BONUS BaltCoast

# Ecosystem Services - Background

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A Systems Approach Framework for Coastal Research and Management in the Baltic

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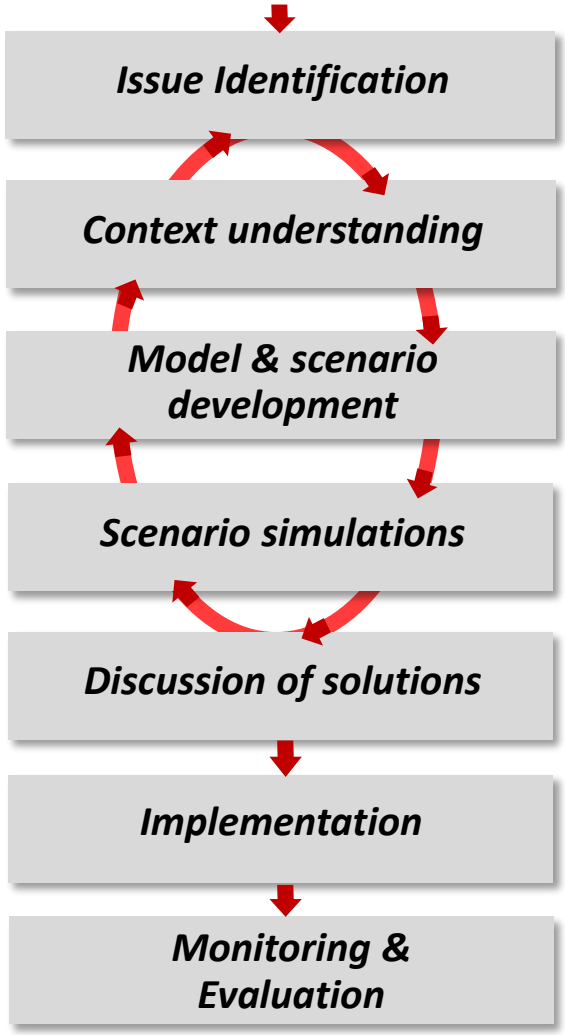
BONUS

# Systems Approach Framework

**Ecological-Social-Economic-Assessment**




***Policy & stakeholder mapping, stakeholder dialogue, dysfunction diagnosis, policy & management options, definition of indicators***

Cause & effect chain, definition of ‚virtual system', identifcation of social & economic components, institutional mapping, external hazard analysis

Data and tool analysis, creation of conceptual & simulation models, development of alternative management solutions (scenarios)

Model calibration & validation, simulations of the scenarios simulations & interpretive analysis

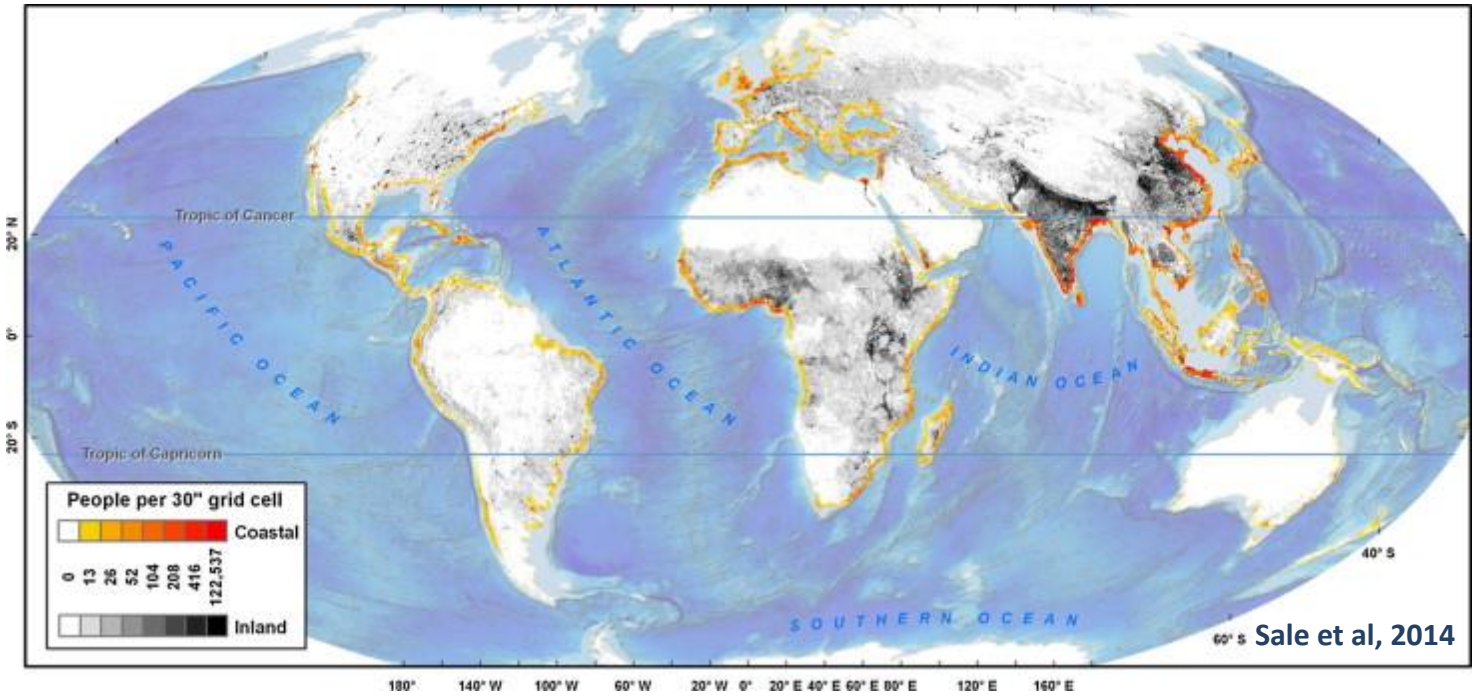
Preparation of decision taking process, evaluation of scenarios stakeholders & managers dialogues and meetings

Plan & measure execution including institutional, legal and financial arrangements

***Social, economic & ecological data collection, indicator based evaluation of process and state***

# Ecosystem Services - Context

## *Coastal areas in a global anthropogenic perspective*




Coastal zones occupy around **20% of the earth's surface**

Host more than **45% of the global population**

75% of the world's **largest urban agglomerations**

Turner et al., 2014

# Ecosystem Services - Context

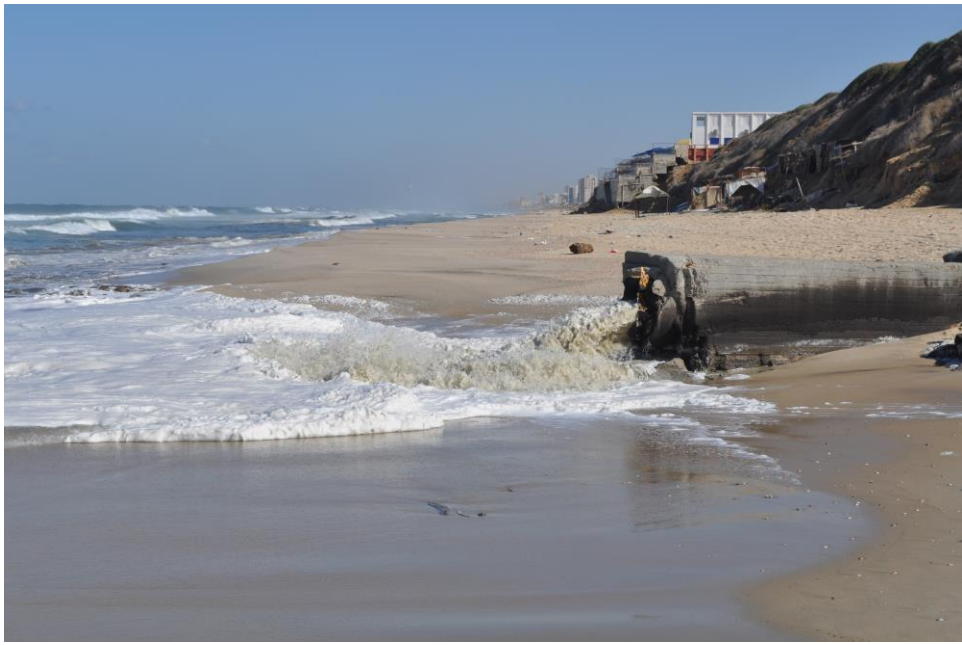
## *Why are coastal zones so important?*


# Ecosystem Services - Context

## *Why are coastal zones so important?*

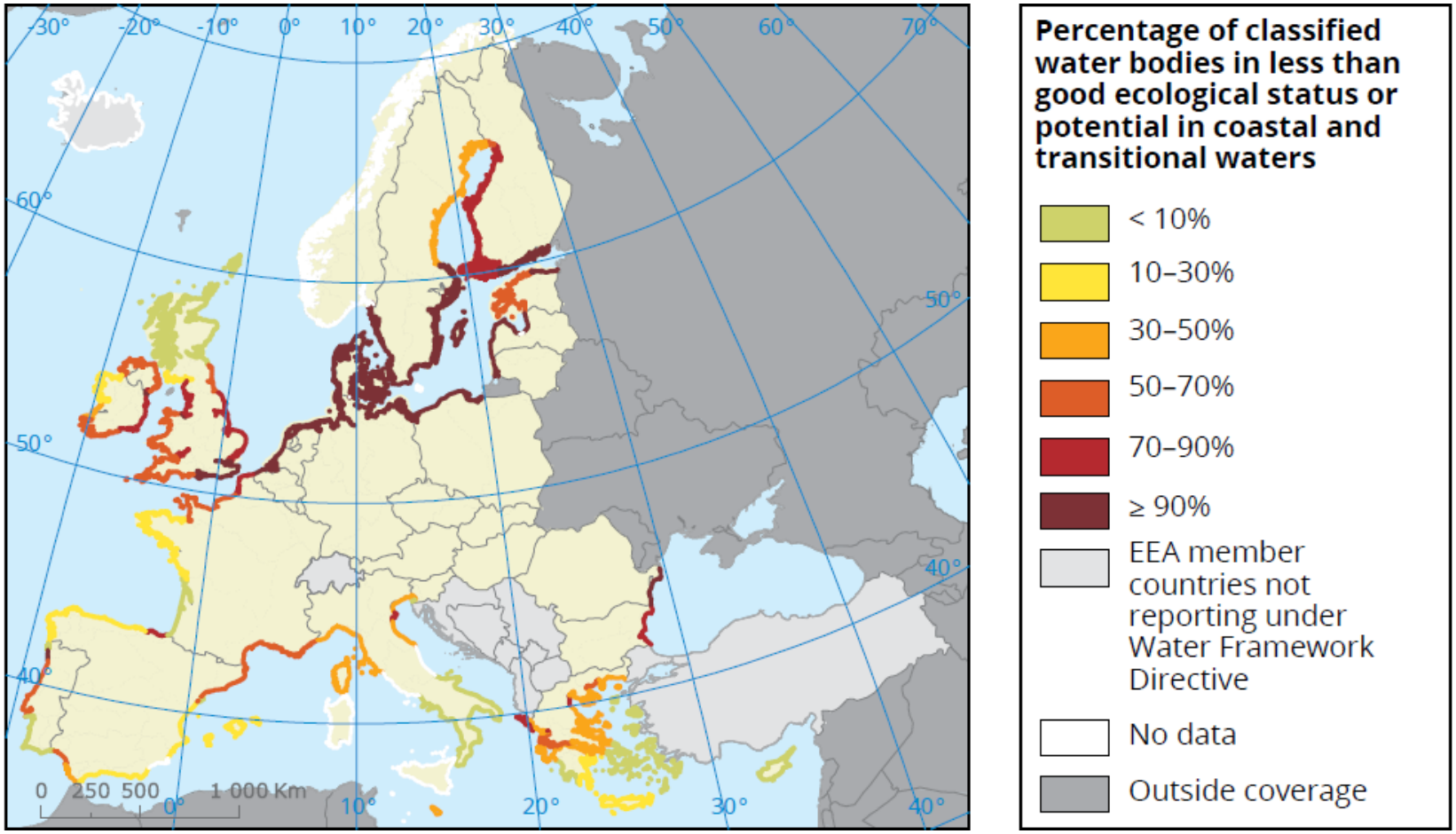
# Ecosystem Services - Context

## *What conflicts does it generate?*



# Ecosystem Services - Context

## *What are the consequences?*

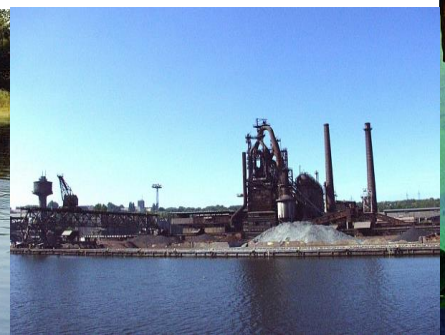



EEA, 2012c

# Ecosystem Services - Concept

*What are the benefits for humans?*

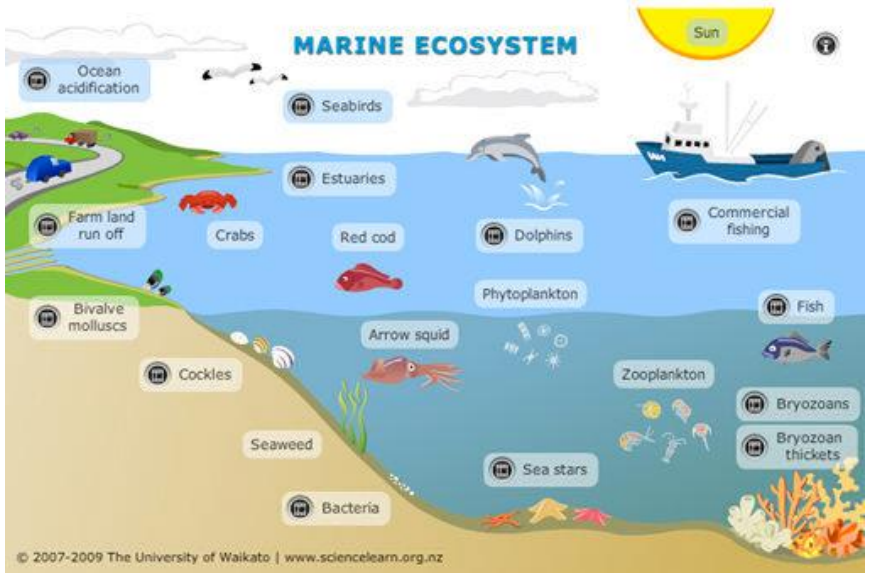
# Ecosystem Goods and Services



# Ecosystem Services - Concept

## Ecosystem Service

### Ecosystem




### Service

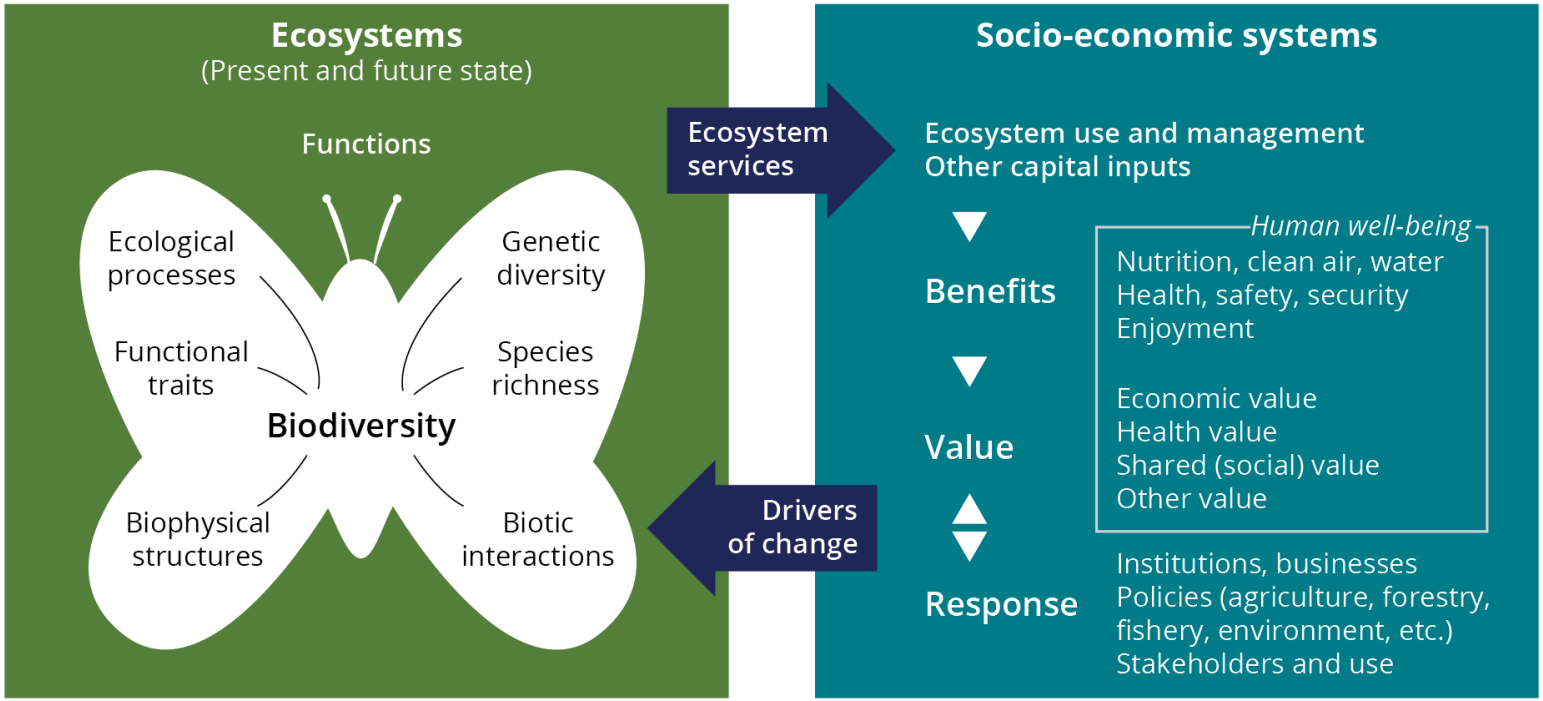
# Ecosystem Services - Concept

***What is "ecosystem services?"***

# Ecosystem Services - Concept

## Ecosystem services:

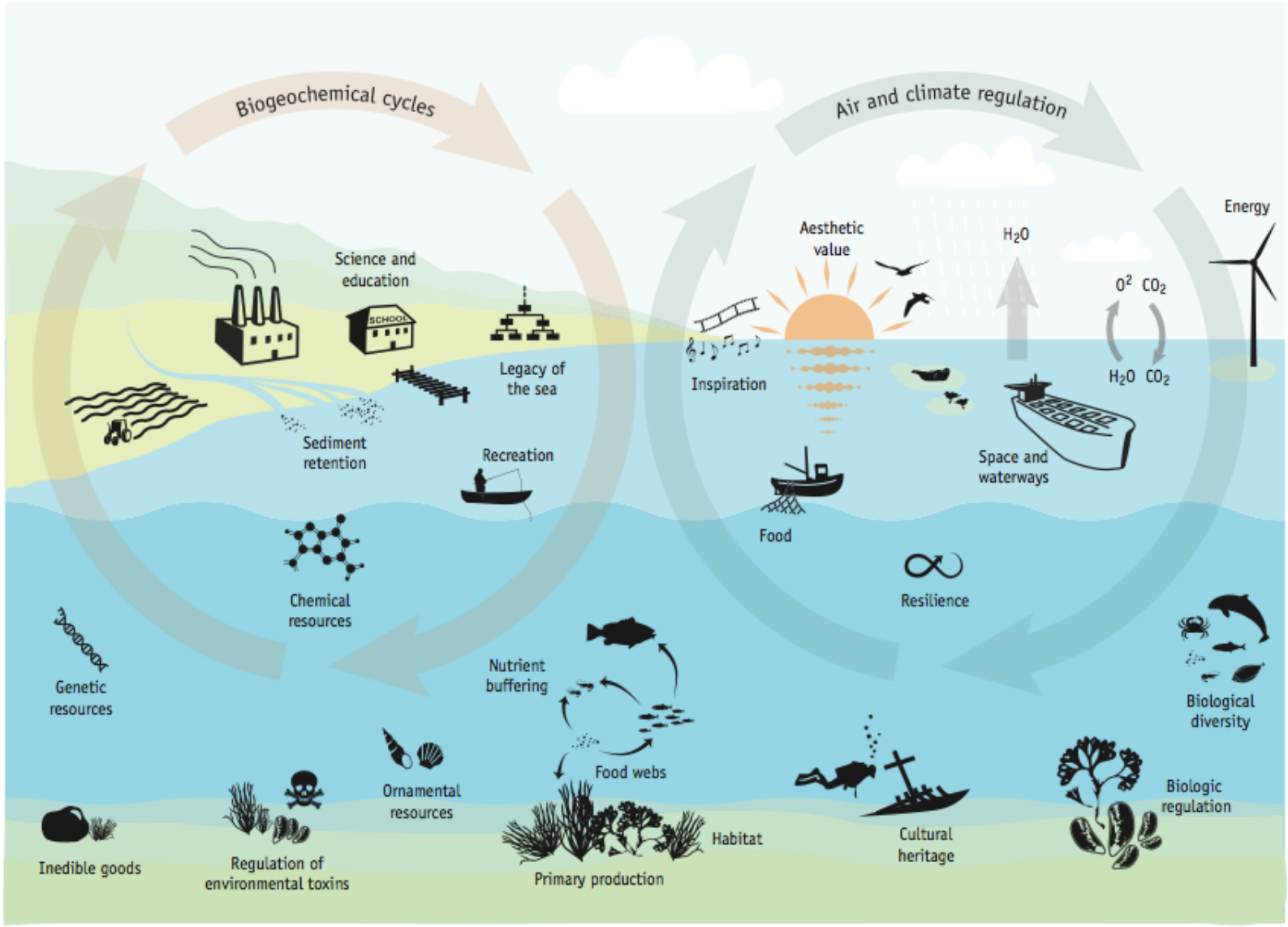
"benefits that people take from the ecosystem" (MEA, 2005)




European Environment Agency

(MEA, 2005)

# Ecosystem Services - Concept



# Ecosystem Services - Definition

Different definitions of ES but all most similar:

- "Ecosystem services are the outputs of ecosystem from which people derive benefits" (*National Ecosystem Services assessment, 2011 and Millennium Ecosystem Services Assessment, 2005)*

- "the aspects of ecosystems utilized (actively or passively) to produce human well-being" *(Fisher et al. 2009)*

- "The direct and indirect contributions of ecosystems to human well-being. The concept of ecosystem goods and services is synonymous with ecosystem services *(The Economics of Ecosystems and Biodiversity: TEEB, 2010)*

- Ecosystem services are made up of tangible goods (e.g. food and raw materials) and intangible services (e.g. the regulation of our climate and the remediation of waste). *(Hattam et al 2016)*

# Ecosystem Services - Definition

## Ecosystem services:

"contributions of ecosystem structure and function – in combination with other inputs – to human well-being" (Burkhard et al., 2012)

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

Mapping ecosystem service supply, demand and budgets

Benjamin Burkhard[a,*], Franziska Kroll[a], Stoyan Nedkov[b], Felix Müller[a]

# Ecosystem Services - Definition

According to Nahlik (2012) the concept of ES should be:

1. definition and classification of ecosystem services classes including those issues such as double-counting are added;
2. trans-disciplinary – providing for the integration of collaboration between disciplines, including them in the development of the framework and ensuring that the terminology used is appropriate for all;
3. community engagement – dialog with local stakeholders and scientist;
4. resilient – adaptable and responsive to changing conditions, experience and improved knowledge, to ensure that they are operational over the long-term;
5. cohesive and coherent – conceptually sound and organized logically, realistically and its use demonstrated
6. policy-relevant – the framework should include policy objectives as a major component of the framework

# Ecosystem Services - Concept

**Ecosystem services:**

"benefits that people obtain from the ecosystem" (MA, 2005)

| Environmental | Social | Economic |
|---|---|---|

**4 Categories**
**3 Categories**

| S[illegible]ting services | Regulating services | Provisioning services | Cultural services |
|---|---|---|---|
|  |  |  |  |

# Ecosystem Services - Concept

Intermediate Services

Regulating services

Final Services

Provisioning services

Regulate the provisioning of final services

Direct use by humans

Cultural services


# Ecosystem Services - Classification

The classification of ES has been constantly updated and evolved from the Millennium Assessment to TEEB and now the updated and accepted is CICES classification;

MEA

↓

TEEB

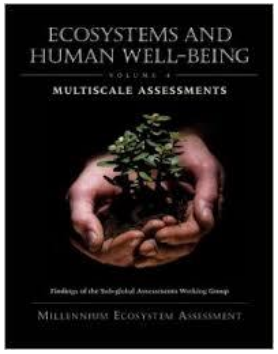
↓

CICES

| MA categories | TEEB categories | CICES v4.3 group* |
|---|---|---|
| Food (fodder) | Food | Biomass [Nutrition] |
| | | Biomass (Materials from plants, algae and animals for agricultural use) |
| Fresh water | Water | Water (for drinking purposes) [Nutrition] |
| | | Water (for non-drinking purposes) [Materials] |
| Fibre, timber | Raw Materials | Biomass (fibres and other materials from plants, algae and animals for direct use and processing) |
| Genetic resources | Genetic resources | Biomass (genetic materials from all biota) |
| Biochemicals | Medicinal resources | Biomass (fibres and other materials from plants, algae and animals for direct use and processing) |
| Ornamental resources | Ornamental resources | Biomass (fibres and other materials from plants, algae and animals for direct use and processing) |
| | | Biomass based energy sources |
| | | Mechanical energy (animal based) |
| Air quality regulation | Air quality regulation | [Mediation of] gaseous/air flows |
| Water purification and water treatment | Waste treatment (water purification) | Mediation [of waste, toxics and other nuisances] by biota |
| | | Mediation [of waste, toxics and other nuisances] by ecosystems |
| Water regulation | Regulation of water flows | [Mediation of] liquid flows |
| | Moderation of extreme events | |
| Erosion regulation | Erosion prevention | [Mediation of] mass flows |
| Climate regulation | Climate regulation | Atmospheric composition and climate regulation |
| Soil formation (supporting service) | Maintenance of soil fertility | Soil formation and composition |
| Pollination | Pollination | Lifecycle maintenance, habitat and gene pool protection |
| Pest regulation | Biological control | Pest and disease control |
| Disease regulation | | |
| Primary production Nutrient cycling (supporting services) | Maintenance of life cycles of migratory species (incl. nursery service) | Lifecycle maintenance, habitat and gene pool protection |
| | | Soil formation and composition |
| | | [Maintenance of] water conditions |
| | Maintenance of genetic diversity (especially in gene pool protection) | Lifecycle maintenance, habitat and gene pool protection |
| Spiritual and religious values | Spiritual experience | Spiritual and/or emblematic |
| Aesthetic values | Aesthetic information | Intellectual and representational interactions |
| Cultural diversity | Inspiration for culture, art and design | Intellectual and representational interactions |
| | | Spiritual and/or emblematic |
| Recreation and ecotourism | Recreation and tourism | Physical and experiential interactions |
| Knowledge systems and educational values | Information for cognitive development | Intellectual and representational interactions |
| | | Other cultural outputs (existence, bequest) |

# Ecosystem Services - Classification

## MEA

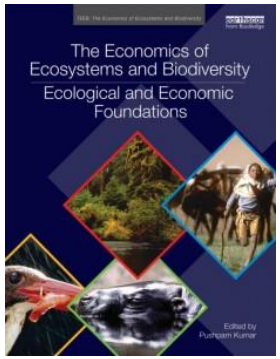



4 Categories

21 Sections

Classification accepted and used in global sub global assessments

## TEEB




4 Categories

22 Sections

Updated classification based on MA, used in ongoing national TEEB studies across Europe

## CICES

3 Categories

30 Sections

Build on MA and TEEB, hierarchical system tailored to accounting

# Ecosystem Services - Classification

## Common International Classification for Ecosystem Services (CICES)

- Build on the need of standardization for the development of accounting methods and at the same time with the objective of allowing comparisons
- CICES has been evolving following the idea that besides the standardization this classification should work on mapping and valuing ES and ecosystem
- CICES does this in a more hierarchical and systematic approach of assessing ES.
- This classification is the “officially” accepted by EU, mainly connected with “Mapping and assessment of ecosystems and their services”, which forms part of EU Biodiversity 2020 Strategy

# Ecosystem Services - Classification

CICES Classification divides the Ecosystem in 3 major categories (sections):

- Provisioning
- Regulation & Maintenance
- Cultural

This classification is further divided into:

- Division
- Group
- Class
- Class type

# Ecosystem Services - Definition

## Provisioning services:

- All material and biota-dependent energy outputs from ecosystems
- Tangible things that can be directly exchanged or traded

3 Major divisions:

- Nutrition – all ecosystem outputs use directly or indirectly as food
- Material (biotic) – used directly or employed in the manufacture of goods
- Energy (biomass) – biotic renewable energy sources and mechanical energy provided by animals

# Ecosystem Services - Definition

## Regulating and maintenance services:

- All ways in which ecosystems control or modify biotic or abiotic parameters that define the environment of people
- These services are not consumed directly but affect the performance of individuals communities and populations and their activities

3 Major divisions:

- Mediation of waste, toxics and other nuisances – the services biota ecosystems provide to detoxify or simply dilute substances mainly as result of human action
- Mediation of flows – services such as regulation and maintenance of land and snow masses, flood and storm protection
- Maintenance of physical, chemical, biological conditions – ecosystem provide for sustainable living conditions (climate regulation, soil formation, nursery functions) supporting the provisioning services

# Ecosystem Services - Definition

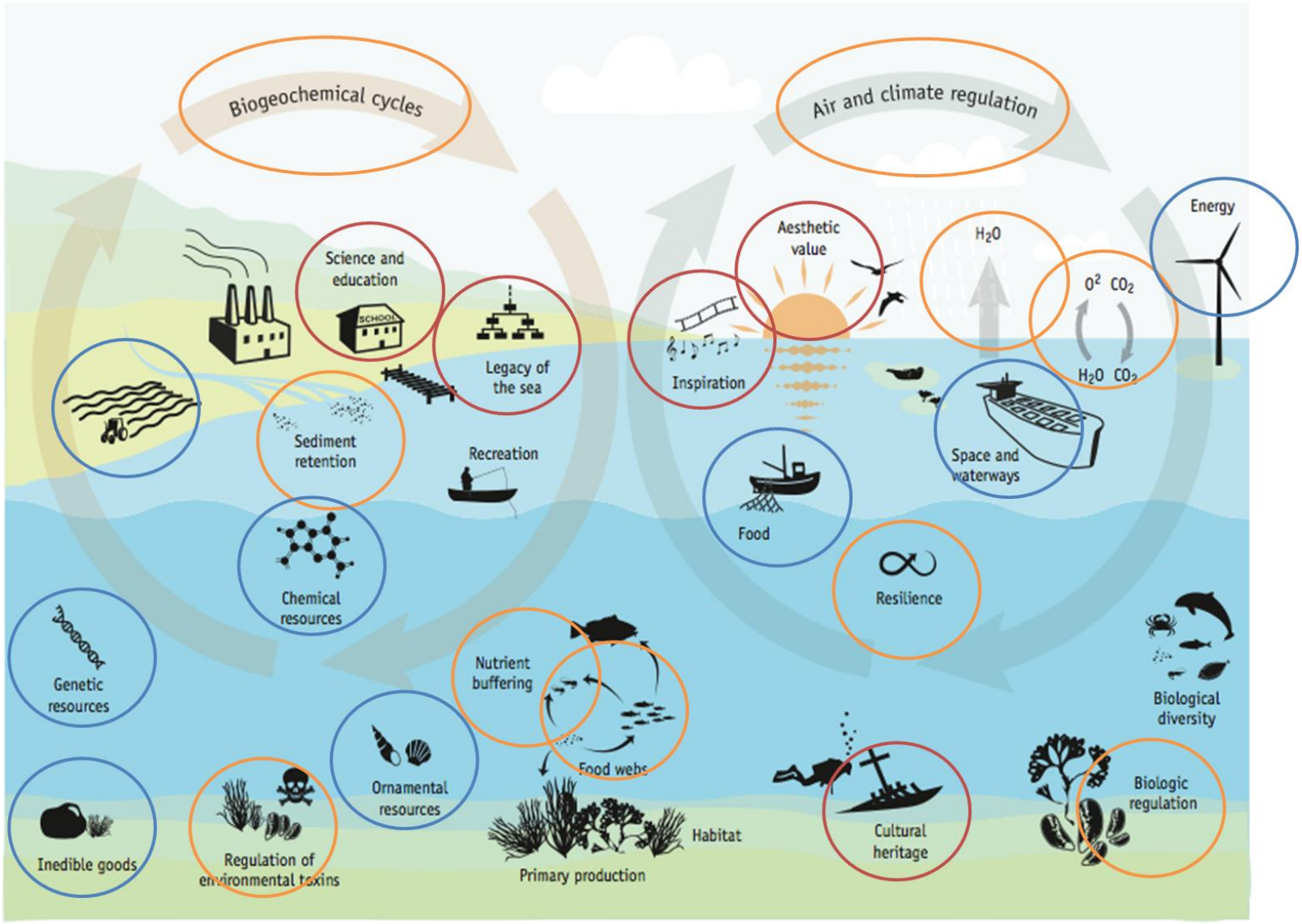
## Cultural Services:

- All non-material ecosystem outputs that have symbolic, cultural or intellectual significance

2 Major divisions:

- Physical and intellectual interactions with biota, ecosystems and land-/-seascapes
- Spiritual, symbolic and other interactions with biota, ecosystems and land-/-seascapes

# Ecosystem Services - Concept



# Ecosystem Services - Indicators

The best way of assessing ES is through the use of Indicators, but since the concept was in general focus on terrestrial assessments there are **few indicator lists available for the marine environment**!

…but, some efforts have been done and the **EU Project MAES**, developed an indicator set for application of ES concept in marine realm!

**Indicators for ecosystem services delivered by marine ecosystems**

| Division | Group | Class | Marine inlets and transitional waters | Coastal waters | Shelf waters | Open Ocean |
|---|---|---|---|---|---|---|
| Nutrition | Biomass | Cultivated crops | | | | |
| | | Reared animals and their outputs | | | | |
| | | Wild plants, algae and their outputs | • Harvest (ton/a) | | | |
| | | Wild animals and their outputs | • Landings (ton) | • Landings (ton) • CPUE (ton) | | |
| | | Plants and algae from in-situ aquaculture | • Harvest (ton/a) | | | |
| | | Animals from in-situ aquaculture | • Harvest (ton/a) | | | |
| | Water | Surface water for drinking | | | | |
| | | Ground water for drinking | | | | |

Marine ecosystem services: Linking indicators to their classification

Caroline Hattam [a,*], Jonathan P. Atkins [b], Nicola Beaumont [a], Tobias Börger [a], Anne Böhnke-Henrichs [c], Daryl Burdon [d], Rudolf de Groot [c], Ellen Hoefnagel [e], Paulo A.L.D. Nunes [f], Joanna Piwowarczyk [g], Sergio Sastre [h], Melanie C. Austen [a]

Typology and indicators of ecosystem services for marine spatial planning and management

Anne Böhnke-Henrichs [a,*], Corinne Baulcomb [b], Rebecca Koss [c], S. Salman Hussain [b], Rudolf S. de Groot [a]

The UK National Ecosystem Assessment

Synthesis of the Key Findings

# Ecosystem Services - Methodology

There are different approaches and methodologies for ES assessment, although there is no standard one to follow!

different kinds of approaches

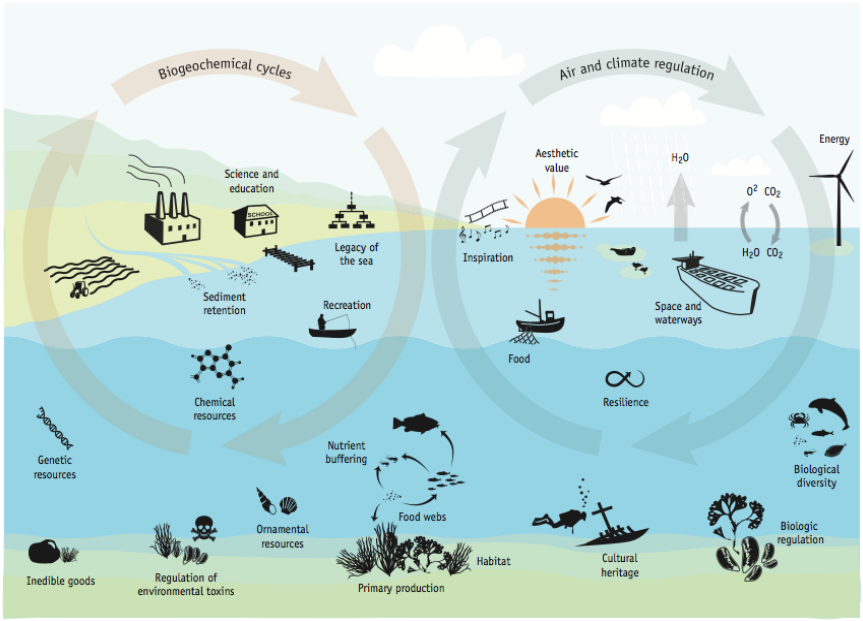
**Qualitative**

**Semi-Quantitative**

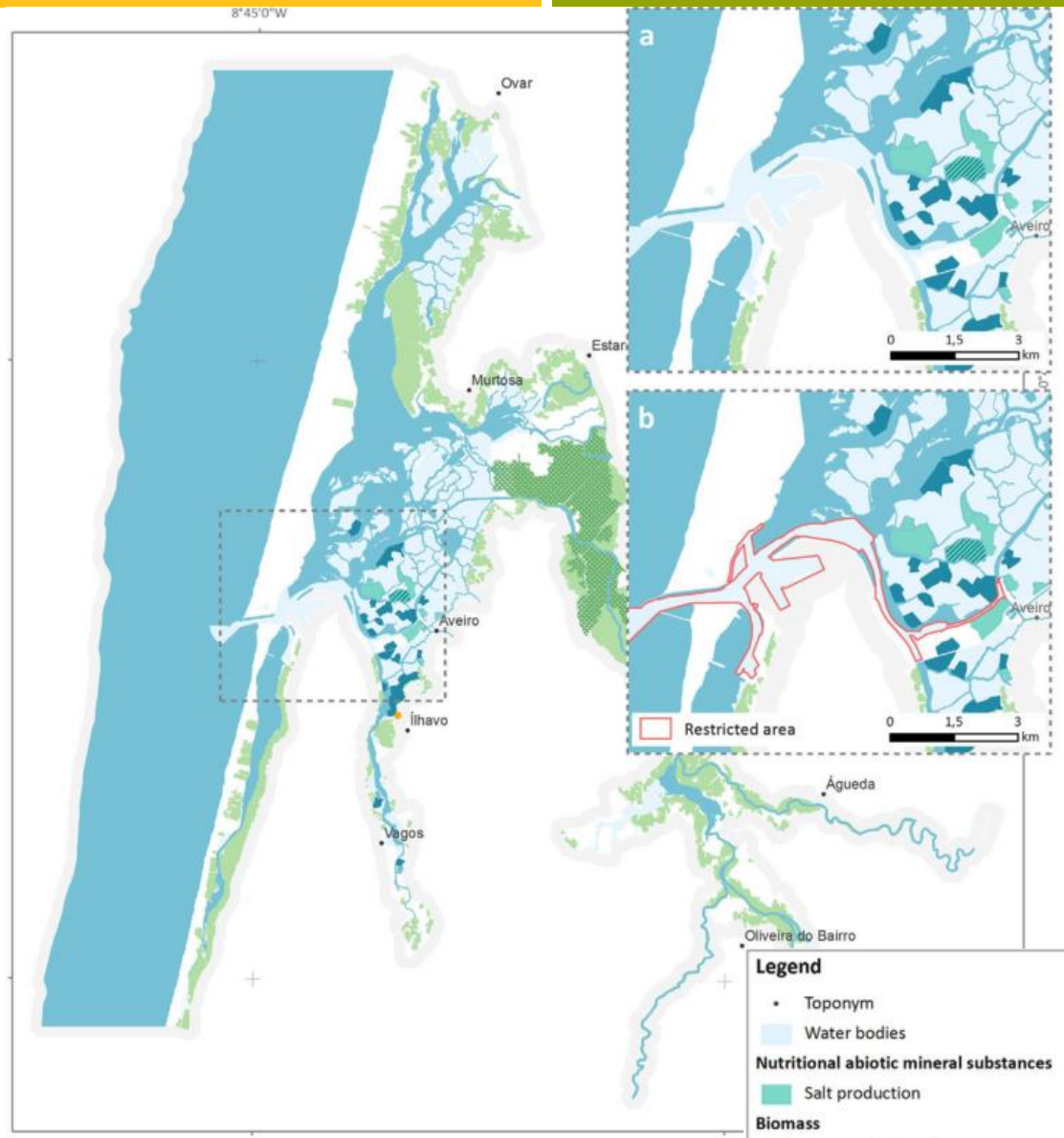

**Quantitative**

Which approach to take depends on the scope of the assessment

# The different ways to assess ecosystem services can then furthermore be divided into the number of ES to be assessed!

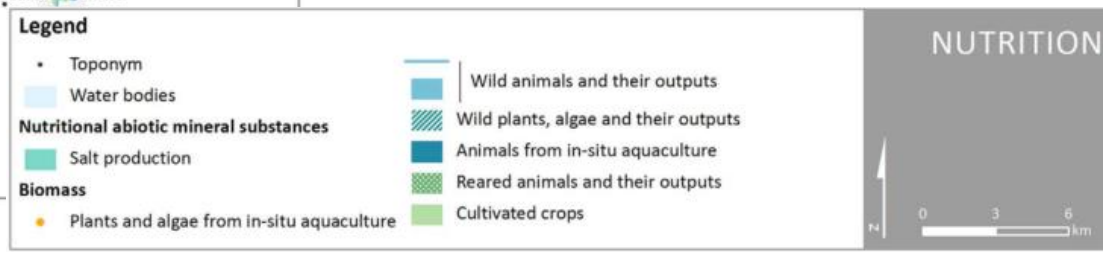


# Ecosystem Services - Methodology




## Ecosystem services provided by a complex coastal region: challenges of classification and mapping

Lisa P. Sousa[1], Ana I. Sousa[2], Fátima L. Alves[1] & Ana I. Lillebø[2]



# The “Matrix” Approach!

Developed by

**Benjamin Burkhard**

& colleagues from Kiel University

Many applications not only in Europe

but also already applied in Indonesia!

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

Mapping ecosystem service supply, demand and budgets

Benjamin Burkhard[a,*], Franziska Kroll[a], Stoyan Nedkov[b], Felix Müller[a]

# The “Matrix” Approach!

Land Cover Types (LCT)

Supply of ES

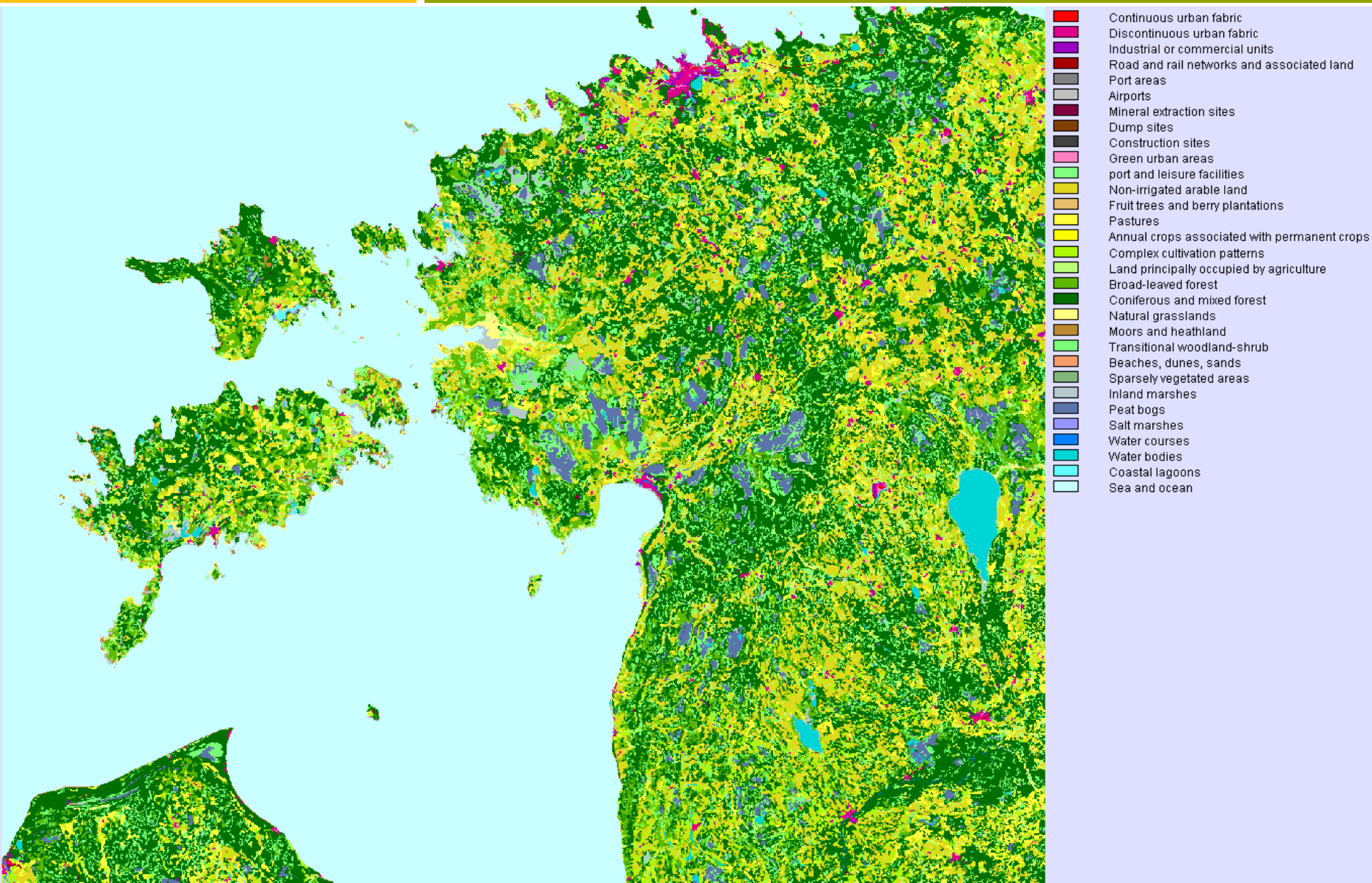
Demand of ES by LCT

“Budget” of ES

Based on Expert judgment

Semi-Quantitative method

**but how does this Matrix look like??**


Continuous urban fabric
Discontinuous urban fabric
Industrial or commercial units
Road and rail networks and associated land
Port areas
Airports
Mineral extraction sites
Dump sites
Construction sites
Green urban areas
port and leisure facilities
Non-irrigated arable land
Fruit trees and berry plantations
Pastures
Annual crops associated with permanent crops
Complex cultivation patterns
Land principally occupied by agriculture
Broad-leaved forest
Coniferous and mixed forest
Natural grasslands
Moors and heathland
Transitional woodland-shrub
Beaches, dunes, sands
Sparsely vegetated areas
Inland marshes
Peat bogs
Salt marshes
Water courses
Water bodies
Coastal lagoons
Sea and ocean

| CORINE land cover type: | Ecological Integrity Σ | Abiotic heterogeneity | Biodiversity | Biotic waterflows | Metabolic efficiency | Exergy Capture (Radiation) | Reduction of Nutrient loss | Storage capacity (SOM) | Regulating services Σ | Local climate regulation | Global climate regulation | Flood protection | Groundwater recharge | Air Quality Regulation | Erosion Regulation | Nutrient regulation | Water purification | Pollination | Provisioning services Σ | Crops | Livestock | Fodder | Capture Fisheries | Aquaculture | Wild Foods | Timber | Wood Fuel | Energy | Biochemicals and Medicine | Freshwater | Cultural services Σ | Recreation& Aesthetic Values | Intrinsic Value of Biodiversity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Continuous urban fabric | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Discontinuous urban fabric | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Industrial or commercial units | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Road and rail networks | 4 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Port areas | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| Airports | 7 | 1 | 1 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mineral extraction sites | 4 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 |
| Dump sites | 8 | 2 | 1 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Construction sites | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green urban areas | 18 | 3 | 3 | 2 | 1 | 4 | 3 | 2 | 11 | 2 | 1 | 0 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 3 | 3 | 0 |
| Sport and leasure facilities | 16 | 2 | 2 | 2 | 1 | 4 | 3 | 2 | 9 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 0 |
| Non-irrigated arable land | 22 | 3 | 2 | 3 | 4 | 5 | 1 | 4 | 5 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 21 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 1 | 1 | 0 |
| Permanently irrigated land | 21 | 3 | 2 | 5 | 2 | 5 | 1 | 3 | 5 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 5 | 5 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| Ricefields | 20 | 3 | 2 | 5 | 1 | 5 | 1 | 3 | 4 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 7 | 5 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| Vineyards | 14 | 3 | 2 | 3 | 1 | 3 | 0 | 2 | 3 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 5 | 5 | 0 |
| Fruit trees and berries | 21 | 4 | 3 | 4 | 2 | 3 | 2 | 3 | 19 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 5 | 13 | 5 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 1 | 0 | 0 | 5 | 5 | 0 |
| Olive groves | 17 | 3 | 2 | 3 | 2 | 3 | 1 | 3 | 7 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 12 | 4 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 1 | 0 | 0 | 5 | 5 | 0 |
| Pastures | 24 | 2 | 2 | 4 | 5 | 5 | 2 | 4 | 8 | 1 | 1 | 1 | 1 | 0 | 4 | 0 | 0 | 0 | 10 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 3 | 3 | 0 |
| Annual and permanent crops | 18 | 2 | 2 | 3 | 2 | 4 | 2 | 3 | 7 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 20 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| Complex cultivation patterns | 20 | 4 | 3 | 3 | 2 | 4 | 1 | 3 | 5 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 9 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 2 | 2 | 0 |
| Agriculture& natural vegetation | 19 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 13 | 3 | 2 | 1 | 2 | 1 | 3 | 0 | 1 | 0 | 21 | 3 | 3 | 2 | 0 | 0 | 3 | 3 | 3 | 2 | 1 | 0 | 5 | 2 | 3 |
| Agro-forestry areas | 27 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 13 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 3 | 14 | 3 | 3 | 2 | 0 | 0 | 0 | 3 | 3 | 2 | 0 | 0 | 3 | 3 | 0 |
| Broad-leaved forest | 31 | 3 | 4 | 5 | 4 | 5 | 5 | 5 | 39 | 5 | 4 | 3 | 2 | 5 | 5 | 5 | 5 | 5 | 21 | 0 | 0 | 1 | 0 | 0 | 5 | 5 | 5 | 1 | 5 | 0 | 10 | 5 | 5 |
| Coniferous forest | 30 | 3 | 4 | 4 | 4 | 5 | 5 | 5 | 39 | 5 | 4 | 3 | 2 | 5 | 5 | 5 | 5 | 5 | 21 | 0 | 0 | 1 | 0 | 0 | 5 | 5 | 5 | 1 | 5 | 0 | 10 | 5 | 5 |
| Mixed forest | 32 | 3 | 5 | 5 | 4 | 5 | 5 | 5 | 39 | 5 | 4 | 3 | 2 | 5 | 5 | 5 | 5 | 5 | 21 | 0 | 0 | 1 | 0 | 0 | 5 | 5 | 5 | 1 | 5 | 0 | 10 | 5 | 5 |
| Natural grassland | 30 | 3 | 5 | 4 | 4 | 4 | 5 | 5 | 22 | 2 | 3 | 1 | 1 | 0 | 5 | 5 | 5 | 0 | 5 | 0 | 3 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 6 | 3 | 3 |
| Moors and heathland | 30 | 3 | 4 | 4 | 5 | 4 | 5 | 5 | 20 | 4 | 3 | 2 | 2 | 0 | 0 | 3 | 4 | 2 | 10 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 0 | 0 | 10 | 5 | 5 |
| Sclerophyllous vegetation | 21 | 3 | 4 | 2 | 3 | 3 | 4 | 2 | 7 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 8 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 3 | 0 | 6 | 2 | 4 |
| Transitional woodland shrub | 21 | 3 | 4 | 2 | 3 | 3 | 4 | 2 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 1 | 0 | 0 | 4 | 2 | 2 |
| Beaches, dunes and sand plains | 10 | 3 | 3 | 1 | 1 | 1 | 0 | 1 | 6 | 0 | 0 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 7 | 5 | 2 |
| Bare rock | 6 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 0 |
| Sparsely vegetated areas | 9 | 2 | 3 | 1 | 0 | 1 | 1 | 1 | 3 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Burnt areas | 6 | 2 | 1 | 0 | 0 | 0 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Glaciers and perpetual snow | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 10 | 3 | 3 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 0 |
| Inland marshes | 25 | 3 | 2 | 4 | 4 | 4 | 3 | 5 | 14 | 2 | 2 | 4 | 2 | 0 | 0 | 4 | 0 | 0 | 7 | 0 | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Peatbogs | 29 | 3 | 4 | 4 | 4 | 4 | 5 | 5 | 24 | 4 | 5 | 3 | 3 | 0 | 0 | 3 | 4 | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 8 | 4 | 4 |
| Salt marshes | 23 | 2 | 3 | 4 | 3 | 3 | 3 | 5 | 8 | 1 | 0 | 5 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 |
| Salines | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 |
| Intertidal flats | 13 | 2 | 3 | 0 | 2 | 1 | 4 | 1 | 7 | 1 | 0 | 5 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 | 4 | 0 |
| Water courses | 18 | 4 | 4 | 0 | 3 | 3 | 3 | 1 | 10 | 1 | 0 | 2 | 1 | 0 | 0 | 3 | 3 | 0 | 12 | 0 | 0 | 0 | 3 | 0 | 4 | 0 | 0 | 3 | 0 | 5 | 10 | 5 | 5 |
| Water bodies | 23 | 4 | 4 | 0 | 4 | 4 | 3 | 4 | 7 | 2 | 1 | 1 | 2 | 0 | 0 | 1 | 0 | 0 | 12 | 0 | 0 | 0 | 3 | 0 | 4 | 0 | 0 | 0 | 0 | 5 | 9 | 5 | 4 |
| Coastal lagoons | 25 | 4 | 4 | 0 | 5 | 5 | 3 | 4 | 5 | 1 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 4 | 5 | 4 | 0 | 0 | 1 | 0 | 0 | 9 | 5 | 4 |
| Estuaries | 21 | 3 | 3 | 0 | 5 | 5 | 3 | 2 | 9 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 3 | 0 | 17 | 0 | 0 | 0 | 5 | 5 | 4 | 0 | 0 | 2 | 0 | 0 | 7 | 4 | 3 |
| Sea and ocean | 15 | 2 | 2 | 0 | 3 | 3 | 4 | 1 | 13 | 3 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 11 | 0 | 0 | 1 | 5 | 5 | 0 | 0 | 0 | 3 | 0 | 0 | 6 | 4 | 2 |

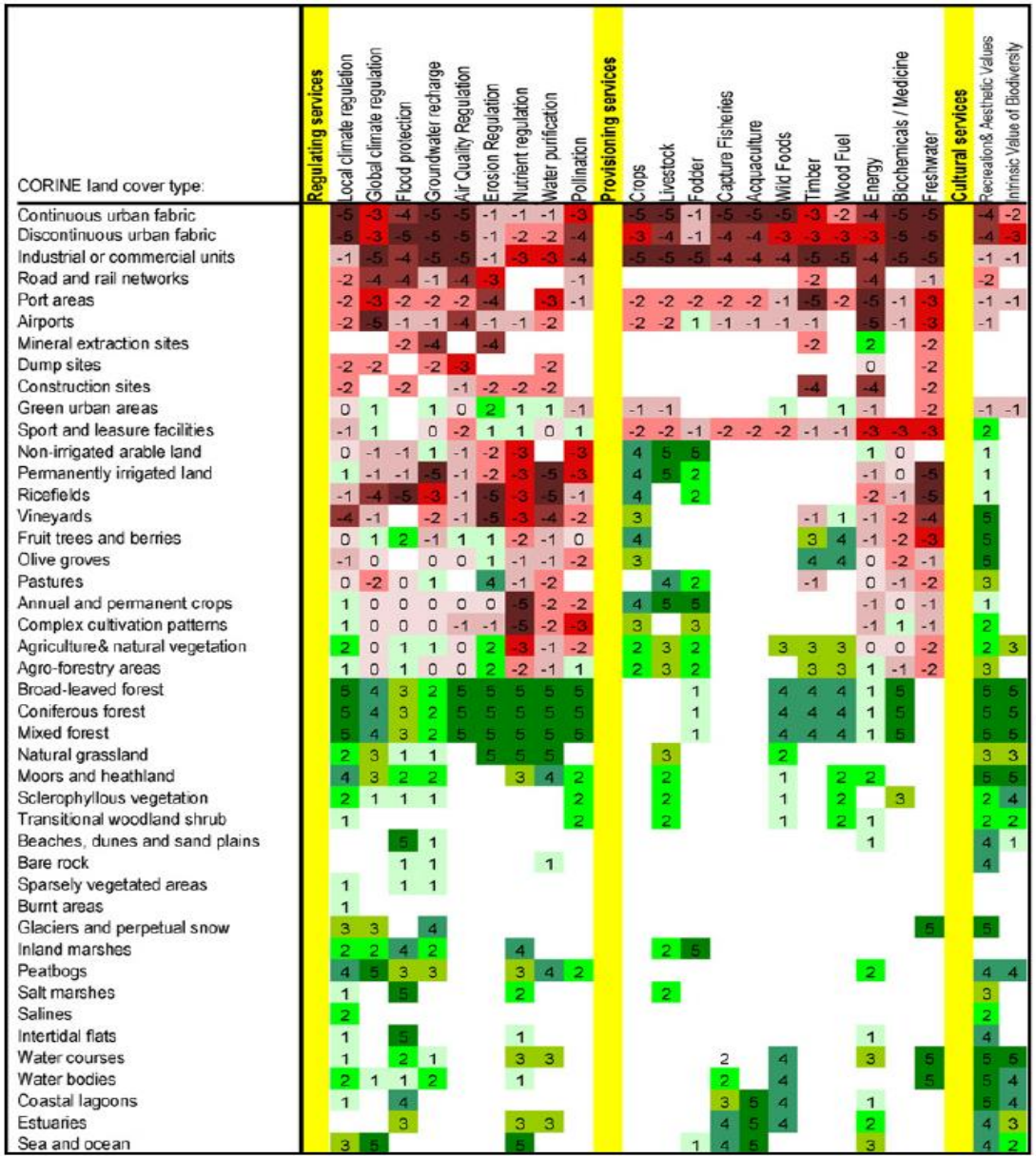
scale for assessing capacities:

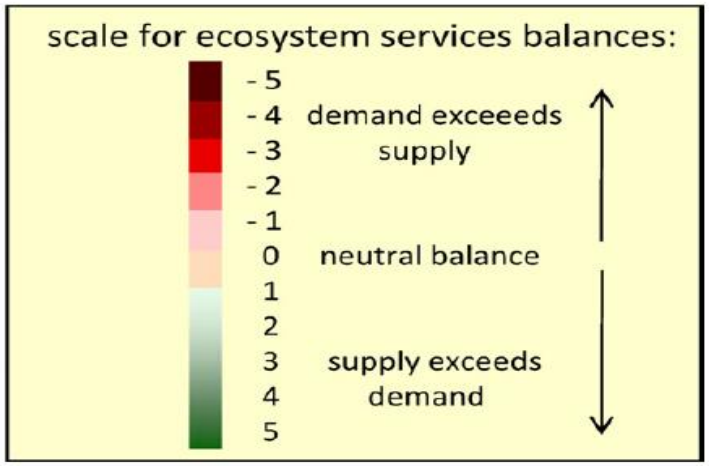
0 = no relevant capacity
1 = low relevant capacity
2 = relevant capacity
3 = medium relevant capacity
4 = high relevant capacity
5 = very high relevant capacity

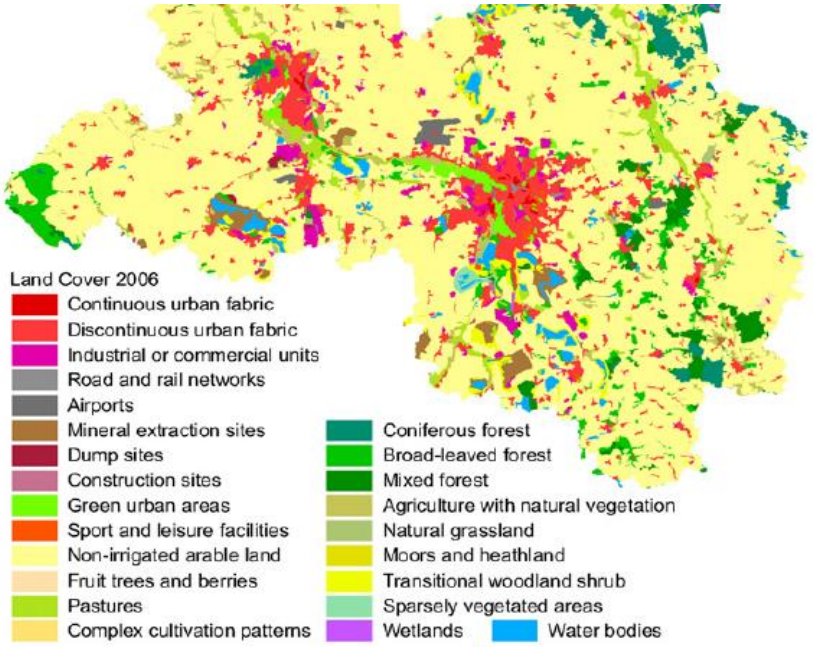
| CORINE land cover type: | Regulating services | | | | | | | | | | Provisioning services | | | | | | | | | | | | Cultural services | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Local climate regulation | Global climate regulation | Flood protection | Groundwater recharge | Air Quality Regulation | Erosion Regulation | Nutrient regulation | Water purification | Pollination | | Crops | Livestock | Fodder | Capture Fisheries | Aquaculture | Wild Foods | Timber | Wood Fuel | Energy | Biochemicals / Medicine | Freshwater | | Recreation& Aesthetic Values | Intrinsic Value of Biodiversity |
| Continuous urban fabric | | 5 | 3 | 4 | 5 | 5 | 1 | 1 | 1 | 3 | | 5 | 5 | 1 | 5 | 5 | 5 | 3 | 2 | 5 | 5 | 5 | | 4 | 2 |
| Discontinuous urban fabric | | 5 | 3 | 5 | 5 | 5 | 1 | 2 | 2 | 4 | | 4 | 4 | 2 | 4 | 4 | 4 | 3 | 3 | 4 | 5 | 5 | | 4 | 3 |
| Industrial or commercial units | | 1 | 5 | 4 | 5 | 5 | 1 | 3 | 3 | 4 | | 5 | 5 | 5 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | | 1 | 1 |
| Road and rail networks | | 2 | 4 | 4 | 1 | 4 | 3 | 0 | 0 | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 4 | 0 | 1 | | 2 | 0 |
| Port areas | | 2 | 3 | 5 | 2 | 2 | 4 | 0 | 3 | 1 | | 2 | 2 | 2 | 2 | 2 | 1 | 5 | 2 | 5 | 1 | 3 | | 2 | 1 |
| Airports | | 2 | 5 | 1 | 1 | 4 | 1 | 1 | 2 | 0 | | 2 | 2 | 0 | 1 | 1 | 1 | 1 | 0 | 5 | 1 | 3 | | 1 | 0 |
| Mineral extraction sites | | 0 | 0 | 2 | 4 | 0 | 4 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 3 | 0 | 2 | | 0 | 0 |
| Dump sites | | 2 | 2 | 0 | 2 | 3 | 0 | 0 | 2 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | | 0 | 0 |
| Construction sites | | 2 | 0 | 2 | 0 | 1 | 2 | 2 | 2 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 4 | 0 | 2 | | 0 | 0 |
| Green urban areas | | 2 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | | 4 | 1 |
| Sport and leasure facilities | | 2 | 0 | 0 | 2 | 3 | 0 | 0 | 1 | 0 | | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 3 | | 3 | 0 |
| Non-irrigated arable land | | 2 | 2 | 2 | 0 | 1 | 2 | 3 | 0 | 3 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | | 0 | 0 |
| Permanently irrigated land | | 2 | 2 | 2 | 5 | 1 | 2 | 3 | 5 | 3 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 5 | | 0 | 0 |
| Ricefields | | 3 | 4 | 5 | 5 | 1 | 5 | 3 | 5 | 1 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 5 | | 0 | 0 |
| Vineyards | | 5 | 2 | 0 | 3 | 1 | 5 | 3 | 4 | 2 | | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 4 | | 0 | 0 |
| Fruit trees and berries | | 2 | 1 | 0 | 3 | 1 | 1 | 3 | 2 | 5 | | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 3 | | 0 | 0 |
| Olive groves | | 2 | 1 | 0 | 1 | 1 | 0 | 2 | 2 | 2 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | | 0 | 0 |
| Pastures | | 1 | 3 | 1 | 0 | 0 | 0 | 1 | 2 | 0 | | 0 | 1 | 3 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 2 | | 0 | 0 |
| Annual and permanent crops | | 1 | 1 | 1 | 1 | 1 | 1 | 5 | 2 | 2 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | | 0 | 0 |
| Complex cultivation patterns | | 1 | 1 | 1 | 1 | 1 | 1 | 5 | 2 | 3 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | | 0 | 0 |
| Agriculture & natural vegetation | | 1 | 2 | 0 | 1 | 1 | 1 | 3 | 2 | 2 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 2 | | 0 | 0 |
| Agro-forestry areas | | 1 | 1 | 0 | 1 | 1 | 0 | 3 | 2 | 2 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | | 0 | 0 |
| Broad-leaved forest | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | | 0 | 0 |
| Coniferous forest | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | | 0 | 0 |
| Mixed forest | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | | 0 | 0 |
| Natural grassland | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Moors and heathland | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Sclerophyllous vegetation | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Transitional woodland shrub | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Beaches, dunes and sand plains | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 1 | 1 |
| Bare rock | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Sparsely vegetated areas | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Burnt areas | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Glaciers and perpetual snow | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Inland marshes | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Peatbogs | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Salt marshes | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Salines | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Intertidal flats | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Water courses | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Water bodies | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Coastal lagoons | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Estuaries | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| Sea and ocean | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |

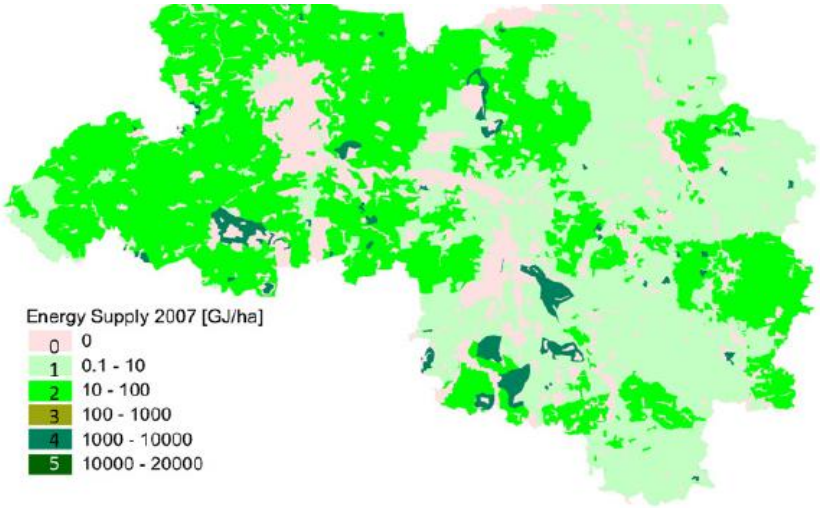
scale for assessing demands:

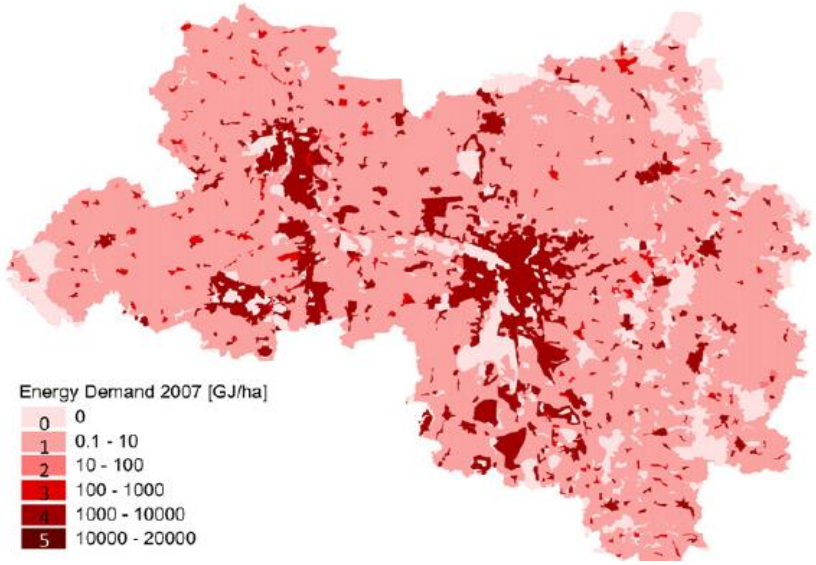
- 0 = no relevant demand
- 1 = low relevant demand
- 2 = relevant demand
- 3 = medium relevant demand
- 4 = high relevant demand
- 5 = very high relevant demand

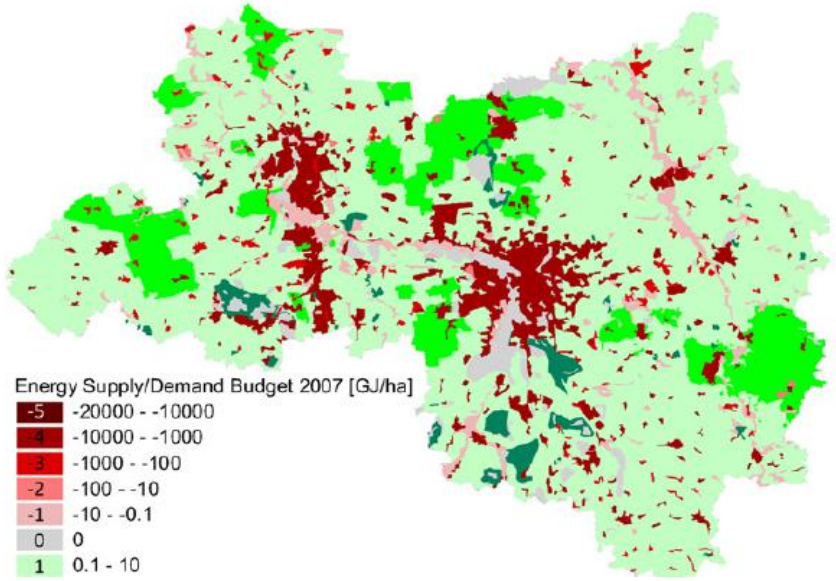

CORINE land cover type:
Regulating services
Local climate regulation
Global climate regulation
Flood protection
Groundwater recharge
Air Quality Regulation
Erosion Regulation
Nutrient regulation
Water purification
Pollination
Provisioning services
Crops
Livestock
Fodder
Capture Fisheries
Aquaculture
Wild Foods
Timber
Wood Fuel
Energy
Biochemicals / Medicine
Freshwater
Cultural services
Recreation& Aesthetic Values
Intrinsic Value of Biodiversity
Continuous urban fabric
Discontinuous urban fabric
Industrial or commercial units
Road and rail networks
Port areas
Airports
Mineral extraction sites
Dump sites
Construction sites
Green urban areas
Sport and leasure facilities
Non-irrigated arable land
Permanently irrigated land
Ricefields
Vineyards
Fruit trees and berries
Olive groves
Pastures
Annual and permanent crops
Complex cultivation patterns
Agriculture& natural vegetation
Agro-forestry areas
Broad-leaved forest
Coniferous forest
Mixed forest
Natural grassland
Moors and heathland
Sclerophyllous vegetation
Transitional woodland shrub
Beaches, dunes and sand plains
Bare rock
Sparsely vegetated areas
Burnt areas
Glaciers and perpetual snow
Inland marshes
Peatbogs
Salt marshes
Salines
Intertidal flats
Water courses
Water bodies
Coastal lagoons
Estuaries
Sea and ocean


scale for ecosystem services balances:
- 5
- 4
- 3
- 2
- 1
0
1
2
3
4
5
demand exceeeds supply
neutral balance
supply exceeds demand


Land Cover 2006
Continuous urban fabric
Discontinuous urban fabric
Industrial or commercial units
Road and rail networks
Airports
Mineral extraction sites
Dump sites
Construction sites
Green urban areas
Sport and leisure facilities
Non-irrigated arable land
Fruit trees and berries
Pastures
Complex cultivation patterns
Coniferous forest
Broad-leaved forest
Mixed forest
Agriculture with natural vegetation
Natural grassland
Moors and heathland
Transitional woodland shrub
Sparsely vegetated areas
Wetlands
Water bodies


Energy Supply 2007 [GJ/ha]
0 0
1 0.1 - 10
2 10 - 100
3 100 - 1000
4 1000 - 10000
5 10000 - 20000


Energy Demand 2007 [GJ/ha]
0 0
1 0.1 - 10
2 10 - 100
3 100 - 1000
4 1000 - 10000
5 10000 - 20000


Energy Supply/Demand Budget 2007 [GJ/ha]
-5 -20000 - -10000
-4 -10000 - -1000
-3 -1000 - -100
-2 -100 - -10
-1 -10 - -0.1
0 0
1 0.1 - 10

# The “Matrix” Approach

## Weaknesses

- Time consuming
- Resource consuming
- Specific for an area
- Doesn’t take into consideration the status of the environment
- Too slow for a broader application

## Strengths

- Spatial units well defined
- Visualization of ES
- Involvement of the local community and stakeholders

# The “Matrix” Approach

Space for improvement through

**Modeling**

Hydrographical modeling

Bio/Physical/Chemical modeling

**Quantitative Approach!**

Past and Future Scenarios

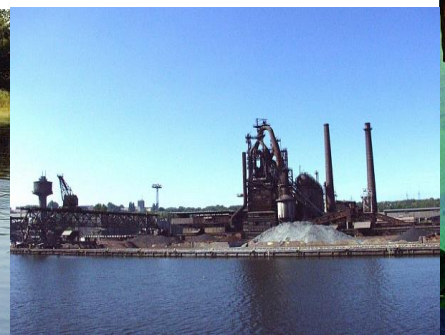
Relative change of ES provision

Sustainability regarding ES

- Developing a new methodology which aims to:

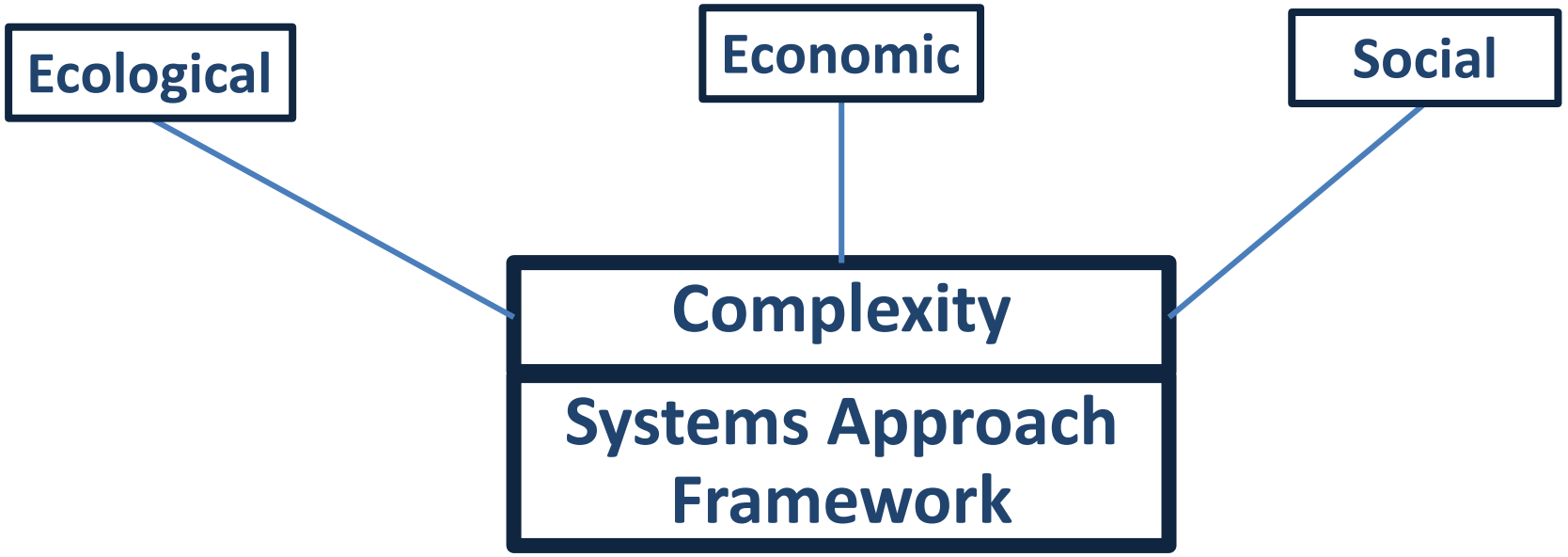
**Provide an easy to apply tool for ecosystem services assessment in the marine environment**




# Relevance

What is the objective of the concept or why is important?



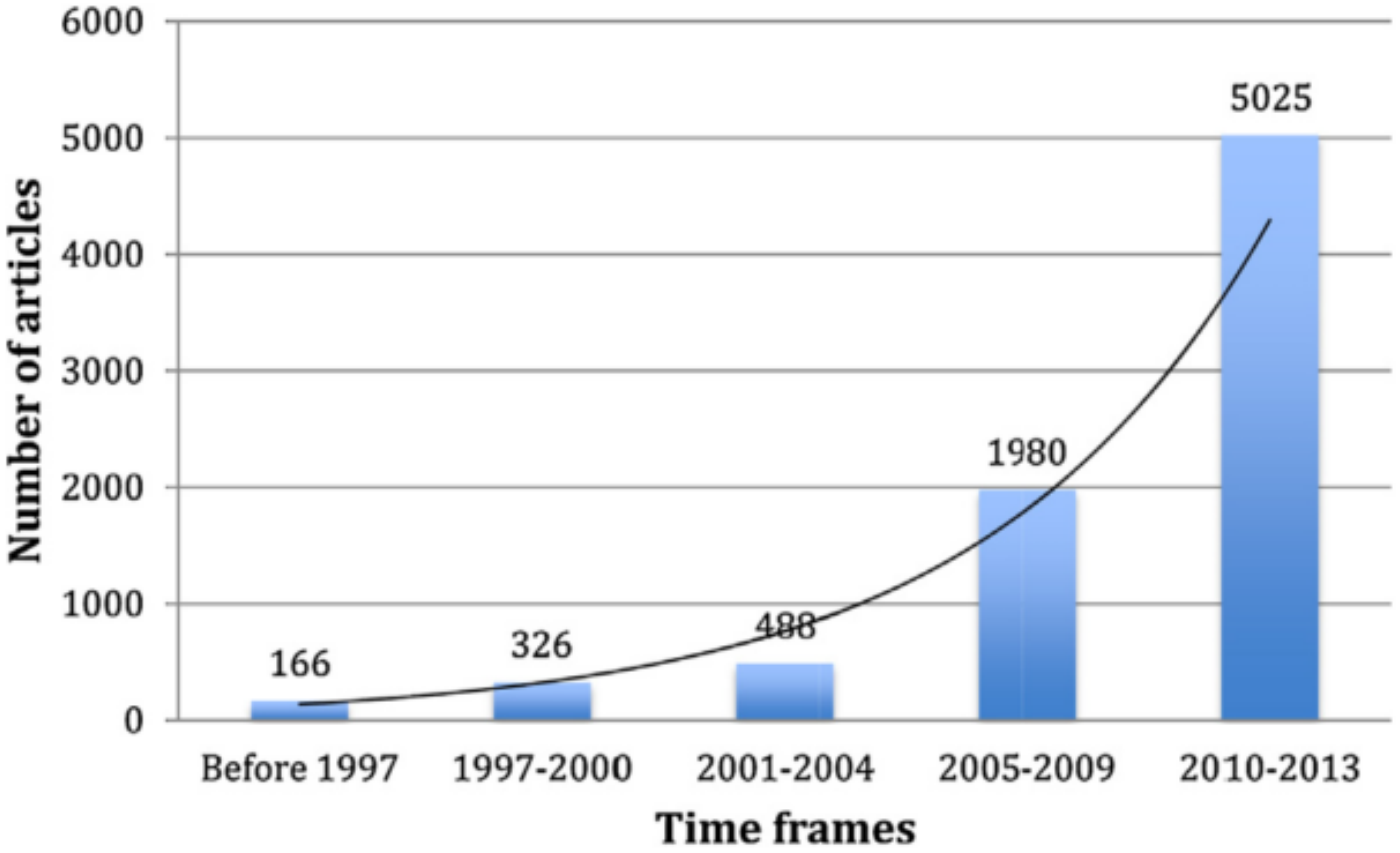

*Raise awareness about the destruction of the natural capital provided by our ecosystems, ensure an integrative management with the aim of make a sustainable use of resources for the next generations*

Review

# The evolution of ecosystem services: A time series and discourse-centered analysis

Sunita Chaudhary [a,*], Andrew McGregor [a], Donna Houston [a], Nakul Chettri [b]

[a] Department of Geography and Planning, Macquarie University, Sydney, NSW 2109, Australia
[b] International Centre for Integrated Mountain Development (ICIMOD), GPO Box: 3226, Kathmandu, Nepal



# Current Status and Future Prospects for the Assessment of Marine and Coastal Ecosystem Services: A Systematic Review

**Camino Liquete[1]*, Chiara Pir
Aymen Charef[3], Benis Egoh[1]**

1 Water Resources Unit, Institute for Environm
Institute for Environment and Sustainability, Eu
the Citizen, European Commission - Joint Rese

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Contents lists available at ScienceDirect

Ecosystem Services

journal homepage: www.elsevier.com/locate/ecoser


# An indicator framework for assessing ecosystem services in support of the EU Biodiversity Strategy to 2020

CrossMark

ELSEVIER

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind


# Marine ecosystem services: Linking indicators to their classification

CrossMark

International Association for Landscape Ecology
Region Deutschland - IALE-D

ESMERALDA

ipbes

ESP

SEC OS

## Mapping and Assessment of Ecosystems and their Services

Indicators for ecosystem assessments under Action 5 of the EU Biodiversity Strategy to 2020

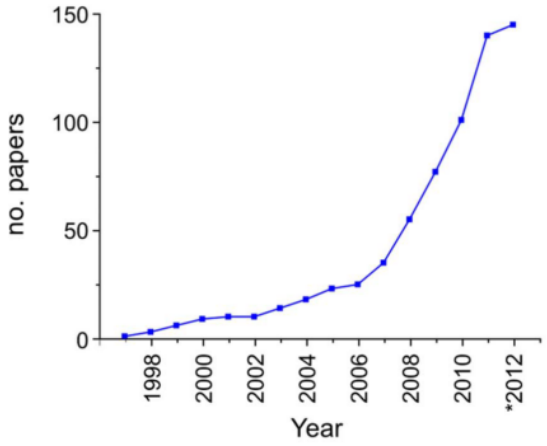
2nd Report – Final, February 2014

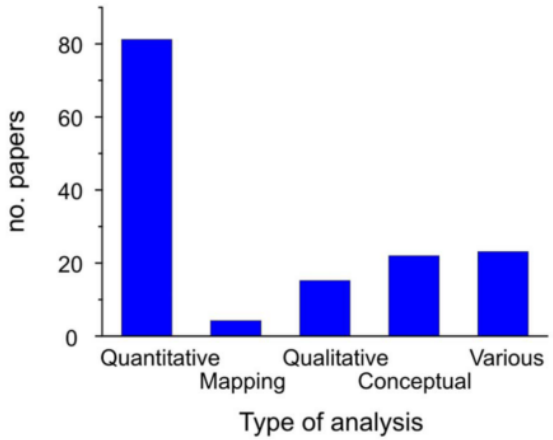
# Research Gaps:

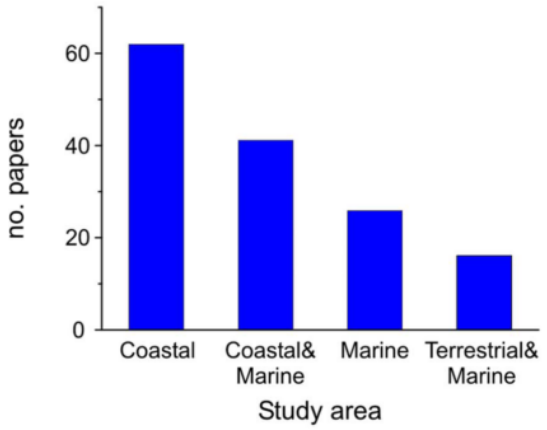
- The concept is too focused on monetary valuation, this leaves the ecological understanding of ES on the side
- There are few assessment available with a full assessment of ES (for marine environment
- Weak understanding of interaction between services
- No suitable Indicators for a comprehensive and proper assessment
- Assessments are site specific and consume a lot of resources and time
- Within assessments, services are not comparable between each other – due to different units

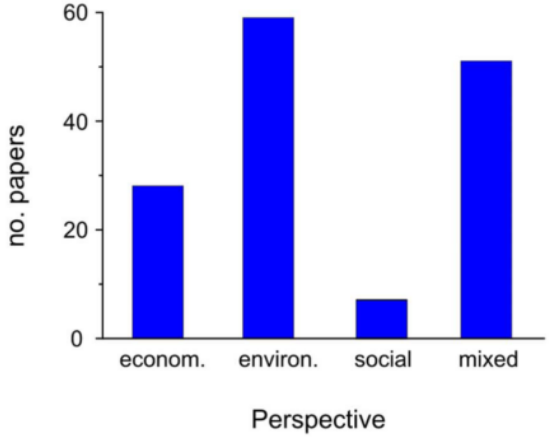
# Marine and Coastal Ecosystem Services

**For the marine environment things are starting to change!**



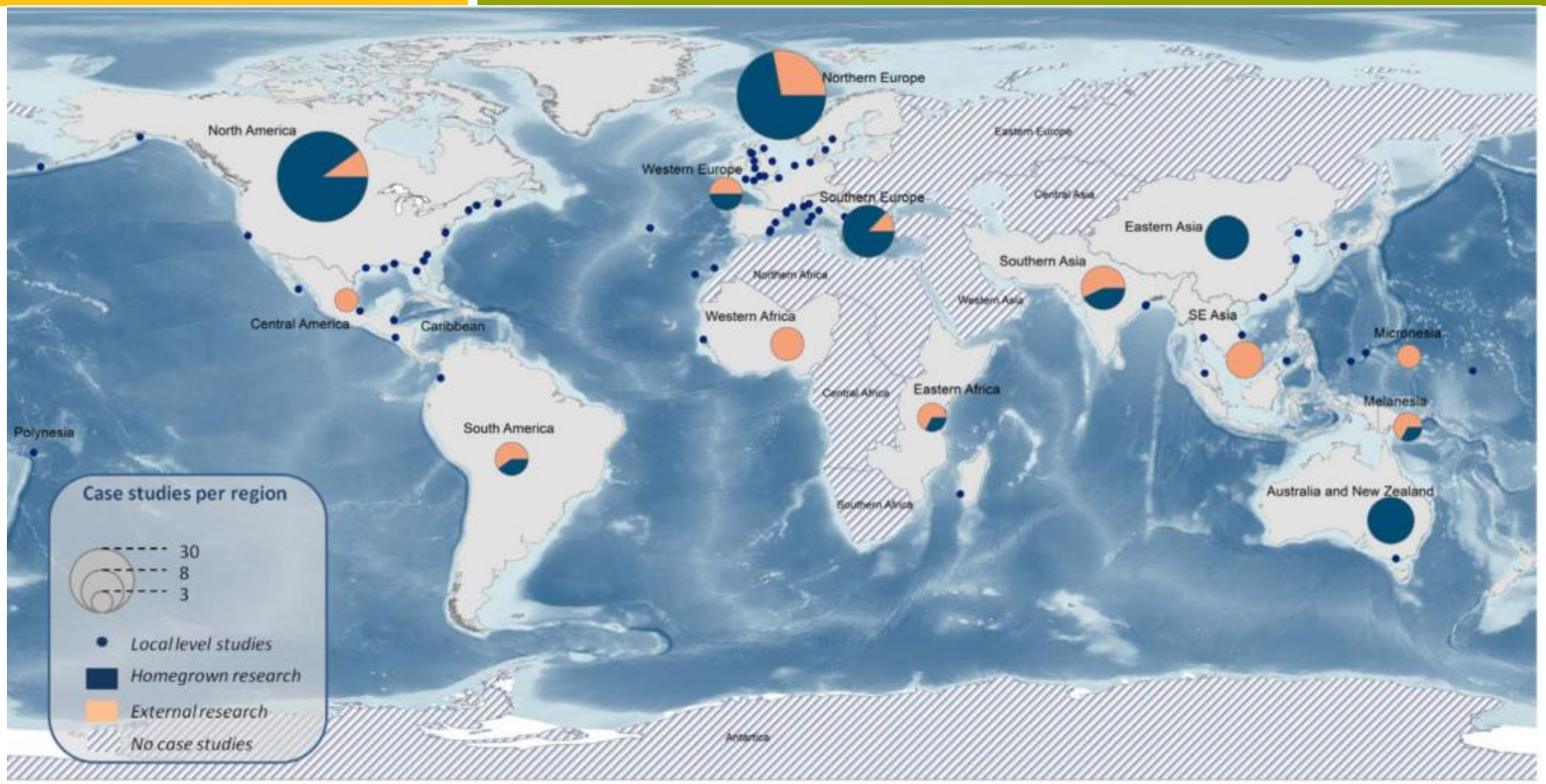




**Current Status and Future Prospects for the Assessment of Marine and Coastal Ecosystem Services: A Systematic Review**

Camino Liquete[1]*, Chiara Piroddi[1], Evangelia G. Drakou[2], Leigh Gurney[1], Stelios Katsanevakis[1], Aymen Charef[3], Benis Egoh[1]




# Current Status and Future Prospects for the Assessment of Marine and Coastal Ecosystem Services: A Systematic Review

**Camino Liquete[1]*, Chiara Piroddi[1], Evangelia G. Drakou[2], Leigh Gurney[1], Stelios Katsanevakis[1], Aymen Charef[3], Benis Egoh[1]**


norden
Ecosystem Services in the Baltic Sea
Valuation of Marine and Coastal Ecosystem Services in the Baltic Sea
NATUR VÅRDS VERKET
The economic valu
ecosystem servi
provided by
Baltic Sea and Skage
Existing information and gaps of kn
REPORT 5874 • DECEMBE
UK National Ecosystem Assessment
Understanding nature's value to society
Synthesis of the Key Findings
defra
E·S·R·C
NATURAL ENVIRONMENT RESEARCH COUNCIL
NIEA
The Scottish

## ➢ To whom this concept can be relevant?

- Governments
- Managers and Policy makers
- Stakeholders
- Scientists
- NGO's
- General Public


**TARGET 2 Maintain and restore ecosystems and their services**

# Conclusions and recommendations

- Although there is an increasing effort on it most of the assessments focus only on a group of ES **not providing a whole picture regarding the concept**

- The increase of assessments and mapping of ES in the oceans will develop our **knowledge about the interaction of economic and social with the ecologic** part of the system

- Development of a **standard methodology** that fits both land and sea and incorporates land-sea interface;

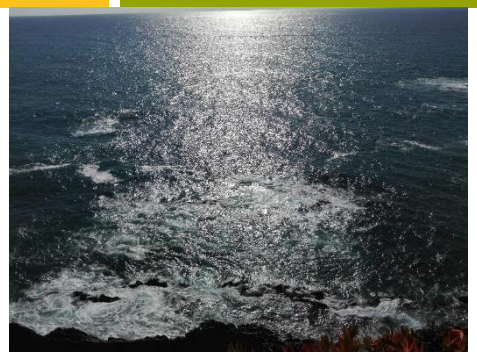
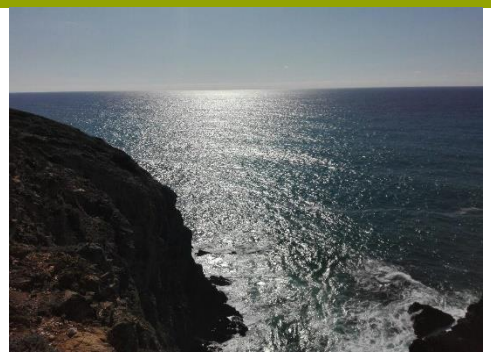
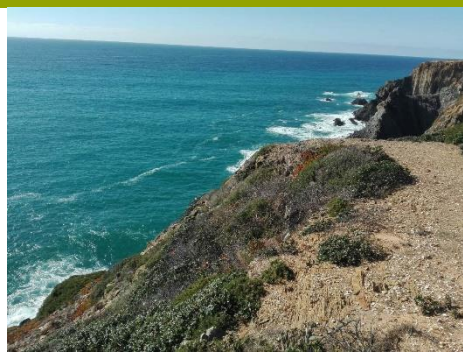
- Development of **standard indicators** to be used for marine ecosystem services assessment;

- Deal with **subjectivity** in a way that the scientific output can be inserted into **management**;

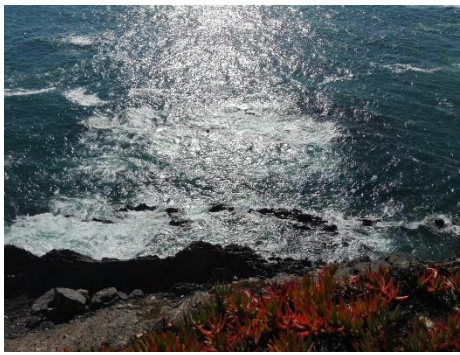
- Raise public's awareness about the concept and explain its importance!

## Weaknesses

## Strengths


# Thank You
# Ačiū





**Any question send email to:** miguel.inacio@io-warnemuende.de / miguel.inacio@jmtc.ku.lt

# Ecosystem Services

## Picture sources:

- https://www.flickr.com/photos/ellennetcom/4565061357
- http://www.goodplanet.org/wp-content/uploads/2013/10/2.5.-Photo-transport-maritime-1024x682.jpg
- http://www.worldwildlife.org/places/coastal-east-africa
- http://ichef-1.bbci.co.uk/news/624/media/images/80085000/jpg/_80085310_maersk_triple_e_portoffelixstowe.jpg
- https://upload.wikimedia.org/wikipedia/commons/2/24/The_universe.jpg
- © Directorate of Curonian Spit National Park
- http://news.nationalgeographic.com/content/dam/news/photos/000/213/21352.ngsversion.1422032540574.adapt.768.1.jpg
- http://www.thirstingforjustice.org/wp-content/uploads/2013/05/Gaza-wastewater-treatment-plant-discharging-untreated-and-partially-treated-wastewater-into-Gaza-beach..jpg
- http://i0.wp.com/www.ecomena.org/wp-content/uploads/2014/03/marine-litter.jpg
- http://earthjournalism.net/resources/covering-the-seas/Belize_SmithsonianLightHawk_shrimpfarm.jpg
- http://jorisvanalphen.com/blog/mating-cuttlefish/