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European Maritime and
Fisheries Fund of the
European Union

Mapping marine green infrastructure at the Baltic Sea scale: Pan Baltic Scope approach

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MSP NATURE 2021 • Online Conference, 19-21 January 2021

Background: GI concept in EU policy

- GI concept introduced in the EU policy as a tool for implementation of the **EU Biodiversity Strategy 2020** on halting the loss of biodiversity (Target 2).
- **EU-wide strategy promoting investments in green infrastructure** (EC, 2013):
 - defines GI as *“Strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas.”*
 - encourages the deployment of GI across Europe as well as calls for GI becoming a standard part of spatial planning and territorial development
- **Guidance on a strategic framework for further supporting the deployment of EU-level green and blue infrastructure** (EC, 2019):
 - encourage scaling-up of investments in GI and stimulating a more strategic and integrated approach to deployment of GI at EU level.
- **EU Biodiversity Strategy 2030** (EC, 2020):
 - calls for investments in Natura 2000 and green infrastructure

Background: application of GI concept in marine context

- **HELCOM-VASAB MSP working group**, Warsaw, November 2017:
 - calls to investigate the possible regional concept of GI in the Baltic Sea region by 2019
- **Swedish approach:**
 - Green map - applying of GI concept in MSP
 - Regional “GI Action Plans” using Mosaic tool to facilitate EBA to spatial management of marine nature values
- **Joint Research Centre report “Strategic Green Infrastructure and Ecosystem Restoration” (2019):**
 - *“There is a significant gap in knowledge regarding the deployment of GI in the marine environment and regarding the nexus between blue-green infrastructure. The provision of a conceptual framework, data and tools for the mapping and assessment of marine ecosystems and their services (a marine MAES) would certainly help deploy a marine GI, particularly at the sea-land interface.”*
- **Report from the EC on progress in implementation of the EU GI strategy (2019):**
 - GI *“is not sufficiently used in maritime spatial plans, whereas it could contribute to healthy marine ecosystems and deliver substantial benefits in terms of food production, recreation and tourism, climate change mitigation and adaptation, shoreline dynamics control and disaster prevention”*

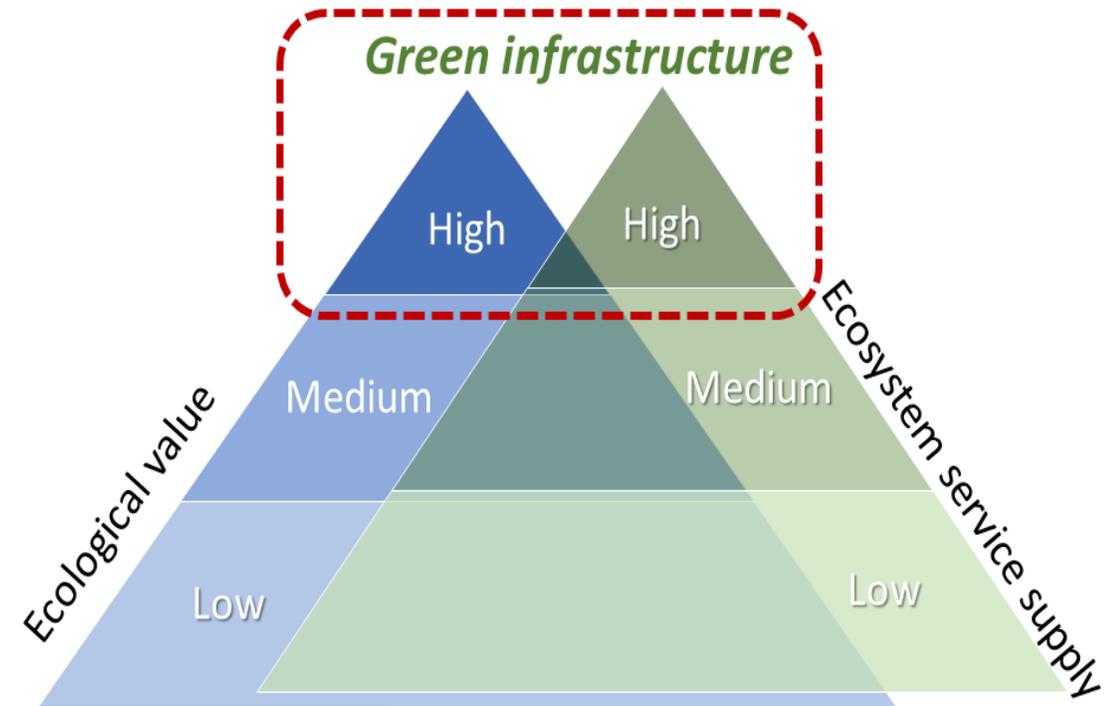
Pan Baltic Scope approach to marine GI mapping

Objective of the «Green Infra» activity in the Pan Baltic Scope

- To outline a concept of marine “green infrastructure”
- To test the concept by utilizing available data

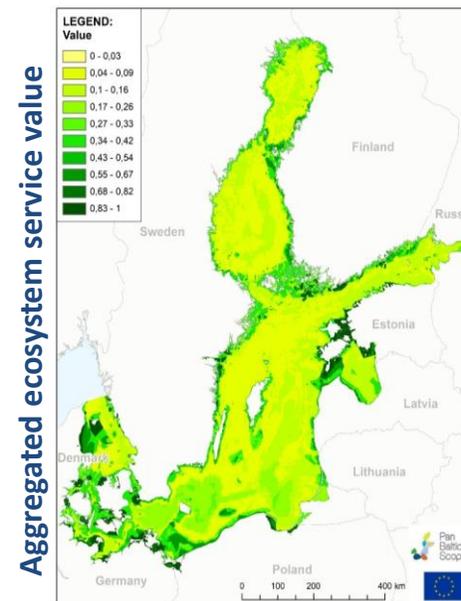
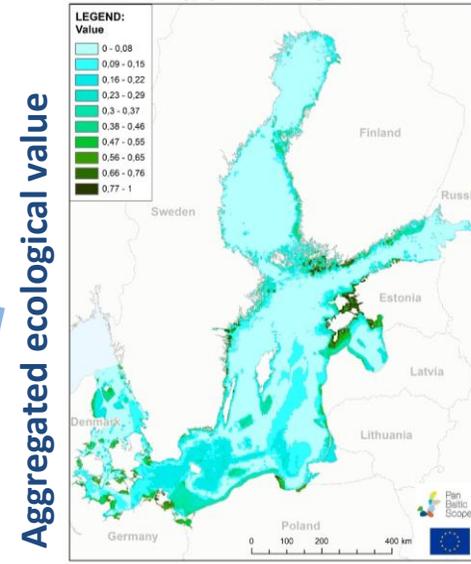
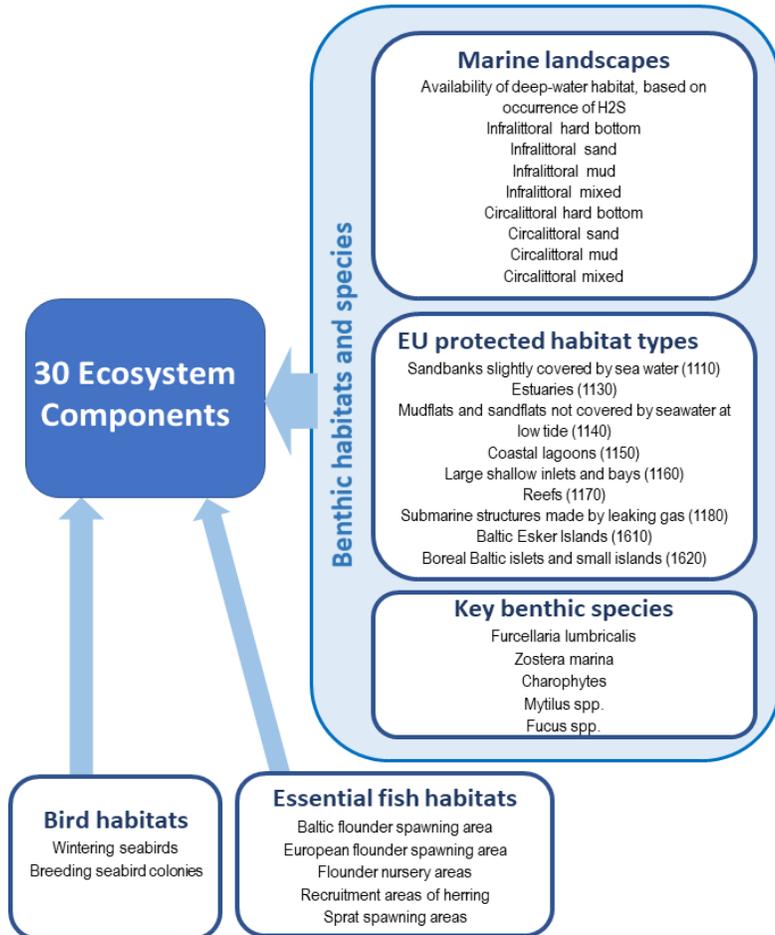
Pan Baltic Scope definitions: Marine GI is formed by a spatial network of ecologically valuable areas significant for:

- ecosystems’ health and resilience,
- biodiversity conservation and,
- multiple delivery of ES essential for human well-being.

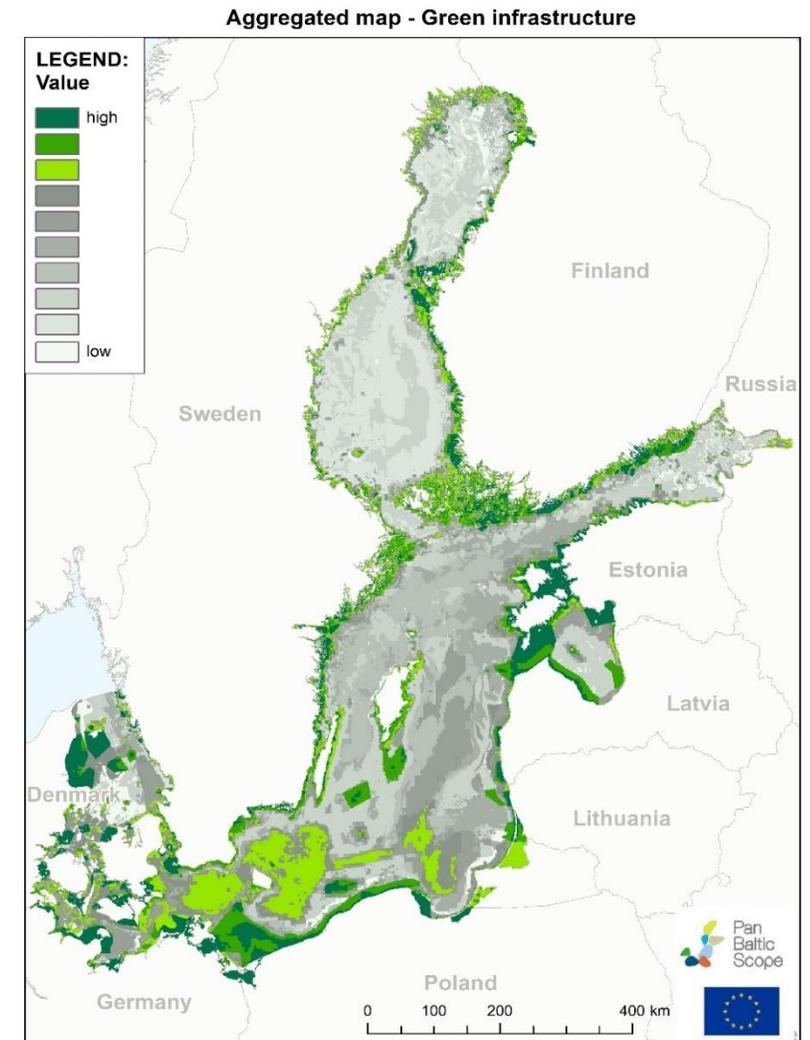


Pan Baltic Scope approach to marine GI mapping

Mapping based on available data sets:
 HELCOM Maps and Data services, prepared
 in the HELCOM HOLAS II project



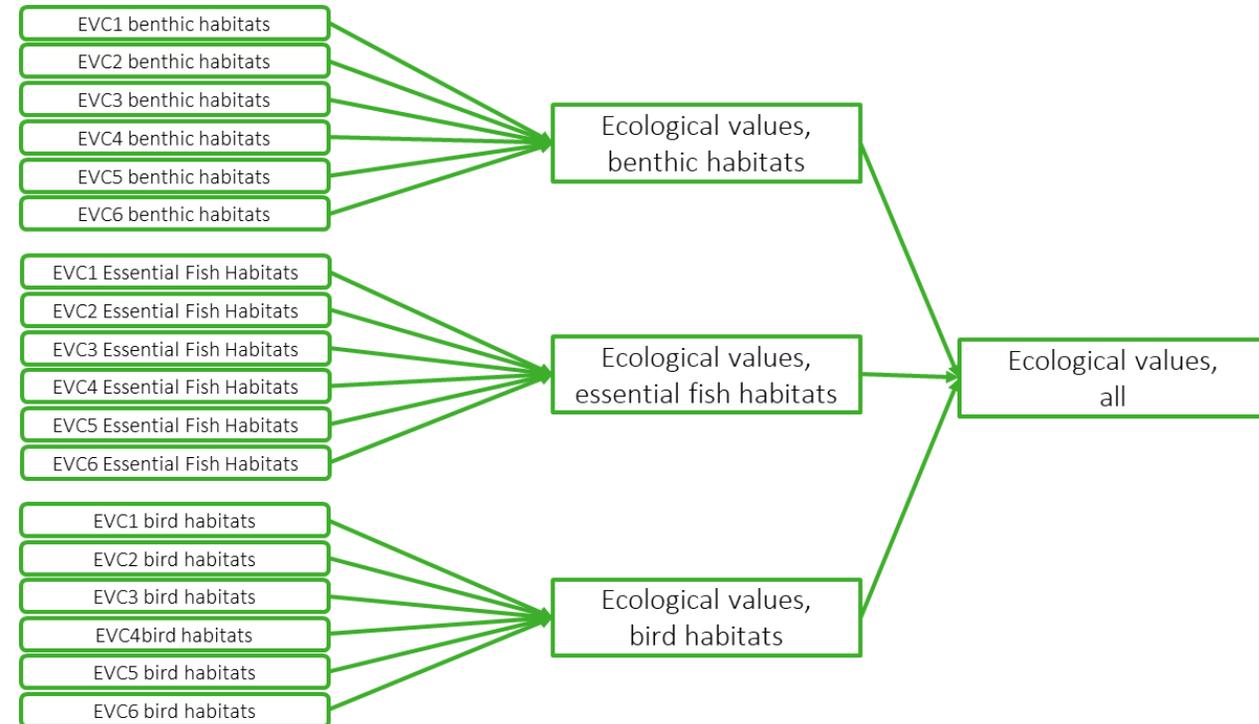
Areas of highest value identified as marine GI



Mapping areas of high ecological value

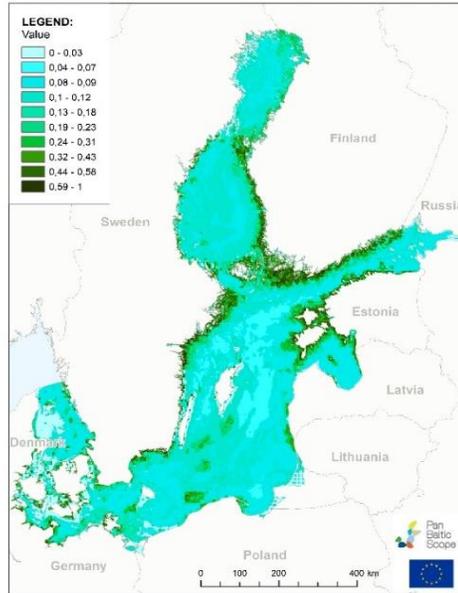
- **Matrix assessment (0 or 1): Ecosystem components in relation to 7 ecological value criteria:** biological diversity; rarity; importance for threatened, endangered or declining species and/or habitats; vulnerability, fragility, sensitivity, or slow recovery; special importance for life-history stages of species; biological productivity
- **Hierarchical data aggregation method in GIS:**

HELCOM BSII Ecological Diversity Components	Biodiversity	Rarity	Importance for threatened, endangered or declining species and/or habitats	Vulnerability, fragility, sensitivity or slow recovery	Special importance for life-history stages of species	Biological productivity
Availability of deep water habitat, based on occurrence of H2S	0	1	0	0	0	0
Infralittoral hard bottom	0	1	0	0	0	0
Infralittoral sand	0	1	0	0	0	0
Infralittoral mud	0	1	0	0	0	0
Infralittoral mixed	0	1	0	0	0	0
Circalittoral hard bottom	1	1	1	1	1	1
Circalittoral sand	0	1	1	1	1	1
Circalittoral mud	0	1	1	1	1	1
Circalittoral mixed	1	1	1	1	1	1
Sandbanks which are slightly covered by sea water at all time (1110)	1	1	1	1	1	1
Estuaries (1130)	1	1	1	0	1	1
Mudflats and sandflats not covered by seawater at low tide (1140)	0	1	0	0	0	0
Coastal lagoons (1150)	1	1	1	0	1	1
Large shallow inlets and bays (1160)	1	1	1	1	1	1
Reefs (1170)	1	1	1	1	1	1
Submarine structures made by leaking gas (1180)	1	1	1	1	1	1
Baltic Esker Islands (UW parts, 1610)	1	1	1	1	1	1
Boreal Baltic islets and small islands (UW parts, 1620)	1	1	1	1	1	1
Furcellaria lumbricalis	1	1	1	1	1	1
Zostera marina	1	1	1	1	1	1
Charophytes	1	1	1	1	1	1
Mytilus sp.	1	1	1	1	1	1
Fucus sp.	1	1	1	1	1	1
Productive surface waters	1	1	1	0	1	1
Cod abundance	0	0	1	0	0	1
Cod spawning area	1	1	1	1	1	1
Herring abundance	0	0	0	0	0	1
Sprat abundance	0	0	0	0	0	1
Recruitment areas of perch	1	1	1	1	1	1
Recruitment areas of pikeperch	0	1	1	1	1	1
Wintering seabirds	1	1	1	1	1	0
Breeding seabird colonies	1	1	1	1	1	0
Grey seal distribution	0	0	0	0	0	0
Harbour seal distribution	0	0	0	0	0	0
Ringed seal distribution	1	1	1	1	0	0
Distribution of harbour porpoise	1	1	1	1	0	0



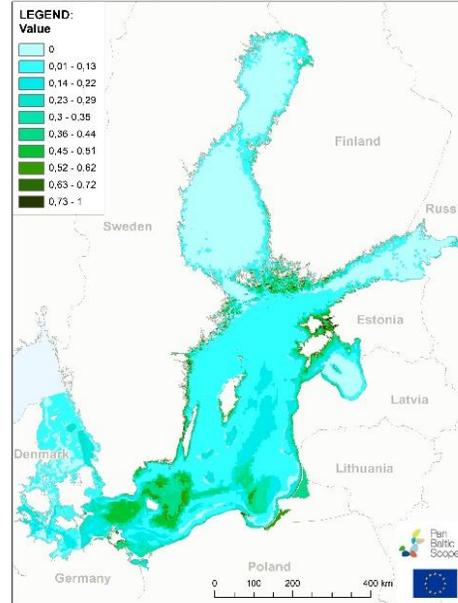
EV - Benthic

Aggregated map of ecological value – benthic habitats and species



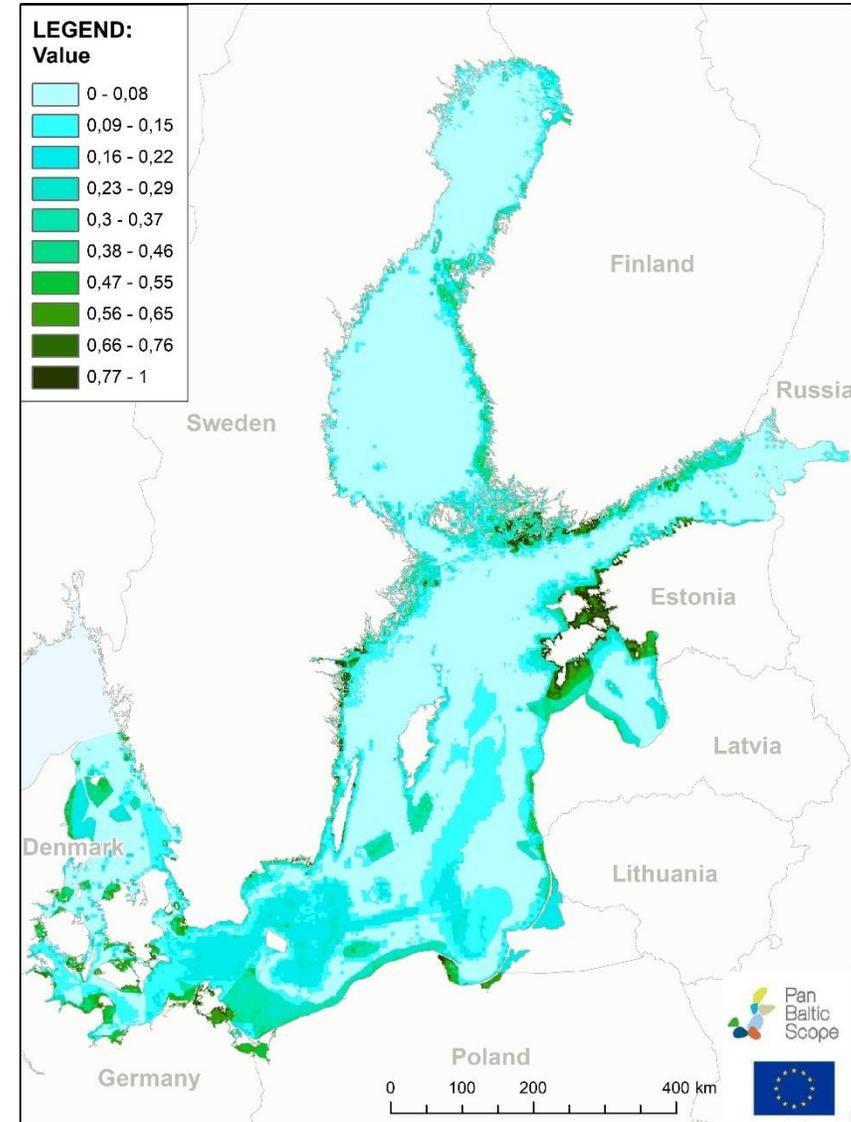
EV - Fish

Aggregated map of ecological value – essential fish habitats



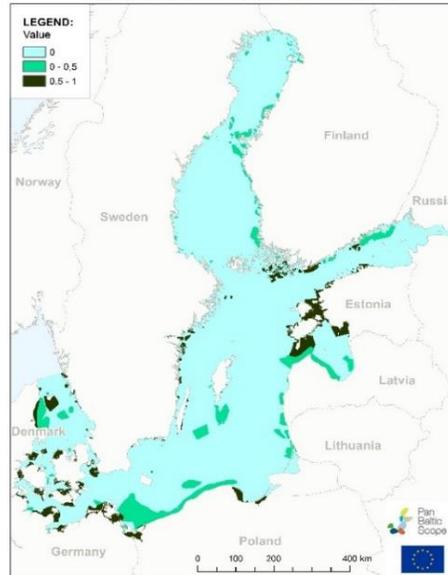
Aggregated EV maps

Aggregated map of ecological value



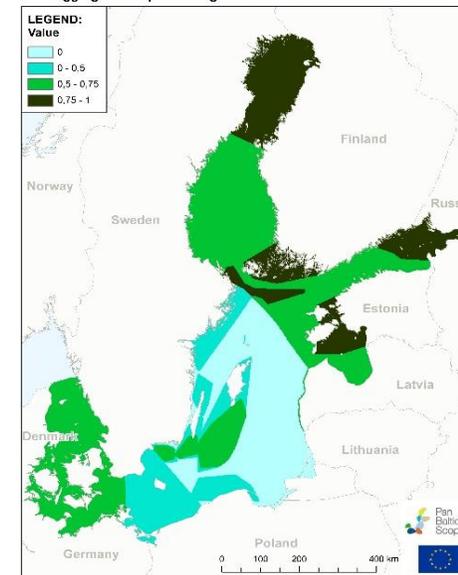
EV - Birds

Aggregated map of ecological value – bird habitats



EV - mammals

Aggregated map of ecological value – marine mammal habitats



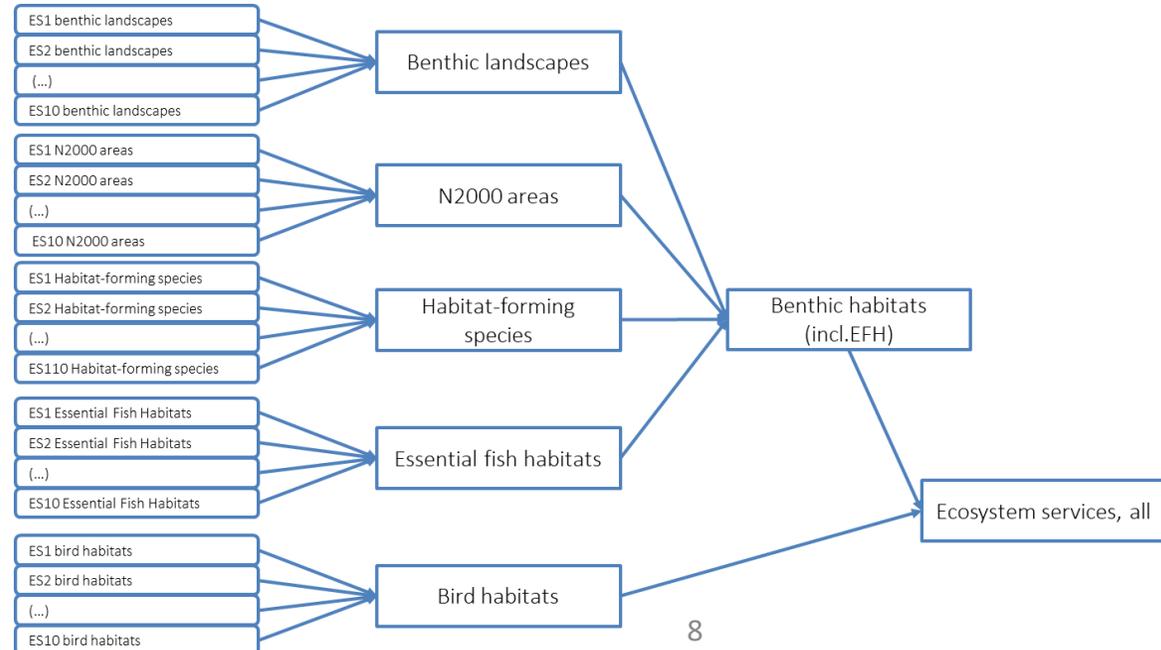
Mapping of the areas of ecosystem service (ES) supply potential

➤ Matrix assessment: Ecosystem components in relation to 10 ecosystem services:

- 1) filtration of nutrients; 2) storage of nutrients; 3) storage of hazardous substances;
- 4) erosion control; 5) nursery habitats; 6) pest control;
- 7) climate control by biological fixation photosynthesis & 8) by sequestration in sediments;
- 9) recreation through active a& 10) passive interactions

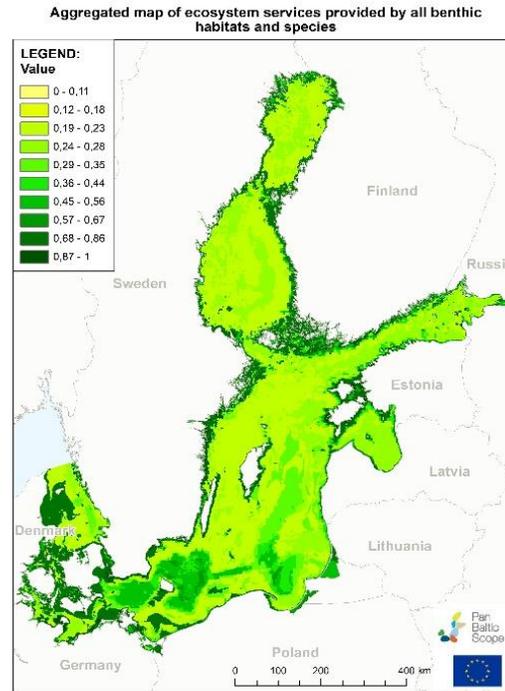
➤ Hierarchical data aggregation method in GIS:

HELCOM BSII Ecological Diversity Components	Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals			Control of erosion rates	Maintaining nursery populations and habitats	Pest control (including invasive species)	Regulation of chemical composition of atmosphere and oceans (atmospheric CO ₂ and other greenhouse gases)		Characteristics of living systems that enable activities promoting health, recuperation or enjoyment	
	filtration of nutrients	storage of nutrients	storage of hazardous substances				by biological fixation in process of photosynthesis	by sequestration in sediments	through active or immersive interactions	through passive or observational interactions
Availability of deep water habitat, based on occurrence of H2S	0	1	1	0	0	0	0	1	0	0
Infralittoral hard bottom	1	1	1	1	1	0	1	0	1	1
Infralittoral sand	0	1	1	0	1	0	1	0	1	1
Infralittoral mud	0	1	1	0	1	0	1	1	0	0
Infralittoral mixed	1	1	1	1	1	0	1	0	0	0
Circalittoral hard bottom	1	1	1	0	0	0	0	0	0	0
Circalittoral sand	0	1	1	0	0	0	0	1	0	0
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Productive surface waters	1	0	0	0	1	0	1	0	1	1
Cod abundance	0	1	1	0	0	1	0	0	1	0
Cod spawning area	0	1	1	0	1	1	0	0	0	0
Herring abundance	0	1	1	0	0	0	0	0	1	0
Sprat abundance	0	1	1	0	0	0	0	0	1	0
Recruitment areas of perch	0	1	1	0	1	1	0	0	0	0
Recruitment areas of pikeperch	0	1	1	0	1	1	0	0	0	0
Wintering seabirds	0	1	1	0	0	1	0	0	1	1
Breeding seabird colonies	0	1	1	0	0	1	0	0	1	1
Grey seal distribution	0	1	0	0	0	0	0	0	1	1
Harbour seal distribution	0	1	0	0	0	0	0	0	1	1
Ringed seal distribution	0	1	0	0	0	0	0	0	1	1
Distribution of harbour porpoise	0	0	0	0	0	0	0	0	1	1

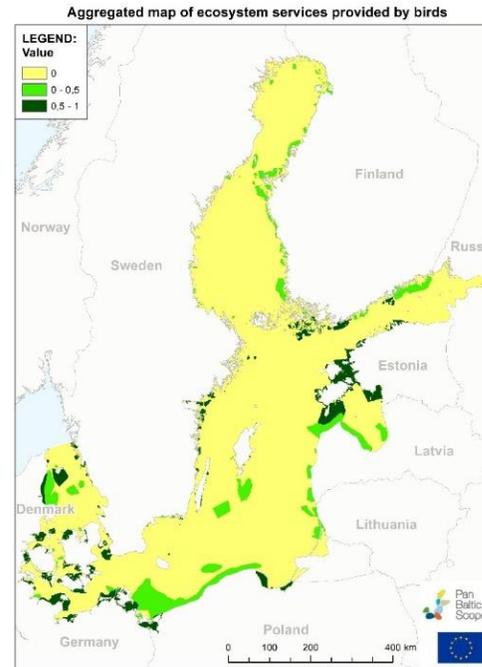


Aggregated ecosystem service maps

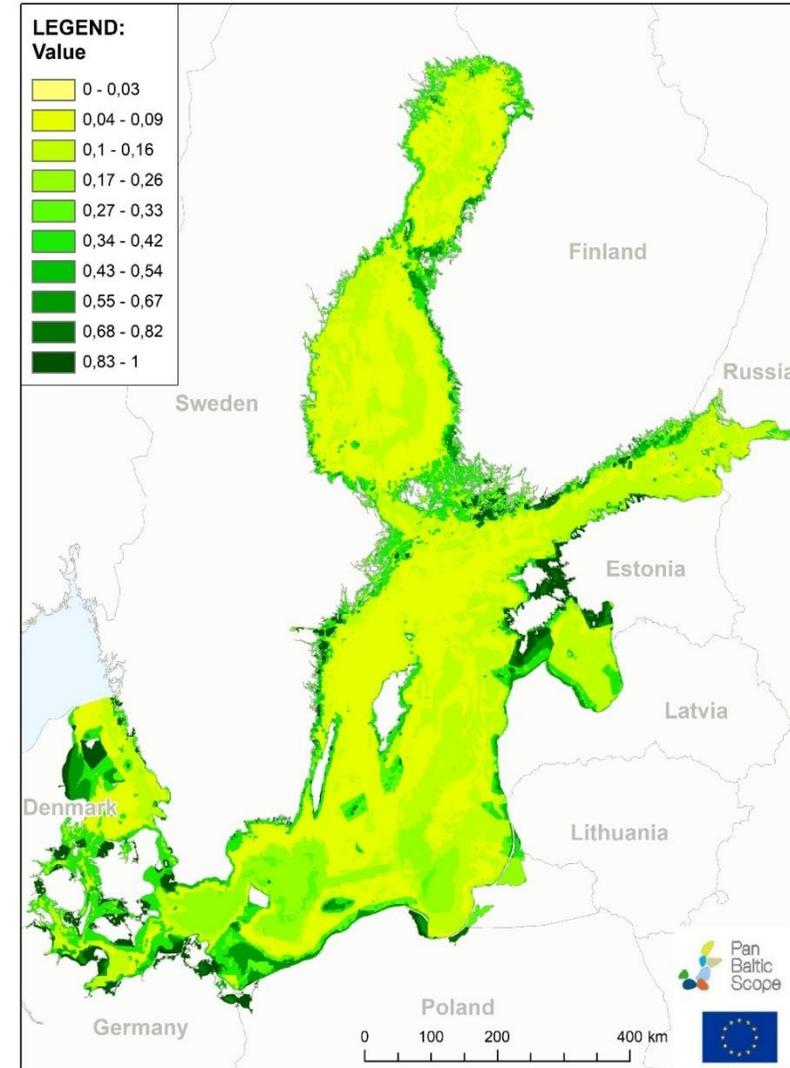
ES – Benthic (including ESH)



ES - Birds



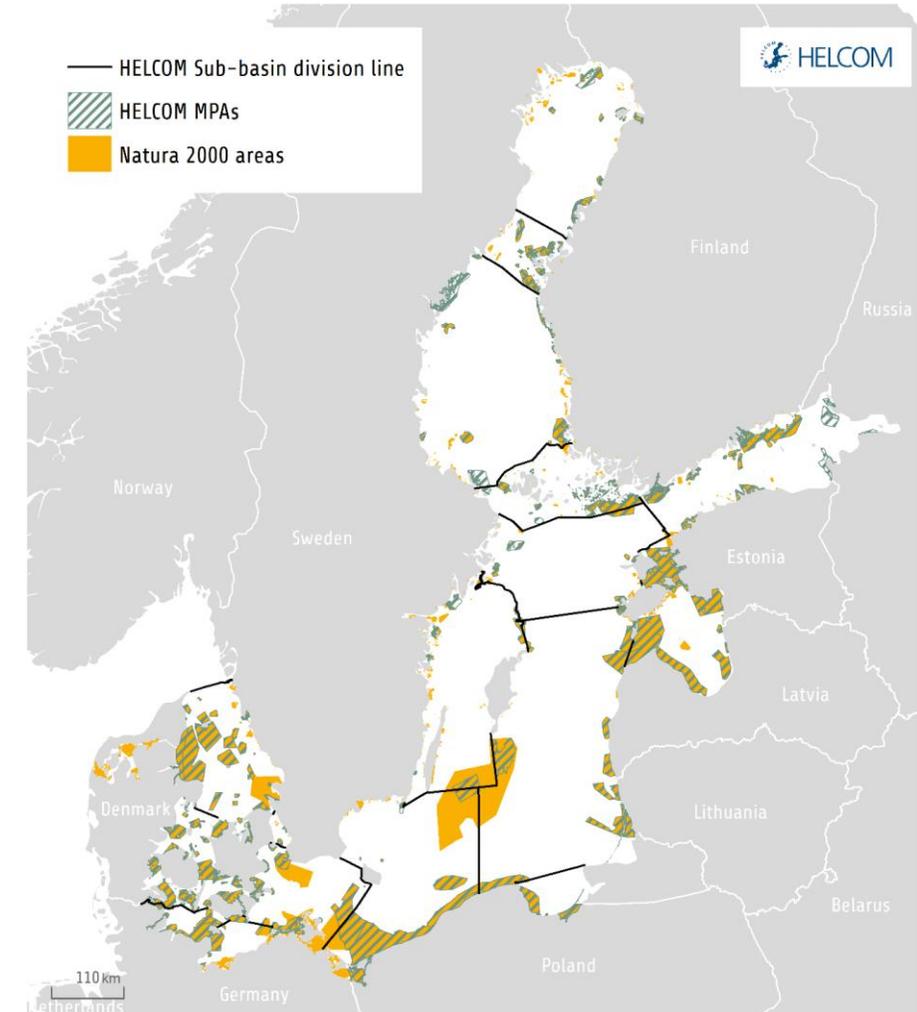
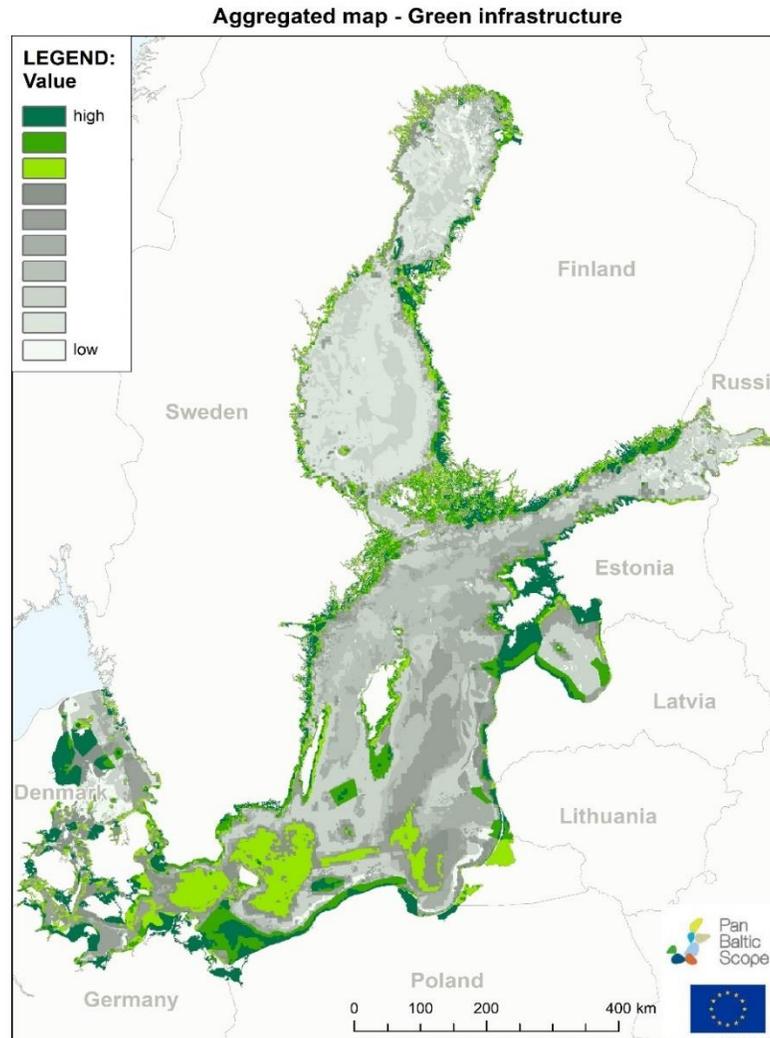
Aggregated map of the ecosystem services supply potential



Marine GI mapping: combining the tow

Results of testing Pan Baltic Scope approach to marine GI mapping :

- green color indicates the 30 % of the Baltic Sea area which represents the highest ecological and ecosystem service supply value (the most valuable areas in dark green, other highly valuable areas in light green).



The outcomes of the 3rd Baltic MSP Forum

19-21 November 2019, Riga, Latvia

organised together by VASAB, UNESCO's IOC, EC DG-Mare, Pan Baltic Scope and University of Latvia



Session on marine GI and its role in MSP – main conclusions:

- GI concept is good for supporting implementation of EBA in MSP
- GI can help boosting MPA network and vice versa. It goes beyond MPAs – helping to improve connectivity of MPAs as well as respecting common species, which are important for ecosystem and for us.
- GI does not require statutory protection, but should be considered in development of MSP solutions
- GI mapping should consider climate change impacts on ecosystem
- It is good tool for communicating ecological values to decision makers, but we should think about better “packaging” of the concept

Study on Integrating an Ecosystem-based Approach into MSP

The study commissioned by the European Commission/DG MARE & EASME

Aims of the study: to develop a “practical method with a set of guidelines and tools for Member States to integrate EBA in MSP”

Tasks: include review and analysis of the baseline information; developing a practical method, case studies and workshops





Baltic Case study

Aims:

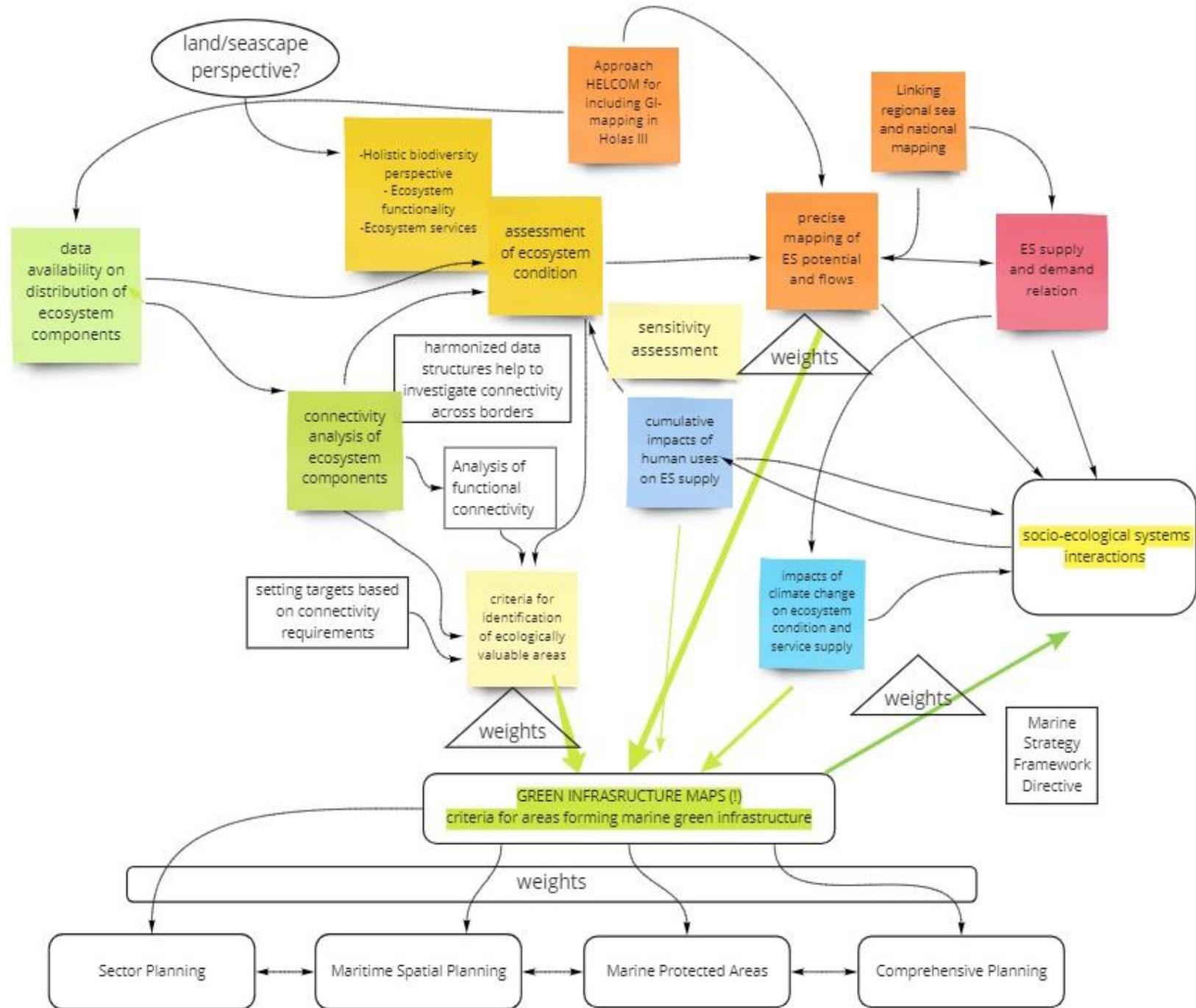
- to examine the methods applied in the Baltic Sea region for marine GI mapping
- to explore opportunities for its further methodological development and operationalising in MSP

Implementation:

- built on experience gained in the Pan Baltic Scope project
- online expert workshop, presentation at CAPACITY4MSP Planning forum
- case study report will be available in end January 2021

Outcomes of the online expert workshop, 26 October 2020

- **Mind map** of different aspects to be considered in marine GI mapping:
 - ecosystem condition & connectivity
 - ecologically valuable areas
 - mapping of ecosystem services
 - sensitivity assessment
 - cumulative impact assessment
 - assessment of climate change impact
- **Data availability** - precondition for GI mapping. HELCOM support needed in development of new data sets
- **Connectivity analysis** - the major focus for further development of GI mapping methodology: functional connectivity of ecosystem components, conditions for dispersal of species, and how sea-use activities can hamper the connectivity.



Potentials for operationalising GI concept at different stages of MSP

MSP steps	Opportunities
Defining	<ul style="list-style-type: none"> defining ecosystem components essential for marine ecosystem and human well-being setting objectives & targets
Developing	<ul style="list-style-type: none"> mapping of marine GI considering ecologically valuable or sensitive areas in development of spatial solutions using GI mapping as a basis for development of sustainable Blue Economy
Assessing	<ul style="list-style-type: none"> assessing impacts of alternative scenarios & SEA applying in GI/ ES in socioeconomic analysis identifying mitigation measures to minimize negative impacts on GI
Implementing	<ul style="list-style-type: none"> applying in EIA supporting cross-border coordination of the planning solutions in respect to ecological values
Follow-up	<ul style="list-style-type: none"> applying in monitoring: assessment of ecosystem condition and impacts of applied MSP solutions linking to MSFD-monitoring frameworks

Thank you!



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