Systematic conservation planning at an Ocean Basin and regional scales

ATLAS 5th General Assembly 2020 Edinburgh

All WP3 participants (presented by Telmo Morato & Magali Combes)

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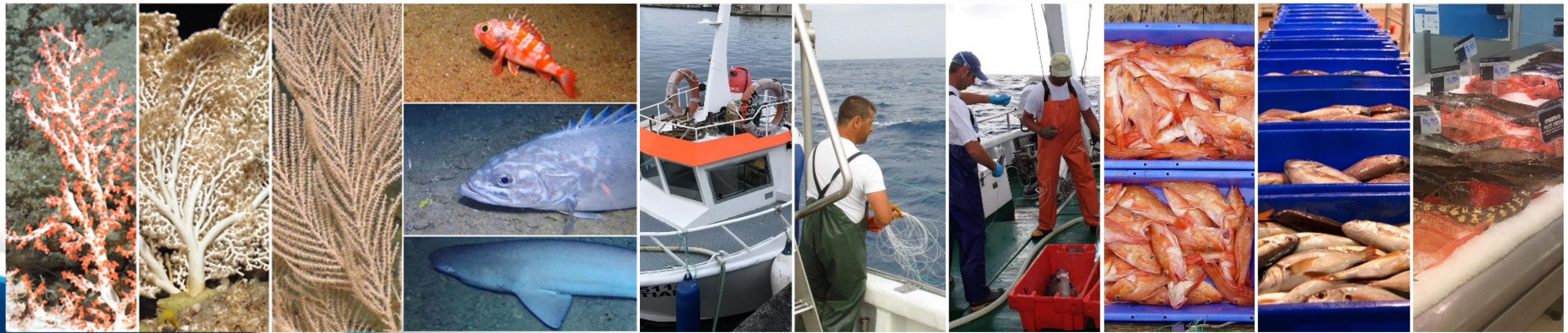
Objectives

Integrate available data into a comprehensive Systematic Conservation Planning approach at Ocean Basin and regional scales, for identifying priority areas in the deep-sea to:

Protect natural diversity, ecosystem structure, function, connectivity and resilience of deep-sea communities in a changing planet, while allowing the environmentally sustainable use of natural resources for current and future generations



Systematic Conservation Planning approach

Guiding Principles

Data driven: based on the best available information

Precautionary Principle: if information is insufficient, the safest choice must be made

Adaptive approach: designed to be improved whenever new information is available

Transparency principle: should be transparent, objective, and easily understood

Ecosystem integrity principle: maintaining ecosystem structure and functioning

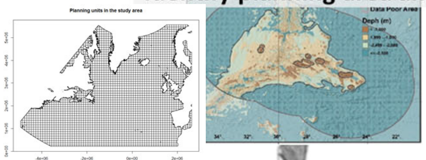
Ecosystem-based approach principle: consider an ecosystem approach, recognising the variety of landscapes, habitats and interactions, including human activities

Native species diversity principle: consider native ecosystems and functions

SCP Approach

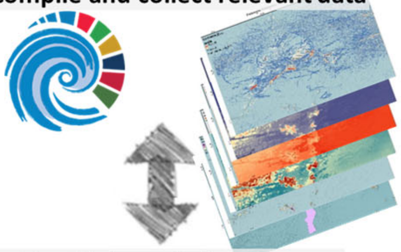
Identify overarching statement, Principles, Goals, Objectives

Identify planning area and units



Identify relevant features

Compile and collect relevant data



Identify knowledge gaps

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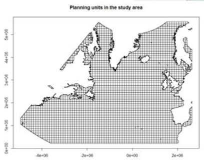

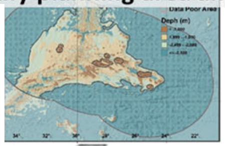

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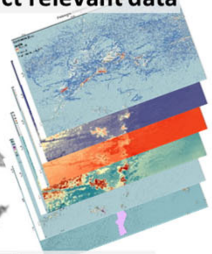


Identify knowledge gaps

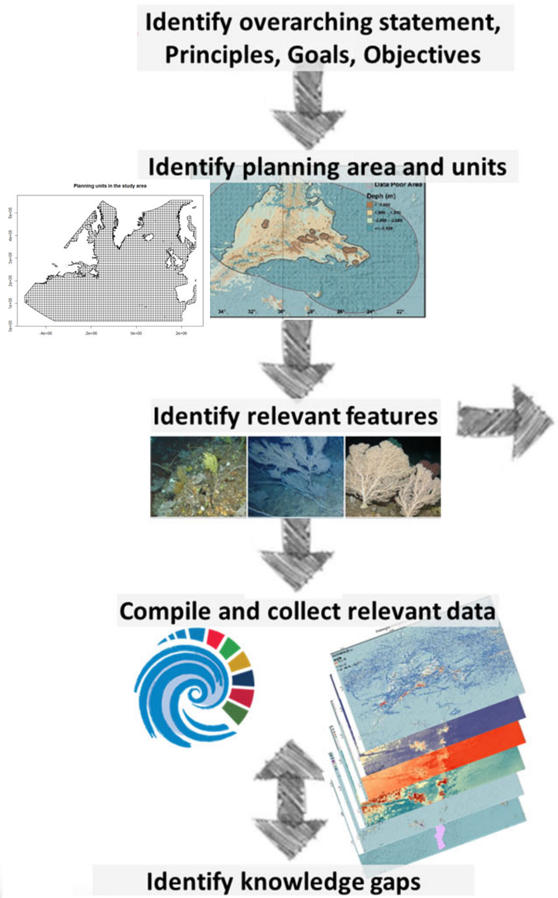
Overarching mission	Ecological Goals
Protect natural diversity	• Maintain biological diversity of deep-sea ecosystems; • Ensure protection of vulnerable, endangered, or critically endangered species or habitats; • Ensure protection of hotspots of biodiversity of deep-sea ecosystems; • Ensure protection of potential near natural areas; • Ensure the protection of representative benthic habitats and associated ecosystems;

Objectives	
• Ensure no further loss of deep-sea biodiversity at ecologically relevant scales by 2030	●●●●●●● ●●●●
• Halt significant adverse impacts on vulnerable, endangered, or critically endangered species or habitats by 2030	●●●●●●●● ●
• Protect a minimum of 75% of the known hotspots of biodiversity of deep-sea ecosystems by 2023	●
• Protect at 100% of the near-natural habitat within current fishing depths by 2023	●
• Ensure at least 15% of all deep-sea benthic habitats and associated ecosystems are protected by 2023	●●
• (food-web structure objectives)	?
• Ensure fully protection (100%) of bona fide Vulnerable Marine Ecosystems by 2023	●
• Protect at least 30% of known records of endemic, extremely long-lived, and reef engineers Vulnerable Marine Ecosystems indicators by 2023	●
• Protect at least 15% of inferred Vulnerable Marine Ecosystems by 2023	●●●
• Protect a minimum of 75% of the known essential deep-sea habitats by 2023	NA
• Ensure the identification of keystone and foundation species by 2025	NA
• Protect a minimum of 30% of the known keystone and foundation species distribution by 2028	NA
• (objectives for maintaining functional diversity of deep-sea ecosystems)	?
• Ensure the connectivity patterns, maximum larval dispersal distances and average annual mobile animals movements of deep-sea foundation, keystone, vulnerable, and economically important deep-sea species are revealed by 2030	NA
• Ensure the maximum distance between the units of the network are not greater than the 75th percentile of median larval dispersal distances and average annual mobile animals movements by 2033	○
(Resilience)	
• Ensure the identification of areas with least climate hazards and climate refugia areas for deep-sea biological diversity and commercially important deep-sea benthic fish by 2025	NA
• Protect a minimum of 75% of the climate-resilient and climate refugia areas by 2028	NA
• Rebuild fish stocks of commercially important deep-sea benthic species to levels prior to 1990's by 2040	●●●●
• Protect at least 15% of suitable habitat of commercially important deep-sea benthic fish species by 2023	●●
• Ensure the identification of essential fish habitats of commercially important deep-sea benthic species by 2025	NA
• Protect at least 50% of essential fish habitats of commercially important deep-sea benthic species by 2028	●

Supporting scientific information

- ● Known essential fish habitats (Santos et al., 2010; Menezes et al., 2012; Melo and Menezes, 2002)
- ● Known Vulnerable Marine Ecosystems (Morato, Carreiro-Silva, Dominguez-Carrió et al., unpublished data; Beaulieu & Szafranski, 2019)
- ● Known occurrence records of selected Vulnerable Marine Ecosystems indicator taxa (endemic, extremely long-lived, and reef engineers) (Coleta database; multiple other sources)
- ● Known shallow (<250m) and deep (>1500m) seamounts (Morato et al., 2008; 2013; Rodrigues et al., unpublished data)
- ● Known near natural areas in the range of current deep-sea benthic fishing activities (< 1200m) (Morato et al., unpublished data)
- ● Geomorphic Management Units derived from the best-compiled bathymetry dataset (Gerald Taranto, unpublished data)
- ● Habitat suitability and abundance models of commercially important deep-sea benthic fish (Parra et al., 2017)
- ● Habitat suitability models of habitat forming and vulnerable cold-water corals (Taranto et al., unpublished data)
- ● Habitat suitability models of endangered or critically endangered deep-water sharks and rays (Das et al., unpublished data)
- ● Inferred Vulnerable Marine Ecosystems index (Morato et al., 2018)
- ● Existing area based management tools (e.g. MPAs)
- ○ Other published sources

SCP Approach



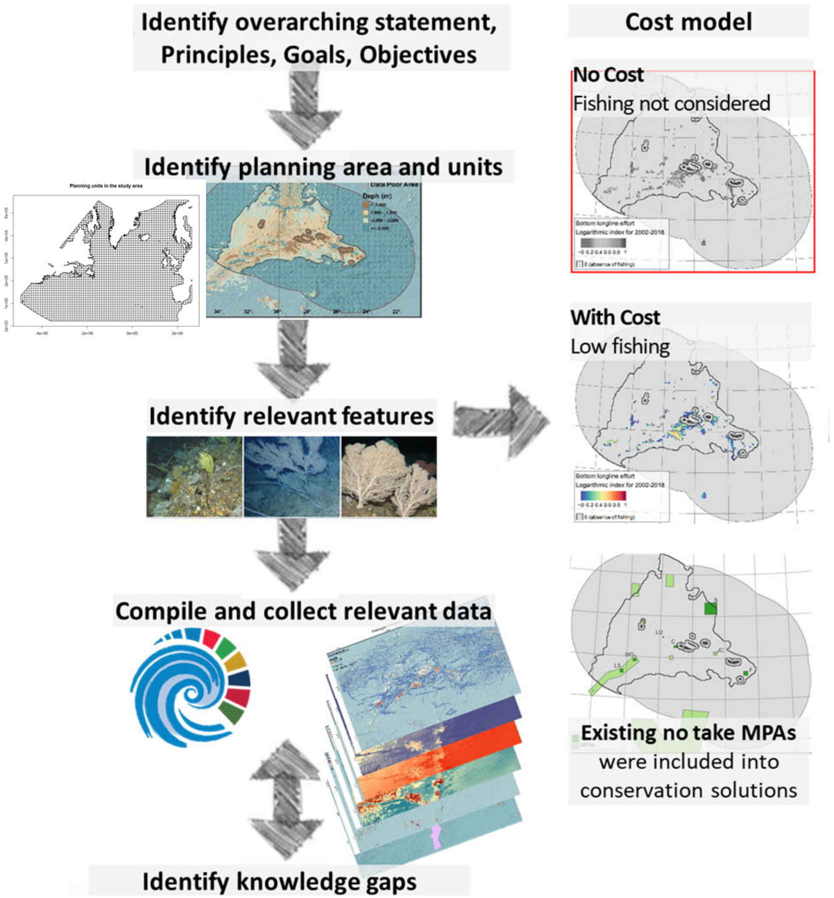
Important areas: a selection ecologically or biologically important “locked-in” areas

Prioritization approach for:

Important resources: best available scientific data on several conservation features

Representativity: best available scientific data on proxies for different ecosystem properties

SCP Approach



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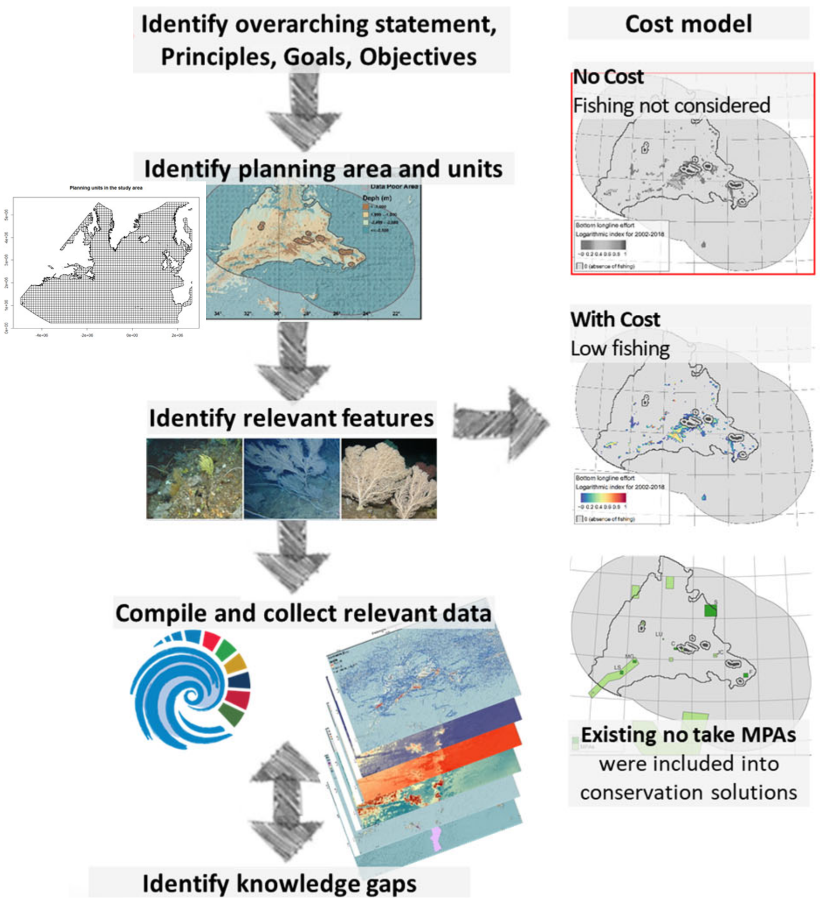

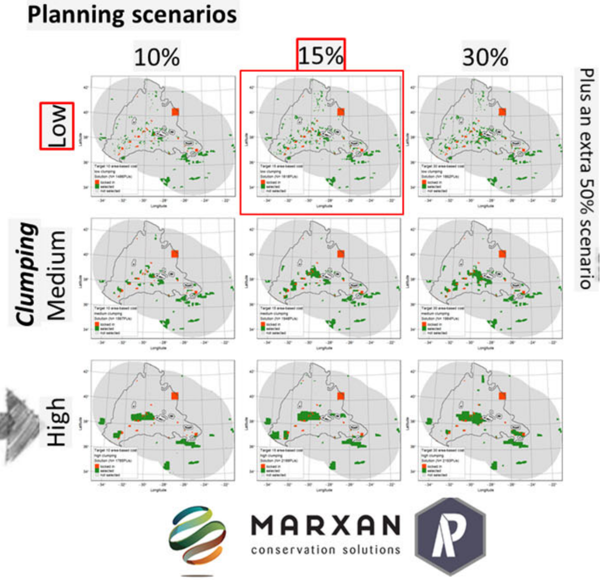

“minimum set” objective function: Finds the set of PUs that minimizes the cost of the solution whilst ensuring that all targets and other constraints are met

Targets are set for the habitats and **species** rather than a defined area, and it explores what area (% of planning area) is needed for protecting those features given their individual targets

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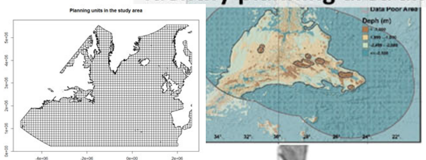

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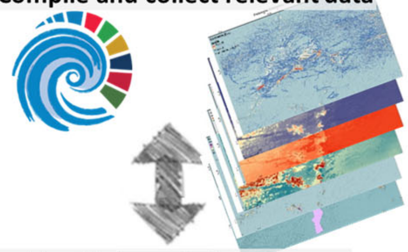
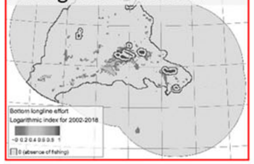


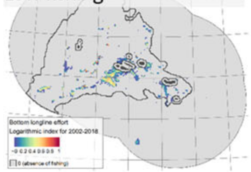
Identify knowledge gaps

Cost model

No Cost
Fishing not considered

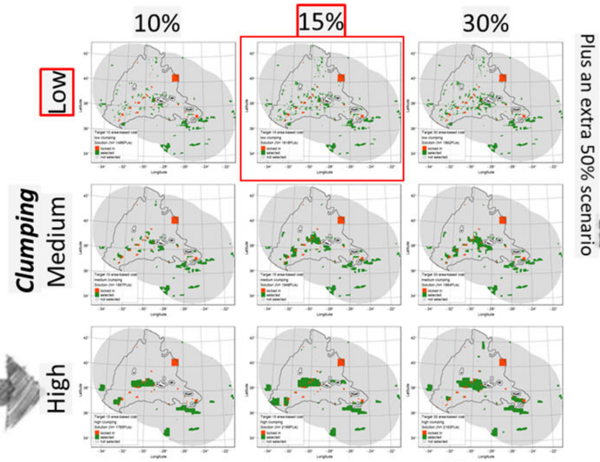


With Cost
Low fishing



Existing no take MPAs were included into conservation solutions

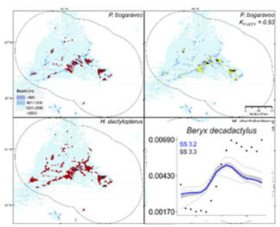
Planning scenarios



Performance assessment

Protect								
Single			Bands			Multi		
15	30	50	15	30	50	15	30	50
1	1	1	6	4	5	6	5	4
101	115	130	25	66	102	71	91	116
62	105	157	45	85	133	81	150	216
	0	55	81	131	175	19	60	138
0	11	21	9	21	50			4
47	132	188	46	104	211	42	105	185
7	32	67	4	20	56	1	8	48

Spatial ecosystem projections



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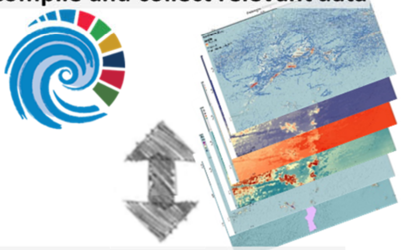

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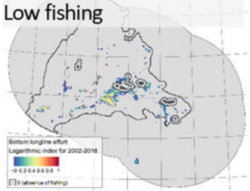
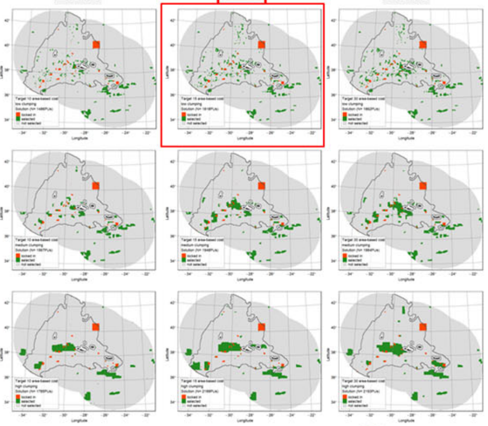


Existing no take MPAs were included into conservation solutions

Planning scenarios

Clumping: Low / Medium / High — 10% / 15% / 30%

Plus an extra 50% scenario



MARXAN conservation solutions

Performance assessment

Protect								
Single			Bands			Multi		
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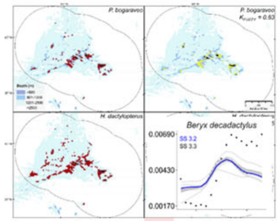


Adaptive approach principle

Policy and **Stakeholder** interaction at all moments of the process atlas

- **To conserve features of interest**

  1- VMEs: known VMEs including chemosynthetic ecosystems, predicted VME likelihood;

  2- Species: present suitable habitat and future climate refugia of six coral, one sponge and six fish species;

  3- Large functional hotspots: canyons, seamounts and fracture zones

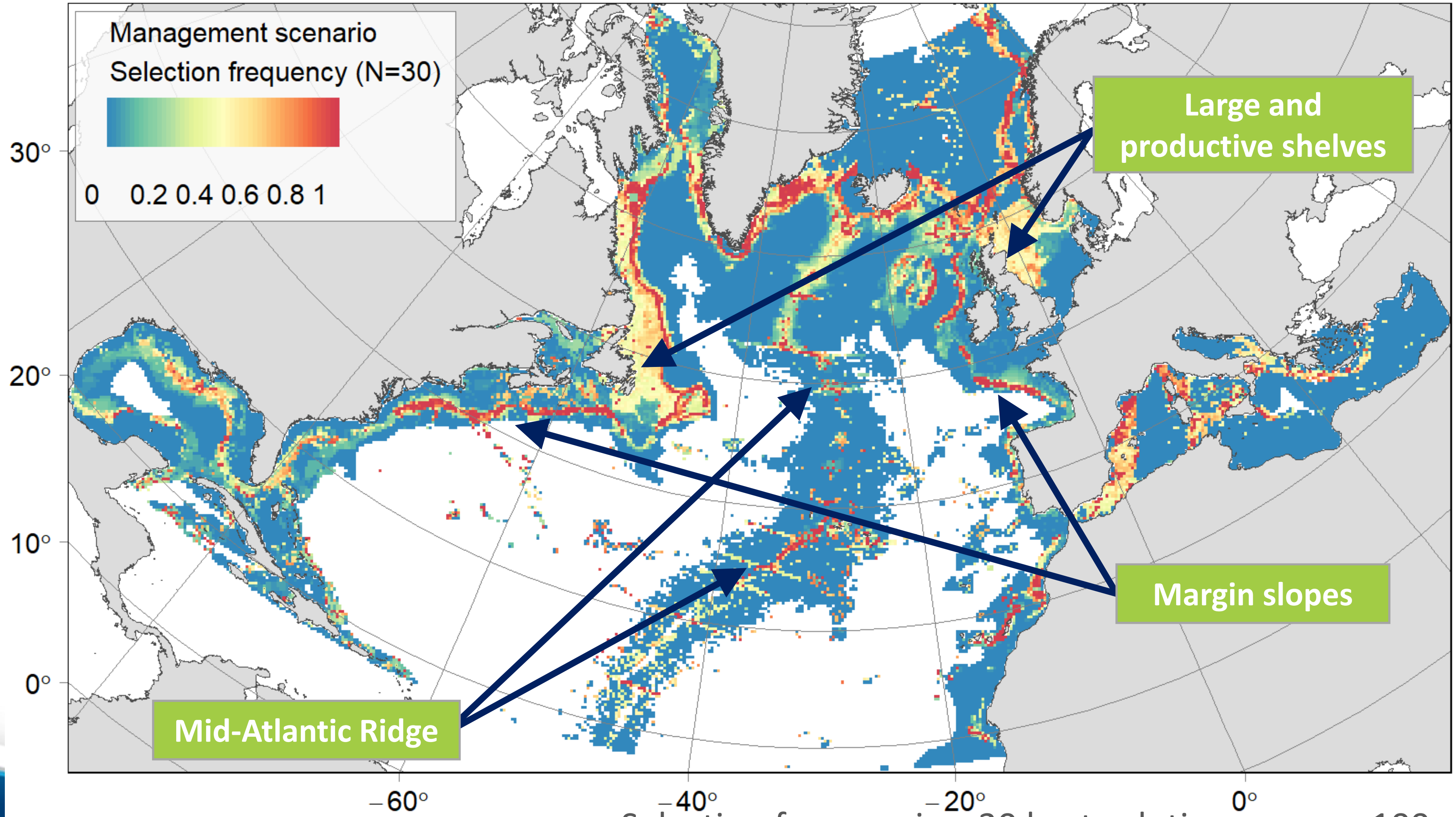
- **To design a conservation network** with **long-term viability, connectivity and replication**

- **To combine conservation objectives with**

  1 - The current conservation management framework: fishing closures, MPAs and EBSAs;

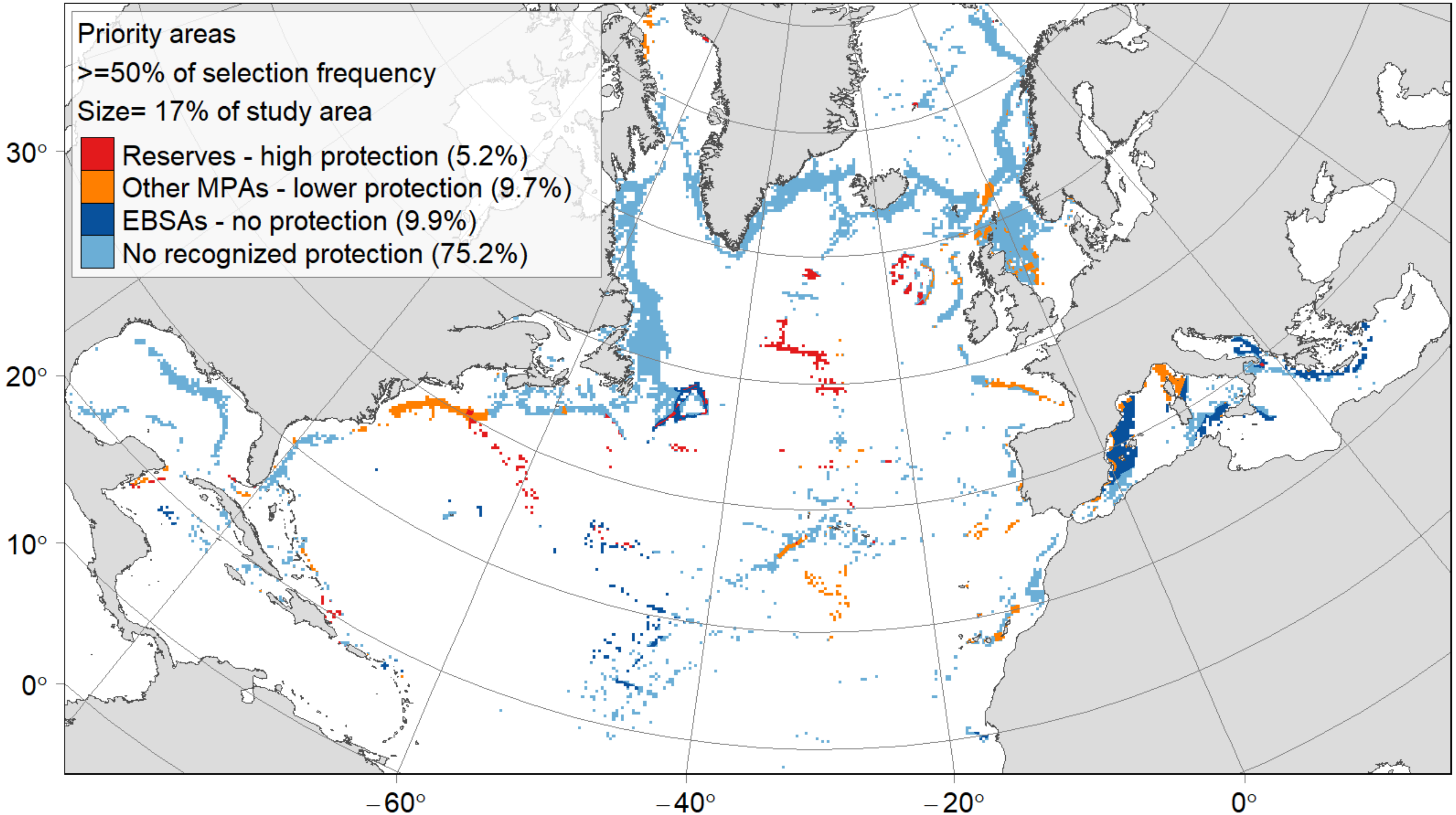
  2- Socioeconomic stakes: bottom-fishing

Ocean basin scale - Scenarios



Selection frequencies: 30 best solutions among 100

Ocean basin scale - Scenarios



Overall, 25% of the priority areas already benefit from some form of recognition, 5% benefit from protection against trawling, none benefit from full protection against all types of human activities.

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atlas

Regional scale - implementation

- **Important areas** ecologically or biologically important areas
- known shallow (<250m) and deep (>1500m) seamounts, known near natural areas, known essential fish habitats, known Vulnerable Marine Ecosystems
- **Important resources** best available scientific data on several conservation features
- known occurrence and predicted distribution of commercially important benthic deep-sea fish, endangered or critically endangered deep-water sharks, vulnerable cold-water coral species, essential habitats, known VME indicators, inferred index of VME likelihood.
- **Representativity** mostly the Geomorphic Management Units (GMUs) but also many of the above

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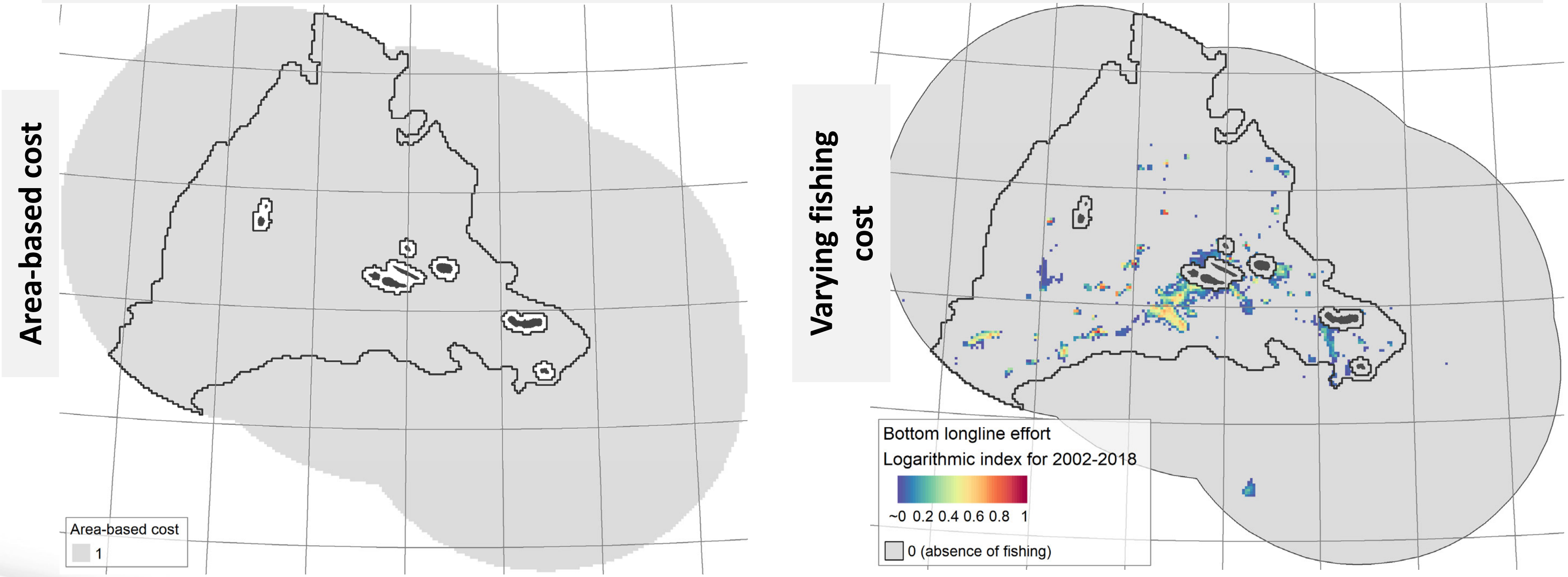
Regional scale - implementation

Cost model

1) target areas with high conservation potential **regardless of the cost** or **2**) target areas with high conservation potential but **reduced human activities**



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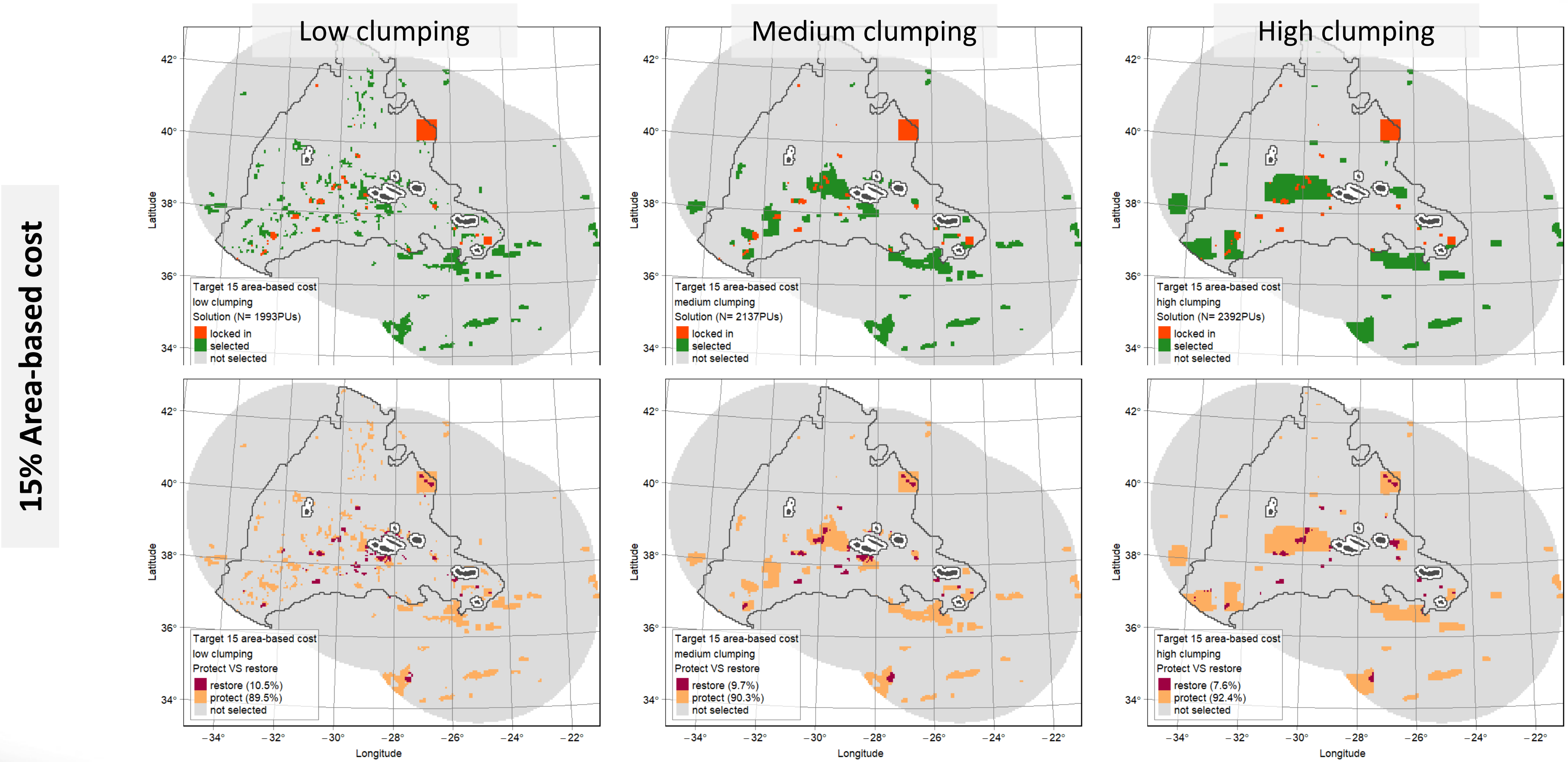
Regional scale - Scenarios



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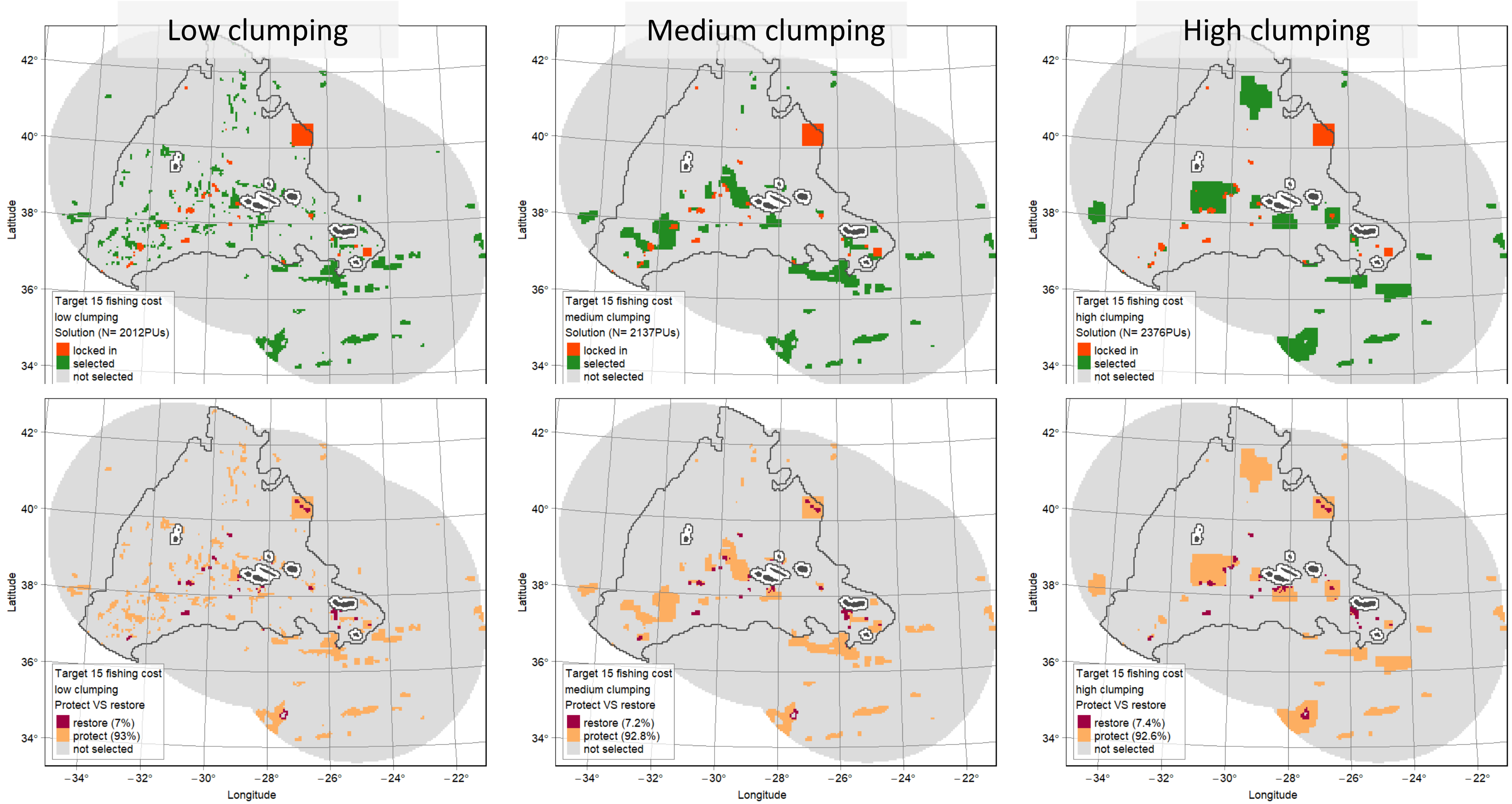
Regional scale - Scenarios

15% Varying-fishing cost



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Regional scale - Performance assessment

Target	15%					
Cost	Area-based			Fishing-based		
Clumping	Low	Med.	High	Low	Med.	High
Viability and adequacy						
Size of the network (x1000 km^2)	49.8	53.4	59.8	50.3	53.4	59.4
% Spatial planning area	5.3	5.7	6.3	5.3	5.7	6.3
% "Data-rich" area	8.6	9.4	10.8	8.7	9.5	10.6
% "Data-poor abyssal" area	3.6	3.7	4.0	3.6	3.7	4.1
% Target achieved	35.2	37.7	42.3	35.5	37.7	41.9
% "Data-rich" target achieved	57.0	62.9	72.1	57.9	63.2	70.6
% "Data-poor abyssal" target achieved	24.1	24.9	26.9	24.1	24.7	27.3
% Priority areas in "data-poor abyssal"	45.3	43.6	42.2	44.9	43.4	43.1
Average size of priority areas (km^2)	264	1008	1391	273	1008	1414
Max. size of priority areas (x1000 km^2)	4.3	8.4	15.7	4.3	9.0	10.8
% Network already protected	11.7	11.0	9.8	11.6	11.0	9.9
% Fishing footprint in the network	22	21	19	14	16	18
% Fishing effort in the network	25	25	23	19	19	21
Replication						
N priority areas	189	53	43	184	53	42
N priority areas larger than 100km^2	86	45	35	97	45	35
Connectivity						
Ave distance to closest neighbour (km)	12.9	34.0	42.2	14.3	31.4	34.6
Max distance to closest neighbour (km)	178.7	155.0	125.4	173.9	132.9	137.9
% Isolated priority areas (dist. >100km)	1.1	9.4	4.7	1.1	3.8	4.8
% Network area that is isolated	0.4	13.2	1.6	0.5	8.1	11.8
% Highly connected areas	74.1	1.9	0.0	73.9	13.2	0.0
% Network area that is highly connected	55.8	15.8	0.0	59.2	32.5	0.0

Target	15%					
Cost	Area-based			Fishing-based		
Clumping	Low	Med.	High	Low	Med.	High
Important resources						
Commercially important fish						
% Fish HSI in network	21.3	21.2	23.5	19.8	19.8	20.3
% Fish habitat (HSM) in network	23.9	24.0	24.9	22.1	22.0	22.6
Avg. fish HSI in network	0.21	0.20	0.22	0.21	0.21	0.21
% Fish predicted abundance in network	23.4	23.5	25.7	22.5	22.6	23.2
Avg. fish predicted abundance in network	0.19	0.19	0.20	0.20	0.19	0.20
% Fish HSI in "protect"	1.31	1.31	1.38	1.46	1.33	1.43
% Fish HSI in "restore"	20.0	19.9	22.1	18.3	18.4	18.8
Vulnerable deep-sea sharks/rays						
% Sharks/rays HSI in network	15.7	16.3	16.4	15.8	16.4	16.4
% Sharks/rays habitat (HSM) in network	16.2	17.4	17.8	15.7	16.9	17.2
Avg. Sharks/rays HSI in network	0.23	0.22	0.21	0.24	0.22	0.22
% Sharks/rays predicted abund in network	15.6	17.0	16.6	16.1	17.2	16.8
Avg. Sharks/rays predicted abund in network	0.16	0.17	0.16	0.18	0.18	0.17
% Sharks/rays HSI in "protect"	5.7	6.2	6.5	6.9	6.9	7.0
% Sharks/rays HSI in "restore"	10.0	10.1	9.9	9.0	9.5	9.4
Habitat-structuring CWC						
% CWC HSI in network	28.4	30.3	29.7	27.6	29.2	29.6
% CWC habitat (HSM) in network	22.7	24.2	24.4	21.2	23.3	23.0
Avg. CWC HSI in network	0.26	0.26	0.25	0.27	0.26	0.26
% CWC HSI in "protect"	4.1	5.5	5.2	4.2	5.7	5.3
% CWC HSI in "restore"	24.3	24.8	24.5	23.4	23.5	24.3
Observed habitat-structuring CWC						
% CWC records in network	39.4	38.7	38.7	36.1	38.0	36.8
% CWC records in "protect"	7.4	9.9	9.3	8.5	10.4	8.0
% CWC records in "restore"	32.0	28.9	29.4	27.6	27.6	28.9
Inferred VMEs						
% VME index in network	32.0	32.8	30.8	28.1	28.3	29.2
Avg. VME index in network	3.5	3.4	3.5	3.5	3.5	3.5
Avg. VME index in network	0.87	0.85	0.87	0.87	0.86	0.88
% VME index in "protect"	8.0	9.0	8.5	8.5	8.4	8.5
% VME index in "restore"	24.0	23.8	22.3	19.6	19.8	20.7

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Regional scale - Forecasting ecosystem-level outcomes

MARXAN
conservation solutions

Forecast whole-ecosystem and fisheries outcomes

resulting from the implementation of **management strategies**,

including **fishing closures**

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Regional scale - Forecasting
ecosystem-level outcomes

Evaluation of ecosystem outcomes in response to management scenarios

MANAGEMENT-TOOLS		MPA STRATEGY	MPA + FE STRATEGY	FE STRATEGY
	NO-TAKE AREAS	✓	✓	✗
	FISHING EFFORT REDUCTIONS	✗	✓	✓

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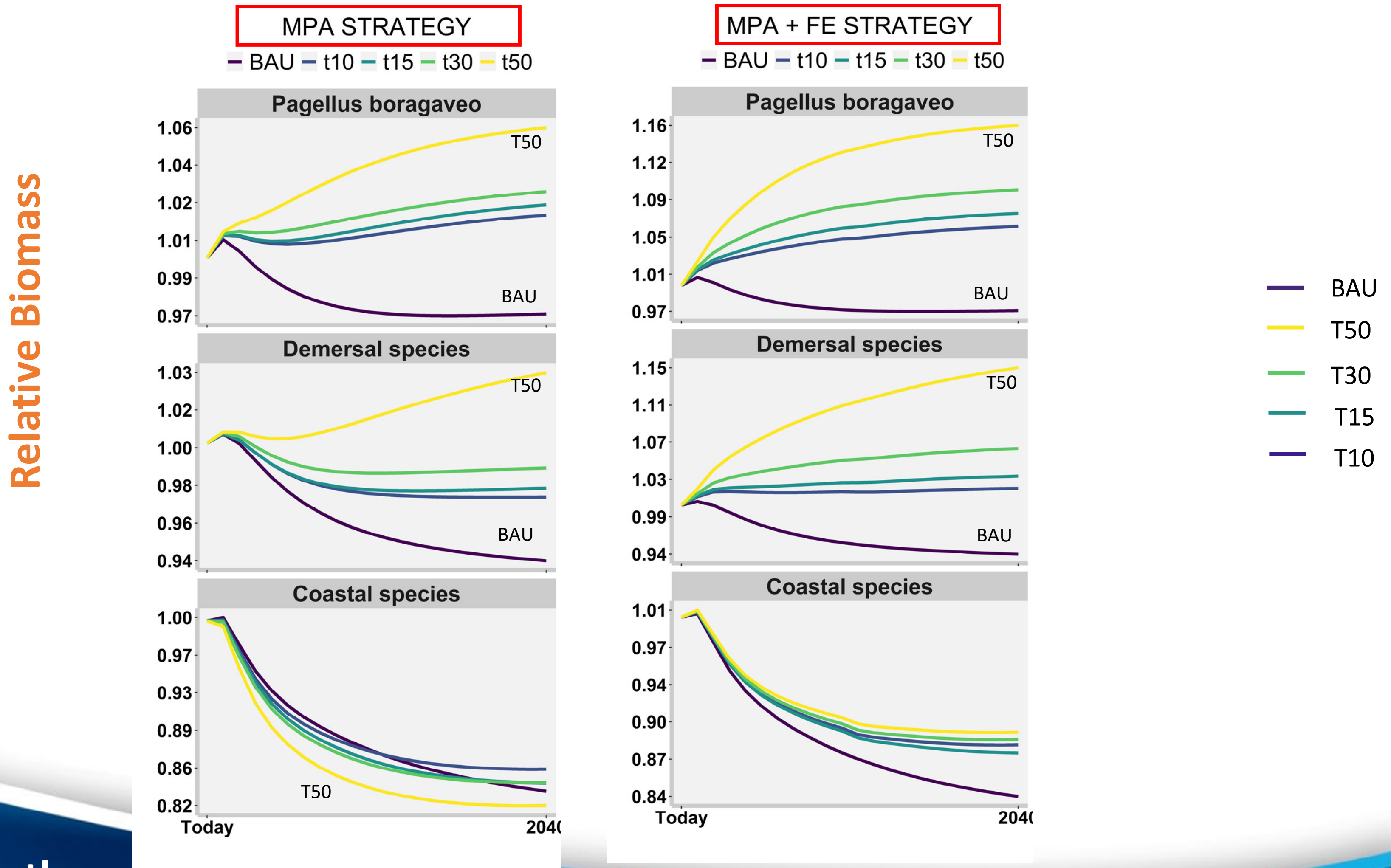
Regional scale - Forecasting ecosystem-level outcomes



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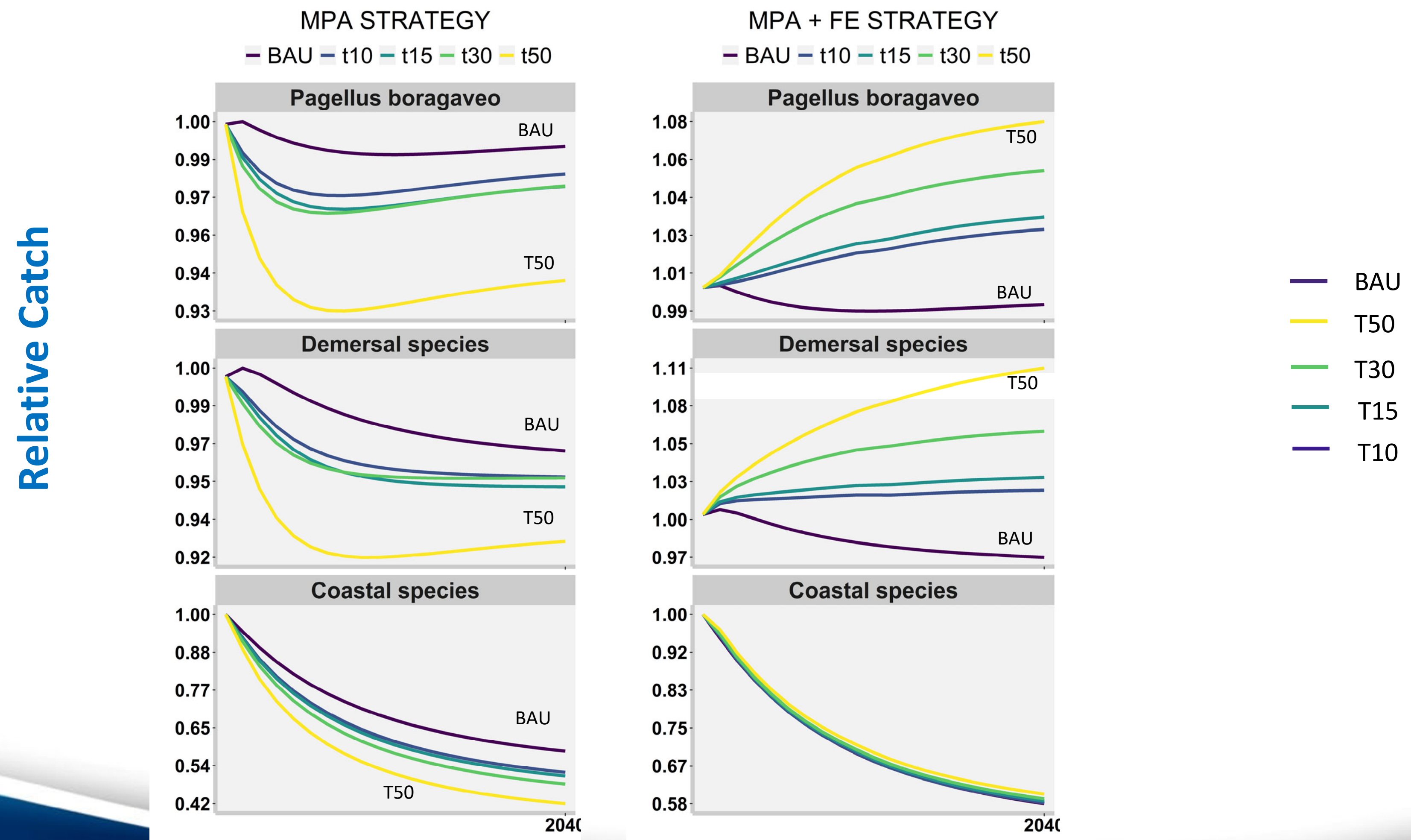
Regional scale - Forecasting ecosystem-level outcomes



Conclusions

Developing transparent and science based prioritizations is possible at ocean-basin and regional scales

The prioritization outputs are highly dependent on the goals and objectives adopted but also on the range of conservation features, conservation targets, cost model, boundary penalties, and constraints adopted

The implementation of closed areas maintaining the current levels of fishing effort may have limited positive effects on commercially important deep-sea fish

Conclusions

Controversial preliminary conclusion:

Area Based Management Tools should be accompanied by other fisheries management measures in order to avoid potential negative effects in the some fishing stocks and to achieve ecosystem-based management goals

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Thank you

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