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Table 2 has been revised to correct the calculations on needed reductions in nutrient inputs based on MAI. The result in Table 3 for the input of nitrogen in the Gulf of Finland has been revised based on the new calculations. The other results remain unchanged.

Background

Sufficiency of measures (SOM) analysis is one of the activities agreed through the Strategic Plan for the BSAP update (cf. activity 2.5). It is carried out by the HELCOM ACTION project and the HELCOM SOM Platform. The SOM analysis supports the update of the BSAP by assessing what kind of improvements in environmental state and pressures can be achieved with existing measures by 2030-2035, and whether these are sufficient to achieve good environmental status (GES) in the Baltic Sea. The methodology for the SOM analysis has been developed by the ACTION project with guidance from the SOM Platform, and it has been endorsed by GEAR 22-2020 (Outcome, para 4.21).

This document presents the results of the SOM analysis for the input of nutrients (eutrophication). The results provide a basis for evaluating proposed actions in the BSAP UP workshop on eutrophication by identifying gaps in existing measures to achieve the pressure reductions of the HELCOM nutrient reduction scheme. In addition to the main result for sufficiency of existing measures the document presents findings on what are the pressure reductions from existing measures and which activities contribute to pressures. The results provide supporting information for evaluating where new measures are likely needed (geographically and by pressure/state) and what types of measures are likely effective in reducing certain pressures and improving state.

The SOM analysis presents the first attempt to quantify the effects of existing measures and policies on the environment and achieving objectives. It is aimed at a Baltic Sea level assessment on the overall sufficiency of existing measures for a variety of environmental topics. The results of the analyses are based mainly on expert elicitation, and thus they should be interpreted appropriately. The findings do not provide complete and final answers on the reductions in pressures and should thus also be considered in relation to other relevant results and assessments.

This document presents the first results of the SOM analysis for the input of nutrients, which may be amended and revised in the autumn 2020.

Action

The workshop is invited to take note of the information and use it to support discussion and evaluation of proposed new actions in the workshop.

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Results of the SOM analysis for eutrophication

Background information for understanding and interpreting the results

The SOM analysis involves estimating the status of the marine environment at a specific future point in time, given measures in existing policies, their implementation status and projected development of human activities over time (Figure 1).

The main components of the analysis are assessing: the contribution of activities to pressures (Step 3), the effect of existing measures on pressures (Step 4), the effect of development of human activities on pressures (Step 5), and the effect of changes in pressures to environmental state (Step 6). The result is the state (in terms of pressure reductions or improvements in environmental components) in 2030-2035, which can then be compared to the threshold for good environmental status, when available (Step 7). This allows assessing the probability to achieve GES with existing measures.

Note the distinction between pressure inputs and pressures (Figure 1). For a variety of reasons, the input of a pressure is often measured rather than the pressure itself, for example ease of measurement, generation of data relevant to regulation, and/or the presence of significant time lags. In the SOM analysis, pressure inputs and pressures have been distinguished from each other, and their relationship is one of the following: 1) pressure input and pressure are equivalent or assumed to be equivalent, 2) pressure input and corresponding pressure are present in the analysis but no connection is made between them, or 3) only the pressure is present in the model. For eutrophication, both the pressure input (input of nutrients) and pressure (effects of eutrophication) are present in the analysis, but they are not connected (i.e. option 2, see Figure 3).

A detailed description of the SOM methodology and data collection is presented in this document.

The methodology for the SOM analysis is designed to accommodate for the broad array of topics relevant in the HELCOM region and to enable a region-level analysis. It balances between state-of-the-art knowledge, availability of data, and advice taken onboard from various HELCOM meetings and bodies.

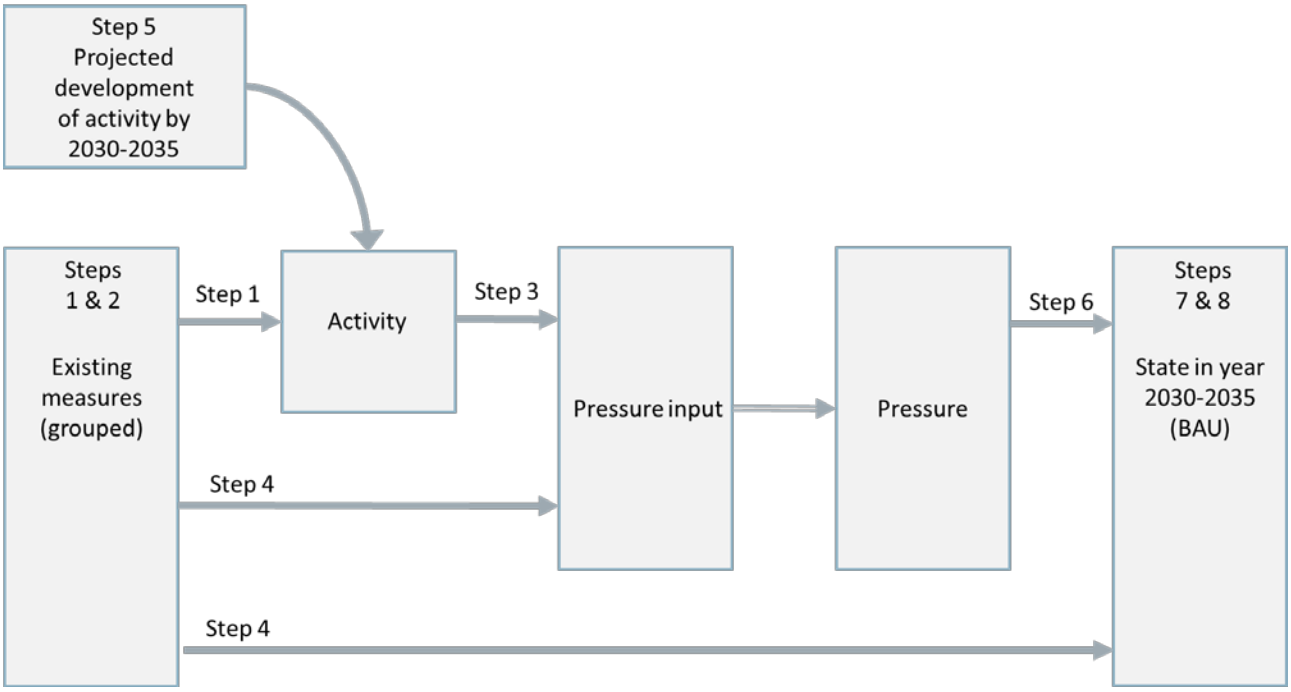

Figure 1. General schematic of the main components of the SOM analysis

Step 1. Existing measures and measure types, including activity-measure links
Step 2. Time-lags for measure effects on pressures
Step 3. Contribution of activities to pressures
Step 4. The effects of measure types
Step 5. Projected development of human activities
Step 6. Effect of changes in pressures on state components
Step 7. Comparison of business-as-usual and good status and gap assessment
Step 8. Effect of time lags in the recovery of state components

The results are in the format of percent shares or probabilities. The main finding of the analysis is the probability to achieve GES or specific state improvements/pressure reductions, taking into consideration the effects of existing measures and changes in the activities on pressures. The contribution of activities to pressures, the effect of measures on pressures, and the significance of pressures to state components are presented in percent (e.g. how many percent would the measure reduce the pressure). Results are presented mainly in tables, which show the the most likely (expected) values and standard deviations. Standard deviation is a way of showing the variation in the values, and when it is high, values are spread over a wider range, and when it is low, values are closer to the most likely value. Figures and graphs presenting distributions will be added later in the autumn 2020 as annexes. They will show the same results as the tables but allow either more detailed information or alternative visualisation of the results.

For the data that are based on expert surveys, the confidence rating gives the most common answer to experts' assessment of the confidence in their own responses on a low-moderate-high scale. More detailed information on how each result has been calculated is presented in a separate document.

The projected development of human activities is based on the most likely future development until 2030 (for details, see the methodology document).

Application of the SOM approach to eutrophication

The SOM analysis estimates the reduction in the input of nutrients from existing measures, taking into consideration the effects of potential future change in activities. The spatial resolution (level of detail) differs across the data components of the SOM analysis. All areas are based on the 17 HELCOM scale 2 sub-basins and the assessment area ranges from the single Baltic Sea wide area to 17 individual sub-basins. The activity-pressure contributions for the input of nutrients (Step 3) are assessed across 7 sub-areas of the Baltic Sea (Figure 2). The methodology for nutrients differs significantly from other topics to take advantage of existing reduction projections. The spatial scale of these projections can be sub-national, national, or the 7 PLC sub-areas of the Baltic Sea. Information on existing measures and their implementation status is at the sub-basin scale. The effect of the development of human activities (Step 5) is assessed for the entire Baltic Sea scale. Table 1 shows the origin and spatial resolution for the data components in the SOM analysis for the input of nutrients.

Table 1. Data for nutrients (more information on data collection is available in the methodology document).

Data component	Origin of data	Spatial resolution
Activity-pressure contributions	HELCOM ACTION	7 sub-areas of the Baltic (Figure 2)
Existing measures	Literature review, Contracting Parties	17 sub-basins
Projected reductions in nutrient inputs	EMEP (HELCOM ENIREDII), HELCOM PLC database (HELCOM ACTION), national estimates of agricultural reduction	7 sub-areas of the Baltic (Figure 2); national or sub-national agricultural estimates
Development of human activities	Literature review, existing data and projections	Whole Baltic Sea
Pressure-state links	NA	NA

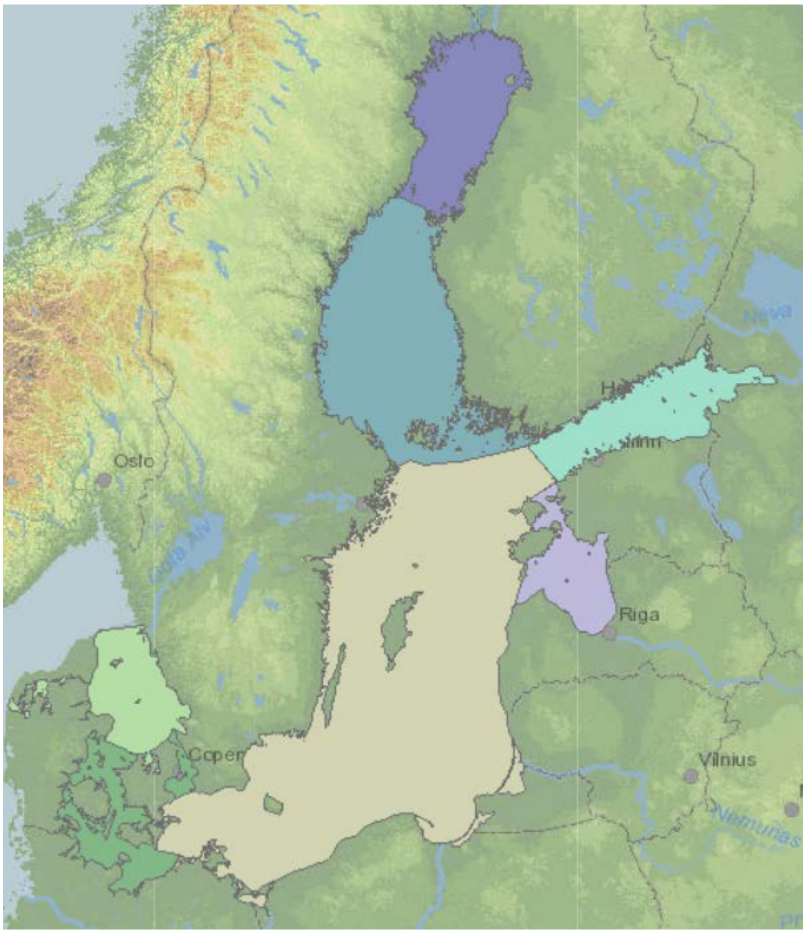

Figure 2. Spatial division of the Baltic Sea used in the SOM analysis of nutrients with 7 sub-areas: Kattegat; Danish Straits (Great Belt, The Sound, Kiel Bay, Bay of Mecklenburg); Baltic Proper (Arkona Basin, Bornholm Basin, Gdansk Basin, Eastern Gotland Basin, Western Gotland Basin, Northern Baltic Proper); Gulf of Riga; Gulf of Finland; Bothnian Sea (Åland Sea, Bothnian Sea); and Bothnian Bay (The Quark, Bothnian Bay).

Nutrients and eutrophication are considered in two distinct ways in the SOM analysis (Figure 3). The first is as the pressure inputs *input of nitrogen* and *input of phosphorus*, which reflect the structure of the HELCOM indicator "Inputs of nutrients (nitrogen and phosphorus) to the sub-basins" and the nutrient reduction targets as Maximum Allowable Inputs (MAIs) established in the HELCOM Baltic Sea Action Plan and updated by the 2013 Ministerial Declaration. The MAI values have been designed to reach good status with regard to eutrophication and the goals of MSFD criteria D5C1[1]. Separate MAI have been established for each of the 7 PLC sub-areas (Figure 2). In the latest HOLAS assessment period (2011-2016) (HELCOM 2018), MAI were met in four sub-areas for nitrogen and three sub-areas for phosphorus.

The second aspect of nutrients and eutrophication in the SOM model is the pressure *effects of eutrophication*, which includes e.g. oxygen debt and water clarity. This aspect more directly reflects the structure of the MSFD criteria D5C1. In the expert surveys on pressure-state linkages, this pressure could be selected as being significant to any of the various state components included in the SOM analysis, and is thus included in the pressure-state assessment of the analysis. No connection has been estimated between the input of nutrients and the effects of eutrophication in the SOM analysis, i.e. the analysis cannot say how changes in the input of nutrients impact eutrophication effects. However, modelling exercises exist that can provide information of this relationship (e.g. Murray et al. 2019).

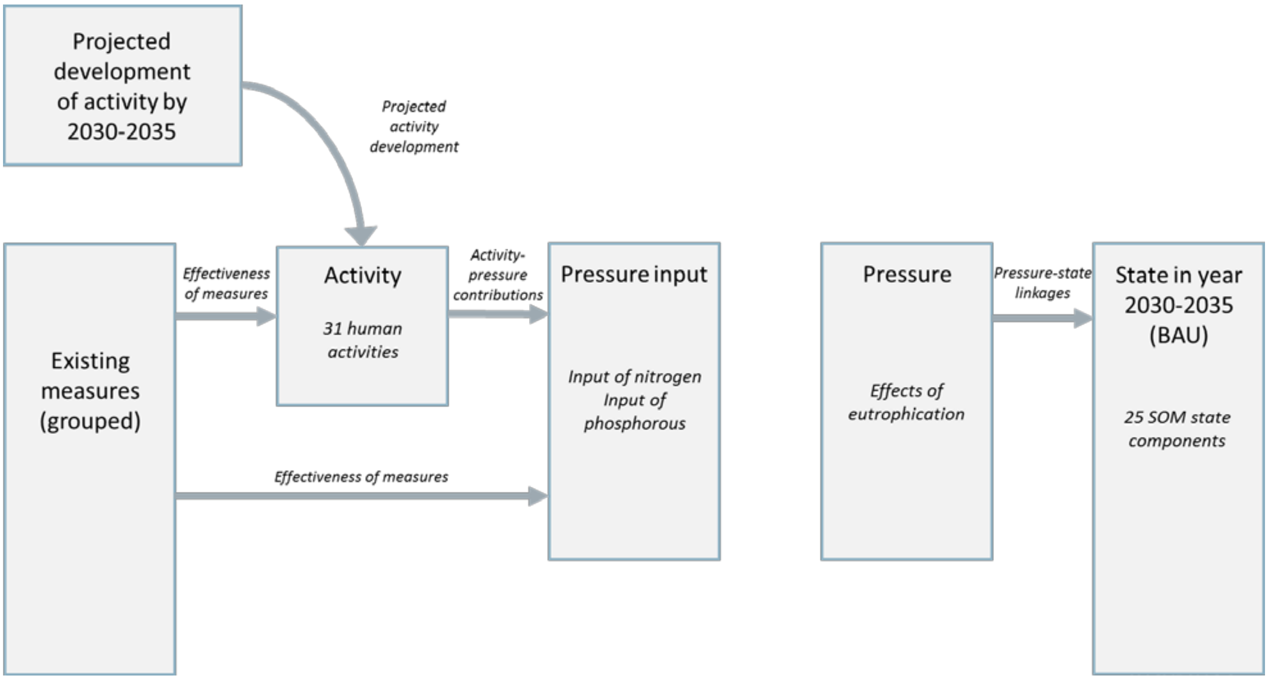

Figure 3. Schematic of the SOM analysis for nutrients and eutrophication. The impacts of the pressure inputs (*input of nitrogen, input of phosphorus*) on the pressure (*effects of eutrophication*) have not been estimated within the SOM analysis.

Are existing measures sufficient for achieving reduction targets?

For eutrophication, it is possible to compare the projected reductions in the input of nutrients from existing measures in the SOM analysis with the HELCOM nutrient reduction targets agreed in the HELCOM Baltic Sea Action Plan and revised in the Ministerial Declaration in 2013 (HELCOM 2013a). This comparison gives some indication on whether existing measures are sufficient in reducing nutrient inputs as required by the reduction targets.

[1] Marine Strategy Framework Directive criteria D5C1 – Primary: Nutrient concentrations are not at levels that indicate adverse eutrophication effects. The threshold values are as follows:
(a) in coastal waters, the values set in accordance with Directive 2000/60/EC;
(b) beyond coastal waters, values consistent with those for coastal waters under Directive 2000/60/EC. Member States shall establish those values through regional or subregional cooperation

The HELCOM Baltic Sea Action Plan nutrient reduction scheme defines the targets as maximum allowable inputs (MAI), which indicate the maximum nutrient inputs allowed to each sub-area of the Baltic Sea to achieve GES for eutrophication (HELCOM 2013a, 2013b). Table 2 presents needed reductions based on MAI and exceedance of MAI in 2017, as assessed in the HELCOM core indicator report on the status of nutrient inputs to the Baltic Sea (HELCOM 2019).

Table 3 shows the projected reductions in the input of nutrients from existing measures by 2035 based on the SOM analysis. Comparison between needed reductions (Table 2) and projected reductions from existing measures (Table 3) indicates some differences. The SOM analysis projects reductions in nitrogen and phosphorus inputs for all sub-areas of the Baltic Sea. These range between 7-24% for phosphorus and 12-24% for nitrogen. Based on nutrient reduction targets, reductions are required only in some sub-areas to achieve GES, with largest reductions allocated to the Baltic Proper and Gulf of Finland.

The results of the SOM analysis indicate that reductions in phosphorus inputs from existing measures may not be as large as required reductions in the Baltic Proper, Gulf of Riga and Gulf of Finland, but larger than those needed in the Bothnian Bay. For nitrogen, it seems that reductions from existing measures would be as large as required reductions for the Bothnian Bay, Gulf of Riga and Gulf of Finland, but smaller than those required for the Baltic Proper. However, the SOM analysis suggests that both phosphorus and nitrogen inputs are reduced with existing measures also in those basins not requiring any further reductions based on MAI and nutrient inputs in 2017.

The comparison is a rough approximation for several reasons, most importantly: 1) the SOM analysis does not include all potential sources of nutrient inputs, notably missing any estimate of reductions in inputs from scattered dwellings due to unavailability of data, 2) reductions from agricultural measures in the SOM analysis are partially based on expert elicitation instead of model estimates, and 3) due to varying data sources, the data used to make these nutrient reduction projections come from more than one year (ranging between 2014 and 2020) which may result in underestimating already achieved reductions.

Table 2. Needed reductions for the input of nitrogen and phosphorus in sub-areas of the Baltic Sea based on comparing maximum allowable inputs (MAI) and inputs in 2017. Source: HELCOM (2019).

Nutrient	**Phosphorus**			**Nitrogen**		
Sub-area	**Maximum allowable input (MAI)**	**Exceedance of MAI**	**Needed reduction (%)**	**Maximum allowable input (MAI)**	**Exceedance of MAI**	**Needed reduction (%)**
Kattegat	1687			74000		
Danish Straits	1601			65998		
Baltic Proper	7360	7111	49.1	325000	108102	25.0
Gulf of Riga	2020	610	23.2	88417	5954	6.3
Gulf of Finland	3600	2012	35.9	101800	12662	11.1
Bothnian Sea	2773			79372		
Bothnian Bay	2675	47	1.7	57622	639	1.1
Total	21716	9780	31.1	792209	127357	13.8

Table 3. Projected reductions (%) in the input of nutrient from existing measures by 2035. Source: SOM analysis.

Colour scale: expected reduction is larger than required by the nutrient reduction scheme, expected reduction is smaller than required by the nutrient reduction scheme

Sub-area	Reduction in phosphorus input (%) (minimum-maximum)	Reduction in nitrogen input (%) (minimum-maximum)
Kattegat	9.4 (6.6–12.5)	22.8 (18.6–26.3)
Danish Straits	10.0 (7.9–12.4)	20.9 (16.6–24.3)
Baltic Proper	16.9 (14.1–20.0)	18.2 (13.8–21.7)
Gulf of Riga	9.0 (6.9–11.6)	12.8 (7.5–17.1)
Gulf of Finland	24.1 (21.7–26.9)	12.4 (9.2–15.0)
Bothnian Sea	8.1 (5.3–11.4)	23.6 (21.4–25.5)
Bothnian Bay	6.8 (4.1–10.0)	24.0 (20.9–26.6)

Time lags

Information on time lags related to eutrophication and the input of nutrients were not specifically collected in the literature reviews or expert surveys related to eutrophication. However, such information is available from existing literature, e.g. Murray et al. (2019), which suggests time lags in the range of 50 to 100 years between the reduction in the input of nutrients and full impact on the effects of eutrophication. HELCOM ACTION WP5 will also produce information on time lags related to eutrophication, which will be added later in the autumn.

What are the reductions in pressure inputs from existing measures?

This section includes the effects of existing measures in reducing the input of nitrogen and phosphorus (Table 4). They are based on the activity-pressure contributions, pressure reductions from existing measures, and projected development of activities. The activity-pressure and pressure reductions data are assessed at the level of 7 sub-areas of the Baltic (Figure 2), thus the total pressure reductions are presented for those sub-areas. The projected pressure reductions account for the joint impacts across measure types as well as the spatial area where the pressures can be reduced to avoid overestimating the pressure reductions.

Table 4 shows the total pressure reduction, the pressure reduction from non-agricultural measures, and pressure reduction from agricultural measures for the input of nitrogen and phosphorus. The total reduction is the sum of the reductions from the non-agricultural and agricultural measures, and it is used in Table 3 in the previous section for comparison with the nutrient reduction targets.

For the total reduction, the percent reductions for the input of nitrogen from existing measures are in general larger than for the input of phosphorus. The only exception is the Gulf of Finland, which is the only sub-areas that the reduction of total phosphorus input is larger than 20%. The total reduction of the phosphorus input in most of the sub-areas is smaller than 20%. By contrast, in around half of the sub-areas, the total reduction of nitrogen input projected to be over 20%.

In Table 4, the pressure reductions from the non-agricultural measures include the reductions from the measures related to wastewater treatment plants (WWTPS) and atmospheric deposition. The estimation of these reductions does not include uncertainty, because the reported input data does not include any variation. The input of phosphorus related to non-agricultural measures in the Bothnian Sea and Bothnian Bay is expected to increase (shown as negative pressure reductions), meaning that the measures to reduce the pressure inputs cannot compensate for the pressure increases caused by changes in human activities. The input of phosphorus in the remaining sub-areas and the input of nitrogen for all of the sub-areas are projected to be reduced 0-20% by these non-agricultural measures.

The pressure reductions from the agricultural measures are of the same magnitude across the sub-areas, ranging from 5% to 12% for both phosphorus and nitrogen.

There are no estimates of the effectiveness of measure types for the input of nutrients, as the approach for the SOM analysis has differed from the other topics and there are no extensive expert survey data on the effectiveness of various measure types in reducing nutrient inputs.

Table 4. Projected reductions (%) in the input of nutrient from existing measures. The table depicts the most likely reduction in the input of nutrients. Minimum and maximum reductions for agricultural measures and total reduction are given in parenthesis. They are calculated based on the survey responses for the effect of existing measures in reducing runoff from agriculture. There is no variation in the reported input data for non-agricultural measures.

Colour scale for the projected reductions in percent (based on the most likely value):
<0%,0-10%, 10-20%, 20-40%, 40-60%, 60-100%

Pressure	Total reduction (%)		Reduction from non-agricultural measures (%)		Reduction from agricultural measures (%)	
Sub-area	Phosphorus input (minimum-maximum)	Nitrogen input (minimum-maximum)	Phosphorus input	Nitrogen input	Phosphorus input (minimum-maximum)	Nitrogen input (minimum-maximum)
Kattegat	9.4 (6.6–12.5)	22.8 (18.6–26.3)	0.1	13.2	9.3 (6.5–12.4)	9.6 (5.4–13.1)
Danish Straits	10.0 (7.9–12.4)	20.9 (16.6–24.3)	3.0	11.3	7.0 (4.9–9.4)	9.6 (5.4–13.0)
Baltic Proper	16.9 (14.1–20.0)	18.2 (13.8–21.7)	7.7	8.3	9.2 (6.5–12.3)	9.9 (5.5–13.4)
Gulf of Riga	9.0 (6.9–11.6)	12.8 (7.5–17.1)	1.7	0.8	7.3 (5.1–9.8)	12.0 (6.7–16.3)
Gulf of Finland	24.1 (21.7–26.9)	12.4 (9.2–15.0)	16.0	5.1	8.1 (5.7–10.9)	7.3 (4.1–9.9)
Bothnian Sea	8.1 (5.3–11.4)	23.6 (21.4–25.5)	-1.5	18.6	9.6 (6.8–12.9)	5.0 (2.8–6.9)
Bothnian Bay	6.8 (4.1–10.0)	24.0 (20.9–26.6)	-2.5	16.9	9.3 (6.6–12.5)	7.1 (4.0–9.7)

Which activities contribute to pressures?

Tables 5.1 and 5.2 shows the contribution of activities to the input of nutrients. A data-based approach was used to estimate the activity-pressure linkages, which were produced by HELCOM ACTION Work Package 4 and based primarily on PLC-7 data. The activity-pressure contributions were assessed for 7 sub-areas of the Baltic Sea (Figure 2).

The list of activities for the input of nutrients is different than the activities used for the other SOM topics. Here, activities are divided into six sectors to reflect the different pathways for nutrients that reach the Baltic Sea (see Tables 5.1 and 5.2). For the input of nitrogen (Table 5.1), 15 different activities were identified to contribute to the pressure. Here, agriculture from diffuse losses through rivers (i.e. runoff) contributes the most to the pressure in all 7 areas of the Baltic Sea (23-54%). Most other activities contribute less than 10% to the input of nitrogen to the Baltic Sea, with the exception of WWTPs, atmospheric deposition from agricultural sources into the Baltic (direct), and river borne transboundary loads from non-Contracting Parties, which exhibit in some areas higher percentages (20-31%).

For the input of phosphorus (Table 5.2), 11 different activities were identified to contribute to the pressure. Similar to nitrogen, agriculture from diffuse losses through rivers (i.e. runoff) is the activity that contributes the most to the pressure, although this applies only to 6 of the 7 areas (36-49%). In the Gulf of Riga, transboundary inputs from the sector transboundary loads from non-Contracting Parties via rivers contributes the most to the pressure (47%). Other activities that contribute a lot to phosphorus input are stormwater/overflows (21%) in the Danish Straits, WWTPs in Gulf of Finland (33%) and Danish Straits (25%), and atmospheric deposition on the Bothnian Sea (22%). Most other activities less than 10% contributions to the pressure.

Table 5.1. Activity-pressure contributions (%) for the input of nitrogen. The activity-pressure contributions show the percentage share the activity contributes to the pressure (input of nutrients). The table depicts the most likely/expected contribution. The activities are based on six sectors to reflect the different pathways for nutrients that reach the Baltic Sea and differ from the activity list for other topics. Activities that are not relevant for nitrogen are labelled as NA.

Colour scale for the activity-pressure contribution in percent (based on the expected value):
0-10%, 10-20%, 20-40%, 40-60%, 60-100%

Sector	Diffuse losses through rivers					Industrial point sources from inland and coastal areas		Inland point sources through rivers	Point sources emitting directly to BS Sea	Atmospheric deposition on Baltic Sea					Transboundary loads from non-CPs via rivers
Input of nitrogen	Agriculture	Forestry	Storm water/overflows	Atmospheric deposition	Scattered Dwellings	WWTP	Industry	Freshwater aquaculture	Marine aquaculture	Agriculture	Combustion	Transportation	Airborne transboundary	Other	Riverborne Transboundary
Baltic Proper	44.9	0.4	1.1	1.5	1.4	6.3	1.4	0.3	0.0	9.8	3.3	7.2	8.0	1.0	13.4
Bothnian Bay	32.5	5.0	0.2	9.3	2.0	13.0	8.0	0.1	0.1	8.4	4.4	8.7	7.0	1.4	0.0
Bothnian Sea	22.9	2.2	0.2	5.4	1.8	11.4	3.5	0.4	1.1	12.7	7.2	15.7	13.4	2.2	0.0
Gulf of Finland	33.2	2.2	1.2	11.0	2.0	27.4	4.1	0.0	0.0	5.0	2.8	5.6	4.5	0.8	0.0
Gulf of Riga	54.4	0.0	1.4	3.8	1.0	0.9	0.1	0.0	0.0	2.2	1.0	2.0	1.9	0.3	31.1
Kattegat	43.6	0.4	0.8	7.1	1.2	6.4	1.3	0.3	0.0	14.9	2.8	8.9	10.9	1.2	0.0
Danish Straits	43.6	0.0	2.0	1.1	0.7	8.3	0.4	0.1	0.6	20.7	2.9	8.1	10.7	0.8	0.0

Table 5.2. Activity-pressure contributions (%) for the input of phosphorus. The activity-pressure contributions show the percentage share the activity contributes to the pressure (input of nutrients). The table depicts the most likely/expected contribution. The activities are based on six sectors to reflect the different pathways for nutrients that reach the Baltic Sea and differ from the activity list for other topics. Activities that are not relevant for phosphorus are labelled as NA.

Colour scale for the activity-pressure contribution in percent (based on the expected value):
0-10%, 10-20%, 20-40%, 40-60%, 60-100%

Sector	Diffuse losses through rivers					Industrial point sources from inland and coastal areas		Inland point sources through rivers	Point sources emitting directly to BS Sea	Atmospheric deposition on Baltic Sea	Transboundary loads from non-CPs via rivers
Input of phosphorus	Agriculture	Forestry	Storm water/overflows	Atmospheric deposition	Scattered Dwellings	WWTP	Industry	Freshwater aquaculture	Marine aquaculture	Atmospheric	Transboundary
Baltic Proper	47.1	0.7	3.7	0.7	2.3	17.4	1.4	1.1	0.0	7.6	18.0
Bothnian Bay	47.9	8.5	1.3	7.9	9.7	3.1	6.6	0.3	0.3	14.5	0.0
Bothnian Sea	49.3	1.8	1.1	2.2	7.7	3.2	7.7	1.6	3.2	22.2	0.0
Gulf of Finland	41.5	1.0	4.3	4.3	7.4	33.0	3.0	0.0	0.1	5.2	0.0
Gulf of Riga	37.5	0.0	4.1	0.3	3.6	4.1	0.3	0.0	0.0	3.0	47.2
Kattegat	47.5	0.3	9.7	2.0	9.2	14.2	3.3	2.0	0.0	11.9	0.0
Danish Straits	35.8	0.0	20.9	0.7	6.7	24.5	1.0	0.5	2.5	7.5	0.0

Summary of results

The SOM analysis projects reductions in the input of nitrogen (12-24%) and phosphorus (7-24%) in all sub-areas of the Baltic Sea. The initial findings of the analysis suggest that existing measures may not be sufficient in reducing the input of nutrients as indicated by the maximum allowable inputs (MAI) in the nutrient reduction scheme. The spatial distribution of the reductions also differs from the scheme. Projected reductions in phosphorus input are smaller than needed in the Baltic Proper, Gulf of Riga and Gulf of Finland, and in nitrogen input in the Baltic Proper. However, the SOM analysis suggests that both phosphorus and nitrogen inputs are reduced with existing measures also in those basins not requiring any further reductions based on MAI.

When interpreting the results, the assumptions and generalizations that were made when collecting and using the input data need to be taken into account. For the input of nutrients, most of the input data are based on existing models and data, but the input reductions in agriculture come partly from expert elicitation, and no reductions in inputs from scattered dwellings have been taken into account due to lack of data. Note that the analysis has not been able to link the inputs of nutrients to the effects of eutrophication. For more information on the SOM methodology, data collection and assumptions, see this document.

Background of respondents

Most of the data for nutrients come from existing data sources rather than expert surveys. An expert survey was conducted to assess the effectiveness of agricultural measures to reduce nutrient runoff, and some of these estimates were based on model results instead of expert judgement. Altogether 8 survey responses from 10 individual experts were received for the effectiveness of measures for nutrient runoff survey. One response was a group response with three participating experts. Approximately half of the responses were based on model estimates and half on expert opinion.

The number of experts contributing to the nutrient survey by Contracting Parties is shown in Table 6. Additionally, model estimates were received from Lithuania and Sweden by correspondence, which are marked as asterisks in the table below.

Table 6. Number of experts contributing to the nutrient survey

Survey	DE	DK	EE	FI	LT	LV	PL	RU	SE	Total
Nutrients from agriculture EoM	2	1	2	1	*	1	3	-	*	10

* indicates data submitted by correspondence.

Background information for those experts who responded to the survey shows that the fields of the experts included agriculture, water/soil science, monitoring and Water Framework Directive. All of the experts had at least 5 years of experience in the field (Table 7). Experts represented research institutions, government institutes, state agencies or ministries. Background information for the experts who submitted model-based responses from Lithuania and Sweden is not available and is thus not included in the table below.

Table 7. Years of experience in the field for the nutrient survey

	Effectiveness of measures survey	
Years	**Number of experts**	**Share of experts**
0-2 years	0	0 %
3-5 years	0	0 %
5-10 years	3	30 %
10-20 years	3	30 %
over 20 years	4	40 %

References

HELCOM 2013a. HELCOM Copenhagen Ministerial Declaration. Taking Further Action to Implement the Baltic Sea Action Plan-Reaching Good Environmental Status for a healthy Baltic Sea. 3 October2013, Copenhagen, Denmark. Available at; https://helcom.fi/media/documents/2013-Copenhagen-Ministerial-Declaration-w-cover-1.pdf

HELCOM 2013b. Summary report on the development of revised Maximum Allowable Inputs (MAI) and updated Country Allocated Reduction Targets (CART) of the Baltic Sea Action Plan. Document prepared for the 2013 HELCOM Ministerial Meeting to give information on the progress in implementing the HELCOM Baltic Sea Action Plan. Available at: https://helcom.fi/wp-content/uploads/2019/08/Summary-report-on-MAI-CART.pdf

HELCOM 2019. Inputs of nutrients to the sub-basins. HELCOM core indicator report. Online. Accessed 31 July 2020. Available at: https://helcom.fi/wp-content/uploads/2019/08/HELCOM-core-indicator-on-inputs-of-nutrients-for-period-1995-2017_final.pdf. ISSN 2343-2543.

Murray CJ, Müller-Karulis B, Carstensen J, Conley DJ, Gustafsson BG and Andersen JH (2019) Past, Present and Future Eutrophication Status of the Baltic Sea. *Front. Mar. Sci.* 6:2. doi: 10.3389/fmars.2019.00002