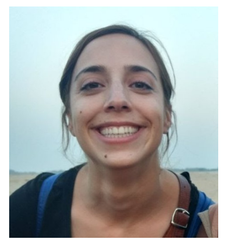
Biogeographic patterns in the deep ocean: a revision of the Global Open Oceans and Deep-Seabed classification system

Berta Ramiro Sánchez[1*], Lea-Anne Henry[1], J. Murray Roberts[1], Telmo Morato[2], Gérald Hechter Taranto[2], Marina Carreiro-Silva[2], Íris Sampaio[2], Sophie Arnaud-Haond[3], Bramley Murton[4]

[1]School of GeoSciences, The University of Edinburgh, [2]IMAR-Uaz, [3]MARBEC-Ifremer, [4]NOC



Introduction

Biogeographic classifications are used to analyse patterns of marine biodiversity; advance knowledge of evolutionary and ecosystem processes; and assist governments in designing management tools. The Global Open Oceans and Deep Seabed (GOODS) biogeographic classification system for the deep ocean[1,2] was developed to aid management efforts and minimize impacts of activities in the high seas, where governance is limited.

Vulnerable marine ecosystems[3] (VMEs) provide essential ecosystem services (e.g. nursery grounds[4]; nutrient cycling[5]) and are protected through international initiatives[6]. Most of the VMEs, however, lie in the high seas, receiving little attention.

Based entirely on physical proxies presumed to reflect species biogeography, the GOODS tool is not grounded in species data. of GOODS is currently only a static product, as the classification does not account either for projected future climate change scenarios

Objectives

(1) To validate the GOODS classification for complex habitats formed by VME indicator taxa.

(2) To test biogeographic boundaries at present and under future ocean climate change projections for the year 2100[7], based on the output of the Intergovernmental Panel on Climate Change Fifth Assessment Report models.

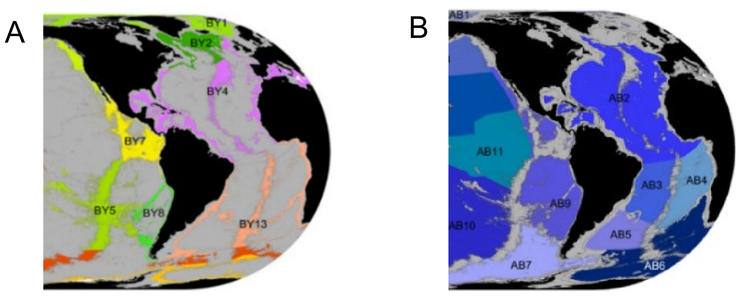


Figure 1. Current proposed GOODS benthic provinces in the North Atlantic. A. Shows three lower bathyal (801-3500 m) provinces, BY1: Arctic; BY2: Northern Atlantic Boreal; BY4: North Atlantic (included MAR hydrothermal vents). B. Shows one abyssal (3501-6500 m) province, AB2: North Atlantic. Modified from Watling et al. (2013).

Methodology

1. Validation of GOODS for complex habitats formed by VME indicator taxa

Data compilation

Existing environmental variables (depth, temperature, salinity, dissolved oxygen, POC flux and silicate) and presence and absence point data of VME indicator species in the North Atlantic will be compiled.

Data analysis

Metacommunity structure analysis will be used to quantify the spatial structure of VME species distribution and obtain distinct faunal provinces. VME indicator species will be assigned to the environmental and historical cluster with which they spatially co-occur.

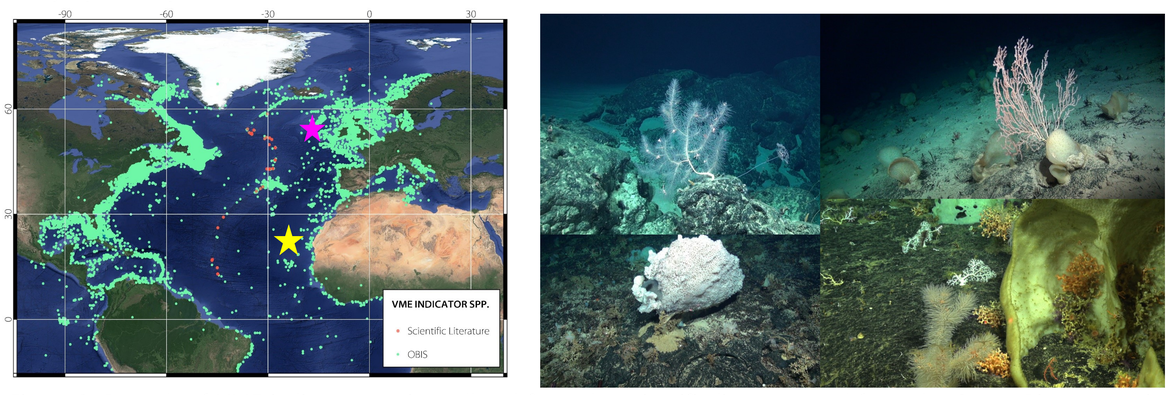


Figure 2. Records of VME indicator species collated from the scientific literature and from the Ocean Biogeographic Information System (OBIS). Two case studies are contributed to this work: the Tropic Seamount (yellow star) and the Logachev Mounds (pink star). B. Deep-sea corals and sponges found at the Tropic Seamount.

2. Testing biogeographic boundaries at present and under future climate change scenarios

Data compilation

Data will consist of species distribution models (SDMs) from 6-8 VME taxa in the North Atlantic and modelled changes in environmental variables for the year 2100[5].

Data analysis

SDMs will be correlated with the environmental and historical clusters producing faunal breaks in the projected conditions. Through Procrustes rotation the projected GOODS for the year 2100 will be contrasted with the present-day GOODS.

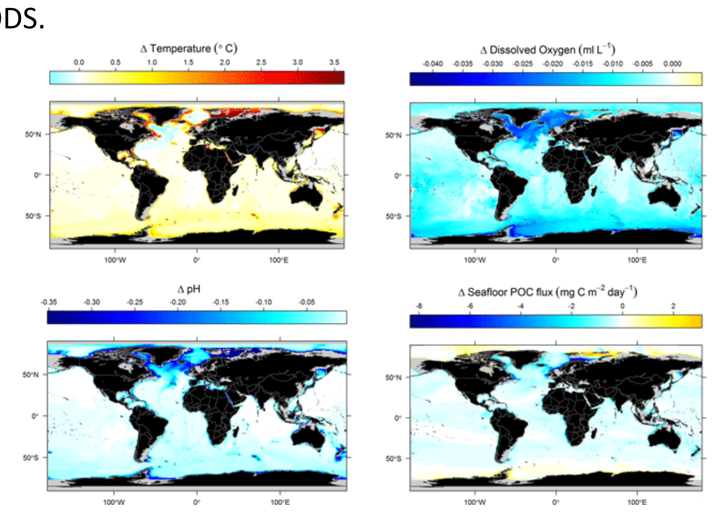


Figure 3. Modelled environmental changes at the deep seafloor (>200) in the year 2100 relative to present-day conditions, following the IPCC card reports. Modified from Sweetman et al. (2017).

Challenges

The spatial resolution of available environmental datasets is broad enough to encompass areas that may not have sufficient data, but equally to miss detailed information.

Similarly, VME indicator species point data is abundant on continental waters, however, despite ATLAS case studies contribution, there is still a lack of data covering the high seas

References

[1]UNESCO, 2009. Global Open Oceans and Deep Seabed (GOODS) - biogeographic classification. IOC Technical Series 84, 84.

[2]Watling, L., et al., 2013. A proposed biogeography of the deep ocean floor. Progress in Oceanography 111, 91–112.

[3]UNGA resolution 61/1052, 2006

[4]Henry, L.-A., et al., 2016. Seamount egg-laying grounds of the deep-water skate *Bathyraja richardsoni*. Journal of Fish Biology 89, 1473–1481.

[5]Oevelen, D. van, et al., 2009. The cold-water coral community as hotspot of carbon cycling on continental margins: A food-web analysis from Rockall Bank (northeast Atlantic). Limnology and Oceanography 54, 1829–1844.

[6]FAO, 2008. International guidelines for the management of deep-sea fisheries in the High Seas. Food and Agriculture Organization of the United Nations.

[7]Sweetman, A.K., et al. 2017. Major impacts of climate change on deep-sea benthic ecosystems. Elem Sci Anth 5, 4.

Find out more:
Berta Ramiro Sánchez
Berta.ramiro@ed.ac.uk
www.eu-atlas.org

Follow us:
@eu_ATLAS
@EuATLAS
ATLAS – Deep Discoveries
EU_ATLAS

Contact us:
PROJECT OFFICE CONTACT:
EU-Atlas@ed.ac.uk
COMMUNICATION & PRESS:
annette@aquatt.ie

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.