

How does harvesting of problem macroalgae within Milford Haven affect the ecology of receiving habitats?

Aberystwyth University, IBERS

Project ID: AU30019

Annual Stipend: £14,340

Application Deadline: 24th May 2018

This PhD is funded by the European Social Fund and GreenSeas Resources (<http://www.greenseas.co.uk>). The PhD will, therefore, be applied in focus with strong links to industry.

Background: Milford Haven is failing to meet Water Framework Directive benchmarks for Good Environmental Status due to increased nitrification of the water. One impact of this is an increase in opportunistic macroalgae growing in the waterway, estimated at over 3700t per year. The macroalgae primarily consist of different species of *Ulva*, growing across mudflats and within the water column. Here they have a detrimental impact on water oxygen levels, zoobenthic communities and native eelgrass populations. The macroalgae can detach and form rafts, negatively affecting important recreational amenities such as sailing and fishing. As it decays, in addition to the visual impact, it also releases the toxic gas hydrogen sulphide.

GreenSeas propose the collection of seaweed rafts and harvesting of opportunistic seaweed to produce high value products including fertilizers. Their aim is to create a value chain in the circular economy to support remediation activities in Milford Haven. In order for GreenSeas to demonstrate the utility of this approach, an understanding of the effects of the macroalgae within the estuary is required. The main focus of the PhD would be ecological studies on the impacts of both current excess macroalgae and future reduced algae following harvesting on estuarine community structure and food web dynamics. At the same time this studentship will identify harvesting techniques that are the most ecological beneficial. The research project will also contain a socioeconomic assessment on the ecosystem services affected by this increase in macroalgae. Together, this knowledge will allow GreenSeas to optimise the positive effects and avoid any negative effects when conducting their operations within Milford Haven. Though the PhD is locally focussed, increased nitrification in waterways worldwide mean it will generate globally relevant findings.

The PhD will: A) Assess the standing stock of opportunistic macroalgae to determine its spatial extent and biomass yield; B) Determine the ecological effects (e.g. changes in community structure, sediment dynamics, water clarity, nutrient dynamics) of a variety of harvesting approaches; C) Examine the effects of different algal harvesting techniques on the behaviour and diet of higher trophic levels e.g. waterfowl, crustaceans; and D) Create a socioeconomic assessment of the impacts

of opportunistic macroalgal presence to determine the recovery value of ecosystem services and recreational amenities.

The candidate will be supervised by Dr Jessica Adams (<https://www.aber.ac.uk/en/ibers/staff-profiles/listing/profile/jaa>) and Dr Pippa Moore (<https://www.aber.ac.uk/en/ibers/staff-profiles/listing/profile/pim2>) at Aberystwyth University and Dr Andrew Woolmer at GreenSeas Resources. The candidate will benefit from the outstanding research environment at IBERS, Aberystwyth University, including research vessels, a modern marine aquarium and access to the Innovation Campus currently under construction. The student will also gain invaluable industry experience, access to field sites and

equipment through working with GreenSeas Resources. The research will involve considerable amounts of fieldwork both intertidally and from boats and the successful student will gain valuable field and experimental skills as well as extensive training in experimental design and analysis. This project therefore represents a tremendous opportunity to conduct applied research with an industry focus with the potential of leading to ecosystem remediation by providing a value chain for nuisance algae, thereby contributing to the circular economy. This PhD is complemented by a second PhD with GreenSeas Resources focussing on the utilisation of the harvested macroalgae for the generation of high value compounds and products.

This award is available to enthusiastic and highly motivated students. Candidates should have (or expect to have) a first-class or 2.1 honours degree in the biological sciences (e.g. ecology, marine biology, biology and related disciplines). An MSc/MRes or relevant experience is also highly desirable. Candidates should have knowledge of UK marine species and habitats and be physically able to undertake the substantial amounts of field work required to complete this project.

For further information and to apply please visit position AU30019 on <https://www.aber.ac.uk/en/rbi/business/services/initiatives/kess/currentscholarshipvacanciesandapplications/forms/>

Biorefining problem macroalgae to produce selected high value products

Aberystwyth University, IBERS

Project ID: AU30020

Annual Stipend: £14,340

Application Deadline: 24th May 2018

This PhD is funded by the European Social Fund and GreenSeas Resources (<http://www.greenseas.co.uk>). The PhD will, therefore, be applied in focus with strong links to industry.

Background: Milford Haven is failing to meet Water Framework Directive benchmarks for Good Environmental Status due to increased nitrification of the water. One impact of this is an increase in opportunistic macroalgae growing in the waterway, estimated at over 3700t per year and primarily consisting of the following species: Ulva, Cladophora and Chaetophora. The macroalgae can detach and form rafts, negatively affecting important recreational amenities such as sailing and fishing. GreenSeas Resources consider this excess macroalgal biomass a valuable resource which could be processed to generate a variety of high value products, creating a value chain in the circular economy. An understanding of the main macroalgal species, composition and applicability to different end products is essential before the instigation of any large scale commercial macroalgae processing.

This PhD is in the area of biotechnology and will: A) Assess how the different species vary in presence and composition throughout the growing season (e.g. carbohydrates, lipids, protein, specific elements and selected additional compounds). B) Trial a range of processing mechanisms e.g. drying, chopping and pressing and assess the impact of these on downstream processes. C) Investigate: (i) High value products either directly extracted from the biomass such as potential dyes and phenolic compounds/bioactive

secondary metabolites, or produced through fermentation or anaerobic digestion such as organic acids and hydrogen. (ii) Biorefining opportunities, with multiple products generated from the macroalgae by fractionation or sequential processing. (iii) Bulk material such as the use of macroalgae fraction with a high solid content as a fertiliser and soil enhancer through pot trials. D) Conduct energy monitoring on up- and down-stream processes and use it to generate carbon credit-inspired nitrogen credits, producing a valuation model for future macroalgae removal.

The candidate will be supervised by Dr Jessica Adams (<https://www.aber.ac.uk/en/ibers/staff-profiles/listing/profile/jaa>) and Dr Ana Winters (<https://www.aber.ac.uk/en/ibers/staff-profiles/listing/profile/alg>) at Aberystwyth University and Dr Andrew Woolmer at GreenSeas Resources. The candidate will benefit from the outstanding research environment at IBERS, Aberystwyth University, including fermentation and extraction laboratories, the BEACON demonstration-scale bioprocessing facility, research vessels, a modern marine aquarium and access to the Innovation Campus (currently under construction). The student will also gain invaluable industry experience, access to field sites and equipment through working with GreenSeas Resources. The research will involve fieldwork both intertidally and from boats and the successful student will gain valuable field skills in addition to laboratory training. This project represents a tremendous opportunity to conduct applied research with an industry focus with the potential of leading to ecosystem remediation by identifying viable value chains for the macroalgae, thereby contributing to the circular economy. This PhD is complemented by a second PhD with GreenSeas Resources focussing on the environmental effects caused by large-scale harvesting and raft collection of the macroalgae.

This award is available to enthusiastic and highly motivated students. Candidates should have (or expect to have) a first-class or 2.1 honours degree in the chemical or biological sciences (e.g. chemistry, microbiology, marine biology, biology and related disciplines). An MSc/MRes or relevant experience is also highly desirable. Candidates should have knowledge of UK marine species and be physically able to undertake the field work required to complete this project.

For further information and to apply please visit position AU30020 on <https://www.aber.ac.uk/en/rbi/business/services/initiatives/kess/currentscholarshipvacanciesandapplications/forms/>