

USA RESTORATION BRIEFS

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

Volume Four: Ecosystem Services Provided by Oyster Reefs

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HIGHLIGHTS

- Oyster reefs are often restored to improve water clarity and create habitat for fishes and crustaceans
- This study restored oyster reefs in tidal creeks near Little Dauphin Island to experimentally examine their effect on water clarity and fish and crustacean (shrimp and crabs) abundances compared to tidal creeks without oysters
- Restoration was successful with abundant live adult and juvenile oysters and only low numbers of dead oysters measured over a two-year period
- Only slight changes in water clarity were measured very close to the reef, and there was no clear enhancement of fishes or crustaceans
- The tidal creek and salt marsh setting for the study likely contributed to the lack of observable post-restoration effects on fishes and water quality
- This study supported the M.S. thesis research of Rochelle Plutchak (under Dr. Cebrian) and Nathan Gerdal (under Dr. Powers) and produced three papers in scientific journals

RESEARCH OBJECTIVES

The central objectives of the study were to determine if, after oyster reef restoration, there was:

- Recruitment and survival of oysters
- Increased water clarity
- Increased abundance of juvenile fishes and invertebrates .

These services were measured in paired tidal creeks with and without restored oyster reefs.

BACKGROUND

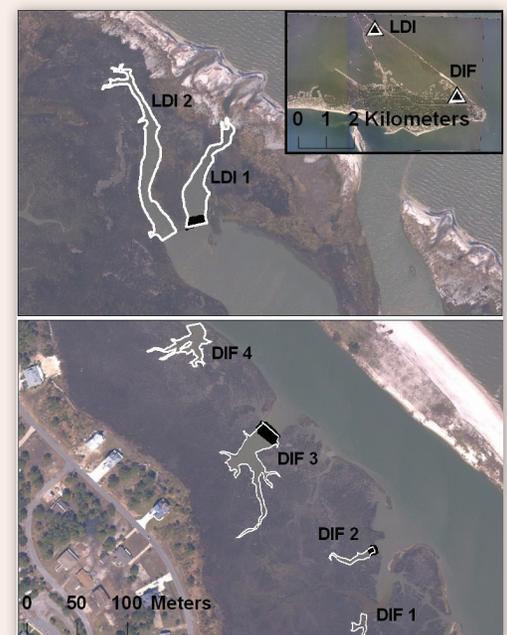


In addition to playing their traditional role as valuable fishery resources, oyster reefs are increasingly recognized for the many valuable ecosystem services they provide. Among the most important services provided by oyster reefs is three-dimensional habitat for diverse communities of invertebrates and small fishes. Several economically-important species, including spotted seatrout, blue crabs, gag grouper, and shrimp are among the many species claimed to be enhanced by oyster reefs.

Another often touted benefit of oyster reefs is their ability to improve water clarity and potentially quality by filtering out large quantities of suspended particles and phytoplankton (microscopic floating algae) from the water column. Despite the increasing recognition of the ecological benefits of oyster reefs, only a few studies measuring these benefits have been conducted in the field and published. This study constructed oyster reefs in tidal creeks near Little Dauphin Island and Dauphin Island (Figure 1) to experimentally examine their effect on water clarity and fish and crustacean abundances compared to tidal creeks without oysters.

FIGURE 1.

Aerial photographs of the six tidal creeks around the east end of Dauphin Island, Alabama (top right insert) that were studied. The upper photo shows the two paired sites on Little Dauphin Island and the lower photo shows the four tidal creeks on Dauphin Island. The sites were paired based on similarity in physical parameters (LDI 1 and 2, DIF 1 and 2, and DIF 3 and 4) and are shown within the white lines. Experimental creeks were randomly chosen and the restored reef areas are indicated by black polygons.



METHODS

Tidal creeks of similar size and location were chosen for the experiment. Three creeks were restored with oysters and compared to three "control" creeks (Figure 1). Oyster densities were quantified by collecting 0.25 m² of shell from each reef to count and measure live and dead oysters. Fish and invertebrates abundances were measured by collecting, identifying and counting specimens using seines and experimental gillnets. Water clarity was estimated by measuring light penetration through the water column.

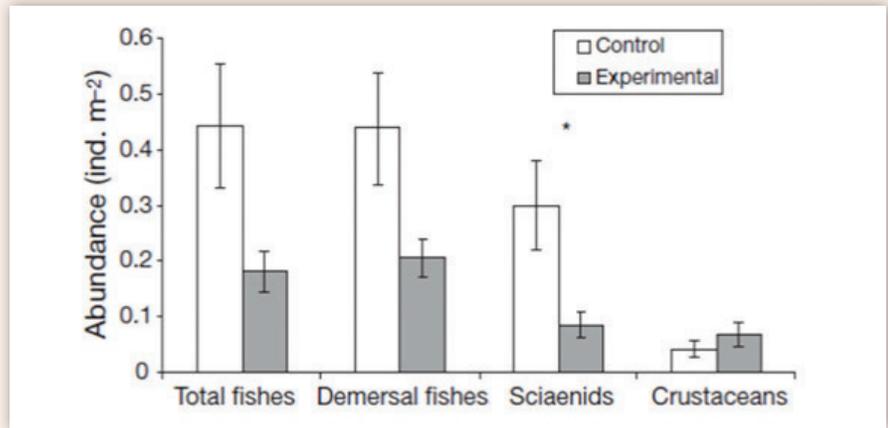


FIGURE 2.

Experimental creeks with restored oyster reefs did not show measurable increases in fish or crustacean densities as many previous studies have predicted.

FINDINGS

Restoration of oyster reefs within the tidal creeks was successful as populations of adult oysters remained above the targeted 150 oysters m⁻² for two years post-construction. The abundance of juvenile oysters increased, and the number of dead adults remained constantly low. However, despite the presence of healthy oyster reefs, there was little increase in water clarity. Measurements showed that phytoplankton (algae) abundance was not reduced and light penetration was similar in the water-column of the creeks with reefs and those without. The only observable effects of the reefs on algae abundance were at small distances directly above the reefs. Somewhat more unexpectedly, no significant effects were found from the addition of oyster reefs on the overall fish or crustacean (shrimp and crabs) assemblages within the tidal creeks (Figure 2). We did observe a weak positive effect on the abundance of demersal fishes (demersal fishes feed on bottom-living resources) after reefs were constructed, but this was not significant compared to control creeks.

These results are opposite to many current predictions that restoration of oyster reefs will result in overall increases in fish and invertebrate densities. Our findings may be because reef were placed in tidal creeks that were already surrounded by dense salt marsh habitat that was similar to the protection an oyster reef would provide fish and invertebrates. These results do not necessarily imply that oyster reef restoration should be abandoned, since our reef building efforts were successful and there are demonstrable benefits of reef restoration. Importantly, this study has helped to show that the types, magnitudes and extent of benefits that can be expected after reef restoration need to be re-evaluated.

PUBLICATIONS

Geraldi, N. R., S. P. Powers, K. L. Heck, Jr., and J. Cebrian. (2009) Response of transient fish and crustaceans to oyster reef restoration in tidal creeks. *Marine Ecology Progress Series* 389: 171-180.

Plutchak, R., K. Major, J. Cebrian, C.D. Foster, M.E. Miller, A. Anton, K.L. Sheehan, K.L. Heck Jr., and S.P. Powers. (2010) Impacts of oyster reef restoration on primary productivity and nutrient dynamics in tidal creeks of the North Central Gulf of Mexico. *Estuaries and Coasts* 33: 1355-1364.

Heck, K.L., Jr. J. Cebrian, S.P. Powers, N. Geraldi, R. Plutchak, D. Byron, K. Major (In Review). *Ecosystem Services Provided by Oyster Reefs: An Experimental Assessment*. *Marine Ecology Progress Series*

APPLICATION

- The role of the surrounding landscape is important in predicting the response of fish and invertebrates to oyster reef restoration.
- Expectations that healthy oyster reefs will be able to drastically improve water clarity are probably unrealistic, but localized or short-lived clarity may be possible



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