relationships with BQEs. Such relationships are well established for lakes while for rivers they are much weaker due to other confounding pressures (e.g. hydromorphology). There is often a wide range of nutrient concentrations permissible to allow for good status of BQEs and whether MS have

set nutrient boundaries at the lower or higher end of this range is very much determined by how these boundaries are used. Two strategies can be distinguished – minimising the chance of nutrients downgrading the assessment (by setting boundaries at the higher end of the range) or minimising the chance of the nutrient pressure causing a problem (by setting precautionary boundaries at the lower end of the range). Which of the two strategies MS have followed essentially determines the applied boundaries and leads to differences in these between MS.

Following the presentation on freshwater nutrient boundaries, participants noted:

- In terms of outliers in the data, these may be a result of some MS setting high boundaries for nutrients in general – more a political decision than a scientific one (DK)
- Outliers in nutrient boundaries should be made to come down as they are not compliant with the WFD (NO)
- One way to reduce outliers in nutrient boundaries is to focus on a common statistical approach for setting standards as opposed to relying on expert judgement (NL)
- In addition to nutrient boundaries, we need to also look more closely at ecosystem functions (AT)
- The fact that there is a lack of measures to address nutrients in the RBMPs might be a result of not the right boundary being defined. The link between setting standards in rivers and objectives in coastal waters is largely missing (COM).
- The legal link between BQE and nutrients is not always the same across MS (DE)
- Use of boundaries differs between MS
- The standards from the Groundwater Directive and the Drinking Water Directive are often used as standard, but this does not necessarily define good status (COM)

"Comparison of saline nutrient boundary values". Presented by Thomas Dworak, Fresh-Thoughts Consulting

There is a very large heterogeneity between MS in nutrient boundaries – starting with the parameters used, the metrics applied, the time of the year nutrients are assessed up to different methods being used to derive reference conditions and G/M boundaries. This large heterogeneity hampers a direct comparison of nutrient boundaries within a regional sea. Reference conditions have often been derived by looking at historic nutrient inputs and extrapolating them into the sea, often supported by modelling. Considering the application of nutrient boundaries some MS have followed the CIS guidance while others permit the achievement of good status even if nutrient standards are not good. Again others have followed the OOAO-approach according to the CIS guidance but failure to achieve good status if BQEs are good and nutrients are less than good is not triggering measures.

Following the presentation on saline nutrient boundaries, participants noted:

- Many MS have national types that cannot be translated into common types – an explanation as to why perhaps many MS did not report common types in the questionnaire (JRC).
- Currently working on the gaps in the Mediterranean (HR).
- Data being collected under the Barcelona Convention and its Working Group on nutrients should be included in the report.
- MS should report the same information to the COM as to Regional Sea Conventions.
- The questionnaire was not always clear and hence it was difficult to provide answers.

"Using nutrient boundaries in ecological assessment" Presented by Sandra Poikane, Joint Research Centre. The presentation reminded workshop participants about relevant guidance of how to set and apply nutrient boundaries under the WFD, laid down in the Directive itself as well as

in the CIS guidance documents No. 13 (classification) and No.23 (eutrophication). CIS guidance No.23 explicitly states that "*the process of deriving appropriate nutrient standards should ideally involve....deciding on the best available techniques for deriving the standards and on the appropriate level of precaution and summary statistic to be used in defining the standard*". This is an important aim of the workshop. While nutrient standards depend on the functioning of the ecosystem and differences across ecoregions and types they should not follow national boundaries and there is a need for harmonisation where this is the case. The presentation also emphasised that attention should be paid at the workshop to the question of how the overall assessment of nutrients is undertaken. How are for instance nitrogen and phosphorus parameters combined?

Following the presentation on nutrient boundaries in ecological assessment, participants noted:

- Beyond the assessment, there is a need to take additional steps. If the nutrients are not in good status this triggers measures (NL).
- In Germany in transitional and coastal waters the BQEs are not in good status, hence there was so far no need to consider the nutrients in the assessment.
- The opposite is the case in Croatia. Nutrients are mostly in good status (oligotrophication of the Mediterranean Sea).
- It is important to distinguish if the boundaries are used as guiding values or as legally-binding standards (AT).
- There is a need to think about how to collect information on the use of nutrient boundaries in a better way; the questionnaire that was distributed was not always clear.
- If the biology is good and the nutrient are bad, then clearly the boundary set is wrong (DK). If few BQEs are available for the assessment of the status then the nutrients play an important role in the assessment.
- We need to consider whether we want guidance on how to combine supporting elements and BQEs. We need to consider whether we need something instead of good status. Perhaps "at risk". There is also a need to coordinate with people working on hydromorphology (UK).
- Applying the OOAO-principle between nutrients and BQEs is problematic when there is no strong relationship between the nutrients and the biology. It is too early to consider an amendment of the WFD, so we need to work with the current situation. Need to understand how nutrient standards are set and how measures are then selected. Need to further consider how setting standards allow objectives to be set (COM).
- Point was raised that if not using nutrient standards, then how are MS setting targets for measures to be designated (EEA).
- All MS should use statistical approaches for setting nutrient standards (NL).
- Care should be taken to avoid circularity – BQEs are often based on the nutrient standards and have been used to identify ranges of nutrient concentrations that allow a good status of BQEs. Nevertheless, if this is valid then it is surprising that nutrient standards differ so much between MS (NO).

After the introductory presentations, presentations were given by MS experts highlighting their experiences in fresh and saline waters. Four presentations focussed on approaches within individual MS and one presentation informed about the regional sea approach of HELCOM. The presenters were asked to address two questions:

- Which methods were used by selected MS to set nutrient boundaries that support Good Ecological Status?
- How have these worked in practice?

A brief question and answer session (circa 5 min) took place after each presentation.

"Swedish Environmental Quality Criteria, Nutrients in Lakes and Watercourses". Presented by Lars Sonesten, Swedish University of Agricultural Sciences.

Boundary setting for lakes and watercourses has focussed on phosphorus, nitrogen boundaries are under development (for TN and DIN/TP ratios). Reference conditions have been set assuming <10% arable land and no obvious point sources. G/M boundaries have been set at approximately two times the reference values. If the BQEs are in good status and the nutrients not then reasons for these discrepancies are explored. There is a constant increase in humic substances in Swedish lakes and watercourses (brownification) which requires a revision of the nutrient boundaries. Currently the BQEs are under revision but there is no organised process for the physico-chemical quality elements.

The discussion focused on how monitoring in SE is problematic due to the large number of water bodies and will improve in the second cycle. Need to further develop boundaries (COM).

"Norwegian methods used to set TP boundaries and how they have worked in practice". Presented by Anne Lyche Solheim, NIVA.

Nutrient boundaries (TN, TP) have been derived by regressions with intercalibrated BQEs (phosphorus versus phytoplankton/chlorophyll-a; in rivers TP versus benthic algae) and boundaries for BQEs are based on the species composition of existing water bodies in areas with few anthropogenic impacts. Boundaries for TN have been derived by regression with TP. The nutrient boundaries are generally precautionary and they are used to assess the need for nutrient reductions. Few water bodies are downgraded just because of the nutrients. A source-apportionment approach is used to plan measures.

The discussion focused on the use of BOD or oxygen for assessing water bodies (AT). NO currently has a poor system for assessing BOD. TOC is measured but this is not sufficient. NO bases its good status designation on regression analysis. They looked at existing lakes for reference.

"Setting saline water nutrient boundaries in Swedish waters". Presented by Karin Wesslander, Swedish Meteorological and Hydrological Institute.

Nutrient boundary setting in Swedish coastal and marine waters is challenging due to strong gradients across as well as along the coast. The basis for deriving nutrient boundaries are the reference conditions defined by OSPAR and HELCOM in offshore waters. These have been extrapolated along the salinity gradients to coastal waters (no transitional waters designated). At the same time a modelling approach was used to derive riverine nutrient inputs. G/M boundaries were set at a 50% deviation from reference conditions.

The discussion focused on how SE has dealt with different approaches between OSPAR and HELCOM (DE). These have been applied to the respective waters without trying to harmonise them.

"MS contributions" – Croatian, Italian and Slovenian approach in the Mediterranean". Presented by Robert Precali, Ruđer Bošković Institute, Center for Marine Research.

Croatia, Italy and Slovenia have chosen a common approach in the Mediterranean GIG to derive nutrient boundaries. Three main water types were defined based on salinity (type I <34.5; type II 34-37; type III >37.5; type II A "Adriatic" is shared by all three countries). The Mediterranean Sea is oligotrophic and strongly phosphorus limited (TP:TN = 150). Oligotrophication takes place in recent decades due to decreasing freshwater inputs (that bring less nutrients to the sea). Boundaries for TP were derived by looking at relationships with chlorophyll-a. To describe eutrophication the trophic index TRIX is used (based on Chlorophyll-a, DIN, TP and oxygen). In Croatia all waters are at least in

good condition. Chlorophyll-a concentrations of type III waters are so low that no assessment can take place.

The discussion focused on the use of TRIX (trophic index). While TRIX is good for management, it is not an assessment tool.

"The HELCOM common regional approach for eutrophication target setting in the Baltic Sea". Presented by Wera Leujak, German Environment Agency

HELCOM has used a common approach to derive "target values" (boundaries) for eutrophication parameters including nutrients. The approach has focussed on finding relevant "break points" in the historic time series (often going back to 1900) and such break points have been identified for oxygen (around 1940) and for Secchi depth and have been used to set G/M boundaries. Reference conditions have not been set. For nutrients the approach was not so conclusive because the historic time series only extended back to the 1970s, a time were the Baltic Sea was already eutrophied. The targets set for the eutrophication parameters are the anchor point for the nutrient reduction targets of the Baltic Sea Action Plan.

After the presentations by the MS representatives, the plenary broke up into two working groups, one for freshwater and one for saline waters.

Working Group 1: Freshwater

This group was supposed to consider the following questions, but not all could be addressed in the discussion:

1. What are the most important reasons for the differences in MS boundary values? Do the observed differences reflect real variation in nutrient/biology relationships across MS or geographic regions? Are the differences a result of different approaches to monitoring, boundary setting and subsequent use for management? Is uncertainty in pressure/response relationships a significant factor?
2. In addition to differences between MS, do we understand: Why river boundaries are more variable than those for lakes? Why nitrogen boundaries are more variable than phosphorus?
3. Are the comparisons valid? Are the measured parameters comparable? Are the summary statistics an important factor? Are IC or broad types appropriate? How should we compare type-specific with site-specific approaches?
4. Differences between MS: What does "expert judgement" really mean? /Why have MS adopted different methods? How are high status conditions established? What happens where no undisturbed conditions occur? How far can G/M deviate from high status? Is only part of the possible pressure gradient represented? Approach to use of boundary values, for both classification and management: does this influence the boundary setting procedure? Are multiple pressures contributing to uncertainty with nutrients?
5. Where do we go from here? Can we propose best practice approaches for all water categories, for all nutrients? Can we eventually decide what differences will be acceptable for compliance with the WFD? Will any difference be acceptable if best practice is followed?

The report back highlighted:

- **Comments on report:** The report should not imply that if nitrogen assessments have not been carried out it is a gap. It's not always considered relevant for lakes. Some problems with the methods used in analysing the information in the report (there was an opinion that box plots

give the wrong picture as some values are more important than others, and dot plots would have been preferred – however this does not affect the overall conclusion, and further information is available in the Appendices to the report). Direct comparison of boundary values may be mis-leading because they do not say anything about their application.

- **Reason why a certain boundary setting method is (not) applied:** BQE are not intercalibrated; risks are incorporated (e.g. 90% percentile); historic tradition or political reasons.
- **How to obtain „high status“:** Different approaches, No clear picture across EU. There might be an exception to the concept of high=low nutrients status (e.g. role of geology for setting boundaries).
- **Other reasons for the differences in MS boundary values:** MS use them in different situations. Precaution is built in or not. Political issues have some influence. The understanding of these issues is limited.
- **How are boundaries used:** DE: uses the supporting elements as a further indication of the problem. AT: Used for licensing. They are just 2 values in a more complex system. Are they target values (non-legally binging) or are they standards (legally-binding)?
- **Recommendations/next steps:** Values should be based in scientific evidence. Focus on the 3rd cycle. Future effort to work on pressure-response. Further work on application of boundaries in classification assessments. Work on how boundaries are (not) used for designing the programmes of measures (PoM)?

Working Group 1: Saline waters

This group considered the following:

1. Comparison of methods to derive reference conditions and G/M boundaries. What are the reasons for using different approaches in deriving reference conditions (e.g. different historic year) and G/M boundaries (e.g. sometimes >50% “acceptable deviation”)? Is it possible to agree on a more harmonized approach?
2. Gaps: Why did some MS not report on reference conditions and G/M boundaries for nutrients? Were these not set or were they just not reported? [Why did most MS not report on the common types?]
3. Why is there such a large variety of nutrient parameters used by MS? Are there ecological reasons why dissolved nutrients or total nutrients are assessed or is this mainly driven by monitoring practicalities or cost efficiency (monitoring frequency of dissolved nutrients is less than for total nutrients)? Is there a possibility to agree on a key set of suitable nutrient parameters at least for regional seas? Could a general agreement be reached that total nutrients are important parameters to describe eutrophication effects since they can be used for calculating nutrient budgets and they are generally more robust (more measurements are generally collected, less affected by climate change)? Why are some MS using different nutrient parameters (e.g. TN or inorganic nitrogen) in transitional, coastal and marine waters? Does this support nutrient management?
4. What are reasons for diverging from the general pattern of monitoring total nutrients all year round and dissolved nutrients in winter? What are the reasons for using different statistics when assessing nutrients? Could we give a recommendation for one statistic to be used? Could we think about an option to convert from one statistics to another?

5. Why were there so few responses on the questions concerning the mismatches in pressure-response relationships? Where there is a mismatch of classification for biology and nutrients, how does the assessment of nutrient concentrations affect the classification of the overall ecological status and vice versa? How are nutrient boundaries used in the assessment of ecological status? Purely as supporting parameters? Do they have any legal status and if so, to what extent? Do they drive measures? Do the characteristics of the nutrient boundaries set affect their use in the assessment of ecological status? If yes, how?
6. Why do some MS – despite being Contracting Parties of HELCOM/OSPAR, not use the nutrient boundaries agreed in HELCOM and OSPAR?

The report back highlighted:

- **Comparison of methods to derive reference conditions and G/M boundaries:** Different approaches have been used for deriving reference conditions. In the North Sea and Baltic Sea historical years have been used largely based on pragmatism (not go back too far to create unrealistic conditions, data availability). The aim was to find a historic time scale where impacts were likely to be not too high. In the oligotrophic Mediterranean Sea reference sites are still existing today and have been used for boundary setting. Often pressure-response relationships were considered. IE and UK use remote, off-shore values (based on OSPAR background levels) as the reference and extrapolate these along salinity gradients towards the coast. Coming from land UK also uses existing low-impact sites along the coast and correlates these with off-shore values. Despite different approaches some MS have similar boundaries. Very few examples were provided of using pressure-response relationships and these have mainly focussed on chlorophyll-a (DK- seagrass). G/M boundaries have mainly been derived by allowing an acceptable deviation of 50% from the reference conditions (OSPAR approach – allows max 50%) but some MS have allowed for higher deviations (e.g. IE two times 50% (50 % reference - H/G + 50 % G/M), but crosschecked with other eutrophication parameters (e.g. oxygen)). DK has not derived nutrient boundaries yet but will use a modelling approach in the future. FR has not set nutrient boundaries in the Mediterranean and is not assessing nutrients there since the sea is oligotrophic. NL and SE have clarified that although reference conditions were not provided in the questionnaire they have been set.
- **Use of different parameters for N and P:** There are different reasons why some MS do not assess total nutrients. They are more costly to assess and less relevant for eutrophication effects since total nutrients include fractions not available for the biology (UK). Their assessment might also be methodologically unreliable due to high variability (TN in the Mediterranean Sea when assessed by photooxidation). Vice versa dissolved phosphorus cannot be assessed in the Mediterranean Sea since it is below the detection limit and hence only TP is assessed. Furthermore, in transitional waters/estuaries it is difficult to assess total nutrients due to suspended matter. In light of climate change, total nutrients might be the more robust measurement but more investigation into this aspect is needed. Total nutrients are necessary for calculating budgets (used in modelling) and for setting nutrient reduction targets, but these are different objectives and not directly needed for eutrophication assessments. Decision on which parameters to assess even within one MS depends on many issues and could be as simple as that different institutions are responsible for assessing different water types and there might not be a scientific reason behind the choice of parameters. In principle it would be good to have a consistent approach but in practice this is dependent on the ecosystems, also on objectives and pollution pathways (riverine, atmospheric, transboundary). Within regions it should be possible to have a common approach but it‘s not necessary for all regional seas to have the same approach. As a result of the discussion a common regional approach based on assessing DIN and TP seemed feasible in the Mediterranean Sea and possibly in the Baltic Sea (DIN, DIP, TN and TP), but there was no agreement to include total nutrients as common parameters in

the NE Atlantic. In principle there is also agreement that the nutrient parameters used should be consistent at least within MS (between transitional, coastal and marine waters) to allow for a consistent management approach, but how this can be achieved was left unanswered.

- **Use of different seasons:** In the Baltic and NE Atlantic it makes sense to assess dissolved nutrients in winter because the biological activity is low. In the Mediterranean Sea this is not the case and therefore nutrients are assessed year-round. In principle it should be possible to agree on a common approach within a regional sea.
- **Use of different statistics:** If there are a lot of outliers the median is used while if there are lots of data and few outliers it is better to use the mean. Mean and median don‘t give very different values if there are not too many outliers. A strategic approach is needed to set up the monitoring framework. If the variability in the data is high it is best to use the geometric mean to smooth out this variability. The choice of the statistical method depends on the sampling size and quality and also on what you want to achieve with monitoring. Some MS (SE, UK) use maximum values since averages are thought to be less meaningful. Strictly speaking it is not appropriate to directly compare nutrient boundaries based on different statistics but it could be tried out to see what results this would give. When comparing nutrient boundaries it is important to consider salinities.
- **Application of nutrient boundaries and dealing with mismatches:** How the nutrient boundaries are used in the assessment under the WFD and MSFD is determined by how the ecosystem responds to the nutrients. In highly turbid waters or in waters with constant flushing and short residence times as commonly found in the NE Atlantic nutrient concentrations might exceed the G/M boundary but might not lead to eutrophication effects. Nutrients then only account for 30-40% of the variability in eutrophication effects. In such cases the water body might still be downgraded because of the nutrients but this does not trigger measures (DK, UK, NL, IE). Rather, a “weight of evidence” approach is used to assess the need for measures (UK, Ireland). There are also differences in the role of nitrogen and phosphorus. In the Mediterranean Sea phosphorus is limiting and is hence much more important compared to nitrogen (CR). CR flags the mismatches but nutrients do not lead to a downgrading of the assessment result since they are only “supporting” for the classification. HR uses operational and investigative monitoring when there is a mis-match to better understand the situation. The OOAO principle is legally binding.
- In the discussion the point was also raised that the questions about mismatches were particularly confusing in the questionnaire and this might explain the large number of missing answers. The choice of boundaries does have a political implication but the science/data is technical.
- **Discrepancies between WFD/MSFD and HELCOM/OSPAR nutrient boundaries:** Some MS (DK, ES) stated that the fact that OSPAR/HELCOM nutrient boundaries have not been reported in the questionnaire was mainly a communication problem. Others stated that the nutrient boundaries set in the regional conventions do not necessarily need to agree with the WFD/MSFD since the objectives as well as the legal character are different (IE, NL). SE mentioned that offshore nutrient boundaries were already laid down in the regulation when HELCOM came up with new target values and the regulation could not be changed. DE pointed out that HELCOM only derived targets for the open sea and hence a national modelling approach was applied to derive nutrient boundaries for the coastal waters. This approach has resulted in slightly different values also for the open sea. Some MS mentioned that there is a lack of communication between coastal and marine people.
- **Pan-European comparisons**: NL proposes to compare the nutrient boundaries rather by region than by regional sea since this is too broad, but lack of data perhaps might not allow for such an

approach. EU prefers to compare nutrient boundaries by common types. JRC is working on broad types for transitional and coastal waters, but there is currently no work on marine broad types. In the Baltic Sea the common types are the same as the broad types while in the NE Atlantic broad types are broader.

- **Examining the range of nutrient boundaries set:** In general it was stated that a wide spread can be expected since the comparison does not differentiate different salinity ranges. Of the few comparisons of nutrient boundaries that could be made within the report the apparent outliers were discussed. In the case of SE those might be fjords, but there seemed also to be some wrong values used in the report. RO has provided expert values for the nutrient boundaries and will provide new boundaries based on the actual legislation that is in force for the WFD.
- **Transboundary effects of nutrients**: When nutrients are not in good status and biology is good there might still be a need to take measures since the nutrients are transported to the waters of other MS and might cause eutrophication problems there (DE). There has been some modelling to quantify this transboundary transport of nutrients. MS felt that while the issue of transboundary transport is important it should be separated from eutrophication status assessment. It is necessary to look downstream to see if the nutrients in estuaries are having an effect on the coast. Reduction targets based on commonly agreed nutrient boundaries would be one way of dealing with transboundary transport (HELCOM approach). The HELCOM eutrophication assessment tool HEAT uses nutrient concentrations as one of the OOAO-criteria, so that nutrients need to be in good status in order to achieve good eutrophication status.

Session 2: Analysis of pressure-response relationships and application of nutrient boundaries

Three presentations focussed on pressure-response relationships found in the MS.

Two presentations:

- "Methods and Results for Lakes". Presented by Geoff Phillips, on behalf of JRC
- "Analysis of pressure-response relationships and application of nutrient boundaries – Results for Rivers". Presented by Sebastian Birk, on behalf of JRC

For rivers and lakes MS have used pressure-response relationships between the nutrients and the biological quality elements to derive reference conditions and G/M boundaries for nutrients. The approach has worked much better in lakes than in rivers because relationships in lakes are much more pronounced while in rivers they are affected by a number of other confounding pressures (e.g. hydromorphology). In a study by JRC pressure-response relationships based on fitting linear models have been analysed for rivers and lakes and they were used to derive bands for nutrient concentrations that allow for a good biology. Where MS have put the nutrient G/M boundaries within these bands depends on how they have used nutrients in the classification of good status (precautionary or trying to avoid mismatches).

In the discussion NO pointed out that if nutrient boundaries are set in the middle of the range identified by the pressure-response relationships then there is only a 50% chance to restore the biology. In Norway nutrient boundaries are set so that this chance is at least 75%. There was also some criticism on using linear relationships in multi-stressor environments (DE).

- "Report on pressure-response relationships for saline waters". Presented by Thomas Dworak, Fresh Thoughts Consulting.

Pressure response-relationships in saline waters have mainly been established between nutrients and chlorophyll-a. Macrophytes and macrozoobenthos have not been used very often.

On Day 2 the plenary broke out into two working groups – one for freshwater and one for saline waters. Each group focussed on two aspects:

1. Relating to pressure-response relationships in general and approaches used by MS
    a. What kind of pressure-response relationships were used?
    b. Does this differ between freshwater and saline waters?
    c. Why do the majority of MS not establish a pressure-response relationship? Is the monitoring system not set up to glean the necessary data?
    d. If pressure-response relationships were used, how can the results be interpreted?
    e. How to deal with uncertainty, particularly for rivers?
2. Relating specifically to the findings of the report on pressure-response relationships
    a. What is the opinion of the participants on the approaches proposed in the report?
    b. Can these approaches be used to set nutrient boundaries to "good" biological boundaries?
    c. Can these approaches be used to check the correspondence of the MS boundaries to "good" biological boundaries?
    d. Should this work be transferred to coastal, transitional and marine waters and if yes, how?

Working Group 2a (1): Freshwater

The report back highlighted:

- **Part 1:**
    - Focus on TP and TN for most countries
    - Mainly for phytobenthos, phytoplankton and macrophytes.
    - Linear regressions, categorical approaches, modelling, even multivariate approaches were used to investigate pressure-response relationships.
    - Often these approaches were used in combination with expert judgement. Often other factors besides nutrients were looked at in parallel.
    - Databases often insufficient to establish satisfactory relationships. Expert judgement was used especially at the beginning. "Evolution" of approaches in most countries (from expert judgement through various statistical approaches).
    - Lakes easier than rivers (rivers often problematic →solved by expert judgement).
    - Political/communication issues were involved in some cases.
    - International collaboration proved to be helpful (like IC).
    - Changes in types sometimes call for revisions of nutrient relationships.

- **Part 2:**
    - Focus on regression.
    - No inclusion of references.
    - More details on categorical approach needed.
    - "Biased" by lakes; more difficult for rivers (more scatter).
    - Further approaches for non-linearity or low R relationships needed.
    - Main question: What to do with the boundary values not covered yet.

        - Instead of top-down (starting with boundaries to what to do), bottom-up needed (what are the values needed for).
        - Differentiation between assessments and actions needed.
    - Statistics are descriptive – more emphasis on the underlying causes and mechanisms needed
    - Circularity is possible but mostly not influential (BQE boundaries set by biological approaches)
    - More work needed for rivers.
    - Can these approaches be used to set nutrient boundaries to "good" biological boundaries? Generally yes but other approaches needed for weak relationships, especially when more detailed typology is applied with fewer points. Data might be of limiting quality. Representativeness is needed – not achieved yet by all countries. More emphasis on special situations/types instead of statistics to get more precise results (results inherently imprecise anyway). Biology is always a reflection of nutrients **+ other factors** -> nutrient boundaries not directly comparable.

- **Part 3:** Way forward
    - Establish working group on harmonization (developing / testing approaches). Capacity building is important (increase the knowledge of everyone). Should be a more technical group than a harmonization group.
    - Method manual to support the work within countries.
    - Common data processing / procedures to get further with the general ideas / problems.
    - Collaboration between countries needed, but mandatory harmonisation (like for IC) is problematic (e.g. due to specific situations), should be initiated by the countries (bottom-up instead of top-down).
    - Further results should be achieved within 1 year (manual), 1 more year for applying it and 1 more year for looking at the consequences.

Working Group 2a (2): Freshwater

The report back highlighted:

- **Part 1:**
    - Lumping biological types is advisable (to increase the pressure gradient, assuming similar pressure-impact relationship).
    - Two-step process: setting thresholds, interpreting WB score (from observed values).
    - Main obstacles for not using pressure-response relationships are lack of data, short pressure gradient, political reasons and convenience (referring to old, established standards).
    - Main difficulties to using pressure-response relationships are noisy datasets (due to multiple pressures) and R^2 above a certain value to use pressure-impact relationships; equivalent necessary for categorical approach
    - There is a need to define uncertainty (incl. critical R^2-values). MS should chose value within this range of uncertainty. Document reasons of choice. Our guidance should provide arguments for pros and cons of different nutrient boundary setting approaches.
- **Part 2:**
    - Need for guidance: no comparison of national boundaries but devising methodological approach
    - Need to define appropriate nutrient values for reference (high status)!

Working Group 2b Saline waters

This working group focussed mainly on discussing the previous day's comments as less work on pressure-response relationships has taken place in saline waters in comparison to freshwater.

A tour-de-table showed that most MS present have actually looked at pressure-response relationships between nutrient and the following biological quality elements: DK-chlorophyll-a, modelling approach; NL-pyhtoplankton but no good relationship was obtained, modelling was used; CR-good relationship between phosphorus and chlorophyll-a; SI – chlorophyll-a but lack of data and pooling data was necessary; DE – chlorophyll-a, modelling approach was based on historic nutrient concentrations of 1880; FR – DIN and chlorophyll-a; ES – chlorophyll-a; IE – chlorophyll –a and for rivers macroinvertebrates, for marine waters dynamic modelling and looked at unimpacted waters; SE – chlorophyll-a and macrophytes; UK – boundaries for the biology were derived first and then matched with the nutrients; RO – new approach uses pressure-response relationships for phytoplankton, work in progress. In conclusion most MS present have used pressure-response relationships but mainly with chlorophyll-a and less with the other biological quality elements since for these the relationship with nutrients is not so clear because of other confounding pressures (turbidity, fishing). The merging of data across countries is useful for the analysis of pressure-response relationships. One limitation for saline waters is that models have often been used to derive G/M boundaries based on historic nutrient inputs and these models are not yet capable to consider macrophytes and macroinvertebrates. Nevertheless, the models do deliver results on secchi depth and oxygen and these are good proxis for macrophytes and macrozoobenthos.

In a second tour de table MS participating in the discussion were asked whether the approach used for rivers and lakes (deriving nutrient boundaries from pressure-response relationships with the biology) is also feasible for saline waters. The majority of MS present agreed that this is an approach that is worthwhile to explore for marine waters at least for chlorophyll-a. In estuaries with their weak pressure-response relationships the approach will not work but for coastal and marine waters it is feasible. However, it needs to be taken into account that the approach might lead to circularity in cases where the G/M boundary for chlorophyll-a has been derived from the G/M boundary of the nutrients to start with (DE). Another limitation might be the limited data availability (CR). Also, the approach requires the existence of full gradients (from high to bad conditions) but this might be challenging in some regional seas e.g. the Baltic Sea where most of the waters are heavily affected by eutrophication. Some MS cautioned that the ecological relevance of nutrient boundaries resulting from such an approach needs to be considered (FR, UK). DE emphasised that the approach will only lead to reasonable results if intercalibrated boundaries are used for chlorophyll-a. In particular in the NE Atlantic not all boundaries have been successfully intercalibrated yet. Also, results of the intercalibration are sometimes questionable, e.g. in the case of chlorophyll-a where in the Baltic Sea a deviation of 50% from the reference conditions is allowed while in the NE Atlantic this deviation can lie anywhere between 50 up to 300%.

Further it was discussed how the pressure-response approach could best be implemented. It is necessary to include not only coastal but also marine waters. The team that can carry out the approach needs knowledge of the ecology of saline waters as well as knowledge of the tools to be used. At least one coastal scientist per ecoregion should participate in the team. To get access to data, in particular for marine waters, the RSCs need to be involved. Clarification is needed what data are required. The Commission pointed out that it is necessary to communicate this issue to the WG GES. A short document should be prepared and submitted by the end of the year. DE already volunteered to participate in the work.

In the discussion following the reporting back from the working groups the following points were made:

The freshwater work was largely focussed on lakes but for rivers more work is still needed that needs to pay special attention to ecological relevance. In particular there is a need for other approaches allowing for non-linearity. More emphasis should be given to special situations / special types. There was also the wish voiced that in the future work should be more bottom-up and the control needs to remain with the MS. Mandatory harmonisation (like in intercalibration) is problematic due to the special situations and the fact that the status of the biology is often the reflection not only of nutrients but of other factors that are highly variable amongst MS. However, there were also contradictory statements voiced, in particular that special types should not be the rule and that harmonisation is required soon since the WFD is already in its 2nd management cycle and the nutrient concentrations are the decisive link to the measures (DE, NO). MS that share a broad type should harmonise and such harmonisation is principally easier for nutrients than for the biology.

In relation to saline waters it was further discussed that when carrying out pressure-response work care needs to be taken to avoid circularity where biological quality elements are based on nutrients, but essentially where nutrients are the basis for deriving boundaries for the biological quality elements the work is already done (NO). The work on pressure-response relationships is in particular valuable for marine waters since the MSFD does not foresee an intercalibration process. While applying the pressure-response approach in transitional waters is challenging such relaionships should nevertheless not be forgotten since they are the important link to the rivers and inland water management. MS are interested in a "hands-on" workshop to learn how to apply the pressure-response approach and there was also broad support for developing a manual.

Session 3: How to align or relate nutrient boundaries for different water categories in order to allow for a consistent management approach

Three presentations were given on the results of the questionnaires:

- Presentation by Geoff Phillips, University College, London, on lakes and rivers
- Presentation by Thomas Dworak, Fresh Thoughts Consulting, on saline waters

  In the questionnaires on freshwater little was reported on this question in particular concerning the connection between inland and coastal waters while there were efforts to link at least rivers and lakes. For saline waters the situation was similar with few MS indicating that they have aligned their nutrient boundaries for rivers and coastal waters (exception DK, DE).

- Presentation by Wera Leujak, German Environment Agency, on the example from Germany

DE presented its approach of setting a "management target" for the concentration of TN in rivers that allows for the achievement of good status in transitional, coastal and marine waters. For the rivers going to the North Sea this target was set at 2.8 mg/l TN and for the rivers entering the Baltic Sea at 2.6 mg/l TN. The target was then transferred to inland waters by using the catchment model MONERIS and by considering retention.

Points raised in the discussion were the following:

- Most standards are below 3mg/l in rivers so standard set for 2.6 mg/l in coastal waters is okay. There is the possibility that the freshwater standards that have already been set provide enough protection for the saline waters but this needs to be checked (NO).
- The 2.6 mg/l value from the German example is a management value, not a legal standard. The idea is to get the nutrient values in rivers down so that coastal waters will achieve good status.
- The German approach for deriving a "management target" for the rivers has so far only focussed on chlorophyll and only on an averaged chlorophyll-a concentration over the whole national waters (3,6 µg/l for the Baltic Sea).
- In the UK not planning on changing boundaries linked to GES in freshwaters to take into account saline waters. There may be a different "management standard" required to that for GES in rivers, but this would be identified by the needs of the saline water and inform the PoM for the catchment.
- The approach presented by Germany should not be misunderstood. The aim is not to change the G/M boundaries already set for inland waters but to establish a management target on top of these values that considers the saline waters as the often most susceptible parts in the chain.
- In the NL coastal concentrations are used to set objectives in rivers and determine load reductions.
- There is a reporting gap on nutrient values in rivers and coastal waters in some MS, for example in the Danube and the Black Sea so it's hard to align.

In conclusion the discussion has shown that relating nutrient boundaries set for freshwater to boundaries in saline waters has so far only been practiced by very few MS although it is an issue essential for a consistent nutrient management in the catchments.

Wrap up, final conclusions, next steps and work plan

The workshop wrapped up by discussing the next steps, including the drafting of a guidance document for establishing pressure-response relationships. Specifically:

- Short term:
  - Finalisation of the reports on fresh and saline water (deadline for comments on the saline report: 10.12.2015). Presentation of the finalised reports to ECOSTAT in spring 2016.
  - Draft „Berlin" report for participants to comment until 1stFebruary 2016. Final Report in February 2016 to be presented at ECOSTAT.
  - Pressure Response Report comments until 1stFebruary 2016 to be presented at ECOSTAT in spring 2016.
- Medium term:
  - Make the results accessible and understandable for non-experts (e.g. produce policy summaries, maps with boundary values) to be reported to ECOSTAT second half of 2016.

Possible work programme elements:

- Further work is needed to achieve a better/common/coherent understanding for all surface water bodies.
- Issues:
  - Methods applied
  - Derivation of reference conditions (and definition of high status)

    - Setting of G/M boundaries - What is behind the outliers?
    - Use of the boundaries: Guidance vs. Target values; Status assessment; PoM design
- Tools/ways for setting and use of boundaries: **Collection of information how MS use the boundaries in ecological assessment; Guidance/Best practice on setting and using nutrient boundaries in ecological assessment**
- Pressure response relationships:
    - Freshwater: Approach has been generally welcomed
    - Guidance on defining nutrient boundaries, focus on methodologies (steps to harmonise approaches), set up task team
    - Provides tools to implement the guidance
    - Helping MS to apply the guidance by a technical WS
    - Central data processing to get further with general ideas/problems?
    - Collaboration between countries (no mandatory harmonisation)
    - Saline waters, first trial using BQE chlorophyll-a in close cooperation RSC and MSFD WG GES
- Co-ordination of boundaries: within a Sea Basin and within a River Basin and from the source to the marine waters
- Co-ordination with other Directives
    - Linking surface water boundaries to ground water, UWWTD, Nutrients Directive, MSFD and Habitats Directive