USA Restoration Briefs

• *University of South Alabama Oyster Reef and Fisheries Habitat Enhancement Program* •

Volume Seven: Hypoxia and Juvenile Oyster Survival **Summer 2011**

Highlights

- During summer months, many locations in Mobile Bay have low oxygen or hypoxic events near the sea floor which can damage or kill oysters.
- This study deployed newly settled oysters (spat) at three sites with known normal (Dauphin Island), moderate (Whitehouse Reef) and severely low (Theodore Canal) oxygen levels, and at varying depths (bottom, mid-water and surface) to learn how different oxygen levels affected growth and survival.
- Oyster population growth was highest at Dauphin Island and higher near the surface than bay floor.
- Under extended periods of moderately low oxygen events, oyster shell growth is reduced in a similar way if they had experienced short periods of severe low oxygen.
- These results highlight the importance of site-selection and reef design for success in oyster restoration projects.

Research Objectives

The objectives of this study were to:

- Determine extent and frequency of low oxygen events near western Mobile Bay oyster reefs during summer months.
- Estimate the effects of low oxygen on oyster spat survival, shell growth and population growth.
- Apply findings to further improve reef designs and selection of restoration sites in the region.

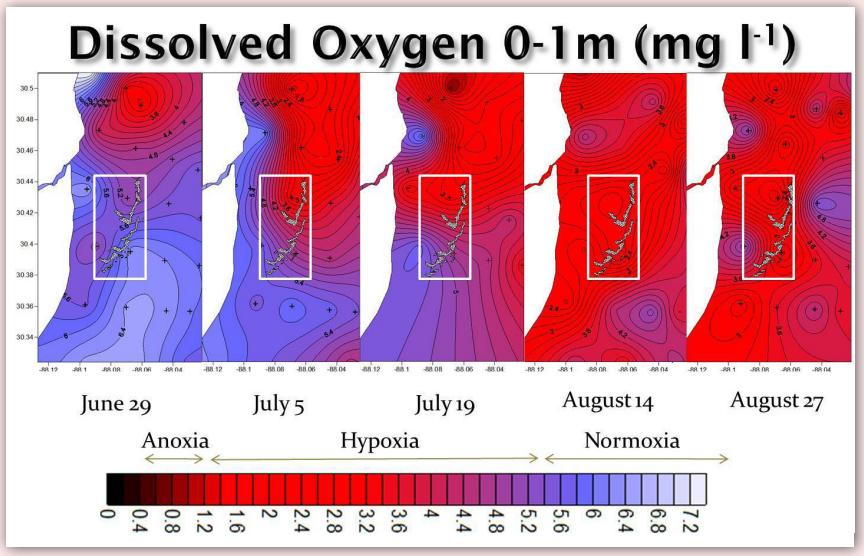
Background

Hypoxic and anoxic events, when oxygen levels within the bay become very low, frequently occur within Mobile Bay waters and can have profound impacts of numerous fisheries species (Figure 1). The most frequent and severe low oxygen occurs near the bay floor when bay and coastal waters become stratified into different layers (For review, see Spring 2010 Brief). Low oxygen levels stress many organisms and while many mobile organisms are able to flee, many sessile invertebrates, such as oysters, have no means to escape the poor water quality. The cumulative effects of hypoxia, hurricanes, predation and decreasing reef habitat has left many oyster reefs in poor condition and generated increased interest and support for restoration. Basing this design on known environmental factors is important when restoring reefs to ensure long-term survival of oysters.

Efforts to restore some of the relic reefs and increase oyster stocks located within western Mobile Bay have been initiated in recent years. Prior to this study, the frequency and consequences of low oxygen events near the historical oyster grounds were largely unknown. Several recent studies on oyster reef design have found that taller reefs have higher survival of juvenile oysters than shorter reefs. This study measured oxygen levels in the water at varying depths to test this concept and to inform restoration project design to ensure good oyster growth and survivability in the area.

Figure 1.

Maps showing summer dissolved oxygen levels within Mobile Bay. Bright red shades reflect moderate to severe hypoxia and anoxia, whereas blue regions have normal oxygen values. The white box outlines Whitehouse Reef.



Methods

At the three sites, replicate panels with settled oysters (spat) where placed at varying depths (bottom, ~1m, and surface). Dissolved oxygen was measured during summer months at the three experimental sites: Dauphin Island, Whitehouse Reef, Theodore Canal (Figure 2). Oysters were counted and measured for shell length and height to show population and shell growth.

Findings

Measurements of dissolved oxygen levels found that low oxygen events were common in western Mobile Bay, especially at the sea floor. Population growth was the lowest at Whitehouse Reef which has moderately low oxygen levels and highest at Dauphin Island which usually experiences normal oxygen levels. At the Dauphin Island site, the oyster population was 3-4 times greater per panel than the other sites (Figure 3).

Shell height and length were greater at the surface than at depths for both sites. Results suggest that when water quality is decreased due to moderately low oxygen waters, oyster population growth can be greatly affected. When prolonged, moderate low oxygen events can be as detrimental as short periods of severe low oxygen. In terms of restoration design, results indicated that taller reefs (>1-m) in height may not be adequate to ensure re-establishment of oyster populations for the western part of Mobile Bay.

Reefs in excess of 1-m in height may be required for sustainable oyster populations, but may be cost-prohibitive to build.

Figure 2.

Map showing sites of No, Moderate and Extreme Hypoxia within Mobile Bay. The white lines and black numbers represent the gradient of oyster larval supply described in the Summer 2010 Brief.

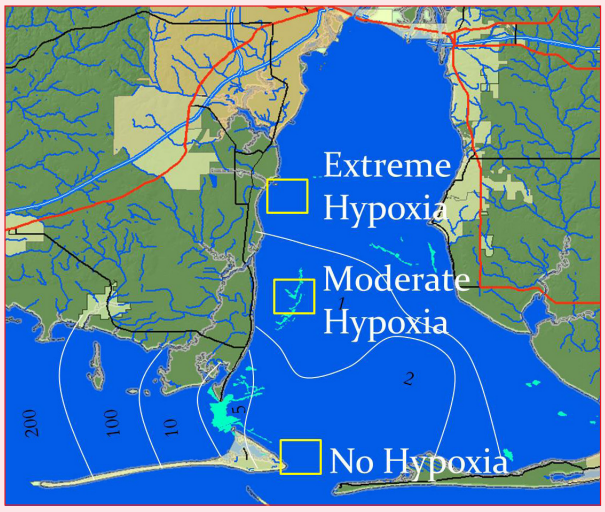
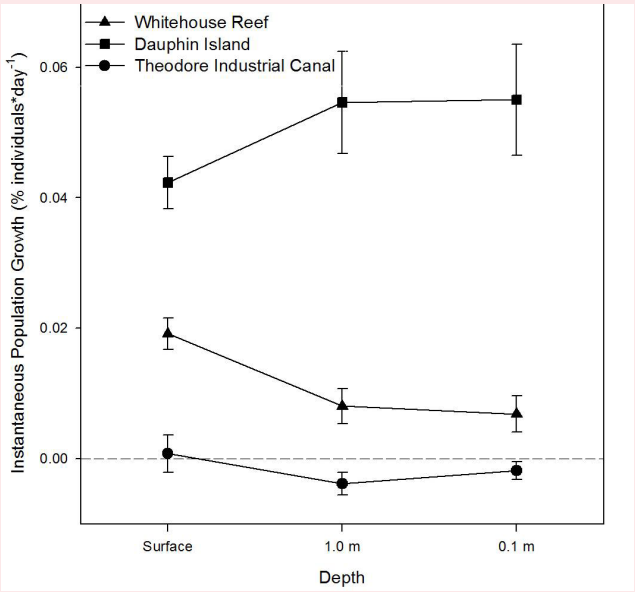


Figure 3.

Effects of site and depth placement of juvenile oysters on oyster population growth. Positive values indicate oyster population growth.



Publications

Johnson, M.W., Powers, S., Senne, J. and Park, K. 2009. Assessing in situ tolerance of Easter Oyster (Crassostrea virginica) under moderate hypoxic regimes: implications for restoration. Journal of Shellfish Research 28(2): 185-192.

Senne, J. 2009. Variability in salinity and dissolved oxygen in southwest Mobile Bay,AL. MS Thesis, University of South Alabama.

Application

The results of this study highlight the importance of good site selection (e.g. areas with good oxygen levels) and/or design (e.g. high relief reefs >1m) for oyster restoration projects to ensure success.

This study also demonstrated that low-cost experiments prior to restoration can ensure success by providing critical information on environmental conditions of the location and appropriate design specifications.

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