Benthic Community Assessment Report

US Wind
Offshore Export Cable Survey
Offshore of MD and DE

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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

Analysis of benthic imagery revealed bottom habitats ranging from fine sand to gravel, and allowed for the identification of many mobile species that were not captured in benthic grabs.

Table A. Summary of Macroinvertebrate Taxa Observed in Benthic Imagery

Phyla	Taxa	Common Name	# Samples with Taxa
Porifera	Porifera	Sponge	1
Echinodermata	Clypeasteroida	Sand dollar	4
Bryozoa	Arborescent Bryozoan	Moss Animal	2
Cnidaria	Ceriantharia	Tube-dwelling anemone	2
	Leptogorgia sp.	Whip Coral	3
	Astrangia sp.	Stony Coral	2
Polychaeta	*Diopatra sp.*	Decorator Worm	5
Mollusca	*Crepidula sp.*	Slipper Shell	5
	Buccinidae	Small Whelk	1
	Busyconidae	Busycon Whelk	1
	Astartidae	Astarte Clam	2
Crustacea	*Pagurus sp.*	Hermit Crab	5
	Decapoda	Shrimp	1
	Cancer sp.	Cancer Crab	2
Chordata	Ascidiacea	Colonial Ascidian	1

Phyla	Taxa	Common Name	# Samples with Taxa
	Osteichthyes	Unidentified Fish	2
	Cottoidea	Sculpin	1
	Pleuronectiformes	Left-eyed Flatfish	1

The organisms most frequently observed in benthic imagery along the Offshore Export Cable Route were slipper shells (*Crepidula sp*.), hermit crabs (*Pagurus sp*.) and decorator worms (*Diopatra sp.*), which were present at five of the of the 18 image sample locations (Table A). Other widely distributed organisms included sand dollars (Clypeasteroidea) and whip coral (*Leptogorgia sp.*). All other organisms were found at less than 3 image sample locations. Sandy areas were generally inhabited by sand dollars and slipper shells, while common gravel and rocky bottom organisms included crabs (*Cancer sp*.), whip coral (*Leptogorgia sp*.), stony coral (*Astrangia sp*.), and arborescent bryozoans. Fish (sculpin, left-eyed flatfish, and unidentified bony fish) were observed in images from both sandy and gravel-dominated areas, and only at benthic grab locations.

The results of benthic imagery analysis along the Offshore Export Cable Route are consistent with recent video surveys and survey trawls of the Lease Area, which suggest that the primary benthic epifaunal taxa include common sand dollar (*Echinarachnius parma*), hermit crab (*Pagurus* spp.), and rock crab (*Cancer irroratus*) (Guida et al. 2015). However, other species found by Guida et al. (2015) to be common in the Lease Area, including moon snails (Naticidae), nassa snails (*Ilyanassa* [=*Nassarius*] spp.), and sea stars (*Asterias* spp.) were not observed along the Offshore Export Cable Route.

3.2 Benthic Grab Sampling

The benthic grab samples provided information about taxa richness, density and community composition along the Offshore Export Cable Route in waters offshore of MD and DE (Table B).

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

Statistic	Value
Number of Samples	14
Mean Density per Square Meter (±1 SD)	813 ± 1241
Mean Taxa Richness (±1 SD)	8 ± 5.48
Total Number of Taxa	73
Number of Taxa Observed by Taxonomic Group	
Polychaete worms	26
Crustaceans	26
Mollusks	12
Oligochaete worms	3
Other	6
Percent of Total Abundance by Taxonomic Group	
Polychaete worms	10.5%
Crustaceans	6.7%
Mollusks	15.2%
Oligochaete worms	0.8%
Other	66.9%

3.2.1 Taxa Richness

Overall, 73 species of benthic fauna were observed in the fourteen grab samples analyzed (Appendix A). Taxa richness per sample ranged from two to 22, and mean taxa richness was 8.0 per site (Tables B and Table C).

Table C. Taxa Richness by Sample Site

Taxon	Taxa Richness													
	BG-A-02	BG-A-04	BG-A-05	BG-A-06	BG-A-07	BG-A-09	BG-A-11	BG-A-13	BG-A-15	BG-A-16	BG-A-17	BG-A-19	BG-A-21	BG-A-23
Polychaeta	2	4	7	7	6	5	1	1	1	1	1	0	1	2
Crustacea	0	0	2	7	2	2	1	2	2	7	1	1	1	7
Mollusca	0	1	0	4	3	4	1	0	1	0	1	1	1	0
Oligochaeta	0	1	0	2	1	0	0	0	0	0	1	0	0	0
Other	1	2	2	2	2	1	2	0	0	1	2	0	1	0
Total	**3**	**8**	**11**	**22**	**14**	**12**	**5**	**3**	**4**	**9**	**6**	**2**	**4**	**9**

3.2.2 Macrofaunal Density

The mean macrofaunal density for the analyzed samples was 813 individuals/m^2 (Table B). The highest macrofaunal density (4,394 individuals/m^2) was found at BG-A-02, while macrofaunal density was lowest (30 individuals/m^2) at BG-A-19 (Table D). Of the fourteen samples analyzed, five were characterized by densities of 900 individuals/m^2 or more.

Table D. Macrofaunal Density by Sample Site

Taxon	Macrofaunal Density													
	BG-A-02	**BG-A-04**	**BG-A-05**	**BG-A-06**	**BG-A-07**	**BG-A-09**	**BG-A-11**	**BG-A-13**	**BG-A-15**	**BG-A-16**	**BG-A-17**	**BG-A-19**	**BG-A-21**	**BG-A-23**
Polychaeta	179	238	218	198	188	60	10	10	20	10	10	0	20	30
Crustacea	0	0	40	208	69	20	10	30	20	159	30	10	20	149
Mollusca	0	10	0	913	60	675	10	0	10	0	10	20	20	0
Oligochaeta	0	20	0	40	10	0	0	0	0	0	20	0	0	0
Other	4,216	2,172	645	69	20	179	89	0	0	169	30	0	30	0
Total	4,394	2,440	903	1,428	347	932	119	40	50	337	99	30	89	179

3.2.3 Community Composition

The benthic macrofaunal assemblage documented in the analyzed samples consisted of polychaete worms, nematode round worms, crustaceans, mollusks, oligochaete worms, nemertean ribbon worms, sea cucumbers, sea stars, and sand dollars, and lancelets (Amphioxiformes) (Appendix A).

The most speciose taxonomic groups were polychaete worms and crustaceans, which each contributed 36% of the taxa documented in the analyzed samples. Other, a grouping which includes nematode roundworms, nemertean ribbon worms, and echinoderms, was the taxonomic group with the highest density, followed by mollusks and crustaceans (Table B).

The most abundant taxon was nematode roundworms, which accounted for over 66% of all individuals identified in this study. The common slipper shell *Crepidula fornicata*, and the syllid polychaete *Exogone sp.* were the next most abundant taxa, and together accounted for over 15% of individuals (Table E).

Most of the taxa observed in the grab samples are typical of soft-sediment habitats. Nematodes, which were vary abundant, are meiofaunal organisms that dwell in the spaces between sediment grains. Other common species, including *Mediomastus ambiseta, Diopatra cuprea*, and *Unciola* sp. build tubes in sediments (Dobbs and Vozarik 1983, Weiss 1995, Bousfield 1973).

No taxa indicative of sensitive habitats were observed in the benthic grab samples. Soft-shell clams (*Mya sp.*) were observed at only one site, BG-A-21.

Table E. Relative Abundance of Taxa Encountered*

Scientific Name	Common Name	Relative Abundance (%)
Nematoda	Nematode Roundworm	66
Crepidula fornicata	Common Slipper Shell	12
Exogone sp.	Syllid Polychaete	3
Mediomastus ambiseta	Capitellid Polychaete	2
Diopatra cuprea	Decorator Worm	2
Unciola sp.	Aorid Amphipod	1
Scoletoma sp.	Lumbrinerid Worm	1
Crepidula plana	Eastern White Slippersnail	1

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

The most widespread taxa (i.e., observed in the most samples) were nematode roundworms, and the decorator worm *Diopatra cuprea*, which were observed in at least five samples (Table F). Other relatively widely distributed taxa included aorid amphipods, common slipper shells, syllid and capitellid polychaetes, Atlantic jackknife clams, oligochaete worms, and various amphipods (all found in at least three samples).

Table F. Most Widespread Taxa Encountered*

Scientific Name	Common Name	Number of Samples Containing this Taxon
Nematoda	Nematode Roundworm	9
Diopatra cuprea	Decorator Worm	5
Unciola sp.	Aorid Amphipod	4
Crepidula fornicata	Common Slipper Shell	4

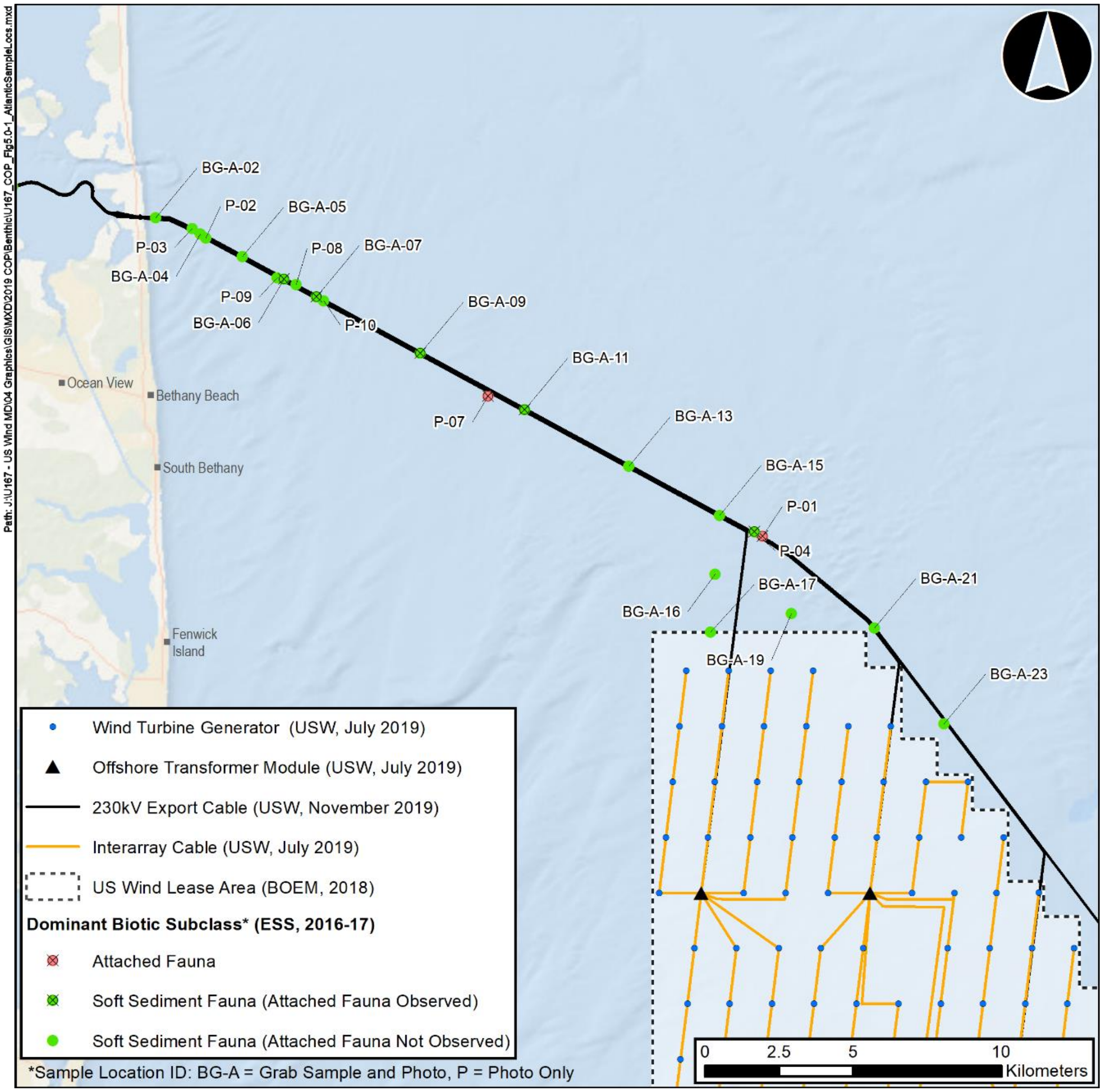

Figure 1. Offshore Export Cable Benthic Samples CMECS Biotic Subclass Classification and Attached Organism Presence

Table G. CMECS Classification of Benthic Sample Sites Along the Offshore Export Cable Route

CMECS Level		Classification
Biogeographic Setting	Realm	Temperate North Atlantic
	Province	Cold Temperate Northwest Atlantic
	Ecoregion	Virginian
Aquatic Setting	System	Marine
	Subsystem	Nearshore
	Tidal Zone	Subtidal
Water Column Component	Water Column Layer	Marine Nearshore Lower Water Column
	Salinity Regime	Euhaline Water
	Temperature Regime	Moderate Water (Seasonal Variation from Cold to Warm)
Geoform Component	Tectonic Setting	Passive Continental Margin
	Physiographic Setting	Continental Shelf
	Geoform Origin	Geologic
Substrate Component	Substrate Origin	Geologic Substrate
	Substrate Class	Unconsolidated Mineral Substrate
	Substrate Subclass	Fine Unconsolidated Substrate, Coarse Unconsolidated Substrate
	Substrate Group	Sand, Gravel, Mud
	Substrate Subgroup	Coarse Sand, Fine Sand, Medium Sand, Pebble, Silty Clay, Cobble
Biotic Component	Biotic Setting	Benthic Biota
	Biotic Class	Faunal Bed
	Biotic Subclass	Soft Sediment Fauna, Attached Fauna

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

5.0 SUMMARY

A benthic field survey was completed to collect supplemental site-specific data along the Offshore Export Cable Route through offshore MD and DE waters for the Maryland Offshore Wind Energy Project. Twenty-three locations along the Offshore 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 in the Offshore Export Cable Route in the waters offshore of MD and DE under CMECS.

Benthic imagery documented variable seafloor habitats including sandy areas dominated by sand dollars (Clypeasteroidea), and gravel beds occupied by slipper shells (*Crepidula sp*.), hermit crabs (*Pagurus sp*.), and decorator worms (*Diopatra sp*.). Various mobile organisms, including sculpin, shrimp, and a left-eyed flatfish were observed in images but not in benthic grab samples. Rocky bottom areas were inhabited by different taxa than were observed in images of benthic grab locations. These organisms included whip coral (*Leptogorgia sp*.), stony coral (*Astrangia sp*.), cancer crabs, bushy bryozoans, and colonial ascidians.

Seventy-three marine invertebrate taxa, including nematode round worms, polychaetes, slipper shells, bivalves, gastropods, amphipods, isopods, cumacean shrimp, crabs, oligochaete worms, sand dollars, sea stars, sea cucumbers, nemertean ribbon worms, and lancelets, were observed in the fourteen samples analyzed for this project. Mean macroinvertebrate density was 813 organisms/m^2, and taxa richness averaged 8.0 per site, with samples containing between two and 22 taxa. The benthic community observed in the analyzed samples was dominated by nematode roundworms, which accounted for 67% of all organisms. When this group was excluded, mollusks (slipper shells, bivalves, and gastropods) and polychaetes were dominant, constituting 45% and 31% of all non-nematode organisms. The most abundant non-nematode organism was the common slipper shell *Crepidula fornicata*, which accounted for 12% of all individuals. The most widely distributed taxa were nematodes and decorator worms (*Diopatra cuprea)*, which were observed in nine and five samples, respectively. Polychaetes and crustaceans were the most taxonomically diverse groups, each accounting for over 35% of all documented taxa.

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Appendix A

Benthic Sample Taxonomy and Enumeration Results

	Organisms/m^2													
	BG-A-02	BG-A-04	BG-A-05	BG-A-06	BG-A-07	BG-A-09	BG-A-11	BG-A-13	BG-A-15	BG-A-16	BG-A-17	BG-A-19	BG-A-21	BG-A-23
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	0.101	0.101	0.101	0.101	0.101	0.101
Taxa														
Crustacea														
Ampelisca sp.				9.9										
Ampeliscidae										9.9				
Amphipoda				39.7	19.8	9.9								
Batea sp.				79.4										
Byblis serrata														39.7
Cancer irroratus						9.9								
Crustacea									9.9					
Cumacea							9.9							9.9
Diastylis sp.														9.9
Dissodactylus mellitae										19.8				
Edotia montosa										9.9				29.8
Ericthonius sp.				9.9										
Euceramus praelongus			9.9											
Gammaridea														29.8
Hippomedon serratus														9.9
Leptocuma sp.										9.9				
Leptognathia caeca												9.9	19.8	
Libinia emarginata				19.8										
Lysianopsis sp.				9.9										
Pagurus sp.									9.9					

	Organisms/m^2													
	BG-A-02	BG-A-04	BG-A-05	BG-A-06	BG-A-07	BG-A-09	BG-A-11	BG-A-13	BG-A-15	BG-A-16	BG-A-17	BG-A-19	BG-A-21	BG-A-23
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	0.101	0.101	0.101	0.101	0.101	0.101
Taxa														
Politolana polita								9.9						
Protohaustorius sp.										9.9				
Pseudunciola obliquua										89.3				
Rhepoxynius epistomus										9.9				
Trichophoxus sp.				39.7										19.8
Unciola sp.			29.8		49.6			19.8			29.8			
Mollusca														
Anadara transversa					19.8									
Astarte sp.									9.9					
Boonea seminuda				69.4										
Crenella sp.												19.8		
Crepidula fornicata				813.4	29.8	515.8	9.9							
Crepidula plana						119.0								
Ensis directus					9.9	9.9					9.9			
Mya sp.													19.8	
Mytilus edulis						29.8								
Nucula sp.				9.9										
Solen viridis		9.9												
Tellina sp.				19.8										
Other														
Amphioxiformes		9.9												

	Organisms/m^2													
	BG-A-02	BG-A-04	BG-A-05	BG-A-06	BG-A-07	BG-A-09	BG-A-11	BG-A-13	BG-A-15	BG-A-16	BG-A-17	BG-A-19	BG-A-21	BG-A-23
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	0.101	0.101	0.101	0.101	0.101	0.101
Taxa														
Nematoda	4215.9	2162.5	634.9	49.6		178.6	79.4			168.6	19.8		29.8	
Nemertea					9.9						9.9			
Asterias sp.					9.9									
Cucumaria pulcherrima			9.9	19.8										
Echinarachnius parma							9.9							
Oligochaeta														
Enchytraeidae				19.8										
Oligochaeta				19.8										
Tubificinae		19.8			9.9						19.8			
Polychaeta														
Aglaophamus circinata										9.9				
Ampharetidae						19.8								
Brania sp.		9.9												
Capitellidae					9.9									
Ceratonereis sp.				9.9										
Diopatra cuprea		9.9	9.9	69.4	89.3	9.9								
Exogone sp.		208.3	49.6	69.4	39.7									
Glycera americana						9.9								
Glycinde solitaria					9.9									
Levinsenia gracilis				9.9										
Lumbrineridae					9.9									

	Organisms/m^2													
	BG-A-02	BG-A-04	BG-A-05	BG-A-06	BG-A-07	BG-A-09	BG-A-11	BG-A-13	BG-A-15	BG-A-16	BG-A-17	BG-A-19	BG-A-21	BG-A-23
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	0.101	0.101	0.101	0.101	0.101	0.101
Taxa														
Lumbrineris sp.			9.9											
Lumbrineris fragilis				9.9										
Mediomastus ambiseta	168.6		9.9			9.9							19.8	
Micronephthys minuta														9.9
Neoleanira tetragona				19.8										19.8
Nephtys bucera	9.9													
Nephtys picta		9.9												
Nereididae					29.8									
Pherusa sp.						9.9								
Pilargidae											9.9			
Scoletoma sp.			109.1						19.8					
Scoletoma tenuis			19.8											
Sigalion arenicola								9.9						
Syllidae			9.9											
Travisia parva				9.9			9.9							
Total Density	**4394**	**2440**	**903**	**1428**	**347**	**932**	**119**	**40**	**50**	**337**	**99**	**30**	**89**	**179**
Taxa Richness	**3**	**8**	**11**	**22**	**14**	**12**	**5**	**3**	**4**	**9**	**6**	**2**	**4**	**9**