# Intertidal blue carbon ecosystems and their socio-economic value at Lindisfarne, northern England

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This presentation participates in OSPP

Outstanding Student & PhD candidate Presentation contest

## Blue carbon intertidal ecosystems

Intertidal ecosystems offer many ecosystem services which benefit local communities, including flood defence, feeding grounds for migrant birds and fish nurseries, etc. They have also been noted as efficient carbon sinks, termed "Blue carbon", and are being explored as a nature-based solution to climate change [1].

## Lindisfarne National Nature Reserve (NNR)

The Holy Island of Lindisfarne, UK, has a resident population and many visitors due to its ecological aesthetics and cultural significance. Its intertidal region, Lindisfarne NNR, contains saltmarshes, seagrass meadows and tidal flats, managed by Natural England. Previous study here indicates the saltmarshes are efficient at carbon storage [2], and Lindisfarne seagrass can inform an important UK data gap for these ecosystems [3].

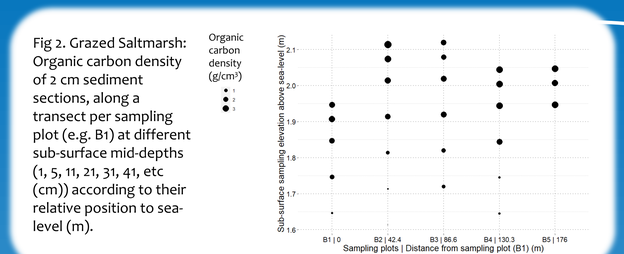



Fig 2. Grazed Saltmarsh: Organic carbon density of 2 cm sediment sections, along a transect per sampling plot (e.g. B1) at different sub-surface mid-depths (1, 5, 11, 21, 31, 41, etc (cm)) according to their relative position to sea-level (m).

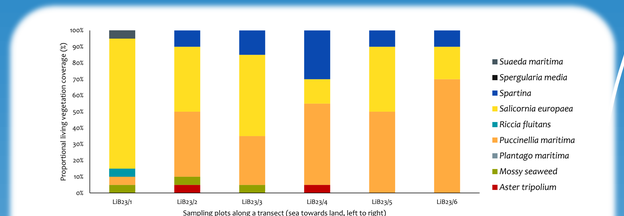



Fig 4. Grazed Saltmarsh: Vegetation percentage coverage and proportions per sampling plot (e.g. LiB23/1) along one transect.

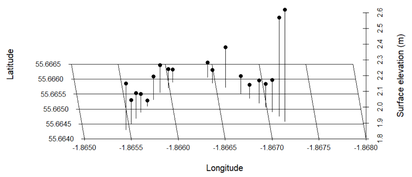



Fig 6. *Spartina*-dense Saltmarsh: latitude and longitude coordinates and surface elevation (m) from DGPS readings of sampling plots along both transects.


Fig 1. Lindisfarne National Nature Reserve (NNR) with the sampling plots marked using differential GPS (DGPS) in 6 different intertidal ecosystems: Grazed Saltmarsh has annual sheep grazing; Ungrazed Saltmarsh has no livestock grazing but migrant birds feeding; Sandy Seagrass has growth of *Zostera spp.* seagrass on sandy sediment; Sand flat is unvegetated sand; *Spartina*-dense Saltmarsh has predominantly *Spartina* growing across it; and Silty Seagrass has growth of *Zostera spp.* seagrass on silty sediment. The stratigraphy of each sampling plot was used to guide selection of representative cores for further high-resolution analysis, using $^{210}$Pb and $^{137}$Cs dating and thermogravimetric analysis. UK map inserted with blue pin to mark Lindisfarne NNR (Image source: Google Earth)

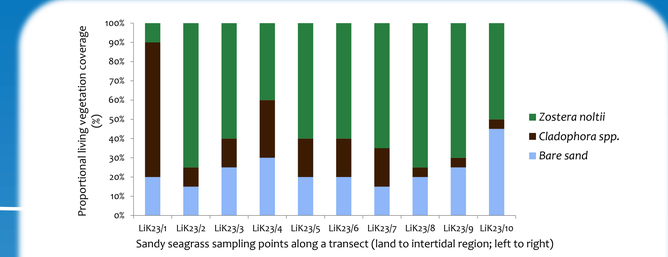



Fig 3. Sandy Seagrass: Vegetation percentage coverage and proportions per sampling plot (e.g. LiK23/1) along one transect.

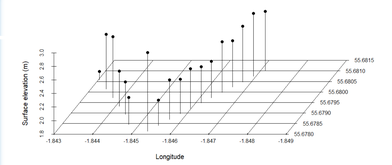



Fig 5. Ungrazed Saltmarsh: latitude and longitude coordinates and surface elevation (m) from DGPS readings of sampling plots along both transects.

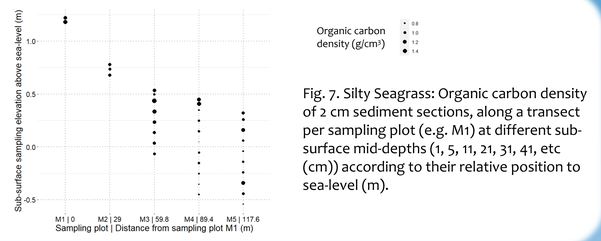



Fig. 7. Silty Seagrass: Organic carbon density of 2 cm sediment sections, along a transect per sampling plot (e.g. M1) at different sub-surface mid-depths (1, 5, 11, 21, 31, 41, etc (cm)) according to their relative position to sea-level (m).

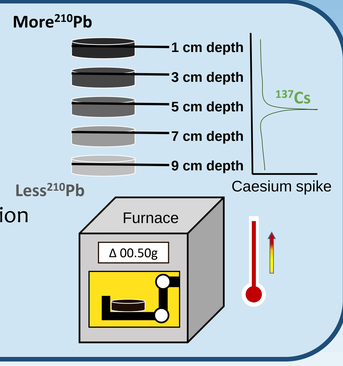
## Fieldwork

We have sampled six intertidal ecosystems for:

- Total sediment organic carbon stock of different depths
- Plant species coverage & biomass
- Surface elevation
- Sediment stratigraphy
- Carbon accumulation rates of representative cores per ecosystem

## Laboratory Work

- Dry bulk density (different depths sediment samples and representative core slices)
- C/N elemental analysis, for total organic carbon stock (all samples)
- $^{210}$Pb and $^{137}$Cs profile, for carbon accumulation rates (representative core slices)
- Thermogravimetric analysis, for different carbon pools (representative core slices)




## Choice experiment survey

We have created a survey to assess the perceptions UK citizens have towards coastal environments. It contains a choice experiment, where participants choose which hypothetical management option they would prefer, depending on predicted outcomes and a one-off donation. This can help estimate people's priorities and willingness to contribute towards ecosystem restoration.

**A EGU beta-test smaller version of the survey is here, with the choice experiment selection. Please scan the QR code and complete the survey to help with some improvements before it goes to the UK public, danke!**

[1] Macredie, P.I., Costa, M.D.P., Atwood, T.B. *et al.* Blue carbon as a natural climate solution. *Nat Rev Earth Environ* **2**, 826-839 (2021). [2] Smeaton, C., Ladd, C.J.T, Miller, L.C. *et al.* Organic Carbon Stocks of Great British Saltmarshes. *Frontiers* (2023) [3] Parker, R. Benson, L. Graves, *et al.* Blue Carbon stocks and accumulation analysis for Secretary of State (SoS) region:. *Centre for Environment Fisheries & Aquaculture Science* (2021)