

Perspective on how the UK can make a successful research contribution to the UN Decade of Ocean Science

Introduction

All life on Earth depends directly or indirectly on the ocean, including both the coastal zone that represents the link to the land and the deeper offshore waters. The state of the ocean interacts with every aspect of sustainability via its role in climate regulation, biodiversity and ecosystem support, the provisioning of food and water, human health, well-being and culture, as well as contributing to renewable energy, tourism, transport and trade. The growing impacts of climate change and other human pressures on ocean health, including biodiversity, require urgent action that is underpinned by science to avoid irreversible damage and negative effects on people's lives and livelihoods around the globe*.

The [UN Decade of Ocean Science for Sustainable Development](#) (hereafter the Ocean Decade) challenges us to articulate “the science we need for the ocean we want” to deliver a clean, healthy and resilient, productive, predicted, safe, accessible, and inspiring and engaging ocean by 2030 (see Box 1), fully integrated with the [UN Sustainable Development Goals](#). The Ocean Decade emphasises the role of ‘[Ocean Literacy](#)’, which is not only about seeking to increase awareness of the importance of the ocean, but also about the tools and approaches necessary to transform ocean knowledge into actions that promote sustainability.

Decision makers can lack the critical scientific evidence to manage and mitigate the wide-ranging impacts of human activity on the ocean and its consequences for society. The Ocean Decade seeks to overcome this hurdle.



Image: James Cook JC156 voyage to the mid Atlantic ridge
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BOX 1

Desired UN Ocean Decade outcomes

1. A clean ocean where sources of pollution are identified and removed;
2. A healthy and resilient ocean where marine ecosystems are mapped and protected;
3. A predictable ocean where society has the capacity to understand current and future ocean conditions;
4. A safe ocean where people are protected from ocean hazards;
5. A sustainably harvested ocean ensuring the provision of food supply;
6. A transparent ocean with open access to data, information and technologies;
7. An inspiring and engaging ocean where society understands and values the ocean.

Source: IOC-UNESCO

* IPCC. Summary for Policymakers. In: *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*. [Internet] 2019. Available from: <https://www.ipcc.ch/srocc/chapter/summary-for-policymakers/>

The UK has globally acknowledged expertise in ocean science, generating new understanding and delivering impact at the forefront of the discipline. Continuing and expanding this leadership role within the Ocean Decade is complementary to stated government ambitions and priorities around the [UK Marine Strategy](#), the [30x30 initiative](#) to protect 30% of ocean area by 2030, the [Commonwealth Blue Charter](#) and [DEFRA's 25 Year Environmental Plan](#). The UK should grasp the opportunity to play a foundational role in shaping innovative ways of conducting and using ocean research internationally during and beyond the Ocean Decade, and leave a positive legacy for future generations.

During October 2020, the Royal Society's [Global Environmental Research Committee](#) held a workshop to scope and prioritise potential UK research contributions to the Ocean Decade initiative. Summarising key findings of the workshop, this paper lays out how the UK can support the Ocean Decade initiative through targeted research and novel research approaches. A synthesis of the workshop discussion is attached and includes the workshop agenda and attendees list.

The objectives of this paper are to:

- Identify the essential elements that make Ocean Decade research distinct from business as usual;
- Provide the leading exemplar priorities that emerged from the workshop;
- Propose how Ocean Decade research can be supported and delivered.

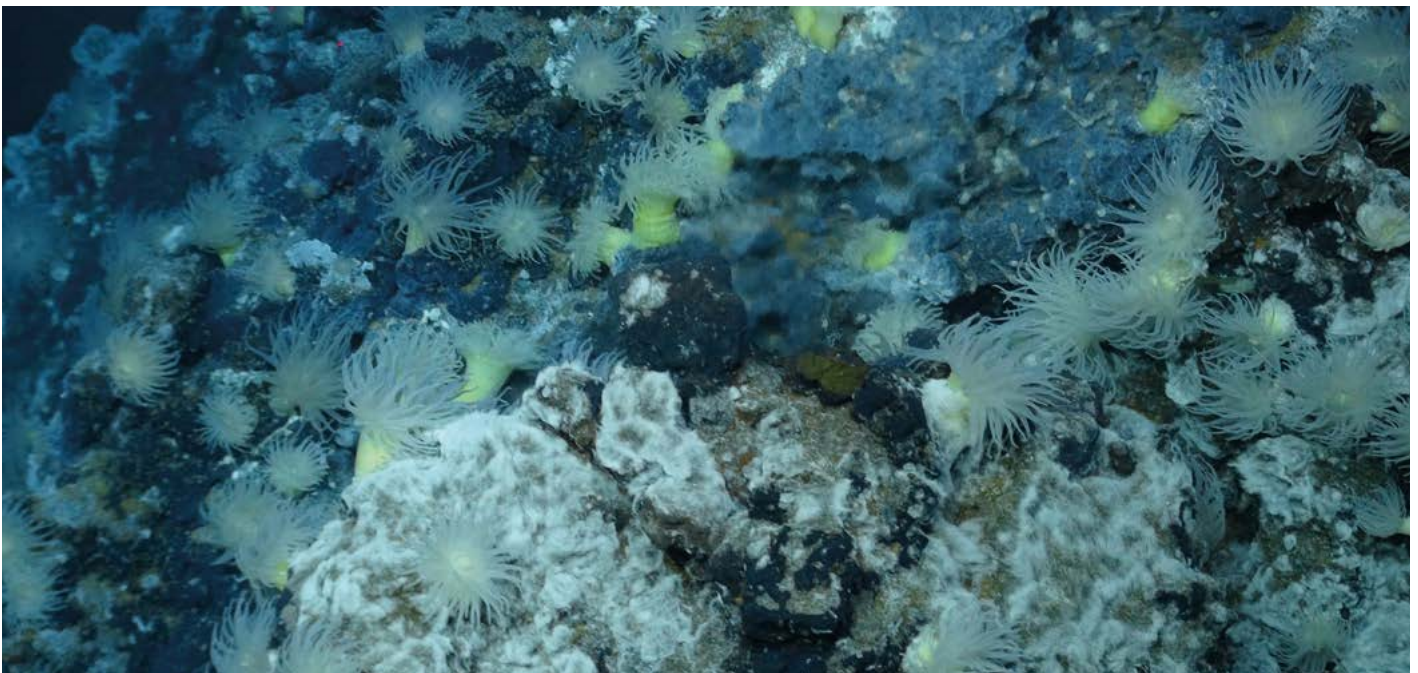


Image: Actinostolid anemones and mats of filamentous bacteria at the world's deepest known hydrothermal vents, 5,000m deep on the Mid-Cayman Spreading Centre, British Overseas Territories. © University of Southampton.

Workshop findings

1. Essential elements for identifying suitable UK research priorities for the Ocean Decade

Research priorities are those where there is an urgent need for scientific evidence to operate alongside enhanced ocean literacy to support sustainable management of the sea and deliver the Decade's outcomes. They are identified in the context of multiple interacting pressures faced by the ocean and its biodiversity, such as the impacts of climate change (e.g. warmer waters, acidification), pollution, exploitation and disease.

The workshop identified five **essential elements**, which UK science research priorities should address in delivering world leading science for the Ocean Decade. When these essential elements are applied internationally at scale, they offer the potential for a step change in our ability to use ocean resources sustainably while protecting ocean health and biodiversity. This will require new ways of working and supporting ocean research beyond 'business as usual'. Examples of how these essential elements can be applied to a specific topic can be found in the annex.

1. Assess the changes to, and resilience of, marine systems across different space (from local to global) and time scales;
2. Deliver a step change in the predictive capacity required for forecasting and management of diverse marine resources;
3. Link ocean and ecosystem services to the quality and equity of people's lives and livelihoods;
4. Address human health and well-being in the context of the Ocean Decade outcomes;
5. Assess ecological and societal solutions, including their equity and scalability, via ocean literacy actions.

2. Priority research areas identified by the workshop

From the workshop, four areas of research emerged as priorities that the essential elements could be applied to. Pursuing research in these areas would catalyse the production of the science we need to advance the Ocean Decade outcomes in a way that grows and develops the global impact and reach of UK science in partnership with international colleagues, whilst addressing challenges affecting the UK and the Commonwealth:

1. Connecting the deep sea to society to support sustainable development

The scope of human impacts in the 'out of sight, out of mind' deep sea linked to fishing, mining, new products such as pharmaceuticals, green energy and blue carbon is increasing rapidly. However, sustainable management of the deep sea is being held back by fundamental knowledge gaps. A better understanding of the deep sea is critical to allow the balancing of the potential societal benefits alongside the science needed to ensure irreversible damage is avoided.

2. Accelerating participatory solutions to the rapid changes facing coral coast ecosystems and dependent communities

These highly sensitive and biodiverse tropical systems support the livelihoods of many of the world's poorest people, but are already severely impacted by climate change, fishing and poor water quality. This brings an urgency to providing science that is focused on solutions for environmental and societal benefit in partnership with local stakeholder and rightsholder communities.

3. Improving our capacity to understand and predict sea level rise and its extremes to enable sustainable adaptation

The consequences of sea level rise, and potential changes in wave characteristics, for low-lying island and coastal habitats and their dependent societies relies upon decisions taken now and in the next few years. This requires new understanding of ice melt, key tipping points, extreme events and ocean health allied to societal impacts and implications, to enable the development of solutions for predicting and adapting to sea level rise that reduce negative impacts and the costs of inaction in an equitable manner.

4. Understanding, forewarning and mitigating the impacts of multiple pressures on marine ecosystems and the services they provide

A key challenge facing all ocean ecosystems, from the coasts to the high seas, is the presence of multiple interacting pressures. There is need for a framework that integrates and assesses the cumulative impacts of these pressures on ocean biodiversity and aquatic food systems, at different spatial and temporal scales. Such a framework would help to better understand, forewarn and mitigate these pressures.

All four areas bring opportunities around innovation, new technologies, and jobs that would harness international collaboration and build on world leading UK science and expertise. Progressing these ideas within the context of the recommended essential elements for Ocean Decade research priorities would facilitate the development of a new way of working across communities that is essential to underpin the long term, sustainable, future of our oceans and coasts.

3. How to support and deliver Ocean Decade research?

The Ocean Decade seeks to energise the development of transformative ocean research for the benefit of society. The workshop explored how innovative Ocean Decade research programmes should be supported and delivered to achieve this objective. Overall, successful support and delivery of such programmes would require engagement across different disciplines and sectors to address the complexity of this scientific challenge. The workshop found that:

- Successful support of Ocean Decade research efforts requires appropriate funding mechanisms that recognise the multi-disciplinary, cross community and multi-national nature of UN Ocean Decade science needs. Research funding for the Ocean Decade requires both environmental and interdisciplinary support to catalyse the seamless integration of projects across society, social science, and policy.
- Successful delivery of the overall Decade challenges requires a multidisciplinary and international approach that identifies both research and social outcomes. The trade-offs that exist between different beneficiaries of the ocean's services must be recognised to deliver on Decade goals. Projects should prioritise participatory community engagement as well as harnessing ocean literacy. Such an approach would facilitate the production of equitable and sustainable solutions that balance protection of biodiversity with sustainable use by a diverse set of scientists and stakeholders to address the emerging challenges to ocean health.



Image: Underwater shot of vivid coral reef with fishes in Indonesia

ANNEX Mapping examples of identified research priorities onto the essential elements

1. Connecting the deep sea to society to support sustainable development

- Determining the response of different deep sea ecosystems to human and climate pressures.
- Integrating knowledge from past and ongoing change to predict and assess future impacts.
- Link the deep sea more closely to society by quantifying its impact on different ecosystem services to ensure sustainable use.
- Expanding deep sea discovery (e.g. genetic materials or pharmaceuticals) to benefit human health and well being.
- Creating partnerships that make use of traditional and indigenous knowledge to promote sustainable management of deep sea ecosystems.

2. Accelerating participatory solutions to the rapid changes facing coral coasts and dependent communities

- Determining the individual and combined impacts of climate change, overfishing and pollution on coral reef and mangrove ecosystem biodiversity, productivity and function.
- Predicting the potential for coral reef acclimation and adaptation to climate change, and identifying management strategies that enhance resilience and aid recovery.
- Identifying marine-based sustainable livelihood options that are resilient to climate change and other external shocks.
- Quantifying the relationships between coral coast marine ecosystem health, and the nutrition and health of coastal communities.
- Co-designing reef and mangrove system management tools with communities and governments to achieve multiple social and ecological benefits.

3. Improving our capacity to understand and predict sea level rise and its extremes to enable sustainable adaptation

- Understanding how different emissions trajectories interact with coastal geomorphology and extreme events to shape local sea level changes.
- Forecasting the evolution of the coastal zone, for ecosystems and people.
- Accounting for the suite of impacts on ecosystem services.
- Addressing consequences linked to human migration, disease, culture and livelihoods.
- Developing, assessing and implementing human and nature-based solutions to the impacts of sea level rise.

4. Understanding, forewarning and mitigating the impacts of multiple pressures on marine ecosystems and the services they provide

- Determining the variability in cumulative exposure of multiple pressures on key ecosystems across the seascape.
- Integrating knowledge from different scales into stock projections for seafood.
- Accounting for the role of human activity and land use changes alongside climate pressures on ecosystem services.
- Managing the impacts of disease, toxins in seafood and harmful algal blooms in the face of increasing pressures.
- Assessing whether past interventions have worked to reduce exposure and to explore novel solutions, including those from traditional and indigenous knowledge.