

BANOS CSA deliverables

Baltic and North Sea Coordination and Support Action 2018-2021

Work package 1 Strategic research and innovation agenda

Deliverable: D1.1 Report defining the scope of the future programme

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Main Outcomes:

-Three overarching **Strategic Objectives** (1. *Healthy seas and coasts*, 2. *Sustainable blue economy* and 3. *Human wellbeing*) are proposed, that are further defined with ten **Specific Objectives**.

-In the further development of the BANOS SRIA the following aspects need to be included.

The regional seas approach

- Demonstrate clear evidence for the need of a joint Baltic and North Sea approach
- Present direct connections between the research priorities and the environmental goals set by EU directives, various regional sea conventions, the Agenda 2030 and the UN Decade of the Ocean.
- Follow the development and update of other relevant SRIAs, e.g. the JPI Ocean, to identify common objectives and challenges, as well as differences.

Interdisciplinary approach

- Strong emphasis on the interdisciplinary research and early involvement of end-users. For instance, interdisciplinary cooperation is needed between scientists and stakeholders to achieve common standards of the regional seas in relation to the WFD, MSFD and MSP.
- Clear arguments for the selected research and innovation themes.

Forward-looking approach

- Forward looking and solution oriented. The research programme has to anticipate not only the environmental challenges, but also changes ahead, for instance the increased demands for renewable energy, while also dealing with present issues, such as, reducing pollution and sustaining food production.
- Take into consideration the increasing anthropogenic pressure on the land-coastal-sea continuum.

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Description of task:

This task will develop and propose the contours of the new programme. To this end, a set of general principles will be identified for delineating the thematic scope and strategic dimensions of the programme. The programme's principal aim is to promote excellent science and innovation and hereby contribute to sustainable blue growth and to knowledge generation needed for the implementation of the Agenda 2030 goals. Additional strategic objectives such as overcoming fragmentation, supporting ecosystem-based management, intensifying knowledge transfer and supporting human well-being will also be central to the new programme. These general principles shared by all participants will form the point of departure for jointly scoping, identifying and agreeing on specific research and innovation objectives for the new programme.

Task 1.1 will include one two-day workshop that gathers all participants of BANOS CSA. The goal of the workshop is to agree on a set of general principles that will guide the further development of the SRIA and the programme's implementation modalities. The role of the task leaders will be to prepare the workshop, facilitate the process at the workshop and to draft the outcome. The active contribution by all BANOS CSA participants at the workshop is envisaged. Importantly, it is expected that project's strategic partners, namely HELCOM, OSPAR, ICES and JPI Oceans, will assist in delineating the thematic contours of the future programme. The discussion on how scientific research carried out within the future programme will contribute to innovation efforts will be initiated already at the scoping stage.

The outcome of this task will directly feed into the development of the strategic research and innovation agenda (SRIA). Programme scoping definitions prepared by the task leader will be discussed at the Forum of Programme Managers (T5.5) and adopted by the BANOS CSA Steering Committee (T.5.1). The scoping task will be carried out in project months 1-6; it will be fulfilled in three work steps: Gathering initial information and preparing the scoping workshop (M1-M4); the scoping workshop (M5); completing the report defining scope of the future programme (M5-M6).

BANOS CSA

Work package 1 *Strategic research and innovation agenda*

Task 1.1 *Scoping the strategic framework for the future programme*

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Introduction to the BANOS CSA

In total 15 major research and innovation funders of 13 countries (BE, DK, EE, FR, DE, LV, LT, NL, NO, PL, SE, UK, and FI as an observer, table 1) and four strategic partners (HELCOM, OSPAR, ICES and JPI Oceans, Annex 1: Table 1 List of consortium members, partners and observers) have come together to prepare BANOS, the joint Baltic and North Sea Research and Innovation Programme. The programme, as it is planned in the Baltic and North Sea Coordination Action (BANOS CSA), intends to fund projects and deliver policy relevant science and innovation, based on its joint marine and maritime strategic research and innovation agenda (SRIA). This will be done in support of sustainable use of ecosystem goods and services while generating strong EU added value and impact. As such, the programme aims to deliver a decisive boost to sustainable marine and maritime economy, including new products and solutions, and bringing this way the research and innovation capacity of the Northern European region to the next level.

Research and innovation programme for the ‘sister seas’

The possibility of extending geographically the scope of the predecessor programme BONUS, the joint Baltic Sea Research and Development Programme implemented as a TFEU Art185, to cover also the North Sea in the future programme was first considered in 2013. In 2015, the initial outline of the future Baltic and North Sea Research and Innovation Programme was drafted with the participating states expressing their clear commitments. Subsequently in 2016, the outline of the future programme was published as a BONUS publication No 15 Towards sustainable blue growth¹ (further referred to as the Programme Outline). In this document, which was published prior to the start of the BANOS CSA, five strongly interlinked initial strategic research objectives were outlined (Box 1). These objectives are critical for achieving desired Northern European macro-regional development and delivering on European marine and maritime strategies and policies, such as Marine Strategy Framework Directive (MSFD), Common Fisheries Policy (CFP) and Blue Growth Strategy. In 2017, a call topic BG-01-2018: “Towards a Baltic and North Sea innovation programme” was published within the Horizon 2020 Work Programme 2018-2020, and in November 2018 the implementation of the BANOS CSA commenced.

Box 1. Five strategic objectives outlined in the Programme Outline 2016¹

1. Overcoming fragmentation in research and innovation
2. Supporting ecosystem-based management
3. Fostering sustainability of blue growth
4. Transferring knowledge to practice
5. Supporting human wellbeing

The workplan of the BANOS CSA contains five work packages (WPs) of which WP1 is dedicated to the development of the BANOS Strategic Research and Innovation Agenda (SRIA). The other WPs include development of efficient and legally sound implementation modalities, communication and stakeholder engagement strategy and means of reinforcing the future programme’s lasting impact. As such, BANOS CSA WPs are set to successfully create all the

¹ Bonus Publication 15 Towards sustainable blue growth *Outline of the joint Baltic Sea and the North Sea research and innovation programme 2018–2023*
https://www.bonusportal.org/files/4699/BONUS_Publication_No_15.pdf

necessary conditions for durable coordination of joint research and innovation efforts in the Baltic and North Sea region by preparing a complete framework and consequently launch BANOS from 2021 onwards.

Together with the synthesis of the existing priorities of marine and maritime research and innovation at national, macro-regional, EU and international levels (Task 1.2), this report will constitute the baseline for further BANOS SRIA development. It is anticipated that an expert drafting team will commence its work already by mid-2019 and the first SRIA draft will be delivered for consultations with key stakeholders in early 2020. The process of stakeholder consultation will culminate to the Strategic Orientation Workshop (SOW) which will be held in spring 2020. In accordance with the BANOS CSA work plan, the first edition of the BANOS SRIA will be completed by the end of 2020.

Foreseen benefits of BANOS, the joint Baltic and North Sea Research and Innovation Programme

In respect to a worldwide comparison, the EU has made a good progress towards reaching the sustainable development goals². However, on average in the global ranking, the 27 EU Member States get their lowest score on SDG 14 – *Conserve and sustainably use the oceans, seas and marine resources for sustainable development*, with big differences between the member states. As such, a lot of work remains to be done, if SDG 14 is to be reached by 2030. Therefore, urgent actions are needed to provide sustainable ecosystem-based management solutions for preservation and protection of the marine environment, while supporting the Blue Growth strategy. As much of the ecosystem services exist on the coastal and continental shelf seas, actions should focus on these environments. As such, the Baltic Sea and the North Sea are exceptionally well-suited for a joint research and innovation programme. Furthermore, these *sister seas* have many similarities, in respect to natural parity, societal similarities and human induced pressures that enables comparative research, supports a strong programme coherence and provides ample scientific learning opportunities.

Natural parity between the Baltic and North Sea include:

- interconnected shelf seas, forced by the same weather patterns and water exchange with the North Atlantic. Also, connected by the migratory routes of biota
- represent extended gradients in physical, chemical, and biological properties of the natural environment.
- located at the same latitudes, thus, face similar challenges in respect to climate change and associated sea level rise

These natural couplings, which are analysed in detail in Programme Outline (part B)¹, provide unique opportunities to study the effects of various environmental pressures and management strategies on marine ecosystem functioning. In addition, the natural gradients, for example in salinity, temperature and associated biogeochemical parameters, from marine North Sea to a nearly freshwater dominated Botnia Bay in the Baltic Sea, allow studying the effects of different environmental pressures on ecosystem functioning. Studies along such gradients are extremely useful, allowing scientist to replace time with space.

Examples of societal similarities in the Baltic and North Sea include:

² European Commission, 2019, Reflection paper towards a sustainable Europe by 2030, doi: 10.2775/676251, ISBN: 978-92-79-98963-6 https://ec.europa.eu/commission/publications/reflection-paper-towards-sustainable-europe-2030_en0

- relatively homogeneous cultures
- similar visions for sustainable management of marine resources and conducting maritime activities
- similarities in land-use and economic development plans of catchments.

These societal similarities make the co-operation and joint management approaches feasible, allowing the member states to benefit from each other's experience in sustainable management approaches and conservation of marine resources. In addition, multiple states share coastline in both Baltic and North Sea, making a joint management strategy desirable.

Examples of similarities in human-induced pressures on the Baltic and North Sea include:

- influence by runoff from large, in general from densely populated and heavily exploited catchment areas, resulting in excessive loading with nutrients, contaminants and marine litter.
- both traversed by one of Europe's busiest waterways presenting pressures and contamination risks to the ecosystems.
- changes in the food-web structure due to overfishing.

Next steps

Regarding the exact scope of the future programme, while endorsing consensus on the core content, the outcome of the consultations with the participating national funders as carried out by the task 1.1 team suggests leaving the exact outer border of the scope open for the time being. Further work on SRIA development may reveal knowledge gaps that are critical for achieving the objectives even if for some reason not covered in all participating states by the currently involved national research and innovation funders. Obviously, such issues may be resolved through broadening the funding base of BANOS by attracting new funders.

In conclusion, it is worth stressing that following the practice adopted in BONUS, the BANOS SRIA should be viewed as a 'living document', meaning that it will undergo systematic periodic reviews, based on analysis of the evolving policy landscape and regular stakeholder consultations throughout the programme's life-time.

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Task 1.1

Scoping the strategic framework for the future programme

Executive Summary

The overarching objective of the proposed Baltic and North Sea Coordination and Support Action (BANOS CSA) is to create the necessary conditions for durable coordination of research and innovation in the North Sea and Baltic Sea region by preparing a framework for BANOS, the joint Baltic and North Sea Research and Innovation Programme envisaged to start in 2021.

The goal of the BANOS CSA Task 1.1 *Scoping the strategic framework for the future programme* is to establish a framework for the further development of the joint strategic research and innovation agenda (SRIA). This report presents the outcome of the scoping process, which is based on the input from the participating member organisations that represent major research and innovation funders of 13 countries (BE, DK, EE, FR, DE, LV, LT, NL, NO, PL, SE, UK, and FI as an observer), the strategic partners (HELCOM, OSPAR, ICES and JPI Oceans) as well as the BONUS EEIG Secretariat (the coordinator of BANOS CSA) and the BANOS CSA Advisory Board.

Based on the initial strategic research objectives, *Supporting ecosystem-based management*, *Fostering sustainability of blue growth* and *Supporting human wellbeing*, originating from the Programme Outline (BONUS Publication No 15), three overarching strategic objectives are proposed for the future programme: *Healthy seas and coasts*, *Sustainable blue economy* and *Human wellbeing*. These strategic objectives were defined with more specific objectives. As explanation of each specific objective, some examples of research and innovation themes are presented. This list of themes will be further refined and ‘downscaled’ to specific topics and innovation tasks in the course of more detailed expert analysis and stakeholder consultations that are envisaged in the development of the BANOS SRIA. Ultimately, future BANOS calls are intended to be issued and projects funded respectively, all based on the themes and topics of the BANOS SRIA.

The framework needs to remain open for adjustments and should be treated as a living document as new research, innovation and policy needs are bound to arise within the timeframe of the development of the BANOS SRIA, as well as during the implementation of a future programme. The BANOS SRIA will be sharpened during this process to further define the research areas, as well as to complement other outcomes of the BANOS CSA work packages and tasks.

Petra Wallberg and Sif Johansson
Formas

1 Introduction

The goal of BANOS, the joint Baltic and North Sea Research and Innovation Programme, as planned in the BANOS CSA, is to elevate the Northern European regions' research and innovation capacity to a level necessary to achieve a decisive boost in the development of a sustainable marine and maritime economy and enable ecosystem-based management while fostering human wellbeing. Researchers in the countries surrounding two regional seas, the Baltic Sea and the North Sea, will jointly generate new knowledge that is needed for a sustainable use of the ecosystem services. In this way, the science and innovation effort will contribute at national, macro-regional, EU and international levels, while providing also benefits for individual citizens.

This report is the delivery of the BANOS CSA Task 1.1 *Scoping the strategic framework for the future programme*, coordinated by the Swedish Research Council Formas. It is part of the first work package, *WP1 Strategic research and innovation agenda* (SRIA), coordinated by the BANOS CSA Secretariat. The aim of the Task 1.1 is to provide the framework for the future development of the BANOS SRIA by BANOS CSA members and strategic partners.

An objective-driven approach is intended to be used throughout the development of the SRIA, of which the first step is the scoping process. Here, the aim is to identify the broad objectives of the programme, more specifically how it pursues to benefit the society at large.

2 Methods

A bottom-up approach was applied in the scoping process, and all member organisations and observers (Annex 1) were invited to participate in an online survey, which was created using the web-based tool, Howspace³.

2.1 An online survey for suggestions on research and innovation needs

The survey was divided into three sections based on the initial three strategic research objectives originating from the Programme Outline⁴: 1) *Supporting ecosystem-based management*, 2) *Fosters sustainability of blue growth* and 3) *Supporting human wellbeing*. Two strategic objectives *Overcome fragmentation* and *From knowledge to practice* are not included in the Task 1.1 as they are covered in other BANOS CSA tasks, primarily in WP 4 *Specific measures reinforcing future programmes lasting impact*.

Under each strategic research objective, participants were asked to fill in the appropriate primary research and innovation interests by their organisation. In addition, participants were asked to indicate if there are research and innovation areas related to these strategic objectives that according to their organisation's policy or practice should not be included into the research scope of the future programme. As an additional input, participants were also asked to suggest how the research and innovation themes will strengthen and add value to the EU. The online survey was open for the participants between 8th and 22nd of February 2019. The answers were uploaded anonymously at Howspace or sent directly to Formas by e-mail.

The number of primary research and innovation interests presented by the organisations in the Howspace survey were impressive, and therefore, in order to get an overview, they were grouped

³ www.howspace.com

⁴ BONUS Publication No. 15, February 2016 (original proposal) www.banoscsa.org/files/6338/BONUS_Publication_No_15.pdf

under headlines (later named as *specific objectives*; Annex 2). The primary research and innovation interests were further summarised and modified during the working process and named as *research and innovation themes*. The outcome of the Howspace survey was presented in a first draft report (Annex 3), which was distributed to the Consortium Members, Strategic Partners, the Advisory Board and the Observers for commenting prior to a workshop organised as the next stage of the process on 12 March 2019 in Brussels.

2.2 A scoping workshop

On 12 March 2019 (Annex 4) task leaders convened a workshop in Brussels to further discuss the scope and the framework of the joint SRIA. It was attended by 29 participants, representing 14 BANOS CSA Consortium Member Organisations, three Strategic Partners (HELCOM, ICES and JPI Oceans) and one Observer Organisation (Academy of Finland).

During the workshop the participants were divided into three groups. Each group subsequently discussed each of the three strategic objectives with an assigned rapporteur (see section 2.1) and each dialogue lasted approximately 30 minutes. The rapporteur of the *Ecosystem-based management*-dialogue was Sif Johansson (Formas), rapporteur of the *Blue growth*-dialogue was Petra Wallberg (Formas) and of the *Human wellbeing*-dialogue was Karoliina Koho (BONUS EEIG). The focus for these discussions were the results of the Howspace survey (Annex 3). In the end, the rapporteurs summarised the outcome of the discussions and the results were presented in the plenary and further discussed and debated.

A second draft report was compiled based on the workshop results, which was distributed among the Consortium Members, the Observers and the Advisory Board for comments and corrections. The final report was approved at the second BANOS CSA Steering Committee meeting on 6 June 2019.

3 Results

As a result, the titles of strategic objectives suggested in the Programme Outline³, were reformulated to the following: 1) *Healthy seas and coasts*, 2) *Sustainable blue economy* and 3) *Human wellbeing*. In addition, specific objectives were suggested under each strategic objective in order to further define the scope of the future programme. This now created framework is intended to remain open for adjustments, as and when new research, innovation, and policy related needs arise during the timeframe of the development of the SRIA. Also, following the experience of BONUS Art 185 (BONUS SRA1, 2011⁵, and BONUS SRA2, 2014⁶), it is anticipated that the BANOS SRIA will be systematically updated based on the development of policy and scientific context.

3.1 Strongly interlinked strategic objectives

The three **strategic objectives** 1) *Healthy seas and coasts*, 2) *Sustainable blue economy* and 3) *Human wellbeing* (Figure 1), are the cornerstones of the future programme and follow the original intentions in the Programme Outline³.

³ Bonus Publication 12 Strategic research agenda 2011-2017 *The joint Baltic Sea research and development programme*
https://www.bonusportal.org/files/1246/Publication_No._12_SRA.pdf

⁶ Bonus Publication 14 Strategic research agenda 2011–2017, update 2014 *The joint Baltic Sea research and development programme*
https://www.bonusportal.org/files/2981/Publication_No._14_update.pdf

In the centre of the framework is **ecosystem-based management**, which is the process by which the trade-offs are identified, understood and managed. This process ensures that healthy seas and coasts, a sustainable blue economy and human wellbeing can all be achieved. The interactions between these objectives, and, thus, the associated requirement for ecosystem-based management, justifies the necessity of a holistic, interdisciplinary approach to research and innovation. Furthermore, when successful, ecosystem-based management bases on interdisciplinary collaboration between social scientists, natural scientists and stakeholders.

The structure and function of the ecosystems of the Baltic Sea and the North Sea are strongly influenced by climate and climate change. The structure and function of the ecosystems also define the environment on which healthy seas and coasts, a sustainable blue economy and human wellbeing depend, including feedbacks from human uses onto the environment.

Thus, all research and innovation studies must consider the ecosystems of the regional sea basins and take into account the context of changing climate and the ecosystems structure and functioning in the Baltic Sea and the North Sea. Furthermore, also the human induced impact influences the health of the seas and coasts, the sustainability of the blue economy and the human wellbeing itself.

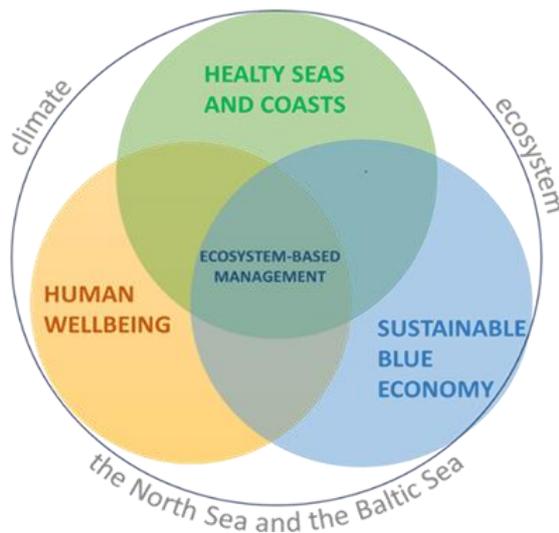


Figure 1. The programme has three strongly interlinked strategic objectives. In the centre is ecosystem-based management, the process by which the trade-offs between objectives are identified, understood and managed to meet goals for humans and the environment.

HEALTHY SEAS AND COASTS, with the aim to increase the ecosystem resistance and resilience by better understanding the natural processes and how they are affected by human activities.

SUSTAINABLE BLUE ECONOMY, with the aim to optimise the use of marine resources while minimising the negative impact through understanding the cumulative effects of human activities on marine ecosystem functioning.

HUMAN WELLBEING, with the aim of establishing an ecosystem-based marine governance, including early engagement of all appropriate stakeholders.

3.2 Specific objectives underpin the strategic objectives

Based on the research and innovation interests presented by the organisations (see section 2.1), three to four **specific objectives** were identified for each strategic objective. These specific objectives specify and contribute to the accomplishment of the strategic objectives (Table 2). For simplicity of presentation, the specific objectives are linked to the most relevant strategic objective, although many of them apply to more than one or in some cases to all three.

Table 2. The strategic and the specific objectives

Strategic Objectives	Healthy Seas and Coasts	Sustainable Blue Economy	Human Wellbeing
Specific Objectives	A resilient marine ecosystem Seamless governance linking land, coast and sea Digital Ocean - Competent ecosystem modelling, assessments and forecasting Efficient techniques 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

3.3 Suggested research and innovation themes under each specific objective

In the following sections the specific objectives are presented in more detail. As explanation of each specific objective, some examples of research and innovation themes are given (based on the organisations’ research and innovation interests; see Annex 2 for a complete list). The final set of themes and related specific questions to be addressed by the research and innovation projects intended to be funded by BANOS in the future will be further considered during the development of the SRIA.

The following sections provide short introductions to each strategic objective based on the partner organisations’ contributions considered of value for the further development of the SRIA.

3.3.1 Healthy Seas and Coast

In order to resolve the conflict between the demand for aquatic resources and the conservation of coastal and shelf-sea ecosystems, a scientifically sound understanding of the long-term, cumulative effects of different pressures on ecosystems, under the changing climate, are urgently needed. Innovative, cost-effective systems for observation, monitoring and data acquisition are required for efficient reporting of environmental status. The new knowledge will provide a basis for future decision making, while supporting ecosystem-based management and delivering policy relevant science and, thereby, strengthening the resilience of marine ecosystems.

In a recent publication, a large number of scientists argue that regional seas are potential time machines, where impacts of regional and global change are accumulating faster than in the oceans (Reusch et al 2018⁷). Within such a perspective, in particular the Baltic Sea stands out, as it

⁷ Reusch et al. The Baltic Sea as a time machine for the future coastal ocean. *Sci. Adv.* (2018) <https://advances.sciencemag.org/content/4/5/eaar8195.full>

provides a strong scientific foundation together with the accessibility of long-term data series that, for instance, provide the possibility to assess the efficiency of management actions. Furthermore, studies on both the Baltic Sea and the North Sea, offer the possibility to investigate extensive natural gradients, for example in terms of biogeochemistry and food web dynamics. As such, the “*sister seas approach*” provides a unique opportunity to enhance our knowledge of ecosystem functioning along gradients, providing the basis for a sustainable ecosystem-based management for the entire Baltic Sea and North Sea region, for example in the context of marine spatial planning.

Below each specific objective listed under the strategic objective *Healthy Seas and Coasts* are further defined through examples of key research and innovation themes.

A resilient marine ecosystem

- Understanding food-web interactions and their services, with respect to species, population and system levels.
- Understanding critical drivers of change on ecosystems and biodiversity, such as direct, indirect, short and long-term impacts of various, cumulative stresses, including pollutants, litter (including plastic), acidification, eutrophication, physical disturbance to the sea floor, invasive species, shipping, overfishing, underwater sound, human activities and climate change.
- Identification of critical drivers of change in marine ecosystems and ecosystem functioning, and development of early indicators for understanding the strength of resilience in order to identify and prevent tipping points.
- Understanding the role of marine ecosystems on climate change and ocean acidification mitigations and adaptations.
- Develop a scientific basis for a common view of the conceptual framework “ecosystem approach” used to protect and manage the marine environment.
- Scientific support for the implementation of the ecosystem approach.

Seamless governance linking land, coast and sea

- Understanding the impact of land-derived pollution, litter and nutrients on the status of the marine environment and ecosystem services (e.g. fish stocks, aquaculture and tourism), including ways to reach good environmental status (GES).
- Evaluation of efficiency and cost-effectiveness of various pressure mitigation actions, including the effect of these actions, and in relation to non-action, at different time scales.
- Evaluation of synergies and conflicts of targets and innovative solutions to assess environmental status in relation to different environmental targets, taking multiple stressors into consideration.
- Development of alternative policy instruments and new governance structures, which respond to current and future sustainability challenges.
- Incorporation of ecosystem goods and services into national accounts (cf OECD, UN environment⁸).

⁸ <https://www.oecd.org/sdd/na/> and <https://www.unenvironment.org/explore-topics/ecosystems/what-we-do/accounting-ecosystems>

Digital Ocean - Competent ecosystem modelling, assessments and forecasting

- Use of satellites and automated sampling techniques and platforms for real-time data acquisition, for example, for climate, weather, sea-levels and biological observations.
- Development of fast feedback mechanisms from monitoring results to evaluation and risk-assessment.
- Development of machine learning (computer systems thought to find patterns in observed data to make short-term future predictions) in ecosystem modelling.
- Improved, ecologically relevant modelling from coasts to deep-seas of distribution of benthic habitats (substrates and biota) and the associations between species and abiotic parameters.
- Development of models to predict tipping points or cascade effects in biological systems, including identification of the drivers of the changes and their impact on biota.

Efficient techniques for environmental monitoring

- Develop Citizen science in environmental monitoring, which will also enhance ocean literacy.
- Further development and application of environmental DNA (e-DNA) approaches and remotely operated vehicles, such as drones for monitoring.
- Sensor development and associated technology to e.g. enhance monitoring practices in respect to sustainable ecosystem management.
- Develop and undertake research and innovation, in cooperation with civil society, on detection, monitoring, disposal and separation of macro-waste from the marine environment.

3.3.2 Sustainable Blue Economy

Comprehensive protection of marine ecosystems will require the development of sustainable, circular blue solutions. Thereby the negative effects on coastal and marine resources can be prevented, or at least minimised.

BANOS, the joint Baltic and North Sea Research and Innovation Programme as planned in the BANOS CSA, aims to appraise the socio-economic value of different ecosystem services of the Baltic and North Sea areas and to provide innovative tools for comprehensive planning and management of maritime activities, and mitigating the trade-offs among different uses.

Below each specific objective listed under the strategic objective *Sustainable Blue Economy* are further defined through examples of key research and innovation themes.

Sustainable resource management of marine global common

- Understanding the resource base and how to sustainably unlock new resources.
- Sustainable production and use of marine goods and resources, such as new recyclable materials, pharmaceutical substances, food products and natural fabrics.
- Explore possibilities for innovation in seafood and marine technology for zero food waste throughout the entire production system, for example, through valorisation of bycatch and recycling of waste.
- Development and monitoring of sustainable approaches in mineral and sand extraction.

- The development of multifactorial marine spatial planning management tools as knowledge bases for the competing demands of space utilisation. Tools should be based on the ecosystem approach and take climate change into account. Examples of competing demands include, for example, conservation of ecosystems, habitats of marine mammals and sea birds, fishing grounds with shipping routes, offshore energy, hydrocarbon extraction (oil and gas), dredging, sand extraction, and tourism.

Understanding the value of ecosystem goods and services

- Develop a holistic analysis of the socio-ecological linkages between the economy, citizens and the marine environment to understand the social and economic valuation, and to estimate the value of ecosystem services, their benefits to humans and the cost of their degradation.
- Development of risk assessment strategies for marine resources recovery.
- Distribution and maximisation of economic value of fishing and ecosystem services, including estimates of the social and economic effects of different decision scenarios, economic and social drivers, and the streamlining of value chains in fishing.
- Understanding the prerequisite for sustainable fishing. For instance, how fish populations and their biomass are influenced by selective removal of fish, by-catch, bottom trawling, littering and lost gear, as well as the effects of eutrophication and habitat changes.

Smart Seas - sustainable, circular and bio-based blue solutions

- Development of secure, clean and efficient renewable energy.
- Finding innovative solutions to increase the sustainability of infrastructures.
- Broadening the scope of sustainable maritime activities, such as green maritime transports by application of artificial intelligence and robotics, observation and measuring techniques, smart sensors, big data and connectivity.

3.3.3 Human Wellbeing

The proposed research programme aims to provide a new knowledge base for increasing human wellbeing, including health aspects and a fair access to the benefits of ecosystem services among citizens in different regions and states, representatives of different groups in the society and people of different occupations. An active participation, through e.g. citizen science, is fundamental in order to reach these goals.

Human health and wellbeing are intrinsically connected to and impacted by the sea. Extreme weather events, such as storms and flooding, as well as human exposure to marine-borne pathogens and chemical pollution pose significant threats to human health and wellbeing. Strong interdisciplinary research, connecting science and humanities, from several disciplines are needed to tackle these challenges.

Below each specific objective listed under the strategic objective *Human Wellbeing* are further defined through examples of key research and innovation themes.

Safe food and feed

- Sustainable and safe fisheries, aquaculture and food production in the sea and on land under the changing climate.
- Prediction on the prevalence and reduction of the impacts of marine toxins, including cyanobacteria and pathogens.

Safe and accessible coast

- Innovative solutions for sustainable development of urban coastal areas together with stakeholders, for example to tackle climate change and associated sea-level rise, storms, ecosystem degradation and pollution.
- Developing innovative and sustainable blue tourism.
- Deepening the knowledge of the link between ecosystem services and human impact/activities, evaluating both positive and negative effects on human wellbeing and welfare.
- Valorisation of coastal climate adaptation actions and understanding the impact of climate change on the value of marine ecosystem services.

Open Science - Access to knowledge and information

- Ensuring equitable and ease of access to scientific information and pursuing *Responsible Research and Innovation Principles* together with the application of other relevant mechanisms that add to transparency and accountability in the Blue Economy (e.g. the Non-Financial-Reporting Directive and Climate-related Disclosures).
- Incorporating the value of ecosystem goods and services as part of informed decision-making.
- Innovative communication and engagement strategies with civil society, science, authorities and businesses to identify solutions for sustainable management, use and preservation of marine resources with Source-to-Sea-perspective.

4 Themes not to be included

Participants of the Howspace survey were invited to suggest research themes that should not be included in the scope of the future research programme to establish some initial borders for the scope (Annex 2). However, over time it became evident that the scope should not be narrowed down at this stage of the process, as the development of the SRIA also depends on the outcome of other BANOS CSA tasks, such as 1.2 *Exploring the existing research and innovation priorities*. In addition, the development within Horizon Europe and other research programmes (e.g. SOPHIE - Seas, Oceans and Public Health in Europe⁹) may influence also the final scope of BANOS.

⁹ The final SOPHIE conference will be held 1-4th of March 2020 will showcase the findings of this two-year project and launch the SRA for Oceans and Human Health research. The SRA will recommendations for the future of Oceans and Human Health science in Europe

5 Added EU value

BANOS, the joint Baltic and North Sea Research and Innovation Programme, as planned in the BANOS CSA, intends to deliver strong EU added value and achieve a high international standing. As it is also planned in the BANOS CSA, the programme will aspire to promote sustainable maritime practises while addressing specific problems or needs of one or more sea basins surrounding the Northern European coast. The policy-driven nature of the programme will be set to accommodate the scientific and technological support to various EU policies, such as the Integrated Maritime Policy (IMP), the Common Fisheries Policy (CFP) and the Common Agricultural Policy (CAP), relevant EU directives, such as the Marine Strategy Framework Directive (MSFD), the Directive on Maritime Spatial Planning (MSP) and the Water Framework Directive (WFD), as well as provide support and impact on the regional seas conventions, HELCOM and OSPAR.

The difference in the implementation of the WFD and the MSFD emphasise the need for regional marine partnerships, such as BANOS intends to be. For instance, with the WFD the same assessment system is used within all European countries, while with the MSFD the regional sea conventions are used as a basis, demonstrating different prerequisites between the sea areas.

The future BANOS programme is also planned to contribute to global policies, programmes and institutions, such as the 2030 Agenda for Sustainable Development, and United Nations Decade of Ocean Science for Sustainable Development (2021-2030), Convention on Biological Biodiversity (CBD), the International Maritime Organisation (IMO), and the World Climate Research Programme (WCRP).

The BANOS programme's effort is intended to be put on those issues where EU objectives only can be successfully achieved by implementation of a regional sea scale approach. In the Howspace survey, statements were collected to indicate the EU added value of each of the strategic objectives (see Annex 2 for the complete list). A summary of the main statements are listed below and will be further elaborated during the development of the SRIA.

- The joint programme will lead to improved science-policy collaboration, targeted management approaches and targeted research and innovation. Overall, the governance of issues which move across national boundaries, will be improved and become more effective.
- Ecosystem based management is only possible at the macroregional level (i.e. regional seas approach). In addition, a joint approach is required to deliver solutions for reaching the sustainability goals, GES, and EU policy and directives (MSFD, MSP, CFP, Bathing Water Directive, Habitats Directive).
- Efficient and novel monitoring solutions will improve observations, assessments and forecasting capacity under the global change while keeping the cost of the monitoring at bay.
- Pooling resources can lead to identification of potential knowledge-gaps and bottle necks in research and innovation, which can be subsequently solved more easily via “a joint effort approach”.
- New innovations and technologies can offer more efficient and economical solutions to the sustainable management of the marine environment and, for example, lead to the development of new industries and jobs.

- Development of innovative, sustainable and blue tourism will enhance the local economy and create new jobs.
- Optimisation of trade-offs between uses of space and resources to increase efficiency and minimise the impact on the marine environment and ecosystem functioning.
- Development of open science and data management policies, and citizen science will lead to an increase in ocean literacy.
- Sustainable development of marine activities, such as fisheries, aquaculture, sand and gravel extraction and maritime transports, are needed to ensure the future of the global commons.
- Ecosystem research to advance the knowledge base is essential to implement ecosystem-based approaches for the sustainable development of the marine environment: with special emphasis on human, societal, cultural, inter- and intragenerational aspects.

6 General remarks

Some additional comments and suggestions were received both from the Advisory Board and during the workshop that should be considered during the further development of the SRIA:

The regional seas approach

- demonstrate clear evidence for the need of a joint Baltic Sea and North Sea approach.
- present direct connections between the research priorities and the environmental goals set by EU directives, various regional sea conventions and the Agenda 2030 as well as priorities outlined within UN Decade of the Ocean.

The interdisciplinary approach

- have strong emphasis on the interdisciplinary research and early involvement of end-users. For instance, interdisciplinary cooperation is needed between scientists and stakeholders to achieve common standards of the regional seas in relation to the WFD, MSFD and MSP.
- have prioritisations and clear arguments for the selected research and innovation themes.

The forward-looking approach

- be forward looking and solution-oriented research programme enabling anticipation of not only the environmental challenges, but also changes ahead, for instance the increased demands for renewable energy, while also dealing with present issues, such as, reducing pollution and sustaining food production.
- consider the increasing anthropogenic pressure on the land-coast-sea continuum.

7 Concluding remarks

The BONUS CSA Task 1.1 *Scoping the strategic framework for the future programme* is one of the preparatory steps in developing the BANOS SRIA. This report represents the shared vision on its overall framework and scope by participants of the action – the potential funders of the future programme. In addition, the development of the BANOS SRIA will closely follow the

development and update of other relevant SRIAs, e.g. the JPI Ocean, for identification of common objectives and challenges as well as differences.

There is a general consensus that the primary framework of the programme is built upon three mutually interlinked overarching strategic objectives: 1) *Healthy seas and coasts*, 2) *Sustainable blue economy* and 3) *Human wellbeing*. This triad of strategic objectives shares as a decisive enabler to the application of an ecosystem approach to management and is further underpinned by a constellation of specific objectives, fulfilment of which is critical for the achievement of the strategic ones. As an outcome of the objective-driven approach, it was possible to suggest already, a substantial, although unfinished, list of broad research and innovation themes that will be further refined and ‘downscaled’ to specific topics and innovation tasks during the course of more detailed expert analysis and stakeholder consultations envisaged in further development of the BANOS SRIA.