Living Oyster Reefs as a Significant Source/Modifier of Epizooic Microalgal Biomass in Tidal Creek Systems: Implications of Particulate Inputs

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Abstract

Oyster reefs are an important habitat in coastal creeks and sounds, supporting fisheries, nursery habitat, shoreline stabilization, and filtration ecosystem functions. Oyster stocks in southeastern North Carolina tend to grow predominantly in intertidal habitats in relatively sheltered back marsh areas and tidal creek systems. We examined epizooic microalgae associated with oyster populations growing within three tidal creek ecosystems in southeastern North Carolina. Although the land use (predominantly single family dwellings) is similar among the systems, the estuaries differ in the magnitude of human impacts, based on watershed metrics of population density, percent of impervious surface, and drainage area. Initial evaluation suggests that the creeks have similar oyster coverage across most of the tidally influenced portion of each watershed. Data on microalgal biomass (as chl a levels) associated with oyster shells have been collected near the mouth and in upper regions of each of three target creeks. Samples were taken from the surface of the oyster matrix and from within the oyster matrix on each reef. Data have also been collected on the amounts and characteristics of other materials attached to the oyster shell surfaces. These data suggest an interesting and potentially significant link between intertidal oysters and epizooic microalgal production in this system. At the very least live oysters support very large microalgal biomass per unit of bottom area. Beyond this there appear to be differences in oyster associated microalgal biomass between locations and among creeks that are strongly influenced by the composition and quantity of particulates associated with living oyster shells.

Aerial photo of typical tidal creek

Typical oyster reef

Hewletts Creek

Methods

- Sites established in the lower region (near the creek mouth) and upper region (headwaters) of Hewletts Creek, Howe Creek, Pages Creek and Masonboro Island (control site).
- Oysters were collected from 3 reefs at each site.
- Oysters collected from two positions within each reef; reef tops (~10-15cm high) and within the reef, just above (4-6 cm) the sediment surface
- Sediment and associated chl *a* was removed from oyster shell using an acetone extraction.
- Chl *a* was measured using a Turner 10-AU fluorometer. All data output was in micrograms chl *a* per oyster.
- All analyses on log transformed data to meet assumptions of homogeneity.
- 3 WAY ANOVA shows strong main effects and interactions:
- SEASON: F=14.99; Pr > F = 0.0001; CREEK: F=18.60; Pr > F = <0.0001; POSITION Creek: F=26.75; Pr > F = <0.0001; SEASON * CREEK: F=19.76; Pr > F = <0.0001; CREEK * POSITION Creek: F=5.50; Pr > F = 0.0044.
- Where interactions occurred analyses were broken down into 1-WAY ANOVAS

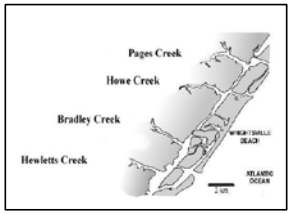
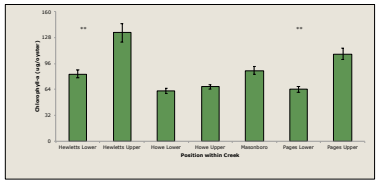


Figure 1. Tidal creeks of New Hanover County, NC



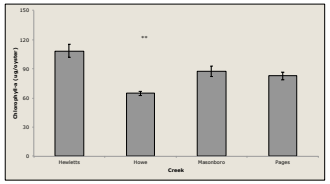


Figure 2. (A) Comparison among sites within each creek shows differences between positions in Hewletts and Pages creeks. There were also differences (**) between the upper position in creek sites and the Masonboro control site. (B) Comparison among creeks for all positions combined showed lower levels of chl a in Howe creek, which has intermediate background conditions

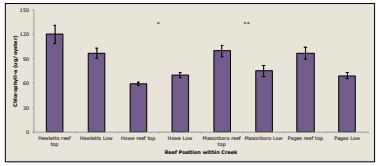


Figure 3. Comparison among reefs based on position within the reef (reef top vs. lower positions within the oyster matrix

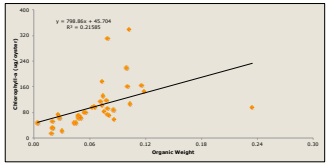


Figure 4. Comparison of chl a/oyster and weight of organic material per sample.

Results and Conclusion

- Greatest BMA levels detected in the creek system with the highest level of historical inputs (Hewletts Creek). Differences among creeks are consistent across multiple sampling periods.
- Creek with historically lowest level of watershed development inputs and non-creek control show intermediate levels.
- Highest level of BMA found at sites near the head waters of creeks, potentially closer to input source.
- Comparison of BMA on oysters based on position in the reef indicate greater BMA from oysters collected at higher elevations in the oyster matrix compared to those lower in the reef matrix.
- Significant relationship between chl *a* levels and organic content (both by weight (g) and percent).
- As one of the most significant habitat forming species in the intertidal region, oysters have a structuring influence on the estuarine ecosystem potentially disproportionate to their spatial coverage.
- Oysters provide a significant amount of potential primary production on a per area basis compared to other habitats within the system
- Potential interaction between organic material and inorganic material that adheres to oyster shells.

Summary

The Tidal creeks systems in New Hanover County provide an interesting model system(s) that may prove useful in testing responses of key ecosystem parameters to moderate inputs. The systems in this study could be considered mesotrophic, although the level of background inputs vary based on watershed characteristics. Oyster peak densities in these systems approach 125-200 m^2, providing significant attachment surface many times that provided by adjacent non-structured habitats. Estimates of BMA on a per oyster basis exceed those reported from adjacent sandflat communities. These data would suggest a significant potential for oysters to act as modifiers of primary production (at least over the areas covered by oyster reefs) but also likely potential impacts (positive and negative) as background inputs are modified.

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