Baltic Marine Environment Protection Commission

HELCOM BSAP UP workshop on hazardous substances and litter

BSAP UP WS-HZ 2020

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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 marine litter. The results provide a basis for evaluating proposed actions in the HELCOM BSAP UP workshop on hazardous substances and litter (BSAP UP WS-HZ 2020) by identifying pressure reductions until 2030-2035, taking into consideration existing measures and changes in human activities. The document presents findings on what are the pressure reductions from existing measures, how effective are measure types in reducing pressures, and which activities contribute to pressures. The results provide supporting information for evaluating where new measures are likely needed (geographically and by pressure) 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 litter, 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 marine litter

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). The input of a pressure is often measured rather than the pressure itself for a variety of reasons, including 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 analysis.

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.

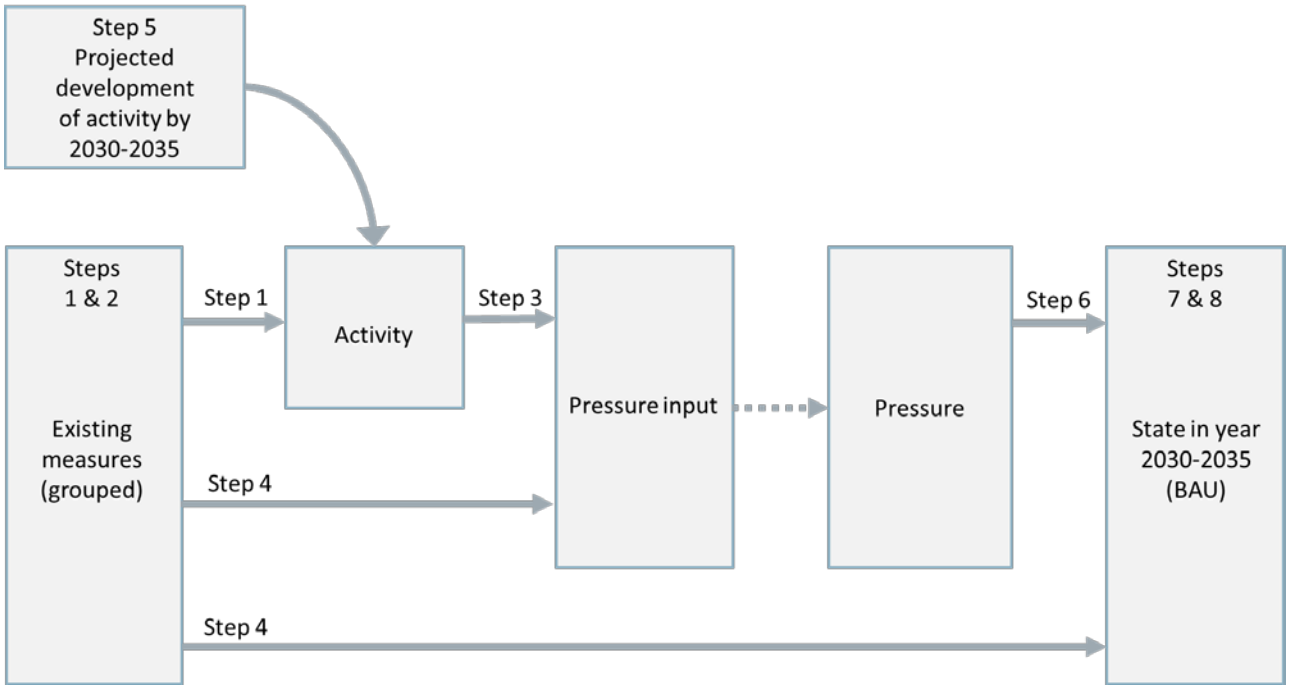

Figure 1. General schematic of the main components of the SOM analysis

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 SOM results are presented 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 also standard deviations, when available. Standard deviation is a way of showing the variation in the values. 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 to the annexes. They will show the same results as the tables but allow either more detailed information or alternative visualization 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 survey responses on a low-moderate-high scale. More detailed information on how each result has been calculated is presented in a separate document.

This document presents the results based on the expert-based data (i.e. survey responses). Literature data on the effectiveness of measures has been collected but are not included at this point. 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 litter

The SOM analysis estimates the reduction in the input of litter from existing measures, taking into consideration the future development of human 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 in size from a single Baltic Sea to individual sub-basins. The activity-pressure contributions for marine litter (Step 3) are assessed across 6 sub-areas of the Baltic Sea (Figure 2), while the effectiveness of measure types in reducing pressures (Step 4) and the effect of development of human activities (Step 5) are assessed at the scale of the entire Baltic Sea. Table 1 shows the origins and spatial resolution for the data components in the SOM analysis for the input of litter.

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

Data component	Origin of data	Spatial resolution
Activity-pressure contributions	Expert evaluation	6 sub-areas (Figure 2)
Existing measures	Literature review, Contracting Parties	17 sub-basins
Effectiveness of measures	Expert evaluation	Whole Baltic Sea
Development of human activities	Literature review, existing data and projections	Whole Baltic Sea
Pressure-state links	NA	NA

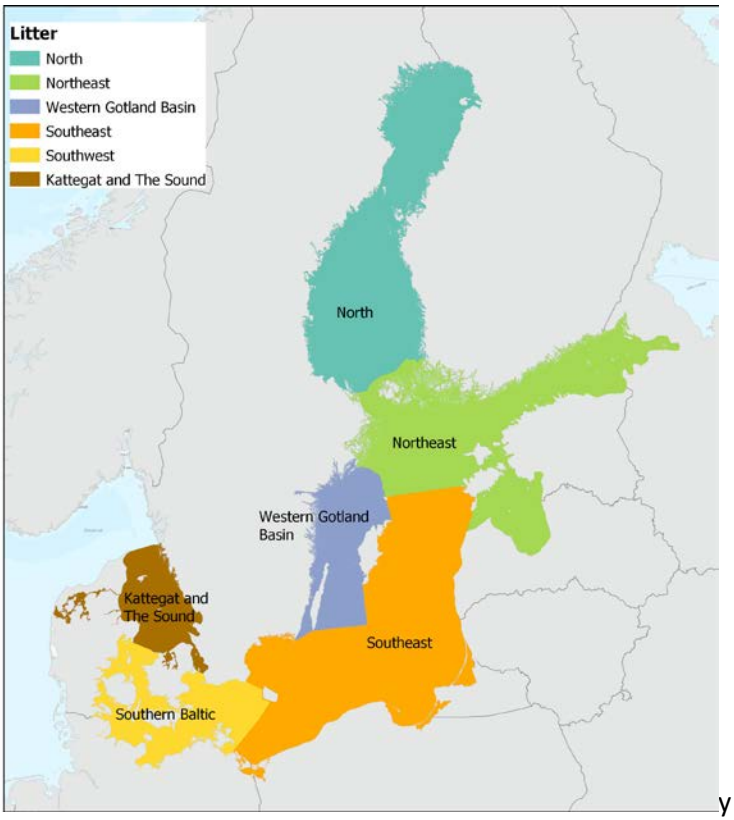

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Figure 2. Spatial division of the Baltic Sea used for determining contributions of human activities to the input of marine litter. The six sub-areas are: Kattegat and the Sound; Southern (Great Belt, Kiel Bay, Bay of Mecklenburg, Arkona Basin); Southeast (Bornholm Basin, Gdansk Basin, Eastern Gotland Basin); Western Gotland Basin; Northeast (Gulf of Riga, Northern Baltic Proper, Gulf of Finland, Åland Sea); and North (Bothnian Sea, The Quark, Bothnian Bay).

Marine litter is a complex topic in the SOM analysis. While the impacts of marine litter on the environment can be very similar across litter items, legislation and regulation are frequently targeted toward specific litter items. Estimating the impact of a measure targeted toward a single litter item on the total input of litter was not considered feasible. This led to a hybrid approach that balances between the importance of individual litter items while maintaining a single cohesive litter pressure input, *input of top litter items to the beach* (Figure 3).

This pressure input reflects the structure of the HELCOM pre-core indicator "Beach litter" and MSFD criteria D10C1[1]. No GES threshold value has been established for the input of litter, and therefore the SOM analysis assesses the relative improvement from present conditions. It is important to note that the SOM analysis only addresses the top 15 litter items, which comprise 67% percent of all items collected from surveyed beaches around the Baltic Sea. Thus, a 100% reduction of the pressure input would not lead to the eventual elimination of all beach litter. Change in this pressure input in the SOM analysis is based on effectiveness of measures assessment targeted at the 15 top litter items on Baltic beaches (HELCOM 2018). These effectiveness estimates are then used to assess the reduction in the total input of top beach litter items based on data from the HELCOM SPICE project. Full details of this approach can be found in the SOM methodology document.

[1] Marine Strategy Framework Directive criteria D10C1 – Primary: The composition, amount and spatial distribution of litter on the coastline, in the surface layer of the water column, and on the seabed, are at levels that do not cause harm to the coastal and marine environment. Member States shall establish threshold values for these levels through cooperation at Union level, taking into account regional or subregional specificities

In addition to the primary analysis focusing on the input of top beach litter items as a pressure input, two marine litter pressures are included in the SOM analysis: *bycatch in ghost nets* and *effects of marine litter (excluding bycatch in ghost nets)* (Figure 3). These two pressures related to marine litter could be selected when identifying the most significant pressures linked to any of the state components included in the SOM analysis. The pressures reflect the impacts of marine litter rather than the quantity of litter added to the environment. The pressures do not directly correspond to a HELCOM indicator or MSFD criteria, but instead more holistically assess marine litter effects in the Baltic Sea. While the MSFD criteria D10C4[2] might be used as a metric to generate species-specific litter pressure assessments, a complete assessment of the pressure using concrete criteria is beyond the scope of this project. Bycatch in ghost nets has been separated from the main litter pressure due to its very specific source and effect on the environment. In the SOM analysis, no link has been made between the litter pressure input, *input of top litter items to the beach,* and either litter pressure (Figure 3). If either of the marine litter pressures has been identified as significant to one of the state components in the SOM analysis, these results are reported in the documents for other SOM topics.

Finally, experts were also asked to assess the effectiveness of measures in controlling the *direct input of microplastics*. Microplastics are not included further in the SOM analysis, but these supplementary effectiveness data are included in this document and could be used to inform future work on the issue.

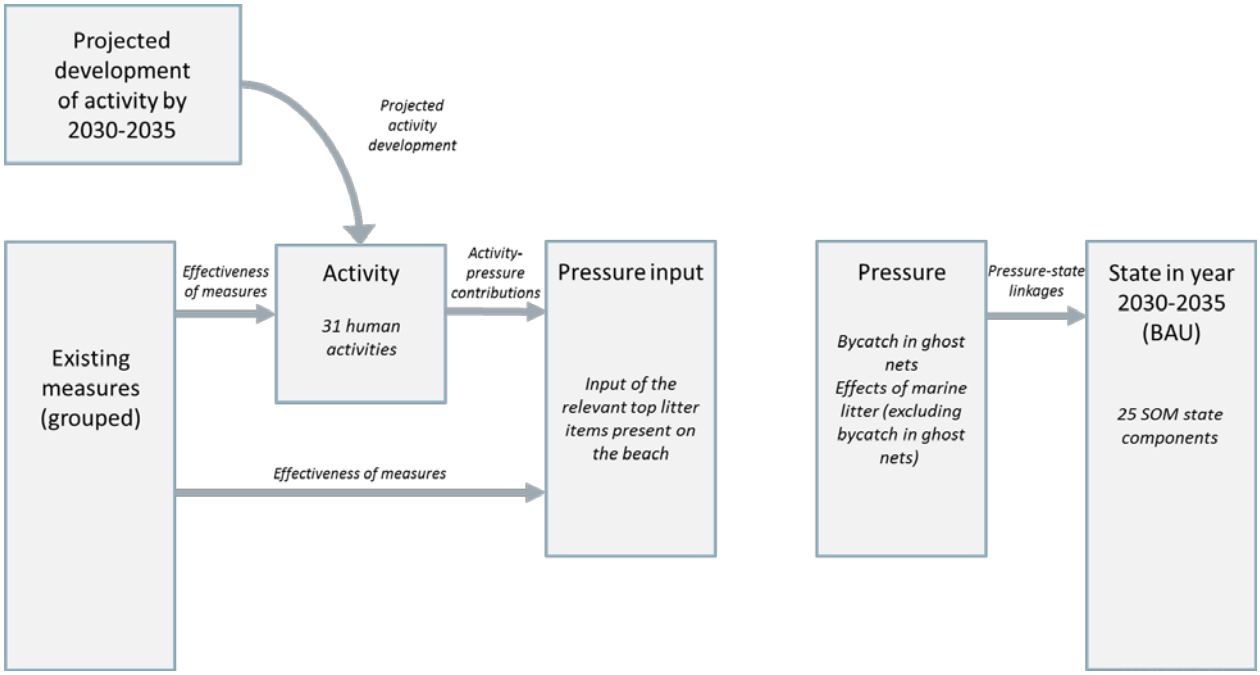

Figure 3. Schematic of the SOM analysis for marine litter. The impacts of the litter pressure input (*Input of the relevant top litter items present on the beach*) on the litter pressures (*Bycatch in ghost nets; Effects of marine litter (excluding bycatch in ghost nets)*) have not been estimated within the SOM analysis.

What are the reductions in pressure inputs from existing measures?

For the topic of marine litter, the SOM analysis is only able to assess the reductions in the input of litter considering the effect of existing measures and development of human activities. There is no agreed HELCOM GES threshold or a core indicator for marine litter, only a pre-core indicator on beach litter. As GES has not been defined, a full assessment of the sufficiency of measures is impossible, i.e. the results cannot indicate

[2] Marine Strategy Framework Directive criteria D10C4 – Secondary: The number of individuals of each species which are adversely affected due to litter, such as by entanglement, other types of injury or mortality, or health effects. Member States shall establish threshold values for the adverse effects of litter, through regional or subregional cooperation.

whether existing measures are sufficient in achieving the objective. However, the analysis can still suggest what kind of reductions in the input of litter are likely given existing measures.

Table 2 shows the effects of existing measures in reducing the input of marine litter by assessment area (Figure 2). They are based on the activity-pressure contributions, effectiveness of measure types, links between existing measures and measure types, and projected development of activities. The activity-pressure data are at the level of 6 sub-areas (Figure 2) and the effectiveness of measures data at the Baltic Sea level. The total pressure reductions are presented at the sub-area level. They 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.

Both *input of top litter items to the beach* and *string and ropes of different size (PLASTIC)* are projected to be reduced at least 60% across all the sub-areas, and the certainty of the estimation is high in all cases. *Input of top litter items to the beach* is even expected to be reduced up to 100% in the Southeast area. The high projected reductions are a result of several EU directives and regulations adopted in recent years. These measures are often expected to have strong effects and, importantly, are implemented in 8 of the 9 Baltic Sea countries. It is important to note that the analysis only includes the top 15 litter items, which comprise 67% percent of all items collected from surveyed beaches around the Baltic Sea. Thus, a 100% reduction of the pressure input would not lead to the elimination of the input of all beach litter. Estimates of the effectiveness of measure types (Table 4.1) and activity-pressure contributions (Table 5) used to generate these projected pressure reductions are included later in the document.

The total reductions in the *input of top litter items to the beach* are aggregated based on the share of 15 most common litter items listed in Table 3. *String and ropes of different size (PLASTIC)* can be used as a proxy for ghost nets. So, in addition to being included in the weighted average of the *input of top litter items to the beach*, the expected total reduction of *string and ropes of different size (PLASTIC)* (no. 6) is also displayed individually in Table 2.

Table 2. Projected total reductions (%) in the input of marine litter from existing measures in the Baltic Sea. The table depicts the most likely/expected values of total pressure reductions and gives standard deviations in parenthesis.

Colour scale for the pressure reductions in percent (based on the expected value):
0-10%, 10-20%, 20-40%, 40-60%, 60-100%
Categories for the certainty of the pressure reductions (based on the relative size of the standard deviation to the expected value):
low: ○○●, moderate: ○●●, high: ●●●

Pressure input **Sub-area**	**Input of top litter items to the beach**	**String and ropes of different size (PLASTIC)**
Kattegat and the Sound	76.4 (1.5) ●●●	72.6 (2.2) ●●●
Southern	77.2 (2.5) ●●●	65.6 (3.2) ●●●
Southeast	100.0 (1.6) ●●●	85.2 (2.8) ●●●
Western Gotland Basin	98.9. (0.7) ●●●	85.9 (1.7) ●●●
Northeast	96.1 (2.1) ●●●	87.6 (3.5) ●●●
North	87.4 (1.4) ●●●	75.7 (4.1) ●●●

Table 3. List of the 15 most common beach litter items

No.	**Litter item**
1	Plastic and polystyrene pieces 0-50 cm (PLASTIC)
2	Food related items, such as containers, lolly sticks, wrappers, packets (PLASTIC)
3	Drinking related items such as cups, caps, lids, six-pack rings (PLASTIC)
4	Plastic bags of different size and colour (PLASTIC)
5	Bottles and containers (PLASTIC)
6	String and ropes of different size (PLASTIC)
7	Cigarette butts and remains
8	Glass and ceramic fragments of different sizes and other glass items (GLASS)
9	Industrial packaging, such as sheeting and strapping bands (PLASTIC)
10	Processed wood and pieces of processed wood of different sizes (WOOD)
11	Drinking related items such as bottle caps, lids, pull tabs (METAL)
12	Single-use cutlery and straws (PLASTIC)
13	Paper and cardboard items and pieces of different size (PAPER)
14	Drinking related cans (METAL)
15	Foil wrappers and pieces of metal (METAL)

How effective are measure types in reducing pressure inputs?

This section presents the percent effectiveness of measure types in reducing the *input of top litter items to the beach* and *direct input of microplastics* from specific activities. Data on the effectiveness of measure types originate from expert surveys on the effectiveness of measures and are at the Baltic Sea scale. This assumes that the measure types are equally effective throughout the Baltic region. The effectiveness of measure types targeting the *direct input of microplastics* was assessed in the expert surveys but was not used further to assess the projected reductions in the input of litter (see previous section).

In the following, percent effectiveness is presented per pressure, activity and measure type, and pooled over experts. The effectiveness estimates can be compared across measure types to assess, on average, how effective they are in relation to each other in reducing the pressure from the specific activities, or across activities to assess which measure type could be the most effective for each activity.

Tables 4.1 and 4.2 present the most likely percent effectiveness of each measure type and its standard deviation. Confidence in Tables 4.1 and 4.2 depict the most common rating of expert's confidence in their own responses to the effectiveness of measure types question.

Table 4.1 shows the effectiveness of measures that reduce *the input of top litter items to the beach* from four different activities. In this case, each measure type can only reduce the pressure from one activity. Six measure types have an effectiveness over 40%, three of which are related to information, educational programs or public awareness and two of which are related to no-special fee system for waste reception in ports. The effectiveness of other measure types ranges between 0-40%. The activity *riverine inputs covering other land-based activities (e.g. urban uses, wastewaters, solid waste)* does not have any measure types with effectiveness over 40%. The confidence of the effectiveness estimates is moderate.

Table 4.1 Effectiveness of measure types (%) in reducing the *input of top litter items to the beach*. The effectiveness of a measure type is the percent reduction in the pressure input resulting from a specific activity. The table depicts the most likely/expected effectiveness, and standard deviation is given in parenthesis.

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: ●●●

Activity **Measure type**	**Fish and shellfish harvesting (all gears; professional, recreational)**	**Tourism and leisure activities (boating, beach use, water sports, etc.)**	**Transport – shipping (incl. anchoring, mooring)**	**Riverine inputs covering other land-based activities (e.g. urban uses, wastewaters, solid waste)**
More stringent controlling and reporting of ships' delivery of waste in ports	NA	NA	34.1 (19.0) ○●●	NA
Implementation of ISO standard for port waste reception facilities	NA	NA	26.6 (15.2) ○●●	NA
Full implementation of the no-special fee system for waste reception in all Baltic Sea ports	NA	NA	45.5 (24.2) ○●●	NA
Implementing ecolabel schemes and/or incentive systems for environmentally friendly shipping	NA	NA	26.0 (14.8) ○●●	NA
Including marine litter issues in educational programs and materials for professional sea use sectors	NA	NA	40.6 (20.7) ○●●	NA
No-special fee system for waste reception in ports from fishing vessels, including for the litter caught in fishing nets	44.2 (23.7) ○●●	NA	NA	NA
Information and education to fishermen about management and environmental impacts of fishing gear containing plastics and best practice in waste management within fishing sector	40.5 (24.4) ○○●	NA	NA	NA
Improvement in the marking of fishing gear and reporting on lost fishing gear	0.7 (0.7) ○○●	NA	NA	NA
Promotion of garbage collection for pleasure crafts by marinas (e.g. through ecolabeling, such as Blue Flag)	NA	30.0 (13.2) ○●●	NA	NA
Public awareness raising measures on marine litter impacts and prevention, promotion of sustainable consumption and production and appropriate waste management of single-use plastic products	NA	41.7 (19.8) ○●●	NA	NA
Including marine litter issues in educational programs and materials for recreational sea use sectors (e.g. for diving and sailing schools)	NA	33.1 (19.3) ○●●	NA	NA

Activity **Measure type**	**Fish and shellfish harvesting (all gears; professional, recreational)**	**Tourism and leisure activities (boating, beach use, water sports, etc.)**	**Transport – shipping (incl. anchoring, mooring)**	**Riverine inputs covering other land-based activities (e.g. urban uses, wastewaters, solid waste)**
Reducing the amount of plastic litter through improving municipal regulatory provisions concerning organisation of beach waste management, requirements for waste management and clean-up for public beach events and leases on beaches	NA	48.0 (21.5) ○●●	NA	NA
National measures for "significant reduction" in consumption of single-use plastic food containers and beverage cups (following relevant EU Directives)	NA	9.0 (4.3) ○●●	NA	NA
Prohibition for placing on market certain single-use plastic products (cotton bud sticks, cutlery, plates, straws, beverage stirrers, balloons sticks)	NA	2.8 (1.6) ○●●	NA	NA
Requiring that plastic caps and lids remain attached to single use plastic beverage containers during the product's intended use	NA	5.3 (3.4) ○○●	NA	NA
Establishing extended producer responsibility schemes for all packaging and plastic products which create the most frequently found litter items in the marine environment	NA	31.2 (18.8) ○○●	NA	NA
Labelling biodegradable and compostable plastic bags	NA	1.0 (0.8) ○○●	NA	NA
EU mandated reduction in consumption of lightweight plastic bags by implementing administrative and/or economic measures	NA	2.6 (1.6) ○●●	NA	NA
EU mandated increase in the share of reusable packaging on the market and of systems to reuse packaging in an environmentally sound manner	NA	12.4 (6.1) ○●●	NA	NA
Establishing systems to provide for return and/or collection of used packaging and packaging waste from consumers, including achieving 90% level of separate collection for beverage bottles	NA	12.7 (5.9) ○●●	NA	NA
Modification of products and substitution of materials creating high risk litter for the marine environment	NA	19.1 (11.2) ○●●	NA	NA
Regional (Baltic Sea) guidelines on best practice for improving wastewater systems and stormwater management	NA	NA	NA	26.0 (19.9) ○○●
Improving stormwater collection systems to prevent emissions of litter into the environment	NA	NA	NA	33.1 (26.2) ○○●
Including marine litter in national and municipal waste management plans and implementing provisions of these plans in coastal municipalities to prevent litter entering the aquatic environment	NA	NA	NA	33.3 (29.4) ○○●

Activity **Measure type**	**Fish and shellfish harvesting (all gears; professional, recreational)**	**Tourism and leisure activities (boating, beach use, water sports, etc.)**	**Transport – shipping (incl. anchoring, mooring)**	**Riverine inputs covering other land-based activities (e.g. urban uses, wastewaters, solid waste)**
Public awareness raising measures on marine litter impacts and prevention, promotion of sustainable consumption and production and appropriate waste management of single-use plastic products	NA	NA	NA	35.0 (23.7) ○○●
National measures for "significant reduction" in consumption of single-use plastic food containers and beverage cups (following relevant EU Directives)	NA	NA	NA	6.4 (5.0) ○○●
Prohibition for placing on market certain single-use plastic products (cotton bud sticks, cutlery, plates, straws, beverage stirrers, balloon sticks)	NA	NA	NA	1.9 (1.6) ○○●
Requiring that plastic caps and lids remain attached to single use plastic beverage containers during the product's intended use	NA	NA	NA	3.9 (3.2) ○○●
Establishing extended producer responsibility schemes for all packaging and plastic products which create the most frequently found litter items in the marine environment	NA	NA	NA	25.0 (19.1) ○○●
Labelling biodegradable and compostable plastic bags	NA	NA	NA	0.7 (0.8) ○○●
EU mandated reduction in consumption of lightweight plastic bags by implementing administrative and/or economic measures	NA	NA	NA	1.9 (1.6) ○○●
EU mandated increase in the share of reusable packaging on the market and of systems to reuse packaging in an environmentally sound manner	NA	NA	NA	9.6 (6.5) ○○●
Establishing systems to provide for return and/or collection of used packaging and packaging waste from consumers, including achieving 90% level of separate collection for beverage bottles	NA	NA	NA	9.3 (5.2) ○●●
Modification of products and substitution of materials creating high risk litter for the marine environment	NA	NA	NA	17.5 (12.3) ○○●
Confidence	Moderate	Moderate	Moderate	Moderate
Number of experts	10-13	9-13	8-12	11-14

Table 4.2 shows the effectiveness of measures that reduce the *direct input of microplastics* from the activity *riverine inputs covering other land-based activities (e.g. urban uses, wastewaters, solid waste)*. The other three activities shown in Table 4.1 are not applicable to this pressure input in this SOM analysis. Table 4.2 indicates that measures *improving stormwater collection systems to prevent emissions of microlitter into the environment* and *improved wastewater treatment to reduce emissions of microplastics* are the two most effective measure types. The confidence of the effectiveness estimates is moderate.

Table 4.2 Effectiveness of measure types (%) in reducing the potential *direct input of microplastics*. 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 values of effectiveness, and standard deviation is given in parenthesis.

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: ●●●

Activity **Measure type**	**Riverine inputs covering other land-based activities (e.g. urban uses, wastewaters, solid waste)**
Regulatory measures or voluntary commitments by producers to avoid the use of microplastics in products (e.g. cosmetics, cleaning products).	38.3 (24.8) ○○●
Information measures on microplastics in consumer products (e.g. awareness raising, implementing eco certification schemes)	29.6 (19.1) ○○●
Regional (Baltic Sea) guidelines on best practice for improving wastewater systems and stormwater management	37.6 (19.2) ○●●
Improving stormwater collection systems to prevent emissions of microlitter into the environment	46.9 (22.8) ○●●
Improved wastewater treatment to reduce emissions of microplastics	45.8 (24.0) ○●●
Confidence	Moderate
Number of experts	12-13

Which activities contribute to pressures?

Table 5 shows the contribution of activities to the input of top litter items to the beach. Expert elicitation has been used to estimate the activity-pressure relationships for the input of litter (further differentiated into top litter items). For the assessment, the Baltic Sea was divided into 6 sub-areas (Figure 2). For the input of top litter items to the beach (divided into 15 items), the same four activities are identified to contribute to the pressure input. These activities are *fish and shellfish harvesting*, *tourism and leisure activities*, *transport – shipping*, and *riverine inputs covering other land-based activities (e.g. urban uses, wastewaters, solid waste)*. The contribution of the activities to the input of litter to the beach varies in the six areas of the Baltic Sea and depends also on the litter item. Generally, tourism and leisure activities are the main contributors for the input of many of the litter items. In almost all areas of the Baltic Sea, they contribute the most to the input of the following litter items:

- Food related items, such as containers, lolly sticks, wrappers, packets (PLASTIC)
- Drinking related items such as cups, caps, lids, six-pack rings (PLASTIC)
- Plastic bags of different size and colour (PLASTIC)
- Bottles and containers (PLASTIC)
- Cigarette butts and remains
- Glass and ceramic fragments of different sizes and other glass items (GLASS)
- Drinking related items such as bottle caps, lids, pull tabs (METAL)
- Single-use cutlery and straws (PLASTIC)
- Drinking related cans (METAL)
- Foil wrappers and pieces of metal (METAL)

For plastic and polystyrene pieces 0-50 cm (PLASTIC) and paper and cardboard items and pieces of different size (PAPER), *tourism and leisure activities* as well as *riverine inputs covering other land-based activities (e.g. urban uses, wastewaters, solid waste)* contribute the most to the pressure. The activity *transport – shipping* has the highest contribution for industrial packaging, such as sheeting and strapping bands (PLASTIC), as well as processed wood and pieces of processed wood of different sizes (WOOD). *Fish and shellfish harvesting*, as well as *tourism and leisure activities* contribute the most to string and ropes of different sizes (PLASTIC).

Table 5. Activity-pressure contributions (%). The activity-pressure contributions show the percentage share the activity contributes to the *input of top litter items to the beach*. The table depicts the most likely/expected contribution (%), and standard deviation is given in parenthesis. Activity-pressure contributions were assessed for six sub-areas of the Baltic Sea and estimates for the sub-basins within an area are identical. The type of litter is given in parentheses.

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

Activity **Litter item and area**	**Fish and shellfish harvesting**	**Tourism and leisure activities**	**Transport – shipping**	**Riverine inputs covering other land-based activities (e.g. urban uses, wastewaters, solid waste)**
Kattegat & The Sound *Plastic and polystyrene pieces 0-50 cm (PLASTIC)*	15.4 (6.3) ○●●	14.9 (12.4) ○○●	8.7 (7.0) ○○●	61.0 (14.4) ●●●
Southwest *Plastic and polystyrene pieces 0-50 cm (PLASTIC)*	12.0 (10.7) ○○●	30.6 (16.2) ○●●	4.3 (2.9) ○○●	53.1 (22.3) ○●●
Southeast *Plastic and polystyrene pieces 0-50 cm (PLASTIC)*	21.0 (21.8) ○○●	42.8 (29.3) ○○●	22.0 (22.2) ○○●	14.2 (15.4) ○○●
Western Gotland Basin *Plastic and polystyrene pieces 0-50 cm (PLASTIC)*	24.9 (5.8) ●●●	25.0 (5.8) ●●●	24.9 (5.8) ●●●	25.1 (5.8) ●●●
Northeast *Plastic and polystyrene pieces 0-50 cm (PLASTIC)*	21.6 (15.2) ○○●	39.1 (25.0) ○○●	17.4 (12.6) ○○●	22.0 (17.3) ○○●
North *Plastic and polystyrene pieces 0-50 cm (PLASTIC)*	18.1 (14.1) ○○●	34.8 (13.9) ○●●	12.0 (9.0) ○○●	35.0 (13.9) ○●●
Kattegat & The Sound *Food related items, such as containers, lolly sticks, wrappers, packets (PLASTIC)*	8.5 (10.0) ○○●	46.1 (32.2) ○○●	8.9 (10.6) ○○●	36.4 (29.6) ○○●
Southwest *Food related items, such as containers, lolly sticks, wrappers, packets (PLASTIC)*	5.7 (6.9) ○○●	54.1 (31.9) ○●●	11.7 (13.9) ○○●	28.6 (25.5) ○○●
Southeast *Food related items, such as containers, lolly sticks, wrappers, packets (PLASTIC)*	24.9 (23.7) ○○●	46.9 (29.9) ○○●	18.9 (17.9) ○○●	9.3 (8.7) ○○●

Activity **Litter item and area**	**Fish and shellfish harvesting**	**Tourism and leisure activities**	**Transport – shipping**	**Riverine inputs covering other land-based activities (e.g. urban uses, wastewaters, solid waste)**
Western Gotland Basin *Food related items, such as containers, lolly sticks, wrappers, packets (PLASTIC)*	17.1 (6.2) ○●●	49.4 (9.2) ●●●	16.5 (6.5) ○●●	17.0 (6.5) ○●●
Northeast *Food related items, such as containers, lolly sticks, wrappers, packets (PLASTIC)*	4.3 (3.4) ○○●	59.4 (20.9) ○●●	9.6 (9.4) ○○●	26.8 (19.0) ○○●
North *Food related items, such as containers, lolly sticks, wrappers, packets (PLASTIC)*	5.2 (0.64) ○○●	62.6 (17.6) ●●●	5.0 (3.2) ○○●	27.1 (15.1) ○●●
Kattegat & The Sound *Drinking related items such as cups, caps, lids, six-pack rings (PLASTIC)*	12.9 (14.0) ○○●	41.6 (33.1) ○○●	8.3 (9.0) ○○●	37.3 (30.5) ○○●
Southwest *Drinking related items such as cups, caps, lids, six-pack rings (PLASTIC)*	5.4 (4.5) ○○●	57.3 (21.3) ○●●	8.4 (8.1) ○○●	28.9 (17.5) ○○●
Southeast *Drinking related items such as cups, caps, lids, six-pack rings (PLASTIC)*	14.7 (15.8) ○○●	53.0 (30.4) ○●●	24.1 (23.3) ○○●	8.2 (8.6) ○○●
Western Gotland Basin *Drinking related items such as cups, caps, lids, six-pack rings (PLASTIC)*	16.3 (6.3) ○●●	50.2 (9.2) ●●●	17.1 (6.5) ○●●	16.5 (6.3) ○●●
Northeast *Drinking related items such as cups, caps, lids, six-pack rings (PLASTIC)*	8.9 (9.5) ○○●	53.9 (31.4) ○●●	9.5 (10.5) ○○●	27.6 (23.0) ○○●
North *Drinking related items such as cups, caps, lids, six-pack rings (PLASTIC)*	7.4 (6.4) ○○●	58.1 (25.5) ○●●	8.0 (6.9) ○○●	26.5 (22.1) ○○●
Kattegat & The Sound *Plastic bags of different size and color (PLASTIC)*	5.8 (4.8) ○○●	35.2 (29.4) ○○●	5.9 (4.9) ○○●	53.0 (25.9) ○●●
Southwest *Plastic bags of different size and color (PLASTIC)*	6.3 (7.0) ○○●	49.7 (29.5) ○●●	12.5 (13.7) ○○●	31.4 (25.1) ○○●
Southeast *Plastic bags of different size and color (PLASTIC)*	17.3 (12.7) ○○●	48.0 (19.1) ○●●	28.9 (22.5) ○○●	5.8 (3.6) ○○●
Western Gotland Basin *Plastic bags of different size and color (PLASTIC)*	12.7 (4.8) ○●●	37.3 (7.5) ●●●	12.7 (4.7) ○●●	37.2 (7.6) ●●●
Northeast *Plastic bags of different size and color (PLASTIC)*	11.3 (12.3) ○○●	49.1 (29.0) ○●●	11.5 (10.8) ○○●	28.0 (21.4) ○○●
North *Plastic bags of different size and color (PLASTIC)*	7.4 (6.2) ○○●	42.4 (32.7) ○○●	13.4 (11.6) ○○●	36.8 (23.7) ○○●
Kattegat & The Sound *Bottles and containers (PLASTIC)*	9.2 (10.4) ○○●	38.0 (29.9) ○○●	9.4 (10.9) ○○●	43.5 (32.4) ○○●

Activity **Litter item and area**	**Fish and shellfish harvesting**	**Tourism and leisure activities**	**Transport – shipping**	**Riverine inputs covering other land-based activities (e.g. urban uses, wastewaters, solid waste)**
Southwest *Bottles and containers (PLASTIC)*	2.6 (1.4) o●●	57.4 (16.1) ●●●	7.7 (5.9) oo●	32.3 (17.6) o●●
Southeast *Bottles and containers (PLASTIC)*	11.5 (10.9) oo●	64.5 (21.2) o●●	18.2 (18.9) oo●	5.9 (4.4) oo●
Western Gotland Basin *Bottles and containers (PLASTIC)*	25.5 (8.9) o●●	24.1 (9.3) o●●	24.5 (8.9) o●●	25.8 (9.5) o●●
Northeast *Bottles and containers (PLASTIC)*	15.1 (12.8) oo●	47.4 (28.2) o●●	14.4 (12.3) oo●	23.1 (17.9) oo●
North *Bottles and containers (PLASTIC)*	7.4 (1.7) ●●●	64.0 (3.4) ●●●	7.4 (1.8) ●●●	21.1 (2.8) ●●●
Kattegat & The Sound *String and ropes of different size (PLASTIC)*	35.2 (29.2) oo●	35.7 (29.4) oo●	22.4 (23.0) oo●	6.7 (7.8) oo●
Southwest *String and ropes of different size (PLASTIC)*	38.0 (27.2) oo●	20.5 (19.1) oo●	22.2 (19.7) oo●	19.4 (22.2) oo●
Southeast *String and ropes of different size (PLASTIC)*	52.2 (34.8) oo●	11.1 (10.7) oo●	26.0 (23.0) oo●	10.8 (10.3) oo●
Western Gotland Basin *String and ropes of different size (PLASTIC)*	37.4 (7.6) ●●●	12.7 (4.7) o●●	37.4 (7.6) ●●●	12.5 (4.9) o●●
Northeast *String and ropes of different size (PLASTIC)*	45.7 (27.8) oo●	18.6 (15.5) oo●	25.0 (18.9) oo●	10.7 (9.1) oo●
North *String and ropes of different size (PLASTIC)*	22.9 (21.5) oo●	49.0 (34.8) oo●	19.1 (20.2) oo●	9.0 (9.0) oo●
Kattegat & The Sound *Cigarette butts and remains*	13.0 (13.9) oo●	49.1 (34.8) oo●	8.2 (8.9) oo●	29.7 (26.8) oo●
Southwest *Cigarette butts and remains*	4.5 (3.1) oo●	67.8 (15.5) ●●●	6.8 (6.6) oo●	20.9 (14.5) oo●
Southeast *Cigarette butts and remains*	8.1 (6.0) oo●	75.5 (15.8) ●●●	8.3 (6.3) oo●	8.2 (6.1) oo●
Western Gotland Basin *Cigarette butts and remains*	10.6 (4.1) o●●	68.4 (6.3) ●●●	10.4 (4.1) o●●	10.7 (4.0) o●●
Northeast *Cigarette butts and remains*	3.8 (2.1) o●●	81.2 (6.2) ●●●	4.7 (3.4) oo●	10.3 (5.9) o●●
North *Cigarette butts and remains*	3.2 (1.5) o●●	79.3 (8.9) ●●●	6.1 (3.8) oo●	11.4 (8.4) oo●
Kattegat & The Sound *Glass and ceramic fragments of different sizes and other glass items (GLASS)*	9.3 (8.5) oo●	44.6 (31.4) oo●	22.8 (19.0) oo●	23.3 (19.0) oo●
Southwest *Glass and ceramic fragments of different sizes and other glass items (GLASS)*	9.3 (8.1) oo●	44.7 (31.3) oo●	22.8 (19.5) oo●	23.2 (19.4) oo●

Activity **Litter item and area**	**Fish and shellfish harvesting**	**Tourism and leisure activities**	**Transport – shipping**	**Riverine inputs covering other land-based activities (e.g. urban uses, wastewaters, solid waste)**
Southeast *Glass and ceramic fragments of different sizes and other glass items (GLASS)*	17.0 (16.7) ○○●	47.6 (30.1) ○○●	26.4 (25.0) ○○●	8.9 (8.6) ○○●
Western Gotland Basin *Glass and ceramic fragments of different sizes and other glass items (GLASS)*	25.3 (9.1) ○●●	25.3 (9.2) ○●●	24.8 (8.8) ○●●	24.7 (9.4) ○●●
Northeast *Glass and ceramic fragments of different sizes and other glass items (GLASS)*	8.0 (9.0) ○○●	64.0 (31.8) ○●●	15.7 (17.9) ○○●	12.3 (13.9) ○○●
North *Glass and ceramic fragments of different sizes and other glass items (GLASS)*	14.1 (12.6) ○○●	57.9 (33.7) ○●●	14.0 (12.8) ○○●	14.0 (12.9) ○○●
Kattegat & The Sound *Industrial packaging, such as sheeting and strapping bands (PLASTIC)*	9.2 (10.6) ○○●	9.3 (10.7) ○○●	41.2 (30.7) ○○●	40.3 (30.4) ○○●
Southwest *Industrial packaging, such as sheeting and strapping bands (PLASTIC)*	3.0 (1.3) ○●●	3.0 (1.4) ○●●	60.4 (13.9) ●●●	33.6 (15.0) ○●●
Southeast *Industrial packaging, such as sheeting and strapping bands (PLASTIC)*	25.4 (8.6) ○●●	25.1 (9.1) ○●●	24.7 (8.9) ○●●	24.8 (9.1) ○●●
Western Gotland Basin *Industrial packaging, such as sheeting and strapping bands (PLASTIC)*	25.2 (9.1) ○●●	25.2 (8.9) ○●●	24.8 (9.2) ○●●	24.8 (8.5) ○●●
Northeast *Industrial packaging, such as sheeting and strapping bands (PLASTIC)*	13.6 (12.6) ○○●	14.1 (12.8) ○○●	57.8 (33.9) ○●●	14.4 (12.9) ○○●
North *Industrial packaging, such as sheeting and strapping bands (PLASTIC)*	13.7 (13.1) ○○●	13.3 (12.9) ○○●	59.8 (34.0) ○●●	13.2 (12.6) ○○●
Kattegat & The Sound *Processed wood and pieces of processed wood of different sizes (WOOD)*	28.7 (23.5) ○○●	15.7 (14.3) ○○●	26.7 (22.2) ○○●	28.9 (24.1) ○○●
Southwest *Processed wood and pieces of processed wood of different sizes (WOOD)*	17.9 (14.8) ○○●	16.3 (5.0) ●●●	39.3 (9.1) ○●●	26.6 (10.3) ○●●

Activity **Litter item and area**	**Fish and shellfish harvesting**	**Tourism and leisure activities**	**Transport – shipping**	**Riverine inputs covering other land-based activities (e.g. urban uses, wastewaters, solid waste)**
Southeast *Processed wood and pieces of processed wood of different sizes (WOOD)*	26.5 (21.1) ○○●	5.5 (4.1) ○○●	42.2 (20.3) ○●●	25.8 (21.0) ○○●
Western Gotland Basin *Processed wood and pieces of processed wood of different sizes (WOOD)*	12.6 (4.9) ○●●	12.9 (5.0) ○●●	61.7 (8.0) ●●●	12.7 (5.0) ○●●
Northeast *Processed wood and pieces of processed wood of different sizes (WOOD)*	18.7 (16.8) ○○●	11.7 (12.2) ○○●	50.4 (29.6) ○●●	19.2 (20.4) ○○●
North *Processed wood and pieces of processed wood of different sizes (WOOD)*	17.4 (15.3) ○○●	6.5 (5.0) ○○●	69.8 (20.3) ○●●	6.3 (5.0) ○○●
Kattegat & The Sound *Drinking related items such as bottle caps, lids, pull tabs (METAL)*	2.4 (0.9) ○●●	75.4 (3.2) ●●●	2.3 (0.9) ○●●	19.9 (2.9) ●●●
Southwest *Drinking related items such as bottle caps, lids, pull tabs (METAL)*	9.6 (10.1) ○○●	49.2 (34.7) ○○●	9.5 (10.1) ○○●	31.7 (27.8) ○○●
Southeast *Drinking related items such as bottle caps, lids, pull tabs (METAL)*	2.9 (1.1) ○●●	91.4 (1.9) ●●●	2.8 (1.1) ○●●	2.9 (1.1) ○●●
Western Gotland Basin *Drinking related items such as bottle caps, lids, pull tabs (METAL)*	12.9 (5.0) ○●●	62.1 (7.9) ●●●	12.3 (4.8) ○●●	12.8 (5.1) ○●●
Northeast *Drinking related items such as bottle caps, lids, pull tabs (METAL)*	2.6 (1.1) ○●●	74.8 (11.6) ●●●	7.5 (5.3) ○○●	15.0 (12.1) ○○●
North *Drinking related items such as bottle caps, lids, pull tabs (METAL)*	8.6 (10.6) ○○●	44.2 (33.6) ○○●	8.5 (10.6) ○○●	38.7 (31.8) ○○●
Kattegat & The Sound *Single-use cutlery and straws (PLASTIC)*	2.4 (0.9) ○●●	75.4 (3.1) ●●●	2.4 (0.9) ○●●	19.8 (2.9) ●●●
Southwest *Single-use cutlery and straws (PLASTIC)*	9.4 (10.1) ○○●	49.5 (35.1) ○○●	9.6 (10.6) ○○●	31.5 (27.8) ○○●
Southeast *Single-use cutlery and straws (PLASTIC)*	2.9 (1.2) ○●●	91.4 (1.9) ●●●	2.9 (1.2) ○●●	2.8 (1.1) ○●●
Western Gotland Basin *Single-use cutlery and straws (PLASTIC)*	12.7 (4.8) ○●●	62.2 (7.7) ●●●	12.1 (5.0) ○●●	13.0 (4.8) ○●●
Northeast *Single-use cutlery and straws (PLASTIC)*	2.4 (1.0) ○●●	70.2 (8.0) ●●●	7.3 (5.0) ○○●	20.1 (7.6) ○●●

Activity **Litter item and area**	**Fish and shellfish harvesting**	**Tourism and leisure activities**	**Transport – shipping**	**Riverine inputs covering other land-based activities (e.g. urban uses, wastewaters, solid waste)**
North *Single-use cutlery and straws (PLASTIC)*	5.1 (4.9) ○○●	56.7 (27.3) ○●●	5.1 (4.8) ○○●	33.0 (28.6) ○○●
Kattegat & The Sound *Paper and cardboard items and pieces of different size (PAPER)*	2.4 (0.9) ○●●	47.7 (2.6) ●●●	2.4 (0.9) ○●●	47.6 (2.6) ●●●
Southwest *Paper and cardboard items and pieces of different size (PAPER)*	2.4 (1.0) ○●●	47.6 (2.6) ●●●	2.4 (0.9) ○●●	47.6 (2.6) ●●●
Southeast *Paper and cardboard items and pieces of different size (PAPER)*	2.8 (1.1) ○●●	91.5 (2.0) ●●●	2.9 (1.1) ○●●	2.8 (1.2) ○●●
Western Gotland Basin *Paper and cardboard items and pieces of different size (PAPER)*	24.9 (8.8) ○●●	25.5 (9.5) ○●●	25.0 (9.3) ○●●	24.6 (9.1) ○●●
Northeast *Paper and cardboard items and pieces of different size (PAPER)*	7.9 (5.9) ○○●	54.0 (12.1) ○●●	7.9 (5.7) ○○●	30.2 (14.2) ○●●
North *Paper and cardboard items and pieces of different size (PAPER)*	2.2 (0.9) ○●●	43.5 (2.6) ●●●	10.9 (2.3) ●●●	43.4 (2.5) ●●●
Kattegat & The Sound *Drinking related cans (METAL)*	2.1 (0.8) ○●●	69.5 (3.2) ●●●	2.1 (0.9) ○●●	26.3 (3.1) ●●●
Southwest *Drinking related cans (METAL)*	2.2 (0.9) ○●●	69.5 (3.3) ●●●	2.2 (0.8) ○●●	26.1 (3.1) ●●●
Southeast *Drinking related cans (METAL)*	9.4 (8.2) ○○●	61.7 (21.0) ○●●	25.7 (22.2) ○○●	3.2 (2.2) ○●●
Western Gotland Basin *Drinking related cans (METAL)*	24.3 (9.1) ○●●	24.8 (8.8) ○●●	25.7 (9.1) ○●●	25.2 (9.0) ○●●
Northeast *Drinking related cans (METAL)*	3.0 (1.1) ○●●	59.0 (3.3) ●●●	2.9 (1.2) ○●●	35.1 (3.3) ●●●
North *Drinking related cans (METAL)*	1.9 (0.7) ○●●	59.0 (3.0) ●●●	1.9 (0.7) ○●●	37.2 (2.8) ●●●
Kattegat & The Sound *Foil wrappers and pieces of metal (METAL)*	2.9 (1.2) ○●●	91.4 (2.0) ●●●	2.9 (1.1) ○●●	2.9 (1.2) ○●●
Southwest *Foil wrappers and pieces of metal (METAL)*	14.6 (12.9) ○○●	56.4 (34.0) ○●●	14.9 (13.2) ○○●	14.2 (12.4) ○○●
Southeast *Foil wrappers and pieces of metal (METAL)*	25.4 (9.0) ○●●	25.5 (9.3) ○●●	24.6 (8.9) ○●●	24.5 (8.8) ○●●
Western Gotland Basin *Foil wrappers and pieces of metal (METAL)*	25.4 (9.1) ○●●	24.7 (8.8) ○●●	25.0 (8.7) ○●●	24.8 (8.8) ○●●
Northeast *Foil wrappers and pieces of metal (METAL)*	12.8 (2.8) ●●●	82.1 (3.1) ●●●	2.5 (1.0) ○●●	2.6 (1.0) ○●●

Activity **Litter item and area**	**Fish and shellfish harvesting**	**Tourism and leisure activities**	**Transport – shipping**	**Riverine inputs covering other land-based activities (e.g. urban uses, wastewaters, solid waste)**
North *Foil wrappers and pieces of metal (METAL)*	25.6 (8.6) ○●●	24.5 (8.8) ○●●	25.1 (8.3) ○●●	24.9 (8.9) ○●●

Summary of the results

Both the *input of top litter items to the beach* and *string and ropes of different size (PLASTIC)* are projected to be reduced at least 60% across all the sub-areas, and the certainty of the estimation is high in all the cases. Reductions above 95% are projected for the Northeast (Northern Baltic Proper, Gulf of Riga, Åland Sea and Gulf of Finland), Southeast (Bornholm Basin, Gdansk Basin, Eastern Gotland Basin), and Western Gotland Basin.

There are no agreed reduction targets for litter and hence definite conclusions of the sufficiency of the measures cannot be drawn. As the top 15 litter items comprise only 67% off all beach litter, the pressure reductions result in a smaller decrease in all beach litter. Moreover, the results do not include projected pressure reductions in microlitter.

The high projected reductions are a result of several EU directives and regulations adopted in recent years. These measures are often expected to have strong effects and, importantly, are implemented in 8 of the 9 Baltic Sea countries.

The same four activities are identified to contribute to the input of top litter items to the beach: *fish and shellfish harvesting*, *tourism and leisure activities*, *transport – shipping*, and *riverine inputs covering other land-based activities*. Their relative importance varies among the assessment areas.

When interpreting the results, the assumptions and generalizations that were made when collecting the input data and defining and using the data on activity-pressure contributions and measure type effectiveness need to be taken into account. The input data are based mainly on expert elicitations rather than existing models and data. For more information on the SOM methodology, data collection and assumptions, see this document.

Background of respondents

For the litter effectiveness of measures survey, altogether 11 survey responses with 14 contributing experts were received. Two of the answers were group responses, with two and three contributing experts. For the activity-pressure survey, six responses were received, each from a different contracting party. The number of experts contributing to the litter surveys is shown in Table 6.

Table 6. Number of experts contributing to the litter surveys

Survey	**DE**	**DK**	**EE**	**FI**	**LT**	**LV**	**PL**	**RU**	**SE**	**Total**
Effectiveness of measures	2	3	2	1	1	1	1	-	3	14
Activity-pressure contributions	1	1	1	1	-	-	1	-	1	6

More detailed information about their background is available for the experts participating in the effectiveness of measures survey (Table 7). Experts stated most often litter or marine science as their

respective field, but also ecology/earth science and nature protection were mentioned. Almost half of the experts had 5-10 years of experience in their field, while about 20% had over 20 years or 0-2 years of experience, and the rest between 3-5 years or 10-20 years of experience. Experts represented research institutions, NGOs, government institutes, state agencies or ministries.

Table 7. Years of experience in the field for the litter effectiveness of measures survey.

	Effectiveness of measures survey	
Years	**Number of experts**	**Share of experts**
0-2 years	3	21 %
3-5 years	1	7 %
5-10 years	6	43 %
10-20 years	1	7 %
over 20 years	3	21 %