Deep-sea ecosystems in a changing ocean and the importance of basin-scale research for their long-term management and conservation

J Murray Roberts

ATLAS project coordinator, University of Edinburgh

4th International Symposium The Effects of Climate Change on the World's Oceans

The Deep sea Under Climate Change, 4 June 2018

A story in three parts

1. The issues of global change in the deep sea
2. The challenge of Blue Growth
3. The ATLAS approach

Ocean Warming

Ocean Acidification

Reduced oxygen

Harmful Fishing Practices

Invasive species

Deep-sea Mining

Plastics & Pollution

Hydrocarbon Exploitation

Bioprospecting

ELEMENTA
Sweetman, AK et al 2017 Major impacts of climate change on deep-sea benthic ecosystems. *Elem Sci Anth*, 5: 4, DOI: https://doi.org/10.1525/elementa.203

REVIEW

Major impacts of climate change on deep-sea benthic ecosystems

Andrew K. Sweetman[a], Andrew R. Thurber[b], Craig R. Smith[c], Lisa A. Levin[d], Camilo Mora[e], Chih-Lin Wei[g], Andrew J. Gooday[h,*], Daniel O. B. Jones[h,*], Michael Rex[ii], Moriaki Yasuhara[jj], Jeroen Ingels[kk], Henry A. Ruhl[l,*], Christina A. Frieder[b,lll], Roberto Danovaro[mm,nnn], Laura Würzberg[ooo], Amy Baco[ppp], Benjamin M. Grupe[b,qqq], Alexis Pasulka[lll], Kirstin S. Meyer[mm,nnn,rrr], Katherine M. Dunlop[s], Lea-Anne Henry[ttt] and J. Murray Roberts[ttt]

- Abyssal temp ↑ 1°C within 84 years
- O_2 declines in areas deep-water formation
- Up to 40-55% ↓ in POC flux in some regions
- Rapid pH ↓ at bathyal depths

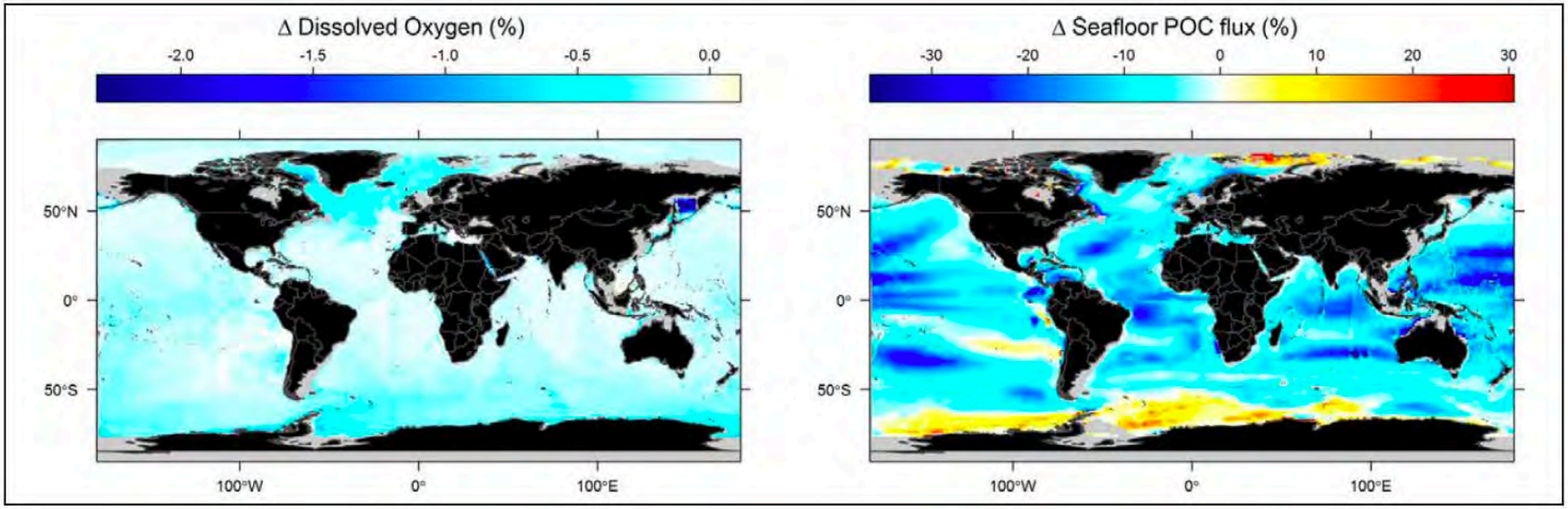
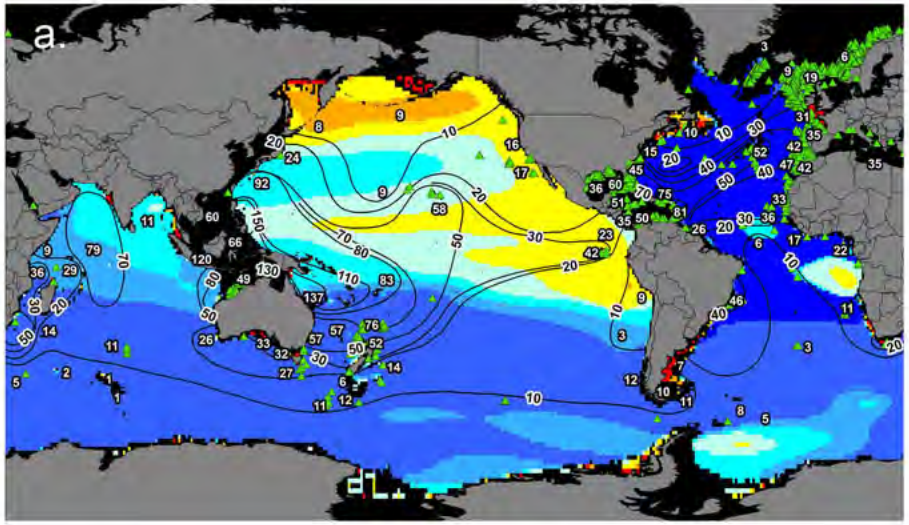
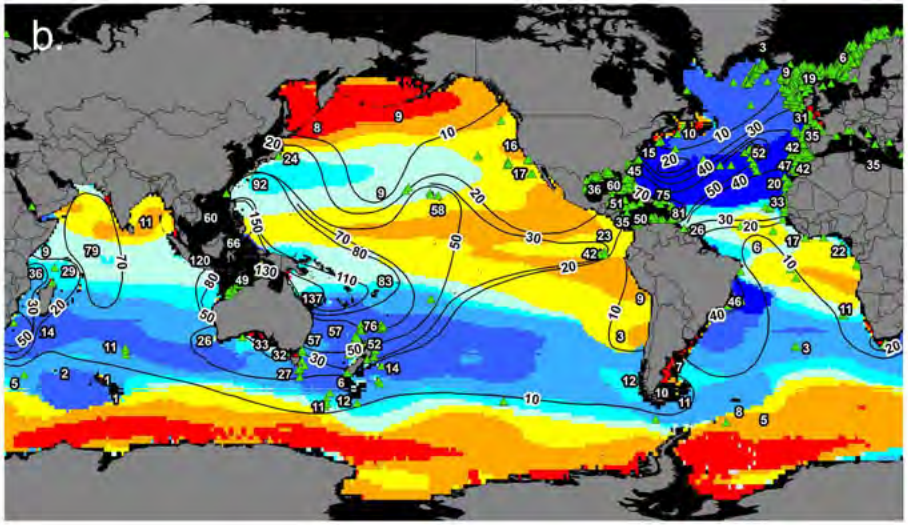
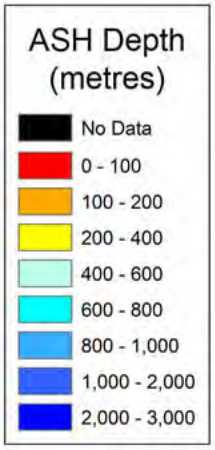


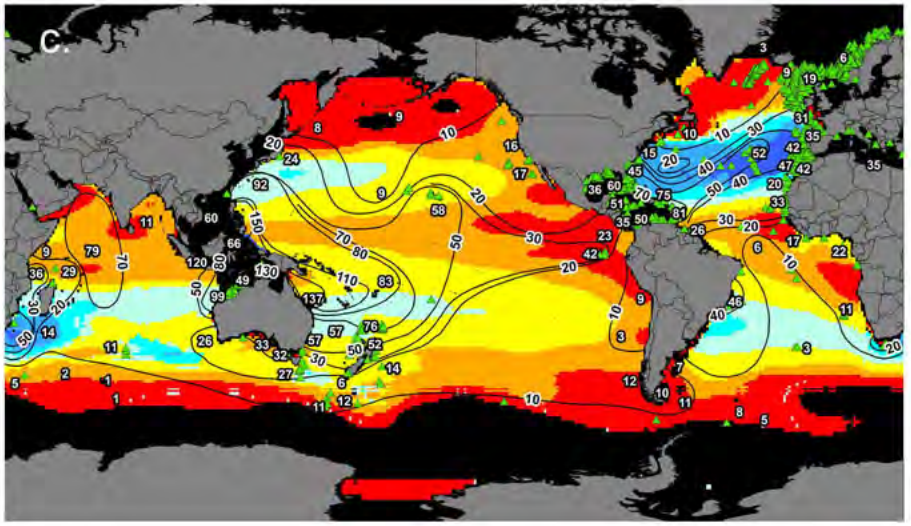
Figure 3: Relative environmental changes at the deep seafloor in the year 2100. Relative change (%) in dissolved oxygen (mL L^{-1}) and seafloor POC flux (mg C m^{-2} d^{-1}) conditions that could be seen at the deep (> 200 m) seafloor by 2100 relative to present-day conditions. DOI: https://doi.org/10.1525/elementa.203.f3

Image: Rohan Holt









Modelled depth of the aragonite saturation horizon (a) for year 1765, pCO_2 278 ppm; (b) for year 2040, pCO_2 513 ppm; (c) for year 2099, pCO_2 788 ppm. Green triangles show locations of reef framework-forming scleractinian cold-water corals. Lines are diversity contours for 706 species of azooxanthellate scleractinian corals (see Fig. 2.20, p. 00). Black areas appearing in previously coloured portions of the Southern Ocean and North Pacific in image (c) indicate areas where the ASH depth has reached the surface. Figures reproduced from Guinotte *et al.* (2006)

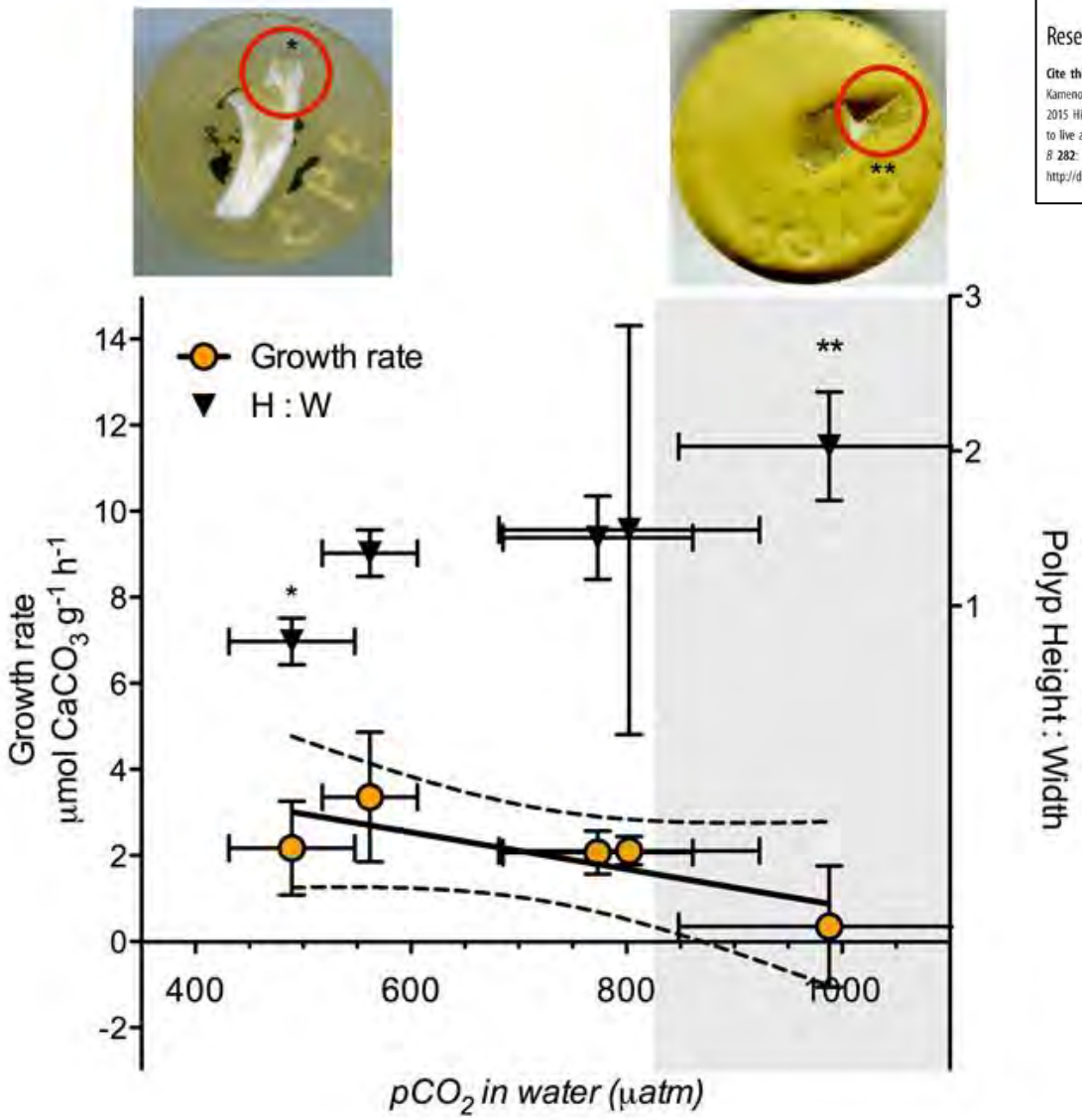
LETTER

doi:10.1038/nature25493

Meridional overturning circulation conveys fast acidification to the deep Atlantic Ocean

Fiz F. Perez[1]*, Marcos Fontela[1]*, Maribel I. García-Ibáñez[1]*, Herlé Mercier[2]*, Anton Velo[1], Pascale Lherminier[2], Patricia Zunino[2], Mercedes de la Paz[1], Fernando Alonso-Pérez[1], Elisa F. Guallart[1] & Xose A. Padin[1]

- Aragonite saturation horizon could shoal by 1000–1700 m in the subpolar North Atlantic within the next three decades.
- Present-day transport of carbonate ions towards the deep ocean is about 44% lower than in preindustrial times.
- Doubling CO_2 levels within next three decades could reduce the transport of excess of carbonate over aragonite saturation by 64–79 % of preindustrial times



PROCEEDINGS B

rspb.royalsocietypublishing.org

Research

Cite this article: Hennige SJ, Wicks LC, Kamenos NA, Perna G, Findlay HS, Roberts JM. 2015 Hidden impacts of ocean acidification to live and dead coral framework. *Proc. R. Soc. B* **282**: 20150990. http://dx.doi.org/10.1098/rspb.2015.0990

Hidden impacts of ocean acidification to live and dead coral framework

S. J. Hennige[1], L. C. Wicks[1], N. A. Kamenos[2], G. Perna[2], H. S. Findlay[3] and J. M. Roberts[1,4,5]

[1]Centre for Marine Biodiversity and Biotechnology, Heriot-Watt University, Edinburgh EH14 4AS, UK
[2]School of Geographical and Earth Sciences, University of Glasgow, Glasgow G12 8QQ, UK
[3]Plymouth Marine Laboratory, Plymouth PL1 3DH, UK
[4]University of North Carolina Wilmington, Wilmington, NC 28403-5928, USA
[5]Scottish Association for Marine Science, Oban, Argyll PA37 1QA, UK

Cold-water corals, such as *Lophelia pertusa*, are key habitat-forming organisms found throughout the world's oceans to 3000 m deep. The complex three-dimensional framework made by these vulnerable marine ecosystems support high biodiversity and commercially important species. Given their importance,

Growth rates:

- Significant negative correlation with increasing CO_2 : Driven by dissolution in high CO_2 treatment

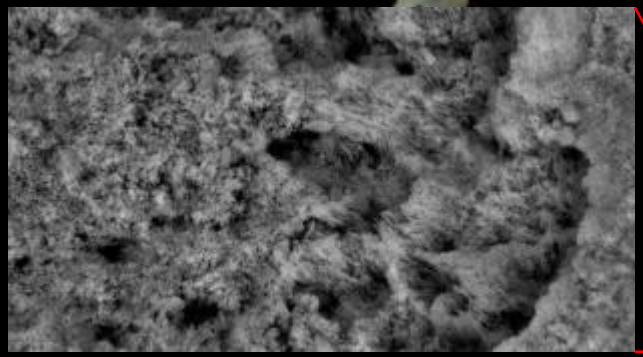
Growth forms:

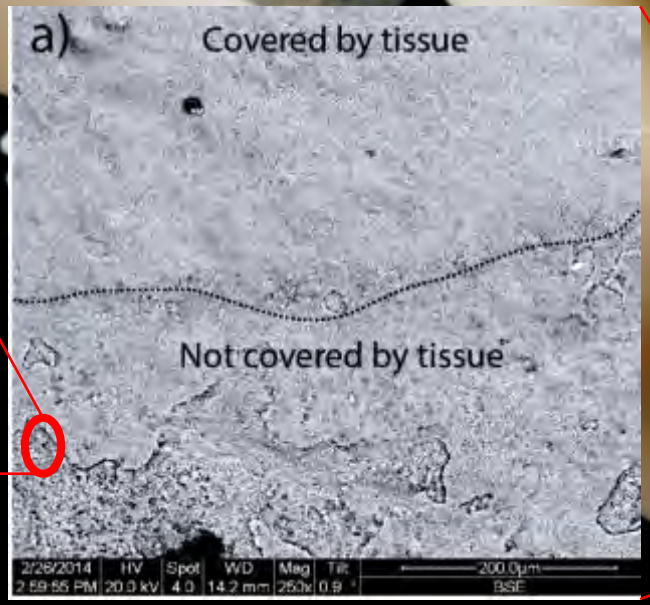
- Growth form of new polyps significantly changes

- New polyps are longer and thinner under high CO_2

Skeleton protected by tissue

Skeleton exposed to ocean acidification





SEM images: S. Hennige
Coral image: Solvin Zankl, BIOACID

Marine Policy 87 (2018) 111–122

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

Climate change is likely to severely limit the effectiveness of deep-sea ABMTs in the North Atlantic

David Johnson[a], Maria Adelaide Ferreira[a,*], Ellen Kenchington[b]

[a] Seascape Consultants, Ltd., Jermyn's House, Romsey SO52 0QA, UK
[b] Fisheries and Oceans Canada - Bedford Institute of Oceanography, P.O. Box 1006, 1 Challenger Dr., Dartmouth, N.S. Canada B2Y 4A2

Impacted

Low impact

No impact

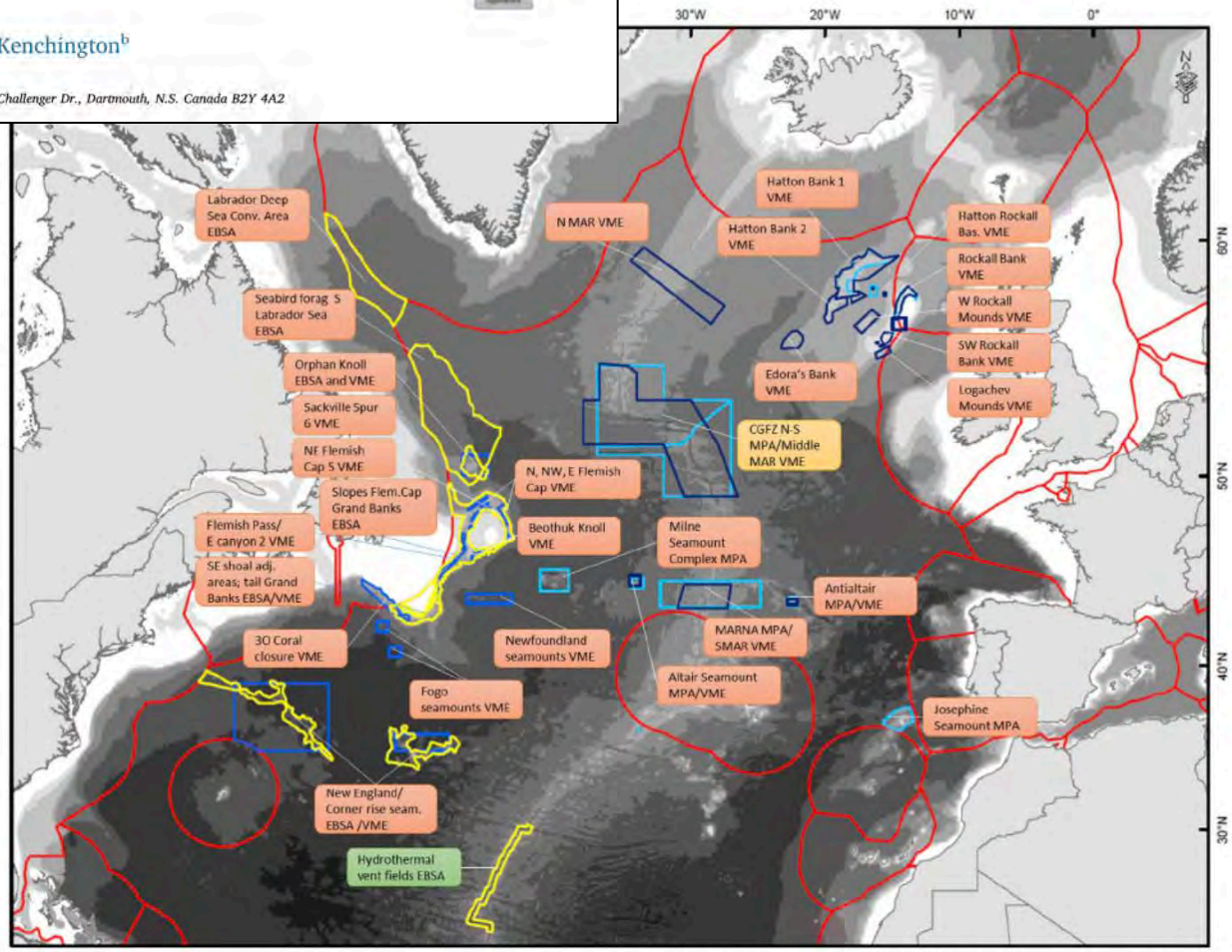
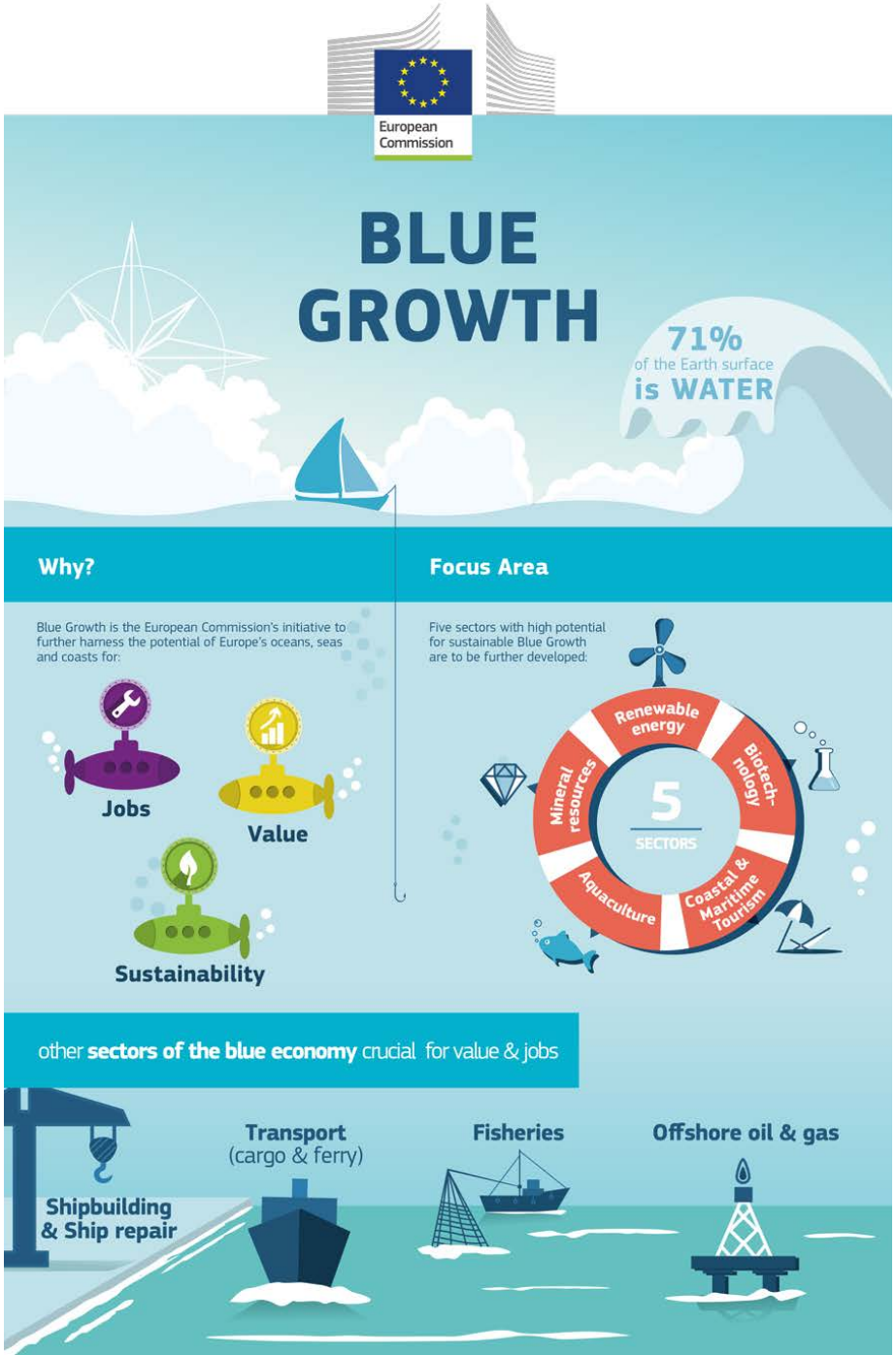


Fig. 2. Expected effect of changing environmental variables on main taxa listed in the conservation objectives for each North Atlantic ABMT in ABNJ. Green: no expected impact; Yellow: low expected impact; Orange: impacted. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)



INFOBOX 1.1

Blue Growth

http://ec.europa.eu/maritimeaffairs/policy/blue_growth/

Blue Growth (COM (2012) 494) is Europe's long term strategy to support sustainable growth in the marine and maritime sectors. As a maritime contribution to achieving the goals of the Europe 2020 strategy for smart, sustainable and inclusive growth, the Blue Growth strategy consists of three components:

(1) Development of sectors that have a high potential for sustainable jobs and growth, such as aquaculture, coastal tourism, marine biotechnology, ocean energy and seabed mining.

(2) Provision of new knowledge, legal certainty and security in the blue economy, such as improvement of access to information about the sea, maritime spatial planning that will ensure efficient and sustainable management of activities at sea and integrated maritime surveillance to give authorities a better picture of what is happening at sea.

(3) Development of sea basin strategies to ensure tailor-made measures that will foster cooperation among countries.

Blue Growth aims to harness the potential of Europe's seas and coasts to create jobs and growth that will develop the blue economy, while making efforts to reduce negative environmental impacts of maritime activities, safeguard biodiversity and protect the marine environment.

atlas

UNDERSTANDING DEEP ATLANTIC ECOSYSTEMS

A trans-Atlantic assessment and deep-water ecosystem-based spatial management plan for Europe

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.

At a Glance

A trans-Atlantic assessment and deep-water ecosystem-based spatial management plan for Europe

Call: EU Horizon 2020: BG-2015-2 (Unlocking the potential of seas and oceans)

Duration: May 2016 – April 2020 (48m)

Consortium: 24 partners +1 linked 3rd party, from 12 countries

Budget: €9.3M

Coordinator: University of Edinburgh (UK)

Focus: Providing essential new knowledge of North Atlantic ecosystems through data gathering and synthesis

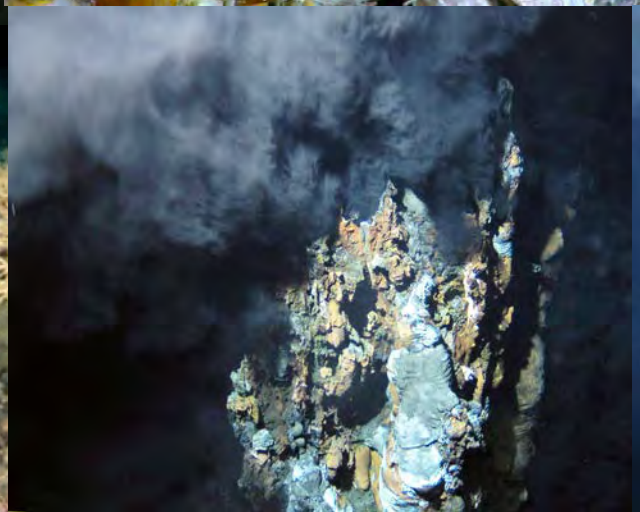
Impact: Discoveries and outputs will inform and facilitate stakeholder agreement on marine policy and regulation and spur Blue Growth

Core activities: 25+ research cruises investigating 12 case studies across the Atlantic



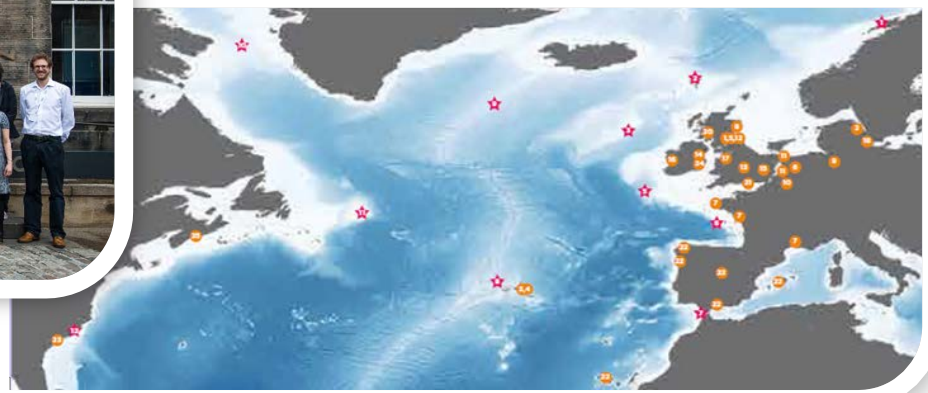





Transatlantic collaboration

ATLAS kick-off meeting Edinburgh (June 2016)

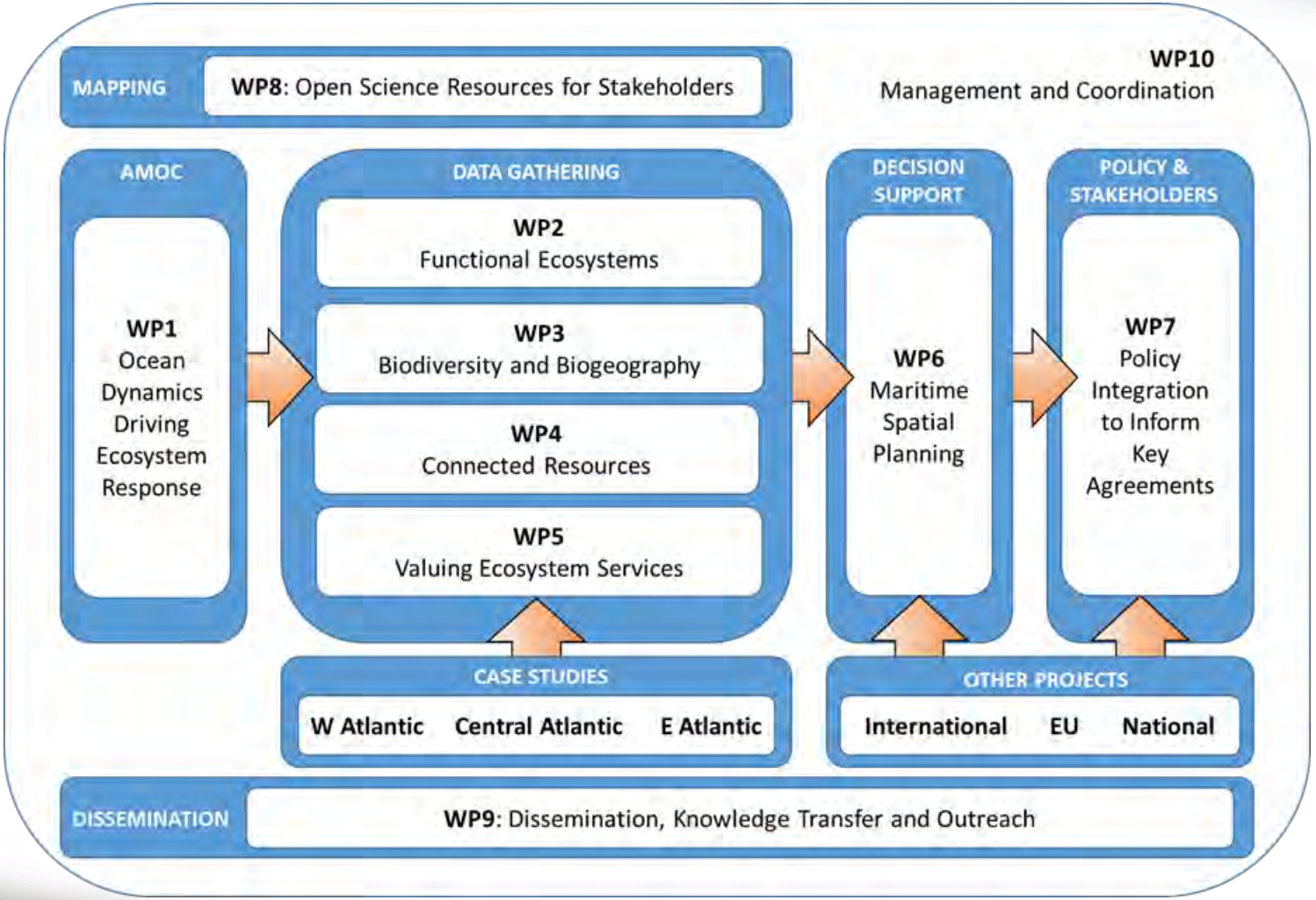


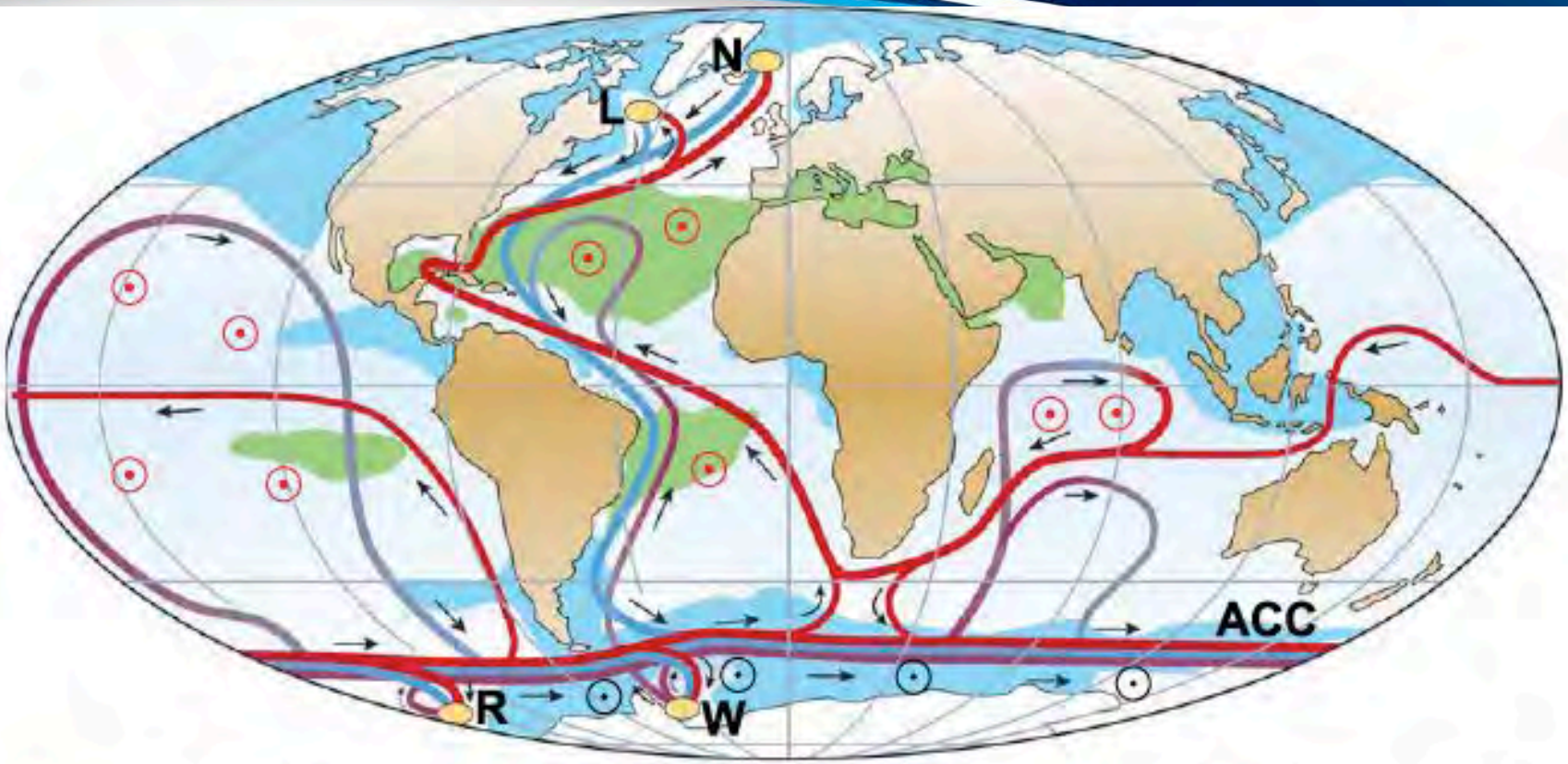
★ Case studies ● Project Partners

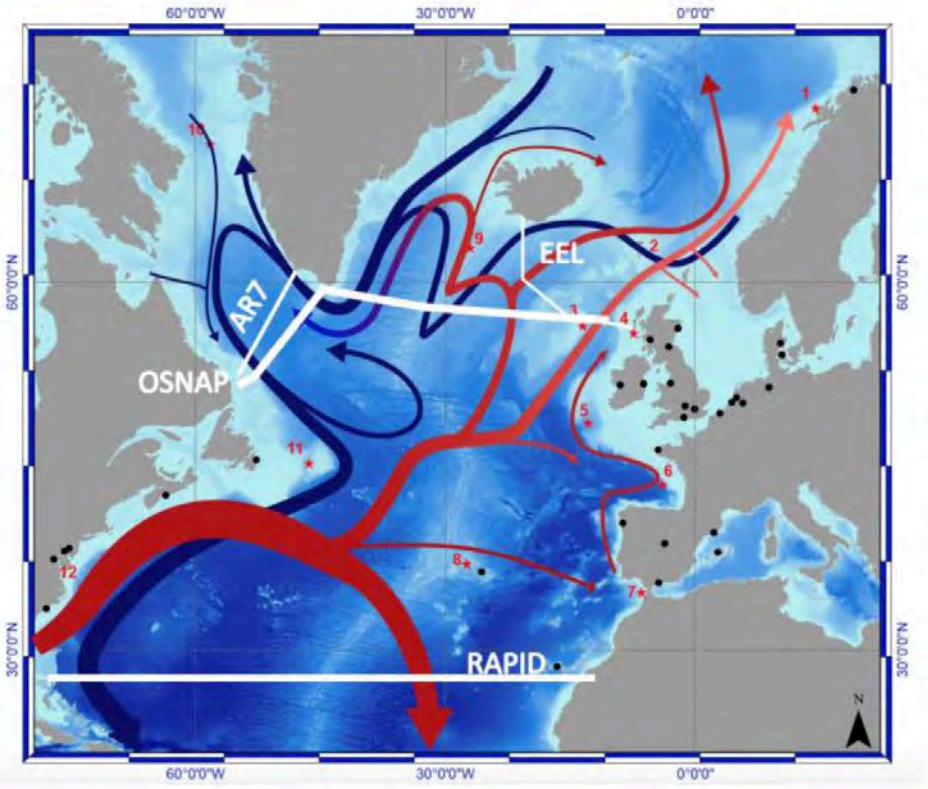
1 University of Edinburgh (UEDIN)
2 Aarhus Universitet (AU)
3 IMAR - Instituto do Mar (IMAR -Uaz)
4 Secretária Regional do Mar, Ciência e Tecnologia (DRAM)
5 British Geological Survey (BGS/NERC)
6 Gianni Consultancy (GC)
7 Institut Francais de Recherche pour L'Exploitation de la Mer (Ifremer)
8 Marine Scotland (MSS)
9 Universitaet Bremen (UniHB)
10 Iodine (Iodine)
11 NIOZ Koninklijk Nederlands Instituut voor Onderzoek der Zee (NIOZ)
12 Dynamic Earth (DE)
13 University of Oxford (UOX)
14 University College Dublin (UCD)
15 University College London (UCL)
16 National University of Ireland, Galway (NUIG)
17 University of Liverpool (ULIV)
18 Syddansk Universitet (USD)
19 UiT The Arctic University of Norway (UiT)
20 Scottish Association for Marine Science (SAMS)
21 Seascape Consultants (SC)
22 Instituto Español de Oceanografía (IEO)
23 University of North Carolina at Wilmington (UNCW)
24 AquaTT UETP Ltd (AquaTT)
25 Fisheries and Oceans Canada (DFO)

Objectives

- **Advance** our understanding of deep Atlantic marine ecosystems and populations
- **Improve** our capacity to monitor, model and predict shifts in deep-water ecosystems and populations
- **Transform** new data, tools and understanding into effective ocean governance
- **Scenario-test** and develop science-led, cost-effective adaptive management strategies that stimulate Blue Growth


MAPPING
WP8: Open Science Resources for Stakeholders
WP10
Management and Coordination
AMOC
WP1
Ocean Dynamics Driving Ecosystem Response
DATA GATHERING
WP2
Functional Ecosystems
WP3
Biodiversity and Biogeography
WP4
Connected Resources
WP5
Valuing Ecosystem Services
DECISION SUPPORT
WP6
Maritime Spatial Planning
POLICY & STAKEHOLDERS
WP7
Policy Integration to Inform Key Agreements
CASE STUDIES
W Atlantic
Central Atlantic
E Atlantic
OTHER PROJECTS
International
EU
National
DISSEMINATION
WP9: Dissemination, Knowledge Transfer and Outreach


N
L
ACC
R
W
Surface flow
Deep flow
Bottom flow
Deep Water Formation
Wind-driven upwelling
Mixing-driven upwelling
Salinity > 36 ‰
Salinity < 34 ‰
L Labrador Sea
N Nordic Seas
W Weddell Sea
R Ross Sea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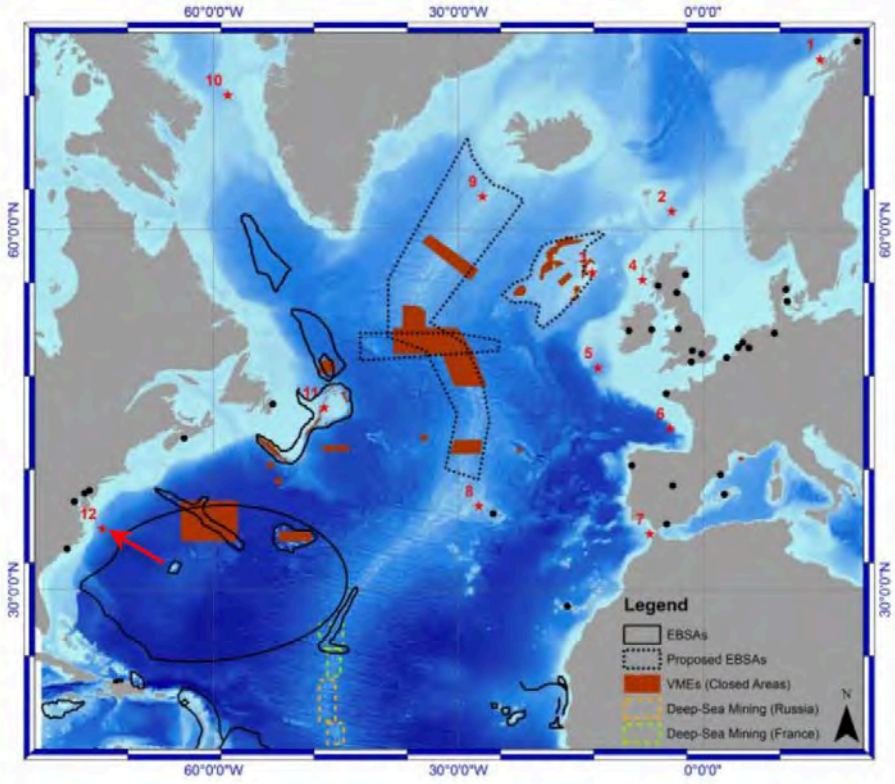
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Legend
EBSAs
Proposed EBSAs
VMEs (Closed Areas)
Deep-Sea Mining (Russia)
Deep-Sea Mining (France)
N

Deep-Sea Research I 88 (2014) 8–16

Contents lists available at ScienceDirect

Deep-Sea Research I

journal homepage: www.elsevier.com/locate/dsri

Global ocean conveyor lowers extinction risk in the deep sea

Lea-Anne Henry [a], Norbert Frank [b], Dierk Hebbeln [c], Claudia Wienberg [c], Laura Robinson [d], Tina van de Flierdt [e], Mikael Dahl [f,1], Mélanie Douarin [g,2], Cheryl L. Morrison [h], Matthias López Correa [i], Alex D. Rogers [j], Mario Ruckelshausen [b], J. Murray Roberts [a,k,l,*]

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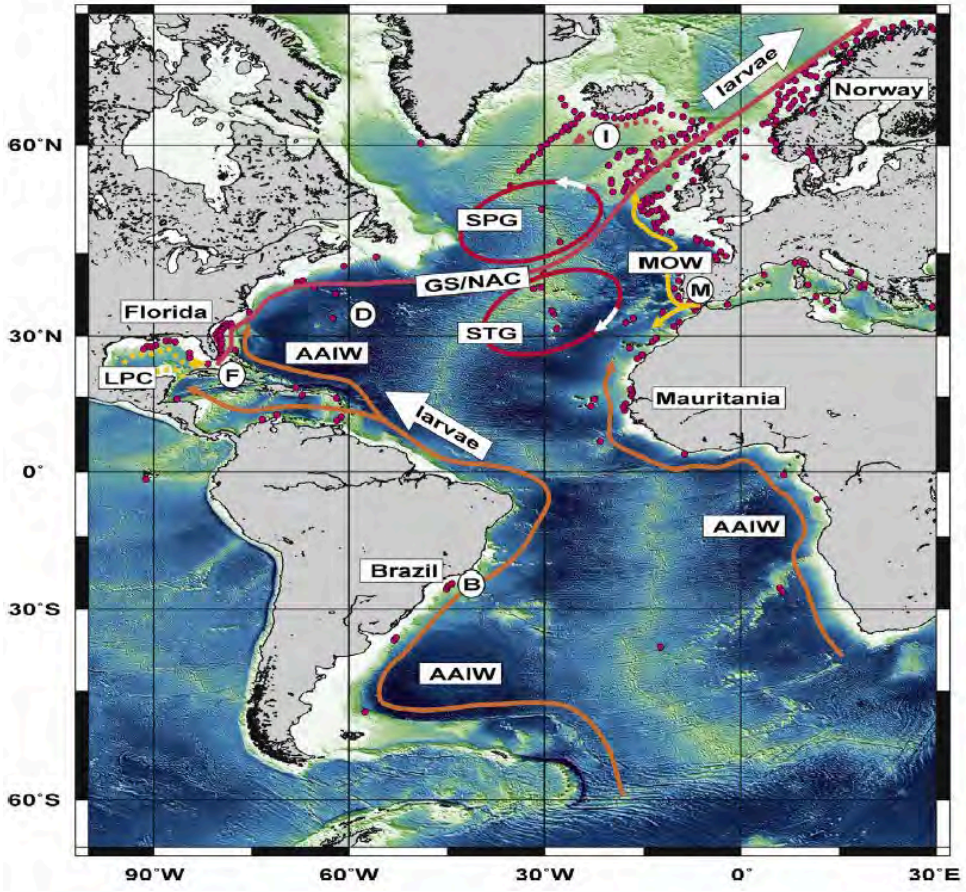
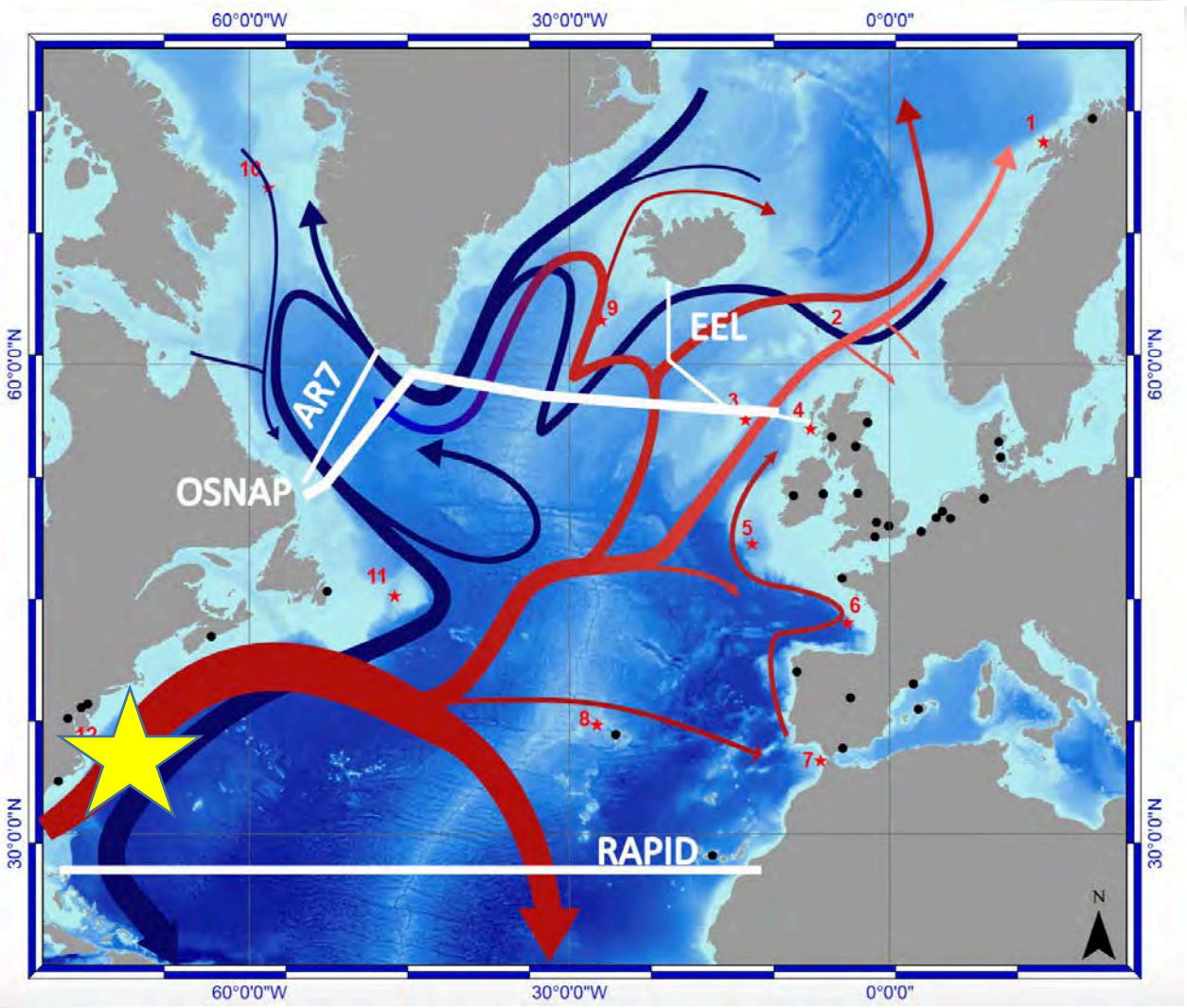
[b] Institut für Umweltphysik, Universität Heidelberg, Im Neuenheimer Feld 229, Heidelberg 69120, Germany
[c] MARUM – Center for Marine Environmental Sciences, University of Bremen, Leobener Strasse, Bremen 28359, Germany
[d] Department of Earth Sciences, University of Bristol, Queens Road, Bristol BS8 1RJ, United Kingdom
[e] Department of Earth Science and Engineering, Imperial College London, London SW7 2AZ, United Kingdom
[f] Department of Biological and Environmental Sciences, Tjärnö, University of Gothenburg, Gothenburg SE-452 96, Sweden
[g] School of Geosciences, University of Edinburgh, Edinburgh EH9 3JW, United Kingdom
[h] U.S. Geological Survey, Leetown Science Center, Aquatic Ecology Branch, 11649 Leetown Road, Kearneysville, WV 25430, United States of America
[i] GeoZentrum Nordbayern, Universität Erlangen-Nürnberg, Loewenichstraße 28, Erlangen 91054, Germany
[j] Department of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, United Kingdom
[k] Scottish Association for Marine Science, Oban PA37 1QA, United Kingdom
[l] Center for Marine Science, University of North Carolina Wilmington, 601S. College Road, Wilmington, NC 28403-5928, United States of America

TRACES



- Links paleo and genetic literature
- Role AMOC in driving rapid post-glacial range expansion in deep ocean
- 7500 km range expansion in <400 years
- *What are implications of future AMOC variability?*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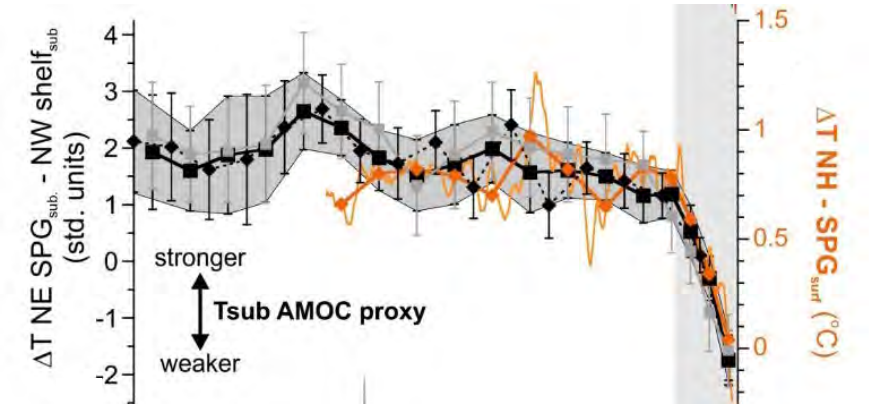
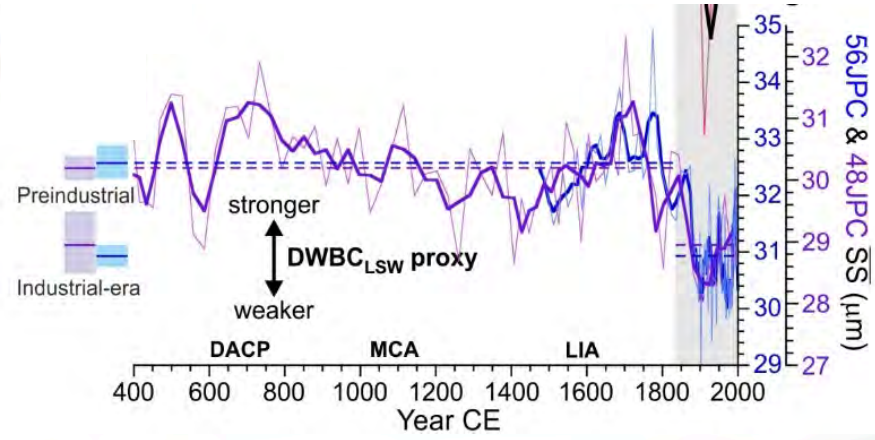
AMOC strength over last 1600 years

- Proxy-records show anomalously weak AMOC strength over past ~150 years.
- Imply modern circulation atypical of longer term.
- Important when interpreting distribution & functioning of Atlantic ecosystems.





SS = Sortable Silt

Thornalley et al. (2018) Anomalously weak Labrador Sea convection and Atlantic overturning during the last 150 years. *Nature*.

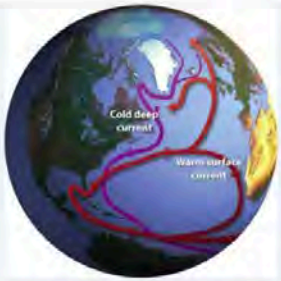
BBC NEWS

Science & Environment

Climate change dials down Atlantic Ocean heating system

By Victoria Gill
Science correspondent, BBC News

11 April 2018



The circulation system plays a "significant role" in regulating the Earth's climate by distributing the globe.

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Koreas make nuclear pledge after summit
Historic talks between North and South Korea's leaders end with promises on peace and nuclear arms.

The Guardian

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Climate change

Gulf Stream current at its weakest in 1,600 years, studies show

Warm current that has historically caused dramatic changes in climate is experiencing an unprecedented slowdown and may be less stable than thought - with potentially severe consequences

Damian Carrington
Environment editor

20,035

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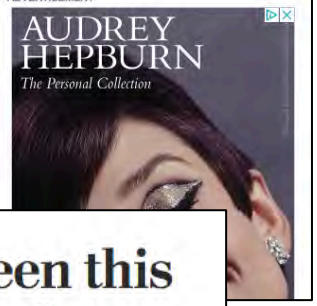
World faces climate CHAOS because the circulation of the Atlantic Ocean is the weakest it has been in more than 1,500 years, warn scientists

- A key cog in the global ocean circulation system has not been running
- If the system continues to weaken, researchers say it may disrupt weather
- Experts believe the Atlantic began to warm near the end of the Little Ice Age

By PHOEBE WESTON FOR MAILONLINE



Infact.

Environment

Is the Gulf Stream about to collapse and is the new ice age coming sooner than scientists think?

Science Correspondent | Thursday 12 April 2018

1. What is the Atlantic Meridional Overturning Circulation?
2. So is The Day After Tomorrow about to become a reality, and are we going to plunge into another ice age?
3. So how likely is it that those ocean currents will collapse?
4. If the Amoc isn't shutting down completely, what is going on?

INDEPENDENT

Energy and Environment

The oceans' circulation hasn't been this sluggish in 1,000 years. That's bad news.

By Chris Mooney April 11 Email the author

The Washington Post
Democracy Dies in Darkness

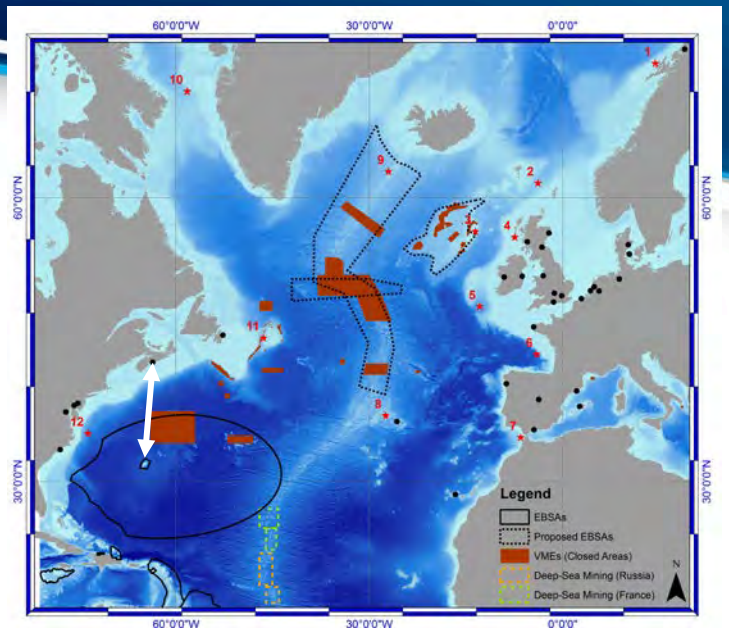
www.eu-atlas.org

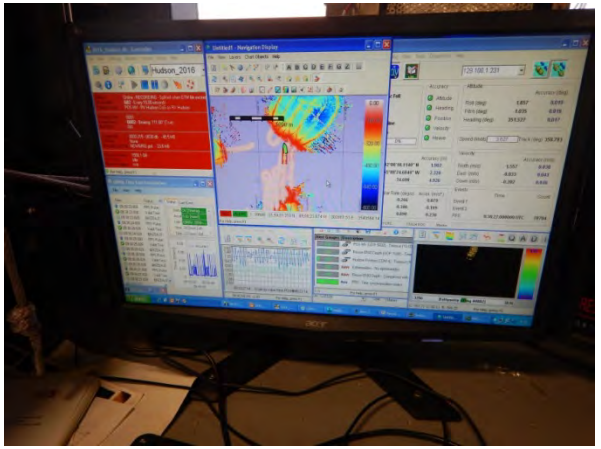
Bermuda to Atlantic Canada
28 July – 8 August 2016

Deep-sea habitat mapping; Oceanographic profiling; Seamounts; Biodiversity; Geology and fossil history

CCGS *Hudson* in St. Georges' Harbour

CTD casts on 3 seamounts (Argus, Challenger and Bowditch)





Oceanographic seamount profiling

Fisheries and Oceans Canada

www.eu-atlas.org

atlas

MEDWAVES

21th September 2016 – 26th October 2016 (36 days; one scale in Azores)
Research Vessel "Sarmiento de Gamboa" (CSIC)

RV Sarmiento de Gamboa (image: Joan Costa, CSIC)

- ROV "Liropus" Super Mohawk
- 2 CDT rosettes
- ADCP and EK-60
- Multibeam echosounder
- Sidescan sonar
- Box corer, Multicorer, van Veen grab

Follow medwavescruise on Facebook
https://www.facebook.com/medwavescruise/

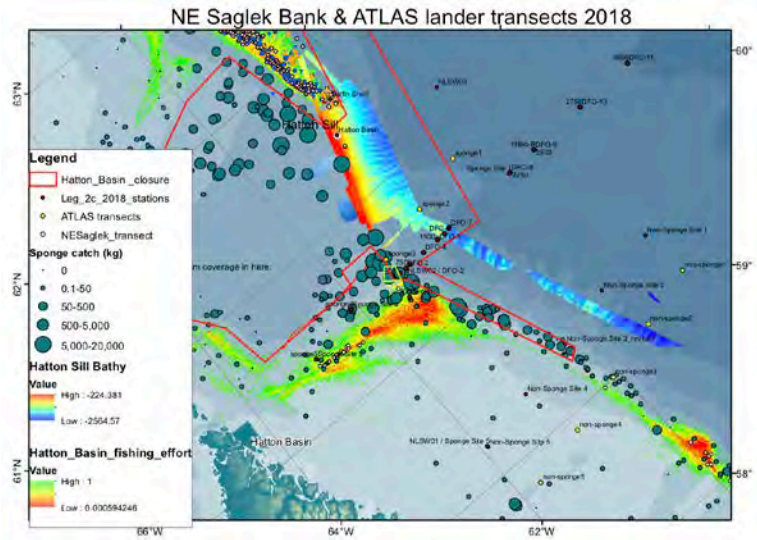
facebook

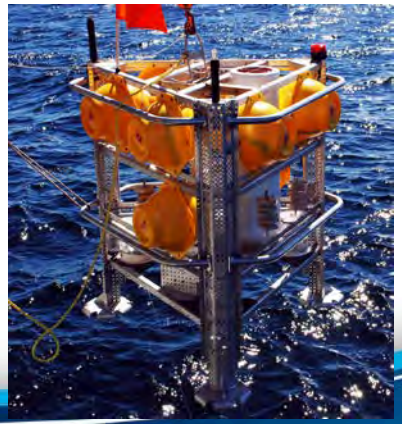
RV *Pelagia* 2017 & 2018

Royal Netherlands Institute for Sea Research

CCGS *Amundsen* cruise 2018

- Controls on deep-water sponges in Davis Strait
- CAN$150k raised by DFO to support shiptime
- Work led by NIOZ with UEDIN, BGS, ULIV & UNCW
- Galway transatlantic alliance in action





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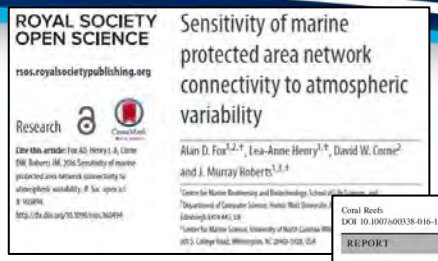
ROYAL SOCIETY OPEN SCIENCE

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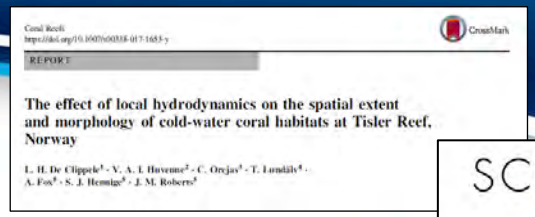
Research

Sensitivity of marine protected area network connectivity to atmospheric variability

Alan D. Fox[1,2,†], Lea-Anne Henry[1,†], David W. Corne[2] and J. Murray Roberts[1,3,†]


Coral Reefs

https://doi.org/10.1007/s00338-017-1653-y

CrossMark

REPORT

The effect of local hydrodynamics on the spatial extent and morphology of cold-water coral habitats at Tisler Reef, Norway

L. H. De Clippele[1] · V. A. I. Huvenne[2] · C. Orejas[3] · T. Lundälv[4] · A. Fox[5] · S. J. Hennige[5] · J. M. Roberts[5]

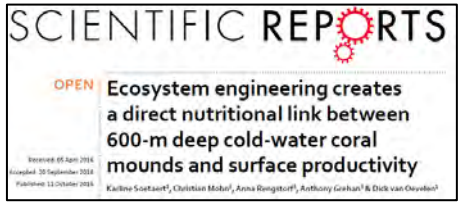

SCIENTIFIC REPORTS

OPEN

The subpolar gyre regulates silicate concentrations in the North Atlantic

Received: 31 May 2017
Accepted: 17 October 2017
Published online: 06 November 2017

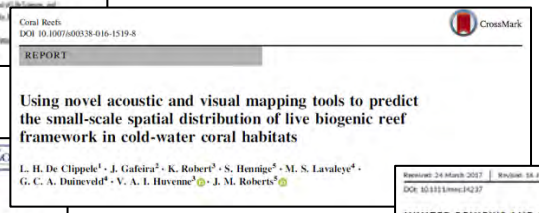
H. Hátún[1], K. Azetsu-Scott[2], R. Somavilla[3], F. Rey[3], C. Johnson[4], M. Mathis[5], U. Mikolajewicz[5], P. Coupel[6], J.-É. Tremblay[6], S. Hartman[7], S. V. Pacariz[8,10], I. Salter[8,10] & J. Olafsson[9]


SCIENTIFIC REPORTS

OPEN

Ecosystem engineering creates a direct nutritional link between 600-m deep cold-water coral mounds and surface productivity

Kerline Soetaert[1], Christian Mohn[1], Anna Rengstorf[2], Anthony Grehan[3] & Dick van Oevelen[1]


Coral Reefs

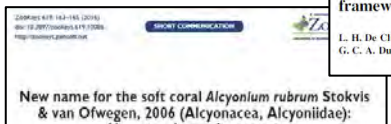
DOI 10.1007/s00338-016-1519-8

CrossMark

REPORT

Using novel acoustic and visual mapping tools to predict the small-scale spatial distribution of live biogenic reef framework in cold-water coral habitats

L. H. De Clippele[1] · J. Gafeira[2] · K. Robert[3] · S. Hennige[3] · M. S. Lavaleye[4] · G. C. A. Duineveld[4] · V. A. I. Huvenne[2] · J. M. Roberts[3]


SHORT COMMUNICATION

New name for the soft coral *Alcyonium rubrum* Stokvis & van Ofwegen, 2006 (Alcyonacea, Alcyoniidae): *Alcyonium burmedju* nom. n.

Íris Sampaio[1,2], Frank R. Stokvis[2], Leen P. van Ofwege


frontiers in Marine Science

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

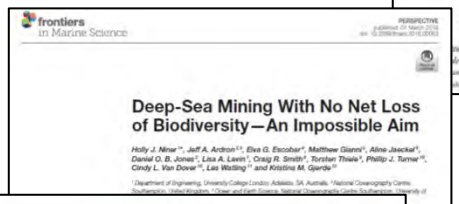
Marina Carreiro-Silva[1,2,3], Oscar Ocaña[4], David Stankovic[1], Iris Sampaio[1,2], Filipe M. Porteiro[1,2,3], Maria-Claire Fabri[5] and Sergio Stefanni[6]


INVITED REVIEWS AND SYNTHESES

WILEY MOLECULAR ECOLOGY

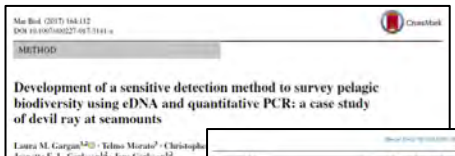
Invertebrate population genetics across Earth's largest habitat: The deep-sea floor

M. L. Taylor | C. N. Roterman


frontiers in Marine Science

Deep-Sea Mining With No Net Loss of Biodiversity—An Impossible Aim

Holly J. Niner[1*], Jeff A. Ardron[2,3], Elva G. Escobar[4], Matthew Gianni[5], Aline Jaeckel[6], Daniel O. B. Jones[7], Lisa A. Levin[8], Craig R. Smith[9], Torsten Thiele[3], Phillip J. Turner[10], Cindy L. Van Dover[11], Les Watling[12] and Kristina M. Gjerde[13]


Mar Biol (2017) 164:112

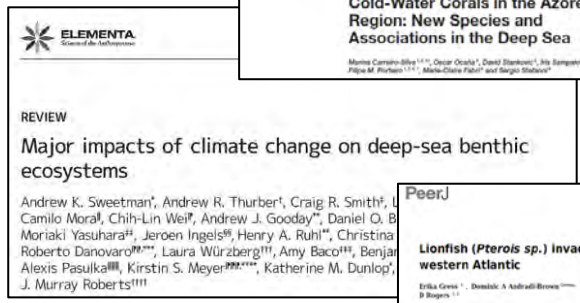
DOI 10.1007/s00227-017-3141-x

CrossMark

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 Morato[3] · Christophe Jeanette E. L. Carlsson[1,2] · Jens Carlsson[1,2]


ELEMENTA Science of the Anthropocene

REVIEW

Major impacts of climate change on deep-sea benthic ecosystems

Andrew K. Sweetman*, Andrew R. Thurber†, Craig R. Smith‡, L Camilo Moral‖, Chih-Lin Wei#, Andrew J. Gooday**, Daniel O. B Moriaki Yasuhara##, Jeroen Ingels§§, Henry A. Ruhl‖‖, Christina Roberto Danovaro[¶¶,***], Laura Würzberg†††, Amy Baco‡‡‡, Benjar Alexis Pasulka‖‖‖, Kirstin S. Meyer[¶¶,***,†††], Katherine M. Dunlop‡, J. Murray Roberts†††


Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Developing a performance evaluation mechanism for Portuguese marine spatial planning using a participatory approach

Maria Adelaide Ferreira[a,*], David Johnson[b], Carlos Pereira da Silva[a], Tomás B. Ramos[a]


PeerJ

Lionfish (*Pterois sp.*) invade the upper bathyal zone in the western Atlantic

Erika Gress[1], Dominic A Andradi-Brown[Corresp., 2,3], Lucy Woodall[1,3], Pamela J Schofield[4], D Rogers[1,5]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Scientific rationale and international obligations for protection of active hydrothermal vent ecosystems from deep-sea mining

C.L. Van Dover[a,*], S. Arnaud-Haond[b], M. Gianni[c], S. Helmreich[d], J.A. Huber[e], A.L. Jaeckel[f], A. Metaxas[g], L.H. Pendleton[h], S. Petersen[i], E. Ramirez-Llodra[j], P.E. Steinberg[k], V. Tunnicliffe[l], H. Yamamoto[m]


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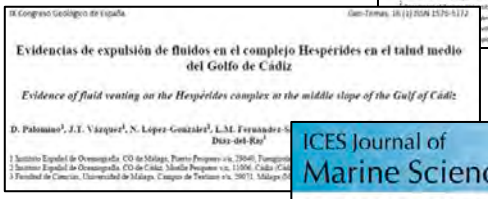
Mainstreaming marine biodiversity into the SDGs: The role of other effective area-based conservation measures (SDG 14.5)

Daniela Diz[a,*], David Johnson[b], Michael Riddell[c], Sian Rees[d], Jessica Baitle[e], Kristina Gjerde[f], Sebastian Hennige[g], J. Murray Roberts[g]

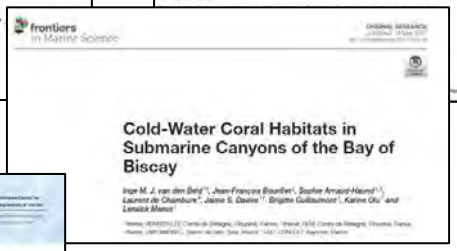

IX Congreso Geológico de España

Geo-Temas. 16 (4) ISSN 1570-5172

Evidencias de expulsión de fluidos en el complejo Hespérides en el talud medio del Golfo de Cádiz

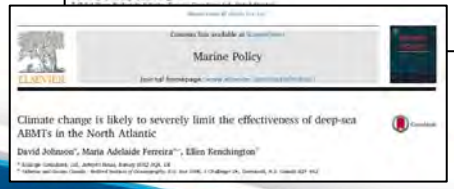
Evidence of fluid venting on the Hespérides complex at the middle slope of the Gulf of Cádiz

D. Palomino[1], J.T. Vázquez[1], N. López-González[1], L.M. Fernandez-Salas[2], Díaz-del-Río[3]


frontiers in Marine Science

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

Inge M. J. van den Beld[1†], Jean-François Bourillet[1], Sophie Arnaud-Haond[2,3], Laurent de Chambure[1], Jaime S. Davies[1,4], Brigitte Guillaumont[1], Karine Olu[1] and Lenaick Menot[1]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Climate change is likely to severely limit the effectiveness of deep-sea ABMTs in the North Atlantic

David Johnson*, Maria Adelaide Ferreira**, Ellen Kenchington**


ICES Journal of Marine Science

ICES CIEM

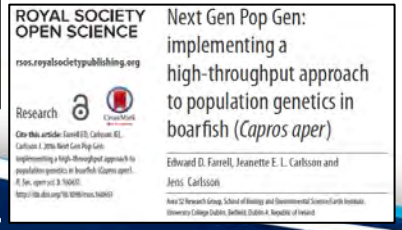
ICES Journal of Marine Science (2017), 74(1), 406–415. doi:10.1093/icesjms/fsw181

Contribution to the Themed Section: '*Case studies in operationalizing ecosystem-based management*'

Food for Thought

Moving from ecosystem-based policy objectives to operational implementation of ecosystem-based management measures

Roland Cormier[1,*] Christopher R. Kelble[2] M. Robin Anderson[3] J. Icarus Allen[4] Anthony Grehan[5] and Ólavur Gregersen[6]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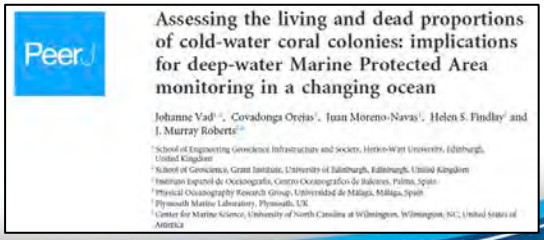
Research

Next Gen Pop Gen: implementing a high-throughput approach to population genetics in boarfish (*Capros aper*)

Edward D. Farrell, Jeanette E. L. Carlsson and Jens Carlsson


PeerJ

Assessing the living and dead proportions of cold-water coral colonies: implications for deep-water Marine Protected Area monitoring in a changing ocean

Johanne Vad[1], Covadonga Orejas[2], Juan Moreno-Navas[3], Helen S. Findlay[4] and J. Murray Roberts[5]

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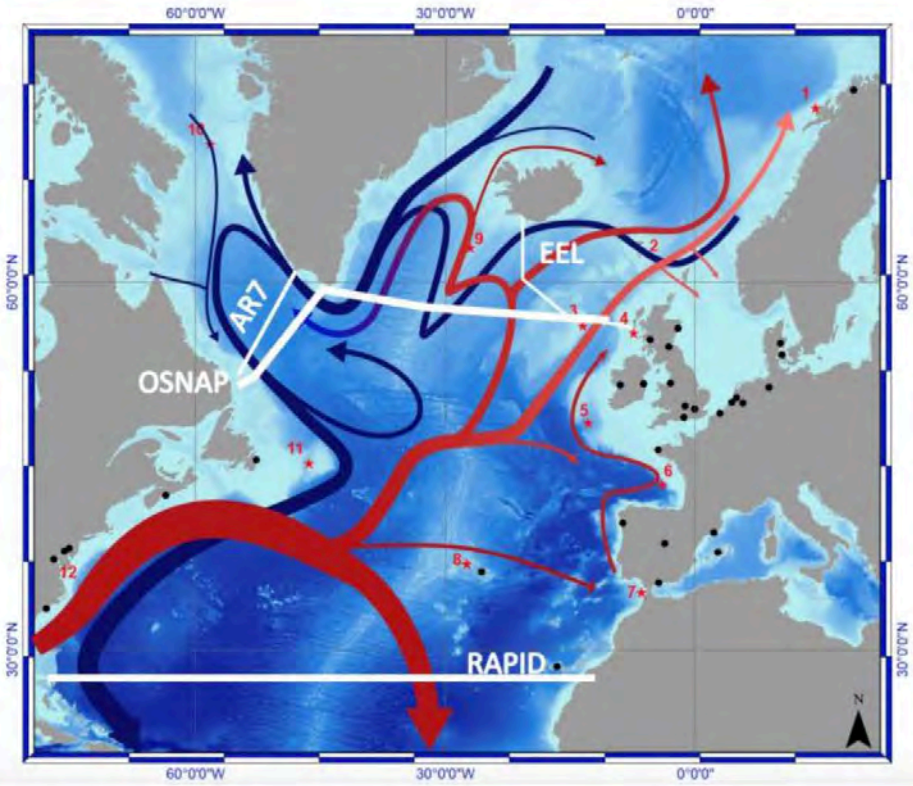

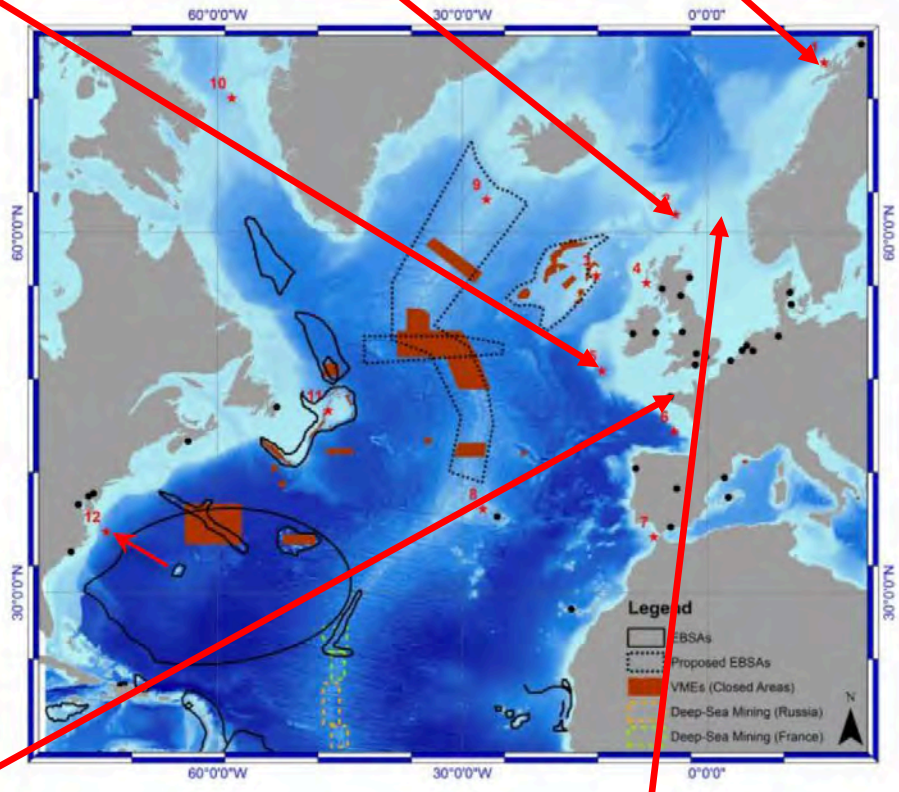

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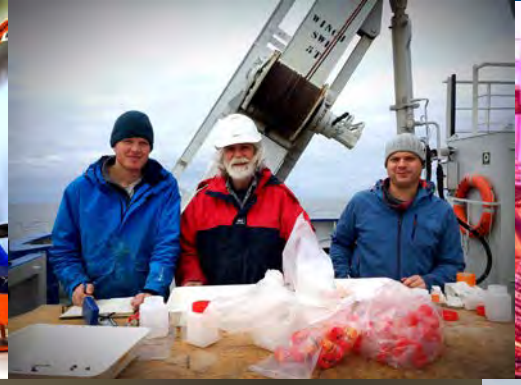
Expected Impacts

- Improve **resource management** (ecosystem approach) and governance
- Improve **cooperation** within EU and trans-Atlantic
- Contribute to the **EU Integrated Maritime Policy**
- Strengthen international **agreements to conserve** Vulnerable Marine Ecosystems and Ecologically & Biologically Significant Areas
- Engage with UN process developing an international legally binding instrument under UNCLOS on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction

Multidisciplinary Approach

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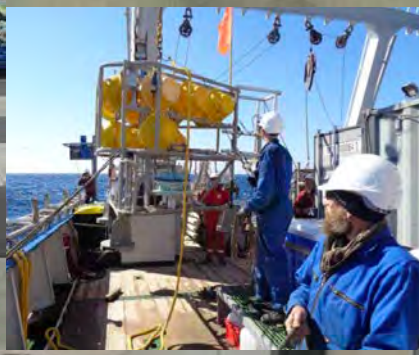
Deep-Sea Science for Sustainable Development
Monday 5 June
09.00-10.00
United Nations, New York

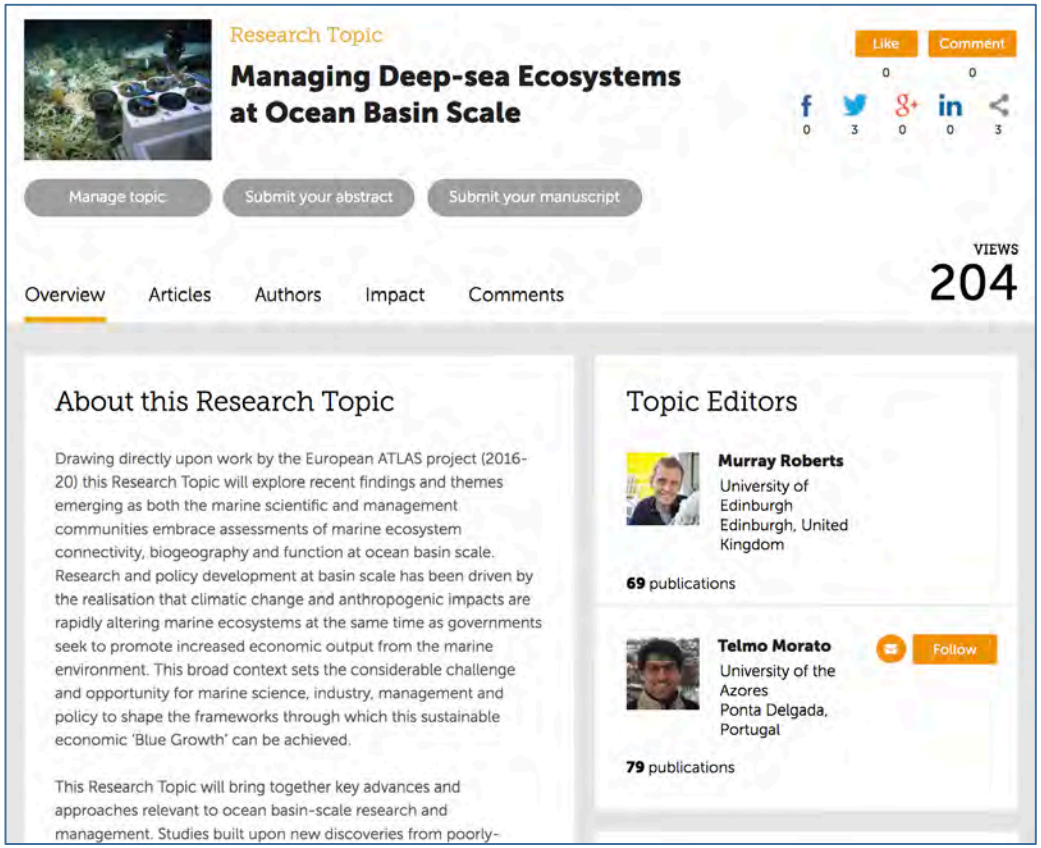



EU-funded project on deep-sea sponge ground ecosystems of the North Atlantic
SponGES

Frontiers in Marine Science Theme for ATLAS

Submission Deadlines

- 12 July 2018 Abstract
- 15 November Manuscript
- Similar deadlines planned for 2019 and 2020



Many thanks!

Project Contact Details:

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murray.roberts@ed.ac.uk
Project Management: Julia Eighteen
EU-Atlas@ed.ac.uk
Communication & Press: Annette Wilson
annette@aquatt.ie

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