atlas

UNDERSTANDING DEEP ATLANTIC ECOSYSTEMS

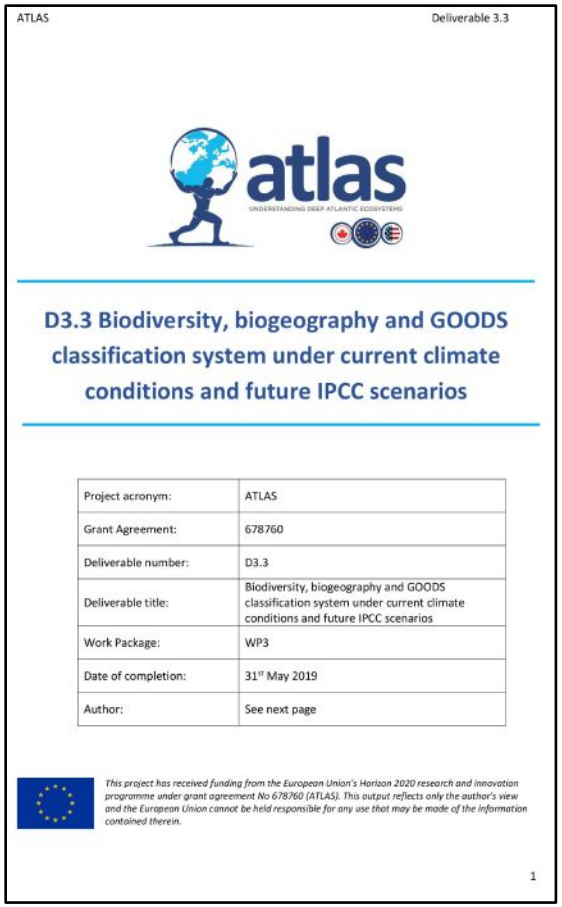
Improving the understanding of biodiversity in the deep N Atlantic

ATLAS GA, Edinburgh 9-12 March 2020

Carlos Dominguez-Carrió, Marina Carreiro-Silva, Telmo Morato

and the ATLAS case study leaders

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 678760 (ATLAS). This output reflects only the author's view and the European Union cannot be held responsible for any use that may be made of the information contained therein.



ATLAS Deliverable 3.3

D3.3 Biodiversity, biogeography and GOODS classification system under current climate conditions and future IPCC scenarios

Project acronym:	ATLAS
Grant Agreement:	678760
Deliverable number:	D3.3
Deliverable title:	Biodiversity, biogeography and GOODS classification system under current climate conditions and future IPCC scenarios
Work Package:	WP3
Date of completion:	31st May 2019
Author:	See next page

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 678760 (ATLAS). This output reflects only the author's view and the European Union cannot be held responsible for any use that may be made of the information contained therein.

1

WP3 Biodiversity and Biogeography

Task 3.1. Improve the understanding of biodiversity and biogeography in the deep N Atlantic

Task 3.2. Biogeography of the deep North Atlantic: Evaluating the 'Global Open Oceans and Deep Seabed' and the 'Ecological Marine Units' biogeographic classification systems

Task 3.3. Predicted spatial distribution of biodiversity in the deep N Atlantic under current environmental

Task 3.4. Changes in biodiversity, GOODS and GES under IPCC scenarios

WP3 Biodiversity and Biogeography

Task 3.1. Improve the understanding of biodiversity and biogeography in the deep N Atlantic

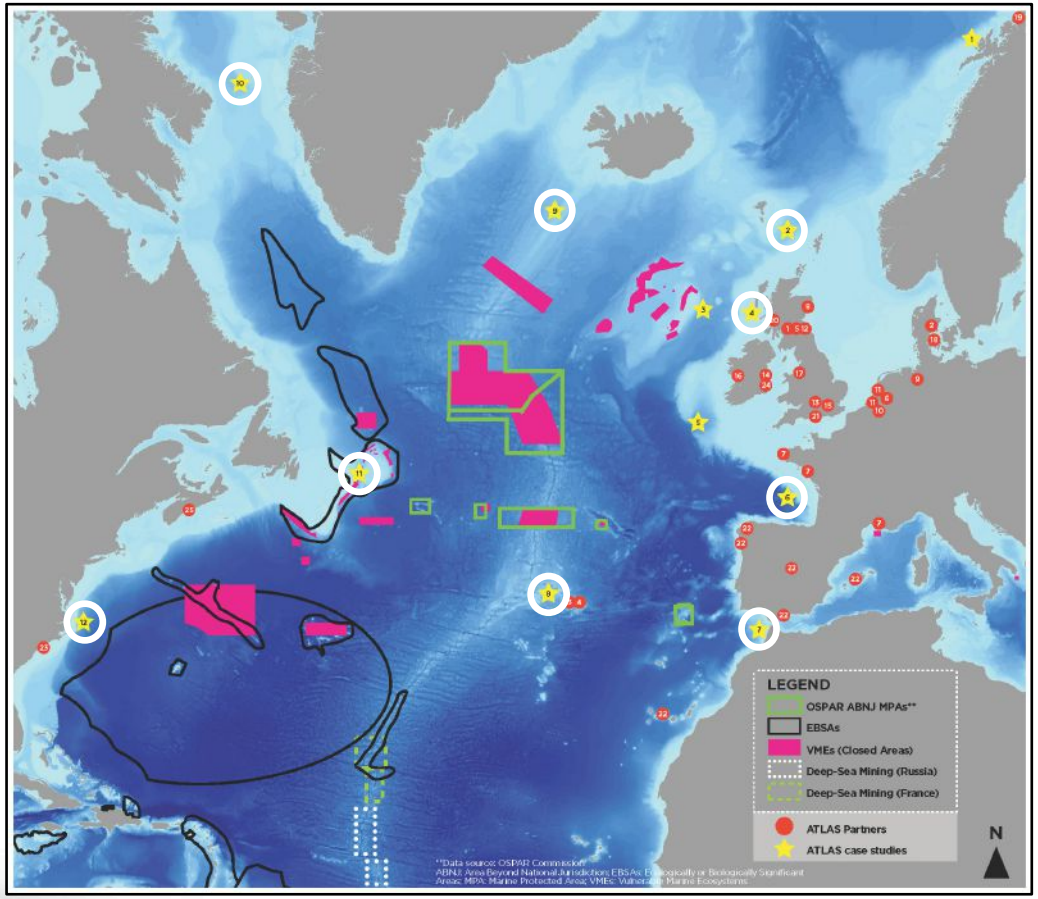
1. Overview of the diversity of **benthic habitats** in the different study cases

2. Some of the **new species** described or being described

3. Taxonomic **review** done for the Azores

Benthic habitats & communities

All areas



Case Study 1 LoVe Observatory

Case Study 2 West of Shetland and W Scotland slope (UK)

Case Study 3 Rockall Bank

Case Study 4 Mingulay Reef Complex, Faroe Shetland Channel, Tropic seamount

Case Study 5 Porcupine Seabight

Case Study 6 Submarine Canyons of the Bay of Biscay

Case Study 7 Gulf of Cádiz, Gazul mud volcano, Chella Bank, Ormonde Seamount

Case Study 8 Condor seamount, Great Meteor, Gigante seamount complex, Formigas bank

Case Study 9 Reykjanes Ridge

Case Study 10 Davies strait, Western Greenland, Labrador sea

Case Study 11 Flemish Cape

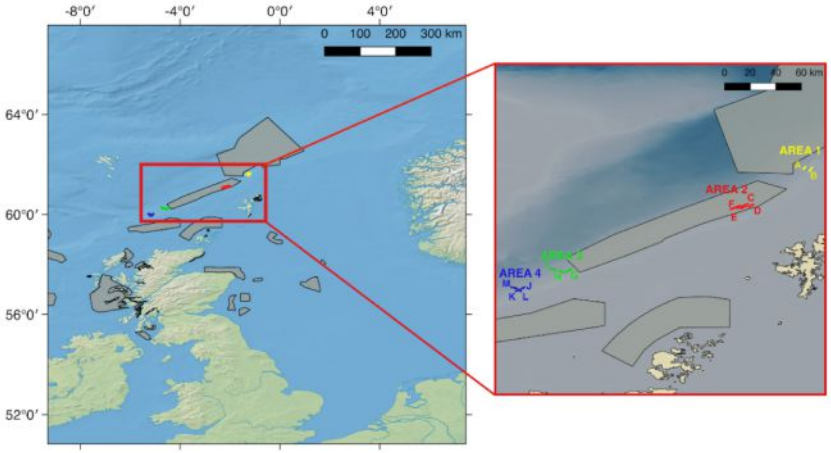
Case Study 12 Southeastern USA and mid-Atlantic canyons

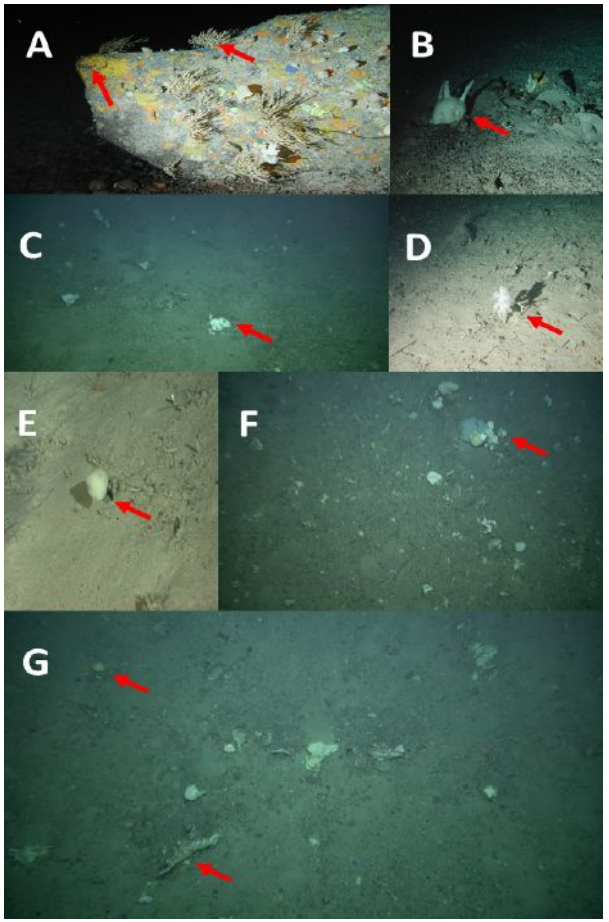
Case Study 13 Tropic seamount

Case Study 2

West of Shetland and W Scotland slope (UK)

Distribution and structure of deep-sea sponge aggregations





Complex hydrography as **five water masses flow through it.** Many different sedimentary **habitat types** and **multisectoral human activities** including demersal fisheries, oil & gas installations and shipping.

Hosts **diverse faunal communities including dense sponge aggregations** at ~500 m water depth.

Higher sponge morphotype diversity, and number of body-size cohorts inside than outside the NCMPA.

Evidence that demersal fisheries, substratum, salinity and temperature explained sponge morphotype density across the studied area

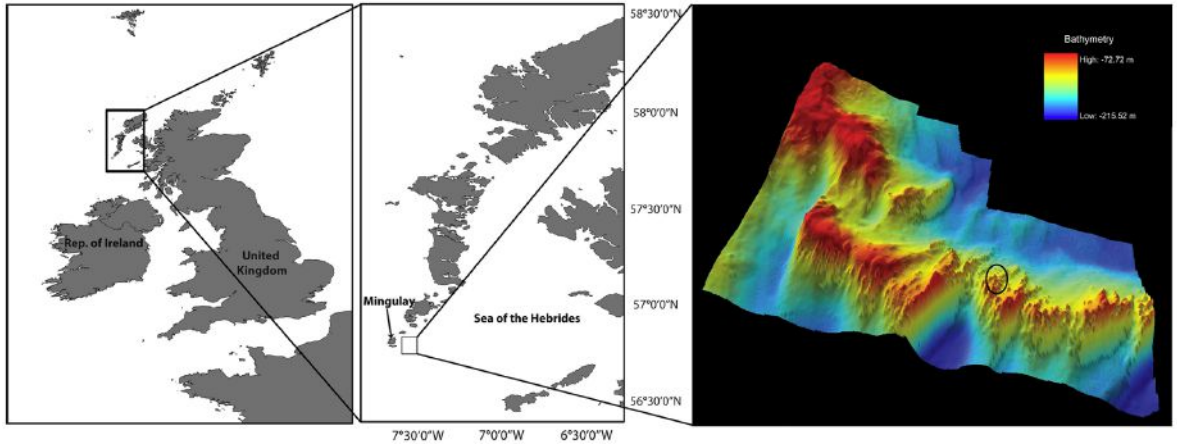
Case Study 4

Mingulay Reef Complex

"One on top of the other": Habitat supply by macrobenthos

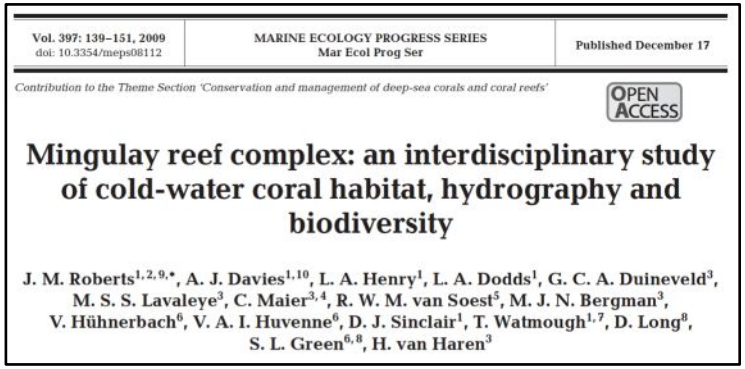
The Mingulay Reef Complex is an inshore seascape of reef mounds in western Scotland

Topographically complex deep-water channel connecting the Scottish continental shelf and the Atlantic Ocean



MRC is one of the most-studied cold-water coral reefs in terms of acoustic seabed mapping, hydrographic circulation and biodiversity

MRC hosts a mosaic of habitats including framework of live ***Lophelia pertusa***, coral rubble and dead coral framework with the latter being colonized by a **species-rich community** dominated by suspension- and filter-feeders.



Vol. 397: 139–151, 2009 | MARINE ECOLOGY PROGRESS SERIES | Published December 17
doi: 10.3354/meps08112 | Mar Ecol Prog Ser

Contribution to the Theme Section 'Conservation and management of deep-sea corals and coral reefs'

OPEN ACCESS

Mingulay reef complex: an interdisciplinary study of cold-water coral habitat, hydrography and biodiversity

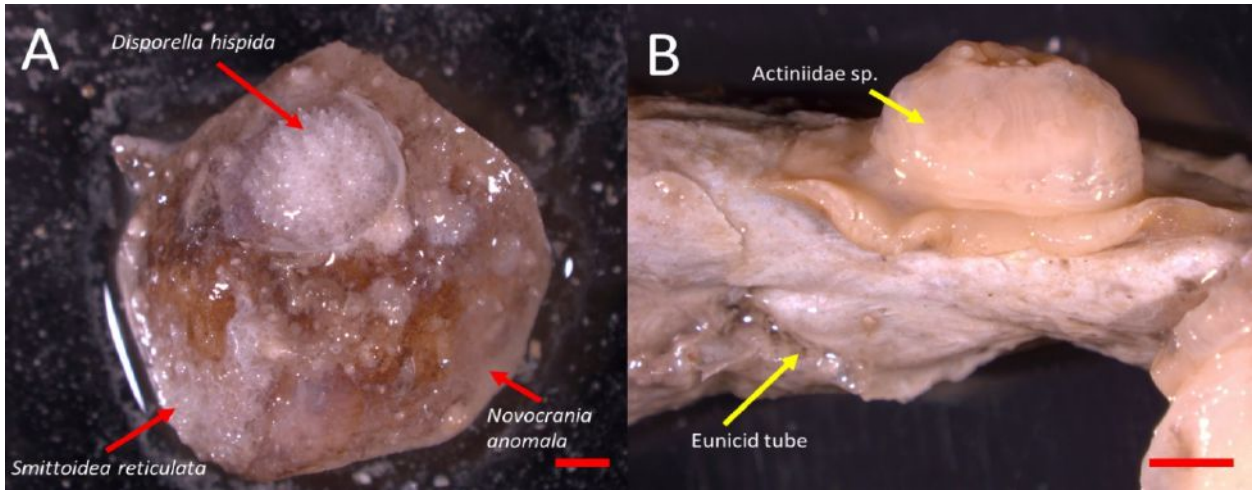
J. M. Roberts[1,2,9,*], A. J. Davies[1,10], L. A. Henry[1], L. A. Dodds[1], G. C. A. Duineveld[3], M. S. S. Lavaleye[3], C. Maier[3,4], R. W. M. van Soest[5], M. J. N. Bergman[3], V. Hühnerbach[6], V. A. I. Huvenne[6], D. J. Sinclair[1], T. Watmough[1,7], D. Long[8], S. L. Green[6,8], H. van Haren[3]

Case Study 4

Mingulay Reef Complex

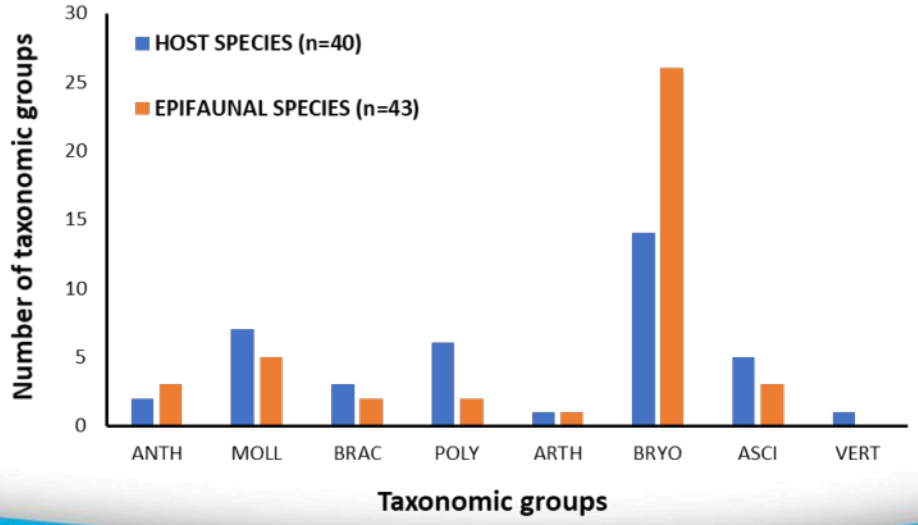
"One on top of the other": Habitat supply by macrobenthos

Apart from the *L. pertusa* fragments and sponges, **almost nothing was known about habitat supply** from other organisms in Mingulay Reef



40 habitat-providing taxonomic groups and 43 epifaunal taxonomic groups

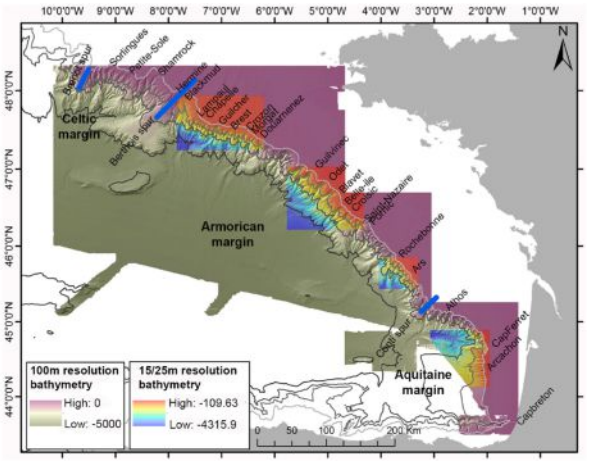
Habitat-providing species (hosts) comprise a wide group of sessile organisms and mobile fauna

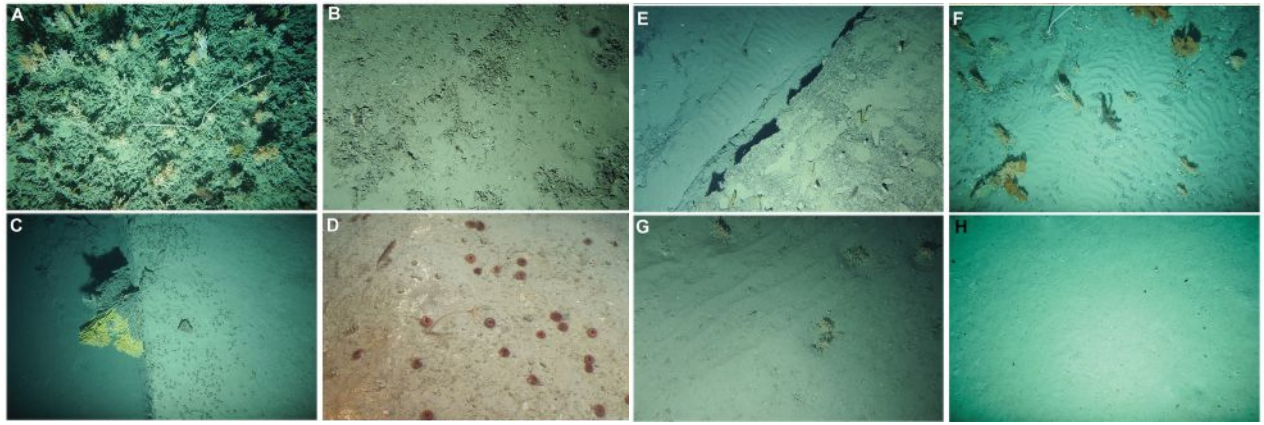


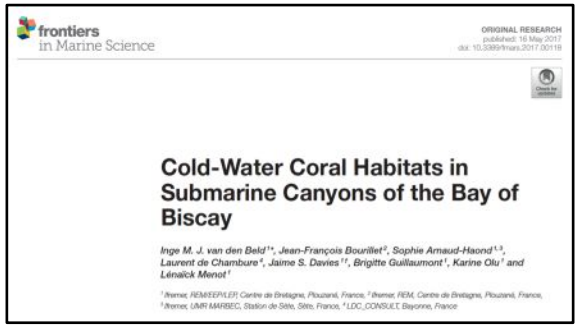
Case Study 6

Bay of Biscay

Cold-water coral habitats in submarine canyons of the Bay of Biscay






frontiers in Marine Science

ORIGINAL RESEARCH

Cold-Water Coral Habitats in Submarine Canyons of the Bay of Biscay

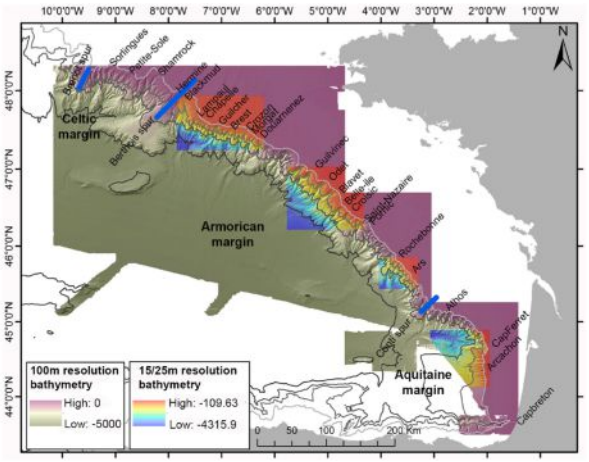
The continental margin of the Bay of Biscay is incised by over **100 submarine canyons**. Oceanographic conditions in the area are influenced by **several water masses**.

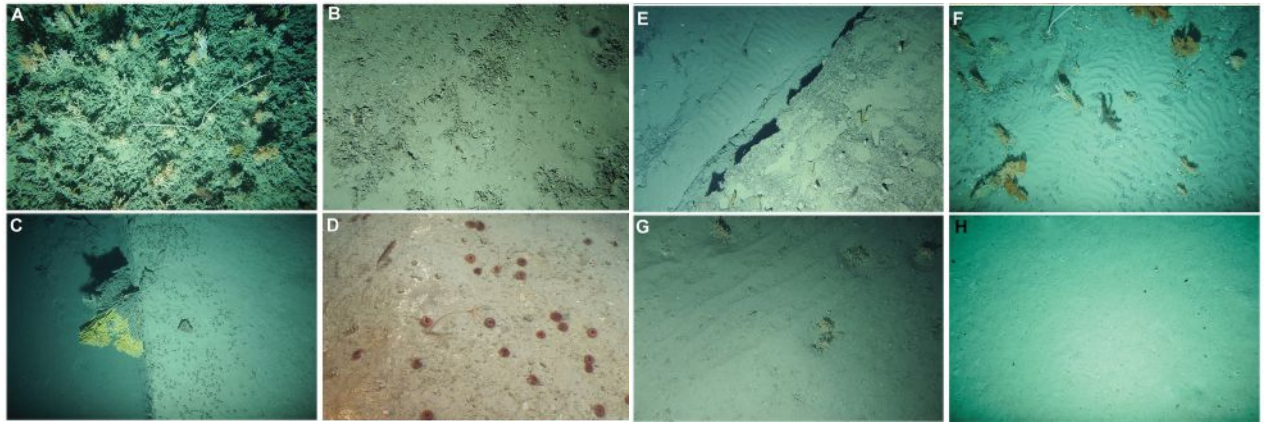
24 canyons explored during **48 dives** of an ROV and a towed camera.

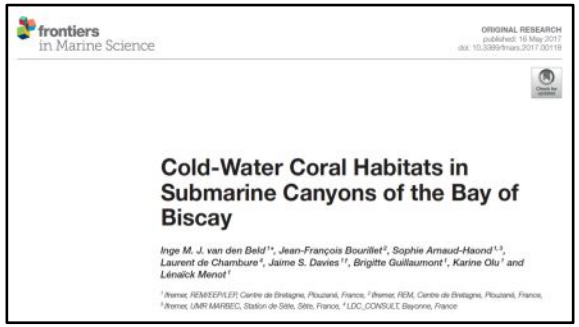
Case Study 6

Bay of Biscay

Cold-water coral habitats in submarine canyons of the Bay of Biscay






frontiers in Marine Science

ORIGINAL RESEARCH

Cold-Water Coral Habitats in Submarine Canyons of the Bay of Biscay

Inge M. J. van den Beld[1*], Jean-François Bourillet[2], Sophie Arnaud-Haond[1,3], Laurent de Chambure[4], Jaime S. Davies[1†], Brigitte Guillaumont[1], Karine Olu[1] and Lénaïck Menot[1]

59 morphotypes of scleractinians, gorgonians, antipatharians and seapens

11 coral habitats under CoralFISH classification including colonial scleractinians on hard substrate, antipatharians/gorgonians on hard and mixed substrate and sea pens on soft substrate

Coral habitats were observed in all **24** canyons, with at least four different coral habitats, up to a maximum of seven habitats in Lampaul and Odet Canyons

Results of this study feed into a proposal of a Natura 2000 network in the Bay of Biscay to define sectors to protect reef habitats under the Habitats Directive

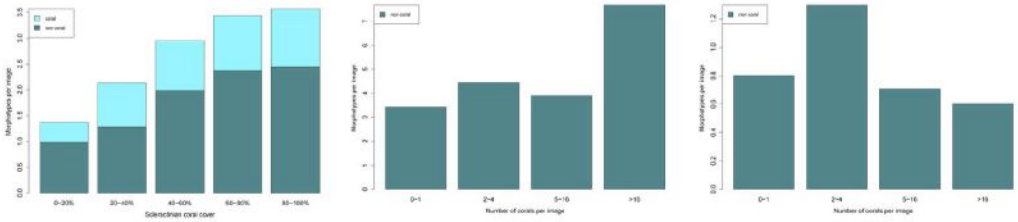
Case Study 6

Bay of Biscay

Cold-water coral habitats in submarine canyons of the Bay of Biscay

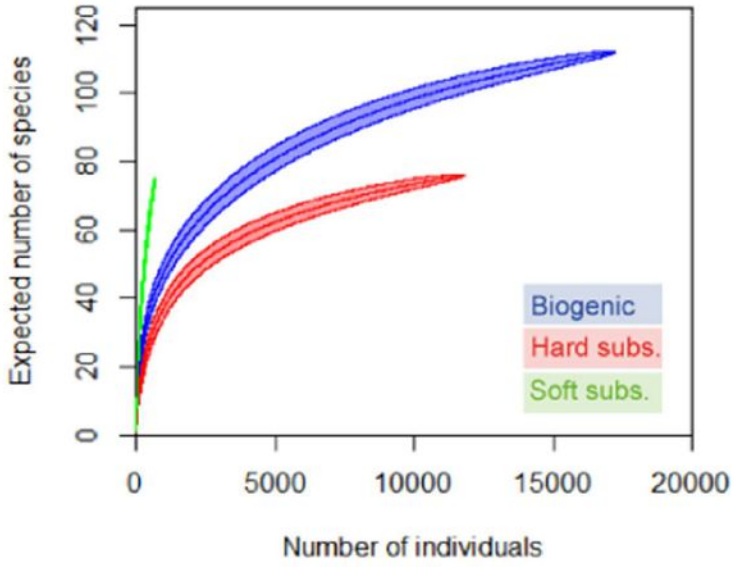
Coral habitat cluster into three groups:

1) aggregations of the two **reef-building** corals *Lophelia pertusa* and *Madrepora oculata*
2) aggregations of **antipatharians**, **alcyonaceans** and **scleractinians** on hard substrates
3) aggregations of **gorgonians** or **pennatulids** on soft substrates



Tested the relationship between coral cover/density and abundance/diversity of associated fauna.

In **biogenic habita**ts, the abundance/diversity of megafauna linearly increases with coral cover, providing evidence for the **ecological role of coral reefs**



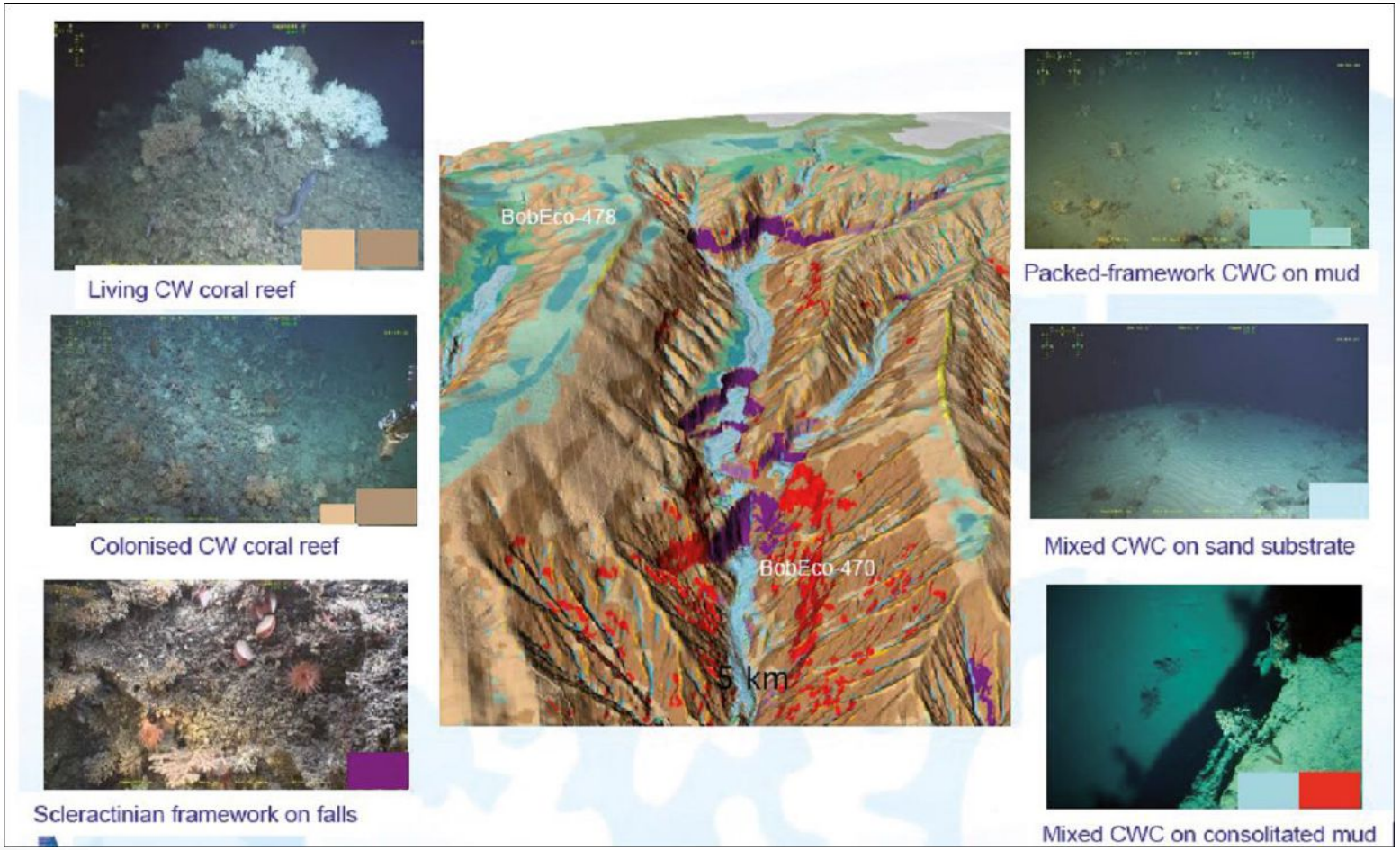
Case Study 6

Bay of Biscay

Cold-water coral habitats in submarine canyons of the Bay of Biscay

Lampaul canyon

Spatial distribution of cold-water coral habitats

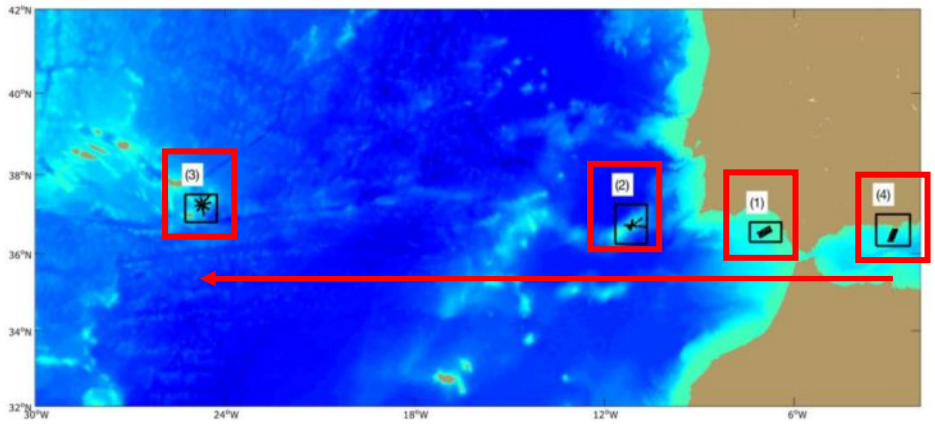


Case Study 7

Gulf of Cádiz, Gazul, Chella Bank & Ormonde

Diversity of benthic communities under the influence of the MOW

MEDWAVES

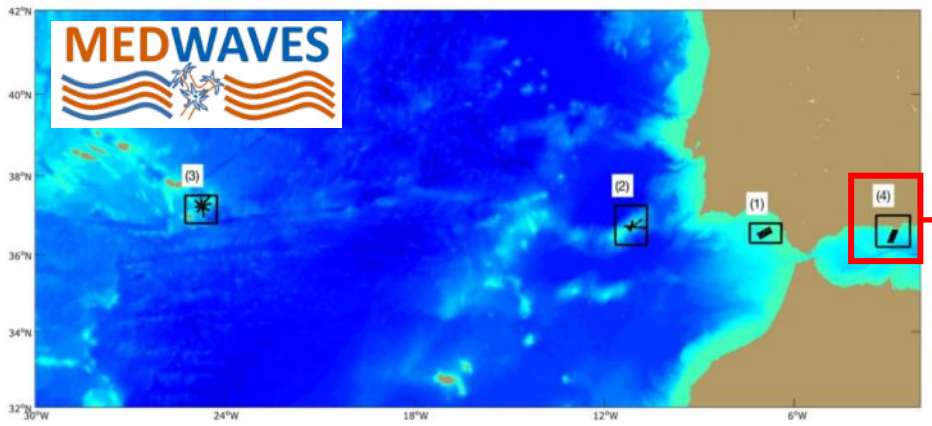


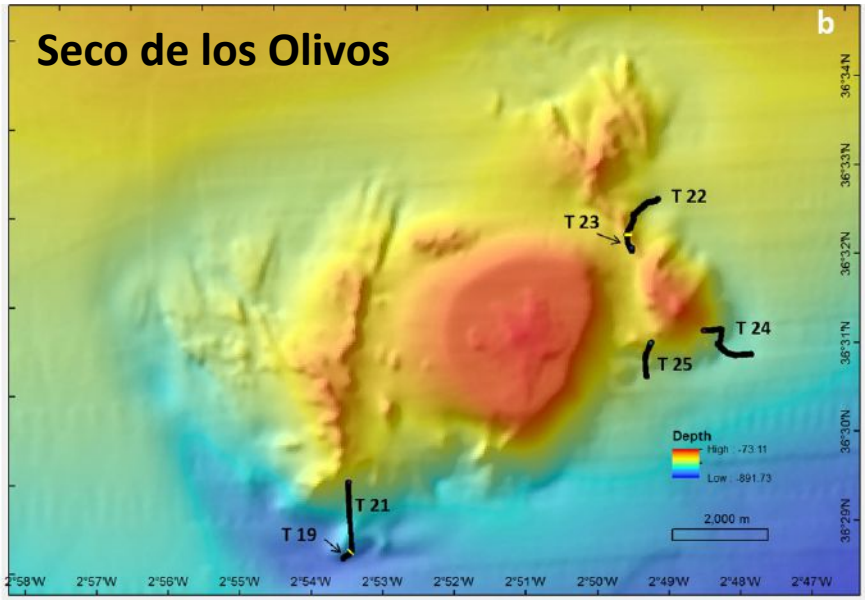
The Strait of Gibraltar, the Gulf of Cádiz in the Atlantic, and Alboran sea in the Mediterranean, are key areas to understand the **distribution and connectivity** of marine communities

Case Study 7

Gulf of Cádiz, Gazul, Chella Bank & Ormonde

Diversity of benthic communities under the influence of the MOW





62 species of megabenthic invertebrates. **Cnidaria** and **Porifera** the most representative

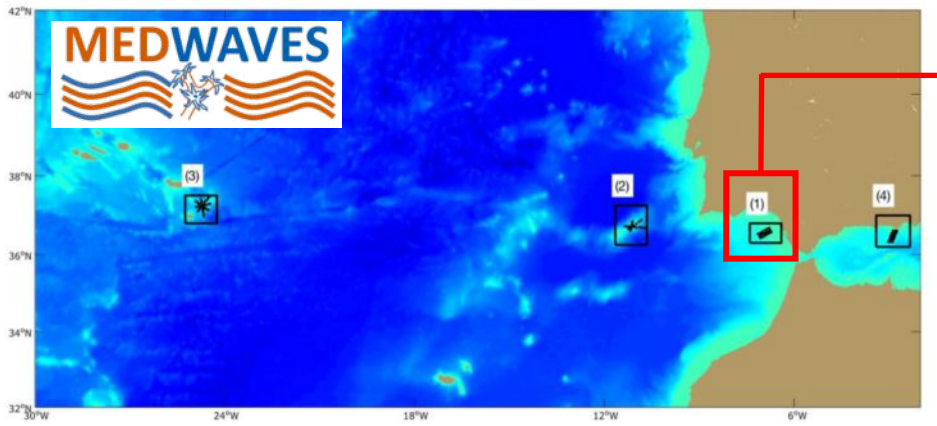
Two main types of benthic communities:

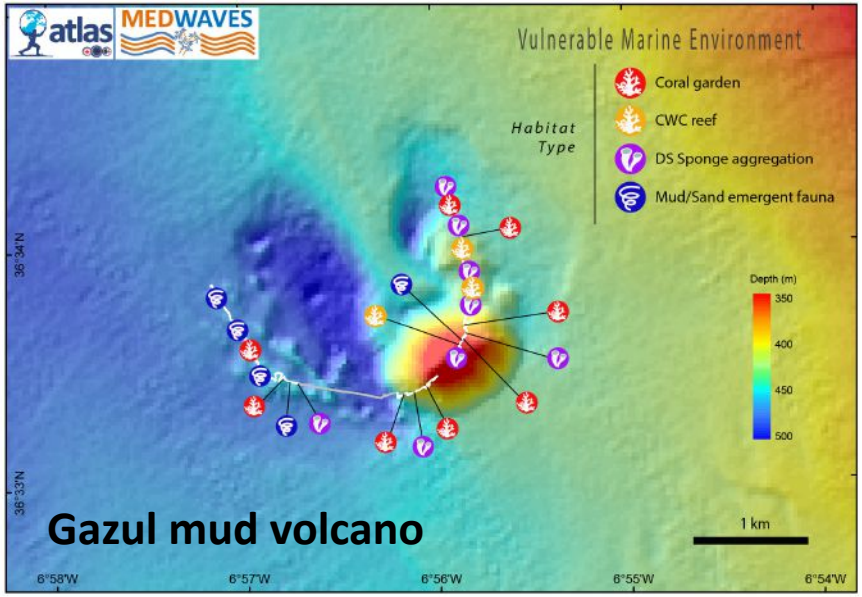
- muddy substrates and soft detritic: low occurrence of mega-benthic organisms
- Mixed detritic and rocky bottoms: diverse assemblage of sponges with the sporadic occurrences of different cnidarian species

Case Study 7

Gulf of Cádiz, Gazul, Chella Bank & Ormonde

Diversity of benthic communities under the influence of the MOW





Cone-shaped edifice built up by successive episodes of mud flows

39 species of megabenthic invertebrates, with abundances generally low

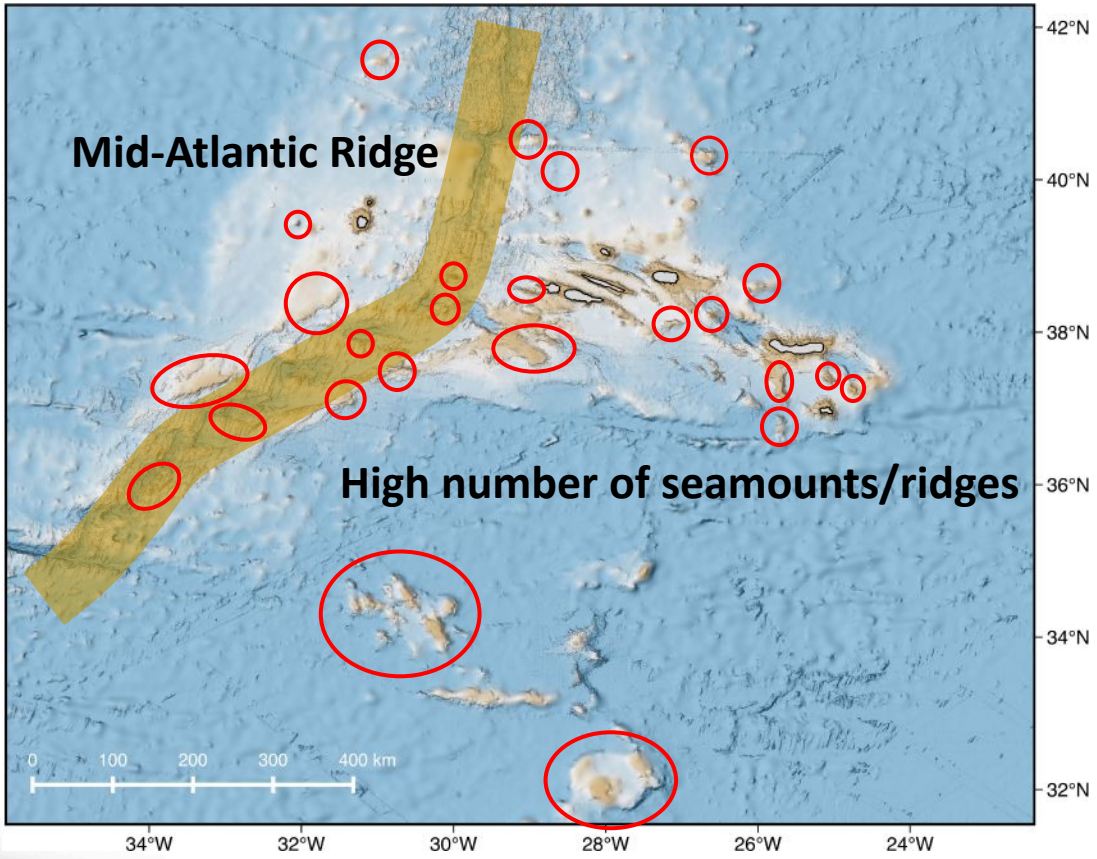
5 types of benthic communities, with areas dominated by **large sponge fields** and **gorgonian aggregations**

Also, colonies of ***Lophelia pertusa*** and ***Madrepora oculata***

Case Study 8

Azores region

Diversity of benthic communities in offshore seamounts



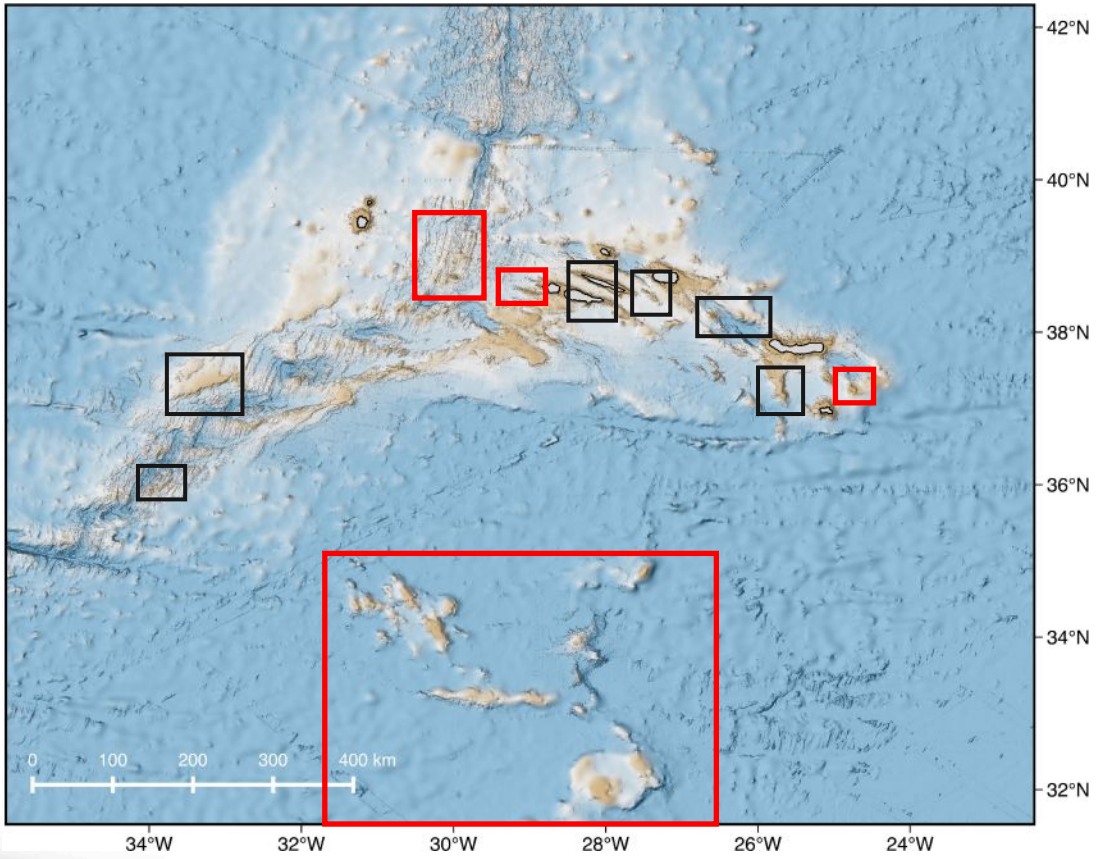
460 seamount-like features identified to date that may occupy 37% of the total area of the EEZ

These structures favour the occurrence of **different deep-sea ecosystems** in the region comprising deep-sea hydrothermal vents, cold-water coral gardens and reefs, and sponge aggregations

Case Study 8

Azores region

Diversity of benthic communities in offshore seamounts



9 study areas, but focus on:

Gigante seamount complex

Condor seamount

Formigas bank

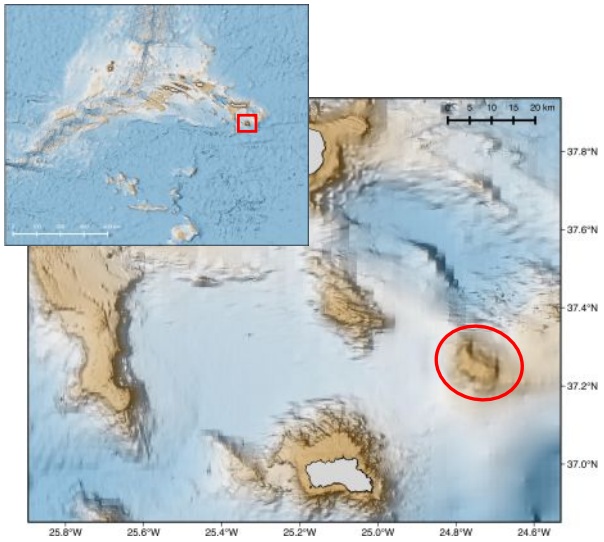
Great Meteor complex

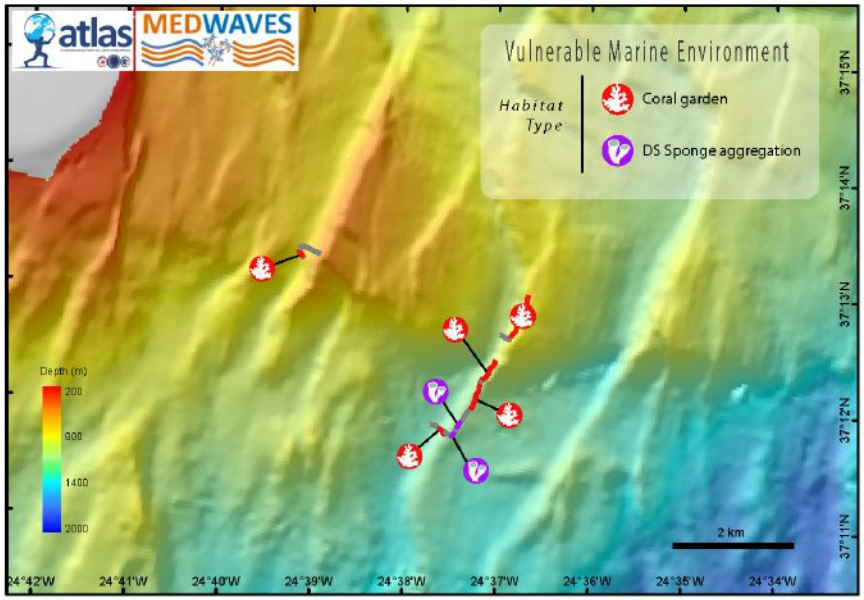
Case Study 8

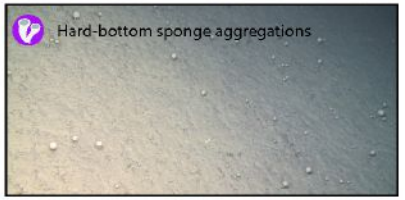
Azores region

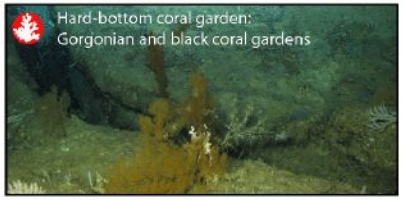
Diversity of benthic communities in offshore seamounts

Formigas bank

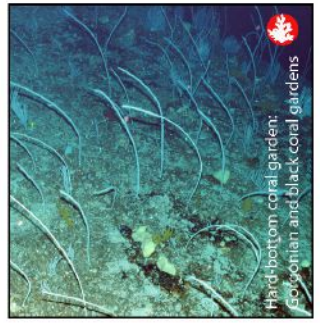








A very diverse seamount regarding the coral fauna, with several aggregations dominated by gorgonian and black coral species

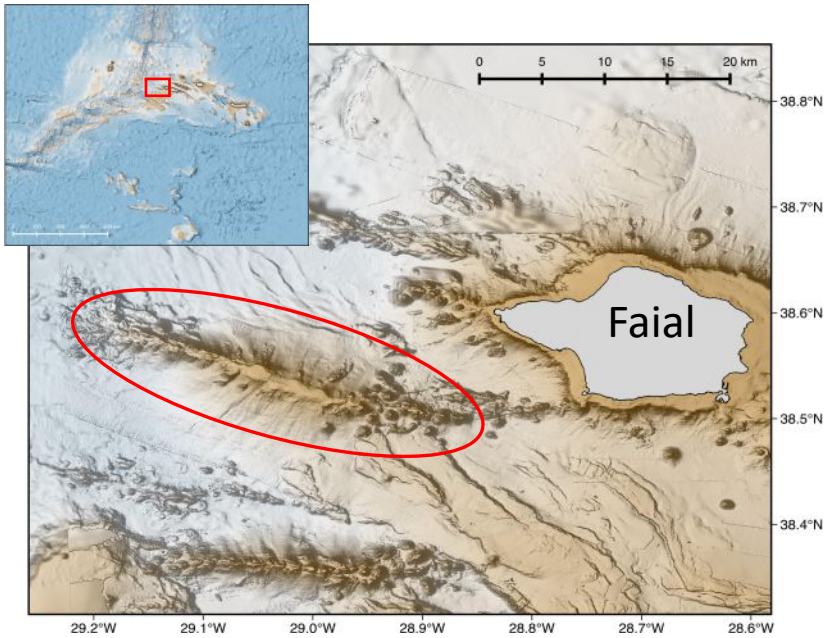


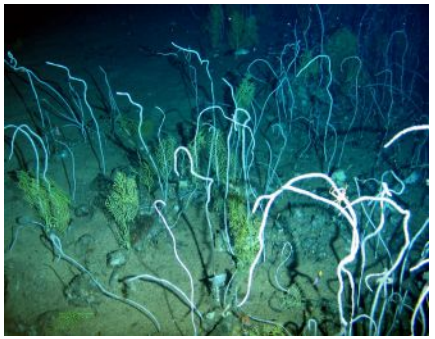
Case Study 8

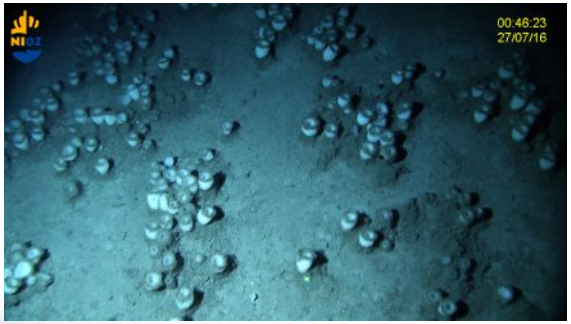
Azores region

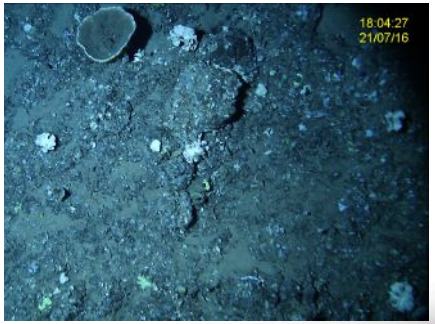
Diversity of benthic communities in offshore seamounts

Condor seamount









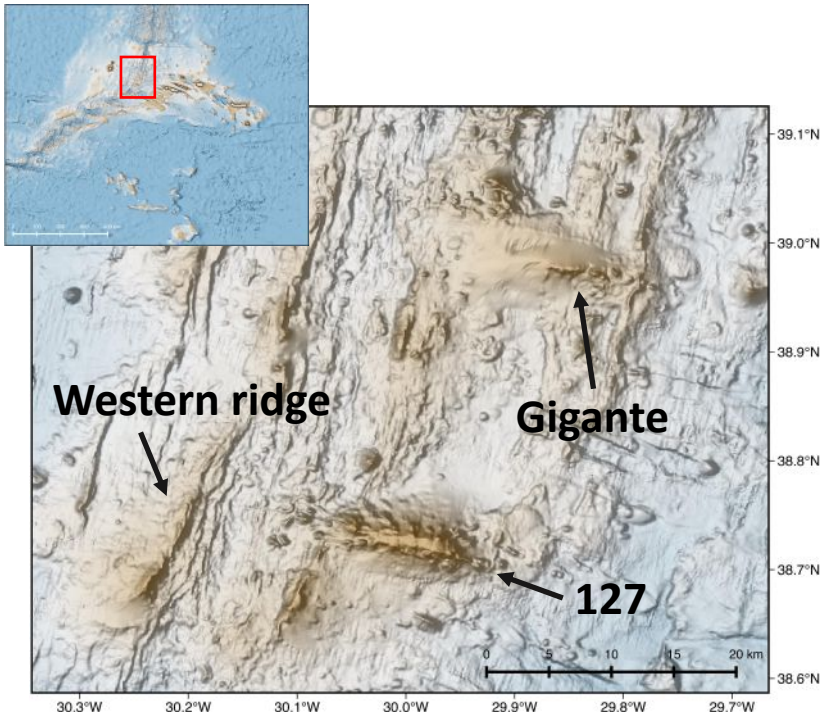
- Dense gorgonian gardens on the summit
- Sponge fields on the flanks

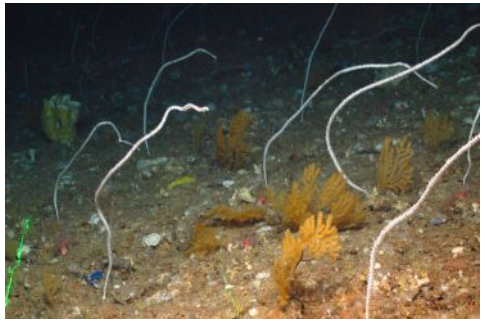
Case Study 8

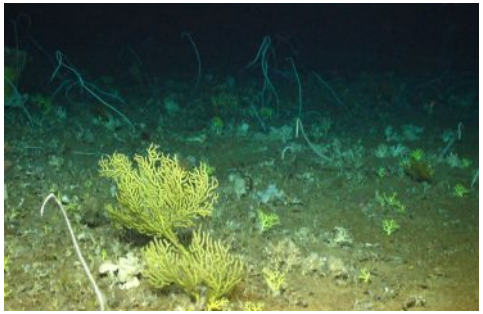
Azores region

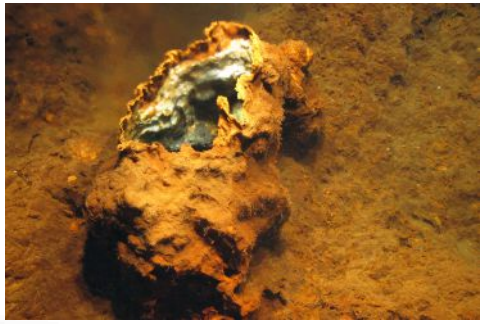
Diversity of benthic communities in offshore seamounts

Gigante seamount complex









Great diversity of habitats & communities

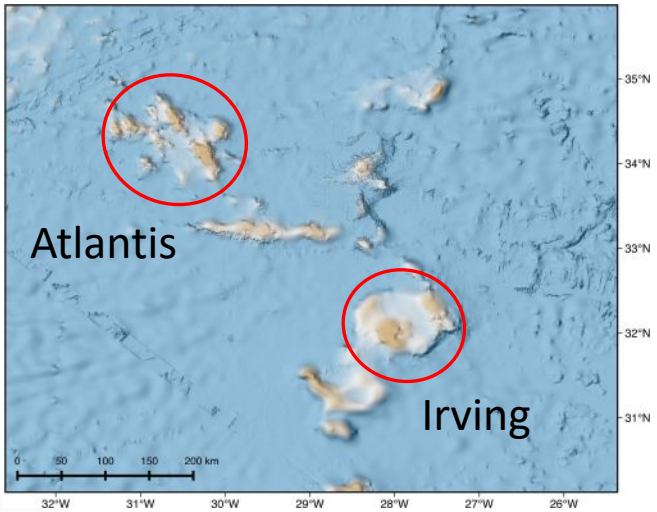
New HV field discovered

Case Study 8

Azores region

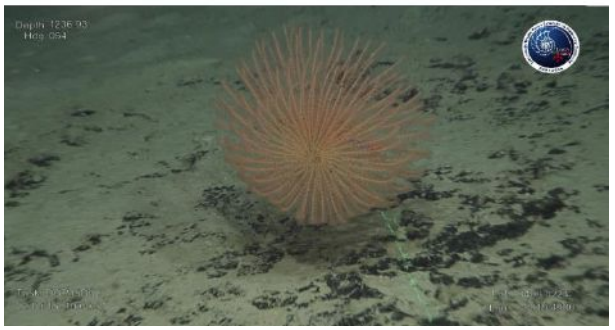
Diversity of benthic communities in offshore seamounts

Great Meteor seamount complex



Relatively high species diversity, with 40 coral and 30 sponge species

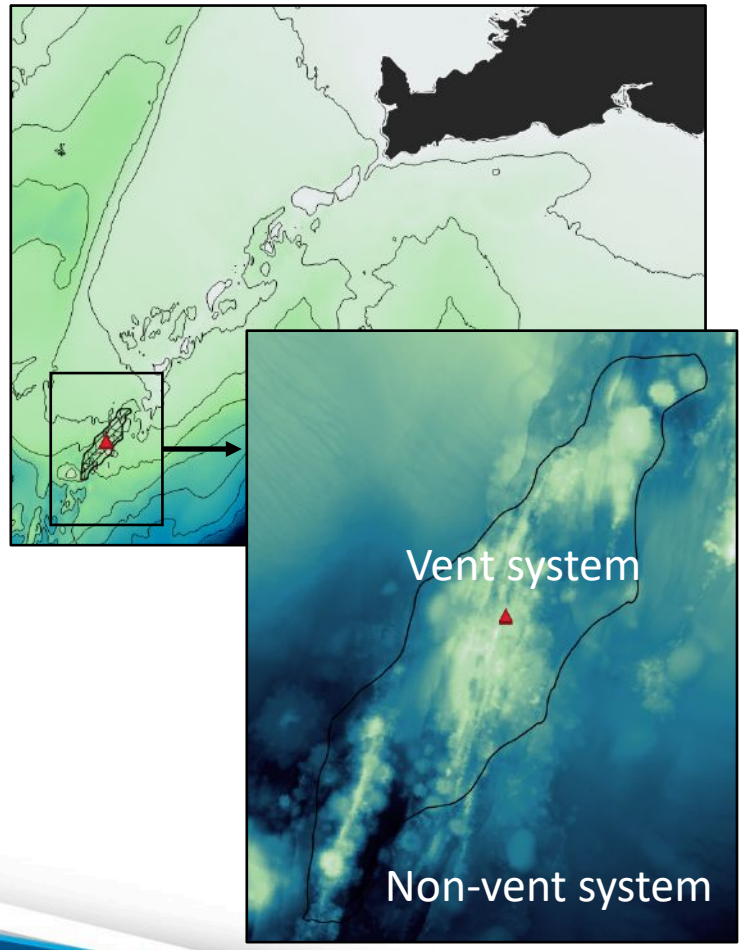
Very low abundances overall



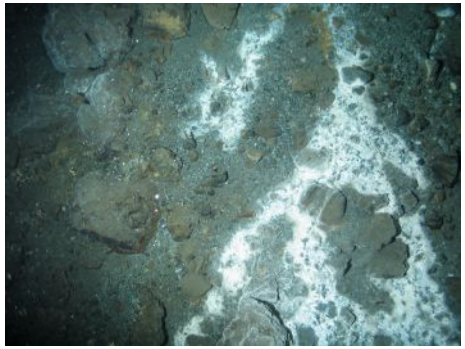
Case Study 9

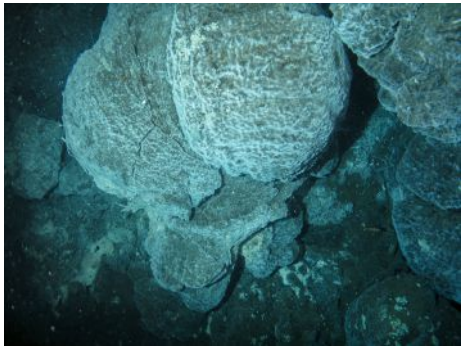
Reykjanes Ridge

Comparing vent system to non-vent system communities



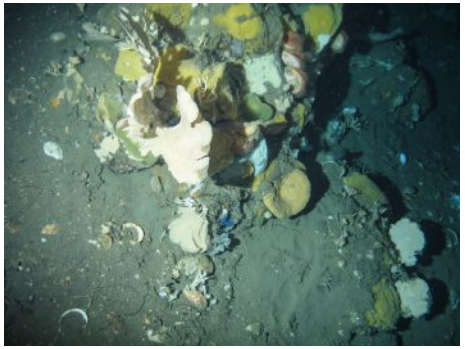
Vent system





Benthic diversity on and around the Steinahóll hydrothermal vent is low, with bacterial mats dominating

Non-vent system



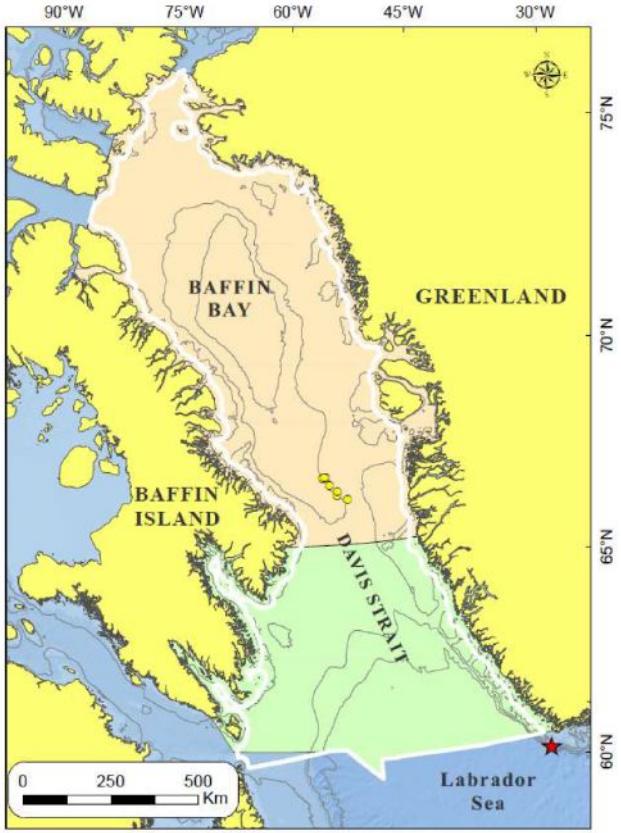
Benthic biodiversity increases further away from the Steinahóll hydrothermal vent area, with reefs of sclerctinian corals and sponge aggregations

Fisheries and Oceans Canada

Case Study 10

Davies strait, Western Greenland, Labrador sea

Lophelia pertusa reefs and new deep-sea benthic communities



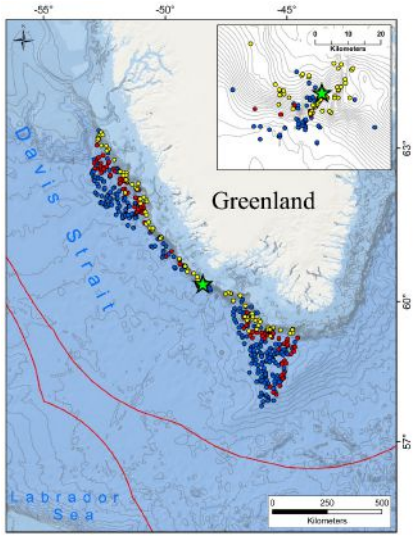
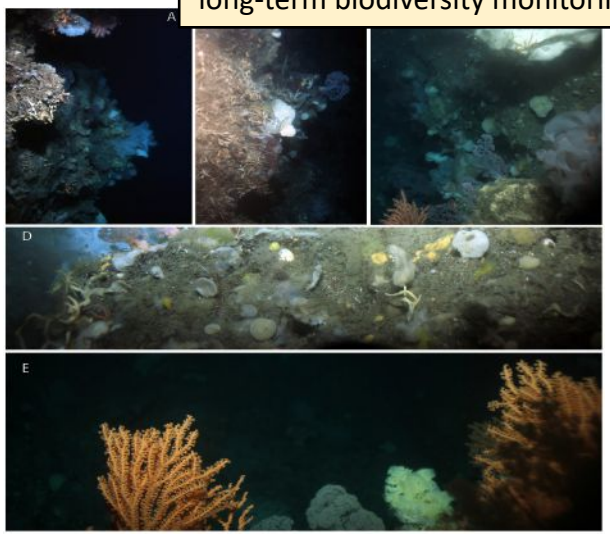


Photo transects were established as long-term biodiversity monitoring



Discovery of a new ***Lophelia pertusa* reef** in Greenlandic waters, the first in Greenlandic waters and the northernmost record in the NW Atlantic.

A **diversified associated fauna** was described and included species common in the area, rare species, species new to Greenland and species new to science

Fisheries and Oceans Canada

Case Study 10

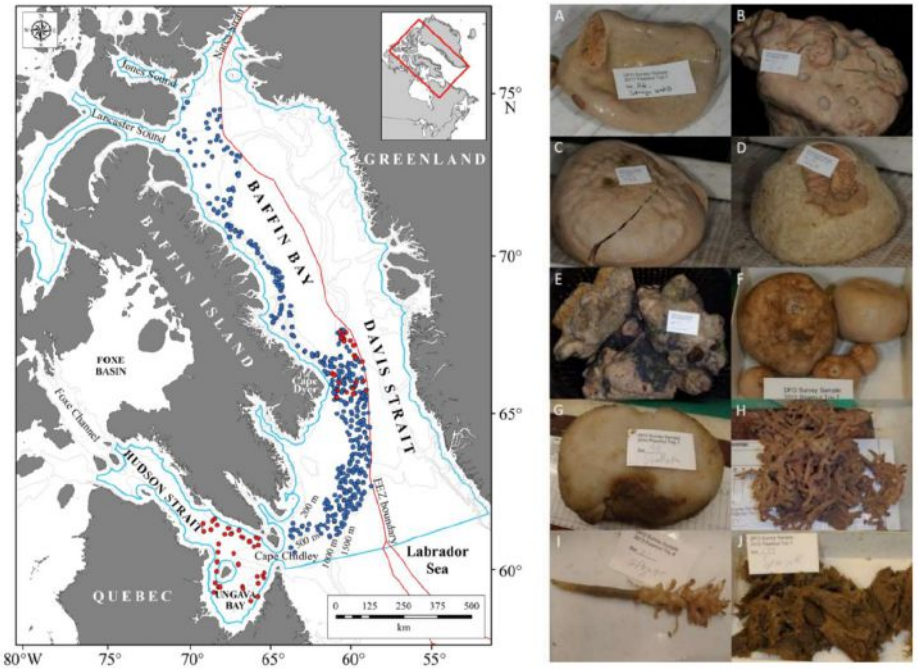
Davies strait, Western Greenland, Labrador sea

Lophelia pertusa reefs and new deep-sea benthic communities

In the eastern Canadian Arctic, **sponges and sponge grounds** occur in both Davis Strait and Baffin Bay.

Sponge communities include arctic and boreal astrophorid grounds and at least **112** species have been identified from the region.

Identification of **areas with relevant VMEs**, which have been **mapped** using predictive modelling techniques for sponges and some corals taxa**.**

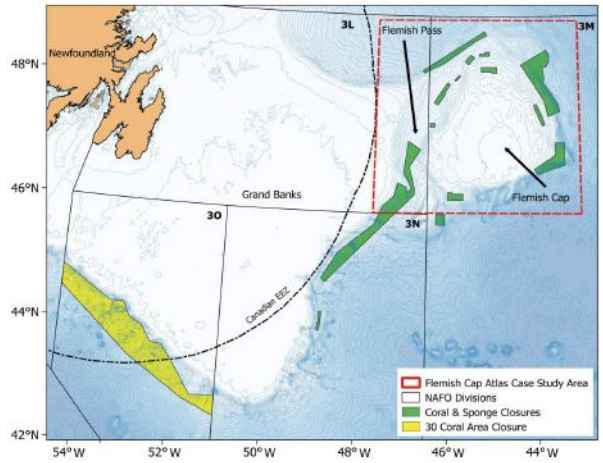


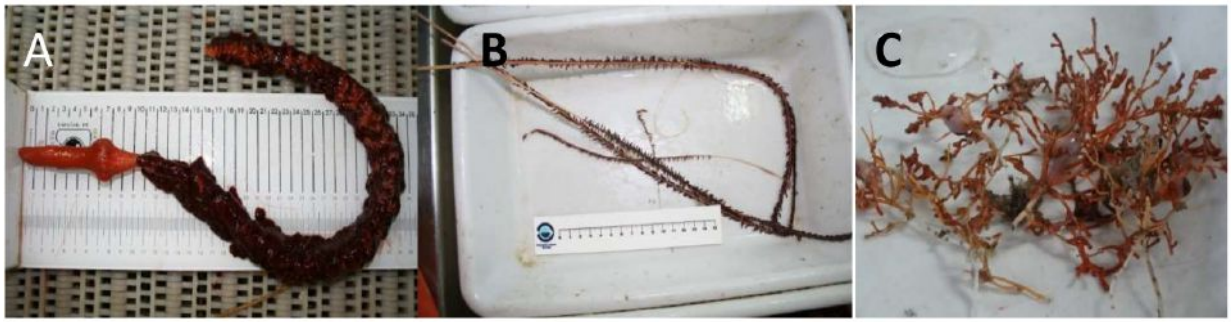
Within the Canadian portion of the Case Study Area, the identification of coral, sponge and sea pens from the trawl surveys was used to establish 3 marine refuges in the Eastern Canadian Arctic

Case Study 11

Flemish Cap

Biological traits of deep-sea corals





40 taxa of corals were identified in the area from bottom trawl research vessel surveys (2006-2015) and rock dredges (2009-2010).

They include **22 Alcyonacea**, **11 Pennatulacea**, **3 Antipatharia** and **4 Scleractinia**.

21 biological traits were identified as suitable to define deep-sea corals

This work contributes to **defining biological traits for deep-sea corals** which best describe the Vulnerable Marine Ecosystems

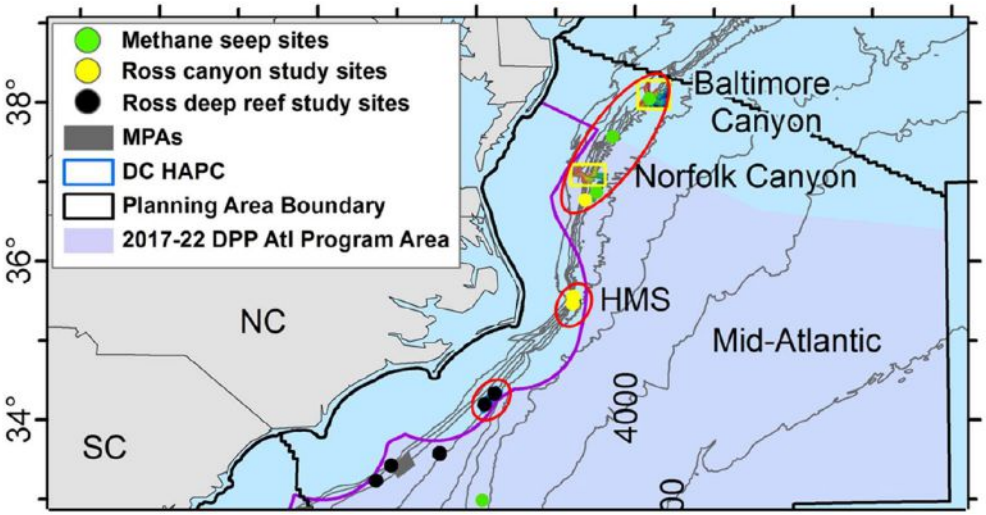
Case Study 12

Southeastern USA and mid-Atlantic canyons

Recent deep-sea discoveries off the eastern U.S.

3 sub-areas:

- two **mid-Atlantic canyons** (Norfolk and Baltimore)
- the **Hatteras middle slope**
- the deep-sea coral banks off **Cape Lookout**, North Carolina (NC)



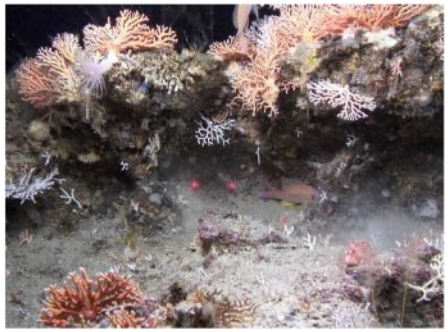
New deep-sea coral habitats were discovered within the region, which occur as large bioherms as well as smaller colonies associated with submarine canyons.

Deep-sea coral **biodiversity is high**, but species **zoogeography differs** north and south of Cape Hatteras, NC.

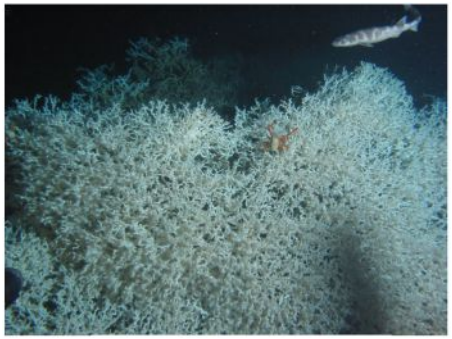
Case Study 12

Southeastern USA and mid-Atlantic canyons

Recent deep-sea discoveries off the eastern U.S.



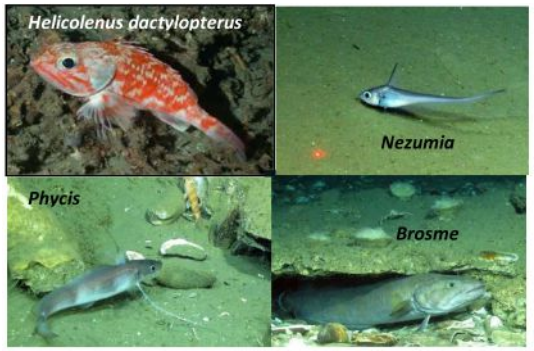
North of Cape Hatteras: **78** species of corals, with systems dominated by **Octocorals,** mainly *Paragorgia arborea*



South of Cape Hatteras: **201** species of corals, with systems dominated by ***Lophelia pertusa*** and other **scleractinians**

Reasons for the different benthic coral communities are not fully understood, but the relative rarity of *L. pertusa* in the northeastern Atlantic may be due to a combination of infrequent larval delivery, specific habitat requirements and loss of older colonies.

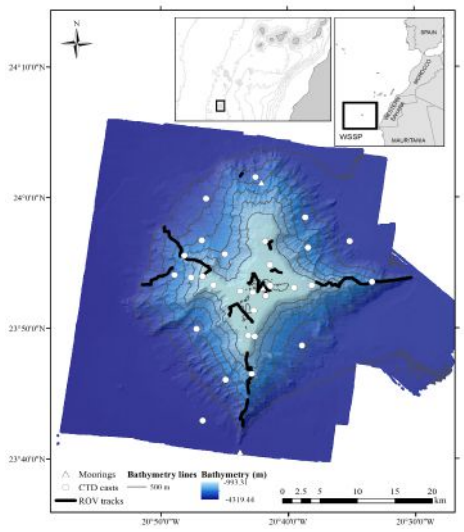
99 fish species were documented, more than any other area of deep corals to date.
About **20%** of fish fauna is new to the SEUS region.

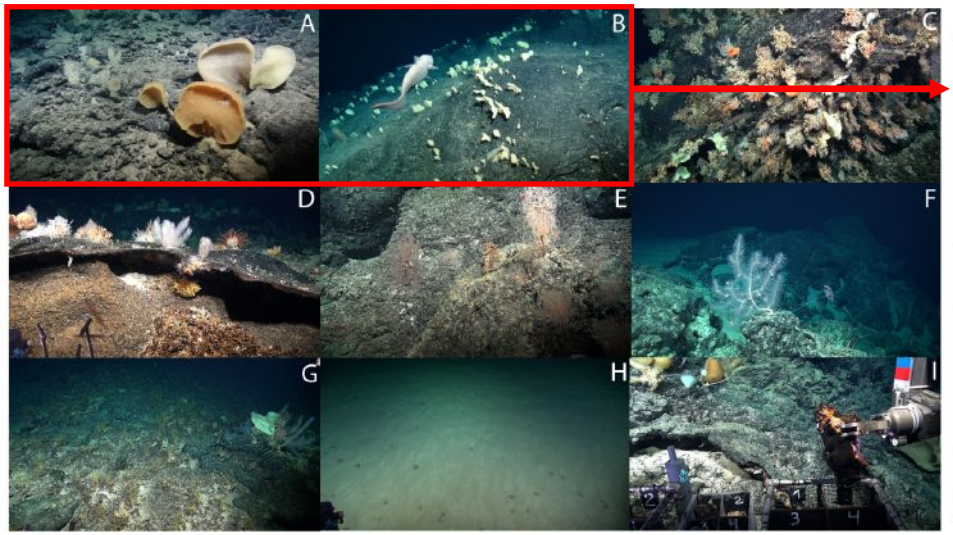


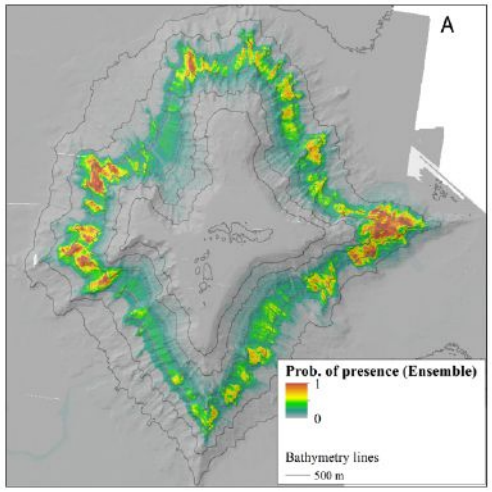
Case Study 13

Tropic seamount

Biodiversity and biogeography of VMEs







Discovery of multiple VME types on the seamount, including a relatively rare and biogeographically restricted type of deep-sea sponge ground, formed by the glass sponge *Poliopogon amadou*.

identification of at least 30 megafaunal species including **17 species of cold-water corals**

Other benthic communities included coral gardens with diverse octocorals, dense patches of *Solenosmilia variabilis,* octocoral gardens on coral rubble, crinoids fields and aggregations of xenophyophores

New species described

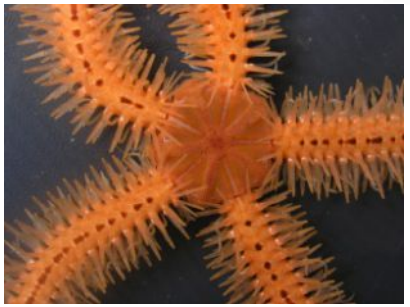
Alboran Sea & Greenland

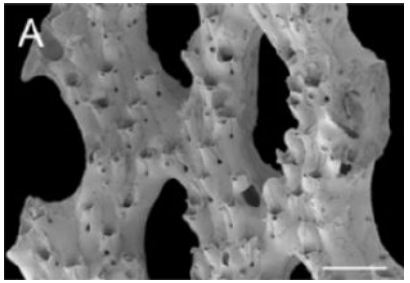
Chella Bank & Gulf of Cádiz

Several species currently under description:

- Focussing at the moment on **Molluscs** and **Bryozoans**
- An Ophiuroidea is also currently under description

IEO Málaga team





Seco de los Olivos (Chella Bank):

- A Gastropoda species (Genus *Mitrella*)
- Other potential new Molluscs species under analysis
- Two Bryozoan species (to be dedicated to ATLAS and MEDWAVES)

Gazul Mud volcano and Gulf of Cádiz:

- Three Molluscs under review (Genus *Cuspidaria, Onoba, Dentimargo*)
- One Bryozoan species described and three new ones under description

Western Greenland

Two new bryozoan species have been described: *Turbicellepora hansenae* sp. n. and *Turbicellepora greenlandica* sp. n., both by Denisenko. Two new sponges also being described.

Fisheries and Oceans Canada

New species described

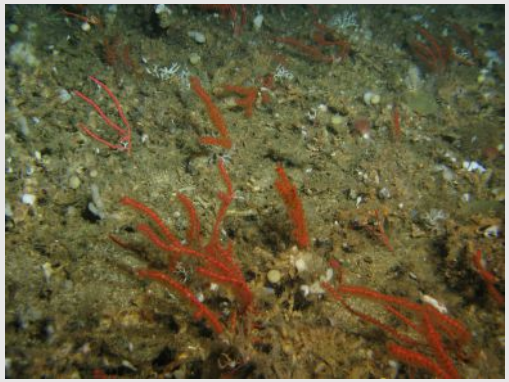
Azores and Macaronesia

AZORES

Corallium sp.

Swiftia sp. I

MAURITANIA



Swiftia sp. II

Paramuricea sp.

Putative **new**
Octocoral species

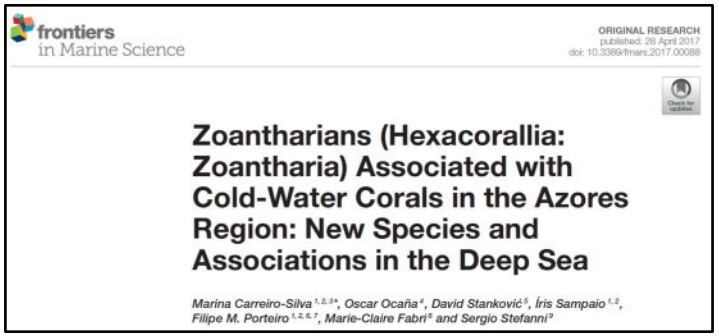
CAPE VERDE

Thesea sp.

cf. *Placogorgia* sp.

New species described

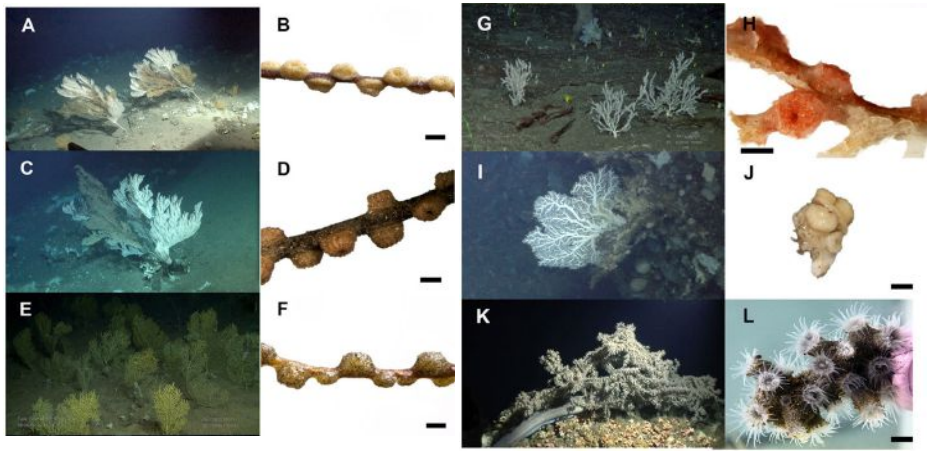
Azores


frontiers in Marine Science

ORIGINAL RESEARCH
published: 28 April 2017
doi: 10.3389/fmars.2017.00088

Zoantharians (Hexacorallia: Zoantharia) Associated with Cold-Water Corals in the Azores Region: New Species and Associations in the Deep Sea

Marina Carreiro-Silva[1,2,3], Oscar Ocaña[4], David Stanković[5], Íris Sampaio[1,2], Filipe M. Porteiro[1,2,6,7], Marie-Claire Fabri[8] and Sergio Stefanni[9]*



5 new species of parasitic zoanthids associated with different species of corals

Luso hydrothermal vent

A barnacle likely to be a new species was found in the area under the influence of the Luso HV. It is related to *Pachylasma giganteum* known from the Tertiary as well as recent of Sicily and from the west coast of Africa

Taxonomic literature review

Azores

Zootaxa 4550 (4): 451–498
https://www.mapress.com/j/zt/

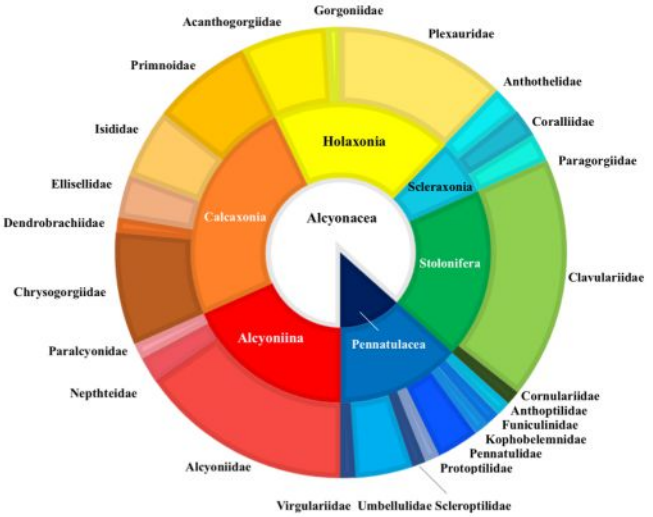
Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.4550.4.1
http://zoobank.org/urn:lsid:zoobank.org:pub:A9B702EF-A193-4A08-8DB6-CC7D3428D61E

Census of Octocorallia (Cnidaria: Anthozoa) of the Azores (NE Atlantic) with a nomenclature update

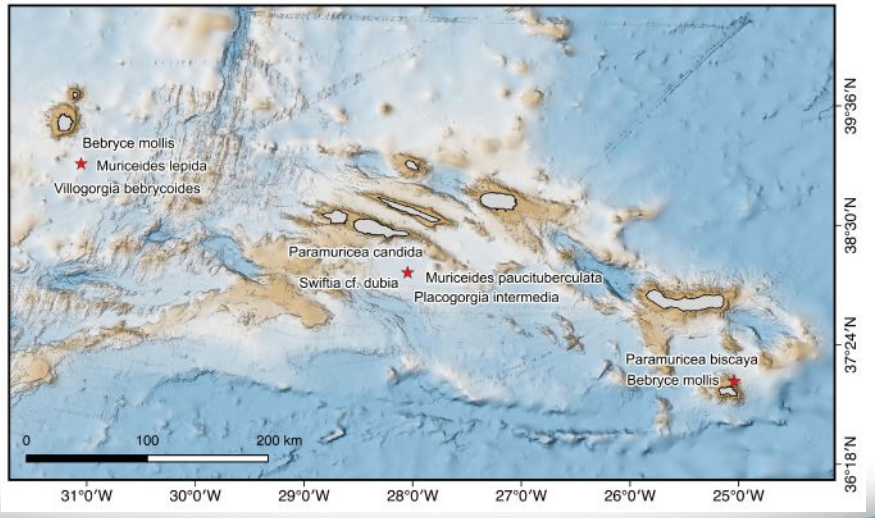
SAMPAIO ÍRIS[1, 2, 3, 7], FREIWALD ANDRE[3], PORTEIRO FILIPE MORA[2,4,5], MENEZES GUI[2,4,6], & CARREIRO-SILVA MARINA[1,2,4]



98 species of **Octocorallia** in the Azores archipelago reported

After a visit to Naturalis Biodiversity Center:

- A new species **record**: *Paramuricea biscaya*
- 10 records with high **taxonomic accuracy**
- 2 species with **depth range** now known in the region
- 3 species occuring **deeper**



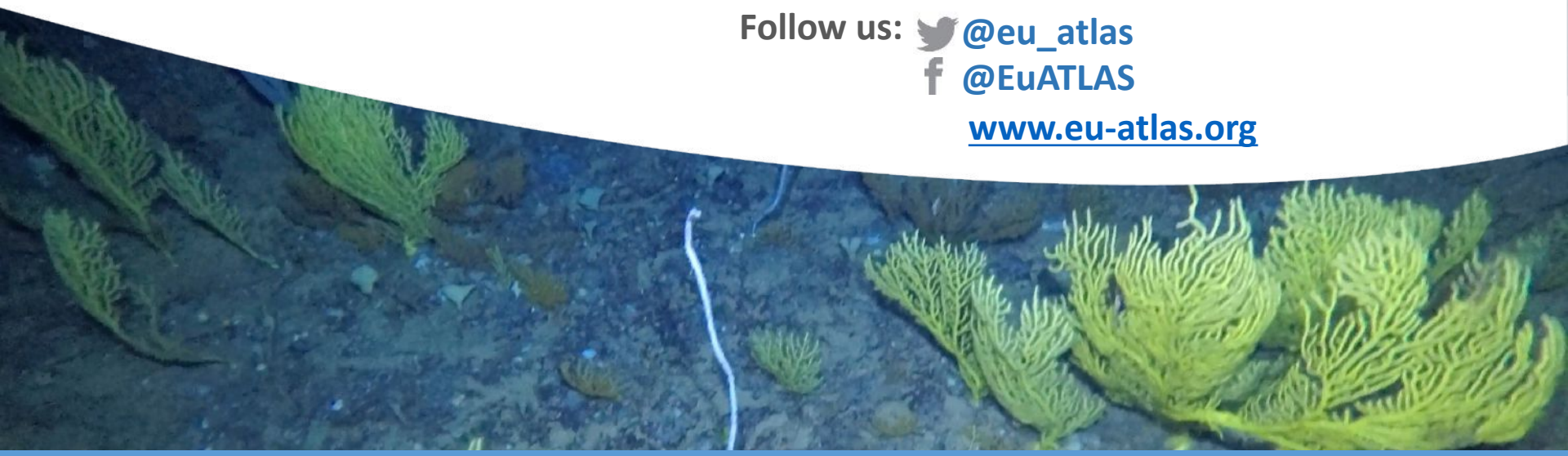
Thank you!

Carlos Dominguez-Carrió
IMAR Instituto do Mar, Universidade dos Açores
Horta, Faial (Portugal)
carlosdominguezcarrio@gmail.com

Project Contact Details:

Coordination: Professor Murray Roberts
murray.roberts@ed.ac.uk
Project Management: Julia Eighteen
eu-atlas@ed.ac.uk
Communication & Press: Dr. Annette Wilson
annette@aquatt.ie

Follow us: **@eu_atlas**
@EuATLAS
www.eu-atlas.org



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 678760 (ATLAS). This output reflects only the author's view and the European Union cannot be held responsible for any use that may be made of the information contained therein.