



UK Blue Carbon Evidence Partnership Evidence Needs Statement

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Department
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Foreword from the Chair of the Partnership



As Chair of the UK Blue Carbon Evidence Partnership (UKBCEP), I am pleased to support the Partnership in delivering on its commitment to set out priority evidence needs for blue carbon for the four nations of the UK. Developed by the UKBCEP members and drawing on the significant wealth of science, policy and delivery expertise in each administration, this Evidence Needs Statement (ENS) clearly articulates the shared evidence requirements across the UK and serves as a call to action for the research community both in the UK and internationally.

The ENS outlines the key areas where we want to work together, to collaborate and deliver innovative research to help enable the management, protection, enhancement, restoration and creation of these important habitats. This will support the UK's collective net zero and biodiversity ambitions and help towards building resilient, vibrant and healthy coastal and marine habitats as nature-based solutions to the benefit of nature and people. The accelerating rate of global climate change, the global biodiversity crisis, and the UK's commitments made at the UN Climate Change Conference (COP26) and the UN Biodiversity Conference (COP15) provide context for the urgency of this work.

In developing this ENS, I have welcomed the positive engagement I have had, particularly with the UK Blue Carbon Forum and the Scottish Blue Carbon Forum and look forward to working with both groups, researchers, the partners and the wider blue carbon community, drawing on the expertise of the UK's world-leading environmental science, social science and economic sectors to deliver collectively on our blue carbon ambitions.

I look forward to working with you all as we develop opportunities to deliver against these evidence needs.

Professor Graham J.C. Underwood, University of Essex

Chair of the UK Blue Carbon Evidence Partnership

Executive Summary



Executive Summary

The UK's marine and coastal ecosystems offer a range of benefits to people and nature. They provide nursery grounds for a variety of fish species, absorb contaminants and nutrients to improve water quality, create a buffer against sea level rise, flooding and coastal erosion, and capture and store organic 'blue carbon'.

In the UK, blue carbon habitats typically refer to saltmarsh and seagrass (and mangroves in the UK Overseas Territories)¹, although other habitats are being investigated for their potential, so we include them within this Evidence Needs Statement.

The UK Blue Carbon Evidence Partnership (UKBCEP) recognises the important benefits of blue carbon habitats. However, there remain significant evidence gaps where improved understanding would support our commitments to managing, protecting and restoring blue carbon habitats as a nature-based solution and enable us to better build blue carbon into policies across the UK. Addressing these gaps will also contribute to the global knowledge base and help ensure that international blue carbon action is underpinned by robust science and research, driving positive outcomes for climate, nature and people.

The UKBCEP supports partners to work together to coordinate and progress the evidence base for blue carbon habitats across the whole of the UK. To support our policy developments, we are calling for further research, development and evidence via this Evidence Needs Statement, which will be used to shape collaboration across and between partners, while signalling our shared priority areas and key evidence gaps to the wider blue carbon community.



¹ These are the only blue carbon habitats where guidance from the Intergovernmental Panel on Climate Change exists for their inclusion in national inventories

The Partnership has identified the following five interconnected blue carbon objectives where further evidence is needed to support the UK in advancing our blue carbon commitments:



Working towards the potential inclusion of saltmarsh and seagrass in the UK Greenhouse Gas Inventory



Encouraging and enabling investment in blue carbon habitats



Reducing the impacts of human and environmental pressures, including climate change risks, on blue carbon habitats



Managing coastal and marine habitats on a seascape scale, with consideration of land and marine connectivity



Achieving climate change mitigation, adaptation and biodiversity benefits from blue carbon habitats as nature-based solutions

The specific evidence needs can be grouped into five key interconnected themes to support these blue carbon objectives:



1. Standardised Methods and Quality Control



2. Habitat Mapping



3. Carbon Stock, Accumulation, Burial and Emissions Data



4. Impacts of Human Activities and Climate Change



5. Socio-Economic Benefits and Costs

The Partnership will work together with the blue carbon community to develop plans and strategies to mobilise new research, share knowledge to meet these evidence needs and to push for positive change in marine and coastal environments.

Introduction



1. Introduction

The UK's blue carbon habitats

As the UK Blue Carbon Evidence Partnership (UKBCEP), we recognise that well managed blue carbon habitats can be highly biodiverse, nature-based solutions providing a suite of ecosystem services and benefits to people and nature, including supporting climate change mitigation, adaptation and resilience.

The Intergovernmental Panel on Climate Change (IPCC) defines blue carbon as organic carbon² stored in coastal and marine habitats that can be managed³ to increase carbon sequestration or prevent Greenhouse Gas (GHG) emissions, although we appreciate the importance of blue carbon habitats' full range of ecosystem services as nature-based solutions.

There is a wide spectrum of blue carbon habitats around the world that we recognise as significant, and we advocate for greater research and understanding of them all. The blue carbon habitats of priority interest to the UKBCEP and UK policy include saltmarsh, seagrass, marine sediments and macroalgae (kelp forests). We also welcome further knowledge on habitats whose potential are still being explored, including biogenic reefs and calcifying aggregations, intertidal mud flats, sand dunes, machair and lacustrine systems. The evidence needs, unless noted otherwise, apply to all blue carbon habitats in the UK.

Across some habitats, there have been significant historic losses, including up to 85% coverage loss of saltmarsh in the UK over recent centuries, largely owing to modification by drainage, land use change, decreasing water quality and increasing seabed disturbance⁴. As such, there is a need for focus on evidence for both the restoration of degraded or recreation of lost blue carbon habitats, as well as the adapting to, and mitigating the impacts of, climate change, lowering greenhouse gas emissions in sea-food production and supporting our Net Zero commitments.



² "Organic carbon" is referred to throughout as "carbon"

³ IPCC (2019), [Special Report on the Ocean and Cryosphere in a Changing Climate, Chapter 5](#)

⁴ Wildlife and Countryside Link (2022), [Tackling the climate crisis through ocean protection](#)

The UK Blue Carbon Evidence Partnership

The UKBCEP was announced at COP26 in Glasgow in 2021 and was established in 2022. It brings together science and policy experts from across the UK Administrations, including: the Department for Environment Food & Rural Affairs, the Department for Energy Security and Net Zero, the Scottish Government, the Welsh Government and the Department of Agriculture, Environment and Rural Affairs in Northern Ireland. The aim of the Partnership is to enable the UK to have a joint and robust shared scientific understanding of blue carbon and to advance the UK's shared commitments to managing, protecting, enhancing and restoring blue carbon habitats.

The blue carbon community of researchers, funders, third sector organisations, international forums and the public sector are working hard to increase knowledge and action for blue carbon habitats. There are, however, still evidence gaps, or areas where evidence requires coordination. To inform this future work, the UKBCEP, assisted by its secretariat, will identify and address key blue carbon research questions by supporting coordination between the administrations to encourage progression of the UK's evidence base on blue carbon.

This Evidence Needs Statement clearly establishes these key blue carbon research questions and was developed through each of the partners assessing their current policy priorities and evidence gaps for the full range of blue carbon habitats, then working alongside public bodies to produce a shared set of evidence priorities. We recognise that there are multiple types of evidence that can support us in addressing these research questions, so we have developed benchmarks for assessing the quality and robustness of evidence that would support the integration of blue carbon into UK policy.



Blue Carbon Objectives



2. Blue Carbon Objectives

The UKBCEP shares an overarching aim to progress the collective evidence base to help manage, protect, enhance and restore blue carbon habitats. To support this aim, five key blue carbon objectives have been identified where further evidence is needed:



Working towards the potential inclusion of saltmarsh and seagrass in the UK Greenhouse Gas Inventory (UK GHGI)



Encouraging and enabling investment in blue carbon habitats



Reducing the impacts of human and environmental pressures, including climate change risks, on blue carbon habitats



Managing coastal and marine habitats on a seascape scale, with consideration of land and marine connectivity



Achieving climate change mitigation, adaptation and biodiversity benefits from blue carbon habitats as nature-based solutions



Working towards the potential inclusion of coastal wetlands in the UK GHGI

The UK GHGI contains estimates of GHG emissions and removals associated with human activity. Voluntary guidance⁵ exists on how to include coastal wetlands (including saltmarsh and seagrass) in national inventories, but robustly including these habitats is currently a challenge in the UK. In part, this is due to significant UK wide data gaps on emissions from managed coastal wetlands, activity data such as extraction activities, and changes in habitat extent, all of which hinder accurate reporting. In the UK, the overall potential contribution to emissions reductions from coastal wetlands is small due to their limited habitat extent.

⁵ IPCC (2013), [Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands](#)

Policies across the UK government and devolved administrations include saltmarsh and seagrass within unquantified policies that could deliver further GHG emissions savings in the future. Through the UKBCEP, all the partners will work together to produce a roadmap for potential inclusion of coastal wetlands in the UK GHGI, prioritising the inclusion of saltmarsh before seagrass, as the mitigation potential from saltmarsh is higher and there is already a greater availability and strength of evidence and data for saltmarsh carbon storage and sequestration potential. The evidence gaps include the identification of data requirements and preferred data collection methods that will enable both the more accurate monitoring of these habitats and provide greater reliability in the recording of their GHG emissions and removals, which will also better inform wider blue carbon considerations into policy.



Encouraging and enabling investment in blue carbon habitats

Funding from both the private and public sector, can support the management, protection, enhancement, restoration and creation of blue carbon habitats across the UK. The development of blue carbon markets can help direct investment towards blue carbon initiatives. However, for investment in such markets to grow, participants need to have clarity and confidence in the principles and standards that should be used to structure investments. Clarity is also needed on the governance arrangements to ensure that new, emerging markets will operate transparently and deliver benefits for nature, the economy and local communities. Frameworks and principles across the UK government and devolved administrations provide a set of criteria and policy guardrails for the development of new nature markets.

We are looking to improve our evidence base on the business models, costs, benefits and return on investment for projects that manage, protect, enhance, restore and create blue carbon habitats, as well as improving understanding of measurement, reporting and verification activities for blue carbon markets. This will help to inform policy decisions about which habitats would benefit the most from different management actions, as well as facilitating the development of blue carbon markets.



Reducing the impacts of human and environmental pressures on blue carbon habitats

Environmental or direct human pressures on blue carbon habitats, including the exacerbating effects of climate change, can reduce the beneficial ecosystem services these habitats provide, or even produce damaging effects, such as through releasing sequestered carbon. Having a greater awareness of the risks to blue carbon habitats, including to existing carbon stores⁶, can be used to better inform how pressures can be reduced, and contribute to the management of these habitats as nature-based solutions.

The UK needs to develop a more detailed understanding of the response and sensitivity of natural and restored blue carbon habitats, including their ecosystem services, to numerous human and environmental pressures under various conditions, such as those we might see under different climate change scenarios. Developing this evidence base will help inform policy decisions around adaptation responses to climate change risks, protected area designation and marine and coastal management more generally.



Managing coastal and marine habitats on a seascape scale

Applying whole systems approaches to managing blue carbon habitats, such as natural capital and seascape approaches, will facilitate greater understanding of their environmental and socio-economic interactions and value. Improving our understanding of the dynamics and interconnectivity between blue carbon habitats allows us to consider them as part of a unified and interlinked system, creating a view that considers benefits, interactions and trade-offs across land and marine management policy areas.

To facilitate this holistic seascape approach, the UK needs to increase its understanding of how blue carbon habitats interact dynamically with other ecosystems around them, such as carbon flows across marine, terrestrial and atmospheric sources. We also need to establish a better understanding of how the specific ecosystem services provided by blue carbon habitats are affected by the conditions of their surrounding environment. This will support the integration of blue carbon considerations into a range of other policy areas that consider the terrestrial, coastal and marine environments.

⁶ Identified as a “Priority Risk Area” in the [UK Climate Change Risk Assessment 2022](#)



Achieving multiple benefits from blue carbon habitats as nature-based solutions

The effective and adaptive management, protection, enhancement, and where appropriate, restoration and creation of blue carbon habitats, can help us to benefit from their full range of ecosystem services. These vary between the habitats, but range from being biodiverse, wildlife rich environments that can provide nursery grounds for commercial fish species (such as cod and sea bass), to improving the resilience of coastal areas to sea level rise and coastal erosion, as well as reducing flood risk. Saltmarshes and seagrass also trap sediment and absorb contaminants which can improve local water quality, while blue carbon habitats' other services include capturing and storing carbon, supporting nutrient cycling to maintain other ecosystems and serving as recreational spaces which local communities can enjoy.

Developing the evidence base for a natural capital approach for blue carbon habitats can increase our understanding of the value of the diverse range of ecosystem services they provide in support of nature, the economy and society. This increased understanding will help inform UK approaches to how we manage and use these habitats as nature-based solutions to the challenges presented by climate change and biodiversity decline. Further developing the evidence base in this area can help the UK meet various national and international climate and biodiversity objectives as well supporting more effective policy decisions on how we adapt to the impacts of climate change. This includes how England, Scotland, Wales and Northern Ireland, through their National Adaptation Programmes, can better respond to the risks and opportunities as identified by the Climate Change Risk Assessment⁷.



⁷ HMG (2022), [UK Climate Change Risk Assessment 2022](#)

Evidence Needs



3. Evidence Needs

The Partnership has categorised the evidence needs required to address our overarching aim and objectives under the following five themes:



1. Standardised Methods and Quality Control



2. Habitat Mapping



3. Carbon Stock, Accumulation, Burial and Emissions Data



4. Impacts of Human Activities and Climate Change



5. Socio-Economic Benefits and Costs

The specific evidence needs relating to each of the themes are detailed below. They should not be considered in isolation as there are significant synergies that can be achieved through the linking of multiple evidence needs.

The relative priority and evidence to date across these themes varies between the UK administrations and there are many projects across the blue carbon community that have addressed or are working to address some of these evidence needs; however, this work may only be applicable to a specific administration or habitat. Hence, we recognise the need for partnership and effective collaboration to ensure that we collate, supplement and develop the existing evidence base to enable a unified UK wide evidence approach for the full suite of relevant blue carbon habitats.



The UKBCEP recognises that there are multiple types of evidence and a range of these are required to address the needs and gaps outlined in this statement to inform policy development. We use the term 'evidence' to encompass material from a variety of disciplines: scientific research, statistics, economics, social research or operational research and geographical information. Evidence should be fit for purpose and adhere to established codes of practice for research, that includes engaging with local knowledge holders and early career professionals⁸ where possible. The overall quality of evidence will be assessed by the Partnership against the following benchmarks:

- **Reputable:** Evidence to address our needs should be from credible sources, including published literature, official government reports, NGO reports, website databases and other grey literature where deemed appropriate.
- **Reliable:** There should be high confidence of robust provenance, with a preference for peer reviewed evidence, a complete list of cited references and/or familiarity of the source or project to the Partnership.
- **Relevant:** Evidence should be specific to the need it is hoping to address, with robust undertaking of research and a focus on the UK blue carbon habitats of most interest.



⁸ In line with the actions of the [United Nations Decade of Ocean Science for Sustainable Development](#)



1. Standardised Methods and Quality Control

Currently, a range of different methodologies and definitions exist and so the Partnership encourages consensus across the UK blue carbon community, with alignment towards international best practice. By having clear guidance on standardised approaches and quality control measures, we can increase the effectiveness of how separate groups collaborate and share data with one another across various projects, increase confidence, consistency and accuracy of the evidence base and develop more formalised reporting and accounting on blue carbon habitats. This is particularly critical for better understanding these habitats' ecosystem services and supports the UK GHGI objective.

The specific needs identified are:

- a. Cost effective and repeatable approaches for surveying and monitoring habitats' extent and condition change over time, supporting UK GHGI work and informing habitat mapping activities that assess how habitats adapt to climate change.
- b. Standardised approaches with appropriate quality control measures for sampling, analysing and reporting carbon stocks and GHG fluxes (accumulation rate, burial, emissions and removals) from different habitats, under natural, impacted and recovery conditions. These should build upon existing frameworks and manuals. This will facilitate comparison between different habitats across the UK, support existing monitoring of GHG emissions, and contribute to/encourage, where appropriate, the development of Emissions Factors for UK GHGI work.
- c. Cost effective and repeatable methodologies, building on existing metrics where available, to enable the standardised quantification of mitigation, adaptation and resilience benefits of blue carbon habitats and their full range of ecosystem services. This supports the management, planning and design of blue carbon habitats.
- d. Common datasets across different monitoring sites, habitats and regional areas, while enabling fair sharing of this data to support collaboration across the blue carbon community.



2. Habitat Mapping

A range of habitat mapping projects have been conducted across parts of the UK. However, we require coordinated UK-wide maps of each of the blue carbon habitats, incorporating details on the extent and condition, with surveys and ongoing monitoring informing these mapping activities. This baseline information can then be utilised for accounting purposes, for monitoring biodiversity, for assessing how habitats adapt to the impacts of climate change, as well as informing future management approaches.

- a. Annual spatial activity data for habitat creation, enhancement, degradation and loss, including where habitats have been affected by human activities. This supports the monitoring and management of these habitats.
- b. Annual estimates of the extent, condition and restoration success of UK blue carbon habitats. Existing data should first be collated before outstanding data gaps are identified and then filled. This supports the monitoring and management of these habitats.
- c. For blue carbon habitats with potential for inclusion in the UK GHGI, maps of change from a 1990 baseline, drawing on existing data, ongoing monitoring work and new spatial data.
- d. Identification of geographical areas with the greatest need or the largest potential for interventions including the management, protection, enhancement, and where appropriate, restoration and creation of blue carbon habitat. This will support decision making and the effective management of these habitats.





3. Carbon Stock, Accumulation, Burial and Emissions Data

Further evidence is needed to increase confidence in estimates of carbon stock (long term storage of organic carbon within the habitat), accumulation (rate at which subsequent carbon is added to the stock), net-burial (difference between carbon accumulated and the carbon eventually buried/stabilised) and emissions (any GHG that are re-emitted) in blue carbon habitats. Developing a stronger evidence base, which considers a wider range of local conditions and environmental dynamics as part of a seascape approach, will enable more accurate GHG emissions reporting and can inform assessments on the likely impacts of various pressures and management approaches.

The specific needs identified are:

- a. Measurements using standardised approaches to fill data gaps in carbon stock, accumulation, burial and emission rates for a range of natural, managed, impacted and restored blue carbon habitats. This requires the initial collation of existing measurements to identify these data gaps. Measurements should be taken to develop an understanding of the drivers of within-habitat variability for these stocks and rates to provide stratified values (e.g., between zones and at differing latitudes and depths), to support the development of blue carbon codes and the production of country specific (UK wide) and regional emissions factors across blue carbon habitats.
- b. Understanding of carbon dynamics, including seasonality and carbon cycles, on the accumulation, burial and emission capabilities of blue carbon habitats to support a seascape approach to their management.
- c. Understanding of the impacts of additionality, permanence and risk of leakage at natural and restored habitats in support of the work on carbon codes.
- d. Identification of the sources and age of carbon stocks, linking to the need to develop our understanding of flux and transportation pathways on a seascape wide scale, while informing decisions around carbon double counting issues.





4. Impacts of Human Activities and Climate Change

The UK needs a greater understanding of how blue carbon habitats and their ecosystem services, including existing carbon stocks, respond and adapt to different impacts and pressures. Human induced climate change pressures include ocean warming, sea level rise, deoxygenation, ocean acidification, increased storminess and flooding, while direct human pressures include the various forms and methods of fishing, dredging, drainage, onshore and offshore development, grazing regimes, nutrient enrichment, pollution and land management. Developing the evidence base will increase our understanding of their resilience and sensitivity to pressures from the land, sea and atmosphere, as well as their adaptation and mitigation potential, hence helping to inform future management actions

The specific needs identified are:

- a. Continued monitoring of baselines for the vertical and horizontal inland limits of saltmarsh to inform predictions of the impacts of sea level rise and habitat restoration success, which will support blue carbon decision making.
- b. Development of biological indicators and assessment tools to help quantify the health, vulnerability and sensitivity of blue carbon habitats. Subsequently, greater understanding of how blue carbon habitats respond to different management approaches, such as protected area designation and restoration techniques, or how their ecosystem services respond to increased or sustained pressures, all measured against baseline control regions, is needed. Initially, existing data should be collated before further work supplements this evidence need.
- c. Knowledge of the processes involved in potential impacts of seabed disturbance on carbon stocks and GHG emissions. For example, assessment of the fate of resuspended sediment and increased understanding of the role of local sea water chemistry, vertical mixing, and water column production and respiration in controlling vulnerability of carbon stocks. This links to the holistic management of these habitats alongside other marine activities.
- d. Developing understanding of different carbon transport pathways on a seascape scale, including how management plans should adapt to reflect these, with consideration across the interfaces of the land, sea and atmosphere. This supports natural capital approaches and holistic blue carbon management.
- e. Developing greater understanding of the human (social, economic and behavioural) engagement and response to the management, protection, enhancement, restoration and creation of blue carbon habitats. This will support blue carbon decision making through developing a greater understanding of the effectiveness of different management, protection, enhancement, restoration or creation proposals.



5. Socio-economic Benefits and Costs

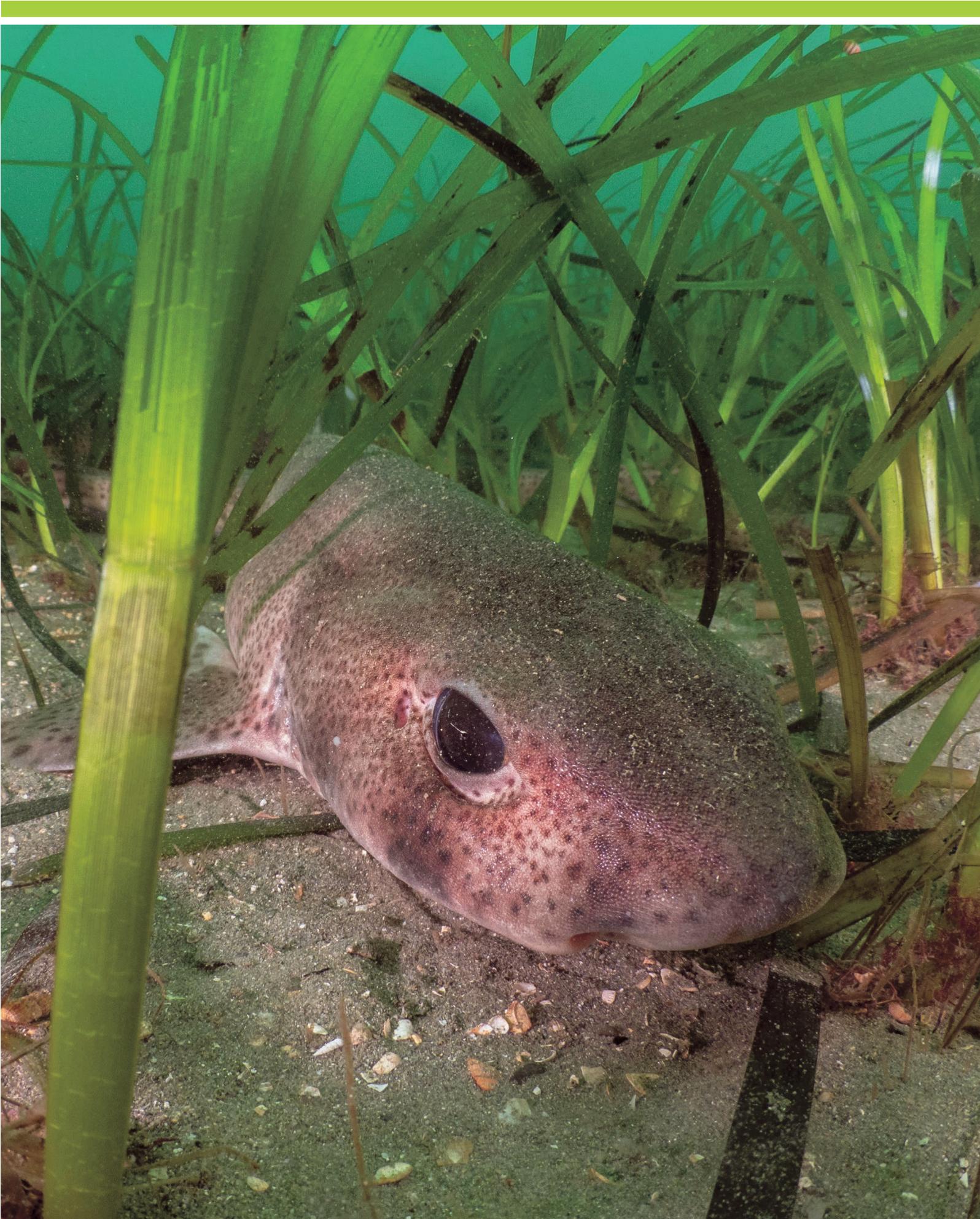
By progressing the UK evidence base on the ecosystem services and the subsequent socio-economic benefits that blue carbon habitats can provide, these will be more reliably understood and quantified. Valuing these benefits could support business cases for financing blue carbon projects, provide greater confidence to potential investors as well as better informing decisions on how to manage blue carbon habitats that may interact with other activities across terrestrial, coastal and marine environments.

The specific needs identified are:

- a. Developing understanding of how concepts, including natural capital approaches, can be used to quantify the social, cultural, environmental and economic benefits of blue carbon habitats as a nature-based solution, at both a local and national scale. Compiling and then building on the existing evidence base will help facilitate coordination with policy interventions that may drive blue carbon management, protection, enhancement, restoration or creation.
- b. Understanding of future costs and revenues of blue carbon projects through further business planning and investment modelling, to support future blue carbon decision making.
- c. Developing understanding of carbon spatial distribution relative to offshore industries and what the consequences of potential management decisions may be for both the habitats and the human activities, supporting a holistic approach to the management of offshore blue carbon habitats.



Opportunities



4. Opportunities

The UKBCEP is committed to working together as a collaborative blue carbon community, across the UK and with international partners, to address our evidence needs and ultimately bring about positive change to our blue carbon habitats to deliver social, cultural, environmental and economic benefits on a local, national and global scale.

The UKBCEP and the Evidence Needs Statement provide an exciting opportunity to work collaboratively at both a UK and an international level, to accelerate action across a number of key areas, and more generally to support the continued protection of marine and coastal environments across the globe.

We acknowledge the large amount of work being undertaken across a range of groups and bodies in the blue carbon space, with expertise that can help the UKBCEP progress its objectives. It will be important for the UKBCEP to develop an understanding of the evolving evidence base to recognise where work underway contributes to filling identified evidence gaps and where new research is required. The UKBCEP is actively seeking opportunities to open discussions with others as well as welcoming input into our own work. Please get in touch [here](#).

Research translation and knowledge exchange is critical to understanding the implications of the research for decision makers, organisations, business and society. The Partnership encourages researchers to consider the various knowledge exchange methods and tools available to ensure research outcomes and implications are communicated to the right audience, at the right time through the right medium to maximise the impact of their work.

The UKBCEP partners will work together with academic and public sector research establishments, research funders, third sector organisations and international forums to develop and share plans and strategies to coordinate, mobilise new research, share innovation and knowledge to meet these evidence needs and to push for positive change in the marine and coastal environments while maximising our collective value.



Acknowledgements

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UKBCEP partners are

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The Centre for Environment, Fisheries and Aquaculture Science (Cefas) provide the UKBCEP secretariat.

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Experts consulted

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