Offshore Wind Infrastructure:
The scale of change for benthic communities

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1. Background & Aims

Offshore wind (OW) is experiencing scale-up as demand for renewables increases to meet 2050 net zero targets, current global OW capacity has increased to ~70GW from just 12GW in 2015. [1]

The UK contributes greatly to this with a current capacity of roughly 15GW, with hopes to reach 50GW by 2030. [1]

To achieve this size & quantity of offshore infrastructure increasing, OW arrays are becoming more spatially expansive & the number of projects is rising. Over 5,000 turbines are expected to populate UK waters by 2030, approx. double current quantities. [2]

The introduction of infrastructure causes physical disturbances & fundamental changes in habitat type from typically soft bottom sediment to artificial hard substrata. [3,4]

Such changes are likely to result in shifts amongst benthic communities from soft bottom infaunal to epifaunal communities (attached to new artificial substrate). [3,4]

Benthic communities play key roles in cycling nutrients, oxygenating sediments, creating habitat & providing food to fish. [5]

In isolation the impacts are local, but the cumulative impacts and in-combination effects are not yet known. Significant changes in the structure & functioning, functional connectivity at large, landscape scales are highly likely.

Aims hope to measure the scale of change in benthic habitat availability for monopile projects & determine what the possible change to benthic community type, biomass and function may be

2. Methods

- Used online data bases & EIA reports to calculate the spatial area of baseline sediment lost and hard substrata gained resulting from the installation of monopile turbine foundations & associated scour protection
- Analysed 0.06m² scrapes of fouling communities from monopile foundations for species abundance, diversity & biomass
- Compared species abundance, diversity & biomass of 0.1m² pre and post benthic grab data from monitoring reports for a selection of farms

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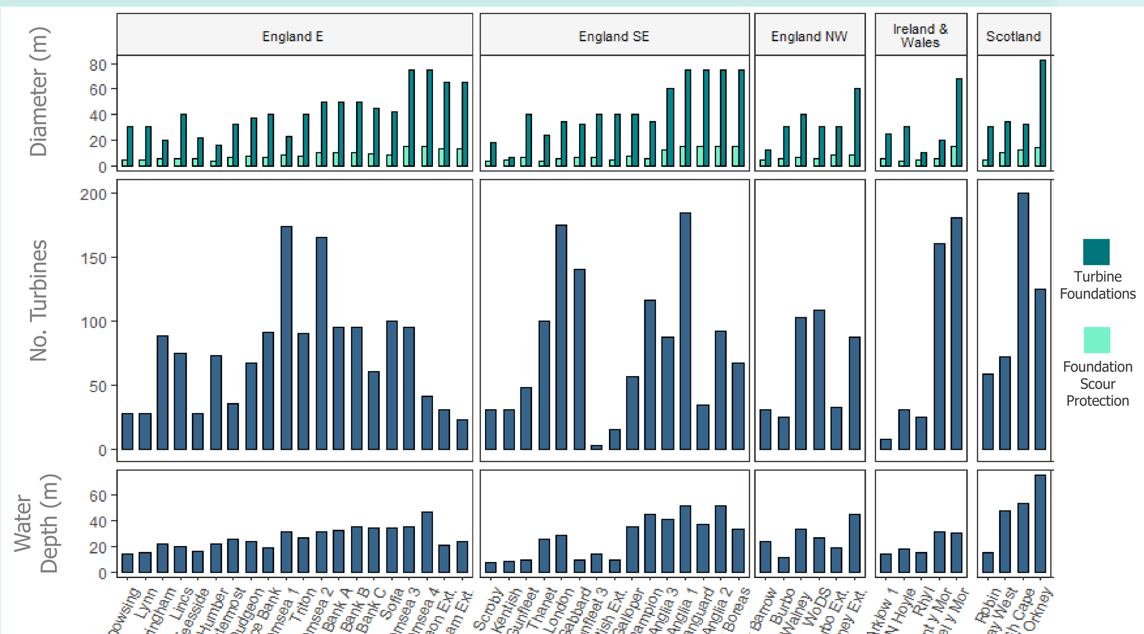
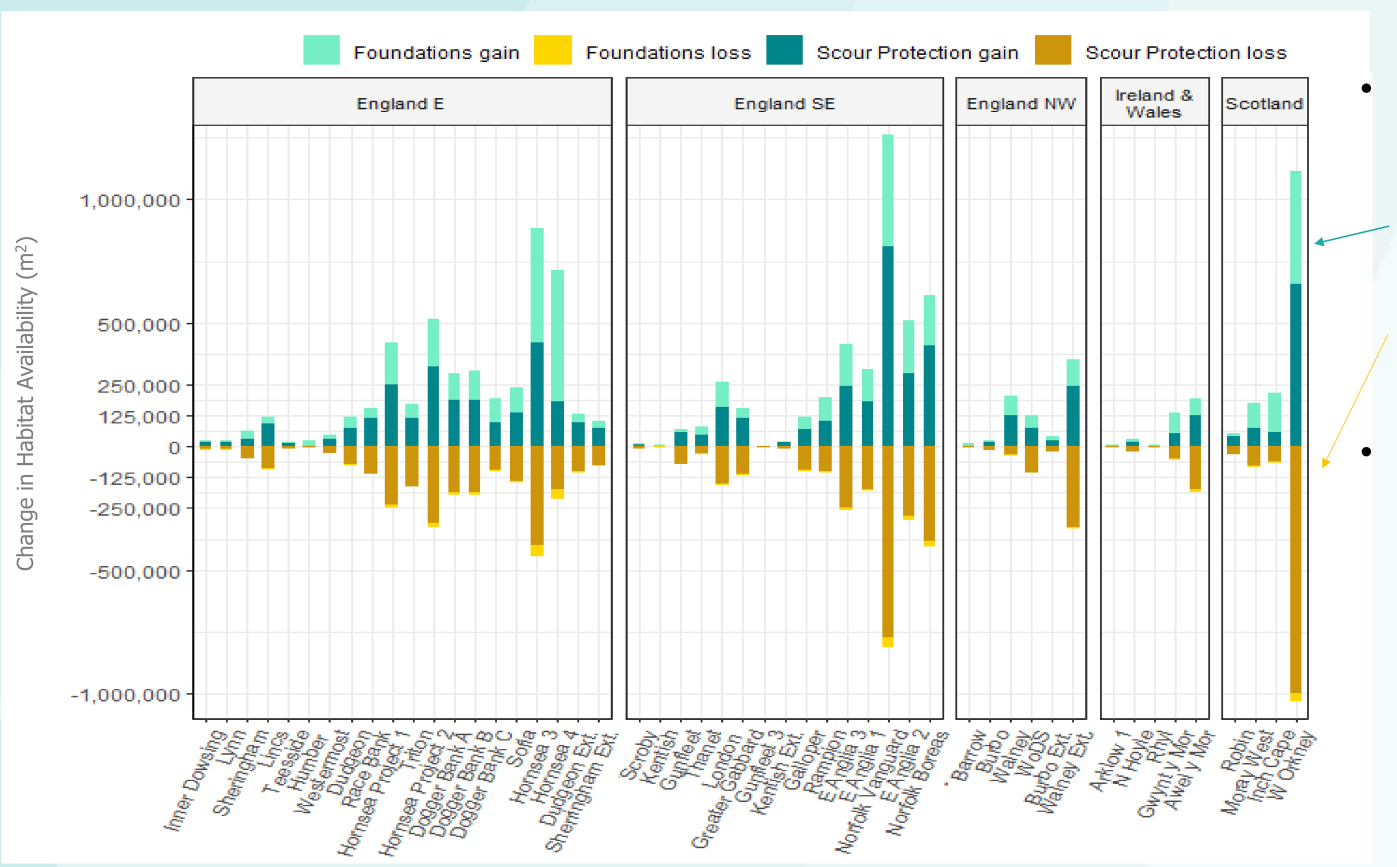
3. Spatial Scale of Change

Offshore Wind Farm	Total Seabed Lost (m²)		Total Hard Substrata Gained (m²)		Change in Habitat Surface Area (%)		
	Monopiles	Scour	Monopiles	Scour	Monopiles	Scour	Monopiles + Scour
Hornsea 2	13,035	311,025	191,697	323,813	1,471	104	159
Lynn	476	12,490	7,181	19,076	1,508	153	203
Rampion	2,755	101,645	95,659	101,616	3,473	100	189
Burbo Bank	491	16,176	5,299	17,663	1,080	109	138
…	…	…	…	…	…	…	…

- Estimations suggest **an overall (%) disproportionate gain** in available benthic habitat (gain of hard substrata in typically soft sediment environments)
- Magnitude of gains in surface area **between farms** varied & influenced by project characteristics



- **Trends** show an **increase** in **size** of infrastructure & greater **number** of turbines per project with time, whilst projects are located **further offshore** in deeper waters
- Cumulatively
  - Total seabed lost **7,160,088 m²**
  - Total hard substrata gained **11,316,759 m²**
  - Total surface area of habitat increase **158%**
- Values are likely to largely **underestimate** real life scenarios as other types of OW associated structures have not been included



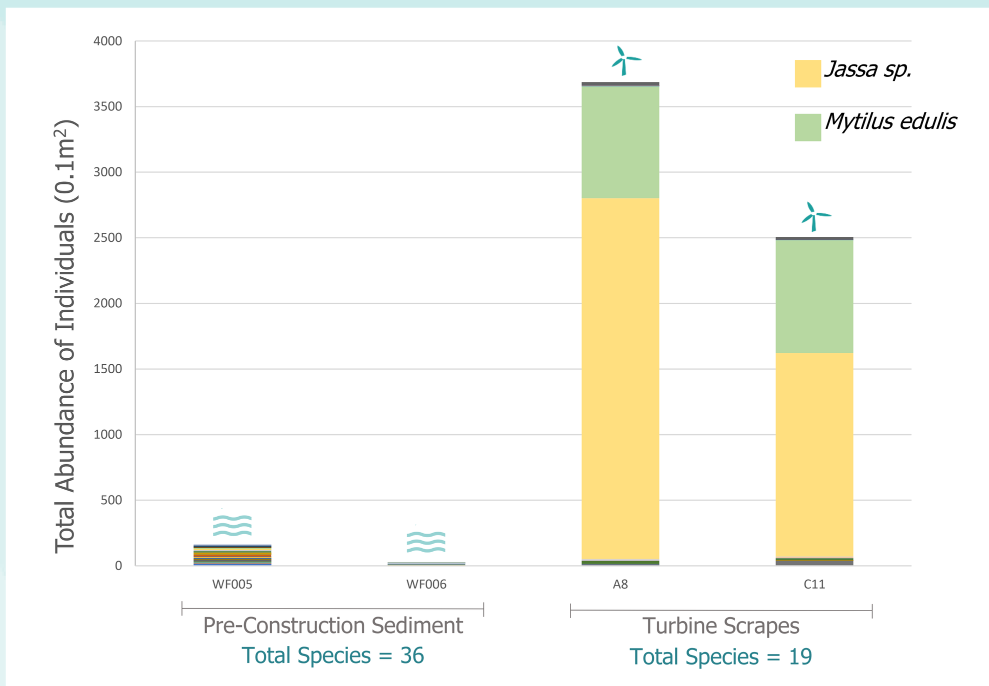
- Overall, there is a greater increase in **hard substrata** than loss of **soft sediment** for each OW project
- Trends show greater increase in **hard substrata** gained & **soft sediment** lost with more recent & future OW projects

4. Ecological Change: Rampion

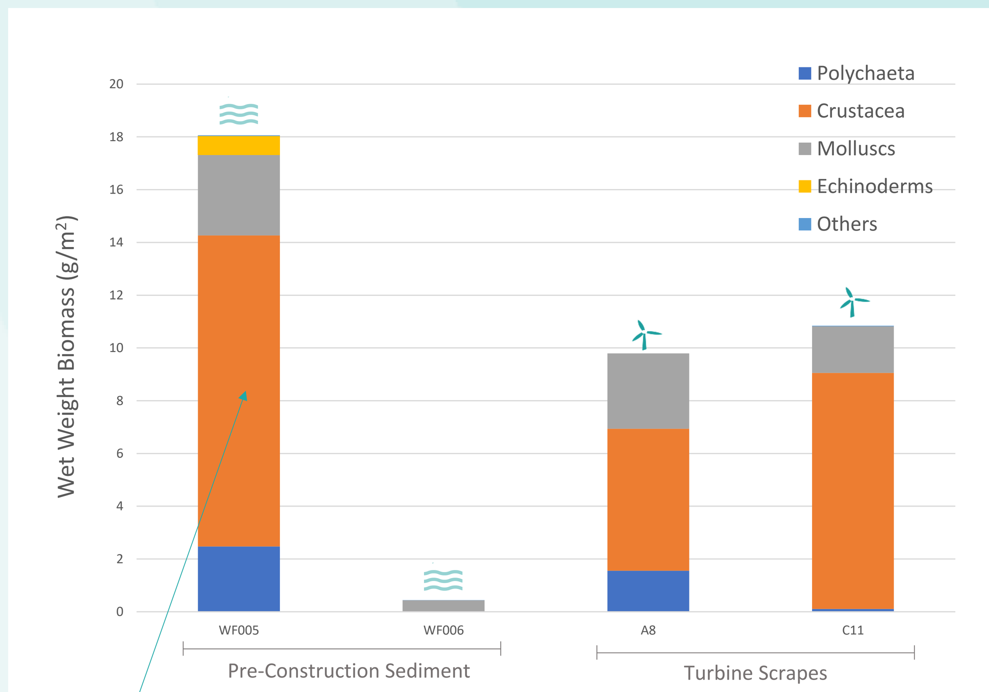
Abundance, Diversity, Evenness

Sample	N	d	H'	J'	Dominating sp.
Sediment WF005	160	6.8	3.2	0.9	*Abra prismatica* (mollusca) & polychaete sp.
Sediment WF006	27	3.0	2.0		
Turbine A8	3687	1.6	0.7	0.3	*Jassa herdmani* (crustacea) & mollusca sp.
Turbine C11	2506	1.7	0.9		

- Turbine scrapes had greater **abundance** of individuals, was considerably **dominated** by a couple of species, showed reduced species **diversity** & **richness**

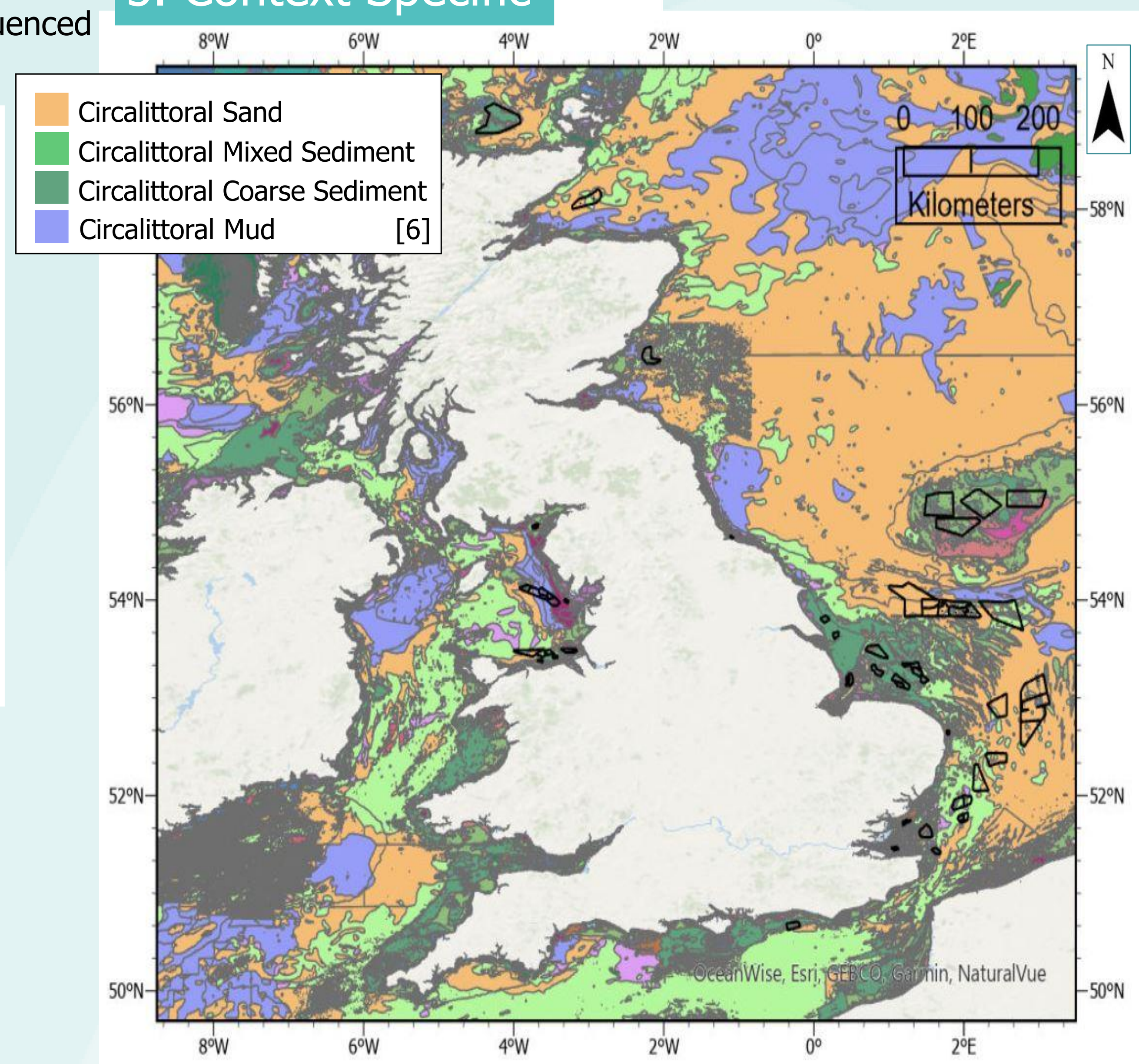


Biomass:
- Biomass appears **greater** for turbine communities



Large mud lobster **individuals**, *Upogebia deltaura*, likely to have caused large biomass for WF005

5. Context Specific



Level of impact is context specific
magnitude of change from baseline soft sediments to artificial hard substrata is greater compared to differences between baseline coarse sediments and artificial hard substrata

6. Conclusions & Future Work

Large **increase** in number & spatial extent of **offshore infrastructure**; benthic impact needs to be better understood.

Our initial study suggests an overall **disproportionate gain** in benthic habitat. Magnitude of increase for each OW project influenced by design & location. **Diversity** was less, but **abundance** & **biomass** appear higher on turbines compared to pre-construction sediment.

New communities may differ from baselines, causing local **ecological functional shifts**. Level of impact is **context specific**. The planned expansion of OW, may substantially change ecological functioning at **landscape scales**.

Ongoing work will consider **functional trait analysis** to further assess shifts in ecological functioning

References

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