# FutureMARES Science for Policy

Session 3: Digital marine labs as experiments to investigate the effects of socio-political scenarios with combined Nature-based Solutions and Nature-inclusive Harvesting




**MARTA COLL (ICM-CSIC):** CP LYNAM, X CORRALES, L ESPASANDÍN, M ORTEGA, R PUNTILA-DODD, J STEENBEEK, D SZALAJ, M TOMCZAK, M BUTENSCHÖN, E ANDONEGI, M DOLORES CASTRO, S HEYE, T KRISTIANSEN, B MULLER-KARULIS, L VAN DUREN, L VILMIN & MA PECK

TEXEL, 26 JUNE 2024

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# Environmental policies & digital labs

- MSFD, MSP, Habitat Directive, CFP, Restoration Law, …
- HELCOM, OSPAR, Barcelona Convention
- Multiple objectives and trade-offs, spatial-temporal domains, need to implement multiple actions and test them together

## Digital laboratories can be useful platforms:

- Make use of complex models representing an area, driven with environmental data, incl. ecological interactions and human activities
- To test multiple and contrasting management interventions

Habitat Restoration

Marine Conservation

Seafood Harvesting

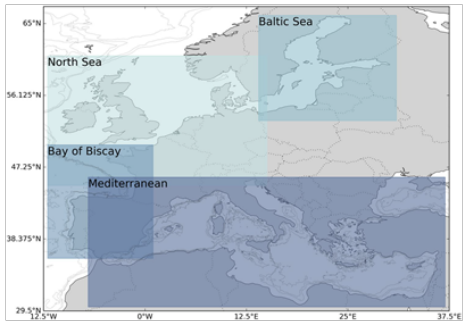
# What have we done?
# Mechanistic projections for changing species and ecosystems

1

***Global Earth System Models***

*Downscaled projections in European Seas & ensemble*

IPSL-CM6A-LR
CMCC-ESM2
(...)






2

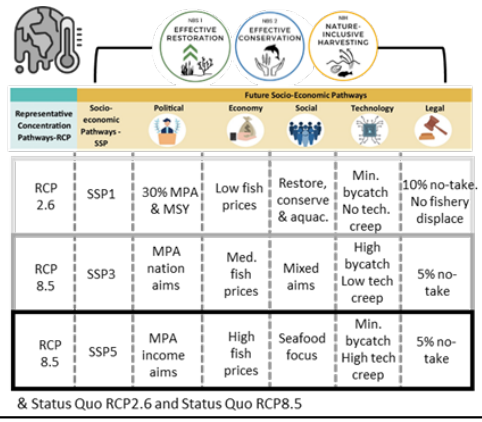
***Global Socioeconomic Scenarios***

*Downscaled narratives in European Seas*

Global Sustainability

National enterprise

World Markets




| Representative Concentration Pathways-RCP | Future Socio-Economic Pathways: Socio-economic Pathways - SSP | Political | Economy | Social | Technology | Legal |
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| RCP 2.6 | SSP1 | 30% MPA & MSY | Low fish prices | Restore, conserve & aquac. | Min. bycatch No tech. creep | 10% no-take. No fishery displace |
| RCP 8.5 | SSP3 | MPA nation aims | Med. fish prices | Mixed aims | High bycatch Low tech creep | 5% no-take |
| RCP 8.5 | SSP5 | MPA income aims | High fish prices | Seafood focus | Min. bycatch High tech creep | 5% no-take |

& Status Quo RCP2.6 and Status Quo RCP8.5

# What have we done?
# Mechanistic projections for changing species and ecosystems

Future MARES

1

**Global Earth System Models**

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CMCC-ESM2
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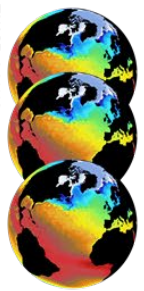
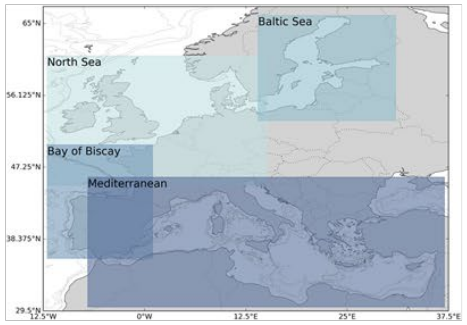


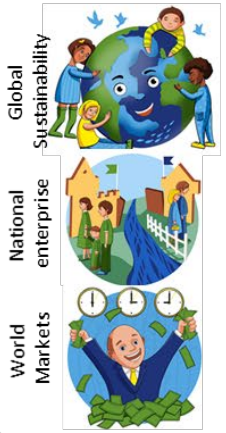
*Downscaled projections in European Seas & ensemble*




2

**Global Socioeconomic Scenarios**

*Downscaled narratives in European Seas*





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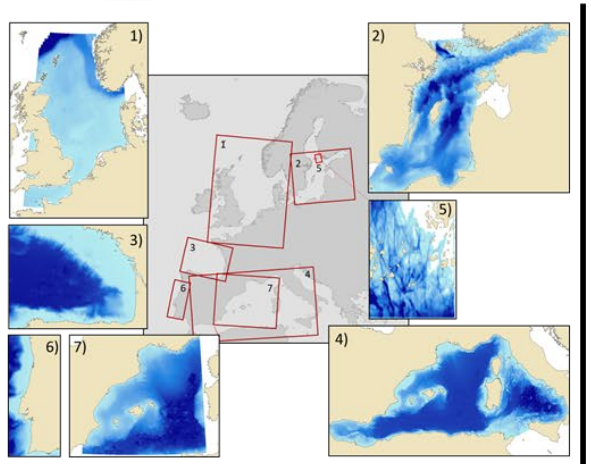
& Status Quo RCP2.6 and Status Quo RCP8.5

3

**Spatial-Temporal Marine Ecosystem Models**




*Standardized regional and sub-regional models & mechanistic processes for climate, restoration, protection and fishing sustainability*




# What have we done?
# Mechanistic projections for changing species and ecosystems

Future MARES

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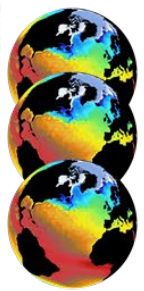
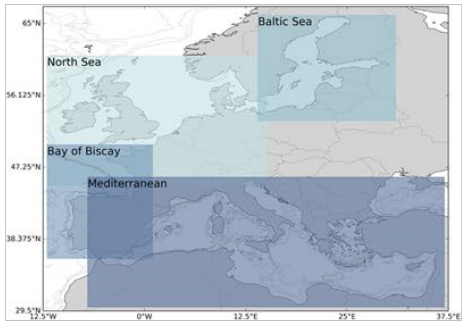
***Global Earth System Models***

IPSL-CM6A-LR
CMCC-ESM2
(...)



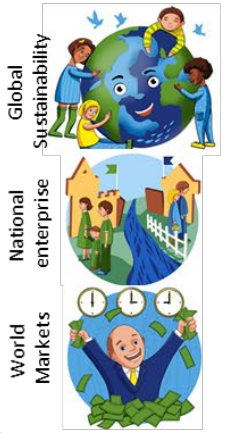
*Downscaled projections in European Seas & ensemble*

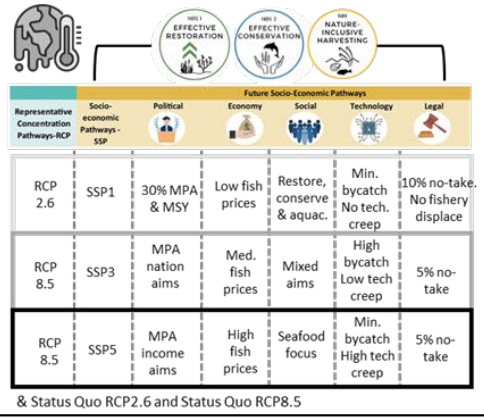



**2**

***Global Socioeconomic Scenarios***

*Downscaled narratives in European Seas*

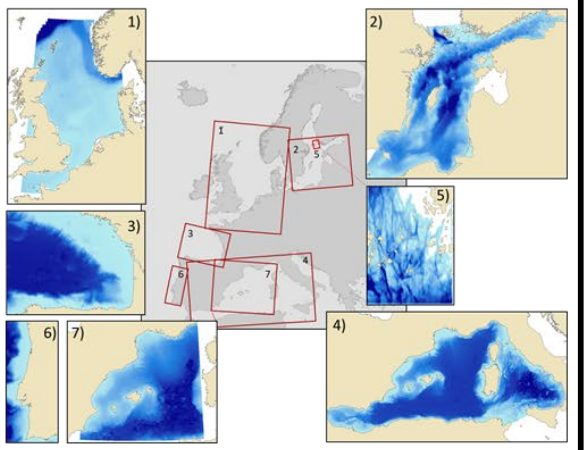



& Status Quo RCP2.6 and Status Quo RCP8.5

**3**

***Spatial-Temporal Marine Ecosystem Models***

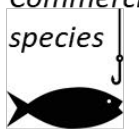



*Standardized regional and sub-regional models & mechanistic processes for climate, restoration, protection and fishing sustainability*

**4**

***Ecological indicators***
*(biomass, catch, biodiversity, trophic-based)*

*Commercial species*



*Vulnerable species*

*Ecosystem*

*Standardized indicators, time series, maps*

# Downscaled narratives in European Seas

## FutureMares scenarios to general narratives and downscaled narratives for each region

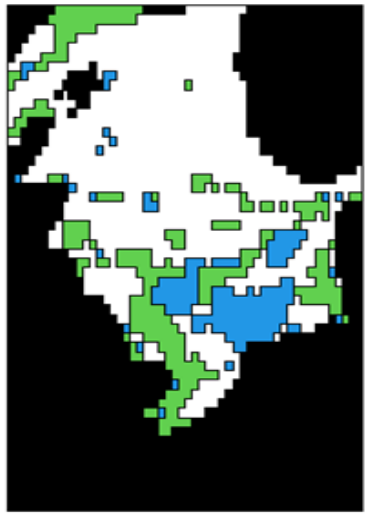
| Representative Concentration Pathways-RCP | Future Socio-Economic Pathways: Socio-economic Pathways - SSP | Political | Economy | Social | Technology | Legal |
|---|---|---|---|---|---|---|
| Global sustainability (RCP2.6, SSP1)  | Minimal warming [RCP2.6] | Mitigate & adapt [SSP1] | MPA 30% by 2030 with MSY | Low fish prices | Focus on restoration, conservation & aquaculture | Min. bycatch No tech. creep | 10% sea no-take. Avoid fishery displacement |
| National enterprise (RCP8.5, SSP3)  | 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 |
| Global markets (RCP8.5, SSP5)  | 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 |

& Status quo (climate analogues)

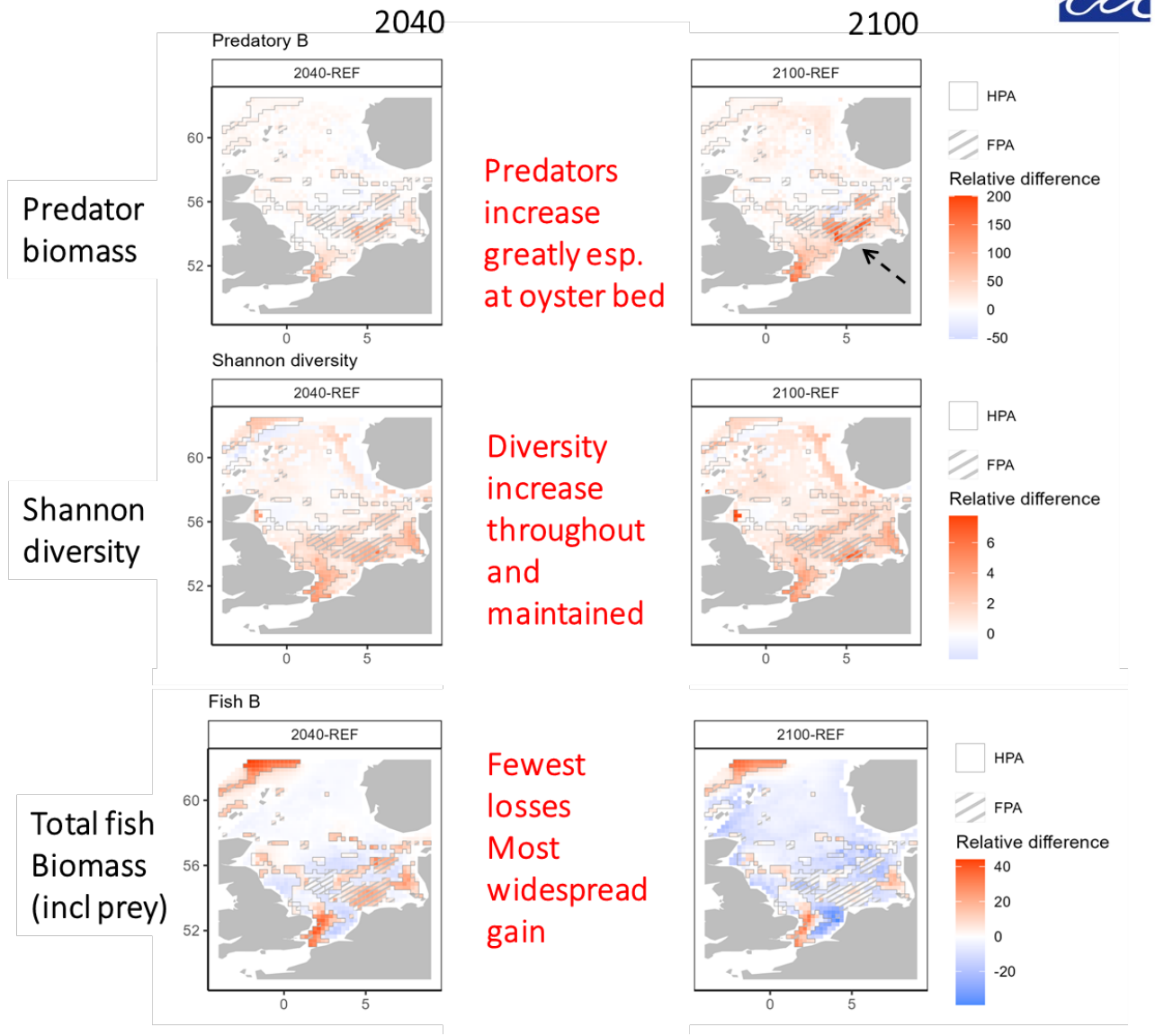



# Comparative results

## Global sustainability



Highly protected areas (green)
Fully protected areas (blue)



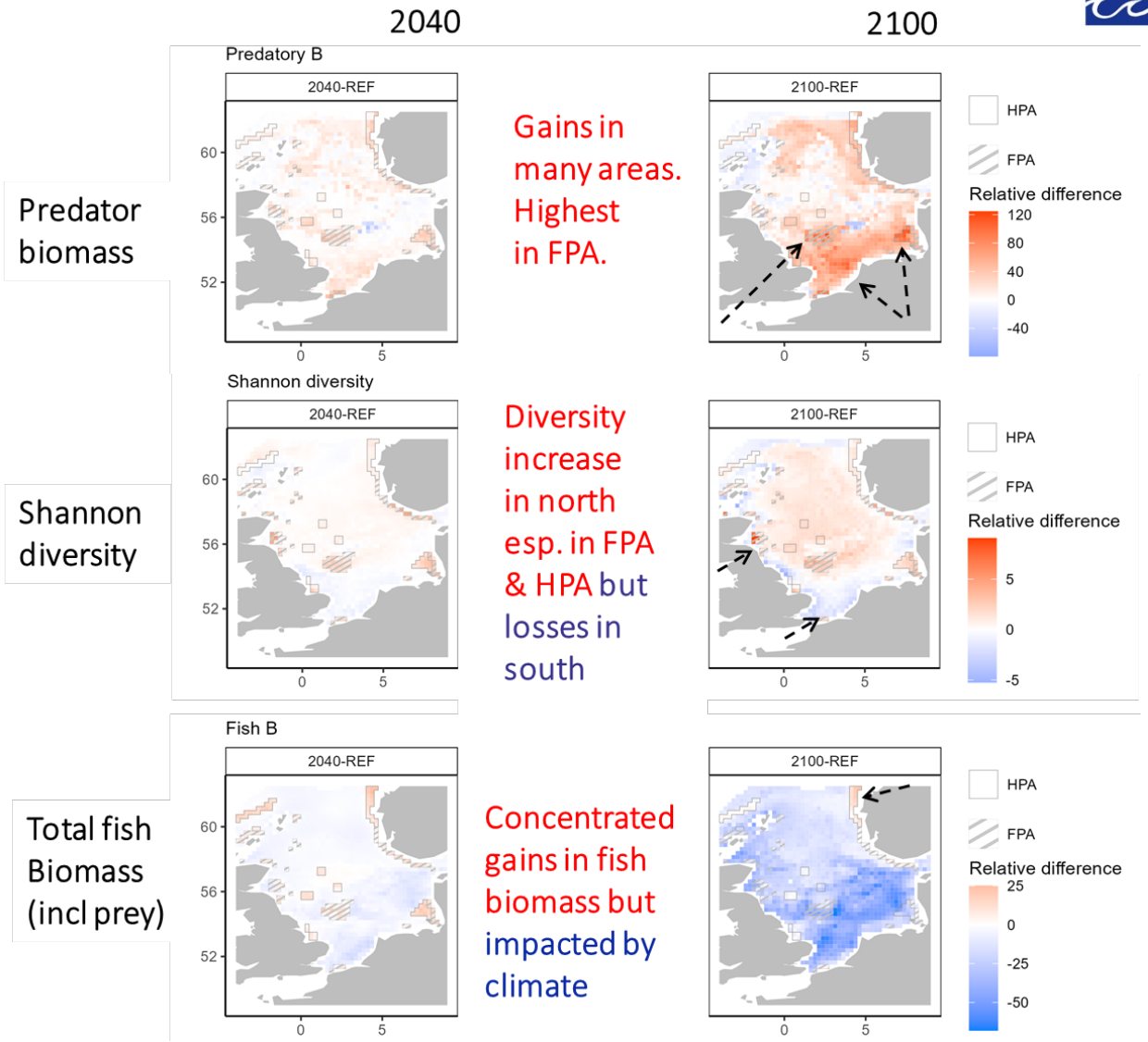




# Comparative results

## National Enterprise

Highly protected areas (green)
Fully protected areas (blue)

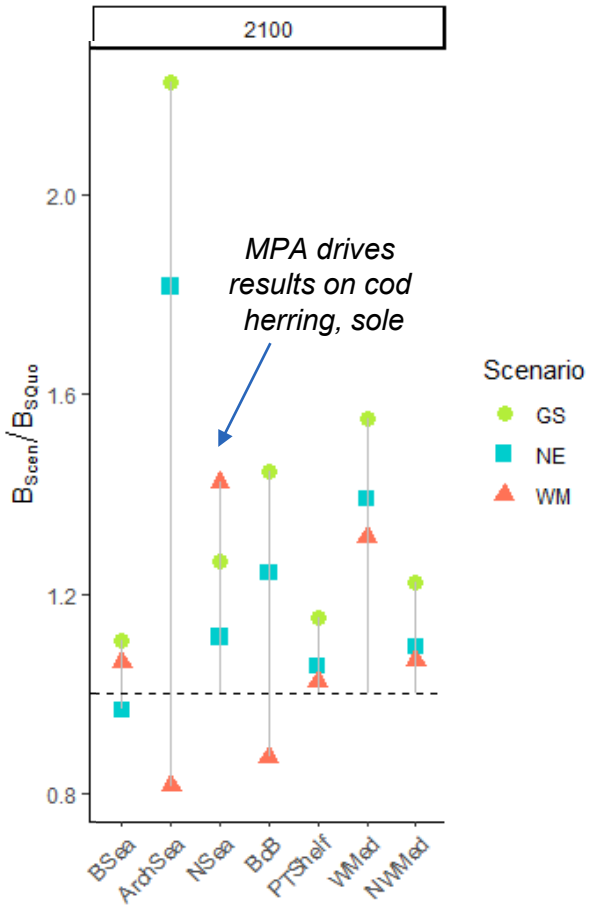




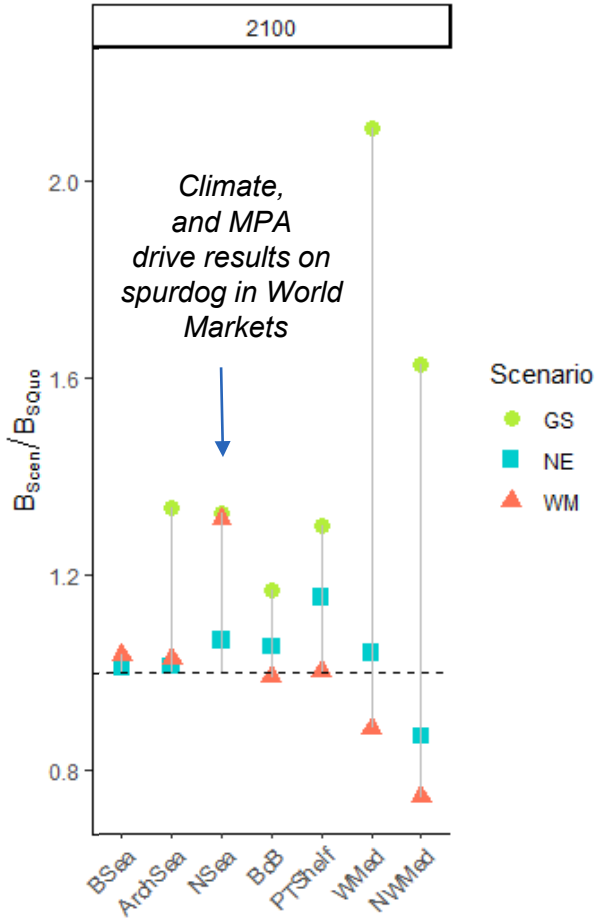


# Comparative results: inside MPAs

Change in total biomass of key **commercial species** in **no-take zones** relative to climate only run




Change in total biomass of key **conservation species** in **no-take zones** relative to climate only run




## Key messages

- **Noticeable effects of management** compared to non-management
- **Commercial species**: impact is especially noticeable in local Baltic Sea, WMed & BoB
- **Conservation species**: impact is especially noticeable in Med. systems
- Larger effects of FPA in **GS > NE > WM** (exception NSea)
- **Heterogeneity** between regions

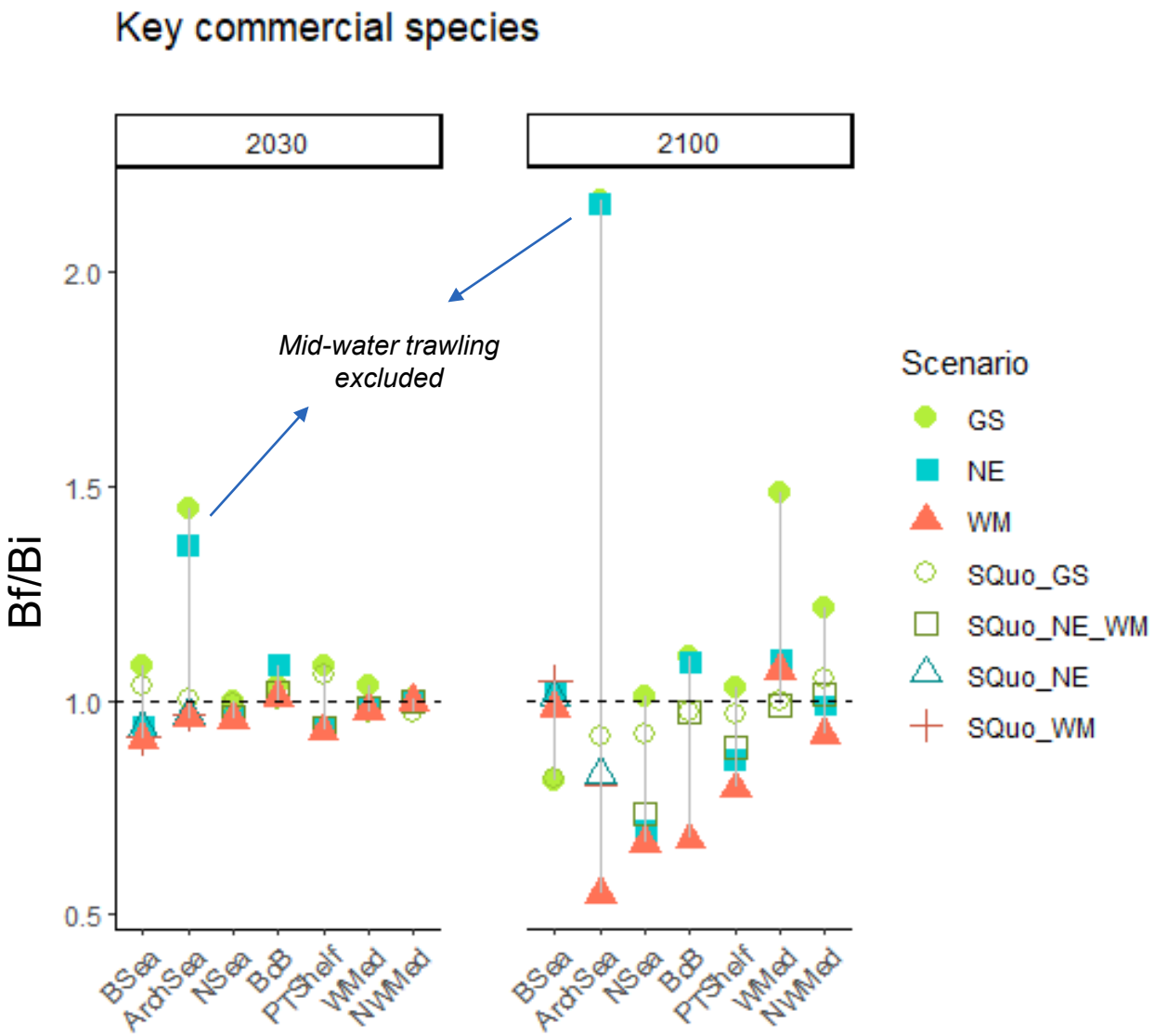
Bsea = Baltic Sea
ArchSea = Archipelago Sea (Baltic)
NSea – North Sea
BoB – Bay of Biscay
PTShelf – Portuguese Shelf
WMed - Western Mediterranean
NWMed – NorthWestern Med. Sea

GS Global Sustainability
NE National Enterprise
WM World Market



Coll, Lynam et al., 2024. D4.4 (submitted)

# Comparative results: whole area




## Key messages

- **Noticeable effects of management**
- Larger effects in the **long term**
- SQ and WM show declines with time
- GS show increases
- **GS > NE > WM** (except local Baltic)

**GS Global Sustainability**
**NE National Enterprise**
**WM World Market**
**SQuo Status Quo (climate change only)**

Bsea = Baltic Sea
ArchSea = Archipelago Sea (Baltic)
NSea – North Sea
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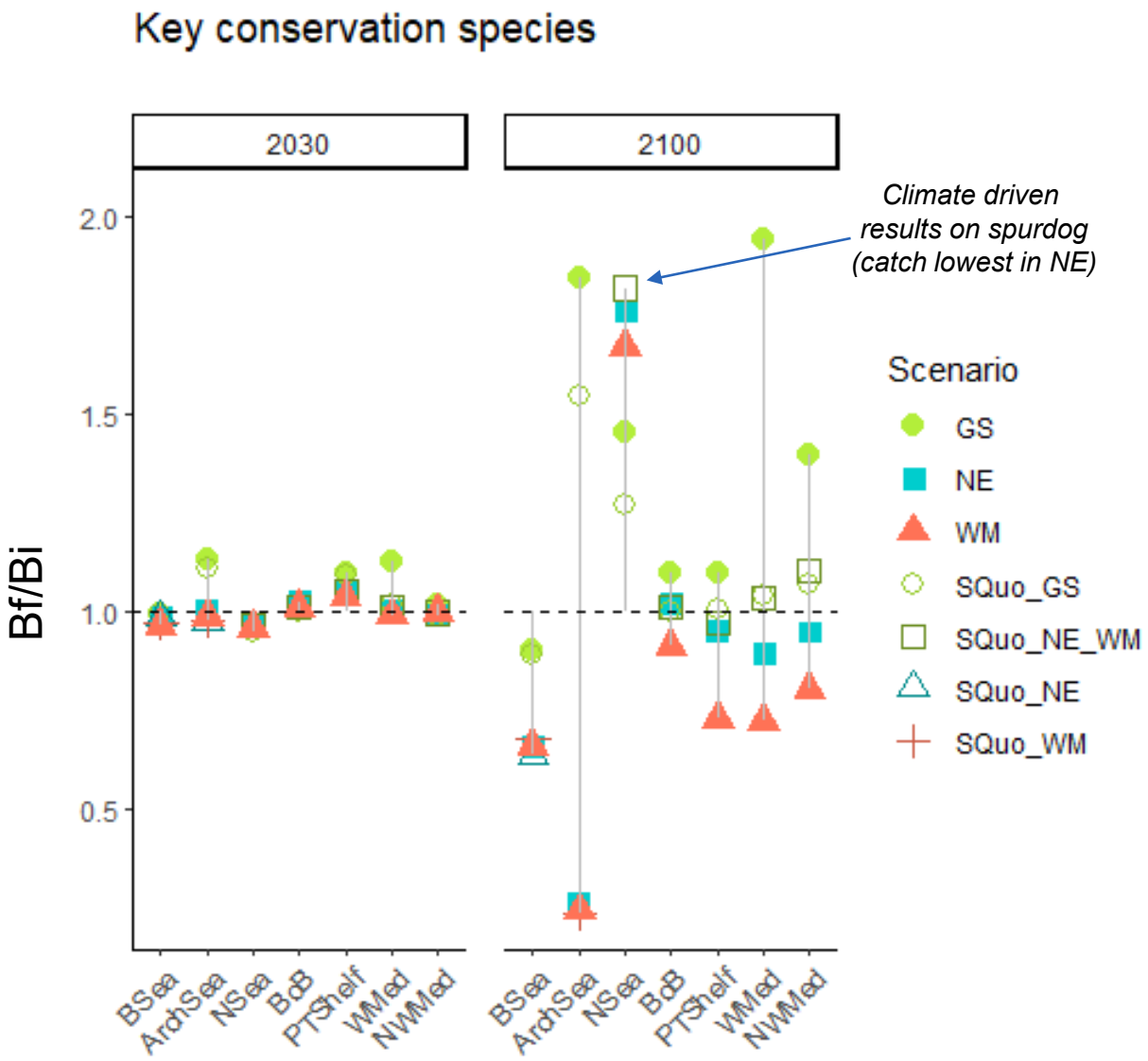
# Comparative results: whole area




## Key messages

- Noticeable effects of management in the long term
- SQ shows declines with time (except NSea)
- WM larger declines than SQ
- GS show increases
- GS > NE > WM

**GS Global Sustainability**
**NE National Enterprise**
**WM World Market**
**SQuo Status Quo (climate change only)**

Bsea = Baltic Sea
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# Key outcomes of our work

- **Noticeable effects of management** compared to non-management
  (amplified in regions with current low protection)
- Under **Global Sustainability** the effect of MPAs is larger
- **Location and implementation** of MPAs matter
- **NBSs play a key role** to (partially) mitigate and adapt to CC impacts
- **Proactive management** of European Regional Seas can make a difference
- Results highlight **areas' specificities** and regional **management choices**
- Digital tools can **promote dialogue between scientists and stakeholders useful to test diverse scenarios**

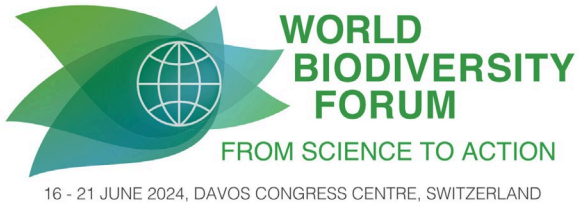



# Dissemination plans

- Deliverable will be published in the FutureMARES website
  - https://www.futuremares.eu/deliverables
- Conferences and congresses, publications
- EU projects policy sessions:
  - Ecopath 40Y conference policy event

**What would you like to see?**
**What would be useful?**





GES4SEAS

ACTNOW

MarinePlan

# Recommendations for the EC

- **Public data**: needs to have (further) access to observations and data from Member States to improve our models (e.g. MEDITS; MEDIAS, …)
- **Model improvements**: need to access funding where data acquisition and modelling improvements are possible
- **Model uncertainty**: need to access funding where we can validate our tools and develop uncertainty analyses

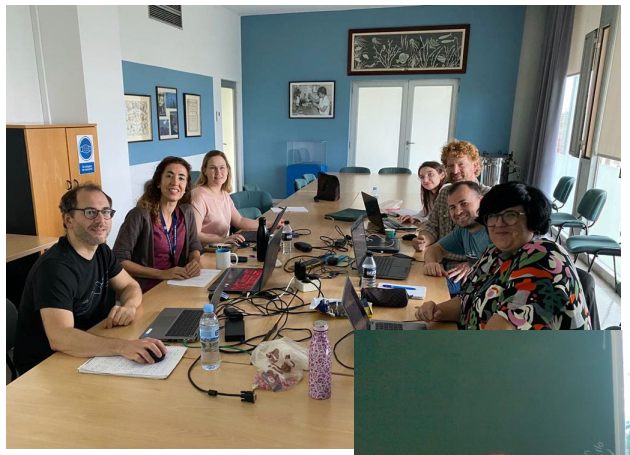
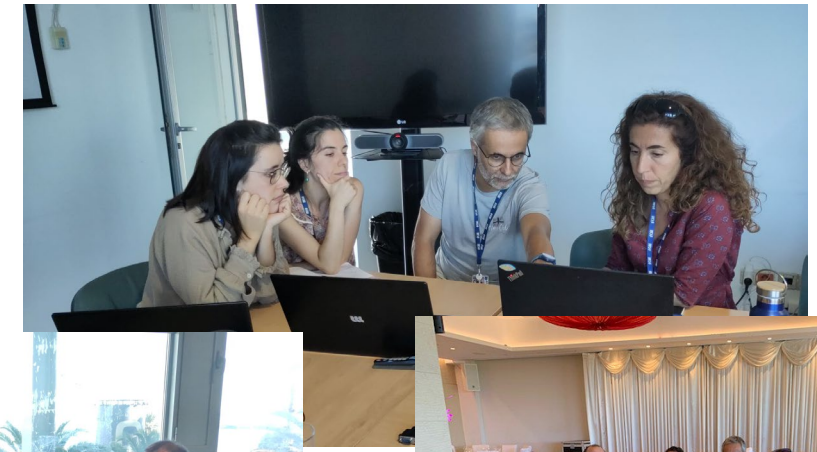
- **Building community**: need to promote collaborative modelling initiatives is essential, also at the ecosystem modelling level




EDITO
European Digital Twin Ocean

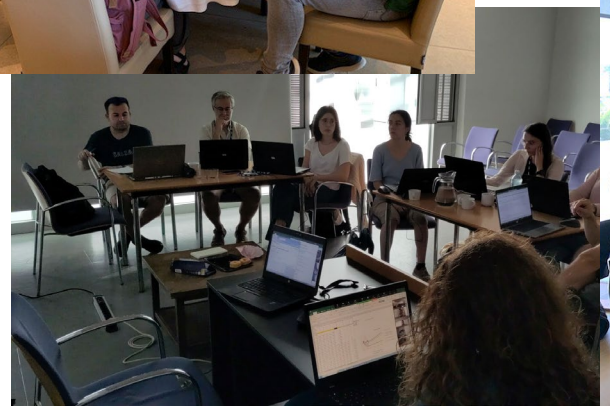
# Thank you!

## Collaborative modelling











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# FutureMARES Science for Policy

## Session 3: Evaluating the Effectiveness of Nature-based Solutions using Climate Risk Assessments




**JUAN BUENO-PARDO (UNIVERISTY OF VIGO):** E OJEA, A RUIZ-FRAU, M MAAR, D KRAUSE-JENSEN,S JERNBERG, M VIITASALO, C DAMBRINE, H CABRAL, M LEPAGE, A DEL CAMPO, J FERNANDEZ, M DOLBETH, I SOUSA PINTO, A RUIZ-FRAU, J TERRADOS, I CATALÁN, A DOXA, S KATSANEVAKIS, E CHATZINIKOLAOU, C PAVLOUDI, F BULLERI, L MILLÁN, J GARRABOU, L SONEIRA, M COLL, A DOXA ,A MAZARIS

TEXEL, 26 JUNE 2024

# KEY PRODUCTS DEVELOPED

## Evaluating the effectiveness of Nature-based Solutions using Climate Risk Assessments

1

Received: 27 July 2023 | Revised: 6 March 2024 | Accepted: 30 March 2024
DOI: 10.1111/gcb.17296

RESEARCH ARTICLE

Global Change Biology WILEY

**Assessing the effectiveness of marine nature-based solutions with climate risk assessments**

Juan Bueno-Pardo[1] | Ana Ruiz-Frau[2] | Clement Garcia[3] | Elena Ojea[1]

2

**Nature-based Solutions Climate risk tool**



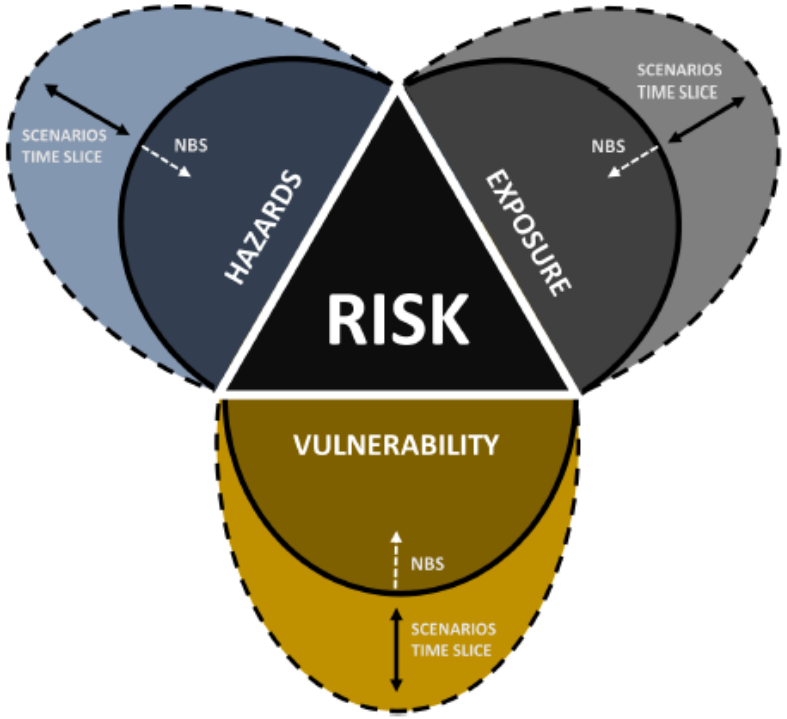

# A NOVEL METHODOLOGY FOR NBS EFFECTIVENESS

- Our methodology measures the **effectiveness of NBS** considering their capacity to reduce climate risks.
- The method uses both expert elicitation processes and projections data from physical models
- We compare the risk estimated when the NBS is applied (**NBS ON**) and when it is not (**NBS OFF**) with **expert-based** risk assessments.

$$\textbf{NBS effectiveness} = \textbf{RISK}_{\textbf{NBS OFF}} - \textbf{RISK}_{\textbf{NBS ON}}$$

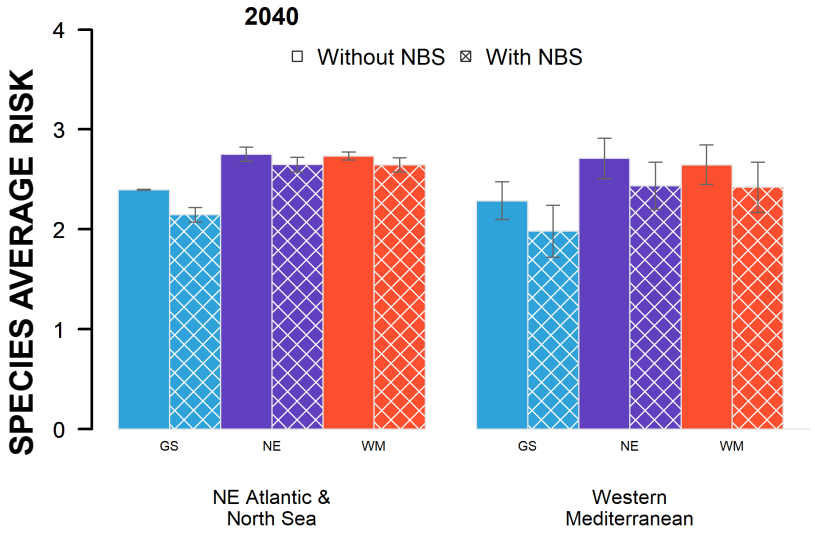
**POLICY versatility** and **applicability**:

- ✓ To different types of marine Nature-based solutions
- ✓ To different units of analysis: a given species, a given social group
- ✓ Under different future scenarios (e.g., RCP's, SSP's)

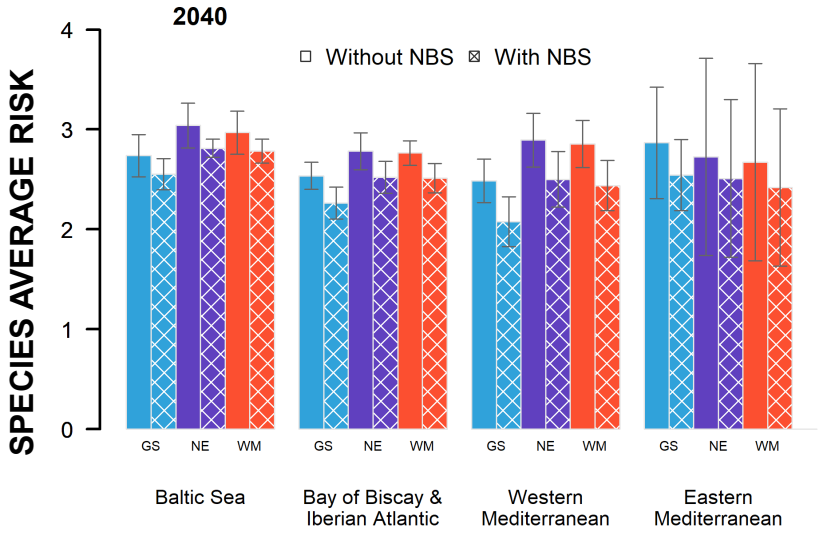



# RESULTS FROM THE APPLICATION OF THE METHOD

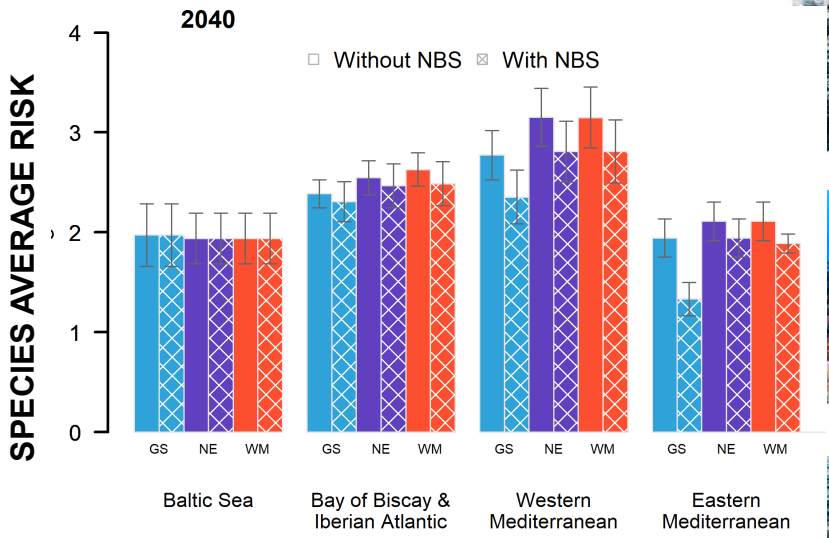
## RESTORATION




## CONSERVATION



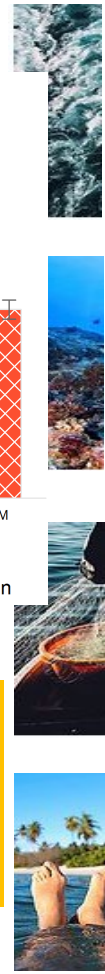

## NATURE-INCLUSIVE HARVESTING




**Restoration decrease capacity is similar across the regions tested**
**The effectiveness of restoration might decrease under the NE and WM scenarios.**

**Conservation decrease capacity is higher at the Western Mediterranean.**
**The scenarios tested had no clear effect geographically.**

**NIH effectiveness was very low at the Baltic Sea. In other regions it was especially low under NE and WM scenarios.**



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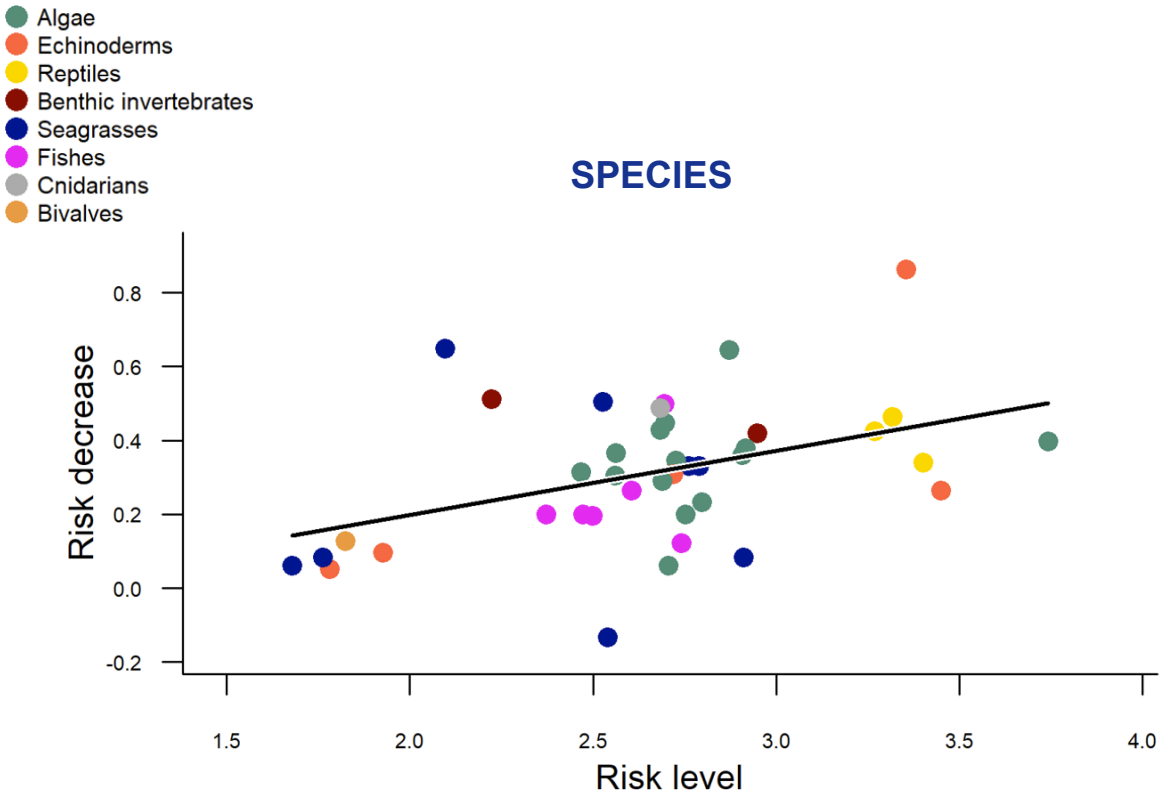
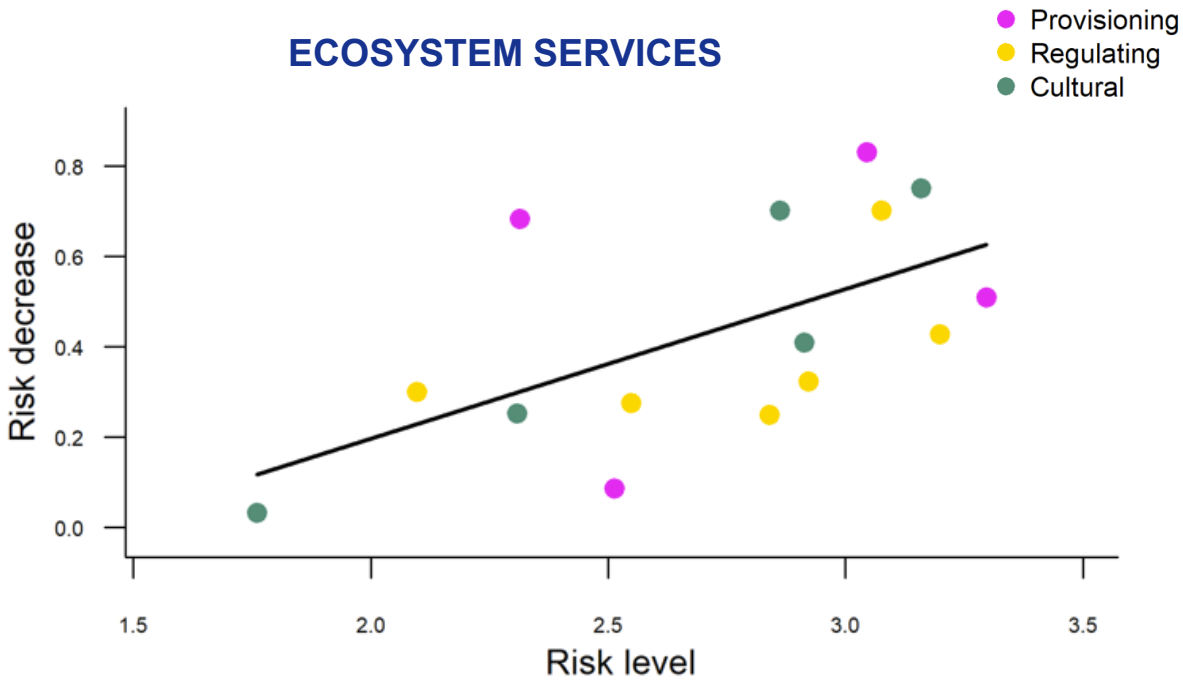
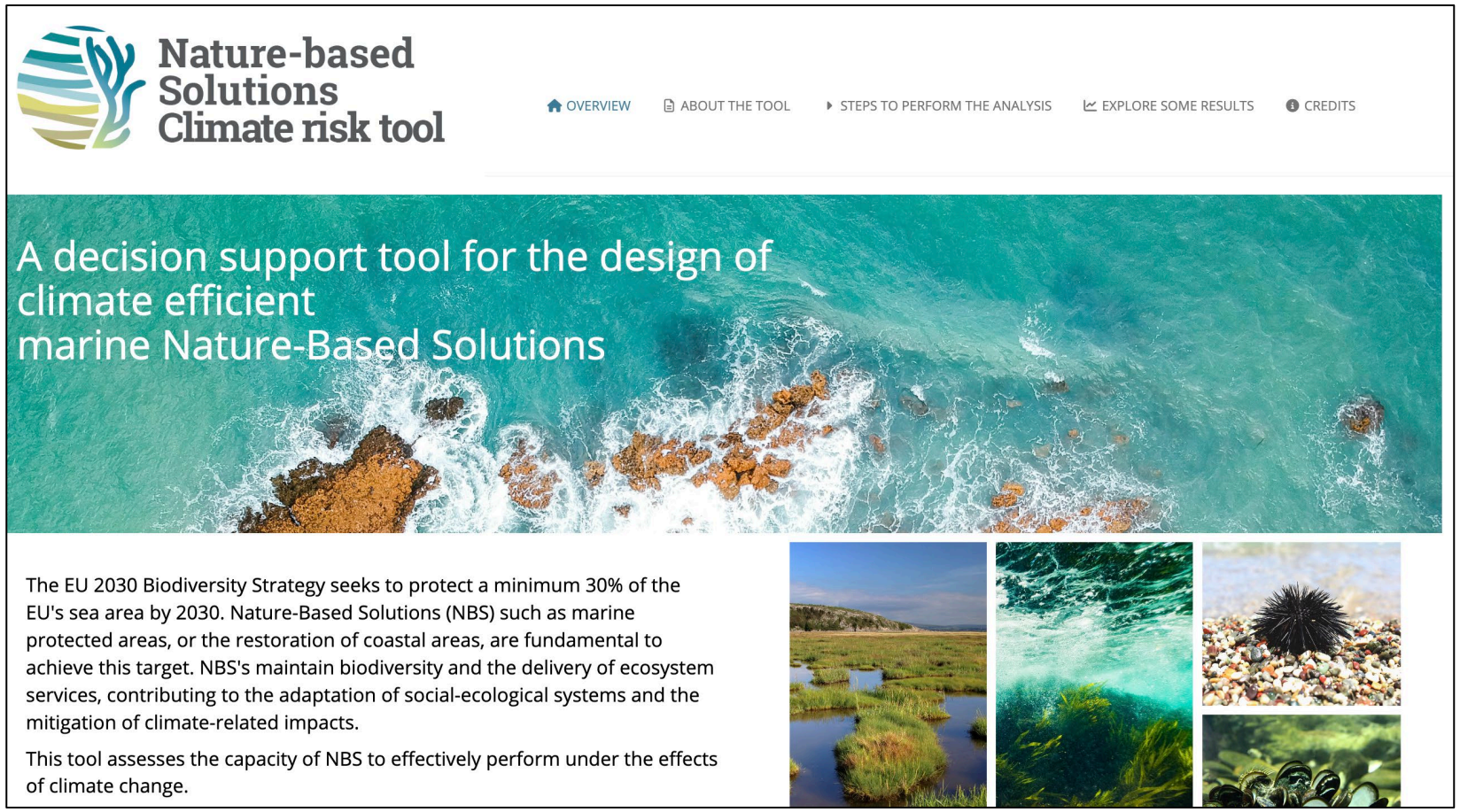



**NBS conservation is more effective for the species and ecosystem services more at risk.**

# 2 NATURE-BASED SOLUTIONS CLIMATE RISK TOOL




Online toolkit with:




2

# 2 NATURE-BASED SOLUTIONS CLIMATE RISK TOOL

Nature-based Solutions Climate risk tool

OVERVIEW | ABOUT THE TOOL | STEPS TO PERFORM THE ANALYSIS | EXPLORE SOME RESULTS | CREDITS

Step 1: Implementation plan | Step 2: Expert elicitation | Step 3: Calculate indicators & confidence | Step 4: Compute the risk assessment

Once the opinion of the different experts is gathered, it is time to put them together and calculate the value of the indicators of the risk assessment (Fig. 3).

The Indicator-calculator templates are intended to combine the opinion of the different experts, calculate a single value for each indicator and esteimate the confidence (see below).

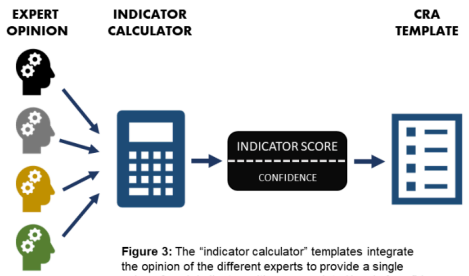



**Figure 3:** The "indicator calculator" templates integrate the opinion of the different experts to provide a single value of each indicator, with an associated level of confidence.

Downloads of calculators for indicators

Indicator calculator - species | Indicator calculator - habitats | Indicator calculator - ecosystem services | Indicator calculator - social actors

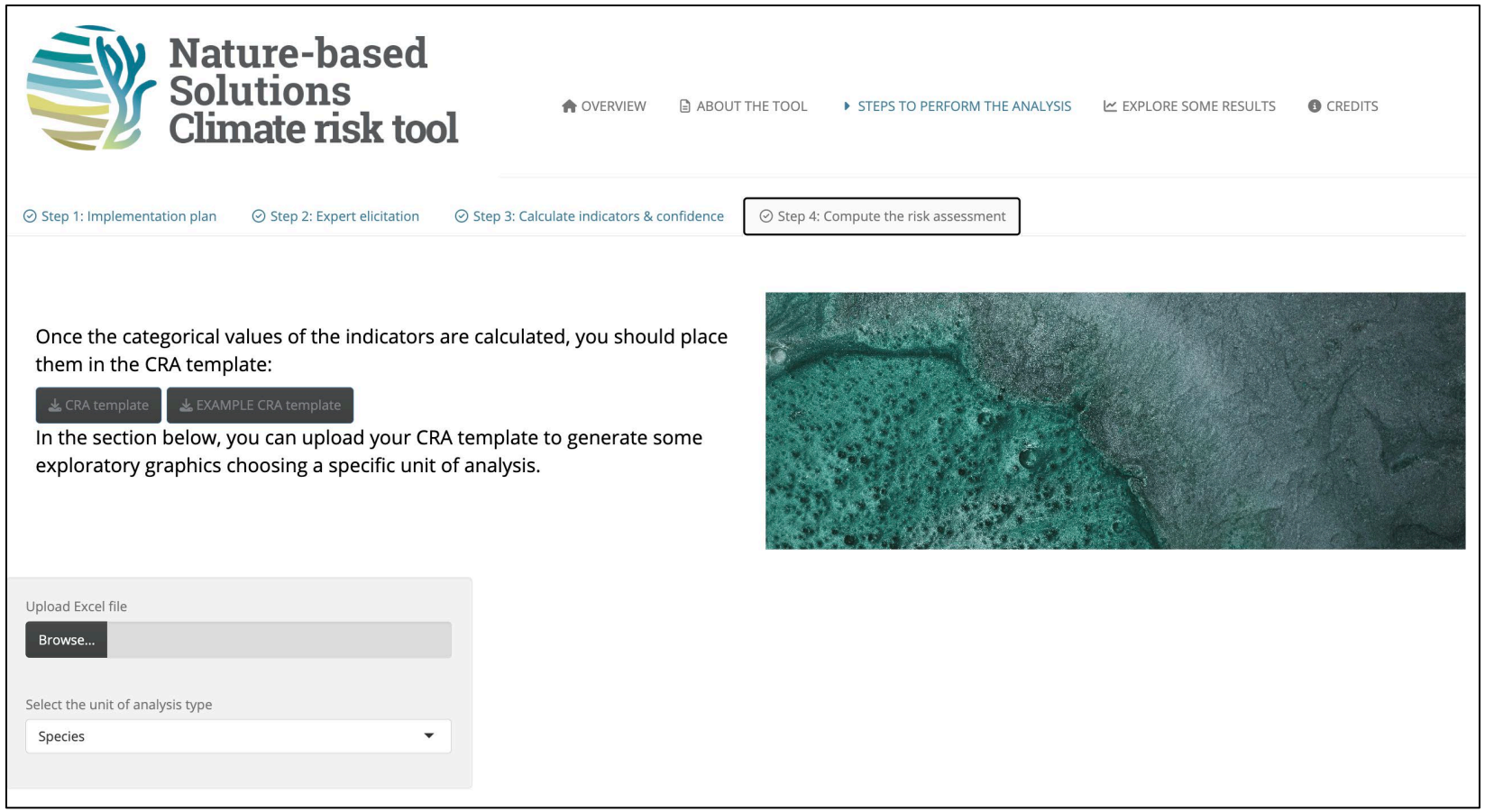
Online toolkit with:

- **Steps to do the analysis**




2

# 2 NATURE-BASED SOLUTIONS CLIMATE RISK TOOL



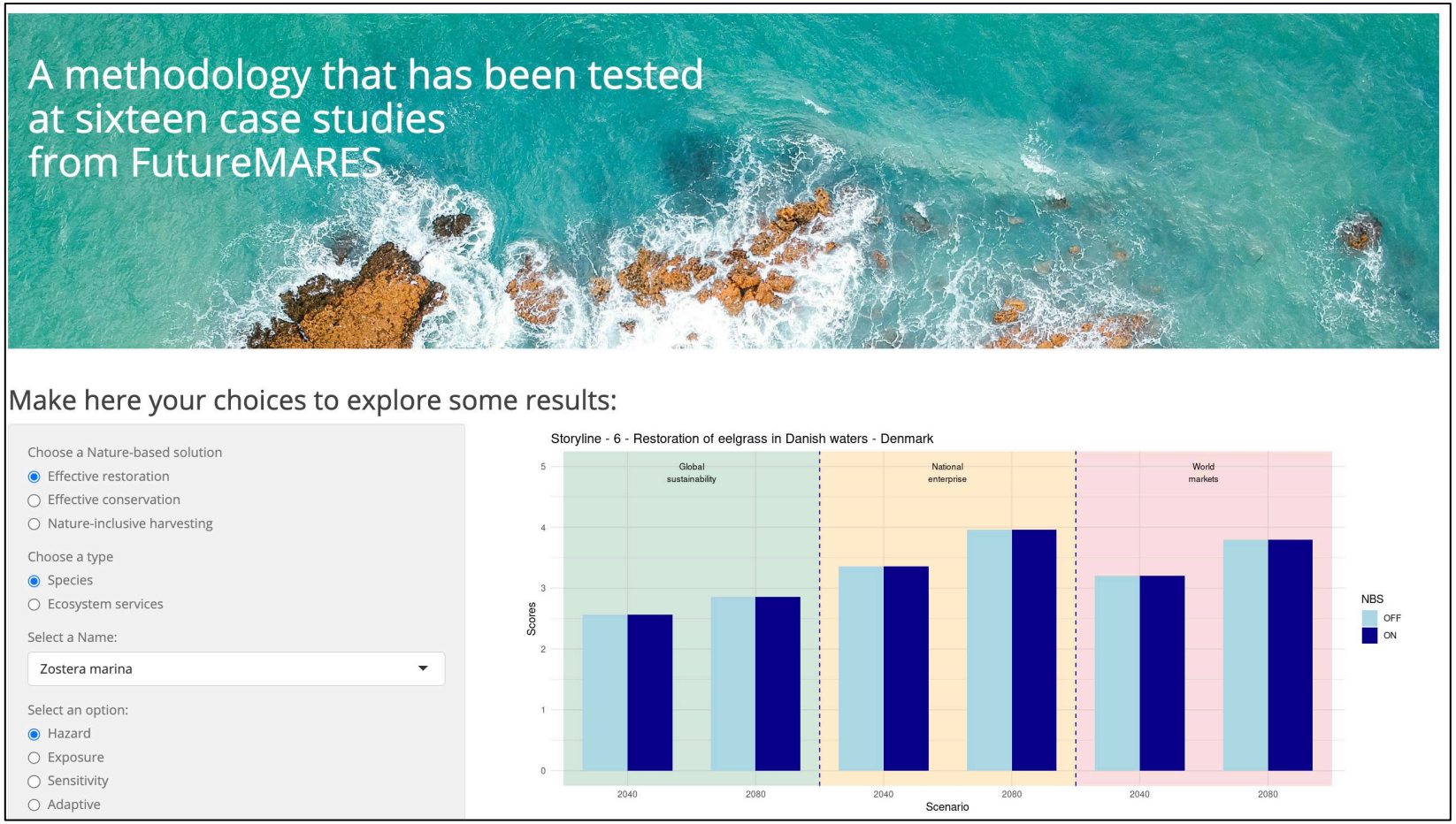

Online toolkit with:

- Steps to do the analysis
- **Automatic calculation with filled templates**




2

# 2 NATURE-BASED SOLUTIONS CLIMATE RISK TOOL




Online toolkit with:

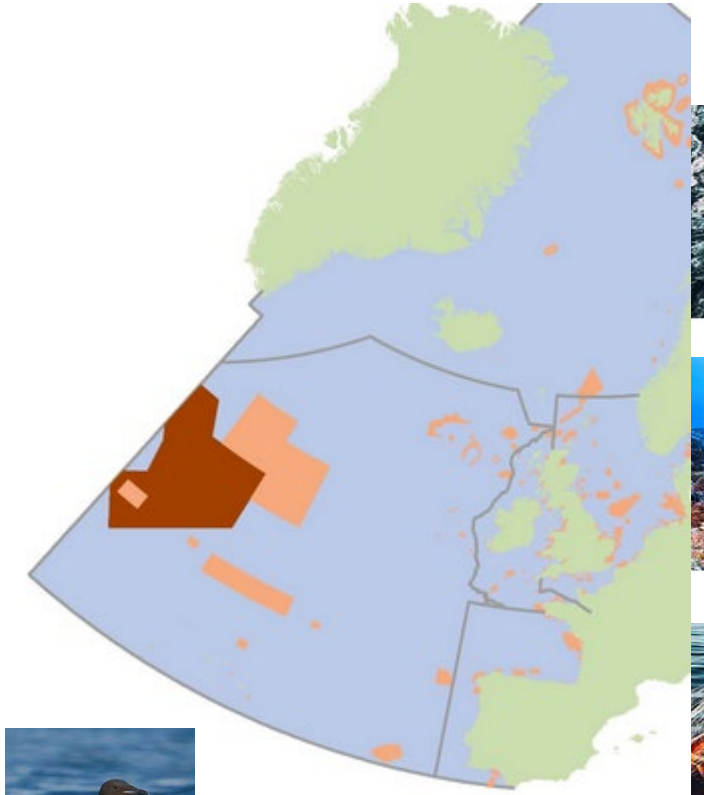
- Steps to do the analysis
- Automatic calculation with filled templates
- **Exploration of FutureMARES results**



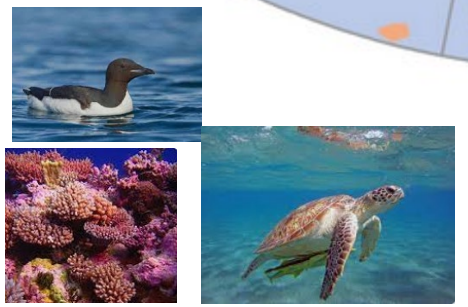

2

# OPPORTUNITIES FOR THE FUTURE

- Climate risk assessments are being applied **everywhere**. The idea of using them to measure the **effectiveness** of NBSs is new and could take advantage of much of the knowledge that is being produced.
- **Unifying methodologies** for risk assessments is challenging as dimensions and indicators are interpreted in different ways. We urge to unifying criteria regarding dimensions and indicators of risk.
- **Call for Knowledge [Norwegian Environment Agency]:** The method was presented and applied at the **NACES High Seas MPA** proposed by the OSPAR (Area Beyond National Jurisdiction).
- Promote the **use of the NBS Climate Risk Tool** and its accessibility from EU portals and other platforms for its broader use



Nature-based Solutions Climate risk tool



# KEY PRODUCTS DEVELOPED

## Evaluating the effectiveness of Nature-based Solutions using Climate Risk Assessments

1

Received: 27 July 2023 | Revised: 6 March 2024 | Accepted: 30 March 2024
DOI: 10.1111/gcb.17296

RESEARCH ARTICLE

Global Change Biology WILEY

**Assessing the effectiveness of marine nature-based solutions with climate risk assessments**

Juan Bueno-Pardo[1] | Ana Ruiz-Frau[2] | Clement Garcia[3] | Elena Ojea[1]

2

**Nature-based Solutions Climate risk tool**




# Thank you for your attention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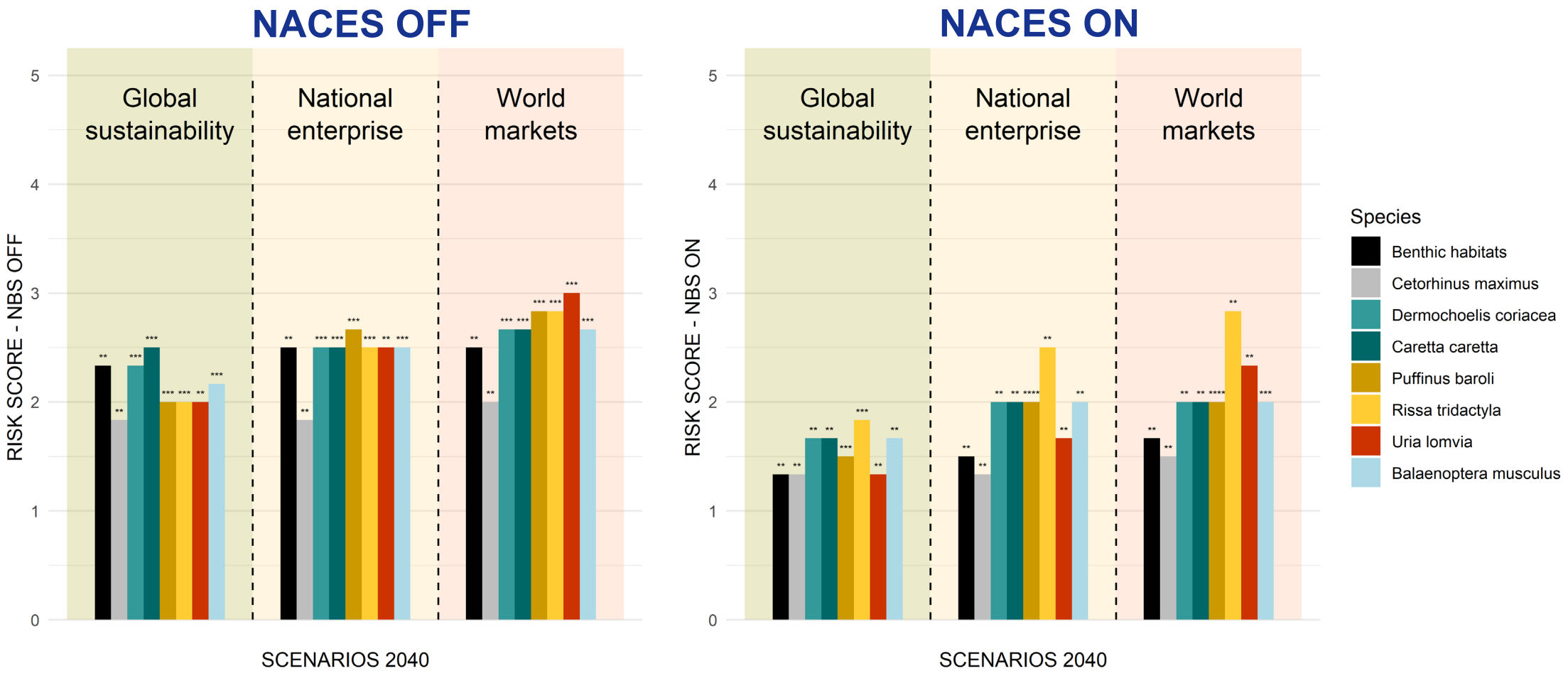
# Supplementary material




# FutureMARES Science for Policy

## Session 3: Ecosystem Service Valuation for NBS Assessment




**SARAH SIMONS (THÜNEN INSTITUTE FOR SEA FISHERIES):**
C DEVRIES, P KAMERMANS, A MURILLAS, F BULLERI, F VISINTIN, A DI CINTIO, C RAVAGLIOLI, F NICCOLINI, V STAMATIADOU, W CHEN, T KRISTIANSEN, K KVISLE, J LIU, A MERLINE, R BELLERBY, E SULANKE , E DELPIAZZO, G STANDARDI, F BOSELLO, R KEY

TEXEL, 26 JUNE 2024

# ES valuation for Marine Protected Areas (MPAs)

Tuscan Archipelago


Aegean Sea


1. **Benefits of MPA**:
   - **Ecosystem Services**:
     - conservation of critical habitats essential for ES (nursery provisioning, carbon sequestration, and recreational activities).
   - **Economic Impact**:
     - benefits through activities like diving, tourism, and sustainable resource use, contributing to local economies and livelihoods.
   - **Climate Change Mitigation**: preserving biodiversity and sustaining ES provision.
2. **Costs of MPA**:
   - **Management Costs**: enforcement, monitoring, research, and stakeholder engagement.
   - **Opportunity Costs**: restrict certain activities like fishing or development, leading to potential economic losses for stakeholders in the short term.

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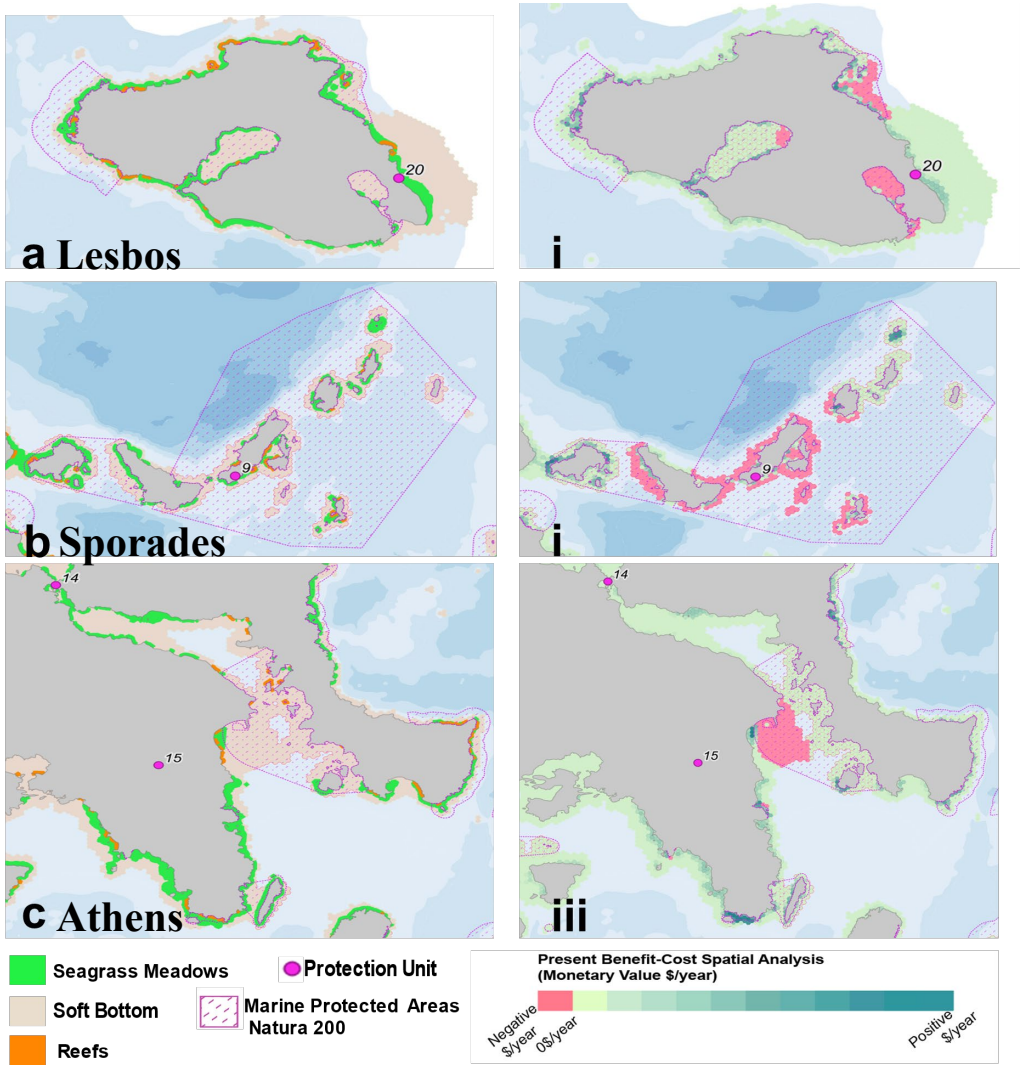
# ES valuation for Marine Protected Areas (MPAs)




**Ecosystem Services Enhancement**:

**Finding**:

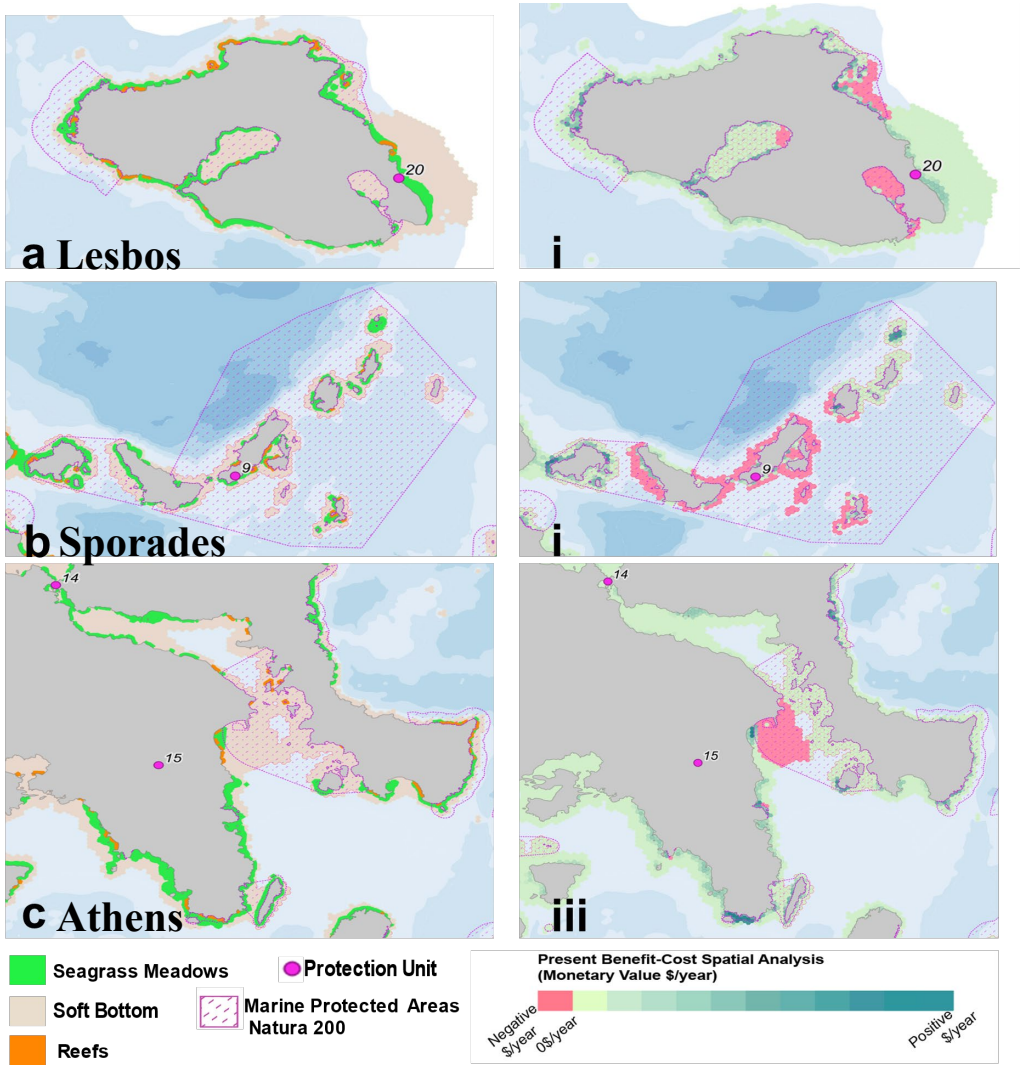
- MPAs significantly enhance the value of ES within their boundaries
- Estimated value of ES within MPAs is $50,543/ha, compared to $8,215/ha outside the MPAs, indicating a 615% increase

**Application**:

- ➢ Advocate for the establishment and expansion of MPAs in areas with high biodiversity and critical habitats
- ➢ This will maximize the provision of valuable ES such as coastal protection, water purification, and recreational opportunities.




# ES valuation for Marine Protected Areas (MPAs)




**Cost-Benefit Analysis for Optimal Spatial Planning**:

**Finding**:

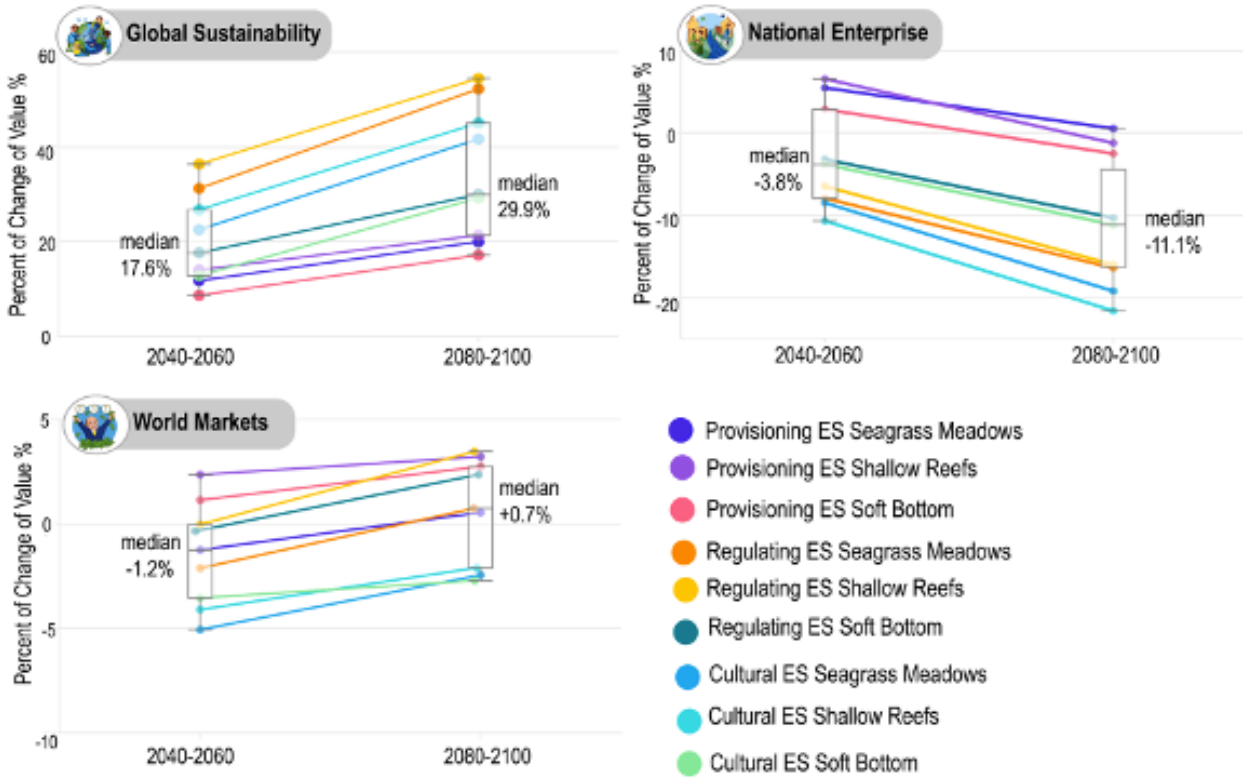
- Predominantly positive values in most areas, indicating that benefits surpassed costs.
- Soft bottom habitats near protected area hubs exhibited negative difference, but show overall positive balance when connectivity among MPAs was considered.

**Application**:

- ➢ Use spatial cost-benefit analysis to identify and prioritize regions for MPA expansion.
- ➢ Emphasis should be placed on areas where ecological benefits and connectivity between MPAs outweigh management costs, ensuring sustainable and economically viable conservation efforts.




# ES valuation for Marine Protected Areas (MPAs)

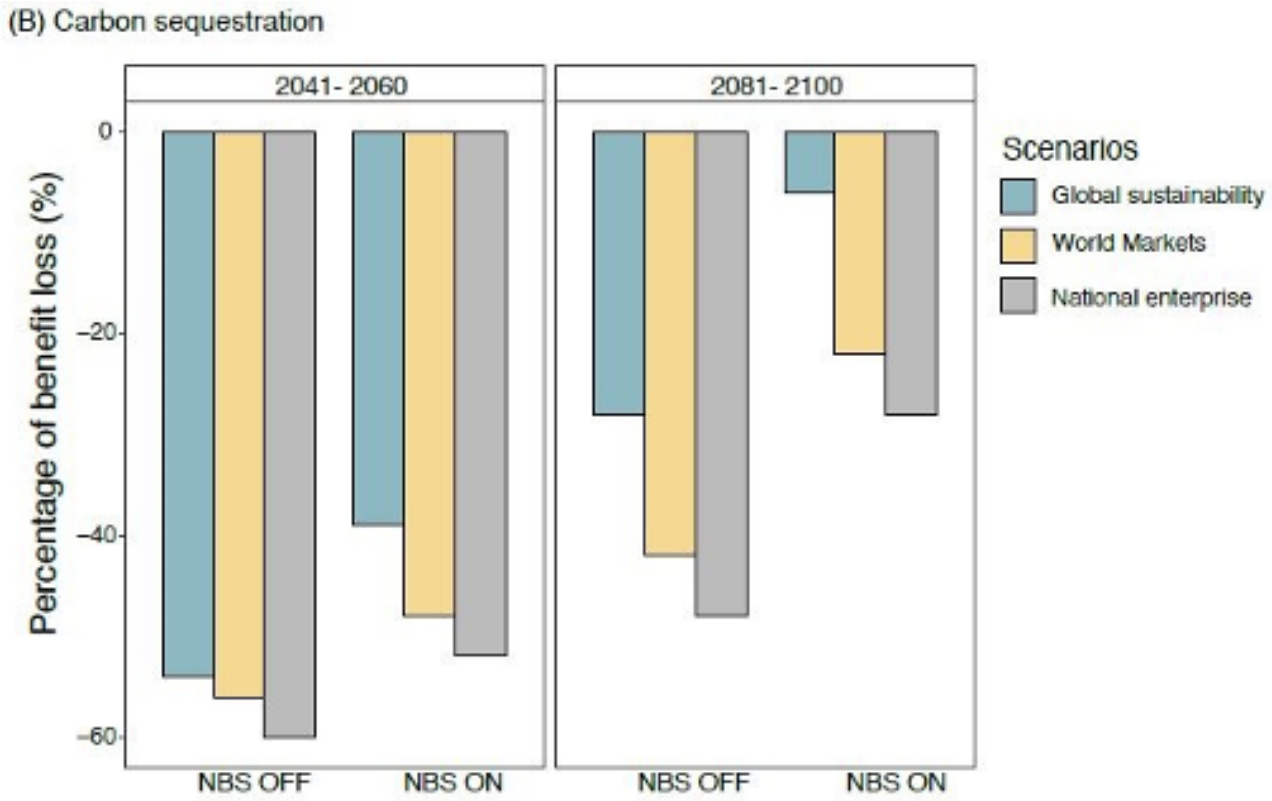



**Climate Change Mitigation and Adaptation**:

**Finding**:

- MPAs play a crucial role in mitigating the impacts of climate change on marine ecosystems.
- Under the Global Sustainability scenario, benefits are highest, and operational costs are lowest per hectare with 30% coverage of MPAs.

# ES valuation for Marine Protected Areas (MPAs)




- MPAs alone might not be sufficient to fully offset the impacts of CC on ES
- EU policies should aim for ambitious targets, such as the 30% MPA coverage under the Global Sustainability scenario.




https://maremmablog.com

# ES valuation for Marine Protected Areas (MPAs)

**Support for Marine Tourism and Local Economies**:

**Finding**:

- The TA and Aegean Sea's MPAs contribute significantly to marine tourism, which supports local economies.
- Recreational activities like diving generate substantial economic benefits.

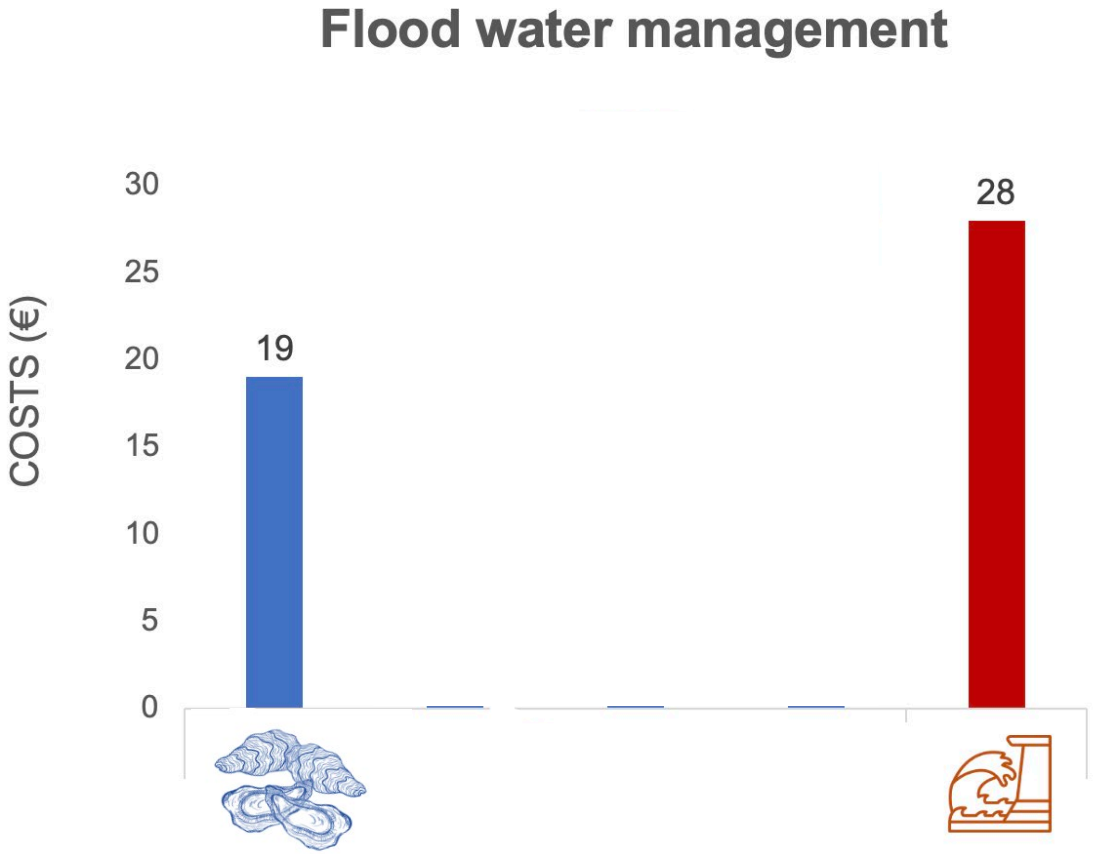
**Application**:

- ➢ Integrate marine tourism development into MPA management plans.
- ➢ By promoting sustainable tourism practices, they can ensure that the economic benefits of tourism are maximized while minimizing environmental impacts.

# ES valuation for Restoration

**Cost-Effectiveness of Oyster Reefs**
**versus**
**Man-made Solutions**

# ES valuation for Restoration



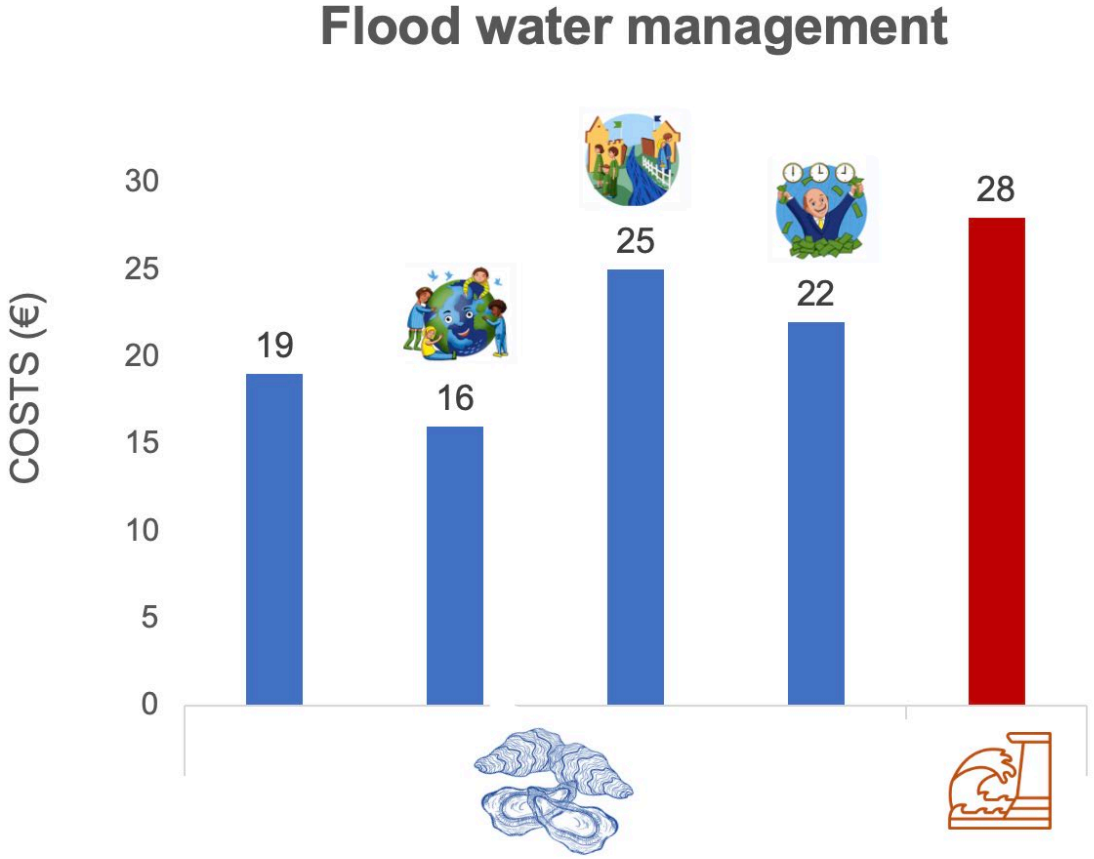

**Cost-Effectiveness of Oyster Reefs vs. Man-made Solutions**

**Key Findings:**

- Oyster reefs are more cost-effective for flood management.
- Long-term benefits of oyster reefs outweigh initial high costs.




# ES valuation for Restoration

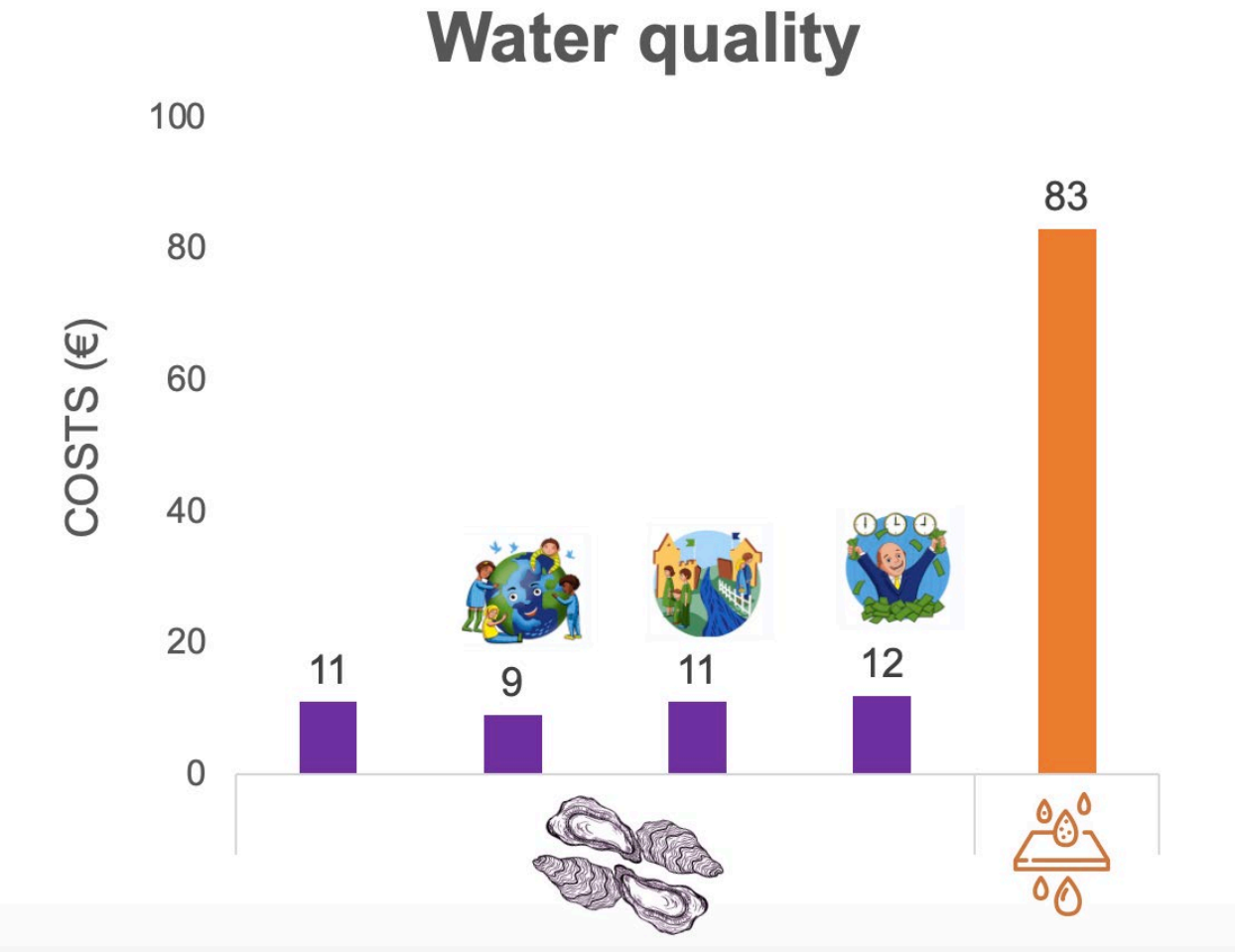



**Cost-Effectiveness of Oyster Reefs vs. Man-made Solutions**

**Key Findings:**

- Oyster reefs are more cost-effective for flood management.
- Long-term benefits of oyster reefs outweigh initial high costs.
- Consistent performance across climate scenarios.

# ES valuation for Restoration




**Improved Water Quality**:

**Key Finding**:

- contribute to water quality improvement through natural filtration, reducing nitrogen levels and turbidity.

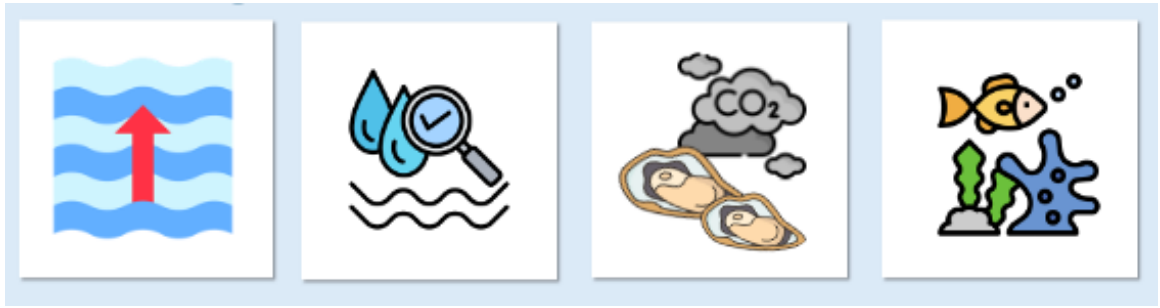



# ES valuation for Restoration

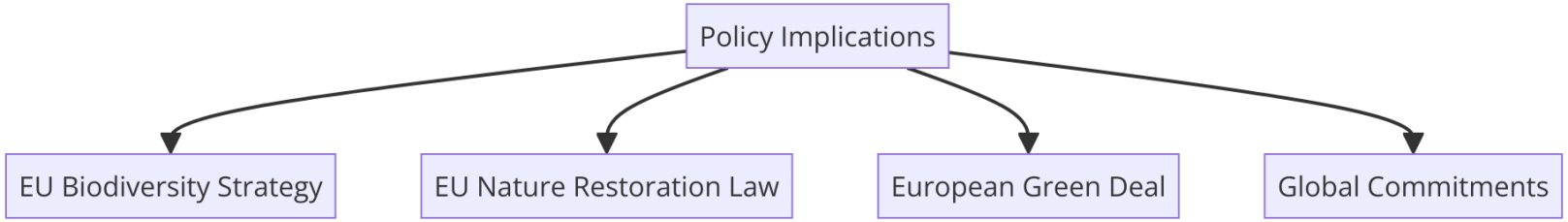
**Enhanced Coastal Protection**:

**Application**:

- promote oyster reef restoration as a cost-effective alternative to traditional man-made coastal defenses, such as seawalls and breakwaters.
- this approach not only enhances coastal protection but also supports biodiversity and ecosystem health.




# ES valuation for Restoration




**EU Nature Restoration Law:**

- Providing **evidence on the effectiveness of NBS** in restoring marine habitats and improving ecosystem services. This can guide the implementation of restoration targets set by the law.

**EU Blue Growth Strategy:**

- The **economic benefits of NBS align with the Blue Growth Strategy**, which seeks to promote sustainable growth in the marine and maritime sectors. Restoration can **enhance sustainable fisheries, tourism, and other blue economy activities** .

**Application:**

- **Policy Development and Investment:** Policymakers can use these results to **prioritize investments** in NBS, demonstrating their long-term economic viability and environmental benefits.
- **Regional Adaptation Plans:** The detailed scenario analyses provide valuable insights for developing regional adaptation plans that incorporate NBS**, tailored to specific local conditions** and challenges. This supports adaptive management strategies in response to climate change .




# Dissemination

***FutureMARES featured in German TV production***

**FutureMARES** was featured in the **German TV** channel Swr3. **Brenda Walles** and **Pauline Kamermans** (Wageningen University & Research) were interviewed about the relevance of **oyster reefs** as indicators of **marine biodiversity development**, along with students doing field work in the **tidal flats**. The short documentary inquired about "**How does the EU support biodiversity conservation**?" Watch the full video here.

- Peer-reviewed **publications**
- **Interviews** with 3 Managers of Marine Protected Areas in Greece (Alonissos, Zakynthos, Kefalonia)
- Interactions with Natural Environment and Climate Change Agency Greece (NECCA), eg support activities for the designation of new MPAs, participation in **workshops** and **trainings**.
- Presentations in 4 meetings organized by NECCA (in Zakynthos, Kefalonia and Ithaka) presenting progress and outputs of FUMA.
- Became partners in LIFE MareNatura a flagship project for MPAs in Greece with NECCA having a key role in it.

- Interview passed on regional **TV** (TV Toscana) on the 21/05/2024
- Participation to the public event: Oceans on fire. Museo di Storia Naturale di Livorno 25/05/2024
- Participation to **public event** at the Acquario di Livorno to present the results of FutureMARES scheduled for the 5/07/2024
- **Interactions with management bodies** of the National Park of the Tuscan Archipelago throughout the duration of the project
- Stakeholder Workshops ( Community of Practice for co_use of the North Sea, shellfish farmers, North Sea days where **researchers, policymakers, practitioners and NGOs**)

# Thanks a lot!

## Ecosystem Service Valuation for NBS Assessment

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