Cumulative impacts in the Baltic Sea – findings from the third HELCOM holistic assessment

Offshore wind and migratory fish – Seminar

Kemi, Finland, 09 October 2024

By HELCOM staff
Thursday, October 10, 2024

Presentation

- Terminology and definitions
- HELCOM approach to cumulative impacts
- Spatial Pressure and Impact assessment (SPIA) data and methodology
- Results of the assessment in HOLAS 3
- How can SPIA support management?
- The SPIA tool

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Terminology

- CIA (Cumulative Impact Assessment) or CEA (Cumulative effect Assessment)
  - umbrella term for assessment of cumulative impacts
  - *“The analysis of cumulative impacts aims at identifying areas in the sea where the environmental and ecological components are exposed to anthropogenic pressures that negatively affect them.”*
- Third HELCOM holistic assessment (HOLAS 3)
  - HELCOM carries out holistic assessments every six years to follow up on how the Baltic Sea ecosystem is doing
  - assessments cover ‘moments’ in time over the dynamic life history of the Baltic Sea (2016-2021)
  - includes results at various levels of detail, including monitoring data, indicator reports and thematic assessments.
  - Summary report and 5 thematic assessments: Biodiversity, ESA, Eutrophication, SPIA and Pollution
- SPIA (Spatial Pressure and Impact Assessment)
  - the umbrella term for the assessment of pressures and impacts in HOLAS 3
  - the (cumulative) pressure or impact of any given combination of pressures and ecosystem components
  - includes BSII and BSPI, the full assessments of impact and pressures

HELCOM approach to cumulative impacts

- HELCOM recognized a need to map the combined effects of anthropogenic pressures in a holistic way, as these effects were largely unknown
- No internationally agreed and routinely applied methodologies to do assessments combining multiple pressures

  -> the suitable method depends on factors such as scope and objective of the assessment, as well as available data on pressure and biodiversity
- HELCOM chose to use the rather technical and data driven assessment method developed by Halpern et al. in 2008
- Based on the overlap of GIS data layers on pressures and ecosystems
- The identification of pressure and impacts related to human activities originates from the MSFD, Annex III
- Cumulative impact assessment (CIA) was first introduced in the initial holistic assessment in 2010 (HOLAS 1)
  - The aim to assess which areas of the Baltic Sea are sensitive to anthropogenic pressures and to give an estimation of potential anthropogenic cumulative pressures and impacts is presented for the entire Baltic Sea area
- Carried out in HOLAS 2 (2018) and HOLAS 3 (2023) with methodological development in between and during the assessments

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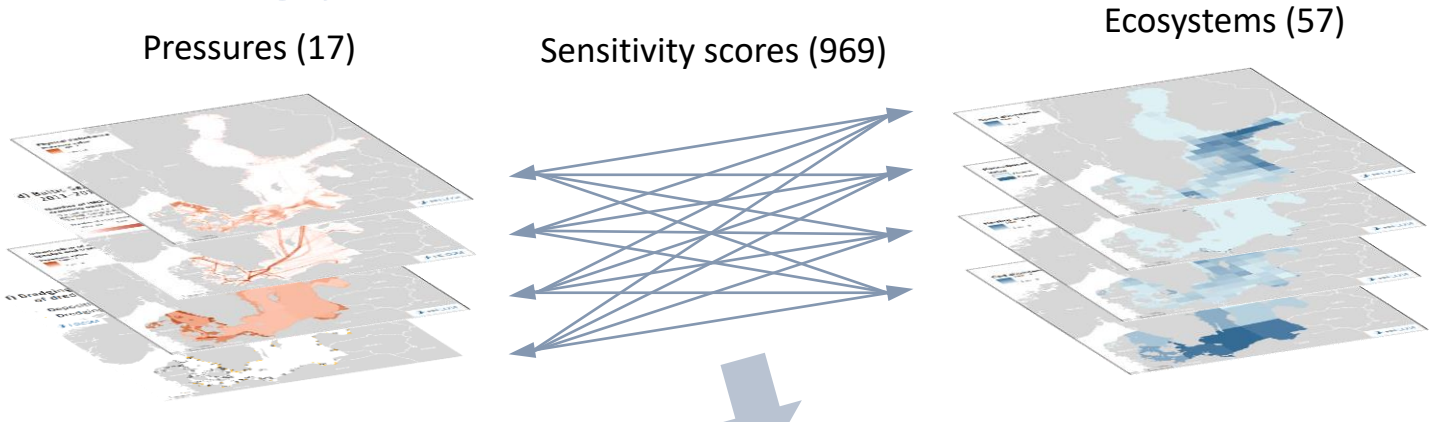
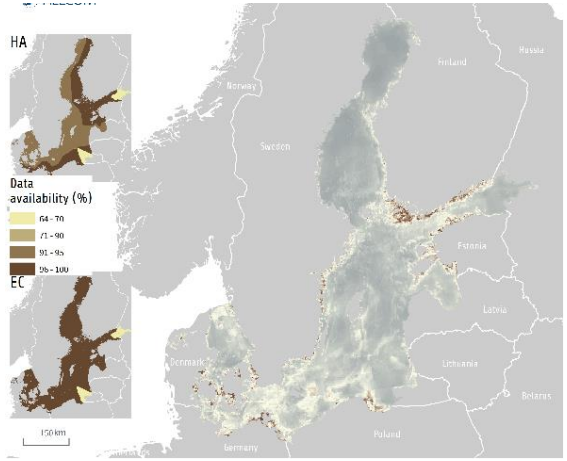
Assessment methodology

- Main components in the assessment are the data sets on human activities, pressures and ecosystem components and sensitivity scores
- SPIA aims to reveal the potential *combined spatial pattern and the relative magnitude* of pressure and impacts



$$BSII(x,y) = \sum_{i=1}^{n} \sum_{j=1}^{m} PL_i(x,y) * EC_j(x,y) * SS_{i,j}$$



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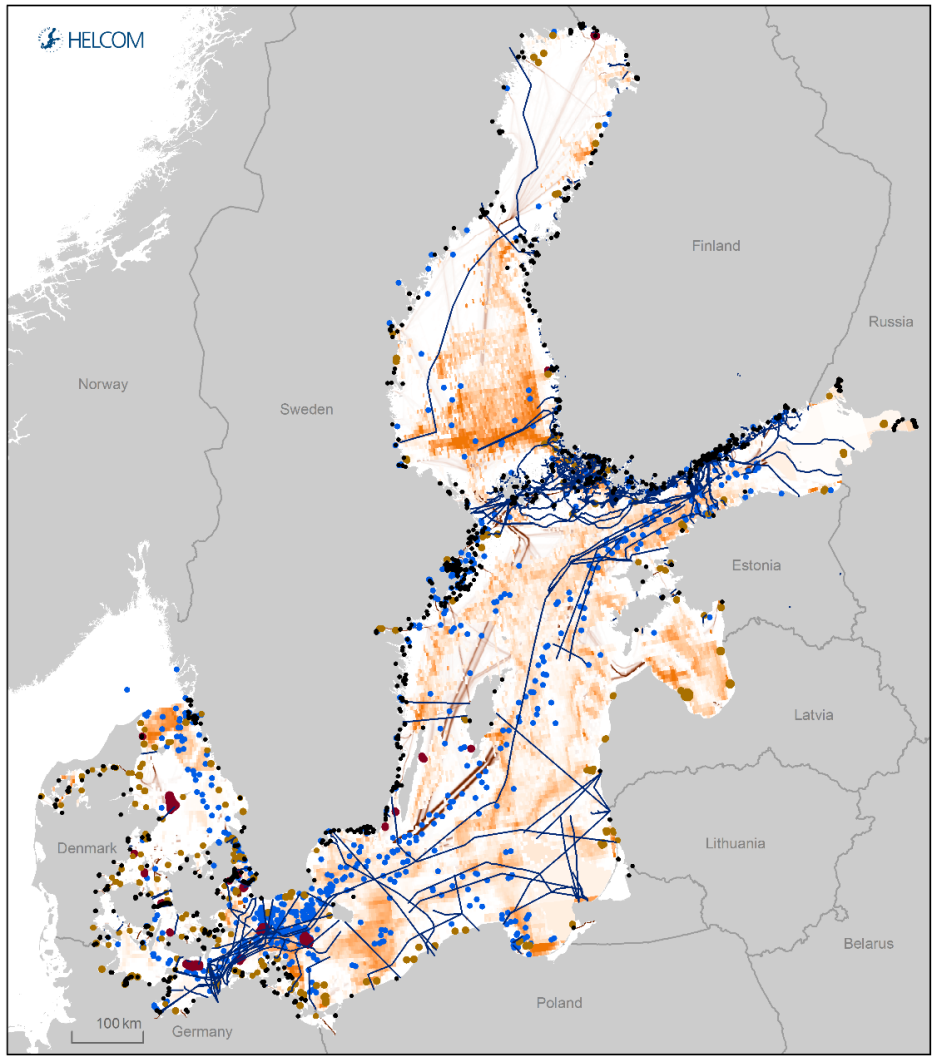
Datasets on human activities



- Approximately 30 data sets
- Collected by
  - HELCOM annual reporting programmes
  - Open sources
  - Data requests to other organisations
  - National data calls

- Datasets include e.g.
  - Bridges and other constructions
  - Deposit of dredged material
  - Wind turbines
  - Cables
  - Illegal oil discharges
  - Shipping density
  - Fishing of herring

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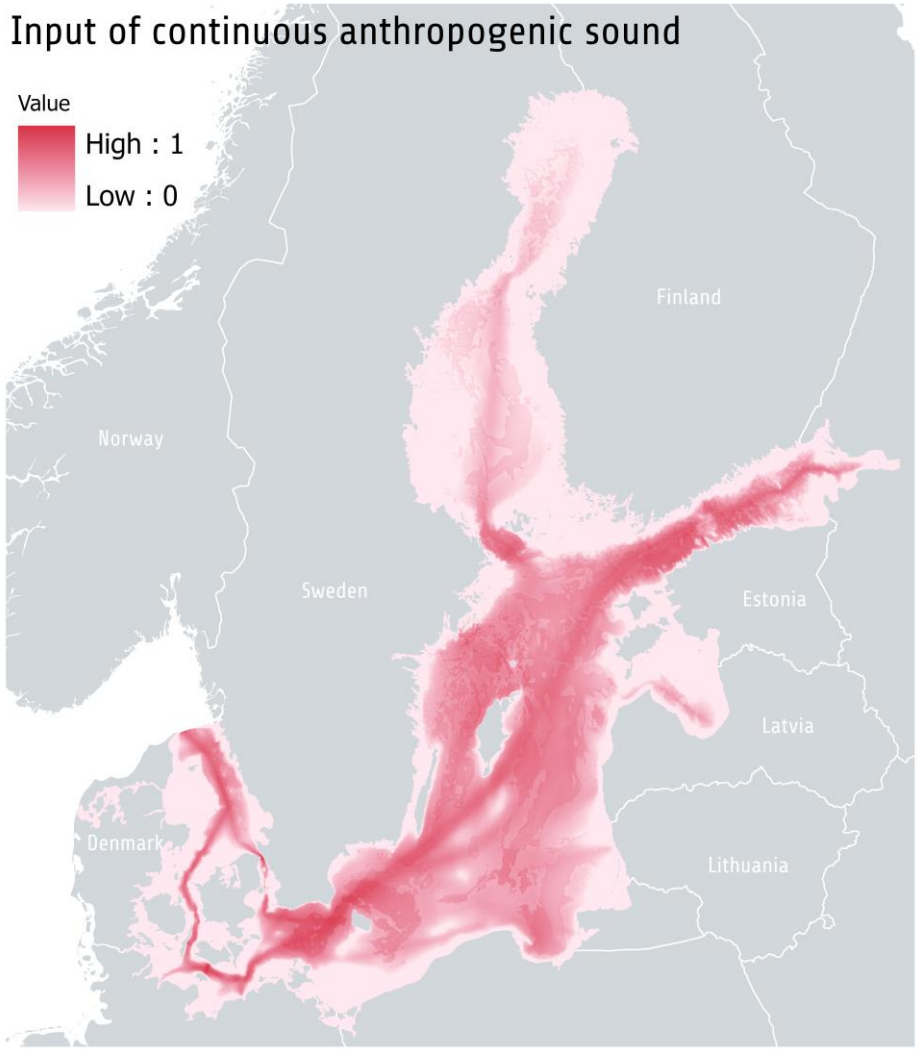
Aggregated pressure layers

- Spatial distribution of pressures on the scale 0 to 1
- Some human activities effect the marine environment in similar ways
  - these activities are aggregated to one pressure layer
    - Physical disturbance
    - Physical loss
    - Disturbance to species due to human presence
- Some pressure layers are constructed from other HELCOM assessment products or modelled data
  - Hazardous substances (indicator)
  - Input of continuous anthropogenic sound (modelled noise data)



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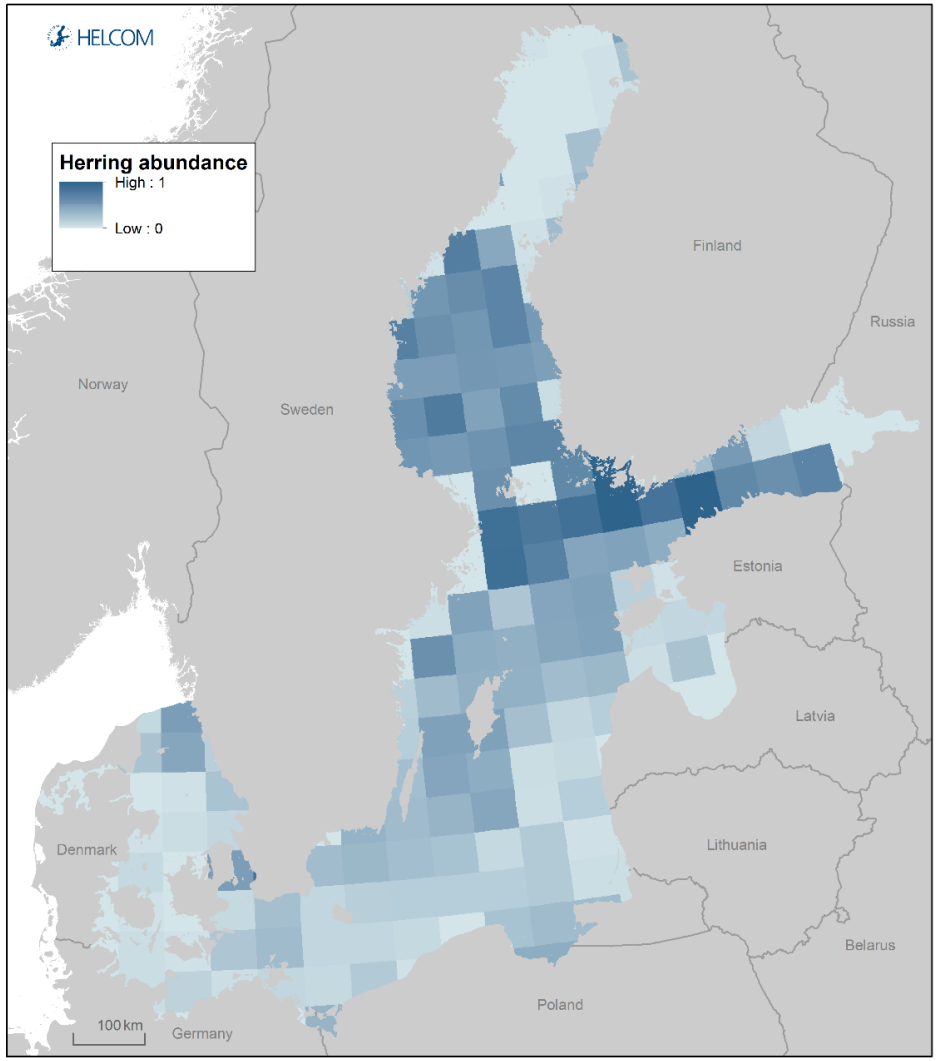
Ecosystem components

- Showing the spatial distribution of ecosystem components on the scale 0 to 1
- Data collected by national data call, projects and HELCOM expert networks, datasets include e.g.:
  - Benthic habitats (presence/absence)
    - Species: Fucus
    - Large scale habitats: Infralittoral sand
  - Marine mammals (Classified distribution)
    - Harbour porpoise
  - Fish (Continuous data)
    - Herring abundance



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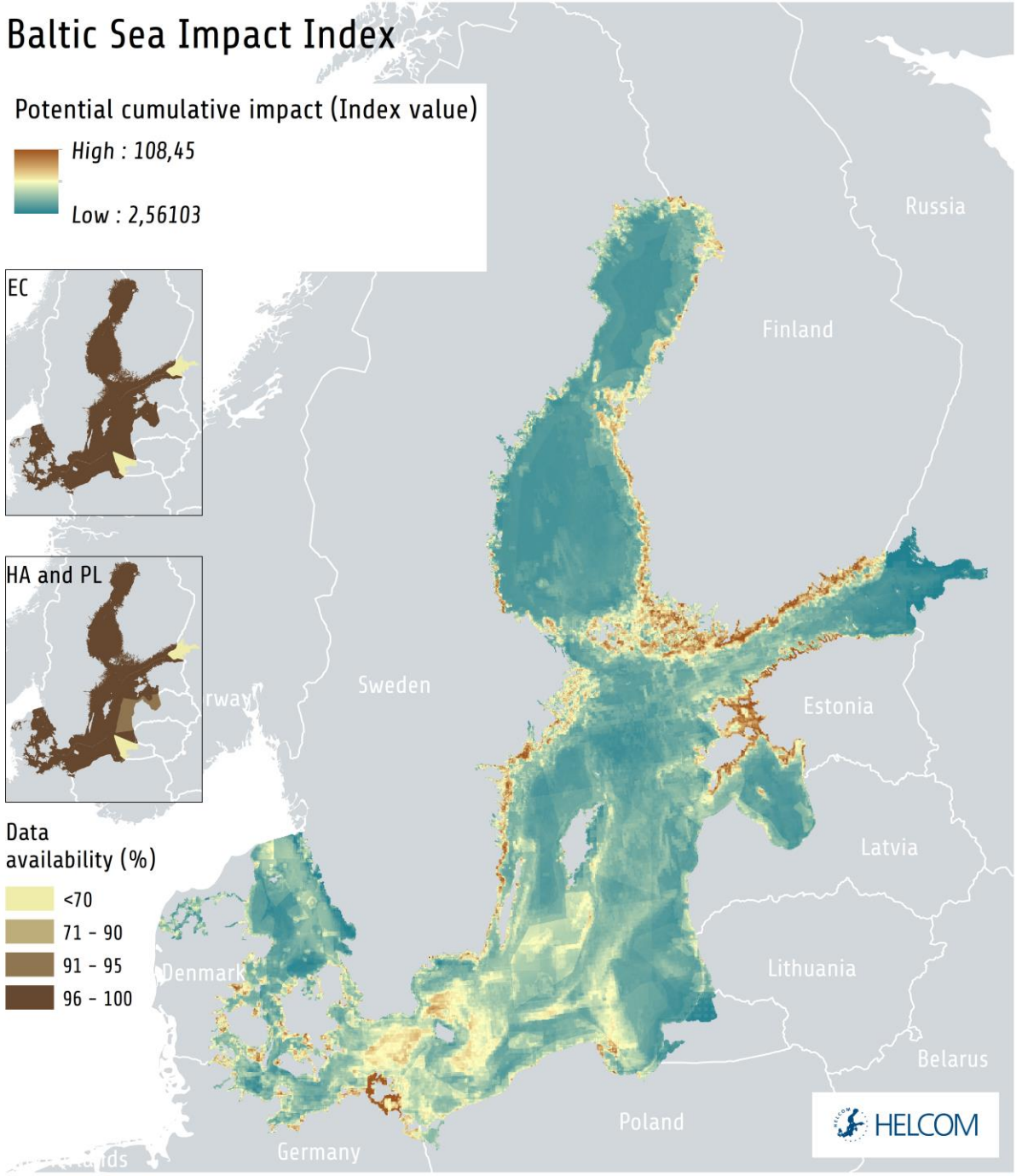
Results of the assessment

- The results are not to be considered as a status of the environment in absolute terms, but rather as a relative distribution of potential pressures and impacts, describing the pattern of most impacted areas
- The results provide a framework to communicate these patterns and to highlight hotspots and areas where further attention and studies might be needed
- As contrary to HELCOM indicators, having a more sectoral approach, the SPIA draws attention to the cumulative burden of pressures across ecosystems on an accurate spatial scale
- Results consists of BSII, BSPI and thematic analyses

Baltic Sea Impact Index (BSII)

- Based on
  - 17 pressure layers
  - 57 Ecosystem components
  - Sensitivity scores
- All areas affected
- Shallow areas most impacted, most EC layers



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Impact per sub-basin

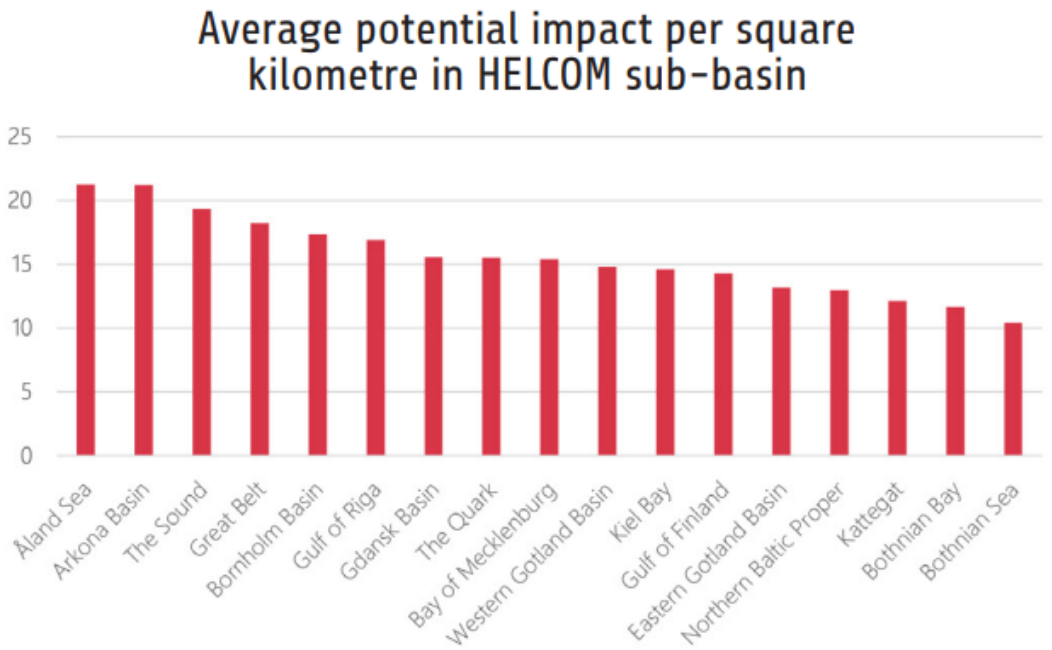
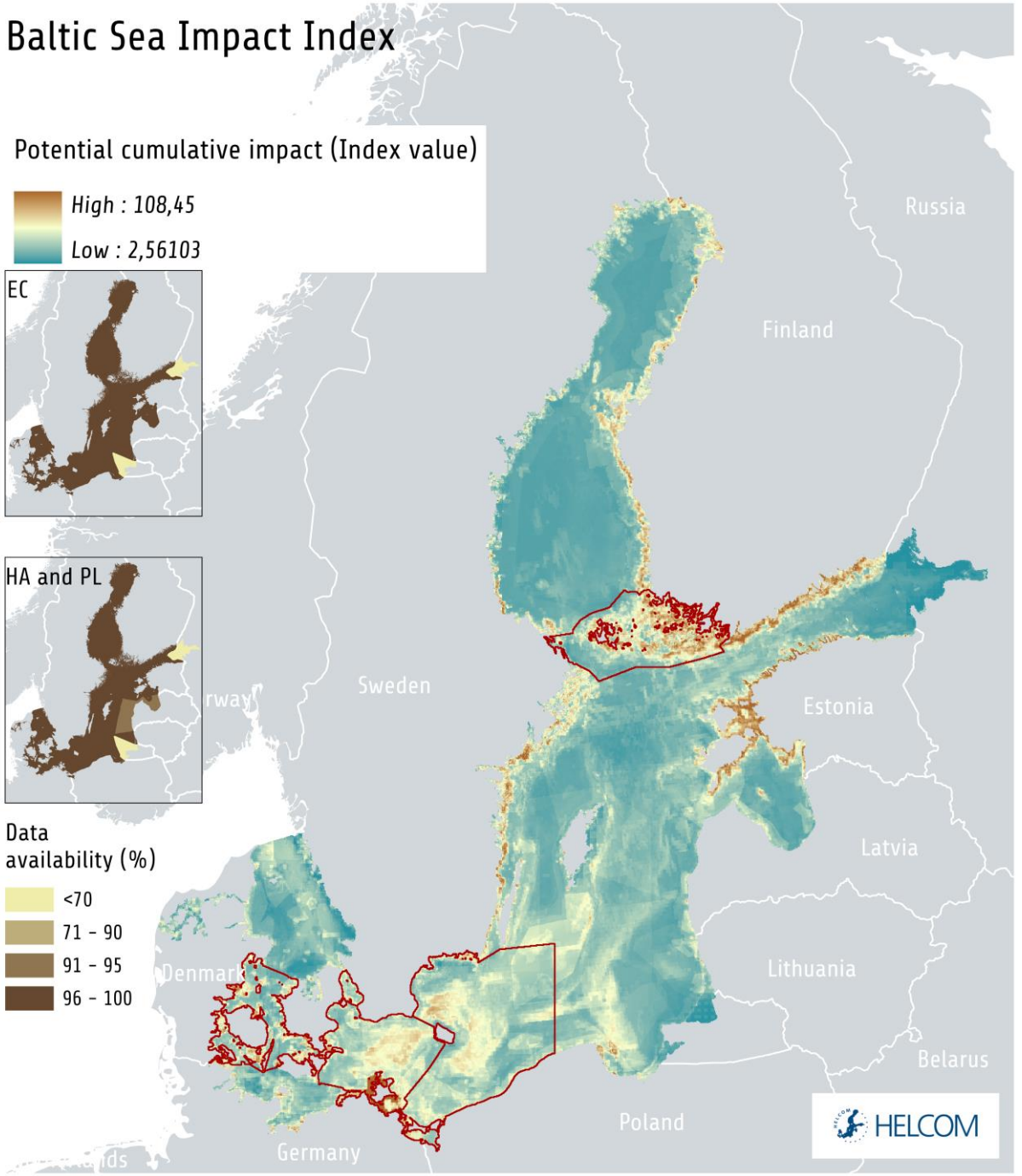


Figure 21. Average potential cumulative impact per square kilometre in HELCOM sub-basin in BSII.



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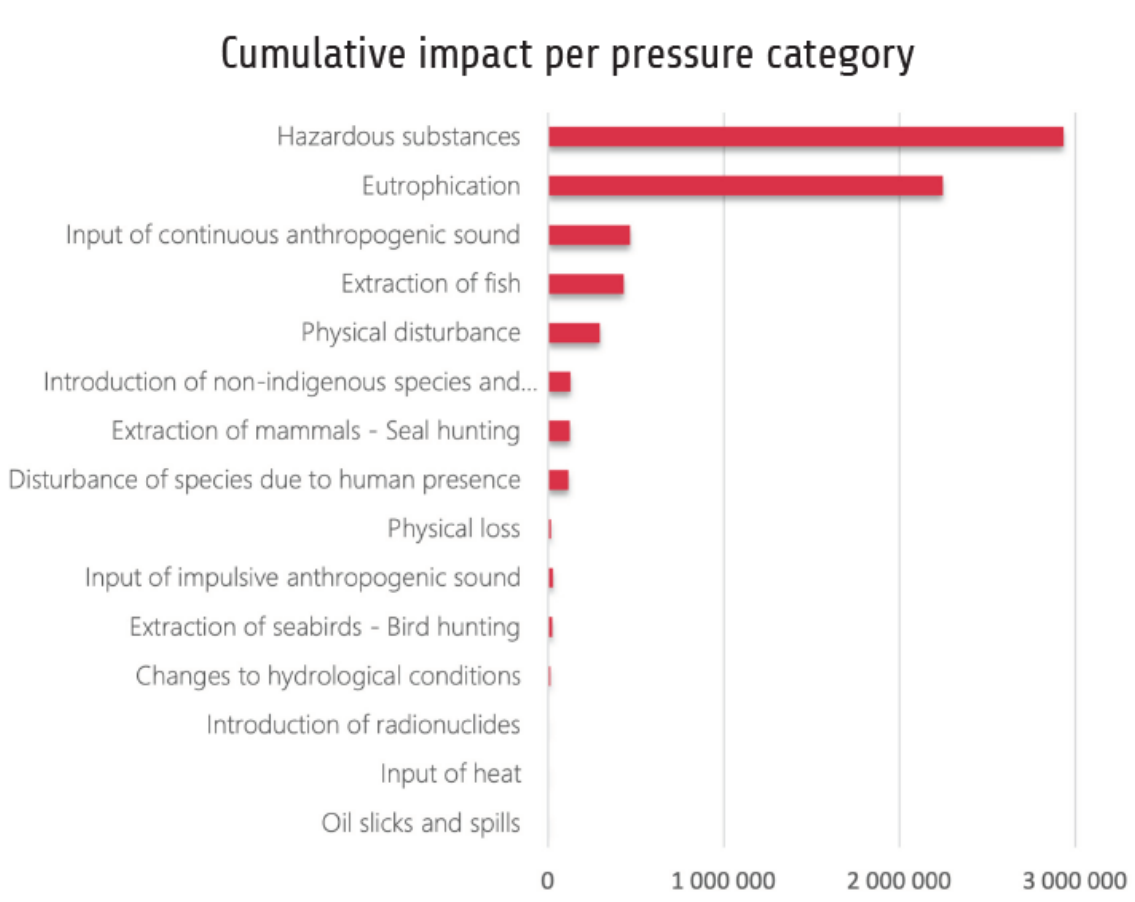
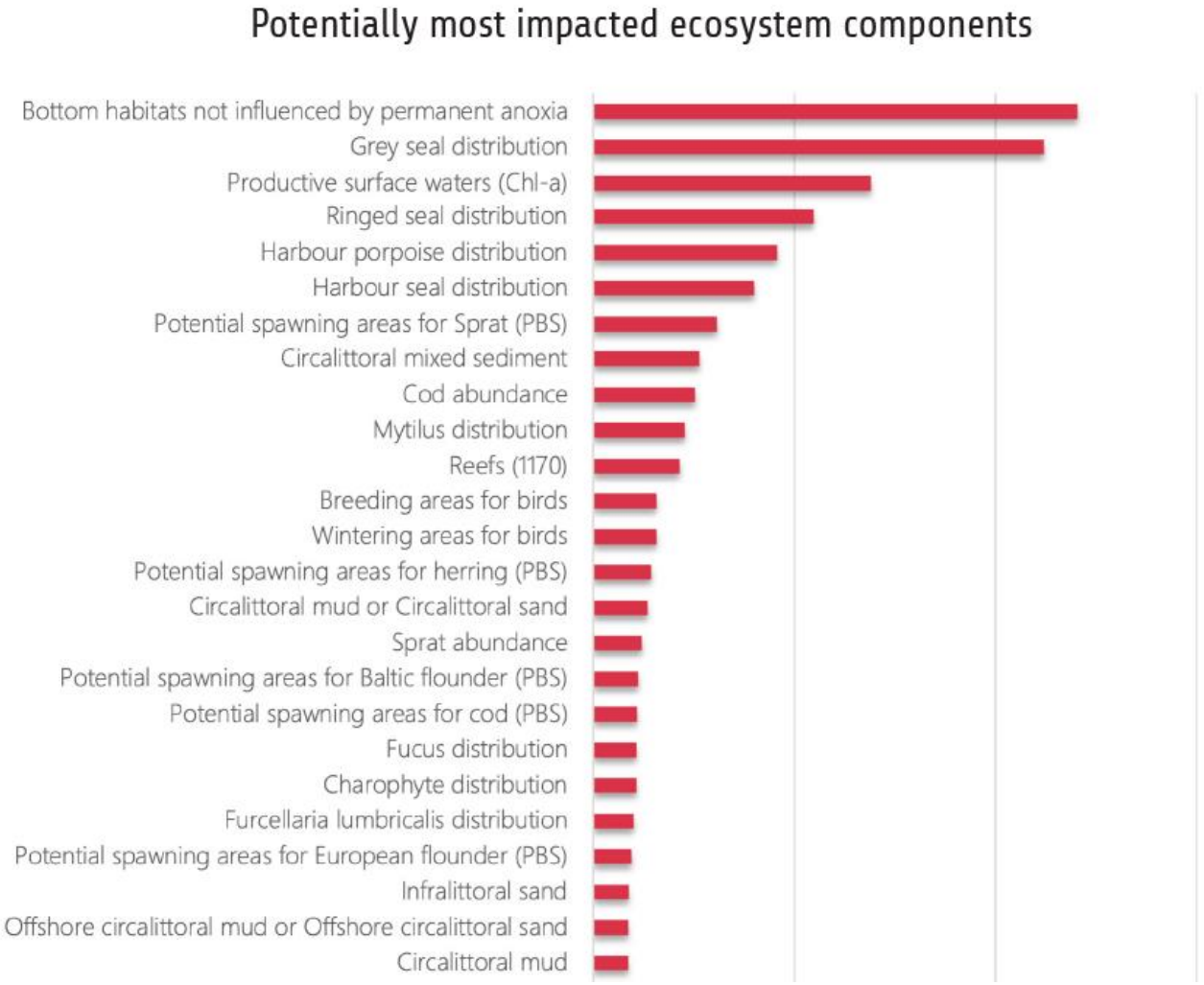
BSII top pressures and most impacted ecosystem components





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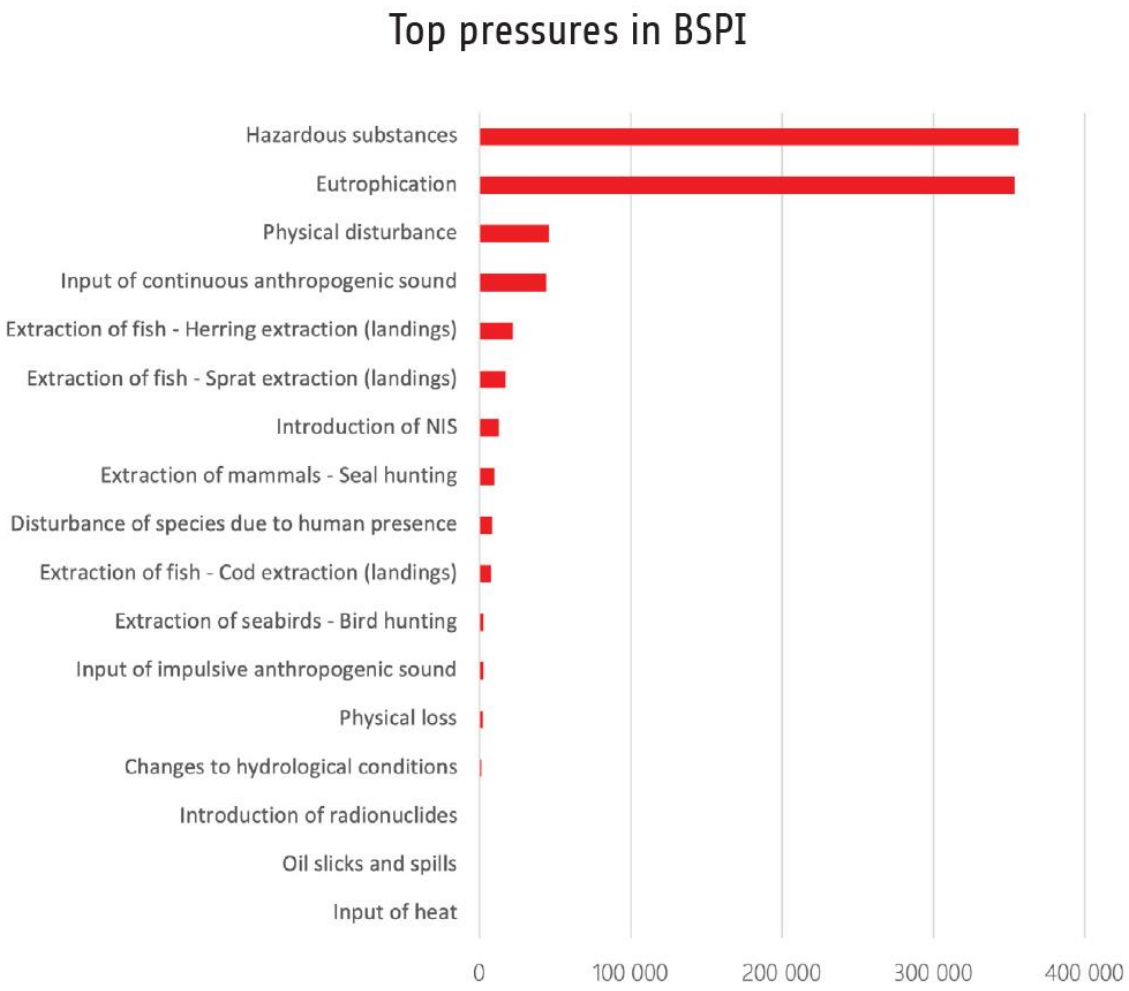
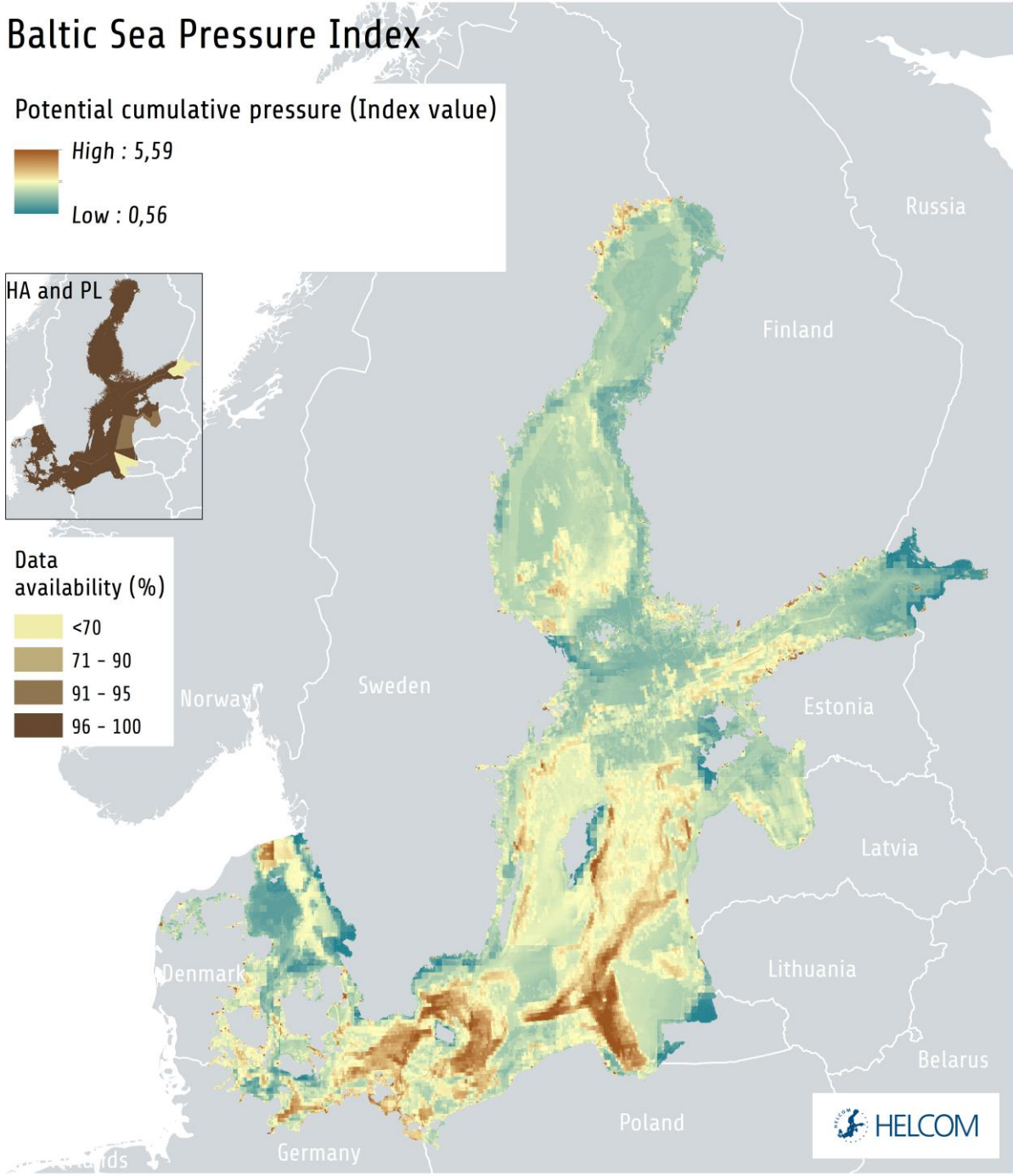
Baltic Sea Pressure Index (BSPI)





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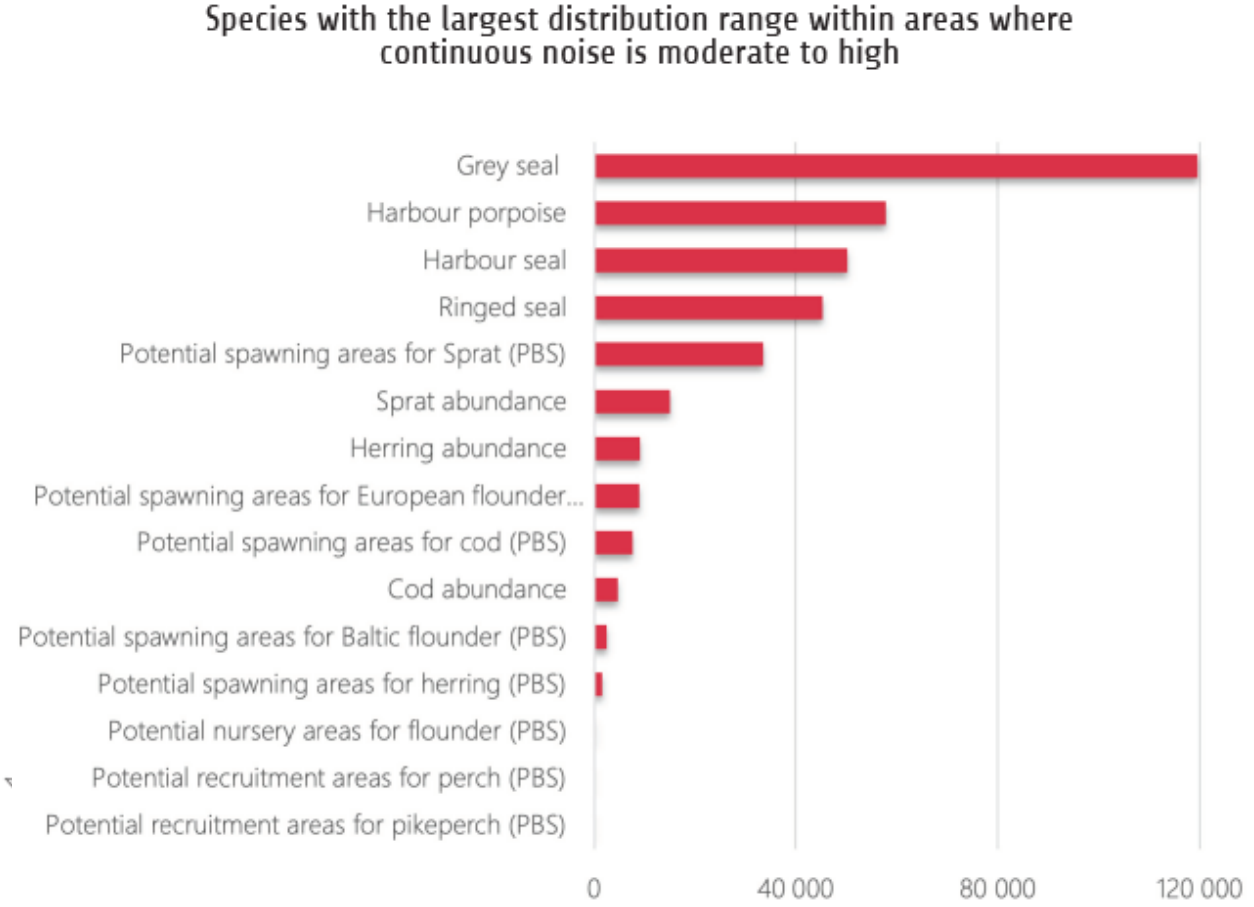
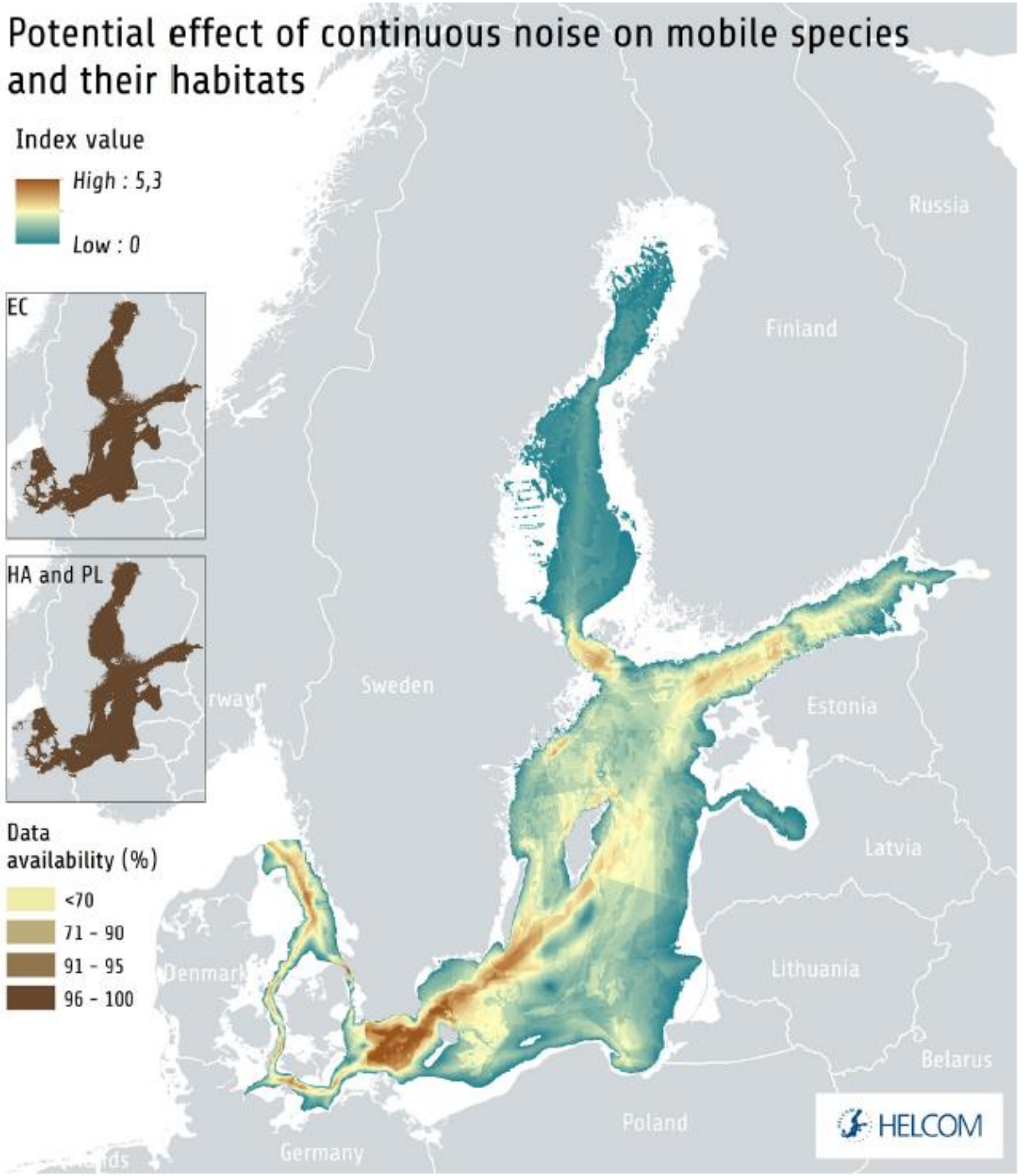
Potential effect of continuous noise to mobile species





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How can SPIA support management?

- **Identifying key areas:** The assessment recognizes and displays the potentially most impacted areas in the region, making it possible to place any local impacts in a regional perspective, and identifying areas, activities, pressures and habitats which should be given special focus in management.
- **Data resource:** Substantial amounts of data on activities, pressures and ecosystem components (species and habitats) are needed to carry out the assessment, and the publication of these data sets provides a unique, region-wide and harmonized data resource to support management
- **Communication:** The cumulative impact assessment is an effective way to describe and visualize potential impacts of human activities on the Baltic Sea environment. This can help raise awareness of these impacts, and can also function as a platform to discuss the underlying causes and potential future solutions
- **Interactive tool:** In the SPIA tool it is possible to further explore the activities and pressures behind identified impacts, as well as the affected ecosystem components, and allows to run the assessment on any given combination of these layers

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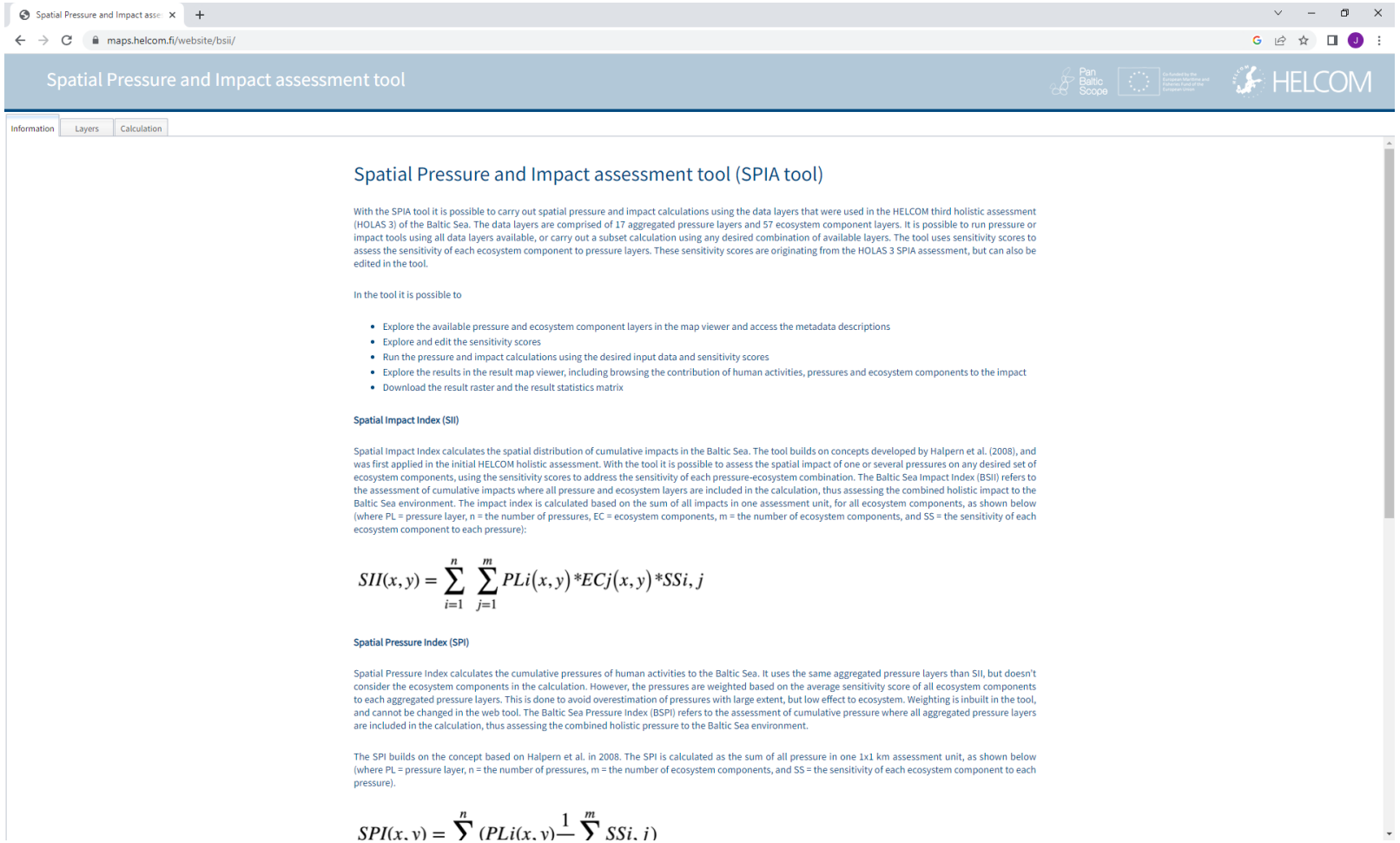
SPIA online tool

In the tool it is possible to

- Explore the available pressure and ecosystem layers in the map viewer and access the metadata descriptions
- Explore and edit the sensitivity scores
- Run the pressure and impact calculations using the desired input data and sensitivity scores
- Explore the results in the result map viewer, including browsing the contribution of human activities, pressures and ecosystem components to the impact
- Download the result raster and the statistics matrix



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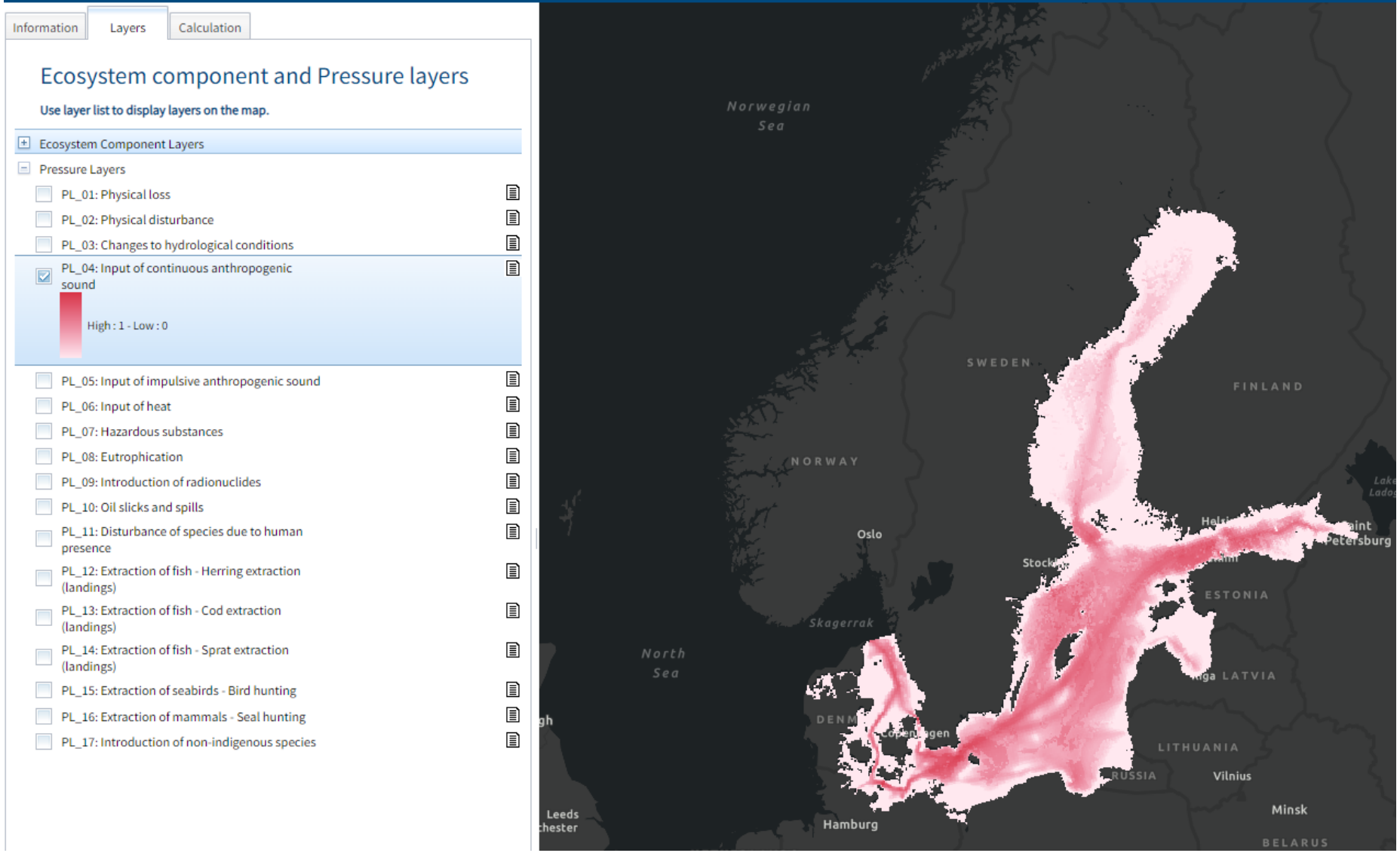
Spatial Pressure and Impact assessment tool



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Spatial Pressure and Impact assessment tool

Information | Layers | Calculation

SII and SPI calculation

SII | SPI (sum) | SPI (weighted sum)

SII calculation

Select the area for which to perform calculation

Baltic Sea

Select Ecosystem component and Pressure layers to include in calculation

Ecosystem component layers

- EC_01: Productive surface waters (Chl-a)
- EC_02: Bottom-water habitats not influenced by permanent anoxia
- EC_03: Infralittoral coarse sediment
- EC_04: Infralittoral mixed sediment
- EC_05: Infralittoral mud
- EC_06: Infralittoral mud or Infralittoral sand
- EC_07: Infralittoral rock and biogenic reef
- EC_08: Infralittoral sand

Select all

Pressure layers

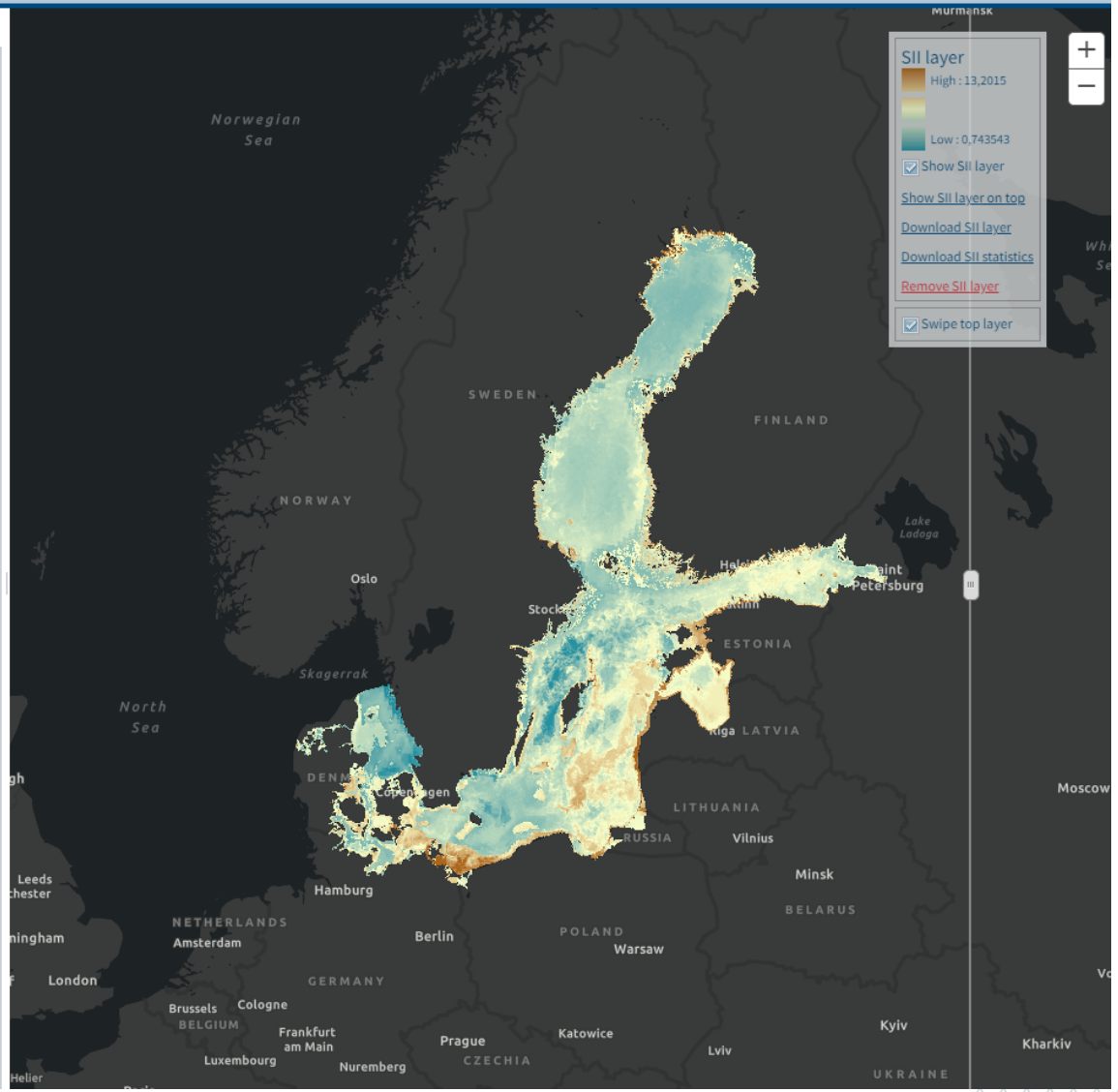
- PL_01: Physical loss
- PL_02: Physical disturbance
- PL_03: Changes to hydrological conditions
- PL_04: Input of continuous anthropogenic sound
- PL_05: Input of impulsive anthropogenic sound
- PL_06: Input of heat
- PL_07: Hazardous substances
- PL_08: Eutrophication
- PL_09: Introduction of radionuclides

Select all

Get Sensitivity Scores | Reset sensitivity scores

Default sensitivity scores for selected layers are displayed in the table below. Sensitivity scores can be edited directly in the table. Edited values will be used in SII calculation. Use **Calculate SII** button below to calculate SII.

CODE	PL_01	PL_02	PL_03	PL_04	PL_05	PL_06	PL_07	PL_08
EC_01	0	1	0.8	0.6	0.2	1	1	1.8
EC_02	1.5	0.9	1.3	0.5	0.2	0.6	0.9	1.9
EC_03	1.9	1.3	1.2	0.2	0.2	1.3	1	1.3
EC_04	1.9	1.2	1.1	0.3	0.3	1.1	1	1.3
EC_05	1.9	1.1	1.1	0.3	0.3	1	1	1.3
EC_06	1.9	1.2	1	0.3	0.3	1	1	1.3
EC_07	1.9	1.3	1.2	0.2	0.2	1.3	1	1.3
EC_08	1.9	1.2	0.9	0.3	0.3	1	0.9	1.3



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Information | Layers | Calculation

Back to calculation settings

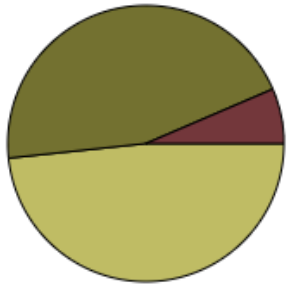
Location information

SII value: 5.6185

Ecosystem components contribution to SII

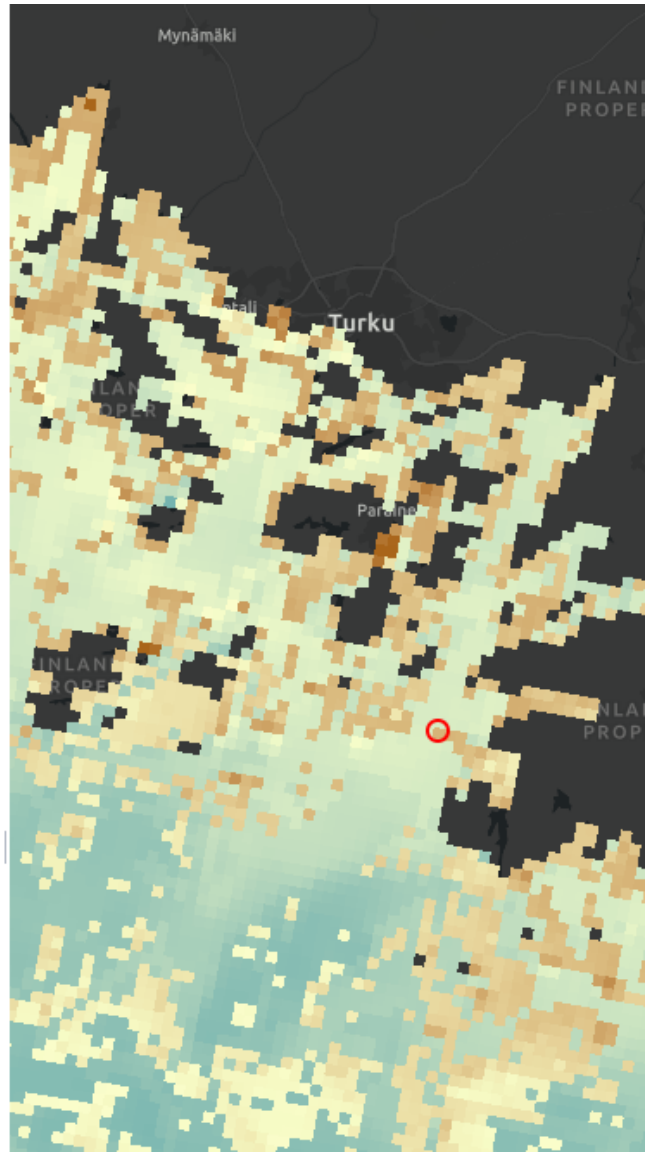
- Bottom-water habitats not influenced by permanent anoxia (36.36 %)
- Infralittoral rock and biogenic reef (33.18 %)
- Productive surface waters (Chl-a) (30.45 %)

Pressures contribution to SII



- Hazardous substances (48.31 %)
- Eutrophication (45.23 %)
- Physical disturbance (6.45 %) Human activities

Back to calculation settings



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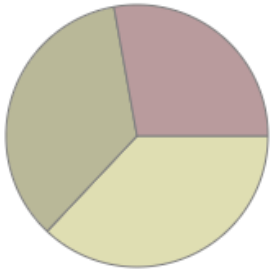
Information | Layers | Calculation

Back to calculation settings

Location information

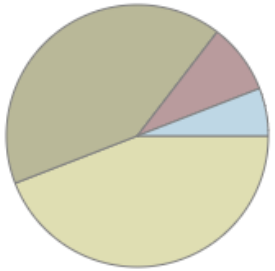
SII value: 6.1533

Ecosystem components contribution to SII

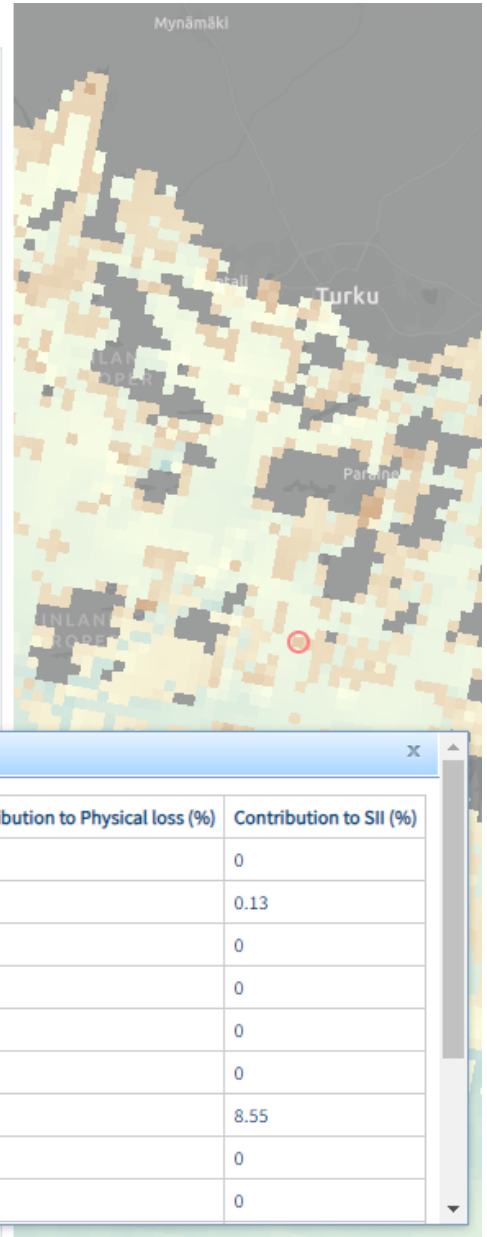


- Bottom-water habitats not influenced by permanent anoxia (37.03 %)
- Infralittoral rock and biogenic reef (35.15 %)
- Productive surface waters (Chl-a) (27.82 %)

Pressures contribution to SII



- Hazardous substances (44.12 %)
- Eutrophication (41.31 %)
- Physical loss (8.68 %) Human activities
- Physical disturbance (5.89 %) Human activities



Human activities contributions

Human activity	Contribution to Physical loss (%)	Contribution to SII (%)
Bridges and other constructions	0	0
Cables (operational)	1.5	0.13
Coastal defence and flood protection	0	0
Capital dredging	0	0
Extraction of sand and gravel	0	0
Finfish mariculture	0	0
Harbours	98.5	8.55
Land claim	0	0
Marinas and leisure harbours	0	0

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Conclusion

- There are many ways to conduct a CIA, HELCOM uses the “Halpern method”
- The Spatial pressure and impact assessment is a powerful tool to assess and to communicate the relative pattern of activities, pressures and impacts in the Baltic Sea
- Potential pressures and impacts on the marine environment are widely distributed in the Baltic Sea and no area in the region is without human footprint
- HELCOM cumulative impact work support management by identifying key areas of interest, providing a data resource, acting as a mean of communication and by providing an interactive tool to explore the underlying data and results

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Thank you!

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