PhD Project Advertisement

Project title: Seaweed from seawalls: developing an innovative, environmentally friendly approach to vertical seaweed farming in the intertidal zone

Project No: FBS2023-26-Ironside-aq

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Project description:

Many of the UK's seaweeds grow between the high-tide and low-tide marks of the seashore and are covered by the sea for only part of each day. For thousands of years, these intertidal seaweeds have been harvested from seashores around the UK as food for humans and their livestock. In recent years there has also been interest in seaweed cultivation, which does not require inputs of fertilizers and can store more carbon than terrestrial cropping systems. However, there are concerns about whether the UK's shores can produce enough seaweed to sustain this emerging market. Although the UK's seaweed aquaculture industry is growing rapidly, it has focussed mainly on subtidal habitats and species, leaving intertidal culture of seaweeds largely unexplored. This oversight is striking, given that the greatest demand for native UK seaweeds comes from intertidal species, both for food (e.g. dulse, laver) and for plant fertilisers (Ascophyllum or egg wrack). Many of the bioactive compounds of interest to the livestock industry are found in higher concentrations in intertidal species than in those that occur subtidally.

The UK's extensive coastline and large tidal range, provide a huge intertidal zone that could be used for growing seaweeds. However, natural shores are ecologically valuable and already under pressure due to the need to protect homes and infrastructure from storms and erosion and to allow the expansion of the marine renewable energy and maritime industries (Evans et al. 2019). Large areas of the UK's coastline are now protected by vertical seawalls, which reduce the area of the intertidal zone (coastal squeeze) and provide poor habitat for wildlife. Despite their low ecological value, these artificial shores could potentially provide a large area to produce food if a viable vertical farming crop system can be developed.

This project investigates innovative ways to grow seaweeds intertidally to help meet demands for food and animal feed in an environmentally friendly manner. Preliminary experiments indicate that seaweed can be grown by attaching concrete panels that project out from a vertical seawall and contain large holes, allowing water to flow through (Figure 1). The student will optimise this approach by investigating the effects of aspect, tidal height, temperature and humidity on seaweed growth and quality. This will involve measuring the cover, density, biomass, fecundity, sex-ratio, length and growth rate of seaweeds on each panel and analysing their nutritional content using proximate analysis (Ford et al. 2020). Timing of reproduction and attacks by herbivores will also be monitored and a random sample of individuals on each panel will be tagged in order to record the rate of dislodgement. The ecological impact of the panels will also be assessed by comparing the biodiversity of the panels with equivalent control areas of unmodified seawall. In parallel, the student will grow seaweed on living seawall panels under controlled environmental conditions in an outdoor laboratory, in which temperature, light exposure and water levels will be varied to explore their effects upon seaweed growth and biochemistry, which may enhance or hinder its use as a food ingredient.

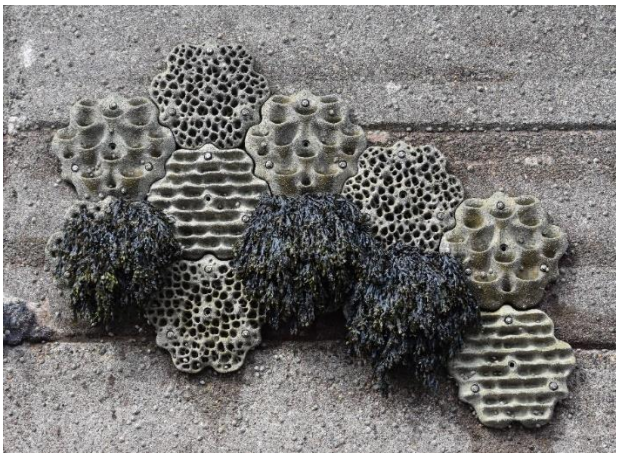

Figure 1: Living seawall panels at Milford Haven, Wales. After 15 months, panels of the 'swim-through' design show far greater seaweed growth than the bare wall or any of the other panel designs.

Training opportunities:

The student will be based at Aberystwyth University, where they will be trained to measure the density, biomass, growth rate and reproduction of seaweed crops and will also receive training in intertidal ecological methods, including the collection, analysis and interpretation of data using traditional survey methods (quadrat, SACFOR, etc.), data loggers and underwater video cameras.

The student will also spend several months at Queens University Belfast, where they will be trained to perform basic proximate analysis on the seaweeds grown. Working with the SeaFeed project team, they will learn how to prepare samples for analysis and how to run each set of analysis, providing them with an interdisciplinary skill set. The student will also learn cultivating techniques within the macroalgal hatchery and will have opportunities to conduct experiments in the outdoor mesocosm area, which has constantly running seawater from the Strangford Lough.

In addition to specialists training, the student will have access to standard PG training courses at Aberystwyth University and QUB, that include, scientific writing, poster presentations skills, oral presentation skills, statistics and more.

Student profile:

This is an interdisciplinary project, involving elements of aquaculture, ecology, biochemistry and engineering. The ideal student will have a strong biological sciences background and an interest in marine systems, but also a passion for finding practical solutions to problems in applied scientific research. The student should be willing and able to travel (a driver's license is essential) and to undertake research on rough terrain and in all weathers.

Stipend (Salary):

FoodBioSystems DTP students receive an annual tax free stipend (salary) that is paid in instalments throughout the year. For 2022/23 this will be £17,668 and this will increase slightly each year at rate set by UKRI.

Equality Diversity and Inclusion:

The FoodBioSystems DTP is committed to equality, diversity and inclusion (EDI), to building a doctoral researcher(DR) and staff body that reflects the diversity of society, and to encourage applications from under-represented and disadvantaged groups. Our actions to promote diversity and inclusion are detailed on the FoodBioSystems DTP website.

In accordance with UKRI guidelines, our studentships are offered on a part time basis in addition to full time registration. The minimum registration is 50% FT and the studentship end date will be extended to reflect the part-time registration.

References:

Bishop MJ, Vozzo ML, Mayer-Pinto M, Dafforn KA (2022) Complexity-biodiversity relationships on marine urban structures: reintroducing habitat heterogeneity through eco-engineering. Philos T R Soc B 377 doi: ARTN 20210393

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Evans AJ, Firth LB, Hawkins SJ, Hall AE, Ironside JE, Thompson RC, Moore PJ (2019) From ocean sprawl to blue-green infrastructure - A UK perspective on an issue of global significance. Environ Sci Policy 91:60-69

Ford L et al. (2020) Effect of Phlorotannins from Brown Seaweeds on the In Vitro Digestibility of Pig Feed. Animals 10:2193 doi:10.3390/ani10112193

For up to date information on funding eligibility, studentship rates and part time registration, please visit the FoodBioSystems website.