FutureMARES

Climate Change and
Future Marine Ecosystem Services
and Biodiversity

FutureMARES: Climate-smart Conservation Planning

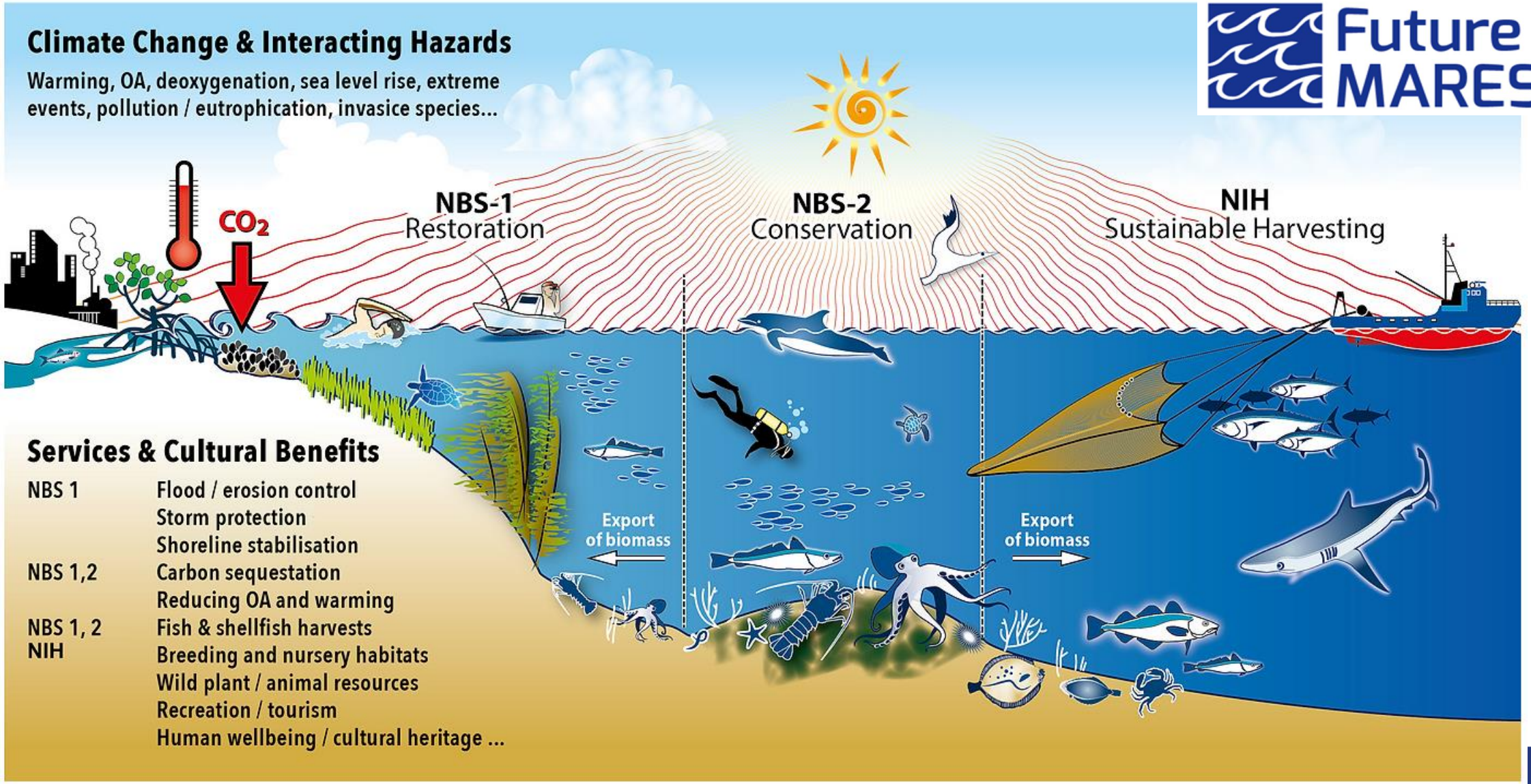



Myron A. Peck (and > 200 collaborators)

Climate-Ready Marine Protected Areas: Building Resilience and Supporting Marine Adaptation – Virtual Workshop - 10/12/2024

Royal Netherlands Institute for Sea Research

Goal: Provide socially and economically viable actions, strategies and Nature-based Solutions for Climate Change adaptation and mitigation to safeguard future biodiversity, and ecosystem functions, maximising natural capital and its delivery of services from marine ecosystems.



LC-CLA-06-2019 Inter-relations between climate change, biodiversity and ecosystem services
4 years (1st September 2020 – 31st August 2024), 8.5 million €
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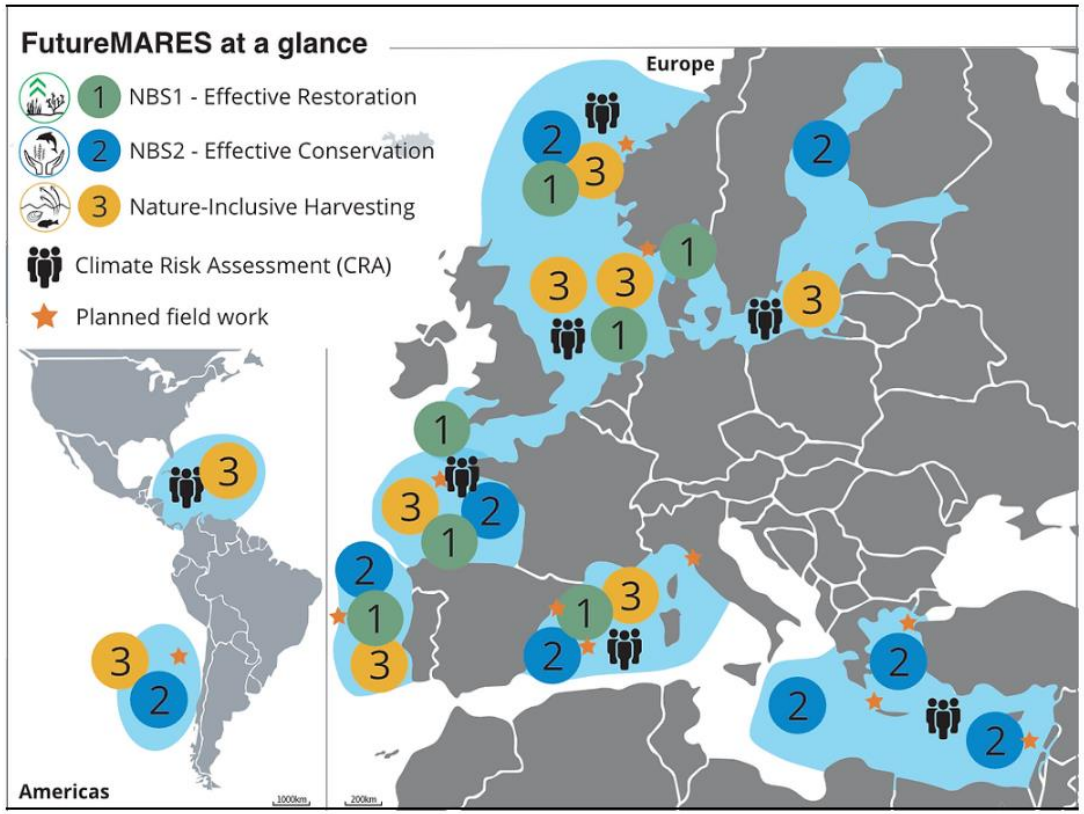
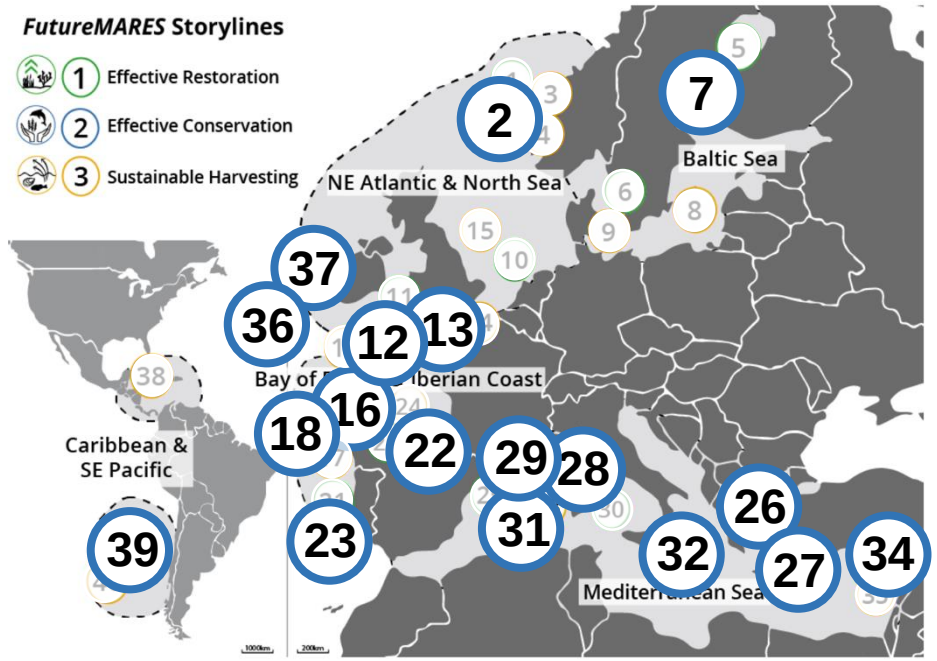
futuremares.eu



Royal Netherlands Institute for Sea Research
AARHUS UNIVERSITY
ARISTOTLE UNIVERSITY OF THESSALONIKI
AZTI MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE
BIOPOLIS
CCMAR Centro de Ciências do Mar
CEAZA
Cefas
cmcc Centro Euro-Mediterraneo sui Cambiamenti Climatici
ciimar
Consortio di Gestione dell'Area Marina Protettadel Promontorio
CSIC
Deltares
DTU Danmarks Tekniske Universitet
GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel
hcmr ΕΛΚΕΘΕ
INRAE
IRD Institut de Recherche pour le Développement FRANCE
Israel Oceanographic & Limnological Research
THE MARINE BIOLOGICAL ASSOCIATION Incorporated by
NIVA
NORTH DEVON BIOSPHERE
PML Plymouth Marine Laboratory
Stockholm University
SYKE
THÜNEN
UN environment programme WCMC
Universität Hamburg DER FORSCHUNG | DER LEHRE | DER BILDUNG
UNIVERSITÀ DI PISA
UNIVERSITY OF Southampton
FUTURE OCEANS LAB Universidade de Vigo
WAGENINGEN UNIVERSITY & RESEARCH

NBS2: Effective Conservation Storylines



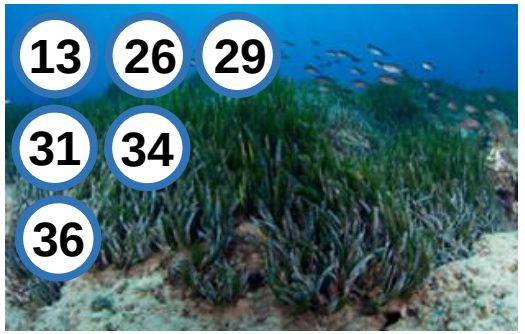
Enhance effectiveness of Marine Protected Area (MPA) networks as part of climate adaptation planning.

Examples:

- Identify climate refugia to set MPAs at regional and subregional scales
- Develop adaptation action plans

HABITAT-FORMING SPECIES

Seagrasses
North Sea,
Bay of Biscay
Karpathos/Greece
NW Mediterranean



Seaweeds / Algal Turf
NE Baltic Sea
SE Mediterranean Sea

Corals
W Mediterranean
E Mediterranean

Kelp
Norwegian Coast
North Sea
N Portugal

TRANSITIONAL WATERS

Diadromous species
Marine-estuarine opportunists
Rocky Intertidal Coasts
Atlantic

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CHARISMATIC SPECIES

Mediterranean Sea

SOFT SHELF SEABED

North Sea

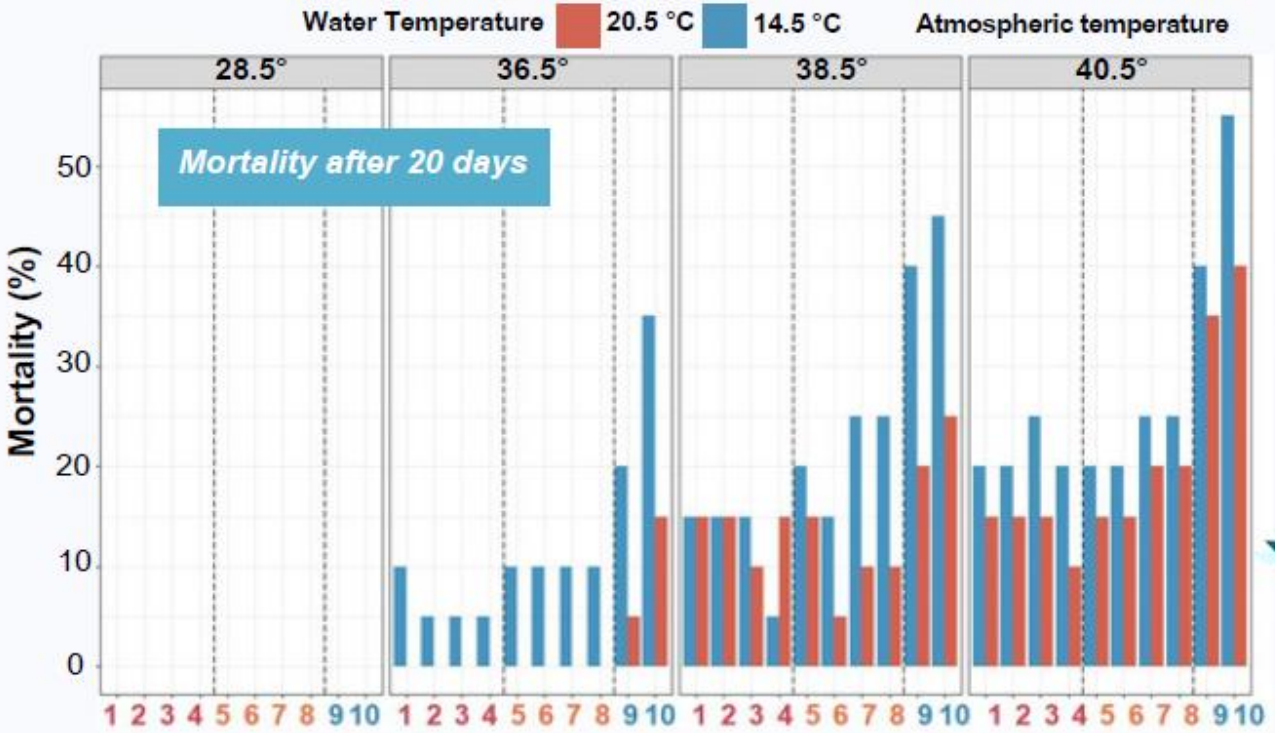
ISLAND ECOSYSTEMS

Chile

RESULTS: Example of New Experiments (population differences in climate sensitivity)

Macroalgae Ascophyllum nodosum

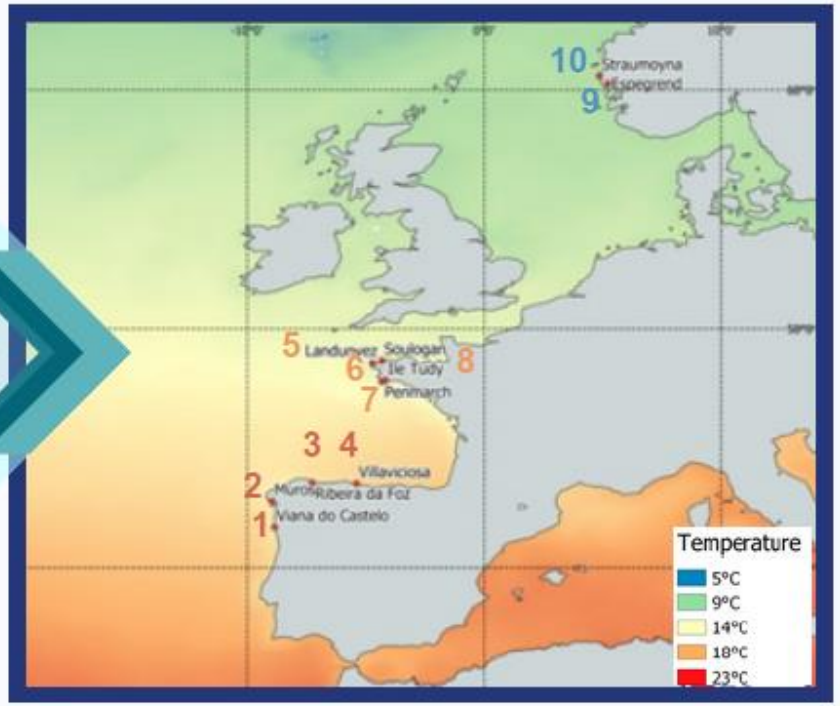
An atmospheric (aerial) heatwave lab experiment was designed to simulate present and extreme future atmospheric conditions



Identification of heat-resistant ecotypes is a crucial factor for successful restoration efforts

Seawater temperature has synergistic role in shaping the ecophysiological response of this seaweed

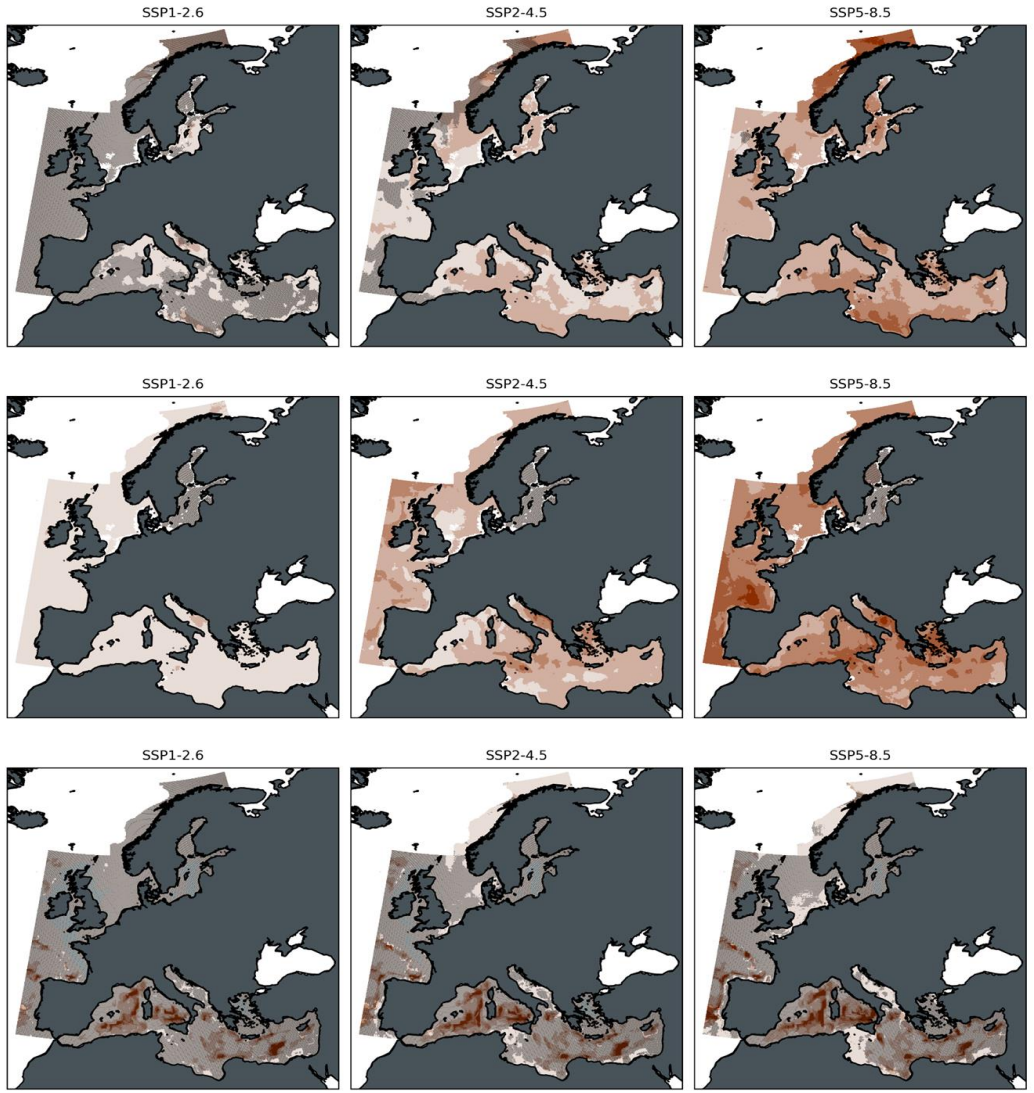
Collection sites of different population of Ascophyllum nodosum

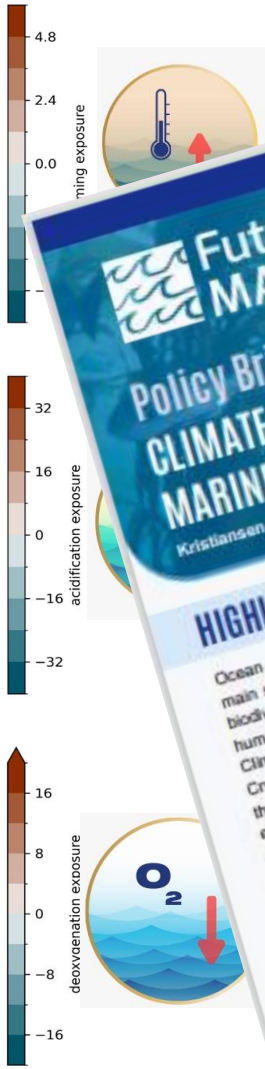


1-Viana do Castelo, 2- Ria de Muros, 3- Ria da Foz, 4- Ria de Villaviciosa, 5- Landunvez, 6- Île- Tudy, 7-Penmarch, 8- Soulogan, 9- Espegrend and 10- Straumoyna

RESULTS: Higher-resolution climate change projections

strong mitigation **intermediate** **no mitigation**





Exposure to **the natural** ns. well below hat do not areas.

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Baltic Sea results highly uncertain due to importance of unresolved coastal processes missing in underlying Eart System Models

Risk Assessment Tool

Evaluating ness of Nature-based Solutions using Climate Risk Assessments (species t to human communities)

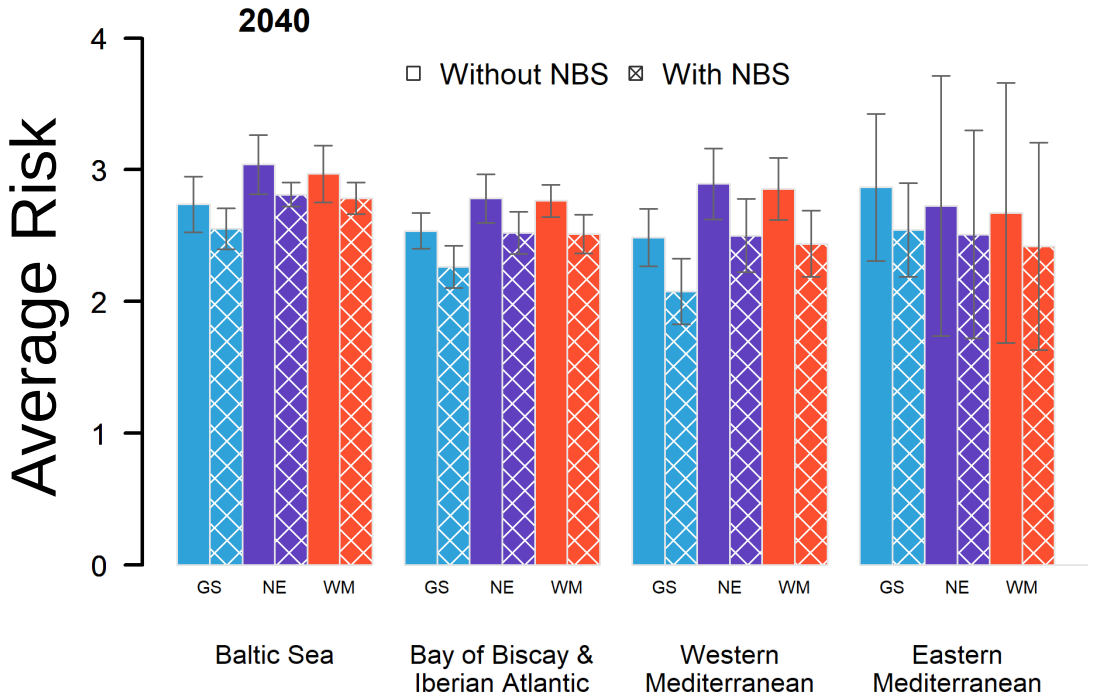
1

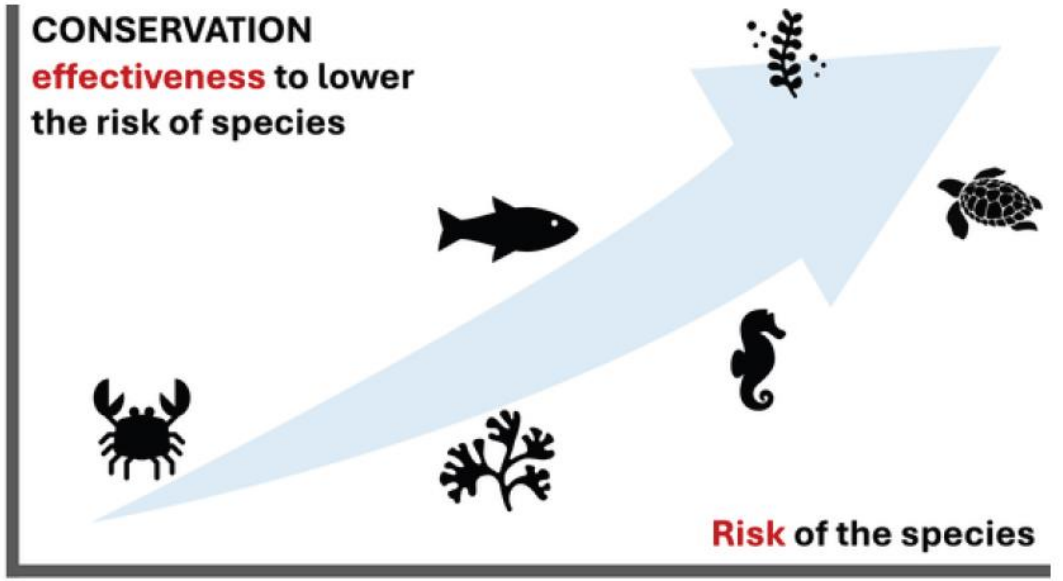
2

Nature-based Solutions Climate risk tool

RESULTS: Risks to species with / without conservation (NBS)

CONSERVATION





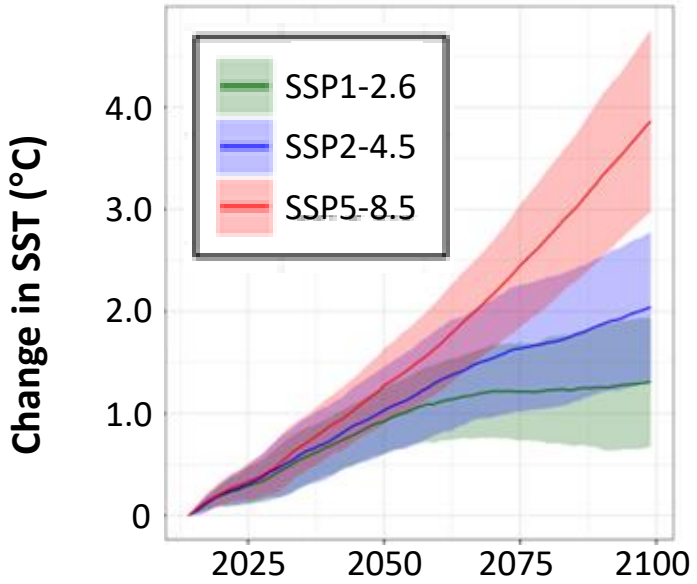
Climate risk decreased more with NBS in Western Mediterranean. Scenario results context-specific

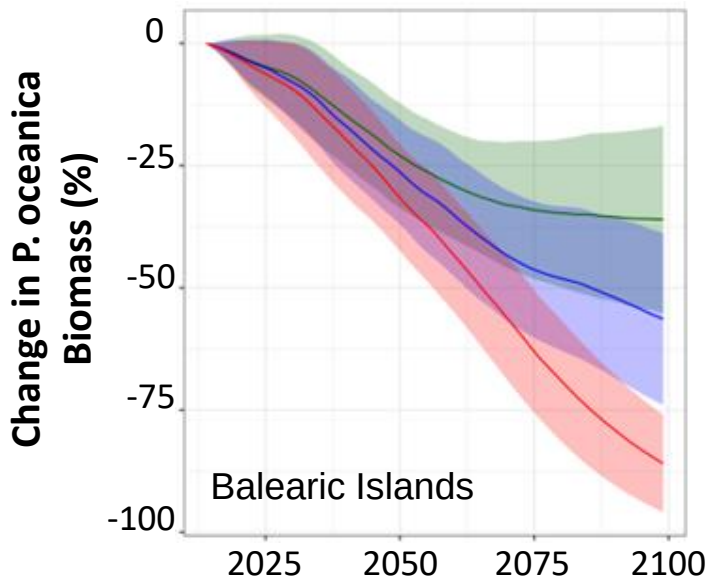
Positive relationship between estimated risk of species and effectiveness of conservation measures to decrease risk across the European seas.




RESULTS: New Projections of Suitable Habitats

- Projected changes since 1995-2014 in **average sea surface temperature (SST) and above-ground *Posidonia oceanica* biomass** in the Balearic Islands (NW Mediterranean).
- Future impacts of climate change on seagrass projected using a mechanistic seagrass model and an ensemble of 16 bias-corrected global climate models. Line = mean, shaded area represents ± one standard deviation of the multi-model spread.
- Spatial modeling of the distribution and biomass of *P. oceanica* shows dramatic declines in expected future habitats without CC mitigation.





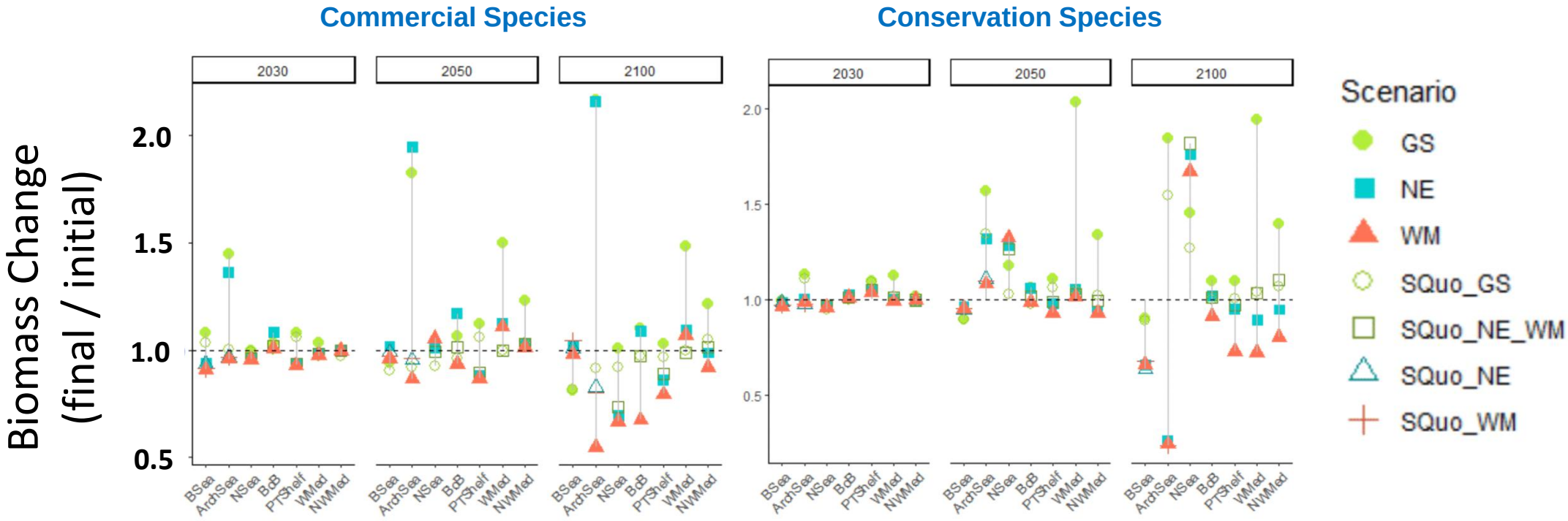
RESULTS: New Projections of Ecosystem Impacts
(multiple pressures with / without management / NBS)

Scenarios

	Representative Concentration Pathways-RCP	Future Socio-Economic Pathways: Socio-economic Pathways - SSP	Political	Economy	Social	Technology	Legal
Global Sustainability 	Minimal warming [RCP2.6]	Mitigate & adapt [SSP1]	MPA 30% by 2030 with MSY	Low fish prices	Focus on restoration, conservation & aquaculture	Min. bycatch No tech. creep	10% sea no-take. Avoid fishery displacement
National Enterprise 	Strong Warming [RCP8.5]	Not mitigate nor adapt [SSP3]	MPA for National aims	Med. fish prices	Mixed aims	High bycatch Low tech. creep (0.4% p.a.)	5% of sea no-take
World Markets 	Strong Warming [RCP8.5]	Adapt not mitigate [SSP5]	New MPAs - commercial fish habitat	High fish prices	Focus on seafood	Min. bycatch High tech. creep creep (0.9% p.a.)	5% of sea no-take

RESULTS & Tool (Digital Laboratories)

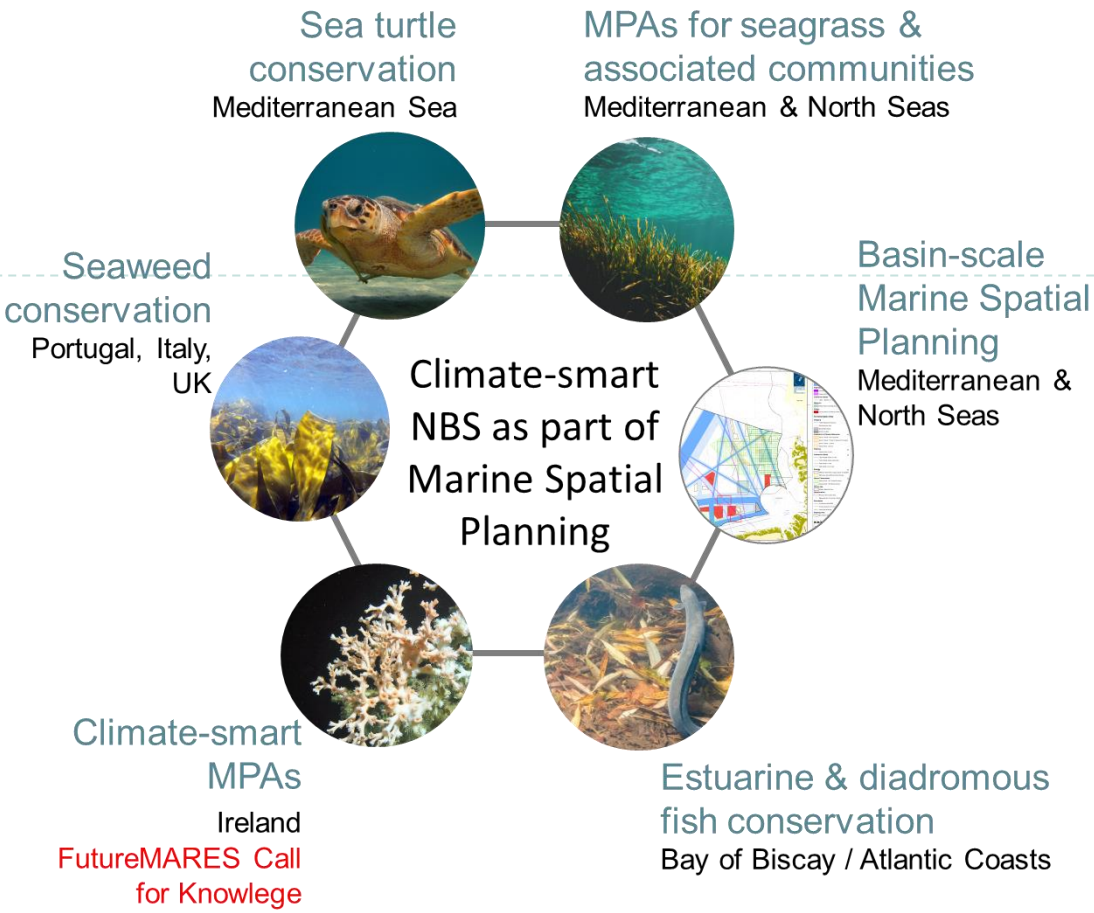
- **Ecosystem impacts across 7 seas** (Baltic, Finnish Archip, North Sea, Bay of Biscay, Iberian Shelf, Western Med., NW Med).
- Relative change in biomass of **commercial species and conservation species**
- Tested 3 scenarios with / without management measures (7 combinations… complex – apologies!).
- **Long-term effects are larger** (lag time in ecosystem responses, careful of 2030 expectations)
- **Status Quo (SQuo) management shows declines** with time in almost all cases
- Lower emissions (GS) scenario **shows increases, higher emissions (WM) has larger declines**






Bright Spot Mapping

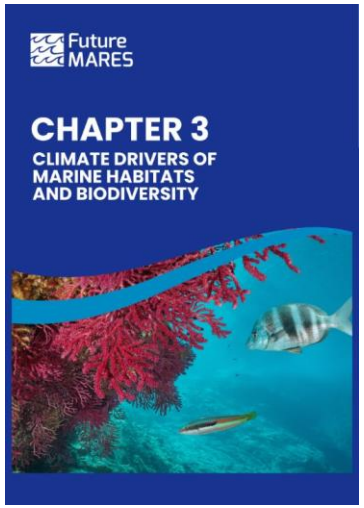
Maps identifying areas with most potential for successful, climate-smart NBS interventions (‘brightspots’) co-located with activities of other marine sectors (energy, shipping, fishing) and users.

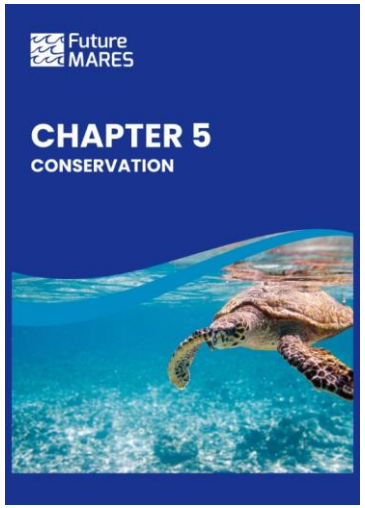


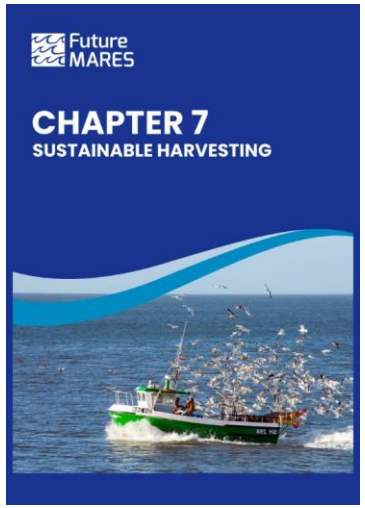
A Climate-resilient Path for Ireland’s Marine Protected Areas Network

Synthesis Materials Available Online

Synthesis Report (9 chapters, ~145 pp)







https://www.futuremares.eu/

https://www.actnow-project.eu/

Storyline Documents (29)

FutureMARES Storylines

Storylines 1, 2, 3
Norwegian Coast, inter-relationships among kelp, sea urchins and cod

Storyline 4
Salmon at Hardangerfjord, Norway

Storyline 6
Restoration of eelgrass (Zostera marina) in the south-west Baltic Sea

Storyline 7
Conservation of coastal seaweeds, seagrasses, invertebrates and fish in the north-east Baltic Sea

Storyline 8
Basin scale management & MPAs in the Baltic Sea

Storyline 9
Sustainable mussel culture in the Limfjorden, SW Baltic Sea

Storyline 10
Restoration of oysters in Dutch coastal waters

Storyline 11
Saltmarsh, seagrass and kelp habitats in the North Devon UNESCO World Biosphere Reserve

Storylines 12 &14
Marine spatial planning (broad coverage)

Storyline 13
Conservation of ecosystem services from shelf (soft) seabed in the North Sea

Storyline 15
Seaweed, mussels, and oysters in the north-east Atlantic and North Sea

Storylines 16 &17
Marine-estuarine opportunists in the NE Atlantic Ocean

Storylines 18 &19
Diadromous species in the NE Atlantic Ocean, including transitional and upstream waters

Storylines 20, 22, 24
Nature-based Solutions in the Basque coast of Bay of Biscay: seagrass restoration, protected areas, and sustainable seafood harvesting

Storylines 21 & 23
Kelp forests & biodiversity in northern Portugal

Storyline 25
Restoration of seagrass (Posidonia oceanica) in the Balearic Islands (NW Mediterranean)

Storyline 26
Marine Protected Area network for Aegean biodiversity

Storyline 27
Karpathos & Saria MPAs: seagrasses and meadows, soft/rocky bottom

Storyline 28
Seagrass meadows and macroalgal forests in the MPA network of the Tuscan Archipelago

Storyline 29
Habitat-forming macroalgae / corals in the western Mediterranean Sea

Storylines 30, 31, 33
Conservation / Fisheries Sustainability in the Western Mediterranean from a regional perspective + synergies

Storyline 32
Basin-wide sea turtle conservation in the Mediterranean Sea

Storyline 34 & 35
Climate change and bioinvasion impacts on reef & canopy-forming macroalgae and shelf fisheries in SE Mediterranean Sea

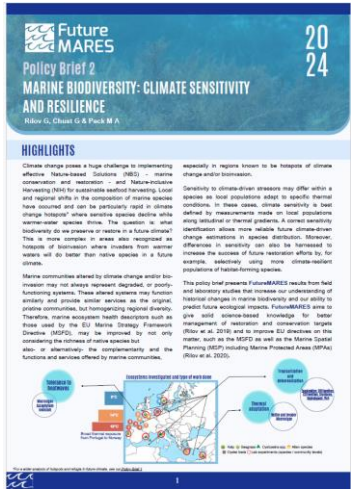
Storyline 36
Biogeography and biodiversity change on coastal communities at continental scales

Storyline 37
Offshore European Seas: Climate Change, Biodiversity and resilience

Storyline 38
Sustainable Seafood Harvesting in the Belize EEZ

Storyline 39 & 40
Ecosystem approach for the Chilean island systems

Policy Briefs (5)



Thanks for listening!