

A coastal scene at sunset or sunrise. The sky is a mix of light blue and yellow, with a few wispy clouds. The sea is dark blue with white foam from the waves. In the foreground, there are dark, silhouetted rocks. A single seagull is perched on one of the rocks. In the distance, several large ships are visible on the horizon. A white text box is overlaid on the right side of the image, containing the title and author information.

Ecosystem Services - coastal and marine policy

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Overview

1. Introduction
2. Ecosystem services within EU policy
3. Mapping and assessment of marine ecosystem services
4. Overview of marine ecosystem services
5. Application in the Baltic Sea
6. Summary



1. Introduction

Pressures on marine ecosystems

→ Coastal and marine policy: aims at reducing or mitigating pressures

Eutrophication

Species removal by fishing and hunting

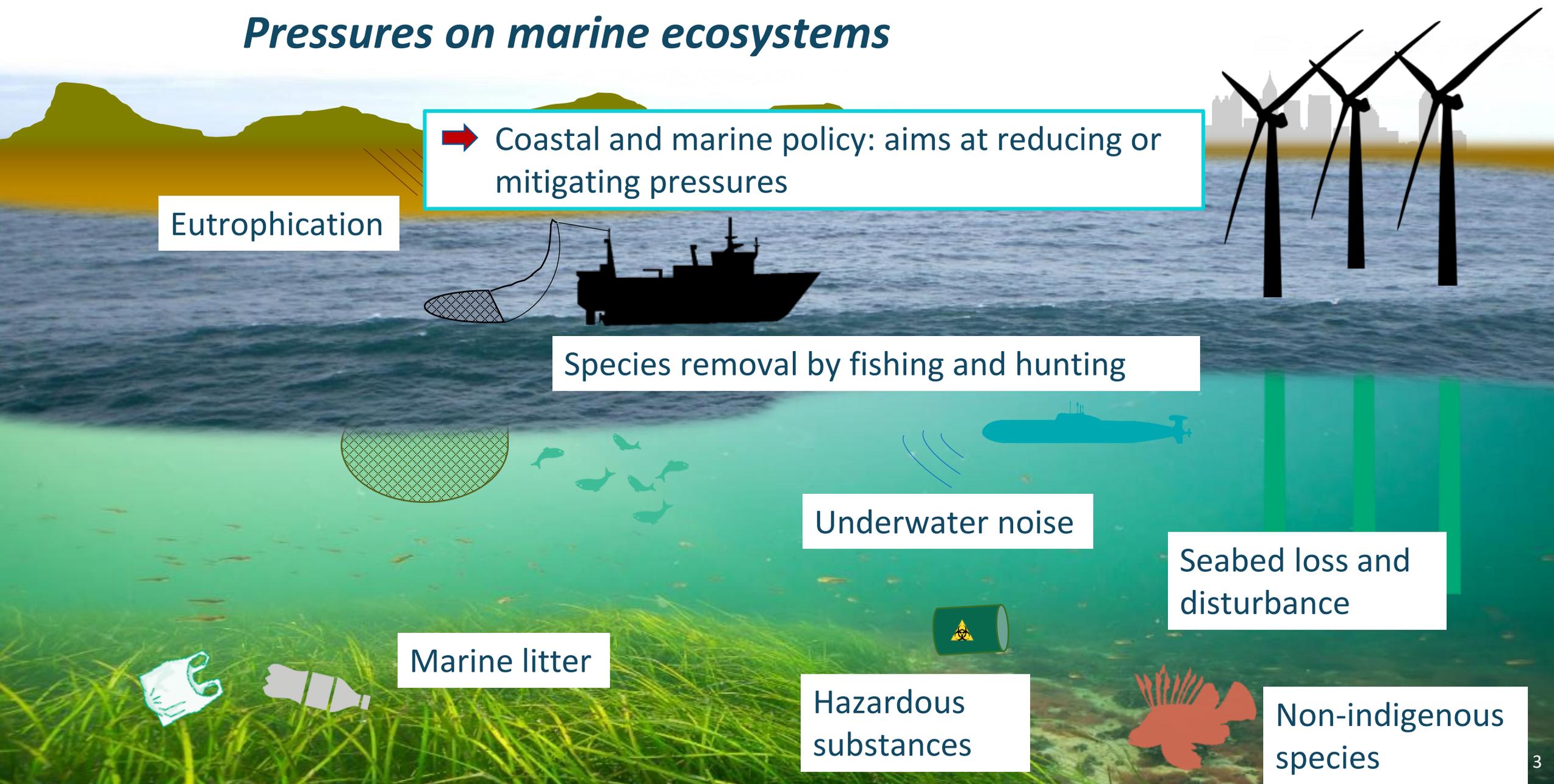
Underwater noise

Seabed loss and disturbance

Marine litter

Hazardous substances

Non-indigenous species



1. Introduction

Marine ecosystem services



Provisioning services

Harvest of food



Harvest of energy



Shoreline protection

Regulating and maintenance services



Carbon storage



Enjoyment of wildlife

Cultural services

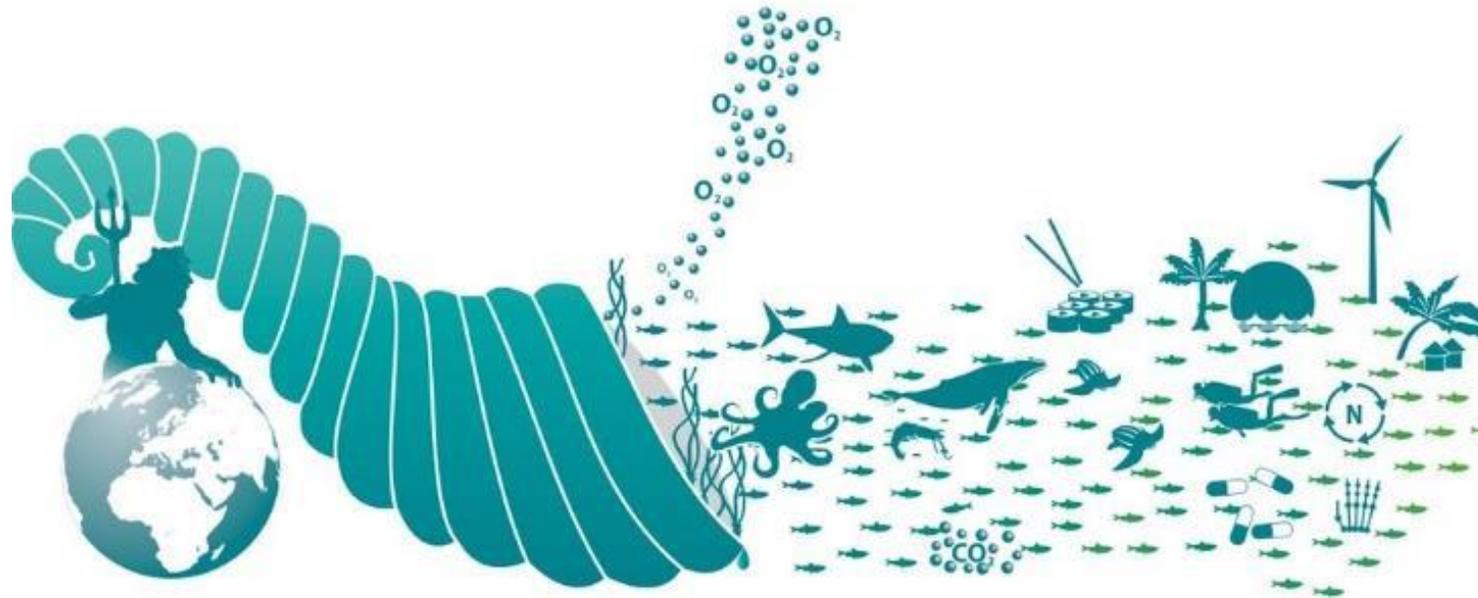


Recreational space

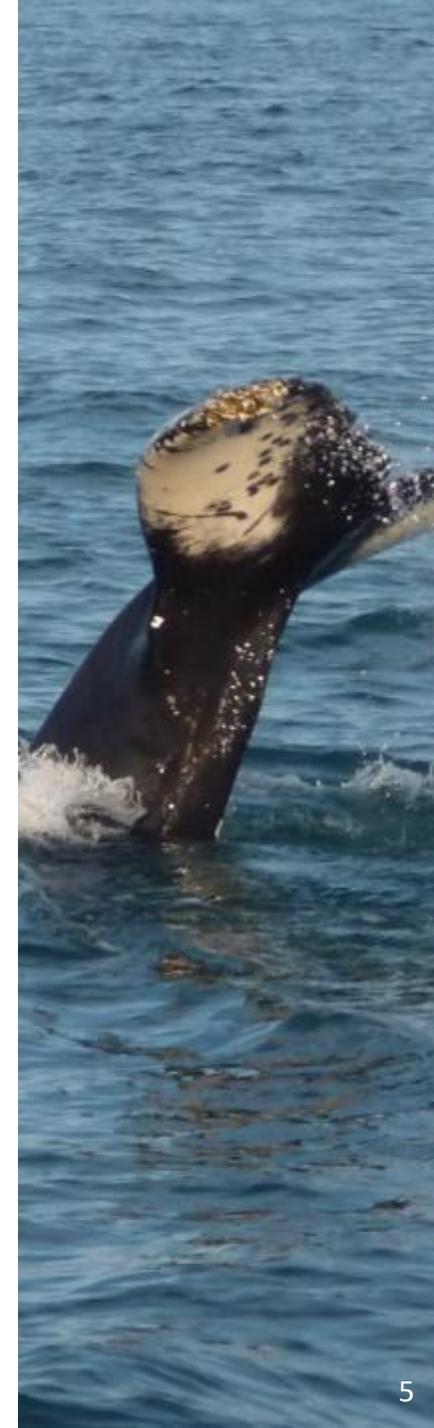
1. Introduction

Definition of ecosystem services (ES)

“The direct and indirect contributions of ecosystems to human well-being.” (The Economics of Ecosystems and Biodiversity, 2010)



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2. Ecosystem services within EU policy

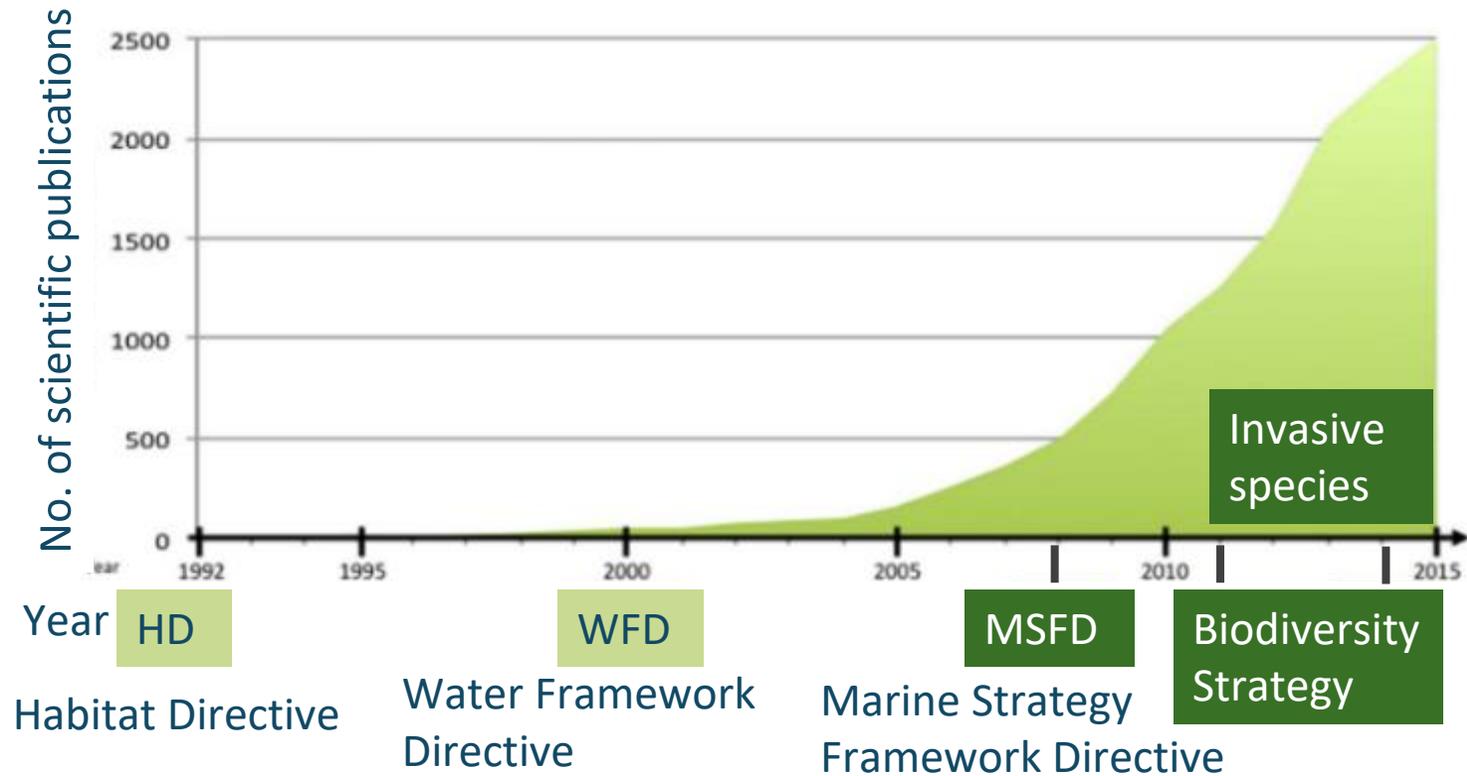
Expectations

- 
- It is expected that the ecosystem service concept can
 - Raise awareness of nature's contributions to societies' socio-economic wellbeing
 - Encourage decision-makers to prioritise solutions provided by nature (-> nature-based solutions)
 - Promote long-term, holistic approaches

Adopted from the EU guidance on integrating ecosystems and their services into decision-making, 2019

➔ The ecosystem service concept as a **holistic**, systems' perspective on the complex relationships between **nature and humans**, expected to ensure a **sustainable** use of resources

2. Ecosystem services within EU policy



- Contains framing around ES but is hardly relevant for/mirrored in policy measure design
- ES fully embedded throughout the regulatory framework, incl. objectives and policy measure design

Adapted from Bouwma et al. 2019

➔ Fast growing scientific field and increasing incorporation into policy

EU Biodiversity Strategy

Water Framework Directive (WFD)

Maritime Spatial Planning Directive (MSPD)

Marine Strategy Framework Directive (MSFD)

Habitat Directive

Invasive Alien Species Regulation (IAS)

2. Ecosystem services within EU policy

EU Directives and ES

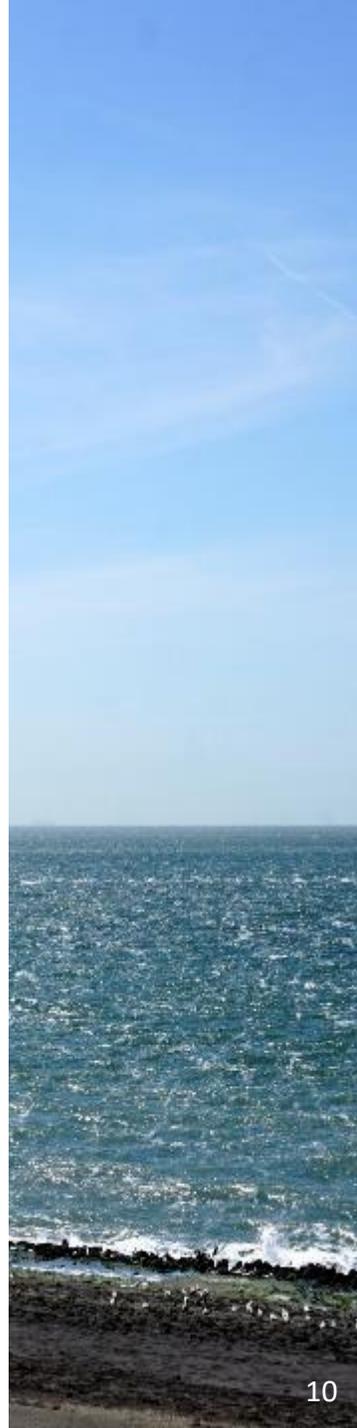
- WFD: no explicit mention of ES in the Directive but support for the integration of ES assessments into the Directive's implementation in a subsequent guidance document
- MSPD: acknowledges the benefits provided by healthy marine ecosystems and their services and the importance to integrate it in planning decisions
- MSFD: the first EU policy containing framing of the ES concept
- IAS: integration of the ES concept within implementation at the local level
- Habitat Directive: a core element in implementing the EU Biodiversity Strategy
- Biodiversity Strategy: requirement for mapping and assessing ES

2. Ecosystem services within EU policy

Status

- The ecosystem service concept has not been coherently established in EU policies
- Policies addressing the environment and ecosystems more likely to take up the ecosystem service concept
- Mostly only strategic policies (e.g. EU Biodiversity Strategy) have fully embedded ecosystem services (not legally binding)

Adopted from Bouwma et al. 2019



2. Ecosystem services within EU policy

Biodiversity strategy

EU Biodiversity Strategy 2020 (2011-2020): in total 6 targets

- Target 2: Maintain and restore ecosystems and their services
 - Action 5: Improve knowledge of ecosystems and their services in the EU

- Map and assess the state of ecosystems and their services

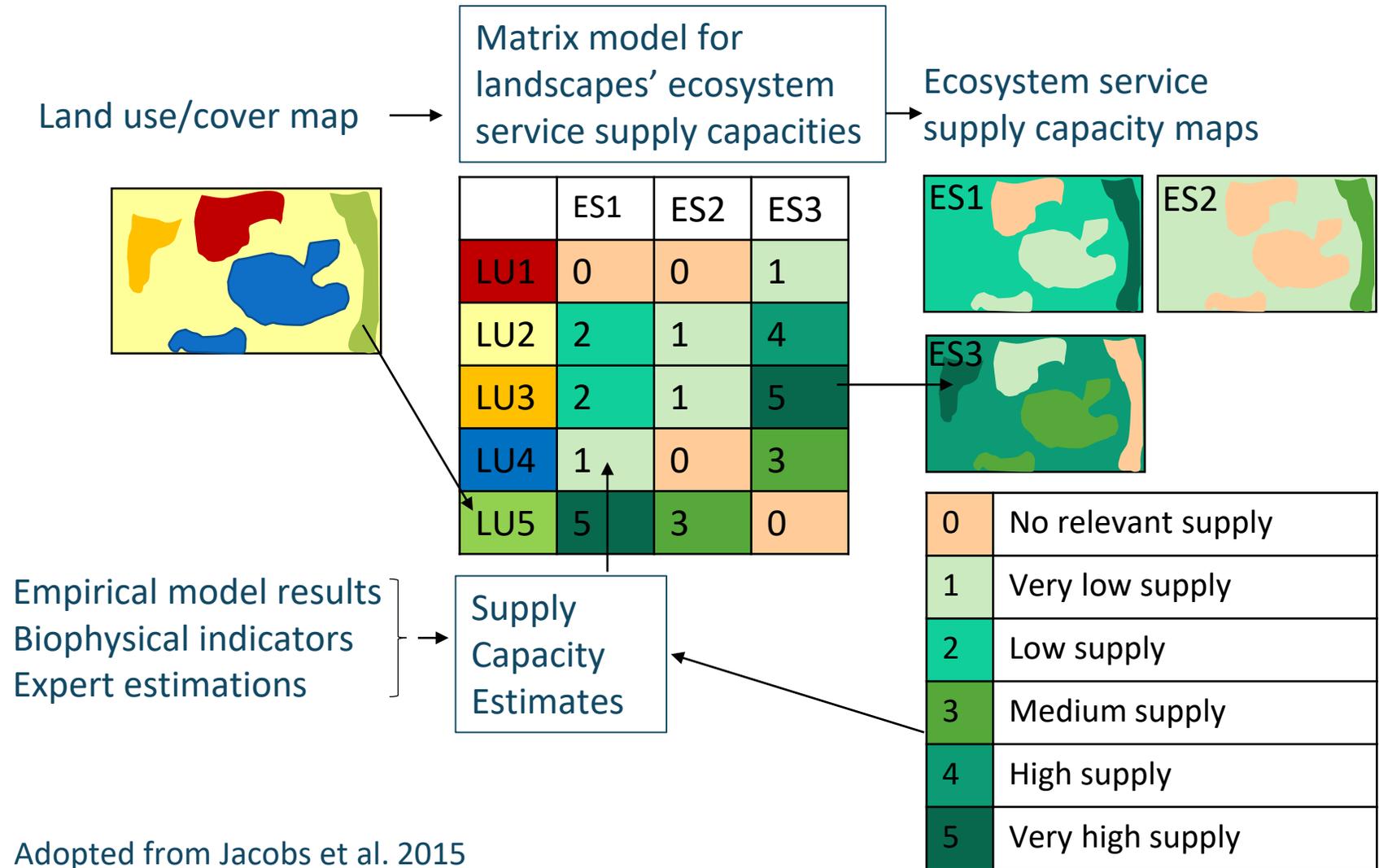
- Mapping and Assessment of Ecosystems and their Services (MAES)

- Assess the economic value of such services
- Promote the integration of these values into accounting and reporting systems

- The Common International Classification of Ecosystem Services (CICES) -> provisioning, regulating & maintenance, and cultural ecosystem services

3. Mapping and assessment of marine ecosystem services

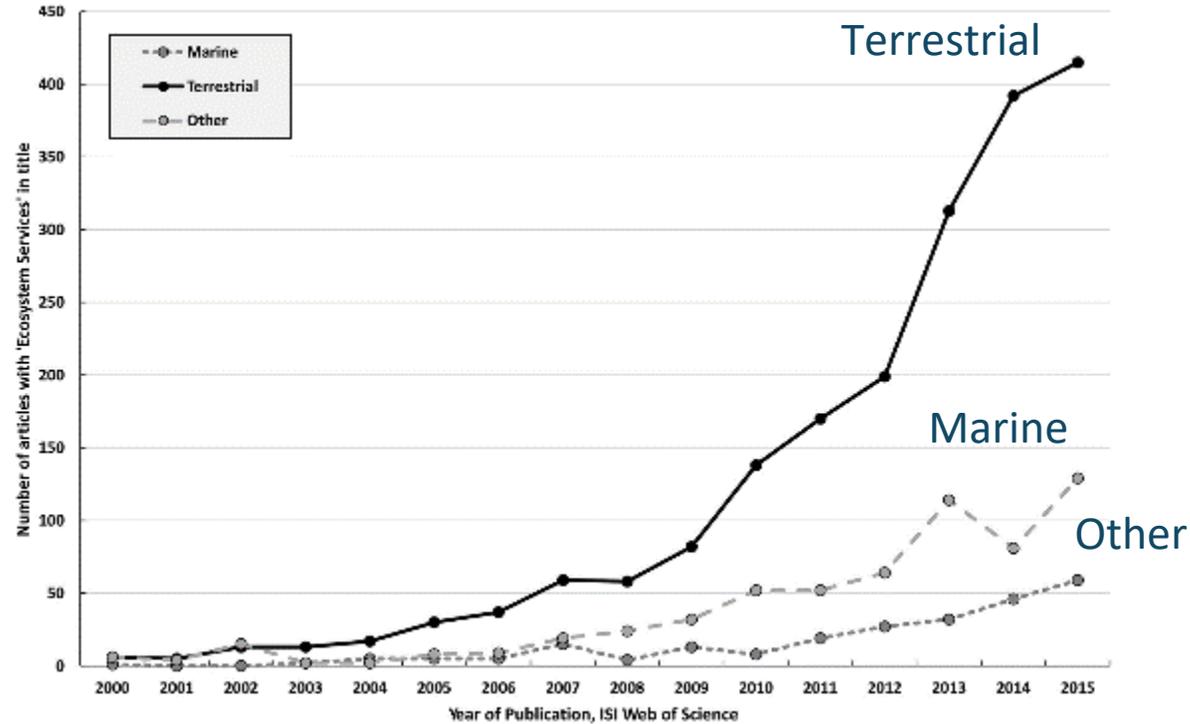
The terrestrial approach



Adopted from Jacobs et al. 2015

3. Mapping and assessment of marine ecosystem services

Terrestrial vs. marine



Townsend et al., 2018

➔ Marine ecosystem service research is lagging behind

3. Mapping and assessment of marine ecosystem services

Challenges

- Classifications such as the Common International Classification of Ecosystem Services were developed for terrestrial ecosystem services
- Transfer to marine ecosystems difficult
 - Less data on distribution of marine habitats
 - Three-dimensional marine environment
 - Spatially and highly temporally dynamic ecosystem services

- ➔ There is a need for approaches to **assess marine ecosystem services**
- ➔ There is a need for a **spatial typology** to extrapolate and compare assessments

4. Overview of marine ecosystem services

Provisioning services

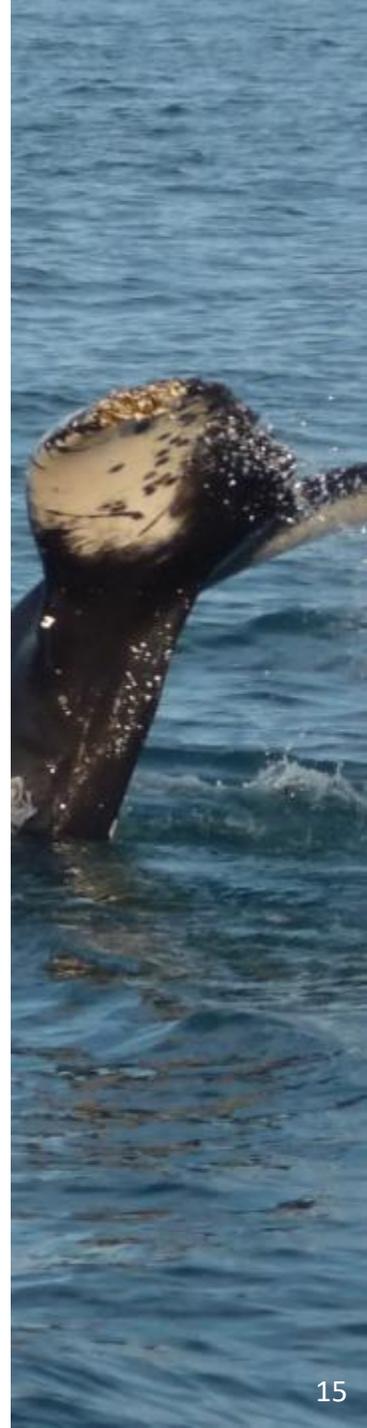
- Nutrition, e.g. wild & cultivated seafood, surface water for drinking
- Provision of material, e.g. pharmaceuticals, cosmetics, organic fertilizer or surface water for non-drinking purposes
- Provision of energy, e.g. biofuels from algae

Cultural services

- Recreation & leisure
- Science & education
- Cultural heritage
- Inspiration
- Spiritual experience
- Intrinsic & bequest value

Regulating and maintenance services

- Reduction of excess nutrients by e.g. macrophytes
- Control of erosion rates by e.g. seagrass meadows
- Protection of shorelines by e.g. coral reefs
- Provision of nursery habitats
- Regulation of the climate by e.g. carbon storage



5. Application in the Baltic Sea

The Marine Ecosystem Service Assessment Tool

Ecosystem service classes according to CICES*

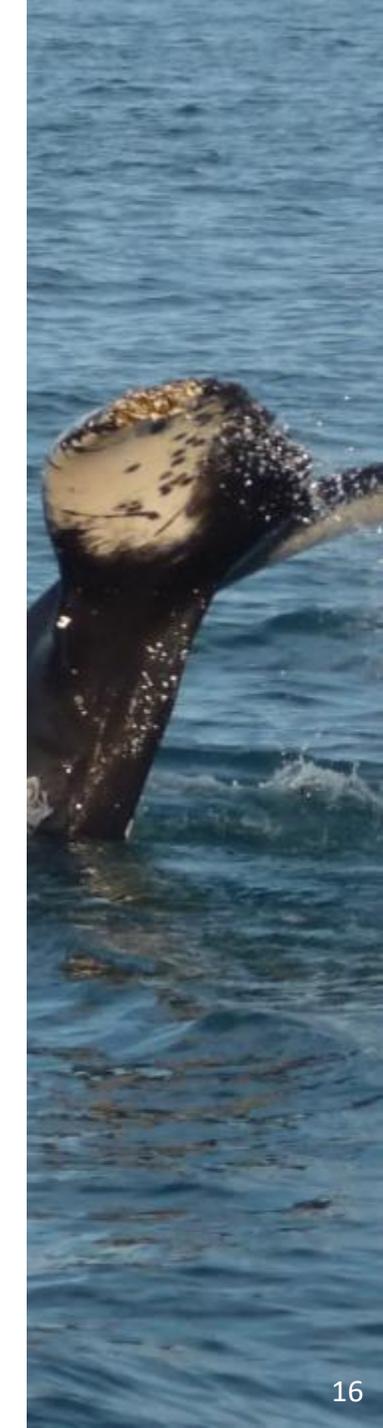
Ecosystem service class	Indicator	Units	Ecosystem service class	Indicator	Units
P1. Wild plants, algae and their outputs	Harvest	ton/a/km ²	R7. Pest and Disease control	Harmful algal bloom outbreaks	n ² /km ²
	N ² of species	n ² /km ²		R8. Decomposition and fixing processes	Presence of alien species
P2. Wild animals and their outputs	Landings	ton/a/km ²	R9. Provisioning of food and other products		Nitrogen removal
	Landing of key market species	ton/a/km ²		R10. Provisioning of raw materials	Water residence time
P3. Animals from in situ aquaculture	Harvest	ton/a	R11. Micro and regional climate regulation		Nutrients concentration
P4. Plants from aquaculture				C1. Experiential use of plants, animals and land-/seascapes in different environmental settings	Salinity
P5. Surface water for various purposes			C2. Scientific and educational		pH
P6. Fibres and other materials from plants, algae and animals for direct use or processing	Harvest	ton/a/km ²		C3. Scientific and educational	FP
			C4. Cultural heritage		Evaporation rate
P7. Materials from plants, algae and animals for agriculture	Harvest	ton/a/km ²		C5. Cultural heritage	N ² of visitors taking part in activities related to biota
P8. Surface water for non-drinking purposes	Use of water	m ³ /km ²	C6. Cultural heritage		
P9. Plant based				C7. Cultural heritage	
P10. Animal based			C8. Sacred and/or religious		
R1. Filtration, denitrification and accumulation by ecosystems	Burial	kg/a/km ²		C9. Existence	N ² of coastal zones
	Denitrification	kg/a/km ²	C10. Bequest		Scientific studies, documentaries, educational publications
R2. Dilution by atmosphere, freshwater & marine ecosystems	Average of beach closures per year	n ² /km ²		C10. Bequest	Visits to scientific and artistic exhibits
R3. Mass stabilisation and control of erosion rates	Extent of emerged, submerged & intertidal habitats	km ² /km ²	C10. Bequest		N ² of cultural and heritage structures
R4. Buffering and attenuation of mass flows	Sediment acc.			C10. Bequest	Local movies and events
R5. Flood Protection	Shoreline erosion		C10. Bequest		Structures
	Maximum deep water height	m		C10. Bequest	Reported list & iconic species
R6. Maintaining nursery populations and habitats	Flood prot. design basis	m	C10. Bequest		N ² of religious events (within 3 km from coastline)
	Submerged and intertidal habitats diversity	n ² /km ²		C10. Bequest	N ² of offices for health treatments (within 3 km from coastline)
	Duration of oxygen concentration < 6 mg/l	days/a	C10. Bequest		Extent of marine protected areas
	Secchi depth	m			
R6. Maintaining nursery populations and habitats	Species distribution	km ² /km ²	Provisioning ecosystem services		
	Nursery areas	km ² /km ²	Regulating & maintaining services		
	Total versus protected nursery areas	km ² /km ²	Cultural ecosystem services		

10 provisioning ecosystem services

11 regulating & maintenance services

10 cultural services

*Common International Classification of Ecosystem Services



5. Application in the Baltic Sea

The Marine Ecosystem Service Assessment Tool

Methodology for **comparative** ecosystem service assessments

Division	Group	Class	S1. Mussel farm	Class	Group	Division	Section
Nutrition	Biomass	P1. Wild plants, algae and their outputs				2	2
		P2. Wild animals and their outputs	1	-1			
		P3. Animals from in situ aquaculture	5	5			
		P4. Plants and algae from in situ aquaculture					
	Water	P5. Surface water for drinking purposes					2
Materials	Biomass	P6. Fibres and other materials from plants, algae and animals for direct use or processing	3	3	3	2	2
		P7. Materials from plants, algae and animals for agriculture	3	3			
	Water	P8. Surface water for non-drinking purposes	1	1	1		
Energy	Biomass-based energy resources	P9. Plant based resources		1	1	1	1
		P10. Animal based resources	1	1			

< 1/4.1	1/2.5	1/1.7	1/1.3	1/1.1	Initial Status	1.1	1.3	1.7	2.5	> 4.1
	1/4.1	1/2.5	1/1.7	1/1.3	0	1.3	1.7	2.5	4.1	
-5	-4	-3	-2	-1	0	1	2	3	4	5

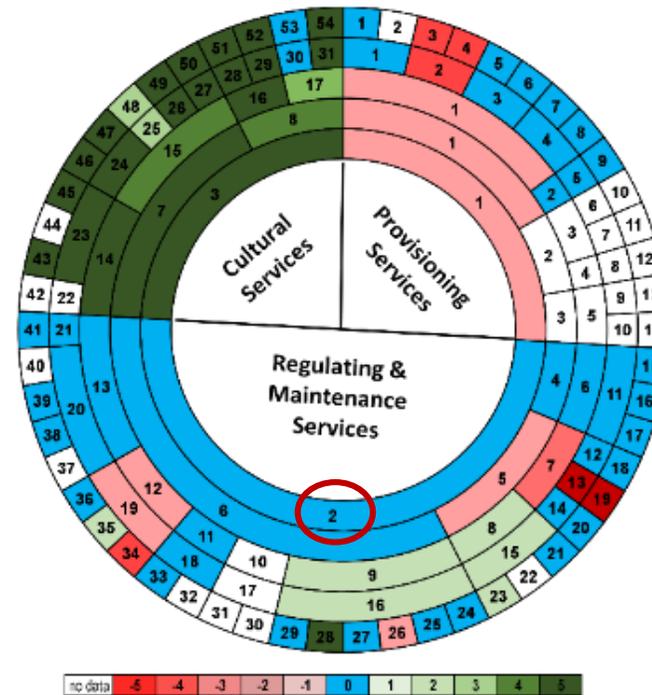
← Lower provision No change Higher provision →

➔ How has the use (flow) of ecosystem services changed over time?

➔ How will the use (flow) of ecosystem services change under different (future scenarios)?

5. Application in the Baltic Sea

The Marine Ecosystem Service Assessment Tool



Inácio et al, 2019

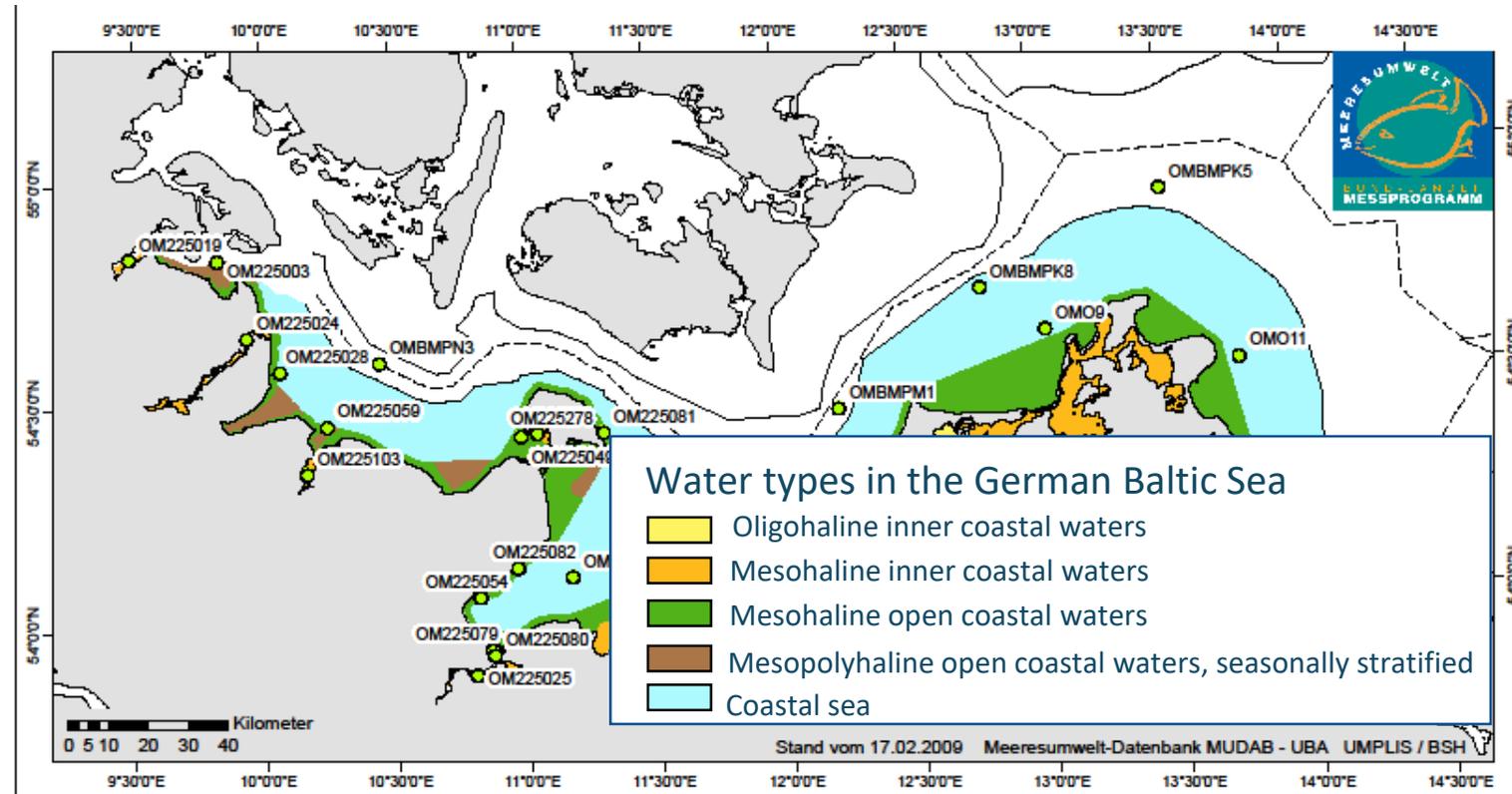
➔ Approach for marine ecosystem service assessment of water bodies, defined by the Water Framework Directive



5. Application in the Baltic Sea

Spatial Sea typology

- Water bodies: e.g. single lagoons and estuaries
- Water types: division based on physicochemical parameters

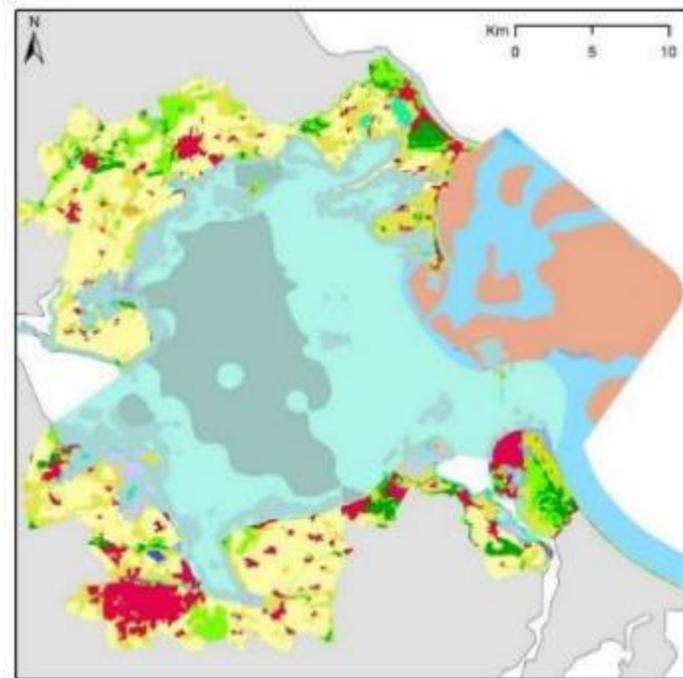


➔ The typology allows spatial extrapolation

5. Application in the Baltic Sea

Spatial Sea typology

- Coastal waters up to 15 m further divided according to habitat types



- Lagoons & estuaries: sand, gravel, sandbanks
- Lagoons & estuaries: non-vegetated clay & mud
- Open coastal waters: non-vegetated sand, gravel, sandbanks
- Open coastal waters: reefs

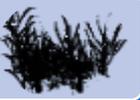
Adopted from Schumacher et al. 2021

- ➔ allows assessment of the hypothetical capacity (potential) of ecosystem types to provide services
- ➔ can be used as basis to assess impacts of marine uses on these ecosystems

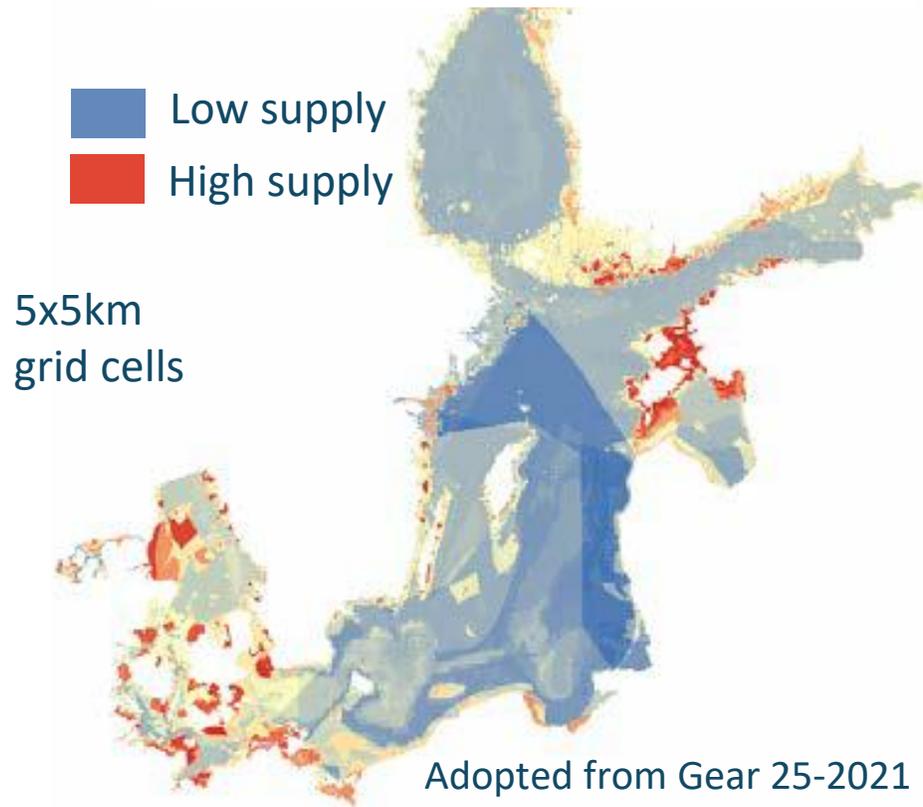


5. Application in the Baltic Sea

Sea basin approach

-  Benthic landscapes
-  Habitat-forming species
-  Essential fish habitats
-  Marine mammals
-  Seabirds
-  Nature 2000 areas

Potential ecosystem services supply areas in the Baltic Sea



Regulating ecosystem services

- Filtration of nutrients
- Storage of nutrients
- Storage of hazardous substances
- Erosion control
- Nursery Habitat
- Pest control
- Climate control by photosynthesis
- Climate control by sequestration in sediments

Cultural ecosystem services

- Recreation through active interactions
- Recreation through passive interactions

➔ Link between ecosystem components and ecosystem services still needs to be improved

6. Summary

Marine ecosystem service assessments - status

- Ecosystem service concept developed on land
 - Difficulties with transferring the approach to marine ecosystems
- Mapping and assessment of marine ecosystem services less advanced than on land
 - Three-dimensional, dynamic, data-scarce marine environment
- The Marine Ecosystem Service Assessment Tool allows to assess relative changes in ecosystem services between different points in time
- The spatial sea typology allows to assess and map the capacity of marine ecosystems to provide services
- In the Baltic Sea, approaches for assessments exist at case study level and increasingly also at basin-scale

6. Summary

Ecosystem services in EU policy

Strengths

- **Links humans and nature**
- Interdisciplinary
- **Holistic approach**
- Works on different scales
- Conceptually simple
- Supports communication
- Supports public participation
- Fast application possible

Opportunities

- Integration into policies
- **Usage in policy implementation**
- International harmonisation of tools and approaches
- **Better understanding of human-nature interaction**

Weaknesses

- Limited reliability
- **Oversimplification**
- Heterogeneous approach
- Weak scientific basis
- **Focus on anthropocentric-instrumental view on nature**
- Outcome scale dependent
- Difficult to apply
- Benefits unclear

Threats

- Loss of scientific interest
- **Loss of interest from policy**
- **Resistance to use results**
- Insufficient capacity/funding
- Focus on monetary view

6. Summary

Ecosystem services in EU policy

- Ecosystem services are increasingly considered in EU policies
- But: ecosystem services only fully embedded in strategic policies (e.g. EU Biodiversity Strategy)
- Despite benefits for policy (e.g. holistic approach, comparison of different ecosystem states, communication of the value of nature), the approach has also (methodological) weaknesses

→ Ecosystem service concept met with high expectations from policy makers, however, current use for policy implementation still limited

Thank you for your attention!



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