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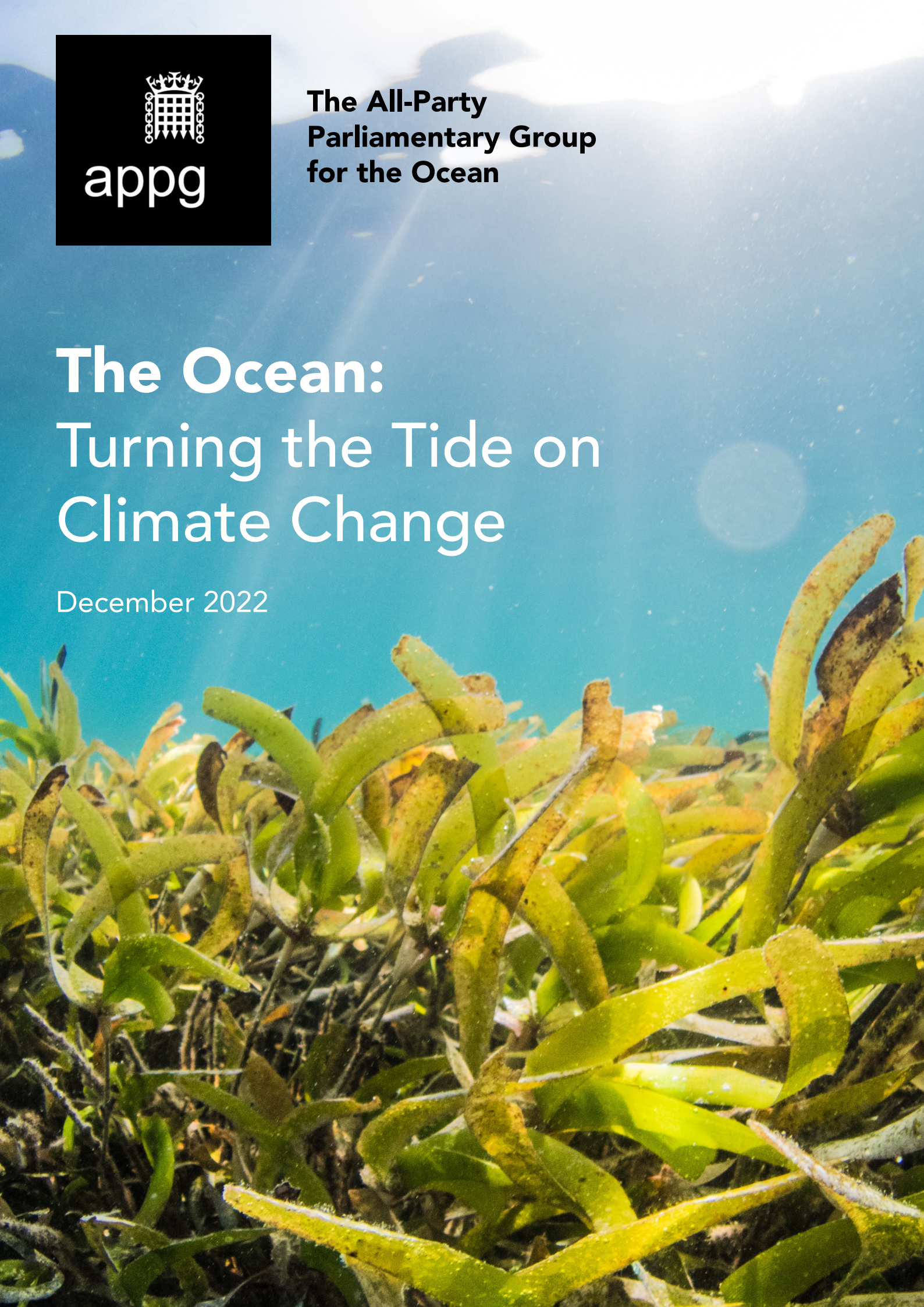
The All-Party Parliamentary Group for the Ocean

The Ocean: Turning the Tide on Climate Change

December 2022



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Foreword

Sally-Ann Hart MP

One of the greatest threats facing the planet, particularly coastal areas, is the rapidly growing rate of climate change. In order to ensure that the global rise of temperature does not exceed 1.5°C, global carbon dioxide emissions must be reduced and managed. I am pleased to see productive conversations and policy developments from Governments across the world focused around restoring and protecting land-based habitats, and an awareness of the importance of carbon stores across the planet which deliver a tremendous benefit in capturing carbon.

As an MP for a coastal community, I also recognise first-hand the solutions which the ocean can offer in mitigating and combating climate change. The ocean occupies over 70% of the planet's surface area and is the largest carbon sink in the world. Without the ocean, the Earth would have heated up at a much greater rate. Along the UK coasts, around 500,000 km^2 of the UK's shelf seas hold over 200 million tonnes of carbon, and saltmarsh and seagrass coastal habitats can store and hold carbon for thousands of years. There is a huge potential lying beneath our waters – and ocean-based solutions and blue carbon can have a significant impact on coastal communities above land too. These solutions offer opportunities for employment, industry, and the economy, and can support the UK Government's ambitions in levelling up regions across the UK.

Worryingly, marine habitats that deliver blue carbon and ocean-based solutions are disappearing and require urgent restoration and protection. I am pleased that the UK Government has such ambitious net zero targets, but in order for these to be met, awareness of the ocean's role in climate change must be realised. The UK Government's approach to environmental policy includes a pledge to increase international spending on nature-based solutions, including ocean-based solutions. As leader of the Global Ocean Alliance, the UK Government is also advocating for the 30by30 target, to meaningfully protect at least 30% of UK and overseas territory waters by 2030. I am delighted that the UK recognises the role of the ocean and is making significant pledges to protect and restore it. But there is more to be done, and further investment, restoration, protection and research on the ocean must be delivered in order to realise the full potential that the ocean offers.

On behalf of the APPG, I would like to thank all stakeholders who submitted evidence to this inquiry and all members of the APPG for their continued support for this important cause. Our report highlights the huge potential that ocean-based solutions offer, discusses the challenges they currently face, and provides key recommendations to Government focused on restoration, protection, research, and funding.

Now is the time for government, parliamentarians, and ocean stakeholders to work together to ensure that blue carbon habitats are restored and ocean-based solutions are funded, so we can provide opportunities to coastal communities, protect against coastal destruction, restore marine ecosystems and most importantly to meet the UK's ambitious net zero targets.

Executive Summary

The debate on climate change is predominately focused on the role of land-based solutions. This includes how land-based habitats can mitigate climate change and reduce consequences, and how destruction of these habitats – for example, deforestation – have huge negative impacts. These solutions are significant and have huge benefits for the environment, but discussions on climate change tend to overlook the role that the ocean can play.

The ocean occupies over 70% of the planet's surface area and produces around 50% of the oxygen we breathe. It is a hugely significant player in mitigating climate change, yet the ocean's role is usually viewed as passive, rather than active. For example, whilst welcome attention is paid to the threat that climate change poses to the ocean, such as acidification, deoxygenation and destruction of marine and coastal wildlife, little is paid to the positive contributions that the ocean can play in mitigating climate change. In fact, the ocean has a significant role to play in slowing down the rate of climate change. Since 1978, over 90% of the Earth's increased heat and 40% of carbon emitted from burning fossil fuels have been absorbed by the ocean. Furthermore, it's estimated that the ocean has absorbed between 25-30% of all carbon dioxide emissions caused by human activity, making it the largest carbon sink in the world. Despite this, the ocean is often overlooked in conversations about climate change, and little is understood about its true potential.

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Blue carbon and ocean-based solutions have a significant role to play in combating climate change, one of the biggest threats the Earth is facing. In light of this, we launched an inquiry into blue carbon and ocean-based solutions and their role in tackling climate change. This inquiry has sought to examine the different types of ocean-based solutions, the benefits that ocean-based solutions can offer for coastal communities, the challenges currently facing ocean-based solutions and blue carbon ecosystems, and how these solutions can better used to realise their full potential.

The call for written evidence ran between 15 June and 10 August, and we were delighted to receive over 30 written responses from key stakeholders.

The inquiry found that:

- Marine ecosystems store and sequester carbon at a significant rate, which reduces the level of carbon in the atmosphere and slows down climate change. In fact, the ocean is the largest carbon sink in the world, and without it, the Earth would have heated up at a much faster rate.
- Blue carbon and ocean-based solutions are often neglected in conversations about climate change, despite the fact that the destruction of marine habitats, such as seagrass, may be of greater consequence than land-based destructions, such as deforestation.
- Part of the reason that the ocean and blue carbon ecosystems are overlooked is because of the lack of understanding, research, and data. Certain types of ocean-based solutions, such as those which could occur in the open ocean or seabed, are even less understood and require greater mapping in order to understand the clear benefits.
- Ocean-based solutions can offer a whole host of benefits to coastal communities, including employment, industry, tourism and health and wellbeing. Investing in coastal and ocean-based solutions can considerably boost industry and the economy in coastal areas.
- While the importance of ocean-based solutions and blue carbon habitats should no longer be overlooked, climate change can only be slowed down and combated with a full and holistic approach of all decarbonisation efforts. This means that ocean-based solutions and land-based solutions should be used in conjunction with each other.

We are calling on the UK Government to therefore prioritise and facilitate investment in blue carbon and ocean-based solutions. The key recommendations made to Government are:

1. Blue carbon habitat mapping to be included in UK's EEZ
2. No trawl or dredge zone in the UK MPAs
3. Establish Highly Protected Marine Areas
4. Government should include more aspects of marine carbon storage and sequestration into UK Greenhouse Gas Inventory
5. Government to adopt code of conduct into ocean-based carbon dioxide removal
6. Government to prioritise funding into ocean-based CDR approaches
7. Government to re-align and restore 20% of UK's saltmarsh and seagrass habitats by 2030
8. Creation of a Minister for the Ocean role in government

By protecting, researching and investing into ocean-based solutions and blue carbon habitats, the UK can ensure that net zero targets are met, that coastal communities can benefit, and that the ocean becomes an active player in climate change mitigation.

Recommendations

1. Blue carbon habitat mapping to be included in UK's EEZ

The majority of the evidence provided to the APPG's inquiry advocates that blue carbon habitat mapping is needed in the UK's Exclusive Economic Zone. The UK's EEZ is an area of the sea which is under territorial ownership of a single country. The UK's EEZ is the fifth largest in the world, but how much carbon is currently sequestered within this area is not currently included within its mapping. The APPG for the Ocean recommends that the government includes blue carbon habitat mapping within the UK's EEZ as this will allow the UK to play a world-leading role in the monitoring, reporting and understanding blue carbon stores, which would allow the UK to make more informed blue carbon management decisions.

2. No trawl or dredge zone

Bottom trawling, or dredging, is a method of industrial fishing that involves dragging very heavily weighted nets across the seafloor to catch large quantities of fish. These practices are dangerous and harmful, and result in destruction of marine ecosystems and the disturbance of seabed carbon stores. In fact, such practices are potentially more harmful than deforestation. The APPG for the Ocean therefore urges the government to ensure that bottom trawling or dredging are banned in all 371 UK Marine Protected Areas.

3. Establish Highly Protected Marine Areas

Globally, the ocean covers 70% of the world's surface, yet only 2.7% of it lies within a highly protected area. Marine Protected Areas are set up to look after particular animals, plants and habitats at sea, and there are currently 371 MPAs across the UK seas, with nearly 40% of UK waters in a designated protected area. Highly Protected Marine Areas (HPMA) are a type of MPAs which offer the strictest possible environmental protections. This means there could be no fishing, construction or digging, and that these areas and ecosystems are offered the best chance of restoration and recovery. Although DEFRA have planned to pilot 5 HPMAs in English waters, the APPG for the Ocean wants to see a guaranteed commitment and extension of HPMAs across the UK coast.

Photo credit: The Ocean Agency/Ocean Image Bank

Photo credit: Tracey Jennings /Ocean Image Bank

4. Government should include more aspects of marine carbon storage and sequestration into UK Greenhouse Gas Inventory

The UK's Greenhouse Gas (GHG) inventory is an annual series of UK greenhouse gas emissions from 1990 onwards. This data is used to predict trends and allow regular monitoring of progress against any targets. It is estimated that UK blue carbon ecosystems sequester and store around 2% of all UK emissions per year. However, blue carbon habitats are not currently included in the UK's national GHG inventory. A significant number of respondents advocated for including blue carbon ecosystems into the GHG inventory as this would facilitate greater monitoring and understanding of blue carbon storage potential in marine ecosystems and would provide a wider picture of emissions and emission sinks within the UK. Of all the blue carbon habitats, the APPG for the Ocean is recommending to the government that saltmarshes and seagrass are included in the UK's GHG inventory.

5. Government to adopt code of conduct into ocean-based carbon dioxide removal

In a pivotal article released in June 2022 in the World Economic Forum, leading oceanographers proposed a code of conduct to govern an ocean-based carbon removal (CDR) research strategy.[1] Ocean based solutions offer great CDR potential, yet they are under researched and not without risks. There are no agreed criteria to guide the research required to adopt ocean-based CDR applications at scale, and so the APPG for the Ocean advocates for the government to adopt a code of conduct to govern ocean-based carbon dioxide removal which focuses on collective benefit, responsibility, co-operative research, evaluation and assessment, and public engagement.

[1] World Economic Forum (2022), 'Why we need a code of conduct for ocean-based carbon dioxide removal', available at: https://www.weforum.org/agenda/2022/06/ocean-carbon-dioxide-removal-code-of-conduct/

6. Government to prioritise funding into ocean-based CDR approaches

There is an urgent need for greater research into ocean-based CDR approaches, as laid out in Recommendation 5. The APPG for the Ocean urges government to prioritise strategic and coordinated funding streams to assess the feasibility of implementing ocean-based CDR approaches which might enhance the ocean's capacity to absorb and store carbon including iron fertilisation, artificial upwelling and downwelling, electrochemical approaches, seaweed cultivation and ocean alkalinity enhancement.

7. Government to re-align and restore 20% of UK's saltmarsh and seagrass habitats by 2030

The UK Government, as leader of the Global Ocean Alliance, is advocating for the 30by30 target, to meaningfully protect at least 30% of UK and overseas territory waters by 2030. Evidence submitted to the inquiry notes the need to go further, to commit to protection and restoring of UK coasts, to support blue carbon solutions along the coast, such as saltmarsh and seagrass. In 2021, the journal Frontiers in Plant Science revealed that the UK has lost more than 90% of seagrass meadows since the 1930s, and saltmarshes in South-East England have been eroding at a rate of about 40 hectares per year.[2] APPG for the Ocean is therefore recommending to government that by 2030, 20% of the UK's saltmarsh and seagrass habitats are re-aligned and restored.

8. Creation of a Minister for the Ocean role in government

Despite the huge importance of the ocean and its relationship with several key policy and strategy areas, including climate change, there is a Ministerial gap in UK Government, with no-one currently and directly responsible for all ocean issues. There is a keen urgency for a specific Minister for the Ocean position in UK Government which would have direct and exclusive responsibility for all ocean issues, and the APPG for the Ocean is recommending that UK Government seriously consider creating this position.

Photo credit: David Schrichte/Ocean Image Bank

[2] Frontiers in Plant Science (2021), 'Historical Analysis Exposes Catastrophic Seagrass Loss for the United Kingdom', available at: https://www.frontiersin.org/articles/10.3389/fpls.2021.629962/full

Background to the inquiry

The All-Party Parliamentary Group for the Ocean was founded in 2022 to provide a collective space where all parliamentarians can support and promote ocean research and awareness, to develop greater understanding of the ocean and its role in tackling challenges such as climate change, and to debate wider issues.

As our first inquiry, the APPG for the Ocean wanted to focus on the role of the ocean and climate change. The APPG for the Ocean was pleased to welcome discussions held at COP26 in 2021 on the urgent need to take action to mitigate climate change. However, a hugely important player in tackling climate change was overlooked in conversations at COP26: the ocean. There was recognition of nature's contribution in climate change mitigation, with part of the Glasgow Pact emphasising "the importance of protecting, conserving and restoring nature and ecosystems… including through…marine ecosystems."[3] However, while welcome, there needs to be further commitment to strategy, policy, and development of these solutions, alongside research. The APPG felt that the pivotal role of the ocean was downplayed, and instead should have been given the same welcome attention paid to deforestation, pollution, and plastics. An often-overlooked aspect of the ocean is the positive and active role it plays in affecting climate change and mitigating its dangerous consequences.

This inquiry therefore looks at the role that the ocean plays in impacting on and mitigating climate change, including the hugely important role of blue carbon. The APPG is grateful to all the stakeholders who responded to share their knowledge and expertise on the issue, and the best ways to ensure that the potential benefits that blue carbon and ocean-based solutions to climate change can offer in tackling climate change are realised. A full list of the respondents to the call for evidence and the questions posed in the written evidence can be found in the Appendix.

Case study

Deep Sea Conservation Research Unit

The Deep-Sea Conservation Research Unit (DeepSeaCRU) is a PhD project that aims to quantify the role of deep-sea organisms and looks at providing the science to support the management and conservation of the deep sea and High Seas. DeepSeaCrus is part of the Marine Institute at Plymouth University and is an academic research group led by Dr Kerry Howell, an expert in deep-sea ecology and marine conservation. The DeepSeaCRU focuses on deep-sea ecology, deep-sea conservation and management, deep-sea marine protected areas, and the ecosystem impacts of deep-water fisheries.

[3] United Nationals Framework Convention on Climate Change (2022), 'Report of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement on its third session', available at: https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

What is blue carbon?

Discussions on the ocean and climate change usually refer to the ocean as a passive participant. Attention is often paid to the threat that climate change poses on the ocean, relating to rising ocean temperature, ice, and glacier melting, rising sea levels and destruction of marine and coastal wildlife through changing sea temperature and sea pollution. Greenhouse gas emissions, including carbon dioxide and methane, have a hugely significant impact on climate change, rising global temperatures, and long-term shifts in temperatures and weather patterns on a global scale. The burning of fossil fuels represents a carbon source – it releases more carbon into the atmosphere than it absorbs, impacting negatively on the atmosphere.

Carbon sinks, however, act as the opposite. They absorb more carbon dioxide from the atmosphere than they release. By capturing and absorbing carbon dioxide, this can result in reducing the impacts of climate change on a global scale and mitigating some of serious and dangerous consequences that climate change results in.

Conversations around carbon sinks generally focus on the role of forests, soils, and plants. There is no doubt that land-based carbon sinks play a significant role in absorbing carbon and mitigating climate change, and it is hugely important to ensure that these natural land-based carbon sinks are protected and restored. However, these are not the only solutions.

The ocean is the largest carbon sink in the world, absorbing between 25-30% of all carbon dioxide emissions caused by human activity.[4] The importance of the ocean in mitigating climate change is stated in the written evidence submitted by the National Oceanography Centre, as *"without the ecosystem the Ocean provides, the Earth would be substantially warmer than it is at present."*[5] This is further corroborated in evidence provided by the Marine Conservation Society, which notes that *"there is no Nature-based solution without the inclusion of marine and coastal blue carbon habitats."*[6] Blue carbon, as the name suggests, relates to ocean-based carbon sinks, where-in the ocean plays an active role in providing carbon capture solutions.

There is a recognised ambiguity over the term blue carbon. The Intergovernmental Panel on Climate Change (IPCC) noted that *"there is a current debate regarding the application of the blue carbon concept to other coastal and non-coastal processes and ecosystems, including the open ocean."*[7] The original definition of blue carbon was coined to refer to *"carbon sequestered by salt marshes, seagrasses and mangroves"*[8] and is most commonly the definition used in scientific literature.[9] However, this meaning tends to be more narrow in its definition, and given that blue carbon is the central aspect of this inquiry, the definition being used will focus on a wider remit. For the purpose of this inquiry, the definition of blue carbon will relate to *"carbon that is stored in marine ecosystems, where management of those ecosystems impacts that carbon"* as provided by the National Oceanography Centre in their written evidence submission.[10] This definition includes the three coastal systems with rooted vegetation, that form the more standard, narrow definition – saltmarsh, seagrass and mangroves – alongside the other coastal and marine ecosystems which have a role in carbon capture and absorption, such as deep ocean habitats, seaweed forests, marine mammals, and others.

[4] Marine Conservation Society Inquiry Submission August 2022, National Oceanography Centre Inquiry Submission August 2022
[5] National Oceanography Centre Inquiry Submission August 2022
[6] Marine Conservation Society Inquiry Submission August 2022
[7] IPCC (2019) 'Special Report on the Ocean and Cryosphere in a Changing Climate', available at: https://www.ipcc.ch/srocc/chapter/glossary/
[8] Dr Chris Vivian, Co-Chair GESAMP Working Group on 'Ocean interventions for climate change management' Inquiry Submission August 2022
[9] Dr Phil Williamson, University of East Anglia Inquiry Submission August 2022
[10] National Oceanography Centre Inquiry Submission August 2022

Ocean-based solutions: as important as land-based?

Evidence provided by the National Oceanography Centre note that processes which increase the rate at which the ocean naturally removes carbon dioxide have the "potential to decrease global temperature and mitigate future impacts of climate change."[11] According to the UK Office for National Statistics, around 320,000 km^2 of saltmarsh, mudflat and sand coastal habitats can *"draw down and store the equivalent of between 10.5 and 60.1 million tonnes of carbon dioxide annually."*[12] This is in comparison to land-based solutions, which are estimated to capture around 28 million tonnes of carbon per year. Ocean carbon sequestration and storage solutions in the UK are estimated to have a value of nearly £60 billion per year, with the sequestration rate estimated to be around 11 million tCO2e/year – which accounts for around 2% of the total UK emissions.[13]

Furthermore, the Marine Conservation Society states in their evidence submission that *"blue carbon habitats are potentially more efficient than Nature-Based Solutions on land for climate change mitigation due to their high capacity for carbon sequestration."*[14] Not only do blue carbon solutions have a potential greater impact on mitigating climate change compared to land-based solutions in terms of the amount of carbon stored, but there is evidence to suggest that the destruction of blue carbon ecosystems is potentially more damaging and widespread than that of land-based systems. For example, despite the combined global area of the three most well-known blue carbon sinks – mangroves, salt marshes and seagrasses – equating to only 2-6% of the total area of a tropic forest, *"their degradation is equivalent to up to 19%" of emissions from global deforestation."*[15]

This is not to say that one form of decarbonisation is better than the other, but to highlight that to truly affect climate change, a holistic approach is needed. Professor William Austin, in his role as Chair of the Scottish Blue Carbon Forum, states in his written evidence that *"ocean-based solutions that can play a role in tackling climate change can never be a substitute for the urgent task of decarbonising all sectors of the economy."*[16] This view is further supported by many of the respondents, including the UK Hydrographic Office (UKHO), the Blue Marine Foundation and the Wildlife Trusts.[17] It is integral, therefore, that any recommendations suggested in this inquiry are done so in conjunction with, and to further support, decarbonisation efforts on a large-scale and holistic approach, rather than in replacement of another method. Only by utilising potential benefits of all decarbonisation methods, can climate change and its negative consequences be truly tackled.

[11] National Oceanography Centre Inquiry Submission August 2022
[12] Marine Conservation Society Inquiry Submission August 2022
[13] Howell Marine Consulting Inquiry Submission August 2022
[14] Marine Conservation Society Inquiry Submission August 2022
[15] Marine Conservation Society Inquiry Submission August 2022
[16] Professor William Austin, Scottish Blue Carbon Forum Inquiry Submission August 2022
[17] UK Hydrographic Office Inquiry Submission August 2022, Blue Marine Foundation Inquiry Submission August 2022, The Wildlife Trusts Inquiry Submission August 2022

Dr Phil Williamson, Honorary Reader in the School of Environmental Sciences at University of East Anglia, notes the 5 main ways that ocean-based solutions can help in tackling climate change:[18]

1. By providing renewable energy
2. Coastal-based actions that assist in climate adaptation
3. Coastal and ocean-based actions that reduce emissions of greenhouse gases
4. Coastal and ocean-based actions that increase the removal of carbon dioxide from the atmosphere (blue carbon)
5. Ocean-based actions that increase sunlight reflection

The focus of this inquiry is on blue carbon and coastal-based actions that assist in climate adaptation. There is some recognition of the role that tidal solutions play in providing renewable energy, and Dr Phil Williamson noted the immense potential of this in his oral evidence given to the APPG and the APPG may look at this in more detail in the future.[19] However, the overwhelming majority of the evidence and of this inquiry relates to blue carbon and coastal-based actions that assist in climate adaptation. The UKHO also offers some additional aspects of ocean-based solutions, which include solutions to shipping emissions. According to the UKHO, *"shipping accounts for 3% of global emissions"*, and as *"more than 90% of international trade"* is carried by sea, there is an urgent need to tackle the carbonising impact of shipping.[20] While solutions like the ones that the UKHO offer, such as voyage optimisation, are not the overall and main focus of this inquiry, it is important to note the importance of green shipping in marine decarbonisation efforts.

Photo credit: David Troeger/Unsplash

[18] Dr Phil Williamson, University of East Anglia Inquiry Submission August 2022
[19] Dr Phil Williamson, University of East Anglia Oral Inquiry Submission October 2022
[20] UK Hydrographic Office Inquiry Submission August 2022

Ocean-based solutions do not only offer solutions for climate mitigation, but also for adaptation.[21] This means that blue carbon and ocean-based solutions can provide opportunities for climate change adaptation, particularly along coastal areas, *"whereby coastal habitats can protect coastal communities and infrastructure, from rising sea level and increased storms and storm effects."*[22] The majority of the respondents to the inquiry further support the notion that ocean-based solutions are crucial for climate change adaptation. For example, the Marine Conservation Society notes the opportunity of ocean-based solutions in preventing *"coastal erosion and flood prevention"*[23], *the Wildlife Trust states that "coastal wetlands, mudflats and biogenic reefs offer protection against sea level rise and coastal erosion"*[24], and Professor Callum Roberts, Chief Scientist of the Convex Seascape Survey blue carbon investigation and Professor of Marine Conservation at University of Exeter, notes the significance of adaptation to climate change through *"improving water quality, building resilience among natural populations…and increasing human wellbeing."*[25] Professor William Austin, whose inquiry submission focuses on the relationship between ocean-based solutions to climate change and climate adaptation, also notes how sand dunes and saltmarshes can *"absorb wave energy"*, which lessens impacts from storms – a consequence of climate change – alongside providing *"dune mobility or saltmarsh accretion"*, which can act as a buffer against rising sea levels.[26] The most important role that ocean-based solutions can play in the context of climate change adaptation, noted by the majority of respondents, is *"responding to the increasing risk of flooding and coastal erosion in England and Wales."*[27] It is therefore clear that alongside providing clear proactive climate change mitigation solutions, ocean-based solutions can also help manage the negative impacts of climate change, such as rising sea levels, and offer practical, adaptive, solutions.

There is a feeling, however, amongst the respondents that ocean carbon dioxide removal and blue carbon is generally *"poorly understood."*[28] This is partially due to the ambiguous meaning of blue carbon, but generally due to the fact that *"the role of the marine environment has largely been overlooked,"*[29] resulting in lack of research and evidence, funding, and government attention, with detailed interrogation of blue carbon in its infancy. The written submissions point to many different ways that blue carbon and ocean-based solutions can start to be greater understood and developed, which focus on aspects including research, data, mapping, funding, and government interventions, which will be explored in full later in this report.

Case study

Marine Biomass Regeneration

The Marine Biomass Regeneration is an extension of the Centre for Climate Repair's effort to remove greenhouse gases. It adds to the understanding that oceans have been damaged as a result of human activity. The Marine Biomass Regeneration project is examining how we might regenerate the biomass in oceans and bring the population of whales. This would allow the ocean to be regenerated and replenished, and contribute to carbon sequestration.

[21] Professor William Austin, Scottish Blue Carbon Forum Inquiry Submission August 2022
[22] Professor William Austin, Scottish Blue Carbon Forum Inquiry Submission August 2022
[23] Marine Conservation Society Inquiry Submission August 2022
[24] The Wildlife Trusts Inquiry Submission August 2022
[25] Professor Callum Roberts Inquiry Submission August 2022
[26] Professor William Austin, Scottish Blue Carbon Forum Inquiry Submission August 2022
[27] British Geological Survey Inquiry Submission September 2022
[28] Professor William Austin, Scottish Blue Carbon Forum Inquiry Submission August 2022
[29] The Wildlife Trusts Inquiry Submission August 2022


Photo credit: Hiroko Yoshii/Unsplash

Current UK policy

Ocean-based solutions and blue carbon are vital in meeting the target to reach net zero greenhouse gas emissions by 2050 in England, Wales, and Northern Ireland, and 2045 in Scotland, which the UK Government legislated in 2019. The UK's 2050 net zero target is one of the most ambitious in the world. In terms of marine and ocean policy, the UK leads the Global Ocean Alliance (GOA), made up of 73 countries, which advocates for ocean action within the Convention on Biological Diversity. The GOA advocates for the 30by30 target, the aim to protect at least 30% of the global ocean in Marine Protected Areas (MPAs) and Other Effective area-based Conservation Measures (OECMs) by 2030.

Furthermore, the UK has pledged to increase international spending on nature-based solutions, including ocean-based solutions, such as the Blue Planet Fund.[30]

Yet, despite these solutions providing up to one-third of the climate change mitigation which is needed to sufficiently address the climate crisis, only 1-3% of international climate financing goes towards this.[31] Globally, the ocean covers 70% of the world's surface, yet only 2.7% of it lies within a highly protected area.[32] Within the UK, the majority of the respondents note that "not enough action is being taken" in regard to blue carbon.[33]

[30] Marine Conservation Society Inquiry Submission August 2022
[31] Marine Conservation Society Inquiry Submission August 2022
[32] Marine Conservation Society Inquiry Submission August 2022
[33] Wildlife and Countryside Link and Northern Ireland Marine Taskforce Inquiry Submission August 2022

As a signatory to the Convention on Biological Diversity, the UK had legislative obligations to restore at least 15% of degraded ecosystems by 2020 – but this target was not reached. Furthermore, even though the UK was one of the first countries to *"produce a significant overview of carbon dioxide removal techniques"* in 2009, there has not been enough dedicated funding since this time from either the UK Government or British scientific funding agencies to support research into ocean-based CDR approaches.[34]

Blue carbon habitats, in spite of their potential impact on climate change and the fact that it is estimated that UK blue carbon ecosystems sequester and store around 2% of UK emissions per year, are not currently included in the UK's national greenhouse gas inventory, and carbon sequestration and release from the ocean *"is not accounted for."*[35]

In Scotland, the position is slightly improved. According to evidence submitted by representatives of the British Antarctic Survey, the Scottish Government have been *"proactive and supportive"* of blue carbon research and work, but this is not echoed in wider UK Government.[36] Furthermore, there have been some blue carbon studies which have been supported by the Scottish Government – such as the Blue Carbon International Policy Challenge.[37] However, there is still a general feeling that devolved administrations, including Scotland, *"could be doing more"* to support blue carbon projects.[38]

This neglect is due largely to lack of scientific evidence, data and research, and a general lack of understanding. Despite the multitude of blue carbon solutions, only the best well known habitat types - saltmarsh, seagrass and mangroves – are currently included in the IPCC's guidelines on national greenhouse gas inventories.[39] The UKHO note that there is *"significant evidence of a lack of coordination, in terms of data standards, specifications and operational activity"* within the UK Government, which means that blue carbon stock is currently not being utilised, managed or developed to its best ability.[40]

Case study

ReMeMaRe

The Restoring Meadow, Marsh and Reef (ReMeMaRe) project is a habitat restoration initiative which aims to understand and reverse the decline of three major coastal habitats – seagrass meadows, saltmarshses and the European native oyster reefs. Led by the Environment Agency, the mission of the project is to restore at least 15% along the English coast by 2043.

[34] National Oceanography Centre Inquiry Submission August 2022
[35] UK Parliament POSTnote (2021), Blue Carbon, available at: https://researchbriefings.files.parliament.uk/documents/POST-PN-0651/POST-PN-0651.pdf
[36] David Barnes, Simon Morley, Theresa Gossman and Chester Sands, British Antarctic Survey Inquiry Submission August 2022
[37] Dr Phil Williamson, University of East Anglia Inquiry Submission August 2022
[38] Sustainable Inshore Fisheries Trust Inquiry Submission August 2022
[39] Wildlife and Countryside Link and Northern Ireland Marine Taskforce Inquiry Submission August 2022
[40] UK Hydrographic Office Inquiry Submission August 2022

Solutions and benefits

A wider and holistic definition of blue carbon – and the definition which is adhered to in this report – is *"carbon that is stored in marine ecosystems, where management of those ecosystems impacts that carbon."*[41] There are more common and specific solutions, which are explored in detail in this section, but all aspects of ocean life offer a significant range of blue carbon and ocean-based solutions, from the biggest of whales to the smallest of plankton.[42] As Professor William Austin states, ocean-based solutions should include *"the protection of existing habitats, the restoration of ecosystems that have been degraded, the sustainable management of marine systems and the creation of novel new ecosystems."*[43] By this definition, there are a whole host of blue carbon and ocean-based solutions available.

Seagrass, saltmarsh, mangroves

By far, the most popular and well understood blue carbon solutions highlighted by the respondents are seagrass, saltmarsh and mangroves – known also as *"coastal vegetated habitats"*[44] or *"coastal blue carbon."*[45] These work by taking carbon into the biological material, stored over different timescales.[46]

Seagrass, saltmarsh and mangroves tend to be most featured in the evidence submissions due to the high carbon sequestration rates they offer, and the fact they provide climate change mitigation. These are also habitats which are recognised by the UNFCCC and IPCC.[47] Of these groups, saltmarshes are seen to be more beneficial for carbon sequestration than seagrass or mangroves, and are the most used solution within England.[48] Colin Scott, a senior marine environmental consultant at ABPmer, posits that, *"the restoration of saltmarsh habitat offers by far the best opportunity to deliver Blue Carbon and contribute to this country's climate change mitigation."*[49] Within the UK, there are nearly 45,000 hectares of saltmarsh – representing a huge potential of carbon capture for the UK, which could build the future foundation of a thriving UK blue carbon market.[50] Seagrass meadows also provide carbon storage potential, and the UK has between 7,000-9,000 hectares of seagrass. Seagrass meadows can improve water quality, reduce flood risk and act as an ecosystem habitat for species.[51] Outside of the UK, mangroves are the best solutions for carbon storage.[52]

Put in another way, around 500,000 km^2 of the UK's shelf seas, along the continental shelf, hold around 205 million tonnes of carbon. This is 50 million tonnes more than the entire quantity held within the UK's forests. Seagrass itself can capture around 83 million tonnes of carbon per year, and global saltmarsh habitats are estimated to capture around 90 million tonnes of carbon per year.[53] Furthermore, if these blue carbon stores are left undisturbed, the carbon is considered to be stored for around 1,000 years, if not longer.[54]

[41] National Oceanography Centre Inquiry Submission August 2022
[42] National Oceanography Centre Inquiry Submission August 2022
[43] Professor William Austin, Scottish Blue Carbon Forum Inquiry Submission August 2022
[44] National Oceanography Centre Inquiry Submission August 2022
[45] Dr Chris Vivian, Co-Chair GESAMP Working Group on 'Ocean interventions for climate change management' Inquiry Submission August 2022
[46] Dr Shaun Fitzgerald, Professor Sir David King, Professor John Taylor, Professor Sasha Turchyn, Dr Oscar Branson Inquiry Submission August 2022
[47] Blue Marine Foundation Inquiry Submission August 2022
[48] Environment Agency Inquiry Submission August 2022
[49] Colin Scott, ABPmer Inquiry Submission August 2022
[50] Blue Marine Foundation Inquiry Submission August 2022
[51] Blue Marine Foundation Inquiry Submission August 2022
[52] Environment Agency Inquiry Submission August 2022
[53] Wildlife and Countryside Link and Northern Ireland Marine Taskforce Inquiry Submission August 2022
[54] Dr Chris Vivian, Co-Chair GESAMP Working Group on 'Ocean interventions for climate change management' Inquiry Submission August 2022

Photo credit: Luke Bender/Unsplash

There are significant environmental, social and economic benefits to restoring coastal vegetated habitats and reversing their destruction. According to National Oceanography Centre, healthy coastal ecosystems in protected habitats can help to prevent erosion along the coast – which may in turn reduce the negative consequences of storms and the chance of flooding in these areas. Therefore, alongside acting as carbon stores, these areas can also combat floods and sea level rises – another form of climate change mitigation. In fact, according to Howell Marine Consulting, it is predicted that the estimated value of flood mitigation provided by saltmarshes in 2019 was £62 million in England, and £9 million in Wales.[55]

If these solutions are degraded or destroyed, the Marine Conservation Society predicts that there could be a risk of the release of carbon dioxide.[56] Activities such as bottom trawling, which is the method of fishing that involves dragging very heavy weighted nets across the sea floor to catch huge quantities of fish, risk releasing significant amounts of carbon emissions – at times, more so than the destruction of land habitats, such as deforestation.[57] Over the next decade, harmful fishing activities such as bottom trawling, have the *"potential to result in the loss of 13 million tonnes of carbon from the sink over the next decade."*[58] The protection of these natural habitats are essential.

Open ocean

In his oral evidence, Dr Phil Williamson highlighted that the ocean was more crucial for climate change than the atmosphere, but that also warned about the risks of relying only on coastal blue carbon solutions, noting that coastal vegetated habitats can actually release methane in some instances. Furthermore, while we can measure the amount of carbon, it is more difficult to measure the rate of accumulation of carbon. We cannot view coastal blue carbon solutions as a silver bullet to the climate crisis – these aspects must be preserved, but other solutions – particularly in the open ocean, need to be explored and developed.[59]

[55] Howell Marine Consulting Inquiry Submission August 2022
[56] Marine Conservation Society Inquiry Submission August 2022
[57] Marine Conservation Society Inquiry Submission August 2022
[58] Marine Conservation Society Inquiry Submission August 2022
[59] Dr Phil Williamson, University of East Anglia Oral Inquiry Submission October 2022

The continental shelf is the portion of a continent that lies under the ocean. It is the relatively shallow shelf of submerged land which forms part of the continental crust, which extends from the coastline to a drop-off point: the shelf break. Beyond the continental shelf lies the open, or deep, ocean – categorised into the Sunlight Zone, the Twilight Zone, the Midnight Zone, the Abyss, and then the Trenches, at a depth of around 11,000m.

In the context of blue carbon, there is some debate around the inclusion of open ocean solutions, with some of the respondents posting that the open ocean should not be included within blue carbon and ocean-based solutions. However, the majority of the respondents note the importance of the open ocean alongside coastal marine habitats. The APPG for the Ocean recognises the potential of the open ocean and believes that it should be seriously considered and researched for its Carbon Dioxide Removal (CDR) potential. The National Oceanography Centre notes that blue carbon habitats such as seagrass, saltmarshes and mangroves may deliver excellent co-benefits such as coastal defence mechanisms, whereas open-ocean approaches are considered mainly for carbon dioxide removal.[60] Professor Callum Roberts from the University of Exeter notes that *"the whole of the ocean should be considered with regard to its role in blue carbon,"*[61] and the Whale and Dolphin Conservation highlight the "enormous blind spot" that the open ocean provides.[62]

Kyran Graves, a deep-sea biologist at the Deep-Sea Conservation Research Unit at the University of Plymouth, who is conducting a PhD on the role of deep-sea organisms in the blue carbon budget across UK and Irish waters, notes the importance of deep-sea mapping of blue carbon sinks. He notes that *"it is frequently the case that the deep-sea is overlooked… and therefore is late to the agenda"* and highlights the significance of including the open ocean in conversations about blue carbon, particularly in parliamentary and governmental discussions.[63] These solutions include, for example, forms of *"biological pump"* carbon dioxide removal solutions, which pull carbon from the surface down. Although these are not generally considered to be blue carbon solutions, according to the National Oceanography Centre, *"the net benefit could be significant"*, depending on the scale that these would be deployed following focused research into their efficacy.[64]

There are some key benefits of using blue carbon approaches in the open ocean. Given the huge size, the solutions are highly scalable, there is the potential to access a huge amount of open ocean carbon storage, and it has minimal impact on the other marine users.[65] Furthermore, the open ocean stores around 37,000 GtC, and has the potential to store this for hundreds to thousands of years.[66]

Another open ocean-based solution is sinking farmed seaweed, also known as *"macroalgal sequestration,"*[67] or *"large-scale seaweed aquaculture."*[68] Due to some of the uncertainties associated with sinking farmed seaweed, such as the fact that some of the macroalgae may risk being broken down back into dissolved carbon dioxide during the process of sinking, there is a need for much further research into this area.[69] Additionally, there are reports that seaweed cultivation only sequesters around 1 tonne of carbon per hectare – which is too low a rate to rely on solely.[70]

[60] National Oceanography Centre Inquiry Submission August 2022
[61] Professor Callum Roberts Inquiry Submission August 2022
[62] The Whale and Dolphin Conservation Inquiry Submission August 2022
[63] Kyran Graves Inquiry Submission August 2022
[64] National Oceanography Centre Inquiry Submission August 2022
[65] SeaCURE Project Inquiry Submission August 2022
[66] Dr Shaun Fitzgerald, Professor Sir David King, Professor John Taylor, Professor Sasha Turchyn, Dr Oscar Branson Inquiry Submission August 2022
[67] National Oceanography Centre Inquiry Submission August 2022
[68] Dr Phil Williamson, University of East Anglia Inquiry Submission August 2022
[69] National Oceanography Centre Inquiry Submission August 2022
[70] Sustainable Inshore Fisheries Trust Inquiry Submission August 2022

It should be noted that these solutions are more risky, less regulated, and may have increased costs. There's also less understanding and monitoring known about these open ocean blue carbon solutions, compared to the coastal vegetated habitats.[71] Furthermore, although open ocean solutions offer the opportunity for much larger scale solutions, this can be hindered by international legal frameworks and time frames.[72] Some of the risks are difficult to quantify and measure, and there is a real sense that there needs to be detailed and extensive research into open-ocean techniques in order to understand the potential full risks and benefits. There is an overall sense among the responses that while open ocean CDR solutions have the huge potential to be beneficial and successful as blue carbon approaches to climate change mitigation, that there needs to be much greater mapping, research and understanding of the open ocean, in order to understand the full risks and benefits.

Marine species

Marine animals, specifically cetaceans – whales, dolphins and porpoises – are a proposed form of blue carbon, according to the IPCC's latest report.[73] Firstly, in the case of cetaceans, there has been more than *"80% reduction in the amount of carbon captured, stored, or sequestered"* due to industrial whaling.[74] In fact, the removal of whales from the ocean has caused an estimated loss of, according to Whale and Dolphin Conservation, around 300,000 metric tons of carbon sequestration per year, the same as losing more than 50,000 hectares of forest in the same time.[75]

Interestingly, and perhaps an overlooked and lesser-known blue carbon solution, is whale carcasses. If the bodies of whales sink to the deep sea when they die, this contributes to carbon sequestration. However, if a whale is killed and removed from the ocean, *"the majority of the carbon stored within its biomass is released to the atmosphere as it decomposes"* – one of many significant reasons for curtailing industrial whaling.[76]

Photo credit: Toby Matthews/Ocean Image Bank

[71] SeaCURE Project Inquiry Submission August 2022
[72] National Oceanography Centre Inquiry Submission August 2022
[73] The Whale and Dolphin Conservation Inquiry Submission August 2022
[74] The Whale and Dolphin Conservation Inquiry Submission August 2022
[75] The Whale and Dolphin Conservation Inquiry Submission August 2022
[76] The Whale and Dolphin Conservation Inquiry Submission August 2022

Antarctic krill are also estimated to remove a large amount of carbon from the atmosphere. According to Wildlife Countryside Link and the Northern Ireland Marine Taskforce, across the entire ocean, krill can store 0.3 tonnes of carbon on a daily basis – this is the same as the daily domestic CO2 emissions of the UK.[77] Furthermore, mussels on ropes play a significant role in blue carbon solutions. These provide the potential to regenerate marine ecosystem biodiversity, alongside providing food, in a highly sustainable solution to more harmful fishing practices, such as bottom trawling.[78]

Additional techniques

The importance of kelp is noted throughout the inquiry submissions.[79] Although kelp is not as understood as well as seagrass and saltmarsh, it has huge potential. For example, the quantity and restoration potential of kelp is large, at between 400 and 800,000 hectares.[80] Kelp cultivation can also provide other benefits such as biodiversity, fish stock, coastal employment, and diversification, according to the Kelp Forest Foundation's inquiry response.[81]

There is also evidence of physical structures acting as blue carbon solutions. For example, the British Antarctic Territory, South Georgia and the South Sandwich Islands, Antarctic continental shelves and fjords have all been identified as blue carbon stores.[82] Furthermore, the JNCC note that there's significant evidence of blue carbon storage in cold-water coral reefs in overseas territories, and in kelp forests in the Falkland Islands.[83]

On a wider level, there are ocean-related techniques which have an impact on climate change, although may not obviously be included in the standard definition of blue carbon. Dr Phil Williamson notes the importance of *"tidal energy extraction"*[84] in areas such as North Wales and Cardiff. These types of solutions – falling into blue carbon's wider remit – can provide benefits to coastal communities and deliver types of clean energy.[85] This is further corroborated by Sustainable Inshore Fisheries Trust (SIFT)'s inquiry response, who note the *"untapped potential"* of marine renewable energy capacity.[86]

Photo credit: The Ocean Agency/Ocean Image Bank

[77] Wildlife and Countryside Link and Northern Ireland Marine Taskforce Inquiry Submission August 2022
[78] The Wildlife Trusts Inquiry Submission August 2022
[79] Dr Emma Cavan and Mark Beeston Inquiry Submission August 2022
[80] Blue Marine Foundation Inquiry Submission August 2022
[81] Kelp Forest Foundation Inquiry Submission August 2022
[82] Wildlife and Countryside Link and Northern Ireland Marine Taskforce Inquiry Submission August 2022
[83] Joint Nature Conservation Committee Inquiry Submission August 2022
[84] Dr Phil Williamson, University of East Anglia Inquiry Submission August 2022
[85] Dr Phil Williamson, University of East Anglia Inquiry Submission August 2022
[86] Sustainable Inshore Fisheries Trust Inquiry Submission August 2022

Photo credit: Lee Jeffs/Unsplash

Community impact

There is a great emphasis on the role of local communities when it comes to ocean-based solutions to climate change. This refers not only to the impact that local residents have on their local environment, but also the huge benefits and potential that ocean-based solutions can have on coastal communities, industry, economy, and social aspects – solutions which *"benefit local communities by educating and empowering them."*[87]

A significant benefit that ocean-based solutions have on coastal communities is employment. The National Oceanography Centre references the potential of investment which can *"provide coastal communities with jobs in ecosystem restoration"*, alongside tourism and fishing benefits.[88] Professor William Austin refers to the *"job-creation and upskilling"* related to ensure "sustainable use of the coastline."[89] Hugh Venables, an oceanographer at British Antarctic Survey discusses the "*extra jobs in the marine environment*" which are created from the construction of wind farms.[90] This is further corroborated by Howell Marine Consulting in their written submission, which gives detail into the types of jobs that are created in the marine and coastal environment. These include conservation projects, fisheries and aquaculture, recreation and tourism, and innovative business opportunities.[91] An important aspect here is that all the potential jobs that can be created from ocean-based solutions do not necessarily require a background in marine biology – as one might expect – and instead can offer work to people with differing levels and types of experience, including project management, community engagement and manual labour.[92]

[87] National Oceanography Centre Inquiry Submission August 2022
[88] National Oceanography Centre Inquiry Submission August 2022
[89] Professor William Austin, Scottish Blue Carbon Forum Inquiry Submission August 2022
[90] Hugh Venables Inquiry Submission August 2022
[91] Howell Marine Consulting Inquiry Submission August 2022
[92] The Wildlife Trusts Inquiry Submission August 2022

Ocean-based solutions also offer the opportunities for technical skill-building, specifically relating to *"seabed mapping activity."*[93] This notion of the technical workforce and skill-building is explored further in the response submitted by Whale and Dolphin Conservation, which notes the *"creation of a new, highly-skilled workforce of individuals"* who are involved in the *"development, measurement, monitoring, management and delivering of ocean-based solution."*[94] Job creation stretches beyond the UK – in their written submission, representatives from the British Antarctic Survey refer to the benefits of ocean and nature-based solutions in terms of monitoring and modelling for *"capacity and job building"* around UK overseas territories, for example, the Falkland Islands.[95]

The Wildlife and Countryside Link and Northern Ireland Marine Taskforce note the huge economic and industrial benefits that ocean-based solutions can provide for local communities, arguing that *"active restoration of blue carbon habitats in itself is a source of job creation."*[96] This evidence notes that by actively restoring saltmarshes, this could lead to a job creation of anywhere between 14 and 74 new jobs per 100 hectares of habitats.[97] The Environment Agency also provides estimates of the benefits from potential job and economic contributions, stating that by increasing native oyster production in Scotland to Pacific levels, it is calculated that around 5% growth would be added to the overall Scottish aquaculture sector. This in turn could potentially create up to 50 full-time equivalent jobs and add an overall £3.5 million gross value.[98]

The importance of job creation in more deprived and less economically viable areas cannot be overstated and is further backed by evidence provided by SIFT, which notes the benefits on "*rural employment"*[99] and Hugh Venables, who states that extra jobs in the marine environment *"are very well placed to help coastal communities that are in need of economic stimulus and diversification of employment opportunities."*[100] This is further reinforced by the Climate Foundation who note the *"multiple economic, societal and environmental benefits"* that ocean-based solutions offer to industry and the economy, including local jobs in more economically disadvantaged regions."[101]

The Whale and Dolphin Conservation also highlight the potential benefits that ocean-based solutions can offer to communities in terms of lifestyle activities, including water sports, diving and sailing, and whale and marine wildlife watching. This in turn provides huge benefits for tourism – the whale and dolphin watching industry, for example, is worth over $2 billion per year.[102]

It is clear that ocean-based solutions and the significant industrial and economic potentials are a huge benefit for coastal communities and should continue to be considered significantly in the government's levelling up priorities.

Blue carbon and ocean-based solutions can provide significant benefits to coastal communities, including jobs, health, lifestyle and tourism. Alongside making a positive impact on resident's living and employment conditions, ocean-based solutions can also future-proof areas against further climate change – the important adaptation aspect of blue carbon. Blue carbon habitats can support growth and sustainability of the ecosystem in the coastal area, which could include services such as flood protection and resilience against erosion.[103] There is, therefore, a necessary and urgent need to ensure that blue carbon and ocean-based solutions are invested in, scaled up, and properly managed and protected, to benefit local coastal communities in a multitude of ways.

[93] UK Hydrographic Office Inquiry Submission August 2022
[94] The Whale and Dolphin Conservation Inquiry Submission August 2022
[95] David Barnes, Simon Morley, Theresa Gossman and Chester Sands, British Antarctic Survey Inquiry Submission August 2022
[96] Wildlife and Countryside Link and Northern Ireland Marine Taskforce Inquiry Submission August 2022
[97] Wildlife and Countryside Link and Northern Ireland Marine Taskforce Inquiry Submission August 2022
[98] Environment Agency Inquiry Submission August 2022
[99] Sustainable Inshore Fisheries Trust Inquiry Submission August 2022
[100] Hugh Venables Inquiry Submission August 2022
[101] The Climate Foundation Inquiry Submission August 2022
[102] The Whale and Dolphin Conservation Inquiry Submission August 2022
[103] Blue Marine Foundation Inquiry Submission August 2022

Key challenges

There are several key challenges which ocean-based solutions and blue carbon currently face. The most pressing and significant challenges relate to the lack of research and understanding, lack of funding, and lack of government attention – which in turn affect the former challenges.

Lack of research and data

A huge and *"critical"*[104] challenge facing blue carbon and ocean-based solutions is the lack of data, research, evidence, and scientific understanding. According to the UKHO, for example, only 24% of the world's oceans are currently mapped to *"modern standards,"*[105] and in their oral evidence, the UKHO highlighted that some areas of the UK have only just very recently been mapped, such as North Cornwall.[106] Evidence provided by Chris Vivian, the Co-Chair of GESAMP Working Group 41 on 'Ocean interventions for climate change mitigation' suggests that there is an *"uncertainty about how much carbon is sequestered by coastal blue habitats."*[107]

The lack of data and research is a problem because the lack of certainty means that the true figures of carbon sequestration from blue carbon ecosystems may be even higher – as evidence provided by the Marine Conservation Society notes, *"it is likely that the marine environment captures more carbon than is currently proved, not less."*[108] Such an oversight means that the true potential of blue carbon may continue to be neglected and overlooked in favour of the better known land-based solutions – such as plants and soil. In fact, sediment traps *"are believed to underestimate total carbon export"* as these are under sampled, sampled on very short time frames, and because active transport is not sampled.[109] As there's less known about ocean-based solutions, this means that the development

Case study

UK Blue Carbon Forum

The UK Blue Carbon Forum was founded to examine and address the role of blue carbon in mitigating climate change. The forum is supported by the Calouste Gulbenkian Foundation and its members include academic institutions, such as the University of Exeter, University of Portsmouth and Swansea University, and organisations such as WWF, RSPB, National Oceanography Centre and Marine Conservation Society. The forum offers a chance to access scientific advice and guidance that can help with the transition towards a structure which accounts for and examines blue carbon ecosystems.

[104] Dr Shaun Fitzgerald, Professor Sir David King, Professor John Taylor, Professor Sasha Turchyn, Dr Oscar Branson Inquiry Submission August 2022
[105] UK Hydrographic Office Inquiry Submission August 2022
[106] UK Hydrographic Office Oral Inquiry Submission October 2022
[107] Dr Chris Vivian, Co-Chair GESAMP Working Group on 'Ocean interventions for climate change management' Inquiry Submission August 2022
[108] Marine Conservation Society Inquiry Submission August 2022
[109] Marine Conservation Society Inquiry Submission August 2022

of carbon dioxide removal, including approaches and technologies, have been mainly *"terrestrially focused."*[110] This is a self-perpetuating issue – the less that is known about ocean-based solutions, the less their benefits are understood, and the less that they then are researched.

Evidence from the National Oceanography Centre posits that *"there are no ocean-based solutions to limit global warming by actively removing carbon dioxide from the atmosphere that are currently ready for implementation,"* other than the conservation and restoration of marine ecosystems which deliver benefits beyond carbon dioxide sequestration.[111] This may seem damning – but scientists at the National Oceanography Centre concede that this is mainly due to a lack of evidence required to safely and effectively implement ocean-based CDR methods, and lack of knowledge around how much carbon these methods can remove or how long they store it for. Once there is more research and understanding, these projects can then be sufficiently funded.

Furthermore, *"large gaps"* in understanding of different types of ocean-based solutions mean that certain approaches, especially ones which are more complex than the more common ones, become even more complex.[112] For example, in his evidence, Chris Vivian notes the uncertainty of open ocean CDR techniques.[113] The National Oceanography Centre also note that any *"absence of verifiable standards or methods for CDR evaluation"* may end up risking and undermining all carbon dioxide removal schemes – meaning that solutions which are already better known, for example, seagrass, saltmarsh and mangrove conservation and restoration, may also end up being impacted on by wider lack of understanding.[114] There is a *"growing body"* of verifiable scientific evidence, according to representatives of the British Antarctic Society, which shows the efficiency of pathways from carbon capture to carbon storage and sequestration – but there is still difficulty in measuring contributions.[115]

Lack of funding

The majority of the written inquiry responses do not feel that there is enough funding and support for research into how the ocean absorbs carbon, with many responding with a clear *"no"* to this question. This is an issue which Professor Callum Roberts feels is felt more broadly within *"many areas of climate-related science."*[116] Financial and funding barriers present a clear obstacle to efficiently and effectively review ocean-based solutions in their efficiency and impact, and in developing science and mechanisms which lead to verifiable scientific and research standards.[117]

[110] Dr Chris Vivian, Co-Chair GESAMP Working Group on 'Ocean interventions for climate change management' Inquiry Submission August 2022
[111] National Oceanography Centre Inquiry Submission August 2022
[112] National Oceanography Centre Inquiry Submission August 2022
[113] Dr Chris Vivian, Co-Chair GESAMP Working Group on 'Ocean interventions for climate change management' Inquiry Submission August 2022
[114] National Oceanography Centre Inquiry Submission August 2022
[115] David Barnes, Simon Morley, Theresa Gossman and Chester Sands, British Antarctic Survey Inquiry Submission August 2022
[116] Professor Callum Roberts Inquiry Submission August 2022
[117] The Whale and Dolphin Conservation Inquiry Submission August 2022

According to the Drop in the Ocean report, referenced in the Whale and Dolphin Conservation inquiry submission, the ocean receives only 1% of climate finance,[118] so there is a keen urgency for additional government and wider private sector funding. Funding into ocean-based solutions is increasing, particularly in more recent years, but this still remains limited.[119] The National Oceanography Centre noted a need to support ocean-based CDR research as part of a longer-term, strategic approach to science funding.[120] Dr Emma Cavan and Mark Beeston note in their submission that NERC recently ran a call for research proposals on open-ocean carbon stores – but these only funded 5 projects worth £250,000 each.[121]

Furthermore, the funding that has been provided by the UK Government is not targeted at all different ocean-based solutions and carbon dioxide removal techniques. For example, the Centre for Climate Repair note that while £100 million has been allocated by the UK Government for greenhouse gas removal, this excludes work in the deep ocean.[122] There needs to be, therefore, government funding which is focused on all levels and types of ocean-based solutions.

Potential government funding could be targeted at a range of different approaches, including data analysis, modelling, experiments, and wider public engagement and research. In doing so, there would be greater understanding of the objectives and benefits of ocean-based solutions, creating a holistic benefit to society.[123]

Case study

Convex Blue Carbon Seascape Survey

The Convex Blue Carbon Seascape Survey is a five-year global programme of research and public outreach that started in April 2022. It will bring together a consortium of researchers led by University of Exeter, in partnership with Blue Marine Foundation and supported by the Convex Insurance Group, to map, gather, research, understand and make publicly accessible high-quality data on seascape blue carbon. The aim of the project is to identify the origins of carbon on continental shelves, and to understand better how it has changed and where the biggest carbon stores are. The team has many ways to approach the surveys, which include: sampling and quantifying seascape carbon in polar, temperate and tropical seas, utilising existing data sources to develop hydrographic models, and carrying out field observations to understand better the role of seascape carbon storage. Over the five years, the survey will be undertaking 16 global expeditions and employing drones, ships, submarines and satellites to sample and record data on the world's shelf seabed carbon stores.

[118] The Whale and Dolphin Conservation Inquiry Submission August 2022
[119] Dr Chris Vivian, Co-Chair GESAMP Working Group on 'Ocean interventions for climate change management' Inquiry Submission August 2022
[120] National Oceanography Centre Inquiry Submission August 2022
[121] Dr Emma Cavan and Mark Beeston Inquiry Submission August 2022
[122] Dr Shaun Fitzgerald, Professor Sir David King, Professor John Taylor, Professor Sasha Turchyn, Dr Oscar Branson Inquiry Submission August 2022
[123] Dr Shaun Fitzgerald, Professor Sir David King, Professor John Taylor, Professor Sasha Turchyn, Dr Oscar Branson Inquiry Submission August 2022

Lack of government attention

The UK Government aims to be a *"Science Superpower,"*[124] but this is not being reached when it comes to ocean science and blue carbon.[125] There was a common feeling amongst the respondents that the UK Government is *"not doing enough to support blue carbon or blue carbon projects."*[126] Dr Phillip Williamson states that the UK Government support for blue carbon projects is *"extremely low, verging on the negligible or non-existent."*[127]

Evidence provided by the National Oceanography Centre noted that while the UK was one of the first countries to produce a significant overview of carbon dioxide removal (CDR) techniques with the Royal Society's 2009 report,[128] since that time UK research funding into ocean-based CDR approaches has not kept pace with initiatives in either the US or the EU.[129]

Even within the UK Government oceans community, there seems to be a "lack of coordination" in relation to data standards and operational activity – this means that the data collection itself is not always done so in a collaborative, coordinated and efficient way.[130]

Clearly, the lack of scientific confidence around blue carbon and ocean-based solutions, including coastal vegetated ecosystem restoration and ocean-based CDR techniques, impacts the amount of funding and government understanding paid to these issues. These three barriers are all connected, and only with an urgent increase in understanding, will funding and government investment into projects follow.

Photo credit: Jeff Hester/Ocean Image Bank

[124] Lords Select Committee, Science and Technology (2022), 'Science and technology superpower: more than a slogan?', available at: https://publications.parliament.uk/pa/ld5803/ldselect/ldsctech/47/4704.htm#_idTextAnchor004
[125] Dr Emma Cavan and Mark Beeston Inquiry Submission August 2022
[126] MyOcean Resources Inquiry Submission August 2022
[127] Dr Phil Williamson, University of East Anglia Inquiry Submission August 2022
[128] Royal Society (2009), 'Geoengineering the climate: science, governance and uncertainty', available at: https://royalsociety.org/-/media/Royal_Society_Content/policy/publications/2009/8693.pdf
[129] National Oceanography Centre Inquiry Submission August 2022
[130] UK Hydrographic Office Inquiry Submission August 2022

Need for change

Blue carbon and ocean-based solutions are one of the most important tools in the battle against climate change, despite receiving less attention than land-based solutions. According to the National Oceanography Centre's submission, the IPCC's 2022 report into the Mitigation of Climate Change Summary for Policymakers notes that *"the deployment of carbon dioxide removal (CDR) to counterbalance…residual emissions is unavoidable if net zero greenhouse gas emissions are to be achieved."*[131] There is overwhelming proof and evidence that the ocean has a significant potential to remove, store and sequester carbon dioxide, which can mitigate climate change and lessen the severity of some of the consequences. It is worth reiterating that in order to effectively manage and tackle climate change, all decarbonisation tactics need to be deployed in a holistic, collaborative manner – that is to say, blue carbon and ocean-based solutions are not the only solution and must be used in tandem with other decarbonisation solutions.

Yet, it is clear that blue carbon habitats which could provide ocean-based solutions are being destroyed. Evidence provided by the Blue Marine Foundation shows a prediction that, over the last 50-100 years, over a third of global blue carbon ecosystems have been degraded or destroyed, with estimated continuous losses occurring at a rate of 0.1% to 3% per year. Most shockingly, perhaps, over 90% of seagrass – one of the most popular and most understood forms of blue carbon – has been lost over the past 30 years.[132]

Furthermore, these solutions – in contrast to land-based carbon stores, such as forests, plants, and soil – are overlooked, underfunded, and poorly understood. Better and long-term research, data and mapping, and government funding, leadership, and sustainable policies, must be supported in order for blue carbon and ocean-based solutions to realise their full potential.

Restoration, protection and maintenance

Despite signing the Convention on Biological Diversity to restore at least 15% of degraded ecosystems by 2020, the UK fell short of the target.[133] Marine ecosystems and environments – particularly seagrass and saltmarshes – are continually degraded, and restoration and protection efforts are small.[134] Restoration projects, for example of saltmarshes, have the potential to deliver blue carbon solutions – and contribute to the UK's climate change mitigation, according to Colin Scott.[135]

International trials and projects are starting to lead the way into marine environment restoration. A seagrass bed restoration project in Chesapeake Bay in America, for example, has succeeded in restoring eelgrass and bay scallops in that area.[136] There are many similar restoration efforts already taking place in the UK, for example, native oyster farms in the Orkney Islands and Portsmouth.[137] Much more support and scaling of these restoration projects are needed to tackle mammoth degradation, however.

[131] National Oceanography Centre Inquiry Submission August 2022
[132] Blue Marine Foundation Inquiry Submission August 2022
[133] National Oceanography Centre Inquiry Submission August 2022
[134] National Oceanography Centre Inquiry Submission August 2022
[135] Colin Scott, ABPmer Inquiry Submission August 2022
[136] Virginia Institute of Marine Science, Seagrass Restoration, available at: https://www.vims.edu/research/units/programs/sav1/restoration/index.php and Environment Agency Inquiry Submission August 2022
[137] Environment Agency Inquiry Submission August 2022

Seagrass is particularly vulnerable to bottom trawling and dredging, a form of industrial fishing, which can result in the destruction of marine ecosystems and the disturbance of seabed carbon stores.[138] In fact, seabed trawling could release up to 20 million tonnes of carbon, and trawling activities could cost the UK economy additional £1 billion over 25 years, just within the Marine Protected Areas.[139]

There is an overwhelming urgency among the respondents to protect marine carbon stores by creating *"no trawl or dredge zones"* in particularly vulnerable areas.[140] Specifically, there are calls for bottom trawling and dredging to be banned in all Marine Protected Areas,[141] and to create Highly Protected Marine Areas (HPMAs), where any disturbance of the seabed is banned. These should be located in areas which are *"carbon-rich and vulnerable to disturbance."*[142] Essentially, the HPMAs should have much stricter protections, and all MPAs should be well-managed and continually monitored, with the ability to restore and protect marine ecosystems.[143] Howell Marine Consulting note that MPAs, when well-managed and coherent, could alleviate other pressures and challenges such as "pollution, over-exploitation, and habitat destruction", highlighting the multitude of benefits.[144]

Case study

ReSow UK Project

Restoration of Seagrass for Ocean Wealth (ReSOW UK) is a project that brings together teams from the National Oceanography Centre, Swansea University and the University of Stirling, and is funded by SMMR (Sustainable Management of UK Marine Resources). It includes collaboration between principal scientists, political bodies, and NGOs, all focused on seagrass management restoration in the UK. The project will include the collection of data to fill gaps, field measurements, and the development of online tools to enable integration of seagrass into sustainable marine management. An aspect of the project is to explore the efficiency of seagrass meadows at storing and sequestering carbon in the UK context, but the project also focuses on other issues that are not only carbon related, such as fisheries and habitats for fish species. The purpose of the project is to promote long-term recovery and enhancement of the natural environment, to mitigate climate change, and to meet UK Net Zero goals.

Research, data and mapping

Many of the respondents note the discrepancies between terrestrial carbon stores, such as plants and soil, and ocean and blue carbon stores, in reference to research and understanding. For example, the UK has invested in research for terrestrial carbon stores such as peatlands, but there has not been the same investment made towards submerged peatlands.[145]

[138] Marine Conservation Society Inquiry Submission August 2022
[139] Marine Conservation Society Inquiry Submission August 2022
[140] Sustainable Inshore Fisheries Trust Inquiry Submission August 2022
[141] Blue Marine Foundation Inquiry Submission August 2022
[142] Sustainable Inshore Fisheries Trust Inquiry Submission August 2022
[143] The Wildlife Trusts Inquiry Submission August 2022
[144] Howell Marine Consulting Inquiry Submission August 2022
[145] The Wildlife Trusts Inquiry Submission August 2022

There are some national mapping projects which exist and are very welcome signs of progress being made. For example, the UK recently launched the UK Centre for Seabed Mapping, created by the UKHO, which seeks to utilise the UK's expertise in seabed mapping, nationally and internationally.[146] In their oral evidence, the UKHO noted the significant number of organisations who have already signed up to this. To better realise the potential of project, the UKHO state in their written submission that the UK Centre for Seabed Mapping could better establish coordination with national and international stakeholders *"with proper support from the UK Government."*[147]

An overwhelming majority of the respondents to the inquiry note that blue carbon habitat mapping is needed in the UK's Exclusive Economic Zone, the area of sea under territorial ownership of a single country. The UK's EEZ is the fifth largest in the world and compromises exclusive economic zones around the UK, the Crown Dependencies and the British Overseas Territories. The UK's EEZ in Europe is around 773,000 km^2, but if blue carbon habitats were mapped across the whole of the UK's EEZ – including in the UK's Overseas Territories – this would represent nearly 7million km^2,[148] highlighting the magnitude of including blue carbon habitat mapping to the whole of the UK's EEZ.

The Climate Foundation notes the potential benefits of including blue carbon habitat mapping in the UK's EEZ, which could see the UK *"play a leading role in funding and examining some of the key scientific and monitoring, report and verification challenges"* to scale up the blue carbon approaches.[149] Dr Phil Williamson posits that there is a *"well-recognised scientific and societal need for comprehensive geomorphological, biogeochemical and ecological mapping of the seafloor in the UK EEZ."*[150] High-resolution mapping could allow greater understanding of vulnerability of different seabeds and sediments and should be expanded both on inshore waters and more offshore areas.[151] Furthermore, detailed research could look at long-term consequences of carbon which may be displayed from blue carbon stores, and what the impact of climate change is on blue carbon habitats.[152] Mapping could also allow a greater understanding of the impacts of other marine processes, such as energy, dredging and fishing, and these could then be assessed or changed in a *"carbon change perspective."*[153] There is a strong sense among the respondents that in order for the UK to achieve Net Zero, mapping and quantifying the impact of blue carbon habitats is hugely necessary.[154]

The Scottish Association for Marine Science, funded by WWF-UK and in collaboration with the Wildlife Trusts and the RSPB, leads the Blue Carbon Mapping project. This builds on a similar blue carbon mapping project which began in Scotland and aims to understand how much carbon is stored in and sequestered by UK marine habitats.[155] The work is currently underway, and results are likely to be published by Summer 2023. Such a project shows the need and potential for detailed mapping to be undertaken to inform the scientific community, government, and decision makers. Furthermore, there is an appetite for multi-disciplinary approach for blue carbon research, which could include all major relevant players in the field.[156]

[146] UK Hydrographic Office Inquiry Submission August 2022
[147] UK Hydrographic Office Inquiry Submission August 2022
[148] National Oceanography Centre Inquiry Submission August 2022
[149] The Climate Foundation Inquiry Submission August 2022
[150] Dr Phil Williamson, University of East Anglia Inquiry Submission August 2022
[151] Sustainable Inshore Fisheries Trust Inquiry Submission August 2022
[152] The Wildlife Trusts Inquiry Submission August 2022
[153] David Barnes, Simon Morley, Theresa Gossman and Chester Sands, British Antarctic Survey Inquiry Submission August 2022
[154] Dr Emma Cavan and Mark Beeston Inquiry Submission August 2022
[155] The Wildlife Trusts (2022), 'Scientists embark on world-first study to reveal carbon stored in UK seas', available at: https://www.wildlifetrusts.org/news/scientists-embark-world-first-study-reveal-carbon-stored-uk-seas
[156] British Geological Survey Inquiry Submission September 2022

There are some projects which currently map coastal vegetated habitats. For example, the Environment Agency maps saltmarsh in England and maintains the national seagrass inventory.[157] Therefore, while blue carbon should be included in all of the UK's EEZ, this should be done in a co-ordinated, collaborative way to avoid any duplication.

Research into all ocean-based solutions and CDR techniques, including those targeted at the deep ocean, is desperately needed to understand the full risks and benefits of each approach. As Samantha Deane from Kelp Forest Foundation notes in her response, *"you can't manage what you don't measure,"* highlighting the importance of measuring and understanding blue carbon approaches for future environmental and climate change policy.[158] This research should be coordinated at both a national and global level[159] and requires cross-departmental and joined-up thinking. There are currently no agreed criteria to guide research required to adopt ocean-based CDR applications at a large scale. In its evidence, the National Oceanography Centre also urged that the government adopt a code of conduct for CDR research strategies, along the lines proposed by oceanographers in a June 2022 World Economic Forum article, to guide and govern research and strategies into ocean-based carbon removal and storing strategies.[160] The code of conduct would support the following aims:

"1) prioritise collective benefit, 2) establish responsibility, 3) commit to open and cooperate research, 4) perform evaluation and assessment and 5) engage the public."[161]

Many of the respondents to the inquiry also state that the government should include blue carbon habitats within the UK Greenhouse Gas Inventory. The Environment Agency in particular specify that saltmarsh and seagrass should be added to the Inventory, which would allow *"long-term, real time continuous monitoring"* of carbon sequestration and greenhouse gas emissions of these habitats.[162] Howell Marine Consulting note that inclusion of blue carbon ecosystems in the UK GHG inventory should also include commitments and targets for restoration and protection of blue carbon in the fourth UK National Adaptation Programme under the UNFCCC, which is due in 2023.[163]

Ocean-based solutions which are deployed at scale require high-tech and enhanced ocean monitoring and modelling capabilities. Improvements in satellite and eDNA technology are needed for scaling up ocean-based solutions, for example. However, while expanding and enhancing high-technology solutions are essential, the Blue Marine Foundation note that "the singularly most effective nature-based solution in the sea is to leave parts of it alone," and advocate for creation of MPAs and HPMAs as a way to do so.[164]

A co-ordinated, joined-up and collaborative approach into measuring and monitoring is a key priority. This would mean that the process is standardised, and measuring is uniform across all areas.

[157] Environment Agency Inquiry Submission August 2022
[158] Kelp Forest Foundation Inquiry Submission August 2022
[159] National Oceanography Centre Inquiry Submission August 2022
[160] National Oceanography Centre Inquiry Submission August 2022
[161] World Economic Forum (2022), 'Why we need a code of conduct for ocean-based carbon dioxide removal', available at: https://www.weforum.org/agenda/2022/06/ocean-carbon-dioxide-removal-code-of-conduct/
[162] Environment Agency Inquiry Submission August 2022
[163] Howell Marine Consulting Inquiry Submission August 2022
[164] Blue Marine Foundation Inquiry Submission August 2022

Government action and leadership

There is a keen need for collaborative, co-ordinated and joined-up leadership and thinking when it comes to blue carbon and ocean-based solutions. Colin Scott, notes that there needs to be *"clear leadership and direction"* on the issue, and that although there are a wide range of leading scientists, organisations, NGOs and researchers doing work in this area, *"there is no focus or consensus"* on the wider approach.[165] Groups, such as the UK Blue Carbon Forum and DEFRA's new Blue Carbon Evidence Partnership, offer a way to *"share understanding, highlight research gaps and coordinate action."*[166] There is also a desire for many of these coordinated strategies and policies to come from UK Government top down. For example, Howell Marine Consulting advocate for a "*UK-wide Blue Carbon Strategy"* which would avoid siloed decision making and would ensure joined-up thinking on blue carbon strategy.[167] Colin Scott also notes the urgency of a *"central voice with clear messaging"*, a voice which the APPG for the Ocean believes could, and should, be represented and created within top-level government, such as a Minister for the Ocean role.[168] The APPG for the Ocean recently sent an open letter to the Prime Minister, advocating for this position to be created within UK Government. There is a keen urgency among stakeholders and parliamentarians for a specific Minister for the Ocean position in UK Government which would have direct and exclusive responsibility for all ocean issues. These positions are currently held in other European countries, such as Portugal and France, and there is a need for this level of direct and clear leadership within UK Government too.

It is key that all UK Government departments are aligned, coordinated and collaborative on blue carbon, climate, and biodiversity policies.[169] The UK Government, as leader of the GOA, is advocating for the 30b30 target, to meaningfully protect at least 30% of UK and overseas territory waters by 2030. Alongside the 30by30 recognition, the Wildlife Trusts also advocate for *"managed realignment plans to realign 10% of England's coasts by 2030,"* which would create over 6,000 ha of blue carbon habitat.[170] The APPG for the Ocean advocate that this is extended to 20% - and that by 2030, in 8 years' time, 20% of the UK's coasts are re-aligned and restored.

The National Oceanography Centre advocates for the government to prioritise funding into ocean-based CDR approaches which are outlined in the US National Academies of Sciences, Engineering and Medicine report.[171] Strategic and coordinated funding streams can assess the feasibility of implementing ocean-based CDR approaches, which may result in the ocean's enhanced capacity to absorb and store carbon. These include:

1. Iron, nitrogen or phosphorus fertilization
2. Artificial upwelling and downwelling
3. Electrochemical ocean CDR approaches
4. Seaweed cultivation
5. Ocean alkalinity enhancement
6. Ecosystem recovery[172]

There is also a sense from all the inquiry responses that government funding is currently lacking into the research, development, and restoration of blue carbon and ocean-based solutions. For example, Professor Callum Roberts notes that while he's leading a $15 million, five-year programme, the Convex

[165] Colin Scott, ABPmer Inquiry Submission August 2022
[166] The Wildlife Trusts Inquiry Submission August 2022
[167] Howell Marine Consulting Inquiry Submission August 2022
[168] Colin Scott, ABPmer Inquiry Submission August 2022
[169] The Wildlife Trusts Inquiry Submission August 2022
[170] The Wildlife Trusts Inquiry Submission August 2022
[171] National Oceanography Centre Inquiry Submission August 2022
[172] US National Academies of Science, Engineering and Medicine report (2022), 'A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration', available at: https://nap.nationalacademies.org/read/26278/chapter/1

Seascape Survey, these sort of projects need to be expanded and developed by government sources too.[173] Specifically, Dr Emma Cavan and Mark Beeston note that BEIS and UKRI should be doing more to fund research in the area, for example, *"a large budget to fund cross-disciplinary research."*[174] They also argue that other government departments, such as the MoD, could also fund research into blue carbon and ocean-based solutions.[175] There are some projects which are currently supported by BEIS funding – notably the SeaCURE project based at the University of Exeter, and the FCDO support for overseas surveys carried out by Cefas,[176] but Paul Halloran notes that *"rapid progress"* is needed for research and funding around large-scale, rapid and cost-effective carbon storage projects.[177]

Many of the key policy points which are discussed within the inquiry submissions are linked to, and rely on, each other. For example, a comprehensive blue carbon map – supported by blue carbon habitats' inclusion into the UK's EEZ – will make it possible for blue carbon ecosystems to be included in UK GHG inventories, due to sufficient evidence, data and understanding on the topic. Once included into the inventory, this will also make it easier for the management and protection of blue carbon habitats and ecosystems.[178] Research and mapping is needed first, before funding can be provided.

Both the oral and written evidence submitted to the APPG for the Ocean's inquiry show the clear need for greater research, awareness and funding for blue carbon and ocean-based solutions to climate change. The ocean offers a key opportunity for climate change mitigation and adaptation, and to continue overlooking or ignoring these solutions, or any destruction of these habitats, will only speed climate change and its negative consequences. Blue carbon and ocean-based solutions should not only focus on protection of the more common and better understood habitat types – saltmarshes, seagrass and mangroves – but should also include research into ocean-based CDR approaches. The APPG for the Ocean wants to ensure that research and understanding is further developed into blue carbon and ocean-based solutions, which can then provide a greater impetus for adequate government funding, and private sector investment.

The APPG has listed several key recommendations below which we believe should be urgently fulfilled by UK Government.

Case study

UK Blue Carbon mapping project

Building on the blue carbon mapping that has already begun in Scotland, the UK Blue Carbon mapping project aims to better understand the UK's blue carbon habitats. Thanks to this project, the UK will become the first country to produce a complete map of its blue carbon stores. The project is led by the Scottish Association for Marine Science (SAMS) and funded by WWF-UK in collaboration with The Wildlife Trusts and RSPB. The Blue Carbon Mapping Projects aims to address the scientific blind spot while also working towards a better understanding and protection of the UK's blue carbon habitats. Scientists will assess the carbon storage and sequestration potential of all UK seas, as well as within the Marine Protected Areas (MPAs).

[173] Professor Callum Roberts Inquiry Submission August 2022
[174] Dr Emma Cavan and Mark Beeston Inquiry Submission August 2022
[175] Dr Emma Cavan and Mark Beeston Inquiry Submission August 2022
[176] Dr Phil Williamson, University of East Anglia Inquiry Submission August 2022
[177] SeaCURE Project Inquiry Submission August 2022
[178] Howell Marine Consulting Inquiry Submission August 2022

Key recommendations

1. Blue carbon habitat mapping to be included in UK's EEZ
2. No trawl or dredge zone in the UK MPAs
3. Establish Highly Protected Marine Areas
4. Government should include more aspects of marine carbon storage and sequestration into UK Greenhouse Gas Inventory
5. Government to adopt code of conduct into ocean-based carbon dioxide removal
6. Government to prioritise funding into ocean-based CDR approaches
7. Government to re-align and restore 20% of UK's saltmarsh and seagrass habitatsb by 2030
8. Creation of a Minister for the Ocean role in government

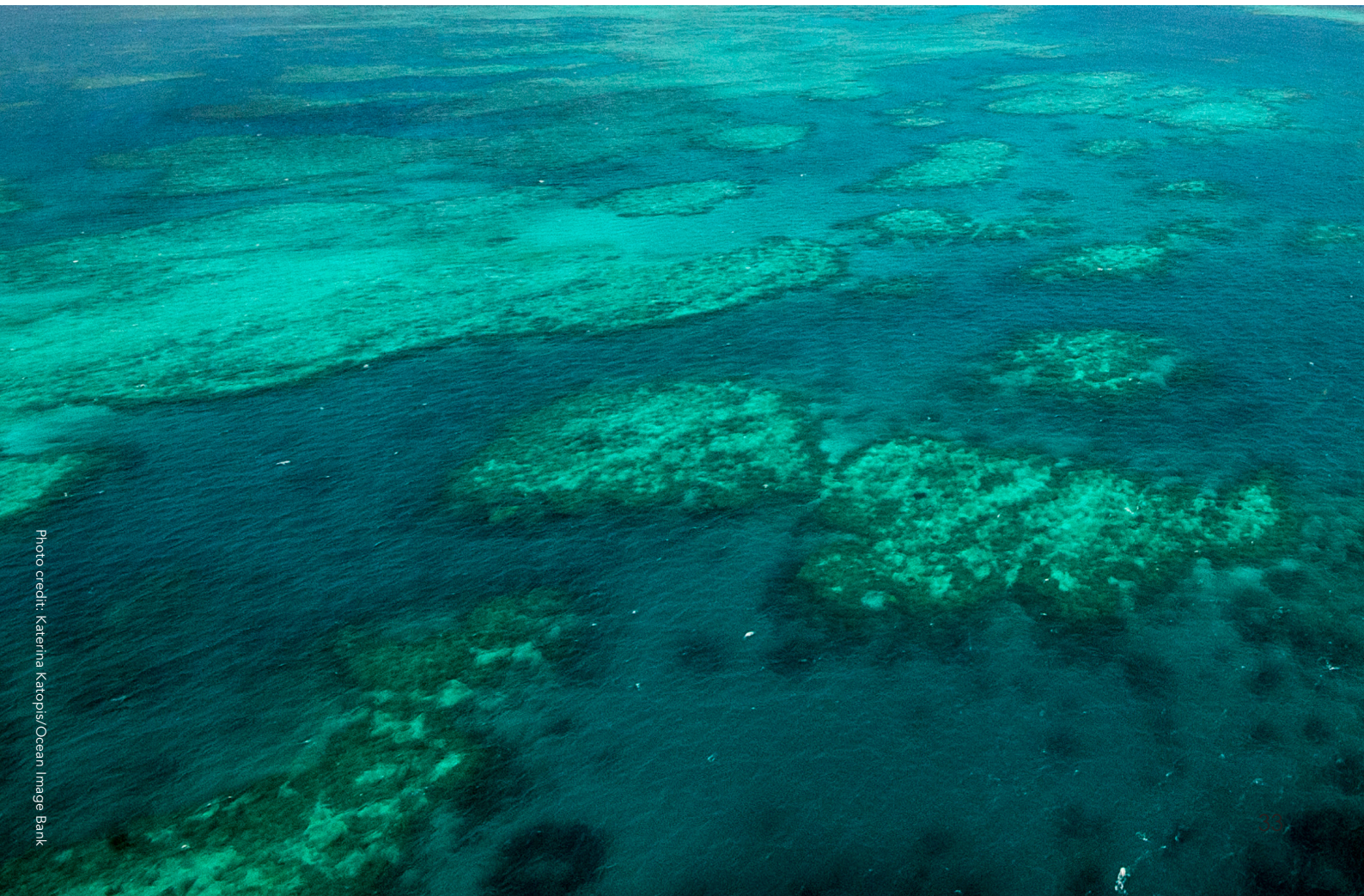

Photo credit: Katerina Katopis/Ocean Image Bank

Appendices

List of written evidence inquiry questions:

1. What role can ocean-based solutions play in tackling climate change?
2. Do you feel that the Government is doing enough to support blue carbon and blue carbon projects? What action would you like them to take?
3. What kinds of ocean/nature-based solutions would you like to see implemented and how would they benefit a) coastal communities, b) flood prevention, and c) tackling climate change?
4. Do you feel that there is enough funding and support for research into how the ocean absorbs carbon?
5. What is the net benefit (carbon stored minus carbon used) for each Blue Carbon approach and for how long is the carbon stored in the ocean in each case?
6. Do you agree with the recommendation by the Lords Science and Technology Committee, in its report "Nature-based solutions: rhetoric or reality?", that blue carbon mapping is needed in the UK's exclusive economic zone?
7. What additional benefits might the implementation of nature-based solutions in the marine environment bring such as skills training, capacity-building, sustainable development, and job creation?
8. Carbon dioxide removal (CDR) ideas are also being discussed for the open ocean, beyond the continental shelves, as well as for the coastal zone (e.g., US National Academy report). How do the benefits, risks and costs compare if CDR techniques were applied to each of these parts of the marine system?
9. How do the lack of verifiable standards of data and scientific evidence hinder investments in blue carbon projects across coastal and deep ocean components of the marine ecosystem?
10. What kinds of engineering solutions could contribute to scaling up and increasing the feasibility of nature-based solutions in marine environments?

List of organisations and representatives who submitted written evidence to the inquiry:

- Blue Marine Foundation
- British Geological Survey
- Chris Vivian: Co-Chair GESAMP Working Group 41 on 'Ocean interventions for climate change mitigation'
- Colin Scott: ABPmer
- David Barnes, Simon Morley, Theresa Gossman and Chester Sands: British Antarctic Survey
- Dr Emma Cavan: Imperial College London, and Mark Beeston: Fair Carbon/Gallifrey Foundation
- Dr Georgie Sowman: GP North East England and Co-Founder Healthcare Ocean
- Dr Paul Gilliland: Marine Management Organisation
- Dr Phillip Williamson: University of East Anglia
- Dr Shaun Fitzgerald: Centre for Climate Repair at Cambridge, Professor Sir David King: Centre for Climate Repair at Cambridge, Professor John Taylor: University of Cambridge, Professor Sasha Turchyn: University of Cambridge, Dr Oscar Branson: University of Cambridge
- Environment Agency: Estuaries and Coasts Planning team
- Howell Marine Consulting
- Hugh Venables: British Antartic Survey
- Joint Nature Conservation Committee
- Kyran Graves: University of Plymouth
- Marine Conservation Society
- MyOcean
- National Oceanography Centre
- Olivia Rendon: Plymouth Marine Laboratory
- Professor Callum Roberts: University of Exeter
- Professor William Austin: Scottish Blue Carbon Forum
- Samantha Deane: Kelp Forest Foundation
- SeaCURE
- Sustainable Inshore Fisheries Trust
- The Climate Foundation
- The Wildlife Trusts
- UK Hydrographic Office
- Whale and Dolphin Conservation
- Wildlife and Countryside Link and Northern Ireland Marine Taskforce

APPG for the Ocean

All-Party Parliamentary Groups are informal groups of Members of both Houses with a common interest in particular issues. The views expressed in this report are those of the group. Tendo Consulting Ltd are funded by the National Oceanography Centre to act as the Secretariat to the APPG.

The APPG for the Ocean was founded to provide a collective space where all parliamentarians can support and promote ocean research and awareness, to develop greater understanding of the ocean and its role in tackling challenges such as climate change, and to debate wider issues.

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