A practical guide to interpreting the SOM results

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Introduction

Background on SOM analysis

The sufficiency of measures (SOM) analysis assesses improvements in environmental state and reduction of pressures that can be achieved with existing measures in the Baltic Sea region, and whether these are sufficient to achieve good environmental status (GES). The analysis involves estimating the state of the marine environment in 2030, based on a starting point of 2016 (i.e. the latest HELCOM status assessment), and given measures in existing policies, their implementation status, and the projected development in the extent of human activities over time. The evaluation can be carried out compared to relevant and agreed HELCOM threshold values for GES, where available.

The same overall approach has been applied across all topics to ensure comparability and coherence of the results, while considering topic-specific aspects and making necessary adjustments. The main components of the analysis include assessing the contribution of activities to pressures, the effect of existing measures on pressures, the effect of changes in the extent of human activities on pressures, and the effect of changes in pressure on environmental state. Topic reports have been prepared for all nine topics covered in the SOM analysis. In addition, the results are summarized in the main report and the full methodology is described in the methodology report.

Report background

This report is aimed at increasing the usability of the SOM results through improved understanding and interpretation of its outputs. The report walks through the various types of results available in the SOM topic reports and provides a visual guide for how to read and interpret each result type. The presentation of results has been standardized across the SOM reports; however, each result type within an individual report utilizes a different presentation format to best illustrate its findings. The presentation formats are often information dense, each containing multiple assessments and presentations of uncertainty. In particular, the thorough presentation of uncertainty has been a priority of the reporting process and multiple ways of expressing uncertainty can be found depending upon the result type, including standard deviations, confidence intervals, expert confidence levels, and number of participating experts.

The aim of this report is to use clear language and visuals to increase the usability and clarity of the entire SOM report series. Each of the examples below has been taken directly from one of the topic reports. However, these examples only cover interpretation of the model results and should not be used outside the context of the relevant topic report. Additional interpretation and reflection by topic experts and the HELCOM ACTION project can be found in the relevant topic reports and is crucial for contextualizing the SOM model outputs.

Practical examples

Example 1: Sufficiency of measures in maintaining or achieving GES, achieving a noticeable state improvement or achieving specific state improvements

Results example 1, below, is Table 3 from the commercial fish topic report. A similar table is available for each topic that assesses a state component, but the table number and name will vary slightly by topic. Each table starts with the state component (e.g. herring, purple box) and the specific assessment area or management unit (e.g. SD 20-24, spring spawners, purple box), followed by the total pressure reduction (blue box) and ends with the maximum possible pressure reduction due to model coverage (red box). The type of the assessment for each specific state component determines the format of the results: probability to achieve GES (%) with expected pressure reduction (green box), probability (%) to achieve specific state improvement with expected pressure reduction (orange box), and probability to achieve a noticeable state improvement (%) with expected pressure reduction (not pictured). Note that four state assessments were not completed for commercial fish due to insufficient data (grey table rows marked 'insufficient data'; indicated by blue arrows on the right). In this table, whole rows are marked as 'insufficient data', but other tables may only have individual cells marked this way. The number of results marked as 'insufficient data' depends on what input data is lacking and how it is incorporated into the SOM model.

Results are presented in two different formats in this table. The first and most common shows the expected value. Below that are the 10th and 90th percentiles in square brackets [ ]. This format is used below in the blue, green, and orange boxes. For example, the data in the red dashed circle indicates that the expected probability to achieve a 10% state improvement in herring in the assessment area SD 30-31 is 64% and that 80% of the model outcomes on the probability of achieving a 10% state improvement fall between 25% and 83%. The second result format is used in the final column (red box). Here, this value is a sum of the pressures on the state component (Results example 4) which are fully modelled in the SOM analysis. For herring in SD 30-31, this is 47%.

Interpretation of the results in this table might best begin with consideration of the maximum possible pressure reduction due to model coverage (red box). In the case of herring in SD 30-31, 47% of the significant pressures have fully modelled reductions in the SOM analysis. It is not known how much the remaining 53% might be reduced, and thus these are assumed to stay constant at their current level. In some cases, this unknown portion represents a completely unmodeled pressure (e.g. human induced food web modification), while in other cases some aspects may be modelled (e.g. input of nitrogen) but a complete link is not present (e.g. effects of eutrophication) and therefore potential pressure reductions are unknown. Review of the significant pressures which are not fully modelled may provide indications of the scale of the unmodeled pressure reductions (appearing in grey in Results example 4). The 47% figure is low and indicates that a majority of the significant pressures on herring in SD 30-31 are not captured in the model. Thus, the pressure reduction and state improvement results are likely underestimations, given the low model coverage. Total pressure reduction (blue box) is low to moderate with very similar levels across commercial fish assessments. The value indicates that the positive effect of measures outweighs the projected growth of human activities, but this result is difficult to interpret with information only from this table. Comparison can be made with the total pressure reduction required to achieve or maintain GES/specific state improvement/noticeable state improvement (Results example 2); however, this comparison is inherent in the probability to achieve or maintain GES/specific state improvement/noticeable state improvement (green and orange boxes) which more accurately captures variation in the underlying data. Herring in SD 30-31 has a 64% [25-83] probability of achieving a 10% improvement but that drops considerably for the 25% and 50% improvement results. If the likely underestimation is considered, a 10% state improvement might be considered likely, but a greater improvement does not.

Results example 1.

Sufficiency of measures in achieving GES or specific state improvements for commercial fish from the commercial fish topic report.

Table 3. Sufficiency of measures in achieving GES or specific state improvements for commercial fish. The table presents the expected values and the 10-90 percentile in brackets, which shows the range in which 80% of the observations fall in. When a GES threshold exists, the result shows the probability to achieve GES with expected pressure reduction. When there is no GES threshold, the table shows the probability to achieve a specific state improvement (10%, 25% and 50%) with expected pressure reduction.

State	Assessment area	**Total pressure reduction (%)** [10 percentile – 90 percentile]	**Probability to achieve GES (%) with expected pressure reduction** [10 percentile – 90 percentile]	**Probability (%) to achieve specific state improvement with expected pressure reduction** [10 percentile – 90 percentile]			**Maximum possible pressure reduction due to model coverage (%)**
				10% state improvement	**25% state improvement**	**50% state improvement**	
Herring	SD 20-24, spring spawners	23 [16-29]	0 [0-0]				47
	SD 25–29 and 32, excluding the Gulf of Riga	19 [13-24]	58 [43-67]				56
	SD 28.1 (Gulf of Riga)			Insufficient data			
	SD 30-31	20 [14-26]		64 [25-83]	2 [0-18]	1 [0-4]	47
Cod	Western Baltic			Insufficient data			
	Eastern Baltic			Insufficient data			
Sprat	SD 22–30 and 32	18 [13-23]	38 [24-46]				43
Plaice	Baltic Sea, excluding the Quark and Bothnian Bay			Insufficient data			

Data used: expert estimates of effectiveness of measure types, information on existing measures, expert estimates of significance of pressures to state components, expert estimates of required pressure reductions to achieve GES, information and projections on development of human activities

Example 2: Total pressure reduction required to maintain or achieve GES, achieve a noticeable state improvement or achieve a specific state improvement

Results example 2, below, is Table 5 from the waterbirds topic report. A similar table is available for each topic that assesses a state component, but the table number and name will vary slightly by topic. The table presents the results for several state components in a single row and additional state components are presented after a grey bar (blue box highlights one result in the first row). Each state component assessment contains three components: most likely pressure reduction required (%), confidence, and number of experts.

For great cormorant – breeding season (red circle), the expected value for the most likely pressure reduction required is 23% with a standard deviation of 21 which appears in parentheses ( ). The open and closed circles next to the standard deviation result (○○● for great cormorant; red circle) indicate categories of certainty based on the relative size of the standard deviation to the expected value (see orange box). Finally, the colour of the cell (green for great cormorant; red circle) indicates categories of percent pressure reduction (see purple box below table for colour scale). The confidence result depicts the most common rating of expert confidence in their own survey response (low, moderate, high). For great cormorant, expert confidence was moderate (red circle). The number of experts indicates the number of experts responding to this question in the expert survey. Results for great cormorant are based on four expert responses (red circle).

The type of result (based on GES threshold values, specific state improvements or noticeable state improvement) are not directly recorded in the table but can be found in the table title (green box). In Results example 2, results are either based on GES threshold values (common eider, great cormorant, sandwich tern, great black-backed gull) or specific state improvement (long-tailed duck, red-throated diver). Note that two results have insufficient data to complete the assessment (sandwich tern, great-black backed gull; grey table cells marked 'insufficient data'). Probability distributions of these data are available in Annex 10 of the relevant topic reports and are discussed in Results example 11.

Interpretation of the results in this table should begin with consideration of the number of experts, confidence and certainty (○○● for great cormorant). In the case of great cormorant, the number of experts is rather low, as is the certainty. Confidence has a moderate rating. Taking these data together, the reliability of the expected required reduction of 23% is low. Instead, the result might be best characterized as indicating that achieving GES likely requires a moderate reduction in pressures.

Results example 2. Total pressure reduction required to maintain GES or achieve a specific state improvement for birds from the waterbirds topic report.

Table 5. Total pressure reduction required to maintain GES or achieve a specific state improvement for birds. Standard deviation is given in parentheses. Note: values are calculated directly from expert survey data and will differ somewhat from model results. Confidence depicts the most common rating of expert's confidence in their own responses to the question on total pressure reduction required to maintain GES/achieve state improvements.

State	**Common eider - Breeding season**	**Great cormorant - Breeding season**	**Sandwich tern - Breeding season**	**Great black-backed gull - Wintering season**
Most likely pressure reduction required (%)	35 (23) ○○●	23 (21) ○○●	Insufficient data	Insufficient data
Confidence	Low	Moderate	NA	NA
Number of experts	8	4	Less than 3	Less than 3
State	**Long-tailed duck - Wintering season, 10% state improvement**	**Long-tailed duck - Wintering season, 25% state improvement**	**Long-tailed duck - Wintering season, 50% state improvement**	
Most likely pressure reduction required (%)	36 (16) ○●●	59 (18) ●●●	87 (7) ●●●	
Confidence	High	High	High	
Number of experts	4	4	4	
State	**Red-throated diver - Wintering season, 10% state improvement**	**Red-throated diver - Wintering season, 25% state improvement**	**Red-throated diver - Wintering season, 50% state improvement**	
Most likely pressure reduction required (%)	36 (15) ○●●	54 (18) ○●●	87 (7) ●●●	
Confidence	High	High	High	
Number of experts	4	4	4	

Colour scale for the percent reduction in pressures required to maintain GES or achieve a specific state improvement in percent (based on the expected value): 0-10%, 10-20%, 20-40%, 40-60%, 60-100%

Categories for the certainty of the reduction required estimate (based on the relative size of the standard deviation to the expected value): low: ○○●, moderate: ○●●, high: ●●●

NA = not applicable

Data used: expert estimates of required pressure reductions to achieve GES

Example 3: Time lags in achieving GES/environmental target/state improvements with sufficient measures

Results example 3, below, is Table 5 from the migratory fish topic report. A similar table is available for most topics that assess a state component, but the table number and name will vary slightly by topic. This table covers the time lag between the full implementation of a measure and the effect that measure has on the state component in question. The presentation format of this table is quite different from the other results. The top half of the table presents the raw responses from experts (e.g. green box shows the responses for salmon in the assessment area AU 1-2) and the bottom half presents summary statistics and data on responding experts (e.g. red circle shows this for sea trout in the Gulf of Bothnia).

For sea trout in the Gulf of Bothnia (red circle), the average time lag to achieve GES once sufficient measures are implemented is 7.5 years with a standard deviation of 0. The 0 standard deviation does not mean that the 7.5-year estimate is certain; instead, this is an artifact of the calculation and the result should be read as a time lag ranging from 6 to 10 years with high agreement among contributing experts. This result focuses on time lags following the full implementation of sufficient measures. If an expert clearly referenced other time lags in their response (e.g. time lags in measure implementation), their response was excluded from the table. In the example of sea trout in the Gulf of Bothnia (red circle), no expert responses have been excluded. The confidence result depicts the most common rating of expert confidence in their own survey response (low, moderate, high). For seatrout in the Gulf of Bothnia (red circle), expert confidence was moderate. The number of experts indicates the number of experts responding to this question in the expert survey. Results for seatrout in the Gulf of Bothnia are based on six expert responses (red circle).

Interpretation of the results in this table should begin with consideration of the number of experts and their confidence. For seatrout in the Gulf of Bothnia (red circle), these give an indication of moderate confidence. However, the high level of agreement among experts, as indicated by both the standard deviation and the raw responses, adds weight to the average result. Additionally, in this case a comparison can be made between seatrout in the Gulf of Bothnia and in other Baltic Sea areas. There is close agreement across areas future supporting the average result for the Gulf of Bothnia. However, many experts are likely responding to more than one seatrout assessment so this supporting evidence should not be over-interpreted. Taken together the result suggests that given sufficient measures seatrout in the Gulf of Bothnia could likely recover in less than 10 years. While this timeframe is not short, it would not seem to suggest that natural time lags are a significant direct impediment to seatrout recovery, as could be suspected for other species, like eel, where the time lag was estimated by experts to be 40 years on average (last column).

Results example 3. Time lags in achieving GES/environmental target/state improvements with sufficient measures for migratory fish from the migratory fish topic report.

Table 5. Time lags in achieving GES/environmental target/state improvements with sufficient measures for migratory fish. The values in the row 'Number of experts' includes experts with excluded responses.

Time lag	Salmon					Sea trout					Eel
	AU 1-2	AU 3	AU 4	AU 5	AU 6	Gulf of Bothnia	Gulf of Finland	Western Baltic	Eastern Baltic	Southern Baltic	Entire Baltic Sea
0 years (no time lag)	0	0	0	0	0	0	0	0	0	0	0
0-5 years	1	1	0	0	1	0	0	0	0	2	0
6-10 years	6	6	6	0	3	6	3	6	3	7	0
11-25 years	0	0	3	4	0	0	0	0	0	1	4
26-50 years	0	0	0	0	0	0	0	0	0	0	6
51-100 years	0	0	0	0	0	0	0	0	0	0	0
More than 100 years	0	0	0	0	0	0	0	0	0	0	1
Excluded	0	0	0	0	0	0	0	0	0	0	0
Average	6.8	6.8	10.8	17.5	6.3	7.5	7.5	7.5	7.5	7.5	40.8
SD	1.8	1.8	4.7	0.0	2.2	0.0	0.0	0.0	0.0	3.9	37.6
Confidence	High	High	High	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Number of experts	7	7	9	4	4	6	3	6	3	10	11

Data used: expert estimates of time lags

Example 4: Significance of pressures

Results example 4, below, is Table 6.2 from the benthic habitats topic report. A similar table is available for each topic that assesses a state component, but the table number and name will vary slightly by topic. Each state component has its own table, with columns specifying the spatial assessment area, if there are several (blue box shows the results for the Southern Baltic). For benthic habitats, five tables are presented as there are five habitat types (state component indicated in table title). The rows list the pressures considered significant for the state component by the experts. Three results are shown: the average significance of the pressure to the state component (%) which sums to 100 by column, experts' evaluation of their own confidence in the evaluations, and number of experts. No variance is presented in the significance of pressures tables due to the format of the data. Empty (white) cells indicate that the pressure is not among the most significant pressures to the state component.

Results for soft substrate vegetation dominated community in the Southern Baltic indicate that the most significant pressures are effects of eutrophication (28%), physical disturbance of marine habitats (20%) and physical loss of marine habitats (16%) (blue box). The colour of the cell (green for effects of eutrophication, red box) indicates categories of percent significance of pressures (see purple box below table for colour scale). The confidence result depicts the most common rating of expert confidence in their own survey response (low, moderate, high). For the Southern Baltic, expert confidence was moderate (bottom of blue box). The number of experts indicates the number of experts responding to this question in the expert survey. Results for Southern Baltic are based on seven expert responses (bottom of blue box).

A distinction is made between pressures covered fully in the SOM model (white background) and pressures not fully modelled (grey background; green box). Pressures in white are those that have a quantified link from pressure inputs to pressures and state components and have measure types that affect them in the SOM analysis (explained also in orange box). The significance estimates for pressures with the white background are summed and the resulting value is the maximum possible pressure reduction due to model coverage presented in Results example 1 (red box). For soft substrate vegetation dominated community, many important pressures were not fully modelled in the SOM analysis, including effects of eutrophication. Thus, the analysis does not include information on how reductions in the input of nutrients affects eutrophication and further the state of soft substrate vegetation dominated communities.

Note that Kattegat has insufficient data to complete the assessment (grey table column marked 'insufficient data').

Interpretation of the results in this table should begin with consideration of the number of experts and confidence. For soft substrate vegetation dominated community in the Southern Baltic, the number of experts and confidence are both moderate. Further, the pressures not fully modelled in the SOM model should be considered, because it provides information on how well the sufficiency of measures analysis has been able to account for the effects of reductions in pressures on state. Taking these data together, there is uncertainty in the estimates, but they can give information on what are the significant pressures to the state component and their relative magnitude.

Results example 4. Significance of pressures (%) affecting soft substrate vegetation dominated community from the benthic habitats topic report.

Table 6.2. Significance of pressures (%) affecting *soft substrate vegetation dominated community*.

Area Pressure	Kattegat	Southern Baltic	Eastern Baltic	Northern Baltic
Extraction of fish (includes prey depletion)	Insufficient data	9		
Species disturbance or displacement by human presence		2		
Effects of non-indigenous species		3	7	5
Physical disturbance of marine habitats		20	11	27
Physical loss of marine habitats		16	22	19
Effects of eutrophication		28	33	41
River, lake, or land habitat loss/degradation		5		
Pharmaceutical pollution				
Change in hydrologic conditions		8	11	8
Human-induced food web imbalance		9	15	
Confidence	NA	Moderate	High	High
Number of experts	Less than 3	7	3	3

Colour scale for the significance of the pressure to the state variable (based on the expected value): 0-10%, 10-20%, 20-40%, 40-60%, 60-100%

Pressures for which we cannot quantify the link between the pressure input, pressure and state in the SOM analysis are highlighted in grey, e.g. we cannot link reductions in nutrient inputs to reductions in the effects of eutrophication and further to the state of benthic habitats.

Data used: expert responses on significance of pressures to state components

Example 5: Top five state components most affected by a specific pressure

Results example 5, below, is Table 3 from the input of nutrients topic report. A similar table is available for most topics; however, the table number and name will vary slightly by topic. The table shows the five most affected state components in the SOM analysis (columns) by a specific pressure (rows). The results are Baltic wide averages of the significance of pressures results (Results example 4) presented from the inverse perspective. They are intended to highlight the impacts pressures included in the analysis have on a variety of state components. Each cell contains the name of a state component and the average number of expert responses received in parentheses () to the relevant assessments.

In example 5, only one pressure is present (Effects of eutrophication), but tables in other reports can include multiple pressures in a single table. The most affected state component is listed furthest to the left (blue box, hard substrate vegetation dominated community) and the fifth most affected on the right (red box, blank). In this example, the average number of contributing experts to the most affected state component is 5.8 (blue box). If one or more of the most affected state components had insufficient data to meet the presentation standards of the SOM reports, these results were removed, and additional pressures were not added to the top five list (see green box). Instead, a blank cell will appear in the right most cell of the table (red box). If two of the top five most affected state components had insufficient data, then the two right most cells will appear blank, and so on.

These results should not be over interpreted. They indicate the state components which are most affected by a specific pressure only within the SOM model. In the case of the effects of eutrophication, benthic habitats are the most affected state components. However, this is only presented as a ranking; no indication is given as to the magnitude of differences either within the states listed or between those listed and those that are not. From the results presented below it might be appropriate to say that the listed benthic habitats are among the most affected state components by the effects of eutrophication and that benthic habitats are generally highly affected by eutrophication as four of the five benthic habitat types appear on this list.

Results example 5. Top five state component most affected by the effects of eutrophication from the input of nutrients topic report.

Table 3. Top five state components most affected by effects of eutrophication. Listing is based on Baltic-wide averages of the significance of pressures to state components presented in each respective topic report. Average number of expert responses for the state component is given in parenthesis (total response count for the state component divided by the number of geographic areas for the state component).

Pressure	**1st most affected state component**	**2nd most affected state component**	**3rd most affected state component**	**4th most affected state component**	**5th most affected state component**
Effects of eutrophication	Hard substrate vegetation dominated community (5.8)	Hard substrate epifauna dominated community (5.3)	Soft substrate infauna dominated community (5.0)	Soft substrate vegetation dominated community (3.8)	

Data used: expert responses on significance of pressures to state components for all topics

Less than five most affected state components are presented in cases where there is insufficient data for some state component(s) affected by the pressure, i.e. there are not enough expert responses to the significance of pressures to the state component in the survey (e.g. some mammals species). This corresponds to the criteria for the format of presentation.

Examples 6 & 7: Projected pressure reduction

Results example 6, below, is Table 8 from the [hazardous substances topic report](). A similar table is available for all topics, but the table number and name will vary slightly by topic. The table shows the projected pressure reduction for each pressure input in its own column. The cells present the expected value of the pressure reduction (%) by 2030 and its standard deviation in parenthesis ( ). The spatial assessment area is also given (rows) and -depending on the topic report- can be assessed on a Baltic Sea scale, or subbasin level, or a topic specific subdivision of areas.

For the input of TBT (red circle), the projected pressure reduction is -13% with a standard deviation of 15. The open and closed circles next to the standard deviation result (○○● for input of TBT; red circle) indicate categories of certainty based on the relative size of the standard deviation to the expected value (see orange box). Finally, the colour of the cell (red for the input of TBT; red circle) indicates categories of percent pressure reduction (see purple box). In this case, the projected pressure reduction is negative, indicating a pressure increase. This happens when the changes in the extent of human activities have a larger effect on pressures than existing measures.

No information on confidence or number of responses is presented, as the results do not come directly from expert survey responses but are calculated using data on activity-pressure contributions, effectiveness of measure types and information on existing measures. However, these indications of confidence are available for the underlying data and the quality of these data should be considered when interpreting the values presented here.

Interpretation of the results in this table should begin with consideration of the quality of the underlying data, along with the expected value, standard deviation and certainty category in this table. For the input of TBT, the standard deviation is larger than the expected value, and certainty of the assessment is classified as low. Thus, there is considerable uncertainty in the estimate, but it indicates that the input of TBT is not expected to be reduced with existing measures. In addition, the number of responses and confidence of experts for the underlying data elements can be examined for further information on certainty of the result.

Results example 6. Projected reductions in the input of mercury, TBT, PFOS and diclofenac in 2016-2030 from the hazardous substances topic report.

Table 8. Projected reductions (%) in the input of mercury, TBT, PFOS and diclofenac from existing measures in the Baltic Sea in 2016-2030. The table depicts the most likely/expected values of reductions in pressure inputs and gives standard deviations in parenthesis.

Pressure input Area	Input of mercury	Input of TBT	Input of PFOS	Input of diclofenac
Baltic Sea	38 (15) ○●●	-13 (15) ○○●	24 (11) ○●●	-2 (2) ○○●

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

Categories for the certainty of the pressure input reductions (based on the relative size of the standard deviation to the expected value): low: ○○●, moderate: ○●●, high: ●●●

Data used: expert estimates of activity-pressure input contributions, expert estimates of effectiveness of measure types, information on existing measures

Results example 7, below, is Table 2 from the input of nutrients topic report. The table takes a somewhat different format for the input of nutrients. The projected reductions by 2030 are presented together with the maximum allowable inputs (MAI) and needed reductions based on the nutrient reduction scheme. The projected reduction shows the expected value (%) and the minimum and maximum values in parenthesis ( ) (blue box for phosphorus). The required reduction is shown as the percent based on exceedance of MAI (green box for phosphorus). The spatial assessment area is given in the rows. The colour of the cell indicates whether the projected reduction is larger, smaller, or approximately equal to the needed reduction (see orange box).

For the Gulf of Riga, the projected reduction in the input of phosphorus is 5%, and considerably smaller than the required 23% (purple box). Of note here, transboundary inputs of phosphorus into the Gulf of Riga are particularly high and not presented in this table. This is an example of the complementary or even interdependent nature of the results presented in the topic reports. While many individual results can and should be used independently (see the Main SOM report section 1.3 How to use the results: Relationships between results), it is recommended that the results of the entire report are considered before extracting individual elements for use.

Interpretation of the results in this table should begin with consideration of the expected value and minimum and maximum values. For the input of phosphorus to the Gulf of Riga, the minimum and maximum are close to the expected value, and thus certainty of the assessment could be classified as rather high. However, uncertainty is perhaps underrepresented here, as variation is only present in the agricultural reduction data. Further, the expected, minimum and maximum pressure reductions should be compared to the required reduction to evaluate the likelihood of achieving the targets with existing measures. The result indicates that existing measures would not be sufficient to achieve the reduction target for the input of phosphorus in the Gulf of Riga, as the expected and required reductions are quite far apart.

Results example 7. Projected reductions (%) in the input of nutrients from existing measures by 2030 and needed reduction based on comparing maximum allowable inputs (MAI) and inputs in 2017 from the input of nutrients topic report.

Table 2. Projected reductions (%) in the input of nutrients from existing measures by 2030 (Source: SOM analysis) and needed reductions 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 (%)**	**Projected reduction with existing measures (%) (minimum-maximum)**	**Maximum allowable input (MAI)**	**Exceedance of MAI**	**Needed reduction (%)**	**Projected reduction with existing measures (%) (minimum-maximum)**
Kattegat	1687	–	–	10 (9–11)	74000	–	–	17 (13–24)
Danish Straits	1601	–	–	6 (5–7)	65998	–	–	19 (11–26)
Baltic Proper	7360	7111	49	14 (10–17)	325000	108102	25	16 (10–22)
Gulf of Riga	2020	610	23	5 (4–5)	88417	5954	6	7 (4–10)
Gulf of Finland	3600	2012	36	11 (11–14)	101800	12662	11	6 (3–8)
Bothnian Sea	2773	–	–	4 (2–13)	79372	–	–	18 (11–23)
Bothnian Bay	2675	47	2	2 (1–7)	57622	639	1	12 (7–15)
Total	21716	9780	31		792209	127357	14	

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

Data used: ACTION WP4 based on source apportionment data collected within the PLC-6 and PLC-7 projects, survey responses on reductions in agricultural runoff, ACTION WP4 estimates on reductions in wastewater treatment, potential reduction of airborne input of nitrogen from ENIRED II, HELCOM maximum allowable inputs (MAI)

Example 8: Effectiveness of measures

Results example 8, below, is Table 4.2 from the underwater noise topic report. A similar table is available for most topics; however, the table number and name will vary slightly by topic. The table presents the estimated measure type effectiveness for one or more human activities, together with information on whether the measure type is implemented in the Baltic Sea region for the pressure input in question (input of continuous noise 2 kHz in the example below). Each row represents a single measure type, with the first two columns giving identifying information on that measure type (e.g. orange box for measure type 155 Speed limits in sensitive areas or times). Effectiveness information is contained in the next column(s), with a separate column for each relevant human activity (e.g. blue box for fish and shellfish harvesting). The final column in the table indicates whether the measure type has a corresponding existing measure or measures in the SOM existing measures list (green box). Rows mark with a 'Yes' have at least one measure implemented somewhere in the Baltic Sea region that was included in the SOM analysis. Rows marked with a 'No' have no corresponding measure in the SOM analysis, but may still be present in the Baltic Sea region due to the measure either not being reported to the project or the measure being fully implemented before 2016.

For measure type 155 Speed limits in sensitive areas or times (orange box), effectiveness was assessed for three human activities, fish and shellfish harvesting, tourism and leisure activities, and transport – shipping. The remaining two human activities in the table are marked as 'Not assessed' for that measure type. No data was gathered in these cases and the measure type may or may not be relevant for those activities. For fish and shellfish harvesting, measure type 155 (red circle) has an expected effectiveness value of 13% pressure with a standard deviation of 14 which appears in parentheses ( ). The open and closed circles next to the standard deviation result (○○● for measure type 155 for fish and shellfish harvesting; red circle) indicate categories of certainty based on the relative size of the standard deviation to the expected value (see purple box). Finally, the colour of the cell (yellow for measure type 155 for fish and shellfish harvesting; red circle) indicates categories of percent pressure reduction (see purple box). The confidence result (second lowest row) depicts the most common rating of expert confidence in their own survey response (low, moderate, high). For fish and shellfish harvesting, average expert confidence across all measure types was moderate (bottom of blue box). The number of experts indicates the range of experts responding to this question in the expert survey. However, in the example below the same number of experts responded to each measure type-activity combination, so only a single value is shown. Results for fish and shellfish harvesting for all relevant measure types are based on 5 expert responses (bottom of blue box). Finally, no existing measure corresponds to this measure type in the SOM analysis (intersection of yellow and green boxes).

Interpretation of the results in this table should begin with consideration of the number of experts and confidence followed by the expected value, standard deviation and certainty category. For fish and shellfish harvesting under measure type 155 (red circle), the number of experts is low, and the confidence level is moderate (bottom of blue box). Additionally, the standard deviation is larger than the expected value which indicates great uncertainty. This is also suggested by the certainty category ○○●. Overall, these results suggest that speed limits in sensitive areas or times would likely have a small but positive effect on the input of continuous noise in the 2 kHz band. When compared to the other measure types affecting fish and shellfish harvesting, speed limits appear to be one of the least effective options surveyed and similar in effectiveness with awareness raising measures (157 Improve awareness of ship owners/companies about noise input, effects, and avoidance).

Results example 8.

Effectiveness of measures types (%) in reducing the input of continuous noise 2 kHz from the underwater noise topic report.

Table 4.2 Effectiveness of measure types (%) in reducing the *input of continuous noise 2 kHz*. The effectiveness of a measure type is the percent reduction in the pressure resulting from a specific activity. The table depicts the most likely/expected effectiveness, and standard deviation is given in parenthesis.

Measure type ID	Activity Measure type	Fish and shellfish harvesting	Extraction of minerals	Restructuring of seabed morphology	Tourism and leisure activities	Transport – shipping	Has corresponding existing measures in the SOM analysis (Yes/No)
150	Promotion of alternative/low noise technologies	23 (21) ○○●	25 (24) ○○●	31 (21) ○○●	34 (21) ○○●	30 (26) ○○●	Yes
151	Implementation of restrictions/permitting based on ship noise classifications	23 (23) ○○●	Not assessed	Not assessed	36 (16) ○●●	26 (21) ○○●	No
152	Use of shore-based power while in port	Not assessed	Not assessed	Not assessed	Not assessed	10 (15) ○○●	No
153	Optimized scheduling to reduce time spent at anchorage sites	Not assessed	Not assessed	Not assessed	Not assessed	12 (11) ○○●	No
154	Spatial/temporal restrictions for sensitive areas and species	31 (23) ○○●	Not assessed	Not assessed	38 (14) ○●●	31 (21) ○○●	No
155	Speed limits in sensitive areas or times	13 (14) ○○●	Not assessed	Not assessed	39 (17) ○●●	27 (19) ○○●	No
156	Raise consumer awareness about noise input and effects	Not assessed	Not assessed	Not assessed	Not assessed	13 (12) ○○●	No
157	Improve awareness of ship owners/companies about noise input, effects, and avoidance	14 (11) ○○●	Not assessed	Not assessed	29 (14) ○●●	20 (16) ○○●	No
158	Introduce engine noise standards	Not assessed	Not assessed	Not assessed	36 (17) ○●●	Not assessed	No
	Confidence	Moderate	Moderate - Low	Low	High	Moderate	
	Number of experts	5	7	7	5	6	

Colour scale for the effectiveness of a measure type in percent (based on the expected value): 0-10%, 10-20%, 20-40%, 40-60%, 60-100%
Categories for the certainty of the effectiveness estimate (based on the relative size of the standard deviation to the expected value): low: ○○●, moderate: ○●●, high: ●●●
Data used: expert estimates of the effectiveness of measure types

Example 9: Activity-pressure contributions

Results example 9, below, is Table 5 from the non-indigenous species (NIS) topic report. A similar table is available for some topics, but the table number and name will vary slightly by topic. The table presents the human activities (columns) that contribute to the listed pressure. Each pressure will be shown in a separate table, and the row(s) indicate the spatial area of the assessment. In the example below, there is only one spatial area and therefore only one row of data.

Results example 9 presents the activity-pressure contributions for the anthropogenic introduction of NIS. Transport – shipping ballast water appears as the dominate source of NIS introductions (blue box) and has an expected contribution of 38% of NIS introductions with a standard deviation of 4, which appears in parentheses ( ). The open and closed circles next to the standard deviation result (●●● for transport – shipping ballast water; blue box) indicate categories of certainty based on the relative size of the standard deviation to the expected value (see purple box). Finally, the colour of the cell (green for transport – shipping ballast water; blue box) indicates categories of percent activity-pressure contribution (see purple box). The activity-pressure contributions for NIS were determined using existing data gathered from the AquaNIS database. However, other topics relied on expert opinion. Those topics will also include the total number of contributing experts in the last column of the table.

Interpretation of the results in this table should begin with consideration of the number of experts (if applicable), followed by the expected value, standard deviation and certainty category. In the case of transport – shipping ballast water, the certainty suggests a high confidence in this estimate. However, the methodology used to generate these values is vulnerable to the rare nature of NIS introductions and, as with all topics, the methodology and assumptions used to arrive at these results should be kept in mind when interpreting their implications.

Results example 9. Activity-pressure contributions (%) from the non-indigenous species topic report.

Table 5. Activity-pressure contributions (%). The activity-pressure contributions show the percentage share the activity contributes to the pressure input (*anthropogenic input of NIS*). The table depicts the most likely/expected contribution (%), and standard deviations are given in parenthesis.

Anthropogenic introduction of NIS	Aquaculture	Activities and sources outside the Baltic Sea Region	Transport – shipping ballast water	Transport – shipping biofouling	Transport – shipping infrastructure (canals)	Other/not determined
Whole Baltic Sea	6 (2) ●●●	29 (4) ●●●	38 (4) ●●●	17 (4) ●●●	6 (3) ○●●	4 (2) ○●●

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

Categories for the certainty of the activity-pressure input contribution estimate (based on the relative size of the standard deviation to the expected value): low: ○○●, moderate: ○●●, high: ●●●

Data used: entries on primary introductions into the Baltic Sea from the AquaNIS database for 2005-2016

Example 10: Impact of existing measures

Results example 10, below, is Table 6 from the non-indigenous species (NIS) topic report. A similar table is available for most topics, but the table number and name will vary slightly by topic. The table is arranged with the results for each existing measure given in a single row. Each row contains information on the existing measure, the activities it affects, link to a measure types in the SOM analysis, and countries where it is implemented. Results are presented for impact at the Baltic Sea scale (%) and impact in the area affected (%), together with information on the affected area of the total Baltic Sea (%). Standard deviation for the impact estimates is given in parenthesis (). The impact is the reduction in the pressure (anthropogenic introduction of NIS) from implementing the existing measure.

The IMO Ballast Water Management Convention (BWMC) is applied in the entire Baltic Sea (red box), and thus its impact at the Baltic Sea scale and the affected area are identical at 26%. In contrast, the Danish aquaculture measure on NIS affects only 11% if the Baltic Sea (green box). It has a low impact in the area affected at 3%, and thus its impact in the Baltic Sea scale is very low and rounded to zero in the presentation. An individual measure may appear more than once in this table. For instance, the two measures in the blue box are recording the same measure from multiple perspectives (top measure is the EU requirement, the bottom measure is the national implementation; blue box). As only one instance of an individual measure type can be implemented at a time (see methodology report), the double counting does not affect analysis results and is only maintained for recording purposes.

No information on confidence or number of responses is presented, as the results do not come directly from survey responses but are calculated using data on activity-pressure contributions, effectiveness of measure types and information on existing measures.

The impact of existing measures is related to the impact of measure types (Results example 13). The impact of existing measures, presented below, covers the estimated impact of real measures that have been or will be implemented in the Baltic Sea region. While the impact of measure types, results example 13, covers the hypothetical impact of a measure type if implemented in all relevant areas. The impact of existing measures provides information on the impact of environmental efforts while the impact of measure types provides a standardized view of the impact of measure types which can support selection of new measures.

Interpretation of this table should focus on the last four columns. As these data are a product of the activity-pressure contribution data and the implementation area of existing measures, the impact of any specific measure depends on the activity/activities it targets, the importance of that activity/activities to the pressure, and the size of the area where the measure is implemented. When considering the larger impact of the BWMC compared to the Danish aquaculture measure, the BWMC targets a more important source of NIS (transport – shipping ballast water), causing the impact in the affected area to be higher, and covers a larger area, causing the impact at the Baltic Sea scale to be higher. As a result, the BWMC is a more impactful measure on reducing the anthropogenic introduction of NIS than the Danish aquaculture measure.

Results example 10.

Impacts of existing measures in reducing anthropogenic introduction of non-indigenous species from the non-indigenous species topic report.

Table 6. Impacts of existing measures in reducing anthropogenic introduction of non-indigenous species. Impact is the percent reduction in a specific pressure from implementing the measure. Measure name and description correspond to those used in Annex 4 for referencing purposes. In rare cases, the name and description may not be representative of the existing measure due to the free text reporting format used during existing measures data collection. Standard deviations are given in parenthesis. Note that values less than 0.5 have been rounded to zero.

Measure name	Description	Countries	Measure type	Activities	Impact at the Baltic Sea scale (%)	Impact in the area affected (%)	Affected area of the total Baltic Sea (%)
IMO Ballast Water Management Convention	IMO Ballast Water Management Convention	All countries	Full implementation of the Ballast Water Management Convention	Transport – shipping ballast water	26 (9)	26 (9)	100
Aquaculture NIS	Article 4 Measures for avoiding adverse effects 1. Member States shall ensure that all appropriate measures are taken to avoid adverse effects to biodiversity, and especially to species, habitats and ecosystem functions which may be expected to arise from the introduction or translocation of aquatic organisms and non-target species in aquaculture and from the spreading of these species into the wild. 2. The competent authorities in the Member States shall monitor and supervise aquaculture activities so as to ensure that: (a) closed aquaculture facilities comply with the requirements laid down in Article 3(3); and (b) transport from or to closed aquaculture facilities takes place in conditions that are such as to prevent the escape of alien or non-target species.	DK	Tighten restrictions for aquaculture management (transportation between facilities/prevent escapes etc)	Aquaculture	0 (0)	3 (1)	11
Denmark - Aquaculture Manual	Mariculturists prevent the release of NIS from their activities (aquaculture). The revised Aquaculture Manual will describe the conditions that should be monitored by the authorities in relation to aquaculture operations, as well as those that should be monitored during transportation of fish between port and aquaculture areas. The Manual also includes the notification of authorities and follow-up/limitation of releases.	DK	Tighten restrictions for aquaculture management (transportation between facilities/prevent escapes etc)	Aquaculture	0 (0)	3 (1)	11

Example 11: Supplementary results for required pressure reductions

Results example 11, below, is Annex 10 from the coastal fish topic report. A similar annex is available for each topic that assesses a state component, but the annex number may vary slightly by topic. Each cell of this table contains a figure of the probability density function presenting the combined expert responses to the question on required pressure reduction to achieve GES or state improvement. Required pressure reduction (%) appears on the x-axis and probability density on the y-axis. Note that the y-axis is not identical for all figures. Two scales are used: 0–5 scale (red box) and 0–20 scale (blue box). Required pressure reduction values with greater density (i.e. where the blue line is further above the x-axis) are more likely than values with less density (i.e. where the blue line is closer to the x-axis). The number of experts and average confidence are shown above the figure (e.g. green box). The confidence result depicts the most common rating of expert confidence in their own survey response (low, moderate, high). The annex presents more detailed data for the expected value and standard deviations presented in Results example 2, showing the views of the experts in more detail and more accurately illustrating variation in expert responses than the standard deviations.

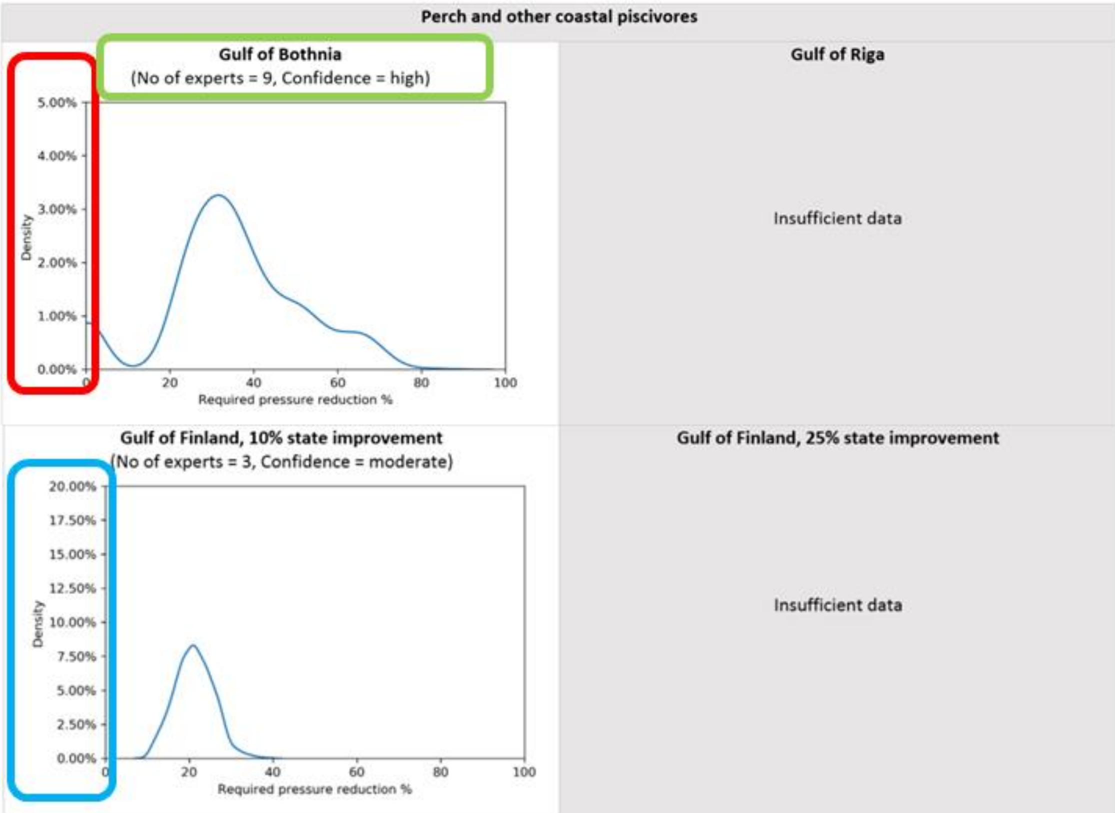
Interpretation of the results in this table should begin with consideration of the number of experts and average confidence. For perch and other coastal piscivores in the Gulf of Bothnia, confidence is high and the number of contributing experts is moderate at nine (green box). This suggests the certainty of the presented results is also moderate. The distribution itself has a small peak at 0% reduction and a much larger peak at approximately 30% reduction. Importantly, there is very little probability mass (i.e. area under the blue line) less than 20-25%, which indicates a likely minimum range for the required pressure reduction to reach or maintain GES. The maximum range is less well defined with the probability mass noticeably less from about 50-80%. However, this maximum range still has significant probability mass, indicating that these values are not unlikely.

Note that the Gulf of Riga and 25% state improvement in the Gulf of Finland have insufficient data (grey cells marked ‘insufficient data’).

Results example 11. Supplementary results for required pressure reductions – Perch and other coastal piscivores from the coastal fish topic report.

Annex 10 Supplementary results for required pressure reductions

This annex presents the probability density functions of required pressure reductions to achieve a noticeable state improvement based on responses to the expert survey. The graphs show the probability distribution of the pooled expert responses on how much pressures should be reduced to achieve a noticeable state improvement. Pressure reduction is presented on the x-axis (0-100%) and probability density on the y-axis. The probability density function presents the probability of the pressure reduction falling within a particular range of values. This probability is given by the integral of the probability density over that range—that is, it is given by the area under the density function but above the horizontal axis and between the lowest and greatest values of the range.



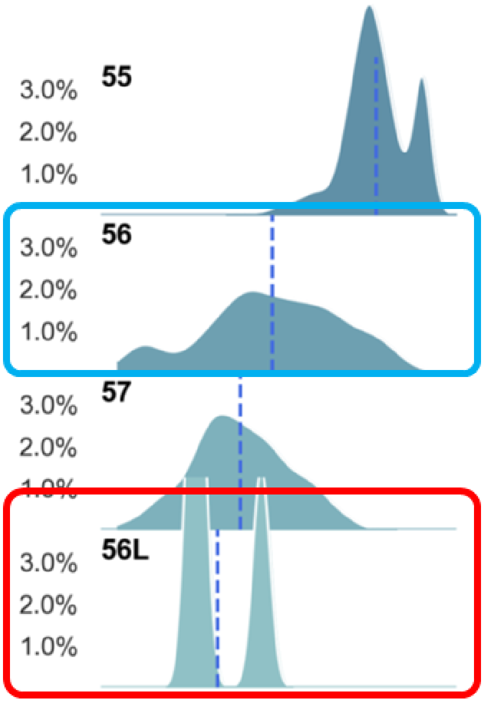
Example 12: Supplementary results for effectiveness of measures

Results example 12, below, is Annex 10 from the waterbirds topic report. A similar annex is available for most topics; however, the annex number may vary slightly by topic. The figure presents the probability density functions for either the combined expert responses to the effectiveness of measures survey (e.g. blue box) or the combined literature-based data on effectiveness of measure types (e.g. red box). Literature-based data is indicated with a 'L' following the measure type number, both in the figure legend (purple box; note measure type 56L) and the figure itself (red box, note measure type 56L). Measure type effectiveness (%) appears on the x-axis and probability density on the y-axis. The scale of the x-axis does not appear in the figure but ranges from 0 on the left to 100 on the right. Measure type effectiveness values with greater density (i.e. where the shape extends further above the x-axis) are more likely than values with less density (i.e. where the shape stays closer to the x-axis). The expected value is indicated by a vertical dashed line. The range of experts and average confidence are shown above the figure (green box box). The confidence result depicts the most common rating(s) of expert confidence in their own survey response (low, moderate, high). The annex presents more detailed data for the expected value and standard deviations presented in Results example 8, showing the views of the experts in more detail and more accurately illustrating variation in expert responses than the standard deviations.

Interpretation of the results in this table should begin with consideration of the number of experts and average confidence. For measures affecting waterbird bycatch of pelagic feeders from fish and shellfish harvesting, confidence is moderate to high and the number of contributing experts is moderate at ten to eleven (green box). This suggests the certainty of the presented results is also moderate. The distribution of measure type 56 (blue box) is quite broad with noticeable probability mass ranging from 0 to approximately 80% and the bulk of the mass ranging from 20-70%. This broad distribution suggests the effect of this measure type is uncertain. The distribution of measure type 56L (red box), the literature-based version of measure type 56 is much more concentrated. Based on the shape it appears to be based on only two datapoints (review appropriate annex 6 for confirmation). The expected value of 56L compared to 56 is lower and the distribution range is much narrower. Use of the literature values instead of the expert derived values would slightly reduce the effectiveness of measure type 56 in the model, but it would more significantly impact the certainty of the effect.

Results example 12. Supplementary results for effectiveness of measures waterbird bycatch – pelagic feeders from the waterbirds topic report.

Pressure:	Waterbird bycatch - pelagic feeders
Activity:	Fish and shellfish harvesting (all gears; professional, recreational)
Measure type:	55: Reduce fishing effort with gillnets or other gears causing bycatch of waterbirds
	56: Reduce bycatch of waterbirds by modifications of fishing gears
	57: Implement fisheries management measures in MPAs
	56L: Reduce bycatch of waterbirds by modifications of fishing gears (literature based)
Expert assessment:	10-11 experts, confidence = high-moderate



Example 13: Impact of measure types

Results example 13, below, is Annex 11 from the marine mammals topic report. A similar annex is available for most topics, but the annex number may vary slightly by topic. This table presents the hypothetical impact of measure types across all activities if they were implemented in all relevant areas, in a given spatial assessment unit (see red box). The first column gives the pressure followed by the spatial scale in parentheses () (e.g. red box). The middle column identifies the measure type, and the last column shows the mean impact and standard deviation in parentheses () (e.g. blue box). This table provides a standardized perspective on the aggregate impact of a given measure type which takes into account measure type effectiveness and activity-pressure contributions. Results with insufficient data for either measure type effectiveness or activity-pressure contribution will show as 'insufficient data' here.

The impact of measure types is related to the impact of existing measures (Results example 10). The impact of measure types, presented below, covers the hypothetical impact of a measure type if implemented in all relevant areas. While the impact of existing measures, results example 10, covers the estimated impact of real measures that have been or will be implemented in the Baltic Sea region that are expected to have new impacts on the environment from 2016 on. The impact of measure types provides a standardized view of the impact of measure types which can support selection of new measures, while the impact of existing measures provides information on the impact of environmental efforts.

Interpretation of this table should begin with review of the underlying data and their uncertainties: effectiveness of measures (Results example 8) and activity-pressure contributions (Results example 9), and proceed to examining the expected value and standard deviation. Comparison of measure types to control seal bycatch suggest similar effectiveness across all the listed measures types.

Results example 13. Impacts of measure types (%) in reducing pressures on marine mammals from the marine mammals topic report.

Table A7. Impacts of measure types (%) in reducing pressures on marine mammals. The impact shows how much the measure type reduces the pressure across all activities contributing to the pressure.

Pressure on marine mammals *(spatial scale)*	**Measure type**	**Mean (Standard deviation)**
Porpoise bycatch	Reduce fishing effort with gillnets or other gears causing bycatch of harbour porpoise	insufficient data
(Baltic Sea)	Strengthen fishing regulations in existing marine protected areas	insufficient data
	Reduce bycatch of harbour porpoise by modifications of fishing gears	insufficient data
	New Marine Protected Areas with implemented management plans restricting fishing activity	insufficient data
	Expanded mandatory use of acoustic deterrent devices (pingers)	insufficient data
	National management plans for harbour porpoise	insufficient data
Seal bycatch	Reduce bycatch of seals by modifications of fishing gears	58 (22)
	Reduce fishing effort with gillnets or other gears causing bycatch of seals	56 (18)
(Baltic Sea)	Strengthen fishing regulations in existing marine protected areas	52 (14)
	New Marine Protected Areas with implemented management plans restricting fishing activity	51 (22)

SOM report series

HELCOM ACTION 2021a. Sufficiency of existing measures to achieve good status in the Baltic Sea. Available at: http://www.helcom.fi/SOM/MainSOMReport

HELCOM ACTION 2021b. Methodology for the sufficiency of measures analysis. Available at: http://www.helcom.fi/SOM/MethodologyReport

HELCOM ACTION 2021c. A practical guide to interpreting the SOM results. Available at: http://www.helcom.fi/SOM/PracticalGuide

HELCOM ACTION 2021d. Sufficiency of existing measures for benthic habitats in the Baltic Sea. Available at: http://www.helcom.fi/SOM/BenthicHabitatsReport

HELCOM ACTION 2021e. Sufficiency of existing measures for coastal fish in the Baltic Sea. Available at: http://www.helcom.fi/SOM/CoastalFishReport

HELCOM ACTION 2021f. Sufficiency of existing measures for commercial fish in the Baltic Sea. Available at: http://www.helcom.fi/SOM/CommercialFishReport

HELCOM ACTION 2021g. Sufficiency of existing measures for hazardous substances in the Baltic Sea. Available at: http://www.helcom.fi/SOM/HazardousSubstancesReport

HELCOM ACTION 2021h. Sufficiency of existing measures for input of nutrients in the Baltic Sea. Available at: http://www.helcom.fi/SOM/NutrientsReport

HELCOM ACTION 2021i. Sufficiency of existing measures for marine litter in the Baltic Sea. Available at: http://www.helcom.fi/SOM/MarineLitterReport

HELCOM ACTION 2021j. Sufficiency of existing measures for marine mammals in the Baltic Sea. Available at: http://www.helcom.fi/SOM/MarineMammalsReport

HELCOM ACTION 2021k. Sufficiency of existing measures for migratory fish in the Baltic Sea. Available at: http://www.helcom.fi/SOM/MigratoryFishReport

HELCOM ACTION 2021l. Sufficiency of existing measures for non-indigenous species in the Baltic Sea. Available at: http://www.helcom.fi/SOM/NISReport

HELCOM ACTION 2021m. Sufficiency of existing measures for underwater noise in the Baltic Sea. Available at: http://www.helcom.fi/SOM/UnderwaterNoiseReport

HELCOM ACTION 2021n. Sufficiency of existing measures for waterbirds in the Baltic Sea. Available at: http://www.helcom.fi/SOM/WaterbirdsReport

HELCOM ACTION 2021o. Cost-effectiveness of proposed new measures for the Baltic Sea Action Plan 2021. Available at: http://www.helcom.fi/SOM/CostEffectivenessReport

Model code is available at: https://github.com/LiisaSaikkonen/ACTION_SOM