ReMeMaRe

5: Restoration Science

Chair - Sally Little,
Senior Lecturer,
Nottingham Trent University

Ocean and Coastal Futures

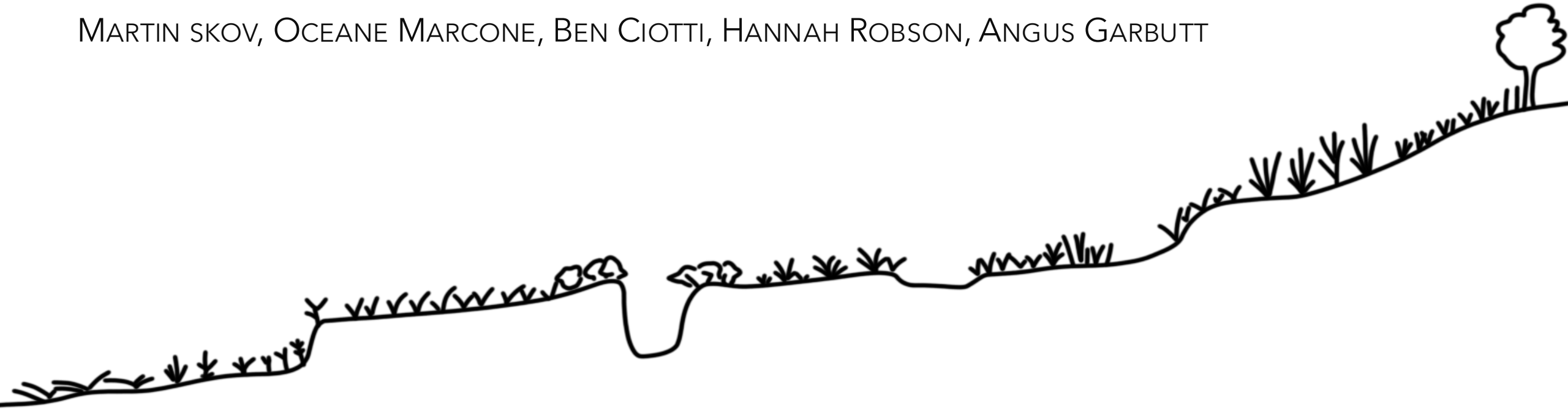
Environment Agency

THE CROWN ESTATE

Why do some saltmarshes attract more fish than others?

Mercedes Lopez

Martin skov, Oceane Marcone, Ben Ciotti, Hannah Robson, Angus Garbutt



Prifysgol Bangor University

SuMMeR Centre for Doctoral Training

WWT

University of Plymouth

UK Centre for Ecology & Hydrology

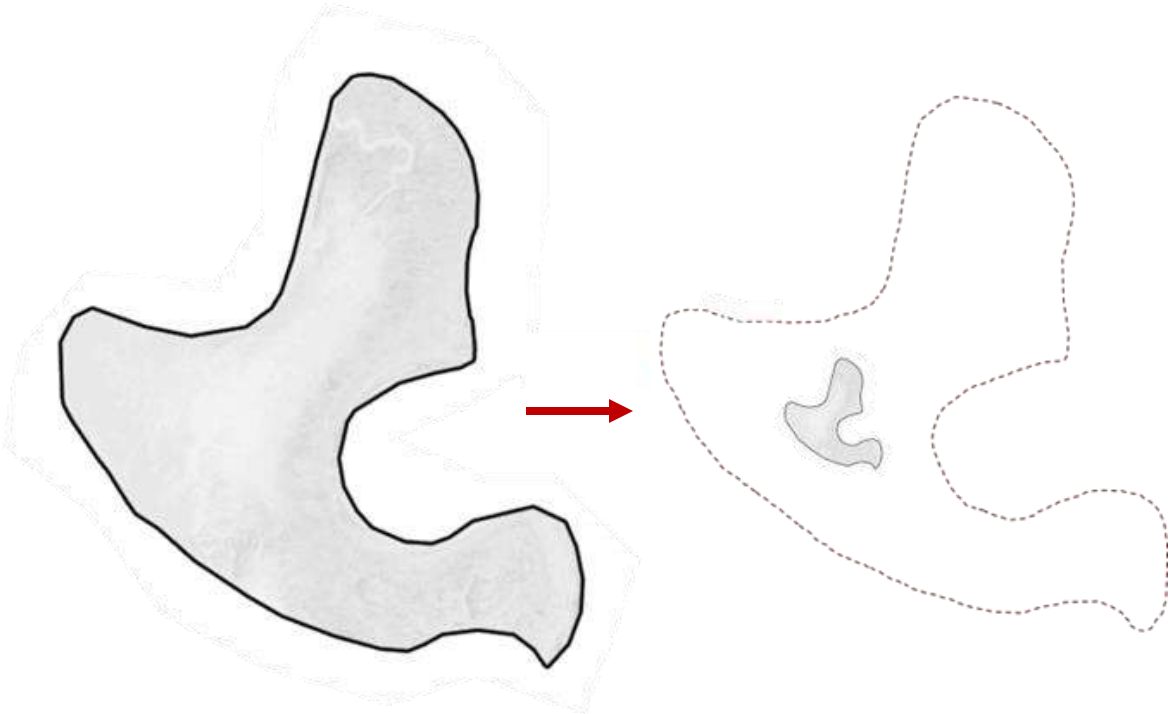
PML Plymouth Marine Laboratory









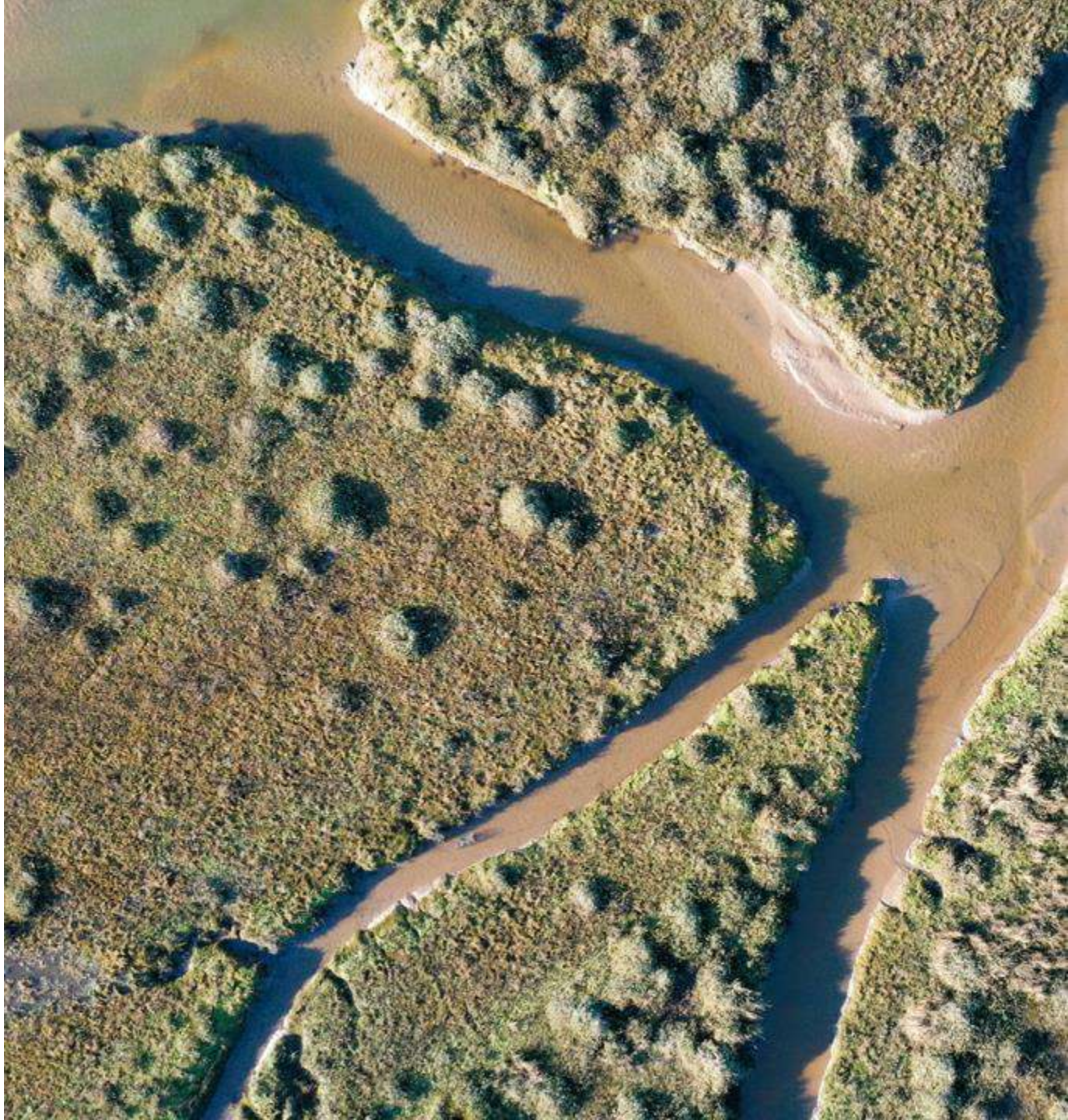



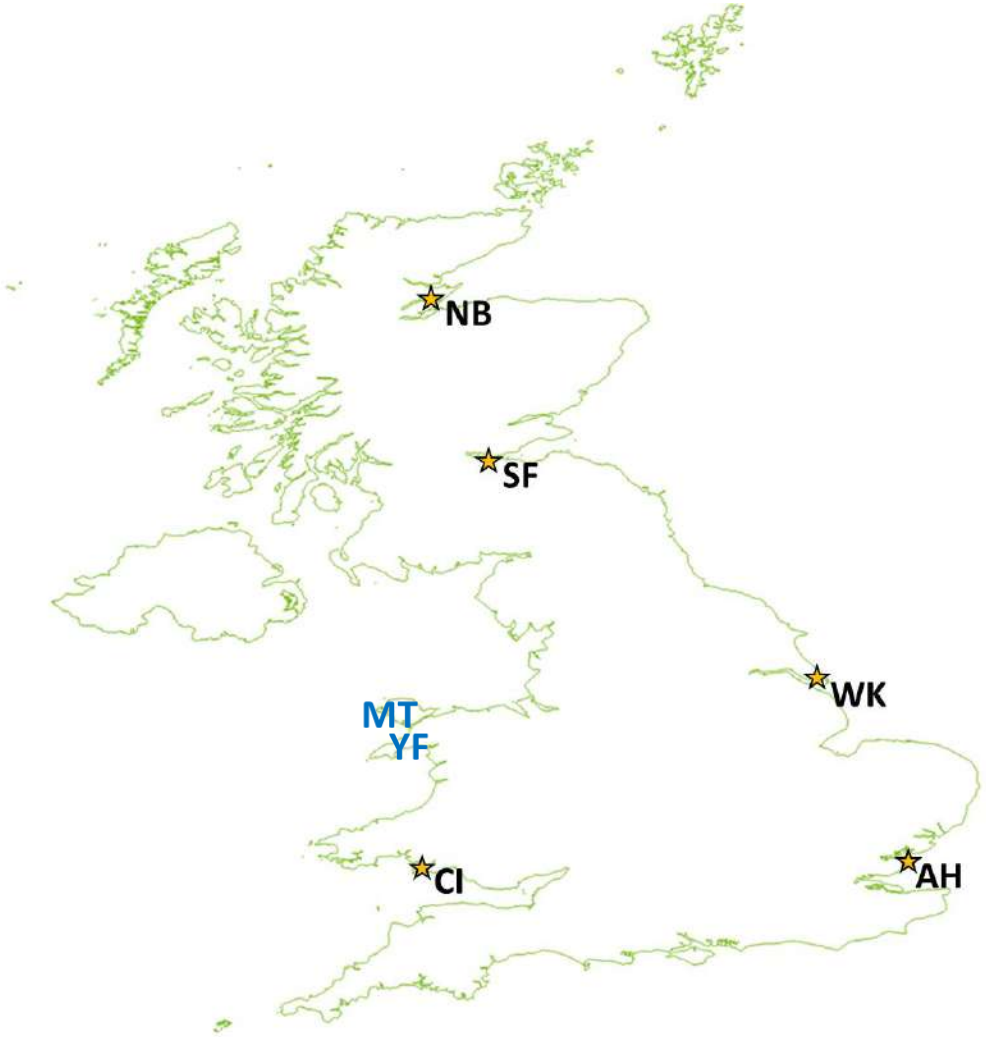
***Skinflats Managed Realignment**, Scotland.*
https://www.innerforthlandscape.co.uk/ifli-legacy/skinflats-managed-realignment

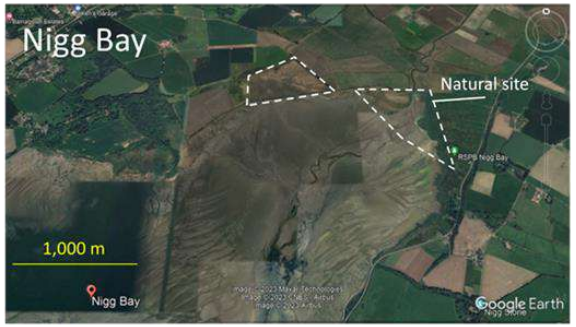
AIMS

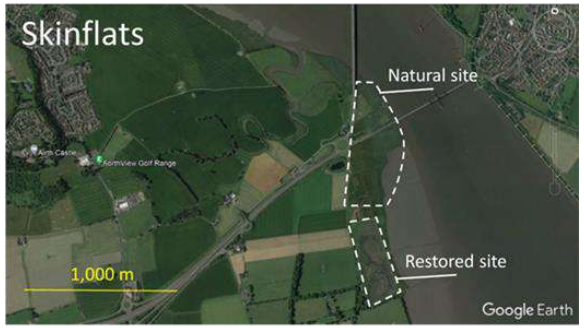
I. Can **restoration replicate the biodiversity** and abundances seen at natural sites, and **which marsh features boost habitat quality**?

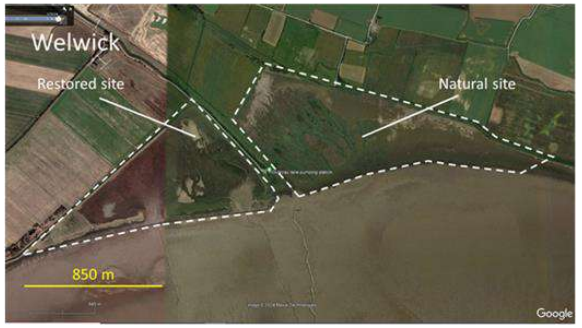
II. Is there a **north-south gradient** in the importance of British marshes to fish and prawns, and **what are the causes**?

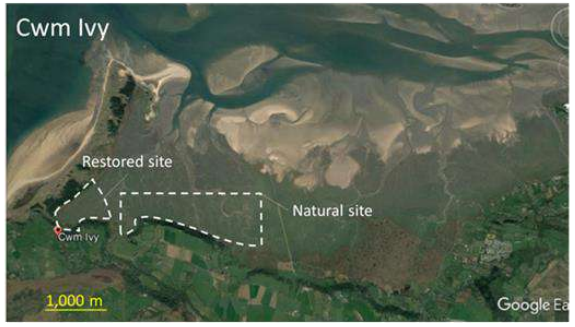


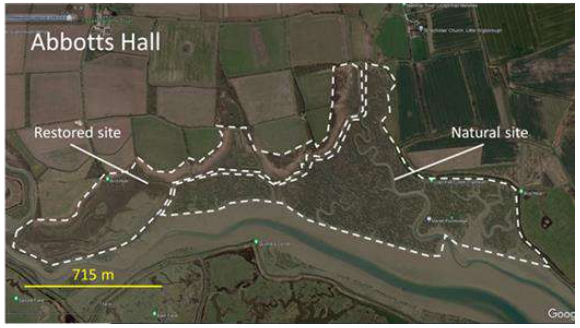




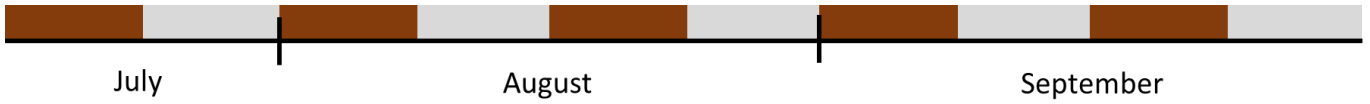








UK - Summer 2024 ★



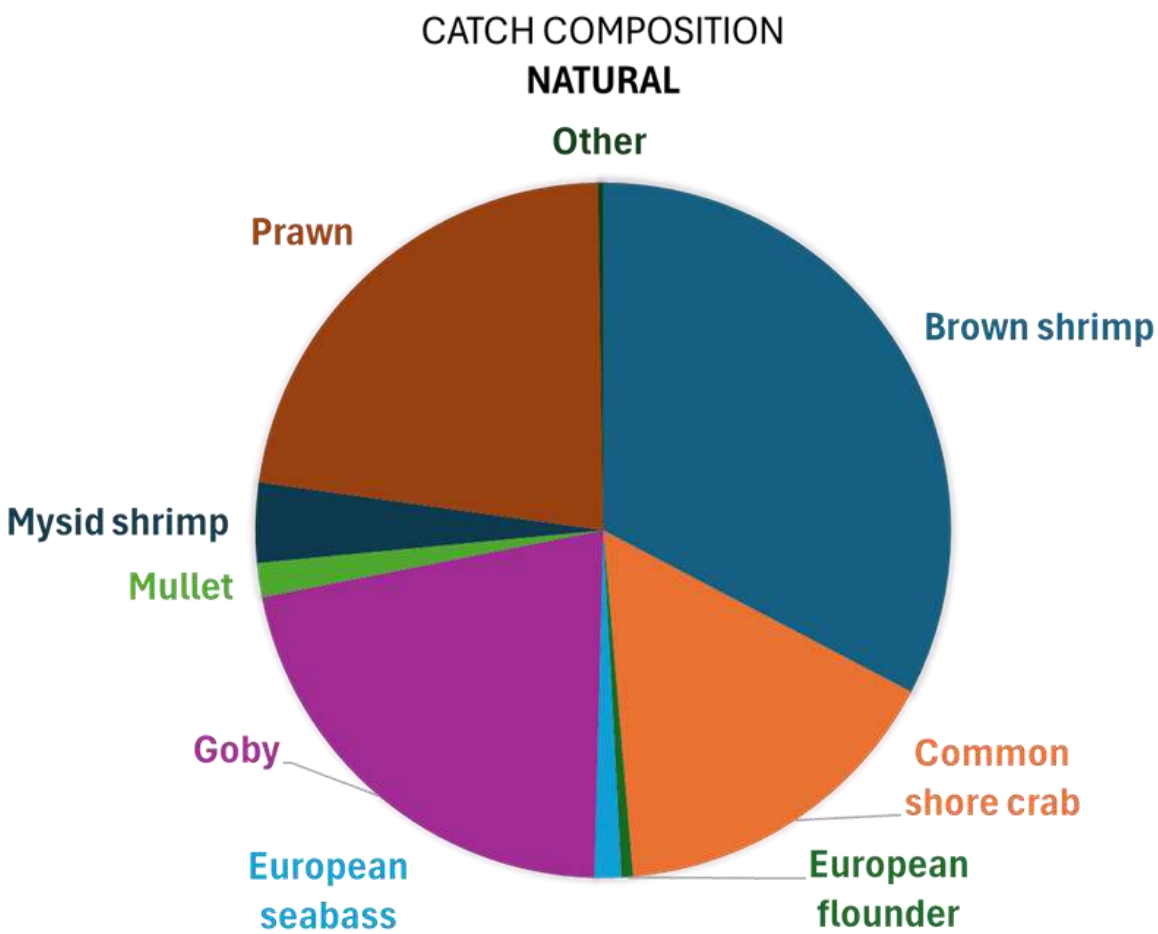
WALES

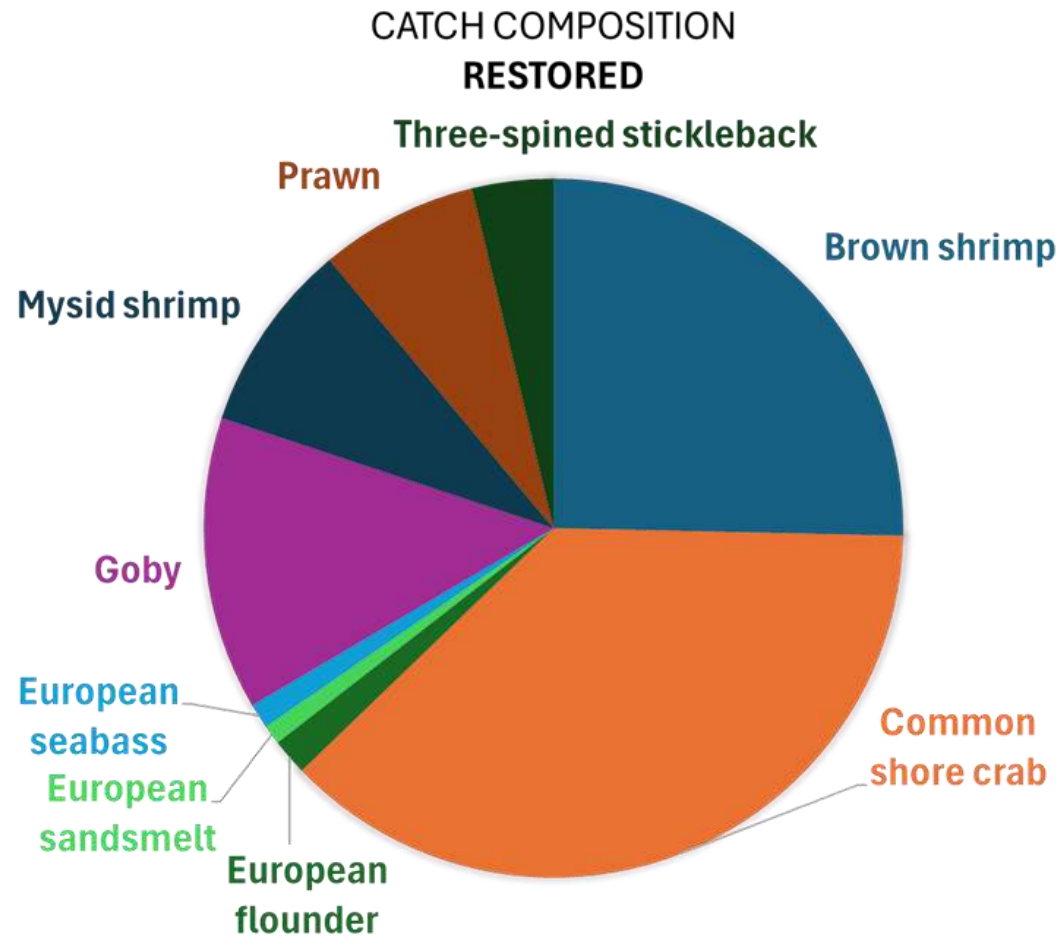

CRAB TRAP

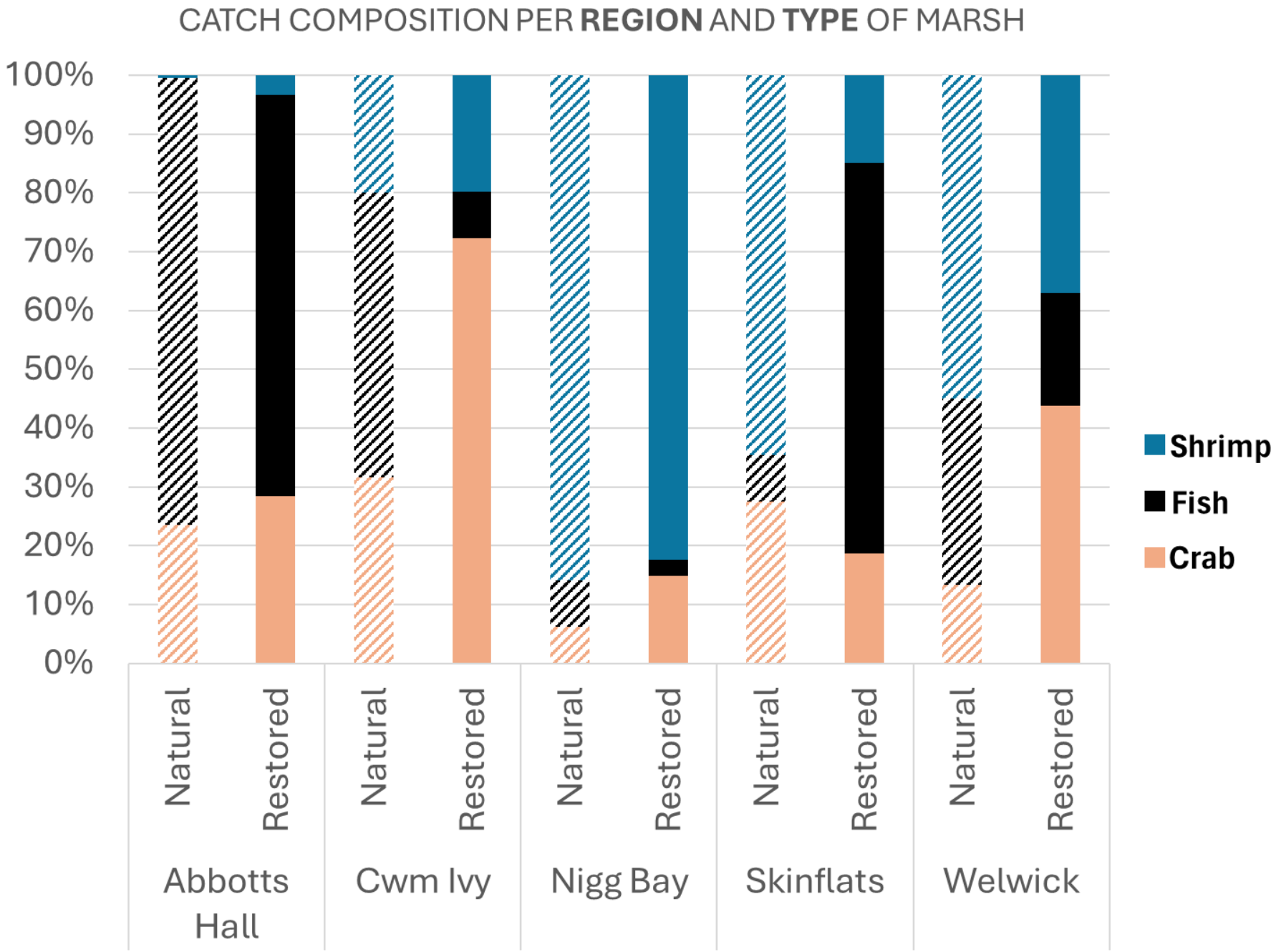

FYKE NET

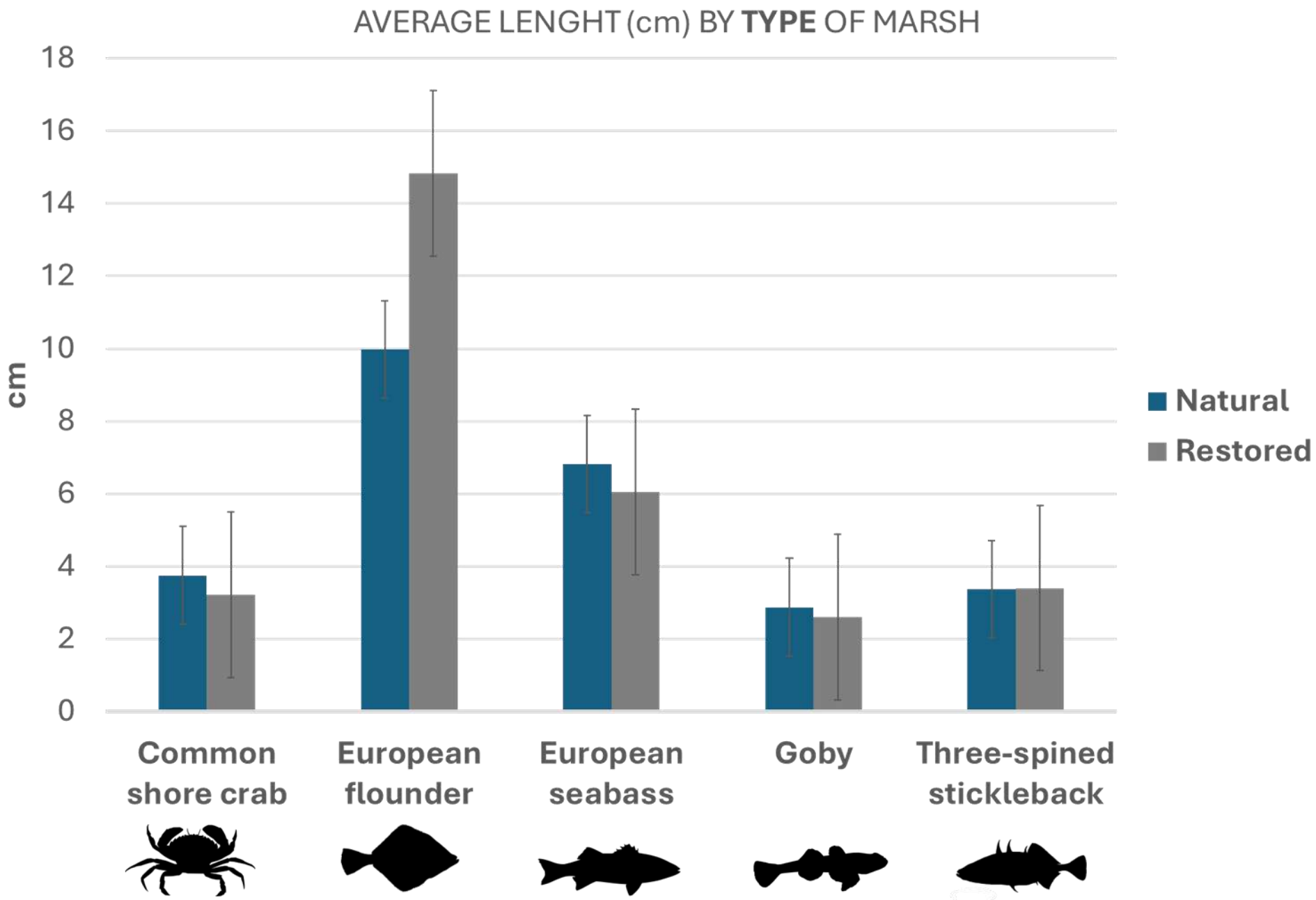
SEINE NET

PUSH NET


CATCH COMPOSITION
NATURAL
Other
Prawn
Brown shrimp
Mysid shrimp
Mullet
Goby
Common shore crab
European seabass
European flounder

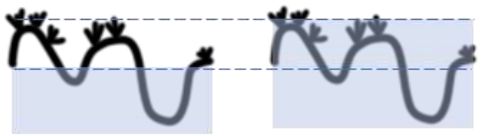

CATCH COMPOSITION
RESTORED
Three-spined stickleback
Prawn
Brown shrimp
Mysid shrimp
Goby
European seabass
European sandsmelt
Common shore crab
European flounder


CATCH COMPOSITION PER **REGION** AND **TYPE** OF MARSH
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Natural
Restored
Abbotts Hall
Cwm Ivy
Nigg Bay
Skinflats
Welwick
Shrimp
Fish
Crab

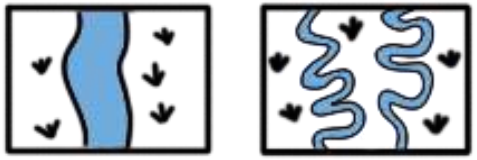

AVERAGE LENGHT (cm) BY **TYPE** OF MARSH
cm
18
16
14
12
10
8
6
4
2
0
Natural
Restored
Common shore crab
European flounder
European seabass
Goby
Three-spined stickleback

Drivers and scale of variability

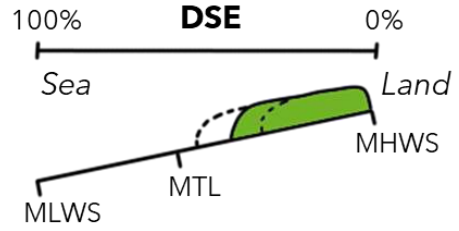
Hydrology



Geomorphology: Creek interspersion

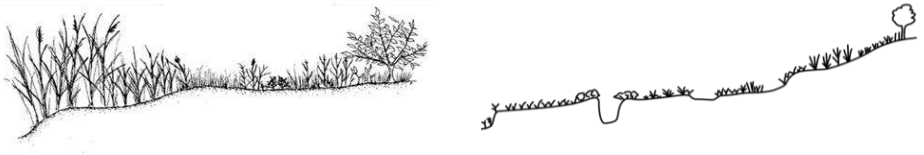


Down-shore extent (DSE):
North-South variation



Duggan-Edwards, M. (2019)

Vegetation:
Creek-bank plant community composition

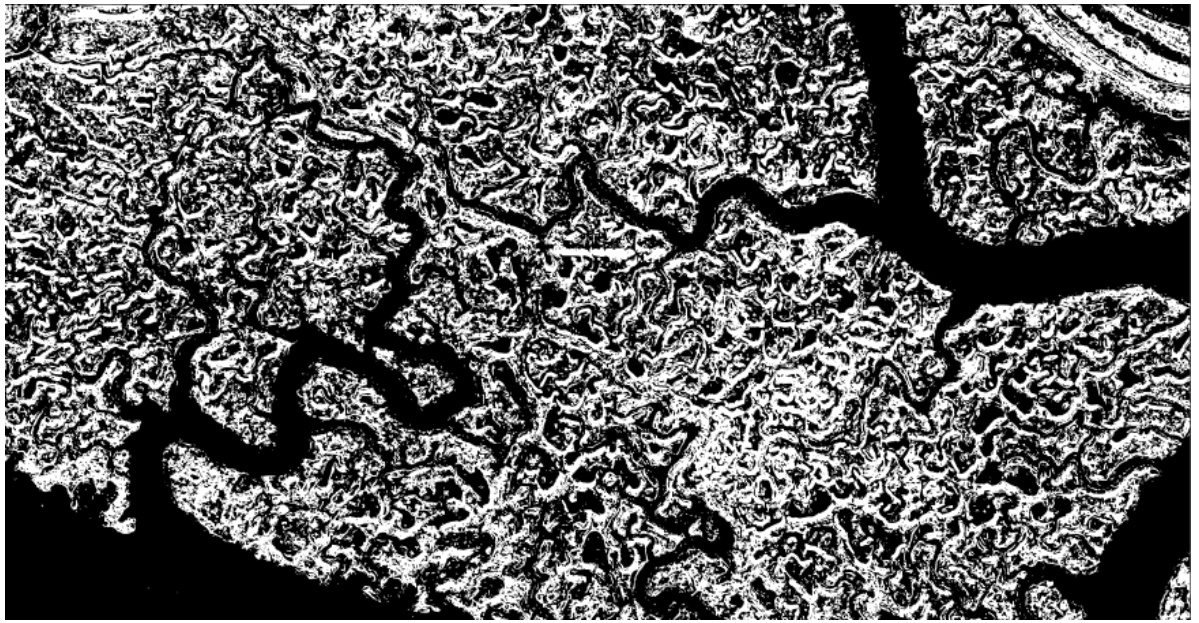



August 2024
Giulia Leanza

***Skinflats**, Scotland.*

***Welwick**, England.*

***Cwm Ivy**, Wales.*



***Abbots Hall**, England.*

Data Collected

- **Abundance and size** of fish and crustaceans & fish specimens
- Sediment
- Vegetation
- Insects
- **Morphological characteristics** of the marsh

I. Elevation
II. Creek morphology

- **Physical variables**

I. Temperature
II. Salinity
III. Water pressure (tidal regime)

Future directions

- Compare data on **catch abundance and size** with data collected on **bio-physical factors.**

- **UK saltmarsh fisheries species:** integrate the data collected with data from other UK studies to synthesis the importance of these ecosystems for fisheries species.

- **Map stakeholder** network and **governance** structure.

- Identify **governance opportunities and barriers** to boosting marsh management for fish.

BOOSTING SALTMARSH MANAGEMENT FOR FISHERIES SPECIES

✉ mrl23dpp@bangor.ac.uk

marshtales.bsky.social

ACKNOWLEDGEMENTS

Many thanks to the **Wildfowl & Wetland Trust, CDT SuMMeR** and **Bangor University** for funding the project and the sampling campaign. To the **volunteers** who took part in the sampling and to the **School of Ocean Sciences staff** for constant help with administration and equipment.

PRIFYSGOL BANGOR UNIVERSITY

WWT

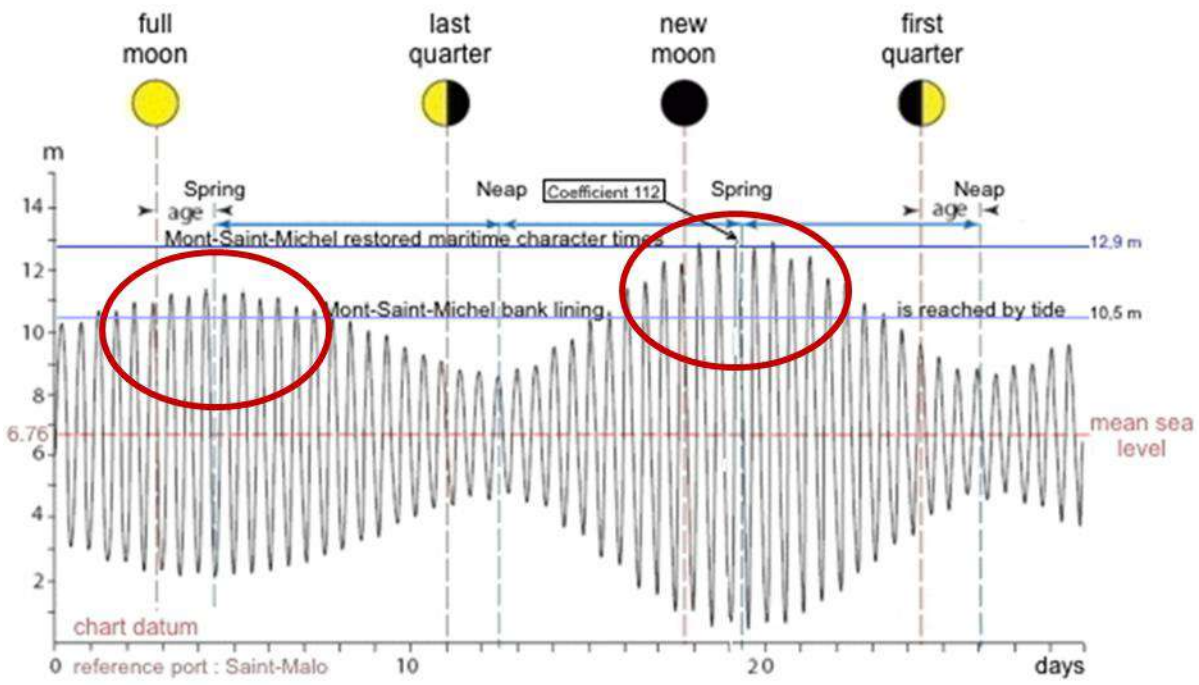
UNIVERSITY OF PLYMOUTH

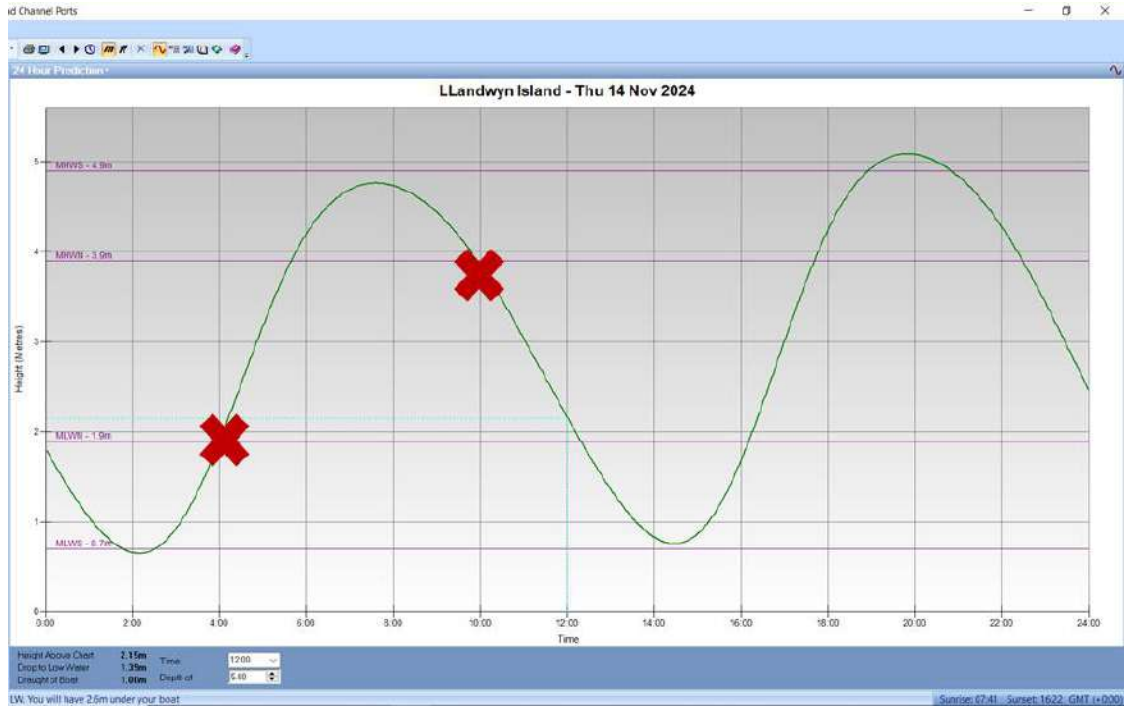
Sustainable Management of Marine Resources
SuMMeR Centre for Doctoral Training

UK Centre for Ecology & Hydrology

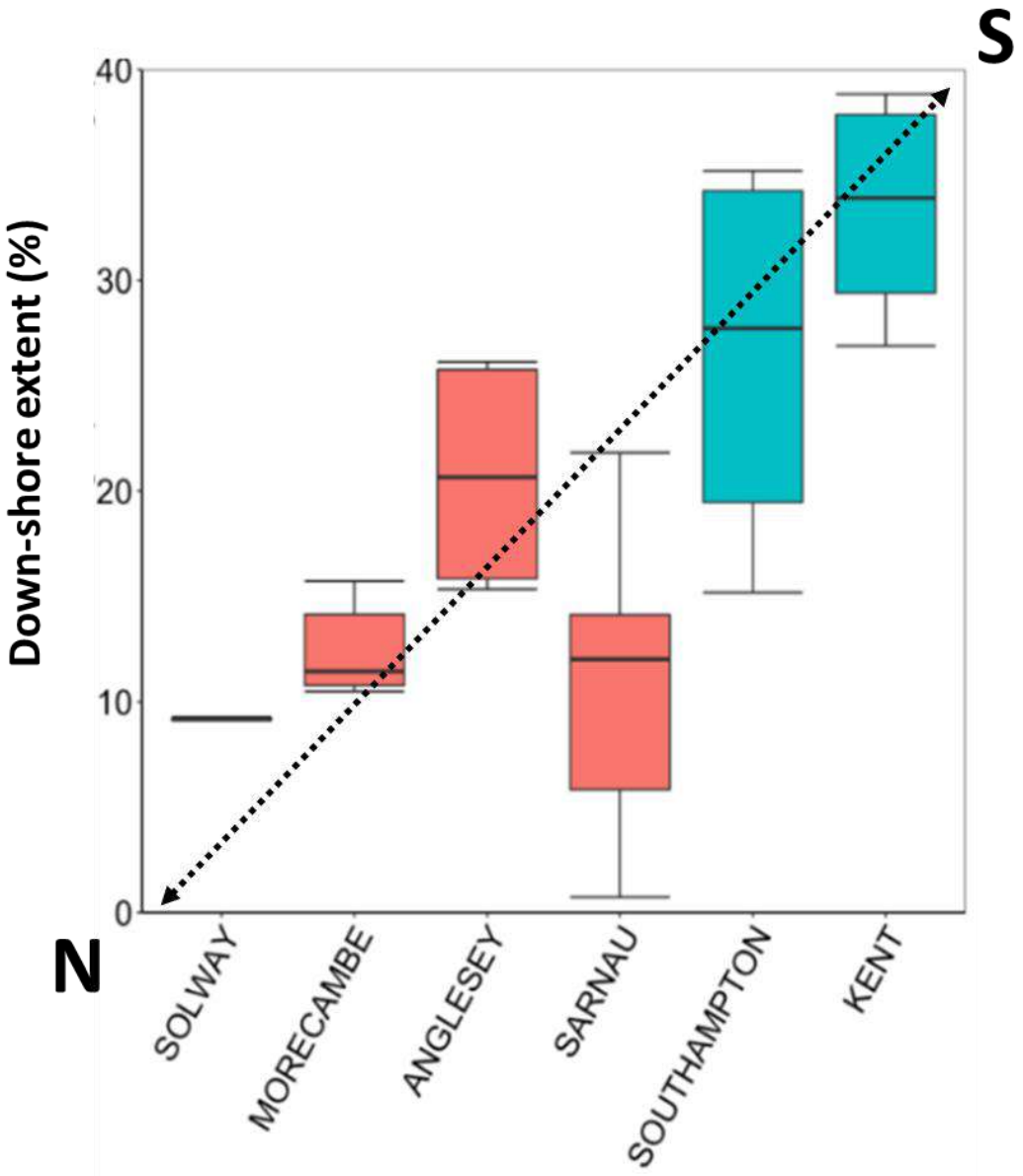
PML | Plymouth Marine Laboratory

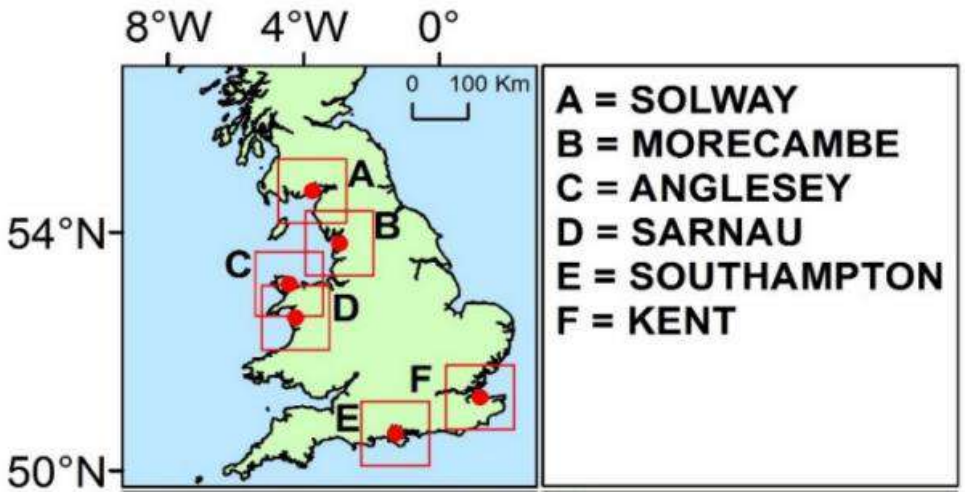
SALT MARSHES


full moon
last quarter
new moon
first quarter
m
Spring tide age
Neap
Coefficient 112
Spring
Neap tide age
Mont-Saint-Michel restored maritime character time
12,9 m
Mont-Saint-Michel bank lining is reached by tide
10,5 m
mean sea level
6.76
chart datum
0 reference port : Saint-Malo
10
20
days


LLandwyn Island - Thu 14 Nov 2024
Height (Metres)
Time
MHWS - 4.9m
MHWN - 3.9m
MLWN - 1.9m
MLWS - 0.7m
LW. You will have 2.6m under your boat

North-South Gradient





Duggan-Edwards, M. *(2019). Erosional resilience of salt marshes: Bio-physical processes from patch to national scales.*

SAMS and Seawilding: the role of science in informing seagrass restoration

Alasdair O'Dell
alasdair.odell@sams.ac.uk

...working for healthy and sustainably managed seas and oceans through marine research, education, business development and public engagement.

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Community-led Marine Habitat Restoration

SAMS
Scottish Association for Marine Science

A partner of UHI

@alasdairodell

Content

- Seawilding and SAMS a partnership
- Generating baselines
- Seagrass mapping
- Sediment carbon
- REDOX insights
- Biodiversity
- The future of seagrass restoration in Scotland

SAMS Scottish Association for Marine Science

A partner of UHI

- A collaborative partnership since 2021
- Advice, network, science
- Generate baseline of environmental data prior to restoration
- Map existing beds
- Capture aspects of the physical, chemical, and biological environment which might be affected by the establishment of restored seagrass habitats
- Biodiversity Challenge Fund
- Nature Restoration Fund

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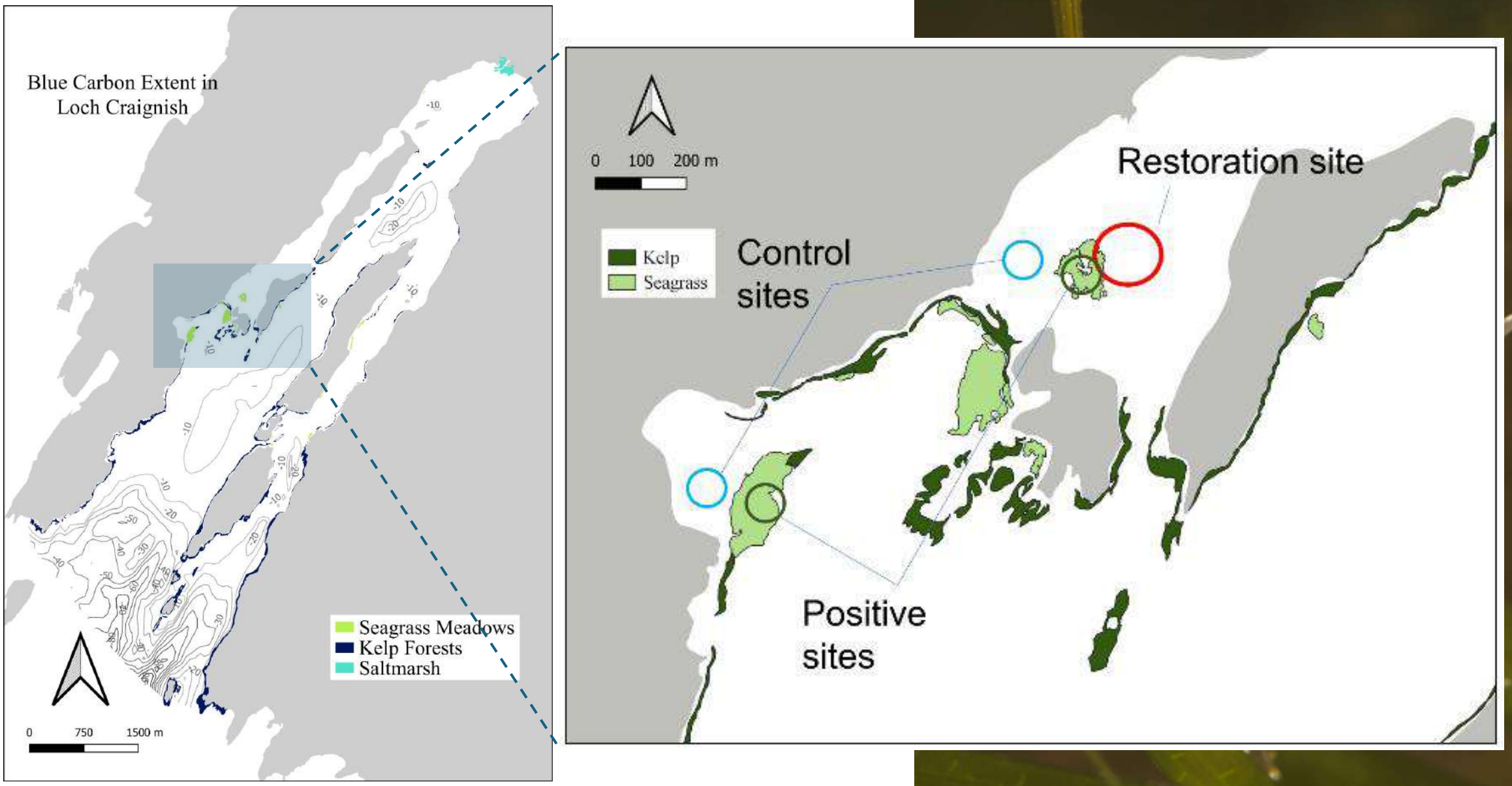
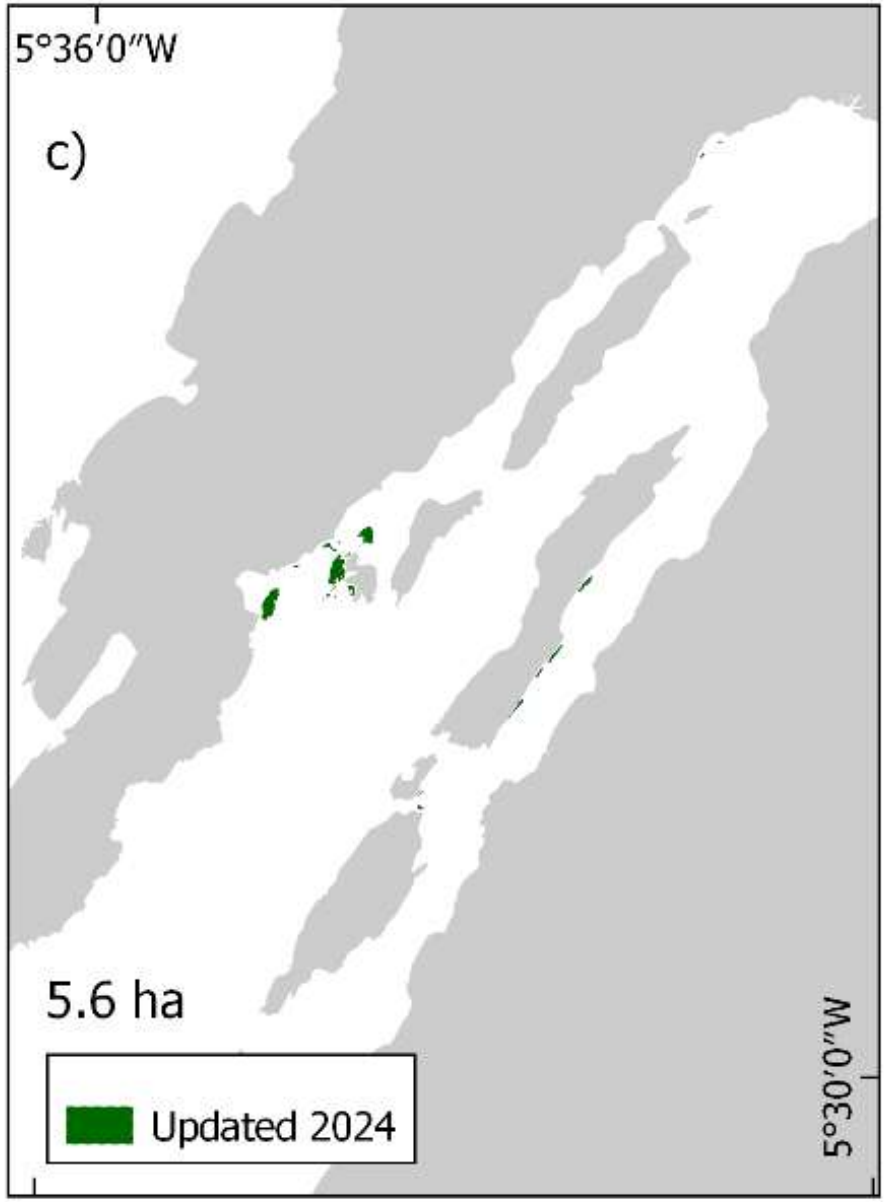

Blue Carbon Extent in
Loch Craignish
Seagrass Meadows
Kelp Forests
Saltmarsh
0 750 1500 m
0 100 200 m
Kelp
Seagrass
Control
sites
Restoration site
Positive
sites

SAMS

Mapping

- Improve knowledge of the extent of seagrass in Loch Craignish
- Monitor changes over time as restoration progresses
- Look at old satellite data to see if changes have occurred over time
- In 2021 there were 2.4 ha of mapped meadows in Loch Craignish
- We now know of 5.6 ha



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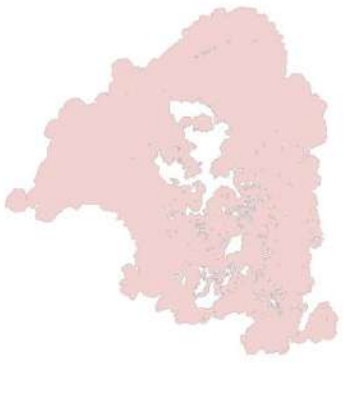
2010

2015

2020

2021

2022



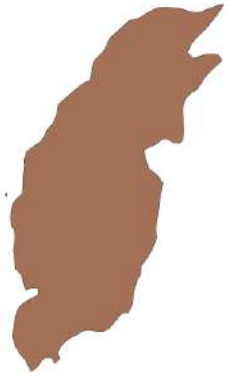
2023

2024

2015

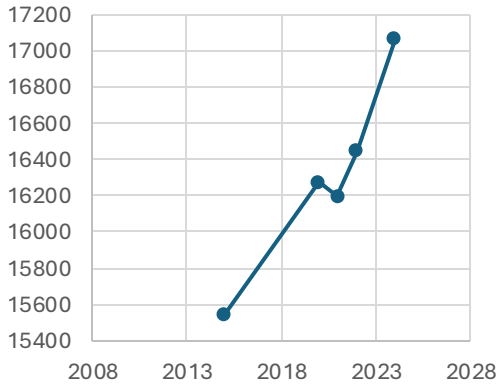
2020

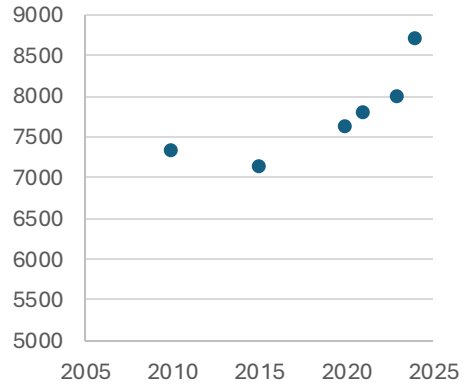
2021



2022

2024





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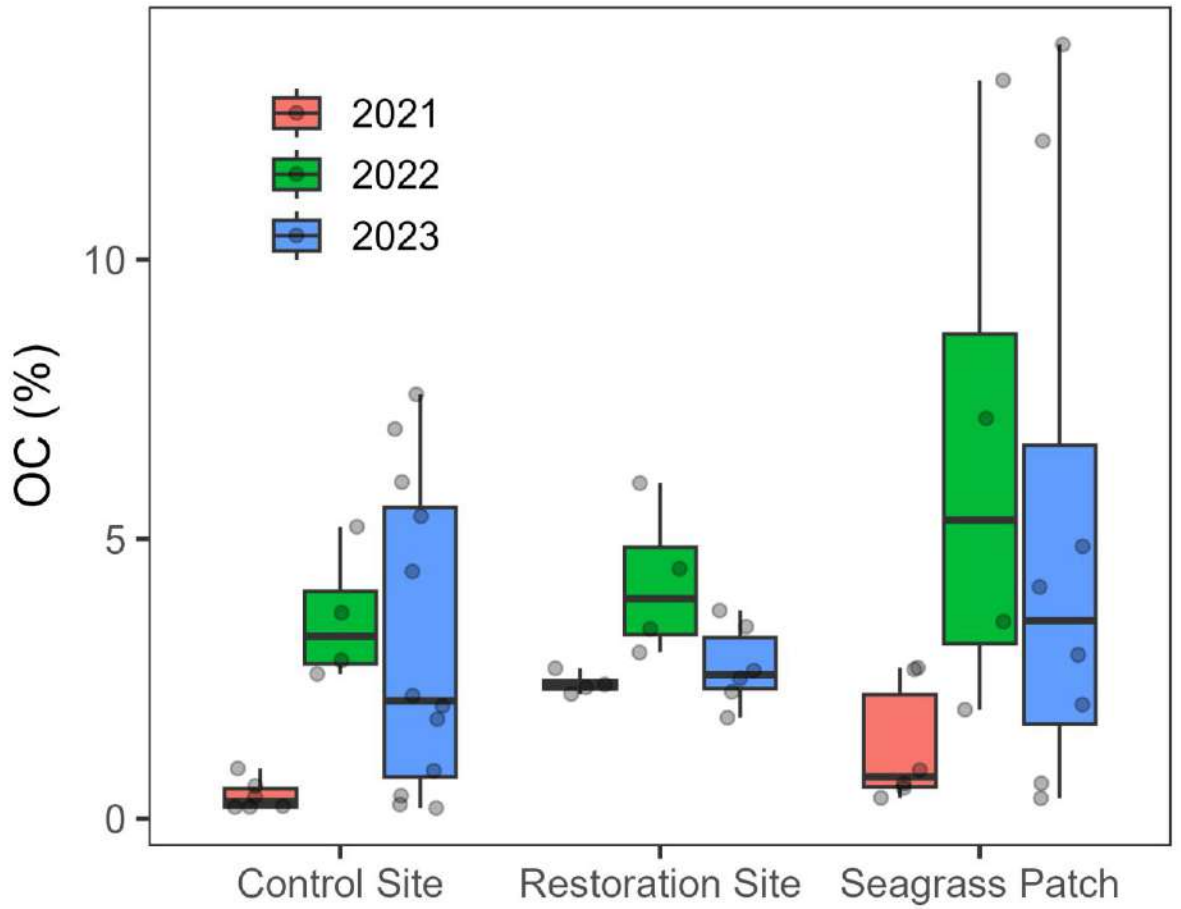
Sediment carbon



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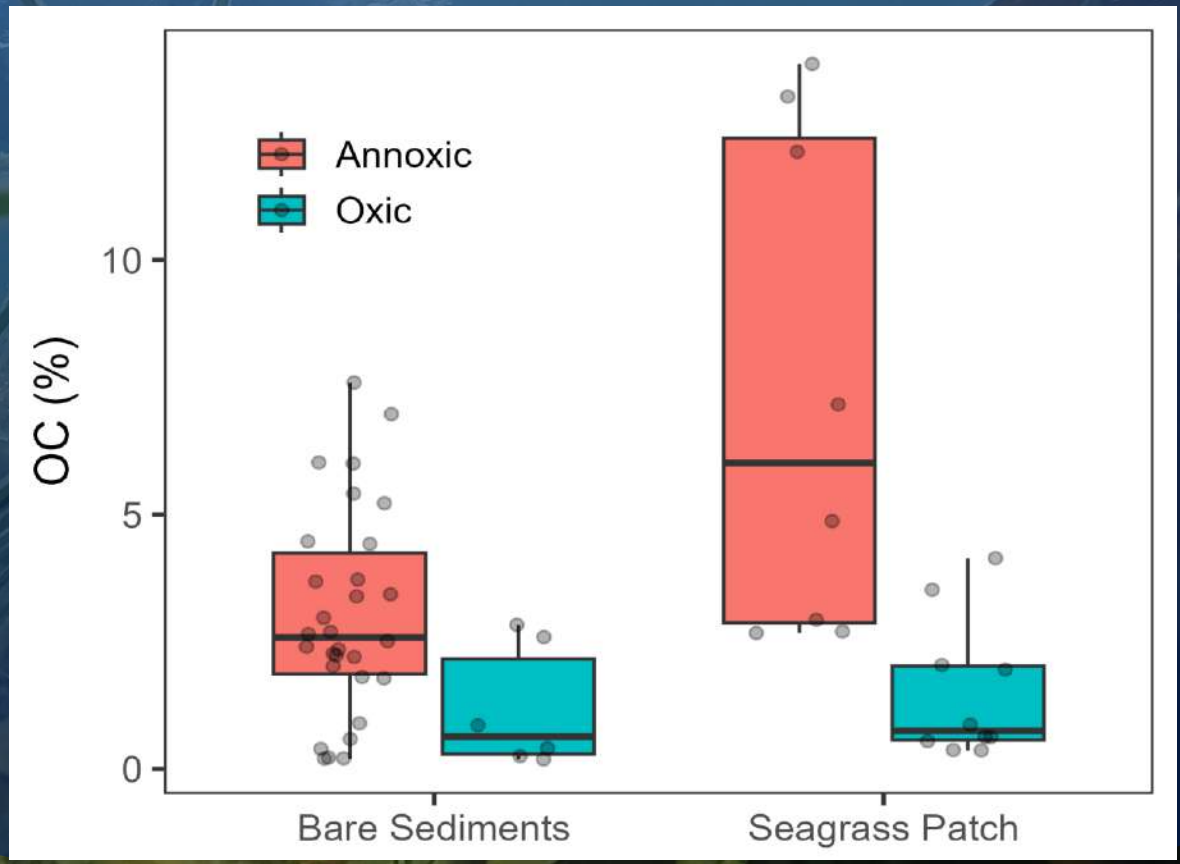
Sediment REDOX

- 2021 Challenges with transplants
- PSA showed very fine mud in the area
- Habitat suitability suggested this was suitable



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Biodiversity

- What type do we want to measure?
- Pros and cons
- Methods
- eDNA
- Infaunal analysis
- Seasonal differences

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Shannon – Diversity
Pielou's – Evenness or spread
Margelef's – Richness
Simpson index – (inverse diversity score)
Gini-Simpson – diversity score

2022	Shannon	Pielo's Index	Margelef's index	Simpson Index	Gini-Simpson
Sediment	1.61	0.90	2.17	0.24	0.76
Seagrass	2.82	0.26	6.45	0.10	0.90
Restoration	0.45	0.65	0.56	0.72	0.28

2023	Shannon	Pielo's Index	Margelef's index	Simpson Index	Gini-Simpson
Sediment	1.28	0.92	1.54	0.31	0.69
Seagrass	2.21	0.40	3.41	0.12	0.88
Restoration	1.15	0.83	1.06	0.36	0.64

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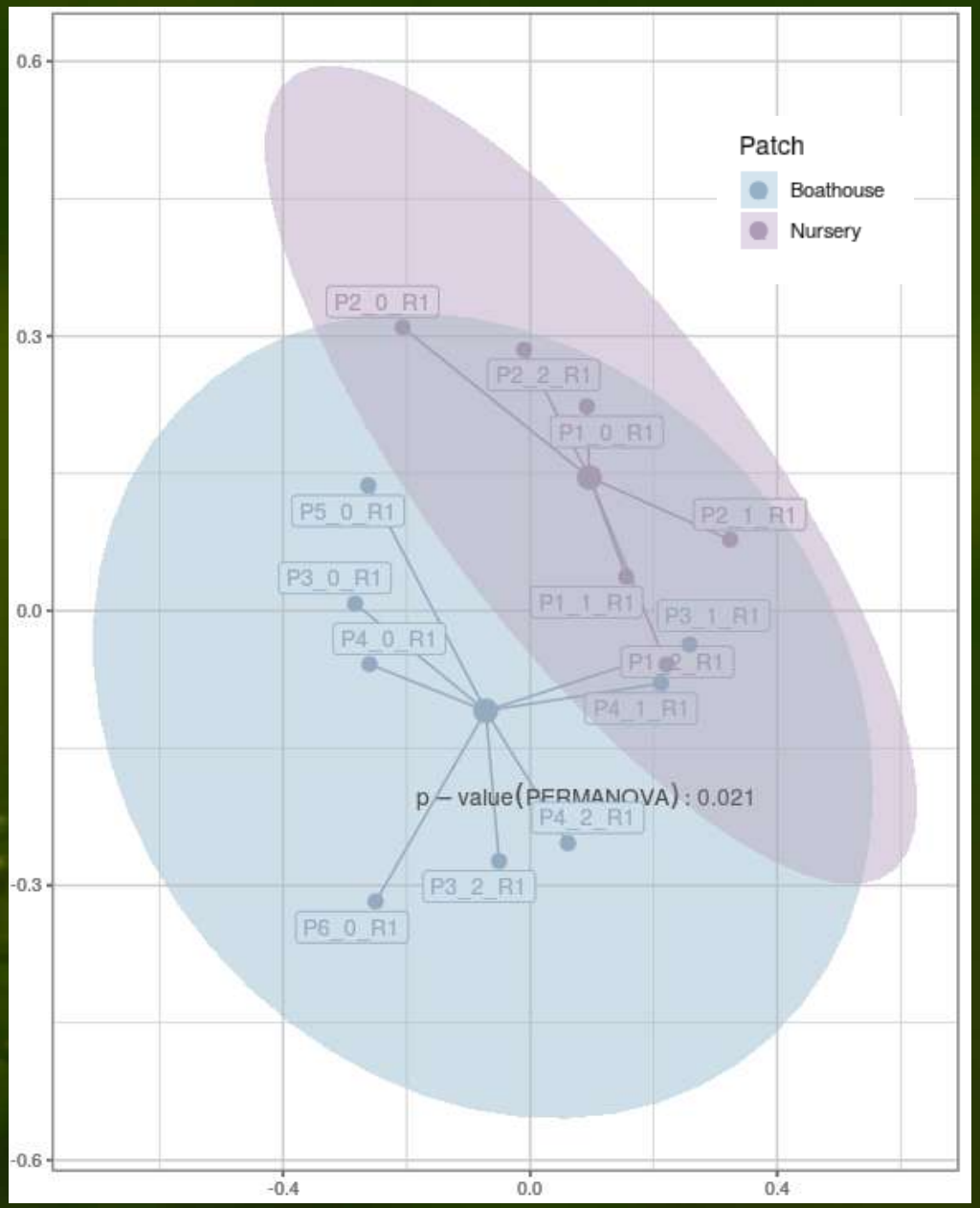
eDNA


Patch
Boathouse
Nursery
P2_0_R1
P2_2_R1
P1_0_R1
P5_0_R1
P2_1_R1
P3_0_R1
P1_1_R1
P3_1_R1
P4_0_R1
P1_2_R1
P4_1_R1
p – value(PERMANOVA) : 0.021
P4_2_R1
P3_2_R1
P6_0_R1
0.6
0.3
0.0
-0.3
-0.6
-0.4
0.0
0.4

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Future of Seagrass Restoration in Scotland

- Expanding rapidly
- Collaborations and partnerships are really useful
- Focus on hands on restoration
- Input from private sectors
- Exciting future and opportunities
- Community groups

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Thanks for listening

Things I haven't talked about –

qPCR for historic seagrass DNA
Nutrients – long-term study in Scottish Sea lochs

Floor, J. R., van Koppen, K., & van Tatenhove, J. P. M. (2018). Science, uncertainty and changing storylines in nature restoration_ The case of seagrass restoration in the Dutch Wadden Sea. Ocean and Coastal Management, 157, 227–236.

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@alasdairodell

The Great Yorkshire Kelp Forest

Mapping, monitoring and advocating for our kelp

YORKSHIRE MARINE NATURE PARTNERSHIP

UNIVERSITY OF HULL

With thanks to our project funders

YORK & NORTH YORKSHIRE COMBINED AUTHORITY

Environment Agency

North East Coastal Observatory

EAST RIDING OF YORKSHIRE COUNCIL

The project...

A mixed methodology was created to:

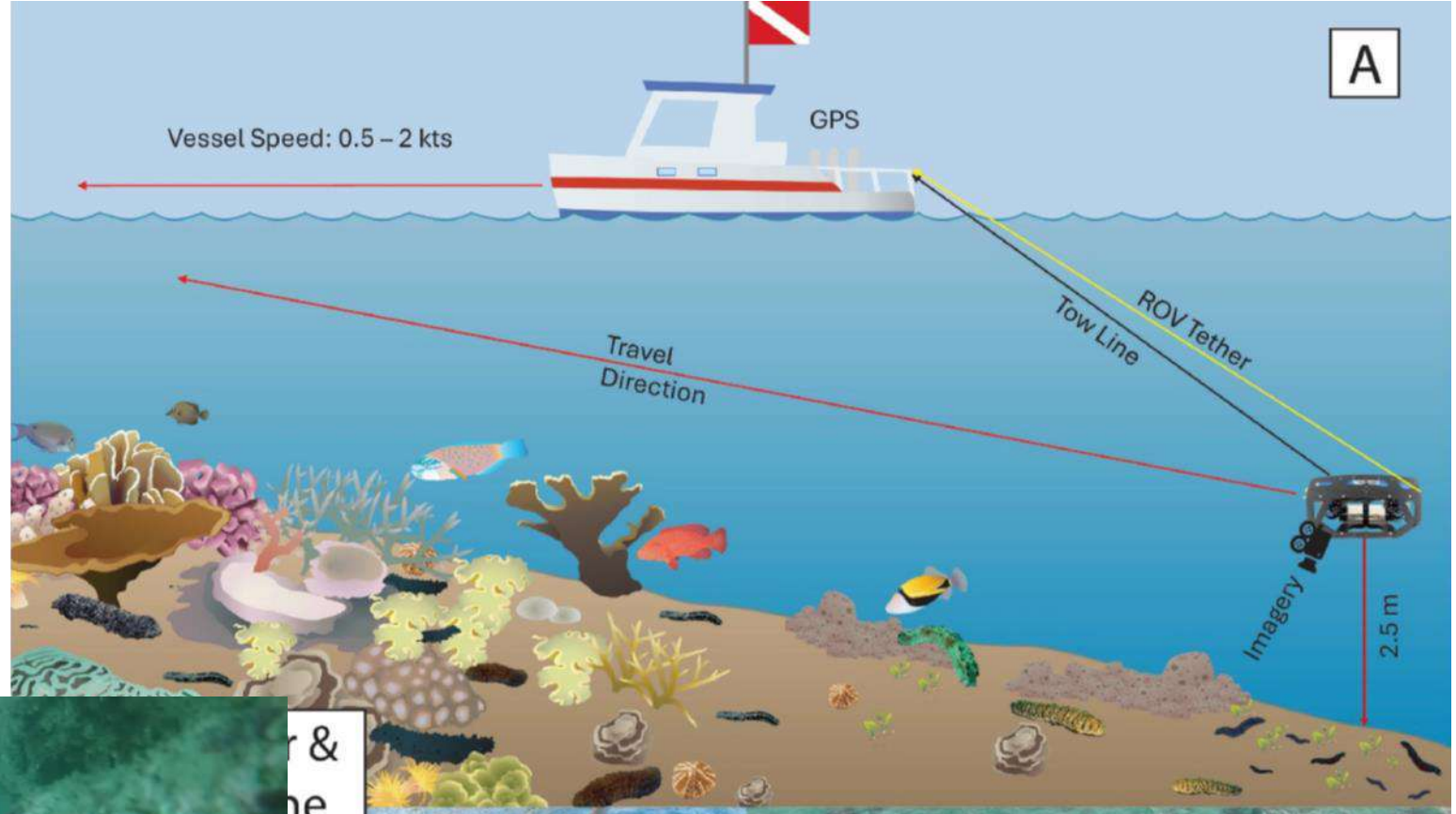
- Measure the extent and distribution of kelp using remote sensing data
- Assess species distribution, quality and quantity with dive, video and shoreline surveys
- Generate estimations for how much the kelp habitats contribute to carbon sequestration processes

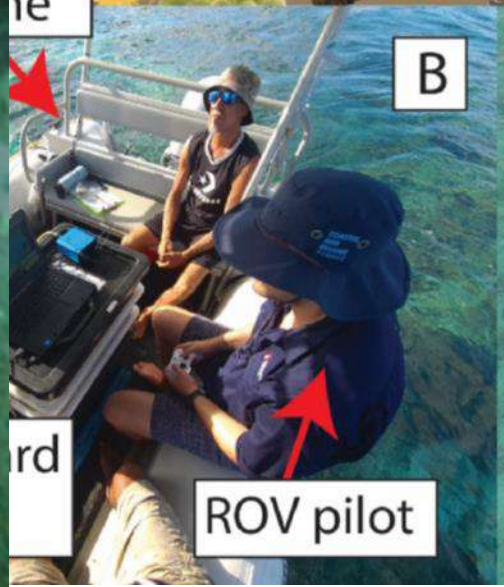
Previous kelp surveys (1960s-80s)

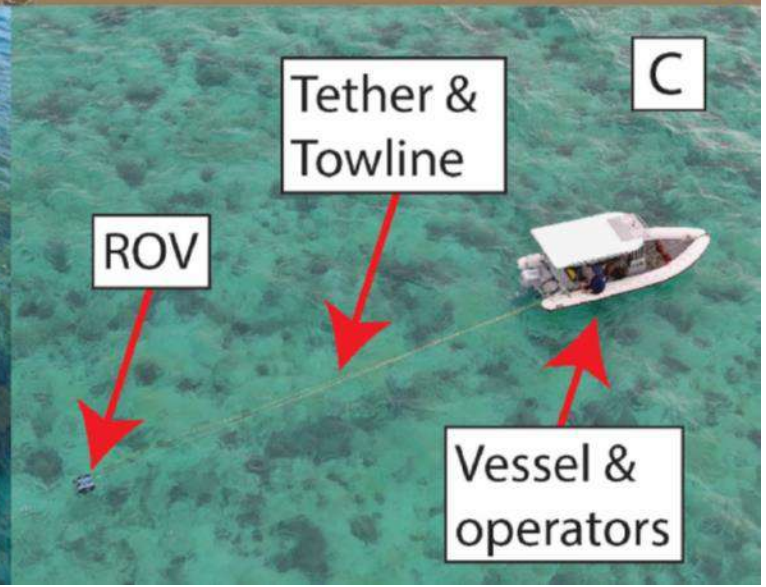
Location	Maximum depth (m)
Whitby	9.5
Robin Hood's Bay	6.5
Scarborough	6.8
Flamborough	9.8
Newbiggin	2.5
Marsden	2
Souter	3

- **1967 - 25 BSAC clubs involved in Operation Kelp**
  1967 was the year of Operation Kelp, a massive environmental science project organised by David Bellamy. It involved the help of 25 BSAC clubs and 262 members from all over the UK, who took kelp samples from the North Sea as a method of checking pollution levels. Bellamy and the divers went on to win the Duke of Edinburgh prize for their hard work, with botanist Bellamy becoming BSAC's Science Officer.
- **1970 - BSAC military 'Centre of Excellence'**

Video drift surveys



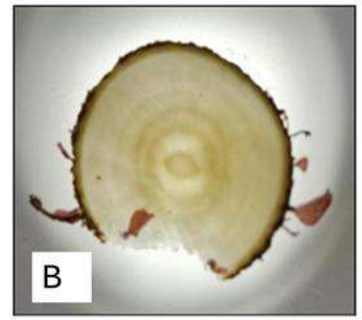




Data processing

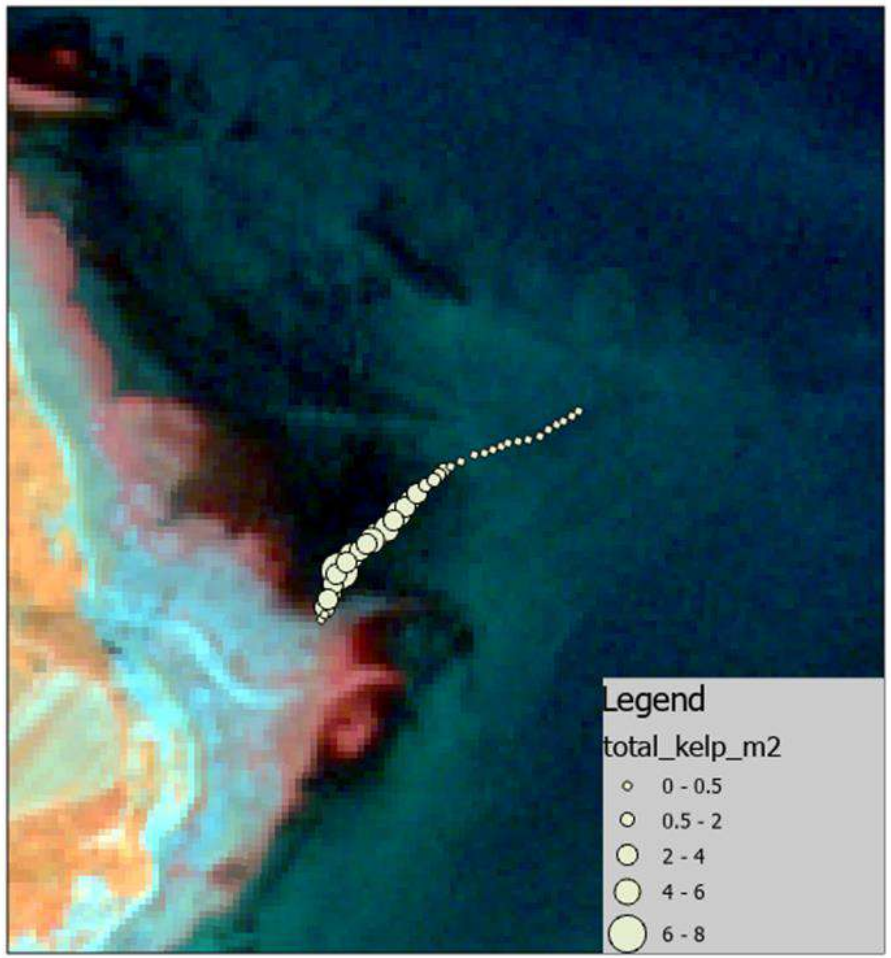
Standardised counting of video to give geo-located data for kelp species and associated biodiversity

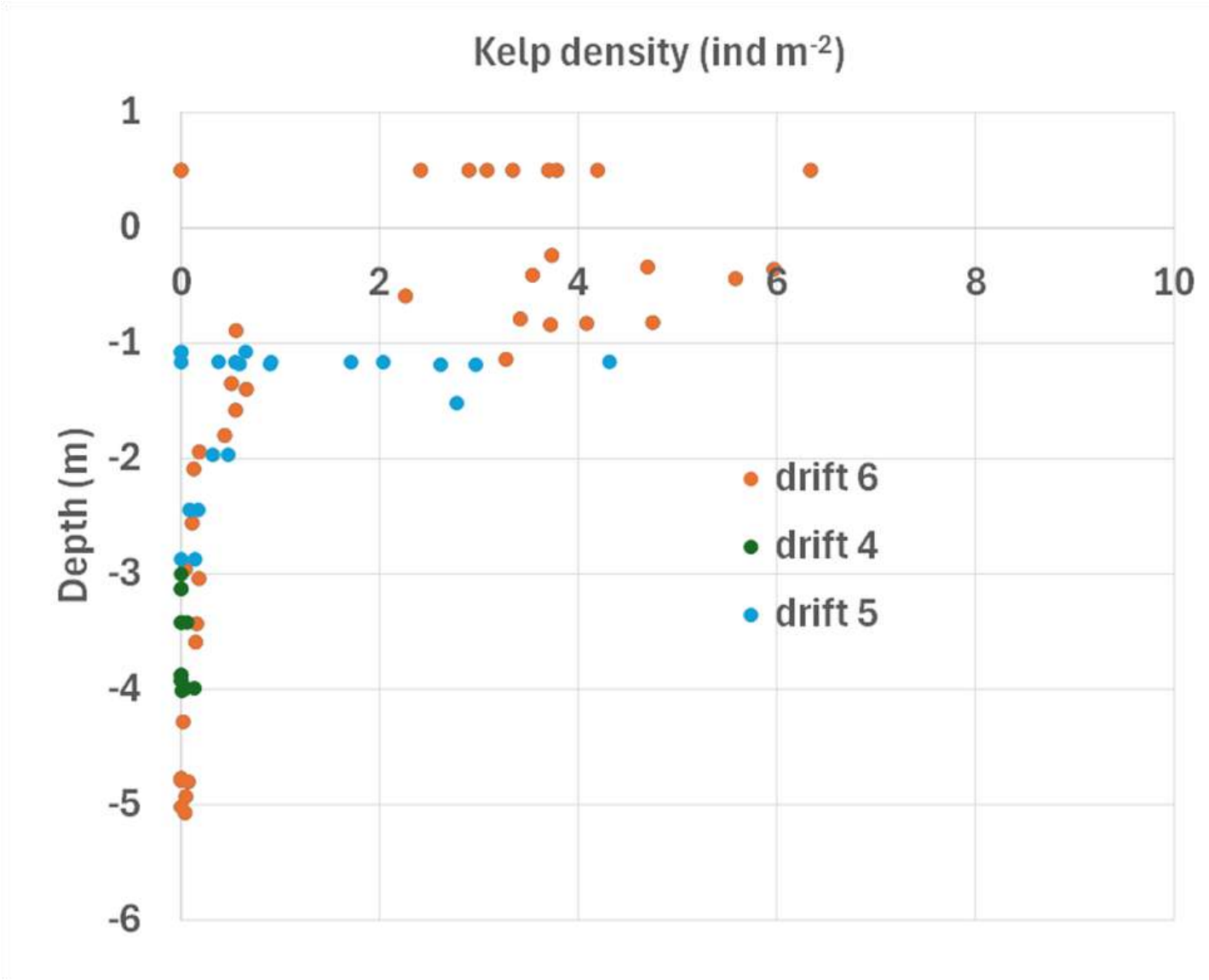
Link counts to depth, seabed type, satellite image colour bands



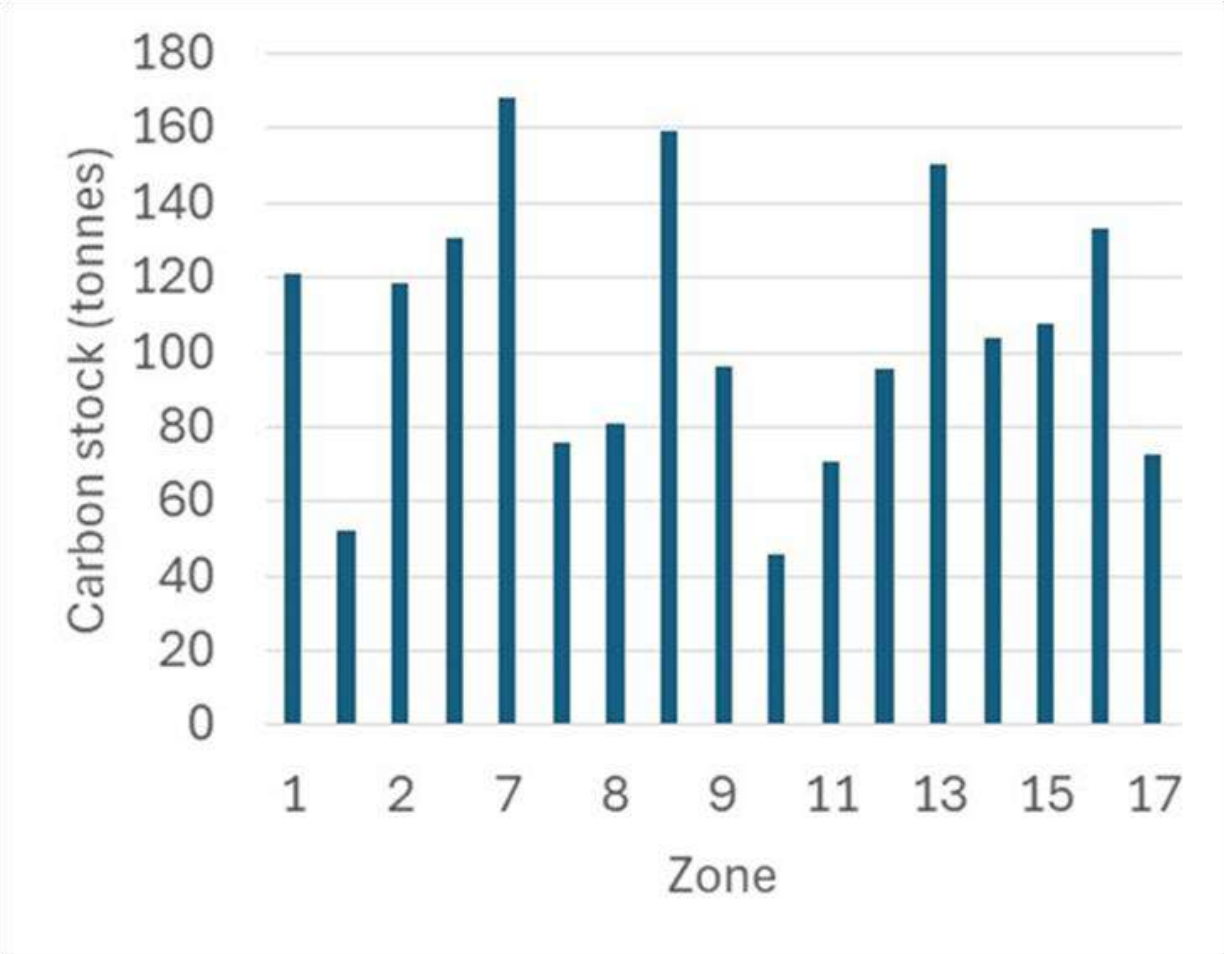
Lab analysis for biometrics, photosynthetic ability, carbon content

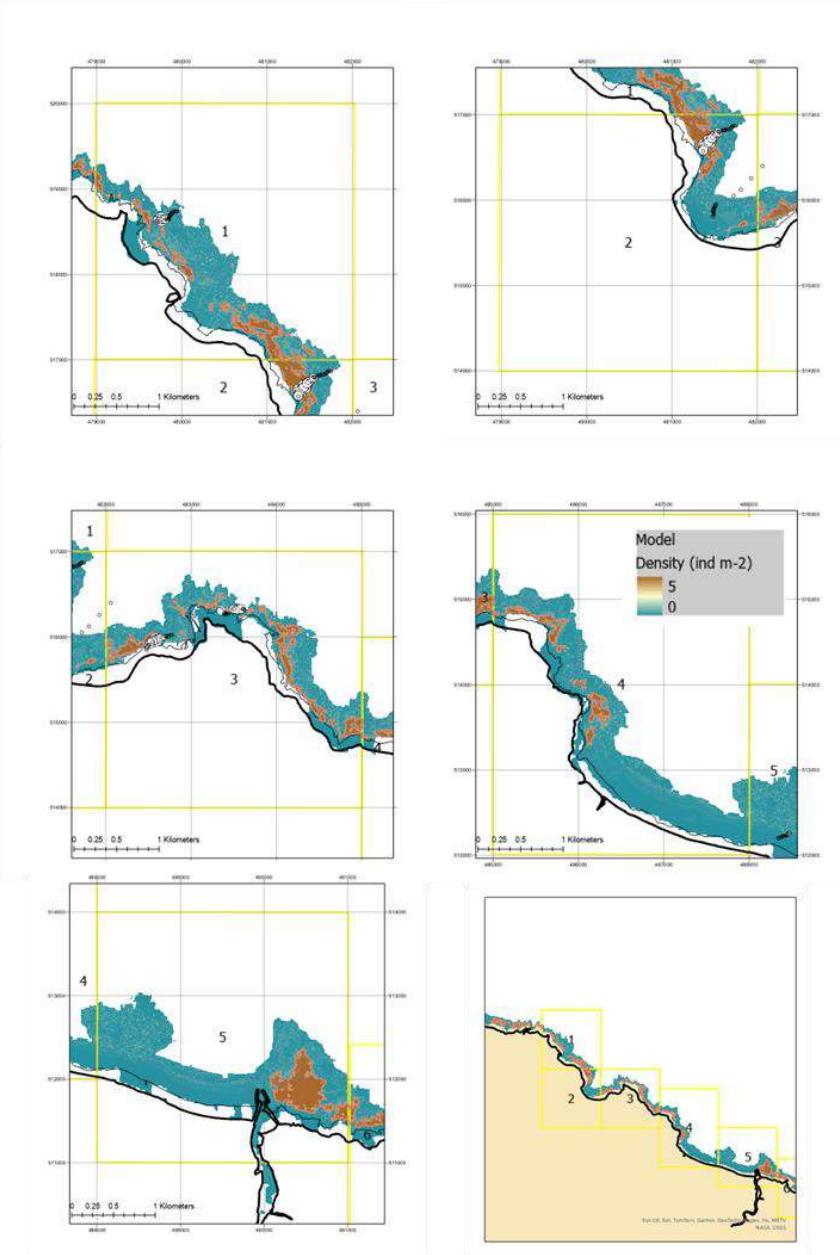
Kelp abundance decreases with depth





Kelp carbon stock estimates





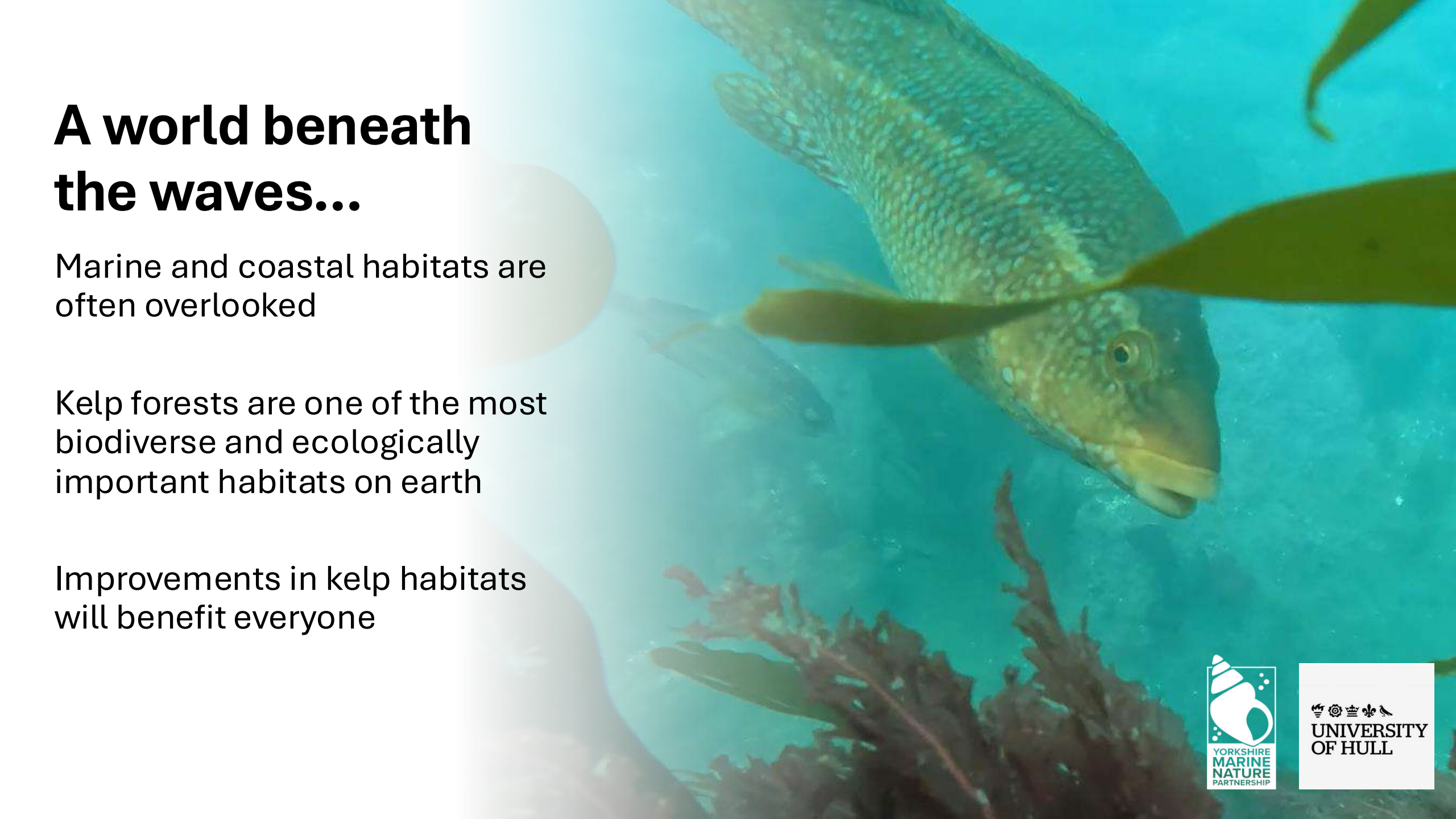
Staithes to Filey – standing stock – 1783 tonnes carbon

A world beneath the waves...

Marine and coastal habitats are often overlooked

Kelp forests are one of the most biodiversity and ecologically important habitats on earth

Improvements in kelp habitats will benefit everyone



YORKSHIRE MARINE NATURE PARTNERSHIP

UNIVERSITY OF HULL

The challenge…

We need support and investment in scientific research to inform decision-making:

‘The right ~~tree~~ kelp in the right place’

- Net Zero / Carbon Negative
- Nature recovery
- Climate change adaptation
- Blue health

YORKSHIRE MARINE NATURE PARTNERSHIP

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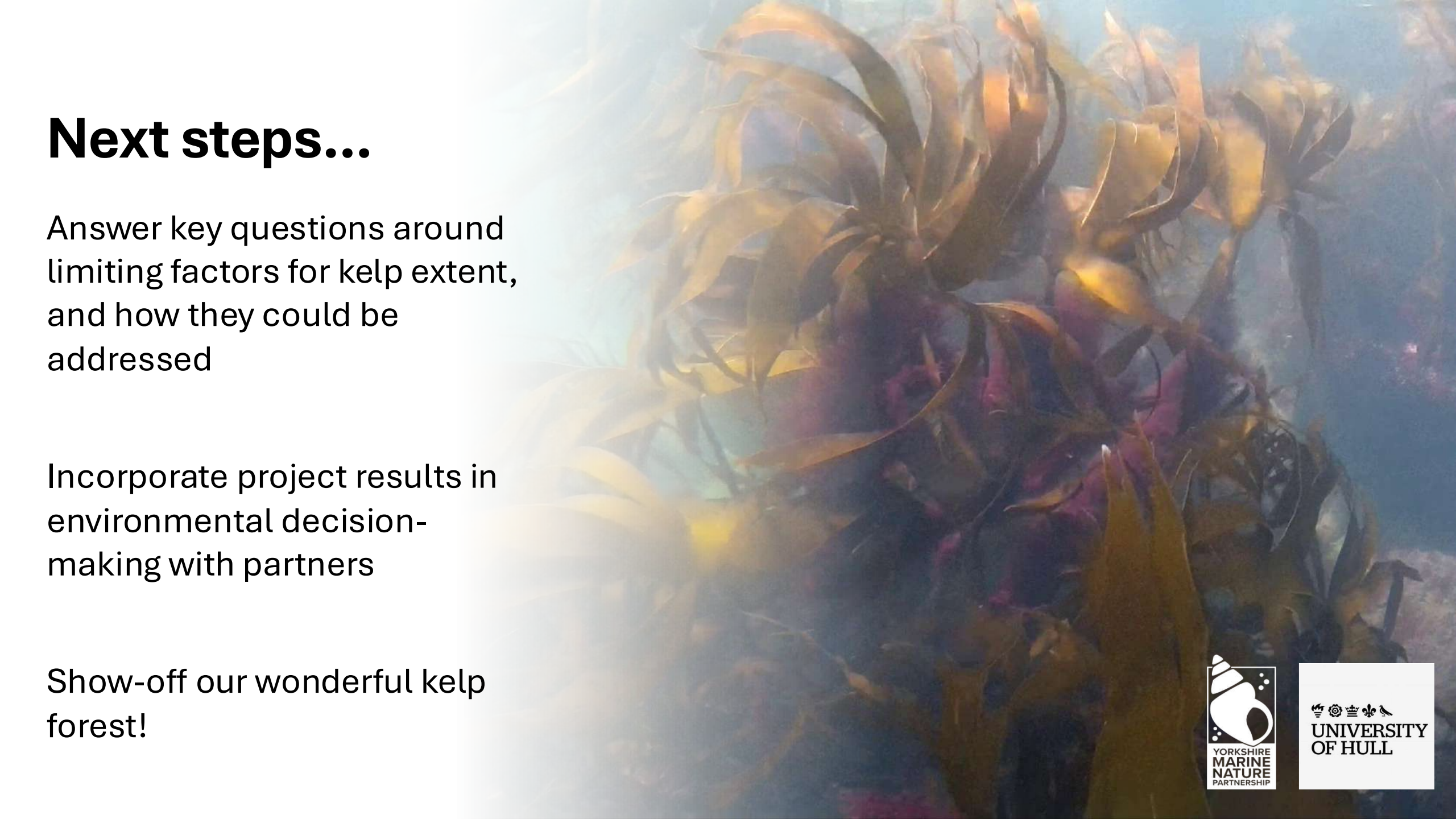
Next steps...

Answer key questions around limiting factors for kelp extent, and how they could be addressed

Incorporate project results in environmental decision-making with partners

Show-off our wonderful kelp forest!



Scan the code for more info

Heather Davison-Smith
Heather.davison-smith@eastriding.gov.uk

www.ymnp.org.uk

Prof. Rodney Forster
r.forster@hull.ac.uk

www.hull.ac.uk

Saltmarsh restoration: Evaluation of small-scale methods for big coastal gains

Stefanie Carter, Annette Burden, Angus Garbutt

Danielle Roth, Kristina J Chilver, Nicola J. D. Slee, Graham J. C. Underwood

Maddie Millington-Drake

10.07.25

UK Centre for Ecology & Hydrology

University of Essex

BLUE MARINE FOUNDATION

Introduction

SALTMARSH CODE

- Desk-based Review
- Fieldwork

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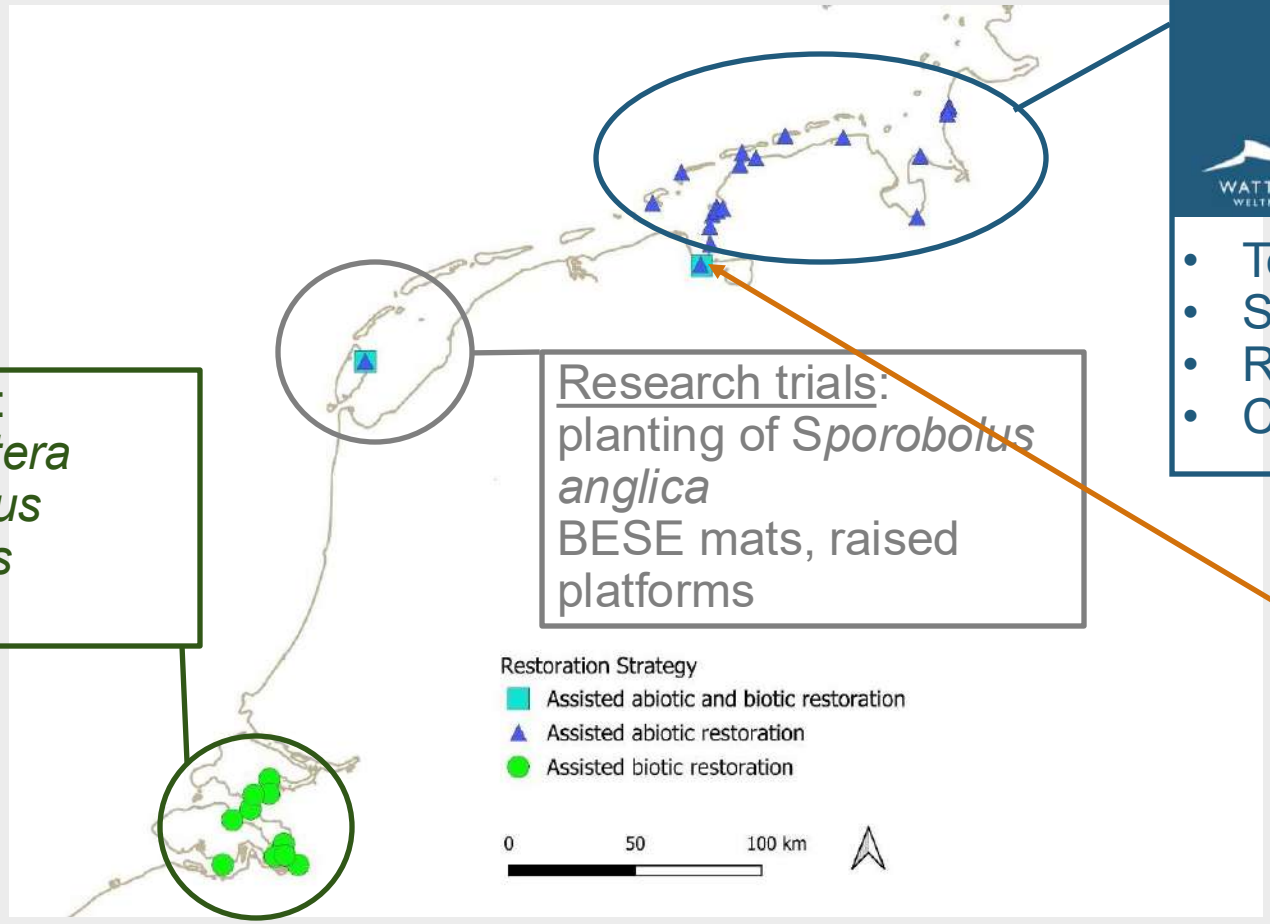
Northwest Europe



Research trials:
planting of *Zostera noltii*, *Sporobolus anglica*, *Scirpus maritimus*

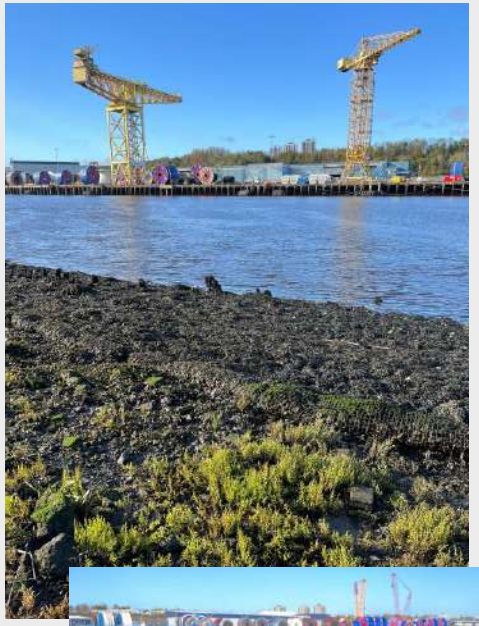
Research trials:
planting of *Sporobolus anglica*
BESE mats, raised platforms

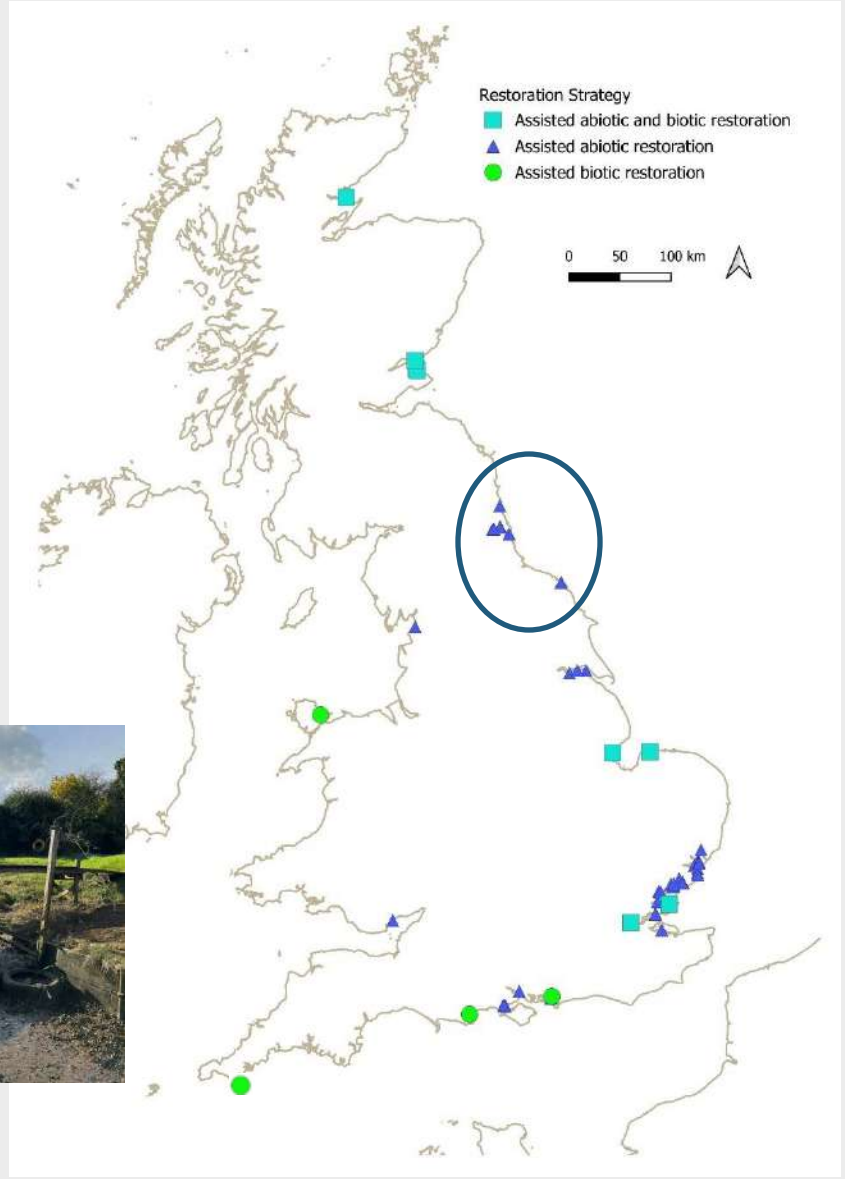
- Topsoil removal
- Sediment deposition
- Removal of summer dykes
- Creation of tidal creeks

Marconi Delfzijl Project
- Combined saltmarsh restoration with a research trial

UK

Groundwork NE & Cumbria – Revitalising our Estuaries





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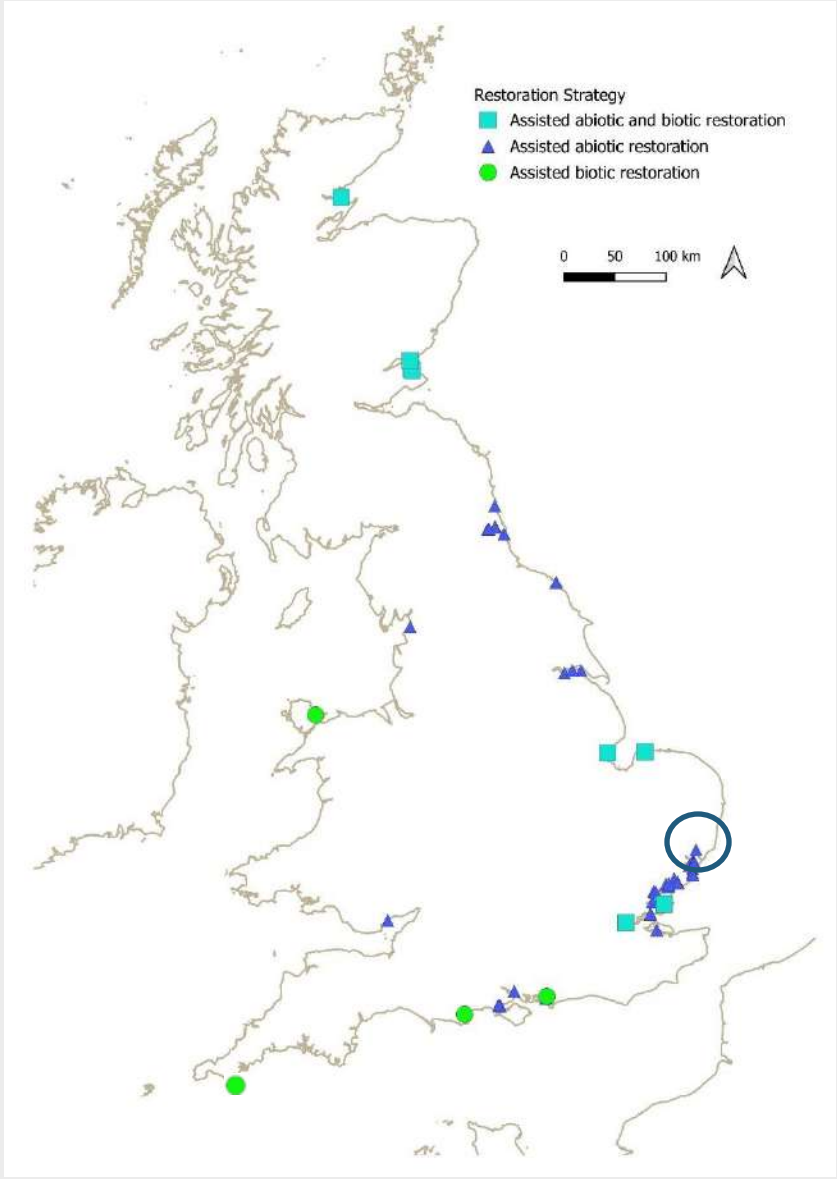
Suffolk Yacht Harbour, Orwell



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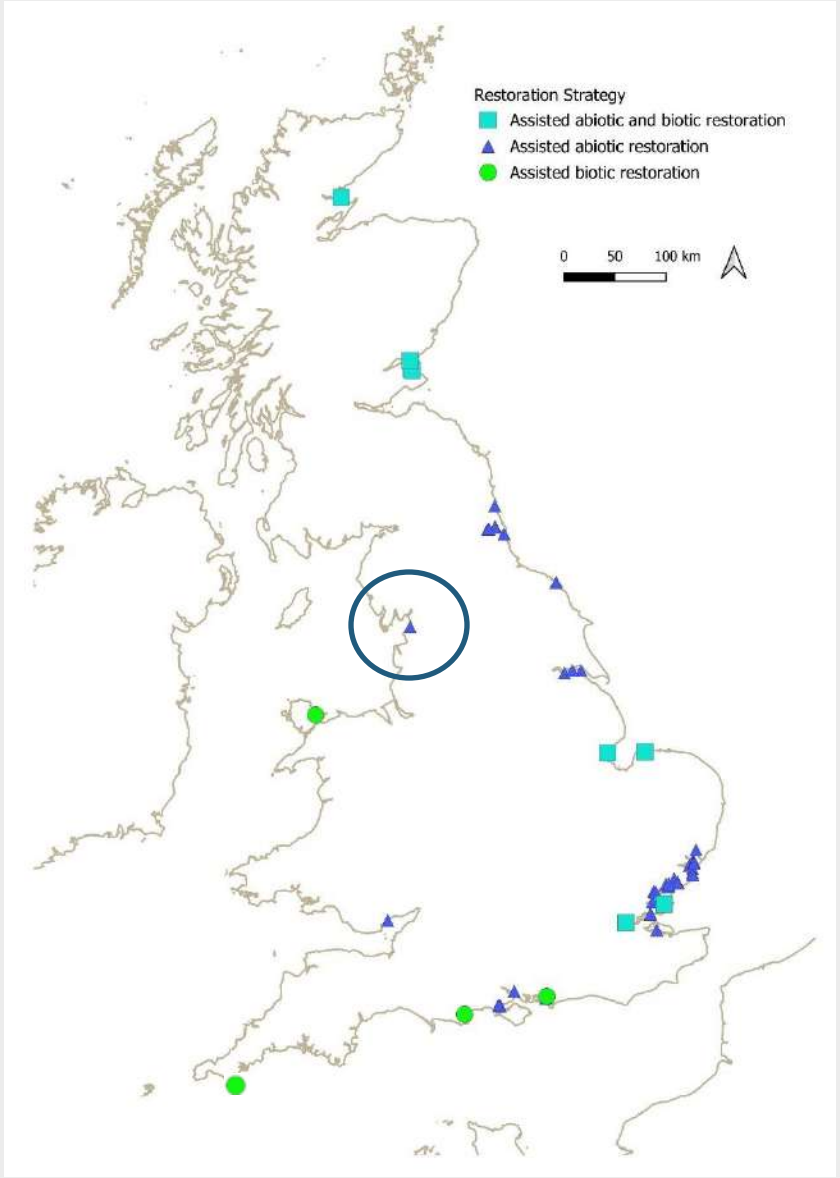
Morecambe Bay / Our Future Coast



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Fieldwork

- Restoration vs control
- Creek blocking, BUDS and both combined

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Fieldwork

Vegetation survey

Sediment shear strength

LOI, TOC, IC, bulk density, water content

Theodolite measurements for marsh and creek height

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Conclusions

- Beneficial Use of Dredge Sediment (BUDS) works (provided the sediment is retained)
- Keys to successful restoration:
    - Marsh height
    - Favourable sediment characteristics
    - Wave exposure
- Evidence that creek blocking works is lacking
- Site-specific context is an important factor
- Lack of systematic research trial approach / controls in restoration
- Next steps: Further validation needed to support inclusion into SALTMARSH CODE

Diolch / thank you

For more information
please contact:

Steffi Carter stecar@ceh.ac.uk

@UK_CEH

ceh.ac.uk

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BLUE MARINE FOUNDATION

ReSOW UK

Restoration of Seagrass for Ocean Wealth

Amani Becker, Tobias Ferriera and Claire Evans

SMMR
Sustainable Management of UK Marine Resources

SMMR
Sustainable Management of UK Marine Resources

National Oceanography Centre

Swansea University Prifysgol Abertawe

University of Stirling

Project Seagrass

ReSOW UK

Restoration of Seagrass for Ocean Wealth

Claire Evans, Leanne Cullen-Unsworth, Richard Unsworth, James Bull, Danny Campbell, Amani Becker, Alison Evans, Clive Neil, Chiara Bertelli, Anouska Mendzil, Eleanor Ford, Sara Driscoll, Tobias Ferreira, Sarah Taylor, Richard Lilley, Kate Peel

Environment Agency

Department for Environment Food & Rural Affairs

Cyfoeth Naturiol Cymru Natural Resources Wales

Heriot Watt University

Global Ocean Accounts Partnership

Natural England

marinescotland

The Scottish Government

The Crown Estate

Fauna & Flora International

complydirect

LIFE Recreation ReMEDIES

Young's Est. 1805

NatureScot

14 HRONO

National Oceanography Centre — British Ocean Sediment Core Research Facility

Deloitte.

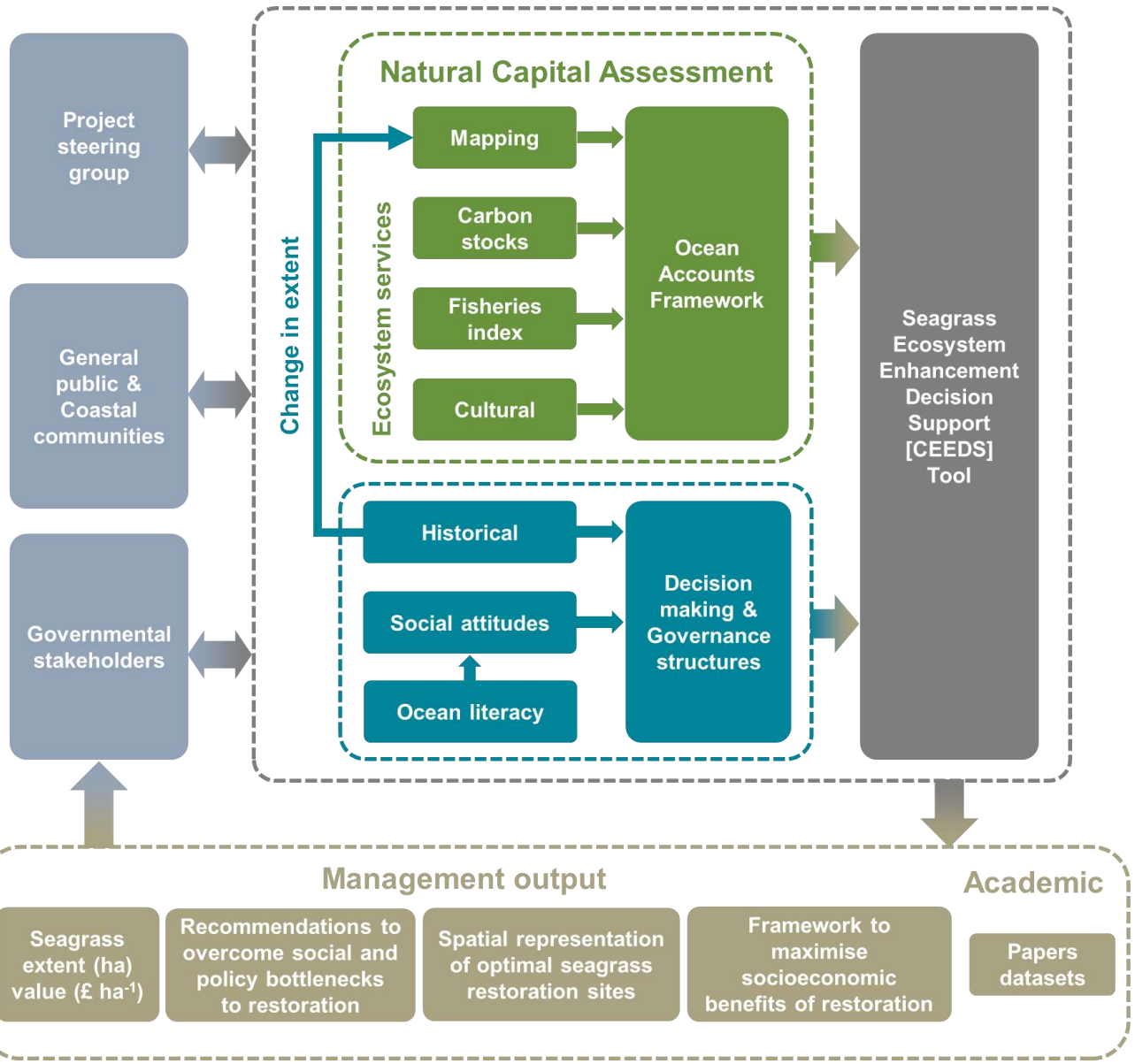
EVMT ProgRess Limited

SEAWILDING Community-led Marine Habitat Restoration

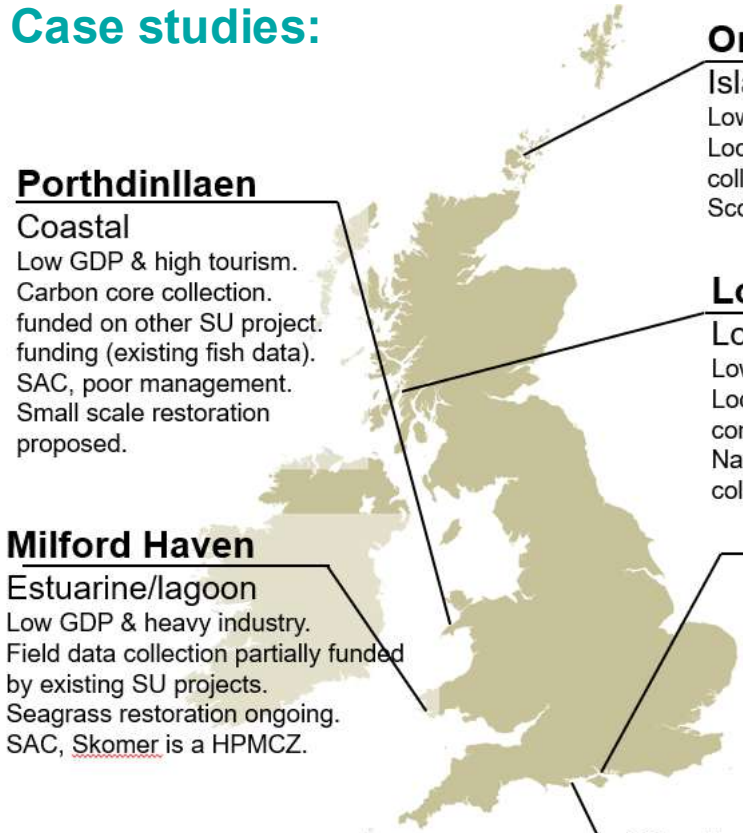
Marine Management Organisation

CGI

PROJECT OVERVIEW



Case studies:



Orkney
Island
Low GDP & small scale fishing.
Loch partner and ongoing project to collect cores funded by Nature Scot.

Porthdinllaen
Coastal
Low GDP & high tourism.
Carbon core collection.
funded on other SU project.
funding (existing fish data).
SAC, poor management.
Small scale restoration proposed.

Loch Craignish
Loch
Low GDP. Extent data collected.
Local partner 'Seawilding' ongoing community restoration project.
Nature Scot funding for cores collection.

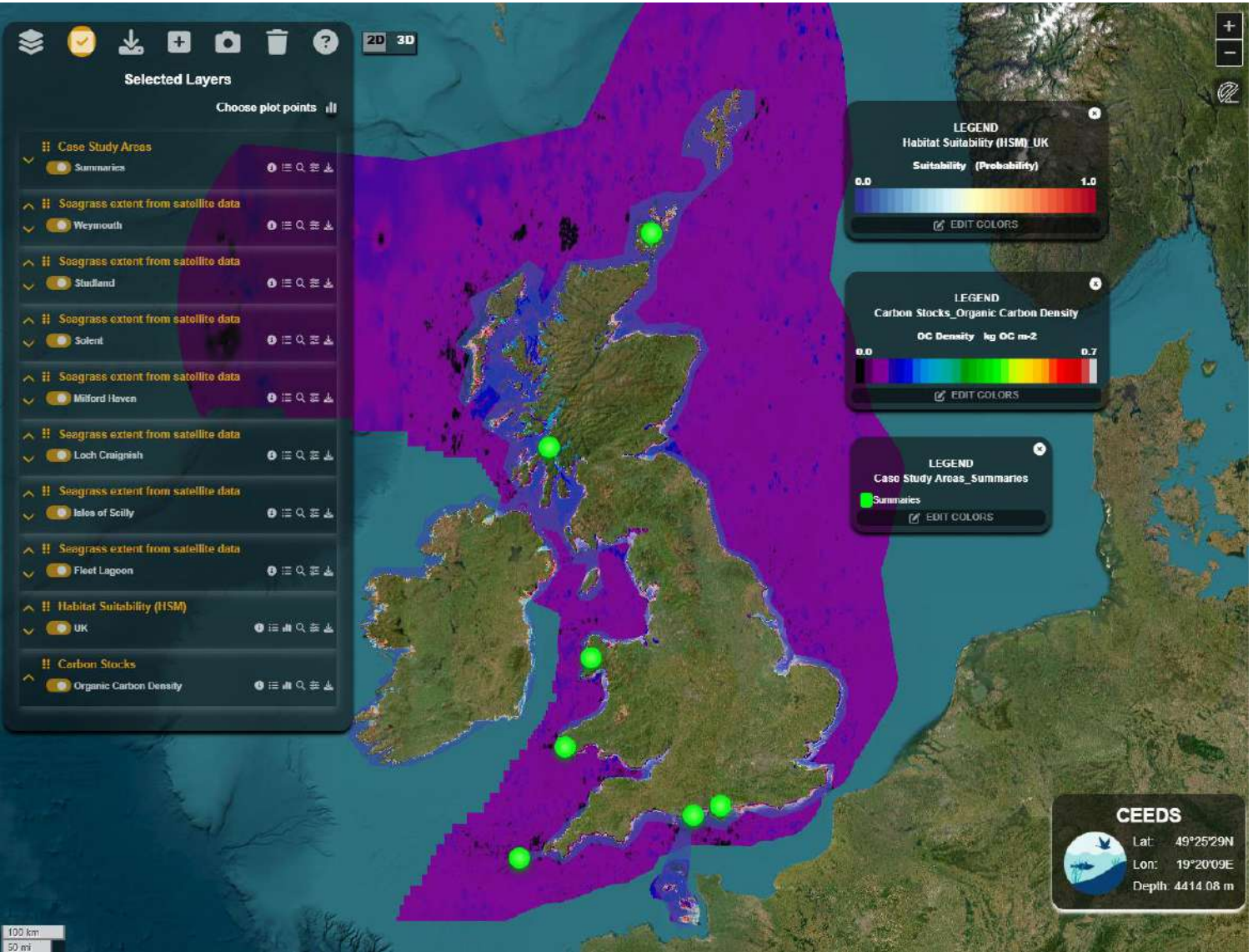
Milford Haven
Estuarine/lagoon
Low GDP & heavy industry.
Field data collection partially funded by existing SU projects.
Seagrass restoration ongoing.
SAC, Skomer is a HPMCZ.

Solent
Estuarine/lagoon
Medium GDP Industry & tourism
Field data collection partially funded by existing SU projects.
Seagrass restoration proposed.
SAC and MCZ, some management.

Isles of Scilly
Island
High GDP & high tourism.
Field data collection partially funded by existing NE/Project Seagrass activity. SAC and MCZ, some management.

Studland Bay
Coastal
High GDP& high tourism.
Carbon data available.
Local partner.
New MCZ and limited management.
Complex stakeholder seagrass interactions.

COASTAL ECOSYSTEM ENHANCEMENT DECISION SUPPORT (CEEDS) TOOL



- Integrates data from the ReSOW project
- Integrates third party data
- Allows users to upload their own data
- Users can interrogate data
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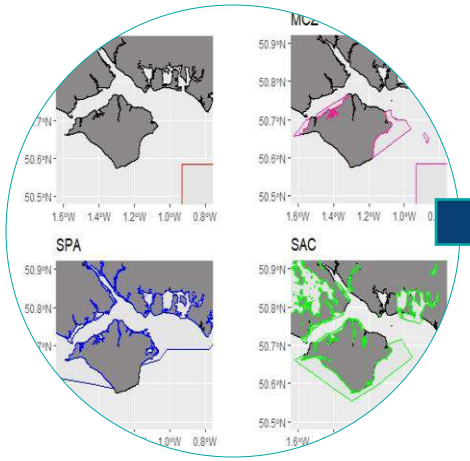
SOCIAL AND GOVERNANCE FACTORS



Mapping stakeholder at case study sites

Develop semi-structured interview guide, qualitative approach, based on literature review

Pilot studies (Loch Craignish, Scotland and Dale, Wales)

Refine interview guide and roll out across study sites

Finalizing analysis of the qualitative data

CEEDS TOOL – CASE STUDIES

Case Study Area: Orkney

Case Study Area: Loch Craignish

Case Study Area: North Wales

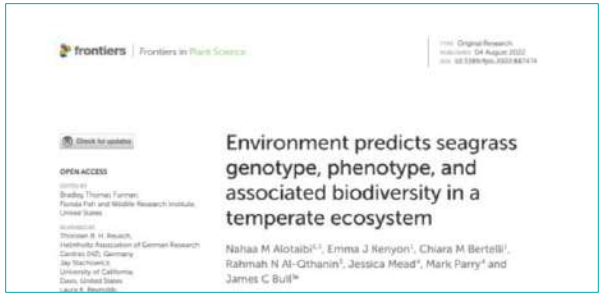
Case Study Area: Milford Haven

Case Study Area: Isles of Scilly

Case Study Area: Studland Bay

Case Study Area: The Solent

HABITAT SUITABILITY MODELLING



frontiers | Frontiers in Plant Science

Environment predicts seagrass genotype, phenotype, and associated biodiversity in a temperate ecosystem

Nahaa M Alotaibi, Emma J Kenyon, Chiara M Bertelli, Rahmah N Al-Qthanin, Jessica Mead, Mark Parry and James C Bull*

frontiers | Frontiers in Marine Science

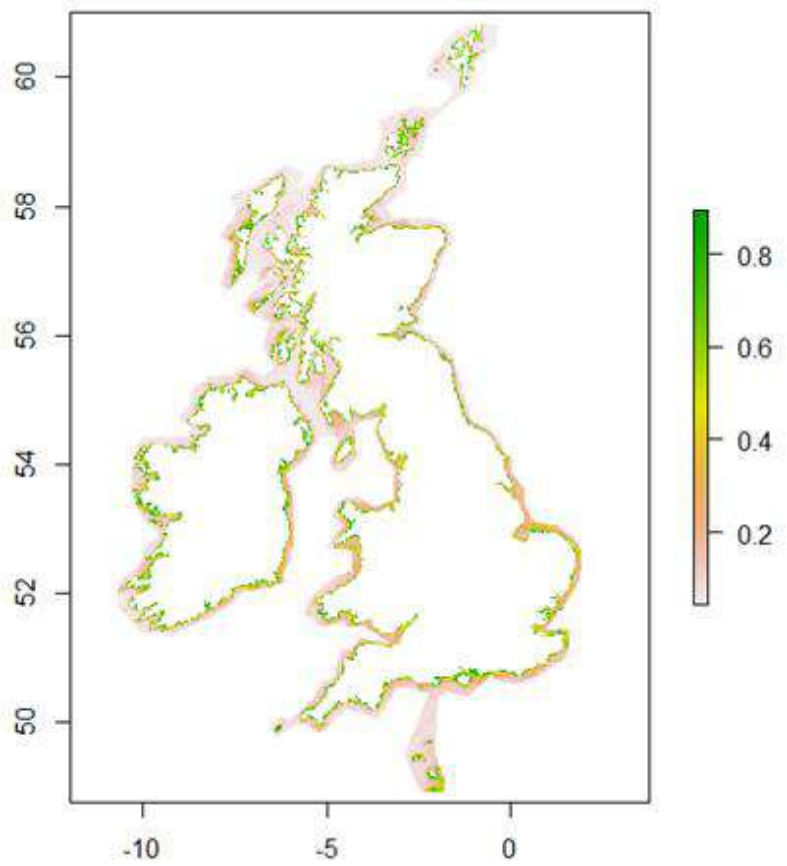
High-resolution wave data for improving marine habitat suitability models

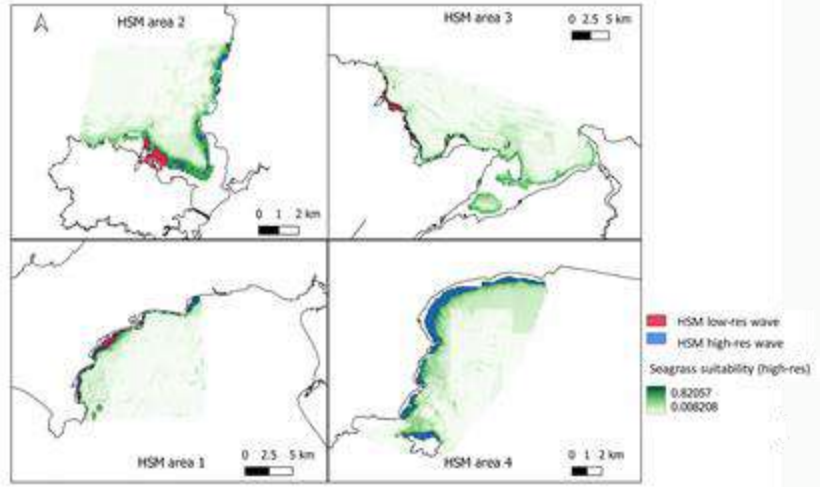
Chiara M. Bertelli*, William G. Bennett, Harshinie Karunarathna, Dominic E. Reeve, Richard K. F. Unsworth and James C. Bull

frontiers | Frontiers in Marine Science

The use of habitat suitability modelling for seagrass: A review

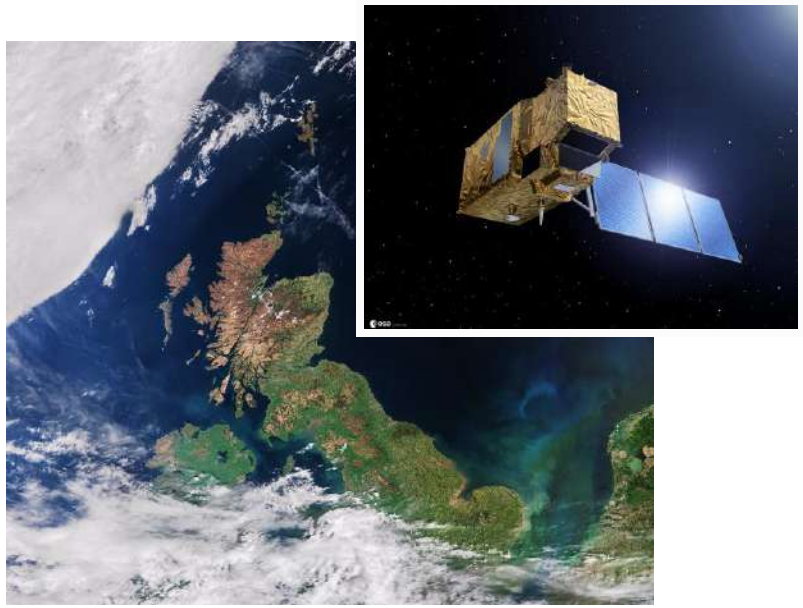
Chiara M. Bertelli*, Holly J. Stokes, James C. Bull and Richard K. F. Unsworth

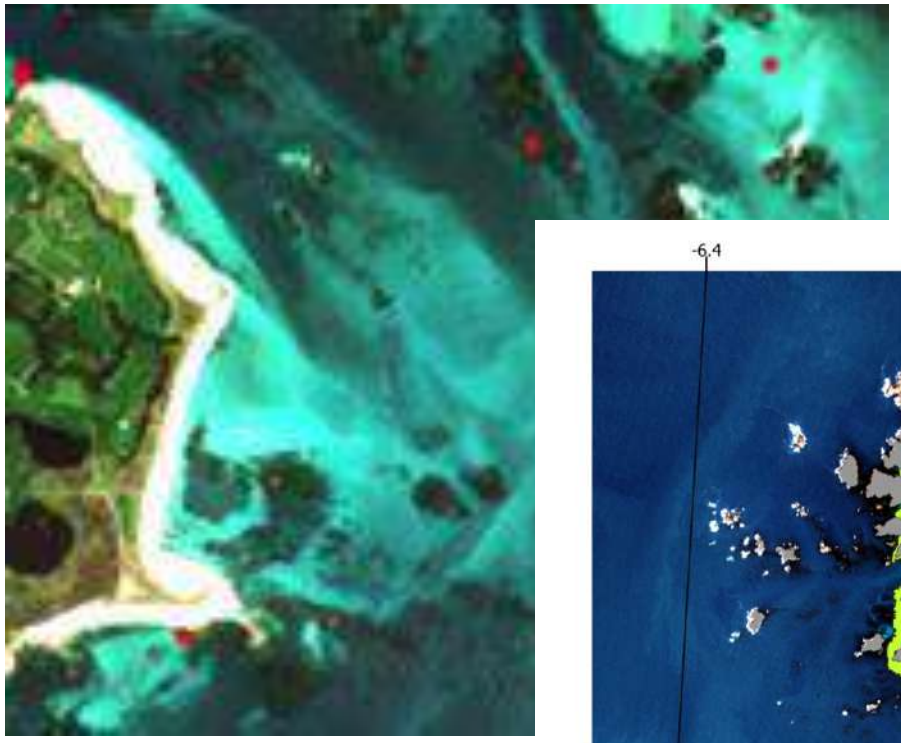


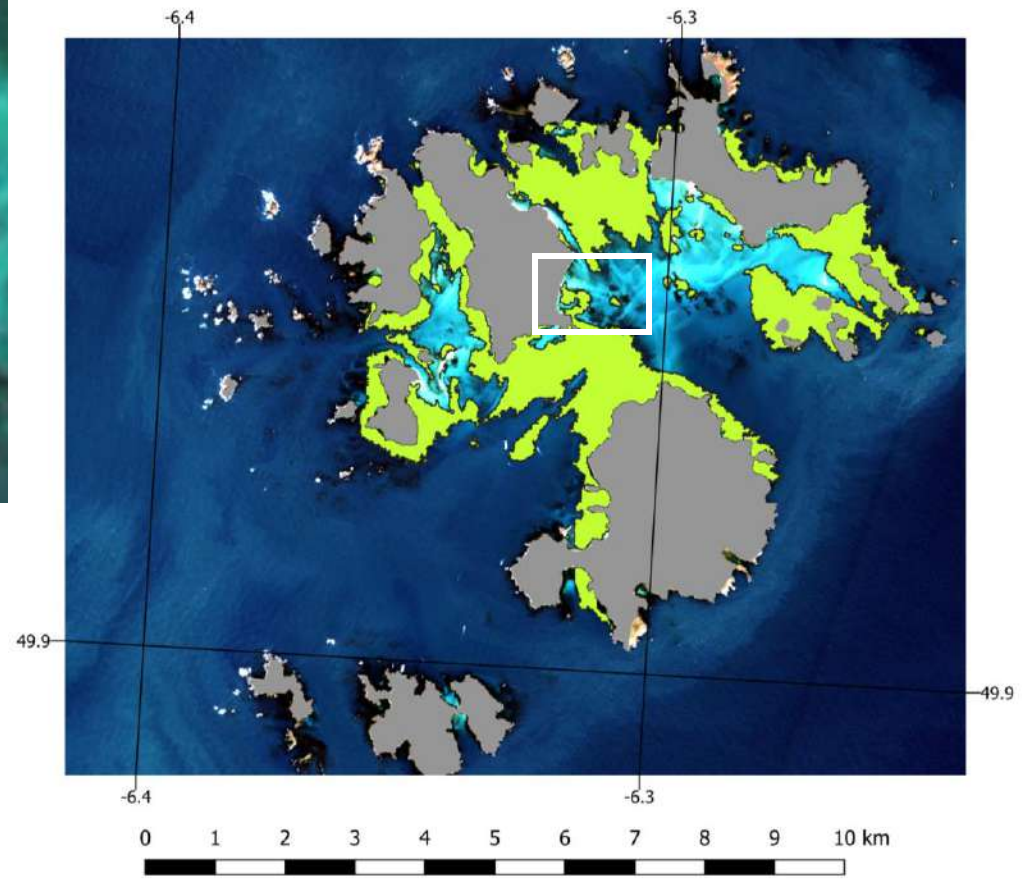


CEEDS TOOL – HABITAT SUITABILITY MAPPING

SEAGRASS EXTENT FROM SATELLITE DATA



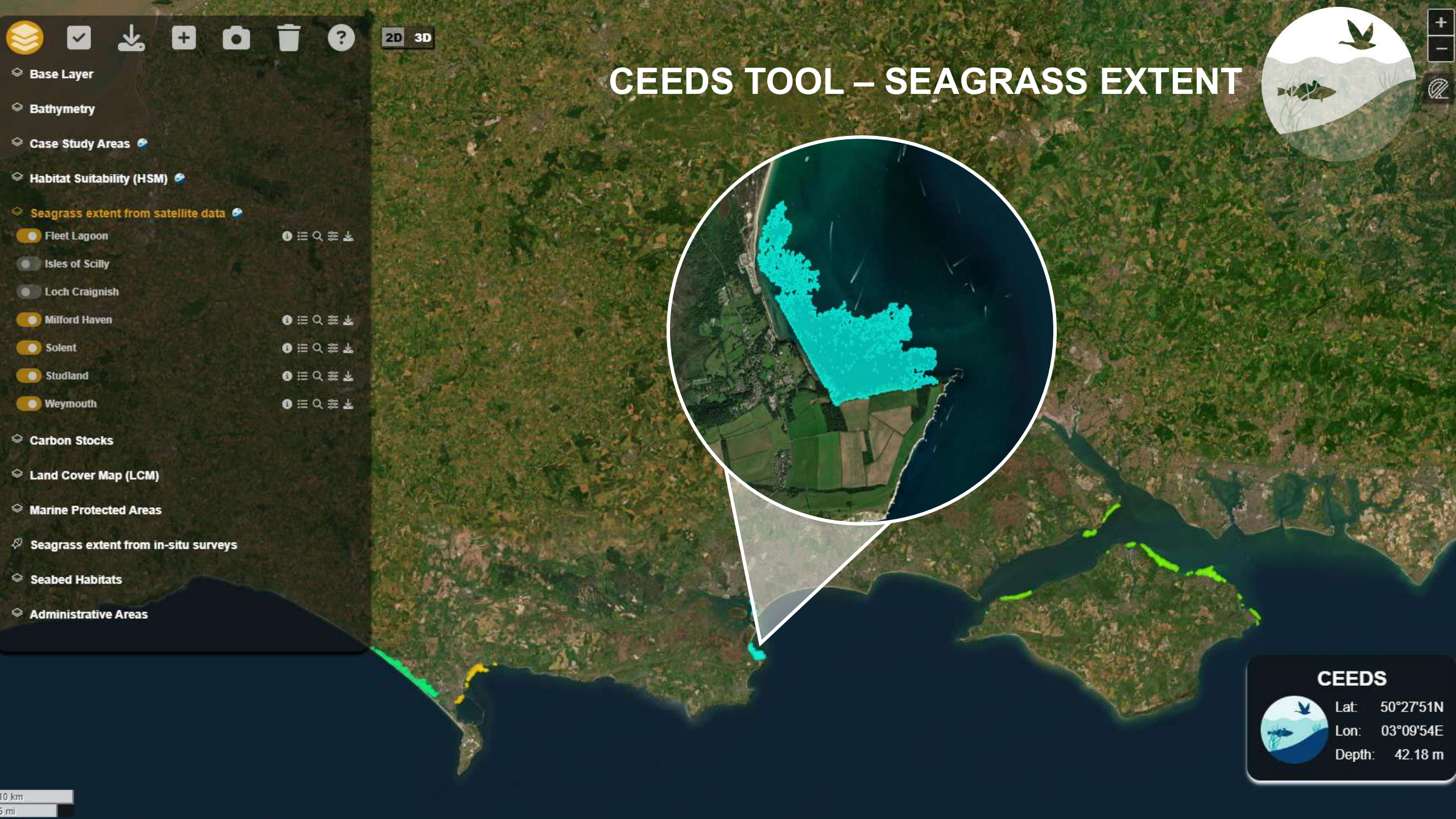




Isles of Scilly

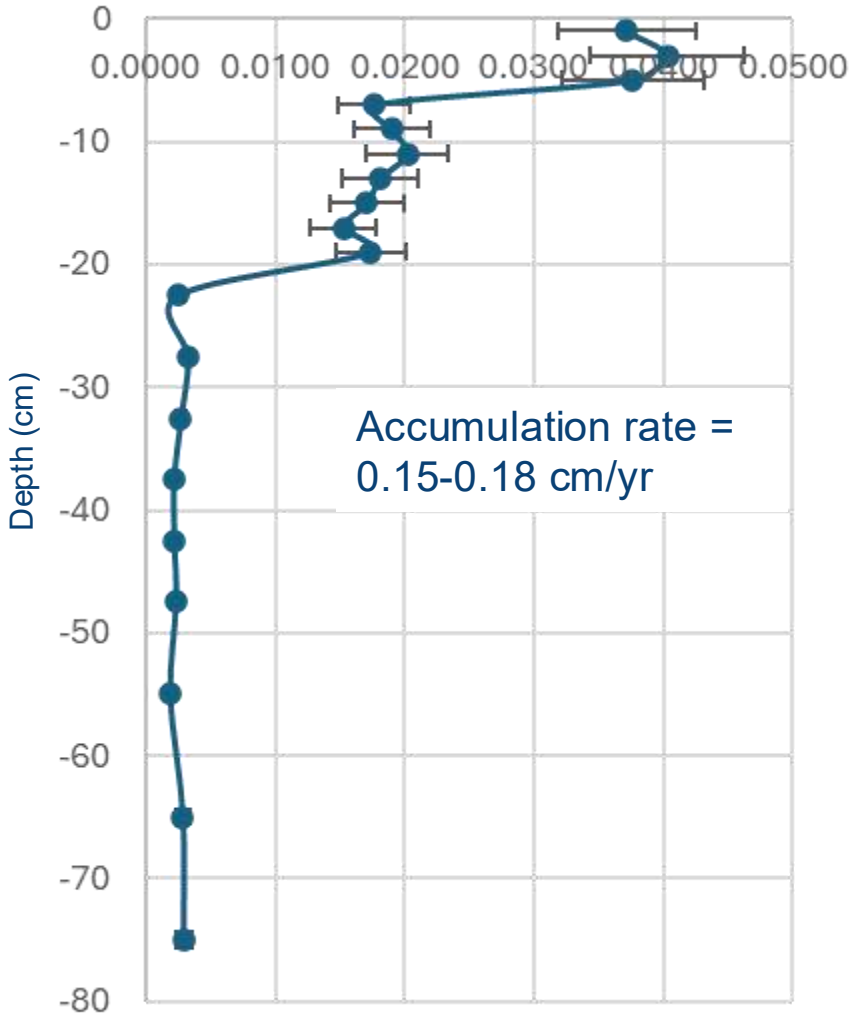
- Sentinel-2 data
- Training data from ground surveys
- Potential to be used for monitoring

CEEDS TOOL – SEAGRASS EXTENT



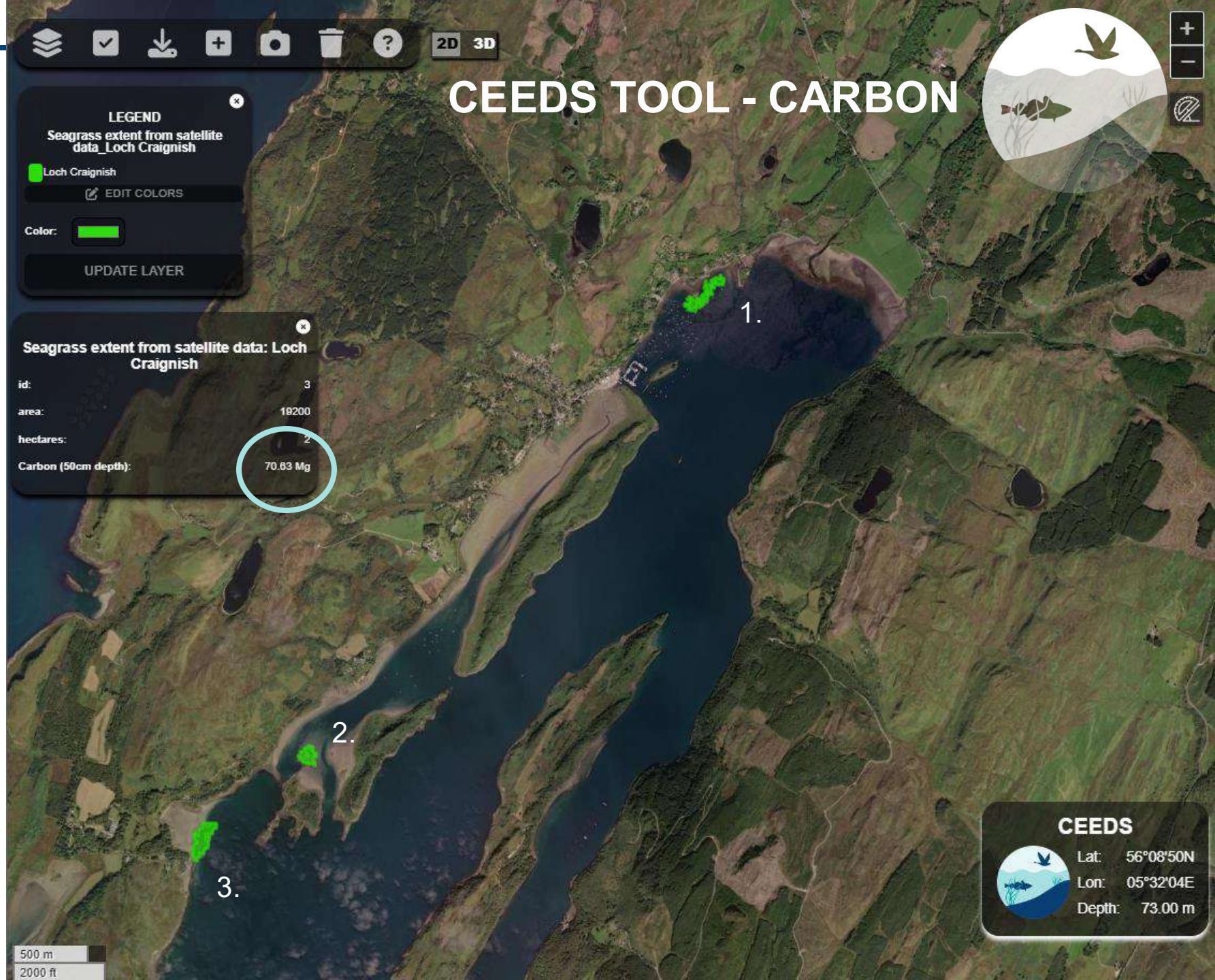
CARBON STORAGE AND ACCUMULATION

WEYMOUTH

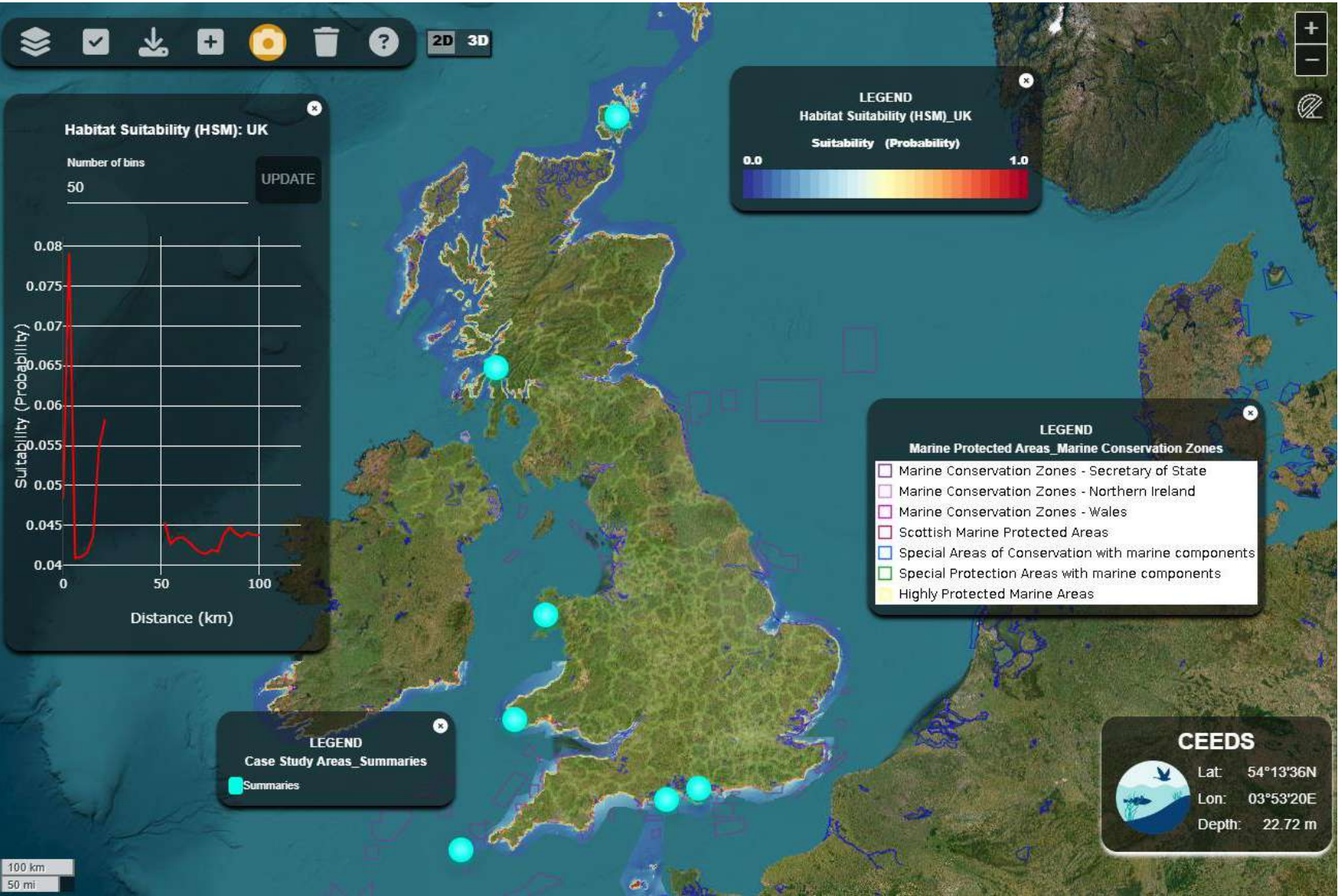


Organic Carbon to 50 cm depth

1. 50.40 Mg
2. 32.37 Mg
3. 70.63 Mg



COASTAL ECOSYSTEM ENHANCEMENT DECISION SUPPORT (CEEDS) TOOL



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ReSOW UK

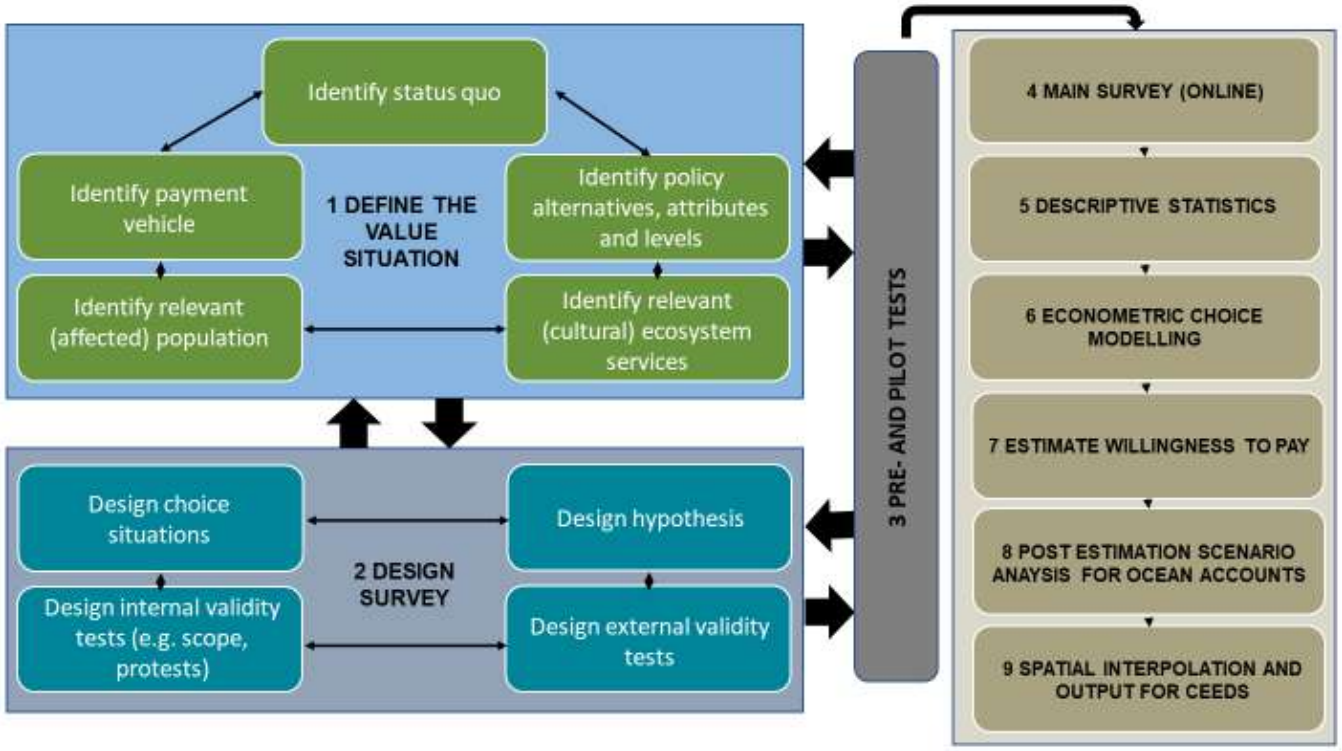
Restoration of Seagrass for Ocean Wealth

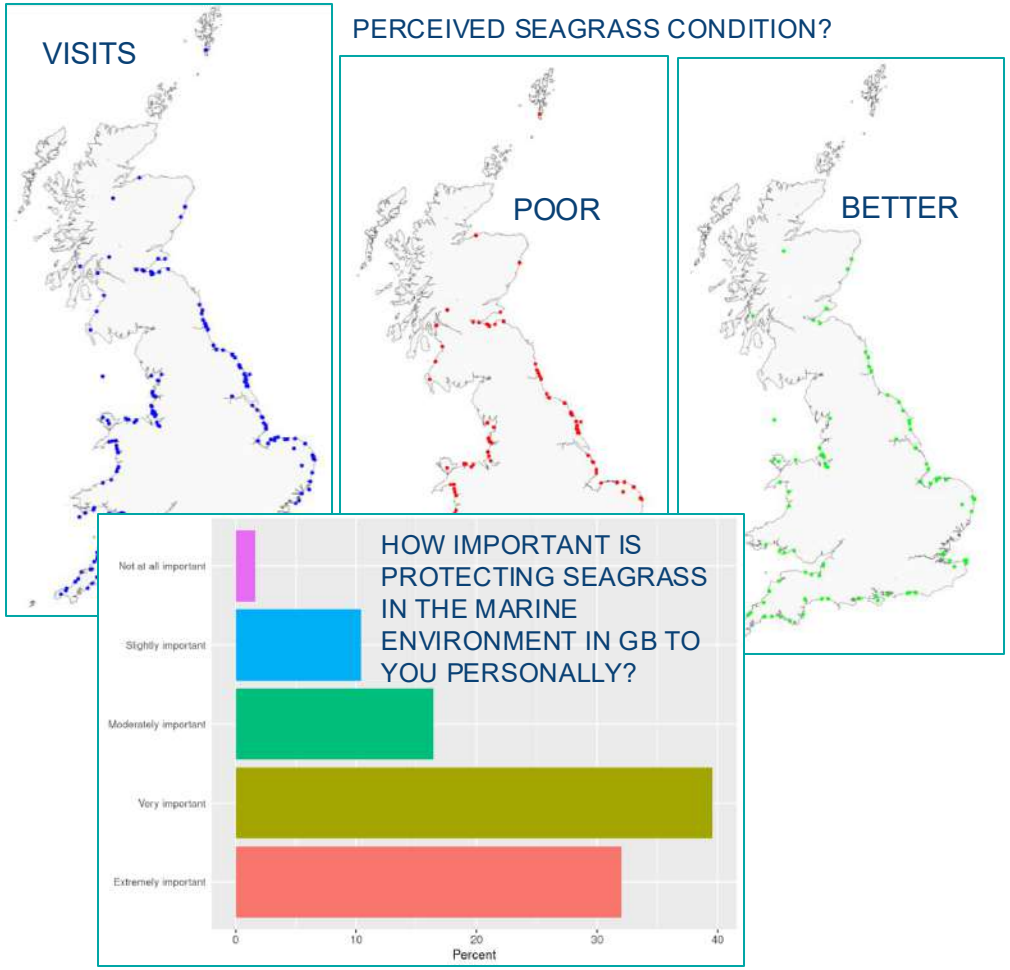
resow.uk

Thank You

SMMR
Sustainable Management of UK Marine Resources

CULTURAL VALUES AND ECOSYSTEM SERVICES





Manuscripts in prep:

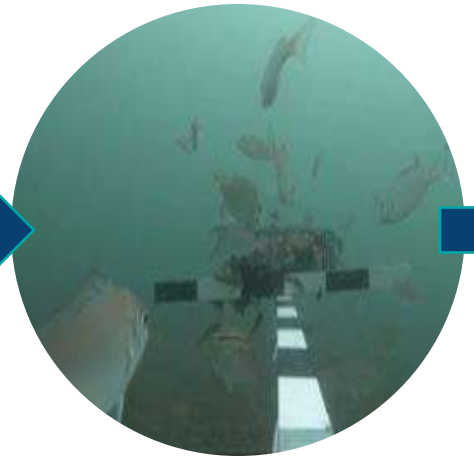
Campbell et al (in prep) Linking willingness with capacity to pay

Campbell et al (in prep) The role of attitudes in determining willingness to pay for seagrass protection

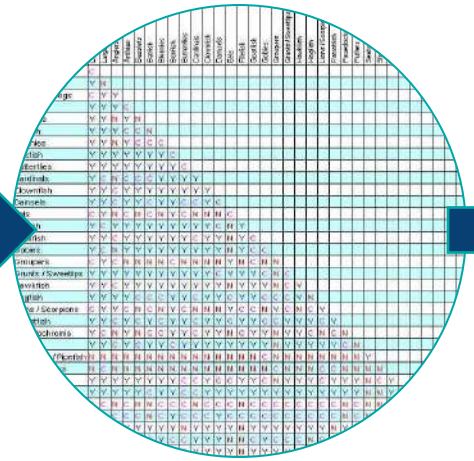
FISHERIES AND BIODIVERSITY SUPPORT

Specimens collected by seine netting

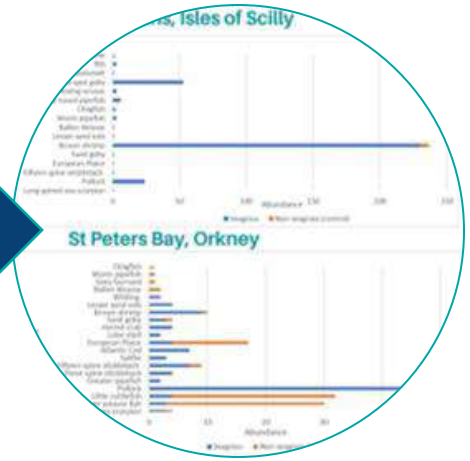
Species composition, size-frequency, tropic score, juveniles v adults, eDNA



Baited Remote Underwater Video



Integration with data available from fisheries databases



Calculate Seagrass Fishery Residence Index

Manuscripts in prep:

Mendzil et al (in prep) Finding the fisheries 'sweet spot' in temperate seagrass meadows

Mendzil & Unsworth (in prep) Seagrass Security: Assessing the role of fisheries supporting and provisioning services in UK's temperate seagrass (Zostera marina) meadows