2007 ANNUAL REPORT
on
Reef Ball Epibenthic and Fish Habitat
Swan Creek Mitigation Wetland
ANNE ARUNDEL COUNTY, MARYLAND
April, 2008

Prepared by:
Maryland Environmental Service

Prepared for:
Maryland Port Administration

Cox Creek DMCF Location Map.

Swan Creek Mitigation Wetlands

PURPOSE

This 2007 annual report prepared by Maryland Environmental Service (MES) for Maryland Port Administration (MPA) provides an update on the monitoring and maintenance activities surrounding the Reef Ball installation at the Swan Creek Mitigation Wetland (SCMW). The Reef Balls were installed to provide shoreline stabilization, and benthic and fish habitat adjacent to SCMW. Data obtained from this project can be used to evaluate epifaunal and fish community associated with Reef Balls at SCMW and for future projects utilizing Reef Balls for mitigation and shoreline stabilization through "living shoreline" systems.

INTRODUCTION

The SCMW is located adjacent to the South Cell of the Cox Creek Dredged Material Containment Facility (CCDMCF), which is located on Kembo Road in northern Anne Arundel County on the Patapsco River (Figure 1). To compensate for the loss of 4.87 acres of Patapsco River shallow open water habitat utilized in the renovation of the CCDMCF, a mitigation plan was developed to enhance approximately 11.13 acres of wetlands in the neighboring Swan Creek watershed. Prior to restoration and enhancement of the SCMW, much of the area was devoid of tidal influence. Construction of the mitigation area occurred in 2003. The mitigation project created a tidal marsh environment that includes areas of open water, low marsh interspersed with non-vegetated tidal flats, saltbush assemblages and a preserved and enhanced beach/bar habitat.

The SCMW is located in an area prone to high energy from southeast winds. These winds accumulate over a 17-mile fetch between Anne Arundel County and Queen Anne's County on the eastern shore of Maryland. With such a large fetch the beach/bar is currently vulnerable to moderate to severe erosion. In December 2006, MES installed forty-eight (48) Reef Balls as shallow water habitat structures to assist in reducing this wave energy. In August 2007, thirty-two (32) Reef Balls were placed. In November 2007, one hundred forty-eight (148) additional Reef Balls were installed further south down the beach for additional protection. This resulted in a total of two hundred twenty-eight (228) Reef Balls installed at the site. The completed Reef Ball breakwater extends for approximately 300 ft. southward with three rows of Reef Balls.

Epibenthic Community Analysis

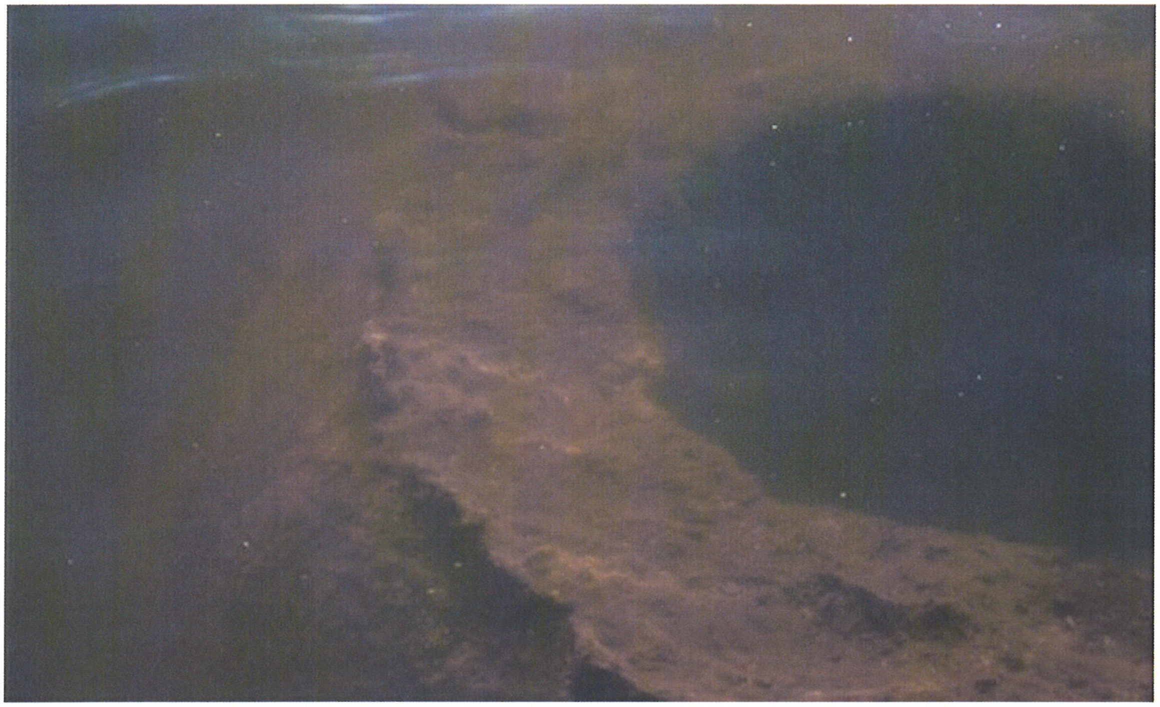
An epibenthic community is defined as plants or organisms that live attached to, but above, the substrate. The epibenthic community on the Reef Balls was qualitatively assessed by visual inspection and photographed four times during 2007 (Figures 4(a-d)) to adequately document epibenthic growth. As stated previously, quantitative analysis of the epibenthic community was not performed due to limited species diversity and costs. In addition, a mini-bay ball was removed from the line for up close evaluation. Initial observations during the January 2007 (48 Reef Balls) monitoring showed limited epibenthic growth, mostly due to winter dormancy and cold water. As the season progressed and the water warmed, the epibenthic growth increased. In the March 2007 observations, algal growth had increased with filamentous algae covering the bottom holes of the Reef Ball, but not yet covering the ball completely. Small invertebrates, such as amphipods and worms, were also observed on the surface. By mid-late summer (August-October 2007/196 reef balls) the epibenthic community had completely covered the Reef Balls, making the aggregate surface of the Reef Balls only visible during close inspection. The Reef Ball was covered with filamentous algae, in addition to small populations of amphipods, worms and a mud crab.

The current monitoring plan calls for qualitative observations of the epibenthic community of the reef balls. Should the diversity of the epibenthic coverage increase, a quantitative analysis could be considered.

Figure 4(a): March 2007 Reef Ball Epibenthic Growth

This photograph was taken in March 2007 to document the epibenthic community that colonized the reef balls following deployment in December 2006. This close-up shot shows a small community of filamentous algae attached to the aggregated surface. The small population of epibenthics during this sampling event may be due to cold-water temperatures.

Figure 4(b): August 2007 Reef Ball Epibenthic Growth



This photograph was taken in August 2007 and shows the epibenthic community attached to the crown of a Bay Ball. The aggregated surface is covered with filamentous algae and small invertebrates. This Reef Ball is one of the original balls installed during November 2006.

Figure 4(c): August 2007 Reef Ball Epibenthic Growth

This photograph was taken on August 10, 2007 and documents the epibenthic community on a Reef Ball from the second installation in August 2007. Small populations of filamentous algae are visible on the crown of the Reef Ball.

Figure 4(d): October 2007 Reef Ball Epibenthic Growth and Fish Grazing

This photograph was taken on October 10, 2007 to document the epibenthic community on a Reef Ball from the original installation in December 2006. Small fish, mostly mummichogs (*Fundulus heteroclitus)*, can be seen grazing on the surface.

3.5 Fish Community Analysis

Fish community analysis was conducted in May, June, August, and October 2007 utilizing a 30-foot seine net with 1/8-inch mesh. Sampling occurred in 4 separate seine transects (Figure 5(a)) on the eastern and western aspect of the Reef Balls during high tide. Two seine transects were utilized as controls, south of the Reef Ball line and one along the jetty (Figure 5(b)). In seines 1 and 2, the net was drawn from the center of the interior of the Reef Balls to the end and then back to the beach for collection. In seines 3 and 4, the net was drawn from the center of the exterior of the Reef Balls to the end and then back to the beach for final collection. In seine 5 (open water control), the net was drawn from 20 yards off shore, down the beach 40 yards and back to the beach for collection. In seine 6 (jetty), the net was drawn from the beach, out around the tip of the jetty, and back to the beach for collection.

Figure 5(a): Reef Ball Seine Location and Direction

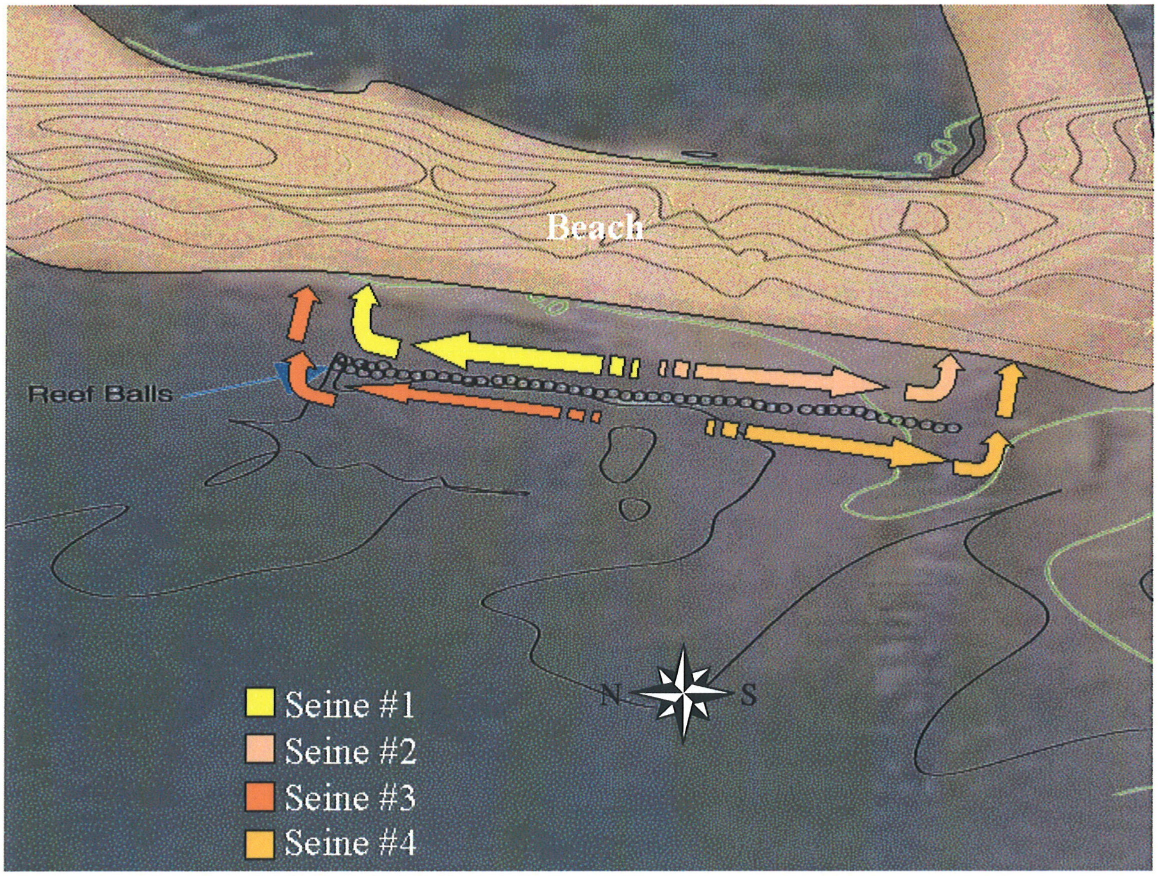
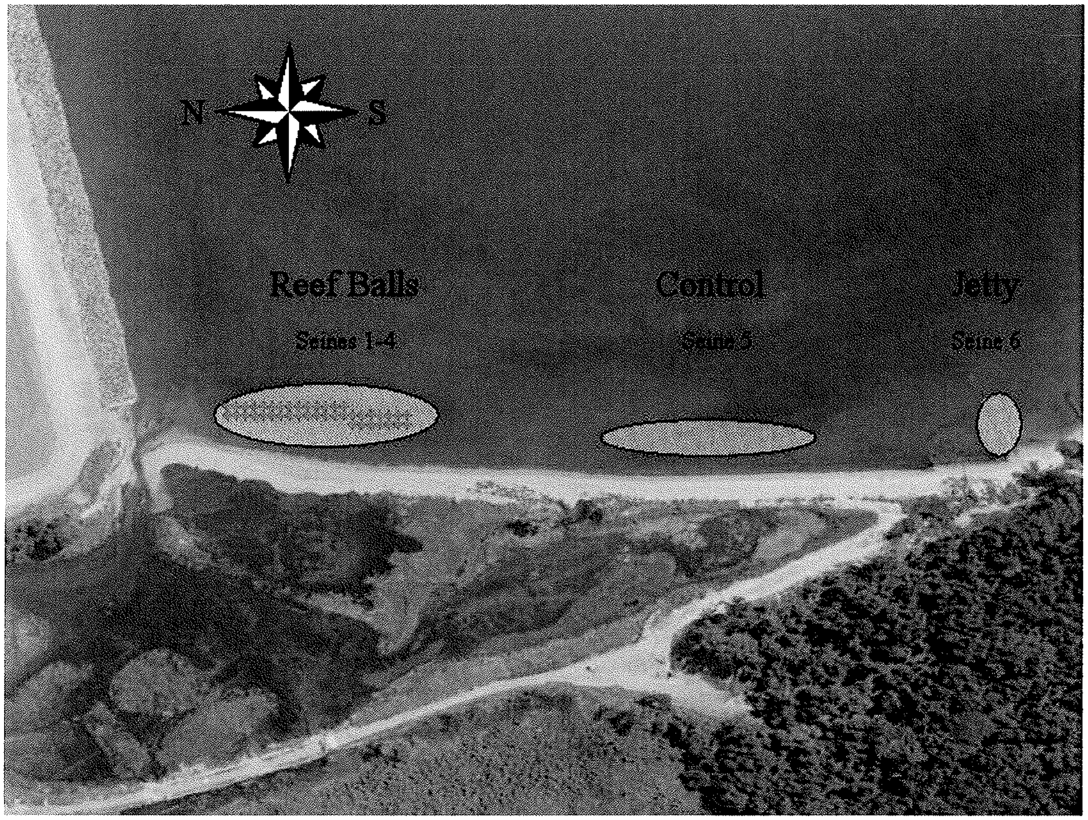


Figure 5(b): **Seine Locations**



Analysis of the fisheries data collected (Table 1) from the four seine sites provides important data on the success of Reef Balls as habitat. Seventeen species of fish, aquatic crustaceans and assorted aquatic insects were captured during the monitoring events. The most abundant fish captured in the seines adjacent to the Reef Balls relative to the control, were bay anchovy (*Anchoa mitchilli*). The bay anchovy, a small, schooling fish, is one of the most abundant species of fish native to the Chesapeake Bay. It is a planktivore (eats plankton) and is a major food of predatory fish, making it a key species in the Bay's food web. Comparing the data of the seven most abundant finfish species shows the trend of fish population throughout the year. In mid-late summer (August-October) total fish usage of the Reef Balls increased, most likely due to the natural migratory cycle of these species (Figure 6). A comparison of the habitat types and fish preferences shows smaller numbers of anchovies, silversides, white perch, and striped bass captured in the control seines (no structures) versus Reef Ball seines (structure). Beginning in August 2007, the stone jetty in the cove was also sampled to compare to the Reef Ball breakwater and open water control. Comparing the two submerged structures (Reef Balls and jetty) shows differences between the Reef Ball line, open water controls, and jetty (Figure 7). Although sampling of the jetty didn't occur until August 2007, it appears that structures in the cove (Reef Ball, jetty) are preferred habitat for fish relative to open water, with the Reef Balls showing increased abundance and more species diversity (Table 2) than the control or jetty.

Table 1: Total Individuals (N) Captured along Reef Balls 2007

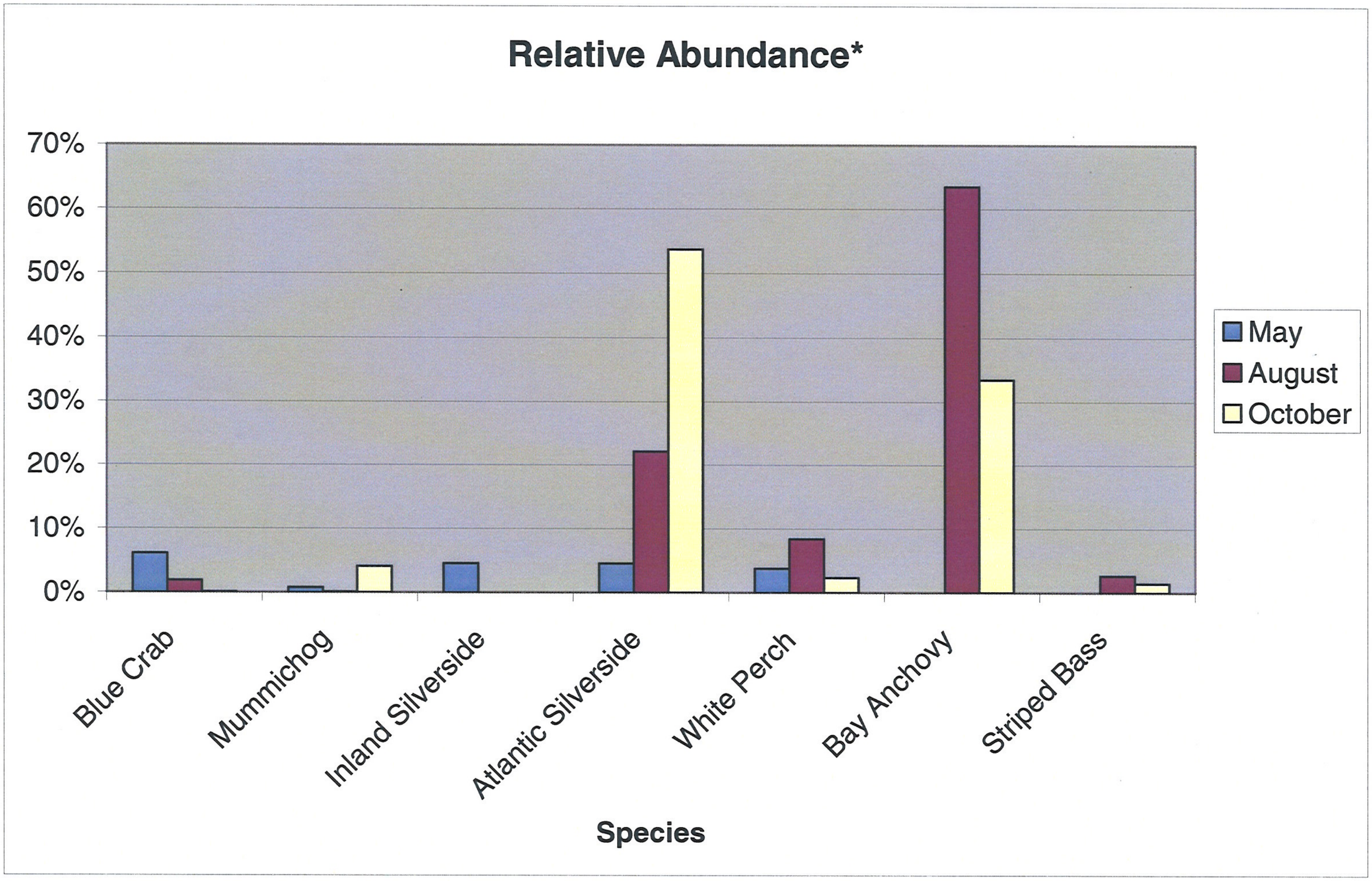
Scientific Name	Common Name	May	June	August	October	Total
Callinectes sapidus	Blue Crab	8	10	24	1	43
Fundulus heteroclitus	Mummichog	1	0	1	30	32
Cyprinodon variegatus	Sheepshead Minnow	0	0	3	0	3
Fundulus majalis	Striped Killifish	2	14	4	13	33
Fundulus diaphanus	Banded Killifish	0	0	1	13	14
Lucania parva	Rainwater Killifish	0	0	2	1	3
Lepomis gibbosus	Pumpkinseed Sunfish	1	0	0	1	2
Menidia beryllina	Inland Silverside	6	0	0	0	6
Menidia menidia	Atlantic Silverside	6	0	252	484	742
Morone americana	White Perch	5	23	72	14	114
Morone saxatilis	Striped Bass	0	0	27	5	32
Micropogonias undulatus	Atlantic Croaker	0	0	1	0	1
Palaemonetes pugio	Grass Shrimp	32	32	0	0	64
Anchoa hepsetus	Bay Anchovy	0	700	769	320	1789
Pomolobus pseudoharengus	Alwife	0	0	4	5	9
Not identified to species	Amphipod spp.	9	0	0	1	10
Cnetofora not identified to species	Jellyfish spp.	0	0	1	1	2
Not identified juveniles <10 mm	Juvenile spp. fish	54	0	0	0	54
		124	779	1161	889	**2953**

Table 2: Species Diversity Measured in 2007 at the SCMW

Seining Date	Avg. # Species, Reef Balls	Avg. # Species, Control	Avg. # Species, Jetty
5/1/2007	5.7	2.0	N/S
6/6/2007	5.0	2.0	N/S
8/10/2007	7.5	5.0	3.0
10/10/2007	7.2	7.0	8.0
Average	6.3	4.0	5.5

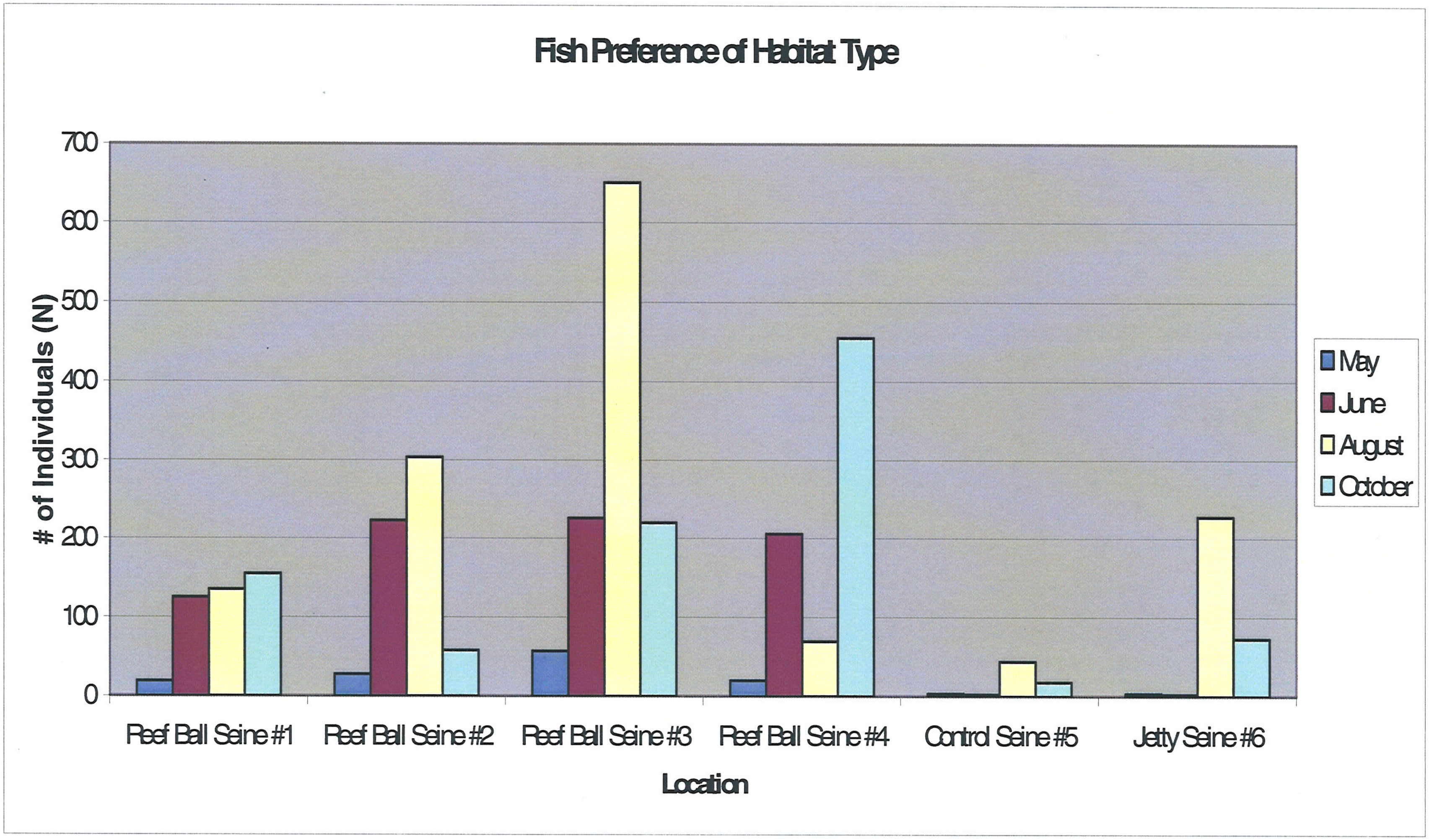
N/S: The jetty was not sampled in May and June

Figure 6: Relative Abundance - Population Trend of the Seven Most Abundant Species in 2007 at the Swan Creek Mitigation Wetland



* Relative Abundance – The number of each species relative to the number of each species identified.

Figure 7: Fish Preferences – Habitat type in 2007 at the Swan Creek Mitigation Wetland (Note: the jetty was not sampled in May and June)

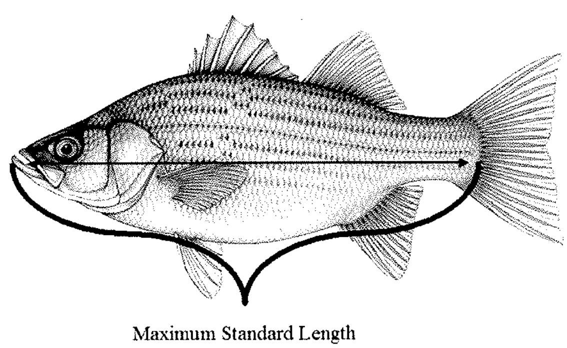


Maximum Standard Length (MSL) was measured to obtain data on age structure of fish using the Reef Balls. Maximum Standard Length is used to estimate the age of the fish as a reference to age structure. The measurements in Figure 8 show the average length in centimeters of several captured species in the monitoring events.

Figure 8: Maximum Standard Length (average all monitoring events)

Scientific Name	Morone americana	Morone saxatilis	Lepomis gibbosus	Fundulus majalis	Fundulus heteroclitus
Common Name	White Perch	Striped Bass	Pumpkinseed	Killifish	Mummichog
Avg. MSL in cm	7.44	5.53	7.43	7.29	3.60
Age Structure	Adult	Juvenile (yoy)*	Adult	Adult	Adult

* Young-of-the-Year



CONCLUSIONS AND RECOMMENDATIONS

The Reef Ball breakwater system at the Swan Creek Mitigation Wetland area was completed in November 2007. It consists of two hundred and twenty eight (228) Reef Balls, in three rows, extending approximately 300 ft. southward. Biological analysis showed abundant epibenthic coverage, however diversity was limited, consisting mainly of algae. Although sampling of the jetty didn't occur until August 2007, data from seine sampling performed in 2007 for fish usage indicates more abundance and species diversity in the vicinity of the Reef Balls than the control or jetty, providing improved habitat value in the area.