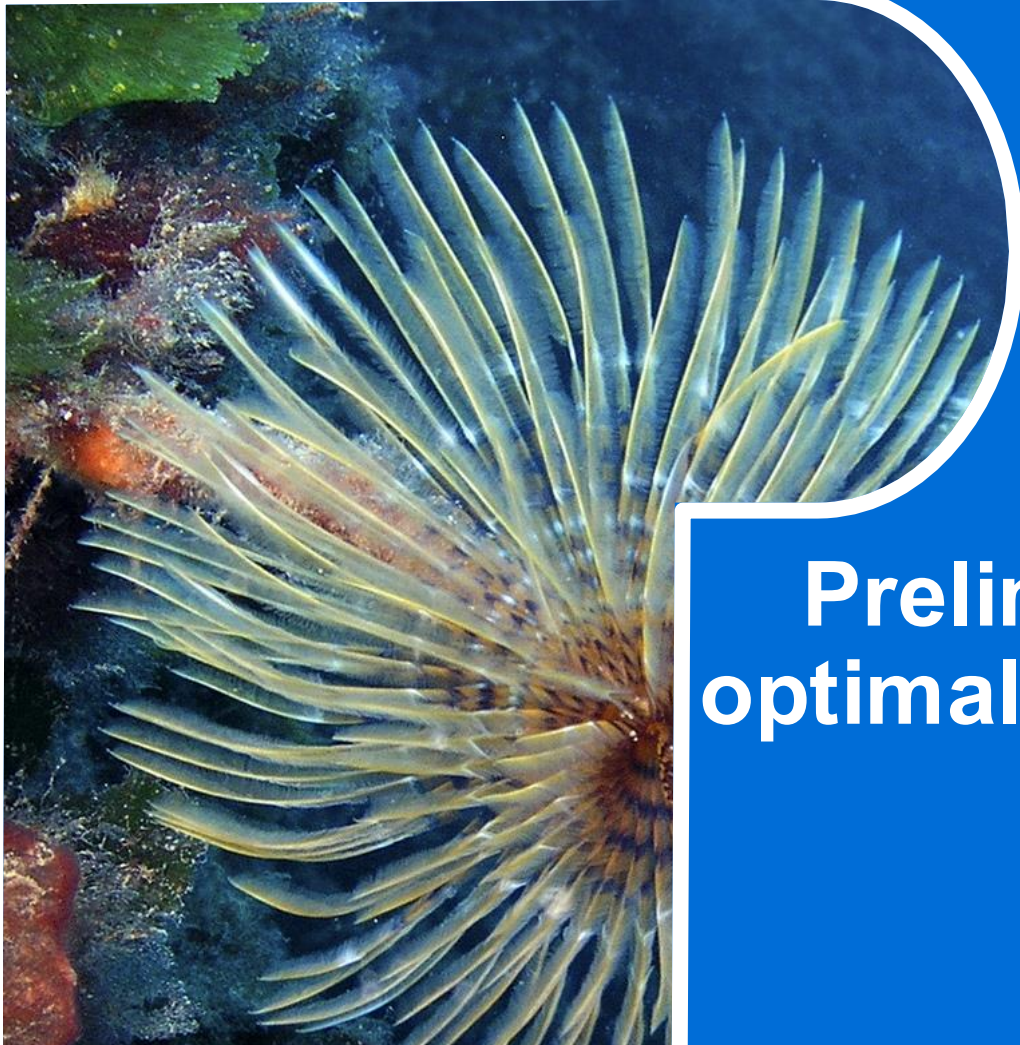




PI: Prof. Mark J. Costello, Nord University (NORD, Norway)

Preliminary prioritisation of spatially optimal places for MPA in European seas

Anna M. Addamo, Nord University

MPA Symposium & North Atlantic Stakeholder Workshop
18 Feb 2025, Copenhagen



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SYSTEMATIC CONSERVATION PLANNING (SCP)

BENEFITS

- **Prevent species extinctions**
- **Protect biodiversity**, including well-known and associated species from data on
 1. Species – richness and composition (endemicity, rare, threatened, habitat-forming)
 2. Habitats and biomes
 3. Ecosystems
- **Design optimal network** protecting more representative biodiversity than random

APPLICATIONS

- **CONSERVATION REPORTING**
(Maps of biologically relevant regions)
- **CONSERVATION PLANNING**
(Priority areas high endemicity and richness)
- **CLIMATE CHANGE PREDICTIONS**
- **INVASIVE SPECIES RISK ASSESSMENT**



Ecological criteria to identify areas for biodiversity conservation
Irawan Asaad ^{a,b,*}, Carolyn J. Lundquist ^{a,c}, Mark V. Erdmann ^d, Mark J. Costello ^a

Designating Spatial Priorities for Marine Biodiversity Conservation in the Coral Triangle

Irawan Asaad ^{1,2,*}, Carolyn J. Lundquist ^{1,3}, Mark V. Erdmann ⁴, Ruben Van Hooidonk ^{5,6} and Mark J. Costello ¹

Delineating priority areas for marine biodiversity conservation in the Coral Triangle

Irawan Asaad ^{a,b,*}, Carolyn J. Lundquist ^{a,c}, Mark V. Erdmann ^d, Mark J. Costello ^a

^a Institute of Marine Science, University of Auckland, Auckland, New Zealand
^b Ministry of Environment and Forestry, Jakarta, Indonesia
^c National Institute of Water & Atmospheric Research, Hamilton, New Zealand
^d Conservation International Asia Pacific Marine Programs, Auckland, New Zealand

8 common criteria & 7 variables
Requires knowledge biogeographic distribution and theory

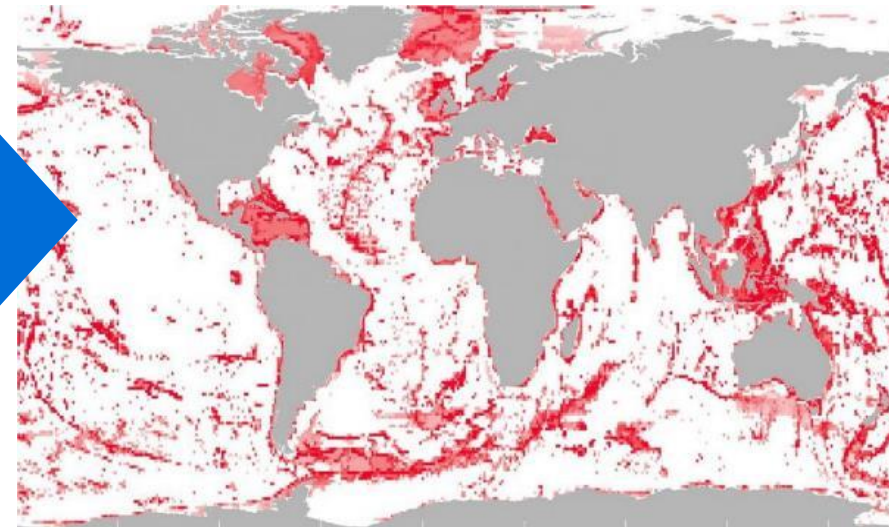
DATA LAYERS

1. Ecosystems (20 environmental variables)
2. Biogeographic realms (endemicity)
3. Species richness (ranges)
4. Biomes (mangrove, coral, seagrass, kelp)
5. Habitat (seabed rugosity)



Where Marine Protected Areas would best represent 30% of ocean biodiversity

Qianshuo Zhao ^a, Fabrice Stephenson ^{a,b}, Carolyn Lundquist ^{a,b}, Kristin Kaschner ^c, Dinusha Jayatilake ^a, Mark J. Costello ^{a,d,e}

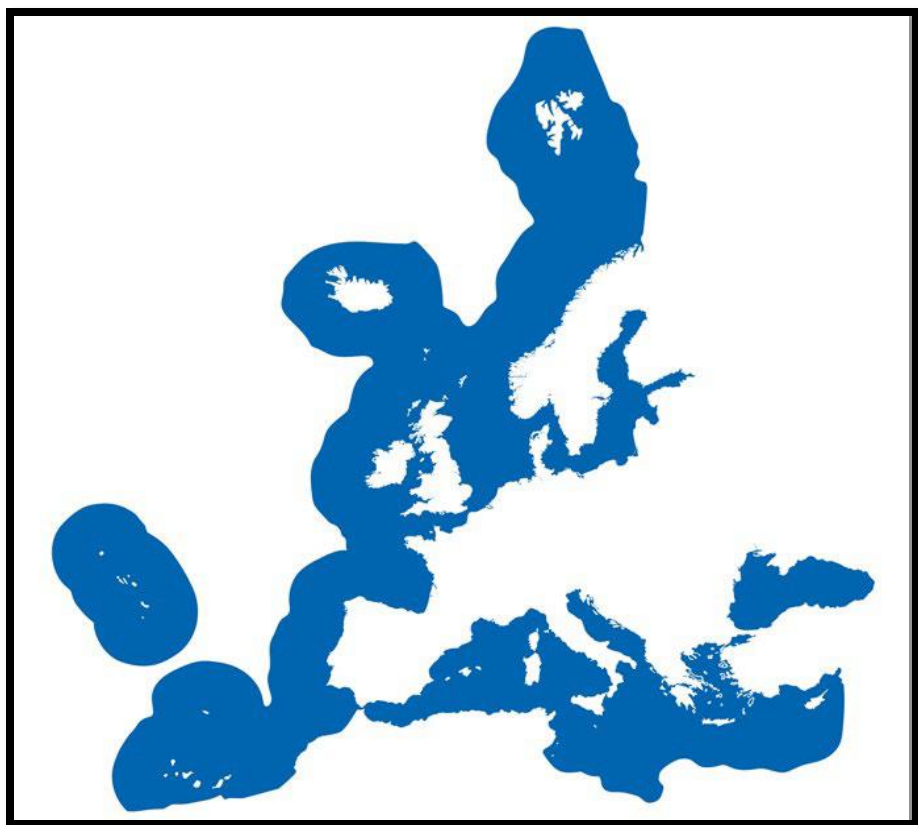


60% biodiversity in 30% ocean
75% biodiversity in 50% of the ocean
90% biomes & habitats
58% Coastal & 42% High Seas

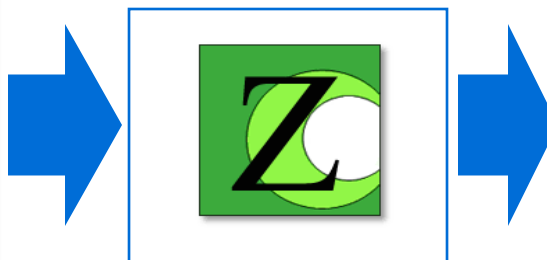
PROJECT APPROACH: SCP

Repeat in Europe with more data and finer spatial resolution ~5 km

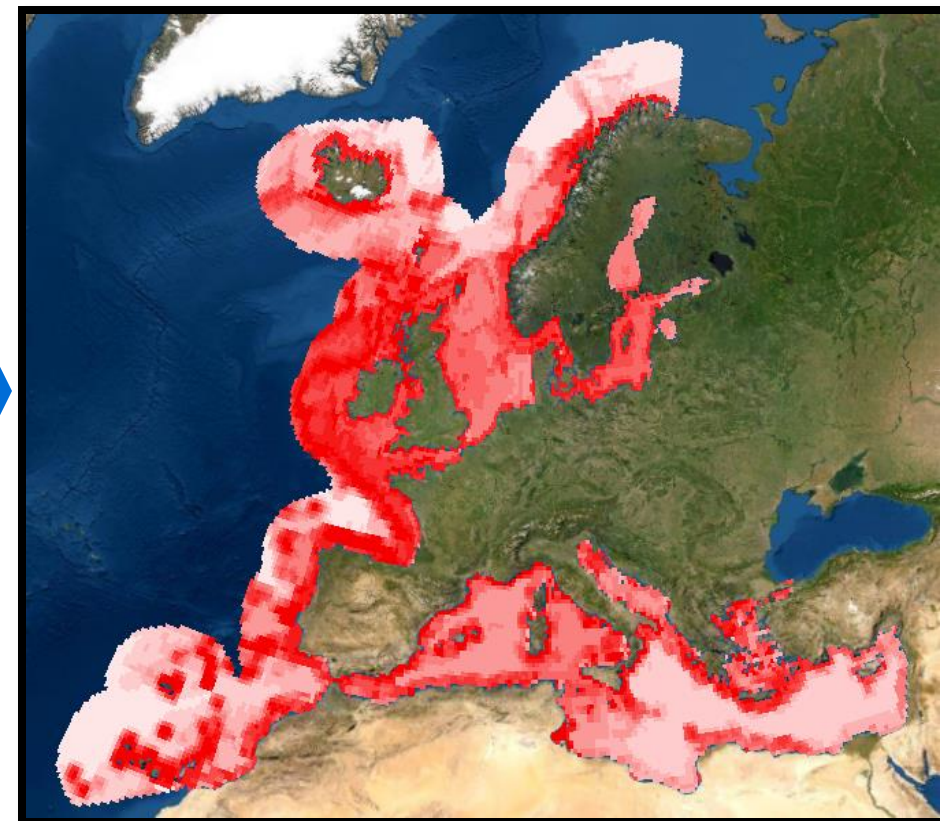
Standardised and
complete data layers



© MPA Europe



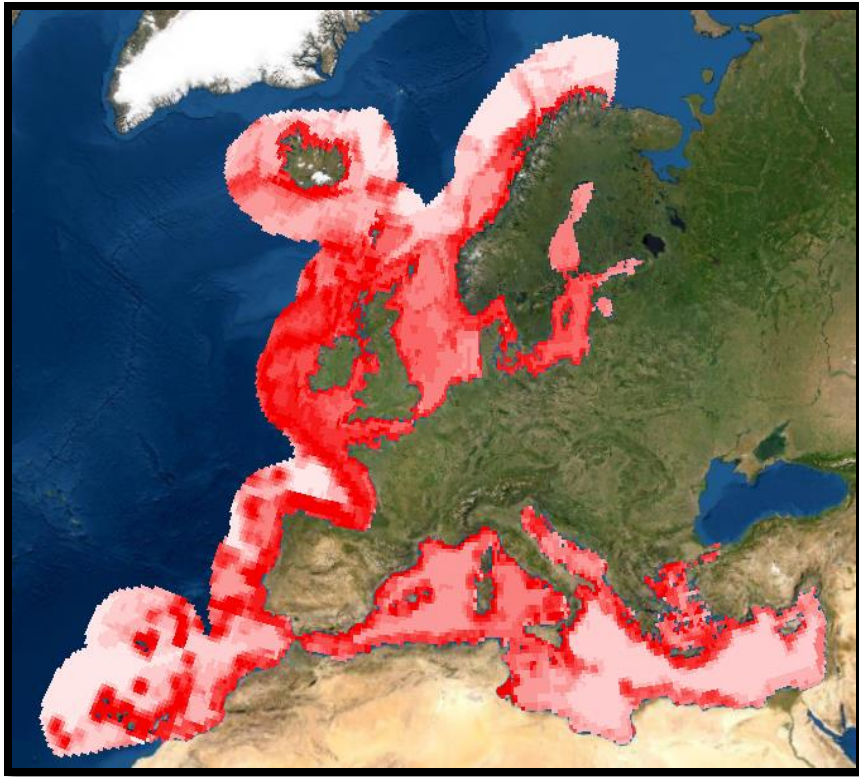
Example of prioritised areas
(**darker red** = **higher** priority)



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PROJECT APPROACH

PRIORITIZATION



MARINE
REGION



COUNTRY
(12NM)

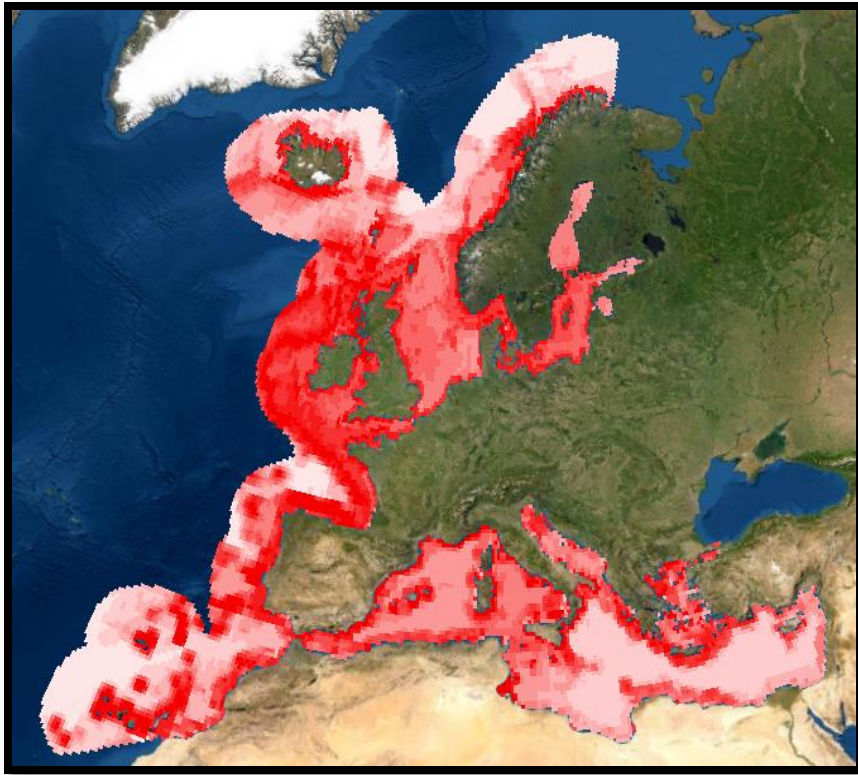


COUNTRY
(EEZ)

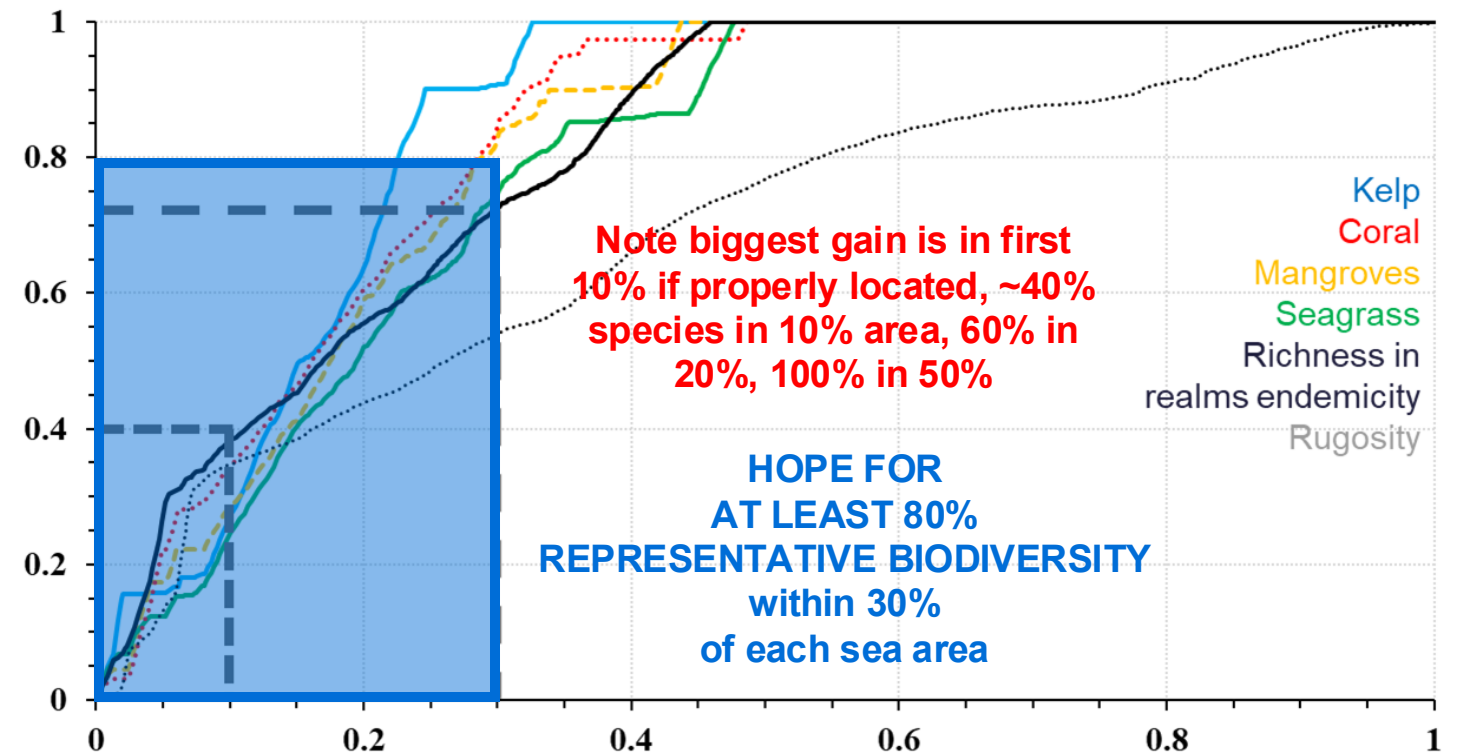


PROJECT APPROACH

PRIORITIZATION

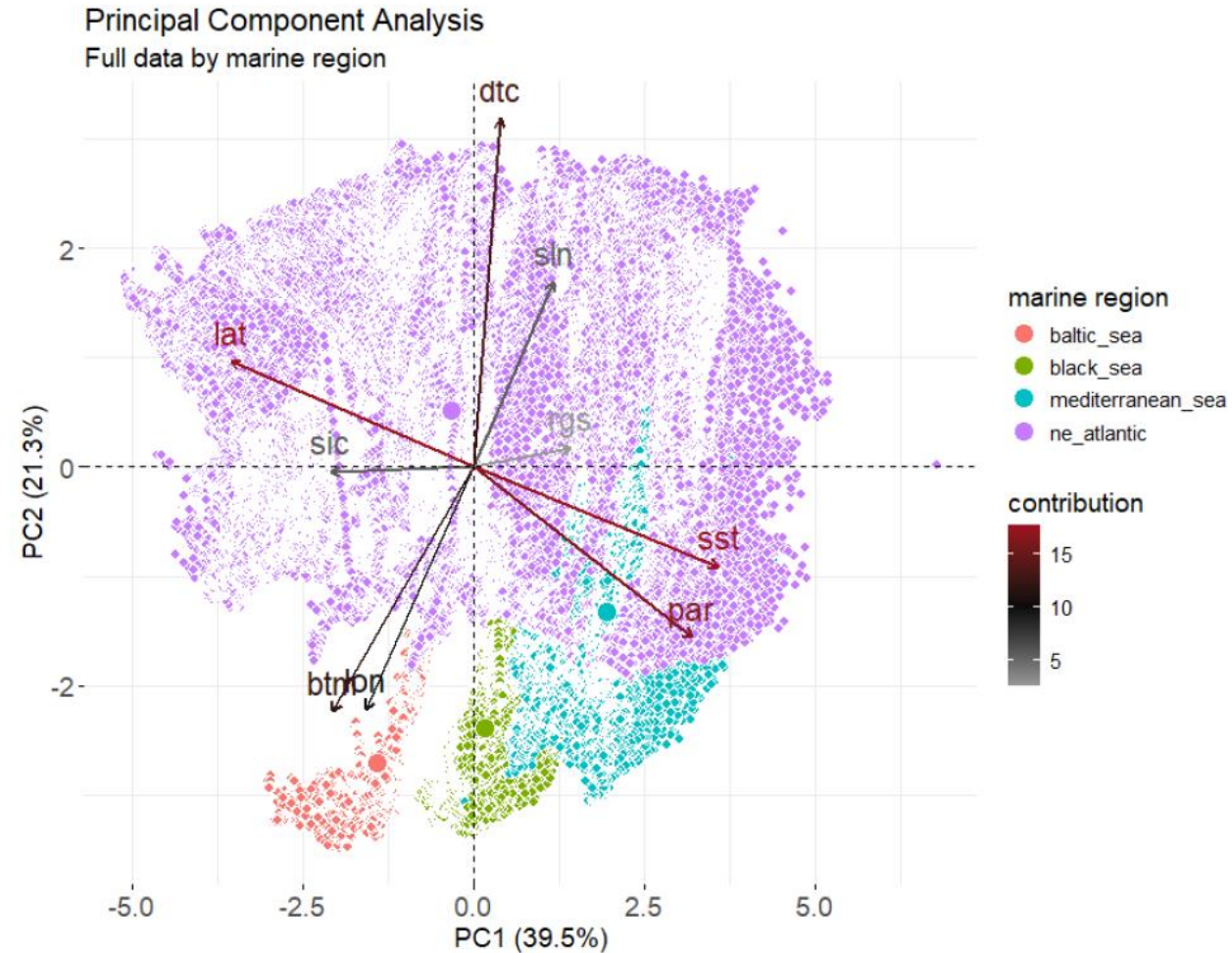
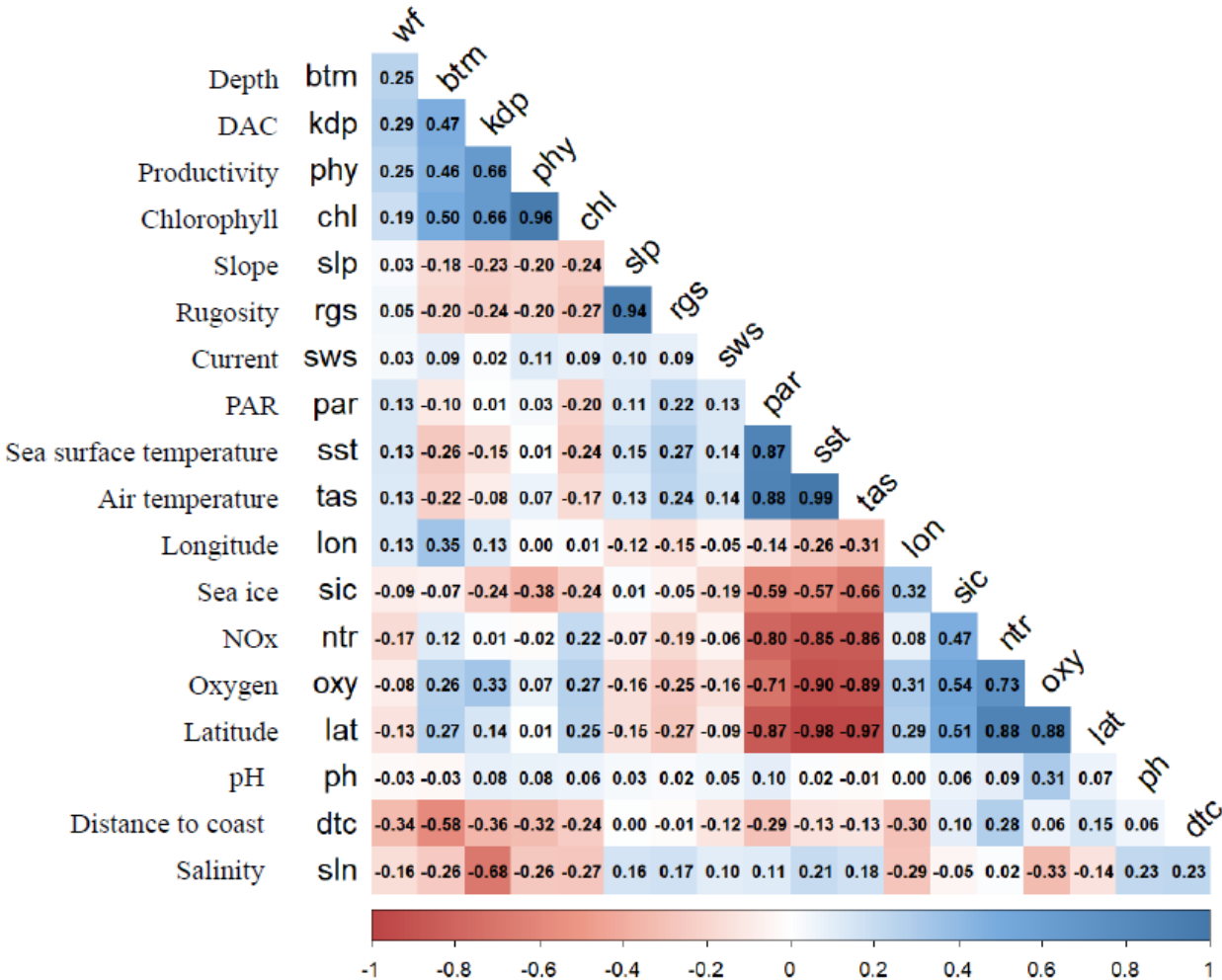


The proportion of **biodiversity** protected

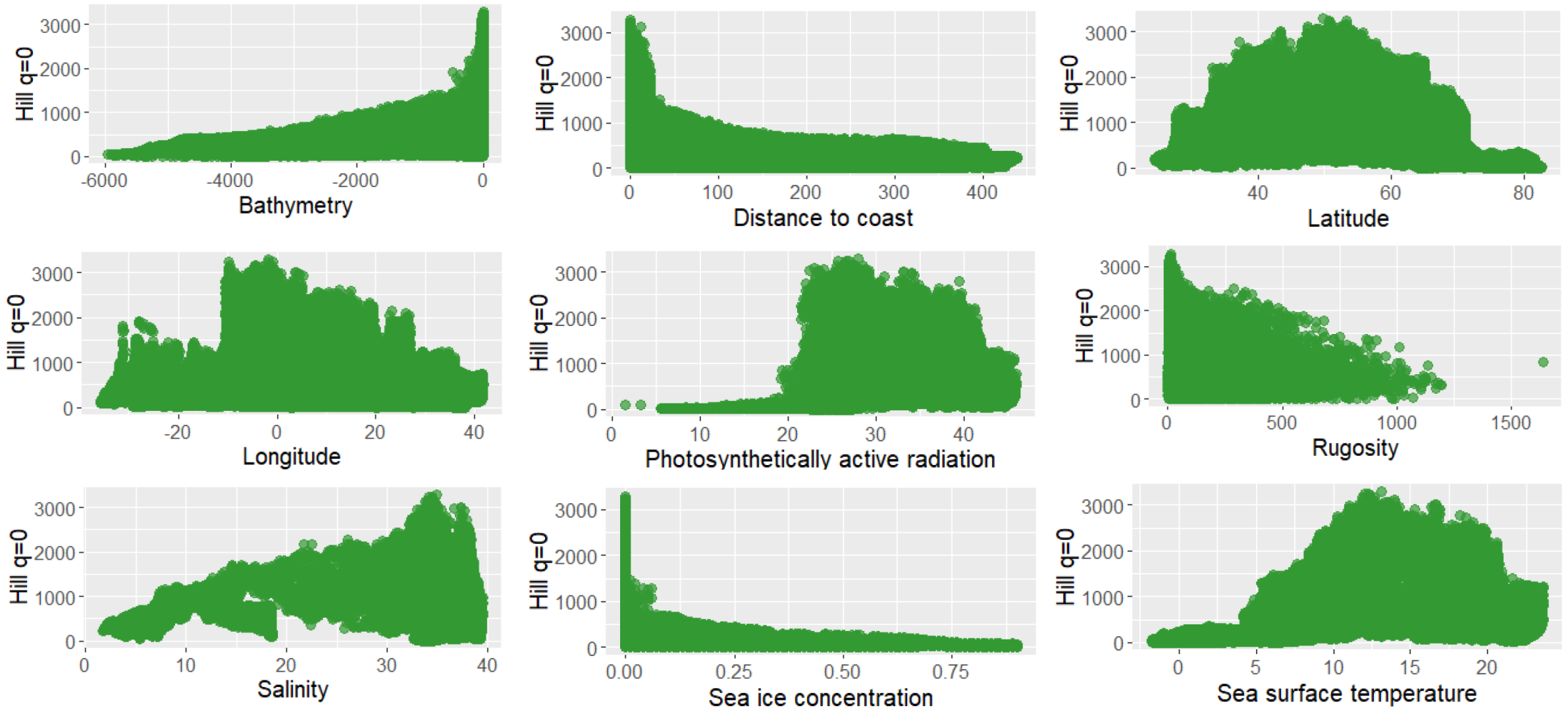


The proportion of **area** protected

Zhao et al 2020

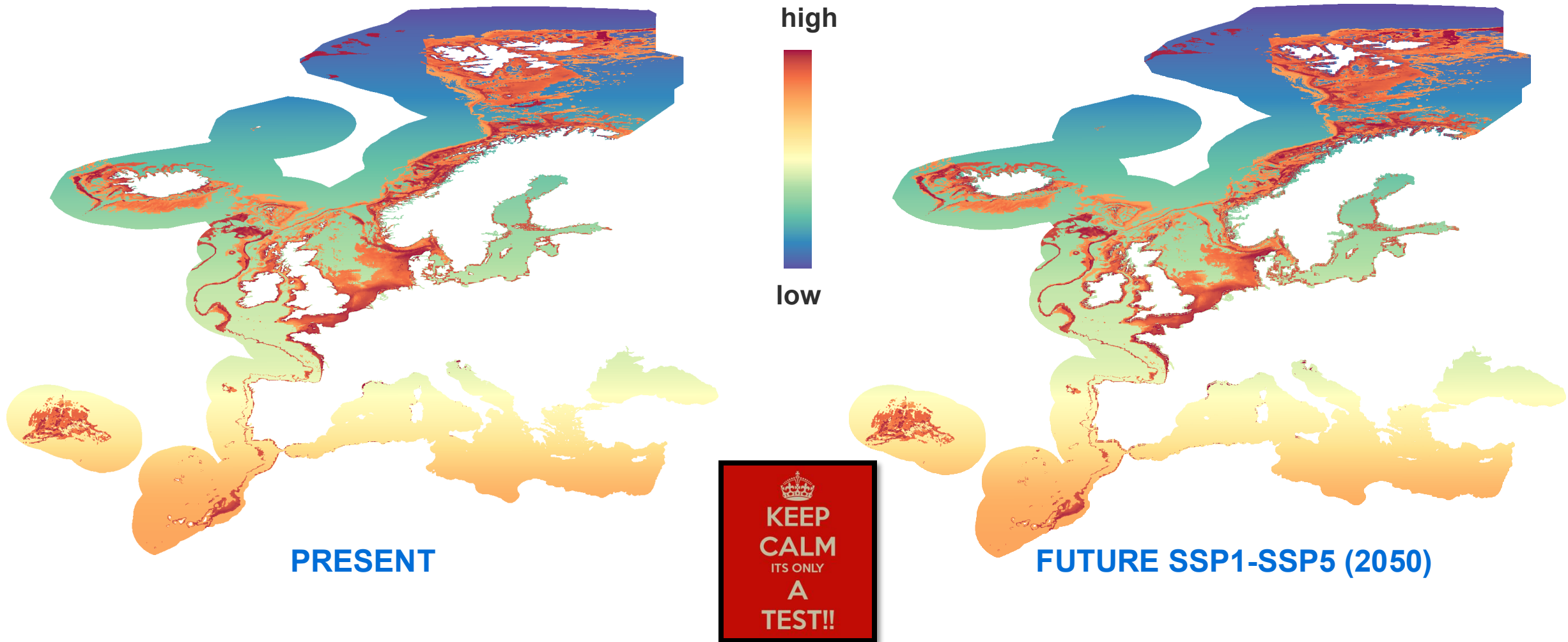


Sea surface temperature (sst) and photosynthetically active radiation (par), and latitude (lat) have a positive and negative relationship to PC1, respectively



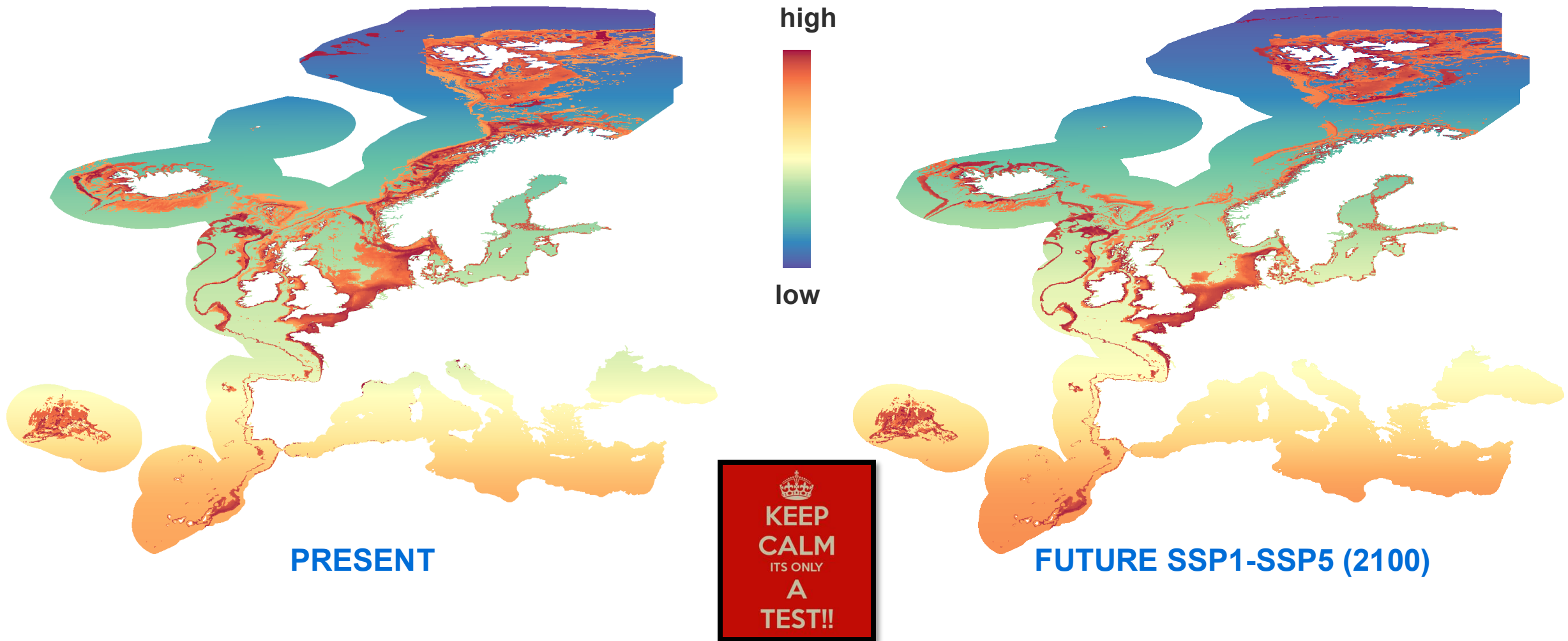
Comparison between diversity metrics Hill $q=0$ (left) and environmental variables

PRIORITISATION BASED ON BIODIVERSITY VARIABLES



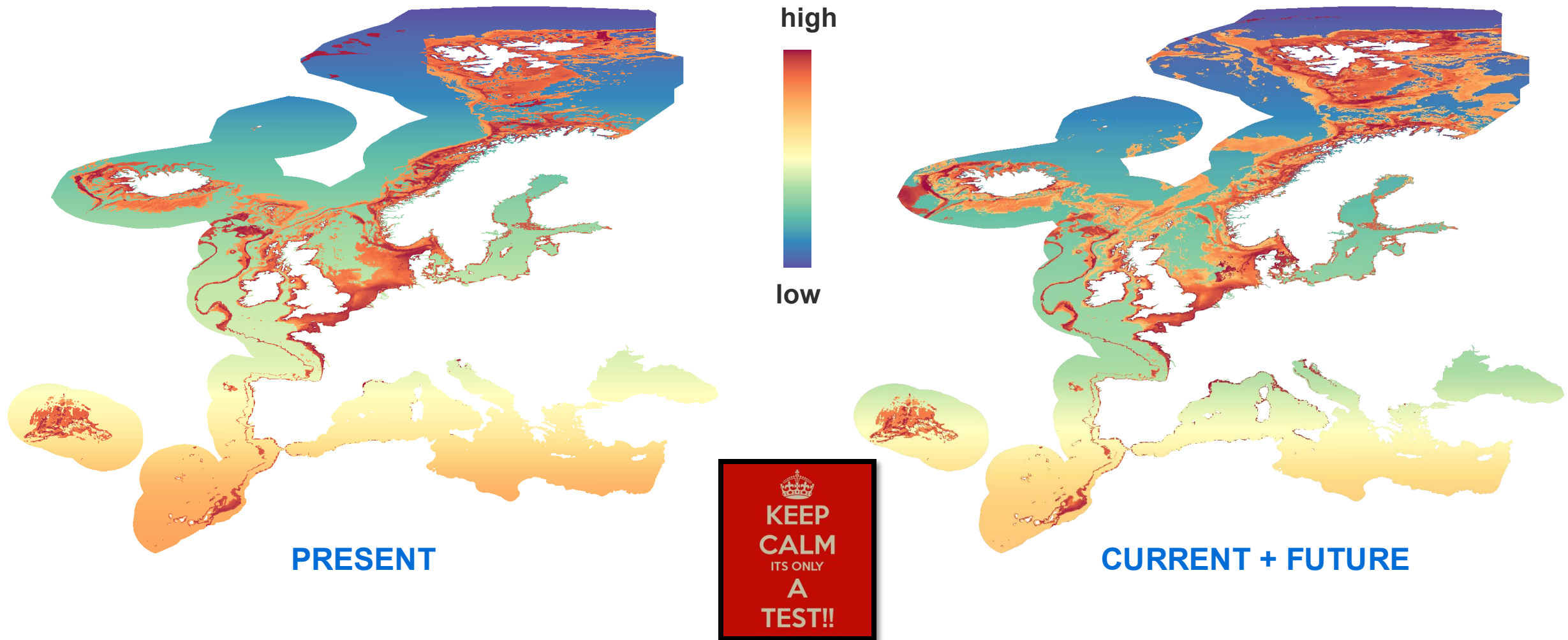
Comparison between current distribution (left) and future projections 2050 (right)

PRIORITISATION BASED ON BIODIVERSITY VARIABLES



Comparison between current distribution (left) and future projections 2100 (right)

PRIORITISATION BASED ON BIODIVERSITY VARIABLES



Comparison between current distribution (left) and potential refugia detections (right)



10 species
6 groups

5 climate change scenarios (SSP1-SSP5)

2 time periods (2050-2010)

Unweighted biodiversity

Weighted biodiversity

Refugia test

NEXT STEPS

1. Results discussion within team

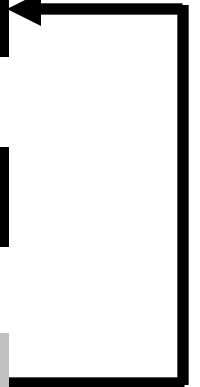


2. Final settings (criteria & layers)



3. Test with 100s species

4. Final runs with 1000s species



THANK YOU

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AREA SELECTION CRITERIA: SPECIES

Variable ~ Asaad et al. 2016	Zhao et al., 2020 & Jefferson et al. 2022	Selig et al., 2014	Visalli et al., 2020, High Seas only	Jones et al., 2020	Sala et al., 2021
Species richness	Species ranges	Species ranges	Species ranges		Species ranges
Number species	24,904	12,497	12,013	22,885	4,242
Restricted range (endemic)	Realms' endemism based on 65,000 species	Range rarity			
Of conservation concern	IUCN Threatened species		Species threatened on IUCN Red List	% species in MPAs, KBAs, wilderness	species affected by threats abatable by MPA + species reported in global catch databases

AREA SELECTION CRITERIA: HABITATS

Variable ~ Asaad et al. 2016	Zhao et al., 2020	Selig et al., 2014	Visalli et al., 2020, High Seas only	Jones et al., 2020	Sala et al., 2021
Rare, unique	Biogenic habitats Seagrass, kelp, mangroves, shallow coral reefs, physical habitat as rugosity and ecosystems				
Fragile, sensitive					
Representativeness			Seamounts, Hydrothermal vents		Seamounts and biogeographical provinces by experts' opinion
Integrity		Human impact	Fishing effort	Human stressors	Human impacts including area of seabed trawled
Total area prioritized	30%	< 5%*	13% and 24% High Seas	2%	21%
Spatial resolution	100 km	0.5 °	0.5 °	50 km	50 km

VARIABLES NEEDED FOR THE 8 COMMON CRITERIA

Criteria	Variable						
	Habitat cover	Species Endemic	Occurrence Threatened	Native	Species richness	Geographic range	Species abundance
Unique and rare habitat	+	+	+	+	-	-	-
Fragile & sensitive habitat	+	+	+	+	-	-	-
Ecological integrity	+	-	-	-	+	-	+
Representativeness	+	-	-	-	+	-	+
Species conservation concern	-	+	+	+	-	-	-
Restricted-range species	-	+	+	+	-	+	-
Biological diversity	-	-	-	+	+	-	+
Important for a species evolutionary process	-	+	+	+	+	-	-