RE: ATLAS Submission to the UK Government Sustainable Seas Inquiry

15th May 2018

Dear UK Environment Audit Committee,

In response to the Sustainable Seas Inquiry, we would like to offer the enclosed evidence addressing a subset of the specific questions listed within the Inquiry.

This evidence is submitted on behalf of the EU ATLAS Horizon 2020 Project, the Consortium of which includes 8 UK partners and is coordinated by the University of Edinburgh. The focus for ATLAS is the North Atlantic sea basin but two of the project's twelve case studies, Mingulay Reef and Faroe Shetland Channel, are located in UK waters. This submission has been coordinated by Seascape Consultants Ltd, a UK based SME and lead for the ATLAS Marine Policy Work Package. Partners from the Scottish Government have elected not to contribute to this submission on the basis of a potential conflict of interest.

Our submission includes expert advice from members of the ATLAS Project. Specific sections are not accredited to individual experts, instead all of the contributions have been combined into a single ATLAS Project response. The final draft was approved by contributors prior to submission to the Inquiry.

For more information on the ATLAS Project, please see the website https://www.eu-atlas.org, or contact Prof David Johnson david.johnson@seascapeconsultants.co.uk. Further information on ATLAS Case Studies can be found in Appendix 2, page 15 of this Submission.

If you require any further details about the enclosed submission to the Inquiry, please do not hesitate to contact me.

Yours faithfully,

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ATLAS Submission to the UK Government Sustainable Seas Inquiry

The EU ATLAS Project welcomes the opportunity to submit evidence to the Sustainable Seas Inquiry. Taking into consideration the European Parliament resolution of 16 January 2018 on international ocean governance: an agenda for the future of our oceans in the context of the 2030 SDGs (2017/2055(INI)); and the Government Office for Science 'Foresight Future of the Sea: a report from the Government Chief Scientific Advisor', we offer expert comments on a subset of the questions listed within the Sustainable Seas Inquiry.

Section 1: The impact of environmental changes and the legal framework protecting ocean biodiversity

What forms of pollution are most prevalent in the ocean, and what impact are they having?

The ATLAS Project is not directly researching the impacts of pollution but clearly some forms of pollution can impede blue growth opportunities. Detailed State of the Environment reporting on pollution, of relevance to UK, is delivered nationally by DEFRA (Charting Progress[1]), and regionally by the European Environment Agency[2] and OSPAR the Regional Seas Convention for the Protection of the North-East Atlantic[3]. In general terms, good progress has been made to tackle pollution in the North Atlantic from a range of hazardous substances (including oil pollution) and radioactive wastes. Eutrophication is persistent and may be linked to sediments, making it difficult to remediate in the short-term, even if tackled at source. The diffuse sources of nutrient enrichment make remediation of eutrophication more difficult. Different pollutants are more prevalent in different locations.

More recently recognised pollutants, such as plastics and noise, are of growing concern. Evidence for plastic pollution has been found within animals and surrounding water as deep as 2200 m in the North Atlantic (1). Noise pollution is able to travel 1000's of km through the deep-sound channel, whilst ocean acidification is set to reduce the ocean's ability to absorb sound pollution in the future (2). In the deep-sea locations being studied by ATLAS, climate change impacts (including ocean acidification) are having an impact far greater than pollutant loading (see below) but continued efforts are needed to meet agreed targets and reduce cumulative pressures.

What impact is climate change having on the ocean? What are the effects of ocean acidification now and in the future? How important is meeting the goals set out in the 2015 Paris Agreement on climate change for marine biodiversity?

Impact of climate change on our ocean: A major recent finding has been the detection of a long-term decline in the largest part of Atlantic Ocean circulation; since the 19th century, circulation has declined by around 15 % (3,4). The Atlantic Meridional Overturning Circulation (AMOC) transports warm, salty water to the North Atlantic where it gets very cold, sinks, and

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1 http://webarchive.nationalarchives.gov.uk/20141203170558/http://chartingprogress.defra.gov.uk/

2 http://www.eea.europa.eu/themes/water/interactive/by-category/status-of-water-quality

3 https://www.ospar.org/

flows back southwards and all around the world's oceans. Climate models have consistently predicted that the AMOC will slow down due to greenhouse warming, with estimates ranging from a decline of 10 %, to up to 50 % under the IPCC scenario RCP8.5. The weakening found in this recent study appears to be relatively extreme compared to that suggested by many models and is part of a long-term trend rather than a short-term oscillation. These findings may point to substantial future change.

Current and future weakening may trigger a variety of responses, including a small reduction in ocean carbon storage (7). Ocean carbon storage will also likely be reduced by warming of the surface ocean and ocean acidification. These combined effects will reduce the current value of the ocean as a sink of anthropogenic carbon. A weakening AMOC may also have direct impacts on marine ecology. For example, a reduction of deep-water formation may inhibit oxygen supply to the deep ocean. From analyses of past climate events, we know that a weakened AMOC can lead to changes in the depth and strength of deep ocean currents. These currents typically determine the locations and connectivity (and therefore resilience) of important deep-sea habitats, including very large cold-water coral reefs (8).

AMOC strength may also be related to surface ocean properties, such as temperature and salinity. Changes in surface ocean temperature are known to drive shifts in species distribution and abundance in the North Atlantic. For example, in recent decades species have typically moved northwards (some by around 1000 km) or deeper as temperatures have risen[4]. It is currently unclear how a weakening AMOC will impact the general trend for a warming North Atlantic over the next century. However, the overall effect of an ocean in which warming and changing circulation patterns is occurring is to force marine species to move.

Predicted impacts from changes in AMOC circulation highlight the importance of flexible approaches to marine management. For example, the best locations for the protection of certain species today are likely to change in the future. This will be true for both shallow water species and for deep-water species. The scientific uncertainty with regards to the detailed impacts of changing large-scale ocean circulation highlights the need to continue with ocean observing programs such as OSNAP[5] and RAPID[6], to improve our understanding of both the ocean's modern state and variability, as well as improving modelling of future change.

Further research from the ATLAS Project on the influence of changing ocean temperatures in the Atlantic includes examining the distribution of cold-water larvae under different environmental conditions and how this may affect the connectivity (7); processing of food resources by cold-water corals and sponges (8); biodiversity and biogeography in deep-sea ecosystems under current and future scenarios (9,10,11,12,13); and the assessment of Good Environmental Status in ATLAS European case studies. An analysis has also been made of the impacts of climate change on Atlantic Area-Based Management Tools (EBSAs, VMEs and MPAs (14))

Effects of ocean acidification: Marine ecosystems occurring between 200-3,000 m worldwide will face substantial reductions in pH in all oceans by year 2100 (11). These reductions in pH

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[4] https://www.eea.europa.eu/data-and-maps/indicators/northward-movement-of-marine-species-2/assessment

[5] http://www.o-snap.org/

[6] http://www.rapid.ac.uk/rapidmoc/

will have serious impacts on the fitness of organisms, the suitability of existing marine habitat, and the structure and composition of marine food webs. A reduction in pH will cause the aragonite and carbonate compensation depths (CCD) to become shallower; below these depths, aragonite and carbonate are more likely to dissolve than to form. This has serious implications for organisms that use carbonate (e.g. corals) and aragonite (e.g. some species of phytoplankton) in their bodies. Below the CCD, these organisms will have to expend more energy to maintain and build the mineral parts of their bodies; some species will not be able to survive in lower pH conditions as a result. The amount of suitable habitat will reduce for calcifying organisms, such as the reef-building cold-water coral *Lophelia pertusa.* Cold-water corals exposed to projected ocean acidification scenarios exhibit more disorganised calcification within their skeletons, compromising their structural framework. Dead coral skeleton, which forms a significant proportion of the reef framework and habitat for reef species, is 20-30 % weaker when exposed to projected ocean acidification conditions than dead coral kept in present-day conditions (15).

Ocean acidification will have impacts across the marine food web. Some species, for example the marine calcifiers, will struggle to survive (the 'losers'). When these species decline, others may be able to fill the niche they leave behind and be more successful than they were prior to ocean acidification (the 'winners'). Changes in the balance of species abundance and composition in marine communities (more 'winners', fewer 'losers') could have negative impacts on ecosystem function and ultimately the services the marine environment provides. For example, calcareous phytoplankton, such as coccolithophores, form large blooms in the North Atlantic and play important roles in carbon sequestration to the deep sea and climate regulation (16). Calcifying phytoplankton are also important contributors to the base of marine food webs; changes to the abundance and quality of phytoplankton will alter the diets for many marine species, even commercial fish species (17). Echinoderms (such as sea stars, sea cucumbers, brittle stars, sea urchins and sea lilies) are often the dominant group of large animals on the seafloor and can be a significant contribution to the diet of commercially important species such as American plaice (18). Echinoderms also incorporate carbonate into their bodies, and the growth of echinoderm larvae can be severely disrupted by lower pH (19). Although marine calcifiers are generally thought to be at risk from ocean acidification, some appear better able to adapt than others, with different life stages being more or less vulnerable (20). It is not always clear which species will be 'winners' and 'losers' in future ocean acidification scenarios, making the exact nature of ecosystem responses to ocean acidification hard to predict.

<u>Paris Agreement Goals</u>: Holding the increase in global average temperature to well below 2˚C above pre-industrial levels, and if possible below 1.5˚C, is an important step towards limiting climate change impacts on marine biodiversity. Detecting a reduction in AMOC circulation is a clear sign that warming is impacting global currents, with potentially serious effects on marine biodiversity. The invasion of warm-water species to traditionally colder areas, and the loss of cold-water species that are unable to adapt to warmer waters, will have serious impacts on biodiversity at all levels, from phytoplankton, through zooplankton, fishes, invertebrates and apex predators, such as sharks and humans.

Measures that limit the warming of the ocean provide a chance to conserve the marine biodiversity of the ocean in its current state, acknowledging that some loss to climate change has already occurred. It should also be considered that capping the increase in global average temperature will not immediately halt biodiversity loss from climate change; there may be a lag phase between meeting these targets and biodiversity loss, as ecosystems adjust to the new environmental conditions associated with higher global average temperature. It should be considered that not all species will be able to adapt to the new higher temperatures, even capped at 1.5˚C global average. It should also be remembered that these targets are global averages, and that some marine ecosystems will experience higher temperature increases than others; the magnitude and rate of biodiversity loss will be different in regions experiencing a greater or smaller rise in temperature. However, overall meeting the Paris Agreement Goals would be an important step towards conserving biodiversity from impacts of climate change.

What more should the Government do to hasten progress towards Aichi targets?

Progress towards Aichi Target 11: Conserving 10 % of coastal and marine areas by 2020 through protected areas, is a substantial challenge, particularly as these protected areas need to be "ecologically representative and well-connected"[7]. Establishing networks of Marine Protected Areas (MPAs) is an important component of meeting this target, and if MPAs are to be ecologically representative, deep-sea habitats need to be included. The 10 % to be conserved doesn't just apply to the UK Exclusive Economic Zone, but to all waters, including those within and beyond national jurisdiction. Achieving 10 % in areas beyond national jurisdiction will require international collaboration between signatories to UNCLOS, including the UK. Achieving 10 % within UK national jurisdiction will include coastal and marine areas in UK overseas territories; this means a considerable range of marine habitats will need to be included for the 10 % to be ecologically representative. Further consideration needs to be given to protecting marine areas in Overseas Territories to cover the range of marine habitats they represent, and how the UK can continue to contribute to protecting marine areas beyond national jurisdiction.

Designating well-connected MPAs is challenging, as the dynamics of ocean connectivity are currently poorly understood and the contribution of climate variability (e.g. North Atlantic Oscillation) is unknown. Recent work suggests that the existing network of deep-sea MPAs may be vulnerable to atmospheric-driven changes in ocean circulation (7). To strengthen MPA networks, and designate future MPAs, there needs to be a greater understanding of connectivity between sites, and how this may alter with climate change. For MPAs to be ecologically representative, there also needs to be basic information on the habitats and ecosystems present, which can only be achieved through extensive survey efforts.

One potential strategy to achieve connectivity and representativity in the face of uncertainty is to protect larger areas of seabed that are presumed to cover examples of all habitats within the region. The designation of large scale MPAs (100 000 km^2 or larger) can have considerable benefits, such as encompassing biologically connected and diverse ecosystems across depth gradients and topographical features, but there are also criticisms (21). For example, not all marine habitats can be protected through large spatial closures; in high use areas, a network of smaller MPAs may be more feasible than a single large MPA. Whilst large scale MPAs could help to reach the target of 10 % more rapidly, a range of area-based management tools, including networks of smaller MPAs, may be required to ensure ecological representativity and connectivity.

[7] https://www.cbd.int/sp/targets/

To ensure protected areas encompass areas of particular importance for biodiversity and ecosystem services, there needs to be a greater understanding of marine ecosystems in general. Deep-sea ecosystems are some of the least well-known, with fundamental knowledge gaps in aspects of biology and ecology, such as species' life history characteristics, species and habitat distribution, elemental cycling and energy transfer, and baseline environmental status. Large interdisciplinary international projects, such as ATLAS, are an important contribution towards addressing these knowledge gaps, providing some of the information needed to approach Aichi Target 11.

For specific protected areas and protected area networks to remain effective conservation tools, they also need to be monitored over time. If protected areas become degraded, new protected areas may be required, or larger buffers between protected areas and marine activities may be needed to prevent further degradation. These decisions can only be made based on information gathered during robust environmental monitoring programs. The UK Marine Biodiversity Monitoring Strategy document developed by JNCC[8] is a big step towards this, proposing a risk-based approach to develop monitoring options for both within and outside of protected areas. Having a monitoring strategy is particularly appropriate for the deep sea, where although monitoring is more expensive, the risk of not meeting reporting obligations is greater. A re-balancing of monitoring needs is encouraged (e.g. reducing emphasis on monitoring of commercial fish species), to ensure wider ecological representation within monitoring programs.

What outcomes and protections should the UK Government be pushing for at the forthcoming UN negotiations on the conservation and sustainable use of marine biological diversity in the world's oceans?

The UK Government should be pushing for a precautionary approach in marine environments where baseline information is still limited; this will include many areas of the deep sea, which are often poorly characterised. Protections for the marine environment should consider the regional and basin-scale variation in marine communities, and safeguard connectivity of species and habitats, for example through Marine Protected Areas and other Area-Based Management Tools.

ATLAS Partners are currently working with Industry interested in Environmental Impact Assessment for the deep sea and Area-Based Management Tools. ATLAS is also doing research on Atlantic biogeography, and species distribution modelling to help support sustainable deep-sea management. For the time being, UK input to the UN negotiations on the conservation and sustainable use of marine biological diversity will be coordinated by the EU but as negotiations progress, ATLAS deliverables have the potential to inform a national UK position. ATLAS has participated in the UN PrepCom process for developing the instrument on the conservation and sustainable use of biodiversity. ATLAS will follow the forthcoming negotiations and provide relevant policy briefs and side-events.

As a further contribution to the instrument on the conservation and sustainable use of biodiversity, the UK can support capacity building and technology transfer through investments in science excellence and new technology, including remote sensing for monitoring and enforcement of regulations.

[8] http://jncc.defra.gov.uk/pdf/Marine_Monitoring_Strategy_ver.4.1.pdf

Section 2: A sustainable blue economy

What could the UK do to promote a sustainable marine economy and achieve sustainable marine and coastal ecosystems management in the Overseas Territories?

A sustainable marine economy relies heavily on a healthy marine environment. Understanding current environmental status and having the ability to monitor and predict changes in environmental status is an important part of maintaining a healthy marine environment. Achieving Good Environmental Status (GES) within European Waters by 2020 is the main goal of the Marine Strategy Framework Directive, and has been underscored by a series of 11 descriptors[9]. As the UK moves to separate from the EU, the pressure to achieve GES may no longer apply. However, ATLAS would encourage the UK Government to continue to strive towards these goals, even if it needs to be under a new national framework. Providing the support and expertise for Overseas Territories to achieve GES (or the new equivalent) would be a big step towards promoting a sustainable marine economy and sustainable ecosystems management within the waters of Overseas Territories.

ATLAS is closely examining GES through a series of case studies and is addressing the selection of appropriate indicators to describe current status in biodiversity, fisheries, seafloor integrity and marine litter. Use of these indicators will lead to greater understanding of Atlantic deep-sea ecosystems and help inform marine spatial planning and sustainable Blue Growth. Experience from the ATLAS Project could inform the process of seeking the equivalent of GES for Overseas Territories.

Section 3: The impact of marine industries, science and innovation, and blue finance

What is the environmental impact of marine industries, such as deep sea mining, and how effectively does the Government and the International Seabed Authority regulate them to mitigate their environmental impact?

Environmental impact of deep-sea mining: Commercial exploitation of deep-sea minerals has not yet occurred, making it difficult to predict the environmental impacts. The methods used for extracting minerals from the seabed will be different for each mineral type, leading to different types and scales of impacts (22). Impacts will occur at the mine site but also for 10's of km beyond this through the spread of suspended particles (plumes) disturbed by mining.

Polymetallic nodule mining will have the greatest spatial extent of impact, with each mine expected to disturb in the order of 120 km^2 of seabed per year and mine life may be 30 years or more. To date, there is 1 contract in the Indian Ocean and 16 contract areas approved for exploration by the International Seabed Authority (ISA) in the Clarion Clipperton Zone of the Pacific[10]. If each of these contract areas progress to exploitation, the scale of impact will be orders of magnitude larger than any mining on land. The soft sediment disturbed by mining will create large plumes that could travel considerable distances. Natural sedimentation rates in nodule areas are very low and the additional sedimentation from plumes will smother seafloor organisms. Nodules occur in a relatively stable seafloor environment; the organisms that live there are not adapted to the acute and chronic habitat alteration that will occur

[9] http://ec.europa.eu/environment/marine/good-environmental-status/index_en.htm
[10] https://www.isa.org.jm/contractors/exploration-areas

during mining activity. Some organisms may only occur on nodules, these species will not be able to recolonise once their nodule substrate is removed. The few studies investigating recovery indicate it will take decades if not centuries for these seafloor communities to re-establish, if they are able to recover at all (23).

Cobalt-rich ferro-manganese crust mining will occur on a smaller scale, removing in the order of 20-60 km^2 of seabed per year per mine. This is still considerably larger than the spatial extent of any terrestrial mines. To date, there are 5 exploration contract areas approved by the ISA; 3 in the Western Pacific, 1 in the Pacific, and 1 on the Rio Grande Rise[11]. Crusts form slowly over thousands of years on exposed, current-swept hard surfaces. Many crust deposits occur on seamounts, which support diverse seabed faunas and deep-sea fisheries (24). Fragile suspension feeders, such as corals and sponges, are common on seamounts and are particularly at risk from physical disturbance and smothering. These organisms are very slow growing, so that recovery from mining will take decades if not centuries. It is not known if crust deposits support unique species; research to date suggests the animals living on crusts are also found on other hard seafloor in the region (25).

Polymetallic Sulphide (also known as Seafloor Massive Sulphide) mining will have the smallest physical footprint on the seafloor, with mines expected to be of a similar size to terrestrial mines. For example, a deposit offshore of Papua New Guinea known as Solwara 1 has a footprint of 0.112 km^2, although plume impacts may spread for several km beyond this (26). To date, there are 7 exploration contract areas approved by the ISA; 3 on the Mid-Atlantic Ridge, 2 in the Central Indian Ocean, 1 on the Central Indian Ridge, and 1 on the Southwest Indian Ridge[12]. Polymetallic Sulphide deposits form through hydrothermal activity, this activity supports unique ecosystems with endemic species that rely on hydrothermal fluid for survival. Mining could remove or degrade hydrothermal habitat, which would lead to localised biodiversity loss and could result in either regional extirpation or global extinction for some species. As a result of these concerns, some groups have called for all active hydrothermal habitat (and its associated vent fauna) to be protected from deep-sea mining (27). Fauna inhabiting sulphide deposits that are no longer hydrothermally active are also at risk from habitat loss, although very little is known about these organisms making recovery predictions uncertain (28). Fauna not inhabiting sulphide deposits but under the fallout from the mining plume are at risk from smothering and burial; the plumes from sulphide mining may also contain toxic compounds (29). Fauna colonising hard seafloor near the mined area include fragile, slow-growing suspension feeders that will take decades if not centuries to recover from mining.

Regulation to mitigate deep-sea mining impacts: The International Seabed Authority (ISA) is responsible for regulating deep-sea mining in areas beyond national jurisdiction. The UK government would be responsible for regulating deep-sea mining that occurred in any area under national jurisdiction. To date, commercial exploitation of deep-sea minerals has not occurred, and the ISA does not have regulations in place for exploitation. It would be premature to comment on how effectively the ISA regulates deep-sea mining to mitigate environmental impacts. Whilst the UK government has regulations in place for the marine aggregates and the oil and gas industry, it does not have regulations specific to deep-sea mining.

[11] https://www.isa.org.jm/contractors/exploration-areas
[12] https://www.isa.org.jm/contractors/exploration-areas

How is the deep-sea mining industry likely to grow in the years ahead? What environmental risks will this bring? What legal protections are in place to mitigate these risks? Are additional legal protections needed?

Growth of deep-sea mining industry: There are currently a total of 28 exploration contracts granted by the International Seabed Authority (ISA) in areas beyond national jurisdiction[13], including two nodules exploration contracts with UK Seabed Resources, sponsored by the UK Government. Any of these contractors could apply for an exploitation contract, and within 2 years the ISA would need to implement Regulations for Exploitation. This means commercial deep-sea mining could occur as early as 2020, although it is unlikely contractors would put in an application for exploitation before the Regulations are established. It is possible other UK companies may seek sponsorship through the UK government for contracts with the ISA for nodules, crusts or sulphides.

Seafloor Mining Tools and the equipment needed for a full mining system are being developed for sulphide and nodule mining by multiple companies and consortia. These include the once UK company SMD[14], which designed and manufactured equipment for mining polymetallic sulphides off Papua New Guinea by the Nautilus Minerals Inc. (SMD now has a Chinese owner). The EU Horizon 2020 Blue Nodules Project[15] includes one UK partner (Seascape Consultants) and is developing a deep-sea mining system for nodules. Further mining equipment could be built in the UK to supply the industry, although companies in many other countries are well advanced in developing designs and prototypes.

If the first contractors are successful, the technology is proven and returns are profitable, there could be an increase in the number of contract areas granted for both exploration and exploitation. In anticipation of this, the ISA has established a Regional Environmental Plan (REMP) for the Clarion Clipperton Zone nodule area (30) and has workshops planned for the development of REMPs in the Southwest Pacific for crusts and in the Atlantic for sulphides. Seascape Consultants is leading a project to develop a REMP for the Atlantic Ocean in collaboration with the ISA.

Deep-sea mining will probably occur first in the national jurisdictions of other countries. To date, the only commercial exploitation licence for deep-sea mining to be granted is through the Papua New Guinea Government for Nautilus Minerals Inc. to mine Solwara 1, a small polymetallic sulphide deposit in the Bismark Sea[16]. This project has been repeatedly delayed and is now not scheduled to begin until at least 2019. Mining is also likely to occur in some Commonwealth countries, such as the Cook Islands, where the Government of the Cook Islands already has a Seabed Minerals Act, Seabed Minerals Authority, Seabed Policy, and Seabed Minerals (Prospecting and Exploration) Regulations[17]. Staff within the Commonwealth Secretariat are very familiar with the development of Pacific Island Nations regulations for deep-sea mining and have a strong background in the environmental, legal and regulatory aspects of deep-sea mining.

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13 https://www.isa.org.jm/contractors/exploration-areas

14 www.smd.co.uk

15 http://www.blue-nodules.eu/

16 http://www.nautilusminerals.com/IRM/content/default.aspx

17 http://www.seabedmineralsauthority.gov.ck/

Environmental risks: Deep-sea habitats are relatively unknown, so that predicting the impacts of deep-sea mining is difficult. Studies have been conducted on hydrothermal vent ecosystems but there are substantial knowledge gaps for other deep-sea fauna. For sulphides, key areas for further research include the organisms colonising inactive polymetallic sulphides (areas that are no longer hydrothermally active but still have mineral deposits); and the background fauna (animals that are thought to exist elsewhere in the deep sea but live in greater densities around the periphery of hydrothermal vents). For all mineral resources, more information is needed on the ability of faunas to recover from mining impacts. A critical knowledge gap relates to mining plumes generated from different mineral resources: how large will plumes be, how far will they spread, will they be toxic, and what will be their impact on the water column and seabed fauna.

Legal protections in place: The ISA is currently developing Regulations for Exploitation, which are expected to come into force in 2020. The UK does not have national regulations specific to deep-sea mining.

Legal protections needed: Whilst the UK's EEZ is unlikely to contain sufficient mineral deposits to attract commercial seabed mining operations, there may be mineral resources in territorial waters. There are 17 hydrothermal vent fields within UK Overseas Territories: 4 in the Cayman Islands; 1 at Montserrat; 4 near Ascension; 6 near South Georgia and the South Sandwich Islands; 1 in the British Indian Ocean Territory; and 1 at Pitcairn. The details of these vent fields can be found in the freely available InterRidge Vents Database Version 3.4[18]. There may also be nodules and crust deposits in some Overseas Territories. Not all hydrothermal vents have economically viable polymetallic sulphide deposits and some may occur within protected areas. However, the existence of hydrothermal vents within national jurisdiction means there could be a need for the UK to develop national regulations for deep-sea mining, including environmental protection measures such as the establishment of Marine Protected Areas. As a signatory to UNCLOS, the UK will be obliged to adopt regulations for deep-sea mining in territorial waters that are at least as stringent as those implemented by the ISA.

What national or international measures could the UK pursue to minimise the impact of marine resource extraction, such as sand mining, aggregate dredging and deep-sea mining?

National and international measures to mitigate deep-sea mining impacts: The UK is contributing to the development of the International Seabed Authority (ISA) Regulations for Exploitation by making submissions on the draft Regulations. These Regulations will need to strike the balance between profitability and environmental protection and in some cases decisions may need to be made based on sparse environmental information. Minimising environmental impacts can include designing mining equipment to minimise damage, for example by limiting the formation of sediment plumes. However, any requirement for equipment to minimise environmental impact would need to be carefully written into the Regulations from the outset, as it may be very costly to change equipment designs at a later stage. The UK has substantial experience in regulating marine industries, such as aggregates and oil and gas, and has a lot to offer in the drafting of the Regulations. Involving leading

[18] http://vents-data.interridge.org/

figures from established regulatory bodies in any future UK submissions on the draft Regulations may facilitate further sharing of this regulatory insight with the ISA.

Providing submissions on the draft Regulations is the main phase where the UK can have input on the development of the Regulations and presents an opportunity to shape them in favour of UK priorities. Providing detailed, technical input at this stage could help strengthen environmental protection within the Regulations. There are a number of experts within the UK who could provide additional input to any future UK submission to the drafting process, including partners on the ATLAS Project. Seascape Consultants is part of the PEW Charitable Trusts CODE Project[19], which has produced two reports relating to the development of the Regulations for Exploitation. Individuals on the ATLAS Project are also members of the Deep-Ocean Stewardship Initiative Deep-Sea Mining Working Group[20], who have provided commentary on previous drafts on the Regulations and could offer cross-discipline expertise for any future submissions to the ISA.

Further information resources on Deep-Sea Mining can be found in Appendix 1, page 14.

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Appendices

Appendix 1: Further information resources on Deep-Sea Mining

There have been a number of EU-funded projects gathering information on the impacts of deep-sea mining, developing technological solutions to minimise environmental impacts, and moving towards strategic environmental management for mining:

- MIDAS: Managing Impacts of Deep-Sea Resource Exploitation. This 3-year project ended in October 2016. MIDAS consisted of 32 partners and was led by Seascape Consultants. The project issued a report of Recommendations for Future Regulations and a report of Research Highlights: http://www.eu-midas.net/
- JPI Oceans MiningImpact. This 3-year project ended in December 2017. MiningImpact consisted of 25 partners, including three UK institutions. The project produced various publications and resources relating to the long-term impacts of polymetallic nodule mining: https://jpio-miningimpact.geomar.de/publications
- Blue Mining: breakthrough solutions for sustainable deep sea mining. This 4-year project ended in January 2018. Blue Mining consisted of 19 partners, including three UK institutions. The project produced a series of public reports and resources: http://www.bluemining.eu/
- Blue Nodules: developing a deep-sea mining system for harvesting polymetallic nodules from the seafloor with minimal environmental impact. This 4-year project will continue until January 2020. Blue Nodules consists of 14 partners, including one UK partner (Seascape Consultants). The project will produce a series of public reports and resources: http://www.blue-nodules.eu/

The Deep-Sea Minerals Project was a collaboration between the Pacific Community (SPC) and the European Union (EU). This 4-year project ended in December 2016 and produced a series of resources, including a Regional Environmental Management Framework, Regional Legislative and Regulatory Framework, and four reports on the state of knowledge of Pacific marine minerals. The SPC-EU resources have a Pacific-focus but much of the information is applicable to deep-sea mining in other regions: http://dsm.gsd.spc.int/index.php/publications-and-reports

Appendix 2: The ATLAS Project

Overview

ATLAS will provide the first coherent, integrated basin-scale assessment of Atlantic deep-water ecosystems and their Blue Growth potential. To achieve this ambition, ATLAS is employing innovative methods and integrating data in new ways. By unifying ATLAS research from physical oceanography through ecosystem function, biodiversity, and connectivity, the ATLAS consortium sets out a uniquely data-led science plan as the foundation for its socioeconomic, spatial planning, and policy integration activities. Multi-way dialogue with stakeholders will transfer ATLAS outputs into policy-making to create a new platform informing both Blue Growth and research agendas. ATLAS will disseminate knowledge and data through systemic EU and global data infrastructure, and complement this with pan-EU and international public dissemination and outreach.

Work Packages

1. <u>Ocean dynamics driving ecosystem response.</u> Conducting key research to understand ocean circulation in the Atlantic, in particular climate change impacts on the Atlantic Meridional Overturning Circulation and implications these may have for ecosystem functioning, biodiversity and genetic connectivity.
2. <u>Functional ecosystems.</u> Developing predictive models to map Atlantic ecosystems, their species, and how they function at spatial scales relevant to environmental management. These models will enable predictions for how Atlantic ecosystems may respond to future environmental changes.
3. <u>Biodiversity and biogeography.</u> Conducting key research on the biodiversity and biogeographic patterns of sensitive ecosystems and species, and forecasting changes under future scenarios of water mass structure and ocean currents.
4. <u>Connected resources.</u> Providing new models to identify critical source areas of marine genetic resources, and exploring how these resources are connected on regional and basin-scale levels to understand their vulnerability to climate change and human activities.
5. <u>Valuing ecosystem services and Blue Growth potential.</u> Assessing the many ecosystems services the Atlantic area provides to society (supporting, provisioning, regulating, and cultural) will allow ATLAS to establish firm foundations upon which Blue Growth and conservation scenarios can be evaluated and balanced.
6. <u>Maritime spatial planning.</u> Developing an adaptive Atlantic Marine Strategic Planning approach within ATLAS, based on the Monitoring and Evaluation of Spatially Managed Areas framework, will enable stakeholders to explore and respond to various scenarios of ocean dynamics and cross-sectoral Blue Growth.
7. <u>Policy integration to inform key agreements.</u> Translating ATLAS' scientific findings to policy and practice will inform national and international agreements regarding Blue Growth and systematic conservation planning.
8. <u>Open science resources for stakeholders.</u> Integrating different data formats spanning national to small local systems into a coherent portal, the European Marine Observation and Data Network (EMODnet) makes environmental data and products from the ocean surface, water column and seafloor available to stakeholders.
9. <u>Dissemination, knowledge transfer and outreach.</u> Effective external communication, dissemination and knowledge transfer of ATLAS outputs will contribute to the Atlantic

Action Plan initiatives on Ocean Literacy and support development of the European Research Area and the Atlantic Ocean Research Alliance.

10. Co-ordination and management. Co-ordinating ATLAS involves supporting all ATLAS activities, convening meetings of the Steering Committee and Advisory Board, and ensuring ATLAS liaises with relevant transatlantic initiatives during the course of the project.

Case Studies

1. LoVe Observatory (Norway). A cabled ocean observatory outside Lofoten-Vesterålen on the seabed in northern Norway, an area known as the gateway to the Barents Sea.
2. Faroe Shetland Channel (UK). The Channel lies between the Faroe Islands and Shetland Islands, north of northern Scotland.
3. Rockall Bank (northern Northeast Atlantic). Rockall Bank is a shallow bank forming one of the western boundaries of the Rockall Trough, and lies northwest of Ireland and west of Scotland.
4. Mingulay Reef (UK). Mingulay Reef is located 14 km east of the Island of Mingulay in the Sea of Hebrides, western Scotland.
5. Porcupine Seabight (northern Northeast Atlantic). The Porcupine Seabight lies southwest of southern Ireland and just south of the Porcupine Bank.
6. Bay of Biscay (Northeast Atlantic). The Bay of Biscay lies west of France and north of Spain.
7. Gulf of Cadiz/Strait of Gibraltar/Alborán Sea (East Atlantic). The Gulf of Cadiz lies off the southwest coast of Spain, the Strait of Gibraltar occurs between Gibraltar and Morocco, the Alborán sea lies east of Gibraltar between north Morocco and south Spain.
8. Azores (Portugal). The Azores is a volcanic archipelago located along the Mid-Atlantic Ridge, off the west coast of Portugal.
9. Reykjanes Ridge (northern North Atlantic). The Reykjanes Ridge runs southwest from the southwest tip of Iceland.
10. Davis Strait (northern Northwest Atlantic). The Davis Strait joins two oceanic basins, Baffin Bay and the Labrador Sea, and separates western Greenland and Baffin Island. It connects to the Arctic Ocean in the north via the Baffin Bay and to the Atlantic Ocean in the south via the Labrador Sea.
11. Flemish Cap (Northwest Atlantic). The Flemish Cap is an oceanic bank east of Halifax, Canada. The Cap is separated from the Grand Banks by the Flemish Pass.
12. Mid-Atlantic Canyons (USA). The western North Atlantic between Cape Hatteras and Cape Cod is characterised by numerous and diverse submarine canyons that straddle the outer shelf and slope. The focus is on the area between Baltimore Canyon and Cape Hatteras, to include data from the Blake Plateau off the south-eastern USA.

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For more information on the ATLAS Project, please see our website: https://www.eu-atlas.org/