



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

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project news



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ATLAS is a four-year research and innovation project that aims to advance our understanding of the 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).

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WELCOME FROM THE ATLAS COORDINATOR



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

At the end of June 2019, **ATLAS** went through its second major external review at the European Commission and I want to start this newsletter by thanking our reviewers for the time and dedication they've given to our project. The feedback at both our reviews has been insightful and constructive and is really appreciated by all of us.

I also find it hard to believe that **ATLAS** ends in just 9 months. At the Project Office we are working hard to make sure our final months are as productive as possible. We have now set the date for our final General Assembly and will use this meeting not only to showcase our findings but to arrange focussed writing groups to work on final deliverables and manuscripts for publication. Stay tuned for details.

This 6th newsletter does a brilliant job of illustrating just what a diverse and ambitious transatlantic project **ATLAS** has become. You can read here about topics ranging from the exciting discovery of cold-water corals growing in remarkably low oxygen waters off the African coast through to our 2-year collaboration with Canada to study sponge field ecosystems in Davis Strait.

Our work on the sponge grounds in Davis Strait is a superb example of the Galway Statement on Atlantic Ocean Cooperation in action. These expeditions worked so well because they pulled together a team from Canada, Europe and the USA with both the expertise and equipment to monitor this poorly understood ecosystem with benthic landers for a full year!

The Davis Strait expeditions, like all the work **ATLAS** undertakes, is all about the hard work and dedication of the people involved. I hope everyone across the **ATLAS** consortium has had a good summer and is ready for our final push through to April 2020.

Murray.Roberts@ed.ac.uk



HIGHLIGHTS AND HEADLINES

Save the Date!

We are delighted to announce that the final **ATLAS** General Assembly will take place from 8 to 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 writing workshops and some typically Scottish activities!

Girl Power - Women in STEM

Celebrating the International Day of Women and Girls in Science on 11 February 2019, **ATLAS**-partners Mar Sacau and Ana García-Alegre (IEO-Vigo, Spain) welcomed women and girls into the IEO-Vigo lab facilities in Spain for a series of inspiring talks and activities. Promoting gender equality, the event showcased work carried out in **ATLAS** by female researchers and scientists.

CleanAtlantic Workshop

ATLAS researchers from IEO-Vigo (Spain) have been working with the CleanAtlantic project, to study marine litter in Case Study 11 - Flemish Cap. The team recently presented their work on *New tools for monitoring marine litter* at the Centro Tecnológico del Mar (CETMAR) in Vigo. For more information on this collaboration, please see: www.cleanatlantic.eu/workshops.

Update from Frontiers, Research Topics

Bringing together **ATLAS** partners and deep-sea researchers from outside the consortium, J. Murray Roberts (UEDIN, UK) and Telmo Morato (IMAR-UAZ, Portugal) are co-editing the Frontiers in Marine Science Research Topic 'Managing deep-sea ecosystems at ocean basin scale', in the journal Frontiers in Marine Science. The journal was awarded a whopping **3.086** for its first Impact Factor in June 2019. The current call for submissions closes 30 September 2019! For more information, please see: <https://bit.ly/2Nztp2w>

All-Atlantic Ocean Research Forum

Political and community leaders, researchers, industry, youth ambassadors and inspirational speakers from around the Atlantic will come together from 6-7 February 2020 in Brussels to celebrate international policy achievements since the signing of the Galway Statement (2013) and the Belém Statement (2017). Don't miss this great opportunity to showcase **ATLAS'** contribution to this Atlantic Journey. For more information, please see: <https://bit.ly/2LEgJcG>

We are always eager to hear about your exciting research results and stories! Please send your news to atlas@aquatt.ie

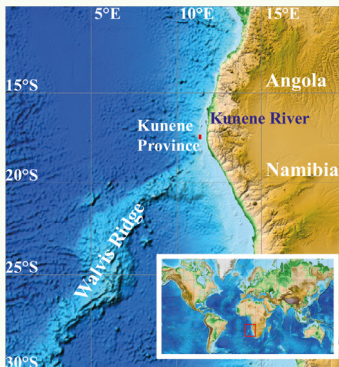


ATLAS NEWS AND STORIES

Cold-water coral growth—How much oxygen is really needed?

By: Laura Korte, Furu Mienis, Marc Lavaleye, Gerard Duineveld (NIOZ, the Netherlands)

In February 2019, **ATLAS** researchers from research institutes NIOZ, the Netherlands, and MARUM, Germany, participated in the Research Vessel *Pelagia* cruise 64PE450 to study living cold-water corals in low oxygen waters of the Southern Atlantic Ocean off the African coast (see map below).



Map of the Kunene Province, off the Angolan and Namibian coasts © ETOPO1 (Amante & Eakins, 2009).

The team set off to find out the threshold of oxygen concentration along the anoxic-hypoxic gradient where cold-water corals are still able to survive despite low oxygen concentrations. They were inspired by high densities of cold-water coral reefs of *Lophelia pertusa* found living in low oxygen concentrations (5.6 O₂ ml L⁻¹) off Angola in

2016 (Meteor cruise M122) and fossil cold-water corals found off Namibia, south of the Walvis Ridge, where oxygen concentrations were even lower (i.e. anoxic).

The newly discovered Kunene Coral Mound Province, named after the boundary river between Namibia and Angola, is located slightly south of the border and between the two sites surveyed in 2016. The province covers an area of 111 square kilometres and lies in water depths of between 230 and 290 metres. The site is characterised by low oxygen concentrations, and measurements by the team displayed values of ~0.6 O₂ ml L⁻¹.

The team surveyed the area using a multibeam echosounder that revealed small sea mounds of relatively low heights, extending up to 15 metres from the seafloor. Samples from the seabed confirmed that the mounds were formed by corals.

Underwater video footage further established the presence of coral and revealed dead *L. pertusa* fragments, but also small scattered colonies of living coral (see photos below). Adding to the surprise, communities of benthic fauna, dominated by sponges, bryozoans, ophiuroids and polychaetes, were also found living in these very poor oxygen conditions.

The oxygen values detected at this site are well below the values globally considered to be the oxygen survival limit for living *L. pertusa*, leading the team to believe that the corals can indeed survive in much lower oxygen levels than previously anticipated. Prior to this finding, only giant fossil reefs off Mauritania have been found living in such low oxygen environments.

Cold-water corals and their ecosystems are threatened by further expansion of the ocean's low oxygen zones, but these findings suggest that the corals may be able to compensate for the unfavourable oxygen conditions with other environmental parameters, such as food availability.



Photos from video footage showing small white colonies of living cold-water coral *Lophelia pertusa* within coral rubble and dead coral framework in the Kunene Coral Mound Province off Namibia found under very low oxygen conditions ©NIOZ RV Pelagia cruise 64PE450

Reference: Amante, C. and B.W. Eakins, 2009. ETOPO11 Arc-Minute Global Relief Model: Procedures, Data Sources and Analysis. NOAA Technical Memorandum NESDIS NGDC-24. National Geophysical Data Center, NOAA. doi:10.7289/V5C8276M [last access date May 28, 2019].

Risks to ecosystem services in the deep sea

By: Claire W. Armstrong (UiT, Norway), Godwin K, Vondolia (UiT, Norway), Naomi Foley (NUIG, Ireland), Lea-Anne Henry (UEDIN, UK), Katherine Needham (University of Glasgow, UK) & Adriana Ressurreição (MARE, Portugal)

Complex ecosystems formed by cold-water corals and sponges, seamounts and hydrothermal vents in the deep sea not only support unique and endemic species, but also provide many ecosystem goods and services to human wellbeing (see Figure 1). However, these habitats and the associated services have degraded due to resource exploitation from industries such as fisheries, oil and gas. They are further challenged by climate change effects such as increasing water temperatures and ocean acidification.

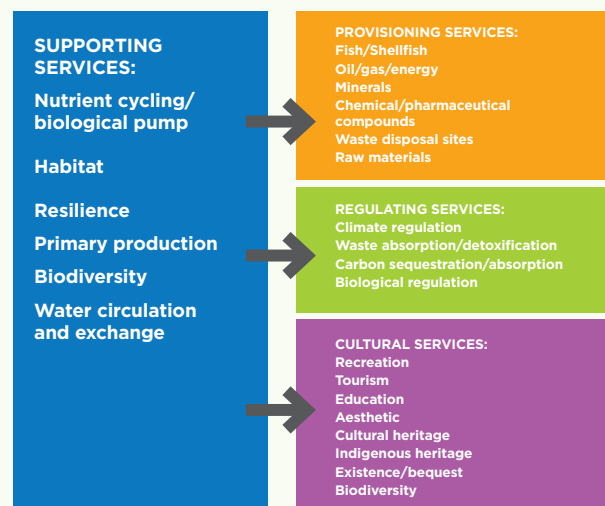


Figure 1 Ecosystem services in the deep sea, using the Millennium Ecosystem Assessment framework (Armstrong et al. 2019).

continued on next page

Recently, the European Commission, under its Blue Growth Strategy, has been seeking to support sustainable growth in the North Atlantic across five sectors of the Blue Economy: aquaculture, maritime and coastal tourism, blue biotechnology, ocean energy, and seabed mining.

However, the balance between societal needs and environmental sustainability required for sustainable Blue Growth poses challenges to economic and policy agendas. One way to approach this and consider this

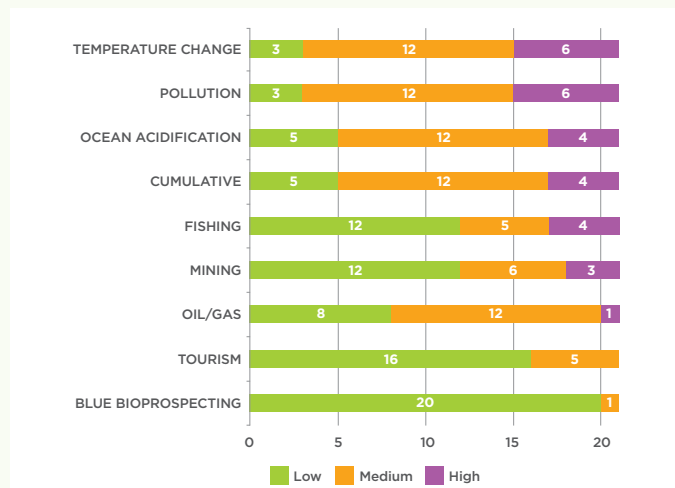


Figure 2 Human drivers risk levels upon ecosystem services from the assessment of negative effects of human drivers on ecosystem services (Armstrong et al. 2019). The x-axis represents the number of ecosystem services within each risk category (low, medium and high).

delicate equilibrium is to assess the potential impacts or risks posed by different human activities on deep-sea ecosystem services.

ATLAS researchers under Work Package 5 are doing just that, using the ‘Delphi approach’—an iterative expert-based survey process which assesses risks to

deep-sea ecosystem services in the North Atlantic Ocean including climate change, the Blue Economy, pollution, fisheries, oil and gas, and their cumulative effects.

The results indicate that pollution and temperature change pose a high risk to almost a third of deep-sea ecosystems services, while almost a fifth are at high risk from ocean acidification and fisheries. The study found that the projected negative impacts from temperature change and ocean acidification, fishing, pollution, and oil and gas activities are overwhelmingly more probable than the projected positive impacts (Figure 2). The study also found that ecosystem services were not seen to be at serious risk from tourism and blue biotechnology.

The services to human wellbeing considered to be most at risk to anthropogenic activities were biodiversity and habitat as supporting services, biodiversity as a cultural service, and fish and shellfish as provisioning services.

Achieving sustainable exploitation of deep-sea resources is challenged by the considerable uncertainty around the many risks posed by human activities. However, this study contributes to blue growth development and marine spatial planning in the deep-sea by identifying human activities and climate change effects that may have an impact on ecosystem services and provides guidance on future research priorities for the Atlantic deep sea.

So, why should we specially assess risks to ecosystem services in the deep sea, rather than environments, ecosystems, ecosystem functions, or ecosystem services in coastal areas?

To find out why and to learn more about this work, please see the full article in the latest issue of *Frontiers, Research Topics: Managing Deep-sea ecosystems at Ocean Basin Scale*: <https://bit.ly/2LdzUcV>

YOUNG SCIENTIST CORNER



Name: Dr Grant Campbell
From: Aberdeen, Scotland
Education: Cranfield University (PhD), University of Aberdeen (B.Sc. Geography)
Current role: Spatial Ecologist, Marine Scotland

Welcome to ATLAS, Grant! You were a soil scientist in a past life - what brought you to ATLAS and the deep sea?

I’ve always had an interest in Geography and Environmental related issues, particularly the interaction of human, physical and environmental sciences, ever since my secondary school days. This led me to undertaking my undergraduate degree at Aberdeen University from 2009–2013 and then

onwards to my PhD at Cranfield University from 2014 to 2018. My PhD involved mapping and modelling soil properties at 2D and 3D scales using an approach called Digital Soil Mapping, which provided me with a transferable skill set in modelling, GIS and spatial statistics—applicable to soil science and the deep sea. I am honoured to be part of the EU **ATLAS** project at Marine Scotland.

So what research questions are you interested in?

The project I am working on, which is in Work Package 6, looks at Maritime Spatial Planning, with a particular focus to systematically conserving marine species and ecosystem components for Rockall Bank in the Atlantic. My main research question is—How many species and environmental components of an area can we target to save, for the lowest possible cost? I am also keen to understand how these marine ecosystem environments are affected by issues such as oil and gas spills, fishing, and potentially climate change.

Why are you curious about that particular topic?

Protecting marine species and biodiversity is critical, especially to understand the ways our Earth evolves and develops. The impact on biodiversity loss and impacts with other important issues such as overfishing, and oil and gas exploration are topics which must be highlighted to drive action from policymakers and other stakeholders.

What have you discovered so far through your work in ATLAS?

I've found out an array of interesting stuff so far relating to how marine species such as fish, corals and sponges and environmental components react with one another in an area. The dynamic however that has interested me just as much has been this social/economical aspect, particularly regarding how multiple species and environmental ecosystem components can interact with one another, and also the impact that these may have if under threat from issues such as oil and gas extraction.

What do you think is the biggest challenge facing the deep sea? How will your work help address this challenge?

There are so many! The main challenges for me are overfishing, destructive trawling and exploration for oil, gas and minerals. It is critical that we continue to find ways as a community to minimise these problems in a manner that will protect as many species and marine environments as much as possible. Hopefully my work will help to inform stakeholders of the considerations that need to be taken into account in order to best protect our landscape, whilst also ensuring that other industries are not overly disadvantaged.

What would be your ATLAS highlight?

For me, this is easy – I was so inspired by the **ATLAS** General Assembly in Mallorca back in April 2019. Just getting involved and engaged in discussions with experienced, well-rounded, focused scientists and policy makers really whetted my appetite. Hopefully I will be able to put some of the advice I received into practice in the future.

Exciting times ahead! Grant, thank you for taking the time to tell us about your research within ATLAS! Best of luck for the future!

INDUSTRY CORNER

Data, data everywhere – ATLAS GeoNode makes it 'FAIR'!

By: Kate Larkin, Tim Collart & Pascal Derycke (Seascope Belgium)

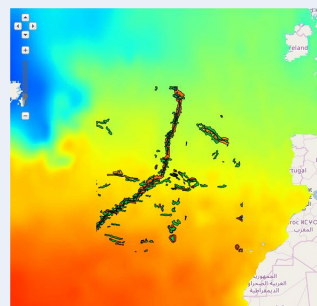
The global demand for oceanographic data, information and services is rapidly increasing. This has driven a rapid expansion in ocean data collection to support numerous sectors from science, industry and public authorities. However, to achieve a balanced and sustainable human interaction with our seas, ocean data and information need to be Findable, Accessible, Interoperable and Reusable (FAIR) across multiple parameters, spatial scales and resolutions. In Europe, this drive for open and free marine knowledge has led to the European Commission funding the European Marine Observation and Data Network (EMODnet).

Seascope Belgium is a marine and maritime consultancy that coordinates the EMODnet Secretariat and is a contributing partner to **ATLAS** Work Package 8 – Open Science Resources for Stakeholders. Seascope Belgium are facilitating the entry of **ATLAS** data into EMODnet and are also developing geo-spatial visualisation tools to enrich the **ATLAS** marine knowledge value chain. Through this work, **ATLAS** data will be more user-friendly for wider stakeholders, including those in industry, ocean governance and management.

Specifically, Seascope Belgium is using an open source geospatial content management system—GeoNode—to develop an online platform that focuses on users and facilitates collaborative use of geospatial data and maps. The GeoNode is designed around the 12 **ATLAS**

project case studies. It provides an online platform for enhanced exchange of information amongst **ATLAS** partners on data produced across the project, and it facilitates project development of area-based management plans (Work Package 6).

The **ATLAS** GeoNode is embedded in an Atlantic **ATLAS** community page, hosted on the EMODnet central portal. This promotes the **ATLAS** project to a wide range and number of stakeholders already visiting the EMODnet web services. It also ensures the long-term visibility and impact of **ATLAS** data beyond the duration of the project. This is vital to raise awareness among the marine and maritime community on the wealth of data and products produced by **ATLAS** and to make them FAIR. It also promotes the use of **ATLAS** data for a range of applications in marine management and conservation.



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

Discover more about Seascope Belgium's contribution to **ATLAS** in the presentation from the 4th **ATLAS** General Assembly: <https://bit.ly/2JxsViz> or check out the **ATLAS** GeoNode: atlas-horizon2020.eu.

An extended version of this article is also available on the **ATLAS** project website <https://www.eu-atlas.org/news>.

POLICY SPACE

Policy Brief on Marine Protected Area network design

By: Christopher Barrio Froján (Seascope Consultants Ltd, UK).

IODINE and Seascope Consultants Ltd, in collaboration with partners within the **ATLAS** project, have produced a policy brief on Marine Protected Area (MPA) network design to be circulated at the next session of the Intergovernmental Conference (IGC) to negotiate an international legally binding instrument under the United Nations Convention on the Law of the Sea (UNCLOS) on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ) (UNCLOS BBNJ IGC3, New York, 19–30 August 2019). The policy brief is part of the project's commitment to deliver **ATLAS** Work Package 7 on Policy Integration to Inform Key Agreements.

The brief introduces a notion of growing concern amongst scientists, conservation practitioners and decision makers, which is that of safeguarding nature conservation measures in light of changes brought about by climate change. Climate change is predicted to have certain broad-scale effects on ocean circulation patterns, sea-water chemistry and, consequently, the location and suitability of habitats for species. In turn, species have evolved their own mechanisms for dispersing as adults, juveniles and gametes (eggs or sperm), often in synchrony with hitherto predictable environmental cues. Cues to breed, disperse or settle can be anything from water temperature, salinity and oxygen concentration, to season, nourishment level or time spent dispersing.

Present-day conservation measures in the North Atlantic Ocean rely heavily on identifying and protecting areas of known importance for the survival of populations of interesting species, such as deep-sea corals, sponge grounds, fish nursery areas, bird feeding

areas and areas of high biological productivity. It is now feared that with the disruption of environmental cues and conditions brought about by climate change, many of the areas currently under some form of environmental protection will not be fit for purpose, as they will no longer accommodate the conditions that are favourable to the species they are intended to protect.

Informed conceptual models of how environmental conditions are likely to change under different climate change scenarios are enabling scientists to identify areas that may be resilient to change or that may offer new suitable habitat for displaced and disrupted species. To complicate matters, however, not all species will likely be able to adapt their reproductive and dispersal behaviours; many could be left stranded or may be unable to disperse for long enough or far enough to breed, feed or settle in a new refuge. Designing networks of numerous, dynamic and strategically ephemeral marine protected areas that optimise the probability of species adapting to climate change is at the forefront of conservationists' efforts to safeguard their future.

Lastly, to mitigate any potential shortfall in the efficacy of such a network of marine protected areas, a paradigm shift in ocean management is proposed, from the current model of declaring marine protected areas in an otherwise exploitable ocean, to declaring discrete resource exploitation zones in an otherwise protected ocean. Whilst past exploitation activities cannot be reversed, any future activity beyond the present-day extent of those activities may require a precautionary approach with a proven demonstration that any benefits from the activity outweigh the environmental costs.

The policy brief can be found on the **ATLAS** website at: <https://www.eu-atlas.org/resources/atlas-library> (under Work Package 7)

International Marine Spatial Planning Forum

By: IEO-Vigo Team (Mar Sacau, Pablo Durán Muñoz, Ana García-Alegre Garralda)

ATLAS findings were recently brought to the 3rd International Marine Spatial Planning Forum (MSPforum) by IEO-Vigo in Vigo (Spain) in May 2019, with the aim of highlighting plans for increased hydrocarbon exploration and exploitation, which could potentially come into conflict with existing activities and uses of the marine space and the ecosystems, at the Flemish Cap (**ATLAS** Case Study 11).

The MSPforum was recently included in the joint MSPglobal initiative, launched by UNESCO's Intergovernmental Oceanographic Commission (IOC-UNESCO) and the European Maritime Affairs and Fisheries Commission (EC DG-MARE), aiming to develop new international MSP guidelines.



IEO-Vigo team in action at the MSPforum © IEO

For more information, please see: <https://www.msp-platform.eu/>

Making Strides Towards Social Innovation

By: Vikki Gunn & David Jonson (Seascope Consultants Ltd, UK).

The 3rd **ATLAS** science-policy meeting took place in Brussels on Wednesday 22 May 2019. The meeting aimed to link research and policy, establish an ongoing dialogue with stakeholders and potential users of **ATLAS** results, and to provide policymakers and stakeholders with timely and relevant scientific knowledge in support of policy developments.

A full report on the 3rd **ATLAS** Science-Policy meeting is now available on the **ATLAS** project website at: <https://www.eu-atlas.org/news/project-news>

ATLAS CRUISE NEWS AND CASE STUDY 10—DAVIS STRAIT

By: Graham Tulloch (BGS, UK) & Johanne Vad (UEDIN, UK)

ATLAS is built around 12 case studies that monitor a variety of ecosystems spanning the North Atlantic Ocean from Norway to the Eastern Arctic. In the summers of 2018 and 2019, **ATLAS** joined the ArcticNet expeditions onboard the **CCGS Amundsen in the Davis Strait**. Here we learn more about these expeditions and the emerging results from this case study.



Alex Ingle, Graham Tulloch (BGS, UK) and Johanne Vad (UEDIN, UK) sporting their **ATLAS** Beanies before boarding the **CCGS Amundsen**. © Alex Ingle

In late July 2018, Graham Tulloch (BGS, UK) and Sabena Blackbird (ULIV, UK) boarded the Canadian ice breaker, **CCGS Amundsen**, on a mission to deploy two benthic landers, gather video footage of fauna living in the strait, and collect water samples – no mean feat! This year, in Summer 2019, Graham was joined by Johanne Vad (UEDIN, UK) and photographer and filmmaker, Alex Ingle. Their mission began on the 23 June 2019 as the ship departed from St Anthony, Newfoundland and travelled all the way to Iqaluit, Nunavut, arriving on 5 July 2019.

In addition to successfully recovering the two landers, during this year's expedition, they also collected biological samples gathered by rock dredge, including a three kilogram *Geodia* sponge. This will allow the



'There's a polar bear on the port side!' © Alex Ingle

fauna seen in the gathered video footage to be identified at species level.

The team is particularly interested in the sponges in this area, as they are often present in high densities, creating precious sponge grounds for other animals including fish, crustaceans and echinoderms to inhabit.

The recovered landers house a number of instruments that will provide the team with information on water temperature at each location, as well as pressure, conductivity, oxygen concentration of the water and sediment volume and composition.

The team also witnessed some of the amazing Arctic scenery and iconic wildlife including seals, walrus and a polar bear! The amazing video footage captured by Alex, including images taken from the Canadian Coast Guards helicopter (see cover photo) will be included in the upcoming **ATLAS** movie!

You can read more about the expedition on the scientists blog here: <https://bit.ly/2ZsgsNc>.

Many thanks to **ATLAS** colleagues from the University of Edinburgh (UEDIN), Royal Netherlands Institute for Sea Research (NIOZ), University of North Carolina Wilmington (UNC-W), University of Liverpool (ULIV), Aarhus University (AU) and Fisheries & Oceans, Canada (DFO) and the ArcticNet programme who made this transatlantic collaboration possible. Special thanks to Alain Vezina, Karen Davison, Barry MacDonald and Ellen Kenchington (all DFO), Steve Ross (UNC-W), Dan Hanes, Graham Tulloch (BGS), Johanne Vad (UEDIN), Sabena Blackbird (ULIV) and the crew of the **CCGS Amundsen**.



Successful recovery of the **ATLAS** lander ©Alex Ingle

ATLAS OUTREACH & PUBLIC ENGAGEMENT

ATLAS Educational Outreach Portfolio

ATLAS partners Dynamic Earth (UK) have created a range of exciting educational resources, based on ATLAS science and results! These amazing materials are all free to download and are designed to be used by educators and the public to facilitate a wider understanding of deep-sea ecosystems.

Here is a short summary of some (not all!) of these cool new resources:

- **Reef Survey Pack**—consists of a reef floor mat, survey key and activity instructions to be used at public engagement events (available in English, French, German and Spanish).
- **Public Engagement Sheets** – these A3 sheets illustrate some important deep-sea topics and include instructions that explain how to run activities on ‘Pressure in the Deep’, ‘Hydrothermal Vents’ and ‘Technology used in deep-sea exploration.’
- **Activity Packs for Educators** – linked to European School curricula, these packs include activity sheets, kit lists and instructions on how to run short science experiments and feature a script for a school show!

For more information and to download the pack, check out the Education Tab on the **ATLAS** website <https://www.eu-atlas.org/education/education-packs>



Visitors at Dynamic Earth testing resources from the ATLAS Educational Outreach Portfolio © Dynamic Earth

P.S. We would love to receive photographs of the resources in use! Please send any images to Natalie Walls, ATLAS Science Engagement Officer, Dynamic Earth (Natalie.walls@dynamicearth.co.uk)

ATLAS RECENT PUBLICATIONS

Aanesen and Armstrong (2019) **Trading off co-produced ecosystem services – Natural resource industries versus other use and non-use ecosystem service values.** *Frontiers in Marine Science* 6, 102.

Boavida J et al. (2019) **Out of the Mediterranean? Post-glacial colonization pathways varied among cold-water coral species.** *Journal of Biogeography* 46, 915–931.

De Clippele L H et al. (2019) **The Diversity and Ecological Role of Non-scleractinian Corals (Antipatharia and Alcyonacea) on Scleractinian Cold-Water Coral Mounds.** *Frontiers in Marine Science* 6, 184.

Frajka-Williams E et al. (2019) **Atlantic Meridional Overturning Circulation: Observed Transport and Variability.** *Frontiers in Marine Science* 6, 260.

Johnson D (2019) **Protecting the lost city hydrothermal vent system: All is not lost, or is it?** *Marine Policy* 107, 103593.

Johnson D et al. (2019) **Rockall and Hatton: resolving a super wicked marine governance problem in the high seas of the Northeast Atlantic Ocean.** *Frontiers in Marine Science* 6, 69.

Kenchington E et al. (2019) **Use of species distribution modelling in the deep sea.** *Canadian Technical Report of Fisheries and Aquatic Sciences* 3296.

La Beur, L et al. (2019) **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).** *Frontiers in Marine Science* 6, 80.

Ramiro-Sánchez B et al. (2019) **Characterization and Mapping of a Deep-Sea Sponge Ground on the Tropic Seamount (Northeast Tropical Atlantic): Implications for Spatial Management in the High Seas.** *Frontiers in Marine Science* 6, 278.

Tinch R et al. (2019) **Economic valuation of environmental goods and services: a review.** *Journal of Environmental Economics and Policy*, 1–20.

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 ATLAS - Deep Discoveries

