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UNDERSTANDING DEEP ATLANTIC ECOSYSTEMS



Understanding the fragile deep-sea ecosystems of the North Atlantic Ocean in order to serve their conservation and unlock their blue growth potential: achievements by the H2020 ATLAS project

Joint Nature Conservation Committee, Aberdeen, 21/11/2019

Dr Georgios Kazanidis and ATLAS partners

Post-Doctorate Research Associate in Deep-Sea Biodiversity

Grant Institute, School of GeoSciences, University of Edinburgh, UK



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.

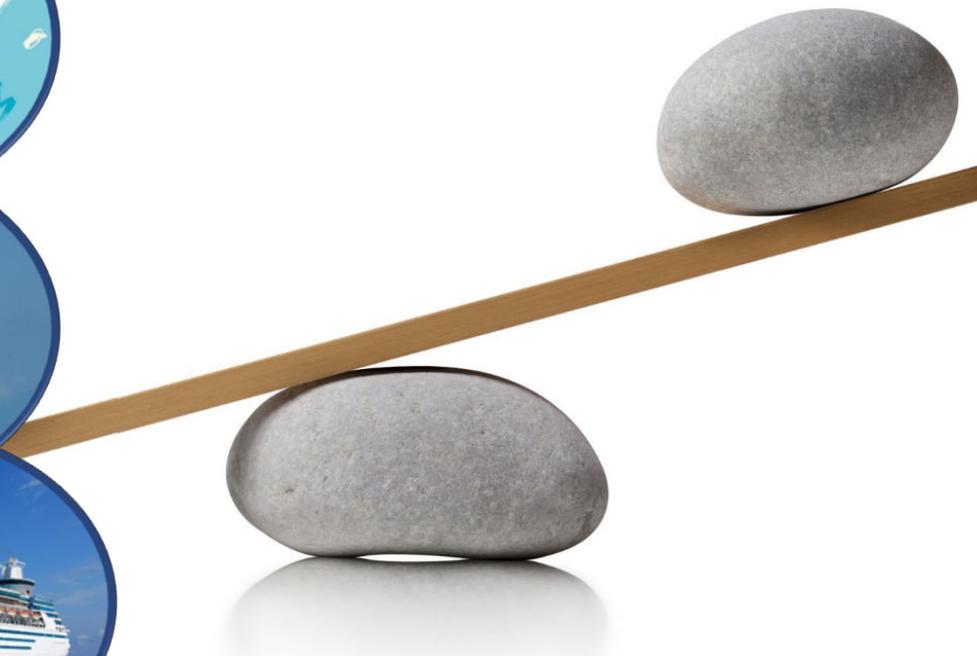


The challenge





The challenge

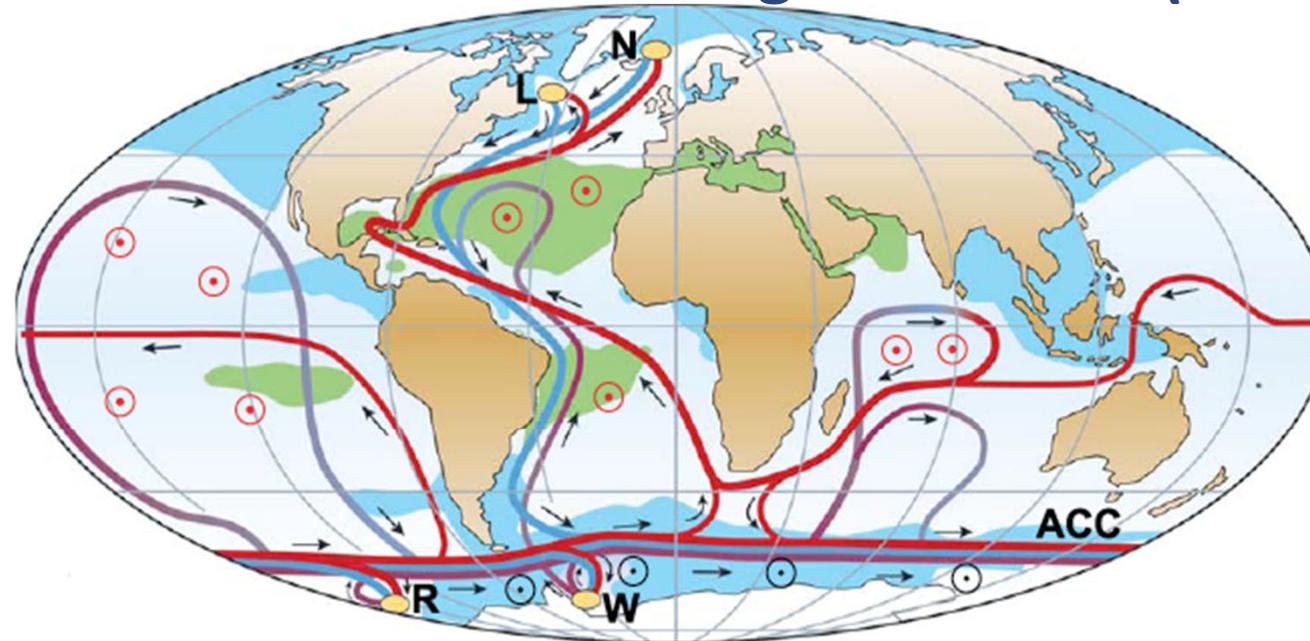




The challenge



Atlantic Meridional Overturning Circulation (AMOC)



- | | | | | | |
|---|----------------------|---|-------------------------|----------|--------------|
|  | Surface flow |  | Wind-driven upwelling | L | Labrador Sea |
|  | Deep flow |  | Mixing-driven upwelling | N | Nordic Seas |
|  | Bottom flow |  | Salinity > 36 ‰ | W | Weddell Sea |
|  | Deep Water Formation |  | Salinity < 34 ‰ | R | Ross Sea |

Delworth et al. (2008), Abrupt Climate Change, US Geological Survey



The call...

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Call Updates  

Blue Growth: Unlocking the potential of Seas and Oceans

Sub call of: H2020-BG-2014-2015

Planned Opening date	25-07-2014	Deadline Date	03-02-2015 17:00:00 (Brussels local time)
Publication date	11-12-2013	Stage 2	11-06-2015 17:00:00 (Brussels local time)
Total Call Budget	€36,000,000	Main Pillar	Societal Challenges
Status	Forthcoming	OJ reference	OJ C361 of 11 December 2013

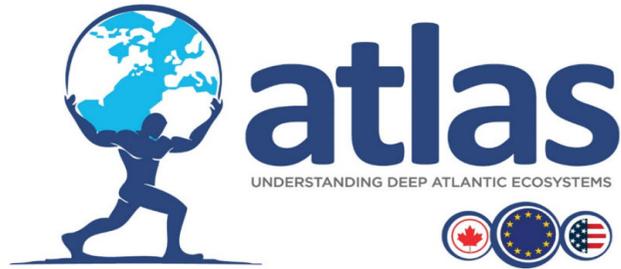
Topic: Improving the preservation and sustainable exploitation of Atlantic marine ecosystems **BG-01-2015**

Other EU Programmes 2014-2020

Research Fund for Coal & Steel

other sectors of the blue economy crucial for value & jobs

The response...



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24 partners

May 2016 – April 2020

Budget: **€9.3M**



34
deep-sea
expeditions

ATLAS kick-off meeting in Edinburgh (June 2016)



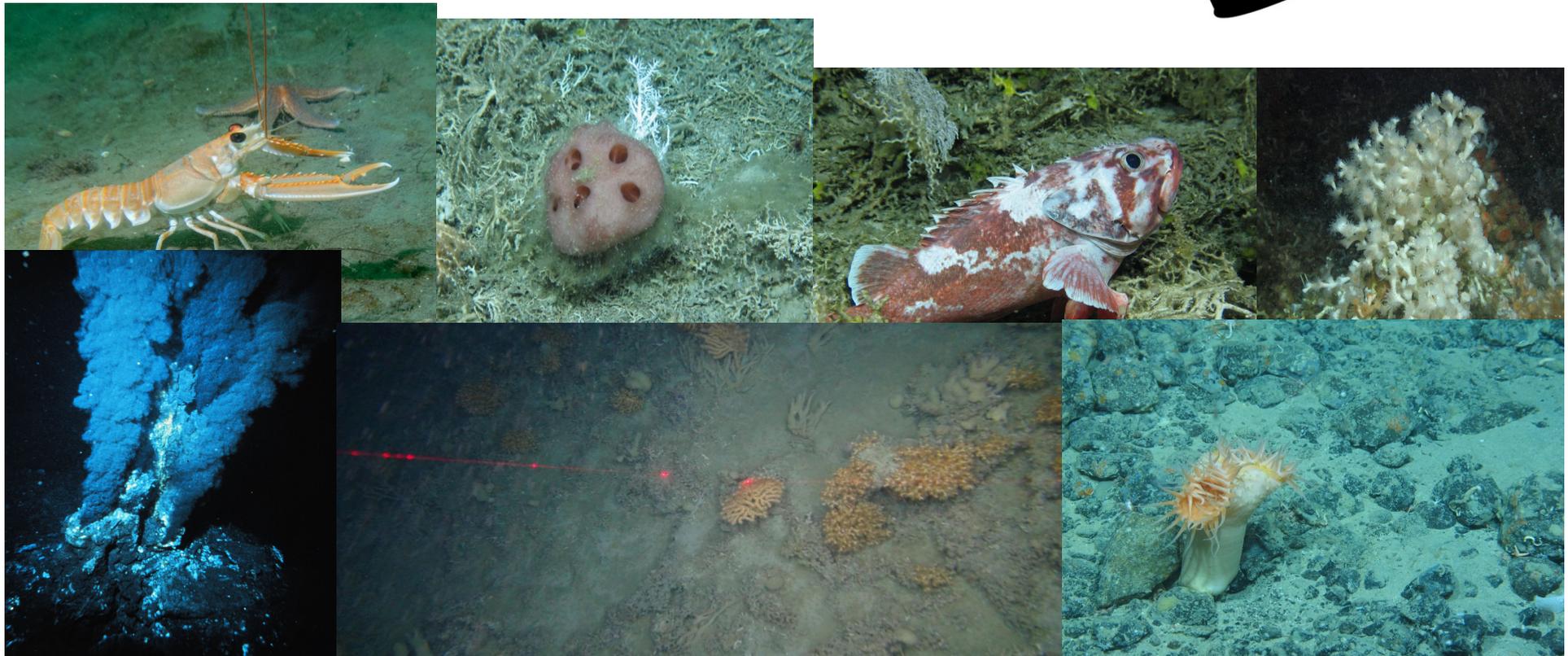
ATLAS vital statistics May 2016 – November 2019

- **71** peer-reviewed publications
- **75** Peer-reviewed publications in preparation
- ATLAS media reach estimated at **85.5M persons** with coverage including BBC (Radio and TV), Sky News, The Times, The Washington Post, The Guardian, and NPR podcast
- ATLAS results have reached **7K** in policy, **20K** in industry and over **70K** members of the scientific community



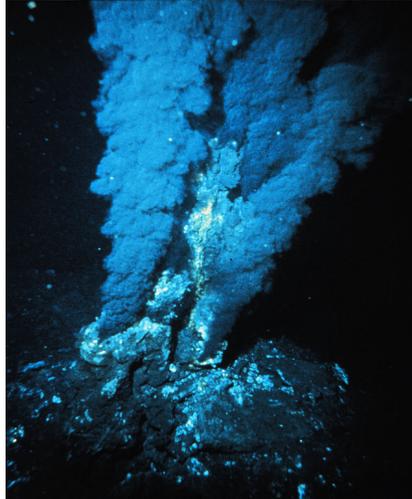
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Objectives





Objectives





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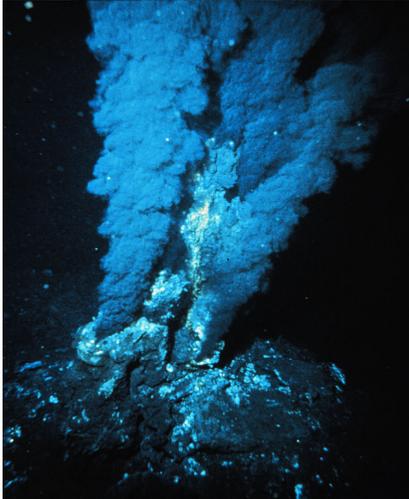
Objectives

BLUE GROWTH
71% of the EU's population lives near water
IS WATER

Why?
Blue Growth is the European Commission's initiative to further develop the potential of Europe's waters, seas, and coasts for:
Jobs
Value
Sustainability

Focus Area
Five sectors with high potential for accelerating Blue Growth are to be further developed:
Renewable energy
Maritime transport
Aquaculture
Fisheries
Offshore oil & gas

Other sectors of the Blue economy crucial for value & jobs:
Shipbuilding & Ship repair
Transport (cargo & ferry)
Fisheries
Offshore oil & gas





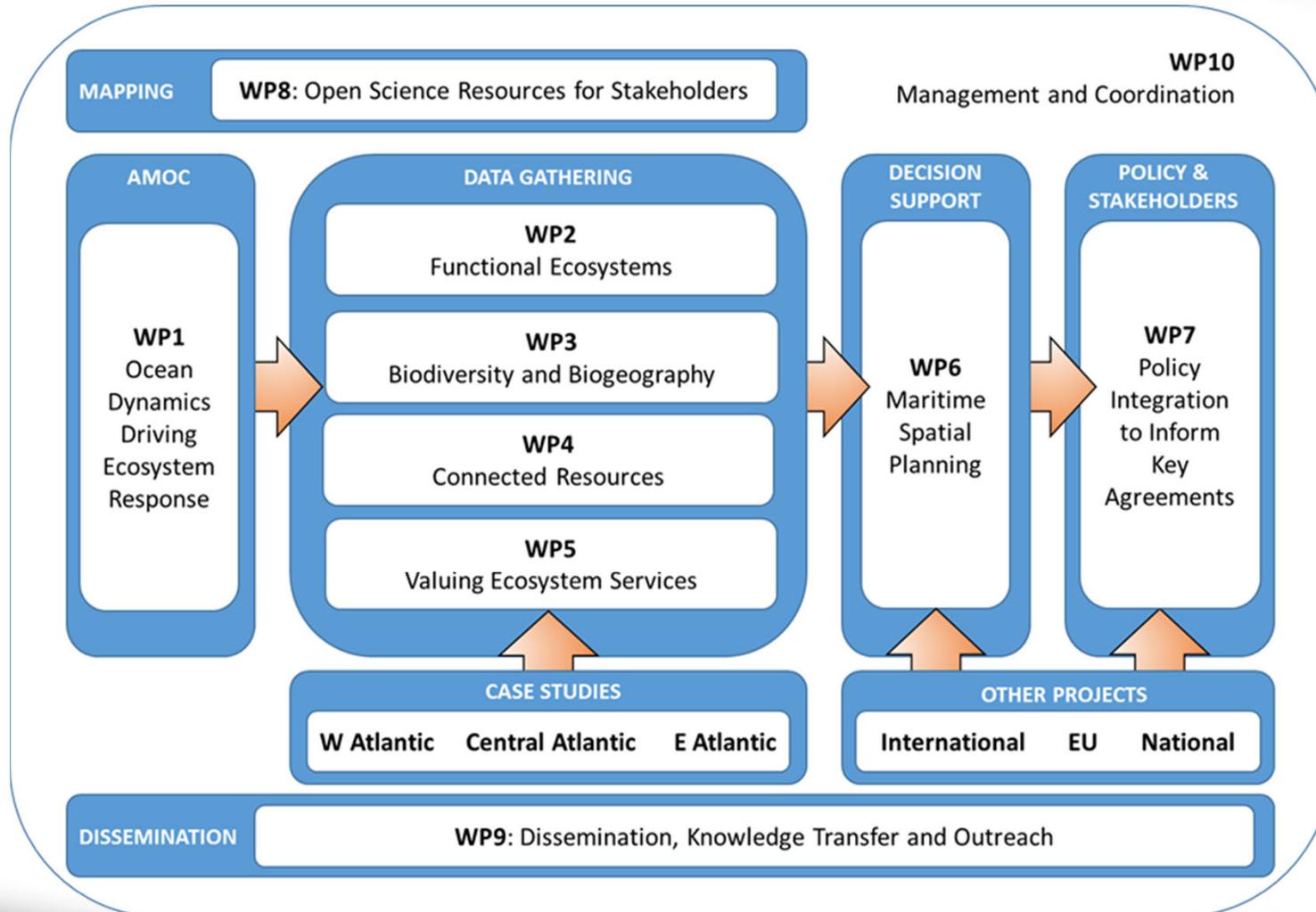
Lea-Anne Henry
Case Study co-ordinator
Chancellor's Fellow, University of Edinburgh



★ Case studies ● Project Partners



Work Packages (WP)





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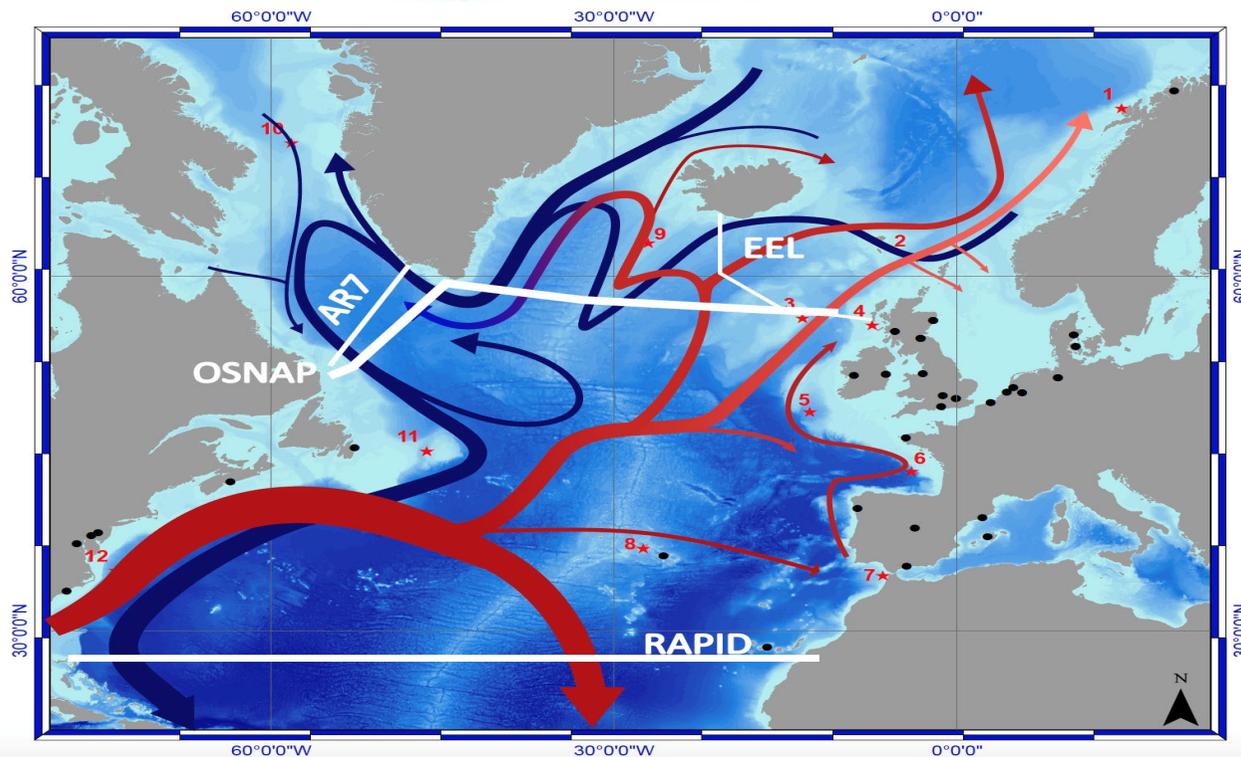
WP1: Ocean Dynamics Driving Ecosystem Response



SCOTTISH
ASSOCIATION
for MARINE
SCIENCE



Stuart Cunningham





Anomalous weak Labrador Sea convection and Atlantic overturning during the past 150 years

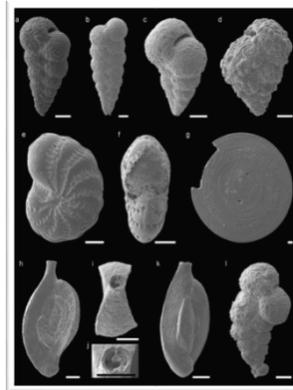
David J. R. Thornalley^{1,2*}, Delia W. Oppo², Pablo Ortega³, Jon I. Robson³, Chris M. Brierley¹, Renee Davis¹, Ian R. Hall⁴, Paola Moffa-Sanchez⁴, Neil L. Rose¹, Peter T. Spooner¹, Igor Yashayaev⁵ & Lloyd D. Keigwin²

Thornalley et al. (2018), *Nature* 556, 227-230



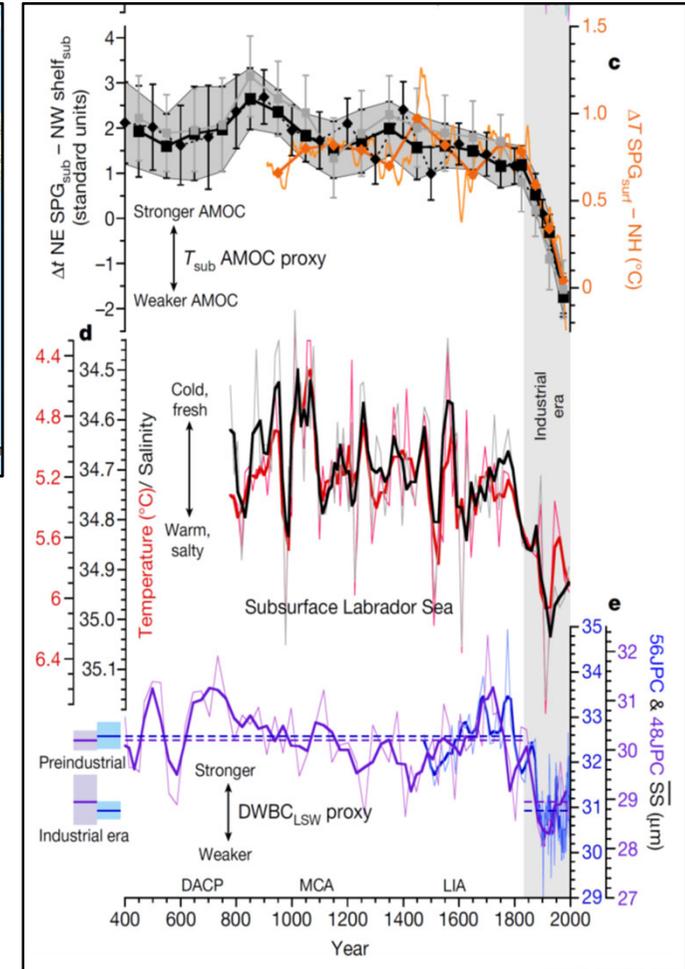
Sediment cores

Image credit: [https:// briticechronoblog.com](https://briticechronoblog.com)

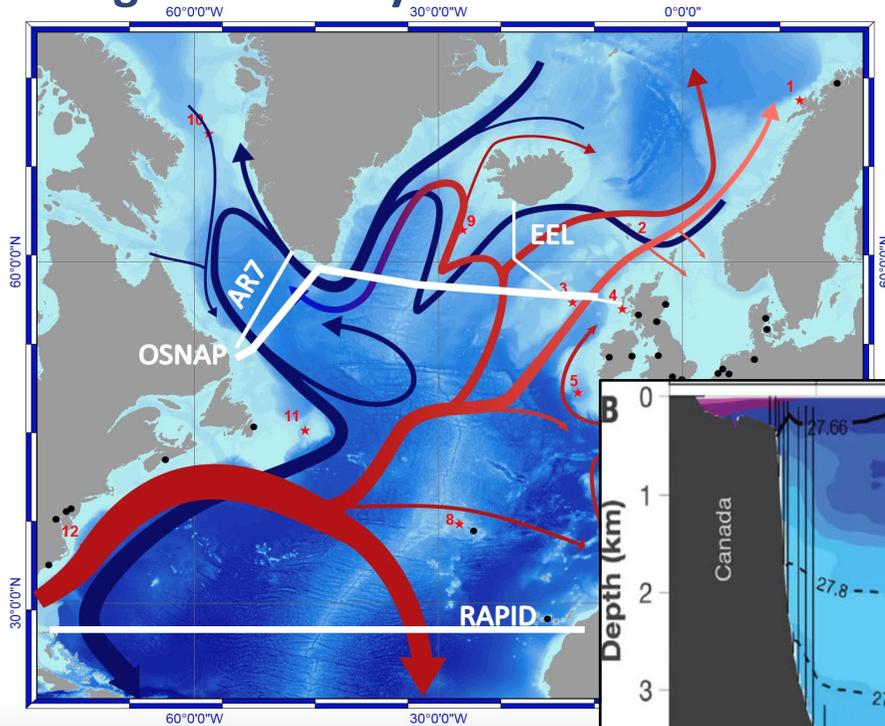


Forams as a palaeoproxy

Isaack et al. (2016)

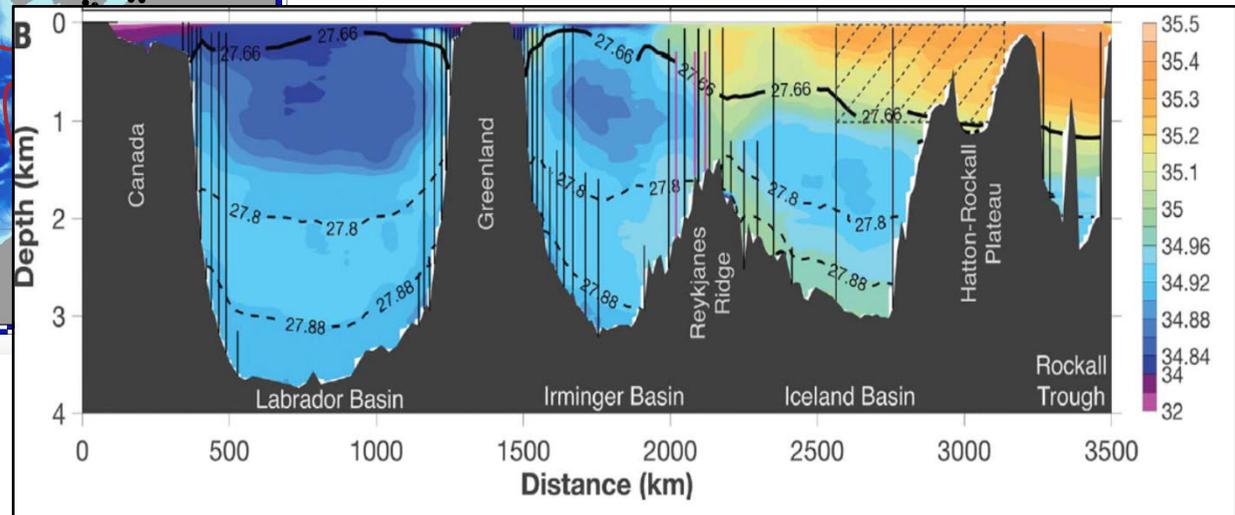


Biogeochemistry measurements & circulation

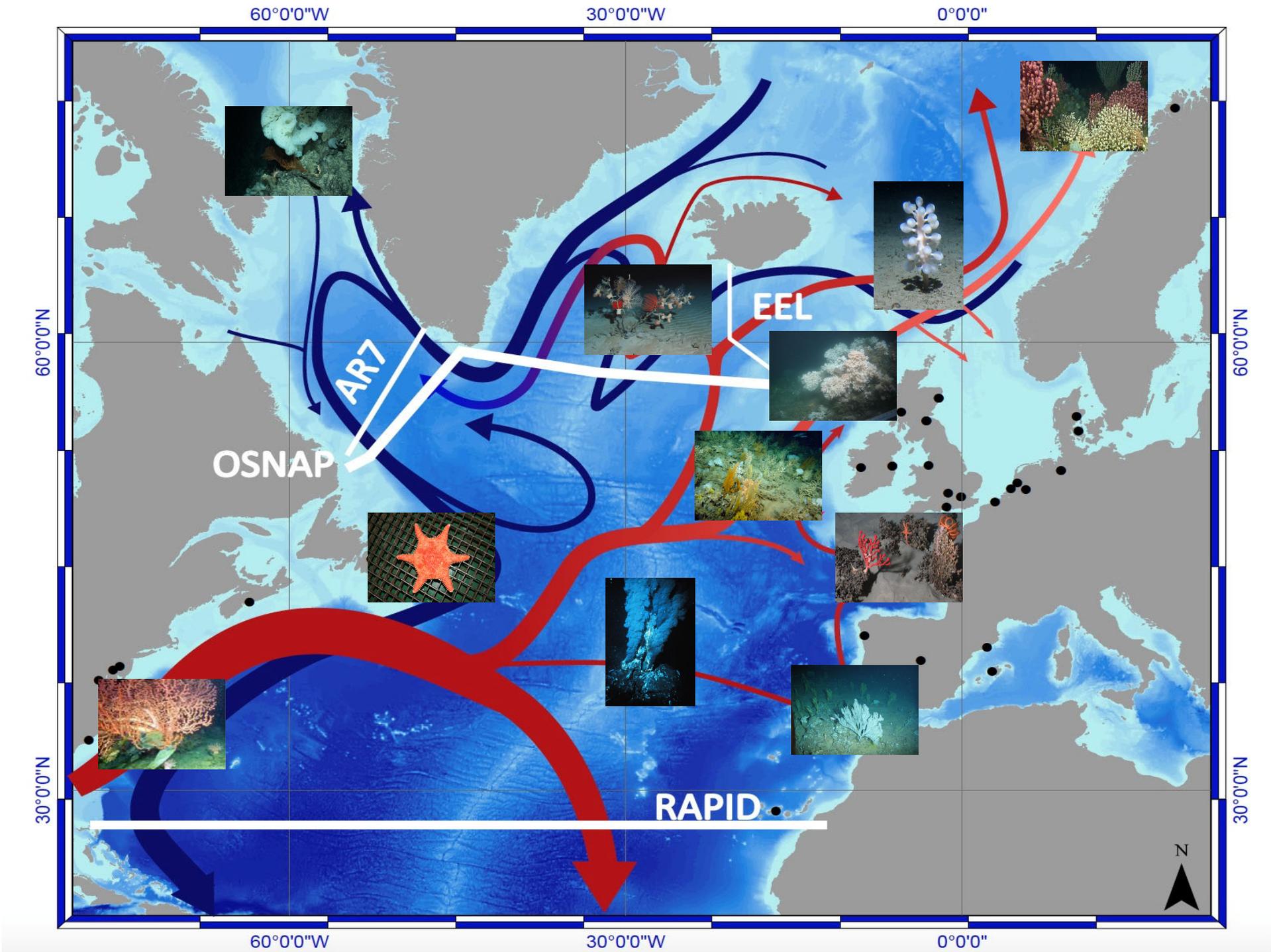


A sea change in our view of overturning in the subpolar North Atlantic

Lozier et al. (2019), *Science* 363: 516-521



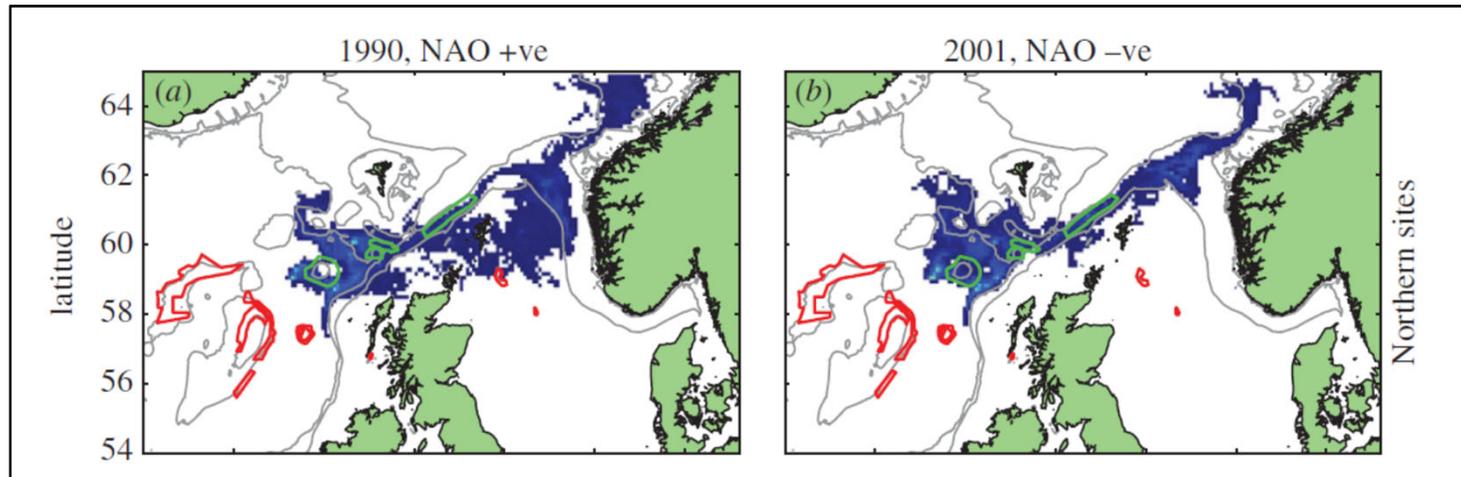
The OSNAP section with moorings marked by vertical black lines. Mean salinity (colored, with scale at the right-hand side) and potential density (contoured) are calculated from Argo and OSNAP data from August 2014 to April 2016.



Sensitivity of marine protected area network connectivity to atmospheric variability

Alan D. Fox^{1,2,+}, Lea-Anne Henry^{1,+}, David W. Corne² and J. Murray Roberts^{1,3,+}

Fox et al. (2016), *Royal Society Open Science* 3, 160494



Heat map of competent larval distribution for releases in single years, demonstrating interannual variability. (a) Source northern MPAs, 1990. (b) Source northern MPAs, 2001.



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WP2: Functional Ecosystems

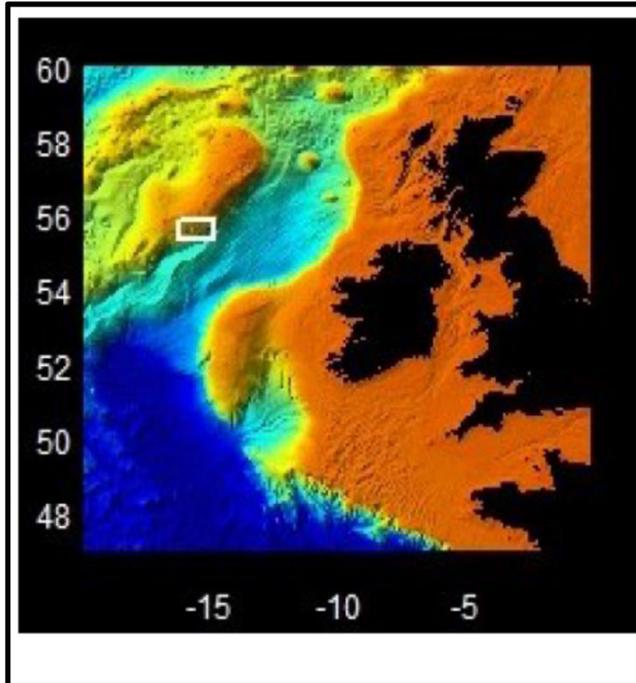


Dick van Oevelen



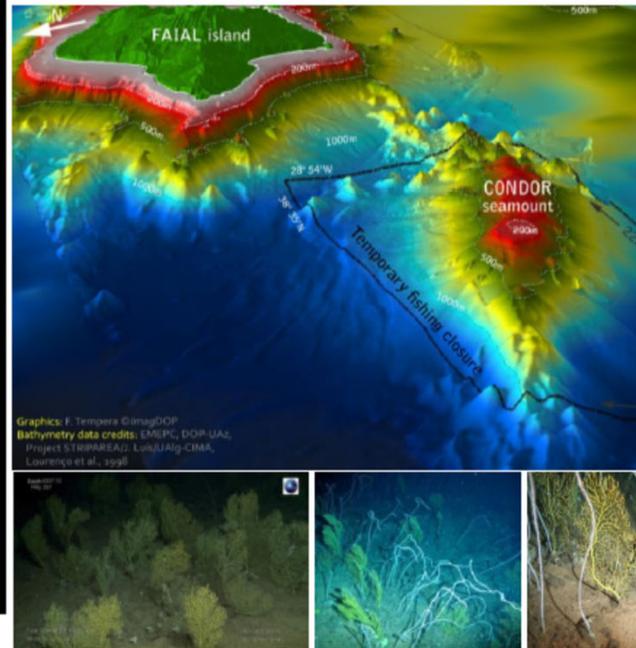
Image credit: D van Oevelen

Rockall Bank



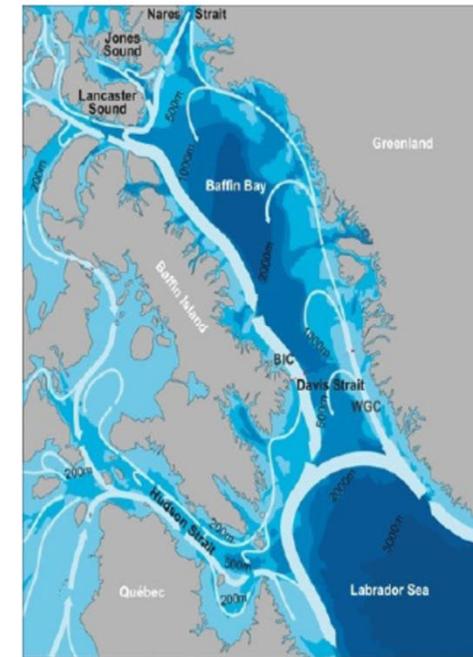
- Large coral mounds
- 600 m deep
- High data availability
- Existing models

Condor Seamount



- Coral gardens
- 200 m deep
- High data availability
- Closed for fishing

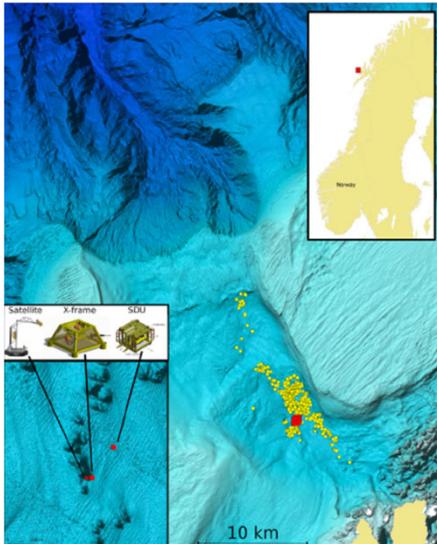
Davis Strait



- Sponge grounds
- Background data
- Cruise opportunities



Identify hydrodynamic controls and organic matter supply



Cabled ocean observatory data reveal food supply mechanisms to a cold-water coral reef

Tom Van Engeland^{a,*}, Olav Rune Godø^{b,1}, Espen Johnsen^b, Gerard C.A. Duineveld^c, Dick van Oevelen^a

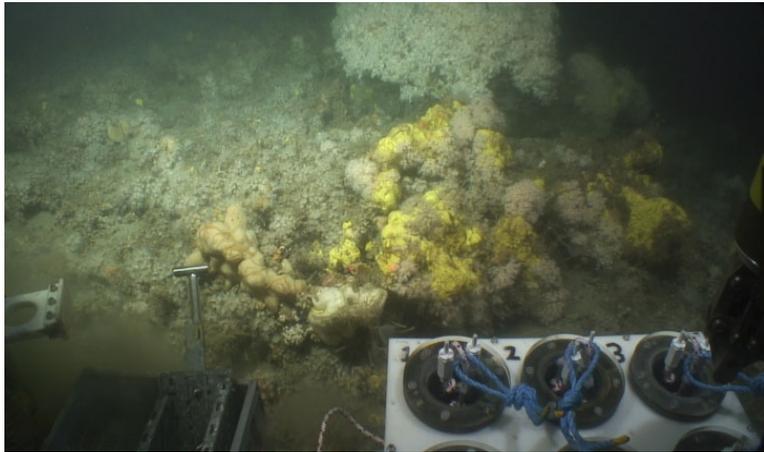
Van Engeland et al. (2019), *Progress in Oceanography* 172, 51-64

Characterization/mineralization of organic matter



The CCGS icebreaker "Amundsen" in the Canadian Arctic (Credit: Alex Ingle)

Physiology



The massive *Spongosorites coralliophaga* at Mingulay Reef Complex

Unravelling the versatile feeding and metabolic strategies of the cold-water ecosystem engineer *Spongosorites coralliophaga* (Stephens, 1915)

Georgios Kazanidis^{a,*}, Dick van Oevelen^b, Bart Veuger^b, Ursula F.M. Witte^a

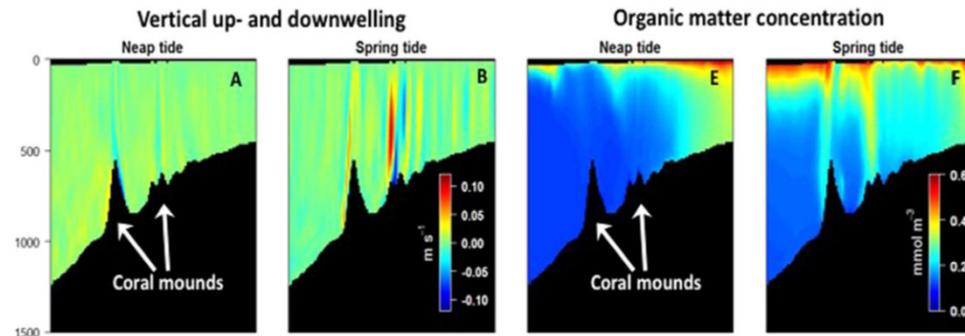
Kazanidis et al. (2018), *Deep-Sea Research I* 141: 71-82

RESEARCH ARTICLE

Niche overlap between a cold-water coral and an associated sponge for isotopically-enriched particulate food sources

Van Oevelen et al. (2018), *PLoS ONE* 13: e0194659

Model simulations



SCIENTIFIC REPORTS

Soetaert et al. (2016), *Scientific Reports* 6: 35057



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WP3: Biodiversity & Biogeography



Telmo Morato

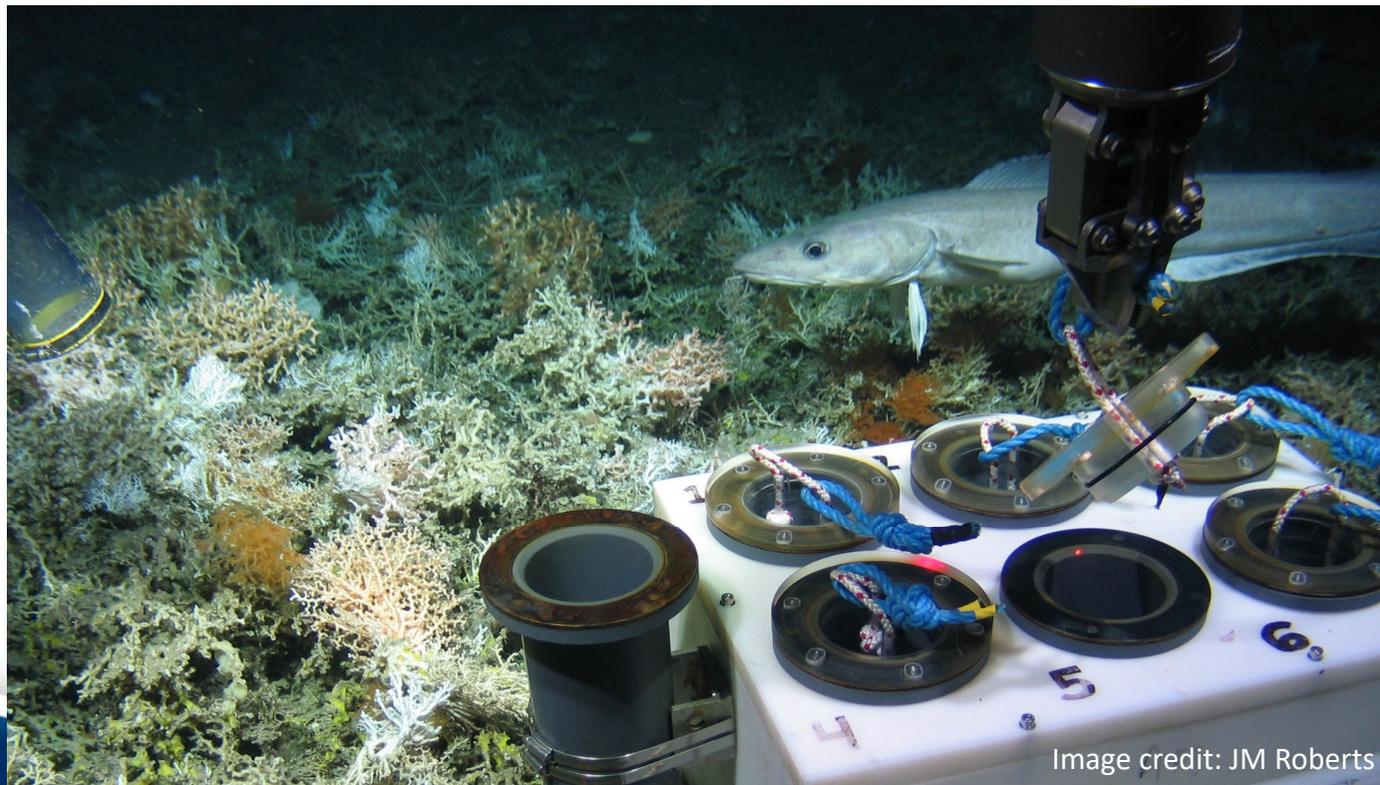
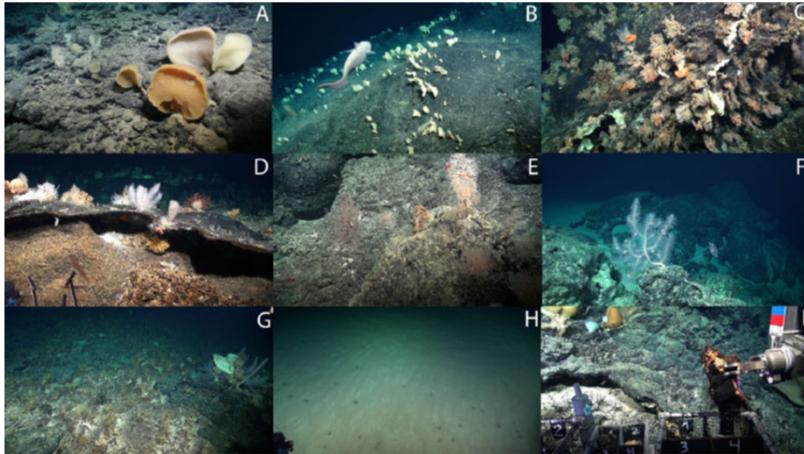


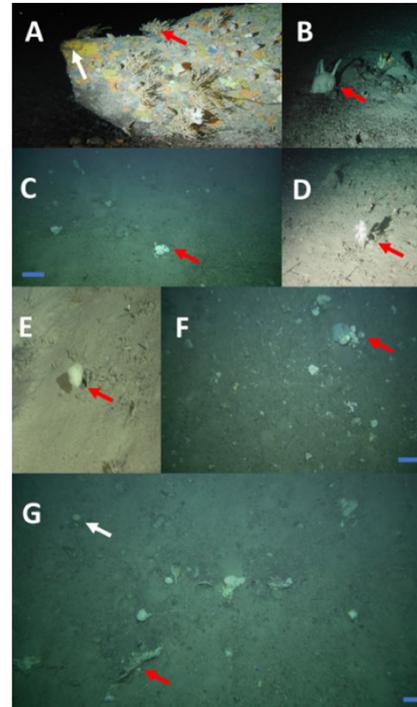
Image credit: JM Roberts

Improved understanding of biodiversity and biogeography



Characterization and Mapping of a Deep-Sea Sponge Ground on the Tropic Seamount (Northeast Tropical Atlantic): Implications for Spatial Management in the High Seas

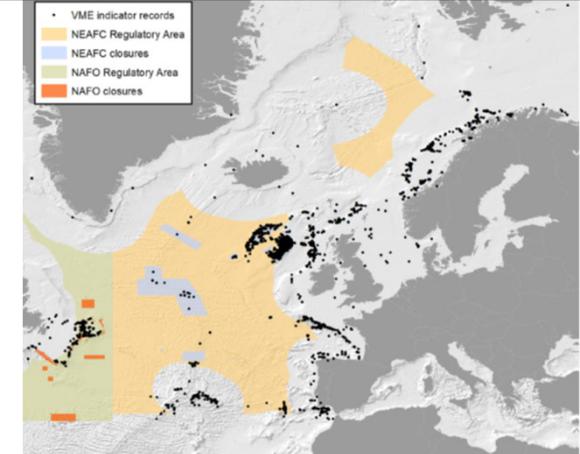
Ramiro-Sánchez. (2019), *Frontiers in Marine Science* 6: 278



Population dynamics of Faroe-Shetland Channel sponge aggregations

Kazanidis et al. (2019), *Frontiers in Marine Science* 6: 163

A Multi Criteria Assessment Method for Identifying Vulnerable Marine Ecosystems in the North-East Atlantic



Morato et al. (2018),

Frontiers in Marine Science 5: 460



Discovery of new deep-sea hydrothermal vent in mid Atlantic!

Credit: ROV "LUSO", Portuguese Task Force for the Extension of the Continental Shelf



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Validation of eDNA methods for monitoring biodiversity

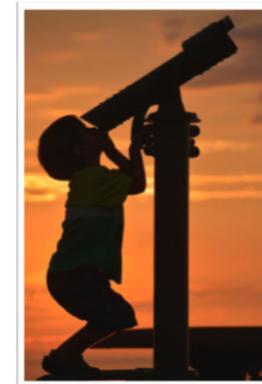
Mar Biol (2017) 164:112
DOI 10.1007/s00227-017-3141-x

METHOD

Development of a sensitive detection method to survey pelagic biodiversity using eDNA and quantitative PCR: a case study of devil ray at seamounts

Laura M. Gargan^{1,2} · Telmo Morato³ · Christopher K. Pham³ · John A. Finarelli² · Jeanette E. L. Carlsson^{1,2} · Jens Carlsson^{1,2}

Species/habitats' distribution under IPCC scenarios



Biodiversity assessments to facilitate MSFD implementation



- Propose scientific indicators (D1, D3, D6, D10)
- To evaluate the performance of the Nested Environmental Status Assessment Tool (NEAT) in the deep sea
- To identify the challenges and opportunities
- To propose guidelines/recommendations for the assessment of deep-sea status

Orejas et al. (in prep), Kazanidis et al. (in prep)

Baseline Assessment of Marine Litter and Microplastic Ingestion by Cold-Water Coral Reef Benthos at the East Mingulay Marine Protected Area (Sea of the Hebrides, Western Scotland)

La Beur et al. (2019), *Frontiers in Marine Science* 6: 163



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WP4: Connected Resources

Ifremer

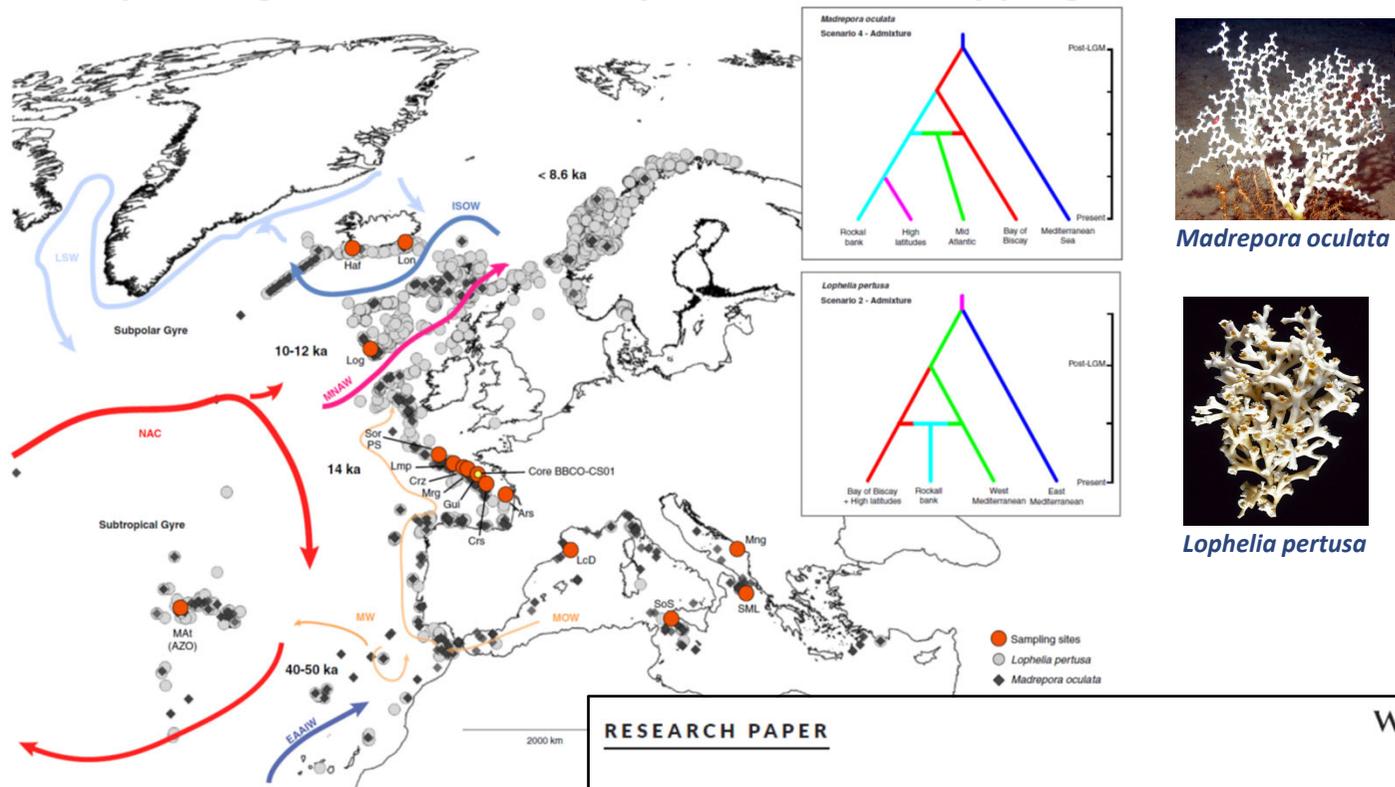


Sophie Arnaud-Haond



Image credit: JM Roberts

Multi-species genomics to identify sources and steppingstones



Madrepora oculata



Lophelia pertusa

RESEARCH PAPER

WILEY Journal of Biogeography

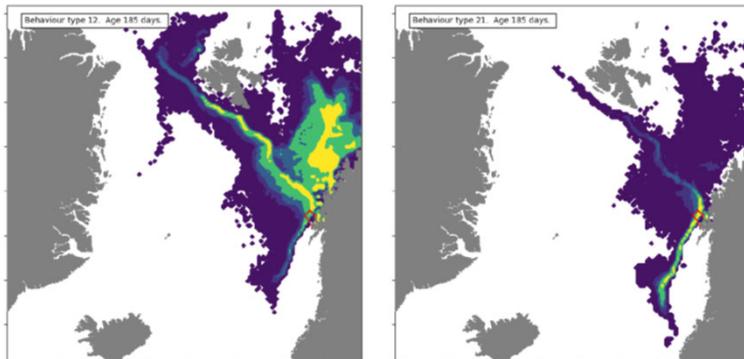
Out of the Mediterranean? Post-glacial colonization pathways varied among cold-water coral species

Boavida et al. (2019), Journal of Biogeography, 46:915–931

Predicted and realized dispersal and connectivity

Deliverable 1.6

Biologically realistic Lagrangian dispersal and connectivity

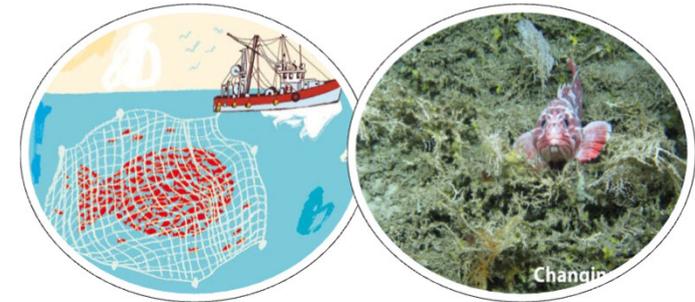


Fox et al. (2019)

Ocean sprawl facilitates dispersal and connectivity of protected species

Henry et al. (2018), *Scientific Reports* 8: 11346

Effects of fisheries on fish metapopulations



Develop species-connectivity tools for adaptive management

ATLAS Deliverable 4.4

Reproduction, dispersal and genetic connectivity in benthos and fishes

Carreiro-Silva et al. (2019)



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WP5: Evaluating Ecosystem services & Blue Growth Potential

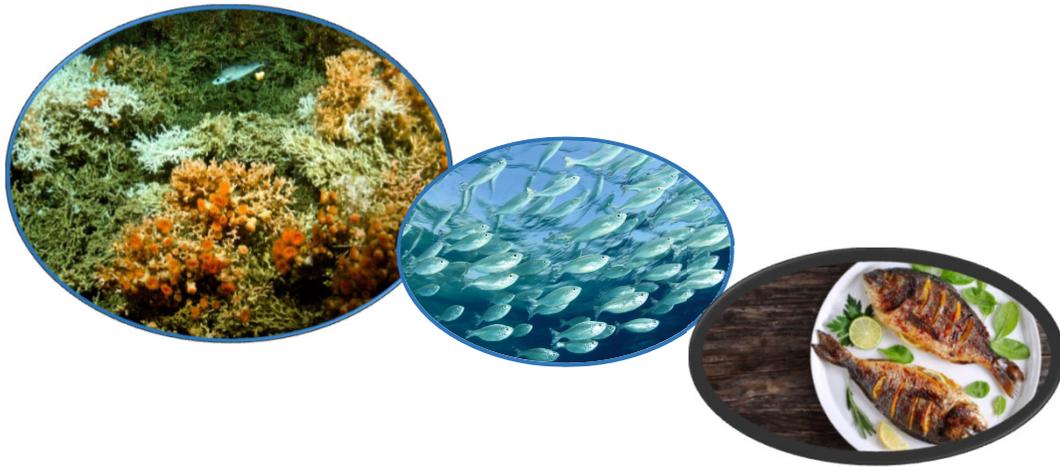


Claire Armstrong





Assessment of ecosystem goods and services



Define risks and pressures for ecosystem services



Delphi survey

**Expert Assessment of Risks Posed
by Climate Change and
Anthropogenic Activities to
Ecosystem Services in the Deep
North Atlantic**

Armstrong et al. (2019), *Frontiers in Marine Science* 6: 158



Trading Off Co-produced Marine Ecosystem Services: Natural Resource Industries Versus Other Use and Non-use Ecosystem Service Values

Aanesen and Armstrong (2019), *Frontiers in Marine Science* 6: 102

Willingness to pay for conservation





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WP6: Marine Spatial Planning



NUI Galway



Anthony Grehan



Image credit: DeepSeaLab, IMAR-UJAZ



Set MSP goals and operational objectives in each case study

ATLAS Deliverable D6.1: Sectoral activities, institutional landscape, existing management plans and MSP goals

Grehan et al. (2018)

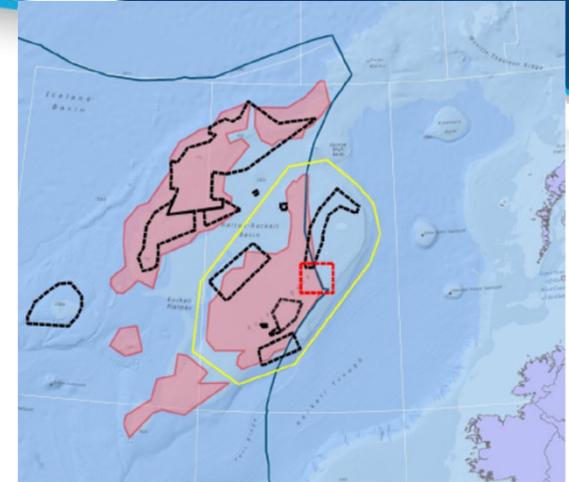
Example: Rockall Bank

Goal:

Maintain fisheries productivity while ensuring VMEs are not compromised

Objectives:

- Maintain current fisheries close to MSY
- Assess potential impacts of oil & gas developments
- Protect VMEs through MPAs



Rockall Area and NEAFC management measures that apply to the ABNJ. Pink polygons are existing fishing areas. Black dashed line polygons are areas closed to protect VMEs (In Grehan et al. 2018).

Marine spatial planning in areas beyond national jurisdiction

Glen Wright^{a,*}, Kristina M. Gjerde^b, David E. Johnson^c, Aria Finkelstein^d, Maria Adelaide Ferreira^e, Daniel C. Dunn^f, Mariamalia Rodriguez Chaves^g, Anthony Grehan^h

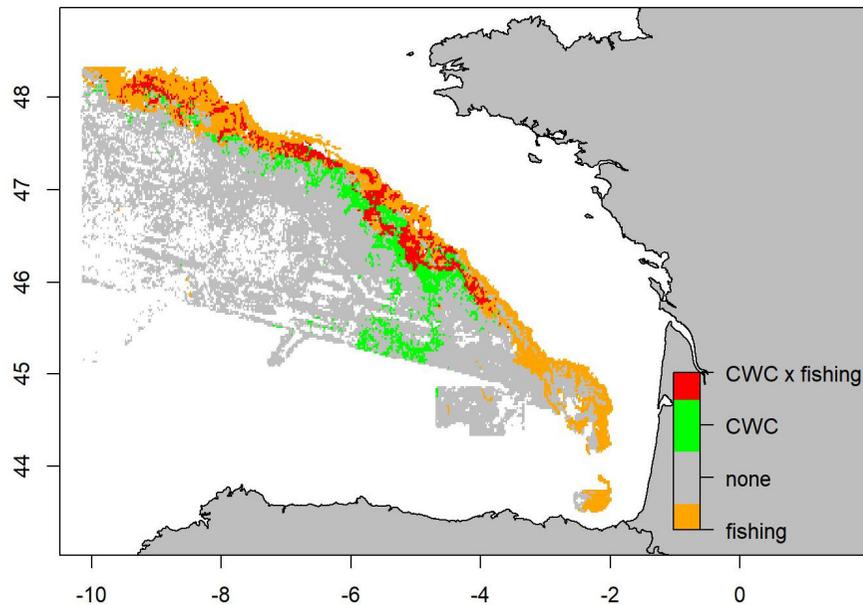
Wright et al. (2019), *Marine Policy*, in press

Rockall and Hatton: Resolving a Super Wicked Marine Governance Problem in the High Seas of the Northeast Atlantic Ocean

Johnson et al. (2019), *Frontiers in Marine Science* 6: 69



Map VMEs, fish habitat and ecosystem services



Potential interactions between fisheries footprint and the predicted distribution of cold-water coral reefs in the Bay of Biscay.

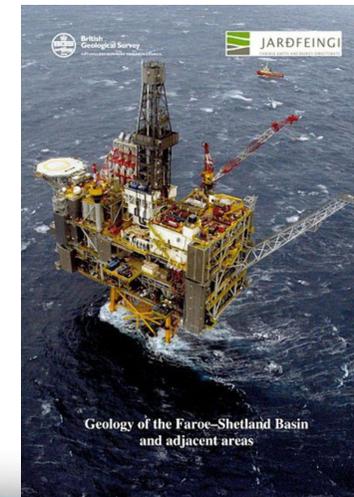
Carry out Strategic Environmental Assessments

ATLAS Deliverable 6.2

Ecosystem goods and services valuation and environmental risk assessment

Grehan et al. (2019)

Test Blue-Growth scenarios





WP7: Policy Integration to Inform Key Agreements



David Johnson





Stakeholder engagement/Set up & Implementation of Science-Policy mechanisms



ATLAS Science-Policy panel at European Parliament (2017)



ATLAS Science-Policy panel at DFO, Canada (2018)



ATLAS event "Ocean-scale science for effective marine governance: A new approach to managing Atlantic ecosystems" at UN PrepCom for BBNJ (2017)



ATLAS at the GOBI secretariat side event at the InterGovernmental Conference 3 for BBNJ (2019)

- Consultations [e.g. MSFD D6 (2018), Scottish deep-sea MPA (2019)]
- Engagement with EC's Joint Research Centre on MSFD/GES (2019)
- UN 2nd World Ocean Assessment (in prep.), IPCC 2019



Making explicit the connection with Blue Growth



**Science, Policy & Blue Growth:
An Atlantic Assessment**

Join us for an interactive workshop to discuss key scientific findings from the EU-ATLAS Project and implications for Blue Growth

Where: National Oceanography Centre, Southampton. Lab G1, Level 6
When: Wednesday 10th April 2019, 0930 - 1630

Ocean Business (2019)

Ocean sprawl facilitates dispersal and connectivity of protected species

Lea-Anne Henry¹, Claudia G. Mayorga-Adame², Alan D. Fox¹, Jeff A. Polton², Joseph S. Ferris^{3,6}, Faron McLellan^{3,7}, Chris McCabe^{3,8}, Tina Kutti⁴ & J. Murray Roberts^{1,5}

Henry et al. (2018), *Scientific Reports* 8: 11346

Environmental controls and anthropogenic impacts on deep-sea sponge grounds in the Faroe-Shetland Channel, NE Atlantic: the importance of considering spatial scale to distinguish drivers of change

J. Vad^{1,2*}, G. Kazanidis¹, L.-A. Henry¹, D. O. B. Jones³, A. R. Gates³, and J. M. Roberts^{2,4}

Vad et al. (2019), *ICES Journal of Marine Science*

Implications for Atlantic VMEs and EBSAs



ATLAS workshop on EBSAs and VMEs in Montreal (2018)



ATLAS at the NE Atlantic EBSA Regional Workshop in Stockholm (2019)



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WP8: Open Science Resources for Stakeholders



PANGAEA.



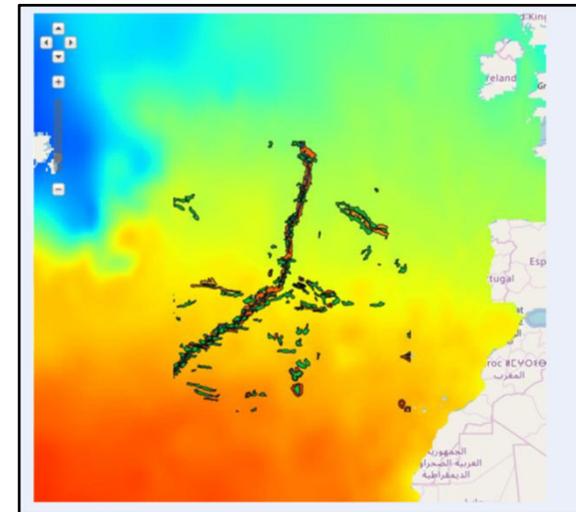
Universität Bremen



Stéphane Pesant

ATLAS GeoNode makes it “FAIR”!

<http://www.atlas-horizon2020.eu/>



Example of an ATLAS GeoNode map – EMODnet physics gridded climatology overlain with ATLAS data layers

www.eu-atlas.org



WP9: Dissemination, Knowledge Transfer & Outreach



<https://www.eu-atlas.org/>



Marieke Reuver

ATLAS newsletter

www.eu-atlas.org



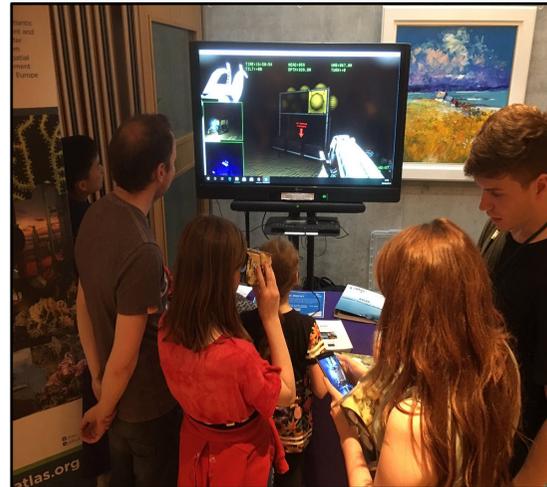
WP9: Dissemination, Knowledge Transfer & Outreach



Hermione Cockburn

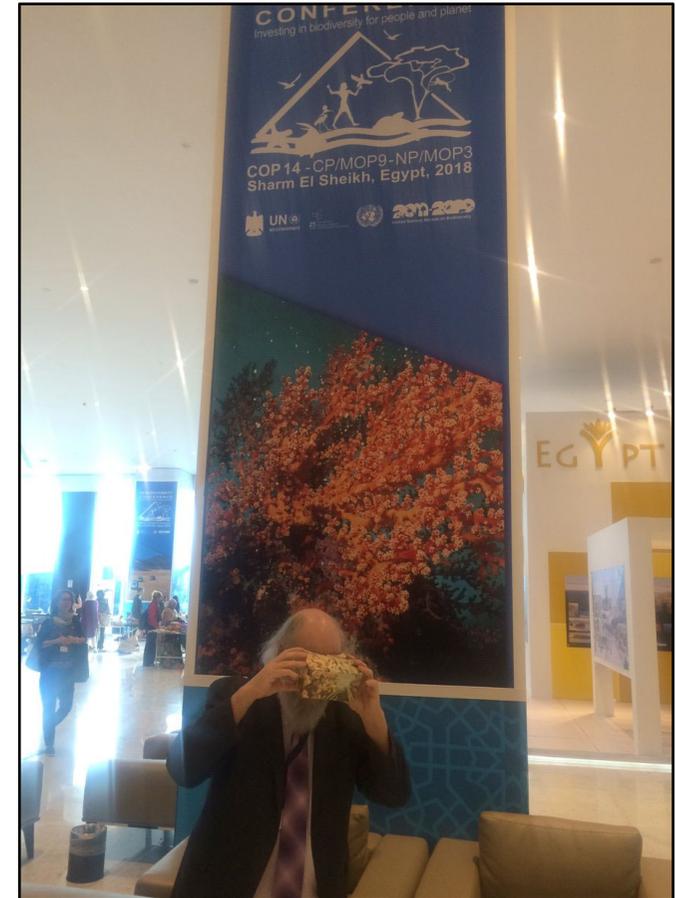


Deep-Sea learning through “Spectacular! Colouring pages” at “Science is Wonderful!” event in Brussels (2019)



ROV simulator experience in Scottish Parliament (2019)

ATLAS-SPONGES-MERCES booth in WCMB (2018)



Jake Rice 360° camera experience at UN Biodiversity Conference (2018)



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WP10: Coordination & Management



Jacques-Louis David – “Napoleon Crossing the Alps”.
Kunsthistorisches Museum



J Murray Roberts





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iAtlantic

INTEGRATED ASSESSMENT OF ATLANTIC
MARINE ECOSYSTEMS IN SPACE AND TIME

iAtlantic launched in June 2019 and will run for 4 years. The multidisciplinary consortium of 33 partners (Europe, USA, Canada, South Africa, Brazil and Argentina) is led by Prof. Murray Roberts at University of Edinburgh.

**For more details please contact
i-atlantic@ed.ac.uk**





Many thanks

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 [@EuATLAS](https://www.facebook.com/EuATLAS)

www.eu-atlas.org

Template developed by AquaTT



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.

Image credit: BGS