2022_59_DoLS_Jimenez: Analysis of the microbiota of kelp

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Decreasing the dependence on animal protein is one of the actions that could be taken in the short-term to mitigate human derived CO2 emissions. Seaweed farming has been proposed as an alternative to conventional agriculture to feed an ever-increasing human population while contributing to CO2 fixation, decreasing the pressure for farming soil and improving the health of marine ecosystems.

Kelp constitutes the main seaweed crop worldwide. It is part of the human diet in Asian countries and it is widely accepted as a protein source in vegetarian diets. Kelp is part of a complex environmental community, which includes a large number of marine microorganisms that play a role in the development of the seaweed. Dysbiosis has an impact on kelp quality, and a number of pests have been identified. These pests inhibit growth, generate fouling and loss of pigmentation, resulting in productivity losses.

Kelp farming is on the rise in the UK. The relatively cold waters limit the presence of pathogens but also limit the yields of the crops, as they need to be harvested before the summer months, when the seaweed can benefit from more hours of light. The kelp industry faces the challenge of global warming, as crops could be compromised by the increased presence of pathogenic and invasive species (e.g. algal blooms).

This PhD project is a collaboration with Green Ocean Farming, a SME developing seaweed farms in the UK. The project will focus on understanding the microbiota associated with kelp to develop resilient crops and methods of production. The specific questions addressed are:

1) How do the kelp microbiota change over time? The microbiota of seaweed is likely to be dynamic and potentially exhibit seasonal behaviour. We will determine the relevant species, their role, and the timing of their emergence by analysing samples supplied at different times during the farming cycle from different locations. Microbiota will be characterised following a conventional 16S rDNA and ITS sequencing pipeline for, respectively, bacteria and fungi. The student will be trained in library preparation and bioinformatics analyses which are in place in the host laboratories.

2) What is the effect of farming in warmer waters? We will answer this question by analysing samples of kelp cultured during the summer and investigating the presence of colonising species using the procedures described above.

3) Can dysbiosis be prevented? We will leverage the knowledge gained from the previous two objectives to develop a lab-scale kelp farm and investigate the potential of beneficial microorganisms for preventing the colonisation of pathogens in different lab-controlled conditions. We will develop mathematical models capturing the main interactions in these communities accounting for changes in the temperature of the environment.

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