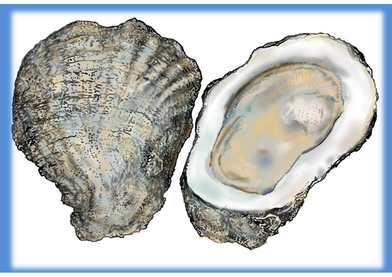

The Capacity of Oyster Aquaculture to Improve Water Quality in Rhode Island Coastal Lagoon Systems

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INTRODUCTION

► The health and function of Rhode Island's coastal lagoons depends on the water quality. Increased nutrient inputs, nitrogen in particular, can cause major water quality concerns for these coastal systems (Figure 1).

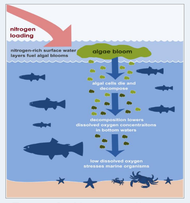


Figure 1. Negative effects of excess nitrogen in lagoon

Figure 2. Visible water quality improvement from oysters

► A single oyster can filter up to 55 gallons of water per day, helping to control populations of phytoplankton, suspended solids, and excess nutrients in the process (Figure 3).This suggests that oyster aquaculture may improve water quality, via filter-feeding processes (Figure 2).

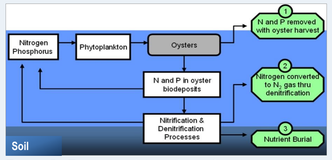


Figure 3. Ecosystem interactions of oyster aquaculture

► Our study investigated the impact of oyster aquaculture on water quality in three coastal lagoons located in southern Rhode Island (Ninigret, Potter, and Winnapaug Ponds) (Figure 4).

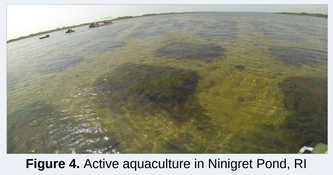


Figure 4. Active aquaculture in Ninigret Pond, RI

HYPOTHESES

Because oysters are filter feeders, we expect to observe improved water quality at aquaculture sites, compared to control sites. Thus, we hypothesized that the following differences between aquaculture and control sites will be observed:

WQ Parameter	Temperature	pH	Salinity	Chl *a*	TSS	DO
Aquaculture	Seasonal Flux	Seasonal Flux	Seasonal Flux	↓	↓	↑
Control	Seasonal Flux	Seasonal Flux	Seasonal Flux	↑	↑	↓

RESULTS

► Graphs represent mean values (n=3), error bars represent one standard deviation from the mean.

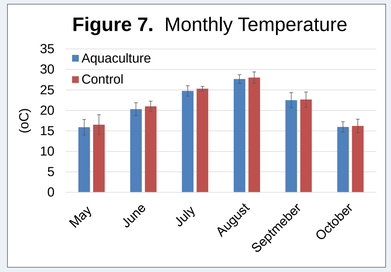


Figure 7. Monthly Temperature

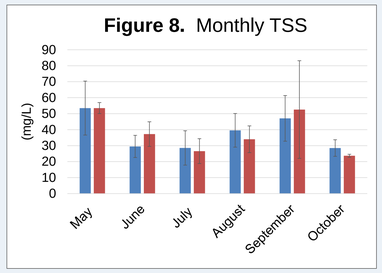


Figure 8. Monthly TSS

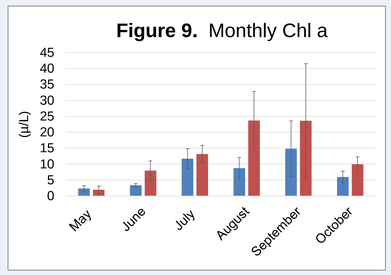


Figure 9. Monthly Chl a

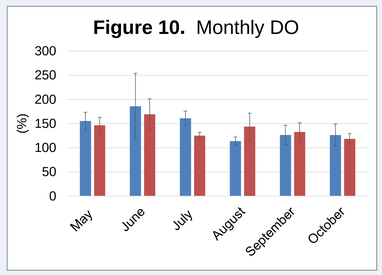


Figure 10. Monthly DO

Lagoon	DO	Chl *a*
Winnapaug	136	9
Ninigret	138	8
Potter	171	8

Table 2. AHI results for aquaculture sites

Lagoon	DO	Chl *a*
Winnapaug	70	0
Ninigret	62	0
Potter	44	15

Table 3. AHI results for RISP 2014 data

DISCUSSION

► There is a direct relationship between temperature and oyster filtration (Figure 7 and 9). This is expected as oysters are noted to be more active during warmer months.

► There is no visible trend for TSS at either site, nor between sites (Figure 8). This is to be expected in shallow areas.

► June- August shows the lowest chl *a* concentrations throughout the entire study (Figure 9). Because oysters are most active during warmer months, it is also expected that they filter more phytoplankton out of water column at these times.

► Dissolved oxygen was notably higher in aquaculture sites compared to control sites (Figure 10). This could be due to the constant movement of racks and people in aquaculture areas, helping to incorporate more O_2 into the water column.

AHI Comparison:

► Chl *a* concentrations have increased since 2014 (Table 2 and 3). This may be due to seasonal and annual fluctuations in the water column (Figure 11).

► All three lagoons are experiencing an increase in DO since 2014 . This difference could be due to variation in procedure, as our study aimed to measure highest DO in the afternoon when photosynthesis is at peak productivity.

► Although our AHI values for chl *a* are "worse" than the 2014 values, our data suggest that oysters may improve water quality by reducing chl *a* and increasing DO in the water column.

Figure 11. Visible seasonal differences in water clarity and algae growth

CONCLUSIONS

► Comparing our data to pre-existing data made it clear that seasonal and annual fluctuations occur for all water quality parameters.

► Oysters have a greater impact on improving water quality when water temperatures are warmest, due to increased filtration capacity at higher temperatures.

►Our results suggest that oyster aquaculture has a positive effect on the water quality of coastal lagoons by lowering chlorophyll *a* concentrations and increasing dissolved oxygen levels.

WQ Parameter	Chl *a*	TSS	DO
Aquaculture	↓	No Clear Result	↑
Control	↑	No Clear Result	↓

Future Studies:

Additional research could further analyze the relationship between temperature and filtration capacity of oysters. Continuing monthly water quality monitoring of these areas would help to benefit oyster farmers, and to expand the RISPC range of monitoring sites to both aquaculture and shallow waters.

METHODS

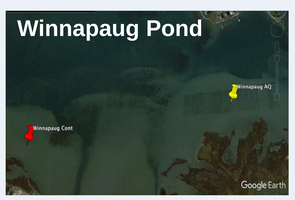
Site Selection:

► We selected three coastal lagoons in Southern Rhode Island that had pre-existing oyster aquaculture.

► We used Google Earth to determine where aquaculture sites were located.

► Experimental sites had pre-existing aquaculture. Control sites were 300-600 m away from the experimental sites.

► Both control and aquaculture sites were on the same soil type (Sulfic Psammowassents).



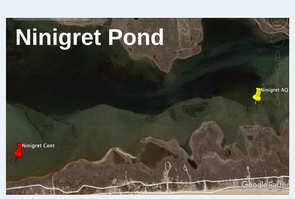


Figure 5. Field measurement of DO, temperature, salinity, and pH were taken using YSI probe

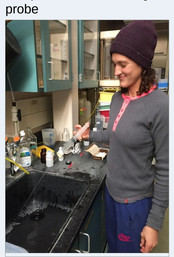


Figure 6. Chl *a* and TSS were analyzed in the lab via filtration methods

Water Quality Analysis:

► The RI Salt Pond Coalition (an environmental conservation organization) uses the Aquatic Health Index (AHI) to measure the overall health of RI's coastal lagoons.

► AHI is calculated based on several parameters including DO mg/L and chl *a* measurements. It uses linear equations, based on the values of those parameters, to score the data on a scale of 0-100 (Table 1).

► In our study, we calculated the AHI values for DO and chl *a*, to compare aquaculture data to the most recent (2014) data available for the coastal lagoons.

AHI Quality	Value Range
GOOD	>65
FAIR +	50-65
FAIR -	35-50
POOR	<35

Table 1. Rhode Island Salt Pond Coalition AHI guidelines

LOWER Chl-a Concentration (micrograms per liter, ug/L) is **GOOD**
GOOD: < 5.5 ug/L
POOR: > 7.6 ug/L

HIGHER Dissolved Oxygen Saturation is **GOOD**
GOOD: > 72.5 % saturation
POOR: < 57.5 % saturation

ACKNOWLEDGEMENTS

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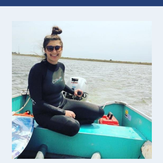

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