Benthic Community Assessment Report

US Wind
Inshore Export Cable Route
Indian River Bay, DE

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1.0 INTRODUCTION

1.1 Background

ESS Group, Inc. (ESS) conducted a benthic habitat assessment survey in the vicinity of the proposed submarine transmission cable associated with the Construction and Operations Plan (COP) for the Maryland Wind Energy Area (MD WEA) leased by US Wind, Inc. (US Wind). Sampling was conducted in accordance with *Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585* issued November 4, 2013 by the Bureau of Ocean Energy Management (BOEM).

The survey included the collection and analysis of benthic grab samples from Indian River Bay, along the Inshore Export Cable Route. These data were used to supplement existing studies and generate a taxonomic classification of benthic habitat in the Inshore Export Cable Route under the Coastal and Marine Ecological Classification Standard (CMECS) (FGDC 2012).

1.2 Definitions

Benthic macroinvertebrate: For the purposes of this assessment, benthic macroinvertebrates are defined as those invertebrate organisms greater than 500 microns (μm) in length that either live on (epifauna) or within (infauna) the substrate, including but not limited to annelid (segmented) worms, mollusks, crustaceans, and echinoderms.

Hard bottom: Coral, cobble, rock, clay outcroppings, or other shelter-forming features.

SAV: Submerged aquatic vegetation, such as eelgrass (*Zostera marina*) or macroalgae.

Sensitive habitat: Benthic habitats containing hard bottom or SAV features.

2.0 APPROACH

The BOEM guidelines for benthic habitat survey (issued November 4, 2013) were used as the primary guidance document for developing the survey approach. Additional comments received from BOEM on February 23, 2015 were also incorporated into the approach. Protocols and sampling locations were approved by BOEM and the Delaware Department of Natural Resources and Environmental Conservation (DNREC) Division of Water.

The benthic field survey was conducted from the MV George in October 2017 and was composed of two primary elements: 1) collection of still images of the seafloor on October 13 and 14, and 2) collection of benthic grab samples for laboratory analysis of taxonomic composition on October 11.

To obtain site-specific information on the benthic community, twelve sampling locations along the Inshore Export Cable Route were targeted in Indian River Bay (Figure 1). The survey vessel navigated to and recorded each sampling position using a Differential Global Positioning System (DGPS).

2.1 Benthic Imagery

Images of the seafloor were captured at each survey location with a Kongsberg/Simrad OE14-208 5.0-megapixel underwater camera with a dedicated strobe and video lamp, mounted within a stainless-steel frame.

A hover and drift technique allowed the frame to move progressively along the seafloor as the vessel traversed the study area. Footage was viewed in real time via an umbilical, assisting in the control of the digital stills camera and selection of still photograph locations. Images were captured using the surface control unit and initially stored on the camera's internal memory card. On completion, photographs were downloaded onto a PC and copied onto CD-ROM.

At least ten images were captured at each station, separated by a time gap of approximately 5 to 10 seconds. Benthic images were collected within the Inshore Export Cable Route on October 13 and 14, 2017.

2.2 Benthic Grab Sampling

2.2.1 Sample Collection

Surface benthic grab samples were successfully collected using a Day grab sampler at each of the twelve sampling locations on October 11, 2017. The sampler measured approximately 12.5 inches by 12.5 inches (31.75 cm by 31.75 cm) at the sampling interface. After retrieval, each sample was examined for quality and a decision was made to accept or reject the sample based on representativeness of the grab. Sample grabs that did not retain at least 2.5 inches (6.4 cm) of material or showed evidence of uneven penetration (i.e. angled sample) were rejected as incomplete and the grab was redeployed until an acceptable sample was retained. Over the course of the field program, only four sample attempts were rejected, due to overpenetration, inadequate recovery, or sample washout.

Day grab sampler on MV George

Once an acceptable sample was retrieved, descriptions of sample recovery and sediment type (i.e. grain size) were recorded in a field notebook. The top 4 inches (10 cm) of sediment in the grab was then removed from the sampler using a stainless-steel spoon and sieved in the field. Sieving consisted of gently rinsing the sample material through a bucket sieve with 500-µm mesh to remove fine sediments. Sieved samples were preserved in a solution containing 10% buffered formalin in seawater. Preserved samples were stored in plastic quart-size sample jars and labeled with the project name, sample identification code, sampling date, preservative, and the initials of the collector.

Preserved samples were returned to ESS offices in East Providence, Rhode Island for storage and laboratory analysis.

2.2.2 Laboratory Analysis

Upon receipt at the laboratory, each sample was logged in and decanted through a 500-µm sieve. Samples were gently rinsed in the sieve to remove the formalin fixative and any additional fine sediment that remained after the initial field sieving process. Once thoroughly rinsed, each sample was returned to a labeled jar and preserved with 70% ethanol for storage.

For sorting, the contents of each sample were examined using a high-power dissecting microscope (7X to 45X magnification) and high-intensity gooseneck fiber optic lamp.

Most samples were sorted in their entirety. However, sorting was conducted using a randomized sub-sampling methodology where a high density of organisms or large material volume was observed. For the sub-sampling process, sample material was emptied into and evenly distributed within a gridded tray, each cell of which was assigned a number. Cells were then randomly selected, one at a time, for sorting using a random number generator. Randomized selection of cells continued until a target of at least 100 organisms was retained for each sample. All randomly selected fractions of sample material were sorted in their entirety.

Organisms found during the sorting process were removed with forceps and placed in 70% ethanol. Each vial was labeled with the project name, collection date and sample identification number. All residue (sediment and organic matter) from the sorted and unsorted portion of each sample was placed in a separate labeled container and re-preserved in 70% ethanol.

Sorted organisms were subsequently identified by a qualified taxonomist to the lowest taxonomic level possible using a dissecting microscope and readily available taxonomic keys and references (Bartholomew 2001, Pollock 1998, Martinez 1999, Abbott and Morris 1995, Weiss 1995, Gosner 1971, 1978, Bousfield 1973, Smith 1964, Pettibone 1963). Temporary slide mounts were prepared for annelid worms, as necessary to improve the taxonomic precision of identification for these groups. Slide-mounted organisms were identified under a compound microscope capable of 64X to 1600X magnification.

For quality assurance and control (QA/QC) purposes, a second qualified staff member (quality assurance officer) resorted 10% of the samples (or one, whichever was greater) analyzed by each sorter to ensure organisms were being adequately removed from the samples. The quality assurance officer checked the sorted sample material for remaining organisms and calculated an efficiency rating (E) using the following formula:

$$E = 100 \times \frac{n_a}{n_a + n_b}$$

Where n_a is the number of individuals originally sorted and verified as identifiable organisms by the QC checker and n_b is the number of organisms recovered by the QC checker. If the original sorter achieved E < 90% (i.e., less than 90% of the organisms in the sample removed), corrective action was taken to ensure greater sorting efficiency for other samples sorted by the same individual. Corrective action includes but is not necessarily limited to, additional training on organism recognition and re-sorting of sample material.

In the identification phase, the QA/QC reviewer checked at least 10% of taxonomic identifications for accuracy. Incorrect identifications were reviewed with the taxonomist and revised, as applicable, in the project taxonomic database.

2.2.3 Data Analysis

Measures of benthic diversity, abundance and community structure were selected to describe the affected environment. The rationale behind selection of each measure is as follows:

Diversity: *Taxa richness* is the number of different taxa that are found within a given area or community and is widely accepted as a good assessment measure of diversity (Magurran 2003). For this study, taxa richness is defined as the total number of unique taxa found in a sample.

Abundance: *Macrofaunal density* is a measure of abundance expressed as an estimate of the number of individuals per unit area. Although macrofaunal density can reflect the productivity of marine habitats (Taylor 1998), it may also serve as an indication of stress or disturbance at a location (Dean 2008). Consequently, the density of benthic organisms may increase or decrease in response to different types of stress (e.g., thermal or chemical pollution, sediment deposition, physical abrasion or displacement).

The density of benthic organisms responds to disturbance as mitigated by the tolerance (or preference) of a given organism to the particular source of disturbance. However, density may vary substantially over small areas or short periods of time and should therefore be interpreted cautiously. For this study, macrofaunal density is expressed as the number of organisms per square meter.

Community structure: *Community composition* is a multivariate measure identifying the different benthic taxa present and respective abundances of each taxon. This descriptive measure provides detail to complement and help interpret summary metrics like taxa richness and macrofaunal density. Multivariate statistical analyses can also be used to evaluate changes in community composition over time.

3.0 RESULTS

3.1 Benthic Imagery

Benthic imagery obtained during this survey was of limited use due to turbid conditions during data collection. However, qualitative analysis of the imagery indicated the presence of scattered patches of macroalgal growth, including sea lettuce (*Ulva lactuca*). No live epibenthic macrofauna were discernable in the imagery reviewed, though empty bivalve shells were observed.

3.2 Benthic Grab Sampling

The benthic grab samples provided information about taxa richness, density and community composition along the cable Route in the Indian River Bay (Table A).

Table A. Summary of Key Statistics from the Benthic Sample Analysis

Statistic	Value
Number of Samples	12
Mean Density per Square Meter (±1 SD)	6,488 ± 8,796
Mean Taxa Richness (±1 SD)	15.8 ± 3.79
Total Number of Taxa	63
Number of Taxa Observed by Taxonomic Group	
Polychaete worms	31
Crustaceans	18
Mollusks	7
Oligochaete worms	3
Other	4
Percent of Total Abundance by Taxonomic Group	
Polychaete worms	88.3%
Crustaceans	9.1%
Mollusks	1.0%
Oligochaete worms	0.9%
Other	0.8%

3.2.1 Taxa Richness

Overall, 63 species of benthic fauna were observed in the twelve grab samples analyzed (Appendix A). Taxa richness per sample ranged from 10 to 23, and mean taxa richness was 15.8 per site (Tables A and B). The least rich sample was obtained from BG-IRB-02, located near the Substation Landfall location, while the richest sample was obtained from BG-IRB-14, located near the Inshore Landfall location (Table B).

Table B. Taxa Richness by Sample Site

Taxon	Taxa Richness											
	BG-IRB-02	BG-IRB-04	BG-IRB-05	BG-IRB-06	BG-IRB-07-ALT	BG-IRB-08-ALT	BG-IRB-24	BG-IRB-09-ALT	BG-IRB-10-ALT	BG-IRB-11-ALT	BG-IRB-12	BG-IRB-14
Polychaeta	5	7	12	11	13	9	8	9	8	4	7	13
Crustacea	2	3	5	5	4	4	4	4	6	3	5	6
Mollusca	1	2	0	1	1	1	0	0	1	3	1	2
Oligochaeta	1	0	0	0	0	0	0	0	1	3	0	1
Other	1	1	1	3	0	3	0	2	2	0	0	1
Total	**10**	**13**	**18**	**20**	**18**	**17**	**12**	**15**	**18**	**13**	**13**	**23**

3.2.2 Macrofaunal Density

The mean macrofaunal density for the analyzed samples was 6,488 individuals/m^2 (Table A). The highest macrofaunal density (27,617 individuals/m^2) was found at BG-IRB-06, while macrofaunal density was lowest (466 individuals/m^2) at BG-IRB-24 (Table C). Of the twelve samples analyzed, nine were characterized by densities of 1,000 individuals/m^2 or more.

Table C. Macrofaunal Density by Sample Site

Taxon	Macrofaunal Density											
	BG-IRB-02	BG-IRB-04	BG-IRB-05	BG-IRB-06	BG-IRB-07-ALT	BG-IRB-08-ALT	BG-IRB-24	BG-IRB-09-ALT	BG-IRB-10-ALT	BG-IRB-11-ALT	BG-IRB-12	BG-IRB-14
Polychaeta	17,856	3,153	11,507	24,998	1,716	893	357	1,042	3,214	283	556	3,194
Crustacea	763	319	1,984	2,420	337	198	109	317	218	47	208	149
Mollusca	153	248	0	40	10	10	0	0	40	79	60	40
Oligochaeta	153	0	0	0	0	0	0	0	99	394	0	50
Other	76	106	40	159	0	40	0	99	99	0	0	20
Total	**19,001**	**3,826**	**13,531**	**27,617**	**2,063**	**1,141**	**466**	**1,458**	**3,670**	**803**	**823**	**3,452**

3.2.3 Community Composition

The benthic macrofaunal assemblage documented in the analyzed samples consisted of polychaete worms, crustaceans, mollusks, oligochaete worms, nemertean ribbon worms, sea anemones (Actiniaria), sea spiders (Pycnogonida), and flat worms (Platyhelminthes) (Appendix A).

The most speciose taxonomic groups were polychaete worms and crustaceans, which contributed 48% and 29% of the taxa documented in the analyzed samples, respectively. Similarly, polychaete worms were the taxonomic group with the highest density, followed by crustaceans (Table A).

The most abundant taxon was the spionid polychaete *Streblospio benedicti*, which accounted for over 71% of all individuals identified in this study. The capitellid polychaete *Mediomastus ambiseta*, and the four-eyed amphipod *Ampelisca sp.* were the next most abundant taxa, and together accounted for over 14% of individuals (Table D).

Most of the taxa observed in the grab samples were small tube-building organisms. The most commonly observed polychaete taxa include *Streblospio benedicti* and *Mediomastus ambiseta* (Table D), both typical of soft sediment habitats (Masterson 2008, Dobbs and Vozarik 1983). The most abundant crustacean, the four-eyed amphipod *Ampelisca sp*., also builds tubes in medium to coarse sands (Bousfield 1973).

No taxa indicative of sensitive habitats were observed in the benthic grab samples. Hard clams (*Mercenaria mercenaria*) were observed at only one site, BG-IRB-11-ALT, where they consisted of very small juveniles, approximately 0.08 inches (2 mm) in diameter.

Table D. Relative Abundance of Taxa Encountered*

Scientific Name	Common Name	Relative Abundance (%)
Streblospio benedicti	Spionid polychaete	71
Mediomastus ambiseta	Capitellid polychaete	10
Ampelisca sp	Four-eyed amphipod	4
Leucon americanus	Hooded shrimp	3
Goniadidae	Chevron worm	2
Orbiniidae	Orbiniid polychaete	1

*Includes taxa accounting for at least 1% of total abundance

The most widespread taxa (i.e., observed in the most samples) were the spionid polychaete *Streblospio benedicti,* the capitellid polychaete *Mediomastus ambiseta*, and the orbiniid polychaetes, all of which were observed in at least twelve samples (Table E). Other widely distributed taxa included four-eyed amphipods, tellin clams, chevron worms, and lumbrinerid polychaetes (all found in at least eight samples).

Table E. Most Widespread Taxa Encountered*

Scientific Name	Common Name	Number of Samples Containing this Taxon
Streblospio benedicti	Spionid polychaete	12
Mediomastus ambiseta	Capitellid polychaete	11
Ampelisca sp	Four-eyed amphipod	10
Orbiniidae	Orbiniid polychaete	10
Goniadidae	Chevron worms	8
Scoletoma tenuis	Lumbrinerid polychaete	8
Leucon americanus	Hooded shrimp	7
Nemertea	Nemertean ribbon worm	7
Listriella barnardi	Liljeborgiid amphipod	6
Tellina sp.	Tellin clam	6

*Includes taxa observed in at least six samples

3.3 Quality Assurance/Quality Control

QA/QC sorting efficiency checks were conducted on two samples. All QA/QC criteria were met for this project.

Identifications represent the lowest practicable taxonomic level, given the maturity and condition of the organisms encountered, as well as the current state of taxonomic consensus. With the exception of heavily damaged or immature specimens, organisms were successfully identified to family level or better.

4.0 TAXONOMIC CLASSIFICATION OF BENTHIC HABITAT

Based on information reviewed in DIBEP (1993) and Chaillou et al. (1996), and site-specific investigations, benthic habitat in the Inshore Export Cable Route has been classified under the Coastal and Marine Ecological Classification System (CMECS) (Table F).

Benthic habitat in Indian River Bay is generally characterized as unconsolidated soft sediment with some areas of shell material (DIBEP 1993). The DIBEP (1993) review describes the Indian River Bay as being dominated by sand and clayey silt, though a later study by Chaillou et al. (1996) reported higher percentages of silty-clay substrates, and less sand.

Benthic habitat along the Inshore Export Cable Route is typical of Indian River Bay, consisting primarily of fine sand and silty clay. Water depths at benthic sample locations ranged from 1.2 m to 4.6 m (4 ft to 15.25 ft). To identify potentially sensitive habitat areas, the dominant biotic subclass under the CMECS framework was determined for each benthic sample site along the Inshore Export Cable Route. All twelve sample sites in the Indian River Bay were characterized by soft sediment fauna, and no attached fauna or sensitive or unique benthic habitats, such as hard bottom, live bottom, or SAV, were observed. Though hard clam beds are known to be present in Indian River Bay (Bott and Wong 2012), juvenile hard clams were only encountered at one sample location (BG-IRB-11-ALT).

Table F. CMECS Classification of Benthic Sample Sites Along the Inshore Export Cable Route

CMECS Level		Classification
Biogeographic Setting	Realm	Temperate North Atlantic
	Province	Cold Temperate Northwest Atlantic
	Ecoregion	Virginian
Aquatic Setting	System	Estuarine
	Subsystem	Coastal
	Tidal Zone	Subtidal
Water Column Component	Water Column Layer*	Estuarine Coastal Lower Water Column, Estuarine Open Water Lower Water Column
	Salinity Regime*	Upper Polyhaline Water, Lower Polyhaline Water, Mesohaline Water
	Temperature Regime*	Moderate Water (seasonal variation from very cold to hot)
Geoform Component	Tectonic Setting	Passive Continental Margin
	Physiographic Setting	Embayment/Bay
	Geoform Origin	Geologic
Substrate Component	Substrate Origin	Geologic Substrate
	Substrate Class	Unconsolidated Mineral Substrate
	Substrate Subclass	Fine Unconsolidated Substrate
	Substrate Group*	Muddy Sand, Sand, Mud
	Substrate Subgroup*	Silty Sand, Fine Sand, Medium Sand, Coarse Sand, Silt-Clay
Biotic Component	Biotic Setting	Benthic Biota
	Biotic Class	Faunal Bed
	Biotic Subclass	Soft Sediment Fauna

*Indicates multiple classifications within this level of the CMECS hierarchy among sample sites

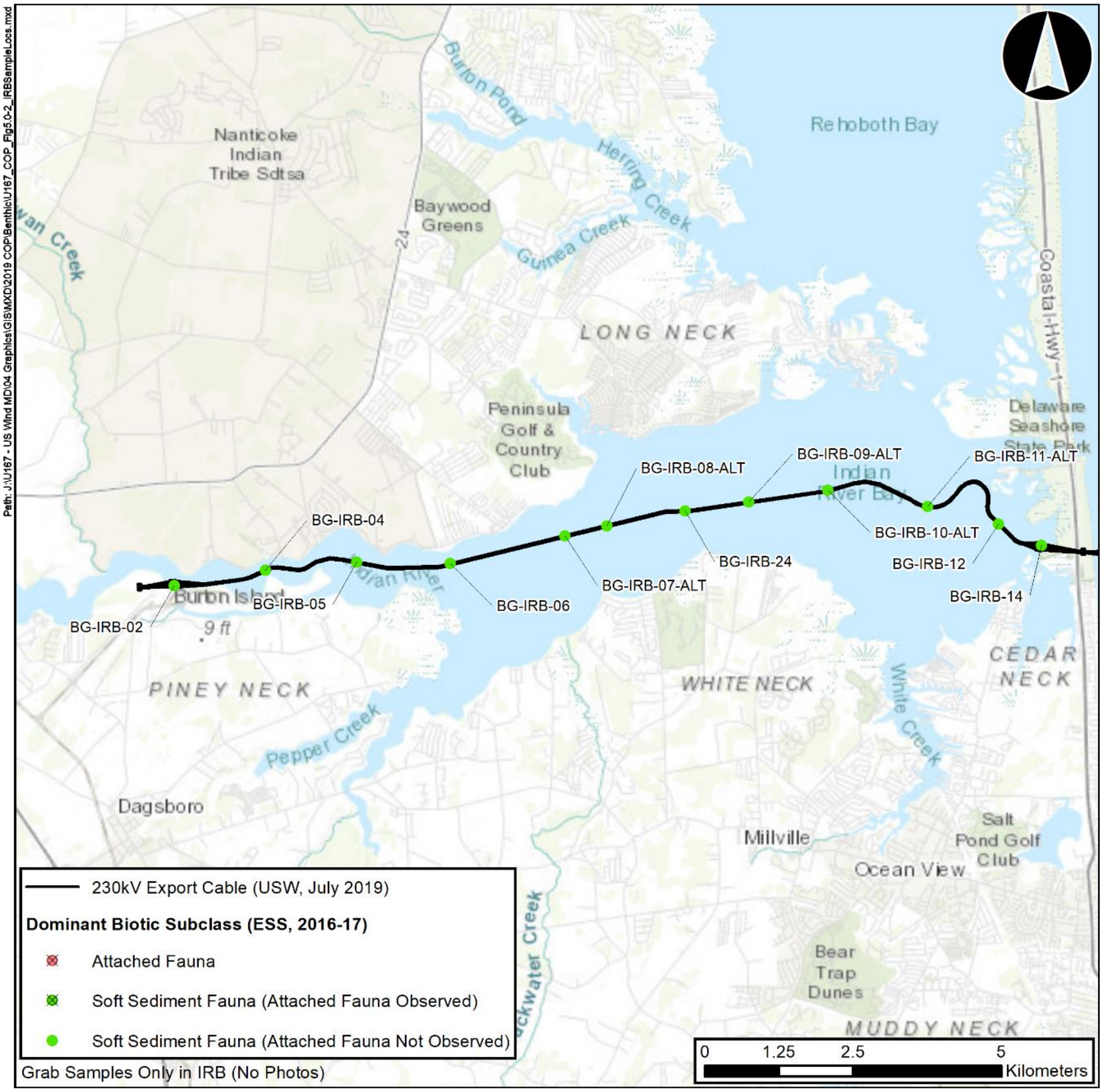

Figure 1. Inshore Export Cable Benthic Sample CMECS Biotic Subclass Classification and Attached Organism Presence

5.0 SUMMARY AND DISCUSSION

A benthic field survey was completed to collect supplemental site-specific data in the Inshore Export Cable Route in the Indian River Bay for the Maryland Offshore Wind Energy Project. Twelve locations along the Inshore Export Cable Route were sampled using collection of still images of the seafloor and collection of benthic grab samples. These data were used to characterize the benthic community and generate taxonomic classifications of benthic habitats under CMECS.

Benthic imagery collected during this survey was of limited use due to turbid conditions. However, qualitative analysis indicated the presence of scattered patches of macroalgal growth along the Inshore Export Cable Route.

Sixty-three marine invertebrate taxa were observed in the twelve samples analyzed for this project, including polychaete worms, crabs, cumaceans, amphipods, isopods, and caridean shrimp, bivalves, gastropods, oligochaete worms, nemertean ribbon worms, sea anemones, sea spiders, and flatworms. Mean macroinvertebrate density was over 6,488 organisms/m^2 and taxa richness averaged 15.8 per site, with all samples containing at least ten taxa. The benthic community observed in the analyzed samples was dominated by polychaete worms, which constituted approximately 88% of all organisms, and 48% of all taxa. The most abundant and widely distributed organism was the spionid polychaete *Streblospio benedicti*, which accounted for 71% of all organisms was observed in all twelve samples.

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Appendix A

Benthic Sample Taxonomy and Enumeration Results

	Organisms/m^2											
	BG-IRB-02	BG-IRB-04	BG-IRB-05	BG-IRB-06	BG-IRB-07-ALT	BG-IRB-08-ALT	BG-IRB-24	BG-IRB-09-ALT	BG-IRB-10-ALT	BG-IRB-11-ALT	BG-IRB-12	BG-IRB-14
Conversion Factor (multiply by density for raw sample abundance)	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.050	0.101	0.101	0.101
Taxa												
Crustacea												
Ampelisca sp.			1,627	913	60	40	10	50	60	16	10	69
Ampelisca vadorum			79									
Amphipoda		71										
Callinectes sapidus		35										
Caprella penantis												10
Corophiidae				40								
Corophium sp.			40									
Diastylis sp.				40			10		40		30	20
Edotia montosa	76	213							40		109	20
Elasmopus sp.										16		
Hyalidae								10	20			
Leucon americanus	687		159	1,389	20	20	10		20			
Listriella barnardi					218	99	79	248	40			20
Monoculodes edwardsi											50	
Ogyrides limicola			79	40	40	40						
Pagurus sp.										16		
Periploma sp.											10	
Pinnixa sp.								10				10

	Organisms/m^2											
	BG-IRB-02	BG-IRB-04	BG-IRB-05	BG-IRB-06	BG-IRB-07-ALT	BG-IRB-08-ALT	BG-IRB-24	BG-IRB-09-ALT	BG-IRB-10-ALT	BG-IRB-11-ALT	BG-IRB-12	BG-IRB-14
Conversion Factor (multiply by density for raw sample abundance)	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.050	0.101	0.101	0.101
Taxa												
Mollusca												
Crepidula fornicata										16		
Mercenaria mercenaria										16		
Nassarius trivittatus		35										
Nassarius vibex		213		40								
Nucula proxima					10							
Tellina sp.	153					10			40	47	60	30
Turbonilla sp.												10
Oligochaeta												
Peloscolex sp.										331		
Tubificinae w/ hair										47		
Tubificinae w/out hair	153								99	16		50
Other												
Actiniaria		106		79								
Anoplodactylus sp.						10		40	20			
Nemertea	76		40	40		10		60	79			20
Platyhelminthes				40		20						

	Organisms/m^2											
	BG-IRB-02	BG-IRB-04	BG-IRB-05	BG-IRB-06	BG-IRB-07-ALT	BG-IRB-08-ALT	BG-IRB-24	BG-IRB-09-ALT	BG-IRB-10-ALT	BG-IRB-11-ALT	BG-IRB-12	BG-IRB-14
Conversion Factor (multiply by density for raw sample abundance)	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.050	0.101	0.101	0.101
Taxa												
Polychaeta												
Asychis elongata					50	30	89	10				
Capitella sp.												89
Cirratulidae									20	157		20
Clymenella torquata								10				
Diopatra cuprea		142										
Eteone sp.	76		239	159	10							
Glycera americana			40						20			
Glycera capitata										31		
Glycera sp.			79				69					
Glyceridae			79									10
Goniadidae	153	71		397	208	99		149	179			20
Heteromastus filiformis			79		50							30
Lumbrineridae				119								
Mediomastus ambiseta	458	1,878	2,143	1,746	79	218	40	248	417	16		208
Neanthes acuminata											10	
Nephtys picta											10	
Nereididae		106	40	79	10			20				
Nereis grayi					10							
Nereis sp.			40									
Notomastus sp.			40		30	40	20					

	Organisms/m^2											
	BG-IRB-02	BG-IRB-04	BG-IRB-05	BG-IRB-06	BG-IRB-07-ALT	BG-IRB-08-ALT	BG-IRB-24	BG-IRB-09-ALT	BG-IRB-10-ALT	BG-IRB-11-ALT	BG-IRB-12	BG-IRB-14
Conversion Factor (multiply by density for raw sample abundance)	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.050	0.101	0.101	0.101
Taxa												
Orbiniidae	382	213	119	40	30	20	69	40	40			10
Paraonis sp.						10					119	
Phyllodoce arenae				40	20		10		40			
Pilargidae											20	
Polydora sp.				79								10
Prionospio sp.				40	20			10			149	10
Scoletoma sp.				119								30
Scoletoma tenuis		35	159		208	89	30	40	20			30
Spio sp.						20						
Spionidae											20	30
Streblospio benedicti	16,788	709	8,452	22,181	992	367	30	516	2,480	79	228	2,698
Total Density	**19,001**	**3,826**	**13,531**	**27,617**	**2,063**	**1,141**	**466**	**1,458**	**3,670**	**803**	**823**	**3,452**
Taxa Richness	**10**	**13**	**18**	**20**	**18**	**17**	**12**	**15**	**18**	**13**	**13**	**23**