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Stormwater Management Database for the City of Dover, New Hampshire

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Restoration of Oyster (*Crassostrea virginica*) Habitat for Multiple Estuarine Species Benefits

A Final Report to

The Piscataqua Region Estuaries Partnership

Submitted by

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PISCATAQUA REGION Estuaries Partnership

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Abstract

The overall goal of the project was to make a significant contribution to the Piscataqua Region Estuaries Partnership goal of increasing oyster (*Crassostrea virginica*) bottom in New Hampshire, and to do so using methods that positively affect multiple species. The focus was on those organisms (mainly macroalgae, invertebrates, and fish) that spend most of their time on oyster reefs—the resident species. A 0.5 hectare (1.25 acres) area was restored in August 2007 by constructing twelve mini-reefs (each ~6 m in diameter) in an area protected from harvest using spat-on-shell ("spat seeding") from remotely set larvae. There was a consistent trend over time of higher oyster densities on the mini-reefs and on the natural reef within the protected area compared to the adjacent unprotected natural reef. At the end of the project period (1.8 years post-construction of the mini-reefs), total oyster densities in the overall restoration area were about 26% higher than the adjacent unprotected reef. The constructed mini-reefs also consistently had higher total densities and biomass of resident animals, which consisted mainly of invertebrates (only one fish was captured over the entire study), compared to the other reef areas. A total of 15 species of invertebrates were collected from the mini-reefs compared to 10 and 11 species, respectively, from the natural reef in the restored area and the natural reef in the harvested area. The resident (attached) macroalgae community patterns over time indicated higher biomass on the mini-reefs and the protected natural reefs compared to the unprotected reef area on most sampling dates, though there was typically wide variability among replicates. Macroalgal taxonomic richness was similar in all three areas, and there was a total of fourteen species collected from the three areas. Overall, the project resulted in enhancement of oyster reef habitat within the 0.5 hectare restoration area, and characterized the substantial value of oyster reefs in providing habitat for a variety of plant and animal species.

Executive Summary

The Piscataqua Region Estuaries Partnership (PREP) has a goal of restoring 20 acres of oyster (*Crassostrea virginica*) bottom in New Hampshire by 2010. Historically, oysters have been viewed mainly as a food resource for humans, and this has been the main concern of management agencies. Recently, however, there has been increasing emphasis on the broader ecological importance of oysters, particularly in the context of ongoing restoration programs. The present project was designed to restore oyster bottom using methods that positively affected multiple species, with the focus on those organisms (mainly macroalgae, invertebrates, and demersal fish) that spend most of their time on oyster reefs—the resident species.

The project consisted of five work tasks: produce oyster spat-on-shell; construct replicate mini-reefs in the overall restoration area; assess development of the mini-reefs; assess performance of the mini-reefs; and determine success of restoration project. The project had two major deliverables: restoration of 0.5 hectare (1.25 acres) of oyster reef habitat; and quantification of the benefits of the restored area to resident plant, invertebrate, and demersal fish species.

The mini-reefs, the unharvested natural reef inside the restoration area, and the adjacent natural reef open to harvest were sampled on six occasions over the 1.8-year project period (ending in May 2008) using a box corer with a 0.1 m^2 sampling area. All live oysters were counted and measured; all plants, invertebrates and fish were identified, counted, and weighed then returned to the estuary.

At the end of the project period (1.8 years post-construction of the mini-reefs) the mean densities of oysters on the mini-reefs, the protected natural reef, and the unprotected natural reef were, respectively, 273/m^2, 238/m^2, and 203/m^2. Thus, oyster densities in the 0.5 hectare restoration area overall were about 26% greater (255 oysters/m^2 compared to 203/m^2) than the adjacent natural reef open to harvest. This increase in density corresponds to approximately 260,000 additional oysters (52 oysters/m^2 x 5,000 m^2) in the overall restoration area at the end of the project period.

The mini-reefs consistently had higher total densities and biomass of resident animals, which consisted mainly of invertebrates (only one fish was captured over the entire study), compared to the other reef areas. A total of 15 species of invertebrates were collected from the mini-reefs compared to 10 and 11 species, respectively, from the natural reef in the restored area and the natural reef in the harvested area. The resident (attached) macroalgae community patterns over time consistently indicated higher biomass on the mini-reefs and the protected natural reefs compared to the unprotected reef area, though there was typically wide variability among replicates on each sampling date. Taxonomic richness was similar in all three areas, and there was a total of fourteen algal species collected from the three areas.

The project achieved the goal of restoring 0.5 hectare (1.25 acres) of shellfish habitat, and the restored area had enhanced habitat value for other species compared to the adjacent natural reef. It is emphasized, however, that this project should only be considered an initial restoration effort. An adaptive approach consisting of ongoing monitoring and possibly additional restoration activities (e.g., addition of shell and/or spat-on-shell) is recommended if the goal is long-term sustainability of oyster reefs.

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Introduction

The Piscataqua Region Estuaries Partnership (PREP) has a goal of restoring 20 acres of oyster (*Crassostrea virginica*) bottom in New Hampshire by 2010 (Trowbridge 2003). Historically, oysters have been viewed mainly as a food resource for humans, and this has been the main concern of management agencies. Recently, however, there has been increasing emphasis on the broader ecological importance of oysters, particularly in the context of ongoing restoration programs (Brumbaugh et al. 2006; Grabowski and Peterson 2007; Brumbaugh and Toropova 2008). Thus, oyster restoration projects sometimes are explicitly aimed at restoration of ecological functions, which can involve water filtration, food for other animals, and creation of structurally complex habitat that supports other species (Newell 1988, 2004; Kennedy 1996; Grizzle et al. 2006, 2008; Coen et al. 1999a, 2007). These ecological benefits mainly result when oysters occur in densities sufficient to be considered living reefs. Therefore, restoration of oysters in a manner that results in reef formation is expected to produce ecological benefits potentially affecting many other species.

Nearly all research on plant and animal communities associated with eastern oyster reefs has been done in estuaries in the mid- and southern Atlantic regions and the Gulf of Mexico. Studies in these areas have repeatedly shown enhanced abundances and biomass of a variety of other species on oyster reefs compared to adjacent areas without oysters (Wells 1961; Galtsoff 1964; Bahr and Lanier 1981; Luckenbach et al. 2005; Coen and Grizzle 2007). In contrast, there is little information on the plant and animal communities associated with oyster reefs in New England (Odell et al. 2006). Our observations on restored and natural reefs in the Great Bay estuarine system, however, indicate that many species of plants, invertebrates, and fish commonly occur in and around the reefs. The present project characterized the early development of oyster populations and the resident plants and animals that occurred on newly constructed (restored) oyster reefs compared to natural degraded reef areas at a site in Great Bay, New Hampshire.

Project Goals, Objectives, and Deliverables

The overall goal of the project was to make a significant contribution to the PREP goal of increasing oyster bottom in New Hampshire (Trowbridge 2003), and to do so using methods that positively affect multiple species. The focus was on those organisms (mainly macroalgae, demersal fish, and invertebrates) that spend most of their time on oyster reefs—the resident species. This goal was addressed by accomplishing five major work tasks (objectives).

Task 1. Produce oyster spat-on-shell.
Task 2. Construct mini-reefs.
Task 3. Assess development of mini-reefs.
Task 4. Assess performance of mini-reefs.
Task 5. Determine success of restoration project.

The project had two major deliverables, briefly described as follows with their associated work tasks.

Deliverable 1: Restoration of 0.5 hectare (1.25 acres) of oyster reef habitat (Tasks 1 and 2)

Deliverable 2: Quantification of the benefits of the restored area to associated plant, invertebrate, and demersal fish species (Tasks 3, 4 and 5)

Methods

Project location and site characterization

The project location was on the eastern edge of an oyster reef typically referred to as "Nannie Island North" or "Woodman Point." Figure 1 is a composite map showing historical eelgrass (*Zostera marina*) distributions and the boundaries of bottom area that have been mapped as predominantly "oyster bottom" (two red polygons) in recent years. The restoration area for the present project (orange box) covered about 0.7 hectare (1.75 acres) and included about 0.4 hectare (1 acre) of a 1.0 hectare (2.5 acre) area previously permitted for oyster restoration in 2004 (Grizzle et al. 2006). Thus, only 0.5 hectare (1.25 acres) of this area was considered to be new restored oyster habitat at the completion of the project.

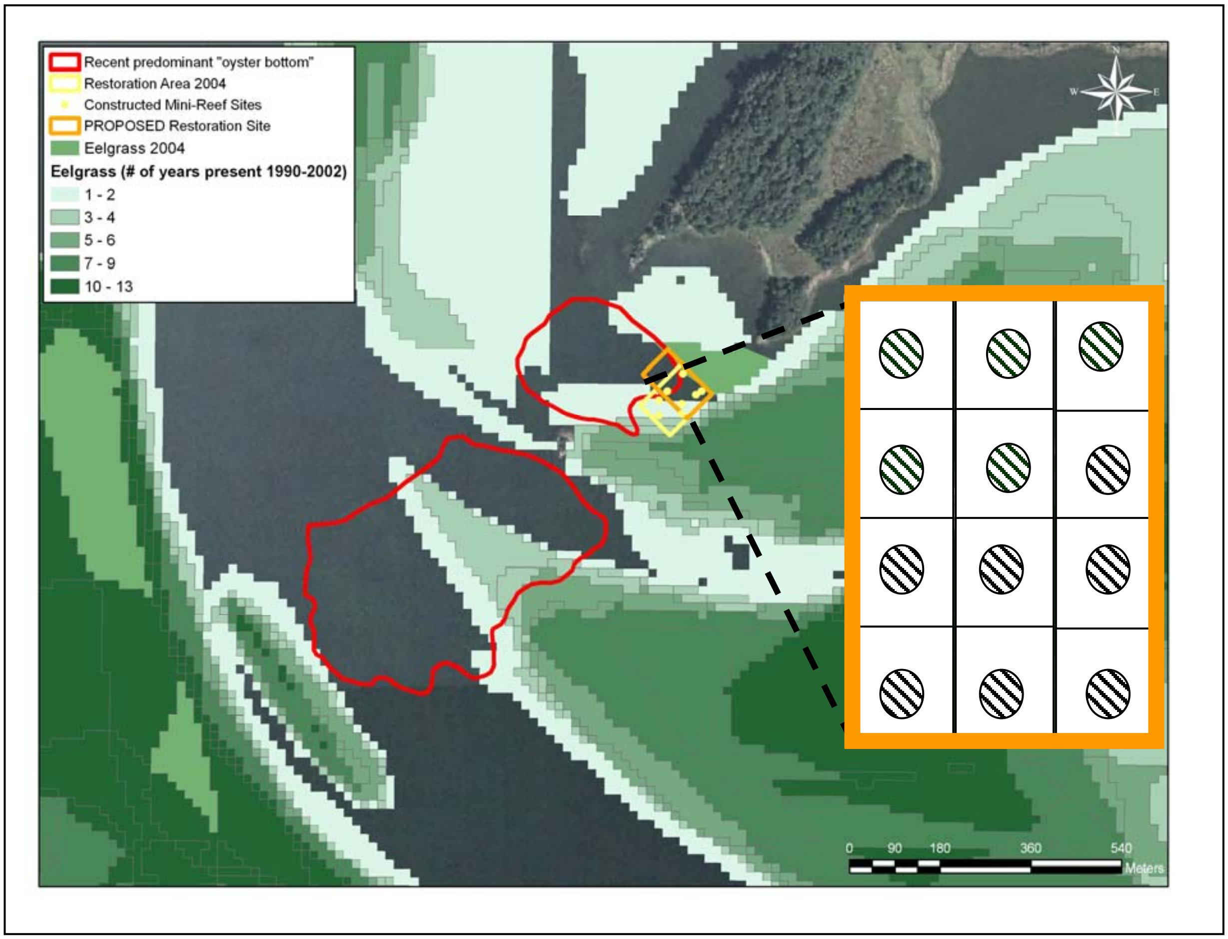

Figure 1. Location of restoration area for the present project (orange box) in relation to existing "oyster bottom" (two red polygons) and historical occurrences of eelgrass (green polygons). The inset orange box shows twelve mini-reefs constructed in 2007 for the present project. The restoration area for a previous project is delimited by the yellow box which contains eight yellow dots showing the locations of eight mini-reef areas constructed in 2004. Eelgrass data were provided by P. Trowbridge.

The natural oyster reef (red polygon in Fig. 1) within the boundaries of the present restoration area (orange box) consisted of scattered clumps of live oysters among dead shells. The general area had an average density of 12.5 live oysters/m^2 (all size classes included) based on multiple sampling occasions in 2005 and 2006 (Grizzle et al. 2006). Towed video imagery over the same period indicated patchy shell (live and dead combined) coverage but probably averaging less than 50% in the overall restoration area; see Fig. 2 for example stills from recent video imagery from the natural reef in the general vicinity of the present restoration area. These data confirmed the persistent degraded condition of this area since at least the late 1990s (Langan 2000; Trowbridge 2005).

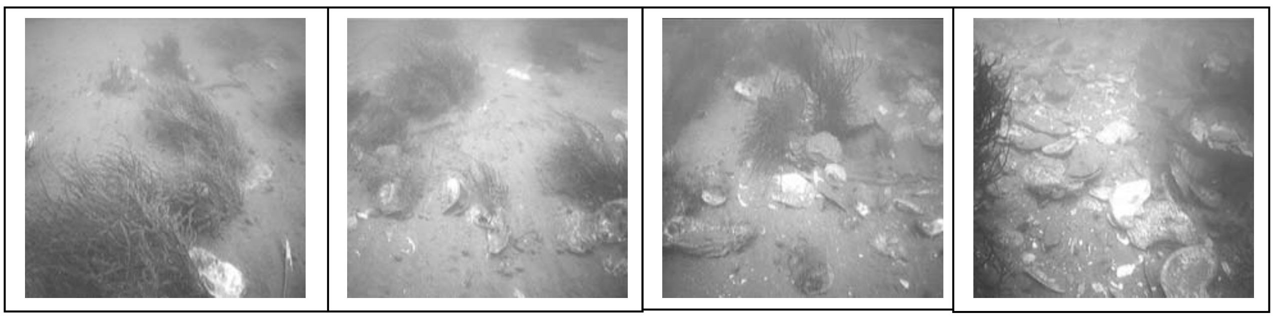

Figure 2. Video stills from imagery taken on 13 September 2006 in the vicinity of the present restoration area showing the general condition of the degraded natural reef and the range of shell coverages from <10% (far left) to ~50% (far right). Note macroalgae clumps in several areas.

Overall project design

The general restoration protocol was based on the recommendations in Grizzle et al. (2006), and consisted mainly of placement of oyster spat-on-shell produced by remote setting (Task1 in the Methods section below). The overall study (experimental) design was a single-factor (reef type: constructed, natural protected, and natural unprotected) with multiple constructed mini-reefs in the restoration area (Fig. 1). This design allowed comparisons to be made between the constructed mini-reefs, the natural reef areas between the mini-reefs that were protected from harvest, and the natural reef immediately west of the restoration area that was open for harvest.

The overall aim of the project with respect to assessing success was twofold: (1) to assess development of the constructed mini-reefs and adjacent protected areas (the restoration area) compared to the unprotected natural reef areas (see Task 3 below); and (2) to assess development of the resident plant and animal communities in the restoration area compared to the unprotected natural reef areas (Task 4). These two aims were formally addressed by testing the following two hypotheses (Task 5).

Hypothesis H_1: The restoration area provides enhanced oyster reef habitat (based on total oyster density) compared to the adjacent natural unprotected and potentially harvested oyster reef.

Hypothesis H_2: The restoration area provides enhanced habitat for plant (macroalgae) and animal (invertebrates and demersal fish) species compared to the adjacent natural unprotected and potentially harvested oyster reef.

Methods by work task

Task 1. Produce oyster spat-on-shell. Seawater tanks at Jackson Estuarine Laboratory (JEL) were used to remotely set (during early August 2007) ~6,000,000 hatchery-reared oyster larvae to produce spat-on-shell for reef construction (Task 2) following the general methods described in Castagna et al. (1996) and Supan et al. (1999); see Grizzle et al. (2006) for details on JEL setting tanks. Approximately 21,500 oyster shells obtained from our ongoing shell recycling program were used as cultch material, and oyster larvae were from fast-growth, disease-resistant oyster broodstock supplied by Muscongus Bay Aquaculture (Bremen, Maine).

Task 2. Construct mini-reefs. A total of twelve (12) mini-reefs were constructed on August 14 and 15, 2007 following the overall design layout shown in Figure 1. Each mini-reef was constructed by manually spreading a thin layer of spat-on-shell (from Task 1) over a 30 m^2 area (~6 m diameter circular area), resulting in a total of 360 m^2 covered by spat-on-shell in the overall 0.5-hectare (1.25 acres) restoration area.

Task 3. Assess development of mini-reefs. Development of the mini-reefs was assessed by sampling immediately after construction in the fall of 2007 (August 30, September 18 and November 27), the following spring and fall of 2008 (May 8 and 20, July 8, September 16 and November 17), and spring 2009 (May 26). On each sampling occasion, four to six replicate box corer (with a 0.1 m^2 sampling area; see design details in Task 4) samples were taken from each of the three study areas (mini-reefs, unharvested natural reef inside the protected restoration area, and adjacent natural unprotected reef open to harvest). All live oysters were counted and measured (shell height to nearest mm with calipers), then returned to the estuary.

The primary aim of this task was to test Hypothesis H_1 (see above). Because of the wide variability among samples, but a consistent trend in relative oyster densities over time (see below), it was decided to run ANOVA on the overall means of means from each of the time series of samples from the three reef types. Other dependent variables (e.g., oyster size, other bivalve taxa) were only compared graphically, and in the context of assessing the overall success of the project (see Task 5).

Task 4. Assess performance of mini-reefs. Performance here refers to the colonization of the constructed oyster mini-reefs by other plant and animal species that spend most of their life on the reef—the resident species. These organisms are typically sampled using a box or tray that is placed into the reef structure in the initial construction phase and allows the removal of oysters, sediments, and all associated organisms as an intact unit (Coen et al. 1999b; Posey et al. 1999; Rodney and Paynter 2006; see brief review by Brumbaugh et al. 2006). The present project, however, required direct comparisons of data from all three reef types, and thus the use of the same sampling method in all three areas. A custom-made coring device consisting of a box open only on one end was used to sample all three areas. All samples taken for assessing reef development (Task 3) were further processed to assess reef performance.

On each sampling occasion, the open end of the box corer was inserted into the reef to just below the sediment/shell surface, and a steel plate on a pivot arm was used to close off the bottom sealing the sample inside the box. The box contents were washed on a 5 mm mesh sieve and all plants and animals (fish and invertebrates) were removed, placed into a plastic bag, and refrigerated until processed. In the laboratory, all organisms were sorted to the lowest taxonomic level practical (species in most cases), counted, and weighed (wet weight), and returned to the estuary. The resulting data were used to test Hypothesis H_2 using the methods described in Task 3 but for the following dependent variables: resident community taxa, densities, and biomass.

Task 5. Determine success of the project. This task consisted of an assessment of the development and performance data from Tasks 3 and 4 in the context of the two project deliverables, and with respect to the potential need for further reef enhancement actions.

Results and Discussion

Task 1. Produce oyster spat-on-shell for mini-reef construction. A total of approximately 4,000,000 spat-on-shell resulted from the 1-week long remote setting process in early August 2007. This represents a 50% setting success rate (based on 8,000,000 eyed larvae initially placed in the tanks). Although counts were not made during the interval between the remote setting process and mini-reef construction (Task 2), counts made on the mini-reefs on August 30 (Task 3) indicate that a total of at least 1,500,000 spat-on-shell were probably placed into the overall restoration area.

Task 2. Construct mini-reefs in restoration area. The initial mini-reef construction process (conducted on August 13 and 14, 2007) resulted in a total of 360 m^2 of bottom area covered by spat-on-shell, representing 7.2% of the total 0.5-hectare (1.25 acres) restoration area. Assuming 1,500,000 live spat were used in constructing the 12 mini-reefs, the initial average live spat density was ~4,000/m^2. Spat size was not measured until September 18, 2007 (see Task 3), but those data suggest an initial spat size of about 1.5 mm shell height.

Based on previous oyster restoration efforts in New Hampshire, including the previous project in the present restoration area (Fig. 1), the target for the present project was to cover at least 5% of the restoration area with oyster spat at a density of 200/m^2 to 500/m^2. This criterion was also based on cost and other constraints, as discussed in Grizzle et al. (2006). Both construction criteria targets were met.

Task 3. Assess development of mini-reefs. This task had two aims: (1) compare development over time of the oyster populations on the constructed mini-reefs with the natural reef within the overall protected restoration area and the adjacent unprotected natural reef potentially exposed to harvest; and (2) test Hypothesis H_1 which compared oyster densities in the three areas.

The first sampling of the mini-reefs for comparison to the other reef areas occurred on November 27, 2007, 3.5 months after construction of the mini-reefs. At that time, however, only the natural unprotected reef was also sampled (concurrent sampling of all three reef areas did not commence until July 2008). Densities on the mini-reefs at 3.5 months post-construction averaged 432 oysters/m^2 compared to 180/m^2 in the unprotected area (Fig. 3). Most of the oysters on the mini-reefs were $<$ 50 mm shell height indicating that the oyster population on the mini-reefs consisted mainly of the initially seeded spat-on-shell, as expected (Appendix A). These data also indicated that substantial mortality had occurred on the mini-reefs; ~90% loss had occurred if an initial planting density of 4,000/m^2 is assumed (see Task 2).

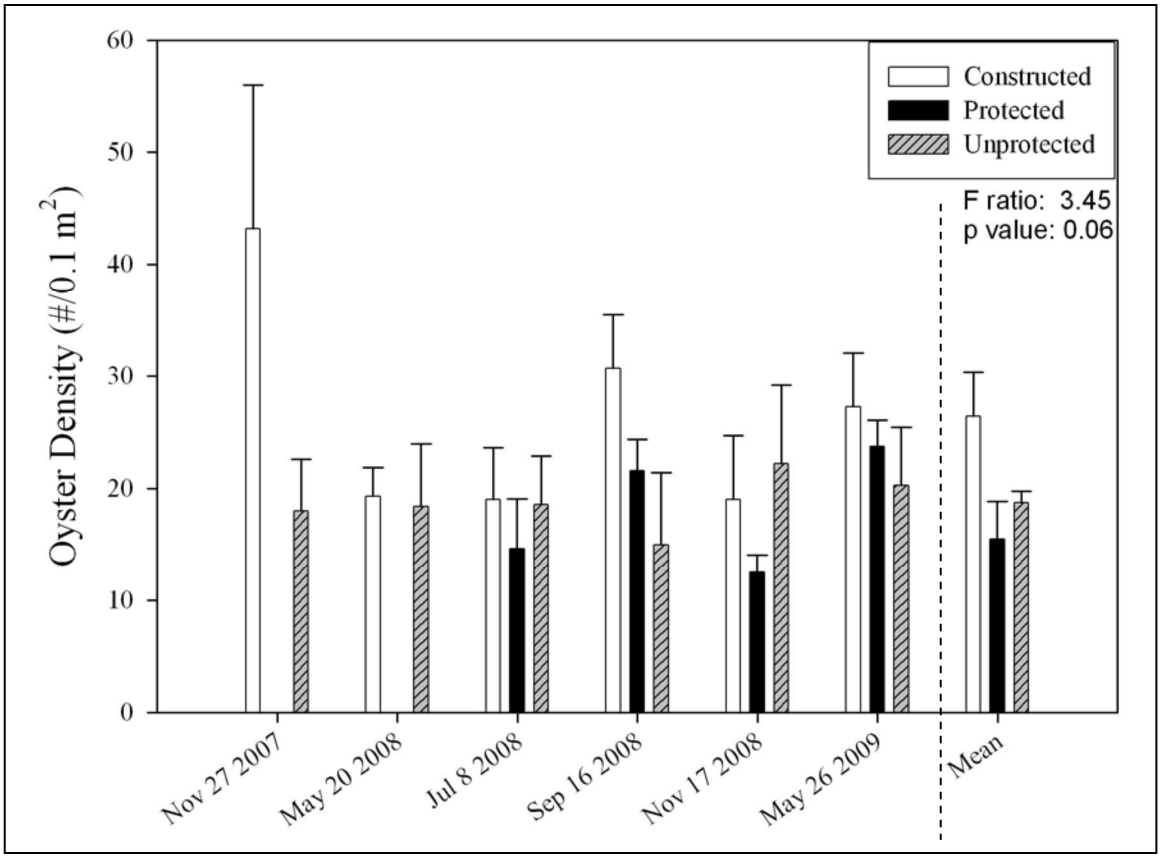

Fig. 3. Mean total oyster densities (1 SE shown) in all three reef types by date. ANOVA results (F and *P*) shown only for means of means from all sampling dates (bars labeled "Mean" on far right).

Visual inspection of the time series of samples taken from the three areas indicated total oyster densities on the mini-reefs at least somewhat higher than the other two areas for all but one of the six sampling periods (Fig. 3). However, there was substantial variability among the samples and thus wide error bars on most occasions, due in part to small sample sizes (n= 4 to 6). Therefore, in order to provide a test of Hypothesis H_1—the restoration area provides enhanced oyster reef habitat compared to the adjacent natural unprotected and potentially harvested oyster reef—in the context of the overall study period, ANOVA was run on a dataset consisting of means of means. In other words, the means of each of the three time series of means were calculated: constructed mini-reefs = 264 oysters/m^2; protected area = 181 oysters/m^2; and unprotected area = 188 oysters/m^2. ANOVA conducted on these three means indicated marginally significant differences (P = 0.06), among the three; no post-hoc tests were run.

To set these data in broader context, it should be noted that many areas of the Great Bay Estuary, including all three areas in the present study, experienced an unusually high natural spat set in 2006 (Trowbridge 2009). This event was of sufficient magnitude (~10x typical natural sets) to at least partially overshadow the enhancements made by spat seeding because of the high early mortality rates of the spat-on-shell (Fig. 3). Even so, the mini-reefs maintained elevated total oyster densities throughout the 1.8-year study period.

Task 4. Assess performance of the mini-reefs. The constructed mini-reefs consistently had higher total densities and biomass of resident animals, which consisted mainly of invertebrates (only one fish was captured over the entire study), compared to the other reef areas (**Fig. 4**; see Appendix B for raw data and list of all taxa collected). A total of 15 species of invertebrates were collected from the mini-reefs compared to 10 and 11 species, respectively, from the natural reef in the restored area and the natural reef in the harvested area.

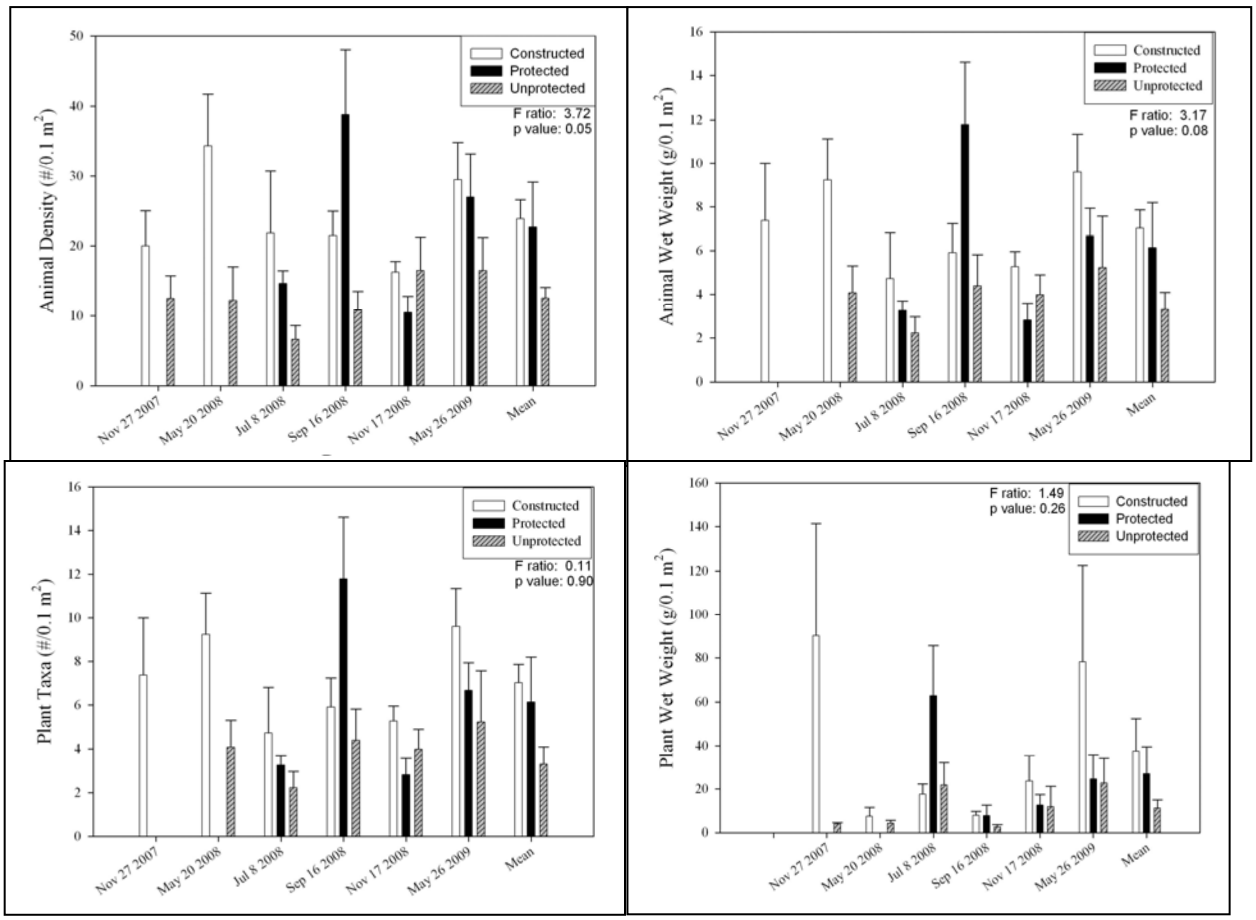

Fig. 4. Total resident animals (invertebrates only) and plants (macroalgae) collected from the three reef types by date; ANOVA (F and *P* values shown) run only on means of means from all sampling dates (bars on far right).

Inspection of the data on resident invertebrates and plants showed consistent trends of higher total densities, biomass, and taxonomic richness on the constructed mini-reefs and in the protected restoration area compared to the unprotected reef over most sampling dates (Fig. 4). As discussed in Task 3 for oyster densities, there was substantial variability among the samples and thus wide error bars on most occasions, due in part to small sample sizes (n= 4 to 6). Therefore, in order to provide a test of Hypothesis H_2—the restoration area provides enhanced habitat for plant and animal species compared to the adjacent natural unprotected and potentially harvested oyster reef—in the context of the overall study period, ANOVA was run on a dataset consisting of means of means.

ANOVAs on the means of means indicated marginally significant differences for invertebrate density (P=0.05) and wet weight (P=0.08). Although similar overall trends were observed for plant taxonomic richness (total taxa collected) and plant biomass (wet weight), there were no significant differences among the three reef types. A total of fourteen species were collected from the three reef types (Appendix B).

Task 5. Determine success of restoration project. The overall goal of the project was to make a significant contribution to the PREP goal of increasing oyster bottom in New Hampshire (Trowbridge 2003), and to do so using methods that positively affect multiple species. This goal was reflected in the project's two major deliverables: restoration of 0.5 hectare (1.25 acres) of oyster reef habitat, and quantification of the benefits of the restored area to associated plant, invertebrate, and demersal fish species.
Both deliverables were achieved.

At the end of the project period (1.8 years post-construction of the mini-reefs) the mean densities of oysters on the mini-reefs, the protected natural reef, and the unprotected natural reef were, respectively, 273/m^2, 238/m^2, and 203/m^2 (Fig. 3). Thus, oyster densities in the 0.5 hectare restoration area overall were about 26% greater (255 oysters/m^2 compared to 203/m^2) than the adjacent natural reef open to harvest. This increase in density corresponds to approximately 260,000 additional oysters (52 oysters/m^2 x 5,000 m^2) in the overall restoration area at the end of the project period compared to an equivalent 0.5 hectare unprotected area adjacent to the protected restoration area.

As already briefly discussed (see Task 3), the live oyster densities in the general Nannie Island area on all oyster bottom has increased dramatically, about 10-fold in some cases, compared to pre-2006 levels due to the 2006 natural spat set (Trowbridge 2009). Samples taken in the general area in 2005 and 2006 had average densities of <15 oysters/m^2 (Grizzle et al. 2006). Thus, when the first samples were taken after the mini-reefs were constructed the degraded natural reefs had already attained extraordinarily high densities compared to most other areas of Great Bay. Secondly, although the spat-on-shell on the mini-reefs suffered very high initial mortalities, substantial numbers survived for the 1.8 years of the project. These surviving spat probably represent most of the increased total oyster densities on the mini-reefs compared to the natural reefs. In any case, deliverable 1—restoration of 0.5 hectare (1.25 acres) of oyster reef habitat—was achieved.

A second major focus of the project was to assess the benefits of the restored area to associated plant, invertebrate, and demersal fish species. Oyster reefs in the mid-Atlantic and southeastern estuaries have been shown to provide enhanced habitat for many invertebrates and fish, both resident and transient species (see reviews by Bahr and Lanier 1981; Coen et al. 1999a; Coen and Grizzle 2007). The present project confirmed this trend for invertebrates but not fish. Surprisingly, only one fish was collected during the entire study. This result, however, mainly may have been due to the sampling methods. The box corer used in the present study was a custom-made unit, and there is no way to compare its effectiveness for sampling fish to other methods more typically used (Wenner et al. 1996). In any case, our results strongly suggest that different methods should be used in future studies to assess fish use of oyster reefs.

In contrast to the results for resident fish, all three reef areas had substantial densities, biomass, and taxonomic richness of invertebrates. And the restoration area in general (combined data from mini-reefs and immediately surrounding areas of natural reef) provided substantially and significantly greater habitat value for invertebrates and plants. A total of 15 species of invertebrates were collected from the mini-reefs compared to 10 and

11 species, respectively, from the natural reef in the restored area and the natural reef in the harvested area. Thus, the present project confirmed for northern New England the observations made in other areas that oyster reefs provide enhanced habitat value for many invertebrate species.

The resident (attached) macroalgae data consistently indicated higher biomass on the mini-reefs and the protected natural reefs compared to the unprotected reef area, though there was typically wide variability among replicates. Taxonomic richness for plants, however, was similar in all three areas; there were fourteen algal species collected from the three areas. Macroalgal communities in other areas have been shown to provide valuable habitat for many fish species (Levring et al. 1969; Michanek 1975; Norton and Matheison 1983). Although we are aware of no literature on macroalgal communities on oyster reefs in the northeastern US, it seems reasonable to expect that similar relationships exist in New England. The present project, however, did not confirm this trend for fish. Even so, our hypothesized (see Introduction section) value of oyster reefs as providing enhanced habitat for many macroalgae species and associated invertebrates was confirmed.

Conclusions

The project achieved the goal of restoring 0.5 hectare (1.25 acres) of shellfish habitat, and the restored area had enhanced habitat value for other species compared to the adjacent natural reef. We emphasize, however, that this project should only be considered an initial restoration effort. An adaptive approach consisting of ongoing monitoring and possibly additional restoration activities is recommended if the goal is long-term sustainability of oyster reefs. Our studies at several sites and involving methods used in the present project indicate that densities of juvenile and adult oysters greater than that on adjacent natural reefs are typically maintained for several years, but development of substantial vertical structure and densely aggregated oysters probably requires at least 5 years (Grizzle et al. 2006). Moreover, due to the very sporadic nature of recruitment (spat sets) in the Great Bay system (Trowbridge 2005, 2009) and high mortality rates sometimes observed on constructed reefs, additional restoration efforts such as spat seeding or shell planting may be needed after the initial restoration to ensure long-term reef development. Hence, some type of adaptive management approach to oyster restoration is needed. Unfortunately, such an approach is not common due to the limited funding duration of most projects. A longer-term approach to the restoration process is badly needed.

Recommendations

For most previous oyster restoration projects in New Hampshire, including the present project, spat seeding was the major method. Grizzle et al. (2006) recommended some combination of spat seeding and shell planting as the general protocol for restoring New Hampshire’s oyster reefs. The exceptional natural spat set that occurred in 2006 underscores the importance of shell planting. Based on anecdotal evidence, it appeared that oyster larvae settled on much of the exposed hard substrates, including natural and man-made, in many areas of the estuary during summer 2006. The present project confirmed the extent of 2006 spat set on the badly degraded natural reefs in the present study area. This suggests that if a shell planting program had been in place at that time, natural spat set would have been exceptional in those areas. Unfortunately, there is no way to predict spat set levels for any given year. Therefore, we recommend that both approaches should probably be considered in some combination for most future projects.

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APPENDIX A: Bivalve Density and Size Data

Table A-1. Density data for suspension feeding bivalves collected from all three reef types: Constructed (mini-reefs); Protected (natural reef areas between constructed mini-reefs); Unprotected (natural reef west of restoration area).

Date	Reef Type	Reef # (constructed only)	Sample #	Oyster (#/0.1 m2)	Ribbed Mussel (#/0.1 m2)	Blue Mussel (#/0.1 m2)	Hard Clam (#/0.1 m2)
11/27/2007	Constructed	2	1	28	1	0	0
11/27/2007	Constructed	2	2	35	0	0	0
11/27/2007	Constructed	6	3	10	0	0	0
11/27/2007	Constructed	9	4	60	0	0	0
11/27/2007	Constructed	9	5	83	0	0	0
			MEAN:	**43.2**	**0.2**	**0**	**0**
5/8/2008	Constructed	4	1	16	0	0	0
5/8/2008	Constructed	4	2	13	1	0	0
5/8/2008	Constructed	10	3	23	1	0	0
5/8/2008	Constructed	10	4	13	0	0	0
5/8/2008	Constructed	12	5	23	0	0	0
5/8/2008	Constructed	12	6	28	2	1	0
			MEAN:	**19.3**	**0.7**	**0.2**	**0.0**
7/8/2008	Constructed	1	1	39	0	0	0
7/8/2008	Constructed	1	2	5	0	0	0
7/8/2008	Constructed	8	3	13	0	0	0
7/8/2008	Constructed	8	4	16	0	0	0
7/8/2008	Constructed	11	5	21	0	0	0
7/8/2008	Constructed	11	6	20	0	0	0
			MEAN:	**19.0**	**0.0**	**0.0**	**0.0**
9/16/2008	Constructed	4	1	17	3	0	0
9/16/2008	Constructed	4	2	16	1	0	0
9/16/2008	Constructed	7	3	37	3	0	0
9/16/2008	Constructed	7	4	31	1	0	0
9/16/2008	Constructed	9	5	44	0	0	0
9/16/2008	Constructed	9	6	39	0	0	0
			MEAN:	**30.7**	**1.3**	**0.0**	**0.0**
11/17/2008	Constructed	5	1	30	0	0	0
11/17/2008	Constructed	5	2	23	0	0	0
11/17/2008	Constructed	12	3	3	0	0	0
11/17/2008	Constructed	12	4	20	2	0	0
			MEAN:	**19.0**	**0.5**	**0.0**	**0.0**
5/26/2009	Constructed		1	19	0	0	0
5/26/2009	Constructed		2	37	0	0	0
5/26/2009	Constructed		3	19	2	0	0
5/26/2009	Constructed		4	34	3	0	0
			MEAN:	**27.3**	**1.3**	**0.0**	**0.0**
5/20/2008	Protected		1	0	0	0	0
5/20/2008	Protected		2	9	0	0	0
5/20/2008	Protected		3	0	0	0	0
5/20/2008	Protected		4	3	0	0	0
5/20/2008	Protected		5	13	1	0	0
			MEAN:	**5.0**	**0.2**	**0.0**	**0.0**
7/8/2008	Protected		1	31	0	0	0
7/8/2008	Protected		2	5	0	0	0
7/8/2008	Protected		3	14	0	0	0

7/8/2008	Protected	4	8	0	0	0
7/8/2008	Protected	5	15	0	0	0
		MEAN:	**14.6**	**0.0**	**0.0**	**0.0**
9/16/2008	Protected	1	27	1	0	0
9/16/2008	Protected	2	11	0	0	0
9/16/2008	Protected	3	25	1	0	0
9/16/2008	Protected	4	23	3	0	0
9/16/2008	Protected	5	22	4	0	0
		MEAN:	**21.6**	**1.8**	**0.0**	**0.0**
11/17/2000	Protected	1	13	0	0	0
11/17/2000	Protected	2	8	2	0	0
11/17/2000	Protected	3	15	1	0	0
11/17/2000	Protected	4	14	0	0	0
		MEAN:	**12.5**	**0.8**	**0.0**	**0.0**
5/26/2009	Protected	1	18	0	0	0
5/26/2009	Protected	2	23	2	1	0
5/26/2009	Protected	3	29	1	0	0
5/26/2009	Protected	4	25	0	0	0
		MEAN:	**23.8**	**0.8**	**0.3**	**0.0**

11/27/2007	Unprotected	1	21	0	0	0
11/27/2007	Unprotected	2	28	0	0	0
11/27/2007	Unprotected	3	17	1	0	0
11/27/2007	Unprotected	4	6	0	0	0
		MEAN:	**18.0**	**0.3**	**0.0**	**0.0**
5/20/2008	Unprotected	1	28	0	0	0
5/20/2008	Unprotected	2	29	1	0	0
5/20/2008	Unprotected	3	24	0	0	0
5/20/2008	Unprotected	4	11	0	0	0
5/20/2008	Unprotected	5	0	0	0	0
		MEAN:	**18.4**	**0.2**	**0.0**	**0.0**
7/8/2008	Unprotected	1	5	0	0	1
7/8/2008	Unprotected	2	26	1	0	0
7/8/2008	Unprotected	3	14	0	0	0
7/8/2008	Unprotected	4	29	0	0	0
7/8/2008	Unprotected	5	19	0	0	0
		MEAN:	**18.6**	**0.2**	**0.0**	**0.2**
9/16/2008	Unprotected	1	18	0	0	0
9/16/2008	Unprotected	2	2	0	0	0
9/16/2008	Unprotected	3	1	0	0	0
9/16/2008	Unprotected	4	36	0	0	0
9/16/2008	Unprotected	5	18	1	0	0
		MEAN:	**15.0**	**0.2**	**0.0**	**0.0**
11/17/2008	Unprotected	1	5	0	0	0
11/17/2008	Unprotected	2	39	0	0	0
11/17/2008	Unprotected	3	24	0	0	0
11/17/2008	Unprotected	4	21	0	0	0
		MEAN:	**22.3**	**0.0**	**0.0**	**0.0**
5/26/2009	Unprotected	1	32	1	0	0
5/26/2009	Unprotected	2	7	1	0	0
5/26/2009	Unprotected	3	20	1	0	0
5/26/2009	Unprotected	4	22	0	0	0
		MEAN:	**20.3**	**0.8**	**0.0**	**0.0**

Table A-2. Size data for suspension feeding bivalves collected from all three reef types: Constructed (mini-reefs); Protected (natural reef areas between constructed mini-reefs); Unprotected (natural reef west of restoration area).

Date	Reef Type	Reef # (constructed only)	Rep	Oyster (mm)	Ribbed Mussel (mm)	Blue Mussel (mm)	Hard Clam (mm)	Soft Shell Clam (mm)
11/27/2007	Constructed	2	1	33	83			
11/27/2007	Constructed	2	1	33				
11/27/2007	Constructed	2	1	40				
11/27/2007	Constructed	2	1	28				
11/27/2007	Constructed	2	1	33				
11/27/2007	Constructed	2	1	56				
11/27/2007	Constructed	2	1	20				
11/27/2007	Constructed	2	1	35				
11/27/2007	Constructed	2	1	20				
11/27/2007	Constructed	2	1	39				
11/27/2007	Constructed	2	1	19				
11/27/2007	Constructed	2	1	27				
11/27/2007	Constructed	2	1	31				
11/27/2007	Constructed	2	1	41				
11/27/2007	Constructed	2	1	37				
11/27/2007	Constructed	2	1	19				
11/27/2007	Constructed	2	1	43				
11/27/2007	Constructed	2	1	30				
11/27/2007	Constructed	2	1	28				
11/27/2007	Constructed	2	1	40				
11/27/2007	Constructed	2	1	26				
11/27/2007	Constructed	2	1	45				
11/27/2007	Constructed	2	1	34				
11/27/2007	Constructed	2	1	46				
11/27/2007	Constructed	2	1	28				
11/27/2007	Constructed	2	1	33				
11/27/2007	Constructed	2	1	47				
11/27/2007	Constructed	2	1	27				
11/27/2007	Constructed	2	2	4				
11/27/2007	Constructed	2	2	4				
11/27/2007	Constructed	2	2	5				
11/27/2007	Constructed	2	2	9				
11/27/2007	Constructed	2	2	7				
11/27/2007	Constructed	2	2	4				
11/27/2007	Constructed	2	2	6				
11/27/2007	Constructed	2	2	5				
11/27/2007	Constructed	2	2	20				
11/27/2007	Constructed	2	2	45				
11/27/2007	Constructed	2	2	41				
11/27/2007	Constructed	2	2	26				
11/27/2007	Constructed	2	2	52				
11/27/2007	Constructed	2	2	49				
11/27/2007	Constructed	2	2	35				
11/27/2007	Constructed	2	2	32				
11/27/2007	Constructed	2	2	54				
11/27/2007	Constructed	2	2	63				
11/27/2007	Constructed	2	2	54				
11/27/2007	Constructed	2	2	47				
11/27/2007	Constructed	2	2	40				
11/27/2007	Constructed	2	2	92				
11/27/2007	Constructed	2	2	40				
11/27/2007	Constructed	2	2	42				

11/27/2007	Constructed	2	2	31
11/27/2007	Constructed	2	2	33
11/27/2007	Constructed	2	2	39
11/27/2007	Constructed	2	2	47
11/27/2007	Constructed	2	2	44
11/27/2007	Constructed	2	2	53
11/27/2007	Constructed	2	2	52
11/27/2007	Constructed	2	2	48
11/27/2007	Constructed	2	2	49
11/27/2007	Constructed	2	2	47
11/27/2007	Constructed	2	2	50
11/27/2007	Constructed	6	3	10
11/27/2007	Constructed	6	3	9
11/27/2007	Constructed	6	3	8
11/27/2007	Constructed	6	3	5
11/27/2007	Constructed	6	3	5
11/27/2007	Constructed	6	3	44
11/27/2007	Constructed	6	3	46
11/27/2007	Constructed	6	3	35
11/27/2007	Constructed	6	3	54
11/27/2007	Constructed	6	3	48
11/27/2007	Constructed	9	4	11
11/27/2007	Constructed	9	4	6
11/27/2007	Constructed	9	4	5
11/27/2007	Constructed	9	4	4
11/27/2007	Constructed	9	4	7
11/27/2007	Constructed	9	4	3
11/27/2007	Constructed	9	4	8
11/27/2007	Constructed	9	4	5
11/27/2007	Constructed	9	4	10
11/27/2007	Constructed	9	4	44
11/27/2007	Constructed	9	4	36
11/27/2007	Constructed	9	4	37
11/27/2007	Constructed	9	4	31
11/27/2007	Constructed	9	4	54
11/27/2007	Constructed	9	4	37
11/27/2007	Constructed	9	4	45
11/27/2007	Constructed	9	4	44
11/27/2007	Constructed	9	4	31
11/27/2007	Constructed	9	4	30
11/27/2007	Constructed	9	4	29
11/27/2007	Constructed	9	4	44
11/27/2007	Constructed	9	4	40
11/27/2007	Constructed	9	4	39
11/27/2007	Constructed	9	4	48
11/27/2007	Constructed	9	4	45
11/27/2007	Constructed	9	4	32
11/27/2007	Constructed	9	4	24
11/27/2007	Constructed	9	4	34
11/27/2007	Constructed	9	4	30
11/27/2007	Constructed	9	4	58
11/27/2007	Constructed	9	4	38
11/27/2007	Constructed	9	4	33
11/27/2007	Constructed	9	4	38
11/27/2007	Constructed	9	4	34
11/27/2007	Constructed	9	4	35
11/27/2007	Constructed	9	4	28
11/27/2007	Constructed	9	4	36
11/27/2007	Constructed	9	4	56

11/27/2007	Constructed	9	4	48
11/27/2007	Constructed	9	4	36
11/27/2007	Constructed	9	4	44
11/27/2007	Constructed	9	4	57
11/27/2007	Constructed	9	4	49
11/27/2007	Constructed	9	4	45
11/27/2007	Constructed	9	4	34
11/27/2007	Constructed	9	4	37
11/27/2007	Constructed	9	4	58
11/27/2007	Constructed	9	4	43
11/27/2007	Constructed	9	4	37
11/27/2007	Constructed	9	4	35
11/27/2007	Constructed	9	4	56
11/27/2007	Constructed	9	4	37
11/27/2007	Constructed	9	4	35
11/27/2007	Constructed	9	4	28
11/27/2007	Constructed	9	4	30
11/27/2007	Constructed	9	4	51
11/27/2007	Constructed	9	4	42
11/27/2007	Constructed	9	4	49
11/27/2007	Constructed	9	4	45
11/27/2007	Constructed	9	4	40
11/27/2007	Constructed	9	5	32
11/27/2007	Constructed	9	5	35
11/27/2007	Constructed	9	5	50
11/27/2007	Constructed	9	5	50
11/27/2007	Constructed	9	5	37
11/27/2007	Constructed	9	5	40
11/27/2007	Constructed	9	5	46
11/27/2007	Constructed	9	5	48
11/27/2007	Constructed	9	5	39
11/27/2007	Constructed	9	5	69
11/27/2007	Constructed	9	5	47
11/27/2007	Constructed	9	5	43
11/27/2007	Constructed	9	5	36
11/27/2007	Constructed	9	5	43
11/27/2007	Constructed	9	5	42
11/27/2007	Constructed	9	5	36
11/27/2007	Constructed	9	5	29
11/27/2007	Constructed	9	5	38
11/27/2007	Constructed	9	5	42
11/27/2007	Constructed	9	5	46
11/27/2007	Constructed	9	5	44
11/27/2007	Constructed	9	5	44
11/27/2007	Constructed	9	5	43
11/27/2007	Constructed	9	5	50
11/27/2007	Constructed	9	5	40
11/27/2007	Constructed	9	5	24
11/27/2007	Constructed	9	5	26
11/27/2007	Constructed	9	5	36
11/27/2007	Constructed	9	5	39
11/27/2007	Constructed	9	5	30
11/27/2007	Constructed	9	5	35
11/27/2007	Constructed	9	5	31
11/27/2007	Constructed	9	5	38
11/27/2007	Constructed	9	5	38
11/27/2007	Constructed	9	5	43
11/27/2007	Constructed	9	5	44
11/27/2007	Constructed	9	5	36
11/27/2007	Constructed	9	5	38

11/27/2007	Constructed	9	5	66
11/27/2007	Constructed	9	5	57
11/27/2007	Constructed	9	5	37
11/27/2007	Constructed	9	5	39
11/27/2007	Constructed	9	5	58
11/27/2007	Constructed	9	5	39
11/27/2007	Constructed	9	5	34
11/27/2007	Constructed	9	5	28
11/27/2007	Constructed	9	5	35
11/27/2007	Constructed	9	5	34
11/27/2007	Constructed	9	5	49
11/27/2007	Constructed	9	5	29
11/27/2007	Constructed	9	5	42
11/27/2007	Constructed	9	5	35
11/27/2007	Constructed	9	5	36
11/27/2007	Constructed	9	5	20
11/27/2007	Constructed	9	5	40
11/27/2007	Constructed	9	5	30
11/27/2007	Constructed	9	5	34
11/27/2007	Constructed	9	5	26
11/27/2007	Constructed	9	5	54
11/27/2007	Constructed	9	5	28
11/27/2007	Constructed	9	5	38
11/27/2007	Constructed	9	5	43
11/27/2007	Constructed	9	5	36
11/27/2007	Constructed	9	5	34
11/27/2007	Constructed	9	5	40
11/27/2007	Constructed	9	5	42
11/27/2007	Constructed	9	5	45
11/27/2007	Constructed	9	5	52
11/27/2007	Constructed	9	5	47
11/27/2007	Constructed	9	5	50
11/27/2007	Constructed	9	5	32
11/27/2007	Constructed	9	5	38
11/27/2007	Constructed	9	5	32
11/27/2007	Constructed	9	5	19
11/27/2007	Constructed	9	5	34
11/27/2007	Constructed	9	5	33
11/27/2007	Constructed	9	5	38
11/27/2007	Constructed	9	5	43
11/27/2007	Constructed	9	5	34
11/27/2007	Constructed	9	5	49
11/27/2007	Constructed	9	5	40
11/27/2007	Constructed	9	5	50
11/27/2007	Constructed	9	5	40
11/27/2007	Unprotected		1	20
11/27/2007	Unprotected		1	35
11/27/2007	Unprotected		1	13
11/27/2007	Unprotected		1	53
11/27/2007	Unprotected		1	43
11/27/2007	Unprotected		1	28
11/27/2007	Unprotected		1	33
11/27/2007	Unprotected		1	27
11/27/2007	Unprotected		1	43
11/27/2007	Unprotected		1	28
11/27/2007	Unprotected		1	46
11/27/2007	Unprotected		1	25
11/27/2007	Unprotected		1	21
11/27/2007	Unprotected		1	34
11/27/2007	Unprotected		1	60

11/27/2007	Unprotected	1	48	
11/27/2007	Unprotected	1	48	
11/27/2007	Unprotected	1	54	
11/27/2007	Unprotected	1	85	
11/27/2007	Unprotected	1	87	
11/27/2007	Unprotected	1	21	
11/27/2007	Unprotected	2	28	
11/27/2007	Unprotected	2	28	
11/27/2007	Unprotected	2	21	
11/27/2007	Unprotected	2	38	
11/27/2007	Unprotected	2	50	
11/27/2007	Unprotected	2	48	
11/27/2007	Unprotected	2	46	
11/27/2007	Unprotected	2	43	
11/27/2007	Unprotected	2	43	
11/27/2007	Unprotected	2	18	
11/27/2007	Unprotected	2	38	
11/27/2007	Unprotected	2	30	
11/27/2007	Unprotected	2	24	
11/27/2007	Unprotected	2	46	
11/27/2007	Unprotected	2	46	
11/27/2007	Unprotected	2	50	
11/27/2007	Unprotected	2	40	
11/27/2007	Unprotected	2	50	
11/27/2007	Unprotected	2	44	
11/27/2007	Unprotected	2	34	
11/27/2007	Unprotected	2	48	
11/27/2007	Unprotected	2	38	
11/27/2007	Unprotected	2	32	
11/27/2007	Unprotected	2	40	
11/27/2007	Unprotected	2	44	
11/27/2007	Unprotected	2	54	
11/27/2007	Unprotected	2	60	
11/27/2007	Unprotected	2	32	
11/27/2007	Unprotected	3	44	87
11/27/2007	Unprotected	3	43	
11/27/2007	Unprotected	3	40	
11/27/2007	Unprotected	3	32	
11/27/2007	Unprotected	3	28	
11/27/2007	Unprotected	3	42	
11/27/2007	Unprotected	3	43	
11/27/2007	Unprotected	3	80	
11/27/2007	Unprotected	3	31	
11/27/2007	Unprotected	3	34	
11/27/2007	Unprotected	3	32	
11/27/2007	Unprotected	3	43	
11/27/2007	Unprotected	3	40	
11/27/2007	Unprotected	3	63	
11/27/2007	Unprotected	3	35	
11/27/2007	Unprotected	3	33	
11/27/2007	Unprotected	3	28	
11/27/2007	Unprotected	4	40	
11/27/2007	Unprotected	4	43	
11/27/2007	Unprotected	4	48	
11/27/2007	Unprotected	4	49	
11/27/2007	Unprotected	4	54	
11/27/2007	Unprotected	4	52	

Date	Reef Type	Reef # (constructed only)	Rep	Oyster (mm)	Ribbed Mussel (mm)	Blue Mussel (mm)	Hard Clam (mm)	Soft Shell Clam (mm)
5/8/2008	Constructed	4	1	15				
5/8/2008	Constructed	4	1	16				
5/8/2008	Constructed	4	1	25				
5/8/2008	Constructed	4	1	33				
5/8/2008	Constructed	4	1	25				
5/8/2008	Constructed	4	1	29				
5/8/2008	Constructed	4	1	18				
5/8/2008	Constructed	4	1	40				
5/8/2008	Constructed	4	1	20				
5/8/2008	Constructed	4	1	53				
5/8/2008	Constructed	4	1	41				
5/8/2008	Constructed	4	1	56				
5/8/2008	Constructed	4	1	50				
5/8/2008	Constructed	4	1	51				
5/8/2008	Constructed	4	1	44				
5/8/2008	Constructed	4	1	39				
5/8/2008	Constructed	4	2	59	83			
5/8/2008	Constructed	4	2	58				
5/8/2008	Constructed	4	2	33				
5/8/2008	Constructed	4	2	41				
5/8/2008	Constructed	4	2	48				
5/8/2008	Constructed	4	2	24				
5/8/2008	Constructed	4	2	46				
5/8/2008	Constructed	4	2	35				
5/8/2008	Constructed	4	2	42				
5/8/2008	Constructed	4	2	39				
5/8/2008	Constructed	4	2	45				
5/8/2008	Constructed	4	2	43				
5/8/2008	Constructed	4	2	47				
5/8/2008	Constructed	10	3	39	24			
5/8/2008	Constructed	10	3	50				
5/8/2008	Constructed	10	3	47				
5/8/2008	Constructed	10	3	34				
5/8/2008	Constructed	10	3	36				
5/8/2008	Constructed	10	3	40				
5/8/2008	Constructed	10	3	43				
5/8/2008	Constructed	10	3	35				
5/8/2008	Constructed	10	3	66				
5/8/2008	Constructed	10	3	40				
5/8/2008	Constructed	10	3	55				
5/8/2008	Constructed	10	3	62				
5/8/2008	Constructed	10	3	37				
5/8/2008	Constructed	10	3	50				
5/8/2008	Constructed	10	3	30				
5/8/2008	Constructed	10	3	57				
5/8/2008	Constructed	10	3	35				
5/8/2008	Constructed	10	3	35				
5/8/2008	Constructed	10	3	49				
5/8/2008	Constructed	10	3	32				
5/8/2008	Constructed	10	3	42				
5/8/2008	Constructed	10	3	29				
5/8/2008	Constructed	10	3	18				
5/8/2008	Constructed	10	4	33				
5/8/2008	Constructed	10	4	37				

5/8/2008	Constructed	10	4	39		
5/8/2008	Constructed	10	4	50		
5/8/2008	Constructed	10	4	31		
5/8/2008	Constructed	10	4	60		
5/8/2008	Constructed	10	4	47		
5/8/2008	Constructed	10	4	41		
5/8/2008	Constructed	10	4	44		
5/8/2008	Constructed	10	4	55		
5/8/2008	Constructed	10	4	43		
5/8/2008	Constructed	10	4	41		
5/8/2008	Constructed	10	4	81		
5/8/2008	Constructed	12	5	8		
5/8/2008	Constructed	12	5	8		
5/8/2008	Constructed	12	5	7		
5/8/2008	Constructed	12	5	5		
5/8/2008	Constructed	12	5	30		
5/8/2008	Constructed	12	5	37		
5/8/2008	Constructed	12	5	65		
5/8/2008	Constructed	12	5	35		
5/8/2008	Constructed	12	5	30		
5/8/2008	Constructed	12	5	48		
5/8/2008	Constructed	12	5	32		
5/8/2008	Constructed	12	5	52		
5/8/2008	Constructed	12	5	25		
5/8/2008	Constructed	12	5	24		
5/8/2008	Constructed	12	5	36		
5/8/2008	Constructed	12	5	37		
5/8/2008	Constructed	12	5	30		
5/8/2008	Constructed	12	5	60		
5/8/2008	Constructed	12	5	53		
5/8/2008	Constructed	12	5	49		
5/8/2008	Constructed	12	5	36		
5/8/2008	Constructed	12	5	29		
5/8/2008	Constructed	12	5	36		
5/8/2008	Constructed	12	6	8	17	63
5/8/2008	Constructed	12	6	7	19	
5/8/2008	Constructed	12	6	8		
5/8/2008	Constructed	12	6	34		
5/8/2008	Constructed	12	6	46		
5/8/2008	Constructed	12	6	42		
5/8/2008	Constructed	12	6	38		
5/8/2008	Constructed	12	6	29		
5/8/2008	Constructed	12	6	42		
5/8/2008	Constructed	12	6	41		
5/8/2008	Constructed	12	6	36		
5/8/2008	Constructed	12	6	28		
5/8/2008	Constructed	12	6	42		
5/8/2008	Constructed	12	6	30		
5/8/2008	Constructed	12	6	38		
5/8/2008	Constructed	12	6	29		
5/8/2008	Constructed	12	6	41		
5/8/2008	Constructed	12	6	40		
5/8/2008	Constructed	12	6	33		
5/8/2008	Constructed	12	6	25		
5/8/2008	Constructed	12	6	52		
5/8/2008	Constructed	12	6	44		
5/8/2008	Constructed	12	6	60		
5/8/2008	Constructed	12	6	50		
5/8/2008	Constructed	12	6	55		
5/8/2008	Constructed	12	6	36		

5/8/2008	Constructed	12	6	45	
5/8/2008	Constructed	12	6	23	
5/20/2008	Protected		1	0	
5/20/2008	Protected		2	41	
5/20/2008	Protected		2	55	
5/20/2008	Protected		2	24	
5/20/2008	Protected		2	54	
5/20/2008	Protected		2	37	
5/20/2008	Protected		2	34	
5/20/2008	Protected		2	33	
5/20/2008	Protected		2	28	
5/20/2008	Protected		2	30	
5/20/2008	Protected		3	0	
5/20/2008	Protected		4	28	
5/20/2008	Protected		4	34	
5/20/2008	Protected		4	54	
5/20/2008	Protected		5	38	10
5/20/2008	Protected		5	33	
5/20/2008	Protected		5	33	
5/20/2008	Protected		5	26	
5/20/2008	Protected		5	37	
5/20/2008	Protected		5	31	
5/20/2008	Protected		5	50	
5/20/2008	Protected		5	47	
5/20/2008	Protected		5	49	
5/20/2008	Protected		5	26	
5/20/2008	Protected		5	41	
5/20/2008	Protected		5	63	
5/20/2008	Protected		5	20	
5/20/2008	Unprotected		1	51	
5/20/2008	Unprotected		1	44	
5/20/2008	Unprotected		1	54	
5/20/2008	Unprotected		1	45	
5/20/2008	Unprotected		1	25	
5/20/2008	Unprotected		1	34	
5/20/2008	Unprotected		1	49	
5/20/2008	Unprotected		1	21	
5/20/2008	Unprotected		1	25	
5/20/2008	Unprotected		1	40	
5/20/2008	Unprotected		1	51	
5/20/2008	Unprotected		1	41	
5/20/2008	Unprotected		1	21	
5/20/2008	Unprotected		1	37	
5/20/2008	Unprotected		1	50	
5/20/2008	Unprotected		1	66	
5/20/2008	Unprotected		1	43	
5/20/2008	Unprotected		1	52	
5/20/2008	Unprotected		1	27	
5/20/2008	Unprotected		1	41	
5/20/2008	Unprotected		1	42	
5/20/2008	Unprotected		1	31	
5/20/2008	Unprotected		1	38	
5/20/2008	Unprotected		1	40	
5/20/2008	Unprotected		1	36	
5/20/2008	Unprotected		1	48	
5/20/2008	Unprotected		1	20	
5/20/2008	Unprotected		1	82	
5/20/2008	Unprotected		2	29	78
5/20/2008	Unprotected		2	44	

5/20/2008	Unprotected	2	34
5/20/2008	Unprotected	2	56
5/20/2008	Unprotected	2	48
5/20/2008	Unprotected	2	51
5/20/2008	Unprotected	2	33
5/20/2008	Unprotected	2	44
5/20/2008	Unprotected	2	26
5/20/2008	Unprotected	2	38
5/20/2008	Unprotected	2	31
5/20/2008	Unprotected	2	20
5/20/2008	Unprotected	2	23
5/20/2008	Unprotected	2	41
5/20/2008	Unprotected	2	33
5/20/2008	Unprotected	2	38
5/20/2008	Unprotected	2	42
5/20/2008	Unprotected	2	44
5/20/2008	Unprotected	2	42
5/20/2008	Unprotected	2	45
5/20/2008	Unprotected	2	32
5/20/2008	Unprotected	2	57
5/20/2008	Unprotected	2	38
5/20/2008	Unprotected	2	39
5/20/2008	Unprotected	2	54
5/20/2008	Unprotected	2	33
5/20/2008	Unprotected	2	30
5/20/2008	Unprotected	2	58
5/20/2008	Unprotected	2	24
5/20/2008	Unprotected	2	61
5/20/2008	Unprotected	3	57
5/20/2008	Unprotected	3	18
5/20/2008	Unprotected	3	43
5/20/2008	Unprotected	3	30
5/20/2008	Unprotected	3	54
5/20/2008	Unprotected	3	43
5/20/2008	Unprotected	3	42
5/20/2008	Unprotected	3	38
5/20/2008	Unprotected	3	33
5/20/2008	Unprotected	3	33
5/20/2008	Unprotected	3	53
5/20/2008	Unprotected	3	51
5/20/2008	Unprotected	3	28
5/20/2008	Unprotected	3	52
5/20/2008	Unprotected	3	18
5/20/2008	Unprotected	3	38
5/20/2008	Unprotected	3	40
5/20/2008	Unprotected	3	36
5/20/2008	Unprotected	3	39
5/20/2008	Unprotected	3	34
5/20/2008	Unprotected	3	30
5/20/2008	Unprotected	3	45
5/20/2008	Unprotected	3	44
5/20/2008	Unprotected	3	59
5/20/2008	Unprotected	4	53
5/20/2008	Unprotected	4	48
5/20/2008	Unprotected	4	43
5/20/2008	Unprotected	4	37
5/20/2008	Unprotected	4	44
5/20/2008	Unprotected	4	72
5/20/2008	Unprotected	4	27
5/20/2008	Unprotected	4	31

5/20/2008	Unprotected		4	41				
5/20/2008	Unprotected		4	55				
5/20/2008	Unprotected		4	39				
5/20/2008	Unprotected		5	31				
5/20/2008	Unprotected		5	29				
5/20/2008	Unprotected		5	50				
5/20/2008	Unprotected		5	60				
5/20/2008	Unprotected		5	40				
5/20/2008	Unprotected		5	30				
5/20/2008	Unprotected		5	44				
5/20/2008	Unprotected		5	42				

Date	Reef Type	Reef # (constructed only)	Rep	Oyster (mm)	Ribbed Mussel (mm)	Blue Mussel (mm)	Hard Clam (mm)	Soft Shell Clam (mm)
7/8/2008	Constructed	1	1	13				
7/8/2008	Constructed	1	1	20				
7/8/2008	Constructed	1	1	26				
7/8/2008	Constructed	1	1	31				
7/8/2008	Constructed	1	1	11				
7/8/2008	Constructed	1	1	27				
7/8/2008	Constructed	1	1	32				
7/8/2008	Constructed	1	1	17				
7/8/2008	Constructed	1	1	20				
7/8/2008	Constructed	1	1	20				
7/8/2008	Constructed	1	1	20				
7/8/2008	Constructed	1	1	22				
7/8/2008	Constructed	1	1	17				
7/8/2008	Constructed	1	1	22				
7/8/2008	Constructed	1	1	31				
7/8/2008	Constructed	1	1	19				
7/8/2008	Constructed	1	1	23				
7/8/2008	Constructed	1	1	25				
7/8/2008	Constructed	1	1	30				
7/8/2008	Constructed	1	1	22				
7/8/2008	Constructed	1	1	15				
7/8/2008	Constructed	1	1	20				
7/8/2008	Constructed	1	1	26				
7/8/2008	Constructed	1	1	43				
7/8/2008	Constructed	1	1	25				
7/8/2008	Constructed	1	1	26				
7/8/2008	Constructed	1	1	20				
7/8/2008	Constructed	1	1	60				
7/8/2008	Constructed	1	1	43				
7/8/2008	Constructed	1	1	47				
7/8/2008	Constructed	1	1	55				
7/8/2008	Constructed	1	1	30				
7/8/2008	Constructed	1	1	78				
7/8/2008	Constructed	1	1	60				
7/8/2008	Constructed	1	1	65				
7/8/2008	Constructed	1	1	70				
7/8/2008	Constructed	1	1	70				
7/8/2008	Constructed	1	1	55				
7/8/2008	Constructed	1	1	73				
7/8/2008	Constructed	1	2	23				
7/8/2008	Constructed	1	2	49				
7/8/2008	Constructed	1	2	33				
7/8/2008	Constructed	1	2	40				

7/8/2008	Constructed	1	2	40
7/8/2008	Constructed	8	3	45
7/8/2008	Constructed	8	3	60
7/8/2008	Constructed	8	3	33
7/8/2008	Constructed	8	3	65
7/8/2008	Constructed	8	3	68
7/8/2008	Constructed	8	3	40
7/8/2008	Constructed	8	3	48
7/8/2008	Constructed	8	3	71
7/8/2008	Constructed	8	3	50
7/8/2008	Constructed	8	3	35
7/8/2008	Constructed	8	3	32
7/8/2008	Constructed	8	3	22
7/8/2008	Constructed	8	3	42
7/8/2008	Constructed	8	4	17
7/8/2008	Constructed	8	4	22
7/8/2008	Constructed	8	4	21
7/8/2008	Constructed	8	4	24
7/8/2008	Constructed	8	4	37
7/8/2008	Constructed	8	4	28
7/8/2008	Constructed	8	4	44
7/8/2008	Constructed	8	4	50
7/8/2008	Constructed	8	4	69
7/8/2008	Constructed	8	4	28
7/8/2008	Constructed	8	4	62
7/8/2008	Constructed	8	4	47
7/8/2008	Constructed	8	4	46
7/8/2008	Constructed	8	4	55
7/8/2008	Constructed	8	4	50
7/8/2008	Constructed	8	4	67
7/8/2008	Constructed	11	5	19
7/8/2008	Constructed	11	5	41
7/8/2008	Constructed	11	5	73
7/8/2008	Constructed	11	5	50
7/8/2008	Constructed	11	5	50
7/8/2008	Constructed	11	5	52
7/8/2008	Constructed	11	5	55
7/8/2008	Constructed	11	5	70
7/8/2008	Constructed	11	5	26
7/8/2008	Constructed	11	5	75
7/8/2008	Constructed	11	5	43
7/8/2008	Constructed	11	5	48
7/8/2008	Constructed	11	5	30
7/8/2008	Constructed	11	5	30
7/8/2008	Constructed	11	5	30
7/8/2008	Constructed	11	5	40
7/8/2008	Constructed	11	5	60
7/8/2008	Constructed	11	5	55
7/8/2008	Constructed	11	5	55
7/8/2008	Constructed	11	5	45
7/8/2008	Constructed	11	5	38
7/8/2008	Constructed	11	6	15
7/8/2008	Constructed	11	6	30
7/8/2008	Constructed	11	6	22
7/8/2008	Constructed	11	6	25
7/8/2008	Constructed	11	6	30
7/8/2008	Constructed	11	6	20
7/8/2008	Constructed	11	6	32
7/8/2008	Constructed	11	6	35
7/8/2008	Constructed	11	6	41

7/8/2008	Constructed	11	6	56
7/8/2008	Constructed	11	6	37
7/8/2008	Constructed	11	6	60
7/8/2008	Constructed	11	6	32
7/8/2008	Constructed	11	6	56
7/8/2008	Constructed	11	6	67
7/8/2008	Constructed	11	6	63
7/8/2008	Constructed	11	6	55
7/8/2008	Constructed	11	6	50
7/8/2008	Constructed	11	6	46
7/8/2008	Constructed	11	6	58
7/8/2008	Protected		1	59
7/8/2008	Protected		1	45
7/8/2008	Protected		1	40
7/8/2008	Protected		1	32
7/8/2008	Protected		1	25
7/8/2008	Protected		1	78
7/8/2008	Protected		1	34
7/8/2008	Protected		1	35
7/8/2008	Protected		1	72
7/8/2008	Protected		1	55
7/8/2008	Protected		1	30
7/8/2008	Protected		1	28
7/8/2008	Protected		1	45
7/8/2008	Protected		1	37
7/8/2008	Protected		1	57
7/8/2008	Protected		1	57
7/8/2008	Protected		1	37
7/8/2008	Protected		1	44
7/8/2008	Protected		1	22
7/8/2008	Protected		1	39
7/8/2008	Protected		1	58
7/8/2008	Protected		1	107
7/8/2008	Protected		1	40
7/8/2008	Protected		1	40
7/8/2008	Protected		1	44
7/8/2008	Protected		1	35
7/8/2008	Protected		1	33
7/8/2008	Protected		1	43
7/8/2008	Protected		1	27
7/8/2008	Protected		1	37
7/8/2008	Protected		1	62
7/8/2008	Protected		2	61
7/8/2008	Protected		2	30
7/8/2008	Protected		2	50
7/8/2008	Protected		2	65
7/8/2008	Protected		2	54
7/8/2008	Protected		3	25
7/8/2008	Protected		3	56
7/8/2008	Protected		3	49
7/8/2008	Protected		3	48
7/8/2008	Protected		3	57
7/8/2008	Protected		3	38
7/8/2008	Protected		3	63
7/8/2008	Protected		3	65
7/8/2008	Protected		3	36
7/8/2008	Protected		3	54
7/8/2008	Protected		3	40
7/8/2008	Protected		3	50
7/8/2008	Protected		3	50

7/8/2008	Protected	3	60		
7/8/2008	Protected	4	78		
7/8/2008	Protected	4	65		
7/8/2008	Protected	4	52		
7/8/2008	Protected	4	40		
7/8/2008	Protected	4	50		
7/8/2008	Protected	4	53		
7/8/2008	Protected	4	45		
7/8/2008	Protected	4	60		
7/8/2008	Protected	5	59		
7/8/2008	Protected	5	58		
7/8/2008	Protected	5	67		
7/8/2008	Protected	5	72		
7/8/2008	Protected	5	63		
7/8/2008	Protected	5	21		
7/8/2008	Protected	5	67		
7/8/2008	Protected	5	58		
7/8/2008	Protected	5	38		
7/8/2008	Protected	5	46		
7/8/2008	Protected	5	34		
7/8/2008	Protected	5	44		
7/8/2008	Protected	5	44		
7/8/2008	Protected	5	65		
7/8/2008	Protected	5	60		
7/8/2008	Unprotected	1	55		52
7/8/2008	Unprotected	1	44		
7/8/2008	Unprotected	1	73		
7/8/2008	Unprotected	1	69		
7/8/2008	Unprotected	1	60		
7/8/2008	Unprotected	2	38	20	
7/8/2008	Unprotected	2	37		
7/8/2008	Unprotected	2	54		
7/8/2008	Unprotected	2	62		
7/8/2008	Unprotected	2	56		
7/8/2008	Unprotected	2	43		
7/8/2008	Unprotected	2	41		
7/8/2008	Unprotected	2	35		
7/8/2008	Unprotected	2	83		
7/8/2008	Unprotected	2	30		
7/8/2008	Unprotected	2	29		
7/8/2008	Unprotected	2	50		
7/8/2008	Unprotected	2	75		
7/8/2008	Unprotected	2	89		
7/8/2008	Unprotected	2	57		
7/8/2008	Unprotected	2	64		
7/8/2008	Unprotected	2	27		
7/8/2008	Unprotected	2	53		
7/8/2008	Unprotected	2	90		
7/8/2008	Unprotected	2	62		
7/8/2008	Unprotected	2	76		
7/8/2008	Unprotected	2	40		
7/8/2008	Unprotected	2	54		
7/8/2008	Unprotected	2	44		
7/8/2008	Unprotected	2	72		
7/8/2008	Unprotected	2	37		
7/8/2008	Unprotected	3	119		
7/8/2008	Unprotected	3	45		
7/8/2008	Unprotected	3	34		
7/8/2008	Unprotected	3	51		
7/8/2008	Unprotected	3	58		

7/8/2008	Unprotected	3	69
7/8/2008	Unprotected	3	49
7/8/2008	Unprotected	3	70
7/8/2008	Unprotected	3	75
7/8/2008	Unprotected	3	40
7/8/2008	Unprotected	3	39
7/8/2008	Unprotected	3	40
7/8/2008	Unprotected	3	30
7/8/2008	Unprotected	3	35
7/8/2008	Unprotected	4	50
7/8/2008	Unprotected	4	28
7/8/2008	Unprotected	4	48
7/8/2008	Unprotected	4	33
7/8/2008	Unprotected	4	57
7/8/2008	Unprotected	4	52
7/8/2008	Unprotected	4	54
7/8/2008	Unprotected	4	60
7/8/2008	Unprotected	4	46
7/8/2008	Unprotected	4	86
7/8/2008	Unprotected	4	48
7/8/2008	Unprotected	4	50
7/8/2008	Unprotected	4	71
7/8/2008	Unprotected	4	40
7/8/2008	Unprotected	4	60
7/8/2008	Unprotected	4	61
7/8/2008	Unprotected	4	48
7/8/2008	Unprotected	4	30
7/8/2008	Unprotected	4	50
7/8/2008	Unprotected	4	53
7/8/2008	Unprotected	4	50
7/8/2008	Unprotected	4	54
7/8/2008	Unprotected	4	57
7/8/2008	Unprotected	4	46
7/8/2008	Unprotected	4	19
7/8/2008	Unprotected	4	54
7/8/2008	Unprotected	4	54
7/8/2008	Unprotected	4	46
7/8/2008	Unprotected	4	42
7/8/2008	Unprotected	5	

Date	Reef Type	Reef # (constructed only)	Rep	Oyster (mm)	Ribbed Mussel (mm)	Blue Mussel (mm)	Hard Clam (mm)	Soft Shell Clam (mm)
9/16/2008	Constructed	4	1	16	16			
9/16/2008	Constructed	4	1	13	33			
9/16/2008	Constructed	4	1	39	65			
9/16/2008	Constructed	4	1	42				
9/16/2008	Constructed	4	1	47				
9/16/2008	Constructed	4	1	53				
9/16/2008	Constructed	4	1	41				
9/16/2008	Constructed	4	1	38				
9/16/2008	Constructed	4	1	48				
9/16/2008	Constructed	4	1	49				
9/16/2008	Constructed	4	1	34				
9/16/2008	Constructed	4	1	34				
9/16/2008	Constructed	4	1	39				
9/16/2008	Constructed	4	1	62				
9/16/2008	Constructed	4	1	65				

9/16/2008	Constructed	4	1	44	
9/16/2008	Constructed	4	1	6	
9/16/2008	Constructed	4	2	25	28
9/16/2008	Constructed	4	2	73	
9/16/2008	Constructed	4	2	34	
9/16/2008	Constructed	4	2	43	
9/16/2008	Constructed	4	2	48	
9/16/2008	Constructed	4	2	69	
9/16/2008	Constructed	4	2	30	
9/16/2008	Constructed	4	2	53	
9/16/2008	Constructed	4	2	65	
9/16/2008	Constructed	4	2	18	
9/16/2008	Constructed	4	2	38	
9/16/2008	Constructed	4	2	70	
9/16/2008	Constructed	4	2	34	
9/16/2008	Constructed	4	2	26	
9/16/2008	Constructed	4	2	29	
9/16/2008	Constructed	4	2	45	
9/16/2008	Constructed	7	3	53	9
9/16/2008	Constructed	7	3	59	29
9/16/2008	Constructed	7	3	56	8
9/16/2008	Constructed	7	3	56	
9/16/2008	Constructed	7	3	59	
9/16/2008	Constructed	7	3	38	
9/16/2008	Constructed	7	3	48	
9/16/2008	Constructed	7	3	74	
9/16/2008	Constructed	7	3	47	
9/16/2008	Constructed	7	3	53	
9/16/2008	Constructed	7	3	38	
9/16/2008	Constructed	7	3	29	
9/16/2008	Constructed	7	3	75	
9/16/2008	Constructed	7	3	57	
9/16/2008	Constructed	7	3	27	
9/16/2008	Constructed	7	3	74	
9/16/2008	Constructed	7	3	60	
9/16/2008	Constructed	7	3	33	
9/16/2008	Constructed	7	3	43	
9/16/2008	Constructed	7	3	47	
9/16/2008	Constructed	7	3	49	
9/16/2008	Constructed	7	3	66	
9/16/2008	Constructed	7	3	49	
9/16/2008	Constructed	7	3	53	
9/16/2008	Constructed	7	3	63	
9/16/2008	Constructed	7	3	55	
9/16/2008	Constructed	7	3	24	
9/16/2008	Constructed	7	3	37	
9/16/2008	Constructed	7	3	60	
9/16/2008	Constructed	7	3	60	
9/16/2008	Constructed	7	3	46	
9/16/2008	Constructed	7	3	56	
9/16/2008	Constructed	7	3	56	
9/16/2008	Constructed	7	3	59	
9/16/2008	Constructed	7	3	63	
9/16/2008	Constructed	7	3	68	
9/16/2008	Constructed	7	3	73	
9/16/2008	Constructed	7	4	43	90
9/16/2008	Constructed	7	4	53	
9/16/2008	Constructed	7	4	20	
9/16/2008	Constructed	7	4	33	
9/16/2008	Constructed	7	4	47	

9/16/2008	Constructed	7	4	43
9/16/2008	Constructed	7	4	47
9/16/2008	Constructed	7	4	40
9/16/2008	Constructed	7	4	40
9/16/2008	Constructed	7	4	41
9/16/2008	Constructed	7	4	51
9/16/2008	Constructed	7	4	37
9/16/2008	Constructed	7	4	39
9/16/2008	Constructed	7	4	45
9/16/2008	Constructed	7	4	35
9/16/2008	Constructed	7	4	21
9/16/2008	Constructed	7	4	38
9/16/2008	Constructed	7	4	31
9/16/2008	Constructed	7	4	44
9/16/2008	Constructed	7	4	48
9/16/2008	Constructed	7	4	47
9/16/2008	Constructed	7	4	30
9/16/2008	Constructed	7	4	30
9/16/2008	Constructed	7	4	30
9/16/2008	Constructed	7	4	40
9/16/2008	Constructed	7	4	23
9/16/2008	Constructed	7	4	23
9/16/2008	Constructed	7	4	46
9/16/2008	Constructed	7	4	31
9/16/2008	Constructed	7	4	21
9/16/2008	Constructed	7	4	17
9/16/2008	Constructed	9	5	37
9/16/2008	Constructed	9	5	16
9/16/2008	Constructed	9	5	34
9/16/2008	Constructed	9	5	26
9/16/2008	Constructed	9	5	51
9/16/2008	Constructed	9	5	17
9/16/2008	Constructed	9	5	35
9/16/2008	Constructed	9	5	35
9/16/2008	Constructed	9	5	48
9/16/2008	Constructed	9	5	91
9/16/2008	Constructed	9	5	36
9/16/2008	Constructed	9	5	43
9/16/2008	Constructed	9	5	33
9/16/2008	Constructed	9	5	43
9/16/2008	Constructed	9	5	43
9/16/2008	Constructed	9	5	38
9/16/2008	Constructed	9	5	48
9/16/2008	Constructed	9	5	50
9/16/2008	Constructed	9	5	32
9/16/2008	Constructed	9	5	27
9/16/2008	Constructed	9	5	40
9/16/2008	Constructed	9	5	30
9/16/2008	Constructed	9	5	30
9/16/2008	Constructed	9	5	40
9/16/2008	Constructed	9	5	41
9/16/2008	Constructed	9	5	50
9/16/2008	Constructed	9	5	58
9/16/2008	Constructed	9	5	62
9/16/2008	Constructed	9	5	40
9/16/2008	Constructed	9	5	70
9/16/2008	Constructed	9	5	67
9/16/2008	Constructed	9	5	26
9/16/2008	Constructed	9	5	26
9/16/2008	Constructed	9	5	33

9/16/2008	Constructed	9	5	41	
9/16/2008	Constructed	9	5	40	
9/16/2008	Constructed	9	5	30	
9/16/2008	Constructed	9	5	42	
9/16/2008	Constructed	9	5	21	
9/16/2008	Constructed	9	5	21	
9/16/2008	Constructed	9	5	37	
9/16/2008	Constructed	9	5	31	
9/16/2008	Constructed	9	5	32	
9/16/2008	Constructed	9	5	27	
9/16/2008	Constructed	9	5	17	
9/16/2008	Constructed	9	5	26	
9/16/2008	Constructed	9	5	36	
9/16/2008	Constructed	9	5	39	
9/16/2008	Constructed	9	6	31	
9/16/2008	Constructed	9	6	62	
9/16/2008	Constructed	9	6	87	
9/16/2008	Constructed	9	6	30	
9/16/2008	Constructed	9	6	61	
9/16/2008	Constructed	9	6	55	
9/16/2008	Constructed	9	6	57	
9/16/2008	Constructed	9	6	68	
9/16/2008	Constructed	9	6	18	
9/16/2008	Constructed	9	6	37	
9/16/2008	Constructed	9	6	63	
9/16/2008	Constructed	9	6	68	
9/16/2008	Constructed	9	6	52	
9/16/2008	Constructed	9	6	73	
9/16/2008	Constructed	9	6	50	
9/16/2008	Constructed	9	6	56	
9/16/2008	Constructed	9	6	27	
9/16/2008	Constructed	9	6	21	
9/16/2008	Constructed	9	6	43	
9/16/2008	Constructed	9	6	40	
9/16/2008	Constructed	9	6	60	
9/16/2008	Constructed	9	6	35	
9/16/2008	Constructed	9	6	46	
9/16/2008	Constructed	9	6	14	
9/16/2008	Constructed	9	6	55	
9/16/2008	Constructed	9	6	59	
9/16/2008	Constructed	9	6	38	
9/16/2008	Constructed	9	6	53	
9/16/2008	Constructed	9	6	47	
9/16/2008	Constructed	9	6	55	
9/16/2008	Constructed	9	6	79	
9/16/2008	Constructed	9	6	39	
9/16/2008	Constructed	9	6	82	
9/16/2008	Constructed	9	6	35	
9/16/2008	Constructed	9	6	37	
9/16/2008	Constructed	9	6	41	
9/16/2008	Constructed	9	6	50	
9/16/2008	Constructed	9	6	61	
9/16/2008	Protected		1	55	77
9/16/2008	Protected		1	41	
9/16/2008	Protected		1	54	
9/16/2008	Protected		1	67	
9/16/2008	Protected		1	51	
9/16/2008	Protected		1	55	
9/16/2008	Protected		1	59	
9/16/2008	Protected		1	41	

9/16/2008	Protected	1	36	
9/16/2008	Protected	1	34	
9/16/2008	Protected	1	62	
9/16/2008	Protected	1	50	
9/16/2008	Protected	1	80	
9/16/2008	Protected	1	31	
9/16/2008	Protected	1	37	
9/16/2008	Protected	1	24	
9/16/2008	Protected	1	43	
9/16/2008	Protected	1	78	
9/16/2008	Protected	1	39	
9/16/2008	Protected	1	50	
9/16/2008	Protected	1	75	
9/16/2008	Protected	1	29	
9/16/2008	Protected	1	29	
9/16/2008	Protected	1	29	
9/16/2008	Protected	1	31	
9/16/2008	Protected	1	49	
9/16/2008	Protected	1	53	
9/16/2008	Protected	2	53	
9/16/2008	Protected	2	23	
9/16/2008	Protected	2	56	
9/16/2008	Protected	2	70	
9/16/2008	Protected	2	41	
9/16/2008	Protected	2	32	
9/16/2008	Protected	2	32	
9/16/2008	Protected	2	52	
9/16/2008	Protected	2	67	
9/16/2008	Protected	2	63	
9/16/2008	Protected	2	42	
9/16/2008	Protected	3	49	71
9/16/2008	Protected	3	56	
9/16/2008	Protected	3	59	
9/16/2008	Protected	3	59	
9/16/2008	Protected	3	74	
9/16/2008	Protected	3	68	
9/16/2008	Protected	3	42	
9/16/2008	Protected	3	61	
9/16/2008	Protected	3	63	
9/16/2008	Protected	3	65	
9/16/2008	Protected	3	43	
9/16/2008	Protected	3	61	
9/16/2008	Protected	3	48	
9/16/2008	Protected	3	56	
9/16/2008	Protected	3	48	
9/16/2008	Protected	3	68	
9/16/2008	Protected	3	70	
9/16/2008	Protected	3	35	
9/16/2008	Protected	3	65	
9/16/2008	Protected	3	73	
9/16/2008	Protected	3	67	
9/16/2008	Protected	3	69	
9/16/2008	Protected	3	59	
9/16/2008	Protected	3	37	
9/16/2008	Protected	3	31	
9/16/2008	Protected	4	66	9
9/16/2008	Protected	4	41	16
9/16/2008	Protected	4	60	25
9/16/2008	Protected	4	63	
9/16/2008	Protected	4	54	

9/16/2008	Protected	4	60	
9/16/2008	Protected	4	74	
9/16/2008	Protected	4	75	
9/16/2008	Protected	4	100	
9/16/2008	Protected	4	88	
9/16/2008	Protected	4	57	
9/16/2008	Protected	4	50	
9/16/2008	Protected	4	66	
9/16/2008	Protected	4	90	
9/16/2008	Protected	4	27	
9/16/2008	Protected	4	46	
9/16/2008	Protected	4	56	
9/16/2008	Protected	4	66	
9/16/2008	Protected	4	70	
9/16/2008	Protected	4	36	
9/16/2008	Protected	4	44	
9/16/2008	Protected	4	41	
9/16/2008	Protected	4	49	
9/16/2008	Protected	5	58	25
9/16/2008	Protected	5	68	47
9/16/2008	Protected	5	59	55
9/16/2008	Protected	5	67	80
9/16/2008	Protected	5	82	
9/16/2008	Protected	5	57	
9/16/2008	Protected	5	51	
9/16/2008	Protected	5	53	
9/16/2008	Protected	5	41	
9/16/2008	Protected	5	72	
9/16/2008	Protected	5	35	
9/16/2008	Protected	5	68	
9/16/2008	Protected	5	65	
9/16/2008	Protected	5	62	
9/16/2008	Protected	5	53	
9/16/2008	Protected	5	55	
9/16/2008	Protected	5	50	
9/16/2008	Protected	5	60	
9/16/2008	Protected	5	58	
9/16/2008	Protected	5	49	
9/16/2008	Unprotected	1	45	
9/16/2008	Unprotected	1	58	
9/16/2008	Unprotected	1	43	
9/16/2008	Unprotected	1	30	
9/16/2008	Unprotected	1	54	
9/16/2008	Unprotected	1	55	
9/16/2008	Unprotected	1	30	
9/16/2008	Unprotected	1	63	
9/16/2008	Unprotected	1	31	
9/16/2008	Unprotected	1	32	
9/16/2008	Unprotected	1	54	
9/16/2008	Unprotected	1	41	
9/16/2008	Unprotected	1	60	
9/16/2008	Unprotected	1	53	
9/16/2008	Unprotected	1	49	
9/16/2008	Unprotected	1	60	
9/16/2008	Unprotected	1	51	
9/16/2008	Unprotected	1	33	
9/16/2008	Unprotected	2	50	
9/16/2008	Unprotected	2	52	
9/16/2008	Unprotected	3	56	
9/16/2008	Unprotected	4	47	

9/16/2008	Unprotected	4	33	
9/16/2008	Unprotected	4	38	
9/16/2008	Unprotected	4	54	
9/16/2008	Unprotected	4	56	
9/16/2008	Unprotected	4	55	
9/16/2008	Unprotected	4	55	
9/16/2008	Unprotected	4	64	
9/16/2008	Unprotected	4	63	
9/16/2008	Unprotected	4	43	
9/16/2008	Unprotected	4	40	
9/16/2008	Unprotected	4	45	
9/16/2008	Unprotected	4	50	
9/16/2008	Unprotected	4	18	
9/16/2008	Unprotected	4	58	
9/16/2008	Unprotected	4	48	
9/16/2008	Unprotected	4	57	
9/16/2008	Unprotected	4	37	
9/16/2008	Unprotected	4	55	
9/16/2008	Unprotected	4	40	
9/16/2008	Unprotected	4	27	
9/16/2008	Unprotected	4	42	
9/16/2008	Unprotected	4	40	
9/16/2008	Unprotected	4	40	
9/16/2008	Unprotected	4	44	
9/16/2008	Unprotected	4	60	
9/16/2008	Unprotected	4	61	
9/16/2008	Unprotected	4	70	
9/16/2008	Unprotected	4	45	
9/16/2008	Unprotected	4	83	
9/16/2008	Unprotected	4	45	
9/16/2008	Unprotected	4	56	
9/16/2008	Unprotected	4	39	
9/16/2008	Unprotected	4	53	
9/16/2008	Unprotected	4	55	
9/16/2008	Unprotected	4	56	
9/16/2008	Unprotected	5	57	79
9/16/2008	Unprotected	5	56	
9/16/2008	Unprotected	5	66	
9/16/2008	Unprotected	5	78	
9/16/2008	Unprotected	5	55	
9/16/2008	Unprotected	5	40	
9/16/2008	Unprotected	5	37	
9/16/2008	Unprotected	5	51	
9/16/2008	Unprotected	5	53	
9/16/2008	Unprotected	5	65	
9/16/2008	Unprotected	5	39	
9/16/2008	Unprotected	5	64	
9/16/2008	Unprotected	5	38	
9/16/2008	Unprotected	5	50	
9/16/2008	Unprotected	5	60	
9/16/2008	Unprotected	5	80	
9/16/2008	Unprotected	5	60	
9/16/2008	Unprotected	5	54	

Date	Reef Type	Reef # (construct ed only)	Rep	Oyster (mm)	Ribbed Mussel (mm)	Blue Mussel (mm)	Hard Clam (mm)	Soft Shell Clam (mm)
11/17/2008	Constructed	5	1	30				
11/17/2008	Constructed	5	1	37				
11/17/2008	Constructed	5	1	60				
11/17/2008	Constructed	5	1	45				
11/17/2008	Constructed	5	1	50				
11/17/2008	Constructed	5	1	55				
11/17/2008	Constructed	5	1	37				
11/17/2008	Constructed	5	1	39				
11/17/2008	Constructed	5	1	60				
11/17/2008	Constructed	5	1	6				
11/17/2008	Constructed	5	1	50				
11/17/2008	Constructed	5	1	53				
11/17/2008	Constructed	5	1	68				
11/17/2008	Constructed	5	1	52				
11/17/2008	Constructed	5	1	24				
11/17/2008	Constructed	5	1	43				
11/17/2008	Constructed	5	1	63				
11/17/2008	Constructed	5	1	59				
11/17/2008	Constructed	5	1	63				
11/17/2008	Constructed	5	1	9				
11/17/2008	Constructed	5	1	91				
11/17/2008	Constructed	5	1	28				
11/17/2008	Constructed	5	1	48				
11/17/2008	Constructed	5	1	35				
11/17/2008	Constructed	5	1	50				
11/17/2008	Constructed	5	1	42				
11/17/2008	Constructed	5	1	49				
11/17/2008	Constructed	5	1	57				
11/17/2008	Constructed	5	1	58				
11/17/2008	Constructed	5	1	53				
11/17/2008	Constructed	5	2	15				
11/17/2008	Constructed	5	2	27				
11/17/2008	Constructed	5	2	36				
11/17/2008	Constructed	5	2	42				
11/17/2008	Constructed	5	2	38				
11/17/2008	Constructed	5	2	35				
11/17/2008	Constructed	5	2	23				
11/17/2008	Constructed	5	2	38				
11/17/2008	Constructed	5	2	38				
11/17/2008	Constructed	5	2	10				
11/17/2008	Constructed	5	2	58				
11/17/2008	Constructed	5	2	44				
11/17/2008	Constructed	5	2	50				
11/17/2008	Constructed	5	2	64				
11/17/2008	Constructed	5	2	46				
11/17/2008	Constructed	5	2	60				
11/17/2008	Constructed	5	2	64				
11/17/2008	Constructed	5	2	40				
11/17/2008	Constructed	5	2	49				
11/17/2008	Constructed	5	2	39				
11/17/2008	Constructed	5	2	48				
11/17/2008	Constructed	5	2	56				
11/17/2008	Constructed	5	2	69				
11/17/2008	Constructed	5	3	30				
11/17/2008	Constructed	5	3	48				

11/17/2008	Constructed	5	3	52	
11/17/2008	Constructed	5	4	57	16
11/17/2008	Constructed	5	4	43	39
11/17/2008	Constructed	5	4	40	
11/17/2008	Constructed	5	4	70	
11/17/2008	Constructed	5	4	77	
11/17/2008	Constructed	5	4	45	
11/17/2008	Constructed	5	4	46	
11/17/2008	Constructed	5	4	71	
11/17/2008	Constructed	5	4	72	
11/17/2008	Constructed	5	4	62	
11/17/2008	Constructed	5	4	11	
11/17/2008	Constructed	5	4	14	
11/17/2008	Constructed	5	4	50	
11/17/2008	Constructed	5	4	55	
11/17/2008	Constructed	5	4	85	
11/17/2008	Constructed	5	4	72	
11/17/2008	Constructed	5	4	29	
11/17/2008	Constructed	5	4	41	
11/17/2008	Constructed	5	4	43	
11/17/2008	Constructed	5	4	70	
11/17/2008	Protected		1	45	
11/17/2008	Protected		1	56	
11/17/2008	Protected		1	43	
11/17/2008	Protected		1	31	
11/17/2008	Protected		1	69	
11/17/2008	Protected		1	40	
11/17/2008	Protected		1	22	
11/17/2008	Protected		1	56	
11/17/2008	Protected		1	33	
11/17/2008	Protected		1	44	
11/17/2008	Protected		1	47	
11/17/2008	Protected		1	55	
11/17/2008	Protected		1	71	
11/17/2008	Protected		2	57	26
11/17/2008	Protected		2	11	11
11/17/2008	Protected		2	8	
11/17/2008	Protected		2	81	
11/17/2008	Protected		2	71	
11/17/2008	Protected		2	20	
11/17/2008	Protected		2	69	
11/17/2008	Protected		2	50	
11/17/2008	Protected		3	5	95
11/17/2008	Protected		3	70	
11/17/2008	Protected		3	46	
11/17/2008	Protected		3	33	
11/17/2008	Protected		3	30	
11/17/2008	Protected		3	39	
11/17/2008	Protected		3	44	
11/17/2008	Protected		3	51	
11/17/2008	Protected		3	71	
11/17/2008	Protected		3	78	
11/17/2008	Protected		3	43	
11/17/2008	Protected		3	80	
11/17/2008	Protected		3	12	
11/17/2008	Protected		3	25	
11/17/2008	Protected		3	43	
11/17/2008	Protected		4	61	
11/17/2008	Protected		4	53	
11/17/2008	Protected		4	40	

11/17/2008	Protected	4	40
11/17/2008	Protected	4	47
11/17/2008	Protected	4	60
11/17/2008	Protected	4	47
11/17/2008	Protected	4	44
11/17/2008	Protected	4	34
11/17/2008	Protected	4	17
11/17/2008	Protected	4	70
11/17/2008	Protected	4	66
11/17/2008	Protected	4	33
11/17/2008	Protected	4	6
11/17/2008	Unprotected	1	50
11/17/2008	Unprotected	1	42
11/17/2008	Unprotected	1	67
11/17/2008	Unprotected	1	79
11/17/2008	Unprotected	1	93
11/17/2008	Unprotected	2	49
11/17/2008	Unprotected	2	31
11/17/2008	Unprotected	2	16
11/17/2008	Unprotected	2	22
11/17/2008	Unprotected	2	72
11/17/2008	Unprotected	2	50
11/17/2008	Unprotected	2	61
11/17/2008	Unprotected	2	54
11/17/2008	Unprotected	2	49
11/17/2008	Unprotected	2	36
11/17/2008	Unprotected	2	80
11/17/2008	Unprotected	2	37
11/17/2008	Unprotected	2	25
11/17/2008	Unprotected	2	67
11/17/2008	Unprotected	2	57
11/17/2008	Unprotected	2	52
11/17/2008	Unprotected	2	52
11/17/2008	Unprotected	2	46
11/17/2008	Unprotected	2	50
11/17/2008	Unprotected	2	29
11/17/2008	Unprotected	2	49
11/17/2008	Unprotected	2	14
11/17/2008	Unprotected	2	22
11/17/2008	Unprotected	2	45
11/17/2008	Unprotected	2	65
11/17/2008	Unprotected	2	57
11/17/2008	Unprotected	2	71
11/17/2008	Unprotected	2	63
11/17/2008	Unprotected	2	47
11/17/2008	Unprotected	2	66
11/17/2008	Unprotected	2	10
11/17/2008	Unprotected	2	36
11/17/2008	Unprotected	2	32
11/17/2008	Unprotected	2	30
11/17/2008	Unprotected	2	35
11/17/2008	Unprotected	2	51
11/17/2008	Unprotected	2	41
11/17/2008	Unprotected	2	21
11/17/2008	Unprotected	2	53

Date	Reef Type	Reef # (constructed only)	Rep	Oyster (mm)	Ribbed Mussel (mm)	Blue Mussel (mm)	Hard Clam (mm)	Soft Shell Clam (mm)
5/26/2009	Constructed	8	1	34				
5/26/2009	Constructed	8	1	62				
5/26/2009	Constructed	8	1	40				
5/26/2009	Constructed	8	1	64				
5/26/2009	Constructed	8	1	35				
5/26/2009	Constructed	8	1	41				
5/26/2009	Constructed	8	1	63				
5/26/2009	Constructed	8	1	51				
5/26/2009	Constructed	8	1	60				
5/26/2009	Constructed	8	1	58				
5/26/2009	Constructed	8	1	65				
5/26/2009	Constructed	8	1	62				
5/26/2009	Constructed	8	1	51				
5/26/2009	Constructed	8	1	40				
5/26/2009	Constructed	8	1	40				
5/26/2009	Constructed	8	1	51				
5/26/2009	Constructed	8	1	40				
5/26/2009	Constructed	8	1	33				
5/26/2009	Constructed	8	1	61				
5/26/2009	Constructed	8	2	60				
5/26/2009	Constructed	8	2	30				
5/26/2009	Constructed	8	2	38				
5/26/2009	Constructed	8	2	54				
5/26/2009	Constructed	8	2	47				
5/26/2009	Constructed	8	2	35				
5/26/2009	Constructed	8	2	35				
5/26/2009	Constructed	8	2	60				
5/26/2009	Constructed	8	2	67				
5/26/2009	Constructed	8	2	85				
5/26/2009	Constructed	8	2	63				
5/26/2009	Constructed	8	2	30				
5/26/2009	Constructed	8	2	58				
5/26/2009	Constructed	8	2	42				
5/26/2009	Constructed	8	2	47				
5/26/2009	Constructed	8	2	14				
5/26/2009	Constructed	8	2	48				
5/26/2009	Constructed	8	2	82				
5/26/2009	Constructed	8	2	46				
5/26/2009	Constructed	8	2	42				
5/26/2009	Constructed	8	2	50				
5/26/2009	Constructed	8	2	51				
5/26/2009	Constructed	8	2	40				
5/26/2009	Constructed	8	2	24				
5/26/2009	Constructed	8	2	47				
5/26/2009	Constructed	8	2	28				
5/26/2009	Constructed	8	2	33				
5/26/2009	Constructed	8	2	75				
5/26/2009	Constructed	8	2	40				
5/26/2009	Constructed	8	2	72				
5/26/2009	Constructed	8	2	64				
5/26/2009	Constructed	8	2	60				
5/26/2009	Constructed	8	2	80				
5/26/2009	Constructed	8	2	60				
5/26/2009	Constructed	8	2	95				
5/26/2009	Constructed	8	2	57				

5/26/2009	Constructed	8	2	70		
5/26/2009	Constructed	6	3	61	86	
5/26/2009	Constructed	6	3	61	11	
5/26/2009	Constructed	6	3	56		
5/26/2009	Constructed	6	3	68		
5/26/2009	Constructed	6	3	10		
5/26/2009	Constructed	6	3	40		
5/26/2009	Constructed	6	3	52		
5/26/2009	Constructed	6	3	50		
5/26/2009	Constructed	6	3	45		
5/26/2009	Constructed	6	3	44		
5/26/2009	Constructed	6	3	26		
5/26/2009	Constructed	6	3	48		
5/26/2009	Constructed	6	3	57		
5/26/2009	Constructed	6	3	72		
5/26/2009	Constructed	6	3	63		
5/26/2009	Constructed	6	3	60		
5/26/2009	Constructed	6	3	32		
5/26/2009	Constructed	6	3	46		
5/26/2009	Constructed	6	4	53	24	
5/26/2009	Constructed	6	4	46	9	
5/26/2009	Constructed	6	4	35	12	
5/26/2009	Constructed	6	4	60		
5/26/2009	Constructed	6	4	52		
5/26/2009	Constructed	6	4	35		
5/26/2009	Constructed	6	4	33		
5/26/2009	Constructed	6	4	40		
5/26/2009	Constructed	6	4	60		
5/26/2009	Constructed	6	4	55		
5/26/2009	Constructed	6	4	55		
5/26/2009	Constructed	6	4	60		
5/26/2009	Constructed	6	4	37		
5/26/2009	Constructed	6	4	54		
5/26/2009	Constructed	6	4	37		
5/26/2009	Constructed	6	4	46		
5/26/2009	Constructed	6	4	16		
5/26/2009	Constructed	6	4	12		
5/26/2009	Constructed	6	4	35		
5/26/2009	Constructed	6	4	50		
5/26/2009	Constructed	6	4	40		
5/26/2009	Constructed	6	4	60		
5/26/2009	Constructed	6	4	42		
5/26/2009	Constructed	6	4	46		
5/26/2009	Constructed	6	4	63		
5/26/2009	Constructed	6	4	64		
5/26/2009	Constructed	6	4	57		
5/26/2009	Constructed	6	4	88		
5/26/2009	Constructed	6	4	55		
5/26/2009	Constructed	6	4	51		
5/26/2009	Constructed	6	4	92		
5/26/2009	Constructed	6	4	48		
5/26/2009	Constructed	6	4	47		
5/26/2009	Constructed	6	4	61		
5/26/2009	Protected		1	32		9
5/26/2009	Protected		1	58		
5/26/2009	Protected		1	74		
5/26/2009	Protected		1	10		
5/26/2009	Protected		1	30		
5/26/2009	Protected		1	48		
5/26/2009	Protected		1	50		

5/26/2009	Protected	1	66		
5/26/2009	Protected	1	63		
5/26/2009	Protected	1	53		
5/26/2009	Protected	1	72		
5/26/2009	Protected	1	36		
5/26/2009	Protected	1	53		
5/26/2009	Protected	1	53		
5/26/2009	Protected	1	55		
5/26/2009	Protected	1	87		
5/26/2009	Protected	1	85		
5/26/2009	Protected	1	14		
5/26/2009	Protected	2	26	83	67
5/26/2009	Protected	2	60	82	
5/26/2009	Protected	2	56		
5/26/2009	Protected	2	60		
5/26/2009	Protected	2	54		
5/26/2009	Protected	2	54		
5/26/2009	Protected	2	82		
5/26/2009	Protected	2	92		
5/26/2009	Protected	2	63		
5/26/2009	Protected	2	8		
5/26/2009	Protected	2	53		
5/26/2009	Protected	2	50		
5/26/2009	Protected	2	60		
5/26/2009	Protected	2	55		
5/26/2009	Protected	2	60		
5/26/2009	Protected	2	58		
5/26/2009	Protected	2	45		
5/26/2009	Protected	2	63		
5/26/2009	Protected	2	38		
5/26/2009	Protected	2	54		
5/26/2009	Protected	2	58		
5/26/2009	Protected	2	62		
5/26/2009	Protected	2	62		
5/26/2009	Protected	3	50	30	
5/26/2009	Protected	3	32		
5/26/2009	Protected	3	47		
5/26/2009	Protected	3	80		
5/26/2009	Protected	3	65		
5/26/2009	Protected	3	50		
5/26/2009	Protected	3	40		
5/26/2009	Protected	3	64		
5/26/2009	Protected	3	57		
5/26/2009	Protected	3	47		
5/26/2009	Protected	3	65		
5/26/2009	Protected	3	44		
5/26/2009	Protected	3	54		
5/26/2009	Protected	3	59		
5/26/2009	Protected	3	56		
5/26/2009	Protected	3	61		
5/26/2009	Protected	3	61		
5/26/2009	Protected	3	59		
5/26/2009	Protected	3	20		
5/26/2009	Protected	3	42		
5/26/2009	Protected	3	51		
5/26/2009	Protected	3	66		
5/26/2009	Protected	3	52		
5/26/2009	Protected	3	65		
5/26/2009	Protected	3	67		
5/26/2009	Protected	3	72		

5/26/2009	Protected	3	48	
5/26/2009	Protected	3	70	
5/26/2009	Protected	3	46	
5/26/2009	Protected	4	72	
5/26/2009	Protected	4	68	
5/26/2009	Protected	4	73	
5/26/2009	Protected	4	40	
5/26/2009	Protected	4	18	
5/26/2009	Protected	4	64	
5/26/2009	Protected	4	76	
5/26/2009	Protected	4	45	
5/26/2009	Protected	4	45	
5/26/2009	Protected	4	80	
5/26/2009	Protected	4	40	
5/26/2009	Protected	4	50	
5/26/2009	Protected	4	46	
5/26/2009	Protected	4	66	
5/26/2009	Protected	4	13	
5/26/2009	Protected	4	18	
5/26/2009	Protected	4	82	
5/26/2009	Protected	4	70	
5/26/2009	Protected	4	50	
5/26/2009	Protected	4	31	
5/26/2009	Protected	4	63	
5/26/2009	Protected	4	56	
5/26/2009	Protected	4	53	
5/26/2009	Protected	4	76	
5/26/2009	Protected	4	54	
5/26/2009	Unprotected	1	50	92
5/26/2009	Unprotected	1	44	
5/26/2009	Unprotected	1	60	
5/26/2009	Unprotected	1	60	
5/26/2009	Unprotected	1	52	
5/26/2009	Unprotected	1	50	
5/26/2009	Unprotected	1	52	
5/26/2009	Unprotected	1	55	
5/26/2009	Unprotected	1	51	
5/26/2009	Unprotected	1	37	
5/26/2009	Unprotected	1	62	
5/26/2009	Unprotected	1	52	
5/26/2009	Unprotected	1	56	
5/26/2009	Unprotected	1	54	
5/26/2009	Unprotected	1	27	
5/26/2009	Unprotected	1	78	
5/26/2009	Unprotected	1	33	
5/26/2009	Unprotected	1	35	
5/26/2009	Unprotected	1	33	
5/26/2009	Unprotected	1	45	
5/26/2009	Unprotected	1	54	
5/26/2009	Unprotected	1	71	
5/26/2009	Unprotected	1	32	
5/26/2009	Unprotected	1	63	
5/26/2009	Unprotected	1	50	
5/26/2009	Unprotected	1	72	
5/26/2009	Unprotected	1	50	
5/26/2009	Unprotected	1	48	
5/26/2009	Unprotected	1	70	
5/26/2009	Unprotected	1	52	
5/26/2009	Unprotected	1	52	
5/26/2009	Unprotected	2	55	85

5/26/2009	Unprotected	2	35		
5/26/2009	Unprotected	2	37		
5/26/2009	Unprotected	2	55		
5/26/2009	Unprotected	2	52		
5/26/2009	Unprotected	2	65		
5/26/2009	Unprotected	2	58		
5/26/2009	Unprotected	3	52	83	
5/26/2009	Unprotected	3	28		
5/26/2009	Unprotected	3	43		
5/26/2009	Unprotected	3	40		
5/26/2009	Unprotected	3	33		
5/26/2009	Unprotected	3	68		
5/26/2009	Unprotected	3	65		
5/26/2009	Unprotected	3	12		
5/26/2009	Unprotected	3	37		
5/26/2009	Unprotected	3	52		
5/26/2009	Unprotected	3	40		
5/26/2009	Unprotected	3	50		
5/26/2009	Unprotected	3	65		
5/26/2009	Unprotected	3	53		
5/26/2009	Unprotected	3	43		
5/26/2009	Unprotected	3	50		
5/26/2009	Unprotected	3	45		
5/26/2009	Unprotected	3	64		
5/26/2009	Unprotected	3	51		
5/26/2009	Unprotected	3	46		
5/26/2009	Unprotected	4	51		10
5/26/2009	Unprotected	4	78		
5/26/2009	Unprotected	4	52		
5/26/2009	Unprotected	4	58		
5/26/2009	Unprotected	4	48		
5/26/2009	Unprotected	4	67		
5/26/2009	Unprotected	4	45		
5/26/2009	Unprotected	4	64		
5/26/2009	Unprotected	4	42		
5/26/2009	Unprotected	4	66		
5/26/2009	Unprotected	4	80		
5/26/2009	Unprotected	4	76		
5/26/2009	Unprotected	4	53		
5/26/2009	Unprotected	4	17		
5/26/2009	Unprotected	4	50		
5/26/2009	Unprotected	4	73		
5/26/2009	Unprotected	4	33		
5/26/2009	Unprotected	4	60		
5/26/2009	Unprotected	4	64		
5/26/2009	Unprotected	4	46		
5/26/2009	Unprotected	4	30		
5/26/2009	Unprotected	4	57		

APPENDIX B: Reef Resident Flora and Fauna Data

Table B-1. Density data (#/0.1m^2) for invertebrates and fish collected from all three reef types: Constructed (mini-reefs); Protected (natural reef areas between constructed mini-reefs); and Unprotected (natural reef west of restoration area).

Date	Reef Type	Rep	*Ilyanassa obsoleta*	*Crepidula plana*	*Mya arenaria*	*Macoma balthica*	*Balanus sp.*	gammarid amphipod	*Panopeus herbstii*	*Dyspanopeus sayi*	*Eurypanopeus depressus*	*Carcinus maenas*	*Palaemonetes sp.*	*Crangon septemspinosa*	*Cancer irroratus*	*Nereis sp.*	cunner	Wet Wt. (g/0.1 m^2)	Total Taxa (#/0.1 m^2)
11/27/2007	constructed	1	12									2						14	2
11/27/2007	constructed	2	30									5						35	2
11/27/2007	constructed	3	4				1									1		6	3
11/27/2007	constructed	4	10				6					2						18	2
11/27/2007	constructed	5	12				4			9		2						27	3
5/8/2008	constructed	1	24		2		1			1						1		29	5
5/8/2008	constructed	2	46		15		3			2						1		67	5
5/8/2008	constructed	3	26		6		6			1						3		42	5
5/8/2008	constructed	4	12		3		3			1								19	4
5/8/2008	constructed	5	22								7							29	2
5/8/2008	constructed	6	6		3		7				4							20	4
7/8/2008	constructed	1	3													1		4	2
7/8/2008	constructed	2	15				5				2		1			2		25	5
7/8/2008	constructed	3	56				2				1					3		62	4
7/8/2008	constructed	4	10		1		3			2	2					2		20	6
7/8/2008	constructed	5	4				6			2	1					5		18	5
7/8/2008	constructed	6	1							1								2	2
9/16/2008	constructed	1	2	5			4		2							1		14	5
9/16/2008	constructed	2	11				2		1	4	2					2		22	6
9/16/2008	constructed	3	14				2			1	3					8		28	5
9/16/2008	constructed	4	14	1						3						2		20	4
9/16/2008	constructed	5	2	4			2				1					2		11	5
9/16/2008	constructed	6	19	1			6			2	1					5		34	6
11/17/2008	constructed	1		1			1	2		5	1		1			1		12	7
11/17/2008	constructed	2	8	4									2			3		17	4
11/17/2008	constructed	3	10	3						2	1						1	17	5
11/17/2008	constructed	4	3	4		2	2			4	2					2		19	7
5/26/2009	constructed	1	28	4				5		2						3		42	5
5/26/2009	constructed	2	13					1		5	4					10		33	5
5/26/2009	constructed	3	9	1			1	2		3			1					17	6
5/26/2009	constructed	4	21					1		4								26	3
7/8/2008	protected	1	7				2			4	1					5		19	5
7/8/2008	protected	2	13							2						1		16	3
7/8/2008	protected	3	8				2			2	2					3		17	5
7/8/2008	protected	4	5							3						1		9	3
7/8/2008	protected	5	5				2			2	1					2		12	5
9/16/2008	protected	1	44	2			3			3						11		63	5
9/16/2008	protected	2	2				2		1							2		7	5
9/16/2008	protected	3	17	3			2			6	2					6		36	6
9/16/2008	protected	4	27				4			4						4		39	4
9/16/2008	protected	5	38				2			4	2					3		49	5
11/17/2008	protected	1	7				4			1	2					2		16	5
11/17/2008	protected	2	1				1			1						2		5	4
11/17/2008	protected	3	1	1			1	1		2	1		1			3		11	8
11/17/2008	protected	4	2				6			1						1		10	4
5/26/2009	protected	1	21	2			3	1								2		29	5
5/26/2009	protected	2	23	6			3	2		2	2			1		2		41	8
5/26/2009	protected	3	24	1				1								1		27	4
5/26/2009	protected	4	9							1	1							11	3

11/27/2007	unprotected	1	3			2		1	2					8	3
11/27/2007	unprotected	2	15	1		2								18	1
11/27/2007	unprotected	3	16						1				1	18	3
11/27/2007	unprotected	4				4					2			6	1
5/20/2008	unprotected	1	20		3				2	2			3	30	4
5/20/2008	unprotected	2	6						1	1			1	9	4
5/20/2008	unprotected	3	7							2				9	3
5/20/2008	unprotected	4	11							1				12	2
5/20/2008	unprotected	5								1				1	1
7/8/2008	unprotected	1											1	1	1
7/8/2008	unprotected	2	1			1			3				1	6	4
7/8/2008	unprotected	3	9										3	12	2
7/8/2008	unprotected	4							2	2				4	2
7/8/2008	unprotected	5				1			4	3			2	10	4
9/16/2008	unprotected	1								3			1	4	2
9/16/2008	unprotected	2	4			1			2				3	10	4
9/16/2008	unprotected	3	6			1			1					8	3
9/16/2008	unprotected	4	3			6			2	1				12	4
9/16/2008	unprotected	5	13	2					3	1			1	20	5
11/17/2008	unprotected	1	1	3		1				1		1	1	8	6
11/17/2008	unprotected	2	5	7		3			3	2			2	22	6
11/17/2008	unprotected	3	6	8		3			4	2		1	3	27	7
11/17/2008	unprotected	4	4	1		3							1	9	4
5/26/2009	unprotected	1	3	1		1			2					7	4
5/26/2009	unprotected	2	11			1	3		4	3			3	25	6
5/26/2009	unprotected	3	2			2	2		1	1			2	10	6
5/26/2009	unprotected	4	12			2	2		5	2			1	24	6

Table B-2. Biomass (wet weight) data ($g/0.1m^2$) for invertebrates and fish collected from all three reef types: Constructed (mini-reefs); Protected (natural reef areas between constructed mini-reefs); and Unprotected (natural reef west of restoration area).

Date	Reef Type	Rep	*Ilyanassa obsoleta*	*Crepidula plana*	*Mya arenaria*	*Macoma balthica*	*Balanus sp.*	gammarid amphipod	*Panopeus herbstii*	*Dyspanopeus sayi*	*Eurypanopeus depressus*	*Carcinus maenas*	*Palaemonetes* sp.	*Crangon septemspinosa*	*Cancer irroratus*	*Nereis sp.*	cunner	Total Wet Wt. ($g/0.1\ m^2$)
11/27/2007	constructed	1	3.5									1.8						5.33
11/27/2007	constructed	2	14.5									1.8						16.31
11/27/2007	constructed	3	1.1													0.2		1.34
11/27/2007	constructed	4	0.9									3.3						4.14
11/27/2007	constructed	5	4.3							4.5		1.0						9.79
5/8/2008	constructed	1	7.4		0.2					0.1						0.1		7.72
5/8/2008	constructed	2	15.0		1.5					0.2						0.1		16.74
5/8/2008	constructed	3	8.9		0.6					2.5						0.6		12.50
5/8/2008	constructed	4	3.8		0.2					0.2								4.13
5/8/2008	constructed	5	6.9								1.3							8.18
5/8/2008	constructed	6	2.3		0.2						3.7							6.16
7/8/2008	constructed	1	1.4													0.1		1.50
7/8/2008	constructed	2	4.5				0.1				0.5		0.1			0.2		5.40
7/8/2008	constructed	3	14.0				0.1				0.3					0.1		14.50
7/8/2008	constructed	4	3.0		0.1		0.1			0.7	0.2					0.2		4.30
7/8/2008	constructed	5	1.4				0.1			0.4	0.1					0.3		2.30
7/8/2008	constructed	6	0.2							0.1								0.30
9/16/2008	constructed	1	0.7	0.1			0.1		2.9							0.1		3.90
9/16/2008	constructed	2	3.2				0.1		2.3	3.6	1.0					0.1		10.30
9/16/2008	constructed	3	3.9				0.1			0.5	1.1					0.2		5.80
9/16/2008	constructed	4	4.1	0.1						2.0						0.1		6.30
9/16/2008	constructed	5	0.6	0.1			0.1				0.1					0.1		1.00
9/16/2008	constructed	6	6.3	0.1			0.1			1.0	0.6					0.1		8.20
11/17/2008	constructed	1		0.1			0.1	0.1		4.1	0.7		0.3			0.1		5.50
11/17/2008	constructed	2	2.5	0.1									0.5			0.2		3.30
11/17/2008	constructed	3	3.0	0.1						1.6	0.6						1.0	6.30
11/17/2008	constructed	4	1.0	0.1		1.0	0.1			3.5	0.1					0.2		6.00
5/26/2009	constructed	1	8.1	0.1				0.1		1.8						0.1		10.20
5/26/2009	constructed	2	3.0					0.1		7.8	1.4					0.8		13.10
5/26/2009	constructed	3	2.9	0.1			0.1	0.1		1.5			0.1					4.80
5/26/2009	constructed	4	6.1					0.1		4.1								10.30
7/8/2008	protected	1	2.0				0.1			0.9	0.2					0.3		3.50
7/8/2008	protected	2	3.4							0.6						0.1		4.10
7/8/2008	protected	3	2.1				0.1			0.3	0.6					0.4		3.50
7/8/2008	protected	4	1.2							0.3						0.1		1.60
7/8/2008	protected	5	1.5				0.1			1.8	0.1					0.1		3.60
9/16/2008	protected	1	13.9	0.1			0.1			1.3						0.4		15.80
9/16/2008	protected	2	0.5				0.1		1.1							0.1		1.80
9/16/2008	protected	3	4.7	0.1			0.1			7.0	1.0					0.3		13.20
9/16/2008	protected	4	7.7				0.1			1.9						0.3		10.00
9/16/2008	protected	5	11.4				0.1			6.0	0.5					0.1		18.10
11/17/2008	protected	1	1.8				0.1			0.1	1.7					0.1		3.80
11/17/2008	protected	2	0.3				0.1			0.1						0.1		0.60
11/17/2008	protected	3	0.2	0.1			0.1	0.1		2.5	0.1		0.3			0.3		3.70
11/17/2008	protected	4	1.0				0.1			2.0						0.1		3.20
5/26/2009	protected	1	6.3	0.1			0.1	0.1								0.1		6.70
5/26/2009	protected	2	6.4	0.1			0.1	0.1		1.1	1.2			0.3		0.1		9.40
5/26/2009	protected	3	6.9	0.1			0.1	0.1								0.1		7.30
5/26/2009	protected	4	2.6							0.2	0.5							3.30

11/27/2007	unprotected	1										0.00
11/27/2007	unprotected	2										0.00
11/27/2007	unprotected	3										0.00
11/27/2007	unprotected	4										0.00
5/20/2008	unprotected	1	6.9		0.1			0.4	0.4		0.1	7.90
5/20/2008	unprotected	2	1.8					1.0	0.4		0.1	3.30
5/20/2008	unprotected	3	2.3						2.2			4.50
5/20/2008	unprotected	4	4.0						0.4			4.40
5/20/2008	unprotected	5							0.2			0.20
7/8/2008	unprotected	1									0.1	0.10
7/8/2008	unprotected	2	0.2			0.1		0.7			0.1	1.10
7/8/2008	unprotected	3	2.7								0.1	2.80
7/8/2008	unprotected	4						0.7	1.9			2.60
7/8/2008	unprotected	5				1.0		1.5	1.9		0.1	4.50
9/16/2008	unprotected	1							2.9		0.1	3.00
9/16/2008	unprotected	2	1.4			0.1		1.2			0.1	2.80
9/16/2008	unprotected	3	2.0			0.1		0.3				2.40
9/16/2008	unprotected	4	1.0			0.1		2.2	0.3			3.60
9/16/2008	unprotected	5	4.0	0.1				4.0	1.0		1.0	10.10
11/17/2008	unprotected	1	0.5	0.1		0.1			2.5	0.2	0.1	3.50
11/17/2008	unprotected	2	1.7	0.1		0.1		2.1	0.6		0.1	4.70
11/17/2008	unprotected	3	2.0	0.1		0.1		2.9	0.5	0.3	0.1	6.00
11/17/2008	unprotected	4	1.4	0.1		0.1					0.1	1.70
5/26/2009	unprotected	1	0.8	0.1		0.1		0.3				1.30
5/26/2009	unprotected	2	3.3			0.1	0.1	2.2	1.6		0.1	7.40
5/26/2009	unprotected	3	0.6			0.1	0.1	0.1	0.4		0.1	1.40
5/26/2009	unprotected	4	3.9			0.1	0.1	6.5	0.1		0.1	10.80

Table B-3. Biomass (wet weight) data (g/0.1m^2) for macroalgae collected from all three reef types: Constructed (mini-reefs); Protected (natural reef areas between constructed mini-reefs); and Unprotected (natural reef west of restoration area).

Date	Reef Type	Rep	*Gracilaria tikvahiae*	*Ulva intestinalis*	*Ulva lactuca*	*Ceramium virgatum*	*Ascophyllum nodosum*	*Polysiphonia meunadata*	*Petalonia fascia*	*Neosiphonia harveyi*	*Chondria baileyana*	*Daysia baillouviana*	*Ceramium deslongchampii*	*Audouinella secundata*	*Callithamnion tetragonum*	*Enteromorpha prolifera*	Total Wet Wt. (g/0.1 m^2)	Total Taxa (#/0.1 m^2)
11/27/2007	constructed	1	0.5		6.1	2.0	0.3										8.9	4
11/27/2007	constructed	2	4.0		14.0	0.7			1.5								20.2	4
11/27/2007	constructed	3	101.0		7.0	2.5		0.3									110.8	4
11/27/2007	constructed	4	275.0		7.0												282.0	4
11/27/2007	constructed	5	6.0		19.0	2.5	1.5										29.0	4
5/8/2008	constructed	1	1.2		0.5												1.7	2
5/8/2008	constructed	2	20.0		0.5		7.0										27.5	3
5/8/2008	constructed	3	1.5		5.5												7.0	2
5/8/2008	constructed	4	0.7		3.5												4.2	2
5/8/2008	constructed	5	0.8														0.8	1
5/8/2008	constructed	6	1.2	0.5	0.7												2.4	3
7/8/2008	constructed	1	1.0		5.5					0.1	0.1						6.7	4
7/8/2008	constructed	2	17.0		18.0						0.5						35.5	3
7/8/2008	constructed	3	13.0		3.0						0.1						16.1	3
7/8/2008	constructed	4	4.5		18.0						1.0						23.5	3
7/8/2008	constructed	5	1.5		12.5	0.1				0.5	5.5						20.1	5
7/8/2008	constructed	6	1.0		2.0					0.1							3.1	3
9/16/2008	constructed	1	10.0		3.2												13.2	2
9/16/2008	constructed	2	6.0		6.5												12.5	2
9/16/2008	constructed	3	3.2		4.0												7.2	2
9/16/2008	constructed	4	1.0		2.5												3.5	2
9/16/2008	constructed	5	1.5		6.0												7.5	2
9/16/2008	constructed	6	1.0		1.5												2.5	2
11/17/2008	constructed	1	1.3														1.3	1
11/17/2008	constructed	2	7.0		1.0												8.0	2
11/17/2008	constructed	3	52.5		0.5												53.0	2
11/17/2008	constructed	4	31.5		0.5												32.0	2
5/26/2009	constructed	1	107.0														107.0	1
5/26/2009	constructed	2	191.0														191.0	1
5/26/2009	constructed	3	5.5														5.5	1
5/26/2009	constructed	4	7.0		1.0	1.0											9.0	3
7/8/2008	protected	1	22.0		50.0	1.0				1.0	0.1						74.1	5
7/8/2008	protected	2	68.0		11.0						0.5		0.5				80.0	4
7/8/2008	protected	3	108.0		22.0	0.5	2.0			0.5	0.5						133.5	6
7/8/2008	protected	4	2.0		13.5	0.5				0.1	0.5		0.1				16.7	6
7/8/2008	protected	5	1.0		5.0					2.0	2.0		0.1				10.1	5
9/16/2008	protected	1	0.5		6.0												6.5	2
9/16/2008	protected	2	18.0		8.8												26.8	2
9/16/2008	protected	3	0.1		0.8												0.9	2
9/16/2008	protected	4	1.5		1.0												2.5	2
9/16/2008	protected	5	0.8		0.9												1.7	2
11/17/2008	protected	1	8.0														8.0	1
11/17/2008	protected	2	27.0														27.0	1
11/17/2008	protected	3	6.5														6.5	1
11/17/2008	protected	4	7.5		1.0												8.5	2
5/26/2009	protected	1	5.5		1.0												6.5	2
5/26/2009	protected	2	11.0		3.0												14.0	2
5/26/2009	protected	3	57.0		0.5												57.5	2
5/26/2009	protected	4	20.0														20.0	1

11/27/2007	unprotected	1	0.1	1.5		3.2									4.8	3
11/27/2007	unprotected	2	1.5			1.0	2.2								4.7	3
11/27/2007	unprotected	3	1.5	0.5		0.1									2.1	3
11/27/2007	unprotected	4	1.9	0.7		1.0									3.6	3
5/20/2008	unprotected	1	1.2		0.5										1.7	2
5/20/2008	unprotected	2	2.0		3.0										5.0	2
5/20/2008	unprotected	3	0.8		7.0										7.8	2
5/20/2008	unprotected	4	3.5		2.2										5.7	2
5/20/2008	unprotected	5	0.6												0.6	1
7/8/2008	unprotected	1	1.0		1.0										2.0	2
7/8/2008	unprotected	2	0.5		15.0			1.3	1.2			0.1	0.1		18.1	6
7/8/2008	unprotected	3	8.0		7.5						3.0				18.5	3
7/8/2008	unprotected	4	1.0		42.0					18.0					61.0	3
7/8/2008	unprotected	5	0.5		4.5		3.5	0.5			0.5				9.5	5
9/16/2008	unprotected	1	0.8		0.5										1.3	2
9/16/2008	unprotected	2											0.1	0.1	0.0	2
9/16/2008	unprotected	3	0.5		1.0										1.5	2
9/16/2008	unprotected	4	0.9		1.9										2.8	2
9/16/2008	unprotected	5	6.0		0.5										6.5	2
11/17/2008	unprotected	1	2.0		0.5										2.5	2
11/17/2008	unprotected	2	29.0		11.0										40.0	2
11/17/2008	unprotected	3	3.0												3.0	1
11/17/2008	unprotected	4	1.5												1.5	1
5/26/2009	unprotected	1	27.0												27.0	1
5/26/2009	unprotected	2	1.0		1.0										2.0	2
5/26/2009	unprotected	3	9.0												9.0	1
5/26/2009	unprotected	4	53.0												53.0	1