Supporting Information

Title: Climate-induced changes in the habitat suitability of cold-water corals and commercially important deep-sea fishes in the North Atlantic

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Supporting Information Appendix S1

Within the scope the H2020 ATLAS project WP3 (Biodiversity and biogeography), a data call was launched to compile an update geo-referenced dataset for twelve species of cold-water corals and fish to perform the ocean basin scale Habitat Suitability Modelling (Table S1). The VME indicator taxa selected included three scleractinian corals that form aragonite skeletons (*Lophelia pertusa[1]*, *Madrepora oculata*, and *Desmophyllum dianthus*), and three octocorals that form calcite skeletons (*Acanella arbuscula*, *Acanthogorgia armata*, and *Paragorgia arborea*). The six deep-sea fish species selected were the commercially harvested roundnose grenadier (*Coryphaenoides rupestris*), Atlantic cod (*Gadus morhua*), blackbelly rosefish (*Helicolenus dactylopterus*), American plaice (*Hippoglossoides platessoides*), Greenland halibut (*Reinhardtius hippoglossoides*), and beaked redfish (*Sebastes mentella*). Partners were asked to share the best available geo-referenced data, including confidential data, and provide with specific acknowledgments to funders, colleagues or others. In order to facilitate the data call, a simple reporting table with the basic information required was prepared. Therefore, georeferenced presence-only records were obtained for twelve species from institutional databases of partners participating in this work (a.k.a the H2020 ATLAS project Database). Here we summarised the occurrence data provided by the different partners and that was used in habitat suitability models.

Supporting Table S1. Geo-referenced data of key benthic species provided by partners in this study used in the basin scale habitat suitability models.

Data provider	VME indicator	Fish	Total
Fisheries and Ocean, Canada (DFO)	11,911	93,359	105,270
Marine and Freshwater Research Institute (MFRI)		44,198	44,198
Temple University, USA (TU)	9,873		9,873
Insituto do Mar, University of the Azores, Portugal (IMAR-UAz)	184	5,447	5,631
L'Institut Français de Recherche pour l'Exploitation de la Mer, France (IFREMER)	3,576	1,828	5,404
School of GeoSciences, University of Edinburgh, UK (UEDIN)	3,947		3,947
Marine Scotland Science, Scotland, UK (MSS)	715	3,047	3,762
Instituto Español de Oceanografía, Centro Oceanográfico de Baleares, Spain (IEO – Maiorca)	1,492	235	1,727
Instituto Español de Oceanografía, Centro Oceanográfico de Vigo, Spain (IEO – Vigo)	520		520
Instituto Español de Oceanografía, Centro Oceanográfico de Málaga, Spain (IEO – Malaga)	136	45	181
Department of Biology, University of Bari Aldo Moro, Italy (UOB)	116		116
Earth and Ocean Sciences, National University of Ireland, Galway, Ireland (NUIG)	53		53
MARUM, Center for Marine Environmental Sciences, University of Bremen, Germany (UNI-HB)	39	14	53
Center for Marine Science, University of North Carolina, Wilmington, USA (UNC-W)	38	8	46
P.P. Shirshov Institute of Oceanology, Russia (P.P. Shirshov)	37		37
TOTAL	**32,637**	**148,181**	**180,818**

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[1] recently synonymised to *Desmophyllum pertusum*, Addamo et al., 2016

Data provider: Fisheries and Oceans (DFO), Canada

Fisheries and Oceans (DFO), Canada, conducts annual research vessel bottom trawl surveys on the Atlantic coast of Canada and in the Eastern Canadian Arctic. These surveys share the basic stratified random sampling design, but use different vessels, trawl gears, and differ on the details of their sampling protocols (Chadwick et al., 2007). Fish and cold-water coral data used in this study was obtained from these surveys, and from optical surveys using ROVs and drop cameras. Here we used data from 1995-2017 from the Newfoundland and Labrador region, 2005-2017 from the Eastern Arctic region and 1978-2016 from the Scotian Shelf and Gulf of Maine.

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DFO Scientific Research (Video) Survey (1999-2003, 2005-2013), Fisheries And Oceans Canada - Maritime Region, Contact: Ellen Kenchington, Ellen.Kenchington@dfo-mpo.gc.ca

Northern Shrimp Trawl Surveys (2005-2017), Fisheries and Oceans Canada - Central and Arctic Region, Contact: Ellen Kenchington, Ellen.Kenchington@dfo-mpo.gc.ca

Research Vessel Multispecies Bottom Trawl Surveys (1970-2018), Fisheries and Oceans Canada - Maritimes Region, Contact: Ellen Kenchington, Ellen.Kenchington@dfo-mpo.gc.ca

Research Vessel Multispecies Bottom Trawl Surveys (2006, 2008-2016), Fisheries And Oceans Canada - Central and Arctic Region, Contact: Ellen Kenchington, Ellen.Kenchington@dfo-mpo.gc.ca

Data provider: Marine and Freshwater Research Institute (MFRI)

Marine and Freshwater Research Institute (MFRI) shared data on the occurrence of *Helicolenus dactylopterus* in Icelandic waters originate from the annual MFRI groundfish surveys carried out in spring and autumn. The spring survey takes place in March (1989 onwards) with around 500 bottom trawl tows obtained annually, mostly in shelf areas. The autumn survey (1996 onwards) takes place in October, with about 300 bottom trawls obtained annually, both on the shelf and in deeper waters (down to 1400 m).

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Data provider: Temple University (TU)

Temple University shared presence data of two live scleractinian species – *Lophelia pertusa* and *Madrepora oculata* – on the mid-Atlantic continental margin of the United States. Presence points were generated from DEEP Sea Exploration to Advance Research on Corals/Canyons/Cold seeps (DEEP SEARCH) and NOAA ship *Okeanos Explorer* expeditions in 2018. Video imagery from two dives with the HOV *Alvin* aboard the R/V *Atlantis* (AL4962 & AL4963), and one dive off the *Okeanos Explorer* with the ROV *Deep Discoverer* (EX1806-7) were annotated and coral presence documented at a s^{-1} temporal resolution; all coral presence data were matched by timestamp to submersible position data.

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Catarino, D., G. Menezes, M.R. Pinho, A. Rosa, O. Melo (2007) Relatório do cruzeiro de Monitorização de Demersais realizado durante a Primavera de 2007 nos Açores (ARQDAÇO-27-P07). Universidade dos Açores, Departamento de Oceanografia e Pescas. Arquivos do DOP: Série Cruzeiros, 1/2007, DOP/UAç AD-87, 19pp.

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Data provider: L'Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER)
Ifremer shared occurrence data on coral taxa that are indicators of VME in the Bay of Biscay. These records were obtained in 24 submarine canyons, from video annotations of 46 dives of the ROV *Victor 6000* and the towed camera *Scampi*, during six cruises carried out between 2009 and 2012 (BobGeo, BobGeo 2, and Evhoe 2009, 2010, 2011 and 2012). In addition, Ifremer shared occurrence data on four species of fish (*Helicolenus dactylopterus*, *Gadus morhua*, *Hippoglossoides platessoides*, *Coryphaenoides rupestris*) from the Bay of Biscay. Those records were obtained using a 36/47 GOV bottom trawl during the multiannual International Bottom Trawl Survey EVHOE. The data provided were extracted from the ICES database DATRAS. The geographic coverage spans the latitude 44°N to 52°N. The bathymetric coverage spans the depth 20 to 800 m.
Acknowledgments: Ifremer wishes to thank the scientific party and crew members involved in the EVHOE cruises as well as the BobGeo and BobEco cruises. The data on VME indicator taxa were produced with funding from the CoralFISH project (FP7 GA 213144).
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Data provider: University of Edinburgh (UEDIN)
UEDIN data provided occurrence of the reef framework-forming coral *Lophelia pertusa* in the North Atlantic from Scottish waters, particularly the inshore Mingulay Reef Complex off Scotland. Data include ROV transects and Van Veen/videograb/boxcore stations.
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Data provider: Marine Scotland Science, Scotland, UK (MSS)

MSS shared occurrence fish data that arose from MSS's Rockall Haddock demersal trawl (1985-present) and Deep Water demersal trawl surveys (1999 – present). While MSS undertake other surveys, for example in the North Sea, these are routinely submitted to DATRAS as part of the IBTS. The data given represent raw numbers based on trawl duration and haven't been standardised on effort. Benthic invertebrate data is routinely submitted by MSS to the ICES VME database. Most, but not all, are bycatch from trawling.

Acknowledgments: MSS data was generated under work funded by the Scottish Government and contain information from the Scottish Government (Marine Scotland) licensed under the Open Government License v3.0. We would like to thank the master and crew of the MRV Scotia for help in sample collection.

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ICES Vulnerable Marine Ecosystem (VME) Database. http://vme.ices.dk. ICES, Copenhagen

Data provider: InstitutoEspañol de Oceanografía (IEO) - Mallorca

IEO-Mallorca shared occurrence data collected during the MEDWAVES (MEDiterranean out flow WAter and Vulnerable EcosystemS) cruise. MEDWAVES was conducted on board the Spanish Research Vessel Sarmiento de Gamboa, took place from the 21st September to the 26th October 2016 and targeted Mediterranean and Atlantic geomorphological features under the potential influence of the Mediterranean Outflow Water (MOW). The main goals of the cruise were: (1) to characterize physically and bio-geochemically the MOW path and understand its interaction with the general Atlantic Meridional Overturning Circulation (AMOC) stream, from the Alborán Sea to the Azores, through the Gulf of Cádiz, and the Ormonde Seamount, exploring the relationship between the oceanographic settings of these target areas and the benthic ecosystems therein and (2) to characterize communities associated with the transition area, and sample for population genetic analysis aiming at understanding the way the populations located in the target areas contribute or have contributed to the connectivity between the Mediterranean Sea and the Atlantic Ocean. Data extracted from ROV video transects conducted with the Liropus ROV, during the MEDWAVES cruise for the following species: *Madrepora oculata*, *Lophelia pertusa*, *Desmophyllum dianthus*, *Solenosmilia variabilis*, *Acanthogorgia* cf. *armata*, *Acanella arbuscula*, *Funiculina quadrangularis*, *Pennatula* cf *aculeata*, *Helicolenus dactylopterus*, and *Coryphaenoides rupestris*.

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Data provider: InstitutoEspañol de Oceanografía (IEO) – Vigo

IEO–Vigo shared occurrence data for *Funiculina quadrangularis* and *Pennatula aculeata* collected during 2007-2017 bottom-trawl groundfish surveys carried out by the IEO jointly with the European Union (EU). Data was originated from three different surveys: i) the EU-Spain & Portugal Flemish Cap survey sampled all the Flemish Cap (NAFO Division 3M); ii) the Spanish 3L survey sampled the "Nose" of the Grand Banks of Newfoundland and the Flemish Pass (NAFO Division 3L) and iii) the EU-Spain 3NO sampling the Grand Banks of Newfoundland (NAFO Division 3NO).

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Data provider: Instituto Español de Oceanografía (IEO) – Málaga

IEO-Málaga shared occurrence data on *Madrepora oculata*, *Lophelia pertusa*, *Funiculina quadrangularis*, *Pennatula aculeata* and *Helicolenus dactylopterus* for the Gulf of Cádiz and the Alborán Sea. These data were obtained using samples and underwater images of different expeditions (INDEMARES-CHICA, ISUNEPCA, MEDWAVES). Samples of some of those species were obtained with a beam-trawl (2 m width, 60 cm height, 1cm mesh size) in the INDEMARES-

CHICA expeditions in 2010 and 2011. In following years, underwater images were obtained with a Remotely Operated Vehicle (ROV) LIROPUS 2000 (INDEMARES-CHICA 0412, MEDWAVES) and one Underwater Camera Sled HORUS (UCSH) (ISUNEPCA expeditions from 2014 to 2017). Seafloor observations were generally captured between 0.5 and 2.5 m from the seafloor, for 1-3 hours (ROV), 0.6-1 hour (UCSA) and 10-15 minutes (UCSH) per transect. Underwater images were georeferenced with a transponder that allowed the determination of their position in relation to the research vessel along each transect.

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Data provider: University of Bari Aldo Moro (UOB)

University of Bari Aldo Moro (UOB) shared Mediterranean occurrence and distribution data of the colonial cold-water coral species *Madrepora oculata* and *Lophelia pertusa*, as well as the solitary coral *Desmophyllum dianthus* (Chimienti et al. 2018). Data was gathered by a multisource approach including research papers, conference proceedings, project reports and unpublished data (Chimienti et al., 2019 and references therein).

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Chimienti G, Bo M, Mastrototaro F (2018) Know the distribution to assess the changes: Mediterranean cold-water coral bioconstructions. Rend Lincei Sci Fis Nat 29:583–588. https://doi.org/10.1007/s12210-018-0718-3

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Data provider: National University of Ireland, Galway (NUIG)

NUIG shared occurrence (presence-only) data of living *Lophelia pertusa* reefs in the Irish continental margin, which were assembled from databases, cruise reports and publications. A total of 4423 records were inspected and quality assessed to ensure that they (1) represented confirmed living *L. pertusa* reefs (so excluding 2900 records of dead and isolated coral colony records); (2) were derived from sampling equipment that allows for accurate (<200 m) geo-referencing (so excluding 620 records derived mainly from trawling and dredging activities); and (3) were not duplicated. The remaining coral observations were highly clustered in regions targeted by research expeditions (which might lead to falsely inflated model evaluation measures), so the data were therefore coarsened by deleting all but one record within grid cells of 0.02 resolution. The final dataset comprised 53 records of living *Lophelia pertusa* reefs.

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Data provider: MARUM, University of Bremen, Germany (UNI-HB)

MARUM UNI-HB data provided are based on four expeditions to various regions at the Irish margin (Ratmeyer et al., 2006; Wienberg et al., 2008), the Gulf of Cadiz (Hebbeln et al., 2008; Wienberg et al., 2013), the Alboran Sea (Hebbeln et al., 2009), and the southeastern Gulf of Mexico (Hebbeln et al., 2012; 2014). During all these expeditions, an ROV has been deployed to allow for detailed in-situ observations of cold-water coral settings at the sea floor.

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Data provider: University of North Carolina, Wilmington, USA (UNC-W)

UNC-W provided occurrence data for selected coral and fish species occurring in the area roughly from off Cape Lookout, NC to Baltimore Canyon (100-1600 m) from numerous research cruises conducted by S.W. Ross from 1991 through 2013. The most intense study sites were the Cape Lookout coral banks (Ross and Nizinski 2007), The Hatteras Middle Slope (Sulak and Ross 1996), and Norfolk and Baltimore canyons (CSA et al. 2017). These cruises collected species occurrence data using HOVs, ROVs (video plus collections) and various nets. Basic oceanographic data (e.g., CTD data) were also collected. The cruises generally targeted complex habitats, including coral bioherms, canyons, seeps, and rocky reefs, but surrounding soft bottoms were also surveyed. Benthic terrain of all study areas had been mapped with multibeam sonars.

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Brooke, S.D., M.W. Watts, A.D. Heil, M. Rhode, F. Mienis, G.C.A. Duineveld, A.J. Davies and S.W. Ross. 2017. Distributions and habitat associations of deep water corals in Norfolk and Baltimore canyons, Mid-Atlantic Bight, USA. Deep-Sea Res. II. 137: 131-147.

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Data provider: P.P. Shirshov Institute of Oceanology RAS

P.P. Shirshov Institute of Oceanology RAS (IORAS) provided data on cold-water corals from the Mid-Atlantic Ridge and Reykjanes Ridge, and adjacent area based on long-term deep-sea biological collection of IORAS including trawls and HOVs samples (some of samples were also reported by Keller, 1984, 1985; Pasternak, 1985) and also collaborative MARECO cruise (reported by Molodtsova et al., 2008).

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Supplementary Tables

Supplementary Table S2. Model performance statistics for the different modelling approaches. The ability of the training data to predict the probability of presence was tested with different statistical metrics using the maximum sensitivity and specificity (MSS) threshold. The weighting factor (W_f) used to produce the ensemble model outputs are also shown.

| Species	Modelling approach	Relative importance		
		AUC	TSS	W_f
Lophelia pertusa	GAM	0.86±0.10	0.64±0.18	0.32
	Maxent	0.89±0.06	0.69±0.13	0.34
	RF	0.90±0.07	0.66±0.14	0.33
Madrepora oculata	GAM	0.88±0.07	0.70±0.15	0.33
	Maxent	0.90±0.06	0.71±0.13	0.34
	RF	0.90±0.06	0.70±0.13	0.33
Desmophyllum dianthus	GAM	0.90±0.06	0.70±0.13	0.32
	Maxent	0.93±0.04	0.76±0.09	0.34
	RF	0.94±0.02	0.79±0.05	0.32
Acanthogorgia armata	GAM	0.92±0.06	0.77±0.10	0.34
	Maxent	0.93±0.05	0.78±0.12	0.34
	RF	0.91±0.06	0.73±0.15	0.34
Acanella arbuscula	GAM	0.86±0.05	0.63±0.11	0.32
	Maxent	0.88±0.04	0.66±0.13	0.33
	RF	0.90±0.05	0.69±0.12	0.33
Paragorgia arborea	GAM	0.89±0.10	0.68±0.22	0.32
	Maxent	0.93±0.08	0.75±0.17	0.34
	RF	0.90±0.12	0.73±0.19	0.33
Helicolenus dactylopterus	GAM	0.97±0.02	0.85±0.05	0.33
	Maxent	0.98±0.01	0.87±0.04	0.34
	RF	0.97±0.02	0.82±0.04	0.33
Sebastes mentella	GAM	0.98±0.01	0.85±0.03	0.34
	Maxent	0.97±0.01	0.84±0.01	0.33
	RF	0.97±0.01	0.84±0.01	0.33
Gadus morhua	GAM	0.95±0.02	0.81±0.03	0.34
	Maxent	0.94±0.02	0.79±0.01	0.33
	RF	0.95±0.03	0.78±0.14	0.34
Hippoglossoides platessoides	GAM	0.94±0.02	0.79±0.06	0.34
	Maxent	0.93±0.01	0.80±0.03	0.34
	RF	0.94±0.04	0.71±0.16	0.34
Reinhardtius hippoglossoides	GAM	0.87±0.01	0.61±0.02	0.33
	Maxent	0.87±0.01	0.62±0.02	0.33
	RF	0.87±0.01	0.62±0.02	0.33
Coryphaenoides rupestris	GAM	0.99±0.01	0.92±0.02	0.33
	Maxent	0.99±0.00	0.92±0.02	0.33
	RF	0.99±0.01	0.91±0.04	0.33

Supplementary Table S3. Importance of each variable to the individual habitat suitability models predictions, measured as 1-Pearson correlation, for six species of Vulnerable Marine Ecosystem indicators and six deep-sea fish in the North Atlantic Ocean. Predictor variable were depth, slope, Bathymetric Position Index (BPI), temperature at seafloor (Temp), particulate organic carbon flux to seafloor (POC), and Aragonite (Ωar) and Calcite (Ωcal) saturation state at seafloor. Modelling approaches used were: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF).

Species	Modelling approach	Relative importance						
		Depth	*Slope*	*BPI*	*Temp*	*POC*	*Ωar*	*Ωcal*
Lophelia pertusa	GAM	-	0.02±0.00	0.01±0.00	0.34±0.01	0.13±0.00	0.55±0.01	-
	Maxent	-	0.06±0.00	0.02±0.00	0.59±0.01	0.35±0.01	0.17±0.00	-
	RF	-	0.11±0.00	0.13±0.00	0.31±0.01	0.29±0.01	0.35±0.00	-
Madrepora oculata	GAM	-	0.04±0.00	0.01±0.00	0.44±0.01	0.49±0.01	0.09±0.00	-
	Maxent	-	0.21±0.01	0.06±0.00	0.65±0.02	0.37±0.01	0.08±0.00	-
	RF	-	0.22±0.01	0.13±0.01	0.31±0.01	0.35±0.01	0.24±0.01	-
Desmophyllum dianthus	GAM	-	0.09±0.00	0.01±0.00	0.26±0.00	0.76±0.01	0.07±0.00	-
	Maxent	-	0.38±0.01	0.04±0.00	0.62±0.02	0.38±0.01	0.06±0.00	-
	RF	-	0.35±0.01	0.09±0.00	0.44±0.02	0.30±0.01	0.20±0.01	-
Acanthogorgia armata	GAM	-	0.03±0.00	0.01±0.00	0.07±0.00	0.05±0.01	-	0.42±0.01
	Maxent	-	0.30±0.01	0.02±0.00	0.19±0.01	0.54±0.02	-	0.47±0.02
	RF	-	0.24±0.01	0.12±0.00	0.18±0.01	0.29±0.01	-	0.17±0.01
Acanella arbuscula	GAM	-	0.01±0.00	0±0	0.06±0.00	0.03±0.00	-	0.55±0.01
	Maxent	-	0.11±0.00	0.01±0.00	0.21±0.01	0.38±0.01	-	0.44±0.01
	RF	-	0.15±0.00	0.08±0.00	0.25±0.01	0.22±0.01	-	0.24±0.01
Paragorgia arborea	GAM	-	0±0	0.01±0.00	0.03±0.00	0.01±0.00	-	0.74±0.01
	Maxent	-	0.05±0.00	0.08±0.00	0.19±0.01	0.65±0.01	-	0.72±0.02
	RF	-	0.12±0.00	0.14±0.01	0.24±0.01	0.39±0.01	-	0.29±0.01
Helicolenus dactylopterus	GAM	0.95±0.01	0.47±0.00	0.48±0.00	0.48±0.00	0.47±0.00	-	-
	Maxent	0.65±0.01	0.01±0.00	0.01±0.00	0.42±0.00	0.11±0.00	-	-
	RF	0.32±0.00	0.02±0.00	0.07±0.00	0.46±0.01	0.12±0.00	-	-
Sebastes mentella	GAM	0.93±0.00	0.48±0.00	0.49±0.00	0.54±0.00	0.52±0.00	-	-
	Maxent	0.62±0.01	0±0	0±0	0.32±0.00	0.57±0.00	-	-
	RF	0.41±0.00	0.01±0.00	0.04±0.00	0.29±0.00	0.19±0.00	-	-
Gadus morhua	GAM	0.89±0.00	0.37±0.00	0.37±0.00	0.45±0.00	0.40±0.00	-	-
	Maxent	0.71±0.00	0±0	0±0	0.18±0.00	0.51±0.00	-	-
	RF	0.52±0.00	0.07±0.00	0.06±0.00	0.17±0.00	0.30±0.00	-	-
Hippoglossoides platessoides	GAM	0.75±0.00	0.31±0.00	0.29±0.00	0.46±0.00	0.33±0.00	-	-
	Maxent	0.67±0.00	0±0	0±0	0.21±0.00	0.57±0.00	-	-
	RF	0.50±0.00	0.05±0.00	0.05±0.00	0.20±0.00	0.33±0.00	-	-
Reinhardtius hippoglossoides	GAM	0.97±0.00	0.64±0.00	0.64±0.00	0.67±0.00	0.66±0.00	-	-
	Maxent	0.59±0.00	0.01±0.00	0±0	0.39±0.00	0.55±0.00	-	-
	RF	0.35±0.00	0.01±0.00	0.04±0.00	0.38±0.00	0.29±0.00	-	-
Coryphaenoides rupestris	GAM	0.88±0.01	0.48±0.00	0.47±0.00	0.48±0.00	0.49±0.00	-	-
	Maxent	0.61±0.01	0.07±0.00	0±0	0.04±0.00	0.49±0.01	-	-
	RF	0.51±0.00	0.08±0.00	0.02±0.00	0.09±0.00	0.27±0.00	-	-

Supplementary Figures
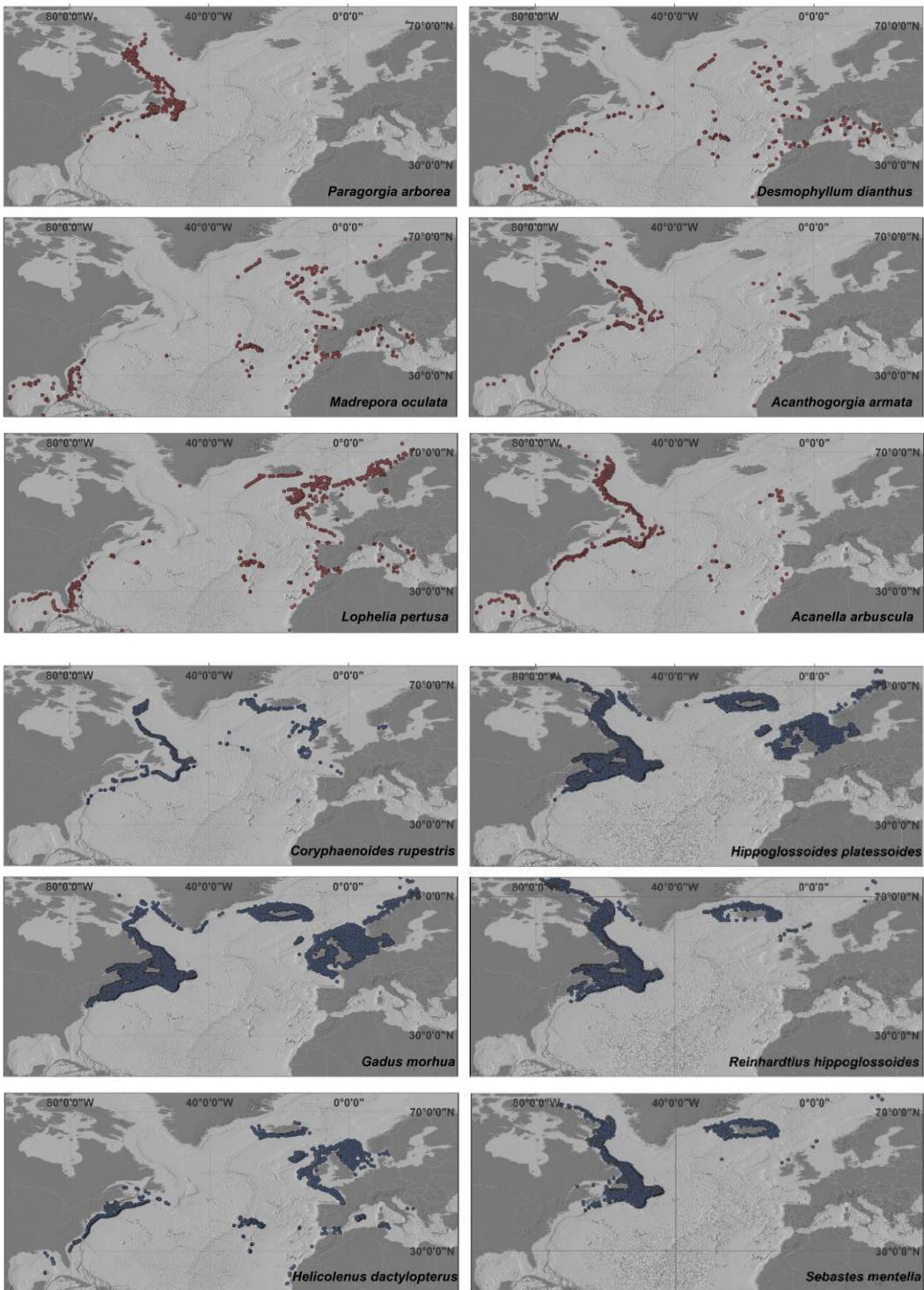
Supplementary Figure S1. Georeferenced presence-only records obtained for the twelve species of cold-water corals and commercially important deep-sea fish in the North Atlantic Ocean from institutional and public databases.
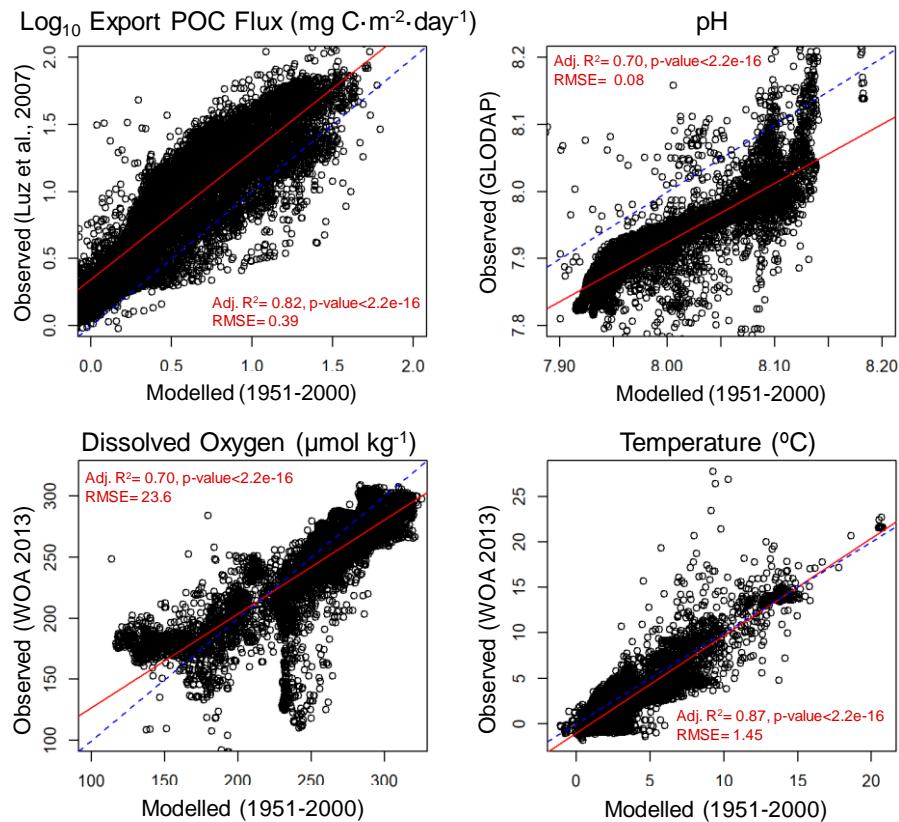
Supplementary Figure S2. Evaluation of the historical modelled (1951-2000) at seabed environmental layers' against field observations. The correlation between the modelled and observed climatological mean were evaluated with the root-mean-square error (RMSE) and the Adjusted R-squared. The simulated values of POC-flux were compared against Lutz et al. (2007) estimates based sediment trap, and remotely sensed estimates of net primary production and sea surface temperature. Dissolved oxygen, pH and temperature were compared against the World Ocean Atlas 2013 (WOA13; Garcia et al., 2013), GLODAP (Olsen et al., 2016; 2019), and WOA13 (Locarnini et al., 2013), respectively. Errors in accuracy and precision have been described to be insufficient to offset the projected changes (e.g. Mora et al., 2013). Blue lines show 1:1 relationship.

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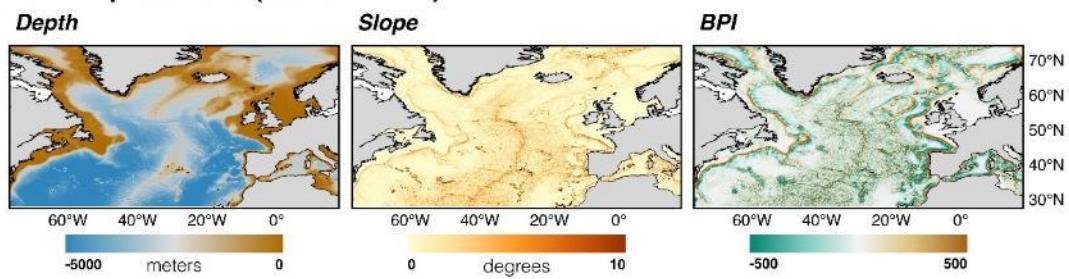
Supplementary Figure S3. Environmental predictors used to develop environmental niche models for present-day conditions and forecast habitat suitability under future environmental conditions in the North Atlantic Ocean.
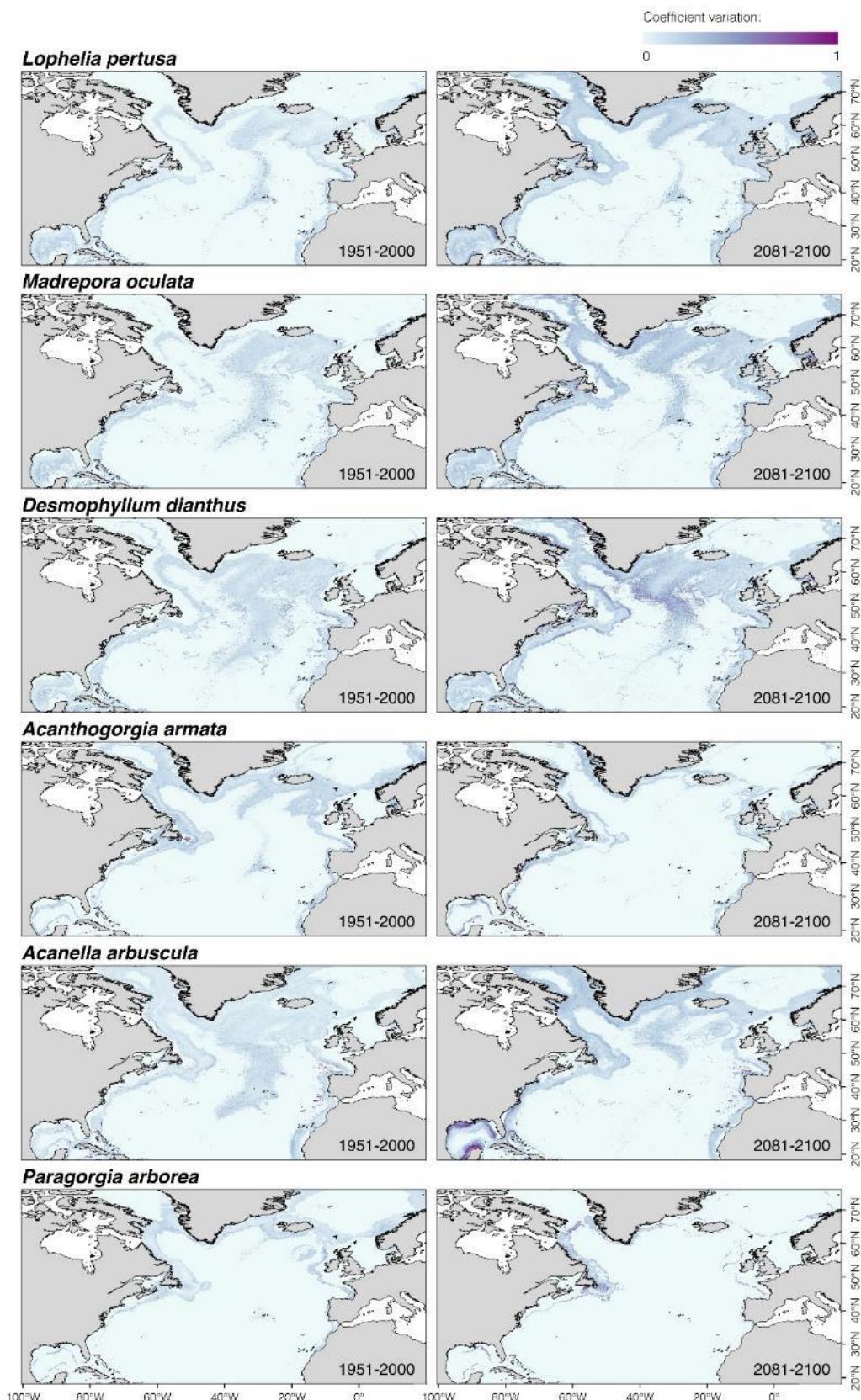
Supplementary Figure S4a. Uncertainty associated to the habitat suitability model predictions under present-day (1951-2000) and future (2081-2100; RCP8.5 or business-as-usual scenario) environmental conditions for cold-water corals in the North Atlantic Ocean using an ensemble modelling approach.
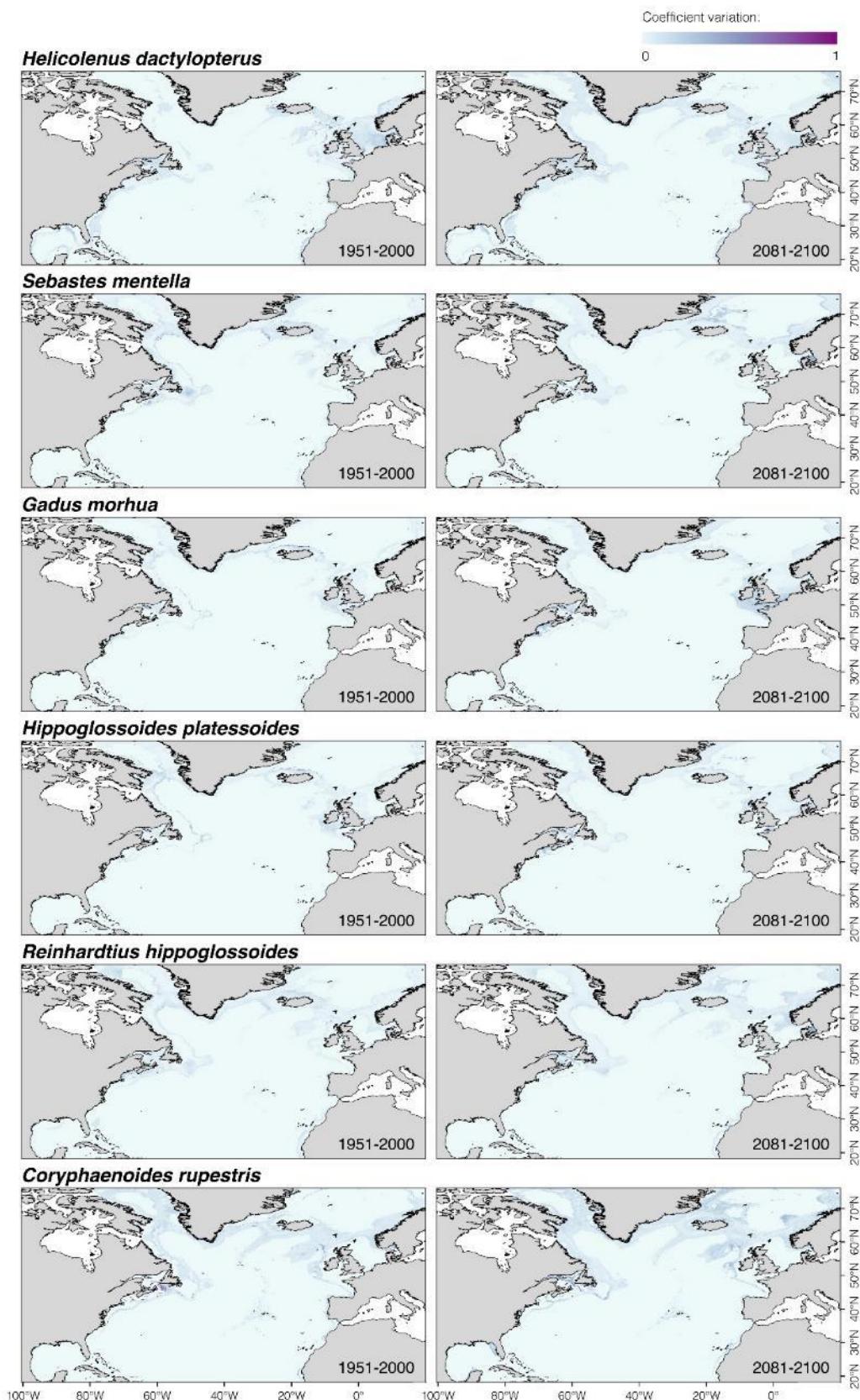
Supplementary Figure S4b. Uncertainty associated to the habitat suitability model predictions under present-day (1951-2000) and future (2081-2100; RCP8.5 or business-as-usual scenario) environmental conditions for cold-water corals in the North Atlantic Ocean using an ensemble modelling approach.
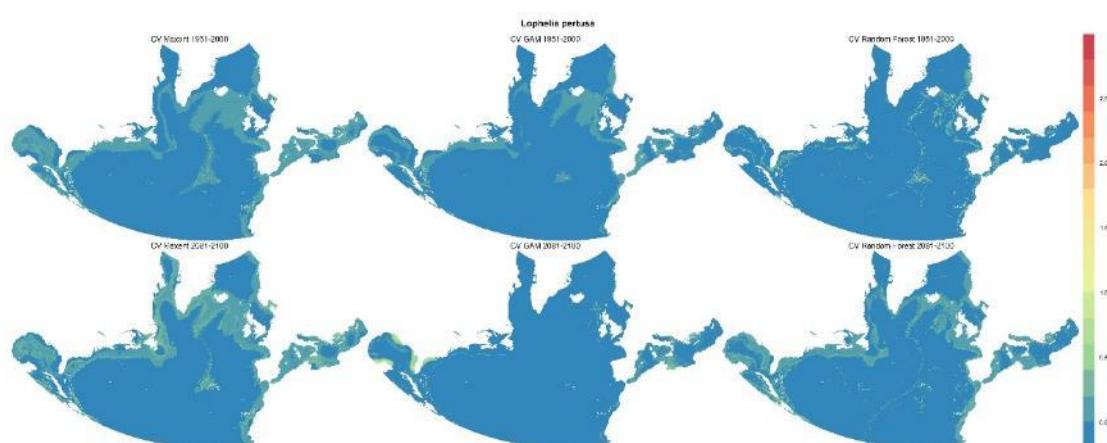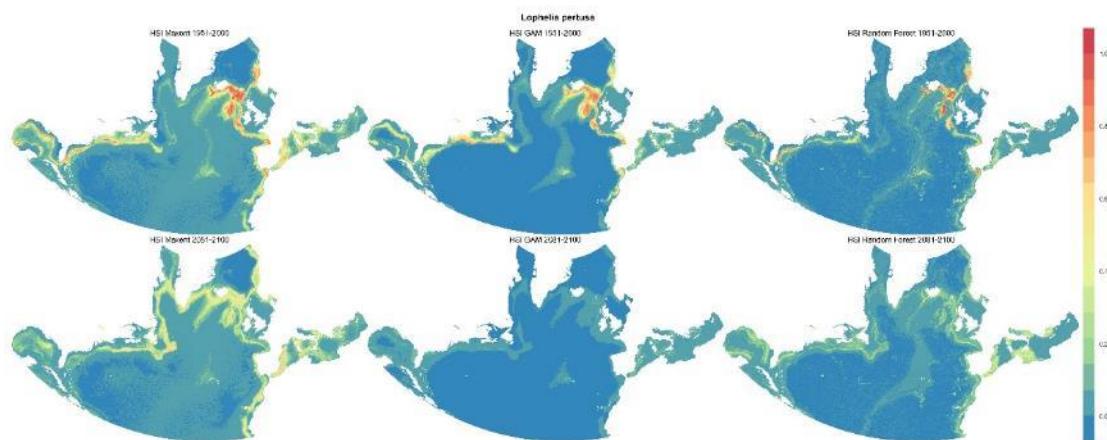
Supplementary Figure S5a. Predicted habitat suitability index (top) and Coefficient of Variance (CV; bottom) under present-day (1951-2000) and future (2081-2100; RCP8.5 or business-as-usual scenario) environmental conditions for the scleractinian coral *Lophelia pertusa* in the North Atlantic Ocean using three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF).
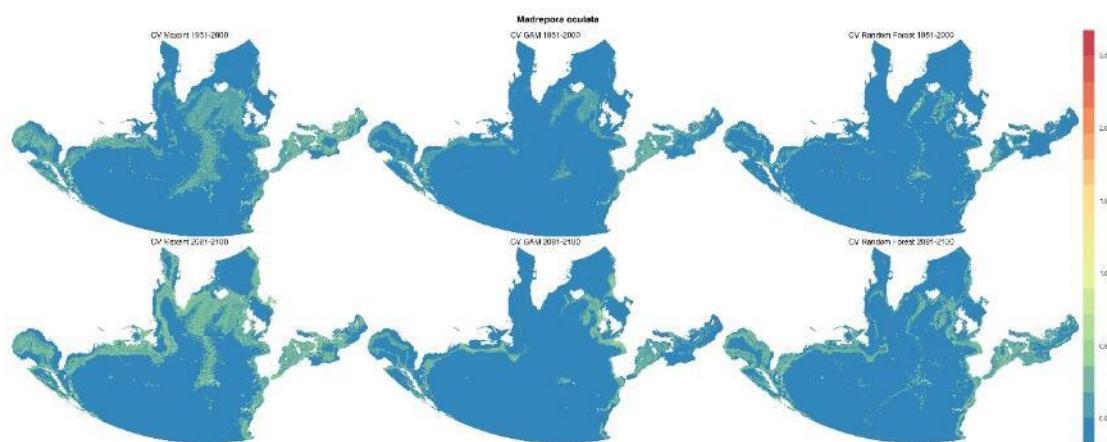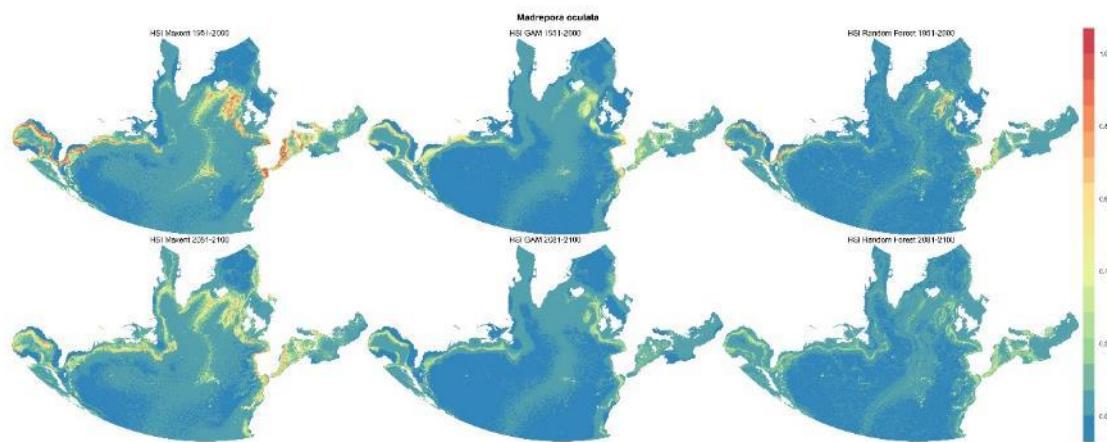
Supplementary Figure S5b. Predicted habitat suitability index (top) and Coefficient of Variance (CV; bottom) under present-day (1951-2000) and future (2081-2100; RCP8.5 or business-as-usual scenario) environmental conditions for the scleractinian coral *Madrepora oculata* in the North Atlantic Ocean using three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF).
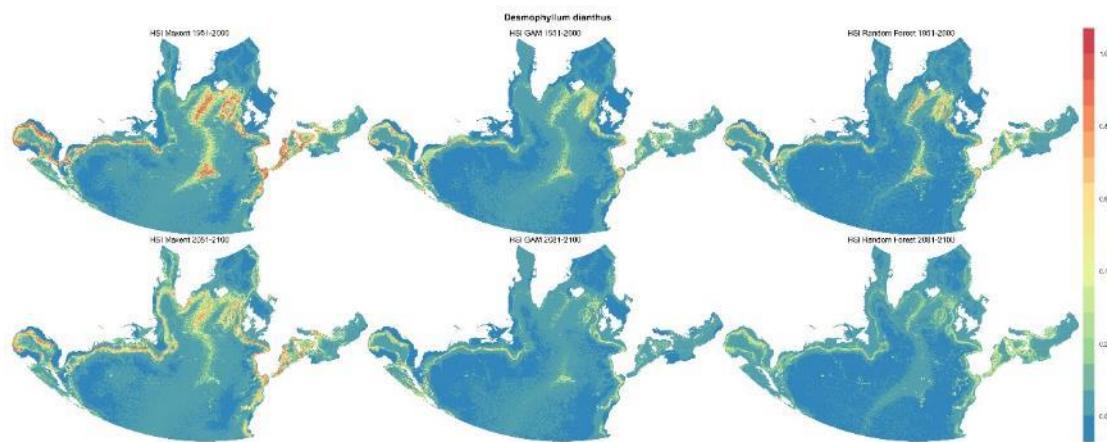
Supplementary Figure S5c. Predicted habitat suitability index (top) and Coefficient of Variance (CV; bottom) under present-day (1951-2000) and future (2081-2100; RCP8.5 or business-as-usual scenario) environmental conditions for scleractinian coral *Desmophyllum dianthus* in the North Atlantic Ocean using three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF).
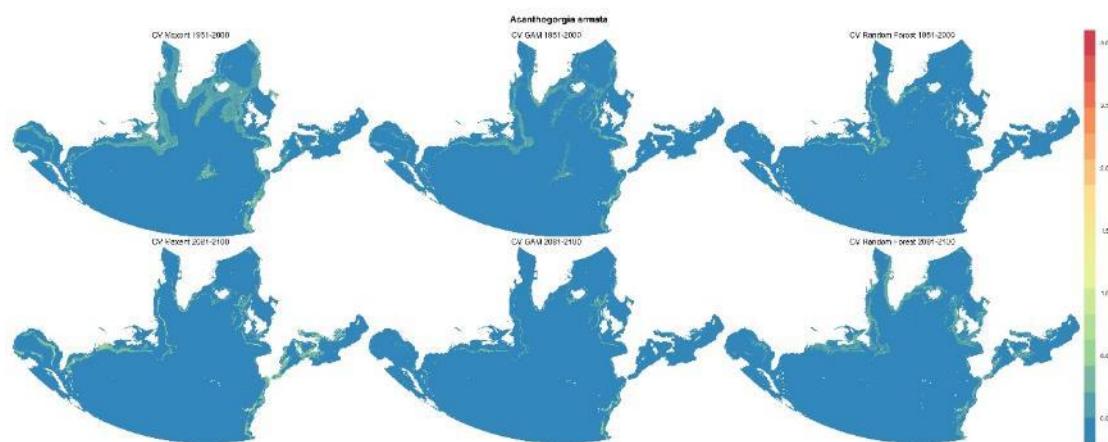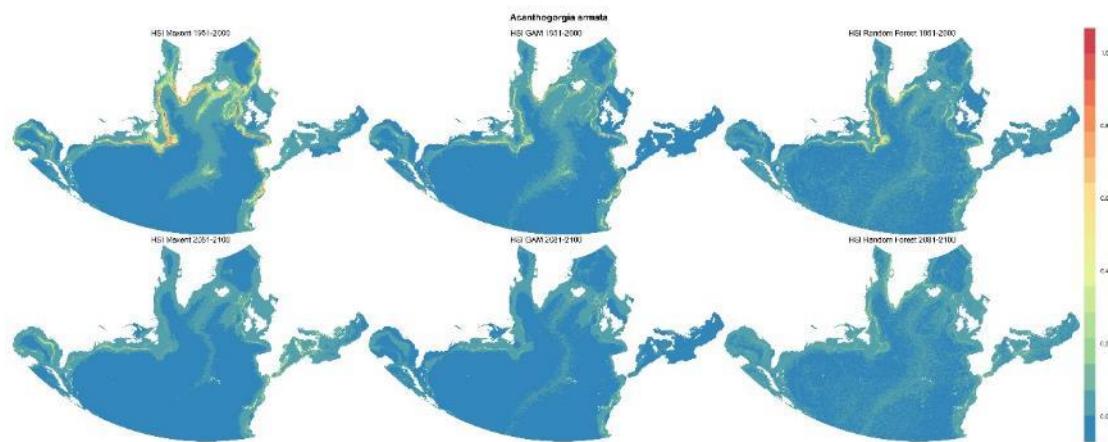
Supplementary Figure S5d. Predicted habitat suitability index (top) and Coefficient of Variance (CV; bottom) under present-day (1951-2000) and future (2081-2100; RCP8.5 or business-as-usual scenario) environmental conditions for the octocoral *Acanthogorgia armata* in the North Atlantic Ocean using three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF).
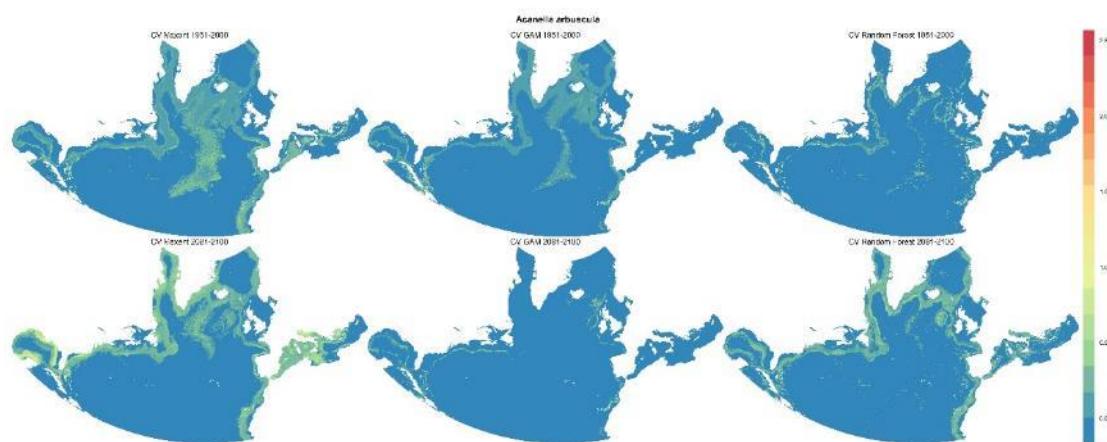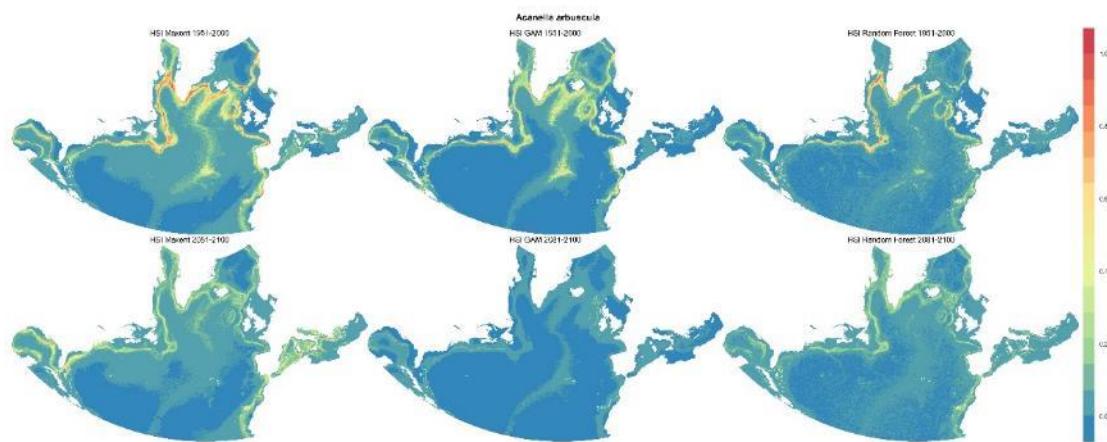
Supplementary Figure S5e. Predicted habitat suitability index (top) and Coefficient of Variance (CV; bottom) under present-day (1951-2000) and future (2081-2100; RCP8.5 or business-as-usual scenario) environmental conditions for the octocoral *Acanella arbuscula* in the North Atlantic Ocean using three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF).
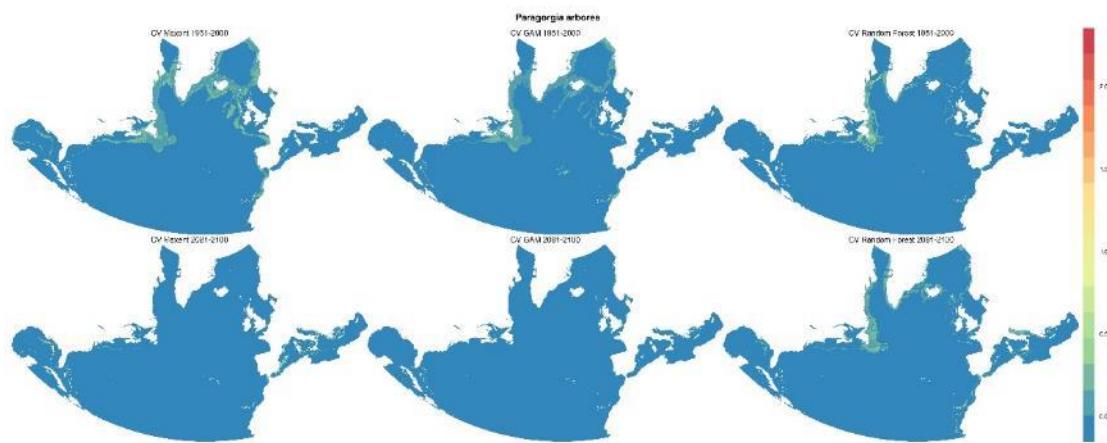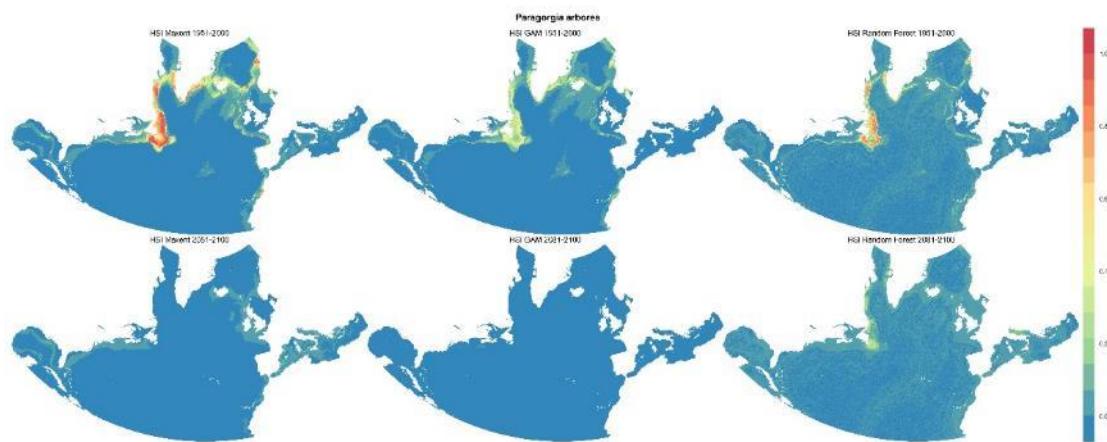
Supplementary Figure S5f. Predicted habitat suitability index (top) and Coefficient of Variance (CV; bottom) under present-day (1951-2000) and future (2081-2100; RCP8.5 or business-as-usual scenario) environmental conditions for the octocoral *Paragorgia arborea* in the North Atlantic Ocean using three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF).
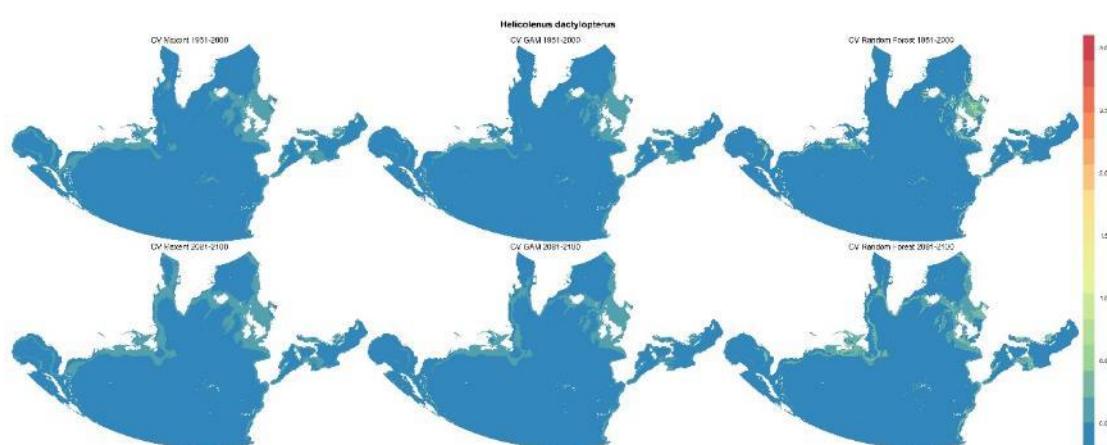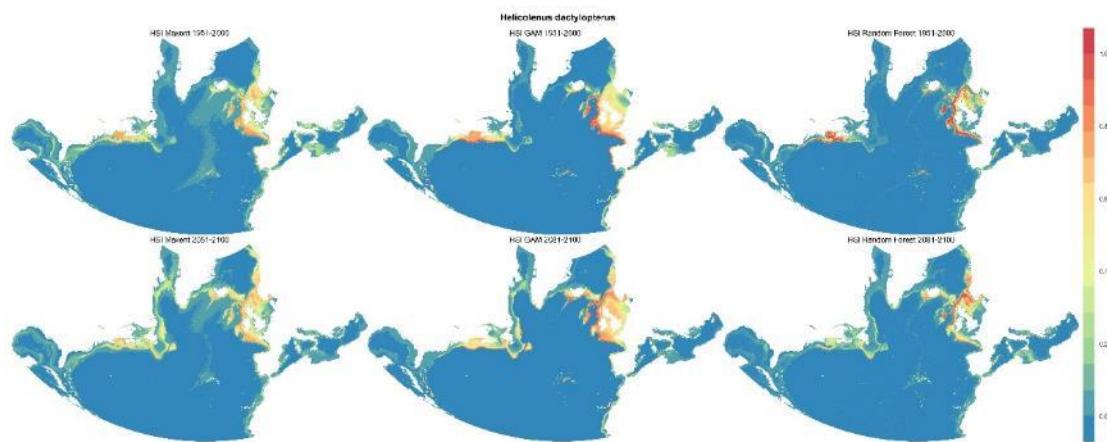
Supplementary Figure S5g. Predicted habitat suitability index (top) and Coefficient of Variance (CV; bottom) under present-day (1951-2000) and future (2081-2100; RCP8.5 or business-as-usual scenario) environmental conditions for the commercially important deep-sea fish *Helicolenus dactylopterus* in the North Atlantic Ocean using three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF).
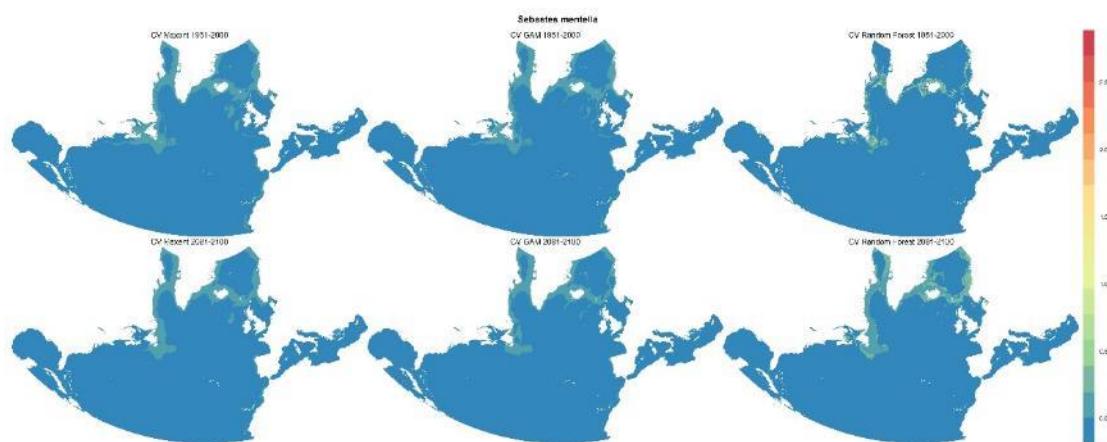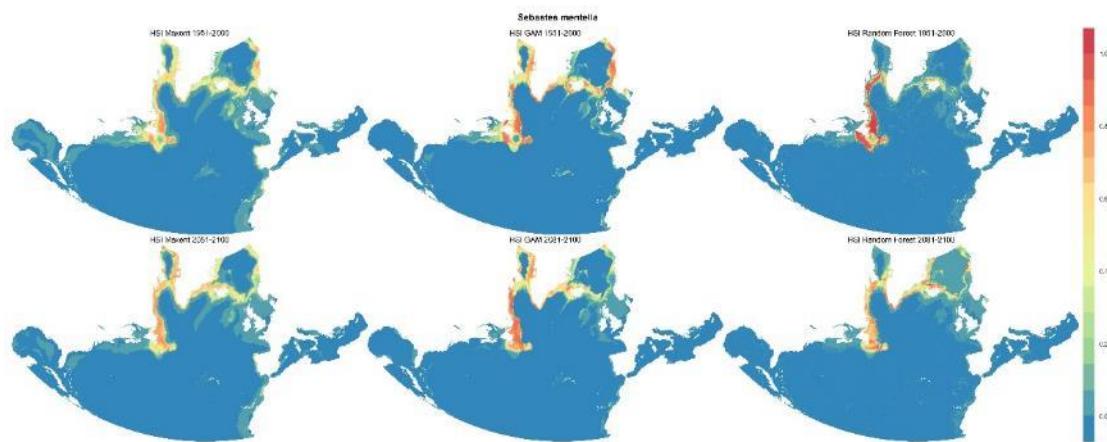
Supplementary Figure S5h. Predicted habitat suitability index (top) and Coefficient of Variance (CV; bottom) under present-day (1951-2000) and future (2081-2100; RCP8.5 or business-as-usual scenario) environmental conditions for the commercially important deep-sea fish *Sebastes mentella* in the North Atlantic Ocean using three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF).
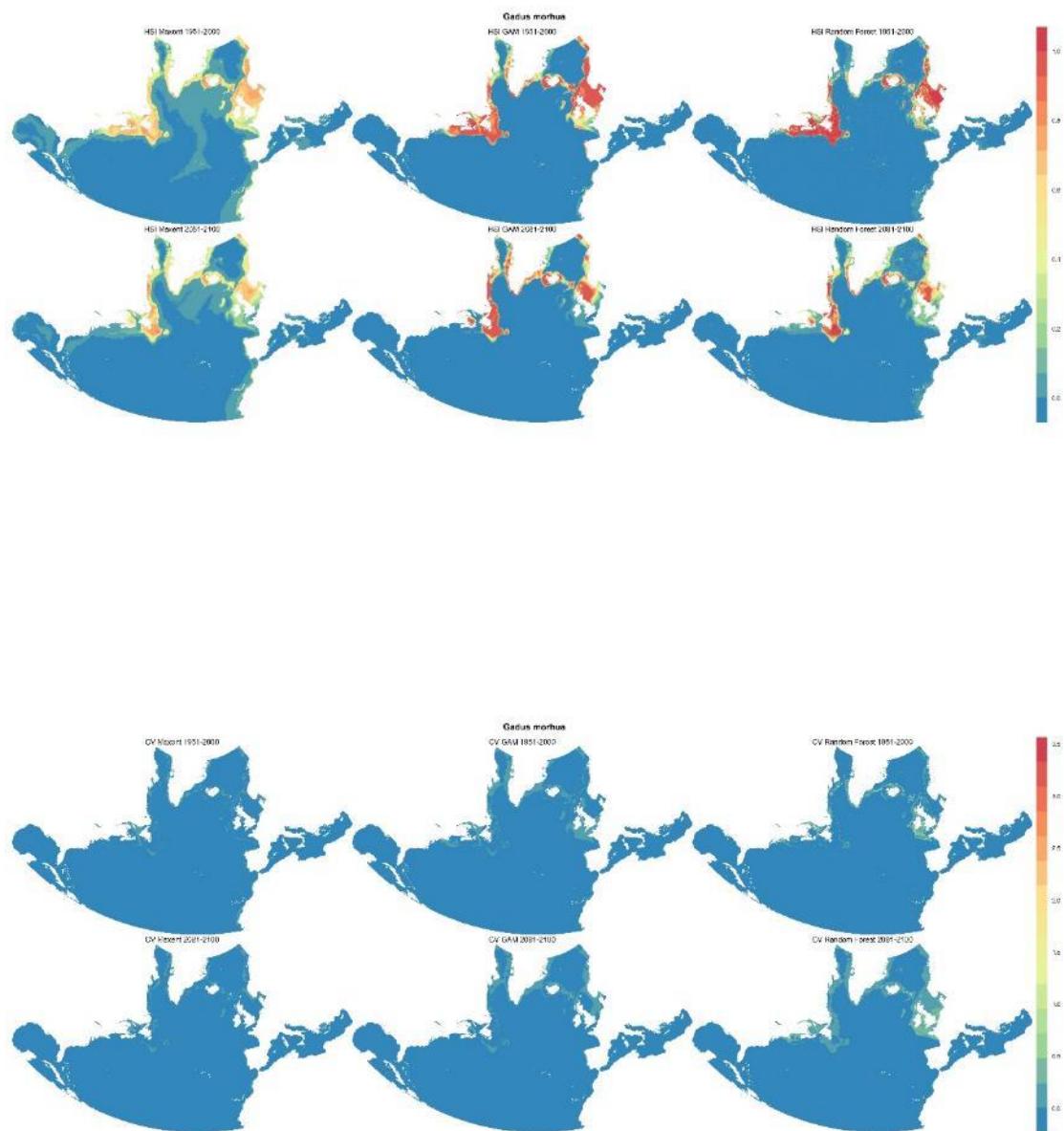
Supplementary Figure S5i. Predicted habitat suitability index (top) and Coefficient of Variance (CV; bottom) under present-day (1951-2000) and future (2081-2100; RCP8.5 or business-as-usual scenario) environmental conditions for the commercially important deep-sea fish *Gadus morhua* in the North Atlantic Ocean using three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF).
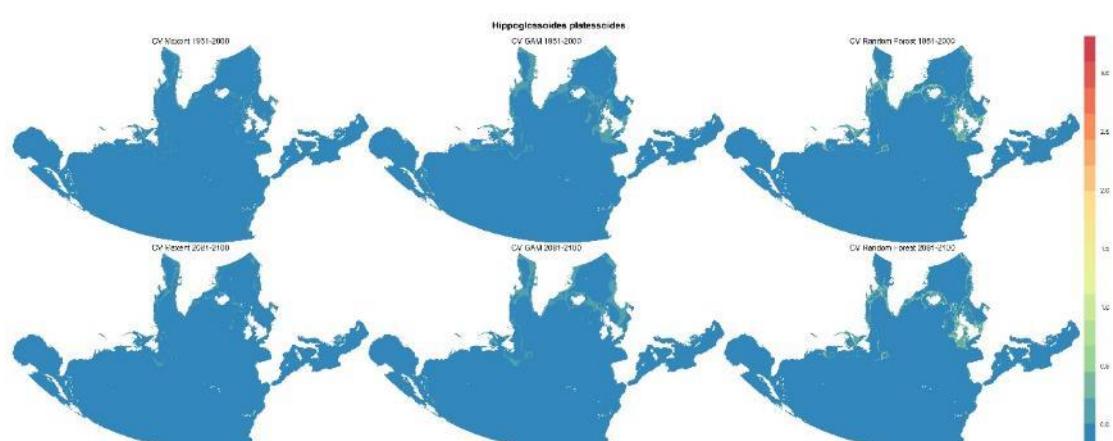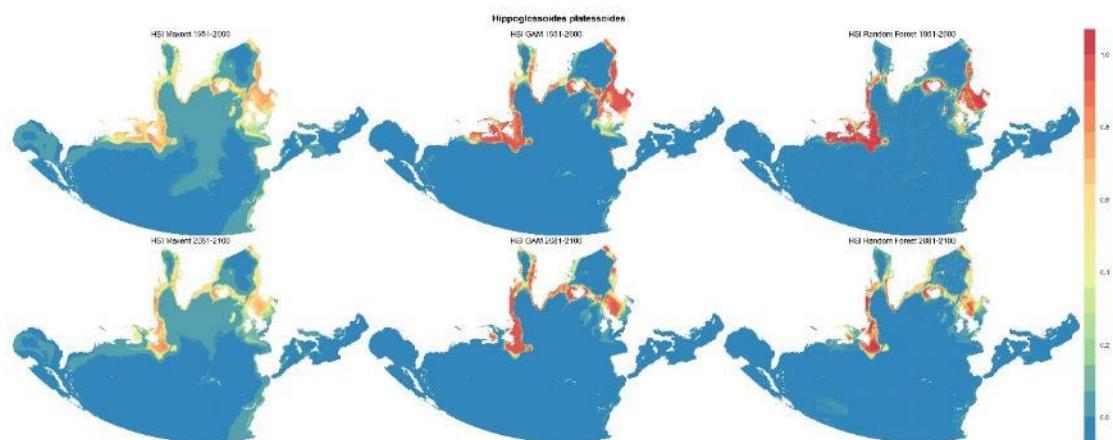
Supplementary Figure S5j. Predicted habitat suitability index (top) and Coefficient of Variance (CV; bottom) under present-day (1951-2000) and future (2081-2100; RCP8.5 or business-as-usual scenario) environmental conditions for the commercially important deep-sea fish *Hippoglossoides platessoides* in the North Atlantic Ocean using three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF).
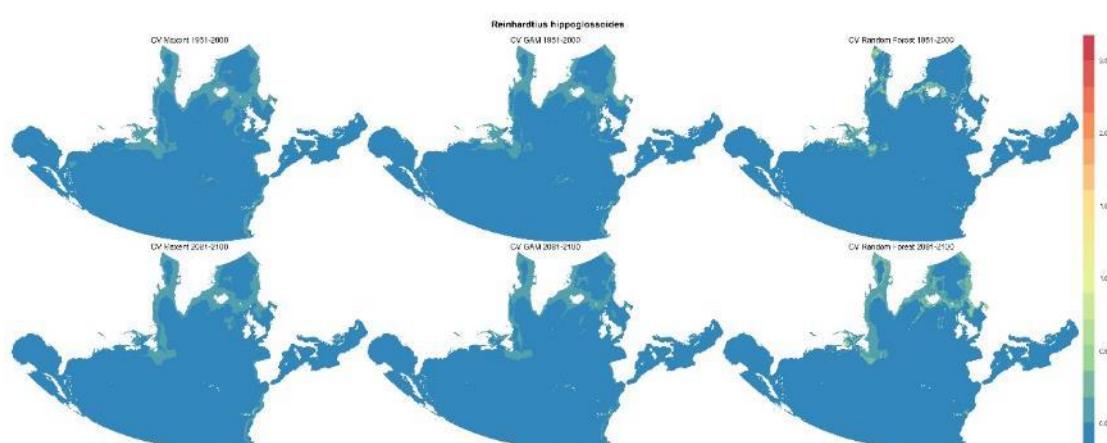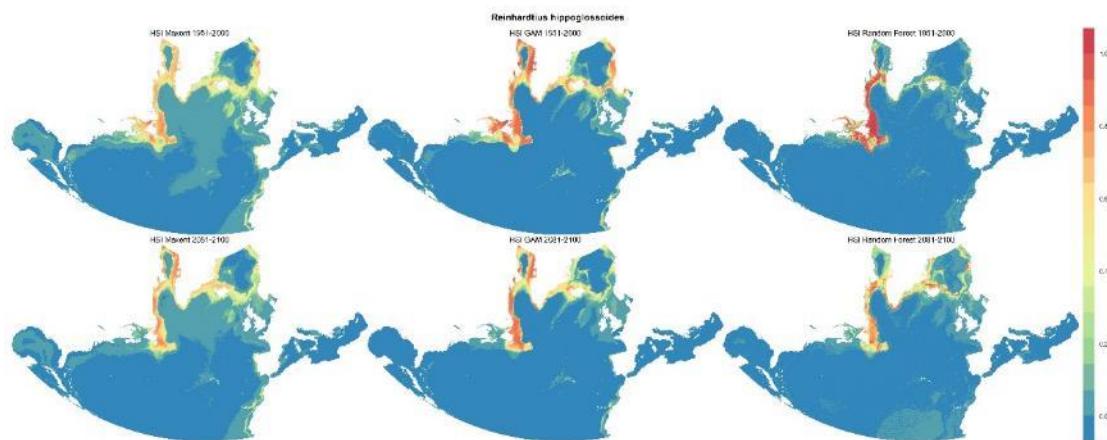
Supplementary Figure S5k. Predicted habitat suitability index (top) and Coefficient of Variance (CV; bottom) under present-day (1951-2000) and future (2081-2100; RCP8.5 or business-as-usual scenario) environmental conditions for the commercially important deep-sea fish *Reinhardtius hippoglossoides* in the North Atlantic Ocean using three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF).
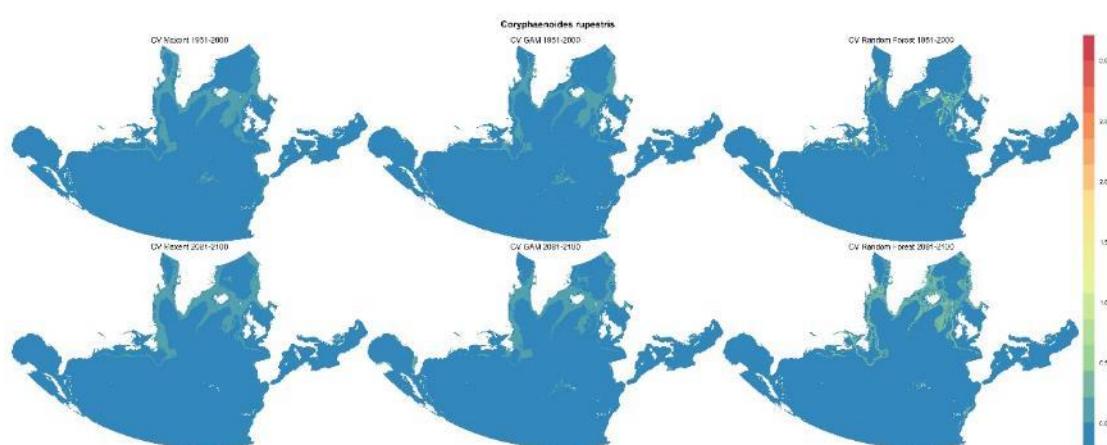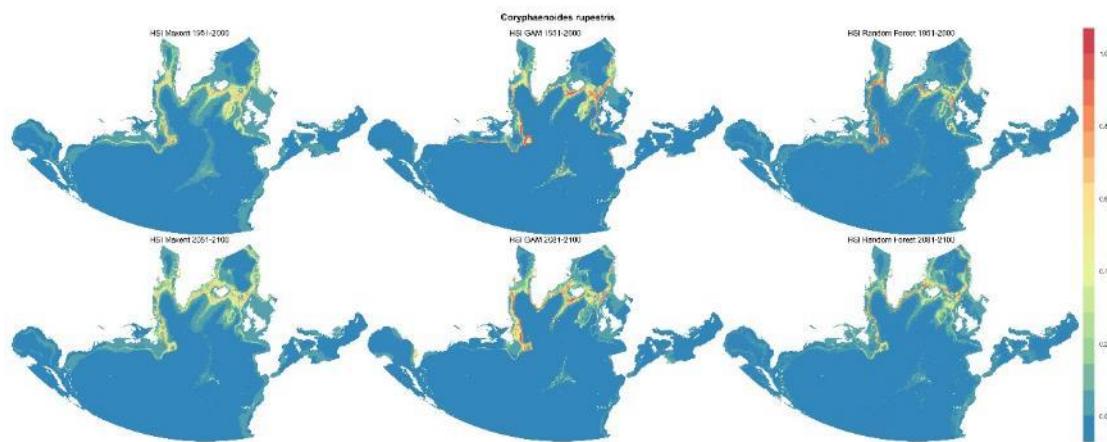
Supplementary Figure S5l. Predicted habitat suitability index (top) and Coefficient of Variance (CV; bottom) under present-day (1951-2000) and future (2081-2100; RCP8.5 or business-as-usual scenario) environmental conditions for the commercially important deep-sea fish *Coryphaenoides rupestris* in the North Atlantic Ocean using three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF).
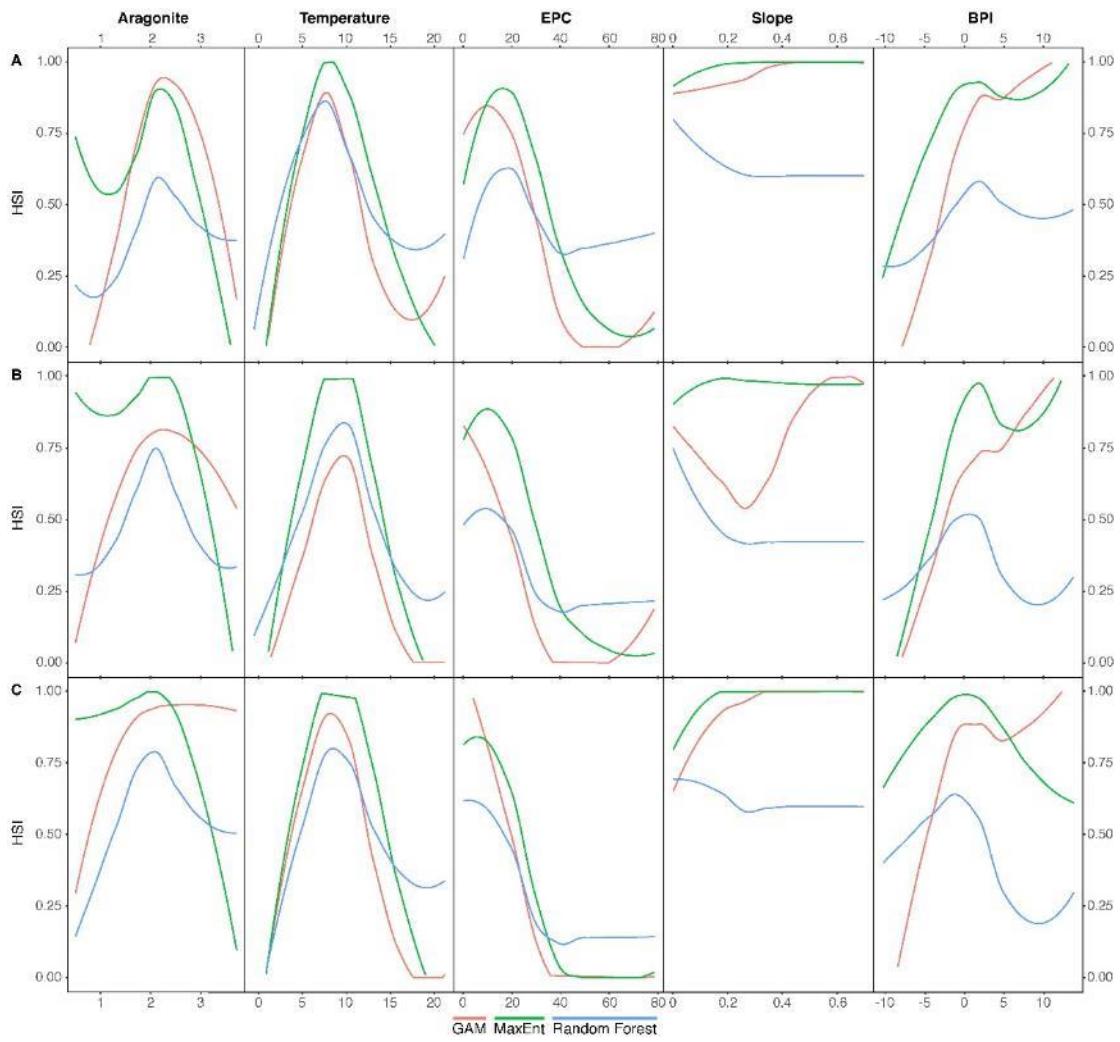
Supplementary Figure S6a. Response curves for predictor variables for scleractinian species as determined by the three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF). A) *Lophelia pertusa*; B) *Madrepora oculata*; C) *Desmophyllum dianthus*. Predictor variables included aragonite saturation state at seafloor, temperature at seafloor (°C), particulate organic carbon flux at the seafloor (EPC, mg C·m⁻²·d⁻¹), slope (in radians) and standardized Bathymetric Position Index (BPI).
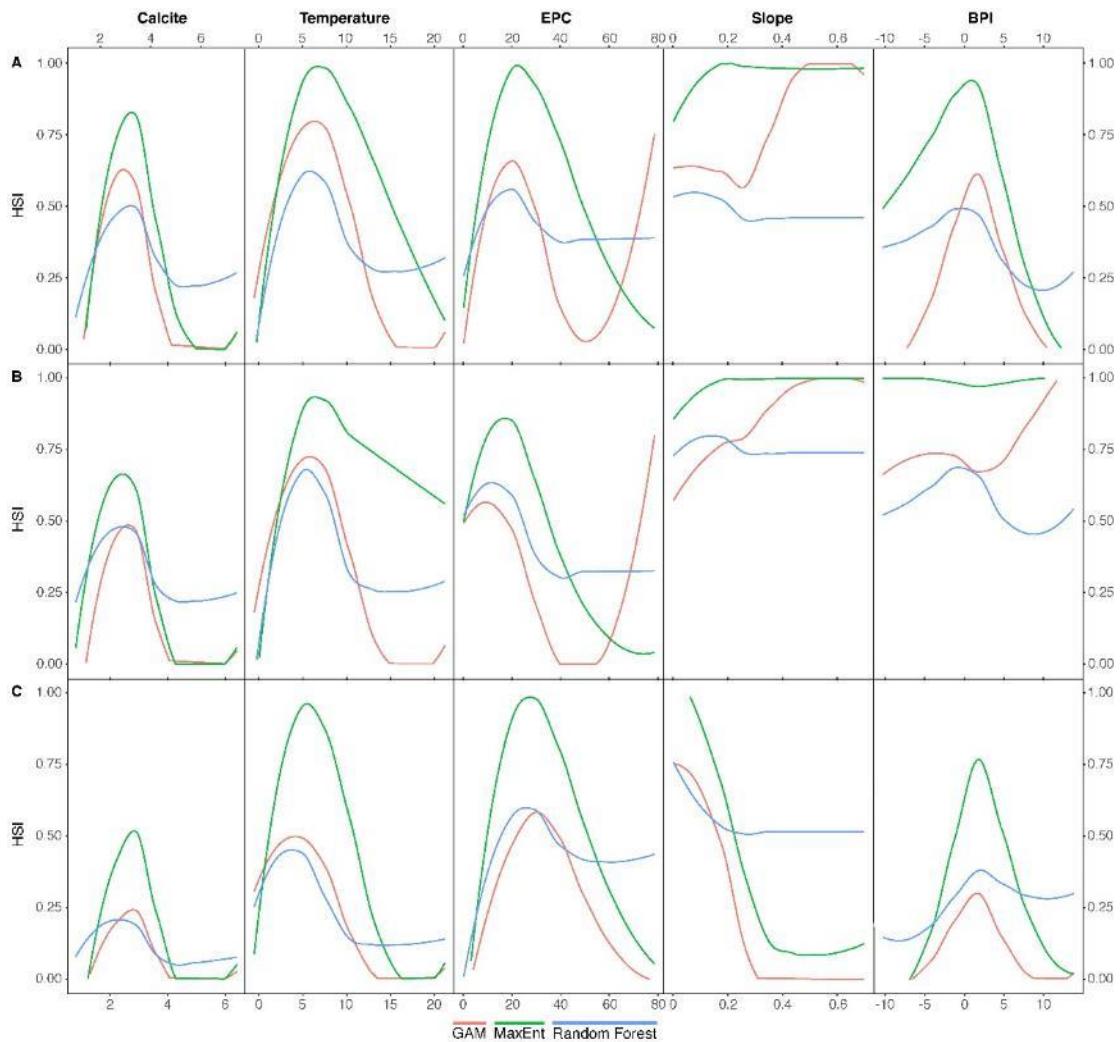
Supplementary Figure S6b. Response curves for predictor variables for octocoral species as determined by the three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF). A) *Acanthogorgia armata*; B) *Acanella arbuscula*; C) *Paragorgia arborea*. Predictor variables included calcite saturation state at seafloor, temperature at seafloor (°C), particulate organic carbon flux at the seafloor (EPC, mg C·m^{-2}·d^{-1}), slope (radians) and standardized Bathymetric Position Index (BPI).
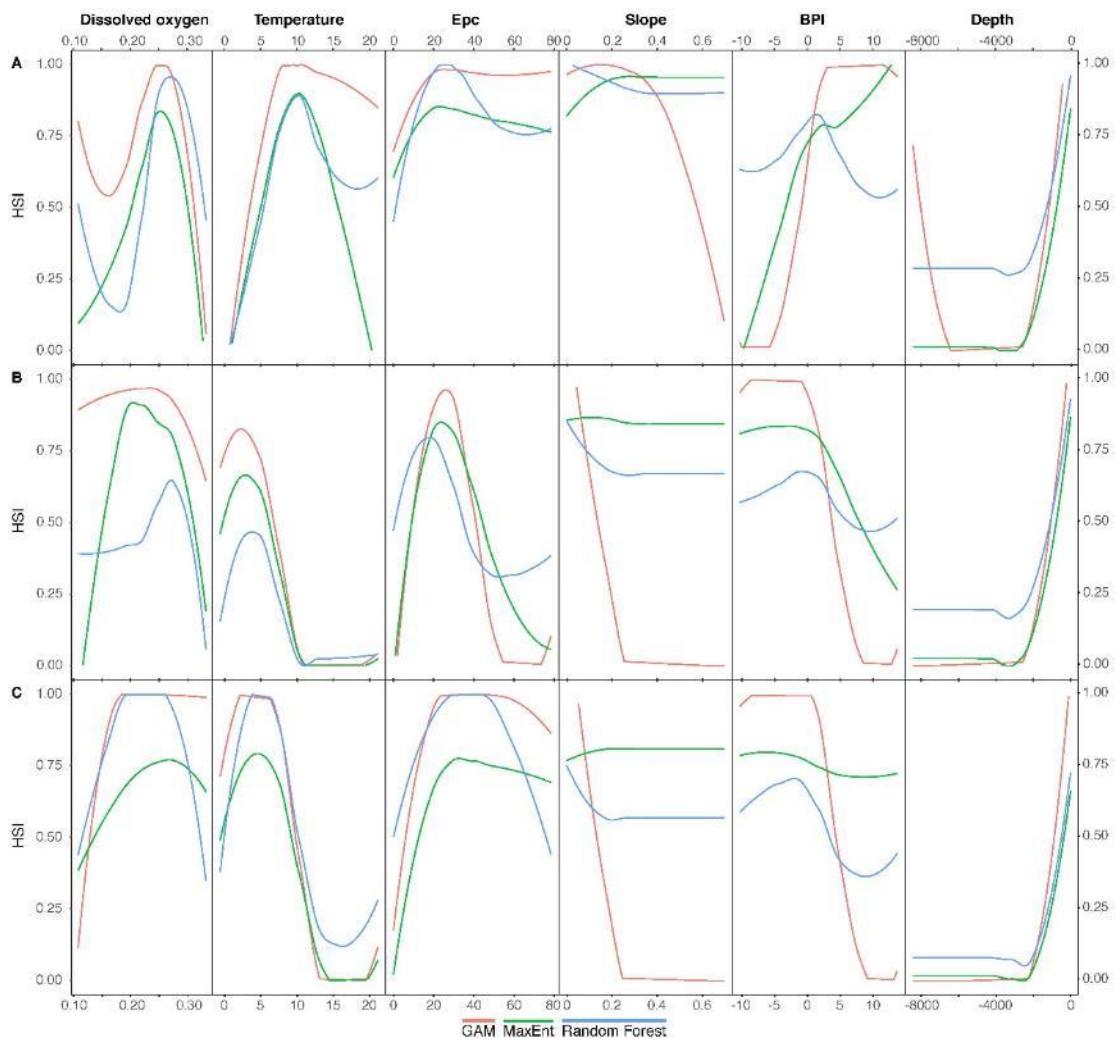
Supplementary Figure S7a. Response curves for predictor variables for commercially important deep-sea fish as determined by the three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF). A) *Helicolenus dactylopterus*; B) *Sebastes mentella*; C) *Gadus morhua*. Predictor variables included dissolved oxygen concentration at seafloor (mL·L⁻¹), temperature at seafloor (°C), particulate organic carbon flux at the seafloor (EPC, mg C·m⁻²·d⁻¹), slope (in radians), standardized Bathymetric Position Index (BPI), and depth (m).
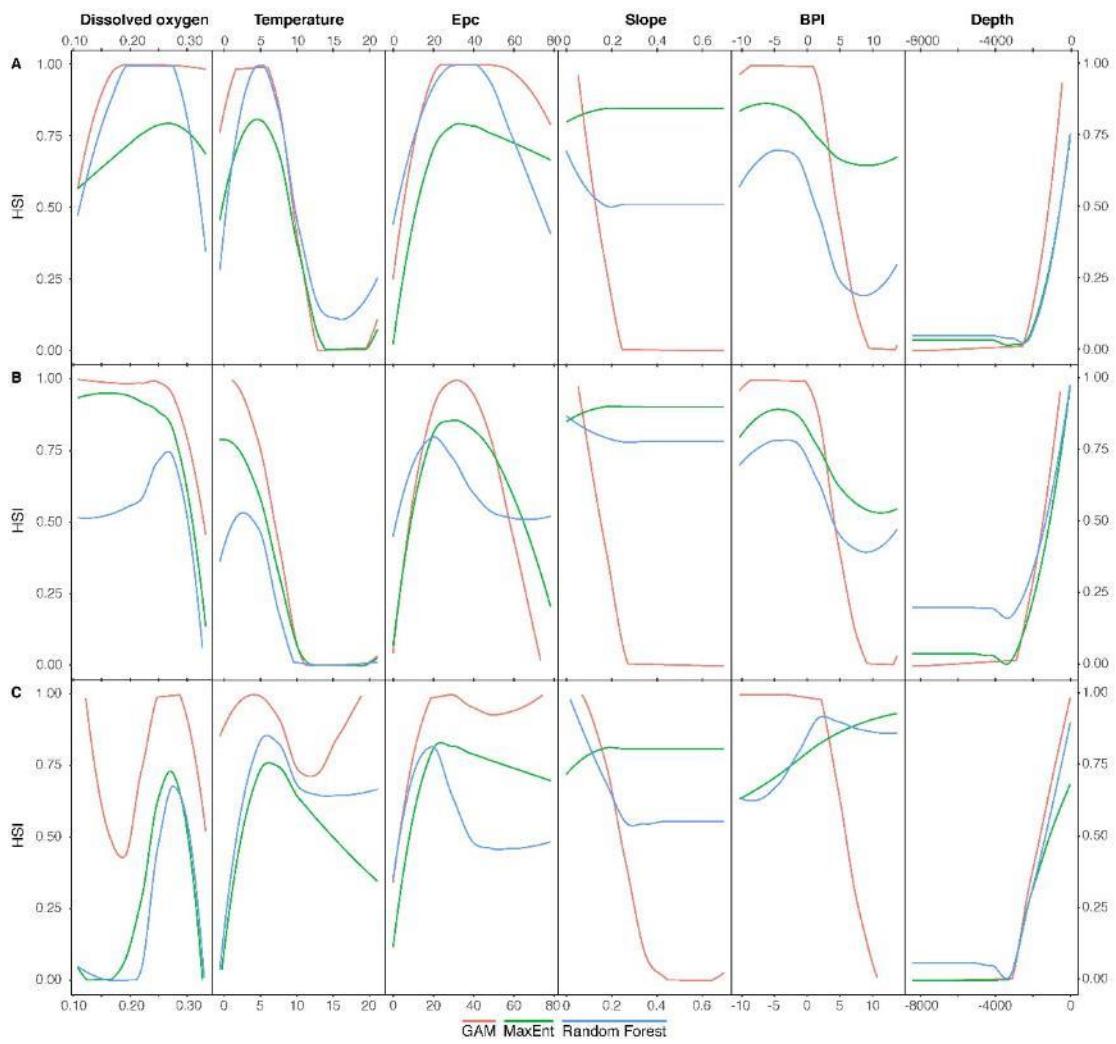
Supplementary Figure S7b. Response curves for predictor variables for commercially important deep-sea fish as determined by the three different modelling approaches: Generalized Additive Model (GAM), maximum entropy model (Maxent), and Random Forest (RF). A) *Hippoglossoides platessoides*; B) *Reinhardtius hippoglossoides*; C) *Coryphaenoides rupestris*. Predictor variables included dissolved oxygen concentration at seafloor (mL·L^{-1}), temperature at seafloor (°C), particulate organic carbon flux at the seafloor (EPC, mg C·m^{-2}·d^{-1}), slope (in radians), standardized Bathymetric Position Index (BPI), and depth (m).
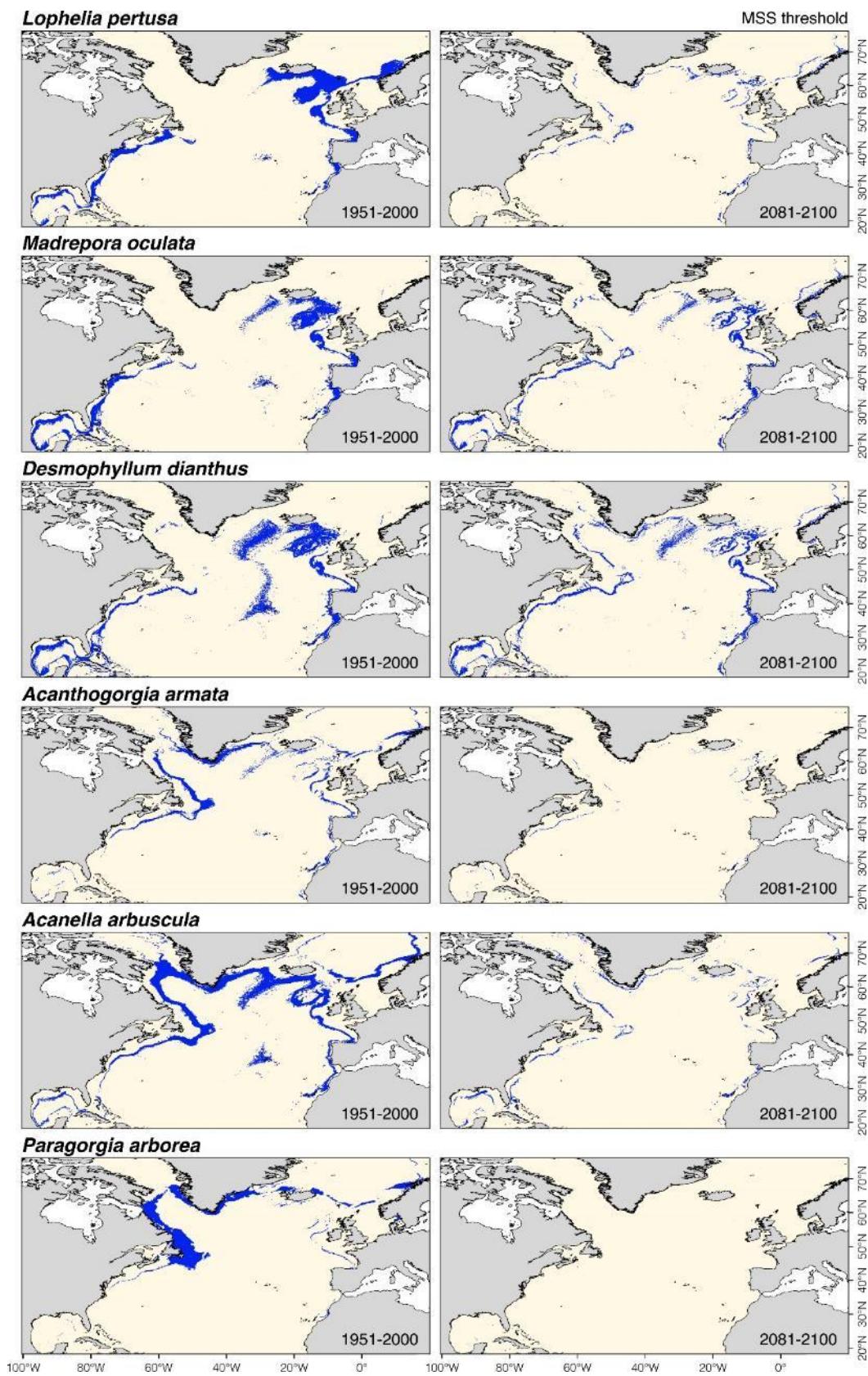
Supplementary Figure S8a. Climate induced changes in the suitable habitat of cold-water corals in the North Atlantic Ocean, as determined by binary maps built with an ensemble modelling approach and the maximum sensitivity and specificity (MSS) threshold.
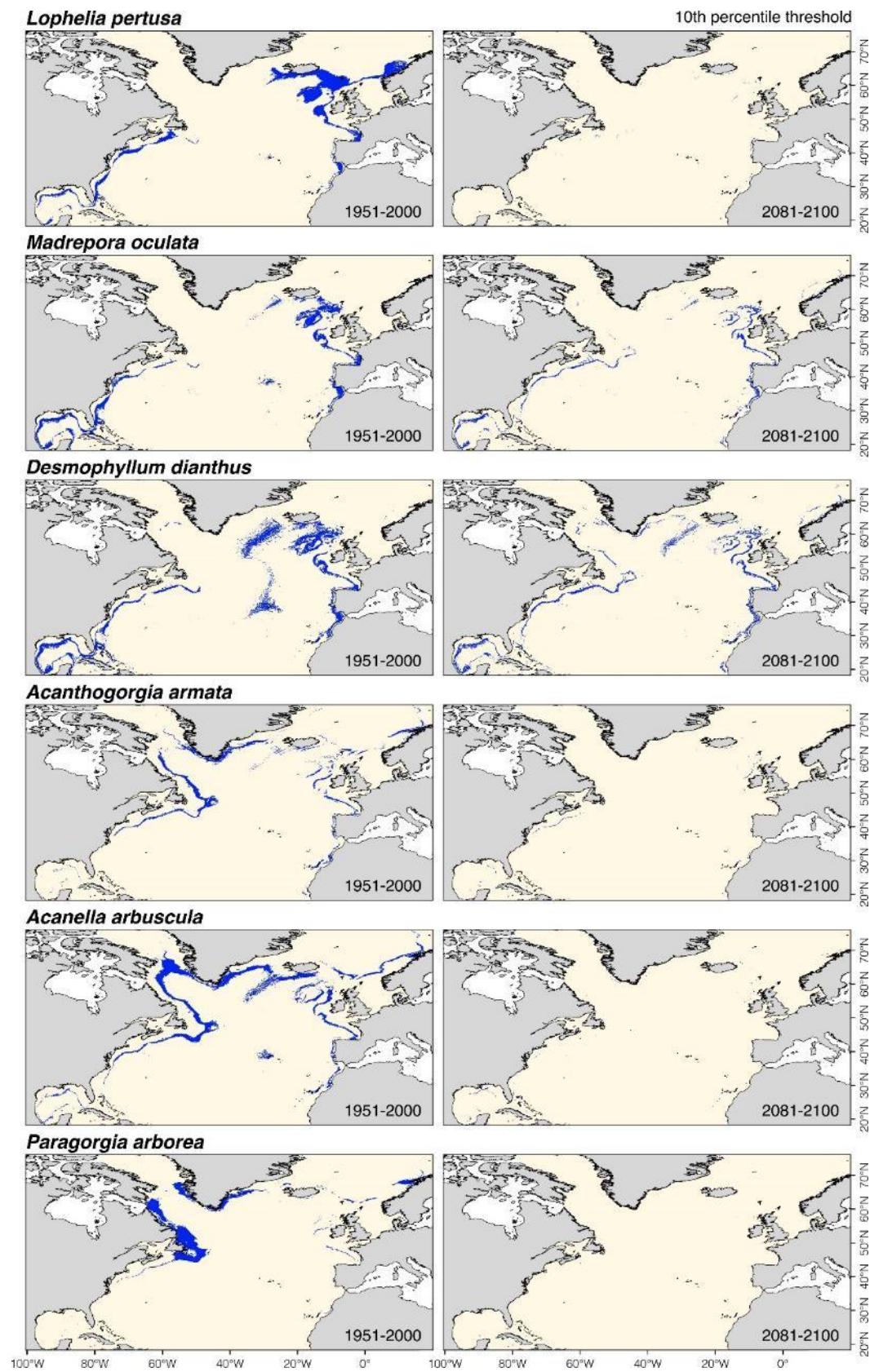
Supplementary Figure S8b. Climate induced changes in the suitable habitat of cold-water corals in the North Atlantic Ocean, as determined by binary maps built with an ensemble modelling approach and the 10th-percentile training presence logistic (10th percentile) threshold.
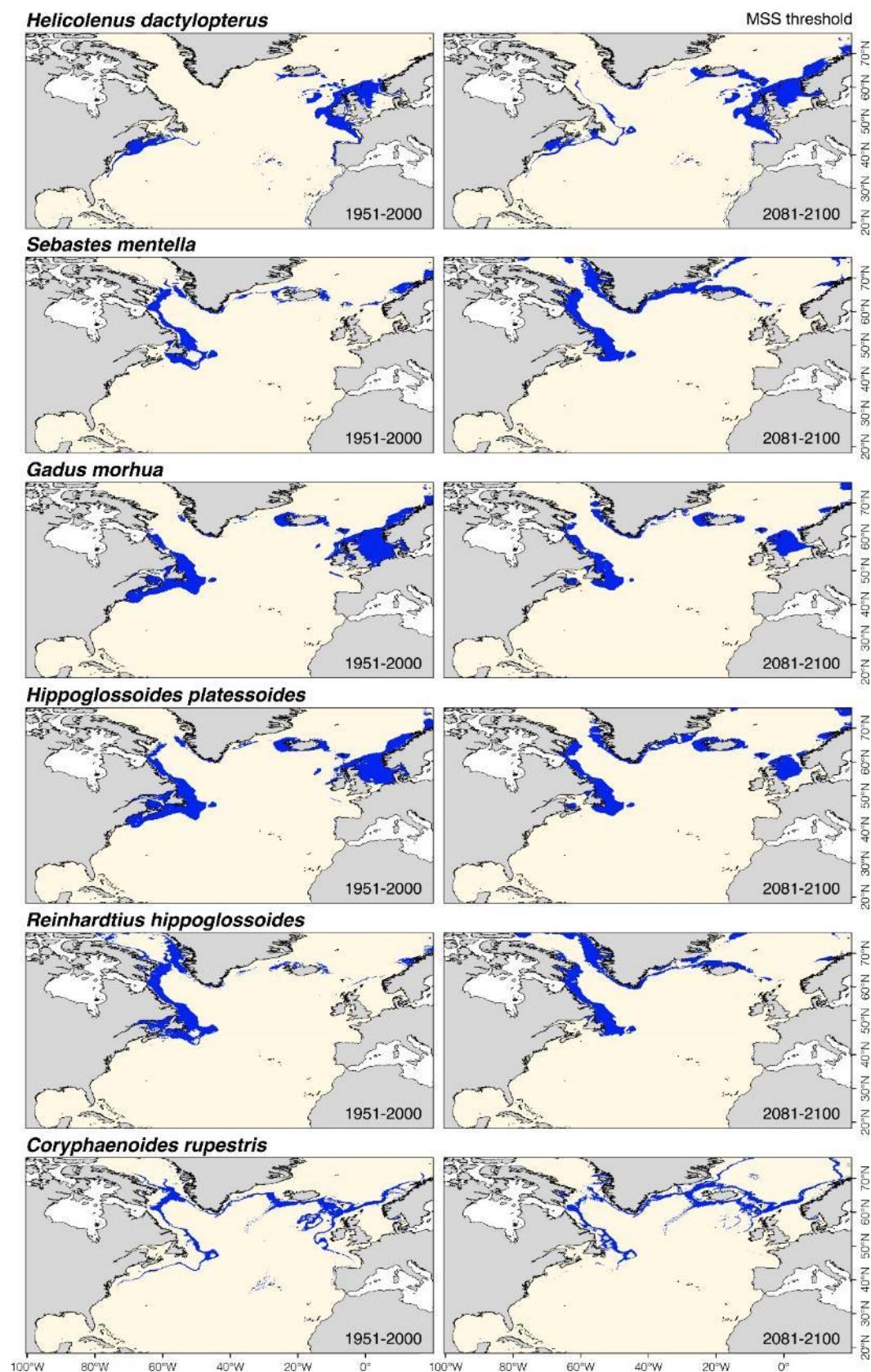
Supplementary Figure S9a. Climate induced changes in the suitable habitat of commercially important deep-sea fish in the North Atlantic Ocean, as determined by binary maps built with an ensemble modelling approach and the maximum sensitivity and specificity (MSS) threshold.
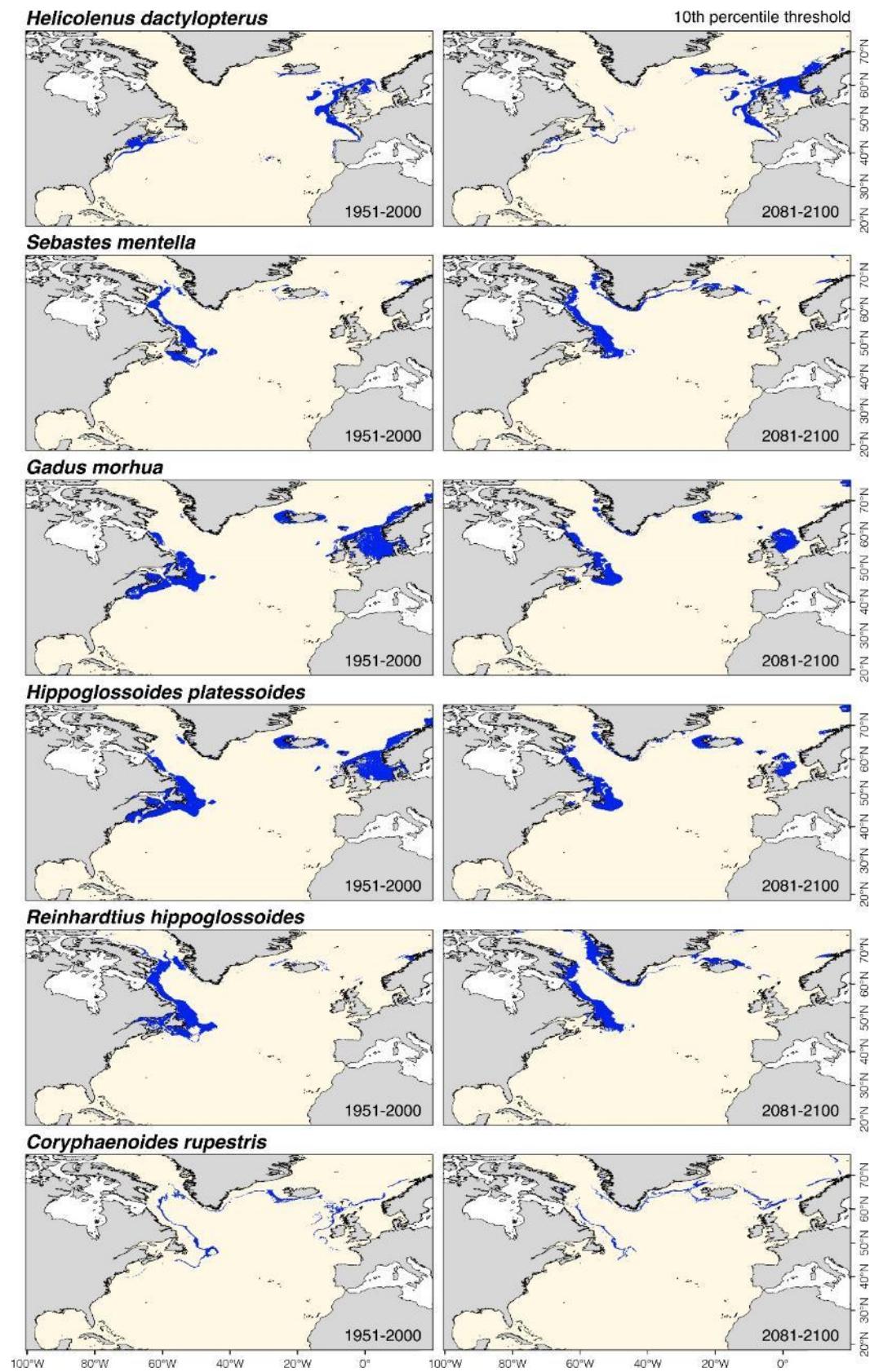
Supplementary Figure S9b. Climate induced changes in the suitable habitat of commercially important deep-sea fish in the North Atlantic Ocean, as determined by binary maps built with an ensemble modelling approach and the 10-percentile training presence logistic (10th percentile) threshold.