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Natural Resources Wales

Pressures and Impacts on Blue Carbon

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Pressures and Impacts on Blue Carbon

- Impacts can arise from:
  - Human activities
  - Environmental Change
- UK Blue Carbon Evidence Partnership priority to reduce pressures on blue carbon habitats
- Significant knowledge gaps exist on quantifying pressures and impacts on blue carbon stores and consequences for emissions

Priorities

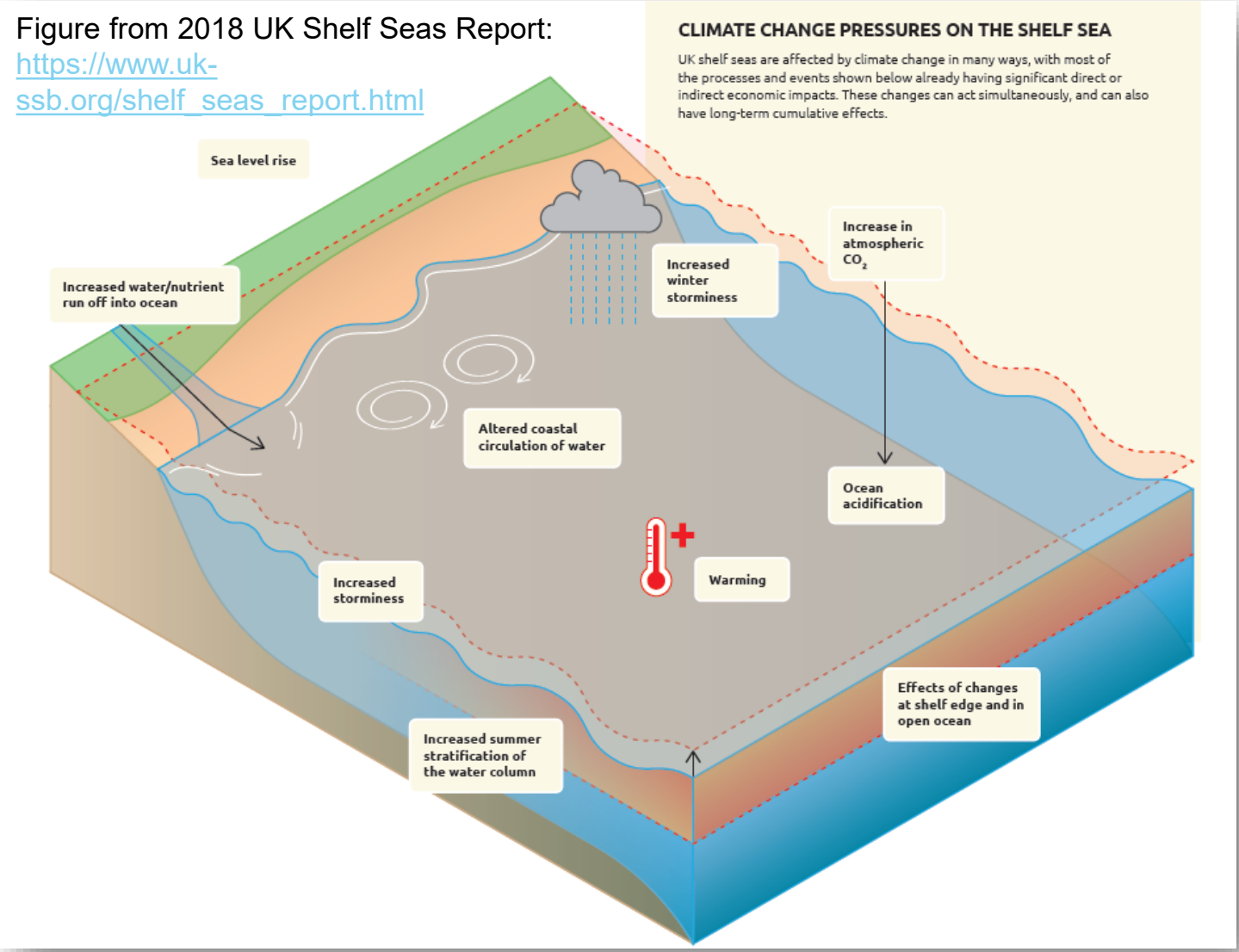
- Working towards the potential inclusion of saltmarsh and seagrass in the UK Greenhouse Gas Inventory
- Encouraging and enabling investment in blue carbon habitats
- Reducing the impacts of human and environmental pressures, including climate change risks, on blue carbon habitats
- Managing coastal 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

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

Impacts of Climate Change on Blue Carbon

Figure from 2018 UK Shelf Seas Report: https://www.uk-ssb.org/shelf_seas_report.html



- >90% of the earth's excess heat, as well as increasing amounts of greenhouse gases have been absorbed by the ocean (IPCC 2019 SROCC report).
- This causes changes in water temperature, ocean acidification and deoxygenation, leading to changes in oceanic circulation and chemistry, rising sea levels, changes in storm patterns, and changes to marine ecosystems.
- Climate change weakens the ability of the ocean and coasts to provide critical ecosystem services such as food, carbon storage, oxygen generation etc.

Impacts of climate change on blue carbon in Welsh SACs

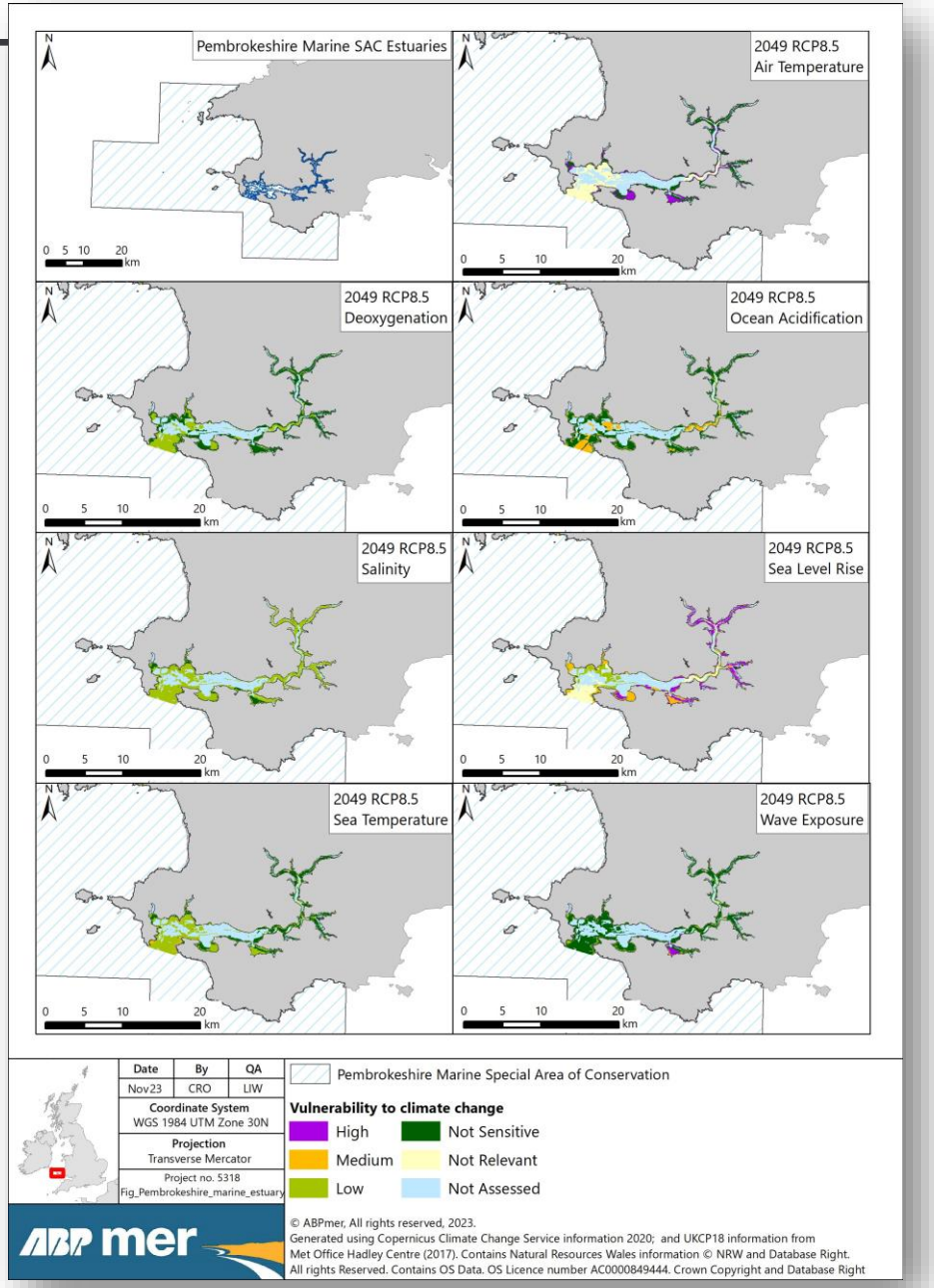
NRW MPA network actions project:

Climate change and blue carbon assessments for Annex 1 features in Wales

Aim: To develop a series of climate change profiles for marine Annex 1 features in Wales, highlighting pressures and risks to both biodiversity and blue carbon, to support the development of future conservation objectives and advice for our SACs.

Outputs:

- Climate Change Vulnerability Summaries for each feature in each SAC in Wales
- Climate-related risks to blue carbon assessed for all features
- Summaries included in the updated Conservation Advice Packages for Welsh SACs



Example: Vulnerability of features to climate change pressures in Pembrokeshire Marine SAC

Impacts of climate change on blue carbon in sites and features across Wales

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Sir Benfro Forol / Pembrokeshire Marine – Atlantic salt meadows

Area of feature m^2: 11511271.06
Biomass standing stock (kg per m^{-2}): 0.190
Soil standing stock (kg (top 10 cm) per m^{-2}): 3.849
Carbonate stock (kg (top 10 cm) per m^{-2}): 3.243
Sequestration (kg yr^{-1} per m^{-2}): 0.077

Table A6. Climate change and blue carbon profile indicating the climate change vulnerabilities (percentage spatial extent of Atlantic salt meadows feature) and consequential vulnerability of blue carbon.

Climate change pressure	Vulnerability: Not relevant	Vulnerability: Not sensitive	Vulnerability: Low	Vulnerability: Medium	Vulnerability: High	Overall climate change vulnerability	Biomass standing stock vulnerability	Soil standing stock vulnerability	Carbonate stock vulnerability	Sequestration vulnerability
Air temperature	0	0	0	0	100	High	High	High	High	High
Deoxygenation	100	0	0	0	0	Not vulnerable	Not vulnerable	Not vulnerable	Not vulnerable	Not vulnerable
Ocean acidification	100	0	0	0	0	Not vulnerable	Not vulnerable	Not vulnerable	Not vulnerable	Not vulnerable
Salinity	0	0	100	0	0	Low	Low	Low	Low	Low
Sea level rise	0	0	0	0	100	High	High	High	High	High
Sea temperature	0	0	100	0	0	Low	Medium	Medium	Medium	Medium
Wave exposure	0	0	0	100	0	Medium	Medium	Medium	Medium	Medium

Summary: The overall vulnerability of Atlantic salt meadows in response to sea level rise and air temperature was deemed as high, a medium vulnerability classification was assigned to wave exposure and a low overall vulnerability score was allocated to salinity and sea temperature, whilst deoxygenation and ocean acidification were deemed as not vulnerable (under a RCP 8.5 scenario – 2049). When considering the feature as a whole across the site, a high vulnerability score was allocated to all blue carbon parameters in response to air temperature and sea level rise. A medium vulnerability score was assigned to all blue carbon parameters in response to wave exposure, whilst salinity and sea temperature had a low vulnerability score across all blue carbon parameters.

Impacts of climate change on blue carbon in sites and features across Wales

Conclusions

Existing mechanisms to deliver protection and enhancement of blue carbon stores include:

- Reducing human pressures to increase resilience
- Identifying opportunities for habitat creation and restoration schemes
- Highlighting blue carbon habitats in the Conservation Objectives for our SACs

Future options could include:

- Development of specific policies / objectives for protection of blue carbon
- Adaptive management of MPAs to allow for climate-induced changes to habitat distribution and ecosystem services

Links to wider recommendations and actions:

- Climate Change Adaptation Plan Actions 18) Use the Welsh National Marine Plan policies to maintain and enhance the resilience of marine ecosystems and the benefits they provide, and 22) Continue to develop our understanding of blue carbon and the role it can play in adapting to future climate change
- R3 of the CCC Briefing on Blue Carbon (2022): The UK government and devolved administrations should continue to strengthen protection and restoration in marine areas, and support efforts to manage marine and coastal ecosystems sustainably in the context of the changing climate, taking due consideration to their carbon value.
- Climate Change Mitigation Opportunity identified in SoNaRR 2025: enhancing blue carbon through protecting and restoring marine and coastal ecosystems

Impacts of Human Activities

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Potential activities and pressures that could damage blue carbon habitats and stores include:

- Demersal trawling
- Offshore developments (e.g. oil and gas installations, power and telecoms cabling, pipelines, offshore renewables)
- Dredging, disposal, aggregate extraction
- Coastal developments (e.g. flood defences, new infrastructure)
- Land management practices (e.g. drainage or grazing of coastal marshes)
- Water quality
- Introduction of Invasive Non-Native Species (INNS) or pathogens

Magnitude of impact depends on nature of activity, associated pressures and habitat type

Significant evidence gaps exist on the fate of carbon in disturbed / impacted habitats

Filling the knowledge gaps

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NRW Marine Programme task and high priority evidence need:

- How do climate change and human activities affect carbon sequestration and storage in the marine environment?

Research work with Wales relevance:

- NRW evidence projects
  - Risks from human activities and management options for blue carbon stores in Welsh MPAs
  - Coastal Squeeze project
- CEFAS research work on carbon in sediments
  - Development of an evidence paper on carbon storage in seabed sediments and potential impacts of bottom disturbance.
  - Collaborative work on understanding organic carbon accumulation, storage and loss in seabed sediments (understanding environmental drivers and potential vulnerabilities).
- Marine Impacts Evidence Group project (CEFAS)
  - Understanding how benthic macrofauna influence seabed carbon stocks and climate regulation
- NERC research project SeaStore (Bangor Uni lead)
  - How do fishing gears, trawling frequency and the sedimentary environment affect the potential for marine sediments to act as a net source of CO2?

Risks to Blue Carbon within MPA features

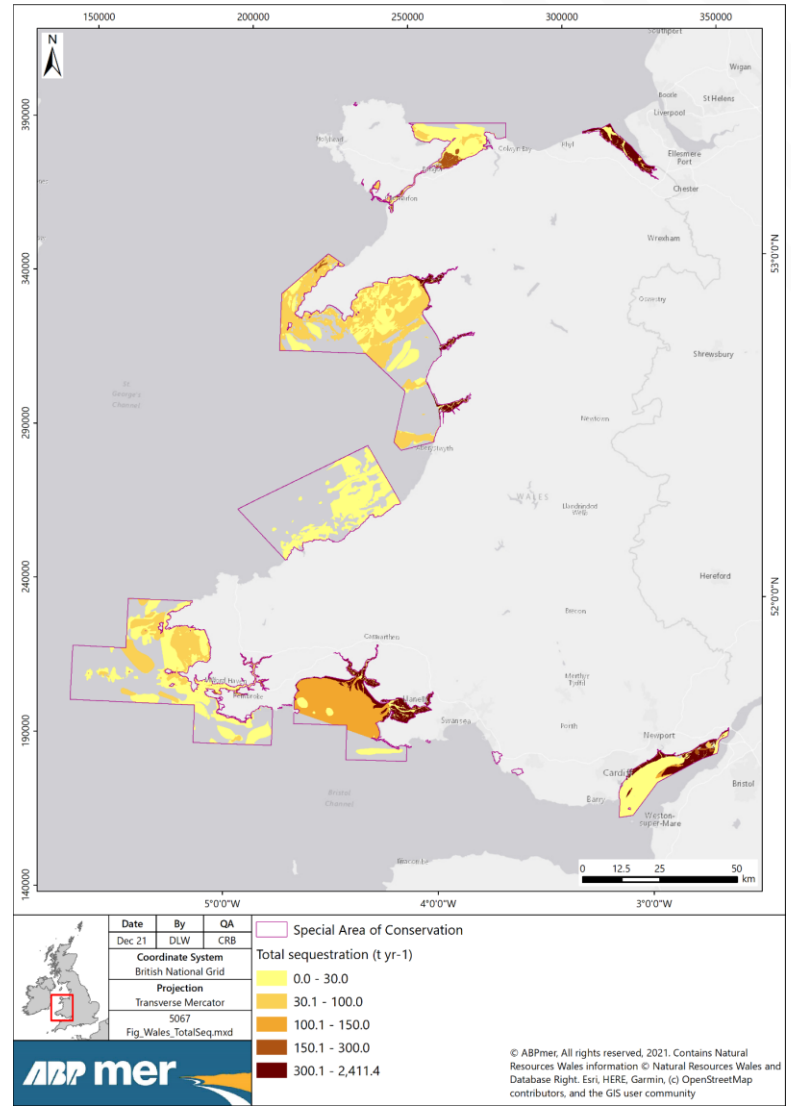
Key objectives:

- Review the most recent literature on carbon storage and sequestration for different marine habitats and features present in Wales;
- Estimate the carbon storage and sequestration potential of Annex I features in the SAC network
- Identify potential risks to blue carbon stored in Annex 1 features
- Review the policy and regulatory pathways to managing and protecting blue carbon using the existing legislative and policy frameworks

Key risks to features:

Blue carbon habitat	Potential pressures for which management could be implemented					
	Water Quality	Grazing	Access and recreation	Fishing	Invasive non-native species	Pathogens and disease
Saltmarsh	✓	✓	✓		✓	
Seagrass	✓		✓	✓	✓	✓
Kelp	✓			✓	✓	
Maerl beds	✓		✓	✓	✓	
Shellfish beds	✓			✓	✓	✓
Sediment habitats	✓		✓	✓		

[Understanding how management of the Welsh MPA network can contribute to the protection and enhancement of blue carbon]



Carbon sequestration of Annex I features across the SAC network

Potential management actions identified for Saltmarsh

Potential management action to protect and enhance blue carbon	Wider ecosystem benefits of management	Feasibility of management approach	Principles of SMNR	Potential SACs where management could be implemented
Management of potential pressure				
Improve water quality	Increased biodiversity; establish potential nursery grounds; reduced erosion	Medium. The source of the pollution must first be identified then management could enforce regulations or provide incentives to reduce sewage outflows and eutrophication.	Evidence; multiple benefits; preventative action	Carmarthen Bay and Estuaries / Bae Caerfyrddin ac Aberoedd Glannau Môn Cors Heli / Anglesey Coast: Saltmarsh Kenfig / Cynffig Pembrokeshire Marine / Sir Benfro Forol
Reduce grazing activity	Improved species richness in birds and plants	High. Grazing has successfully been controlled at several sites by establishing incentives for farmers.	Adaptive management; scale; collaboration & engagement; preventative action	Carmarthen Bay and Estuaries / Bae Caerfyrddin ac Aberoedd Kenfig / Cynffig Pen Llŷn a'r Sarnau / Lleyn Peninsula and the Sarnau
Reduce access and recreation	Reduced disturbance to birds and mammals; reduced trampling pressure on non-target habitats and species	High. Measures may need to be legislative (as well as voluntary) but monitoring of compliance would be recommended. Physical barriers and clear signage could also be used.	Adaptive management; scale; collaboration & engagement; public participation; evidence; multiple benefits; long-term; preventative action	Carmarthen Bay and Estuaries / Bae Caerfyrddin ac Aberoedd Severn Estuary / Môr Hafren
Manage invasive non-native species	Reduce competition with native species; improve native species richness and biomass	Low. Biosecurity most effective approach; management action is often ineffective once species are established.	Multiple benefits; preventative action	More research needed
Habitat restoration and creation schemes				
Sediment recharging	Create or extend saltmarsh habitat; increase bird and fish diversity; create natural coastal flood barrier; provision new habitats for colonization; improve coastal resilience to environmental change	Medium. Evidence of success exists; however site-specific surveys are required to ensure suitability. Requires suitable sediment source, detailed assessments, stakeholder engagement and consenting.	Scale; multiple benefits; long-term; building resilience	Pen Llŷn a'r Sarnau / Lleyn Peninsula and the Sarnau Severn Estuary / Môr Hafren
Habitat creation	Create or extend saltmarsh habitat; increased diversity of fish and bird species; create a natural coastal flood barrier; provision new habitats for colonisation	Medium. Evidence of success exists such as managed realignment; however, feasibility is site-dependent, and often requires purchasing of land, complex assessments, stakeholder engagement and consenting.	Scale; multiple benefits; long-term; building resilience	Pen Llŷn a'r Sarnau / Lleyn Peninsula and the Sarnau Severn Estuary / Môr Hafren
Replanting vegetation	Create or extend saltmarsh habitat; increased species diversity	Medium. Success depends on physical and biological conditions at sites. Natural recolonisation preferred.	Scale; long-term; building resilience	Pen Llŷn a'r Sarnau / Lleyn Peninsula and the Sarnau Severn Estuary / Môr Hafren

Links to relevant reports:

The Blue Carbon Potential of the Marine Protected Area Network in the Welsh Marine Environment

Understanding how management of the Welsh MPA network can contribute to the protection and enhancement of blue carbon

CEFAS Blue Carbon Evidence Programme

Evidence Review: Impacts of human pressures on seabed sediment carbon storage

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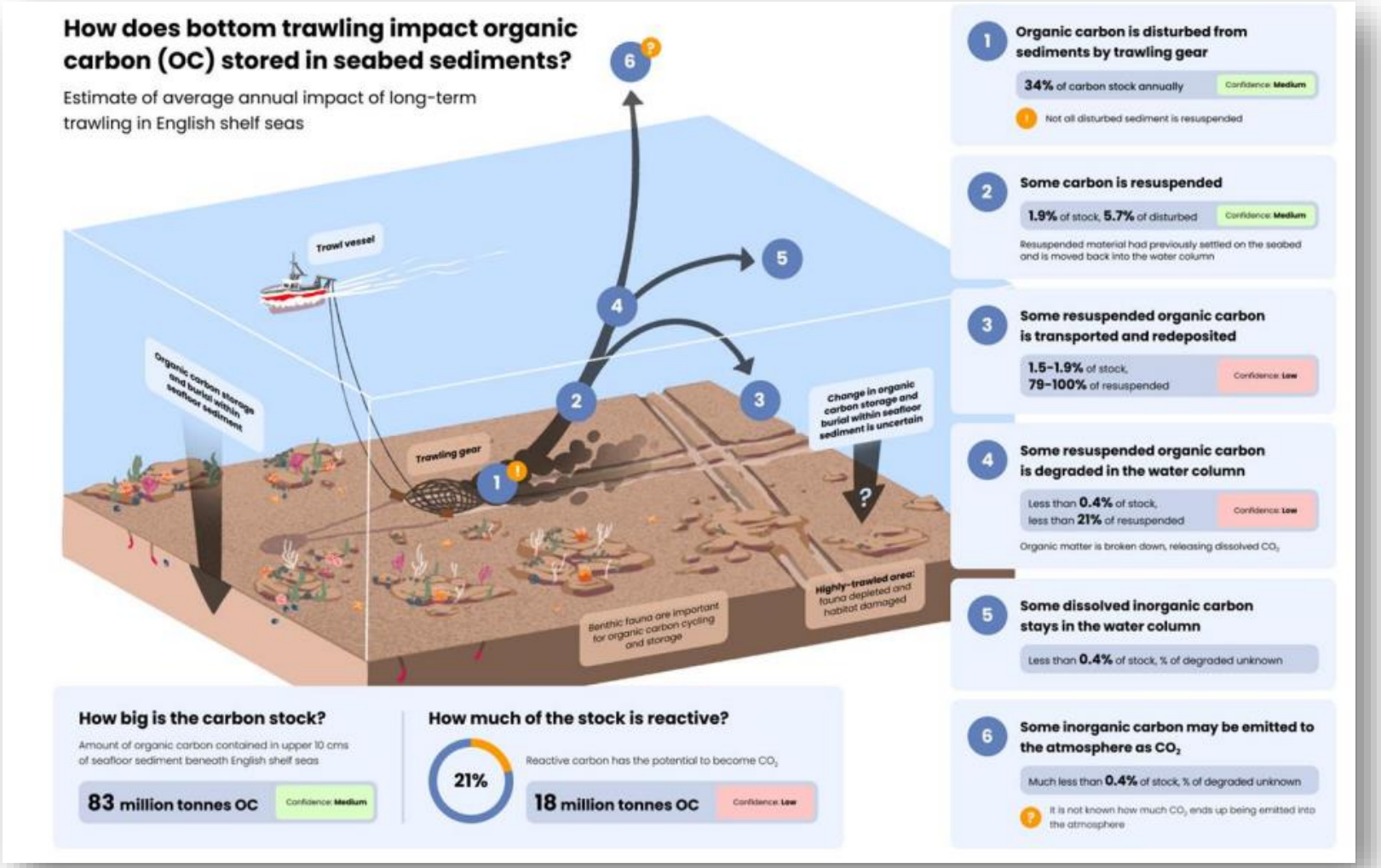

Centre for Environment Fisheries & Aquaculture Science

Cefas

The role of English seabed sediments in carbon storage, impact of human activities, environmental pressures and potential management options: Evidence review

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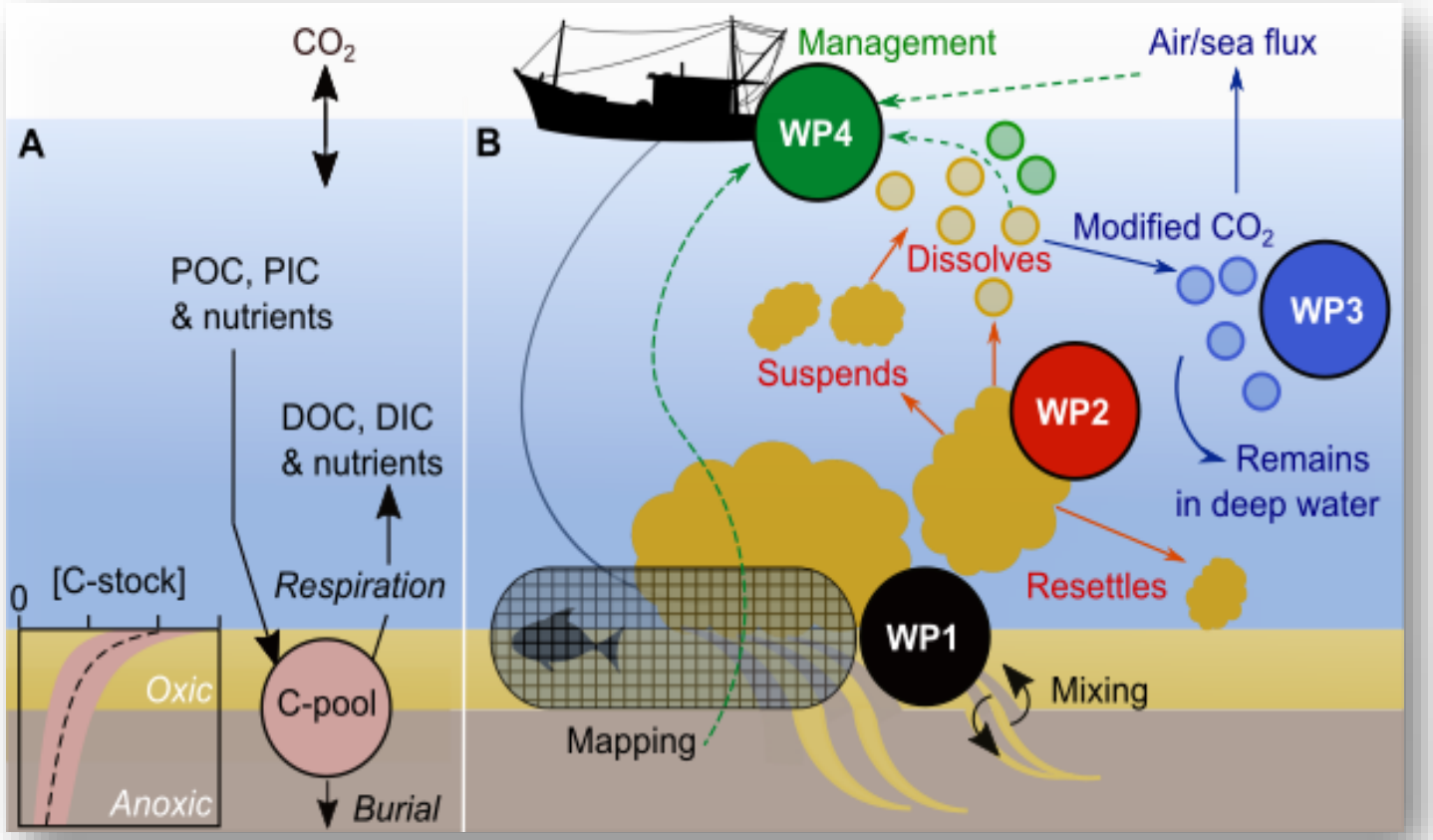
SeaStore

Project will determine how the disturbance associated with bottom trawling modifies C-storage, -cycling and air/sea CO_2 fluxes, providing essential guidance on seabed activity management policies that mitigate climate impacts and help achieve net-zero.



SeaSTORE Stakeholder Workshop
Impacts of bottom trawling on seabed carbon storage

Authors: Paulina Ramirez-Monsalve[1], Lorna McKellar[2], Marija Sciberras[3], Martin Skov2, Ruth Parker[4], Jan Geert Hiddink[2]
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Table 1. Distribution of management scenarios across stakeholder prioritization categories.

Management Scenario	High Priority	Medium Priority	Low Priority	Unacceptable
Spatial management – **Full-area closures to all towed bottom gear**	5	2	1	5
Spatial management – **Gear-specific restricted areas (most impacting gear types)**	4	7	2	0
Spatial management – **Zonation based on carbon sensitivity**	11	1	2	0
Effort management – **Limit days at sea through permits**	0	1	4	9
Effort management – **Swept-Area Ratio (SAR) thresholds. Threshold varying with carbon vulnerability**	0	2	9	2
Temporal management – **Seasonal closures based on risk driven by temperature and stratification**	4	4	7	1
Technical measures – **Gear modifications to low penetration fishing methods**	12	2	2	0
Technical measures – **Total bans on most impacting gear types**	3	2	1	9

C/O Jan Hiddink, Bangor University

Managing impacts via legislative drivers

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Climate Change Act:

- Net zero targets and role of blue carbon as lever for protection

Fisheries Act:

- Joint Fisheries Statement and Fisheries Management Plans: ambitions to reduce emissions, reduce seabed impacts and preserve carbon stocks

UK Marine Strategy:

- Benthic Impacts Reduction Group (linked with fisheries management)

Habitats Regulations / Environment Act / OSPAR:

- MPA designation and management (co-benefits of protection of features and sites)
- Restoration, recreation and enhancement of blue carbon habitats
- State of Natural Resources Reporting (SoNaRR)

Environmental Impact Assessment Regulations

- Scope to include Blue Carbon in climate change assessment elements of EIAs?

Marine and Coastal Access Act

- Marine Planning - Aligning Marine Planning with Climate Smart Principles (Welsh Government)
  - How could embedding climate smart principles in marine planning could afford greater consideration to blue carbon habitats?
  - TCE's Whole of Seabed Approach

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