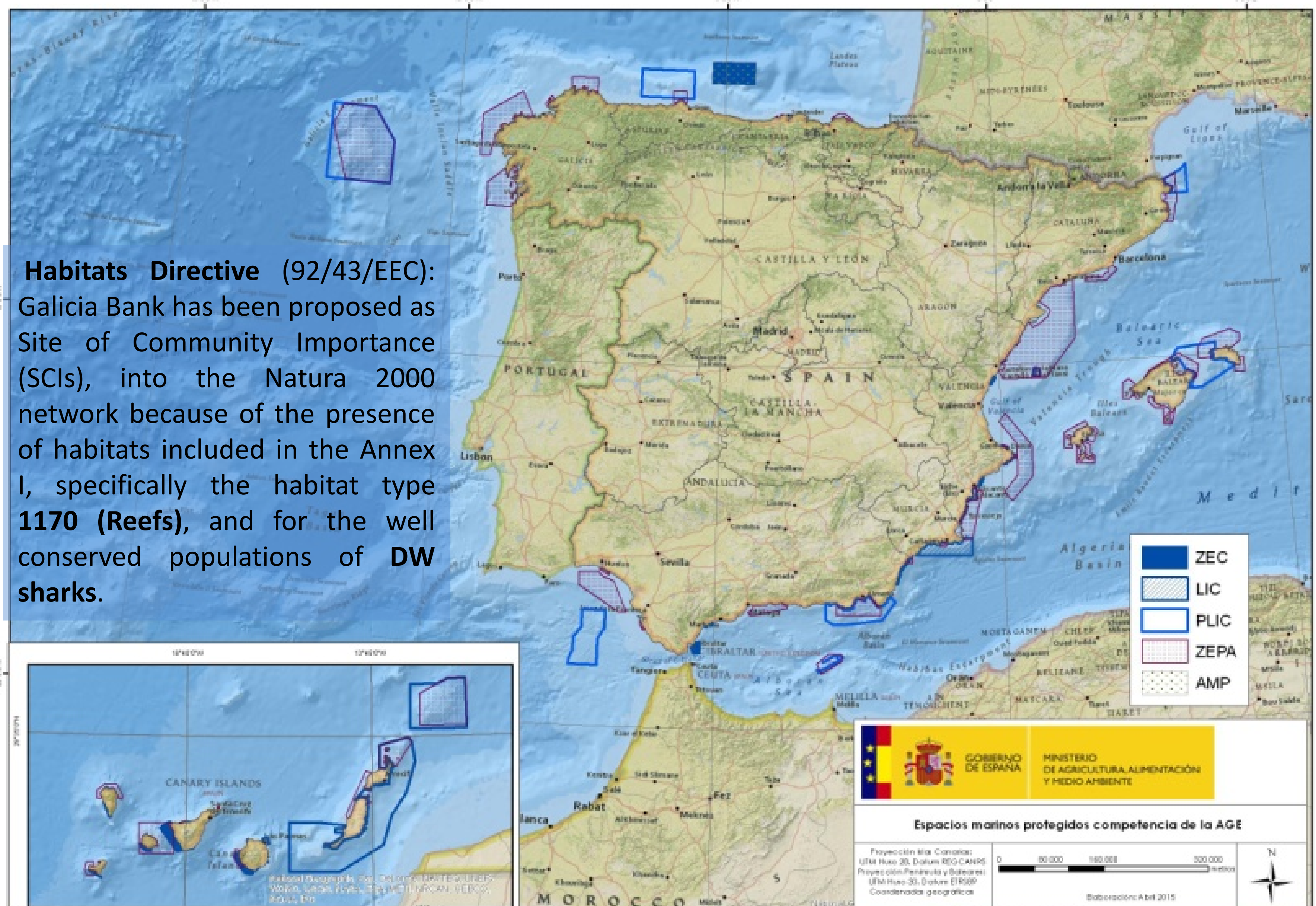
Benthic habitats modelling and mapping of Galicia Bank (NE Atlantic)

Serrano, A., JM González-Irusta, A. Punzón, A. García-Alegre, A. Lourido, P. Rios, M. Blanco, M. Gómez-Ballesteros, M. Druet, J. Cristobo, J. E. Cartes

Galicia Bank: deepest SCI in Spanish N2000 proposal

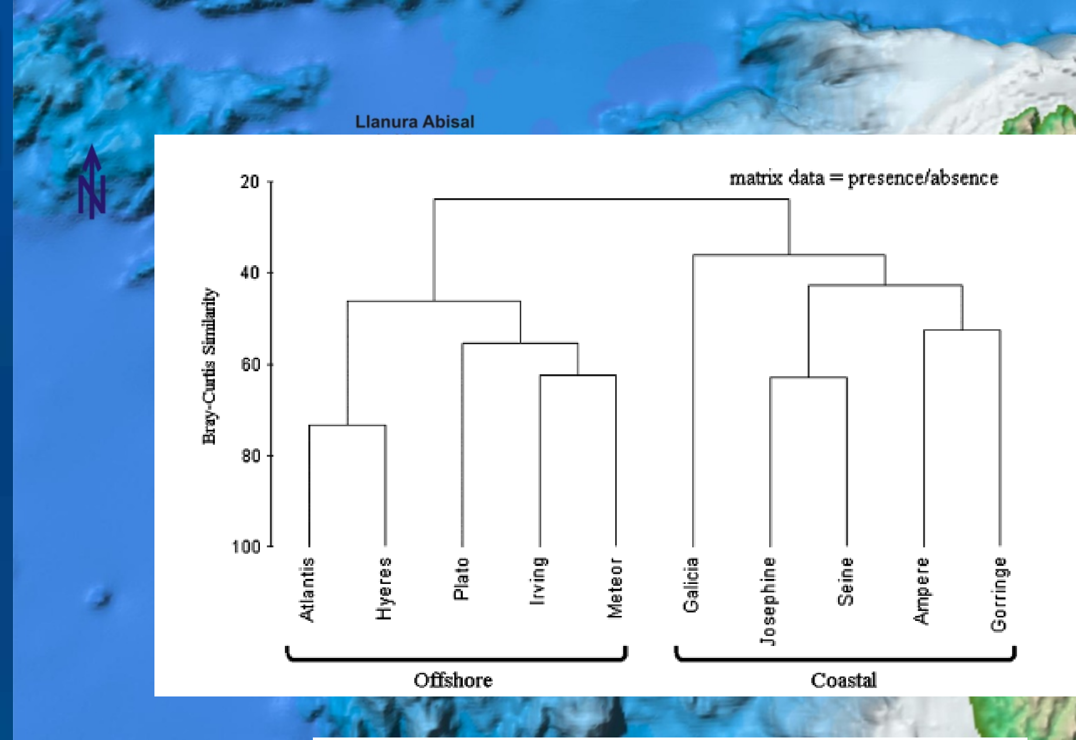


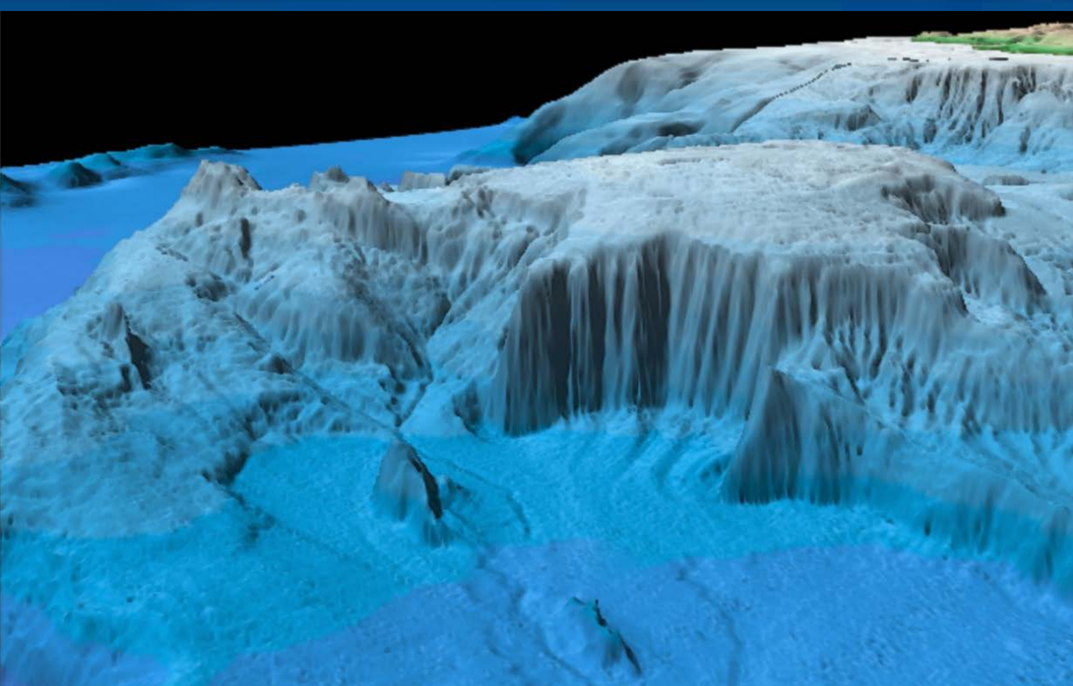
Habitats Directive (92/43/EEC): Galicia Bank has been proposed as Site of Community Importance (SCIs), into the Natura 2000 network because of the presence of habitats included in the Annex I, specifically the habitat type **1170 (Reefs)**, and for the well conserved populations of **DW sharks**.

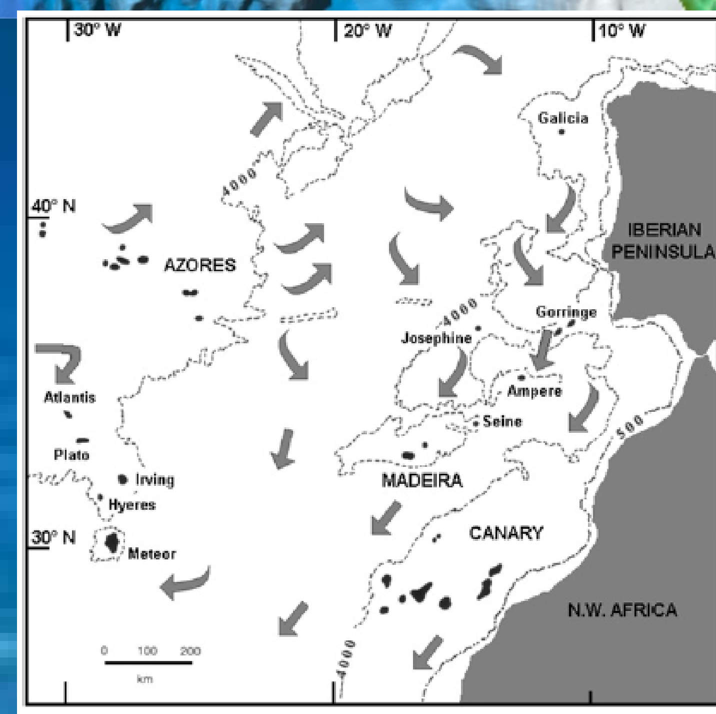
Galicia Bank: deepest SCI in Spanish N2000 proposal

Singularity of GB:

- A “coastal“ seamount with a deep summit: water depth at the seamount’s summit is a key factor that controls the occurrence and abundance of benthos (Clark et al., 2011; Tempera et al., 2012)
- Hydrografical links (water masses, currents) with other seamounts and other biogeographical regions (common fauna with NW Atlantic (Flemish Cap), NE Atlantic, Macaronesia, SE Atlantic (Africa) and Mediterranean.







Methodology: Sampling effort

3 multidisciplinary surveys (summer 2009, 2010, 2011):

ECOMARG09
B/O *Cornide de Saavedra*

INDEMARES-BANGAL 0810
B/O *Thalassa*

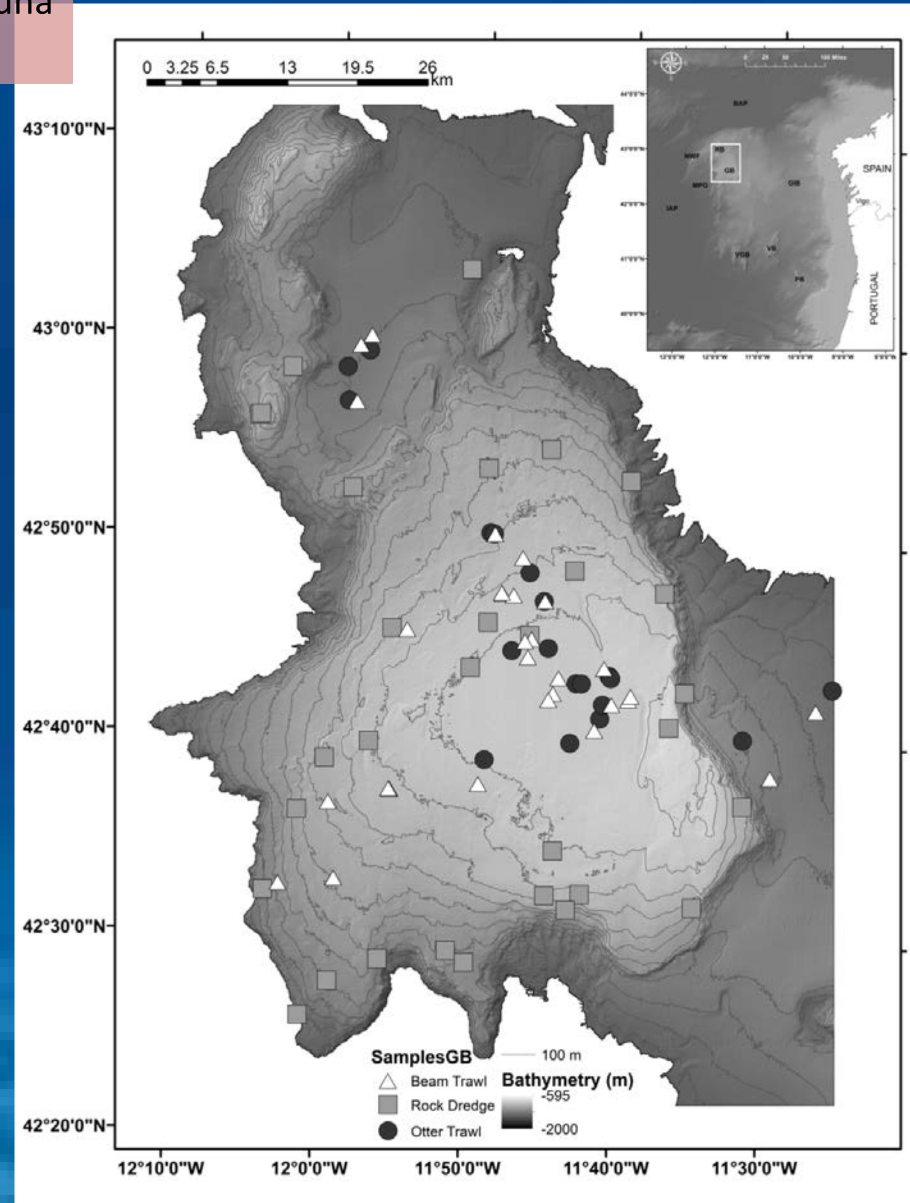
INDEMARES-BANGAL 0811
(B/O *Miguel Oliver*)

OTTER TRAWL
Megaepibenthic and demersal fauna
19 samples

BEAM TRAWL
Mega- and macroepibenthic fauna
29 samples

ROCK DREDGE
Rocky habitats
31 samples

MEGABOXCORER
Sediment analysis



Methodology

Assemble first, predict later

Otter and beam trawl faunal data is quantitative and expressed in biomass (wet weight) whereas rock dredge faunal data was standardized as biomass percentage of each sample.

Trawl and dredge matrices were reduced, considering only structural species, defined as sessile, three-dimensional, large-bodied (mainly cnidarians and sponges), or those accompanying megafauna which appear in large numbers, with a limited motility

Assemble first, predict later approach. First, the structural species assemblages were identified using clustering analysis. The second step, distribution of the assemblages in the GB was predicted using binomial Generalized Additive models (GAM) in a DM framework.

PRESENCE-ABSENCE vs. PRESENCE-ONLY MODELS

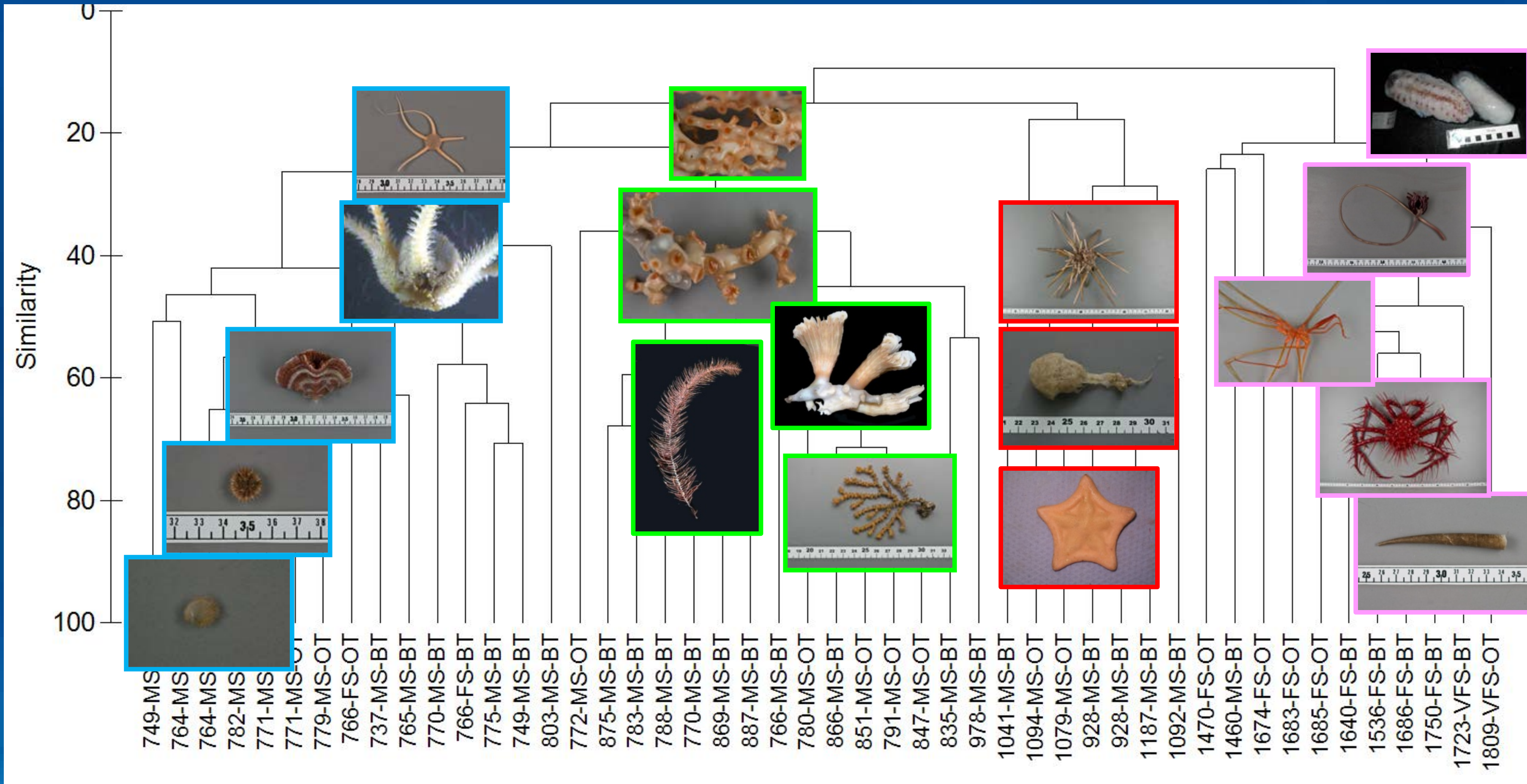
- A presence-absence model has been used to predict assemblage presence: GAM
- According to the results of several recent studies (Brotons et al., 2004; Bedia et al., 2011; González-Irusta et al, 2014), the use of absences obtained from sampling (presence–absence data) provides better results that using randomly generated absences or background data.
- Presence-only models (ENFA, MAXENT): Only when absence data are not available or are clearly unreliable, presence-only models are a suitable option (restricted, patchy, or biased records of species' occurrence, as is often the case in museum, herbaria, etc.: Phillips et al., 2006; Elith et al., 2011).

RESULTS

1- Assemble first…

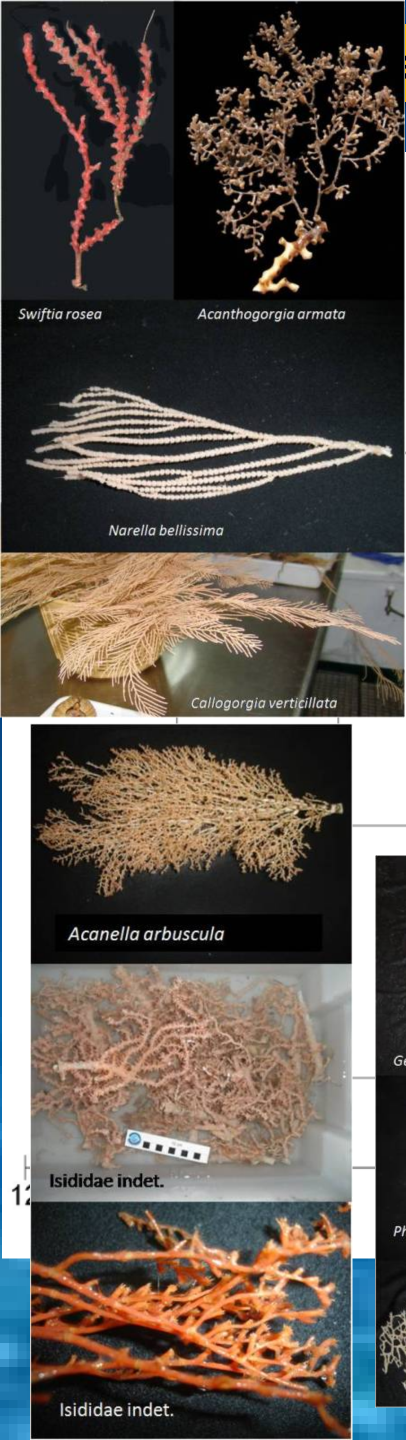
Sedimentary habitats assemblages

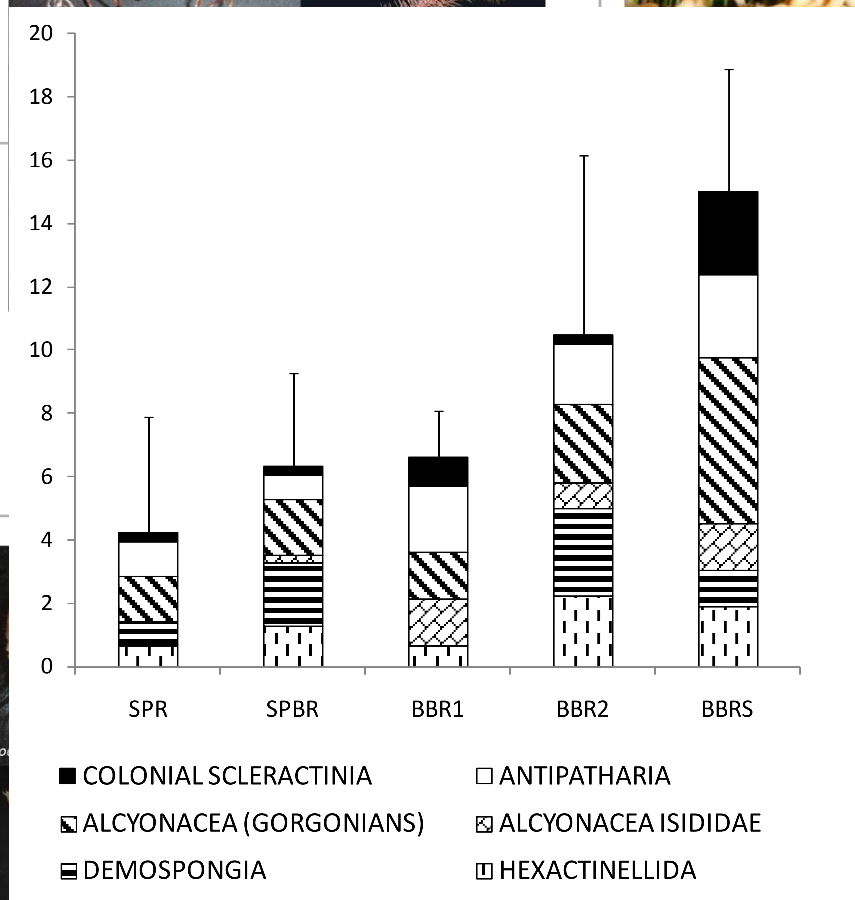
Assemble first...



SS Summit medium sands (750-800 m)	**SSrf** Summit medium sands with CW corals (800-1000 m)	**BBS** Bank break medium sands (1000-1200)	**FS** Bank flanks fine and very fine sands (1400-1800 m)
Ophiomyces grandis, Ophiacanta sp, Flabellum chuni, Deltocyathus moseley Limopsis minuta	***Lophelia pertusa, Madrepora oculata, Desmophyllum cristagalli, Acanthogorgia armata, Parantipathes sp***	***Thenea muricata*** ***Cidaris cidaris*** ***Peltaster placenta*** ***Colus spp***	***Benthogone rosea*** ***Umbellula sp*** ***Colossendeis colossea*** ***Neolithodes grimaldii*** ***Fissidentalium capillosum***

Assemble first...





SPR
(Summit plain rock)
Black corals, gorgonians

SPBR
(summit & break)
Gorgonians, black corals, large sponges

BBR1
(bank break North & East)
Bamboo & black corals, gorgonians

BBR2
Bamboo & black corals, gorgonians, Large sponges

BBR
Bank break rock

BBRS
Bank break- south & Rucabado
Colonial, bamboo & black corals, large sponges

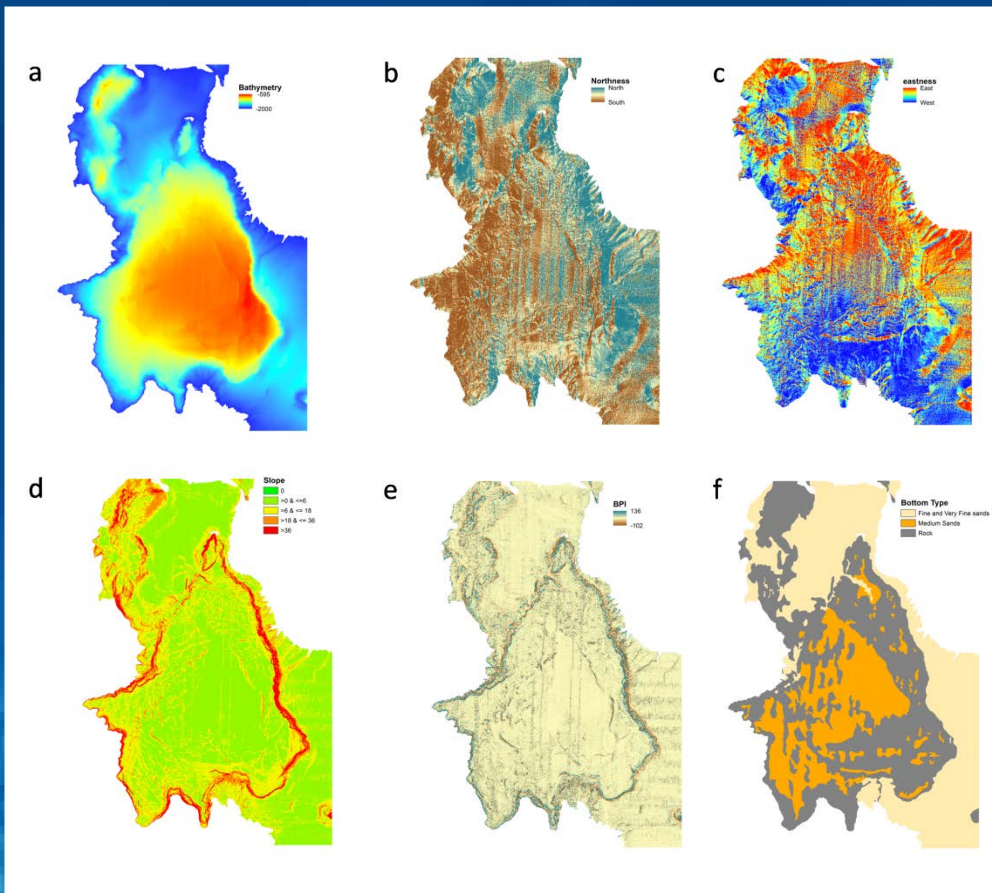
GB geohabitat	EUNIS 3	GB habitats	EUNIS 4-6	OSPAR list	HD
Plain rock (summit)	A6.1 Deep-sea rock A6.2 Deep-sea mixed substrata A6.6 Deep-sea bioherms	Summit plain rock with gorgonians and black corals	A6.11 Deep sea bedrock A6.13 Deep-sea manganese nodules A6.722 Summit communities of seamount within the mesopelagic zone	Coral garden	
Steep rock (bank break and slope)	A6.1 Deep-sea rock A6.7 Raised features of the deep-sea bed	Bank break rock with black & bamboo corals, gorgonians and large sponges	A6.11 Deep sea bedrock A6.14 Boulders on the deep-sea bed A6.62 Deep-sea sponge aggregations A6.621 Facies with Pheronema grayi	Coral garden Deep-sea sponge aggregations	1170
	A6.1 Deep sea rock A6.6 Deep sea bioherms A6.7 Raised features of the deep-sea bed	Bank break rock with white, black & bamboo corals, gorgonians and large sponges	A6.11 Deep sea bedrock A6.61 Communities of deep sea corals A6.611 Deep-sea Lophelia pertusa reefs A6.62 Deep-sea sponge aggregations A6.14 Boulders on the deep-sea bed A6.22 Deep-sea biogenic debris A6.75 Carbonate mounds	Lophelia reefs Coral garden Deep-sea sponge aggregations Carbonate mounds	1170
Medium sands (summit)	A6.3 Deep sea sand	Summit medium sands with Ophiacantidae and *Flabellum chunii*	A6.722 Summit communities of seamount within the mesopelagic zone	Coral garden	
	A6.2 Deep-sea mixed substrata A6.3 Deep sea sand A6.6 Deep sea bioherms	Summit medium sands with white corals reef patches	A6.61 Communities of deep sea corals A6.611 Deep-sea Lophelia pertusa reefs A6.722 Summit communities of seamount within the mesopelagic zone A6.22 Deep-sea biogenic debris A6.75 Carbonate mounds	Lophelia reefs Carbonate mounds	1170
	A6.2 Deep-sea mixed substrata A6.3 Deep sea sand	Bank break medium sands with *Cidaris* and *Thenea muricata*	A6.722 Summit communities of seamount within the mesopelagic zone		
Fine and very fine sands (flanks)	A6.3 Deep sea sand A6.4 Deep sea muddy sand	Bank flanks fine sands with elasipodid holothurians (*B. rosea*)	A6.724 Flanks of seamount or bank		

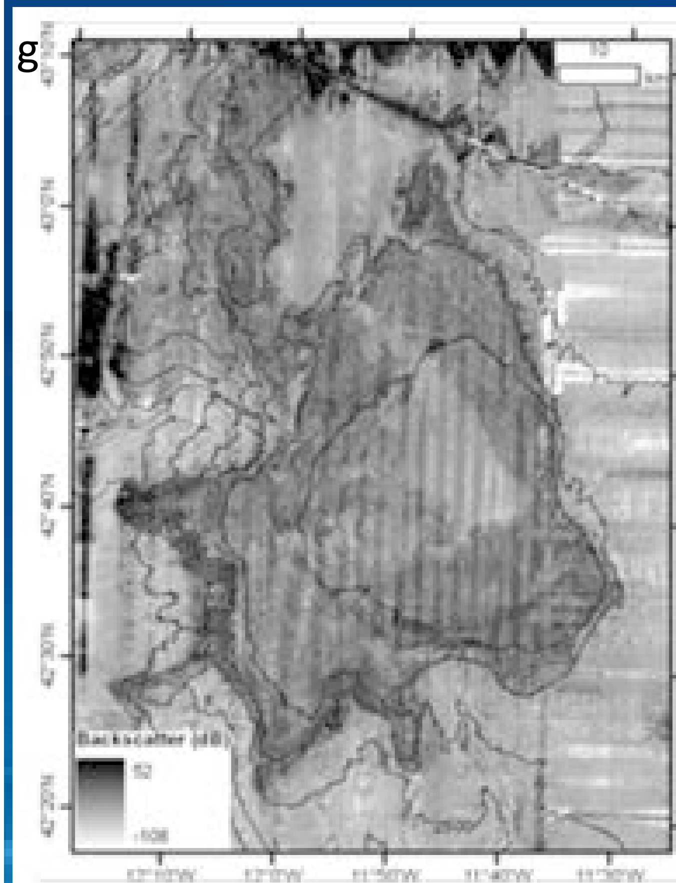
RESULTS

2- …predict later

Modelling assemblages

Environmental layers. a) Processed bathymetry, b) northness, c) eastness, d) slope, e) fine Bathymetric Position Index (BPI), f) substrate facies, g) backscatter





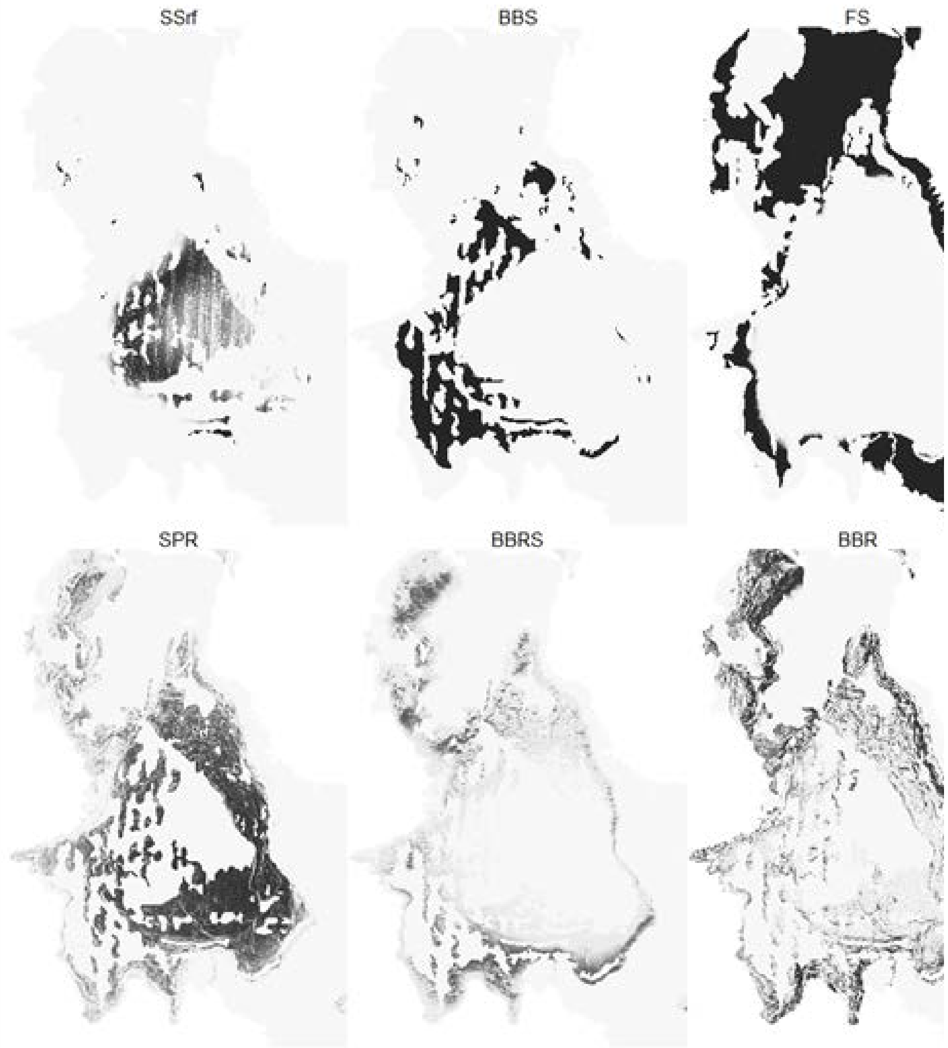
Modelling assemblages

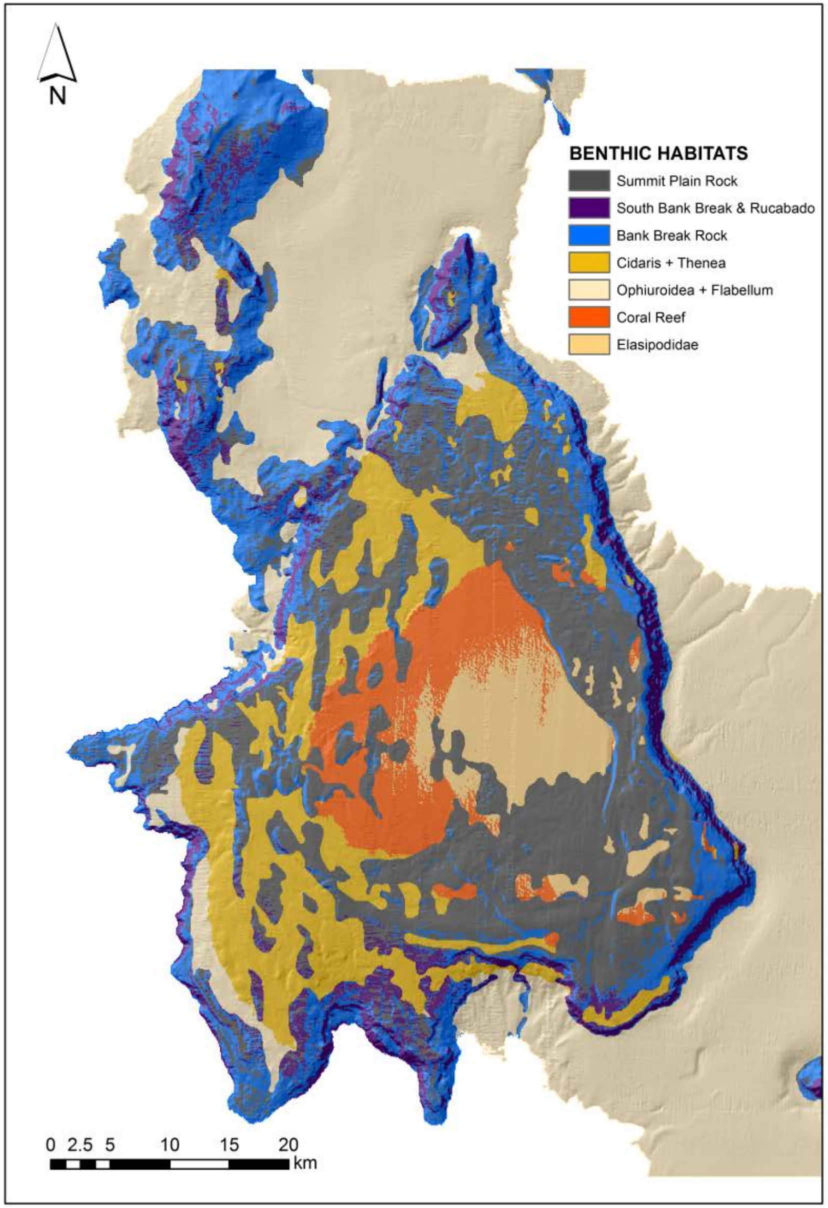
Model performance was good in all cases with high values of explained deviance, AUC and kappa values

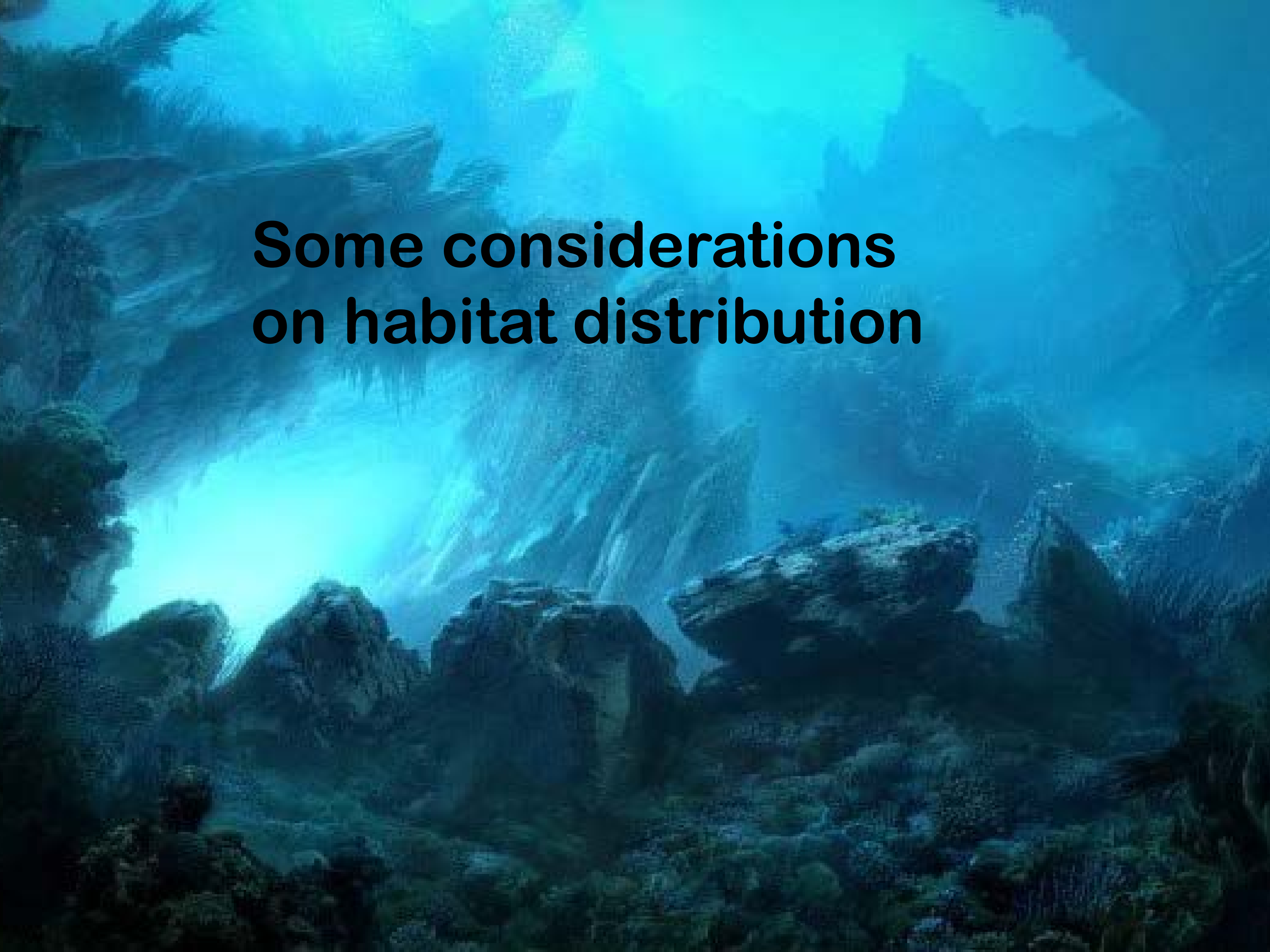
Assemblage	GAM Formula	Explained deviance	AUC	Kappa
SS	$P_p = \beta_1 + s(depth) + sediment + \mathcal{E}_1$	65.2%	0.95±0.02	0.84±0.08
SSrf	$P_p = \beta_2 + s(depth) + s(eastness) + sediment + \mathcal{E}_2$	54.4%	0.86±0.04	0.64±0.05
BS	$P_p = \beta_3 + s(depth) + sediment + \mathcal{E}_3$	99.8%	0.99±0.01	0.94±0.08
FS	$P_p = \beta_4 + s(depth) + \mathcal{E}_4$	100%	1	1
SPR	$P_p = \beta_5 + s(depth) + s(slope) + sediment + \mathcal{E}_5$	64.3%	0.97 ±0.03	0.87 ±0.13
BBR	$P_p = \beta_6 + s(eastness) + s(slope) + sediment + \mathcal{E}_6$	69.6%	0.94±0.06	0.37 ±0.15
BBRS	$P_p = \beta_7 + s(northness) + s(depth) + sediment + \mathcal{E}_7$	57.8%	0.71 ± 0.09	0.76 ±0.16

Modelling assemblages

- Model maps per habitat were merged in a unique map selecting for each pixel the habitat with the highest probability of presence

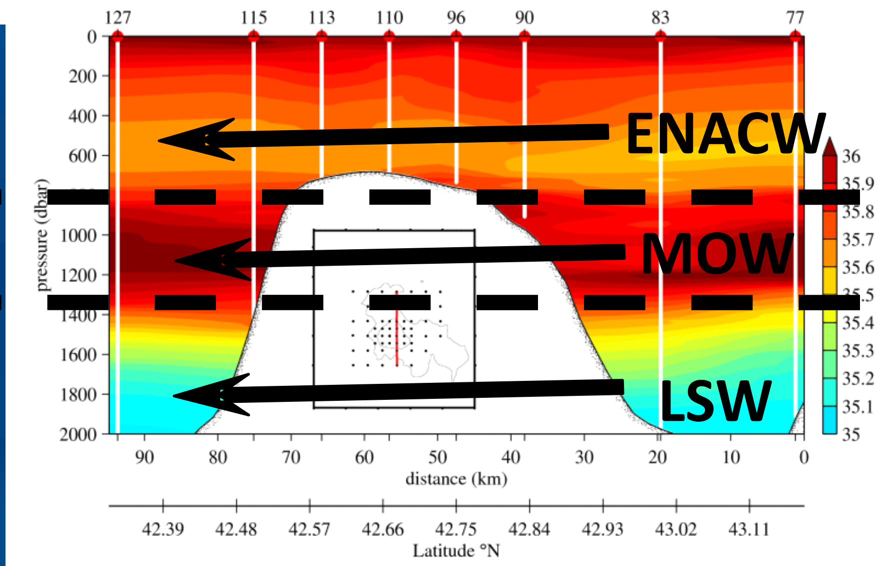





Some considerations
on habitat distribution

Environmental boundaries: bathymetry / water masses

SEDIMENTARY EPIBENTHOS This study	DW FISHES Punzón et al, 2010	CRUSTACEANS Cartes et al, 2014	ENDOBENTHOS Lourido et al
SS- Ophiuroids / **SSrf DW corals**	**SUMMIT** *Hoplostethus*	**SUMMIT** *Plesionika, Cancer, Sergia, Systellaspis*	**SUMMIT** *Syllidae*
BBS Cidaris, Thenea	**BANK BREAK** Ampharetids		**BANK BREAK** Ampharetidae
FS Holothurians	**FLANKS** *Alepocephalidae*	**FLANKS** Neolithodes, Glyphocrangon	**FLANKS** *Spionidae, Glyceridae*

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Distribution and biogeographic trends of decapod assemblages from Galicia Bank (NE Atlantic) at depths between 700 and 1800 m, with connexions to regional water masses

J.E. Cartes[a,*], V. Papiol[a], I. Frutos[b], E. Macpherson[c], C. González-Pola[d], A. Punzón[b], X. Valeiras[e], A. Serrano[b]

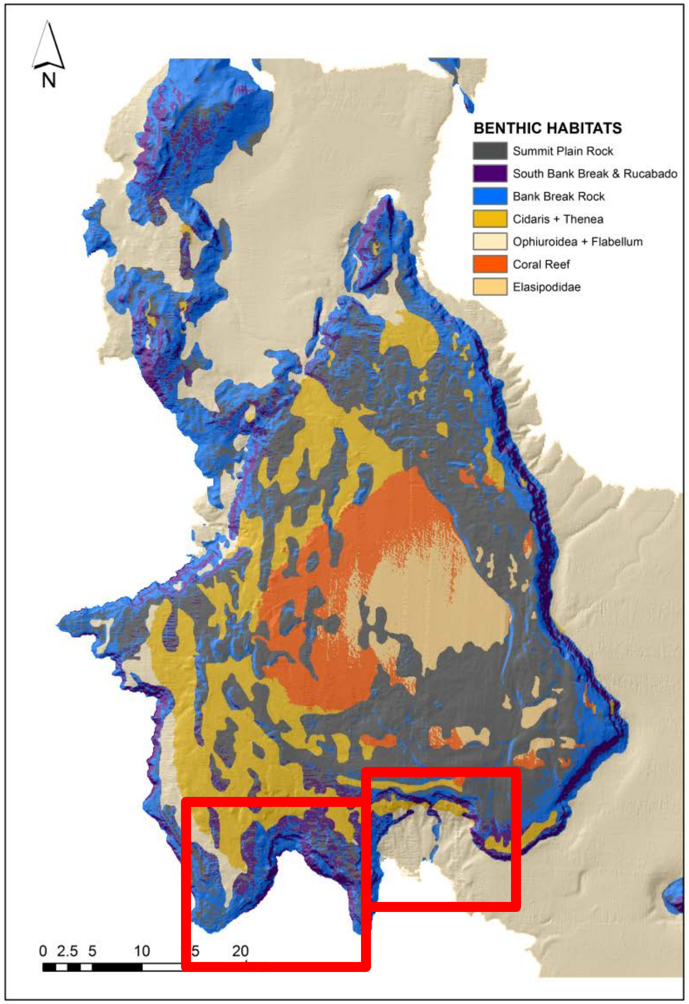
Lourido et al (submitted). Bathyal endobenthic communities in a deep seamount (Galicia bank)

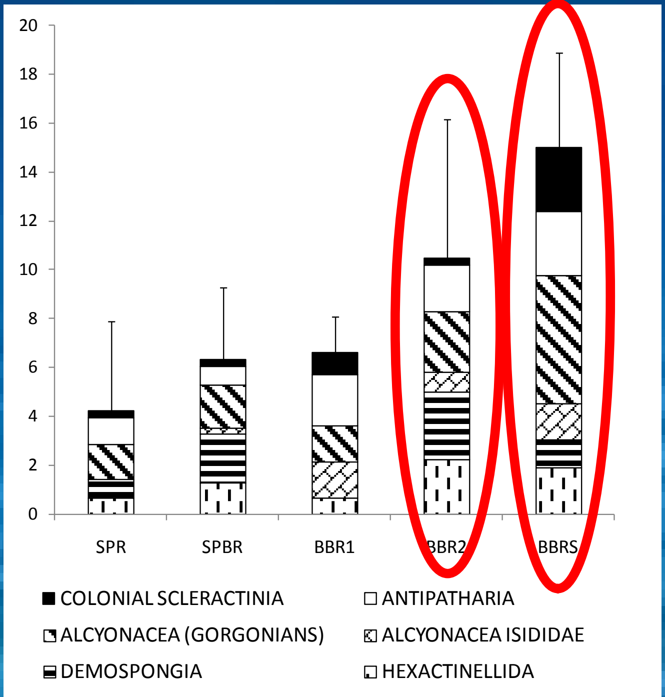
Punzón et al (2010). Environmental heterogeneity preference of deep-water fishes in a deep seamount (Galicia Bank). Póster ISOBAY

Environmental boundaries: bathymetry / water masses

Bottom trapping hypothesis (Genin and Dower, 2007)

- On the GB we found the highest near-bottom zooplankton biomass (4.3 g/1000 m3), ca. 5 times > than the average on the rest of the bank (Papiol et al., 2014), in a haul performed in parallel to a vertical wall (at 42º27.36' N- 11º53.84' W: S of Bank).
- Zooplankton is the main compartment supporting trophic webs over seamounts (Genin and Dower, 2007; Preciado et al, in press).
- Key role of aspect (orientation) in SSrf (CW corals) distribution model





- Enrichment by northern water masses (LSW) arriving to GB and possible zooplankton biomass increase at vertical-steep walls by "bottom trapping" can explain the higher diversity of habitat providing filter-feeders at slope rocky breaks.

Highlights

- Nine habitats have been described in the Galicia Bank, 5 in hard substrates and 4 in sedimentary ones.
- Habitat distribution of these habitat has been predicted using a habitat suitability model
- Depth, substrate type and water masses (all of them depth-related variables) were key factors in sedimentary habitats whereas rocky habitats were also determined by slope and slope orientation.
- Seamount topography can control communities via trophic effects (zooplankton)