Changes in *Laminaria hyperborea* holdfast-associated macroinvertebrate assemblages along gradients of historic mining pollution

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Introduction

- *Laminaria hyperborea* widely distributed around UK.

Smale et al. 2013

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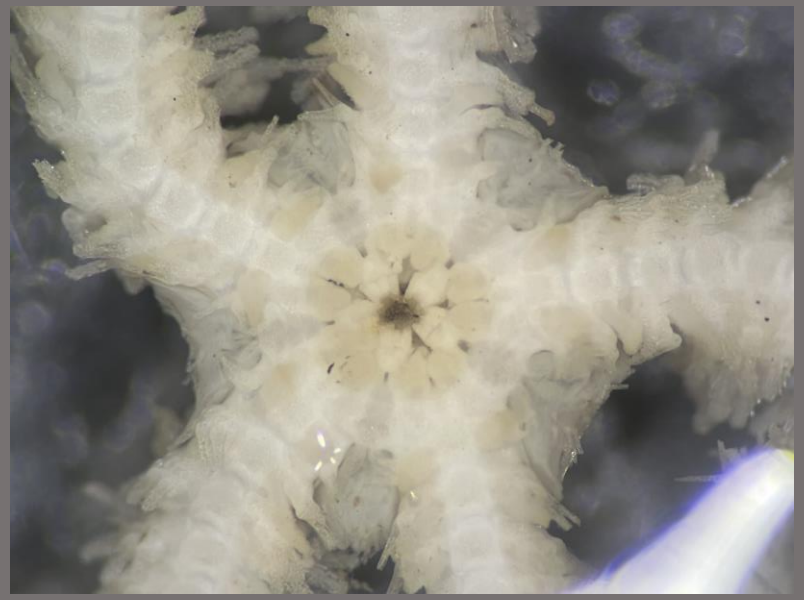
- Large holdfast creates 3-dimensional space.
- Stipe hosts epiphytic algae.
- Important for supporting increased levels of diversity and abundance.



British coal mining

- Primary source of electricity generation until 1970s
- Northumberland and Durham coalfields some of the most productive in the country
- Pollution – Iron, Copper, Lead, Arsenic, Aluminium etc.

- 40 million tonnes of coal slag dumped on coastline over 150 years.
- Severe negative effects on coastline – 48% reduction in fauna and flora. Max. 2 macroinvert species at each short height (Hyslop et al. 1997)
- Turning the tide project (1997 – 2003) – 1.3 million tonnes removed – SSSI, SPA etc.

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Understand the effect of historic coal mining on kelp forest structure and function, comparing sites affected by mining with those unaffected.

Methods

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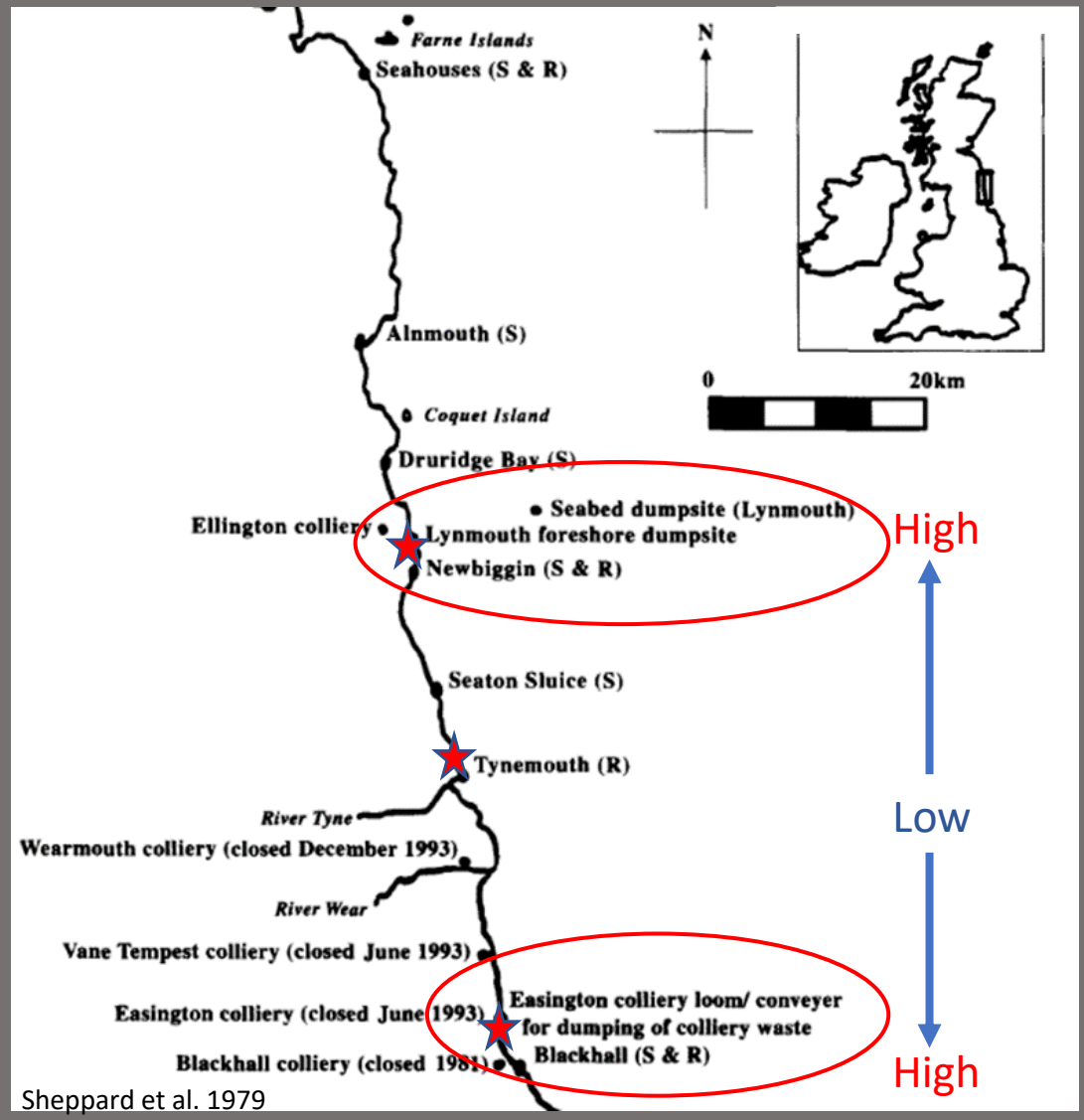

Sheppard et al. 1979

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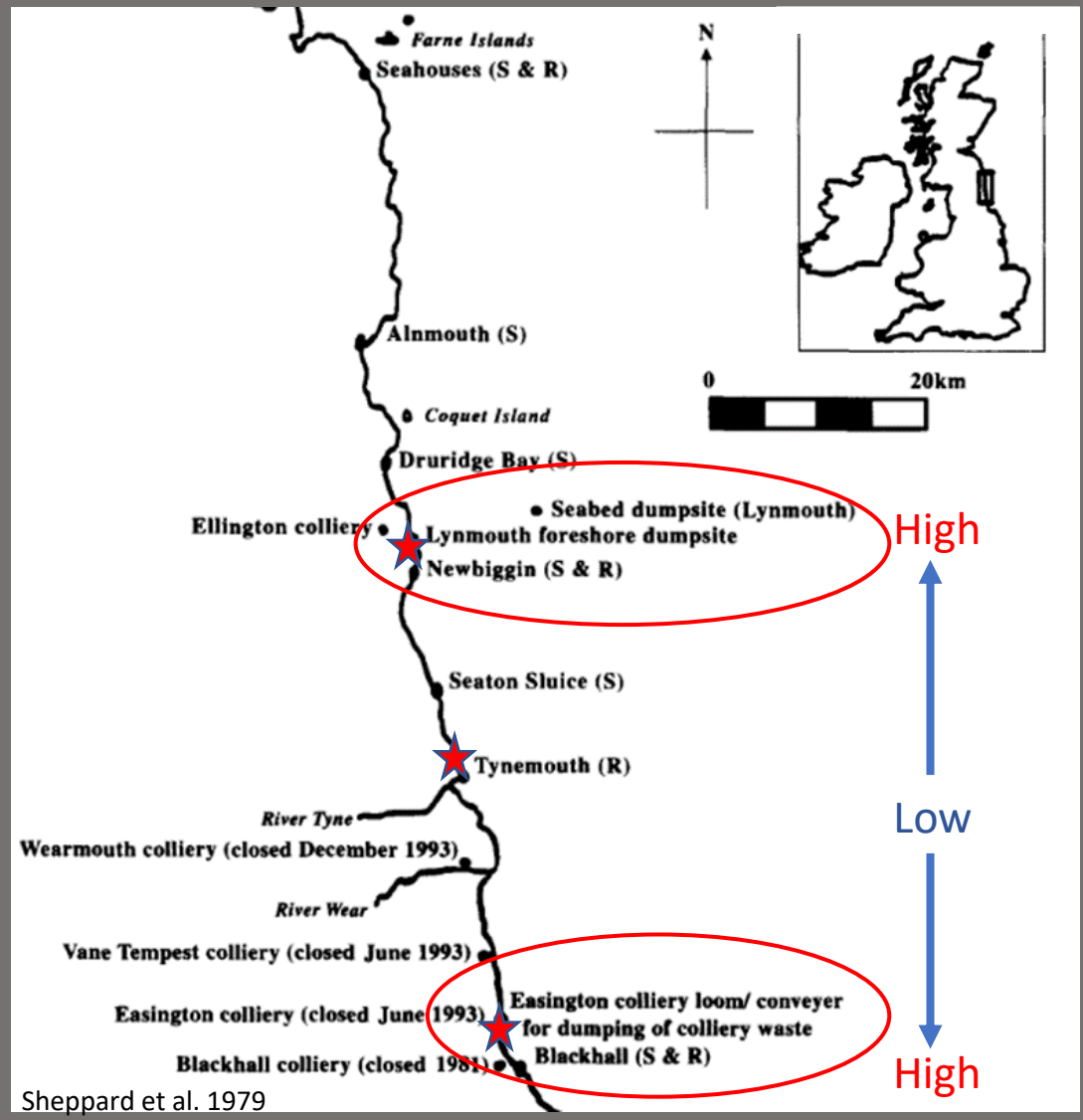
- Holdfasts and stipes – macroinvertebrates
- Growth, productivity, carbon standing stock, carbon donation
- Holdfasts, blades, controls – Microbiome swabs
- Holdfast, blades, water – Metal pollution



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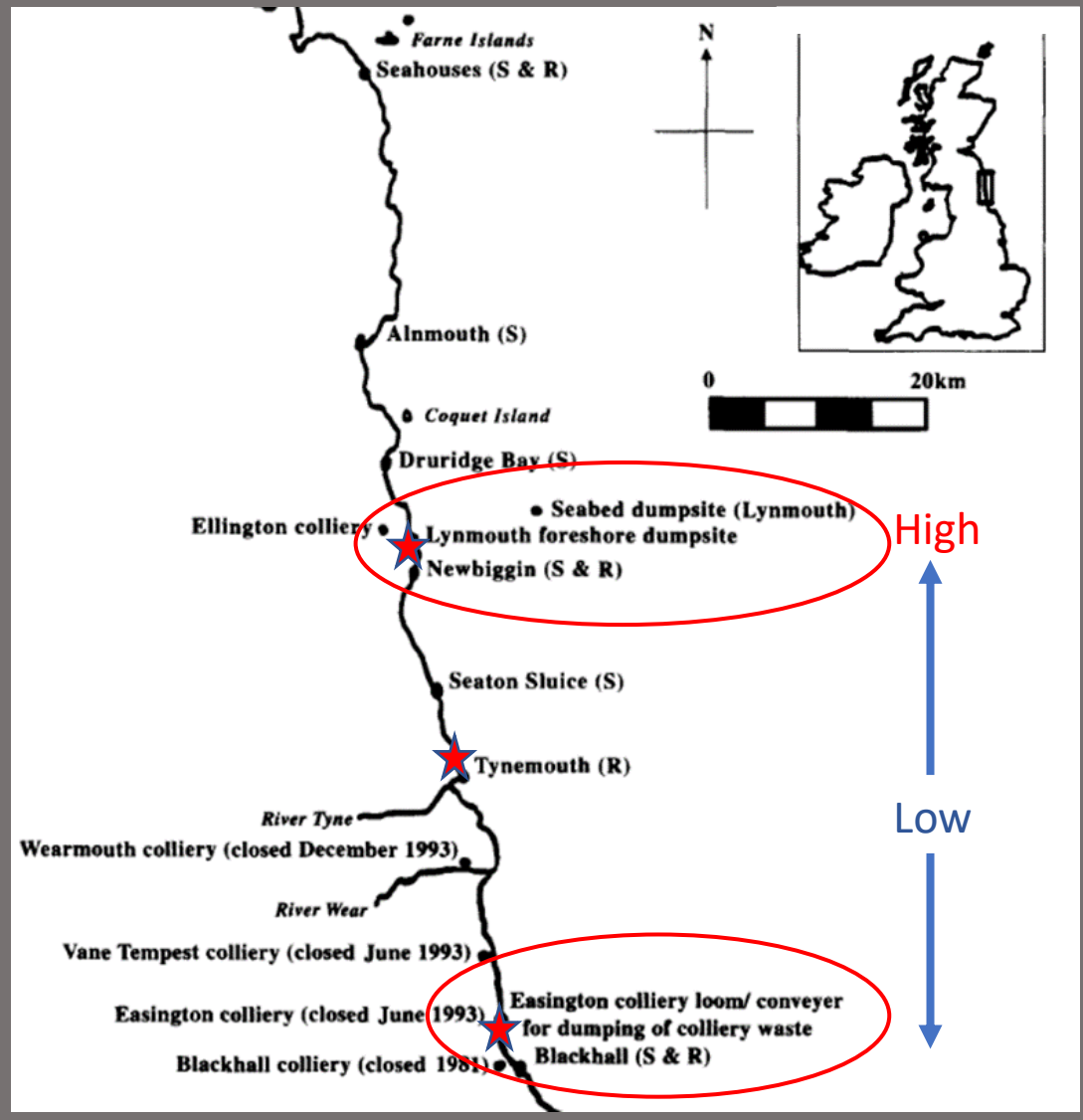


Methods

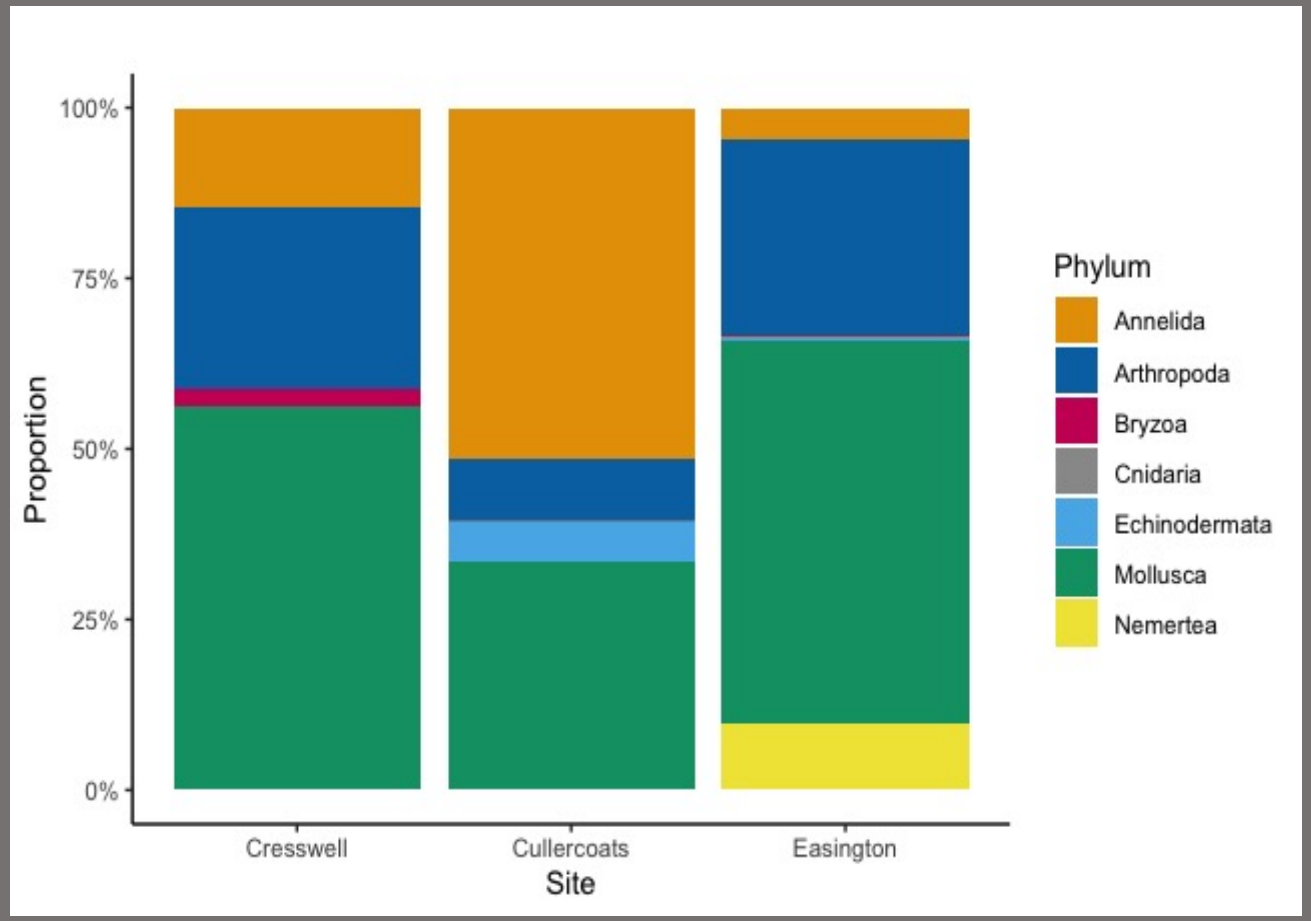
- 3 replicate *Laminaria hyperborea* holdfasts.
- Collected in late summer during spring low tides at 1m bcd.
- Remove and identify all macroinvertebrates larger than 1mm.

Statistical analysis

- Variability in assemblage structure – Multivariate ANOVA.
- Which taxa contribute to observed dissimilarity – SIMPER
- Visualise patterns in assemblage structure – MDS
- Variability in abundance and diversity measures – Univariate ANOVA

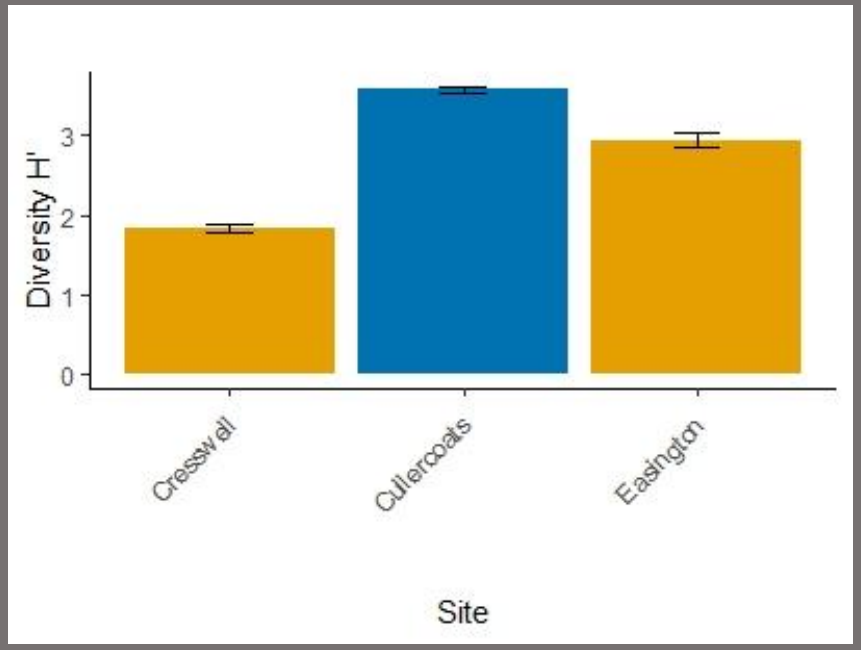
Results

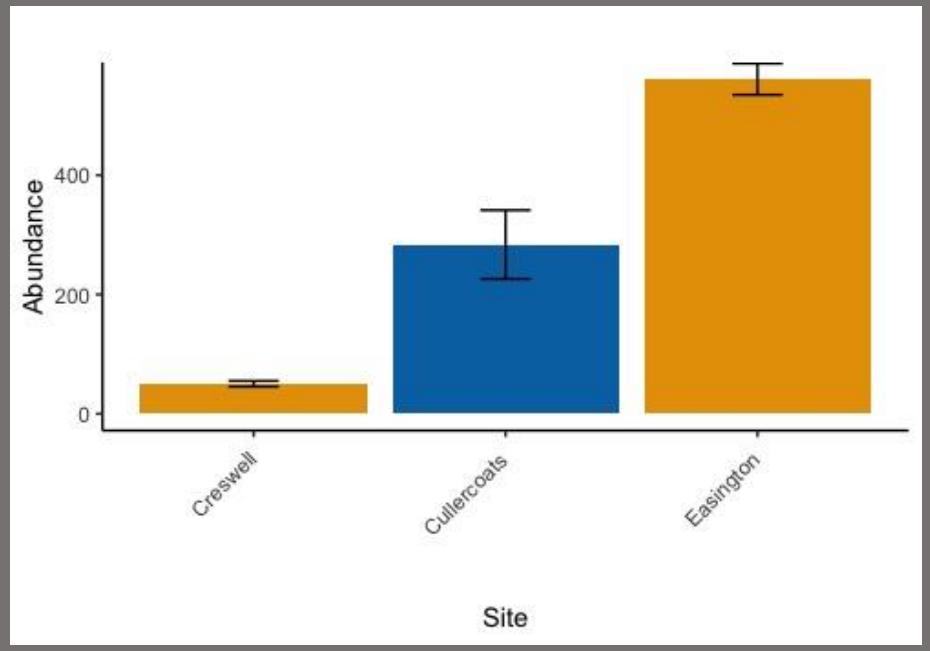
- 2,687 individuals from 89 taxa (mostly species level) were identified.
- Abundance - Annelida (540 ind.) followed by Mollusca (315 ind.)
- Diversity - Mollusca (35 taxa) followed by Annelida (28 taxa)

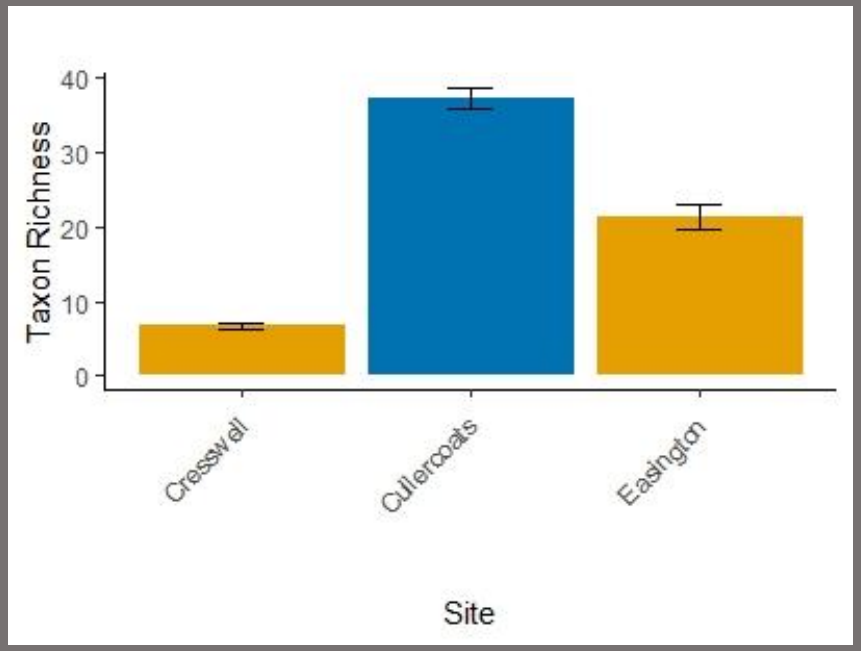


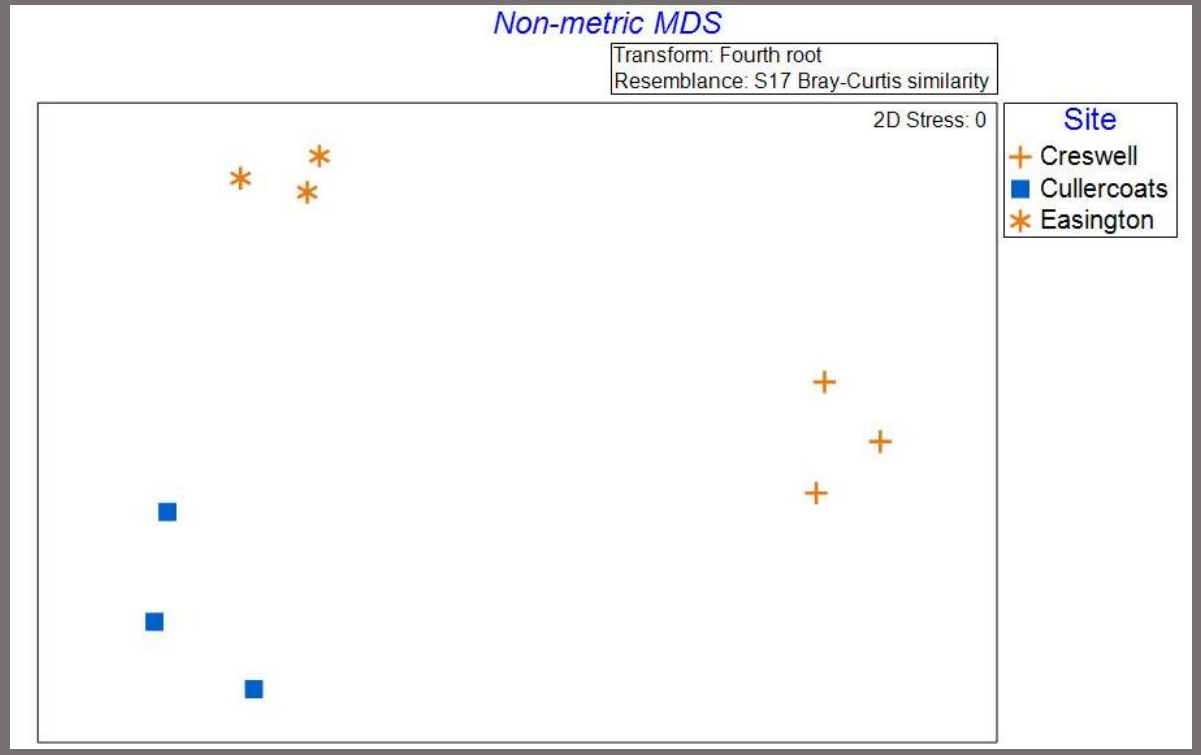
Results

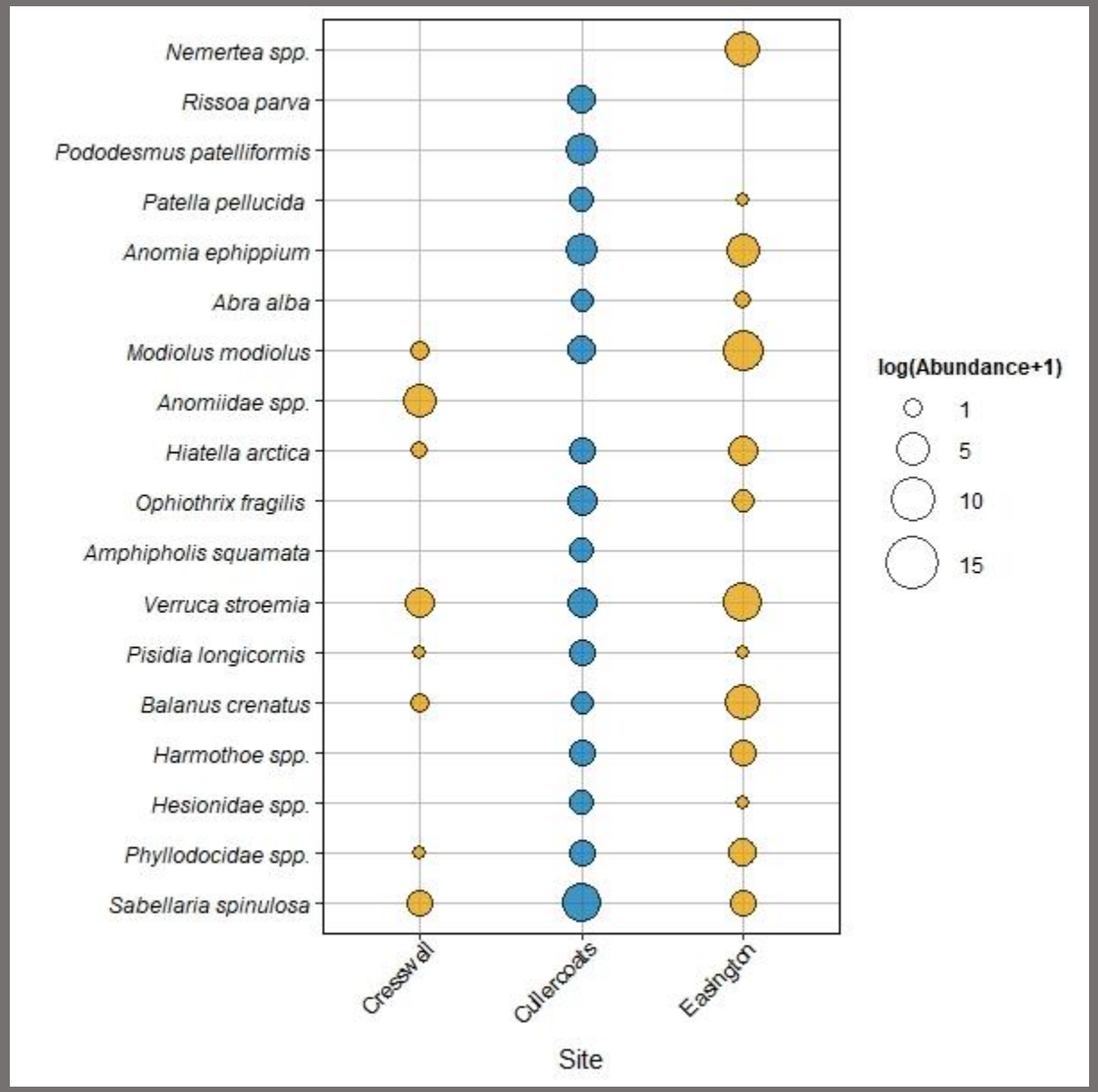
- Sig. differences between all sites in all measures ($p<0.001$)
- Highest richness, diversity & evenness in non-polluted site
- High abundance at Easington almost exclusively driven by juv. Mollusc *Modiolus modiolus* and Atrhropod *Verruca stroemia*








Non-metric MDS
Transform: Fourth root
Resemblance: S17 Bray-Curtis similarity
2D Stress: 0
Site
Creswell
Cullercoats
Easington


Nemertea spp.
Rissoa parva
Pododesmus patelliformis
Patella pellucida
Anomia ephippium
Abra alba
Modiolus modiolus
Anomiidae spp.
Hiatella arctica
Ophiothrix fragilis
Amphipholis squamata
Verruca stroemia
Pisidia longicornis
Balanus crenatus
Harmothoe spp.
Hesionidae spp.
Phyllodocidae spp.
Sabellaria spinulosa
Creswell
Cullercoats
Easington
Site
log(Abundance+1)
1
5
10
15

Conclusions

- Historic mining looks to have negatively impacted holdfast associated fauna in terms of assemblage structure and diversity measures
- Remediation work has improved macroinvertebrate assemblages but still not recovered to natural levels
- Evidence suggests holdfast associated fauna could be used as a bioindicator to assess levels of environmental pollution.
- Expand to more sites, more replicates and include stipe fauna.

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Understanding and using algae

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