Spatial Pressure and Impact Assessment in HOLAS 3

Joint workshop of the Communities of Practice on Ecosystem Based Approach in MSP and on Sustainable Blue Economy of eMSP project.

Helsinki, Finland, 13 June 2023

By HELCOM staff
Friday, June 16, 2023

Presentation

- Terminology and definitions
- Spatial Pressure and Impact assessment (SPIA) methodology
- SPIA results
- How could SPIA contribute to MSP?

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 more exposed to anthropogenic pressures that negatively affect them.”*
- 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
- BSII (Baltic Sea Impact Index)
  - Assessment of cumulative impacts, all pressure and ecosystem layers included, index refers to the unitless output of the assessment
- BSPI (Baltic Sea Pressure Index)
  - Assessment of cumulative pressures, all pressure layers included, index refers to the unitless output of the assessment

SPIA assessment in HOLAS 3

- SPIA is the cumulative impact assessment carried out in the HOLAS 3 assessment, based on methodology by Halpern et al. (2008)
- Differing from the sectoral approach of the incdicators, the SPIA aims to identify the cumulative burden to the marine environment.
- Integral part of the assessment is also the ”thematic analysis”, where only a subset of layers are selected
- Outputs:
  - Thematic report on Spatial pressure and impact assessment (March 2023)
  - Summary report (main findings)
  - HOLAS 3 web page
  - 100 data sets published in HELCOM Map and Data Service (MADS)
  - Deasktop and online tool

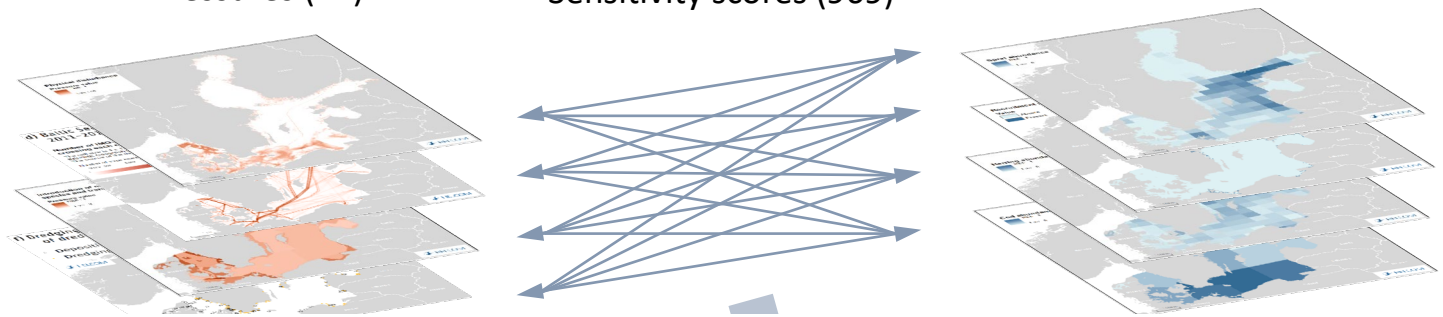
Assessment methodology

- Marine environments are facing multiple, simultaneous and overlapping pressures from human activities
- SPIA aims to reveal the combined spatial pattern and magnitude of pressure and impacts
- Uses human activities pressures, ecosystem components and sensitivity scores as input data

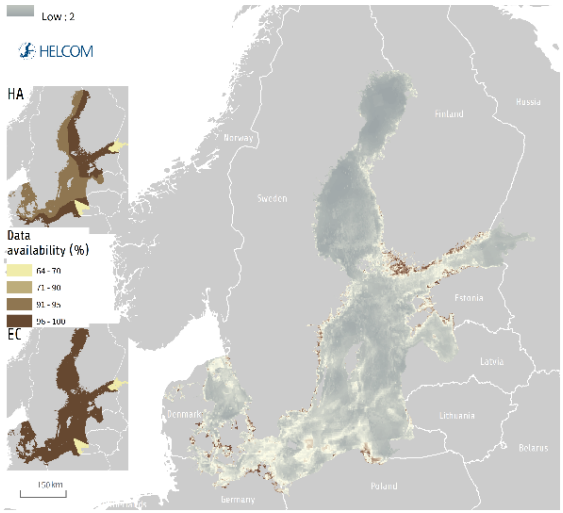
Pressures (17)

Sensitivity scores (969)

Ecosystems (57)



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



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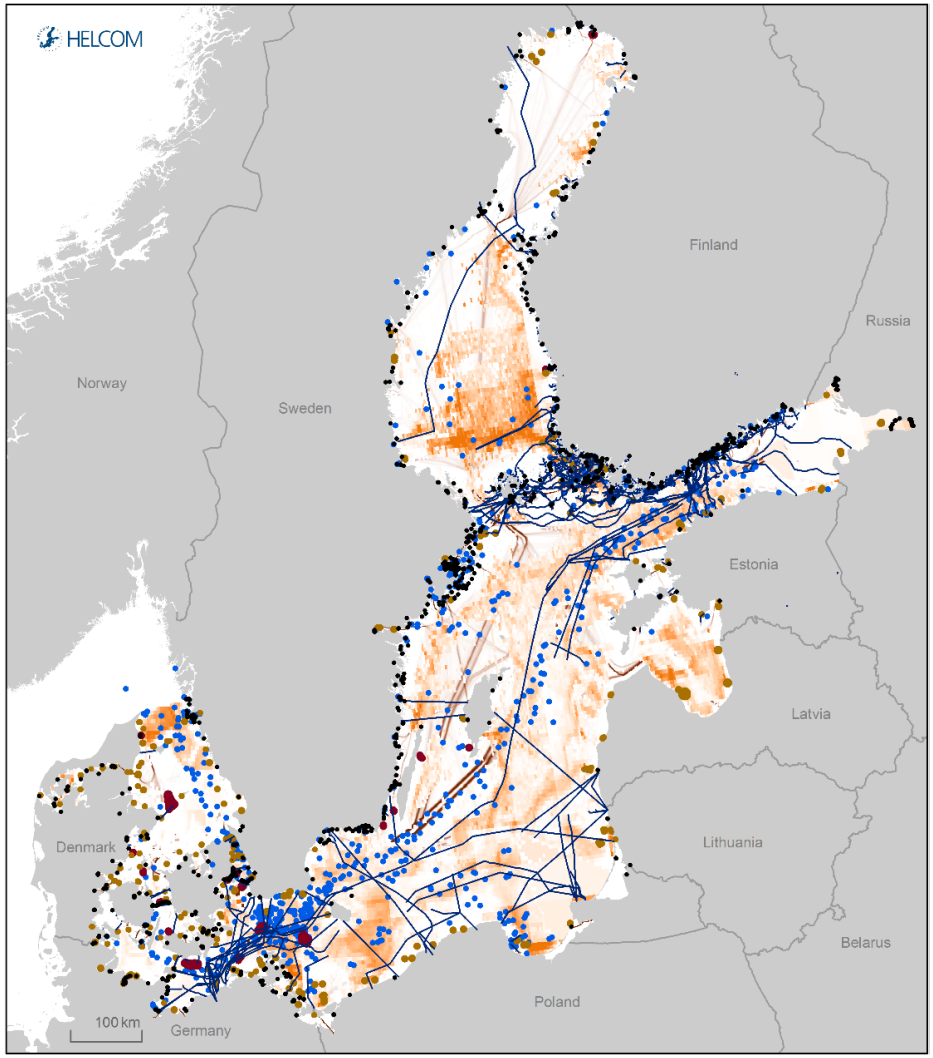
Datasets on human activities



- 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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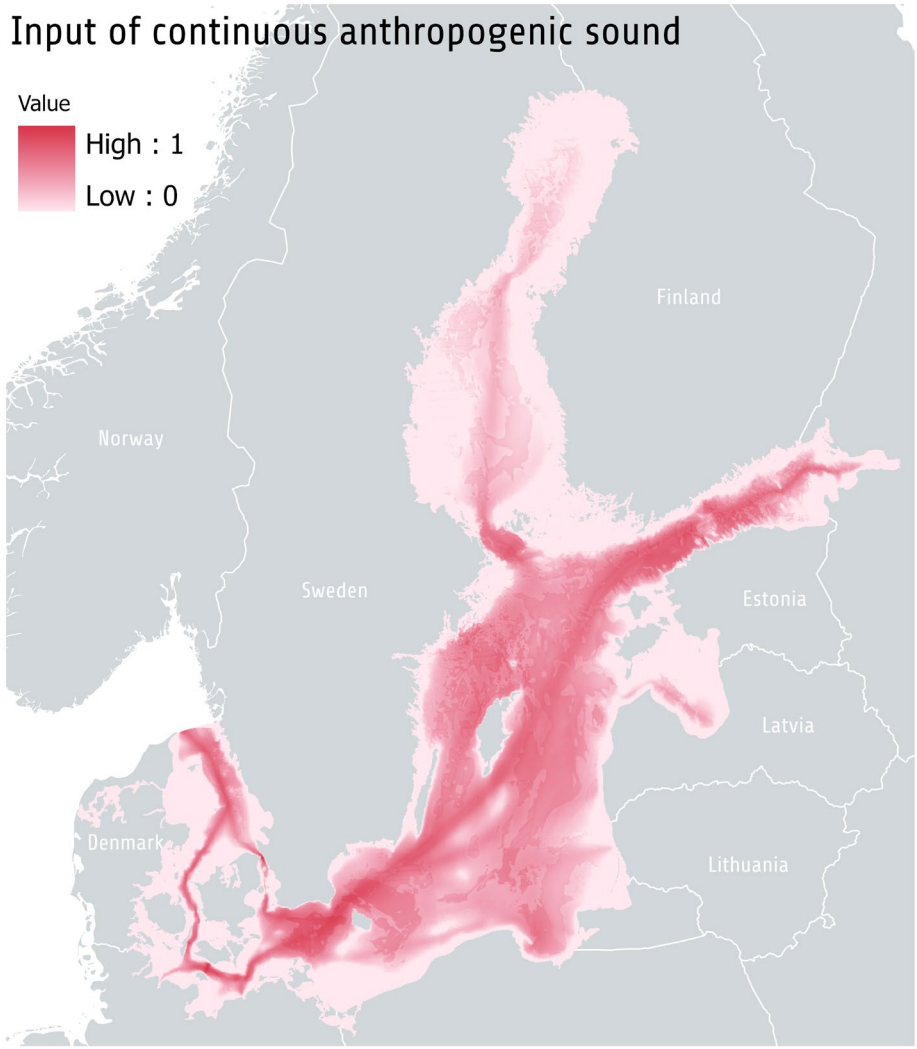
Aggregated pressure layers

- 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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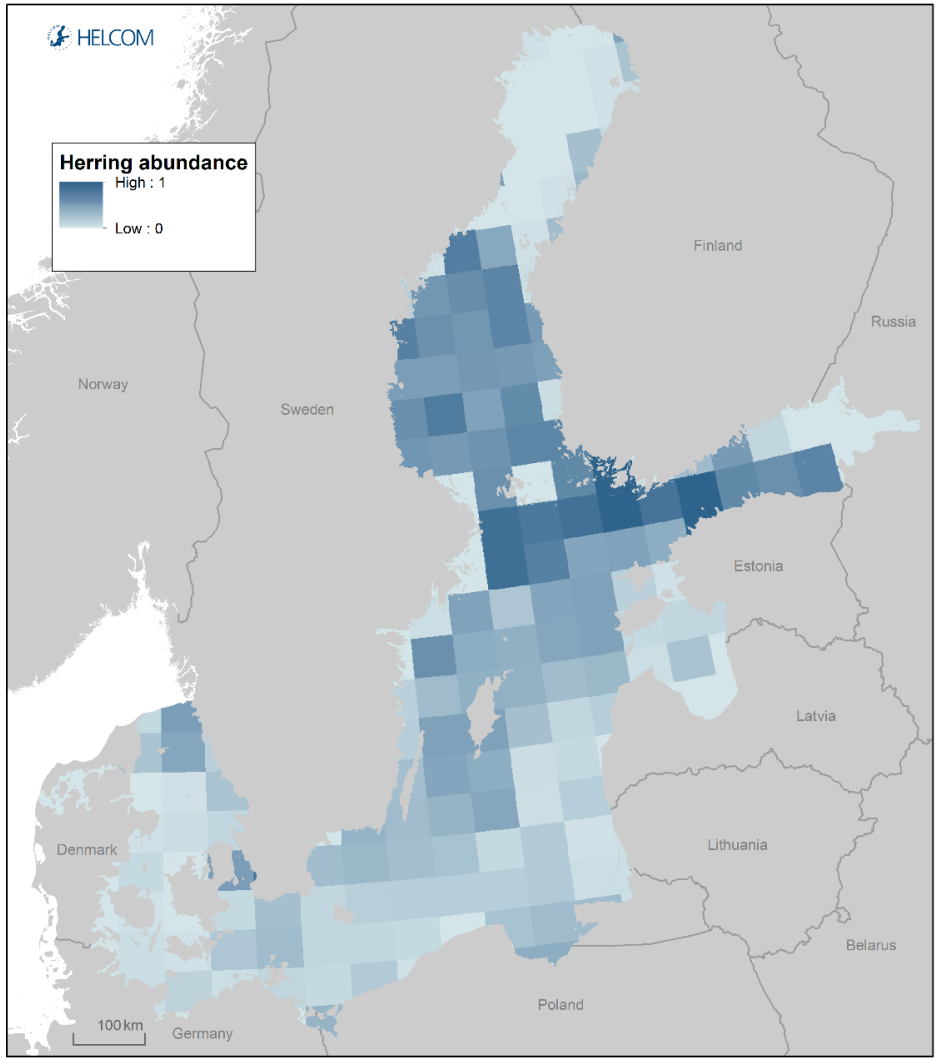
Ecosystem components

- 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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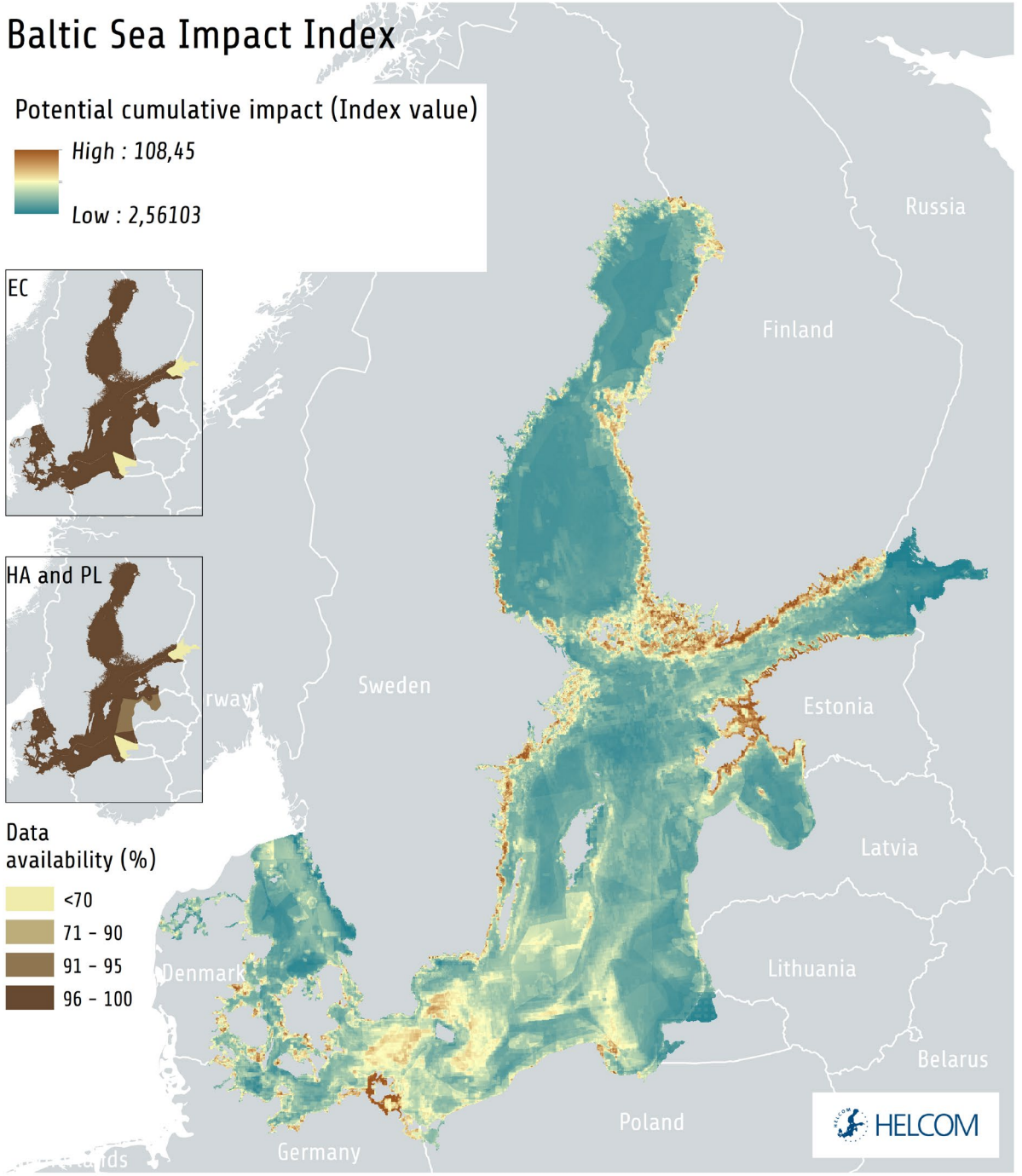
Results of the assessment

- 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 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

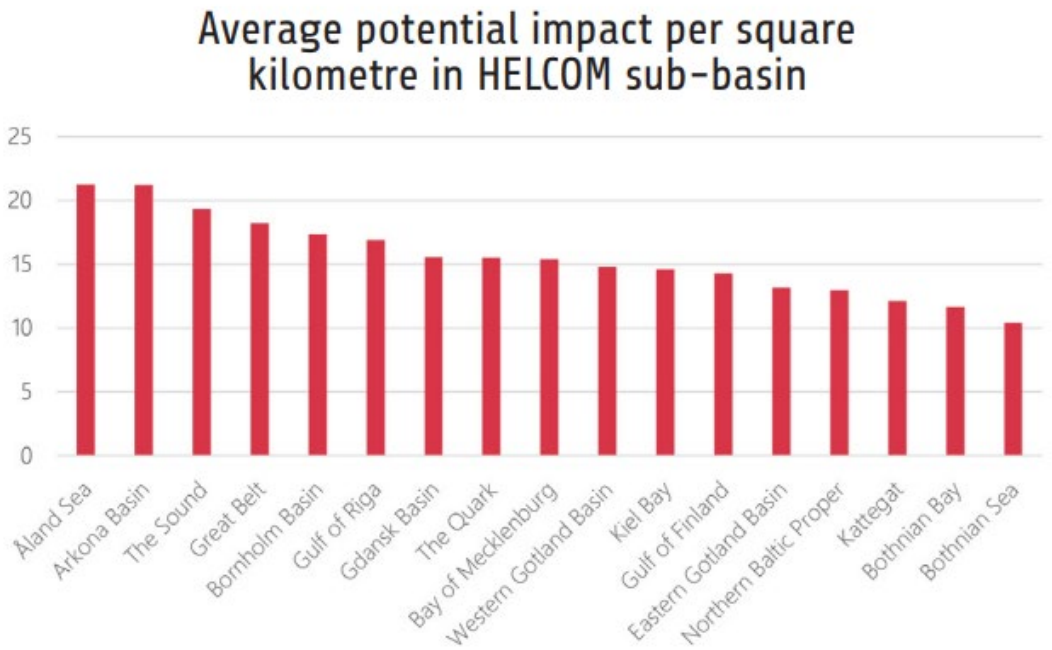
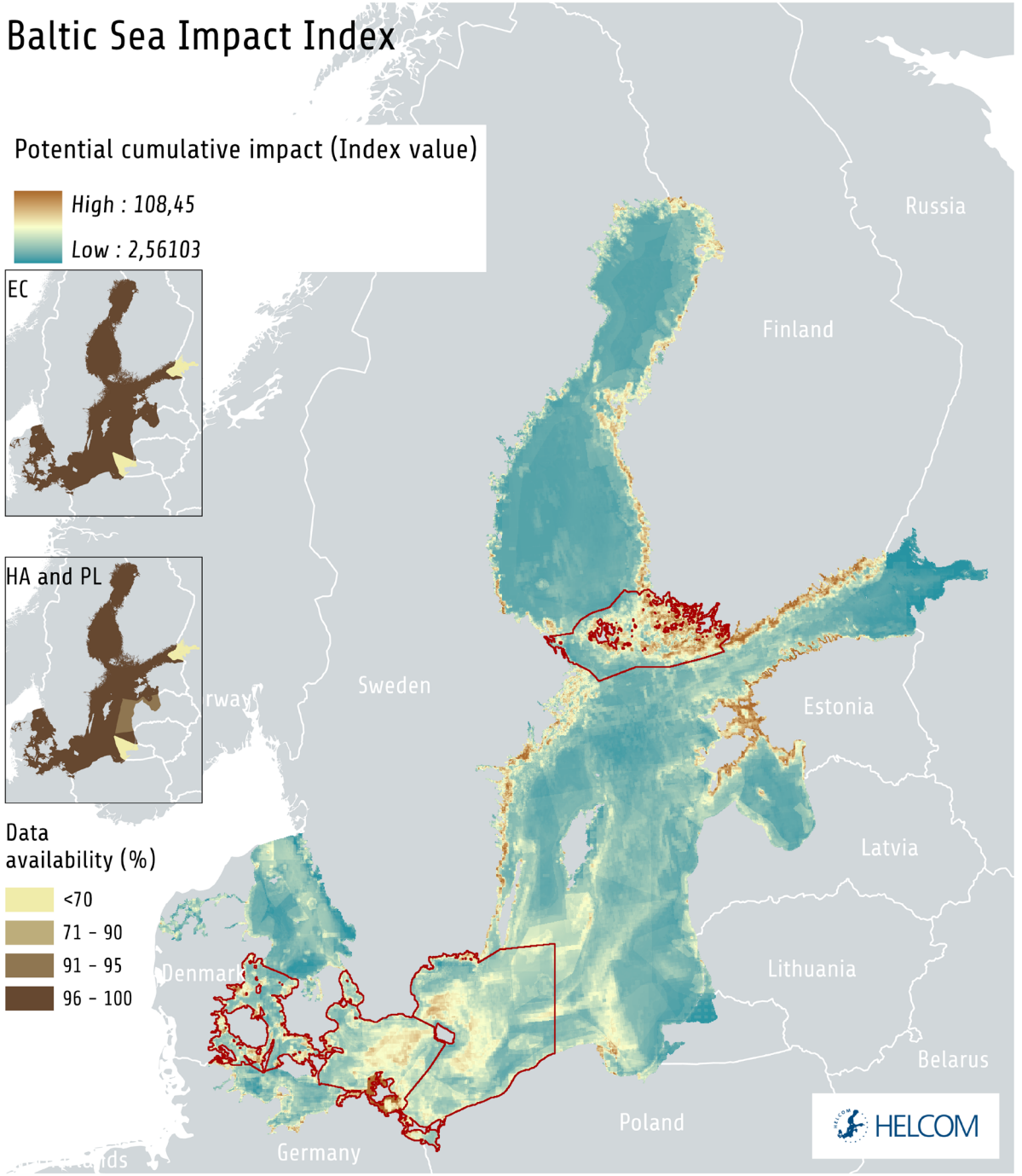


Figure 21. Average potential cumulative impact per square kilometre in HELCOM sub-basin in BSII.



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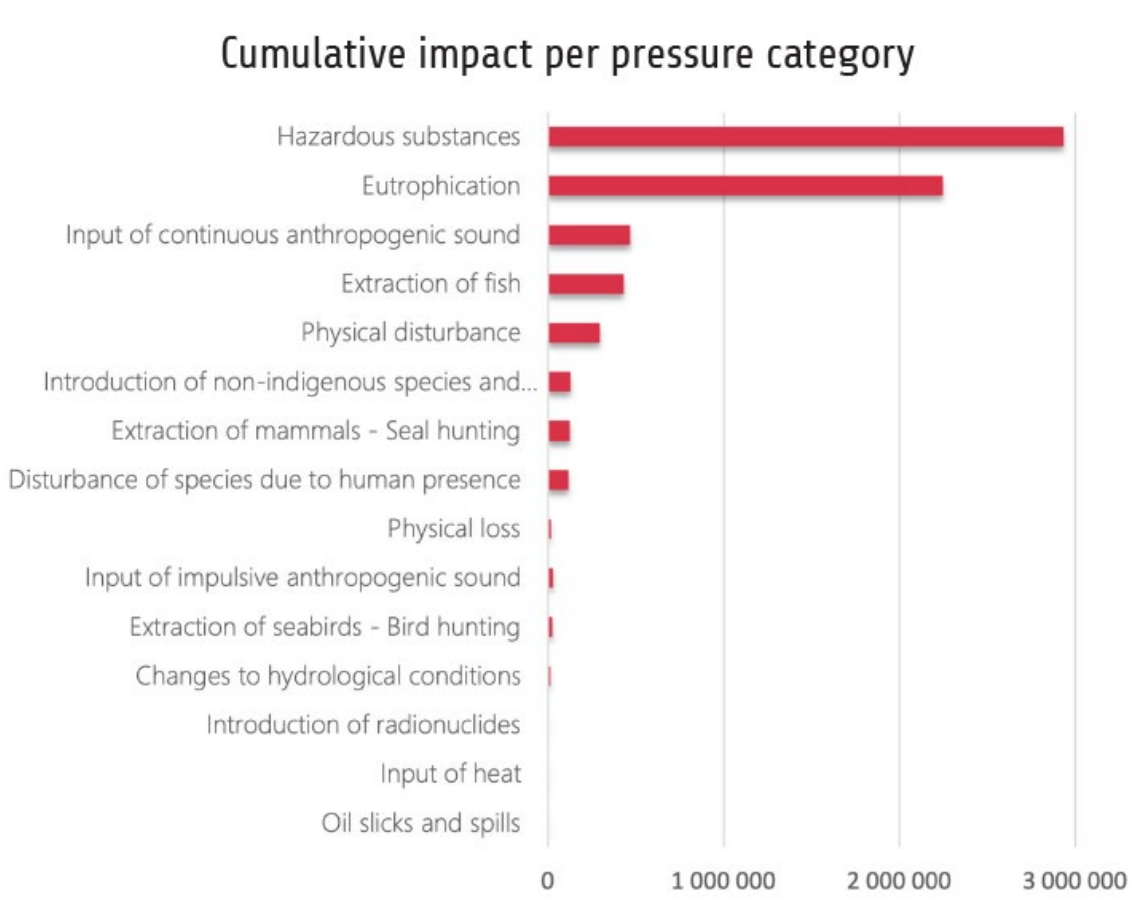
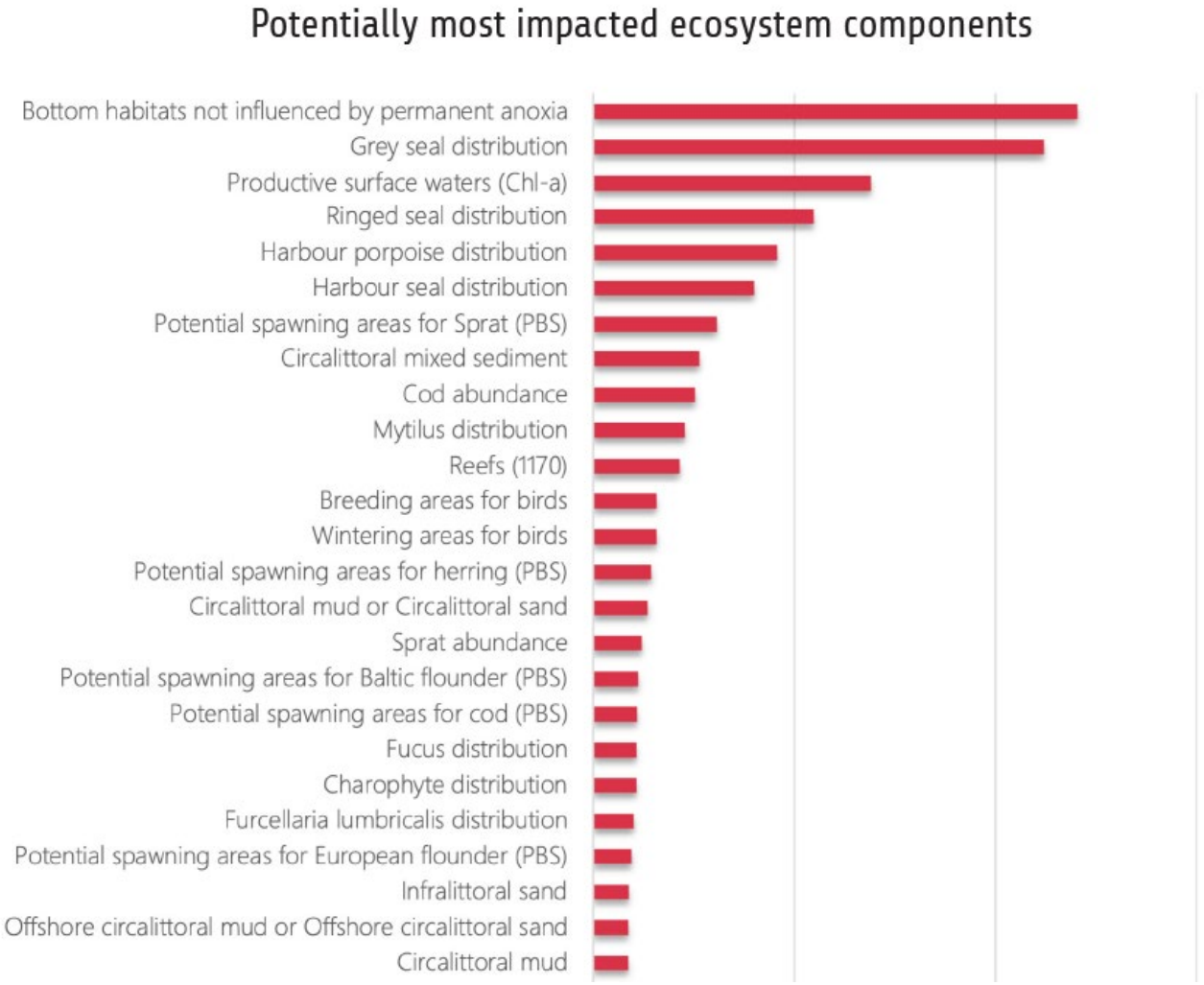
BSII top pressures and most impacted ecosystem components





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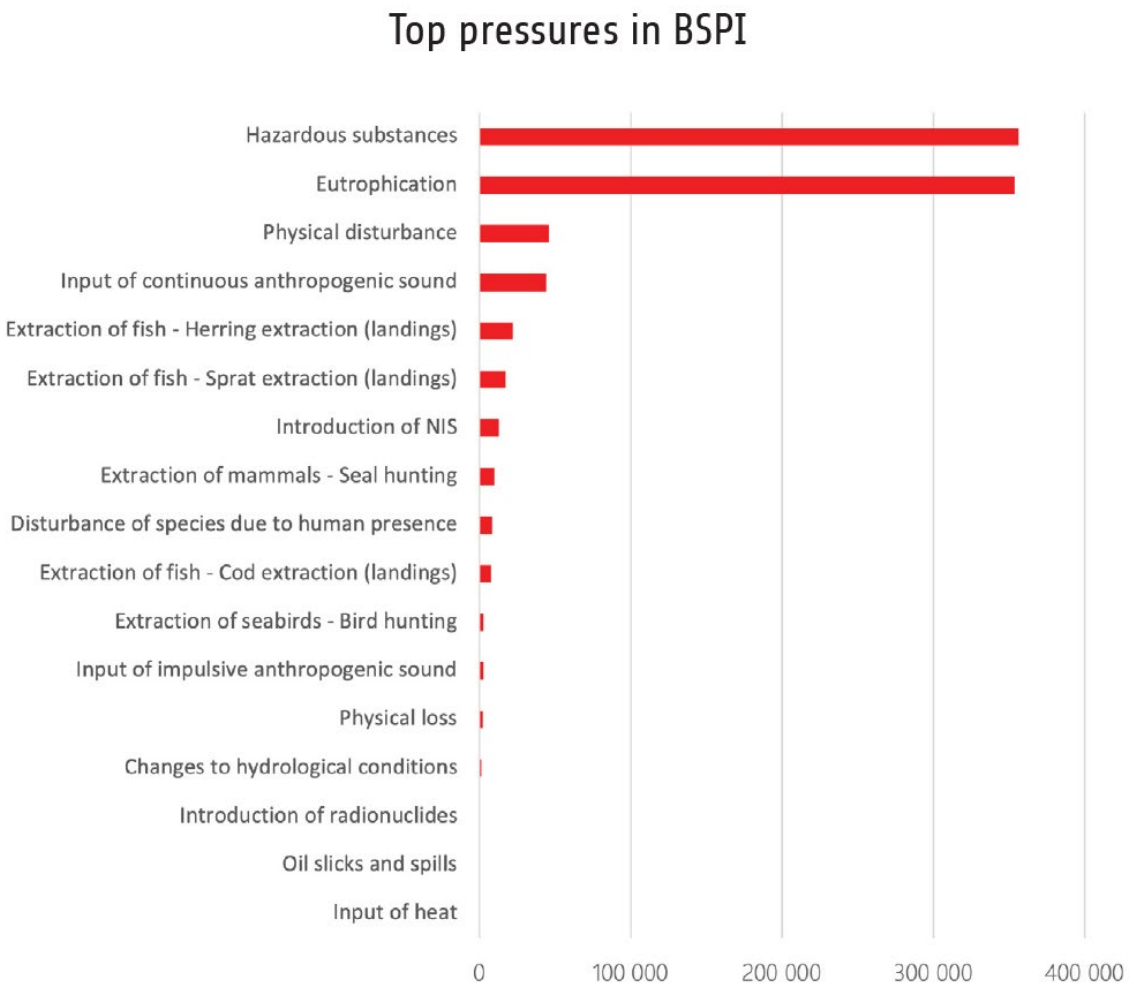
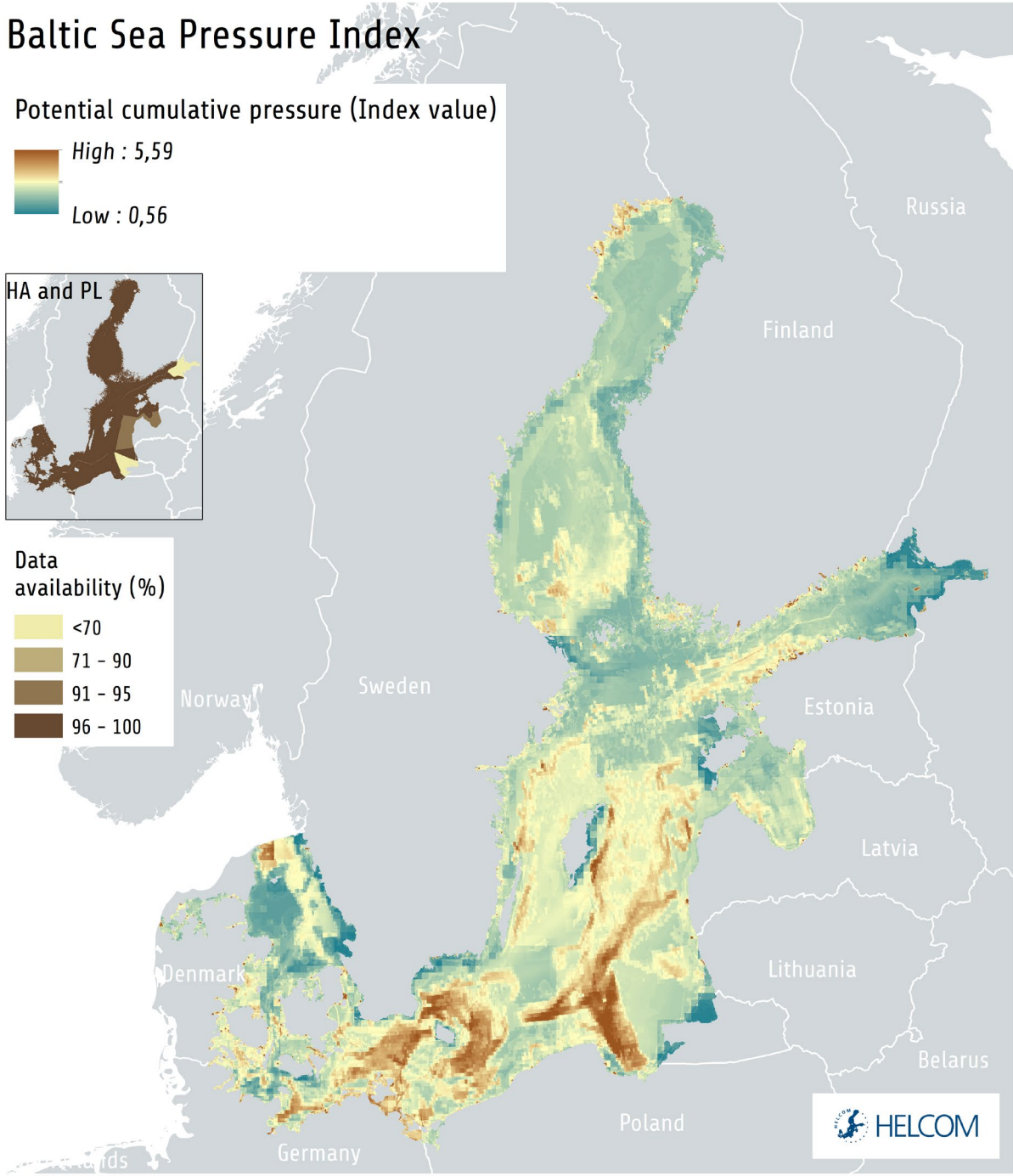
Baltic Sea Pressure Index (BSPI)





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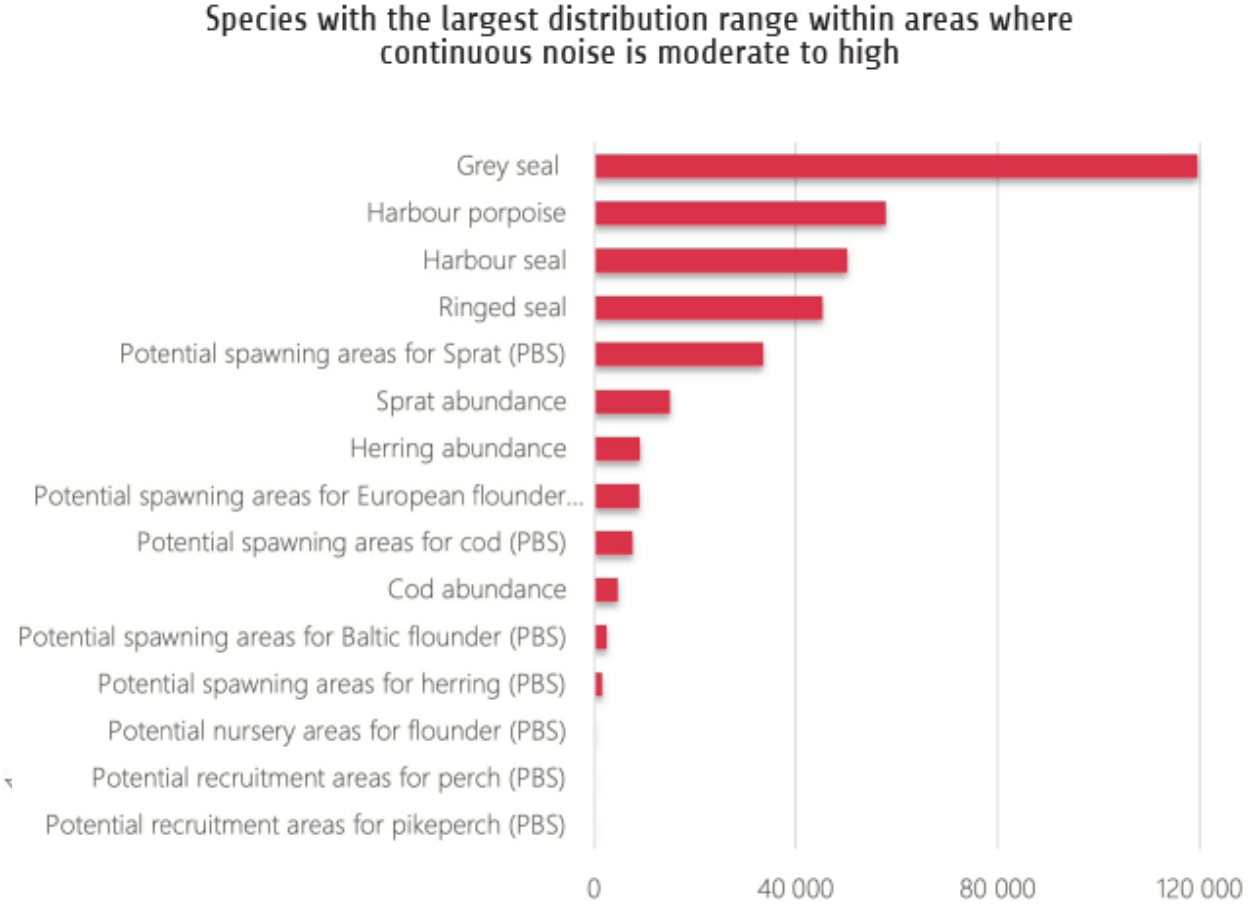
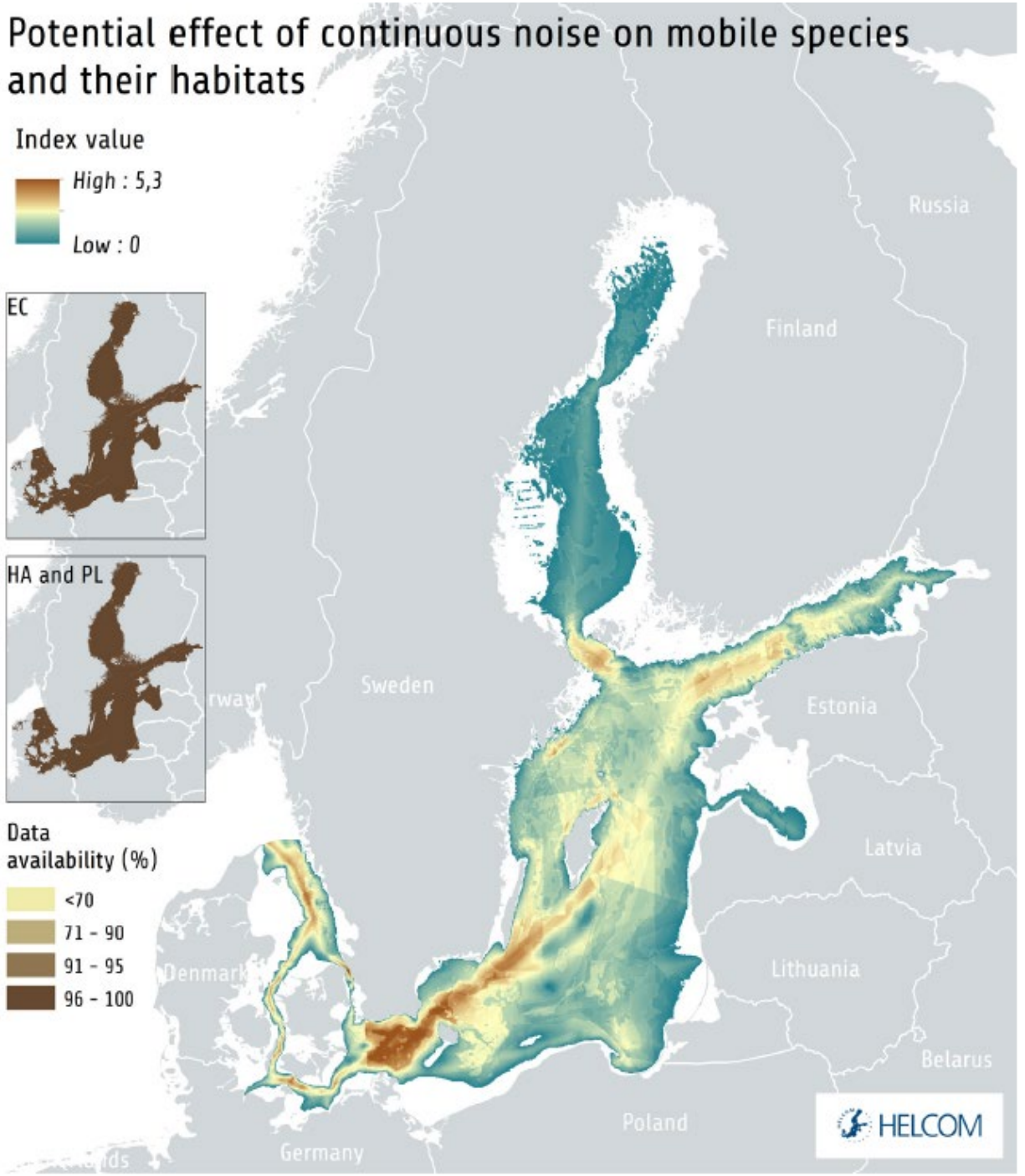
Potential effect of continuous noise to mobile species





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SPIA to support MSP and management

- The increasing use of sea areas leads to complex patterns and interactions between human activities, pressures and ecosystem components at sea.

  -> Tools to assess the spatial distribution of pressures and impacts are helpful to evaluate the combined and cumulative impact of human induced pressures on the environment, and to identify potential key areas of concern and enhanced management efforts.

- Outputs from the SPIA provide valuable information for marine spatial planning and marine management from various perspectives.

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SPIA to support MSP and 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:** The SPIA tool supports the written report, makes it 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
- **Scenario analyses:** Studying the impact of potential future sea uses

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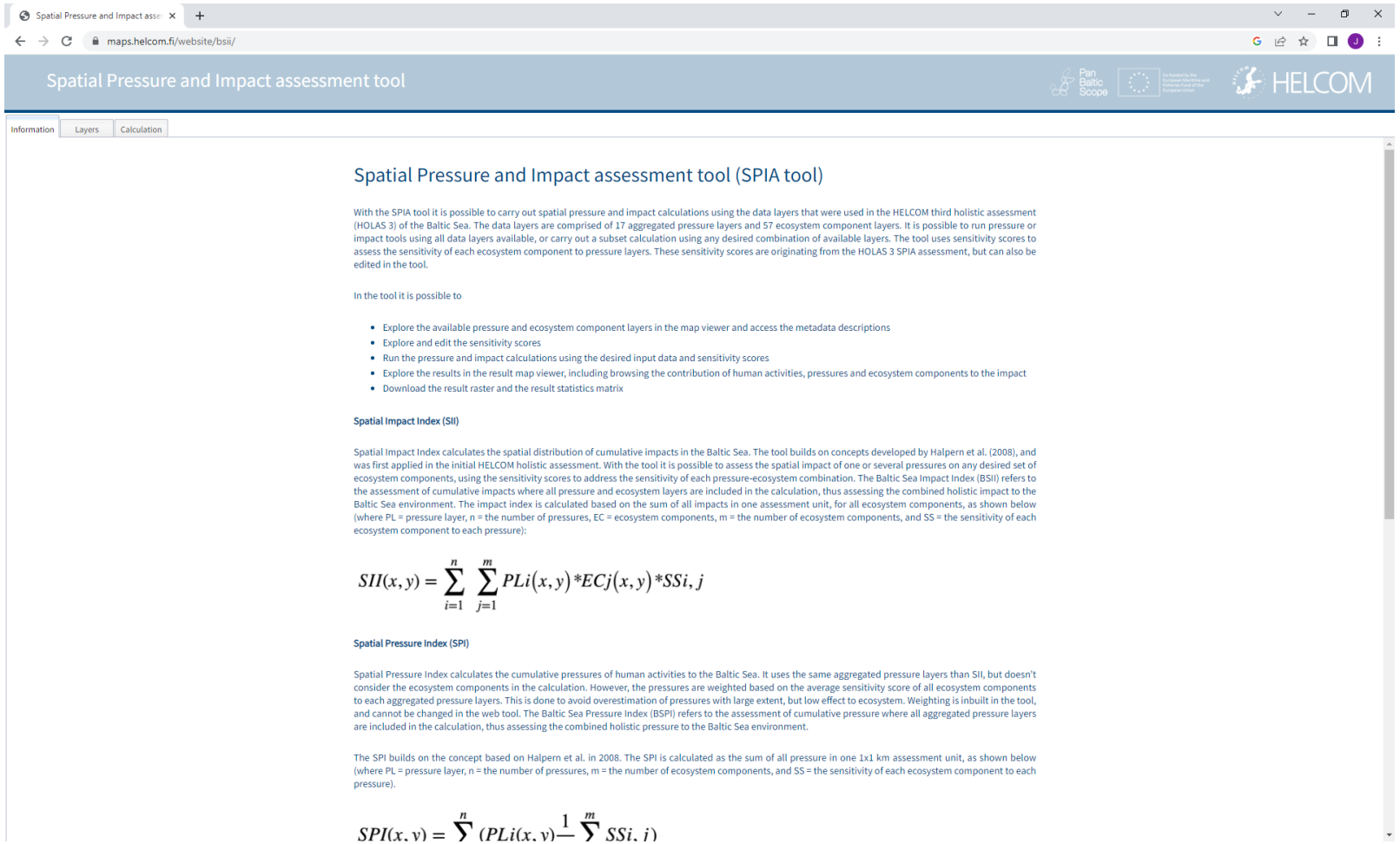
SPIA online tool

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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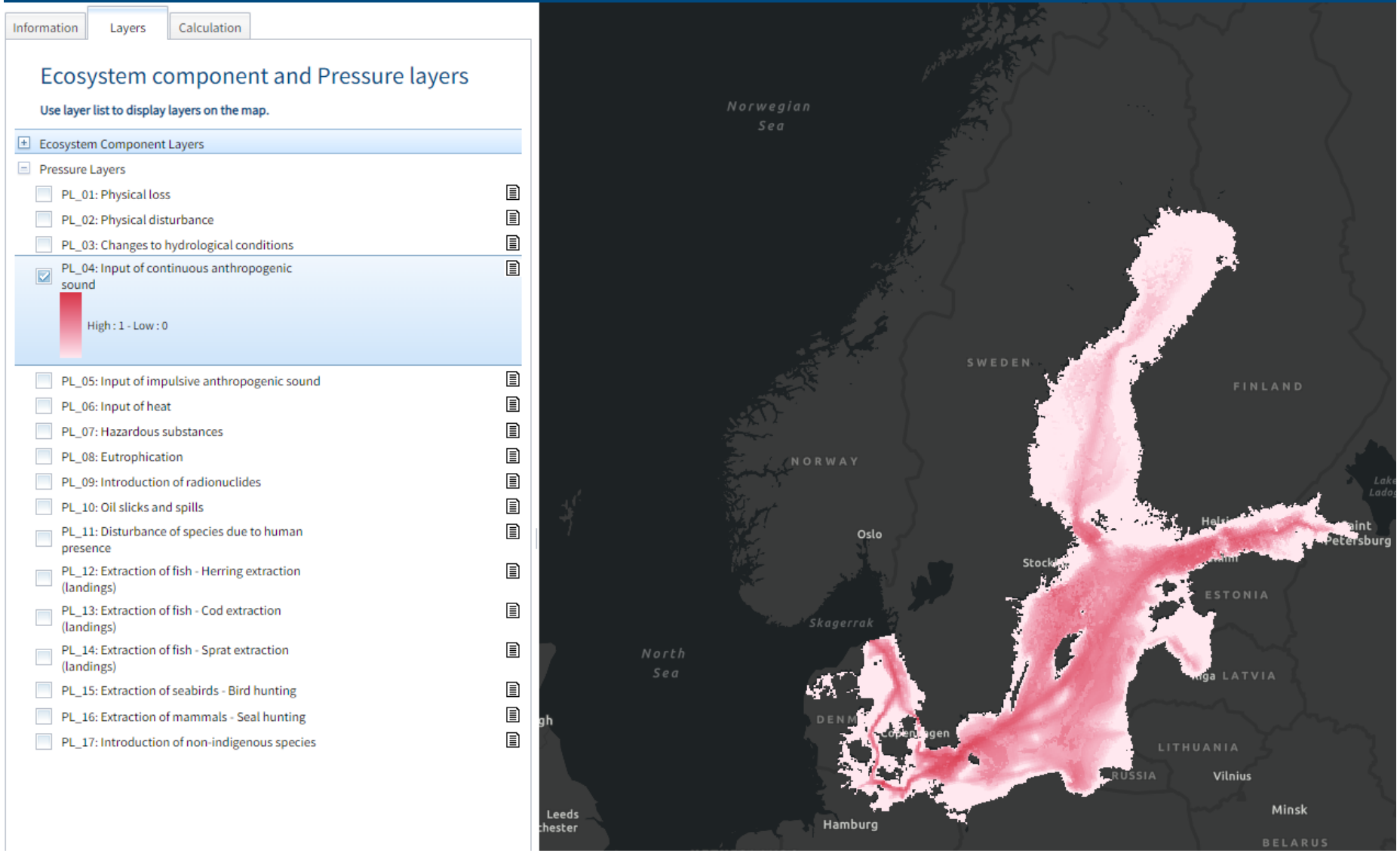
Spatial Pressure and Impact assessment tool



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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

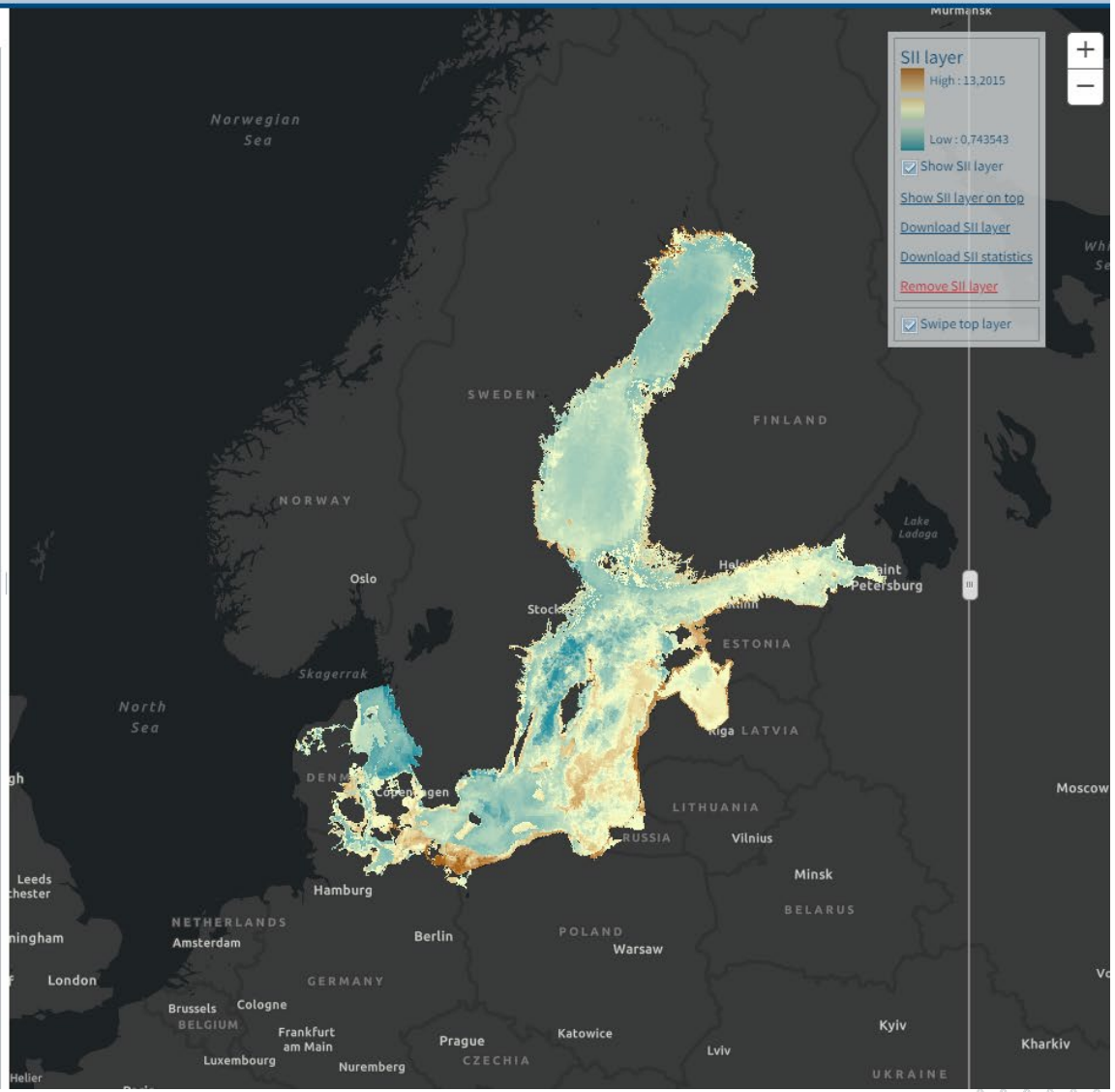
- PL_01: Physical loss
- PL_02: Physical disturbance
- PL_03: Changes to hydrological conditions
- PL_04: Input of continuous anthropogenic sound
- PL_05: Input of impulsive anthropogenic sound
- PL_06: Input of heat
- PL_07: Hazardous substances
- PL_08: Eutrophication
- PL_09: Introduction of radionuclides

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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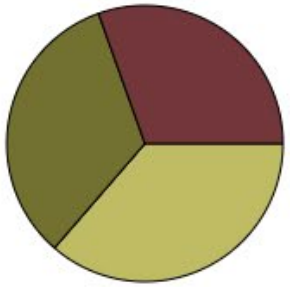
Information | Layers | Calculation

Back to calculation settings

Location information

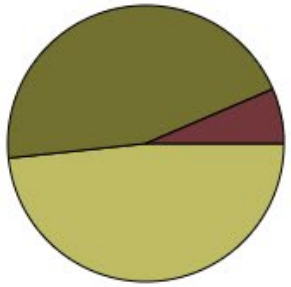
SII value: 5.6185

Ecosystem components contribution to SII



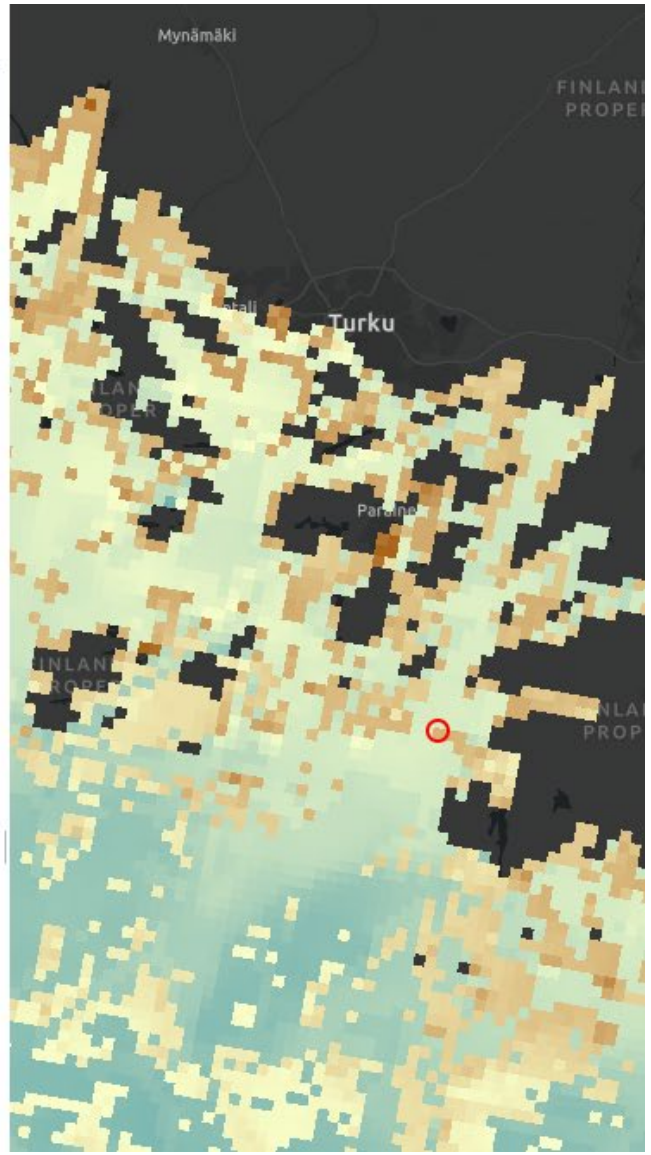
- Bottom-water habitats not influenced by permanent anoxia (36.36 %)
- Infralittoral rock and biogenic reef (33.18 %)
- Productive surface waters (Chl-a) (30.45 %)

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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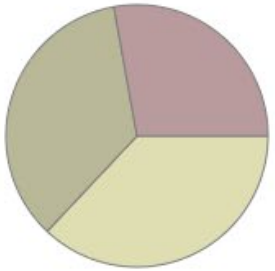
Information | Layers | Calculation

Back to calculation settings

Location information

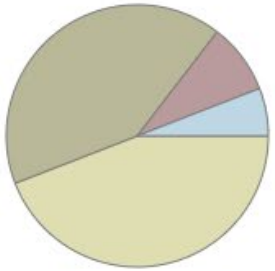
SII value: 6.1533

Ecosystem components contribution to SII

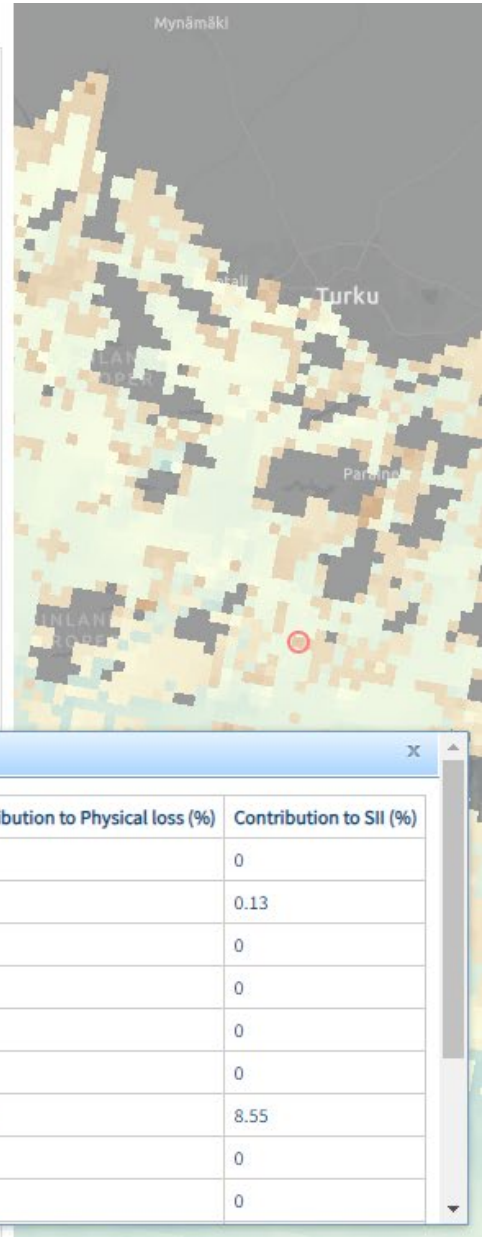


- Bottom-water habitats not influenced by permanent anoxia (37.03 %)
- Infralittoral rock and biogenic reef (35.15 %)
- Productive surface waters (Chl-a) (27.82 %)

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

- 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
- Supports MSP 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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