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Project Deliverable Report

White paper based on (preliminary) results of FutureMARES work for major international events / initiatives and/or related EU marine environmental policies

Dissemination level: **Public**

Type of deliverable: Report

Due date (revised): Project month 31 [31 Mar 2023]

Project Milestone(s) achieved:
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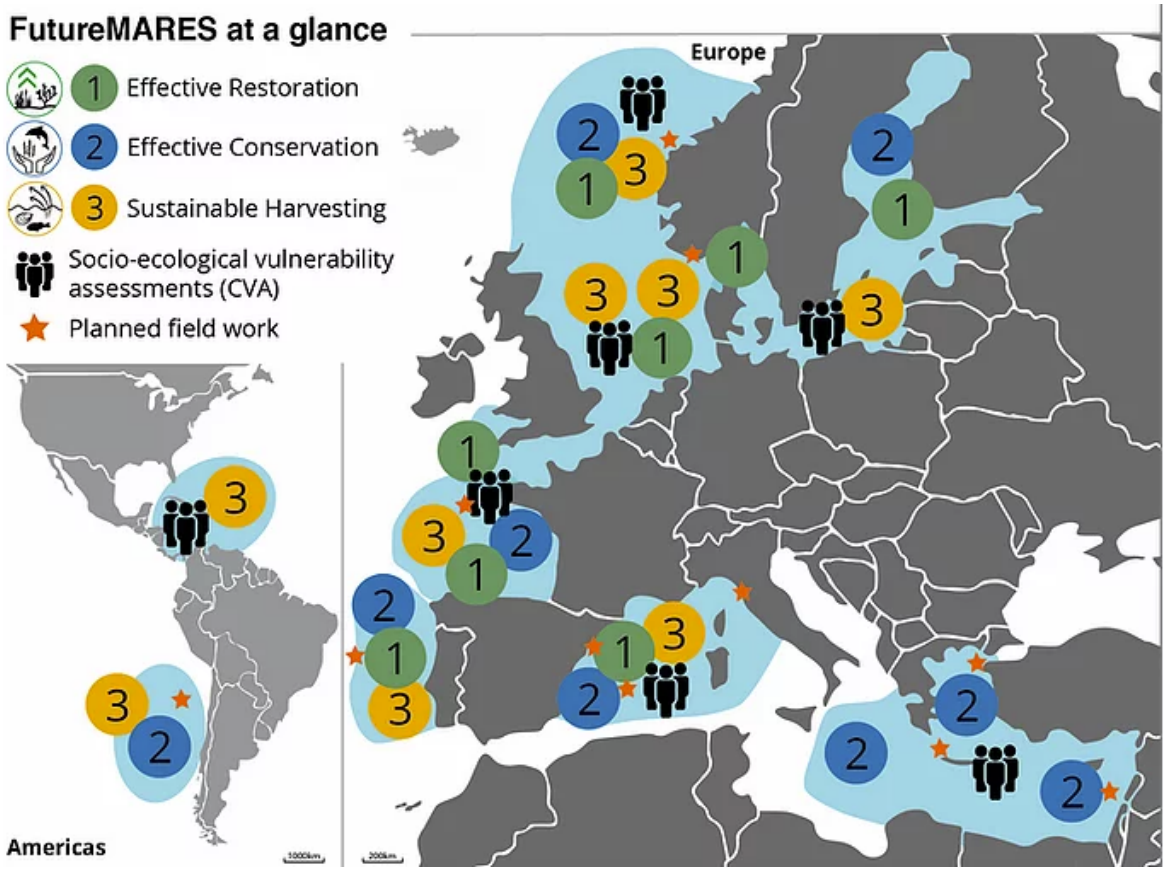
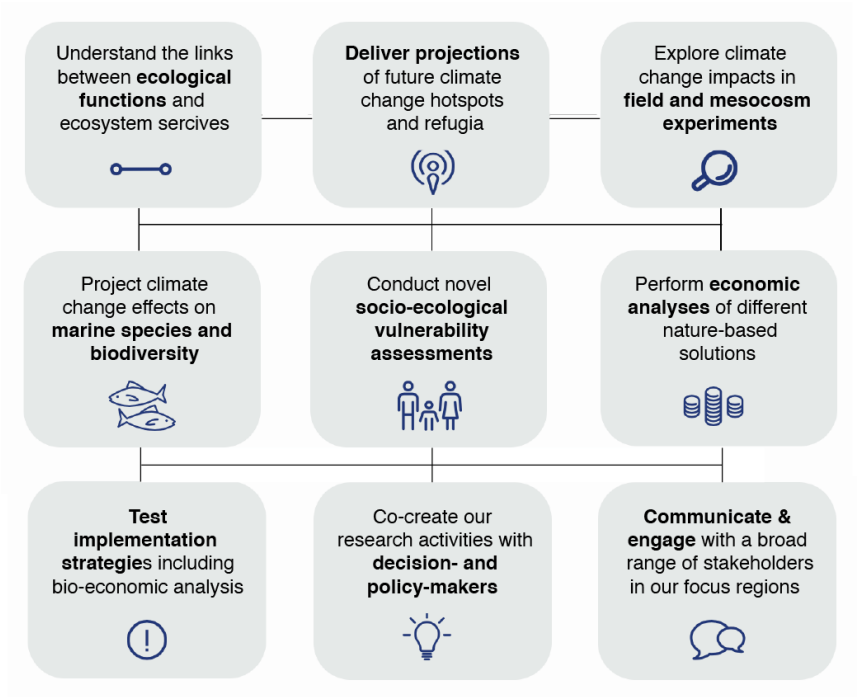
FutureMARES Project

FutureMARES - Climate Change and Future Marine Ecosystem Services and Biodiversity is an EU-funded research project examining the relations between climate change, marine biodiversity and ecosystem services. Our activities are designed around two Nature-based Solutions (NBS) and Nature-inclusive Harvesting (NIH):



We are conducting our research and cooperating with marine organisations and the public in Case Study Regions across Europe and Central and South America. Our goal is to provide science-based policy advice on how best to use NBS and NIH to protect future biodiversity and ecosystem services in a future climate.

FutureMARES provides socially and economically viable actions and strategies for climate change adaptation and mitigation. We develop these solutions to safeguard future biodiversity and ecosystem functions to maximise natural capital and its delivery of services from marine and transitional ecosystems. To achieve this, the objectives of *FutureMARES* defined following goals:


Understand the links between **ecological functions** and ecosystem sercives
Deliver projections of future climate change hotspots and refugia
Explore climate change impacts in **field and mesocosm experiments**
Project climate change effects on **marine species and biodiversity**
Conduct novel **socio-ecological vulnerability assessments**
Perform **economic analyses** of different nature-based solutions
Test implementation strategies including bio-economic analysis
Co-create our research activities with **decision- and policy-makers**
Communicate & engage with a broad range of stakeholders in our focus regions

Deliverable data	
Work Package(s) / Task(s):	WP7 – Policy Dialogue
Lead beneficiary:	UNEP-WCMC
Responsible author:	Chris McOwen & Giulia Costa Domingo
Contact:	Chris.mcowen@unep-wcmc.org; giulia.costa-domingo@unep-wcmc.org
Co-authors:	Isabel Sousa Pinto
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Involved partners

Project partner (affiliation)	First name	Last name	E-mail
ECOS	Dorte	Krause-Jensen	<dkj@ecos.au.dk
Ciimar	Isabel	Sousa Pinto	isabel.sousa.pinto@gmail.com>

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Version	Date	Description
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Table of content

List of symbols, abbreviations and a glossary

ABMT Area-Based Management Tools

BBNJ Draft agreement on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction

CBD UN Convention on Biological Diversity

COP Conference of the Parties

CMS Convention on Migratory Species

HELCOM Baltic Marine Environment Protection Commission – Helsinki Commission

MPA Marine Protected Area

MSP Marine Spatial Planning

NBS Nature-based Solutions

OSPAR Regional Seas Convention for the Protection of the Marine Environment of the North-East Atlantic - Oslo and Paris Conventions

RFMO Regional Fisheries Management Organisations

SDG Sustainable Development Goal

UN United Nations

UNCLOS UN Convention on the Law of the Sea

UNFCCC UN Framework Convention on Climate Change

WP Work Package

Executive summary

This deliverable embeds the research objectives and outputs of the FutureMARES project to relevant international policy instruments and processes. The interconnected nature of the climate and biodiversity crises are increasingly reflected in international policy where they are frequently seen as two interlinked components of a broader crisis which needs to be tackled in an integrated manner. By evaluating the potential of nature-based solutions and nature inclusive harvesting for climate, nature, and people, FutureMARES can inform the integration of international biodiversity and climate objectives.

A number of key international instruments and processes are relevant to the work of FutureMARES including initatives under international treaties on biodiversity and climate, and sustainability targets. The knowledge, tools, solutions, and activities produced under FutureMARES can inform and contribute to these international initiatives at various stages of a simplified policy cycle, including policy agenda setting, policy formation and policy monitoring and evaluation. The potential relevance of the work of FutureMARES to specific international policy instruments is illustrated by linking elements of the research program to relevant elements of the new Kunming-Montreal global biodiversity package newly adopted by the parties of the UN Convention on Biological Diversity.

Introduction

This white paper contains

1) A summary of the role of FutureMARES in supporting the development and implementation of marine nature-based solutions and nature-inclusive harvesting for climate, nature, and people.

2) An overview of key international agreements and processes that can be considered in the context of the activities of FutureMARES.

3) A summary on how information produced under FutureMARES can inform all stages of the policy cycle

4) A deep-dive into the Convention on Biological Diversity's Kunming-Montreal Global Biodiversity Framework in the context of FutureMARES

5) A selection of examples from FutureMARES Storylines that showcase the potential contributions of the project's research to international initatives.

Defining the Challenge

The world is not on course to meet the global target to limit warming to well below 2°C, preferably 1.5°C. Urgent action is therefore required to bring about rapid and wide-ranging reductions in emissions and help people and nature adapt to, and withstand the impacts of, climate change. Similarly, urgent policy action is required globally, regionally, and nationally to stabilise the trends that have exacerbated biodiversity loss and allow for the recovery of natural ecosystems.

Effective and evidence-based Nature-based solutions (NBS), such as taking measures to conserve, manage or restore ecosystems, can help meet global climate and biodiversity policy objectives and broader sustainability targets. In parallel, it is essential that the pressures which have, and continue to, impact marine ecosystems are significantly reduced. For example, through the development and implementation of Nature-Inclusive Harvesting solutions (NIH) to ensure fishing is in line with biodiversity and climate management and policy objectives.

To ensure NBS and NIH deliver their intended benefits for nature, people, and the climate, it is essential that they are planned and implemented in an evidence-based way. To support this, the aim of FutureMARES is to develop the knowledge, tools and practical guidance required to ensure marine ecosystems are effectively conserved and restored in order to deliver upon national, regional and international policy aspirations. The aim of this deliverable is to demonstrate links between current policy initiatives and the research objectives and outputs of FutureMARES.

Approach

FutureMARES objectives, completed activities, and storyline documents from the project's progress reports and website were reviewed to identify policy-relevant activities and outputs. Key international treaties and policy processes which have a mandate on topics covered by the project were reviewed to identify potential links to FutureMARES work.

Contribution to the project

The work in this report links the activities under WP1, 2, 3, 4, 5, and 6 to international policy objectives and processes . The identified policy synergies useful for communicating with policy-relevant stakeholders in WP8

Dissemination and Exploitation

The results described in this report are being exploited within the FutureMARES project by providing project participants with the knowledge they require to a) put the work of FutureMARES in a wider policy context; b) identify entry points to embed the work of FutureMARES in the most relevant stages of International Policy (e.g., policy formation, implementation and monitoring and evaluation).

1. Policy-relevant solutions to safeguard marine biodiversity and ecosystem services under climate change

The world is not on course to meet one of the key objectives of the Paris Agreement under the United Nations Framework Convention on Climate Change, that is to limit warming to well below 2°C, preferably 1.5°C. Urgent action is therefore required to bring about rapid and wide-ranging reductions in emissions and help people and nature adapt to, and withstand the impacts of, climate change. Similarly, urgent policy action is required globally, regionally, and nationally to stabilise the trends that have exacerbated biodiversity loss and allow for the recovery of natural ecosystems.

Effective and evidence-based Nature-based solutions (NBS)[1], such as taking measures to conserve, manage or restore ecosystems, help address key societal challenges while supporting ecosystems and their biodiversity. These NBS can support climate change mitigation and adaptation and play a key role in improving the status of biodiversity, safeguard ecosystems and enhance the benefits provided by nature to people.

To deliver the intended benefits for nature, people, and the climate, it is essential that NBS are planned and implemented in an evidence-based way. To support this, FutureMARES (Future Marine Ecosystem Services and biodiversity under a changing climate) has been funded by the European Union to evaluate how NBS can be implemented to conserve and restore marine ecosystems in a changing climate and ensure the capacity of these systems to deliver societal benefits.

The harvesting of marine resources, through fishing and aquaculture, creates pressures on marine biodiversity while relying on healthy marine ecosystems for its future survival. In parallel, climate change is exacerbating the challenges faced by the fishing and aquaculture by impacting the distribution, interactions, and survival of marine species of commercial interest. Sustainable fishing and aquaculture must therefore be carefully managed to ensure they are compatible with the conservation of marine ecosystems under future climate change. FutureMARES is exploring how Nature-Inclusive Harvesting solutions (NIH) can provide flexible, adaptable, ecosystem-level approaches to ensure our use of the rich natural resources our seas provide us with is in line with biodiversity conservation and climate adaptation objectives.

[1] "Nature-based solutions are actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience and biodiversity benefits". Full text in ref: Nature-based solutions for supporting sustainable development. Additionally, NBS is defined in the EU as "Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions."

1.1. Marine nature-based solutions for climate, nature and people

The interconnected nature of the climate and biodiversity crises are increasingly reflected in international policy where they are frequently seen as two interlinked components of a broader crisis which needs to be tackled in an integrated manner.

FutureMARES focuses on evaluating the potential of two nature-based and one nature-inclusive harvesting solution:

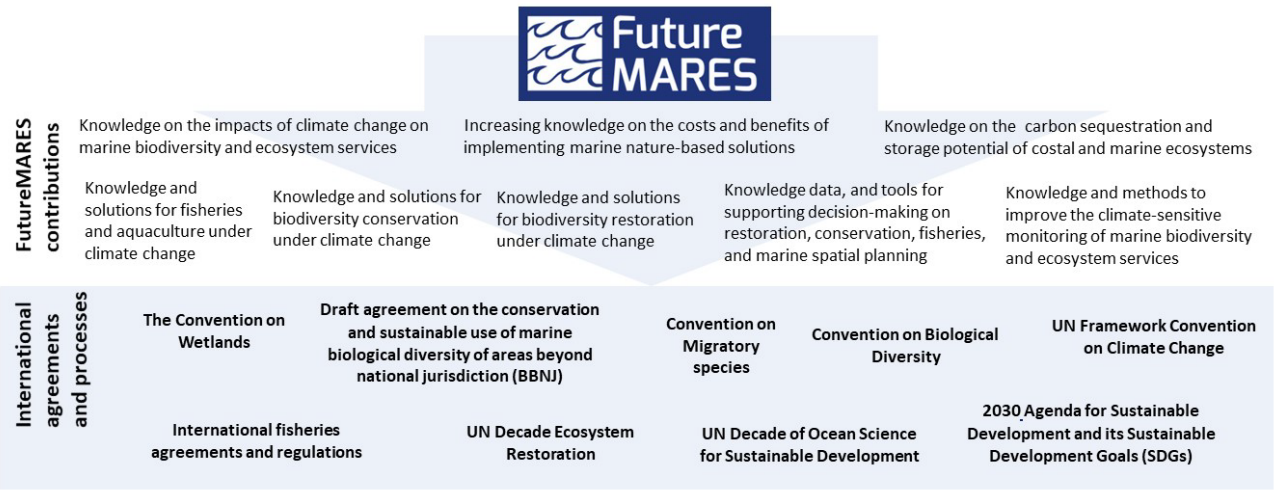
Restoration of habitat-forming species such as seagrass, salt marshes, mangroves, macroalgal forests, coral reefs, and shellfish reefs which can enhance the delivery of services including sea level rise and flood risk mitigation, carbon sequestration and storage, nursery habitat provision and improved water quality.

Conservation which protects nature from human pressures while supporting the resilience of marine ecosystems to climate change impacts. This includes preserving food web integrity and maintaining and enhancing connectivity across seascapes to allow for species to shift their ranges and find new suitable habitat in response to climate change.

Nature-inclusive harvesting from fisheries and aquaculture that is climate-smart, adaptive and follows an ecosystem-based, multi-species approach.

The potential impact of climate change on marine ecosystems and the services they provide is evaluated in 39 case studies across 5 regions, and scientifically robust solutions are subsequently provided which could enhance climate resilience, societal wellbeing, and the stability, functioning and productivity of ecosystems.

1.1.1. International processes of relevance to the work of FutureMARES



1.1.2. Key international agreements and processes that can be considered in the context of FutureMARES work

Below are a number of key international instruments and processes that are relevant to the work of FutureMARES. The boxes detail some provisions and recent outcomes of the respective international treaties which have a mandate on topics covered by the project.

The Convention on Biological Diversity:

The mission of the Kunming-Montreal Global Biodiversity Framework is to put nature on a path to recovery by 2030 so that by 2050 "biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet, and delivering benefits essential for all people". To achieve this ambition, effective conservation, restoration and sustainable use of marine ecosystems and their resources they provide is needed. An in-depth overview of the contribution of FutureMARES is provided in page 7.

The Convention on Wetlands:

The Ramsar Convention provides the framework for the conservation and wise use of wetlands and their resources. The convention supports the development and implementation of plans, policies, and strategies for the conservation, restoration, and sustainable use wetlands, as well as the designation and effective management of sites as Ramsar "Wetlands of international importance". These sites include areas that are important to the resilience and adaptability of populations, such as climate refuges or important sites for connectivity. Recognising the important role wetlands play in tackling climate change, resolutions under Ramsar encourage Parties to manage marine wetlands to increase their resilience to climate change while maintaining and enhancing their contributions to climate mitigation and adaptation (Resolutions X.24, XI.14, XII.3 and XIII.14). This requires understanding how and where to restore and conserve wetlands such as seagrass beds, estuaries, and coral reefs, information which is being generated by FutureMARES, for example, through the restoration and conservation of seagrass in the Basque estuary.

The UN Framework Convention on Climate Change:

The impacts of climate change on natural ecosystems are explicitly acknowledged under the UNFCCC. At the most recent Conference of the Parties to the UNFCCC (COP27), governments acknowledged the interlinked global crises of climate change and biodiversity loss in the broader context of achieving the Sustainable Development Goals. Furthermore, governments emphasised the importance of protecting, conserving and restoring nature and ecosystems to achieve the Paris Agreement temperature goal, including through forests and other terrestrial and marine ecosystems acting as sinks and reservoirs of greenhouse gases and by protecting biodiversity, while ensuring social and environmental safeguards.

In addition, for the first time the COP encouraged Parties to consider NBS or ecosystem-based approaches, taking into consideration United Nations Environment Assembly resolution 5/5,21 for their mitigation and adaptation action while ensuring relevant social and environmental safeguards. The evidence on NBS being developed under FutureMARES can contribute to advance the understanding on these issues, thereby supporting the implementation of UNFCCC and its Paris Agreement. While NBS can help reach climate reduction targets by maintaining and enhancing the ability of ecosystems to sequester and store carbon, these cannot be a replacement for the rapid emissions reductions needed across all sectors to decarbonise our economies.

The evidence and solutions developed under FutureMARES can be used as an evidence base for countries as they refine Nationally Determined Contributions and national adaptation plans. For example, in North Devon, FutureMARES is developing tools to support the effective restoration of saltmarshes, kelp beds and seagrass habitats deliver climate mitigation and adaptation benefits including flood defence, coastal protection, and carbon sequestration.

Previously, through The Glasgow Climate Pact, Parties to UNFCCC noted the importance of ensuring the integrity of ecosystems and biodiversity, calling for the strengthened consideration of ocean-based climate solutions. In 2022, the Ocean and Climate dialogue, which sought to strengthen the role of ocean action under the Paris Agreement, highlighted potential ocean-based solutions including climate resilient fisheries and aquaculture, and the protection and restoration of coastal and marine ecosystems, which are key components of FutureMARES.

The Convention on Migratory Species (CMS):

The Convention seeks to protect migratory species, such as marine mammals, turtles, fish, and birds, which are endangered or in need of cooperation across national jurisdictions. Parties to the CMS are encouraged to conserve these species through actions including sustainable fishing, establishing protected area networks, and maintaining and enhancing connectivity, for example through restoring coastal habitats. As part of FutureMARES, the connectivity levels of habitat-forming and harvested species is being evaluated under climate change scenarios, and climate smart restoration and conservation strategies will be identified for migratory species listed under the CMS including loggerhead sea turtles, fin whales and bottlenose dolphins, and the Balearic Shearwater.

International fisheries agreements and regulations:

The UN Convention on the Law of the Sea (UNCLOS) is a multilateral treaty on maritime law, including the conservation and management of marine species in areas beyond national jurisdiction. The implementation of provisions on the conservation and management of highly migratory and straddling fish stocks are outlined in the UN Fish Stocks Agreement. International fisheries in the high seas are regulated by 17 Regional Fisheries Management Organisations (RFMOs). RFMOs are diverse instruments which can focus on single highly migratory species or multiple species in each region and can be purely advisory or can have binding decision-making power. In addition, the UN Code of Conduct for Responsible Fisheries is a voluntary instrument setting international standards for fisheries that ensure the conservation and sustainable management of marine resources. FutureMARES can contribute to the knowledge base and solutions needed to meet the sustainable use and conservation objectives of these international initiatives by developing nature-inclusive harvesting solutions and building capacity to assess and adapt to the effects of climate change on fish stocks.

In addition, there are a range of other international processes that are also relevant to the work of FutureMARES, including the following:

2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs):

The work of FutureMARES is most relevant to SDG Target 14, related to "Life below water" and Target 13, related to "Climate Action", particularly Target 14.2 which seeks the protection, sustainable use, and restoration of marine and coastal ecosystems and Target 13.1 which seeks to strengthen the resilience and adaptive capacity of countries to climate change and natural hazards.

Beyond targets 14 and 13, effective conservation, protection, and management solutions developed by FutureMARES can be relevant to Goal 8 "Decent work and economic growth" by protecting livelihoods under climate change scenarios, Goal 2 "Zero hunger" by enhancing the climate readiness of fisheries, aquaculture and seaweed harvesting, and Goal 12 "Sustainable consumption and production" by promoting sustainable tourism and the sustainable management and use of marine natural resources". In fact, through supporting Goal 14, FutureMARES will indirectly contribute to targets across all other SDGs.

Draft agreement on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ):

The overarching objective of the draft BBNJ agreement, which is yet adopted, is to conserve and sustainably use marine biodiversity in areas beyond national jurisdiction, including by protecting and restoring ecosystems in these areas. The draft text highlights the need to "follow an ecosystem resilience approach that considers the impacts of climate change and maintains and restores ecosystem integrity and services, including climate change mitigation services." This ambition aligns with FutureMARES' objective to support biodiversity conservation, restoration, and sustainable use solutions to enhance the resilience of marine ecosystems to climate change. Once adopted, the agreement will need to be ratified by 60 States or regional economic integration organization before it enters into force.

The UN Decade on Ecosystem Restoration:

Restoration nature-based solutions developed and tested under FutureMARES can contribute to the aims of the decade by informing how to design, implement and monitor the success of restoration, and provide details on the ecological, environmental, and socio-economic benefits that can arise. FutureMARES will identify opportunities and challenges in the scaling-up of NBS under climate change, assessing their economic costs and benefits and using tools to support decision-making to deliver policy ambitions. In addition, the methods and tools developed and used by FutureMARES could contribute to the development of common criteria, standards, and guidelines for the implementation of NBS across habitats and provide best-practice examples of marine NBS. These contributions directly align with the Decade's goals relating to best practices, monitoring, and science-based action.

UN Decade of Ocean Science for Sustainable Development:

The mission of the decade is to support transformative ocean science solutions for sustainable development. This includes identifying and implementing actions which result in a healthier and more resilient ocean, where marine ecosystems are conserved, restored, and sustainably managed, and can respond to climate change. Activities in FutureMARES are particularly aligned with addressing the Ocean Decade's challenge 5: to "Unlock ocean-based solutions to climate change" and will contribute to enhancing our understanding on the marine-climate nexus.

1.1.3. Information produced under FutureMARES can inform all stages of the policy cycle

The knowledge, tools, solutions, and activities produced under FutureMARES can inform and contribute to the international initiatives at various stages of a simplified policy cycle, including ***policy agenda setting, policy formation and policy monitoring and evaluation.***

Whilst it is the governments that set the agenda for the formulation of new or adjustment of existing policies, the provision of timely and robust evidence can help certain issues be prioritised and considered. For example, in the context of FutureMARES, this could include demonstrating the climate-related threats which are anticipated to have the greatest impact on marine ecosystems and the services they provide. Furthermore, by demonstrating the potential of NBS and NIH to address specific climate scenarios and impacts, FutureMARES can inform decision makers on different options available to enhance the resilience of ecosystems to climate change.

Specifically, the knowledge, tools and outputs produced by FutureMARES can support:

- **Area-based management tools:** FutureMARES can inform on climate-ready area-based management tools (ABMTs), such as marine protected areas MPAs). Specifically, knowledge is generated on where MPAs should be located now and in the future to help ensure their effectiveness such as safeguarding climate refugia and providing steppingstones to maintain and enhance connectivity. The data and methods developed in FutureMARES will help identify priority areas for the conservation of CMS-listed loggerhead turtles by modelling their foraging site distribution and migration corridors under climate change, and for cetacean species (including fin whales and bottlenose dolphins) and birds (including the Balearic Shearwater) in the Bay of Biscay. In addition, by bringing together information on the ability of ABMTs to

safeguard and enhance ecosystem services, FutureMARES can aid the transition to sustainable and equitable blue economies in changing conditions.

- **Restoration planning:** FutureMARES is strengthening models to inform the design of regional and national climate-smart policy strategies for restoration. For example, a study in the Baltic Seas was used to understand the connectivity of seagrass beds and to design restoration plans which account for the local ecological and environmental context.
- **Climate adaptation plans**: The evidence generated by FutureMARES can guide the design of policies to enhance the adaptive capacity, strengthen the resilience, and reduce the vulnerability of marine ecosystems to climate change. This includes providing evidence relating to the resilience and recovery potential of habitats and harvested species, aiding the development of climate adaptation strategies, including climate adaptation plans under the Paris Agreement.
- **Decarbonisation plans**: FutureMARES can detail how NBS can contribute to climate mitigation plans and strategies, including through countries Nationally Determined Contributions submitted under the Paris Agreement. Specially, FutureMARES can assist by demonstrating the carbon sequestration and storage potential of various NBS under climate change. For example, FutureMARES has contributed to quantifying the blue carbon sinks in UNESCOs marine world heritage sites.
- **Sustainable harvesting plans**: FutureMARES can inform the evaluation of management practices, including restoration and conservation interventions, in terms of the health and profitability of commercial fish stocks under climate change scenarios.
- **The effective response to climate change using best available scientific knowledge.** The information generated by FutureMARES can support countries and regions to develop early warning systems, for example, by providing an early warning for potential barriers to salmon migration under climate change.
- **Stakeholder engagement and support**: By building knowledge on the benefits, costs, and trade-offs of NBS and NIH, and disseminating these findings, FutureMARES is contributing to improving understanding and awareness of the interventions which can promote their implementation by **increasing buy-in from relevant stakeholders and support from the public**.

1.2. Deep dive: The Kunming-Montreal Global Biodiversity Framework in the context of FutureMARES

While implementation of the Kunming-Montreal Global Biodiversity Framework will primarily occur at the national level, some key areas of interest based on the scope of the work under FutureMARES are noted below.

The activities of FutureMARES are directly relevant to Goal A of the Kunming-Montreal Global Biodiversity Framework and its related targets. FutureMARES is developing knowledge and strategies to maintain, enhance, and restore the integrity, connectivity, and resilience of marine ecosystems across European regional seas, also aiming to enhance the adaptive capacity of charismatic and vulnerable species considering connectivity. Moreover, the work under FutureMARES is also relevant to **Goal B** by supporting solutions for the nature-inclusive harvesting of species through wild capture and aquaculture and by developing methods for valuing, maintaining, and enhancing marine ecosystem functions and services.

FutureMARES is developing solutions to support marine ecosystems adapt to a changing climate, which aligns with Target 8 of the Kunming-Montreal Global Biodiversity Framework. Target 8 seeks to minimise the impacts of climate change and enhance the resilience of ecosystems. In addition to enhancing the climate resilience of marine ecosystems, FutureMARES aims to safeguard and enhance the ecosystem services they provide including flood control, providing nursery habitat for commercially and culturally important species and supporting tourism. This aligns with **Target 11** of the agreement which seeks to "restore, maintain, and enhance nature's contributions to people, including ecosystem services, through nature-based solutions".

By supporting the development of effective restoration and conservation interventions, FutureMARES aligns with Targets 1, 2, 3, and 4, which seek to halt the loss of areas of high biodiversity importance (Target 1); upscale restoration action so that 30% of degraded ecosystems are under effective restoration to enhance biodiversity, ecosystem functions and services, and ecological integrity and connectivity (Target 2); increase conserved areas so that at least 30% of terrestrial and marine areas are effectively conserved and managed (Target 3) and ensure that management actions are in place to halt human-caused extinctions of threatened species and to recover and conserve threatened species (Target 4). For example, FutureMARES is assessing the current MPA network in the northeast Baltic Sea to determine how it can be expanded to maximise its climate resilience (Storyline 7), providing guidelines for the management of key habitats such as eelgrass (Storyline 6), and supporting the design implementation of restoration plans in the northeast Baltic and in the Bay of Biscay (Storylines 7 & 24).

FutureMARES work to support the development of nature-inclusive harvesting strategies aligns with Targets 5, 9, and 10 which seek to ensure the use, harvesting, and management of wild species, aquaculture and fisheries is sustainable and thereby delivers environmental, social, and economic benefits. For example, FutureMARES is helping inform sustainable salmon farming under climate change in Norway, sustainable mussel culture in the Baltic Sea, sustainable harvesting of Juan Fernandez lobster in Chile, and spiney lobster and queen conch harvesting in Belize (Storylines 4, 9, 38 & 39).

By developing knowledge on the valuation of biodiversity and ecosystem services and integrating these values into decision-making FutureMARES aligns with Target 14. For example, FutureMARES is describing methods to integrate increased consideration of climate change in marine spatial planning. The project is also working to ensure that the best available knowledge and data are accessible and relevant to decision-makers, managers, and the public, aligning with **Target 21**.

1.2.1. Design and implementation: informing national biodiversity strategies and action plans

By informing climate-responsive restoration, conservation, and sustainable harvesting actions, FutureMARES can support the design, prioritisation, implementation, and review of targets under the Kunming-Montreal Global Biodiversity Framework. For example, FutureMARES will produce tools to support decision-making relating to marine restoration, conservation, and sustainable use of habitats and species under climate change scenarios. This includes the development of methods which can be used to identify habitats and species vulnerable to climate change, identify refugia to inform the design of conservation and restoration strategies, and models of ecosystem service supply and risk to understand how management decisions affect people.

The data, information, lessons, and tools produced by FutureMARES can support the development of national biodiversity strategies and action plans (NBSAPs) under the Kunming-Montreal Global

Biodiversity Framework. The Kunming-Montreal Global Biodiversity Framework is part of a package of decisions including one on planning, monitoring, reporting, and review which includes guidelines for revising and updating NBSAPs. FutureMARES can inform several of the elements in the guidance including national-level targets, the selection of actions, policies and programs designed to achieve these targets, national monitoring, and reviewing and assessment.

In addition, by better understanding the links between biodiversity conservation, climate change, and the harvesting of marine species, FutureMARES can strengthen synergies with other MEAs (Multilateral Environmental Agreements) and international organisations.

1.2.2. Monitoring and evaluation: strengthening the monitoring of the framework's progress in implementation

The work carried out under FutureMARES can support Parties when reporting on the measures undertaken in response to the Kunming-Montreal Global Biodiversity Framework. FutureMARES will identify policy-relevant and climate-sensitive indicators and underlying data sources to measure the ecosystem service benefits of protecting, restoring, and sustainably using marine ecosystems and resources. This will include tools to select indicators which quantify the ecological, social, and economic benefits of NBS and NIH.

Not all indicators of the monitoring framework have data available to report progress. An ad hoc technical expert group on indicators will advise on the further operationalization of the monitoring framework for the Kunming-Montreal global biodiversity framework. The effectiveness of the monitoring framework will be reviewed at the next Conference of the Parties to the Convention on Biological Diversity. The work of FutureMARES on identifying the most meaningful ecosystem service indicators for monitoring the impacts of NBS could inform this process.

1.3. Showcasing the contributions of FutureMARES – examples from Storylines

Knowledge and solutions for biodiversity conservation under climate change

Climate-smart conservation in the Baltic Sea

FutureMARES is informing the climate-smart expansion of the MPA network in the north-east Baltic Sea. The project is modelling the impacts of climate change on habitats and their ecosystem services as well as on the distribution of widespread, habitat-forming, endangered, and non-indigenous species. These include coastal seaweeds, seagrasses, invertebrates, and fish. This will help inform the location of protected and conserved areas by identifying priority areas that are particularly vulnerable to climate change or that can act as refuges for species. This knowledge will be used to re-assess the current network of MPAs in the region to propose how it can be expanded to increase its resilience to climate change in collaboration with local stakeholders.

Source: FutureMARES Storyline 7

Knowledge and solutions for biodiversity restoration under climate change

Supporting the restoration of eelgrass in the Baltic Sea Coast

Healthy eelgrass meadows deliver important ecosystem roles and services including supporting biodiversity by providing habitat for marine species, sequestering, and storing carbon, protecting coastlines from storms, and improving water quality. FutureMARES is supporting the climate-ready management and restoration of eelgrass meadows in Denmark. Through modelling the potential impacts of climate change on eelgrass, the project has (1) improved understanding on the key risks climate change poses to eelgrass restoration and ecosystem service provision, (2) identified populations that are particularly vulnerable to climate change, and (3) identified populations that can be restored to improve connectivity across eelgrass meadows in the region. Based on this, the project will develop guidelines and recommendations for climate-ready eelgrass management which can help inform the planning and implementation of eelgrass restoration. In partnership with other initatives, FutureMARES is sharing this knowledge and experience with the OSPAR Regional Seas Conventions to support their initiative of producing eelgrass restoration guidelines for the region.

Knowledge on the carbon sequestration and storage potential of costal and marine ecosystems

Contributions to the knowledge base on blue carbon

FutureMARES has been contributing to knowledge on the ability of marine ecosystems to contribute to climate change mitigation by capturing carbon (blue carbon). This includes work on the climate mitigation potential of macroalgal forests in the Mediterranean, the distribution and carbon sequestration of Nordic coastal marine vegetated habitats, the potential climate mitigation contributions of restoring oyster reefs in the Atlantic and North Sea, and the blue carbon potential in coastal ecosystems in the Baltic Sea. This will contribute to the knowledge base needed to inform marine management which maximises contributions to climate change mitigation. The research produced under FutureMARES has been shared with key stakeholders including Regional Seas Conventions (e.g. experience on marine restoration and blue carbon has been shared by contributing to a factsheet for blue carbon storage capacity for HELCOM).

Knowledge data, and tools for supporting decision-making on restoration, conservation, fisheries, and marine spatial planning

Bright spots for climate-smart marine spatial planning in Ireland

The output of models advanced by FutureMARES can be used to inform marine spatial planning under climate change. Projecting the impact of climate change scenarios can help plan marine conservation and fisheries activities in a future climate change and identify potential management solutions to increase climate resilience and adaptability. Analyses being undertaken by FutureMARES in its "Call for Knowledge" build on previous efforts to highlight the extent to which Ireland's current marine spatial planning policy sufficiently consider future climate risks. Previous analyses conducted as part of FutureMARES suggested that spatial planning does not adequately cover climate risks and that many current marine activities in Ireland may become unsustainable under climate change. To address this, the project has identified climate change hotspots (where climate change impacts are predicted to threaten the ability of ecosystems to continue supporting current activities and uses), refugia (areas which are predicted to continue being compatible with current uses) and a few bright spots (areas where climate change might create opportunities for blue growth and effective marine conservation).

Source: Bright spots as climate-smart marine spatial planning tools for conservation and blue growth - Queirós A et al. (2021) - Global Change Biology - (https://doi.org/10.1111/gcb.15827)

Knowledge and solutions for fisheries, aquaculture, and seaweed cultivation under climate change

Informing the sustainable and climate-smart harvesting of marine species

FutureMARES is developing knowledge which will help increase the climate change resilience of the sustainable harvesting of marine species by, for example:

- Exploring the risks and opportunities of different climate change scenarios to Atlantic salmon farming in Norway.
- Strengthening knowledge of the impacts of climate change on key species in the Bay of Biscay which will help inform the adaptation of sustainable seafood harvesting activities to climate change and explore how they can contribute to climate change mitigation.
- Exploring the role of sustainable seaweed farming in support of sustainable development goals and the potential risks of recent climate change mitigation initiatives of farming seaweed.
- Examining the carrying capacity of shellfish restoration and cultivation in the southern North Sea, particularly in Dutch coastal waters and Dutch EEZ.

Source: FutureMARES Storylines 4, 10, 15, 20, 22 & 24

2. Annexes

Table 1 The broad objectives of FutureMARES and their policy relevance.

Objective	WP	Details	Policy relevance
Understanding the links between ecological functions and ecosystem services	1	Analysis of historical climate impacts on species and habitats. Advancing understanding of relationships between species traits, community roles, functions, and ecosystem services and how these are impacted by climate change.	Building knowledge on the links between species traits, ecological functions and ecosystem services under climate change can help inform climate-smart management strategies to conserve species and their ecosystem services.
Deliver projections of future climate change hotspots and refugia	2	Deliver regionalised ensemble projections from CMIP6 to analyse NBS and NIH including the identification of hotspots and refugia. The first physical and biogeochemical outputs from downscaled projections (including their uncertainty) have been produced for regional Storylines.	Building knowledge and developing methods to identify key sites for conservation under climate change which can inform the planning and implementation of conservation, restoration, and sustainable management strategies.
Explore climate change impacts in field and mesocosm experiments	3	Field experiments comparing ecological function (e.g., metabolism, carbon uptake potential, biodiversity) of healthy and degraded habitats including brown macroalgal forest in Italy, Israel and Spain, seagrass in Greece, oyster, and mudflat areas in the Netherlands. Laboratory experiments on species/ habitats most relevant to habitat restoration or protection. Genetic analyses to explore adaptative capacity.	Addressing key knowledge gaps on the impacts of climate change on key species and habitats to inform biodiversity protection and restoration policies and activities.
Explore climate change effects on marine species and biodiversity	4	Creating and updating species and habitat models to explore the distribution and/or productivity of seagrasses, vulnerable species (e.g., marine turtles), and species that are being restored or harvested. Methods have been harmonized to transfer outputs single-species to whole-ecosystem models (for the Central Baltic Sea, North Sea, Bay of Biscay, and the Mediterranean Sea).	Improved modelling of climate change impacts on the distribution and productivity of keystone, habitat-forming and endangered species can inform the design and implementation of activities to restore, protect and sustainably use these species.
Conduct novel socio-ecological risk assessments	5	Designing a general methodology for socio-ecological risk assessments for species, habitats, ecosystem services, and dependent human communities. This is based on the IPCC Risk-Assessment framework. Incorporating the effect of NBS on risk-mitigation in Storylines within different climate change scenarios.	Climate vulnerability assessments can help inform climate-smart policies and decision-making.

Perform economic analysis of different nature-based solutions	6	Performing economic analyses, including costs and benefits, of implementing NBS and NIH under different scenarios at demonstration sites.	Contributing to the valuation of nature's contributions to people. Supporting the implementation of nature-based solutions through assessing their costs, benefits, and overall economic viability. Helping integrate biodiversity and its values into decision making.
Test implementation strategies including bio-economic analysis	6	Assessing nature-based solution and sustainable harvesting strategies using both biological and economic analysis tools and methods.	Informing the implementation of nature-based solutions by developing methods to assess their implementation. Building the evidence base on the economic impacts of nature-based solutions.
Co-create our research activities with decision and policy-makers	7	Creating impactful science-based evidence and advice to inform decision making on climate change mitigation and adaptation strategies. Co-developing project activities with decision makers including policy makers and managers. A call for knowledge for EU and other policymakers and managers has been implemented and work is underway.	Ensuring the research activities of the project are relevant to inform decision making.
Communicate with a broad range of stakeholders in our focus regions	8	Effectively engaging with stakeholders involved in the stewardship of marine and coastal ecosystems across regions to communicate on the project's progress and relevant activities.	Ensuring the evidence and findings of the project are communicated to decision makers, including policy makers and managers

Table 2 - Summary of the specific objectives and activities of FutureMARES WPs and their policy relevance.

WP	Aim	Key activities	Policy relevance
1	To review and establish common knowledge base to improve monitoring and biodiversity indicators and guide activities through common scenario pathways	○ Looking at historical trends and tipping points in biodiversity metrics related to climate change, identifying candidate traits which can help determine responses to climate change and impacts on ecosystem functions ○ Identify biodiversity indicators that relate to ecosystem services which are sensitive to climate change ○ Creating socio-political scenarios pulling from IPCC and IPBES ○ Compiling ecosystem service indicators for each Storyline	Adding to the scientific knowledge base on the impacts of climate change on marine biodiversity in Europe. Identifying indicators and underlying data to monitor impacts of climate change on biodiversity. Capacity building for scientific community on methods for identifying trait environment relationships.
2	Create ensemble of available climate model runs for regional physical, biological, and chemical conditions which impact biodiversity and ecosystem functions under climate	○ Ensemble covering all FutureMARES storyline regions over recent past and IPCC scenarios SSP1-RCP2.6, SSP4-RCP8.5, SSP5-RCP8.5 for 7 CIMP6 models ○ Assessed species tolerance ranges for key stressors	Building knowledge on the impacts of different, policy-relevant climate change scenarios on the biological, chemical, and physical components of marine and coastal ecosystems.

	change and past and future trends and uncertainties in these.		
3	Filling gaps in ecological knowledge to understand how climate change impacts biodiversity, biological traits, and ecosystem functions	○ Ecological experiments to understand how climate change impacts biodiversity, traits, and functions (e.g., carbon mitigation potential, metabolic functions) for habitats including macroalgal forests, oyster beds, and alternate states such as invasive macrophyte communities and turf. ○ Assess adaptation and recovery potential of marine species to extreme events (considering connectivity). ○ Results in open access repositories - can inform climate change models etc	Building knowledge on the impacts of climate change on marine and coastal ecosystems, their biodiversity and functions and the capacity of marine species to adapt to these impacts.
4	Developing and applying species, habitat, and food web modelling tools to improve the development of climate-ready restoration, conservation, and sustainable managing programmes.	○ Develop and address current gaps in modelling capability to inform policy strategies for restoration, marine conservation, and sustainable harvesting. ○ Using ecosystem modelling to inform management actions for marine biodiversity, resources, and services. ○ Collate data and develop methods to inform the restoration and conservation of seagrass and seaweed in European Regional Seas under climate change. ○ Collate data and develop methods to inform the conservation of charismatic and vulnerable species in European Regional Seas under climate change. ○ Identified priority areas for marine megafauna, modelling foraging site distribution and migratory corridors for loggerhead turtles. ○ Identifying and mapping conservation hotspots. ○ Developing understanding of climate change impacts on sustainable harvesting of wild capture and aquaculture of fish, macroinvertebrates, and seaweed. ○ Advancing food web models for European marine regions. Exploring food web responses to fishing and climate change and how this can inform marine ecosystem condition assessment.	Supporting the design and implementation of programmes and activities to conserve, restore and sustainably mange marine ecosystems under climate change.
5	Developing and implementing methodologies to identify marine species, habitats, ecosystem services,	○ Developing and implementing methodologies for ecological climate risk assessment by improving traits-based ecological sensitivity metrics.	Informing the design and implementation of climate-ready strategies and activities by identifying areas and species that are most at risk from the impacts of climate change. Contributing to

	and communities that are most at risk from the impacts of climate change.	○ Identifying ecosystem service users, their demands, and how these can be impacted by climate change. ○ Developing methodology for ecosystem service climate risk assessments. ○ Integrating ecological vulnerability, social sensitivity, and adaptive capacity in a composite index of socio-ecological climate risk.	activities to maintain and enhance ecosystem services under climate change by identifying services most at risk from climate impacts. Strengthening the measurement of climate risk.
6	Demonstrating and co-developing nature-based solutions to enhancing the resilience of marine and coastal ecosystems to climate change and assess their economic, social, and practical viability.	○ Estimating the economic value and costs of nature's contributions to people. ○ Identifying economic opportunities and challenges of the implementation of nature-based solutions under climate change scenarios at the local, regional and international levels. ○ Looking at alternatives to enhance nature-based solutions ○ Informing practitioners on how nature-based solutions can enhance the resilience of ecosystems and their services to the impacts of climate change ○ Describing method for a tool for climate smart marine spatial planning ○ Informing climate readiness strategies ○ Integrating cost benefit analysis and cost effectiveness analysis into project. ○ Employing decision support tools for the viability of different nature-based solutions. ○ Visualisation tools to show how interventions are expected to impact ecosystem services and aligning these to policy targets and climate change indicators.	Directly contributing to the integration of biodiversity and its values into decision, making. Making data, information and knowledge on the implementation of nature-based solutions for climate resilience in marine ecosystems available to decision-makers. Supporting the implementation of economically viable nature-based solutions for the protection, restoration, and sustainable management of marine ecosystems while enhancing their ability to adapt to climate change.
7	Ensuring that the knowledge and products of FutureMARES are policy-relevant and are used in policy development and implementation at the national, European and international levels.	○ Co-developing knowledge products with key policy makers. Creating platforms where policy makers can request development of specific knowledge products and possibility to co create research and form working groups of experts. ○ Contributing science-based advice to draft national climate change policy ○ Contributing to status assessments ○ Mainstreaming climate adaptation into MPAs	Bridging the science policy gap for the implementation of nature-based solutions to safeguard the marine environment under future climate change.

8	Creating and maintaining engagement with target audiences to communicate project outputs.	○ Communicate and disseminate results and products of FutureMARES using audience-specific approaches and building collaborations with other projects ○ Coordinating exchanges with stakeholders ○ Synthesising outputs to ensure they contribute to the adaptation of marine ecosystems to climate change.	Directly contributing to making the best available data and knowledge accessible to decision makers, managers, and the public to guide marine ecosystem conservation under climate change. Supporting the implementation of restoration, conservation, sustainable use, climate resilience, and nature-based solution enhancement targets by informing relevant decision-makers and practitioners.