USA Restoration Briefs

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

Volume Five: Oyster Reefs as Breakwaters to Protect Shorelines Winter 2011

Highlights

- Oyster reefs were restored along two eroding salt marsh habitat to test the effectiveness of these reefs in creating habitat for invertebrates and fishes and protecting shorelines from erosion.
- Overall vegetation retreat rates were high across all treatments, but was reduced by more than 40% at one site.
- There was documented oyster recruitment and survival to reproductive size, but substantial mortality limited reef cementing and success.
- Blue crabs, brown and grass shrimp, and several economically-important finfish were more abundant near breakwater reefs than mudflat controls.
- Although shoreline erosion was only slowed at oyster breakwater sites, the habitat enhancement for invertebrates and fishes is uncommon among shoreline protection schemes.
- This study supported a portion of Steven Scyphers's dissertation research, (a current student of Dr. Powers) and produced one scientific paper currently in peer-review.

Background

Coastal and shoreline habitats like salt marshes, oyster reefs, and seagrass meadows protect coastal lands from waves and storms, provide shelter and food for many marine organisms, and supply food, occupation, and recreation for human societies. Unfortunately, many of these habitats are also among the most degraded and threatened habitats in the world because of their sensitivity to sea level rise, storms, and increased human utilization. Many previous efforts to protect shorelines have involved the introduction of hardened structures, such as seawalls, rocks, or bulkheads to dampen or reflect wave energy. A major concern in implementing bulkheads and seawalls for coastal property protection is that many nearshore habitats are damaged and destroyed because erosive wave energies are reflected back into the water body, instead of absorbed or dampened. Mobile Bay, like many other coastal areas, is highly developed with a large and increasing proportion of the shorelines armored by bulkheads and seawalls.

At last analysis in 1997, over 30% of the bay's available coastline was armored with over 10-20 acres of intertidal habitat lost, a high percentage in this microtidal bay. A recent study found that historical armoring and marsh-edge losses have already had negative fisheries consequences, and projected further reductions of blue crab harvest if armoring continues. Recently, a growing initiative for sustainable shoreline protection has focused on balancing effective protection and habitat creation by a variety of new methodologies collectively termed "living-shorelines". Wave-reducing breakwaters are becoming an increasingly common along sheltered coastlines and are proclaimed by many as a more responsible alternative to traditional shoreline armoring; however, their effectiveness or ecological impact is largely untested.

Research Objectives

We constructed wave-reducing breakwaters of loose oyster shell paired with non-restored control areas along two different stretches of rapidly eroding salt marsh habitat (Point aux Pins and Alabama Port) to experimentally examine their effect on the nearshore physical setting (e.g. shoreline erosion) and ecology (e.g. fish abundance) (Figure 1). At both sites we measured shoreline change, density and survival of oysters, abundance and community structure of fishes and mobile invertebrates.

Figure 1. Each experimental breakwater was constructed of loose oyster shell and designed to reduce wave action.

Methods

We documented shoreline erosion by periodically measuring the distance from a fixed point (established stake) and to vegetation line. We quantified oyster densities and survival by removing 0.25 m2 areas of oyster shell to calculate live and dead oyster densities. Small fishes and invertebrates were captured using seines, and larger fishes were collected with experimental gillnets. All fish and invertebrates were counted, measured and weighed.

Findings

- At both sites, we documented oyster recruitment and survival to reproductive size, but substantial mortality limited reef cementing and success.
- From our seine sampling, blue crabs, brown and grass shrimp, and juvenile silver perch were more abundant near breakwater reefs than mudflat controls.
- From our 10 cm gillnet sampling, spotted seatrout, drum, and flounder were substantially enhanced by oyster reefs (Figure 2). This habitat enhancement is uncommon among shoreline protection schemes and could be a vast improvement over traditional armoring techniques.
- Overall vegetation retreat and erosion rates were high across all treatments and at both sites, but was reduced by more than 40% at Alabama Port (Figure 3)

While our experimental breakwaters were an "ecology-first" approach and were successful in creating valuable habitat as seen by abundance of invertebrates and fishes on restored reefs, they did not provide the amount of protection to the shoreline that could be offered by well-engineered methodologies. Breakwater reef treatments mitigated the retreat by more than 40% at one site (Figure 3), but overall vegetation retreat and erosion rates were high across all treatments and at both sites. Rapid erosion was due to high wave energies which also reduced the vertical relief of the breakwaters. However, an approach similar to this could serve as an immediate solution to the habitat losses experienced along many sheltered coasts. "Living shoreline" approaches, including breakwater reefs, that protect coastal uplands, could provide a more ecologically-responsible alternative to traditional armoring and not only mitigate coastal erosion, but also enhance certain economically-valuable stocks (e.g. spotted seatrout and blue crabs). However, as our study demonstrated, efforts to sustainably and responsibly protect coastal shoreline habitats must balance both engineering and ecology.

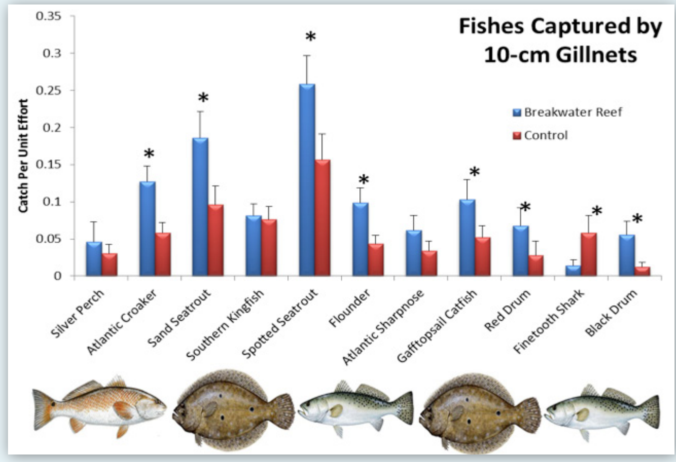

Figure 2.

Average number of fishes captured per hour by 10 cm gillnets. Notice that in most cases there are more fishes captured near the breakwater reef (blue bars) than in the control areas with no reef (red bars).

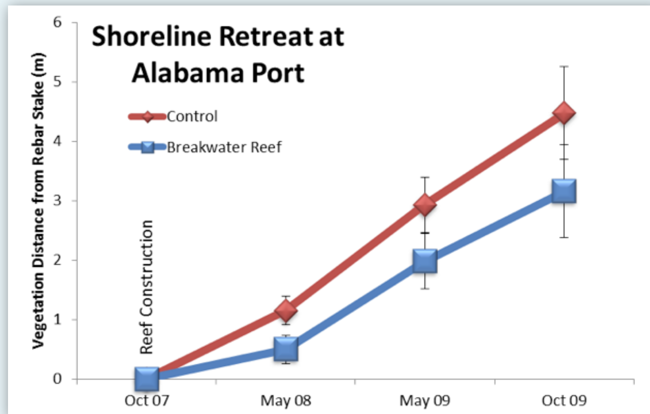

Figure 3.

This graph shows that shoreline erosion at the Alabama Port site appeared to be slowed by the presence of breakwater reefs. This was a 40% reduction over the course of the two-year study.

Publications

Scyphers, Steven B, Sean P. Powers, Kenneth L. Heck, Dorothy Byron. (In Review) Oyster reefs as natural breakwaters mitigate shoreline loss and facilitate fisheries.

Application

- Living-shoreline approaches, including breakwater reefs, that protect coastal uplands, could provide a more ecologically-responsible alternative to traditional armoring and not only reduce coastal erosion, but also enhance certain economically-valuable fisheries.

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