European Commission

JRC TECHNICAL REPORTS

Spatial distribution of marine ecosystem service capacity in the European seas

Fernando Tempera
Camino Liquete
Ana Cristina Cardoso

2016

Joint Research Centre

EUR 27843 EN

Contact information
Name: Fernando Tempera
Address: Joint Research Centre, Via Enrico Fermi 2749, TP 270, 21027 Ispra (VA), Italy
E-mail: fernando.tempera@jrc.ec.europa.eu
Tel.: +39 0332 78 5001

JRC Science Hub
https://ec.europa.eu/jrc

JRC93906

EUR 27843 EN

ISBN 978-92-79-57761-1 (print)
ISBN 978-92-79-57762-8 (PDF)

ISSN 1018-5593 (print)
ISSN 1831-9424 (online)

doi:10.2788/165385 (print)
doi:10.2788/753996 (online)

Printed in Italy

How to cite: Tempera F., C. Liquete & A.C. Cardoso (2016). Spatial distribution of marine ecosystem service capacity in the European seas. EUR 27843. Luxembourg (Luxembourg): Publications Office of the European Union. doi:10.2788/753996

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Abstract

Practitioners and policy makers at European Union (EU) and Member States level are increasingly seeking spatially-explicit ecosystem service information to use in decision-making and the implementation of the **EU Biodiversity Strategy to 2020**. Whilst under the **MAES** Action, land-cover data has already been used to map the distribution of several ecosystem services provided over the European land surface, a similar exercise exploiting existing seabed habitat data is still lacking for the European Seas.

In this work **we map the distribution of seabed-associated ecosystem services capacity** by using a methodology that brings together (i) a geospatial dataset representing the broadscale distribution of permanently-submerged seabed habitats with (ii) information on each habitat capacity to provide ecosystem services.

A compilation of **EUNIS-harmonized** broadscale seabed habitat maps based on EMODNET Seabed Habitats and UNEP GSGFM is exploited as the pan-European cartographic basis. The exercise extends out to the limits of the Extended Continental Shelf claims, achieving an areal **coverage of** approximately **8.7 million km^2**, i.e., **more than 90% of the EU seafloor area in the Northeast Atlantic and adjacent seas**. Alongside, expert-based assessments of each marine EUNIS habitat's capacity to provide **CICES-harmonized** Ecosystem Services are compiled from a literature review into a presence-only lookup table.

Overall, the new seabed habitats *versus* ecosystem services lookup tables relate 33 ecosystem services to 67 EUNIS and 24 non-EUNIS seabed habitats. These results suggest that **out of all marine habitats (n=974) in the EUNIS classification (EUNIS A1 to A7), only 14% (n=141) have so far been related to at least one ecosystem service. When all potential connections between the existing seabed EUNIS classes and CICES services are considered (n=104,218),** results further show that **only 2% (i.e., n=2,241) of the have been addressed** qualitatively or semi-quantitatively.

Based on this information, a total of **30 CICES ecosystem service categories are mapped**: 3 at level 1 (CICES Sections), 5 at level 2 (CICES Divisions), 10 at level 3 (CICES Groups) and 12 at level 4 (CICES Classes). From these maps, **area-based indicators of ecosystem service capacity** (i.e., extent where each service is potentially provided) are **extracted per MSFD region/subregion, Ecoregion, Fishing Area and an approximation of EU Member States (MS) maritime areas in the Northeast Atlantic and Adjacent Seas.**

Along with the maps, the study presents also some spatial statistics based on the extent over which each service is potentially provided. Different segmentations of the European Seas are used to aggregate these statistics including MSFD region/subregion, Ecological Region, FAO Fishing Area and an approximation of the Member State maritime area.

Overall, **continental shelves and oceanic elevations (islands, seamounts and ridges) were highlighted as ecosystem services hotspots** where a larger number of services could be potentially held. When maps were segmented using MSFD region/subregion limits, the Extended Continental Shelf areas claimed by the EU MS in the Northeast Atlantic, together with the Celtic Seas and the Greater North Sea sub-regions stood as the regions holding most ecosystem service capacity. An ecoregion-based segmentation of the maps emphasized the Atlantic Deep Sea as the major ecosystem service capacity holder, followed by ecoregions containing large shelves, notably the Boreal Proper, the Boreal-Lusitanean and the Western Mediterranean. A disaggregation of the results per Fishing Area highlighted the Northeast Atlantic, namely areas around the British Isles and Macaronesia, as well as the western Mediterranean. When an approximation of EU Member States (MS) maritime areas was used, MS with larger EEZs (namely, UK, IT, PT and ES) came up as holding most of the marine ecosystem service capacity.

The new maps and associated area-based indicators **provide a first spatially-explicit baseline concerning the EU-wide distribution of marine ecosystem services**. They contribute to the marine component of MAES and fulfil key objectives of the JRC's SEACOAST and BES projects. Options to develop this research line and eventually make it more quantitative are expounded in the discussion and summarized in the conclusions.

The new information is of value to **practitioners, managers and policy makers**, at European or Member State level, seeking spatially-explicit ecosystem service information for marine spatial planning and environmental management. Researchers initiating and developing marine ecosystem service mapping studies are also expected users.

1. Introduction

Oceans and seas cover 70% of the earth surface. As the land surface becomes more heavily populated and terrestrial sources of water, energy, food and mineral resources become increasingly scarcer, marine areas become ever more perceived as an exploitable realm holding the plethora of critical resources that will secure the future and continued development of mankind.

The continental territory of the EU is surrounded by marine areas under jurisdiction of EU countries in the North Atlantic Ocean, the Baltic Sea, the North Sea, the Mediterranean Sea and the Black Sea. Overall, 23 of the 28 Member States of the European Union have a coastline, which in total amounts to 70,000 km. On their own, the Exclusive Economic Zones (EEZs[1]) directly attached to continental EU margins represent a sizeable 4.23 million km^2, which nearly correspond to the EU land surface (4.37 million km^2). Accounting for the size of the EEZ subareas attached to the EU Outermost Regions, this value mounts to nearly 6.75 million km^2. With the potential for the Extension of the Continental Shelves under the United Nations Law of the Sea adding another 3.40 million km^2, a total seabed area exceeding 10 million km^2 might be put under sovereignty of EU Member States.

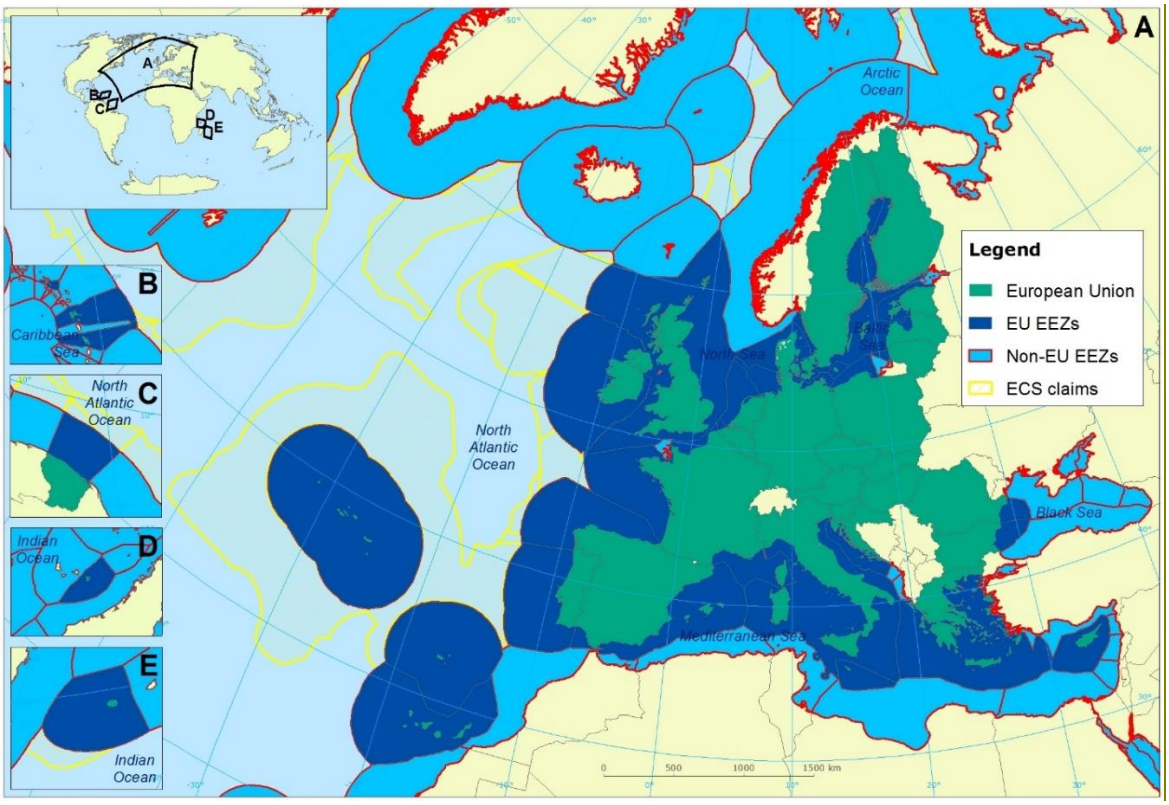


Figure 1. Maritime areas associated with the European Union (EU) Member States, including their Outermost Regions (OR).
A. Continental Europe, including the adjacent OR of Azores, Madeira and Canary Islands. B. French overseas departments (DOM) of Guadeloupe and Martinique and collectivity of Saint Martin. C. French Guyana DOM. D. Mayotte Island DOM. E. Reunion Island DOM. EEZ[1] – Exclusive Economic Zones approximation using the geographical median lines between countries baselines. ECS - Extended Continental Shelf claims. Large map and insets represented at the same scale and projection to facilitate areal comparison.

[1] See *Legal Notice* on top of page ii

Such vast marine domain encompasses a broad range of environmental conditions from subtropical to boreal regimes and from shallow seas to deep-sea environments. This complex and dynamic ecosystem mosaic supports diverse sea life and complex ecological processes that are important to Man from ecological and economical perspectives. Healthy marine ecosystems sustain a multitude of environmental functions that are essential to the entire biosphere. With regard to human societies, these functions are best expressed by the vital goods and services enjoyed by Man, including the provision of food, materials, coastal protection and cultural amenities such as opportunities for leisure and recreation (e.g.: Liquete et al., 2013a; Beaumont et al., 2007).

Marine regions are an integral part of the European identity and economy. In 2009, a total of 206 million Europeans, i.e., 41% of the total population of the 23 European coastal countries, lived within 50 kilometres of the coast (Eurostat, 2011). The active population based in these areas (approximately 97 million people) generally grew faster than the EU average.

An assessment of the economic contribution stemming from the biosphere to human societies globally yielded an estimate of 33,268 billion USD per year (Costanza et al., 1997). Marine ecosystems were considered to represent more than 60% of this value, with particular relevance to coastal ecosystems. At EU level, almost 40% of the gross domestic product is generated in the maritime regions and a staggering 75% of the EU foreign trade is conducted by sea [COM(2012) 494 final]. Excluding the military sector, an estimated 5.6 million people are currently employed by the marine-related industries and services depending on the European seas, i.e., the so-called "blue economy" (ECORYS et al., 2012). Such numbers correspond to 2.4 % of total EU employment and contribute a gross added value (GAV) of € 495 billion per year, mostly generated by coastal tourism, shipping and the fishing industry.

Overall, the European maritime economy is in a general state of growth and development (EEA, 2013). Supported by the Blue Growth Europe 2020 strategy, the EU maritime sectors are expected to substantially grow in economic terms in the coming years and decades. It is estimated that by 2020, their activities generate a GAV of € 590 billion and employ 7 million people, including a substantial contribution from activities linked to offshore wind energy (see, e.g., ECORYS et al., 2012).

1.1 The ecosystem services approach

The increasingly varied, intense and widespread suite of human activities is degrading the Earth's ecosystems, as highlighted by the Millennium Ecosystem Assessment (2005) or the study on the economic significance of the global loss of biological diversity (TEEB, 2010). The European seas are subject to powerful impacts that include (i) physico-chemical changes induced by the burning of fossil fuels for energy production, (ii) overfishing, (iii) loss of habitats near the coast and in intensively-fished areas, (iv) anthropogenically-assisted biological invasions by alien species and (v) water contamination (Maes et al., 2014). In a world with a globalised economy and a growing human population incapable of quickly adopting less impacting consumption and production patterns, pressures that have been altering marine ecosystems and extracting marine natural capital are expected to continue growing (e.g., EEA, 2015).
Predicted long-lasting consequences to coastal and marine ecosystems include regimes shifts and substantial changes to the biological communities they contain. Such changes have serious socio-economic implications for human societies, as they threaten the capacity of natural systems to provide food, maintain water quality and recover from perturbations (e.g., Worm et al., 2006). Halting biodiversity loss, reversing the environmental damages generated by human behaviours and promote sustainable uses of natural resources are therefore highly-noted on the current political agendas [e.g., the EU Biodiversity Strategy to 2020 (2008/56/EC) or the Marine Strategy Framework Directive (2011/2307(INI))].

Conservation arguments based on non-use values or bequest to future generations have not always been sufficient to promote a good governance of Earth's ecosystems. The *Millennium Ecosystem Assessment* (2005) and *The Economics of Ecosystems and Biodiversity* initiative (TEEB, 2010) were the first broadscale efforts that gave political acknowledgement to the concept of ecosystem services, advocating for a better understanding of the links between human well-being and the functions, goods and benefits offered by biodiversity and ecosystems.

Over the last two decades, this more pragmatic approach has been developed and applied by a growing number of environmental scientists in line with prevailing political and economic views. The approach is cross-disciplinary, integrating environmental and socio-economic concepts. It advocates that decisions on natural resource management and protection must be informed not only by (i) the presence of certain species and habitats but also by (ii) an assessment of the ecosystem functions and the services they provide (e.g., TEEB, 2010).

Conceptually, the valuation of ecosystem services should be based upon an estimation of worth or importance in non-monetary terms that combines economic, cultural and ecologic values (Dendoncker et al., 2013). Economic schools of thought usually endorse valuation methods that ultimately quantify the goods and benefits extracted by Man from the ecosystems in terms of a measurable and tangible currency value. Ideally, if a proper articulation and economic valuation of the derived goods and benefits is done, management decisions should be facilitated, as evidence for ecosystem protection is brought under a common framework with the costs and benefits of other human uses.

This anthropocentric strategy is believed to contribute to a more straightforward demonstration of (i) the frequently underestimated and neglected value of biodiversity to humans, (ii) the socio-economic and wellbeing consequences of ecological change and degradation for humans and (iii) the economic benefits of environmental investments. As a result, ecosystem service concepts increasingly underpin and inform planning tools and policy instruments (Fisher & Brown, 2014). However, concerns exist among conservation practitioners about the potential for ecosystem service-based arguments to rule-out non-utilitarian arguments (e.g., cultural, ethical) from the deliberation process [e.g., see Fisher & Brown (2014), but also the exchange between Adams & Redford (2010) and Skroch & Lopez-Hoffman (2010)].

Inherent to this approach is establishing the links between biodiversity and ecosystems and the services they provide. Biological diversity at species and population levels is closely linked to ecosystem functioning and it is assumed to positively influence the provision of particular ecosystem services (e.g.: Naeem et al., 1995; Mace et al., 2012). However, given the reduced accessibility of marine ecosystems in comparison to terrestrial environments, this challenge is particularly substantial in permanently-submerged areas (Worm et al., 2006). Consequently, the distribution of most marine ecosystems and of the environmental services they provide is still poorly understood in time, space and quantity, as is the sensitivity and resilience of many biotopes to human activities. Such situation has hampered delimiting in a systematic way the areas of environmental concern requiring protection and using that information to design marine spatial plans and protected area networks.

1.2 Ecosystem service mapping under the EU Biodiversity Strategy

Quantifying and mapping the supply of ecosystem services is currently a popular research theme and a conceptual framework for numerous programmes (Burkhard et al., 2009). In 2011, the concept of ecosystem services was integrated in the European Commission EU Biodiversity Strategy to 2020 (COM (2011) 244) as a means of mainstreaming biodiversity into other policies, notably agriculture, fisheries, forestry and regional development. This strategy, which includes 6 targets and 20 associated Actions, sets the roadmap for the EU to meet not only its own biodiversity conservation goals but also the global objectives set by the Convention on Biological Diversity (CBD).

Under its Action 5 - Target 2, the EU Biodiversity Strategy foresees that *"Member States, with the assistance of the Commission, will map and assess the state of ecosystems and their services in their national territory by 2014, assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020".* This effort has been steered by MAES, the working group dedicated to Mapping and Assessing Ecosystem and their Services.

As regards to the terrestrial surface of EU, the work of Maes et al. (2011) has brought together the available data on a number of ecosystem services and assessed them based on CORINE land-cover data. However similar spatially-explicit analyses of marine and coastal ecosystem services at regional to continental scales are still scarce (but see Galparsoro et al., 2014).

1.3 Aims

The main aims of the present study are:

- To produce an updated and comprehensive inventory of the ecosystem services provided by seabed ecosystems;
- To exploit existing pan-European knowledge of EUNIS broadscale marine habitat distribution to map seabed-related ecosystem service capacity at EU scale, covering the Northeast Atlantic and adjacent seas;
- To demonstrate this habitat-based approach to mapping ecosystem service capacity at EU scale;
- To derive a set of preliminary area-based indicators for ecosystem services for the EU waters as a whole as well as per Member State, MSFD (sub)region, Ecoregion and FAO Fishing Area;
- To highlight gaps in available knowledge on habitat-service relationships and shortcomings in the resulting ecosystem service maps;
- To explore spatial synergies and trade-offs of ecosystem services at EU scale.

1.4 Expected users

The analyses are of value to researchers initiating and developing new marine ecosystem service mapping studies. Results can also be used by practitioners, managers and policy makers, at European or Member State level, seeking spatially-explicit ecosystem service information of use for marine spatial planning and environmental management in coastal, shelf and open waters and some marine inlets and transitional waters.

2. Methods

2.1 Conceptual framework

A conceptual framework describing the flow of an ecosystem service as a cascade starting out from a biophysical structure or process and culminating in a final monetary value has been proposed by De Groot et al (2010) and Haines-Young & Potschin (2010, 2013) with further developments in Maes et al. (2013). In this cascade model (**Figure 2**), the BIOPHYSICAL STRUCTURES AND PROCESSES of an ecosystem determine its FUNCTIONS, i.e., a subset of the ecological interactions that underpin a CAPACITY of the ecosystem to provide a service. Those FUNCTIONS that ultimately contribute to human well-being make up the FLOW of FINAL ECOSYSTEM SERVICES addressed by CICES. This FLOW is made up of the ecosystem outputs that may consist of TANGIBLE GOODS (e.g., food, fuel, fibres) or more INTANGIBLE SERVICES (e.g., air purification, climate stabilization, protection against natural disasters), that are directly used by a BENEFICIARY (a social group consisting of households, companies or governments). Societal BENEFITS derived from the goods and services extracted from the ecosystems can then be allocated VALUE. Different methodologies exist with the more objective being to try and establish the ECONOMICAL value associated with the alternative human uses (e.g., monetary value). Since it is not always possible to convey all benefits in monetary terms, other plural or integrated values related to ecosystem health, human health, social relevance, or equity, among others may be used to complement decision-making.

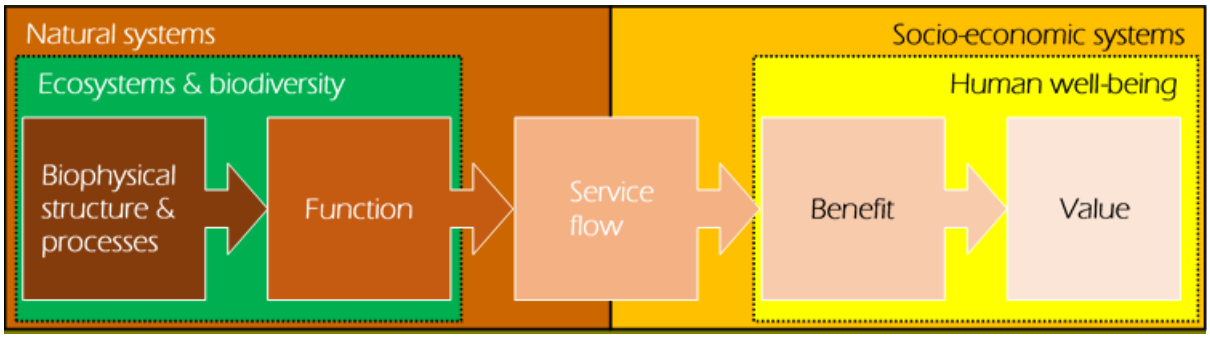


Figure 2. Cascade model of ecosystem services

This report focuses on mapping the CAPACITY of the ecosystems to potentially deliver goods and benefits effectively used by Man. This CAPACITY is directly linked to the presence of ecosystem structures, processes and functions that underpin the actual services ('*Ecosystems and Biodiversity*' level in **Figure 2**). The concept is closely related to the notion of (standing) STOCK from Layke (2009), who suggests ecosystem service capacity may be expressed in total area occupied by the providing ecosystems, or the total abundance of a population either in terms of numbers or preferably biomass.

2.2 Mapping of marine ecosystem services

The use of ecosystem services for natural resource management and marine spatial planning requires knowing where they are produced. In the EU Biodiversity Strategy, a commitment is made to develop a first set of biophysical maps of ecosystem services of key importance at the EU level by the end of 2014. These maps must identify the spatial differences in services supplied by all ecosystems situated in the European Union, including also semi-natural and artificial systems contributing to the green infrastructure.

According to Eigenbrod et al. (2010) methods used to produce ecosystem service maps can be broadly divided into those that are based on at least some primary data (i.e., direct ecosystem function/service measurements) from within the study region (*category 1*), and those that are based on proxies (*category 2*). *Category 1* can be further subdivided into mapping based on representative sampling across the whole study region and modelled

surfaces based on primary data, while the *category 2* can be broadly divided into landscape-based proxies and modelled surfaces driven by prior knowledge.

Due to the generalized lack of direct ecosystem service measurements, a common alternative expeditious approach is to use landscape units as proxies for differing capacities to provide ecosystem goods and services (e.g., Burkhard et al., 2009). This typically involves bringing together landscape maps, often in the form of digital rasters, and qualitative (or semi-quantitative) information on the ecosystem service capacity of each landscape unit. By highlight broadscale spatial variations and crude trends in ecosystem services the results instigate further hypothesis-testing and validation by alternative methods (e.g., Eigenbrod et al., 2010).

In the marine environment, this approach was first used by Galparsoro et al. (2014) to map the distribution of ecosystem services in a large portion of the Northeast Atlantic EU waters. Similarly, in the current work, qualitative knowledge compiled from scientific literature on the capacity of different seabed habitats to provide a variety of ecosystem services (in terms of presence/absence) is used to convert knowledge of the broadscale distribution of permanently-submerged seabed habitats into maps of ecosystem service capacity distribution (**Figure 3**).

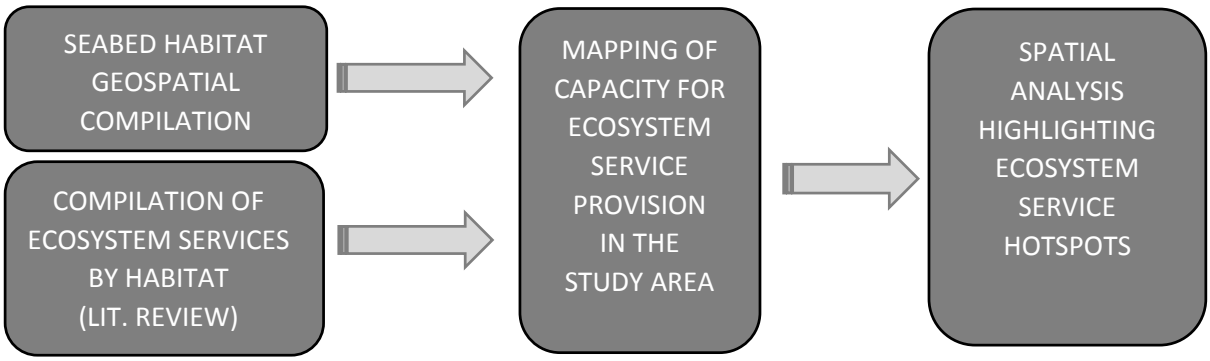


Figure 3. Methodological sequence used: from marine habitat maps to ecosystem service hotspot identification using a lookup table of ecosystem service provision potential.

The results are data-driven **maps illustrating a potential distribution of the capacity of the European waters to provide ecosystem services**. By delivering spatially-explicit information, they permit extracting quantitative indicators based on the **areal extent** where the service is suggested to be present. No quantitative distinction of service capacity is made throughout the area mapped for each service. Such variation will depend on the levels of effective service related to each ecosystem type and its condition but no information on these aspects was available. Furthermore, no realized flows of goods and benefits are implicit, nor any consideration on whether this flow is or may be sustainable (see also section 6.5.1).

The coming sections present the first three methodological steps of the assessment, namely: the classification and cross-reference of marine ecosystem services (section 0), the classification and mapping of seabed habitats (section 2.4), and the integration of both sources of information (section 2.5).

2.3 Classification of ecosystem services

The ecosystem services that can be extracted from marine habitats may be divided in 3 main categories:

- *Provisioning services* – which include the material or energetic products obtained from the living organisms and the ecosystems, including food resources, raw materials, biochemical, genetic, biochemical, pharmaceutical, ornamental products;
- *Regulating services* - which include, in the marine context, the benefits the society obtains from the ecosystem mechanisms that regulate biotic and abiotic processes, namely water and sediment quality, climate regulation (through gas capture and retention), natural hazard prevention (through storm and coastal flood protection), erosion control, sediment retention, biological control (of pest and disease spreading), or propagule dispersal;
- *Cultural services* - which include the non-material gains people obtain from organisms or ecosystems such as aesthetic, spiritual, recreational, religious, heritage and identity, cognitive benefits as well as non-use benefits (feel good or warm glow).

The MAES working group has established the Common International Classification of Ecosystem Goods and Services (CICES) as the harmonized typology of ecosystem services to be used in mapping and assessing ecosystem and their services in the EU (Maes et al., 2013, 2014). This framework categorizes provisioning, regulating and cultural ecosystem services into 20 Groups and 48 detailed Classes that can be linked to the framework of the UN System of Environmental-Economic Accounts (SEEA). As presented in Haines-Young & Potschin (2013), these categories are intended to represent 'final services', i.e., the ecosystem outputs directly consumed or used by a beneficiary, i.e., the GOODS and BENEFITS described in the previous section.

In order to identify and analyse a specific list of marine ecosystem services, the following criteria were followed in this work:

- **Only ecosystem services delivered by permanently-submerged EUNIS seabed ecosystems** are mapped (i.e., EUNIS classes A3 to A6; http://www.eea.europa.eu/themes/biodiversity/eunis/eunis-habitat-classification). This excludes intertidal environments, coastal wetlands, lagoons and estuaries. Services delivered by the water column (pelagic domain) are also excluded from this exercise.
- **Only ecosystem services provided by biota are considered**. This include not only services resulting from the natural functioning of the ecosystems but also functions mediated by humans in semi-natural or highly-modified natural systems (e.g., aquaculture). This assumption links the delivery of ecosystem services directly to ecological structures and/or processes emphasising the overall target of the Biodiversity Strategy: halt biodiversity loss and ecosystem service degradation.
- **Environmental services based on the abiotic components** of ecosystems and independent of living processes (e.g. hydrological power, wind energy, metal ores) **are not considered** as ecosystem services and are therefore excluded from this report. We do not consider either the extraction of natural non-living resources, or the provision of water for human consumption as an ecosystem service, even when services performed by biota were implied in the past (for instance fossil fuel reserve maturation). Interested parties are referred to the last version of the CICES classification (http://cices.eu/), which proposes a separate table of abiotic outputs that can be used in such contexts.
- Only services related to **goods and benefits** are considered in the analyses. Therefore, **supporting services** (i.e., those that underpin the production of all other ecosystem services but effectively do not result in direct outputs to people) **were left out of the analysis**.
- **Services delivered by sub-seafloor systems are also excluded** from this assessment. This is justified by the lack of knowledge about the function and

timescales at which the sub-surficial biosphere contributes towards global biogeochemical cycles, biodiversity and the climate system. Still, it is recognised that marine sediments cover more than 2/3 of the Earth surface and may accumulate in layers of several kilometres thickness. This ecosystem may therefore represent the largest Bacteria and Archae habitat on Earth and a most important fraction of Earth's living biomass.

A complete list of the CICES Ecosystem Services and their hierarchical organization is presented in **Table 1** (Provisioning services), **Table 2** (Regulation & Maintenance services) and **Table 3** (Cultural services). Table cells corresponding to ecosystem services irrelevant to the marine environment are shaded in dark grey and those for which the literature review did not provide information are shaded in light grey. A numerical index was added to the name of the services for ease of reference throughout the analysis and the report. With the CICES classification, the differentiation of some marine ecosystem services by final human use was not possible, e.g., the water purification service that is due to 'mediation by biota' or 'mediation by ecosystems'). Further challenges using this classification system for freshwater and marine systems are discussed in Maes et al. (2016).

Knowledge on the capacity of different seabed habitats to provide ecosystem services was compiled from the following selection of publications: Agardy et al. (2005), Millennium Ecosystem Assessment (2005), Armstrong et al. (2012), Salomidi et al. (2012), Potts et al. (2014) and Galparsoro et al. (2014). In these works, the capacity of different seabed habitats to provide ecosystem services is scored based on literature reviewing and expert judgement.

To establish a common ground between those publications and this EU-wide analysis, a cross-correlation of ecosystem services classifications was needed. The resulting lookup tables are provided in **Tables 4 to 7**. The cross-reference with the CICES Ecosystem Services is established by the first column of the table. Where the original descriptions were not sufficiently clear, the first authors of each study were consulted on the translation of their original ecosystem service into a CICES category. No confirmation on the CICES allocation could be obtained from T. Potts for his 2013 paper.

Table 1. List of CICES Provisioning Ecosystem Services. Services in grey are not addressed in this report.
An index is added to the name of the services for ease of reference. Table cells of ecosystem services irrelevant to the marine environment are in dark grey and those for which the literature review did not provide information are in light grey.

Section	Division	Group	Class
1. Provisioning	1.1. Nutrition	1.1.1. Biomass	1.1.1.1. Cultivated crops
			1.1.1.2. Reared animals and their outputs
			1.1.1.3. Wild plants, algae and their outputs
			1.1.1.4. Wild animals and their outputs
			1.1.1.5. Plants and algae from in-situ aquaculture
			1.1.1.6. Animals from in-situ aquaculture
		1.1.2. Water	1.1.2.1. Surface water for drinking
			1.1.2.2. Ground water for drinking
	1.2. Materials	1.2.1. Biomass	1.2.1.1. Fibres and other materials from plants, algae and animals for direct use or processing
			1.2.1.2. Materials from plants, algae and animals for agricultural use
			1.2.1.3. Genetic materials from all biota
		1.2.2. Water	1.2.2.1. Surface water for non-drinking purposes
			1.2.2.2. Ground water for non-drinking purposes
	1.3. Energy	1.3.1. Biomass-based energy sources	1.3.1.1. Plant-based resources
			1.3.1.2. Animal-based resources
		1.3.2. Mechanical energy	1.3.2.1. Animal-based energy

Table 2. List of CICES Regulation and Maintenance Ecosystem Services. Services in grey are not addressed in this report. An index is added to the name of the services for ease of reference. Table cells of ecosystem services irrelevant to the marine environment are in dark grey and those for which the literature review did not provide information are in light grey.

Section	Division	Group	Class
2. Regulation & Maintenance	2.1. Mediation of waste, toxics and other nuisances	2.1.1. Mediation by biota	2.1.1.1. Bio-remediation by micro-organisms, algae, plants, and animals
			2.1.1.2. Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals
		2.1.2. Mediation by ecosystems	2.1.2.1. Filtration/sequestration/storage/accumulation by ecosystems
			2.1.2.2. Dilution by atmosphere, freshwater and marine ecosystems
			2.1.2.3. Mediation of smell/noise/visual impacts
	2.2. Mediation of flows	2.2.1. Mass flows	2.2.1.1. Mass stabilisation and control of erosion rates
			2.2.1.2. Buffering and attenuation of mass flows
		2.2.2. Liquid flows	2.2.2.1. Hydrological cycle and water flow maintenance
			2.2.2.2. Flood protection
		2.2.3. Gaseous / air flows	2.2.3.1. Storm protection
			2.2.3.2. Ventilation and transpiration
	2.3. Maintenance of physical, chemical, biological conditions	2.3.1. Lifecycle maintenance, habitat and gene pool protection	2.3.1.1. Pollination and seed dispersal
			2.3.1.2. Maintaining nursery populations and habitats
		2.3.2. Pest and disease control	2.3.2.1. Pest control
			2.3.2.2. Disease control
		2.3.3. Soil formation and composition	2.3.3.1. Weathering processes
			2.3.3.2. Decomposition and fixing processes
		2.3.4. Water conditions	2.3.4.1. Chemical condition of freshwaters
			2.3.4.2. Chemical condition of salt waters
		2.3.5. Atmospheric composition and climate regulation	2.3.5.1. Global climate regulation by reduction of greenhouse gas concentrations
			2.3.5.2. Micro and regional climate regulation

Table 3. List of CICES Cultural Ecosystem Services. Services in grey are not addressed in this report.
An index is added to the name of the services for ease of reference. Table cells of ecosystem services irrelevant to the marine environment are in dark grey and those for which the literature review did not provide information are in light grey.

Section	Division	Group	Class
3. Cultural	3.1. Physical and intellectual interactions with biota, ecosystems, and land-/seascapes [environmental settings]	3.1.1. Physical and experiential interactions	3.1.1.1. Experiential use of plants, animals and land-/seascapes in different environmental settings
			3.1.1.2. Physical use of land-/seascapes in different environmental settings
		3.1.2. Intellectual and representative interactions	3.1.2.1. Scientific
			3.1.2.2. Educational
			3.1.2.3. Heritage, cultural
			3.1.2.4. Entertainment
			3.1.2.5. Aesthetic
	3.2. Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes [environmental settings]	3.2.1. Spiritual and/or emblematic	3.2.1.1. Symbolic
			3.2.1.2. Sacred and/or religious
		3.2.2. Other cultural outputs	3.2.2.1. Existence
			3.2.2.2. Bequest

Table 4. Cross-reference table between the Common International Classification of Ecosystem Services (CICES) and the seabed habitat-related provisioning ecosystem services derived from the literature considered in this report.
Services in grey were not considered in this study.

CICES service	Agardy et al., 2005	Mill. Ecos. Assessmt., 2005	Salomidi et al., 2012	Armstrong et al., 2012	Potts et al., 2013	Galparsoro et al., 2014
1. Provisioning	–	Fiber, timber, fuel	–	–	–	–
1.1.1. (Prov.; Nutr.) Biomass	Food	Food	Food provision	–	Food	Food provision
1.1.1.3. (Prov.; Nutr; Biomass) Wild plants, algae and their outputs	–	–	–	–	–	–
1.1.1.4. Wild animals and their outputs	–	–	–	Finfish, shellfish, marine mammals	–	–
1.1.1.5. Plants and algae from in-situ aquaculture	–	–	–	–	–	–
1.1.1.6. Animals from in-situ aquaculture	–	–	–	–	–	–
1.2.1. Biomass	–	–	Raw materials	Chemical compounds for industrial and pharmaceutical uses	Medicine & blue technology	Raw materials
1.2.1.1. Fibres and other materials from plants, algae and animals for direct use or processing	Fiber, timber, fuel Biochemical Medicines, other	Biochemical products	–	–	Fish feed Ornaments (including aquaria)	–
1.2.1.2. Materials from plants, algae and animals for agricultural use	–	–	–	–	Fertiliser	–
1.2.1.3. Genetic materials from all biota	–	Genetic materials	–	–	–	–
1.2.2. Water	Freshwater storage and retention	Freshwater	–	–	–	–

Table 5. Cross-reference table between the Common International Classification of Ecosystem Services (CICES) and the seabed habitat-related Regulation and Maintenance ecosystem services derived from the literature considered in this report.

CICES service	Agardy et al., 2005	Mill. Ecos. Assessmt., 2005	Salomidi et al., 2012	Armstrong et al., 2012	Potts et al., 2013	Galparsoro et al., 2014
2. Regulation & Maintenance	–	–	Photosynthesis, chemosynthesis, and primary production	Primary production	Primary production	Photosynthesis, chemosynthesis, and primary production
2. Regulation & Maintenance	–	–	–	Resilience	–	–
2. Regulation & Maintenance	Biodiversity	Biodiversity	–	Biodiversity	–	–
2.1. Mediation of waste, toxics and other nuisances	Biological regulation	–	–	Biological regulation	–	–
2.1. Mediation of waste, toxics and other nuisances	Waste processing	Pollution Control and Detoxification	Water quality regulation / Bioremediation of waste	Waste absorption and detoxification	Regulation of water & sediment quality Clean water and sediments Immobilisation of pollutants	Water quality regulation / Bioremediation of waste
2.2. Mediation of flows	–	Natural hazards	Disturbance and natural hazard prevention	–	Natural hazard regulation Prevention of coastal erosion	Disturbance and natural hazard prevention
2.2.1 Mass flows	Erosion control	Erosion protection	–	–	–	–
2.2.2 Liquid flows	Hydrological	Hydrological regimes	–	–	–	–
2.2.2.1. Hydrological cycle and water flow maintenance	–	–	–	Water circulation & Exchange	Water cycling	–
2.2.2.2. Flood protection	Flood/storm protection	–	–	–	Formation of physical barriers	–

Table 5 (continued). Cross-reference table between the Common International Classification of Ecosystem Services (CICES) and the seabed habitat-related Regulation and Maintenance ecosystem services derived from the literature considered in this report.

CICES service	Agardy et al., 2005	Mill. Ecos. Assessmt., 2005	Salomidi et al., 2012	Armstrong et al., 2012	Potts et al., 2013	Galparsoro et al., 2014
2.3.1 Lifecycle maintenance, habitat and gene pool protection	–	–	Reproduction and nursery areas	–	Larval / gamete supply	Reproduction and nursery areas
2.3.1 Lifecycle maintenance, habitat and gene pool protection	–	–	Maintenance of biodiversity	–	–	Maintenance of biodiversity
2.3.1 Lifecycle maintenance, habitat and gene pool protection	–	–	–	Habitat	Formation of species habitat	–
2.3.2. Pest and disease control	–	Biological regulation	–	–	Biological control	–
2.3.2.2. Disease control	Human disease control	–	–	–	–	–
2.3.3. Soil formation and composition	–	Soil Formation	–	–	–	–
2.3.4.2. Chemical condition of salt waters	Nutrient cycling and fertility	Nutrient cycling	Nutrient cycling	Nutrient cycling	Nutrient cycling	Nutrient cycling
2.3.5. Atmospheric composition and climate regulation	Atmospheric and climate regulation	Climate regulation	Air quality and climate regulation	Gas & climate regulation	Healthy climate	Air quality and climate regulation
2.3.5.1 Global climate regulation by reduction of greenhouse gas concentrations	–	–	–	–	Carbon sequestration	–

Table 6. Cross-reference table between the Common International Classification of Ecosystem Services (CICES) and the seabed habitat-related cultural ecosystem services derived from the literature considered in this report.

CICES service	Agardy et al., 2005	Mill. Ecos. Assessmt., 2005	Salomidi et al., 2012	Armstrong et al., 2012	Potts et al., 2013	Galparsoro et al., 2014
3. Cultural	Cultural and amenity	–	–	–	–	–
3.1. Physical and intellectual interactions with biota, ecosystems, and seascapes [environmental settings]	–	–	Leisure, recreation and cultural inspiration	–	Formation of seascape	Leisure, recreation and cultural inspiration
3.1.1 Physical and experiential interactions	–	–	–	–	Tourism / Nature watching	–
3.1.1.2 Physical use of seascapes in different environmental settings	Recreational	Recreational	–	–	–	–
3.1.2. Intellectual and representative interactions	–	–	Cognitive benefits	–	–	Cognitive benefits
3.1.2.1. Scientific	–	–	–	Scientific	–	–
3.1.2.2. Educational	–	Educational	–	Educational	Education	–
3.1.2.5. Aesthetic	Aesthetics	Aesthetic	–	Aesthetic	Aesthetic benefits	–
3.2. Spiritual, symbolic and other interactions with biota, ecosystems, and seascapes [environmental settings]	–	–	–	–	Spiritual / cultural wellbeing	–
3.2.1. Spiritual and/or emblematic	–	Spiritual and inspirational	–	–	–	–

Table 7. Cross-reference table between the Common International Classification of Ecosystem Services (CICES) and the seabed habitat-related abiotic ecosystem services derived from the literature considered in this report. Services in grey were not considered in this study.

CICES service	Agardy et al., 2005	Mill. Ecos. Assessmt., 2005	Salomidi et al., 2012	Armstrong et al., 2012	Potts et al., 2013	Galparsoro et al., 2014
A1.3.2. Non-renewable energy sources	–	–	–	Energy: oil, gas, minerals	–	–
A2.1.1 Mediation of waste, toxics and other nuisances by natural chemical and physical processes	–	–	–	Carbon capture & storage (artificial)	–	–
A2.1.1 Mediation of waste, toxics and other nuisances by natural chemical and physical processes	–	–	–	Waste disposal sites	–	–

2.4 Ecosystem mapping

The application of Ecosystem Service approaches beyond a single habitat requires a broadscale understanding of the distribution of biota, habitats and bio-physical characteristics (Townsend et al. 2014). In practice, this knowledge is typically encapsulated in more or less detailed ecosystem or habitat maps.

For terrestrial and freshwater ecosystems, MAES has endorsed the satellite-imagery-based CORINE land cover maps as the most comprehensive dataset at EU level. Contrastingly, obtaining detailed habitat maps in marine areas is particularly more arduous than analysing the full-coverage high-resolution data provided by satellites. For instance, the massive pelagic domain typically holds a three-dimensional lattice of life-cycle pathways and short to long-term migratory behaviours that are not easily discernible from the surface. Defining ecosystems exhibiting such dynamic processes requires taking onboard a major component of spatio-temporal variability that not only remains poorly known but also is not obviously represented by the conventional two-dimension (2D) maps.

Providentially, the situation of seabed ecosystems is more analogous to land surfaces given that most habitat-structuring organisms are sessile and can therefore be represented on 2D maps. However, satellite imagery can only resolve a very small fraction of the benthic domain. At best, i.e. in clear shallow waters, satellite optical sensors acquire seafloor data down to a few tens of meters underneath the surface.

Surveying and groundtruthing the vast seabed areas located beyond the penetration capacity of satellite sensors (i.e., in turbid or deep areas) often requires costly and/or time-demanding work at sea. Currently, such work typically involves deploying swath sonars (multibeam or interferometric) or laser-beam systems (LIDAR) on surface vessels, aircraft or underwater platforms to survey the topography and the reflectivity of the seabed. On a second stage, divers, sampling instruments (e.g., grabs, corers) or optical platforms (e.g., drop-down cameras, remotely-operated vehicles or manned submarines) are used to obtain physical samples and/or images from the seabed. By interpreting, extrapolating or modelling the information from the remote sensing survey in association with the groundtruthing data on the substrate and the associated biology, full maps of areas are eventually produced. Although this approach may produce very detailed maps, it usually takes a few years between the first survey and the completion of a map that usually covers from a few square kilometers to a few tens of thousands square kilometers. Using it to map the full extent of the European Seas can therefore only be envisaged as a long-term undertaking, leaving vast areas poorly resolved in terms of habitat distribution in the meantime.

2.4.1 *EUNIS as the ecosystem classification*

For the purpose of this study, an ecosystem was generally equated to a habitat class defined by the EUNIS classification. The EUNIS classification is the pan-European habitat classification system maintained by the European Topic Centre on Biological Diversity for the European Environment Agency (ETC-BD/EEA) and the European Environmental Information Observation Network (EIONET). EUNIS aims to describe and classify in a hierarchical framework all types of habitats in the whole of the European terrestrial, freshwater and marine domains, including both natural and artificial ones. Biogeographically, it covers the European mainland as far east as the Ural Mountains, the Caucasus and Anatolian Turkey. Seawards it covers the marine ecoregions contiguous to mainland Europe and extends as far as Iceland, the Macaronesian archipelagos and the Mediterranean islands of EU Member States.

The current version of the classification (v. 2007) is available at http://www.eea.europa.eu/themes/biodiversity/eunis/eunis-habitat-classification/habitats/eunis-habitats-complete-with-descriptions.xls. In what concerns the permanently-submerged seabed habitats addressed by this study, EUNIS includes 651

habitat categories hierarchically distributed. The most general marine level (which corresponds to EUNIS level 2) splits seabed habitats into 4 classes. Using further environmental and biological criteria, level 3 establishes 30 seabed habitat classes, level 4 encompasses 99 seabed habitat classes, level 5 encompasses 402 seabed habitat classes, level 6 encompasses 112 seabed habitat classes and level 7 (the most specific level) encompasses 4 seabed habitat classes.

2.4.2 *The EMODNET seabed habitat maps*

The Seabed Habitat datasets publicly-available from the European Marine Observation and Data Network (EMODNET) portal (http://www.emodnet.eu/seabed-habitats) currently provide the best available information for mapping and assessing marine habitats in European waters. Rather than resulting from a fully groundtruthed interpretation of dense habitat distribution sampling, the broadscale datasets available through the portal are produced using an efficient desktop-based modelling technique. The approach, developed under the projects MESH and BALANCE, produces predictive broadscale maps of EUNIS seabed habitats down to level 3, based upon geospatial datasets concerning substrate type, depth, light availability, salinity and hydrodynamic energy. Detailed in Coltman et al. (2008) and Vasquez et al. (2015), the method was disseminated through the EUSeaMap programme and MeshAtlantic project. It has thus far delivered seabed habitat maps for a number of European regions including: the Celtic Seas, Greater North Sea, Baltic Sea, western Mediterranean, southwestern Europe Seas and the Azores.

Despite, the EMODNET datasets covers already half of the European Seas, using them on their own would still imply very broad data gaps. This would represent a major drawback for the desired geographical comprehensiveness and usefulness of an EU-wide assessment of marine Ecosystem Functions and Services. An exercise was thus made to expeditiously achieve a broader coverage of the permanently-submerged seabed habitats (i.e., EUNIS classes A3 to A6) throughout the EU maritime area. The approach followed is detailed in Tempera (2015) and was based on bringing together, and harmonizing where need, complementary EUNIS-compliant geospatial information from the UNEP's Global Seafloor Geomorphic Features Map (GSGFM; Harris et al., 2014) with the EMODNET data. Several of the seabed classes used in GSGFM could be translated into EUNIS classes either straightforwardly or after some basic GIS processing.

The new synthesis comprehends geospatial information about 69 different seabed habitats down to EUNIS level 5. The dataset (a polygon shapefile) covers approximately 8.7 million km^2 and more than doubles the coverage of EUNIS seabed habitat classes when compared to the datasets available from the EMODNET portal. It details more than 90% of the EU waters down to EUNIS level 2 and 3 and a small part down to level 5. Its most important inputs are at the level of geomorphic-based deep-sea and offshore areas in the wider Atlantic, including Macaronesia, the western Mediterranean and parts of the Celtic Seas, which were largely uncharted in the existing EUNIS datasets.

The distribution of the EUNIS classes mapped throughout the different hierarchical levels of EUNIS is shown in **Figure 4**. Detailed information on habitat specific mapped extents can be found in Tempera (2015). Since EUSeaMap-type efforts have not yet comprehensively and equally covered all EU waters, it is worth-noting that the overall mapped extents of several habitats are geographically biased and underestimated in relation to their actual extent. However, until new geospatial datasets are available from EMODNET Seabed Habitats, this dataset represents a legitimate and most comprehensive basis for conducting area-based assessments of seabed-related Functions and Services.
Table 8 lists the EUNIS benthic habitats classes for which geospatial information was found and/or were related to ecosystem services by the literature sources used (see section 2.5 below).

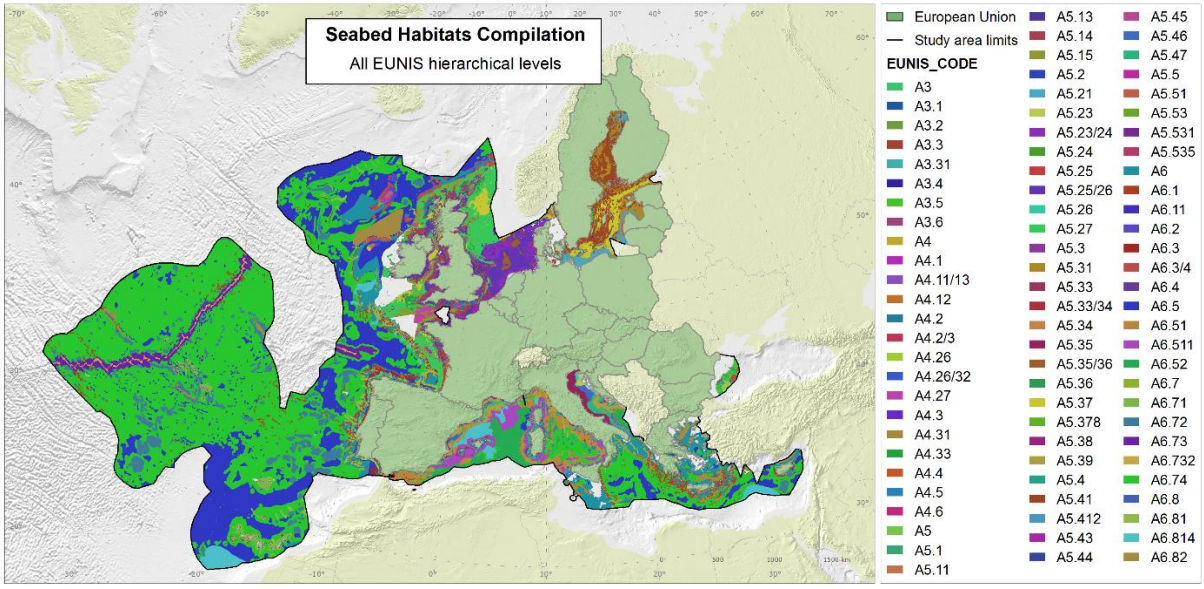


Figure 4. Spatial distribution of the EUNIS seabed habitat classes used in the analysis.

Source: Tempera (2015). For an interpretation of the habitat codes see Table 8.

Table 8. List of EUNIS seabed habitat classes either mapped and/or for which ecosystem services were attributed in the literature sources used.
Grey rows underline habitats where geospatial information existed as well as an assessment of its ecosystem services capacities. An *ag* subscript on the X symbol indicates habitats which extent or services was obtained by aggregation from their subordinate classes. This includes cases where doubts existed between two distinct EUNIS classes (uncertain habitats with slashed codes). The superscripts Ad (for Adriatic), Bal (for Baltic) and NC (for North and Celtic Seas) denote the specific areas the uncertain habitats are spatially limited to.

EUNIS code	Habitat name	Geospatial information	Ecosystem services
A3	Infralittoral rock and other hard substrata	X	X
A3.1	Atlantic and Mediterranean high-energy infralittoral rock	X	X
A3.11	Kelp with cushion fauna and/or foliose red seaweeds		X
A3.12	Sediment-affected or disturbed kelp and seaweed communities		X
A3.126	[Halidrys siliquosa] and mixed kelps on tide-swept infralittoral rock with coarse sediment		X
A3.13	Mediterranean and Pontic communities of infralittoral algae very exposed to wave action		X
A3.2	Atlantic and Mediterranean moderate-energy infralittoral rock	X	X
A3.21	Kelp and red seaweeds (moderate energy infralittoral rock)		X
A3.2112	[Laminaria digitata] and under-boulder fauna on sublittoral fringe boulders		X
A3.213	[Laminaria hyperborea] on tide-swept infralittoral mixed substrata		X
A3.22	Kelp and seaweed communities in tide-swept sheltered conditions		X
A3.23	Mediterranean and Pontic communities of infralittoral algae moderately exposed to wave action		X
A3.24	Faunal communities on moderate energy infralittoral rock		X
A3.3	Atlantic and Mediterranean low-energy infralittoral rock	X	X
A3.31	Silted kelp on low-energy infralittoral rock with full salinity	X	X
A3.32	Kelp in variable salinity on low energy infralittoral rock		X
A3.33	Mediterranean submerged fucoids, green or red seaweeds on full salinity infralittoral rock		X
A3.4	Baltic exposed infralittoral rock	X	
A3.5	Baltic moderately exposed infralittoral rock	X	
A3.6	Baltic sheltered infralittoral rock	X	
A3.71	Robust faunal cushions and crusts in surge gullies and caves		X
A3.72	Infralittoral fouling seaweed communities		X
A3.73	Vents and seeps in infralittoral rock		X
A4	Circalittoral rock and other hard substrata	X	X
A4.1	Atlantic and Mediterranean high-energy circalittoral rock	X	X
A4.11	Very tide-swept faunal communities on circalittoral rock		X
A4.11/13	Circalittoral rock (doubt between A4.11 and A4.13)	X^{NC}	X
A4.12	Sponge communities on deep-circalittoral rock	X	X
A4.13	Mixed faunal turf communities on circalittoral rock		X
A4.131	Bryozoan turf and erect sponges on tide-swept circalittoral rock		X
A4.133	Mixed turf of hydroids and large ascidians with [Swiftia pallida] and [Caryophyllia smithii] on weakly tide-swept circalittoral rock		X
A4.2	Atlantic and Mediterranean moderate-energy circalittoral rock	X	X
A4.2/3	Atlantic and Mediterranean circalittoral rock (doubt between A4.2 and A4.3)	X	X_{ag}
A4.211	[Caryophyllia smithii] and [Swiftia pallida] on circalittoral rock		X
A4.2122	[Caryophyllia smithii] and sponges with [Pentapora foliacea], [Porella compressa] and crustose communities on wave-exposed circalittoral rock		X
A4.22	Sabellaria reefs on circalittoral rock		X
A4.23	Communities on soft circalittoral rock		X
A4.24	Mussel beds on circalittoral rock		X
A4.26	Mediterranean coralligenous communities moderately exposed to hydrodynamic action	X	X
A4.26/32	Mediterranean coralligenous communities (doubt between A4.26 and A4.32)	X^{Ad}	X
A4.268	Association with [Laminaria ochroleuca]		X
A4.27	Faunal communities on deep moderate-energy circalittoral rock	X	X

Table 8 (continued). List of EUNIS seabed habitat classes either mapped and/or for which ecosystem services were attributed in the literature sources used.

EUNIS code	Habitat name	Geospatial information	Ecosystem services
A4.3	Atlantic and Mediterranean low-energy circalittoral rock	X	X
A4.31	Brachiopod and ascidian communities on circalittoral rock	X	X
A4.32	Mediterranean coralligenous communities sheltered from hydrodynamic action		X
A4.33	Faunal communities on deep low-energy circalittoral rock	X	X
A4.4	Baltic exposed circalittoral rock	X	
A4.5	Baltic moderately exposed circalittoral rock	X	
A4.6	Baltic sheltered circalittoral rock	X	
A4.71	Communities of circalittoral caves and overhangs		X
A5	Sublittoral sediment	X_{ag}	X_{ag}
A5.1	Sublittoral coarse sediment	X	X_{ag}
A5.11	Infralittoral coarse sediment in low or reduced salinity	X^{Bal}	X
A5.12	Sublittoral coarse sediment in variable salinity (estuaries)		X
A5.13	Infralittoral coarse sediment	X	X
A5.133	[Moerella] spp. with venerid bivalves in infralittoral gravelly sand		X
A5.14	Circalittoral coarse sediment	X	X
A5.15	Deep-circalittoral coarse sediment	X	X
A5.2	Sublittoral sand	X_{ag}	X
A5.21	Sublittoral sand in low or reduced salinity	X^{Bal}	
A5.23	Infralittoral fine sand	X	X
A5.23/24	Infralittoral sand (doubt between A5.23 and A5.24)	X	X_{ag}
A5.24	Infralittoral muddy sand	X	X
A5.25	Circalittoral fine sand	X	X
A5.25/26	Circalittoral sand (doubt between A5.25 and A5.26)	X	X_{ag}
A5.26	Circalittoral muddy sand	X	X
A5.27	Deep-circalittoral sand	X	X
A5.28	Mediterranean communities of superficial muddy sands in sheltered waters		X
A5.3	Sublittoral mud	X_{ag}	X
A5.31	Sublittoral mud in low or reduced salinity	X^{Bal}	
A5.33	Infralittoral sandy mud	X	X
A5.33/34	Infralittoral mud (doubt between A5.33 and A5.34)	X^{NC}	X
A5.34	Infralittoral fine mud	X	X
A5.35	Circalittoral sandy mud	X	X
A5.35/36	Circalittoral mud (doubt between A5.35 and A5.36)	X	X
A5.36	Circalittoral fine mud	X	X
A5.361	Seapens and burrowing megafauna in circalittoral fine mud		X
A5.37	Deep-circalittoral mud	X	X
A5.371	[Ampharete falcata] turf with [Parvicardium ovale] on cohesive muddy sediment near margins of deep stratified seas		X
A5.378	Baltic muddy bottoms of the aphotic zone	X	
A5.38	Mediterranean communities of muddy detritic bottoms	X	X
A5.39	Mediterranean communities of coastal terrigenous muds	X	X
A5.4	Sublittoral mixed sediments	X_{ag}	X_{ag}
A5.41	Sublittoral mixed sediment in low or reduced salinity	X^{Bal}	
A5.412	Baltic mixed sediment bottoms of the aphotic zone	X	
A5.43	Infralittoral mixed sediments	X	X
A5.434	[Limaria hians] beds in tide-swept sublittoral muddy mixed sediment		X
A5.435	[Ostrea edulis] beds on shallow sublittoral muddy mixed sediment		X
A5.44	Circalittoral mixed sediments	X	X
A5.45	Deep-circalittoral mixed sediments	X	X
A5.46	Mediterranean animal communities of coastal detritic bottoms	X	X
A5.47	Mediterranean communities of shelf-edge detritic bottoms	X	X

Table 8 (continued). List of EUNIS seabed habitat classes either mapped and/or for which ecosystem services were attributed in the literature sources used.

EUNIS code	Habitat name	Geospatial information	Ecosystem services
A5.5	Sublittoral macrophyte-dominated sediment	Xag	X
A5.51	Maerl beds	X	X
A5.5112	[Phymatolithon calcareum] maerl beds with [Neopentadactyla mixta] and other echinoderms in deeper infralittoral clean gravel or coarse sand		X
A5.52	Kelp and seaweed communities on sublittoral sediment		X
A5.53	Sublittoral seagrass beds	X_{ag}	X
A5.531	[Cymodocea] beds	X	
A5.535	[Posidonia] beds	X	
A5.545	[Zostera] beds in reduced salinity infralittoral sediments		X
A5.6	Sublittoral biogenic reefs		X
A5.61	Sublittoral polychaete worm reefs on sediment		X
A5.62	Sublittoral mussel beds on sediment		X
A5.63	Circalittoral coral reefs		X
A5.64	Pontic [Ostrea edulis] reefs		X
A5.71	Seeps and vents in sublittoral sediments		X
A5.72	Organically-enriched or anoxic sublittoral habitats		X
A6	Deep-sea bed	X_{ag}	
A6.1	Deep-sea rock and artificial hard substrata	X	X
A6.11	Deep-sea bedrock	X	X
A6.12	Deep-sea artificial hard substrata		X
A6.13	Deep-sea manganese nodules		X
A6.2	Deep-sea mixed substrata	X	X
A6.3	Deep-sea sand	X	X
A6.3/4	Deep-sea sand (doubt between A6.3 and A6.4)	X^{NC}	X
A6.31	Communities of bathyal detritic sands with [Gryphus vitreus]		X
A6.4	Deep-sea muddy sand	X	X
A6.5	Deep-sea mud	X	X
A6.51	Mediterranean communities of bathyal muds	X	
A6.511	Facies of sandy muds with [Thenea muricata]	X	
A6.52	Communities of abyssal muds	X	
A6.61	Communities of deep-sea corals		X
A6.62	Deep-sea sponge aggregations		X
A6.7	Raised features of the deep-sea bed	X_{ag}	X
A6.71	Permanently-submerged flanks of oceanic islands	X	X
A6.72	Seamounts, knolls and banks	X	X
A6.73	Oceanic ridges	X	X
A6.732	Communities of ridge axial trough (i.e. non-vent fauna)	X	
A6.74	Abyssal hills	X	X
A6.75	Cold-water coral carbonate mounds		X
A6.8	Deep-sea trenches and canyons, channels, slope failures and slumps on the continental slope	X	X
A6.81	Canyons, channels, slope failures and slumps on the continental slope	X	X
A6.814	Turbidites and fans	X	
A6.82	Deep-sea trenches	X	X
A6.91	Deep-sea reducing habitats		X
A6.94	Vents in the deep sea		X
A6.95	Pontic anoxic H2S black muds of the slope and abyssal plain		X
A7.7	Fronts in reduced salinity water column		X
A7.82	Mesopelagic zone in unstratified full salinity water		X
A7.83	Bathypelagic zone in unstratified full salinity water		X
A7.84	Abyssopelagic zone in unstratified full salinity water		X
A7.A	Fronts in full salinity water column		X
B1	Coastal dune and sand habitats		X
B3.11	Lichens or small green algae on supralittoral and littoral fringe rock		X
B3.114	[Blidingia] spp. on vertical littoral fringe chalk		X
X01	Estuaries		X
X02	Saline coastal lagoons		X
X03	Brackish coastal lagoons		X

Table 9 lists additional habitat classes that despite not being EUNIS-compliant were also related to marine ecosystem services in the literature sources and added a non-negligible 10.4% coverage of the European seabed.

Table 9. List of additional marine habitat classes non-compliant with EUNIS for which geospatial information was compiled and ecosystem services were identified in the literature sources.

EUNIS code	Habitat name	Geospatial information	Ecosystem services
A4.28 NEW	Pontic [Phyllophora crispa] beds on circalittoral bedrock and boulders		X
A6.96 NEW	Pontic anaerobic microbial biogenic reefs above methane seeps		X
Non-EUNIS N_1	Abyssal seabed	X	X
Non-EUNIS N_2	Deep-circalittoral mixed hard sediments	X	X
Non-EUNIS N_3	Deep-circalittoral seabed	X	X
Non-EUNIS N_4	Deep-sea coarse sediment	X	X
Non-EUNIS N_5	High-energy circalittoral mixed hard sediments	X	X
Non-EUNIS N_6	High-energy circalittoral seabed	X	X
Non-EUNIS N_7	High-energy infralittoral mixed hard sediments	X	X
Non-EUNIS N_8	High-energy infralittoral seabed	X	X
Non-EUNIS N_9	Low-energy circalittoral mixed hard sediments	X	X
Non-EUNIS N_10	Low-energy circalittoral seabed	X	X
Non-EUNIS N_11	Low-energy infralittoral mixed hard sediments	X	X
Non-EUNIS N_12	Low-energy infralittoral seabed	X	X
Non-EUNIS N_13	Lower-bathyal coarse sediment	X	
Non-EUNIS N_14	Lower-bathyal seabed	X	X
Non-EUNIS N_15	Mid-bathyal coarse sediment	X	
Non-EUNIS N_16	Mid-bathyal seabed	X	X
Non-EUNIS N_17	Moderate-energy circalittoral mixed hard sediments	X	X
Non-EUNIS N_18	Moderate-energy circalittoral seabed	X	X
Non-EUNIS N_19	Moderate-energy infralittoral mixed hard sediments	X	X
Non-EUNIS N_20	Moderate-energy infralittoral seabed	X	X
Non-EUNIS N_21	Upper-bathyal coarse sediment	X	
Non-EUNIS N_22	Upper-bathyal seabed	X	X
Non-EUNIS N_23	Upper-slope mixed hard sediments	X	X
Non-EUNIS N_24	Upper-slope seabed	X	X
Non-EUNIS N_25	Black Sea shelf seabed	X	
Non-EUNIS N_26	Black Sea upper-slope seabed	X	
Non-EUNIS N_27	Black Sea upper-bathyal seabed	X	
Non-EUNIS N_28	Black Sea mid-bathyal seabed	X	
Non-EUNIS N_29	Black Sea lower-bathyal seabed	X	
Non-EUNIS N_30	Shelf seabed	X	

Overall, for 65 EUNIS habitats and 21 non-EUNIS ones geospatial information existed along with an assessment of their respective ecosystem service capacities. Still, for 18 EUNIS habitats and 9 non-EUNIS ones, geospatial information was available but no information on their ecosystem service capacity was found. Finally, for 62 EUNIS habitats no geospatial information was compiled despite information on their ecosystem services was available.

Despite its hierarchical structure, the current version of the EUNIS classification is not yet strictly univocal. This is to say, the presence of a certain habitat does not exclude all the others, meaning that more than one habitat may occur on the same location (polygon overlap). This affects in particularly the deep-sea section of the classification, where at the same EUNIS level one you may address certain deep-sea areas both from a substrate type perspective as well as from a broader geomorphology-based perspective (A6.1 to A6.6). Bringing together the EMODNET datasets with the geomorphology-based information from GSGFM, accentuated this issue, producing a number of collocated seabed habitats in the geospatial layer used as cartographical basis. Given that it permitted a more complete mapping of ecosystem services, the overlapping information was nonetheless kept.

2.5 Association of EUNIS broadscale marine habitats classes to ecosystem services

Information on the capacity of each seabed habitat to provide ecosystem services was extracted from key syntheses of habitat-related ecosystem services capacity. These sources are based on information from scientific literature evidence and expert judgement and included: the Agardy et al. (2005), the Millennium Ecosystem Assessment (2005), Armstrong et al. (2012), Salomidi et al. (2012), Potts et al. (2014) and Galparsoro et al. (2014).

Given the difficulty in harmonizing the semi-quantitative scores used in the different works, the information was reduced to mere qualitative categories: *presence*, *absence* and *no data*. The information compiled is summarized in a large lookup table relating harmonized EUNIS habitats with harmonized CICES ecosystem services (**Tables 13 to 15**). Since geospatial data was not available beyond EUNIS level 4, the tables do not contain information beyond this level either. For the sake of simplifying the presentation of long tables, listings are organized in EUNIS shelf (**Table 10**), EUNIS deep-sea (**Table 11**) and non-EUNIS habitats (**Table 12**).

These lookup tables bring together information on 34 ecosystem services (columns) provided by 67 EUNIS and 24 non-EUNIS seabed habitats (rows). Where the geospatial compilation provided uncertain classes (notably, A4.2/3, A4.26/32, A5.23/24, A5.25/26, A5.33/34, A5.35/36, A6.3/4), services were assigned by aggregating the services identified for both potential classes whilst checking if they were equivalent. These cases are denoted by an '*ag*' subscript on the ecosystem service column. In a single case (A5.25/26) did the services of the two compounding habitat classes not absolutely match. In this situation, priority was given to presence information and the differing service (*2.1 Regulation and maintenance/Mediation of waste, toxics and other nuisances*) was considered as present in A5.25/26 as in A5.26. In the remaining cases (A4.11/13, A4.26/32, A5.33/34, A5.35/36 and A6.3/4), the services originally attributed to both compounding classes were exactly the same. A generalisation of service capacity was also made to a non-EUNIS shelf habitat class by extrapolation from the services provided by the subordinate classes.

2.5.1 *EUNIS marine habitats to CICES ecosystem services lookup table*

The information from the different sources was concatenated into a final lookup table of seabed habitat *versus* ecosystem services that was used in the geospatial analysis. **Capacity of a certain habitat to provide a service was assumed where at least one literature source indicated its presence**. Habitats for which no information was available (**no data**) or for which the sources indicated the **absence** of service supply did not contribute to this mapping exercise meaning that the **maps produced represent only substantiated presence of the ecosystem service**.

The result of this data integration is shown in **Tables 16 to 18**. These lookup tables condense only information for seabed habitats for which maps were available and at least one ecosystem service had been assessed.

Overall, **marine ecosystem services were identified for 4 EUNIS level-2 seabed habitats, 20 EUNIS level-3 ones** (2 of which are uncertain categories) **and 42 EUNIS level-4 ones** (6 of which are uncertain categories). Additionally, **22 non-EUNIS seabed habitats** present in the broadscale seabed habitat compilation were also related to marine ecosystem services. **In terms of ecosystem services, a total of 36 were identified**: 3 at CICES level 1 (Section), 7 at CICES level 2 (Division), 13 at CICES level 3 (Group) and 13 at CICES level 4 (Class).

Table 10. CICES marine ecosystem services capacity by EUNIS shelf seabed habitats as compiled from literature sources. The 6-component vector provided in each cell represents indications of service provisioning appearing in each of the 6 literature sources used in this study. Indications of service *presence* are coded as 1; *absences* are coded as 0; *no data* is coded as -. The sources are organized in the following order along the vector: component 1 = Agardy et al., *2005*; component 2 = *Millennium Ecosystem Assessment, 2005*; component 3 = *Salomidi et al., 2012*; component 4 = *Armstrong et al., 2012*; component 5 = *Potts et al., 2013*; component 6 = *Galparsoro et al., 2014*. Ecosystem service codes are translated in Tables 1 to 3. Seabed Habitat codes are translated in Tables 11 and 12.

Seabed	CICES Provisioning Ecosystem Services							
Habitats	1	1.1.1	1.1.1.4	1.2.1	1.2.1.1	1.2.1.2	1.2.1.3	1.2.2
A3	-,0,-,-,-,-	1,1,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	0,0,-,-,-,-	-,-,-,-,-,-	-,0,-,-,-,-	0,0,-,-,-,-
A3.1	-,-,-,-,-,-	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A3.2	-,-,-,-,-,-	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A3.3	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A3.31	-,0,-,-,-,-	1,1,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	1,1,-,-,-,-	-,-,-,-,-,-	-,1,-,-,-,-	0,0,-,-,-,-
A4	-,0,-,-,-,-	1,1,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	0,0,-,-,-,-	-,-,-,-,-,-	-,0,-,-,-,-	0,0,-,-,-,-
A4.1	-,-,-,-,-,-	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A4.11/13	-,-,-,-,-,-	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A4.12	-,-,-,-,-,-	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A4.2	-,-,-,-,-,-	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A4.2/3	-,-,-,-,-,-	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A4.26	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A4.26/32	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A4.27	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A4.3	-,-,-,-,-,-	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A4.31	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A4.33	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.1	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,1,-	-,-,-,-,0,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.11	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.12	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.13	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.14	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.15	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.2	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.23	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.23/24	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.24	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.25	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.25/26	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.26	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.27	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.3	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.33	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.33/34	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.34	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.35	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.35/36	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.36	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.37	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.38	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.39	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.4	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,0,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.43	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.44	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.45	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.46	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.47	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.5	-,0,-,-,-,-	1,1,1,-,1,-	-,-,-,-,-,-	-,-,1,-,1,-	0,0,-,-,1,-	-,-,-,-,1,-	-,0,-,-,-,-	0,0,-,-,-,-
A5.51	-,-,-,-,-,-	-,-,1,-,1,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,1,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,-
A5.53	-,0,-,-,-,-	1,1,1,-,1,-	-,-,-,-,-,-	-,-,1,-,1,-	0,0,-,-,-,-	-,-,-,-,1,-	-,0,-,-,-,-	0,0,-,-,-,-

Seabed	CICES Regulation & Maintenance Ecosystem Services													
Habitats	2	2.1	2.2	2.2.1	2.2.2	2.2.2.1	2.2.2.2	2.3.1	2.3.2	2.3.2.2	2.3.3	2.3.4.2	2.3.5	2.3.5.1
A3	1,1,-,-,-,1	1,1,-,-,-,1	-,1,-,-,-,1	0,0,-,-,-,-	0,0,-,-,-,-	-,-,-,-,-,-	1,-,-,-,-,-	-,-,-,-,-,1	-,1,-,-,-,-	1,-,-,-,-,-	-,0,-,-,-,-	1,1,-,-,-,1	1,1,-,-,-,1	-,-,-,-,-,-
A3.1	-,-,-,-,1,1	-,-,-,-,-,1	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,1,-	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-
A3.2	-,-,-,-,1,1	-,-,-,-,-,1	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,1,-	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-
A3.3	-,-,-,-,1,1	-,-,-,-,-,1	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,1,-	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-
A3.31	1,1,-,-,-,1	0,-,-,-,-,1	-,1,-,-,-,0	0,0,-,-,-,-	0,0,-,-,-,-	-,-,-,-,-,-	1,-,-,-,-,-	-,-,-,-,-,1	-,0,-,-,-,-	0,-,-,-,-,-	-,0,-,-,-,-	1,1,-,-,-,1	0,0,-,-,-,1	-,-,-,-,-,-
A4	1,1,-,-,-,0	1,1,-,-,-,1	-,1,-,-,-,1	0,0,-,-,-,-	0,0,-,-,-,-	-,-,-,-,-,-	1,-,-,-,-,-	-,-,-,-,-,1	-,1,-,-,-,-	1,-,-,-,-,-	-,0,-,-,-,-	1,1,-,-,-,1	1,1,-,-,-,1	-,-,-,-,-,-
A4.1	-,-,-,-,1,0	-,-,-,-,-,1	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,1,-	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-
A4.11/13	-,-,-,-,-,0	-,-,-,-,1,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,-,-	-,-,-,-,1,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,0	-,-,-,-,-,-
A4.12	-,-,-,-,-,0	-,-,-,-,1,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,-,-	-,-,-,-,1,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,0	-,-,-,-,-,-
A4.2	-,-,-,-,1,0	-,-,-,-,-,1	-,-,-,-,1,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,1,-	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-
A4.2/3	-,-,-,-,1,1	-,-,-,-,-,1	-,-,-,-,1,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,1,-	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-
A4.26	-,-,1,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-
A4.26/32	-,-,1,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-
A4.27	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-
A4.3	-,-,-,-,1,1	-,-,-,-,-,1	-,-,-,-,1,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,1,-	-,-,-,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-
A4.31	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-
A4.33	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-
A5	-,-,0,-,1,0	-,-,1,-,1,0	-,-,0,-,1,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.1	-,-,0,-,1,0	-,-,0,-,1,0	-,-,0,-,1,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,1,-	-,-,1,-,1,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.11	-,-,0,-,1,0	-,-,0,-,1,0	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.12	-,-,0,-,1,0	-,-,0,-,1,0	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.13	-,-,0,-,1,0	-,-,0,-,1,0	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.14	-,-,0,-,-,0	-,-,0,-,-,0	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.15	-,-,0,-,-,0	-,-,0,-,-,0	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.2	-,-,0,-,1,0	-,-,0,-,1,0	-,-,0,-,1,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.23	-,-,0,-,-,0	-,-,0,-,-,0	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.23/24	-,-,0,-,-,0	-,-,1,-,-,0	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.24	-,-,0,-,-,0	-,-,1,-,-,0	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.25	-,-,0,-,-,0	-,-,0,-,-,0	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.25/26	-,-,0,-,-,0	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.26	-,-,0,-,-,0	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.27	-,-,-,-,-,0	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,0	-,-,-,-,-,-
A5.3	-,-,0,-,1,0	-,-,1,-,1,1	-,-,0,-,1,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.33	-,-,0,-,-,0	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.33/34	-,-,0,-,-,0	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.34	-,-,0,-,-,0	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.35	-,-,0,-,-,0	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.35/36	-,-,0,-,-,0	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.36	-,-,0,-,-,0	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.37	-,-,0,-,-,0	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.38	-,-,0,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-
A5.39	-,-,0,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-
A5.4	-,-,0,-,1,0	-,-,1,-,1,1	-,-,0,-,1,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.43	-,-,0,-,-,0	-,-,1,-,1,1	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,1,1	-,-,0,-,1,0	-,-,-,-,1,-
A5.44	-,-,0,-,-,0	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.45	-,-,0,-,-,0	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1	-,-,0,-,-,0	-,-,-,-,-,-
A5.46	-,-,0,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-
A5.47	-,-,0,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-
A5.5	1,1,1,-,1,-	1,1,1,-,1,-	-,1,1,-,1,-	1,1,-,-,-,-	0,0,-,-,-,-	-,-,-,-,0,-	1,-,-,-,1,-	-,-,1,-,1,-	-,0,-,-,1,-	1,-,-,-,-,-	-,0,-,-,-,-	0,0,1,-,1,-	1,1,1,-,1,-	-,-,-,-,1,-
A5.51	-,-,1,-,1,-	-,-,0,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,0,-	-,-,-,-,1,-	-,-,1,-,1,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,1,-	-,-,1,-,-,-	-,-,-,-,-,-
A5.53	1,1,1,-,1,-	1,1,1,-,1,-	-,1,1,-,1,-	1,1,-,-,-,-	0,0,-,-,-,-	-,-,-,-,0,-	1,-,-,-,1,-	-,-,1,-,1,-	-,0,-,-,1,-	1,-,-,-,-,-	-,0,-,-,-,-	0,0,1,-,1,-	1,1,1,-,1,-	-,-,-,-,1,-

Seabed	CICES Cultural Ecosystem Services										
Habitats	3	3.1	3.1.1	3.1.1.2	3.1.2	3.1.2.1	3.1.2.2	3.1.2.5	3.2	3.2.1	3.2.2
A3	1,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	0,0,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,1,-,-,-,-	0,0,-,-,-,-	-,-,-,-,-,-	-,1,-,-,-,-	-,-,-,-,-,1
A3.1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1
A3.2	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1
A3.3	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1
A3.31	1,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	1,1,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,0,-,-,-,-	0,0,-,-,-,-	-,-,-,-,-,-	-,1,-,-,-,-	-,-,-,-,-,1
A4	1,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	0,0,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,1,-,-,-,-	0,0,-,-,-,-	-,-,-,-,-,-	-,1,-,-,-,-	-,-,-,-,-,1
A4.1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1
A4.11/13	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1
A4.12	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1
A4.2	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1
A4.2/3	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1
A4.26	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-
A4.26/32	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-
A4.27	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1
A4.3	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,-,1
A4.31	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1
A4.33	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1
A5	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.1	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,1,-,-,1
A5.11	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,1,-,-,1
A5.12	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,1,-,-,1
A5.13	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,1,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,1,-,-,1
A5.14	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.15	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.2	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.23	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1
A5.23/24	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,1
A5.24	-,-,-,-,-,-	-,-,0,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,1
A5.25	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.25/26	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.26	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.27	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
A5.3	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.33	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.33/34	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.34	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.35	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.35/36	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.36	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.37	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.38	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-
A5.39	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-
A5.4	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.43	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,1,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.44	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.45	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0
A5.46	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-
A5.47	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-
A5.5	1,-,-,-,-,-	-,-,1,-,1,-	-,-,-,-,1,-	0,0,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,0,-,-,1,-	0,0,-,-,1,-	-,-,-,-,1,-	-,1,-,-,-,-	-,-,1,-,-,-
A5.51	-,-,-,-,-,-	-,-,1,-,1,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,1,-	-,-,-,-,1,-	-,-,-,-,1,-	-,-,-,-,-,-	-,-,0,-,-,-
A5.53	1,-,-,-,-,-	-,-,1,-,1,-	-,-,-,-,1,-	0,0,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,0,-,-,1,-	0,0,-,-,1,-	-,-,-,-,1,-	-,1,-,-,-,-	-,-,1,-,-,-

Table 11. CICES marine ecosystem service capacity by EUNIS deep-sea seabed habitats as compiled from literature sources. Notations are as in Table 10.

Seabed	CICES Provisioning Ecosystem Services								CICES Regulation & Maintenance Ecosystem Services														CICES Cultural Ecosystem Services										
Habitats	1	1.1.1	1.1.1.4	1.2.1	1.2.1.1	1.2.1.2	1.2.1.3	1.2.2	2	2.1	2.2	2.2.1	2.2.2	2.2.2.1	2.2.2.2	2.3.1	2.3.2	2.3.2.2	2.3.3	2.3.4.2	2.3.5	2.3.5.1	3	3.1	3.1.1	3.1.1.2	3.1.2	3.1.2.1	3.1.2.2	3.1.2.5	3.2	3.2.1	3.2.2
A6	-,-,-,-,-,-	-,-,1,-,-,1	-,-,-,1,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,1,-,0	-,-,-,0,-,0	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,1,1,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,1,-,0	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,1,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,0
A6.1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,1,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,0	-,-,-,0,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,1,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,1,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
A6.11	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
A6.2	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,1,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,0	-,-,-,0,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,1,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,1,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
A6.3	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,1,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,0	-,-,-,0,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,1,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,1,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
A6.3/4	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,1,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,0	-,-,-,0,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,1,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,1,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
A6.4	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,1,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,0	-,-,-,0,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,1,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,1,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
A6.5	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,1,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,0	-,-,-,0,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,1,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,1,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
A6.7	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,1,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,1,-,-	-,-,0,0,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,1,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,1,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-
A6.71	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,-	-,-,-,0,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,1,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-
A6.72	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,1,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,1,-,-	-,-,1,0,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,1,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,0,0,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,1,-,-	-,-,-,1,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-
A6.73	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-
A6.74	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,0,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-
A6.8	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-
A6.81	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-
A6.82	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,0,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,0,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,1,-,-,-

Table 12. CICES marine ecosystem service capacity by non-EUNIS seabed habitats as compiled from literature sources. Notations are as in Table 10.

Seabed	CICES Provisioning Ecosystem Services								CICES Regulation & Maintenance Ecosystem Services														CICES Cultural Ecosystem Services										
Habitats	1	1.1.1	1.1.1.4	1.2.1	1.2.1.1	1.2.1.2	1.2.1.3	1.2.2	2	2.1	2.2	2.2.1	2.2.2	2.2.2.1	2.2.2.2	2.3.1	2.3.2	2.3.2.2	2.3.3	2.3.4.2	2.3.5	2.3.5.1	3	3.1	3.1.1	3.1.1.2	3.1.2	3.1.2.1	3.1.2.2	3.1.2.5	3.2	3.2.1	3.2.2
N_1	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
N_2	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
N_3	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
N_4	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
N_5	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1
N_6	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1
N_7	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1
N_8	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1
N_9	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,1	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1
N_10	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,1	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1
N_11	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1
N_12	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1
N_14	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
N_16	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
N_17	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,1	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1
N_18	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,1	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1
N_19	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1
N_20	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1
N_22	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
N_23	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
N_24	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,-	-,-,-,-,-,0
N_30	-,0,-,-,-,-	1,1,-,-,-,1	-,-,-,-,-,-	-,-,-,-,-,1	0,0,-,-,-,-	-,-,-,-,-,-	-,0,-,-,-,-	0,0,-,-,-,-	1,1,-,-,-,0	1,1,-,-,-,1	-,1,-,-,-,1	0,0,-,-,-,-	0,0,-,-,-,-	-,-,-,-,-,-	1,-,-,-,-,-	-,-,-,-,-,1	-,1,-,-,-,-	1,-,-,-,-,-	-,0,-,-,-,-	1,1,-,-,-,1	1,1,-,-,-,1	-,-,-,-,-,-	1,-,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	0,0,-,-,-,-	-,-,-,-,-,1	-,-,-,-,-,-	-,1,-,-,-,-	0,0,-,-,-,-	-,-,-,-,-,-	-,1,-,-,-,-	-,-,-,-,-,1

Table 13. Final lookup table of CICES marine ecosystem service capacity per EUNIS shelf seabed habitats used in the analysis. Service *presence* is coded as 1; a*bsence* is coded as 0; *no data* is coded as -. Ecosystem service codes are translated in Tables 1 to 3; * indicates aggregation of services from subordinate CICES levels. Translation of seabed habitat codes is provided in Tables 11 and 12; ** indicates aggregation of services from subordinate EUNIS levels. Bold denotes scores derived by aggregation and diverging from Tables 13 to 15. Completeness of the evidence on the provision of each ecosystem service by seabed habitats down to EUNIS level 4 is highlighted using colour ('very poor' - red; 'poor' - orange; 'fair' - yellow; 'good' – light green; 'very good' – dark green; see details in section 2.5.3).

Seabed	CICES Provisioning Ecosystem Services									CICES Regulation & Maintenance Ecosystem Services																CICES Cultural Ecosystem Services										
Habitats	1*	1.1*	1.1.1	1.1.1.4	1.2*	1.2.1*	1.2.1.1	1.2.1.2	1.2.1.3	2*	2.1	2.2*	2.2.1	2.2.2*	2.2.2.1	2.2.2.2	2.3*	2.3.1	2.3.2*	2.3.2.2	2.3.3	2.3.4*	2.3.4.2	2.3.5	2.3.5.1	3*	3.1*	3.1.1*	3.1.1.2	3.1.2*	3.1.2.1	3.1.2.2	3.1.2.5	3.2*	3.2.1	3.2.2
E.S. Ass. Qual.	*97*	*95*	*98*	*15*	*62*	*62*	*20*	*6*	*8*	*98*	*100*	*45*	*8*	*33*	*42*	*21*	*98*	*100*	*12*	*8*	*8*	*95*	*100*	*98*	*5*	*67*	*65*	*26*	*8*	*61*	*15*	*50*	*9*	*56*	*8*	*98*
A3	**1**	1	1	-	**1**	1	0	-	0	1	1	1	0	**1**	-	1	**1**	1	1	1	0	1	1	1	-	1	1	-	0	1	-	1	0	**1**	1	1
A3.1	**1**	1	1	-	**1**	1	-	-	-	1	1	1	-	**1**	0	1	**1**	1	-	-	-	1	1	1	-	**1**	1	1	-	1	-	1	-	1	-	1
A3.2	**1**	1	1	-	**1**	1	-	-	-	1	1	1	-	**1**	0	1	**1**	1	-	-	-	1	1	1	-	**1**	1	1	-	1	-	1	-	1	-	1
A3.3	**1**	1	1	-	**1**	1	-	-	-	1	1	1	-	**1**	0	1	**1**	1	-	-	-	1	1	1	-	**1**	1	1	-	1	-	1	-	1	-	1
A3.31	**1**	1	1	-	**1**	1	1	-	1	1	1	1	0	**1**	-	1	**1**	1	0	0	0	1	1	1	-	1	1	**1**	1	1	-	0	0	**1**	1	1
A4	**1**	1	1	-	**1**	1	0	-	0	1	1	1	0	**1**	-	1	**1**	1	1	1	0	1	1	1	-	1	1	-	0	1	-	1	0	**1**	1	1
A4.1	**1**	1	1	-	**1**	1	-	-	-	1	1	1	-	**1**	0	1	**1**	1	-	-	-	1	1	1	-	**1**	1	1	-	1	-	1	-	1	-	1
A4.11/13	**1**	1	1	-	**1**	1	-	-	-	**1**	1	1	-	-	0	-	**1**	1	1	-	-	1	1	0	-	**1**	1	1	-	1	-	1	-	1	-	1
A4.12	**1**	1	1	-	**1**	1	-	-	-	**1**	1	1	-	-	0	-	**1**	1	1	-	-	1	1	0	-	**1**	1	1	-	1	-	1	-	1	-	1
A4.2	**1**	1	1	-	**1**	1	-	-	-	1	1	1	-	**1**	0	1	**1**	1	-	-	-	1	1	1	-	**1**	1	1	-	1	-	1	-	1	-	1
A4.2/3	**1**	1	1	-	**1**	1	-	-	-	1	1	1	-	**1**	0	1	**1**	1	-	-	-	1	1	1	-	**1**	1	1	-	1	-	1	-	1	-	1
A4.26	**1**	1	1	-	**1**	1	-	-	-	1	1	-	-	-	-	-	**1**	1	-	-	-	1	1	1	-	**1**	1	-	-	1	-	-	-	**1**	-	1
A4.26/32	**1**	1	1	-	**1**	1	-	-	-	1	1	-	-	-	-	-	**1**	1	-	-	-	1	1	1	-	**1**	1	-	-	1	-	-	-	**1**	-	1
A4.27	**1**	1	1	-	**1**	1	-	-	-	1	1	-	-	-	-	-	**1**	1	-	-	-	1	1	1	-	**1**	1	-	-	1	-	-	-	**1**	-	1
A4.3	**1**	1	1	-	**1**	1	-	-	-	1	1	1	-	**1**	0	1	**1**	1	-	-	-	1	1	1	-	**1**	1	1	-	1	-	1	-	1	-	1
A4.31	**1**	1	1	-	**1**	1	-	-	-	1	1	1	-	-	-	-	**1**	1	-	-	-	1	1	1	-	**1**	1	-	-	1	-	-	-	**1**	-	1
A4.33	**1**	1	1	-	**1**	1	-	-	-	1	1	-	-	-	-	-	**1**	1	-	-	-	1	1	1	-	**1**	1	-	-	1	-	-	-	**1**	-	1
A5**	**1**	1	**1**	-	**1**	1	**1**	-	-	1	**1**	1	-	-	**0**	-	**1**	**1**	-	-	-	1	**1**	**0**	-	**1**	**1**	-	-	**1**	-	**1**	-	1	-	**0**
A5.1**	**1**	1	**1**	-	**1**	1	**1**	**0**	-	1	**1**	1	-	**1**	**0**	**1**	**1**	**1**	1	-	-	1	**1**	**0**	-	**1**	1	1	-	**1**	-	**1**	-	1	-	**1**
A5.11	**1**	1	1	-	**1**	1	1	-	-	1	1	-	-	-	0	-	**1**	1	-	-	-	1	1	0	-	**1**	1	1	-	**1**	-	1	-	1	-	1
A5.13	**1**	1	1	-	**1**	1	1	-	-	1	1	-	-	-	0	-	**1**	1	-	-	-	1	1	0	-	**1**	1	1	-	**1**	-	1	-	1	-	1
A5.14	**1**	1	1	-	**1**	1	-	-	-	**1**	0	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.15	**1**	1	1	-	**1**	1	-	-	-	**1**	0	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.2**	**1**	1	**1**	-	**1**	1	**1**	-	-	1	**1**	1	-	-	**0**	-	**1**	**1**	-	-	-	1	**1**	**0**	-	**1**	**1**	-	-	**1**	-	**1**	-	1	-	**0**
A5.23	**1**	1	1	-	**1**	1	-	-	-	**1**	0	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	**1**	1	-	-	-	-	-	-	**1**	-	1
A5.23/24	**1**	1	1	-	**1**	1	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	**1**	1	-	-	-	-	-	-	**1**	-	1
A5.24	**1**	1	1	-	**1**	1	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	**1**	1	-	-	-	-	-	-	**1**	-	1
A5.25	**1**	1	1	-	**1**	1	-	-	-	**1**	0	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.25/26	**1**	1	1	-	**1**	1	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.26	**1**	1	1	-	**1**	1	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.27	**1**	1	1	-	**1**	1	-	-	-	**1**	1	1	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.3**	**1**	1	**1**	-	**1**	**1**	**1**	-	-	1	**1**	1	-	-	**0**	-	**1**	**1**	-	-	-	1	**1**	**0**	-	**1**	**1**	-	-	**1**	-	**1**	-	1	-	**0**
A5.33	**1**	1	1	-	-	-	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.33/34	**1**	1	1	-	-	-	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.34	**1**	1	1	-	-	-	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.35	**1**	1	1	-	-	-	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.35/36	**1**	1	1	-	-	-	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.36	**1**	1	1	-	-	-	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.37	**1**	1	1	-	-	-	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.38	**1**	1	1	-	-	-	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.39	**1**	1	1	-	-	-	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.4**	**1**	1	**1**	-	**1**	1	**1**	-	-	1	**1**	1	-	-	**0**	-	**1**	**1**	-	-	-	1	**1**	**0**	-	**1**	**1**	-	-	**1**	-	**1**	-	1	-	**0**
A5.43	**1**	1	1	-	**1**	1	-	-	-	**1**	1	-	-	-	0	-	**1**	1	-	-	-	1	1	1	1	**1**	**1**	1	-	**1**	-	1	-	1	-	0
A5.44	**1**	1	1	-	**1**	1	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.45	**1**	1	1	-	**1**	1	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.46	**1**	1	1	-	-	-	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.47	**1**	1	1	-	-	-	-	-	-	**1**	1	-	-	-	-	-	**1**	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A5.5**	**1**	1	**1**	-	**1**	1	**1**	**1**	**0**	1	**1**	1	**1**	**1**	**0**	**1**	**1**	**1**	1	**1**	**0**	1	**1**	**1**	**1**	1	1	1	**0**	1	-	**1**	**1**	1	**1**	**1**
A5.51	**1**	1	1	-	**1**	1	1	1	-	1	0	**1**	-	**1**	0	1	**1**	1	1	-	-	1	1	1	-	**1**	1	1	-	1	-	1	1	1	-	0
A5.53	**1**	1	1	-	**1**	1	0	1	0	1	1	1	1	**1**	0	1	**1**	1	1	1	0	1	1	1	1	1	1	1	0	1	-	1	1	1	1	1

Table 14. Final lookup table of CICES marine ecosystem service capacity by EUNIS deep-sea seabed habitats used in the analysis.

Notations are as in Table 13.

Seabed	CICES Provisioning Ecosystem Services									CICES Regulation & Maintenance Ecosystem Services														CICES Cultural Ecosystem Services										
Habitats	1*	1.1*	1.1.1	1.1.1.4	1.2*	1.2.1*	1.2.1.1	1.2.1.2	1.2.1.3	2*	2.1	2.2*	2.2.1	2.2.2*	2.2.2.1	2.2.2.2	2.3*	2.3.1	2.3.2*	2.3.2.2	2.3.3	2.3.4*	2.3.4.2	2.3.5	2.3.5.1	3*	3.1*	3.1.1*	3.1.1.2	3.1.2*	3.1.2.1	3.1.2.2	3.1.2.5	3.2*	3.2.1	3.2.2
A6**	1	1	1	1	-	-	-	-	-	1	0	1	-	1	1	-	1	1	-	-	-	1	1	0	-	1	1	-	-	1	1	1	-	1	-	1
A6.1	1	1	1	1	-	-	-	-	-	1	0	1	-	1	1	-	1	1	-	-	-	1	1	0	-	1	1	-	-	1	1	1	-	-	-	0
A6.11	-	-	0	-	-	-	-	-	-	1	0	-	-	-	-	-	1	1	-	-	-	-	0	0	-	-	-	-	-	-	-	-	-	-	-	0
A6.2	1	1	1	1	-	-	-	-	-	1	0	1	-	1	1	-	1	1	-	-	-	1	1	0	-	1	1	-	-	1	1	1	-	-	-	0
A6.3	1	1	1	1	-	-	-	-	-	1	0	1	-	1	1	-	1	1	-	-	-	1	1	0	-	1	1	-	-	1	1	1	-	-	-	0
A6.3/4	1	1	1	1	-	-	-	-	-	1	0	1	-	1	1	-	1	1	-	-	-	1	1	0	-	1	1	-	-	1	1	1	-	-	-	0
A6.4	1	1	1	1	-	-	-	-	-	1	0	1	-	1	1	-	1	1	-	-	-	1	1	0	-	1	1	-	-	1	1	1	-	-	-	0
A6.5	1	1	1	1	-	-	-	-	-	1	0	1	-	1	1	-	1	1	-	-	-	1	1	0	-	1	1	-	-	1	1	1	-	-	-	0
A6.7	1	1	1	1	-	-	-	-	-	1	0	-	-	-	-	-	1	1	-	-	-	1	1	0	-	1	1	-	-	1	1	1	-	1	-	1
A6.71	1	1	-	1	-	-	-	-	-	1	0	1	-	1	1	-	1	1	-	-	-	1	1	-	-	1	1	-	-	1	1	1	-	-	-	-
A6.72	1	1	1	1	-	-	-	-	-	1	1	-	-	-	-	-	1	1	-	-	-	1	1	0	-	1	1	-	-	1	1	1	-	1	-	1
A6.73	1	1	1	-	-	-	-	-	-	1	0	-	-	-	-	-	1	1	-	-	-	1	1	0	-	1	-	-	-	-	-	-	-	1	-	1
A6.74	-	-	0	-	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-	-	-	-	0
A6.8	1	1	1	-	1	1	-	-	-	1	1	-	-	-	-	-	1	1	-	-	-	1	1	0	-	1	1	-	-	1	-	-	-	1	-	1
A6.81	1	1	1	-	-	-	-	-	-	1	1	-	-	-	-	-	1	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
A6.82	1	-	0	-	1	1	-	-	-	1	0	-	-	-	-	-	1	1	-	-	-	-	0	0	-	1	1	-	-	1	-	-	-	1	-	1

Table 15. Final lookup table of CICES marine ecosystem service capacity by non-EUNIS seabed habitats used in the analysis.

Notations are as in Table 13.

Seabed	CICES Provisioning Ecosystem Services									CICES Regulation & Maintenance Ecosystem Services														CICES Cultural Ecosystem Services										
Habitats	1*	1.1*	1.1.1	1.1.1.4	1.2*	1.2.1*	1.2.1.1	1.2.1.2	1.2.1.3	2*	2.1	2.2*	2.2.1	2.2.2*	2.2.2.1	2.2.2.2	2.3*	2.3.1	2.3.2*	2.3.2.2	2.3.3	2.3.4*	2.3.4.2	2.3.5	2.3.5.1	3*	3.1*	3.1.1*	3.1.1.2	3.1.2*	3.1.2.1	3.1.2.2	3.1.2.5	3.2*	3.2.1	3.2.2
N_1	-	-	0	-	-	-	-	-	-	1	0	-	-	-	-	-	1	1	-	-	-	-	0	0	-	1	1	-	-	1	-	-	-	-	-	0
N_2	1	1	1	-	-	-	-	-	-	1	0	-	-	-	-	-	1	1	-	-	-	-	0	0	-	-	-	-	-	-	-	-	-	-	-	0
N_3	1	1	1	-	1	1	-	-	-	1	0	-	-	-	-	-	1	1	-	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	0
N_4	1	1	1	-	-	-	-	-	-	1	0	-	-	-	-	-	1	1	-	-	-	-	0	0	-	-	-	-	-	-	-	-	-	-	-	0
N_5	1	1	1	-	1	1	-	-	-	1	1	1	-	-	-	-	1	1	-	-	-	1	1	1	-	1	1	-	-	1	-	-	-	1	-	1
N_6	1	1	1	-	1	1	-	-	-	1	1	1	-	-	-	-	1	1	-	-	-	1	1	1	-	1	1	-	-	1	-	-	-	1	-	1
N_7	1	1	1	-	1	1	-	-	-	1	1	1	-	-	-	-	1	1	-	-	-	1	1	1	-	1	1	-	-	1	-	-	-	1	-	1
N_8	1	1	1	-	1	1	-	-	-	1	1	1	-	-	-	-	1	1	-	-	-	1	1	1	-	1	1	-	-	1	-	-	-	1	-	1
N_9	1	1	1	-	1	1	-	-	-	1	1	-	-	-	-	-	1	1	-	-	-	1	1	1	-	1	1	-	-	1	-	-	-	1	-	1
N_10	1	1	1	-	1	1	-	-	-	1	1	-	-	-	-	-	1	1	-	-	-	1	1	1	-	1	1	-	-	1	-	-	-	1	-	1
N_11	1	1	1	-	1	1	-	-	-	1	1	-	-	-	-	-	1	1	-	-	-	1	1	1	-	1	1	-	-	1	-	-	-	1	-	1
N_12	1	1	1	-	1	1	-	-	-	1	1	-	-	-	-	-	1	1	-	-	-	1	1	1	-	1	1	-	-	1	-	-	-	1	-	1
N_14	-	-	0	-	-	-	-	-	-	1	0	-	-	-	-	-	1	1	-	-	-	-	0	0	-	1	1	-	-	1	-	-	-	-	-	0
N_16	-	-	0	-	-	-	-	-	-	1	0	-	-	-	-	-	1	1	-	-	-	-	0	0	-	1	1	-	-	1	-	-	-	-	-	0
N_17	1	1	1	-	-	-	-	-	-	1	1	-	-	-	-	-	1	1	-	-	-	1	1	1	-	1	1	-	-	1	-	-	-	1	-	1
N_18	1	1	1	-	-	-	-	-	-	1	1	-	-	-	-	-	1	1	-	-	-	1	1	1	-	1	1	-	-	1	-	-	-	1	-	1
N_19	1	1	1	-	1	1	-	-	-	1	1	1	-	-	-	-	1	1	-	-	-	1	1	1	-	1	1	-	-	1	-	-	-	1	-	1
N_20	1	1	1	-	1	1	-	-	-	1	1	1	-	-	-	-	1	1	-	-	-	1	1	1	-	1	1	-	-	1	-	-	-	1	-	1
N_22	-	-	0	-	-	-	-	-	-	1	0	-	-	-	-	-	1	1	-	-	-	-	0	0	-	1	1	-	-	1	-	-	-	-	-	0
N_23	1	1	1	-	-	-	-	-	-	1	0	-	-	-	-	-	1	1	-	-	-	-	0	0	-	-	-	-	-	-	-	-	-	-	-	0
N_24	1	1	1	-	-	-	-	-	-	1	0	-	-	-	-	-	1	1	-	-	-	-	0	0	-	-	-	-	-	-	-	-	-	-	-	0
N_30**	1	1	1	-	1	1	0	-	0	1	1	1	0	1	-	1	1	1	1	1	0	1	1	1	-	1	1	-	0	1	-	1	0	1	1	1

The number of relationships established by the literature sources between CICES ecosystem services and seabed habitats is summarized in **Table 16**. Approximately 31% of the services in CICES are related to at least one marine habitat. On the other hand, 14% of the EUNIS marine habitats are related to at least one ecosystem service in the literature sources that informed the present study (**Table 17**).
Considering the overall number of possible relationships (matrix intersections) between the 107 CICES categories and all the 590 permanently-submerged seabed EUNIS classes (i.e., 63,130 relationships), only 3% have been scored in the source literature (**Table 18**). If we consider all the 974 (littoral and permanently-submerged) seabed EUNIS classes (yielding 104,218 relationships), this percentage marginally decreases to 2% (**Table 18**).

Table 16. Services in CICES related to marine habitats.

CICES Hierarchical level	Number of CICES categories	Number of those related to a habitat in the ecos. serv. compilations	Percentage (%)
1 - Section	3	3	100
2 - Division	8	4	50
3 - Group	20	13	65
4 - Class	76	13	17
Total	**107**	**33**	**31**

Table 17. EUNIS marine habitats in related to ecosystem services in CICES.
(no. = number)

	Only permanently-submerged benthic habitat classes (EUNIS A3 to A6)			All Marine Habitats Classes (EUNIS A1 to A7)		
EUNIS HIERARCHICAL LEVEL	**No. of EUNIS categories**	**No. related to ecos. serv. in literature**	**%**	**No. of EUNIS categories**	**No. related to ecos. serv. in literature**	**%**
2	4	2	50	5	4	80
3	30	19	63	33	32	97
4	99	74	75	131	84	64
5	402	12	3	589	17	3
6	112	3	3	212	4	2
7	4	0	0	4		0
Total	590	110	**1**	974	141	**14**

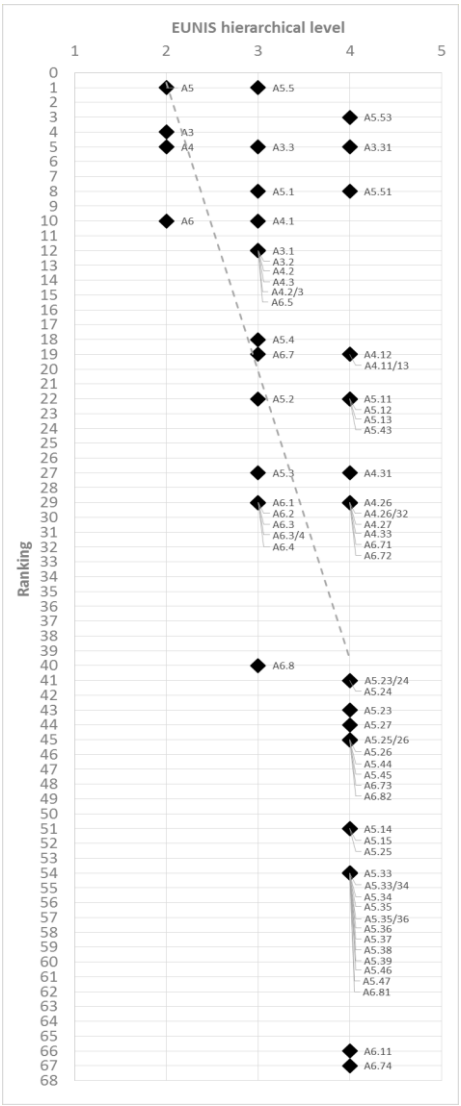
Table 18. Possible number of relationships (matrix intersections) between CICES categories and marine EUNIS classes, and actual information found in the source literature.

CICES x EUNIS	All CICES categories *X* Permanently-submerged marine EUNIS classes (focus of this report)	All CICES categories *X* Marine EUNIS classes
Number of mathematically-possible relationships	63,130	104,218
Number of relationships already assessed by the habitat-based ecosystem service compilations used as information sources	1,792	2,241
Percentage	**3%**	**2%**

2.5.1 *Habitat highlights*

A horizontal reading of the final lookup table informs on the ecosystem services that are potentially provided by a particular habitat. This analysis indicated that habitat classes generally have the capacity to supply multiple ecosystem services. Since CICES is a hierarchical classification system, establishing a ranking of the habitats based on the number of ecosystem services each of them provides required averaging the ranking obtained by each habitat at each CICES hierarchical level. The final ranking is shown in **Figure 5**.

Figure 5. Ranking of the EUNIS habitats by number of ecosystem services provided.
(to interpret the EUNIS habitats numbering use **Table 8**; dashed line indicates trend between the ranking of the different EUNIS hierarchical levels)



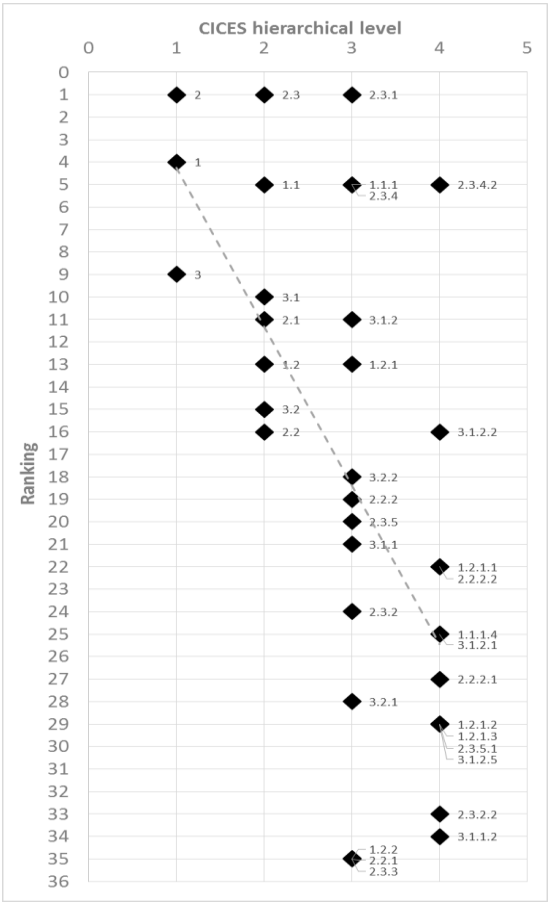
Sublittoral sediment dominated by macrophytes (i.e., EUNIS class A5.5) is highlighted as the habitat **associated with the highest number of ecosystem services**, attesting the importance of seagrasses, maerl and kelp beds. Generally, it is worth noting that a higher number of services are provided by shelf habitats (A3, A4 and A5.5), which are also those that are usually more accessible from the populated shores.
On the other hand, **sublittoral sediments without macrophytes (A5.1, A5.2, A5.3, A5.4), and deep-sea habitats (A6) generally scored lower in the ranking**. This is

either because of lower macroepibenthic diversity and biomass or because they are simply less known and/or less used by Man.
Considering all levels together, there is naturally a **trend for habitats placed higher in the EUNIS hierarchy** (note dots stacked under hierarchical level number 2) to **rank higher than finer habitats located lower in the hierarchy** (see indicative dashed trendline in **Figure 5**).

2.5.2 *Service highlights*

A vertical reading of **Tables 16 to 18** highlights the number of habitats providing particular services. A ranking of the CICES ecosystem services was established based on the number of EUNIS marine habitats providing each of them. Since EUNIS is a hierarchical system, the final ranking of the ecosystem services is based on the average ranking obtained by each ecosystem service at each EUNIS hierarchical level. The results are presented in **Figure 6**.

Figure 6. Ranking of the ecosystem services by number of EUNIS habitats providing them.
(to interpret the ecosystem services references labelling dots use Table 1; dashed line indicates trend between the ranking of the different CICES hierarchical levels)



Regulation & Maintenance Services (dot #2) **are** the ones **present in a higher number of habitats**, followed by Provisioning services (dot #1) and lastly by Cultural Services (dot #3). Considering all levels together, there is naturally a trend for broader **services placed higher in the CICES hierarchy** (dots stacked under hierarchical level number 1) to **rank higher than more specific services** located lower in the hierarchy (see indicative dashed trendline in **Figure 6**). In effect, CICES sections aggregate a higher diversity of services which are provided by a higher diversity of habitats.

Among all, CICES services linked to *Lifecycle maintenance, habitat and gene pool protection* (#2.3.1), the *Provision of Biomass for Nutrition* (dot #1.1.1) and the *Regulation & Maintenance of the Chemical Condition of Salt Waters* (dot #2.3.4.2) score the highest in terms of number of providing habitats.

2.5.3 *Quality of the evidence per ecosystem service*

A **quality score of the individual ecosystem services assessment** was established based on the completeness of the habitat-related evidence sourced from the literature review. The score resulted **directly from the percentage of mapped EUNIS habitats for which presence/absence of a certain service could be established from the literature review**. For instance, if a certain service presented ecosystem service information for 41 out of the 66 EUNIS habitats for which maps were available, its cartographic representation would score a 62% quality. Based on this percentage, five quality categories were defined: 'very poor assessment' [0-20%[; 'poor assessment' [20-40%[; 'fair assessment' [40-60%[; 'good assessment' [60-80%[; 'very good assessment' [80-100%]. This information is summarized in **Table 19** and highlighted using a green-amber-red colour scheme that is also used in **Tables 16 to 18**.

Table 19. Quality of the ecosystem services assessment.
Colours highlight assessment quality ('very poor' - red; 'poor' - orange; 'fair' - yellow; 'good' – light green; 'very good' – dark green; see text for details).

Scoring of Ecosystem Services in habitat list						Averages	
Prov.	%	Reg. & Maint.	%	Cult.	%	Hierarch.	%
1	97	2	98	3	67	CL1	87
1.1	95	2.1	100	3.1	65	CL2	75
1.1.1	98	2.2	45	3.1.1	26	CL3	54
1.1.1.4	15	2.2.1	8	3.1.1.2	8	CL4	24
1.2	62	2.2.2	33	3.1.2	61	Overall	50
1.2.1	62	2.2.2.1	42	3.1.2.1	15		
1.2.1.1	20	2.2.2.2	21	3.1.2.2	50		
1.2.1.2	6	2.3	98	3.1.2.5	9		
1.2.1.3	8	2.3.1	100	3.2	56		
		2.3.2	12	3.2.1	8		
		2.3.2.2	8	3.2.2	98		
		2.3.3	8				
		2.3.4	95				
		2.3.4.2	100				
		2.3.5	98				
		2.3.5.1	5				

Overall, 50% of the 'mapped seabed habitats *versus* assessed ecosystem services' lookup table was completed. Out of the 36 ecosystem services, 15 were graded as *well* or *very-well* assessed, 6 were assessed *fairly* and 17 were *poorly* or *very poorly* assessed. A trend was evident along the CICES hierarchy. Services belonging to the uppermost levels (1 and 2) were *well* or *very-well* assessed (averages of 87% and 75 %, respectively) whilst services at level 3 are *fairly* assessed and those at level 4 are on average *poorly* assessed.

Poorly and *very poorly* assessed services (red cells in **Tables 16 to 18**) lacked information on their delivery by too many mapped habitats. For the sake of completion, most of them were kept in the mapping exercise presented below but they are very biased. *Scientific services* (see section 3.4.5) is a good examples of these biases stemming for an incomplete

lookup table. As none of the ecosystem service compilations specified their link to shelf habitats, they end up only being mapped over deep-sea habitats. Thus, shelf areas are erroneously blanked when they are knowingly major providers of such service.

2.6 Study area

The exercise extended between the European shores and the following seaward limits:

(i) in the Baltic Sea, North Sea, Mediterranean Sea, Black Sea, the geographical median lines defined between countries baselines;
(ii) off the Canary Islands, the 200nm limit
(iii) in the remaining Northeast Atlantic area, the limits of the merged Extended Continental Shelf areas claimed by EU Member States.

Shorelines were delimited using the Global Self-consistent Hierarchical High-resolution Shorelines (GSHHS, version 2.2.2, 1/1/2013; GSHHS_f_L1 shapefile), available for download from http://www.ngdc.noaa.gov/mgg/shorelines/gshhs.html. Seaward limits were based upon the Maritime Boundaries of the World dataset (version 8, 28/2/2014) available for download from http://www.marineregions.org/downloads.php. Extended Continental Shelf (ECS) limits were based on GRID-Arendal's compilation of ECS proposals submitted to the UNEP Shelf Program available from http://continentalshelf.org/onestopdatashop/4204.aspx.

A total maritime area covering 8,996,398 km^2 extending throughout the Northeast Atlantic and Adjacent Seas was targeted (**Figure 7**). These limits and spatial extent, hereafter referred as the Study Area, are used for analytical purposes. Them, or the quantitative information resulting from their analytical use, serve for information purposes only and do not in any way represent an official position or statement by the European Commission or the Joint Research Centre regarding the maritime territory of EU Member States or other sovereign States in accordance with international law.

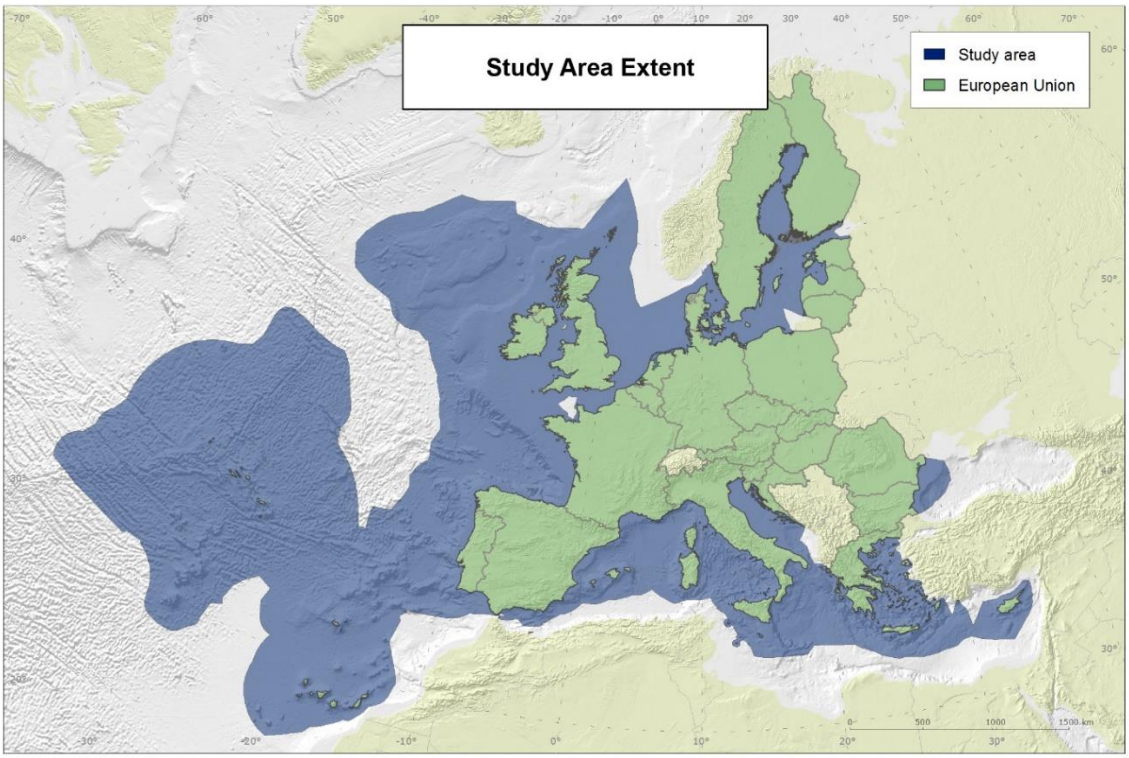


Figure 7. Spatial extent targeted by this study.
(see *Legal Notice* on top of page ii)

3. Marine ecosystem service maps

3.1 Spatial indicators for marine ecosystem service capacity

By combining the data in the ecosystem service vs. ecosystem service capacity lookup tables (**Tables 16 to 18**) with the vectorial geospatial data of those same habitats (i.e., the polygon shapefile representing the distribution of EUNIS marine habitats) using a common field (habitat code), the ecosystem services become spatially explicit. Using a geographical information system their distribution can then be displayed as maps which are presented in this section. A standardized factsheet format is used that underlines the following attributes:

- *Definition*: brief description of what this CICES class encompasses in the context of this report;
- *Habitats related to the provision of this service*: list of seabed habitats suggested by the literature review described in 2.5 as providing or not the marine ecosystem service. Seabed habitat names corresponding to the codes used are provided in **Tables 11 and 12**. The full 'seabed habitat vs. ecosystem service' lookup table is provided in **Tables 16 to 18;**
- *Map*: cartographic representation of the ecosystem service spatial distribution resulting from the approach described in section 2; the original resolution of the ecosystem geospatial units is kept;
- *Area*: extent in km^2 ecosystem service where the ecosystem is estimated to be present in the study area; corresponds to attribute *4.2.* in **Table 21** below;
- *Quality score*: Likert scale self-assessment of the map usefulness for decision-making (1=yes to 5=no); it corresponds to attribute *9.* in **Table 21** below and is based on the quality categories established in the previous section;
- *Highlights*: summary of the main patterns observed on the map highlighting:
  - "Member State(s) holding larger capacity to provide this service", as indicated by a percent contribution to the total ecosystem service area >5% on **Table 24**;
  - "Ecoregion(s) holding larger capacity to provide this service", as indicated by a percent contribution to the total ecosystem service area >10% on **Table 31**;
  - "Fishing Unit(s) holding larger capacity to provide this service", as indicated by a percent contribution to the total ecosystem service area >10% on **Tables 29 and 33**.

  MSFD regions/subregions
  - "Region/subregion(s) holding larger capacity to provide this service", as indicated by a percent contribution to the total ecosystem service area >10% on **Table 27**;
  - "Major component of the ecosystem services capacity make-up in specific ecoregions", as indicated by presence of the service in >50% of the individual ecoregion area on **Table 32**.
- *Limitations*: some critical thought / short discussion on, e.g., the key assumptions underlying the model, limitations of the data, data gaps, level of uncertainty inherent to the map); corresponds to attribute *10.* in **Table 21** below;
- *Further work*: suggestions on some quantitative metrics and indicators for quantitatively mapping the ecosystem service (i.e., actual flow of benefits and goods) at EU scale compiled from Maes et al. (2014) and Scholes et al. (2010).

3.2 Standard metadata

As suggested by Crossman et al. (2013), the growing policy attention towards ecosystem service demands increased knowledge, rigour, transparency and certainty in accounting, modelling, mapping and valuing methods so that ecosystem services can become mainstream. These authors propose that standard metadata accompany each study and produced map in order to facilitate cataloguing, scrutiny and review. These metadata are provided below documenting the study itself (**Table 20**) as well as individual ecosystem service maps (**Table 21**). They are of value to both researchers starting a new mapping study and to practitioners and policy makers searching for ecosystem service information to use in decision-making.

Table 20. Standard metadata for the study

1. Name of mapping study	Spatial distribution of marine ecosystem service capacity in the European Seas
2. Purpose of the study	Map the distribution of seabed-related ecosystem services capacity by bringing together (i) a geospatial dataset of the distribution of permanently-submerged EUNIS seabed habitats with (ii) information on each habitat capacity to provide CICES-harmonized ecosystem services.
3. Location of the study site and biophysical type	Permanently-submerged EUNIS seabed habitats of the northeast Atlantic and adjacent seas
4. Study duration	24 months (2014-2016)
5. Administrative Unit	continent, ocean and sea basins
6. Main investigators	Fernando Tempera, Camino Liquete, Ana Cristina Cardoso
7. References	Tempera F., C. Liquete & A.C. Cardoso (2016). Spatial distribution of marine ecosystem service capacity in the European Seas. Publications Office of the European Union. iv+133 pp. DOI: 10.2788/753996
8. Type of project	Research
9. Funding source	SEACOAST project (European Commission, Joint Research Centre)
10. Contact details	Fernando Tempera, Joint Research Centre, Via Enrico Fermi 2749, TP 270, 21027 Ispra (VA), Italy; e-mail: fernando.tempera@jrc.ec.europa.eu; tel. +39 0332 78 5001

Given the single methodology used throughout this report, attributes provided in **Table 21** apply to all the ecosystem service maps presented. They are presented once here in order to avoid unnecessary repetition. Inversely, variable attributes are provided in the individual sections dedicated to each marine ecosystem service map, namely: '*4.2. Area*', '*9. Likert scale self-assessment*' and '*10. Comments*' as presented above.

Table 21. Standard attributes for the individual ecosystem service maps.

1. Mapped ecosystem service	CICES-harmonized ecosystem services
2. Accounting definitions	Area-based assessment based on empirical model data
2.1. Type	Capacity (as indicated by the presence of a seabed habitat related in literature to the service provisioning)
2.2. Beneficiary	Providing area (seabed habitats list provided under the heading *Habitats related to the provision of this service*)
3. Ecosystem service indicator	Natural capacity to deliver the service
4. Quantification unit	Area in km^2 (extent)
4.1. Quantity	Not applicable
4.2. Area	Area in km^2 (extent) (presented along with each service map under the heading *Area*)
4.3. Timeframe	Study does not relate to a specific timeframe as the results represent the natural capacity of an ecosystem in good status to provide the service. The approach ignores the condition of the ecosystem.
5. Input data source	Expert opinion and literature review used together with spatially-explicit proxy (seabed habitat presence)
6. Quantification method	Empirical (qualitative information based on literature review and expert opinion resulting in maps and area-based assessment)
7. Spatial details	Datum: ETRS 1989. Projection: Lambert Azimuthal Equal Area.
7.1. Scale	Regional (Northeast Atlantic and Adjacent Seas)
7.2. Extent	8,996,398 km^2
7.3. Resolution	Vectorial dataset (polygon) targeting minimum geospatial units of 250m x 250 m (roughly equivalent to a scale of 1:1,000,000)
8. Mapped year or period	Study does not relate to a specific period as the results represent the natural capacity of an ecosystem in good status to provide the service.
9. Study objective met (1=yes to 5=no)	Presented along with each service map under the heading *Quality*
10. Comments (limitations, key assumptions)	Presented along with each service map under the heading *Limitations*

3.2 Provisioning services (CICES Level 1 - Section)

Definition

The services in this CICES section include all nutritional, material and energetic outputs from living systems. A distinction is made in the CICES structure between (i) nutrition-related and (ii) material outputs derived from biological or organic materials (including biomass or genetic structures). The latter includes services provided by water which are not covered in this report as water was considered primarily an abiotic, mineral output.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 10%

Percentage of mapped habitats assessed for this service: 97%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.26, A4.26/32, A4.27, A4.3, A4.31, A4.33, A5, A5.1, A5.11, A5.12, A5.13, A5.14, A5.15, A5.2, A5.23, A5.23/24, A5.24, A5.25, A5.25/26, A5.26, A5.27, A5.3, A5.33, A5.33/34, A5.34, A5.35, A5.35/36, A5.36, A5.37, A5.38, A5.39, A5.4, A5.43, A5.44, A5.45, A5.46, A5.47, A5.5, A5.51, A5.53, A6, A6.1, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.7, A6.71, A6.72, A6.73, A6.8, A6.81, A6.82

Non-EUNIS: N_2, N_3, N_4, N_5, N_6, N_7, N_8, N_9, N_10, N_11, N_12, N_17, N_18, N_19, N_20, N_23, N_24, N_30

Map

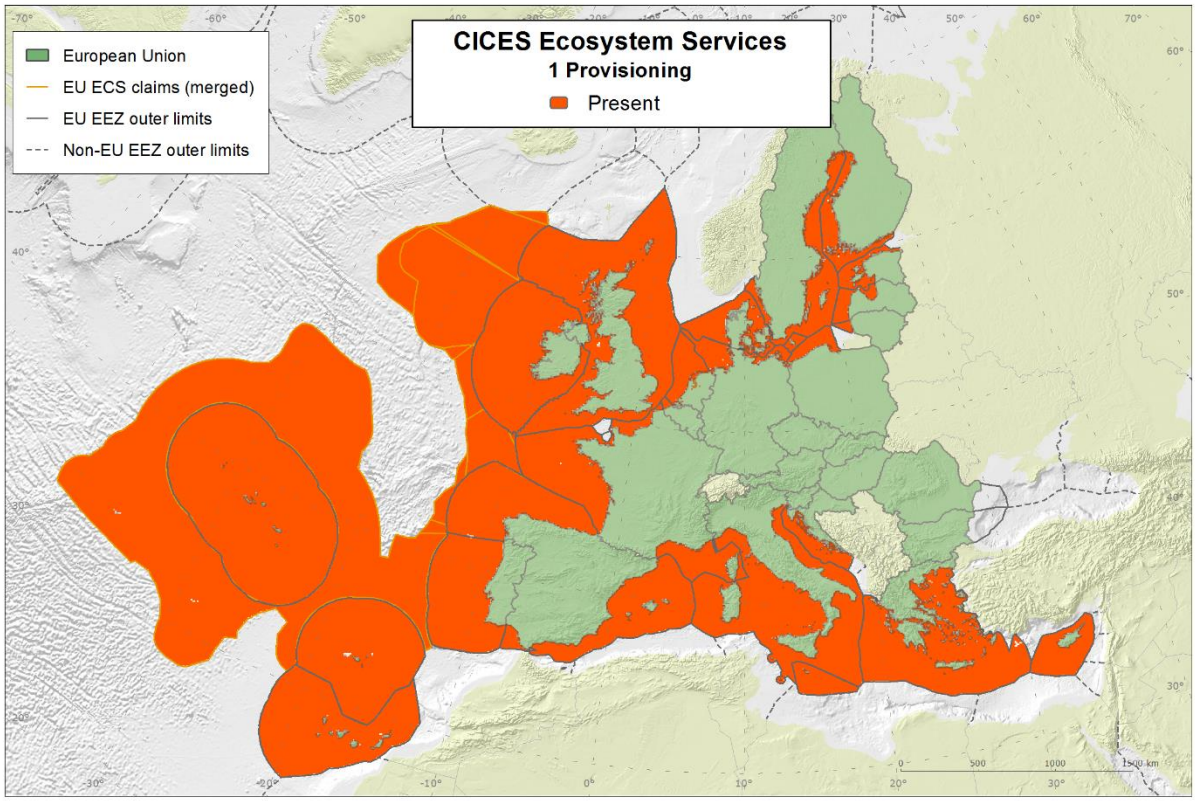


Figure 8. Spatial distribution of the seabed-associated Provisioning Ecosystem Services.

Area: 8,927,254 km^2 (99.2% of study area)

Quality score (1=best to 5=worst): 1

Highlights

Member State(s) holding larger capacity to provide this service: NE Atlantic ECS, PT, ES, UK, EL, IT, IE

Ecoregion(s) holding larger capacity to provide this service: Deep Sea (Atlantic, Mediterranean), Boreal

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10), 34, 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (NE Atlantic ECS, Macaronesia), Mediterranean

Major component of the ecosystem services capacity make-up in: Baltic, NE Atlantic Ocean (all subregions), Mediterranean Sea (Western Mediterranean, Adriatic, Aegean-Levantine)

Limitations

An area-based assessment of service capacity (like the one followed in the present work) results in a largely biased perception of the distribution and delivery of this service. The deep-sea areas identified as holding most of the capacity for this service do encompass large extents from which some level of service may be extracted. However, given the naturally low renewal rates of the extracted resources, it is likely that only a very low level of some provisioning services can be sustainably provided.

Further work

In order to map service capacity quantitatively use species stocks in conjunction with sustainable harvest rates (see section 6.5.1 below). In order to express service flow quantitatively, use offtake (landings, harvest) or production of exploited living marine resources (plants, algae, animals) in tonnes per year or Catch per Unit Effort (CPUE). Monetary benefits can be expressed by gross annual profits of the fishing sector.

In this assessment it is important to use indicators referring to spatial units that resolve the geographical distribution of the service adequately. Preferably, ecosystem-specific values or systematic grids that adequate reflect mesoscales should be used. Subjective or excessively-broad data aggregation units may mask spatio-temporal patterns of local stock depletion that ought to be timely managed. *Vessel monitoring systems* (e.g., VMS, AIS) and fishing logbooks can provide geographical data of great use to delimit fishing grounds, activity footprint and/or estimate effort statistics at fine resolutions. In what concerns aquaculture-related services, aerial/satellite imagery may be used to map the location, extent and capacity (e.g. number and size of tanks) in aquaculture facilities. In both cases, linking the fishing or aquaculture statistics with the geospatial information will result in a much more refined and rigorous mapping of provisioning ecosystem services.

3.2.1 *Nutrition (CICES Level 2 - Division)*

Definition

This service encompasses the capacity of the oceans and seas to deliver fishery products for (i) human consumption as food and (ii) for use as animal feed. These goods can be harvested from wild populations or produced in the marine environment using aquaculture techniques.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 10%

Percentage of mapped habitats assessed for this service: 96%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.26, A4.26/32, A4.27, A4.3, A4.31, A4.33, A5, A5.1, A5.11, A5.12, A5.13, A5.14, A5.15, A5.2, A5.23, A5.23/24, A5.24, A5.25, A5.25/26, A5.26, A5.27, A5.3, A5.33, A5.33/34, A5.34, A5.35, A5.35/36, A5.36, A5.37, A5.38, A5.39, A5.4, A5.43, A5.44, A5.45, A5.46, A5.47, A5.5, A5.51, A5.53, A6, A6.1, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.7, A6.71, A6.72, A6.73, A6.8, A6.81

Non-EUNIS: N_2, N_3, N_4, N_5, N_6, N_7, N_8, N_9, N_10, N_11, N_12, N_17, N_18, N_19, N_20, N_23, N_24, N_30

Map

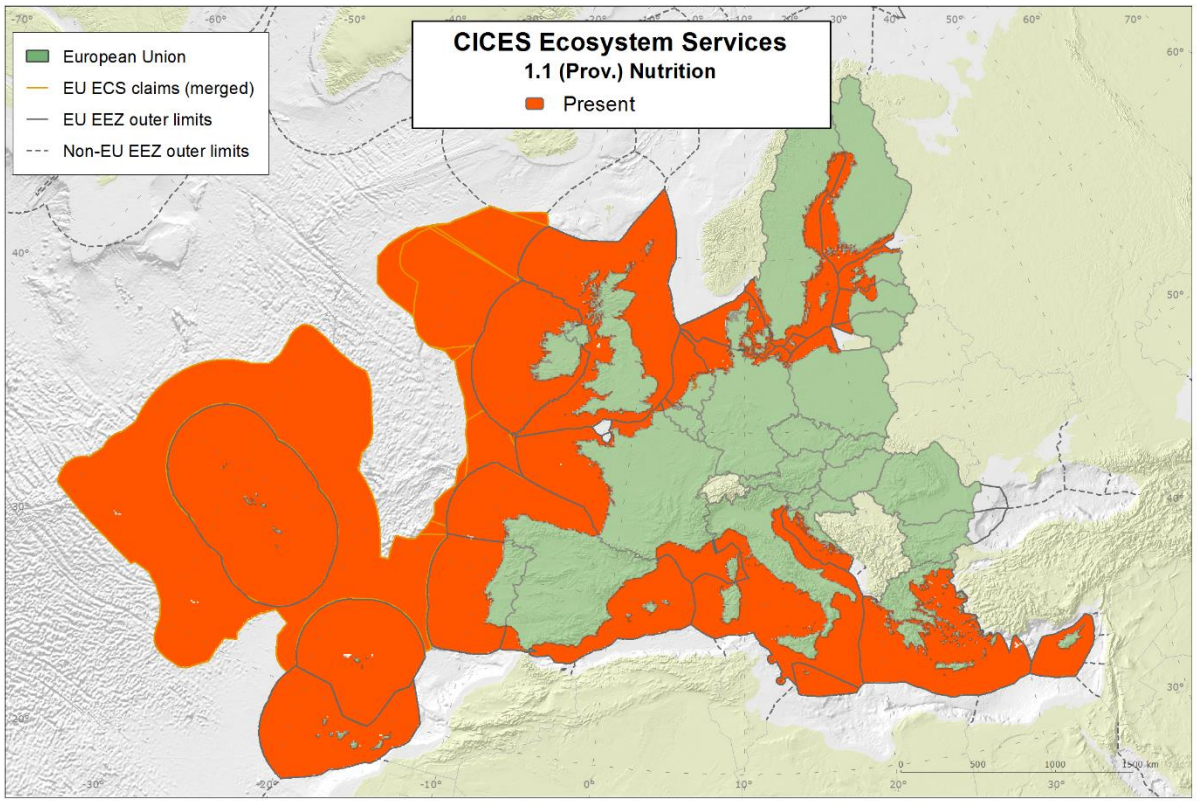


Figure 9. Spatial distribution of the seabed-associated ecosystem services in the CICES division "Nutrition".

Area: 8,927,254 km^2 (99.2% of study area)

Quality score (1=best to 5=worst): 1

Highlights

Member State(s) holding larger capacity to provide this service: NE Atlantic ECS, PT, ES, UK, EL, IT, IE

Ecoregion(s) holding larger capacity to provide this service: Deep Sea (Atlantic, Mediterranean), Boreal

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10), 34, 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (NE Atlantic ECS, Macaronesia), Mediterranean

Major component of the ecosystem services capacity make-up in: Baltic, NE Atlantic Ocean (all subregions), Mediterranean Sea (Western Mediterranean, Adriatic, Aegean-Levantine)

Limitations

An area-based assessment of service capacity (like the one followed in the present work) results in a largely biased perception of the distribution and delivery of this service. The deep-sea areas identified as holding most of the capacity for this service do encompass large extents from which some level of service may be extracted. However, given the naturally low renewal rates of the extracted resources, it is likely that only a very low level of this service can be sustainably provided.

Further work

In order to map service capacity quantitatively use species stocks in conjunction with sustainable harvest rates (see Section 6.5.1). In order to express service flow quantitatively, use offtake (landings, harvest) or production of exploited living marine resources (plants, algae, animals) in tonnes per year or Catch per Unit Effort (CPUE). Monetary benefits can be expressed by gross annual profits of the fishing sector.

In this assessment it is important to use indicators referring to spatial units that resolve the geographical distribution of the service adequately. Preferably, ecosystem-specific values or systematic grids that adequate reflect mesoscales should be used. Subjective or excessively-broad data aggregation units may mask spatio-temporal patterns of local stock depletion that ought to be timely managed. *Vessel monitoring systems* (e.g., VMS, AIS) and fishing logbooks can provide geographical data of great use to delimit fishing grounds, activity footprint and/or estimate effort statistics at fine resolutions. In what concerns aquaculture-related services, aerial/satellite imagery may be used to map the location, extent and capacity (e.g. number and size of tanks) in aquaculture facilities. In both cases, linking the fishing or aquaculture statistics with the geospatial information will result in a much more refined and rigorous mapping of provisioning ecosystem services.

3.2.2 *Biomass for nutrition (CICES Level 3 - Group)*

Definition

This CICES group relates to the potential for extracting animal and plant biomass by either industrial or subsistence fishing activities or to find conditions to grow them using aquaculture techniques in marine environments.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 10%

Percentage of mapped habitats assessed for this service: 99%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.26, A4.26/32, A4.27, A4.3, A4.31, A4.33, A5, A5.1, A5.11, A5.12, A5.13, A5.14, A5.15, A5.2, A5.23, A5.23/24, A5.24, A5.25, A5.25/26, A5.26, A5.27, A5.3, A5.33, A5.33/34, A5.34, A5.35, A5.35/36, A5.36, A5.37, A5.38, A5.39, A5.4, A5.43, A5.44, A5.45, A5.46, A5.47, A5.5, A5.51, A5.53, A6, A6.1, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.7, A6.71, A6.72, A6.73, A6.8, A6.81

Non-EUNIS: N_2, N_3, N_4, N_5, N_6, N_7, N_8, N_9, N_10, N_11, N_12, N_17, N_18, N_19, N_20, N_23, N_24, N_30

Seabed habitats NOT providing the service

EUNIS: A6.11, A6.74, A6.82

Non-EUNIS: N_1, N_14, N_16, N_22

Map

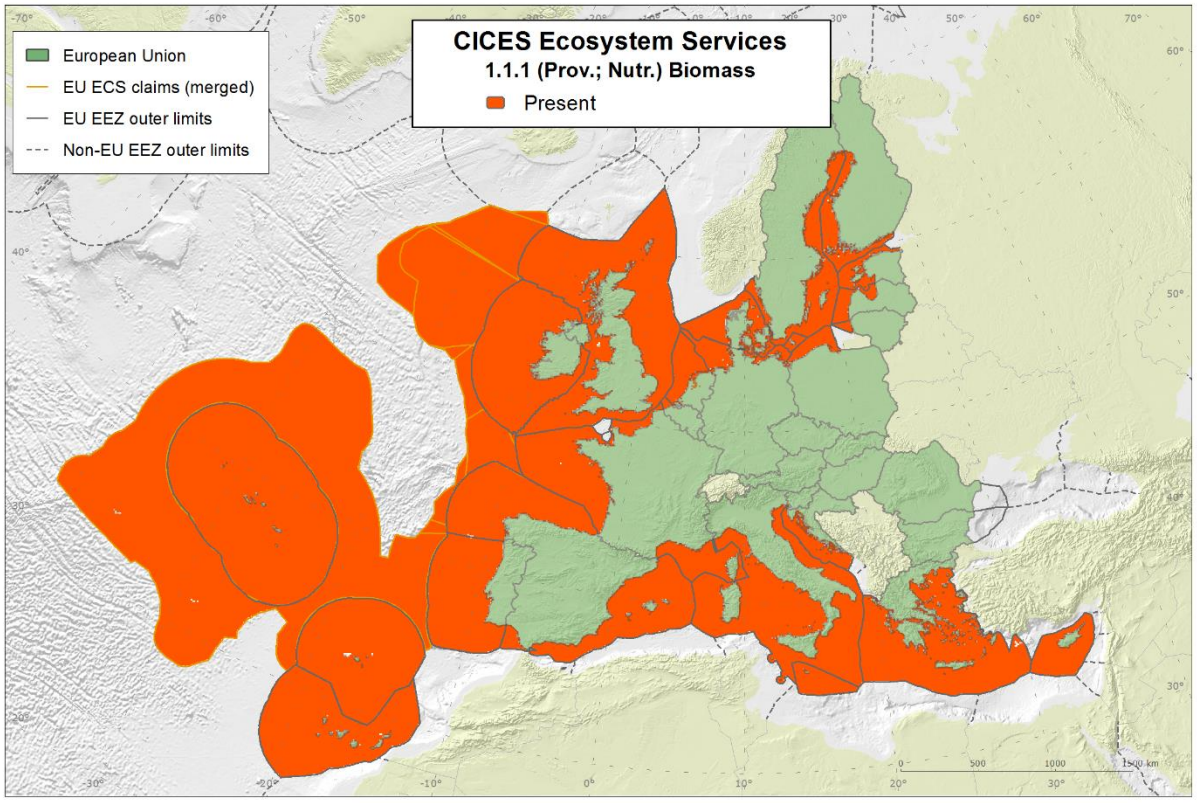


Figure 10. Spatial distribution of the seabed-associated ecosystem services in the CICES group "Biomass" for Nutrition.

Area: 8,927,254 km^2 (99.2% of study area)

Quality score (1=best to 5=worst): 1

Highlights

Member State(s) holding larger capacity to provide this service: NE Atlantic ECS, PT, ES, UK, EL, IT, IE

Ecoregion(s) holding larger capacity to provide this service: Deep Sea (Atlantic, Mediterranean), Boreal

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10), 34, 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (NE Atlantic ECS, Macaronesia), Mediterranean

Major component of the ecosystem services capacity make-up in: Baltic, NE Atlantic Ocean (all subregions), Mediterranean Sea (Western Mediterranean, Adriatic, Aegean-Levantine)

Limitations

An area-based assessment of service capacity (like the one followed in the present work) results in a largely biased perception of the distribution and delivery of this service. The deep-sea areas identified as holding most of the capacity for this service do encompass large extents from which some level of service may be extracted. However, given the naturally low renewal rates of the extracted resources, it is likely that only a very low level of this service can be sustainably provided.

As documented by Morato et al. (2006), at a global level, this service is still prevailingly provided by shelf habitats (i.e., depth <200m). In the North Atlantic the average depth of extracted fish was at nearly 200m and showed a fast downwards trend. Given the years passed since the study, and assuming a maintenance of the trend, fishery resources caught in EU waters should presently be sourced on average from upper slope depths.

Further work

In order to map service capacity quantitatively use species stocks in conjunction with sustainable harvest rates (see section 6.5.1). In order to express service flow quantitatively, use offtake (landings, harvest) or production of exploited living marine resources (plants, algae, animals) in tonnes per year or Catch per Unit Effort (CPUE). Monetary benefits can be expressed by gross annual profits of the fishing sector.

In this assessment it is important to use indicators referring to spatial units that resolve the geographical distribution of the service adequately. Preferably, ecosystem-specific values or systematic grids that adequate reflect mesoscales should be used. Subjective or excessively-broad data aggregation units may mask spatio-temporal patterns of local stock depletion that ought to be timely managed. *Vessel monitoring systems* (e.g., VMS, AIS) and fishing logbooks can provide geographical data of great use to delimit fishing grounds, activity footprint and/or estimate effort statistics at fine resolutions. In what concerns aquaculture-related services, aerial/satellite imagery may be used to map the location, extent and capacity (e.g. number and size of tanks) in aquaculture facilities. In both cases, linking the fishing or aquaculture statistics with the geospatial information will result in a much more refined and rigorous mapping of provisioning ecosystem services.

3.2.3 *Biomass for materials (CICES Level 3 - Group)*

Definition

This category covers the use of biomass or biotic elements derived from wild and cultivated coastal and marine species for non-nutritional uses. In the EU marine context, these services consist mostly of the use of:

- Fibres (e.g., sponges), skin, bones, and other products, which are not further processed;
- Bait for fisheries;
- Pelagic fish species and fish waste from the fish processing industry for producing fish meal and fish oil used in the feeding of, e.g., farmed poultry, pigs and fish;
- Chemicals extracted or synthesised from algae, plants and animals material to produce industrial oils, dyes and colours, food supplements (e.g. chondritin from sharks), natural remedies, medicinal drugs and cosmetics (e.g. sperm whale ambergris used in perfumes);
- biotic material such as shells, corals, pearls or aquarium fish from ecosystems for consumptive ornamental use in decoration, fashion, handicrafts or souvenirs;
- Plant and seaweed material for fertilizer in agriculture
- Animal biomass for fodder in aquaculture;
- Bio-prospecting activities;
- Genetic material (DNA) from wild plants, algae and animals for biochemical industrial and pharmaceutical processes (e.g. medicines, fermentation, detoxification).

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 6.3%

Percentage of mapped habitats assessed for this service: 63%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.26, A4.26/32, A4.27, A4.3, A4.31, A4.33, A5, A5.1, A5.11, A5.12, A5.13, A5.14, A5.15, A5.2, A5.23, A5.23/24, A5.24, A5.25, A5.25/26, A5.26, A5.27, A5.3, A5.4, A5.43, A5.44, A5.45, A5.5, A5.51, A5.53, A6.8, A6.82

Non-EUNIS: N_3, N_5, N_6, N_7, N_8, N_9, N_10, N_11, N_12, N_19, N_20, N_30

Map

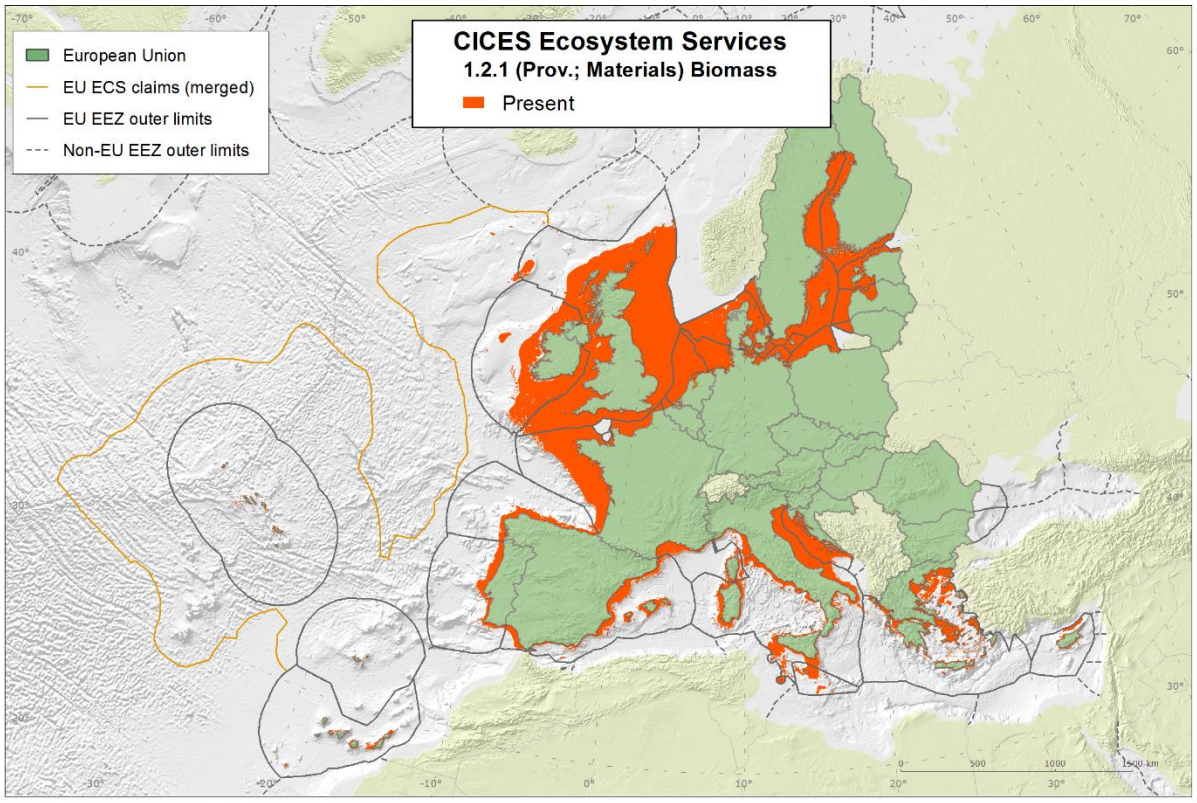


Figure 11. Spatial distribution of the seabed-associated ecosystem services in the CICES class "Fibres and other materials from plants, algae and animals for direct use or processing".

Area: 1,817,228 km^2 (20.2% of study area)

Quality score (1=best to 5=worst): 3

Highlights

Member State(s) holding larger capacity to provide this service: UK, IE, IT, FR, EL, ES, SE, NE Atlantic ECS

Ecoregion(s) holding larger capacity to provide this service: Boreal (Boreal Proper, Boreal-Lusitanean), Mediterranean, Baltic

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10), 34, 37

<u>MSFD regions/subregions</u>

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Greater North Sea, Celtic Seas), Mediterranean Sea (Western Mediterranean), Baltic Sea

Major component of the ecosystem services capacity make-up in: Baltic, Adriatic, Greater North Sea and Celtic Seas.

Limitations

Likely significantly underestimated as the capacity for providing this service has not been assessed for roughly one third of the habitats.

Further work

In order to express flow quantitatively, analyse data reflecting annual harvest of raw materials, known medicinal species acquired by industry channels based on marine biomass for non-food purposes. Some proxies can also be obtained from the yield of products by the industries, their turnover or gross profits, or the number of people using the products.

3.2.4 *Fibres and other materials from plants, algae and animals for direct use or processing (CICES Level 4 - Class)*

Definition

In the geographical context of this work, this CICES class encompasses the use of biomass or biotic elements derived from wild and cultivated coastal and marine species for non-nutritional uses. In the EU marine context, these services consist mostly of the use of:

- Fibres (e.g., sponges), skin, bones, and other products, which are not further processed;
- Bait for fisheries;
- Biotic materials (e.g., pelagic fish species with limited market value, fish waste from the industrial processing of fish for human consumption) for producing fish meal and fish oil used in the feeding of, e.g., farmed poultry, pigs and fish;
- Chemicals extracted or synthesised from algae, plants and animals material to produce industrial oils, dyes and colours, food supplements (e.g. chondritin from sharks), natural remedies, medicinal drugs and cosmetics (e.g. sperm whale ambergris used in perfumes).
- Biotic material such as shells, corals, pearls or aquarium fish from ecosystems for consumptive ornamental use in decoration, fashion, handicrafts or souvenirs;
- Bio-prospecting activities for biotechnological and pharmaceutical products.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 2.0%

Percentage of mapped habitats assessed for this service: 21%

Seabed habitats providing the service
EUNIS: A3.31, A5, A5.1, A5.11, A5.12, A5.13, A5.2, A5.3, A5.4, A5.5, A5.51

Seabed habitats NOT providing the service
EUNIS: A3, A4, A5.53
Non-EUNIS: N_30

Map

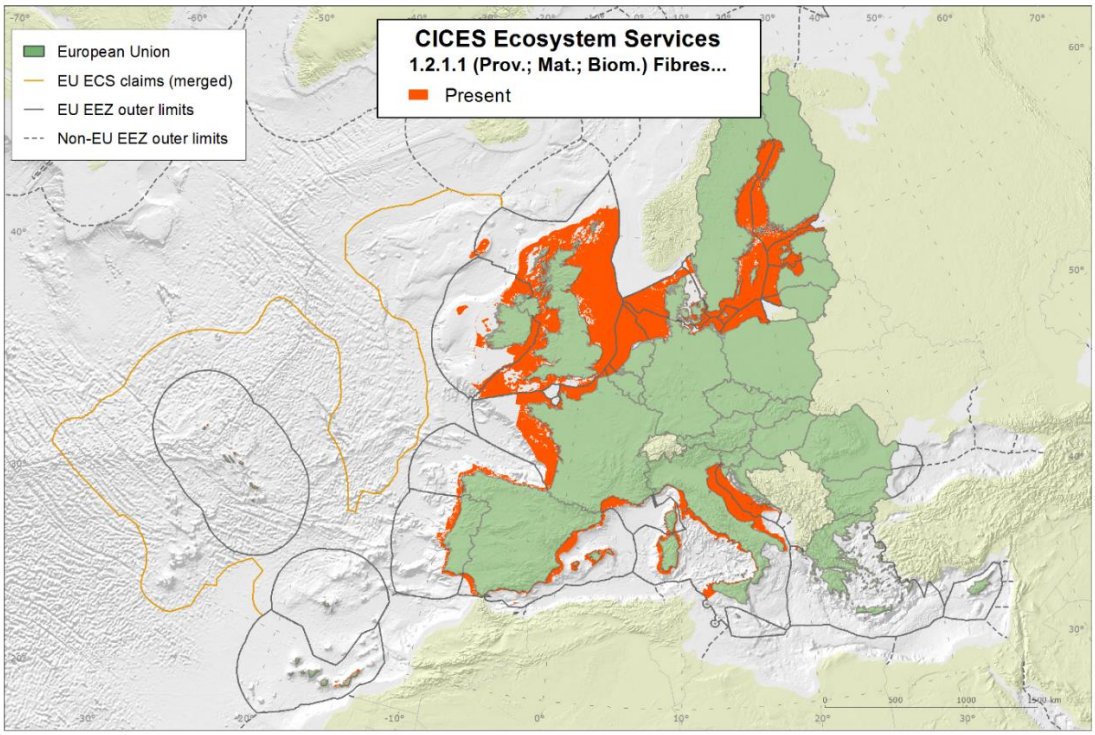


Figure 12. Spatial distribution of the seabed-associated ecosystem services in the CICES class "Fibres and other materials from plants, algae and animals for direct use or processing".

Area: 1,362,152 km^2 (15.1% of study area)

Quality score (1=best to 5=worst): 4

Highlights

Member State(s) holding larger capacity to provide this service: UK, SE, FR, IT, DK, ES, FI

Ecoregion(s) holding larger capacity to provide this service: Boreal (Boreal proper, Boreal-Lusitanean), Baltic Sea (Baltic Proper), Mediterranean, Lusitanean

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.3, 27.3.D., 27.4, 27.4.B, 27.7), 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: Northeast Atlantic (Greater North Sea, Celtic Seas), Baltic Sea, Mediterranean Sea

Major component of the ecosystem services capacity make-up in: Baltic Sea, Greater North Sea, Adriatic Sea

Limitations

Since only one 21% of the habitats have been properly assessed for this ecosystem service, the spatial distribution of its capacity is likely significantly underestimated and misrepresented.

A few discontinuities can be perceived in the Celtic Seas shelves. They stem from the lack of scoring of this service for a number of non-EUNIS seabed habitat classes cover these sectors of the European seas. Judging for the fact that the service capacity is present around these holes, it is likely that they will be filled when the EUNIS class present in such areas is resolved.

An area-based assessment of service capacity (like the one followed in the present work) results in a largely biased perception of the distribution of this service capacity. Extensive shelf areas are identified as presenting some capacity to deliver this service. However, the technological possibility, the economical viability or the sustainability of this extraction remains unassessed.

Further work

In order to express service flow quantitatively, analyse spatially-explicit data reflecting annual statistics on catch per unit effort (CPUE), landings, harvest or production (in tonnes) of the fish species acquired by the fish meal, fish oil and fish-based supplements industry pathways. Complementarily, quantify volumes of fish waste channelled to the same purpose from the fish processing industry.

Some proxies can also be obtained from the yield of products by the industries, their turnover or gross profits, or the number of people using the products.

It is important to use indicators connecting the biomass or monetary statistics to spatial units that resolve the geographical distribution of the service adequately. Subjective or excessively-broad data aggregation units may conceal spatio-temporal patterns of local stock depletion that ought to be timely managed. Preferably, ecosystem-specific values or systematic grids that adequate reflect mesoscales should be used.

In the scope of the new Common Fisheries Policy (EU Reg. 1380/2013), the European Union has been implementing a framework for the collection and use of fisheries data (Data Collection Framework or DCF). The introduction of (i) modern vessel positioning systems, (ii) detailed fisheries logging technology and (iii) new reporting standards all concur in promoting a more precise positioning of catches throughout the European seas. The adoption of the ICES rectangles (0.5° Latitude x 1° Longitude) as the geographical catch allocation standard shall allow a more precise analysis of the distribution of provisioning services notably in terms of spatial patterns and trends.

3.2.5 *Materials from plants, algae and animals for agricultural use (CICES Level 4 - Class)*

Definition

In the marine context of this report, this CICES class encompasses essentially the use of biotic materials derived from marine seaweeds and plants as fertilizers in agricultural practices.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 0.6%

Percentage of mapped habitats assessed for this service: 6%

Seabed habitats providing the service

EUNIS: A5.5, A5.51, A5.53

Seabed habitats NOT providing the service

EUNIS: A5.1

Map

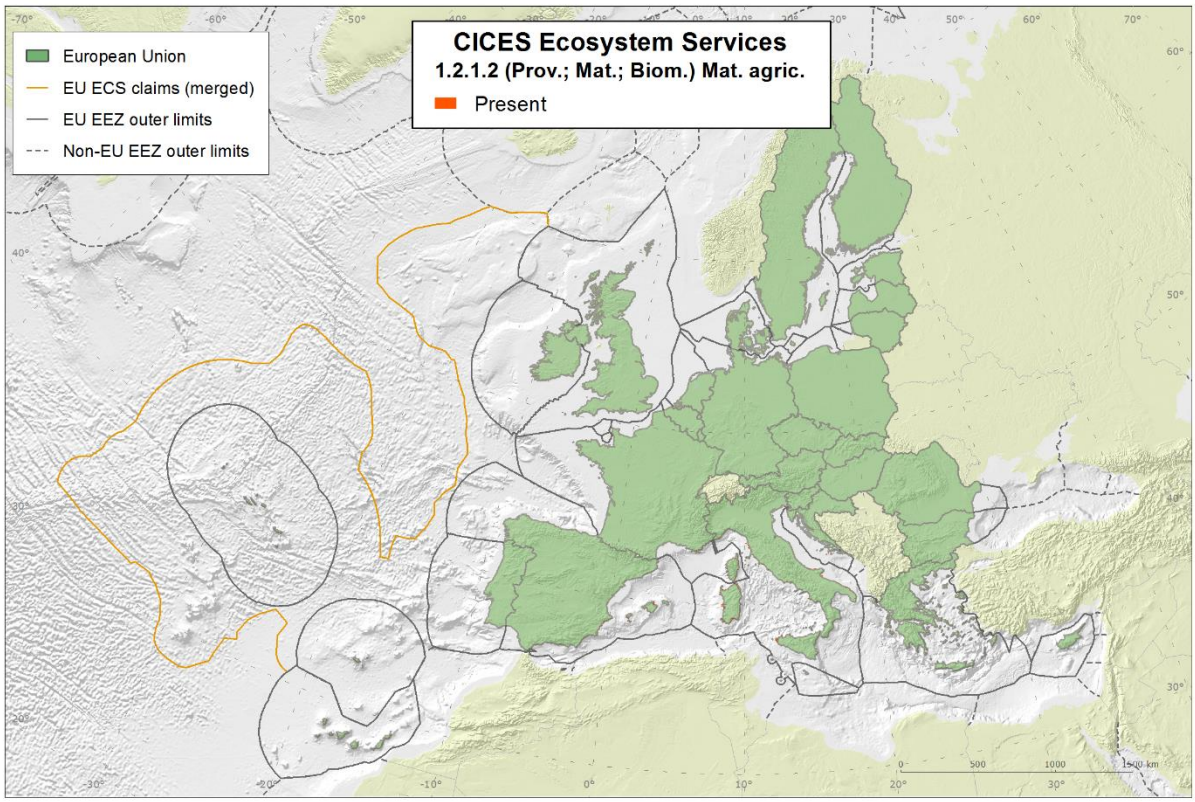


Figure 13. Spatial distribution of the seabed-associated ecosystem services in the CICES class "Materials from plants, algae and animals for agricultural use".

Area: 5,703 km^2 (0.06% of study area)

Quality score (1=best to 5=worst): 5

Highlights

Member State(s) holding larger capacity to provide this service: IT, ES, FR

Ecoregion(s) holding larger capacity to provide this service: Mediterranean Sea (Western Mediterranean, Adriatic Sea)

Fishing Unit(s) holding larger capacity to provide this service: 37 (37.1, 37.1.3, 37.1.3.11, 37.1.3.112)

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: Mediterranean Sea (Western Mediterranean, Adriatic Sea)

Major component of the ecosystem services capacity make-up in: No region

Limitations

Since only 6% of the habitats have been properly assessed for this ecosystem service, the spatial distribution of its capacity is likely considerably underestimated and misrepresented.

Further work

Analyse spatially-explicit annual statistics of catch per unit effort (CPUE), landings, harvest or production in tonnes of marine biotic materials used in agricultural practices (e.g., plants, seaweed). Given the small scale of these practices, information will likely have to be gathered from local surveys.

3.2.6 *Genetic materials from all biota (CICES Level 4 - Class)*

Definition

This CICES class is associated with the extraction of genetic material from marine organisms for biotechnological application in non-marine, non-medicinal contexts including biochemical industries, waste treatment, genetic enhancement of agricultural crops, pharmaceutics and cosmetics. It excludes the research value of genetic resources which is covered under the Scientific Services (section 3.4.5).

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 0.8%

Percentage of mapped habitats assessed for this service: 7%

Seabed habitats providing the service
EUNIS: A3.31

Seabed habitats NOT providing the service
EUNIS: A3, A4, A5.5, A5.53
Non-EUNIS: N_30

Map

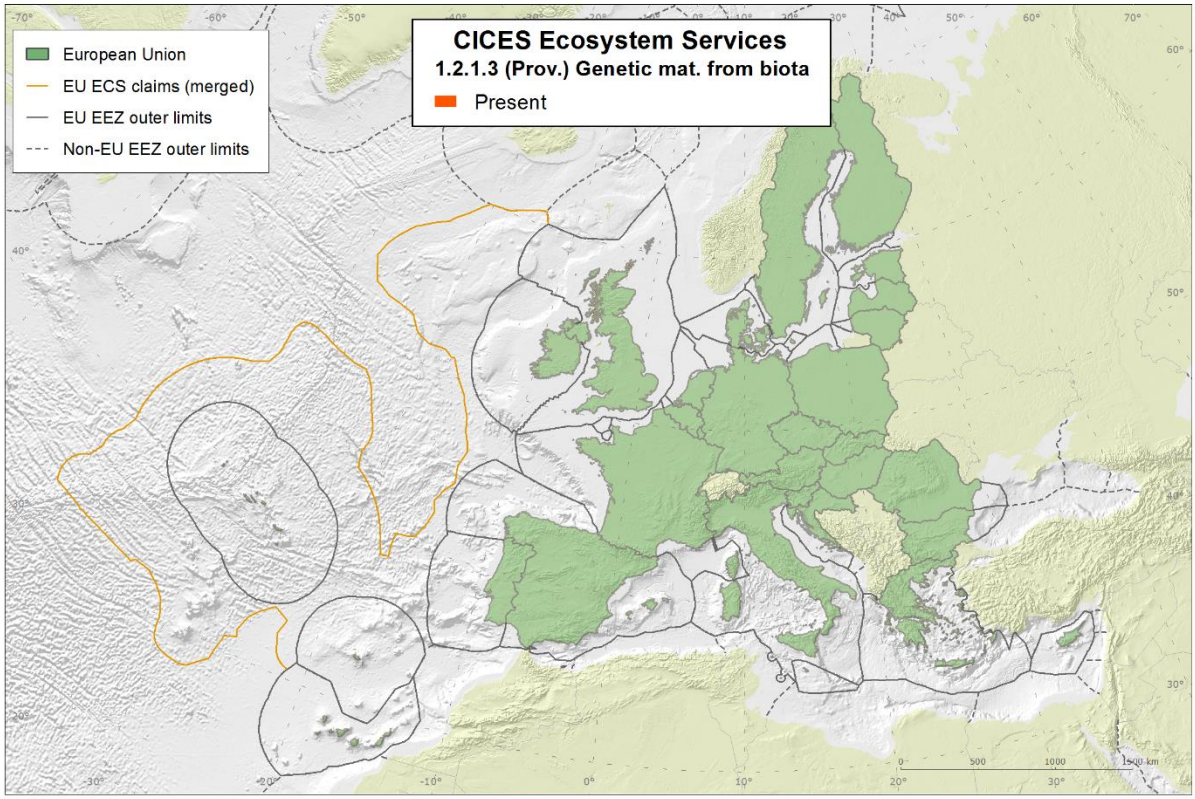


Figure 14. Spatial distribution of the seabed-associated ecosystem services in the CICES class "Genetic materials from all biota".

Area: 966 km^2 (0.01% of study area)

Quality score (1=best to 5=worst): 5

Highlights

Member State(s) holding larger capacity to provide this service: UK

Ecoregion(s) holding larger capacity to provide this service: Boreal (Boreal-Lusitanean, Boreal Proper)

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.4, 27.4.A, 27.6, 27.6.A)

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Celtic Seas, Greater North Sea)

Major component of the ecosystem services capacity make-up in: No region

Limitations

Since only 7% of the habitats have been properly assessed for this ecosystem service, the spatial distribution of its capacity is likely considerably underestimated and misrepresented.

Further work

In order to express flow quantitatively, analyse data reflecting the annual number of biochemical and pharmaceutical patents or the number of articles published concerning genetical resources derived from marine organisms. Claims listed in the patent division of GenBank are relevant.

3.3 Regulation and maintenance services (CICES Level 1 - Section)

Definition

This CICES section covers all the ways in which living organisms can mediate or moderate the physico-chemical and biological environment that affects human performance. It encompasses (i) the degradation of wastes and toxic substances by living processes, (ii) the mediation of mass, liquid and gaseous flows by organisms and ecosystems, as well as (iii) the maintenance of a series of physical, chemical, biological conditions concerning the atmosphere, the water, the seabed and their biological systems.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 10%

Percentage of mapped habitats assessed for this service: 99%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.26, A4.26/32, A4.27, A4.3, A4.31, A4.33, A5, A5.1, A5.11, A5.12, A5.13, A5.14, A5.15, A5.2, A5.23, A5.23/24, A5.24, A5.25, A5.25/26, A5.26, A5.27, A5.3, A5.33, A5.33/34, A5.34, A5.35, A5.35/36, A5.36, A5.37, A5.38, A5.39, A5.4, A5.43, A5.44, A5.45, A5.46, A5.47, A5.5, A5.51, A5.53, A6, A6.1, A6.11, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.7, A6.71, A6.72, A6.73, A6.8, A6.81, A6.82

Non-EUNIS: N_1, N_2, N_3, N_4, N_5, N_6, N_7, N_8, N_9, N_10, N_11, N_12, N_14, N_16, N_17, N_18, N_19, N_20, N_22, N_23, N_24, N_30

Map

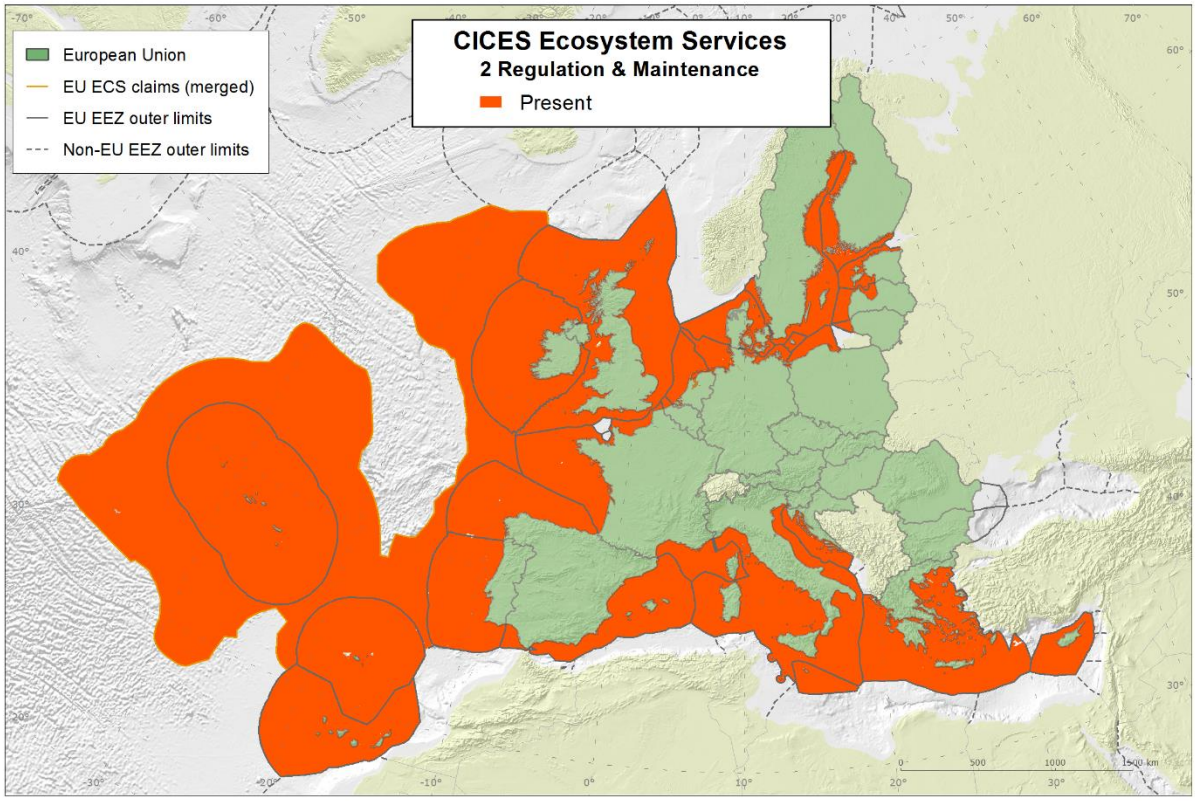


Figure 15. Spatial distribution of the seabed-associated Regulation and Maintenance Ecosystem Services.

Area: 8,927,221 km^2 (99.2% of study area)

Quality score (1=best to 5=worst): 1

Highlights

Member State(s) holding larger capacity to provide this service: NE Atlantic ECS, PT, ES, UK, EL, IT, IE

Ecoregion(s) holding larger capacity to provide this service: Deep Sea (Atlantic, Mediterranean), Boreal

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10, 27.10.A), 34 (34.2), 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic (Wider NE Atlantic, Macaronesia), Mediterranean Sea

Major component of the ecosystem services capacity make-up in: Baltic Sea, NE Atlantic Ocean (Greater North Sea, Celtic Seas, Bay of Biscay and Iberian Coast, Macaronesia, Wider NE Atlantic), Mediterranean Sea (Western Mediterranean, Adriatic, Aegean-Levantine)

Limitations

Further work

Approaches to quantitatively assess the services in this CICES section are detailed per subordinate service in the following sections (3.3.1 to 3.3.12).

3.3.1 *Mediation of waste, toxics and other nuisances (CICES Level 2 - Division)*

Definition

This CICES division covers the biochemical and physico-chemical processes involved in the removal of wastes products and pollutants from the coastal and marine environments. It encompasses processes like dilution, retention/trapping or sequestration (e.g., of nitrogen, pesticide residues or industrial pollutants), bioremediation (e.g. bio-augmentation after marine oil spills), oxygenation of "dead zones", filtration and absorption, sedimentation, remineralisation and decomposition.
By reconnecting human waste streams to living processes, these processes can be considered to be on the opposite side from provision.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 10%

Percentage of mapped habitats assessed for this service: 100%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.26, A4.26/32, A4.27, A4.3, A4.31, A4.33, A5, A5.1, A5.11, A5.12, A5.13, A5.2, A5.23/24, A5.24, A5.25/26, A5.26, A5.27, A5.3, A5.33, A5.33/34, A5.34, A5.35, A5.35/36, A5.36, A5.37, A5.38, A5.39, A5.4, A5.43, A5.44, A5.45, A5.46, A5.47, A5.5, A5.53, A6.72, A6.8, A6.81

Non-EUNIS: N_5, N_6, N_7, N_8, N_9, N_10, N_11, N_12, N_17, N_18, N_19, N_20, N_30

Seabed habitats NOT providing the service

EUNIS: A5.14, A5.15, A5.23, A5.25, A5.51, A6, A6.1, A6.11, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.7, A6.71, A6.73, A6.74, A6.82

Non-EUNIS: N_1, N_2, N_3, N_4, N_14, N_16, N_22, N_23, N_24

Map

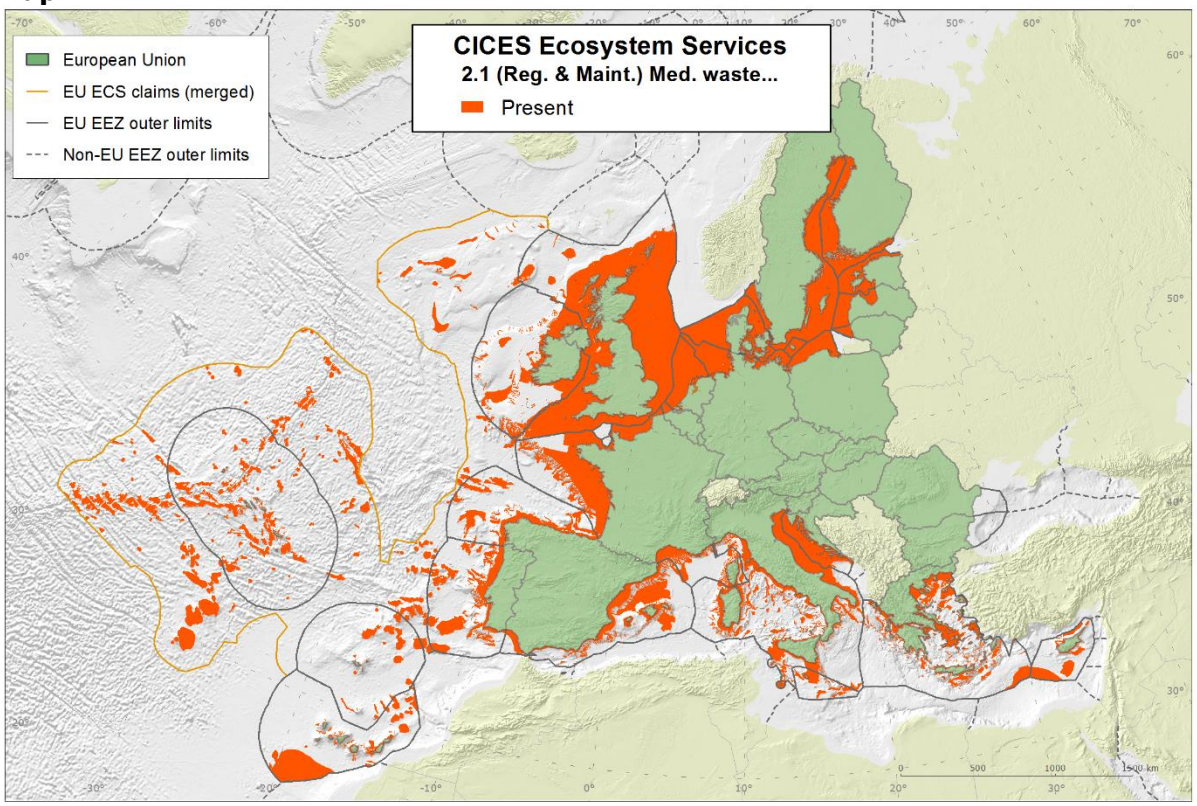


Figure 16. Spatial distribution of the seabed-associated ecosystem services in the CICES division "Mediation of waste, toxics and other nuisances".

Area: 2,494,425 km^2 (27.7% of study area)

Quality score (1=best to 5=worst): 1

Highlights

Member State(s) holding larger capacity to provide this service: UK, ES, NE Atlantic ECS, FR, PT, IT, SE, EL

Ecoregion(s) holding larger capacity to provide this service: Boreal (Boreal Proper), Deep Sea (Atlantic), Baltic, Mediterranean

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.3, 27.3.D, 27.4, 27.4.B, 27.7), 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Greater North Sea, Celtic Seas, Bay of Biscay and Iberian Coast, Wider NE Atlantic), Mediterranean Sea, Baltic Sea

Major component of the ecosystem services capacity make-up in: Baltic Sea, Greater North Sea, Adriatic

Limitations

A few discontinuities can be perceived in the Celtic Seas shelves. They stem from the lack of scoring of this service for a number of non-EUNIS seabed habitat classes cover these sectors of the European seas. Judging for the fact that the service capacity is present around these holes, it is likely that they will be filled when the EUNIS class present in such areas is resolved.

Further work

Analyse spatially-explicit indicators estimating nutrient load to coast (ton/year), HM and POP deposition (ton/year) or Oxyrisk index.

3.3.2 *Mediation of flows (CICES Level 2 - Division)*

Definition

These CICES division covers the contribution of marine ecosystem structures to the dampening of the intensity of environmental disturbances such as storm floods, tsunamis, and hurricanes. In Europe, these services are mostly provided by living habitats like salt marshes, sea grass beds or near-shore kelp beds which locally reduce the energy of currents and swells and thereby regulate erosion and sedimentation processes.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 4.6%

Percentage of mapped habitats assessed for this service: 45%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.3, A4.31, A5, A5.1, A5.2, A5.27, A5.3, A5.4, A5.5, A5.51, A5.53, A6, A6.1, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.71

Non-EUNIS: N_5, N_6, N_7, N_8, N_19, N_20, N_30

Map

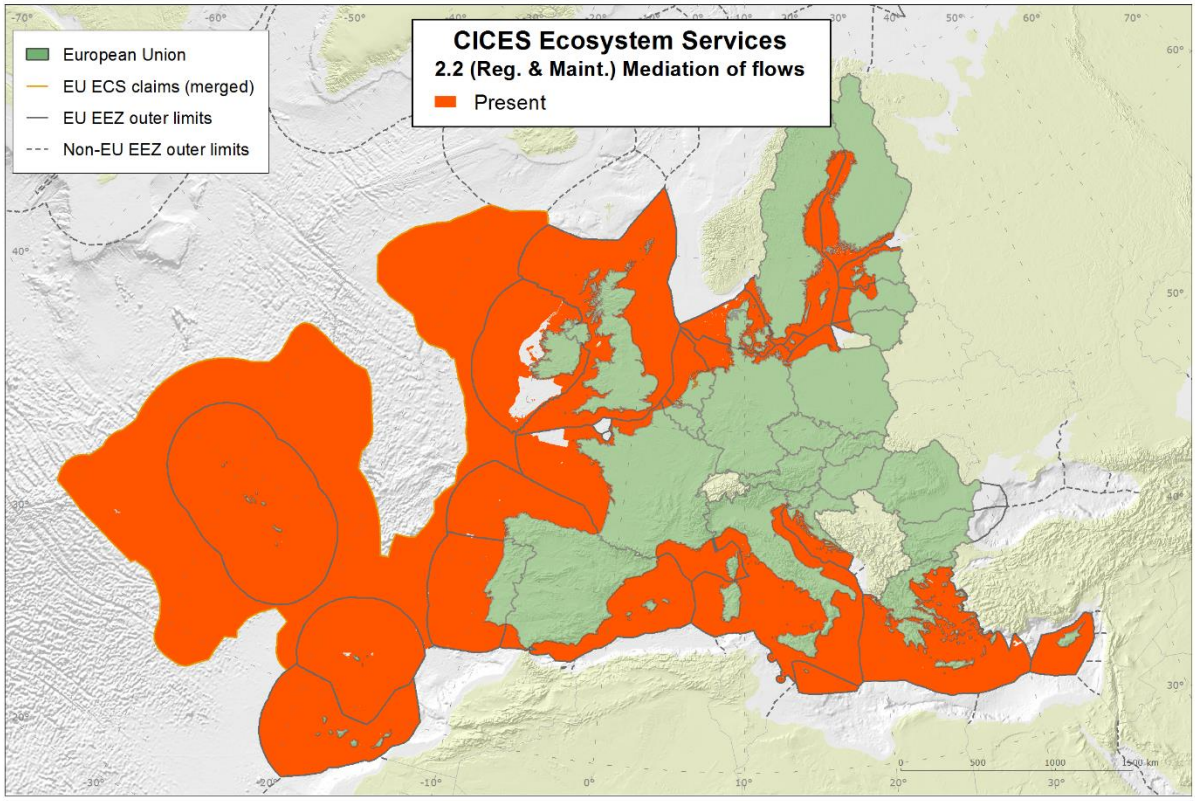


Figure 17. Spatial distribution of the seabed-associated ecosystem services in the CICES division "Mediation of flows".

Area: 8,830,030 km^2 (98.2% of study area)

Quality score (1=best to 5=worst): 3

Highlights

Member State(s) holding larger capacity to provide this service: NE Atlantic ECS, PT, ES, UK, EL, IT

Ecoregion(s) holding larger capacity to provide this service: Deep Sea (Atlantic, Mediterranean), Boreal

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10, 27.10.A), 34 (34.2), 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Wider NE Atlantic, Macaronesia), Mediterranean Sea

Major component of the ecosystem services capacity make-up in: Baltic Sea, NE Atlantic Ocean (Greater North Sea, Bay of Biscay and Iberian Coast, Macaronesia, Wider NE Atlantic, Celtic Seas), Mediterranean Sea (Western Mediterranean, Adriatic, Aegean-Levantine)

Limitations

Since only 45% of the habitats have been properly assessed for this ecosystem service, the spatial distribution of its capacity may be underestimated and misrepresented. Given the already widespread mapped capacity, these effects are probably local.

A few holes are visible in the Celtic Seas which stem from the lack of scoring of this service for a number of non-EUNIS seabed habitat classes cover these sectors of the European seas. Judging for the fact that the service capacity is present around these holes, it is likely that they will be filled when the EUNIS class present in such areas is resolved.

Further work

Analyse composite indices based on extent of selected emerged, submerged and intertidal habitats, coastline slope and coastal geomorphology in association with parameters reflecting wave regime, tidal range, relative sea level and storm surge incidence.

3.3.3 *Mass flows (CICES Level 3 - Group)*

Definition

This CICES group comprehends the natural protection provided by the marine ecosystems like salt marshes, sea grass beds or kelp beds against erosion, landslides and other gravity flows. This service is generally based on biogenic structures that disrupt and reduce the water movement associated with currents and swells. Thereby they contribute to the storage and/or stabilization of sediments, creating buffer zones that protect coastal areas.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 0.8%

Percentage of mapped habitats assessed for this service: 7%

Seabed habitats providing the service
EUNIS: A5.5, A5.53

Seabed habitats NOT providing the service
EUNIS: A3, A3.31, A4
Non-EUNIS: N_30

Map

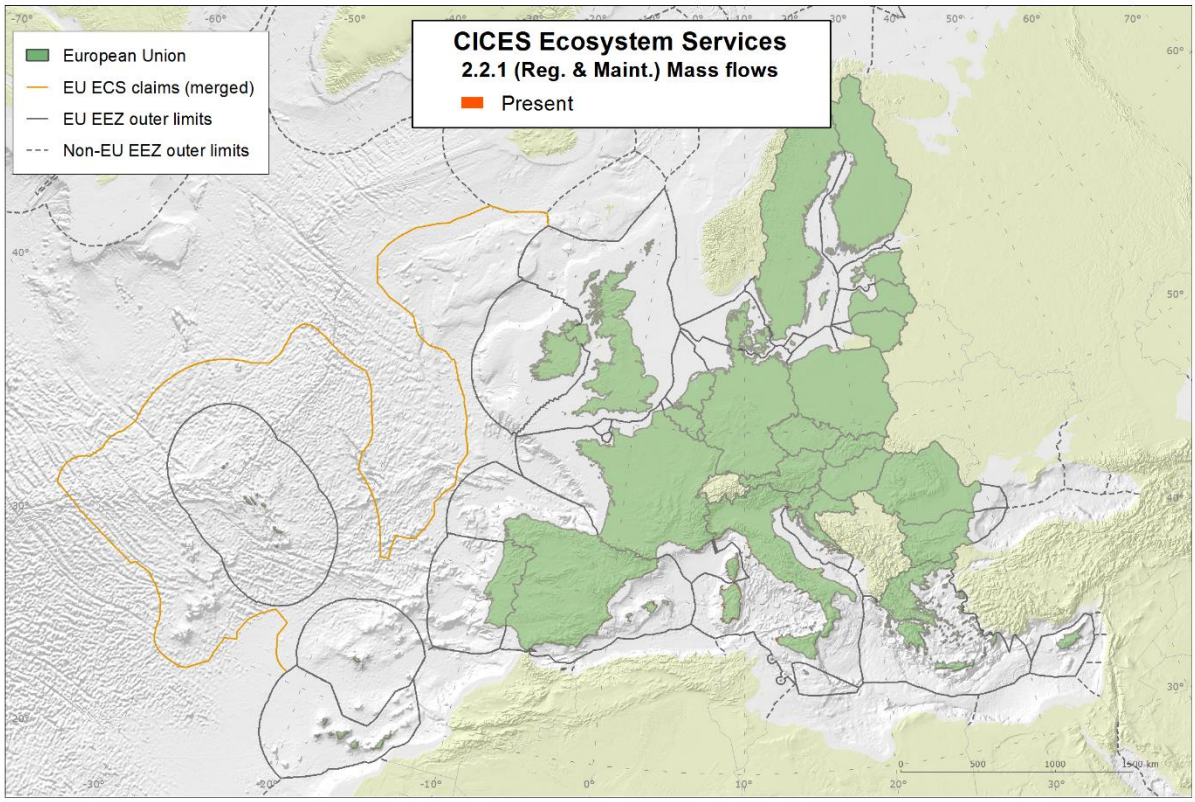


Figure 18. Spatial distribution of the seabed-associated ecosystem services in the CICES group "Mass flows".

Area: 5,703 km² (0.06% of study area)

Quality score (1=best to 5=worst): 5

Highlights

Member State(s) holding larger capacity to provide this service: IT, ES, FR

Ecoregion(s) holding larger capacity to provide this service: Mediterranean Sea (Western Mediterranean, Adriatic)

Fishing Unit(s) holding larger capacity to provide this service: 37 (37.1, 37.1.1, 37.1.1.6, 37.1.3, 37.1.3.11, 37.1.3.112, 37.1.3.8, 37.2)

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: Mediterranean Sea (Western Mediterranean, Adriatic)

Major component of the ecosystem services capacity make-up in: No region

Limitations

Since only 7% of the habitats have been properly assessed for this ecosystem service, the spatial distribution of its capacity is likely underestimated and misrepresented.

Further work

Analyse composite indices based on extent of selected emerged, submerged and intertidal habitats, coastline slope and coastal geomorphology in association with parameters reflecting wave regime, tidal range, relative sea level and storm surge incidence.

3.3.4 *Hydrological cycle and water flow maintenance (CICES Level 4 - Class)*

Definition

This CICES group encompasses the contribution of marine ecosystems (e.g., seagrass or macroalgal beds) to the maintenance of localized current regimes that regulate sedimentation and, for instance, maintain navigation passages free of sediments or supplement the protection provided by coastal ecosystems (e.g., wetlands or dunes) against flooding.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 4.3%

Percentage of mapped habitats assessed for this service: 43%

Seabed habitats providing the service
EUNIS: A6, A6.1, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.71

Seabed habitats NOT providing the service
EUNIS: A3.1, A3.2, A3.3, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.3, A5, A5.1, A5.11, A5.12, A5.13, A5.2, A5.3, A5.4, A5.43, A5.5, A5.51, A5.53

Map

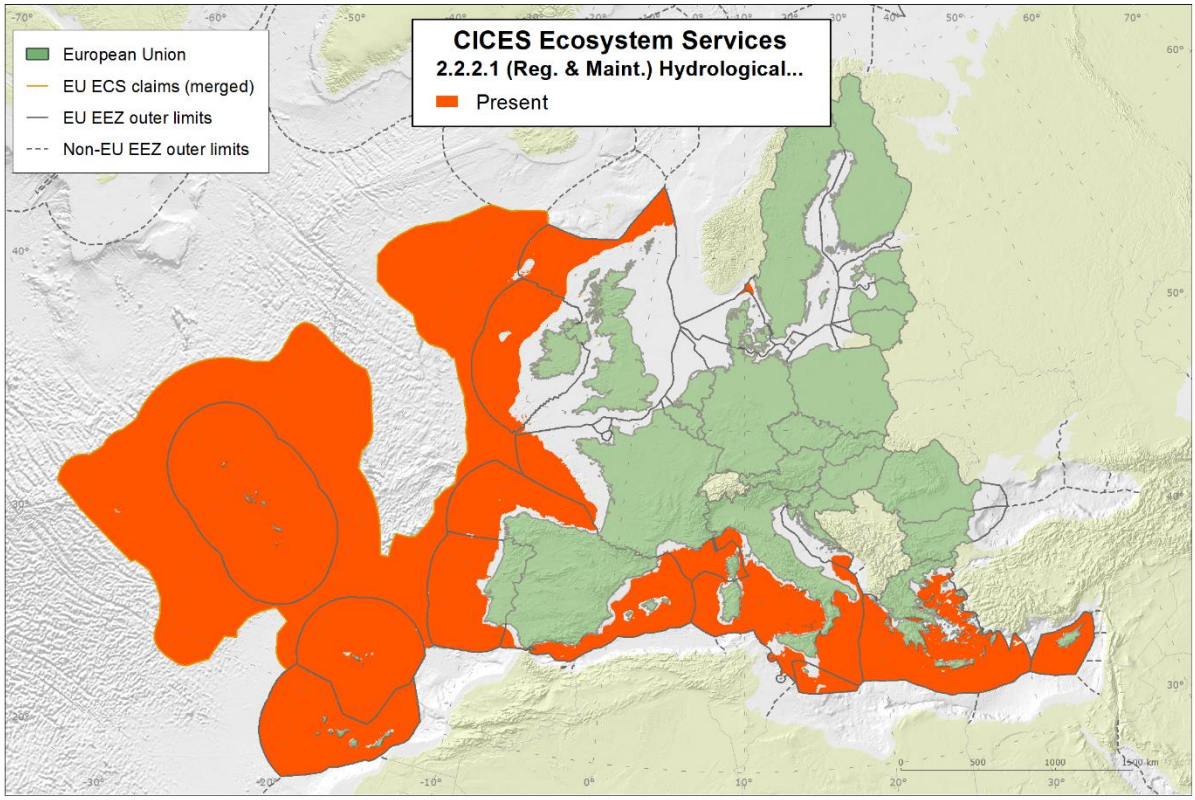


Figure 19. Spatial distribution of the seabed-associated ecosystem services in the CICES class "Hydrological cycle and water flow maintenance".

Area: 7,184,659 km^2 (80% of study area)
Quality score (1=best to 5=worst): 3

Highlights

Member State(s) holding larger capacity to provide this service: NE Atlantic ECS, PT, ES, EL, IT

Ecoregion(s) holding larger capacity to provide this service: Deep Sea (Atlantic, Mediterranean)

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10, 27.10.A, 27.10.A.2), 34 (34.2, 34.1), 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Wider NE Atlantic, Macaronesia), Mediterranean Sea

Major component of the ecosystem services capacity make-up in: NE Atlantic Ocean (Wider NE Atlantic, Macaronesia, Bay of Biscay and Iberian Coast, Celtic Seas), Mediterranean Sea (Ionian Sea and Central Mediterranean, Aegean-Levantine, Western Mediterranean)

Limitations

Since only 43% of the habitats have been properly assessed for this ecosystem service, the spatial distribution of its capacity is likely underestimated and misrepresented. Despite several continental shelf habitats are known to play a role in hydrological cycle and water flow maintenance, none of the references informing this study identified it. For instance, seagrass or macroalgal beds interact with currents at local scales and thereby regulate sedimentation processes that are important for maintaining safe navigation channels, anchorages or berthing areas.

Further work

Analyse composite indices based on extent of selected emerged, submerged and intertidal habitats, coastline slope and coastal geomorphology in association with parameters reflecting wave regime, tidal range, relative sea level and storm surge incidence.

Possible proxies include the days per year of navigational operability gained as a result of ecosystem-mediated infilling prevention, prevented material damages and losses from infilling-related shipping incidents or savings in dredging or beach nourishment/replenishment.

3.3.5 *Flood protection (CICES Level 4 - Class)*

Definition

This service refers to the natural protection provided by biogenic structures like salt marshes, sea grass beds or kelp beds that disrupt the water movement and therefore protects the coastal areas against storms, inundation, sea level surges and sea level rise.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 2.2%

Percentage of mapped habitats assessed for this service: 21%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.2, A4.2/3, A4.3, A5.1, A5.5, A5.51, A5.53

Non-EUNIS: N_30

Map

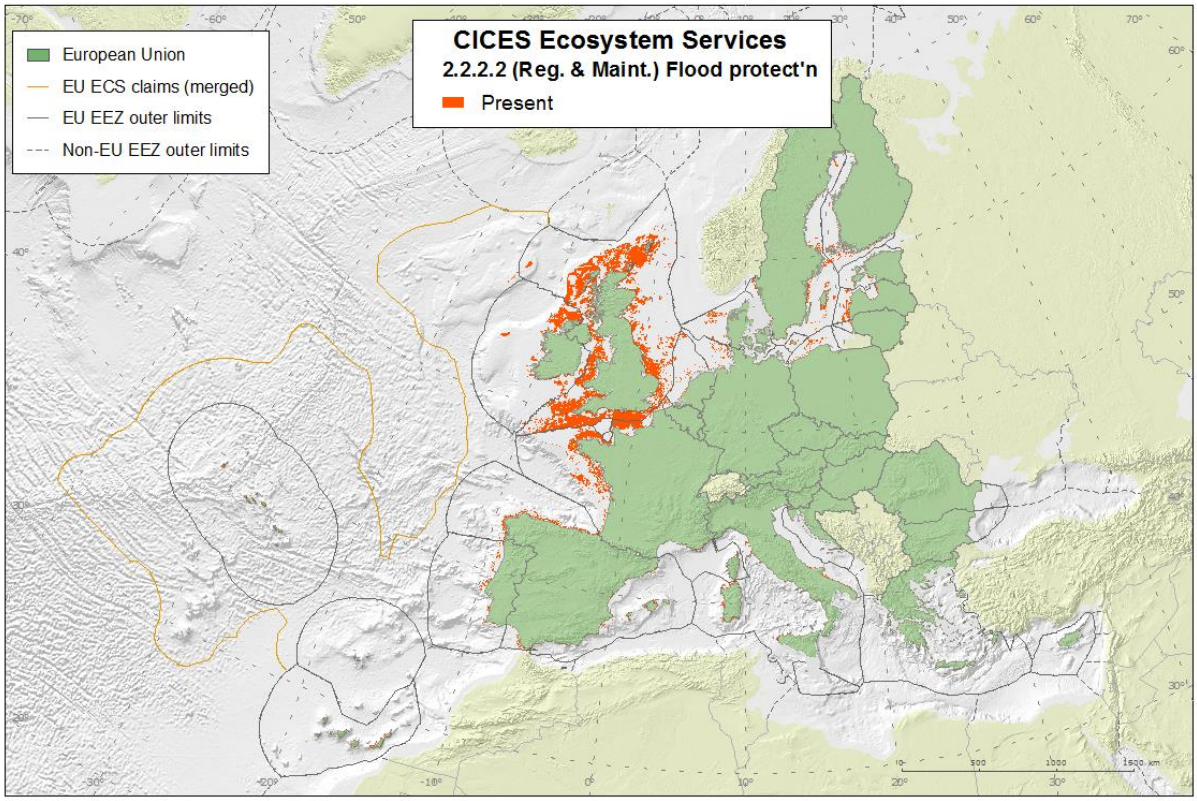


Figure 20. Spatial distribution of the seabed-associated ecosystem services in the CICES class "Flood protection".

Area: 501,383 km^2 (5.6% of study area)

Quality score (1=best to 5=worst): 4

Highlights

Member State(s) holding larger capacity to provide this service: UK, EL, FR, DK, IE, IT

Ecoregion(s) holding larger capacity to provide this service: Boreal (Boreal Proper, Boreal-Lusitanean), Lusitanean (Lusitanean-Boreal), Mediterranean (Aegean)

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.3, 27.4, 27.6, 27.6.A, 27.7), 37 (37.2, 37.3, 37.3.1)

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Greater North Sea, Celtic Seas), Mediterranean Sea (Aegean-Levantine)

Major component of the ecosystem services capacity make-up in: No region

Limitations

Since only 21% of the habitats have been properly assessed for this ecosystem service, the spatial distribution of its capacity is likely underestimated and misrepresented.

Further work

Analyse composite indices based on extent of selected emerged, submerged and intertidal habitats, coastline slope and coastal geomorphology in association with parameters reflecting wave regime, tidal range, relative sea level and storm surge incidence (e.g. Liquete et al. 2013b).

Other indicators may rely more simply on measuring the height and duration of the flood peak or the extent of affected infrastructure or resources. Possible proxies include losses of life and property due to flooding, extent of coast with intact vegetation and costs of coastal damage.

3.3.6 *Maintenance of physical, chemical, biological conditions (CICES Level 2 - Division)*

Definition

This large CICES division encompasses the contribution of marine ecosystems to a number of processes upon that ensure physical, chemical, biological conditions that are favourable for biota. It is delivered by processes that regulate (i) bio-geochemical seabed conditions, (ii) seawater properties, (iii) habitat resilience, (iv) life cycles, (v) natural healthy population dynamics, (vi) gene pools, (vii) food web structure and flows, (viii) biological invasions and diseases affecting marine populations and Man, and (ix) atmospheric composition and climate at global, regional and local scales.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 10%

Percentage of mapped habitats assessed for this service: 99%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.26, A4.26/32, A4.27, A4.3, A4.31, A4.33, A5, A5.1, A5.11, A5.12, A5.13, A5.14, A5.15, A5.2, A5.23, A5.23/24, A5.24, A5.25, A5.25/26, A5.26, A5.27, A5.3, A5.33, A5.33/34, A5.34, A5.35, A5.35/36, A5.36, A5.37, A5.38, A5.39, A5.4, A5.43, A5.44, A5.45, A5.46, A5.47, A5.5, A5.51, A5.53, A6, A6.1, A6.11, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.7, A6.71, A6.72, A6.73, A6.8, A6.81, A6.82

Non-EUNIS: N_1, N_2, N_3, N_4, N_5, N_6, N_7, N_8, N_9, N_10, N_11, N_12, N_14, N_16, N_17, N_18, N_19, N_20, N_22, N_23, N_24, N_30

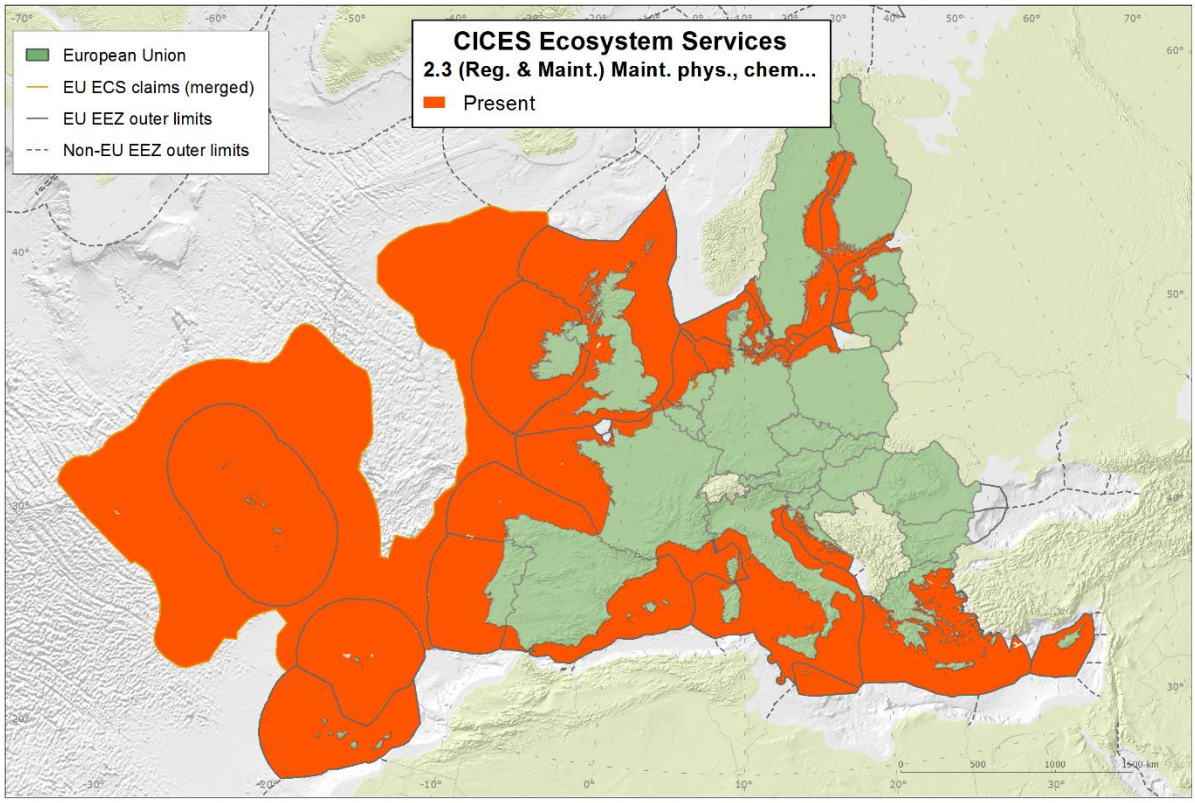


Figure 21. Spatial distribution of the seabed-associated ecosystem services in the CICES division "Maintenance of physical, chemical, biological conditions".

Area: 8,927,221 km^2 (99.2% of study area)

Quality score (1=best to 5=worst): 1

Highlights

Member State(s) holding larger capacity to provide this service: NE Atlantic ECS, PT, ES, UK, EL, IT, IE

Ecoregion(s) holding larger capacity to provide this service: Deep Sea (Atlantic, Mediterranean), Boreal

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10, 27.10.A), 34 (34.2), 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Wider NE Atlantic, Macaronesia), Mediterranean Sea

Major component of the ecosystem services capacity make-up in: Baltic Sea, NE Atlantic Ocean (Greater North Sea, Celtic Seas, Bay of Biscay and Iberian Coast, Macaronesia, Wider NE Atlantic), Mediterranean Sea (Western Mediterranean, Adriatic, Aegean-Levantine)

Limitations

Further work

Proxies for different services may be derived from spatially-explicit measurements of environmental parameters like oxygen concentration, turbidity or light penetration, while others will require estimating marine habitat diversity, coverage by certain species (km^2, ha), age-classed abundance and richness (ton/year), nursery extent (km^2, ha) or MPA extent (km^2, ha)

3.3.7 *Lifecycle maintenance, habitat and gene pool protection (CICES Level 3 - Group)*

Definition

This service refers to the contribution of marine ecosystems to the successful life cycle of species, notably by guaranteeing the dispersal of gametes, offspring and adults and the maintenance of viable levels of inter and intra-specific genetic diversity that ensure species adaptability to environmental changes. The service is provided by key habitats (e.g., seagrasses, coastal wetlands, kelp beds, coral reefs, mangroves) that act as (i) mating, spawning or nursery areas, (ii) feeding grounds, (iii) resting areas or (iv) sustain connectivity along migratory routes.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 10%

Percentage of mapped habitats assessed for this service: 100%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.26, A4.26/32, A4.27, A4.3, A4.31, A4.33, A5, A5.1, A5.11, A5.12, A5.13, A5.14, A5.15, A5.2, A5.23, A5.23/24, A5.24, A5.25, A5.25/26, A5.26, A5.27, A5.3, A5.33, A5.33/34, A5.34, A5.35, A5.35/36, A5.36, A5.37, A5.38, A5.39, A5.4, A5.43, A5.44, A5.45, A5.46, A5.47, A5.5, A5.51, A5.53, A6, A6.1, A6.11, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.7, A6.71, A6.72, A6.73, A6.8, A6.81, A6.82

Non-EUNIS: N_1, N_2, N_3, N_4, N_5, N_6, N_7, N_8, N_9, N_10, N_11, N_12, N_14, N_16, N_17, N_18, N_19, N_20, N_22, N_23, N_24, N_30

Seabed habitats NOT providing the service

EUNIS: A6.74

Map

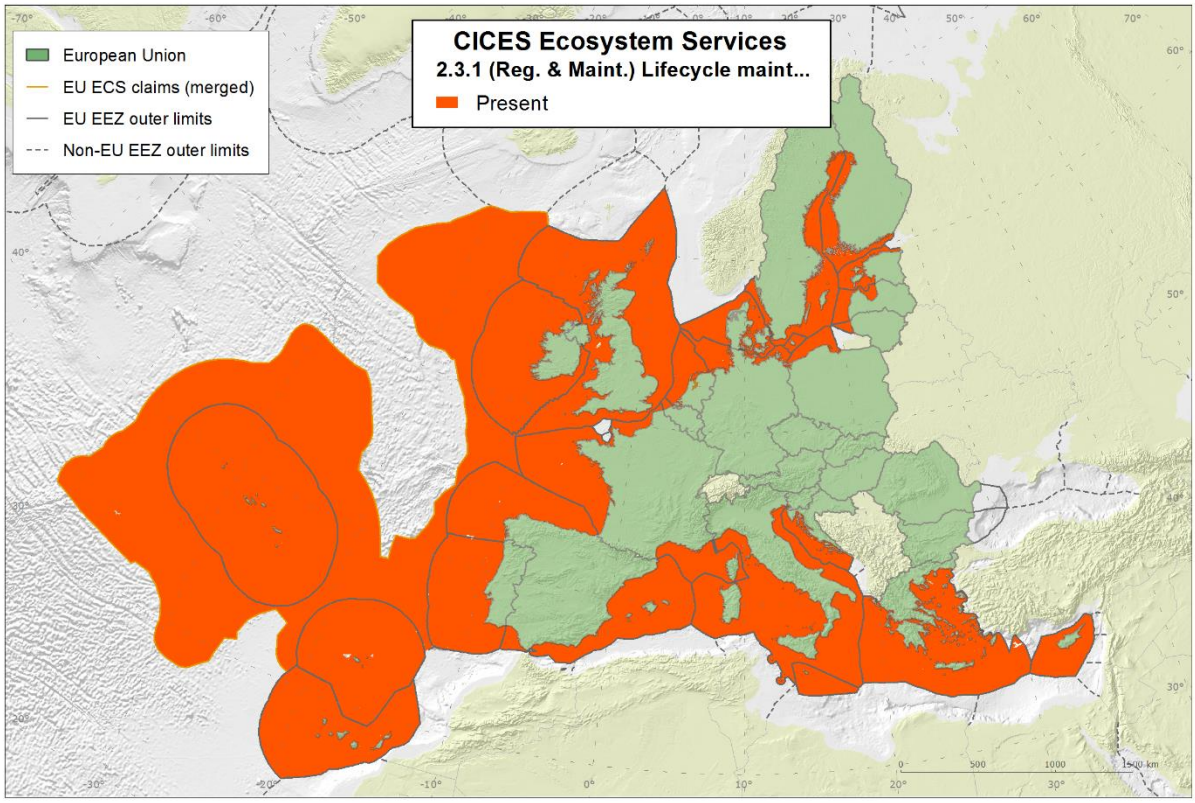


Figure 22. Spatial distribution of the seabed-associated ecosystem services in the CICES group "Lifecycle maintenance, habitat and gene pool protection".

Area: 8,927,221 km^2 (99.2% of study area)

Quality score (1=best to 5=worst): 1

Highlights

Member State(s) holding larger capacity to provide this service: NE Atlantic ECS, PT, ES, UK, EL, IT, IE

Ecoregion(s) holding larger capacity to provide this service: Deep Sea (Atlantic, Mediterranean), Boreal

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10, 27.10.A), 34 (34.2), 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Wider NE Atlantic, Macaronesia), Mediterranean Sea

Major component of the ecosystem services capacity make-up in: Baltic Sea, NE Atlantic Ocean (Greater North Sea, Celtic Seas, Bay of Biscay and Iberian Coast, Macaronesia, Wider NE Atlantic), Mediterranean Sea (Western Mediterranean, Adriatic, Aegean-Levantine)

Limitations

Further work

Proxies for different services may be derived from spatially-explicit measurements of environmental parameters like oxygen concentration, turbidity or light penetration, while others will require estimating marine habitat diversity, coverage by certain species (km^2, ha), age-classed abundance and richness (ton/year), nursery extent(km^2, ha), extent of suitable habitat for keystone species (km^2, ha), or MPA extent (km^2, ha).

Some indicators resulting from modelling activities can be extracted from JRC datasets on EMIS or DOPA. National level indicators (e.g. for the ecosystem service "Maintaining nursery populations and habitats") may be available from Habitat Directive reports but may require harmonization throughout the EU.

3.3.8 *Pest and disease control (CICES Level 3 - Group)*

Definition

These services refer to the contribution of marine ecosystems to the regulation of pests and vector-borne diseases that attack plants, animals and people. These services are frequently supplied via the predation and parasitic activities of a number of organisms that act as natural controls of pests affecting animal and plant crops and thereby impact commercial activities and human health. In the marine environment these biotic services include (i) the control of pathogens affecting fish and bivalve aquaculture installations, (ii) the role of cleaner fishes for reef fish health, (iii) the control predators exert over the populations of opportunistic/invasive species (e.g., sea urchins, jelly fish, macroalgae) or (iv) the control on the spread of vector-borne human diseases (including toxic algal blooms).

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 1.2%

Percentage of mapped habitats assessed for this service: 12%

Seabed habitats providing the service
EUNIS: A3, A4, A4.11/13, A4.12, A5.1, A5.5, A5.51, A5.53
Non-EUNIS: N_30

Seabed habitats NOT providing the service
EUNIS: A3.31

Map

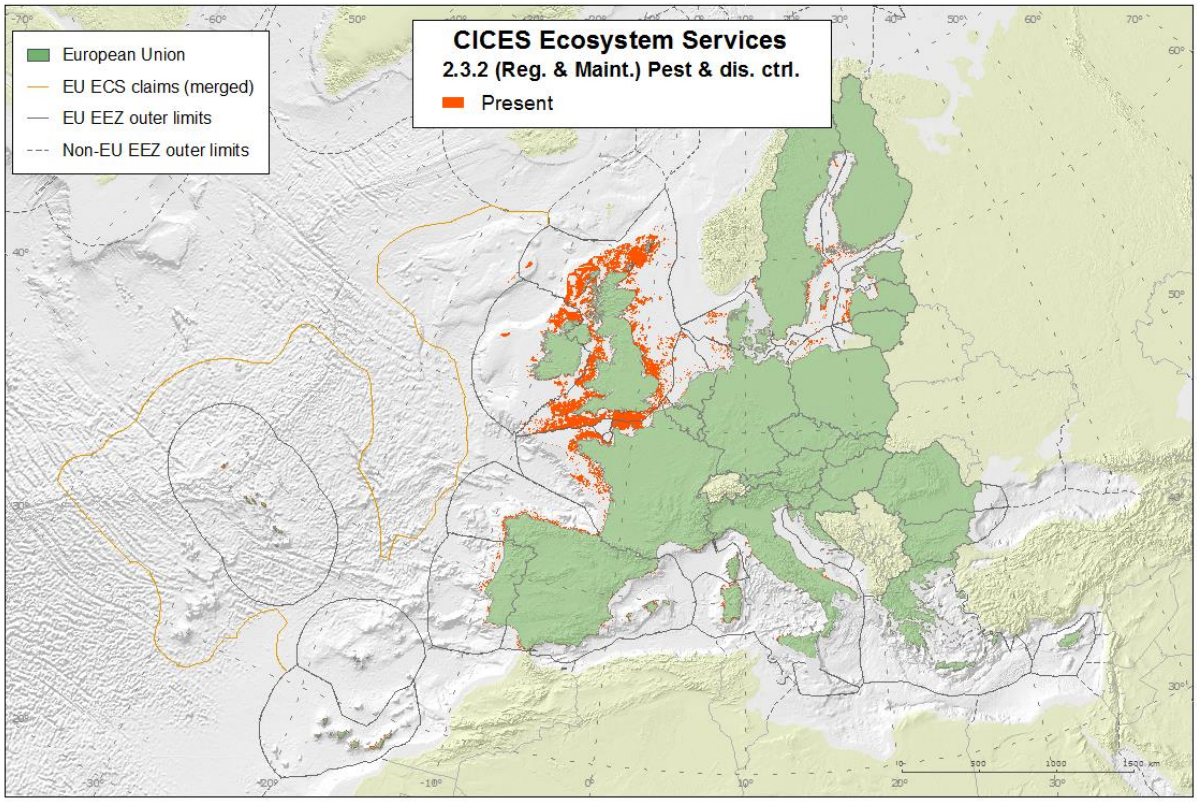


Figure 23. Spatial distribution of the seabed-associated ecosystem services in the CICES group "Pest and disease control".

Area: 501,383 km^2 (5.6% of study area)

Quality score (1=best to 5=worst): 5

Highlights

Member State(s) holding larger capacity to provide this service: UK, EL, FR, DK, IE, IT

Ecoregion(s) holding larger capacity to provide this service: Boreal (Boreal Proper, Boreal-Lusitanean), Lusitanean (Lusitanean-Boreal), Mediterranean (Aegean)

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.3, 27.4, 27.6, 27.7), 37 (37.2, 37.3)

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Greater North Sea, Celtic Seas), Mediterranean Sea (Aegean-Levantine)

Major component of the ecosystem services capacity make-up in: No region

Limitations

Since only 12% of the habitats have been properly assessed for this ecosystem service, the spatial distribution of its capacity is likely underestimated and misrepresented.

Further work

Pest and pathogen control may be reflected by the intensity, duration and extent of outbreaks of undesirable species, number of alien species, area occupied by alien species. Proxies may be provided by number of hospital cases attributable to marine toxins, incidence of fish kills, expenditure in biocides and pest control programmes or percentage of invasive species with a management plan.

3.3.9 *Disease control (CICES Level 4 - Class)*

Definition
These services refer to the contribution of marine ecosystems to the control on the spread of vector-borne diseases that attack plants, animals and people. These services are frequently supplied via the predation and parasitic activities of a number of organisms that act as natural controls of pests affecting animal and plant crops and thereby impact commercial activities and human health. In the marine environment these biotic services include (i) the control of pathogens affecting fish and bivalve aquaculture installations, (ii) the role of cleaner fishes for reef fish health or (iii) the control of human disease vector dispersal (including toxic algal blooms).

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 0.8%

Percentage of mapped habitats assessed for this service: 7%

Seabed habitats providing the service
EUNIS: A3, A4, A5.5, A5.53
Non-EUNIS: N_30

Seabed habitats NOT providing the service
EUNIS: A3.31

Map

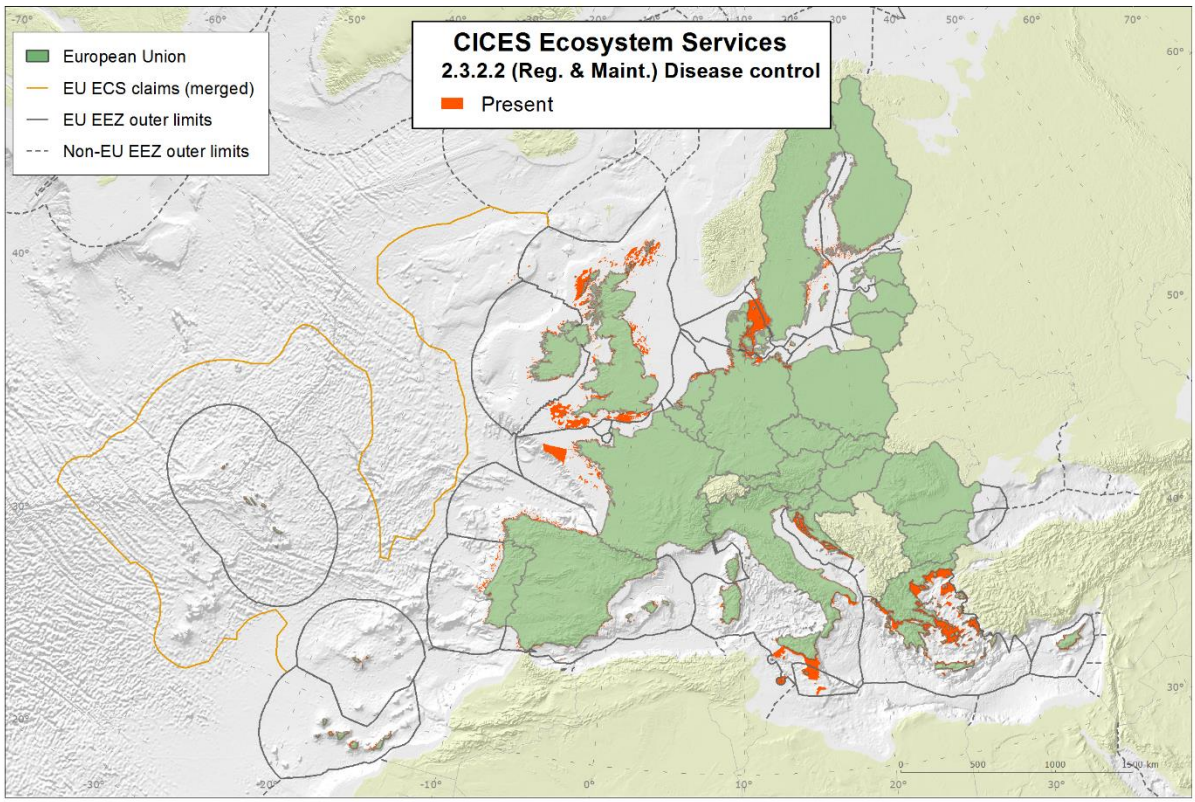


Figure 24. Spatial distribution of the seabed-associated ecosystem services in the CICES class "Disease control".

Area: 288,399 km^2 (3.2% of study area)
Quality score (1=best to 5=worst): 1

Highlights

Member State(s) holding larger capacity to provide this service: UK, EL, DK, IT, FR, ES, SE

Ecoregion(s) holding larger capacity to provide this service: Mediterranean (Aegean, Ionian), Boreal (Boreal Proper, Boreal-Lusitanean), Lusitanean

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.3, 27.7), 37 (37.2, 37.2.2, 37.3)

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Greater North Sea, Celtic Seas), Mediterranean Sea (Aegean-Levantine, Ionian Sea and Central Mediterranean)

Major component of the ecosystem services capacity make-up in: No region

Limitations

Since only 7% of the habitats have been properly assessed for this ecosystem service, the spatial distribution of its capacity is likely underestimated and misrepresented. Isolated patches of service capacity in the Kattegat, northern Bay of Biscay, Straits of Sicily, Adriatic and Aegean result from a generalisation of service capacity made to a non-EUNIS shelf habitat class by extrapolation from the services provided by the subordinate classes.

Further work

Pathogen control may be reflected by the intensity, duration and extent of outbreaks of undesirable species, number of hospital cases attributable to marine toxins, incidence of fish kills or expenditure on biocides.

3.3.10 *Chemical condition of salt waters (CICES Level 4 - Class)*

Definition

This service refers to the contribution of marine biotic features to the removal of anthropogenic pollutants through processes such as storage, burial and biochemical recycling.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 10%

Percentage of mapped habitats assessed for this service: 100%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.26, A4.26/32, A4.27, A4.3, A4.31, A4.33, A5, A5.1, A5.11, A5.12, A5.13, A5.14, A5.15, A5.2, A5.23, A5.23/24, A5.24, A5.25, A5.25/26, A5.26, A5.27, A5.3, A5.33, A5.33/34, A5.34, A5.35, A5.35/36, A5.36, A5.37, A5.38, A5.39, A5.4, A5.43, A5.44, A5.45, A5.46, A5.47, A5.5, A5.51, A5.53, A6, A6.1, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.7, A6.71, A6.72, A6.73, A6.8, A6.81

Non-EUNIS: N_3, N_5, N_6, N_7, N_8, N_9, N_10, N_11, N_12, N_17, N_18, N_19, N_20, N_30

Seabed habitats NOT providing the service

EUNIS: A6.11, A6.74, A6.82

Non-EUNIS: N_1, N_2, N_4, N_14, N_16, N_22, N_23, N_24

Map

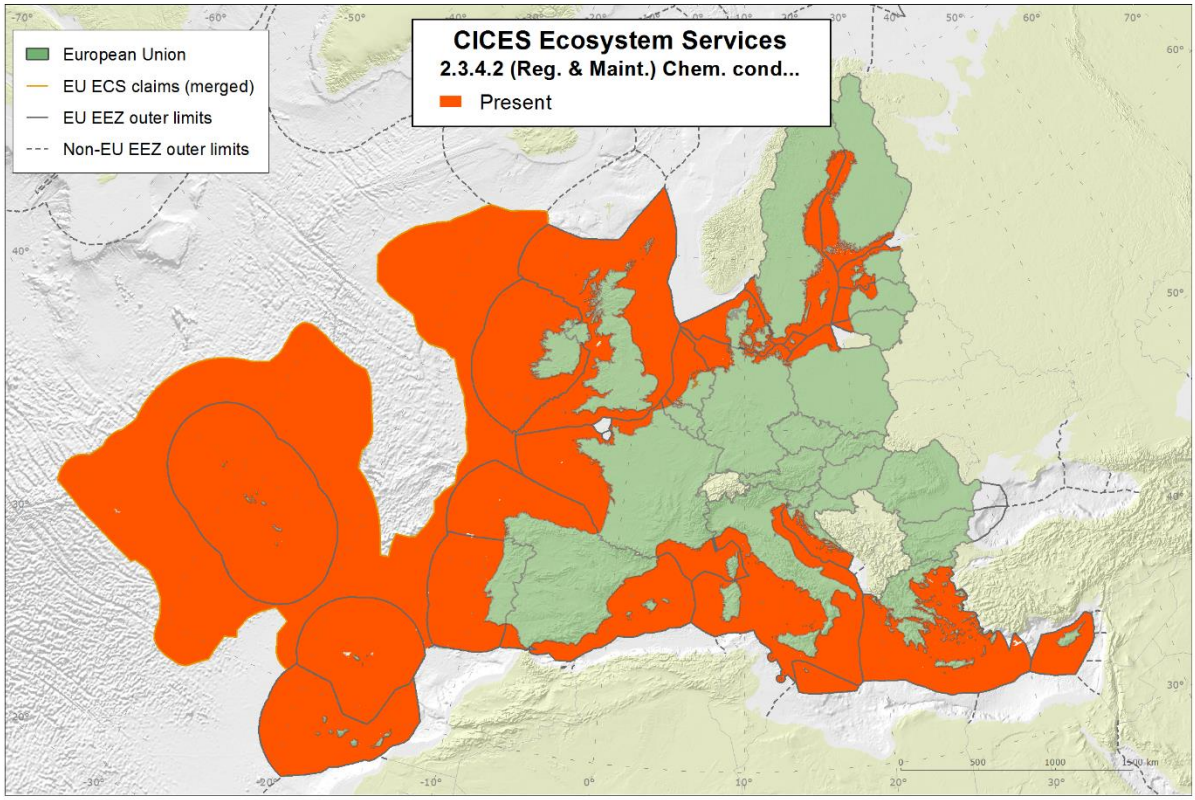


Figure 25. Spatial distribution of the seabed-associated ecosystem services in the CICES class "Chemical condition of salt waters".

Area: 8,927,193 km^2 (99.2% of study area)

Quality score (1=best to 5=worst): 1

Highlights

Member State(s) holding larger capacity to provide this service: NE Atlantic ECS, PT, ES, UK, EL, IT, IE

Ecoregion(s) holding larger capacity to provide this service: Deep Sea (Atlantic, Mediterranean), Boreal

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10, 27.10.A), 34 (34.2), 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Wider NE Atlantic, Macaronesia), Mediterranean Sea

Major component of the ecosystem services capacity make-up in: Baltic Sea, NE Atlantic Ocean (Greater North Sea, Celtic Seas, Bay of Biscay and Iberian Coast, Macaronesia, Wider NE Atlantic), Mediterranean Sea (Western Mediterranean, Adriatic, Aegean-Levantine)

Limitations

Further work

Analyse measurements of nutrient load to coast (ton/year), HM and POP deposition (ton/year), Oxyrisk index and/or pH.

3.3.11 *Atmospheric composition and climate regulation (CICES Level 3 - Group)*

Definition

These services refer to the role of marine biotic features in removing pollutants and climate-influencing substances from the air and thereby contributing to maintaining a climate favourable to human societies. They are based on a variety of biologically-mediated processes that produce, consume, use and store gases (e.g., carbon dioxide, water vapour, sulphur dioxide, nitrous oxides, methane, dimethyl sulphide), fine dust and particular matter.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 10%

Percentage of mapped habitats assessed for this service: 99%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.2, A4.2/3, A4.26, A4.26/32, A4.27, A4.3, A4.31, A4.33, A5.43, A5.5, A5.51, A5.53

Non-EUNIS: N_5, N_6, N_7, N_8, N_9, N_10, N_11, N_12, N_17, N_18, N_19, N_20, N_30

Seabed habitats NOT providing the service

EUNIS: A4.11/13, A4.12, A5, A5.1, A5.11, A5.12, A5.13, A5.14, A5.15, A5.2, A5.23, A5.23/24, A5.24, A5.25, A5.25/26, A5.26, A5.27, A5.3, A5.33, A5.33/34, A5.34, A5.35, A5.35/36, A5.36, A5.37, A5.38, A5.39, A5.4, A5.44, A5.45, A5.46, A5.47, A6, A6.1, A6.11, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.7, A6.72, A6.73, A6.74, A6.8, A6.81, A6.82

Non-EUNIS: N_1, N_2, N_3, N_4, N_14, N_16, N_22, N_23, N_24

Map

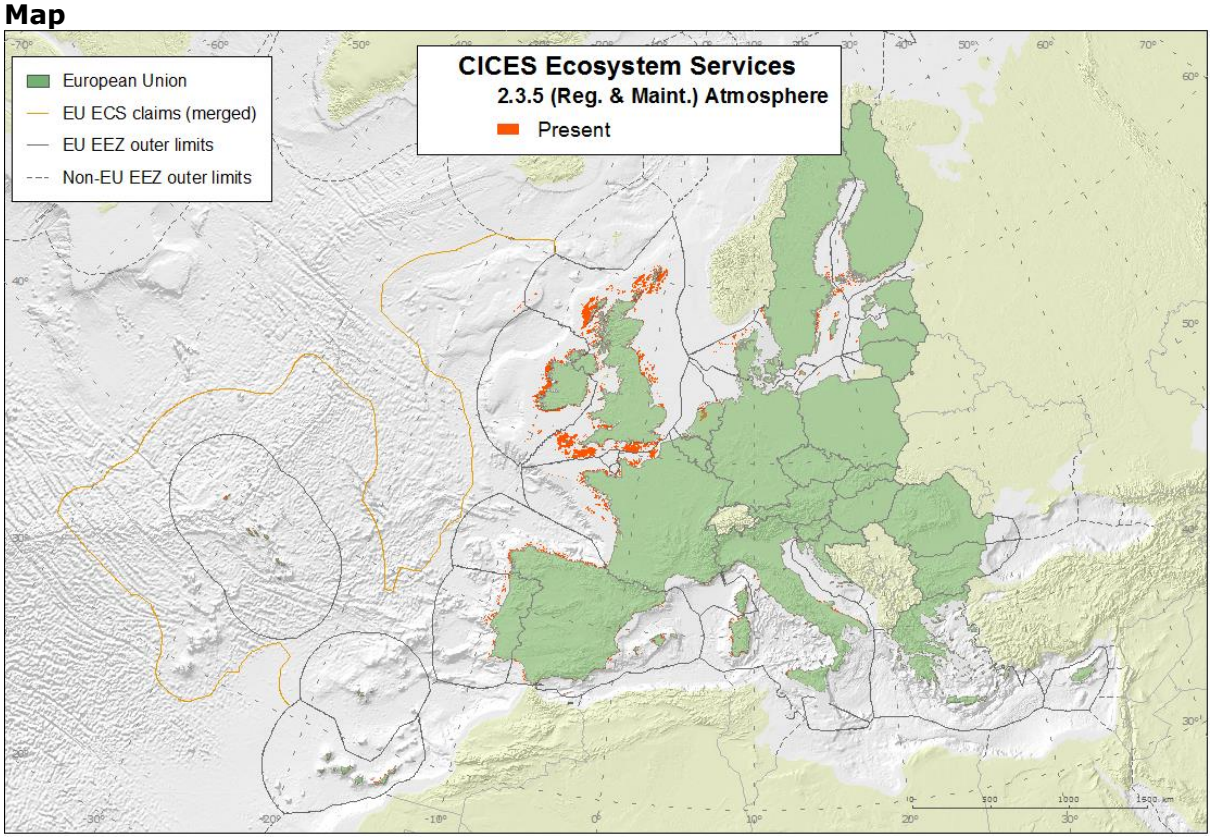


Figure 26. Spatial distribution of the seabed-associated ecosystem services in the CICES group "Atmospheric composition and climate regulation".

Area: 312,994 km^2 (3.5% of study area)

Quality score (1=best to 5=worst): 1

Highlights

Member State(s) holding larger capacity to provide this service: UK, EL, DK, FR, IT, IE

Ecoregion(s) holding larger capacity to provide this service: Boreal (Boreal Proper, Boreal-Lusitanean), Mediterranean (Aegean, Ionian), Lusitanean

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.3, 27.4, 27.7), 37 (37.2, 37.2.2, 37.3)

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Greater North Sea, Celtic Seas), Mediterranean Sea (Aegean-Levantine, Ionian Sea and Central Mediterranean)

Major component of the ecosystem services capacity make-up in: No region

Limitations

Given that geospatial information on certain seabed habitats relevant for this service (e.g., seagrass, macrophyte or kelp beds) is incomplete throughout the European Seas, the spatial distribution of its capacity is likely underestimated and misrepresented.

Further work

Biologically-mediated climate regulation services can be expressed by proxies reflecting (i) the uptake of carbon dioxide by primary producers, as well as (ii) the amounts of organic carbon that are stored as marine biomass (e.g., food webs standing stocks from primary producers to top predators) or (iii) the amounts that are effectively sequestrated by deposition of biogenic carbonates in the sediments. The exploitation of quantitative indexes such as carbon stock (tonC), carbon sequestration (tonC/year), blue carbon (tonC) or primary production (tonC/year) is suggested.

Ideally, this service should be estimate in terms of the climatic anomalies (e.g., temperature, air pressure or precipitation variations) resulting from the carbon sequestration associated with marine ecosystems.

3.3.12 *Global climate regulation by reduction of greenhouse gas concentrations (CICES Level 4 - Class)*

Definition

The ocean acts as a sink (and only a very marginal source) for greenhouse and climate active gases such as carbon dioxide, methane and nitrous oxide. These CICES class refers to the role of marine biotic features in the maintenance of the chemical composition of the atmosphere, namely through the removal from the atmosphere of major climate-influencing gases. Biologically-mediated sink processes occurring in the sea include (i) photosynthesis by phytoplankton, macroalgae and marine angiosperms and (ii) carbonate-mineralization processes and (iii) methane consumption by marine methanotrophic microbial organisms.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 0.5%

Percentage of mapped habitats assessed for this service: 4%

Seabed habitats providing the service
EUNIS: A5.43, A5.5, A5.53

Map

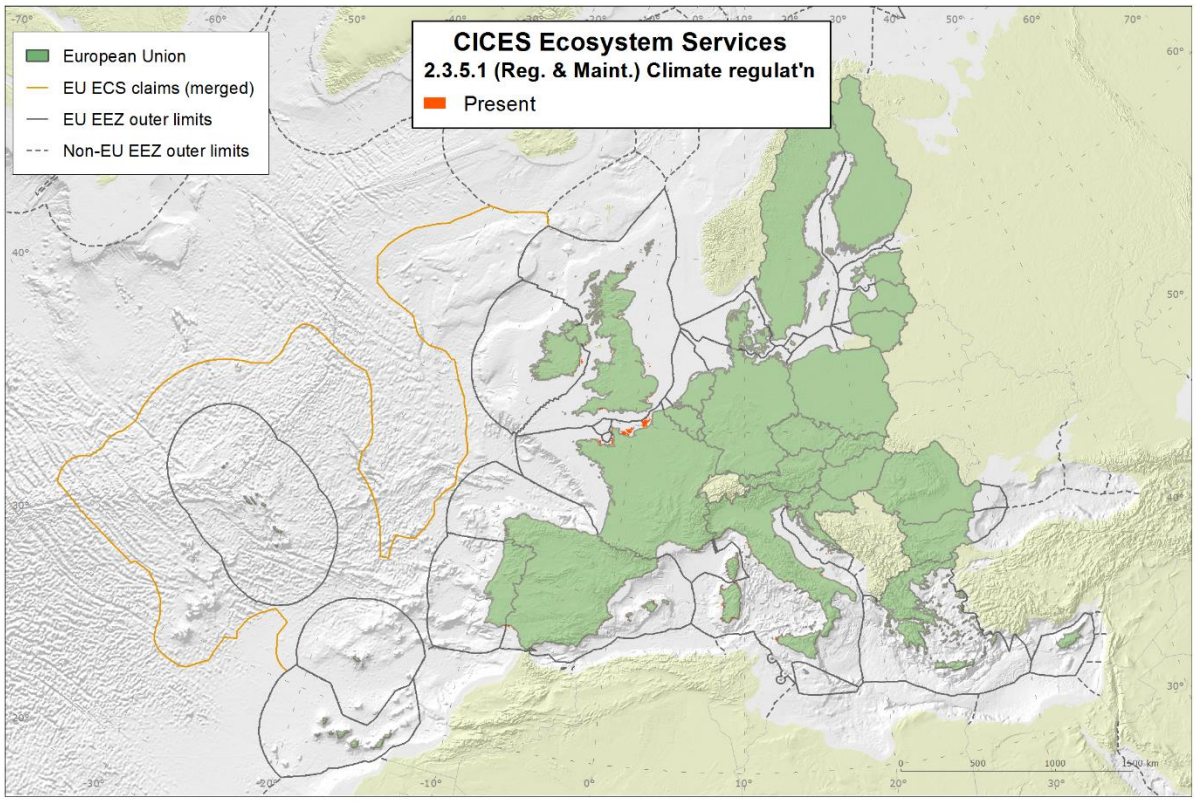


Figure 27. Spatial distribution of the seabed-associated ecosystem services in the CICES class "Global climate regulation by reduction of greenhouse gas concentrations".

Area: 14,030 km^2 (0.2% of study area)

Quality score (1=best to 5=worst): 5

Highlights

Member State(s) holding larger capacity to provide this service: FR, IT, UK, ES

Ecoregion(s) holding larger capacity to provide this service: Boreal (Boreal Proper), Mediterranean Sea (Western Mediterranean), Lusitanean

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.7, 27.7.E), 37 (37.1, 37.1.3.11, 37.1.3.112)

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Greater North Sea, Celtic Seas), Mediterranean Sea (Western Mediterranean)

Major component of the ecosystem services capacity make-up in: No region

Limitations

Since only 4% of the habitats have been properly assessed for this ecosystem service, the spatial distribution of its capacity is likely underestimated and misrepresented. Furthermore, geospatial information on certain seabed habitats relevant for this service (e.g., seagrass, macrophyte or kelp beds) is also incomplete throughout the European Seas.

Further work

Biologically-mediated climate regulation services can be expressed by proxies reflecting (i) the uptake of carbon dioxide by primary producers, as well as (ii) the amounts of organic carbon that are stored as marine biomass (e.g., food webs standing stocks from primary producers to top predators) or (iii) the amounts that are effectively sequestrated by deposition of biogenic carbonates in the sediments. The exploitation of quantitative indexes such as carbon stock (tonC), carbon sequestration (tonC/year), blue carbon (tonC) or primary production (tonC/year) is suggested.

Ideally, this service should be estimate in terms of the climatic anomalies (e.g., temperature, air pressure or precipitation variations) resulting from the carbon sequestration associated with marine ecosystems.

3.4 Cultural services (CICES Level 1 - Section)

Definition

This CICES section refers primarily to physical settings, locations or situations that affect the physical or mental states of people. Their character is fundamentally dependent on living processes, involving non-material, and normally non-consumptive, outputs from individual species, habitats and whole ecosystems. The settings can be either natural or semi-natural (including cultural landscapes) providing they are dependent on *in situ* living processes. The major split under this section is related to settings supporting either (i) interactions consisting of physical activities (e.g., sea sports, sea-going tourist trips) or (ii) intellectual or mental interactions involving analytical, symbolic and representational activities.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 6.8%

Percentage of mapped habitats assessed for this service: 67%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.26, A4.26/32, A4.27, A4.3, A4.31, A4.33, A5, A5.1, A5.11, A5.12, A5.13, A5.2, A5.23, A5.23/24, A5.24, A5.3, A5.4, A5.43, A5.5, A5.51, A5.53, A6, A6.1, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.7, A6.71, A6.72, A6.73, A6.8, A6.82

Non-EUNIS: N_1, N_5, N_6, N_7, N_8, N_9, N_10, N_11, N_12, N_14, N_16, N_17, N_18, N_19, N_20, N_22, N_30

Map

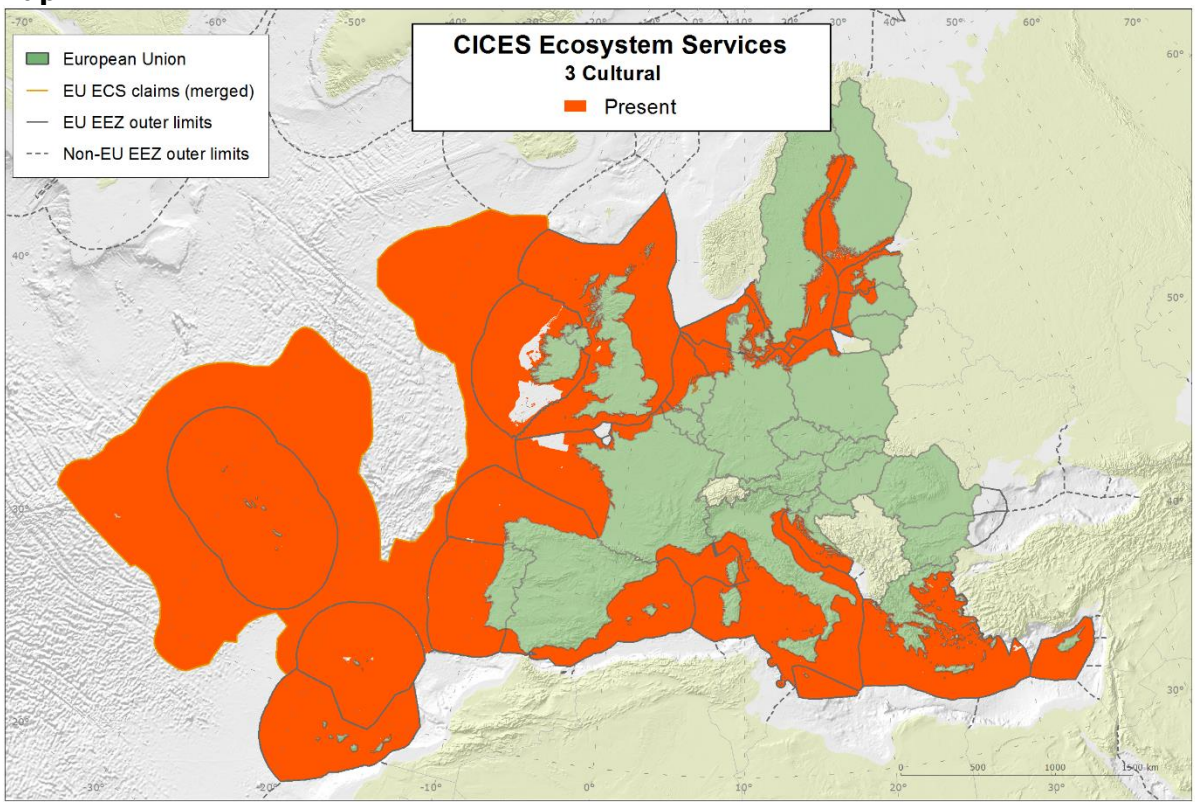


Figure 28. Spatial distribution of the seabed-associated Cultural Ecosystem Services

Area: 8,837,739 km^2 (98.2% of study area)

Quality score (1=best to 5=worst): 2

Highlights

Member State(s) holding larger capacity to provide this service: NE Atlantic ECS, PT, ES, UK, EL, IT

Ecoregion(s) holding larger capacity to provide this service: Deep Sea (Atlantic, Mediterranean), Boreal

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10, 27.10.A), 34 (34.2), 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Wider NE Atlantic, Macaronesia), Mediterranean Sea

Major component of the ecosystem services capacity make-up in: Baltic Sea, NE Atlantic Ocean (Greater North Sea, Bay of Biscay and Iberian Coast, Macaronesia, Wider NE Atlantic, Celtic Seas), Mediterranean Sea (Western Mediterranean, Adriatic, Aegean-Levantine)

Limitations

A few holes are visible in the Celtic Seas which stem from the lack of scoring of this service for a number of non-EUNIS seabed habitat classes cover these sectors of the European seas. Judging for the fact that the service capacity is present around these holes, it is likely that they will be filled when the EUNIS class present in such areas is resolved.

Further work

The capacity and flow of benefits associated with several cultural services are more intangible and difficult to measure than those of provisioning and regulating services given their non-marketable nature. According to Maes et al (2013) most datasets would only be available at local or provincial scales and would not be harmonized even at Member State level. Extensive work would be necessary to extrapolate the datasets in a form relevant for mapping at the national level. Only a few services under the "Physical and intellectual interactions with biota, ecosystems, and land-/seascapes [environmental settings]" division have harmonized datasets or proxies available at EU level. The outlook for "Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes [environmental settings]" is quite similar.

A composite indicator for this upper CICES category should integrate information on each of its subordinate levels. Potential parameters would be MPA extent (in km^2 or ha), Presence or number of iconic or endangered species, annual statistics on in-water tourist/recreational activities, annual statistics (e.g., number, impact) of scientific studies, annual statistics on documentaries and educational publications, annual statistics on visits to scientific and artistic visits exhibits.

3.4.1 *Physical and intellectual interactions with biota, ecosystems, and seascapes [environmental settings] (CICES Level 2 - Division)*

Definition

This CICES section encompasses interactions with marine biotic features consisting of physical activities (e.g., diving, snorkelling, sea-going whale or bird-watching activities) or intellectual ones (particularly via science, arts, history, heritage or media experiences).

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 6.6%

Percentage of mapped habitats assessed for this service: 66%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.26, A4.26/32, A4.27, A4.3, A4.31, A4.33, A5, A5.1, A5.11, A5.12, A5.13, A5.2, A5.23, A5.23/24, A5.24, A5.3, A5.4, A5.43, A5.5, A5.51, A5.53, A6, A6.1, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.7, A6.71, A6.72, A6.8, A6.82

Non-EUNIS: N_1, N_5, N_6, N_7, N_8, N_9, N_10, N_11, N_12, N_14, N_16, N_17, N_18, N_19, N_20, N_22, N_30

Map

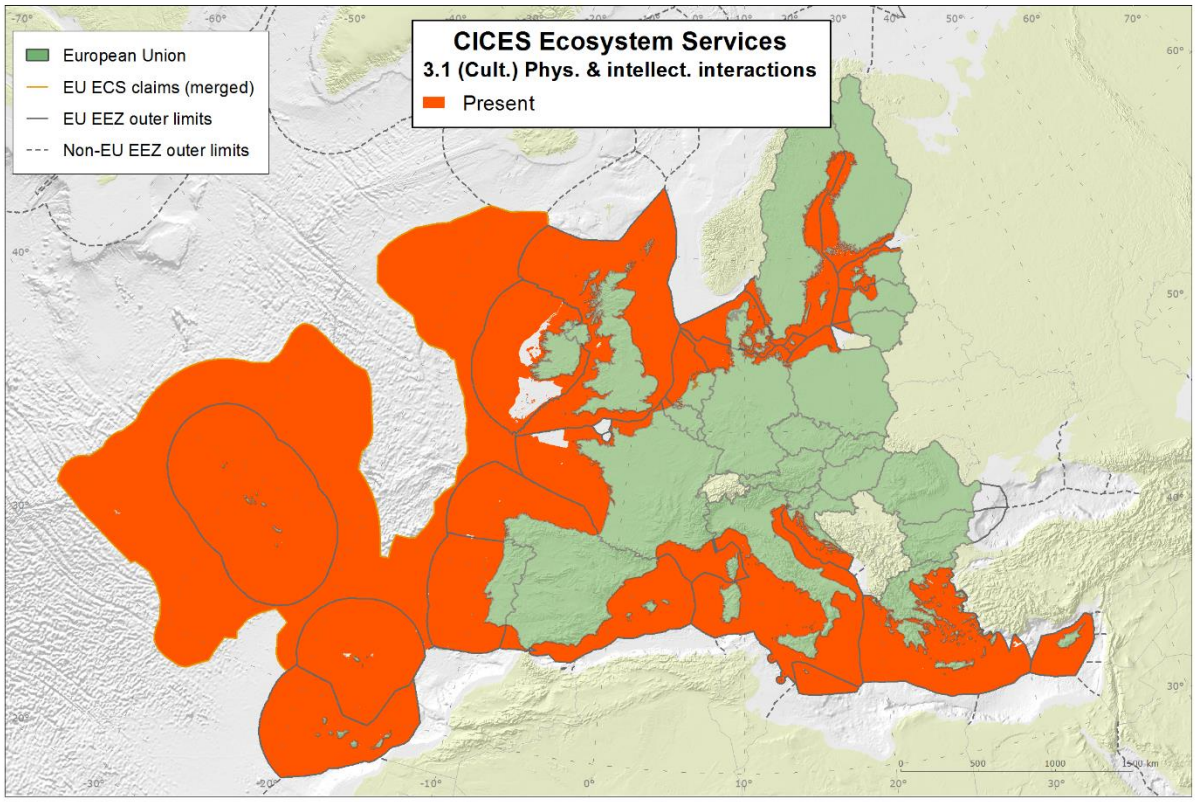


Figure 29. Spatial distribution of the seabed-associated ecosystem services in the CICES division "Physical and intellectual interactions with biota, ecosystems, and land-/seascapes [environmental settings]".

Area: 8,837,739 km^2 (98.2% of study area)

Quality score (1=best to 5=worst): 2

Highlights

Member State(s) holding larger capacity to provide this service: NE Atlantic ECS, PT, ES, UK, EL, IT

Ecoregion(s) holding larger capacity to provide this service: Deep Sea (Atlantic, Mediterranean), Boreal

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10, 27.10.A), 34 (34.2), 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Wider NE Atlantic, Macaronesia), Mediterranean Sea

Major component of the ecosystem services capacity make-up in: Baltic Sea, NE Atlantic Ocean (Greater North Sea, Bay of Biscay and Iberian Coast, Macaronesia, Wider NE Atlantic, Celtic Seas), Mediterranean Sea (Western Mediterranean, Adriatic, Aegean-Levantine)

Limitations

Since only 66% of the habitats have been properly assessed for this ecosystem service, the spatial distribution of its capacity may be underestimated and misrepresented. Given the already widespread mapped capacity, these effects are probably local.

A few holes are visible in the Celtic Seas which stem from the lack of scoring of this service for a number of non-EUNIS seabed habitat classes cover these sectors of the European seas. Judging for the fact that the service capacity is present around these holes, it is likely that they will be filled when the EUNIS class present in such areas is resolved.

Further work

A composite indicator for this CICES division should integrate information on each of its subordinate levels. Potential parameters would be MPA extent (in km^2 or ha), Presence or number of iconic or endangered species, annual statistics on in-water tourist/recreational activities, annual statistics (e.g., number, impact) of scientific studies, annual statistics on documentaries and educational publications, annual statistics on visits to scientific and artistic visits exhibits.

3.4.2 *Physical and experiential interactions (CICES Level 3 - Group)*

Definition

This CICES section encompasses interactions with marine biotic features that consist typically of recreational and touristic activities such as *in situ* whale and bird watching, snorkelling, diving or angling.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 2.6%

Percentage of mapped habitats assessed for this service: 27%

Seabed habitats providing the service
EUNIS: A3.1, A3.2, A3.3, A3.31, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.3, A5.1, A5.11, A5.12, A5.13, A5.43, A5.5, A5.51, A5.53

Map

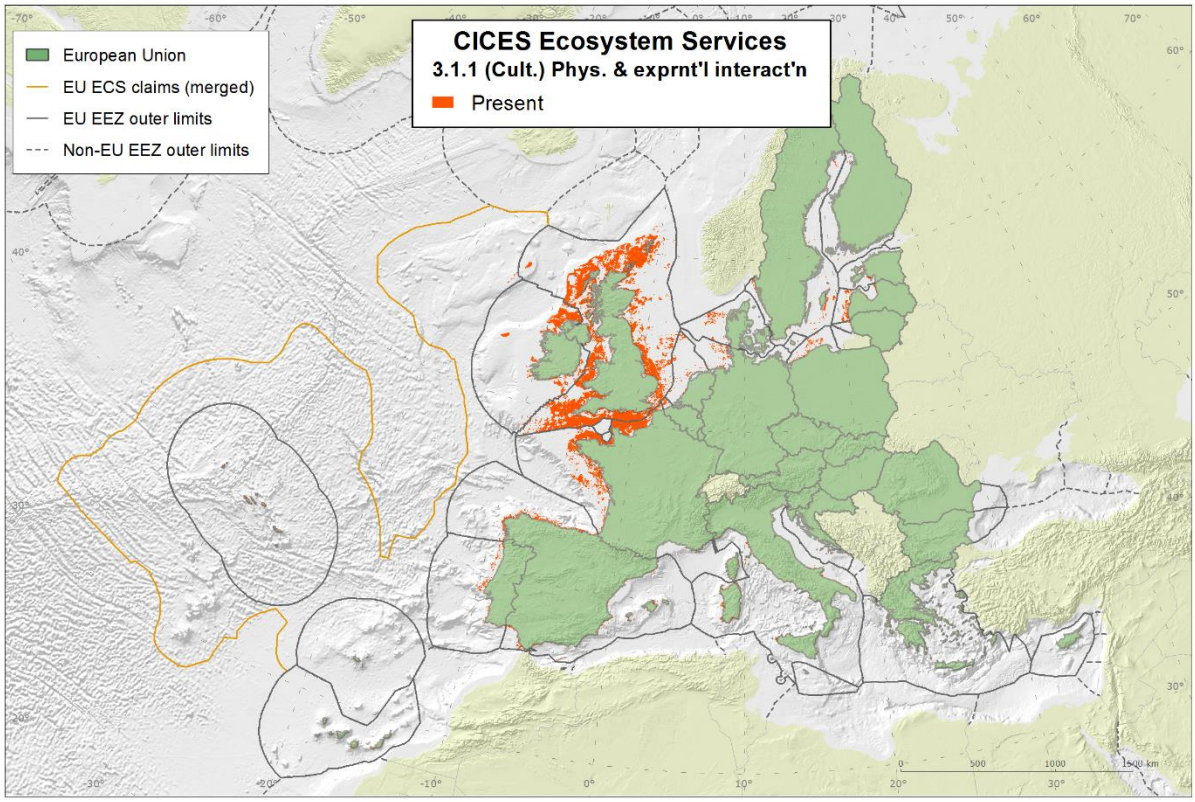


Figure 30. Spatial distribution of the seabed-associated ecosystem services in the CICES group "Physical and experiential interactions" with marine biota, ecosystems, and seascapes [environmental settings]".

Area 321,522 km^2 (3.6% of study area)

Quality score (1=best to 5=worst): 4

Highlights

Member State(s) holding larger capacity to provide this service: UK, FR, IE

Ecoregion(s) holding larger capacity to provide this service: Boreal (Boreal Proper, Boreal-Lusitanean), Lusitanean (Lusitanean-Boreal)

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.7, 27.4, 27.6)

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Greater North Sea, Celtic Seas)

Major component of the ecosystem services capacity make-up in: No region

Limitations

Since only 27% of the habitats have been properly assessed for this ecosystem service, the spatial distribution of its capacity is likely underestimated and misrepresented.

Further work

Potential metrics for this CICES category would be MPA extent (in km^2 or ha), presence or number of iconic or endangered species and annual statistics on sea tourist/recreational activities, including number of visitors and turnover or gross profit of the sector.

3.4.3 *Physical use of seascapes in different environmental settings (CICES Level 4 - Class)*

Definition

This service refers to activities involving the physical use of marine biotic features. Given the seabed related context of this work, it consists primarily of leisure demersal fishing (angling) conducted from the shore or from boats.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 0.8%

Percentage of mapped habitats assessed for this service: 7%

Seabed habitats providing the service
EUNIS: A3.31

Seabed habitats NOT providing the service
EUNIS: A3, A4, A5.5, A5.53
Non-EUNIS: N_30

Map

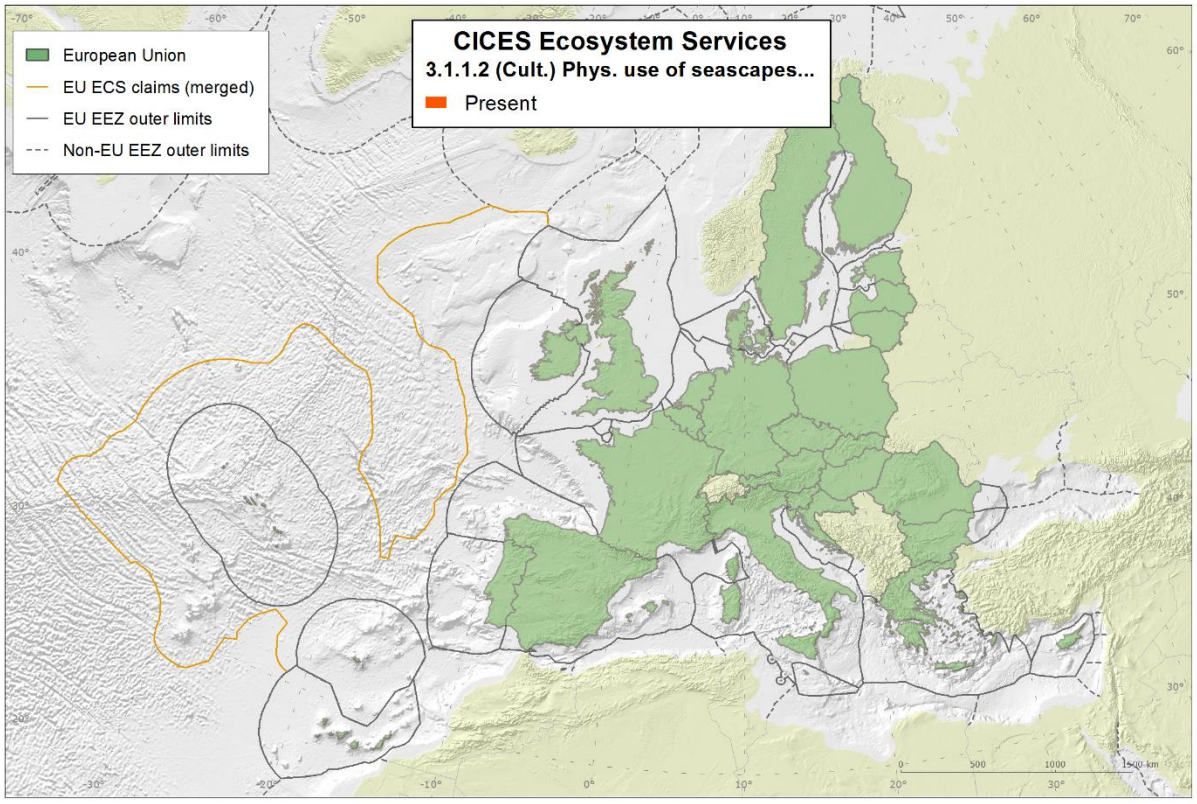


Figure 31. Spatial distribution of the seabed-associated ecosystem services in the CICES class "Physical use of seascapes in different environmental settings".

Area: 966 km^2 (0.01% of study area)

Quality score (1=best to 5=worst): 5

Highlights

Member State(s) holding larger capacity to provide this service: UK

Ecoregion(s) holding larger capacity to provide this service: Boreal (Boreal-Lusitanean, Boreal Proper)

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.6, 27.6.A, 27.4)

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Celtic Seas, Greater North Sea)

Major component of the ecosystem services capacity make-up in: No region

Limitations

Since only 7% of the habitats have been properly assessed for this ecosystem service, the spatial distribution of its capacity is likely underestimated and misrepresented.

Further work

Potential metrics for this CICES category would be *MPA extent (in km^2 or ha*), *Presence or number of iconic or endangered species and annual statistics on in-water tourist/recreational activities* (e.g., visits and boat trips to different sites), *appreciation of sites based on visitor opinion polls*.

3.4.4 *Intellectual and representative interactions (CICES Level 3 - Group)*

Definition

This CICES group encompasses services related to the understanding and awareness of marine landscapes, habitats or species. They consist of (i) research opportunities and discoveries, (ii) knowledge of educational value, (iii) historical and heritage references, (iv) entertainment material for the media and (v) inspiration to arts, engineering or architecture.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 6.1%

Percentage of mapped habitats assessed for this service: 61%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.26, A4.26/32, A4.27, A4.3, A4.31, A4.33, A5, A5.1, A5.11, A5.12, A5.13, A5.2, A5.3, A5.4, A5.43, A5.5, A5.51, A5.53, A6, A6.1, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.7, A6.71, A6.72, A6.8, A6.82

Non-EUNIS: N_1, N_5, N_6, N_7, N_8, N_9, N_10, N_11, N_12, N_14, N_16, N_17, N_18, N_19, N_20, N_22, N_30

Map

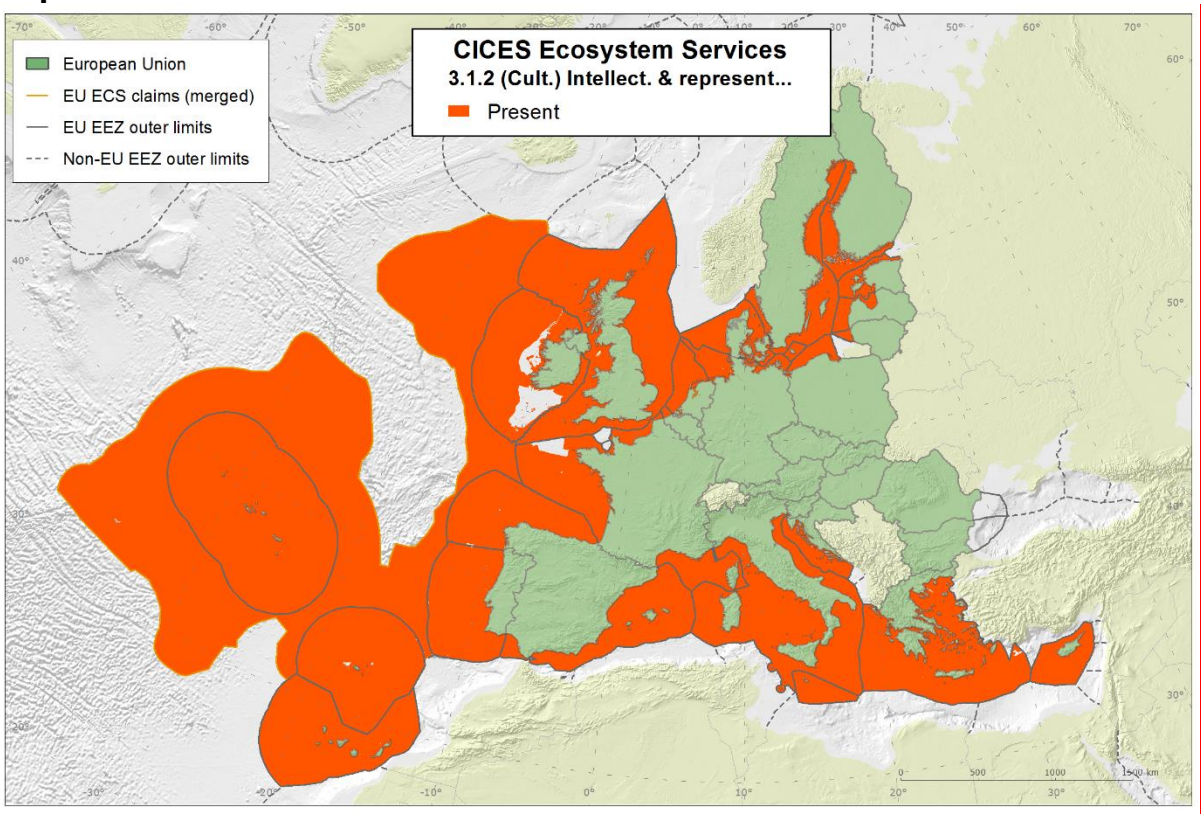


Figure 32. Spatial distribution of the seabed-associated ecosystem services in the CICES Group "Intellectual and representative interactions" with marine biota, ecosystems, and seascapes [environmental settings]".

Area: 8,837,739 km^2 (98.2% of study area)

Quality score (1=best to 5=worst): 2

Highlights

Member State(s) holding larger capacity to provide this service: NE Atlantic ECS, PT, ES, UK, EL, IT

Ecoregion(s) holding larger capacity to provide this service: Deep Sea (Atlantic, Mediterranean), Boreal

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10, 27.10.A), 34 (34.2), 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Wider NE Atlantic, Macaronesia), Mediterranean Sea

Major component of the ecosystem services capacity make-up in: Baltic Sea, NE Atlantic Ocean (Greater North Sea, Bay of Biscay and Iberian Coast, Macaronesia, Wider NE Atlantic, Celtic Seas), Mediterranean Sea (Western Mediterranean, Adriatic, Aegean-Levantine)

Limitations

Since only 61% of the habitats have been properly assessed for this ecosystem service, the spatial distribution of its capacity may be underestimated and misrepresented. Given the already widespread mapped capacity, these effects are probably local.

A few holes are visible in the Celtic Seas which stem from the lack of scoring of this service for a number of non-EUNIS seabed habitat classes cover these sectors of the European seas. Judging for the fact that the service capacity is present around these holes, it is likely that they will be filled when the EUNIS class present in such areas is resolved.

Further work

Potential metrics for this CICES category would be annual statistics on: (i) *the number and impact of scientific studies*, (ii) *number of documentaries and educational publications* and (iii) *number of visitors to scientific and artistic exhibits*.

3.4.5 *Scientific values (CICES Level 4 - Class)*

Definition

This service refers to the contribution of marine biotic features to research fields in terms of opportunities, discoveries and knowledge. This includes research activities on marine sourced bionic design and biomimetics, genetic resources and biochemical compounds with pharmaceutical interest.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 1.5%

Percentage of mapped habitats assessed for this service: 15%

Seabed habitats providing the service

EUNIS: A6, A6.1, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.7, A6.71, A6.72

Map

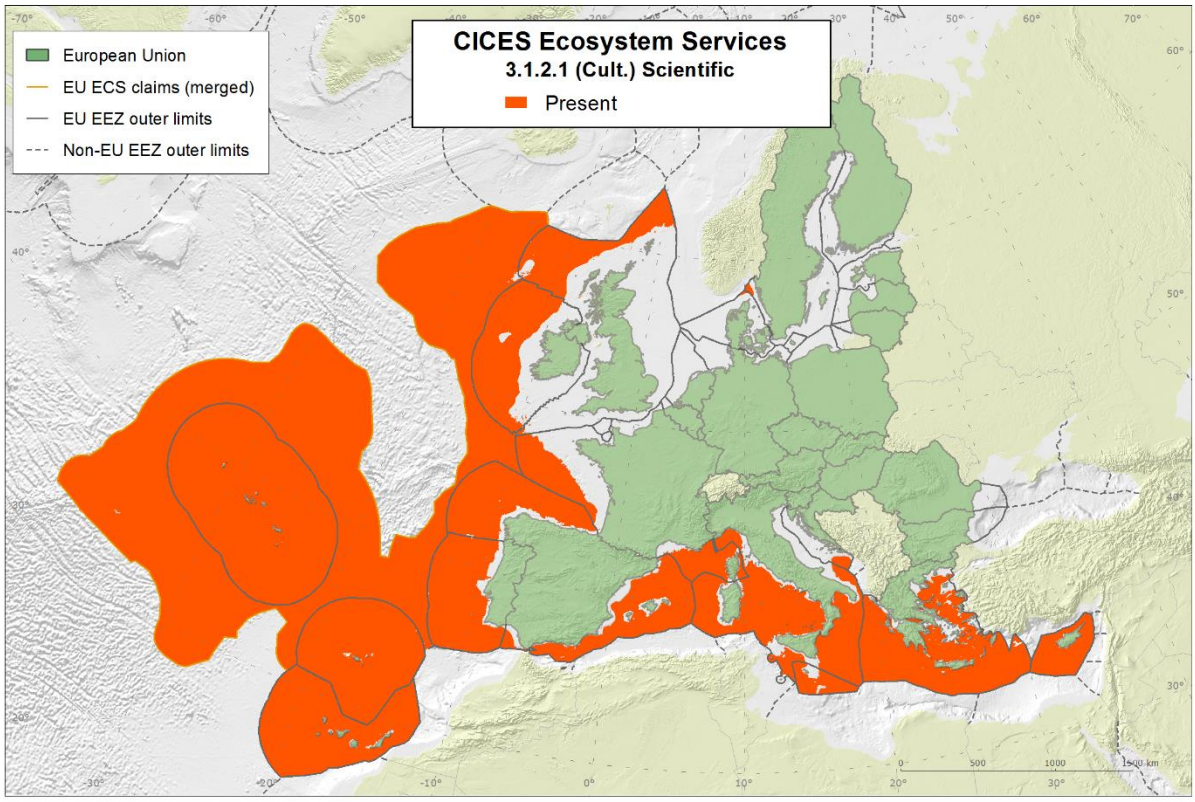


Figure 33. Spatial distribution of the seabed-associated ecosystem services in the CICES class "Scientific" interactions with marine biota, ecosystems, and seascapes [environmental settings]".

Area: 7,184,668 km^2 (79.9% of study area)

Quality score (1=best to 5=worst): 5

Highlights

Member State(s) holding larger capacity to provide this service: NE Atlantic ECS, PT, ES, EL, IT

Ecoregion(s) holding larger capacity to provide this service: Deep Sea (Atlantic, Mediterranean)

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10, 27.10.A), 34 (34.1, 34.2), 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Wider NE Atlantic, Macaronesia), Mediterranean Sea

Major component of the ecosystem services capacity make-up in: NE Atlantic Ocean (Macaronesia, Wider NE Atlantic, Bay of Biscay and Iberian Coast, Celtic Seas), Mediterranean Sea (Ionian Sea and Central Mediterranean, Aegean-Levantine, Western Mediterranean, Adriatic)

Limitations

Since only 15% of the habitats have been properly assessed for this ecosystem service, its spatial distribution is underestimated and misrepresented. This is unquestionably the case of continental shelves which are blanked in the final exercise despite being major providers of scientific ecosystem services.

Further work

Potential metrics for this CICES category would be the presence or extent of sites or species of scientific value, annual statistics (e.g., number, impact factor) of scientific studies, annual statistics on science-based documentaries and publications, annual statistics on visits to scientific exhibits and centres.

Spatially-explicit expenditure on marine research programmes (including monitoring studies) may provide a proxy of the scientific services. Although expenditures on these activities represent costs rather than benefits in a conventional economic framework, the willingness to incur in such costs can be taken to suggest that the benefits are considered greater (Armstrong et al., 2012)

3.4.6 *Educational values (CICES Level 4 - Class)*

Definition
This service refers to the contribution of marine biotic features to environmental education of children and adults.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 5.1%

Percentage of mapped habitats assessed for this service: 51%

Seabed habitats providing the service
EUNIS: A3, A3.1, A3.2, A3.3, A4, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.3, A5, A5.1, A5.11, A5.12, A5.13, A5.2, A5.3, A5.4, A5.43, A5.5, A5.51, A5.53, A6, A6.1, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.7, A6.71, A6.72
Non-EUNIS: N_30

Seabed habitats NOT providing the service
EUNIS: A3.31

Map

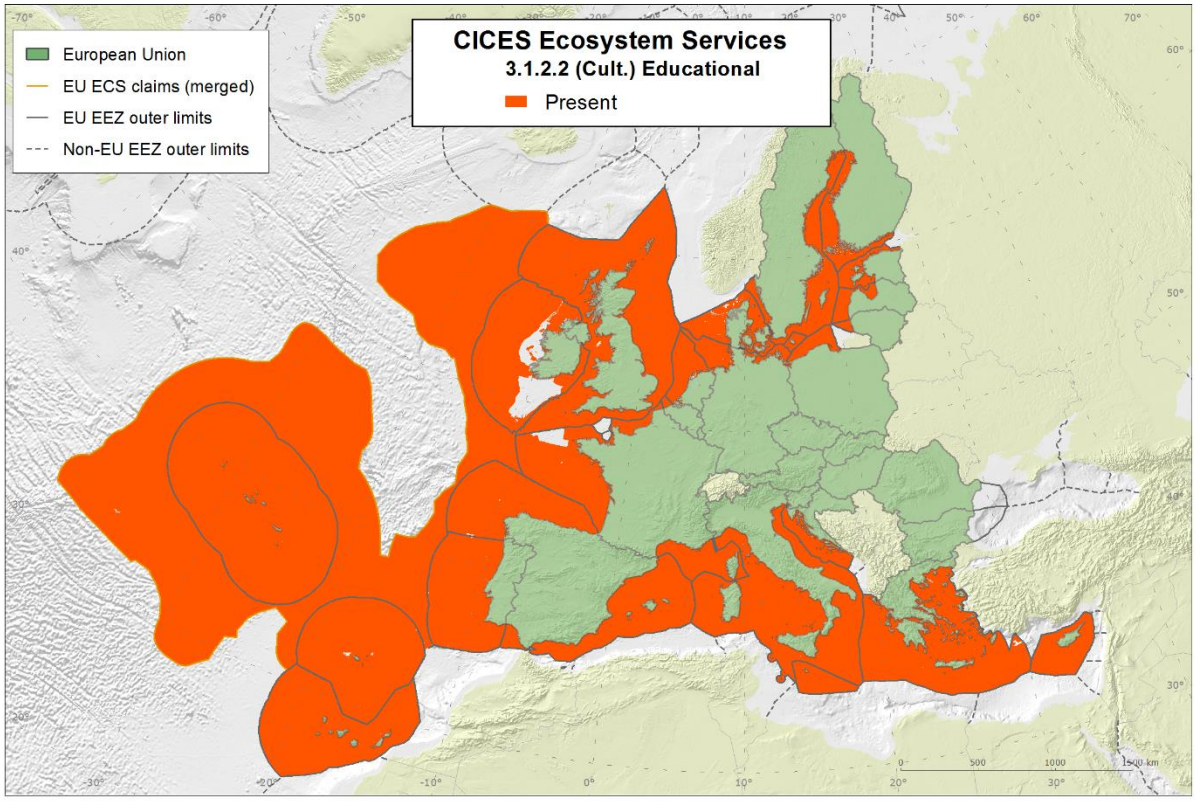


Figure 34. Spatial distribution of the seabed-associated ecosystem services in the CICES class "Educational" interactions with biota, ecosystems, and seascapes [environmental settings]".

Area: 8,821,472 km^2 (98.1% of study area)
Quality score (1=best to 5=worst): 3

Highlights

Member State(s) holding larger capacity to provide this service: NE Atlantic ECS, PT, ES, UK, EL, IT

Ecoregion(s) holding larger capacity to provide this service: Deep Sea (Atlantic, Mediterranean), Boreal

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10), 34 (34.2), 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Wider NE Atlantic, Macaronesia), Mediterranean Sea

Major component of the ecosystem services capacity make-up in: Baltic Sea, NE Atlantic Ocean (Bay of Biscay and Iberian Coast, Macaronesia, Wider NE Atlantic, Greater North Sea, Celtic Seas), Mediterranean Sea (Western Mediterranean, Adriatic, Aegean-Levantine)

Limitations

Since only 51% of the habitats have been properly assessed for this ecosystem service, the spatial distribution of its capacity may be underestimated and misrepresented. Given the already widespread mapped capacity, these effects are probably local.

A few holes are visible in the Celtic Seas which stem from the lack of scoring of this service for a number of non-EUNIS seabed habitat classes cover these sectors of the European seas. Judging for the fact that the service capacity is present around these holes, it is likely that they will be filled when the EUNIS class present in such areas is resolved.

Further work

Potential metrics for this CICES category would be presence or extent of sites or species of educational value, annual statistics on educational documentaries and educational publications or number and attendance of school visits.

3.4.7 *Aesthetic values (CICES Level 4 - Class)*

Definition

These ecosystem services consist of the emotional response that people as observers draw from the sense of beauty or awe offered by natural seascapes (e.g., open 'blue' water, a 'reef-scape' with abundant and colourful marine life) and charismatic species (e.g., sea mammals, sharks). In the context of this report, these services are limited to their seabed-related component.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 0.9%

Percentage of mapped habitats assessed for this service: 9%

Seabed habitats providing the service
EUNIS: A5.5, A5.51, A5.53

Seabed habitats NOT providing the service
EUNIS: A3, A3.31, A4
Non-EUNIS: N_30

Map

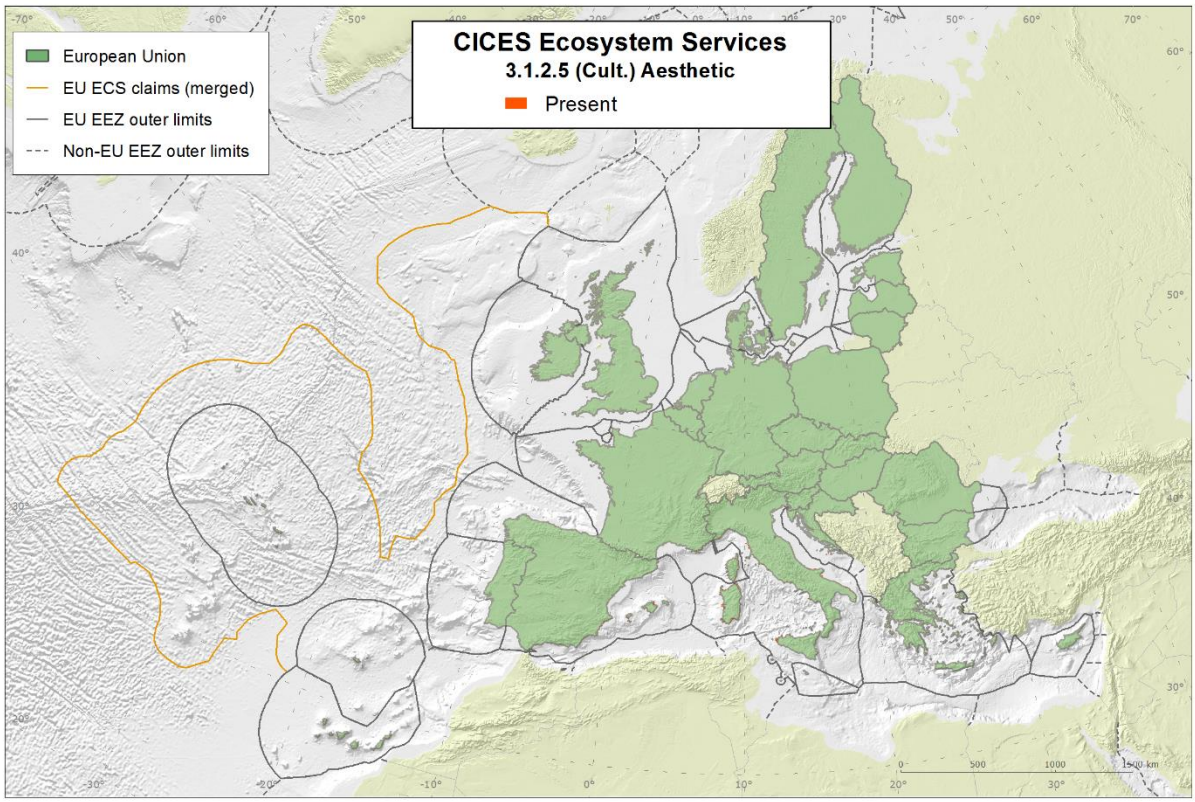


Figure 35. Spatial distribution of the seabed-associated ecosystem services in the CICES class "Aesthetic" interactions with marine biota, ecosystems, and seascapes [environmental settings]".

Area: 5,703 km^2 (0.06% of study area)

Quality score (1=best to 5=worst): 5

Highlights

Member State(s) holding larger capacity to provide this service: IT, ES, FR

Ecoregion(s) holding larger capacity to provide this service: Mediterranean Sea (Western Mediterranean, Adriatic)

Fishing Unit(s) holding larger capacity to provide this service: 37, 37.1, 37.1.1, 37.1.3.11, 37.1.3.112, 37.2

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: Mediterranean Sea (Western Mediterranean, Adriatic)

Major component of the ecosystem services capacity make-up in: No region

Limitations

Since only 9% of the habitats have been properly assessed for this ecosystem service, its spatial distribution is underestimated and misrepresented. More seabed habitats featuring charismatic species have the capacity to deliver this service.

Further work

Potential metrics for this CICES category would be indices of site aesthetical appreciation based on visitor opinion polls or analyses of community-contributed geo-tagged photographs. After isolating aesthetic user motivations using dates, tags, location and photo orientation filters, data derived from social media image-oriented sites (e.g. Flickr, Pinterest, Picasa, Instagram, Panoramio) may be used to map aesthetic hotspots.

3.4.8 *Spiritual, symbolic and other interactions with biota, ecosystems, and seascapes [environmental settings] (CICES Level 3 - Group)*

Definition

This service refers to the use of marine biotic features as symbols in formal religious experiences or emblematic references for particular places and communities. In its non-religious symbolic dimension, this service encompasses also more recent trade-related by-products such as emblematic species of commercial and touristic value becoming popular icons of seaside localities throughout coastal Europe.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 0.8%

Percentage of mapped habitats assessed for this service: 7%

Seabed habitats providing the service
EUNIS: A3, A3.31, A4, A5.5, A5.53
Non-EUNIS: N_30

Map

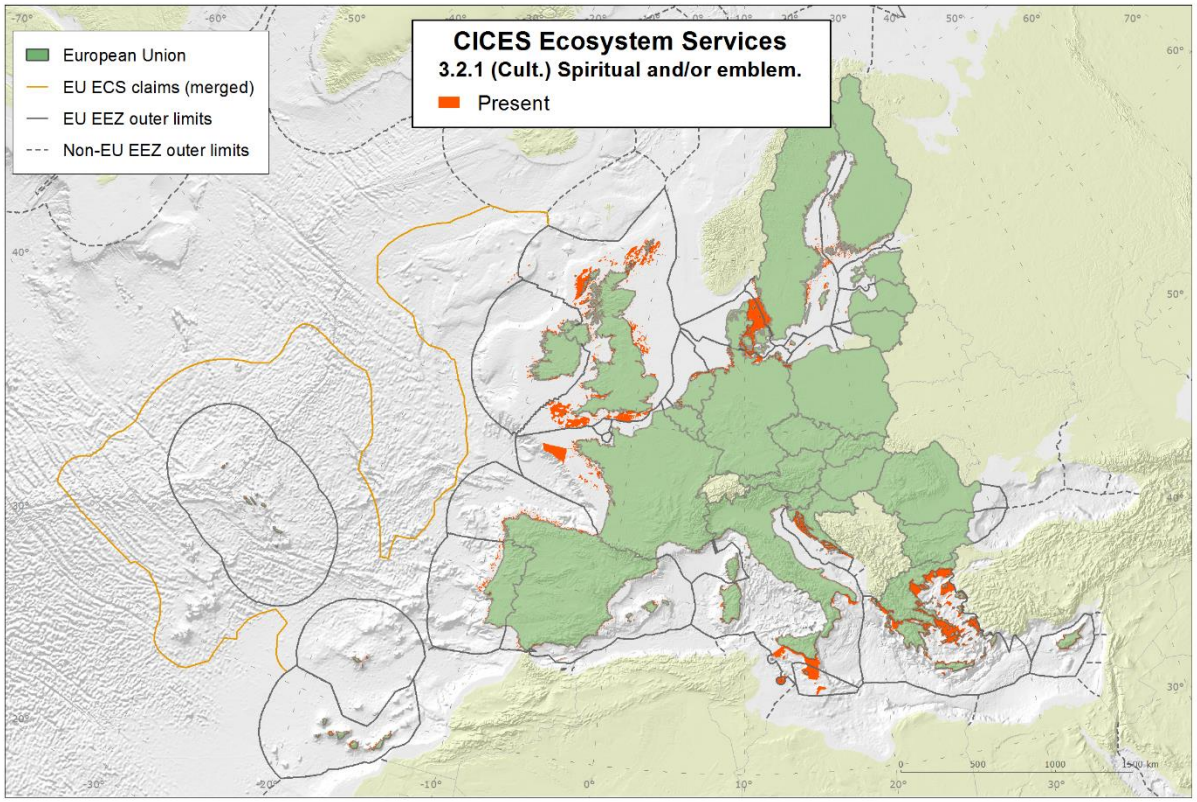


Figure 36. Spatial distribution of the seabed-associated ecosystem services in the CICES Group "Spiritual and/or emblematic" interactions with marine biota, ecosystems, and seascapes [environmental settings]".

Area: 288,399 km^2 (3.2% of study area)

Quality score (1=best to 5=worst): 5

Highlights

Member State(s) holding larger capacity to provide this service: UK, EL, DK, IT, FR, ES, SE

Ecoregion(s) holding larger capacity to provide this service: Mediterranean Sea (Aegean, Ionian), Boreal (Boreal Proper, Boreal-Lusitanean), Lusitanean

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.3, 27.7), 37 (37.3, 37.2, 37.2.2,)

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Greater North Sea, Celtic Seas), Mediterranean Sea (Aegean-Levantine, Ionian Sea and Central Mediterranean), Baltic Sea

Major component of the ecosystem services capacity make-up in: No region

Limitations

Since only 7% of the habitats have been properly assessed for this ecosystem service, its spatial distribution is underestimated and misrepresented.

Further work

A better inventory of the symbols derived from sealife and seascapes that are part of non-religious, commercial or touristic traditions is yet to be done along the European coastal communities. Potential metrics for this CICES category would be MPA extent (in km2 or ha) and the presence or number of iconic or endangered species.

3.4.9 *Other cultural outputs (CICES Level 3 - Group)*

Definition

This service is based on attaching moral, ethical or belief values to the conservation of marine biotic features. It refers to the enjoyment or mental satisfaction derived by both coastal and inland beneficiaries from knowing that certain species or habitats exist (e.g., marine mammals, coral reefs) even if these features are not experienced physically *in situ*. The service can be gauged through the willingness to preserve species, ecosystems or seascapes for the experience and use of future generations.

Habitats related to the provision of this service

Percentage of EUNIS habitats assessed for this service: 10%

Percentage of mapped habitats assessed for this service: 99%

Seabed habitats providing the service

EUNIS: A3, A3.1, A3.2, A3.3, A3.31, A4, A4.1, A4.11/13, A4.12, A4.2, A4.2/3, A4.26, A4.26/32, A4.27, A4.3, A4.31, A4.33, A5.1, A5.11, A5.12, A5.13, A5.23, A5.23/24, A5.24, A5.5, A5.53, A6, A6.7, A6.72, A6.73, A6.8, A6.82

Non-EUNIS: N_10, N_11, N_12, N_17, N_18, N_19, N_20, N_5, N_6, N_7, N_8, N_9, N_30

Seabed habitats NOT providing the service

EUNIS: A5, A5.14, A5.15, A5.2, A5.25, A5.25/26, A5.26, A5.27, A5.3, A5.33, A5.33/34, A5.34, A5.35, A5.35/36, A5.36, A5.37, A5.38, A5.39, A5.4, A5.43, A5.44, A5.45, A5.46, A5.47, A5.51, A6.1, A6.11, A6.2, A6.3, A6.3/4, A6.4, A6.5, A6.74, A6.81

Non-EUNIS: N_1, N_2, N_3, N_4, N_14, N_16, N_22, N_23, N_24

Map

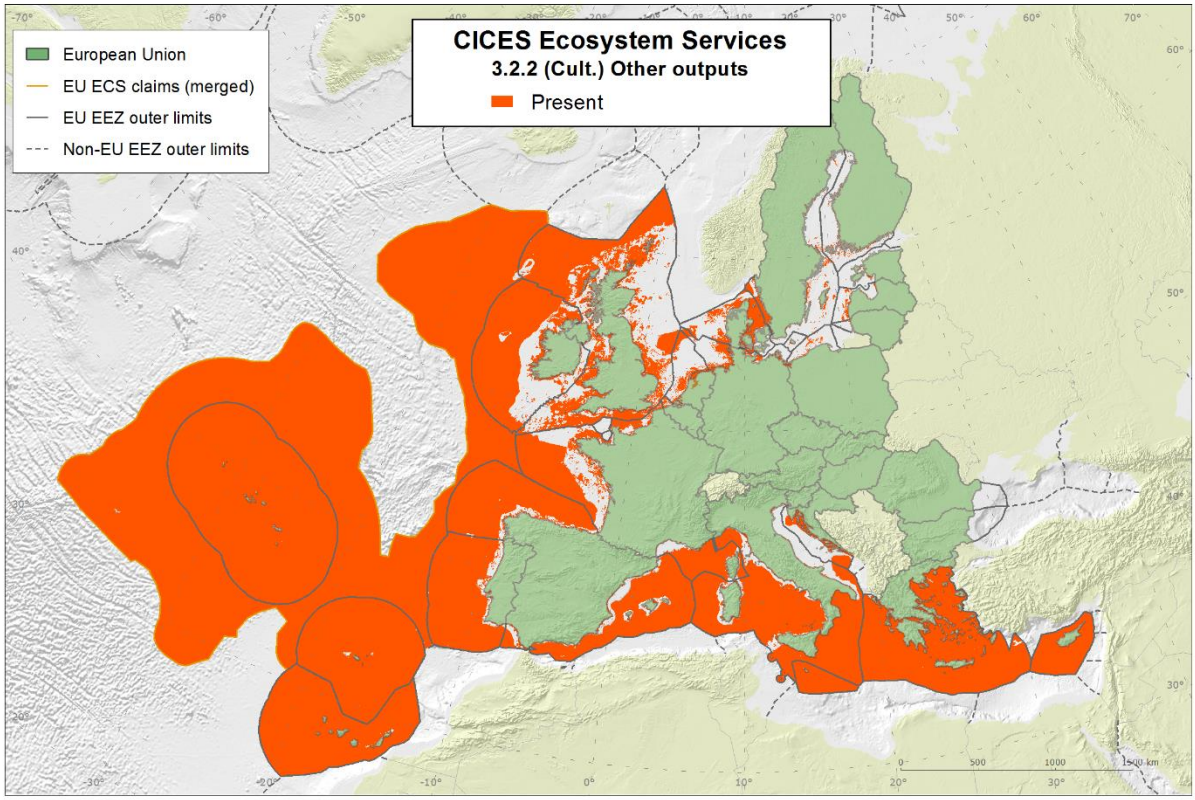


Figure 37. Spatial distribution of the seabed-associated ecosystem services in the CICES Group "Other cultural outputs", comprising values of existence and bequest.

Area: 7,783,932 km² (86.5% of study area)

Quality score (1=best to 5=worst): 1

Highlights

Member State(s) holding larger capacity to provide this service: NE Atlantic ECS, PT, ES, EL, IT, UK

Ecoregion(s) holding larger capacity to provide this service: Deep Sea (Atlantic, Mediterranean)

Fishing Unit(s) holding larger capacity to provide this service: 27 (27.10), 34, 37

MSFD regions/subregions

Region/subregion(s) holding larger capacity to provide this service: NE Atlantic Ocean (Wider NE Atlantic, Macaronesia), Mediterranean Sea

Major component of the ecosystem services capacity make-up in: NE Atlantic Ocean (Macaronesia, Wider NE Atlantic, Bay of Biscay and Iberian Coast, Celtic Seas), Mediterranean Sea (Aegean-Levantine, Western Mediterranean)

Limitations

Biased by broadscale generalisation.

Further work

Potential metrics for this CICES category would be MPA extent (in km2 or ha) and the presence or number of iconic or endangered species.

3.5 Aggregated distribution per CICES Section

The spatial distribution of the seabed-associated ecosystem service capacity at the level of CICES sections is summarized in **Figure 38** (A-C) together with the cumulative presence of services in the three CICES sections (D). The maps highlight the widespread distribution of the capacity when the results are bundled per upper CICES category.

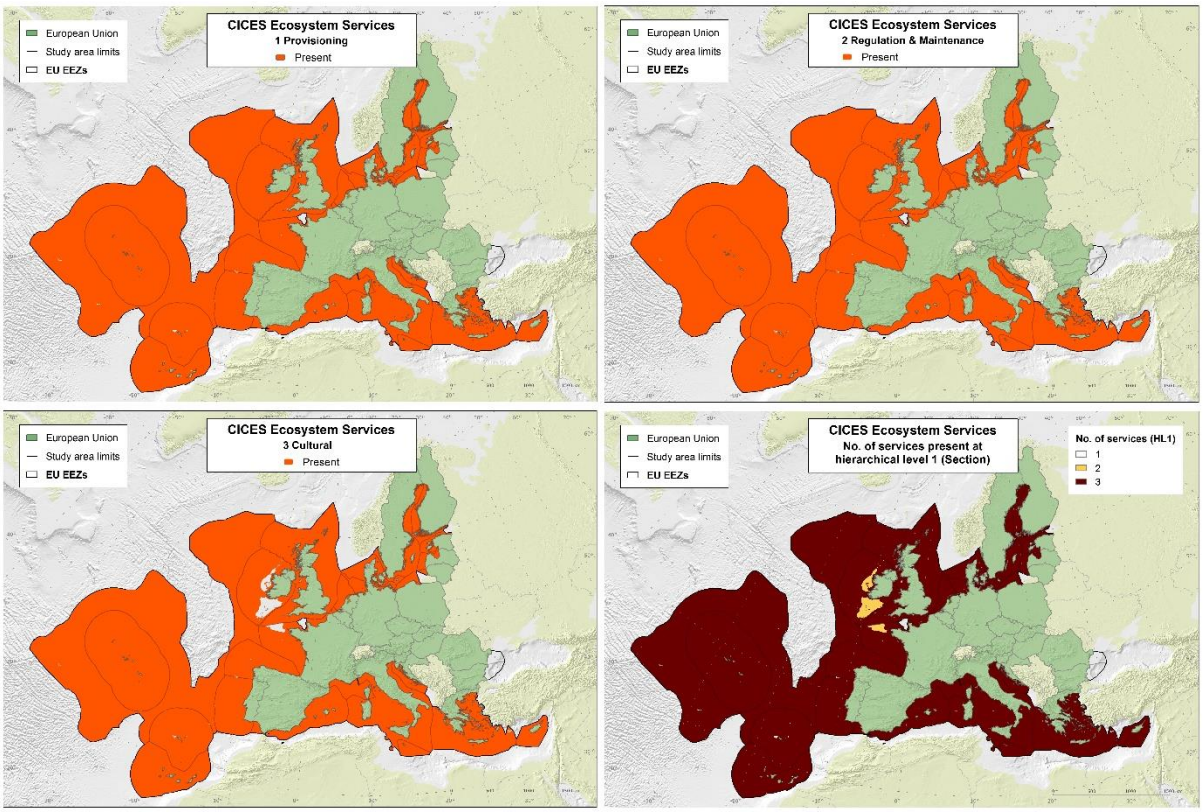


Figure 38. Spatial distribution of the seabed-associated *Provisioning* (A), *Maintenance and Regulation* (B) and Cultural Ecosystem Services (C). Cumulative presence of the three CICES sections (D).

A summary of the area estimates obtained for each ecosystem service and their proportion in relation to the whole study area is shown in **Table 22**.

Table 22. Estimates of overall areas exhibiting capacity to deliver each of the analysed ecosystem services in the Northeast Atlantic and adjacent seas.

	Ecosystem Service	Area (km²)	prevalence (% of total area)
PROVISIONING	**1**	8,927,254	99
	1.1	8,927,254	99
	1.1.1	8,927,254	99
	1.1.1.4	7,184,700*	80
	1.2	1,817,228*	20
	1.2.1	1,817,228*	20
	1.2.1.1	1,362,152*	15
	1.2.1.2	5,703*	0.06
	1.2.1.3	966*	0.01
MAINT. & REGUL.	**2**	8,927,221	99
	2.1	2,494,425	28
	2.2	8,830,030	98
	2.2.1	5,703*	0.06
	2.2.2	7,683,887*	85
	2.2.2.1	7,184,659*	80
	2.2.2.2	501,383*	5.6
	2.3	8,927,221	99
	2.3.1	8,927,221	99
MAINT. & REGUL.	**2.3.2**	501,383*	5.6
	2.3.2.2	288,399*	3.2
	2.3.3	0	0.00
	2.3.4	8,927,193	99
	2.3.4.2	8,927,193	99
	2.3.5	312,994	3.5
	2.3.5.1	14,030*	0.2
CULTURAL	**3**	8,837,739	98
	3.1	8,837,739	98
	3.1.1	321,522*	3.6
	3.1.1.2	966*	0.01
	3.1.2	8,837,739	98
	3.1.2.1	7,184,668*	80
	3.1.2.2	8,821,472	98
	3.1.2.5	5,703*	0.06
	3.2	8,837,739	98
	3.2.1	288,399*	3.2
	3.2.2	7,783,932	87

* Asterisks denote likely underestimated service capacity areas due to the large extent of data poor regions.

4. Region-based statistics

Based on the maps presented before, data were disaggregated using different segmentations or regionalisations of the study area. Area-based ecosystem service indicators were extracted for different spatial units based on (i) an approximation of the Member States maritime areas, (ii) the EU Marine Strategy Framework Directive (MSFD) regions/sub-regions, (iii) a compilation of marine ecoregions and (iv) the FAO Fishing Areas.

Given the lack of formally-agreed limits for these maritime areas, the following scientific results serve for information purposes only. The resulting maps and the associated quantitative information extracted from their use in the analysis do not imply a policy position of the European Commission of the EU marine borders in accordance with international law (see also *Legal Notice* on top of page ii).

4.1 Analysis per EU Member State maritime area

The approximated geographical extent and distribution of the maritime areas associated with EU Member States in the Northeast Atlantic Ocean and adjacent seas is shown in **Figure 39**. Shorelines were delimited using the Global Self-consistent Hierarchical High-resolution Shorelines (GSHHS, version 2.2.2, 1/1/2013; GSHHS_f_L1 shapefile), available for download from http://www.ngdc.noaa.gov/mgg/shorelines/gshhs.html. Seaward limits were those from the Maritime Boundaries of the World dataset (version 8, 28/2/2014) available for download from http://www.marineregions.org/downloads.php (which uses

200 nm limits and geographical median lines between countries baselines) and the GRID-Arendal compilation of Extended Continental Shelf claims submitted to the UNEP Shelf Program.

The seabed extents holding ecosystem service capacity per maritime Member State are shown in **Table 23**. For Baltic Member States, percent areas affected by hypoxia are also provided using 2001-2006 average extent from HELCOM (2009).

The relative contributions per ecosystem service of the maritime areas associated with the different Member State (in percentage of total area) are presented in **Table 24**. For the purpose of this analysis, all ECS areas claimed by EU Member States in the Northeast Atlantic were merged into a single area due to overlapping claims that have not yet been resolved under UNCLOS. Therefore ECS statistics refer to that single joint area and are not broken up per Member State claim.

Area-based prevalence (%) of each seabed-related Ecosystem Service across the Member States maritime areas is shown in **Table 25**. The later index highlights which Ecosystem Services are most widespread in the maritime area of each Member State. A percentage of 100% indicates that the capacity to deliver a certain service is potentially present throughout its whole maritime area.

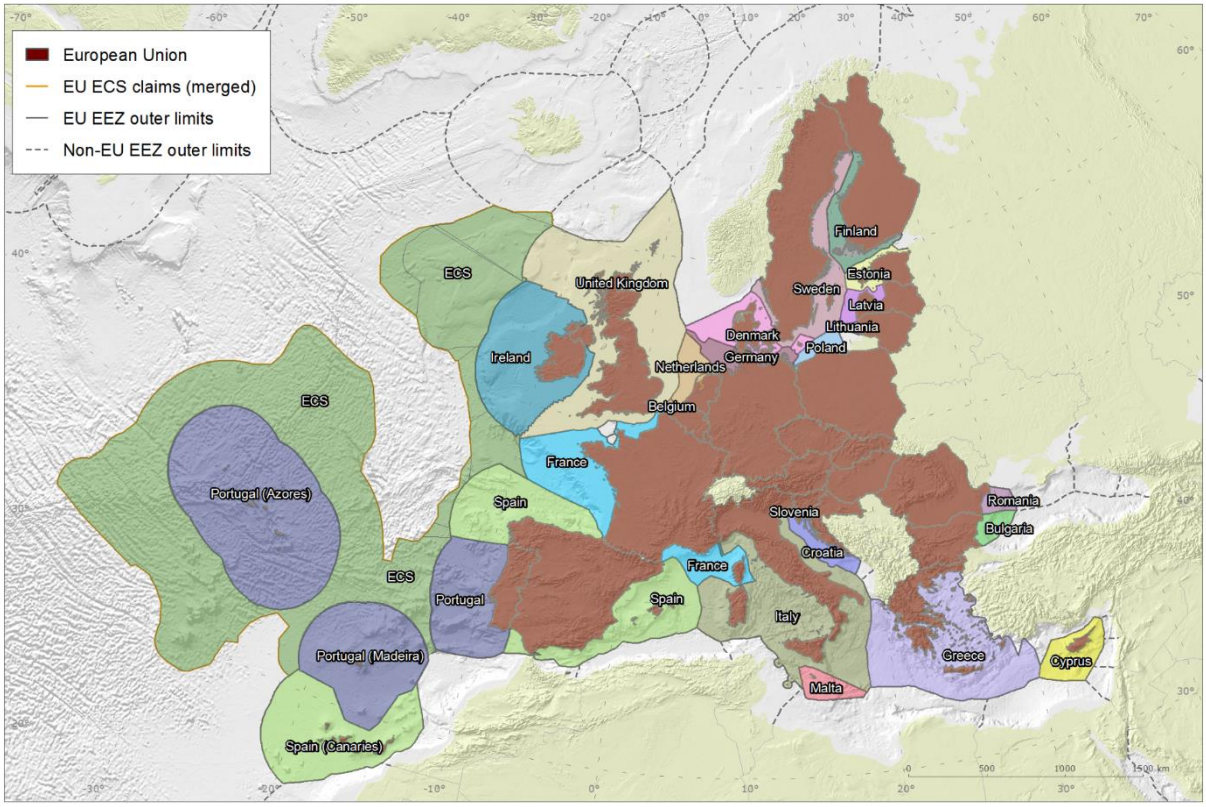


Figure 39. Geographical distribution of the maritime areas associated with EU Member States in the Northeast Atlantic Ocean and adjacent seas.

Table 23. Seabed area holding ecosystem service capacity per maritime EU Member State.
Percentages in brackets for Baltic Member States represent the percentage area affected by hypoxia using the 2001-2006 average extent of hypoxia suggested by HELCOM (2009).

Ecos. Serv.	BE	CY	DE	DK	EE	EL	ES	FI	FR	HR	IE	IT	LT	LV	MT	NE	PL	PT	SE	SI	UK	EU-ECS	Total Area	% of Mar. Area
1	3,472	98,030	56,501	100,836 (-3%)	36,421 (-14%)	492,149	1,003,405	79,772 (-2%)	344,182	55,438	427,226	538,125	6,140 (-3%)	28,972 (-30%)	55,409	64,355	32,032 (-16%)	1,719,211	155,425 (-19%)	113	724,320	2,904,943	8,926,477	100
1.1	3,472	98,030	56,501	100,836 (-3%)	36,421 (-14%)	492,149	1,003,405	79,772 (-2%)	344,182	55,438	427,226	538,125	6,140 (-3%)	28,972 (-30%)	55,409	64,355	32,032 (-16%)	1,719,211	155,425 (-19%)	113	724,320	2,904,943	8,926,477	100
1.1.1	3,472	98,030	56,501	100,836 (-3%)	36,421 (-14%)	492,149	1,003,405	79,772 (-2%)	344,182	55,438	427,226	538,125	6,140 (-3%)	28,972 (-30%)	55,409	64,355	32,032 (-16%)	1,719,211	155,425 (-19%)	113	724,320	2,904,943	8,926,477	100
1.1.1.4		95,823		1,233		426,615	927,810		176,677	7,957	278,375	424,195			46,873			1,693,688	2,672		199,331	2,903,005	7,184,254	80
1.2	3,472	6,506	56,501	99,715 (-3%)	36,420 (-14%)	83,789	87,670	79,771 (-2%)	178,064	47,775	147,647	133,148	6,139 (-3%)	28,971 (-30%)	10,479	64,211	32,031 (-16%)	30,012	155,407 (-19%)	113	526,389	2,661	1,816,896	20
1.2.1	3,472	6,506	56,501	99,715 (-3%)	36,420 (-14%)	83,789	87,670	79,771 (-2%)	178,064	47,775	147,647	133,148	6,139 (-3%)	28,971 (-30%)	10,479	64,211	32,031 (-16%)	30,012	155,407 (-19%)	113	526,389	2,661	1,816,896	20
1.2.1.1	3,448		48,811	74,714 (-4%)	36,014 (-14%)	471	64,703	73,891 (-2%)	132,691	35,822	60,552	94,627	6,112 (-3%)	28,719 (-30%)		58,811	31,360 (-17%)	20,537	139,437 (-21%)	113	449,619	1,598	1,362,053	15
1.2.1.2						8	1,324		834	75		3,457											5,699	0
1.2.1.3				1					3		5								7		947		963	0
2	3,472	98,030	56,501	100,835 (-3%)	36,420 (-14%)	492,149	1,003,405	79,771 (-2%)	344,182	55,438	427,226	538,125	6,139 (-3%)	28,971 (-30%)	55,409	64,355	32,031 (-16%)	1,719,211	155,425 (-19%)	113	724,320	2,904,944	8,926,477	100
2.1	3,472	28,349	56,501	100,835 (-3%)	36,420 (-14%)	114,178	258,949	79,771 (-2%)	196,597	47,775	106,965	169,476	6,139 (-3%)	28,971 (-30%)	14,836	64,302	32,031 (-16%)	211,039	155,407 (-19%)	113	535,398	246,545	2,494,042	28
2.2	3,472	98,030	56,501	99,708 (-3%)	36,420 (-14%)	492,149	1,003,405	79,771 (-2%)	327,240	55,438	348,704	538,125	6,139 (-3%)	28,971 (-30%)	55,409	64,159	32,031 (-16%)	1,719,211	155,424 (-19%)	113	723,937	2,904,933	8,829,295	99
2.2.1						8	1,324		834	75		3,457											5,699	0
2.2.2	1,375	98,030	10,880	28,045 (-0%)	1,322	491,687	943,924	6,315	231,775	19,728	303,289	448,568	474	4,537 (-0%)	55,409	5,339	3,502	1,699,431	20,656 (-5%)		405,597	2,903,335	7,683,218	86
2.2.2.1		95,822		1,233		426,615	927,810		176,677	7,957	278,375	424,195			46,873			1,693,688	2,672		199,331	2,902,997	7,184,245	80
2.2.2.2	1,375	2,208	10,880	26,813 (-0%)	1,322	66,386	16,498	6,315	55,157	11,771	24,914	24,384	474	4,537 (-0%)	8,536	5,339	3,502	6,104	17,984 (-6%)		206,293	338	501,128	6
2.3	3,472	98,030	56,501	100,835 (-3%)	36,420 (-14%)	492,149	1,003,405	79,771 (-2%)	344,182	55,438	427,226	538,125	6,139 (-3%)	28,971 (-30%)	55,409	64,355	32,031 (-16%)	1,719,211	155,425 (-19%)	113	724,320	2,904,944	8,926,477	100
2.3.1	3,472	98,030	56,501	100,835 (-3%)	36,420 (-14%)	492,149	1,003,405	79,771 (-2%)	344,182	55,438	427,226	538,125	6,139 (-3%)	28,971 (-30%)	55,409	64,355	32,031 (-16%)	1,719,211	155,425 (-19%)	113	724,320	2,904,944	8,926,477	100
2.3.2	1,375	2,208	10,880	26,813 (-0%)	1,322	66,386	16,498	6,315	55,157	11,771	24,914	24,384	474	4,537 (-0%)	8,536	5,339	3,502	6,104	17,984 (-6%)		206,293	338	501,128	6
2.3.2.2	24	2,208	7,690	23,183 (-0%)	406	66,386	13,677	5,880	19,562	11,739	5,216	23,843	28	252	8,536	2,622	671	5,872	14,220 (-5%)		75,818	338	288,170	3
2.3.4	3,472	98,030	56,501	100,807 (-3%)	36,420 (-14%)	492,149	1,003,405	79,771 (-2%)	344,182	55,438	427,226	538,125	6,139 (-3%)	28,971 (-30%)	55,409	64,355	32,031 (-16%)	1,719,211	155,425 (-19%)	113	724,320	2,904,944	8,926,448	100
2.3.4.2	3,472	98,030	56,501	100,807 (-3%)	36,420 (-14%)	492,149	1,003,405	79,771 (-2%)	344,182	55,438	427,226	538,125	6,139 (-3%)	28,971 (-30%)	55,409	64,355	32,031 (-16%)	1,719,211	155,425 (-19%)	113	724,320	2,904,944	8,926,448	100
2.3.5	24	2,208	7,736	25,263 (-0%)	406	66,386	14,080	5880	24,970	11,739	16,518	23,843	28	252	8,536	5,494	671	6,080	14,248 (-5%)		78,053	338	312,754	4
2.3.5.1			46			8	1,728		6,099	75	618	3,457				3		208	20		1,759		14,021	0
3	3,472	98,030	56,501	100,805 (-3%)	36,420 (-14%)	492,149	1,003,405	79,771 (-2%)	327,262	55,438	354,822	538,125	6,139 (-3%)	28,971 (-30%)	55,409	64,302	32,031 (-16%)	1,719,211	155,424 (-19%)	113	724,251	2,904,942	8,836,999	99
3.1	3,472	98,030	56,501	100,805 (-3%)	36,420 (-14%)	492,149	1,003,405	79,771 (-2%)	327,262	55,438	354,822	538,125	6,139 (-3%)	28,971 (-30%)	55,409	64,302	32,031 (-16%)	1,719,211	155,424 (-19%)	113	724,251	2,904,942	8,836,999	99
3.1.1	1,351		3,246	3,635 (-1%)	917	8	12,586	434	49,069	107	23,737	4,472	446	4,285 (-0%)		2,721	2,831	4,912	4,545 (-9%)		201,829	338	321,469	4
3.1.1.2				1					3		5								7		947		963	0
3.1.2	3,472	98,030	56,501	100,805 (-3%)	36,420 (-14%)	492,149	1,003,405	79,771 (-2%)	327,262	55,438	354,822	538,125	6,139 (-3%)	28,971 (-30%)	55,409	64,302	32,031 (-16%)	1,719,211	155,424 (-19%)	113	724,251	2,904,942	8,836,999	99
3.1.2.1		95,822		1,233		426,615	927,810		176,677	7,957	278,375	424,195			46,873			1,693,688	2,672		199,331	2,903,006	7,184,254	80
3.1.2.2	3,472	98,030	56,500	98,725 (-3%)	36,420 (-14%)	492,149	1,003,405	79,771 (-2%)	327,118	55,438	344,137	538,125	6,139 (-3%)	28,971 (-30%)	55,409	61,433	32,031 (-16%)	1,719,211	155,418 (-19%)	113	723,774	2,904,942	8,820,738	99
3.1.2.5						8	1,324		834	75		3,457											5,699	0
3.2	3,472	98,030	56,501	100,805 (-3%)	36,420 (-14%)	492,149	1,003,405	79,771 (-2%)	327,262	55,438	354,822	538,125	6,139 (-3%)	28,971 (-30%)	55,409	64,302	32,031 (-16%)	1,719,211	155,424 (-19%)	113	724,251	2,904,942	8,836,999	99
3.2.1	24	2,208	7,690	23,183 (-0%)	406	66,386	13,677	5,880	19,562	11,739	5,216	23,843	28	252	8,536	2,622	671	5,872	14,220 (-5%)		75,818	338	288,170	3
3.2.2	2,136	98,030	20,550	43,638 (-0%)	1,322	491,777	949,298	6,315	237,300	23,294	315,543	453,209	474	4,537 (-0%)	55,409	21,028	3,502	1,700,960	20,680 (-5%)		430,904	2,903,344	7,783,251	87

EU-ECS - merged Extended Continental Shelf areas claimed by EU Member States in the Northeast Atlantic.

Table 24. Relative contribution of each approximated EU Member State maritime area and ECS for the capacity of seabed-related ecosystem services.

Member State	Provisioning Services									Regulation & Maintenance Services																Cultural Services								
	1	1.1	1.1.1	1.1.1.4	1.2	1.2.1	1.2.1.1	1.2.1.2	1.2.1.3	2	2.1	2.2	2.2.1	2.2.2	2.2.2.1	2.2.2.2	2.3	2.3.1	2.3.2	2.3.2.2	2.3.4	2.3.4.2	2.3.5	2.3.5.1	3	3.1	3.1.1	3.1.1.2	3.1.2	3.1.2.1	3.1.2.2	3.1.2.5	3.2	3.2.1	3.2.2
Austria (AT)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Belgium (BE)	0.04	0.04	0.04		0.2	0.2	0.3			0.04	0.1	0.04		0.02		0.3	0.04	0.04	0.3	0.008	0.04	0.04	0.008		0.04	0.04	0.4		0.04		0.04		0.04	0.008	0.03
Bulgaria (BG)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Croatia (HR)	0.6	0.6	0.6	0.1	3	3	3	1		0.6	2	0.6	1	0.3	0.1	2	0.6	0.6	2	4	0.6	0.6	4	0.5	0.6	0.6	0.03		0.6	0.1	0.6	1	0.6	4	0.3
Cyprus (CY)	1	1	1	1	0.4	0.4				1	1	1		1	1	0.4	1	1	0.4	0.8	1	1	0.7		1	1			1	1	1		1	0.8	1
Czech Republic (CZ)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denmark (DK)	1	1	1	0.02	5	5	5		0.1	1	4	1		0.4	0.02	5	1	1	5	8	1	1	8		1	1	1	0.1	1	0.02	1		1	8	0.6
Estonia (EE)	0.4	0.4	0.4		2	2	3			0.4	1	0.4		0.02		0.3	0.4	0.4	0.3	0.1	0.4	0.4	0.1		0.4	0.4	0.3		0.4		0.4		0.4	0.1	0.02
Finland (FI)	0.9	0.9	0.9		4	4	5			0.9	3	0.9		0.08		1	0.9	0.9	1	2	0.9	0.9	2		0.9	0.9	0.1		0.9		0.9		0.9	2	0.08
France (FR)	4	4	4	2	10	10	10	15	0.3	4	8	4	15	3	2	11	4	4	11	7	4	4	8	43	4	4	15	0.3	4	2	4	15	4	7	3
Germany (DE)	0.6	0.6	0.6		3	3	4			0.6	2	0.6		0.1		2	0.6	0.6	2	3	0.6	0.6	2	0.3	0.6	0.6	1		0.6		0.6		0.6	3	0.3
Greece (EL)	6	6	6	6	5	5	0.03	0.1		6	5	6	0.1	6	6	13	6	6	13	23	6	6	21	0.06	6	6	0.003		6	6	6	0.1	6	23	6
Hungary (HU)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ireland (IE)	5	5	5	4	8	8	4		0.5	5	4	4		4	4	5	5	5	5	2	5	5	5	4	4	4	7	0.5	4	4	4		4	2	4
Italy (IT)	6	6	6	6	7	7	7	61		6	7	6	61	6	6	5	6	6	5	8	6	6	8	25	6	6	1		6	6	6	61	6	8	6
Latvia (LV)	0.3	0.3	0.3		2	2	2			0.3	1	0.3		0.06		0.9	0.3	0.3	0.9	0.09	0.3	0.3	0.08		0.3	0.3	1		0.3		0.3		0.3	0.09	0.06
Lithuania (LT)	0.07	0.07	0.07		0.3	0.3	0.4			0.07	0.2	0.07		0.006		0.09	0.07	0.07	0.09	0.01	0.07	0.07	0.009		0.07	0.07	0.1		0.07		0.07		0.07	0.01	0.006
Luxembourg (LU)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Malta (MT)	0.6	0.6	0.6	0.7	0.6	0.6				0.6	0.6	0.6		0.7	0.7	2	0.6	0.6	2	3	0.6	0.6	3		0.6	0.6			0.6	0.7	0.6		0.6	3	0.7
Netherlands (NL)	0.7	0.7	0.7		4	4	4			0.7	3	0.7		0.07		1	0.7	0.7	1	0.9	0.7	0.7	2	0.02	0.7	0.7	0.8		0.7		0.7		0.7	0.9	0.3
Poland (PL)	0.4	0.4	0.4		2	2	2			0.4	1	0.4		0.05		0.7	0.4	0.4	0.7	0.2	0.4	0.4	0.2		0.4	0.4	0.9		0.4		0.4		0.4	0.2	0.04
Portugal (PT)	19	19	19	24	2	2	2			19	8	19		22	24	1	19	19	1	2	19	19	2	1	19	19	2		19	24	19		19	2	22
Romania (RO)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Slovakia (SK)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Slovenia (SI)	0.001	0.001	0.001		0.006	0.006	0.008			0.001	0.005	0.001					0.001	0.001			0.001	0.001			0.001	0.001			0.001		0.001		0.001		
Spain (ES)	11	11	11	13	5	5	5	23		11	10	11	23	12	13	3	11	11	3	5	11	11	5	12	11	11	4		11	13	11	23	11	5	12
Sweden (SE)	2	2	2	0.04	9	9	10		0.7	2	6	2		0.3	0.04	4	2	2	4	5	2	2	5	0.1	2	2	1	0.7	2	0.04	2		2	5	0.3
United Kingdom (UK)	8	8	8	3	29	29	33		98	8	21	8		5	3	41	8	8	41	26	8	8	25	13	8	8	63	98	8	3	8		8	26	6
NE Atlantic ECSs	33	33	33	40	0.1	0.1	0.1			33	10	33		38	40	0.07	33	33	0.07	0.1	33	33	0.1		33	33	0.1		33	40	33		33	0.1	37

EU-ECS - merged Extended Continental Shelf areas claimed by EU Member States in the Northeast Atlantic. NA – not applicable as Member State has no maritime area; ND – no data.

Table 25. Area-based prevalence (%) of each seabed-related Ecosystem Service across the Member States maritime areas.
(a capacity present in >50% of the Member State maritime area highlighted services constituting major traits of the Member State ecosystem service make-up)

Member State	Provisioning Services									Regulation & Maintenance Services																Cultural Services										Marine area (km2)
	1	1.1	1.1.1	1.1.1.4	1.2	1.2.1	1.2.1.1	1.2.1.2	1.2.1.3	2	2.1	2.2	2.2.1	2.2.2	2.2.2.1	2.2.2.2	2.3	2.3.1	2.3.2	2.3.2.2	2.3.4	2.3.4.2	2.3.5	2.3.5.1	3	3.1	3.1.1	3.1.1.2	3.1.2	3.1.2.1	3.1.2.2	3.1.2.5	3.2	3.2.1	3.2.2	
Austria (AT)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Belgium (BE)	100	100	100	0	100	100	99	0	0	100	100	100	0	40	0	40	100	100	40	1	100	100	1	0	100	100	39	0	100	0	100	0	100	1	62	3,472
Bulgaria (BG)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	35,157
Croatia (HR)	100	100	100	14	86	86	65	0	0	100	86	100	0	36	14	21	100	100	21	21	100	100	21	0	100	100	0	0	100	14	100	0	100	21	42	55,438
Cyprus (CY)	100	100	100	98	7	7	0	0	0	100	29	100	0	100	98	2	100	100	2	2	100	100	2	0	100	100	0	0	100	98	100	0	100	2	100	98,038
Czech Republic (CZ)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Denmark (DK)	100	100	100	1	99	99	74	0	0	100	100	99	0	28	1	27	100	100	27	23	100	100	25	0	100	100	4	0	100	1	98	0	100	23	43	100,929
Estonia (EE)	100	100	100	0	100	100	99	0	0	100	100	100	0	4	0	4	100	100	4	1	100	100	1	0	100	100	3	0	100	0	100	0	100	1	4	36,456
Finland (FI)	100	100	100	0	100	100	93	0	0	100	100	100	0	8	0	8	100	100	8	7	100	100	7	0	100	100	1	0	100	0	100	0	100	7	8	79,772
France (FR)	100	100	100	51	52	52	39	0	0	100	57	95	0	67	51	16	100	100	16	6	100	100	7	2	95	95	14	0	95	51	95	0	95	6	69	344,254
Germany (DE)	100	100	100	0	100	100	86	0	0	100	100	100	0	19	0	19	100	100	19	14	100	100	14	0	100	100	6	0	100	0	100	0	100	14	36	56,501
Greece (EL)	100	100	100	87	17	17	0	0	0	100	23	100	0	100	87	13	100	100	13	13	100	100	13	0	100	100	0	0	100	87	100	0	100	13	100	493,195
Hungary (HU)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Ireland (IE)	100	100	100	65	35	35	14	0	0	100	25	82	0	71	65	6	100	100	6	1	100	100	4	0	83	83	6	0	83	65	81	0	83	1	74	427,226
Italy (IT)	100	100	100	79	25	25	18	1	0	100	31	100	1	83	79	5	100	100	5	4	100	100	4	1	100	100	1	0	100	79	100	1	100	4	84	538,128
Latvia (LV)	100	100	100	0	100	100	99	0	0	100	100	100	0	16	0	16	100	100	16	1	100	100	1	0	100	100	15	0	100	0	100	0	100	1	16	28,972
Lithuania (LT)	100	100	100	0	100	100	100	0	0	100	100	100	0	8	0	8	100	100	8	0	100	100	0	0	100	100	7	0	100	0	100	0	100	0	8	6,140
Luxembourg (LU)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Malta (MT)	100	100	100	85	19	19	0	0	0	100	27	100	0	100	85	15	100	100	15	15	100	100	15	0	100	100	0	0	100	85	100	0	100	15	100	55,409
Netherlands (NL)	100	100	100	0	100	100	91	0	0	100	100	100	0	8	0	8	100	100	8	4	100	100	9	0	100	100	4	0	100	0	95	0	100	4	33	64,355
Poland (PL)	100	100	100	0	100	100	98	0	0	100	100	100	0	11	0	11	100	100	11	2	100	100	2	0	100	100	9	0	100	0	100	0	100	2	11	32,034
Portugal (PT)	100	100	100	98	2	2	1	0	0	100	12	100	0	99	98	0	100	100	0	0	100	100	0	0	100	100	0	0	100	98	100	0	100	0	99	1,720,801
Romania (RO)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	29,722
Slovakia (SK)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
Slovenia (SI)	61	61	61	0	61	61	61	0	0	61	61	61	0	0	0	0	61	61	0	0	61	61	0	0	61	61	0	0	61	0	61	0	61	0	0	186
Spain (ES)	100	100	100	92	9	9	6	0	0	100	26	100	0	94	92	2	100	100	2	1	100	100	1	0	100	100	1	0	100	92	100	0	100	1	95	1,003,932
Sweden (SE)	100	100	100	2	100	100	90	0	0	100	100	100	0	13	2	12	100	100	12	9	100	100	9	0	100	100	3	0	100	2	100	0	100	9	13	155,426
United Kingdom (UK)	100	100	100	27	73	73	62	0	0	100	74	100	0	56	27	28	100	100	28	10	100	100	11	0	100	100	28	0	100	27	100	0	100	10	59	724,905
NE Atlantic ECSs	100	100	100	100	0	0	0	0	0	100	8	100	0	100	100	0	100	100	0	0	100	100	0	0	100	100	0	0	100	100	100	0	100	0	100	2,905,590

EU-ECS - merged adjacent Extended Continental Shelf claimed area. NA – not applicable; ND – no data.

4.2 Analysis per MSFD Region/Subregion

In the absence of a formally-agreed delimitation of MSFD regions and sub-regions, an unofficial delimitation was developed using the MSFD text (for nomenclature), 200nm limits, median lines, Extended Continental Shelf limits, OSPAR Regions limits and Fisheries Areas limits (FAO and GFCM). The specific limits used in each sub/region are summarized in **Table 26**. The resulting MSFD segmentation is shown in **Figure 40**.

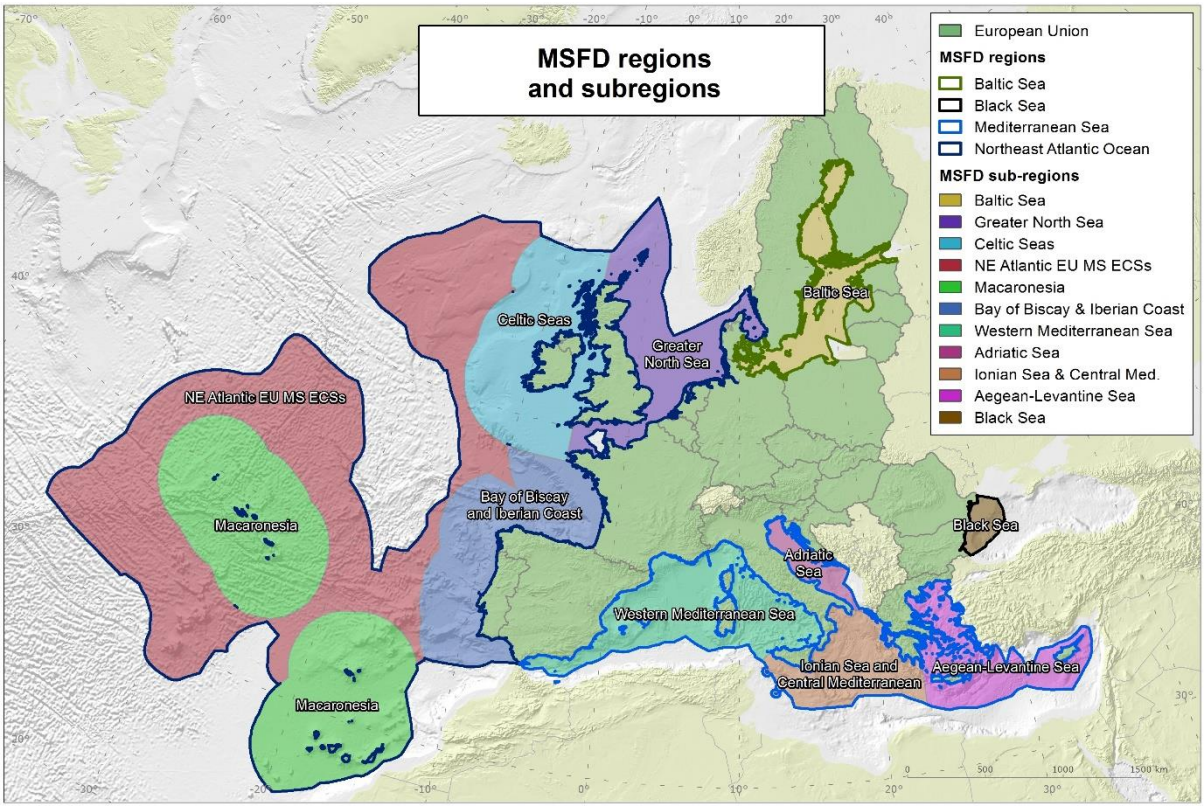


Figure 40. Geographical distribution of the EU Marine Strategy Framework Directive (MSFD) regions and sub-regions.

The total area proportion contained in each MSFD region and sub-region regarding each ecosystem service capacity is presented in **Table 27**. Area-based prevalence of each service per MSFD region/sub-region is shown in **Table 28**.

The relative contributions of each MSFD region and sub-region (in percentage of total area) to the capacity of each service are presented in **Table 27**. Area-based prevalence of each service per MSFD region/sub-region is shown in **Table 28**.

It is highlighted that the ECSs areas claimed by the EU MS in the Northeast Atlantic, together with the Celtic Seas and the Greater North Sea sub-regions (each representing 16%) stand as the main ecosystem service providing regions. They are closely followed by the Western Mediterranean Sea (14%) and the Macaronesia (11%).

Table 26. Limits used in the definition of the MSFD sub-regions.

	Western limit	Northern limit	Eastern limit	Southern limit
Baltic Sea	Same as OSPAR	EU coastline, except waters under RU jurisdiction		
Greater North Sea	Same as OSPAR	Median line to Faroes (DK) and NO	Same as OSPAR	Same as OSPAR
Celtic Seas	200nm limit	Median line to Faroes (DK)	Same as OSPAR	Same as OSPAR
Bay of Biscay and Iberian Coast	200nm limit from EU coastline (FR, ES, PT)	Same as OSPAR	Europe coastline	Median line between PT+ES (from SW Iberia baselines) and the waters under MA jurisdiction off the NW African coast
Macaronesia	200nm buffer to the archipelagos of Azores (PT), Madeira (PT) and Canaries (ES) excluding waters under MA and EH jurisdiction off the NW African coast			
Wider Atlantic	Area between outer limits of the 200nm limit and the claimed Extended Continental Shelf areas limits			
Western Mediterranean	EU coastline except waters under GI jurisdiction	EU coastline except waters under MC jurisdiction	EU coastline	Median line to North Africa countries
Adriatic Sea	EU coastline or median line to BH and AL			Southern limit of the GFCM sub-area 18
Ionian Sea and Central Mediterranean	Median line to North Africa countries	Southern limit of the GFCM sub-area 18 on the Strait of Otranto (boundary to the Adriatic), limit between FAO fishing area 37.1 and 37.2 in the Strait of Sicily (boundary to western Mediterranean, Strait of Messina, coastline elsewhere.	Limit between FAO fishing area 37.2 and 37.3	Median line to North Africa countries
Aegean and Levantine Sea	EU coastline (EL)	Median line between EL baseline and TR	Median line between EL baseline and TR	Median line between EL baseline and TR
Black Sea	Coastline (BG and RO)	Median line to UA to the N/NW and TR to the S/SW		

Table 27. Relative contribution of each MSFD region and sub-region (in percentage of total area) to the overall capacity of European waters to deliver each of the ecosystem services.

MSFD Region / Sub-region	Provisioning Services									Regulation & Maintenance Services																Cultural Services								
	1	1.1	1.1.1	1.1.1.4	1.2	1.2.1	1.2.1.1	1.2.1.2	1.2.1.3	2	2.1	2.2	2.2.1	2.2.2	2.2.2.1	2.2.2.2	2.3	2.3.1	2.3.2	2.3.2.2	2.3.4	2.3.4.2	2.3.5	2.3.5.1	3	3.1	3.1.1	3.1.1.2	3.1.2	3.1.2.1	3.1.2.2	3.1.2.5	3.2	3.2.1	3.2.2
1. Baltic Sea	**4**	**4**	**4**	**0**	**20**	**20**	**25**	**0**	**0**	**4**	**15**	**4**	**0**	**1**	**0**	**8**	**4**	**4**	**8**	**10**	**4**	**4**	**9**	**0**	**4**	**4**	**4**	**0**	**4**	**0**	**4**	**0**	**4**	**10**	**1**
2. Northeast Atlantic Ocean	**82**	**82**	**82**	**82**	**60**	**60**	**61**	**0**	**100**	**82**	**65**	**81**	**0**	**85**	**82**	**68**	**82**	**82**	**68**	**49**	**82**	**82**	**53**	**59**	**81**	**81**	**93**	**100**	**81**	**82**	**81**	**0**	**81**	**49**	**85**
2.1. Greater North Sea	7	7	7	1	31	31	36	0	28	7	22	7	0	3	1	33	7	7	33	23	7	7	25	45	7	7	44	28	7	1	7	0	7	23	4
2.2. Celtic Seas	9	9	9	6	21	21	17	0	71	9	13	8	0	8	6	26	9	9	26	15	9	9	18	10	8	8	39	71	8	6	8	0	8	15	8
2.3. Bay of Biscay & Iberian Coast	9	9	9	9	8	8	8	0	0	9	11	9	0	10	9	8	9	9	8	9	9	9	9	4	9	9	9	0	9	9	9	0	9	9	9
2.4. Macaronesia	22	22	22	26	1	1	0	0	0	22	8	22	0	25	26	1	22	22	1	2	22	22	1	1	22	22	0	0	22	26	22	0	22	2	25
2.5. Northeast Atlantic ECSs	34	34	34	40	0	0	0	0	0	34	10	34	0	40	40	0	34	34	0	0	34	34	0	0	34	34	0	0	34	40	34	0	34	0	39
3. Mediterranean Sea	**14**	**14**	**14**	**18**	**19**	**19**	**14**	**100**	**0**	**14**	**20**	**14**	**100**	**14**	**18**	**24**	**14**	**14**	**24**	**41**	**14**	**14**	**38**	**41**	**14**	**14**	**3**	**0**	**14**	**18**	**14**	**100**	**14**	**41**	**14**
3.1. Western Mediterranean Sea	8	8	8	8	7	7	7	86	0	8	9	8	86	8	8	2	8	8	2	3	8	8	3	35	8	8	2	0	8	8	8	86	8	3	8
3.2. Ionian Sea & Central Mediterranean	0	0	0	5	3	3	0	4	0	0	3	0	4	0	5	7	0	0	7	13	0	0	12	2	0	0	0	0	0	5	0	4	0	13	0
3.3. Adriatic Sea	1	1	1	0	5	5	6	10	0	1	4	1	10	0	0	3	1	1	3	5	1	1	4	4	1	1	0	0	1	0	1	10	1	5	1
3.4. Aegean-Levantine Sea	5	5	5	5	4	4	0	0	0	5	5	5	0	6	5	12	5	5	12	20	5	5	18	0	5	5	0	0	5	5	5	0	5	20	6
4. Black Sea	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND – No data.

Table 28. Area-based prevalence of each service per MSFD region/sub-region.

(>50% indicates that the service capacity is widespread throughout the MSFD region/sub-region and is therefore a major trait of its ecosystem service make-up)

MSFD Region / Sub-region	Provisioning Services									Regulation & Maintenance Services																Cultural Services									Area (km2)
	1	1.1	1.1.1	1.1.1.4	1.2	1.2.1	1.2.1.1	1.2.1.2	1.2.1.3	2	2.1	2.2	2.2.1	2.2.2	2.2.2.1	2.2.2.2	2.3	2.3.1	2.3.2	2.3.2.2	2.3.4	2.3.4.2	2.3.5	2.3.5.1	3	3.1	3.1.1	3.1.1.2	3.1.2	3.1.2.1	3.1.2.2	3.1.2.5	3.2	3.2.1	3.2.2	
1. Baltic Sea	**100**	**100**	**100**	**0**	**100**	**100**	**92**	**0**	**0**	**100**	**100**	**100**	**0**	**11**	**0**	**11**	**100**	**100**	**11**	**8**	**100**	**100**	**8**	**0**	**100**	**100**	**3**	**0**	**100**	**0**	**100**	**0**	**100**	**8**	**11**	**367,903**
2. Northeast Atlantic Ocean	**100**	**100**	**100**	**84**	**16**	**16**	**12**	**0**	**0**	**100**	**23**	**99**	**0**	**89**	**84**	**5**	**100**	**100**	**5**	**2**	**100**	**100**	**2**	**0**	**99**	**99**	**4**	**0**	**99**	**84**	**98**	**0**	**99**	**2**	**91**	**6,974,611**
2.1. Greater North Sea	100	100	100	9	91	91	79	0	0	100	91	100	0	36	9	27	100	100	27	11	100	100	13	1	100	100	23	0	100	9	99	0	100	11	47	613,943
2.2. Celtic Seas	100	100	100	53	47	47	29	0	0	100	41	88	0	70	53	16	100	100	16	6	100	100	7	0	89	89	16	0	89	53	87	0	89	6	72	802,110
2.3. Bay of Biscay & Iberian Coast	100	100	100	82	19	19	14	0	0	100	34	100	0	87	82	5	100	100	5	3	100	100	3	0	100	100	4	0	100	82	100	0	100	3	88	794,914
2.4. Macaronesia	100	100	100	100	1	1	0	0	0	100	11	100	0	100	100	0	100	100	0	0	100	100	0	0	100	100	0	0	100	100	100	0	100	0	100	1,858,054
2.5. Northeast Atlantic ECSs	100	100	100	100	0	0	0	0	0	100	8	100	0	100	100	0	100	100	0	0	100	100	0	0	100	100	0	0	100	100	100	0	100	0	100	2,905,590
3. Mediterranean Sea	**75**	**75**	**75**	**81**	**22**	**22**	**12**	**0**	**0**	**75**	**32**	**75**	**0**	**65**	**81**	**7**	**75**	**75**	**7**	**7**	**75**	**75**	**7**	**0**	**75**	**75**	**1**	**0**	**75**	**81**	**75**	**0**	**75**	**7**	**65**	**1,588,834**
3.1. Western Mediterranean Sea	100	100	100	85	19	19	15	1	0	100	33	100	1	86	85	2	100	100	2	1	100	100	1	1	100	100	1	0	100	85	100	1	100	1	88	659,369
3.2. Ionian Sea & Central Mediterranean	0	0	0	89	14	14	1	0	0	0	19	0	0	0	89	10	0	0	10	10	0	0	10	0	0	0	0	0	0	89	0	0	0	10	0	384,207
3.3. Adriatic Sea	100	100	100	18	82	82	71	1	0	100	82	100	1	30	18	12	100	100	12	12	100	100	12	1	100	100	1	0	100	18	100	1	100	12	34	115,790
3.4. Aegean-Levantine Sea	100	100	100	86	18	18	0	0	0	100	29	100	0	100	86	14	100	100	14	14	100	100	14	0	100	100	0	0	100	86	100	0	100	14	100	429,468
4. Black Sea	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**64,878**

ND – No data.

4.3 Analysis per FAO Fishing Area units

The world's oceans, adjacent seas and inland waters have been geographically broken down by FAO (the United Nations Food and Agriculture Organization) in 27 major fishing areas. These geospatial units allow a systematic collection, compilation, analysis and diffusion of fisheries and aquaculture data and information. In the waters surrounding continental Europe and its adjacent archipelagos, this system follows a hierarchical segmentation in major areas, sub-areas, divisions and sub-divisions.

The limits of these divisions were established in consultation with international fishery agencies taking into consideration: (i) the boundary of natural regions and the natural divisions of oceans and seas; (ii) the boundaries of adjacent statistical fisheries bodies already established in inter-governmental conventions and treaties; (iii) existing national practices; (iv) national boundaries; (v) the longitude and latitude grid system; (vi) the distribution of the aquatic fauna; and (vii) the distribution of the resources and the environmental conditions within an area.

These geographical polygons have been developed and implemented by ICES for the Northeast Atlantic (area 27), by CECAF for Eastern Central Atlantic (area 34) and by GCFM for the Mediterranean and Black Sea (area 37). For the purpose of this work, they were downloaded from http://www.fao.org:80/figis/geoserver/area/ows?service=WFS&request=GetFeature&version=1.0.0&typeName=area:FAO_AREAS&outputFormat=SHAPE-ZIP.

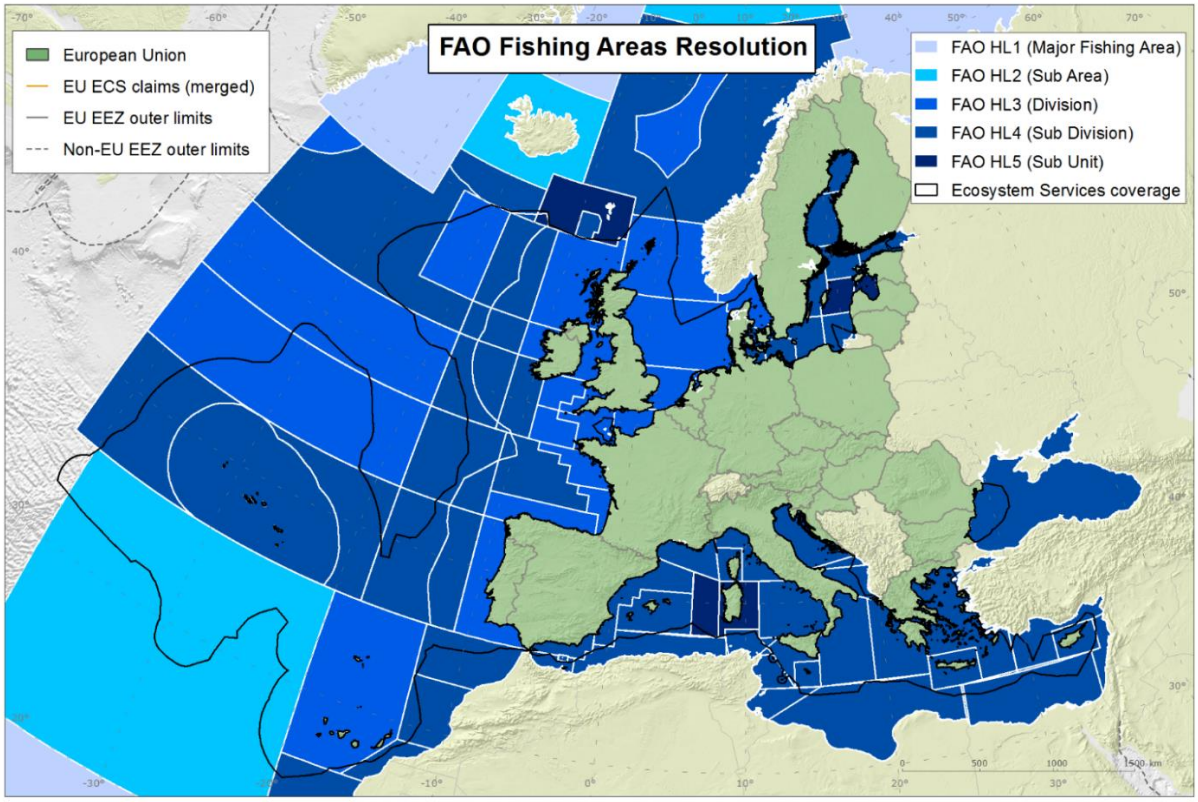


Figure 41. Geographical distribution of the FAO Fishing Area Units. The darker the blue, the more resolution attained in terms of FAO unit (Major Fishing Area > Sub Area > Division > Sub Division > Sub Unit).

Disaggregating ecosystem service capacity by using the FAO Fishing Areas units facilitates comparison of the new information with other market activity statistics concerning the same geospatial units. The relative contribution of each FAO area intersecting the study area to the area-based capacity of service provision is presented in **Table 29** (FAO Area 27) and **Table 30** (FAO Areas 34 and 37).

Focusing on percentage contributions exhibiting double digits areas around the British Isles and Macaronesia as well as the western Mediterranean are highlighted as concentrating higher levels of ecosystem service capacity.

Table 29. Relative contribution of each FAO Fishing Area in FAO Area 27 (in percentage of total area) to the overall capacity of European waters to deliver each ecosystem service.

FAO Fishing area	HL*	Name	1	1.1	1.1.1	1.1.1.4	1.2	1.2.1	1.2.1.1	1.2.1.2	1.2.1.3	2	2.1	2.2	2.2.1	2.2.2	2.2.2.1	2.2.2.2	2.3	2.3.1	2.3.2	2.3.2.2	2.3.4	2.3.4.2	2.3.5	2.3.5.1	3	3.1	3.1.1	3.1.1.2	3.1.2	3.1.2.1	3.1.2.2	3.1.2.5	3.2	3.2.1	3.2.2
27	1	Atlantic, Northeast	61	61	61	55	79	79	86		87	61	69	60		57	55	74	61	61	74	55	61	61	59	58	60	60	97	87	60	55	60		60	55	57
27.2	2	Norwegian Sea, Spitzbergen, and Bear Island	0	0	0	0	0	0				0	0	0		0	0		0	0			0	0			0	0			0	0	0		0		0
27.2.A	3	Norwegian Sea					0	0				0	0	0		0	0		0	0			0	0			0									
27.2.A.2	4	Norwegian Sea Non-NEAFC Regulatory Area					0	0				0	0	0		0	0		0																	
27.3	2	Skagerrak, Kattegat, Sound, Belt Sea and Baltic Sea	4	4	4	0	22	22	26		1	4	16	5		1	0	12	4	4	12	16	4	4	15	0	5	5	4	1	5	0	5		5	16	1
27.3.A	3	Skagerrak and Kattegat				0	2	2	1		1	0	2	0		0	0	4	0	0	4	7	0	0	7	0	0				0						
27.3.B.23	3	Sound					0	0	0		0	0	0	0		0		0	0											0						
27.3.BC	3	Sound and Belt Sea or Transition Area					1	1	1		0	0	1	0		0		2	0	0	2	4	0	0	4		0			0						
27.3.C.22	3	Belt Sea					1	1	0		0	0	1	0		0		2	0											0						
27.3.D	3	Baltic Sea					19	19	24			4	14	4		0		5	4	4	5	5														
27.3.D.24	4	Baltic West of Bornholm					1	1	2			0	1	0		0		0	0																	
27.3.D.25	4	Southern Central Baltic - West					2	2	3			0	2	0		0		1	0																	
27.3.D.26	4	Southern Central Baltic - East					2	2	2			0	1	0		0		0	0																	
27.3.D.27	4	West of Gotland					2	2	2			0	1	0		0		1	0																	
27.3.D.28	4	East of Gotland or Gulf of Riga					3	3	4			1	2	1		0		1	1																	
27.3.D.28.1	5	Gulf of Riga	0	0	0		1	1	1			0	1	0		0		0	0	0	0	0	0	0	0		0	0	0		0		0		0	0	0
27.3.D.28.2	5	East of Gotland (Open Sea)	0	0	0		2	2	3			0	2	0		0		1	0	0	1	0	0	0	0		0	0	1		0		0		0	0	0
27.3.D.29	4	Archipelago Sea					3	3	3			1	2	1		0		1	1																	
27.3.D.30	4	Bothnian Sea					3	3	5			1	3	1		0																				
27.3.D.31	4	Bothnian Bay					2	2	3			0	1	0		0													0							
27.3.D.32	4	Gulf of Finland					1	1	1			0	1	0		0																				
27.4	2	North Sea	5				24	24	30		23	5	18	5		1	0	17	5	5	17	9	5	5	10	5	5	5	25	23	5	0	5		5	9	2
27.4.A	3	Northern North Sea					7	7	8		19	2	5	2		1	0	7	2																	
27.4.B	3	Central North Sea					14	14	17		3	3	10	3		0	0	7	3																	
27.4.C	3	Southern North Sea					4	4	4		0	1	3	1		0		4	1																	
27.5	2	Iceland and Faroes Grounds	0				0	0				0	0	0		0	0		0	0			0	0			0	0			0	0	0		0		0
27.5.B	3	Faroe Grounds					0	0				0	0	0		0	0		0																	
27.5.B.1	4	Faroe Plateau					0	0				0	0	0		0	0																			
27.5.B.1.A	5	Faroe Plateau - Part of NEAFC Regulatory Area	0	0	0	0	0	0				0	0	0		0	0		0	0			0	0			0	0			0	0	0		0		0
27.5.B.1.B	5	Faroe Plateau - Part of Non-NEAFC Regulatory Area	0	0	0	0	0	0				0	0	0		0	0		0	0			0	0			0	0			0	0	0		0		0
27.5.B.2	4	Faroe Bank										0		0		0	0																			
27.6	2	Rockall, NW Coast of Scotland and North Ireland	5				7	7	7		57	5	5	5		5	5	12	5	5	12	7	5	5	6	1	5	5	19	57	5	5	5		5	7	5
27.6.A	3	Northwest Coast of Scotland and North Ireland					6	6	7		57	3	5	3		2	2	12	3											57							
27.6.B	3	Rockall					0	0	1			2	0	3		3	3	0	2			0				0									0	
27.6.B.1	4	Rockall - Part of NEAFC Area					0	0	0			1	0	1		1	2	0			0	0			0				0						0	
27.6.B.2	4	Rockall Non-NEAFC Area					0	0	0			1	0	1		1	1									0										
27.7	2	FAO Sub Area 27.7					18	18	15		6	7	11	6		6	4	24	7	7	24	14	7	7	18	47	6	6	39	6	6	4	6		6	14	
27.7.A	3	Irish Sea					3	3	3		5	1	2	1		0	0	4	1																	
27.7.B	3	West of Ireland					1	1	0			0	0	0		0	0	0	0							0										
27.7.C	3	Porcupine Bank					0	0	0			1	0	1		1	1	0	1		0								0							
27.7.C.1	4	Porcupine Bank - NEAFC Regulatory Area										0	0	0		0	0		0																	
27.7.C.2	4	Porcupine Bank Non-NEAFC Regulatory Area					0	0	0			1	0	1		1	1	0			0								0							
27.7.D	3	Eastern English Channel					2	2	2		0	0	1	0		0		5	0											0						
27.7.E	3	Western English Channel					2	2	2		1	0	2	1		0		6	0							11										
27.7.F	3	Bristol Channel					1	1	1		0	0	1	0		0		3	0							0										
27.7.G	3	Celtic Sea North					3	3	2		0	1	1	0		0		2	1							0										
27.7.H	3	Celtic Sea South					3	3	2			1	2	0		0	0	3	1																	
27.7.J	3	Southwest of Ireland - East					3	3	1			1	1	1		1	1	0	1		0	0			1										0	
27.7.J.1	4	Sw of Ireland - East - NEAFC Regulatory										0	0	0		0	0		0																	
27.7.J.2	4	Sw of Ireland - East - Non-NEAFC Regulatory					3	3	1			1	1	1		1	1	0			0	0			1										0	
27.7.K	3	Southwest of Ireland - West					0	0				2	1	2		2	2		2																	
27.7.K.1	4	SW of Ireland - West - NEAFC Regulatory Area										1	0	1		1	1		1																	
27.7.K.2	4	SW of Ireland - West - Non-NEAFC Regulatory Area					0	0				1	1	1		1	1		1																	
27.8	2	Bay of Biscay					6	6	6			6	7	6		6	6	7	6	6	7	7	6	6	7	0	6	6	7		6	6	6		6	7	
27.8.A	3	Bay of Biscay - North					3	3	3			1	2	1		0	0	5	1							0										
27.8.B	3	Bay of Biscay - Central					2	2	2			0	1	0		0	0	1	0																	
27.8.C	3	Bay of Biscay - South					1	1	1			1	1	1		1	1	1	1																	
27.8.D	3	Bay of Biscay - Offshore					0	0	0			2	1	2		2	3	0	2																	
27.8.D.1	4	Bay of Biscay - Offshore - NEAFC Reg. Area										0	0	0		0	0		0																	
27.8.D.2	4	Bay of Biscay - Offshore - Non-NEAFC Reg. Area					0	0	0			2	1	2		2	2																			
27.8.E	3	West of Bay of Biscay										2	1	2		2	2		2																	
27.8.E.1	4	West of Bay of Biscay - NEAFC Reg. Area										1	0	1		1	1		1																	
27.8.E.2	4	West of Bay of Biscay - Non-NEAFC Reg. Area										1	1	1		1	1		1																	
27.9	2	Portuguese Waters					2	2	2			6	5	6		7	7	1	6	6	1	2	6	6	2	4	6	6	2		6	7	6		6	2	
27.9.A	3	Portuguese Waters - East					2	2	2			2	3	2		2	2	1	2							4										
27.9.B	3	Portuguese Waters - West										4	3	4		5	5		4																	
27.9.B.1	4	Portuguese Waters - West - NEAFC Reg. Area										2	1	3		3	3		2	2			2	2												
27.9.B.2	4	Portuguese Waters - West - Non-NEAFC Reg. Area										2	1	2		2	2																			
27.10	2	Azores Grounds	21	21	21	26	0	0	0			21	6	21		24	26	0	21	21	0	0	21	21	0	1	21	21	0		21	26	21		21	0	24
27.10.A	3	Azores Grounds					0	0	0			15	5	15		18	19	0	15	15	0	0	15	15	0	1	15	15	0		15	19					
27.10.A.1	4	Azores Grounds - NEAFC Reg. Area					0	0				6	1	6		7	8		6																	
27.10.A.2	4	Azores Grounds - Non-NEAFC Reg. Area					0	0	0			9	3	9		10	11	0	9																	
27.10.B	3	Northeast Atlantic South										6	2	6		7	7		6	6			6	6			6	6			6	7					
27.12	2	North of Azores	6	6	6	7	0	0				6	1	6		6	7		6	6			6	6			6	6			6	7	6		6		6
27.12.A	3	Southern Mid-Atlantic Ridge										2	0	3		3	3		2	2			2	2			3	3								
27.12.A.1	4	Subdivision XIIa1 - NEAFC Regulatory Area										2	0	2		3	3		2	2																
27.12.A.2	4	Subdivision XIIa2 - NEAFC Regulatory Area										0		0		0	0		0	0																
27.12.A.4	4	Subdivision XIIa4 Non-NEAFC Regulatory Area										0		0		0	0		0	0																
27.12.B	3	Western Hatton Bank					0	0				2	1	2		3	3		2	2			2	2			2	2								
27.12.C	3	Central Northeast Atlantic - South	1	1	1	1						1	0	1		1	1		1	1			1	1			1	1			1	1	1		1		1

*FAO Hierarchical level: 1 - Major Fishing Area; 2 - Sub Area 3 - Division; 4 - Sub Division; 5 - Sub Unit

Table 30. Relative contribution of each FAO Fishing Area in FAO Areas 34 and 37 (in percentage of total area) to the overall capacity of European waters to deliver each ecosystem service.

FAO Fishing area	HL*	Name	1	1.1	1.1.1	1.1.1.4	1.2	1.2.1	1.2.1.1	1.2.1.2	1.2.1.3	2	2.1	2.2	2.2.1	2.2.2	2.2.2.1	2.2.2.2	2.3	2.3.1	2.3.2	2.3.2.2	2.3.4	2.3.4.2	2.3.5	2.3.5.1	3	3.1	3.1.1	3.1.1.2	3.1.2	3.1.2.1	3.1.2.2	3.1.2.5	3.2	3.2.1	3.2.2
34	**1**	**Atlantic, Eastern-central**	**21**	**21**	**21**	**26**	**0**	**0**	**0**			**21**	**9**	**21**		**25**	**26**	**1**	**21**	**21**	**1**	**1**	**21**	**21**	**1**		**21**	**21**	**0**		**21**	**26**	**21**		**21**	**1**	**24**
34.1	2	Northern Coastal					0	0	0			9	5	9		11	11	1	9	9	1	1	9	9	1		9	9	0		9	11	9		9	1	
34.1.1	3	Morocco Coastal					0	0	0			1	1	1		1	1	0	1																	
34.1.11	4	FAO Sub Division 34.1.11					0	0	0			1	0	1		1	1	0			0	0			0				0						0	
34.1.12	4	FAO Sub Division 34.1.12										0	0	0		0	0		0																	
34.1.13	4	FAO Sub Division 34.1.13										0	0	0		0	0																			
34.1.2	3	Canaries/Madeira Insular					0	0	0			8	3	8		9	9	1	8		1	1			1				0						1	
34.1.3	3	Sahara Coastal					0	0				0	1	0		0	0		0	0																
34.1.31	4	FAO Sub Division 34.1.31					0	0				0	1	0		0	0		0																	
34.2	2	Northern Oceanic										12	5	12		14	15		12	12			12	12			12	12			12	15	12		12		
37	**1**	**Mediterranean and Black Sea**	**18**	**18**	**18**	**18**	**19**	**19**	**14**	**92**		**18**	**20**	**18**	**92**	**18**	**18**	**23**	**18**	**18**	**23**	**39**	**18**	**18**	**36**	**37**	**18**	**18**	**3**		**18**	**18**	**18**	**92**	**18**	**39**	**18**
37.1	2	Western Mediterranean					7	7	7	78		7	9	7	78	7	8	2	7	7	2	3	7	7	3	32	7	7	2		7	8	7	78	7	3	
37.1.1	3	Balearic					3	3	3	21		4	4	4	21	4	4	1	4							9								21		
37.1.1.1	4	Northern Alboran Sea					0	0	0	2		0	0	0	2	0	0									1								2		
37.1.1.2	4	Alboran Island					0	0	0			0	0	0		0	0																			
37.1.1.3	4	Southern Alboran Sea					0	0	0			0	0	0		0	0																			
37.1.1.4	4	Algeria										0	0	0		0	0																			
37.1.1.5	4	Balearic Islands					1	1	1	9		1	1	1	9	1	1									4								9		
37.1.1.6	4	Northern Spain					2	2	2	13		1	2	1	13	1	1																			
37.1.2	3	Gulf of Lions					1	1	1	4		1	1	1	4	1	1	0	1																	
37.1.2.7	4	Gulf of Lion					1	1	1	5		1	1	1	5	1	1																			
37.1.3	3	Sardinia					3	3	3	52		3	4	3	52	3	3	1	3																	
37.1.3.10	4	South Tirrenian Sea					1	1	1	9		2	1	2	9	2	2																			
37.1.3.11	4	Sardinia					1	1	1	28		1	1	1	28	1	1	1			1	1			1	12			1				28		1	
37.1.3.111	5	Sardinia West	1	1	1	1	0	0	0			1	0	1		1	1		1	1			1	1			1	1			1	1	1		1		1
37.1.3.112	5	Sardinia East	1	1	1	1	2	2	2	57		1	2	1	57	1	1	1	1	1	1	2	1	1	2	23	1	1	1		1	1	1	28	1	1	1
37.1.3.12	4	Northern Tunisia					0	0	0			0	0	0		0	0																			
37.1.3.8	4	Corsica Island					0	0	0	10		0	0	0	10	0	0																			
37.1.3.9	4	Ligurian and North Tirrenian Sea					1	1	1	9		1	1	1	9	0	1																			
37.2	2	Central Mediterranean					8	8	7	14		6	7	6	14	6	5	10	6	6	10	17	6	6	16	6	6	6	0		6	5	6	14	6	17	
37.2.1	3	Adriatic					5	5	5	5		1	3	1	5	0	0	2	1																	
37.2.1.17	4	Northern Adriatic					5	5	5	4		1	3	1	4	0	0																			
37.2.1.18	4	Southern Adriatic					1	1	1	6		0	1	0	6	0	0																			
37.2.2	3	Ionian					4	4	1	8		5	3	5	8	5	5	7	5		7	13			12										13	
37.2.2.13	4	Gulf of Hammamet					0	0	0			0	0	0		0	0	1			1	1			1										1	
37.2.2.14	4	Gulf of Gabes				0	0	0				0	0	0		0	0														0					
37.2.2.15	4	Malta Island					1	1				0	0	0		0	0																			
37.2.2.16	4	South of Sicily					1	1	0	5		0	1	0	5	0	0									2			0				5			
37.2.2.19	4	Western Ionian					1	1	0	0		2	1	2	0	2	2																			
37.2.2.20	4	Eastern Ionian					1	1	0	0		1	1	1	0	2	2									0			0				0			
37.2.2.21	4	Southern Ionian Sea (Libya)					0	0				0	0	0		1	1																			
37.3	2	Eastern Mediterranean					4	4				5	5	5		5	5	11	5	5	11	19	5	5	18		5	5			5	5	5		5	19	
37.3.1	3	Aegean					4	4				3	3	3		3	3	11	3																	
37.3.1.22	4	Aegean Sea					4	4				2	3	2		3	2																			
37.3.1.23	4	Crete Island					0	0				1	0	1		1	1																			
37.3.2	3	Levant					0	0				2	2	2		2	2	0	2																	
37.3.2.24	4	North Levant (South of Turkey)					0	0				1	0	1		1	1	0			0	0			0										0	
37.3.2.25	4	Cyprus Island					0	0				0	0	0		1	1	0			0	1			1										1	
37.3.2.26	4	South Levant (Egypt)					0	0				1	1	1		1	1																			
37.3.2.27	4	Levant										0		0		0	0		0																	

*FAO Hierarchical level: 1 - Major Fishing Area; 2 - Sub Area 3 - Division; 4 - Sub Division; 5 - Sub Unit

4.4 Analysis per EU marine ecological regions

The disaggregation of the results per ecological region is aimed at emphasizing the variation in the ecosystem service capacity that is intrinsically related to major natural units rather than administrative ones.

Unlike for terrestrial environments - resolved by the biogeographical segmentation put forward by the EEA - no EU marine biogeographical regions map has been officially endorsed. The limits proposed by the project DEVOTES for the MSFD regions/subregions were not considered suitable. Rather than following objective ecologic limits, DEVOTES proposal is largely based on political/administrative criteria stemming from Exclusive Economic Zones limits and the OSPAR regionalisation.

A proposal was therefore put together based on a review of complementary biogeographically-based segmentations of the global and European seas (**Figure 42**), namely, Dinter (2001) for the OSPAR Area Biogeographic Provinces, HELCOM Pollution Load Compilations basins used in the Baltic, the Marine Ecoregions by Spalding et al. (2007), NOAA's Large Marine Ecosystems, the Longhurst Upper Ocean Provinces and the Pelagic Provinces by Spalding et al. (2007).

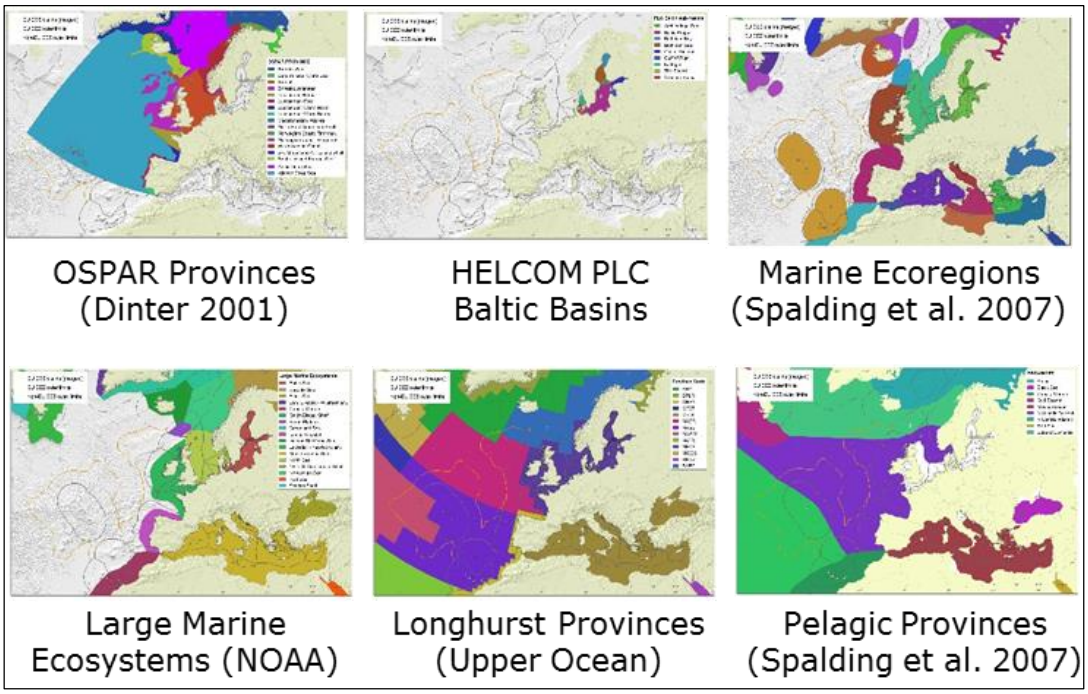


Figure 42. Biogeographical and ecological segmentations of the global and European seas.

The Marine Ecoregions segmentation resulting from this exercise is presented in **Figure 43** and employs:

- the sub-basins used by the HELCOM Pollution Load Compilations (PLC) in the **Baltic Sea**;
- the biogeographical segmentation established by Dinter (2001) for the **OSPAR region** (NE Atlantic Ocean area northwards of Gibraltar's latitude and out to the Macaronesian archipelago of the Azores;
- An extension of Dinter (2001) approach to the **Macaronesian** archipelagos south of Gibraltar's latitude (notably Madeira, Canaries and adjacent seamounts) where margin environments were separated from deep-sea ones using the 1,000m depth contour extracted from the 2015 EMODNET bathymetry;
- An extension of Dinter (2001) approach to the **Mediterranean** where deep-sea environments and continental margins were first split using the 1,000m depth

contour (generally corresponding with the thermocline lower limit) and then margins were divided using the Marine Ecoregions proposed by Spalding et al. (2007).

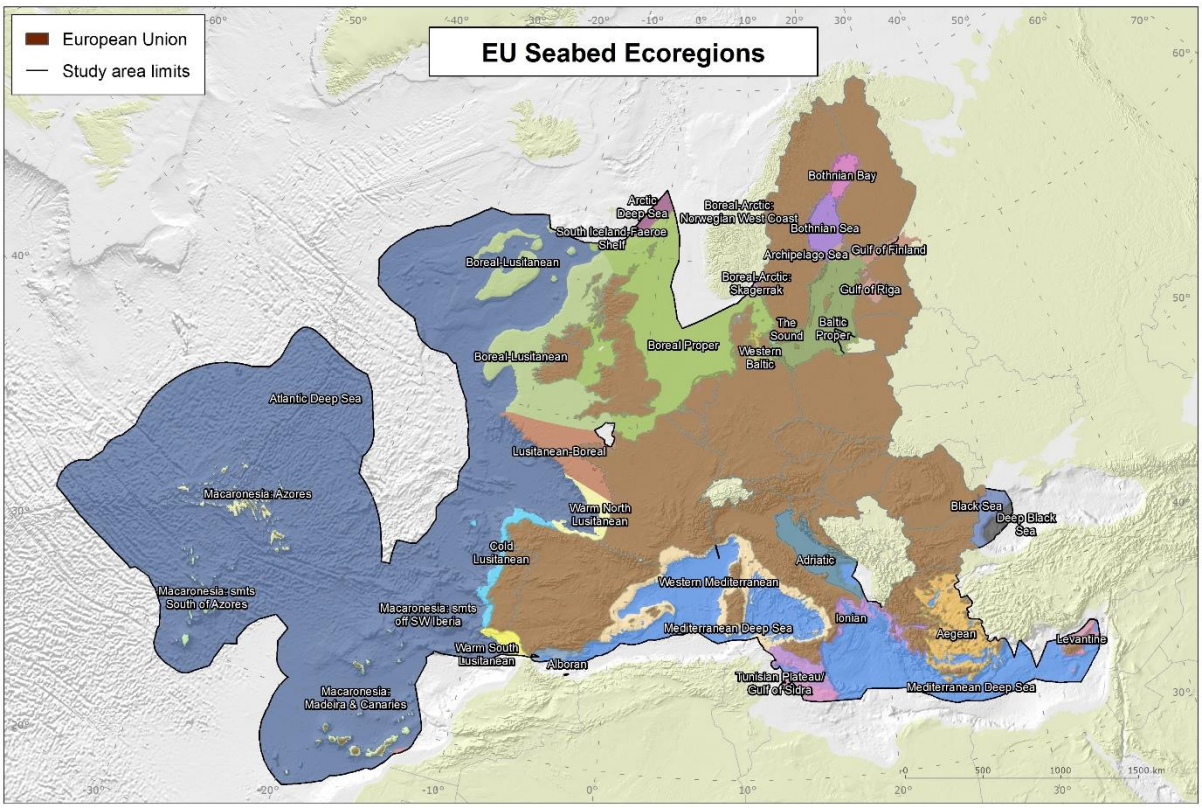


Figure 43. Geographical distribution of the EU Seabed Ecoregions.

The percentage of each service provided by each ecoregion is presented in **Table 31** while the area-based prevalence of each service per biogeographic region/subregion is provided in **Table 32**. As a result of its large area, the Atlantic Deep Sea comes out as the major service provider, accounting for (36%) of all (area-based) service capacity. Areas containing large shelves, notably the Boreal Proper, the Boreal-Lusitanean and the Western Mediterranean, all present double-figure contributions to the overall service capacity with values ranging between 18 and 12%. Besides significant shelves, the latter region includes also significant seagrass areas, which represent major service-providing habitats.

Table 31. Percentage of each service provided by each ecologic region/sub-region.

	Eco-region/sub-region	Provisioning Services									Regulation & Maintenance Services																Cultural Services											Average %
		1	1.1	1.1.1	1.1.1.4	1.2	1.2.1	1.2.1.1	1.2.1.2	1.2.1.3	2	2.1	2.2	2.2.1	2.2.2	2.2.2.1	2.2.2.2	2.3	2.3.1	2.3.2	2.3.2.2	2.3.4	2.3.4.2	2.3.5	2.3.5.1	3	3.1	3.1.1	3.1.1.2	3.1.2	3.1.2.1	3.1.2.2	3.1.2.5	3.2	3.2.1	3.2.2	
<1000m	**Baltic**	**4**	**4**	**4**	**0**	**20**	**20**	**25**	**0**	**0**	**4**	**15**	**4**	**0**	**1**	**0**	**8**	**4**	**4**	**8**	**9**	**4**	**4**	**9**	**0**	**4**	**4**	**4**	**0**	**4**	**0**	**4**	**0**	**4**	**9**	**0**	**5**
	Bothnian Bay	0	0	0	0	2	2	3	0	0	0	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
	Bothnian Sea	1	1	1	0	4	4	5	0	0	1	3	1	0	0	0	0	1	1	0	1	1	1	1	0	1	1	0	0	1	0	1	0	1	1	0	1
	Archipelago Sea	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
	Gulf of Finland	0	0	0	0	1	1	1	0	0	0	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
	Gulf of Riga	0	0	0	0	1	1	1	0	0	0	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
	Baltic Proper	2	2	2	0	11	11	14	0	0	2	8	2	0	0	0	4	2	2	4	3	2	2	3	0	2	2	3	0	2	0	2	0	2	3	0	3
	Western Baltic	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0	2	0	0	2	4	0	0	4	0	0	0	0	0	0	0	0	0	0	4	0	1
	The Sound	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	0	0	0	0	0	0
	Boreal	**12**	**12**	**12**	**3**	**47**	**47**	**49**	**0**	**100**	**12**	**32**	**11**	**0**	**6**	**3**	**54**	**12**	**12**	**54**	**36**	**12**	**12**	**40**	**46**	**11**	**11**	**75**	**100**	**11**	**3**	**11**	**0**	**11**	**36**	**7**	**26**
	Boreal-Arctic: Skagerrak	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Boreal-Arctic: Norwegian West Coast	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	0	0	0	0	0	0
	South Iceland-Faeroe Shelf	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	0	0	0	0	0	0
	Boreal Proper	7	7	7	0	32	32	38	0	41	7	23	7	0	3	0	34	7	7	34	22	7	7	23	42	7	7	45	41	7	0	7	0	7	22	3	15
	Boreal-Lusitanean	5	5	5	2	15	15	11	0	58	5	8	4	0	4	2	20	5	5	20	14	5	5	17	3	4	4	30	58	4	2	4	0	4	14	4	10
	Lusitanean	**3**	**3**	**3**	**1**	**12**	**12**	**12**	**0**	**0**	**3**	**8**	**3**	**0**	**2**	**1**	**13**	**3**	**3**	**13**	**11**	**3**	**3**	**11**	**13**	**3**	**3**	**17**	**0**	**3**	**1**	**3**	**0**	**3**	**11**	**2**	**5**
	Lusitanean-Boreal	2	2	2	0	7	7	7	0	0	2	5	1	0	1	0	10	2	2	10	7	2	2	7	9	1	1	12	0	1	0	1	0	1	7	1	3
	Warm North Lusitanean	0	0	0	0	2	2	2	0	0	0	2	1	0	0	0	1	0	0	1	1	0	0	1	0	1	1	2	0	1	0	1	0	1	1	0	1
	Cold Lusitanean	1	1	1	0	2	2	2	0	0	1	2	1	0	0	0	2	1	1	2	3	1	1	3	1	1	1	3	0	1	0	1	0	1	3	0	1
	Warm South Lusitanean	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0
	Saharan Upwelling	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	0	0	0	0	0	0
	Macaronesia	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**1**	**2**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**2**	**1**	**1**
	Macaronesia: seamounts off SW Iberia	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	0	0	0	0	0	0
	Macaronesia: Madeira and Canaries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
	Macaronesia: Azores	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Macaronesia: seamounts South of Azores	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	0	0	0	0	0	0
	Mediterranean	**7**	**7**	**7**	**5**	**19**	**19**	**14**	**100**	**0**	**7**	**14**	**7**	**100**	**5**	**5**	**24**	**7**	**7**	**24**	**42**	**7**	**7**	**39**	**41**	**7**	**7**	**3**	**0**	**7**	**5**	**7**	**100**	**7**	**42**	**6**	**20**
	Alboran	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0
	Western Mediterranean	2	2	2	1	6	6	7	83	0	2	5	2	83	2	1	2	2	2	2	3	2	2	3	34	2	2	2	0	2	1	2	83	2	3	2	10
	Ionian	1	1	1	1	3	3	1	4	0	1	2	1	4	1	1	7	1	1	7	12	1	1	11	2	1	1	0	0	1	1	1	4	1	12	1	2
	Adriatic	1	1	1	0	5	5	6	10	0	1	4	1	10	0	0	3	1	1	3	5	1	1	4	4	1	1	0	0	1	0	1	10	1	5	0	3
	Tunisian Plateau/Gulf of Sidra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0
	Aegean	2	2	2	2	4	4	0	0	0	2	3	2	0	2	2	11	2	2	11	20	2	2	18	0	2	2	0	0	2	2	2	0	2	20	2	4
	Levantine	0	0	0	0	0	0	0	0	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	1	0	0
	Black Sea	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**
	Deep Sea	**74**	**74**	**74**	**91**	**1**	**1**	**0**	**0**	**0**	**74**	**30**	**75**	**0**	**86**	**91**	**0**	**74**	**74**	**0**	**0**	**74**	**74**	**0**	**0**	**75**	**75**	**0**	**0**	**75**	**91**	**75**	**0**	**75**	**0**	**85**	**43**
>1000m	Arctic Deep Sea	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	0	0	0	0	0	0
	Atlantic Deep Sea	63	63	63	77	0	0	0	0	0	63	23	63	0	73	77	0	63	63	0	0	63	63	0	0	63	63	0	0	63	77	63	0	63	0	72	37
	Mediterranean Deep Sea	11	11	11	13	1	1	0	0	0	11	7	11	0	12	13	0	11	11	0	0	11	11	0	0	11	11	0	0	11	13	11	0	11	0	12	6
	Deep Black Sea	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND – No data.

Table 32. Area-based prevalence of each service per ecological region/sub-region.
(>50% indicates that the service capacity is widespread throughout the eco-region/sub-region and is therefore a major trait of its ecosystem service make-up)

	Eco-region/sub-region	Provisioning Services									Regulation & Maintenance Services																Cultural Services										Average %	Area (km2)
		1	1.1	1.1.1	1.1.1.4	1.2	1.2.1	1.2.1.1	1.2.1.2	1.2.1.3	2	2.1	2.2	2.2.1	2.2.2	2.2.2.1	2.2.2.2	2.3	2.3.1	2.3.2	2.3.2.2	2.3.4	2.3.4.2	2.3.5	2.3.5.1	3	3.1	3.1.1	3.1.1.2	3.1.2	3.1.2.1	3.1.2.2	3.1.2.5	3.2	3.2.1	3.2.2		
<1000m	**Baltic**	**92**	**92**	**92**	**0**	**92**	**92**	**86**	**0**	**0**	**92**	**92**	**92**	**0**	**10**	**0**	**10**	**92**	**92**	**10**	**7**	**92**	**92**	**7**	**0**	**92**	**92**	**3**	**0**	**92**	**0**	**92**	**0**	**92**	**7**	**10**	**49**	**393,927**
	Bothnian Bay	98	98	98	0	98	98	97	0	0	98	98	98	0	3	0	3	98	98	3	1	98	98	1	0	98	98	2	0	98	0	98	0	98	1	3	51	36,249
	Bothnian Sea	98	98	98	0	98	98	95	0	0	98	98	98	0	3	0	3	98	98	3	3	98	98	3	0	98	98	0	0	98	0	98	0	98	3	3	51	65,398
	Archipelago Sea	89	89	89	0	89	89	69	0	0	89	89	89	0	21	0	21	89	89	21	20	89	89	20	0	89	89	0	0	89	0	89	0	89	20	21	49	13,405
	Gulf of Finland	59	59	59	0	59	59	55	0	0	59	59	59	0	4	0	4	59	59	4	4	59	59	4	0	59	59	0	0	59	0	59	0	59	4	4	31	29,998
	Gulf of Riga	99	99	99	0	99	99	98	0	0	99	99	99	0	9	0	9	99	99	9	1	99	99	1	0	99	99	8	0	99	0	99	0	99	1	9	52	18,646
	Baltic Proper	94	94	94	0	94	94	90	0	0	94	94	94	0	9	0	9	94	94	9	4	94	94	4	0	94	94	5	0	94	0	94	0	94	4	9	49	209,258
	Western Baltic	98	98	98	0	98	98	39	0	0	98	98	98	0	59	0	59	98	98	59	59	98	98	59	0	98	98	0	0	98	0	98	0	98	59	59	61	18,647
	The Sound	98	98	98	0	98	98	70	0	0	98	98	98	0	30	0	30	98	98	30	28	98	98	28	0	98	98	2	0	98	0	98	0	98	28	31	56	2,328
	Boreal	**100**	**100**	**100**	**20**	**80**	**80**	**63**	**0**	**0**	**100**	**75**	**93**	**0**	**45**	**20**	**25**	**100**	**100**	**25**	**10**	**100**	**100**	**12**	**1**	**94**	**94**	**23**	**0**	**94**	**20**	**92**	**0**	**94**	**10**	**52**	**55**	**1,057,627**
	Boreal-Arctic: Skagerrak	100	100	100	54	100	100	45	0	0	100	100	100	0	67	54	13	100	100	13	12	100	100	13	0	100	100	11	0	100	54	100	0	100	12	67	60	5,728
	Boreal-Arctic: Norwegian West Coast	99	99	99	99	40	40	0	0	0	99	40	99	0	99	99	0	99	99	0	0	99	99	0	0	99	99	0	0	99	99	99	0	99	0	99	57	776
	South Iceland-Faeroe Shelf	66	66	66	66	0	0	0	0	0	66	0	66	0	66	66	0	66	66	0	0	66	66	0	0	66	66	0	0	66	66	66	0	66	0	66	36	141
	Boreal Proper	100	100	100	5	95	95	84	0	0	100	95	100	0	33	5	27	100	100	27	10	100	100	12	1	100	100	24	0	100	5	99	0	100	10	44	56	608,481
	Boreal-Lusitanean	100	100	100	39	61	61	35	0	0	100	47	83	0	61	39	22	100	100	22	9	100	100	11	0	85	85	22	0	85	39	83	0	85	9	64	53	442,500
	Lusitanean	**100**	**100**	**100**	**20**	**83**	**83**	**61**	**0**	**0**	**100**	**76**	**92**	**0**	**44**	**20**	**25**	**100**	**100**	**25**	**12**	**100**	**100**	**12**	**1**	**92**	**92**	**21**	**0**	**92**	**20**	**92**	**0**	**92**	**12**	**46**	**54**	**265,864**
	Lusitanean-Boreal	100	100	100	9	94	94	62	0	0	100	78	84	0	42	9	34	100	100	34	14	100	100	15	1	84	84	27	0	84	9	84	0	84	14	43	54	143,363
	Warm North Lusitanean	100	100	100	20	84	84	75	0	0	100	85	100	0	34	20	14	100	100	14	5	100	100	5	0	100	100	14	0	100	20	100	0	100	5	36	55	44,252
	Cold Lusitanean	100	100	100	26	78	78	59	0	0	100	80	100	0	44	26	19	100	100	19	16	100	100	16	0	100	100	18	0	100	26	100	0	100	16	47	56	50,303
	Warm South Lusitanean	100	100	100	61	40	40	35	0	0	100	40	100	0	67	61	6	100	100	6	4	100	100	5	1	100	100	6	0	100	61	100	0	100	4	72	55	25,873
	Saharan Upwelling	100	100	100	100	0	0	0	0	0	100	0	100	0	100	100	0	100	100	0	0	100	100	0	0	100	100	0	0	100	100	100	0	100	0	100	54	2,073
	Macaronesia	**87**	**87**	**87**	**79**	**18**	**18**	**7**	**0**	**0**	**87**	**65**	**87**	**0**	**86**	**79**	**10**	**87**	**87**	**10**	**9**	**87**	**87**	**9**	**0**	**87**	**87**	**3**	**0**	**87**	**79**	**87**	**0**	**87**	**9**	**87**	**51**	**49,103**
	Macaronesia: seamounts off SW Iberia	100	100	100	100	0	0	0	0	0	100	100	100	0	100	100	0	100	100	0	0	100	100	0	0	100	100	0	0	100	100	100	0	100	0	100	57	1,775
	Macaronesia: Madeira and Canaries	65	65	65	50	36	36	14	0	0	65	56	65	0	65	50	22	65	65	22	19	65	65	19	0	65	65	2	0	65	50	65	0	65	19	65	41	17,858
	Macaronesia: Azores	100	100	100	94	11	11	4	0	0	100	59	100	0	98	94	5	100	100	5	4	100	100	4	0	100	100	4	0	100	94	100	0	100	4	98	57	22,718
	Macaronesia: seamounts South of Azores	100	100	100	100	0	0	0	0	0	100	100	100	0	100	100	0	100	100	0	0	100	100	0	0	100	100	0	0	100	100	100	0	100	0	100	57	6,751
	Mediterranean	**93**	**93**	**93**	**54**	**53**	**53**	**29**	**1**	**0**	**93**	**54**	**93**	**1**	**66**	**54**	**19**	**93**	**93**	**19**	**18**	**93**	**93**	**18**	**1**	**93**	**93**	**1**	**0**	**93**	**54**	**93**	**1**	**93**	**18**	**68**	**54**	**634,845**
	Alboran	100	100	100	78	26	26	19	1	0	100	27	100	1	82	78	4	100	100	4	4	100	100	4	1	100	100	3	0	100	78	100	1	100	4	84	55	21,806
	Western Mediterranean	100	100	100	53	56	56	46	2	0	100	58	100	2	58	53	4	100	100	4	4	100	100	4	2	100	100	3	0	100	53	100	2	100	4	61	55	200,208
	Ionian	56	56	56	59	50	50	7	0	0	56	50	56	0	51	59	35	56	56	35	35	56	56	35	0	56	56	0	0	56	59	56	0	56	35	51	40	94,120
	Adriatic	100	100	100	10	90	90	79	1	0	100	90	100	1	22	10	12	100	100	12	12	100	100	12	1	100	100	1	0	100	10	100	1	100	12	26	54	105,567
	Tunisian Plateau/Gulf of Sidra	100	100	100	84	18	18	0	0	0	100	18	100	0	100	84	16	100	100	16	16	100	100	16	0	100	100	0	0	100	84	100	0	100	16	100	57	27,229
	Aegean	100	100	100	67	40	40	0	0	0	100	40	100	0	100	67	34	100	100	34	34	100	100	34	0	100	100	0	0	100	67	100	0	100	34	100	60	166,356
	Levantine	100	100	100	89	27	27	0	0	0	100	37	100	0	100	89	11	100	100	11	11	100	100	11	0	100	100	0	0	100	89	100	0	100	11	100	58	19,560
	Black Sea	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**42,488**
	Deep Sea	**100**	**100**	**100**	**100**	**0**	**0**	**0**	**0**	**0**	**100**	**11**	**100**	**0**	**100**	**100**	**0**	**100**	**100**	**0**	**0**	**100**	**100**	**0**	**0**	**100**	**100**	**0**	**0**	**100**	**100**	**100**	**0**	**100**	**0**	**100**	**55**	**6,546,724**
>1000m	Arctic Deep Sea	99	99	99	99	0	0	0	0	0	99	0	99	0	99	99	0	99	99	0	0	99	99	0	0	99	99	0	0	99	99	99	0	99	0	99	54	30,629
	Atlantic Deep Sea	100	100	100	100	0	0	0	0	0	100	10	100	0	100	100	0	100	100	0	0	100	100	0	0	100	100	0	0	100	100	100	0	100	0	100	55	5,562,106
	Mediterranean Deep Sea	100	100	100	100	2	2	0	0	0	100	17	100	0	100	100	0	100	100	0	0	100	100	0	0	100	100	0	0	100	100	100	0	100	0	100	55	953,988
	Deep Black Sea	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	22,390

ND – No data.

5. Hotspots and synergies

Maximizing the cost-benefit of conservation investments from an ecosystem service perspective requires identifying and prioritizing conservation efforts in areas that offer outstanding sustainable benefits for humans.

5.1 Ecosystem service hotspots

A synthesis map highlighting the number of ecosystem services provided per given area was produced by calculating the **number of Ecosystem Services present in 10km by 10km cells. The EEA 10km reference grid** (ERG) was used after being clipped to the cells intersecting the study area. The results obtained at the different CICES levels and across the whole CICES hierarchy are presented in **Figure 44** and **Figure 45** respectively.

The analysis highlights shelf areas (most extensive around the British Isles, North Sea, Baltic and Adriatic) as ecosystem service hotspots along the European shores. On the other hand, in oceanic areas the areas exhibiting a larger ecosystem service capacity are island flanks, seamounts and ridges. These areas could be considered **benefit hotspots** if no biases affected the analyses (but see Discussion below).

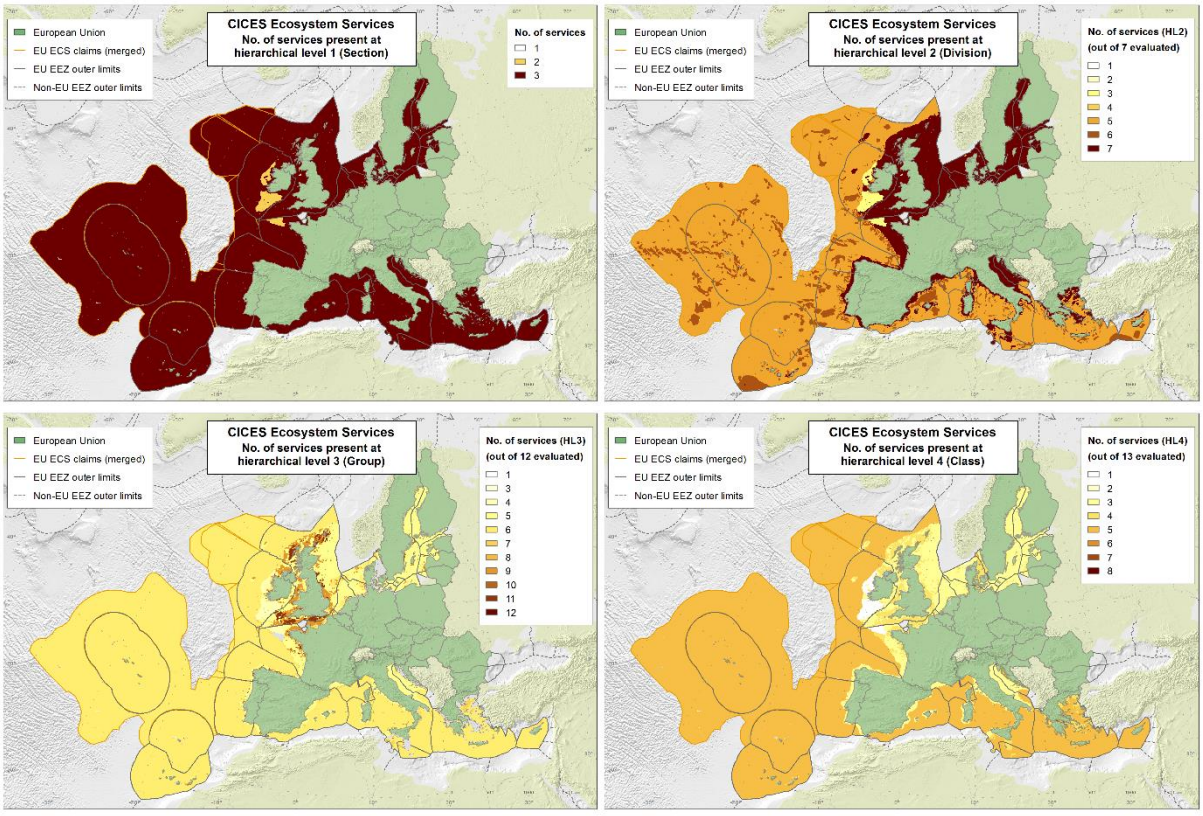


Figure 44. Number of Ecosystem Services per 10km by 10km cell. A: at CICES Section level; B: at CICES Division level; C: at CICES Group level; D: at CICES Class level.

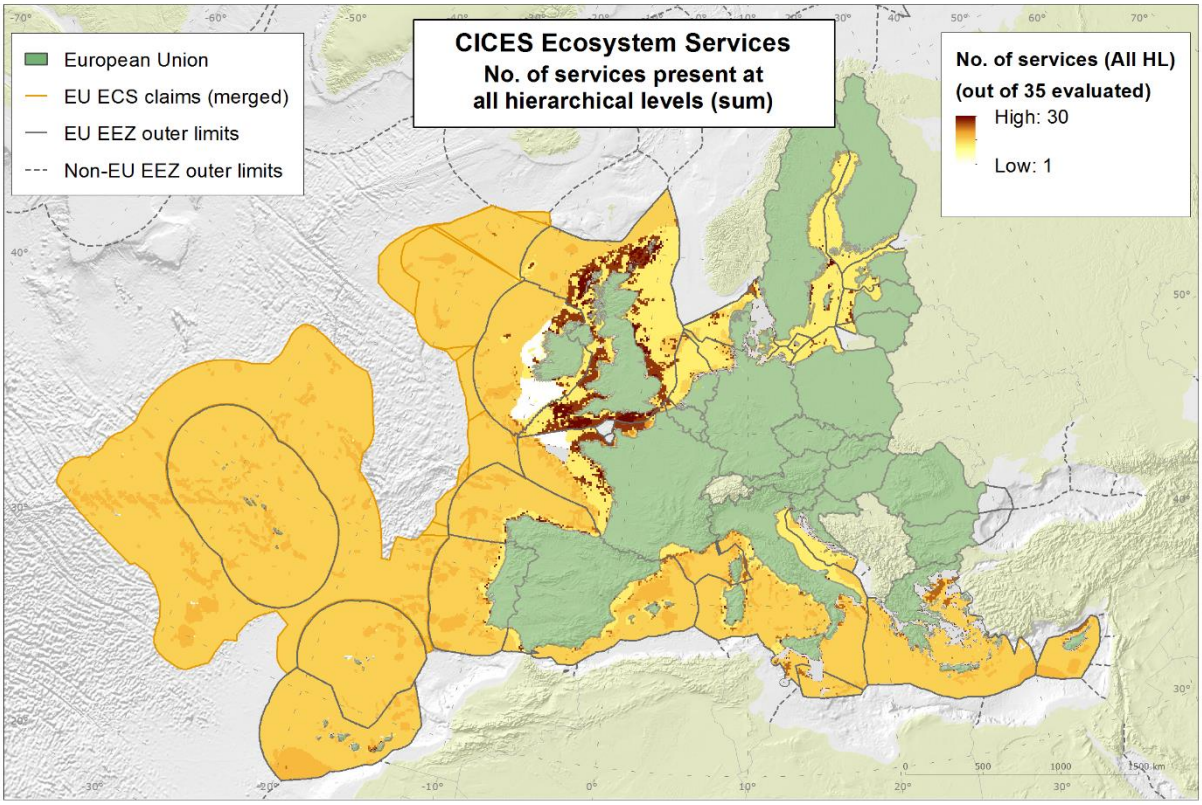


Figure 45. Cumulative number of Ecosystem Services across the whole CICES hierarchy per 10km by 10km cell.

5.2 Ecosystem service synergies

Functioning ecosystems produce multiple services and these interact in complex ways. Some ecosystem services interfere positively, with the consumption of a certain service facilitating the use of the same resource by other beneficiaries (synergy). Instead, other services interfere antagonistically, with a growing use by some beneficiaries curtailing the use of the same resource by rival or conflicting beneficiaries (tradeoff).
Given the unreliability of the absence data, this work used the "ecosystem service *versus* seabed habitat" lookup table to analyse which services are more likely co-occur, thereby focusing on ecosystem service synergies. These ecosystem service similarities were highlighted using clustering and ordination techniques of information visualization. In both cases, pairwise similarities between ecosystem services expressed by the *Jaccard index* were used. This coefficient was considered most appropriate for the data at stake as it focuses on presence data and does not include a term for double absences. It is formulated as:

$$Jaccard\ index = a/(a + b + c)$$

where:

a = number of habitats common to ecosystem services X and Y;
b = number of habitats unique to ecosystem service X;
c = number of habitats unique to ecosystem service Y.

The similarity matrix is graphically represented in **Figure 46**.

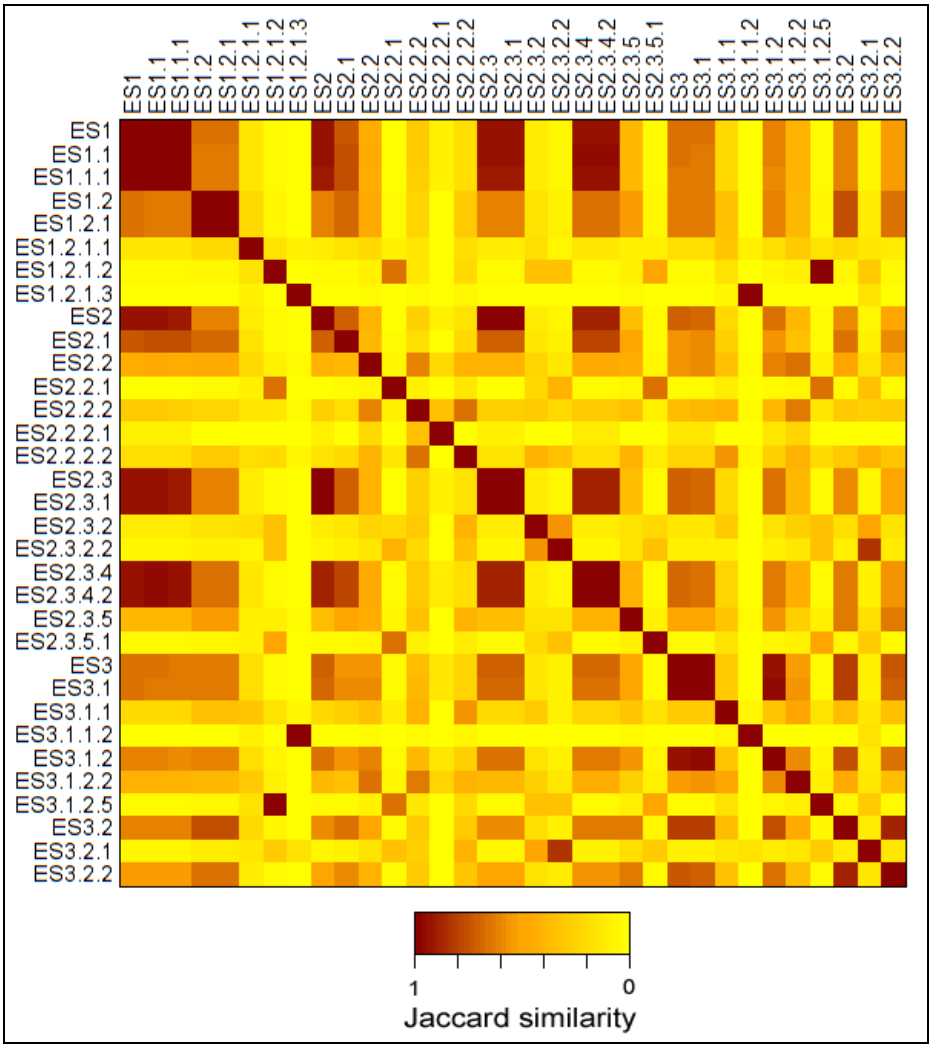


Figure 46. Colour-coded similarity matrix between ecosystem services using the Jaccard index.

Clustering was done using the Unweighted Pair Group Method with Arithmetic Mean (UPGMA) with the Jaccard index expressed as dissimilarity. The UPGMA is one of the most popular methods in ecology for constructing a dendrogram that reflects the structure present in a pairwise similarity (or dissimilarity) matrix between objects (or cases) described by a series of descriptors. At each cycle of the algorithm, the nearest two clusters are combined into a higher-level cluster. The distance between any two clusters A and B is taken to be the average of all distances between pairs of objects "x" in A and "y" in B, that is, the mean distance between elements of each cluster.

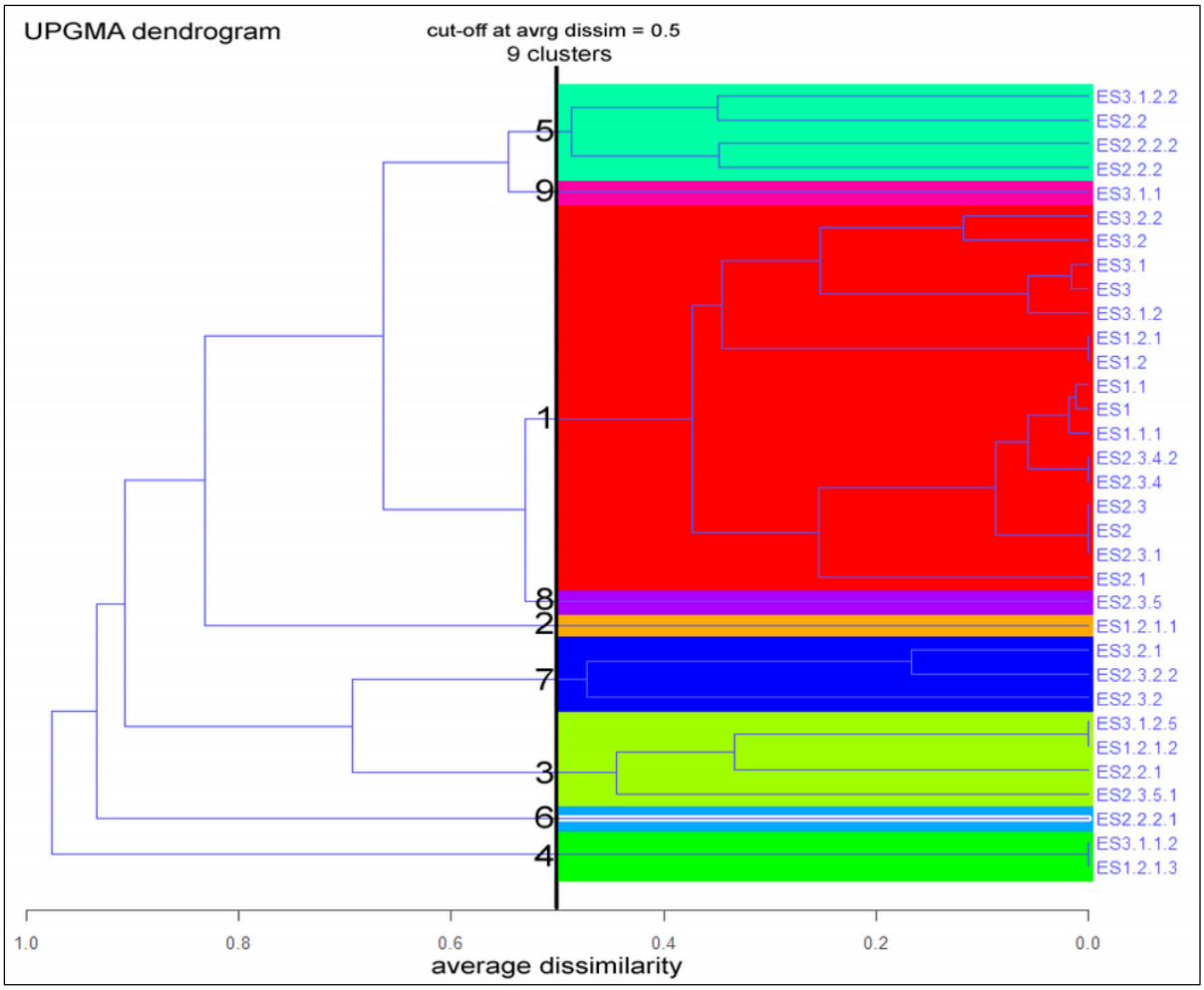


Figure 47. UPGMA clustering of ecosystem services from similarities based on seabed habitat co-occurrence.

A cut-off level of 0.5 dissimilarity was used to cluster ecosystem services, resulting in 9 groups of ecosystem services. The existence of significant differences between these groups of ecosystem services was analysed using ANOSIM. This non-parametric method tests whether two or more groups of objects (set by a categorical factor) are significantly different based on the ranks of the dissimilarities contained in the dissimilarity matrix. An R statistic is calculated by the method which ranges between -1 (anti-grouping) to +1 (strong grouping), with a value of 0 indicating random grouping. Statistical significance is assessed via a permutation test where the assignment of objects to groups is randomly permutated a selected number of times (e.g., 999). An R statistic is computed for each permutation and the *p*-value is the proportion of permuted R statistics that are equal to or greater than the original (unpermutated) R statistic. A statistically-significant R between 0 and 1 indicates that the samples within groups are more similar than would be expected by random chance.

In our case, both the R statistic of 0.989 and the very small *p*-value (p=0.001) support the fact that the groups of Ecosystem Service set by the 0.5 dissimilarity cut-off are valid distinct groups. These groups are summarized in **Table 33**.

Table 33. Clusters of Ecosystem Services as determined by similarities in delivering seabed habitats.

Cluster	Ref.	Ecosystem Service
1	**ES1**	**Provisioning**
	ES1.1	Nutrition
	ES1.1.1	(Prov.; Nutr.) Biomass
	ES1.2	Materials
	ES1.2.1	Biomass
	ES2	**Regulation & Maintenance**
	ES2.1	Mediation of waste, toxics and other nuisances
	ES2.3	Maintenance of physical, chemical, biological conditions
	ES2.3.1	Lifecycle maintenance, habitat and gene pool protection
	ES2.3.4	Water conditions
	ES2.3.4.2	Chemical condition of salt waters
	ES3	**Cultural**
	ES3.1	Physical and intellectual interactions with biota, ecosystems, and seascapes [environmental settings]
	ES3.1.2	Intellectual and representative interactions
	ES3.2	Spiritual, symbolic and other interactions with biota, ecosystems, and seascapes [environmental settings]
	ES3.2.2	Other cultural outputs
2	ES1.2.1.1	Fibres and other materials from plants, algae and animals for direct use or processing
3	ES1.2.1.2	Materials from plants, algae and animals for agricultural use
	ES2.2.1	Mass flows
	ES2.3.5.1	Global climate regulation by reduction of greenhouse gas concentrations
	ES3.1.2.5	Aesthetic
4	ES1.2.1.3	Genetic materials from all biota
	ES3.1.1.2	Physical use of seascapes in different environmental settings
5	ES2.2	Mediation of flows
	ES2.2.2	Liquid flows
	ES2.2.2.2	Flood protection
	ES3.1.2.2	Educational
6	ES2.2.2.1	Hydrological cycle and water flow maintenance
7	ES2.3.2	Pest and disease control
	ES2.3.2.2	Disease control
	ES3.2.1	Spiritual and/or emblematic
8	ES2.3.5	Atmospheric composition and climate regulation
9	ES3.1.1	Physical and experiential interactions

These clusters are also highlighted by the ordination analysis conducted using non-metric Multi-Dimensional Scaling (**Figure 48**). This technique uses the level of dissimilarity (or distance) between objects (in this case, ecosystem services described by the habitats where they occur) to place them in an N-dimensional space in a way that between-object distances are preserved as well as possible. The low level of stress obtained in the two-dimensional plot (0.084) indicates a reliable preservation of relative similarities.

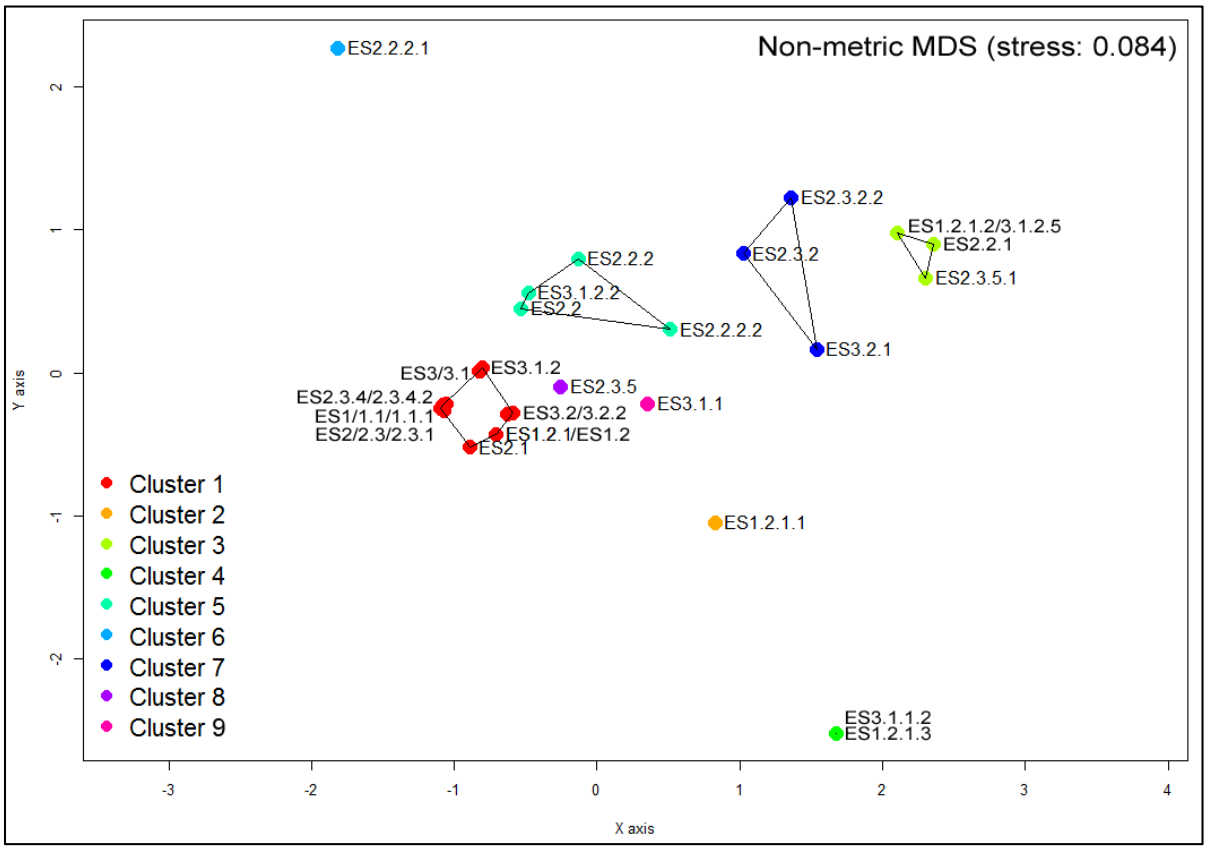


Figure 48. Non-metric MDS ordination of ecosystem services from similarities based on seabed habitat co-occurrence.

6. Discussion

The broadscale maps presented in this report are instrumental to illustrate and understand the spatial distribution of ecosystem service capacity throughout the European Seas required under the MAES process. The maps are based on a new compilation of EUNIS seafloor habitat geospatial information that extends the spatial coverage of similar exercises previously published (notably Galparsoro et al., 2014), covering most EEZs and claimed Extended Continental Shelf areas. Habitat distributions are translated into maps of ecosystem services by using an updated inventory of the ecosystem services related to each habitat. Several of the issues affecting this type of proxy-based analyses are discussed below, including suggestions on how to address them in future exercises.

6.1 Broadscale generalisation

Throughout their extent, habitats encompass more or less significant fluctuations in species composition and abundance as a result of varying abiotic and/or biotic conditions. Because the habitat capacity to provide ecosystem services depends functionally on the presence of a particular biotic feature, habitat patchiness entails spatial discontinuities in ecosystem service delivery.

As highlighted by Potts et al. (2014), it is also **more straightforward to associate ecosystem service capacity levels to more specific habitats with better biological resolution** than to more generic ones. Consequently, the more broadscale the habitat class concerned is, the more significant and uncertain will be the variations of the biological systems encompassed.

As defined by Eigenbrod et al (2010), **generalisation errors** are those due to the assumption that the value of an ecosystem service for a particular landscape unit is (i) the same in the area being mapped as in the studies from which the appraisal was obtained; and (ii) does not vary across the entire area being mapped. Plummer (2009) considers them a common error in the context of proxy-based ecosystem service mapping.

Because maps of highly-resolved habitats are not extensively available for the European Seas, the present work exploited **broadscale seabed habitat maps as a proxy for ecosystem distribution**. This forcibly implies a degree of generalisation that likely induced a spatial inflation of the ecosystem service associated with the geomorphological classes. Although this might be acceptable under a **precautionary perspective** of hotspot probing, it still calls for a refinement of habitat maps and an improved inventory of ecosystem services provided per habitat.

6.1.1 *Classification and mapping enhancements*

A revision of EUNIS marine section is forthcoming from the European Environmental Agency. Upcoming changes will likely include, firstly, a new framework for the upper marine habitat classes down to EUNIS level 3/4 and, at a second stage, an enhancement of the lower marine habitat classes at levels 4 to 6.

The new EUNIS framework will allow a more exact association of ecosystem services to more detailed marine habitats. For as long as this is accompanied by new maps of highly-resolved habitats for the European basins, better habitat-based ecosystem service mapping will be possible. This sets the scene for a refinement of the current assessment that should yield an identification of priority areas that is less inflated by generalisations. Such improvements will permit working at smaller scales, reinforcing the potential of the ecosystem service assessment at national levels and to stakeholders managing sub-national areas.

6.2 Geographical biases

Given that habitat maps were compiled from **two sources exploiting heterogeneous approaches** (EUSeaMap/EMODNET and Global Seafloor Geomorphic Features Map), the mapped extents of several habitats are more accurately represented in some regions than in others. As presented in Tempera (2015), **the eastern Mediterranean, the Black Sea, wider Atlantic deep-sea areas (including part of Macaronesia) and some shelf sectors of the Celtic Seas, Kattegat and Western Baltic await the completion of a harmonised EMODNET coverage**. These areas are currently covered solely by geomorphologically-based EUNIS seabed habitat classes derived from the GSGFM. In other areas, both sources overlap, exploiting EUNIS classes both from a substrate type basis and a geomorphological one. This introduced some bias across the study area. An **underestimation of ecosystem services is expected in areas covered only by the GSGFM when compared to areas covered by both EMODNET and GSGFM**.

Completing the mapping of the data poor regions is essential to mitigate the underestimation artefacts of ecosystem services in several sectors of the European Seas. This will be possible when the EMODNET Seabed Habitats programme completes its harmonised EUNIS-compliant coverage of the European Seas by 2016. Finally, an effort is also required to sort out the EUNIS integration of the substrate-based and the geomorphological pathways, eliminating the concurring classification of some areas (particularly deep-sea ones) via the two pathways.

A geographical bias may also have been introduced by the application of context-specific knowledge to broader areas. In fact the understanding of marine habitat functions and services often originates from studies conducted in specific sites and circumstances that may not be representative of other areas. A deficit of marine and coastal ecosystem service studies concerning southern Europe in comparison with Northern Europe has already been pointed out by Liquete et al. (2013a), as well as the lower number of studies concerning the open ocean ecosystems in comparison with coastal ecosystems.

6.3 Habitat-service relationships

The new synthesis of the ecosystem services associated in the literature to seabed habitats represents a new reference for proxy-based ecosystem service studies. Notwithstanding, results highlight the major gaps persisting in this knowledge. So far **14% of the EUNIS marine habitats** have been **related to at least one ecosystem service**. However, **out of all potential connections between the existing seabed EUNIS classes and CICES services**, **only 2% have been appraised** qualitatively or semi-quantitatively.

In a situation where the cartographic basis was very detailed, such incomplete knowledge would induce an underestimation of the area-based ecosystem service capacity due to many classes being left unassessed. However, this may have been countered in the present study by the overestimation associated with the generalisation implied by the use of broadscale habitats. The extent to which this happens remains unassessed.

The still limited representativeness of the lookup table emphasizes the need for strengthening the knowledge concerning the roles of the different habitats in delivering ecosystem services. This will require extending *in situ* observations of ecosystem functions over more habitat classes (and replicate them) as well as gauging service flows. Such information is crucial to further populate the ecosystem service lookup table and take advantage of the ever more detailed and extensive habitat maps. Expert consultation through targeted workshops and broad scientific reviews by established working groups are suggested as means to this end.

6.4 Quantification of ecosystem services

Our work summarizes **ecosystem service capacity in terms of areal extent**. Despite this is useful to gain a spatial insight of the studied systems and identify gaps, it provides no quantitative information on the variation of the service capacity or delivery throughout the mapped extents. From a technological perspective, assessing these variations across the different marine habitats has been hampered by the fact that most ecosystem functions occurring underwater are simply not directly observable from broad coverage instruments like sensors installed on satellites.

A provisional alternative to quantitative estimates of service capacity/provision would be to use **ordered scores** reflecting a service capacity level per habitat. Such semi-quantitative information did appear in the literature sources that informed this study. However, the differences in the scales and categories established by the different expert groups involved in the studies precluded their coherent translation into harmonized ordered scores. Hence our fall-back choice to reduce information to binary presence/absence categories.

Translating and harmonizing supply levels of ecosystem functions and/or services from expert judgements is complex and would require a dedicated expert effort. In some cases, the scientific information is available but not yet translated and integrated into ecosystem services assessments. Knowledge and expertise from all biogeographic regions should be called for to resolve whether similar habitats exhibit significant variations across Europe in terms of functions and services. Given the uncertainty associated with expert-judgements, **service scores** should be **accompanied by a confidence level** (e.g., see guidance in Mastrandrea et al., 2011).

Moving dependably from qualitative proxies to **accurate quantitative estimates of service capacity/provision will require more field measurements of biophysical functions**, experiments and modelling across the mosaic of ecosystem units. In the absence of algorithms conveying ecosystem functioning in a deterministic manner, statistical regression models are recommended as tools for relating the field measurements of ecosystem processes with a set of environmental and socio-economic variables. In the case of marine ecosystems, this will require coupling (i) broadscale environmental models that simulate physical, chemical and biological processes taking place in the overlying atmosphere, the water column and the seafloor with (ii) models that simulate socio-economic activities with an impact on marine ecosystems (Maes et al., 2011).

More than predicting ecosystem service provision for a set of static conditions, these models must be capable of estimating changes in service provision over time as a function of drivers and pressures like climate change and intensity of impacting maritime activities (Maes et al., 2011). The spatially-explicit metrics and indicators extracted from such models should ultimately (where possible) be converted into maps of economic benefits obtained from the services (e.g., Naidoo et al., 2008; Kienast et al., 2009; Nelson et al., 2009). Achieving this will require substantial international cooperation to integrate multidisciplinary modelling outputs and run a number of scenarios (see e.g. Schröter et al., 2005; Metzger et al., 2008).

6.5 Demand, supply and other measures of ecosystem services

As highlighted in the conceptual framework (section 2), this study reflects the potential capacity of seabed habitats to deliver ecosystem services, by focusing on the overall areal extent where services can be sourced from. Therefore, it falls short of mapping the flow of realized services that humans use and the associated benefits. The next steps should therefore focus on delimiting and quantifying the ***realized service flow*** areas in relation to the areas that are not currently exploited by man. In order to do this it will be necessary to take into account the interactions between the socio-economic activities and ecosystems. The flow of service is usually related to the demand and accessibility. If there

is no demand for a service, or the service is not accessible, ecosystems may hold considerable amounts of natural capital of interest to human societies but offer no service flow or benefits.

The extensive areas mapped in the current work as holding capacity to provide, notably, provisioning, scientific, educational services are a good example of this. Due to the lack of adequate technological or logistical infrastructure to access this areas (e.g., the deep sea) and/or economic reasons (e.g., fuel costs), several of these potential services are not exploited at present.

A possible way to analyse the flow of services in this context is to use a geospatial approach that considers the areas where each service is demanded or used by their beneficiaries [e.g., spatial footprint of maritime activities derived from Vessel Monitoring System (VMS) data]. A simple spatial overlap of qualitative capacity and demand/pressure footprints (e.g., binary presence/absence categories) will deliver pertinent area-based statistics, such as the percentage area of ecosystem service that is already being exploited. More exhaustive analyses may be conducted where the magnitude of exploitation is estimated, e.g., as semi-quantitative ranked pressure levels or continuous indices of pressure. In the absence of maritime activities footprints, coastal population density, location and class of harbour facilities, proximity/density of coastal roads may represent good proxies for coastal pressure and or accessibility.

6.5.1 *Sustainability*

The approach used in this study did not take into consideration whether the current levels of service exploitation (**flow**) are **compatible with the capacity** of the ecosystems to deliver those services, in particular the rates of natural replenishment of the exploited resources. Interpreting the balance between the two is crucial to assess **sustainability or overexploitation** of ecosystems and establish adequate public and private natural resource management measures.

Prioritising areas for management from a point of view of ecological sustainability will require understanding: (i) where the use of the natural capital of interest is being done sustainably, (ii) where sustainability is compromised but can be recovered and (iii) where sustainability cannot be achieved due to the recovery time-scales implied.

Measures of current service use or value by present human populations (e.g. fishery catch totals in tonnes per year, or their respective market value) are insufficient on their own to gauge sustainability. In fact, exploitation of a renewable biological resource at present may hinder the use of that service by future human populations, if the levels at which it is done compromise the resource replenishment. Therefore, the appraisal of current exploitation rates needs to be made in view of the biological boundaries that permit the desired continued use of the resource. Such concept corresponds to the Maximum Sustainable Yield (MSY) applied in fisheries, which estimates the level at which a service can be replenished by natural processes and therefore sustainably consumed into the future (Conservation International, 2012).

As far monospecific assessments go, a **sustainable service flow** may be declared where natural resource extraction is lower than the accessible surplus (or net ecosystem productivity), for as long as there are no significant trade-offs between use and production (see Weber, 2011 for details). Where the realized service exceeds the accessible surplus, the excess constitutes an **unsustainable ecosystem service**.

Such circumstances highlight priority areas for management where curbing the service to a level below corresponding MSY is required. Over-exploitation of ecosystems or species with low resilience and/or slow recovery may be likened to ‘‘mining’’ as natural stocks are not expected to rebuild and service delivery may be compromised for lengths of time amounting to more than a human generation. This is the case of many cartilaginous and deep-sea fishes which exhibit biological characteristics like slow growth and/or low breeding rates that prevent them from rapidly rebuilding their stocks.

Despite offering auditable assessments and tangible metrics, the analysis of fish stocks under the MSY theory is still not a holistic ecosystem analysis and tends to disregard interspecific relationships and habitat degradation effects, among other important factors for commercial species. The spatio-temporal comparison of ecosystem service capacity and flow/benefit (also called supply and demand, or stock and flow in other contexts) may support a more comprehensive sustainability analysis. This should entail a refinement of spatio-temporal aggregation rules, at the level of both the supply and demand metrics. The Fisheries Areas that currently frame most EU fisheries assessments preclude sustainability from being assessed at fine spatial scales where depletion associated with limited biological connectivity may still lastingly compromise recovery of living resources. Temporarily ignoring such effects prevents a timely introduction of corrective management measures aiming towards sustainability.

6.6 Implications to policy

This study delivers not only an improved and harmonized CICES ecosystem service lookup table per EUNIS marine habitat but demonstrates also their use with geospatial data. The series of maps presented are important tools for communication, policy guidance and decision-making. They provide a spatially-explicit overview of marine ecosystem services capacity across the European Seas that is valid as an initial Pan-European marine contribution towards the MAES process (EU Biodiversity Strategy to 2020) and may scope actions under the Marine Strategy Framework Directive (MSFD), the Marine Spatial Planning Directive (MSPD) and the Common Fisheries Policy (CFP).

In order to facilitate their dissemination and use the **new geospatial datasets are made available online through the JRC data portal (http://data.jrc.ec.europa.eu/)**. The spatial resolution of the maps is best suited for shaping policies and initiatives aimed at achieving sustainability and spatial planning in the marine environment at European and regional levels.

6.6.1 *Hotspots*

Proxy-based maps are recognisably crude estimates of ecosystem services' actual distributions (e.g. Turner et al., 2007; Naidoo et al., 2008; Eigenbrod et al., 2010). Their capacity to pinpoint hotspots offering multiple services is limited and caution is therefore necessary when using these putative hotspots to prioritize conservation efforts. Notwithstanding, the pinpointed geographical areas instigate further hypothesis-testing and validation by alternative methods, notably in view of more systematic EUNIS maps for the EU Seas and a more complete ecosystem service lookup table.

Upon confirmation, it will be necessary to analyse where these hotspots coincide with already established protected areas (namely Natura 2000 sites or Marine Protected Areas). Where they do not, it will be necessary to define the percentage to be protected and how the areas should be distributed. Because it will be necessary to award protection to multiple ecosystem services, decision support tools that prioritize areas using multi-criteria optimization will be of use to design this network. The level of priority of an area may be determined by an analysis of the area's *value* (the frequency, quantity, or condition of each feature), *irreplaceability*, *importance to beneficiaries*, type and level of *threat*, and the degree of *integration* (overlap and trade-offs) of multiple features (Conservation International, 2012).

6.6.2 *Support to Member States ecosystem services assessments*

Where the resolution of the data is not too coarse for the geographical scope of the analysis (i.e., in the case of Member States with large marine areas), the new information can be used at a national level, particularly whilst contextualising national data against eco-regional or European-wide statistics.

Proxy-based studies using broadscale landscape units like EUNIS marine habitats are unlikely to capture variation in ecosystem services at a small enough scale that is relevant for management at the level of the smaller Member States and sub-national level. In these cases, the methodology proposed can still be replicated with better geographical information available locally. Maps of value for these exercises should (i) resolve marine habitats in finer spatial resolution (i.e., using grid cells smaller than 10x10km) and (ii) further detail habitat classes (e.g. EUNIS level 4 to 6). Otherwise, ecosystem services could be generalised to areas that are too broad and area-based capacity could be overestimated.

7. Conclusions

By addressing the "what is available where?" question, broadscale qualitative mapping of marine ecosystem service capacity is recognized as a first step on the route towards a quantitative assessment of the ecosystem services actually flowing from the EU Seas. The **area-based indicators for ecosystem services** that are presented in this report represent the most comprehensive spatially-explicit baseline currently available for assessing the **distribution of marine ecosystem services in Europe**.

This comprehensive mapping of the distribution of seabed-associated ecosystem services capacity was possible by bringing together, and harmonizing where needed, broadscale data on the distribution of **permanently-submerged seabed habitats** from EUSeaMap/EMODNET and Global Seafloor Geomorphic Features Map. This new compilation of EUNIS-harmonized broadscale seabed habitat maps went beyond previous exercises and covered most EU waters extending out to EEZ limits and covering claimed Extended Continental Shelf areas. This permitted covering approximately 8.7 million km^2 **corresponding to more than 90% of the EU seafloor area**.

Alongside, a new comprehensive **lookup table of expert-based scores of seabed EUNIS and non-EUNIS habitats' capacity to provide CICES-harmonized Ecosystem Services** was assembled from a literature review. This comprehensive synthesis represents an updated reference base for habitat-based ecosystem service studies with the benefit of being harmonized to EU standard classifications. It shows that **14% of the EUNIS marine habitats are related to at least one ecosystem service** in the literature sources. However, the fact that only 2% of the lookup table cells have been filled with qualitative or semi-quantitative scores emphasized also the **poor knowledge that persists concerning relationships between CICES categories and seabed EUNIS classes**.

By being spatially-explicit, the exercise allowed an area-based assessment of service provision capacity based on different spatial segmentations (e.g., biophysical units, administrative areas). The results highlighted that **continental shelves and oceanic elevations (islands, seamounts and ridges) are ecosystem services hotspots** where a larger number of services can be potentially delivered. When **area-based ecosystem service indicators** were extracted using a **segmentation based on MSFD** boundaries, the Extended Continental Shelf claimed areas claimed by the EU MS in the Northeast Atlantic, together with the Celtic Seas and the Greater North Sea sub-regions stand as the regions containing most ecosystem service capacity. An **ecoregion**-based segmentation of the maps emphasizes the Atlantic Deep Sea as the major potential service provider, followed by ecoregions containing large shelves, notably the Boreal Proper, the Boreal-Lusitanean and the Western Mediterranean. A disaggregation of the results by **Fishing Area** highlighted the Northeast Atlantic, namely areas around the British Isles and Macaronesia as well as the western Mediterranean. When an **approximation of EU Member States (MS) maritime areas** in the Northeast Atlantic and Adjacent Seas is used, MS with larger EEZs (namely, UK, IT, PT and ES) come up as holding most of the marine ecosystem service capacity.

8. Further work

Options to develop the analysis in the future are presented in greater detail in the discussion (section 6). In summary, the main activities include:

Enhancement of Marine Habitat Maps and Classification

(i) sourcing information with **more detailed habitat classes** (e.g. EUNIS level 4 to 6), notably in terms of fine biotic composition; the use of refined habitat classes should reduce generalisation (and thus areal overestimation) when allocating ecosystem services to habitats;

(ii) sourcing marine habitat information with **finer spatial resolution**; this will permit addressing ecosystem service distribution at scales more relevant for national and sub-national decision-making;

(iii) promoting (or contributing to) a comprehensive, systematic, harmonized and increasingly-detailed knowledge-base (maps) of the **distribution of seabed habitats** throughout EU waters (extending to all EU outermost regions); this shall reduce the geographical bias of the information and areal underestimation for a number of habitats;

Marine Ecosystem Service Mapping and Assessment

(iv) enhancing the knowledge of the CICES ecosystem services provided by seabed EUNIS habitat classes (**ecosystem service lookup table**) taking note of possible regional variations;

(v) agreeing upon national jurisdiction, MSFD, or biogeographic **segmentations of the EU seas** that can be used to derive statistics and indicators;

(vi) estimating the **amount of services** flowing from marine and coastal ecosystems using process-based approaches or, at least, harmonized ordered semi-quantitative scores;

(vii) **contrasting** seabed-related ecosystem service distribution **with activity/impact distribution** (including present demand and future scenarios);

Sustainability

(viii) assessing the **sustainability** of service provision by mapping the rates of demand/extraction (for direct use and by indirect damage/loss) *versus* natural capacity and renewal rates;

Valuation

(ix) **articulating the benefits** humans derive from marine ecosystems and find ways of reliably valuating them in monetary terms;

(x) integrating valuated environmental services in conventional **economic accounting systems**.

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List of abbreviations

Ad – Adriatic

AIS - Automatic Identification System

ANOSIM - Analysis of similarity

Avrg - Average

Bal – Baltic

BG - Bulgaria

CBD - Convention on Biological Diversity

CECAF - Fishery Committee for the Eastern Central Atlantic

CFP - Common Fisheries Policy

CICES - Common International Classification of Ecosystem Services

CPUE - Catch per unit effort

DCF - Data Collection Framework

Dissim. - Dissimilarity

DK - Denmark

DNA - Deoxyribonucleic acid

DOM - French overseas department (département d'outre-mer)

DOPA - Digital Observatory for Protected Areas

ECS - Extended Continental Shelf claims

EEA - European Environment Agency

EEZ – Exclusive Economic Zones

EH - Western Sahara

EIONET - European Environmental Information Observation Network

EL - Greece

EMIS - Environmental Marine Information System for Europe

EMODNET - European Marine Observation and Data Network

ERG - European Reference Grid

ES – Ecosystem service

ES - Spain

ETC-BD/EEA - European Topic Centre on Biological Diversity for the European Environment Agency

ETRS - European Terrestrial Reference System

EU - European Union

EU Reg. – European Union Regulation

EUNIS - European Nature Information System

EUSeaMap – European marine broad-scale habitat map

FAO - United Nations Food and Agriculture Organization

FI - Finland

FR - France

GFCM - General Fisheries Commission for the Mediterranean

GI - Gibraltar

GSGFM - Global Seafloor Geomorphic Features Map

GSHHS - Global Self-consistent Hierarchical High-resolution Shorelines

ha - Hectares

HELCOM - Baltic Marine Environment Protection Commission

HL – hierarchical level

HM - heavy metals

ICES - International Council for the Exploration of the Sea

IE - Ireland

IT - Italy

JRC – Joint Research Centre

km – kilometres

km^2 – Square kilometres

LIDAR - Light Detection and Ranging

m – Metres

MA - Morocco

MAES - Mapping and Assessment of Ecosystems and their Services

MC - Monaco

MDS - Multi-Dimensional Scaling

MEA - Millennium Ecosystem Assessment

MPA – Marine Protected Area

MS - Member States

MSFD - Marine Strategy Framework Directive

MSPD - Marine Spatial Planning Directive

MSY - Maximum Sustainable Yield

NA – Not Applicable

NC - North and Celtic Seas

ND – No Data

NE - Northeast

nm – Nautical Miles

NOAA - National Oceanic and Atmospheric Administration

NW - Northwest

NW - Northwest

OR - Outermost Region

OSPAR - Convention for the Protection of the Marine Environment of the North-East Atlantic

PLC - Pollution Load Compilations

POP - Persistent Organic Pollutants

PT - Portugal

RO - Romania

RU - Russia

S - South

SE - Sweden

SEEA – United Nations System of Environmental-Economic Accounts

Smts - Seamounts

SW – Southwest

TEEB - The Economics of Ecosystems and Biodiversity

ton - tonnes

tonC – tonnes of carbon equivalent

TR - Turkey

UA - Ukraine

UK – United Kingdom

UNEP - United Nations Environment Programme

UPGMA - Unweighted Pair Group Method with Arithmetic Mean

VMS - Vessel Monitoring Systems

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Publications Office

doi:10.2788/753996

ISBN 978-92-79-57762-8