Factors affecting trophic control of community structure and ecosystem functioning in experimental seagrass (*Zostera marina* L.) mesocosms

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1. Background
- The growth of opportunistic microalgae via nutrient fertilization (eutrophication) can lead to eelgrass decline through light limitation and competition for limiting nutrients.
- Invertebrate mesograzers, such as amphipods, isopods, gastropods, and shrimps, can mediate the overgrowth of algae, indirectly benefitting seagrasses.
- With increasing nutrient pollution driving eutrophication, and cascading effects of overfishing, it is important to understand the relationship between the top-down control by grazers and the bottom-up control by nutrients in determining seagrass structure and function.

2. Specific Aims
1. What are the effects of changing light, nutrients, and grazers on functioning of eelgrass communities (*Zostera marina* L.)?
2. Is this system under stronger top-down (grazer) or bottom-up (nutrient) control?

3. Methods
- We manipulated:
  - **Grazers (presence/absence);** Grazer presence treatments were inoculated with 10 individuals each of the isopod *Idotea balthica* and the amphipod *Gammarus mucronatus*.
  - **Light (shaded/unshaded);** Shaded treatments were covered with windowscreen leading to 42% reduction in light.
  - **Nutrients (fertilized/ambient);** Osmocote (N:P:K 3:1:2) was placed in suspended, perforated PVC tubes in fertilized treatments.
- Experiments were conducted in a set of 64 flow-through seawater mesocosms in the York River Estuary, Chesapeake Bay, USA in summer 2008.
- After 4 weeks, plant material was harvested, separated, identified to species, and combusted to obtain ash-free dry mass (AFDM).
- All grazers were sieved by size, sorted to species, and counted. Each sieve size class was converted to biomass (in mg AFDM).
- We analyzed eelgrass above- and belowground biomass, macroalgal biomass, epiphyte biomass, and grazer biomass using three-way blocked ANOVAs.

4. Results
- **Figure 3.** Grazer presence significantly increased grazer biomass, particularly in fertilized, unshaded treatments (*p*<0.001).
- **Figure 4.** Grazers significantly decreased epiphytic algae (*p*=0.005). This effect was stronger in fertilized and shaded treatments.
- **Figure 5.** Grazer presence significantly altered macroalgae biomass in unshaded, fertilized treatments (*p*=0.02).
- **Figure 6.** There was a significant decline of eelgrass in shaded and fertilized treatments when grazers were present (*p*<0.001).

5. Discussion
- Grazers decreased epiphytic algae in all treatments, particularly in the unshaded, fertilized treatment, implying stronger top-down control.
- This top-down control did not translate to an increase in *Zostera* biomass.
- The lack of *Zostera* response is likely a combination of:
  - direct consumption of eelgrass by *I. balthica* and
  - shading by macroalgal mats, particularly in the unshaded, fertilized treatment.
- Our study emphasizes the complex interactions among plants and animals in seagrass systems.

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