A peek under the canopy: Does rockweed facilitate intertidal oyster spread in Great Bay?

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1. Background & Motivation

- The intertidal zone is a stressful environment where organisms experience dry conditions and high and low temperature extremes.
- Rockweed (Fig. 1A) provides habitat for organisms and protects them from environmental stress [1, 2].
- Eastern oysters (*C. virginica*), while common subtidally, have only recently expanded into the intertidal in Great Bay, NH and are almost exclusively found under rockweed (Fig. 1B) [3, 4].
- Investigating how rockweed may benefit oysters will help us understand changing oyster distributions.

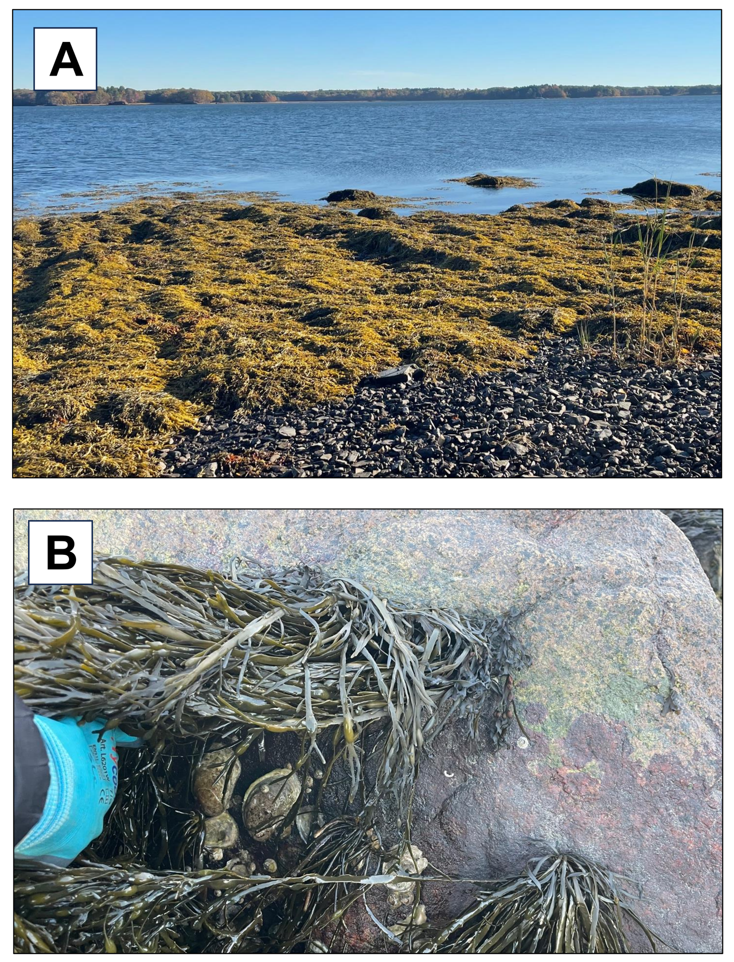

Fig. 1. A) Rockweed covers the shoreline. B) Eastern oysters under rockweed.

2. Objectives

We conducted a multi-season factorial field experiment in Great Bay, NH, from May 2025 to February 2026 to investigate the questions:

1) How does rockweed cover affect flow, moisture, humidity, and air temperature beneath the canopy?

2) How do rockweed cover and predator access affect survival of adult oysters and spat (juvenile oysters) across seasons?

3. Methods

The experimental design was replicated at 5 sites (Fig 2).

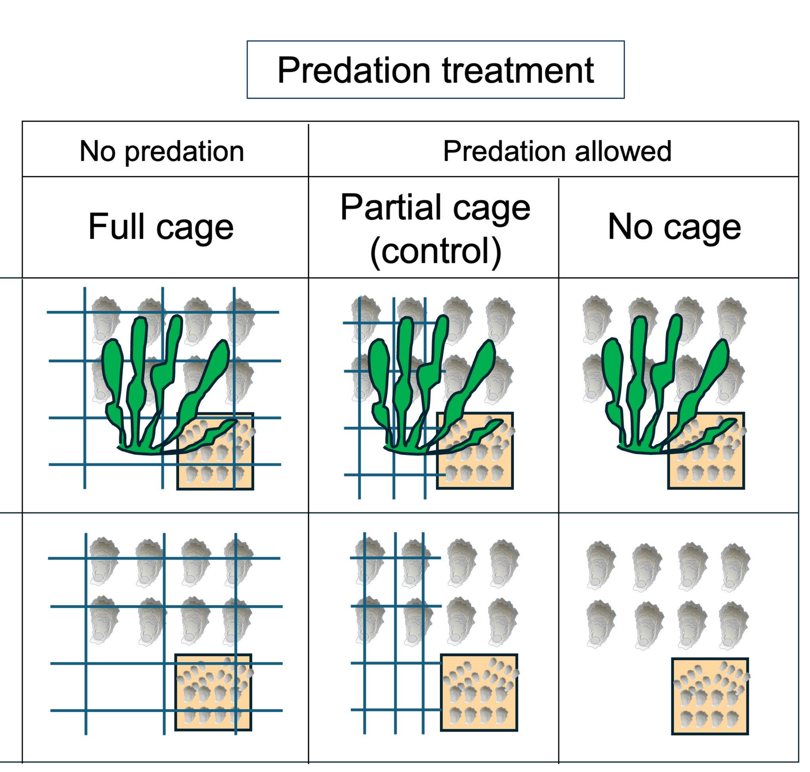

Fig. 2. Experimental design and example of a plot.

Each plot had 8 adult oysters. In Aug. 2025, we added spat-on-shell.

Each month, we measured: flow, moisture, humidity, and adult and spat survival.

We also measured temperature continuously.

4. Results: Environmental conditions

- Rockweed cover led to minor reductions in flow
- Full cage cover led to increased moisture retention
- **Rockweed cover increased relative humidity by 18% compared to bare plots** (Fig. 3).
- **Temperature range in bare plots was 2°C greater than caged plots and 4°C greater than rockweed plots** (Fig. 4).

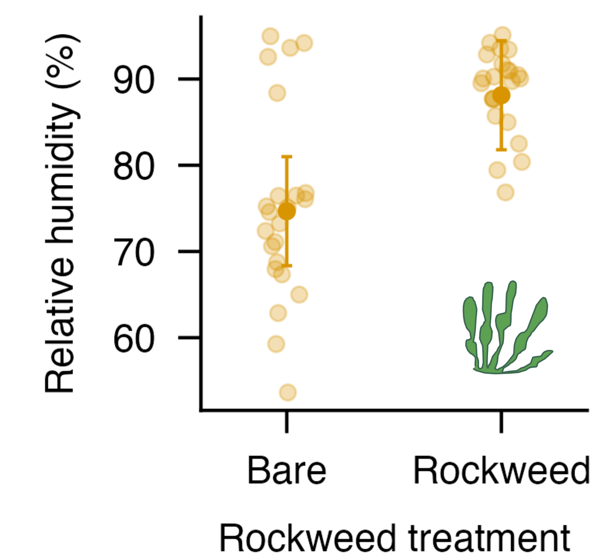

Fig. 3. Points and error bars show humidity model predictions and 95% CIs. Transparent points are raw data.

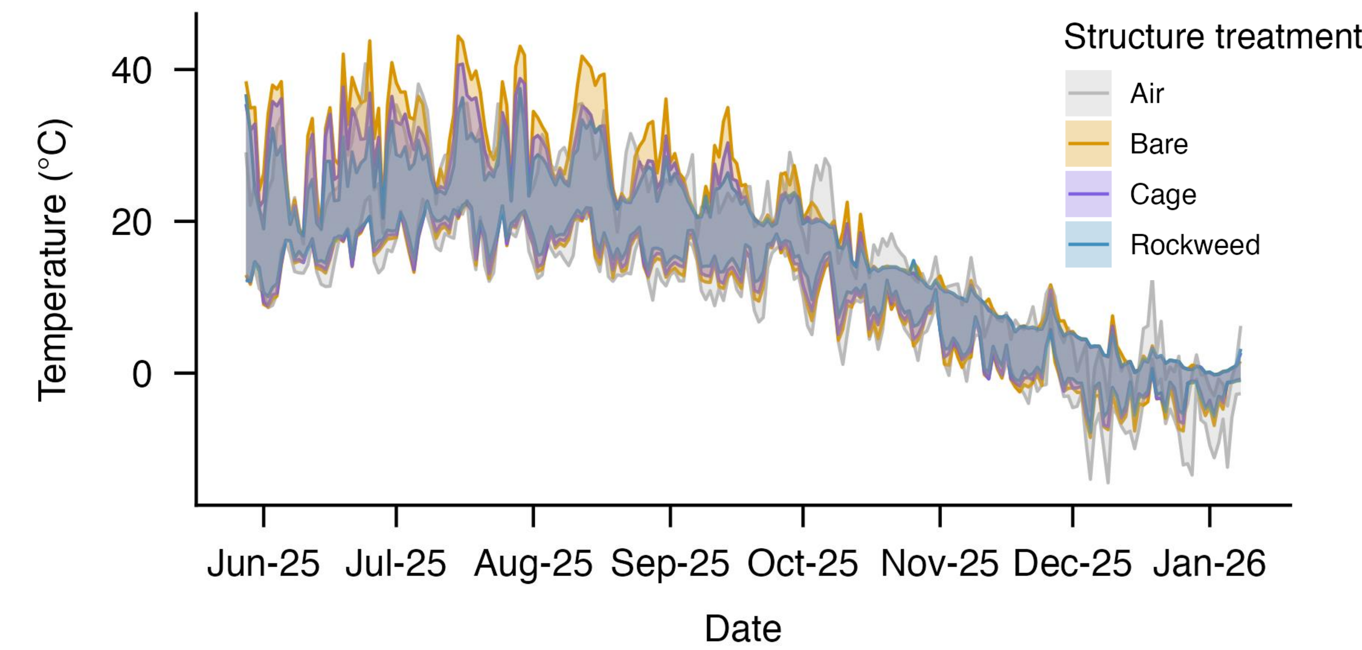

Fig. 4. Average daily temperature range across different treatments and ambient air. Upper and lower bounds of ribbon indicate daily max and min.

5. Results: Spat survival

Probability of spat survival was 2× **higher when protected by a full cage** compared to no cage. Survival was also 8.6× **greater for spat that were larger** when initially deployed in the field (25mm vs 5mm), suggesting **predation on small oysters drives mortality** (Fig. 5).

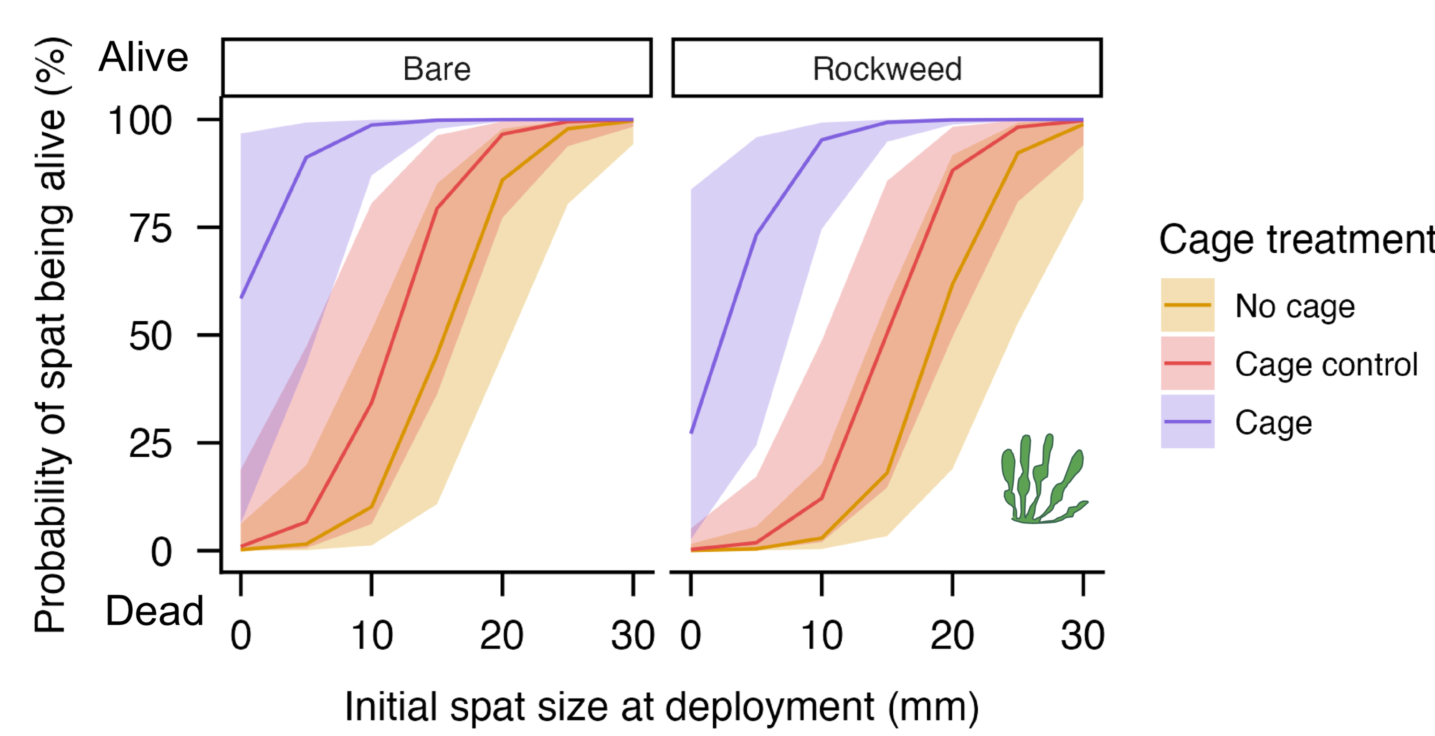

Fig. 5. Lines and shading show Fall 2025 spat survival model predictions and 95% CIs (n = 299 spat).

6. Results: Adult survival & winter conditions

Adult survival was high throughout the summer, with only 4.7% of oysters dead by October 2025. By January 2026, mortality rose to 29.5%.

During winter (Fig. 6), **A)** ice formed directly on oysters and **B)** oysters were crushed, likely by **C)** ice chunks that moved **D)** bay-ward with ebb tide.

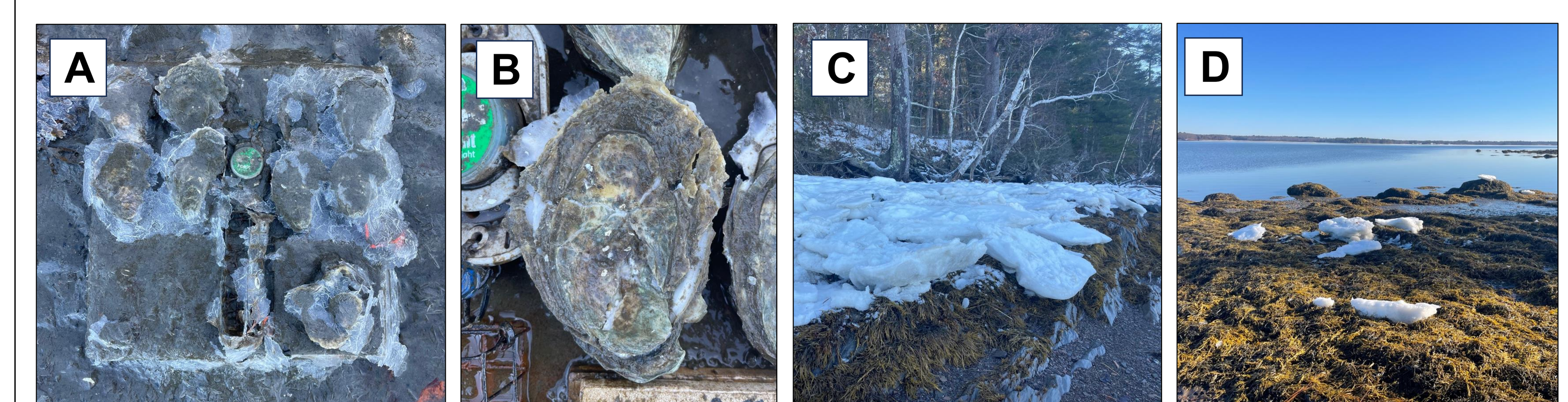

Fig. 6. A) Plot frozen over. B) An oyster crushed to death. C) Ice breaking up on land. D) Ice deposited in the lower intertidal zone during ebb tide.

We examined effects of each treatment on **A)** adult oyster survival **in winter** and **B)** the probability of an adult oyster **being crushed**.

Probability of survival was 10% **higher under rockweed** than bare plots. Oysters were also 5× **less likely to be crushed by ice under rockweed**.

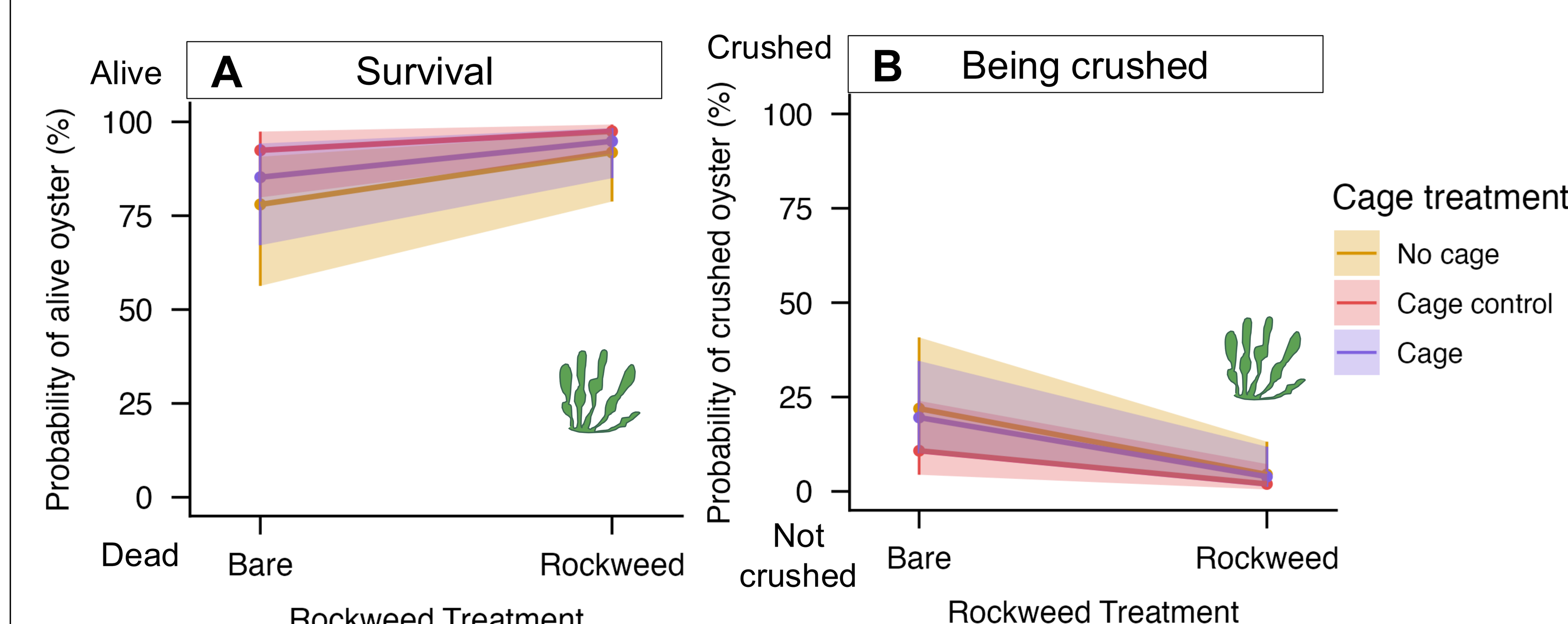

Fig. 7. A) Model results for adult survival (Nov. 2025-Jan. 2026; n = 234 adults). B) Model results for crushing by ice (n = 215 adults). Lines and shading as in Fig. 5.

7. Takeaways

- **Rockweed** creates an environment that is **more humid and stable in temperature** than bare substrate.
- **Predation on small spat**, possibly by green crabs [5-7], is a **major driver of juvenile oyster death** in the intertidal zone, regardless of rockweed presence.
- In the intertidal zone, **winter is a more stressful** season **for adult oysters** than summer. **Rockweed protects adults** from extreme cold and from being crushed by ice during freeze-thaw cycles.

References

Acknowledgments: This project is funded by the University of New Hampshire School of Marine Science and Ocean Engineering via the William R. Spaulding/Jackson Estuarine Lab Endowment. Thanks to all members of QMEL for field assistance and all types of support, and Grant McKown and David Burdick for advising on the project.