atlas
UNDERSTANDING DEEP ATLANTIC ECOSYSTEMS

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

ISSUE 7 | FEBRUARY 2020

project news

25+1 PARTNERS

12 COUNTRIES

The ATLAS Team © Alex Ingle

IN THIS ISSUE:

ATLAS is a four-year research and innovation project that aims to advance our understanding of deep Atlantic Ocean ecosystems. **ATLAS** provides essential new knowledge for effective ocean governance and adaptive management strategies that stimulate Blue Growth. Funded under the European Union's Framework Programme for Research and Innovation, Horizon 2020, **ATLAS** brings together 25 partners (and one linked third party) from 12 European countries, the USA and Canada and is led by the University of Edinburgh (Scotland, UK).

www.eu-ATLAS.org

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Designed and developed by AquaTT, with input from ATLAS partners

WELCOME FROM THE ATLAS COORDINATOR

Prof J Murray Roberts,
ATLAS Coordinator,
The University of Edinburgh
(UEDIN), Scotland, UK

Writing this introduction to the last **ATLAS** newsletter brings mixed emotions – great pleasure in how much we've achieved but tinged with sadness that our voyage is coming to an end. But **ATLAS** isn't over yet. The detailed work pulling results across to our maritime spatial planning work package continues as does work taking our findings directly into policy dialogues at national and international levels.

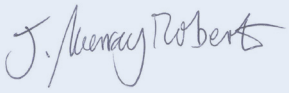
The final **ATLAS** meeting in March is well before the project ends in April and will be followed by a writing retreat at the spectacular Dalhousie Castle outside Edinburgh. Here we can work together without distractions to get those final manuscripts ready to be submitted. And our timing couldn't be better! Since **ATLAS** started in 2016 public concern over climate change and environmental sustainability has moved centre stage. People are more aware and worried about our planetary life support system and the role the oceans play in sustaining life on Earth. We must keep our momentum to translate our findings to as broad an audience as possible building on our engagement with the UN biodiversity beyond national jurisdiction negotiations and looking forward to future UN events like the 2nd Oceans Conference (Lisbon, Portugal, 2-6 June), the next Climate Conference (Glasgow, Scotland, 9-19 November) and the start of the decade of ocean science for sustainable development in 2021.

Throughout **ATLAS** we have always placed people at the heart of what we do, and, in this newsletter, you can find out about the fascinating discoveries Claire Armstrong and her team of socioeconomists have made about how people value deep Atlantic ecosystems. When climate change forecasts and the challenges of achieving sustainable development seem overpowering, there is real cause for optimism in these results. People care about deep Atlantic ecosystems and are prepared to pay for their conservation. I firmly believe that the more people understand about these special places, the more they will care. This is why **ATLAS**'s work is so important and why we've placed so much emphasis on the policy interface, public engagement and education.

Being lucky enough to coordinate **ATLAS** has been the highlight of my career and I want to acknowledge everyone in our consortium, our Advisory Board and across all our stakeholders for their remarkable contributions and dedication over the last four years.

ATLAS could not have been what it's become without you all – thank you!

Murray.Roberts@ed.ac.uk



HIGHLIGHTS AND HEADLINES

All-Atlantic Ocean Research Forum, Brussels

ATLAS Coordinator, J. Murray Roberts (UEDIN, UK), will showcase **ATLAS**' contribution to Atlantic research at this high-level event held in Brussels this month. Political and community leaders, researchers, industry, youth ambassadors and inspirational speakers from around the Atlantic will come together from 6–7 February 2020 to celebrate international policy achievements since the signing of the Galway Statement (2013) and the Belém Statement (2017). **For more information, please see: bit.ly/39lypwi**

Global Change Biology

A new article titled 'Climate-induced changes in the suitable habitat of cold-water and commercially important deep-sea fishes in the North Atlantic' will be published in the journal Global Change Biology in February 2020. Led by **ATLAS** partner Telmo Morato (IMAR-UAz), this collaborative study with partners from **ATLAS** sister project SponGES and authors spanning the Atlantic Ocean, emphasises the need to understand how anticipated climate change will affect the distribution of deep-sea species, including commercially important fishes.

United Nations 2nd World Ocean Assessment

Several **ATLAS** partners have contributed to the Second Cycle of the UN Regular Process including two chapters in the 2nd World Ocean Assessment on 'Cold-Water Corals' and 'Seamount, Knolls and Pinnacles'. This assessment, to be published later this year, will play a decisive supporting role in policy development and decision-making at the national, regional and global level. **For more information, please see: bit.ly/36ALndl**

Life Below Water – SDG14

In December 2019, Scotland's International Development Alliance published its new report 'Working towards the Global Goals'. Coordinated from the University of Edinburgh, **ATLAS**' contribution to Sustainable Development Goal 14 – Life Below Water, was featured in the report.
You can read the full report here: bit.ly/34GkjZv

ATLAS at the European Commission Seminar on Fisheries Science

Dedicated to exploring research needs and priorities in the field of fisheries for the next decade, the European Commission held its annual Fisheries Science seminar

in Brussels in September 2019. Project partner Matt Gianni (Gianni Consultancy) presented several key findings and predictions from **ATLAS**, including the poleward migration of many deep-sea fish species in response to climate change. **For more information on this seminar, please visit bit.ly/2rGrna7**

Horizon Results Platform and the ATLAS Compendium

Providing a platform for H2020 projects to showcase their results, the European Commission launched the Horizon Results Platform at the 'European R&I Days' event in Brussels in September 2019. **ATLAS** partner AquaTT has collected knowledge and key results from the project to be shared on the platform and to help generate their desired value. The **ATLAS** Compendium will be published in April 2020, further supporting value generation and impact creation. This publication will present key knowledge outputs linked to results on the Platform, highlight key activities, and outline the overall impact of **ATLAS** on science, society, industry and our planet. **For more information, please contact annette@aquatt.ie.**

ATLAS film

The **ATLAS** video will be previewed at the All Atlantic Ocean Research Forum this February in Brussels, with the final version launched at the **ATLAS** General Assembly in Edinburgh in March 2020. Shot at locations spanning the Atlantic, the film tells the story of the mighty Atlantic Ocean, how it provides for us, and how **ATLAS** research will help to ensure a healthy ocean for generations to come.

Left: Alex, photographer and film maker, capturing some underwater footage; right: the ATLAS movie in production © Alex Ingle

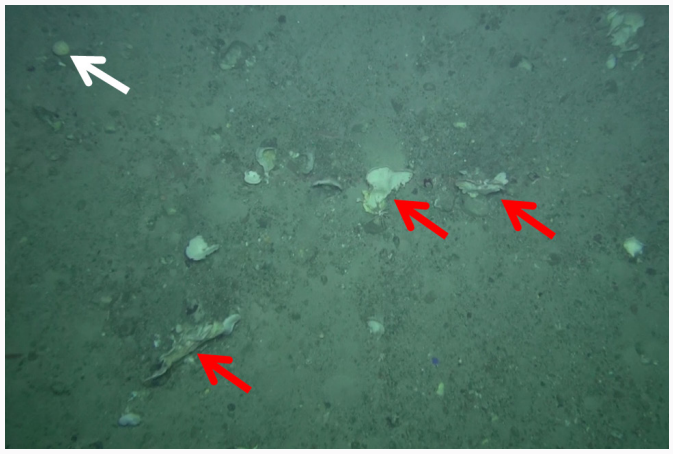
ATLAS NEWS AND STORIES

ATLAS team working with the International Council for the Exploration of the Sea (ICES) on the environmental status of the deep sea

By: Georgios Kazanidis, Post-Doctorate Research Associate (UEDIN, University of Edinburgh, UK)

A key objective of **ATLAS** is to facilitate the implementation of the Marine Strategy Framework Directive (MSFD) and achievement of Good Environmental Status (GES) in North Atlantic deep waters. A group of experts led by Dr Covadonga Orejas (IEO) has addressed this challenge by focusing on nine strategically-selected case studies from northern Norway down to the Gulf of Cadiz.

As part of this work, **ATLAS** participated in the International Council for the Exploration of the Sea (ICES) Working Group on Fishery Benthic Impact and Trade-off (WGFBIT), which took place in Ancona from 7-11 October 2019. **ATLAS** was represented by Georgios Kazanidis who has been deeply involved in the coordination and communication of **ATLAS** work on GES. The ICES WGFBIT group evaluates benthic impact from fisheries at regional scale, while considering fisheries and seabed impact trade-offs. **ATLAS** participated in the meeting firstly to facilitate knowledge exchange between the ICES WGFBIT and the WG on Deep-water Ecology, and also to communicate key findings of **ATLAS** GES work. In order to meet the first objective, Georgios collaborated with Professor Jan Hiddink (Bangor University) to test the Population Dynamics (PD) Model's efficiency in the deep sea. PD assesses the risks to benthos by demersal fisheries (ICES, 2019). The PD model used data about deep-sea sponge aggregations in places of relatively low and high fishing pressure i.e. inside and outside the Faroe-Shetland Channel Nature Conservation Marine Protected Area (Kazanidis et al., 2019). Interestingly, this first implementation of the PD model produced meaningful results showing the high sensitivity of deep-sea sponge aggregations in demersal fisheries. Georgios later presented the key findings of **ATLAS** work on GES to the 33 WGFBIT participants. These included **ATLAS**-proposed scientific indicators for assessing deep-sea environmental status, an evaluation of the Nested Environmental Status Assessment Tool, and recommendations for assessing deep-sea environmental status. Interdisciplinary collaborations and knowledge exchange will play a key role in advancing our understanding of human impacts on deep-sea ecosystems facilitating Blue Growth and the long-term conservation of these fragile ecosystems.



Deep-sea sponge aggregations within the Faroe-Shetland Channel Nature Conservation Marine Protected Area, approx. 450 m depth. Red and white arrows point to fan-shaped and globular sponges respectively. Image collected by Marine Scotland on board the *MRV Scotia* ("MoreDeep" cruise). For more information please see Kazanidis et al. (2019).

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ATLAS would like to thank Sebastian Valanko for inviting the team to WGFBIT, and Emanuela Fanelli for helping with logistics.

References:

ICES. 2019. WGFBIT Report 2018, Annex 4, ICES CM 018/HAPISG:21. 74 pp.

Kazanidis et al (2019) Distribution of Deep-Sea Sponge Aggregations in an Area of Multisectoral Activities and Changing Oceanic Conditions. Frontiers in Marine Science 6, 163.

New atlas of US submarine canyons

The US Bureau of Ocean Energy Management (BOEM) has released "Large submarine canyons of the United States outer continental shelf atlas". The atlas of major submarine canyons within US waters, co-authored by **ATLAS** Partner, Steve W. Ross (UNC-W), is designed to consistently define canyon boundaries, provide large scale bathymetry for each included canyon, note protected areas, and include notable facts for each canyon. The atlas is a valuable resource for the public, managers, agencies, educators, and the science community. **Download the atlas at bit.ly/38Q7RZu.**

Investigating the impact of crude oil-contaminated seawater and marine snow on the shallow water sponge

By: Laura Durán Suja and Johanne Vad (both UEDIN, Scotland)

In May 2019, Johanne Vad and Laura Duran Suja spent a day at Coldingham bay near Edinburgh (UK) to collect samples of the shallow-water sponge *Halichondria panicea*. It was thankfully a rare sunny day, and the pair managed to pick up all samples before getting caught by the tides. They then conducted an experiment at UEDIN exposing *H. panicea* to contaminated seawater, and/or Marine Snow (MS) or Marine Oil Snow (MOS), to determine the potential impacts of an oil spill and MS/MOS that might accumulate on the sponge.

Fig 1. Set up of the experiment at UEDIN.

Marine sponges constitute key organisms in benthic ecosystems. Sponges actively contribute to the recycling of nutrients through their filtrating activities. During a spill, chemical dispersants are often used to reduce the formation of an oil slick. Dispersants also increase the solubility of hydrocarbons in seawater, contribute to the formation of marine oil snow (MOS) and persist in sediments after reaching the seafloor. Johanne and Laura's experiment (Fig 1) monitored changes in sponge health (smell, colour), oxygen concentration, gene expression (metatranscriptomics) as well as hydrocarbon analysis in the sponge and in the water column. Data from this experiment will allow **ATLAS** to describe the effect of a potential oil spill on sponges which play a key role in the food web and nutrient cycling.

Fig 2. *H.panicea* filtering green dye.

During this experiment, a sponge was exposed to green dye (Fig 2) to see how it filtered the surrounding water. By filtering contaminated seawater, *H. panicea* have been found to bioaccumulate hydrocarbons. Following four days of exposure, *H. panicea* individuals were found dead after exposure to oil and MOS.

The results are now being analysed. This work will hopefully improve our understanding of the effect of oil and/or dispersant on benthic fauna and enable predictions of the consequences of an oil spill. It may also support the development of new contingency plans. Next steps should include an investigation and broader discussion around dispersant usage.

Coral Valuation – People are willing to pay to protect cold-water corals in the deep sea

Based on an article by: Claire W. Armstrong (UiT, Norway), Margrethe Aanesen (UiT, Norway), Thomas M. van Rensburg (NUI Galway, Ireland) and Erlend Dancke Sandorf (University of Stirling, UK)

Cold-water corals are highly biodiverse ecosystems that support many unique and endemic species. Occurring in the deep sea, far from shore and well out of sight, they are often out of mind and vulnerable to damage.

Resource exploitation from industries such as fisheries, oil, gas and mining are major sources of revenue and employment. The European Commission, under its Blue Growth Strategy, has been seeking to support sustainable growth in the North Atlantic through sectors including aquaculture, maritime and coastal tourism, blue biotechnology, ocean energy, and seabed mining, also known as the Blue Economy, particularly as they expand into the deep sea.

Yet important questions remain regarding the scientific, technical and socio-economic needs underpinning the increasing extraction of ocean resources. There is a need to generate more economic data on the costs, benefits, and governance associated with marine protection (and developing marine protected areas) that involve a wide variety of stakeholders, often with conflicting interests

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and values, in order to ensure a balance between protection, conservation policies, and economic gain.

Limited research exists on the public's view of marine habitats, or their willingness to trade off conservation measures against competing uses of the open ocean. The public funds marine conservation, management and research through taxes, and derives welfare from direct and non-use (i.e. value derived from their existence) of deep-sea marine resources. The public, therefore, are legitimate stakeholders, with rights, responsibilities and obligations, who need to be involved in marine stewardship and governance.

ATLAS researchers under Work Package 5 have used 'choice experiments' to assess the trade-offs between protection of cold-water reefs and economic activities in Norway and Ireland. Representative survey samples of the population in both countries were conducted online and via workshops, with the aim of placing socioeconomics into the deep-sea conservation discussion.

The results, from a total of 546 respondents, showed similar preferences for protection. The Irish and Norwegian public expressed a clear willingness to pay for cold-water coral conservation in the deep sea, providing that the coral is an important habitat for fish. This was despite possible conflict with extractive and consumptive economic activities. People were willing to pay approximately €34 and €42 for a small and large increase in the size of protected areas, respectively, and approximately €88 if the area is an important fish habitat. Norwegian respondents valued pure existence of cold-water corals more than Irish respondents, while the Irish were less willing to trade off industrial activities than Norwegians.

The results also suggested a strong public endorsement of ecological considerations, whereby priority is afforded to cold-water coral which supports fish well-being. Inclusion of ecological considerations supports broader ecosystem-based management, which would require reform and trade-offs between ecosystems services to support integrated ocean management. It also aligns with scientific efforts to secure biodiversity conservation across large marine spatial areas and jurisdictions, which is reflected in the Convention on Biological Diversity's goal of 10% protection of marine and coastal areas worldwide.

Although most of the public will never directly experience deep-sea marine ecosystems, they are willing to pay to protect these environments, and their views on greater protections should be taken into account.

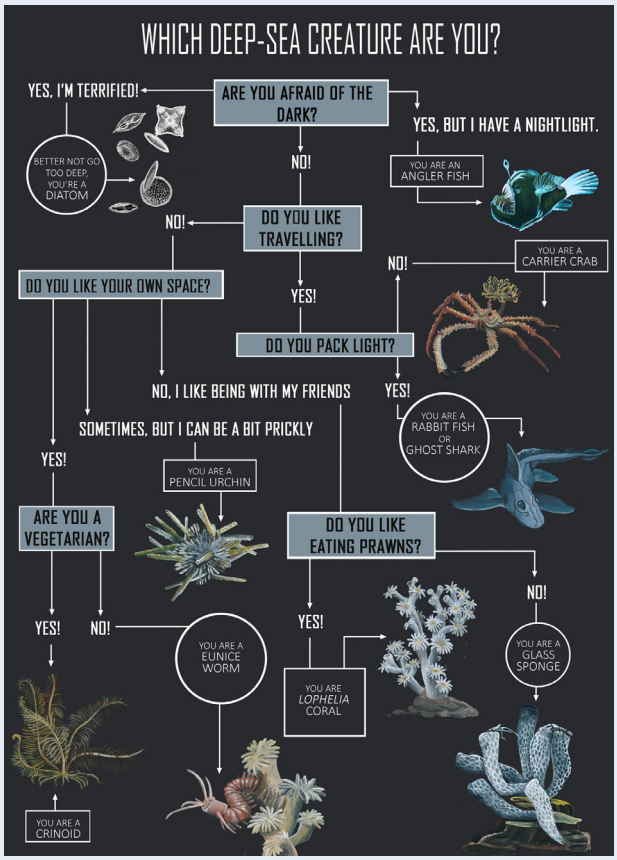
You can learn more about this work in the full journal article published in Conservation Biology: doi.org/10.1111/cobi.13380

OUTREACH AND PUBLIC ENGAGEMENT

Irish Ocean Literacy Network, Dublin Zoo

Supporting Ocean Literacy in Ireland, **ATLAS** Outreach and Educational resources were presented at the Irish Ocean Literacy members meeting in Dublin Zoo on 29 November 2019. Annette Wilson (AquaTT) presented an overview of **ATLAS**' Ocean Innovations and demonstrated **ATLAS** materials that IOLN members could use for their own outreach initiatives. You can learn more about the IOLN on their website at irishoceanliteracy.ie or via Twitter @IOLNetwork.

Sigi Gruber and John Hanus, DG- MARE, enjoying some of the ATLAS Educational Outreach resources in Brussels © Laura Mc Donagh



You can download the new **ATLAS** deep-sea animal flow chart at **bit.ly/30JutHt**

CASE STUDY 11 – IMPLICATIONS OF ATLAS RESEARCH

ATLAS is built around 12 case studies that monitor a variety of ecosystems spanning the North Atlantic Ocean from Norway to the Eastern Arctic. **ATLAS** research on Case Study 11 (Flemish Cap – Flemish Pass) is now being used to advise and manage Areas Beyond National Jurisdiction (ABNJ). Here the IEO-VIGO **ATLAS** team tell us more.

Ecosystem Advice in Areas Beyond National Jurisdictions

*By: Pablo Durán Muñoz and Mar Sacau, **ATLAS** partners, IEO-VIGO.*

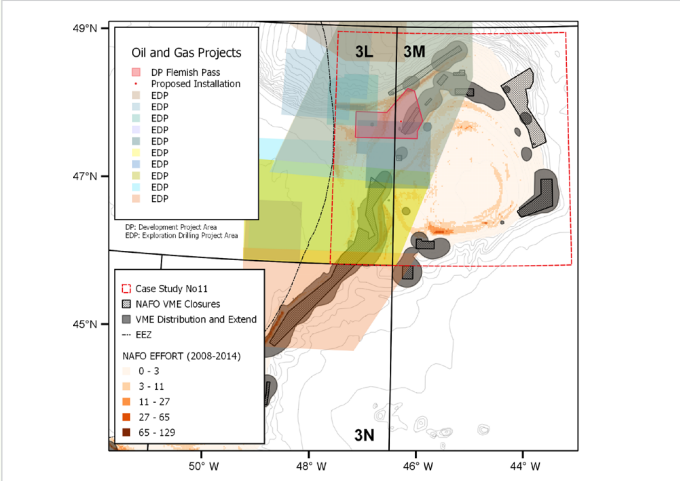
At IEO-VIGO, we are fully involved in the ecosystem advice tasks of the Northwest Atlantic Fisheries Organization (NAFO). This intergovernmental body provides advice and management for the Northwest part of the Atlantic Ocean in Areas Beyond National Jurisdiction (ABNJ).

In July 2019, we presented **ATLAS** results on Maritime Spatial Planning (MSP) at the NAFO Working Group on the Ecosystem Approach Framework to Fisheries Management (WGEAFFM) in Canada. We presented maps from **ATLAS** Case Study 11 showing the spatial overlap of footprints from human activities and ecosystem components, the existing or potential conflicts between users of the NAFO marine space and between Vulnerable Marine Ecosystems (VMEs), as well as preliminary results of our impact assessments.

Currently in the Flemish Pass, there is an oil and gas development project proposed that overlaps with the NAFO fisheries, VMEs, and areas closed to bottom fishing to protect cold-water corals and sponges. This paradigmatic example of potential spatial conflict by users, highlights the need for well advised and strong governance measures.

IEO-VIGO team at the NAFO headquarters © NAFO

The Working Group acknowledged the value of our results in compiling scientific advice for the NAFO Commission, and in September 2019, the Commission recommended that our research in the NAFO area continue. Specifically, they recommended that **ATLAS** results on the potential impact of human activities, other than fishing, be considered to develop new *NAFO Ecosystem Summary Sheets*. This is now complete and supports the next steps in implementing **ATLAS** research in ocean management and governance.



Several oil and gas proposed projects in NAFO Regulatory Area showing overlaps in high seas fisheries, VMEs and fishing closures implemented for VME protection © IEO-Vigo

Continuing with our advisory work, in November 2019, we attended the 12th NAFO Working Group on Ecosystem Science and Assessment (WGESA) in Canada and presented our new data from Spanish and European bottom trawl groundfish surveys in the NAFO Regulatory Area in 2019 including new cold-water corals Species Distribution Models.

These surveys (co-funded through the European Maritime and Fisheries Fund) are essential in providing accurate scientific advice for the Common Fisheries Policy in ABJN and for the re-assessment of VME closures that will be conducted in 2020. We reported on current challenges facing Marine Spatial Planning (MSP) in the NAFO area, such as difficulties in assessing cumulative impact, tension between different regulatory and jurisdictional frameworks that affect fisheries and hydrocarbon activities in ABNJ, and the lack of an appropriate authority needed to undertake MSP.

Data from the trawl surveys also provided vital information on seabed litter. WGESA recommended that protocols for collecting marine litter data should be drafted from our research and be implemented by all NAFO Contracting Parties in their groundfish surveys, and our results on seabed litter were included in new *NAFO Ecosystem Summary Sheets.*

You can learn more about this work in the full journal article by Durán Muñoz et al. (*in press*), Marine Policy (doi.org/10.1016/j.marpol.2019.103712).

POLICY SPACE

Policy Implications of ATLAS research and results

By: Phil Turner (Seascape Consultants Ltd, UK).

Since the beginning of the project, **ATLAS** partners have supported both national and international policy development, ensuring the latest scientific knowledge is available to decision-makers. Within the international policy arena, **ATLAS** has been represented throughout the United Nations BBNJ (Biodiversity Beyond National Jurisdiction) negotiations, provided input to the development of deep-sea mining regulations by the International Seabed Authority, and partners have participated in regional workshops organised by the Convention on Biological Diversity to describe Ecologically or Biologically Significant Marine Areas (EBSAs).

Celebrating the policy-relevant legacy of **ATLAS** and key management recommendations, **ATLAS** partners Phil Turner and David Johnson (Seascape Consultants, UK) are preparing the **ATLAS** science-policy report (Deliverable 7.8). The report will highlight (i) where **ATLAS** research has had an impact on policy development, (ii) upcoming policy initiatives that will benefit from **ATLAS** research and (iii) the key management recommendations from **ATLAS.**

For more information, please contact Phil Turner at: phil.turner@seascapeconsultants.co.uk

INDUSTRY CORNER

WP6 'Supporting Blue Growth' Industry Workshop in Dublin, Ireland

By: Anthony Grehan (NUIG, Ireland), Kate Larkin (Seascape, Belgium), Lea-Anne Henry (UEDIN, Scotland)

On 11 December 2019, the H2020 **ATLAS** project, in collaboration with the Marine and Renewable Energy Research, Development and Innovation Centre (MaREI)/RPS Ireland and the Irish Offshore Operators Association (IOOA) held a workshop in Dublin to address aspects of maritime spatial planning that could benefit industry and support Blue Growth. The workshop focussed on demonstrating enhanced planning decision support tools that better represent the complexity of the marine environment, enabling improved access to data for more cost-effective environmental impact assessments, and the options available to industry to mitigate impacts.

The workshop was attended by representatives of the oil and gas industry from Ireland and Norway, engineering and environmental consultancies, Irish Government officials, and academics. **ATLAS** project partners from the National University of Ireland Galway (NUIG), University of Edinburgh (UEDIN), Seascape Belgium (SBE), British Geological Survey (BGS) and University of Bremen (UniHB) were among the presenters. **ATLAS** partners, Marine Scotland Science (MSS) and Seascape Consultants UK (SC) also attended.

ATLAS-supported open-source resources and services were promoted as a means by which industry could engage with, and benefit from data sharing. These included OpenAire (openaire.eu), Zenodo (zenodo.org), EMODnet (emodnet.eu) and GeoNode (atlas-horizon2020.eu). Industry representatives expressed a desire to see greater connectivity and interoperability between marine data to increase their impact and use and to streamline the process of marine data discovery, uptake and exploitation. While some financial, work culture and data ownership barriers still exist, there is a new recognition in industry of the benefits of sharing (non-commercial) data in open-access portals such as EMODnet.

Top left: Tom Woolley (Irish Department of Housing, Planning and Local Government) explaining the thinking behind the Irish Marine Planning Framework ; top right, Oisín Callery (NUIG) kicking off the workshop with an overview of our MSP research including the development of novel decision support tools; bottom row: Joana Gafeira (BGS) and Kate Larkin (EMODnet/SBE) leading the session on data open access and sharing with industry. © Anthony Grehan

The **ATLAS** GeoNode was presented as a pragmatic clearing house solution to enable sharing of data prior to quality checking (e.g. for INSPIRE metadata compliance) and publication through EMODnet.

Tom Woolley from the Irish Department of Housing, Planning and Local Government was welcomed and provided an insight into the development of the Irish Marine Planning Framework that is currently out for public consultation. The Department expects to publish its Marine Planning and Development Management Bill in late 2020, ahead of the EU MSP Directive deadline in 2021.

Finally, the chair of the Irish Offshore Operators Association drew attention to the scale of the challenge to decarbonise our society given the dependence on fossil fuels, and fossil fuel-derived products, in our individual daily lives. He noted the industry has a key role to play in the transition to a low carbon future. In addition to focusing on net-zero developments, the industry experience of working offshore could be an invaluable resource for the nascent offshore renewable industry and Oil & Gas companies are leading the research into subsea carbon capture and storage solutions.

FAREWELL FROM ATLAS

Final ATLAS General Assembly

Finishing where it all started, **ATLAS** partners will gather for the final project meeting in Edinburgh from the 8-12 March 2020. The meeting will be held in the beautiful Playfair Library at the University of Edinburgh's centrally located Old College, and will include two days of plenary presentations, followed by a writing workshop at the spectacular Dalhousie Castle and some typically Scottish activities! For more information and to join the meeting, please contact Julia Eighteen, **ATLAS** Project Manager, **eu-atlas@ed.ac.uk.**

Frontiers in Marine Science Research Topic

Enhancing **ATLAS**' legacy and deep-Atlantic Ocean research, 14 new articles have been published by **ATLAS** partners and collaborators in the Research Topic 'Managing deep-sea ecosystems at ocean basin scale', in the journal Frontiers in Marine Science. The Topic has had nearly 30,000 views and 4,000 downloads. The current call for submissions closes 29 February 2020!

ATLAS RECENT PUBLICATIONS

Since May 2016, ATLAS partners have published 82 research articles! Below is a selection of the most recent ATLAS publications.

Armstrong et al (2019) **Valuing Blue Carbon Changes in the Arctic Ocean.** Frontiers in Marine Science 6, 102.

de Froe E et al (2019) **Benthic Oxygen and Nitrogen Exchange on a Cold-Water Coral Reef in the North-East Atlantic Ocean.** Frontiers in Marine Science 6, 665.

Durán Muñoz P et al (2019) **Cold-water corals and deep-sea sponges by-catch mitigation: Dealing with groundfish survey data in the management of the northwest Atlantic Ocean high seas fisheries.** Marine Policy, 103712.

Stefanoudis P et al (2019) **Depth-dependent structuring of reef fish assemblages from the shallows to the rariphotic zone.** Frontiers in Marine Science 6, 307.

Rovelli L et al (2019) **Benthic primary production and respiration of shallow rocky habitats: a case study from South Bay (Doumer Island, Western Antarctic Peninsula).** Polar Biology 42, 1459-1474.

Vad J et al (2019) **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.** ICES Journal of Marine Science fsz 185.

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ATLAS - Deep Discoveries

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