Utilizing Biosensors to Monitor Gaping Behavior of *Crassostrea virginica* (Eastern Oyster)

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Introduction

- Eastern oysters demonstrate gaping behaviors for feeding, respiration, and other physiological functions.[2]
- Environmental stressors can alter gaping behavior, making oysters an indicator of water quality.[1]
- As salinity levels in Great Bay shift throughout the year, understanding how oysters respond is important for farms and restoration projects.
- By utilizing magnetic sensors, the correlation between gaping behavior and salinity could be recorded.

Research Goals and Questions

- How does the gaping behavior of Eastern oysters correlate with salinity, and can gaping behavior be used as an indicator of water quality?
- Modify the existing sensors to facilitate long-term deployments by establishing power-independence.

Methods (Biology)

- 8 Oysters were attached to a sensor unit and kept in a tank within Spaulding Hall's Aquatic Core Lab.
- The biosensors recorded the duration and frequency of each oyster's gaping behavior.
- The tank was kept at optimal water quality parameters for 2 weeks before salinity was dropped from 20-25ppt to 10-15ppt. After dropping the salinity, data on gaping behavior was collected for another week.
- A separate biosensor unit with 6 oysters was deployed at NH Sea Grant's Aquafort for 2 weeks to collect continuous data on gaping behavior.

Figure 1: Tank with oysters (top), saltwater test kit (bottom left), water quality sensor (bottom middle), and labeled oysters (bottom right).

Methods (Engineering)

- Define baseline power requirement parameters - 1.2 W (watts) with 6 sensors.
- Modify hardware and firmware to limit power needs – 0.6W.
- Double solar potential from 10W to 20W.
- Upgrade solar harvesting module from 2W to 20W.
- Increase power storage from 10 Ah (amp hours) to 50Ah.

- **Max Deployment length:**
  - Initially: ~3 days
  - Upgraded: ~2 months

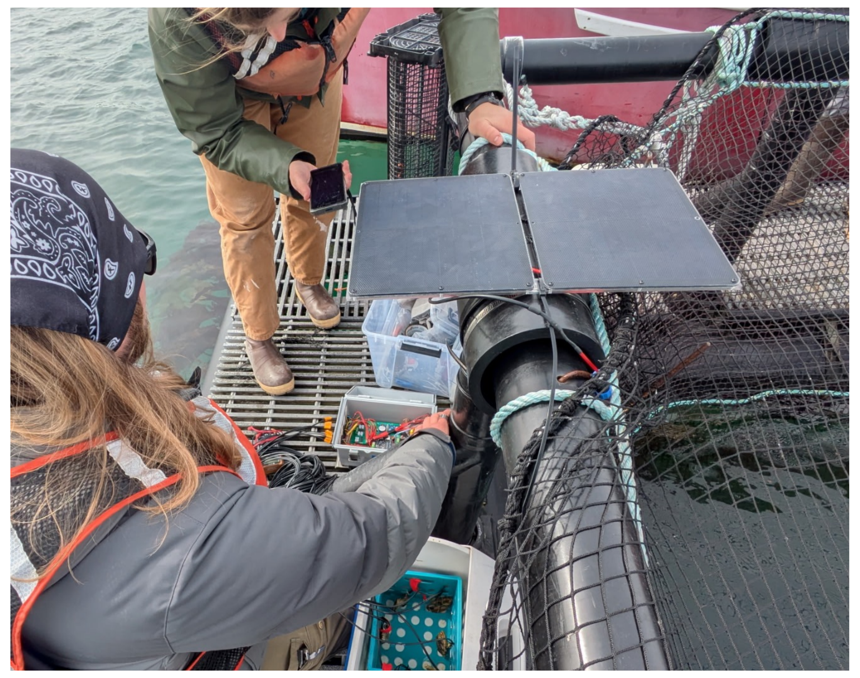

Figure 2: First Power Independent Deployment on AquaFort

Results

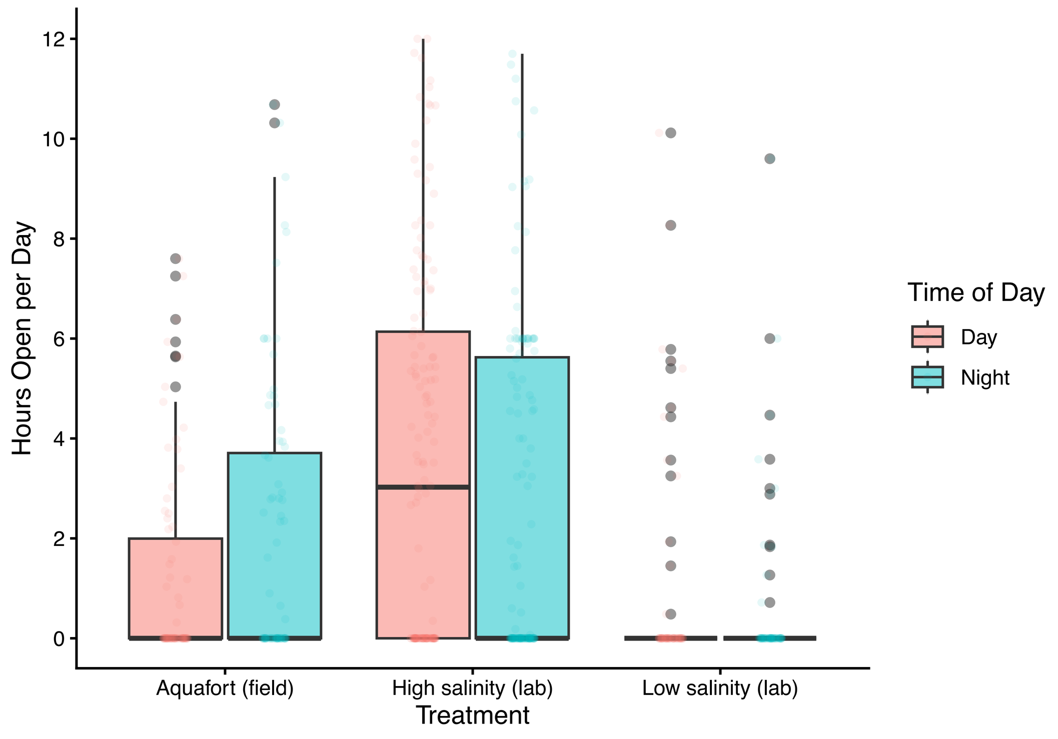

Figure 3: Hours per day oysters are open at the Aquafort and across salinity treatments in the lab experiment.

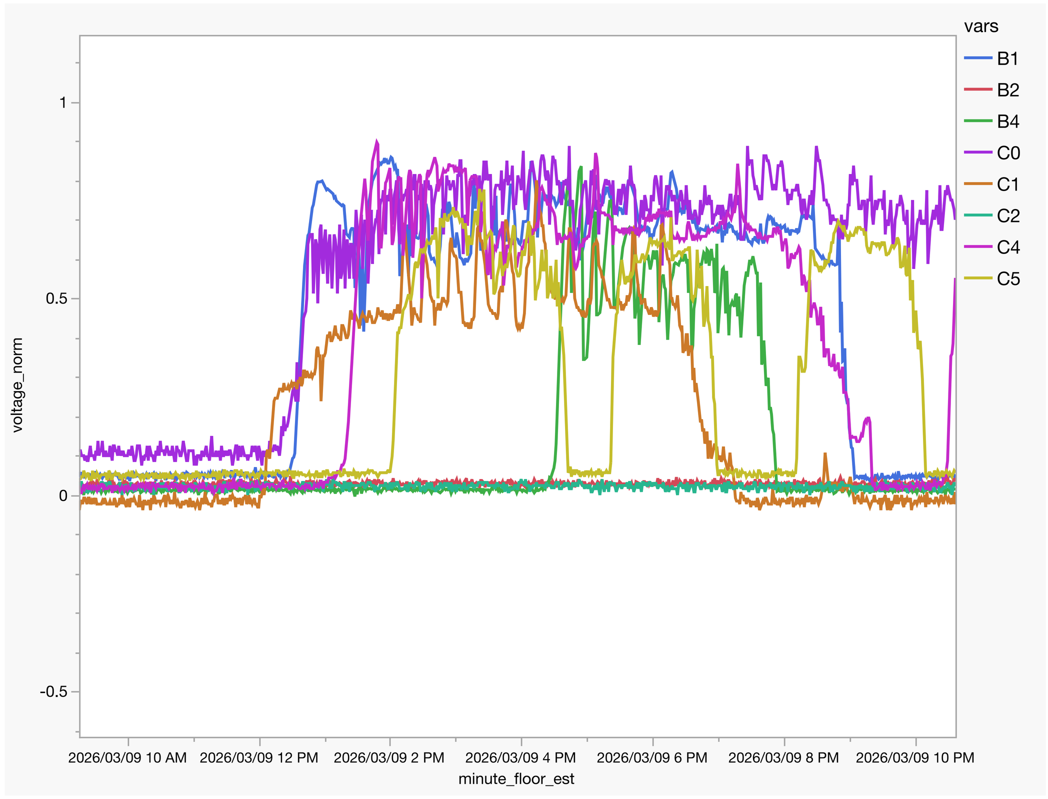

Figure 4: Oyster behavior in low salinity treatment after feeding at 12:15pm .

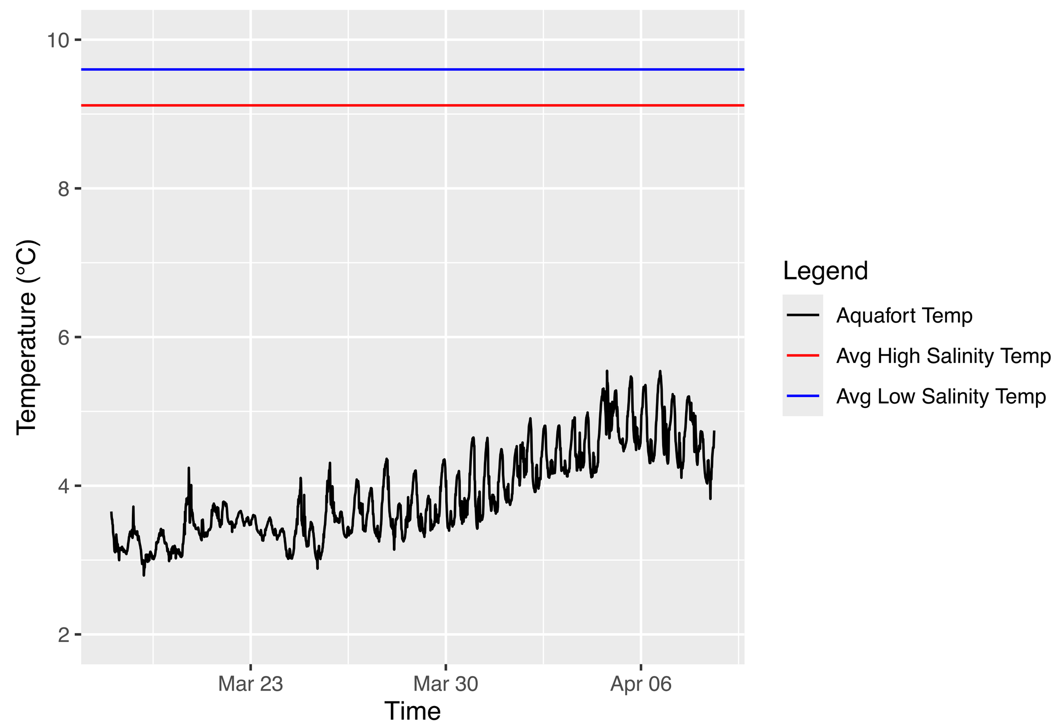

Figure 5: Water temperature at Aquafort during biosensor deployment with average temperatures of high and low salinity lab treatments

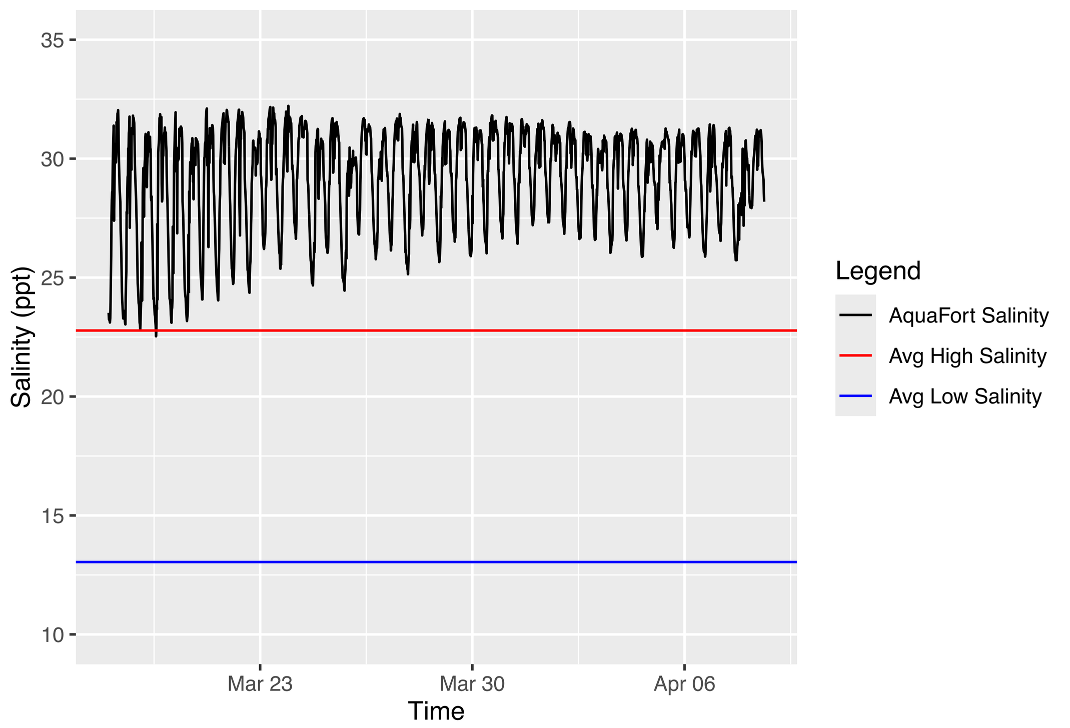

Figure 6: Salinity at Aquafort during biosensor deployment with average salinity values of high and low salinity lab treatments.

- The average temperature was 9.1°C in the high salinity treatment and 9.6°C in the low salinity treatment.
- The average salinity was 22.8 ppt in the high salinity treatment and was 13 ppt in the low salinity lab treatment.

Conclusion

- In the lab, under high salinity conditions, the oysters remained open much longer, indicating that low salinity could inhibit their physiological functions associated with gaping.
- Although the Aquafort had a similar salinity level compared to the high salinity lab treatment (~25ppt), the oysters did not open as frequently. This suggests that oysters are remaining closed due to a variable other than salinity.
- The biosensor unit could be utilized for future research into the gaping behaviors of oysters under various conditions.[6]
  - Temperature, pH, dissolved oxygen, salinity
  - Should include larger sample sizes.
- Deployments are now possible on many natural reefs, allowing for continuous site observation.
- Inexpensive biosensor systems can be used to monitor oyster success instead of expensive systems that monitor potential success metrics.

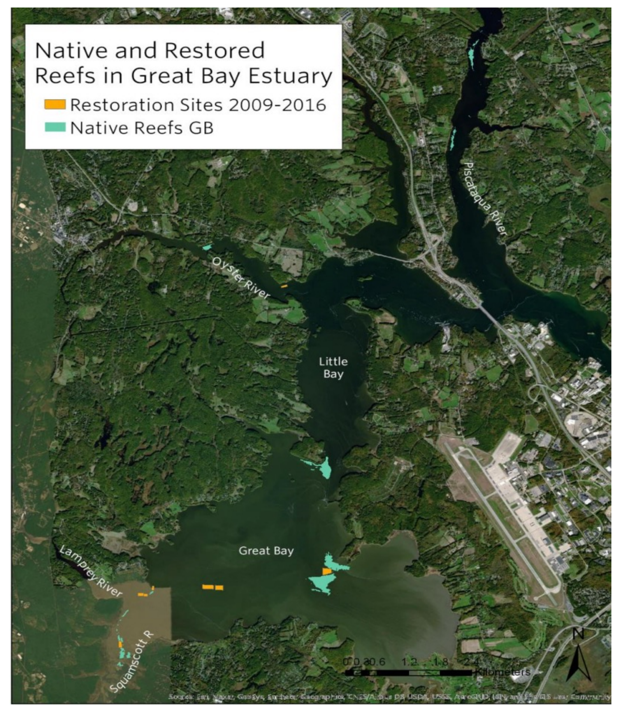

Figure 6: Map of native and restored oyster reefs in Great Bay [1]

Acknowledgements

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References

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