Seaweed Summit 2023 – Student posters

Decellularised seaweed as a novel biomaterial for treatment of skin wounds

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Non-healing or large-scale wounds and their associated complications continue to present a large clinical burden. Scaffolds and skin substitutes have been engineered, but not all provide the physical, mechanical, and biochemical features necessary for skin repair. Decellularisation methods enable isolation of native extracellular matrix (ECM) from animal tissue, providing biocompatible scaffolds, but at high costs. Decellularised plants provide cellulose matrices with similarities to ECM, representing an abundant, ethical, low-cost alternative. This study aims to evaluate decellularize seaweed as scaffolds for skin repair.

Three macroalgae species, *Ulva lactuca*, *Ecklonia radiata*, and *Durvillaea poha*, were selected for their structural variation. Chemical decellularisation methods were optimised for each species. Scaffold architecture was analysed using histology and scanning electron microscopy, with decellularisation confirmed by DNA extraction. Cell compatibility was assessed through culture of scaffolds with fibroblasts and keratinocytes for 7 days. The structural differences between seaweeds were maintained during decellularisation - *U. lactuca* formed a cellulose film, *D. poha* resulted in a hydrogel comprised of interwoven cellulose fibres and *E. radiata* scaffolds could be characterised by a fibrous layer of cellulose flanked by polygonal layers of cellulose (8-10 layers deep). DNA content of *D. poha* was reduced by 97.75%, *U. lactuca* by 65.6% and E. radiata by 89.8%.

These findings indicate that *D. poha* scaffolds may be suitable for deep wounds, while *U. lactuca* and *E. radiata* may be appropriate as skin substitutes. In future, development of a green alternative to chemical decellularisation procedures will be investigated to ensure the process is environmentally sustainable.

Investigating the ecophysiological services provided by* Ecklonia radiata*, in the face of coastal darkening and nutrient pollution

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Ecophysiology: how the functioning of an organism is modified by its immediate environment — but additionally, how this modified functioning shapes the local ecosystem and environment in turn. Interest in the ecophysiology of kelp forests is growing, with global recognition of their high primary productivity and function as foundation species. This swell of interest has been accompanied by an eagerness to restore, conserve and ultimately capitalise on the ecosystem services they provide. However, there are large knowledge deficits regarding how these vital habitats contribute to three regulatory services: 1) pH modulation, 2) carbon sequestration and 3) nutrient cycling. Furthermore, even less is known about how the anthropogenic stressors of coastal darkening and eutrophication may impact the efficacy of service provision.

Using an ecophysiological framework, we investigate how *Ecklonia radiata*, the dominant canopy-forming species in North-eastern Aotearoa, contributes to this trifecta of ecosystem services under 'good' versus degraded conditions. We employ a combination of laboratory and *in-situ* experiments to assess impacts of persistent light limitation and elevated nutrients on the carbon fixation, nitrogen uptake and pH modulation capacity of *E. radiata.* We also investigate whether there is significant evidence of a diurnal pH "halo zone" around *E. radiata* forests, an outcome of photosynthesis that may confer a form of refuge from ocean acidification.

As human land-use and climate change continues to intensify, the results of this study have critical implications for the functioning of *E. radiata* under multiple stressors, and therefore, the wider temperate reef ecosystem. Additionally, this study will provide valuable insights into *E. radiata*'s potential as a bioremediator of excess nutrients and as a Blue Carbon sink within a rapidly changing coastal environment.

Creating opportunities for Bull Kelp aquaculture

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The Blue Economy Co-operative Research Centre is driving innovation in offshore developments to enhance renewable energy output, seafood production, and job creation, thereby transforming traditional blue economy sectors. This study focuses on the potential of large brown algae, specifically *Durvillaea poha* and *D. antarctica*, for offshore seaweed cultivation due to their wave energy tolerance and rich content of alginates and fucoidan. These polysaccharides, crucial in various brown algae, are especially abundant in this genus.

However, a significant knowledge gap exists in the necessary biological information required for successful cultivation of *Durvillaea* species in New Zealand, especially concerning reproduction, early life-cycle development, growth, hatchery methods, and grow-out requirements. Addressing this gap is crucial for developing a successful bull kelp aquaculture industry.

Part of my PhD project is focused on monthly observations of *D. antarctica* and *D. poha* during their reproductive season to assess variations in fecundity and early zygote development and maturation. My study includes experiments to test the effects of harvesting and holding reproductive *Durvillaea* for different durations or in different conditions on gamete viability, gamete release, and rates of fertilization. I am also investigating crossbreeding between the two species to determine whether hybrids are possible and have aquaculture potential.