FINAL REPORT

TWENTY-FOUR MONTH BENTHIC BIOLOGY SURVEY
A COMPONENT OF THE BENTHIC MONITORING STUDY
FOR THE
LONG ISLAND REPLACEMENT CABLE PROJECT

JUNE 2010

SHEFFIELD HARBOR AND LONG ISLAND SOUND
NORWALK, CONNECTICUT

OSI REPORT NO. 07ES077.7B

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1.0 INTRODUCTION

During the period 5 June through 11 June 2010, Ocean Surveys, Inc. (OSI) conducted various oceanographic, biological, hydrographic, and geophysical tasks in and around Sheffield Harbor, Norwalk, CT and in portions of Long Island Sound. These tasks were part of a benthic monitoring program designed to assess the environmental and biological characteristics of the area and to evaluate potential environmental impacts that may result from the Long Island Power Authority (LIPA)/The Connecticut Light and Power Company (CL&P) Long Island Replacement Cable Project ("LIRC" or "Project") which extends from Norwalk, CT to Northport, NY in Long Island Sound. These investigations were performed under contract to ESS Group, Inc. (ESS) on behalf of CL&P. The benthic biology results included in this report are a component of the Monitoring and Mitigation Plan required by regulatory agencies overseeing the Long Island Replacement Cable Project.

The primary objectives of the benthic biology investigation were to (a) identify the major benthic habitats in the study area, (b) assess the quality of benthic habitats and communities, and (c) determine the abundance and species composition of bottom-dwelling organisms in each of the major subtidal habitat types found in the study site. These investigations were conducted by OSI and ESS Group, Inc. This report focuses on the benthic biology tasks conducted during the twenty-four month post-construction survey.

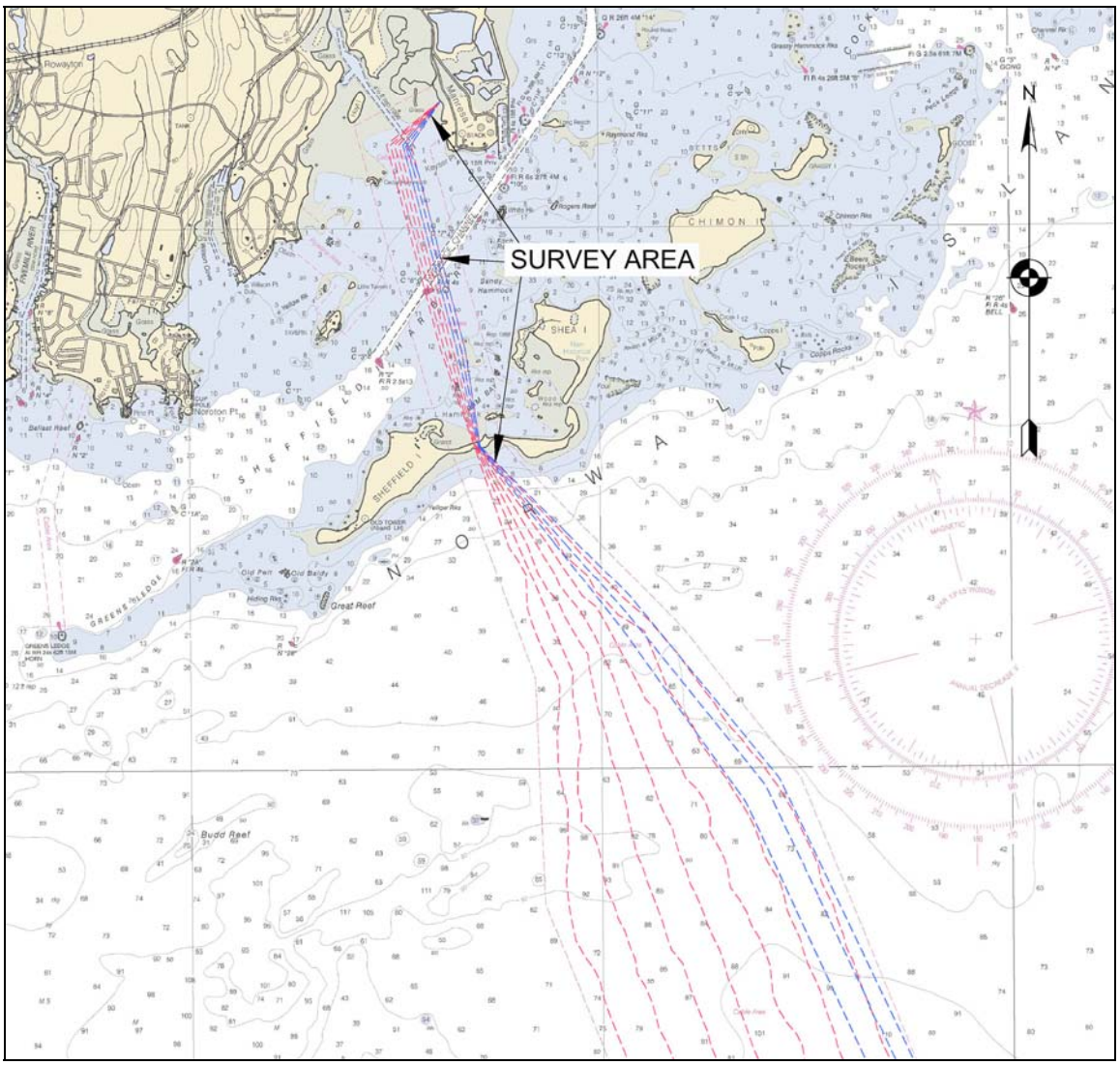

Figure 1: Site map of the benthic biology survey area within Sheffield Harbor and Long Island Sound

1.1 Project Background

The Project involved the replacement of seven fluid-filled submarine transmission cables installed in 1969, with three new solid-core dielectric copper conductor cables. The Connecticut Department of Environmental Protection (CTDEP) and the Connecticut Siting Council (CSC) have required CL&P to monitor the effect of the Project on the seafloor and shellfish resources by conducting periodic investigations for 24 months after the completion of construction. The U.S. Army Corps of Engineers (USACE) also has a parallel requirement.

Utilizing geophysical data previously collected during the Fall of 2000 (Ocean Surveys, Inc. 2001), OSI conducted a benthic habitat mapping survey and shellfish assessment within the existing cable corridor between Manresa Island and south of Sheffield Island in November 2001 (Ocean Surveys, Inc. 2002). In January 2007, prior to construction of the Project, OSI conducted a follow-up investigation and verified that seafloor conditions had not changed significantly since 2001 (Part I – Pre-Construction Survey Reports, Report 1 submitted in July 2008) (Ocean Surveys, Inc. 2007).

The LIRC monitoring plan was developed between December 2006 and September 2007 in consultation with the Bureau of Aquaculture (BOA) and was submitted to CTDEP and CSC for their approval. In September 2007, CL&P obtained final plan approval and required permits prior to initiation of fieldwork. Since this time, OSI has completed pre-construction, construction, and post-construction benthic biology surveys as listed below:

- Pre-construction benthic habitat surveys from 27 September through 10 October 2007 (Part I – Pre-Construction Survey Reports, Report 2) (Ocean Surveys, Inc. 2008).
- Benthic biology construction surveys from October 2007 through May 2008 during in-water cable removal and cable installation activities in Connecticut waters (Part II - Construction and Early Post-Construction Survey Reports submitted in November 2008).
- Initial post-construction benthic habitat survey from 24 July through 15 August 2008 (Ocean Surveys, Inc, 2009a & 2009c).

- Three-month post construction benthic habitat survey from 20 – 29 October 2008 (Ocean Surveys, Inc, 2009c).
- Six-month post-construction benthic habitat survey from 12 January through 22 January 2009 (Ocean Surveys, Inc, 2009b & 2009c).
- Twelve-month post-construction benthic habitat survey from 19 June through 24 June 2009 (Ocean Surveys, Inc, 2009d & 2010a).
- Eighteen month post-construction benthic habitat survey from 1 December through 14 December 2009 (Ocean Surveys, Inc. 2010b & 2010c).
- Twenty-four month post-construction benthic habitat survey from 5 June through 11 June 2010 (Ocean Surveys, Inc. 2010d & current report).

The twenty-four month post-construction benthic habitat survey completes the benthic monitoring requirements set forth in the Monitoring and Mitigation Plan.

1.2 Project Tasks

A summary of the twenty-four month post-construction monitoring tasks and their purpose is provided below. Results from benthic biology tasks 1a, 1b, and 1c are the subject of this report. Task 8 results for the twenty-four month post-construction seafloor survey have been previously submitted.

Task 1: Benthic Habitat Ground-Truthing (ESS & OSI)

1a: Benthic Sediment Grab Sampling*:* to quantify benthic populations and provide ground-truthing data for benthic habitat mapping

1b: Quantitative Shellfish Quadrat Sampling*:* to assess potential changes in shellfish abundance and size distribution

1c: Underwater Video-camera Surveys: to verify habitat types and quantify shellfish populations

Task 8: Remote Sensing Surveys (OSI)

8a: Multibeam Hydrographic Survey: to map the existing bottom topography

8b: Side Scan Sonar Survey: to identify geomorphologic features on the seafloor

8c: Sediment Profile Imagery: to obtain detailed information on the physical, chemical, and biological parameters

**Tasks 2-7 were conducted during the pre-construction, construction, and previous post-construction periods and are complete.*

2.0 SURVEY AREAS AND CONTROL INFORMATION

2.1 Survey Areas, Tracklines, and Sample Locations

All monitoring activities were conducted in Connecticut waters, across the northern part of the cable corridor around Sheffield Island, as illustrated in Figure 1. The following section provides specific details about stationing and trackline layout. Benthic surveys were performed throughout Sheffield Harbor and Long Island Sound within 1,500 feet of the south side of Sheffield Island.

Appendix 1 provides coordinates for all sampling stations, monitoring locations, and underwater video trackline end points for Task 1 in tabular format. Several overview figures are also provided in order to show the positions relative to benthic habitat monitoring accomplished during previous investigations.

2.2 Horizontal Control

Horizontal positioning of all survey vessels supporting this project was accomplished by utilizing a Trimble survey grade Global Positioning System (GPS) that outputs geodetic coordinates referenced to the WGS-84 datum (World Geodetic System established in 1984), and equivalent to NAD 83 (North American Datum established in 1983). Differential corrections were received from either the U.S. Coast Guard reference station at Moriches, Long Island, New York or a shore-based reference station set on a known control point (for the multibeam survey). The computer navigation software utilized aboard the survey vessel converts the geodetic positions (latitude-longitude) to state plane coordinates (easting-northing) for navigation while logging these positions along survey tracklines. The survey was conducted in the Long Island Lambert coordinate system, New York State Plane (Zone 3104), referenced to NAD 83 with all coordinates in feet.

Daily navigation checks were conducted to verify system accuracy at points established at the Norwalk Cove Marina by the survey vessel. These checks show that the positioning equipment was operating properly and delivering the positioning accuracy required for investigations. A listing of all control points utilized for these investigations with point coordinates and descriptions are provided below in Table 1.

Table 1. Control Points Used for this Investigation

Control Point	Position *	NAVD88 Elevation	Description
"Norwalk Cover Marina Fuel Dock"	N 335416 E 1150001	N/A	4th cleat from the South at the fuel dock of Norwalk Cove Marina
"Sheet Pile"	N 336169.31 E 1150521.10	8.55 feet	Temporary benchmark installed on the western side of the North Bulk head at Norwalk Cove Marina near the floating docks.

* Coordinates referenced to NY State Plane, Long Island Lambert, Zone 3104, NAD 83 in feet.

3.0 MATERIALS AND METHODS

3.1 Benthic Habitat Ground-Truthing (Task 1)

The following subtasks were performed during the June 2010 benthic survey to provide a comparison with the pre-construction survey that took place during the Fall of 2007 (Ocean Surveys Inc. 2008) and previous post-construction surveys. All data collected pertaining to these tasks has been analyzed by ESS.

3.1.1 Benthic Sediment Grab Sampling (Task 1a)

A total of 23 stations were sampled for this investigation, with three replicate grab samples taken at each station (Figure A1-1, Appendix 1). Samples were collected along five of the video transect lines (1, 3, 4, 6, and 9). Four of these transects are located north of Sheffield Island and one is located south of Sheffield Island. Along each transect, grab samples were collected from the center, the eastern and western edges of the existing cable corridor; as well

as from a number of background stations outside the cable corridor. These station locations were the same as those established during the November 2001 survey and the same as those sampled during the September 2007 pre-construction survey and previous post-construction surveys, accurate to within ten feet.

At each of the 23 stations, grab samples and replicates were obtained using a ship-deployed Ponar grab (9" x 9" surface area). Upon retrieval, contents of the grab were sieved through a 0.5 mm mesh screen and placed in plastic jars containing 3% buffered formalin. Samples were stored in formalin for several days and then re-sieved, with fresh water, through a 0.5 mm mesh screen and preserved in 70% ethyl alcohol containing Rose Bengal. Macrofaunal organisms were sorted from the sample residues under a dissecting microscope. All organisms were identified to lowest practical taxonomic group and counted. Organisms too small to be quantitatively sampled with a 0.5 mm mesh sieve (e.g., nematodes, copepods) were not removed from the sample residues. These results were used to quantify the abundance and species composition of benthic invertebrates.

3.1.2 Quantitative Shellfish Quadrat Sampling (Task 1b)

Quantitative estimates of shellfish abundance and size were made at 20 stations within the monitoring area (16 north and 4 south of Sheffield Island) by way of SCUBA divers (Figure A1-1, Appendix 1). At each site, divers placed a $0.25m^2$ quadrat on the seafloor and collected all material inside the quadrat to a depth of approximately 10 to 15 cm below the sediment surface. The material was placed in mesh bags and brought to the surface where the contents of the bag were washed, all living shellfish (oysters and clams) were removed, and sediment and shell matter were discarded. Living oysters and hard clams were counted and the maximum shell length was recorded using a vernier caliper. Three replicates were collected at each station using a random sampling method, to ensure unbiased samples were collected.

3.1.3 Underwater Video-Camera Surveys (Task 1c)

Underwater video was recorded along ten transects (Figure A1-2, Appendix 1). Eight transects were performed north of Sheffield Island, perpendicular to the existing power cables. Two transects were performed south of Sheffield Island, one oriented perpendicular to the existing cables while the other was oriented parallel to the centerline of the old cable corridor. The survey design for the video transects was primarily based on benthic habitat information derived from the side-scan sonar and video camera surveys originally conducted in 2001.

The underwater video camera was mounted on an epi-benthic sled deployed from a small vessel. Data were recorded on DVDs, which also included a timestamp and transect number for a frame of reference. The timestamp was interfaced with a ship-board GSP navigation system which allowed an accurate estimate of the ship's position along each survey line and the ability to correlate ship-position with the video camera image position on the seafloor. Video transect surveys were used for benthic habitat characterization and to obtain an estimate for shellfish abundance as described below.

Benthic Habitat Characterization

In the laboratory, benthic habitat characterization was conducted by recording all the species and habitat types discernable on the DVD images for the entire length of each transect line. At approximately one-minute intervals, video-images were captured and processed to assess the relative percentage of the major benthic habitat elements (e.g., substrate type, shell hash, biogenic structures) found on the video images.

Similar to the previous surveys, data at each one-minute interval were pooled into three-minute time blocks. While the vessel operator attempted to maintain a constant speed and direction, variability in water current velocity and wind speed and direction caused differences in the distance that the video-sled traveled from minute-to-minute. On average,

the video-sled was estimated to travel ~12 m (~40') per minute. Data pooled for three-minute intervals presented in the benthic habitat characterization figures (Appendix 5) cover a transect length of approximately 120 feet.

Shellfish Abundance

The video survey data were also used to determine the presence of living oysters and obtain a relative estimate of their abundance. There are a number of factors that made it difficult to obtain truly accurate shellfish abundance with the video camera survey data. First, as mentioned previously, the video camera sled did not travel in a fixed position above the seafloor, which precluded ESS's ability to accurately estimate the area comprising each video frame. Second, poor water clarity at some of the survey sites limited the ability to clearly see the seafloor. Therefore, oysters were recorded as "present" or "absent" in the pooled 3 minute time-blocks mentioned previously.

4.0 SUMMARY OF FIELD INVESTIGATIONS

4.1 Survey Crew and Vessel

The following OSI/ESS personnel comprised the field team assembled to perform the post-construction benthic habitat and shellfish monitoring surveys aboard the ***R/V Ready II***:

Dustin Kach	Oceanographic Project Manager (OSI)
Kevin M. Ridarelli	Oceanographic Scientist (OSI)
Steve C. Bodak	Oceanographic Scientist/Diving Assistant (OSI)
Matthew Ladewig	Benthic Biologist (ESS)
Glendon Barnes	Environmental Scientist (ESS)

4.2 Survey Equipment

The major equipment systems utilized for this investigation are listed below in Table 2. The operational procedures employed to collect the data for this project are described in Appendix 2.

Table 2. Summary of Survey Equipment

Equipment System	Description
Trimble ProBeacon USCG Beacon Receiver *Appendix 2*	Beacon receiver, which USCG differential corrections that are input to the Trimble 4000 receiver, increasing the overall system accuracy.
HYPACK navigation computer and software *Appendix 2*	Software runs on a desktop or notebook computer providing real-time trackline control, digital data logging, and many survey utility functions; this package allows the efficient simultaneous acquisition of data from multiple systems.
Simrad "Osprey" OE9031 Color Underwater Video Camera *(Task 1)* *Appendix 2*	Underwater camera system which can be towed or hand held by diver to obtain high quality visual imagery of the bottom for documenting benthic conditions; specially designed for low light / poor visibility.
Ponar Grab Sampler *(Task 1)* *Appendix 2*	Device contains lever arms and two scoops with sharp cutting edges, which allow penetration into soft material. The closing mechanism is a self-releasing pinch-pin attached to the two closing arms, which holds the grabs open until impact with the bottom.

4.3 Chronology of Survey Tasks and Data Acquisition Summary

Using the survey plan and methods described above, the field crew completed the survey tasks as detailed in Appendix 1. See Section 1.2 for task discussions.

5.0 PROCESSING AND DELIVERABLES

Data for Tasks 1a, 1b, and 1c have been analyzed and interpreted by ESS. All sampling locations are provided in tabular format and graphically on overview maps in Appendix 1. A trackline plot for the underwater video investigation, including time stamps for analysis of the video, is also provided in Appendix 1 (Figure A1-2). The underwater video collected

during this investigation can be provided by OSI upon request. Digital copies of all project drawings are provided on the enclosed CD-ROM in Appendix 6.

6.0 RESULTS

6.1 Benthic Sediment Grab Sampling (Task 1a)

The abundance of the benthic invertebrate taxa collected at the 23 sampling stations in June 2010 is summarized in Table A3-1, Appendix 3. A total of 103 invertebrate taxa were found. Of the taxa identified, there were 23 mollusks, 48 annelids, 27 arthropods, 3 nemertines and 2 other non-annelid worm taxa. Similar to previous surveys, benthic samples were dominated primarily by annelid worms (polychaetes and oligochaetes) along with bivalve and gastropod mollusks.

The average number of individuals per station varied from 38 to 833, while the average number of species per station ranged from 10 to 22. Average species diversity estimates ranged from 1.14 to 2.21 (Table A3-2, Appendix 3). Most samples were dominated by polychaete and oligochaete worms; where the average number of individuals per station ranged from 12 to 557 and 1 to 293, respectively. Among annelids, polychaetes were more abundant than oligochaetes, on average, at each transect. Mollusks were typically the second most abundant taxa and the average number of individuals per station varied from 2 to 151. Among mollusks, gastropods were typically found at higher abundances than bivalves. The average number of arthropods per station varied from 1 to 24 individuals (Table A3-3, Appendix 3). Amphipods were the most abundant and widespread crustaceans.

Results of the hierarchical classification analysis illustrate the degree of sample similarity among the various sampling stations (Figure A3-4, Appendix 3). In general, there was considerable variation in species composition and abundance within and between stations. With a few exceptions, most samples in Transects 1 and 5 clustered together with other samples from their respective transect. However, samples from Transects 2, 3 and 4 were

more widely dispersed and more likely to cluster with samples from different transects (Figure A3-4, Appendix 3).

The nMDS plot shows that samples from Transect 1 group together fairly well but that other transects were generally not as distinct (Figure A3-5, Appendix 3). Samples collected from Transect 5 did not separate out well in the June 2010 nMDS plot. This is different from the pattern noted during previous summer monitoring events (July 2008 and June 2009), when the grouping of Transect 5 samples on the nMDS ordination plot were fairly distinct. The exception among the June 2010 samples was Station 5D, which distinctly grouped together away from the rest of the samples (Figure A3-5, Appendix 3).

Samples collected along Transect 1 were typically dominated, in descending order, by an oligochaete worm and four species of polychaete worms (*Tharyx acutus*, *Mediomastus ambiseta*, *Leitoscoloplos fragilis*, and *Cossura longocirrata)*. Samples taken from Transect 2 were similarly dominated by *M. ambiseta*, *T. acutus*, Oligochaeta, and *Leitoscoloplos fragilis*, although *C. longocirrata*, *Polydora cornuta*, and a bivalve, *Tellina agilis*, were also numerically important members of the species assemblage. Samples collected from Transect 3 were dominated by *M. ambiseta* and Oligochaeta, followed by *T. acutus* and the gastropods *Crepidula fornicata*, *Boonea seminuda*, and *Crepidula plana*. The high abundance of *B. seminuda* is likely related to the high abundance of *C. fornicata* and *C. plana*, as *B. seminuda* is an ectoparasite of *Crepidula* species. Transect 4 samples tended to be highly variable in overall abundance and taxonomic composition. In general, samples from Transect 4 were dominated by *M. ambiseta* and Oligochaeta. However, the bivalve *Nucula annulata*, the polychaete *Nephtys incisa* and the gastropod *C. fornicata* were also relatively abundant, on average. Transect 5 samples, located on the south side of Sheffield Island, were also highly variable. For example, the most abundant species overall, *Marenzelleria viridis*, was absent from 7 of the 12 samples collected along Transect 5. Other taxa found at high average abundances from Transect 5 include *M. ambiseta*, *Turbonilla sp*, *T. agilis*, and Oligochaeta.

6.2 Quantitative Shellfish Quadrat Sampling (Task 1b)

Table A4-1, Appendix 4 summarizes the abundance of hard clams (*Mercenaria mercenaria*) and eastern oysters (*Crassostrea virginica*) collected in the diver-deployed quadrats during the June 2010 survey. Hard clams were collected at eight of the 20 survey sites while oysters were found at only three of the 20 sites (F, G, and I). Hard clam densities ranged from 0 to 3 individuals per 0.25 m quadrat and oyster densities varied from 0 to 5 individuals per sample.

Figures A4-3 and A4-4 (Appendix 4) summarize the size-frequency distributions of hard clams and oysters collected during the June 2010 shellfish survey. The oyster population in the survey area tended to be dominated by individuals 31 to 70 mm in shell length, while the hard clam population tended to be mainly composed of 36 to 90 mm sized individuals.

6.3 Underwater Video-camera Surveys (Task 1c)

A list of organisms found in each of the video transects, as well as the occurrence of the major benthic habitat elements found in each of the survey lines during the June 2010 survey of the study area can be found in Appendix 5, Table A5-11. For continuity with previous surveys, benthic habitat characteristics of each survey line will be discussed individually:

Transect Line 1. This transect line, positioned off the western side of Manresa Island, ran across the cable corridor and was dominated by muddy sediments and macroalgae (Figure A5-1, Appendix 5). Most of the transect line contained drift macroalgae (primarily sea lettuce (*Ulva* spp.) and often kelp (*Laminiaria* spp.)). There was some scattered shell debris in the middle portion of the transect line and toward the eastern end of the transect line. Mud snails (*Ilyanassa obsoleta*) were the most dominant epifaunal invertebrate associated with this transect line and a few scattered patches of oyster were observed on the eastern end of the transect line. The eastern end of the transect also contained a large number of hermit crabs (*Pagurus* spp.). Several lobster burrows were observed throughout various parts of the transect line.

Line 2. This transect line ran across the cable corridor and was positioned south of Line 1. The western half of the transect was generally dominated by muddy sediments while the eastern half was composed of a relatively high coverage of shell/shellhash (Figure A5-2, Appendix 5). In the areas composed of muddy sediments, mud snails (*Ilyanassa obsoleta*) were often quite abundant. Scattered patches of drift algae were observed along much of the transect and eastern oysters were observed at the eastern end of the transect when shell/shell hash cover was higher. Oysters were also present in much of the middle portion of the transect. Lobster burrows and several species of crab were observed throughout various parts of the transect line. The eastern end of the transect also contained high densities of ctenophores in the water column.

Line 3. This transect line ran across the cable corridor and was positioned south of Line 2. The bottom was primarily composed of muddy sediment with small to large patches of macroalgae (Figure A5-3, Appendix 5). Scattered amounts of shell/shell hash were found in two pooled intervals in the eastern half of the transect line. Eastern oysters were patchily distributed and only observed at two pooled intervals along this transect line. Several species of crab and the American lobster were also observed occasionally throughout this transect.

Line 4. This transect line, positioned south of Line 3, ran across the cable corridor and crossed the harbor boat channel. The first quarter of the transect on the western end was dominated by a thick cover of macroalgae with muddy sediments and limited amounts of shell/shell hash. The second quarter of the transect line was primarily dominated by muddy sediments. The last half of the transect line moving in the eastward direction had a relatively high coverage of shell/shellhash with muddy sediments. Some rock and cobble was observed in two of the pooled intervals on the eastern end of the transect (Figure A5-4, Appendix 5). . The most abundant epifaunal organisms at this site were mud snails (*Ilyanassa obsoleta*) and slipper limpets (*Crepidula fornicata*). Patches of eastern oysters were observed along much of the transect line.

Line 5. This transect line, positioned to the south of Line 4, also traversed the cable corridor and the harbor channel. The bottom was primarily composed of muddy sediments containing small amounts of macroalgae. Scattered shell debris and shell hash were observed in two of the pooled sampling intervals on the eastern end of the transect. Scattered patches of eastern oysters were observed along much of the transect, especially the eastern end (Figure A5-5, Appendix 5).

Line 6. This transect line was positioned south of Line 5 and crossed the cable corridor and part of the harbor channel at the western end of the transect. The bottom in the western half of the transect was primarily composed of muddy sediments with some scattered shell debris, while the eastern half contained higher coverage of shells and shell debris and varying amounts of macroalgae with muddy sediment (Figure A5-6, Appendix 5). In the western half of the transect, muddy sediment was typically covered in a light coat of encrusting algae. Mud snails were very common when the bottom was primarily composed of muddy sediments and scattered patches of eastern oysters were generally observed throughout much of the transect. In addition to hermit crabs and various other crab species, three separate pairs of mating horseshoe crabs were observed along this video transect line.

Line 7. This transect was located further to the south of Line 6. The bottom along this entire transect was primarily dominated by muddy sediments with varying amounts of macroalgae. The eastern end of the transect contained some macroalgal-covered rocks and cobbles and some scattered shell and shell hash in addition to muddy sediment. Patches of eastern oysters were only observed in one pooled sampling interval in the western end of the transect and in two pooled sampling intervals in the eastern end of the transect (Figure A5-7, Appendix 5). Several species of crab were observed occasionally along this transect line.

Line 8. Line 8 was positioned south of Line 7, close to the northern shore of Sheffield Island. The muddy-sand bottom had a variable coverage of shell/shell hash together with both attached and drift macroalgae. High densities of mud snails were found throughout most of the transect dominated by muddy sediments. In the western end of the transect,

muddy sediment was typically covered in a light coat of encrusting algae. Occasional patches of eastern oysters were observed throughout the survey line (Figure A5-8, Appendix 5).

Line 9. Line 9 ran across the cable corridor on the south side of Sheffield Island. This transect was primarily composed of firm sandy sediments occasionally containing relatively small amounts of scattered shell hash (primarily composed of razor, hard clam and oyster shells) (Figure A5-9, Appendix 5). Water clarity when the survey was conducted was very poor and it was often difficult to accurately assess objects observed on the bottom. No eastern oysters were observed along this survey line; however, due to the poor water clarity, it is possible they were present but not visible. Several horseshoe crab individuals were observed along this transect line along with occasional observations of various crab species. Lobster pots and lines were observed in several places along this transect line.

Line 10. This transect line ran perpendicular to the southern side of Sheffield Island, onshore to offshore along the center of the cable corridor. Near the island, the bottom was composed of gravel, cobbles and boulders (Figure A5-10, Appendix 5). Moving offshore, the bottom was composed of a sandy sediment with occasional small amounts of shell/shellhash and was similar to that described for Line 9. Water clarity during most of the video survey at this site was very poor and it was difficult to clearly see many of the features on the seafloor. No eastern oysters were observed along this survey line; however, due to the poor water clarity, it is possible they were present but not visible.

7.0 DISCUSSION

Quantitative sampling of benthic invertebrate populations revealed many of the same species collected in the 2001 survey. All samples collected in 2007, 2008, 2009 and 2010 were dominated by annelid worms (polychaetes, oligochaetes), bivalve and gastropod mollusks and amphipod crustaceans. The invertebrate species found at the study area are common to southern New England subtidal muddy/sandy benthic habitats (e.g., Pratt 1973, McCall 1977, 1978, Rhoads et al. 1978, Whitlatch 1994). Several species collected, notably the bivalve

Mulinea lateralis and the polychaetes *Streblospio benedicti* and *Capitella* spp. and *Mediomastus ambiseta*, are considered 'opportunistic' and/or 'indicator' species (*sensu* Grassle and Grassle 1974). These species tend to be associated with habitats that experience frequent natural and/or human-induced perturbations (e.g., Zajac and Whitlatch, 1982a, b; Whitlatch and Zajac 1985) and are commonly found in shallow water muddy habitats throughout Long Island Sound (e.g., Reid et al. 1979; Whitlatch 1994; Zajac 2001). Increases in the population density of the polychaete *M. ambiseta* have also been shown to be the result of organically enriched sediments (Grassle et al. 1980).

In October 2007, *M. lateralis* was fairly abundant at sites 2B, 3E and 4C and *Capitella* spp. was found in relatively low abundances at most of the sampling sites. *S. benedicti* was very abundant at most of the sampling localities. *M. ambiseta* and oligochaetes were also abundant species at most of the sampling locations. Other species found in the survey, notably the deposit-feeding bivalve *Nucula annulata* and the polychaete worm *Nephtys incisa*, are generally recognized as members of less disturbed muddy sediment communities in Long Island Sound (e.g., Sanders 1956, Rhoads et al. 1978). *N. annulata* was often one of the most abundant mollusks at most of the sampling stations, while *N. incisa* was found in relatively low numbers at many of the stations.

The post-construction sampling surveys generally found similar population densities and species composition of benthic invertebrates as the October 2007 pre-construction survey. For example, the most abundant and widespread organisms were *M. ambiseta* and oligochaetes. Additionally, samples collected at stations closest to the construction activities (e.g., 1C, 2C, 3C, 4C and 5C) did not appear to consistently vary in abundance and species composition from those collected farther away from the construction activities. The abundance and species composition of benthic invertebrates collected in the June 2010 survey showed similar patterns to previous post-construction surveys.

The underwater video camera surveys revealed similar types and distributions of benthic habitat types which were originally mapped in the 2001 survey and re-mapped before, during and after the construction project. Much of the area inside Sheffield Island is composed of

mud/fine sands sediments with varying coverage of shell debris composed primarily of slipper limpets, oyster and hard clam shells. The most abundant epibenthic invertebrates were mud snails (*IIyanassa obsoleta*), slipper limpets (*Credipula fornicata*), and spider crabs (*Libinia emarginata*). Numerous biogenic structures (e.g., burrows, mounds) were found throughout the survey area, but were more prevalent north of Sheffield Island. In contrast, the study area on the south side of Sheffield Island was generally composed of firmer, finer sand sediments that typically contained a lower coverage of shell debris. A more in-depth analysis of trends observed along the video transect lines will be provided in a final summary report that will be presented by ESS in the first quarter of 2011.

During the June 2010 survey, living oysters were observed on portions of all the video-lines in the survey area except transects 9 and 10 where reduced visibility may have prevented the observation of oysters. In most cases the oysters observed in the video frames were very patchily distributed on the seafloor and were generally associated with sediments containing relatively high amounts of dead shell debris. In the majority of cases, oyster densities were relatively low (e.g., 1-2 individuals per video-frame). The patchy distribution of oysters and low oyster densities were also observed and reported for all previous surveys, including the pre-construction surveys (see Part I – Pre-Construction Survey Reports, Report 3).

Sheffield Harbor has numerous leased tracts of seafloor that are used extensively for oyster culture. In addition, some areas to the south of Manresa Island and north of Sheffield Island are town beds which are used for oyster and hard clam fishing. During the period of the survey, commercial oyster vessels were commonly seen working sites to the west and east of the cable corridor. Similar to the 2001 survey, the 2007-2010 surveys found hard clams and oysters throughout much of the study area. Oysters were found in portions of all video-camera transect line except transect lines 9 and 10 (Figures A5-1 through A5-10, Appendix 5). Similar to previous surveys, including the pre-construction surveys, relatively large oysters and hard clams dominated the quantitative samples taken during June 2010.

Quantitative diver-deployed sampling quadrats indicate that hard clam densities decreased from October 2007 to January 2009 but have modestly increased since January 2009. In June 2010, a total of 19 individuals were collected in the 60 samples and hard clams were recorded at 8 of the 20 sampling sites. Table A4-2, Appendix 4 presents station-by-station comparison of pre-construction (October 2007) and post-construction (July 2008, October 2008, January 2009, June 2009, December 2009, and June 2010) hard clam densities in the survey area. A more in-depth analysis of trends in hard clam density over the monitoring program period will be provided in a final summary report that will be presented by ESS in the first quarter of 2011.

Table A4-2, Appendix 4 also summarizes a station-by-station comparison of oyster densities at the 20 stations sampled in October 2007, July 2008, October 2008, January 2009, June 2009, December 2009, and June 2010. In June 2010, a total of 15 individuals were collected in the 60 samples and oysters were recorded at 3 of the 20 sampling sites. Oyster densities in the monitoring area have been very low for the duration of the sampling program (ranging from a low of 0.03 in July 2008 to a high of 0.85 in October 2008). Therefore, oyster densities appear to have remained relatively consistent during the pre-construction and post-construction survey periods. A more in-depth analysis of trends in oyster density over the monitoring program period will be provided in a final summary report that will be presented by ESS in the first quarter of 2011.

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APPENDIX 1

FIELD SCHEDULE & MONITORING LOCATIONS

- Field Schedule: June 2010
- Benthic Sediment Grab Sampling Locations (Table)
- Quantitative Shellfish Quadrat Locations (Table)
- Figure A1-1: Grab Sample and Quadrat Locations
- Figure A1-2: June 2010 Underwater Video Tracklines

Field Schedule (June 2010)

Date	June 2010 Tasks
5-Jun	Underwater Video Transects
6-Jun	Underwater Video Transects
7-Jun	Grab Sampling Operations
8-Jun	Grab Sampling Operations
9-Jun	Concrete Mat Underwater Video*
10-Jun	Quantitative Shellfish Quadrat Sampling
11-Jun	Quantitative Shellfish Quadrat Sampling

* Concrete mat underwater video conducted and deliver under separate program.

Benthic Sediment Grab Sampling (Task 1a)

Summer 2010		
Station ID	Easting[1]	Northing[1]
1A	1143469	330301
1B	1144689	330296
1C	1145208	330285
1D	1145999	330296
2A	1144267	328753
2B	1144788	328877
2C	1145560	329094
2D	1146172	329260
2E	1147263	329547
3A	1144361	327249
3B	1145139	327509
3C	1145931	327672
3D	1146567	327844
3E	1147160	328002
4A	1144967	325890
4B	1145553	326055
4C	1146309	326251
4D	1146981	326430
4E	1148119	326684
5A	1146120	321649
5B	1146935	322044
5C	1147648	322486
5D	1148244	322879

[1] Coordinates referenced to NY State Plane, Long Island Lambert, Zone 3104, NAD 83 in feet.

Quantitative Shellfish Quadrat (Task 1b)

June 2010		
Station ID	Easting[1]	Northing[1]
A	1145264	330647
B	1144631	330198
C	1145206	330087
D	1145532	329983
E	1145152	329612
F	1145723	327272
G	1146223	327048
H	1145941	326594
I	1146438	326319
J	1146092	326098
K	1146345	325800
L	1146231	325341
M	1146543	325247
N	1146568	324733
O	1146851	324457
P	1147295	323018
Q	1147621	322310
R	1147805	322550
S	1147631	321880
T	1148239	322120

[1] Coordinates referenced to NY State Plane, Long Island Lambert, Zone 3104, NAD 83 in feet.

APPENDIX 2

SURVEY EQUIPMENT

- Trimble 7400 GPS Interfaced with an Onsite Differential Base Station
- HYPACK® Navigation Software
- Simrad OE9031 High Resolution Color Underwater Camera
- Ponar Grab Sampler

Trimble 4000 Global Positioning System Interfaced with a ProBeacon U.S. Coast Guard Differential Beacon Receiver

The Trimble 4000 satellite positioning system provides reliable, high-precision positioning and navigation for a wide variety of operations and environments. The system consists of a GPS receiver, a GPS volute antenna and cable, RS232 output data cables, and a Coast Guard beacon receiver. The Trimble ProBeacon beacon receivers are two common models used frequently. The beacon receiver consists of a small control unit, a volute antenna and cable, and RS232 interface to the Trimble 4000 unit. In this system configuration a position accuracy of ±1-2 meters is reported by the manufacturer, although experience suggests it can provide consistent ±1 meter reliability.

Fully automated, the Trimble 4000 provides means for 9-channel simultaneous satellite tracking with real-time display of geodetic position, time, date, and boat track if desired. The Trimble unit is mounted on the survey vessel with the beacon receiver, which continuously receives differential satellite correction factors via radio link from one of the DGPS United States Coast Guard beacons (1-second update rate). The Trimble 4000 accepts the correction factors and applies the differential corrections to obtain continuous, high accuracy, real-time position updates. The Trimble 4000 system is interfaced to the OSI navigation system running HYPACK software for trackline control.

HYPACK Navigation Software

Survey vessel trackline control and position fixes were obtained by utilizing a PC-based navigation system utilizing HYPACK software interfaced with the GPS positioning system. The navigation system consists of a computer with a customized version of HYPACK software and a color, external monitor for the helmsman. Geodetic coordinate information from the DGPS positioning system was updated regularly and input to the navigation computer which processes the geodetic position data into State Plane Coordinates used to guide the survey vessel accurately along pre-selected tracklines. The incoming data are

logged on disk and processed in real time allowing the vessel position to be displayed on a video monitor and compared to each pre-plotted trackline as the survey progresses. Digitized shoreline and the locations of existing structures, buoys, and control points can also be displayed on the monitor in relation to the vessel position. The navigation system using HYPACK software thus provides an accurate visual representation of survey vessel location in real time, combined with highly efficient data logging capability and post-survey data processing and plotting routines.

Simrad OE9031 High Resolution Color Underwater Camera

A Simrad OE9031 underwater color camera system was used to examine the bottom within the areas surveyed for this investigation. The system consists of a high-resolution color video camera with 8 mm viewing angle, 250 watt light with adjustable light intensity, an 80-meter cable, and power supply unit which houses the light controls, audio and video adjustments, and DVD recorder. The Simrad camera features corrosion and thermal shock resistant pressure housing made of stainless steel. The camera is designed to be extremely low light sensitive, has automatic focus, and its video output is DVD compatible. The system includes a color monitor and DVD recorder, which were used to record all video information, and a microphone with amplifier to allow real-time narration of the underwater scenes, if desired. The video system time is synchronized with the navigation computer and GPS receiver to provide correlation of the vessel position and underwater video footage later.

The topside unit was mounted on the survey vessel while the camera and light were attached to a stainless steel sled designed for stable towing off the side of the vessel. Operationally, the camera and sled were towed at minimal vessel speeds, typically less than 0.25 knots, to maintain high quality video of the bottom as the boat progressed along the trackline. The sled was usually towed as high off the bottom as visibility would allow, except in areas of reduced visibility where the sled was only an inch or two above the bottom. Occasional touchdowns of the tow sled on the seafloor are necessary to provide enhanced close-up views of benthic communities.

Ponar Grab Sampler

The Ponar Grab Sampler contains lever arms and sharp cutting edges on the bottom of the scoops, which allow them to cut into soft material. The closing mechanism is a self-releasing pinch-pin attached to the two closing arms, which holds the grabs open before they hit the bottom. Upon impact, the tension on the stainless steal bars is released, which releases the pinch-pin. The stainless steal bars pull the closing arms together to close the scoops when the cable is lifted. The top of each scoop is covered with a stainless steel screen for water to flow through during descent. The screen is covered with a neoprene rubber flap to prevent sample washout during retrieval

APPENDIX 3

GRAB SAMPLING

Table A3-1. Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 1, June 2010.

Family	Species	1A1	1A2	1A3	1B1	1B2	1B3	1C1	1C2	1C3	1D1	1D2	1D3
Mollusca													
Acteonidae	*Rictaxis punctostriatus*												
Calyptraeidae	*Crepidula fornicata*									2	4		
Calyptraeidae	*Crepidula plana*												
Cylichnidae	*Acteocina canaliculata*												
Haminoidae	*Haminoea solitaria*												
Muricidae	*Urosalpinx cinerea*												
Nassariidae	*Nassarius obsoletus*							4	14	22	2	1	
Nassariidae	*Nassarius trivittatus*												
Onchidoridae	*Acanthodoris pilosa*												
Pyramidellidae	*Boonea seminuda*												
Pyramidellidae	*Turbonilla sp.*						2						
Arcidae	*Anadara transversa*												
Anomiidae	*Anomia simplex*												
Lyonsiidae	*Lyonsia hyalina*												
Mactridae	*Mulinia lateralis*												
Mytilidae	*Mytilus edulis*												
Nuculidae	*Nucula annulata*				2		4		2				
Ostreidae	*Crassostrea virginica*												
Pandoridae	*Pandora gouldiana*												
Pharidae	*Siliqua costata*												
Tellinidae	*Tellina agilis*		4	3			12	6	4	18		2	
Veneridae	*Mercenaria mercenaria*					2				4			
Yoldiidae	*Yoldia limatula*												

Table A3-1 (cont.). Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 1, June 2010.

Family	Species	1A1	1A2	1A3	1B1	1B2	1B3	1C1	1C2	1C3	1D1	1D2	1D3
Arthropoda													
Ampeliscidae	*Ampelisca abdita*	24	48		8		6	12	2		14	14	2
Ampeliscidae	*Ampelisca vadorum*												
Ampithoidae	Ampithoidae									2			
Aoridae	*Leptocheirus plumulosus*												
Aoridae	*Unciola irrorata*												
Aoridae	*Unciola sp.*												
Caprellidae	Caprellidae									2			
Caprellidae	*Caprella sp.*												
Corophiidae	*Corophium sp.*									2			
Ischyroceridae	*Jassa falcata*												
Stenothoidae	*Parametopella cypris*												
Stenothoidae	*Stenothoe minuta*												
Hutchinsoniellidae	*Hutchinsoniella macracantha*							2		2			
Leuconidae	*Leucon americanus*									2	2		2
Crangonidae	*Crangon septemspinosa*												
Paguridae	*Pagurus longicarpus*												
Palaemonidae	*Palaemonetes vulgaris*												
Panopeidae	*Dyspanopeus sayi*									2			
Panopeidae	*Panopeus herbstii*												
Pinnotheridae	*Pinnixa sp.*												
Portunidae	*Callinectes sapidus*												
Upogebiidae	*Upogebia affinis*												
Idoteidae	*Edotia montosa*												
Mysidae	*Neomysis americana*				4							1	4
Archeobalanidae	*Semibalanus balanoides*												
Balanidae	*Balanus sp.*												
Chironomidae	Orthocladiinae												
Non-annelid Worms													
Nemertea	Nemertea A				4								
Nemertea	Nemertea B												

Table A3-1 (cont.). Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 1, June 2010.

Family	Species	1A1	1A2	1A3	1B1	1B2	1B3	1C1	1C2	1C3	1D1	1D2	1D3
Nemertea	*Cerebratulus lacteus*			1									
Sipunculoidea	*Phascolion strombus*												
Turbellaria	Turbellaria A												
Hirudinea													
Hirudinea	Hirudinea A												
Oligochaeta													
Oligochaeta	Oligochaeta A	36	56	10	16	2	10	180	30	306	140	26	116
Oligochaeta	Oligochaeta B	4											
Naididae	Naididae A												
Polychaeta													
Ampharetidae	Ampharetidae												
Ampharetidae	*Asabellides oculata*												
Capitellidae	*Mediomastus ambiseta*	44	72	26	52	4	34	132	64	102	152	11	12
Chaetopteridae	*Spiochaetopterus oculatus*	16						10	6				
Cirratulidae	*Cirratulus grandis*												
Cirratulidae	*Tharyx acutus*	36	8	51	44	8	46	58	42	424	72	3	2
Cossuridae	*Cossura longocirrata*	8		1	138	4	94	132	30	4	34		
Goniadidae	*Glycinde solitaria*												
Glyceridae	*Glycera sp.*												
Glyceridae	*Glycera americana*							2	2		2		
Hesionidae	Hesionidae												
Lumbrinereidae	*Lumbrineris fragilis*				16	16	6	20	2		2		
Lumbrinereidae	*Lumbrineris sp.*	4		5									
Maldanidae	*Asychis elongata*												
Maldanidae	*Clymenella torquata*				10	4	4	2	2				
Nephtyidae	*Nephtys incisa*												
Nereididae	*Neanthes succinea*	8	8	2	2			2	2	12		2	2
Nereididae	*Nereis sp.*			4									
Orbiniidae	*Leitoscoloplos fragilis*	68	48	71	68	42	90	58	14	44	22	39	
Orbiniidae	*Orbinia ornata*												
Orbiniidae	*Scoloplos robustus*				4		4	2		10	2		12
Paraonidae	*Acmira catherinae*												
Pectinariidae	*Pectinaria gouldi*												
Phyllodocidae	*Eteone heteropoda*				2		2			2	2		
Phyllodocidae	*Eteone sp.*												
Phyllodocidae	*Eumida sanguinea*												
Phyllodocidae	*Paranaitis speciosa*				2		2				4	4	
Polygordiidae	*Polygordius sp.*												
Polynoidae	*Harmothoe extenuata*												
Polynoidae	*Lepidonotus squamatus*									8			
Sabellariidae	*Sabellaria vulgaris*												
Spionidae	*Marenzelleria viridis*												
Spionidae	*Polydora sp.*												
Spionidae	*Polydora cornuta*	4		5	6		8	6	10	56	12		4
Spionidae	*Polydora quadrilobata*						2			2			

Table A3-1 (cont.). Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 1, June 2010.

Family	Species	1A1	1A2	1A3	1B1	1B2	1B3	1C1	1C2	1C3	1D1	1D2	1D3
Spionidae	*Prionospio sp.*												
Spionidae	*Spiophanes bombyx*												
Spionidae	*Streblospio benedicti*	4	12	2	14		16	32	12	6	110	15	14
Spionidae	Spionidae												
Syllidae	Syllidae												
Syllidae	*Brania clavata*												
Syllidae	*Exogone dispar*												
Terebellidae	*Polycirrus eximius*												
Terebellidae	*Nicolea venustula*												

Table A3-1 (cont.). Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 2, June 2010.

Family	Species	2A1	2A2	2A3	2B1	2B2	2B3	2C1	2C2	2C3	2D1	2D2	2D3	2E1	2E2	2E3
Mollusca																
Acteonidae	*Rictaxis punctostriatus*															
Calyptraeidae	*Crepidula fornicata*							6	8	2	14	8	6	12		4
Calyptraeidae	*Crepidula plana*										6	2		12		2
Cylichnidae	*Acteocina canaliculata*					7										
Haminoidae	*Haminoea solitaria*															
Muricidae	*Urosalpinx cinerea*															
Nassariidae	*Nassarius obsoletus*	6	3	28	4	9		2	5	2						
Nassariidae	*Nassarius trivittatus*															
Onchidoridiidae	*Acanthodoris pilosa*															
Pyramidellidae	*Boonea seminuda*															2
Pyramidellidae	*Turbonilla sp.*			2												
Arcidae	*Anadara transversa*								1							
Anomiidae	*Anomia simplex*											1				
Lyonsiidae	*Lyonsia hyalina*															
Mactridae	*Mulinia lateralis*				1	1	1									
Mytilidae	*Mytilus edulis*															
Nuculidae	*Nucula annulata*		1		7	11	12	2	1							
Ostreidae	*Crassostrea virginica*															
Pandoridae	*Pandora gouldiana*															
Pharidae	*Siliqua costata*															
Tellinidae	*Tellina agilis*		12	10	7	5	4	8	3	6	8	3		2	24	12
Veneridae	*Mercenaria mercenaria*	2			1			2			2					2
Yoldiidae	*Yoldia limatula*															
Arthropoda																
Ampeliscidae	*Ampelisca abdita*		1		4	3	3				2	1	4	34	18	2
Ampeliscidae	*Ampelisca vadorum*															
Ampithoidae	Ampithoidae			2										2		
Aoridae	*Leptocheirus plumulosus*															
Aoridae	*Unciola irrorata*															
Aoridae	*Unciola sp.*															
Caprellidae	Caprellidae															
Caprellidae	*Caprella sp.*															
Corophiidae	*Corophium sp.*			2							2					2
Ischyroceridae	*Jassa falcata*															
Stenothoidae	*Parametopella cypris*															
Stenothoidae	*Stenothoe minuta*															
Hutchinsoniellidae	*Hutchinsoniella macracantha*															

Table A3-1 (cont.). Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 2, June 2010.

Family	Species	2A1	2A2	2A3	2B1	2B2	2B3	2C1	2C2	2C3	2D1	2D2	2D3	2E1	2E2	2E3
Leuconidae	*Leucon americanus*					1										
Crangonidae	*Crangon septemspinosa*		3			1	1								2	
Paguridae	*Pagurus longicarpus*															
Palaemonidae	*Palaemonetes vulgaris*															
Panopeidae	*Dyspanopeus sayi*	2		2				2	1		6	3	2			
Panopeidae	*Panopeus herbstii*													2		
Pinnotheridae	*Pinnixa sp.*	2		2		1			1							
Portunidae	*Callinectes sapidus*			2												
Upogebiidae	*Upogebia affinis*													2		
Idoteidae	*Edotia montosa*															
Mysidae	*Neomysis americana*				1		3									
Archeobalanidae	*Semibalanus balanoides*															
Balanidae	*Balanus sp.*															
Chironomidae	Othocladiinae			2												
Non-annelid Worms																
Nemertea	Nemertea A	2	3	2	2	2			2	2	2		6			
Nemertea	Nemertea B	2														
Nemertea	*Cerebratulus lacteus*															
Sipunculoidea	*Phascolion strombus*															
Turbellaria	Turbellaria A															
Hirudinea																
Hirudinea	Hirudinea A															
Oligochaeta																
Oligochaeta	Oligochaeta A		23	8	6	10	21	14	42	30	34	51	54	322	8	14
Oligochaeta	Oligochaeta B															
Naididae	Naididae A															
Polychaeta																
Ampharetidae	Ampharetidae								1					2	2	
Ampharetidae	*Asabellides oculata*															
Capitellidae	*Mediomastus ambiseta*	6	37	194	13	50	25	386	50	104	118	30	84	318	64	88
Chaetopteridae	*Spiochaetopterus oculatus*					1										
Cirratulidae	*Cirratulus grandis*															
Cirratulidae	*Tharyx acutus*		20	14	1	2		54	5	56	30	10	24	208	296	168
Cossuridae	*Cossura longocirrata*		47	34	2	7	6	6	2	2				48		2
Goniadidae	*Glycinde solitaria*		1					2								
Glyceridae	*Glycera sp.*															
Glyceridae	*Glycera americana*							2			2	1			6	2
Hesionidae	Hesionidae															
Lumbrinereidae	*Lumbrineris fragilis*	18	7	10											2	
Lumbrinereidae	*Lumbrineris sp.*															

Table A3-1 (cont.). Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 2, June 2010.

Family	Species	2A1	2A2	2A3	2B1	2B2	2B3	2C1	2C2	2C3	2D1	2D2	2D3	2E1	2E2	2E3
Maldanidae	*Asychis elongata*			4	2		1								4	
Maldanidae	*Clymenella torquata*	12	4	24					1							
Nephtyidae	*Nephtys incisa*				1	3	3		3					2	2	
Nereididae	*Neanthes succinea*			2	1			2	13	6	14	7	4	6	10	8
Nereididae	*Nereis sp.*	2														
Orbiniidae	*Leitoscoloplos fragilis*	32	63	34	16	5	1	26	3	30	6	17	24	20	40	12
Orbiniidae	*Orbinia ornata*														6	
Orbiniidae	*Scoloplos robustus*	4		12									2			
Paraonidae	*Acmira catherinae*														4	
Pectinariidae	*Pectinaria gouldi*															
Phyllodocidae	*Eteone heteropoda*	2		4				2								4
Phyllodocidae	*Eteone sp.*											1				
Phyllodocidae	*Eumida sanguinea*	2		2					2		2		2			
Phyllodocidae	*Paranaitis speciosa*			2										6		
Polygordiidae	*Polygordius sp.*															
Polynoidae	*Harmothoe extenuata*															
Polynoidae	*Lepidonotus squamatus*	6		2					1		4	2		6		2
Sabellariidae	*Sabellaria vulgaris*													2		
Spionidae	*Marenzelleria viridis*				1											
Spionidae	*Polydora sp.*															
Spionidae	*Polydora cornuta*		27	14	1			26	1	12	6	5	2	8	10	8
Spionidae	*Polydora quadrilobata*	44	5	60												
Spionidae	*Prionospio sp.*			2	1				1				2	2		
Spionidae	*Spiophanes bombyx*															
Spionidae	*Streblospio benedicti*		1				1	4	1		2	3	2	14	24	8
Spionidae	Spionidae															
Syllidae	Syllidae															
Syllidae	*Brania clavata*															
Syllidae	*Exogone dispar*	2									2			4		
Terebellidae	*Polycirrus eximius*										6					2
Terebellidae	*Nicolea venustula*															

Table A3-1 (cont.). Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 3, June 2010.

Family	Species	3A1	3A2	3A3	3B1	3B2	3B3	3C1	3C2	3C3	3D1	3D2	3D3	3E1	3E2	3E3
Mollusca																
Acteonidae	*Rictaxis punctostriatus*															
Calyptraeidae	*Crepidula fornicata*	2	2	24	24	90	56	2		25	27	64	49	58		40
Calyptraeidae	*Crepidula plana*			4	2	22	4			2	33	65	12	18		12
Cylichnidae	*Acteocina canaliculata*								2					4	2	6
Haminoidae	*Haminoea solitaria*															
Muricidae	*Urosalpinx cinerea*															
Nassariidae	*Nassarius obsoletus*			4		6	2									
Nassariidae	*Nassarius trivittatus*															
Onchidoridiidae	*Acanthodoris pilosa*											1				
Pyramidellidae	*Boonea seminuda*						2				60	70	68	64		
Pyramidellidae	*Turbonilla sp.*															
Arcidae	*Anadara transversa*	2				2				1			1	2		
Anomiidae	*Anomia simplex*										1					
Lyonsiidae	*Lyonsia hyalina*															
Mactridae	*Mulinia lateralis*															
Mytilidae	*Mytilus edulis*	2												2		2
Nuculidae	*Nucula annulata*				4	4	4		9		1	1		2	8	4
Ostreidae	*Crassostrea virginica*	2					4									2
Pandoridae	*Pandora gouldiana*								1							
Pharidae	*Siliqua costata*															
Tellinidae	*Tellina agilis*	12	8	12	2	2		4	3			1		2	4	4
Veneridae	*Mercenaria mercenaria*	2		4										2		2
Yoldiidae	*Yoldia limatula*															
Arthropoda																
Ampeliscidae	*Ampelisca abdita*		4												2	
Ampeliscidae	*Ampelisca vadorum*															
Ampithoidae	Ampithoidae			2												
Aoridae	*Leptocheirus plumulosus*															
Aoridae	*Unciola irrorata*															
Aoridae	*Unciola sp.*															
Caprellidae	Caprellidae															2
Caprellidae	*Caprella sp.*													8		
Corophiidae	*Corophium sp.*	2		6		4										
Ischyroceridae	*Jassa falcata*											1				
Stenothoidae	*Parametopella cypris*													2		
Stenothoidae	*Stenothoe minuta*															
Hutchinsoniellidae	*Hutchinsoniella macracantha*															
Leuconidae	*Leucon americanus*															

Table A3-1 (cont.). Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 3, June 2010.

Family	Species	3A1	3A2	3A3	3B1	3B2	3B3	3C1	3C2	3C3	3D1	3D2	3D3	3E1	3E2	3E3
Crangonidae	*Crangon septemspinosa*									1					2	
Paguridae	*Pagurus longicarpus*															
Palaemonidae	*Palaemonetes vulgaris*			2												
Panopeidae	*Dyspanopeus sayi*	2	2			2		2	1		4	6	1	2		2
Panopeidae	*Panopeus herbstii*				2				1	3	1					
Pinnotheridae	*Pinnixa sp.*															
Portunidae	*Callinectes sapidus*															
Upogebiidae	*Upogebia affinis*															
Idoteidae	*Edotia montosa*															
Mysidae	*Neomysis americana*									1						
Archeobalanidae	*Semibalanus balanoides*								1							
Balanidae	*Balanus sp.*						2	4		9	13	16	14	16		6
Chironomidae	Orthocladiinae															
Non-annelid Worms																
Nemertea	Nemertea A		2			2	2	2	1		2	1	1	8	6	
Nemertea	Nemertea B		2													
Nemertea	*Cerebratulus lacteus*															
Sipunculoidea	*Phascolion strombus*															
Turbellaria	Turbellaria A															
Hirudinea																
Hirudinea	Hirudinea A															
Oligochaeta																
Oligochaeta	Oligochaeta A	284	274	180	232	130	12		2		1	74	10	54	8	108
Oligochaeta	Oligochaeta B															
Naididae	Naididae A															2
Polychaeta																
Ampharetidae	Ampharetidae			2												
Ampharetidae	*Asabellides oculata*															
Capitellidae	*Mediomastus ambiseta*	206	246	192	226	186	16		5	1	3	99	30	92	28	108
Chaetopteridae	*Spiochaetopterus oculatus*															
Cirratulidae	*Cirratulus grandis*															
Cirratulidae	*Tharyx acutus*	436	4	344	20	14						6	3	18		16
Cossuridae	*Cossura longocirrata*		12		2									2		
Goniadidae	*Glycinde solitaria*															
Glyceridae	*Glycera sp.*															
Glyceridae	*Glycera americana*			2	2		4				1	1	1			
Hesionidae	Hesionidae															
Lumbrinereidae	*Lumbrineris fragilis*															
Lumbrinereidae	*Lumbrineris sp.*															
Maldanidae	*Asychis elongata*	2	4						1					6		
Maldanidae	*Clymenella torquata*							2								

Table A3-1 (cont.). Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 3, June 2010.

Family	Species	3A1	3A2	3A3	3B1	3B2	3B3	3C1	3C2	3C3	3D1	3D2	3D3	3E1	3E2	3E3
Nephtyidae	*Nephtys incisa*							6	9	4	5	5	6	2	10	2
Nereididae	*Neanthes succinea*	14	4	12	8	14	10		1	4	3	11	5	4		6
Nereididae	*Nereis sp.*										1		2			
Orbiniidae	*Leitoscoloplos fragilis*	6	24	6	14	4	2		1	1				2		
Orbiniidae	*Orbinia ornata*															
Orbiniidae	*Scoloplos robustus*															
Paraonidae	*Acmira catherinae*						2									2
Pectinariidae	*Pectinaria gouldi*															
Phyllodocidae	*Eteone heteropoda*	2			2											
Phyllodocidae	*Eteone sp.*															
Phyllodocidae	*Eumida sanguinea*			2		10						2	1	8		
Phyllodocidae	*Paranaitis speciosa*	2														
Polygordiidae	*Polygordius sp.*															
Polynoidae	*Harmothoe extenuata*									1						
Polynoidae	*Lepidonotus squamatus*	2		8		10	4				4	15	3	12		4
Sabellariidae	*Sabellaria vulgaris*										1					
Spionidae	*Marenzelleria viridis*								1			1				
Spionidae	*Polydora sp.*										1					
Spionidae	*Polydora cornuta*	24	12	20	18	26	4				1	1	1	4		2
Spionidae	*Polydora quadrilobata*															
Spionidae	*Prionospio sp.*															
Spionidae	*Spiophanes bombyx*		4													
Spionidae	*Streblospio benedicti*	4	52	2		2										
Spionidae	Spionidae															
Syllidae	Syllidae										1	1				
Syllidae	*Brania clavata*										1					2
Syllidae	*Exogone dispar*	2					2				1	2		4		8
Terebellidae	*Polycirrus eximius*	2		2												
Terebellidae	*Nicolea venustula*										1	1		4		12

Table A3-1 (cont.). Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 4, June 2010.

Family	Species	4A1	4A2	4A3	4B1	4B2	4B3	4C1	4C2	4C3	4D1	4D2	4D3	4E1	4E2	4E3
Mollusca																
Acteonidae	*Rictaxis punctostriatus*							2								
Calyptraeidae	*Crepidula fornicata*		2						3		16	22		94	25	2
Calyptraeidae	*Crepidula plana*										4	32		18		4
Cylichnidae	*Acteocina canaliculata*		8		3		4	15	14	4			2			2
Haminoidae	*Haminoea solitaria*															
Muricidae	*Urosalpinx cinerea*															
Nassariidae	*Nassarius obsoletus*							2								
Nassariidae	*Nassarius trivittatus*															
Onchidoridídae	*Acanthodoris pilosa*															
Pyramidellidae	*Boonea seminuda*															8
Pyramidellidae	*Turbonilla sp.*	2														
Arcidae	*Anadara transversa*															
Anomiidae	*Anomia simplex*															
Lyonsiidae	*Lyonsia hyalina*															
Mactridae	*Mulinia lateralis*		2		11	6	6		6	2			2			
Mytilidae	*Mytilus edulis*											2				
Nuculidae	*Nucula annulata*		2	2	135	78	20	3	35	4		2				4
Ostreidae	*Crassostrea virginica*										2	4		2		2
Pandoridae	*Pandora gouldiana*															
Pharidae	*Siliqua costata*															
Tellinidae	*Tellina agilis*			8	14	8	4	3	4		8	2	18	4		
Veneridae	*Mercenaria mercenaria*					2				2	2					2
Yoldiidae	*Yoldia limatula*				4	2	4	1	4							
Arthropoda																
Ampeliscidae	*Ampelisca abdita*	2			1			1	3		2	4				
Ampeliscidae	*Ampelisca vadorum*															
Ampithoidae	Ampithoidae											4				
Aoridae	*Leptocheirus plumulosus*															
Aoridae	*Unciola irrorata*															
Aoridae	*Unciola sp.*															
Caprellidae	Caprellidae															
Caprellidae	*Caprella sp.*		2													
Corophiidae	*Corophium sp.*															
Ischyroceridae	*Jassa falcata*															
Stenothoidae	*Parametopella cypris*															
Stenothoidae	*Stenothoe minuta*		2									2				
Hutchinsoniellidae	*Hutchinsoniella macracantha*			8												
Leuconidae	*Leucon americanus*															

Table A3-1 (cont.). Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 4, June 2010.

Family	Species	4A1	4A2	4A3	4B1	4B2	4B3	4C1	4C2	4C3	4D1	4D2	4D3	4E1	4E2	4E3
Crangonidae	*Crangon septemspinosa*				1		2									
Paguridae	*Pagurus longicarpus*															
Palaemonidae	*Palaemonetes vulgaris*															
Panopeidae	*Dyspanopeus sayi*											16		4		4
Panopeidae	*Panopeus herbstii*	2							1			2			1	
Pinnotheridae	*Pinnixa sp.*															
Portunidae	*Callinectes sapidus*															
Upogebiidae	*Upogebia affinis*															
Idoteidae	*Edotia montosa*															
Mysidae	*Neomysis americana*								1							
Archeobalanidae	*Semibalanus balanoides*															
Balanidae	*Balanus sp.*		14						1							
Chironomidae	Orthocladiinae															
Non-annelid Worms																
Nemertea	Nemertea A				2	2	2	1	9	4	8	2	2			
Nemertea	Nemertea B															
Nemertea	*Cerebratulus lacteus*			2												
Sipunculoidea	*Phascolion strombus*	2														
Turbellaria	Turbellaria A							1								
Hirudinea																
Hirudinea	Hirudinea A							1								
Oligochaeta																
Oligochaeta	Oligochaeta A	8	86		2		22	13	34	20	10	202		554		324
Oligochaeta	Oligochaeta B															
Naididae	Naididae A															
Polychaeta																
Ampharetidae	Ampharetidae													2		
Ampharetidae	*Asabellides oculata*															
Capitellidae	*Mediomastus ambiseta*	16	74		4		26	18	84	64	52	636	2	142	8	208
Chaetopteridae	*Spiochaetopterus oculatus*				2											
Cirratulidae	*Cirratulus grandis*															
Cirratulidae	*Tharyx acutus*		2		1		2		3		2	30		28		24
Cossuridae	*Cossura longocirrata*		8				12	4	4	2		10				
Goniadidae	*Glycinde solitaria*															
Glyceridae	*Glycera sp.*															
Glyceridae	*Glycera americana*															
Hesionidae	Hesionidae															4
Lumbrinereidae	*Lumbrineris fragilis*															
Lumbrinereidae	*Lumbrineris sp.*															
Maldanidae	*Asychis elongata*					2	2					2				
Maldanidae	*Clymenella torquata*			10												

Table A3-1 (cont.). Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 4, June 2010.

Family	Species	4A1	4A2	4A3	4B1	4B2	4B3	4C1	4C2	4C3	4D1	4D2	4D3	4E1	4E2	4E3
Nephtyidae	*Nephtys incisa*	10	14	10	28	18	32	19	11	16	4	2	10			
Nereididae	*Neanthes succinea*								2		6	6		52	17	42
Nereididae	*Nereis sp.*															
Orbiniidae	*Leitoscoloplos fragilis*											2		6	3	6
Orbiniidae	*Orbinia ornata*															
Orbiniidae	*Scoloplos robustus*															
Paraonidae	*Acmira catherinae*															
Pectinariidae	*Pectinaria gouldi*															2
Phyllodocidae	*Eteone heteropoda*															
Phyllodocidae	*Eteone sp.*											4				
Phyllodocidae	*Eumida sanguinea*								1			6		4		10
Phyllodocidae	*Paranaitis speciosa*															
Polygordiidae	*Polygordius sp.*															
Polynoidae	*Harmothoe extenuata*															
Polynoidae	*Lepidonotus squamatus*		6	2							2	8		12		10
Sabellariidae	*Sabellaria vulgaris*															
Spionidae	*Marenzelleria viridis*															
Spionidae	*Polydora sp.*															
Spionidae	*Polydora cornuta*		2								4	26		12	2	32
Spionidae	*Polydora quadrilobata*															
Spionidae	*Prionospio sp.*											2				
Spionidae	*Spiophanes bombyx*															
Spionidae	*Streblospio benedicti*											4		2		
Spionidae	Spionidae															
Syllidae	Syllidae											6				
Syllidae	*Brania clavata*															
Syllidae	*Exogone dispar*										4	2		6	1	4
Terebellidae	*Polycirrus eximius*													4		
Terebellidae	*Nicolea venustula*		6									18				

Table A3-1 (cont.). Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 5, June 2010

Family	Species	5A1	5A2	5A3	5B1	5B2	5B3	5C1	5C2	5C3	5D1	5D2	5D3
Mollusca													
Acteonidae	*Rictaxis punctostriatus*												
Calyptraeidae	*Crepidula fornicata*												
Calyptraeidae	*Crepidula plana*												
Cylichnidae	*Acteocina canaliculata*	5	6	8	11	7		8	9	16			
Haminoidae	*Haminoea solitaria*					1							
Muricidae	*Urosalpinx cinerea*									1			
Nassariidae	*Nassarius obsoletus*												
Nassariidae	*Nassarius trivittatus*	2				2		10	6	1	2	3	1
Onchidoridae	*Acanthodoris pilosa*												
Pyramidellidae	*Boonea seminuda*					4							
Pyramidellidae	*Turbonilla sp.*	15	10	14	9	26		15	18	29			
Arcidae	*Anadara transversa*												
Anomiidae	*Anomia simplex*												
Lyonsiidae	*Lyonsia hyalina*												1
Mactridae	*Mulinia lateralis*					2							
Mytilidae	*Mytilus edulis*												
Nuculidae	*Nucula annulata*	8	9	9	2								
Ostreidae	*Crassostrea virginica*												
Pandoridae	*Pandora gouldiana*												
Pharidae	*Siliqua costata*							1					
Tellinidae	*Tellina agilis*				3			12	8	7	46	30	23
Veneridae	*Mercenaria mercenaria*			1					1				
Yoldiidae	*Yoldia limatula*	3	3	5	4	2	5	1		8			
Arthropoda													
Ampeliscidae	*Ampelisca abdita*			1		1	3	2	1	12	2	3	1
Ampeliscidae	*Ampelisca vadorum*								1				
Ampithoidae	Ampithoidae					1							5
Aoridae	*Leptocheirus plumulosus*							1					
Aoridae	*Unciola irrorata*						9				8		
Aoridae	*Unciola sp.*				2			3	1	5		3	
Caprellidae	Caprellidae												
Caprellidae	*Caprella sp.*												
Corophiidae	*Corophium sp.*												
Ischyroceridae	*Jassa falcata*												
Stenothoidae	*Parametopella cypris*												
Stenothoidae	*Stenothoe minuta*												
Hutchinsoniellidae	*Hutchinsoniella macracantha*												
Leuconidae	*Leucon americanus*												
Crangonidae	*Crangon septemspinosa*					3	1	1		3			
Paguridae	*Pagurus longicarpus*						1	1	2				
Palaemonidae	*Palaemonetes vulgaris*												

Table A3-1 (cont.). Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 5, June 2010

Family	Species	5A1	5A2	5A3	5B1	5B2	5B3	5C1	5C2	5C3	5D1	5D2	5D3
Panopeidae	*Dyspanopeus sayi*												
Panopeidae	*Panopeus herbstii*												
Pinnotheridae	*Pinnixa sp.*	4					5			2			
Portunidae	*Callinectes sapidus*												
Upogebiidae	*Upogebia affinis*												
Idoteidae	*Edotia montosa*												1
Mysidae	*Neomysis americana*											1	
Archeobalanidae	*Semibalanus balanoides*												
Balanidae	*Balanus sp.*				33	8							
Chironomidae	Orthocladiinae												
Non-annelid Worms													
Nemertea	Nemertea A		1		3	2	3	12	2	9			
Nemertea	Nemertea B												
Nemertea	*Cerebratulus lacteus*												
Sipunculoidea	*Phascolion strombus*												
Turbellaria	Turbellaria A									4			
Hirudinea													
Hirudinea	Hirudinea A												
Oligochaeta													
Oligochaeta	Oligochaeta A	12	22	3	3	7	10	18	5	26	2		13
Oligochaeta	Oligochaeta B												
Naididae	Naididae A												
Polychaeta													
Ampharetidae	Ampharetidae									1			
Ampharetidae	*Asabellides oculata*										2	3	
Capitellidae	*Mediomastus ambiseta*		5	3	2	30	28	63	22	199	354	191	33
Chaetopteridae	*Spiochaetopterus oculatus*												
Cirratulidae	*Cirratulus grandis*												1
Cirratulidae	*Tharyx acutus*	1	1				1	1	1	7	4	2	3
Cossuridae	*Cossura longocirrata*							1	1	4			
Goniadidae	*Glycinde solitaria*												
Glyceridae	*Glycera sp.*									2			
Glyceridae	*Glycera americana*								1				
Hesionidae	Hesionidae			1									
Lumbrinereidae	*Lumbrineris fragilis*												
Lumbrinereidae	*Lumbrineris sp.*												
Maldanidae	*Asychis elongata*	1			2								
Maldanidae	*Clymenella torquata*			1	5	1	2		1				
Nephtyidae	*Nephtys incisa*	4	8	10	16	10	23	8	7	7			
Nereididae	*Neanthes succinea*					1							
Nereididae	*Nereis sp.*												
Orbiniidae	*Leitoscoloplos fragilis*							1					1
Orbiniidae	*Orbinia ornata*												
Orbiniidae	*Scoloplos robustus*									1			
Paraonidae	*Acmira catherinae*							2		2	16	5	3
Pectinariidae	*Pectinaria gouldi*									1			
Phyllodocidae	*Eteone heteropoda*												
Phyllodocidae	*Eteone sp.*											1	
Phyllodocidae	*Eumida sanguinea*							1		1	2	3	

Table A3-1 (cont.). Benthic taxa and their abundances per sample collected from benthic habitat sampling transect 5, June 2010

Family	Species	5A1	5A2	5A3	5B1	5B2	5B3	5C1	5C2	5C3	5D1	5D2	5D3
Phyllodocidae	*Paranaitis speciosa*												2
Polygordiidae	*Polygordius sp.*								1				55
Polynoidae	*Harmothoe extenuata*												
Polynoidae	*Lepidonotus squamatus*						1						
Sabellariidae	*Sabellaria vulgaris*												
Spionidae	*Marenzelleria viridis*							1		1	216	319	432
Spionidae	*Polydora sp.*												
Spionidae	*Polydora cornuta*								1	2		1	1
Spionidae	*Polydora quadrilobata*												
Spionidae	*Prionospio sp.*						1						
Spionidae	*Spiophanes bombyx*								1		8	1	
Spionidae	*Streblospio benedicti*									1			
Spionidae	Spionidae		1								2		
Syllidae	Syllidae												4
Syllidae	*Brania clavata*												
Syllidae	*Exogone dispar*										2	1	4
Terebellidae	*Polycirrus eximius*												
Terebellidae	*Nicolea venustula*												

Table A3-2. The average total number of individuals, the average total number of species and the average species diversity per station along transects 1 through 5 in June 2010.

	# of Individuals		# of Species		Species Diversity	
Station	Average	STD (+/-1)	Average	STD (+/-1)	Average	STD (+/-1)
1A	231	43	11	2	1.83	0.22
1B	272	166	14	5	1.88	0.32
1C	644	398	18	3	1.98	0.25
1D	288	251	12	3	1.67	0.39
2A	258	168	19	6	2.21	0.03
2B	91	25	16	3	2.18	0.25
2C	315	206	17	6	1.66	0.43
2D	210	62	17	3	1.97	0.15
2E	633	358	19	3	1.71	0.07
3A	833	178	19	3	1.53	0.10
3B	407	238	16	2	1.81	0.36
3C	38	16	11	4	1.97	0.28
3D	273	150	21	3	2.07	0.09
3E	275	179	20	9	2.13	0.33
4A	105	109	10	5	1.71	0.10
4B	155	47	11	3	1.54	0.52
4C	141	71	14	5	1.86	0.35
4D	407	567	17	12	1.66	0.39
4E	566	458	14	6	1.49	0.09
5A	59	6	10	1	1.99	0.06
5B	99	8	15	2	2.11	0.09
5C	202	135	22	3	2.13	0.27
5D	606	53	16	2	1.14	0.08

Table A3-3. The average total number of individuals and the average total number of species of the major taxa identified at each station along transects 1 through 5 in June 2010.

	Mollusca				Nemertinea				Arthropoda				Polychaeta				Oligochaeta			
	# of Individuals		# of Species		# of Individuals		# of Species		# of Individuals		# of Species		# of Individuals		# of Species		# of Individuals		# of Species	
	Avg	STD (+/-1)	Avg	STD (+/-1)	Avg	STD (+/-1)	Avg	STD (+/-1)	Avg	STD (+/-1)	Avg	STD (+/-1)	Avg	STD (+/-1)	Avg	STD (+/-1)	Avg	STD (+/-1)	Avg	STD (+/-1)
1A	2	2	1	1	0	1	0	1	24	24	1	1	169	22	8	2	35	23	1	1
1B	7	9	2	1	1	2	0	1	6	6	1	1	248	149	10	3	9	7	1	0
1C	25	19	3	1	0	0	--	--	9	6	3	3	437	243	11	1	172	138	1	0
1D	3	3	1	1	0	0	--	--	13	4	2	1	178	205	8	3	94	60	1	0
2A	23	17	2	1	3	1	1	1	6	5	3	2	224	146	12	3	3	11	0	1
2B	23	9	4	1	1	1	1	1	6	1	3	1	48	17	7	2	12	8	1	0
2C	16	5	4	1	1	1	1	1	1	1	1	1	268	219	10	4	29	14	1	0
2D	17	12	3	2	3	3	1	1	7	3	2	1	138	58	10	1	46	11	1	0
2E	24	2	3	2	0	0	--	--	21	18	3	1	473	171	13	2	115	180	1	0
3A	27	19	4	2	1	2	1	1	7	3	2	1	552	173	11	2	246	57	1	0
3B	77	47	5	1	1	1	1	1	3	2	1	1	201	136	8	0	125	110	1	0
3C	16	11	3	1	1	1	1	1	8	6	3	1	12	5	4	2	1	1	0	1
3D	151	44	5	1	1	1	1	0	19	4	3	1	74	63	11	2	28	40	1	0
3E	80	70	7	3	5	4	1	1	14	12	3	1	119	70	8	5	57	51	1	1
4A	9	6	2	2	1	1	0	1	10	7	2	1	53	51	4	3	31	48	1	1
4B	100	65	5	0	2	0	1	0	1	1	1	1	43	28	4	2	8	12	1	1
4C	35	28	5	1	5	4	1	0	2	3	2	2	76	32	4	2	22	11	1	0
4D	39	22	5	2	4	3	1	0	10	16	2	3	283	417	8	7	71	114	1	1
4E	56	54	4	3	0	0	--	--	3	2	1	0	214	163	9	3	293	278	1	1
5A	33	5	5	1	0	1	0	1	2	2	1	1	12	5	4	1	12	10	1	0
5B	26	20	4	3	3	1	1	0	22	11	4	2	41	16	5	1	7	4	1	0
5C	50	10	6	1	8	5	1	0	12	9	4	1	114	102	10	3	16	11	1	0
5D	35	12	2	1	0	0	--	--	8	2	3	1	557	43	10	1	5	7	1	1

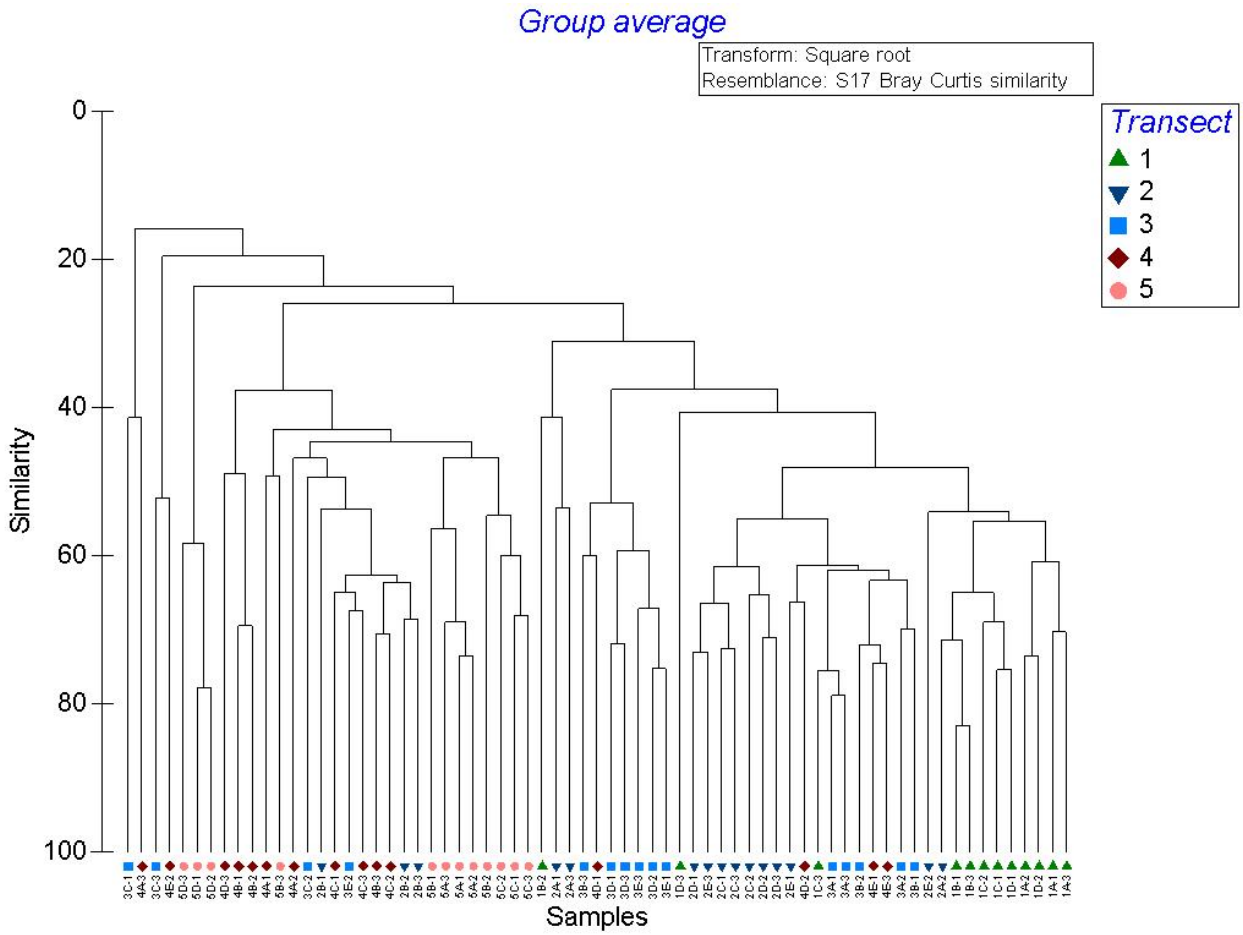

Figure A3-4. Dendrogram showing the percent similarity of species composition and abundance of the quantitative benthic samples collected in the study site, June 2010. Individual transects are noted as 1 through 5, individual stations within each transect are noted as A through E and individual replicates within each station are coded as 1 through 3. Each transect has a different color code for ease of inspection.

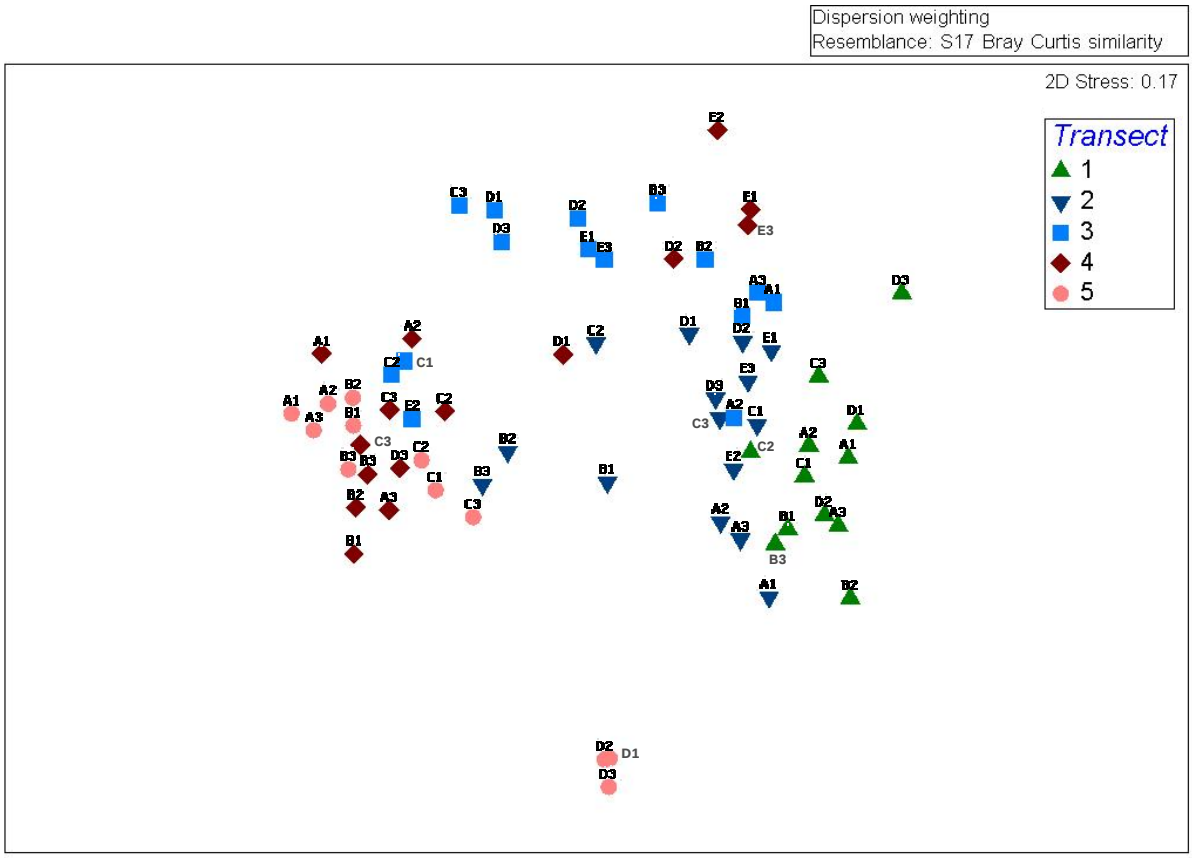

Figure A3-5. Non-metric multidimensional scaling ordination (nMDS) of quantitative benthic samples collected in June 2010 in the study area. Individual transects are noted as 1 through 5, individual stations within each transect are noted as A through E and individual replicates within each station are coded as 1 through 3. Each transect has a different color code for ease of inspection.

APPENDIX 4

QUANTITATIVE SHELLFISH QUADRATS

- Table A4-1: Densities of Hard Clams and Eastern Oysters collected in June 2010.
- Table A4-2a: Comparison of Hard Clams during the October 2007, July 2008, October 2008, January 2009, June 2009, December 2009, and June 2010 Surveys.
- Table A4-2b: Comparison of Eastern Oysters during the October 2007, July 2008, October 2008, January 2009, June 2009, December 2009, and June 2010 Surveys.
- Figure A4-3: Frequency Distribution of Hard Clam Shell Length in June 2010.
- Figure A4-4: Frequency Distribution of Eastern Oyster Shell Length in June 2010.

Table A4-1. Densities of hard clams (*Mercenaria mercenaria*) and eastern oysters (*Crassostrea virginica*) collected from the 0.25 m^2 diver-deployed quadrants, June 2010. Three samples were taken at each station.

Station	Number of Hardclams	Number of Oysters
A	0, 0, 0	0, 0, 0
B	0, 0, 0	0, 0, 0
C	0, 1, 2	0, 0, 0
D	0, 1, 1	0, 0, 0
E	0, 0, 0	0, 0, 0
F	0, 0, 0	5, 0, 0
G	0, 0, 0	1, 2, 0
H	0, 0, 0	0, 0, 0
I	0, 0, 0	2, 2, 3
J	1, 2, 0	0, 0, 0
K	0, 0, 0	0, 0, 0
L	1, 2, 0	0, 0, 0
M	1, 1, 0	0, 0, 0
N	0, 0, 0	0, 0, 0
O	0, 0, 1	0, 0, 0
P	0, 0, 0	0, 0, 0
Q	0, 0, 0	0, 0, 0
R	0, 0, 1	0, 0, 0
S	1, 0, 3	0, 0, 0
T	0, 0, 0	0, 0, 0

Table A4-2a. Comparisons of the densities of hard clams in the October 2007, July 2008, October 2008, January 2009, June 2009, December 2009 and June 2010 quantitative shellfish sampling surveys (mean ± 1 standard deviation).

Site	Hard Clams						
	Oct 2007	July 2008	Oct 2008	Jan 2009	Jun 2009	Dec 2009	June 2010
A	0	0	0	0.33 ±0.58	0	0	0
B	2.00±1.00	2.67± .31	1.33±2.31	0	0	0.67± 1.15	0
C	0.33±0.57	0	1.33±2.31	0	0	0.67± 1.15	1.00±1.00
D	2.00±1.00	3.67±1.16	0.67±0.58	0	0.67±1.55	0.67 ±1.16	0.67±0.58
E	1.00±1.00	0.67±1.16	0.67±1.15	0.33 ±0.58	0	0.33 ±0.58	0
F	7.33±11.02	1.00±1.00	1.00±1.73	0	0	0.67± 1.15	0
G	1.33 ±1.16	0.33±0.58	0.33±0.58	0	0.33±0.57	0	0
H	0	0.33±0.58	0	0		0	0
I	0.67 ±1.55	1.33±0.58	0.33±0.58	0.33±0.58	0	0.33 ±0.58	0
J	0	1.00±1.00	3.00±1.00	0	0.33±0.57	1.00±0.1.0	1.00±1.00
K	2.00 ±1.73	1.33±2.31	0.67±1.15	0	0.67±1.55	0	0
L	1.33 ±1.53	4.00±1.00	0.33±0.58	0	0.67±1.55	0.33 ±0.58	1.00±1.00
M	1.00 ±1.00	0.33±0.58	2.33±0.58	0.33±0.58	0.33±0.57	0	0.67±0.58
N	1.00 ±1.00	3.33±2.52	1.67±1.15	1.00±1.29	0	0	0
O	1.00 ± 1.00	2.0 ±1.73	3.00±1.73	0	0	0	0.33±0.58
P	3.33 ±1.52	4.00±1.73	1.33±1.53	0	0	0	0
Q	4.00 ±3.61	2.00±1.73	6.67±5.51	0	0	0	0
R	1.00 ±1.00	1.33±1.15	1.33±1.15	0	0	0	0.33±0.58
S	5.00 ±2.00	5.67±3.79	4.33±3.51	0.33±0.58	1.33±2.31	0.33± 0.58	1.33±1.53
T	10.33±4.93	4.00±1.73	2.33±1.15	0	1.00±1.00	0.33±0 .58	0

Table A4-2b. Comparisons of the densities of eastern oysters in the October 2007, July 2008, October 2008, January 2009, June 2009, December 2009 and June 2010 quantitative shellfish sampling surveys (mean ± 1 standard deviation).

Site	Oysters						
	Oct 2007	July 2008	Oct 2008	Jan 2009	Jun 2009	Dec 2009	June 2010
A	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
F	1.00 ±1.00	0.33±0.58	6.00±7.00	1.33±1.83	1.67±2.31	11.00±8.0	1.67±2.89
G	0	0	5.33±9.24	4.0 ± 4.55	0	4.67±4.51	1.00±1.00
H	0	0	0.67±1.15	0	0	0	0
I	2.33 ±1.53	0.33±0.58	4.67±7.23	2.0 ±2.45	0	0.33± .58	2.33±0.58
J	0.67 ±1.16	0	0	0	0	0	0
K	0	0	0	0	0	0	0
L	0	0	0	0	0	0	0
M	0	0	0	0	0	0	0
N	0	0	0	0	0.33± .58	0	0
O	0.33 ± 0.58	0	0	0	0	0.33±0.58	0
P	0	0	0	0	0	0	0
Q	0.67 ±0.58	0	0.33±0.58	0	0	0	0
R	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
T	0	0	0	0	0	0	0

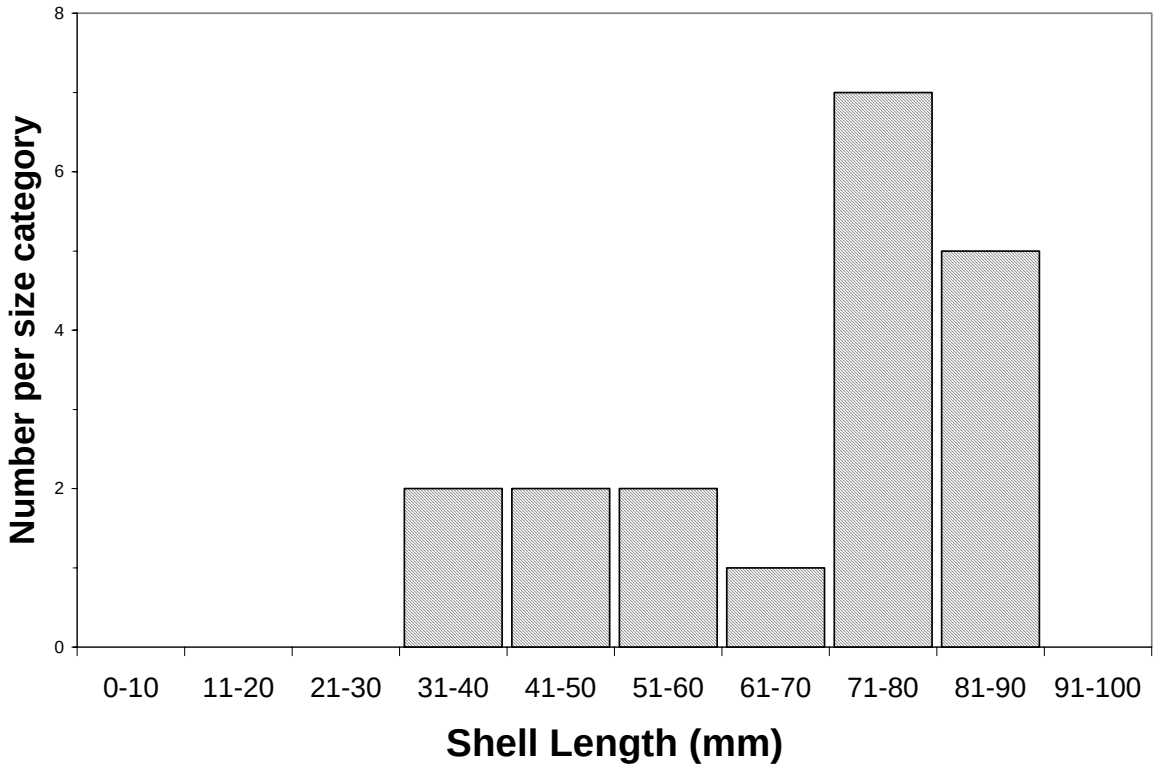

Figure A4-3. Size frequency distribution of the shell length of hard-clams (*Mercenaria mercenaria*) collected in the June 2010 diver survey. Data were pooled from all the sampling stations.

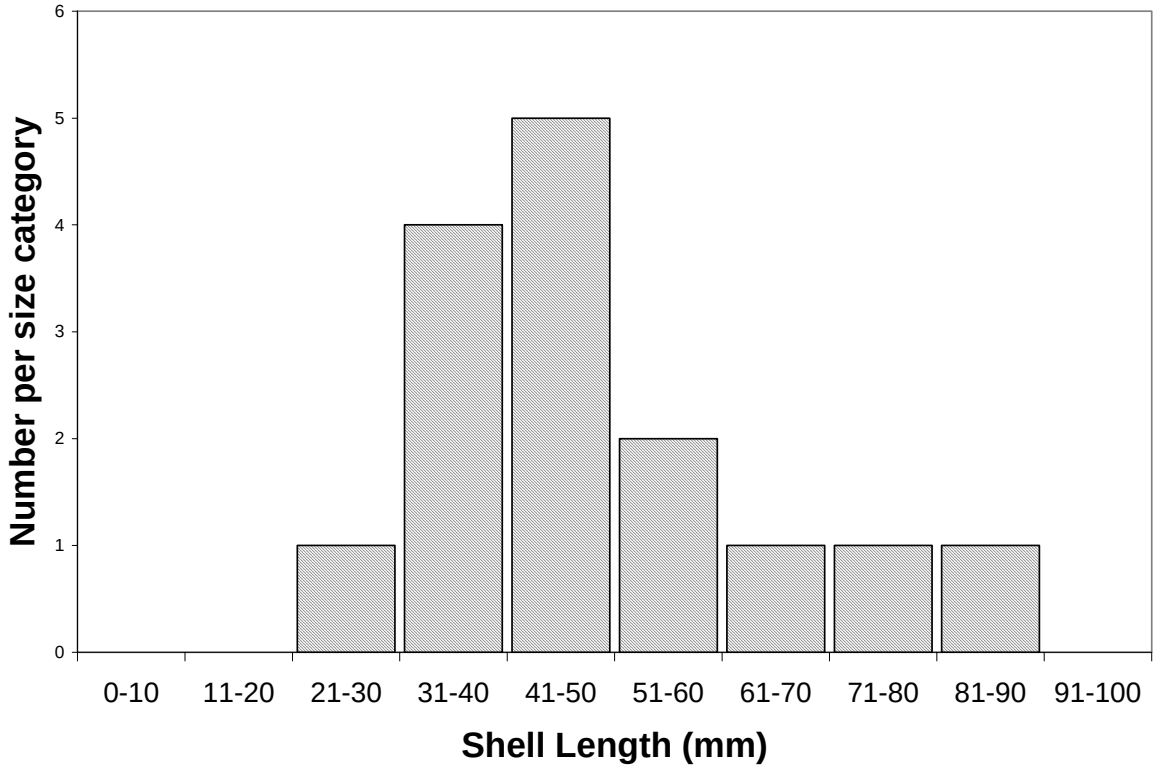

Figure A4-4. Size frequency distribution of eastern oysters (*Crassostrea virginica*) collected in the June 2010 diver survey. Data were pooled from all the sampling stations.

APPENDIX 5

UNDERWATER VIDEO

- Figures A5-1 - A5-10: Summary of the Different Habitats along the June 2010 Video Tracklines.
- Table A5-11: Benthic Habitat Elements Observed during June 2010.

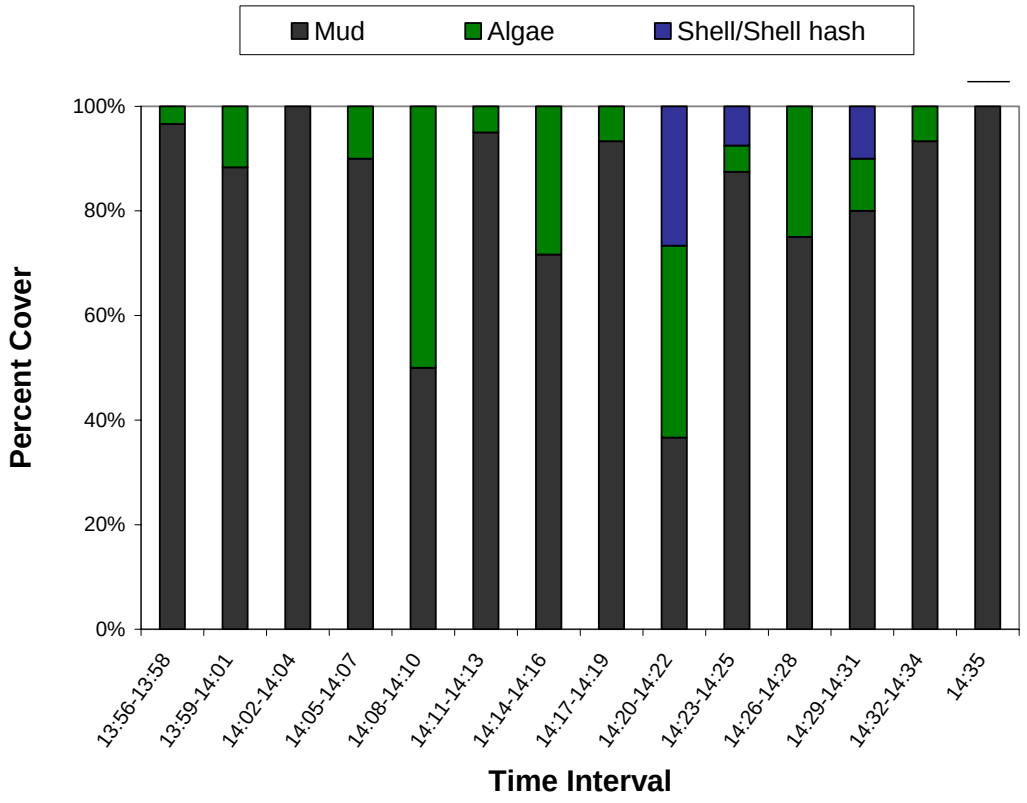

Figure A5-1. Summary of the different benthic habitats found along Line 1 video transect, June 5, 2010. Video data were pooled into three minute sampling intervals (see text for further details). The x-axis indicates the distance along the transect in three minute time units. The transect was run west-to-east across the cable corridor (see Figure A1-2 for transect location). Lines above the histograms denote the presence of eastern oysters (*Crassostrea virginica*) in the video images.

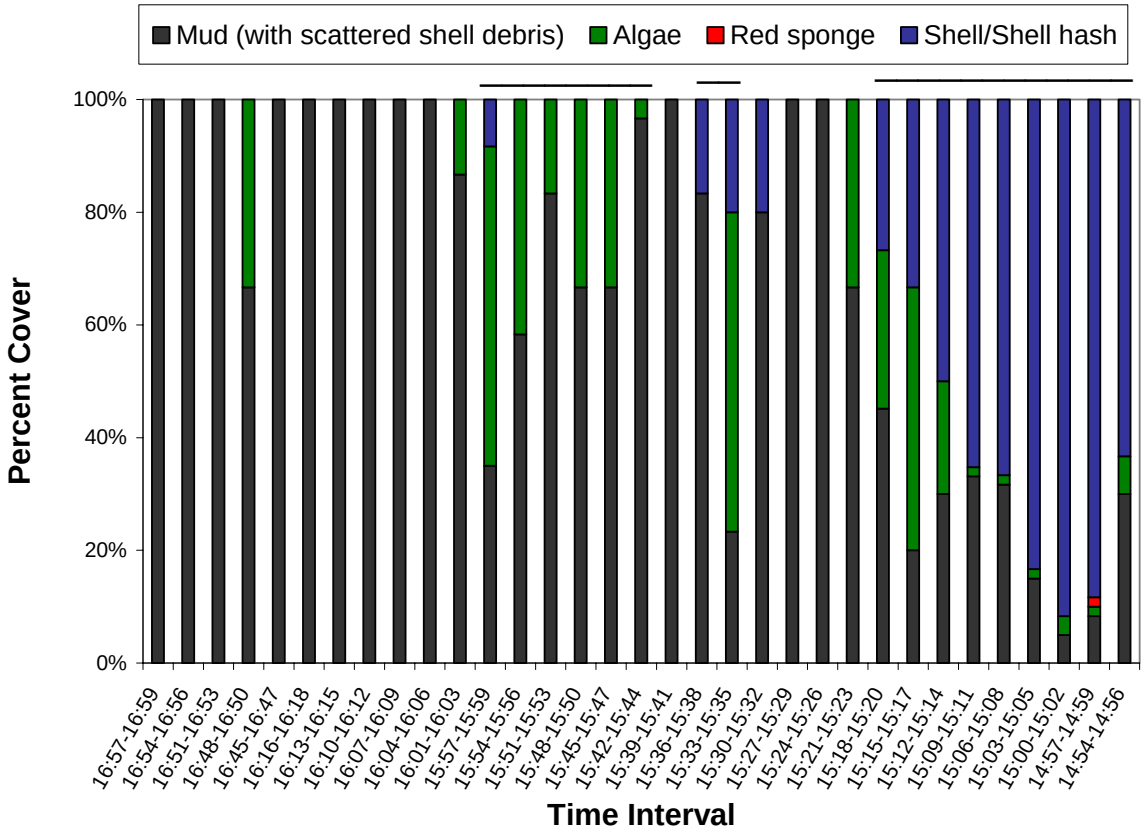

Figure A5-2. Summary of the different benthic habitats found along Line 2 video transect, June 5, 2010. Video data were pooled into three minute sampling intervals (see text for further details). The x-axis indicates the distance along the transect in three minute time units. Note that while the transect was run east-to-west across the cable corridor (Figure A1-2), the data are presented as west-to-east to conform to data presentation in other transect lines and previous reports. The lines above the histograms denote the presence of eastern oysters (*Crassostrea virginica*) in the video images.

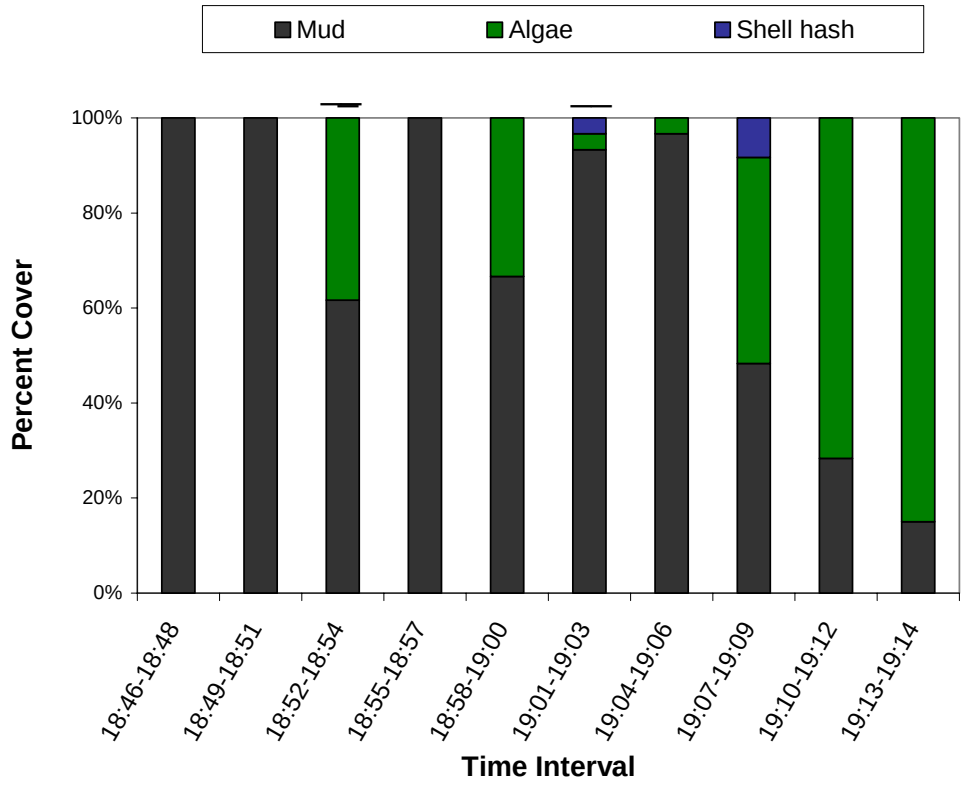

Figure A5-3. Summary of the different benthic habitats found along Line 3 video transect, June 5, 2010. Video data were pooled into three minute sampling intervals (see text for further details). The x-axis indicates the distance along the transect in three minute time units. The transect was run west-to-east across the cable corridor (see Figure A1-2 for transect location). The lines above the histograms denote the presence of eastern oysters (*Crassostrea virginica*) in the video images.

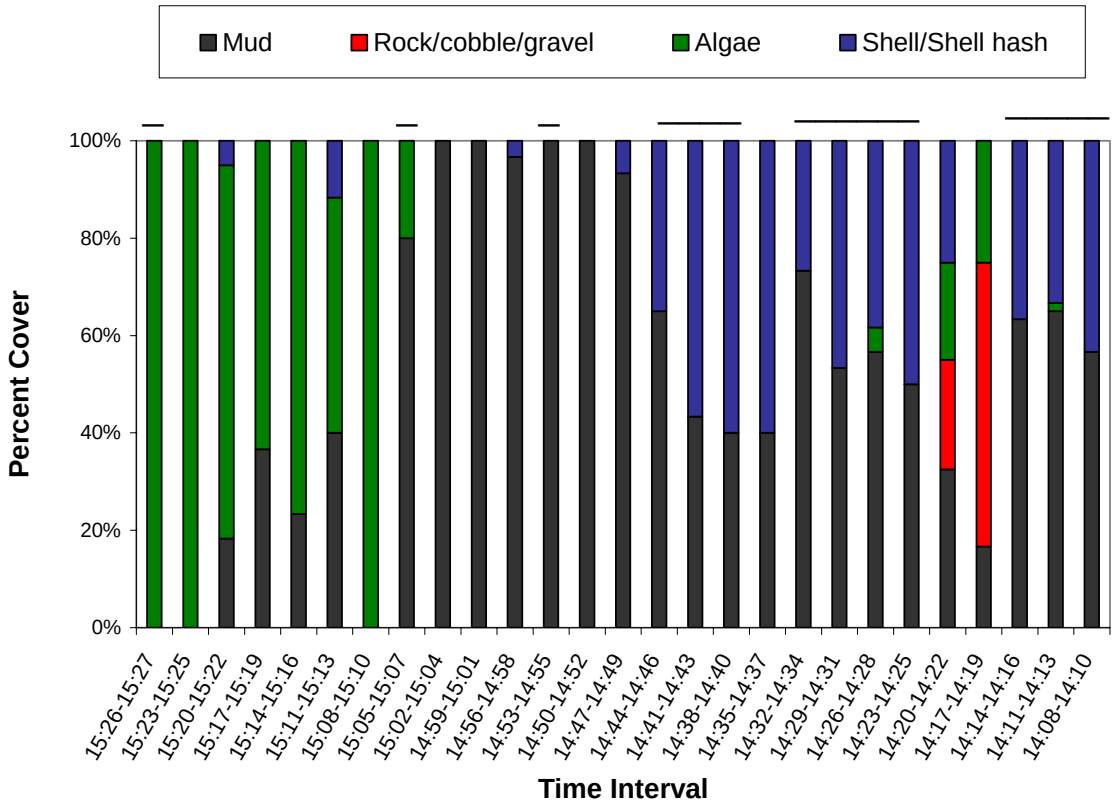

Figure A5-4. Summary of the different benthic habitats found along Line 4 video transect, June 6, 2010. Video data were pooled into three minute sampling intervals (see text for further details). The x-axis indicates the distance along the transect in three minute time units. Note that while the transect was run east-to-west across the cable corridor (Figure A1-2), the data are presented as west-to-east to conform to data presentation in other transect lines and previous reports. The lines above the histograms denote the presence of eastern oysters (*Crassostrea virginica*) in the video images.

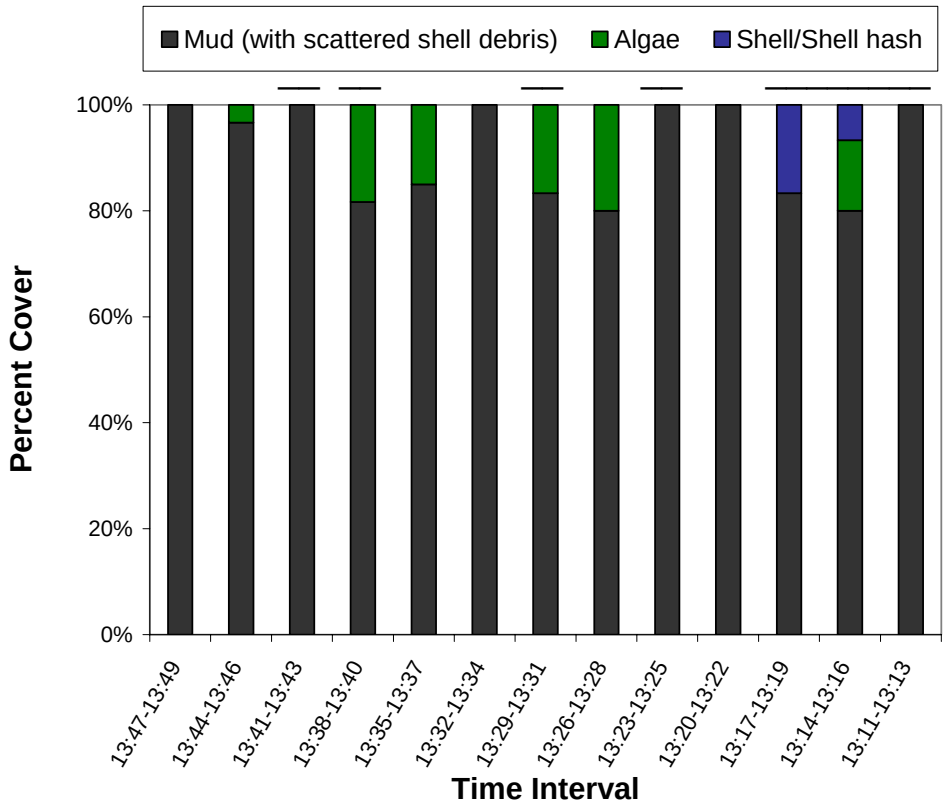

Figure A5-5. Summary of the different benthic habitats found along Line 5 video transect, June 6, 2010. Video data were pooled into three minute sampling intervals (see text for further details). The x-axis indicates the distance along the transect in three minute time units. Note that while the transect was run east-to-west across the cable corridor (Figure A1-2), the data are presented as west-to-east to conform to data presentation in other transect lines and previous reports. The lines above the histograms note the presence of eastern oysters (*Crassostrea virginica*) in the video images.

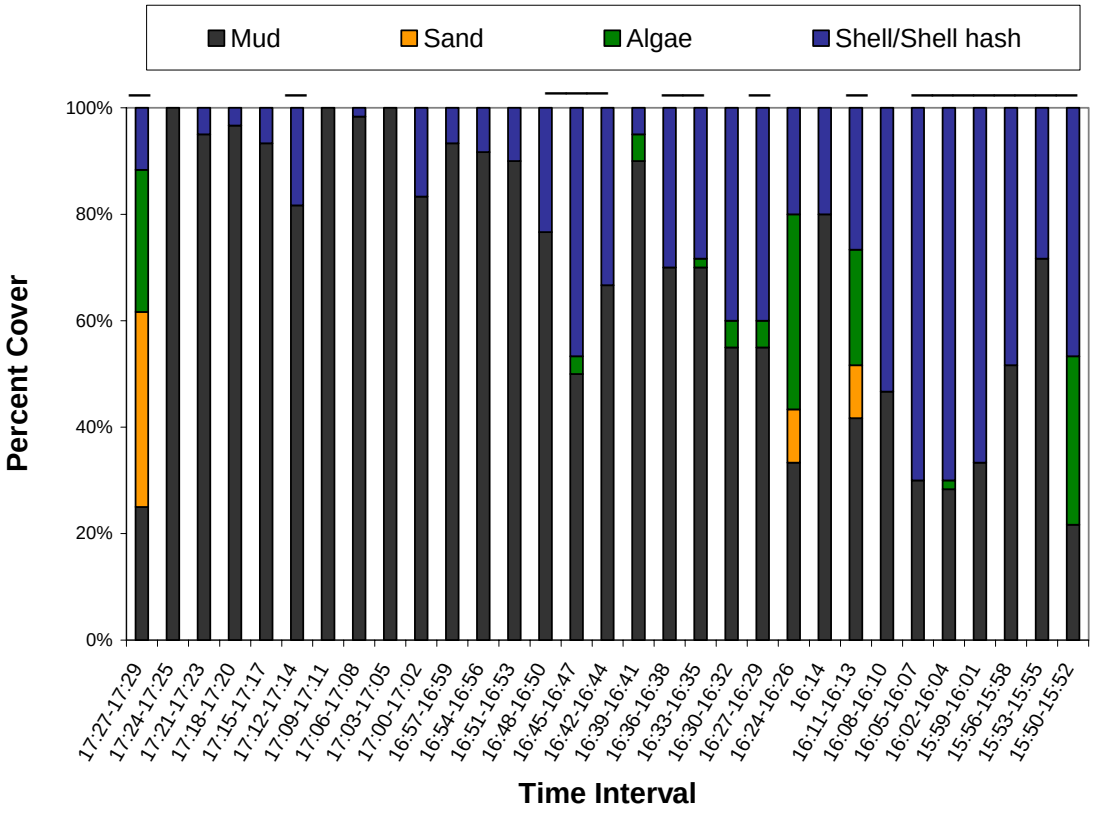

Figure A5-6. Summary of the different benthic habitats found along Line 6 video transect, June 6, 2010. Video data were pooled into three minute sampling intervals (see text for further details). Note that while the transect was run east-to-west across the cable corridor (Figure A1-2), the data are presented as west-to-east to conform to data presentation in other transect lines and previous reports. The x-axis indicates the distance along the transect in three minute time units. The lines above the histograms note the presence of eastern oysters (*Crassostrea virginica*) in the video images.

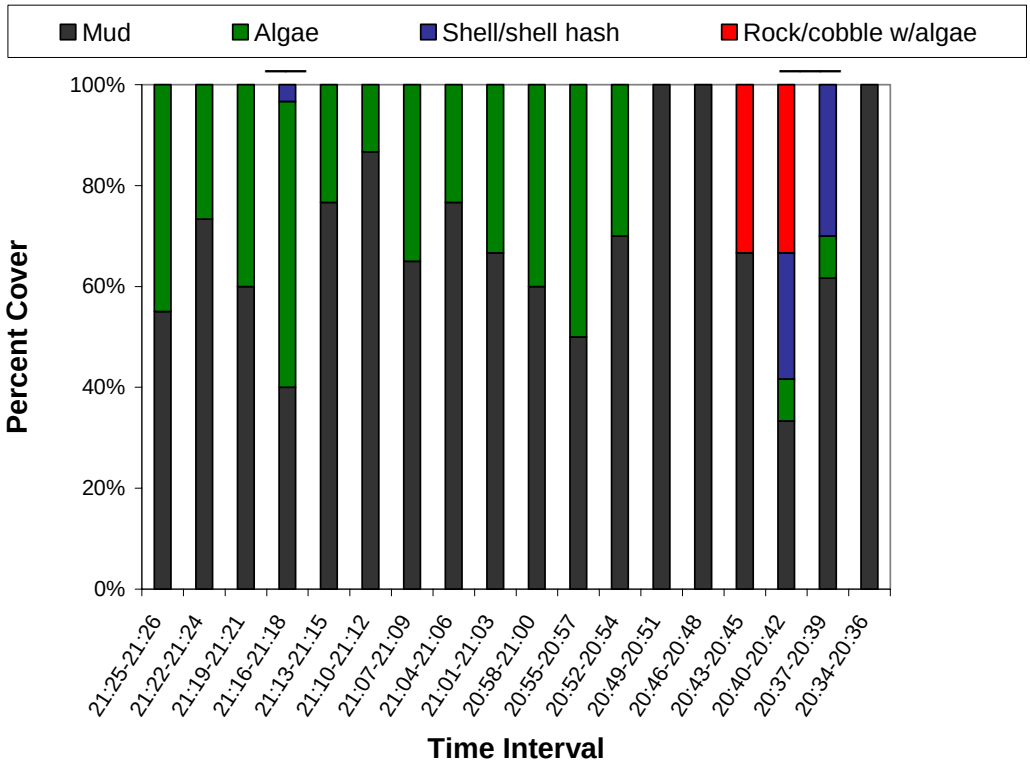

Figure A5-7. Summary of the different benthic habitats found along Line 7 video transect, June 5, 2010. Video data were pooled into three minute sampling intervals (see text for further details). The x-axis indicates the distance along the transect in three minute time units. Note that while the transect was run east-to-west across the cable corridor (Figure A1-2), the data are presented as west-to-east to conform to data presentation in other transect lines and previous reports. The lines above the histograms note the presence of eastern oysters (*Crassostrea virginica*) in the video images.

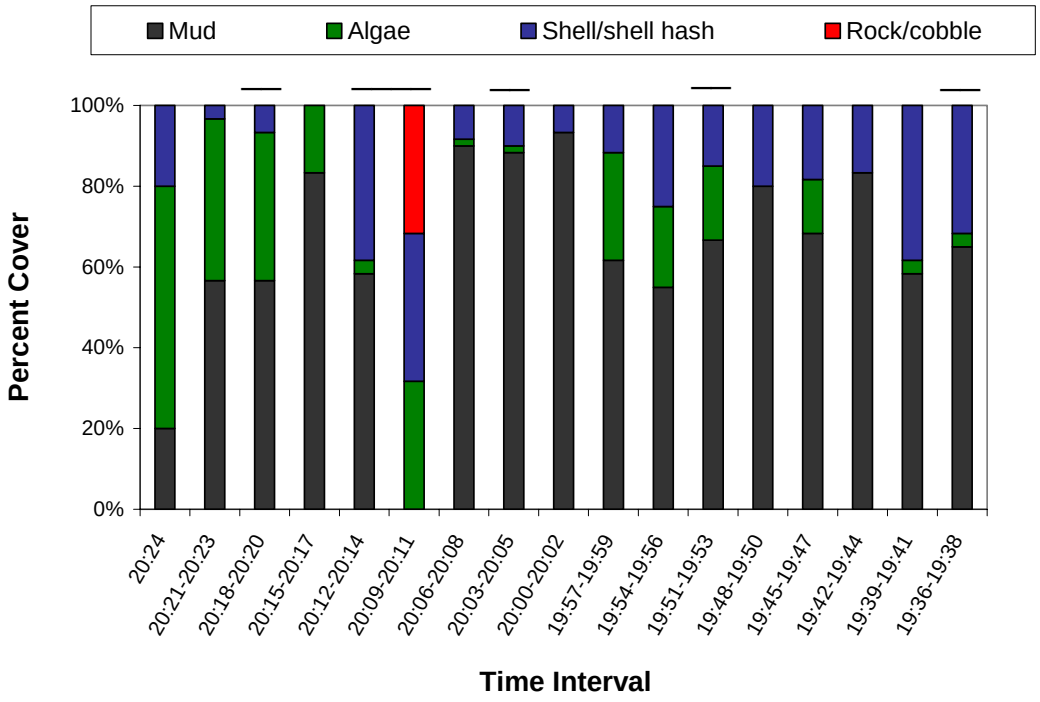

Figure A5-8. Summary of the different benthic habitats found along Line 8 video transect, June 5, 2010. Video data were pooled into three minute sampling intervals (see text for further details). The x-axis indicates the distance along the transect in three minute time units. Note that while the transect was run east-to-west across the cable corridor (Figure A1-2), the data are presented as west-to-east to conform to data presentation in other transect lines and previous reports. The lines above the histograms note the presence of eastern oysters (*Crassostrea virginica*) in the video images.

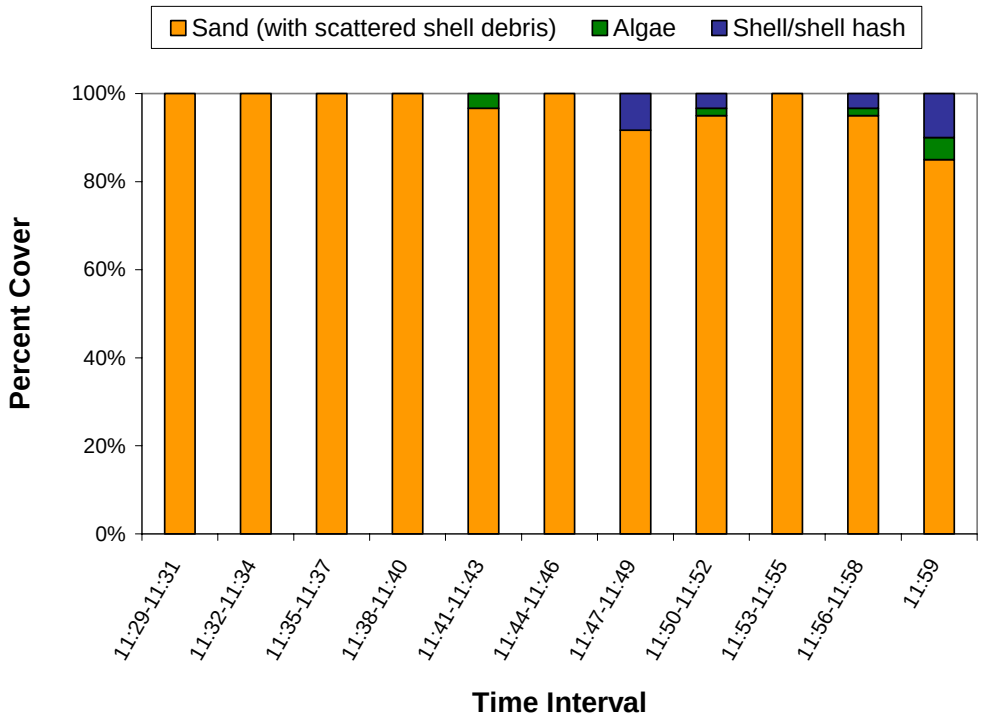

Figure A5-9. Summary of the different benthic habitats found along Line 9 video transect, June 7, 2010. Video data were pooled into three minute sampling intervals (see text for further details). The x-axis indicates the distance along the transect in three minute time units. The transect was run west-to-east across the cable corridor (see Figure A1-2 for transect location). Due to poor water visibility at the time of sampling, it was unclear whether eastern oysters (*Crassostrea virginica*) were present or absent.

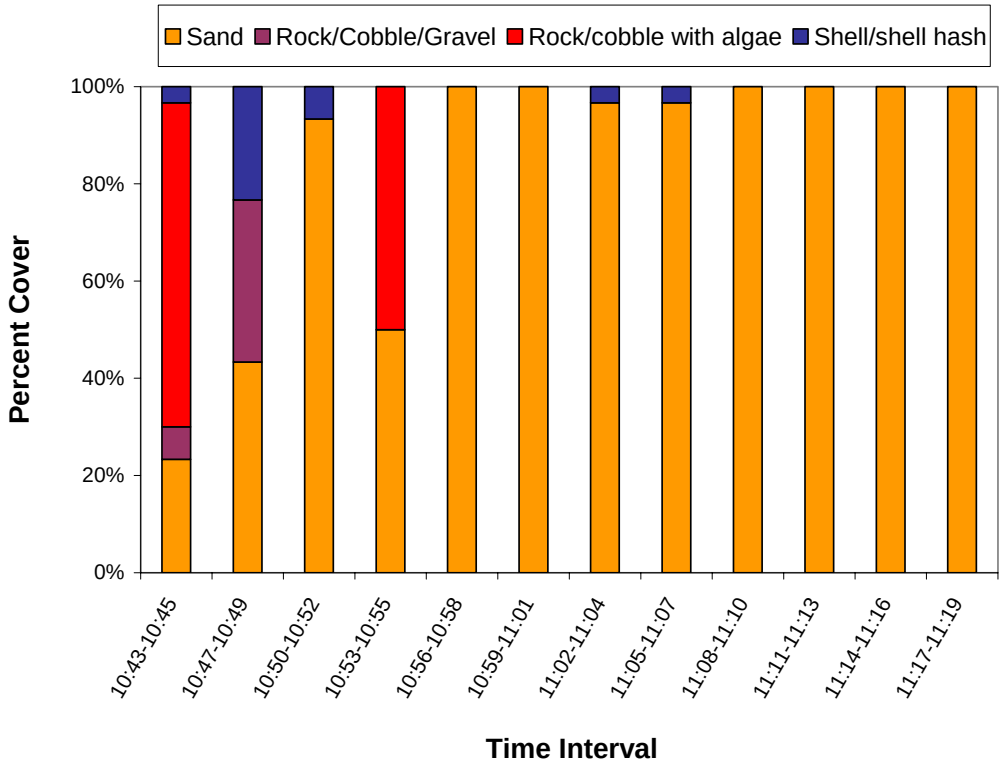

Figure A5-10. Summary of the different benthic habitats found along Line 10 video transect, June 7, 2010. Video data were pooled into three minute sampling intervals (see text for further details). The x-axis indicates the distance along the transect in three minute time units. The transect was run onshore to offshore (see Figure A1-2 for transect location). Due to poor water visibility at the time of sampling, it was unclear whether eastern oysters (*Crassostrea virginica*) were present or absent.

Table A5-11. Benthic habitat elements and epibenthic species observed in the underwater video camera survey (Transects 1-10), June 2010.

Habitat Element	1	2	3	4	5	6	7	8	9	10
Gravel				X						
Muddy/sand sandy/mud sediment	X	X	X	X	X	X		X		X
Shell/shell hash (oyster shells, slipper shells, clam shells)	X	X	X	X	X	X		X	X	X
Algae (e.g, *Ulva*, *Fucus*, *Laminaria*)	X	X	X	X	X	X	X	X	X	X
Fine sand sediment						X			X	
Biogenic structures (e.g., burrows, tubes)	X	X	X	X	X	X	X	X	X	X
Cobbles	X			X				X	X	X
Coarse sand										
Boulders				X			X	X		X
Dredge marks					X		X	X		
Hermit crabs (*Pagurus* spp)	X	X	X	X	X	X	X	X	X	
Green crabs (*Carcinus maenas*)							X			
Cancer crabs (*Cancer* sp.)										
Spider crabs (*Libinia emarginata*)		X	X	X	X	X	X	X	X	X
Mud crabs (*Panopeus* sp.?)		X								
Yellow sponge (*Cliona* spp.)		X								
Crab (unidentified)	X			X	X	X		X	X	
Atlantic slipper shell (*Crepidula fornicata*)	X	X		X	X	X	X	X	X	X
Eastern oyster (*Crassostrea virginica*)	X	X	X	X	X	X	X	X	X	
Horseshoe crab (*Limulus polyphemus*)		X				X		X	X	
Seastar (*Astrias forbesi*)										
Red sponge (*Microciona*)		X	X	X	X	X	X			X
Shrimp (*Crangon* sp)										
Moonsnail (*Euspira* sp.?)					X	X				
Eastern mudsnail (*Ilyanassa obsoleta*)	X		X	X	X	X	X	X	X	X
Whelk (*Busycon* sp.)	X	X		X	X	X	X	X		
Haliclona sp.		X								
Botrylloides		X								
American lobster (*Homarus americanus*)		X	X							
Filamentous algae							X			
Whelk egg case		X				X				
Razor clam or razor clam siphons		X	X			X		X		
Ctenophore		X	X		X					
Lobster traps									X	

APPENDIX 6

DATA CD