The Impacts of Opportunistic Macroalgae on Seagrass

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The research questions:

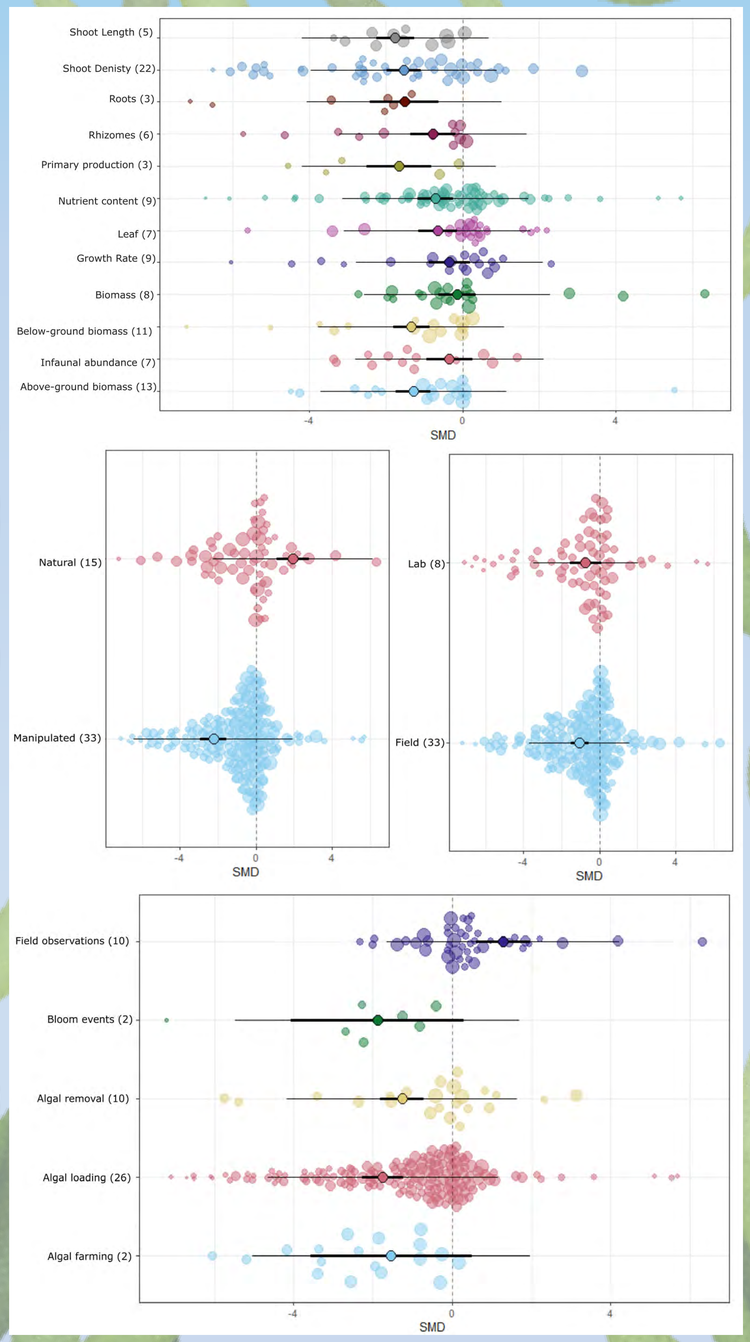
1. What is the **spatial extent** and biomass of **nuisance algae** within Budle Bay and does this change through space and time;
2. What are **the impacts of opportunistic macroalgae** on seagrass above and below-ground productivity and morphology (e.g. growth rates, shoot number);
3. What methods can be used to **remove nuisance macroalgae without harming the seagrass** and;
4. What methods are suitable for **restoring seagrass** in Budle Bay

The Problem

Lindisfarne National Nature Reserve in Northumberland is of **significant conservation importance** (SAC, SPA, underpinned by a SSSI, adjacent an MCZ), but is increasingly subjected to **blooms of opportunistic algae** driven by, for example, diffuse **agricultural pollution**. The resulting eutrophication is having a negative impact on the, **intertidal Zostera seagrass** meadows. Budle Bay is an **important habitat** for many species, including a large population of **overwintering birds**. These large algal mats have been seen to **encroach onto the saltmarsh.**

The Meta-Analysis

A meta-analysis has been undertaken to look at the known **effects of macroalgae blooms on seagrass**. 259 effect sizes from 45 papers were calculated. Seagrass species, study method, type of algae and functional categories were examined. The studies that were selected provided useful methodology for seagrass sampling at the next stage of my PhD.



How to read an Orchard plot.

Points show the **Standard Mean Difference ,** error bars are 95% Confidence interval and thin black lines are the 95% prediction intervals. If **the error bar crosses the dotted line at 0 this means the result is not significant**. If a point and its error bars are **below 0 it shows the test performed worse** than the control.

Results

All studies were **grouped by measured variable**,
Shoot length, shoot density, effect to roots, effects to rhizomes, effect to leaves, primary production, nutrient content, above ground and below ground biomass **all showed negative values**, which shows under algal cover they **perform worse than the control.** Meaning seagrass grew slower, had fewer shoots, had a reduced overall biomass, and a change in its chemical composition. This **results in the degradation of seagrass.**

When looking at the genus of seagrass investigated, I found there is a concentration of **research effort on Zostera.** The findings for Cymodocea were insignificant, which agrees with previous studies. All genus's that produced **significant results, were negative** (Zostera, Thalassia, Halophila, Halodule and Enhalus), indicating that the effects caused by seagrass impacted all genus's in this study, but did show there was **not a uniform effect across all genus's.**

I also looked at the difference in effect of manipulated vs natural and lab vs field. In the manipulated experiments I found a **significant more negative result**, indicating that perhaps manipulated experiments **don't represent natural seaweed densities**, as natural studies produced a positive result. **Lab studies were insignificant**, but only marginally, this may have been due to the small sample size, however spread of data did mirror field trials.

When looking at experimental method, it was shown that studies under **algal loading , showed poorer seagrass health**. Even studies under algal removal scenarios, still showed poor seagrass heath, this shows that even when algal blooms have been removed **seagrass may not recover to prior healthy condition**. Field observations showed a **positive result** indicating in these studies there is recovery. This result indicated that manipulated field trials **may not be representative of what is naturally occurring** in seagrass meadows.

Conclusion

Opportunistic macroalgae **can negatively impact** most aspects of **seagrass morphology** and physiology, show by the decrease in effect size when split into functional categories. This effect occurs across numerous seagrass species. However more research effort is needed to identify what causes the disparity between manipulated and natural density studies.

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