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UNDERSTANDING DEEP ATLANTIC ECOSYSTEMS

Species distribution models under future climate scenarios

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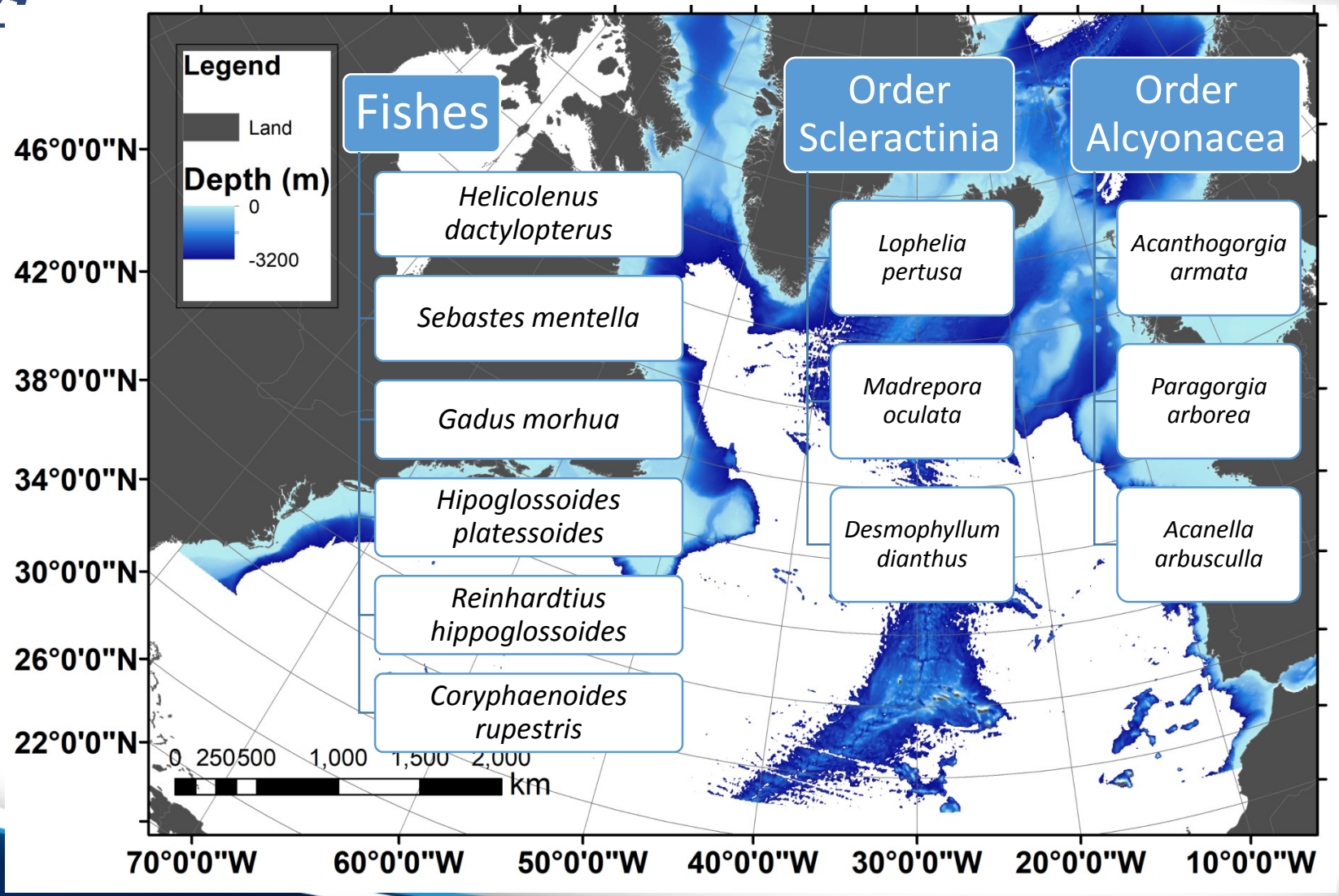
SDMs under future climate scenarios



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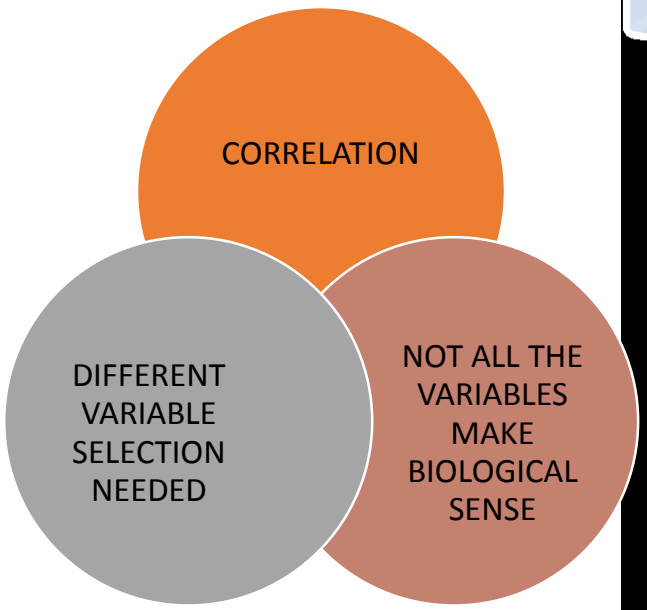
PRESENCE RECORDS

OBIS OCEAN BIOGEOGRAPHIC INFORMATION SYSTEM

- OBIS is a global open-acces data and information cleaing-house on marine biodiversity for science, conservation and sustainable development.
- Include a huge number of presence records but:
  - Not all of them are in the studied area (North Atlantic)
  - Not all of them can be trust
    - Filtering (using depth)

SPECIES	ORIGINAL N	FINAL N	REDUCTION (%)	DEPTH (M)
Gadus morhua	1100699	101230	91	140 (0-700)
Hipoglossoides platessoides	350906	106086	70	150 (2-1400)
Helycolenus dactylopterus	22876	4527	80	235 (6-1000)
Paragorgia arborea	4078	190	95	335 (41-1375)
Reinhardtius hippoglossoides	50910	35989	29	360 (20-1500)
Sebastes mentella	16527	14843	10	370 (20-2850)
Lophelia pertusa	4940	956	81	506 (25-1940)
Madrepora oculata	2860	235	92	810 (188-1770)
Coryphaenoides rupestris	4462	3718	17	900 (50-300)
Acanthogorgia armata	289	170	41	910 (60-2600)
Desmophyllum dianthus	2816	203	93	1070 (140-200)
Acanella arbuscula	519	310	40	1130 (50-2450)

ENVIRONMENTAL VARIABLES



SDMs under future climate scenarios

Static (Depth and derivates)

- Depth
- Slope
- Rugedness
- Benthic Position Index (BPI)

Dynamic

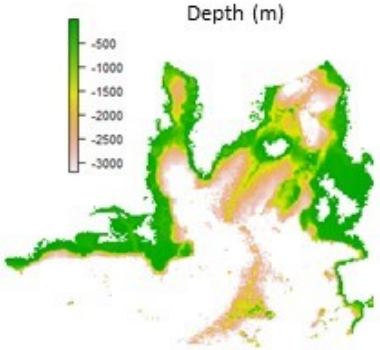
- Mean potential temperature at seafllor (K)
- Mean dissolved oxygen concentration at seafloor (mol m^{-3})
- Mean pH concentration at seafloor (M)
- Mean export POC flux to seafloor (mg C m^{-2} d^{-1})
- Aragonite Concentration (mol m^{-3})
- Calcite concetration (mol m^{-3})
- Mole Concentration of Carbonate expressed as Carbon in Sea Water (mol m^{-3})
- Mole Concentration of Aragonite expressed as Carbon in Sea Water at Saturation (mol m^{-3})
- Mole Concentration of Calcite expressed as Carbon in Sea Water at Saturation (mol m^{-3})

2081-2100 | 2041-2060 | 1951-2000

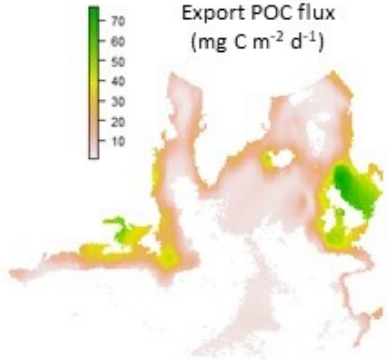
ENVIRONMENTAL VARIABLES

COMMON ALL SPECIES

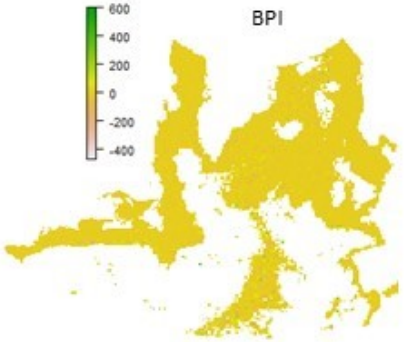
Depth (m)



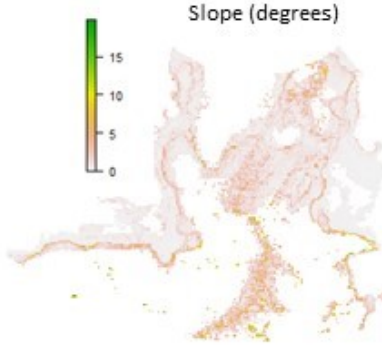
Export POC flux (mg C m^{-2} d^{-1})



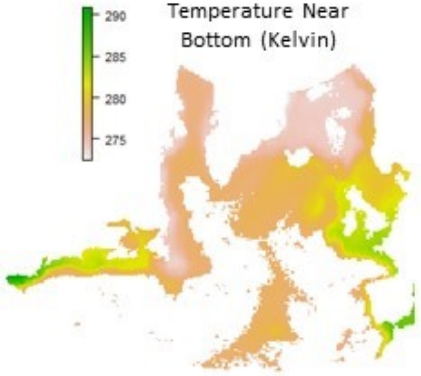
BPI



Slope (degrees)

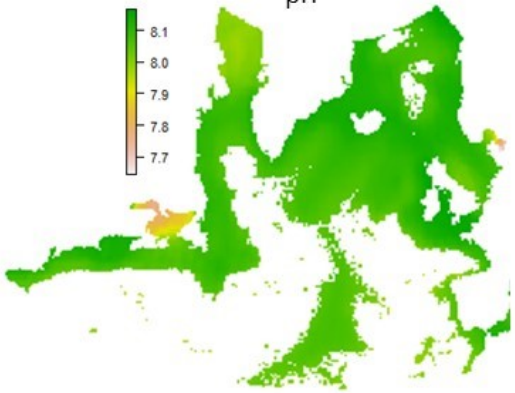


Temperature Near Bottom (Kelvin)



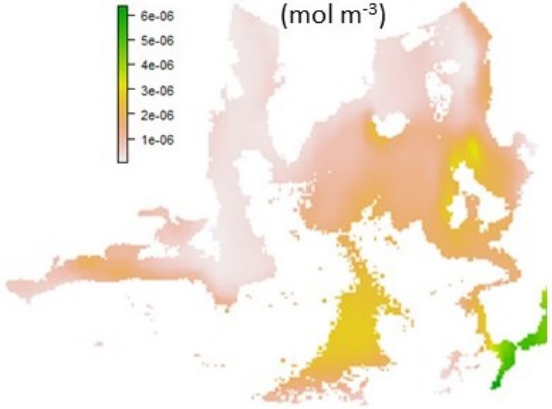
ONLY CORALS

pH



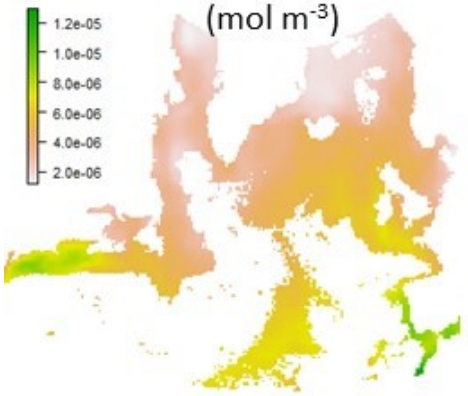
ONLY SCLERACTINIANS

Aragonite Concentration (mol m^{-3})



ONLY ALCYONACEA

Calcite Concetration (mol m^{-3})



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Ecological Modelling 190 (2006) 231–259
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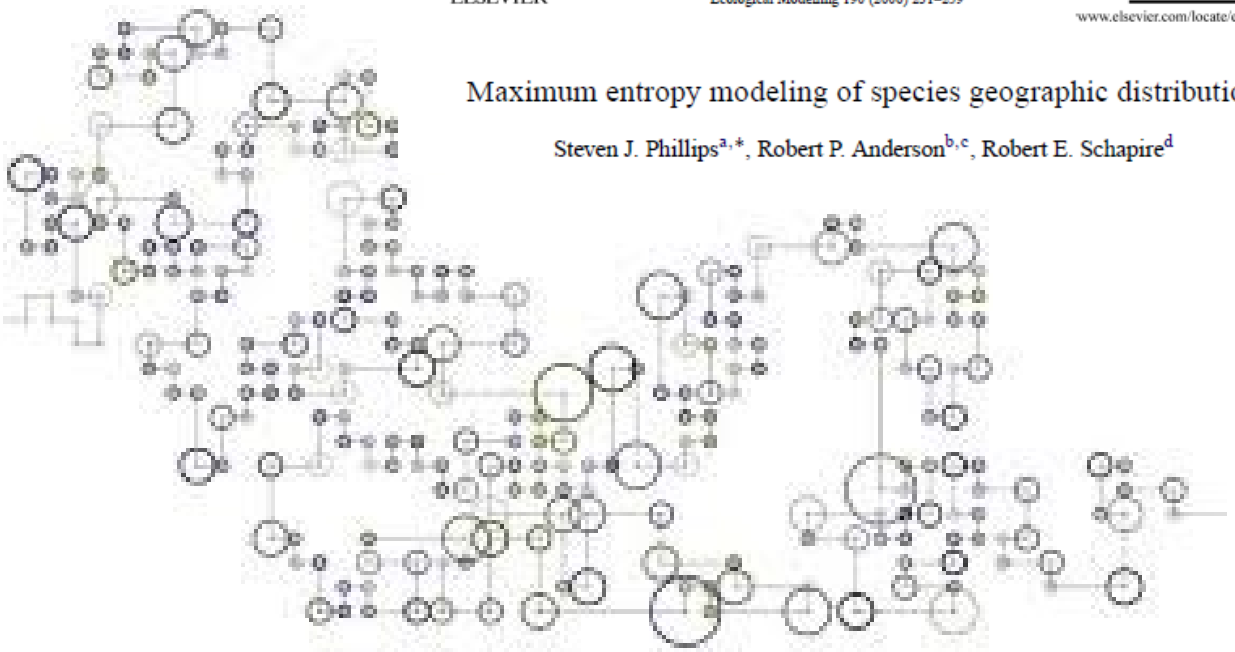
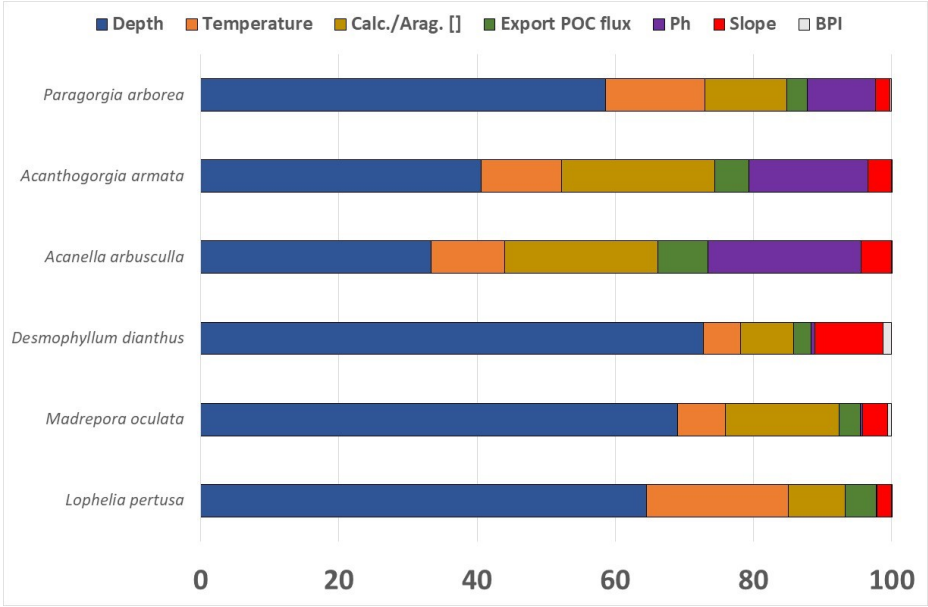
Maximum entropy modeling of species geographic distributions

Steven J. Phillips[a,*], Robert P. Anderson[b,c], Robert E. Schapire[d]

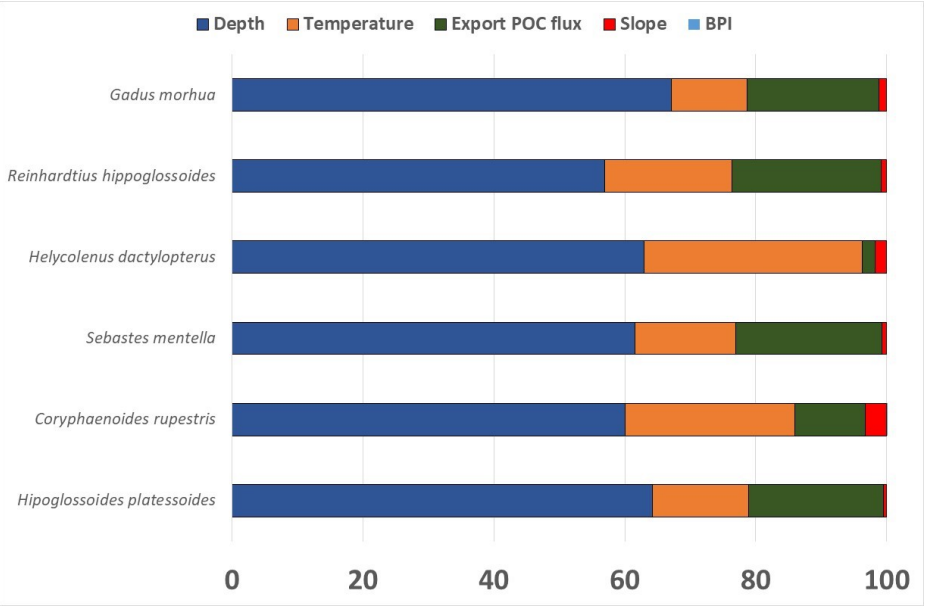


RESULTS: VARIABLE IMPORTANCE

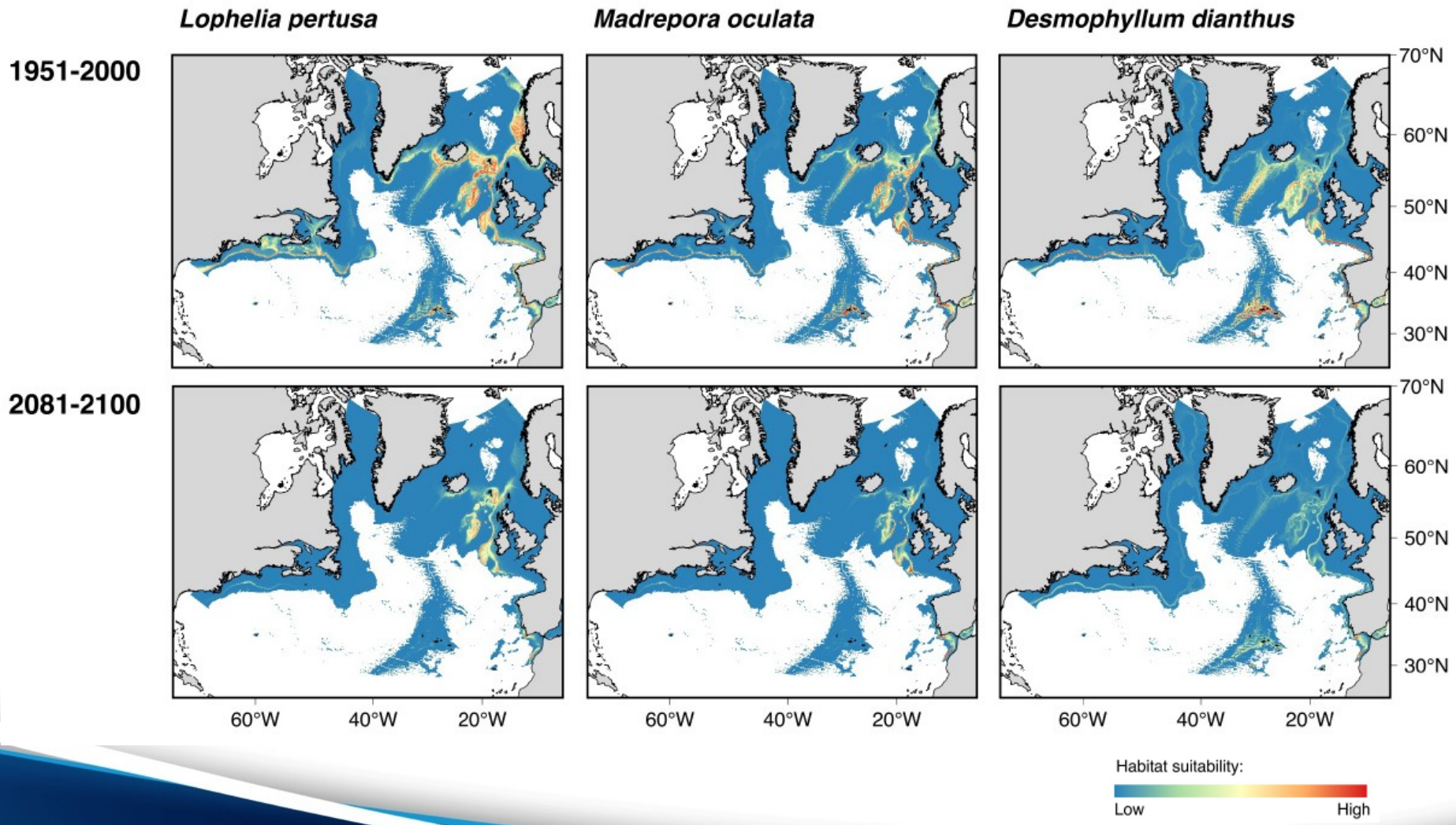
CORALS



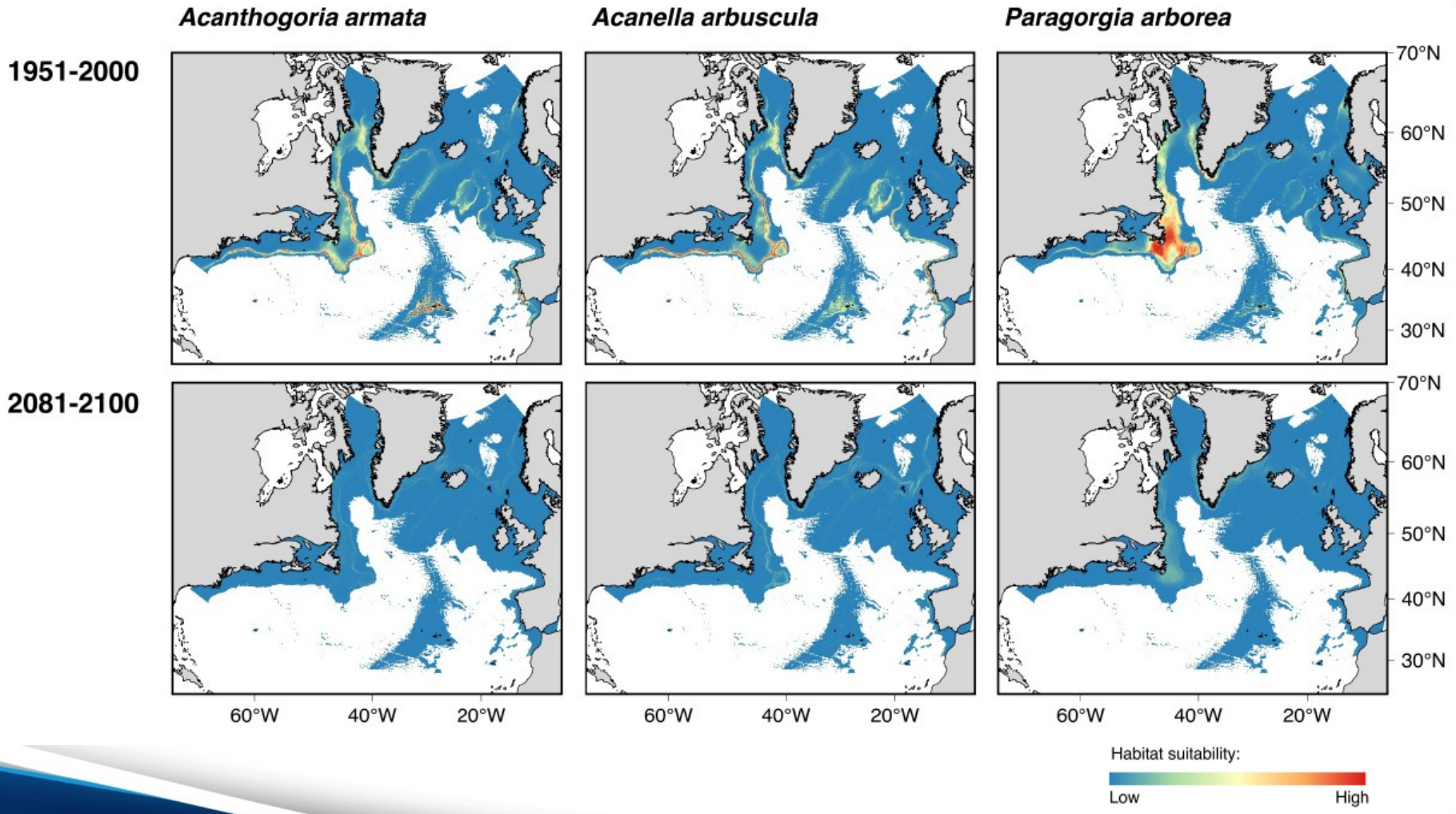
FISHES



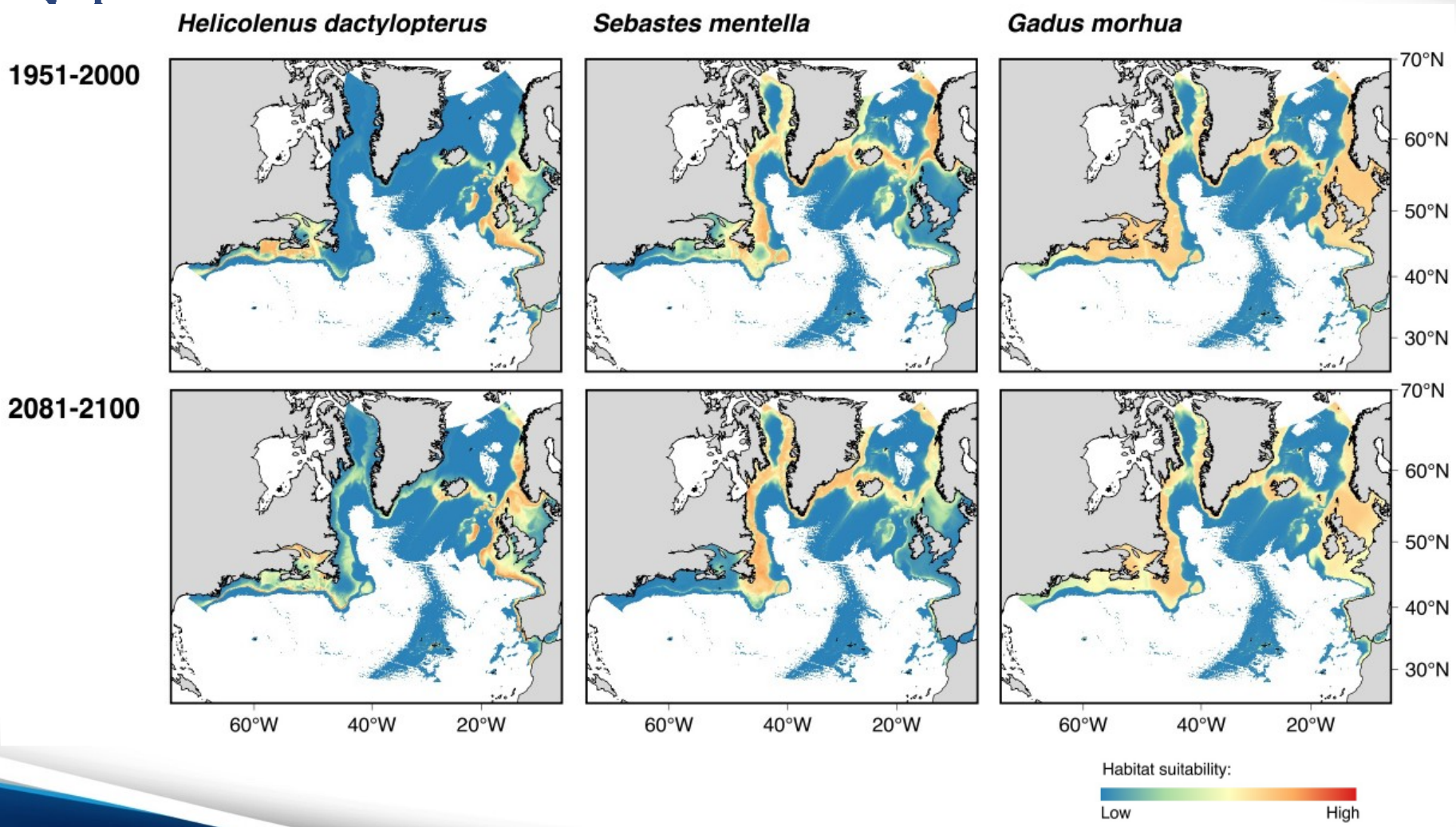
RESULTS


Lophelia pertusa
Madrepora oculata
Desmophyllum dianthus
1951-2000
2081-2100
70°N
60°N
50°N
40°N
30°N
60°W
40°W
20°W
Habitat suitability:
Low
High

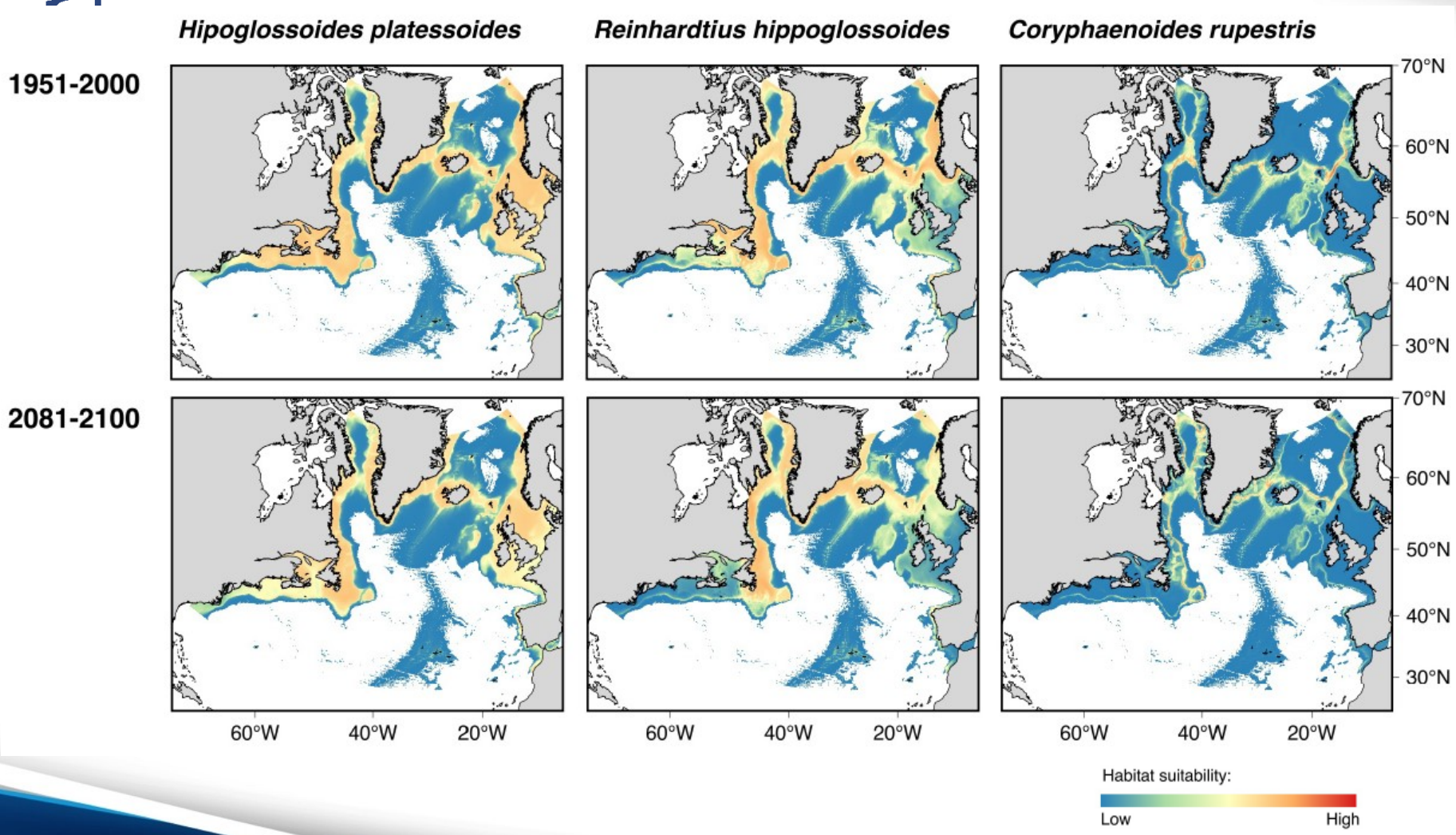
RESULTS


Acanthogoria armata
Acanella arbuscula
Paragorgia arborea
1951-2000
2081-2100
70°N
60°N
50°N
40°N
30°N
60°W
40°W
20°W
Habitat suitability:
Low
High

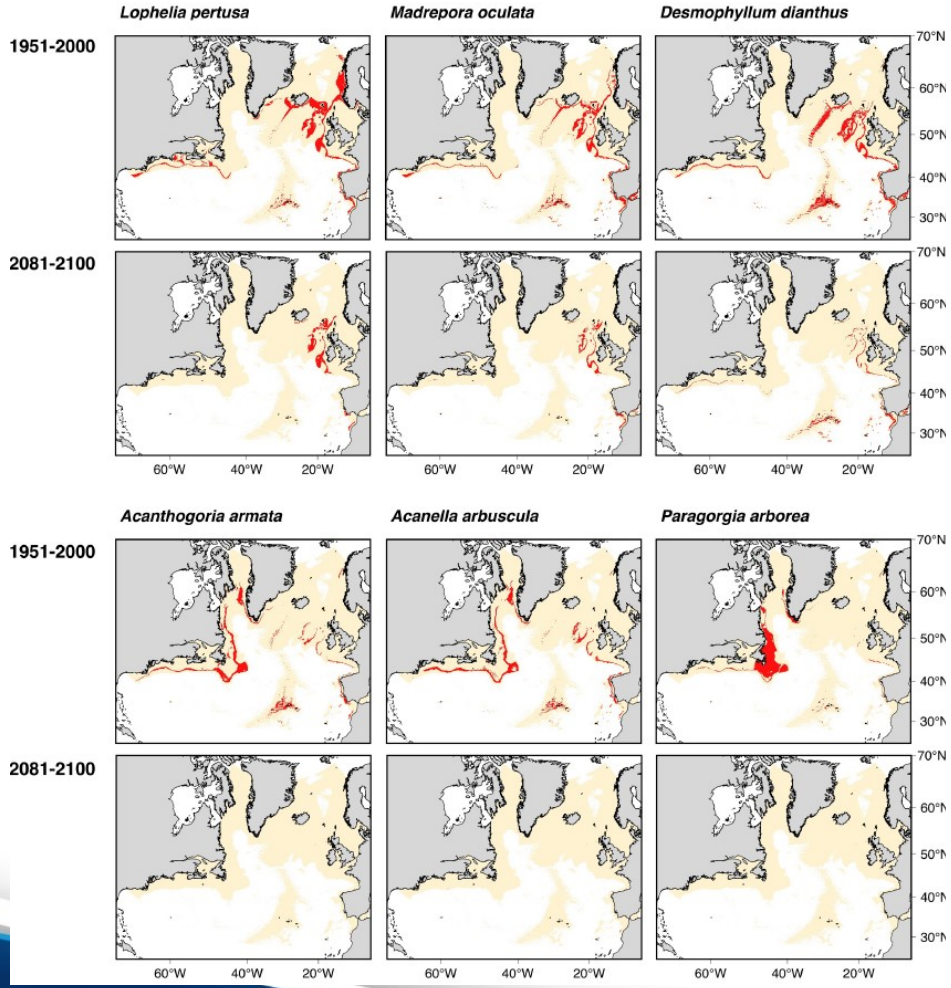
RESULTS

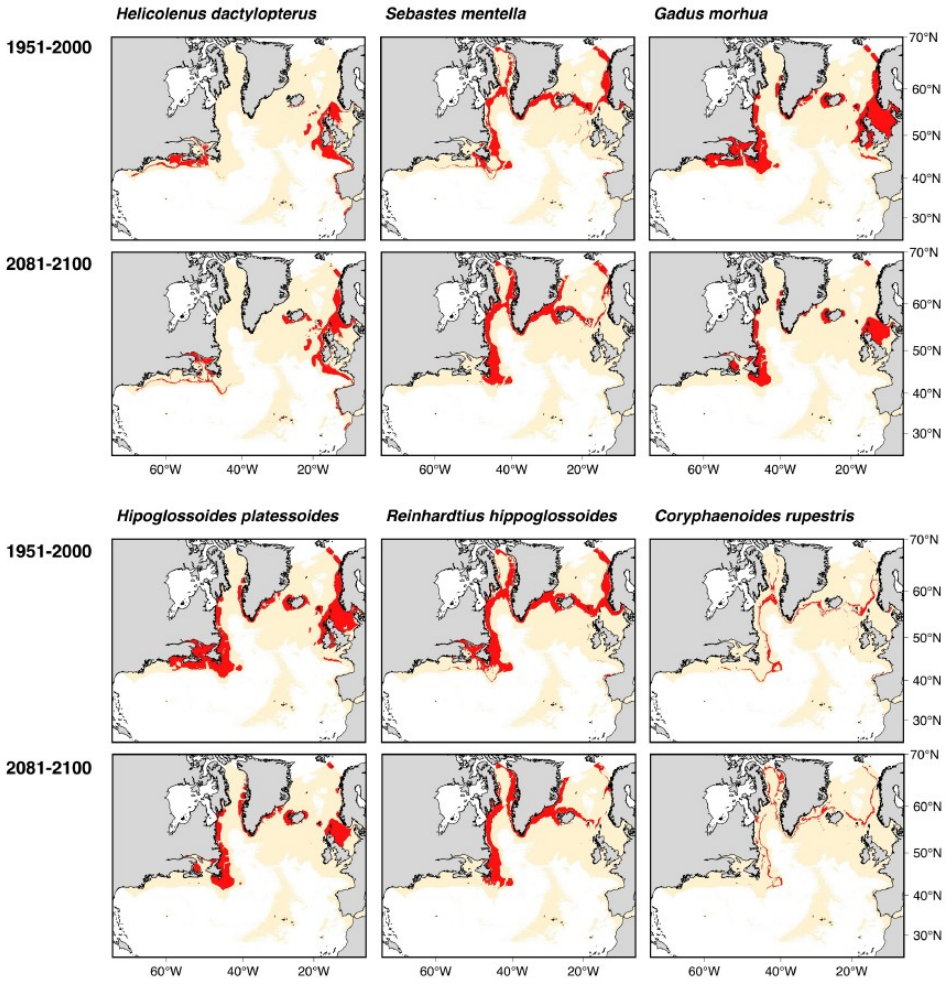

Helicolenus dactylopterus
Sebastes mentella
Gadus morhua
1951-2000
2081-2100
70°N
60°N
50°N
40°N
30°N
60°W
40°W
20°W
Habitat suitability:
Low
High

RESULTS


Hipoglossoides platessoides
Reinhardtius hippoglossoides
Coryphaenoides rupestris
1951-2000
2081-2100
70°N
60°N
50°N
40°N
30°N
60°W
40°W
20°W
Habitat suitability:
Low
High

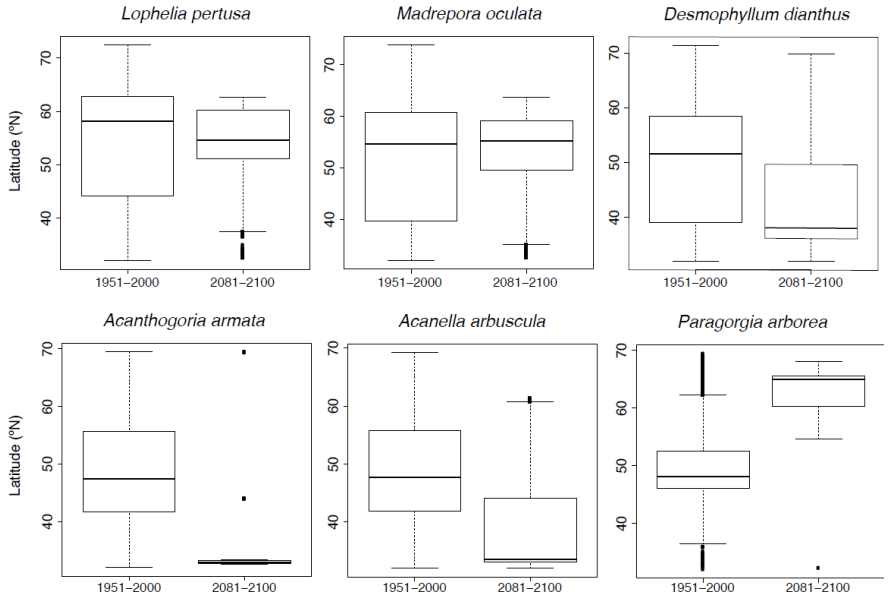
RESULTS


Lophelia pertusa
Madrepora oculata
Desmophyllum dianthus
1951-2000
2081-2100
60°W
40°W
20°W
70°N
60°N
50°N
40°N
30°N

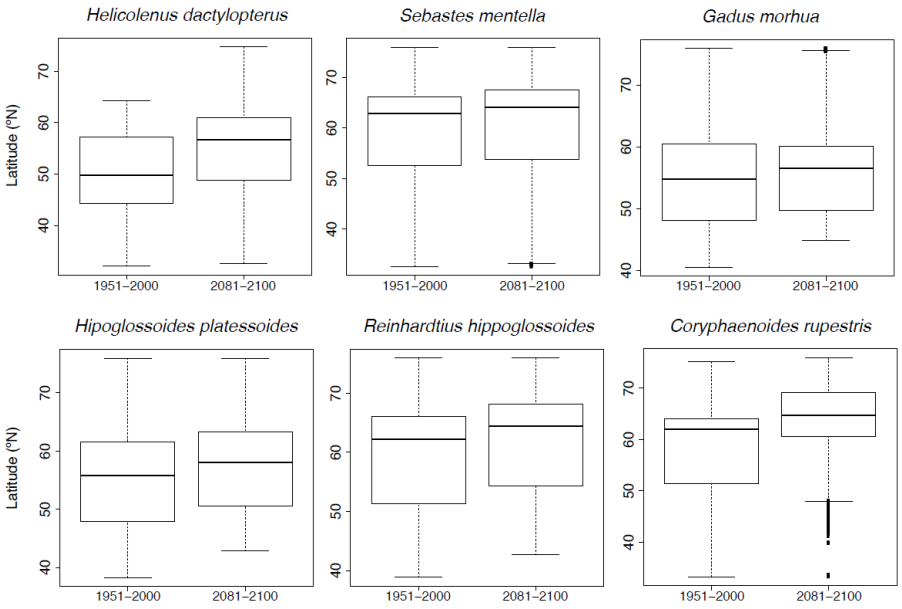

Helicolenus dactylopterus
Sebastes mentella
Gadus morhua
1951-2000
2081-2100
60°W
40°W
20°W
70°N
60°N
50°N
40°N
30°N

RESULTS: CHANGES IN LATITUDE

CORALS

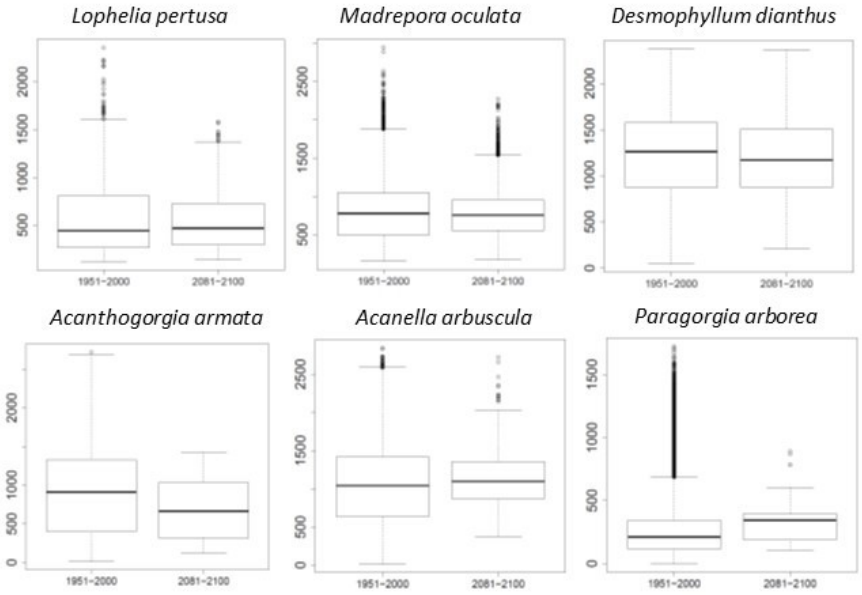


FISHES

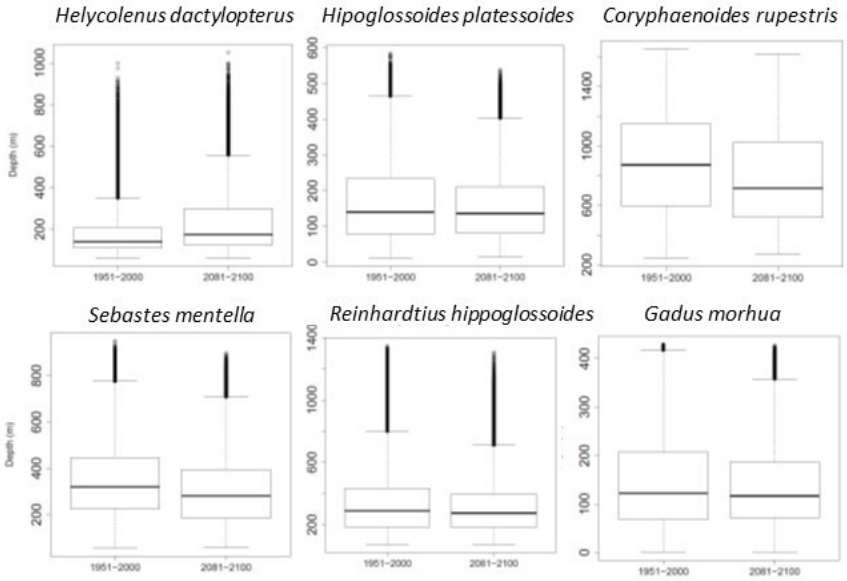


RESULTS: CHANGES IN DEPTH

CORALS

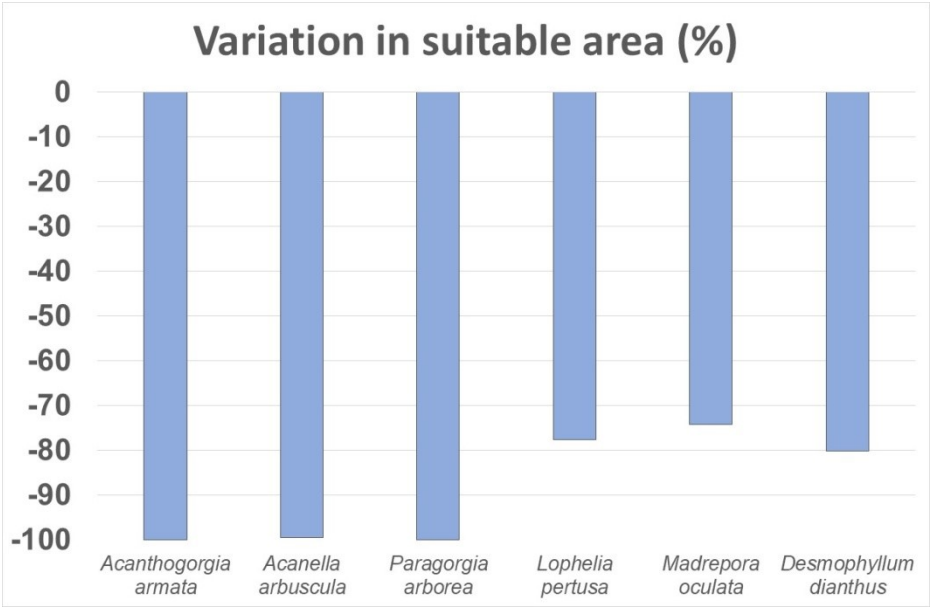


FISHES



RESULTS: CHANGES IN AREA

CORALS



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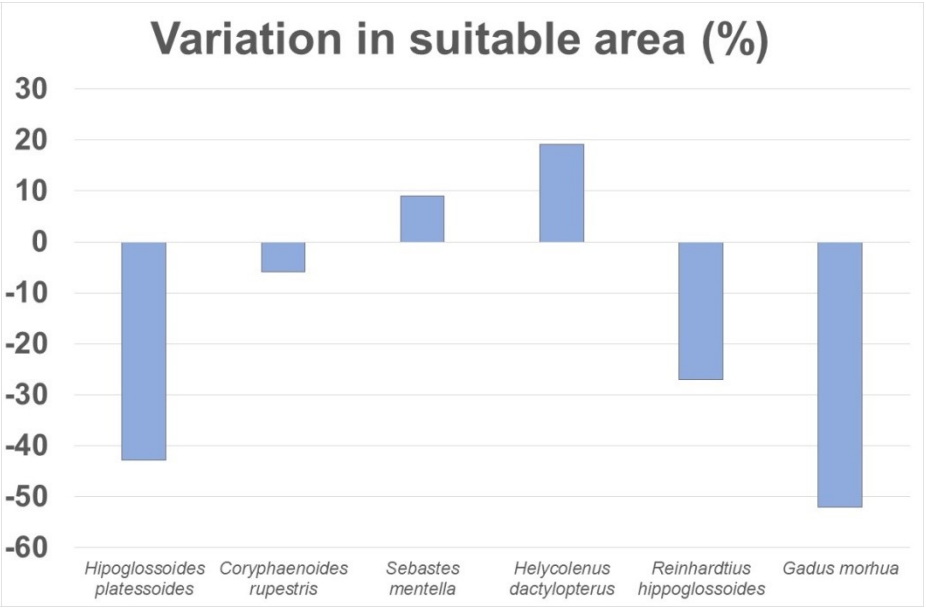
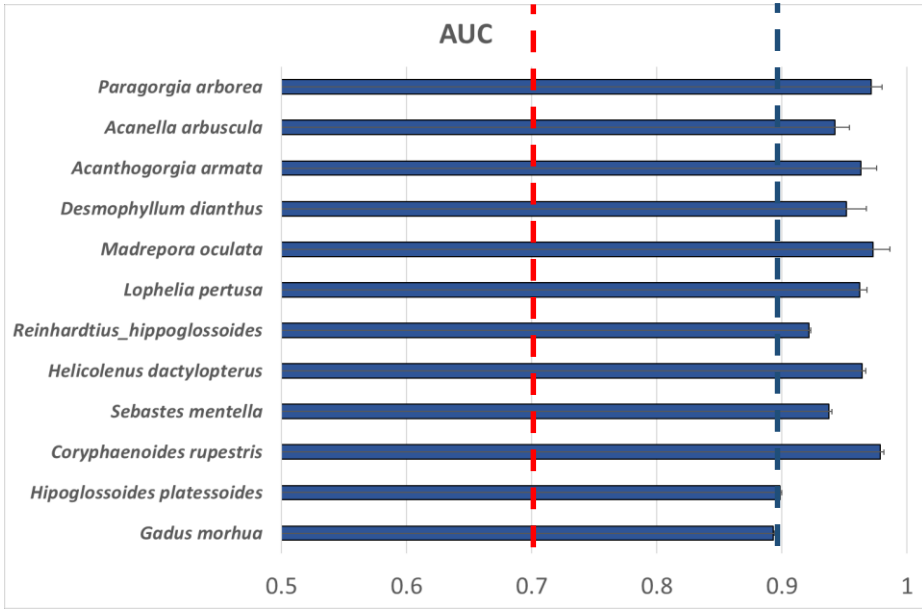


RESULTS:MODEL EVALUATION

CORALS



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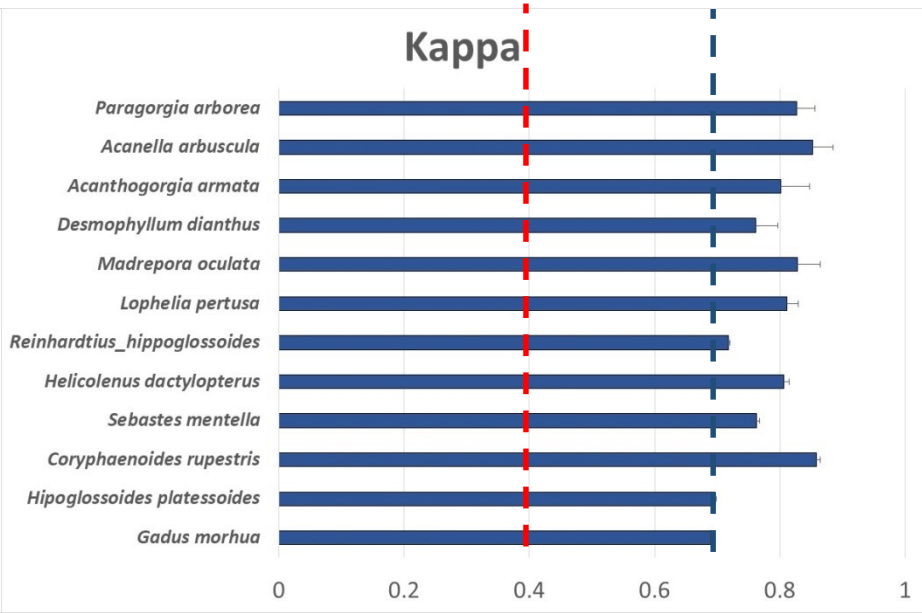

CONCLUSSIONS

1. According to our results corals will suffer severe reductions in the availability of suitable habitat for the period 2081-2100 (close to 100 % for the 3 species of Alcyonacea analysed). The effect on fishes will be highly dependant of the species

2. The 6 fish species analysed showed a polar shift in its distribution whereas changes in depth did not show any clear trend. Corals did not show a clear trend with Latitude or depth.

3. Species distribution model are useful and promising tools to predict how climate change will affect to the deep sea ecosystems. However, at the moment there are still important limitations which greatly reduce the liability of these models:

    1. Presence records biass
    2. Uncertainty in environmental variables (present and especially future)
    3. Lack of important explanatory variables
    4. Coarse resolution

5. Because of all the these limitations caution have to be exercise when interpreting these results

Thank You, Gracias, Obrigado, Merci!

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Marine and Environmental Sciences Centre (MARE), Universidade dos Açores
Departamento de Oceanografia e Pesca
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