

Work package 1

Deliverable: D1.2 Overview of existing priorities, status and capacity in relevant fields of research and innovation in the Baltic Sea and the North Sea regions

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The main outcomes

- The national research priorities in the marine and maritime fields are in general well in line with the strategic and specific objectives defined in BANOS CSA task 1.1 Scoping the strategic framework for the future programme. This means that a common scientific basis of the strategic research and innovation agenda of the intended BANOS Programme can be built on the outcomes of these two tasks.
- The well-equipped marine infrastructure and research facilities (numerous institutions and laboratories, high number of research vessels and other technical equipment) and a critical mass of marine scientists implies that BANOS countries are investing in marine and maritime research and innovation.
- Some of the world-renowned research institutions are based in the BANOS scope region (e.g. NOC Southampton, AWI, IFREMER, NIOZ, SYKE). This concentrated scientific expertise plays a fundamental role for the European Research Area and must be maintained and further developed in the coming years.

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Description of task: (i.e. as in the Description of Work)

This challenging task aims at setting up an overview of the research and innovation priorities in the Baltic Sea and the North Sea basins. These priorities will be developed from an analysis of the existing landscape of national marine and maritime research and innovation strategies defined in these basins, and take account of the current research and innovation capabilities that may need to be strengthened further. Highly relevant research and innovation strategies and foresight analyses issued by transnational initiatives by the member states or research performing organisations e.g. JPI, ERA-nets and networks, e.g. ICES, European Marine Board, EFARO, EuroMarine etc. will also be considered. The outcome will be the basis from which the strategic research and innovation agenda (SRIA) of this proposal will be further developed. As the principal aim of the programme is to promote innovative science contributing to sustainable blue growth and providing knowledge for the implementation of the Agenda 2030 goals, it must be demonstrated that the SRIA proposal will go well beyond the current state-of-the-art. The overview of existing research and innovation priorities prepared by the task leader will be discussed at the Forum of Programme Managers (T5.5) and adopted by the BANOS CSA Steering Committee (T5.1). The work on this task will continue from month 1 to month 8 of the project implementation.

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Executive Summary

The deliverable 1.2 presents an overview of national marine and maritime research and innovation priorities of the 13 countries involved in the BANOS CSA. In addition, the priorities of 13 transnational organizations or initiatives were evaluated independently. The organizations or initiatives were chosen due to their prominent link to the BANOS CSA initial objectives¹, as well as, to provide a comprehensive representation of both global and European level research and innovation priorities. The priorities of relevant other funding programmes linked to European Structural and Investment Funds, such as INTERREG, are not covered here but included in a separate task T2.5 Exploring new forms of cooperation and co-funding mechanisms with initiatives financed by European Structural and Investment Funds.

The BANOS CSA D1.2, presented here, together with BANOS CSA D1.1 'Report defining scope of the future programme' are the first steps in the development of the BANOS CSA Strategic Research and Innovation Agenda (SRIA)². The results of these deliverables set the basis for the drafting of SRIA undertaken in BANOS CSA Task 1.3. Stakeholder input which aims to focus on policy and industry is collected as part of the BANOS CSA Task 1.4 'Strategic orientation workshop (SOW)', as the expert knowledge is provided by a dedicated SRIA drafting team hired for the purposes of T1.3. How best to involve the industry and SMEs in the future programme is additionally explored in a dedicated BANOS CSA task T4.5 'Developing strategies and instruments stimulating innovation diffusion and open innovation'.

The results presented here clearly indicate that the national marine and maritime research and innovation priorities are well aligned with results of the scoping analyses (D1.1). In addition, no significant gaps were identified. Therefore, the joint result of the D1.1. and D1.2 set a robust base for the further BANOS SRIA development.

In addition to the priority analyses, the marine research and innovation capabilities among the countries involved in the BANOS CSA were assessed. The assessment was primarily based on numbers of relevant institution and research vessels per country. The results illustrate that the BANOS countries are well equipped in the discipline and are investing in marine and maritime research and innovation. The highest capabilities were identified for countries with seagoing tradition, such as the United Kingdom, France and Germany followed by Norway and the Netherlands.

¹ As defined in BANOS CSA D1.1 Report defining scope of the future programme.

² BANOS CSA WP 1 Strategic research and innovation agenda

1 Introduction

The aim of task 1.2. of the BANOS CSA project is to produce an overview of the existing research and innovation priorities in the Baltic Sea and North Sea basins. This overview is based on an analysis of the existing landscape of national marine and maritime research and innovation (R&I) strategies within these sea basins. Relevant R&I strategies and foresight analyses issued by transnational initiatives or research performing organisations and networks (e.g. Joint Programming Initiatives, ERA-Nets, ICES, EMB, EFARO) as well as the EU-level policy documents are also considered as part of this overview. In respect to needs of industry and small and medium enterprises (SMEs), a specific innovation strategy³ will be developed.

The regional scope of BANOS CSA encompasses 13 European countries (Belgium, Denmark, Estonia, Finland, France, Germany, Latvia, Lithuania, Netherlands, Norway, Poland, Sweden and United Kingdom), which are all part of this analyses. Identification of the common marine and maritime activities and research and innovation needs are the connecting elements included in this deliverable.

Strong collaboration in the European and northern marine and maritime landscape, which has existed for many years already, is also reflected by the inclusion of analyses of multiple transnational initiatives, like JPI-Oceans, OSPAR, EMB, HELCOM, BONUS and several ERA-Nets in this deliverable. BONUS EEIG, the coordinator of BANOS CSA has also established a strong links with the regional Baltic INTERRG programmes, especially INTERREG Baltic Sea Region. The strategies how to incorporate best with structural funds and build on the BONUS legacy will be further elaborated in the BANOS CSA deliverable *D2.8 Report on new forms of cooperation and co-funding mechanisms with initiatives financed by ESIF and other sources* (T2.5 M28).

In addition to common political goals (e.g. UN's Agenda 2030 for Sustainable Development) and research and innovation frameworks (e.g. JPI-Oceans SRIA or Horizon 2020), country- and region-specific research and innovation needs (structural and thematic) should be incorporated into the BANOS SRIA development. Currently, there is a lack of (1) an overview of the marine and maritime research and innovation landscape in the BANOS region as well as (2) a comparative analysis of country-specific research and innovation topics and priorities. This report intends to fill these knowledge gaps. This overview and analysis is crucially needed as one of the first steps of the BANOS SRIA development, as the results of this report, together with the outcomes of the BANOS CSA task 1.1 *Scoping for the strategic framework for the future programme*, form the basis for the further development of a strategic research and innovation agenda (SRIA) for the Baltic and North Sea Region⁴.

The report is structured in 3 chapters:

Chapter 1 focusses on the national research and innovation priorities in the marine and maritime sector. It gives a short overview of the most significant national priorities. Further, more detailed, information is provided in the Annex 1 of the report. In addition, to get an impression of the national marine research and innovation capabilities, an estimate of numbers of the most important marine

³ D4.6. Report (incl. recommendations) on strategies and instruments to support responsible and sustainable innovation in the Baltic and North Sea region. (T4.5)

⁴ D1.5 Final draft of the proposed new joint Baltic Sea and North Sea research and innovation programme SRIA. (T1.3)

and maritime research and innovation organisations and research groups is provided, as well as the numbers of selected marine infrastructures with a focus on research vessels.

Chapter 2 focusses on transnational research and innovation priorities. A number of transnational research and innovation strategies have emerged in recent years in order to protect the marine environment and to support decision making processes on EU and global level in respect to marine and maritime activities. In this report marine research and innovation priorities of 13 transnational organisations and initiatives are evaluated with a direct relevance to current and future EU marine strategies and policies, and as such to BANOS CSA.

Chapter 3 summarises important EU-level policy documents that should be considered in the subsequent steps in the development of BANOS CSA SRIA.

2 Methodology

An initial overview of mapping of the national and transnational research and innovation priorities was based on internet-based desk research. Afterwards, additional information was provided by the project partners to cross-check the collected data and fill in any gaps in the database. Subsequently, the combined results were presented at the BANOS CSA Forum of Programme Managers (FPM) meeting on 13th March 2019. Following the discussions at the FPM meeting, the partners were given an idea of what the thematic framework for the new research and innovation programme could look like. On this basis, a structure for the present report was further developed and sent to the partners as a further query.

Both national and transnational research and innovation priorities were evaluated against the specific and strategic objectives (Table 1), identified in the BANOS CSA task 1.1⁵. The evaluation was primarily based on key-word searches in the respective strategy documents, listed in Table 6 for national priorities (section *Overview of existing research and innovation priorities per country*) and in Table 7 for transnational priorities (section *Transitional Research and Innovation Priorities*)

Table 1. Strategic and specific objectives of the intended future joint Baltic and North Sea R&I programme identified in BANOS CSA task 1.1. Scoping the strategic framework for the future programme. These objectives were analysed and cross-referenced with here identified national and transnational research and innovation priorities

Strategic Objectives	Healthy Seas and Coasts	Sustainable Blue Economy	Human Wellbeing
Specific Objectives	A resilient marine ecosystem	Sustainable resource management of marine global commons	Safe food and feed
	Seamless governance linking land, coast and sea	Understanding the value of ecosystem goods and services	Safe and accessible coast
	Digital Ocean - Competent ecosystem modelling, assessments and forecasting	Smart Seas - sustainable, circular and bio-based blue solutions	Open Science - Access to knowledge and information
	Efficient techniques for environmental monitoring		

⁵ Task 1.1 Scoping the strategic framework for the future programme

To gain insight into the national research and innovation capabilities, BANOS CSA member organizations were asked to provide information on numbers of the respective national institutions conducting marine and maritime research and innovation. In addition, members were asked to provide information on number of (permanent) staff, working in the marine sector in the respective institutes. Data on national infrastructure, especially in respect to research vessels, was based on data provided by the European Research Vessel Infobase (<http://www.rvinfobase.eurocean.org/>). The research vessel data was cross-checked and updated by the partner organizations. However, due to structural differences in how the marine and maritime research and innovation priorities are managed in the different BANOS CSA partner countries, it was in general challenging to create a comparable database of national research and innovation capabilities, for example in respect to the size and impact of institutions. In addition, challenges were associated with estimation of staff involved in marine sector as such data was not readily available for all countries addressed in this study.

The Global Ocean Science Report (UNESCO IOC 2017, <https://en.unesco.org/gosr>) and the extensive JPI Oceans “Mapping of science landscape and preliminary analysis” (published 2015 as CSA Oceans report, <http://www.jpi-oceans.eu/library?spcollist%5B%5D=815&year=&Field=#main>) were also consulted as background documents for this report.

In the following report a summary of the main results is presented. The complete dataset and additional information can be found in the Annex 1, including detailed country specific description of the main marine and maritime research organisations, research vessels as well as research and innovation priorities.

3 Results

3.1 Chapter 1: National research and innovation priorities

3.1.1 Summary of national research and innovation priorities

Following challenges were encountered during the analyses of the national research and innovation priorities and these limitations should be considered in respect to data interpretations:

- Structure of marine and maritime research and innovation landscape varies among the countries and funding responsibilities are spread across multiple different types of funding organisations (several ministries, research organisations, funding agencies)
- Many countries lack a national marine research and innovation strategy. Instead, general information is included in overarching documents.
- Availability of data is somewhat limited, e.g., outdated information and strategies in some cases are only available in the national language
- Thematic boundaries and definitions vary among the countries (i.e. what topics encompass marine and maritime research and innovation?)
- Heterogenic input by project partners

In general the marine and maritime research and innovation strategies of the countries, participating in the BANOS CSA, are based on one or more of the following programme types: (i) countries with national marine/maritime research and innovation programmes, (ii) countries with regional programmes (county level), (iii) marine or maritime programme included in overarching national and EU level programmes:

- Countries with existing national marine/ maritime research and innovation programmes: Norway, UK, Germany, France, Latvia
- Countries with regional programmes: Sweden, Belgium, Netherlands
- Countries with no marine or maritime related programmes (themes included in overarching programmes on national and EU level): Denmark, Estonia, Poland, Lithuania, Finland

The national R&I priorities were compared and cross-referenced with the three strategic and ten specific objectives that were defined in the BANOS CSA task 1.1 report (Tables 2-5). Overall, it appears that approximately 86% of national research and innovation priorities are congruent with the BANOS CSA strategic and specific objectives.

Strategic objective 1: Healthy Seas and Coasts

Table 2. National research and innovation priorities evaluated against the four specific objectives within the strategic objective “Healthy Seas and Coasts” identified in the BANOS CSA task 1.1. X = highly relevant national priority, (X) = included within the national priorities with some reservation, empty cell= data lacking, or objective not listed within the country priorities.

Country	Resilient marine ecosystem	Seamless governance linking land, coast and sea	Digital Ocean – Competent ecosystem modelling, assessments and forecasting	Efficient technologies for environmental monitoring
Belgium	X	(X)	X	X
Denmark	X	(X)	(X)	X
Estonia	X			X
Finland	X	X	X	X
France	X	(X)	X	X
Germany	X	(X)	X	X
Latvia	X	X	X	
Lithuania	X	X	X	X
Netherlands	X	X		X
Norway	X		X	X
Poland	X			X
Sweden	X		X	X
United Kingdom	X	X	X	X

Research and innovation priorities focussing on an ecosystem-based management approaches, promoting resilient marine ecosystem are supported by all of the partner countries. The high support for the ecosystem-based management may be related to the legacy of the BONUS programme, in which it is highly valued, as well as in country strategies aiming to reach the good environmental status in response to the Marine Strategy Framework Directive (see chapter 3 for more details). Development of efficient technologies for environmental monitoring is also prioritized by all the countries, except Latvia.

Regarding specific objective “Seamless governance linking land, coast and sea”, the results are heterogeneous. This may be due to, at least in part, differences within the governing structures. For example, in some partner countries (*i.e.* Finland, Latvia, Lithuania, Netherlands and United Kingdom), interdisciplinary research, in respect to fresh water and marine researcher and innovation, is well connected, and the linkage between the responsible authorities works. In others (*i.e.* Denmark, Estonia and Norway), the topic is not directly mentioned within the research and innovation priorities or there is a lack of information about it. In case of Belgium, France and Germany, some efforts are evident but obstacles are likely to be associated with structural circumstances in the governance of marine/maritime and land related funding, which fall under the different responsible authorities.

With respect specific objective focussing on the digitisation, the national priorities are also not consistent. In some partner countries (*i.e.* Belgium, Finland, France, Germany, Latvia Lithuania, Sweden and United Kingdom), a clear priority is given to this topic and it is explicitly mentioned in the research and innovation agendas. In case of Denmark, the digitisation is not directly mentioned as a priority but is present in the national strategy documents. In case of Estonia, Netherlands and Poland, information on digitisation is not mentioned.

Strategic objective 2: Sustainable Blue Economy

Table 3. National research and innovation priorities evaluated against the three specific objectives within the strategic objective "Sustainable Blue Economy" identified in the BANOS CSA task 1.1. X = highly relevant national priority, (X) = included within the national priorities with some reservation, empty cell= data lacking, or objective not listed within the country priorities.

Country	Sustainable resource management of marine global commons	Understanding the value of ecosystem goods and services	Smart Seas – sustainable, circular and bio-based blue solutions
Belgium	(X)	X	X
Denmark	X	X	X
Estonia		X	(X)
Finland	X	X	X
France	X	X	X
Germany	X	X	X
Latvia	X	X	
Lithuania	X	X	X
Netherlands	X	X	X
Norway	X	X	X
Poland	X	X	
Sweden	X	X	X
United Kingdom	X	X	X

The strategic objective sustainable blue economy is generally well covered within the national research and innovation priorities of the BANOS CSA countries. The specific objectives are also relatively broadly formulated and represent important pillars in respect to future innovation and economy landscape of each of the partner countries. The gaps (*i.e.* Estonia and Poland) are related to lack of information. Two important points should be mentioned here:

- Belgium pursues a cluster policy with the "Blauwe Cluster" initiative⁶
- Lithuania Maritime Spatial Planning (MSP) plays an important strategic role in economic development of the country.

Strategic objective 3: Human Wellbeing

The strategic objective "Human Wellbeing" and the three respective specific objectives are well covered by the national R&I priorities of the BANOS CSA partner countries (Table 4). New and innovative research and innovation directions within the marine and maritime sector include topics such as safe nutrition or the availability of healthy fish and seafood and linking human wellness to the health of the marine ecosystem. Other new uprising topic, including citizen science, can also be used to increase the awareness of marine science among the general public. In case of Germany, it should be noted that research and innovation funding of fisheries and aquaculture sector are not within the research and innovation priorities of the Federal Ministry of Education and Research, the contracting authority of the BANOS CSA partner organization Jülich, but addressed by the Federal Ministry of Food and Agriculture. The other gaps in table 4 are due to lack of information on the subject of food and feed from Latvia and the UK.

⁶ A group of innovative private companies active in a wide range of sectors, have created an organization dedicated to developing and promoting economic activities that are linked to the sea.
<https://www.blauwecluster.be/>

Table 4. National research and innovation priorities evaluated against the three specific objectives within the strategic objective “Human Wellbeing” identified in the BANOS CSA task 1.1. X = highly relevant national priority, (X) = included within the national priorities with some reservation, empty cell= data lacking, or objective not listed within the country priorities.

Country	Safe seafood	Safe and accessible coast	Open Science Access to knowledge and information
Belgium	X	X	X
Denmark	X	X	X
Estonia			X
Finland	X	X	X
France	X	X	X
Germany	(X)	X	X
Latvia		X	X
Lithuania	X	X	
Netherlands	X	X	X
Norway	X	X	X
Poland	X		
Sweden	X	X	X
United Kingdom		X	X

Other national research and innovation priorities

Table 5. Other national priorities currently not covered by the BANOS CSA objectives identified in T1.1. X = highly relevant national priority, empty cell= data lacking, or objective not listed within the country priorities.

Country	Polar Research	Marinas/ ports development	CO2 capture and storage	Protection of archaeological values	Maritime safety
Belgium	X	(X)			
Denmark	X	(X)			X
Estonia		(X)			X
Finland	X	X			X
France	X	X			X
Germany	X	X			X
Latvia		(X)			
Lithuania		X			
Netherlands	X	X	X	X	X
Norway	X	(X)			(X)
Poland		(X)			
Sweden	X	X			
United Kingdom	X	X	X		(X)

Multiple additional national priorities were identified that are currently not listed in the objectives identified in T1.1 of BANOS CSA (Table 5). For example, in case of 9 partner countries polar research (both Arctic and Antarctic region) is important and mostly conducted within the national marine and maritime research programmes. Although the polar research is out of the geographic scope of the intended future BANOS programme, it is worth to highlight due to its high priority among multiple states and direct link to marine and maritime research and innovation. In addition, polar research is linked to the use of multiple infrastructures, which are discussed in the following section.

The development of marinas and ports are of priority for all BANOS partners and some countries have named the topic directly as a high research and innovation priority. More specific themes within this category, in relation to providing important information and solutions to port managers, include issues dealing with ballast water, the impact of alien species and effects of the sea level rise. Although currently not covered by the BANOS CSA objectives, this national priority is also directly

linked to the strategic objective “Sustainable Blue Economy” (smart seas) and to the objective “Human Wellbeing” as the marinas are important for industry development as well as for tourism.

CO₂ capture and storage are listed as a priority for the Netherlands and the UK. If BANOS CSA decides to include this priority in the subsequent development of BANOS CSA SRIA, it could well be included under the strategic objective "Sustainable Blue Economy".

Protection of archaeological values was only listed as a priority by the Netherlands. The research and innovation within this discipline may be linked to the development of multifactorial marine spatial planning management tools or/and to the development of maritime tourism and could therefore be categorised under the strategic objectives “Sustainable Blue Economy” or/and “Human Well-being”.

Maritime safety was explicitly listed as a priority by Denmark, Estonia, Finland, France, Germany and the Netherlands but is also important for other partner countries. This theme can be linked to strategic objective “Sustainable Blue Economy”, more specifically under the specific objective “Smart Seas - sustainable, circular and bio-based blue solutions”.

In addition to national research and innovation priorities, “Education and promotion of young researchers” was highlighted in the agenda documents of Estonia, France, Germany, Lithuania, the Netherlands and Norway. This priority should be considered in the future development of the SRIA and taken into account in the work of BANOS CSA task 4.3 *Strategies in support of human capacity building and skills development*.

3.1.2 Summary of research and innovation capabilities

Task 1.2 was set to assess the marine and maritime research and innovation capacity of the countries involved in BANOS CSA. Various possibilities were considered, including the amount of funding spent on marine and maritime research and innovation, the quantity (including type) of research infrastructure, the number of innovations or spin-offs or the number of human resources employed in each country. However, due to inconsistencies and limitations in the available data on a national level the results were limited.

In the end the task team decided to focus on marine research infrastructure, which is here used as a proxy to assess the national marine and maritime R&I capabilities (generally more infrastructure translating into higher capabilities). Two types of research infrastructure were included into the final analyses: (1) numbers of research vessels and other important infrastructure and (2) numbers of organisations performing marine and maritime related R&I, such as marine research groups and institutions, and evaluation of permanent staff numbers employed in this sector. However, it should be noted that especially with regards to the numbers of research organizations and staff, it was very difficult to collect concrete numbers and the presented datasets should be treated with care. As such, only the main organizations are considered to get an approximate idea of the concentrated power of marine research and innovation capabilities in the Baltic Sea and North Sea regions.

Marine research and innovation is closely linked to existing research infrastructure, such as research ships, laboratories, and technical equipment (e.g. sensors and much more), which are necessary prerequisites for conducting marine research. In total, 162 research vessels exist in the Northern Seas region. Of these 90 (56%) are classified as smaller vessels (size: $\geq 10\text{m}$ and $< 35\text{m}$) used on local

coastal areas only, 36 (22%) are classed as oceanic and regional research vessels (size: $\geq 35\text{m}$ and $< 65\text{m}$) and 35 (22%) vessels operate globally (size: $\geq 65\text{m}$) (Figure 1 and 2).

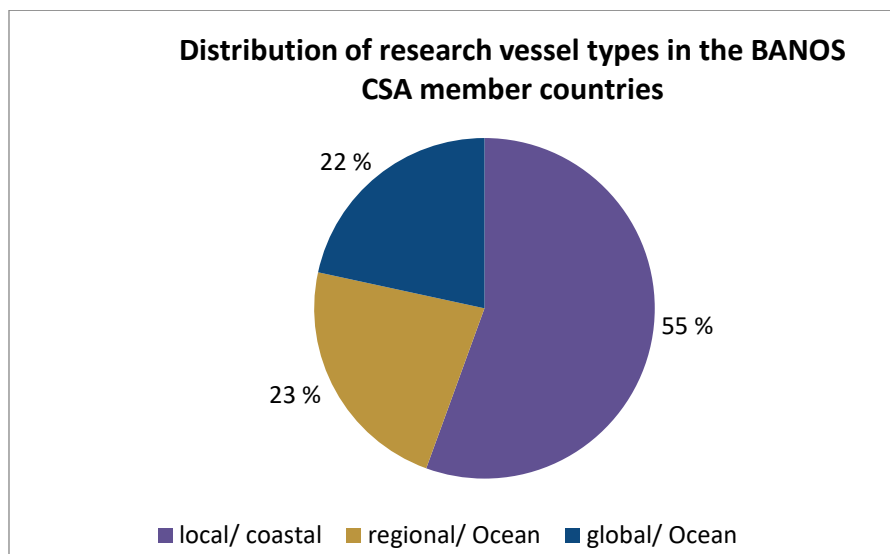


Figure 1. Distribution of research vessel types in the BANOS CSA member countries;
Source: European Research Vessels Infobase: <http://www.rvinfobase.eurocean.org/> Data validated and updated by BANOS
CSA project partners

Of the 36 global research vessels, more than 10 are owned by the UK, and both France and Germany also have 5 or more global research vessels each. Denmark, Norway, Netherlands, Sweden, Poland and Finland have at least one global research vessel each.

Germany owns the highest number of regional research vessels (with 12 vessels), followed by Norway with 5 vessels. The other countries, except Estonia and Latvia, have one or more.

All countries, except Latvia, own coastal/local research vessels. Both UK and France have more than 15 local vessels, followed by Germany with 12 vessels and Norway with 10. Sweden, Netherlands, Poland and Estonia have 5 or more local vessels.

Based on the research vessel data, UK, France and Germany have the highest capacity in the marine and maritime sector.

Obtaining reliable information on the number of marine research and innovation institutions, research groups or scientific staff was complicated due to relatively poor availability of information in the internet. In addition, problems were associated in respect to the differences in the classification (e.g. what constitutes a group) between BANOS CSA participating countries. Nevertheless, based on the available data, in total 128 universities and research and innovation institutions were identified to conduct marine research and innovation in the area of BANOS region. In more detail, 478 marine research groups were counted, employing over 14.600 permanent staff members. However, both of the latter quantifications should be treated with a caution and data treated as an approximate. Furthermore, two BANOS CSA partners (Netherlands and Sweden) were not able to deliver reliable data on the scientific staff numbers and four partners (Germany, Norway, Poland, UK) delivered only partial information. Although the data set is incomplete, it can be stated that Germany, UK and France have the highest numbers of research groups and permanent researchers, which is consistent

with the research vessel and infrastructure data. The lowest numbers of marine research groups are based in the Baltic States, which is in line with the general structural and socio-economic conditions.

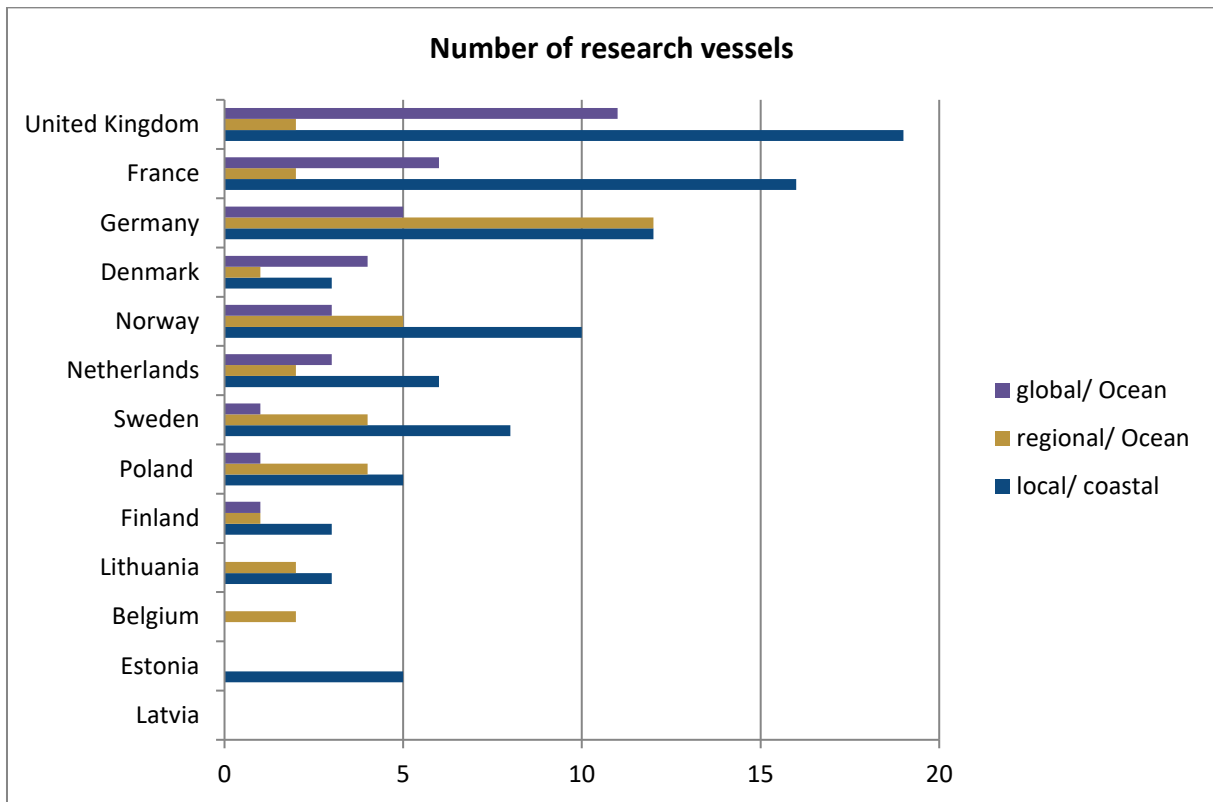


Figure 2. Number of research vessels per BANOS CSA participating country. Source: European Research Vessels Infobase <http://www.rvinfobase.eurocean.org/> Data validated by BANOS CSA project partners.

3.1.3 Country specific summaries of research and innovation priorities

In the following section country specific national marine research and innovation strategies, priorities, and research infrastructure and capabilities are summarised. For complete dataset, see Annex 1. For references used see section 3.1.4. The infrastructure & research and innovation capabilities estimates are based on data provided by the BANOS CSA project partners. The estimated of scientific staff could not be determined at all research and innovation institutions, and hence some data is absent.

Belgium

STRATEGY	
<p>Marine strategy of Belgium is based on overarching programmes on national and EU level. In addition, several regional initiatives exist.</p> <p>In respect to innovation, cluster organizations , which facilitate a network of companies, are active in a certain domains (e.g. “blue cluster”, or blauwe cluster, https://www.blauwecluster.be/) in order to increase their competitiveness through mutual cooperation and collaboration with knowledge institutes.</p>	
PRIORITIES IN RESEARCH AND INNOVATION	
<p>The approach at strategic level is embodied by the Flanders Marine Institute (VLIZ).</p> <p>Six large research and innovation themes are mentioned. All themes encourage a multidisciplinary research approach and apply to both fundamental as well as applied research and innovation:</p> <ol style="list-style-type: none"> 1. Ocean Services in a Changing Ocean aims to improve our understanding of dynamic marine ecosystems and their services to society. 2. Ocean Past includes prehistoric, archaeological and historical marine research. 3. Ocean Observation covers research and innovation to improve technologies for the detection and identification of patterns and processes in the ocean. 4. The Ocean and Human Health aims to achieve a better understanding of the effect of the seas, ocean and coastal environments on human health and wellbeing. 5. Policy Driven and Responsive Mode Research addresses emerging topics of local, regional or international priority. 6. Blue Sky Research and innovation supports excellent but high-risk research related to the ocean. <p>In respect to innovation, following topics are considered: the cultivation of algae in the North Sea, floating solar panels, cleaning up the munitions dump on the Paardenmarkt sandbank, strengthening coastal protection, blue tourism, renewable energy and freshwater production, chemical pollution and solutions to waste, maritime connection, sustainable sea food and biotechnology, and the transversal approaches for a smart sea concept and ecosystem approach</p>	
INFRASTRUCTURE AND R&I CAPABILITIES	
Number of research vessels	2
Number of marine research groups	114
Number of staff in marine science	1,617 people are active in marine research and innovation on a full-time or part-time basis (63.8% male, compared to 36.2% female; 2018)
Other notes:	
<p>An overview of the MRGs is available in Mees et al. (2018) and can also be consulted in an interactive manner on http://www.vliz.be/en/institutes and www.compendiumcoastandsea.be.</p>	

Denmark

STRATEGY	
Denmark has no maritime strategy. Instead most of the relevant research and innovation topics are covered by overarching strategic research and innovation priorities on EU and international level (EMB and ICES). The Danish RESEARCH 2025 R&D programme also addresses marine and maritime related research and innovation topics. Public strategic investments in research and innovation must help to solve societal challenges and create growth and prosperity.	
PRIORITIES IN RESEARCH AND INNOVATION	
Research 2025 - promising future areas and research and innovation gaps in water resources & technologies outlines following priorities:	
<ul style="list-style-type: none"> • understanding of the presence and metabolism of chemicals in the environment, for reasons including assessing the impact of such chemicals on populations and ecosystems. • development modelling tools that can illustrate, describe and predict how different underlying factors interact with and affect ecosystems. Danish effort to develop ocean plans as a result of regulation by the EU in this area. • development of cost-effective instruments that contribute to good ecological and biological condition in the marine areas, and to re-establishing the ecocycle and biodiversity. The research and innovation effort could be focused on the sea's physical, chemical and biological properties, the sea as a source of minerals and food, as a recipient, transport route, energy source and as a site for recreation. • development of technologies that can help reduce marine pollution caused by nutrients, environmentally harmful chemicals, non-degradable waste, microplastics and microfauna (e.g. invasive species). • generation of knowledge about human use and impact on the sea, including the effects of climate change and climate change adaptation. 	
National Institute of Aquatic Resources' (DTU Aqua) research is divided into the following fields: Oceanography, Marine populations and ecosystem dynamics, Freshwater fisheries and ecology, Fish biology, Population genetics, Observation technology, Coastal ecology, Marine living resources, Fisheries technology, Fisheries management, Ecosystem based marine management, Shellfish and seaweed, Aquaculture, Fish and shellfish diseases. DTU Aqua deals with all types of aquatic habitats—from the North Atlantic Ocean and European shelf areas to coastal areas and inner Danish waters, ecosystems in lakes and streams as well as aquaculture.	
Other marine research and innovation groups are based in the Universities of Copenhagen (with focus on microbiology, climate), Aarhus (biogeochemistry, sediment dynamics, contaminants, arctic and marine mammals), Alborg (maritime spatial planning, social science, coastal communities), University of Southern Denmark (SDU; economics, deep sea, climate) and Roskilde (Planktology).	
INFRASTRUCTURE AND R&I CAPABILITIES	
Number of research vessels	8
Number of marine research groups	36
Number of staff in marine science	800
Other notes:	
Danish Research prerequisites with regard to Arctic Research: Danish, Faroese and Greenlandic researchers alike all have access to several well-equipped research and innovation programmes and stations on Greenland, and research vessels are also available. In addition to these resources, there are other research vessels and automated measuring stations, drones and satellites. DTU Aqua Research facilities: Research vessels, Aquaculture facilities, Facilities for eel production, Shellfish and seaweed facilities. Other: labs, facilities for cultivating copepods, flume tank	
Danish Center for Marine Research: Since 2014 DCH has had a close collaboration with the Danish Navy. Central to this collaboration was the aspiration from both sides to accommodate into the design of the new Knud Rasmussen class vessel, Lauge Koch (LAKO), modifications that would facilitate its use as an oceanographic research platform. LAKO was put into service in 2018 and the first oceanographic research cruise is in August 2018.	

Estonia

STRATEGY	
<p>Estonia has no national marine research and innovation strategy or programme. The research and innovation themes are aligned to the HELCOM Baltic Sea Action Plan. Monitoring and observation play a big role within the research and innovation priorities. Furthermore, the implementation of EU MSFD is relevant for Estonian marine research and innovation priorities. Together with education in marine and maritime related fields, marine research and innovation is one of the priorities of the “Estonian Marine Policy 2012-2020”.</p>	
PRIORITIES IN RESEARCH AND INNOVATION	
<p>The European Union has supported the decision to take measures for the establishment of a marine monitoring system with a better resolution to connect the existing monitoring and observation systems that are used for ensuring safe navigation and security, monitoring of the marine biota and quality of water, determining the status of marine environment, assessing the efficiency of measures implemented for the protection of the marine environment, detecting and eliminating marine pollution, fishing control, protecting external borders and other law enforcement activities. Because the marine environment and maritime industry are important, it is necessary to continue providing quality marine education, facilitate scientific research and innovation and continue with marine monitoring. The quantity and quality of Estonian marine research and innovation will be supported by the policy. This is laid down in the strategic environmental assessment of the national development plan “Estonian Marine Policy 2012-2020”</p> <p>The Estonian Marine Institute is one of the biggest marine organizations in Estonia and contributes to research and innovation in several marine study fields. The research and innovation ranges from sea water physics to biology, from microscopic scale to full ecosystems, having unique expert opinions and qualifications in most marine research and innovation fields.</p>	
INFRASTRUCTURE AND R&I CAPABILITIES	
Number of research vessels	5
Number of marine research groups	12
Number of staff in marine science	111
<p>Other notes:</p> <p>BONUS EEIG (BONUS for the Baltic Sea science – network of funding agencies), which was established for the organisation of scientific research and innovation of the Baltic Sea in cooperation with the EU and the countries surrounding the Baltic Sea, and associated one-time funded BONUS projects play an important role in Estonian marine research and innovation landscape.</p>	

Finland

STRATEGY	
<p>The policy guidelines determine the focus areas of Finland’s maritime policy concerning oceans and seas, and present measures required for reaching the set objectives. According to its vision, a healthy Baltic Sea with its vital marine life is a well-protected and sustainably used resource. Finland works actively to make the Baltic Sea Region a global leader in the bioeconomy and the circular economy, at the cutting edge of utilising new technologies and producing model solutions.</p>	
PRIORITIES IN RESEARCH AND INNOVATION	
<p>The aim is to enable Finland to develop its maritime policy into a clear area of strength. In these policy guidelines, the protection of the seas, maritime logistics, the maritime cluster, and marine production are selected as priority areas. The horizontal themes connected to all priority areas include automation, digitalisation and data; competence, research and innovation and education; exercising influence at the EU and international level; a secure operating environment and financing.</p> <p>The priorities for the short- and long-term research and innovation and competence building are based on six UN sustainable development goals and producing competitive solutions to support these goals: Sustainable food production, Clean water and sanitation, Affordable and clean energy, Healthy and diverse marine ecosystems, Climate change mitigation and adaptation, and Health and wellbeing. However, boosting the growth of business and achieving genuine change require adjustments in the operating practices of companies, as well as those of research and innovation and administration.</p> <p>Finland’s Strategy for the Arctic Region from 2013 defines a number of objectives for Finland’s Arctic policy and explores ways of promoting them. The strategy addresses local residents, education, research, the economy, infrastructure, the environment, stability and international cooperation in the Arctic. The action plan for the update of the Arctic Strategy concerns the following priorities in the update: Finland’s foreign and EU policy in the Arctic region, Finland’s arctic expertise, sustainable tourism, and infrastructure solutions that support these.</p> <p>In a summary, following research and innovation priorities were identified:</p> <p style="padding-left: 40px;">Protection of the seas, Maritime cluster, Marine production, Maritime logistics, Sustainable blue growth and blue bioeconomy, Pioneering the bioeconomy and the circular economy, Connecting Finland to the Baltic Sea Region, Logistics and transport connections as enablers of growth, A safe and secure Baltic Sea Region, Reduce nutrient loading and eutrophication, Reduction of hazardous and harmful substance loading, Sustainable use and management of marine natural resources, Prevent the spread of invasive alien species, Reduction of pollution and littering, Reduction of underwater noise pollution, Reduce physical damage and loss of seafloor habitats, Prevent disturbances caused by hydrographic change, Maritime safety and risk management, Maritime spatial planning measures, Enhancing the marine protected area network and other nature conservation activities, Communication and guidance related to the programme of measures for the Finnish marine strategy, Sustainable food production, Clean water and sanitation, Affordable and clean energy, Healthy and diverse marine ecosystems, Climate change mitigation and adaptation, Health and wellbeing, Water for sustainable development, Water for people, Water for peace</p>	
INFRASTRUCTURE AND R&I CAPABILITIES	
Number of research vessels	5
Number of marine research groups	30
Number of staff in marine science	266
Other notes:	
<p>Finnish Marine Research Infrastructure (FINMARI) is the consortium of Finnish marine research infrastructures. It belongs to the roadmap for research infrastructures by the Academy of Finland. FINMARI is a distributed infrastructure network of field stations, research vessels and multi-purpose icebreakers, laboratory facilities, ferry boxes, fixed measurement platforms and buoys. FINMARI is coordinated by SYKE and partners are four Finnish research and innovation institutes (FMI, GTK, Luke, SYKE), three universities (University of Helsinki, University of Turku, Åbo Akademi University), and a state-owned shipping company (Arctic Shipping).</p>	

France

STRATEGY	
France has a national marine research and innovation strategy. However, marine and maritime activities are associated with several ministers in France. Aquaculture is under the Ministry of Agriculture and Food and maritime transport is under the Ministry of Ecology. The National Research Strategy is led by the Ministry of Research.	
PRIORITIES IN RESEARCH AND INNOVATION	
National Research Strategy – France Europe 2020 from the French Ministry of Higher Education, Research and Innovation: Meet the challenges: (1) Efficient resource management and adaptation to climate change, (2) Food security and demographic challenges	
National Strategy for the Sea and the Coastlines from the French Ministry for Ecological and Solidary Transition: themes of action: (1) renewable marine energies; (2) competitiveness and ecological transition of maritime transport; (3) fisheries and aquaculture; (4) sustainable development of seaports; (5) ocean governance and marine spatial planning; (6) support of the maritime sector; (7) protection of the marine environment; (8) combatting marine litter; (9) initiatives in favour of coastal areas; ocean and climate	
<i>Ifremer (French Research Institute for Exploitation of the Sea)</i> Excellence areas: Knowledge and characterization of marine life; Biodiversity and ecosystem functioning and services; Evaluation of anthropic pressures and their socio-economic stakes; Ocean dynamics; Interfaces (ocean/atmosphere, ocean/lithosphere, land/sea).	
Emergent priorities: towards Ocean 2100: Evaluation of coastal ecosystems futures in a global change context; Understanding the dynamics of cumulated impacts using novel evaluation methods; Identifying the effects of interactions between functional groups on the dynamics of exploited ecosystems; Evaluating and anticipating socio-ecosystems' resilience, shifts and tipping points; Identification of the processes of evolution and adaptation of living organisms; Identification of novel marine bio-resources; Supporting adaptive ecosystem management; Dynamics and impacts of the evolution of the physical ocean at horizon 2100; Climatic and geological extreme events; Observing and understanding dynamic fluxes at the ocean-lithosphere interface; Characterization of sedimentary habitats in a global change context; Evaluating the benefits of using populations genomic in ecology;	
Challenges and tools to understand the evolution of oceans: data collection and modelling; Experimentation to enhance our understanding of processes; Predictive and integrated modelling of complex socio-ecosystems; Multi-disciplinary and multi-platform observation for high frequency data; Observing the deep ocean; Developing novel technologies	
INFRASTRUCTURE AND R&I CAPABILITIES	
Number of research vessels	24
Number of marine research groups	12 (department level)
Number of staff in marine science	5.010
Other notes: Examples for national research infrastructure:	
<ul style="list-style-type: none"> • ChemBioFrance: Small molecules for health and research and innovation. ChemBioFrance offers “smart” chemical libraries with high potential for bioactivity, partnership with chemists for medicinal chemistry, drug screening services, tools for data analysis and data mining in chemical collections, ADME and toxicology services for the characterization and development of new biologically active molecules • EMBRC-FRANCE: National Centre for Marine Biological Resources. EMBRC-France incorporates the services and expertise of the three marine stations belonging to Sorbonne University and the Centre National de la Recherche Scientifique: Banyuls-sur-Mer, Roscoff, and Villefranche-sur-Mer. 	

Germany

STRATEGY	
<p>The funding of marine research and innovation is multifaced and several federal and regional ministries are involved. Main research and innovation priorities are defined by the national programmes MARE:N – Coastal, Marine and Polar Research for Sustainability. Scoping processes involving the scientific community as well as stakeholders from industry, society policy and NGOs resulted in dedicated research and innovation agendas. The defined topics will be addressed in a series of calls <i>Maritime research topics</i>, which are covered by Maritime Forschungsstrategie 2025.</p>	
PRIORITIES IN RESEARCH AND INNOVATION	
<p><i>MARE:N Scientific program</i>: Global change and climatic events, Ecosystem function and biodiversity, Global biogeochemical cycles and energy fluxes, Management of natural hazards, Sustainable use of resources, Governance and participation</p> <p><i>Maritime Forschungsstrategie</i>: technology development within the topics: MARITIME.green – environmentally-friendly maritime technologies; MARITIME.smart – maritime digitalisation and smart technologies; MARITIME.safe – maritime safety; MARITIME.value – maritime resources</p> <p>research and innovation pillars: Ship technology, production technologies, shipping and ocean technology</p> <p>"Blue Ocean" Research and innovation Agenda: <i>Research and innovation topics</i>:</p> <ol style="list-style-type: none"> (1) Ocean dynamics in transition: changes in the circulation (climate trends, heat transport, O₂ and CO₂ transport), biogeochemical cycles (CO₂ absorption, nutrients, trace gas), regional impact (Gulf stream circulation, sea level). (2) Marine ecosystems under stress: climate change impacts (multi-stress factors, acidification, ecosystem resilience), pollution (nutrients, plastics, noise), habitat changings (biodiversity, overfishing, invasive species). (3) Dealing with natural hazards in the marine environment: chain-linking of hazards (landslide, earthquakes, tsunami), biological hazards (virus, bacteria, jellyfish), warning systems (tsunamis, algae blooms). (4) Sustainable use of marine resources: geological resources (raw materials, fossil energy sources, fresh water), biological resources (fisheries and aquaculture, natural materials), renewable energies (wind energy, wave energy). (5) Ocean governance and social change: government and ocean (regulatory system, law of the sea, international marine protected areas), society, market and ocean (blue economy, benefit sharing, certification), mitigation and adaptation research (live with environmental changes, adaptation, societal transformation); <p>"Coasts in Transition" Research and innovation Agenda: <i>Fields of Research</i>:</p> <ol style="list-style-type: none"> (1) Climate and coastal dynamics (2) From catchment to coast (3) Ecosystem based coastal protection (4) Biodiversity and food webs (5) Use of the ocean floor (6) Humans and the coastline <p><i>Research and innovation environment (cross cutting themes)</i>:</p> <ol style="list-style-type: none"> (1) Monitoring systems (research vessels, GOOS, sensors), (2) Modelling systems (ocean circulation models, data assimilation), (3) Data systems (data management, open source archives, big data analysis), (4) Knowledge exchange (communication, transdisciplinary, society), (5) Promoting young researchers (career pathways, capacity development, international exchange) 	
INFRASTRUCTURE AND R&I CAPABILITIES	
Number of research vessels	29
Number of marine research groups	68 (departments and research groups mixed; estimated by project partner)
Number of staff in marine science	4030
Other notes:	

Latvia

STRATEGY	
<p>Latvia has a national marine strategy. The <i>Marine Spatial Plan</i> (MSP) is a national level long-term (12 years) spatial development planning document that defines in written and graphical form the conditions for the use of the sea, for the internal waters, territorial sea and exclusive economic zone waters of the Republic of Latvia.</p> <p>The development of the seacoast of Latvia as diverse and multifunctional space should be ensured, which concurrently is a qualitative living environment and the bank of public benefits with clean water and air, seaside, healthy ecosystems, special landscapes, and economically active space with various employment possibilities throughout the year. Coast of the Baltic Sea – one of the largest values of Latvia where the preservation of nature and cultural heritage should be balanced with promotion of economic development.</p>	
PRIORITIES IN RESEARCH AND INNOVATION	
<p><i>The maritime spatial planning process is based on the following conditions:</i></p> <ul style="list-style-type: none"> • The non-deterioration of the environmental condition and ecological parameters must be ensured for the use of the marine space and the ability of the ecosystem to adapt, as well as creating favourable conditions for improving the environmental condition and marine resources. • The existence of existing, traditionally formed types of sea use must be ensured, which already occupy a defined marine space and thereby impact on and create conditions for the placing of new human activities at sea. • The development of existing human activities must be supported, and conditions created for the introduction of new types of use of the sea. • Decisions regarding the introduction of new types of use of marine resources and space must be based on research and innovation regarding the technical and economic grounds thereof, impact on the environment and marine ecosystem, as well as assessing the compliance with state policy aims and priorities. <p><i>Sustainable Development strategy:</i> Development directions: In order to ensure sustainable use of the coast of the Baltic Sea, it is necessary:</p> <ul style="list-style-type: none"> • to develop the environment favourable for the entrepreneurship that would ensure economic activity and employment possibilities along the entire seacoast, supporting it by balancing of the traditional (fishery, fish processing, recreation, resort farm) and —new type of economic activity (international tourism, including yacht tourism, extraction of alternative renewable energy resources) with the interests of environmental protection; • to preserve the unique natural complexes of the seacoast, their biological diversity, ecological processes and outstanding landscapes as the treasure of national and international significance, concurrently ensuring qualitative living environment in the populated areas of the seacoast. • to promote co-operation between local governments of the seacoast, planning regions, state administrative institutions and the society, providing good management of the seacoast; and to activate the co-operation of the countries of the Baltic Sea Region in planning and implementation of the seacoast development and ensure co-ordinated planning of spatial development of the land part of the seacoast and the sea aquarium." (Latvia, June 2010) 	
INFRASTRUCTURE AND R&I CAPABILITIES	
Number of research vessels	0
Number of marine research groups	7
Number of staff in marine science	100
<p>Other notes: Further research and innovation facilities:</p> <ul style="list-style-type: none"> • Biology field station Kolka (Experimental facilities for biology and ecosystem studies) • Aquaculture Research and Education Centre of Institute of Food Safety, Animal Health and Environment "BIOR" • Marine research infrastructure in the Latvian Institute of Aquatic Ecology encompasses <i>in situ</i> systems for remote measurements and field observations, and equipment for <i>ex situ</i> investigations 	

Lithuania

STRATEGY	
<p>No national marine, maritime research and innovation strategy exist for Lithuania.</p> <p>For renewing and management of the Maritime Spatial Plan (MSP), a fundamental knowledge, which is new and applicable for the planning, is needed, including data sets and innovative solutions for improved management of marine resources. MSP is a living strategic document revised periodically in order to complement with the changes happening in marine territories.</p>	
PRIORITIES IN RESEARCH AND INNOVATION	
<p>General Goals related to Marine and Maritime issues:</p> <ul style="list-style-type: none"> - reduction of the impact of the marine complex and other major branches of economy on the environment; - more effective exploitation of natural resources and waste processing; - alleviation of the global climate change and its consequences; - better protection of the biological diversity; - better landscape protection and its more rational management; - increasing of the role of education and science; - exploitation of the resources of alternative energy (geothermal waters, wind and wave energy) - most critical environmental topics to be addressed in the south-eastern Baltic Sea (Lithuanian sector): marine pollution (by biogenic substances, oil products, chemical and synthetic materials); impact on marine fauna and flora due to marine transport; genetic risks to the fish gene pool due to toxic substances; insufficient water exchange in and to the Atlantic Ocean; adverse effects to marine benthic fauna and flora caused by introduced invasive species; risks related to increasing extreme atmospheric events (sea level rise, coastal erosion, and degradation of natural sandy beaches) - key datasets to develop the maritime spatial plan: bottom topography and morphology of the seabed, geological conditions, valuable bottom habitats, nursery and spawning grounds, areas important for wintering birds, hydrodynamic conditions, prospect of mineral resources and areas already occupied by the existing uses - improving the Baltic Sea environment and economies. Novel technologies provide opportunities for new environmentally friendly uses of marine ecosystems: <ul style="list-style-type: none"> - Microalgae cultivation; - Blue biotechnology; - Innovative fish and mussels mariculture solutions - Wave energy - Multi-use offshore wind parks - Reed as a renewable resource 	
INFRASTRUCTURE AND R&I CAPABILITIES	
Number of research vessels	5
Number of marine research groups	24
Number of staff in marine science	251
Other notes:	
<ul style="list-style-type: none"> - Experimental facilities for biology and ecosystem studies (Vente Hydrobiological Station, Šilutė district); - Neringa coastal biological field station (Kalno str. 22, Neringa); - Marine Research Institute (MRI) of Klaipėda University is the main provider of open R&D services using up-to-date research infrastructure. 	

Netherlands

STRATEGY	
<p>There is no coherent national marine/maritime strategy in place. The Cabinet seeks to combine knowledge programming by optimally aligning them with existing international and national strategic and fundamental research and innovation programmes.</p> <p>Something special for the Netherlands is Dutch Delta Programme, which is a huge climate adaptation programme focused on land-water interactions. The Netherlands have so-called economic priority areas, one of them being 'water and maritime'. The economic priority areas are relevant to BANOS CSA as they provide good examples and best practices for direct collaboration between academia, applied research and innovation, businesses and public authorities for stimulating Blue Growth.</p>	
PRIORITIES IN RESEARCH AND INNOVATION	
<p><i>Priorities in knowledge programming:</i></p> <ul style="list-style-type: none"> - Marine ecosystem: Additional knowledge is needed to develop indicators for this combined descriptor, also with a view to detailing the Birds and Habitats Directive (BHD). It is also important to gather knowledge about the effects of the primary disturbances, including bottom trawling, and about how these effects and possible cumulative effects can be identified in the different habitats and species. Optimal use of existing interdepartmental knowledge structures (BHD, Water Framework Directive, OSPAR) would seem obvious. - Litter (including microplastics): Knowledge about the presence and risks of microplastics is a high priority. In a more general sense, the development of research and innovation protocols for the specification of indicators for the presence of litter on the seabed and in the water-column also requires attention.; - Underwater noise: This concerns establishing noise levels, including temporal and spatial variations, the main noise disruptions and sources of noise. The effects of different types of noise and accumulation of noise will also have to be studied. Cost effectiveness of mitigating measures for notably possibilities to prevent or reduce noise emissions will be assessed. - Specification of the three core measures, including research and innovation into the (cost) effectiveness of possible measures under the CFP, into supplementary seabed protection and into countering litter, are needed to prepare the programme of measures. <p><i>National spatial challenges for the North Sea:</i></p> <ul style="list-style-type: none"> - the preservation of the coastal foundation and implementation of the area-based Coastal and Wadden Region sub-programmes of the Delta Programme in association with local and regional government authorities; - the preservation and protection of Natura 2000 areas and the marine ecosystem; - maintaining the unobstructed view of the horizon up to 12 nautical miles from the coast; - providing space for the main network for the transport of (hazardous)substances via pipelines; - protection of archaeological values (submerged settlements, shipwrecks and other archaeological values). <p>Within the European frameworks (WFD, MSFD, BHD and Malta Convention), the Cabinet is giving priority to the activities that are of national interest to the Netherlands: Oil and gas extraction, CO₂ storage, Shipping, Sand extraction, Renewable energy and Defence.</p> <p>The five North Sea 2050 Spatial Agenda themes: building with North Sea nature; energy transition at sea; multiple/ multi-functional use of the space; connection between land and sea; accessibility/ shipping</p>	
INFRASTRUCTURE AND R&I CAPABILITIES	
Number of research vessels	11
Number of marine research groups	34
Number of staff in marine science	n.a.
<p>Other notes: NIOZ is responsible for managing the National Marine Facilities, which includes vessels but also other infrastructure. https://www.nioz.nl/en/about/cos/facilities</p>	

Norway

STRATEGY	
<p>Norway has a national marine/maritime strategy.</p> <p>Technological and knowledge development allow new business opportunities, and the commercial interests associated with using the ocean, are growing. At the same time, ocean environments are threatened by climate change, pollution and littering. Therefore, increased knowledge of various relationships in the ocean, biodiversity, and the function and resilience of the ecosystems, is a necessary foundation for future value creation and sustainable growth.</p>	
PRIORITIES IN RESEARCH AND INNOVATION	
<p>The Norwegian Government's Ocean Strategy:</p> <ul style="list-style-type: none"> - Marine ecosystems: The Government will strengthen the knowledge regarding marine ecosystems, and changes in these as a result of human activities, climate change and pollution. Furthermore, more knowledge is needed about the ecosystems in coastal areas in order to facilitate aquaculture operations, farming of shells, seaweed and kelp, as well as new species, and to ensure a good foundation for long-term management. - Monitoring and data collection: Norway has a long tradition of marine and maritime research and innovation, and this has given Norway valuable datasets on the development in ocean areas. Through the seabed mapping programme MAREANO, bathymetry and data on the geology, sediments, biodiversity, biotopes, and pollution of the seabed are collected. - Knowing the environmental status of the ocean: Challenges: Pollutants may harm ecosystems, seafood production, and other biological products from the ocean. Increased presence of pollutants in the ocean also entails a risk that leftover raw materials from the seafood industry cannot be used or recycled for new, profitable products. The Government will therefore continue efforts to monitor the environmental situation in the oceans and consequences for, among other things, fish health and food safety. The Government will also prioritize increased knowledge of undesirable substances and nutrients in new species. Increased knowledge in these areas may strengthen new and alternative use of marine bioresources. Marine waste, especially related to marine plastic littering, is a persistent and growing problem. Another example is the consequences of dumped munitions. This constitutes a risk both for the environment and maritime traffic. The investigation is based on the purpose of the centre being the promotion of knowledge, technology, and methods for oil spill prevention and response, and the efforts against marine plastic littering and for a cleaner ocean environment. <p>Research and innovation for Sustainable Societal and Industrial Development:</p> <p><i>Priority knowledge areas:</i></p> <ul style="list-style-type: none"> - Areas promoting industrial development that fosters sustainability and green competitiveness: Clean, safe and productive oceans and seas, A sustainable bioeconomy, Clean energy – green competitiveness, The circular economy - Areas promoting societal development that fosters sustainability: Reduced climate change and effective adaptation measures, Abundant biodiversity, preservation of ecosystem services and lower environmental impacts, Sustainable cities, regions and transport systems, Education that ensures future competency and redresses social inequity, Equal access to health and health services, Reduced poverty and inequality - Priority research and innovation topics related to Polar research: Geopolitical issues relating to change in the polar regions, The development of polar policy in collaboration between stakeholders at the international, pan-Arctic and national levels, Regimes for management of resources and the environment, preparedness and security in the polar regions. 	
INFRASTRUCTURE AND R&I CAPABILITIES	
Number of research vessels	18
Number of marine research groups	61
Number of staff in marine science	1.000 (Institute of Marine Research only)
Other notes:	
<p>The Ocean Space Centre in Trondheim is to be a knowledge centre for marine technology. The maritime technology centre at Tyholt has contributed to placing Norwegian industry at the forefront in ships, shipping, offshore oil and gas, fisheries and aquaculture. https://oceanspacecentre.no/english/</p>	

Poland

STRATEGY	
<p>Poland has no national or regional marine strategy. Instead, the Polish maritime policy is conditioned and defined by the Integrated Maritime Policy of the European Union - The European Union Strategy for the Baltic Sea Region (EUSBSR). There is also document called <i>The Basis for the Maritime Policy of the Republic of Poland until 2020</i>, which describes the overall Polish government's maritime policy. Within R&D strategy there exist a National Research Programme, which describes the overall Polish government's research and innovation strategy but marine or maritime issues are not mentioned as a separate chapter but are only outlined as a part of main R&D fields. <i>The National Smart Specialization</i> (NSS) indicates preferences in providing support for the development of research, development and innovation (R & D & I) under the new financial perspective for years 2014-2020. One of NSS is NSS 17, which describes innovative maritime technologies for specialized vessels, maritime and offshore structures and logistics based on the sea and inland waterway transport.</p>	
PRIORITIES IN RESEARCH AND INNOVATION	
<p>General priorities from strategic plans in biotechnology and marine research and innovation include:</p> <ul style="list-style-type: none"> • Fisheries and aquaculture research and innovation, • Industrial biotechnology, • Bio-based industries, • Securing human and animal health, • Biodiscovery and sustainable exploitation of the Baltic Sea resources, • Green energy, • Climate change research, • Pollution monitoring, prevention and remediation, • Preservation of Baltic Sea ecosystems 	
INFRASTRUCTURE AND R&I CAPABILITIES	
Number of research vessels	10
Number of marine research groups	~60
Number of staff in marine science	1138
Other notes:	
<p>Further research infrastructure:</p> <ol style="list-style-type: none"> 1. Hel Marine Station: http://www.hel.ug.edu.pl/info/helmarinestation.htm 2. The Coastal Research Station (CRS) in Lubiato: http://mlb.ibwpan.gda.pl/index.php/en/ 3. The Research Station in Świnoujście: https://mir.gdynia.pl/research-station-in-swinoujscie/?lang=en 	

Sweden

STRATEGY	
Sweden has no national strategy on marine and maritime research and innovation. The research and innovation landscape is characterised by diverse stakeholder landscape with many stakeholders committed to preserving and improving the good environmental status of the Baltic Sea and the archipelagos.	
PRIORITIES IN RESEARCH AND INNOVATION	
<i>Data from national monitoring programmes:</i>	
Inputs to the sea, hydrographic and chemical conditions, phytoplankton, zooplankton, vegetated benthos, soft-bottom macrofauna, metals and organic pollutants, coastal fish-status, coastal fish-health, sea eagles, seals, <i>Monoporeia affinis</i> in the Baltic Sea, seabirds and water birds, non-indigenous species and marine litter;	
Conclusions:	
<ul style="list-style-type: none"> • More focus is needed on the information to be extracted from monitoring. A greater focus on assessments and knowledge building to inform environmental management is the key to meet the full range of government objectives for environmental monitoring. • A more analytical, inquiry-driven use of monitoring data is needed to drive improvements in monitoring and to promote knowledge building. • Knowledge building can be promoted through increased interaction between monitoring analysis and the research community. • A more effective coordination between all monitoring programmes will improve assessments and facilitate knowledge building. • Consistency and continuity of methods in all monitoring programmes constitutes the basis for effective coordination. • Clearer rules for the management of data resources will help steer data stewardship. • Efficient management of marine ecosystems call for cross-programme analyses and joint evaluation of ecological and societal data. 	
<i>Prioritized research and innovation needs:</i>	
The following five topics were found to have particularly critical research and innovation needs from an environmental management perspective:	
<ul style="list-style-type: none"> • Ecosystem based-fisheries management. Implementation with enhanced evaluation of adaptive management systems in order to continuously build up knowledge, • Relationships between pressure-impact-effectiveness of measures, including social indicators for the design and monitoring of measures, • Mapping of marine habitats and more knowledge of food webs (including interactions and dynamics), • Cumulative effects of hazardous substances and other pressures, • Mainstreaming climate change adaptation in sectorial policies and management frameworks 	
INFRASTRUCTURE AND R&I CAPABILITIES	
Number of research vessels	13
Number of marine research groups	>20 (not all groups could be determined)
Number of staff in marine science	n.a.
Other notes:	
The research infrastructures financed by the Swedish Research Council are listed here: https://www.vr.se/english/analysis-and-assignments/research-infrastructure/list-of-research-infrastructure.html	

United Kingdom

STRATEGY	
The UK Department of the Environment, Food & Rural Affairs (Defra) has a high level, 25 year environment plan which applies to both terrestrial & marine environments and includes a specific objective of “Securing clean, healthy, productive and biologically diverse seas and oceans : https://www.gov.uk/government/publications/25-year-environment-plan	
PRIORITIES IN RESEARCH AND INNOVATION	
PRIORITIES IN RESEARCH AND INNOVATION	
<p><i>Marine Science Co-ordination Committee (MSCC): High-level science priorities:</i></p> <ul style="list-style-type: none"> • Understanding how the marine ecosystem functions (role of biodiversity, recovery from disturbance, assessment of GES using natural, social and economic sciences, effects of human activities). • Responding to climate change and its interaction with the marine environment (impact of oceanographic changes on marine ecosystems and feedbacks, effects of acidification on marine organisms, mitigation potential and adaptation (for example, to protect life), implications of natural variability, introduction of alien species); • Sustaining and increasing ecosystem benefits (understanding ecosystem services provided by the marine environment and human behaviour in relation to them, biodiversity impacts of renewable energy, conservation using tools such as Marine protected Areas, cumulative effects of multiple human activities, predicting ecological impact of policy options) <p><i>Strategic implementation plan’s strategic areas:</i></p> <ul style="list-style-type: none"> • Science Alignment Action Plan: (1) Understanding how the marine ecosystem functions, (2) Responding to climate change and its interaction with the marine environment, (3) Sustaining and increasing ecosystem benefits • Data, Monitoring and Assessment Action Plan: (1) Clean and Safe Seas Evidence Group (CSSEG), (2) Ocean Processes Evidence Group (OPEG), (3) Healthy & Biologically Diverse Seas Evidence Group (HBDSEG), (4) Productive Seas Evidence Group (PSEG), (5) Marine Environmental Data and Information Network (MEDIN) • Economic Growth Action Plan: (1) Access to industry data, (2) Reducing monitoring costs, (3) Horizon scanning, (4) Cumulative impacts (CI), (5) Deep-sea mining, (6) Carbon capture and storage, (7) Decommissioning, (8) Ballast Water Management, (9) Biofouling, (10) Underwater Unexploded Ordnance (UXO) Management, (11) UK Seabed mapping initiative, (12) Skills gap, (13) Establishment of a UK marine brand, (14) Marine Industries Technology Roadmap, (15) Marine autonomous systems • Communication Action Plan: (1) Communication from policy makers to marine science community, (2) Provision of communications advice to MSCC working / subgroups, (3) MSCC and the UK marine science strategy 	
INFRASTRUCTURE AND R&I CAPABILITIES	
Number of research vessels	32
Number of marine research groups	Inaccurate information
Number of staff in marine science	1.200 (Plymouth Marine Lab., National Oceanography Centre (NOC), Cefas)
Other notes:	
<ul style="list-style-type: none"> - NOC: The National Marine Equipment Pool (NMEP) is the largest centralised marine scientific equipment pool in Europe with a diverse range of scientific instruments and equipment capable of sampling from the sea surface to the deep ocean. - Plymouth Marine Laboratory: Resources and infrastructure, such as ships, buoys and mesocosm facility, provide our scientists with the tools to conduct meaningful research. Investment in a state-of-the-art lecture facility also enables our scientists to share their knowledge and findings with fellow scientists, key stakeholders and the wider public. - Cefas: In addition to R/V Cefas Endeavour, Cefas offer the very latest aerial and marine survey instrumentation and platforms, including in-house developed technology products and a range of autonomous vehicles. 	

3.1.4 List of reviewed national research and innovation strategies

In Table 6 the most relevant national strategy documents are listed, including those which were used for the analysis of national research and innovation priorities. Information on further priorities and regional strategies can be found in the Annex 1 of this report.

Table 6. National research and innovation strategy documents, including access links, used in the analyses of the national research and innovation priorities.

Country	Name of strategy	Regional scope & timeframe/ date of publication	Link
Belgium	VLIZ Research framework	Flanders, published January 2018	http://www.vliz.be/en/vliz-research-framework
	Biodiversity 2020, Update of Belgium's National Strategy	National, 2014-2020	http://www.biodiv.be/implementation/docs/stratactplan/biodiversity-strategy-2020/full-versions-strategy-2020/be-nbs-overview-en.pdf
	Non-profit organisation "Blue Clusters"	Belgian Part of North Sea, large-scale initiatives, funded for max. 10 years	https://www.blauwecluster.be/about-us
Denmark	Research 2025 - promising future areas (FORSK 2025 catalogue)	Denmark, Arctic region (Greenland, Faroe Islands), related to EU and global topics resp. challenges, published June 2018	https://ufm.dk/en/publications/2018/research2025-catalogue
Estonia	Estonian Marine Policy 2012-2020		https://www.mkm.ee/en/objectives-activities/transport/marine-sector
Finland	Government Resolution on Finland's maritime policy guidelines - From the Baltic Sea to the oceans, Publications of the Prime Minister's Office 2019	Baltic Sea and beyond, published 2019	http://julkaisut.valtioneuvosto.fi/handle/10024/161376
	Government Resolution on Finland's Strategy for the Baltic Sea Region	Baltic Sea, published 2017	http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/160332/15c_Finlands_Strategy_Baltic_Sea.pdf
	Finland's Marine Strategy	Finland's territorial waters and the exclusive economic zone, updated regularly	https://www.ymparisto.fi/en-US/Sea/Protection_and_management_of_the_marine_environment/Development_of_Finlands_marine_strategy
	Research and competence building agenda on the blue bioeconomy	Finland, published 2018	http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/160942/MMM_6a_2018.pdf?sequence=4&isAllowed=y
	Finnish water way. International water strategy Finland	Finland, published 2018	https://um.fi/documents/35732/0/Finnish+Water+Way_en.pdf/34ddcdca-0088-ec90-b04d-c910ed71088c

	Finland's Strategy for the Arctic Region 2013.	Government resolution on 23 August 2013	https://vnk.fi/documents/10616/3474615/EN_Arktisen%20strategian%20toimennidesuunnitelma/0a755d6e-4b36-4533-a93b-9a430d08a29e
France	National Research Strategy – France Europe 2020 from the French Ministry of Higher Education, Research and Innovation (only in French)	France, published 2015, updated 2017	http://www.enseignementsup-recherche.gouv.fr/cid86688/strategie-nationale-de-recherche-france-europe-2020.html
	National Strategy for the Sea and the Coastlines (SNML) from the French Ministry for Ecological and Solidary Transition (only in French)	France, published 2017	https://www.ecologique-solidaire.gouv.fr/strategie-nationale-mer-et-littoral
	National Strategy: Development of sustainable aquaculture 2020 from the French Ministry for Ecological and Solidary Transition (only in French)	France, published 2015	https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwjB7Pn4_7_hAhUEAWMBHai1CQAQFjAAegQIBRAC&url=https://www.ecologie-solidaire.gouv.fr/content/download/attachment/2520VF%2520actu%2520d%2520c%2520a%2520c%25202015.pdf&usg=AOvVaw3aCEhtwAomtANXlUnEMO6f
	European & International Strategy 2018-2022 of the French Ministry of Agriculture and Food	International context, timeframe 2018-2022	https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=2ahUKEwiDnY_FhKXhAhVK1-AKHbNfBmsQFjACegQIAxAC&url=https://agriculture.gouv.fr/telecharger/2F94555%3Ftoken%3D020dc42d8d8a7e308d0e22c719f313b8&usg=AOvVaw2ujsEPfdd7_0-jKNloP0tq
Germany	MARE:N - Coastal, Marine and Polar Research for Sustainability	National, published 2017	https://www.fona.de/en/coastal-marine-and-polar-research-19764.html
	Maritime Forschungsstrategie 2025 (Maritime Research Strategy 2025, only in German)	National, published 2018	https://www.ptj.de/projektfoerderung/maritime-forschungsstrategie-2025
	Research Agenda "Blue Ocean" (English version available in July 2019)	National, published 2018	https://www.fona.de/de/forschung-fuer-die-zukunft-der-meere-24187.html
	Research Agenda "Coasts in Transition" (English version available in July 2019)	National, published 2018	https://www.fona.de/de/massnahmen/foerdermassnahmen/kuestenforschung.php#photo[ajax_1]/0/
Latvia	Marine spatial plan	National, Long-termed (12 years), published 2018	http://www.varam.gov.lv/eng/darbibas_veidi/maritime_spatial_planning/?doc=26326
	Sustainable Development Strategy of Latvia until 2030	National, published June 2010	http://www.pkc.gov.lv/sites/default/files/images-legacy/LV2030/LIAS_2030_en.pdf

Lithuania	Lithuanian national strategy of sustainable development	National, for the period 2003-2020	http://sdgtoolkit.org/wp-content/uploads/2017/02/NATIONAL-STRATEGY-FOR-SUSTAINABLE-DEVELOPMENT-Lithuania.pdf
	Research and (socio-cultural) Development and Innovation Development (Smart Specialization) Programme	National, published April 2014	https://www.smm.lt/uploads/documents/en_smm/smartsp/Programme.pdf
	Comprehensive Plan of the Republic of Lithuania (part: "Maritime territories")	National, adopted by the Parliament in 2015	https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/dde75b13095011e78dacb175b73de379?jfwid=wny8rfncr
Netherlands	The Dutch Maritime Strategy 2015-2025	National, published 2015	https://www.government.nl/documents/reports/2015/07/07/the-dutch-maritime-strategy-2015-2025
	Marine Strategy for the Netherlands part of the North Sea 2012-2020	National, published 2012, a new North Sea strategy (NZ2030) is currently being developed	https://www.noordzeeloket.nl/en/functions-and-use/natuur/@166937/marine-strategy-0/
	Policy Document on the North Sea 2016-2021 (Including the Netherlands' Maritime Spatial Plan appendix 2 to the National Water Plan 2016-2021)	National, published 2015	https://www.government.nl/documents/policy-notes/2015/12/15/policy-document-on-the-north-sea-2016-2021-printversie
	North Sea 2050 Spatial Agenda	National, published 2014	https://www.government.nl/documents/policy-notes/2014/07/28/north-sea-2050-spatial-agenda
	MARIN – Strategieplan 2018-2021 (in Dutch only)	National, published 2017, ongoing process	https://content.yudu.com/web/1r3p1/0A3a046/MR122/flash/resources/8.htm?origin=reader&refUrl=https%253A%252F%252Fwerkenbij.marin.nl%252Fmarin%252Fbetter-ships-blue-oceans%252F
	Delta Programme 2019 - Continuing the work on the delta: adapting the Netherlands to climate change in time	National, published 2019	https://english.deltacommissaris.nl/news/news/2018/09/18/delta-programme-2019-measures-to-adapt-the-netherlands-to-climate-change-in-time
Norway	New Growth, proud History - The Norwegian Government's Ocean Strategy	National, published 2017	https://www.regjeringen.no/contentassets/00f5d674cb684873844bf3c0b19e0511/the-norwegian-governments-ocean-strategy---new-growth-proud-history.pdf
	Research Council of Norway: Norwegian polar research, Research policy 2014-2023	National, published 2014	https://www.forskingsradet.no/servlet/Satellite?pagename=ForskingsradetEngelsk%2FHovedsidemal&cid=1214551683682&c=InnholdsKontainer&p=1220788265688&querystring=03280-4&sortby=title&sortorder=asc&hits=30&configuration=nfrcpspublikasjonsppublish ed&publicationType=ALLE

Poland	Marine Biotech in Poland	National, ongoing; There are no specific Marine Biotechnology strategies, plans or policies in Poland. Relevant Polish research strategies are described in different documents (see website)	http://www.marinebiotech.eu/wiki/Marine_Biotechnology_in_Poland#Overarching_science_strategies.2C_plans_and_policies
Sweden	Key research needs for sustainable management of the Baltic Sea - Current situation, priorities and suggested actions for improvement	National, published 2016	https://www.havochvatten.se/en/swam/our-organization/publications/swam-publications/2016-06-08-key-research-needs-for-sustainable-management-of-the-baltic-sea.html
	God Havsmiljö 2020 – Del 1: Den första delen i Marin strategi för Nordsjön och Östersjön. Delrapporten är en inledande bedömning av miljö tillstånd och socioekonomisk analys (in Swedish)	National, published 2012	https://www.havochvatten.se/hav/uppdrag--kontakt/publikationer/publikationer/2012-12-20-god-havsmiljo-2020---del-1.html
	Svenskt vattenbruk - en grön näring på blå åkrar, Strategi 2012-2020 (in Swedish)	National, published 2012	https://webbutiken.jordbruksverket.se/sv/artiklar/svenskt-vattenbruk-en-gron-naring-pa-bla-akrar-strategi-2012-2020.html
	Marin strategi for Nordsjön och Östersjön	National, published 2018	https://www.havochvatten.se/hav/uppdrag--kontakt/publikationer/publikationer/2018-11-29-marin-strategi-for-nordsjon-och-ostersjon-2018-2023.html
United Kingdom	UK marine science strategy	National, published 2010	https://www.gov.uk/government/publications/uk-marine-science-strategy-2010-to-2025
	MSCC Strategic implementation plan 2015-2025	National, published 2015	https://www.gov.uk/government/groups/marine-science-co-ordination-committee
	NERC strategy: The business of the environment	National, published Nov. 2013	https://nerc.ukri.org/latest/publications/strategycorporate/strategy/
	Science strategy of British Antarctic Survey	Polar regions, ongoing	https://www.bas.ac.uk/science/our-research/our-strategy/
	Cefas science & evidence strategy	National, published 2015, update planned in 2019	https://www.cefas.co.uk/media/52718/making_a_difference_strategy_paper_2015.pdf

3.2 Chapter 2: Transnational Research and Innovation Priorities

Strategies and priorities of 13 transnational organizations or initiatives were evaluated against the three strategic and ten specific objectives identified in the BANOS CSA task 1.1. Scoping the strategic framework for the future programme (Table 7, page 39). The organizations or initiatives were chosen due to their prominent link to the BANOS CSA objectives, as well as, to provide a comprehensive representation of both global and European level research and innovation priorities and needs. In general, the selected organizations and initiatives produce their own strategic agendas on scientific foresight, identifying future research and innovation gaps, or they strive for certain policy objectives, which depend on new scientific knowledge and know-how.

Although highly relevant, the INTERREG programmes were not included here as their scope and relation to future BANOS programme is analysed in detail in BANOS CSA Task 2.5 Exploring new forms of cooperation and co-funding mechanisms with initiatives financed by European Structural and Investment Funds.

3.2.1 Overview of transnational organizations and initiatives

A short description of each of the selected transnational organization and/or initiatives is given in alphabetical order. In addition, the organizations websites are provided for further information.

I. **BONUS European Economic Interest Grouping (BONUS EEIG)**

BONUS EEIG, the legal management organization of the BONUS Programme, the joint Baltic Sea research and development programme implemented as a TFEU Art185 initiative, as well as the coordinator of the BANOS CSA. The funding of the BONUS programme is provided by the Baltic Sea member states and the EU. The programme issues calls on ecosystem research and innovation for scientific community and for small to medium entities, and funds projects of high excellence and relevance to produce knowledge, scientific evidence and innovation solutions needed by policymakers, and to engage end-users and the society in the knowledge-based governance of the fragile Baltic Sea. For more information visit: <https://www.bonusportal.org/>

II. **The European Fisheries and Aquaculture Research Organisations (EFARO)**

EFARO is an association composed of the Directors of the main European Research Institutes involved in Fisheries and Aquaculture research and innovation and it desires to achieve a greater cohesion and coordination of Community fisheries, Research and Development. It aims to promote the interests of research institutes and provide advice on sustainable management and use of seas, oceans and aquatic resources, through the provision of sound science and scientific advice for the people of Europe. Supporting. For more information <http://www.efaro.eu/>

III. **European Marine Board (EMB)**

EMB consists of major European national marine or oceanographic institutes, research and innovation funding agencies, or national consortia of universities with a strong marine research focus. It provides a strategic forum to develop marine research foresight, initiates state-of-the-art analyses and translates these into clear policy recommendations to European institutions as well as national governments. EMB is the leading European think tank in marine science policy, bridging the gap between research, policy, industry and society.

For more information visit: <http://www.marineboard.eu/>

IV. European marine science network (EUROMARINE)

EUROMARINE represents the merger of the scientific communities of three former European Networks of Excellence: (i) EUR-OCEANS (ii) Marine Genomics Europe (iii) MarBEF. Its primary goals are to support the identification and initial development of important emerging scientific topics or issues and associated methodologies in marine sciences, as well as to foster new services relevant to the marine scientific community. It issues small calls primarily to fund fellowships aimed at PhD students and researchers to attend training events, workshops and working group gatherings. Yet, it has no direct implementation mechanisms of its research agenda.

For more information visit: <https://www.euromarinetwork.eu/>

V. Baltic Marine Environment Protection Commission - Helsinki Commission (HELCOM)

HELCOM is the implementing body of the Convention on the Protection of the Marine Environment of the Baltic Sea Area, known as the Helsinki Convention. The Contracting Parties are Denmark, Estonia, the European Union, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden. HELCOM aims to protect the marine environment of the Baltic Sea from all sources of pollution through intergovernmental cooperation. HELCOM is also a strategic partner of BANOS CSA.

For more information visit: <http://www.helcom.fi/>

VI. The International Council for the Exploration of the Sea (ICES)

ICES is an intergovernmental marine science organization, consisting of a network of more than 5,000 scientists from over 700 marine institutes located in 20 member countries and beyond. Its goal is to advance and share scientific understanding of marine ecosystems and the services they provide - and to employ this knowledge to generate state of the art advice on meeting conservation, management and sustainability goals. ICES also provides training and networking opportunities for the marine scientists, focusing on supporting the early career scientists. ICES is also a strategic partner of BANOS CSA.

For more information visit: <http://www.ices.dk/>

VII. Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO)

IOC-UNESCO is the only competent organization for marine science within the UN system. Its core function is to promote international cooperation and to coordinate programmes in marine research, services, observation systems, hazard mitigation, and capacity development in order to understand and effectively manage the resources of the ocean and coastal areas. IOC-UNESCO aims to improve the governance, management, institutional capacity, and decision-making processes of its Member States with respect to marine resources and climate variability and to foster sustainable development of the marine environment.

For more information visit: <http://ioc-unesco.org/>

VIII. International Baltic Earth Secretariat (Baltic Earth)

Baltic Earth, the international and interdisciplinary open Earth system research network for the Baltic Sea region, has been a scientific stakeholder in earth system research and innovation since 2013, when it superseded BALTEX after 20 years. The *Grand Challenges* of Baltic Earth embrace important aspects of regional Earth system science in the sea region and are included in its Science Plan. Baltic Earth and its predecessor BALTEX have been

involved in multiple BONUS projects in the past (ECOSUPPORT, Baltic-C, Amber, Sheba, BalticApp, INTEGRAL), resulting in many scientific publications and stakeholder involvements. For more information visit: <https://www.baltic-earth.eu/>

IX. The Joint Programming Initiative Connecting Climate Knowledge for Europe (JPI Climate)

JPI Climate is a pan-European intergovernmental initiative with 18 members, including both EU members and associated states. It aims to align national programmes by jointly coordinating their climate research and funding new transnational research activities through joint calls. JPI Climate overcomes unwanted fragmentation and makes better use of public research and innovation resources by creating synergies and facilitating cross border collaboration between scientists.

For more information visit: <http://www.jpi-climate.eu/home>

X. The Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI Oceans)

JPI Oceans is a pan-European intergovernmental initiative with 20 member countries and one observing country, including both EU members and associated states. It thrives to increase the impact of national investments in marine and maritime research and innovation through initiating calls based on a joint strategic agenda. JPI Oceans provides its member countries a platform to address complex ocean-related societal challenges that cannot be solved at national level. JPI Oceans is also a strategic partner of BANOS CSA.

For more information visit: <http://jpi-oceans.eu/>

XI. The Joint Programming Initiative Water Challenges for the Changing World (JPI Water)

JPI Water is a pan-European intergovernmental initiative with 23 member countries and 3 observer countries, including both EU members and associated states. It aims to tackle major water related societal challenges via execution of its joint Implementation Plan. As such, it contributes to the development of the European Research Area and strengthens Europe's leadership and competitiveness on water research and innovation.

For more information visit: <http://www.waterjpi.eu/>

XII. The Convention for the protection of the Marine Environment of the North-East Atlantic (OSPAR)

OSPAR is a joint mechanism by which 15 national governments and the EU cooperate to protect the marine environment of the North-East Atlantic. The implementation of the OSPAR Convention and its strategies are taken forward through the adoption of decisions, which are legally binding for the Contracting Parties, recommendations and other agreements. In addition, OSPAR makes recommendations to be taken by the Contracting Parties.

OSPAR is also a strategic partner of BANOS CSA.

For more information visit: <https://www.ospar.org/>

XIII. WATERBORNE Technology Platform (WATERBORNE)

WATERBORNE is an industry-oriented Technology Platform. It was set up to promote continuous dialogue between all waterborne stakeholders, including classification ship societies, shipbuilders, shipowners, maritime equipment manufacturers, infrastructure and service providers, universities or research institutes, and with the EU Institutions and Member States.

For more information visit: <https://www.waterborne.eu/>

3.2.2 Cross-analyses of transnational research and innovation priorities

Generally, the selected organizations or initiatives can be divided into three categories: (i) regional sea conventions, which aim to protect the marine environment (including HELCOM and OSPAR) (ii) implementation bodies that are primarily funding, coordinating and/or supporting research and innovation activities (including BONUS EEIG, and JPI Oceans, -Climate and -Water), and (iii) international or intergovernmental organizations or initiatives that have no direct funding instruments of their strategic science and/or innovation agendas. Instead their core activities include sharing knowledge, developing marine research and innovation foresight analyses, creating cohesions within research and innovation community. In addition, they may provide policy recommendations (including Baltic Earth, EFARO, EMB, EUROMARINE, ICES, IOC-UNESCO and WATERBORNE).

(i.) Implementation of Regional Sea Conventions (HELCOM and OSPAR)

In a recent OSPAR science update¹¹, five high-level strategic priorities/knowledge gaps were identified, including (i) indicator development, (ii) thresholds and reference values for common indicators, (iii) identification of ecologically meaningful assessment areas, (iv) cumulative effects of integration of indicators and (v) effectiveness of measures to reduce pressures. As such, all the priorities, and associated 44 priority knowledge gaps, aim to improve the future monitoring and assessment practices of the OSPAR maritime region, and there is a general urgency for a development of new science-based practices in both of these areas.

In the Baltic Sea, monitoring of physical, chemical and biological variables has a long history and today 12 official HELCOM monitoring programmes are in place that covers sources and inputs of human pressures and various variables reflecting the state of the environment. As such, a range of well-established indices are in place, which is outlined in detail in the HELCOM monitoring manual. However, despite the considerable efforts to protect and restore a healthy Baltic Sea, a recent report published in 2018 HELCOM State of the Baltic Sea — Second HELCOM holistic assessment 2011-2016 concludes that, in general, the Baltic Sea is still in a poor state, despite some improvements and signs of recovery. In addition, EU level policies and directives, e.g. Marine Strategy Framework Directive (MSFD), that supports ecosystem-based management practices, which aim to achieve a good environmental status of the European marine environments by 2020, have set new requirements and needs for indicators and assessment of the marine environment. Therefore, there is also a general consensus for development of new, more efficient science-supported indicator and assessment criteria in the Baltic Sea.

Four general objectives are identified in HELCOM's Baltic Sea Action Plan (BSAP), including (i) Baltic Sea unaffected by eutrophication, (ii) Favourable status of Baltic Sea biodiversity, (iii) Baltic Sea undisturbed by hazardous substances (iv) Environmentally friendly maritime activities. Of these the first objective, combatting eutrophication, is a major environmental concern in the Baltic Sea, causing annual toxic cyanobacterial blooms and oxygen deficiency both within surface sediments and water column. Although, in general eutrophication is somewhat less severe in the OSPAR maritime region, combating human induced eutrophication is highlighted as one of the five thematic strategies in the OSPAR's North Sea Atlantic Environment Strategy 2010-2020. In addition, eutrophication is listed under four of the five strategic knowledge gaps identified in the OSPAR Science Agenda¹¹, especially in terms of indicator development, establishing indicator thresholds and solving incoherent assessment outcomes. Other synergies between OSPAR and HELCOM agendas include preserving biodiversity and combatting the hazardous substances, including radioactive compounds.

In respect to synergies with the BANOS CSA objectives, improvement of monitoring practices and assessments fall namely under two of specific objectives, *Digital Ocean* and *Efficient technologies for*

environmental monitoring, assessment and forecasting, under the strategic objective *Healthy Seas and Coasts* (Table 7). In addition, the other two specific objectives, *Resilient ecosystem* and *Seamless governance* (which includes aspects of evaluation of effectiveness of measures), under the *Healthy Seas and Coasts* are highly relevant to both OSPAR and HELCOM priorities, as they promote development of ecosystem-based management practices and support protection and restoration of marine habitats.

In case of the BANOS CSA strategic objective *Sustainable Blue Economy*, sustainable utilization of the marine goods and services are both strongly supported by both HELCOM and OSPAR. In addition, environmentally friendly maritime activities are specially mentioned in the BSAP, which indirectly supports development of sustainable, circular and bio-based blue solutions.

(ii) Implementation and coordinating of research and innovation (BONUS, JPI Climate, -Oceans and -Water)

In general, JPI Oceans activities are focused on an intersection of three key areas, namely *the marine environment, climate change, and maritime economy and human activities*. In addition, it addresses transversal issues of ocean observation, data and infrastructure, cross-cutting technologies and human capacities. In its strategic research and innovation agenda (SRIA, 2015-202), *10 Strategy Areas* are identified that strongly reflect the above outlined key areas and the cross-cutting fields of research infrastructures, science-policy interactions, and human capacities. The strategy areas are:

- Exploring the deep-sea resources,
- Technology and sensor development,
- Science support to coastal and maritime planning and management,
- Linking oceans, human health and wellbeing,
- Interdisciplinary research and innovation for good environmental status,
- Observing, modelling and predicting ocean state and processes
- Climate change impact on physical and biological ocean processes
- Effects of ocean acidification on marine ecosystems,
- Food security and safety driving innovation in a changing world,
- Use of marine biological resources through development and application of biotechnology.

The BANOS CSA Programme Outline document¹ (Table 7), of the intended joint Baltic and North Sea research and innovation programme is closely aligned with the SRIA and key areas of JPI-Oceans. In the Programme Outline, *five strategic objectives* are listed, which are identified to be vital for macro-regional development of the Baltic and North Sea, as well as to achieve a decisive boost in the development of sustainable marine and maritime economy in the region. The strategic objectives are:

- *Overcoming fragmentation in research and innovation*, with the aim of delivering concerted responses to basin wide challenges across national borders and sectors.
- *Supporting ecosystem-based management*, with the aim of achieving good environmental status in the two neighbouring seas while promoting interdisciplinary ecosystem-based management of human activities along the land-coast-sea continuum, while improving observations, assessment and forecasting capacities under the global change.
- *Fostering sustainable blue growth*, with the aim of delivering new knowledge on value of ecosystem services and innovative tools for managing maritime activities and mitigating trade-offs between different uses.

- *Transferring knowledge to practice*, with the aim of devising fit-for-purpose regulations, policies, management tools, and practices, and enhancing the implementation of innovative maritime technologies without jeopardizing good environmental status of the environment.
- *Supporting human wellbeing*, with the aim of delivering knowledge to support social sustainability of blue growth and wellbeing of both genders, including health aspects and fair and inclusive access to the benefits of blue growth among citizens of different regions and states.

Despite the similarities in the identified research and innovation priorities of JPI-Oceans and BONUS, and their close synergy with the BANOS CSA objectives (Table 7), there are general differences in the scopes of JPI-Oceans and BONUS, especially in terms of their spatial context. Where JPI-Oceans Initiative covers both European deep-sea and shallow marine areas, the BONUS programme is focused on solving more specific research and innovation priorities on the scale regional shelf seas (currently in the Baltic, in future also intended to cover the North-Sea). In addition, where the extent of the actions varies within the JPI-Oceans calls, with only some of the member countries participating on specific calls, all BONUS actions are open to all Baltic Sea EU member states and Russian Federation (under a dedicated MoU), thus implementing a sea-basin-wide approach.

The research and innovation priorities of the JPI Climate are inevitably linked with some of the priorities of the JPI-Oceans and BONUS, as well as with the BANOS CSA objectives (Table 7), as climate is largely driven by the ocean-atmosphere heat exchange and oceans act as major sinks for both carbon dioxide and heat, while climate change and ocean acidification critically impacts marine ecosystems. The SRIA of JPI Climate is focused on solving three climate change associated challenges, which are

- Understanding the processes and consequences of climate change,
- Improving knowledge on climate-related decision-making processes and measures,
- Researching sustainable societal transformation in the context of climate change.

The synergies among the SRIAs and objectives of the implementation bodies are especially evident in the fields of development of modelling, observation and forecasting capabilities, and ensuring the sustainable future development, while targeting reductions in greenhouse gas emission. In addition, potential consequences of climate change, including increase in the extreme events and sea level rise, are closely associated to JPI-Oceans, BONUS and BANOS CSA objectives, having direct implications on human health, safety and well-being.

The SRIA of JPI Water, although in general more focused on a fresh water than marine environment, has also clear synergies with JPI-Oceans and -Climate, BONUS and BANOS CSA objectives/priorities (Table 7). Five main themes are identified in the SRIA of JPI Water:

- Improving ecosystem suitability and human well-being
- Developing safe water systems for citizens
- Promoting competitiveness in the water industry
- Implementing a water-wise bio-based economy
- Closing the water cycle gap – improving sustainable water resource management

Of these the most closely associated priorities are related to ensuring ecosystem resilience in aquatic settings and promoting human well-being. In addition, linking governance actions, including monitoring and assessment, on land to coast, is a joining factor. Tackling climate change and associated issues are also an overarching factor that cannot be overlooked, for example, the increasing effects of hydro-climatic events, like droughts and floods.

(iii) Organizations and initiatives with no direct funding instruments (EFARO, EMB, EUROMARINE, ICES, IOC-UNESCO, WATERBORNE)

The selected organization and initiatives with no direct funding instruments can be further divided into actions that focus on broad aspects of marine and maritime research and innovation and foresight analyses (Baltic Earth, EMB, EUROMARINE, ICES and IOC-UNESCO) and into actions with more specific scope, including fisheries and aquaculture (EFARO) or marine technology (WATERBORNE). For simplicity, the discussion of the priorities and associated documents (listed in Table 7) follows these groupings.

General marine research and innovation foresights

The EMB publication *Navigating the Future V* provides an overarching and comprehensive view of marine and maritime R&I foresights, identifying key themes that are set to significantly advance the understanding of the marine and broader earth and climate systems, while fostering the societal wellbeing in decades to come. Five key scientific themes are posed in the document:

- *4-dimensional ocean and connected ocean*, which focusses on proving a framework for understanding interactions within the physical, biogeochemical and biological ocean, both in time and space, as well as in relation to bio-, geo- and atmosphere.
- *A multi-stressed and rapidly changing ocean*, which focusses on impacts of multiple and cumulative human stressors on the oceans.
- *Science of surprises*, which focusses on extreme events, such as storm surges, heat waves, floods, earth- quakes and tsunamis, which have impact on local ecosystems.
- *Novel technologies, data and modelling for the ocean*, which focusses on novel technologies, such as drones, artificial intelligence and sensor development, allowing open access, real-time monitoring and observations for everyone.
- *Sustainability science for the ocean*, which focusses on interdisciplinary approach, solving social challenges and improving management of marine resources.
- *New frontiers, gaps and recommendations*, which relies to ocean governance.

The ICES strategy and science plan⁷ are closely linked to the EMB priorities, however including a wider geographical scope, covering the Atlantic Ocean (yet with a focus on the North Atlantic) and extending into the Arctic, the Mediterranean, the Black Sea, and the North Pacific. Seven interrelated science priorities were identified in the ICES science plan, which are closely aligned with the EMB priorities:

- *Ecosystem science*: Advance and shape understanding of the structure, function, and dynamics of marine ecosystems — to develop and vitalize marine science and underpin its applications
- *Impacts of human activities*: Measure and project the effects of human activities on ecosystems and ecosystem services — to elucidate present and future states of natural and social systems
- *Observation and exploration*: Monitor and explore the seas and oceans — to track changes in the environment and ecosystems and to identify resources for sustainable use and protection
- *Emerging techniques and technologies*: Develop, evaluate, and harness new techniques and technologies — to advance knowledge of marine systems, inform management, and increase the scope and efficiency of monitoring

⁷ Although document is a science plan, it does cover wide range of fisheries related innovation

- *Seafood production*: Generate evidence and advice for management of wild-capture fisheries and aquaculture — to help sustain safe and sufficient seafood supplies
- *Conservation and management science*: Develop tools, knowledge, and evidence for conservation and management — to provide more and better options to help managers set and meet objectives
- *Sea and society*: Evaluate contributions of the sea to livelihoods, cultural identities, and recreation — to inform ecosystem status assessments, policy development, and management

Two overarching global goals are identified in the IOC-UNESCO's document *Revised roadmap for the UN Decade of the Ocean Science for Sustainable Development* with a focus on promoting the UN Decade of Ocean Science for Sustainable Development, including *Sustainability Development Goal (SDG) 14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development*.

- Goal 1: To generate the scientific knowledge and underpinning infrastructure and partnerships needed for sustainable development of the ocean.
- Goal 2: To provide ocean science, data and information to inform policies for a well-functioning ocean in support of all Sustainable Development Goals of 2030 Agenda.

To achieve the goals, seven priority research and innovation areas are outlined:

- Comprehensive map (digital atlas) of the ocean
- A comprehensive ocean observing system
- A quantitative understanding of ocean ecosystems and their functioning as the basis for their management and adaptation
- Data and information portal (global open access)
- Ocean dimension in an integrated multi-hazard warning system
- Ocean in earth-system observation, research and prediction, with engagement of social and human sciences and economic valuation
- Capacity building and accelerated technology transfer, training and education, ocean literacy

The UN SDGs and UN Decade of the Ocean are also strongly supported by the EUROMARINE strategy document *Ocean Frontiers for Sustainable Development*, which highlights four strategic research and innovation needs:

- Manage the ocean complexity
- Secure the coastal areas
- Target ocean and human health
- Protection of ocean commons

Baltic Earth is dedicated to basic research and as such may help to complement the new SRIA with some basic questions and aspects, which require attention to support more applied research goals. The “Baltic Earth Science Plan 2017” represents a comprehensive description of the Baltic Earth research topics related to following *Grand Challenges*:

- Salinity Dynamics
- Land-Sea biogeochemical linkages
- Natural hazards and extreme events
- Sea level and coastal dynamics of the Baltic Sea
- Regional variability of water and energy exchanges
- Multiple drivers of regional Earth system changes

Multiple synergies and overarching themes are identified within the priorities and strategies of EMB, EUROMARINE, ICES and IOC-UNESCO, which are also closely associated with the BANOS CSA objectives (Table 7). In all the strategies, focus is given to sustainable management of marine environment and global commons, while promoting healthy and viable ecosystems and increasing the understanding the human impact on the environment. Digitalization of the ocean, including development of modern observation technologies and monitoring approaches that are able to deliver high quality, open-access data on-demand, is promoted. For additional reading, EMB Science Brief, which focusses on Strengthening Europe’s capability in biological ocean observations should be consulted.

Understanding the value of ecosystem goods and services, one of the specific BANOS CSA objectives, is also stressed in the strategy document of the IOC-UNESCO in the context of the SDGs. Currently, no existing means are in place to provide a value on marine ecosystem services and this gap should be addressed. The same topic is also highlighted in a recently published EMB Science Brief, which in turn focusses on the need to understand the value of marine ecosystems especially in respect to the developments in the Blue Economy, ensuring the sustainable management of the oceans and its resources. EMB highlights that a pluralistic valuation, including both the monetary and non-monetary valuation of all benefits stemming from marine ecosystem services, can help to assess the long-term sustainability of the oceans and regional seas alike. Improved understanding of the economic and social value of marine ecosystems is also likely to play a crucial role in stimulating the development of marine spatial planning, marine protected areas and other ecosystem-based management solutions.

A need for understanding and forecasting natural hazards and climate associated extreme events, such as tsunamis, earthquakes and storm surges, are stressed in the EMB and IOC-UNESCO documents, as well as within the priorities of JPI-Oceans. To date this theme is not listed within the preliminary subject areas outlined in the report T1.1 *Scoping the strategic framework for the future programme*. Although, it is inevitable related to the BANOS CSA strategic objective *Safe and accessible coast*, and hence it could be considered in the future development of the SRIA.

Fisheries and aquaculture (EFARO)

EFARO’s priorities for H2020 and beyond fall under two topics:

- **Regional cooperation** is needed for implementation Common Fisheries Policy (CFP) and Marine Strategy Framework directive (MSFD). Optimization of scientific surveys (including their strategy), monitoring approaches (including reliable assessments of exploited marine resources) and models that function on macro-regional, or regional seas scale are urgently needed. Also shared use of survey vessels is encouraged. Additionally, innovating ecosystem approaches need to be developed. Currently there is a lack of knowledge on mechanistic understanding of ecosystem functioning and how ecosystems change under multiple forcing.
- **Blue growth** is needed to stabilize and increase fisheries and aquaculture production in Europe and to enable European wide transition from being a net importer to a net exporter of marine produce. To achieve this an optimization of fish breeding programmes, including the involvement of small to medium size enterprises (SME), is critically needed. In addition, development and optimization of seaweed cultivation and industry is encouraged, offering multitude of choice from human and animal feed to cosmetics and bio-based products. Multi-use, integrated infrastructure approaches are encouraged, including integration of aquaculture into windfarms. In addition, more knowledge is needed on reliance and resilience of coastal communities and the social and economic impacts of development and innovation of novel production sectors using the seas and oceans.

The priorities of EFARO are largely supported the BANOS CSA objectives (Table 7) and in general covered by the strategic objectives *Healthy Seas and Coasts* and *Sustainable Blue Economy*. The multi-use, integrated infrastructure approaches is currently not included into the objectives, yet in principle, it could be incorporated into the specific objective Smart Seas - sustainable circulated and bio-based solutions. As the priority is also listed in at least within the national priorities of Lithuania and the Netherlands and is related to all member states with interest in developing wind farms, the topic may be considered in the future development of the SRIA.

Marine technology (WATERBORNE)

The European waterborne sector, including oceans, seas, lakes, canals and inland waterways, aims to address and respond to the global and local challenges in meeting the UN SDGs and fulfilling the societal needs, as well as achieving the full decarbonization of maritime and inland water ways transport by 2050, while also eliminating other transport associated pollutants and harmful substances.

Accordingly, Waterborne stakeholders have set out three main missions:

- *The transformation of Waterborne transport*, including themes green and clean transport; safe and secure transport: connected and automated transport and safe; competitive and eco-friendly shipyards and production sites.
- *Developing European leadership and new business models for blue growth sectors*, including themes understanding and protecting the oceans, seas and inland waters; the oceans, seas and inland waters as a source/font of natural resources; working and living at sea.
- *Integrating shipping and inland navigation into seamless port and logistics operations*, including themes port operations; integrated maritime and hinterland logistics; and port infrastructure.

Sustainable development is highlighted throughout the WATERBORNE strategy; thus, it is in synergy with three specific objectives of BANOS CSA (Table 7), especially in respect to sustainable blue economy. Development of green and clear transport approaches are a priority that ultimately reflect to healthier seas and coasts, while enhancing human wellbeing. Digitalization will enhance data flows and lead to a higher degree of automation and autonomy, which in turn will increase operations, safety and the energy-efficiency of Waterborne transport, and will also lead to an increase in logistic and mobility flows. To date water transport efficiency and associated technologies have not been discussed within BANOS CSA scoping process. As such, the future development of the SRIA must consider what aspects of water transport technology are within the scope of the BANOS CSA SRIA and which technology readiness level (TRL) is aimed for.

Table 7. Strategies and R&I priorities of 13 transnational organizations and initiatives evaluated against three strategic and ten specific objectives identified in the BANOS CSA task 1.1. Scoping the strategic framework for the future programme. The organizations in purple font are primarily funding, coordinating, and/or supporting research and innovation activities. The international or intergovernmental organizations or initiatives in green font generally do not have direct funding mechanisms, yet they aim to share scientific knowledge, develop marine research foresight, create cohesion within research and innovation community, and may provide policy recommendations. The regional sea conventions in blue font, generally aim to protect the marine environment. The filled circles indicate that the objective identified in the T1.2 are explicitly aligned with the respective strategy document of the organization or an initiative. The empty circles indicate that the objective identified in the T1.2 are closely aligned with the respective strategy document of the organization or an initiative. Empty cell indicates that subject of the objective identified in the T1.2 is not specifically discussed in the strategy document.

Organization	HEALTHY SEAS AND COASTS				SUSTAINABLE BLUE ECONOMY			HUMAN WELLBEING		
	A resistant and resilient marine ecosystem	Seamless governance linking land, coast and sea	Digital Ocean - Competent ecosystem modelling, assessments and forecasting	Efficient technologies for environmental monitoring	Sustainable resource management of marine global commons	Understanding the value of ecosystem goods and services	Smart Seas - sustainable, circular and bio-based blue solutions	Safe food and feed	Safe and accessible coast	Open Science - Access to knowledge and information:
Baltic Earth ¹	●	●	○	●					●	○
BONUS EEIG ²	●	●	●	●	●	●	●	●	●	
EFARO ³	○		○	○	●	○	●	○	○	
EUROMARINE ⁴	●	●	○	●	●		●	●	●	
EMB ⁵	●	○	●	●	●	○	●	○	●	●
HELCOM ⁶	●	●	○	○	●		○	●	●	
ICES ⁷	●	○	●	●	●	○	●	●	○	○
IOC-UNESCO ⁸	●	○	●	●	●	●	●	●	●	●
JPI Climate ⁹			●	●	●		●		○	●
JPI Oceans ¹⁰	●	●	●	●	●	●	●	●	●	●
JPI Water ¹¹	●	●	○	○	○		○	●	○	○
OSPAR ¹²	●	●	●	●	○			○	○	
WATERBORNE ¹³	○	●		●	●		●	○	●	○

¹Baltic Earth Science Plan 2017, ²Bonus Publication 15 Towards Sustainable Blue Growth Outline of the joint Baltic and North Sea research and innovation programme, ³EFARO's view on research priorities for H2020 SC2 2018 and beyond, ⁴Ocean Frontiers for Sustainable Development - Contributing to the UN SDGs & the UN Decadal of Ocean Science Initiatives, ⁵Navigating the Future V, ⁶HELCOM - Baltic Sea Action Plan, ⁷ICES Science Plan: Marine ecosystem and sustainability science for the 2020s and beyond & ICES Strategic Plan, ⁸Revised Roadmap for the UN Decade of Ocean Science for Sustainable Development, ⁹Strategic Research & Innovation Agenda 2016 – 2025, ¹⁰Strategic Research and Innovation Agenda 2015-2020, ¹¹Strategic Research & Innovation Agenda 2.0, ¹²Science Agenda 2018 Update and North Sea Atlantic Environment Strategy 2010-2020, ¹³Strategic Research Agenda for European Waterborne Sector

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3.3 Chapter 3: Relevant EU policies

In many of the BANOS CSA partner countries, the research and innovation priorities are closely interlinked to overarching EU policies and directives, including the Marine Research Framework Directive (MSFD), the Common Fisheries Policy (CFP), the Blue Growth Agenda and Regional Seas strategies. In addition, EU strategies which support innovation on a territorial level, the so-called *smart specialisation strategies*, play a major role in the implementation of EU-Structural Funds. All these policies and directives have direct relevance to EU research and innovation priorities, building a basis for R&I activities in the EU member states. For the purposes of this report and further development of the BANOS CSA SRIA, the following policies/strategies should be regarded as additional important background information.

I. Marine Strategy Framework Directive (MSFD)

Date of publication: 2008

Source: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0056>

Publisher: European Commission

The MSFD represents the environmental pillar of the European Integrated Maritime Policy. It was adopted in 2008 and since then, a large amount of activities was put in place to implement the main goals of this strategy. It is the aim of the MSFD to promote the integration of environmental considerations into all relevant marine policy areas, with the intended result of achieving good environmental status (GES) in Europe by 2020.⁸ The MSFD stated in 2008 “On one hand there is a high pressure on marine natural resources and the demand for marine ecological services and on the other hand there is a strong impact on the marine environment”. To monitor if GES has been achieved by 2020, 11 descriptors were defined:

- Biodiversity
- Non-indigenous species
- Populations of commercial species
- Food web structure
- Eutrophication
- Sea floor integrity
- Alteration to hydrography
- contaminants
- sea-food contaminants
- marine litter
- energy and noise

Some key elements of the timeline to reach GES by 2020 are shown in the following graphic:

⁸ MSFD (2008), p. 25: ‘good environmental status’ means the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations



Figure 3. MSFD Cycle

Source: http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/marine-strategy-framework-directive/index_en.htm

II. Water Framework Directive (WFD)

Date of Publication: 22.12.2000

Source: http://ec.europa.eu/environment/water/water-framework/index_en.html

Publisher: European Parliament and Council

The WFD is to be equated with the integrated river basin management for Europe. It deals specifically with the coastal and transitional waters and as such is crucial for the specific objective “Seamless governance linking land, coast and sea” of BANOS CSA.

Twelve "Water notes" aim to give an introduction and overview of key aspects of the implementation of the WFD:

- Joining forces for Europe's shared waters - Coordination in international river basin districts
- Cleaning up Europe's waters - Identifying and assessing surface water bodies at risk
- Groundwater at Risk - Managing the water under us
- Reservoirs, Canals and Ports - Managing artificial and heavily modified water bodies
- Economics in Water Policy - The value of Europe's waters
- Monitoring programmes - taking the pulse on Europe's waters
- Intercalibration - a common scale for Europe's waters
- Pollution - Reducing dangerous chemicals in Europe's waters
- Integrating water policy - linking all EU Water legislation within a single framework
- Climate change - Addressing floods, droughts and changing aquatic ecosystems
- From rivers to the sea - Linking with the new Marine Strategy Framework Directive
- A Common Task - Public Participation in River Basin Management Planning

Further information: http://ec.europa.eu/environment/water/participation/notes_en.htm

III. Common Fisheries Policy (CFP)

Date of publication: 2013

Source: <https://ec.europa.eu/fisheries/cfp/>

Publisher: European Commission

The revised Common Fisheries Policy (CFP) was published in 2013 by the EU-Commission and its purpose is stated as follows: “The scope of the CFP includes the conservation of marine biological resources and the management of fisheries targeting them. In addition, it includes, in relation to market measures and financial measures in support of its objectives, fresh water biological resources and aquaculture activities, as well as the processing and marketing of fishery and aquaculture products, where such activities take place on the territory of Member States or in Union waters, including by fishing vessels flying the flag of, and registered in, third countries, by Union fishing vessels, or by nationals of Member States, without prejudice to the primary responsibility of the flag State, bearing in mind the provisions of Article 117 of the United Nations Convention on the Law of the Sea of 10 December 1982 (UNCLOS).”⁹

It is a key challenge to preserve the marine biodiversity and at the same time to consider commercial fisheries and consumers’ behaviour. Therefore, strategic guidelines within the fisheries sector have been linked to other important strategic guidelines in Europe, like the MSFD, the Europe 2020 strategy and the Blue Growth strategy, as well as to the aquaculture sector. It is especially related to aspects of the Bioeconomy and agricultural sector.

IV. Blue Growth – Opportunities for marine and maritime sustainable growth

Date of publication: 2012

Source: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012DC0494&from=EN>

Publisher: European Commission

This Communication drives forward the Commission's Integrated Maritime Policy and launches a process, which will place the blue economy firmly on the agenda of Member States, regions, enterprise and civil society. It describes how Member States and EU policies are already supporting the blue economy. It then identifies specific areas where targeted action could provide an additional stimulus. A set of initiatives will subsequently be launched to explore and develop the growth potential in these areas.

This Communication has identified five areas (blue energy, aquaculture, maritime, coastal and cruise tourism, marine mineral resources and blue biotechnology) where additional effort at EU level could stimulate long-term growth and jobs in the blue economy, in line with the objectives of the Europe 2020 strategy. With increasing awareness of the blue economy, and further analysis, other promising areas for EU policymaking may emerge.

⁹ REGULATION (EU) No 1380/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC, Art. 2

V. EU Biodiversity strategy

Date of publication: 2011

Source: http://ec.europa.eu/environment/nature/biodiversity/strategy/index_en.htm

Publisher: EU-COM

This strategy is aimed at reversing biodiversity loss and speeding up the EU's transition towards a resource efficient and green economy. It is an integral part of the Europe 2020 Strategy, and in particular the resource efficient Europe flagship initiative. The 2020 Biodiversity strategy includes six mutually supportive and inter-dependent targets that respond to the objectives of the 2020 headline target. They will all help to halt biodiversity loss and the degradation of ecosystem services, with each seeking to address a specific issue: protecting and restoring biodiversity and associated ecosystem services (targets 1 and 2), enhancing the positive contribution of agriculture and forestry and reducing key pressures on EU biodiversity (targets 3, 4 and 5), and stepping up the EU's contribution to global biodiversity (target 6). Each target is broken down into a package of actions designed to respond to the specific challenge addressed by the target. The specific actions are set out in the Annex to this Communication. The actions will be subject to further impact assessments where necessary.

In Practice:

In 2011, the EU adopted an ambitious strategy setting out 6 targets and 20 actions to halt the loss of biodiversity and ecosystem services in the EU by 2020 (read the Strategy). The mid-term review of the strategy assesses whether the EU is on track to achieve this objective. It shows progress in many areas but highlights the need for much greater effort.

On 16 December 2015, the Environmental Council adopted Conclusions on the mid-term review of the EU Biodiversity Strategy to 2020.

On 2 February 2016, the European Parliament adopted a Resolution on the mid-term review of the EU Biodiversity Strategy to 2020.

VI. Progress of the EU's Integrated Maritime Policy

Date of publication: 2012

Source: http://ec.europa.eu/maritimeaffairs/documentation/publications/documents/imp-progress-report_en.pdf

Publisher: European Commission

Since its creation in 2007, the Integrated Maritime Policy (IMP) has sought to enhance the sustainable development of the European maritime economy and to better protect the marine environment by facilitating the cooperation of all maritime players across sectors and borders. This second Report describes the progress of the EU's IMP and maritime sectoral policies between 2010 and 2012. It highlights their contribution to the objectives of the Europe 2020 strategy by taking stock of concrete achievements that help create growth, enhance resource efficiency and save public money.

The Commission is setting the best possible conditions for sustainable economic development to come from the sea. Building on those achievements, Blue Growth is the objective for the coming years. During Cyprus's Council Presidency, an informal Ministerial Conference on IMP will be a major steppingstone towards this

goal. Blue Growth will drive a second phase of the Integrated Maritime Policy to achieve a healthy maritime economy that delivers innovation, growth and sustainability for European citizens.

VII. EU-Directive on Maritime Spatial Planning (MSP)

Date of publication: 23.07.2014

Source: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0089&from=EN>

Publisher: EU Parliament and Council of the EU

The MSP directive is part of the Integrated Maritime Policy (IMP) which identifies maritime spatial planning as a cross-cutting policy tool enabling public authorities and stakeholders to apply coordinated, integrated and trans-boundary approach. The application of an ecosystem-based approach will contribute to promoting the sustainable development and growth of the maritime and coastal economies and the sustainable use of marine and coastal resources. Maritime spatial planning will contribute to the effective management of marine activities and the sustainable use of marine and coastal resources, by creating a framework for consistent, transparent, sustainable and evidence-based decision-making. In order to achieve its objectives, this Directive should lay down obligations to establish a maritime planning process, resulting in a maritime spatial plan or plans; such a planning process should take into account land-sea interactions and promote cooperation among Member States. Without prejudice to the existing Union acquis in the areas of energy, transport, fisheries and the environment, this Directive should not impose any other new obligations, notably in relation to the concrete choices of the Member States about how to pursue the sectoral policies in those areas, but should rather aim to contribute to those policies through the planning process.

Timeline:

2014: Adoption of the directive

2016: Deadline for transposition and designation of competent authorities

2021: Deadline for the establishment of maritime spatial plans

Further information: https://ec.europa.eu/maritimeaffairs/policy/maritime_spatial_planning_en

VIII. MSP data study - Evaluation of data and knowledge gaps to implement MSP

Date of publication: 06.04.2017

Source: <https://publications.europa.eu/en/publication-detail/-/publication/f01f1b26-1b60-11e7-aeb3-01aa75ed71a1>

Publisher: Publication Office of the EU

The MSP Data Study, undertaken on behalf of DG MARE between February and December 2016, presents an overview of what data and knowledge are needed by Member States for MSP decision making, taking into account different scales and different points in the MSP cycle. It examines current and future MSP data and knowledge issues from various perspectives (i.e. from Member States, Sea Basin(s) as well as projects and other relevant initiatives) in order to identify: - What data is available for MSP purposes and what data is actually used for MSP; - Commonalities in MSP projects and Member State experiences; - The potential for EMODnet sea basin portals to help coordination of MSP at a regional level and options for realising marine spatial data infrastructures to implement MSP; - Potential revisions to be made concerning INSPIRE specifications for MSP purposes. The study finds that across all European Sea Basins, countries are

encountering similar issues with respect to MSP data needs. Differences are found in the scope of activities and sea uses between Member States and Sea Basins and the type of planning that is being carried out. Common data gaps include socio-economic data for different uses and socio-cultural information. By and large, data and information gaps are not so much about what data is missing but more about how to aggregate and interpret data in order to acquire the information needed by a planner. Challenges for Member States lie in developing second generation plans which require more analytical information and strategic evidence. Underlying this is the need for spatial evaluation tools for assessment, impact and conflict analysis purposes. Transnational MSP data needs are different to national MSP data needs. While the scope and level of detail of data needed is typically much simpler, ensuring its coherence and harmonisation across boundaries remains a challenge. Pan-European initiatives, such as the EMODnet data portals and Sea Basin Checkpoints have the potential to support transboundary MSP data exchange needs by providing access to a range of harmonised data sets across European Sea Basins and testing the availability and adequacy of existing data sets to meet commercial and policy challenges.

IX. European Union Strategy for the Baltic Sea Region

Date of publication: 10.06.2009

Source: http://ec.europa.eu/regional_policy/sources/docoffic/official/communic/baltic/com_baltic_en.pdf

Publisher: European Commission

The strategy should provide an integrated framework that allows the European Union and Member States to identify needs and match them to the available resources through coordination of appropriate policies. This will enable the Baltic Sea Region to enjoy a sustainable environment and optimal economic and social development. The Commission is therefore proposing an indicative action plan, fully discussed with the Member States and regional stakeholders, to encourage the implementation of visible projects. The action plan is organized around the four pillars. It is, however, an integrated strategy; the proposed actions often contributing to more than one identified objective. The individual actions and flagship projects have been selected for their fast implementation and impact.

The main economic challenges are to overcome the wide disparities (and hence realize the high potential) in research and productive innovation and to remove impediments to the single market. Priority issues for accessibility are the improvement of networks, ending the energy isolation of parts of the region, and ensuring sustainability of transport modes. Finally, priorities in the field of safety are to reduce risks posed to the region's citizens, infrastructure and environment by hazards from a variety of sources, in particular accidental marine pollution and organized crime.

This strategy offers the opportunity to move from words to action and to deliver real benefits for the region as a whole.

X. Action Plan for a Maritime Strategy in the Atlantic area Delivering smart, sustainable and inclusive growth

Date of publication: 2013

Source: <http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1395674057421&uri=CELEX:52013DC0279>

Publisher: European Commission

This Action Plan sets out priorities for R&I and investment to drive the ‘blue economy’ forwards in the Atlantic area. The five Atlantic Member States and their regions can draw on the Action Plan to help create sustainable and inclusive growth in coastal areas. The Action Plan builds on the Commission's Atlantic Strategy and is the result of consultations conducted through the Atlantic Forum.

The Action Plan is intended to have a strong signalling effect for regions and the private sector. They should begin consideration of where they could work together, including on a cross-border basis, to implement the agreed priorities. The process of developing the Action Plan, conducted in partnership with the five Atlantic Member States, has encouraged stakeholders, including regions, port cities and the private sector, to consider how they could take action to grow the blue economy and contribute to sustainable development in the Atlantic area. This should help to attract investment and private sector activity into the blue economy and, in doing so, help to revitalize coastal regions in the Atlantic area.