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UNDERSTANDING DEEP ATLANTIC ECOSYSTEMS



D3.2b: Case Studies on Effects of Hydrography and Oceanography on North Atlantic VME Biodiversity and Biogeography

ATLAS⁴th General Assembly

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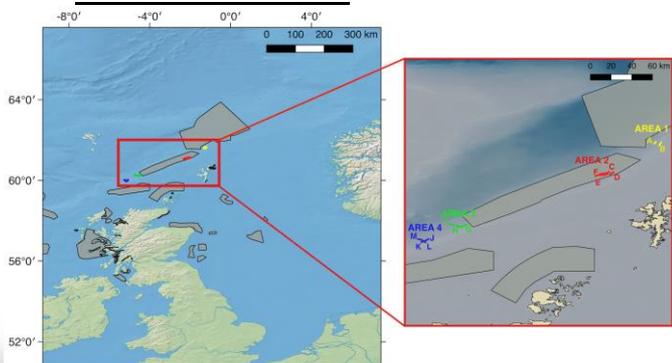
1) Faroe-Shetland Channel (north-east Atlantic UK). Biodiversity of deep-sea sponge grounds in relation to oceanographic and anthropogenic activities

Authors: Georgios Kazanidis, Johanne Vad, Lea-Anne Henry, Francis Neat, Barbara Berx, Konstantinos Georgoulas, J Murray Roberts

Aim: Quantify effects of changing oceanic conditions and human activities on the richness and composition of deep-sea sponge aggregations

Methods:

- Analysis of 465 high-quality images from towed camera
- Transects inside and outside the FSC Nature Conservation Marine Protected Area
- Sponge morphotype composition, sponge density and body-size distribution
- Environmental conditions: Type of substrate, depth, temperature, salinity
- Human activities: Demersal fisheries



Area of study: Camera transects inside and outside the FSC NC MPA

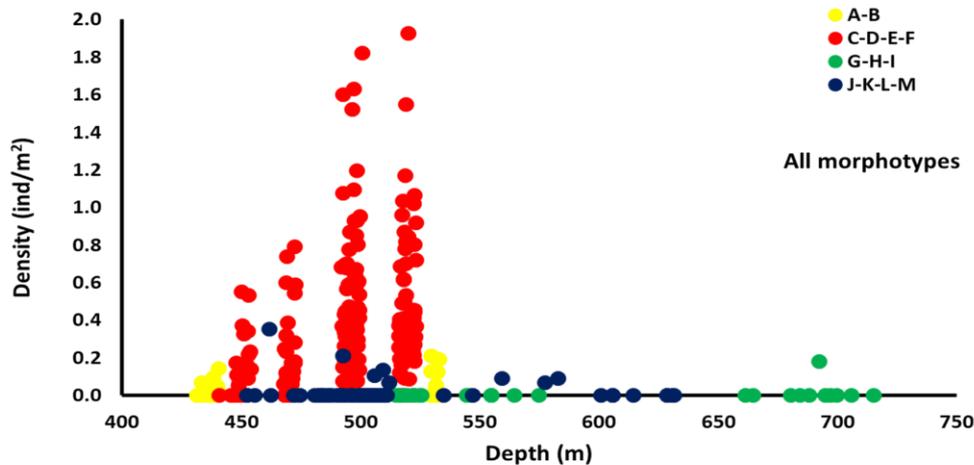


Deep-sea sponge aggregations inside the FSC NC MPA

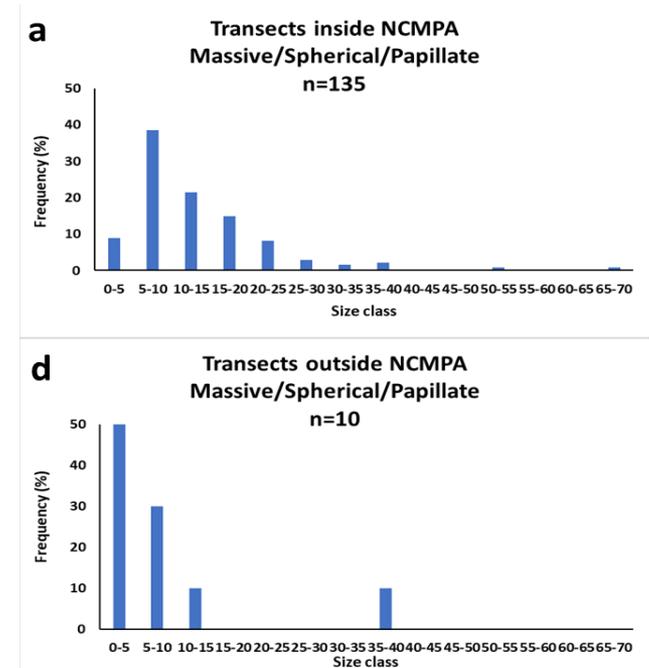


Main findings/conclusions

- Dense sponge aggregations were within a narrow bathymetric zone inside the FSC NCMPA
- Higher number of sponge-size groups inside than outside the FSC NCMPA



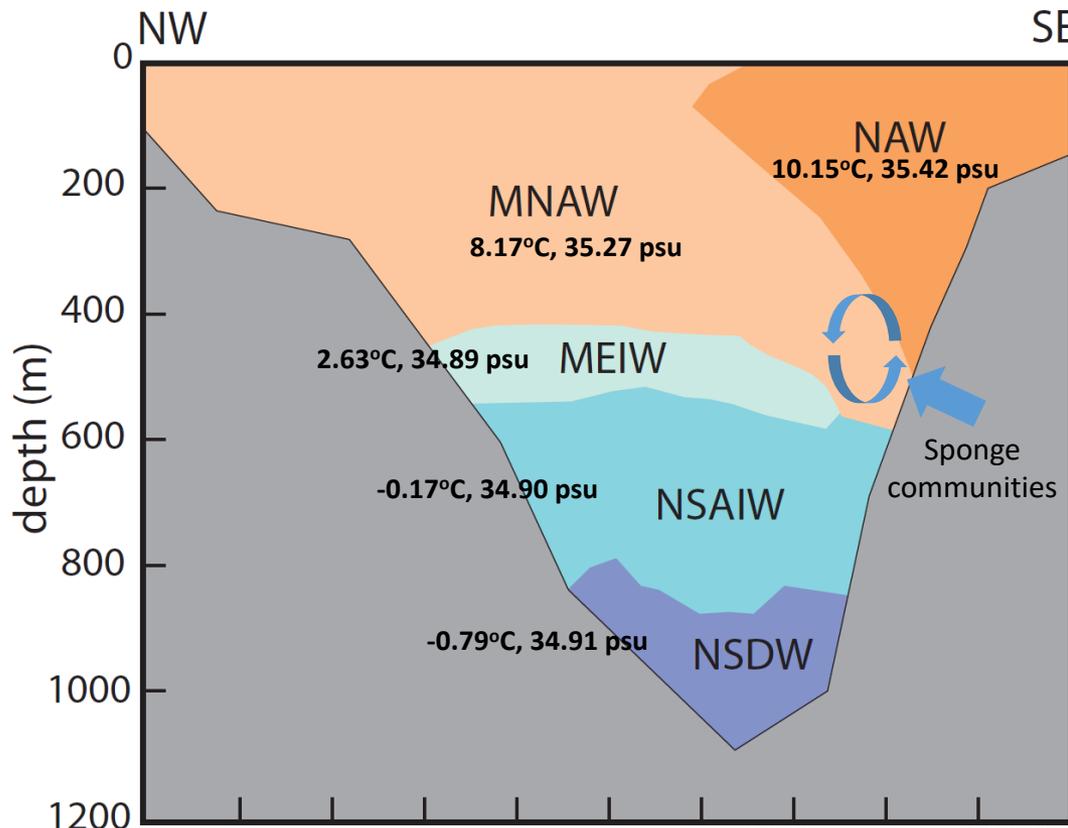
- Contribution of parameters in explaining sponge density variation: Fisheries (29.8%), type of substrate (12%), salinity (4.9%), temperature (1.1%)



Kazanidis et al. (2019) - Frontiers in Marine Science

➤ Vulnerability of deep-sea sponges to fisheries and changing oceanic conditions

Water mass structure in Faroe-Shetland Channel



NAW: North Atlantic Water
MNAW: Modified North Atlantic Water
North-easterly flow

MEIW: Modified East Icelandic Water

NSAIW: Norwegian Sea Arctic Intermediate Water

NSDW: Norwegian Sea Deep Water
South-westerly flow

Berx (2012); McKenna et al. (2016)

2) Mingulay Reef Complex (north-east Atlantic UK). Impacts of North Atlantic Oscillation and gyre dynamics on cold-water coral reef biodiversity and biogeography

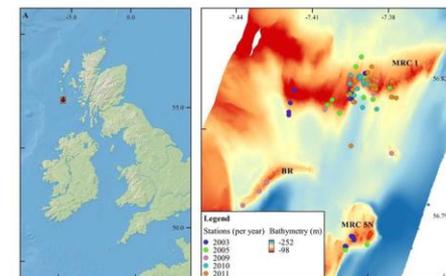
Authors: Georgios Kazanidis, Lea-Anne Henry, Johanne Vad, Laurence H. De Clippele, J Murray Roberts

Acknowledgments: Sam Jones, Clare Johnson, Mark Inall

Aim: Quantify effects of the North Atlantic Oscillation relative to spatial variability in seafloor terrain on cold-water coral reef communities in Scotland

Methods:

- Analysis of benthic samples (Van Veen grab) (78 stations, 2003-2011)
- 14 Phyla, 343 taxa
- Spatial gradients: Depth, slope, northness, eastness, ruggedness, fine-scale bathymetric position index, macrohabitat, maximum current speed, average current speed
- Temporal gradients: Previous and same-year North Atlantic Oscillation Index (NAOI)



Mingulay Reef Complex (a) and sampling stations (b)

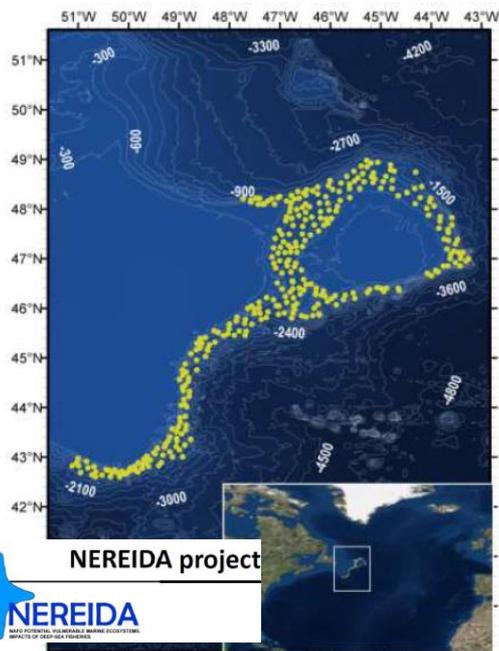


3) Flemish Cap and continental slope (northwest Atlantic, High Seas). Effects of sea temperature, food availability, and currents on macrofaunal species and phylogenetic diversity relative to fishing pressure and biogenic VME habitats

Author: Alex Rogers

Contributors: Oliver Ashford, Andrew Kenny, Christopher Barrio Froján, Michael Bonsall, Tammy Horton, Angelika Brandt, Graham Bird, Sarah Gerken

Aim: Investigate the physical and anthropogenic (fishing) factors driving the structure of deep-sea benthic communities in an area of the High Seas



Box corer deployment locations (yellow dots, n=312) and bathymetry in the Northwest Atlantic (depth range: 582-2294 m)

Macrofauna (sediment samples)

Bathymetry [depth, slope, aspect, seafloor rugosity, bathymetric position index (BPI)]

Physical oceanographic variables (temperature, salinity, current speed)

Seafloor sediment particle size (percentage clay/silt/sand)

Carbon availability [percentage inorganic, organic and total carbon, surface chlorophyll-a and particulate organic carbon (POC) concentrations]

Fishing intensity [(vessel monitoring system (VMS) signal density and total trawl length per km²)]



Conclusions

- Environmental parameters rather than interspecific interactions largely drive the biodiversity and structure of macrofaunal communities at bathyal depths on the NW Atlantic slope
- Seabed trawling has a complex effect on sediment macrofaunal communities, potentially increasing abundance and biomass but reducing the phylogenetic and functional diversity of communities. Trawling potentially selects specific taxa able to survive in conditions where there is physical disturbance (e.g. capitellid polychaetes)
- Benthic community structure may be extremely sensitive to changes in sea temperature
- The presence of VME taxa, specifically sponges, have a significant and positive effect on many biodiversity measures associated with macrofaunal communities on the NW Atlantic slope.

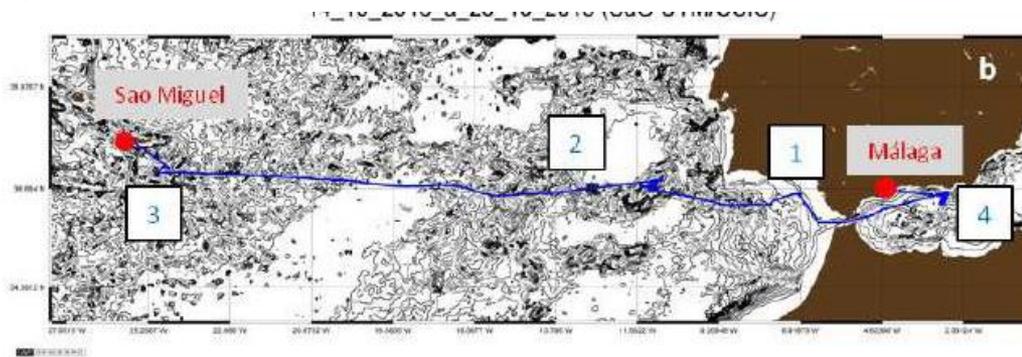
4) Alborán Sea to the Azores: influence of water-mass properties on VME biodiversity and biogeography

Authors: Covadonga Orejas, Patricia Puerta, Ángela Mosquera, Olga Reñones, Carlos Domínguez-Carrió, Jordi Blasco, Albert Fuster, Marina Carreiro-Silva, Jose Luis Rueda, Javier Urra

Contributors: Cristina Gutiérrez-Zárate, Guillem Mateu, Telmo Morato, Jesús Rivera, Yaiza Santana, Pedro Vélez-Belchí

Acknowledgements: Ricardo Aguilar, Álvaro Altuna, Manuela Ramos, Íris Sampaio

Aim: To identify at what degree oceanographic parameters (MOW) shape the distribution patterns of species

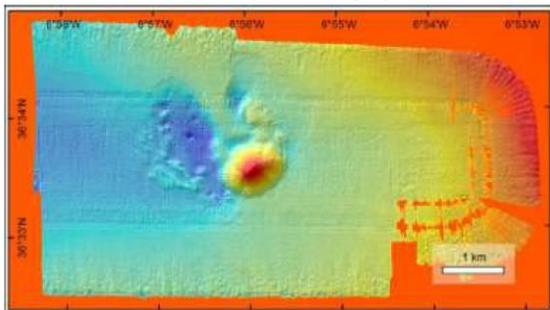


Second leg of MEDWAVES cruise starting in São Miguel (Azores) and finishing in Málaga (Spain)

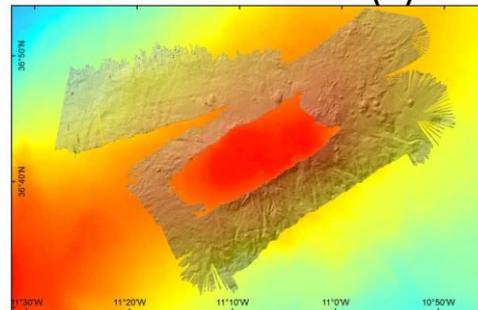


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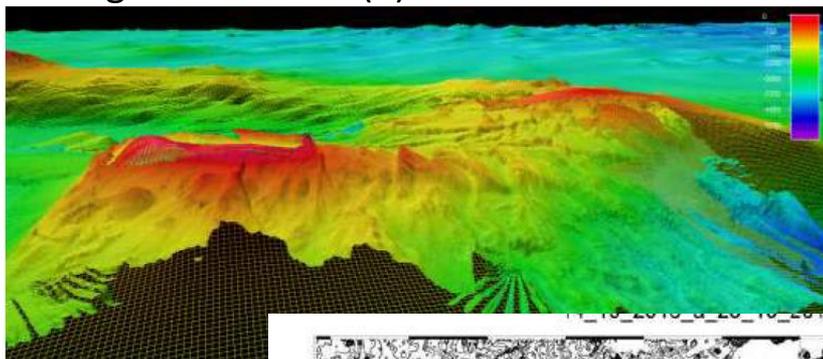
Gazul mud volcano (1)



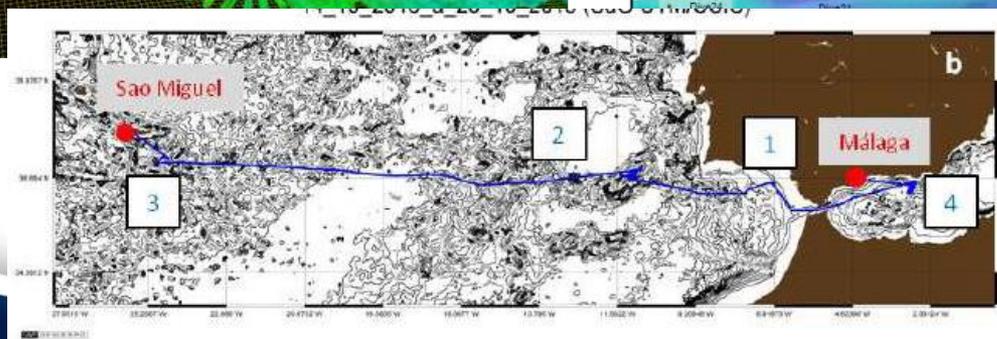
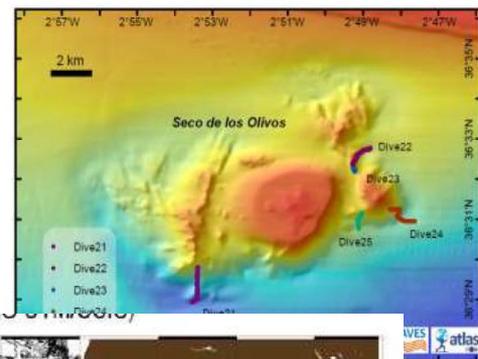
Ormonde Seamount (2)



Formigas Seamount (3)



Seco de los Olivos Seamount (4)





Coral garden dominated by *Acanthogorgia* sp.

Seco de los Olivos/Gazul Mud Volcano

- Most of the VME taxa inhabited areas bathed entirely by Mediterranean Outflow Water (MOW)
- *Flabellum* sp. and *Acanthogorgia* spp. varied with only small variations in O_2

Formigas Seamount

- High VME diversity was noted in areas bathed by MOW
- Effects of O_2 were pronounced for *Lophelia pertusa* and *Acanthogorgia hirsuta*
- Salinity had strong effects on abundances of *Acanthogorgia hirsuta*, *Narella bellissima* and *N. versluyi*

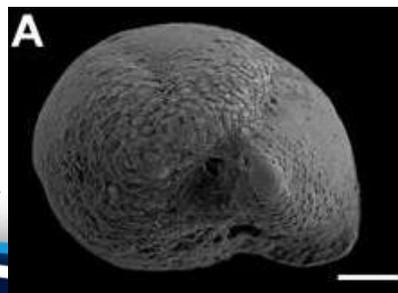


Coral garden dominated by *Narella bellissima*

Seco de los Olivos – Formigas Seamount foraminiferal communities

- Relative abundance of the sinistral forms of the planktonic species *Globorotalia truncatulinoides* reached maximum values in Mediterranean (Saco de los Olivos; 94%) decreasing towards Atlantic (Formigas; 36%); adequate indicator of the Mediterranean influence in the Atlantic.

Talk from Albert Fuster (IEO)
(WP4)



Globorotalia truncatulinoides.
Sinistral form. Scale bar: 100 μ m.



5) Davis Strait, Rockall Bank, Azores: effects of organic matter supply on VME biodiversity

Authors: Lea-Anne Henry, Laurence de Clippele, Dick van Oevelen, Berta Ramiro Sánchez, Karline Soetaert

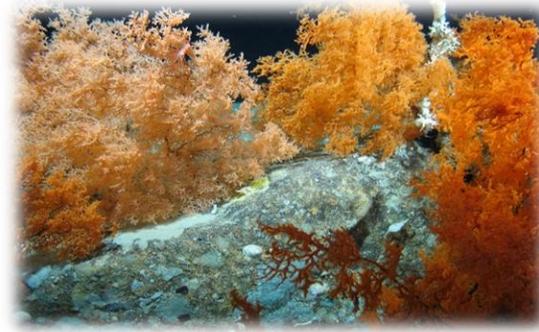
Contributors: Ellen Kenchington, Dierk Hebbeln (for VME data supplied to the ATLAS WP3 Data Call)

Aim 1: To quantify the importance of particulate organic carbon (POC) on VME indicator taxa richness across three ATLAS Case Studies: Davis Strait, Rockall Bank, Azores

Data sources for VMEs: OBIS, ICES WGDEC, NOAA, literature, ATLAS's Data Call for VME records (WP3)

Estimated (POC) flux to seabed was extracted from Sweetman et al. (2017)

Gaussian Mixture Models grouped areas in each of the case studies in classes of low, medium and high POC flux



GMM class means for daily POC flux in each Case Study area.

Case Study	Low POC class mean (mg C m ⁻² d ⁻¹)	Medium POC class mean (mg C m ⁻² d ⁻¹)	High POC class mean (mg C m ⁻² d ⁻¹)
Davis Strait	8.916	14.000	17.624
Rockall Bank	2.189	3.219	88.288
Azores	0.672	0.873	1.053

Conclusions

- POC class had statistically significant effects on VME indicator taxa richness only in the Azores, the case study with the lowest daily POC flux
- VME indicator taxa richness did not exhibit any strong or significant trends related to POC flux in Davis Strait or Rockall Bank

5) Davis Strait, Rockall Bank, Azores: effects of organic matter supply on VME biodiversity

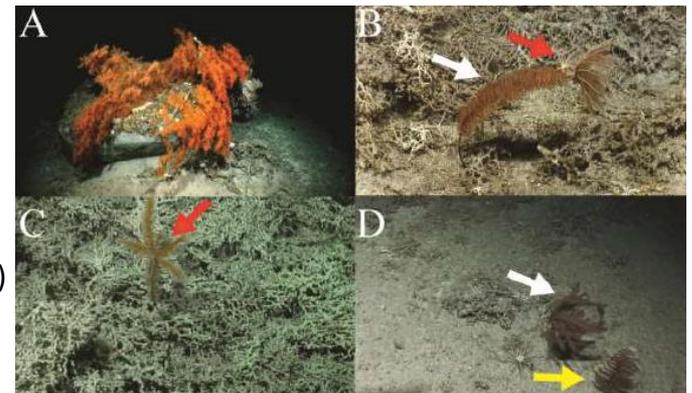
Aim 2: To quantify the role that organic matter (OM) supply plays in structuring biodiversity of non-scleractinian corals in Logachev Mound (Rockall Bank)

Analysis of video material (“James Cook” JC073 Research Expedition)

Numerical model was used to infer the organic matter supply for the Logachev mound province at Rockall Bank (Mohn et al. 2014)

- Diversity and evenness of octocorals and black corals decreased with increasing OM supply
- Density of these corals positively increased with higher OM suggesting that some coral taxa may thrive and even dominate in areas with very high OM levels

(A) *Leiopathes* sp. (B) *Parantipathes* sp. 1 (white arrow) with two crinoids attached to the top (red arrow) (C) *Parantipathes* sp. 2 (D) *Trissopathes* sp. 1 (white arrow) *Bathypathes* sp. (yellow arrow)



Thank You!



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