

Worshipful Livery Company of Wales Report

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Coastlines are one of the most vulnerable ecosystems around the world, with a loss of approximately 28,000km² of coastal land from 1984-2015 (Kantamaneni et.al., 2022). Humans are concentrated along the coastal regions, with at least 60% of the population living within 100km of the coastline (Cohen et.al., 1997). Current estimates suggest that 10 million people currently experience frequent coastal flooding events, with this number projected to rise to 50 million by 2080 (Adger et.al., 2005). In the UK alone, more than 6 million properties have been affected by coastal erosion, including at least 220,000 properties in Wales (Kantamaneni et.al., 2022). £150 billion worth of assets are also classified as at risk of coastal flooding in the UK along with an estimated 4 million people (Brown et.al., 2018).

Grey coastal infrastructure, such as sea walls, can be implemented to reduce the risk of coastal erosion and flooding events, however these structures can cost up to £24,000 per linear metre (Brown et.al., 2018) and most cause irreparable damage to the functioning of the coastal ecosystem reducing biodiversity not only in the surrounding area, but also increasing the erosion experienced downdrift with higher sediment washout rates and habitat degradation (Nunn et.al., 2021). Green infrastructure, however, refers to the use of natural buffering habitats as a defence to coastal erosion. These can be naturally occurring or artificially implemented in an area to create a buffer region between the strandline, and the inland area in need of protection. The green defence I am investigating as part of my PhD is shingle bank habitats, which are characterised by the presence of rocky sediments 2-250mm in size which have been rounded by the sea. These banks are stabilised by various vegetation species, and the one I am currently focussing on is *Crambe maritima* which is a protected species in Wales.

The main question I am trying to address at this time is: Is there a relationship between root mycorrhizal fungi and the fungi in the surrounding sediment that support the colonisation of species such as *C.maritima* on Welsh shingle banks, and if so, is there a way that we can support colonisation to aid in shingle bank stabilisation and increase the buffering capacity of these ecosystems. To assess the fungal communities present, both root and sediment samples were taken from a range of sites across Wales where *C.maritima* colonies were found, along with sediment samples from sites where the plant used to be found but has not been recorded in a number of years.

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Sediment samples were taken in a pre-determined systematic pattern across the transect of shingle bank where *C.maritima* had colonised, the transect was split into four quadrants to accommodate replication of sampling on site. According to restrictions implemented by National Resources Wales, one plant per quadrant was sampled for root tissue from which 4 1cm pieces of root tissue were carefully extracted, and sediment was replaced carefully to cover the remaining root to ensure the impacts of sampling on the survivability of the plant was kept to a minimum.

The sediments sampled have been freeze dried, and fragments <0.05mm in diameter have undergone DNA extraction. These are being processed currently and will be sent for metabarcoding at Cardiff Gene Park. Root samples are awaiting processing, and DNA extracts from these will also be sent for metabarcoding. Metabarcoding is a process whereby numerous species can be identified that are either present within the sample or have left a DNA sample behind while interacting with the sediment (Detheridge and Griffith, 2021). This process is typically used on grassland samples, but preliminary attempts suggest that it will be effective on shingle sediment as well. Results will be processed through a novel system developed at Aberystwyth University using an R based pipeline. These results will then be written up in a subsequent report which I look forward to sharing with you in due course.

I would like to take this opportunity to thank the Worshipful Livery Company of Wales for a generous contribution which allowed me to travel to multiple sites in Wales and get accommodation there to facilitate the sampling effort. Sampling of this magnitude would not have been possible without such a contribution, and I am hopeful that the results of this study will have meaningful implications on how we treat shingle bank habitats in Wales and beyond. Please find below some pictures taken while sampling at Porth Swtan Bay, where *C.maritima* had colonised the shingle, sandy sediment, and the grassy bank at the back of the site.

Many thanks again for this opportunity,

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References:

Adger, W.N. *et al.* (2005) 'Social-ecological resilience to coastal disasters', *Science*, 309(5737), pp. 1036–1039. Available at:

https://doi.org/10.1126/SCIENCE.1112122/ASSET/4158D87A-7877-4B61-B967-9CCDBFC5C220/ASSETS/GRAPHIC/309_1036_F1.JPEG.

Brown, J. *et al.* (2018) 'WireWall: a new approach to coastal wave hazard monitoring'.

Brown, S., *et al.* (2007) *Landslides and Climate Change: Challenges and Solutions: Proceedings of the ...* - Google Books.

Cohen, J.E. *et al.* (1997) 'Estimates of Coastal Populations', *Science*, 278(5341), pp. 1209–1213. Available at: <https://doi.org/10.1126/SCIENCE.278.5341.1209C>.

Detheridge, A.P. and Griffith, G.W., 2021. Standards, methodology and protocols for sampling and identification of grassland fungus species: Using eDNA from soil samples.

Kantamaneni, K., Rice, L., Du, X., Allali, B. and Yenneti, K., 2022. Are current UK coastal defences good enough for tomorrow? An assessment of vulnerability to coastal erosion. *Coastal Management*, 50(2), pp.142-159.

Nunn, P.D., Klöck, C. and Duvat, V. (2021) 'Seawalls as maladaptations along island coasts', *Ocean & Coastal Management*, 205, p. 105554. Available at: <https://doi.org/10.1016/J.OCECOAMAN.2021.105554>.