ReMeMaRe conference 2025

Restoring estuarine, marine & coastal habitats

Posters

Ocean and Coastal Futures

Environment Agency

THE CROWN ESTATE

9 & 10 July 2025 | Scarborough Spa, England

Physical habitat assessment of rivers and estuary margins from source to sea

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A source to sea approach for biophysical habitat assessment: MoRPh Rivers RCA + MoRPh Estuaries

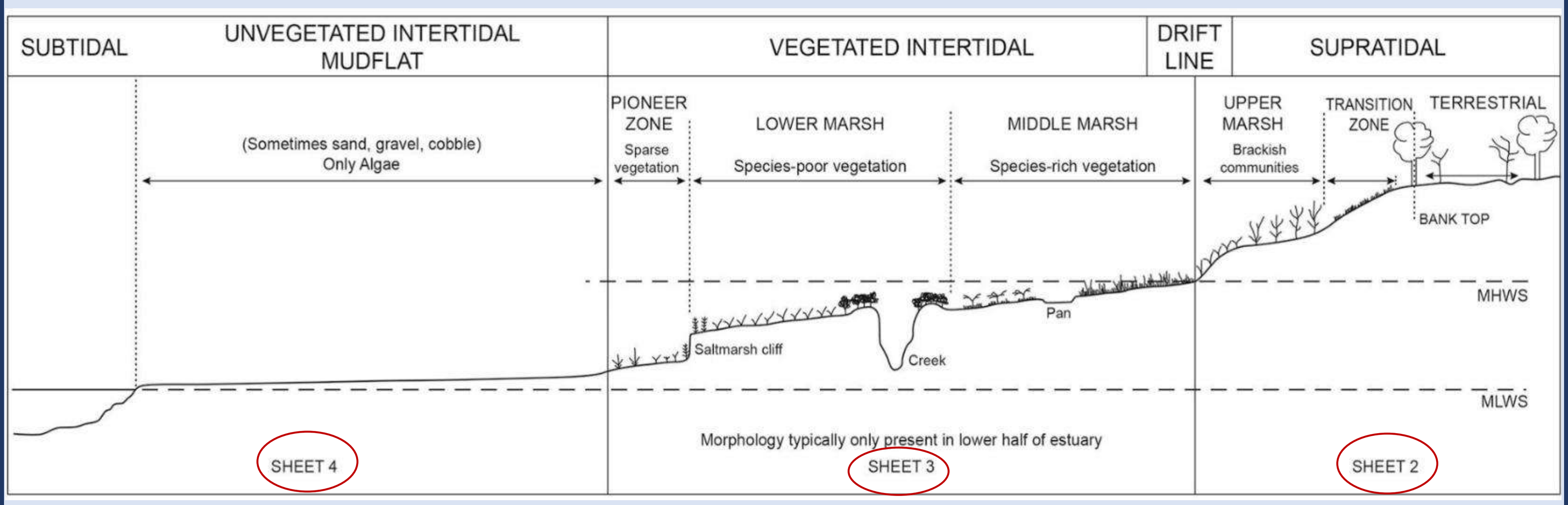
Catchment-based approaches to river assessment and monitoring are strongly advocated.

MoRPh Rivers (for Citizen Science use) and the **River Condition Assessment** (which forms part of the **Watercourse Metric** for Biodiversity Net Gain) are widely used in the UK for non-tidal river reaches (www.modularriversurvey.org)

MoRPh Estuaries (CSci and Pro) are complementary field-based biophysical habitat tools that extend to tidal river reaches and estuary margins and provide a source-to-sea approach.

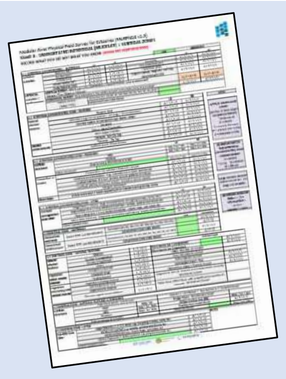
All surveys are supported by the **Cartographer online platform** for data entry, analysis, visualization, and storage. The MoRPh Rivers data base (>6870 approved surveys) is linked to the **CaBA Data Hub**.

Natural estuary – generic cross-section

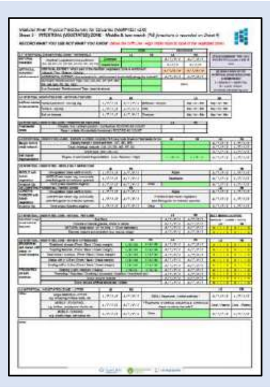


Sheet:

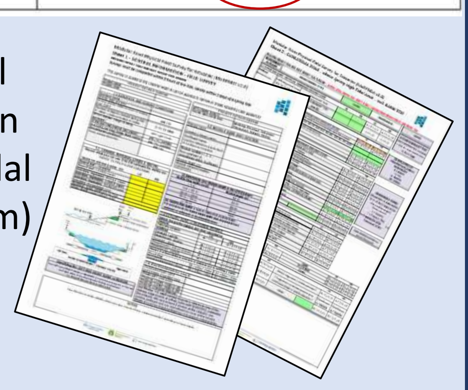
4. Intertidal (unvegetated) & Sub-tidal



3. Intertidal (Vegetated)



1. General information
2. Supra-tidal (within 10 m)



MoRPh Estuaries CSci: baseline assessments in the Wyre Estuary

Stanah saltmarsh holds several protected designations (**SSSI and Morecambe Bay RAMSAR, SAC & SPA**). It covers an area of c. 43ha and is found next to the Wyre Estuary Country Park. Complex biodiversity assemblages are present.

MoRPh Estuaries CSci surveys are providing an **invaluable baseline** dataset of physical habitat condition to support the delivery of the ongoing **Stanah Saltmarsh Restoration Project**, part of the Defra **Our Future Coast** programme, and future monitoring.

MoRPh Estuaries CSci offers a **science-based opportunity for local volunteers** from various backgrounds and organisations (e.g. WRT, Wyre rangers, Blackpool Sea Life, local community, Myerscough College).

MoRPh Estuaries Pro

CBEC Eco-engineering UK Ltd, acting as **lead consultancy**, piloted the **MoRPh Estuaries Pro** methodology across several sites in the **Tyne and Wear Estuaries**, as part of a project commissioned by **Groundwork NE & Cumbria**. CBEC was tasked with developing **estuary enhancement designs** tailored to local site conditions.

Sites ranged from **extensive saltmarsh and mudflats** at **Barons Quay** to **hard-engineered retaining walls** at **Claxheugh**. At Barons Quay, **saltmarsh restoration** involved installing **polder fences** to promote **natural sediment accretion**, raising the **intertidal zone** to support **saltmarsh colonisation**. A visualisation of this design, created by **CBEC's in-house artist**, is shown below.

To inform and evaluate the design process, **MoRPh5 surveys** were conducted at both **restoration** and **adjacent control sites**, providing a **baseline of physical habitat quality**. These surveys will be **repeated post-construction** to assess the success of interventions in terms of **biodiversity uplift** and **habitat condition improvement**.

The MoRPh Estuaries methodology is adept in capturing detail in a wide range of estuarine environments. At Claxheugh, where **vegetated intertidal habitat** is largely absent, **'greening' techniques** such as **Vertipools** and **timber beams** were proposed by CBEC to create **vertical ecological niches** on **artificial walls**. The MoRPh Estuaries indices capture the uplift in biodiversity and physical habitat condition provided by these features, demonstrating their effectiveness across diverse estuarine settings.

Pre-restoration: vertical wall

C6 - Bank face bare sediment extent	0
C7 - Bank face artificial bank profile extent	-355
E4 - Marginal habitat richness	0

Post-restoration (visualisation): vertical wall, bolt-on timbers

C6 - Bank face bare sediment extent	2
C7 - Bank face artificial bank profile extent	-355
E4 - Marginal habitat richness	2

Acknowledgements. We are grateful for support from the QMUL Impact Fund, *The Championing Coastal Coordination (3Cs) initiative,* and Cartographer Studios Ltd and the contributions of the Wyre Rivers Trust, The Rivers Trust, Institute of Fisheries Management; and National Trust. Thank you to all the WRT team and Citizen Science surveyors at WRT.
Want to know more including opportunities for training? Please contact us at: https://modularriversurvey.org/

Local Nature Recovery Strategies

Targeting habitat enhancement and creation opportunities in estuaries and at the coast

What are they?

Local Nature Recovery Strategies (LNRS) are a system of spatial strategies for nature and environmental improvement in England.

They identify locations to create or improve habitat most likely to provide the greatest benefit for nature and the wider environment.

48 strategy areas cover England with no gaps or overlaps.

The responsible authorities leading preparation of the strategies are working with other organisations and partners and seeking input from the people who know and understand the area.

Estuarine and coastal habitats

The strategy areas extend to mean low water, or further around estuaries.

A source-to-sea approach was promoted. Emerging LNRS include actions throughout catchments to improve water quality in rivers which will benefit estuarine, coastal and marine habitats.

25 of the strategy areas have estuarine and intertidal habitats and the emerging strategies identify opportunities to create, restore or enhance them.

How will LNRS be delivered?

LNRS will support targeted, coordinated and collaborative action which will deliver nature recovery and wider environmental outcomes more efficiently.

Delivery of the actions will be a shared effort with public, private and voluntary sectors.

LNRS will help target habitat creation and improvement to meet biodiversity net gain requirements through the 15% 'high strategic significance' multiplier in the metric.

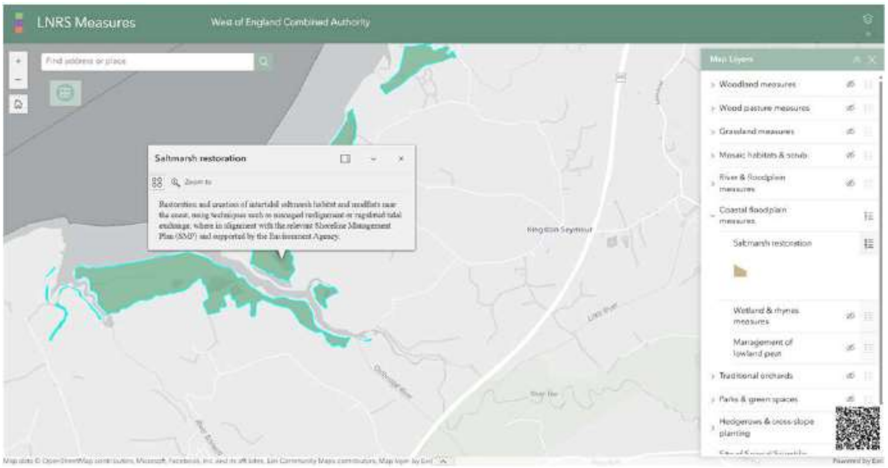
LNRS will inform how public bodies in England meet the legal duty to conserve and enhance biodiversity.

LNRS will provide information to farmers and land managers to help them choose which environmental land management options would be appropriate to their land.

LNRS will inform the preparation of Local Plans. This will enable local authorities to more effectively identify, map and safeguard areas for nature recovery.

LNRS will help leverage and target public and private money for environmental projects - directing funding for specific nature recovery activities and nature-based solutions.

West of England LNRS



Cornwall and Isles of Scilly LNRS

Isle of Wight LNRS

Find out more / get involved

Get involved in preparing and delivering LNRS to help recover nature and the wider environment.

Talk to us about LNRS.

Bethany Lovell

Hannah Hyland

Find out more about LNRS near to you and how you can get involved.

This QR code links to a map of the strategy areas and contact details for the responsible authorities.

Use LNRS to support targeted, coordinated and collaborative actions that will benefit people and wildlife.

Department for Environment Food & Rural Affairs

Environment Agency

Forestry Commission

NATURAL ENGLAND

Version 1 27/06/2025

Coasts In Mind 2024 - 2027

Co-curating community archives, empowering local voices, and mapping coastal change

~ Lawrence Northall ~

Introduction & aims

Coasts in Mind (CiM) is a National Lottery Heritage Fund (NLHF) project, delivered by Museum of London Archaeology (MOLA). Its aim is to better evidence the **effects of anthropogenically induced coastal change** through the knowledge, memories and local archives of coastal communities. Through a bespoke co-designed CiM Mapping Platform, this *community archive* of information will be presented geo-spatially and accessibly online, as well as being available as a downloadable dataset to help inform the understanding of local policymakers.

The methodology has been built in a way that **benefits communities**, with a series of priority audiences targeted in each CiM region, and with social value outcomes linked to audiences and events.

Members of the Upping the Shanty, sea-shanty choir, compose lyrics in response to coastal change as part of a CiM Memory Walk.

Background

Coasts in Mind grew out of the work of CITiZAN (Coastal & Intertidal Zone Archaeological Network), which relied on **local knowledge to help monitor foreshore archaeology** around England. As such, oral history projects became a useful tool for the project (Northall 2019). In 2020 the UKRI Natural Environment Research Council funded *Changing Minds, Changing Coasts* (Hutchinson et al 2021), to map one hundred years of coastal change on Mersea Island, Essex, through local knowledge and locally held historic imagery. Awarded for innovation at the *Archaeological Achievement Awards*, CMCC formed a pilot study for Coasts in Mind and led to the NLHF funding an initial one-year CiM Development Phase.

Recording a Bronze Age trackway on Mersea Island, Essex, for the CITiZAN project. The trackway was identified during an oral history with an Oysterman in 2016.

Regions & partners

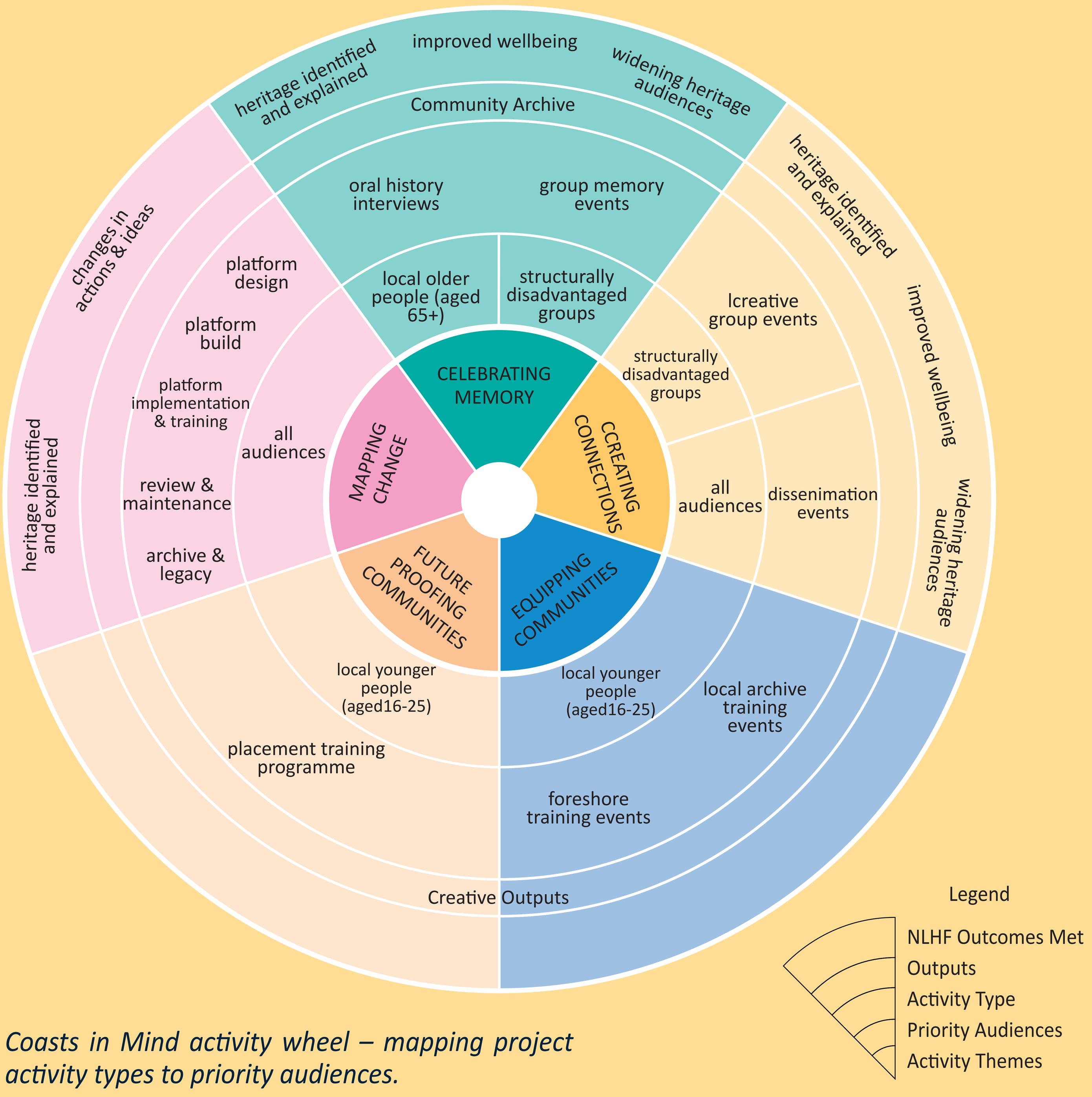
Coasts in Mind's Development Phase tested the project's methods on a national scale and established four regions, now in their active Delivery Phase. Each of these have a Project Officer and Senior Community Archaeologist working with local partners and communities, to co-curate a community archive of data through a series of events.

These are Poole Harbour, Sefton Coast, Swale Estuary and Taw-Torridge Estuary. Alongside various regional partners, CiM's national partners include: Lloyds Register Foundation, Historic England, National Trust and the RNLI.

Audiences, social value, & events

Coastal communities are amongst the most deprived nationally and face some of the **most challenging effects of climate change**. These include coastal retreat, flooding, increased storm frequency and the impact of certain forms of environmental decline on coastal industries and economies. Through consultation with project supporters, three target audiences were identified for CiM's Delivery Phase, each relating to specific events, social value aims and community partner organisations. These are:

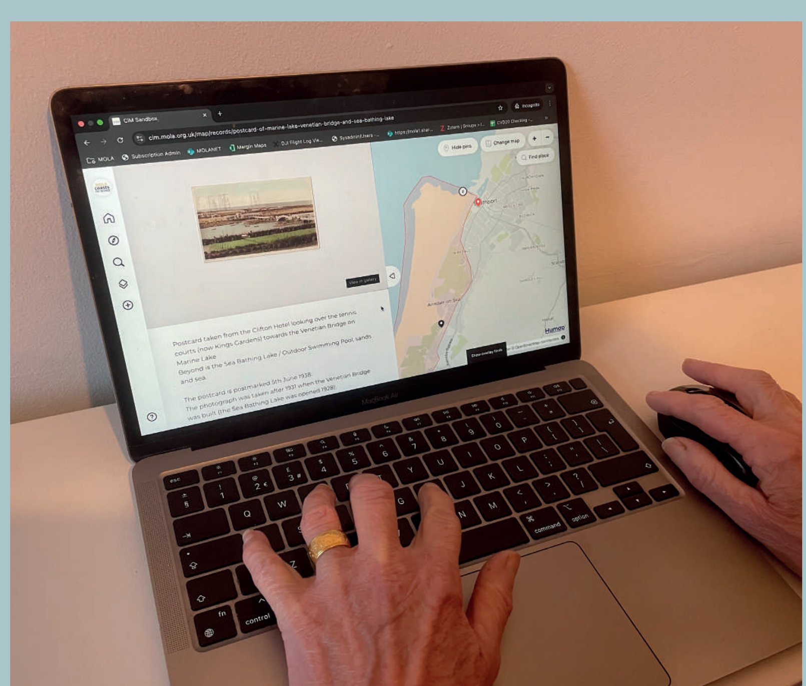
- **Older people** (65 years old and above) have been shown to encounter high levels of social isolation in our regions. Their perceived value and connection to the wider community is being increased by the project's Memory Events, which are learning from their unique experiences and expert local knowledge.
- **Younger people NEET** (16-25 year-olds not in employment education or training) are being trained by CiM in research techniques useful for gathering coastal change data. This is helping them gain valuable work experience, skills and contacts in the community.
- **Structurally Disadvantaged Groups**. To maximise accessibility and community connectivity, CiM is co-designing events with local creative practitioners, in a way that facilitates the participation of a range of structurally disadvantaged groups.



Coasts in Mind activity wheel – mapping project activity types to priority audiences.

CiM Mapping Platform

Coasts in Mind's key digital partners Humap and DigVentures are working with the project to build and implement a bespoke CiM Mapping Platform. This has been co-designed with three of its key end-user groups: policymakers, researchers and community members, to ensure its relevance to their needs. It will map the community archive through a series of sea-level indicators and present it accessibly in a way that policymakers and researchers can download as a dataset.



Testing the Coasts in Mind digital mapping platform in Southport, Sefton.

References:

L. Northall 2019. Searching Mersea: coastal archaeology, oral history and rising sea levels. The Archaeologist, Autumn 2019. (Issue no. 108). https://journals.ub.uniheidelberg.de/index.php/cifatamag/article/view/79753/73658

O. Hutchinson, D. Newman, L. Northall 2021. Changing Minds Changing Coasts: 100 year of coastal change on Mersea Island, Essex. Coastal & Intertidal Zone Archaeological Network. Interim Report (CMPD/2021/01)

MOLA

MOLA coasts IN MIND

Made possible with Heritage Fund

Integrating Natural and Social Science to Measure Successful Coastal Restoration

Manchester Metropolitan University

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Coastal Ecosystems Research Group

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The Challenge:

- Growing consensus of need to upscale coastal habitat restoration to help address the dual climate & biodiversity crises[1]
- Yet, upscaling efforts face persistent social, political and economic barriers, e.g. public disconnect from coastal wetlands[2]
- Current metrics of restoration success are often narrow in scope, focusing on limited ecological or project-specific outcomes
- To overcome barriers, **we must develop more comprehensive and meaningful metrics for coastal restoration success** that:
  - ❑ Reflect the full range of ecosystem services provided
  - ❑ Demonstrate the resilience of restoration schemes and their benefits to climate change
  - ❑ Effectively communicates the changes people will see and act as a decision-making tool

UNITED NATIONS DECADE ON ECOSYSTEM RESTORATION 2021-2030

The Approach: shared framework for defining & measuring restoration success

- Develop a **multi-metric assessment tool** (Fig. 1) based on natural & social science inputs (see boxes below)
- Initial focus on restored UK saltmarshes (30+ years of restoration)
- Sites **scored along different metrics** using habitat-specific criteria and defined quality thresholds
- Tool iteratively validated and refined for broader application to other coastal ecosystems

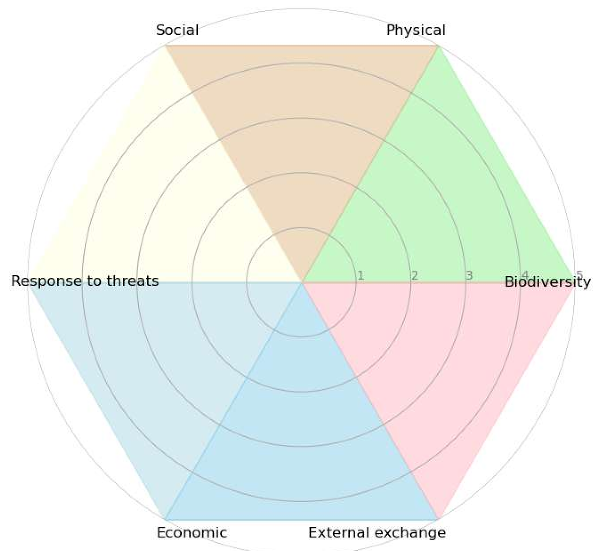

Fig 1. Baseline framework for evaluating restoration success

Development & resilience of restored saltmarshes

- Development insights previously relied on space-for-time substitutions
- Resurvey plots established at restored saltmarshes two decades prior[3] (fig. 2)

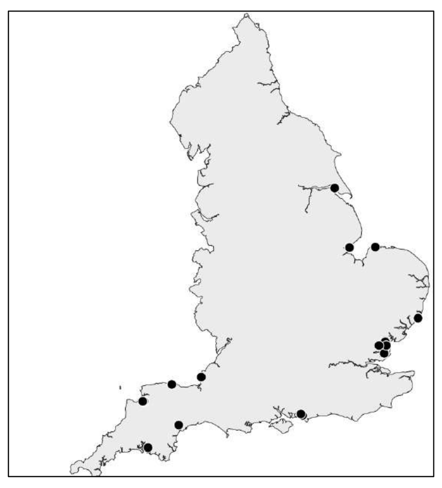

Fig 2. Restored saltmarsh case study sites across England

Conduct first large-scale spatial & temporal assessment of vegetation communities on restored saltmarshes

Establish actual development trajectories of saltmarsh restoration

Use systematic changes in vegetation communities & elevation to assess restored saltmarsh resilience to RSLR

Evaluate potential trade-offs and synergies in ecosystem service delivery

Perceptions of successful saltmarsh restoration

- Saltmarsh restoration must be designed with, not imposed upon, communities
- Public awareness of coastal wetlands and their benefits is limited[2]
- Community resistance to change is often a barrier to restoration
- Despite 30+ years of saltmarsh restoration, little insight into people's views

Repeat public perceptions survey[2] to assess if recent media attention has impacted awareness or knowledge

Focus groups for local communities to ascertain public perceptions of saltmarsh quality

Focus groups for coastal researchers & practitioners to determine perceptions of successful schemes

Compare data for alignment or misalignment of perceptions on success and what a 'good' saltmarsh looks like

Identify and use perception-data mismatches to refine metrics in assessment tool

WWT

[1] Seddon *et al.*, 2021. *Global change biology.*
[2] McMahon *et al.*, 2025. *In Review.*
[3] Mossman *et al.*, 2012. *Journal of Applied Ecology.*

Refining species-habitat modelling: case study with *Zostera marina* restoration

***Cami Domy*[1]**, *Richard Unsworth*[1,2], *Dylan Childs*[3], *Simon Baldwin*[4], *Jim Bull*[1]

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1. Model Building

Species-habitat association models are often used in conservation efforts however, these methods have limitations, including that species data utilised does not consider the changing needs of a target species throughout its life cycle. This project is aimed at creating a framework that incorporates species responses to physical environmental changes through the life cycle. Here, *Zostera marina* is used.

The first step towards building this model was to create a basic life cycle diagram (Figure 1), identifying the key stages and transition rates. This was then translated into a matrix population model (MPM).

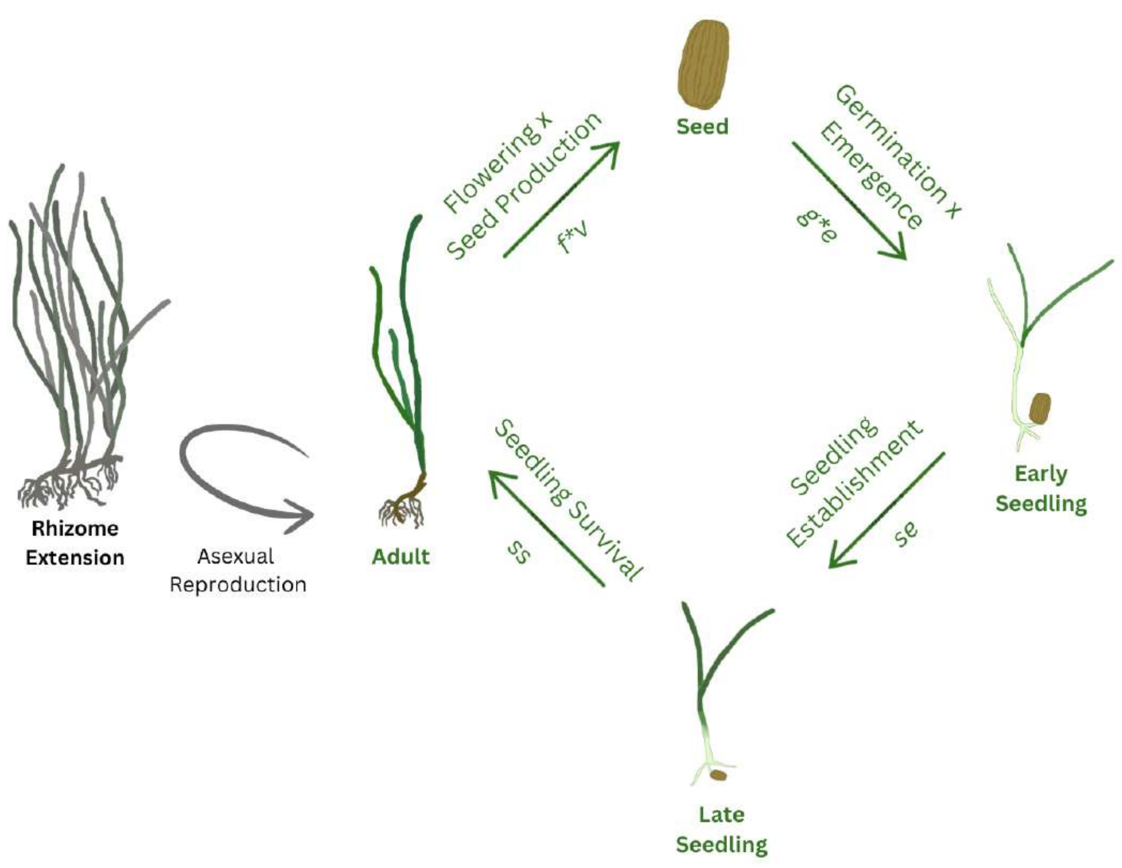


Figure 1: life cycle diagram of *Zostera marina*. Transition rates (arrows) are also labelled in their shorthand notation. The sexual pathway is in green, asexual in grey.

2. Literature Review and Expert Elicitation

The second step was to review the literature surrounding the impact of physical environmental factors on each outlined early life history stage. Overall, 61 studies were identified across all stages and factors, with many gaps were identified (Figure 2). To help fill these gaps, an expert elicitation study was conducted. The plots outlined in red (Figure 2) are the transitions presented to experts, identified based on a decision matrix.

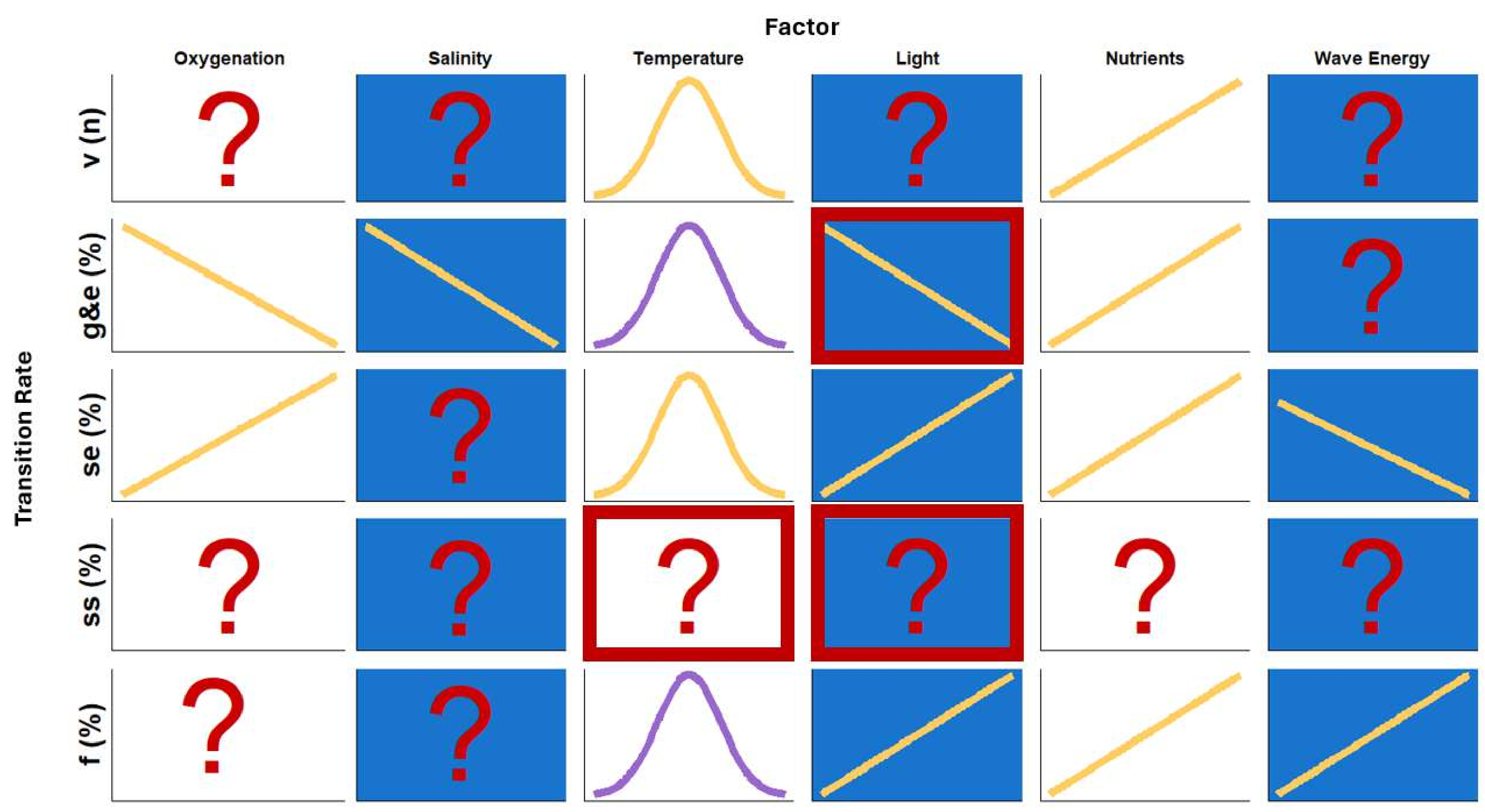


Figure 2: an array of graphs that demonstrate the shape of the relationship between different physical factors and crucial life history stages. Colour represents the number of studies: 1 = none, yellow = 1-5, purple = 5+. Red outlines indicate where experts are being asked to estimate the relationship and ranges.

3. Natural Ranges

To understand how each transition rate naturally varies, a meta-analysis was performed; the volume of data on each transition rate varied widely. A baseline MPM was created from the averages of each transition rate range. The full ranges were then individually fed into the MPM, and the impact on the population growth rate (λ) were plotted (Figure 3). Here, initial results suggest most transition rate ranges result in declining populations, though each rate has a wide natural range.

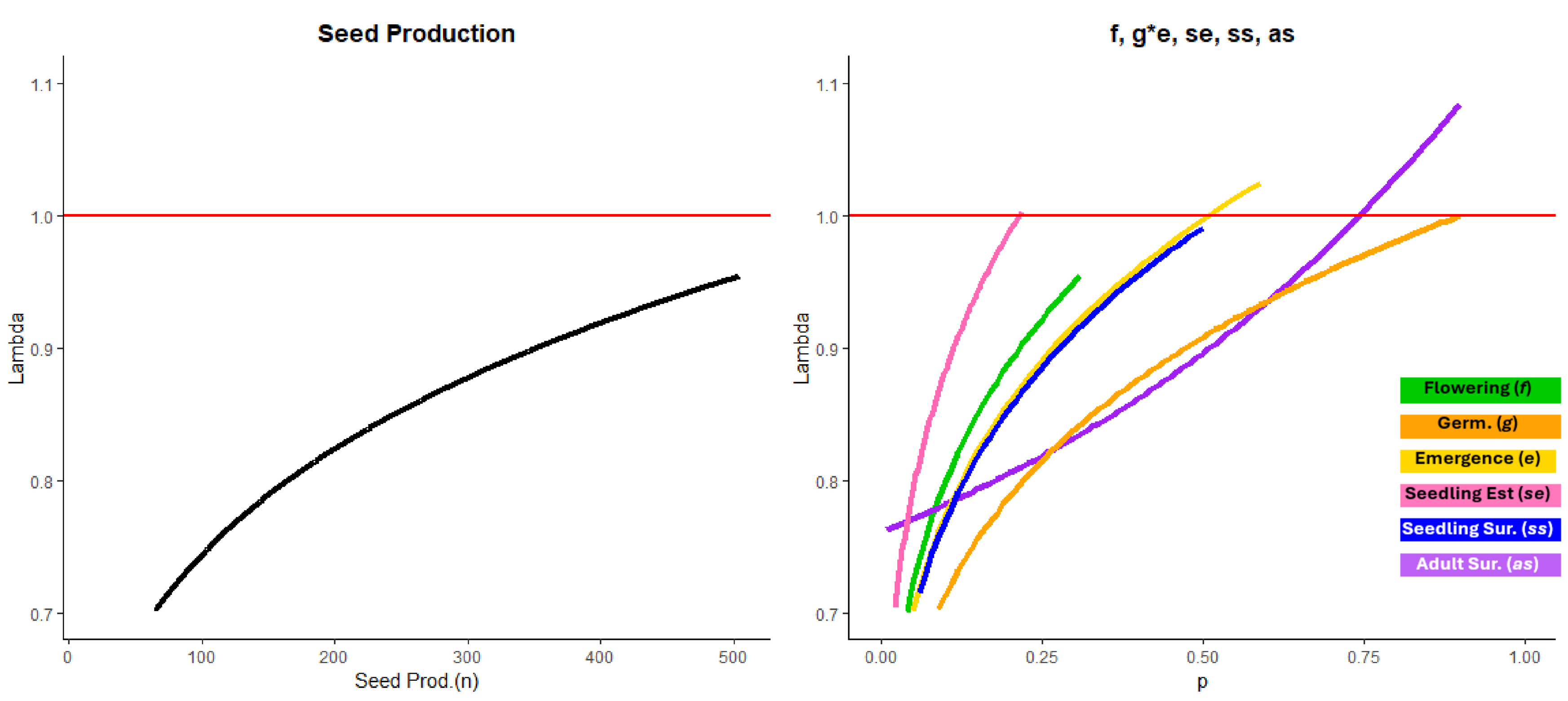


Figure 3: the variation of lambda in response to the range of each transition rate. A λ value of 1 represents a stable population, >1 is a growing population and <1 is declining. The red line represents λ = 1.

4. Mapping Results

Once the meta-analysis and exert elicitation have been used to create a strong MPM, the model can then be used to explore the effects of variations in physical factors, spatially and temporally. The changes in λ can also be plotted around the target area.

There are multiple ways this can be explored; one transition rate can be explored across all environmental factors, or one environmental factor can be applied to all transition rates. Figure 4 demonstrates the changes in λ when examining effects of salinity on germination.

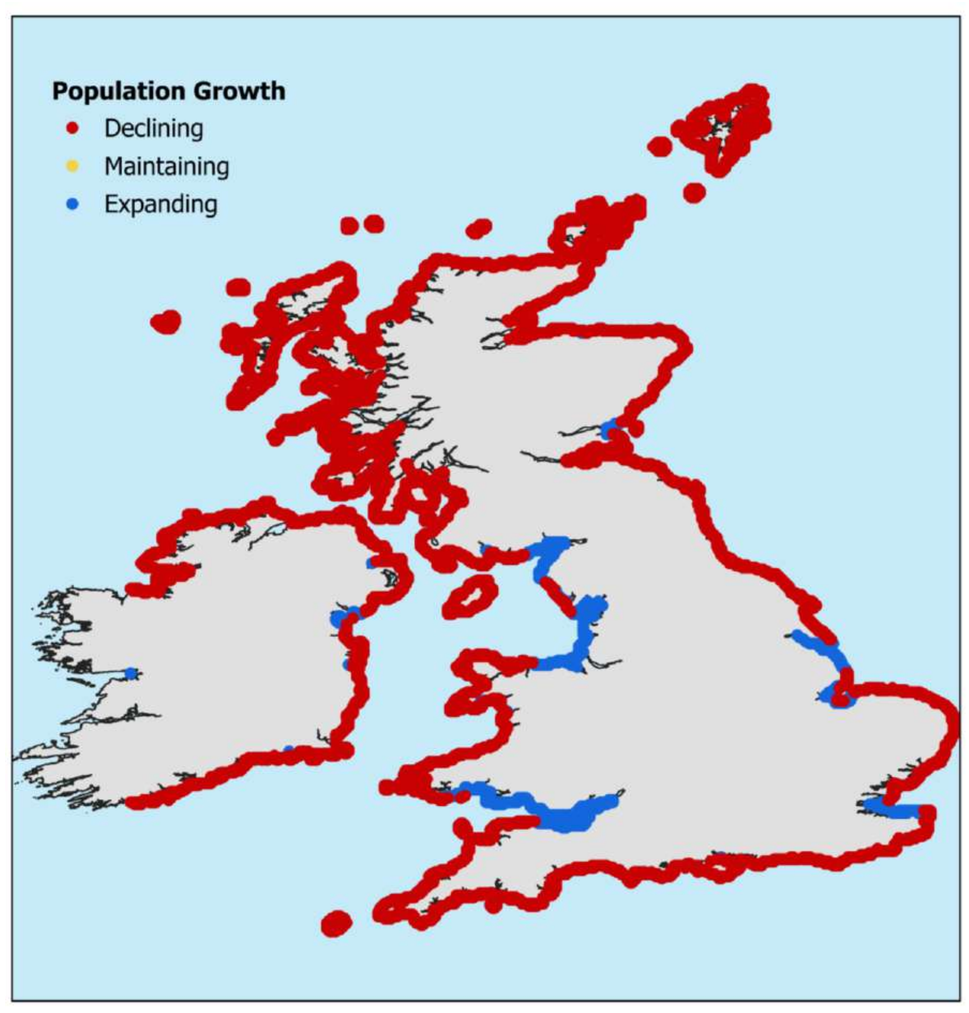


Figure 4: Changes in λ when factoring changes in germination in response to salinity around the GB coast.

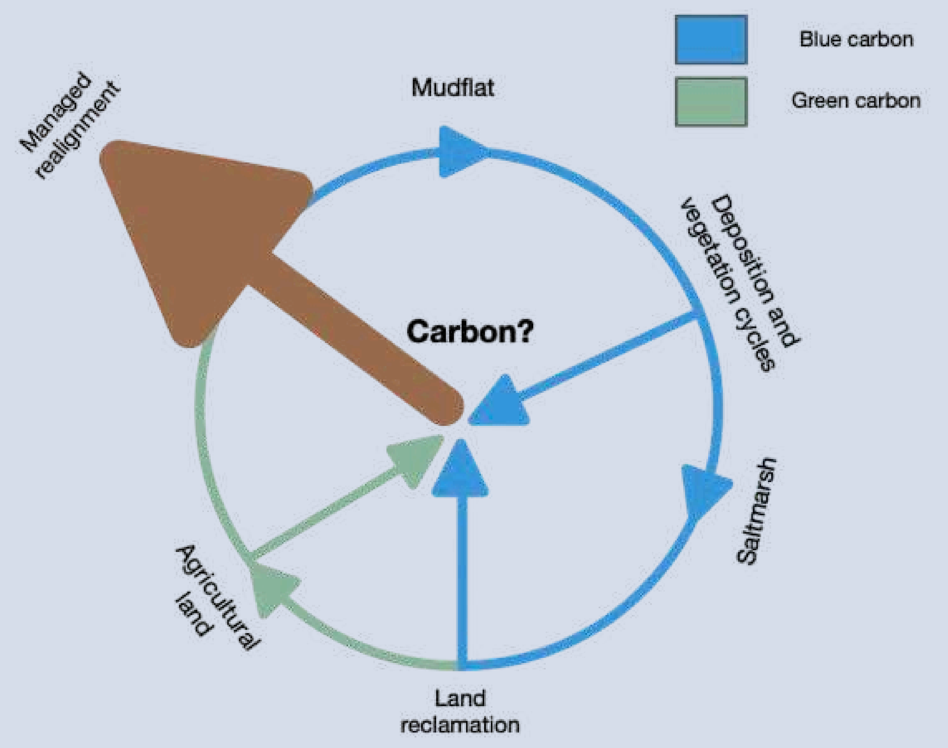
Most recent publication:

1 Swansea University Prifysgol Abertawe SpacePop 2 PROJECT SEAGRASS 3 University of Sheffield 4 Llywodraeth Cymru Welsh Government

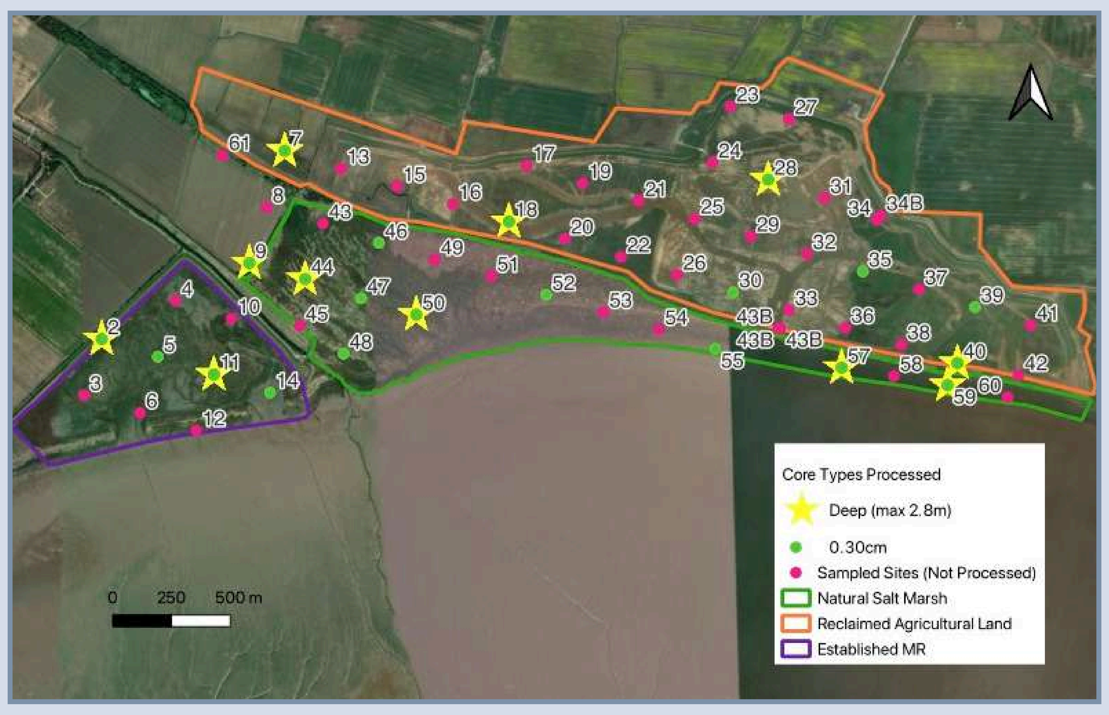
Depth and Geology Matters for Carbon Storage!

Organic and **Inorganic carbon** stores vary with depth.
There is **more organic** carbon **above 1m** in **Managed Realignment** and **Natural Saltmarsh** sites.
There is **more inorganic** carbon **below 1m** in **Agricultural** sites.

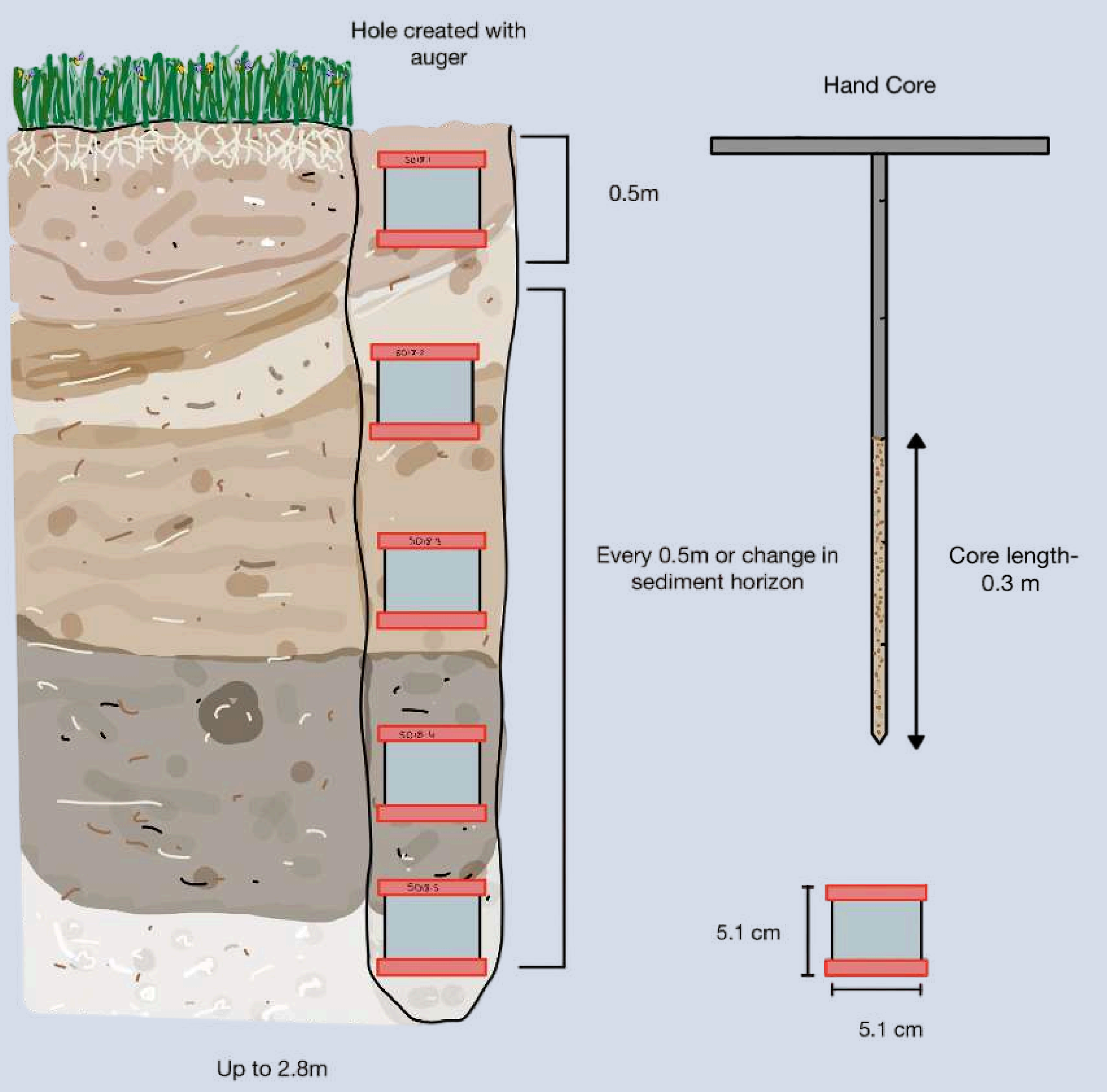
Blue carbon is sequestered by mudflats and saltmarshes. Reclamation permanently stores this. Green carbon is sequestered during agricultural production. Construction of managed realignment potentially releases this. But how much carbon is stored?



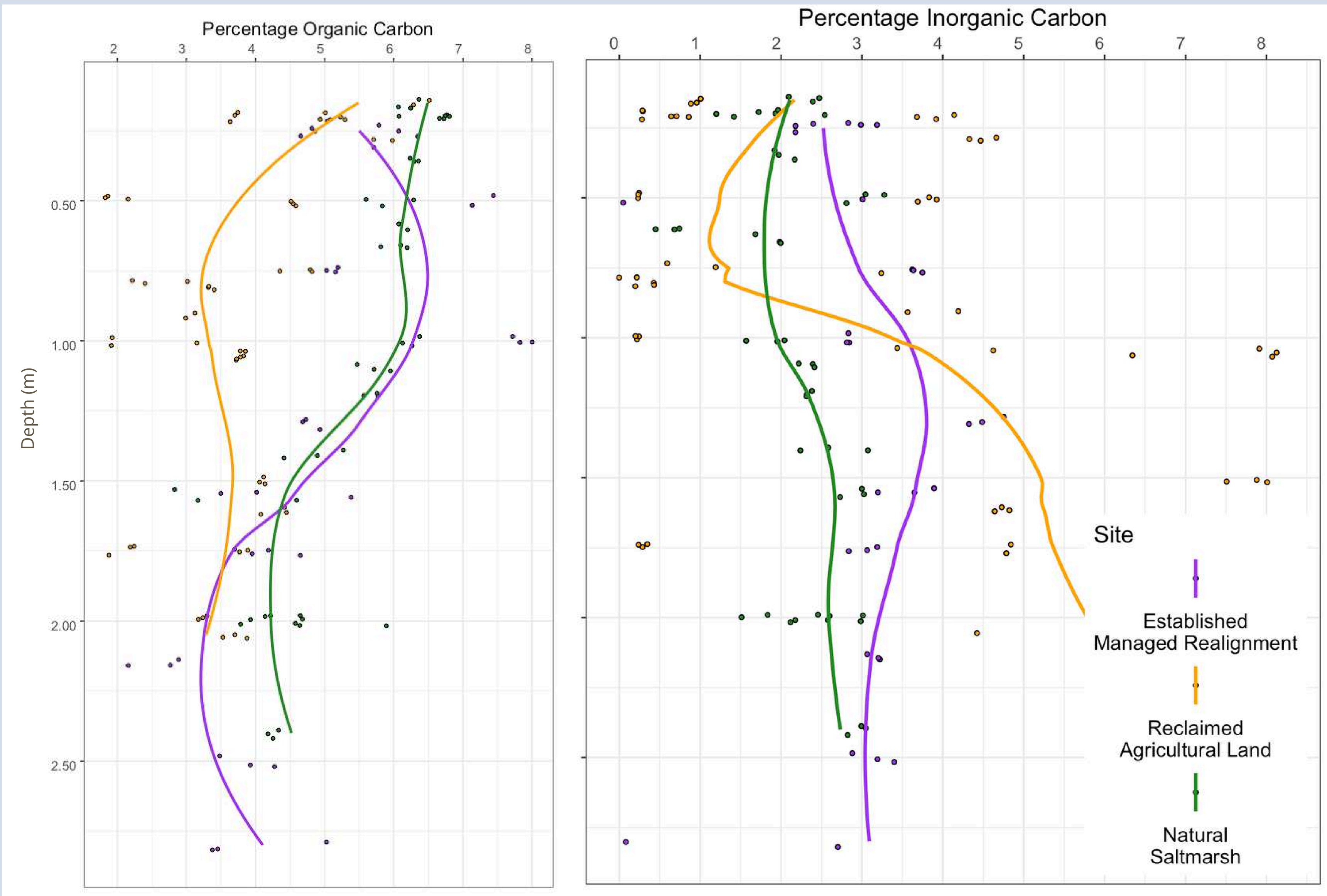
We took sediment cores at neighbouring agricultural, managed realignment and natural saltmarsh sites in the outer Humber.



63 shallow cores taken with small hand auger; 47 deep cores taken with an AMS hand auger kit and compact slide hammer.

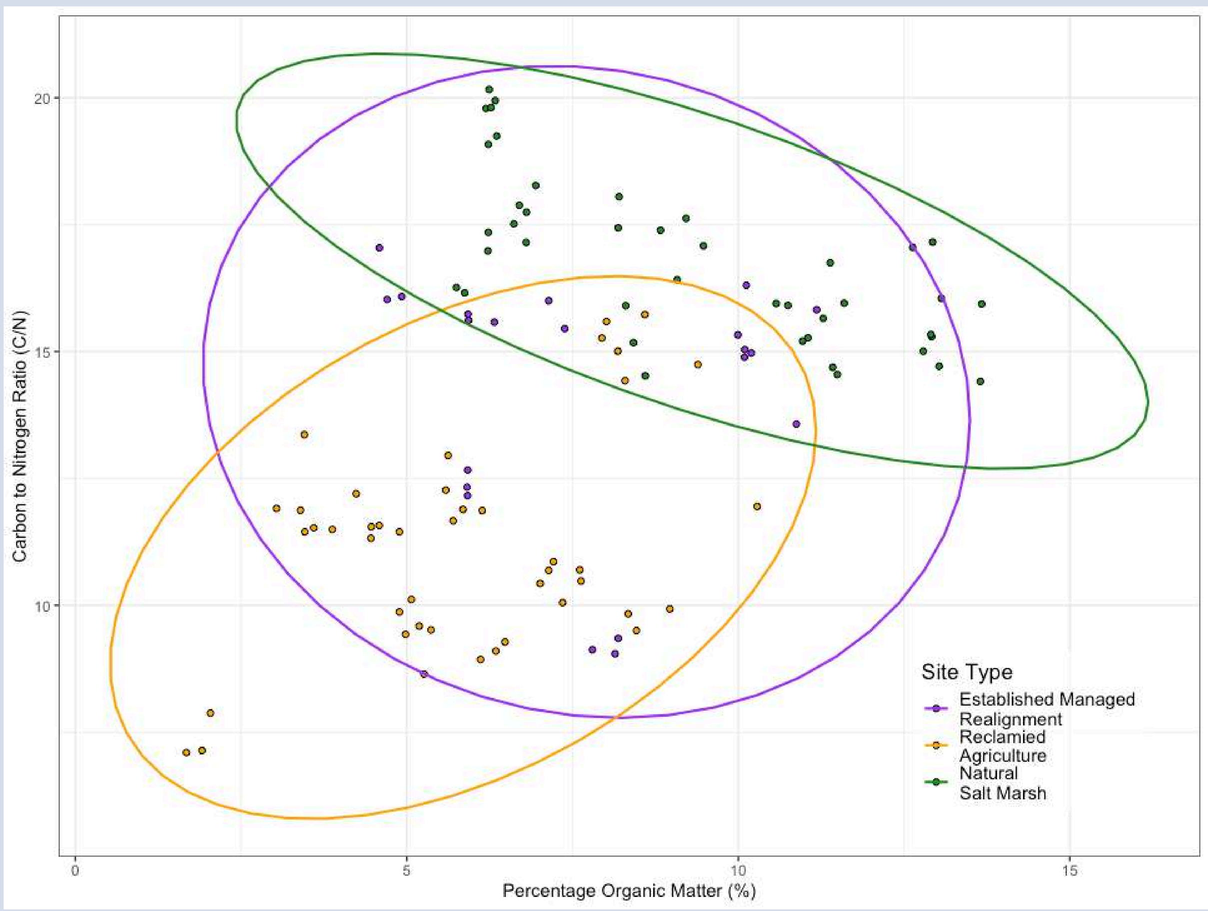


Organic and inorganic carbon distributions are similar in Established Managed Realignment sites (EMR) and Natural Saltmarshes (NSM) but different in Reclaimed Agricultural fields (RAG).



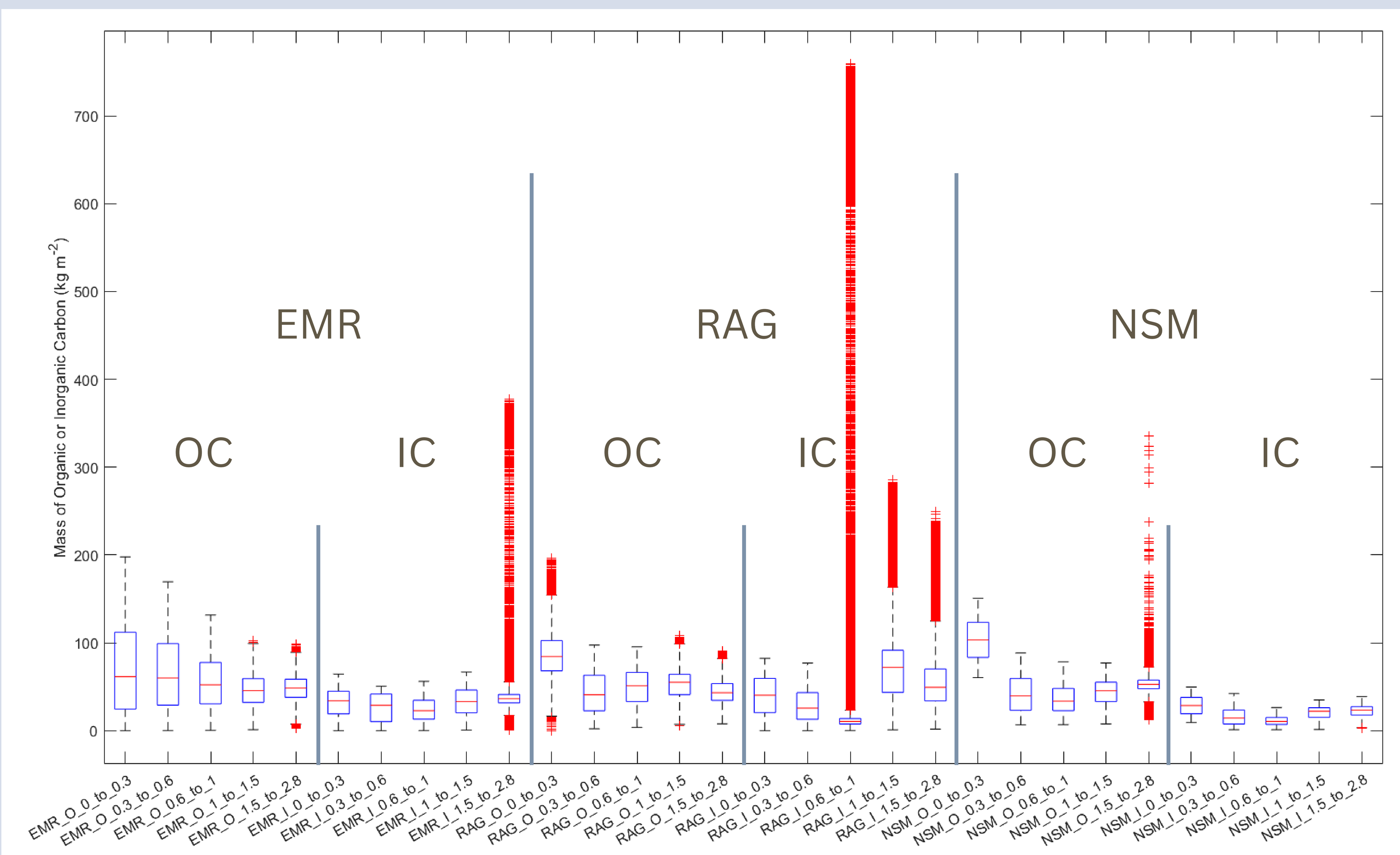
Organic carbon contents vary from >8% in the upper 1m to <2% below 1.5m in EMR and NSM but are near-constant at 3-4% in RAG below 1m. Conversely, inorganic carbon contents are near-constant at 2-4% in EMR and NSM but vary from <1% in the upper 0.8m to >7% below 1.5m in RAG.

C/N ratios show marine origin for natural saltmarshes, marine/terrestrial origin with marine bias for managed realignment sites and marine/terrestrial origin with terrestrial bias for reclaimed agricultural soils.



C/N ratios were measured using elemental analysis. C/N ratios decline with increasing organic matter in salt marshes, but increase with increasing organic matter in agricultural fields. We hypothesise that the mixed marine/terrestrial origin of reclaimed agricultural soils is because deeper cores sampled historical saltmarshes from pre-land reclamation in the Roman period.

Greatest median organic carbon stocks per m^2 in Natural Salt Marsh (NSM) and least in Reclaimed Agricultural Land (RAG). Greatest median inorganic carbon stocks per m^2 in RAG and least in Natural Saltmarsh (NSM).



Monte Carlo simulation of carbon stocks to quantify variability and uncertainty. Organic carbon stocks range from 24.3-72.1 kg/m^2 in Establised Managed Realignment (EMR), 24.7-67.1 kg/m^2 in RAG and 40.3-65.2 kg/m^2 in NSM. Inorganic carbon stocks range from 23.3-50.0 kg/m^2 in EMR, 18.8-122 kg/m^2 in RAG, and 11.0-31.6 kg/m^2 in NSM.

Results are extremely sensitive to depth sampling strategy and greatest sampling depth.

Charlotte E Trotman, Dr Robert E Thomas, Professor Rodney M Forster, Professor Michael Rogerson

Scan for contact details and more info

Rewild · University of Hull · Energy & Environment Institute · Northumbria University Newcastle · Environment Agency

Wilder Humber

Yorkshire Wildlife Trust · Ørsted · Lincolnshire Wildlife Trust

The Nature Conservancy · The Oyster Restoration Company

Follow our restoration journey at **WilderHumber.org.uk**

Oyster nets secured on trestles. Photo by Finn Varney

Remote Larval Setting and Intertidal Deployment of *Ostrea edulis*: A Scalable Approach for Native Oyster Restoration in the UK

Authors: Laura Welton, Monika Smieja, Fiona Woods, Kieran McCloskey, Boze Hancock, and Andy van der Schatte Olivier. Corresponding author: laura.welton@ywt.org.uk

Introduction

The aim of this demonstrator was to address the bottleneck in *Ostrea edulis* restoration of producing reliable and cost-effective seed at scale; a key bottleneck to restoration efforts. Remote setting of spat-on-shell offers a promising solution, enabling early-stage deployment while addressing biosecurity and supply constraints. As part of the Wilder Humber project, Yorkshire Wildlife Trust (YWT), in collaboration with The Nature Conservancy (TNC) and The Oyster Restoration Company (TORC), delivered the UK's first demonstration of remote native oyster larval setting for and the first trial onto granite.

What is remote setting?

Remote setting involves taking oyster larvae and cooling them to below 8°C to halt metabolism for safe transport over several days to a restoration site. Once there, the larvae are rewarmed and introduced to setting tanks to settle on substrate—unlike direct setting, where larvae are added directly to tanks at the hatchery without cooling or transport. This method reduces the high cost of shipping individual mature oysters.

Methods

Two 2.7m^3 circular tanks with scallop shell substrate and two 0.6m^3 rectangle tanks with granite rock were used to compare the settlement rate on different substrates. The final swimming larval stage, eyed pediveliger larvae, were added in two batches: on 1 September 2024 (342,000 total, <1% settlement, batch discarded) and on 4 September 2024 (170,000 total, with 147,330 in shell tanks and 22,670 in rock tanks). After two weeks these were placed onto our trestle system.

Results

Achieved settlement rate: 18% (SE ±4.3%), close to target of 20%. (Comparable to hatchery set rate.)

Survival Post-Deployment:

- 4-week survival post-deployment:
  - Rock: 35% (SE ±8.7%)
  - Shell: 28% (SE ±7.5%)
- 9 month survival post-deployment
  - Rock – no oysters present
  - Shell – oysters still present

Lessons learnt

The first larval batch was lost due to early ice melt during transport; the second batch, shipped with additional ice packs, arrived in good condition—demonstrating a cost-effective and improved delivery method. Spat settlement on granite was difficult to assess due to the mottled surface, suggesting a need to allow longer growth in tanks to improve visibility and counting accuracy. Holding spat on substrate for extended periods pre-deployment may also improve outcomes. The setup we initially trialled involved transporting large water volumes across beach terrain, posing logistical challenges due to tidal restrictions, improved access or on-site water treatment may be beneficial in future trials.

Remote setting tanks, Spurn Field Station

CATE HOLBORN

Submerged granite in tank with settled oyster larvae

LAURA WELTON

Submerged scallop shells in tank with settled oyster larvae

CATE HOLBORN

Oyster spat on shell under a microscope

FINN VARNEY

Oyster spat on granite

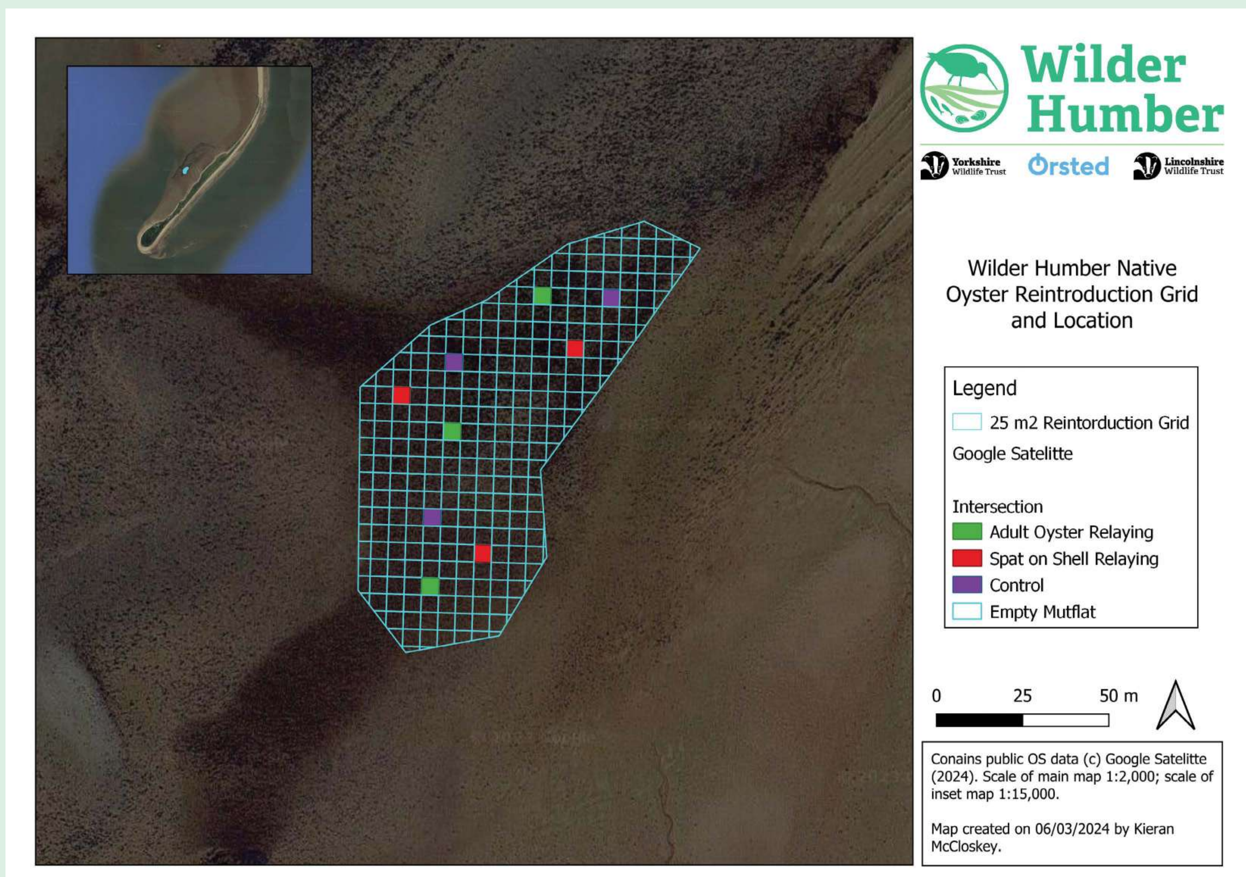
LAURA WELTON

What we are doing now – Greedy Gut Experiment

Building on these results, we are now running an intertidal restoration trial over the next five years, comparing the performance of juvenile oysters on shell versus mature, re-laid oysters. Three different oyster treatments are being assessed on fifteen 25m^2 plots at Spurn Point: clustered and evenly distributed spat-on-shell provided by The Oyster Restoration Company (TORC), and evenly distributed mature oysters cultivated within the Humber.

Distribution Treatment	Total number of oysters	Oysters per plot	Oysters per m²
Evenly distributed adults	2,250	750	30
Evenly distributed spat-on-shell	Approx. 20,000 (1.3 rapid reef bags)	Approx. 6,666	266
Clustered spat on shell	Approx 10,000 (0.6 rapid reef bags)	Approx. 3,333	133
Bare cultch (cockle shell)	0	0	0
Bare sediment	0	0	0

Table 1. Minimum numbers of oysters for restoration trial



Over a two-year period, the project will evaluate oyster survivability, adaptability, recruitment, impact on biodiversity, alongside a cost-benefit analysis comparing juvenile oysters to mature oysters for intertidal restoration. This research aims to inform scalable, evidence-based strategies for native oyster recovery and broader marine habitat restoration across UK coastal waters. In addition, seasonal sub-sampling of live oysters will assess metabolic rates, and nutrient and particulate fluxes by placing oysters from each treatment into incubation chambers to gain a better understanding of the biology of the oysters in this location.

Successful Snapping: Photogrammetry as a Tool for Monitoring Temperate Reef Restoration

Naomi A. Kennon [a], Michael C. Bell [b], William G. Sanderson [a]

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[b] International Centre for Island Technology, School of Energy, Geoscience, Infrastructure and Society, Heriot-Watt University, UK

Biogenic Reef Restoration

- Biogenic shellfish reefs are in decline across the globe.
- Restoration has become a popular conservation tool, which aims to enhance biodiversity and ecosystem services to degraded habitats.
- Across different habitat and restoration techniques there is a variety of measures of success.
- In Europe, the European native oyster (*Ostrea edulis*) has become a popular target for restoration.

Restoration Progress

- There are few reference habitats from which an understanding may be gained of what restoration progress may look like in a restored *Ostrea edulis* reef
- In other biogenic reefs, such as coral, structural complexity is often measured to gauge restoration progress.
- Many studies have linked the importance of structural complexity with species richness.

Measuring Structural Complexity

- Structural complexity can be quantified using different methods giving a range of metrics
- Performance depends on the habitat type and the level of detail required
- Photogrammetry allows for the collection of detailed information on ecosystems at large spatial scales without disturbing delicate or rare habitats.
- Uses multiple photographs of a structure that are inputted into photogrammetry software which stiches overlapping adjacent images together to construct three-dimensional models of landscapes and organisms
- Models can be analysed to calculate measures of surface texture

Methods

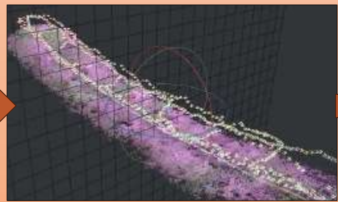
- Survey Location: Loch Ryan Oyster Fishery
- Fourteen transects were across three survey areas
- Biodiversity and photogrammetry survey conducted at each.
- Photogrammetry models generated and surface complexity values calculated (Table 1)
- Measures were compared to species diversity (Shannon's diversity index).

Table 1. Surface complexity measurements.

Measurement	Description
Two-Dimensional Rugosity: Root Mean Square Roughness	A measure of roughness using the average of the height of peaks and dips along five 4m evaluation lines measured from the overall average height.
Three-Dimensional Rugosity: Root Mean Square Roughness	Using the same equation as 2D rugosity however 3D rugosity is a moment-based quantity using integrals of the height distribution function with some powers of height.
Fractal dimension: Power spectrum	The power spectrum method measures the roughness of a surface by analysing how the surface's height changes in a complex pattern. By plotting this information as a wavelength, adding a linear line of best fit and calculating the slope gives a value of fractal dimension that describes how rough and complicated the surface is.

Divers took a time lapse 10m photo transect

MeshRoom rendered overlapping images



This produces a point cloud model

Gwiddion, rasterizes the model and surface complexity measures can be calculated.

Results

- Eleven out of fourteen transects were processed into 3D models (Figure 1).
- 3D Rugosity, 2D Rugosity and Fractal Dimension measured.
- These were compared to biodiversity metrics from the same transects.
- Pearsons's analysis showed a strong positive relationship with fractal dimension and Shannon's diversity index (Pearsons's correlation= 0.732, df = 9, P-value = 0.01, y = 0.696x + 1.2269, R^2 = 0.5355) (Figure 2).

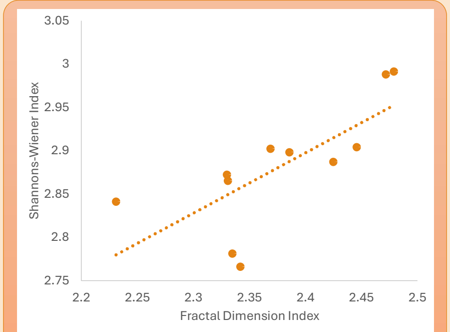


Figure 2. Pearsons correlation plot of Shannon Wiener's Diversity against Fractal Dimension.

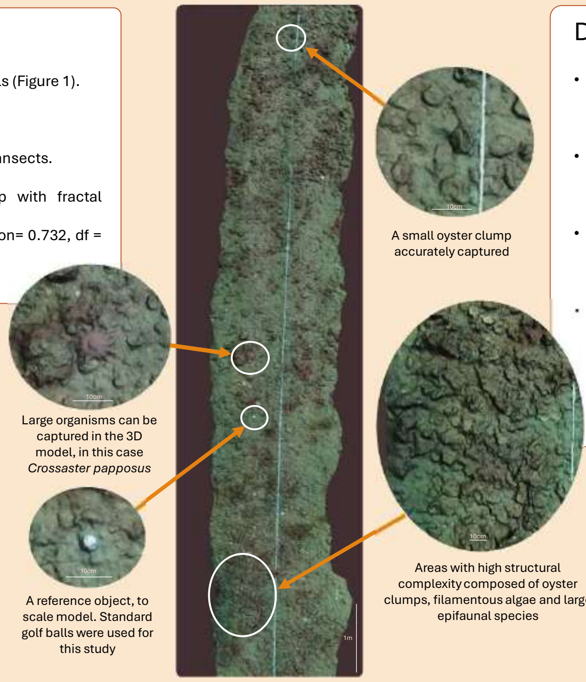


Figure 1. An example of a successful 3D model of the oyster reef.

Discussion

- Significant positive correlation between fractal dimension and Shannon Weiner's diversity index.
- Fractal dimension quantifies complexity across multiple spatial scales.
- Non-invasive and scalable nature of photogrammetric methods offers practical advantages for long-term monitoring
- Findings highlight photogrammetry's potential as a method for monitoring restoration progress and guiding biodiversity outcomes in rare, low-relief reef ecosystems.

Acknowledgements

This work contributes to DEEP (Dornoch Environmental Enhancement Project) and is funded by the James-Watt Scholarship with additional funding from The Glenmorangie Company. In addition, the authors would like to thank the Heriot Watt dive and technician teams for their field and lab support as well as the Loch Ryan Oyster Fishery Company Ltd for access to the study site and providing local ecological knowledge and *Vital Spark* as a research vessel.

DEEP Dornoch Environmental Enhancement Project | GLENMORANGIE SINGLE MALT SCOTCH WHISKY | HERIOT WATT UNIVERSITY | The Loch Ryan Oyster Fishery Co Ltd | MARINE CONSERVATION SOCIETY

Enhancing Blue Carbon and Ecological Services through Nature-Based Solutions:

RESET Integrated Restoration in Irish Coastal Waters

Assessing novel methods for restoring seagrass meadows in Irish coastal habitats

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Introduction

Project Background

Seagrass meadows in Ireland primarily composed of *Zostera marina* L. and *Nanozostera noltei* H. cover an area of at least 54.85 km^2. Maintaining and even extending this distribution through successful restorative actions is vital.

Figure 1. *Zostera marina*

Project Objectives

To evaluate the restorative capacity of seagrass meadows in Irish coastal habitats.

Two different restoration methods are investigated (i) mature adult seagrass shoot transplantations and (ii) juvenile seed plantations.

Project Applications

This research aids ongoing investigations into the capacity of seagrass restoration as an effective Nature-based Solution (NbS) as well as working towards the achievement of the United Nations Sustainable Development Goal 'Life Below Water'.

Shoot-based approaches in intertidal habitats

Study Area:: Baldoyle Bay, Co. Dublin, Ireland

The shoot-based restoration actions of this project are largely focused in Baldoyle Bay, north County Dublin. The saltmarshes and mudflats that characterise this diverse estuarine environment support a plethora of internationally important species, notably Dwarf Eelgrass beds.

Figure 2. *N. noltei* distribution within Baldoyle Bay. Previously mapped *N. noltei* meadow distribution data provided by Dr Pedro Beca-Carretero (Beca-Carretero *et al.*, 2024). Newly mapped *N. noltei* meadow distribution data obtained via a survey on 16/10/2024. Map Projection: WGS 84/ Pseudo-Mercator.

Methodology: Shoots

In winter 2025, *N. noltei* shoots were collected from Baldoyle Bay, and then planted in site specific sediment via a predefined transplantation method (e.g., single shoots, biodegradable materials). The growth and health of shoots were then monitored via PAM fluorometry and physical metrics (e.g., leaf length).

Results: Shoots

Initial results suggest that laboratory cultivation may be a crucial stage in the restoration of *N. noltei* seagrass meadows with significant increases in 2nd leaf length reported for individuals grown in laboratory conditions.

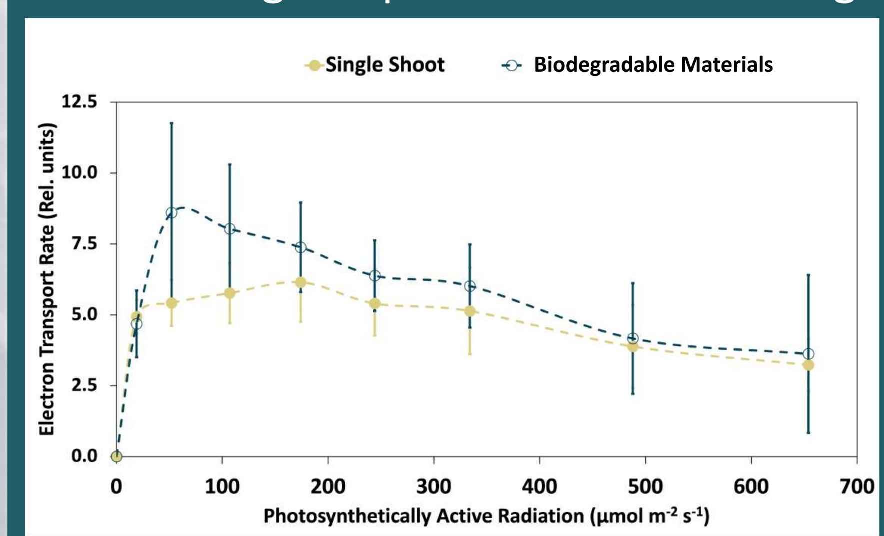


Figure 3. Electron Transport Rate (ETR) plotted against Photosynthetically Active Radiation (PAR) for *N. noltei* plants planted directly into sediment (single shoot) versus those planted in biodegradable materials.

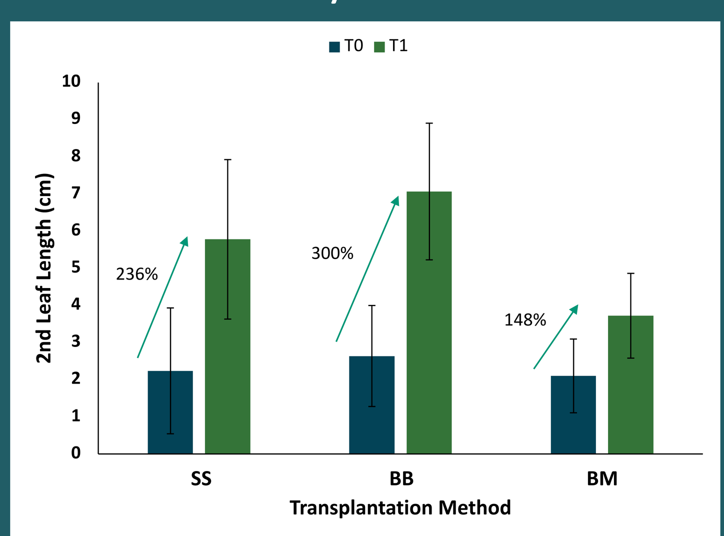


Figure 4. The 2nd leaf length of *N. noltei* shoots at time T_0 = the start of the experiment, and time T_1 = one month after being grown in laboratory conditions. SS, BB, and BM represent the three transplantation methods, single shoot, biodegradable basket, and biodegradable mat, respectively.

Seed-based approaches in subtidal habitats

Study Area: Connemara, Co. Galway, Ireland

Thus far seeds have been collected from Lettercallow in Connemara. Other meadows within Connemara and Galway Bay are being investigated as potential sites for both seed and shoot-based restoration actions. These sites include Barna, Deirin Darach, Glann More, and Mace Head.

Figure 5. Proposed sites for *Z. marina* seed and shoot based restorative actions. Map Projection: WGS 84/ Pseudo-Mercator.

Methodology: Seeds

Seeds were collected in August 2024, processed and then stored over winter. In spring 2025, germinated seeds were planted in site-specific sediment and then grown under laboratory conditions. Seedlings will be transported back to the site of origin once they have reached a sufficient size.

Results: Seeds

Z. marina seedlings have the capacity to be grown in the laboratory from seed with 57.45% of germinated seeds surviving one month after planting. Lab trials also indicate that the most important factors affecting seed germination are anoxia, temperature and salinity.

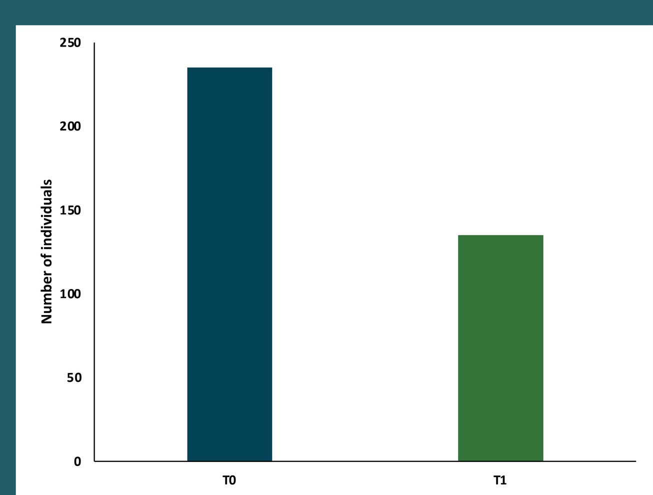
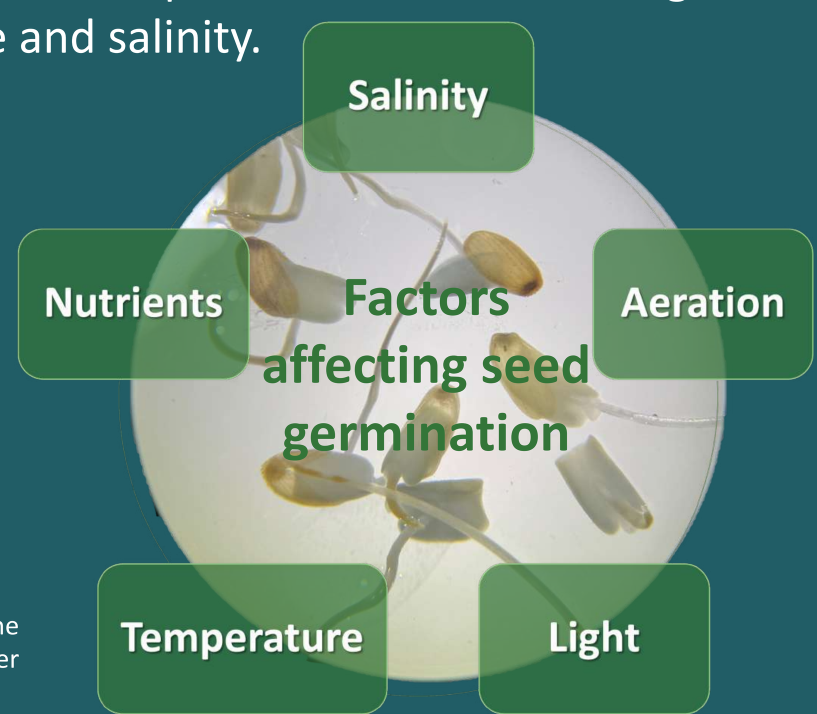


Figure 6. The number of *Z. marina* seedlings present at T_0 = the start of the experiment (April 2025), and time T_1 = one month after being grown in laboratory conditions (May 2025).



The next steps…

Monitoring of seed and shoot-based transplantations will determine whether the restorative methodologies outlined above are as successful under field conditions as they are within a laboratory setting. Further site assessments will also determine suitable areas for combined seagrass bed and oyster reef restoration.

United Nations Decade on Ecosystem Restoration 2021-2030

Ollscoil na Gaillimhe University of Galway | Institiúid Uí Riain Ryan Institute | Algal BioSciences | RESET Integrated Restoration in Irish Coastal Waters | epa Environmental Protection Agency | Baldoyle Bay Seagrass Restoration Project

RESET is funded by the Irish Environmental Protection Agency (EPA) research program 2021–2030 (RESET-2023-NE-1224). There are two project partners: UCD and University of Galway. UCD is coordinating and managing the project.

LEARNING FROM RESTORATION PILOTS:
Loose Cultch to Reef Cubes in Open Coastal Waters

ASHLEIGH TINLIN-MACKENZIE[1], CELINE GAMBLE[2]

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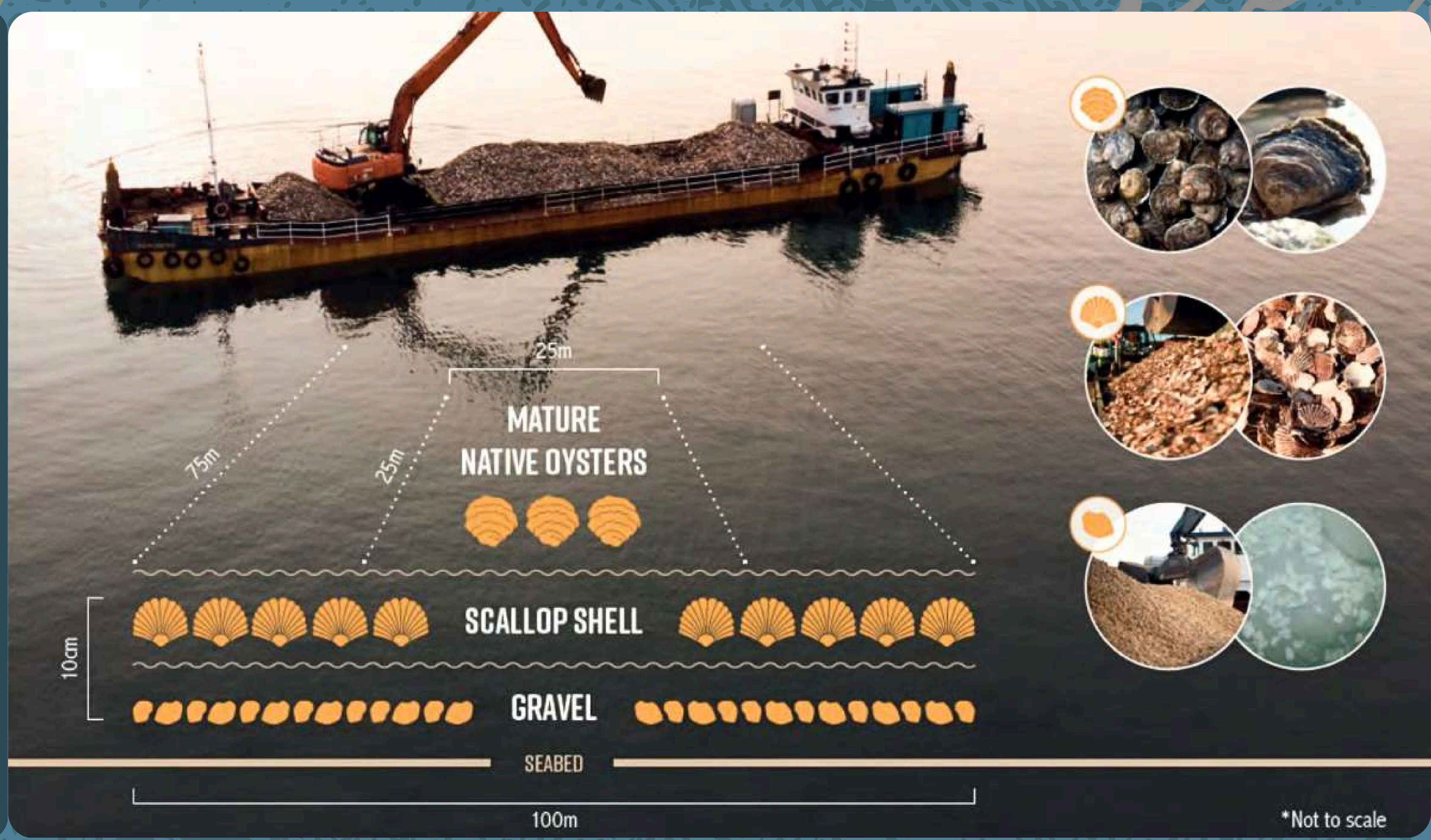
BACKGROUND

Native oyster restoration in the UK has largely relied on deploying loose cultch (shells or stones) followed by adult oysters, typically in sheltered, shallow environments with minimal wave energy. However, spatial modelling by the Environment Agency has identified several high-potential oyster restoration sites along the more exposed North East coast of England. These locations differ significantly in depth and exposure, raising questions about the suitability of standard restoration methods in these areas.

The Wild Oysters Project established an oyster restoration hub in the Tyne & Wear region in 2020, where native oysters are locally extinct. The project is trialling adaptive approaches to reintroduce *Ostrea edulis* to the area, actively responding to successes and learnings along the way to maximise restoration success. This poster explores the seabed restoration approaches taken to date and the findings thus far, and presents the adapted plans for 2025 active restoration.

PILOT 1 – LAYING A LOOSE CULTCH REEF

- Installed in September 2023
- 1.2km off the coast of Seaburn (Sunderland)
- Reef water depth = ~10 meters
- Reef area = 7,500m^2
- Over 750 tonnes of cultch deployed
  - 155 tonnes of weathered scallop shell
  - 620 tonnes of 50mm magnesium limestone
- Stone base with shell on top
- Deployed via excavator onboard split-hopper barge
- 10,000 mature oysters added to the centre of the reef at 16m^2 density
- Deployment was successful, with good coverage achieved



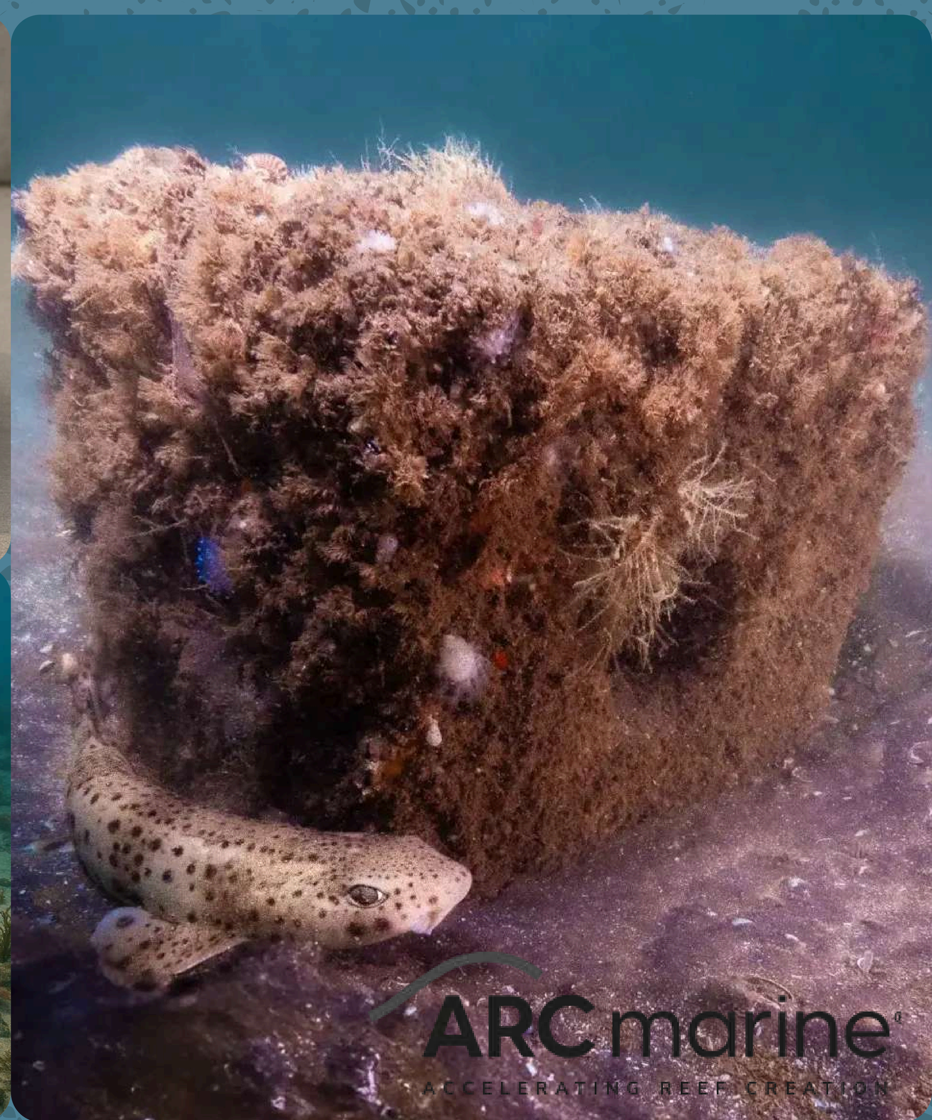
PILOT 1 – FINDINGS & LEARNINGS

Storm Damage:
- Storm occurred within 2 weeks of deployment (8.5 meter waves – 1 in 10 year storm event)
- Reef movement experienced (100-300 meters in SW direction towards the shore)
- Cultch location remapped with DDV in 2024 (after hydrodynamic models predicted the direction of movement)

Successes:
- SCUBA surveys (Project Baseline UK) in June 2025 confirmed the presence of live oysters on the relocated reef
- Positive signs of oyster growth observed
- Colonisation of sessile biodiversity on oyster shells and cultch
- Local conditions confirmed suitable for oyster health over 2 years (positive result for site selection methods and the suitability of the local area more widely for restoration)

PILOT 2 – OYSTER REEF CUBES

- Marine Licence secured in June 2025 (L/2025/00200/1)
- Phase 1 planned for September 2025:
  - 20 reef cubes
  - Scallop shell cultch
  - Up to 4000 oysters
  - 100m^3 scallop shell cultch
  - Spat on shell added to cultch
- Reef cube details:
  - Sourced from ARC Marine Ltd
  - 1.5 meter cubes
  - 5 tonne each
  - Constructed from marinecrete (low carbon, non-toxic, 98% recycled materials)
  - Port holes and textured surface provides additional surface area for colonisation
- Hydrodynamic modelling suggests they would be secure under 1 in 50 year storm conditions



SUMMARY

- Open coast sites at risk of storm damage
- Risk associated with loose cultch in exposed locations
- North East England subtidal conditions proven suitable for oyster survival and growth
- Reef cubes offer a promising approach with higher resistance to storms
- Trial of oyster reef cubes this year – watch this space!

GROUNDWORK CHANGING PLACES CHANGING LIVES · Stronger Shores · ZSL

Marine Management Organisation

Have your say on opportunities for improving the regulatory process for **restoration projects**

Review of restoration marine licence applications

Steart Marshes © S. Stafford

The Marine Management Organisation (MMO) conducted a review of marine licence applications (MLAs) related to restoration projects to identify and document any obstacles. The findings will enable the Department for Environment, Food and Rural Affairs (Defra) to explore opportunities for improving the regulatory process for restoration projects. **The analysis covered MLAs submitted between January 2018 and April 2024.**

Key findings include

- While restoration projects are seldom major, they can be complex to assess.
- Without measures to mitigate adverse impacts, restoration projects could pose unacceptable risks to the environment, and other sea users.
- On average, it took six months from the submission of a restoration MLA to its determination. This timeframe can be improved by all parties involved in the process, such as through clearer communication of MLA expectations, improving the quality of submissions, and being responsive to requests and updates.
- MMO's 'Fees and Charges' policy and associated procedures apply to all plans and projects. Marine licensing fees and charges legislation is reviewed by Defra. Those submitting MLAs, especially for complex projects, should consider a strategic approach to align with restoration project's long-term objectives; this may reduce the percentage that marine licence costs are of the overall project value.


A Bouldnor Vertipool © Artecology


Floating ecosystem © E. Leegwater


Eelgrass © P. Naylor


Coir log retaining soft mud © C. Scott


Hay bale retaining wall © R. Willegers

Defra could explore the following opportunities

- Review Habitats Regulations Assessment procedures to determine if a proposal is directly connected to the management of a site
- Assess the feasibility of introducing new restoration exemptions or self-service options
- Conduct workshops for restoration practitioners to enhance the quality of MLAs
- Explore scenarios where sediment sampling may not be required

The marine licence application process

Validation → Allocation → Technical assessment → Consultation → Review → Decision and approval → Application completion → Monitoring

Marine licence interactive assistance tool

Marine Case Management System

Impact assessments

Marine licence fees

Top tips when applying for a marine licence

Defra consultation

Have your say on changes to marine licences

Restoring Saltmarsh in the Severn Estuary: Polders at Rhymney Great Wharf

Lily Pauls – Marine Projects Team Leader
Natural Resources Wales

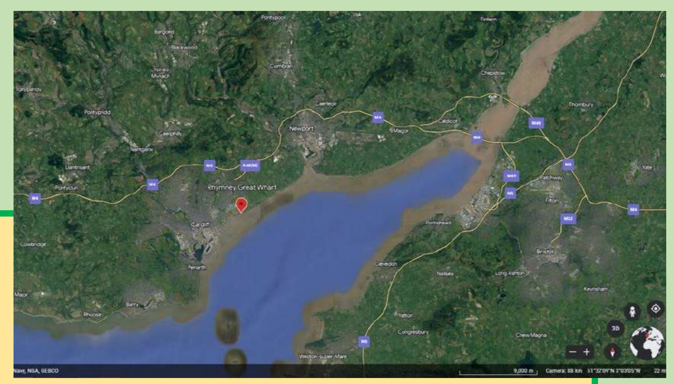
Cyfoeth Naturiol Cymru
Natural Resources Wales

University of Reading

Ariennir gan Lywodraeth Cymru
Funded by Welsh Government

Nature Networks is a Welsh Government funded programme looking to improve biodiversity, resilience and the condition of marine and terrestrial protected sites.

This poster describes one of the marine projects delivered by NRW in the Severn Estuary Special Area of Conservation as part of this programme. This project seeks to restore saltmarsh along the Rhymney Great Wharf by reinstating and extending sedimentation polders and was completed in 2024.



What's a sedimentation polder?

Intertidal area, enclosed by rectangularly arranged brushwood groynes to facilitate enhanced sediment deposition.

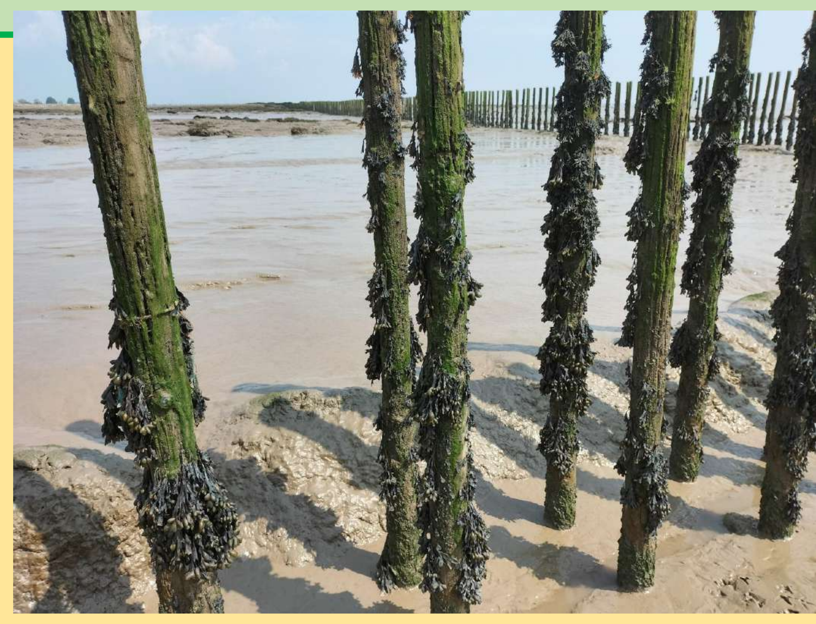
Aims of the project

1. Through a refined sedimentation polder design, protect the frontage of Rhymney Great Wharf from existing erosive pressures upon mudflat and saltmarsh habitats.
2. Create conditions that will support both mudflat and saltmarsh features to varying extents over time, improving biodiversity and resilience of these habitats.
3. Act as pilot to inform future polder schemes in high energy environments.

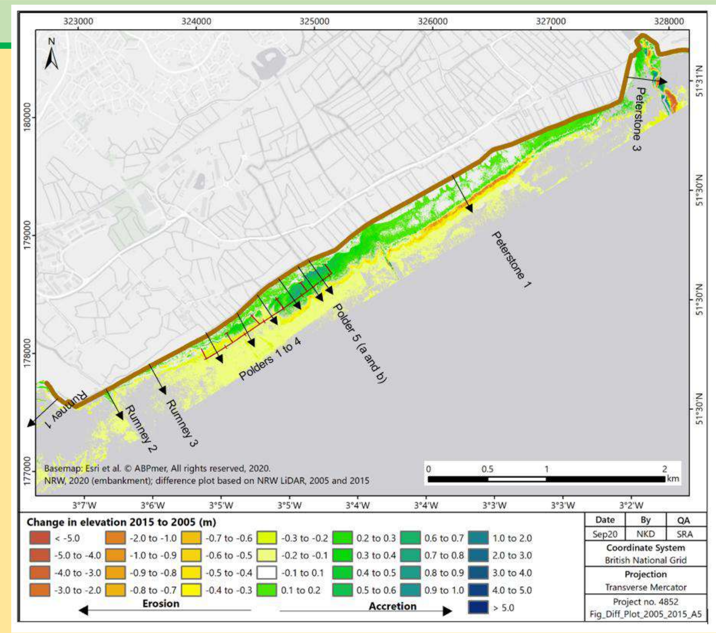
A little bit of history…

The long-term erosive trend in the area was causing loss of habitat and increased flood risk. Fencing and brushwood were originally installed in 1988 and 2005 using different designs, one of which was used commonly at the Wadden Sea. This led to the partial success in restoring the saltmarsh.

However, the original plan did not take into account maintenance and the structures fell into disrepair.
All the brushwood disappeared and only the fenceposts remained.



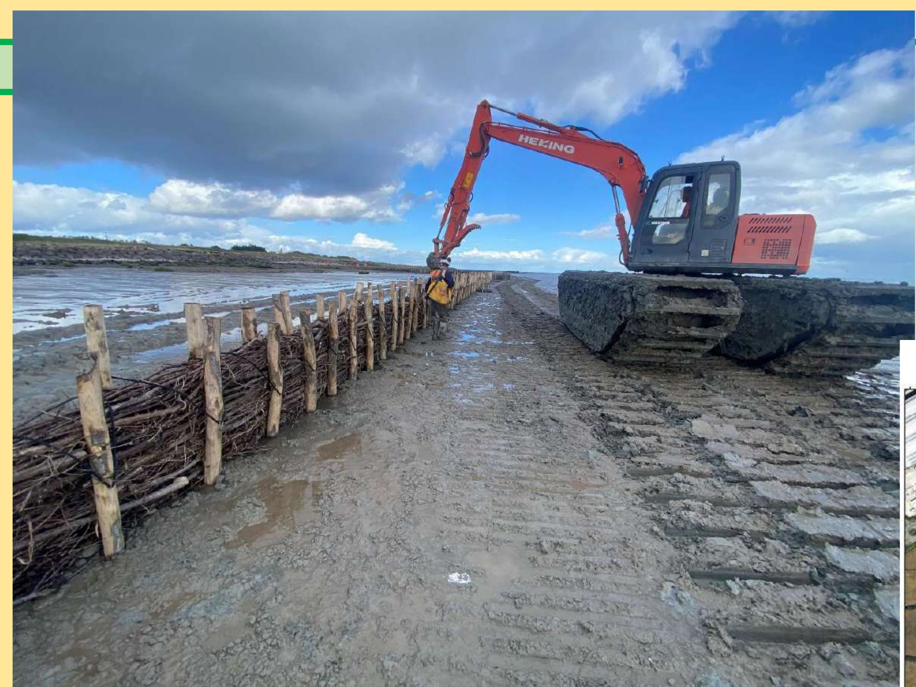
Derelict fenceposts – note scour at base of posts

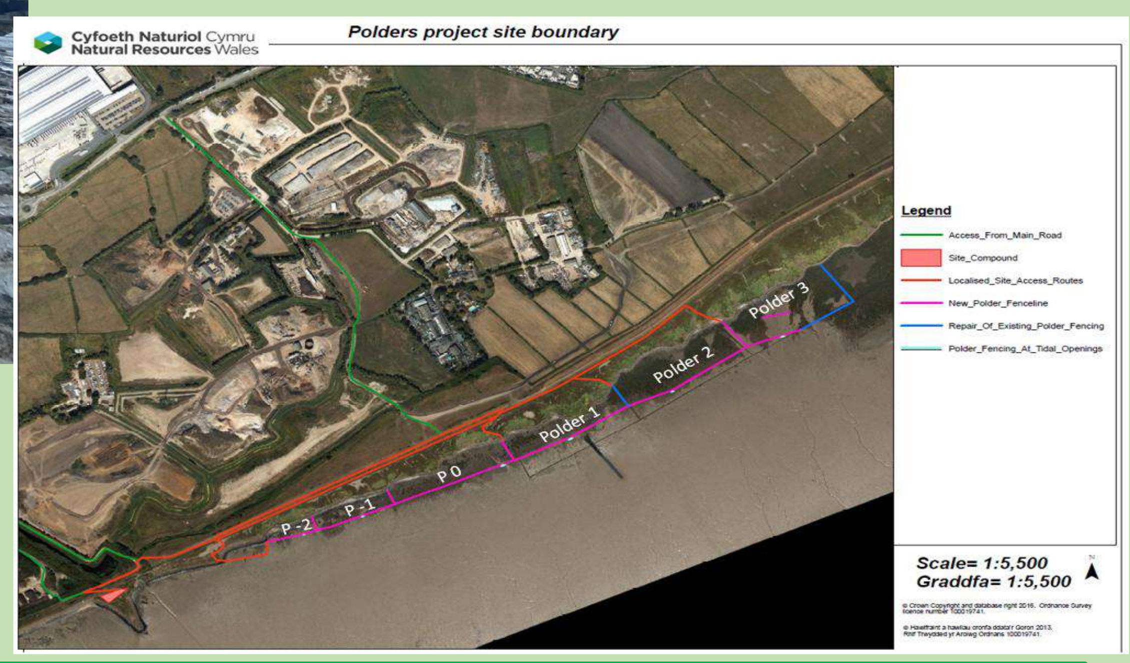


Polders area = 150 m^3 ha^{-1} yr^{-1} **gained** on average, but…
Wider study area = 44 m^3 ha^{-1} yr^{-1} average net **loss** (ABPMer, 2021)

Polders construction 2024

- Marine Licence Band II, planning permission not required
- 2km of new fencing: existing polder restoration and creation of new polders to the west
- 2.3m chestnut fenceposts with hazel brushwood
- Tidal openings for natural drainage channels
- 10 week construction
- £707,000 cost
- Long term programme of maintenance and monitoring





One year later

The polders have survived their first winter storms with minor repairs needed over the summer. Repairs mainly needed to re-tension rope holding brushwood in place.

Reading University led physical monitoring indicates that although there is some mud accretion, we are not seeing extensive consolidation within the polder fields yet.

Extensive baseline monitoring: saltmarsh composition and extent, mudflat biotopes, hydrodynamics and sediment accretion. As part of Marine Licence compliance, planning for suite of survey work in next 5 years

What next? If polders showing success, looking for other opportunities in Wales where coastal erosion and biodiversity would benefit from further polder creation.

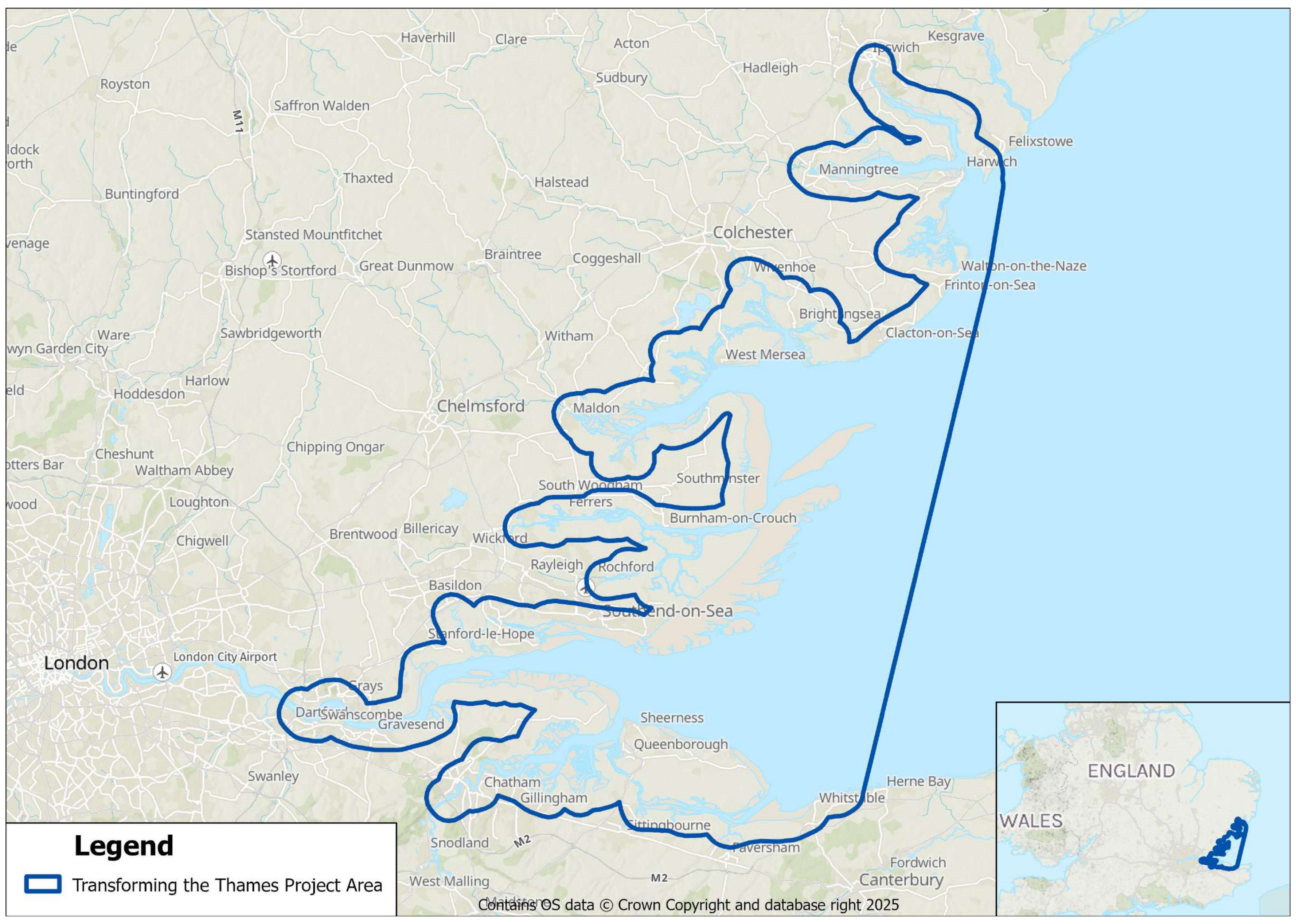
Designing a Seascape Restoration Plan

Transforming the Thames – a case study.

Olwen Belgrove (ZSL), Anna Cucknell (ZSL)

Project overview:

The Transforming the Thames Partnership is currently made up of 19 diverse partners from industry, government organisations, eNGOs, local nature partnership and landowners with a shared vision of the Greater Thames Estuary recovered, reconnected and resilient, an outstanding coastal wetland for nature and communities. With funding from the Endangered Landscape and Seascape Programme we have created a coastal habitat restoration plan detailing how we will work at seascape scale. As part of this we have planned our first tranche of work which will restore 320ha of habitat in the first five years of the programme. More information can be found at the QR code.



Our focal habitats:


Sand and shingle © Paul Rowe


Native oysters © Essex Wildlife Trust


Saline lagoon © RSPB


Saltmarsh © ZSL


Seagrass © ZSL


Coastal grazing marsh © Aaron Hart


Small-spotted catshark in seagrass © ZSL

Our report:

Habitat recovery planning at a seascape scale is a new way of thinking, and as such there is limited information available on the best ways to go about it.

Over the last two years of creating our seascape recovery plan we have had to do much research into, and thinking about the how to bring together various viewpoints, data and science to design our plan. This thinking has been compiled into a report, which we hope will be a useful resource for anyone else undertaking a seascape scale habitat restoration project in the future. The report details our approach to creating our plan using Transforming the Thames as a case study. This is by no means the definitive way to design a seascape plan, but instead demonstrates the way we decided to approach the challenge and our thinking behind it. The report can be found at the following QR code.

Key themes in the report:

- **The Importance of Scale**: We emphasise why thinking at seascape scale is the most holistic approach to coastal habitat restoration.
- **Collaboration and Partnership**: Working in partnership has been instrumental to creating our restoration plan, but it also comes with challenges. We discuss approaches that did and didn't work for our particular partnership.
- **Ecological and Project Seascape Mapping**: Understanding the existing environmental and project context is foundational. We identify key contextual factors that shaped our planning and decision making.
- **Stakeholder Engagement**: Working with existing stakeholders in the environment is an important strategy to long term success. We offer insights into approaches to stakeholder engagement including their strengths and weaknesses.
  Restoration Workstreams: We explain our approach to selecting and prioritising active restoration sites and threat reduction and mitigation strategies.
- **Enabling Conditions**: Habitat restoration goes beyond the practical action on the ground. We explore policy, governance, and sustainable finance, essential aspects to securing the long-term success of a seascape recovery project.


Brent geese on coastal grazing marsh © Paul Rowe


Mersea Harbour Adaptation restoration project in the Greater Thames Estuary undertaken by Harwich Haven Authority and Mersea Harbour Protection Trust. © Jim Pullen

Next steps:

In 2025 we were awarded a delivery grant of $5 million from the Endangered Landscape and Seascape Programme to put our five-year plan into action, and active restoration on those sites will begin in 2026. Alongside delivering those projects, the Partnership will also continue to plan for the longer term. This will include a deep dive into where the priority locations are across the estuary for improving ecological connectivity. We will also create a list of shovel ready projects which we can act on quickly when additional funding becomes available allowing us to efficiently scale up our programme of work.


Juvenile seabass © Essex Wildlife Trust

Adonis Blue Environmental Consultants · Bird Aware Essex Coast · The Crown Estate · Environment Agency · Endangered Landscapes & Seascapes Programme · Essex and Suffolk Rivers Trust · Essex County Council · Essex Rivers Hub · Essex Wildlife Trust · Kent & Essex IFCA · Kent County Council · Medway Swale Estuary Partnership · Natural England · Port of London Authority · Project Seagrass · RSPB · Thames Estuary Partnership · University of Essex · Zoological Society of London

The Concrete Coast programme

Creating intertidal habitats on man-made structures

A project of the Yorkshire Marine Nature Partnership

YORKSHIRE MARINE NATURE PARTNERSHIP

What is the project?

A multi-year landscape-scale project aiming to:

- Improve the ecological value of man-made coastal structures on the Yorkshire Coast
- Create habitats for intertidal species
- Enhance local biodiversity and support partners in exploring local nature recovery and biodiversity net gain opportunities

Why is it important?

The Yorkshire Coast is heavily modified by man-made coastal structures. Whilst necessary for our coastal communities, they reduce available intertidal habitats.

- Intertidal species need highly textured surface and shelter to thrive
- Adding texture and water-retaining features can give local species a foothold to colonise otherwise biota - and species - poor structures

Successes so far

- A range of bespoke artificial habitats have been created and installed in our priority locations
- Limpets, barnacles, periwinkles and mussels quickly colonise newly installed habitats
- Support of asset owners and coastal engineers to progress this project further
- Enthusiasm of local groups to get involved in the design, creation, and monitoring of the enhancements

Next steps

- Trialling of new enhancement designs and techniques on a range of coastal structures
- Citizen science network creation to support the monitoring of our enhancements
- Evaluation of effectiveness and success for upscaling and long-term planning
- Integrating ecological features into planning and design phase new structures
- Connectivity of inland and coastal artificial habitats and outside of the Yorkshire area

EAST RIDING OF YORKSHIRE COUNCIL | Environment Agency | NORTH YORKSHIRE COUNCIL | NORTH YORK MOORS TRUST | North York Moors National Park | Bridlington Harbour Commissioners

Habitat Compensation and Restoration Programme (HCRP)

20 Years of Managed Realignments and Counting

Environment Agency

START **How much do you know about the Habitat Compensation and Restoration Programme (HCRP) and managed realignment in England?**

Without reading on just yet… Please take a few minutes to scan the QR Code and complete this short survey.

2 Flood and Coastal Erosion Risk Management (FCERM)

The National FCERM Strategy[1] vision is "**A nation ready for, and resilient to, flooding and coastal change – today, tomorrow and to the year 2100**".

Shoreline Management Plans (SMPs) and FCERM Strategies ('Strategic Plans'), provide the planning framework to support FCERM activities that achieve this vision.

SMPs are contiguous around the English and Welsh coast, with the boundaries based on physical coastal processes, approximating natural sediment cells (**Fig. 1**).

Visit SMP Explorer[2] online to check your local SMP management approaches…

Fig 1

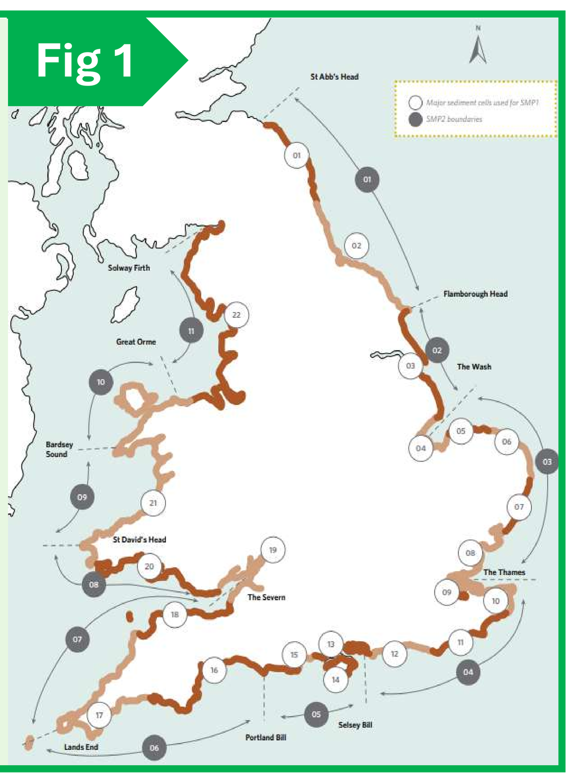
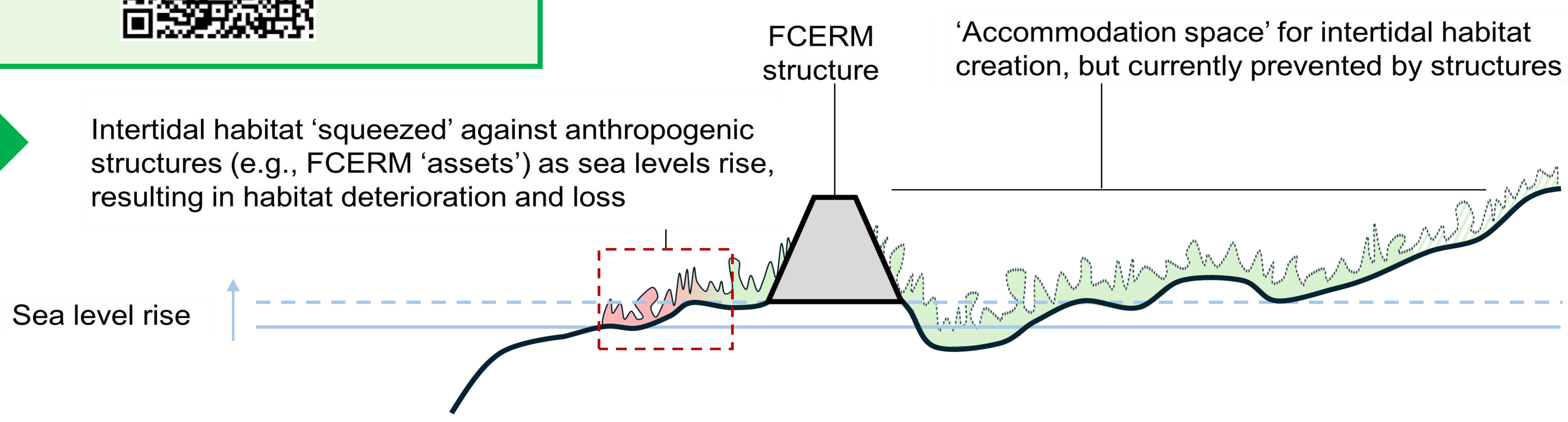


Fig 2



3 Coastal Squeeze

Coastal Squeeze[3] (Fig. 2) is defined as:

"The loss of natural habitats or deterioration of their quality arising from anthropogenic structures or actions, preventing the landward transgression of those habitats that would otherwise naturally occur in response to sea level rise in conjunction with other coastal processes. Coastal squeeze affects habitat on the seaward side of existing structures".

4 Managed Realignment (MR)

MR is the process whereby existing FCERM structures are 'breached', allowing tidal waters to inundate areas of the hinterland behind, as they would have prior to previous land claim of intertidal areas. If needed (e.g., due to low lying ground), a new set back FCERM structure may be built before the breach.

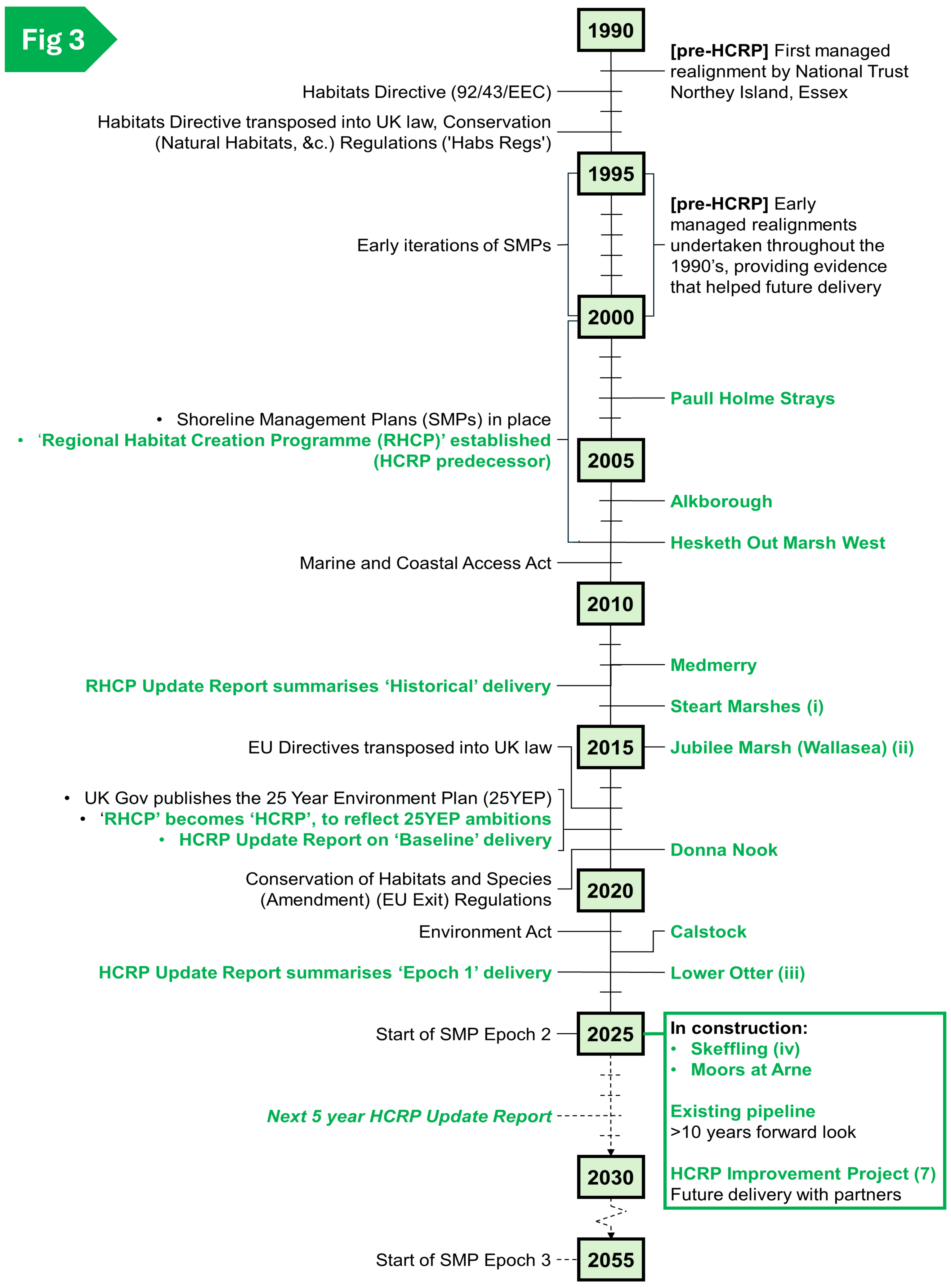
In the context of climate change and sea level rise, **MR is an important coastal management tool** for creating intertidal habitats and increasing their resilience by alleviating coastal squeeze pressures, whilst also improving the sustainability of FCERM assets and society's use of the coastal zone.

5 HCRP: Strategic Delivery Vehicle

The HCRP is the national 'strategic delivery vehicle' for **creating compensatory habitat, for the loss of designated sites, predicted to occur due to FCERM activity at the coast. The majority of losses are due to coastal squeeze**.

Area teams lead delivery with national oversight and support, working in partnership with Natural England, landowners, conservation partners and contractors. Development and delivery of the HCRP Pipeline provides Defra with confidence that coastal FCERM activities meet legal obligations in accordance with the 'Habs Regs' – the **HCRP is therefore a 'critical enabler' of FCERM**.

Fig 3



6 HCRP: Timeline and Delivery

The timeline in **Fig. 3** illustrates historical MR delivery and key legislation and planning milestones in England. Key HCRP milestones, reports and *just a few examples* of MR delivery are in **green** and imagery below (**i – iv**). **In terms of delivery, to date, over SMP Epoch 1 (c.2005 to 2025), the HCRP has created…**

… 1,600 ha of intertidal mudflat and saltmarsh

… 470 ha of freshwater grazing marsh

… 290 ha of other coastal habitats

i

ii

iii

iv

7 HCRP: Improvement Project

Following 20+ years of successful delivery, the HCRP has initiated the '**HCRP Improvement' Project**'. From now to March 2027 and comprised of 10x Workstreams, the Project aims to:

"**Create the tools, guidance, data and governance needed to support and improve development, delivery and strategic oversight of the HCRP, to fulfil FCERM compensation legal obligations and where possible, support wider estuarine and coastal restoration ambitions for the EA and UK Gov**".

As we enter the SMP medium term (Epoch 2, 2025 – 2055), with new legislative drivers for environmental recovery beyond legal compensation, alongside existing and emerging risks, issues and opportunities, the project is timely.

Running in tandem with and feeding into the wider Programme, it provides an opportunity for the next evolution of the HCRP to ensure that it is best placed to work with and support partners in **delivering coastal adaptation for both people and nature**.

END

Resources

[1] Environment Agency (2020) *National Flood and Coastal Erosion Risk Management Strategy for England*.
[2] Environment Agency (2023) Shoreline Management Plan Explorer. *https://environment.data.gov.uk/shoreline-planning*.
[3] Defra et al (2021) *What is Coastal Squeeze (WICS)?*. Project FRS17187.

Contact Details

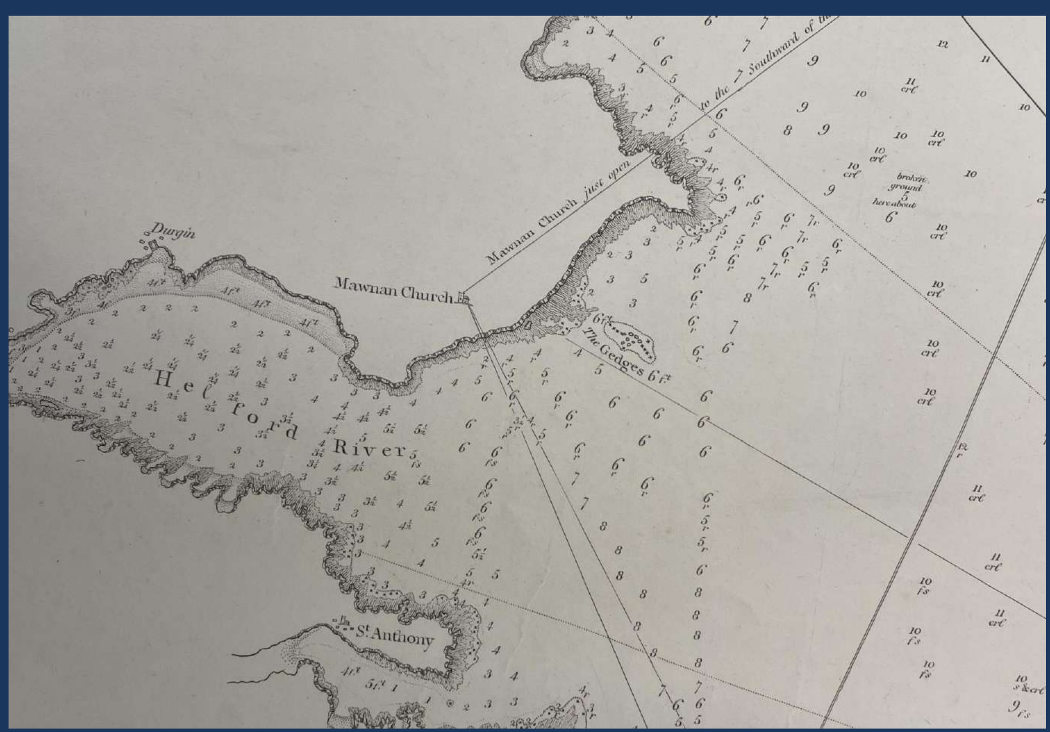
Will Manning, will.manning@environment-agency.gov.uk
Senior Advisor, Coastal Resilience | HCRP National contact | Environment Agency (EA)
For more information, please contact: hcrp@environment-agency.com

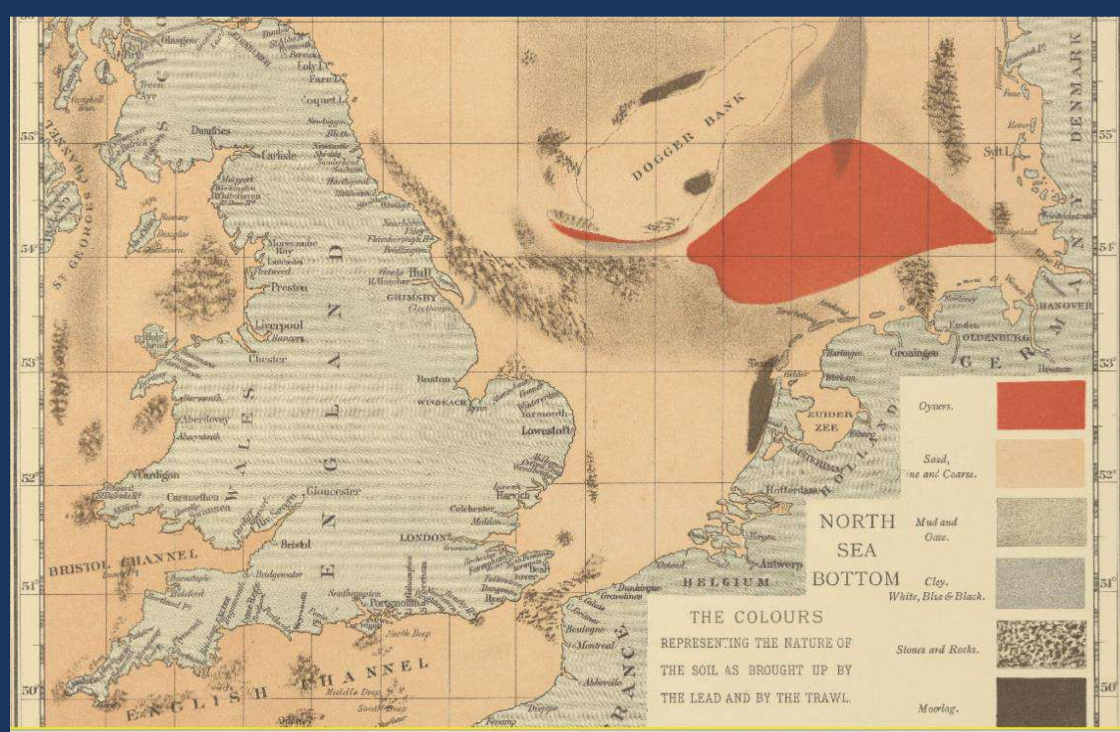
Historical Seabed Habitats: archival records describe distribution and drivers of change in English waters

Ellie Maynard, Ruth H. Thurstan and Charlotte L. E. Johnson e.maynard@exeter.ac.uk

Introduction

- The 19th century witnessed rapid industrialisation of marine industries such as bottom trawl fisheries[1]
- Historical ecology studies suggest vulnerable seabed habitats were substantially altered due to industrialisation[2,] yet our knowledge of the extent of changes to English marine habitats remains limited to a few species
- This lack of knowledge is compounded by the prevalence of <decadal ecological monitoring data in studies of anthropogenic impacts[3]
- Evidence of the historical distribution and extent of seabed habitats may inform marine restoration by countering our understanding of current, often degraded, ecosystems





Methods

- Targeted search of archival parliamentary papers, admiralty charts, scientific literature, museum catalogues, and natural history books
- Mapped **locations** and recorded descriptions of **extent** & **ecosystem health** of key benthic marine habitats

Results

"The Herring Sands [The Wash, Lincolnshire] was covered for **195 acres** with mussels… the area **seems to be inexhaustible**" – 1879, Report from the Inspectors of Sea Fisheries

- New data were mapped for blue mussel reefs, coarse sediments & gravels, subtidal rock reefs, and submerged peat banks
- **284 sources**, published between 1792 and 2024, generated **494 spatial data points** that were combined with previously published data[2]
- **Large declines in distribution and / or extent** of some habitats (e.g. seagrass meadows, biogenic reefs & submerged peat banks), others show **relative consistency** over time (e.g. subtidal rock reefs, gravels & coarse sediments, maerl)
- Documented drivers of change included **pollution**, **overfishing**, **physical damage**, and **coastal development**

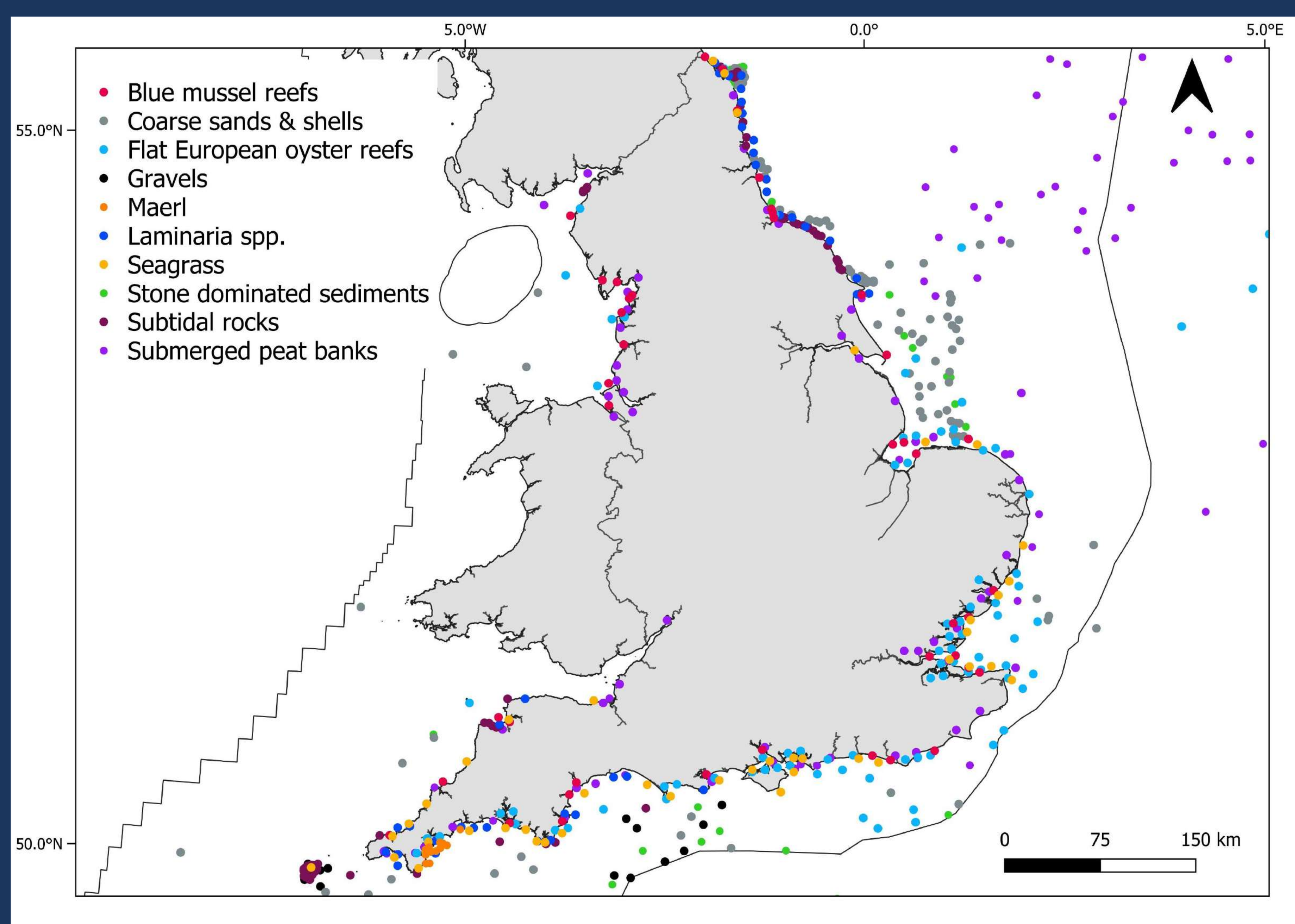


Figure 1: spatial locations of 10 habitats detailed in archival records prior to 1960.

Conclusions

- More, and older, information exists for habitats that were **commercially exploited** or were the focus of significant **scientific interest**
- Archival evidence can be valuable for setting ambitious, informed restoration efforts

References:
1. Kerby et al., 2012. The United Kingdoms role in North Sea demersal fisheries: a hundred year perspective. Reviews in Fish Biology and Fisheries 22, 621-634
2. Thurstan et al 2024. Historical dataset details the distribution, extent and form of lost Ostrea edulis reef ecosystems. Scientific Data 11, 1198
3. Airoldi and Beck, 2007 Oceanography and Marine Biology: An Annual Review 345

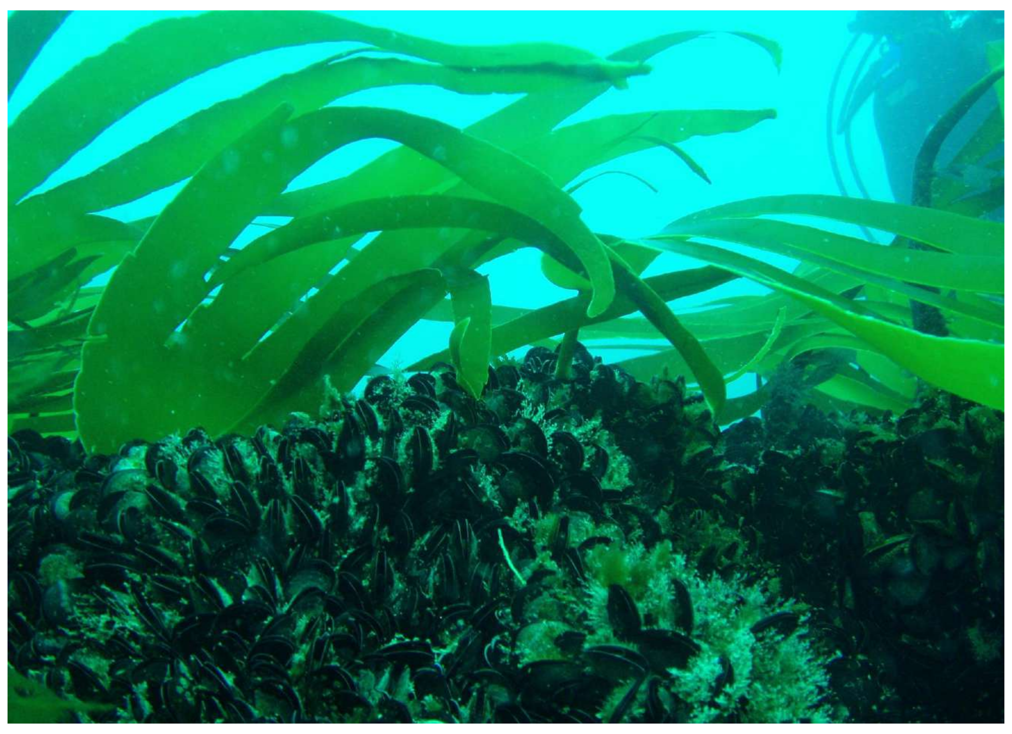
The Crown Estate's Offshore Wind Evidence and Change programme aims to facilitate the sustainable and coordinated expansion of offshore wind to help meet the UK's commitments to low carbon energy transition whilst supporting clean, healthy, productive and biologically diverse seas.

MaRePo+

Marine Restoration Potential + enhancement

Charlotte Johnson
Charlotte.Johnson@naturalengland.org.uk

NATURAL ENGLAND



PROJECT OVERVIEW

Culmination of 3 years of funding from by Defra, Natural England and The Crown Estate's Offshore Wind Evidence and Change programme (OWEC) which aims to facilitate the sustainable and coordinated expansion of offshore wind to help meet the UK's commitments to low carbon energy transition whilst supporting clean, healthy, productive and biologically diverse seas.

Project maps the marine restoration potential of threatened and decline habitats and species in English waters.

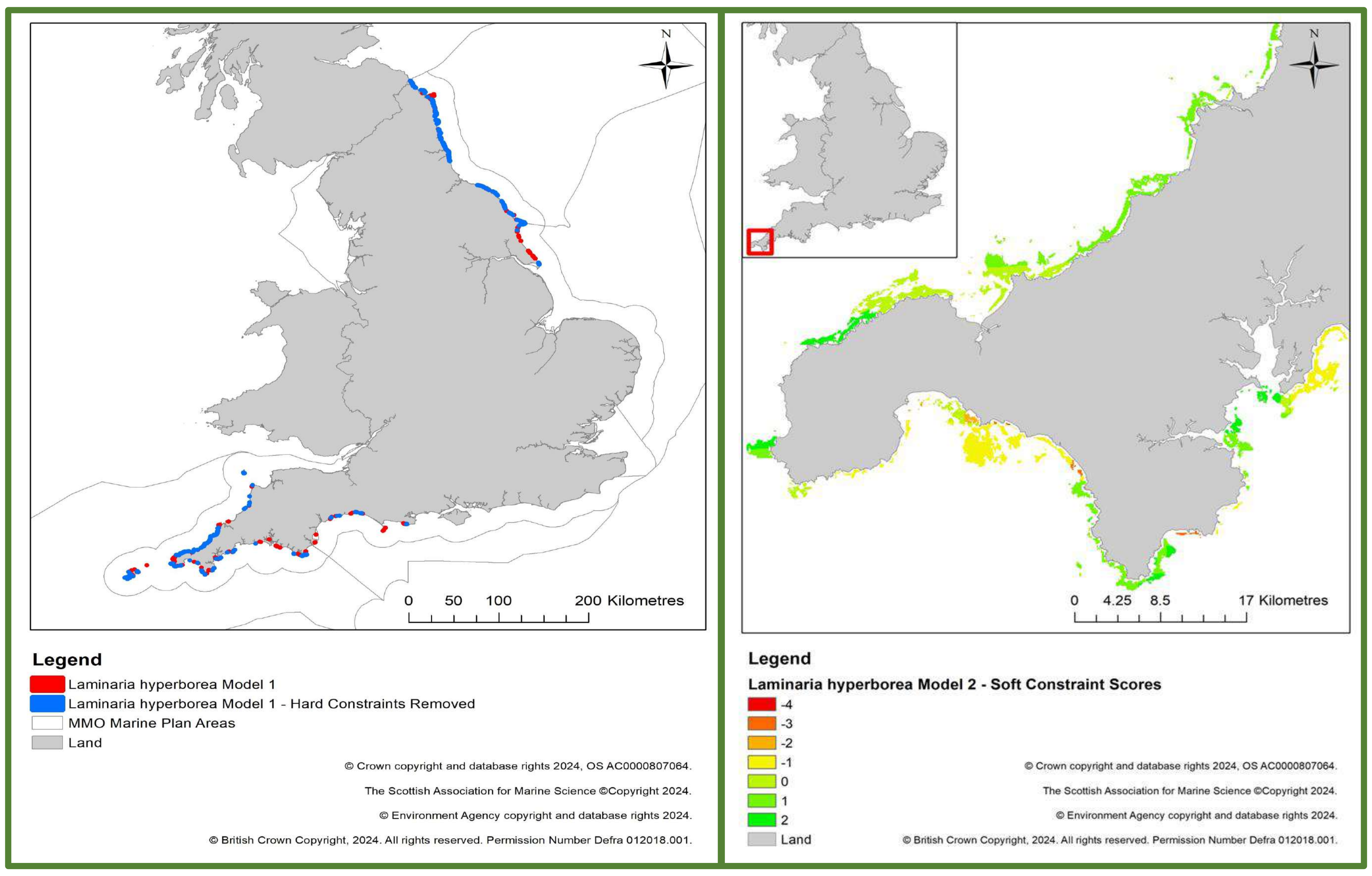
1

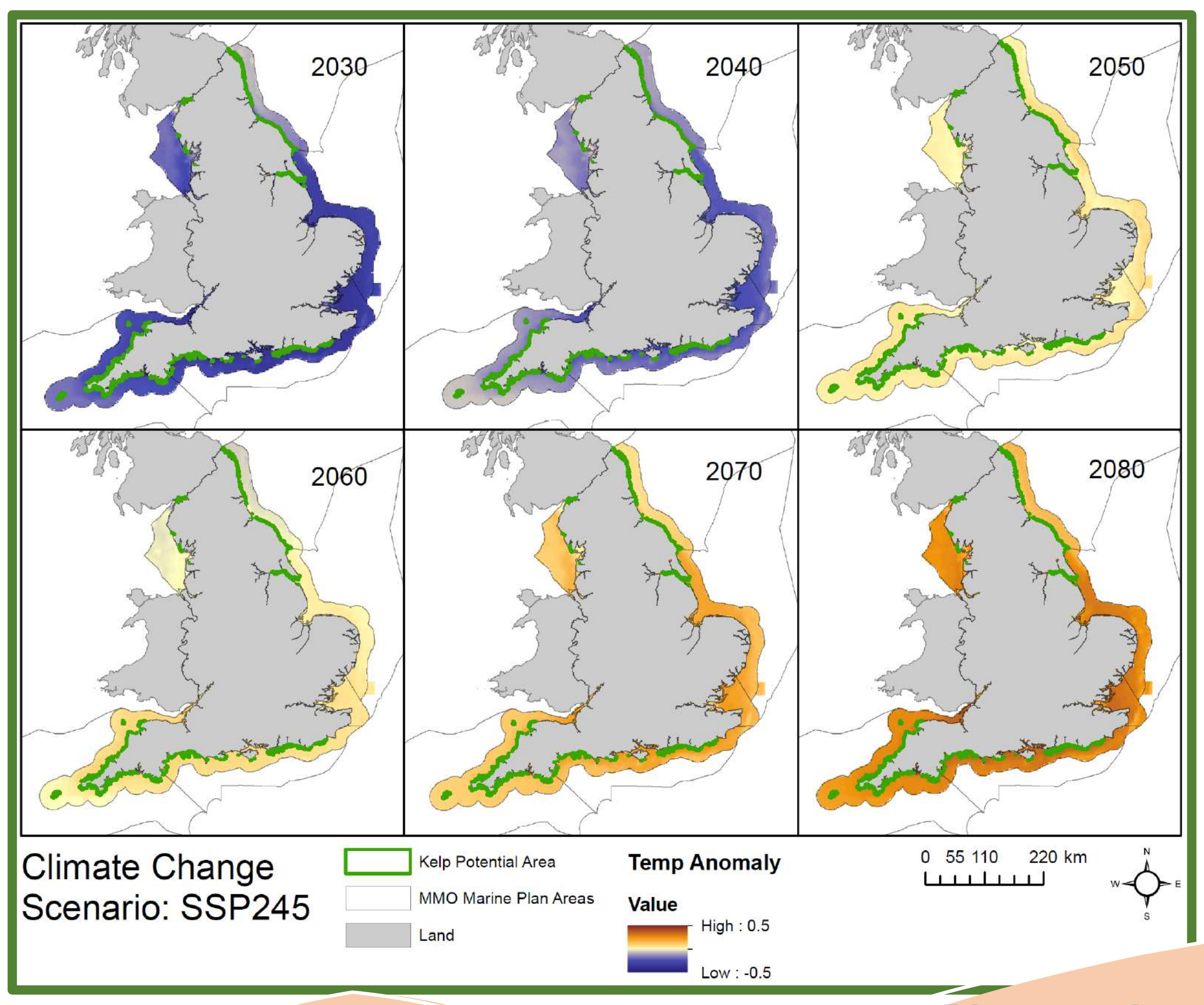
Habitat restoration model refinement

Mapping constraints

Climate change hot spots

OSPAR Habitat	refined restoration potential (km²)	hard constraint exclusion (km²	% of remaining area covered by each soft constraint category: Negative	Neutral	Positive
Tangle Kelp	490	403	23	21	56
Sugar Kelp	78	46	3	85	12
Native Oyster Beds	746	584	54	23	23
Horse Mussel Beds	1276	910	90	7	3
Sea Pens & Burrowing Megafauna	32,976	31,101	28	61	11





MaRePo+

Read the reports and access data here:

2

Pilot restoration guides

- Habitat context, restoration history and outlook
- Restoration planning – permitting and licensing
- Costs, funding
- monitoring and evaluation
- Barriers evidence gaps and recommendations
- Technical considerations of restoration

3

Historic assessment of habitats

See poster by Ellie Maynard

4

Mobile species restoration action plan

HMC Howell Marine Consulting · ERM

Phase 1 developed list of priority mobile species for restoration.

Phase 2 prioritised restoration activities for mobile species identified in Phase 1

Birds	Reducing disturbance, habitat restoration and creation, foraging and nesting habitat.
Fish	Migratory barriers, stock sustainability measures, management or closures, bycatch measures, improving spawning and nursery grounds
Mammal	Pupping site protection, improving prey availability, noise disturbance, reducing bycatch, habitat improvement

NATURAL ENGLAND · Cefas · Environment Agency · JNCC Joint Nature Conservation Committee · www.gov.uk/natural-england · Offshore Wind Evidence + Change Programme · THE CROWN ESTATE · Department for Environment Food & Rural Affairs

The NBS Database & Coastal Data Hub

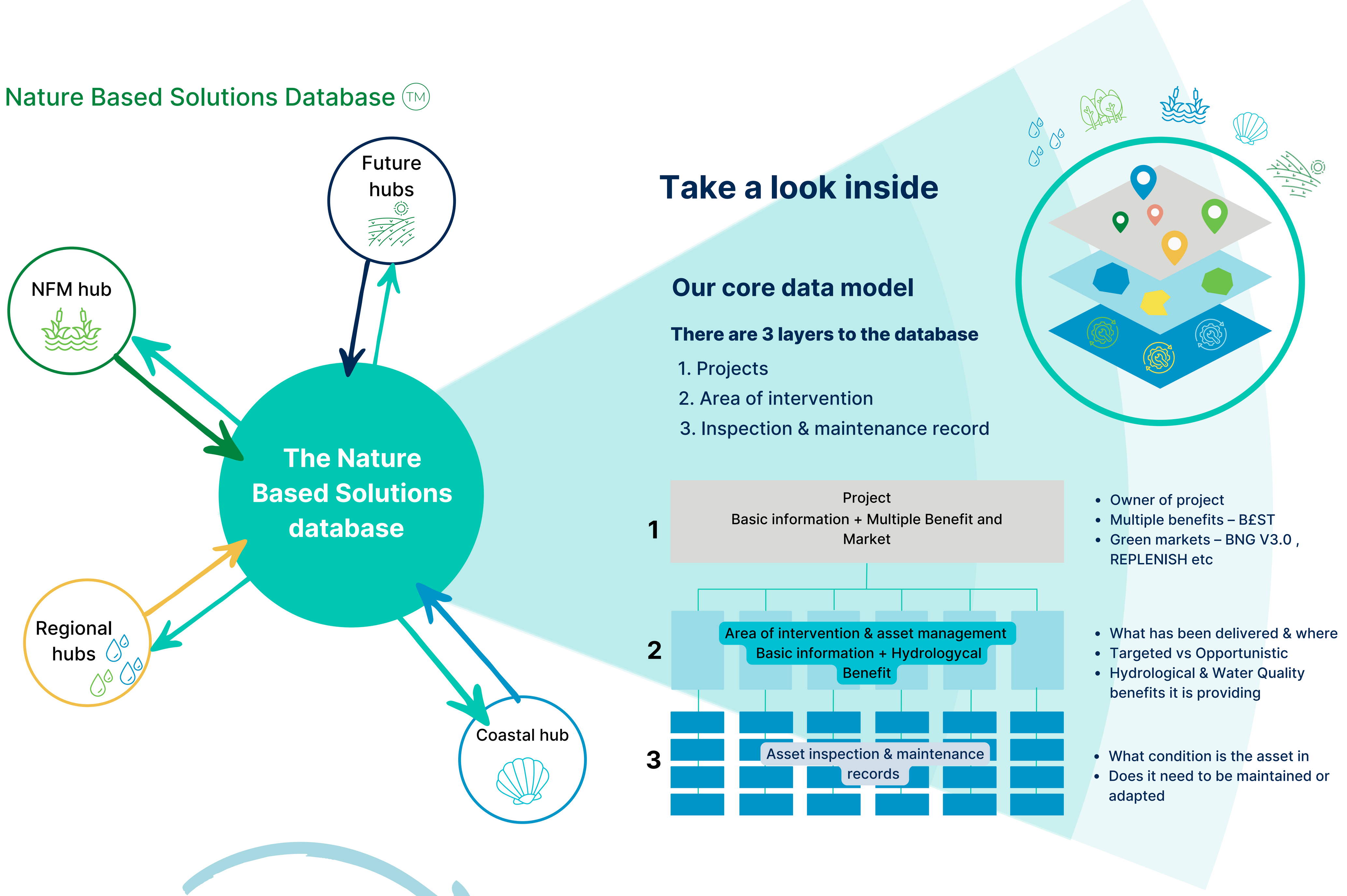
Heather Bell, David Johnson, Alex Gilroy, Will Wright, Amy Pryor, Ciara McGlade, Alison Furber, Harry Shepherd, Michelle Walker, Anneka France
heather.bell@theriverstrust.org or data@theriverstrust.org

THE NBS DATABASE

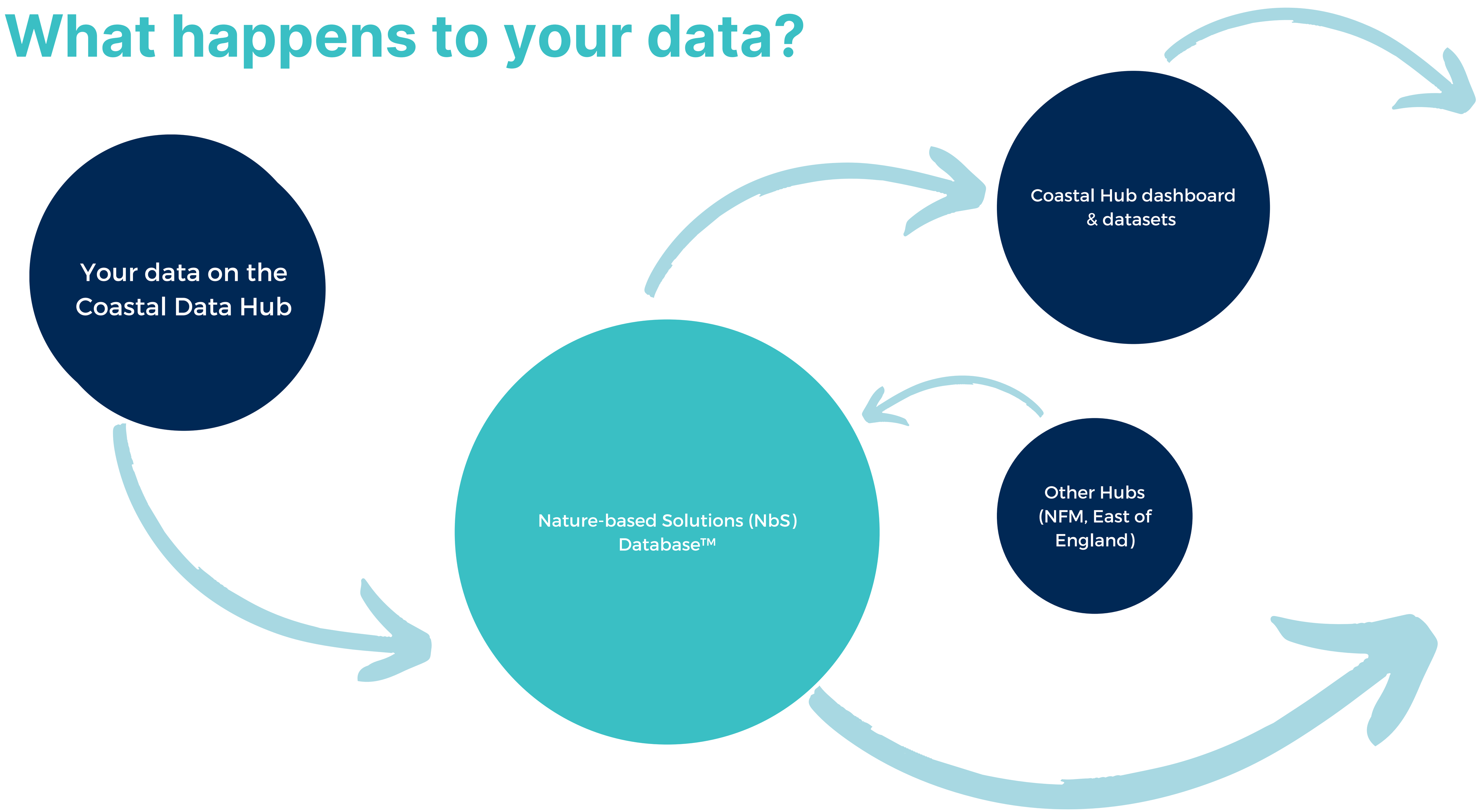
The NBS Database has been developed iteratively since the 2015 NFM Defra Pilot and is a geospatial database for mapping nature based projects, interventions and inspections. The NBS Database underpins a number of platforms led by The Rivers Trust and Catchment Based Approach:

- **The NFM Hub (winner of the Esri Collaborative Award 2024)**
- **The Coastal Hub**
- **The East of England NBS Planning Hub**
- **The Tree Hub**

There are over 6000 interventions and 700 projects registered in the database so far.



What happens to your data?



Used by regulators to:

EA NFM Programme – plan their maintenance of water courses and avoid damaging or removing NFM.

EA – Report on progress towards delivering the Natural Flood Management Program.

NE – Report on progress delivering 30X30 and Wildlife Rich Habitat targets.

Viewed by public:

To understand what is being done to protect coastal environments

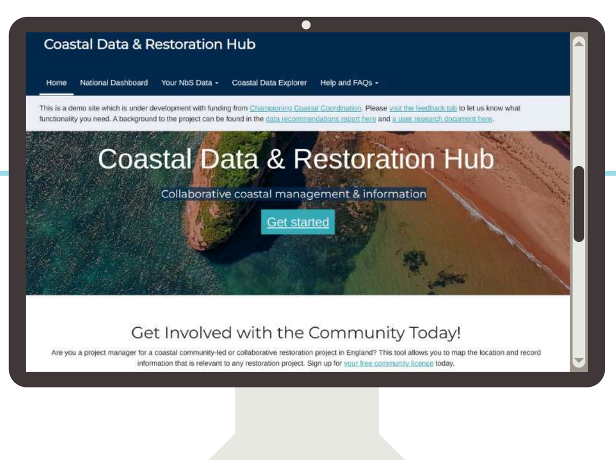
This means that your project can be integrated with delivery for Water Resource, Water Quality and Nature Recovery.

THE COASTAL DATA & RESTORATION HUB

The Coastal Data Hub is a collaborative site for mapping and managing nature based solution projects and interventions in the coastal environment. The platform was developed with funding from the Championing Coastal Coordination (3Cs) project. The Coastal Daa Hub is underpinned by the NBS Database.

The Coastal Data Hub has been developed to overcome barriers such as a lack of GIS software or training for users to add thier projects and interventions data to an online map:

- Free community licenses
- Apps to add and edit NBS Data - projects & interventions
- Map explorer
- Personalised dashboard of projects and interventions
- Guidance videos
- User guide



Warton Mires Wetlands Creation
Led by the RSPB
Opportunity

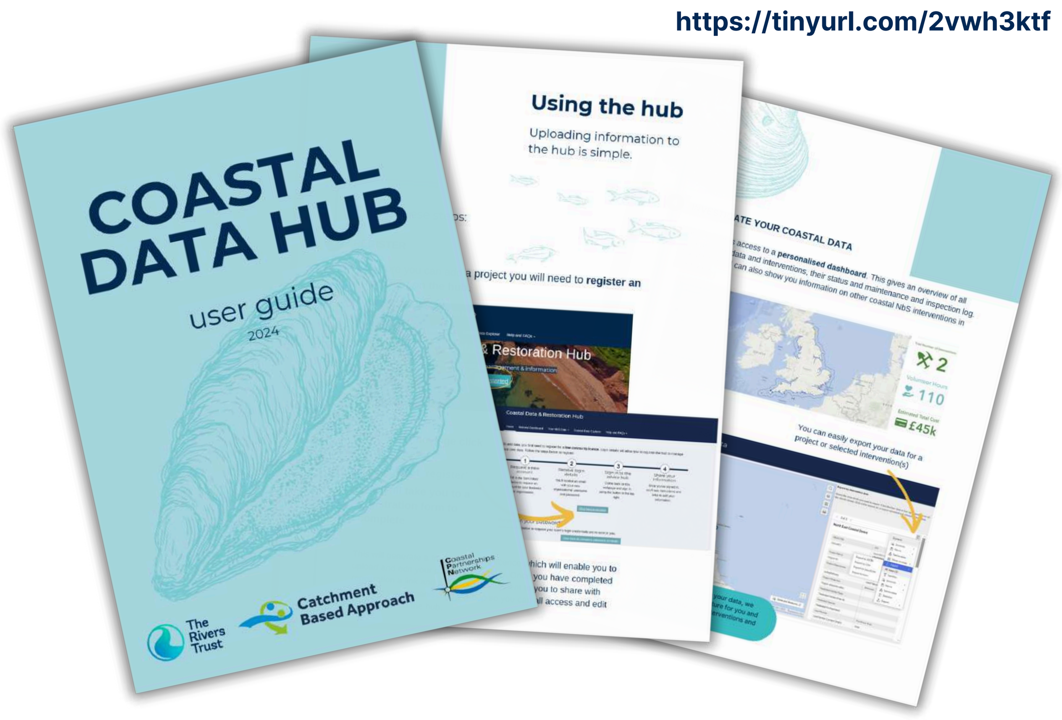
Beneficial use of dredged sediment
Led by the RSPB
Active

Photo source: NBS Database, RSPB

Get started today

User Guide

https://tinyurl.com/2vwh3ktf



Coastal Data Hub

https://coastal-data-hub-theriverstrust.hub.arcgis.com/

The Rivers Trust
Catchment Based Approach
coastal partnerships network

ARE WOOL LOGS A SUSTAINABLE ALTERNATIVE TO COIR?

Designing and producing local sustainable wool products for restoring our landscape: peat restoration, rewetting the land and helping to restore salt marsh.

NATURAL DALES WOOL PRODUCTS

In partnership with

JBA consulting

Environment Agency

H.DAWSON®
WOOL EXPERTS SINCE 1888

Natural Dales Wool Products was set up by Ruth Lindsey in 2021 to test practical, land-based uses for British wool, particularly from low-value Hill and Mountain breeds like the Swaledale.

The aim is to use wool in nature-based restoration projects such as rewetting peatlands and restoring salt marshes, to help reduce erosion and slow water flow. Wool logs have been developed as a UK-grown alternative to imported coconut fibre rolls, for restoration work. Using locally sourced wool supports farmers by creating a new purpose and paying a market leading price for otherwise undervalued fleeces.

NATURAL
UV RESISTANT
FIRE RESISTANT

Results have shown that wool logs

- Hold water inside the log.
- Hold water & grains of peat behind them.
- Have bedded in the landscape

Did you know...

Wool readily biodegrades in the marine environment and does not contribute to microplastic pollution*.

Salt marshes play an important role in coastal protection

- They absorb wave energy
- Trap sediment
- Act as a natural buffer against flooding during high tide

Salt marshes are retreating due to rising sea levels, wave pressure, and human intervention. In some places, erosion at the toe of the embankment and damage from wave over-topping are increasing risk to habitats and flood defences.

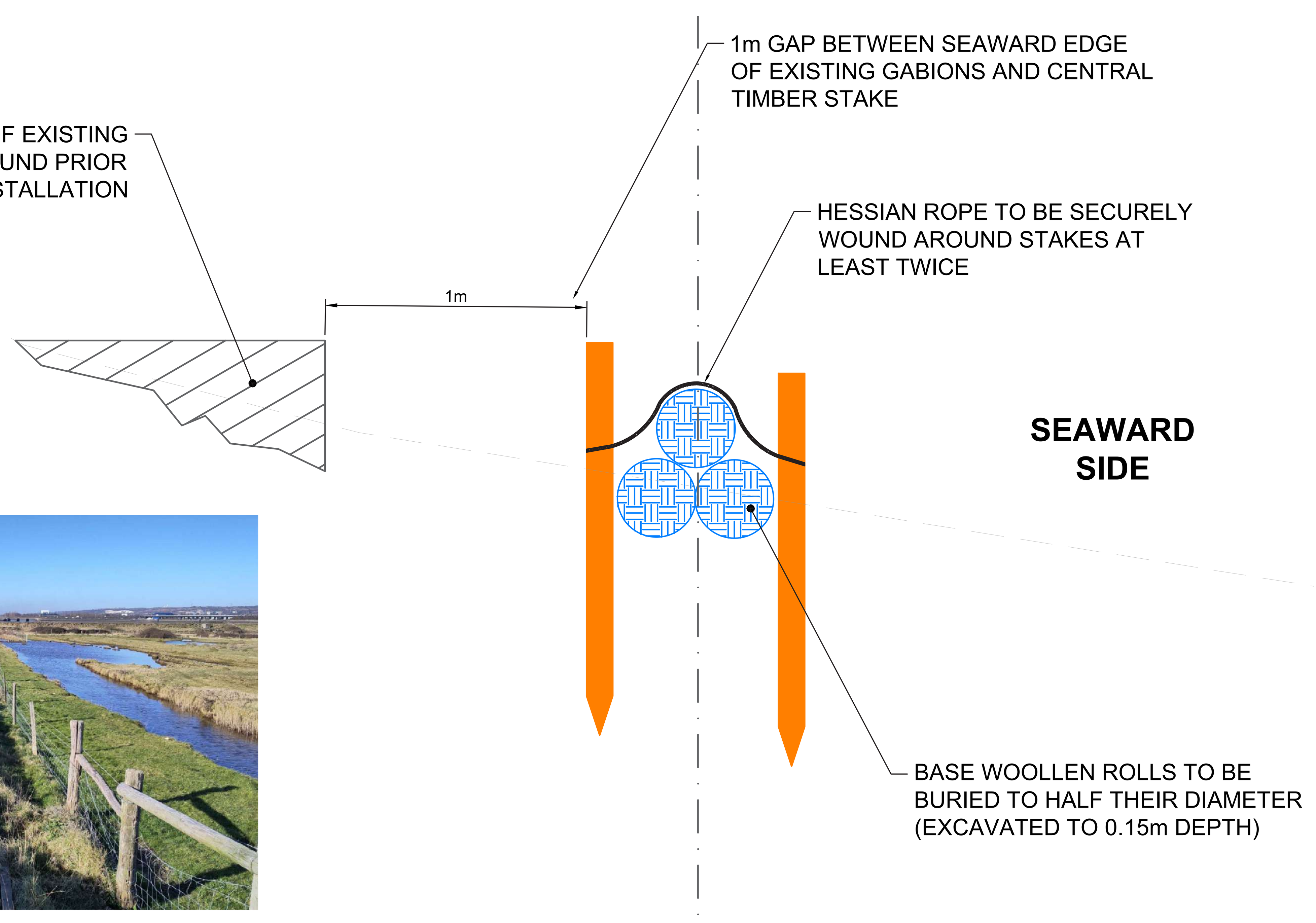
Working with Lydia Burgess-Gamble of JBA Consulting, a trail has been designed at Farlington Marshes in Hampshire in conjunction with Pippa Lawler of the Environment Agency, to test a small-scale scale nature-based approach using wool to protect the shoreline.

TRIAL 01:

Wool logs installed along the base (toe) of the embankment to help reduce erosion and encourage sediment to build up. These are designed to function like coconut fibre rolls, fitting closely to the embankment edge.

TRIAL 02:

Wool felt blanket placed on the landward side to test whether it can reduce the impact of wave overtopping and slow down water movement.



Partners in peatland restoration

Yorkshire Peat Partnership · South West Peatland Partnership · Dartmoor Hill Farm Project · Duchy of Cornwall · Yorkshire Dales National Park

@daleswool ruth@ndwp.uk
www.ndwp.uk

*Royer, S.-J., Wiggin, K., Kogler, M., & Deheyn, D.D. (2023). Marine biodegradation behaviour of wool and other textile fibres. Water, Air, and Soil Pollution

Assessing how coastal habitat health & location benefits society

Susan.Burton@environment-agency.gov.uk
Lucy.Stainthorpe@environment-agency.gov.uk

Coastal habitats provide a critical role in storing carbon, flood protection, sheltering commercial fish, improving water quality and supporting our well-being. Restoring healthy habitats in the right location is essential if we are to realise these services for future generations' wellbeing and economy.

This marine Natural Capital and Ecosystem Assessment (mNCEA) project reviewed literature and identified indicators and metrics that better capture the full value of these habitats to help us:

- Investigate risks, (e.g. sea level rise) and pressures (e.g. poor water quality) on saltmarsh, seagrass, kelp and mudflat habitat **health and functioning**
- Understand how changes in the health, functioning and location of these habitats affect the **delivery of ecosystem service**

Information packs have been created from the outputs of this review. These provide evidence and guide future data collection efforts to explore the links between pressures, habitat health and ecosystem service delivery.

Guidance for practitioners involved in coastal habitat restoration & protection

Resources produced in this mNCEA project support:

- **Monitoring** the health of existing coastal habitats and the success of efforts to restore them
- **Impact assessments**, which reveal how the health of habitats affects ecosystem services
- **Future research** in our estuarine, coastal and marine ecosystems, through identification of research priorities

A key tool created from the evidence review are the Natural Capital Indicator matrices (Figure 2). These identify potential indicators for exploring ecosystem services and pressures.

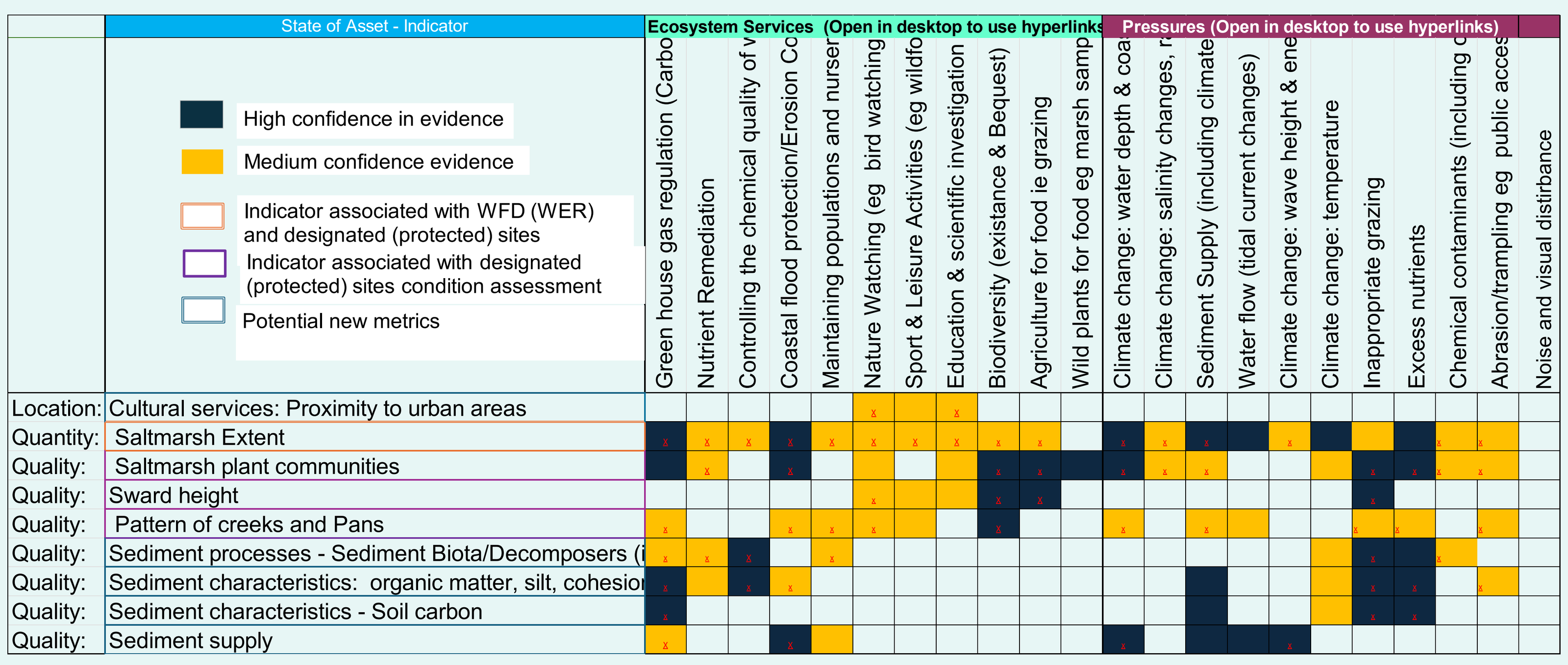


Figure 2. Extract from the saltmarsh indicator matrix from the literature review. Coloured cells indicate confidence levels in evidence available: Blue = High, Amber = Moderate, White = No evidence from review.

Conclusion

- Coastal habitat restoration practitioners are encouraged to use the evidence compiled and guidance for future data collection to consider the estuarine and coastal environment through a natural capital lens.
- This will provide a more compelling case for investment in coastal habitat restoration and protection by demonstrating the full range of benefits they provide, and ensure future generations benefit from the services derived from a healthy coastal ecosystem.

References
1. Burton, S, Burgess-Gamble, L, Stainthorpe, L, Tillin, H, Skalska, K, Davey, S, Piggott, M, Weiland, M, Negus, S, Simpson, S, Tyler-Walters, H 2025 Using Natural Capital Indicators and Metrics to support Coastal Habitat Protection and Restoration. mNCEA report to Defra.
2. Simpson, S. & Skalska, K 2025 Introducing PEAP: A tool for Prioritising Ecosystem Services, Assets and Pressures. mNCEA Report to Defra.

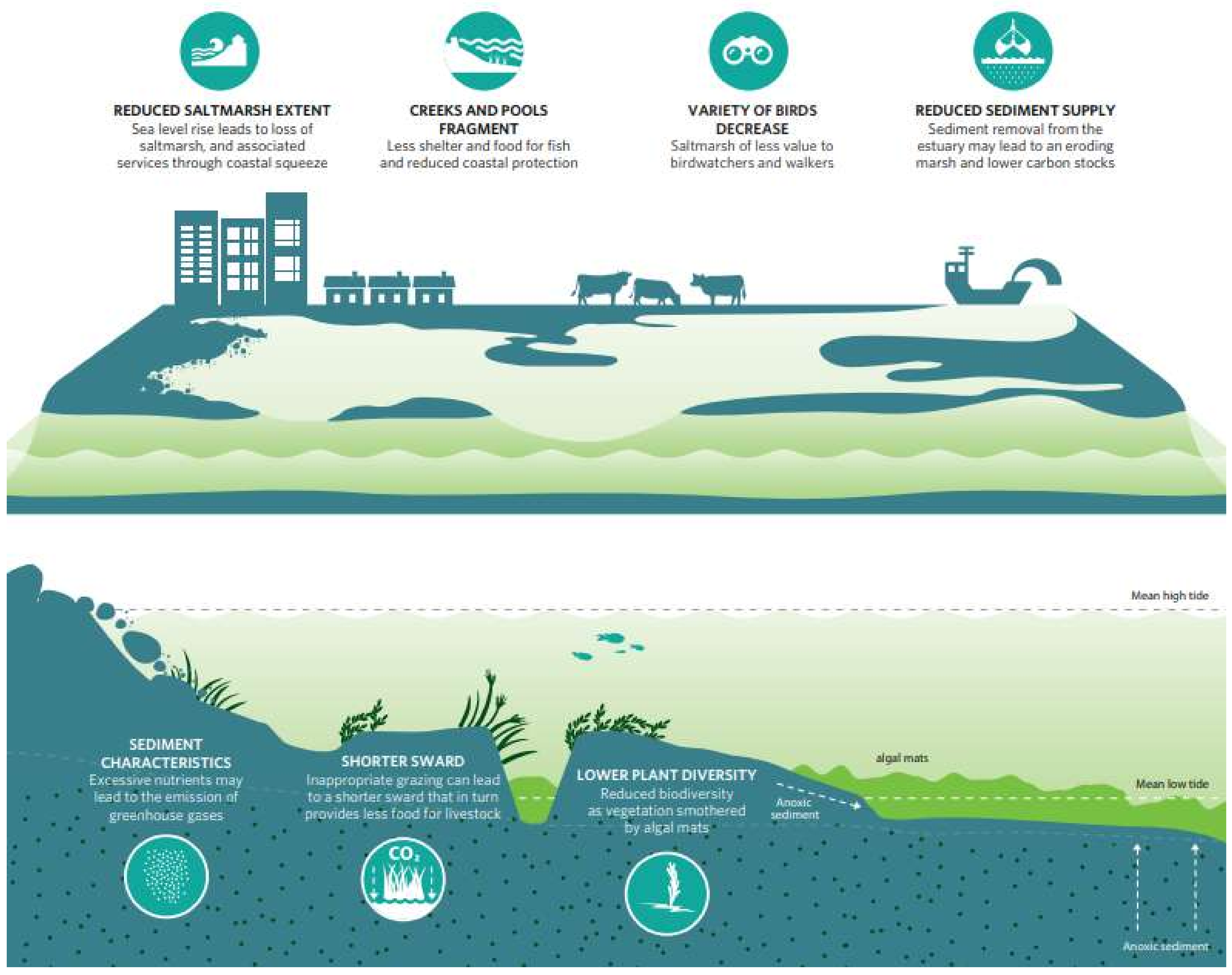


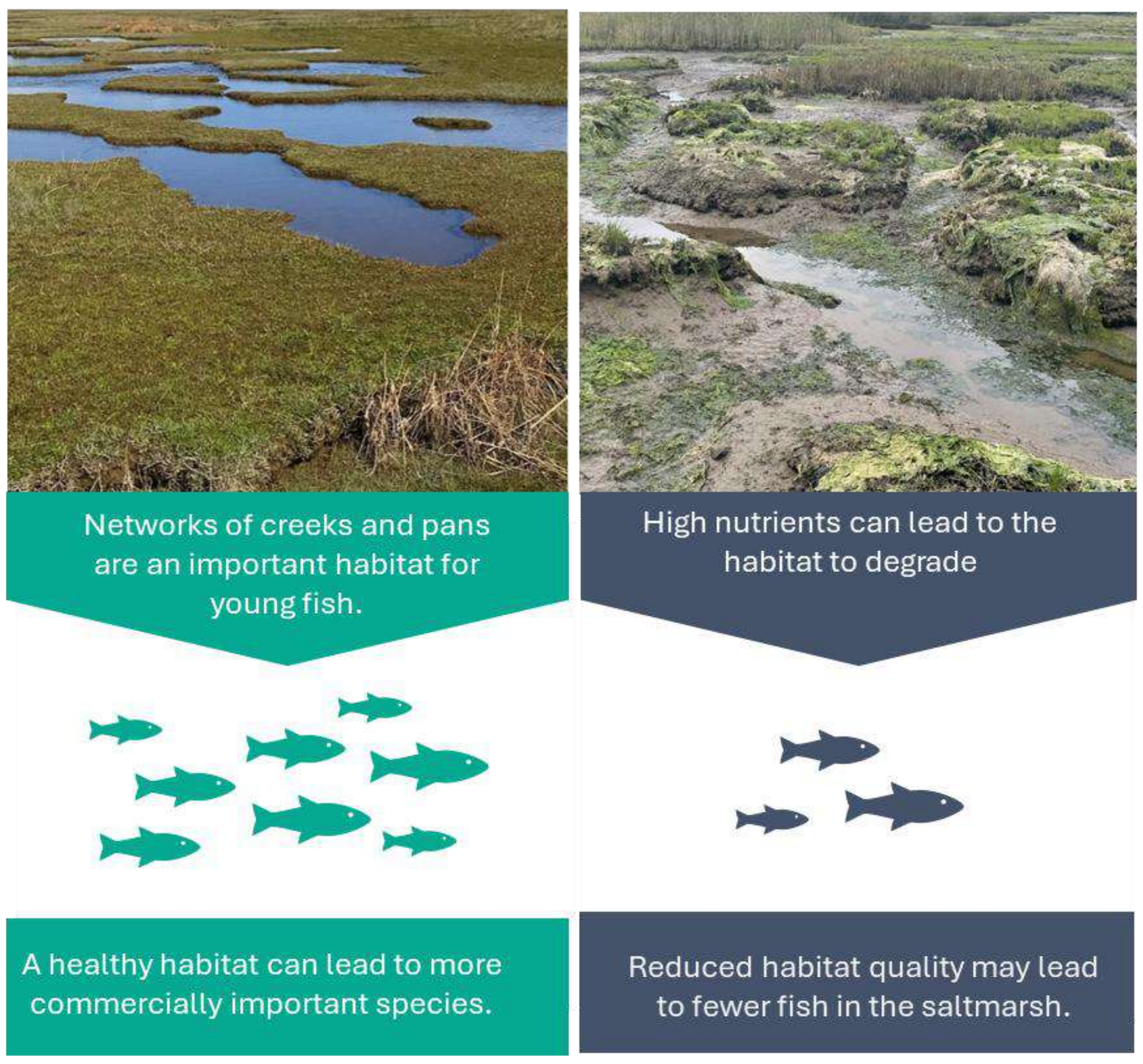
Figure 1. Examples of priority indicators that the literature review suggests can reflect how some risks and pressures may affect how well saltmarsh provides services to society – by compromising its health and location.

CASE STUDY: Water quality, saltmarsh health & commercial fish

The indicator matrix provides evidence as to how excessive nutrients may affect saltmarsh health and, in turn, how saltmarsh health may affect commercial fish. This concurs with modelling, using available national data sets, that found high nitrate concentrations appear to be a factor that may influence saltmarsh extent, and in turn identified that this variable and species diversity can influence the abundance of some commercial fish species (Simpson & Skalsa, 2025).The matrix can be used to help direct future data collection efforts to assess how nutrients and other pressures impact how well saltmarsh supports commercially important fish stocks and other services.

Healthy habitats lead to healthy fish populations

but high nutrients can compromise habitat health



Resources

Please contact Sue Burton and Lucy Stainthorpe on the email addresses above for habitat information packs, which include:

- Saltmarsh, seagrass, kelp and mudflat natural capital **indicator matrices**
- **Recommendations** as to how to improve current coastal habitat monitoring
- A summary of natural capital **evidence gaps**

NAVIGATING THE POLITICS OF CROSS-BORDER CONSERVATION OF COASTAL HABITAT (C3)

Alys Samuel-Thomas
Supervisors: Cai Ladd, Rhian Meara, & Emma McKinley (Cardiff University)

Swansea University Prifysgol Abertawe

Transboundary Coastal Habitats

Coastal habitats namely salt marshes, seagrass meadows, rocky shores, and sand dunes are often divided by (in)visible socio-political boundaries such as national borders and local authority boundaries, but the habitats are interconnected (Li and Jay, 2023).

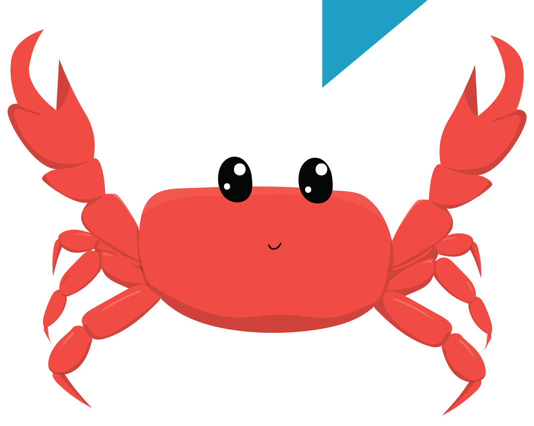
The conservation of transboundary habitats requires large scale coordination and collaboration across stakeholders, governance approaches, and management (Dallimer and Strange, 2015).

Only 43 out of 153 countries which share transboundary rivers, lakes and aquifers report having operational arrangements in place (UN, 2023).

My Study Sites & Borders

Sites	Transnational Borders	Local Authority District Boundaries (May 2024)
Solway Firth	Scotland + England	Dumfries and Galloway and Cumberland
Carlingford Lough	Northern Ireland + Republic of Ireland EU and UK	Newry, Mourne and Down and Louth
Dee Estuary	Wales + England	Chester, Flintshire, and Wirral
Severn Estuary	Wales + England	Vale of Glamorgan, Cardiff, Newport, Monmouthshire, Forest of Dean, Stroud, South Gloucestershire, Bristol, North Somerset, and Somerset

What is your methodology for this study?



CO-DESIGN!

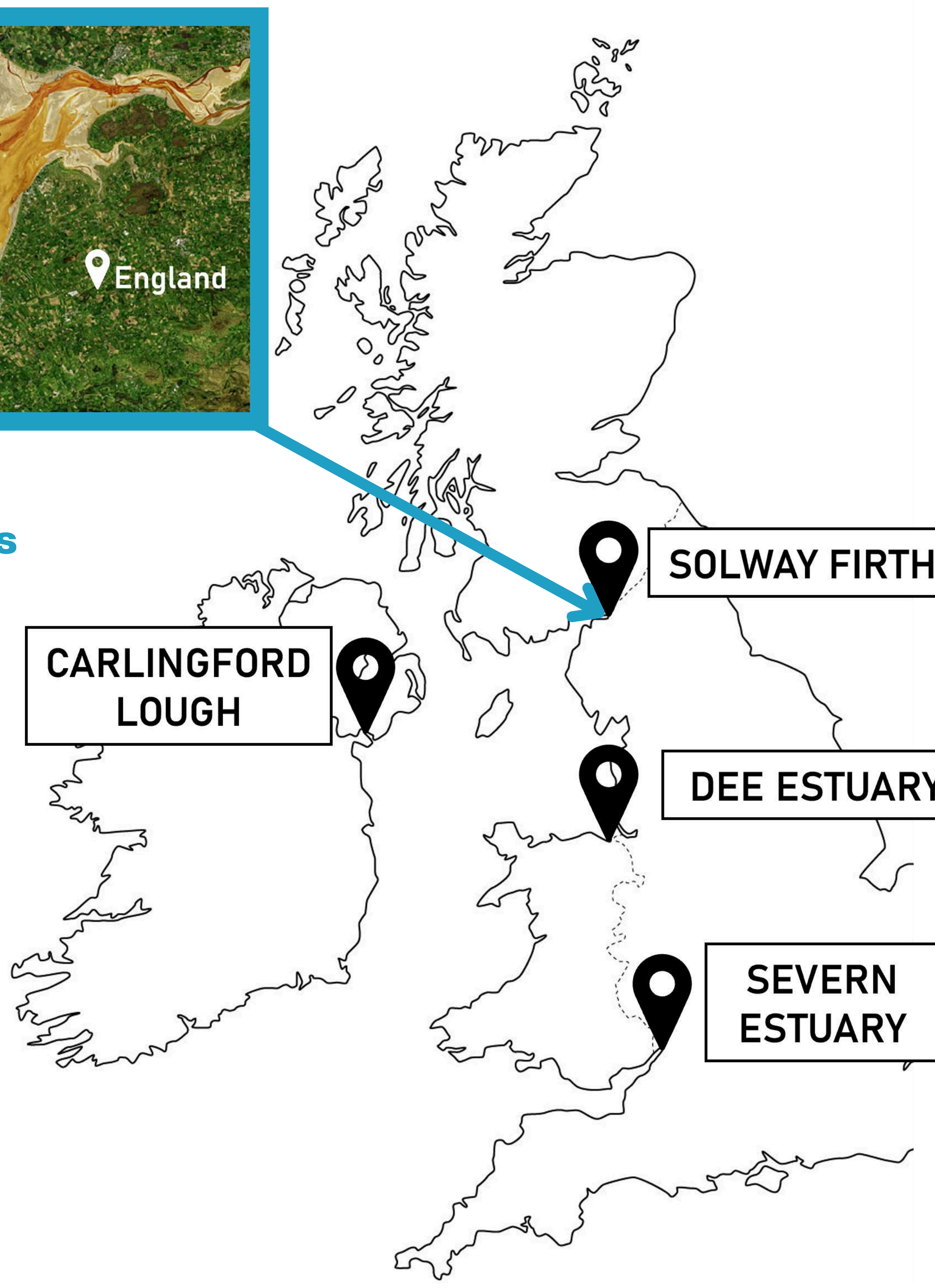
- Interviews with key conservation stakeholders are shaping my PhD research questions and direction.
- Interviewees include representatives from coastal partnerships, local authorities, environmental bodies, NGOs, and community groups.
- These conversations explore transboundary challenges in governance, funding, policy, collaboration, and research needs.

If you would like to get involved please contact me at:
952957@swansea.ac.uk

Guiding Research Questions

- How do governance structures and administrative boundaries shape cross-border coastal habitat conservation?
- In what ways do stakeholders perceive and prioritise certain coastal habitats in transboundary conservation?
- What factors (e.g., funding, land ownership, policy shifts) influence coastal habitat conservation approaches in transboundary regions?

These guiding research questions will be shaped by the ongoing co-design process...



Visits to Existing Restoration Initiatives

Solway Firth: CLEARcoasts Project

Severn Estuary: Poldering Project

Key Co-design Interview Quote

"For example, mud flats and sand flats are really ignored. They're just there. And if they don't have seagrass on them or they don't have salt marsh on them, then they, you know, nobody pays them much attention. But actually they provided an enormous set of ecosystem services, but it's just not very attractive to have a huge expansive mud outside your front window like."

Initial Findings

Local authority boundaries can sometimes be just as or even more challenging than national borders.

Very few examples of truly cross-border funding streams e.g. Shared Island Initiative.

Funding and policy is focused on the "trending" and "attractive" habitats.

More incentives for working on habitat specific approaches, rather than whole estuary. Although this may be changing...

Stakeholders feel that a "one-shoe fits all approach" is being pushed on them.

I would like to thank the Estuarine and Coastal Sciences Association (ECSA) for awarding me the Charles Boyden Small Grant Fund which has made my attendance at ReMeMaRe possible.

References:
Dallimer, M. and Strange, N., 2015. Why socio-political borders and boundaries matter in conservation. Trends in Ecology & Evolution, 30(3), pp.132-139.
ECE, U., 2024. Progress on transboundary water cooperation: mid-term status of SDG indicator 6.5. 2, with a special focus on climate change-2024.
Li, S. and Jay, S., 2023. Addressing transboundary challenges: Exploring the interactive relations between collaborative governance and transboundary marine spatial planning in Europe. Marine Policy, 158, p.105880.
Image Credit: NASA images by Norman Kuring/NASA's Ocean Color Web, using Landsat data from the U.S. Geological Survey. Published 2019.

ECSA · Solway Firth Partnership · UKRI Economic and Social Research Council · YGGCC WGSSS

Marine Management Organisation

Restoring marine ecosystems: Identifying challenges and opportunities in England's East Marine Plan

Marine plans guide those who use and regulate the marine area to encourage sustainable development while considering the environment, economy and society. This poster focusses on environmental considerations for the replacement East Marine Plan.

Replacing the East Marine Plans

The East Inshore and East Offshore Marine Plans were adopted in 2014. Based on the findings of the third East Three-Year Report, The Secretary of State for Environment, Food and Rural Affairs agreed with the Marine Management Organisation's (MMO) recommendation to replace the East Marine Plans in 2022. MMO are currently in the process of replacing the East Marine Plans (figure 1).

Challenges and opportunities for restoring marine ecosystems

Effective marine planning depends on a clear understanding of the key challenges and opportunities facing our marine areas. During the Issues with Supporting Evidence phase of the replacement East Marine Plan, MMO gathered **2,220 issues** and **1,596 evidence** items from stakeholders.

These issues, defined as challenges or opportunities impacting the marine plan areas, have been categorised into six core themes based on UK Marine Policy Statement objectives (figure 2). The Marine Environment theme, "Protection, Recovery & Restoration of the Natural Marine Environment" contains 695 issues, with the most prevalent issues in this theme highlighted in figure 3.

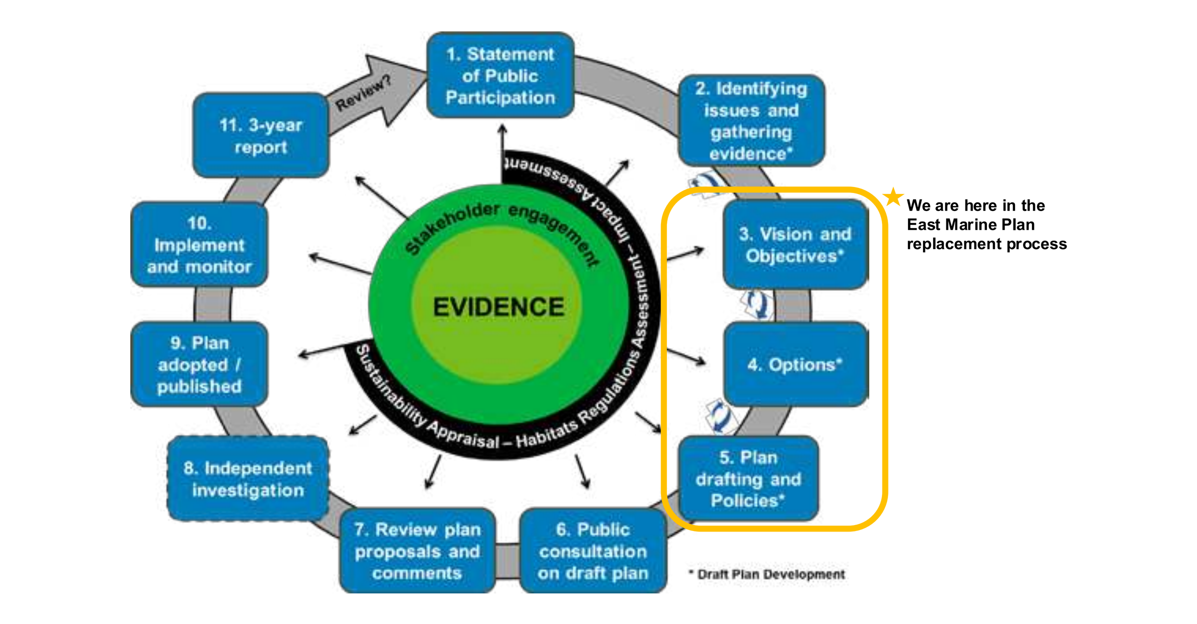


Figure 1

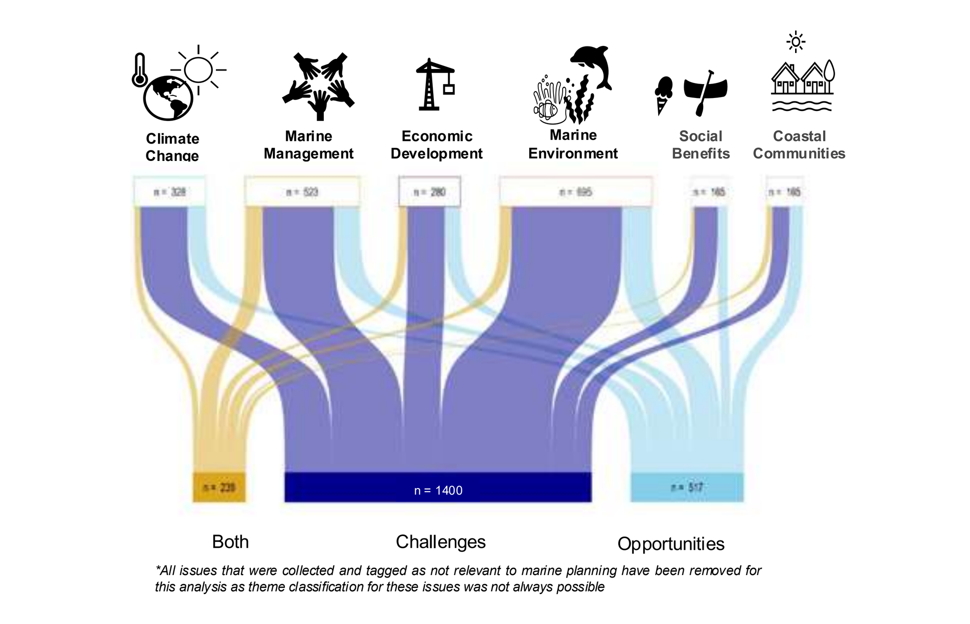


Figure 2

Figure 3

Key challenges identified relating to marine ecosystems

- Extensive loss and degradation of marine and coastal habitats.
- Alteration and decline in marine populations and ecosystems, from pressures such as climate change, infrastructure and disturbance.
- Coastal erosion.
- Cumulative underwater noise levels.
- The combined impacts of various activities on habitats (cumulative effects).
- A need to balance the protection of wildlife with other activities, such as the tourist industry and offshore renewable energy deployment.

Key opportunities identified relating to marine ecosystems

- New data and emerging tools creating opportunities to advance marine habitat restoration and protection.
- A need for strategic planning for nature recovery and environmental compensation.
- Passive acoustic monitoring to better understand and manage high levels of underwater noise.
- Environmental gains from Net Zero initiatives.
- Potential opportunities for Marine Net Gain.

MMO has drafted marine plan objectives and options to help address these issues. The options are being assessed through the sustainability appraisal. All stakeholders will have the opportunity to engage with MMO on marine plan development in **September 2025**, with more details to follow.

Contact us: planning@marinemanagement.org.uk