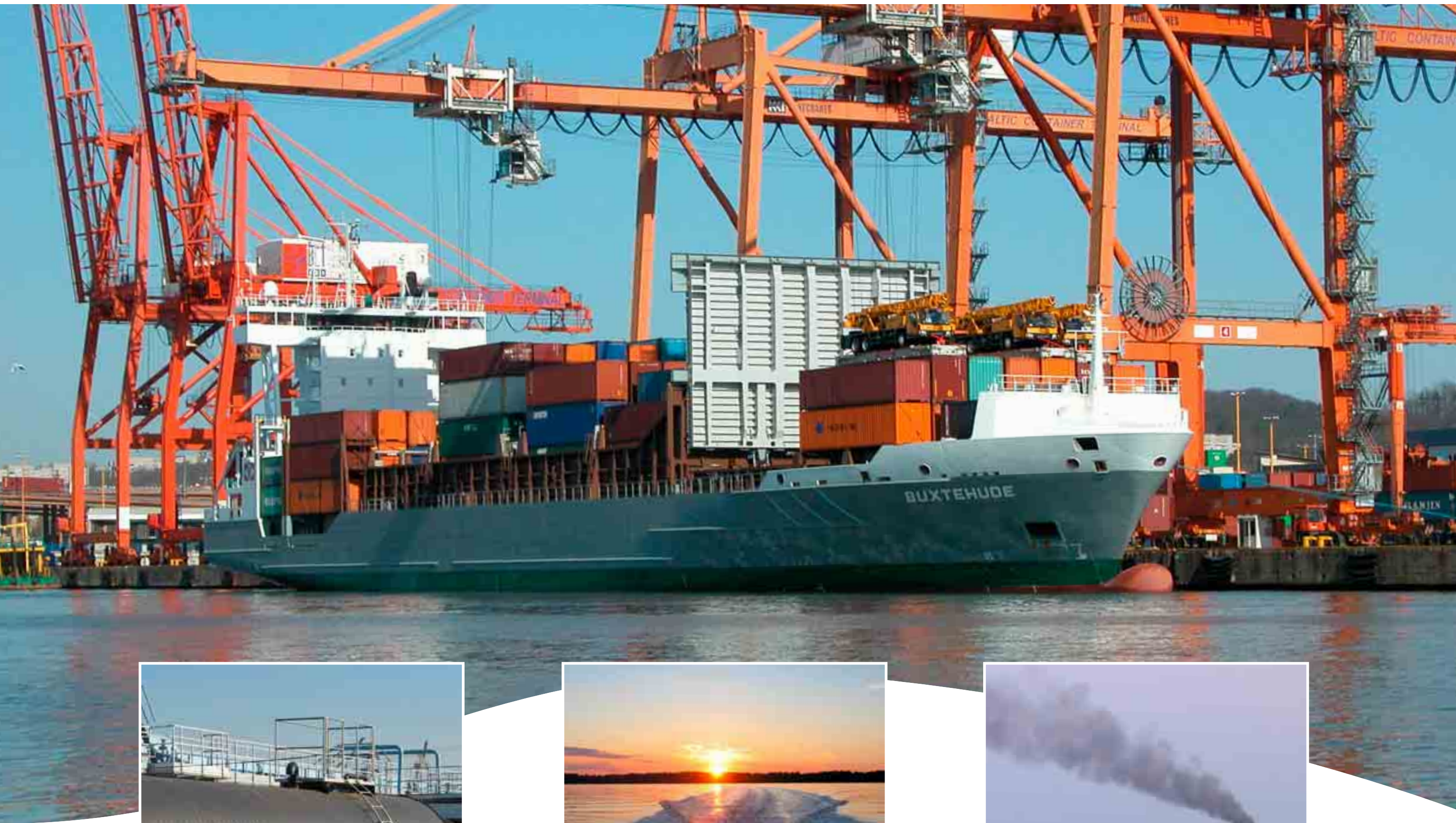
Baltic Sea Environment Proceedings No. 125

Towards a tool for quantifying anthropogenic pressures and potential impacts on the Baltic Sea marine environment

A background document on the method, data and testing of the Baltic Sea Pressure and Impact Indices



Helsinki Commission

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The HELCOM Initial Holistic Assessment (Baltic Sea Environment Proceedings No. 122) is a new and innovative approach, using existing and new tools of HELCOM. The results produced with the new tools HOLAS and the Baltic Sea Pressure/Impacts Indices (BSPI/BSII) should be considered preliminary results which in the future need further elaboration and improvement. Discrepancies between national WFD assessments and HOLAS results arise due to differences in spatial and temporal scaling as well as due to the use of different parameters and differences in the applied assessment methodologies.

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LIST OF CONTENTS

SUMMARY

This is a background report to the methodology and data of the Baltic Sea Pressure Index (BSPI) and the Baltic Sea Impact Index (BSII) used in the HELCOM Initial Holistic Assessment (HELCOM 2010a). The indices were developed for estimating the quantity and geographical distribution of anthropogenic pressures (BSPI) and their potential impacts (BSII). The report was compiled within the HELCOM HOLAS project for the elaboration of the Initial Holistic Assessment under the supervision of the HOLAS Task Force Group.

Quantification of anthropogenic pressures in the Baltic Sea marine area is a prerequisite for understanding the potential impacts of human activities on the marine ecosystem. Such quantification has been estimated for the pressures in the Baltic Sea Pressure Index (BSPI) and for potential impacts of the pressures in the Baltic Sea Impact Index (BSII). The tools have been developed using the method described by Halpern et al. (2007, 2008) as a starting point. Both indices should be seen only as first steps towards a better understanding of the magnitude and spatial distribution of anthropogenic pressures and impacts in the marine environment at a Baltic Sea-wide scale.

HELCOM compiled data on 52 anthropogenic pressures, which were classified according to the list of 18 pressures in Annex III, Table 2 of the Marine Strategy Framework Directive of the European Union (**Table 3.1**) (Anon. 2008). For some pressures, there existed direct measurements, e.g., discharge of radioactive substances, whereas the majority of the pressure data was derived from data on the human activities which act as drivers of those pressures and, thus, the human activities function as proxies for the pressures. For example, smothering of the seabed by disposal of dredged material was quantified based on the known disposal sites of dredged material and the reported amounts. The quantification of pressures was done using different means: for example harbours were used as a proxy for the pressure 'sealing of seabed' and the annual total cargo turn-over was used to scale the pressure. On the other hand, wind farms describe the same pressure in offshore areas, but the number of turbines per assessment unit is the variable to scale the pressure. The data layers were compiled by the HELCOM HOLAS project and were further improved by the HELCOM BSPI workshop held on 11 February 2010 in Stockholm, Sweden. This document presents all the data layers and how they have been used in the indices.

BSPI and BSII were quantified for 5 km × 5 km assessment units over the entire Baltic Sea marine area. Altogether the study area contained 19 276 squares. This unit size is small enough to reveal coastal point sources and impacts of cities and other point sources. Moreover, it is small enough to avoid false signs of impacts in areas where pressures and biotopes should not meet. However, some of the pressure data, such as fisheries data, were provided at a coarser scale.

In many scientific studies, rankings of negatively impacting anthropogenic pressures include the same activities/pressures: fishing, habitat loss/damage, waterborne pollution, invasive species, and changes in hydrology. Various pressures are not, however, directly comparable to each other. For example, waterborne pollution by lead cannot be directly compared to bottom trawling. The differences among pressures can be estimated by evaluating their potential impacts on different components of the ecosystem (e.g., species, biotopes or biotope complexes). To do this, the HELCOM HOLAS Project carried out an expert questionnaire investigation with the Contracting Parties in January–February 2010 to make an expert estimation concerning the 'weights of the anthropogenic pressures'. The questionnaire asked for weighting scores on a scale from zero to four for the potential impacts of 52 different pressures on 14 biological ecosystem components. The ecosystem components included eight benthic biotopes/biotope complexes, two water-column biotope complexes, and four species-related data sets (**Table 3.2**). Six Contracting Parties (Denmark, Estonia, Finland, Lithuania, Poland, and Sweden) provided expert estimations. Sweden provided three independent answers for the questionnaire and the experts in the HELCOM Secretariat provided one set of weighting scores. The questionnaire and its guidelines are in **Appendix A** and the results of the questionnaire are in **Appendix B**.

In the BSII, the potential impacts of the pressures were estimated on specific ecosystem components. Therefore, the spatial distribution of biotopes, biotope complexes, and species represents essential data for the BSII. The BSII is a similar index to the BSPI, but the index value per assessment unit is based on the potential impacts of anthropogenic pressures on specific ecosystem components which are present in the assessment unit (**Fig. 2.3**). The weighing of the pressures is based on the expert-opinion scores of the questionnaire for a specific ecosystem component. These scores ranked the pressures on a scale from 0 to 4. Thus, the index value in an assessment unit strongly depends on the number of ecosystem components in that assessment unit. **Figure 4.1** presents the map of BSII results in the Baltic Sea.

The BSPI is a simple exercise of summing up anthropogenic pressures of the assessment units (**Fig. 4.2**). It does not make any assumption of the magnitude of the impacts of pressures on specific ecosystem components. The pressures can, however, only be compared by considering their potential impacts on the ecosystem in general, which was done here by weighting the pressures by the median weighting score over all the biological ecosystem components. As in the BSII, the scores ranked the pressures on a scale from 0 to 4. The scale was then further 'stretched' to 0 to 10. The resulting ranking was in line with scientific reviews of top pressures in the marine environment. The median weighting scores showed that commercial fishing, nutrient inputs, smothering, and pollution by hazardous substances were seen as the most adverse pressures. The sum of weighted pressure values per 5 km × 5 km assessment unit gives the BSPI index value for that area.

1 INTRODUCTION

Strong evidence of human activities is clearly seen in the Baltic Sea ecosystem in the health of top predators, overexploited fish populations, anoxic sea bottoms, contaminated fish, and extensive algal blooms (e.g., HELCOM, 2009a,b, 2010a,b). Although the human impact on the sea often arises from negatively impacting industrial or municipal discharges or unsustainable use of resources, the activities of dense human populations, tourism, recreational activities, transport, and land-based activities also have significant impacts on the marine environment.

Several initiatives to mitigate the adverse effects of human activities on the marine environment of the Baltic Sea have been taken, but the Baltic Sea Action Plan (BSAP) (HELCOM 2007) is the first full compilation of actions to implement the ecosystem approach to management. In addition to the concerted efforts to limit, control and ban pollution, one of the strengths of the Action Plan is the initiative to activate and coordinate maritime spatial planning (MSP). MSP is a tool to ensure that human activities at sea do not exceed the carrying capacity of the ecosystem. In the Marine Strategy Framework Directive (MSFD) of the European Union (Anon. 2008), the EU Member States are required to develop strategies to ensure that the status of the marine environment will not deteriorate but instead will reach a good environmental status. The directive also lists a number of pressures on the marine environment that are related to human activities. The method for quantifying anthropogenic pressures, as presented in this report, can be seen as a useful tool for MSP and the implementation of the EU MSFD along with the HELCOM BSAP.

The need for an assessment of anthropogenic pressures on the marine environment has been recognized worldwide (Millennium Ecosystem Assessment 2005, Crain et al. 2009). According to Crain et al. (2009), the central questions at present are: (1) What are the human threats to the coastal ocean and what are their impacts? (2) How are these threats distributed and which are of greatest concern? (3) What is the cumulative impact from multiple human threats? and (4) How can coastal ecosystems be best managed in light of human threats?

Recent methodological papers by Halpern et al. (2007, 2008) are the first attempts to produce a method for an assessment of the cumulative pressures that human activities are causing on the seas. The method not only summarizes the presence or quantity of pressures, but also takes account of their impacts on specific components of the marine ecosystem. This is done by expert-judgment weighting scores for each pressure and ecosystem component.

The HELCOM HOLAS project produced an initial holistic assessment of the status of the Baltic Sea (HELCOM 2010a). The purpose of the holistic assessment was to describe the status of the environment and to assess anthropogenic pressures on the environment. For assessing the anthropogenic pressures, it was necessary to produce a cartographic presentation of human pressures in the entire sea area. This approach was termed the Baltic Sea Pressure Index (BSPI) and is presented in **Section 2.2**. The BSPI is a spatial presentation of anthropogenic pressures on the Baltic Sea and is the first of its kind for the Baltic Sea. It presents the sum of pressures without taking into account their impacts on specific ecosystem components. However, the ultimate purpose of this HELCOM work was to assess the impacts of the pressures on the marine ecosystem. This second approach is based on the Halpern method and takes into account the biological characteristics of the marine environment. This approach was termed the Baltic Sea Impact Index (BSII) and is presented in **Section 2.1**. As the BSII is more extensive than the BSPI, its description has been given the major focus in this report.

After presenting the methods to assess pressures and their potential impacts, this report describes the data layers used in testing the methods and presented in the Initial Holistic Assessment (HELCOM 2010a). **Section 3.1** describes pressure data layers, which were compiled by the HELCOM Secretariat and further improved by a HELCOM expert workshop on BSPI. **Section 3.2** describes the ecosystem data layers, which were used to link pressures on the marine environment. In **Chapter 4**, the two methods have been tested and compared to each other and the underlying data have been evaluated.

2 THE BALTIC SEA IMPACT INDEX AND PRESSURE INDEX

2.1 The Baltic Sea Impact Index

2.1.1 The concept of the impact index

The Baltic Sea Impact Index (BSII) is a tool for estimating the potential impacts of anthropogenic pressures on the Baltic marine environment. Its main aim is to provide a spatial overview of the sum of potential impacts of anthropogenic pressures by estimating their harmfulness for key ecosystem components. The procedure has three variables: (1) pressure data, (2) a weighting score to transform a pressure to a potential impact on a specific ecosystem component, and (3) information on the presence or absence of ecosystem components in an assessment unit. The index scores are given for 5 km x 5 km squares (assessment units) for the entire sea area, resulting in 19 276 assessment units. The index is calculated after the method by Halpern et al. (2008) using the following formula (equation 1): $I = \sum_{i=1}^{n} \sum_{j=1}^{m} P_i \times E_j \times \mu_{i,j}$, where P_i is the log-transformed and normalized value (scaled between 0 and 1) of an anthropogenic pressure in an assessment unit i, E_j is the presence or absence of an ecosystem component *j* (1 or 0, respectively), and $\mu_{i,j}$ is the weighting score for P_i in E_j (range 0–4). Thus, the index value per assessment unit is the sum of all pressure data, each of which is multiplied by its specific weighting score, and multiplied by 0 or 1 (the presence or absence of an ecosystem component). By including the potential impacts of all anthropogenic pressures in all the ecosystem components in an assessment unit, the richness of ecosystem components strongly affects the index sum. That is particularly the case if the area contains several ecosystem components that are sensitive to existing pressures. A conceptual model of the BSII tool is presented in **Figure 2.1**.

2.1.2 Testing of the impact index: data layers of anthropogenic pressures and ecosystem components

The BSII contains 52 data layers of anthropogenic pressures. The pressures were grouped under pressure categories according to the list in Annex III, Table 2 of the EU MSFD. The pressure categories and associated pressure data layers are presented in **Table 3.1**. In the BSII, it was required that all pressure data layers cover the entire sea area and originate from the period 2003–2007. All pressure data layers are described in **Section 3.1**.

Altogether 14 ecosystem components were chosen for the BSII. The ecosystem components include eight benthic biotopes/biotope complexes, two water column biotope complexes, and four species-related data sets (**Table 3.2**). The chosen data layers represent some key elements in the Baltic Sea

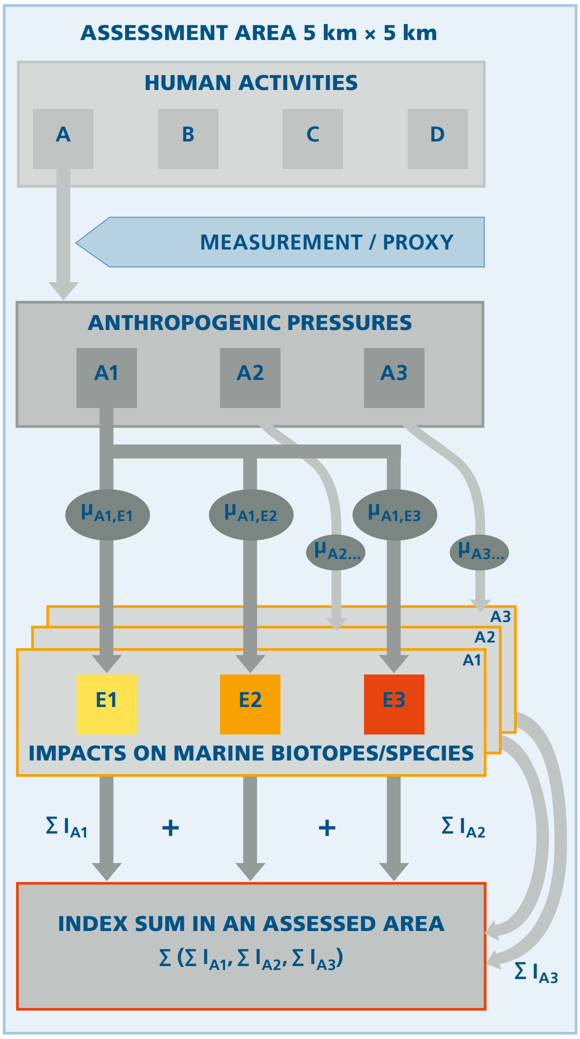


Figure 2.1 Conceptual model of the Baltic Sea Impact Index (BSII). The index value is assessed for an area of 5 km x 5 km. The value is the sum of all potential impacts (I) on all ecosystem components (E) in an assessment unit. Potential impacts are transformed from anthropogenic pressures by weighting scores (μ), which are based on expert estimations. In this figure, there are four activities (A–D) in the assessment unit, but only one of them (A) has been shown in further steps. For each of the three ecosystem components in the assessment unit (E1, E2 and E3), the activity A causes three pressures (A1, A2 and A3) which are weighted by specific scores ($\mu_{A1,E1}$, $\mu_{A1,E2}$, $\mu_{A1,E3}$, $\mu_{A2,E1}$, …, $\mu_{A3,E3}$). Each of the weighted pressures is multiplied by 0 or 1, depending on the presence of E, resulting in impacts (I). Finally, the potential impacts I_{A1}–I_{A3} are summed up, resulting in a sum of nine impact values.

marine ecosystem. However, it was recognized that the limited availability of marine data hindered the inclusion of some other key species and biotope data layers in the index. **Section 3.2** describes the ecosystem data layers.

2.1.3 Weighting scores of the pressures

The various anthropogenic pressures are not directly comparable to each other. For example, atmospheric deposition of lead cannot be directly compared to bottom trawling, because their impacts on the ecosystem have different spatial and temporal scales and they affect different parts of the ecosystem and in very different ways. However, in many scientific studies, rankings of negatively impacting anthropogenic pressures always include the same activities/pressures: fishing, habitat loss/damage, waterborne pollution, invasive species, and changes in hydrology (Venter et al. 2006, Crain et al. 2009). Thus, there seems to be a general understanding among scientists that pressures can be ranked according to their 'harmfulness' to the environment. Halpern et al. (2007) estimated the differences among pressures by evaluating their potential impacts on different components of the ecosystem (e.g., species, biotopes or biotope complexes). To do this for the Baltic Sea conditions, the HELCOM HOLAS Project carried out a questionnaire investigation with experts from the Contracting Parties in January–February 2010 to make an expert estimation of the 'weights of the anthropogenic pressures'. The questionnaire asked for weighting scores on a scale from zero to four for the potential impacts of 52 different pressures on 14 biological ecosystem components. Six Contracting Parties

(Denmark, Estonia, Finland, Lithuania, Poland, and Sweden) provided expert estimations. Sweden provided three independent answers for the questionnaire and the experts in the HELCOM Secretariat provided one set of weighting scores. In order to exclude outlier values (i.e., possible misinterpretations of the questionnaire), the final weighting scores used were medians of the original expert scores. The questionnaire and its guidelines are in **Appendix A** and the results of the questionnaire are in **Appendix B**.

In order to guide the experts through the questionnaire, the HELCOM HOLAS Project advised them to make use of three criteria while producing the weighting scores: functional impact of the pressure on an ecosystem component, resistance of that ecosystem component against the pressure, and recovery time of that ecosystem component after the pressure (**Table 2.1**). The criteria were based on the method by Halpern et al. (2007). The first criterion describes the pressure and the latter two criteria describe the ecosystem component. In many cases, the latter two criteria (or components of the

Table 2.1. Criteria for the production of the weighting scores, after Halpern et al. (2007, 2008).

Component	Value	Remarks and examples
Functional impact	0 = no impact; 1 = ≥1 species; 2 = 1 trophic level; 3= >1 trophic level; 4 = whole community.	Example: Smothering and siltation may be assigned a value 4 for hard bottom biotopes where they block the attachment of species. In soft bottoms, the effect is weaker.
Resistance of the component against the pressure	0 = no impact; 1 = high; 2 = moderate; 3 = low; 4 = vulnerable.	Remark: Sensitive biotopes can be emphasized by this criterion. If a biotope is supported by a few species only, the biotope is probably 'sensitive' and the value is 3 or 4.
Recovery after the pressure	0 = no impact; 1 = <1 year; 2 = 1–5 years; 3 = 5–10 years; 4 = 10–100 years.	Examples: Growth rate of a habitat-forming species after a catastrophe. Return of top-predators after disturbance. Restabilization of sediments. Clearing of water after a sediment plume.

weighting score) are more useful in determining the final weighting score. Moreover, there may arise several questions when transforming pressures to impacts. Therefore, the criteria should not be seen as obligatory components of the score but more as 'guidelines for consideration' when determining the final weighting score. The boundaries of the criteria are given in **Table 2.1**. **Example 1** presents a case for the production of a weighting score.

Example 1: Producing a weighting score for seabed abrasion caused by bottom trawling on photic sand. Bottom trawling has been considered one of the most disturbing human activities to marine life on the seabed. This could mean that the final weighting score should be 4. When building the score from its components, the functional impact is certainly 4 (whole community), resistance against the pressure is 4 (vulnerable), and recovery after the pressure is probably 3 (5–10 years) or 4 (10–100 years). The average of the three values is 4 (or less). On contrary, stationary fishery (traps, pots and gillnets) has less obvious impacts on the photic sand: functional impact is 2 (1 trophic level), resistance is 1 (high) and recovery is 1 (less than one year). The average is 1.33. However, one can also think that those species which are impacted are predatory species (for example cod) and that the bycatch of mammals is high and therefore the final score should be rounded up. Because the criteria are only guidelines to the evaluation, the final weighting score can be increased to 2.

The index formula (equation 1) also has certain consequences for the interpretation of the weighting score. Firstly, the presence or absence of an ecosystem component is not only a technical issue, but also carries an important message: this is the phase where the potential impact is actually taken into account. When experts estimated a weighting score (μ) for a pressure, the score must be a theoretical score (i.e., 'What is theoretically the impact of a pressure for a biotope?'). A potential impact will never take place unless the pressure and the ecosystem component meet in the same square (i.e., E=0). In this method, the impact is always considered as 'potential', because it is not known whether a pressure causes the impact in a specific ecosystem component even in the case of spatial overlap. This is further described in the following example.

Example 2. What is the impact of sand extraction on photic sand bottoms? The imaginary extraction operation took place during the assessment period 2003–2007 and it causes the pressure 'smothering of the seabed'. The proxy value for the operation is the amount of extracted sand per cell (for example, a normalized value 0.5).The value 0.5 is multiplied by 2.8 (the μ score). However, one could argue that the weighting score should be 0, because sand extraction cannot take place, as according to a certain policy it is not allowed in photic sand bottoms. However, that is not an issue, because in that case the sand extraction pressure and that biotope layer do not meet in that area X (i.e., E=0 and Impact = 0.5 x 2.8 x 0 = 0).

The second possibility for misinterpretation of the BSII formula arises from the intensity of a pressure. It would lead to an underestimation of the index value if one included intensity in the weighting score, even though that is taken care by the pressure variable (P). For example, there is a temptation to reason that wind farms are mostly so small (i.e., a few windmills only) that the impact is minor and this should be reflected in the weighting score. However, the intensity of the pressure is included by the variable P. Thus, the weighting score should reflect a 'theoretical impact' or the impact at the higher end of the scale.

The results of the expert-judgment questionnaire were generally in line with previous scientific studies (Kappel 2005, Venter et al. 2006, Halpern et al. 2007, Crain et al. 2009). The impacts of fisheries, excess nutrients, hazardous substances, and physical disturbance were ranked high in the results of the HELCOM questionnaire, but the ranking naturally varied among ecosystem components. The weighting scores for species-related ecosystem components (seals, harbour porpoise, wintering areas of seabirds, and nursery and spawning areas of cod) received high scores for various kinds of fishery, hunting, underwater noise, and hazardous substances. The benthic biotopes and biotope complexes received high scores for various physical disturbance pressures (abrasion, sealing, and smothering), enrichment by nutrients and organic matter, as well as bottom trawling. The water-column biotope complexes had high weighting scores for nutrient enrichment, changes in salinity and temperature, as well as surface and mid-water trawling.

The top 20 expert scores for the 14 ecosystem components are presented in **Table 2.3**. This combination explains the majority of the index results in most assessment units. All the expert scores and the final weighting scores are presented in **Appendix B**.

2.2 The Baltic Sea Pressure Index

The Baltic Sea Pressure Index (BSPI) is a straightforward measure of the geographical distribution and intensity of anthropogenic pressures on the Baltic Sea marine environment. Its main aim is to provide a spatial overview of the sum of pressures without considering their impacts on specific ecosystem components.

The BSPI methodology differs from the BSII in only one variable. While BSII includes the variable *E* for the presence of ecosystem components, the BSPI has only variables *P* (pressure) and *μ* (weighting score). However, the lack of *E* means that *μ* is insensitive to specific ecosystem components. Therefore, a median value was taken of all 14 ecosystem components to obtain the weighting score for BSPI pressures (**Table 2.3** and **Appendix B**). The median scores were considered to reflect the general harmfulness of the pressures on the ecosystem. In order to further balance them in the index, these scores were 'stretched' to a 0 to 10 scale. The weighting scores were explained in the previous section (**Section 2.1**). A conceptual model of the procedure is given in **Figure 2.2**.

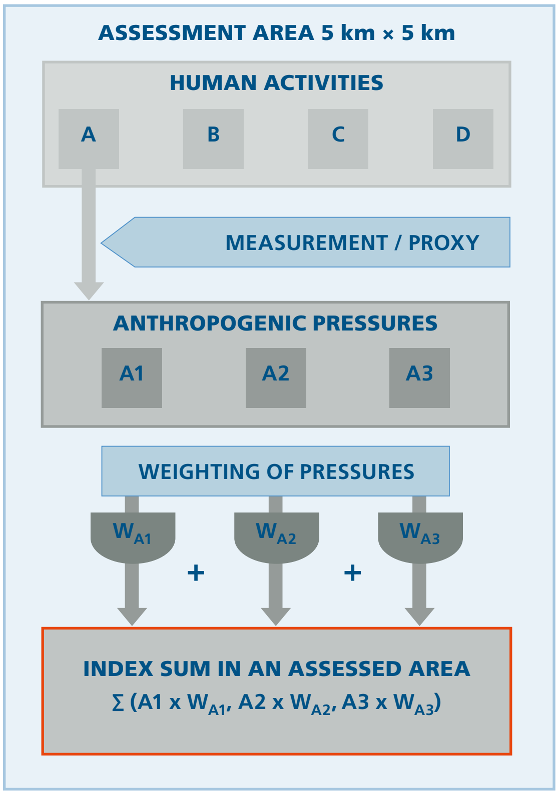


Figure 2.2 Conceptual model of the Baltic Sea Pressure Index (BSPI). The index sums up all anthropogenic pressures in an assessment unit of 5 km x 5 km. Weighting of the pressures by their general harmfulness (weighting score) is required to make the pressures comparable. In this figure the system consists of four activities, but only one of them (A) has been shown in further steps. The activity A causes three pressures which are weighed and finally summed within the 5 km x 5 km assessment unit.

Table 2.3 Top 20 pressures over all ecosystem components according to an expert survey (median ± SE). The rank of the pressures is given also for all 14 ecosystem components. A median (± SE) of the expert scores is used for these specific scores.

Pressures	Median± SE	PSa[1]	PSo[2]	PHa[3]	NSa[4]	NSo[5]
1. Species: bottom trawling	3.20± 0.13	5. 3.00± 0	1. 3.20± 0.53	7. 3.00± 0.43	1. 3.75± 0.64	1. 3.75± 0.64
2. Synthetic compounds: Coastal industry, oil terminals, refineries, oil platforms	2.95± 0.16	9. 3.00± 0	2. 3.00± 0	4. 3.00± 0.06	15. 2.2± 0.17	15. 2.20± 0.17
3. Synthetic compounds: Harbours	2.85± 0.20	6. 3.00± 0	3. 3.00± 0	2. 3.3± 0.06	17. 2.10± 0.16	14. 2.20± 0.14
4. Nutrients: Waterborne discharges of nitrogen	2.84± 0.14	1. 3.40± 0.06	11. 2.60± 0.18	3. 3.2± 0.11	8. 3.00± 0.28	6. 3.00± 0.31
5. Nutrients: Waterborne discharges of phosphorus	2.83± 0.13	2. 3.40± 0.06	10. 2.60± 0.14	5. 3.00± 0.18	9. 3.00± 0.28	7. 3.00± 0.31
6. Synthetic compounds: polluting ship accidents	2.59± 0.21		13. 2.40± 0.10	14. 2.60± 0.12	—	—
7. Salinity change: bridges and dams	2.57± 0.23	11. 3.00± 0.50	4. 3.00± 0.25	6. 3.00± 0.20	7. 3.00± 0.20	4. 3.00± 0.20
8. Synthetic compounds: oil slicks/spills	2.53± 0.22		17. 2.20± 0.15	17. 2.40± 0.11	—	—
9. Smothering: disposal of dredged material	2.53± 0.24	13. 2.80± 0.08	15. 2.20± 0.11	15. 2.60± 0.24	12. 2.45± 0.20	13. 2.35± 0.17
10. Species: surface and mid-water trawling	2.44± 0.25	—	—	—	16. 2.20± 0.61	17. 2.20± 0.61
11. Abrasion: bottom trawling	2.44± 0.31	7. 3.00± 0	7. 2.80± 0.37		2. 3.40± 0.61	2. 3.60± 0.62
12. Organic matter: Riverine input of organic matter	2.43± 0.11	14. 2.80± 0.12	19. 1.90± 0.14	13. 2.60± 0.08	11. 2.75± 0.14	5. 3.00± 0.21
13. Species: Gillnet fishery	2.41± 0.29					19. 2.10± 0.37
14. Sealing: Coastal defense structures	2.40± 0.20	16. 2.60± 0.06		12. 2.70± 0.40	—	—
15. Sealing: Harbours	2.38± 0.20	19. 2.60± 0.07		16. 2.50± 0.10	—	—
16. Siltation: Dredging and sand extraction	2.37± 0.16	10. 3.00± 0.17	20. 1.80± 0.20	19. 2.10± 0.06	5. 3.00± 0.13	11. 2.60± 0.19
17. Siltation: Riverine input of organic matter	2.37± 0.22	17. 2.60± 0.06	—	11. 2.70± 0.05	6. 3.05± 0.13	8. 3.00± 0.42
18. Selective extraction: dredging and sand extraction	2.37± 0.31	3. 3.40± 0.06	14. 2.35± 0.21	—	3. 3.30± 0.10	9. 2.90± 0.42
19. Nutrients: aquaculture	2.36± 0.11	18. 2.60± 0.06	9. 2.70± 0.10	8. 2.80± 0.06	13. 2.40± 0.18	12. 2.40± 0.18
20. Abrasion: Dredging and sand extraction	2.35± 0.29	8. 3.00± 0	8. 2.70± 0.07	—	4. 3.10± 0.04	3. 3.00± 0.17
Average of the top 20	—	**2.95**	**2.56**	**2.77**	**2.91**	**2.77**

1) Ranks 4, 12, 15 and 20: Warm water outflow, organic matter from aquaculture, smothering by wind farm construction, and sealing by bridges, respectively.
2) Ranks 5, 6, 12, 16 and 18: Warm water outflow, organic matter from aquaculture, smothering by wind farm construction, siltation by shipping, and siltation by beach replenishment, respectively.
3) Ranks 1, 9, 10, 18 and 20: Warm water outflow, organic matter from aquaculture, atmospheric deposition of nitrogen, underwater noise by shipping, and smothering by cable construction, respectively.
4) Ranks 10, 14, 18, 19 and 20: Atmospheric deposition of nitrogen, smothering by wind farm construction, organic matter from aquaculture, smothering by cable construction, and waterborne inputs of heavy metals, respectively.
5) Ranks 10, 16, 18 and 20: Atmospheric deposition of nitrogen, waterborne metals, organic matter from aquaculture, and stationary fishery, respectively.
6) Ranks 12, 13, 15 and 18: Atmospheric deposition of nitrogen, smothering by wind farm construction, stationary fishery, and organic matter from aquaculture, respectively.
7) Ranks 1, 8 and 14: Warm water outflow, atmospheric deposition of nitrogen, and organic matter from aquaculture; Ranks 15, 16 and 17: Underwater noise by wind farm construction, cable construction, and oil platforms, respectively; Ranks 19 and 20: Underwater noise by wind farm and cables construction, respectively.
8) Ranks 6, 8, 10 and 11: Underwater noise by oil platforms, smothering by construction of cables, underwater noise by shipping, and underwater noise by wind farm construction, respectively; Ranks 14, 15, 16 and 17: Deposition of dioxins,

Key: PSa=Photic sand, PSo=Photic soft bottom, PHa=Photic hard bottom, NSa=Non-photic sand, NSo=Non-photic soft bottom, NHa=Non-photic hard bottom, PW=Photic water, NW=Non-photic water, Mu=mussel beds, Zo=*Zostera* meadows, Hp=Harbour porpoise, Se=Seals, Co=Cod nursery and spawning areas, and WB=Wintering areas of seabirds.

NHa[6]	PW[7]	NW[8]	Mu[9]	Zo[10]	Hp[11]	Se12	Co[13]	WB[14]
1. 3.75± 0.13	12. 2.65± 0.26	5. 2.70± 0.26	6. 3.00± 0.48	12. 3.00± 0.44	10. 3.50± 0	—	1. 4.00± 0	20. 3.00± 0.37
19. 2.20± 0.13	4. 3.00± 0.03	7. 2.32± 0.17	9. 2.90± 0.15	11. 3.00±0.03	3. 4.00± 0	7. 3.50± 0.10	6. 3.00± 0	1. 4.00± 0
17. 2.20± 0.03	3. 3.00± 0	—	4. 3.20± 0.07	13. 2.95± 0.12	12. 3.50± 0.17	11. 3.50± 0.12	16. 3.00± 0.13	5. 4.00± 0.20
8. 3.00± 0.41	6. 3.00± 0.12	3. 2.80± 0.21	1. 3.40± 0.09	1. 3.40± 0.08	19. 2.00± 0	—	18. 3.00± 0.58	
7. 3.00± 0.34	7. 3.00± 0.12	4. 2.80± 0.21	2. 3.40± 0.09	3. 3.40± 0.17	20. 2.00± 0	—	19. 3.00± 0.58	
—	13. 2.60± 0.13	13. 2.00± 0.26	19. 2.40± 0.16	—	4. 4.00± 0	8. 3.50± 0.10	7. 3.00± 0	2. 4.00± 0
9. 3.00± 0.65	5. 3.00± 0.08	1. 3.00± 0.08	5. 3.00± 0.48	10. 3.00± 0.17	—	—	8. 3.00± 0	—
—	9. 2.80± 0.08	—	20. 2.40± 0.11	—	5. 4.00± 0	9. 3.50± 0.10		3. 4.00± 0
10. 2.95± 0.25	18. 2.20± 0.41	—	10. 2.80± 0.09	4. 3.00± 0.14	17. 3.00± 0.33	—		6. 4.00± 0.33
14. 2.30± 0.52	2. 3.2± 0.11	2. 3.00± 0.15	—	—	6. 4.00± 0.33	13. 3.00± 0	2. 4.00± 0	19. 3.00± 0.21
2. 3.35± 0.16	—	—	16. 2.60± 0.44	7. 3.00± 0.30			9. 3.00± 0	11. 3.00± 0
5. 3.00± 0.06	11. 2.70± 0.19	9. 2.00± 0.11	17. 2.50±0.08	16. 2.80± 0.14	—	—		
16. 2.25± 0.07	—	12. 2.00± 0.18			7. 4.00± 0.33	4. 4.00± 0.20	3. 4.00± 0	8. 4.00± 0.34
—	—	—	12. 2.80± 0.42	5. 3.00± 0.37	14. 3.00± 0	14. 3.00± 0		9. 4.00± 0.40
—	—	—	14. 2.60± 0.13	19. 2.60± 0.09	15. 3.00± 0			7. 4.00± 0.33
6. 3.00± 0.17	—	—	—	6. 3.00± 0	—	15. 3.00± 0		
11. 2.80± 0.25		20. 1.65± 0.12	13. 2.60±0.06	—	—	16. 3.00± 0	10. 3.00± 0	
3. 3.20± 0.55	—	—	—	2. 3.40± 0.11	—	17. 3.00± 0	11. 3.00± 0	12. 3.00± 0
20. 2.20± 0.19	10. 2.80± 0.15	—	7. 2.90± 0.05	—	—	—		
4. 3.05± 0.04	—	—	—	8. 3.00± 0.05	—	18. 3.00± 0	12. 3.00± 0	13. 3.00± 0
2.83	**2.83**	**2.43**	**2.83**	**3.04**	**3.33**	**3.27**	**3.23**	**3.62**

stationary fishery, atmospheric deposition of metals, and waterborne input of metals, respectively; Ranks 18 and 19: warm water outflow and organic matter from aquaculture, respectively.

9) Ranks 3, 8, 11, 15 and 18: Warm water outflow, organic matter from aquaculture, sealing by bridges, atmospheric deposition of nitrogen, and smothering by cable construction, respectively.

10) Ranks 9, 14, 15, 17, 18 and 20: Warm water outflow, smothering by wind farm construction, siltation by beach replenishment, organic matter from aquaculture, smothering by cable construction, and smothering by bridges, respectively.

11) Ranks 1, 2, 8 and 9: Underwater noise by construction of wind farms and cables, by recreational boating, and by shipping, respectively; Ranks 11, 13 and 16: waterborne inputs of metals and deposition of metals and dioxins, respectively.

12) Ranks 1, 2, 5 and 6: Underwater noise by wind farm construction, cable construction, recreational boating, and shipping, respectively. Ranks 3, 10 and 19: Hunting of seals, waterborne inputs of metals, and atm. deposition of metals and dioxins, respectively.

13) Ranks 4, 5 and 13: Stationary fishery, smothering by wind farm construction, and salinity decrease by municipal waste water treatment plants; Ranks 14, 15, 17 and 20: Atmospheric deposition of dioxins, waterborne inputs of metals, and atmospheric deposition of metals and nitrogen, respectively.

14) Ranks 4, 10, 17 and 18: Hunting of birds, smothering by wind farm construction and atmospheric deposition and waterborne inputs of metals; Ranks 14, 15 and 16: Underwater noise by wind farm construction, cable construction, and recreational boating.

3 DATA ON HUMAN ACTIVITIES, ASSOCIATED PRESSURES AND BIOLOGICAL ECOSYSTEM COMPONENTS IN THE BALTIC SEA

This chapter presents the data sets, which were used to describe the anthropogenic pressures, as well as the distribution data of species, biotopes and biotope complexes, which formed the 14 ecosystem components in the BSII.

3.1 Description of the pressure data layers

Human activities cause multiple pressures on different components of the marine ecosystem (see Jackson et al. 2001, Kappel 2005, Crain et al. 2009). For example, dredging of the seabed causes abrasion of the seabed and siltation of the bottom as well as the resuspension of nutrients, organic matter and hazardous substances, each causing impacts on different biotopes.

HELCOM identified 52 data layers of anthropogenic pressures in the Baltic Sea, which were classified under the 18 pressure types in Annex III, Table 2 of the EU MSFD (Anon. 2008) (**Table 3.1**). The pressures were selected on the basis of (1) relevance to the marine environment, (2) data coverage, and (3) data quality. The data coverage was Baltic Sea-wide, whereas the data quality varied among regions and data layers. Because there were no direct measurements for many of the pressures, some data layers were proxies for those pressures and data were sometimes on a class scale or even presence/absence data. Data layers that did not provide a good quantitative proxy for a pressure were discarded. In this section, all 52 pressure data layers are described and the data are shown on maps.

In order to assess anthropogenic pressures using a comparable scale, the data layers were log-transformed, normalized to a 0 to 1 scale, and linked to a grid. The grid consists of 19 276 cells of 5 km x5 km size. If a pressure was present within a cell, the whole cell was given the value of the pressure. In cases of multiple values per cell, an average was taken (details are given under the data descriptions). This approximation provided a compromise between high- and low-resolution data.

Table 3.1 Relationship between pressures in the Marine Strategy Framework Directive and the HELCOM HOLAS data layers

Pressures in MSFD, Annex III, Table 2	HOLAS data layer
Physical loss	
Smothering	Disposal of dredged spoils
	Wind farms, bridges, oil platforms under construction
	Cables and pipelines, which are under construction
Sealing	Harbours
	Coastal defence structures
	Bridges and coastal dams
Physical damage	
Changes in siltation	Riverine runoff of organic matter
	Dredging
	Bathing sites, beaches and beach replenishment
	Coastal shipping
Abrasion	Commercial bottom-trawling fishery
	Dredging
Selective extraction	Dredging

Pressures in MSFD, Annex III, Table 2	HOLAS data layer
Other physical disturbance	
Underwater noise	Coastal and offshore shipping
	Recreational boating and sports
	Operational wind farms
	Wind farms, bridges, oil platforms, which are under construction
	Cables and pipelines, which are under construction
	Oil rigs (operational)
Marine litter	No indicators
Interference with hydrological processes	
Changes in thermal regime	Nuclear power plants
Changes in salinity regime	Bridges and coastal dams
	Coastal wastewater treatment plants
Contamination by hazardous substances	
Introduction of synthetic compounds	Atmospheric deposition of dioxins
	Polluting ship accidents
	Oil slicks and spills
	Coastal industry, oil terminals, oil platforms and refineries
	Harbours
	Population density
Introduction of non-synthetic substances and compounds	Waterborne load of heavy metals (lead, cadmium, mercury, zinc and nickel, separately)
	Atmospheric deposition of metals (lead, cadmium and mercury, separately)
Introduction of radionuclides	Discharges of radioactive substances
Systematic and/or intentional release of substances	
Introduction of other substances	No indicator
Nutrient and organic matter enrichment	
Inputs of fertilizers	Aquaculture
	Atmospheric deposition of nitrogen
	Waterborne discharges of nitrogen
	Waterborne discharges of phosphorus
Inputs of organic matter	Aquaculture
	Riverine runoff of organic matter
Introduction of non-indigenous species	
Introduction of non-indigenous species	No indicator
Biological disturbance	
Introduction of microbial pathogens	Aquaculture
	Coastal wastewater treatment plants
	Passenger ships outside 12 nm
Selective extraction of species	Hunting of birds
	Hunting of seals
	Commercial surface and mid-water fishery
	Commercial bottom-trawling fishery
	Commercial gillnet fishery
	Commercial trap and pot fishery

PRESSURE DATA SETS

The data sets described below were identified and used for testing the indices. Note that, in some cases, an individual data set on a human activity was used to describe two or more different pressures. For example, coastal shipping causes siltation and underwater noise, and bottom trawling causes abrasion and species extraction. Thus, a data set on a specific human activity may be associated with two or more different pressures and, therefore, they were given different weights in the BSPI and BSII.

Data on the 52 data layers in this exercise were requested from Contracting Parties or obtained from other available data sources (e.g., EU, EEA, EMEP, private companies) and they were compiled by the HELCOM HOLAS project. Due to the lack of some direct pressure data, proxies for some pressures were used, which resulted in an approximation of the pressure. However, linking the proxy data into a cell size of 5 km x 5 km in the grid is a useful way to decrease potentially false details and, thus, to increase the confidence of the exercise.

Each data set was logarithmically transformed, then normalized to a 0 to 1 scale, and finally linked to the grid. For the sake of clarity, most of the data maps presented in this section are shown without the grid.

3.1.1 Smothering

1 Disposal of dredged material

The data set is based on reports on the disposal of dredged spoils submitted by HELCOM Contracting Parties to the HELCOM Secretariat from 2005 to 2007 during commonly agreed reporting rounds (**Fig. 3.1)**. The pressure value for the data set is based on the quantity of disposed material (in tonnes). The most recent year was used to give the quantity per cell. If the site included no quantitative data but only an indication of the activity having taken place, then 1 tonne was given for the activity.

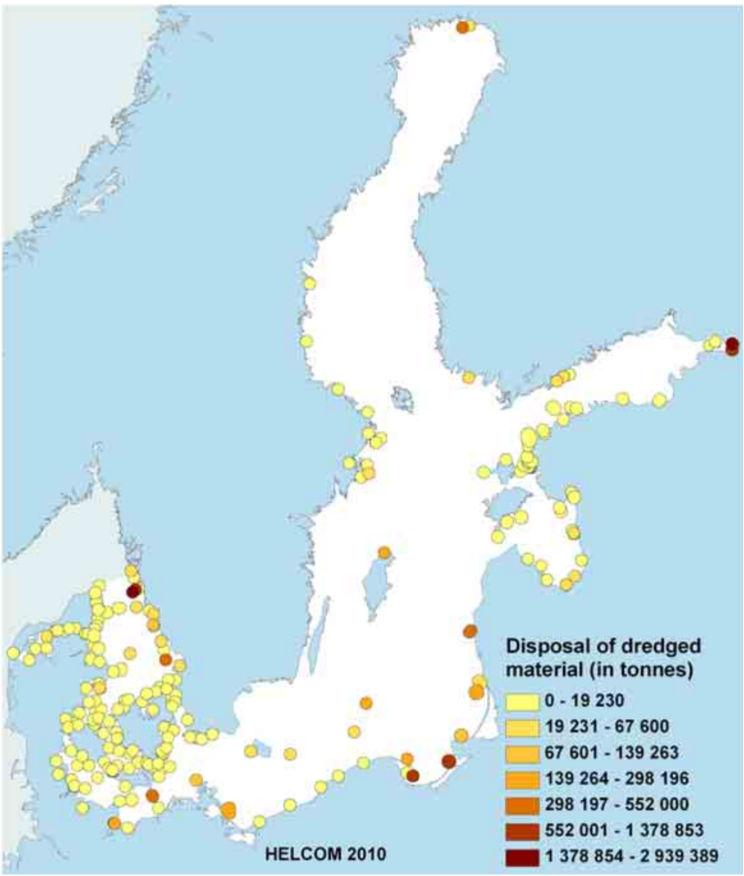


Figure 3.1 Sites for the disposal of dredged material in 2003–200. The sites have been artificially enlarged to increase their visibility. Data source: HELCOM.

2 Wind farms, bridges and oil platforms under construction

No bridges or oil platforms were under construction in the Baltic Sea during the assessment period 2003 to 2007. The data set was based on offshore wind farm data from the European Wind Energy Association (EWEA, www.ewea.com; data received in autumn 2009). Offshore wind farms that were under construction during 2003 to 2007 were selected. The number of wind turbines per cell serves as the pressure value (**Fig. 3.2**).

3 Cables and pipelines, which are under construction

The data set is based on data from the European Wind Energy Association (EWEA, www.ewea.com; data received in autumn 2009) and the homepage of Nordic Energy Link (www.nordicenergylink.com/index.php?id=35). Submarine cables that were installed during 2003–2007 were taken into account, namely, cables from offshore wind farms and the Estlink submarine cable between Finland and Estonia. The pressure value for the data set was the presence (1) or absence (0) of cables under construction in a cell (**Fig. 3.2**).

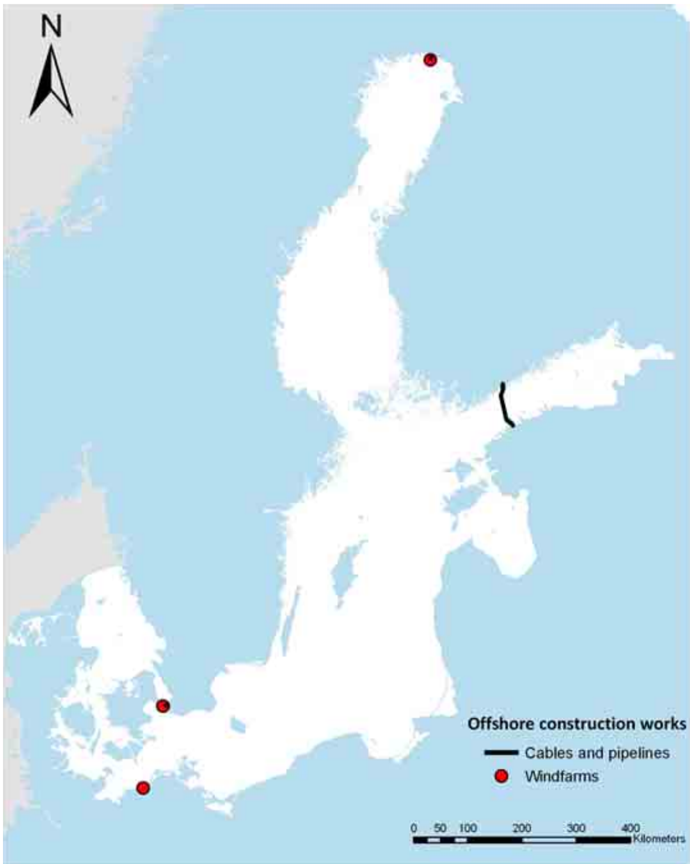


Figure 3.2 Offshore wind farms, cables and pipelines under construction during 2003-2007.

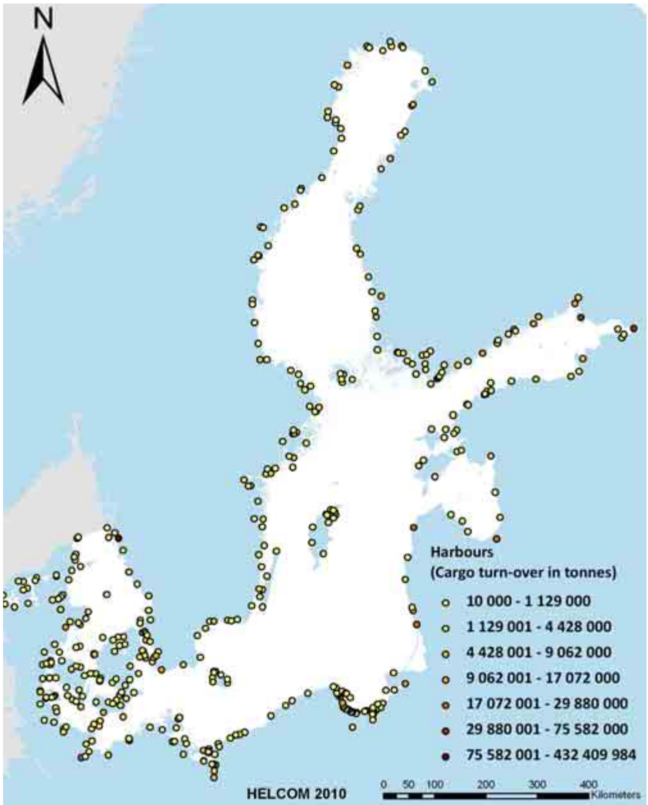


Figure 3.3 Harbours sealing marine biotopes.

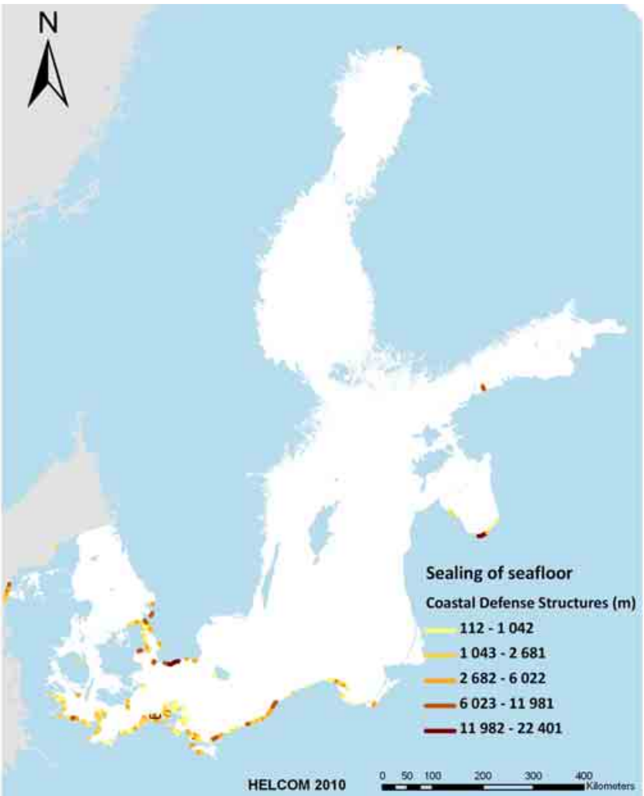


Figure 3.4 Coastal defence structures sealing marine biotopes.

3.1.2 Sealing

4 Harbours

Harbours include wave breakers and other structures that affect the hydrography of the area. The data set was based on HELCOM data on harbours along the coast of the Baltic Sea (**Fig. 3.3**). The pressure was quantified according to the total annual cargo volume in 2008. In cases where there was no quantitative information on the cargo turnover, the site was given a small value (10 000 t). Source: Baltic Port Barometer 2008 (http://mkk.utu.fi/tutkimus/projektit/uusihanke /balticportbarometer2009.html) .

5 Coastal defence structures

Coastal defence structures include wave breakers, which reduce flooding, natural erosion, and also coastal wave dynamics (**Fig. 3.4**). The data set consists of data derived from the report 'EUROSION PROJECT - The Coastal Erosion Layer WP 2.6' (Lenôtre et al. 2004). The total length of the defence structures per cell serves as the pressure value. The length of the structures was summed per cell when associated with the Index grid. Where the data layer overlapped with the bathing site data layer (no. 9), the pressure was removed from the coastal defence structure data layer.

6 Bridges and coastal dams

Bridges and coastal dams are structures that potentially seal sea floor habitats (**Fig. 3.5**). The locations of bridges and coastal dams were compiled by internet searches by the HELCOM HOLAS project. The pressure value is presence/absence in a cell.

3.1.3 Changes in siltation

7 Riverine input of organic matter

The data are based on the biochemical oxygen demand, BOD7, (or chemical oxygen demand, COD5, transformed to BOD7) from river mouths (**Fig. 3.6**). The data set is based on HELCOM data (unpublished PLC-5 data) for the time period 2003 to 2006. The natural background load was subtracted from the loads per sub-basin (Åland and Archipelago Sea, Baltic Proper, Bothnian Bay, Bothnian Sea, Gulf of Finland, Gulf of Riga, Kattegat, Sound and Western Baltic). However, because no information was available on the amount of natural background loads, the phosphorus background load percentage was used instead (HELCOM 2004). The load was presented as a slowly decreasing gradient from the river mouth to the open sea. The gradient was made by Spatial Analyst extension in the ESRI ArcGIS software. Each cell was given an average value of the gradient formed within that cell. Although this does not take into account within- and between-basin advection, it gives an overview of the amount of riverine inputs of organic matter to the basin.

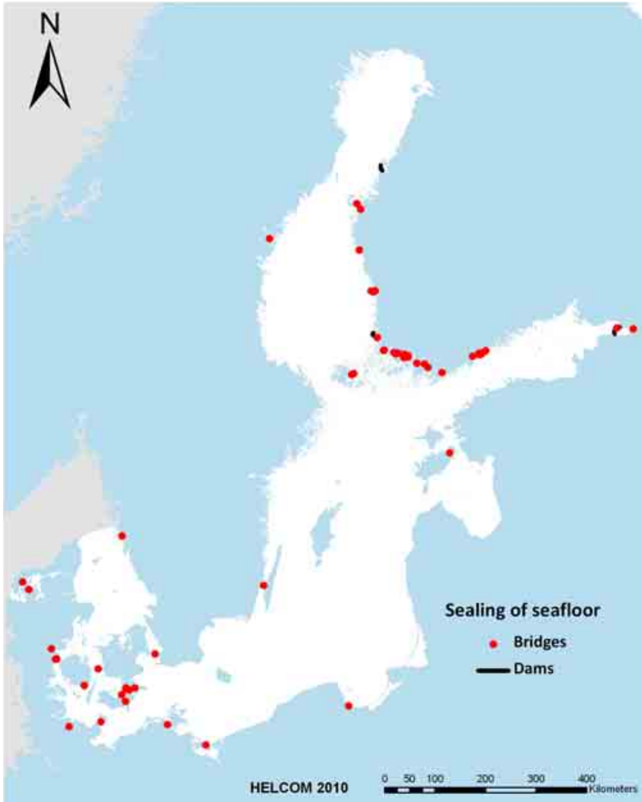


Figure 3.5 Bridges and dams in marine area.

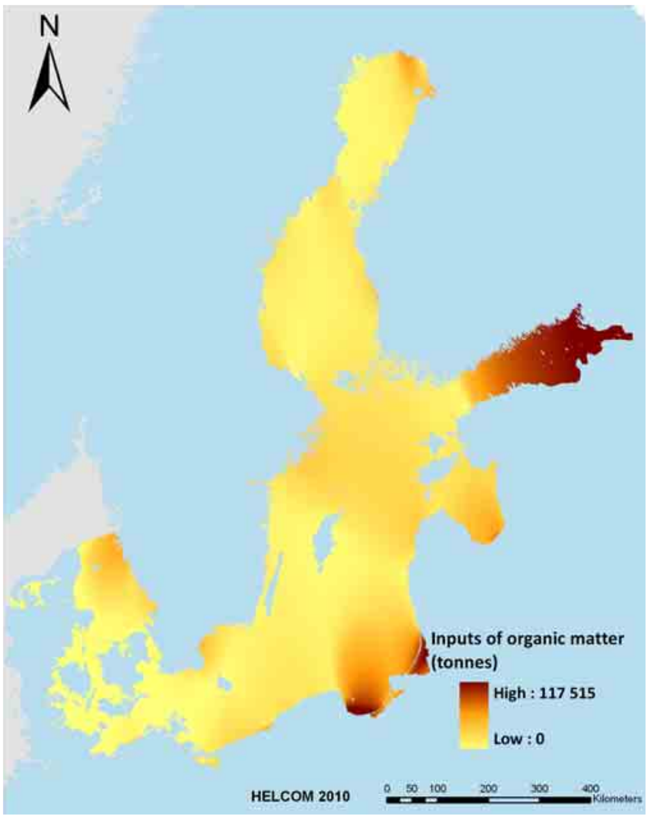


Figure 3.6 Estimated flow of organic matter from river mouths.

8 Dredging

The data set is based on data on maintenance dredging, capital dredging, and sand/gravel/maerl extraction during the time period 2003 to 2007 in the HELCOM Contracting Parties (**Fig. 3.7**). The data were requested from responsible authorities in each country and additional data were retrieved from web sites of dredging companies (for completed projects). The pressure value for the data set is based on the amount of dredged material (in tonnes). The quantity of dredged material was summed per cell when associated with the Index grid.

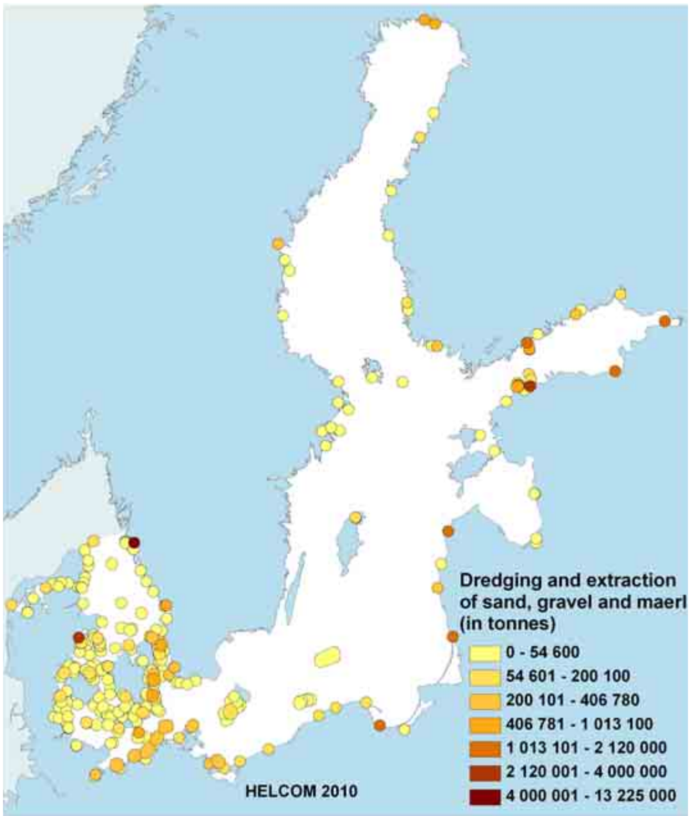


Figure 3.7 Extraction of sand, gravel and maerl and dredging in sea lanes, harbours and various construction projects.

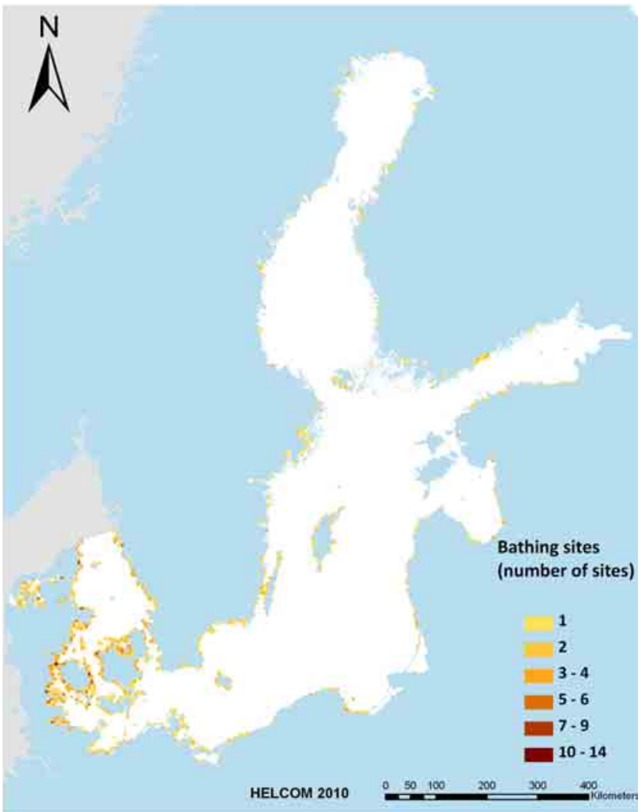


Figure 3.8 Bathing sites.

9 Bathing sites, beaches and beach replenishment

The data set is based on the data set of the European Environment Agency (www.eea.europa.eu). Coastal bathing sites were selected (**Fig. 3.8**). The number of bathing sites per cell was summed and the total number of bathing sites per cell was considered to serve as the pressure value for the data set. Any overlap with coastal defence structures (no. 5) was removed from this data layer.

10 Coastal shipping

Coastal shipping causes resuspension of seabed sediments and erosion of the shorelines (**Fig. 3.9**). The data set is based on AIS (Automatic Identification Systems) HELCOM data from the year 2008. The data set includes AIS data on the following ship types: passenger, tanker, cargo, and other. Only the coastal (within 12 nautical miles from the coast) ship traffic was taken into account. The relative traffic intensity value serves as the pressure value. Because AIS data overemphasize harbours, data from harbours were removed from the data set.

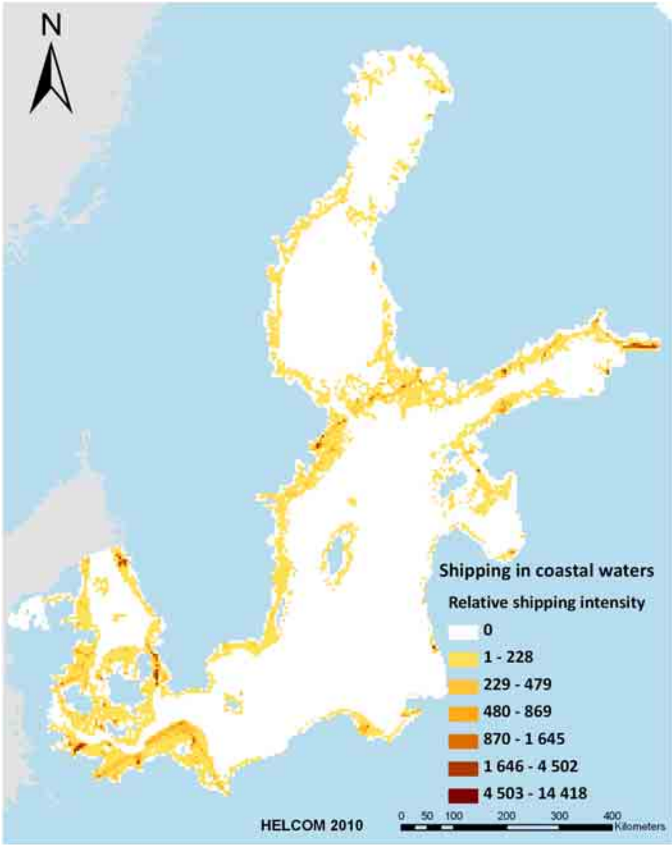


Figure 3.9 Coastal shipping

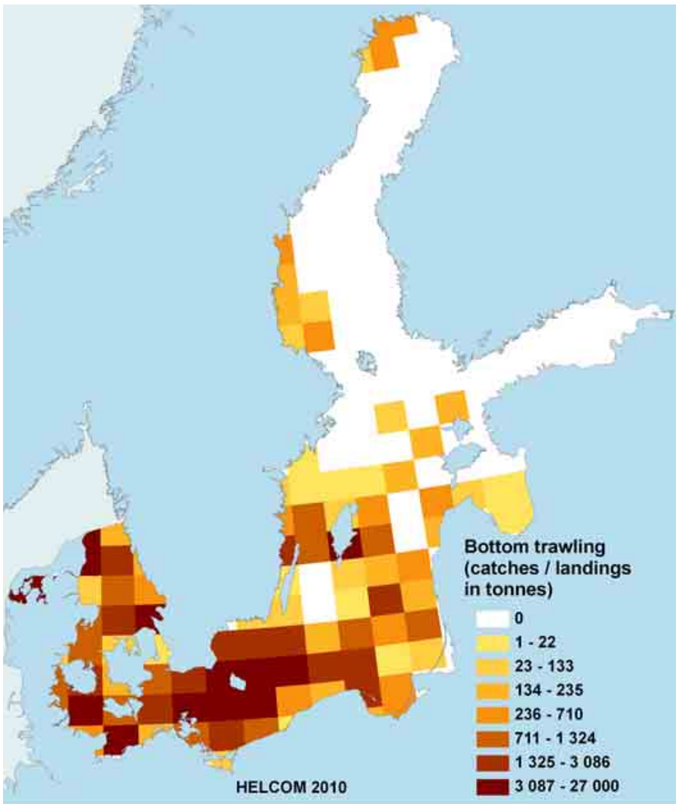


Figure 3.10 Catches or landings of fish by bottom trawling.

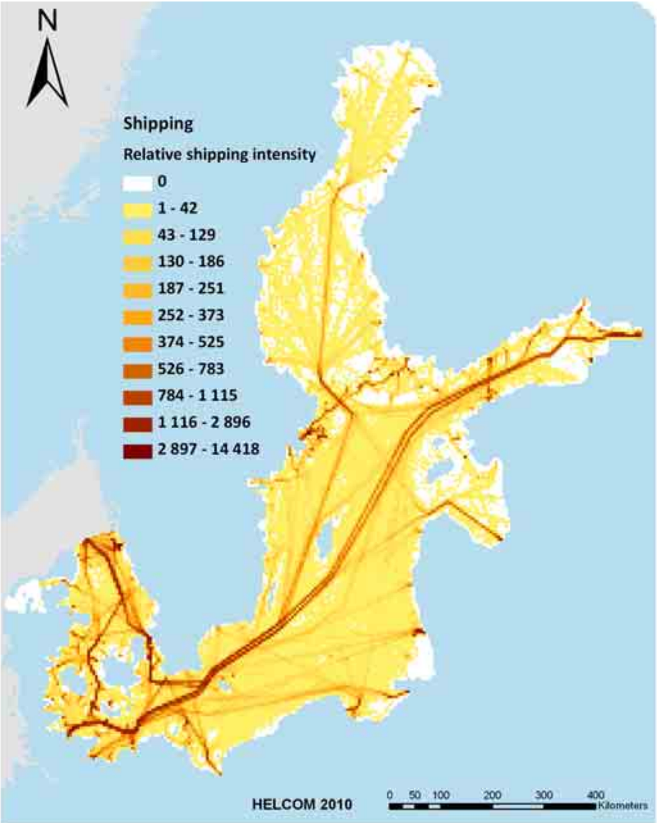


Figure 3.11 **Shipping in the Baltic Sea according to Automatic Identification System.**

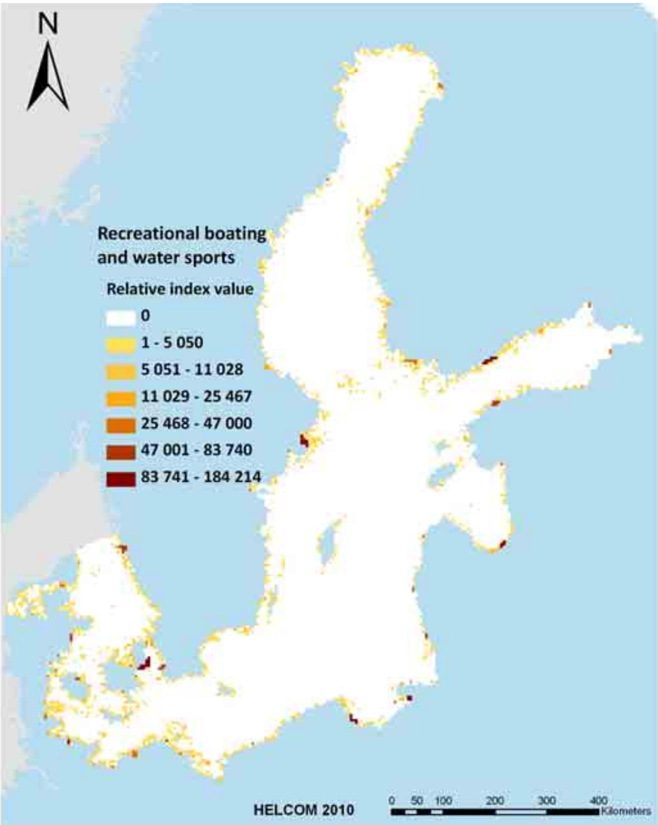


Figure 3.12 **Boating and water sports**

3.1.4 Abrasion

11 Commercial bottom-trawling fishery

Bottom trawling is a form of fishery that damages the upper layer of the seabed, including the benthic fauna, down to 15–30 cm. The data set consists mainly of commercial fishery data from the year 2007, requested by the HELCOM Secretariat from the Contracting Parties (**Fig. 3.10**). The Lithuanian data are from 2008. Russian data on commercial fishery were derived from the 'Report of the Baltic Fisheries Assessment Working Group (WGBFAS)' (ICES 2007). The Danish data for the Limfjord were received from Danish fisheries authorities. Landings or catches were reported for ICES rectangles, sorted by gear type and species. The Russian data were for ICES subdivisions (i.e., the data were spatially less detailed). For this pressure, the catches or landings using the following bottom-trawling gears were taken into account: Scottish seines, demersal seines, boat dredges, bottom otter trawls, bottom pair trawls, beam trawls, otter twin trawls, and unspecified bottom trawls. Each cell was given the same value as the whole ICES rectangle. The pressure value is the total amount of the landings or catches in tonnes.

12 Dredging

Dredging and mineral extraction cause abrasion of the seabed. The data set and procedure are the same as for the dredging data layer (no. 8, **Fig. 3.7**).

3.1.5 Selective extraction of non-living resources

13 Dredging

Dredging and mineral extraction change the structure of the seabed by removing part of the seabed. The data set does not allow distinguishing dredging from mineral extraction. The data set and procedure are the same as for the dredging data layer (no. 8).

3.1.6 Underwater noise

14 Coastal and offshore shipping

Shipping is the major source of underwater noise in the marine environment. All ship traffic (passenger, tanker, cargo, and other), both coastal and offshore, was used to derive an estimate of noise (**Fig. 3.11**). The quantification was based on the relative traffic intensity from the HELCOM AIS (Automatic Identification System) data in the year 2008. Because AIS data overemphasize harbours, data from harbours were removed from the data set.

15 Recreational boating and sports

Recreational boating and sports cause underwater noise in the marine environment. This modelled data layer relies on the assumption that most recreational boating and sports occur in the close vicinity of marinas and that dense human settlements have more marinas than sparsely populated areas (**Fig. 3.12**). The data set is based on an estimate of the number of marinas in coastal urban areas based on the population density ('Urban Morphological Zones 2000, version F1v0 – Definitions and procedural steps', European Environment Agency, 2007). The estimates are as follows: 0–150 individuals per km2 = 0 marinas, 151–1500 = 1, 1501–15000 = 2, 15001–150000 = 3, >150000 = 4. The pressure value for the data set is the summed number of marinas in each cell.

16 Operational wind farms

Noise generated by operating offshore wind turbines causes disturbance in the marine environment. The data set on wind turbines is based on data from The European Wind Energy Association (EWEA, www.ewea.com); data received in autumn 2009). The offshore wind farms which were or became operational during the assessment period 2003 to 2007 were included in this data set (**Fig. 3.13**). The number of turbines serves as the pressure value.

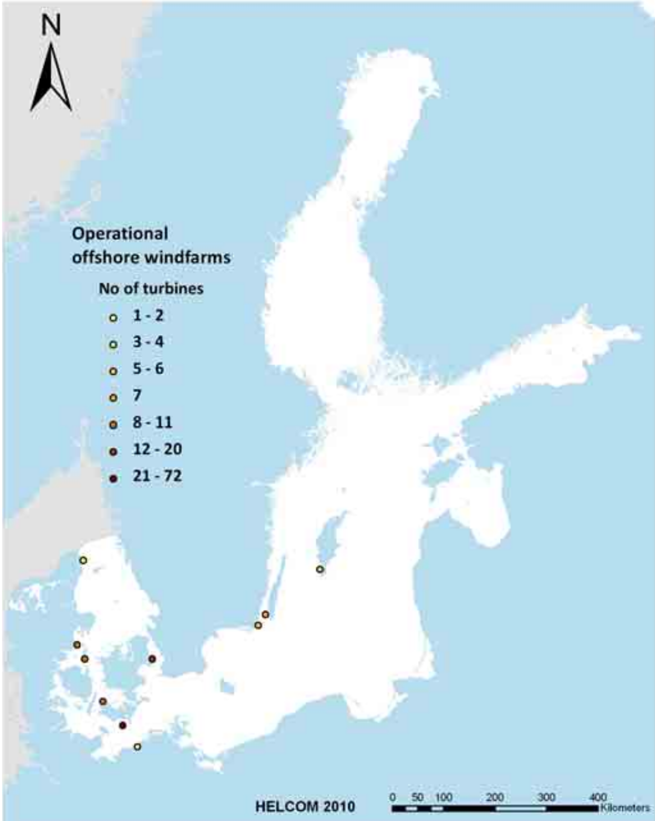


Figure 3.13 Operatonal winfarms

17 Wind farms, bridges, oil platforms, which are under construction

Noise generated by offshore construction activities causes disturbance in the marine environment. The number of turbines that were under construction during the assessment period 2003 to 2007 serves as an approximation of the noise disturbance. The data set and procedure are the same as in data set no. 2, (**Fig. 3.2**).

18 Cables and pipelines, which are under construction

Construction work when submarine cables are installed causes noise disturbance in the marine environment. The data set and procedure are the same as for the data set 'Cables and pipelines, which are under construction' (no. 3 , **Fig. 3.2**).

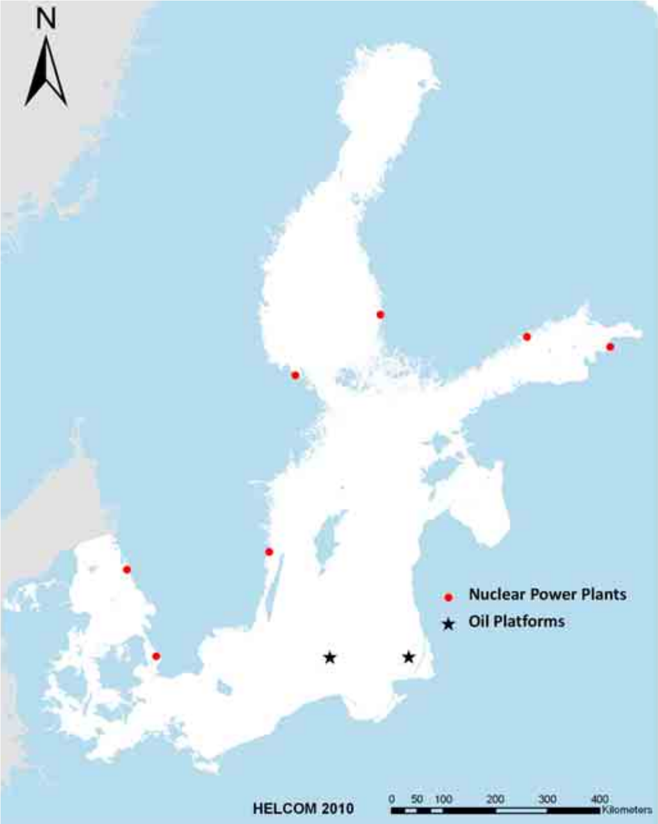


Figure 3.14 Oil platforms and nuclear power plants.

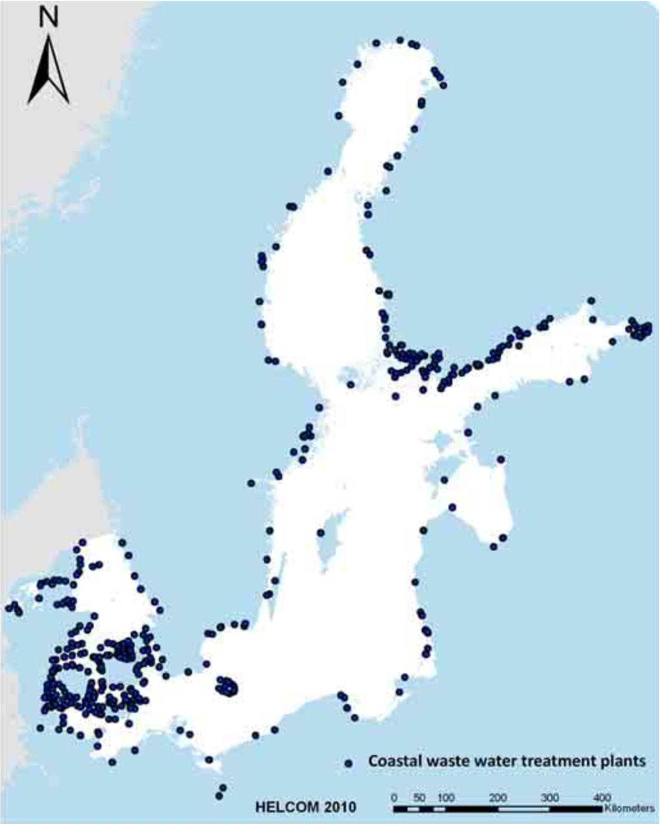


Figure 3.15 Coastal waste water treatment plants.

19 Operational oil platforms
The character of noise from oil platforms is not very well known. There are five installations in the Baltic Sea. The data set contains presence/absence values for oil platforms (**Fig. 3.14**).

3.1.7 Changes in thermal regime

20 Nuclear power plants
The warm-water outflow from coastal nuclear power plants causes changes in the thermal regime with consequent impacts on the marine environment. The data set is based on HELCOM data. All coastal power plants that were active during the years 2003 to 2007 were included in the data set (**Fig. 3.14**). The number of active reactors serves as the pressure value corresponding to the quantity of warm-water outflow.

3.1.8 Changes in salinity regime

Coastal waste-water treatment plants, bridges, and coastal dams cause changes in salinity either due to the freshwater introduced or to physical modification of the coastal hydrography. Two pressure layers were used to represent changes in the salinity regime.

21 Coastal wastewater treatment plants

The data set on municipal wastewater treatment plants (MWWTPs) is based on HELCOM data on the locations of MWWTPs (unpublished PLC-5 data) (**Fig. 3.15**). These data have been supplemented by HELCOM Hotspot data (municipalities) and HELCOM data from the year 2000 on MWWTPs. The pressure is quantified according to the average outflow of treated waste water.

22 Bridges and coastal dams

Bridges and dams are quantified by a presence/absence scale. Data on bridges and coastal dams are presented in the data set 'Bridges and coastal dams' (no. 6 , **Fig. 3.5**).

3.1.9 Introduction of synthetic compounds

23 Atmospheric deposition of dioxins

Dioxins exhibit high toxicity and they bioaccumulate and biomagnify in organisms and through the food chain. Their main sources to the Baltic Sea are atmospheric emissions. The widespread distribution of dioxins is a concern to the health of the marine environment. The data set on dioxin deposition is based on data from the European Monitoring and Evaluation Programme (EMEP) reported to the HELCOM Secretariat during the years 2005 to 2007 (**Fig. 3.16**). The data were reported on a grid used by EMEP and intersected with the Index grid. The average deposition of dioxins (pg TEQ/m^2/year) over the years 2005-2007 serves as the pressure value.

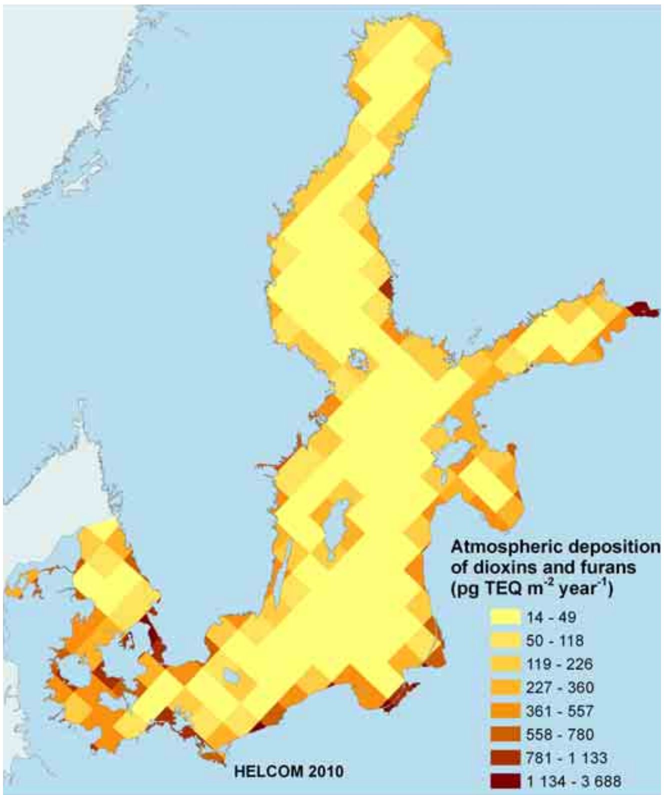


Figure 3.16 Atmospheric deposition of dioxins and furans.

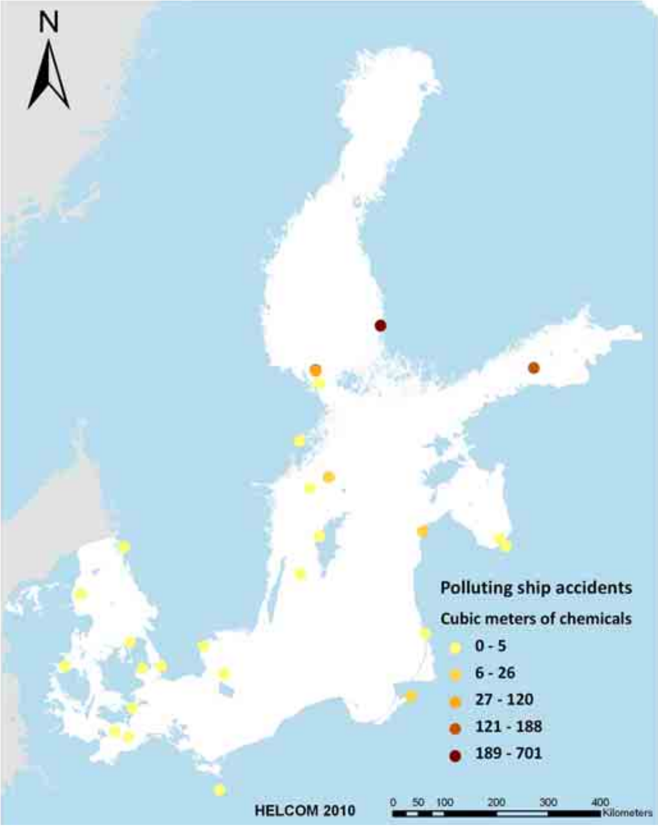


Figure 3.17 Ship accidents where chemical pollution has occurred.

24 Polluting ship accidents

The Baltic Sea is vulnerable and highly sensitive to any release of oil or other hazardous substances. The data set is based on HELCOM data on ship accidents for 2004 to 2007 (**Fig. 3.17**). The amount of pollution (in m3) served as the pressure value. The number of polluting ship accidents during the time period was summed per cell. If the accident site contained no data, the site was given a value of 0.015 m^3, which was the minimum pollution value for the original data set.

25 Oil slicks and spills

The Baltic Sea is highly sensitive to any release of oil. The data set on oil slicks and spills is based on HELCOM data on detected illegal mineral oil discharges for 2003 to 2007 (**Fig. 3.18**). The amount of oil discharged was classified according to three classes: 1, 2, and 3. The class values were summed over the assessment period 2003 to 2007 for each cell and therefore the figure legend has values over 3.

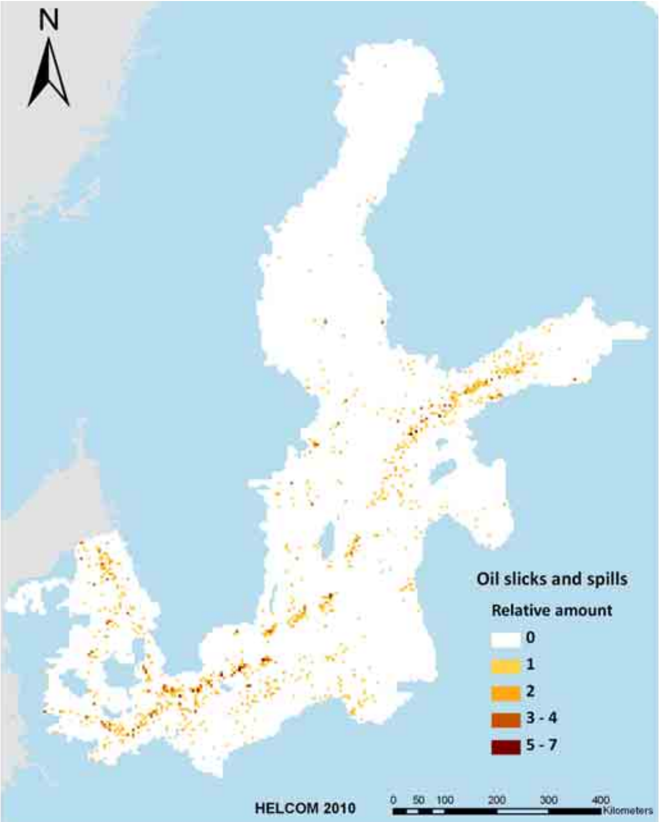


Figure 3.18 Oil spills during the years 2003-2007.

26 Coastal industry, oil terminals, oil platforms and refineries

Discharges from coastal industries may contain hazardous substances. In addition, activities such as extraction of oil and bunkering are processes that cause the leakage of oil and other substances. The data set is based on HELCOM input data (unpublished PLC-5 data) combined with HELCOM data on oil terminals, oil platforms, refineries, and industrial hotspots (**Fig. 3.19**). The pressure value for the data set is the average outflow of discharge water from the site, which has been estimated for oil rigs as the maximum value of the industrial sites. If the industrial site contained no flow data, then an average value of the data set was given.

27 Harbours

Harbours are a source of oil pollution, tributyltin (TBT), and other substances. The data set and procedure are the same as for the data set 'Harbours' (no. 4).

28 Population density

Wastewater effluents are a major source of synthetic compounds, such as pharmaceutical compounds, into the coastal waters. These modelled data are based on the correlation between population density and discharges of synthetic compounds (**Fig. 3.20**). The data set is based on the population density for coastal urban areas derived from the report 'Urban Morphological Zones 2000, version F1v0 – Definitions and procedural steps', European Environment Agency, 2007). The population density for coastal Russian cities was added manually because they were missing from the EEA dataset. The summed population density per cell serves as the pressure value.

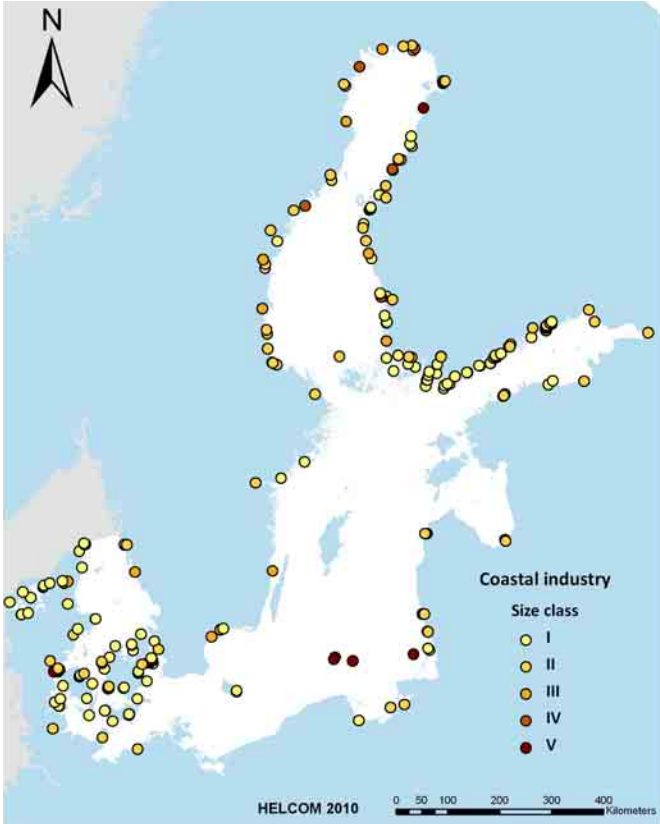


Figure 3.19 Industrial sites in the Baltic Sea coastal areas.

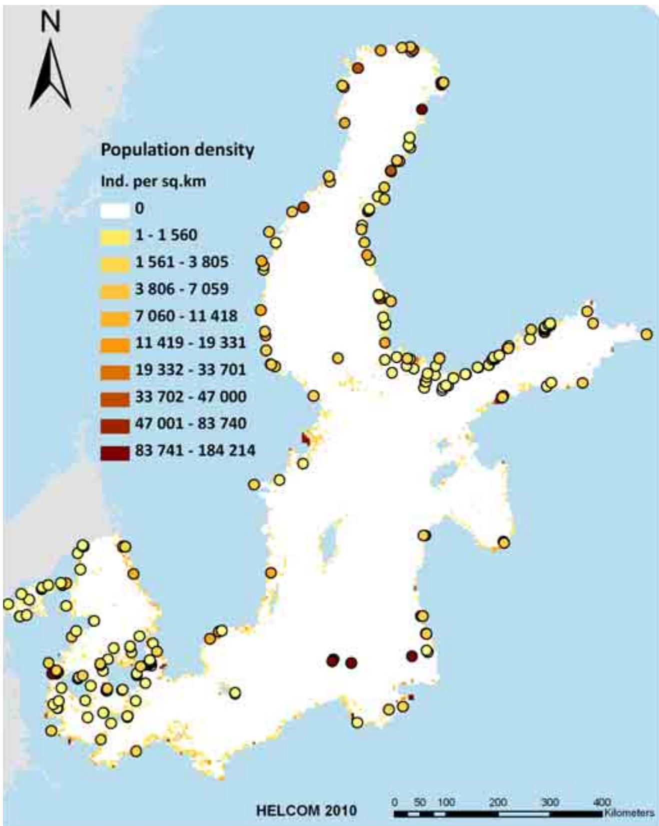


Figure 3.20 Population density in the coastal area reflecting the amount of synthetic compounds being discharged to the sea.

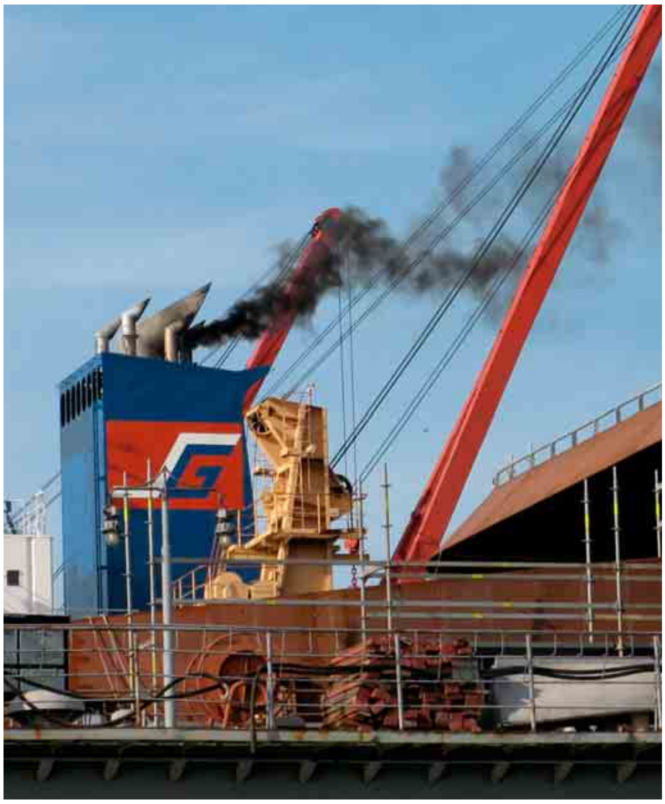
3.1.10 Introduction of non-synthetic substances and compounds

29–33 Waterborne inputs of heavy metals (separately for lead, cadmium, mercury, zinc, and nickel)

Heavy metals, at concentrations exceeding natural levels, can accumulate in the marine food web up to levels which are toxic to marine organisms. The main waterborne inputs of non-synthetic substances to the marine environment are from rivers, and from industrial wastewater and municipal wastewater either discharged directly or transported via rivers. The data set is based on HELCOM input data (unpublished PLC-5) for the time period 2003 to 2006. Inputs of mercury, cadmium, and lead are from rivers, coastal industries, and wastewater treatment plants (**Fig. 3.21–3.23**). Zinc and nickel were included only from rivers due to data scarcity (**Fig. 3.24–3.25**). The inputs are presented separately for the five metals as a gradient from the source. The gradient is not based on flow models but is a simple decreasing distribution from the source. The rivers are given a higher effect range than the point sources because of the greater water flows. The maps in this report do not indicate all the pressure values owing to the limited colour schemes in the maps.

Although the pressure data do not take into account within- and between-basin flows, they give a picture of the amount of annual pressure of heavy metal loads in the basins.

Figure 3.21 Waterborne input of cadmium



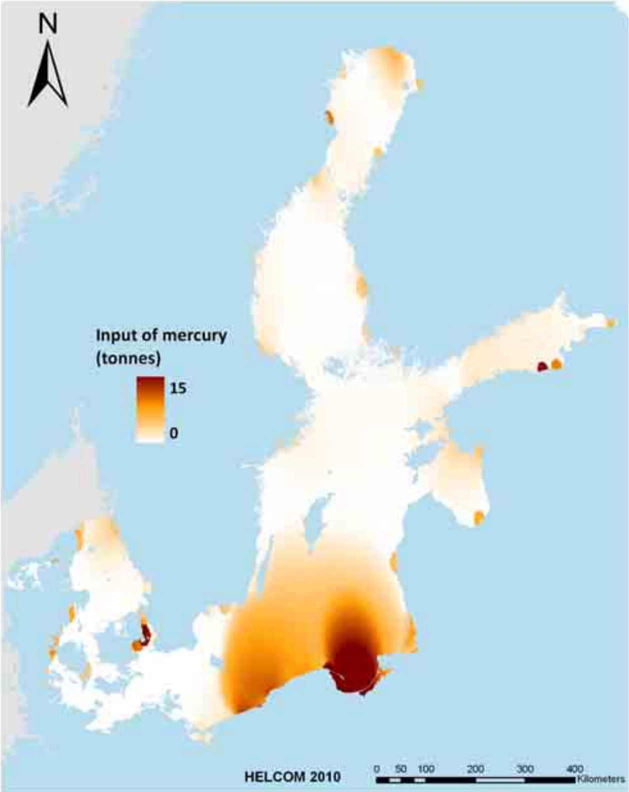


Figure 3.22 Waterborne input of mercury

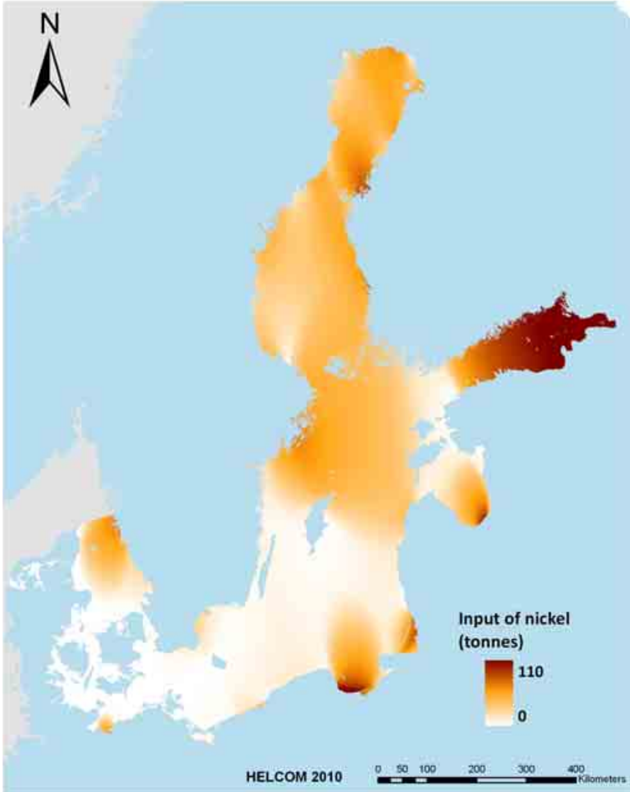


Figure 3.24 Riverine input of nickel

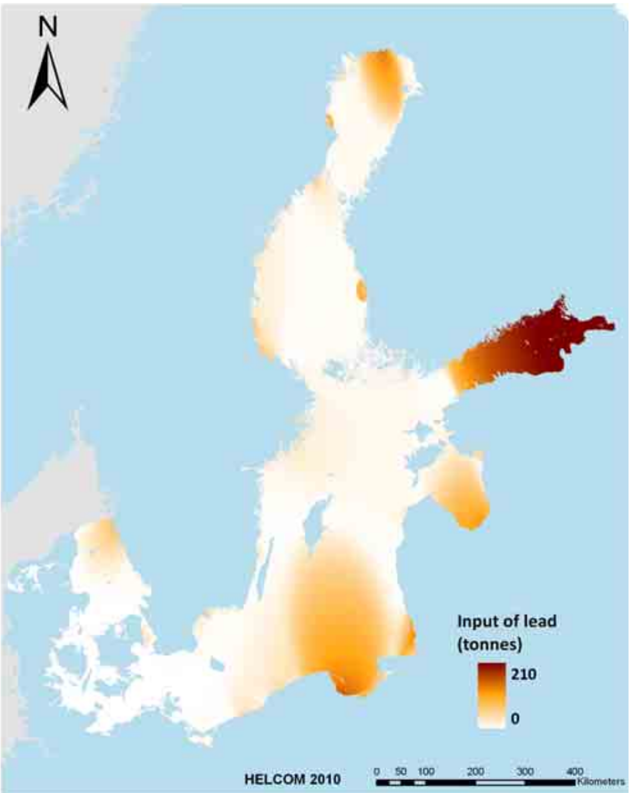


Figure 3.23 Waterborne input of lead

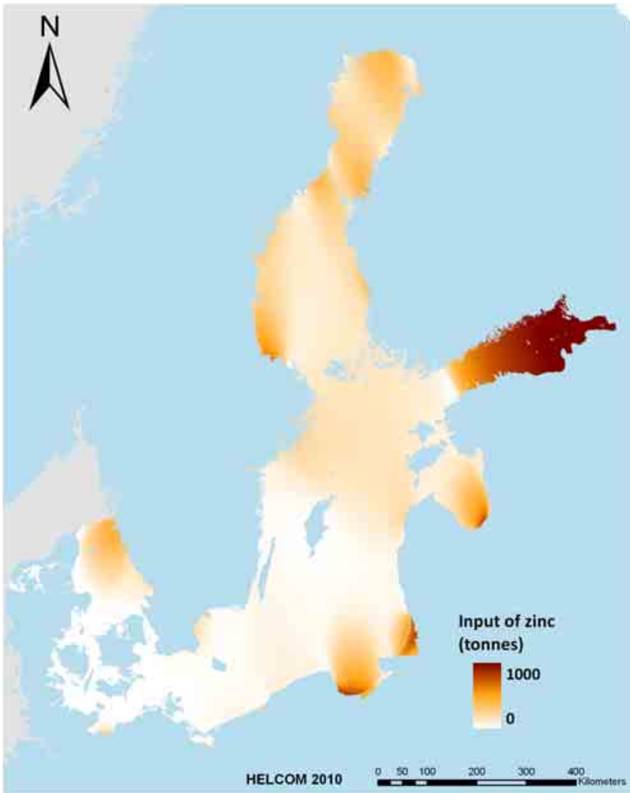


Figure 3.25 Riverine input of zinc

34–36 Atmospheric deposition of metals (lead, cadmium, and mercury separately)

Heavy metals, at concentrations exceeding natural levels, can accumulate in the marine food web up to levels which are toxic to marine organisms. The average atmospheric deposition of mercury, cadmium, and lead (in g/km²) over the years 2005-2007 serves as the pressure value (**Fig. 3.26–3.28**). The procedure follows that used for data set no. 23.

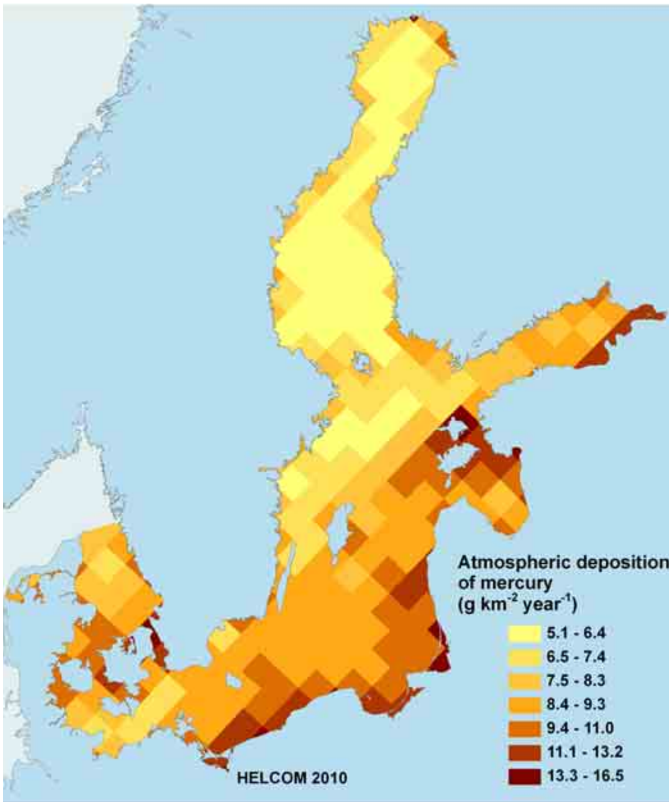


Figure 3.26 Atmospheric deposition of mercury.

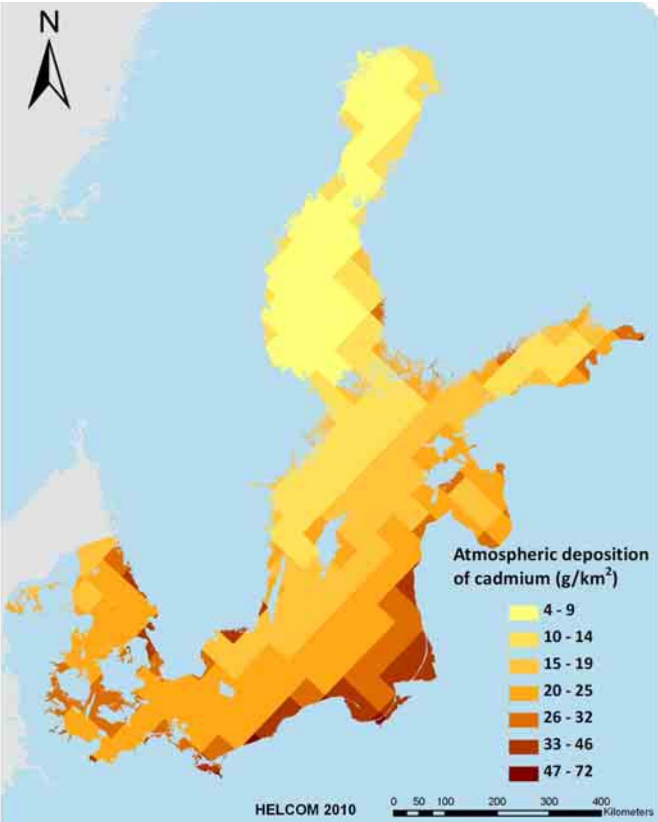


Figure 3.27 Atmospheric deposition of cadmium.

3.1.11 Introduction of radionuclides

37 Discharges of radioactive substances

Radioactive substances cause a radiation burden for organisms in the marine environment. Discharges from nuclear power plants and research reactors are sources of radioactivity in the Baltic Sea (**Fig. 3.29**). The data set is based on HELCOM data from 2003 to 2007. The isotopes taken into account were: caesium-137, strontium-90, and cobalt-60. The average discharges of the radioactive substances (in Bq) over these five years serve as the pressure value for this data set. The load is presented as a gradient from the source (not seen in the map).

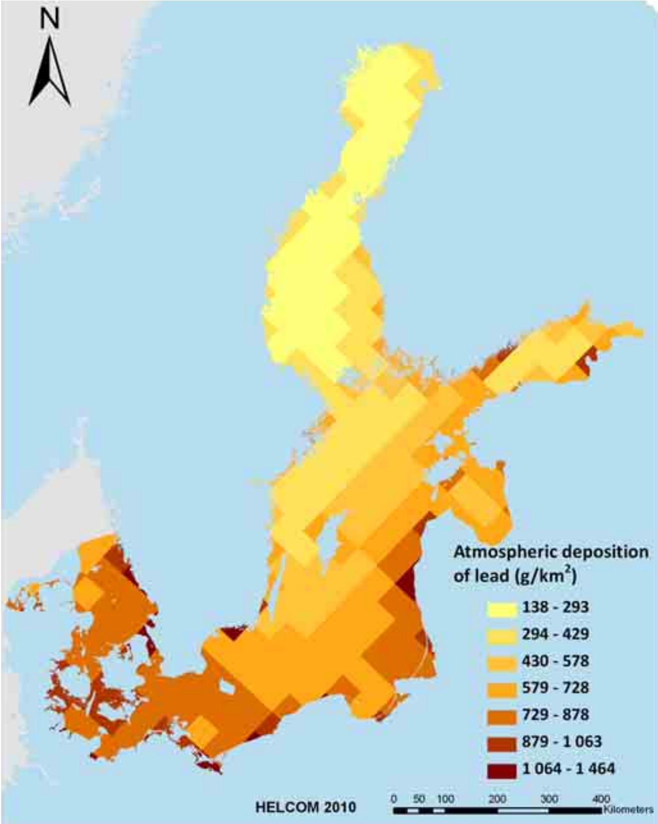


Figure 3.28 Atmospheric deposition of lead.

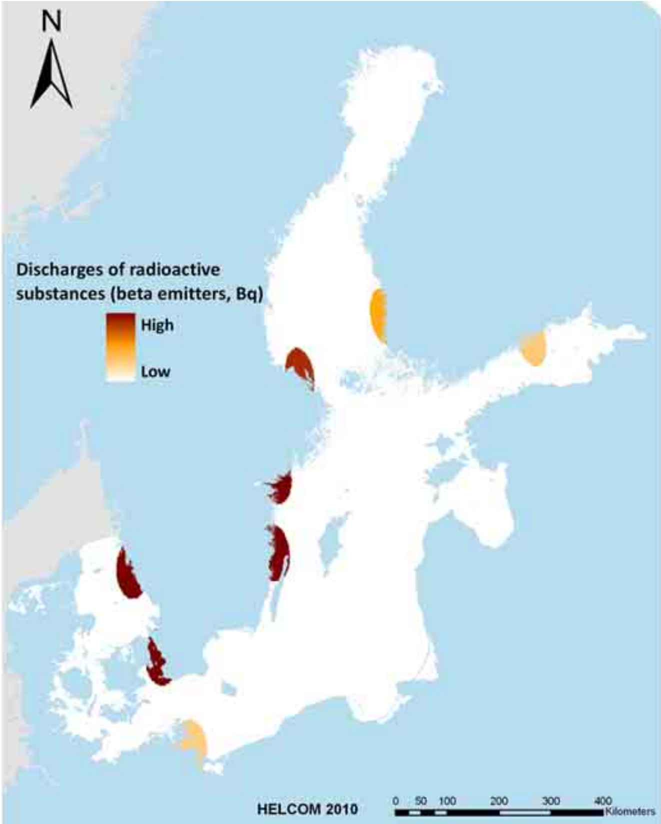


Figure 3.29 Discharges of radioactive substances.

3.1.12 Inputs of nutrients

38 Aquaculture

Fish farms are point sources of nutrient discharges mainly into the coastal surface waters (**Fig. 3.30**). The data set is not Baltic-wide owing to the lack of data. The influence of fish farms was given for all cells 5 km from the coastline. The Finnish data set is based on HELCOM data on fish farms in Finland for the year 2000. Danish and Swedish data were sent by the relevant national authorities. Polish data reported to the HELCOM Secretariat in 2009 were not taken into account because all fish farms are inland. Estonian sites lacked the phosphorus data and they were given a minimum value. The pressure value for the data set is the total phosphorus load (P_TOT) per site.

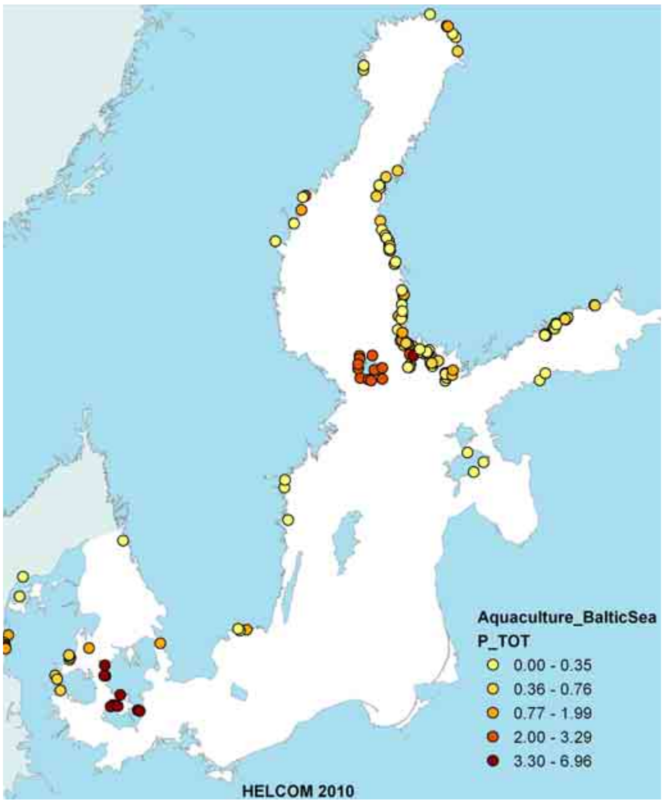


Figure 3.30 Inputs of phosphorus from aquaculture.

39 Atmospheric deposition of nitrogen

About 25% of the nitrogen entering the Baltic Sea is from atmospheric deposition of airborne nitrogen compounds. The average deposition of nitrogen (in mg total nitrogen/m^2/year) over the years 2005-2007 serves as the pressure value (**Fig. 3.31**). Nitrogen was not included as a pressure in the Bothnian Bay, where excess nitrogen has no known adverse impact on the marine environment. The data source and procedure are the same as used in data set no. 23.

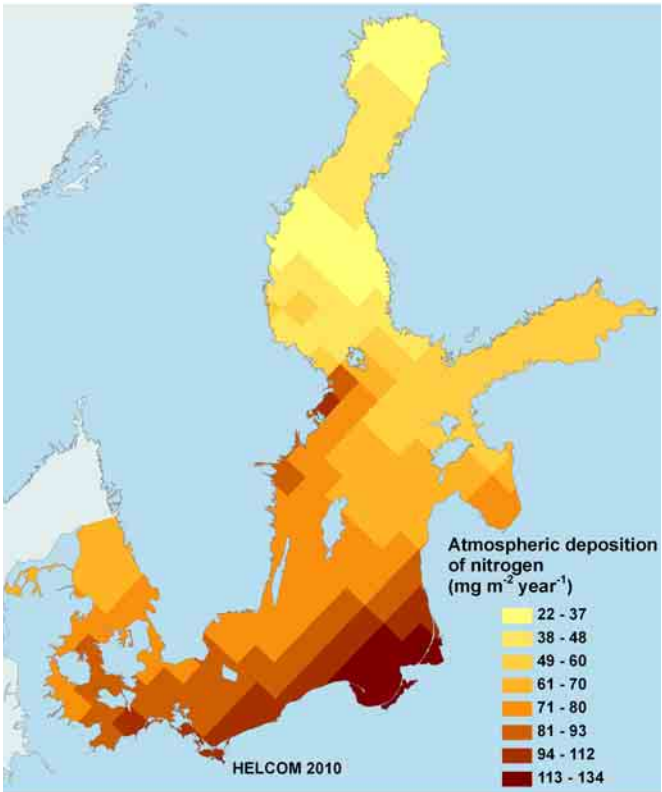


Figure 3.31 Atmospheric deposition of nitrogen.

40 Waterborne inputs of nitrogen

Sources for waterborne inputs of nitrogen are both diffuse (mainly agriculture) and point sources (e.g., municipalities, industries (**Fig. 3.32**). About 75 % of the nitrogen inputs to the Baltic Sea are waterborne. Natural background nitrogen loading was subtracted from the inputs per basin according to source apportionment in HELCOM PLC-4 (HELCOM 2004). The data source and procedure are the same as used in data set nos. 29–33. Nitrogen was not included as a pressure in the Bothnian Bay, where excess nitrogen has no known adverse impact on the marine environment.

41 Waterborne inputs of phosphorus

The majority of the phosphorus entering the Baltic Sea is from waterborne sources (**Fig. 3.33**). The data source and procedure are the same as used in data set nos. 29–33 and in the previous data layer Waterborne input of nitrogen.

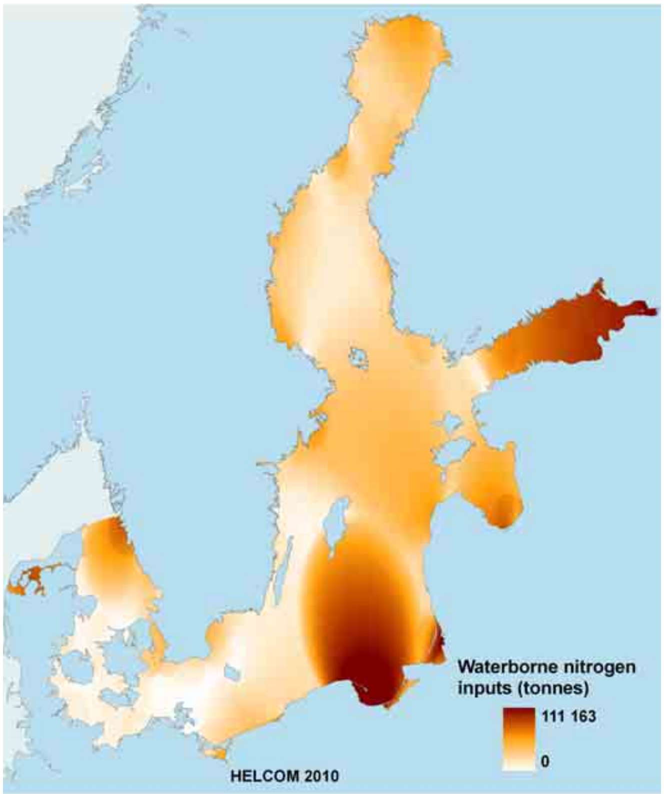


Figure 3.32 Waterborne input of nitrogen

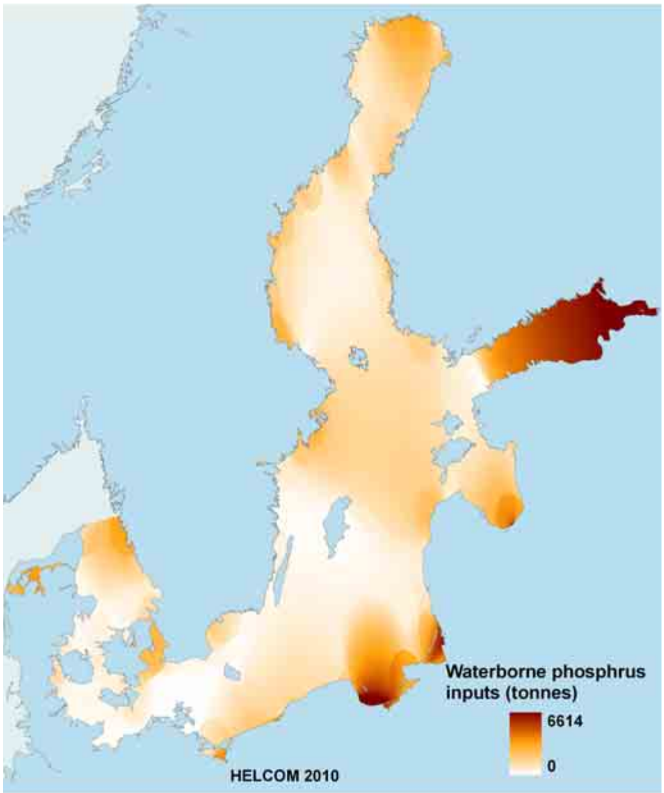


Figure 3.33 Waterborne input of phosphorus

Figure 3.34 Traffic intensity of passenger ships outside territorial waters.

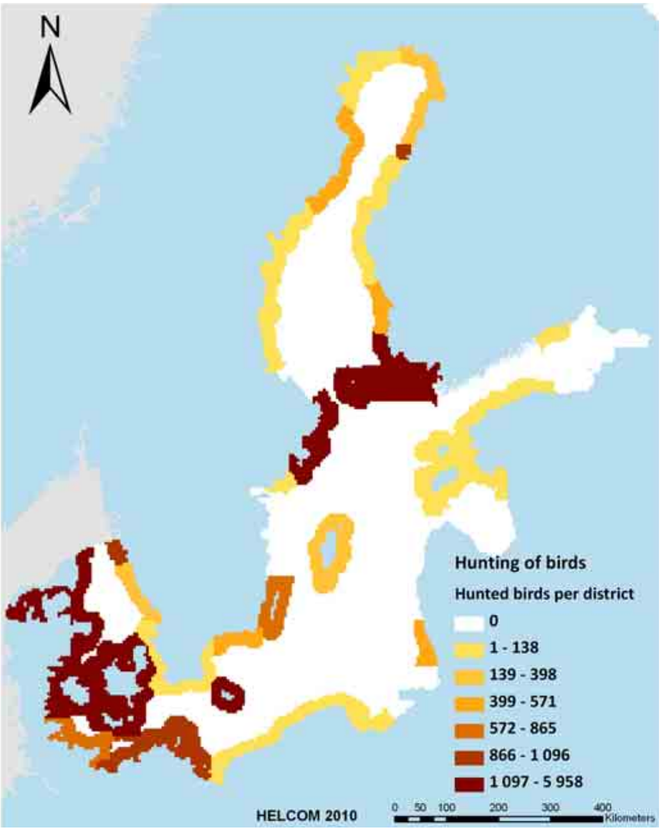


Figure 3.35 Hunting of seabirds.

3.1.13 Inputs of organic matter

42 Aquaculture

The data set and procedure are the same as used in data set no. 38 (**Fig. 3.30**).

43 Riverine inputs of organic matter

The data set and procedure are the same as used in data set no. 7 (**Fig. 3.6**).

3.1.14 Introduction of microbial pathogens

44 Aquaculture

Fish farms are a potential source of microbial pathogens into the marine environment. The data set and procedure are the same as used in data set no. 38, except that the pressure is expressed as the number of fish farms per county (**Fig. 3.30**).

45 Coastal wastewater treatment plants

Wastewaters are sources of pathogens spreading into the marine environment. The data set and procedure are the same as used in data set no. 21, except that the pressure value for the data set is the presence or absence of MWWTPs in a cell (**Fig. 3.15**).

46 Passenger ships outside 12 nm

Passenger ships, mainly cruise ships and ferries, are allowed to discharge wastewaters into the sea in the EEZ (i.e., outward of 12 nm from the coastline) of the Baltic Sea (**Fig. 3.34**). Although some companies do not discharge wastewater and some companies that do discharge have quite efficient onboard treatment, the pressure is high on the Baltic Sea. The Baltic Sea AIS data were used to separate passenger ships from other ship types. The data set is otherwise similar to data set no. 14.

3.1.15 Selective extraction of species

47 Hunting of seabirds

The data set is almost Baltic Sea- wide but it lacks data from Latvia and Russia (**Fig. 3.35**). The time period for the data set is 2003 to 2007. Hunting statistics of cormorants (*Phalacrocorax carbo*), eiders (*Somateri molissima*), and long-tailed ducks (*Clangula* *hymalis*) have been included. Hunting of cormorants was reported by Denmark, Estonia, Finland, Germany, Lithuania, Poland, and Sweden. Hunting of eider was reported by Denmark, Finland, and Sweden. Hunting of long-tailed ducks was reported by Finland and Sweden. The number of hunted birds was mostly reported per county and for that reason the value per county was given to all coastal cells within the county and within 15 km from the coastline. Denmark, Poland, and Lithuania reported the total number of killed birds for the whole coastal area. In that case, the total number was divided equally among all counties. The average number of birds shot over the five years is used as the pressure value.

48 Hunting of seals

The data set covers seal hunting in Finland and Sweden during 2003 to 2007 (**Fig. 3.36**). The number of seals shot was reported per county and the value per county was given to coastal cells within the county and within 12 nm from the coastline. The average number of hunted seals over the five years is used as the pressure value.

49 Commercial surface and mid-water fishery

Surface and mid-water trawling and long lines cause pressure on target species (fish) and non-target species (by-catch). For this pressure, the catches/landings were compiled from the following surface and mid-water gears: mid-water otter trawls, mid-water pair trawls, Danish seines, pelagic trawls, drift nets, trolling lines, drifting long-lines, set long-lines, and unspecified long-lines (**Fig. 3.37**). The largest catches/landings were reported for sprat (378 000 t), herring (214 000 t), cod (13 300 t), and flounder (400 t). The data source and procedure are the same as used in data set no. 11.

50 Commercial bottom-trawling fishery

Bottom trawling is one of the most destructive fishing methods, physically disturbing the seafloor and resulting in high levels of by-catch in addition to the catch of the target species. The largest catches/landings were reported for blue mussels (27 000 t), cod (32 600 t), sprat (32 500 t), herring (18 500 t), and flounder (11 000 t). Note that blue mussel landings were reported only from the Danish Limfjord by Danish fisheries authorities. See pressure data set no. 11 for more information (**Fig. 3.10**).

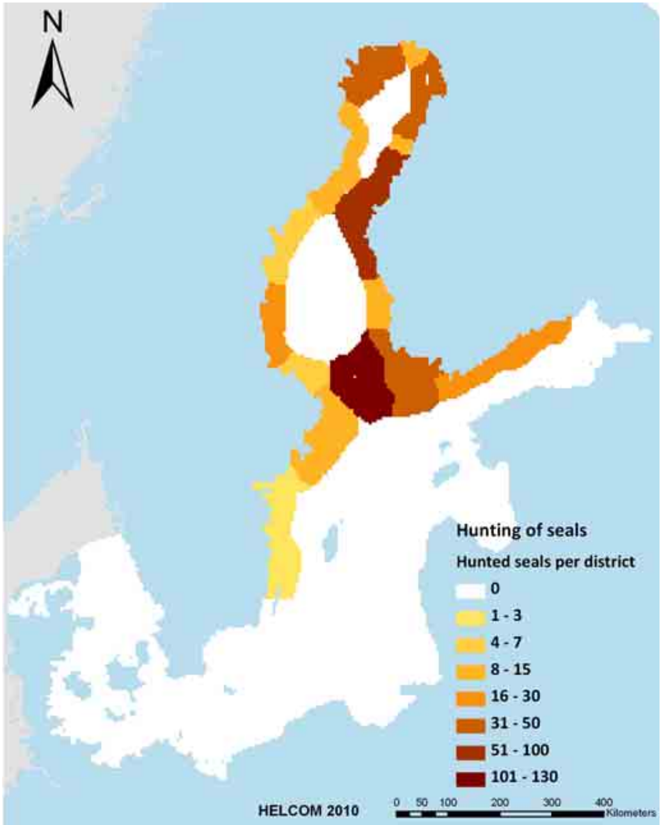


Figure 3.36 Hunting of grey seals.

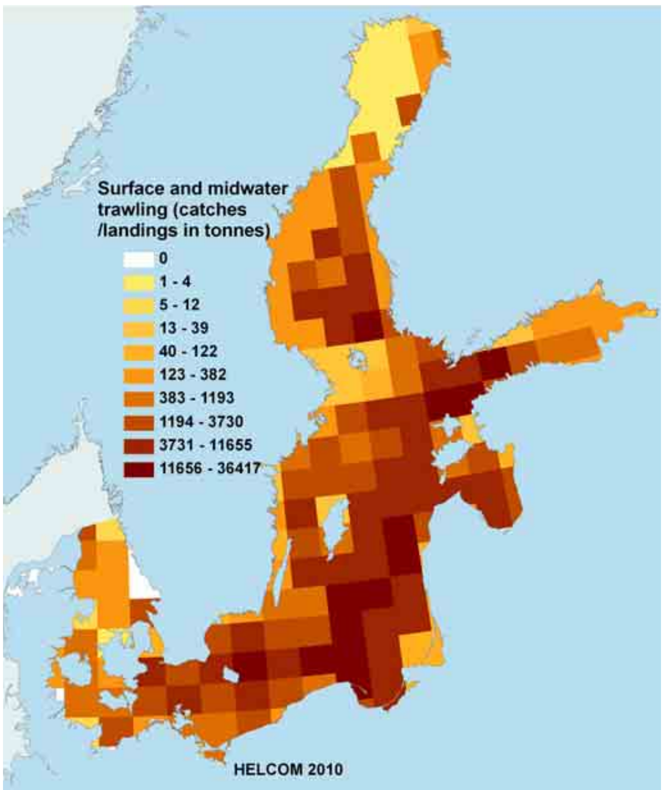


Figure 3.37 Catches or landings of fish by surface and mid-water trawling and long lines.

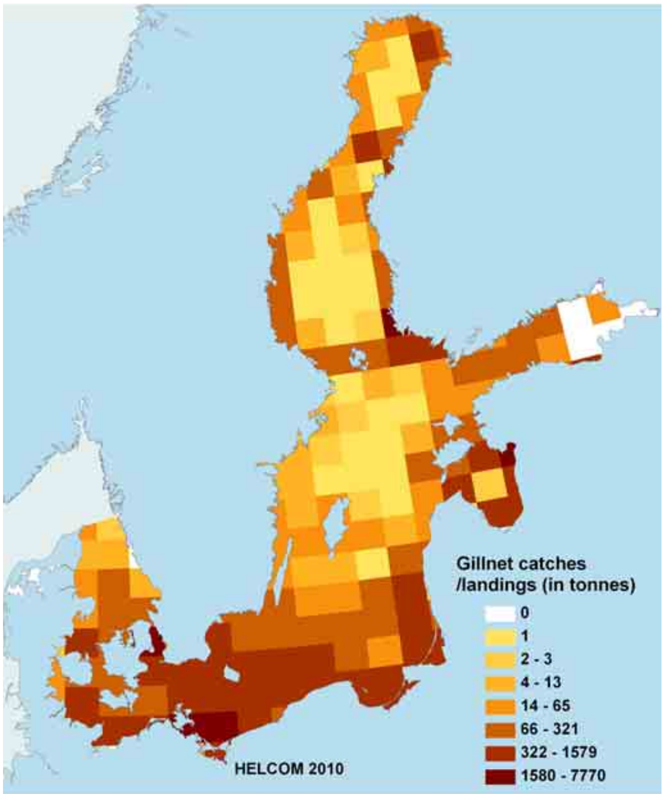


Figure 3.38 Catches or landings of fish by gillnets.

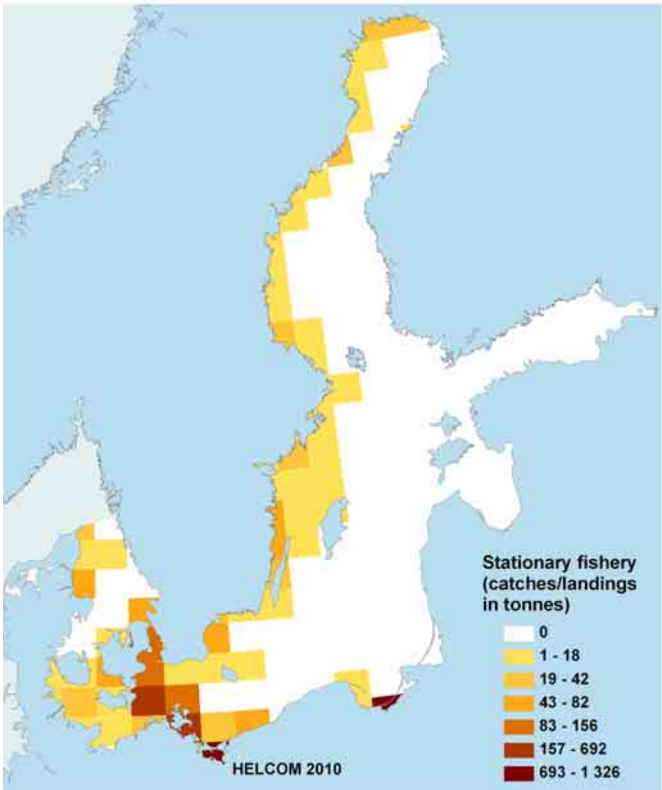


Figure 3.39 Catches or landings of fish by traps and pots and other coastal stationary gears.

51 Commercial gillnet fishery

Gillnets cause pressure on target species (fish) and non-target species (by-catch of marine mammals, birds, and non-target fish). For this pressure, the catches/landings from gillnets, falling gears, live-bait gears, set gillnets, and trammel nets as well as handlines and pole-lines were taken into account (**Fig.3.38**). The largest catches/landings were reported for herring (22 700 t), cod (16 400 t), flounder (8 600 t), and perch (2 400 t). The data source and procedure are the same as used in data set no. 11.

52 Commercial coastal and stationary fishery

Stationary fishery causes pressure on the target fish species, but also results in some level of by-catch. For this pressure, the catches/landings from traps, barriers, fences, weirs, pound nets, and pot gears were taken into account (**Fig. 3.39**). The largest catches/landings were reported for herring (2 100 t), roach (600 t), perch (450 t), and bream (420 t). The data source and procedure are the same as used in data set no. 11.

3.2 Spatial data on biological ecosystem components

Spatial data on biological ecosystem components are used for the Baltic Sea Impact Index, which takes into account the sensitivity of the marine environment in relation to anthropogenic pressures. Currently, 14 data layers are used to describe the Baltic Sea marine environment. The data layers were considered to represent some of the key elements of the Baltic Sea ecosystem. The data layers are listed in **Table 3.2**.

Table 3.2 Spatial data sets on the distribution of species, biotopes, and biotope complexes in the Baltic Sea Impact Index.

	Data set	Source	Remarks
Species data	Harbour porpoise distribution in the Baltic Sea	NERI & ASCOBANS-HELCOM database on harbour porpoise observations	The distribution has been set to include also rare observations.
	Grey seals, ringed seals and harbour seals in the Baltic Sea	Finnish Game and Fisheries Research Institute	The distribution has been set to include also infrequent observations.
	Seabird wintering grounds	Skov et al. 2007 & BirdLife International	The areas are based on seabird density estimates during winter.
	Spawning and nursery areas of cod	Bagge et al. 1994	According to NERI the data represent average distribution of the spawning and nursery areas.
Water column	Photic water	EUSeaMap project (unpublished)	Mean March-October photic zone depths (2003-2008) in the Baltic Sea.
	Non-photic water	EUSeaMap project (unpublished)	Mean March-October photic zone depths (2003-2008) in the Baltic Sea.
Benthic biotopes	Mussel beds	MOPODECO project (unpublished)	Relative density of blue mussels. Only areas of >10% density were selected.
	Zostera meadows	HELCOM (several sources)	See text.
Benthic biotope complexes	Photic sand	BALANCE project, EUSeaMap (Al-Hamnadi & Reker 2007)	Sandy seafloor combined with photic depth.
	Non-photic sand	BALANCE project, EUSeaMap (Al-Hamnadi & Reker 2007)	Sandy seafloor combined with photic depth.
	Photic mud and clay	BALANCE project, EUSeaMap (Al-Hamnadi & Reker 2007)	Mud and clay seafloor combined with photic depth.
	Non-photic mud and clay	BALANCE project, EUSeaMap (Al-Hamnadi & Reker 2007)	Mud and clay seafloor combined with photic depth.
	Photic hard bottom	BALANCE project, EUSeaMap (Al-Hamnadi & Reker 2007)	Bedrock and hard-bottom complex seafloor combined with photic depth.
	Non-photic hard bottom	BALANCE project, EUSeaMap (Al-Hamnadi & Reker 2007)	Bedrock and hard-bottom complex seafloor combined with photic depth.

3.2.1 Benthic biotope complexes

The best available Baltic Sea-wide data set on benthic biotope complexes (or broad-scale habitats or marine landscapes[1]) was produced within the EU Interreg IIIB project BALANCE (www.balance-eu.org). Almost all of the Baltic Sea countries had institutes or organizations as partners in the BALANCE project and data on sediment quality and hydrography were compiled from relevant authorities in all the countries. The BALANCE maps were produced on the basis of geological sediment maps, modelled bottom salinity, and water transparency

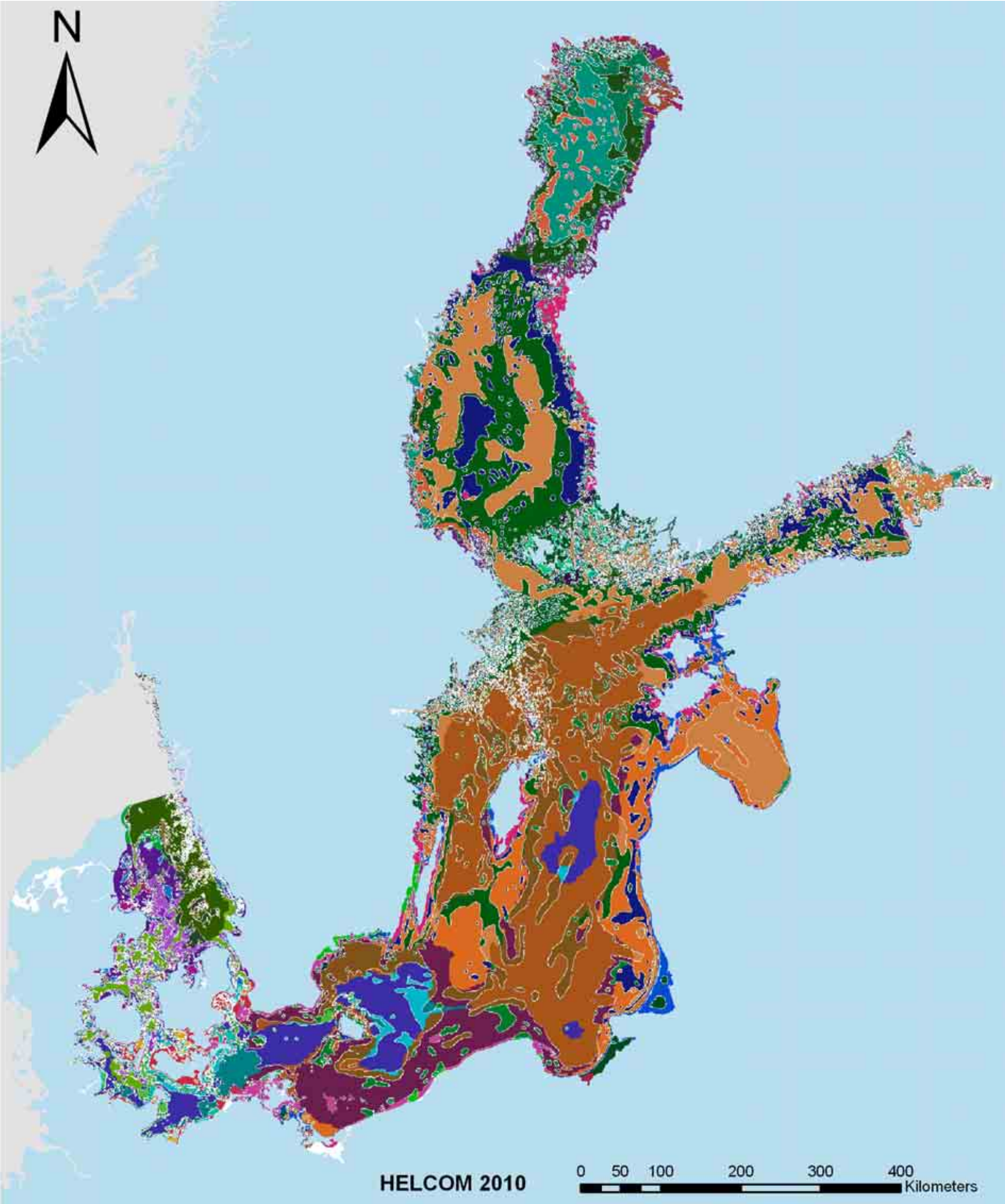


Figure 3.40 **Broad-scale habitats in the Baltic Sea according to Al-Hamnadi & Reker (2007)**

1 The BALANCE project used the term "marine landscapes", but later on experts have agreed that this term was not suitable.

data. However, in this exercise the BALANCE water transparency data were replaced by data from a later project called EUSeaMap (see section on photic data below).

The BALANCE broad-scale habitats represent a combination of sediment data, light availability, and salinity. Thus, they include abiotic factors which mainly determine the species and habitat distributions in the Baltic Sea. For detailed information on the harmonization process and origin of the individual data including a comparison to the EUNIS classification, please see Erlandsson and Lindeberg (2007), Kotilainen et al. (2007), and Reijonen and Kotilainen (2007). The classification resulted in 60 broad-scale habitats, which are presented in **Figure 3.40**.

Photic bedrock <5psu
Photic bedrock 5-7.5psu
Photic bedrock 7.5-11psu
Photic bedrock 11-18psu
Photic bedrock 18-30psu
Photic bedrock >30psu
Non-photic bedrock <5 psu
Non-photic bedrock 5-7.5psu
Non-photic bedrock 7.5-11psu
Non-photic bedrock 11-18psu
Non-photic bedrock 18-30psu
Non-photic bedrock >30psu
Photic hard bottom comp. <5 psu
Photic hard bottom comp. 5-7.5psu
Photic hard bottom comp. 7.5-11psu
Photic hard bottom comp. 11-18psu
Photic hard bottom comp. 18-30psu
Photic hard bottom comp. >30psu
Non-photic hard bottom comp. <5psu
Non-photic hard bottom comp. 5-7.5psu
Non-photic hard bottom comp. 7.5-11psu
Non-photic hard bottom comp. 11-18psu
Non-photic hard bottom comp. 18-30psu
Non-photic hard bottom comp. >30psu
Photic sand <5psu
Photic sand 5-7.5psu
Photic sand 7.5-11psu
Photic sand 11-18psu
Photic sand 18-30psu
Photic sand >30psu
Non-photic sand <5psu
Non-photic sand 5-7.5psu
Non-photic sand 7.5-11psu
Non-photic sand 11-18psu
Non-photic sand 18-30psu
Non-photic sand >30psu
Photic hard clay < 5psu
Photic hard clay 5-7.5psu
Photic hard clay 7.5-11psu
Photic hard clay 11-18psu
Photic hard clay 18-30psu
Photic hard clay >30psu
Non-photic hard clay <5psu
Non-photic hard clay 5-7.5psu
Non-photic hard clay 7.5-11psu
Non-photic hard clay 11-18psu
Non-photic hard clay 18-30psu
Non-photic hard clay >30psu
Photic mud <5psu
Photic mud 5-7.5psu
Photic mud 7.5-11psu
Photic mud 11-18psu
Photic mud 18-30psu
Photic mud >30psu
Non-photic mud <5psu
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Photic mud >30psu

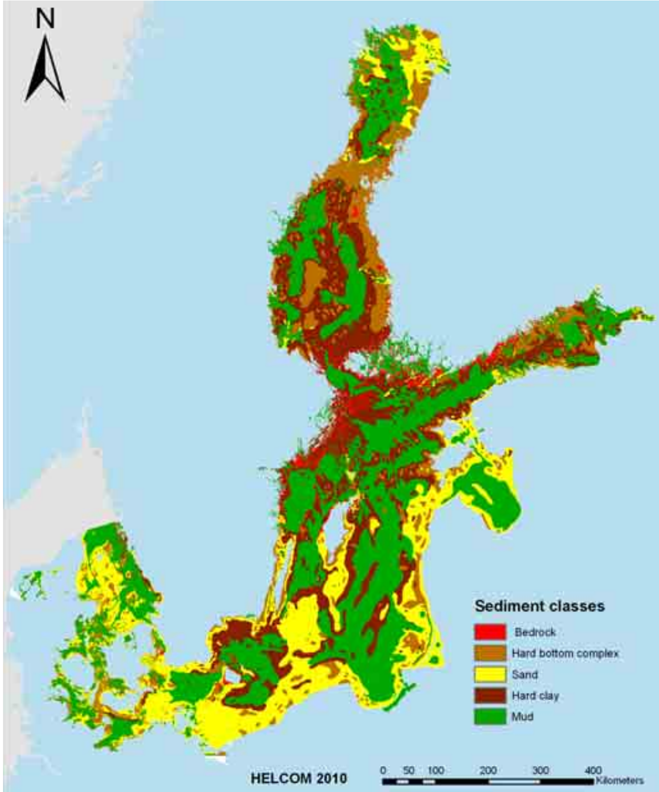

Figure 3.41 Benthic sediment classes according to Al-Hamdani & Reker (2007).

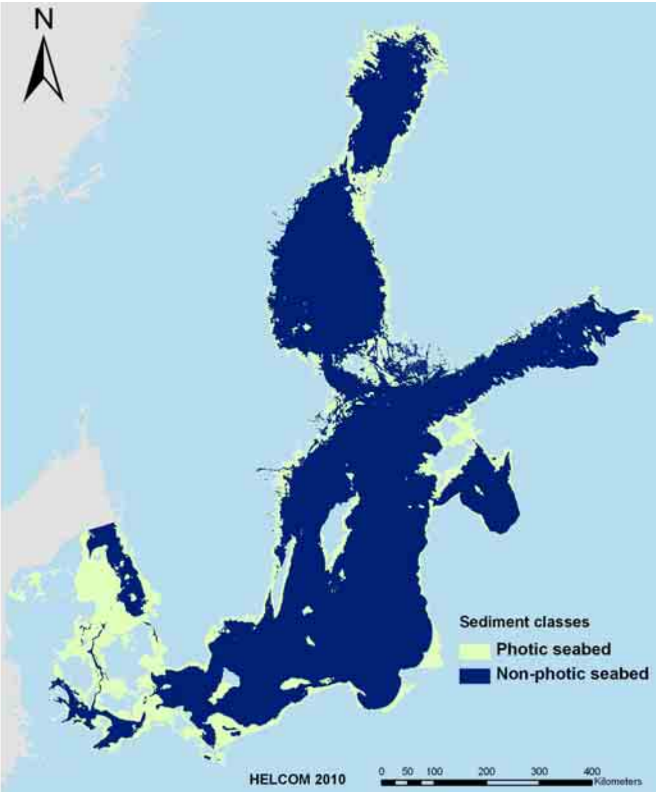

Figure 3.42 Photic depth in the Baltic Sea bottom, defined as the depth at which 1% of the light reaches the bottom (from EUSeaMap, http://www.jncc.gov.uk/page-5020).

The sediment classes in the data set were divided into sand, bedrock, hard-bottom complex, clay, and mud, representing relevant classes for benthic organisms (**Fig. 3.41**).

I. Bedrock.

II. Hard-bottom complex, including patchy hard surfaces and coarse sand (sometimes also clay) to boulders.

III. Sand including fine to coarse sand (with gravel exposures).

IV. Hard clay sometimes/often/possibly exposed or covered with a thin layer of sand/gravel.

V. Mud including gyttja-clay to gyttja-silt.

Areas with various sediment types ranging from mud, sand, gravel, and boulders will contain a larger number of species compared to areas with only one or two sediment types (Dayton 1994, Wennberg et al. 2006). For a description of the production of the sediment maps, see Al-Hamdani and Reker (2007).

The seabed was divided into photic areas and non-photic areas (where 1% of available light reaches the seabed), thus separating species and habitats based on plant growth and species and habitats living on dark bottoms (**Fig. 3.42**). For the purpose of mapping the photic zone in the Baltic Sea, water transparency was calculated utilizing Secchi disc depth between March and October from 2000 to 2008. To derive euphotic zone depths from Secchi depths, a conversion of factor 3 gave the best fit.

Although a broad-scale habitat, such as photic bedrock in 10–15 psu water, may contain several habitats, it nonetheless reflects rather closely the potential habitats (and even species) in the area. The photic bedrock areas include macroalgal habitats and mussel reefs. Such habitats face very similar pressures from human activities, such as siltation and increased nutrient availability. Photic soft bottoms include habitats with seagrasses and non-photic soft bottoms include clam-amphipod communities. In conclusion, the broad-scale habitats are a good proxy for biological entities in the Baltic Sea Impact Index.

The BALANCE report on the production of the benthic maps includes a validation procedure on the biological relevance of three of the broad-scale habitats (non-photic hard-bottom complex at >30 psu, non-photic sand at >30 psu, and non-photic mud at >30 psu (Al-Hamdani and Reker 2007). The three broad-scale habitats differed in species composition, although they differed in only one factor (sediment class). Validation of the other broad-scale habitat classes was not done within the BALANCE project, but it was assumed (based on scientific literature) that salinity and photic depth cause even more differentiation in the species composition.

According to Al-Hamdani and Reker (2007), the evaluation of the resolution and accuracy of the spatial data revealed that:

- The resultant map is no better than the information from which it was developed. For some areas data are scarce and/or only available in low resolution with large distances between points with actual data. The map is thus unsuitable for fine-scale planning unless further improved.
- Due to the many different classification schemes for, e.g., classifying sediments, it was necessary to compromise when merging data for the Baltic Sea.
- The lack of accessibility to a relevant and coherent biological data set of sufficient resolution for benthic biological quality elements covering the Baltic Sea adversely influences the validation process of the map.

Moreover, offshore areas have sparser data than coastal areas, which may have led to missing small-scale biotopes such as offshore reefs in the offshore areas. Some of the modelled areas in the data sets have a 7-km resolution while others have about a 600-m resolution. All data sets were re-gridded to a 200 m × 200 m grid. This process ensures data continuity but it does not increase the output map resolution. In the Baltic Sea Impact Index, such a choice does not impair the assessment because the assessment is made on a coarse scale (5 km x 5 km grid cells).

3.2.2 Development of benthic ecosystem data sets for the Baltic Sea Impact Index

In the HELCOM HOLAS work on the Baltic Sea Impact Index, the number of benthic biotope complexes has been limited compared to the results of the BALANCE project for practical reasons. The full BALANCE data would provide 60 data layers, all of which would require expert opinion scoring (see **Section 2.1**). The full combination would lead to 52 x 60 = 3120 weighting scores, which was considered too great an effort. To ease the work at this stage, the following changes were made:
(1) salinity was not taken into account,
(2) bedrock and hard-bottom complexes were merged, and
(3) mud and clay bottoms were merged.

The resulting map of benthic components of the ecosystem is presented in **Figure 3.43**. The reduction of data layers can be partly justified (e.g., hard-bottom habitats), whereas much useful information is also lost (e.g., salinity).

3.2.3 Pelagic biotope complexes

To include water-column biotopes in theBSII, two data layers were included in the exercise: photic water column biotope complex and non-photic water column biotope complex. The boundary between photic and non-photic was put at 1% light availability and it is based on the EUSeaMap project (http://www.jncc.gov.uk/page-5020). The photic water zone thus covers the entire marine area, whereas the non-photic areas are seen in **Figure 3.43**.

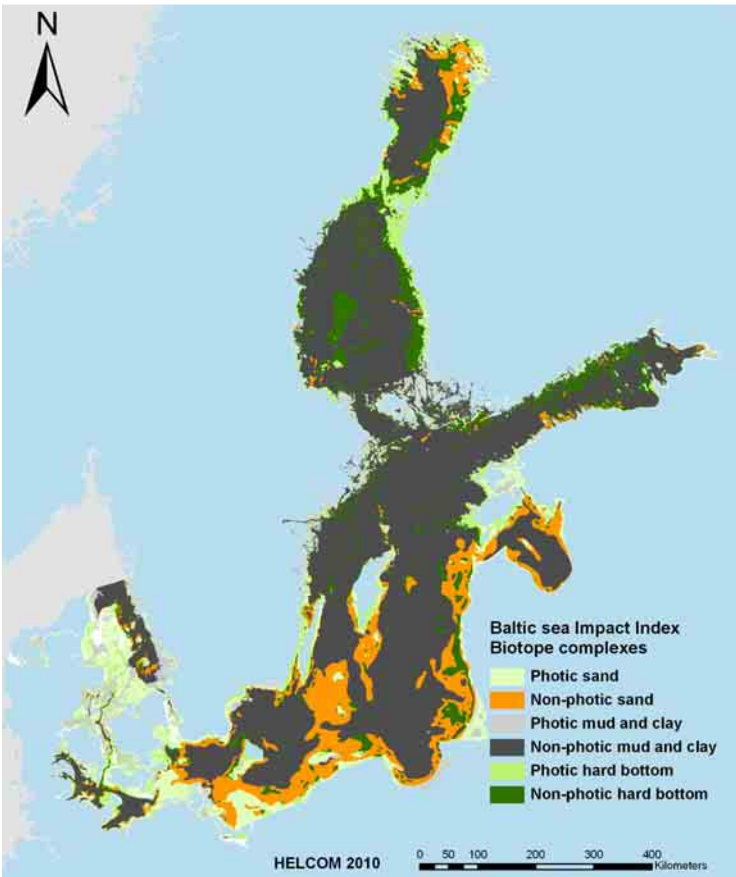

Figure 3.43 Presence of benthic biotope complexes, defined by sediment type and availability of 1% light.

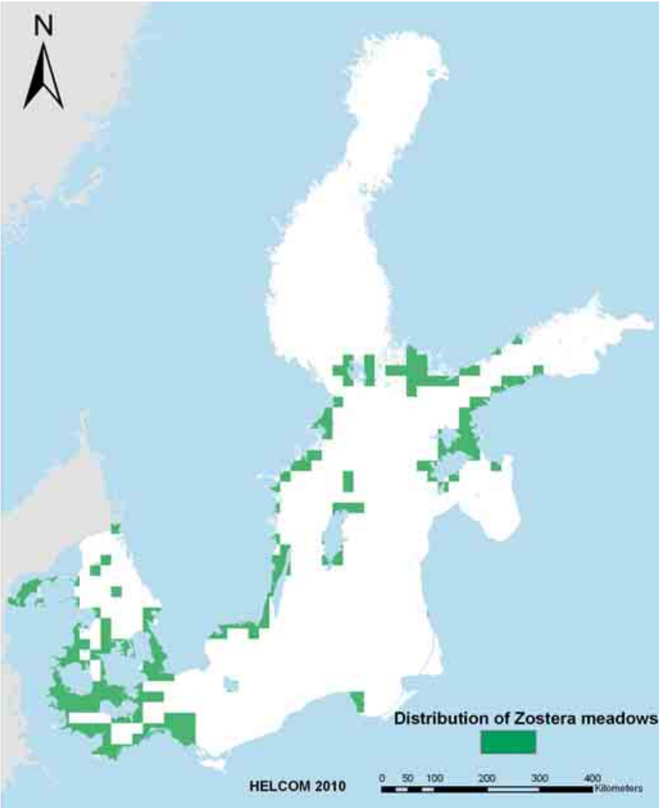

Figure 3.44 The presence of *Zostera* spp. in a 20 km x20 km grid. The distribution is shown in the grid due to the small size of the actual *Zostera* occurrences and the spatial uncertainty of the observations.

3.2.4 Benthic biotope data on Zostera meadows and mussel beds

There are only a few benthic data sets on biotopes available for the entire Baltic Sea area. Currently, the distribution maps of Zostera meadows and mussel beds are the only data sets available.

Zostera meadows

The distribution map of *Zostera* meadows was compiled by the HELCOM Secretariat from several sources (**Fig. 3.44**). The data set is the most updated version available for the region. The basis was the World Atlas of Sea grasses (Green and Short 2003), the Baltic Sea data of which were received from the Baltic Sea seagrass coordinator Dr. Christoffer Boström (Åbo Akademi University, Finland). The Swedish distribution maps were obtained from the web site http://linnaeus.nrm.se/flora/mono/zostera/zoste/zostmarn.jpg (Swedish Museum of Natural History). The Finnish updates were received from a Finnish distribution map (Metsähallitus / Ms. Minna Boström). The Estonian maps were retrieved from the publication by Möller and Martin (2007) and later confirmed by Ms. Tiia Möller (Estonian Marine Institute). The German distribution maps were received from Ms. Karin Fürhaupter (MARILIM, Gesellschaft für Gewässeruntersuchung mbH), based on the German macrophyte monitoring. The Danish distribution maps were based on the data from NERI, Denmark (http://www.dmu.dk/Vand/Havmiljoe/MADS/Makrovegetation/). The Polish data were based on the study by Plinski and Jozwiak (2004) and the habitat mapping conducted in 2009 by the project 'Ecosystem approach to marine spatial planning – Polish marine areas and the Natura 2000 network' (http://www.pom-habitaty.eu/en/index.php?option=com_frontpage&Itemid=1).

Mussel beds

The modelled distribution of mussel beds (*Mytilus* ssp.) was produced in the MOPODECO project in 2009–2010, funded by the Nordic Council of Ministers (**Fig. 3.45**). The scale in this data set is arbitrary and represents the mean carrying capacity for *Mytilus* ssp. during the period 2000 to 2007. The resolution is 617 m. The model has been validated against presence/absence data on percent coverage from all Swedish waters. The threshold for presence was set at 10% coverage. The resulting map does not reflect the occurrence of hard-bottom areas only, but also shows the distribution of blue mussels in sandy bottom areas.

3.2.5 Distribution maps of seabirds, marine mammals and cod spawning and nursery areas

Wintering grounds of seabirds

There are certain relatively shallow areas in the Baltic Sea that are preferred habitats for seabirds in wintertime. These areas have been recognized by BirdLife International as Important Bird Areas (IBA) and their significance has been published in a scientific journal (Skov et al. 2007). The areas are situated mainly in the open sea and therefore this data layer can be used relatively well to reflect pressures in pelagic areas. **Figure 3.46** presents the map of this data layer.

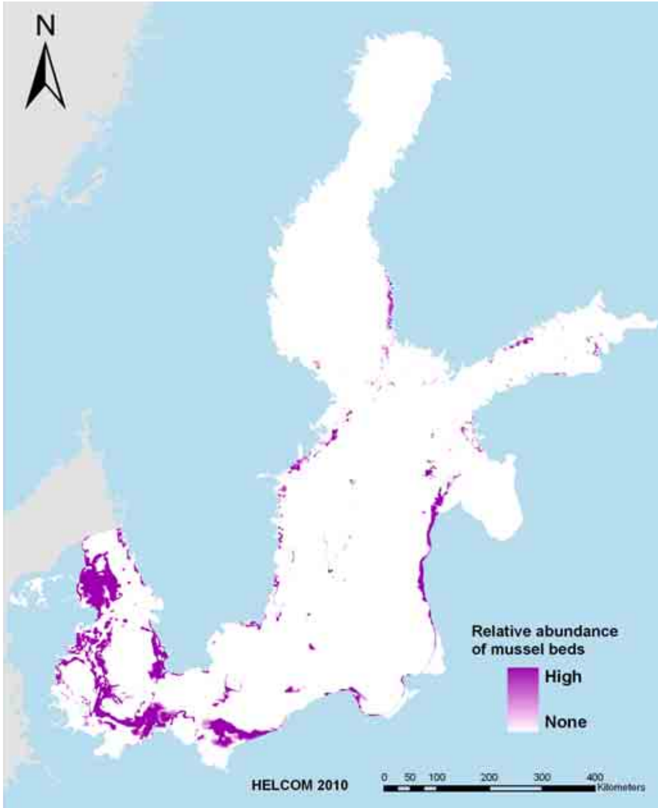

Figure 3.45 Distribution of blue mussels on a relative intensity scale.

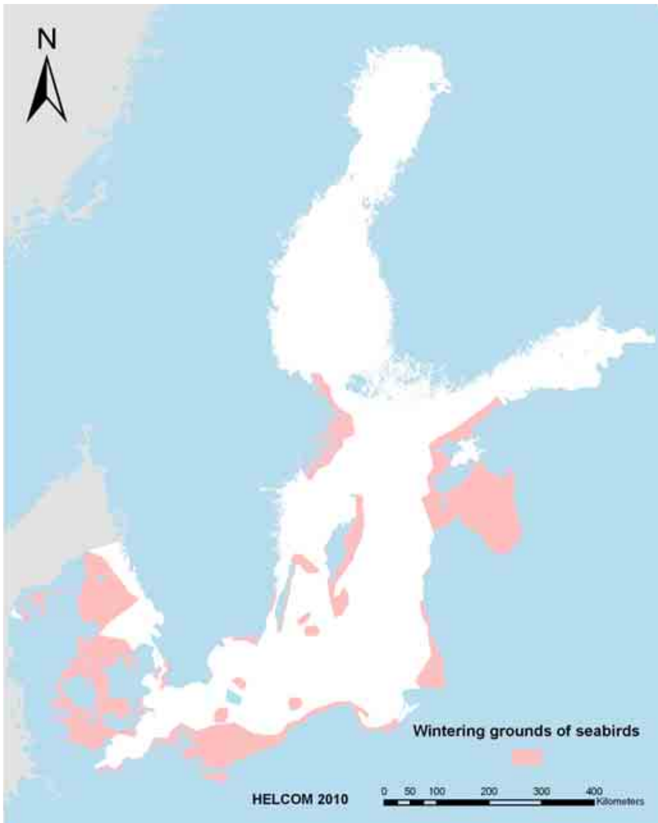

Figure 3.46 Wintering grounds of seabirds.

Figure 3.47 Distribution of (A) three seal species (grey seal, ringed seal, harbour seal) and (B) harbour porpoise.

Marine mammals

Marine mammals are an important part of the marine food web and the impacts of anthropogenic pressures on them are fairly well known. The distribution map of three seal species (combined distribution of grey seal, ringed seal, and harbour seal) and the distribution map of harbour porpoise cover the whole Baltic Sea (**Fig. 3.47 A, B**). It could be argued that seals are less abundant in the southern parts or harbour porpoise is rare in the northern parts, but nonetheless migrations of the seals cover the whole distribution area and harbour porpoises are observed frequently in the northern areas (ASCOBANS-HELCOM database, http://www.helcom.fi/GIS/en_GB/HelcomGIS/). Stranded or by-caught harbour porpoises are often found in the northern areas, indicating that human activities have a high toll on the harbour porpoise population. The data set on seals was based on the maps by the Finnish Game and Fisheries Research Institute and scientific publications. The data set for harbour porpoise distribution was based on the ASCOBANS-HELCOM database and research conducted by NERI, Denmark.

Spawning and nursery areas of cod

Cod is the most important large predatory fish in the Baltic Sea. As a top predator, it has a special role in balancing the food web. Cod spawns pelagically in a water layer of 12 psu salinity and the young fish migrate to shallow areas to forage. Bagge et al. (1994) described the main spawning and nursery areas of Baltic Sea cod (**Fig. 3.48**). The data set has been digitalized by NERI.

Figure 3.48 **Spawning and nursery grounds of cod.**

All the 14 ecosystem components are overlaid in **Figure 3.49**, which shows the number of ecosystem components in the 5 km x 5 km assessment units. A higher number of ecosystem components results in higher values in the BSII.

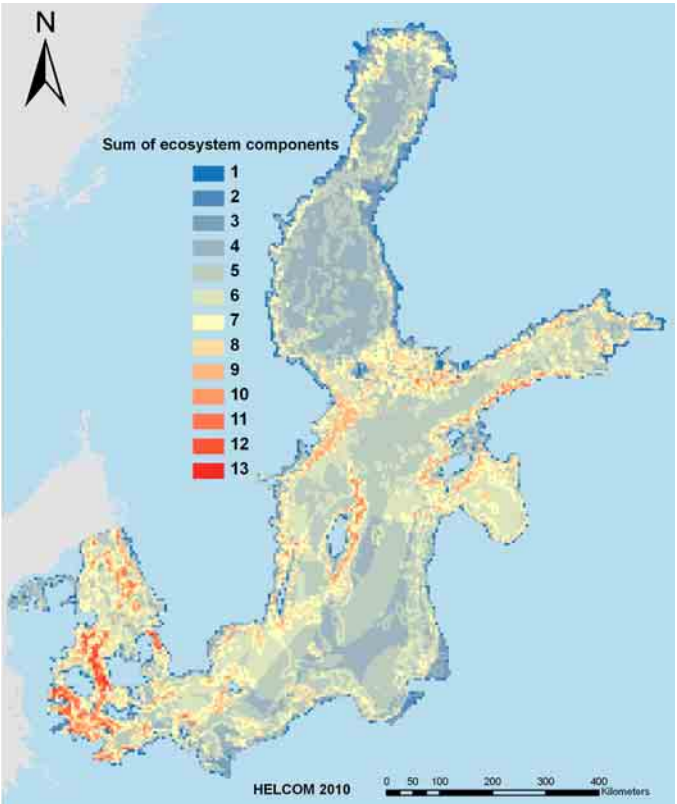

Figure 3.49 **Combined map of all 14 biological ecosystem components (i.e., data sets of species, biotopes and biotope complexes) in the grid (cell size 5 km x 5 km). The number of data layers in a cell is shown by the color gradient from blue (one) to red (14). Note: no cell in the area had all 14 layers present.**

4 TESTING, EVALUATION, AND FURTHER IMPROVEMENT OF THE BSII AND BSPI

4.1 Testing of the BSII and BSPI

The BSII and BSPI methods were tested by producing cartographic presentations of the indices. The map with the BSII results is presented in **Figure 4.1** and the map with the BSPI results is presented in **Figure 4.2**. A comparison of the indices shows that in general the results are similar, even though several differences in details are clearly visible.

The similarities are:

1. the low index values in the Gulf of Bothnia,
2. the higher index values in the coastal areas than in the offshore areas, and
3. the visible influence of offshore shipping (routes visible) and fisheries (ICES rectangles visible) in the Baltic Proper and the Bornholm Basin.

Baltic Sea Impact Index

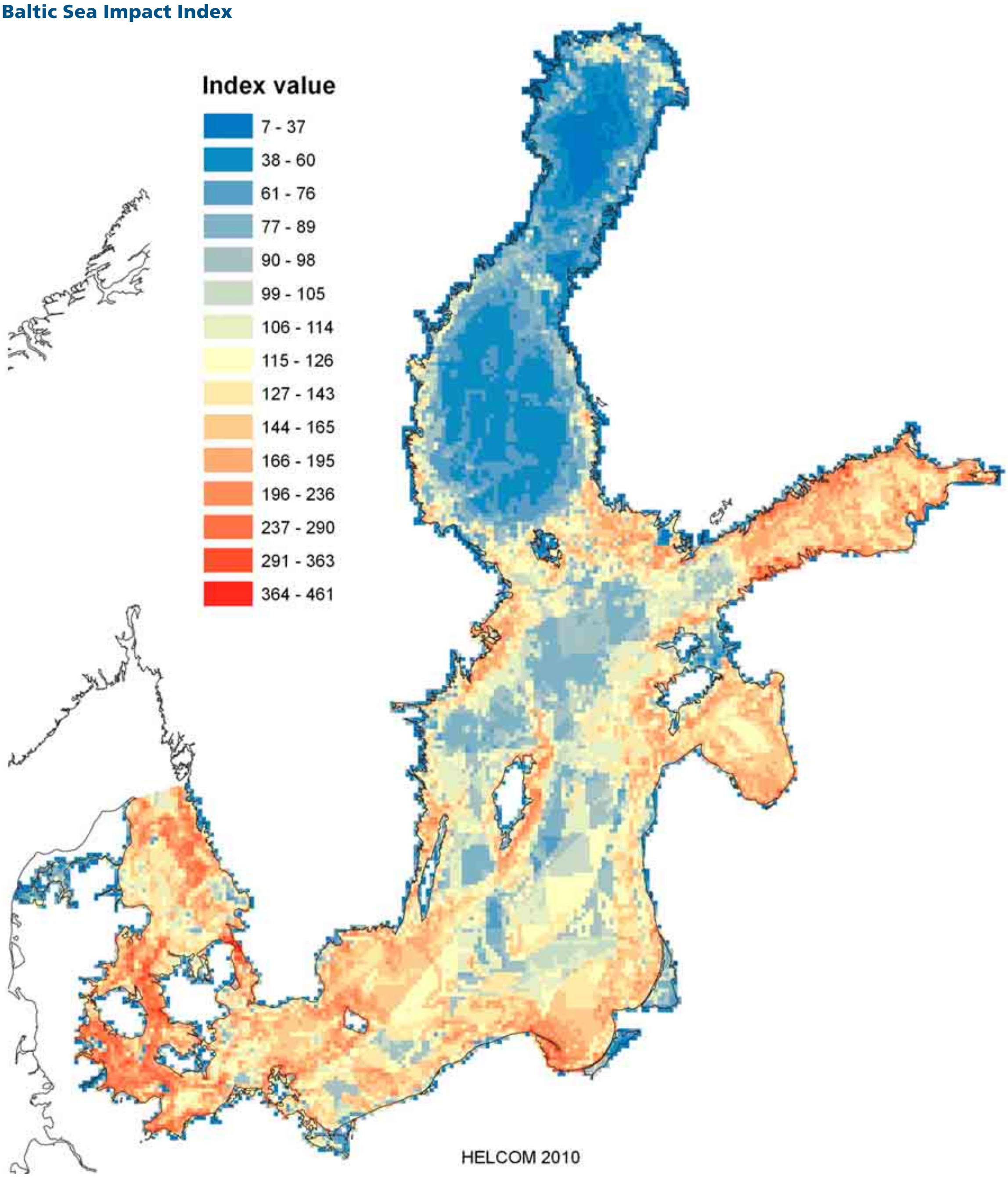

Figure 4.1 **The Baltic Sea Impact Index presenting potential impacts of anthropogenic pressures. The blue colour indicates low cumulative impacts and the red color indicates high cumulative impacts.**

The differences between the indices are:

1. the effect of the larger number of ecosystem components in the Belt Sea and Kattegat, resulting in higher index values in the BSII than in the BSPI in those areas,
2. the effect of the larger number of ecosystem components in the coastal areas than in the offshore areas in the Danish coast, Swedish coast, Kiel and Mecklenburg Bays, Estonian coast, southern Finnish coast, and the Bothnian Bay, resulting in higher index values in the BSII than in the BSPI in those areas,
3. a lower index value in the BSII than in the BSPI for the Gulf of Gdansk and southeastern areas owing to the smaller number of ecosystem components,
4. higher index values for the offshore Baltic Proper in the BSII than in the BSPI, and

Baltic Sea Pressure Index

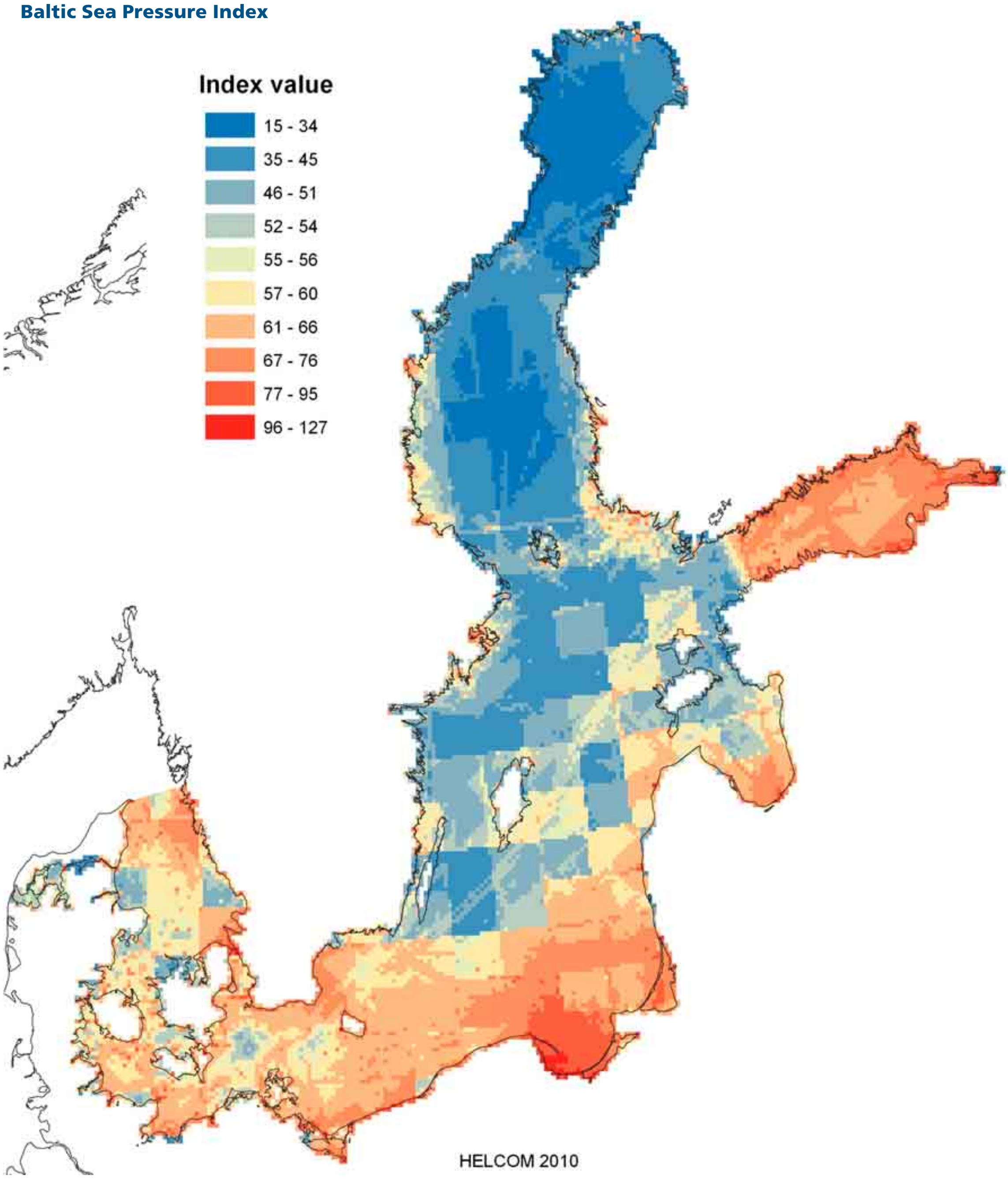

Figure 4.2 Map of cumulative potential pressures in the Baltic Sea based on the Baltic Sea Pressure Index. The blue colour indicates low cumulative impacts and the red color indicates high cumulative impacts.

5. more fine-scale differences in the BSII than in the BSPI due to the inclusion of the ecosystem data and associated weighting scores.

It is useful to acknowledge that the BSPI approach may underestimate the real pressure, which depends on biological components and the sensitivity/vulnerability of the ecosystem. Although the pressure values in the BSPI were weighted, the ecosystem aspect was only indirectly applied to the method. The BSPI method may, however, be a robust means of showing the distribution of anthropogenic pressures and could be also used in cases where ecosystem data are scarce.

4.2 Evaluation of the ecosystem data layers

An estimate of the impacts of human activities on the marine ecosystem depends on the species, habitats, and broader biological entities at a site. In a Baltic Sea-wide assessment, only a limited amount of such detailed information on species or habitat distribution is available. The HELCOM HOLAS project relied on information from the benthic broad-scale habitat maps from the BALANCE project, the maps of mussel reefs and *Zostera* meadows, the water-column biotope complexes from the EUSeaMap project, and four data layers on areas important for certain key species. The 14 ecosystem components chosen for this exercise were seen as key components of the ecosystem and they were considered relatively reliable, as the BSII assessment was conducted on a coarse 5 km x 5 km scale. However, it was acknowledged that some key components were omitted owing to limited data on their geographic distribution or the limited resources for producing weighting scores for them. In future, the effects of salinity and wave exposure should definitely be included in the ecosystem data layers, because these variables have been shown to explain much of the biological variation in the Baltic Sea.

4.3 Evaluation of the quality of the pressure data layers

The index itself can only be as good as the data on which it is compiled. Therefore, it is of major importance that the pressure data layers are of as high a quality as possible. Currently, the data sets are considered to be based on the best accessible data and well-considered data processing. The HELCOM expert workshop on BSPI (11 February 2010, Stockholm, Sweden) and the HOLAS Task Force reviewed all the data layers and provided guidance on the further development of the data sets.

There is no coordinated database on the anthropogenic pressures in the Baltic Sea and there are very few databases for single pressure data layers. This means that the pressure data are often collected and stored in different formats, units, and by different methods and degrees of accuracy. The HOLAS project compiled the data sets from different institutes and ministries as well as from literature and web sites. Although the data sets covered the entire sea area, there were differences in spatial and temporal accuracy. The greatest reliability was considered to be in data sets produced and coordinated

by a single institute, for example, waterborne nutrient inputs and atmospheric deposition of nitrogen, metals, and dioxins.

The next steps in the data processing should be the evaluation of the data sets against scientific measurements of the pressures. That would give reliability to the use of proxies. Other significant improvements would be the use of flow models to estimate the waterborne pressures and finding quantitative data for those data layers where only presence/absence data were available (e.g., microbial pathogens, bridges, coastal dams).

4.4 Evaluation of the index methods

The approach used in producing the BSII has been used on the global scale (Halpern et al. 2008), on the regional scale in Hawaii (Selkoe et al. 2009), and on the California current (Teck et al., submitted) and it has been suggested for use by UNEP to assess human impacts on large marine ecosystems. Thus, the method itself is widely accepted, whereas all the results are only as reliable as the underlying data. A comparison to another method, the Relative Benthic Fauna Damage Index in the Dutch marine area (RBDI, Lindeboom 2005), shows that the results are surprisingly similar. The RBDI uses three factors similar to the BSII, but instead of using weighting scores it uses a score describing the proportion of benthic fauna destroyed (0 to 1). The RBDI does not show the spatial distribution of the impacts, but gives a final impact score for an area.

In the current BSII/BSPI method, one of uncertainties lies in the small number of expert-opinion weighting scores. The advantage of HELCOM producing the BSII/BSPI assessment is in the wide network of experts, which guarantees a wide geographical representation of cultures, policies, environmental conditions, and environmental expertise in the Baltic Sea region. Although the results of the expert survey were in line with previous scientific studies, the reliability of the method would greatly improve if more expert estimates were included.

The future development of the method should also include sub-regional aspects. These could be added to the index formula by including a fourth factor *R* (Region), which can separate the impacts of pressures into different sub-basins. In this assessment, such an approach was already applied in practice as nitrogen loading was excluded from the Bothnian Bay (see data layers in **Section 3.1**). Secondly, the weighting scores used to transform pressures to ecosystem-specific potential impacts should be evaluated against real impact data and should include—if possible—non-linear responses. Thirdly, as our understanding of the synergistic impacts increases, the impact indices should acknowledge them in order to give a more realistic picture of the anthropogenic impacts on the marine ecosystem.

4.5 Strengths and benefits of the indices

This background document describes two new tools: the Baltic Sea Pressure Index (BSPI) and the Baltic Sea Impact Index (BSII). They both enable the presentation of anthropogenic pressures and potential impacts on the marine environment in an integrated cartographic form. The improvement of technical methods and data availability have recently provided a basis for the development of these tools and also opened doors for this kind of spatial analysis using large amounts of data.

The BSII and BSPI can be used as tools to assist in Maritime Spatial Planning and in status assessments of the marine environment. The HELCOM approach to measure the pressures and impacts follows the pressure classification of the EU Marine Strategy Framework Directive (MSFD) and thus also assists the HELCOM Contracting Parties that are also EU Member States in producing their initial assessment under the MSFD on the state of their marine areas.

The HELCOM Initial Holistic Assessment on ecosystem health, which was presented for the HELCOM Ministerial Meeting in Moscow in May 2010, contained specific sections on the anthropogenic pressures on the marine ecosystem and socio-economic aspects in the area. The work on the assessment of the spatial distribution of cumulative pressures and potential impacts comprises a significant part of the holistic assessment. At present, spatial data on human activities is still somewhat scarce and therefore the BSPI and BSII approaches do not give a precise view and most likely underestimate the true pressure and impact. Nevertheless, this work is the first step on the way towards a better understanding of human influences on the environment and is also in the forefront of the development of such integrative cartographic tools, which are also of high communication value to decision-makers.

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APPENDIX A

GUIDELINES FOR THE HELCOM BSII QUESTIONNAIRE

Introduction

The Baltic Sea Impact Index (BSII) is a tool to present the magnitude and spatial distribution of anthropogenic impacts on the marine environment. A key step in the index is the estimation of the weight of each pressure for specific components of the ecosystem. The weighting score is the linkage that transforms a pressure to an impact. The weighting score was determined by sending a questionnaire to experts, asking them to estimate the "significance of different pressures".

Ideally, pressures could be transformed to impacts using specific data sets. In reality, such data sets could be constructed only for some pressures, whereas for other pressures there do not even exist direct measurements, and therefore proxies must be used instead. Thus, this exercise should be seen as a first step towards more comprehensive indices. Nevertheless, there is no reason to underestimate the expert opinion-based assessments.

Classification of pressures in the BSII index follows the EU Marine Strategy Framework Directive, which identifies 18 anthropogenic pressure types on European marine ecosystems. Because a pressure type defined in the classification can originate from several separate human activities, the BSII includes 52 pressure data layers, classified under the 18 pressure classes.

An impact of a pressure depends on its target, i.e., the components of an ecosystem (e.g., species or biotopes or biotope complexes). For example, increased siltation due to coastal shipping affects hard-bottom biotopes differently than soft-bottom biotopes. Therefore, this questionnaire has separate worksheets for 14 'ecosystem data layers': eight benthic biotope complexes, two water-column biotope complexes, and four species-related data layers. Descriptions of the ecosystem data layers are given in the background document 'Towards a tool for quantifying the anthropogenic pressures and potential impacts in the Baltic Sea marine environment' (HELCOM, 2010a).

What is a weighting score?

The weighting scores (μ) are given a value from zero to four depending on the estimated impact of a pressure data layer on a species/biotope/biotope complex.

It is important to keep in mind that the weighting score is a 'theoretical' constant and it should be Baltic

Sea-wide. One can see its role in the index formula (Halpern et al. 2008) $I = \sum_{i=1}^{n} \sum_{j=1}^{m} P_i \times E_j \times \mu_{i,j}$, where P_i is the log-transformed and normalized value (scaled between 0 and 1) of an anthropogenic pressure in an assessment unit *i*, E_j is the presence or absence of an ecosystem component *j* (1 or 0, respectively), and $\mu_{i,j}$ is the weighting score for P_i in E_j (range 0–4). **Therefore, *μ* does not take into account the magnitude of the pressure in a cell or the geographical distribution of the pressure.** The impact of a pressure on a specific species or biotope or biotope complex occurs if B=1. If B=0 (the specific ecosystem component is absent), the pressure has no impact in that grid cell. Therefore, *μ* does not take into account the regional or local distribution of a pressure.

One should also consider the μ score as a 'potential impact' when the pressure is high and the target species/biotope/biotope complex is present in the grid cell. The background document also provides some examples of the *μ* scores in **Section 2.1**.

Producing weighting scores

The weighting scores can be produced either by directly estimating the impact on the ecosystem components or by using so-called 'guidance criteria' (Halpern et al. 2007).

The ***μ*** score can be formed with the help of three criteria: i) functional impact of a pressure, ii) resistance of the ecosystem component against the pressure, and iii) recovery of the ecosystem components after the pressure. The first factor describes the pressure and the latter two factors describe the biotope. **In many cases, the latter two factors are more useful in determining the final *μ* score.** Moreover, there may be some difficult cases with the weighting scores. For example, how should the atmospheric deposition of heavy metals be treated? (What is its impact? What is the recovery time?) Therefore, the components should be seen as 'guidelines for consideration' when determining the final ***μ*** score and can also be compared to other weighting scores (i.e., relative significance). The criteria and their boundaries are given in the table below. The *μ* score can be determined as an average of the three factors (or those factors one sees useful in determining *μ*) or one can judge the final score independently.

Filling in the worksheets

Each expert is asked to fill in those scores which his/her expertise is competent with. The questionnaire can be returned partly filled in.

The questionnaire consists of worksheets each of which includes weighting scores for one ecosystem data layer (14 sheets).

All the *μ* scores are compiled in an overall worksheet. The Secretariat will take a median value of the expert replies, which will be used in the index.

'Help desk'

The HELCOM Secretariat offers guidance for the filling of the questionnaire. Please contact Mr. Samuli Korpinen (tel: +358 400 329157, email: samuli.korpinen@helcom.fi).

Table. **Criteria for the production of the weighting scores, after Halpern et al. (2007, 2008)**

Component	Value	Remarks and examples
Functional impact	FUNC.IMPACT: 0 = no impact; 1 = ≥1 species; 2 = 1 trophic level; 3= >1 trophic level; 4 = whole community.	Example: Smothering and siltation may receive a value of 4 for hard-bottom biotopes where they block attachment of species. In soft bottoms, the effect is weaker.
Resistance of the ecosystem against the pressure	RESISTANCE: 0 = no impact; 1 = high; 2 = moderate; 3 = low; 4 = vulnerable.	Remark: Sensitive biotopes can be emphasized by this criterion. If a biotope is supported by a few species only, the biotope is probably 'sensitive' and the value is high.
Recovery after the pressure	RECOVERY: 0 = no impact; 1 = <1 year; 2 = 1–5 years; 3 = 5–10 years; 4 = 10–100 years.	Examples: Growth rate of a habitat-forming species after a catastrophe. Return of top-predators after disturbance. Restabilization of sediments. Clearance of water after a sediment plume.

APPENDIX B

WEIGHT SCORES

The final weight scores and their minimum and maximum values

	MEDIANS of the weight scores with minimum and maximum scores																		
Smothering	COD	min	max	SEAL	min	max	PORPOISE	min	max	BIRDS	min	max	ZOSTERA	min	max	MUSSELS	min	max	PHOTIC SAND
Disposal of dredged spoils	2.00	0.00	3.50	3.00	0.00	3.00	3.00	2.00	3.00	4.00	2.40	4.00	3.00	2.80	4.00	2.80	2.60	3.00	2.80
Wind farms, bridges, oil platforms (construction)	3.00	3.00	3.50	2.00	2.00	2.00	2.00	2.00	2.00	3.50	2.00	4.00	2.90	2.00	3.00	2.20	1.60	3.00	2.80
Cables and pipelines (construction)	2.00	2.00	3.50	2.00	2.00	2.00	2.00	2.00	2.00	3.00	2.00	4.00	2.60	1.00	2.60	2.50	1.00	2.80	2.50
Sealing																			
Harbours	2.75	2.00	3.50	3.00	2.00	3.00	3.00	3.00	3.00	4.00	2.40	4.00	2.60	2.00	2.80	2.60	2.00	3.00	2.60
Coastal defense structures	2.25	1.00	3.50	3.00	3.00	3.00	3.00	3.00	3.00	4.00	2.00	4.00	3.00	0.00	3.00	2.80	0.00	3.20	2.60
Bridges	2.25	1.00	3.50	3.00	1.50	3.00	2.00	1.00	3.00	2.40	2.00	3.00	2.60	2.20	3.00	2.80	2.20	3.00	2.60
Changes in siltation																			
Riverine runoff of organic matter	3.00	3.00	3.00	3.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.60	2.60	3.00	2.60	2.60	3.00	2.60
Dredging + Sand/gravel/boulder extraction	2.50	2.00	3.00	3.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	2.20	2.00	2.50	3.00
Bathing sites, beaches and beach replenishment	1.00	0.00	3.00	2.00	2.00	3.00	2.00	1.00	2.00	2.00	1.00	2.00	2.80	0.00	3.00	2.00	0.00	2.20	2.20
Shipping (coastal)	2.00	1.00	3.00	3.00	2.00	3.00	2.00	2.00	2.00	2.00	1.00	2.00	2.20	1.80	2.60	2.00	1.50	2.40	2.00
Abrasion																			
Commercial fishery -bottom trawling	3.00	3.00	3.00	3.00	2.00	3.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	0.60	3.20	2.60	0.00	3.20	3.00
Dredging + Sand/gravel/boulder extraction	3.00	3.00	3.00	3.00	3.00	3.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	2.80	3.20	2.20	2.00	3.20	3.00
Selective extraction																			
Dredging + Sand/gravel/boulder extraction (habitat loss)	3.00	3.00	3.00	3.00	3.00	3.00	2.00	2.00	2.00	3.00	3.00	3.00	3.40	2.80	4.00	2.00	1.00	3.20	3.40
Underwater noise																			
Shipping (coastal and offshore)	2.00	1.00	3.50	4.00	2.00	4.00	4.00	2.00	4.00	2.50	2.00	3.00	1.60	0.00	1.60	2.20	0.00	2.60	1.60
Recreational boating + sport	2.00	1.00	3.50	4.00	3.00	4.00	4.00	3.00	4.00	3.00	2.00	3.00	1.40	0.00	3.00	1.40	0.00	2.00	1.40
Wind farms (operational)	1.50	1.00	2.00	2.00	1.00	2.00	2.00	2.00	2.00	2.00	1.00	2.00	1.60	0.00	1.60	1.40	0.00	1.70	1.60
Wind farms, bridges, oil platforms (construction)	2.50	2.00	3.50	4.00	4.00	4.00	4.00	4.00	4.00	3.00	2.00	3.00	1.40	0.00	2.00	1.60	0.00	2.00	1.40
Cables and pipelines (construction)	2.50	2.00	3.50	4.00	4.00	4.00	4.00	4.00	4.00	3.00	2.00	3.00	1.40	0.00	2.00	1.40	0.00	2.00	1.40
Oil platforms	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.40	0.00	1.40	1.40	0.00	1.40	1.40
Marine litter																			
Changes in thermal regime																			
Power plants (warm water outflow)	1.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00	1.80	3.20	3.30	3.20	3.40	3.20
Changes in salinity regime																			
Bridges and coastal dams	3.00	3.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	3.00	2.60	4.00	3.00	3.00	3.80	3.00
Coastal waste water treatment plants	3.00	3.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.50	1.50	4.00	2.25	1.50	3.80	1.50
Introduction of synthetic compounds																			
Atmospheric deposition of dioxins	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00	1.00	2.00	1.55	1.20	2.00	1.50	0.40	3.80	1.50
Polluting ship accidents	3.00	3.00	3.00	3.50	3.00	3.50	4.00	4.00	4.00	4.00	4.00	4.00	2.40	2.30	3.00	2.40	2.00	3.20	2.40
Oil slicks / spills	2.50	2.00	3.00	3.50	3.00	3.50	4.00	4.00	4.00	4.00	4.00	4.00	2.55	2.40	3.00	2.40	2.20	3.00	2.40
Coastal industry, oil terminals, refineries, oil platforms	3.00	3.00	3.00	3.50	3.00	3.50	4.00	4.00	4.00	4.00	4.00	4.00	3.00	2.80	3.00	2.90	2.00	3.20	3.00
Harbours	3.00	2.50	3.00	3.50	3.00	3.50	3.50	3.00	3.50	4.00	3.00	4.00	2.95	2.00	3.00	3.20	3.00	3.40	3.00
Population density (e.g. hormones)	2.00	2.00	2.50	3.00	2.00	3.00	3.00	2.00	3.00	2.00	1.00	2.00	1.60	1.20	1.80	1.80	1.60	3.00	1.65
Introduction of non-synthetic substances and compounds																			
Waterborne load of cadmium	3.00	3.00	3.00	3.50	3.00	3.50	3.50	3.50	3.50	3.00	2.00	3.00	1.60	1.60	3.20	1.40	1.20	3.80	1.60
Waterborne load of lead	3.00	3.00	3.00	3.50	3.00	3.50	3.50	3.50	3.50	3.00	2.00	3.00	1.60	1.60	3.20	1.40	1.20	3.80	1.60
Waterborne load of mercury	3.00	3.00	3.00	3.50	3.00	3.50	3.50	3.50	3.50	3.00	2.00	3.00	1.60	1.60	3.20	1.40	1.20	3.80	1.60
Riverine load of nickel	3.00	3.00	3.00	3.50	3.00	3.50	3.50	3.50	3.50	3.00	2.00	3.00	1.60	1.60	3.20	1.40	1.20	3.80	1.60
Riverine load of zinc	3.00	3.00	3.00	3.50	3.00	3.50	3.50	3.50	3.50	3.00	2.00	3.00	1.60	1.60	3.20	1.40	1.20	3.80	1.60
Atmospheric deposition of cadmium	3.00	2.50	3.00	3.50	3.00	3.50	3.50	3.00	3.50	3.00	2.00	3.00	1.20	1.20	3.40	1.20	0.60	3.80	1.50
Atmospheric deposition of lead	3.00	2.50	3.00	3.50	3.00	3.50	3.50	3.00	3.50	3.00	2.00	3.00	1.20	1.20	3.40	1.20	0.60	3.80	1.50
Atmospheric deposition of mercury	3.00	2.50	3.00	3.50	3.00	3.50	3.50	3.00	3.50	3.00	2.00	3.00	1.20	1.20	3.40	1.20	0.60	3.80	1.50
Introduction of radio-nuclides																			
Discharges of radioactive substances	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.60	0.40	3.20	1.00	0.60	3.60	0.60
Introduction of other substances																			
Inputs of fertilisers																			
Aquaculture	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.60	2.40	3.20	2.90	2.60	3.00	2.60
Atmospheric deposition of nitrogen	3.00	2.00	4.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.60	2.00	4.00	2.60	2.00	3.60	2.00
Waterborne discharges of nitrogen	3.00	2.00	4.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.40	3.00	3.80	3.40	3.00	3.80	3.40
Waterborne discharges of phosphorus	3.00	2.00	4.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.40	3.00	3.40	3.40	3.00	3.80	3.40
Inputs of organic matter																			
Aquaculture	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.70	2.00	3.00	2.90	2.80	3.20	2.80
Riverine runoff of organic matter	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.80	2.60	3.60	2.50	2.00	2.60	2.80
Introduction of microbial pathogens																			
Aquaculture	2.25	1.50	3.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.00	1.50	1.40	0.00	1.40	1.40	1.20	1.40	1.40
Coastal waste water treatment plants	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.00	1.50	1.60	0.00	1.80	1.80	1.60	1.80	1.80
Passenger ships outside 12 nm	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.00	1.50	1.60	0.00	1.80	1.80	1.60	1.80	1.80
Introduction of non-indigenous species																			
Selective extraction of species																			
Hunting of birds	0.25	0.00	1.00	2.50	1.00	2.50	1.00	1.00	1.00	4.00	4.00	4.00	1.20	0.00	1.60	1.60	0.00	1.60	1.60
Hunting of seals	1.00	1.00	1.00	4.00	4.00	4.00	1.00	1.00	1.00	2.00	0.00	2.00	1.20	0.00	1.60	1.40	0.00	1.60	1.60
Commercial fishery -surface and mid-water	4.00	4.00	4.00	3.00	3.00	3.00	4.00	3.00	4.00	3.00	2.00	3.00	1.50	0.00	3.40	1.40	0.00	2.00	1.60
Commercial fishery -bottom trawling	4.00	4.00	4.00	2.50	2.00	3.00	3.50	3.50	3.50	3.00	2.00	4.00	3.00	0.00	4.00	3.00	0.00	4.00	3.00
Commercial fishery -coastal stationary	3.50	3.00	4.00	2.50	2.50	3.00	2.00	2.00	2.00	2.50	2.00	3.00	1.60	1.60	2.00	1.20	0.20	2.00	1.60
Commercial fishery - gillnets	4.00	4.00	4.00	4.00	3.00	4.00	4.00	3.00	4.00	4.00	2.00	4.00	1.60	1.00	1.60	1.20	0.20	2.00	1.40

min	max	PH MUD&CLAY	min	max	PH ROCK	min	max	NP SAND	min	max	NP MUD&CLAY	min	max	NP ROCK	min	max	PH WATER	min	max	NP WATER	min	max
2.40	3.00	2.20	2.00	2.80	2.60	2.40	4.00	2.45	2.00	3.20	2.35	2.00	3.00	2.95	2.20	4.00	2.20	0.00	2.70	0.00	0.00	1.70
1.00	3.00	2.50	0.00	2.80	1.80	0.00	2.60	2.30	0.00	3.00	1.95	0.00	3.00	2.30	0.00	2.80	2.20	0.00	2.70	0.00	0.00	1.70
1.00	2.60	1.80	1.00	2.60	2.00	1.60	2.40	2.10	1.00	2.80	1.80	1.00	2.80	2.20	1.00	2.60	2.20	0.00	2.70	0.00	0.00	1.70
2.40	3.00	1.60	1.20	2.80	2.50	2.40	3.00	2.00	0.00	2.60	1.80	0.00	2.40	2.00	1.40	2.60	2.00	1.00	2.60	0.85	0.00	1.40
2.60	3.00	1.50	0.00	2.00	2.70	0.00	3.00	2.00	0.00	2.60	1.80	0.00	2.40	2.00	1.40	2.60	2.00	0.70	2.20	1.00	0.00	1.00
2.20	3.00	1.80	0.00	2.00	2.00	0.00	2.40	2.00	0.00	2.60	1.80	0.00	2.40	2.00	1.00	2.60	1.40	0.70	2.00	1.40	0.70	2.00
2.60	3.00	0.00	0.00	2.60	2.70	2.60	3.00	3.05	2.60	3.60	3.00	1.00	4.00	2.80	2.30	4.00	2.15	2.00	2.70	1.65	1.00	1.80
1.80	3.00	1.80	1.80	3.00	2.10	2.00	2.40	3.00	2.20	3.00	2.60	1.80	3.00	3.00	2.00	3.00	1.80	1.60	2.70	1.20	1.20	2.00
1.50	2.20	2.10	0.00	2.20	2.00	0.00	2.20	1.40	0.00	2.20	0.90	0.00	2.00	1.40	0.60	2.00	0.40	0.00	0.40	0.20	0.00	0.40
1.50	2.20	2.20	1.50	2.60	2.00	1.50	2.60	1.75	0.80	2.20	1.10	0.00	1.80	1.15	0.00	1.80	1.20	0.80	2.70	1.07	0.00	1.40
3.00	3.00	2.80	0.60	3.00	1.40	0.00	3.00	3.40	0.00	4.00	3.60	0.00	4.00	3.35	3.00	4.00	0.00	0.00	0.00	0.00	0.00	1.70
3.00	3.00	2.70	2.60	3.00	1.90	1.40	3.00	3.10	3.00	3.20	3.00	2.00	3.00	3.05	3.00	3.20	0.00	0.00	0.00	0.00	0.00	0.00
3.00	3.40	2.35	2.00	3.40	1.60	1.00	3.20	3.30	3.00	3.60	2.90	0.40	3.00	3.20	0.00	3.40	0.00	0.00	0.00	0.00	0.00	0.00
1.00	1.60	1.60	0.00	1.60	2.20	0.00	2.40	1.40	0.00	1.40	1.40	0.00	1.40	1.40	1.00	1.40	2.00	1.00	2.00	2.00	1.00	2.00
1.20	2.00	1.20	0.00	2.00	1.40	0.00	2.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.35	1.20	2.00	1.00	1.00	2.00
0.00	1.60	1.60	0.00	1.60	1.60	0.00	2.00	1.40	0.00	1.40	1.40	0.00	1.40	1.40	1.00	1.40	1.60	1.00	1.60	1.40	0.00	2.00
1.40	2.00	1.40	0.00	2.00	1.40	0.00	2.00	1.40	0.00	2.00	1.40	0.00	2.00	1.40	1.40	2.00	2.20	2.00	2.20	2.00	1.00	2.20
1.40	2.00	1.40	0.00	2.00	1.40	0.00	2.00	1.40	0.00	2.00	1.40	0.00	2.00	1.40	1.40	2.00	2.20	2.00	2.20	2.25	2.00	2.40
1.40	1.40	1.40	0.00	1.40	1.40	0.00	1.40	1.40	0.00	1.40	1.40	0.00	1.40	1.40	1.40	1.40	2.20	2.00	2.20	2.35	2.00	2.50
3.20	3.20	2.80	2.80	3.00	3.45	3.20	3.60	1.40	1.00	2.80	1.40	1.00	2.80	1.40	1.00	1.80	3.20	3.20	3.30	1.90	0.80	3.30
1.00	3.00	3.00	3.00	4.00	3.00	2.20	3.00	3.00	3.00	3.80	3.00	3.00	3.80	3.00	0.40	3.00	3.00	3.00	3.30	3.00	3.00	3.30
1.00	1.50	1.50	1.50	4.00	1.50	1.50	2.20	1.50	1.50	3.80	1.50	1.50	3.80	1.50	0.40	1.50	1.50	1.50	3.30	1.50	1.50	3.30
1.20	2.00	1.00	0.80	1.60	1.20	0.40	2.60	1.95	1.00	3.80	1.95	1.00	3.80	1.00	1.00	2.80	2.00	1.30	3.40	2.00	1.00	3.40
2.40	3.00	2.40	2.40	3.00	2.60	2.20	3.00	1.70	1.40	2.60	1.70	1.40	2.60	1.60	1.40	2.00	2.60	2.00	3.00	2.00	1.00	3.00
2.40	3.00	2.20	2.20	3.00	2.40	2.20	3.00	1.70	1.40	2.60	1.70	1.40	2.60	1.60	1.40	2.00	2.80	2.80	3.30	1.63	1.00	2.20
3.00	3.40	3.00	3.00	3.00	3.00	3.00	3.40	2.20	2.20	3.00	2.20	2.20	3.00	2.20	2.20	3.00	3.00	3.00	3.20	2.32	1.80	3.00
3.00	3.00	3.00	3.00	3.00	3.30	3.00	3.40	2.10	2.00	3.00	2.20	2.00	3.00	2.20	2.00	2.20	3.00	3.00	3.00	1.00	0.00	2.33
1.60	1.80	1.60	1.60	1.80	2.00	1.60	2.40	1.70	1.20	3.20	1.60	1.20	3.20	1.60	1.20	2.00	1.80	1.30	1.80	1.20	0.60	1.80
1.60	2.00	1.60	1.60	3.20	1.40	1.20	3.20	2.10	1.40	3.60	2.20	1.40	3.60	2.05	1.40	2.80	2.00	1.80	3.30	1.90	1.00	2.80
1.60	2.00	1.60	1.60	3.20	1.40	1.20	3.20	2.10	1.40	3.60	2.20	1.40	3.60	2.05	1.40	2.80	2.00	1.80	3.30	1.90	1.00	2.80
1.60	2.00	1.60	1.60	3.20	1.40	1.20	3.20	2.10	1.40	3.60	2.20	1.40	3.60	2.05	1.40	2.80	2.00	1.80	3.30	1.90	1.00	2.80
1.60	2.00	1.60	1.60	3.20	1.40	1.20	3.20	2.10	1.40	3.60	2.20	1.40	3.60	2.05	1.40	2.80	2.00	1.80	3.30	1.90	1.00	2.80
1.60	2.00	1.60	1.60	3.20	1.40	1.20	3.20	2.10	1.40	3.60	2.20	1.40	3.60	2.05	1.40	2.80	2.00	1.80	3.30	1.90	1.00	2.80
1.20	2.00	1.20	1.20	3.40	0.60	0.60	3.40	2.00	1.20	3.60	2.10	1.20	3.60	2.00	1.20	2.80	1.90	1.40	3.30	1.95	1.00	3.40
1.20	2.00	1.20	1.20	3.40	0.60	0.60	3.40	2.00	1.20	3.60	2.10	1.20	3.60	2.00	1.20	2.80	1.90	1.40	3.30	1.95	1.00	3.40
1.20	2.00	1.20	1.20	3.40	0.60	0.60	3.40	2.00	1.20	3.60	2.10	1.20	3.60	2.00	1.20	2.80	1.90	1.40	3.30	1.95	1.00	3.40
0.60	1.00	0.60	0.60	3.20	1.00	0.60	3.00	1.00	0.60	3.20	1.00	0.60	3.20	1.00	0.60	2.80	1.00	0.30	1.00	1.00	0.30	3.20
2.60	3.00	2.70	2.60	3.20	2.90	2.80	3.40	2.40	1.80	3.00	2.40	1.80	3.00	2.20	1.80	3.00	2.80	2.80	3.70	1.60	1.60	2.00
2.00	2.00	1.40	1.40	3.40	2.80	2.60	3.60	2.80	1.20	4.00	2.75	1.00	4.00	2.50	1.20	4.00	2.95	2.20	3.70	1.40	1.33	3.40
3.00	3.40	2.60	2.00	3.40	3.20	3.00	3.80	3.00	1.80	4.00	3.00	1.60	4.00	3.00	1.20	4.00	3.00	3.00	3.70	2.80	2.00	3.40
3.00	3.40	2.60	2.60	3.40	3.00	2.00	3.60	3.00	1.80	4.00	3.00	1.60	4.00	3.00	1.80	4.00	3.00	3.00	3.70	2.80	2.00	3.40
2.80	3.00	2.80	2.20	3.40	2.80	2.80	3.20	2.10	2.00	3.20	2.10	2.00	3.20	2.20	2.00	2.20	2.50	2.00	2.80	1.70	1.60	2.00
2.00	2.90	1.90	1.60	2.60	2.60	2.40	3.00	2.75	2.20	3.20	3.00	2.20	3.80	3.00	2.80	3.20	2.70	2.40	3.70	2.00	1.60	2.40
1.40	1.40	1.40	0.00	1.40	1.40	0.00	1.40	1.30	0.00	1.60	1.30	0.00	1.60	1.30	1.00	1.60	1.40	1.30	1.40	0.30	0.00	1.00
1.80	1.80	1.80	0.00	1.80	1.80	0.00	1.80	1.20	0.00	1.20	1.20	0.00	1.20	1.20	1.20	1.20	1.80	1.30	1.80	0.40	0.00	1.00
1.80	1.80	1.80	0.00	1.80	1.80	0.00	1.80	1.20	0.00	1.20	1.20	0.00	1.20	1.20	1.20	1.20	1.80	1.30	1.80	0.40	0.00	1.00
0.00	1.60	1.30	0.00	1.60	1.60	0.00	1.80	0.75	0.00	1.20	0.75	0.00	1.20	0.95	0.00	1.20	1.00	0.00	2.00	0.30	0.00	1.80
0.00	1.60	1.30	0.00	1.60	1.00	0.00	1.60	0.90	0.00	1.20	0.90	0.00	1.20	1.00	0.00	1.20	1.65	0.00	2.00	0.50	0.00	1.60
1.00	2.00	1.40	0.00	2.00	1.40	0.00	2.40	2.20	0.00	4.00	2.20	0.00	4.00	2.30	1.00	4.00	3.20	2.80	3.40	3.00	2.40	3.40
3.00	3.00	3.20	0.00	3.20	3.00	0.00	3.20	3.75	0.00	4.00	3.75	0.00	4.00	3.75	3.40	4.00	2.65	1.80	3.40	2.70	1.80	3.40
1.40	2.00	1.60	1.60	2.00	1.50	0.00	2.00	2.10	0.00	2.40	2.10	0.00	2.40	2.25	2.00	2.40	2.00	1.80	2.30	1.95	1.80	2.33
1.00	1.60	1.60	1.00	1.60	1.50	0.00	2.00	2.10	0.00	2.40	2.10	0.00	2.40	2.25	2.00	2.40	2.00	1.30	2.50	2.00	1.33	2.50

Cod spawning and nursery areas

	Secretariat	Sweden	Poland	Estonia	Denmark	Average	Median	Min	Max
Smothering									
Disposal of dredged spoils	3,5	2	3,5		2	**2,75**	**2,75**	2	3,5
Wind farms, bridges, oil platforms (construction)	3,5	3	3		3	**3,125**	**3**	3	3,5
Cables and pipelines (construction)	3,5	2	3	2	2	**2,5**	**2**	2	3,5
Sealing									
Harbours	3,5	2	3,5		2	**2,75**	**2,75**	2	3,5
Coastal defense structures	3,5	1	3,5		1	**2,25**	**2,25**	1	3,5
Bridges	3,5	1	3,5		1	**2,25**	**2,25**	1	3,5
Changes in siltation									
Riverine runoff of organic matter	3	3	3		3	**3**	**3**	3	3
Dredging + Sand/gravel/boulder extraction	3	2	3		2	**2,5**	**2,5**	2	3
Bathing sites, beaches and beach replenishment	3	0	2		0	**1,25**	**1**	0	3
Shipping (coastal)	3	1	3		1	**2**	**2**	1	3
Abrasion									
Commercial fishery -bottom trawling	3	3	3		3	**3**	**3**	3	3
Dredging + Sand/gravel/boulder extraction	3	3	3		3	**3**	**3**	3	3
Selective extraction									
Dredging + Sand/gravel/boulder extraction (habitat loss)	3	3	3		3	**3**	**3**	3	3
Underwater noise									
Shipping (coastal and offshore)	3,5	1	3		1	**2,125**	**2**	1	3,5
Recreational boating + sport	3,5	1	3		1	**2,125**	**2**	1	3,5
Wind farms (operational)	2	1	2		1	**1,5**	**1,5**	1	2
Wind farms, bridges, oil platforms (construction)	3,5	2	3		2	**2,625**	**2,5**	2	3,5
Cables and pipelines (construction)	3,5	2	3		2	**2,625**	**2,5**	2	3,5
Oil platforms	2	2	2		2	**2**	**2**	2	2
Marine litter									
Population density	2	1	2		1	**1,5**	**1,5**	1	2
Harbours	2	1	2		1	**1,5**	**1,5**	1	2
Changes in thermal regime									
Power plants (warm water outflow)	2	1	2		1	**1,5**	**1,5**	1	2
Changes in salinity regime									
Bridges and coastal dams	3	3	3		3	**3**	**3**	3	3
Coastal waste water treatment plants	3	3	3		3	**3**	**3**	3	3
Introduction of synthetic compounds									
Atmospheric deposition of dioxins	3	3	3		3	**3**	**3**	3	3
Polluting ship accidents	3	3	3		3	**3**	**3**	3	3
Oil slicks / spills	3	2	3		2	**2,5**	**2,5**	2	3
Coastal industry, oil terminals, refineries, oil platforms	3	3	3		3	**3**	**3**	3	3
Harbours	3	3	2,5		3	**2,875**	**3**	2,5	3
Population density (e.g. hormones)	2,5	2	2		2	**2,125**	**2**	2	2,5
Introduction of non-synthetic substances and compounds									
Waterborne load of heavy metals	3	3	3		3	**3**	**3**	3	3
Atmospheric deposition of metals	3	3	2,5		3	**2,875**	**3**	2,5	3
Introduction of radio-nuclides									
Discharges of radioactive substances	1	1	1		1	**1**	**1**	1	1
Introduction of other substances									
Inputs of fertilisers									
Aquaculture	2	2	2		2	**2**	**2**	2	2
Atmospheric deposition of nitrogen	2	4	2		4	**3**	**3**	2	4
Waterborne discharges of nitrogen	2	4	2		4	**3**	**3**	2	4
Waterborne discharges of phosphorus	2	4	2		4	**3**	**3**	2	4
Inputs of organic matter									
Aquaculture	2	2	2		2	**2**	**2**	2	2
Riverine runoff of organic matter	2	2	2		2	**2**	**2**	2	2
Introduction of microbial pathogens									
Aquaculture	1,5	3	1,5		3	**2,25**	**2,25**	1,5	3
Coastal waste water treatment plants	1,5	1,5	1,5		1,5	**1,5**	**1,5**	1,5	1,5
Introduction of non-indigenous species									
Selective extraction of species									
Hunting of birds	0,5	0	1		0	**0,375**	**0,25**	0	1
Hunting of seals	1	1	1		1	**1**	**1**	1	1
Commercial fishery -surface and mid-water	4	4	4		4	**4**	**4**	4	4
Commercial fishery -bottom trawling	4	4	4		4	**4**	**4**	4	4
Commercial fishery -coastal stationary	3	4	3		4	**3,5**	**3,5**	3	4
Commercial fishery - gillnets	4	4	4		4	**4**	**4**	4	4

Distribution of three seal species

	Secretariat	Sweden	Poland	Estonia	Denmark	Average	Median	Min	Max
Smothering									
Disposal of dredged spoils	3	3	3	0	2	**2.2**	**3**	0	3
Wind farms, bridges, oil platforms (construction)	2	2	2	2	2	**2**	**2**	2	2
Cables and pipelines (construction)	2	2	2	2	2	**2**	**2**	2	2
Sealing									
Harbours	3	2	3	3	3	**2.8**	**3**	2	3
Coastal defense structures	3	3	3	3	3	**3**	**3**	3	3
Bridges	3	3	1.5	3	2	**2.5**	**3**	1.5	3
Changes in siltation									
Riverine runoff of organic matter	3	3	3	3	3	**3**	**3**	3	3
Dredging + Sand/gravel/boulder extraction	3	3	3	3	3	**3**	**3**	3	3
Bathing sites, beaches and beach replenishment	3	2	2	3	2	**2.4**	**2**	2	3
Shipping (coastal)	3	2	3	3	2	**2.6**	**3**	2	3
Abrasion									
Commercial fishery -bottom trawling	3	2	3	3	2	**2.6**	**3**	2	3
Dredging + Sand/gravel/boulder extraction	3	3	3	3	3	**3**	**3**	3	3
Selective extraction									
Dredging + Sand/gravel/boulder extraction (habitat lo	3	3	3	3	3	**3**	**3**	3	3
Underwater noise									
Shipping (coastal and offshore)	4	4	4	4	2	**3.6**	**4**	2	4
Recreational boating + sport	4	4	4	4	3	**3.8**	**4**	3	4
Wind farms (operational)	2	2	2	1	2	**1.8**	**2**	1	2
Wind farms, bridges, oil platforms (construction)	4	4	4	4	4	**4**	**4**	4	4
Cables and pipelines (construction)	4	4	4	4	4	**4**	**4**	4	4
Oil platforms	2	2	2		2	**2**	**2**	2	2
Marine litter									
Population density	3	3	3	3	3	**3**	**3**	3	3
Harbours	3	3	3	3	3	**3**	**3**	3	3
Changes in thermal regime									
Power plants (warm water outflow)	2	2	2		2	**2**	**2**	2	2
Changes in salinity regime									
Bridges and coastal dams	1	1	1		1	**1**	**1**	1	1
Coastal waste water treatment plants	1	1	1		1	**1**	**1**	1	1
Introduction of synthetic compounds									
Atmospheric deposition of dioxins	3	3	3	3	3	**3**	**3**	3	3
Polluting ship accidents	3.5	3.5	3.5	3	3.5	**3.4**	**3.5**	3	3.5
Oil slicks / spills	3.5	3.5	3.5	3	3.5	**3.4**	**3.5**	3	3.5
Coastal industry, oil terminals, refineries, oil platform	3.5	3.5	3.5	3	3.5	**3.4**	**3.5**	3	3.5
Harbours	3.5	3.5	3	3	3.5	**3.3**	**3.5**	3	3.5
Population density (e.g. hormones)	3	3	2		3	**2.75**	**3**	2	3
Introduction of non-synthetic substances and compounds									
Waterborne load of heavy metals	3.5	3.5	3.5	3	3.5	**3.4**	**3.5**	3	3.5
Atmospheric deposition of metals	3.5	3.5	3	3	3.5	**3.3**	**3.5**	3	3.5
Introduction of radio-nuclides									
Discharges of radioactive substances	1	1	1	1	1	**1**	**1**	1	1
Introduction of other substances									
Inputs of fertilisers									
Aquaculture	2	2	2	2	2	**2**	**2**	2	2
Atmospheric deposition of nitrogen	2	2	2	2	2	**2**	**2**	2	2
Waterborne discharges of nitrogen	2	2	2	2	2	**2**	**2**	2	2
Waterborne discharges of phosphorus	2	2	2	2	2	**2**	**2**	2	2
Inputs of organic matter									
Aquaculture	2	2	2	2	2	**2**	**2**	2	2
Riverine runoff of organic matter	2	2	2	2	2	**2**	**2**	2	2
Introduction of microbial pathogens									
Aquaculture	1.5	1.5	1.5		1.5	**1.5**	**1.5**	1.5	1.5
Coastal waste water treatment plants	1.5	1.5	1.5		1.5	**1.5**	**1.5**	1.5	1.5
Introduction of non-indigenous species									
Selective extraction of species									
Hunting of birds	2.5	2.5	1	2	2.5	**2.1**	**2.5**	1	2.5
Hunting of seals	4	4	4	4	4	**4**	**4**	4	4
Commercial fishery -surface and mid-water	3	3	3	3	3	**3**	**3**	3	3
Commercial fishery -bottom trawling	2.5	2	2.5	3	2.5	**2.5**	**2.5**	2	3
Commercial fishery -coastal stationary	2.5	2.5	2.5	3	2.5	**2.6**	**2.5**	2.5	3
Commercial fishery - gillnets	4	4	4	4	3	**3.8**	**4**	3	4

Harbour porpoise distribution

	Secretariat	Poland	Denmark	Average	Median	Min	Max
Smothering							
Disposal of dredged spoils	3	3	2	**2.666667**	**3**	2	3
Wind farms, bridges, oil platforms (construction)	2	2	2	**2**	**2**	2	2
Cables and pipelines (construction)	2	2	2	**2**	**2**	2	2
Sealing							
Harbours	3	3	3	**3**	**3**	3	3
Coastal defense structures	3	3	3	**3**	**3**	3	3
Bridges	3	1	2	**2**	**2**	1	3
Changes in siltation							
Riverine runoff of organic matter	2	2	2	**2**	**2**	2	2
Dredging + Sand/gravel/boulder extraction	2	2	2	**2**	**2**	2	2
Bathing sites, beaches and beach replenishment	2	1	2	**1.666667**	**2**	1	2
Shipping (coastal)	2	2	2	**2**	**2**	2	2
Abrasion							
Commercial fishery -bottom trawling	2	2	2	**2**	**2**	2	2
Dredging + Sand/gravel/boulder extraction	2	2	2	**2**	**2**	2	2
Selective extraction							
Dredging + Sand/gravel/boulder extraction (habitat lo	2	2	2	**2**	**2**	2	2
Underwater noise							
Shipping (coastal and offshore)	4	4	2	**3.333333**	**4**	2	4
Recreational boating + sport	4	4	3	**3.666667**	**4**	3	4
Wind farms (operational)	2	2	2	**2**	**2**	2	2
Wind farms, bridges, oil platforms (construction)	4	4	4	**4**	**4**	4	4
Cables and pipelines (construction)	4	4	4	**4**	**4**	4	4
Oil platforms	2	2	2	**2**	**2**	2	2
Marine litter							
Population density	3	3	3	**3**	**3**	3	3
Harbours	3	3	3	**3**	**3**	3	3
Changes in thermal regime							
Power plants (warm water outflow)	2	2	2	**2**	**2**	2	2
Changes in salinity regime							
Bridges and coastal dams	1	1	1	**1**	**1**	1	1
Coastal waste water treatment plants	1	1	1	**1**	**1**	1	1
Introduction of synthetic compounds							
Atmospheric deposition of dioxins	3	3	3	**3**	**3**	3	3
Polluting ship accidents	4	4	4	**4**	**4**	4	4
Oil slicks / spills	4	4	4	**4**	**4**	4	4
Coastal industry, oil terminals, refineries, oil platforms	4	4	4	**4**	**4**	4	4
Harbours	3.5	3	3.5	**3.333333**	**3.5**	3	3.5
Population density (e.g. hormones)	3	2	3	**2.666667**	**3**	2	3
Introduction of non-synthetic substances and compounds							
Waterborne load of heavy metals	3.5	3.5	3.5	**3.5**	**3.5**	3.5	3.5
Atmospheric deposition of metals	3.5	3	3.5	**3.333333**	**3.5**	3	3.5
Introduction of radio-nuclides							
Discharges of radioactive substances	1	1	1	**1**	**1**	1	1
Introduction of other substances							
Inputs of fertilisers							
Aquaculture	2	2	2	**2**	**2**	2	2
Atmospheric deposition of nitrogen	2	2	2	**2**	**2**	2	2
Waterborne discharges of nitrogen	2	2	2	**2**	**2**	2	2
Waterborne discharges of phosphorus	2	2	2	**2**	**2**	2	2
Inputs of organic matter							
Aquaculture	2	2	2	**2**	**2**	2	2
Riverine runoff of organic matter	2	2	2	**2**	**2**	2	2
Introduction of microbial pathogens							
Aquaculture	1.5	1.5	1.5	**1.5**	**1.5**	1.5	1.5
Coastal waste water treatment plants	1.5	1.5	1.5	**1.5**	**1.5**	1.5	1.5
Introduction of non-indigenous species							
Selective extraction of species							
Hunting of birds	1	1	1	**1**	**1**	1	1
Hunting of seals	1	1	1	**1**	**1**	1	1
Commercial fishery -surface and mid-water	4	3	4	**3.666667**	**4**	3	4
Commercial fishery -bottom trawling	3.5	3.5	3.5	**3.5**	**3.5**	3.5	3.5
Commercial fishery -coastal stationary	2	2	2	**2**	**2**	2	2
Commercial fishery - gillnets	4	4	3	**3.666667**	**4**	3	4

Seabird wintering grounds

	Secretariat	Sweden	Poland	Lithuania	Estonia	Denmark	Average	Median	Min	Max
Smothering										
Disposal of dredged spoils	4	4	3		4	2.4	**3.48**	**4**	2.4	4
Wind farms, bridges, oil platforms (construction)	4	2	3.5		4	2.4	**3.18**	**3.5**	2	4
Cables and pipelines (construction)	4	2	3		4	2.2	**3.04**	**3**	2	4
Sealing										
Harbours	4	3	4		4	2.4	**3.48**	**4**	2.4	4
Coastal defense structures	4	2	4		4	4	**3.6**	**4**	2	4
Bridges	3	2	2		3	2.4	**2.48**	**2.4**	2	3
Changes in siltation										
Riverine runoff of organic matter	2	2	2		2	2	**2**	**2**	2	2
Dredging + Sand/gravel/boulder extraction	2	3	2		2	2	**2.2**	**2**	2	3
Bathing sites, beaches and beach replenishment	2	1	2		2	2	**1.8**	**2**	1	2
Shipping (coastal)	2	1	2		2	2	**1.8**	**2**	1	2
Abrasion										
Commercial fishery -bottom trawling	3	3	3		3	3	**3**	**3**	3	3
Dredging + Sand/gravel/boulder extraction	3	3	3		3	3	**3**	**3**	3	3
Selective extraction										
Dredging + Sand/gravel/boulder extraction (habitat lo	3	3	3		3	3	**3**	**3**	3	3
Underwater noise										
Shipping (coastal and offshore)	3	2	3	2	3	2	**2.5**	**2.5**	2	3
Recreational boating + sport	3	2	3	2	3	3	**2.666667**	**3**	2	3
Wind farms (operational)	2	2	2		1	2	**1.8**	**2**	1	2
Wind farms, bridges, oil platforms (construction)	3	2	3		3	3	**2.8**	**3**	2	3
Cables and pipelines (construction)	3	2	3		3	3	**2.8**	**3**	2	3
Oil platforms	2	2	2			2	**2**	**2**	2	2
Marine litter										
Population density	3	3	3		3	3	**3**	**3**	3	3
Harbours	3	3	3		3	3	**3**	**3**	3	3
Changes in thermal regime										
Power plants (warm water outflow)	2	3	2			2	**2.25**	**2**	2	3
Changes in salinity regime										
Bridges and coastal dams	1	2	1			1	**1.25**	**1**	1	2
Coastal waste water treatment plants	1	2	1			1	**1.25**	**1**	1	2
Introduction of synthetic compounds										
Atmospheric deposition of dioxins	2	1	2		2	2	**1.8**	**2**	1	2
Polluting ship accidents	4	4	4		4	4	**4**	**4**	4	4
Oil slicks / spills	4	4	4		4	4	**4**	**4**	4	4
Coastal industry, oil terminals, refineries, oil platform:	4	4	4		4	4	**4**	**4**	4	4
Harbours	4	3	4		4	4	**3.8**	**4**	3	4
Population density (e.g. hormones)	2	1	2			2	**1.75**	**2**	1	2
Introduction of non-synthetic substances and compounds										
Waterborne load of heavy metals	3	2	3		3	3	**2.8**	**3**	2	3
Atmospheric deposition of metals	3	2	2.5		3	3	**2.7**	**3**	2	3
Introduction of radio-nuclides										
Discharges of radioactive substances	1	1	1		1	1	**1**	**1**	1	1
Introduction of other substances										
Inputs of fertilisers										
Aquaculture	2	2	2		2	2	**2**	**2**	2	2
Atmospheric deposition of nitrogen	2	2	2		2	2	**2**	**2**	2	2
Waterborne discharges of nitrogen	2	2	2		2	2	**2**	**2**	2	2
Waterborne discharges of phosphorus	2	2	2		2	2	**2**	**2**	2	2
Inputs of organic matter										
Aquaculture	2	2	2		2	2	**2**	**2**	2	2
Riverine runoff of organic matter	2	2	2		2	2	**2**	**2**	2	2
Introduction of microbial pathogens										
Aquaculture	1.5	1	1.5			1.5	**1.375**	**1.5**	1	1.5
Coastal waste water treatment plants	1.5	1	1.5			1.5	**1.375**	**1.5**	1	1.5
Introduction of non-indigenous species										
Selective extraction of species										
Hunting of birds	4	4	4		4	4	**4**	**4**	4	4
Hunting of seals	2	0	1		2	2	**1.4**	**2**	0	2
Commercial fishery -surface and mid-water	3	2	3	2	3	3	**2.666667**	**3**	2	3
Commercial fishery -bottom trawling	4	2	3	2	4	3	**3**	**3**	2	4
Commercial fishery -coastal stationary	2.5	2	2.5	2	3	2.5	**2.416667**	**2.5**	2	3
Commercial fishery - gillnets	4	4	4	2	4	3	**3.5**	**4**	2	4

Zostera meadows

	Secretaria	Swe1	Swe2	Swe3	Poland	Finland	Estonia	Denmark	Ave	Med	Min	Max
Smothering												
Disposal of dredged spoils	3	3	3	3	3	2.8	4	2.8	3.08	3	2.8	4
Wind farms, bridges, oil platforms (construction)	3	3	3	3	2.8	2.8	2	2.8	2.8	2.9	2	3
Cables and pipelines (construction)	2.6	2.6	2.6	2.6	2.6	2.6	1	2.6	2.4	2.6	1	2.6
Sealing												
Harbours	2.6	2.6	2.6	2.6	2.2	2.8	2	2.4	2.48	2.6	2	2.8
Coastal defense structures	3	3	3	3	2.4	0	3	3	2.55	3	0	3
Bridges	2.6				2.2		3	2.6	2.6	2.6	2.2	3
Changes in siltation												
Riverine runoff of organic matter	2.6	2.6	2.6	2.6	3	2.6	3	2.6	2.7	2.6	2.6	3
Dredging + Sand/gravel/boulder extraction	3	3	3	3	3	3	3	3	3	3	3	3
Bathing sites, beaches and beach replenishment	2.8	2.8	2.8	2.8	2	0	3	2.8	2.38	2.8	0	3
Shipping (coastal)	2.2	2.2	2.2	2.2	1.8	2.6	2	2.2	2.18	2.2	1.8	2.6
Abrasion												
Commercial fishery -bottom trawling	3	3	3	3	3.2	0.6	3	3	2.73	3	0.6	3.2
Dredging + Sand/gravel/boulder extraction	3	3.2	3.2	3	3.2	3	3	2.8	3.05	3	2.8	3.2
Selective extraction												
Dredging + Sand/gravel/boulder extraction (habitat lo	3.4	3.4	3.4	3.4	3.4	3.4	4	2.8	3.4	3.4	2.8	4
Underwater noise												
Shipping (coastal and offshore)	1.6	1.6	1.6	1.6	1.6	0	1	1.6	1.33	1.6	0	1.6
Recreational boating + sport	1.4	1.4	1.4	1.4	1.4	0	3	1.4	1.43	1.4	0	3
Wind farms (operational)	1.6	1.6	1.6	1.6	1.6	0	1	1.6	1.33	1.6	0	1.6
Wind farms, bridges, oil platforms (construction)	1.4	1.4	1.4	1.4	1.4	0	2	1.4	1.3	1.4	0	2
Cables and pipelines (construction)	1.4	1.4	1.4	1.4	1.4	0	2	1.4	1.3	1.4	0	2
Oil platforms	1.4				1.4	0		1.4	1.05	1.4	0	1.4
Marine litter												
Population density	1	1	1	1	1	0	0	1	0.75	1	0	1
Harbours	1	1	1	1	1	0	2	1	1	1	0	2
Changes in thermal regime												
Power plants (warm water outflow)	3.2	3	3.2	1.8	2.5	3		2.5	2.74	3	1.8	3.2
Changes in salinity regime												
Bridges and coastal dams	3	3.4	2.6	3.4	3	4		3	3.2	3	2.6	4
Coastal waste water treatment plants	1.5				1.5	4		1.5	2.13	1.5	1.5	4
Introduction of synthetic compounds												
Atmospheric deposition of dioxins	1.2	2.2	1.2	1.6	1.5	1.6	2	1.5	1.6	1.55	1.2	2
Polluting ship accidents	2.4	2.2	2.4	2.4	2.3	2.6	3	2.3	2.45	2.4	2.3	3
Oil slicks / spills	2.4	2.6	2.4	2.6	2.5	2.8	3	2.5	2.6	2.55	2.4	3
Coastal industry, oil terminals, refineries, oil platforms	3	3	3	2.8	2.9	3	3	2.9	2.95	3	2.8	3
Harbours	3	3	3	2.8	2.9	3	2	2.9	2.83	2.95	2	3
Population density (e.g. hormones)	1.6	1.8	1.6	1.6	1.2	1.8		1.7	1.61	1.6	1.2	1.8
Introduction of non-synthetic substances and compounds												
Waterborne load of heavy metals	1.6	1.6	1.6	1.6	1.6	3.2	2	1.6	1.85	1.6	1.6	3.2
Atmospheric deposition of metals	1.2	1.2	1.2	1.2	1.2	3.4	2	1.2	1.58	1.2	1.2	3.4
Introduction of radio-nuclides												
Discharges of radioactive substances	0.6	0.6	0.6	0.4	0.6	3.2	1	0.6	0.95	0.6	0.4	3.2
Introduction of other substances												
		3.2	3.2	3.2		3.2						
Inputs of fertilisers												
Aquaculture	2.6	2.6	3	2.4	2.6	3.2	3	2.6	2.75	2.6	2.4	3.2
Atmospheric deposition of nitrogen	3.4	2.2	2.2	4	2	3.4	3	2	2.78	2.6	2	4
Waterborne discharges of nitrogen	3.4	3.4	3.4	3.8	3.4	3.4	3	3.4	3.4	3.4	3	3.8
Waterborne discharges of phosphorus	2	3.4	3.4	3.2	3.4	3.4	3	3.4	3.15	3.4	3	3.4
Inputs of organic matter												
Aquaculture	2.6	2.8	3	2.4	2	2.8	3	2.6	2.65	2.7	2	3
Riverine runoff of organic matter	2.4	2.4	2.8	3.6	2.8	2.6	3	2.8	2.8	2.8	2.6	3.6
Introduction of microbial pathogens												
Aquaculture	1.4	1.4	1.2	1.2	1.4	0		1.4	1.14	1.4	0	1.4
Coastal waste water treatment plants	1.8	1.8	1.8	1.2	1.6	0		1.6	1.4	1.6	0	1.8
Introduction of non-indigenous species												
						3	3					
Selective extraction of species												
Hunting of birds	1.6	1.4	1.6	0	0	0	1	1.6	0.9	1.2	0	1.6
Hunting of seals	1.6	1.4	1.6	0	0	0	1	1.6	0.9	1.2	0	1.6
Commercial fishery -surface and mid-water	1.4	1.6	1.4	3.4	1	0	2	2.5	1.66	1.5	0	3.4
Commercial fishery -bottom trawling	3	2.6	3	3.8	3.5	0	4	3	2.86	3	0	4
Commercial fishery -coastal stationary	1.6	1.6	1.6	1.6	1.6	1.6	2	1.6	1.65	1.6	1.6	2
Commercial fishery - gillnets	1.6	1.6	1.6	1.6	1.6	1.6	1	1.6	1.53	1.6	1	1.6

Mussel beds

	Secretariat	Sweden1	Sweden2	Poland	Finland	Estonia	Denmark	Ave	Med	Min	Max
Smothering											
Disposal of dredged spoils	2.4	2.6	2.8	3	3	3	2.6	2.771	2.8	2.6	3
Wind farms, bridges, oil platforms (construction)	2.4	1.6	2.4	2.2	3	2	2.2	2.257	2.2	1.6	3
Cables and pipelines (construction)	2.4	2.6	2.4	2.5	2.8	1	2.5	2.314	2.5	1	2.8
Sealing											
Harbours	2.6	2.6	3.0	2.8	3	2	2.4	2.629	2.6	2	3
Coastal defense structures	2.8	2.8	3.2	2.2	0	3	3	2.429	2.8	0	3.2
Bridges	2.6			2.2		3	3	2.7	2.8	2.2	3
Changes in siltation											
Riverine runoff of organic matter	2.6	2.6	2.6	2.6	2.6	3	2.6	2.657	2.6	2.6	3
Dredging + Sand/gravel/boulder extraction	2.2	2.2	2.4	2.5	2	2	2.3	2.229	2.2	2	2.5
Bathing sites, beaches and beach replenishment	2.2	2.0	2.2	1.5	0	2	2.1	1.714	2	0	2.2
Shipping (coastal)	1.8	1.8	2.2	1.5	2.4	2	2	1.957	2	1.5	2.4
Abrasion											
Commercial fishery -bottom trawling	1.4	2.0	2.6	3.2	0	3	3	2.171	2.6	0	3.2
Dredging + Sand/gravel/boulder extraction	1.4	2.2	2.4	3.2	2	3	2	2.314	2.2	2	3.2
Selective extraction											
Dredging + Sand/gravel/boulder extraction (habitat lo	1	1.0	2.4	3.2	2.8	2	1	1.914	2	1	3.2
Underwater noise											
Shipping (coastal and offshore)	2.6	1.8	2.6	2.4	0	1	2.2	1.8	2.2	0	2.6
Recreational boating + sport	1.4	1.4	1.4	1.4	0	2	1.4	1.286	1.4	0	2
Wind farms (operational)	1.4	1.4	1.4	1.7	0	1	1.7	1.229	1.4	0	1.7
Wind farms, bridges, oil platforms (construction)	1.6	1.6	2.0	1.4	0	2	1.4	1.429	1.6	0	2
Cables and pipelines (construction)	1.4	1.4	1.4	1.4	0	2	1.4	1.286	1.4	0	2
Oil platforms	1.4			1.4	0		1.4	1.05	1.4	0	1.4
Marine litter											
Population density	1	1.0	1.2	1	0	0	1	0.743	1	0	1.2
Harbours	1	1	1	1	0	1	1	0.857	1	0	1
Changes in thermal regime											
Power plants (warm water outflow)	3.4	3.2	3.4	3.3	3.2		3.3	3.3	3.3	3.2	3.4
Changes in salinity regime											
Bridges and coastal dams	1.5			3	3.8		3	2.825	3	3	3.8
Coastal waste water treatment plants	3			1.5	3.8		1.5	2.45	2.25	1.5	3.8
Introduction of synthetic compounds											
Atmospheric deposition of dioxins	0.6	0.4	1.6	1.5	3.8	2	1.5	1.629	1.5	0.4	3.8
Polluting ship accidents	2.2	2.0	3.2	2.4	2.6	3	2.4	2.543	2.4	2	3.2
Oil slicks / spills	2.2	2.2	2.6	2.4	2.8	3	2.4	2.514	2.4	2.2	3
Coastal industry, oil terminals, refineries, oil platforms	3	2.8	3.0	2.9	3.2	2	2.9	2.829	2.9	2	3.2
Harbours	3.4	3.0	3.4	3.2	3.4	3	3.2	3.229	3.2	3	3.4
Population density (e.g. hormones)	1.6	1.6	2.2	1.8	3		1.8	2	1.8	1.6	3
Introduction of non-synthetic substances and compounds											
Waterborne load of heavy metals	1.2	1.2	1.6	1.4	3.8	2	1.4	1.8	1.4	1.2	3.8
Atmospheric deposition of metals	0.6	0.6	1.6	1.2	3.8	2	1.2	1.571	1.2	0.6	3.8
Introduction of radio-nuclides											
Discharges of radioactive substances	0.6	0.6	2.0	1	3.6	1	1	1.4	1	0.6	3.6
Introduction of other substances											
					4						
Inputs of fertilisers											
Aquaculture	2.8	2.8	3.0	2.9	2.6	3	2.9	2.857	2.9	2.6	3
Atmospheric deposition of nitrogen	2	2.0	3.6	2.6	2.8	3	2.6	2.657	2.6	2	3.6
Waterborne discharges of nitrogen	3.4	3.4	3.8	3.5	3.4	3	3.5	3.429	3.4	3	3.8
Waterborne discharges of phosphorus	3.4	3.4	3.8	3.6	3.4	3	3.6	3.457	3.4	3	3.8
Inputs of organic matter											
Aquaculture	2.8	2.8	3.2	2.9	2.8	3	2.9	2.914	2.9	2.8	3.2
Riverine runoff of organic matter	2.4	2.4	2.6	2.5	2.6	2	2.5	2.429	2.5	2	2.6
Introduction of microbial pathogens											
Aquaculture	1.4	1.2	1.4	1.4	1.4		1.4	1.367	1.4	1.2	1.4
Coastal waste water treatment plants	1.8	1.8	1.8	1.8	1.6		1.8	1.767	1.8	1.6	1.8
Introduction of non-indigenous species											
						3					
Selective extraction of species											
Hunting of birds	1.6	1.6	1.6	0	1	1	1.6	1.2	1.6	0	1.6
Hunting of seals	1.6	1.4	1.6	0	0	1	1.6	1.029	1.4	0	1.6
Commercial fishery -surface and mid-water	1.4	1.2	1.4	1	0	2	1.4	1.2	1.4	0	2
Commercial fishery -bottom trawling	3	2.8	3.0	3.5	0	4	3	2.757	3	0	4
Commercial fishery -coastal stationary	1.2	1.0	1.2	1.2	0.2	2	1.2	1.143	1.2	0.2	2
Commercial fishery - gillnets	1.2	1.0	1.2	1.2	0.2	2	1.2	1.143	1.2	0.2	2

Photic sand

	Secretariat	Sweden1	Sweden2	Poland	Finland	Estonia	Denmark	Ave	Med	Min	Max
Smothering											
Disposal of dredged spoils	2.8	2.8	2.8	3	2.8	3	2.4	**2.8**	**2.8**	2.4	3
Wind farms, bridges, oil platforms (construction)	2.8	2.8	3	2.9	2.8	1	2.9	**2.6**	**2.8**	1	3
Cables and pipelines (construction)	2.6	2.4	2.6	2.5	2.6	1	2.5	**2.3143**	**2.5**	1	2.6
Sealing											
Harbours	2.6	2.6	2.6	2.6	2.6	3	2.4	**2.6286**	**2.6**	2.4	3
Coastal defense structures	2.6	2.6	2.6	2.6	2.6	3	2.6	**2.6571**	**2.6**	2.6	3
Bridges	2.6			2.2		3	2.6	**2.6**	**2.6**	2.2	3
Changes in siltation											
Riverine runoff of organic matter	2.6	2.6	2.6	2.6	2.6	3	2.6	**2.6571**	**2.6**	2.6	3
Dredging + Sand/gravel/boulder extraction	3	1.8	3	2.5	3	3	2.5	**2.6857**	**3**	1.8	3
Bathing sites, beaches and beach replenishment	2.2	2.2	2.2	1.5	2.2	2	2.2	**2.0714**	**2.2**	1.5	2.2
Shipping (coastal)	2.2	1.6	2.2	1.5	2.2	2	1.9	**1.9429**	**2**	1.5	2.2
Abrasion											
Commercial fishery -bottom trawling	3	3	3	3	3	3	3	**3**	**3**	3	3
Dredging + Sand/gravel/boulder extraction	3	3	3	3	3	3	3	**3**	**3**	3	3
Selective extraction											
Dredging + Sand/gravel/boulder extraction (habitat lo	3.4	3.4	3.4	3.4	3.4	3	3.4	**3.3429**	**3.4**	3	3.4
Underwater noise											
Shipping (coastal and offshore)	1.6	1.6	1.6	1.6	1.6	1	1.6	**1.5143**	**1.6**	1	1.6
Recreational boating + sport	1.4	1.4	1.4	1.4	1.2	2	1.4	**1.4571**	**1.4**	1.2	2
Wind farms (operational)	1.6	1.6	1.6	1.6	1.4	0	1.6	**1.3429**	**1.6**	0	1.6
Wind farms, bridges, oil platforms (construction)	1.4	1.4	1.4	1.4	1.6	2	1.4	**1.5143**	**1.4**	1.4	2
Cables and pipelines (construction)	1.4	1.4	1.4	1.4	1.4	2	1.4	**1.4857**	**1.4**	1.4	2
Oil platforms	1.4			1.4	1.4		1.4	**1.4**	**1.4**	1.4	1.4
Marine litter											
Population density	1	1	2	1	1	0	1	**1**	**1**	0	2
Harbours	1	1	1.6	1.4	1	2	1.4	**1.3429**	**1.4**	1	2
Changes in thermal regime											
Power plants (warm water outflow)	3.2	3.2	3.2	3.2	3.2		3.2	**3.2**	**3.2**	3.2	3.2
Changes in salinity regime											
Bridges and coastal dams	3			3	1		3	**2.5**	**3**	1	3
Coastal waste water treatment plants	1.5			1.5	1		1.5	**1.375**	**1.5**	1	1.5
Introduction of synthetic compounds											
Atmospheric deposition of dioxins	1.2	1.2	2	1.5	1.2	2	1.5	**1.5143**	**1.5**	1.2	2
Polluting ship accidents	2.4	2.4	2.4	2.4	2.4	3	2.4	**2.4857**	**2.4**	2.4	3
Oil slicks / spills	2.4	2.4	2.4	2.4	2.4	3	2.4	**2.4857**	**2.4**	2.4	3
Coastal industry, oil terminals, refineries, oil platforms	3	3	3.4	3.2	3	3	3.2	**3.1143**	**3**	3	3.4
Harbours	3	3	3	3	3	3	3	**3**	**3**	3	3
Population density (e.g. hormones)	1.6	1.6	1.8	1.7	1.6		1.7	**1.6667**	**1.65**	1.6	1.8
Introduction of non-synthetic substances and compounds											
Waterborne load of heavy metals	1.6	1.6	1.6	1.6	1.6	2	1.6	**1.6571**	**1.6**	1.6	2
Atmospheric deposition of metals	1.2	1.2	1.8	1.5	1.2	2	1.5	**1.4857**	**1.5**	1.2	2
Introduction of radio-nuclides											
Discharges of radioactive substances	0.6	0.6	0.6	0.6	0.6	1	0.6	**0.6571**	**0.6**	0.6	1
Introduction of other substances											
					1						
Inputs of fertilisers											
Aquaculture	2.6	2.6	2.6	2.6	2.6	3	2.6	**2.6571**	**2.6**	2.6	3
Atmospheric deposition of nitrogen	2	2	2	2	2	2	2	**2**	**2**	2	2
Waterborne discharges of nitrogen	3.4	3.4	3.4	3.4	3.4	3	3.4	**3.3429**	**3.4**	3	3.4
Waterborne discharges of phosphorus	3.4	3.4	3.4	3.4	3.4	3	3.4	**3.3429**	**3.4**	3	3.4
Inputs of organic matter											
Aquaculture	2.8	2.8	3	2.8	2.8	3	2.8	**2.8571**	**2.8**	2.8	3
Riverine runoff of organic matter	2.8	2.8	2.8	2.9	2.8	2	2.9	**2.7143**	**2.8**	2	2.9
Introduction of microbial pathogens											
Aquaculture	1.4	1.4	1.4	1.4	1.4		1.4	**1.4**	**1.4**	1.4	1.4
Coastal waste water treatment plants	1.8	1.8	1.8	1.8	1.8		1.8	**1.8**	**1.8**	1.8	1.8
Introduction of non-indigenous species											
						3					
Selective extraction of species											
Hunting of birds	1.6	1.6	1.6	0	1.6	1	1.6	**1.2857**	**1.6**	0	1.6
Hunting of seals	1.6	1.6	1.6	0	1.6	1	1.6	**1.2857**	**1.6**	0	1.6
Commercial fishery -surface and mid-water	1.6	1.6	1.6	1	1.4	2	1.4	**1.5143**	**1.6**	1	2
Commercial fishery -bottom trawling	3	3	3	3	3	3	3	**3**	**3**	3	3
Commercial fishery -coastal stationary	1.4	1.4	1.4	1.6	1.6	2	1.6	**1.5714**	**1.6**	1.4	2
Commercial fishery - gillnets	1.4	1.4	1.4	1.6	1.4	1	1.6	**1.4**	**1.4**	1	1.6

Photic mud and clay

	Secretariat	Sweden	Poland	Finland	Estonia	Denmark	Ave	Med	Min	Max
Smothering										
Disposal of dredged spoils	2.2	2.2	2.2	2.8	2	2.2	**2.267**	**2.2**	2	2.8
Wind farms, bridges, oil platforms (construction)	2.2	2.8	2.5	2.8	0	2.5	**2.133**	**2.5**	0	2.8
Cables and pipelines (construction)	1.8	1.8	1.8	2.6	1	1.8	**1.8**	**1.8**	1	2.6
Sealing										
Harbours	1.8	1.2	1.4	2.8	2	1.4	**1.767**	**1.6**	1.2	2.8
Coastal defense structures	1.2	1.8	1.5	0	2	1.5	**1.333**	**1.5**	0	2
Bridges	1.8		1.3	0	2	1.8	**1.38**	**1.8**	0	2
Changes in siltation										
Riverine runoff of organic matter	0	0	0.6	2.6	0	0	**0.533**	**0**	0	2.6
Dredging + Sand/gravel/boulder extraction	1.8	1.8	1.8	3	2	1.8	**2.033**	**1.8**	1.8	3
Bathing sites, beaches and beach replenishment	2.2	2.2	1.5	0	2	2.2	**1.683**	**2.1**	0	2.2
Shipping (coastal)	2.2	2.2	1.5	2.6	2	2.2	**2.117**	**2.2**	1.5	2.6
Abrasion										
Commercial fishery -bottom trawling	2.8	2.8	2.8	0.6	3	2.8	**2.467**	**2.8**	0.6	3
Dredging + Sand/gravel/boulder extraction	2.6	2.8	2.6	2.8	3	2.6	**2.733**	**2.7**	2.6	3
Selective extraction										
Dredging + Sand/gravel/boulder extraction (habitat lo	2.2	2.8	2.5	3.4	2	2.2	**2.517**	**2.35**	2	3.4
Underwater noise										
Shipping (coastal and offshore)	1.6	1.6	1.6	0	1	1.6	**1.233**	**1.6**	0	1.6
Recreational boating + sport	1.2	1.2	1.2	0	2	1.2	**1.133**	**1.2**	0	2
Wind farms (operational)	1.6	1.6	1.6	0	0	1.6	**1.067**	**1.6**	0	1.6
Wind farms, bridges, oil platforms (construction)	1.4	1.4	1.4	0	2	1.4	**1.267**	**1.4**	0	2
Cables and pipelines (construction)	1.4	1.4	1.4	0	2	1.4	**1.267**	**1.4**	0	2
Oil platforms	1.4		1.4	0		1.4	**1.05**	**1.4**	0	1.4
Marine litter										
Population density	1	1	1	0	0	1	**0.667**	**1**	0	1
Harbours	1	1	1	0	2	1	**1**	**1**	0	2
Changes in thermal regime										
Power plants (warm water outflow)	2.8	2.8	2.8	3		2.8	**2.84**	**2.8**	2.8	3
Changes in salinity regime										
Bridges and coastal dams	3		3	4		3	**3.25**	**3**	3	4
Coastal waste water treatment plants	1.5		1.5	4		1.5	**2.125**	**1.5**	1.5	4
Introduction of synthetic compounds										
Atmospheric deposition of dioxins	1.2	0.8	1	1.6	1	1	**1.1**	**1**	0.8	1.6
Polluting ship accidents	2.4	2.4	2.4	2.6	3	2.4	**2.533**	**2.4**	2.4	3
Oil slicks / spills	2.2	2.2	2.2	2.8	3	2.2	**2.433**	**2.2**	2.2	3
Coastal industry, oil terminals, refineries, oil platforms	3	3	3	3	3	3	**3**	**3**	3	3
Harbours	3	3	3	3	3	3	**3**	**3**	3	3
Population density (e.g. hormones)	1.6	1.6	1.6	1.8		1.6	**1.64**	**1.6**	1.6	1.8
Introduction of non-synthetic substances and compounds										
Waterborne load of heavy metals	1.6	1.6	1.6	3.2	2	1.6	**1.933**	**1.6**	1.6	3.2
Atmospheric deposition of metals	1.2	1.2	1.2	3.4	2	1.2	**1.7**	**1.2**	1.2	3.4
Introduction of radio-nuclides										
Discharges of radioactive substances	0.6	0.6	0.6	3.2	1	0.6	**1.1**	**0.6**	0.6	3.2
Introduction of other substances										
				3.2						
Inputs of fertilisers										
Aquaculture	2.6	2.8	2.6	3.2	3	2.6	**2.8**	**2.7**	2.6	3.2
Atmospheric deposition of nitrogen	1.4	1.4	1.4	3.4	2	1.4	**1.833**	**1.4**	1.4	3.4
Waterborne discharges of nitrogen	2.6	2.6	2.6	3.4	2	2.6	**2.633**	**2.6**	2	3.4
Waterborne discharges of phosphorus	2.6	2.6	2.6	3.4	3	2.6	**2.8**	**2.6**	2.6	3.4
Inputs of organic matter										
Aquaculture	2.2	3.4	2.8	2.8	3	2.8	**2.833**	**2.8**	2.2	3.4
Riverine runoff of organic matter	1.6	2	1.8	2.6	2	1.8	**1.967**	**1.9**	1.6	2.6
Introduction of microbial pathogens										
Aquaculture	1.4	1.4	1.4	0		1.4	**1.12**	**1.4**	0	1.4
Coastal waste water treatment plants	1.8	1.8	1.8	0		1.8	**1.44**	**1.8**	0	1.8
Introduction of non-indigenous species										
					3					
Selective extraction of species										
Hunting of birds	1.6	1.6	0	0	1	1.6	**0.967**	**1.3**	0	1.6
Hunting of seals	1.6	1.6	0	0	1	1.6	**0.967**	**1.3**	0	1.6
Commercial fishery -surface and mid-water	1.4	1.4	1	0	2	1.4	**1.2**	**1.4**	0	2
Commercial fishery -bottom trawling	3.2	3.2	3.2	0	3	3.2	**2.633**	**3.2**	0	3.2
Commercial fishery -coastal stationary	1.6	1.6	1.6	1.6	2	1.6	**1.667**	**1.6**	1.6	2
Commercial fishery - gillnets	1.6	1.6	1.6	1.6	1	1.6	**1.5**	**1.6**	1	1.6

Photic hard bottom

	Secretaria	Swe1	Swe2	Poland	Finland	Estonia	Denmark	Ave	Med	Min	Max
Smothering											
Disposal of dredged spoils	2	2.4	2.8	2.6	2.6	4	2.4	**2.686**	**2.6**	2.4	4
Wind farms, bridges, oil platforms (construction)	2	1.6	2	1.8	2.6	0	1.8	**1.686**	**1.8**	0	2.6
Cables and pipelines (construction)	2	1.6	2	1.8	2.4	2	1.8	**1.943**	**2**	1.6	2.4
Sealing											
Harbours	2.4	2.4	2.6	2.5	3	3	2.5	**2.629**	**2.5**	2.4	3
Coastal defense structures	2.6	2.6	2.8	2.7	0	3	2.7	**2.343**	**2.7**	0	3
Bridges	2.4			2	0	2	2.4	**1.76**	**2**	0	2.4
Changes in siltation											
Riverine runoff of organic matter	2.6	2.6	2.8	2.7	2.8	3	2.7	**2.743**	**2.7**	2.6	3
Dredging + Sand/gravel/boulder extraction	2	2	2.2	2.1	2.4	2	2.1	**2.114**	**2.1**	2	2.4
Bathing sites, beaches and beach replenishment	2	2	2.2	1.5	0	2	2.1	**1.686**	**2**	0	2.2
Shipping (coastal)	1.8	2	2.4	1.5	2.6	2	2.1	**2.057**	**2**	1.5	2.6
Abrasion											
Commercial fishery -bottom trawling	1.4	1.4	2.4	1.9	0	1	3	**1.586**	**1.4**	0	3
Dredging + Sand/gravel/boulder extraction	1.4	1.4	2.4	1.9	2.8	3	1.9	**2.114**	**1.9**	1.4	3
Selective extraction											
Dredging + Sand/gravel/boulder extraction (habitat lo	1	1	2.4	1.6	3.2	2	1	**1.743**	**1.6**	1	3.2
Underwater noise											
Shipping (coastal and offshore)	2.4	2	2.4	2.2	0	1	2.2	**1.743**	**2.2**	0	2.4
Recreational boating + sport	1.4	1.4	1.4	1.4	0	2	1.4	**1.286**	**1.4**	0	2
Wind farms (operational)	1.6	1.6	2	1.8	0	1	1.8	**1.4**	**1.6**	0	2
Wind farms, bridges, oil platforms (construction)	1.4	1.4	1.4	1.4	0	2	1.4	**1.286**	**1.4**	0	2
Cables and pipelines (construction)	1.4	1.4	1.4	1.4	0	2	1.4	**1.286**	**1.4**	0	2
Oil platforms	1.4			1.4	0		1.4	**1.05**	**1.4**	0	1.4
Marine litter											
Population density	1	1	1.2	1.1	0	0	1.1	**0.771**	**1**	0	1.2
Harbours	1	1	1	1	0	2	1	**1**	**1**	0	2
Changes in thermal regime											
Power plants (warm water outflow)	3.4	3.4	3.6	3.5	3.2		3.5	**3.433**	**3.45**	3.2	3.6
Changes in salinity regime											
Bridges and coastal dams	3			3	2.2		3	**2.8**	**3**	2.2	3
Coastal waste water treatment plants	1.5			1.5	2.2		1.5	**1.675**	**1.5**	1.5	2.2
Introduction of synthetic compounds											
Atmospheric deposition of dioxins	0.6	0.4	2	1.2	2.6	1	1.2	**1.286**	**1.2**	0.4	2.6
Polluting ship accidents	2.2	2.2	3	2.6	2.6	3	2.6	**2.6**	**2.6**	2.2	3
Oil slicks / spills	2.2	2.2	2.6	2.4	2.8	3	2.4	**2.514**	**2.4**	2.2	3
Coastal industry, oil terminals, refineries, oil platform	3	3	3.4	3.2	3	3	3.2	**3.114**	**3**	3	3.4
Harbours	3.4	3.2	3.4	3.3	3	3	3.3	**3.229**	**3.3**	3	3.4
Population density (e.g. hormones)	1.6	1.6	2.4	2	2.2		2	**1.967**	**2**	1.6	2.4
Introduction of non-synthetic substances and compounds											
Waterborne load of heavy metals	1.2	1.2	1.6	1.4	3.2	2	1.4	**1.714**	**1.4**	1.2	3.2
Atmospheric deposition of metals	0.6	0.6	0.6	0.6	3.4	1	0.6	**1.057**	**0.6**	0.6	3.4
Introduction of radio-nuclides											
Discharges of radioactive substances	0.6	0.6	2.8	1	3	1	1	**1.429**	**1**	0.6	3
Introduction of other substances											
					3.2						
Inputs of fertilisers											
Aquaculture	2.8	2.8	3	2.9	3.4	3	2.9	**2.971**	**2.9**	2.8	3.4
Atmospheric deposition of nitrogen	2	2.6	3.6	2.8	3.4	3	2.8	**2.886**	**2.8**	2.6	3.6
Waterborne discharges of nitrogen	3	3	3.8	3.4	3.2	3	3.4	**3.257**	**3.2**	3	3.8
Waterborne discharges of phosphorus	3	2	3.6	3	3.2	3	3	**2.971**	**3**	2	3.6
Inputs of organic matter											
Aquaculture	2.8	2.8	2.8	2.8	3.2	3	2.8	**2.886**	**2.8**	2.8	3.2
Riverine runoff of organic matter	2.4	2.4	2.8	2.6	2.6	3	2.6	**2.629**	**2.6**	2.4	3
Introduction of microbial pathogens											
Aquaculture	1.4	1.4	1.4	1.4	0		1.4	**1.167**	**1.4**	0	1.4
Coastal waste water treatment plants	1.8	1.8	1.8	1.8	0		1.8	**1.5**	**1.8**	0	1.8
Introduction of non-indigenous species											
						3					
Selective extraction of species											
Hunting of birds	1.6	1.6	1.8	0	0	1	1.7	**1.1**	**1.6**	0	1.8
Hunting of seals	1.6	0.2	1.6	0	0	1	1	**0.771**	**1**	0	1.6
Commercial fishery -surface and mid-water	1.4	1.4	2.4	1	0	2	1.9	**1.443**	**1.4**	0	2.4
Commercial fishery -bottom trawling	2.8	2.8	3.2	3	0	3	3	**2.543**	**3**	0	3.2
Commercial fishery -coastal stationary	1.2	1.2	1.8	1.5	0	2	1.5	**1.314**	**1.5**	0	2
Commercial fishery - gillnets	1.2	1.2	1.8	1.5	0	2	1.5	**1.314**	**1.5**	0	2

Non-photic sand

	Secretariat	Sweden	Poland	Finland	Estonia	Denmark	Ave	Med	Min	Max
Smothering										
Disposal of dredged spoils	3.2	2.2	2.2	3	2	2.7	**2.55**	**2.45**	2	3.2
Wind farms, bridges, oil platforms (construction)	2.8	1.8	2.2	3	0	2.4	**2.0333**	**2.3**	0	3
Cables and pipelines (construction)	2.6	1.6	2.1	2.8	1	2.1	**2.0333**	**2.1**	1	2.8
Sealing										
Harbours	2.6	1.4	2	0	2	2	**1.6667**	**2**	0	2.6
Coastal defense structures	2.6	1.4	2	0	2	2	**1.6667**	**2**	0	2.6
Bridges	2.6		1	0	2	2	**1.52**	**2**	0	2.6
Changes in siltation										
Riverine runoff of organic matter	2.6	3.6	3.1	3	3	3.1	**3.0667**	**3.05**	2.6	3.6
Dredging + Sand/gravel/boulder extraction	3	3	3	2.2	3	3	**2.8667**	**3**	2.2	3
Bathing sites, beaches and beach replenishment	2.2	0.6	1.4	0	2	1.4	**1.2667**	**1.4**	0	2.2
Shipping (coastal)	2.2	0.8	1.5	2.2	2	1.5	**1.7**	**1.75**	0.8	2.2
Abrasion										
Commercial fishery -bottom trawling	3.2	3.8	3.2	0	4	3.6	**2.9667**	**3.4**	0	4
Dredging + Sand/gravel/boulder extraction	3.2	3	3.1	3.2	3	3.1	**3.1**	**3.1**	3	3.2
Selective extraction										
Dredging + Sand/gravel/boulder extraction (habitat lo	3.4	3	3.2	3.6	3	3.4	**3.2667**	**3.3**	3	3.6
Underwater noise										
Shipping (coastal and offshore)	1.4	1.4	1.4	0	1	1.4	**1.1**	**1.4**	0	1.4
Recreational boating + sport	1	1	1	0	1	1	**0.8333**	**1**	0	1
Wind farms (operational)	1.4	1.4	1.4	0	1	1.4	**1.1**	**1.4**	0	1.4
Wind farms, bridges, oil platforms (construction)	1.4	1.4	1.4	0	2	1.4	**1.2667**	**1.4**	0	2
Cables and pipelines (construction)	1.4	1.4	1.4	0	2	1.4	**1.2667**	**1.4**	0	2
Oil platforms	1.4		1.4	0		1.4	**1.05**	**1.4**	0	1.4
Marine litter										
Population density	0.6	2.6	1.6	0	0	1.6	**1.0667**	**1.1**	0	2.6
Harbours	1	1.8	1.4	0	2	1.4	**1.2667**	**1.4**	0	2
Changes in thermal regime										
Power plants (warm water outflow)	1.8	1	1.4	2.8		1.4	**1.68**	**1.4**	1	2.8
Changes in salinity regime										
Bridges and coastal dams	3		3	3.8		3	**3.2**	**3**	3	3.8
Coastal waste water treatment plants	1.5		1.5	3.8		1.5	**2.075**	**1.5**	1.5	3.8
Introduction of synthetic compounds										
Atmospheric deposition of dioxins	1	2.8	1.5	3.8	2	1.9	**2.1667**	**1.95**	1	3.8
Polluting ship accidents	1.4	1.8	1.6	2.6	2	1.6	**1.8333**	**1.7**	1.4	2.6
Oil slicks / spills	1.4	1.8	1.6	2.6	2	1.6	**1.8333**	**1.7**	1.4	2.6
Coastal industry, oil terminals, refineries, oil platforms	2.2	2.2	2.2	3	3	2.2	**2.4667**	**2.2**	2.2	3
Harbours	2.2	2	2.1	3	2	2.1	**2.2333**	**2.1**	2	3
Population density (e.g. hormones)	1.2	2.2	1.7	3.2		1.7	**2**	**1.7**	1.2	3.2
Introduction of non-synthetic substances and compounds										
Waterborne load of heavy metals	1.4	2.8	2.1	3.6	2	2.1	**2.3333**	**2.1**	1.4	3.6
Atmospheric deposition of metals	1.2	2.8	2	3.6	2	2	**2.2667**	**2**	1.2	3.6
Introduction of radio-nuclides										
Discharges of radioactive substances	0.6	2.8	1	3.2	1	1	**1.6**	**1**	0.6	3.2
Introduction of other substances										
				2.8						
Inputs of fertilisers										
Aquaculture	1.8	2.6	2.2	2.8	3	2.2	**2.4333**	**2.4**	1.8	3
Atmospheric deposition of nitrogen	1.2	4	2.6	3.2	3	2.6	**2.7667**	**2.8**	1.2	4
Waterborne discharges of nitrogen	1.8	4	3	3	3	3	**2.9667**	**3**	1.8	4
Waterborne discharges of phosphorus	1.8	4	3	3	3	3	**2.9667**	**3**	1.8	4
Inputs of organic matter										
Aquaculture	2	2.2	2.1	3.2	2	2.1	**2.2667**	**2.1**	2	3.2
Riverine runoff of organic matter	2.2	3.2	2.7	2.8	3	2.7	**2.7667**	**2.75**	2.2	3.2
Introduction of microbial pathogens										
Aquaculture	1	1.6	1.3	0		1.3	**1.04**	**1.3**	0	1.6
Coastal waste water treatment plants	1.2	1.2	1.2	0		1.2	**0.96**	**1.2**	0	1.2
Introduction of non-indigenous species										
					3					
Selective extraction of species										
Hunting of birds	1.2	0.6	0	0	1	0.9	**0.6167**	**0.75**	0	1.2
Hunting of seals	1.2	0.8	0	0	1	1	**0.6667**	**0.9**	0	1.2
Commercial fishery -surface and mid-water	1.4	4	1	0	3	3	**2.0667**	**2.2**	0	4
Commercial fishery -bottom trawling	3.4	4	3.5	0	4	4	**3.15**	**3.75**	0	4
Commercial fishery -coastal stationary	2	2.4	2.2	0	2	2.2	**1.8**	**2.1**	0	2.4
Commercial fishery - gillnets	2	2.4	2.2	0	2	2.2	**1.8**	**2.1**	0	2.4

Non-photic mud and clay

	Secretariat	Sweden	Poland	Finland	Estonia	Denmark	Ave	Med	Min	Max
Smothering										
Disposal of dredged spoils	2.8	2.2	2	3	2	2.5	**2.4167**	**2.35**	2	3
Wind farms, bridges, oil platforms (construction)	2.4	1.8	1.8	3	0	2.1	**1.85**	**1.95**	0	3
Cables and pipelines (construction)	2	1.6	1.8	2.8	1	1.8	**1.8333**	**1.8**	1	2.8
Sealing										
Harbours	2.4	1.4	1.8	0	2	1.8	**1.5667**	**1.8**	0	2.4
Coastal defense structures	2.4	1.4	1.8	0	2	1.8	**1.5667**	**1.8**	0	2.4
Bridges	2.4		1	0	2	1.8	**1.44**	**1.8**	0	2.4
Changes in siltation										
Riverine runoff of organic matter	2	4	3	3	1	3	**2.6667**	**3**	1	4
Dredging + Sand/gravel/boulder extraction	2.2	3	2.6	1.8	3	2.6	**2.5333**	**2.6**	1.8	3
Bathing sites, beaches and beach replenishment	1.2	0.6	0.9	0	2	0.9	**0.9333**	**0.9**	0	2
Shipping (coastal)	1.4	0.8	1.1	1.8	0	1.1	**1.0333**	**1.1**	0	1.8
Abrasion										
Commercial fishery -bottom trawling	3	3.8	3.5	0	4	3.7	**3**	**3.6**	0	4
Dredging + Sand/gravel/boulder extraction	3	3	3	2	3	3	**2.8333**	**3**	2	3
Selective extraction										
Dredging + Sand/gravel/boulder extraction (habitat lo	2.8	3	2.9	0.4	3	2.9	**2.5**	**2.9**	0.4	3
Underwater noise										
Shipping (coastal and offshore)	1.4	1.4	1.4	0	1	1.4	**1.1**	**1.4**	0	1.4
Recreational boating + sport	1	1	1	0	1	1	**0.8333**	**1**	0	1
Wind farms (operational)	1.4	1.4	1.4	0	1	1.4	**1.1**	**1.4**	0	1.4
Wind farms, bridges, oil platforms (construction)	1.4	1.4	1.4	0	2	1.4	**1.2667**	**1.4**	0	2
Cables and pipelines (construction)	1.4	1.4	1.4	0	2	1.4	**1.2667**	**1.4**	0	2
Oil platforms	1.4		1.4	0		1.4	**1.05**	**1.4**	0	1.4
Marine litter										
Population density	0.6	2.6	1.6	0	0	1.6	**1.0667**	**1.1**	0	2.6
Harbours	1	1.8	1.4	0	2	1.4	**1.2667**	**1.4**	0	2
Changes in thermal regime										
Power plants (warm water outflow)	1.8	1	1.4	2.8		1.4	**1.68**	**1.4**	1	2.8
Changes in salinity regime										
Bridges and coastal dams	3		3	3.8		3	**3.2**	**3**	3	3.8
Coastal waste water treatment plants	1.5		1.5	3.8		1.5	**2.075**	**1.5**	1.5	3.8
Introduction of synthetic compounds										
Atmospheric deposition of dioxins	1	2.8	1.5	3.8	2	1.9	**2.1667**	**1.95**	1	3.8
Polluting ship accidents	1.4	1.8	1.6	2.6	2	1.6	**1.8333**	**1.7**	1.4	2.6
Oil slicks / spills	1.4	1.8	1.6	2.6	2	1.6	**1.8333**	**1.7**	1.4	2.6
Coastal industry, oil terminals, refineries, oil platforms	2.2	2.2	2.2	3	3	2.2	**2.4667**	**2.2**	2.2	3
Harbours	2.2	2.2	2.2	3	2	2.2	**2.3**	**2.2**	2	3
Population density (e.g. hormones)	1.2	2	1.6	3.2		1.6	**1.92**	**1.6**	1.2	3.2
Introduction of non-synthetic substances and compounds										
Waterborne load of heavy metals	1.4	3	2.2	3.6	2	2.2	**2.4**	**2.2**	1.4	3.6
Atmospheric deposition of metals	1.2	3	2.1	3.6	2	2.1	**2.3333**	**2.1**	1.2	3.6
Introduction of radio-nuclides										
Discharges of radioactive substances	0.6	2.8	1	3.2	1	1	**1.6**	**1**	0.6	3.2
Introduction of other substances										
				2.8						
Inputs of fertilisers										
Aquaculture	1.8	2.6	2.2	2.8	3	2.2	**2.4333**	**2.4**	1.8	3
Atmospheric deposition of nitrogen	1	4	2.5	3.2	3	2.5	**2.7**	**2.75**	1	4
Waterborne discharges of nitrogen	1.6	4	3	3	3	3	**2.9333**	**3**	1.6	4
Waterborne discharges of phosphorus	1.6	4	3	3	3	3	**2.9333**	**3**	1.6	4
Inputs of organic matter										
Aquaculture	2	2.2	2.1	3.2	2	2.1	**2.2667**	**2.1**	2	3.2
Riverine runoff of organic matter	2.2	3.8	3	2.8	3	3	**2.9667**	**3**	2.2	3.8
Introduction of microbial pathogens										
Aquaculture	1	1.6	1.3	0		1.3	**1.04**	**1.3**	0	1.6
Coastal waste water treatment plants	1.2	1.2	1.2	0		1.2	**0.96**	**1.2**	0	1.2
Introduction of non-indigenous species										
					3					
Selective extraction of species										
Hunting of birds	1.2	0.6	0	0	1	0.9	**0.6167**	**0.75**	0	1.2
Hunting of seals	1.2	0.8	0	0	1	1	**0.6667**	**0.9**	0	1.2
Commercial fishery -surface and mid-water	1.4	4	1	0	3	3	**2.0667**	**2.2**	0	4
Commercial fishery -bottom trawling	3.4	4	3.5	0	4	4	**3.15**	**3.75**	0	4
Commercial fishery -coastal stationary	2	2.4	2.2	0	2	2.2	**1.8**	**2.1**	0	2.4
Commercial fishery - gillnets	2	2.4	2.2	0	2	2.2	**1.8**	**2.1**	0	2.4

Non-photic hard bottom

	Secretariat	Sweden	Poland	Finland	Estonia	Denmark	Ave	Med	Min	Max
Smothering										
Disposal of dredged spoils	3.2	2.2	2.7	3.2	4	2.7	**3**	**2.95**	2.2	4
Wind farms, bridges, oil platforms (construction)	2.8	1.8	2.3	2.8	0	2.3	**2**	**2.3**	0	2.8
Cables and pipelines (construction)	2.6	1.6	2.2	2.6	1	2.2	**2.0333**	**2.2**	1	2.6
Sealing										
Harbours	2.6	1.4	2	2.6	2	2	**2.1**	**2**	1.4	2.6
Coastal defense structures	2.6	1.4	2	2.6	2	2	**2.1**	**2**	1.4	2.6
Bridges	2.6		1	2.6	2	2	**2.04**	**2**	1	2.6
Changes in siltation										
Riverine runoff of organic matter	2.6	4	2.3	2.6	3	3.3	**2.9667**	**2.8**	2.3	4
Dredging + Sand/gravel/boulder extraction	3	3	2	3	3	3	**2.8333**	**3**	2	3
Bathing sites, beaches and beach replenishment	1.4	0.6	1	1.4	2	1.4	**1.3**	**1.4**	0.6	2
Shipping (coastal)	1.8	0.8	1	1.8	0	1.3	**1.1167**	**1.15**	0	1.8
Abrasion										
Commercial fishery -bottom trawling	3.2	3.8	3	3.2	4	3.5	**3.45**	**3.35**	3	4
Dredging + Sand/gravel/boulder extraction	3.2	3	3	3.2	3	3.1	**3.0833**	**3.05**	3	3.2
Selective extraction										
Dredging + Sand/gravel/boulder extraction (habitat lo	3.4	0	3	3.4	3	3.4	**2.7**	**3.2**	0	3.4
Underwater noise				1.4						
Shipping (coastal and offshore)	1.4	1.4	1.4	1	1	1.4	**1.2667**	**1.4**	1	1.4
Recreational boating + sport	1	1	1	1	1	1	**1**	**1**	1	1
Wind farms (operational)	1.4	1.4	1.4	1.4	1	1.4	**1.3333**	**1.4**	1	1.4
Wind farms, bridges, oil platforms (construction)	1.4	1.4	1.4	1.4	2	1.4	**1.5**	**1.4**	1.4	2
Cables and pipelines (construction)	1.4	1.4	1.4	1.4	2	1.4	**1.5**	**1.4**	1.4	2
Oil platforms	1.4		1.4			1.4	**1.4**	**1.4**	1.4	1.4
Marine litter										
Population density	0.6	2.6	1.6	0.6	0	1.6	**1.1667**	**1.1**	0	2.6
Harbours	1	1.8	1.4	1	2	1.4	**1.4333**	**1.4**	1	2
Changes in thermal regime										
Power plants (warm water outflow)	1.8	1	1.4	1.8		1.4	**1.48**	**1.4**	1	1.8
Changes in salinity regime										
Bridges and coastal dams	3		3	0.4		3	**2.35**	**3**	0.4	3
Coastal waste water treatment plants	1.5		1.5	0.4		1.5	**1.225**	**1.5**	0.4	1.5
Introduction of synthetic compounds										
Atmospheric deposition of dioxins	1	2.8	1	1	1	1	**1.3**	**1**	1	2.8
Polluting ship accidents	1.4	1.8	1.6	1.4	2	1.6	**1.6333**	**1.6**	1.4	2
Oil slicks / spills	1.4	1.8	1.6	1.4	2	1.6	**1.6333**	**1.6**	1.4	2
Coastal industry, oil terminals, refineries, oil platform:	2.2	2.2	2.2	2.2	3	2.2	**2.3333**	**2.2**	2.2	3
Harbours	2.2	2.2	2.2	2.2	2	2.2	**2.1667**	**2.2**	2	2.2
Population density (e.g. hormones)	1.2	2	1.6	1.2		1.6	**1.52**	**1.6**	1.2	2
Introduction of non-synthetic substances and compounds										
Waterborne load of heavy metals	1.4	2.8	2.1	1.4	2	2.1	**1.9667**	**2.05**	1.4	2.8
Atmospheric deposition of metals	1.2	2.8	2	1.2	2	2	**1.8667**	**2**	1.2	2.8
Introduction of radio-nuclides										
Discharges of radioactive substances	0.6	2.8	1	0.6	1	1	**1.1667**	**1**	0.6	2.8
Introduction of other substances										
				1						
Inputs of fertilisers										
Aquaculture	1.8	2.6	2.2	1.8	3	2.2	**2.2667**	**2.2**	1.8	3
Atmospheric deposition of nitrogen	1.8	4	2	1.2	3	3.2	**2.5333**	**2.5**	1.2	4
Waterborne discharges of nitrogen	1.2	4	3	1.8	3	3	**2.6667**	**3**	1.2	4
Waterborne discharges of phosphorus	1.8	4	3	1.8	3	3	**2.7667**	**3**	1.8	4
Inputs of organic matter										
Aquaculture	2.2	2.2	2.2	2.2	2	2.2	**2.1667**	**2.2**	2	2.2
Riverine runoff of organic matter	2.8	3.2	3	2.8	3	3	**2.9667**	**3**	2.8	3.2
Introduction of microbial pathogens										
Aquaculture	1	1.6	1.3	1		1.3	**1.24**	**1.3**	1	1.6
Coastal waste water treatment plants	1.2	1.2	1.2	1.2		1.2	**1.2**	**1.2**	1.2	1.2
Introduction of non-indigenous species										
					3					
Selective extraction of species										
Hunting of birds	1.2	0.6	0	1.2	1	0.9	**0.8167**	**0.95**	0	1.2
Hunting of seals	1.2	0.8	0	1.2	1	1	**0.8667**	**1**	0	1.2
Commercial fishery -surface and mid-water	1.6	4	1	1.6	3	3.8	**2.5**	**2.3**	1	4
Commercial fishery -bottom trawling	3.4	4	3.5	3.4	4	4	**3.7167**	**3.75**	3.4	4
Commercial fishery -coastal stationary	2.2	2.4	2.3	2.2	2	2.3	**2.2333**	**2.25**	2	2.4
Commercial fishery - gillnets	2.2	2.4	2.3	2	2	2.3	**2.2**	**2.25**	2	2.4

Photic water

	Secretariat	Sweden	Poland	Finland	Estonia	Denmark	Ave	Med	Min	Max
Smothering										
Disposal of dredged spoils	0	2.2	2.2	2.7	1	2.2	**1.7167**	**2.2**	0	2.7
Wind farms, bridges, oil platforms (construction)	0	2.2	2.2	2.7	0	2.2	**1.55**	**2.2**	0	2.7
Cables and pipelines (construction)	0	2.2	2.2	2.7	0	2.2	**1.55**	**2.2**	0	2.7
Sealing										
Harbours	1.4	2.6	2	1	2	2	**1.8333**	**2**	1	2.6
Coastal defense structures	1	2.2	2	0.7	2	2	**1.65**	**2**	0.7	2.2
Bridges	1.4		1	0.7	2	1.4	**1.3**	**1.4**	0.7	2
Changes in siltation										
Riverine runoff of organic matter	2.2	2	2.5	2.7	2	2.1	**2.25**	**2.15**	2	2.7
Dredging + Sand/gravel/boulder extraction	1.6	1.6	2	2.7	2	1.6	**1.9167**	**1.8**	1.6	2.7
Bathing sites, beaches and beach replenishment	0.4	0.4	0.4	0.3	0	0.4	**0.3167**	**0.4**	0	0.4
Shipping (coastal)	1.2	1.2	0.8	2.7	2	1.2	**1.5167**	**1.2**	0.8	2.7
Abrasion										
Commercial fishery -bottom trawling	0	0	0	0	0	0	**0**	**0**	0	0
Dredging + Sand/gravel/boulder extraction	0	0	0	0	0	0	**0**	**0**	0	0
Selective extraction										
Dredging + Sand/gravel/boulder extraction (habitat lo	0	0	0	0	0	0	**0**	**0**	0	0
Underwater noise										
Shipping (coastal and offshore)	2	2	2	2	1	2	**1.8333**	**2**	1	2
Recreational boating + sport	1.2	1.4	1.3	2	2	1.3	**1.5333**	**1.35**	1.2	2
Wind farms (operational)	1.6	1.6	1.6	1	1	1.6	**1.4**	**1.6**	1	1.6
Wind farms, bridges, oil platforms (construction)	2.2	2.2	2.2	2	2	2.2	**2.1333**	**2.2**	2	2.2
Cables and pipelines (construction)	2.2	2.2	2.2	2	2	2.2	**2.1333**	**2.2**	2	2.2
Oil platforms	2.2		2.2	2		2.2	**2.15**	**2.2**	2	2.2
Marine litter										
Population density	1.4	2.2	1.9	2.7	0	1.9	**1.6833**	**1.9**	0	2.7
Harbours	1.4	1.8	1.6	2.7	2	1.6	**1.85**	**1.7**	1.4	2.7
Changes in thermal regime										
Power plants (warm water outflow)	3.2	3.2	3.2	3.3		3.2	**3.22**	**3.2**	3.2	3.3
Changes in salinity regime										
Bridges and coastal dams	3		3	3.3		3	**3.075**	**3**	3	3.3
Coastal waste water treatment plants	1.5		1.5	3.3		1.5	**1.95**	**1.5**	1.5	3.3
Introduction of synthetic compounds										
Atmospheric deposition of dioxins	1.6	3.4	2	1.3	2	2.5	**2.1333**	**2**	1.3	3.4
Polluting ship accidents	2.6	2.6	2.6	3	2	2.6	**2.5667**	**2.6**	2	3
Oil slicks / spills	2.8	2.8	2.8	3.3	3	2.8	**2.9167**	**2.8**	2.8	3.3
Coastal industry, oil terminals, refineries, oil platform	3	3.2	3	3	3	3	**3.0333**	**3**	3	3.2
Harbours	3	3	3	3	3	3	**3**	**3**	3	3
Population density (e.g. hormones)	1.8	1.8	1.8	1.3		1.8	**1.7**	**1.8**	1.3	1.8
Introduction of non-synthetic substances and compounds										
Waterborne load of heavy metals	1.8	2.2	2	3.3	2	2	**2.2167**	**2**	1.8	3.3
Atmospheric deposition of metals	1.4	2.2	1.8	3.3	2	1.8	**2.0833**	**1.9**	1.4	3.3
Introduction of radio-nuclides										
Discharges of radioactive substances	0.6	1	1	0.3	1	1	**0.8167**	**1**	0.3	1
Introduction of other substances										
				4						
Inputs of fertilisers										
Aquaculture	2.8	2.8	2.8	3.7	3	2.8	**2.9833**	**2.8**	2.8	3.7
Atmospheric deposition of nitrogen	2.2	3.6	2.5	3.7	3	2.9	**2.9833**	**2.95**	2.2	3.7
Waterborne discharges of nitrogen	3	3	3	3.7	3	3	**3.1167**	**3**	3	3.7
Waterborne discharges of phosphorus	3	3	3	3.7	3	3	**3.1167**	**3**	3	3.7
Inputs of organic matter										
Aquaculture	2.2	2.8	2.5	2.7	2	2.5	**2.45**	**2.5**	2	2.8
Riverine runoff of organic matter	2.4	2.8	2.6	3.7	3	2.6	**2.85**	**2.7**	2.4	3.7
Introduction of microbial pathogens										
Aquaculture	1.4	1.4	1.4	1.3		1.4	**1.38**	**1.4**	1.3	1.4
Coastal waste water treatment plants	1.8	1.8	1.8	1.3		1.8	**1.7**	**1.8**	1.3	1.8
Introduction of non-indigenous species										
				3.7	3					
Selective extraction of species										
Hunting of birds	1	1	0	1.3	1	2	**1.05**	**1**	0	2
Hunting of seals	1	2	0	1.3	2	2	**1.3833**	**1.65**	0	2
Commercial fishery -surface and mid-water	2.8	3.4	3.4	3	3	3.4	**3.1667**	**3.2**	2.8	3.4
Commercial fishery -bottom trawling	1.8	3.4	2	2.3	3	3	**2.5833**	**2.65**	1.8	3.4
Commercial fishery -coastal stationary	1.8	2	2	2.3	2	2	**2.0167**	**2**	1.8	2.3
Commercial fishery - gillnets	1.8	2	2.5	1.3	2	2.5	**2.0167**	**2**	1.3	2.5

Non-photic water

	Secretariat	Sweden	Poland	Finland	Estonia	Denmark	Ave	Med	Min	Max
Smothering										
Disposal of dredged spoils	0	0	0	1.7	0	0	**0.283**	**0**	0	1.7
Wind farms, bridges, oil platforms (construction)	0	0	0	1.7	0	0	**0.283**	**0**	0	1.7
Cables and pipelines (construction)	0	0	0	1.7	0	0	**0.283**	**0**	0	1.7
Sealing										
Harbours	1.4	0	0.7	1	1	0.7	**0.8**	**0.85**	0	1.4
Coastal defense structures	1	0	1	0.7	1	1	**0.783**	**1**	0	1
Bridges	1.4		0.7	0.7	2	1.4	**1.24**	**1.4**	0.7	2
Changes in siltation										
Riverine runoff of organic matter	1.6	1.8	1.7	1.33333	1	1.7	**1.522**	**1.65**	1	1.8
Dredging + Sand/gravel/boulder extraction	1.2	1.2	1.2	1.33333	2	1.2	**1.356**	**1.2**	1.2	2
Bathing sites, beaches and beach replenishment	0.4	0	0.2	0.33333	0	0.2	**0.189**	**0.2**	0	0.4
Shipping (coastal)	1.4	0	0.8	1.33333	0	1.4	**0.822**	**1.067**	0	1.4
Abrasion										
Commercial fishery -bottom trawling	0	0	0	1.7	0	0	**0.283**	**0**	0	1.7
Dredging + Sand/gravel/boulder extraction	0	0	0	0	0	0	**0**	**0**	0	0
Selective extraction										
Dredging + Sand/gravel/boulder extraction (habitat lo	0	0	0	0	0	0	**0**	**0**	0	0
Underwater noise										
Shipping (coastal and offshore)	2	2	2	2	1	2	**1.833**	**2**	1	2
Recreational boating + sport	1	1	1	2	1	1	**1.167**	**1**	1	2
Wind farms (operational)	1.4	0	1.4	2	1	1.4	**1.2**	**1.4**	0	2
Wind farms, bridges, oil platforms (construction)	2.2	1.8	2	1	2	2	**1.833**	**2**	1	2.2
Cables and pipelines (construction)	2.2	2.4	2.3	2	2	2.3	**2.2**	**2.25**	2	2.4
Oil platforms	2.2		2.5	2		2.5	**2.3**	**2.35**	2	2.5
Marine litter										
Population density	0.4	1.6	1	2.7	0	1	**1.117**	**1**	0	2.7
Harbours	0.4	0	0.2	2.7	2	0.2	**0.917**	**0.3**	0	2.7
Changes in thermal regime										
Power plants (warm water outflow)	0.8	3	1.9	3.3		1.9	**2.18**	**1.9**	0.8	3.3
Changes in salinity regime										
Bridges and coastal dams	3		3	3.3		3	**3.075**	**3**	3	3.3
Coastal waste water treatment plants	1.5		1.5	3.3		1.5	**1.95**	**1.5**	1.5	3.3
Introduction of synthetic compounds										
Atmospheric deposition of dioxins	1	3.4	2	1	2	2.2	**1.933**	**2**	1	3.4
Polluting ship accidents	1	3	2	1.66667	2	2	**1.944**	**2**	1	3
Oil slicks / spills	1	2.2	1.6	1.66667	2	1.6	**1.678**	**1.633**	1	2.2
Coastal industry, oil terminals, refineries, oil platforms	1.8	2.8	2.3	2.33333	3	2.3	**2.422**	**2.317**	1.8	3
Harbours	1.8	0	1	2.33333	1	1	**1.189**	**1**	0	2.333
Population density (e.g. hormones)	0.6	1.8	1.2	1		1.2	**1.16**	**1.2**	0.6	1.8
Introduction of non-synthetic substances and compounds										
Waterborne load of heavy metals	1	2.8	1.9	1	2	1.9	**1.767**	**1.9**	1	2.8
Atmospheric deposition of metals	1	3.4	1.9	1	2	2.2	**1.917**	**1.95**	1	3.4
Introduction of radio-nuclides										
Discharges of radioactive substances	0.6	3.2	1	0.3	1	1	**1.183**	**1**	0.3	3.2
Introduction of other substances										
				3.3						
Inputs of fertilisers										
Aquaculture	1.6	1.6	1.6	1.66667	2	1.6	**1.678**	**1.6**	1.6	2
Atmospheric deposition of nitrogen	1.4	3.4	1.4	1.33333	2	1.4	**1.822**	**1.4**	1.33	3.4
Waterborne discharges of nitrogen	2.2	3.4	2.8	2	3	2.8	**2.7**	**2.8**	2	3.4
Waterborne discharges of phosphorus	2.2	3.4	2.8	2	3	2.8	**2.7**	**2.8**	2	3.4
Inputs of organic matter										
Aquaculture	1.6	1.8	1.7	1.7	2	1.7	**1.75**	**1.7**	1.6	2
Riverine runoff of organic matter	1.6	2.4	2	1.7	2	2	**1.95**	**2**	1.6	2.4
Introduction of microbial pathogens										
Aquaculture	0.6	0	0.3	1		0.3	**0.44**	**0.3**	0	1
Coastal waste water treatment plants	0.8	0	0.4	1		0.4	**0.52**	**0.4**	0	1
Introduction of non-indigenous species										
					3					
Selective extraction of species										
Hunting of birds	0.6	1.8	0	1.33333	0	0	**0.622**	**0.3**	0	1.8
Hunting of seals	0	0	0	1.33333	1	1.6	**0.656**	**0.5**	0	1.6
Commercial fishery -surface and mid-water	2.8	3.4	2.4	3	3	3.4	**3**	**3**	2.4	3.4
Commercial fishery -bottom trawling	1.8	3.4	2.4	2.33333	3	3.4	**2.722**	**2.7**	1.8	3.4
Commercial fishery -coastal stationary	1.8	2	1.9	2.33333	2	1.9	**1.989**	**1.95**	1.8	2.333
Commercial fishery - gillnets	1.8	2	2.5	1.33333	2	2.5	**2.022**	**2**	1.33	2.5

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