OCS Study
BOEM 2019-019

Benthic Monitoring During Wind Turbine Installation and Operation at the Block Island Wind Farm, Rhode Island – Year 2


US Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs

OCS Study
BOEM 2019-019

Benthic Monitoring During Wind Turbine Installation and Operation at the Block Island Wind Farm, Rhode Island – Year 2

21 March 2019

Authors:
Monique LaFrance Bartley
Paul English
John W. King
Anwar A. Khan

Prepared under BOEM Award
Contract No. M15PC00002,
Task Order No. M16PD00025
By
HDR
9781 S. Meridian Boulevard, Suite 400
Englewood, CO 80112

US Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs

DISCLAIMER

This report was prepared under contract between the Bureau of Ocean Energy Management (BOEM) and HDR. This report has been technically reviewed by BOEM and has been approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of BOEM, nor does mention of trade names or commercial products constitute endorsement or recommendations for use. It is, however, exempt from review and in compliance with BOEM editorial standards.

REPORT AVAILABILITY

The report may be downloaded from the www.boem.gov website through the Environmental Studies Program Information System. It can also be obtained from BOEM or the National Technical Information Service by writing to the following addresses:

U.S. Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs
45600 Woodland Road
Sterling, Virginia 20166

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161
Phone: (703) 605-6040
Fax: (703) 605-6900
Email: bookstore@ntis.gov

CITATION

HDR. 2019. Benthic Monitoring during Wind Turbine Installation and Operation at the Block Island Wind Farm, Rhode Island – Year 2. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2019-019. 318 pp.

ABOUT THE COVER

Cover photo: Installation of turbine structures (left) and collecting sediment samples (right) at the Block Island Wind Farm Facility. Courtesy of the HDR RODEO Team. Used with permission.

ACKNOWLEDGMENTS

The HDR RODEO Team includes the following subcontractors:

- FUGRO Marine GeoServices, Inc.
- Fugro GB Marine Ltd.
- Subacoustech Environmental
- Clark Group, LLC
- Loughine Limited
- Dr. Arthur Popper
- H.T. Harvey & Associates
- EA Engineering Science & Technology

Additional technical support is also provided by the University of Rhode Island, Marine Acoustics, Inc., Woods Hole Oceanographic Institution, and Blue Land Media. Vessel services for visual monitoring were provided by Hula Charters.

Assistance and support from all team members is greatly appreciated.

Contents

List of Figures

List of Tables

List of Abbreviations and Acronyms

BIWF	Block Island Wind Farm
BOEM	Bureau of Ocean Energy Management
CMECS	Coastal and Marine Ecological Classification Standard
FGDC	Federal Geographic Data Committee
m	meter(s)
OC	organic content
OSAMP	Ocean Special Area Management Plan
OWF	offshore wind farm
QC	quality control
RODEO	Real-Time Opportunity for Development Environmental Observations
TOC	total organic carbon
UTM	Universal Transverse Mercator projection
U.S.	United States

Editorial Notes

- All coordinates used in this report are referenced to WGS84 UTM Zone 19 North unless stated otherwise.
- Current direction is the direction towards which the current is flowing.
- All times are in Coordinated Universal Time unless stated otherwise.

Executive Summary

Key observations, data, findings, and results from two years of benthic monitoring conducted in and around the Block Island Wind Farm (BIWF) Project Area are presented in this report. Year 1 monitoring was initiated soon after the wind farm became operational in December 2016; Year 2 monitoring (this study) was conducted over two consecutive days (November 30 and December 1) in late 2017. Significant observations, data, findings, and results from Year 1 monitoring were previously presented in a separate report (HDR 2017); and they are summarized in this Year 2 report to provide a comparative benchmark for the 2017 monitoring results.

The primary objective of the benthic monitoring within the BIWF Project Area is to gather real-time data on benthic ecological impacts during the installation and initial operations of the wind turbine generators and provides additional information necessary for the Bureau of Ocean Energy Management's (BOEM's) evaluation of environmental effects of future facilities, improve the accuracy of models and establish monitoring references and mitigations.

The BIWF is a five-turbine, 30-megawatt facility located 4.5 kilometers from Block Island, Rhode Island, in the Atlantic Ocean. Turbines are fixed to the seafloor by steel jacket (lattice) structure foundation types. It is the nation's first commercial offshore wind farm is supplying power to Block Island, with excess power being transmitted to mainland Rhode Island.

Three turbine foundation locations were selected for sampling based on their representativeness of the biotopes present in the study area. Triplicate, clustered seabed samples were collected using a quantitative grab at distances of between 30 m and 90 m from the center point of each foundation, and at control stations, to determine the presence of any gradient effects and modified physico-chemical and biological conditions over and above natural variations. Video and photographic stills provided complementary information on seabed substrate types, bedforms and larger epibenthos. This included use of a Lagrangian floating remote digital stills camera designed to capture still images at a rapid rate, allowing for a continuous series of overlapping seabed images of the seabed that can then be mosaicked. This comprehensive set of images and mosaics provided contextual information of the geological environments, as well as conspicuous epibenthic species present throughout the camera deployment.

The observations in Year 1 were used to refine and optimize the sampling strategy in Year 2. This included collection of additional diver video and sediment sampling from directly below and within the lattice framework of each of the three BIWF jacket structure foundations in Year 2 so that the presence of close-range effects could be assessed.

During each monitoring occasion, the sampling strategy and detailed statistical analyses were designed to test the following hypothesis:

- H0 1 – There will be no difference in benthic communities among turbine areas.
- H0 2 – There will be no difference in benthic communities between control areas and turbine areas.
- H0 3 – There is no impact on distance from the wind farm foundation regarding organic enrichment or benthic communities.

Sample data collected over the two years of monitoring were generally indicative of a heterogeneous seabed dominated by mixed coarse and medium grade sand, gravel and cobble sediments reflecting previous accounts of re-worked glacial moraine deposits within the region. A continuum of increasing levels of medium sand and decreasing levels of coarse and very coarse sand from west (Turbine 5) to east (Turbine 1) was apparent. Sediments were characterized by polychaetes and nematodes in coarse sediments in both years. The triplicate cluster sampling demonstrated fine scale species heterogeneity (i.e., across tens of meters), most likely attributable to the natural patchiness of the seabed sediment types in the Block Island area. Analysis of the data supported the need to continue to employ cluster sampling to account for this fine-scale spatial variability and complex structure of benthic macrofaunal communities. Combined, the cluster samples provide a more comprehensive and statistically robust understanding of the sample stations and the study areas.

Biotopes classified for the study area during the period of monitoring were comparable with those previously mapped across the region and reported within the literature prior to construction of the BIWF, suggesting no gross changes. Specifically, biotopes exhibited complex topography containing mixed coarse sediments and supported a typical coarse sand macrofauna including a diverse assemblage of polychaetes, nematodes, amphipods, and bivalves.

Key findings from the monitoring to date are as follows;

- There have been no significant modifications in physico-chemical conditions within the range of 30 to 90 meters from the center of the foundations two years after installation. Significant differences in benthic communities at these distances were attributed to differences in the abundance of characterizing species between turbines and control areas, and between sampling occasions, otherwise species composition was broadly comparable. In these respects H01 and H02 were accepted.
- There have been no significant differences in benthic communities or total organic carbon levels in sediments close to turbine foundations compared to those farther away (H03) or with respect to control conditions. On this basis, it was concluded that seabed modification had not occurred at ranges of 30 meters or more from the center of the foundations within 2 years of installation at BIWF. Levels of sediment TOC at these ranges were low and below those indicative of a potential risk to benthic communities.
- Significant seabed modification has occurred directly below and within the lattice framework of the foundation of Turbine 1. This area was characterized by extremely dense mussels that covered the entire surface of the seafloor, locally finer-grained sediment and the presence of black, potentially anoxic sediment layers. Species richness and abundance values were significantly lower below Turbine 1 compared to sediments elsewhere and levels of sediment TOC suggested that macrofauna were at moderate to high risk of potential adverse effects. Diver sampling below and within the footprints of Turbines 3 and 5 did not find these conditions and records suggested natural conditions here.
- The reasons why these alterations only occurred at Turbine 1 are unclear at present. Similarly, it remains unclear whether this is a seasonal feature. Further monitoring may help clarify the temporal characteristics of the observed benthic alterations at Turbine 1 and will identify any expansion of modified seabed conditions across the study area.
- The results from this study are valuable in improving the understanding of changes to macrofaunal and sediment characteristics resulting from wind facility construction and initial operations in the New England region over short time scales (e.g., < 1 to 2 years). For the area surrounding the turbine foundations, this study has recognized that changes are not likely to take place within two years. Within the footprint of turbine foundations, however, the degree of change can vary. At the BIWF, change is occurring along a geospatial gradient, ranging from minimal changes (i.e., comparatively the same as outside the turbine footprint) to transitioning to a habitat with entirely different characteristics than previously existed. This transformed habitat is characterized by dense mussels, high organic content, and fine sediment. It is anticipated this transition will occur within the footprint of all the turbine structures over time, and potentially expand to the nearby surrounding area. The potential for highly site-specific benthic alterations to occur within wind farm sites, as shown in this study, should be considered in the planning of compliance monitoring programs for future commercial scale offshore wind facilities on the U.S. continental shelf.

The results and findings from this study could serve as the basis for extrapolation to larger wind facilities and will provide useful information on the effects of jacket type foundations which are generally unrepresented in European studies. Additional offshore wind facilities are planned for the U.S. east coast and a sound knowledge of associated influences on benthic communities will be vital for accurate assessment. Observations of effects at the local level can be used to inform future predictions of potential wider scale and cumulative effects associated with larger, and multiple, offshore wind facilities.

The benthic monitoring results presented in this report are from field data collection and laboratory analyses conducted for BOEM by the HDR RODEO Team under Contract M15PC00002, Task Orders M16PD00025 (Task 2.4.3 – Benthic Monitoring) and M17PD00015 (Task 2.4.2 – Benthic Monitoring).

1 Introduction

This report presents key observations, data, findings, and results from the *second* year of benthic monitoring conducted in and around the Block Island Wind Farm (BIWF) Project Area (**Figure 1**). Year 1 monitoring was initiated soon after the wind farm became operational in December 2016. Year 2 monitoring was conducted over two consecutive days (November 30 and December 1) in late 2017. Key observations, data, findings, and results from Year 1 monitoring were previously presented in a separate report (HDR 2017); and they are summarized in this Year 2 report to provide a comparative benchmark for the 2017 monitoring results.

The BIWF is a commercial offshore wind farm in the United States, and it is located 4.5 kilometers from Block Island, Rhode Island, in the Atlantic Ocean. The five-turbine, 30-megawatt facility is owned and operated by Deepwater Wind Block Island, LLC. Power from the turbines is transmitted to the electric grid via a 34-kilometer transmission submarine power cable buried under the ocean floor, making landfall north of Scarborough Beach in Narragansett. The facility primarily supplies power to Block Island, with excess power being transmitted to mainland Rhode Island.

BIWF construction began in July 2015 and was completed in a phased manner by the end of November 2016. During Phase I, five steel jacket foundations were installed from July 26 to October 26, 2015. Phase II was initiated in January 2016 and it included installation of the turbines on the foundations and laying of the submarine power transmission cables. Operational testing of the facility was conducted from August through November 2016 and the initial operations commenced on December 2, 2016. Benthic data were collected over two sampling periods, referred to as “Year 1” and “Year 2.” Year 1 data were collected between December 2016 and August 2017. Year 2 data were collected between November 2017 and June 2018. Data collected in both years include grab samples, seabed video, and still imagery.

Each of the five turbines at the Block Island Wind Farm consists of a 6-megawatt GE Haliade 150 three-bladed turbine with a rotor diameter of 150 meters (m) and mounted to a piled steel jacket foundation. The hub height is 100 m and the overall turbine height is 150 m. The total weight for each turbine, including jackets, decks and piles, is 1,500 tons. It is noted that only 5 percent of offshore wind foundations installed in Europe are jacket structures. Consequently, monitoring data for these foundation types and impacts on benthic ecology are minimal. Therefore, this study contributes to filling knowledge gaps about the effects of offshore renewables and, in particular, the specific construction and operational effects of jacket structures on seabed sediment communities.

The monitoring reported in this document was conducted under the United States (U.S.) Department of the Interior’s Bureau of Ocean Energy Management’s Real-Time Opportunity for Development Environmental Observations (RODEO) Program. The purpose of this program is to make direct, real-time measurements of the nature, intensity, and duration of potential stressors during the construction and/or initial operations of selected proposed offshore wind facilities. The purpose also includes recording direct observations during the testing of different types of equipment that may be used during future offshore development to measure or monitor activities and their impact-producing factors.

Data collected under the RODEO Program may be used as input to analyses or models that are used to evaluate effects or impacts from future offshore activities. This program is not intended to duplicate or substitute for any monitoring that may otherwise be required to be conducted by the developers of the proposed projects. Also, RODEO Program monitoring is coordinated with the industry and is not intended to interfere with or result in delay of industry activities.

The BIWF is the first facility to be monitored under the RODEO Program. **Table 1** identifies the types of field data collected under the RODEO Program during construction and/or initial operations of this facility.

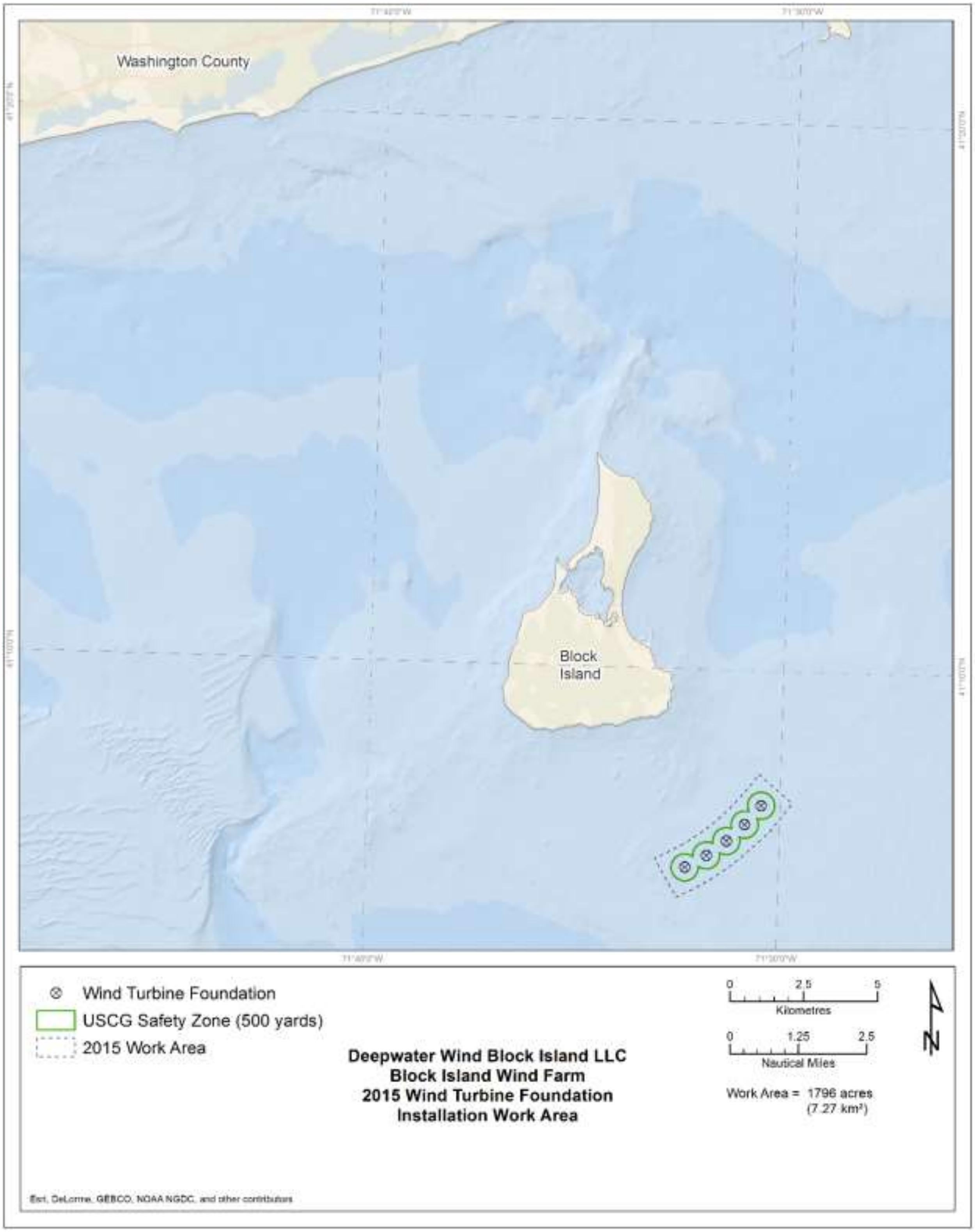


Figure 1. Block Island Wind Farm (BIWF) Work Area.

Table 1. RODEO Program Monitoring conducted at the BIWF.

Phase	Construction Activity	Dates	Monitoring Surveys	Comment
Construction Phase 1	• Steel jacket foundations were installed on the seabed using two different types of hammers. Piles were installed with a 13.27° rake from the vertical.	July 26, 2015 – October 26, 2015	• Visual observations and documentation of the construction activities. • Airborne noise monitoring associated with the pile driving. • Underwater sound monitoring associated with the pile driving. • Seafloor sediment disturbance and recovery monitoring through bathymetry surveys conducted immediately after construction was completed and in approximately 3-month intervals for a year. • Turbine platform scour monitoring through installation of two scour monitoring devices on selected WTG foundations. • An Acoustic Wave and Current Profiler also was deployed within the project area.	See report entitled: "*Field Observations During Wind Turbine Foundation Installation*" for additional information.
Construction Phase 2	• Wind turbine generators installed on the steel foundations.	January 2016 – August 18, 2016	• Visual observations and documentation of the cable laying activities and of turbine installation from both on shore and off shore locations. • Airborne noise monitoring.	Included still photography and filming of portions of trenching operations for cable laying.
	• Submarine transmission power cables connecting Block Island and mainland were laid using a jet plowing in the offshore portions and horizontal directional drilling in the near shore area.	June 3, 2016 – June 26, 2016	• Seafloor sediment disturbance monitoring. • Post-construction seafloor recovery through bathymetry surveys.	See report entitled: "*Observing Cable Laying and Particle Settlement During the Construction of the Block Island Wind Farm*" for additional information

Phase	Construction Activity	Dates	Monitoring Surveys	Comment
Initial Operations	• Testing of the newly installed turbines. • Testing of the submarine transmission power cables.	August 29, 2016 – November 2016 Wind Farm operation began on December12, 2016	• Visual observations of the operational wind farm from varied distances on shore and off shore locations. • Airborne noise monitoring. • Underwater sound monitoring. • Seafloor sediment disturbance and recovery monitoring. • Benthic monitoring[2].	See report entitled "*Field Observations During Wind Turbine Installation and Operation*[1]" for additional information.
Operational Phase	• None	December 12, 2016 – ongoing	• Seafloor sediment disturbance and seabed recovery monitoring. • Benthic monitoring. • Turbine foundation epifouling monitoring.	• One round of seabed recovery monitoring was conducted on October 2 and 3, 2017. Results are presented in a standalone report entitled: "*Seafloor Disturbance and Recovery Monitoring Program, Survey 4 October 2017* Fugro 2017. • A second round of seabed recovery monitoring is scheduled to occur during fall 2018. • This document presents results from the Year 2 benthic monitoring conducted on November 30 and December 1, 2017. • A second round of benthic monitoring is scheduled to occur in fall 2018. • One round of turbine foundation epifouling monitoring surveys were conducted in 2018. The samples from this survey are currently being analyzed and the results will be presented in a separate report.

Notes:

[1] This report is currently a work in progress and it will be completed after the results from the various monitoring surveys are compiled and analysed.

[2] A separate standalone report (this document) was prepared to present the findings and results from the benthic monitoring. Key information from the benthic monitoring report will be excerpted and summarized in the main report.

1.1 Study Goals and Objectives

The overall goal of this study is to better understand the nature, as well as the potential spatial and temporal scales, of anticipated alterations in benthic macrofaunal community characteristics caused by the BIWF facility. These characteristics include species abundance, richness, diversity and assemblage structure, along with relationship dynamics between macrofaunal communities and their associated environments. While long-range and large-scale changes in benthic conditions are not expected from the presence of the five turbines, localized alterations to seabed characteristics near the foundations are anticipated and are poorly understood for the BIWF at this time. The time-frame over which any such alterations may occur is similarly unclear for this location. Results and findings from this monitoring could serve as the basis for extrapolation to larger wind facilities in southern New England.

Alterations in benthic conditions may occur because of the presence of the turbine structures, which can modify local hydrodynamic conditions and sediment grain size distribution. The structures also provide substrate for the growth of marine organisms, which may result in localized sediment enrichment due to increases in the deposition of organic detrital material. Based on preliminary studies in Europe, changes in benthic composition due to the operation of the turbines could be anticipated within 50 m of the foundation scour protection systems (Coates et al. 2012) with the possibility of a long-term shift in community composition, which may become spatially extended.

In design of the measurements, the following three hypotheses were tested over the two-year study period:

- H0 1 – There will be no difference in benthic communities among turbine areas.
- H0 2 – There will be no difference in benthic communities between control areas and turbine areas.
- H0 3 – There is no impact on distance from the wind farm foundation regarding organic enrichment or benthic communities.

1.2 Study Challenges

1.2.1 Natural Variation

The data presented in this report represent a snapshot of benthic ecological conditions in and around the BIWF Project Area. They do not characterize natural variations in local communities that may occur, for instance, between seasons or over years, or as a result of storm events. Data from control areas can be used to characterize natural regional fluctuations in benthic communities over time and to compare for operational effects during future assessments.

1.2.2 Sampling Timeframe

In Year 1, macrofaunal samples were collected over three days throughout the winter season (December 20, 2016; January 20, 2017; and March 21, 2017). The delay between sampling days was due to inclement weather. However, the samples being collected over a four-month period is not considered to be problematic in the BIWF study area. This timeframe is considered adequate because the sampling was completed well within the winter season (i.e., conditions were consistent). Moreover, the benthic macrofaunal communities within Rhode Island Sound and Block Island Sound experience minimal natural variation, both seasonally and over longer periods of time (LaFrance et al. 2014, Steimle 1982, Savard 1966, Pratt Pers. Communication). Steimle (1982) specifically examined seasonal variability of benthic macrofauna within Block Island Sound and concluded that “there were not many apparent, clearly defined seasonal changes, comparing the February and September results” and that “natural benthic community fluctuations in the Sound are probably minimal compared to other areas.” Steimle (1982) also notes that most species recovered in his samples (collected in 1976) also were recovered in samples collected in the mid-to-late 1940s in studies by Smith (1950) and Deevey (1952). Further, Savard (1966) suggested the benthic environments within Block Island Sound are stable and may be predictable. More recently, LaFrance et al. (2014) saw minimal evidence of seasonality in benthic samples collected offshore of Block Island between October 2008 and August 2009 as part of the Ocean Special Area Management Plan (OSAMP). Furthermore, the dominant species recovered by LaFrance et al. (2014) were also identified by Steimle (1982), although the abundances at which they were recovered were not compared. This comparability indicates the composition of macrofaunal communities has persisted in this area for over six decades.

Similar to the macrofaunal communities, the geological environments in and around the BIWF study area show patterns of stability over time. Previous data collected within Rhode Island and Block Island Sounds over the past decade have shown only minor changes in geological environments. For example, the geologic features within the side-scan sonar data collected as part of the Ocean Special Area Management Plan (OSAMP) in September 2008 can easily be identified in the side-scan sonar data collected in December of 2016 for this study (**Figure 2**). This environmental stability further suggests the associated benthic macrofaunal communities likely are stable.

Any remaining concerns regarding time between sampling days were abated in Year 2, as all quantitative grab samples were collected in two consecutive days (November 30 and December 1, 2017). The collection of quantitative diver samples from below the turbine foundations in Year 2, as recommended during the Year 1 monitoring, was completed during May and June of 2018. The Year 2 remote video surveillance data were also collected between May and June of 2018.

1.2.3 Sampling coarse seabed deposits

From the literature and previous data collection, it was expected that coarse seabed deposits, including boulders, cobble, and gravel, would be present within the study area. Experience shows that such coarse seabed deposits can be difficult to sample with repeatable quality using grab samplers and may often result in failed samples or samples of various volumes being recovered.

To account for these sampling challenges, a Smith-McIntyre grab sampler was employed, as it is regarded as reliable for use in open sea conditions from small vessels (Eleftheriou 2013). The use of this sampler at all sampling locations meant that the bite area of the device was consistent across all of the samples collected and that the macrofauna, most of which live within the uppermost seabed sediment layers, were adequately represented and comparable across the study area. The grab sampler was re-deployed after any failed attempts until a sample was collected with a volume of 1/8th or greater of the sampler. It was evident that 1/8th was the largest volume recoverable in areas with dense boulder, cobble, and/or gravel concentrations. It was also believed this volume was enough to capture the surficial material of the seafloor within which the benthic biological community resides.

Furthermore, a cluster sampling strategy was used, which consisted of collecting three grab samples at each sample station. These cluster samples are not considered true replicates due to the difficulties of collecting three co-located samples when working in offshore conditions in waters depths averaging 30 m. This sampling strategy allows for more robust statistical analyses of the biological communities, as well as the assessment of small-scale spatial variability.

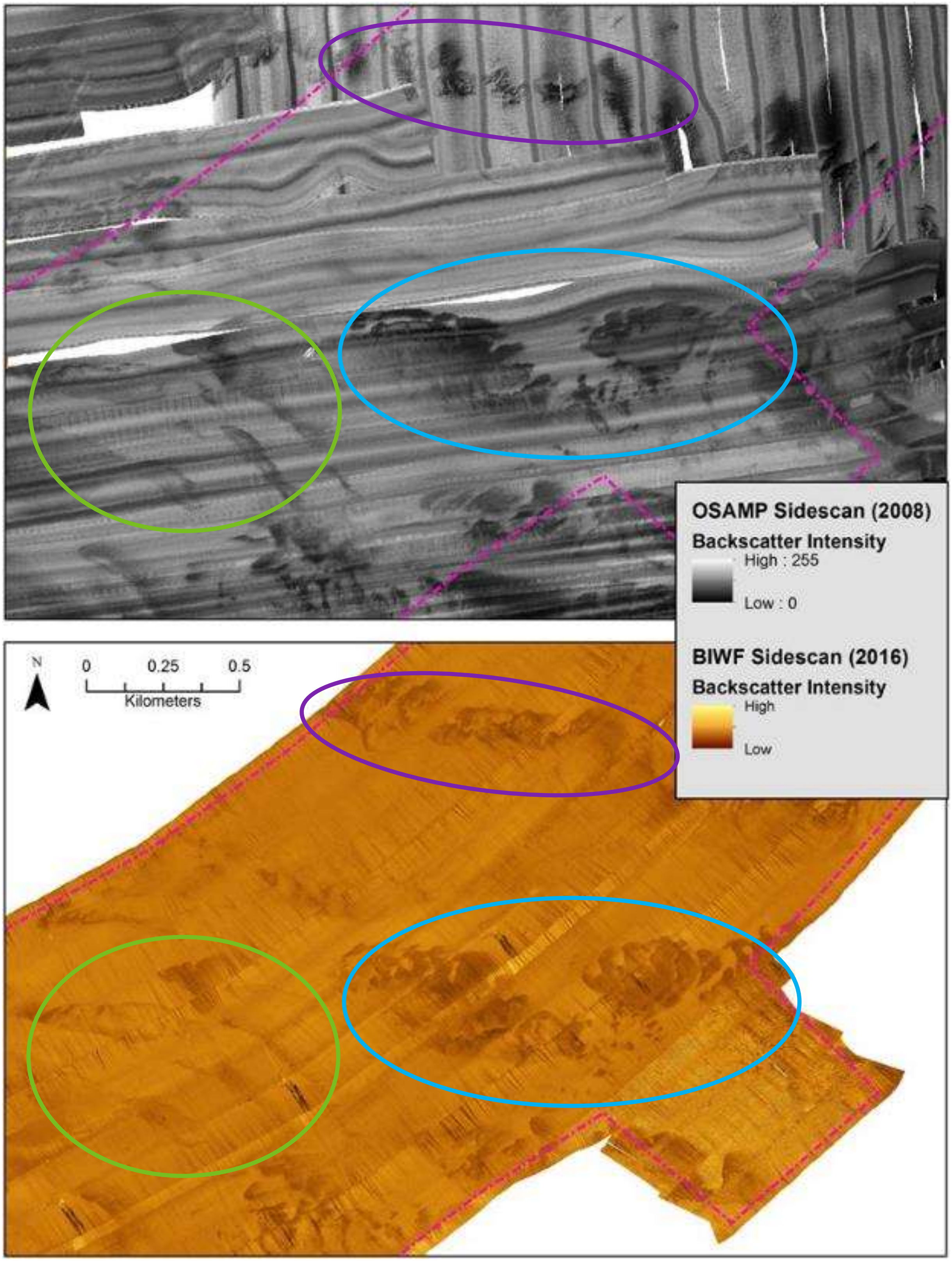


Figure 2. Comparison of 2008 and 2016 side-scan mosaics showing minor changes to geological environment.

Note: Specific examples are highlighted in colored circles, although such similarities are visible throughout the two mosaics.

Examination of species richness and abundance across the three cluster samples at each sample station revealed no consistent relationship with grab volume. More specifically, at some stations, a sample with a lower volume exhibited higher species richness and/or abundance than a sample with a larger volume; whereas at other stations, species richness and abundance increased with volume; and yet, at other stations, cluster samples of the same volume exhibited substantial variations in species richness and abundance. This inconsistency prevented use of a multiplier to standardize the volumes across all the samples in the BIWF study area. As such, samples were analyzed using unadjusted species richness and abundance counts. The inconsistency in sample volume may create bias in interpretation of the data, but this approach was favored over attempting to standardize the samples, which would have knowingly introduced error.

1.3 Study Context

1.3.1 Overview of Physico-chemical and Ecological Conditions within BIWF Region

Marine physico-chemical and ecological conditions for Rhode Island and Block Island Sounds, the wider region surrounding the BIWF development, are described in the Rhode Island OSAMP (CRMC 2010), within which the BIWF is located. Site-specific information is presented in the Block Island Wind Farm and Transmission System Environmental Report (Deepwater Wind 2012) with descriptions of the benthic ecological resources, described through seabed video surveillance, presented in supporting appendices (Normandeau Associates 2012). RPS ASA (2012) described water circulation patterns for the region. Under a parallel BOEM-funded study, which investigated scour around the turbine foundations using installed scour monitors, Fugro, Inc. also deployed an acoustic wave and currents sensor on the seabed at the BIWF site for the measurement of local hydrodynamic conditions. Two scour monitors also were deployed at BIWF turbine 3 to monitor physical changes to the sea floor in the immediate area of the foundation. A brief overview of the findings from these studies is presented below.

Regionally, water depths offshore range between 10 and 55 m. Tides in the region are semidiurnal with a mean range of approximately 1 m. RPS ASA (2012) describes the water circulation in the Block Island Sound and Rhode Island Sound area as predominantly tidally driven and rather complex. Within the wider region, currents on the eastern side of Rhode Island Sound flood to the east into Buzzards Bay and Vineyard Sound, and ebb to the west. Conversely, on the western side of Rhode Island Sound and in Block Island Sound, currents flood to the west, into Long Island Sound and ebb to the east. Here, they split around Block Island and flow almost north-south on either side of Block Island (**Figure 3**).

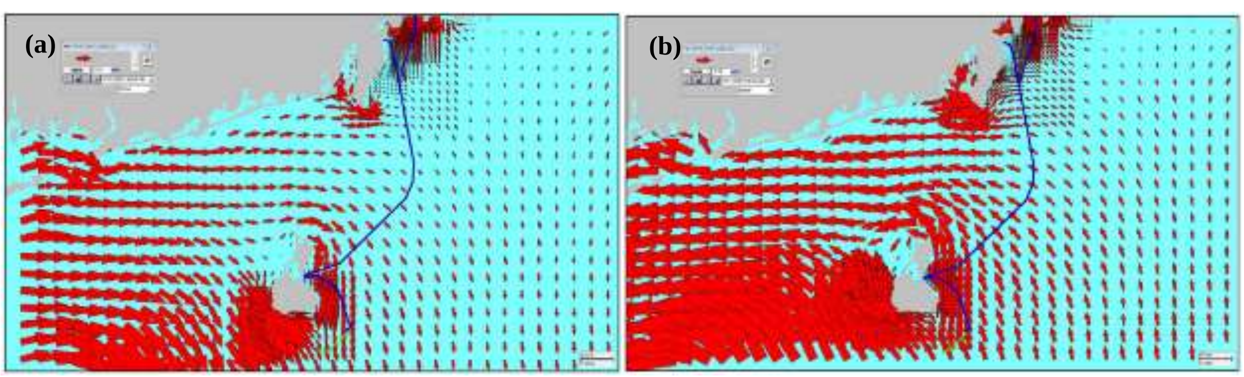


Figure 3. Modelled ebb (a) and flood (b) tidal flow directions within the vicinity of Block Island (taken from RPS ASA (2012).

The description of tidal movements and modelled tidal data from RPS ASA are generally consistent with observations from site specific tidal monitoring conducted using bottom mounted acoustic wave and current sensors at the wind farm site by the HDR Team. This monitoring showed a dominant north-south tidal axis with maximum depth average current speeds up to approximately 0.24 m per second (Fugro 2018).

Review of acoustic data for the wider region reveals a complex seafloor with variable topography comprising a mix of geologic environment types, including sheet sand, sand waves, small dunes, boulder fields, areas of cobble, pebble, and/or gravel, as well as areas of muddy sediment. The geologic environments within the vicinity of the BIWF are primarily characterized by sand of medium, coarse, and/or very coarse grain size.

A review of acoustic survey data coupled with video ground-truthing (Normandeau Associates 2012) identified hard substrate habitats, towards the southwest of the Block Island wind turbines and within an area to the northeast. Video transects across representative seabed areas identified a seabed comprising boulders and cobbles in varying proportions together with medium and coarse sand deposits. Elevation of hard substrate areas did not exceed 0.6 m above the seabed. Sand waves with gravel and shell debris within the wave troughs were also observed from the video footage. Fauna and flora associated with the harder substrate areas included encrusting coralline and erect red algae, together with the encrusting polychaete Spirobidae, Porifera such as *Polymastia* sp., hydroids, and the cnidarian *Urtica felina*. The echinoderms *Henericia sanguinolenta* and *Asterias* sp. were observed on cobbles and boulders. A variety of fish were observed during the site-specific video deployments including cunner (*Tautogolabrus adspersus*), black sea bass (*Centropristis striata*), winter flounder (*Pseudopleuronectes americanus*), windowpane flounder (*Scophthalmus aquosus*), goosefish (*Lophius americanus*), and skate (*Leucoraja* sp.).

Historic benthic sampling has found coarser sand sediments to be characterized by amphipods, *Byblis serrata* and *Haustorius* spp.; polychaetes, *Aricidea* Maldanids, *Nepthys* spp. and Spionids; and dominated by the bivalve, *Nucula* sp. (Steimle 1982). Elsewhere in Block Island Sound, finer grained silty sand sediments persist and support the abundant tube dwelling amphipods *Ampelisca agassizi* and *A. vadorum*, together with the co-dominant bivalve, *Nucula proxima* (Steimle 1982). Correlation analyses support a distribution of macrobenthos based on sediment type, water depth and bottom current strength (CRMC 2010).

1.3.2 Overview of Previous Benthic Habitat Mapping Study within BIWF Region

An extensive benthic habitat mapping study was undertaken as part of the OSAMP (LaFrance et al. 2014 and 2010). As part of this study, full coverage, high resolution side-scan and bathymetry data were collected using interferometric sonar for the area surrounding Block Island to the south and west, which also encompasses the BIWF study area (**Figure 4**). These acoustic datasets were integrated with sediment samples, underwater video, and sub-bottom profiles to interpret geologic depositional environments (**Figure 5**). The sidescan, bathymetry, and geology maps reveal the types and overall complexity of the seafloor environments present within the OSAMP study area.

Geologic depositional environments are defined by a combination of the Quaternary depositional environment, surficial sediment composition, and bedform configuration present within an area. Quaternary depositional environments identified are glacial alluvial fans and moraines. Surficial sediment composition and bedforms represent modern (Late Holocene) processes, and include sheet sand, sand waves, small dunes, boulder fields, as well as areas of cobble, pebble, and/or gravel concentrations. A small portion of the area is composed of fine sediment (i.e., silty sand). Within the BIWF study area itself, the surficial depositional environments are comparatively coarse, characterized by areas of coarse sheet sand, coarse sand with small dunes, coarse sand with pebble and gravel, as well as areas of cobble-gravel concentrations and boulder-gravel concentrations.

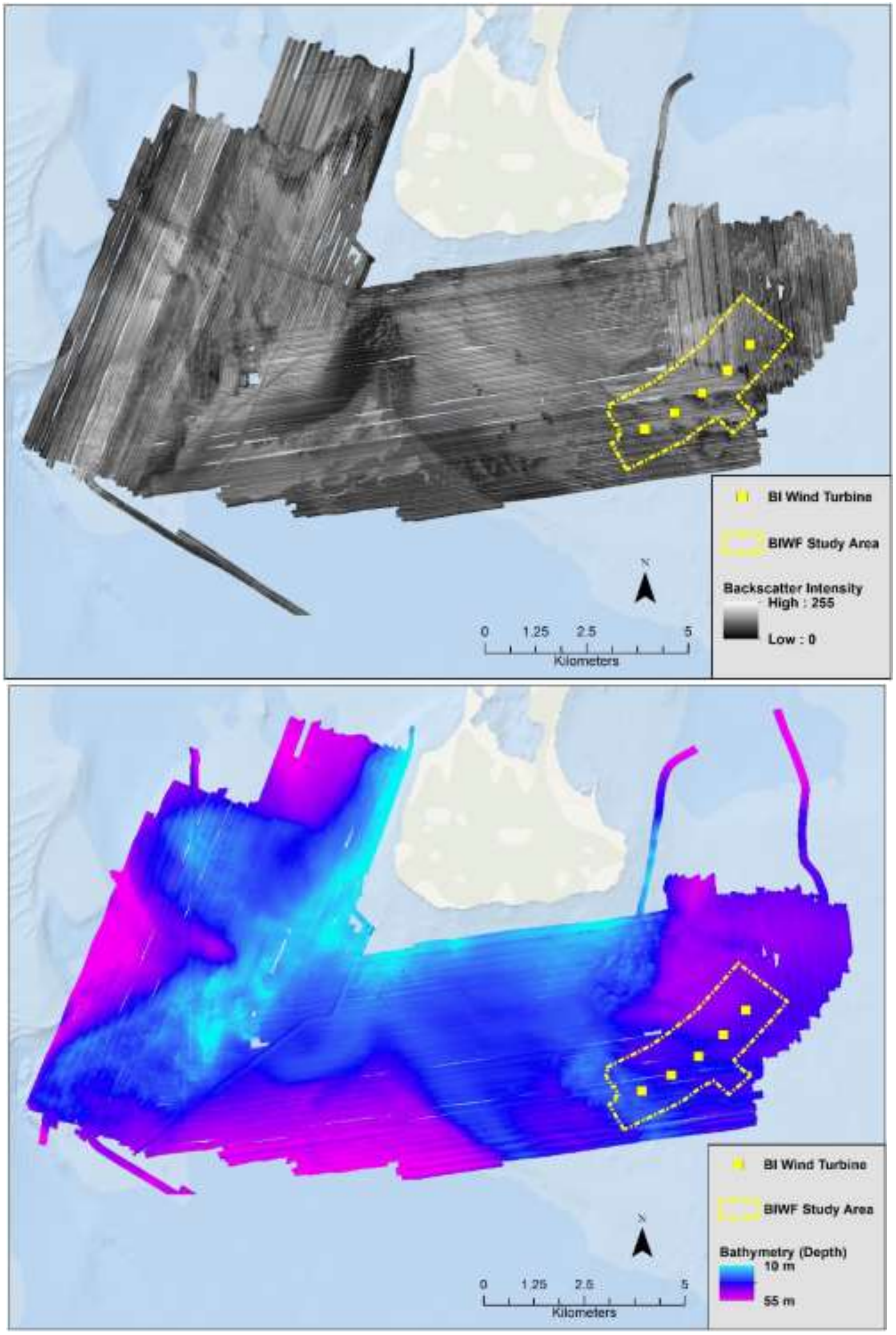


Figure 4. Acoustic datasets (sidescan and bathymetry) collected within the OSAMP study area illustrating the complexity of the area.

Note: The sidescan mosaic is shown at 2 m resolution on an inverse grey scale with pixel values ranging from 0 (black) to 255 (white). Lighter pixels indicate strong acoustic returns and represent hard bottoms, e.g., coarse sand, cobbles, and boulders that tend to reflect sound, whereas darker pixels represent softer sediments, which tend to be acoustically absorbent. The bathymetry (10 m resolution) shows water depths ranging from 10 to 50 m.

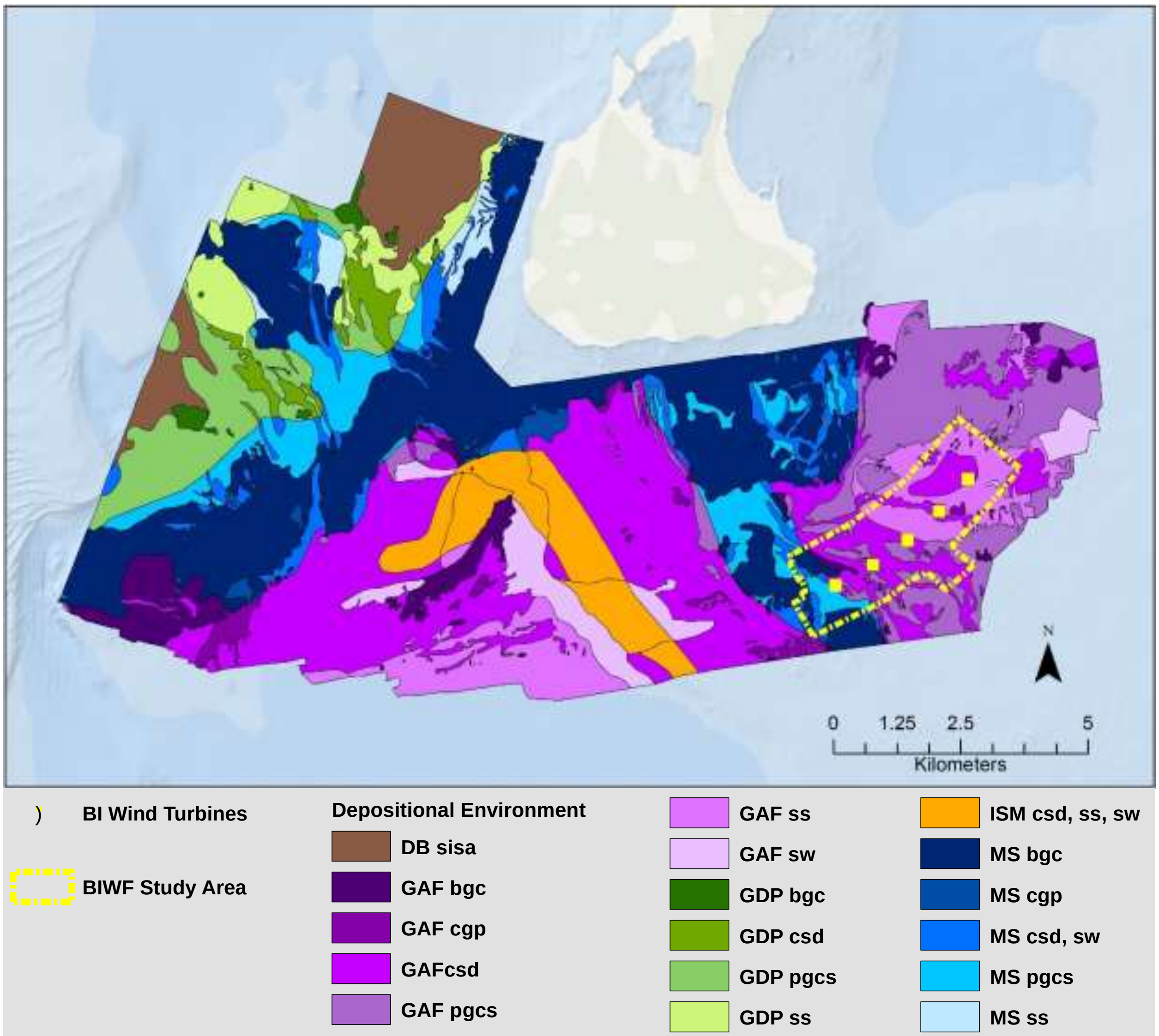


Figure 5. Benthic geologic depositional environments of the OSAMP study area.

Note: The polygons are labeled according to the CMECS Geoform Component Level 1 (capital letters), followed by Level 2 (lowercase letters). For visual emphasis, each general color represents a Geoform Level 1 unit, and shades of the same color represent the Level 2 designation within that Level 1 unit. Abbreviations are as follows: Level 1: DB = Depositional Basin; GAF = Glacial Alluvial Fan; GDP = Glacial Delta Plain; ISM = Inner Shelf Moraine; MS = Moraine Shelf. Level 2: bgc = boulder gravel concentrations; cgp = cobble gravel pavement; csd = coarse sand with small dunes; pgcs = pebble gravel coarse sand; sisa = silty sand; ss = sheet sand; sw = sand waves.

Regarding biological data, a total of 48 benthic grab samples were collected throughout the OSAMP study area using a Smith McIntyre sampler. Recovered macrofauna were enumerated and identified to the species level. The data were examined to gain an understanding of the benthic macrofaunal community structure, particularly species richness and abundance. A series of statistical analyses were then conducted to determine the relationship between the macrofaunal communities and environmental variables. It was found that geological characteristics were primarily responsible for biological-environmental associations and this relationship was used to develop a habitat classification (i.e., biotope) map of the study area (**Figure 6**).

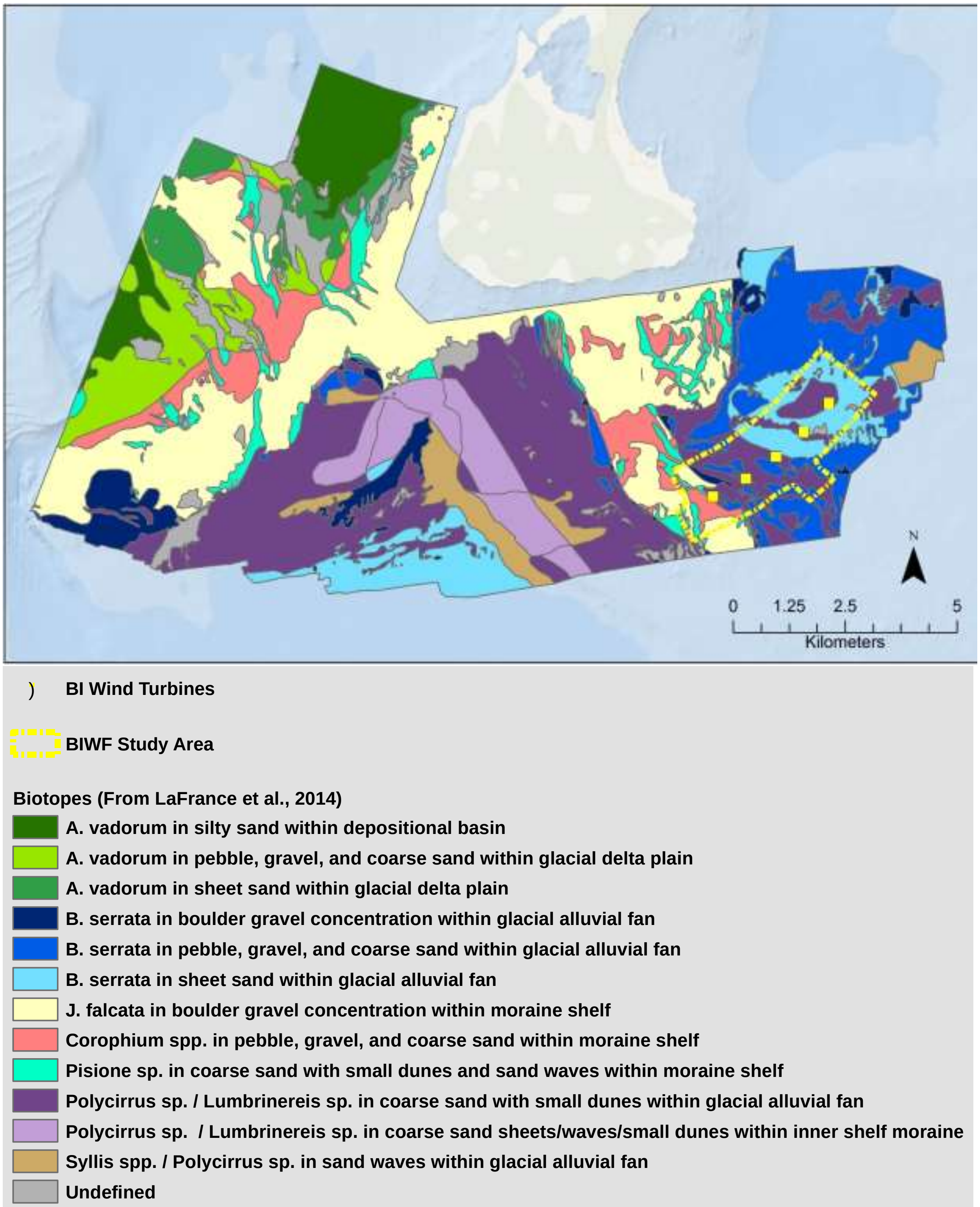


Figure 6. Biotope map of BIWF study area and surrounding area.

Note: Biotope map units are classified according to the Coastal and Marine Ecological Classification Standard (CMECS) and are defined according to the Geoform and Biotic Components, represented by depositional environment type and dominant species, respectively. The color scheme of the biotope map shown here is slightly modified from its original version developed by LaFrance et al. 2014.

The biotopes are defined by the dominant species within the given biotope unit and the associated geologic depositional environment. The map indicates there are twelve distinct biotopes within the OSAMP study area. These biotopes are represented by eight dominant species, of which four are tube-building amphipods and four are polychaete worms (two burrowing, one tube-building, and one mobile) (**Table 2**).

Table 2. List of biotope-defining species within the OSAMP study area.

Species	Phylum	Common Group	Functional Designation
Ampelisca vadorum	Arthropoda	Amphipod	Tube-building
Byblis serrata	Arthropoda	Amphipod	Tube-building
Corophium spp.	Arthropoda	Amphipod	Tube-building
Jassa falcata	Arthropoda	Amphipod	Tube-building
Lumbrineries hebes	Annelida	Polychaete worm	Burrowing; primarily carnivorous
Pisione remota	Annelida	Polychaete worm	Small burrowing; selective deposit feeder
Polycirrus medusa	Annelida	Polychaete worm	Soft tube; selective deposit feeder
Syllis spp.	Annelida	Polychaete worm	Mobile; carnivorous

Note: The functional designation is also provided to describe the ecological role of each species. Species are listed in alphabetical order. (Table adapted from LaFrance et al., 2014).

2 Methods

2.1 Monitoring Survey Design

2.1.1 Turbine Selection

To test the impact hypotheses, samples were collected within pre-determined distance bands around three of the five turbine foundations. The turbines were selected relative to the location of biotopes previously defined by LaFrance et al. (2014). BIWF turbines 1, 3 and 5 were selected for sampling because between them they offer the broadest representation of the biotopes present in the study area (**Figure 7**).

This sampling strategy allows for pre- and post-construction comparisons to be made and is valuable for understanding the responses of macrofaunal communities to potential changes with respect to the BIWF and to natural variation. Furthermore, the data and conclusions drawn from this monitoring study will have maximum utility at future wind farm developments elsewhere within the region and wider U.S. continental shelf where comparable ranges of biotopes exist. In addition, selection of Turbine 3, which hosted the scour monitoring equipment[1], may, in time, allow opportunity for correlations between measured physical seabed changes with observed habitat and biological community effects.

2.1.2 Sampling Strategy

Samples were collected over two sampling periods, referred to as “Year 1” (2016–2017) and “Year 2” (2017–2018). In both years, samples were collected using the same equipment to allow for direct spatial and temporal comparisons. This report compares data derived from the current Year 2 sampling with that collected in Year 1 in efforts to detect any significant temporal differences. In addition, analysis of the Year 2 data follows that of the Year 1 data for the Turbine and control areas to continue to investigate if any significant spatial differences have occurred.

Sample stations were planned at three of the five turbines (T1, T3, and T5) and within three control areas (C1, C2, and C3) (**Figure 7**). A new array of stations was planned within the turbine areas in Year 2, i.e., Year 1 stations were not reoccupied in Year 2. Similarly, entirely new control areas were chosen in Year 2 as one of the control areas (C1) was characterized by coarse sediment and boulders and was thus unrepresentative of the Turbine areas.

Data acquired at each sample station consisted of grab samples for analysis of sediment grain size and macrofaunal community composition, paired with seabed video to provide broader contextual information of the surrounding area. Three grab samples were collected at each station following a cluster sampling strategy. These samples are not considered true replicates due to the difficulties of collecting three co-located samples in offshore conditions in water depths averaging 30 m. The collection of three cluster samples allows for more robust statistical analyses of the biological communities and allows for the degree of small-scale spatial variability present throughout the study areas to be assessed.

Nine sample stations were randomly positioned within each turbine area, resulting in 27 samples per turbine (81 samples total). The turbine areas were modified to exclude any construction-related disturbance features identified in side scan sonar and bathymetry data before samples were positioned. Specifically, the following features were excluded: 1) the locations of the pin piles on the seabed; 2) seabed disturbance from the placement of the spud legs of the jack-up rig; and 3) seabed disturbance from the jetting of trenches of the inter-array cables and the placement of scour protection material over portions of the cable (in the form of concrete mats).

[1] Installed under a concurrent task.

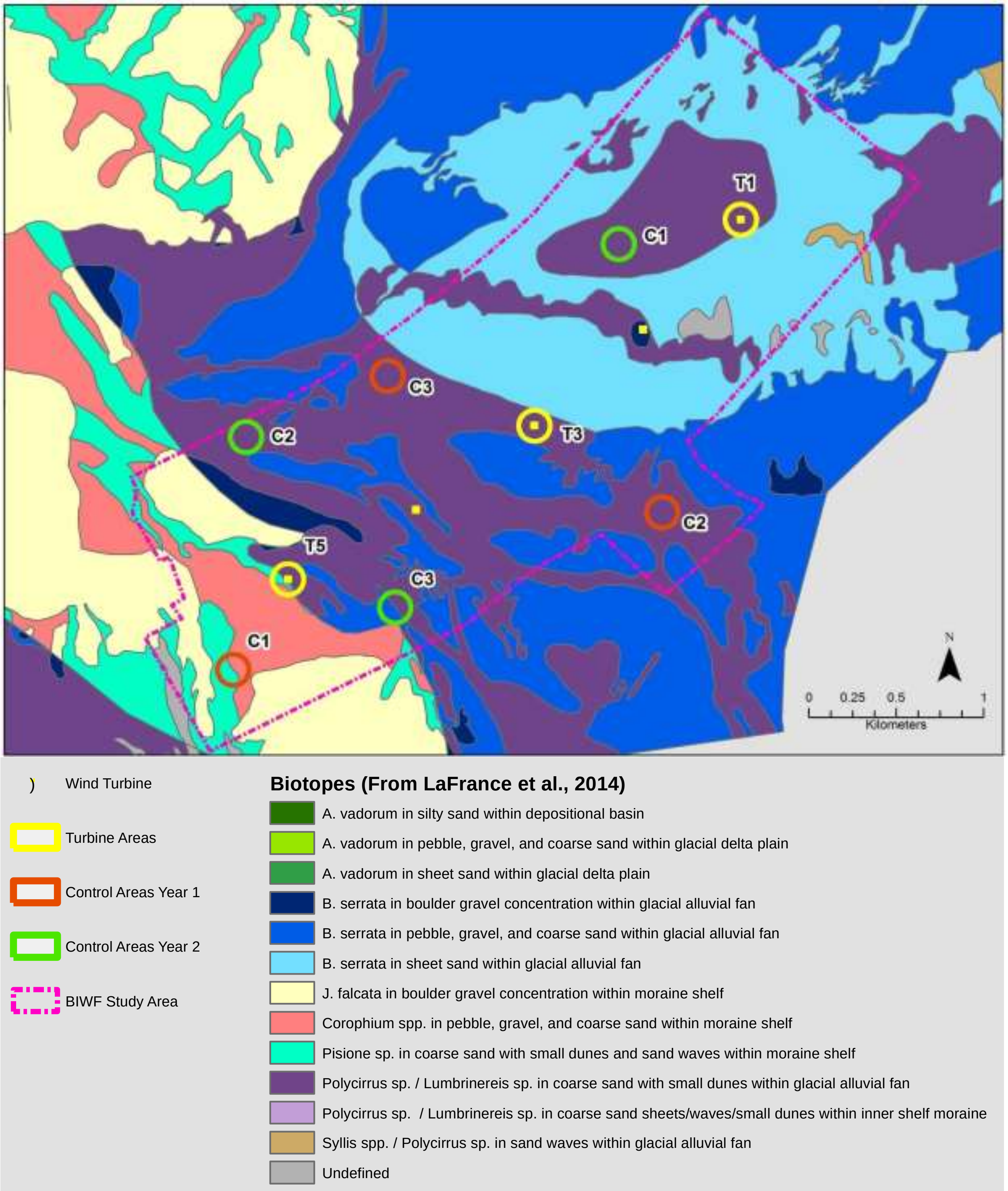


Figure 7. Distribution and extents of classified seabed biotopes in relation to BIWF.

Furthermore, within each turbine area, the random sampling process was stratified to position three sampling stations within three pre-determined distance bands so that samples were collected at increasing distances from the turbine foundation. This strategy was intended to provide adequate coverage of the anticipated effects based on prior observations (Schröder 2006, Coates et al. 2012 and 2014), since one of the principal interests of the study was to investigate potential benthic modification with distance from the turbine foundations. From the center point under the foundation structure, these distance bands were equal to 30 to 49 m, 50 to 69 m, and 70 to 90 m. The footprint of the foundation structure on the seafloor takes the shape of a square that is 24.5 m on each side. As such, the closest distance band (30 m) is located 15 m from each leg and 20 m from the sides of the foundation structure itself **(Figure 8).**

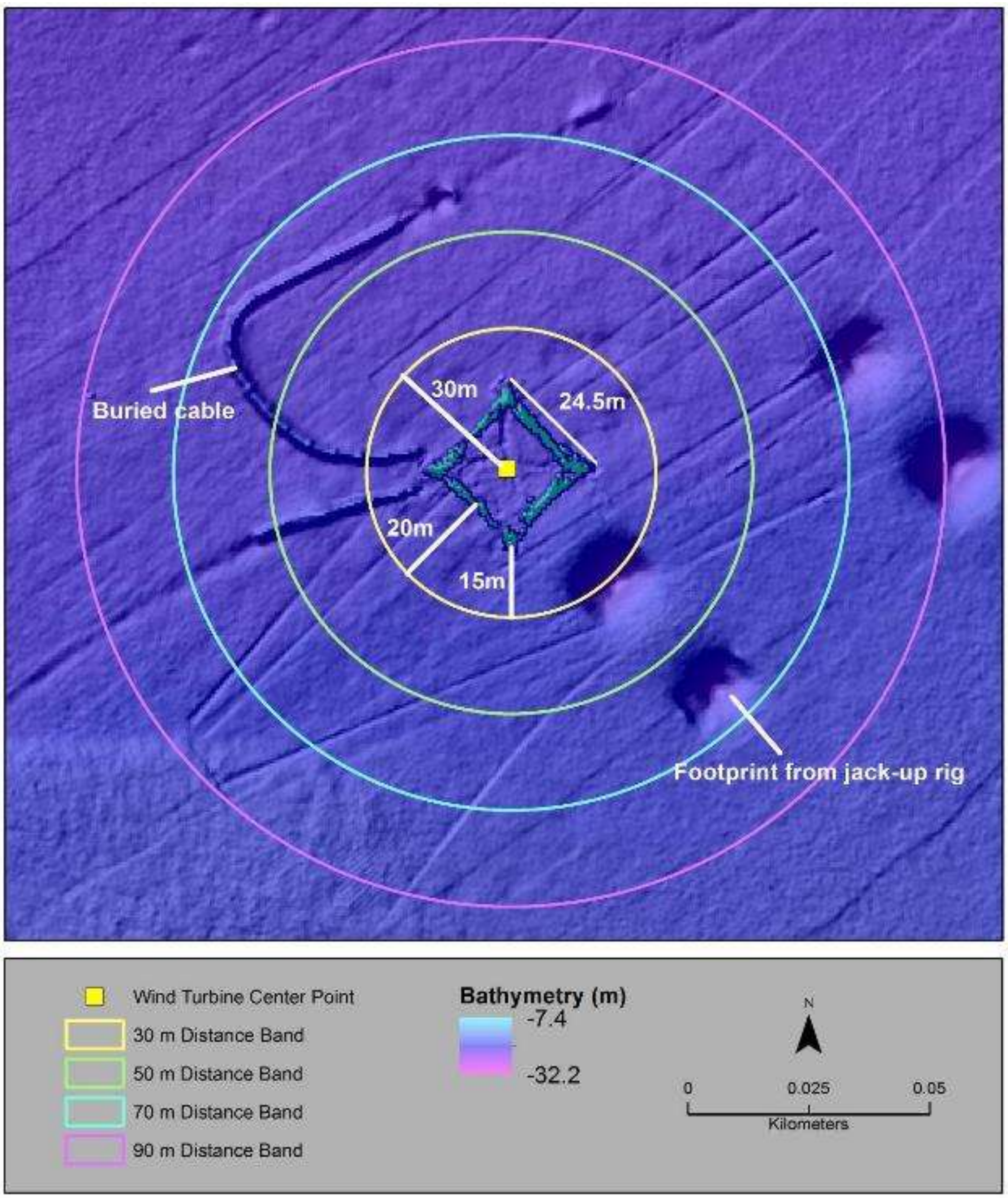


Figure 8. Example of the relationship between distance bands and footprint of the foundation structure (Turbine 5 shown here).

Within each control area, cluster samples were collected at randomly positioned sampling stations (without the use of distance bands). The control areas were selected at locations outside of the predicted influences of the construction and operation of the BIWF (refer to **Figure 7**). The areas were also comparable in substrate and depth conditions to that of the turbine areas. Data from the control areas allowed assessment of benthic change attributable to the BIWF against the natural variation.

2.1.2.1 Year 1 (2016–2017) Benthic Sampling Effort

A total of 121 grab samples were planned within the turbine and control areas **(Table 3)**. These samples include 27 samples collected at nine stations across the three distance bands within each of the three turbine areas (81 samples total); 12 samples collected at four stations within each of the three control areas (36 samples total); and four samples collected for independent quality control (QC).

Table 3. Summary of Benthic Survey Sampling Effort for Year 1.

	Number of Sample Stations					
	Turbine 1	**Turbine 3**	**Turbine 5**	**Control 1**	**Control 2**	**Control 3**
30–49 meters	3	3	3	--	--	--
50–69 meters	3	3	3	--	--	--
70–90 meters	3	3	3	--	--	--
Control Areas	--	--	--	4	4	4
Total no. samples (cluster samples = ×3 per station)	27	27	27	12	12	12
Independent QC samples	1	1	1	--	--	1
Total Number of Samples	**121**					

The QC samples were intended to be subjected to taxonomic analyses by an independent benthic macrofaunal expert not associated with the analysis of the samples collected within the turbine and control areas. One QC sample was randomly selected within each turbine area and within one of the control areas.

2.1.2.2 Year 2 (2017–2018) Benthic Sampling Effort

A total of 123 grab samples were planned within the turbine and control areas **(Table 4)**. These samples include 27 samples collected at nine stations across the three distance bands within each of the three turbine areas (81 samples total); nine samples collected at four stations within each of the three control areas (27 samples total); and five samples collected within the footprint of each turbine structure (15 samples total).

Table 4. Summary of Benthic Survey Sampling Effort for Year 2.

	Number of Sample Stations					
	Turbine 1	**Turbine 3**	**Turbine 5**	**Control 1**	**Control 2**	**Control 3**
30–49 meters	3	3	3	--	--	--
50–69 meters	3	3	3	--	--	--
70–90 meters	3	3	3	--	--	--
Control Areas	--	--	--	3	3	3
Total no. samples (cluster samples = × 3 per station)	27	27	27	9	9	9
Within footprint of turbine structure	5	5	5	--	--	--
Total Number of Samples	**123**					

The slight variation in sampling strategy between the two years is based on experiences from Year 1. The number of sample stations within the control areas was reduced to three (for a total of 27 samples) because the Year 1 design was determined to be unbalanced to which significance testing procedures are sensitive. In Year 1, the sample size for the reference was 36, whereas the sample size for each of the turbines was 27; removing one sample station allowed for the sample size to be 27 for both the turbine and control areas. Further, the QC samples were removed from the sampling plan, as they were considered unnecessary in Year 2.

The Year 2 sampling effort was also modified to include the collection of five grab samples located within the footprint of each of the three turbine structures. These samples were collected by divers as single samples, not in clusters of three. The samples were added in recognition that the sampling design in Year 1 may not have been adequate to detect changes that may be occurring at small distances, i.e., in the order of meters, from the turbine structure because samples were collected at a minimum distance of 15 m from the outer perimeter of the structure and 30 m from the center point under the structure (refer to **Figure 8**). Further, the Year 1 sampling strategy was not designed to consider changes that could be occurring within the footprint of the jacketed structures, despite that this is a sizable area of approximately 625 square meters (i.e., 25 m per side). The samples taken under the structure aimed to address these concerns.

2.2 Vessel-based Data Collection and Processing

2.2.1 Grab Samples

A Smith McIntyre grab sampler (approximately 620-square centimeter sample area) was used to collect the grab samples within the turbine and control areas. An overview of the locations of the grab deployments for Year 1 and Year 2 samples are presented in **Figures 9** and **10.**

Upon recovery of the sample, the sediment within the grab bucket was inspected to assess whether the sample was acceptable (i.e., has not been subject to partial washout during retrieval, and is of sufficient volume relating to depth of bite). The volume of each grab sample, accompanied by a visual description, including conspicuous sediment features and obvious fauna, was recorded in the field. Field survey records are presented in **Appendix 1**. For Year 2, photographs of each sample were also taken upon recovery in the field.

A sub-sample was collected for analysis of sediment grain size and organic content. The remaining material was transferred to a bucket for macrofaunal analysis. All samples were stored in pre-labeled containers with locking lids to ensure no loss of material and brought back to the lab for analyses. Upon arrival to the lab, all samples were stored at 4 degrees Celsius until processed to reduce deterioration.

Sediment properties of the sub-samples were characterized using a particle size analyzer (Malvern Mastersizer 2000E), which generated the weight percent of each particle size fraction (e.g., silt, fine sand, coarse sand, etc.) according to the Wentworth classification system (Wentworth 1927). Therefore, sediment analyses were performed on grain sizes ranging from 0 to 2,000 µm (i.e., clay to very coarse sand). While sediment larger than 2,000 µm (e.g., gravel, cobble, and boulder) were not quantitatively assessed, qualitative data of such material was collected. Within the grab samples, the recovery of gravel and cobbles was noted for both years. Further, in Year 2, gravel and cobbles were retained from each sample during sieving and photographed. In the seabed video, the presence and overall concentrations of gravel, cobble, and boulder were noted for both years.

A portion of each sub-sample was also analyzed for total organic matter and total organic carbon (TOC) content. A muffle furnace was used for the organic matter content determination following the Loss-On-Ignition method of Dean (1974).

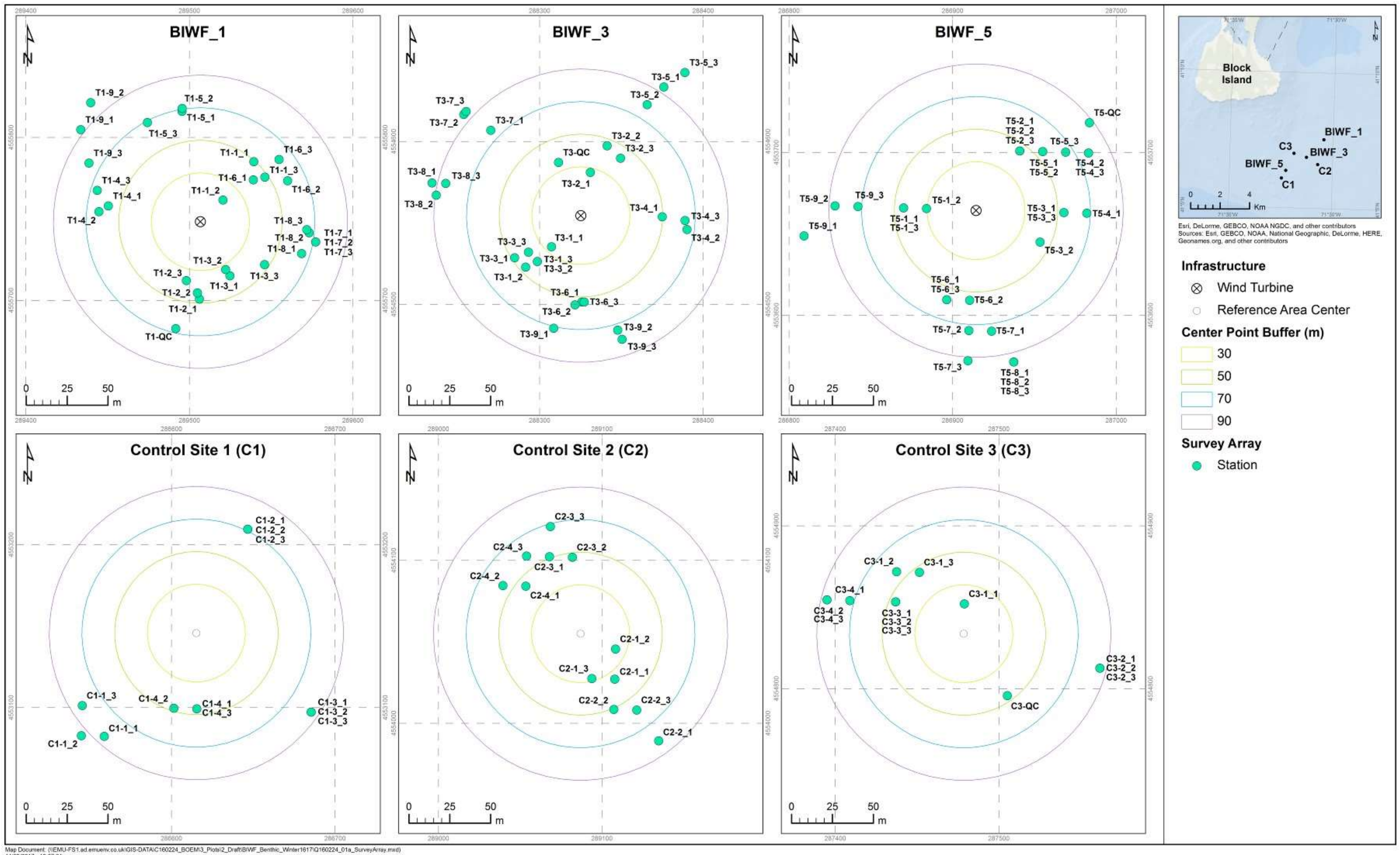
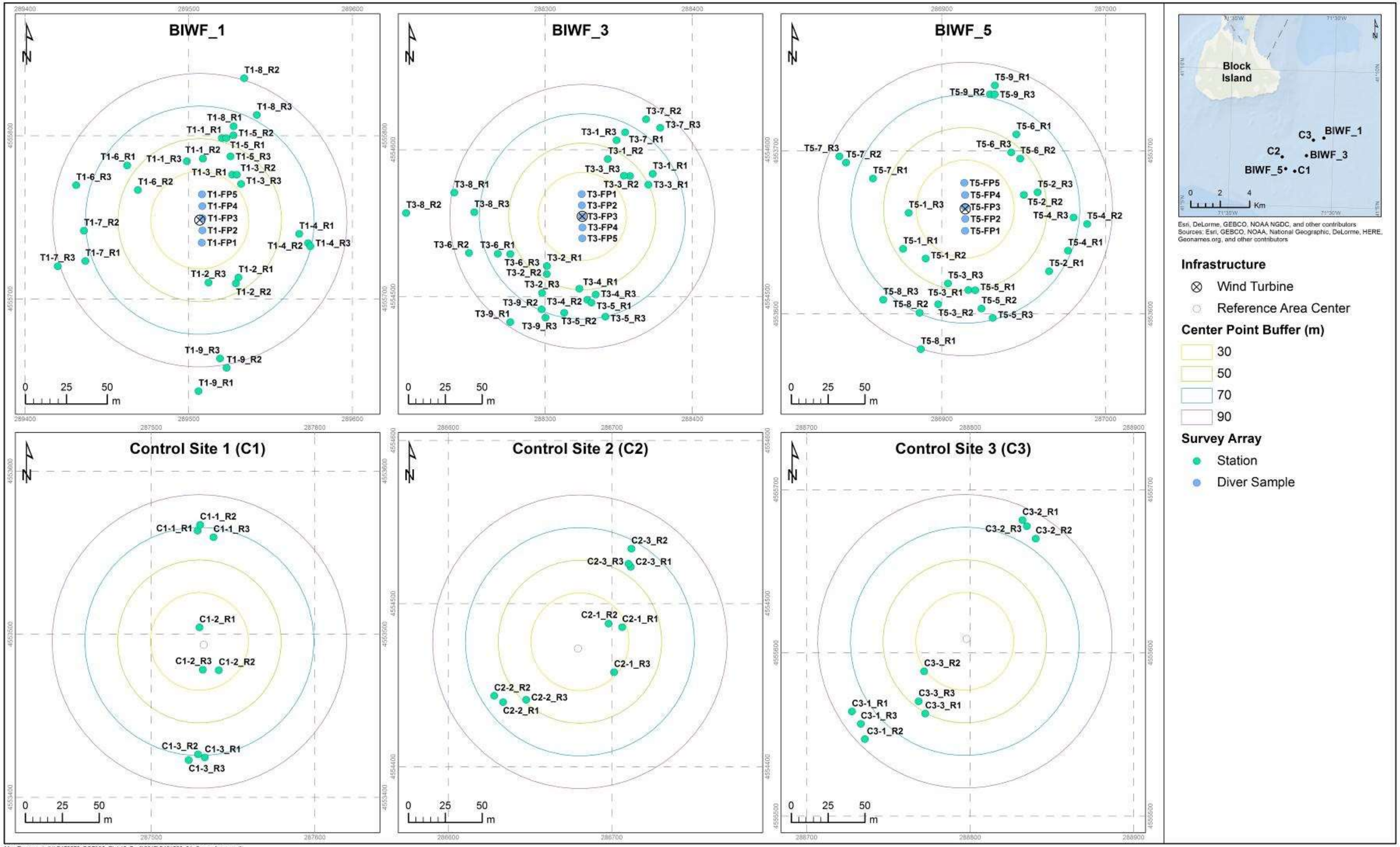


Figure 9. Location of the vessel-based grab samples and seabed video collected within the BIWF study area for Year 1.



Map Document: (V:\C173378_BOEM\3_Plots\2_Draft\2017\Q181223_01_SurveyArray.mxd)
01/08/2018 - 05:48:22

Figure 10. Location of the vessel-based and diver-based grab samples and seabed video collected within the BIWF study area for Year 2.

Prior to biological analysis, the volume and weight of each sample was recorded. The samples were then sieved through a 1-millimeter aperture mesh sieve. The contents of the sieve were transferred into a pre-labeled bucket and fixed on-site using 4 percent buffered saline formalin solution with Rose-Bengal stain added. The samples were transported to the designated lab where all individuals recovered were counted and identified to the species level or lowest possible taxonomic group. The macrofaunal analysis of all the Year 1 and Year 2 samples was conducted by taxonomic specialists at the Ecological Consulting Organization (located in Long Island, New York). The Year 1 macrofauna identification spreadsheet was reviewed by Sheldon Pratt, a local expert on the staff at URI, to ensure consistency with regards to nomenclature and to confirm species identified could be reasonably expected within the study area based on historical accounts. The numbers of individuals of macrofauna remained unadjusted with respect to sample size (i.e., volume), as there was no apparent correlation between these two factors for the samples collected within the BIWF survey area.

The performance of the grab sampler differed depending on substrate type as indicated in the field survey records (**Appendix 1**). In general, the grab returned smaller samples from coarser sediments compared to finer grained deposits. **Figures 11 (a)** and **(b)** summarize the effect of seabed substrate type on the size of sample returned and compares sample sizes from each of the turbine locations, respectively. The substrate types selected in this instance derive from the field visual descriptions of the Year 1 samples.

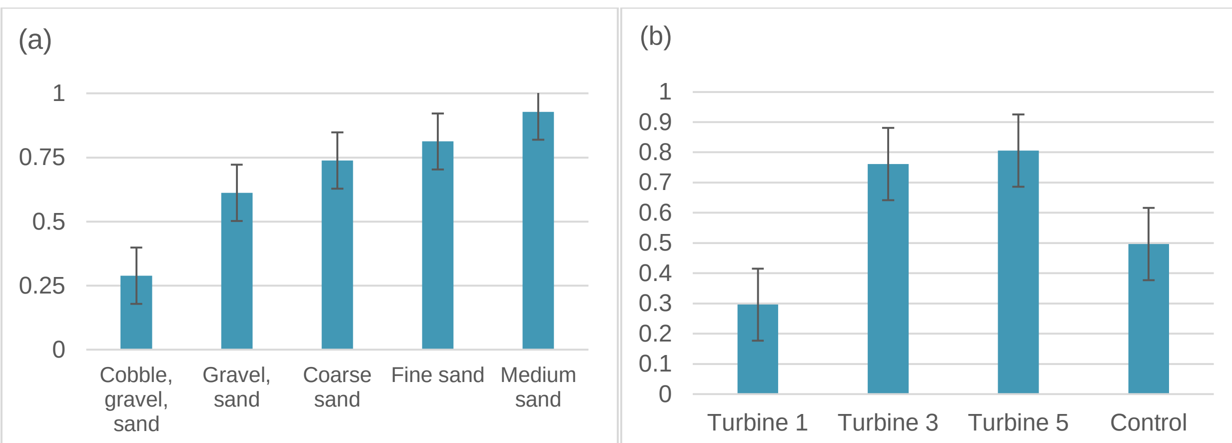


Figure 11. Summary of size of Year 1 vessel-based grab samples collected from (a) different substrates at BIWF and (b) different turbine locations.

In general, samples collected from mixed coarse deposits (e.g., cobble, gravel, and sand) were small and the grabs recovered from this substrate type were on average just above ¼ full. Grab samples collected from ‘gravel, sand’ deposits were on average between ½ and ¾ full those collected in ‘coarse,’ ‘medium’ and ‘fine’ sands were approximately ¾ full or greater. Field records also noted that samples collected at Turbine 1 were comparatively small (on average only 1/3 full) compared with those collected at the other two turbine locations (on average ¾ full).

2.2.2 Seabed Video

A GoPro video camera outfitted with lights was attached to the frame of the Smith McIntyre grab sampler, allowing for datasets with identical spatial and temporal attributes. Such co-located datasets reduce uncertainties associated with returning to an area for sampling. Seabed video was collected to complement the grab sample data, assess the degree of spatial heterogeneity of the environment and associated benthic biological communities, and capture information over a broader scale for context. Additional information provided by the video included the identification of bedforms, coarse surficial material concentrations (e.g., boulders, cobble, gravel), and species that are more mobile or are present at low densities (e.g., crabs, starfish, sponges, algae) and so tend to not be captured by the grab sampler.

2.2.3 Seabed Photography

Within each turbine and control area, high-resolution seabed photography was undertaken using a Lagrangian floating remote digital stills camera. The camera system is free-floating, i.e., its trajectory follows that of the bottom currents. The system is tethered to a surface buoy to allow for easier recovery and to note general location. In Year 1, between one and four camera deployments were completed at each study area, for a total of 15 transects. In Year 2, two deployments were completed at each study area, for a total of 12 transects. The transect locations for both years are presented in **Figures 12** and **13**. The duration of the seabed video surveillance at each station was 15 to 30 minutes. The camera was redeployed where necessary to ensure that all features observed can be confidently described in terms of their spatial extent, composition and characterizing biology. The camera was programmed to follow the seabed at a constant altitude of approximately 2.2 m to ensure high resolution images of the seabed, while maintaining a safe distance from boulders and any raised objects that may be present. The coordinates of the deployment and recovery locations were noted; although the drift pattern of the camera was not documented.

The images are collected at a rapid rate, allowing for a continuous series of overlapping images of the seabed that can then be mosaicked. Knowledge of the deployment and recovery locations allow for the images to be spaced out over the drift track and provide an estimate location of each image. The raw images are color corrected to account for lighting artifacts and small variations in altitude. Similar to the seabed video, the images and mosaics complement the grab samples by providing contextual information of the geological environments and local heterogeneity, as well as capturing conspicuous species present throughout the camera deployment.

The images were also intended to collect information on the presence and distribution of larger mobile epibenthos in relation to the installed wind farm infrastructure and which are not typically captured by grab techniques.

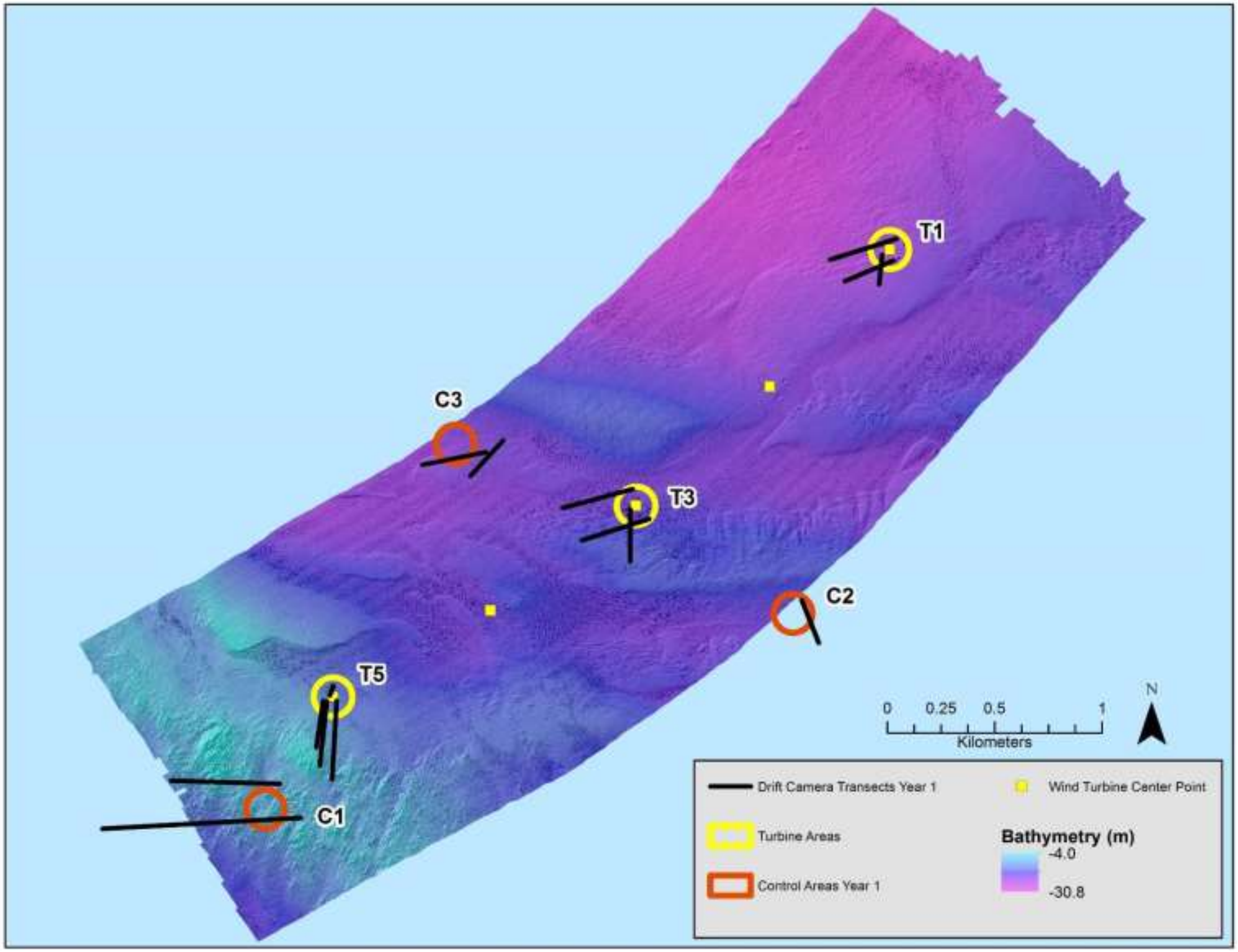


Figure 12. Locations of transects where seabed photography images were collected using a drifting camera system for Year 1.

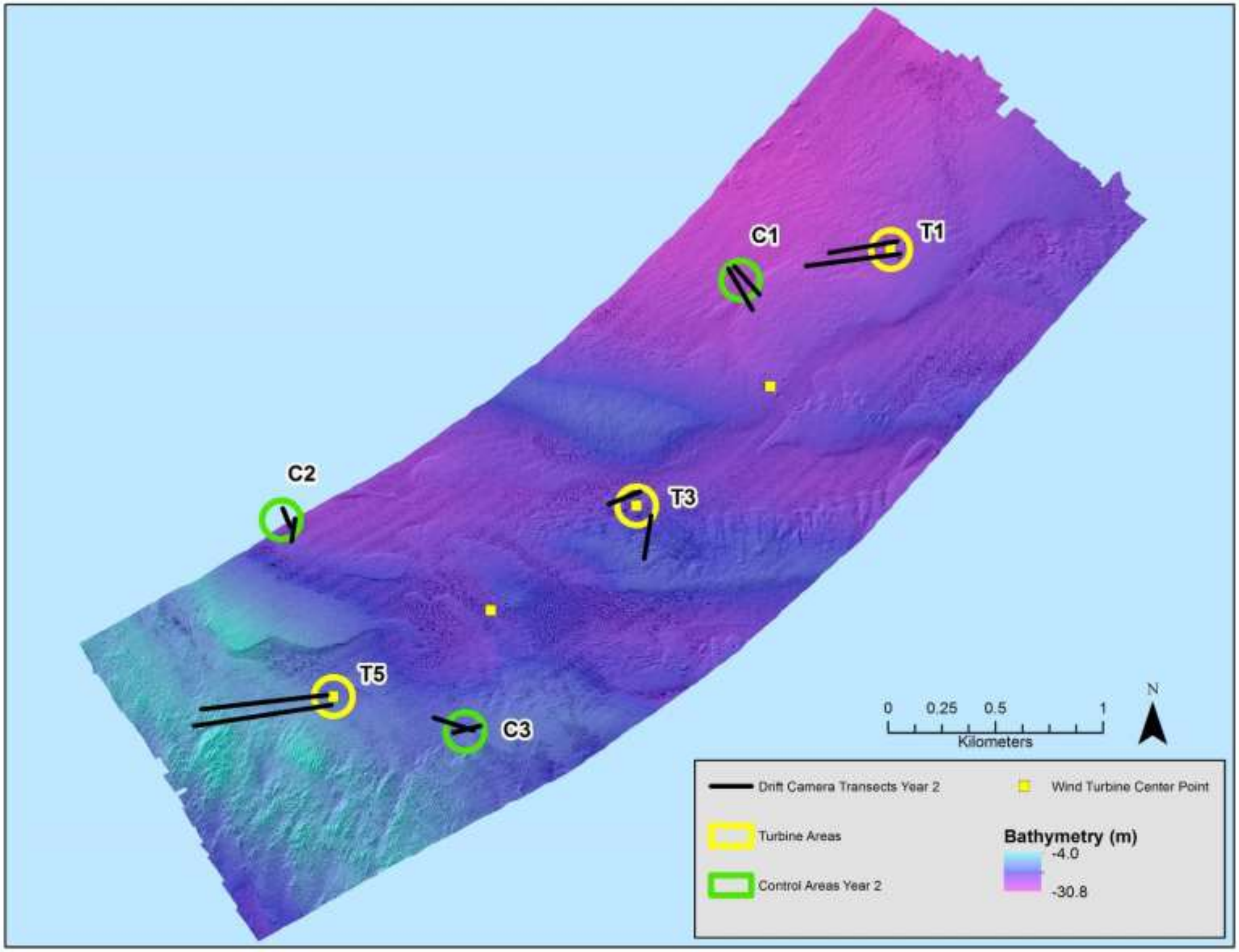


Figure 13. Locations of transects where seabed photography images were collected using a drifting camera system for Year 2.

2.3 Diver-Based Data Collection and Processing

2.3.1 Grab Samples

Divers were used to collect five grab samples within the footprint of each of the three turbine structures for subsequent particle size distribution, organic and macrofaunal analyses (**Figure 10**). For Turbines 1 and 5, the divers descended the southern leg of the structure and, starting at the inside base of that leg, collected a grab sample at equal distances (i.e., 7.5 m) along a transect spanning from the southern leg to the northern leg (i.e., 30 m total). For turbine 3, a north to south transect was followed. The divers used a compass to navigate their course and a measuring tape to measure distance between samples.

The grab samples were collected by scooping sediment into a two-gallon zip lock bag, with the intention of filling the bag to the one-gallon mark. This technique was successful in that suitable material was recovered for organic and particle size distribution analysis. However, it should be noted that while the volume of material recovered collected within a given turbine footprint are comparable, the volume across turbines varies based on the diver responsible for the collection **(Appendix 1)**. As such, the descriptions and comparisons of macrofaunal data between turbines should be considered relative, rather than direct.

All samples were stored in pre-labeled bags and double-bagged upon recovery to ensure no loss of material. Upon arrival to the lab, all samples were stored at 4 degrees Celsius until processed to reduce deterioration. At the time of sieving, photographs were taken of each grab sample, and sample volume, weight, and visual description were recorded. The description included general sediment grain size, any conspicuous sediment features, and visible fauna. Description records are presented in **Appendix 1.** In addition, all gravel and cobbles were removed, retained, and photographed from each sample. A sub-sample was also collected for analysis of sediment grain size and organic content.

The sediment grain size, organic content, and biological analyses of the diver-collected grab samples follow those of the vessel-collected grab samples outlined in **Section 2.2.1**.

2.3.2 Seabed Photography

The Lagrangian floating remote digital camera system (described in **Section 2.2.3**) was used to collect high-resolution photographs of the seafloor within the footprint of the three turbines. The system was modified to be towed along by a diver, rather than programmed for free-floating missions. At Turbines 1 and 5, the divers mimicked the south-north transect along which the grab samples were collected. The transect was then extended beyond the northern leg of the structure out to 90 m to ensure imagery was captured across each of the distance bands. The same methodology was followed at Turbine 3, although the transect was completed in the north-south direction and extended out to 80 m. The completed diver-towed transects are presented in **Figure 14**.

2.4 Data Analyses

Data derived from the Year 2 monitoring were compared with that collected during the Year 1 monitoring campaign to address the hypothesis relating to significant differences in physico-chemical and biological conditions over time. In addition, data collected at each Turbine and control area have been compared in a similar manner to the Year 1 data to continue to the hypothesis regarding significant spatial differences.

2.4.1 Univariate Analyses

The following univariate measures were calculated using PRIMER (Plymouth Routines in Multivariate Ecological Research) v6.0 package of statistical routines: number of species (S), number of individuals (A), and a range of diversity indices, including Shannon Weiner diversity (H'), Margalef's Richness (d), Pielou's Eveness index (J') and Simpson's Dominance (λ). **Table 5** summarizes univariate measures calculated.

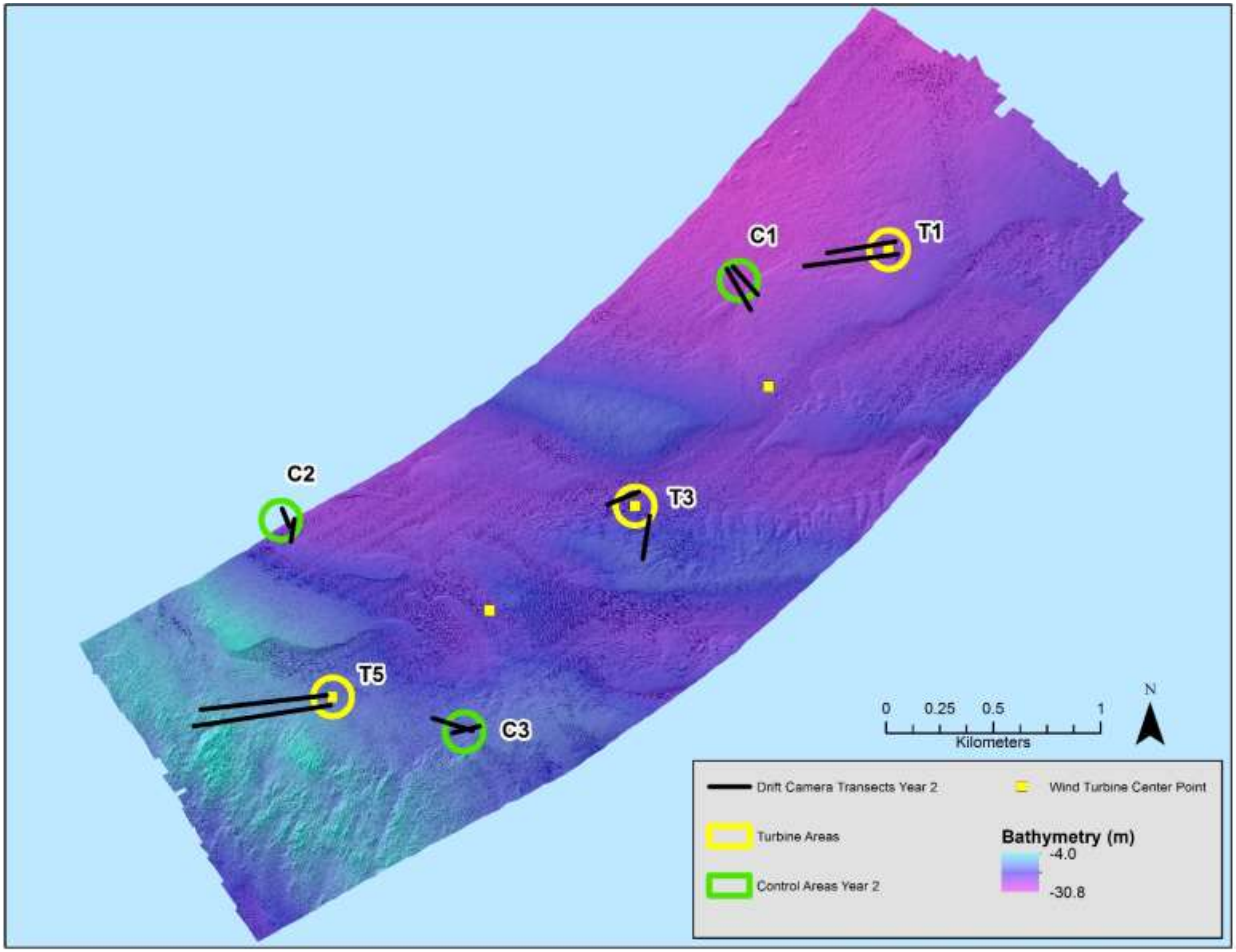


Figure 14. Close-up view of the locations where seabed photography images were collected using a diver-towed camera system in Year 2.

Table 5. Primary and Univariate Indices.

Variable	Dominant Influence/s	Formula	Description
Number of Species (*S*)	Richness	*S* Where: *S* = the total number of species.	The simplest measure of species richness.
Number of Individuals / Abundance (A)	-	*A* Where: *A* = the total number of individuals.	The simplest measure of abundance.
Shannon Weiner (*H′*)	Richness + Evenness	$H' = -\sum_i p_i (\log p_i)$ Where: p_i is the proportion of the total count arising from the *i*th species.	A measure of how the number of individuals are distributed across the number of species found in a sample (Shannon and Weaver 1949).
Margalef's Richness (d)	Richness	$d_{Mg} = \frac{(S - 1)}{\log N}$ Where: *S* = total number of species; *N* = total number of individuals.	A simple index derived from a combination of the number of species (S) and total number of individuals (N) (Clifford and Stevenson 1975).
Pielou's Evenness or Equitability (*J′*)	Evenness	$J' = \frac{H'}{\log S}$ Where: *H′* = Shannon-Wiener Index; *S* = total number of species.	A measure of how evenly individuals are distributed between species (Pielou 1969).
Simpson's Dominance (*λ*)	Evenness	$\lambda = \sum \left(\frac{n_i\ (n_i - 1)}{N\ (N - 1)} \right)$ Where: n_i = number of individuals in the *i*th species; *N* = total individuals.	A measure of the probability that two individuals randomly selected from a sample will belong to the same species (Simpson 1949).

Note: The indices used are useful for reducing community data to a single value for comparison and are typically reported in benthic studies to express important aspects of a species assemblage.

2.4.2 Multivariate Analyses

Multivariate analyses were carried out using the statistical software package, PRIMER v6.0 (Plymouth Routines in Multivariate Ecological Research) with the Permanova+ add-on software (Clarke and Gorley 2006, Anderson et al. 2008). The PRIMER suite of statistical routines is frequently used in monitoring and research and is recommended in relevant guidance for the conduct of benthic ecology studies. Current versions run on the MS Windows platform which makes it a particularly convenient tool for analyzing spreadsheet data. The range of different statistical tools available within PRIMER allow the relative strengths of relationships between samples and groups of samples to be investigated within multivariate space, highlighting those that are similar and those that are dissimilar while identifying the key biotic and abiotic factors most responsible for observed group (dis)similarities.

Macrofaunal data were imported into PRIMER and square root transformed to reduce the influence of any highly abundant taxa allowing less abundant species a greater role in driving the emergent multivariate patterns. The transformed data were then subjected to hierarchical clustering to identify sample groupings based on the Bray-Curtis index of similarity.

Abiotic variables extracted from the grab samples and seabed video data were also imported into PRIMER and used to investigate potential relationships with observed macrofaunal patterns. Quantitative data included sediment particle size, organic content, and water depth. All environmental data were normalized prior to analysis to standardize the differing measuring scales of each variable. Sediment particle size data were also subjected to hierarchical clustering using Euclidean distance as the similarity measure to establish sediment spatial distribution patterns. Categorical data included study area (i.e., Turbine 1, 3, 5, Controls 1, 2, 3), sampling period (i.e., Year 1, Year 2), distance from turbine (i.e., near, mid, far), dominant sediment type (e.g., coarse sand, medium sand), general sediment composition and concentration of gravel, cobble and boulders from the video footage, and the presence of biological features in the video footage (i.e., shell hash, mussels). The geologic depositional environment types, as defined by LaFrance et al. (2010), were also considered in analyses.

Relationships between sample groupings were presented within nMDS (non-metric Multi-dimensional Scaling) plots. As defined, an nMDS plot is an ordination plot for which samples are represented as points and the similarity/dissimilarity between samples is based on their relative distance from one another on the plot (Clarke and Gorley 2015). Therefore, in this study, each point on the plot represents the benthic community composition for one sample and points that are closer together on the plot represent samples that are more similar in composition than those that are farther apart. The representativeness of this two-dimensional plot, in comparison to the multi-dimensional array, is indicated by a stress level. The closer this stress level is to zero, the better the representation. A stress level of 0.20 or less is considered acceptable. The plots were used to compare macrofaunal community composition within and across study areas and sampling periods, as well as to assess the cohesiveness of the cluster samples at each sample station. The plots were also used to investigate patterns in benthic community composition in relation to sediment characteristics and geologic depositional environment, and distance from turbine.

SIMPER (Similarity Percentages) is a quantitative complement to nMDS plots and examines data based on user-defined sample groups. SIMPER analysis was applied to the data to rank species in terms of their contribution to both the within-group similarity and “between” group dissimilarity. SIMPER compares groups of samples by examining the degree (as a percentage) to which individual species contribute to the within-group similarity of the sample groups and reporting the average overall within-group percent similarity. SIMPER also reports the average percent dissimilarity of the sample groups between all pairs of groups and how individual species contribute to this dissimilarity (Clarke and Gorley 2015). For example, SIMPER can be used to assess similarity of macrofaunal samples at each study area and the level of dissimilarity between each study area. Sample groups can also be defined according to sampling period, cluster station, etc. As such, SIMPER can assist the assessment of the distinctiveness of each sample group and the identification of the characterizing taxa.

The ANOSIM (Analysis of Similarity) routine was used to test the null hypothesis that there are no differences between biological communities among different user-defined groups (e.g., study area, sampling period, cluster samples, geologic depositional environment). ANOSIM reports an R value, for which a value of 0 would indicate that there are no differences in the biological communities within the defined groups, while an R value greater than 0 would reflect the degree of the difference, with a value of 1 indicating that the biological communities within each group are completely distinct from one other.

2.4.3 Significance Testing

In Year 1, SigmaPlot 12.5 was used to conduct significance testing on selected abiotic and biotic variables using two-way Analysis of Variance (ANOVA). This technique tests for differences between means of groups of three or more samples and identifies whether the means within the group are consistent or if one or more is significantly different. The advantage of testing group means, as opposed to simply undertaking a series of pairwise tests, is that the latter approach increases the risk of committing a Type 1 error, i.e., concluding a significant result when none was present. The output of ANOVA is an F ratio, which is the ratio of the variability between the groups relative to the variability within the groups. Where the “within” and “between” variability is the same, the F ratio will be 1. However, as the latter increases relative to the former, the F ratio becomes larger. The p value is obtained with reference to freely available “look up” tables of the F distribution and the degrees of freedom within and between sample groups, and indicates the probability of obtaining that, or a larger, F ratio.

The ANOVA test requires normally distributed data and comparable variances between groups and this was tested using a Shapiro-Wilks test within the SigmaPlot software prior to performing the analyses. Data passing initial variance and normality assumptions, as indicated by the results of the Shapiro-Wilks test, were transformed as necessary (sqrt or ln), and subjected to ANOVA.

ANOVA tests for differences within the entire group of samples but does not identify where those differences occur. Thus, on detection of statistical differences in ANOVA, post-hoc comparison between pairs of groups was undertaken using a Holm Sidak test.

Data which did not fulfil the variance and normality assumptions were analyzed using the non-parametric Kruskall Wallis method followed by Tukey Kramer pair-wise tests for significant interactions. The Kruskall Wallis is analogous to the ANOVA approach but where normality/equal variance tests have failed. It then compares on medians only, not means and only for one data set. The Tukey Kramer pair-wise test is analogous to the Holm Sidak test.

Year 2 (2017) abiotic and biotic data were analyzed using the same ANOVA techniques as those employed in 2016 although the SigmaPlot package was replaced by the Microsoft Excel Real Statistics Tool Pack. Also, Welch’s ANOVA was used in place of the non-parametric Kruskall Wallis test in instances where the usual data assumptions were not met or where the design was unbalanced. On detection of statistical differences, post-hoc comparison between pairs of groups was undertaken using a Tukey Honestly Significant Difference (HSD) test to identify where the significant difference lies.

One final slight deviation from the previous methodologies was the use of Levene tests to confirm variance assumptions in addition to the Shapiro-Wilks test to indicate data normality. Data not passing initial variance and normality assumptions, as indicated by the results of the Shapiro-Wilks and Levene tests, were transformed as necessary (sqrt or ln), as per previous occasions.

Note that for Year 1, the use of four sample stations at each of the three control areas led to an unbalanced design for the ANOVA (i.e., there were 36 total control samples, but only 27 samples for each turbine foundation). Thus, whilst analysis is feasible using General Linear Models, for ease of interpretation and power of analysis, one sample station (containing three cluster samples) was randomly removed from each control location (reducing data from four stations to three per control area). Stations were removed using an on-line number generator with control locations numbered 1 through 4 and a random number generated between these values, thus ensuring no bias in data removal. The sampling strategy in Year 2 was revised to achieve a balanced design, i.e., there is a sample size of 27 for each turbine area and the control areas.

Differences between sample groups were tested using ANOSIM and Permanova+ within PRIMER. These tests are analogous to the ANOVA test but are used to distinguish differences in multivariate datasets such as faunal data. Whilst ANOSIM and Permanova+ were essentially used to perform similar functions in this study, the use of the latter routine is able to encompass and compare multivariate datasets between increasing numbers of spatial and temporal factors and also appears to perform well with heterogeneous data compared to ANOSIM (Anderson and Walsh 2013). The PermDisp function was performed in parallel with the Permanova+. The results from this analysis express observed homogeneity/heterogeneity of the faunal data dispersions for selected groups and were used to assess the variability of faunal communities between turbines and control areas and between sampling occasions.

2.5 CMECS Biotope Classification

2.5.1 Description of CMECS

The CMECS habitat classification system (FGDC 2012) is the U.S. national standard adopted by the Federal Geographic Data Committee (FGDC). CMECS provides a common language for organizing and describing scientific information about ecological features in marine and lacustrine environments, including estuaries, coasts, oceans, and the Great Lakes. CMECS provides a catalog of standardized terms for distinct ecological units at respective levels within a classification hierarchy (**Figure 15**).

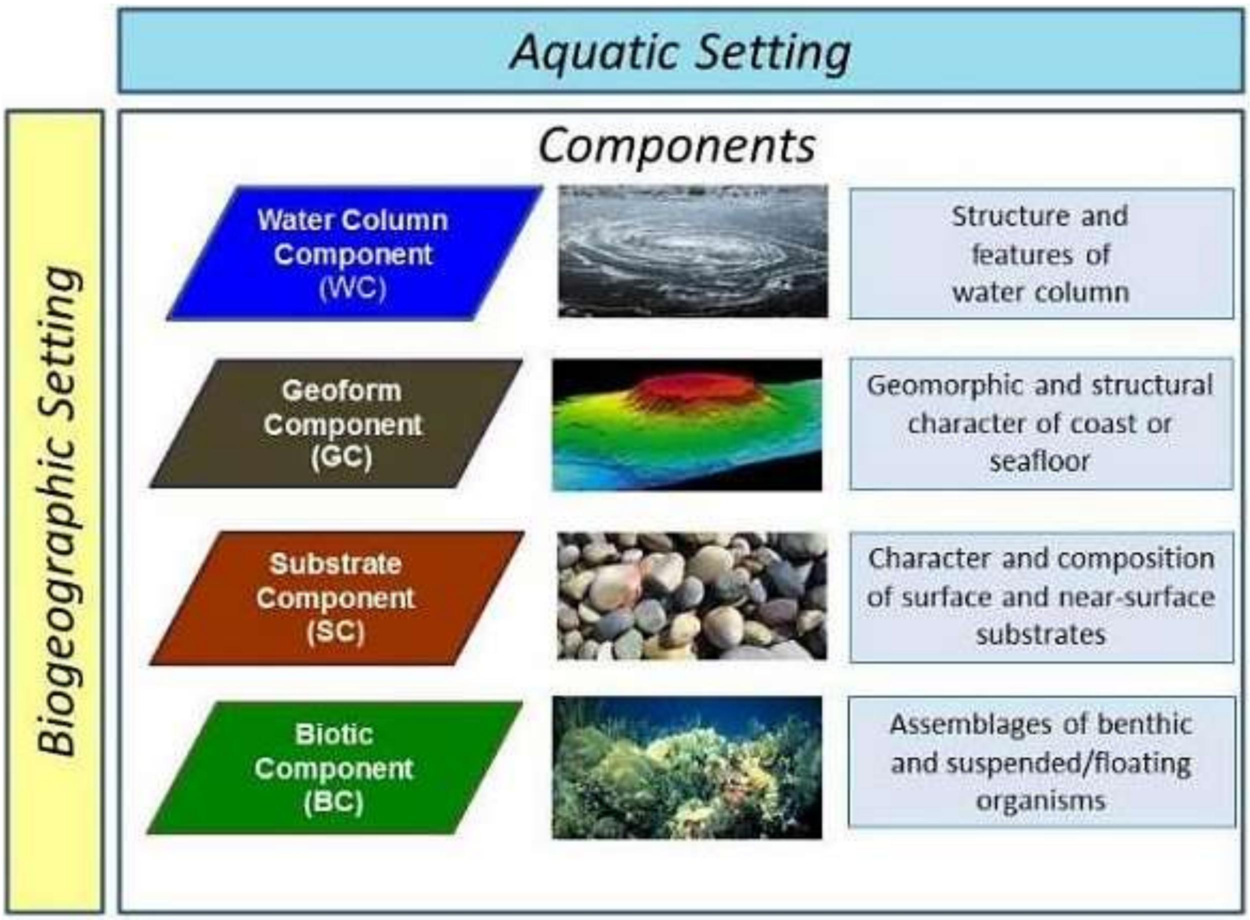


Figure 15. CMECS settings and components (from FGDC 2012).

This framework allows the user to incorporate geological, chemical, physical, and biological information into a single structure. The components can also be integrated to define habitats (referred to as biotopes), resulting in detailed and comprehensive classification outputs. In addition, the CMECS framework is sensor and scale independent. These features offer several advantages to its users, including the ability to classify any dataset (e.g., regardless of collection and processing methods, geographic and temporal scales, resolution, density, etc.); facilitate the integration of information from legacy, current, and future datasets; share and compare information across studies more readily; and be applicable to a wide and multidisciplinary user base.

At the highest level of the organization, CMECS adopts the terms Marine System, Estuarine System, and Lacustrine System; these correspond to terms found in FGDC-STD-004 (FGDC 1996). The marine and coastal environments are described in terms of two settings, Biogeographic and Aquatic. The Biogeographic Setting identifies ecological units based on species aggregations and features influencing the distribution of organisms, following that of Spalding et al. (2007) in Marine Ecosystems of the World. As such, coastal and marine waters are organized according to realm, province, and ecoregion. For the Aquatic Setting, System is the primary component and follows that described in the Classification of Wetlands and Deepwater Habitats in the United States (FGDC 1996). The Aquatic Setting is further divided into Subsystem and Tidal Zone.

The CMECS framework also includes four Components (Geoform, Substrate, Water Column, and Biotic) that are used to define environmental and biological attributes within each setting. The Components can be used independently or in combination with one another. Within CMECS, biotopes, defined as "*combination of abiotic features and associated species*", are not defined, but can be "*derived by identifying repeating biotic communities that are consistently associated with combinations of environmental units from any of the other CMECS settings or components.*"

In this study, the Substrate, Geoform, and Biotic Components are applied. The Substrate Component is compatible with sediment-related elements of FGDC-STD-004 (FGDC 1996). Substrate, natural or manmade, is defined in CMECS as the non-living materials forming an aquatic seafloor, or that provide a surface (e.g., floating objects, buoys) for growth of attached biota. Marine sediments traditionally have not been considered soils, therefore the Substrate Component follows the approaches of Wentworth (1922) to define sediment particle sizes and Folk (1954) to describe mixes.

The Geoform Component describes major geomorphic and structural characteristics. It is hierarchically organized into tectonic province, physiographic province, origin, geoform, and geoform type. In addition, the geoform subcomponent is comprised of two levels, with level 1 describing large scale features (typically > 1 square kilometer) and level 2 describing small-scale surficial characteristics (> 1 square kilometer).

The Biotic Component is hierarchically organized into biotic setting, biotic class, biotic subclass, biotic group, and biotic community. The biotic setting indicates whether the biota are attached or closely associated with the benthos or are suspended or floating in the water column. Biotic classes and biotic subclasses describe major biological characteristics at a coarse level. Biotic groups are descriptive terms based on finer distinctions of taxonomy, structure, position, environment, and salinity levels. Biotic communities are descriptions of repeatable, characteristic assemblages of organisms. Classes and subclasses of the biotic component are determined by the percentage cover of the substrate by the dominant biota; this approach refers to units identified in FGDC-STD-004 (FGDC 1996). The system presents a protocol for the addition of new biotic groups and biotopes, which is modeled on the one proposed in FGDC-STD-005-008, and it also draws from the Marine Habitat Classification for Britain and Ireland (Connor et al. 2004).

2.5.2 CMECS Biotope Classification

The term "biotope" is specific in that it integrates biotic-abiotic data within a given area to offer information that is more ecologically meaningful. In this study, the Geoform, Substrate, and Biotic Components were integrated to define biotope classifications for the turbine areas. As such, biotopes reflect the relationship between macrofaunal communities and associated geological characteristics within the defined map units. In this study, the biotopes are considered preliminary because, although the biotic-abiotic relationships identified in this study are statistically significant and ecologically meaningful, they have not been demonstrated to be consistent through time at this spatial resolution (i.e., very site specific, whereas the OSAMP was conducted at a regional scale).

Preliminary biotope classifications were determined for each of the three turbine study areas using a top-down classification approach following that of LaFrance et al. (2014). Extensive studies and discussion on the top-down approach and its comparisons to other mapping approaches can be found in Smith et al. 2015, LaFrance et al. 2014, Rooper and Zimmermann 2007, Eastwood et al. 2006, Hewitt et al. 2004, Brown et al. 2002, and Kostylev 2001. In this approach, biotope map units are geologically defined based on the presumption that geologic environments or features contain distinct biological assemblages. Statistical analyses can then be used to assess this presumption and gain further understanding of the biotopes.

The geological depositional environments that were developed and that served as the boundaries for the biotope map units in the OSAMP study by LaFrance et al. (2010) were also used in this study (refer to **Figures 5** through **7**). There were several reasons for this decision. First, these depositional environments are well-established. Second, comparison of side-scan and video data collected in this study to previous studies in the area suggests these units have not changed over time, and, thus are still relevant and accurately describe the geological characteristics of the BIWF study area (refer to **Figure 2**). Third, the use of the same depositional environment as the biotope map units allows for more direct comparison of pre- and post- construction macrofaunal community structures and biotope classifications.

Following classification, the degree of distinctness among the defined biotope types was statistically assessed using the ANOSIM and SIMPER routines in PRIMER. ANOSIM was used to test the hypothesis that there are no differences between macrofaunal communities among biotope types. SIMPER was then used to assess the degree of macrofaunal similarity within each biotope type and the degree of similarity across biotope types, as well as examine the degree to which individual species contribute to the within-biotope similarity.

The biotope(s) within each turbine area were classified according to the dominant species and the associated geologic depositional environment within the given biotope unit. The nomenclature follows the Biotic, Geoform, and Substrate Components of the CMECS classification framework. Dominant species is defined as the species with the highest abundance combined across all of the macrofaunal samples present within the given biotope unit within the given turbine area. The classification was completed in ArcGIS (Esri ARCMap version 10.2) by color-coding and labeling each distinct biotope type.

3 Results

3.1 Vessel-Based Data Collection

3.1.1 Survey Effort

For Year 1, cluster grab samples and seabed video were collected concurrently at 39 sample stations within the three turbine and three control areas, for a total of 117 samples (refer to **Figure 9** and **Table 3**). With the addition of the four QC samples, the final total was 121 samples. Grab sample and underwater video data acquisition occurred over three days between December of 2016 and March of 2017 (**Table 6**). The delay between sample days was caused by inclement weather. However, completing the sampling over this time period is not considered a concern, as data from previous studies supports that this region is stable and that there are minimal seasonal effects (refer to Section 1.2 for further details). Also, all sampling occurred in the winter season, so the conditions were constant throughout the data collection period. Data from this study also supports that there are minimal seasonal changes. Specifically, **Figure 25** shows that the QC samples collected at each turbine in March of 2017 are comparable to the samples collected in December 2016 and January 2017.

Table 6. Summary of vessel-based grab samples and seabed video collected within the BIWF study area in Year 1 and Year 2.

<table>
<tr><th>Sampling Period</th><th>Study Area</th><th>Number of Sample Stations</th><th>Number of Samples</th><th>Date of Data Collection</th></tr>
<tr><td rowspan="7">Year 1</td><td>Turbine 1</td><td>9</td><td>27</td><td rowspan="2">20 December 2016</td></tr>
<tr><td>Turbine 3</td><td>9</td><td>27</td></tr>
<tr><td>Turbine 5</td><td>9</td><td>27</td><td rowspan="3">20 January 2017</td></tr>
<tr><td>Control 1</td><td>4</td><td>12</td></tr>
<tr><td>Control 2</td><td>4</td><td>12</td></tr>
<tr><td>Control 3</td><td>4</td><td>12</td><td rowspan="2">21 March 2017</td></tr>
<tr><td>QC Samples</td><td>4</td><td>4</td></tr>
<tr><td rowspan="6">Year 2</td><td>Turbine 1</td><td>9</td><td>27</td><td rowspan="2">30 November 2017</td></tr>
<tr><td>Turbine 3</td><td>9</td><td>27</td></tr>
<tr><td>Turbine 5</td><td>9</td><td>27</td><td>30 November 2017
and
1 December 2017</td></tr>
<tr><td>Control 1</td><td>3</td><td>9</td><td rowspan="3">1 December 2017</td></tr>
<tr><td>Control 2</td><td>3</td><td>9</td></tr>
<tr><td>Control 3</td><td>3</td><td>9</td></tr>
</table>

For Year 2, co-located cluster grab samples and seabed video were collected concurrently over two consecutive days, November 30 and December 1, 2017 (Table 5). A total of 108 samples were collected at 36 sample stations within the three turbine and three control areas (refer to **Figure 10, Tables 4** and **6**).

Samples are named according to turbine (T) or Control (C) area, followed by station number (1 to 9) and sample number (1 to 3). As examples, the name T1-1_1 represents the first cluster sample taken at station 1 from Turbine 1, and C2-3_2 names the second cluster sample taken at station 3 within Control 2.

In addition, the Lagrangian floating camera system was used to complete a total of 15 dives over two days in Year 1 and 12 dives over three days in Year 2 (refer to **Figures 12** and **13, Table 7**).

Table 7. Dates seabed photography images were collected using a drifting camera system for Year 1 and Year 2.

Sampling Period	Study Area	Number of Drifts	Date of Data Collection
Year 1	Turbine 1	3	9 August 2017
	Turbine 3	3	
	Turbine 5	4	
	Control 1	2	28 June 2017
	Control 2	1	
	Control 3	2	
Year 2	Turbine 1	2	15 June 2018
	Turbine 3	2	17 May 2018
	Turbine 5	2	15 June 2018
	Control 1	2	12 June 2018
	Control 2	2	
	Control 3	2	

3.1.2 Particle Size Distribution (PSD) Analysis

Detailed results of the sediment grain size analysis of the vessel-collected grab samples are presented in **Appendix 2**. The sediment analysis confirms the sandy nature of the local seabed within the turbine and control areas. Year 1 and Year 2 show comparable sediment characteristics, with all samples being dominated by medium or coarse sand (**Figures 16** and **17, Table 8**). More specifically, medium and coarse sand fractions, combined with very coarse sand, comprise greater than 90 percent of the sediment composition at 115 of the 121 samples in Year 1 and at 105 of the 108 samples in Year 2 (although the remaining three samples contained >85 percent). Regarding finer sediments, clay and silt sized particles were recorded within 14 samples for Year 1 and two samples for Year 2. These fractions were recovered in minimal quantities within each sample, comprising less than 1 percent of total sediment composition. Coarser gravel and cobble grade particles were also frequently noted from the grab samples and from contemporaneous seabed video footage (see **Section 3.1.3** below). In addition, boulders were noted at stations within Control 1 in Year 1.

The proportion and distribution patterns of each sediment grain size fraction were highly similar for both sampling years. The proportion of fine grain sand (particles of diameter 150–250 µm) within the samples varied between 0 and 17.9 percent for Year 1 and 0 and 14.4 percent for Year 2 (**Table 9**). Highest levels tended to be associated with Turbine 1 for both years (mean Year 1 = 5.5 percent, Year 2 = 6.2 percent). Levels at stations at Turbines 3 and 5 were lower, averaging 0.7 and 1.5 percent at Turbine 3, and 1.6 percent and 0.6 percent at Turbine 5 for Year 1 and Year 2, respectively. Among the control areas, the mean levels of fine sand ranged from 0.1 to 4.5 percent in Year 1 and 0.7 to 2.7 percent in Year 2. The mean levels of fine sand were higher at Control 1, but lower at Control 2 and 3 for Year 2 compared to Year 1 values. The minimal temporal changes in the fine sand component at the turbine locations were largely within the natural variation noted for the control stations.

The proportion of medium grade sand (particles of diameter 250–500 µm) within the samples varied between 2.9 and 62.2 percent for Year 1 and 16.3 and 57.3 percent in Year 2. Highest levels tended to be associated with Turbine 1 (mean = 49.6 percent for both years). Levels at stations at Turbines 3 and 5 were slightly lower, averaging 29.0 and 37.8 percent at Turbine 3, and 25.9 and 29.6 percent at Turbine 5 for Year 1 and Year 2, respectively. Among the control areas, the mean levels of medium sand ranged from 25.7 to 43.9 percent in Year 1 and 31.0 to 37.0 percent in Year 2. The minor temporal differences in the medium sand composition at turbine locations were broadly reflective of the natural variation indicated at the control stations.

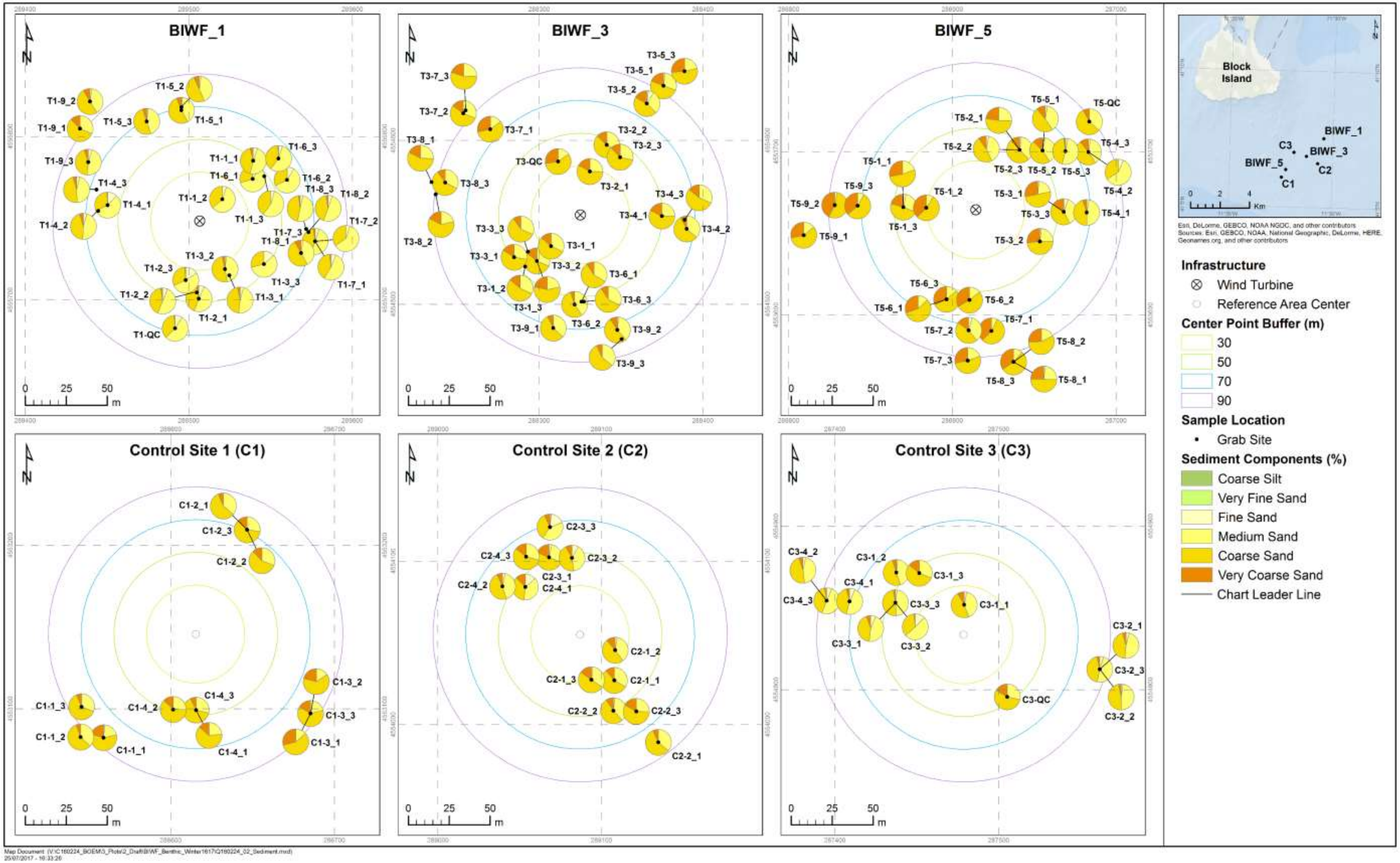


Figure 16. Distribution of sediment fractions of vessel-based sediment samples collected in Year 1.

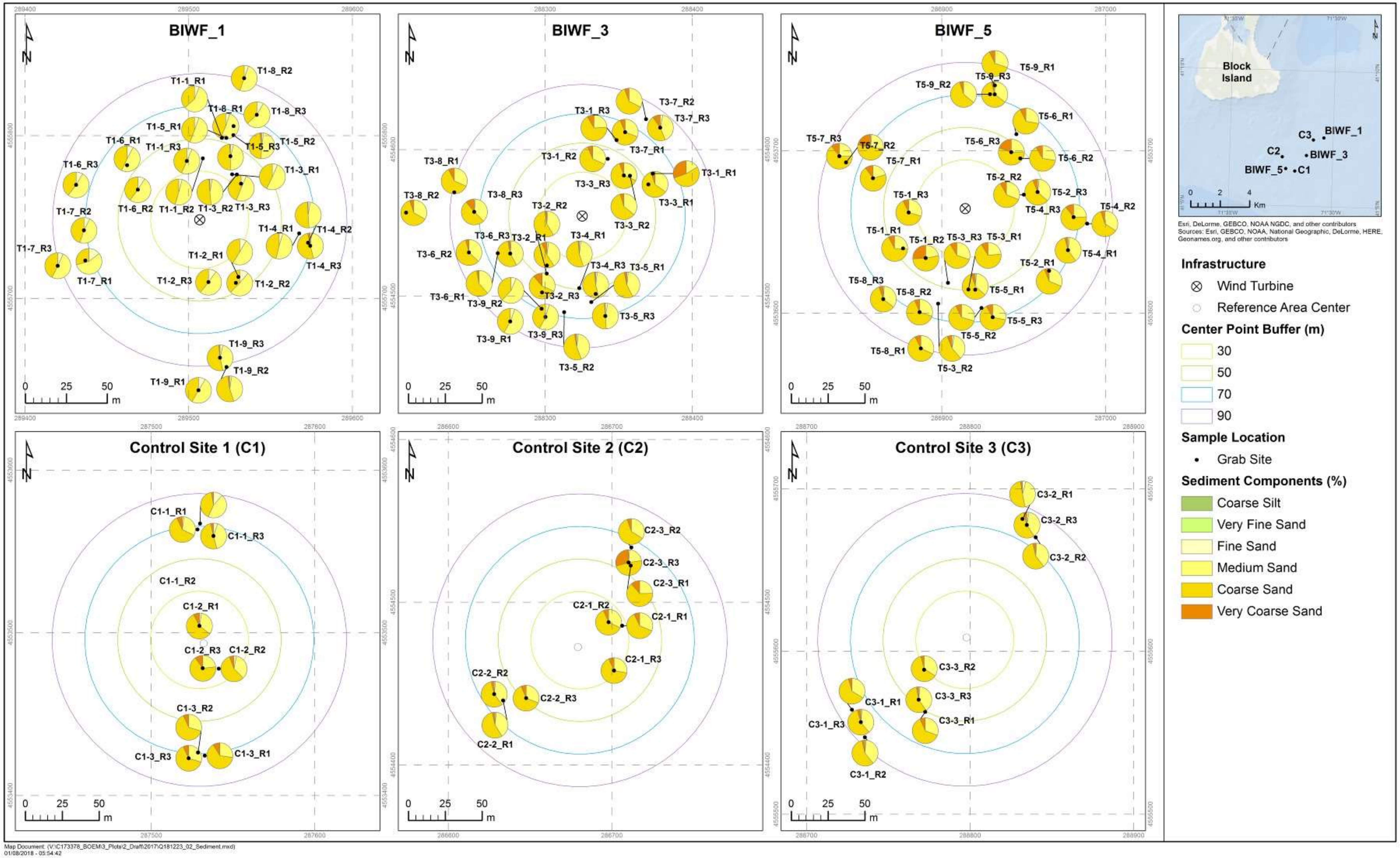


Figure 17. Distribution of sediment fractions of vessel-based sediment samples collected in Year 2.

Table 8. Summary of grain size analysis of vessel-based sediment samples collected within each study area for Year 1 and Year 2.

Sampling Period	Study Area	Total Samples	Number of Samples for which:			
			Dominant Grain Size = Medium Sand	Dominant Grain Size = Coarse Sand	Combined Sand Fraction > 90%	Combined Clay and Silt > 0%
Year 1	Turbine 1	28	20	8	25	0
	Turbine 3	28	0	28	28	2
	Turbine 5	28	3	25	28	4
	Control 1	12	0	12	12	1
	Control 2	12	2	10	10	6
	Control 3	13	7	6	12	1
Year 2	Turbine 1	27	21	6	25	0
	Turbine 3	27	3	24	27	0
	Turbine 5	27	0	27	27	0
	Control 1	9	1	8	8	0
	Control 2	9	0	9	9	1
	Control 3	9	0	9	9	1

Note: All samples were dominated by medium or coarse sand and few samples contained any fine sediments. Sand fraction is defined as the combination of medium sand, coarse sand, and very coarse sand. Note for the combined clay and silt fractions, total contribution was less than 1 percent for all samples. Grain size fractions are classified according to the Wentworth scale.

Table 9. Mean of each sediment grain size fraction for vessel-based sediment samples collected within each study area for Year 1 and Year 2.

Sampling Period	Study Area	Average Fraction of:					
		Clay and Silt	Very Fine Sand	Fine Sand	Medium Sand	Coarse Sand	Very Coarse Sand
Year 1	Turbine 1	0.0%	0.0%	5.5%	49.6%	41.6%	3.4%
	Turbine 3	0.0%	0.1%	0.7%	29.0%	55.3%	17.9%
	Turbine 5	0.01%	0.1%	1.6%	25.9%	50.3%	22.1%
	Control 1	0.02%	0.1%	0.1%	25.7%	60.4%	13.6%
	Control 2	0.22%	0.3%	4.5%	34.7%	48.8%	11.5%
	Control 3	0.07%	0.0%	4.2%	43.9%	45.9%	6.0%
	Range	0 - 0.98%	0 – 1.8%	0 – 17.9%	2.9 – 62.2%	28.8 – 64.0%	0.5 – 42.3%
Year 2	Turbine 1	0.0%	0.0%	6.2%	49.6%	43.4%	0.9%
	Turbine 3	0.0%	0.0%	1.5%	37.8%	55.0%	5.7%
	Turbine 5	0.0%	0.0%	0.6%	29.6%	61.0%	8.8%
	Control 1	0.0%	0.0%	2.7%	32.6%	58.0%	6.7%
	Control 2	0.0%	0.0%	0.7%	31.0%	59.3%	9.0%
	Control 3	0.1%	0.07%	1.3%	37.0%	57.4%	4.1%
	Range	0 - 0.9%	0 – 0.6%	0 – 14.4%	16.3 – 57.3%	29.1 – 69.6%	0 – 30.3%

Note: The range of each grain size fraction within is study area is also provided. Grain size fractions are classified according to the Wentworth scale.

The proportion of the coarse sand fractions (particles of diameter 500–1,000 µm) across the study area varied between 28.8 and 64.0 percent for Year 1 and 29.1 and 69.6 percent for Year 2. Levels were comparable across all the turbine and control sites for both years. In Year 1, the highest levels were associated with Turbine 3, Turbine 5, and Control 1 (mean = 55.3 percent, 50.3 percent, and 60.4 percent, respectively), whereas, levels at Turbine 1, Control 2, and Control 3 were slightly lower (mean = 41.6 percent, 48.8 percent, and 45.9 percent, respectively). In Year 2, levels were nearly equal within all study areas (mean ranges between 55.0 and 61.0 percent), with the exception of Turbine 1, which exhibited a relatively lower mean (43.4 percent).

The proportion of very coarse sand (particles of diameter 1,000–2,000 µm) within the samples varied between 0.5 and 42.3 percent for Year 1 and 0 and 30.3 percent in Year 2. Mean levels were higher in the Year 1 samples, relative to Year 2. Highest levels tended to be associated with Turbines 5 (mean Year 1 = 22.1 percent, Year 2 = 8.8 percent), followed by Turbine 3 (mean Year 1 = 17.9 percent, Year 2 = 5.7 percent). Levels at stations at Turbine 1 were lower (mean Year 1 = 3.4 percent, Year 2 = 0.9 percent), and lower than those found at the control stations. Among the control areas, the mean levels of very coarse sand ranged from 6.0 to 13.6 percent in Year 1 and 4.1 to 9.0 percent in Year 2.

Overall, similar patterns can be seen in the distribution of sediment within each turbine area for Year 1 and Year 2 (refer to **Figures 16** and **17, Table 9**). The minor temporal fluctuations evident in sediment composition were largely reflected at the control stations, indicating the change was caused by natural variations. The data indicate grain size increases across the study area from Turbine 1 to Turbine 5. Turbine 1 exhibits the highest fractions of fine and medium sand, and, conversely, the lowest fractions of coarse and very coarse sand. The sediment becomes coarser moving to Turbines 3 and 5, Year 1 Control 1, and Year 1 Controls 1 and 2, which all share similar characteristics. These areas have greater amounts of coarse and very coarse sand and less fine and medium sand, relative to Turbine 1. The Year 1 Controls 2 and 3 and Year 2 Control 3 fall mid-way along this spectrum.

Coarser grade gravel and cobble particles were not included in the particle size distribution analysis however an indication of the relative proportion of these sediment grades within each of the current samples is provided from cobble weight data recorded as part of data processing. Using these data, the greatest proportions of cobbles were found to be associated with Turbine 1 and Control 3, while lesser amounts of cobbles were recorded around Turbines 3 and 5.

Scatter plots of the levels of combined clay, silt and fine sand (particles <250 µm) for all turbine samples with respect to distance from the center of its respective turbine foundation revealed no strong correlations for Year 1 or Year 2 (**Figure 18**). While a weak inverse relationship (R^2 = 0.1912) of increasing fine sediment levels with decreasing distance to Turbine 1 was found in Year 1, the relationship did not continue in Year 2.

Figure 18. Proportion of fine sediment (particles <250 µm diameter) from vessel-based sediment samples with distance from the center point under each turbine foundation structure at BIWF for Year 1 and Year 2.

3.1.3 Seabed Video Analysis

The underwater video footage from Year 1 and Year 2 complemented and provided context for the grab sample data. Visual analysis of the video provided details about the general type and distribution of various sediment types (e.g., boulder, cobble, gravel, sand) and bedforms, as well as the overall homogeneity of the seafloor in the vicinity of the grab sample locations. Detailed descriptions of the video analysis and a representative image from each sample site are presented in **Appendix 3**.

In general, the video confirms that the turbine and control areas have comparable sedimentary environments, being dominated by sand of medium to very coarse grain size and with various concentrations of gravel and/or cobble present throughout. It is expected that the seabed is naturally mobile within the BIWF study area, as evidenced by the presence of sand waves and sand ripples in the video footage, resulting in the constant winnowing and erosion of fine sediment particles from the seabed. However, the degree to which this occurs varies amongst the turbines. Extensive and well-defined sand waves and ripples are visible in the video collected at all the Turbine 5 stations, whereas the Turbine 1 video footage shows that there are no visible bedforms or that there are sand waves and ripples of very low relief at each station. Turbine 3 falls in the middle of this gradient. All of these findings are consistent from Year 1 to Year 2.

Control 1 in Year 1 was exceptional in that it exhibited areas of boulders, in addition to cobble, gravel, and coarse sand. This area also contained the only two sample sites found not to be homogeneous; instead, having alternating patches of cobble and gravel and of bare coarse sand.

Regarding biological features, the presence of the blue mussel, *Mytilus edulis*, was considered the epifaunal species of greatest interest for this study and was noted from the video footage. A substantial difference in the distribution of *M. edulis* was apparent from Year 1 to Year 2 within the turbine areas (**Table 10**). In Year 1, the only evidence of *M. edulis* occupying the vicinity was provided by empty shells. Such shells were visible at seven sample sites, located at six sites and one site within Turbines 3 and 5, respectively. In Year 2, however, *M. edulis* was much more prevalent throughout the turbine areas, particularly Turbines 1 and 3. Individuals and/or clusters of individuals were noted at 27 sample sites (although a designation of living or non-living could not be confidently determined from the video). In addition, empty shells were noted at 18 sites. In contrast, *M. edulis* was not recorded in any of the video footage collected within the control areas for Year 1 or Year 2, with the exception of a few individuals at one site (Year 2 Control 2). The increased frequency of *M. edulis* in Year 2 throughout all the turbine areas strongly suggests the species has increased in abundance and/or distribution. Further, that this increase did not also occur within the control areas indicates the change is caused by colonization of the turbine structures, rather than natural variation.

Other faunal species were visible within the video footage for all study areas, except Turbine 3 for both Year 1 and Year 2. For Year 1, barnacles were present at 31 of these sample sites (2 sites at Turbine 1, 8 at Turbine 5, 21 at Controls); starfish were present at 9 sample sites (1 site at Turbine 5, 8 sites at Controls 1 and 3); bivalves identified as *Astarte borealis* or *Astarte castanea* were present at 15 samples sites (Turbine 5); the sponge, *Polymastia robusta*, at 6 sample sites (4 sites at Turbine 1, 2 sites at Control 1); and spider crabs were present at one site (Turbine 5). For Year 2, barnacles were present at 17 sample sites (5 sites at Turbine 1, 4 sites at Turbine 5, 8 sites at Control 1); bivalves identified as *Astarte borealis* or *Astarte castanea* were present at 3 samples sites (Control 2); and the sponge, *Polymastia robusta*, at 5 sample sites (3 sites at Turbine 1, 2 sites at Control 1). The most notable difference between Year 1 and Year 2 is the absence of the bivalve, *Astarte*, at Turbine 5. Starfish were also absent, although the majority of the recorded Year 1 sightings were in Control 1, which was not resampled in Year 2.

Table 10. The number of samples stations and category (e.g., individuals, cluster[s], empty shell[s]) of mussels that were identified in the vessel-based video collected for Year 1 and Year 2.

Sampling Period	Study Area	Total Samples	Individuals	Cluster(s)	Individuals and Cluster(s)	Empty Shell(s)
Year 1	Turbine 1	26	0	0	0	0
	Turbine 3	26	0	0	0	6
	Turbine 5	27	1	0	0	0
	Turbine Total	79	0	0	0	7
	Control Areas	36	0	0	0	0
Year 2	Turbine 1	27	2	7	2	1
	Turbine 3	27	8	4	1	2
	Turbine 5	27	3	0	0	15
	Turbine Total	81	13	11	3	18
	Control Areas	27	1	0	0	0

Note: The defined categories are unable to identify mussels as living or non-living, with the exception of "Empty Shell(s)." Also note that video was not collected at two stations in Year 1.

3.1.4 Seabed Photography Analysis

Detailed field survey records for the Lagrangian floating camera deployments are presented in **Appendix 4**. Hundreds of images were collected during each dive. Example still images and a mosaic from a subset of the turbine and control areas for both years are presented in **Figures 19** and **20.** The high-resolution images and mosaics allow for clear interpretation of the seabed, including geological characteristics (e.g., sand, gravel, boulders), biological characteristics (e.g., organisms, shell hash), and artificial features (e.g., concrete mats overlaid on portions of the buried cable). Further, the mosaics present the turbine and control areas in a broader context and provide detailed information regarding heterogeneity.

The imagery from the float camera further supports the findings of the video and sediment grain size analyses, including that there is no noticeable change in sediment characteristics within the turbine areas from Year 1 to Year 2; that Year 1 Control 1 is distinct relative to the other study areas in both years, as it is characterized as a more variable environment and contains boulders throughout; and that the turbine and control areas have sedimentary environments characterized by coarse seabed deposits (e.g., cobble, gravel, medium to very coarse grain sand), although this occurs along a gradient from Turbine 1 (finest sediments) to Turbine 5 (coarsest sediments).

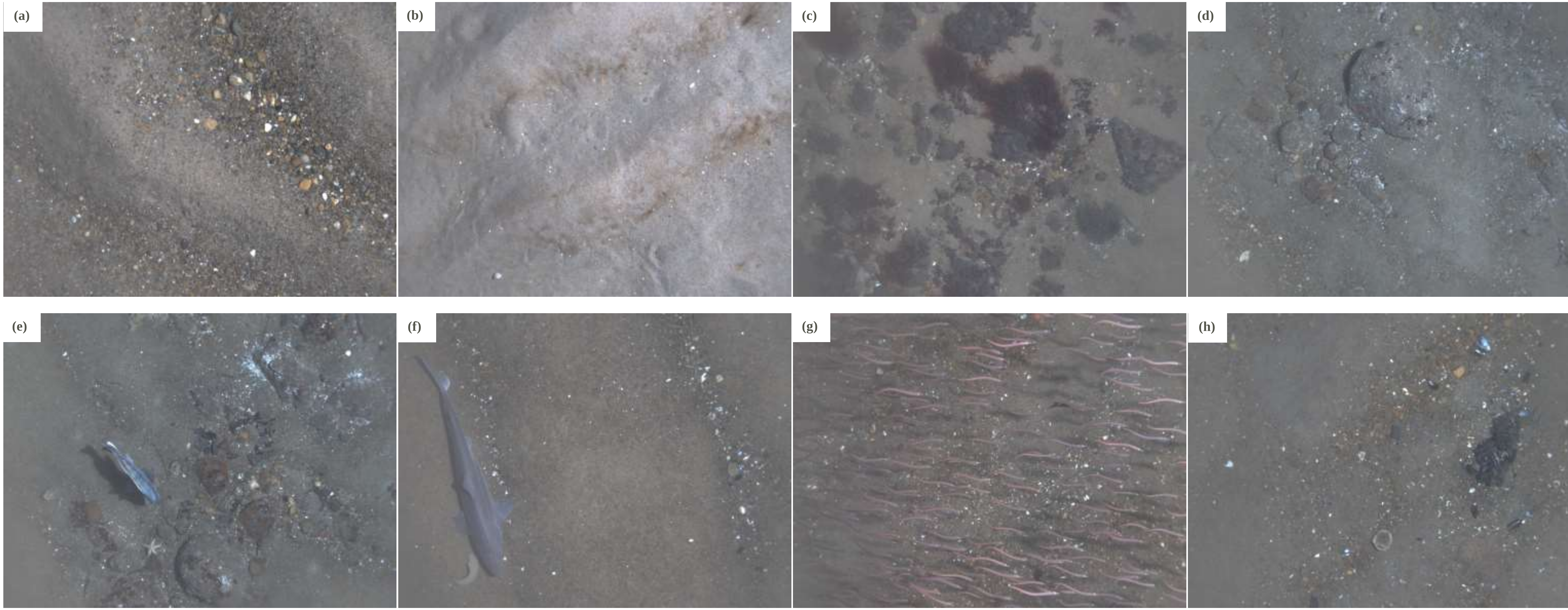


Figure 19. Example images taken by the float camera system in Year 1 and Year 2. Images (a) and (b) are largely representative of the seafloor environment within turbine 1 and 3 and control areas 2 and 3 for both years.

Note: The images show (a) areas with sand waves comprised of grain sizes ranging from coarse sand to gravel and (b) areas of fine sand. Turbine 5 exhibits patchy concentrations of cobbles and boulders (c). Control 1 in both years was notably different, being characterized by cobbles and boulders (d). Images e to h highlight some of the fauna that was present in the study areas: (e) black sea bass; (f) one of many spiny dogfish that were present at Turbine 5 in Year 2; (g) school of sand lance; (h) skate and cluster of mussels on seafloor.

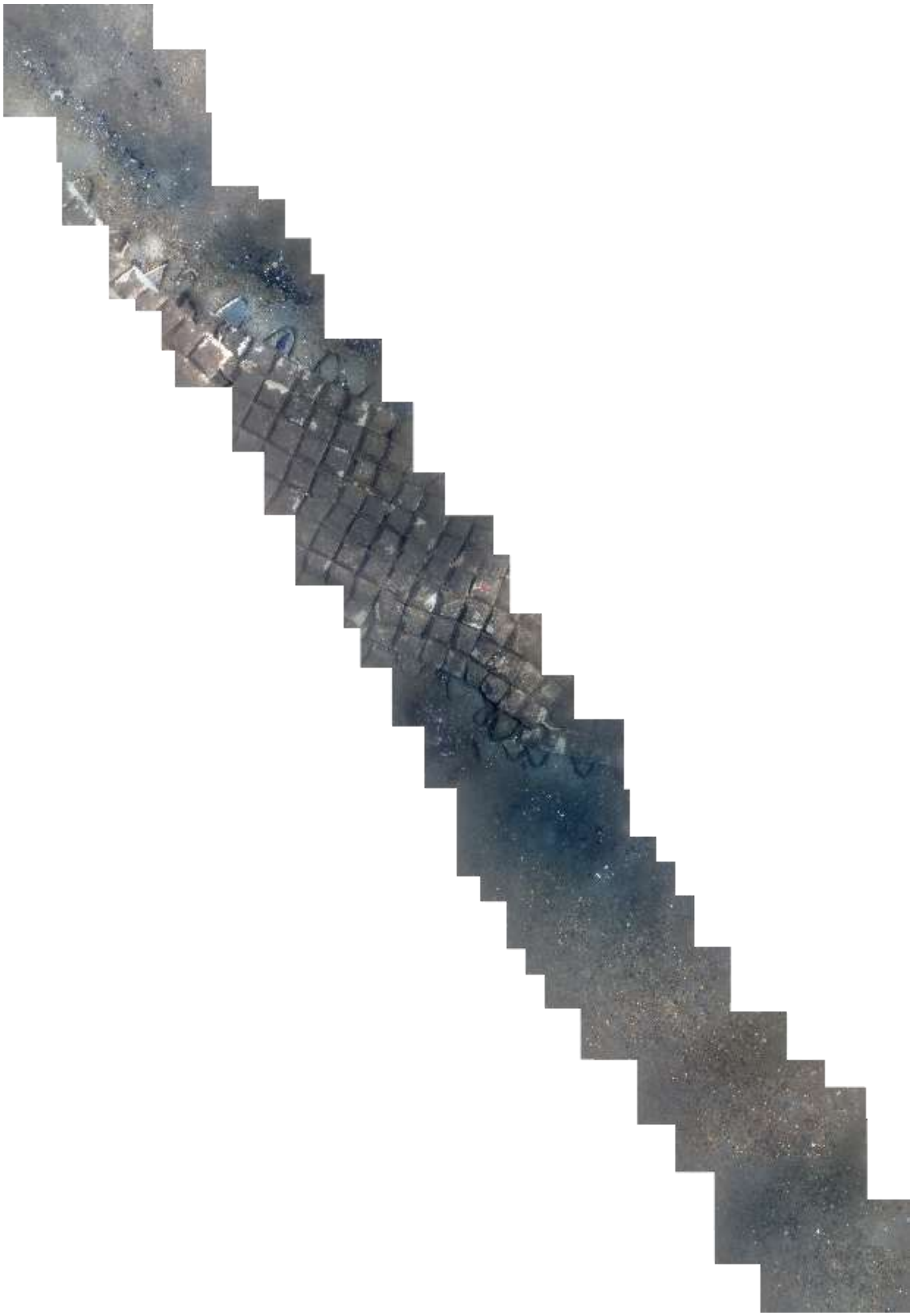


Figure 20. Example mosaic created from photographs taken by the float camera system in Year 1.

Note: The mosaics shows transition zones between gravelly and sandy seabed environments, shell hash (mostly blue mussel shells), and a portion of the concrete mat overlaid on sections of the buried cable. Also visible are fish and a lobster seeking cover under the concrete mat.

3.1.5 Sediment Organic Content

The results of the analysis for total percent organic content (OC) and TOC content of the sediment samples collected in Year 1 and Year 2 are presented in **Appendix 5**. Minimal levels of OC and TOC were recorded for each sample and no appreciable change is evident between Year 1 and Year 2 (**Figure 21, Table 11**). As such, the null hypothesis that there is no impact on distance from the wind farm foundation regarding organic enrichment can be accepted (H03) with respect to samples collected greater than 30m from the center point of the turbine foundation. Data supporting this conclusion are presented below.

Table 11. Average total organic content and total organic carbon content for each study area for vessel-based sediment samples collected in Year 1 and Year 2.

Sampling Period	Study Area	Average Total Organics (%)	Average Total Organic Carbon (%)
Year 1	Turbine 1	0.33%	0.14%
	Turbine 3	0.43%	0.19%
	Turbine 5	0.47%	0.20%
	Turbine Areas Combined	0.42%	0.18%
	Control Areas	0.44%	0.19%
Year 2	Turbine 1	0.46%	0.20%
	Turbine 3	0.42%	0.18%
	Turbine 5	0.41%	0.17%
	Turbine Areas Combined	0.45%	0.18%
	Control Areas	0.52%	0.22%

Levels of OC in the samples collected in Year 1 ranged between 0 and 1.0 percent, with an average of 0.42 and 0.44 percent for the turbine areas and control areas, respectively. For Year 2, values ranged from 0.06 to 1.21 percent. Average levels were 0.45 and 0.52 percent for the turbine areas and control areas, respectively. The average OC levels calculated each year for each study area were broadly similar (0.43 to 0.52 percent), although a slightly lower average was recorded for Turbine 1 in Year 1 (0.33 percent).

With regards to TOC, levels for samples collected in Year 1 ranged between 0 and 0.45 percent, with an average of 0.18 percent for the turbine areas and 0.19 percent for the control areas. The Year 2 samples had a TOC range between 0.03 and 0.52 percent. Average levels were 0.18 and 0.22 percent for the turbine areas and control areas, respectively. Similar to the organic content analysis, the average TOC levels calculated each year for each study area were comparable (0.17 to 0.22 percent), although Turbine 1 in Year 1 had a slightly lower average (0.14 percent).

The TOC level for each sample plotted against distance from the center point of its respective turbine foundation is presented in **Figure 22**. No significant relationship between TOC and distance was evident in Year 1 or Year 2 for any of the turbine areas. Additionally, ANOVA tests revealed no statistically significant differences ($p>0.05$) in sediment OC between study areas, distance bands, or sampling years.

3.1.6 Macrofaunal Analysis

A summary of the total species abundance and species richness for all macrofaunal samples collected within the turbine and control areas for Year 1 and Year 2 is provided in **Table 12**. A species abundance matrix for all samples for both years is presented in **Appendix 6**. Summary species statistics including species richness, abundance and derived univariate measures for all Year 1 and Year 2 samples are presented in **Appendix 7**.

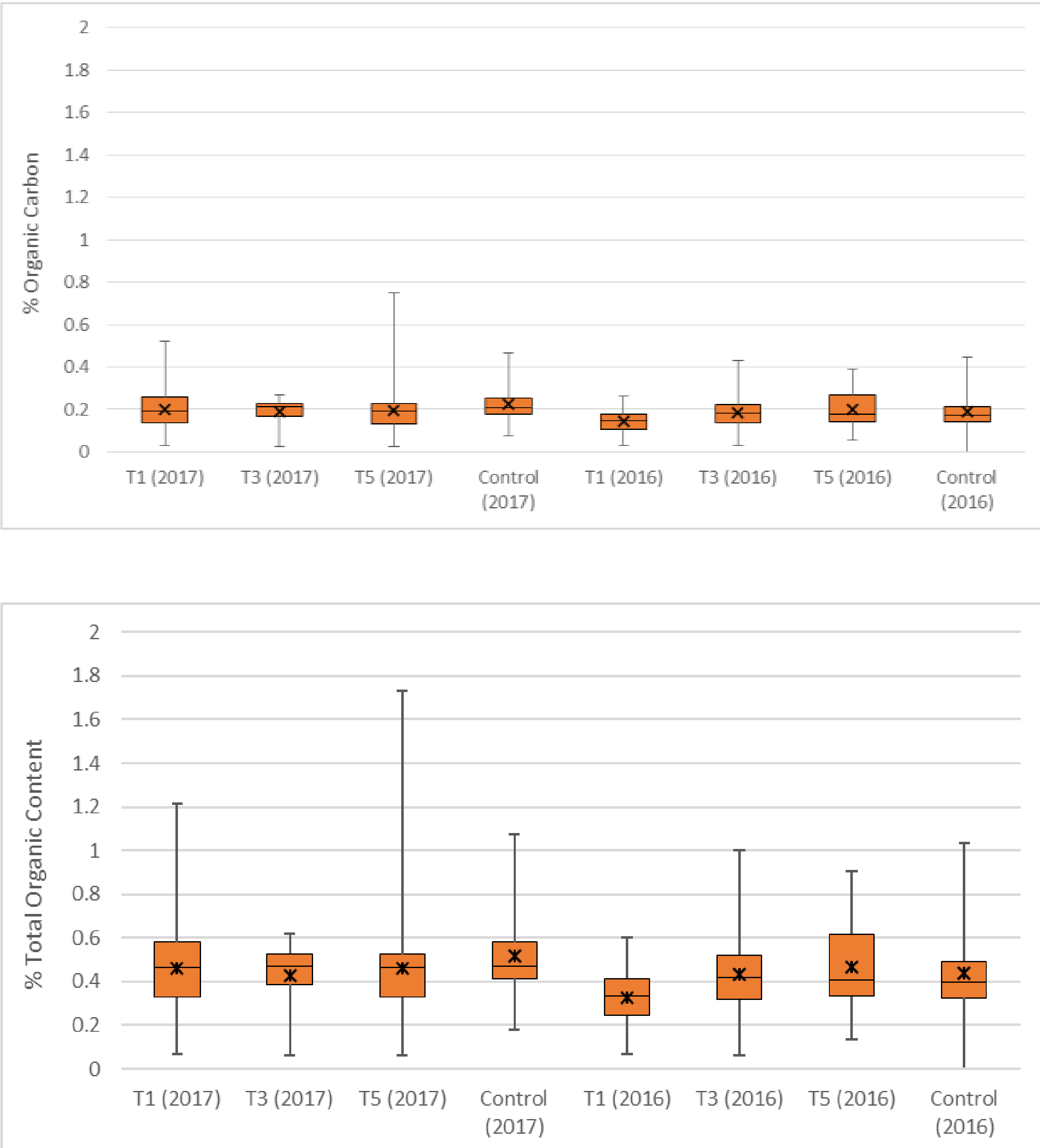


Figure 21. Box plot summarizing the organic carbon content and total organic carbon of vessel-based sediment samples collected in Year 1 and Year 2.

Figure 22. Levels of TOC in vessel-based sediment samples plotted against distance from the center point under each turbine foundation structure at BIWF for Year 1 and Year 2.

Table 12. Summary of species abundance and species richness for all vessel-based macrofaunal samples collected within the turbine and control areas for Year 1 and Year 2.

Study Area	Year 1 (n=117 samples)			Year 2 (n=108 samples)		
	Species Richness (all species)	Species Abundance (all species)	Species Abundance (Nematoda excluded)	Species Richness (all species)	Species Abundance (all species)	Species Abundance (Nematoda excluded)
All Study Areas Combined	139	17,804	13,684	131	61,835	20,033
Turbine 1	78	1,939	1,677	86	4,896	2,056
Turbine 3	64	5,182	3,838	75	21,924	5,710
Turbine 5	79	4,925	3,424	70	16,752	5,778
Turbine Areas Combined	--	12,046	8,939	--	43,572	13,544
Control 1	76	2,212	1,844	61	3,304	1,542
Control 2	69	2,092	1,686	57	11,213	3,383
Control 3	66	1,454	1,215	45	3,746	1,564
Control Areas Combined	--	5,758	4,745	--	18,263	6,489

Note: Four Year 1 QC samples are not included here.

3.1.6.1 Comparison of Sampling Years

In Year 1, a total of 139 macrofaunal species represented by 17,804 individuals were recorded from the 117 grab samples (**Table 12**; note: the four QC samples are excluded here). The majority (96.5 percent) of the macrofauna were annelids (i.e., polychaetes), nematodes, and crustaceans (i.e., amphipods) (**Figure 23**). From the 108 grab samples collected in Year 2, a total of 61,835 individuals belonging to 131 species were recovered. The majority (96.6 percent) of the macrofauna were nematodes and annelids (i.e., polychaetes). The large discrepancy between the total abundance between the Year 1 and Year 2 samples is primarily attributed to an increase in nematodes. In Year 1, a total of 4,120 nematodes were identified, whereas in Year 2, this number increased by a factor of 10 to 41,802 individuals (refer to **Table 12**). The cause of this increase is unknown. When Year 1 versus Year 2 abundances are considered without nematodes, the totals are more comparable, although there is still a noticeable increase of 4,605 individuals over the three turbine areas in Year 2.

With regards to species richness, a combined total of 175 species were identified across all of the Year 1 and Year 2 samples (**Table 13**). Of those, 93 species were recovered in both years, while 45 and 37 species were present solely in Year 1 and Year 2, respectively. Of the 45 species unique to Year 1, only 11 had a total abundance greater than 10 (8 species had abundances between 19 and 50, and the remaining three species had abundances of 59, 70, and 154). For Year 2, only four of the 37 unique species had total abundances greater than 10 (they were 14, 19, 64, and 241). These results indicate that the species unique to each year have minimal influence on overall macrofaunal community composition. Rather, it is the 93 species (or likely a subset of) that are common to both years that are ecologically meaningful.

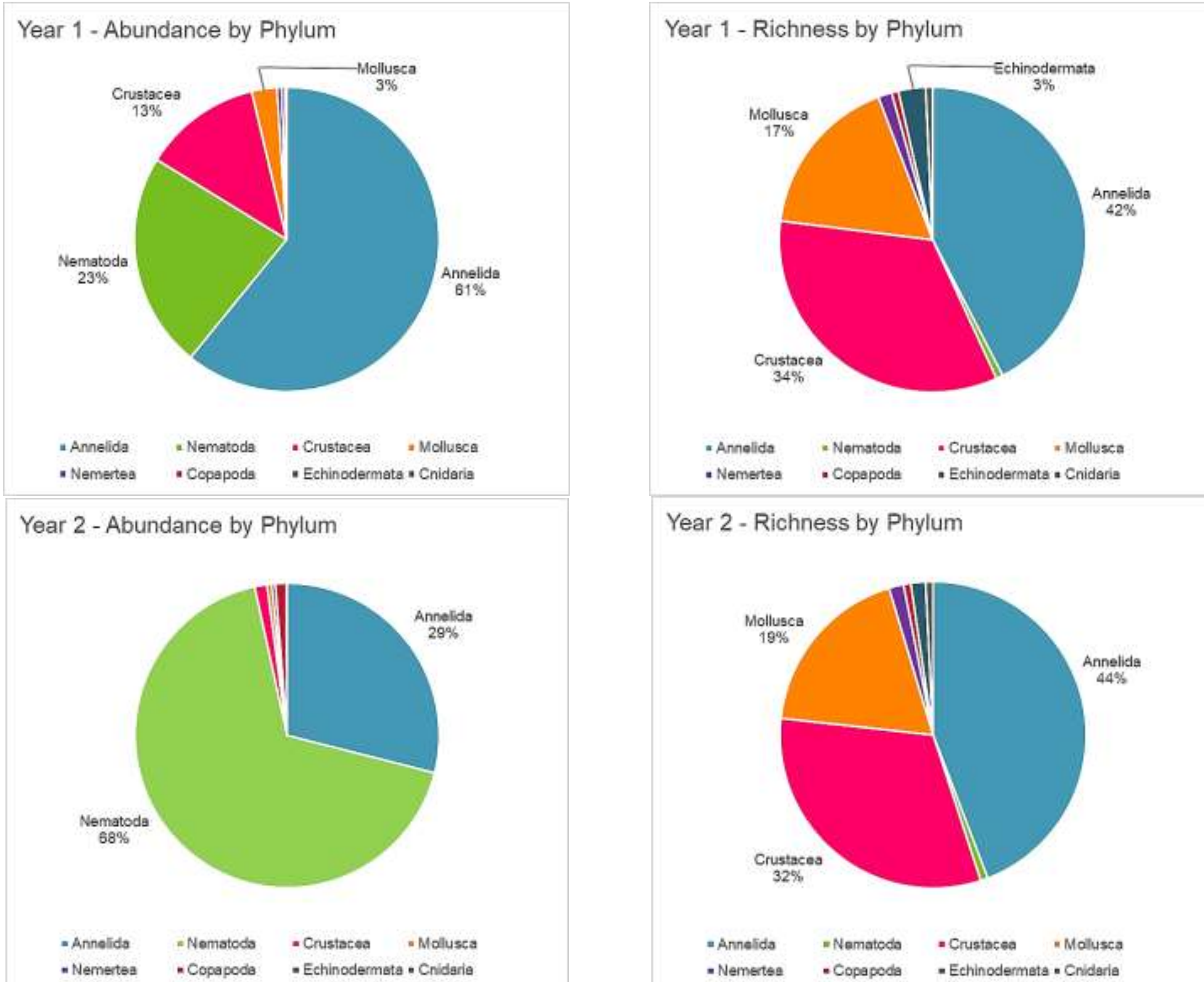


Figure 23. Proportion contribution of macrofauna identified in vessel-based grab samples characterized by phylum to the total abundance and total species richness for Year 1 and Year 2.

Note: Percent labels are not shown when a phylum has a total contribution of less than 1.5 percent.

Table 13. Number of species recovered in vessel-based grab samples for Year 1 and Year 2 combined and individually.

Sampling Period	Number of species present in:
Year 1 and Year 2	93
Year 1 only	45
Year 2 only	37
Total	**175**

By phylum, the dominant faunal group in Year 1 was Annelida, which accounted for 61 percent of the total abundance and 42 percent of the total number of species (**Figure 23**). Polychaetes comprised the Annelida phylum, with the exception of one Oligochaeta species (with 42 individuals found within 14 samples). The second dominant phylum was Nematoda, comprising 23 percent of all fauna. Nematodes were identified to the phylum level, and, therefore, the number of species present cannot be provided. Crustaceans, principally amphipods, were 12.5 and 34 percent of the total species abundance and richness, respectively. The remaining phyla were Molluska, Nemertea, Copepoda, Echinodermata, and Cnidaria, with a combined contribution of 3.5 and 23 percent to the total abundance and richness, respectively.

In Year 2, the primary and secondary faunal group switched, with Nematoda dominating, followed by Annelida. Specifically, nematodes accounted for 68 percent of the total abundance. Because nematodes were identified to the phylum level, the number of species present cannot be provided. The Annelida phylum was comprised of polychaete species, with the exception of one Oligochaeta species (with 53 individuals across 29 samples). These polychaetes contributed 29 percent of the total abundance and 44 percent of the total number of species. Crustacea and Molluska contributed 32 and 19 percent to the total species richness, respectively, although each accounted for less than 1.5 percent of the total abundance. The remaining phyla (i.e., Nemertea, Copepoda, Echinodermata, and Cnidaria) comprised less than 1.5 percent of the total abundance and richness.

Overall, total richness by phylum was highly similar between Year 1 and Year 2, indicating the number of species within each phylum remained consistent over time, despite that there were unique species present in each year. Total abundances by phylum was more variable from Year 1 to Year 2, but are broadly comparable in that both years are overwhelmingly dominated by polychaetes and nematodes, accounting for 83.8 percent of the total in Year 1 and 96.6 percent in Year 2. Also, the phyla Molluska, Echinodermata, Nemertea, Cnidaria, and Copepoda offer minimal contributions and no appreciable change is evidence between years.

The most distinct difference between Year 1 and Year 2 is that annelids were just over twice as abundant as nematodes in Year 1, whereas the reverse is true in Year 2. While the change is largely a result of a ten-fold increase in nematode abundance from Year 1 to Year 2, the number of polychaetes recovered also increased from 11,147 individuals in Year 1 to 17,905 in Year 2. Examination of the macrofaunal data indicates that the overall increase is largely due to an increase in abundance of 9 of the 15 most dominant polychaete species from Year 1 to Year 2. The greatest increase occurred for the spionid worms, *Parapionosyllis longicirrata* (+1,893) and *Sphaerosyllis erinaceus* (+1,430); the eunicid worm, *Parougia caeca* (+920); the small interstitial worms, *Pisione* sp (+899) and *Polygordius* sp (+736); and the terebellid worm, *Polycirrus eximius* (+663). Further, two species that were not dominant in Year 1 showed noticeable increases in abundances, namely *Syllides longocirratus* (+391) and *Travisia carnea* (+141). Two of the dominant polychaete species, *Lumbrinereis acuta* and *Lumbrinereis fragilis*, maintained constant abundances. The remaining four dominant polychaetes experienced a decline, the greatest being the calcareous tube dwelling worm, *Spiroris borealis* (-715), followed by the sand tube dwelling worm, *Sabellaria vulgaris* (-562), although these species exhibited a patchy distribution in Year 1. In particular, *Spirobis borealis* were recovered only in samples collected within Control 1, which was not resampled in Year 2.

Variability between years is also seen in the total abundance of crustaceans, which declines from 13 percent in Year 1 to less than 1.5 percent in Year 2, although the total richness remains essentially the same (34 percent and 32 percent). Examination of the macrofaunal data shows an overall decline of all crustacean species, except for the amphipod, *Unciola irrorata*, which recorded 458 and 431 individuals in Year 1 and Year 2, respectively. Amphipods that showed a noticeable decline between years included *Ampelisca vadorum*, *Byblis serrata*, *Corophium* spp, *Erichthonius rubricornis*, *Gammaropsis maculata*, *Jassa marmorata*, *Lembos websteri*, and *Tanaissus psammophilus*. The barnacle, *Amphibalanus amphitrite*, also showed a substantial decline, but the high abundance in Year 1 was attributed to samples collected within Controls 1 and 3, which were not resampled in Year 2.

Spatially, in Year 1, polychaetes, nematodes, crustaceans, and mollusks were broadly distributed over the BIWF study area, being recovered within 121, 119, 115, and 103 samples, respectively, of the 121 total samples. Polychaetes dominate 27 and co-dominate 57 samples, and nematodes dominate 25 and co-dominate 49 samples. Polychaetes and/or nematodes dominate or co-dominate all of the 81 samples collected within in the turbine areas, with the exception of two. One sample within Turbine 1 was dominated by the barnacle, *Amphibalanus amphitrite*, and one sample within Turbine 5 is co-dominated by the amphipods *Gammaropsis maculata* and *Erichthonius rubricornis*. Amphipods (primarily *Unciola irrorata*) and barnacles also co-dominate seven and three samples, respectively, all within Turbine 1.

Similar spatial distribution patterns were found for Year 2. Polychaetes, nematodes, crustaceans, and mollusks were recovered within 108, 105, 105, and 86 samples, respectively, of the 108 total samples collected within the turbine and control areas. Nematodes dominated or co-dominated 77 of the 81 turbine samples. Specifically, nematodes overwhelmingly dominate 66 samples, followed by polychaetes present in much smaller abundances. Nematodes co-dominate with polychaetes in nearly equal abundances for 10 samples and with nemertea for one sample. There are two samples for which nematodes are present, but do not dominate, both located within Turbine 1. One sample is dominated by the polychaete, *Polygordius* spp., and the other is co-dominated by *Polygordius* spp. and the amphipod, *Unicola irrorata*. Two turbine samples did not contain nematodes; both were located within Turbine 5 and were dominated by polychaetes. Precisely, one sample is co-dominated by *Parougia caeca* and *Pisione* sp. and the other sample is co-dominated by *Polygordius* spp. and *Polycirrus eximius*.

For Year 1, the most conspicuous species present across all samples within both the turbine and control areas, in terms of highest overall abundances, include nematodes and the polychaetes *Polycirrus eximius*, *Polygordius* spp., *Lumbrinereis acuta*, *Pisione* sp., *Goniadella gracilis*, *Spirorbis* sp., *Sabellaria vulgaris*, *Parapionosyllis longicirrata*, *Aricidea catherinae* and *Cirrophorus* sp. (**Table 14**). Also abundant are the amphipods *Unciola irrorata*, *Ampelisca vadorum*, *Erichthonius rubricornis*, *Tanaissus psammophilus*, *Gammaropsis maculata* and *Corophium* spp, as well as the barnacle *Amphibalanus amphitrite*. Although comparatively less well represented within the samples, key mollusk species included the bivalves *Mytilus edulis*, *Spisula solidissima* and *Lyonsia arenosa*.

Of the top ten most abundant species, seven exhibited a broad distribution across the study areas. Precisely, four species were recovered in over 100 samples of the 121 samples collected, two were identified in 77 samples and one species was present in 76 samples (refer to **Table 14**). Accordingly, these seven species are also on the list of top 10 most frequently occurring species.

Table 14. Top 10 most abundant and frequently occurring species for vessel-based grab samples across all study areas collected in Year 1 and Year 2.

Year 1 - Most Abundant			
Species	**Taxonomic Group**	**Total Abundance**	**Occurrence (n=121)**
Nematode*	Nematoda	4,196	119
*Polycirrus eximius**	Polychaete	1,959	77
Polygordius spp*	Polychaete	1,806	112
*Lumbrinereis acuta**	Polychaete	1,361	102
Pisione spp.*	Polychaete	1,325	76
*Goniadella gracilis**	Polychaete	918	108
Spirorbis	Polychaete	726	6
Sabellaria vulgaris	Polychaete	568	40
Amphibalanus amphitrite	Barnacle	483	27
Unciola irrorata	Amphipod	458	77

Year 2 - Most Abundant			
Species	**Taxonomic Group**	**Total Abundance**	**Occurrence (n=108)**
Nematode*	Nematoda	41,802	105
*Polycirrus eximius**	Polychaete	2,622	79
Polygordius spp*	Polychaete	2,542	108
Pisione spp*	Polychaete	2,224	81
Parapionosyllis longicirrata	Polychaete	2,186	103
*Lumbrinereis acuta**	Polychaete	1,775	104
Sphaerosyllis erinaceus	Polychaete	1,553	91
Parougia caeca	Polychaete	1,037	88
*Goniadella gracilis**	Polychaete	724	105
Aricidea catherinae	Polychaete	676	84

Year 1 - Most Frequent			
Species	**Taxonomic Group**	**Total Abundance**	**Occurrence (n=121)**
Nematode*	Nematoda	4,196	119
Polygordius spp*	Polychaete	1,806	112
*Goniadella gracilis**	Polychaete	918	108
*Lumbrinereis acuta**	Polychaete	1,361	102
*Parapionosyllis longicirrata**	Polychaete	293	82
*Unciola irrorata**	Amphipod	458	77
Polycirrus eximius	Polychaete	1,959	77
Pisione spp.	Polychaete	1,325	76
Maldanidae spp.	Polychaete	259	70
Kirkegaardia baptisteae	Polychaete	140	69

Note: Asterisk denotes species listed in both years.

Table 14. Top 10 most abundant and frequently occurring species for vessel-based grab samples across all study areas collected in Year 1 and Year 2 (continued).

Year 2 - Most Frequent			
Species	**Taxonomic Group**	**Total Abundance**	**Occurrence (n=108)**
Polygordius spp*	Polychaete	2,542	108
Nematode*	Nematoda	41,802	105
*Goniadella gracilis**	Polychaete	724	105
*Lumbrinereis acuta**	Polychaete	1,775	104
*Parapionosyllis longicirrata**	Polychaete	2,186	103
Sphaerosyllis erinaceus	Polychaete	1,553	91
Parougia caeca	Polychaete	1,037	88
*Unciola irrorata**	Amphipod	431	86
Aricidea catherinae	Polychaete	676	84
Monticellina baptisteae	Polychaete	240	83

Note: Asterisk denotes species listed in both years.

The remaining three species, despite being numerically superior, showed a patchy distribution (refer to **Table 14**). Populations in some instances appeared to be highly localized and limited to a few grab samples only. For instance, individuals of the polychaete, *Spirobis* spp., were recovered only within Control 1 samples and in a wide range of abundances. In one of the cluster samples, 650 individuals were recorded (sample C1-1_2), but only one individual was recorded within the other two cluster samples collected at this station. Elsewhere, *Spirorbis* sp. only occurred at two other stations (within four samples) at densities between 1 and 50 per sample. Additionally, high numbers (225 individuals) of the polychaete *Sabellaria vulgaris* (sand builder worm) were recorded within one of the samples collected at Turbine 1 (sample T1-3_3, but was only present at 21 additional cluster stations (within 40 samples) at densities between 1 and 41 individuals per grab. Similarly, 102 individuals of the barnacle *Amphibalanus amphitrite* were recorded within sample C3-4_2, but this species was absent from the other two cluster samples collected at this station and was only found at a farther 15 stations (within 27 samples) throughout the study areas.

For Year 2, the most conspicuous macrofauna present across all samples within both the turbine and control areas were nematodes, having an overwhelming total abundance of over 40,000 (refer to **Table 14**). Polychaetes follow as the second most conspicuous macrofauna, namely *Polycirrus eximius*, *Polygordius* spp., *Pisione* sp., *Parapionosyllis longicirrata*, *Lumbrinereis acuta*, *Sphaerosyllis erinaceus*, *Parougia caeca*, *Goniadella gracilis*, *Aricidea catherinae*, *Cirrophorus furcatus*, and *Syllides longocirratus*. Amphipods are present in much lower abundances, with *Unciola irrorata* exhibiting the greatest numbers (n=431). Key bivalve species, such as *Mytilus edulis*, *Spisula solidissima* and *Lyonsia arenosa*, also exhibited low abundances.

All of the top 10 most abundant species exhibited a broad distribution across the study areas. Five species were present in at least 103 of the 108 samples, and the other five species were present in at least 79 samples. Eight of these species are also on the list of top ten most frequently occurring species, although the remaining two rank 11th and 12th on the list.

The Year 1 and Year 2 samples have comparable spatial distribution and species dominance patterns, with nematodes and polychaetes being the most prevalent. The majority of the most conspicuous polychaete species from Year 1 continue to be present in Year 2. **Table 14** shows that six of the ten most abundant and most frequently occurring species are listed in both years. Of those, the top three most abundant species are consistent from year to year. The same is true for the top five most frequent species, although the first and second ranking species are switched.

The primary distinction between years is the substantial increase in nematodes in Year 2, which causes them to be the dominant species for each sample almost exclusively. Also, in Year 2, abundances of amphipods and barnacles are reduced, and their co-dominance of some Turbine 1 samples is not seen, with exception of *Unciola irrorata* for one sample. Further, three of the most abundant species in Year 1 showed a much more localized distribution, being collected primarily within one or a few study areas. This pattern is not present in Year 2. Rather, species that are most abundant are also the most widely distributed across the study areas, being found in at least 73 percent of all samples collected. These differences, considered in their entirety, indicate that Year 1 samples are more variable or disperse, whereas the overall macrofaunal community composition for Year 2 is more cohesive, as represented in **Figure 24**.

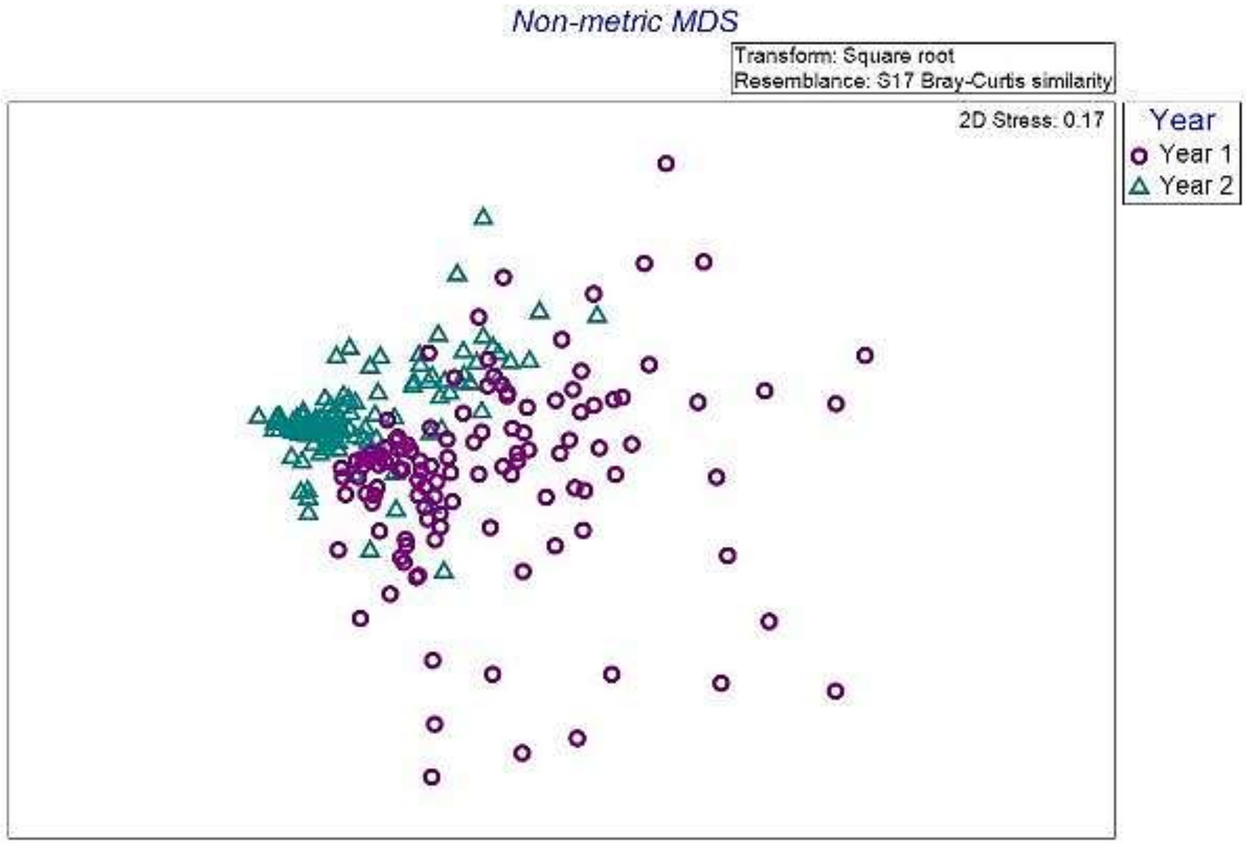


Figure 24. Non-metric MDS plot illustrating the relative macrofaunal (dis)similarities between vessel-based grab samples collected in Year 1 and Year 2.

Note: Each symbol represents an individual grab sample. The spatial distances between each of the samples represent the relative (dis)similarities with respect to species composition and abundance.

While seasonal change, related to the longer sampling period, may have contributed to the apparent greater dispersion between samples in Year 1, other factors are likely responsible. For example, the dominance of Nematodes in Year 2 would have increased similarity between the Year 2 samples, resulting in the observed tighter clustering of the Year 2 samples relative to Year 1 (**Figure 24**). Also, as shown in HDR (2017), the seafloor environment and macrofaunal samples collected at Control 1 in Year 1 were not representative of the turbine areas and other control areas, so that dispersion between samples would be expected to be greater in Year 1 compared to Year 2. Furthermore, similar macrofaunal patterns are noted for both years (i.e., Turbine 1 exhibits the greatest degree of variability), as described in further detail below.

3.1.6.2 Cluster Samples

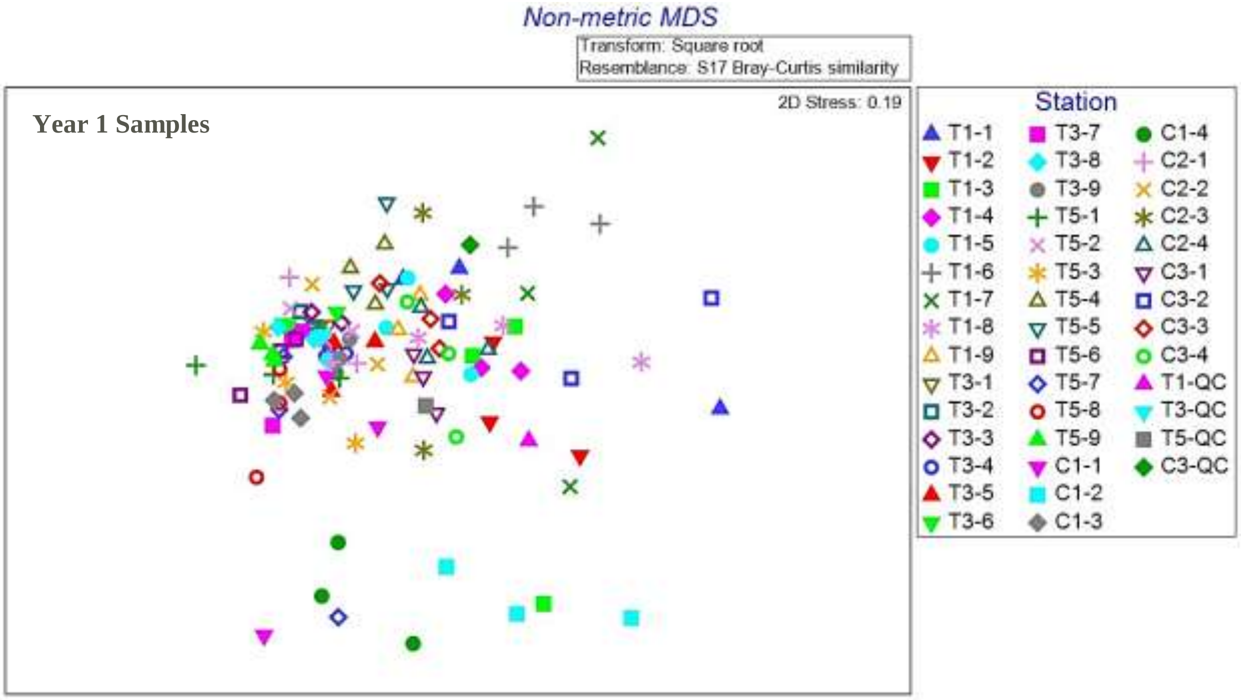
Investigations of the similarity of macrofaunal community composition among cluster samples indicates some spatial variability is present in Year 1 and Year 2. While a few cluster samples were collected close together (<3 m) and a few were separated up to 40 m, most of the cluster samples were taken within 5 m to 25 m of one another (refer to **Figures 9** and **10**). As such, the variability that exists represents changes in macrofaunal community composition across small spatial scales (i.e., tens of meters). Evidence of this variability is shown in the nMDS plot (**Figure 25**) and SIMPER analysis. SIMPER reports the average similarity of cluster samples within a given sample station for Year 1 ranges from 28.32 percent to 76.44 percent (**Table 16**). Of the 39 stations, 21 stations exhibit a similarity between 50 percent and 69 percent and 7 stations have a similarity between 70 percent and 81 percent (**Table 15**). For Year 2, the average similarity of a given cluster sample ranges from 37.46 percent to 81.20 percent, with all but three of the 36 samples having a similarity between 50 percent and 81 percent (**Tables 15** and **16**). For both years, the range of similarities is lowest at Turbine 1. Turbine 3, Turbine 5, and the control areas all have higher and comparable ranges. While the SIMPER results show comparable ranges between Year 1 and Year 2, a higher similarity both overall and within each of the turbine and control areas is evident in the Year 2 samples.

Table 15. Summary of similarity ranges exhibited by cluster samples at a given station for vessel-based grab samples collected in Year 1 and Year 2.

SIMPER Similarity Range	Year 1 Occurrences (n=39)	Year 2 Occurrences (n=36)
28–35%	4	0
36–49%	7	3
50–69%	21	17
70–81%	7	16

Table 16. Summary of SIMPER results showing ranges of similarities of macrofaunal communities within cluster samples across all study areas and individual study areas for vessel-based grab samples collected in Year 1 and Year 2.

Study Area	SIMPER Similarity Range	
	Year 1	Year 2
All Areas	28.32–76.44%	37.46–81.20%
Turbine 1	28.32–59.64% (Note: all but one station ranged between 28.32 and 48.68%)	37.46–69.39% (Note: all but two stations ranged between 58.34 and 69.39%)
Turbine 3	56.90–71.23%	56.95–80.14% (Note: all but two stations ranged between 71.32 and 80.14%)
Turbine 5	37.08–76.44% (Note: all but one station ranged between 50.55 and 76.44%)	60.52–75.79%
Control 1	35.55–71.27% (Note: all but one station ranged between 51.54 and 71.27%)	45.78–71.27%
Control 2	52.02–67.48%	73.30–81.20%
Control 3	32.75–66.36% (Note: all but one station ranged between 53.64 and 66.36%)	64.30–70.80%



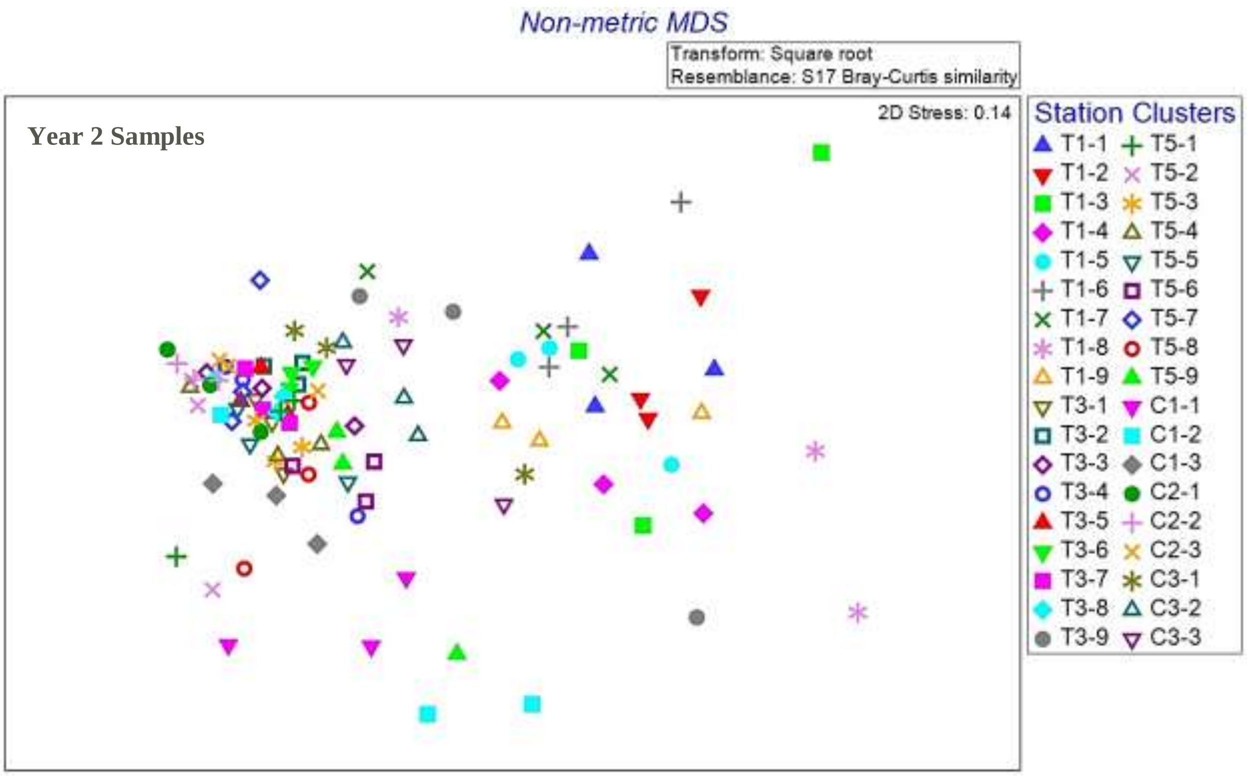


Figure 25. Non-metric MDS plot showing the relative (dis)similarities between cluster samples at each station for vessel-based grab samples collected in Year 1 and Year 2.

Note: Each symbol represents an individual grab sample. The spatial distances between each of the samples represent the relative (dis)similarities with respect to species composition and abundance.

Variability within the cluster samples for each year is further evident through detailed examination of the dominant species at a given station. Within some stations, cluster samples are dominated by the same species, whereas at other stations, each cluster sample is dominated by a different species, and, yet, at other stations, the pattern is somewhere in the middle of the spectrum. These analyses support the need for following a cluster sampling strategy (or similar strategy) to account for the small-scale spatial variability and complex structure of benthic macrofaunal communities. Combined, the cluster samples provide a more comprehensive understanding of the sample stations and the study areas.

3.1.6.3 Comparison of Grouped Turbine and Control Areas

There is substantial data to suggest that there are no appreciable differences between the macrofaunal communities within the turbine and control areas when considered as two general groups in Year 1 or Year 2. Therefore, the null hypothesis that there will be no difference in benthic communities between turbine and control areas can be accepted (H0 2) with respect to samples collected greater than 30 m from the center point of the turbine foundation. Data supporting this conclusion is presented below.

Macrofaunal patterns of species richness, species abundance, and the Shannon Weiner index of diversity (H') show that there are no clear patterns in spatial distribution with respect to the turbine or control areas for each sampling year (**Figures 26** through **31**). The nMDS plots for each year and for both years combined further show there is no clear separation between the two groups (**Figure 32**). The ANOSIM results support this finding, having an R value of 0.18 (p=0.001) for Year 1 samples and an R value of 0.13 (p=0.001) for Year 1 and Year 2 samples combined, indicating the two areas exhibit minimal distinction with respect to one another. The ANOSIM result for Year 2 was not significant. Additionally, the SIMPER analysis shows the similarity among all turbine and control samples collected is high for Year 2 (54.95 percent) and relatively high for Year 1 (38.92 percent) and that a similar suite of species was responsible for the overall similarity within each Year group (**Table 17**).

Table 17. SIMPER results showing average similarity and top contributing species (70% cut-off) across all vessel-based grab samples collected in Year 1 and Year 2.

Study Period	Average Similarity	Contributing Species (70% cut-off)
Year 1	38.92%	Nematoda (20.98%)
		Polygordius (13.38%)
		Lumbrineries acuta (10.26%)
		Goniadella gracilis (9.26%)
		Polycirrus eximius (7.87%)
		Pisione sp. (7.06%)
		Parapionosyllis longicirrata (4.07%)
Year 2	54.95%	Nematoda (30.44%)
		Polygordius (10.62%)
		Parapionosyllis longicirrata (7.24%)
		Lumbrineries acuta (7.19%)
		Goniadella gracilis (5.83%)
		Polycirrus eximius (4.49%)
		Pisione sp. (4.36%)

Note. Table excludes QC samples collected in Year 1.

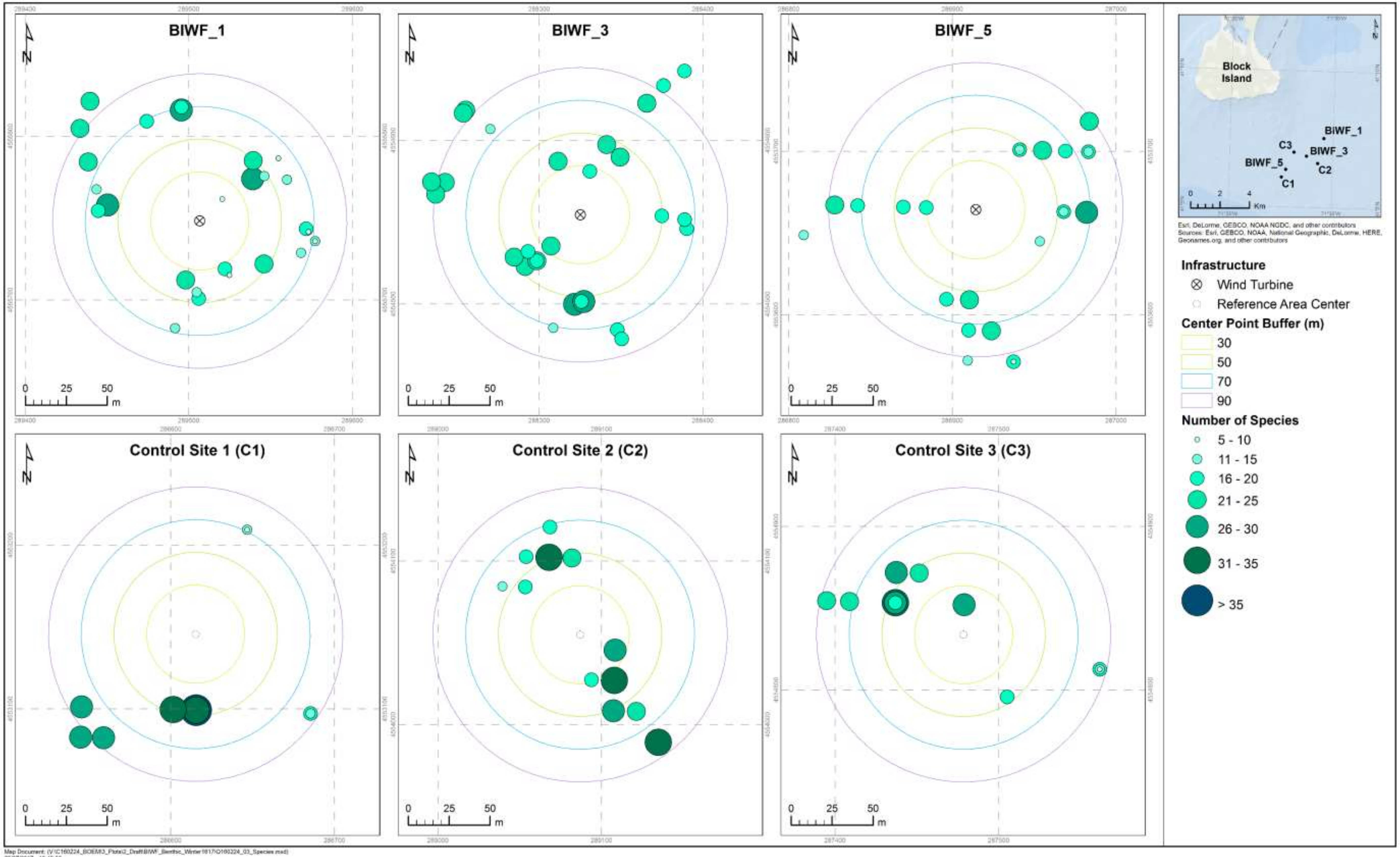


Figure 26. Distribution of numbers of species for vessel-based grab samples collected in Year 1.

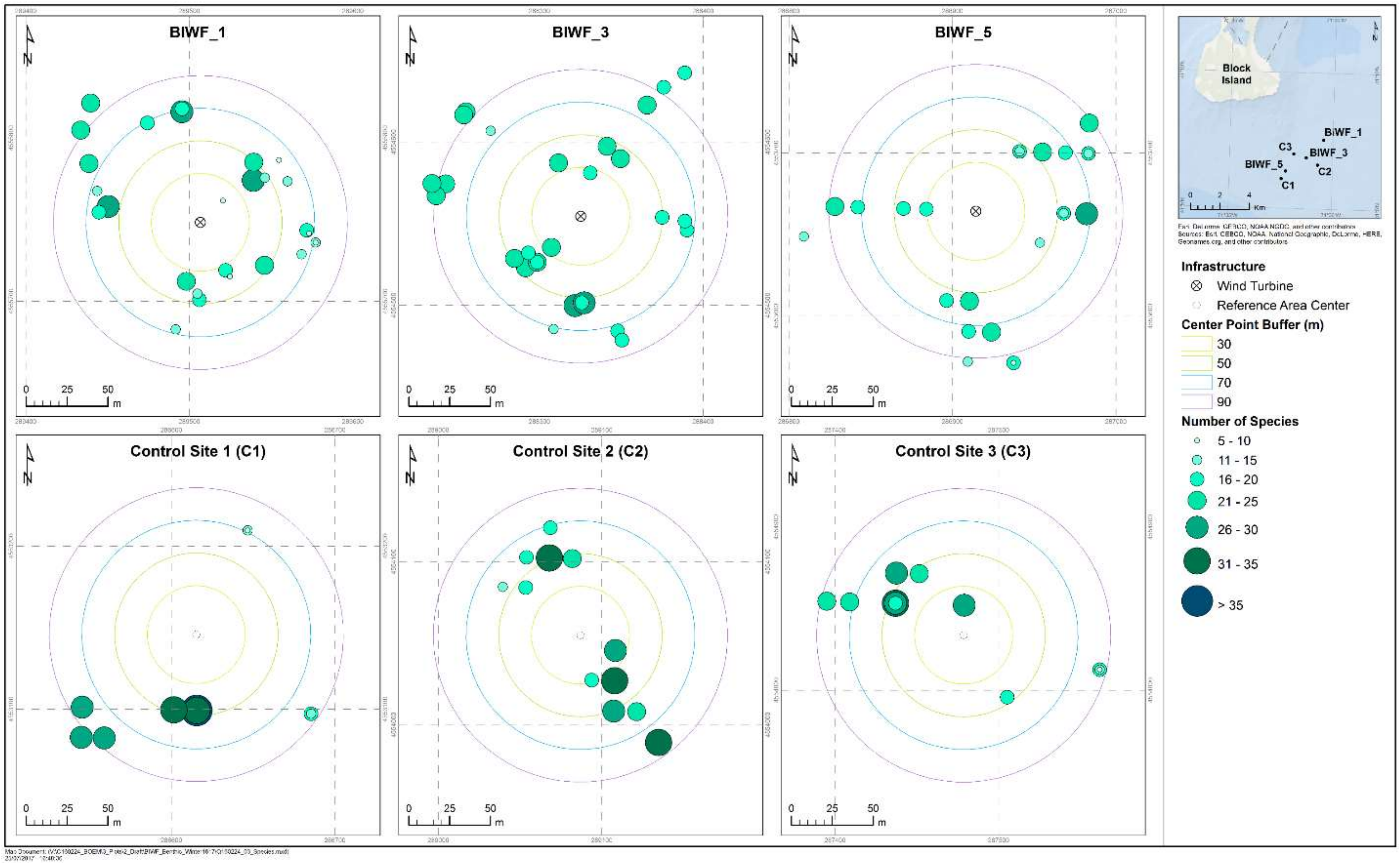


Figure 27. Distribution of numbers of species for vessel-based grab samples collected in Year 2.

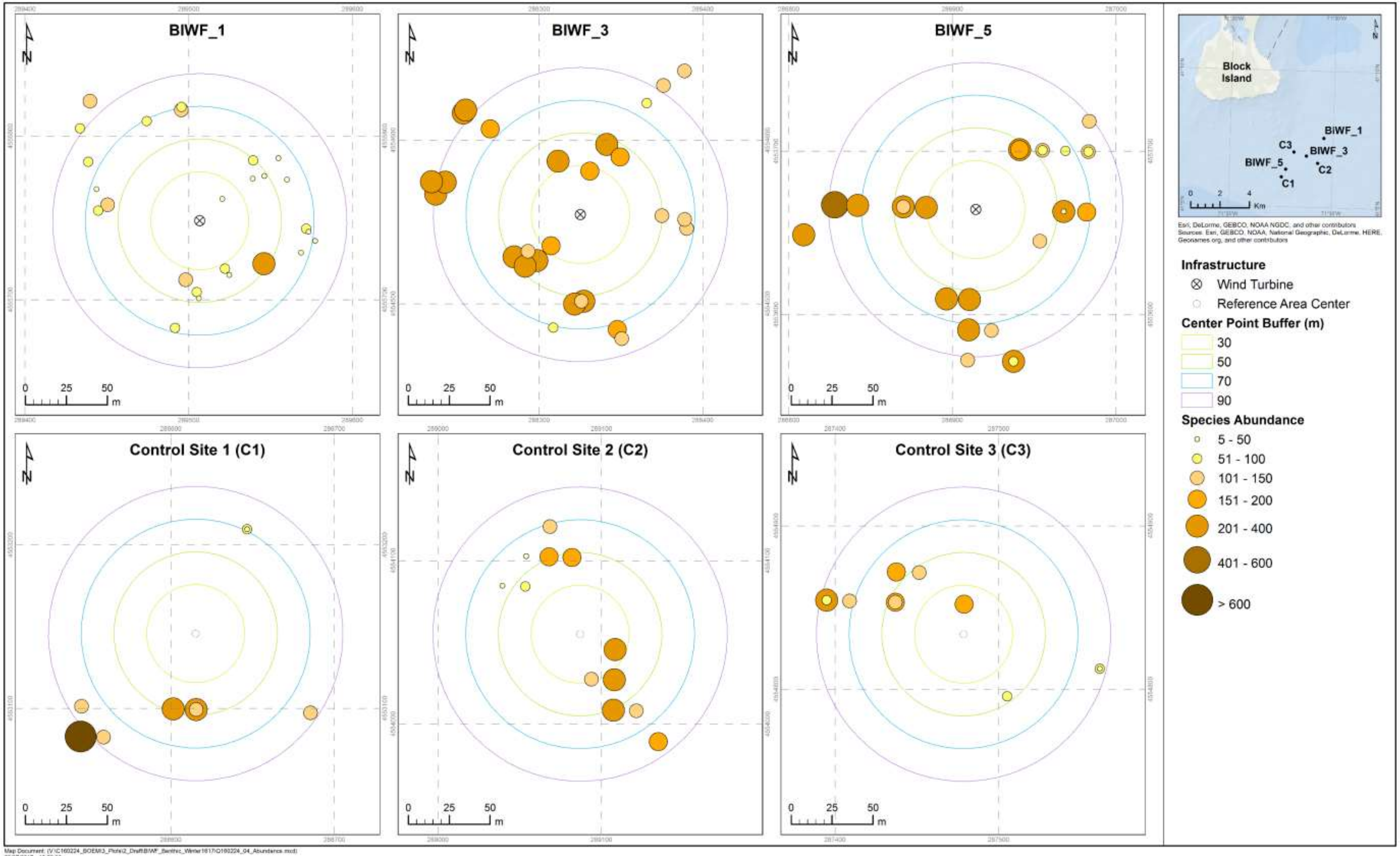
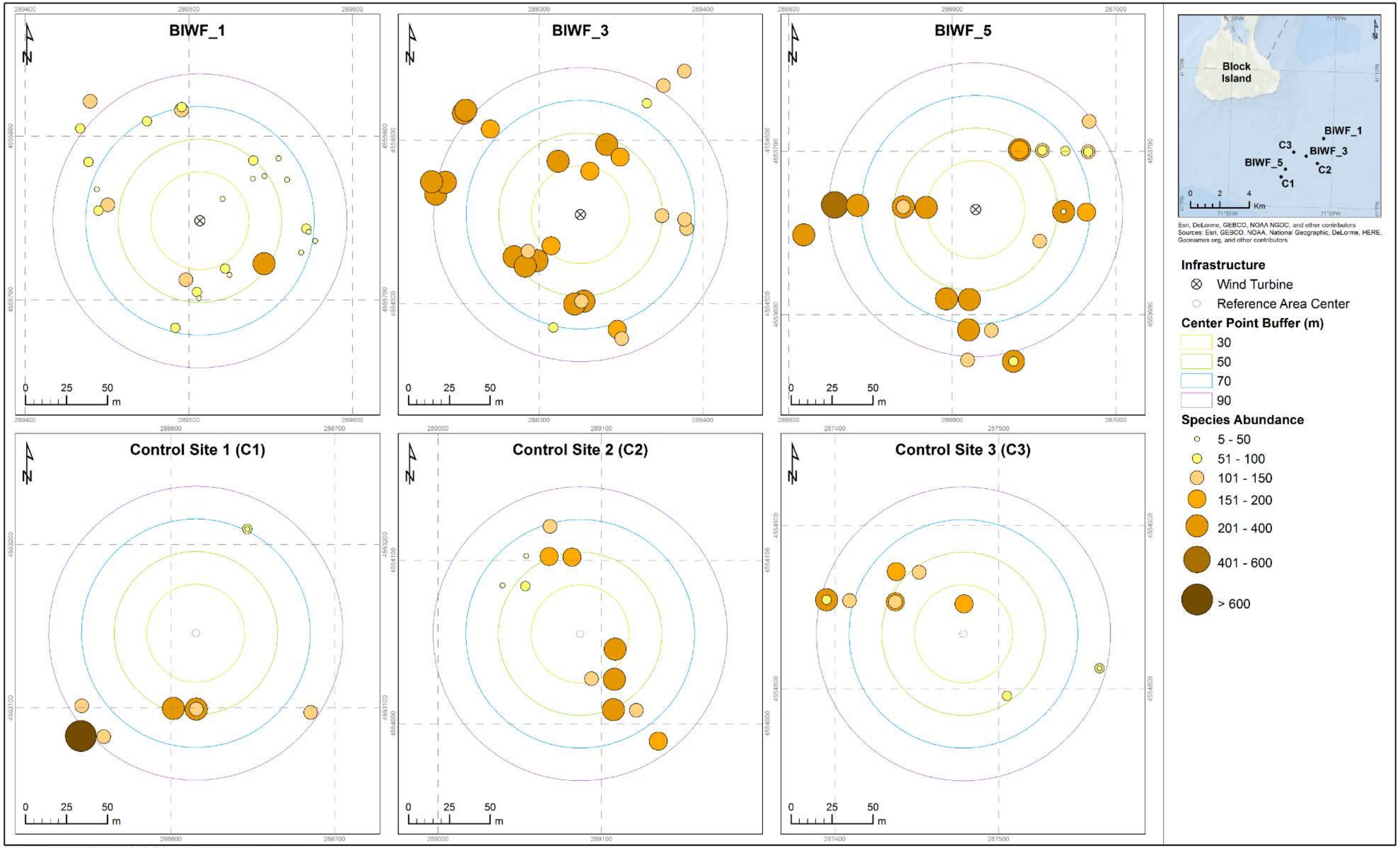


Figure 28. Distribution of numbers of individuals for vessel-based grab samples collected in Year 1.



Map Document: (V:\C160224_BOEM\3_Plots\2_Draft\BIWF_Benthic_Winter1617\Q160224_04_Abundance.mxd)
25/07/2017 - 16:52:30

Figure 29. Distribution of numbers of individuals for vessel-based grab samples collected in Year 2.

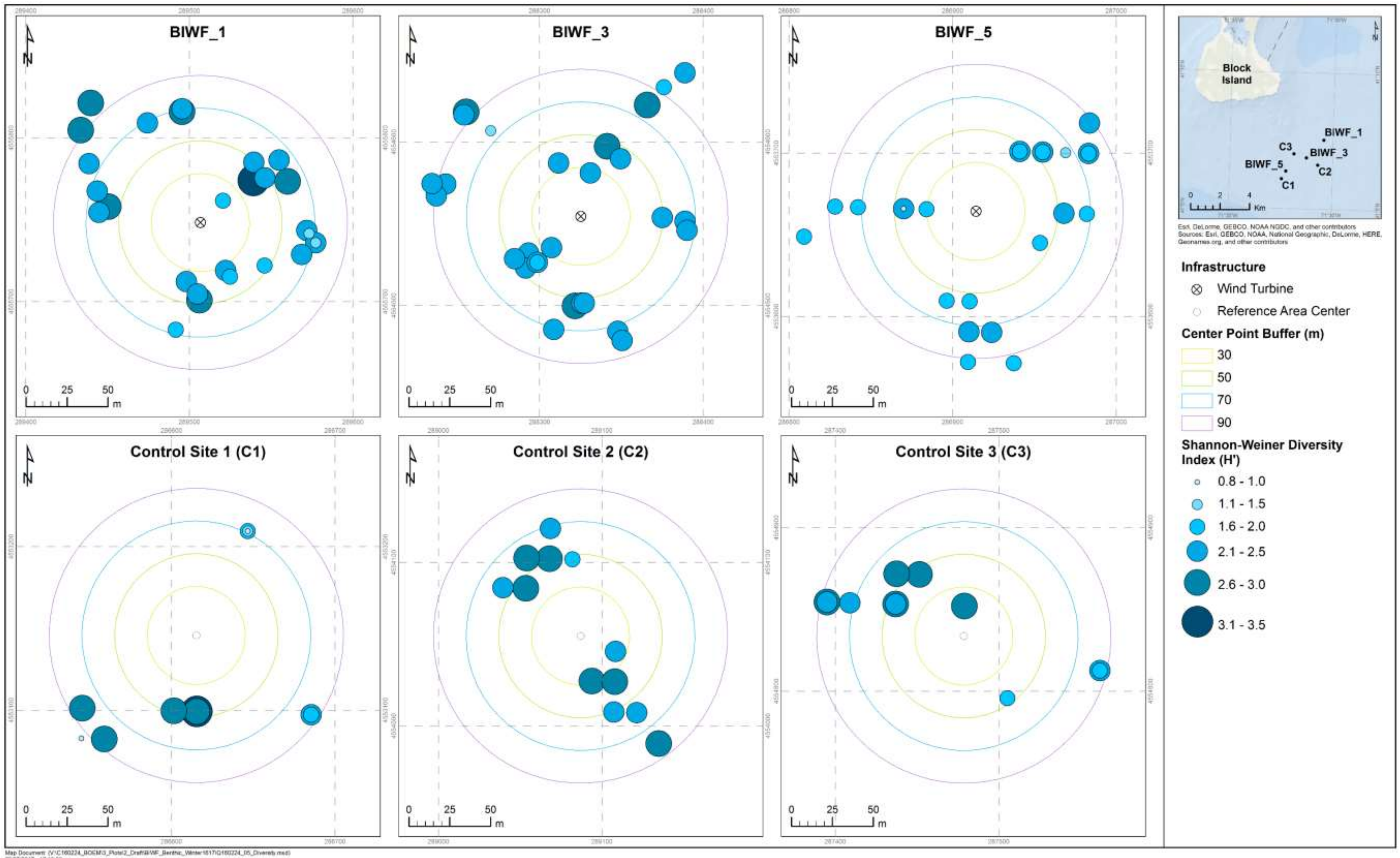


Figure 30. Distribution of the Shannon Weiner index of diversity (H') for vessel-based grab samples collected in Year 1.

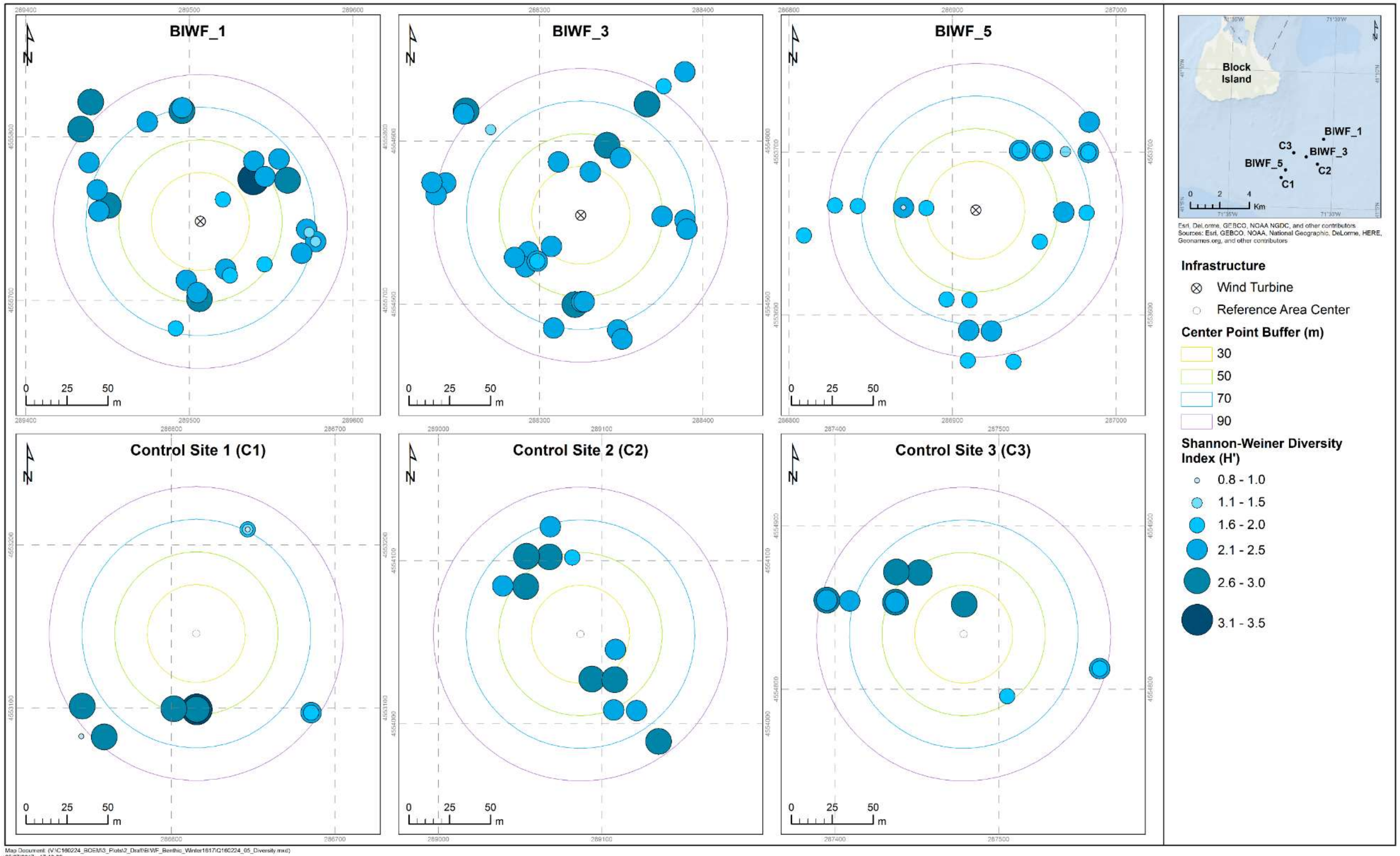


Figure 31. Distribution of the Shannon Weiner index of diversity (H') for vessel-based grab samples collected in Year 2.

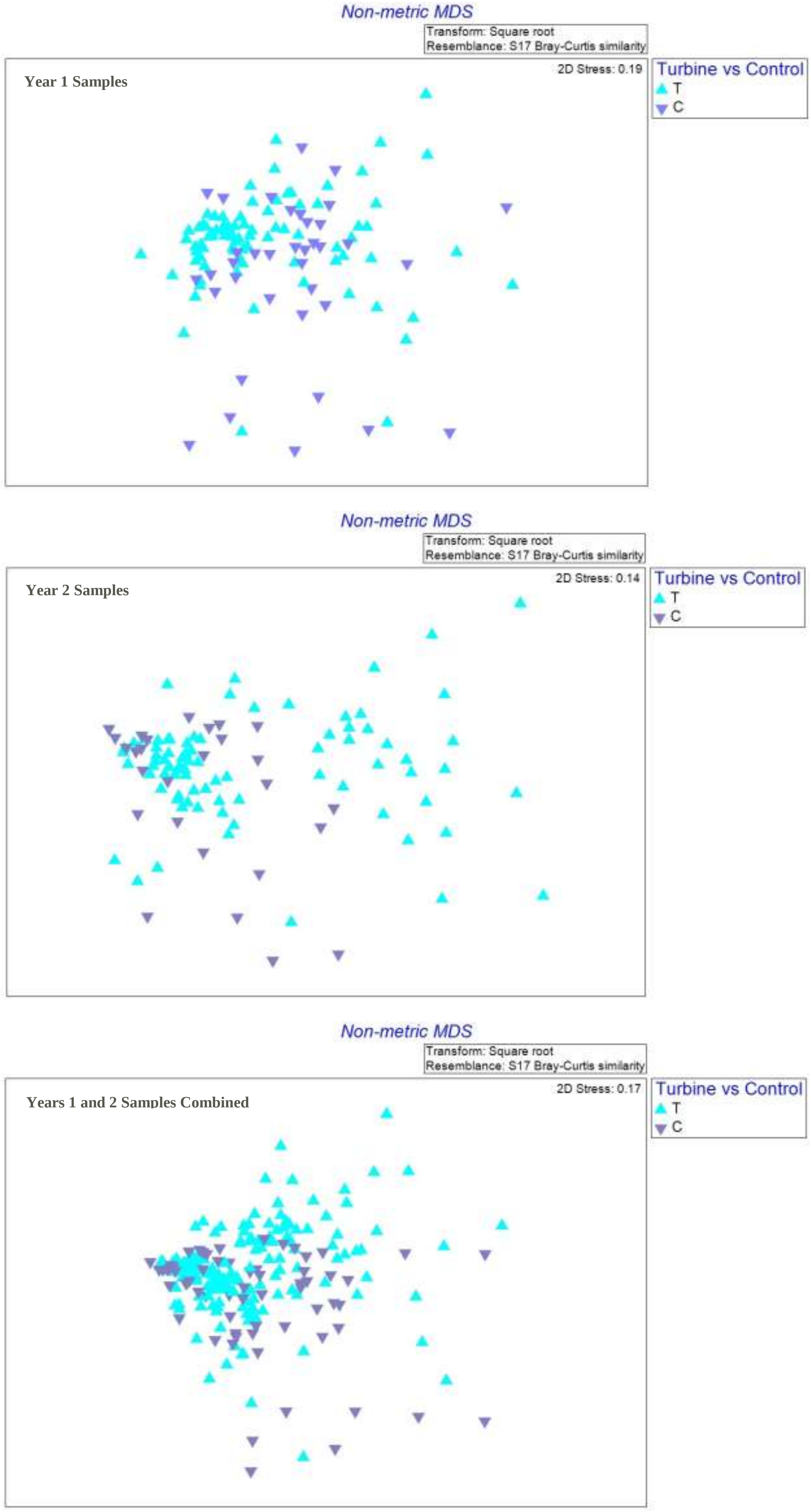


Figure 32. Non-metric MDS plot of Turbine versus control areas for vessel-based grab samples collected in Year 1, Year 2, and both years combined.

Note: The plots show the relative (dis)similarity of each sample (indicated by a triangle symbol) to the other samples within the dataset based on its macrofaunal (species and abundance) characteristics. In this instance, each sample is coded (colored) according to sample location (turbine or control area). The plots show that there is no clear distinction between turbine and control sample groups suggesting a degree of similarity in terms of macrofaunal content.

Species richness for the Year 2 samples is the only metric that indicates any distinction between turbine and control samples. The turbine areas have a higher species richness (range: 70 to 86 species) compared to the control areas (range: 45 to 61 species). This was due to the occurrence of a number of species which occurred only rarely at the turbines (i.e., represented by only one or a few individuals).

3.1.6.4 Comparison of Individual Turbine and Control Areas

Overall, the data indicate that two null hypotheses can be accepted for samples collected greater than 30 m from the center point of the turbine foundation: That there will be no difference in benthic communities among turbine areas (H0 1); and that there will be no difference in benthic communities between control areas and turbine areas (H0 2). Differences that were identified were largely partitioned on the basis of variations in abundances of the characterizing fauna rather than the existence of distinct assemblages. The control samples are generally representative of the turbine samples, suggesting that all of the study areas are reflecting natural conditions associated variability. Data supporting these conclusions are presented below.

Macrofaunal patterns of species richness, species abundance, and the Shannon Weiner index of diversity (H') are broadly comparable across all of the study areas for each sampling year, although some slight differences are evident (**Figure 33** and **Table 18**). In Year 1, species richness ranged from 64 to 80 species within a given area. Mean species richness ranged from 16.6 species to 22.6 species, although the variance around the mean differed considerably, particularly amongst the control samples. Year 2 samples were more variable, with species richness ranging from 45 to 86 species within a given study area and mean species richness ranging between 19.7 at Turbine 1 and 25.3 for the control areas.

Table 18. Summary of macrofaunal indices for vessel-based grab samples collected in Year 1 and Year 2.

		Turbine 1	Turbine 3	Turbine 5	Control Areas
Year 1	Mean No. Species	16.6	20.7	17.3	22.6
	Mean Species Abundance	71.1	191.9	182.4	160.0
	Mean Diversity (H)	2.18	2.21	1.84	2.26
	Mean Richness (d)	3.82	3.79	3.22	4.42
Year 2	Mean No. Species	19.7	23.7	22.8	25.3
	Mean Species Abundance	76.1	211.5	213.9	240.3
	Mean Diversity (H)	1.8	1.3	1.6	1.7
	Mean Richness (d)	3.8	3.5	3.5	3.9

Note. Table excludes QC samples collected in Year 1 and mean abundance values exclude nematodes.

Species abundance (excluding nematodes) varied across the turbine areas in both years. In Year 1, the total abundance was just over double for Turbines 3 and 5 (each approximately 3,600 individuals) compared to Turbine 1 (approximately 1,700 individuals) (refer to **Table 12**). Within the control areas, abundances were comparable to that of Turbine 1 (approximately 1,200 to 1,800 individuals). A similar pattern is evident in Year 2. The total abundance at Turbines 3 and 5 is more than double the abundance at Turbine 1 (approximately 5,700 versus 2,000 individuals). Abundances at Controls 1 and 3 are comparable to Turbine 1 (each approximately 1,500 individuals), although Control 2 recorded 3,400 individuals.

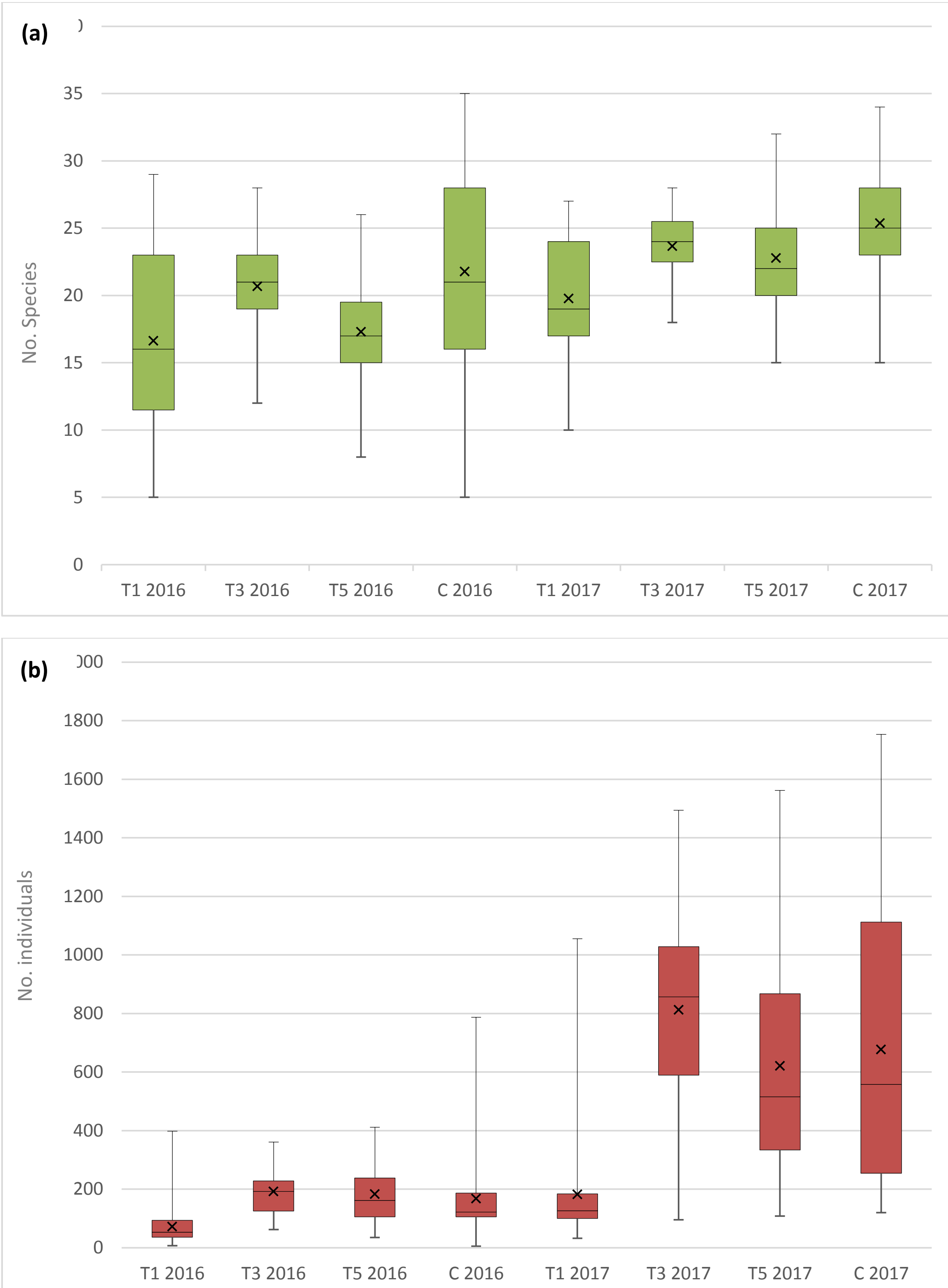


Figure 33. Box and whisker plots showing the mean, median, 1st and 3rd quartiles and data range of the number of species (a) and number of individuals (b) at each turbine station and across all reference areas for vessel-based grab samples collected in Year 1 and Year 2.

In Year 1, the mean value of the Shannon diversity index (H') was comparable across Turbines 1 and 3 and the combined control areas (ranging between 2.18 to 2.26) but was lower at Turbine 5 (1.84). A similar pattern was recorded for mean values of Marglalef's richness index (d). This measured 3.79 and 3.82 at Turbines 1 and 3, respectively, but was lower at Turbine 5 (3.22) (**Table 18**). Mean richness for all the control areas was comparatively high (4.42). Despite overall increases in mean numbers of species, mean diversity (H) values at the turbine and control areas in Year 2 were comparatively lower ranging between 1.3 (Turbine 3) and 1.8 (Turbine 1). The mean Control value (1.7) was broadly representative of those calculated for the turbine location suggesting natural conditions. Mean values of Margalef's Richness (d) were similar across the different locations but were slightly lower than those recorded in 2016 ranging between 3.5 (Turbines 3 and 5) and 3.9 (Controls).

Assessment of macrofaunal community structure using nMDS plots also indicate that the individual study areas are broadly comparable, although some differences are apparent (**Figure 34)**. The patterns are largely consistent from Year 1 to Year 2. The most noticeable difference between years is the Year 2 samples are generally more cohesive within each individual study area (e.g., have higher within-study area similarities and lower among-study area dissimilarities), whereas the Year 1 samples show more variability (**Table 19** and **Figure 34**). This feature is also reflected in the average values of the multivariate dispersion between samples within each year group (calculated from Permdisp). The Year 2 samples exhibited a lower average dispersion (average dispersion = 32.194) compared to that calculated between the Year 1 samples (average dispersion = 43.093) thus collaborating the nMDS observations above. Examination of **Figure 34** suggests that the dispersion amongst some of the T1, T5 and Control samples is lower in Year 2 compared to that in Year 1 and likely contributes to the apparent improvement in sample cohesiveness during the current study.

Table 19. SIMPER results of vessel-based grab samples collected within each turbine and control area in Year 1 and Year 2 (see Figure 34 below for associated nMDS plot.

Average Similarity (%)				Average Dissimilarity (%)		
Station	**Year 1**	**Year 2**		**Station**	**Year 1**	**Year 2**
T1	38.91	55.33		T1, T3	66.47	57.14
T3	62.49	69.95		T1, T5	70.32	58.91
T5	50.49	66.8		T3, T5	48.56	33.6
C1	36.32	54.68		T1, C1	76.19	60.5
C2	51.11	75.15		T3, C1	67.03	47.28
C3	48.52	68.14		T5, C1	66.18	44.42
T1 and T3	41.96	52.94		T1, C2	63.85	62.98
T1 and T5	37.05	51.23		T3, C2	52.8	30.51
T3 and T5	53.92	67.58		T5, C2	61.9	35.26
				C1, C2	71.53	47.7
				T1, C3	61.67	50.64
				T3, C3	61.8	39.84
				T5, C3	66.21	42.68
				C1, C3	72.91	48.37
				C2, C3	59.11	40.76

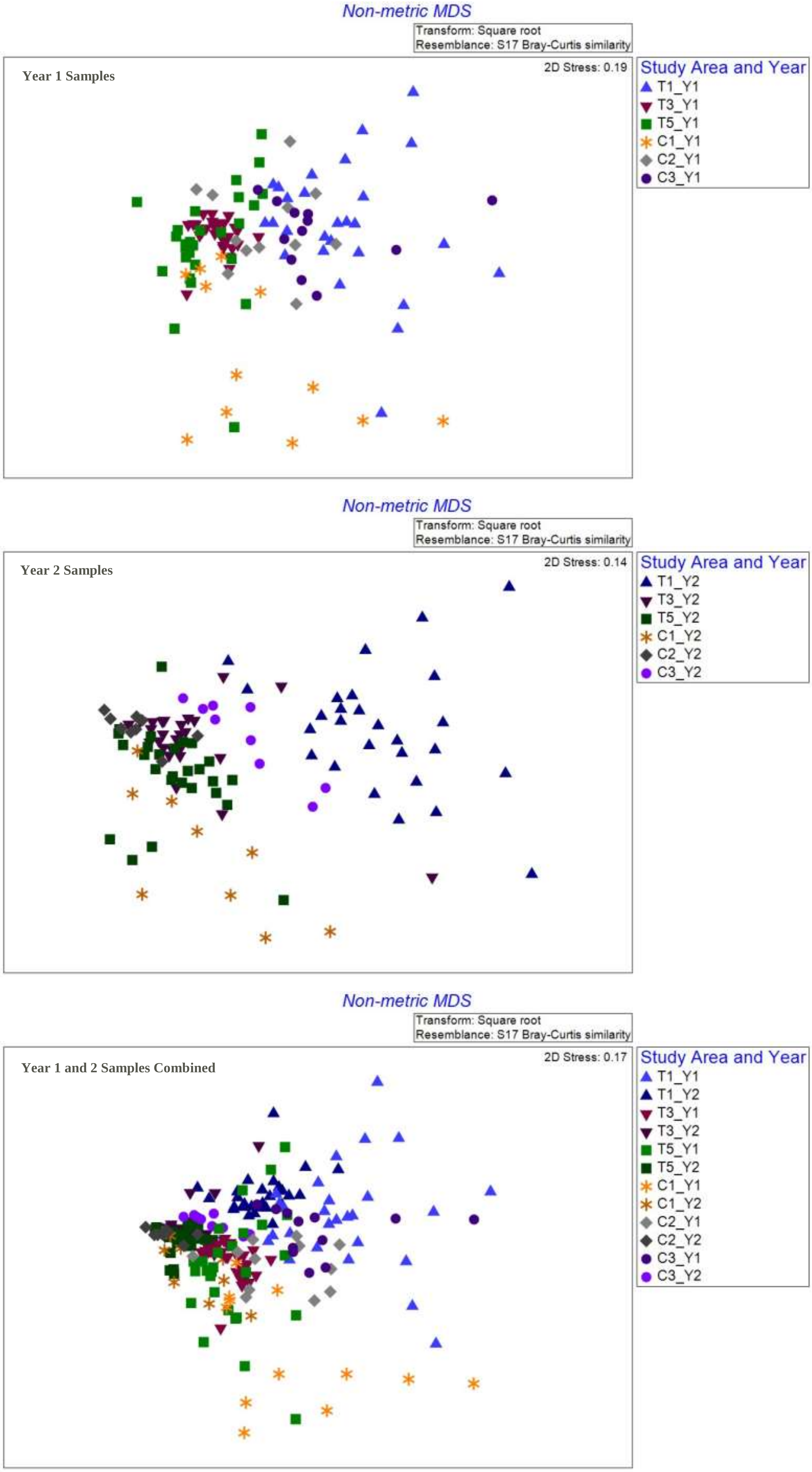


Figure 34. Non-metric MDS plot of vessel-based grab samples collected within each turbine and control area in Year 1, Year 2, and both years combined.

For both years, the nMDS plots suggest macrofaunal community composition changes along a gradient moving across the BIWF study area from Turbine 1 to 5. The control samples generally plot amongst the turbine samples and occupy the sample relative position on the plot from Year 1 to Year 2. For example, the Control 3 samples plot midway between the Turbine 1 samples and the Turbines 3 and 5 samples, while the Control 2 samples exhibit some overlap with the Turbines 3 and 5 samples. The Control 1 samples separate out the most in both years, especially in Year 1. The separation of samples in Control 1 in Year 1 likely reflects a more distinct macrofaunal community structure because of clear differences in environmental characteristics relative to the other study areas, most notably the presence of boulders and coarser substrates (as identified in the video footage and acoustic data) and shallower water depths, rather than activities associated with the BIWF project.

With regards to the turbine areas, the plots indicate that macrofaunal communities within Turbine 1 are more variable for both years. This finding is supported by the SIMPER results (**Table 19**), which states samples within Turbine 1 exhibit the lowest average similarity (Year 1 = 38.91 percent; Year 2 = 55.33 percent) in comparison to Turbine 3 (Year 1 = 62.49 percent; Year 2 = 69.95 percent) and Turbine 5 (Year 1 = 50.49 percent; Year 2 = 66.8 percent). This is again, corroborated by the greater average values for multivariate dispersion (Permdisp) for Turbine 1 samples for both years compared to the other Turbine and Control groups.

There is also substantial evidence in both years to indicate macrofaunal communities at Turbines 3 and 5 are more similar to one another relative to Turbine 1 (e.g., refer to **Tables 12, 16, 18** through **21**, and **Figures 33** and **34**). Specifically, the nMDS plots in **Figure 34** show the Turbine 1 samples separate out from the samples collected at Turbines 3 and 5, especially in Year 2. Conversely, Turbines 3 and 5 samples are clustered together and overlap for both years. The SIMPER results complement the nMDS plots, reporting the lowest average dissimilarity between Turbines 3 and 5 (Year 1 = 48.56 percent; Year 2 = 33.6 percent) (**Table 19**). Comparatively, the average dissimilarity is greater between Turbines 1 and 3 (Year 1 = 66.47 percent; Year 2 = 57.14 percent), and between Turbines 1 and 5 (Year 1 = 70.32 percent; Year 2 = 58.91 percent). Further, when combining the Turbines 3 and 5 samples, SIMPER reported an average similarity of 53.92 percent and 67.58 percent for Year 1 and Year 2, respectively. Comparatively, the combined averaged similarities are noticeably lower for Turbines 1 and 3 (Year 1 = 41.96 percent; Year 2 = 52.94 percent) and for Turbines 1 and 5 (Year 1 = 37.05 percent; Year 2 = 51.23 percent).

The results of the ANOSIM analyses mimic the patterns identified in the nMDS plots and SIMPER analyses. ANOSIM reports similar R values for each year (Year 1 = 0.459; Year 2 = 0.453; both p=0.001), which suggests there is distinction within each of the six areas in Year 1 and Year 2. Turbines 3 and 5 continue to exhibit the lowest degree of distinction (R: Year 1 = 0.251, Year 2 = 0.133; p = 0.001), compared to Turbines 1 and 3 (R: Year 1 = 0.582, Year 2 = 0.729; p = 0.001) and Turbines 1 and 5 (R: Year 1 = 0.552, Year 2 = 0.792; p = 0.001). This result is particularly pronounced in Year 2.

A closer inspection of the species characterizing each turbine and control area shows high agreement in dominant species and general composition across sampling years and across the different study areas (**Tables 20** and **21**). Dominant species included Nematodes, *G. gracilis, P. eximius, Polygordius* spp, *L. acuta, P. longicirrata, Pisione* sp., *Scoletoma fragilis, U. irrorata,* and Maldanidae, all of which were common to two or more of the turbine and control areas. Conspicuous differences in species identities between areas or sampling years were not apparent.

With respect to sampling years, four of the five dominant species at each of the turbines in Year 1 continue to dominate in Year 2 (**Table 20**). In Year 2, the polychaete, *Parapionosyllis longicirrata* becomes a dominant species at Turbines 3 and 5, replacing the polychaete, *Lumbrinereis acuta*, although both species were also present in high abundances for the year they are not listed in the top five. *Parapionosyllis longicirrata* also replaces the polychaete, *Sabellaria vulgaris*, at Turbine 1 in Year 2. The disappearance of *Sabellaria vulgaris* from the current dataset for Turbine 1 was likely attributable to the patchy distribution of the species.

Table 20. Numerically dominant species for vessel-based grab samples collected within each turbine area for Year 1 and Year 2. Note: Asterisk denotes species listed in both years.

Sampling Period	Study Area	Dominant Species	Taxonomic Group	Abundance	Occurrence (n=27)
Year 1	Turbine 1	*Sabellaria vulgaris*	Polychaete	382	16
		Nematoda*	Nematode	262	26
		*Goniadella gracilis**	Polychaete	170	22
		*Polygordius**	Polychaete	170	22
		*Lumbrinereis acuta**	Polychaete	105	20
	Turbine 3	Nematoda*	Nematode	1,344	27
		*Polycirrus eximius**	Polychaete	847	27
		*Pisione**	Polychaete	645	27
		*Polygordius**	Polychaete	481	27
		Lumbrinereis acuta	Polychaete	476	26
	Turbine 5	Nematoda*	Nematode	1,501	27
		*Polycirrus eximius**	Polychaete	863	24
		*Polygordius**	Polychaete	860	27
		*Pisione**	Polychaete	434	26
		Lumbrinereis acuta	Polychaete	385	24
Year 2	Turbine 1	Nematoda*	Nematode	2,840	27
		*Polygordius**	Polychaete	541	27
		*Goniadella gracilis**	Polychaete	303	27
		Parapionosyllis longicirrata	Polychaete	217	23
		*Lumbrinereis acuta**	Polychaete	175	26
	Turbine 3	Nematoda*	Nematode	16,214	27
		*Polycirrus eximius**	Polychaete	838	25
		*Pisione**	Polychaete	731	25
		Parapionosyllis longicirrata	Polychaete	626	27
		*Polygordius**	Polychaete	619	27
	Turbine 5	Nematoda*	Nematode	10,974	25
		*Polycirrus eximius**	Polychaete	876	27
		*Pisione**	Polychaete	786	27
		*Polygordius**	Polychaete	742	27
		Parapionosyllis longicirrata	Polychaete	741	27

Table 21. Summary SIMPER analysis of vessel-based grab samples to compare species identities across turbine and control areas (untransformed data) for Years 1 and 2.

Turbine 1		Turbine 3		Turbine 5		Controls	
Species	**Mean No.**	**Species**	**Mean No.**	**Species**	**Mean No.**	**Species**	**Mean No.**
Year 1							
Nematoda	9.7	Nematoda	49.78	Nematoda	55.59	Nematoda	28.14
Goniadella gracilis	6.3	*Polycirrus eximius*	31.37	*Polycirrus eximius*	31.96	*Polygordius*	7.14
Polygordius	6.3	*Pisione*	23.89	*Polygordius*	31.85	*Goniadella gracilis*	10.97
Unciola irrorata	3.7	*Lumbrinereis acuta*	17.63	*Pisione*	16.07	*Lumbrinereis acuta*	9.44
Nephtys bucera	2.11	*Polygordius*	17.81	*Lumbrinereis acuta*	14.26	*Unciola irrorata*	6.61
Sabellaria vulgaris	14.15	*Goniadella gracilis*	6.41	*Goniadella gracilis*	4.96	*Amphibalanus Amphitrite*	9.58
Lumbrinereis acuta	3.89	*Aricidea (Acmira) catherinae*	6.41			*Polycirrus eximius*	5.94
Kirkegaardia baptisteae	1.22	*Cirrophorus*	6.22			*Ampelisca vadorum*	11.78
Parapionosyllis longicirrata	1.52	*Maldanidae*	4.56			*Pisione*	5.28
Scoletoma fragilis	0.96					*Sabellaria vulgaris*	3.89
Tanaissus psammophilus	0.81					*Scoletoma fragilis*	2.44
Maldanidae	1.44					*Maldanidae*	2.03
Year 2							
Nematoda spp	105.19	Nematoda spp	600.52	Nematoda spp	406.44	Nematoda spp	436.07
Polygordius spp	20.04	*Polycirrus eximius*	31.04	Polycirrus eximius	32.44	Pisione sp	26.07
Goniadella gracilis	11.22	Pisione sp	27.07	Pisione sp	29.11	Polygordius spp	23.7
Lumbrinereis acuta	6.48	Polygordius spp	22.93	Polygordius spp	27.48	*Lumbrinereis acuta*	23.04
Parapionosyllis longicirrata	8.04	*Parapionosyllis longicirrata*	23.19	*Parapionosyllis longicirrata*	27.44	*Polycirrus eximius*	33.52
Exogone hebes	2.63	*Lumbrinereis acuta*	19.89	*Lumbrinereis acuta*	16.33	*Sphaerosyllis erinaceus*	26.22
				Parougia caeca	17.89	*Parapionosyllis longicirrata*	22.3
						Unciola irrorata	7.19
						Aricidea catherinae	9.22

For the turbine areas, for a given year, the same five species dominate within Turbines 3 and 5, three of which are dominant at Turbine 1. The most apparent difference across turbine areas is the variation in the abundances of these dominant species (**Table 20**). This pattern is consistent from Year 1 to Year 2. The discrepancy in species abundances, rather than the species composition, between areas likely accounts for the differences in macrofaunal community structure identified in the ANOSIM tests.

3.1.6.5 Comparison of Distance Bands

Several analyses were undertaken to investigate local differences in macrofaunal communities as a function of distance from the center point of the turbine structures, all of which clearly show there is no relationship between the two variables. Therefore, the null hypothesis that there is no impact on distance from the wind farm foundation regarding benthic communities can be accepted (H0 3) with respect to samples collected greater than 30 m from the center point of the turbine foundation. Data supporting this conclusion is presented below.

With regard to spatial differences in community composition, ANOSIM performed on the sample data between distance bands for each turbine for each year revealed no significant differences ($P>0.05$) between any of the pairwise comparisons, suggesting comparable macrofaunal communities within a 90 m radius of each turbine in both 2016 and 2017. These findings are supported by regression plots comparing species abundance and richness within distance bands (**Figures 35** and **36**), nMDS plots of macrofaunal assemblages coded by distance band (**Figures 37** and **38**), and examination of the spatial distribution of species abundance, richness, diversity (refer to **Figures 26** through **31**). All of these plots show there is not clear relationship between macrofaunal communities with distance from any turbine for either sampling year. The only notable results are from the Turbine 1 Year 2 regression plots, which suggest a weak relationship of increasing species richness and abundance with increasing distance ($R^2 = 0.1293$ and 0.1754, respectively).

Table 22 compares mean number of species and number of individuals for the different distance bands for each turbine/year and control/year and indicates that there was generally a greater species variety and abundance of individuals at each distance band around each Turbine location in Year 2 compared to Year 1. Similar observations for the grouped Control samples suggested that this was a natural condition.

Table 22. Mean numbers of species, numbers of individuals for each distance band, sampling location and year (vessel-based grab sample data).

Distance Bands	2016				2017			
	Turbine 1	Turbine 3	Turbine 5	Control	Turbine 1	Turbine 3	Turbine 5	Control
Mean No. Species								
near	16.56	21.56	16.78	21.78	17.80	23.86	20.43	25.37
intermediate	18.78	20.22	19.22		18.88	22.80	23.09	
far	14.56	20.22	15.89		22.67	24.40	24.22	
Mean No. individuals								
near	96.22	215.22	197.89	167.04	130.90	943.14	528.57	676.41
intermediate	63.56	156.00	153.00		126	794.90	664.00	
far	55.67	204.56	196.33		286.56	737.30	638.33	

Figure 35. Number of species per vessel-based grab sample with distance from the center point under each turbine foundation structure for Year 1 and Year 2.

Figure 36. Number of individuals per vessel-based grab sample with distance from the center point under each turbine foundation structure for Year 1 and Year 2.

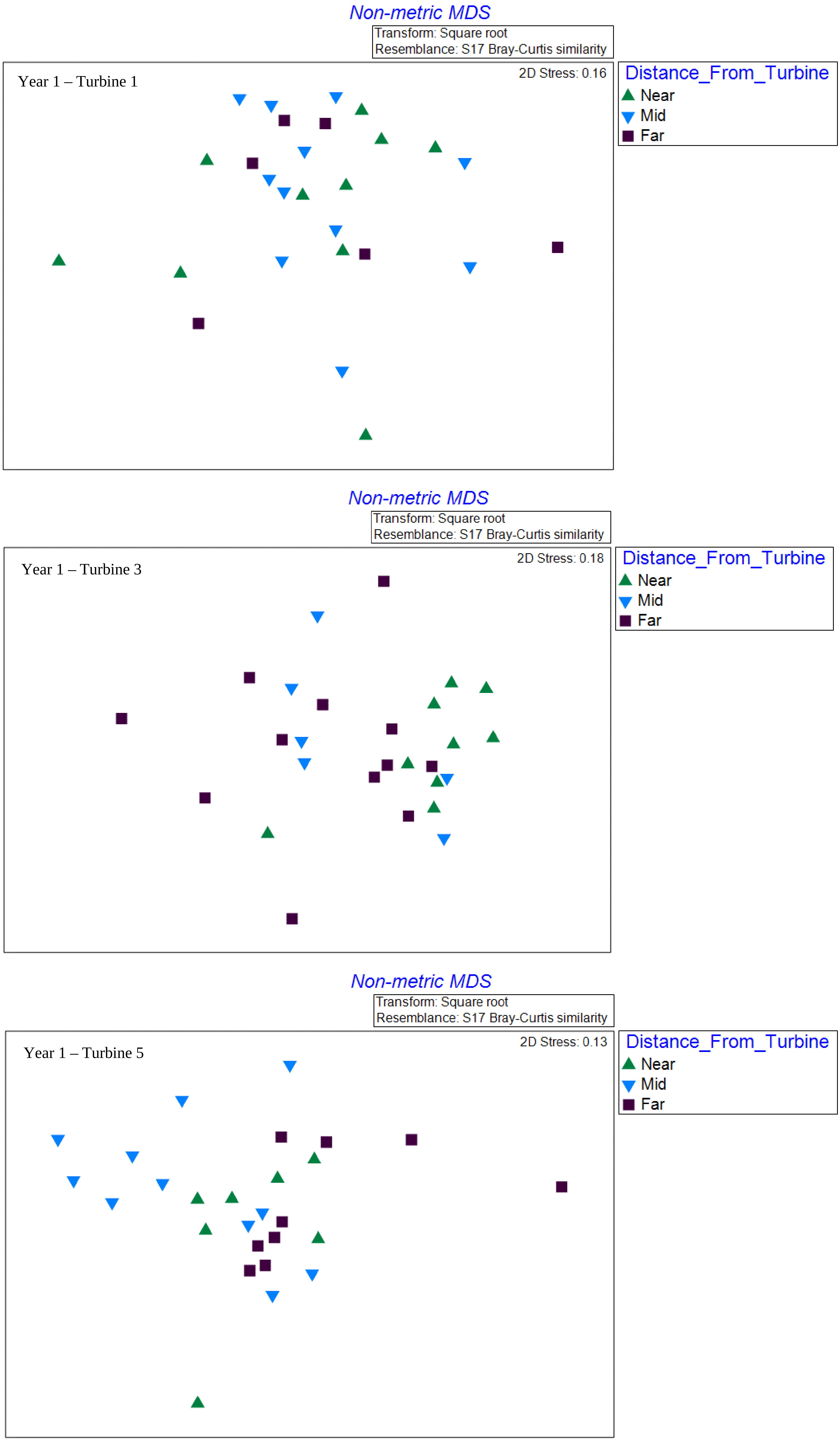
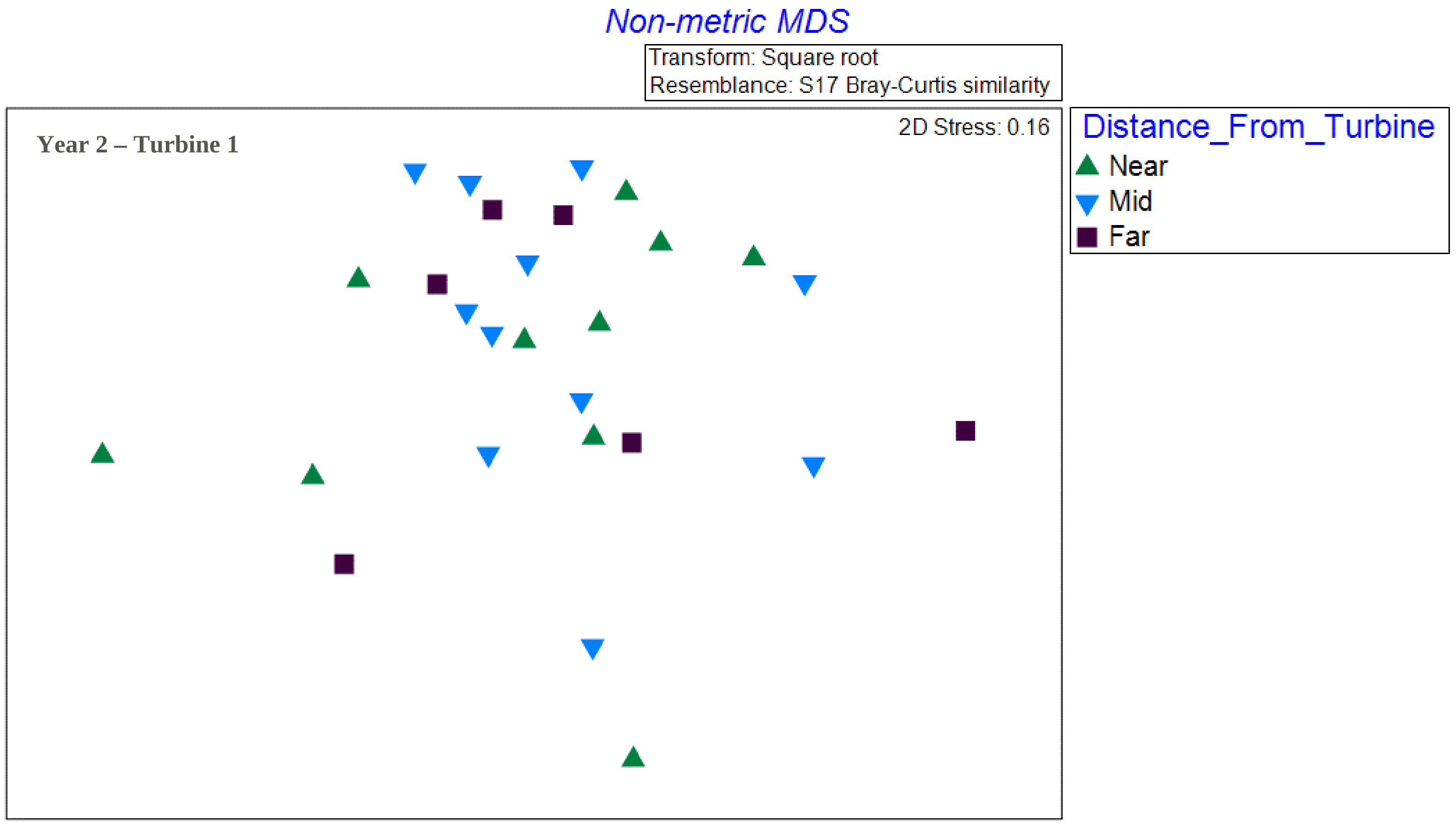
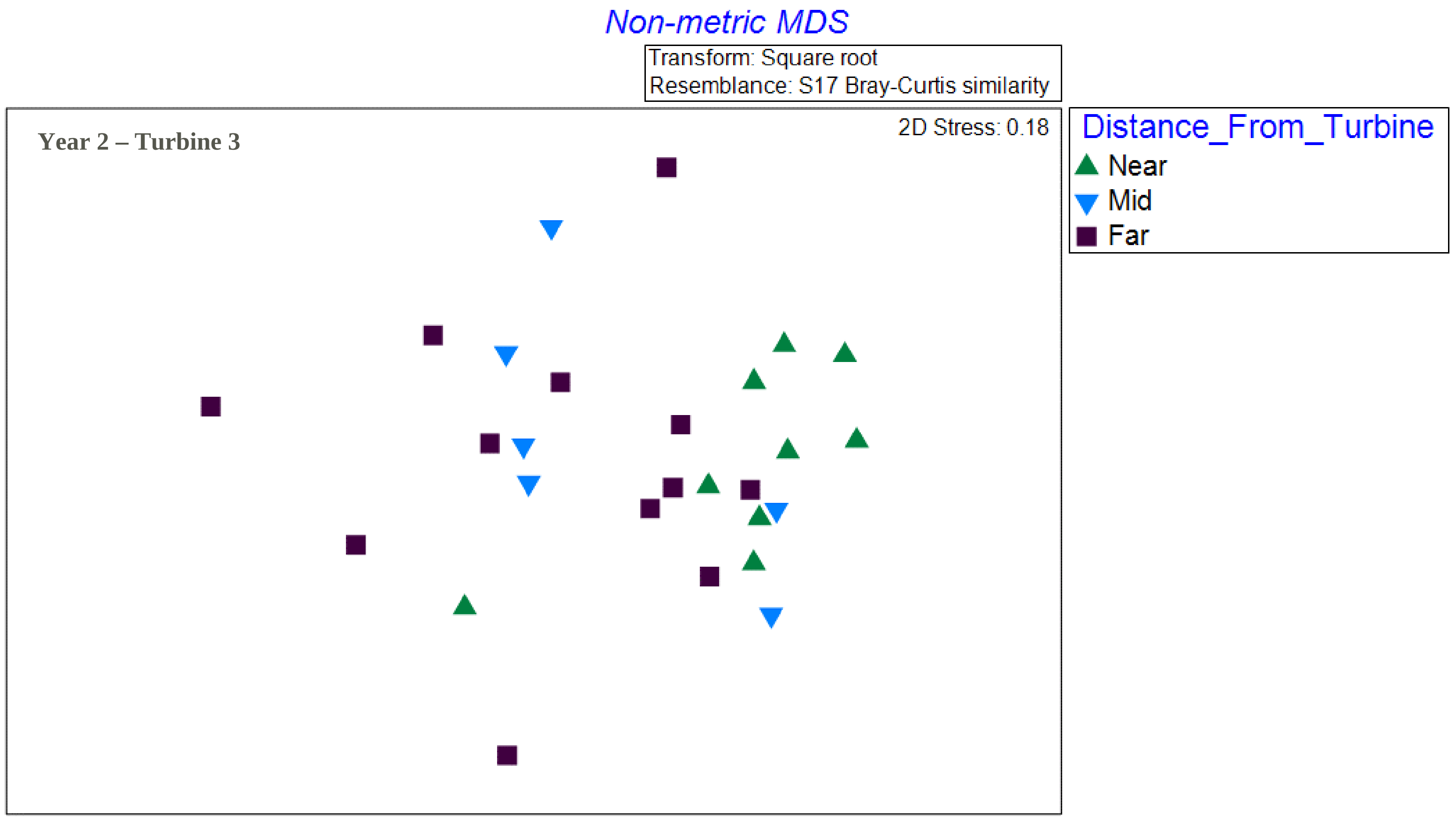


Figure 37. nMDS plots of macrofaunal samples according to distance from the center point of each turbine for each turbine area for each year. "Near," "Mid," and "Far" represent the 30–49 m, 50–69 m, and 70–90 m distance bands, respectively (Year 1 data).

Note: Each sample is represented by a symbol and the distance separations between each of the symbols represent the relative (dis)similarities with regard to species composition and abundance.





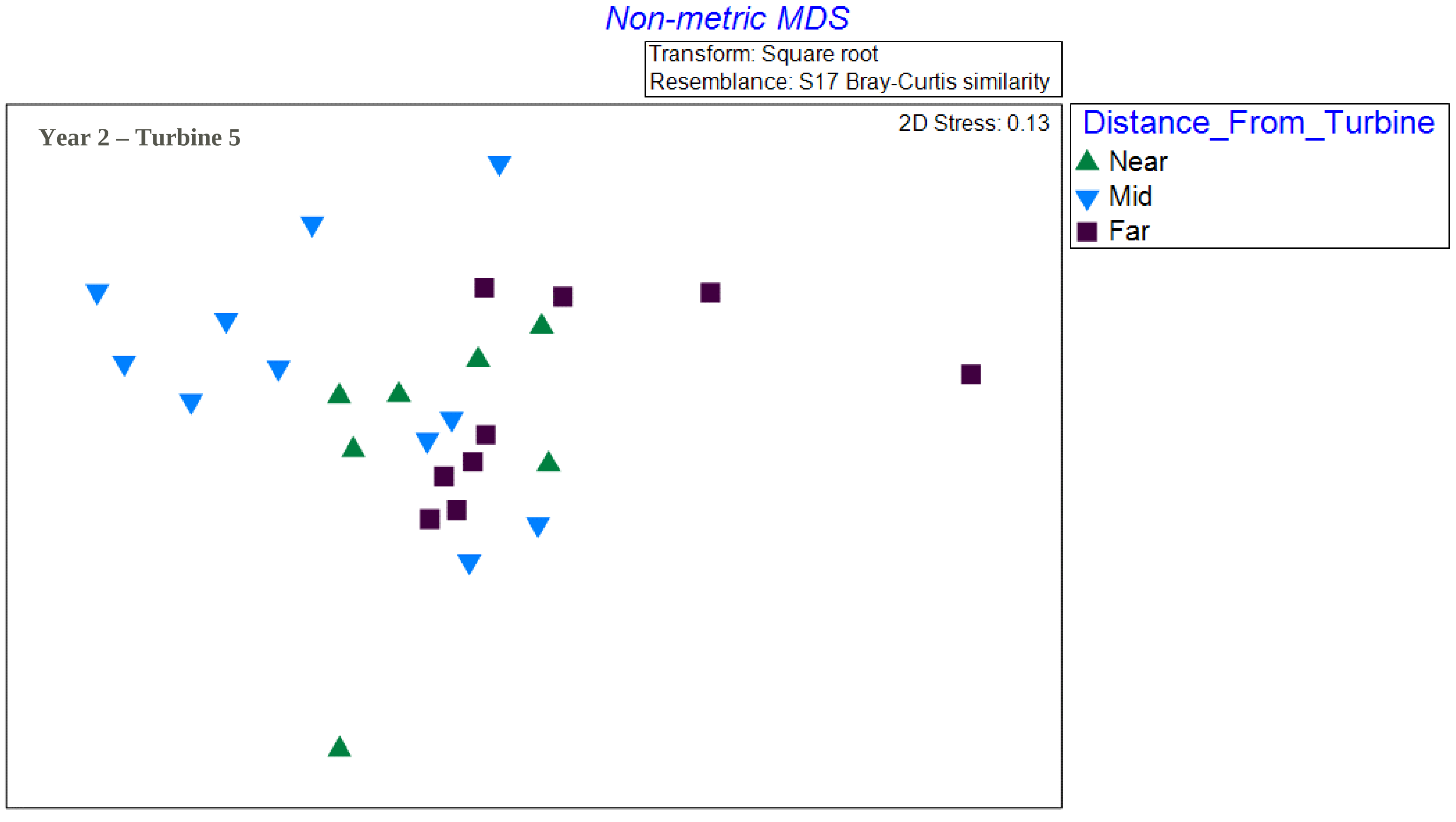


Figure 38. nMDS plots of macrofaunal samples according to distance from the center point of each turbine for each turbine area for each year.

Note: "Near," "Mid," and "Far" represent the 30–49 m, 50–69 m, and 70–90 m distance bands, respectively (Year 2 data). Also, each sample is represented by a symbol and the distance separations between each of the symbols represent the relative (dis)similarities with regard to species composition and abundance.

Two way Anova of the data for factors ‘distance band’ and ‘turbine year’ identified a highly significant difference in the numbers of species between years ($F_{(7,192)} = 9.3941$, $p = 5 \times 10^{27}$) which subsequent follow up Tukey HSD tests identified as a significantly higher number of species within the far field (70 to 90 m) distance band at Turbine 5 in 2017 compared to 2016 ($p<0.05$). The mean number of species recorded at far field locations at Turbine 5 in 2016 was 15.89 compared to 24.22 species in 2017. Key species present far from Turbine 5 in 2017, and which were not represented in 2016 included *Pseudomystides* sp., *Syllides* sp., *Cirrophorus furcastus*, *Marphysa bellii*, Oligochaetes and *Leptosynapta* sp. While not specifically recorded within the far distance band at Turbine 5 in 2016, these species are nonetheless generally characteristic of the study area and have been recorded during both sampling periods at other turbine and control sampling locations. It is thus unlikely that these records represent a significant ecological change at this location but merely reflects the patchy distribution of benthic species within the wider area. Species numbers were not significantly different between other pair-wise tests. There was no significant interaction between the two factors.

Significant differences in macrofaunal abundance were detected between turbines and years (two way Anova) ($F_{(7,192)} = 46.31$. $p = 5.3\text{x}10^{38}$). Abundance of macrofauna was significantly higher at all three turbine locations and at the control stations in 2017 compared to the previous sampling occasion (Tukey HSD $p<0.05$).

There were no statistically significant differences in the numbers of individuals of macrofauna between the different distance bands at each turbine location (Tukey HSD $p>0.05$).

Highest abundance was recorded within the near field distance band (within 30 to 50 m) of Turbine 3 (943.14 individuals) and was largely attributed to the presence of exceptionally high numbers of nematodes here. Comparatively high faunal abundance was also noted at intermediate and far distances at Turbine 3 and were again attributed to high nematode numbers. Lowest macrofaunal abundance was recorded at turbine 1 and were significantly lower than those at turbines 3 and 5 (Tukey HSD $p <0.05$).

Statistical comparison of the current multivariate faunal data using Permanova did not identify any significant differences in community structure between the different distance bands at each turbine location suggesting that there were no significant gradient effects on benthic community structure beyond 30 m and within 90 m from each of the turbine foundations in 2017. This reflects the findings of the initial benthic survey conducted in Year 1 (2016). However, statistical differences were detected between all three turbines and between the different Year 1 and Year 2 sampling occasions. **Table 23** summarizes the results of the Permanova pair-wise tests for the terms location/years and distance bands and the highlights statistically significant differences in community composition.

While there were no statistically significant differences in the faunal communities between 30 and 90 m of each turbine foundation, faunal communities were found to be significantly different between each of the turbine locations and between each turbine and control location. Communities also demonstrated significant temporal differences between sampling occasions at all turbine and control locations. Removal of nematodes from the analysis had no effect on the significance test, other than lowering the t critical values, and all pair-wise combinations remained statistically significantly different regardless of the inclusion / exclusion of nematodes from the analysis. Significant changes in the control data suggested a common and/or natural change across the wider study area.

Table 23. Summary of the Permanova analysis of the BIWF macrofauna data for pair-wise tests between location and years. BOLD denotes a significant difference.

	Pair-wise Tests		t	P(perm)	Unique Perms
Turbine and control groups					
Spatial tests	T1 Yr2,	T3 Yr2	5.6208	**0.0001**	9925
	T1 Yr2,	T5 Yr2	5.7174	**0.0001**	9935
	T3 Yr2,	T5 Yr2	1.9782	**0.0005**	9919
	T1 Yr2,	Control Y2	4.5816	**0.0001**	9920
	T3 Yr2,	Control Y2	2.2228	**0.0003**	9928
	T5 Yr2,	Control Y2	2.1688	**0.0004**	9910
Temporal tests	T1 Yr2,	T1 Yr1	3.4358	**0.001**	998
	T3 Yr2,	T3 Yr1	5.5562	**0.0001**	9928
	T5 Yr2,	T5 Yr1	4.3928	**0.0001**	9925
	Control Y1	Control Y2	3.8032	**0.0001**	9929
Distance band groups					
Spatial tests	T1 near yr2,	T1 far yr2	1.2526	0.0725	9401
	T1 intermediate yr2,	T1 far yr2	1.2159	0.1401	8193
	T1 intermediate yr2,	T1 near yr2	1.1475	0.1779	8894
	T3 intermediate yr2,	T3 far yr2	1.0571	0.3233	9805
	T3 far yr2,	T3 near yr2	1.1862	0.199	6824
	T3 intermediate yr2,	T3 near yr2	0.75274	0.8724	5696
	T5 near yr2,	T5 far yr2	0.87246	0.6755	6634
	T5 intermediate yr2,	T5 far yr2	0.83289	0.7541	9650
	T5 near yr2,	T5 intermediate yr2	1.0671	0.3208	8570
Temporal tests	T1 near yr2,	T1 near yr1	2.1542	**0.0001**	9419
	T1 intermediate yr2,	T1 intermediate yr1	1.8644	**0.0002**	8105
	T1 far yr2,	T1 far yr1	2.4975	**0.0001**	8126
	T3 near yr2,	T3 near yr1	3.0756	**0.0002**	4288
	T3 intermediate yr2,	T3 intermediate yr1	3.9038	**0.0001**	9452
	T3 far yr2,	T3 far yr1	3.2534	**0.0001**	9632
	T5 near yr2,	T5 near yr1	2.437	**0.0002**	6652
	T5 intermediate yr2,	T5 intermediate yr1	3.7319	**0.0001**	9673
	T5 far yr2,	T5 far yr1	2.42	**0.0002**	8131

3.2 Diver-Based Data Collection

3.2.1 Survey Effort

In Year 2, five grab samples were collected by divers within the footprint of each turbine structure (refer to **Figure 10)**. The samples were obtained over three days between mid-May and early June (**Table 24**). In addition, divers towed the Lagrangian floating camera system over two days to collect imagery along a north-south transect under each turbine structure and across the three distance bands (refer to **Figure 14** and **Table 24**).

Table 24. Summary of diver-based data collection within footprint of each turbine structures for Year 2.

Study Area	Number of Grab Samples	Date of Grab Sample Survey	Number of Camera Tows	Date of Camera Survey
Within footprint of Turbine 1	5	8 June 2018	1	15 June 2018
Within footprint of Turbine 3	5	17 May 2018	1	17 May 2018
Within footprint of Turbine 5	5	7 June 2018	1	15 June 2018

3.2.2 Particle Size Distribution (PSD) Analysis

Detailed results of the sediment grain size analysis of the diver-collected grab samples under each turbine structure are presented in **Appendix 2**. The analysis confirms sediment characteristics within the footprint of Turbines 3 and 5 are nearly identical to those of the vessel-based grab samples collected in the vicinity of the turbine structures. Specifically, all ten of the samples taken under Turbines 3 and 5 are dominated by coarse sand, and the fractions of medium, coarse, and very coarse sand combined account for greater than 90 percent of the sediment composition (**Table 25**; refer to **Table 8** for sediment analysis of vessel-based grab samples). None of the samples contained clay or silt particles. For comparison, the vast majority of the 110 vessel-based sediment samples collected in both sampling years from Turbines 3 and 5 were also dominated by coarse sand, exhibited combined sand fraction of greater than 90 percent, and had a combined clay and silt fraction of 0 percent. The only exceptions this description are six samples that are dominated by medium sand and six samples that contain clay and silt particles, but with a total contribution of less than 1%.

Further, the mean fractions of each Wentworth-defined sediment class were comparable for sediment samples collected within the footprint of and in the area around Turbines 3 and 5 (**Table 26**; refer to **Table 9** for sediment analysis of vessel-based grab samples). Precisely, the proportion of fine grain sand (particles of diameter 150–250 µm) of samples from under the structure was 0.3 percent and 0.0 percent for Turbines 3 and 5, respectively, which was comparable to the vessel-based samples (mean range = 0.6 percent to 1.6 percent). The average contribution of medium grade sand (particles of diameter 250–500 µm) from samples under the structure was 28.8 percent at Turbine 3 and 23.1 percent at Turbine 5, similar to the vessel-based samples (mean range = 25.9 percent to 37.8 percent). For the coarse sand fraction (particles of diameter 500–1,000 µm), the mean proportion was 64.4 percent and 65.3 percent for samples collected under Turbines 3 and 5, respectively, and ranged from 50.3 to 61.0 percent for the vessel-based samples. The very coarse sand fraction mean was 6.6 percent for Turbine 3 and 11.1 percent for Turbine 5 for the samples collected under the structure, which falls within mean range of the vessel-based samples (5.7 to 22.1 percent).

Table 25. Summary of grain size analysis of diver-based sediment samples collected within the footprint of each turbine in Year 2.

Study Area	Total Samples	Number of samples for which: Dominant Grain Size = Medium Sand	Dominant Grain Size = Coarse Sand	Combined Sand Fraction > 90%	Combined Clay and Silt > 0%
Within footprint of Turbine 1	5	3	1	0	5
Within footprint of Turbine 3	5	0	5	5	0
Within footprint of Turbine 5	5	0	5	5	0

Note: Combined sand fraction is defined as the combination of medium sand, coarse sand, and very coarse sand. Grain size fractions are classified according to the Wentworth scale.

Table 26. Mean of each sediment grain size fraction for diver-based sediment samples collected within the footprint of each turbine in Year 2.

Study Area	Average Fraction of: Clay and Silt	Very Fine Sand	Fine Sand	Medium Sand	Coarse Sand	Very Coarse Sand
Within footprint of Turbine 1	36.5%	4.4%	6.1%	26.1%	25.9%	1.0%
Within footprint of Turbine 3	0.0%	0.0%	0.3%	28.8%	64.4%	6.6%
Within footprint of Turbine 5	0.0%	0.0%	0.0%	23.6%	65.3%	11.1%
Range	0 – 72.2%	0 – 7.0%	0 – 8.8%	7.3 – 40.7%	7.9 – 70.2%	0.4 – 14.4%

Note: The range of each grain size fraction within is study area is also provided. Grain size fractions are classified according to the Wentworth scale.

In contrast to Turbines 3 and 5, the sediment samples from Turbine 1 show considerable differences between samples collected within the footprint of the turbine structure and those of the surrounding area (refer to **Tables 25** and **26** for analysis diver-based samples and **Tables 8** and **9** for analysis of vessel-based samples). Notably, the five samples from under the structure have a substantially higher finer grain size composition. The clay and silt content of the samples averages 36.5 percent, but is variable among individual samples (combined fraction is 24, 25, 34, 28, and 72 percent for samples 1 through 5, respectively). Three of the samples are dominated by medium sand, one by coarse sand, and one by clay and silt.

While this finding is similar to the vessel-based grab samples, which were all dominated by medium sand (n=41) or coarse sand (n=14), the distinction is attributed to the average proportion of each sediment class. For example, the average contribution of medium sand for the samples collected under Turbine 1 is 26.1 percent, which is nearly half of the 49.6 percent for the vessel-based samples (same percentage for Year 1 and Year 2). Similarly, the average proportion of coarse sand is 25.9 percent, versus 41.6 and 43.4 percent for vessel-based samples collected Year 1 and Year 2, respectively. Further, the average proportion of the clay and silt fraction and the very find sand fraction for samples under the turbine is 36.5 and 4.4 percent, respectively; the vessel-based samples have an average of 0 percent. Only the fine sand content is comparable between the samples, with a mean average of approximately 6 percent for all samples.

3.2.3 Seabed Photography Analysis

The Lagrangian floating camera system produced hundreds of images along each of the three diver-towed transects. Field survey records for the floating camera deployment are presented in **Appendix 4**. Example imagery for each turbine is presented in **Figure 39**. The images clearly show the three turbines vary in the density of blue mussels present on the seafloor within the foundation footprints along a gradient. Specifically, Turbine 1 exhibits extremely dense cover of living mussels and mussel shells. The grate structure on the seafloor is covered in mussels and is not detectable in the images. Conversely, Turbine 5 has very few mussels and shells and the grate structure is not colonized. Turbine 3 is in the middle of this spectrum, although is much more similar to Turbine 5. Furthermore, the images capture several scavenger species that have been attracted to the area due to the mussels, including crabs, starfish, and snails. Also noted were several species of fish and elasmobranchs, including black sea bass, flounder, spiny dogfish, and winter skate.

It is interesting to note that it appears the mussels are contained within the footprint of the turbine structure. The data collected, as well as diver observations, suggest mussels are absent even just outside the footprint, including at Turbine 1. Also, the concrete mats placed to protect portions of the cable are bare at all of the turbines; they are not colonized by mussels or any other organisms, with the exception of encrusting sponges covering small portions (refer to **Figure 39h**).

3.2.4 Sediment Organic Content

The results of the analysis for total percent OC and TOC of the five samples collected under each of the turbine structures are presented in **Appendix 5** and are summarized in **Figure 40** and **Table 27.** Levels of TOC and OC below the foundation at Turbine 1 were substantially higher than those recorded elsewhere (e.g., samples below Turbines 3 and 5, and vessel-based samples within all three turbine areas). The mean level of TOC for the Turbine 1 samples was 2.5 percent and the maximum level was 5.4 percent. The mean and maximum OC levels at Turbine 1 were 1.1 and 2.3 percent, respectively. These levels contrast with those recorded at Turbines 3 and 5 samples, which have lower TOC and OC levels. Specifically, for Turbine 3 and 5, respectively, mean TOC is 0.5 and 0.3 percent, mean OC is 0.2 and 0.1 percent, TOC range is 0.3 to 0.8 percent and 0 to 0.9 percent, and OC range is 0.1 percent to 0.3 and 0 percent to 0.4 percent.

Table 27. Average total organic content and total organic carbon content for samples collected within the footprint of each turbine structure in Year 2.

Study Area	Average Total Organics (%)	Average Total Organic Carbon (%)
Turbine 1	2.5%	1.1%
Turbine 3	0.5%	0.2%
Turbine 5	0.3%	0.1%

A 1-way ANOVA ($\log_{10}+1$ transformed data) demonstrated that both TOC and OC levels in sediment samples from under Turbine 1 were significantly higher than those recorded in samples collected under Turbines 3 and 5 ($p<0.05$) and were also significantly higher than the vessel-based samples collected within the control areas.

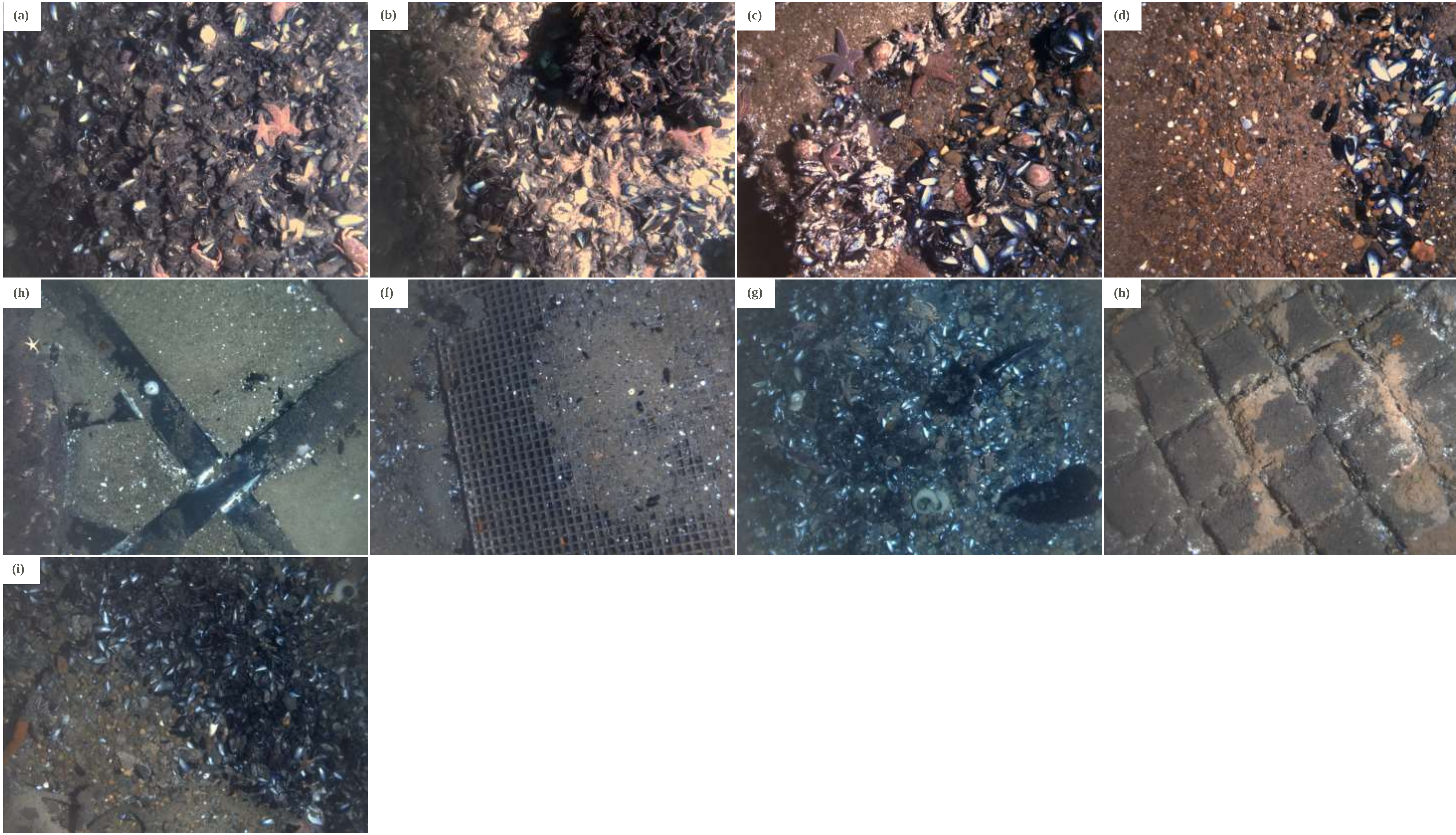


Figure 39. Example images taken within the footprint of the turbine structures by the diver-towed camera system in Year 2.

Note: The images at Turbine 1 (a) and (b) show the dense cover of living mussels and shells at Turbine 1 and the heavy colonization of the grate structure on the seafloor. Image from Turbine 3 (c) and (d) show the partial colonization of the grate structure by mussels and that mussels are present to a much lesser extent. The image at Turbine 5 (e) and (f) show the lack of mussels on the seafloor and that the grate structure is not colonized. Some of the images also show the high density of scavenger species amongst the mussels, including starfish, crabs, moon snails, which is again highlighted in image (g). Neither mussels or other organisms have colonized the protective concrete mats at any of the turbines, as shown in image (h) and (i) taken at Turbine 1. Note in (i) that the high density of mussels extends towards the edge of the mat (in bottom left corner), but then ceases.

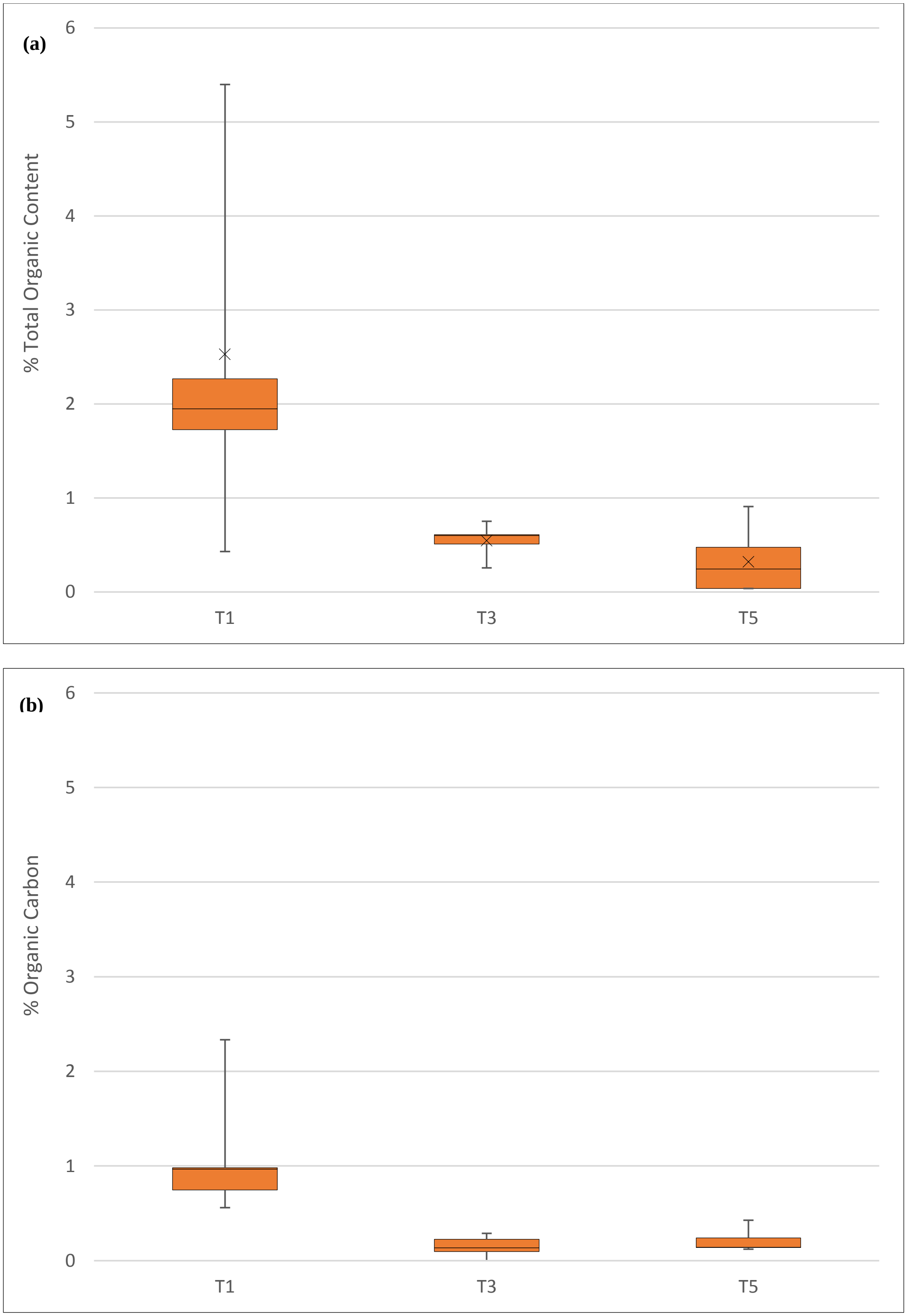


Figure 40. Box plots summarizing the (a) total organic content and (b) organic carbon content of diver-based sediment samples collected under the turbine foundations in Year 2.

3.2.5 Macrofaunal Analysis

3.2.5.1 Overall Results

A species abundance matrix for the macrofaunal samples collected within the footprint of each turbine structure for Year 2 is presented in **Appendix 6**. A summary of the total species abundance and species richness for these samples is provided in **Table 28**. It should be noted that the size of samples collected within a given turbine are comparable, although the sample size amongst turbines varies considerably due to inconsistencies in diver sampling technique (refer to **Table 28**). The smallest samples were collected under Turbine 3 (average volume = 1.2 L), while Turbine 5 had the largest samples (average volume = 7.8 L). Samples from Turbine 1 fell in the middle of the spectrum (average volume = 4.3 L). The samples were not standardized (e.g., by volume) in efforts to avoid knowingly introducing error (refer to **Section 1.2.3**). As such, the results presented in this section should be considered relative, rather than direct, descriptions and comparisons.

Table 28. Summary of species abundance and species richness for all macrofaunal samples collected within the footprint of each turbine structure in Year 2.

	Turbine 1	Turbine 3	Turbine 5	All Combined
Total Species Richness	26	36	50	70
Mean Species Richness	11.4	15.4	23.2	--
Range of Species Richness per Sample	8-16	11-26	17-32	8-32
Total Species Abundance	429	270	2,822	3,521
Total Species Abundance (Nematoda excluded)	349	249	1,200	1,798
Mean Species Abundance	86	54	564	--
Range of Species Abundance per Sample	45-128	29-94	420-716	29-716
Average Volume of Sample (L)	4.3	1.2	7.8	4.4
Average Weight of Sample (lbs)	24	5.2	37.2	22.1

Note: Sample weight is heavily influenced by the concentration of larger sediment particles (i.e., pebble, gravel, and cobbles).

A total of 70 macrofaunal species represented by 3,521 individuals were recorded from the 15 grab samples (**Table 28**). Considering all samples by phylum, the majority of the macrofauna recovered were nematodes, comprising 49 percent of the total species abundance, followed by mollusks, crustaceans and annelids (i.e., polychaetes) in similar proportions (20, 16 and 15 percent, respectively) (**Figure 41**).

Individuals from these four phyla were recovered within all 15 samples. The remaining organisms belonged to the phyla Nemertea, Copepoda, and Platyhelminthes, although in negligible numbers (combined total = 11 individuals). For species richness, organisms were resolved to the species level for only three phyla. Of these, polychaetes contributed 47 percent to the species richness, and crustaceans and mollusks contributed 31 and 16 percent, respectively.

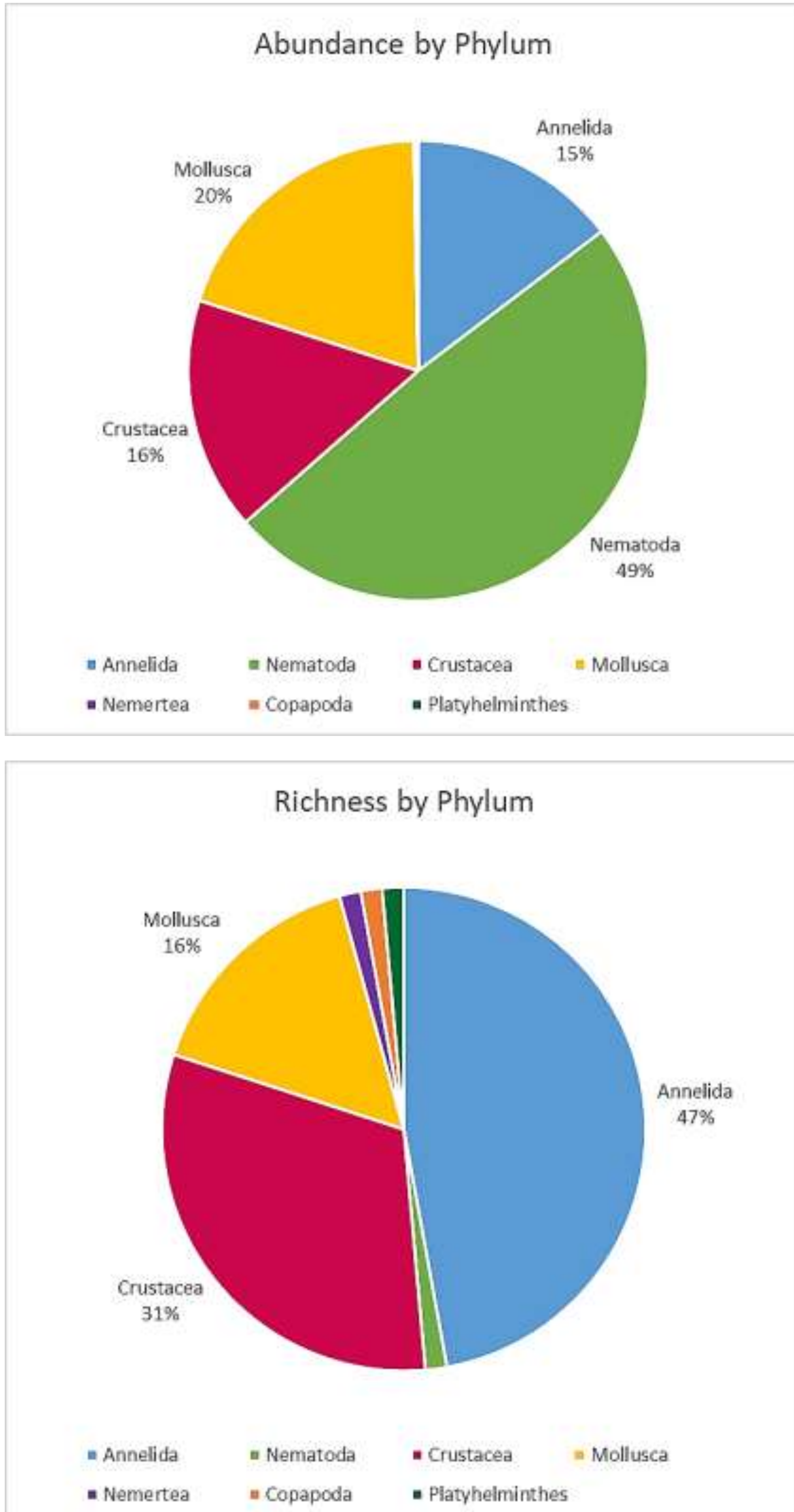


Figure 41. Proportion contribution of macrofauna characterized by phylum to the total abundance and total species richness for all macrofaunal samples collected within the footprint of each turbine structure in Year 2.

The most conspicuous species across all the samples in terms of total abundance were nematodes, followed by the blue mussel, *Mytilus edulis* (**Table 29**). Also dominant were the barnacle, *Balanus*; the amphipods, *Unciola irrorata* and *Byblis serrata*; and the polychaetes *Polygordius* and *Lumbrinereis fragilis*. In general, these dominant species were also the most frequently occurring. Although only four macrofauna were recovered in 14 or all 15 samples (nematodes, *Mytilus edulis*, *Balanus*, and *Lumbrinereis fragilis*), the remaining macrofauna were present in 11 samples or fewer.

Table 29. Most abundant and frequently occurring species for all diver-based samples collected under the structure of each turbine in Year 2.

Species	Taxonomic Group	Total Abundance	Occurrence (n=15)
Most abundant (< 100 individuals)			
Nematode*	Nematoda	1721	15
*Mytilus edulis**	Mollusk	668	15
Balanus spp*	Mollusk	243	14
*Unciola irrorata**	Amphipod	159	11
Polygordius spp*	Polychaete	137	10
Byblis serrata	Amphipod	109	7
*Lumbrinereis fragilis**	Polychaete	99	14
Most Frequent (< 10 samples)			
Nematode*	Nematoda	1721	15
*Mytilus edulis**	Molluska	668	15
Balanus spp*	Molluska	243	14
*Lumbrinereis fragilis**	Polychaete	99	14
*Unciola irrorata**	Amphipod	159	11
Polygordius spp*	Polychaete	137	10
Goniadella gracilis	Polychaete	25	10

Note: Asterisk denotes species listed as both abundant and frequent. Bold font denotes species that were also listed in the vessel-based grab samples collected in Year 1 and/or Year 2.

3.2.5.2 Comparison of Individual Turbines

Macrofaunal patterns of species abundance and richness vary considerably within the footprint of the three turbine structures (refer to **Table 28**). Species abundance is substantially higher at Turbine 5, with a total of 2,822 individuals recovered in the five samples (mean = 564). In contrast, Turbine 1 has total abundance of 429 individuals (mean = 86) and Turbine 3 has 270 individuals (mean = 54). This discrepancy is partially attributed to the elevated presence of nematodes at Turbine 5, which account for nearly 60 percent of the total abundance. The variations in sample size at each turbine also likely explains some of the difference, as there is a clear (although non-linear) pattern of increasing abundance with increasing sample size. However, this pattern does not hold true for species richness across the turbines. While total richness is greatest at Turbine 5 (n=50, mean = 23.2), which has the largest sample size, Turbine 1, with the intermediate sample size, has the lowest richness (n=26; mean = 11.4). Turbine 3 is approximately in the middle of this range, with a species richness of 36 (mean = 15.4).

One way ANOVA of the macrofauna data confirmed significant differences in species numbers between the three turbine locations ($F_{(2,14)} = 3.8853$, $p = 0.009$) and *post-hoc* Tukey HSD tests highlighted that species numbers at Turbine 5 were significantly higher than those at Turbine 1 ($p < 0.05$). Similarly, there were significant differences in the faunal abundance between the three turbines (one-way ANOVA) ($F_{(2,14)} = 3.8853$), $p = 1.72 \text{ x } x10^{6}$) with Turbine 5 supporting significantly higher abundances than Turbines 1 and 3 (Tukey HSD $p < 0.05$).

The turbines also show some distinction with respect to their dominant species. Barnacles, mussels, and nematodes dominate or co-dominate the five samples collected under Turbine 1. At Turbine 3, barnacles dominate three samples, while *Polygordius* and *Unciola irrorata* each dominate one sample. At Turbine 5, four samples are overwhelmingly dominated by nematodes, followed by mussels for three samples and *B. serrata* for one sample. The fifth sample recorded equal abundances of nematodes and mussels (n=300).

ANOSIM results of the diver-based samples also indicate there are differences among the three turbines (R = 0.791; p = 0.001). However, it should be noted that these statistical results are also likely reflecting the discrepancy in species abundances due to the variations in sample size across the turbines. As such, the SIMPER outputs and nMDS plot may be considered more useful for interpreting distinctions (**Table 30, Figure 42**).

Table 30. SIMPER results showing average similarity and top contributing species (70% cut-off) of diver-based samples collected under the structure of each turbine in Year 2.

Study Area	Average Similarity (%)	Contributing Species (70% cut-off)
Turbine 1	54.13	*Mytilus edulis* (24.89%)
		Amphibalanus amphitrite (23.99%)
		Nematoda (15.46%)
		Lumbrinereis fragilis (14.27%)
Turbine 3	44.53	*Amphibalanus amphitrite* (20.48%)
		Mytilus edulis (15.04%)
		Polygordius spp. (14.26%)
		Nematoda (12.76%)
		Lumbrinereis fragilis (6.94%)
		Pisione sp. (5.96%)
Turbine 5	66.46	*Nematoda* (37.50%)
		Mytilus edulis (13.58%)
		Unciola irrorata (8.21%)
		Polygordius spp. (6.82%)
		Pisione sp. (6.27%)
All combined	40.32%	*Mytilus edulis* (20.06%)
		Nematoda (19.71%)
		Amphibalanus amphitrite (17.17%)
		Lumbrinereis fragilis (10.83%)
		Unciola irrorata (6.83%)

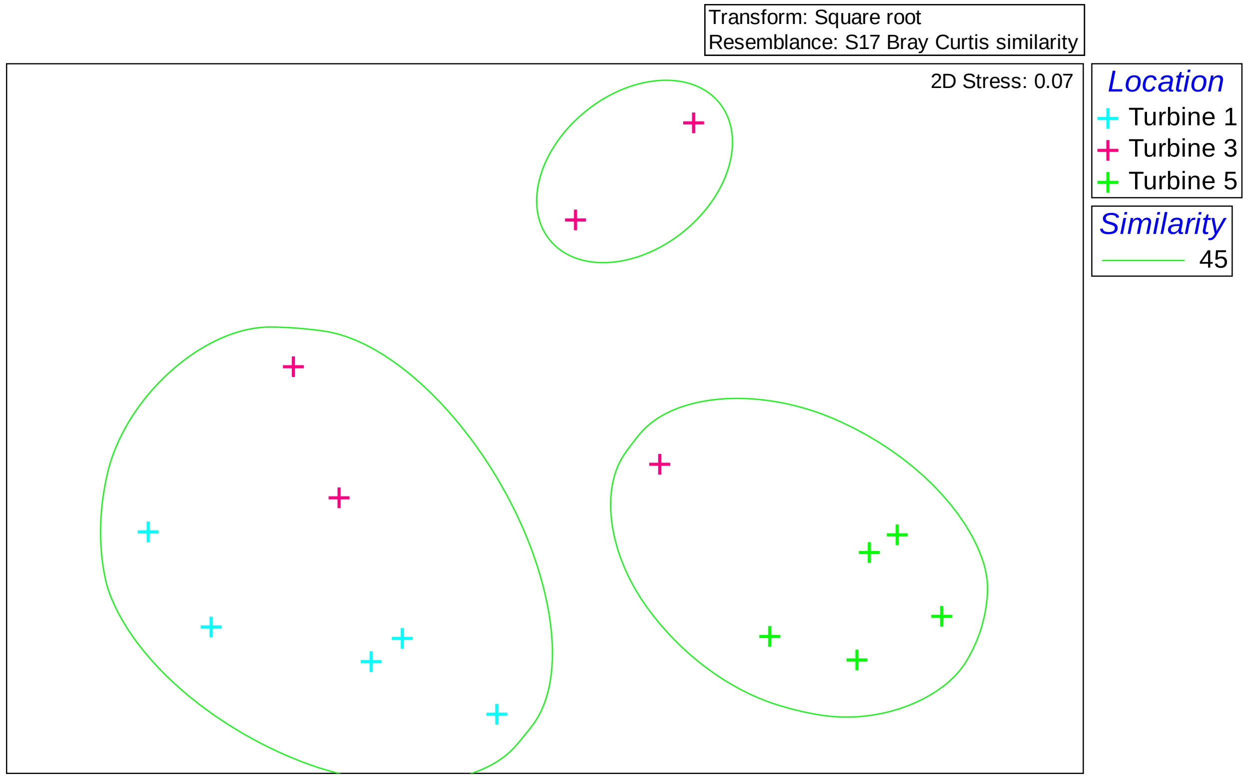


Figure 42. Non-metric MDS plot of diver-based samples collected with the footprint of each turbine in Year 2.

The nMDS plot (**Figure 42**) shows that the samples broadly separate out by turbine, but that Turbine 3 exhibited faunal attributes that were also characteristic of Turbines 1 and 5. Indeed, at the selected similarity level (45 percent) three discrete sample clusters were apparent. For example, the cluster representing Turbine 1 also contained two samples collected below Turbine 3. Key characterizing species included the blue mussel *Mytilus edulis*, the barnacle *Amphibalanus amphitrite*, nematodes and the polychaete *Lumbrinereis fragilis*. The next largest cluster encompassed all of the samples collected below Turbine 5 together with one of the samples collected below Turbine 3. These samples were characterized by a high abundance of nematodes together with mussels, amphipods *Unciola irrorata* and *Byblis serrata*, and polychaetes *Pisione* sp. *Polygordius* spp and *L. fragilis*. The third group contained the remaining two samples collected below Turbine 3 and was characterized by comparatively low abundances of polychaetes *Polygordius* spp., *Parougia caeca*, *Goniadiella gracilis* and *L. fragilis*, amphipods, *B. serrata* and barnacles *B. amphitrite*. The data thus supported the presence of distinct communities below Turbines 1 and 5 with an intermediate community below Turbine 3.

Further examination of the macrofauna data indicates Turbine 3 is intermediate to Turbines 1 and 5. The Turbine 3 samples are similar to the Turbine 5 samples with regards to macrofaunal community composition, although species are found in overall lesser abundances. In particular, Turbine 5 has substantially higher densities of the blue mussel *Mytilus edulis*, the polychaete *Polygordius*, and the amphipods *Unciola irrorata* and *Byblis serrata*, in addition to nematodes. However, Turbine 3 is more similar to Turbine 1 with respect to species abundance, both recording relatively low abundance for all species, with a few exceptions. Note that while the samples record Turbine 5 as having the highest number of mussels, imagery collected by the divers indicate that mussel abundance is substantially greater at Turbine 1 (refer to **Figure 39**). The discrepancy between the datasets is attributed to the sampling technique. Specifically, at Turbine 1, the divers cleared away, rather than retained, the mussels on the seafloor while collecting the grab sample.

Turbine 1 is conspicuously less similar to Turbine 5 in terms of species composition. For example, two of the species with high abundances in Turbine 5 are not present at all in Turbine 1, namely *Byblis serrata* and *Polygordius*. Further, no amphipods were recovered within any of the Turbine 1 samples, with the exception of minor abundances of *Unciola irrorata* (n=19). Polychaetes noticeably absent only at Turbine 1 in addition to *Polygordius* include *Lumbrinereis acuta*, *Parapionosyllis longicirrata*, and *Pisione* sp. Unique to Turbine 1 is the polychaete *Harmothoe* sp, although in relatively minor abundances (n=20), and the relatively high abundance of barnacles (n=130, versus 76 and 37 at Turbines 3 and 5, respectively).

The nMDS plot and SIMPER output also further support macrofaunal community composition changes along a gradient moving from Turbine 1 to 5. Specifically, the nMDS plot shows the Turbine 3 samples fall in between those of Turbines 1 and 5. Also, the SIMPER output reports that of the six contributing species, two are also listed as contributors for Turbine 1, another two species also contribute to Turbine 5, and the remaining two species are contributors for all three turbines. The macrofauna composition at Turbine 3 is also more variable, likely due to its intermediate position along the gradient, further reflecting the transition between Turbines 1 and 5. Evidence of this can be seen in the nMDS plot, for which Turbine 3 samples are more loosely scattered on the plot, whereas the samples for Turbines 1 and 5 are shown as more cohesive clusters. Additionally, the SIMPER output reports Turbine 3 has the lowest average similarity across its fives samples (44.53 percent). In comparison, the average similarity for Turbines 1 and 5 was 54.13 and 66.46 percent, respectively.

3.2.5.3 Comparison of Turbine Samples within Footprint of Structure and Surrounding Area

Five macrofauna listed as most abundant or most frequently occurring across all of the Year 1 and Year 2 vessel-based grab samples collected in the vicinity of the turbines were also listed as such across all of the diver-based grab samples collected under the turbine foundations (refer to **Table 29** and **Table 14**). These macrofauna are nematodes, barnacle *Balanus*, the amphipod *Unciola irrorata*, and the polychaetes, *Polygordius* and *Goniadella gracilis*.

Further cross examination of the macrofauna data revealed that the majority of the remaining dominant and frequently occurring macrofauna identified across all of the vessel-based grab samples are also present within the diver-based samples, although to a much lesser extent. The two exceptions are *Sabellaria vulgaris* and *Kirkegaardia baptisteae*, neither of which were recovered. The dominant species in both the Year 1 and Year 2 vessel-based samples, aside from nematodes, was the polychaete *Polycirrus eximius*, of which 12 individuals were recorded in seven samples from below the turbine structures. The polychaete *Pisione*, has a greater presence, with 62 individuals recovered in nine samples.

For three of the other eight species, abundances ranged from 28 to 32 individuals and frequency of occurrence ranged between 6 and 7 samples. The other five species showed a minimal presence, having 1 to 10 individuals across 1 to 5 samples. Similarly, the three remaining species listed as most dominant or frequently occurring in the diver-based samples were also found within the vessel-based samples. These species were the polychaete *L. fragilis*, with 363 individuals found within 131 samples; the blue mussel *M. edulis*, with 120 individuals found within 46 samples; and the amphipod *B. serrata*, with 45 individuals found within 19 samples. With regards to the macrofaunal composition of the vessel-based samples, the three turbines are broadly comparable. The primary distinction is that Turbines 3 and 5 have overall similar species compositions and show a greater degree of overall similarity relative to Turbine 1, which shows the greatest within-group variability.

With regards to the macrofaunal composition of the diver samples, Turbine 3 is intermediate to Turbine 1 and exhibits the greatest within-in group variability.

Turbine 5 supported a similar macrofauna within and outside of the turbine footprint. In particular, nematodes, the polychaete *Polygodius* spp. and the amphipod *Unciola irrorata* were well represented in both vessel and diver grab samples, such that their distribution may be part of the continuum of species distributions at this location. Turbine 1, on the other hand, represents the opposite end of the spectrum. This location was characterized by dense mussels and barnacles within the foundation footprint but an absence of these species in the surrounding area.

The main distinction between the areas under versus surrounding the turbines is that dense mussels were present in the samples collected under the turbine, but showed a minimal presence in the surrounding area, and thus appear to be a feature solely associated with the foundation.

3.3 CMECS Biotope Classification

The term "biotope" is specific in that it integrates biotic-abiotic data within a given area to offer more ecologically meaningful information. In this study, the Geoform, Substrate, and Biotic Component were integrated to define biotope classifications for the turbine areas. As such, biotopes reflect the relationship between macrofaunal communities and associated geological characteristics within the defined map units. In this study, the biotopes are considered preliminary because, although the biotic-abiotic relationships identified in this study are statistically significant and ecologically meaningful, they have not yet been demonstrated to be consistent over a longer time scale. However, the continuation of this study in the future could lend to the establishment of well-defined biotopes, given the biotic-abiotic relationships identified persist through time. While comparisons of the biotopes developed for this BIWF study and the OSAMP study are insightful, it is acknowledged that the BIWF study was conducted at a very site specific scale, whereas the OSAMP study was conducted at a regional scale.

3.3.1 Rectifying OSAMP and BIWF Macrofauna Datasets

During the classification process, a few nomenclature discrepancies were discovered in comparing species identifications between the BIWF and OSAMP macrofaunal datasets. These discrepancies were rectified through expert knowledge. The two most relevant cases involve the polychaete worms *Lumbrinereis* and *Polycirrus*. Within the OSAMP dataset, *Lumbrinereis hebes* was identified in high abundances and is responsible for defining several of the OSAMP biotopes.

Within the BIWF dataset, *L. hebes* was not identified, but *L. acuta* was. Moreover, *L. acuta* was found in high abundances in areas where *L. hebes* was previously identified and *L. acuta* is responsible for defining one of the BIWF biotopes. Similarly, *Polycirrus medusa* was identified in the OSAMP dataset and *Polycirrus eximius* in the BIWF dataset. Both species are abundant within their respective datasets, do not occur across datasets, and are biotope-defining species. In both cases, it is highly likely that these species are the same. Although taking a conservative approach, identification at the genus level is used for biotope classification.

Furthermore, nematodes were not enumerated in the OSAMP dataset, although they were in the BIWF dataset. Analyses were run both with nematodes included and excluded for comparison purposes, including nMDS plots, SIMPER, and ANOSIM. The differences between the two sets of results were minor, indicating nematodes have little influence in terms of assessing of macrofaunal community structure and biotic-abiotic relationships. Given this finding, nematodes were retained in the analyses for the sake of presenting the most complete understanding of the data. However, nematodes were removed from biotope classification to allow more direct comparisons of the OSAMP and BIWF biotopes.

3.3.2 Year 1 and Year 2 Classification

Biotopes within the three turbine study areas were classified according to CMECS (**Figures 43** and **44, Tables 31** and **32**). The biotope units adhered to boundaries of the geologic depositional environments defined in the OSAMP. As such, Turbines 1 and 3 were each classified as one biotope and Turbine 5 as three biotopes. Each biotope is classified according to its biotic (the dominant species) and abiotic (geologic depositional environment) characteristics. Two species are listed when both occurred in nearly equal abundances. Abundance is calculated as the average number of individuals of a given species among all stations belonging to a given biotope. In general, all biotopes in both Year 1 and Year 2 are defined by polychaetes in depositional environments containing coarse sand.

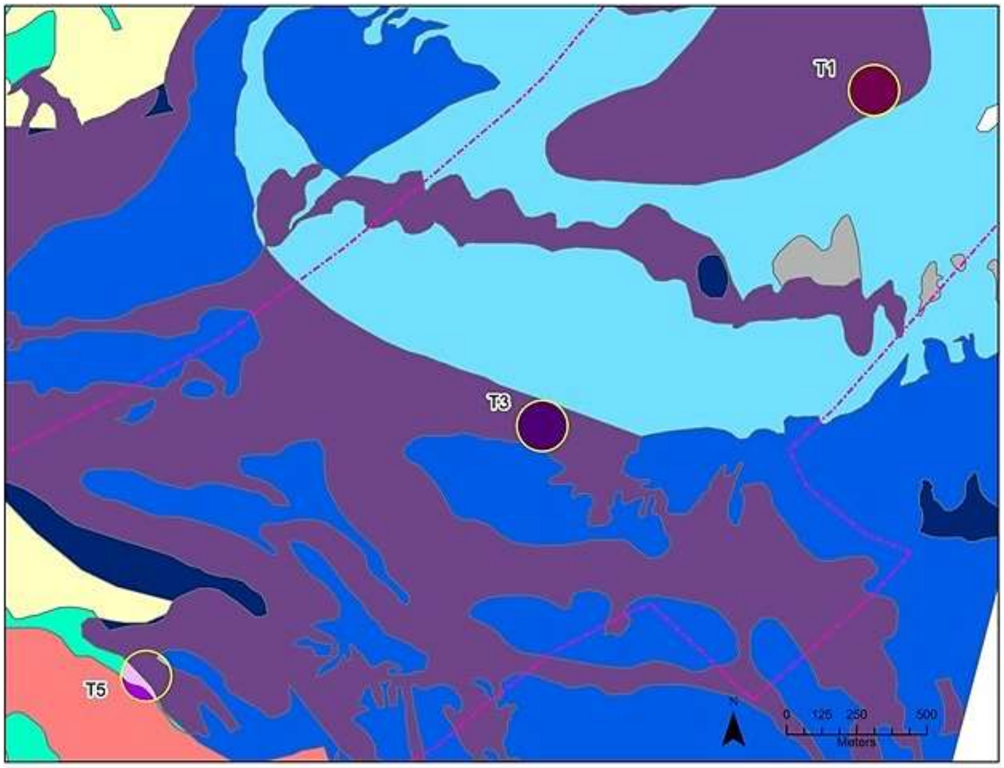
For both sampling years, the Turbine 1 study area was characterized by polychaetes in coarse sand with small dunes within glacial alluvial fan. The primary distinction is the change in dominant species across all samples. In Year 1, the polychaete, *S. vulgaris*, was dominant, which also contributed 5.22% to the overall biotope similarity. In Year 2, the polychaete, *Polygordius*, was the most dominant across all samples and contributed 15.41% to the overall similarity. It should be noted that *Polygordius* was also one of the most dominant species in Year 1 and contributed 11.54% to the overall similarity. The change in the biotope classification between Year 1 and Year 2 is attributed to the highly localized and patchy distribution of *S. vulgaris* and relocation of the sampling sites between years, rather than a result of the turbine structure. While Turbine 1 is well-characterized as a polychaete dominated area, there is some variability in the overall cohesiveness of the biotope, as indicated by the overall biotope similarity (Year 1 = 38.91 percent; Year 2 = 55.33 percent), which is the lowest of the three turbine areas. This variability is also evident in comparing the list of species most responsible for the overall similarity. Three species are listed for both sampling years (*Polygordius* spp, *G. gracilis*, and *L. acuta*) of the six and five total contributors for Year 1 and Year 2, respectively.

The samples collected within Turbine 3 provide a well-defined representation of the turbine study area characterized solely by polychaetes. *Polycirrus* was the dominant species across all samples in Year 1 and Year 2. The biotope is classified as "*Polycirrus sp.* in coarse sand with small dunes within glacial alluvial fan." The high degree of cohesiveness within Turbine 3 is reflected in the overall biotope similarity (Year 1 = 62.49 percent; Year 2 = 69.95 percent), which is the highest of the three turbine areas. Furthermore, four of the six species contributing most the overall biotope similarity in Year 1 continue to do so in Year 2; specifically *Polycirrus*, *Pisione*, *L. acuta* (10.37 percent), and *Polygordius* (10.14 percent).

Turbine 5 was investigated according to the three biotope units used in the OSAMP study. All biotopes are characterized by polychaetes in Year 1 and Year 2. The classification of two of the three biotopes stayed the same for both years: "*Polycirrus* sp. in pebble, gravel, and coarse sand within moraine shelf" and "*Polygordius spp.* in coarse sand with small dunes / sand waves within moraine shelf." The remaining biotope shared was classified in Year 1 as "*Polycirrus sp.* / *Lumbrinereis sp.* in coarse sand with small dunes within glacial alluvial fan" and as "*P. longicirrata*, *Polycirrus* sp., *Pisione* sp. in coarse sand with small dunes within glacial alluvial fan" in Year 2. It should be noted Year 1 also exhibits a relatively high abundance of *Pisione* (n=125) and, similarly, Year 2 a high abundance of *Lumbrinereis* (n=216).

The primary distinction is the increased abundance of *P. longicirrata* in Year 2 across the entire BIWF study area. With respect to macrofaunal community composition, Turbine 5 exhibits a high level of cohesiveness among the sample groups, with the similarity of each biotope ranging from 52.37% to 58.74 percent in Year 1 and 65.07 percent to 69.68 percent in Year 2. However, the data also indicate the species that dominate or co-dominate and that are responsible for the overall similarity within each biotope are identical, suggesting the three biotopes are quite similar. The distinction appears to be based on variations in abundances of the characterizing species, rather than the species themselves. In both years these characterizing polychaetes include *Polycirrus*, *Pisione*, *Polygordius*, and *L. acuta.* Year 1 is also characterized by *G. gracilis* and Year 2 by *P. longicirrata* and *P. caeca*.

Statistical analysis of the biotopes showed there is a significant relationship between the geological depositional environments and the associated macrofaunal community assemblages within each turbine area for both years (ANOSIM R: Year 1 = 0.413, Year 2 = 0.412; p = 0.001).



Biotope Classification

Study Areas

Turbine Study Areas

BIWF Study Area

Turbine 1

Sabellaria vulgaris in coarse sand with small dunes within glacial alluvial fan

Turbine 3

Polycirrus sp in coarse sand with small dunes within glacial alluvial fan

Turbine 5

Polycirrus sp. / Lumbrineries sp. in coarse sand with small dunes within glacial alluvial fan

Polycirrus sp. in pebble, gravel, and coarse sand within moraine shelf environment

Polygordius spp. in coarse sand with small dunes / sand waves within moraine shelf environment

Undefined

OSAMP (From LaFrance et al., 2014)

B. serrata in boulder gravel concentration within glacial alluvial fan

B. serrata in pebble, gravel, and coarse sand within glacial alluvial fan

B. serrata in sheet sand within glacial alluvial fan

J. falcata in boulder gravel concentration within moraine shelf

Corophium spp. in pebble, gravel, and coarse sand within moraine shelf

Pisione sp. in coarse sand with small dunes and sand waves within moraine shelf

Polycirrus sp. / Lumbrinereis sp. in coarse sand with small dunes within glacial alluvial fan

Undefined

Figure 43. Biotope classification map of the turbine areas within the BIWF study area for Year 1.

Biotope Classification

Study Areas

Turbine Study Areas

BIWF Study Area

Turbine 1

Polygordius spp. in coarse sand with small dunes within glacial alluvial fan

Turbine 3

Polycirrus sp. in coarse sand with small dunes within glacial alluvial fan

Turbine 5

P. longicirrata / Polycirrus sp. / Pisione sp. in coarse sand with small dunes within glacial alluvial fan

Polycirrus sp. in pebble, gravel, and coarse sand within moraine shelf environment

Polygordius spp. in coarse sand with small dunes / sand waves within moraine shelf environment

Undefined

OSAMP (From LaFrance et al., 2014)

B. serrata in boulder gravel concentration within glacial alluvial fan

B. serrata in pebble, gravel, and coarse sand within glacial alluvial fan

B. serrata in sheet sand within glacial alluvial fan

J. falcata in boulder gravel concentration within moraine shelf

Corophium spp. in pebble, gravel, and coarse sand within moraine shelf

Pisione sp. in coarse sand with small dunes and sand waves within moraine shelf

Polycirrus sp. / Lumbrinereis sp. in coarse sand with small dunes within glacial alluvial fan

Undefined

Figure 44. Biotope classification map of the turbine areas within the BIWF study area for Year 2. The biotopes in red (n=2) are those that have changed from Year 1 to Year 2.

Table 31. Description of CMECS classification of BIWF biotopes with turbine areas for Year 1.

Year 1 CMECS Classification of BIWF Biotopes	Dominant Species Across All Samples Within Biotope (# Individuals)	Overall Biotope Similarity	Species Most Responsible for Biotope Similarity (% Contribution)
Turbine 1			
Sabellaria vulgaris in coarse sand with small dunes within glacial alluvial fan	*Sabellaria vulgaris* *(382)*	38.91%	*Nematoda* *(20.45%)*
	Nematoda *(262)*		*Goniadella gracilis* *(12.33%)*
			Polygordius spp. *(11.54%)*
			Nephtys bucera *(8.85%)*
			Unciola irrorata *(6.82%)*
			Lumbrinereis acuta *(6.15%)*
			Sabellaria vulgaris *(5.22%)*
Turbine 3			
Polycirrus sp. in coarse sand with small dunes within glacial alluvial fan	*Nematoda* *(1,344)*	62.49%	*Nematoda (14.20%)*
	Polycirrus sp. *(847)*		*Polycirrus* sp. *(12.46%)*
			Pisione sp. *(11.05%)*
			Lumbrinereis acuta *(10.37%)*
			Polygordius spp. *(10.14%)*
			Goniadella gracilis *(6.21%)*
			Cirrophorus sp. *(5.59%)*

Table 32. Description of CMECS classification of BIWF biotopes with turbine areas for Year 1 (continued).

Year 1 CMECS Classification of BIWF Biotopes	Sample Stations Within Biotope (# Samples)	Dominant Species Across All Samples Within Biotope	Overall Biotope Similarity	Species Most Responsible for Biotope Similarity (% Contribution)
Turbine 5				
Polycirrus sp. / *Lumbrinereis sp.* in coarse sand with small dunes within glacial alluvial fan	2, 3, 4, 5 (12)	*Nematoda (717)*	52.37%	*Nematoda (25.28%)*
		Lumbrinereis acuta (193)		*Lumbrinereis acuta (11.43%)*
		Polycirrus sp. *(175)*		*Goniadella gracilis (10.14%)*
				Polygordius spp. *(9.75%)*
				Pisione sp. *(9.23%)*
				Polycirrus sp. *(5.03%)*
Polycirrus sp. in pebble, gravel, and coarse sand within moraine shelf	6, 7, 8, 9 (10)	*Polycirrus* sp. *(468)*	55.90%	*Polycirrus* sp. *(25.09%)*
		Nematoda (442)		*Nematoda (18.00%)*
				Polygordius spp. *(16.32%)*
				Pisione sp. *(13.64%)*
Polygordius spp. in coarse sand with small dunes / sand waves within moraine shelf	1, 9 (5)	*Polygordius* spp. *(526)*	58.74%	*Nematoda (19.68%)*
		Nematoda (342)		*Polygordius* spp. *(19.40%)*
				Polycirrus sp. *(11.89%)*
				Lumbrinereis acuta (9.70%)
				Pisione sp. *(8.26%)*
				Eumida sanguinea (6.14%)

Note: The dominant species among all macrofaunal samples within a given biotope and the species that dominate/co-dominate each individual sample is provided. Also provided are the SIMPER reports of overall biotope similarity and the species contributing a cumulative contribution of 70 percent to the biotope similarity. Cells are color-coded by taxonomic group. Yellow cells are polychaetes, blue cells are amphipods, and green cells are crustaceans (barnacles). Grey cells are nematodes, which were excluded in biotope classification.

Table 33. Description of CMECS classification of BIWF biotopes with turbine areas for Year 2.

Year 2 CMECS Classification of BIWF Biotopes	Dominant Species Across All Samples Within Biotope (# Individuals)	Overall Biotope Similarity	Species Most Responsible for Biotope Similarity (% Contribution)
Turbine 1			
Polygordius spp. in coarse sand with small dunes within glacial alluvial fan	Nematoda *(2,840)*	55.33%	*Nematoda (27.53%)*
	Polygordius spp. (541)		*Polygordius* spp. *(15.41%)*
			Goniadella gracilis (11.20%)
			Lumbrinereis acuta (7.42%)
			Parapionosyllis longicirrata (6.58%)
			Exogone hebes (4.87%)
Turbine 3			
Polycirrus sp. in coarse sand with small dunes within glacial alluvial fan	Nematoda *(16,214)*	69.95%	*Nematoda (33.77%)*
	Polycirrus sp. *(838)*		*Polygordius* spp. *(6.74%)*
			Polycirrus sp. *(6.62%)*
			Parapionosyllis longicirrata (6.17%)
			Pisione sp. *(6.13%)*
			Lumbrinereis acuta (6.05%)

Note: The dominant species among all macrofaunal samples within a given biotope and the species that dominate/co-dominate each individual sample is provided. Also provided are the SIMPER reports of overall biotope similarity and the species contributing a cumulative contribution of 70 percent to the biotope similarity. Cells are color-coded by taxonomic group. Yellow cells are polychaetes, blue cells are amphipods, and green cells are crustaceans (barnacles). Grey cells are nematodes, which were excluded in biotope classification.

Table 34. Description of CMECS classification of BIWF biotopes with turbine areas for Year 2 (continued).

Year 2 CMECS Classification of BIWF Biotopes	Sample Stations Within Biotope (# Samples)	Dominant Species Across All Samples Within Biotope	Overall Biotope Similarity	Species Most Responsible for Biotope Similarity (% Contribution)
Turbine 5				
P. longicirrata, *Polycirrus* sp., *Pisione* sp. in coarse sand with small dunes within glacial alluvial fan	2, 4, 6, 9 (12)	*Nematoda (4,514)*	65.07%	*Nematoda (22.37%)*
		Parapionosyllis longicirrata (371)		*Pisione* sp. *(10.14%)*
		Polycirrus sp. *(331)*		*Polycirrus* sp. *(9.74%)*
		Pisione sp. (322)		*Polygordius* spp. *(8.44%)*
				Lumbrinereis acuta (7.07%)
				Parapionosyllis longicirrata (6.40%)
Polycirrus sp. in pebble, gravel, and coarse sand within moraine shelf	3, 5, 8 (7)	*Nematoda (2,470)*	69.68%	*Nematoda (31.61%)*
		Polycirrus sp. *(267)*		*Polycirrus* sp. *(9.78%)*
				Pisione sp. *(8.29%)*
				Parapionosyllis longicirrata (7.58%)
				Parougia caeca (6.69%)
				Polygordius spp. *(5.90%)*
				Sphaerosyllis erinaceus (5.25%)
Polygordius spp. in coarse sand with small dunes / sand waves within moraine shelf	1, 3, 5, 7 (8)	*Nematoda (3,990)*	69.17%	*Nematoda (30.02%)*
		Polygordius spp. *(410)*		*Pisione* sp. *(9.65%)*
				Polycirrus sp. *(8.35%)*
				Polygordius spp. *(7.33%)*
				Lumbrinereis acuta (6.51%)
				Parougia caeca (6.04%)
				Parapionosyllis longicirrata (5.74%)

Note: The dominant species among all macrofaunal samples within a given biotope and the species that dominate/co-dominate each individual sample is provided. Also provided are the SIMPER reports of overall biotope similarity and the species contributing a cumulative contribution of 70 percent to the biotope similarity. Cells are color-coded by taxonomic group. Yellow cells are polychaetes, blue cells are amphipods, and green cells are crustaceans (barnacles). Grey cells are nematodes, which were excluded in biotope classification.

4 Discussion

4.1 Current Monitoring Practice

To date, there is little, if any, consensus on the level of acceptable benthic ecological change because of offshore wind farm (OWF) construction and operation or on the relevant spatial scales over which such changes may occur. Permit conditions typically do not establish thresholds relating to the severity or spatial extent of benthic impacts, above which effects are deemed undesirable. Instead, OWF benthic monitoring campaigns are typically hypothesis driven and aim to detect significant changes in benthic communities which are then inferred as impacts. This approach often fails to acknowledge the validity of the results in terms of (i) severity and spatial extent aspects against established value systems, (ii) the metrics used or (iii) the context of the power of the test design. Without established thresholds, offering meaningful context for assessment is challenging. Wilding et al. (2017) critiques current approaches to benthic monitoring of offshore renewables and offers a compelling argument for reducing attention on detecting significance in impact assessment and instead adopting justifiable thresholds around which meaningful management decisions can be based.

Potential localized impacts due to the operation of OWFs on benthic ecology have so far received little attention in Europe. Here, statutory monitoring has largely been conducted at medium and broad scales, with no significant impacts reported, and with limited or no coverage of areas close to turbine foundations. There is thus currently, little evidence on which to base assessments of localized impacts of OWFs. While impacts across finer scale distances may seem trivial, multiplied across 100 or more grounded foundations within a typical commercial scale OWF, the total area of impacted seabed could become important especially where gross local change has occurred. For example, benthic modification over an area of 50 m radius from a turbine would equate to a potential impact area of 7,854 square meters, which would equate to 785,000 square meters for an offshore wind farm comprising 100 turbine foundations. For jacket structure foundations, such as that used at BIWF, seabed modification can also clearly occur within the lattice framework. Given that each side of a four-sided jacket foundation measures 24.5 m in length on the seafloor, then an additional 600 square meters per foundation can be added to the potential affected areas.

Whilst the potential ecosystem benefits of artificial structures in the water column are recognized, for example the rigs-to-reef initiative the Gulf of Mexico, longer term ecological consequences at offshore wind farm sites remain unknown. Equally, the consequences of aggregated areas of enriched and modified seabed habitats and communities at the base of foundations over the period of an offshore wind farm license are unclear. Furthermore, the potential consequences of such changes on wider benthic linked ecosystem functions remain unknown.

As well as a paucity of data on local impacts, current monitoring efforts have only covered short timescales (5 years or less). Considering that OWFs may have license terms of around 25 years (or longer where the facility is re-powered), then the available time-series data could be insufficient to have fully captured the severity and spatial extent of benthic impacts which have developed over time.

The lack of longer term (>5 years) study of potential localized impacts at OWFs is curious given the benthic ecological changes that have been documented around fixed oil and gas structures off the west coast of the United States (Wolfson et al. 1979, Page et al. 2005, Manoukian et al. 2010), although it is acknowledged that these are likely regional specific phenomena. Here, conspicuous changes in sediment and benthic species composition have been recorded up to 100 m from piled foundations because of the accumulation of biomass (mostly dead mussel shell) which has fallen from epifouling communities attached to the structures. Effects have included changes to sediment structure, modified infaunal community structure and localized increases in the abundance of larger mobile predator—scavenger fauna, although it is acknowledged that these changes may be specific to the region. The water depths within which these shell mounds have been studied range between 18 m and approximately 50 m and so encompass the depth ranges of the current study area. However it is not clear whether the total surface area available for colonization by fouling communities in the studies cited are comparable with the current study.

Nonetheless, observations of epifouling on renewables infrastructure and jacket foundations (Emu Ltd. 2008a, 2008b, Picken 1986, Schröder et al. 2006) suggest considerable quantities of additional biomass could be introduced to offshore areas. Studies on the soft sediment macrobenthos around a gravity base at the Thorntonbank OWF (Belgium) have also reported local benthic modification attributable to the operation of the wind farm (Coates et al. 2012, 2014).

Localized benthic change due to the presence of infrastructure have in general been detected and characterized by grab sampling and seabed video surveillance techniques, which are suitable for the derivation of quantitative and semi-quantitative data and subsequent univariate and multivariate analysis for assessment purposes.

Recognizing that achieving consensus on acceptable benthic impacts and threshold levels may be difficult, and will likely require considerable multi-stakeholder discussion, the collection of empirical evidence on the severity and spatial scale of benthic changes close to OWF infrastructure should be straightforward and could substantially help inform such discussions and facilitate consensus finding.

The RODEO initiative has provided opportunity to study short-range interactions between OWF and benthic macrofaunal communities at Block Island over the longer term and has allowed relevant benthic information to be collected from as close as possible to the foundations of the United States' first commercial scale offshore wind farm at Block Island. The data presented here therefore establish comprehensive reference information against which subsequent studies can be compared to (i) detect the presence of any gradient effects (ii) measure the spatial extent of effects from the foundations and (iii) characterize the effect in terms of the biotic and abiotic change compared to control data. Results are intended to help improve understanding of the degree and spatial scale of benthic changes, add to existing observations on the potential short-range ecological influences of OWF (i.e., Wilhelmsson et al. 2006) and provide valuable information to underpin future OWF management objectives.

4.2 Sediment Data

4.2.1 Particle Size Data

The underwater video, grab samples, and associated field descriptions during both sampling occasions supported a heterogeneous seabed dominated by mixed coarse and medium grade sand, gravel and cobble sediments, reflecting previous accounts of re-worked glacial moraine deposits within the region. The continuum of increasing levels of medium sand, and decreasing levels of coarse and very coarse sand from west (Turbine 5) to east (Turbine 1), also align with current understanding of the region, as does observations of dense cobble and boulder concentrations within Control 1 in Year 1.

The low values of silt and clay within the sediments sampled within the vessel-based grab samples may be indicative of natural seabed disturbances and the winnowing and erosion of silt and clay particles from seabed deposits resulting from tidal and current movement and associated shear stresses at the seabed. Most samples collected in 2016 and 2017 contained no silt or clay particles. From the video data, a degree of local seabed mobility and disturbance is suggested by the presence of sand waves in some places.

Seabed mobility within the site is further indicated by recent bathymetry data collected under parallel RODEO research efforts. These data show the presence of localized sand ripple fields at Turbines 3 and 5 reflecting the potential for natural current induced disturbances of the surficial sediments here. The data also show no or limited seabed impacts from initial cable and foundation installation activities at Turbines 3 and 5 suggesting that successful in-filling and covering of cable trenches and seabed scars from construction vessels by locally available transient sediments is occurring. In contrast, the seabed at Turbine 1 appears to be immobile and no sediment ripples are indicated at this location within the recent bathymetry data. Construction related impacts remain more conspicuous on the seabed suggesting that there has been comparatively limited in-filling and covering by transient sands at this location.

Historic studies have recorded significantly finer sediments (mean grain size) close to a gravity base foundation at Thorntonbank OWF (within 15 to 50 m) compared to sediments positioned farther away (>100 m), as well as along transects aligned with the principal tidal water flows, three to four years after construction (Coates et al. 2014). Coates et al. (2014) also found that perpendicular to the principal tidal flow direction, sediments were significantly coarser within 15 m of the foundation when compared to those farther away and demonstrated considerable inter-annual variability. These observations were attributed, in part, to the effects of the construction of the OWF and to modification to the local hydrodynamic conditions as a result of the presence of the foundation. Tidal water flows around a turbine foundation will be accelerated around its edges and reduced within its wake creating depositional and erosional conditions within the locale foundation depending on tidal orientation and current speeds (Coates 2014).

At Block Island, the foundations are jacket type structures, as opposed to gravity base, and so water may be able to flow through the structure with less influence on bottom current speeds. A more useful analogue for comparison might be the FINO1 renewables research platform in Germany, which also uses a jacket foundation. Benthic observations via fixed camera and diver sampling (Schröder et al. 2006), recorded changes in the local hydrodynamic regime and associated modifications to the sediment composition nearby. In the direct vicinity of the piles (up to 5 m away) the sediment was found to be much more heterogeneous compared to pre-construction conditions. It contained more dead shells which were assumed to have been washed from the seabed by sediment erosion. Finer sediment material had been eroded creating local pits around the piles up to 1 to 1.5 m deep in which the heavier shell material had been retained.

More recently, no significant sediment changes have been noted 50 m away from turbines at a wind farm dominated by jacket type foundations (Reubens et al. 2016) suggesting alternations to grain size distributions remain localized to within a few tens of meters of turbine foundations (Colson et al. 2017). The authors go on to identify the discrepancy with the earlier results of Coates (2014) and suggested that foundation effects on seabed sediments may manifest at closer ranges than currently monitored and recommended that future targeted studies be undertaken within very close vicinity (7 to 10 m) (Colson et al. 2017).

Following the lack of evidence of any alterations in sediment granulometry at Block Island in Year 1, the current Year 2 sampling campaign implemented similar recommendations and employed divers to collect sediment samples directly below and within the footprint of the foundations where vessel-based grab sampling was not practicable. This identified significantly higher quantities of silt and clay sized particles within the sediments below the foundation of Turbine 1 although similar observations were not observed at Turbines 3 and 5. The mechanism for fine sediment accumulation at Turbine 1 alone is unclear at present but may relate to the apparent limited seabed mobility here as evidenced by the recent bathymetry data. Intuitively, fine sediment accumulation would occur in areas of reduced water flow where current speeds are generally insufficient to erode and winnow fine sediment particles from the seabed. Such conditions might exist in the wake of foundation structures or possibly at the base of any scour depressions. It is similarly unknown whether high levels of fines at Turbine 1 is seasonal or whether this is a permanent feature which may expand in the future. Continued monitoring at BIWF would be needed to understand sediment / foundation interactions and the potential temporal and spatial scales of associated sediment alterations.

At distance from each of the foundations (>30 m), no significant spatial or temporal changes in sediments were detected. Sediment composition in Year 2 was largely comparable with that recorded in Year 1 and remain similar to reference conditions reflecting the natural variation.

Control and QC sediment data were dispersed within the principal multivariate groupings and were not classified as outliers. This suggested that these stations were suitable as controls for the turbine locations.

4.2.2 Total Organic Carbon

Accumulation of organic carbon within marine sediments may occur where the input exceeds the natural utilization rate of the consumers. Effects of excess organic carbon in sediments can result in changes in sediment chemistry and benthic community composition (Valente et al. 1992) according to classic models (e.g., Pearson and Rosenberg 1978) (**Figure 45**). Such changes can include reduced oxygen levels and increased toxin levels (e.g., ammonia and sulfide), which can lead to depletions in species richness, abundance, and biomass.

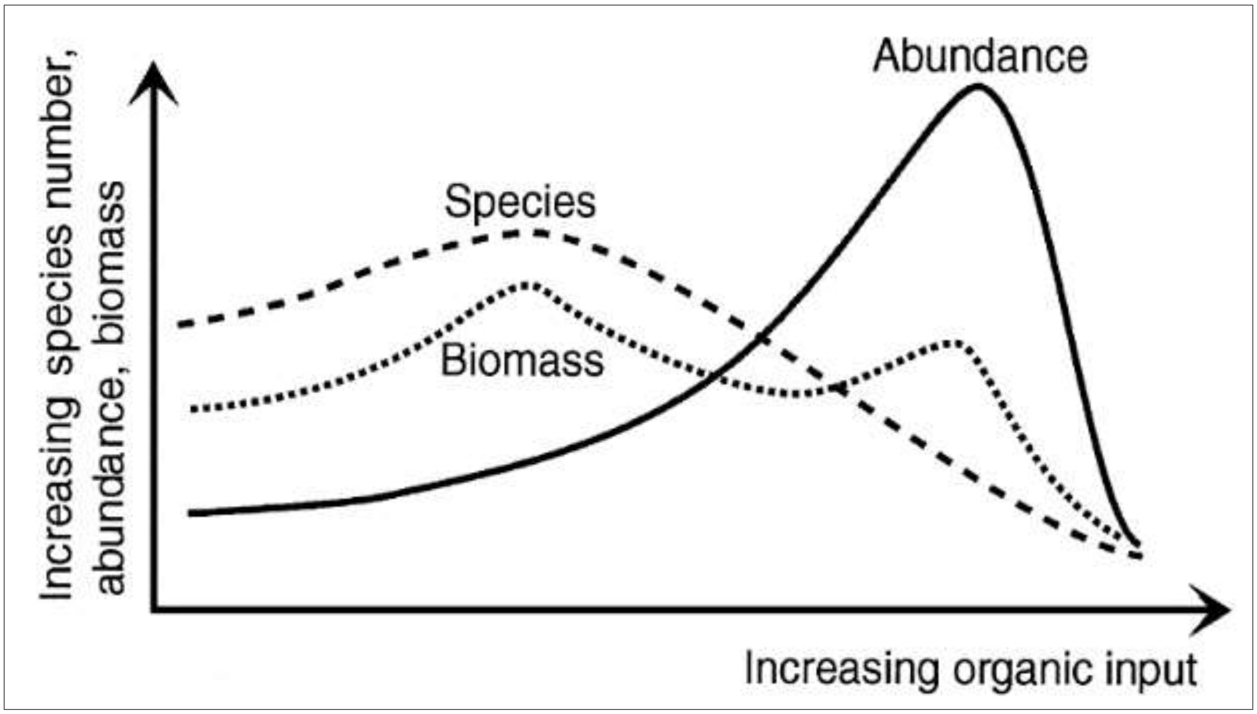


Figure 45. Pearson and Rosenberg's model of increasing organic inputs on species numbers, abundance and biomass SAB.

Hyland et al. (2005) advises that benthic communities are at high risk from organic loading and other stressors where total organic carbon levels in sediments exceed 3.5 percent, at low risk at levels that are less than 1.0 percent and are at intermediate risk at levels in between. The researchers calculated a range of benthic indices from various global macrofaunal datasets and selected Hurlberts species richness $E(S_n)$ for analysis of benthic relationships with TOC levels in sediments owing to its independence of sample size. They found an overall pattern of decreasing species richness with increasing TOC, as predicted by the Person and Rosenberg model (**Figure 45**) and suggested that this could be used to identify ranges of TOC for the assessment of 'low,' 'medium,' and 'high' risk of impaired benthic communities. Mean richness values were found to peak at concentrations of approximately 2.5 to 5 $mg.g^{-1}$ and decline at concentrations between 5 and 10 $mg.g^{-1}$ reaching a minimum at 30 to 40 $mg.g^{-1}$. To define critical lower and upper TOC points, the researchers used the outputs of ANOVA to identify the TOC values which resulted in the greatest differences (F-statistic) and also used regression of richness values as a function of TOC to find the major inflection points of the regression curve. Both methods produced similar results indicating step changes in richness values at 10 mg/l and 35 $mg.g^{-1}$. Thus the likelihood of detecting a decline in benthos in relation to increasing TOC is low at values of TOC that are less than 10 $mg.g^{-1}$ high at concentration of TOC above 35 $mg.g^{-1}$ and intermediate at values of TOC in between.

Further, technical guidance offered by the New York State Department of Environmental Conservation for screening contaminated sediments (2006) suggests that total organic carbon levels for contaminated and severely impacted sediments are 1 and 10 percent, respectively. Using these values as guidance, TOC levels in the sediment at Block Island are unlikely to be indicative of impaired conditions in Year 1 or 2. The exception to this, however, is the sediment organic conditions detected within the footprint of Turbine 1 in Year 2. Here values of TOC ranged between 1.7 percent (17 $mg.g^{-1}$) and 5.4 percent (54 mg. g^{-1}) indicating a moderate to high likelihood of detecting a decline in benthos (Hyland et al. 2005). With reference to New York State Department of Environmental Conservation guidance, the values of TOC found under Turbine 1 were indicative of contaminated sediments.

At BIWF, input of organic material may derive from the fall of biomass from epifouling communities colonizing the turbine foundations. The input and accumulation rate of organic material within the sediments from fouling organisms is currently unknown and may vary seasonally and over time (years) in response to successional change and intra-annual variations in recruitment, growth rates and inter and intra -specific interactions. The reason for the apparent elevation of the organic composition within the seabed sediments below Turbine 1 alone remains unclear at present but again, may relate to the apparent difference in seabed mobility, as evidenced by the bathymetry data, and associated differences in local seabed current speeds and/or the presence of localized accumulation centers within low energy areas within the wake of certain foundations structures. Further sampling is warranted to help further understand spatial and temporal sediment organic content characteristics below each Turbine and with distance from the foundations and to record any expansion of the effect and determine any associated biological consequences.

A picture of epifouling colonization and development at BIWF can be drawn from observations on jacket structures at the FINO1 research platform and installations at the Beatrice Field in the outer Moray Firth, Scotland (Picken 1986). For example, Schröder (2006) describes a rapid initial colonization of the underwater surfaces of the FINO 1 jacket structure within 2 weeks of construction followed by development of distinct patterns of vertical zonation within 2 years. Mussels (*Mytilus*) and tube building amphipods (*Jassa*) constitute most of the biomass at the FINO 1 platform although other fouling organisms are conspicuous including, hydroids, anemones *Sagartiogeton undatus* and *Metridium senile*, starfish *Asterias rubens* and crabs, *Liocarcinus holsatus*. Edible crabs, *Cancer pagurus*, colonize the base of the piles. Within approximately the first year of operation of the FINO1 platform, the amount of biomass predicted to have accumulated on the jacket structure was 3.6 tons. Schröder (2006) reports that a part of this biomass is continually eroded from the structure resulting in increases in the organic matter content of sediments around the piles.

Almost immediately, benthic change within the vicinity of the FINO 1 piles (1 m) was noted but this was attributed to construction effects although local scouring was also thought to be a contributing factor. Over time, changes in sediment structure and increased numbers of predators resulted in a displacement of typical soft sediment fauna and nearly 2 years after installation, the effects of the platform on benthos was noticeable up to 15 m distance.

The results suggest there have been no effects on TOC levels within the sediments at distance from the foundations due to the operation of the BIWF. With the exception of those within the footprint of Turbine 1, TOC levels were comparable across the study area and no spatial distribution patterns were observed. The lack of effects beyond 30 m from the foundations) is not unexpected given that they have been conducted less than 2 years after the installation of the foundations so that fouling communities may not have had time to develop, mature, and subsequently slough off of the structures, and thus contribute significantly to the organic carbon content of local sediments beyond the footprint of the foundations.

There has, however, clearly been alteration of the seabed below one of the Turbine foundations during this timeframe and which has manifest as significant increases in sediment fines and organic levels. That there was little evidence of the presence of fouling organisms (e.g., mussel clusters, shell hash) or increased predators or scavengers (e.g., starfish) visible in the video footage and recovered in the grab samples support that the turbines have not yet experienced heavy biofouling.

Similar studies in the future may detect higher TOC levels where the products of the fouling communities on the foundations accumulate on the seabed. For example, at Thorntonbank, a trend of increasing organic matter content was observed within 25 m of the foundation along the axis of the principal tidal movements but also within 15 m perpendicular to the main tidal flow 3 to 4 years after installation of a gravity base foundation (Coates et al. 2014). Factors other than the prevailing hydrodynamic regime were attributed to this observation (Coates et al. 2014).

4.3 CMECS Biotope Classification

In this study, CMECS demonstrated to be a comprehensive and well-suited framework for classifying data, developing preliminary biotope units, and identifying statistically significant relationships between macrofaunal communities and their associated environment. The biotopes illustrate the complexity of the seabed habitats present and are useful for providing a general classification of the turbine areas in a manner which is easy to convey and understand. The Geoform and Substrate Components offered a high level of detail for classifying the seabed environments of the turbine and control areas. The Biotic Component was valuable for indicating the dominant species within the turbine and control areas. The Biotic Component was found to be most informative when coupled with the SIMPER routine to obtain details of macrofaunal community composition and identify contributing species.

CMECS also proved to be useful for comparing the BIWF data to previously collected data (i.e., OSAMP) to detect gross changes over time, because consistent terminology was used to classify attributes. Such is the case for comparing individual CMECS components, as well as biotopes. The preliminary biotopes defined in this study will serve as a reference point against which to compare biotopes defined from future monitoring surveys at the BIWF that employ the same or a similar sampling strategy.

Each of the biotopes identified in both years within the turbine areas were characterized by polychaetes in depositional environments containing coarse sediments. As such, from a broader perspective, it can be considered that there are no substantial differences in benthic macrofaunal communities or ecological function at these sites. This finding is not unexpected given that the sedimentary environment is largely comparable throughout the BIWF study area, and given this study and others (e.g., LaFrance et al. 2014, LaFrance et al. 2010, Steimle 1982) provide evidence that macrofaunal assemblages in this region are associated with sediment composition.

The primary distinction between Year 1 and Year 2 was that two of the biotopes were characterized by different species, though both were polychaetes. Specifically, at Turbine 1, *S. vulgaris* dominated in Year 1. *Polygordius* dominated in Year 2, though was also a dominant species in the Year 1 samples. The change in the biotope classification between Year 1 and Year 2 is attributed to the highly localized and patchy distribution of *S. vulgaris* and relocation of the sampling sites between years, rather than a result of the turbine structure. At Turbine 5, one of the biotopes was co-defined by *Polycirrus* both years, but the co-dominant species changed from *Lumbrinereis* in Year 1 to *P. longicirrata* and *Pisione* in Year 2. This changes reflects the overall increase in *P. longicirrata* across the BIWF study area in Year 2. It should be noted Year 1 also exhibits a relatively high abundance of *Pisione* (n=125) and, similarly, Year 2 a high abundance of *Lumbrinereis* (n=216), indicating the discrepancies are associated with some fluctuations in total abundances, and that species composition has remained stable. Overall, the changes in biotope classification at these two areas is not considered to be substantial.

4.3.1 Comparison BIWF Biotopes and OSAMP Biotopes

The biotope class boundaries used in this study followed those defined previously as part of the OSAMP study, which reflect the depositional environments that are present offshore of Block Island. The decision to use the OSAMP defined biotope class boundaries in this study was considered valid for several reasons. First, the depositional environments and their boundaries were interpreted from a suite of various high resolution datasets, and, therefore, can be considered accurate over a fine-spatial scale (i.e., tens of meters). Furthermore, comparisons of the side-scan and video data collected in this study to previous studies in the area indicate that the depositional environments have not been altered over time, and, thus are still relevant and accurately describe the geological characteristics of the BIWF study area (refer to **Figure 2**). Also, the use of the same depositional environment as the biotope map units allows for more direct comparison of pre- and post- construction macrofaunal community structures and biotope classifications.

With regard to the biological component, while the same methodology was employed for macrofaunal data acquisition and processing for both studies to ensure comparability of the datasets, sampling density varied. For the OSAMP, macrofaunal samples were collected over a much broader spatial scale, with 48 samples collected over a 56 square mile area (i.e., approximately one sample per square mile). Of these samples, only three were collected within the BIWF study area, with the nearest sample being located 320 m from Turbine 1, another 600 m from Turbine 3, and remaining 700 m from Turbine 5. In comparison, for this study, at each turbine during each sampling year, 27 macrofaunal samples were collected within a 30 m and 90 m radius of the turbine, which equates to a 0.01-square mile area.

This substantial difference in the resolution (i.e., sampling density) of the macrofaunal data made direct comparisons of the OSAMP and BIWF biotopes challenging. The OSAMP biotope map represents a regional perspective, whereas the BIWF biotopes are highly site-specific. However, despite these challenges, examination of the two biotope outputs in relation to one another is still a valuable exercise. The biotope outputs were found to be broadly similar (**Table 33**). This is particularly true when comparisons are based on overall taxonomic group and functional designation, rather than species. The inconsistencies that are noted are attributed to differences in data resolution, rather than changes that have occurred over time, such as the construction or operation of the BIWF facility.

Because it has been determined that the depositional environments have not changed over time, this aspect of the biotope remained the same for both the OSAMP and BIWF biotope classifications. It is the biological component (i.e., dominant species) that had the potential to be re-defined for the BIWF biotopes. The BIWF and OSAMP biotopes at Turbine 1 were all defined by polychaete worms, although the species and their functional designations varied. The BIWF Year 1 biotope was characterized by the sand-builder polychaete, *Sabellaria vulgaris*, whereas the year 2 biotope was characterized by the interstitial polychaete *Polygordius* and the OSAMP biotope by two polychaetes, *Polycirrus* (soft tube-builder) and *Lumbrinereis* (burrower). However, *Lumbrinereis* is a dominant species within the Turbine 1 samples both years, is broadly distributed across the study area, and is a top contributor to the overall macrofaunal similarity of the samples collected within Turbine 1 (refer to **Tables 31** and **32**). *Polycirrus*, conversely, has a minimal presence at Turbine 1 in Year 1 and Year 2.

At Turbine 3, the soft tube-building polychaete, *Polycirrus sp.,* defined the BIWF biotopes both years and co-defined the OSAMP biotope, along with the burrowing polychaete, *Lumbrinereis*. Similar to Turbine 1, while not the defining species, *Lumbrinereis* is considered a key species within the Turbine 3 study area, but to an even greater degree. In this area, *Lumbrinereis*, is a dominant species and also a top contributing species to the overall macrofaunal similarity.

Table 35. Comparison of CMECS biotope classifications within each Turbine area.

	Year 1 BIWF Biotope	Year 2 BIWF Biotope	OSAMP Biotope
Turbine 1	*Sabellaria vulgaris* in coarse sand with small dunes within glacial alluvial fan	*Polygordius spp.* in coarse sand with small dunes within glacial alluvial fan	*Polycirrus* sp. / *Lumbrinereis* sp. in coarse sand with small dunes within glacial alluvial fan
Turbine 3	*Polycirrus* sp. in coarse sand with small dunes within glacial alluvial fan	*Polycirrus* sp. in coarse sand with small dunes within glacial alluvial fan	*Polycirrus* sp. / *Lumbrinereis* sp. in coarse sand with small dunes within glacial alluvial fan
Turbine 5	*Polycirrus sp.* / *Lumbrinereis* sp. in coarse sand with small dunes within glacial alluvial fan	*P. longicirrata* / *Polycirrus sp.* / *Pisione* sp. in coarse sand with small dunes within glacial alluvial fan	*Polycirrus* sp. / *Lumbrinereis* sp. in coarse sand with small dunes within glacial alluvial fan
	Polycirrus sp. in pebble, gravel, and coarse sand within moraine shelf	*Polycirrus* sp. in pebble, gravel, and coarse sand within moraine shelf	*Corophium spp.* in pebble, gravel, and coarse sand within moraine shelf environment
	Polygordius spp. in coarse sand with small dunes / sand waves within moraine shelf	*Polygordius* spp. in coarse sand with small dunes / sand waves within moraine shelf	*Pisione* sp. in coarse sand with small dunes / sand waves within moraine shelf environment
	Undefined	Undefined	*Byblis serrata* in pebble, gravel, and coarse sand within glacial alluvial fan

Note: The BIWF study offers high resolution biotopes, whereas the OSAMP biotopes represent a regional perspective. Please refer to text in this section for more detailed discussion.

Of the three biotope classes within Turbine 5, one shared a co-dominant species for all three datasets, *Polycirrus*. Both the BIWF Year 1 and OSAMP biotopes were also co-defined by *Lumbrinereis*. Though, the co-dominant species changed to *P. longicirrata* and *Pisione* in Year 2. Another biotope was similar in that it was defined by burrowing polychaetes, with *Polygordius* characterizing the BIWF biotope both years and *Pisione* the OSAMP biotope. As was experienced at the other turbine areas, the species defining the OSAMP biotope was found to be a key species in the BIWF dataset. Specifically, *Pisione* is one of the most abundant species among the samples collected at Turbine 5 and is a top contributor to the overall similarity. The third biotope within Turbine 5 exhibited the greatest level of disagreement between the BIWF and OSAMP designation on a species level. The BIWF biotope for both years is defined by the polychaete, *Polycirrus*, whereas the amphipod, *Corophium*, defines the OSAMP biotope. Further, *Corophium* has a minimal presence in the turbine samples. Examination of the roles of these defining species, however, reveals they are both tube-builders, and so the two biotopes are similar on a functional level from an ecological perspective.

4.3.2 Temporal Comparison of Local Benthic Communities

Whilst being undertaken at a comparatively local scale, the current study largely confirms the current understanding of the benthic ecological conditions within the wider area and as reported in the existing literature. For example:

- The dominance of polychaetes in coarser sediments (e.g., coarse sand, gravel) has been demonstrated within the region of the BIWF for several decades (e.g., LaFrance et al. 2014, Steimle 1982) and continues to be demonstrated in this study.
- For all three studies, polychaetes and amphipods account for the majority of all benthic macrofaunal recovered in the samples.

- Comparison of the lists of species identified across all of the sample stations in this study and in the OSAMP study revealed a high degree of overlap. Specifically, 75 of the 130 (58 percent) species recovered in the BIWF samples were also recovered in the OSAMP samples.
- All of the species that characterize biotopes defined in both the OSAMP and in this study were also recovered in the Steimle study (1982). Similarly, Steimle (1982) noted that most of the species recovered in his samples (collected in 1976) were also recovered in samples collected in the mid-to-late 1940s in studies by Smith (1950) and Deevey (1952).

These studies suggest, overall, that benthic macrofaunal species, as well as their associations with the physical environment, have persisted in this region for over seven decades.

4.4 Discussion of Results with Respect to Hypothesis

The following three hypotheses were tested during the two-year study:

1. H0 1 – There will be no difference in benthic communities among turbine areas.
2. H0 2 – There will be no difference in benthic communities between turbine and control areas.
3. H0 3 – There is no impact on distance from the wind farm foundation regarding organic enrichment or benthic communities.

Hypothesis 1 and 2 were evaluated jointly, results are discussed in **Section 4.4.1**. A discussion of the testing of the third hypothesis is presented in **Section 4.4.2**.

4.4.1 Comparison of Turbine and Control Areas

Two of the hypotheses this study aimed to address were: 1) There will be no difference in benthic communities between turbine and control areas, and 2) There will be no difference in benthic communities among turbine areas.

The overall conclusion is that there are no substantial differences in macrofaunal community composition between the three turbine and three control areas for Year 1 or Year 2, noting the video evidence of dense mussels covering the seafloor within the footprint of Turbine 1 in Year 2. While some of the statistical outputs (ANOSIM, Permanova+) detected significant differences among sampling areas, other analyses (SIMPER, nMDS plots) supported a high degree of species overlap among the two groups, and that the primary differences were related to species abundance, rather than species composition. Both the turbine and control areas were predominantly characterized by polychaetes and nematodes. Further, the macrofaunal communities at the control locations were generally representative of those at the turbine sites, suggesting that all of the study areas were reflecting natural benthic community conditions. While the area of seabed within the footprint of Turbine 1 exhibited significantly higher levels of fines and organic content, characterizing infaunal species sampled by the divers were nonetheless comparable with surrounding benthic habitats. In this regard, both null hypotheses can be accepted. A more detailed justification of this conclusion is provided below.

When the turbine and control areas are considered as individual groups, significantly lower species richness and abundance was detected within the footprint of Turbine 1 compared to the footprint of Turbines 3 and 5, as indicated by the diver sample data. In addition, both ANOSIM and Permanova+ revealed significant differences in the benthic communities sampled by the vessel based grabs, between turbine and control locations. On this basis, the two hypotheses would be rejected in favor of the alternative hypotheses, i.e., that there are significant differences in benthic communities among turbine locations and that there are significant differences in benthic communities between turbine and control locations. However, rejection of these hypotheses is confounded by SIMPER outputs, which demonstrated comparable identities of characterizing species across the different locations. The high degree of overlap of samples in the nMDS plot also suggest a lack of distinction in macrofaunal communities across locations. Some separation of some of the samples collected from Control Area 1 was noted and likely relate to a comparatively coarser substrate type at this location as evidenced from the acoustic and imagery data.

Once again, examination of the grab data revealed that macrofaunal abundances were highly variable across sample stations and led to the understanding that macrofauna were largely partitioned on the basis of variations in abundances of the characterizing fauna, rather than the existence of distinct assemblages. Despite differences in sediment volumes, the grab sampled a consistent surface area of seabed and successfully collected the top-most surface layers where most of the macrofauna live at all sample locations. The distribution of abundance is thus considered to be well represented within the current dataset. A number of species were patchily distributed and occurred in high abundance within one or a few of the cluster samples only. This included encrusting epifaunal species such as the polychaetes Spirobidae and *Sabellaria vulgata* and the barnacle *Amphibalanus amphitrite*, probably in response to localized hard substrate conditions.

The species that tend to exhibit wide variations in abundances also tend to be less dominant, which reduces their overall influence on macrofaunal community structure from an ecological standpoint. Consequently, while differences may be detected, they do not tend to be representative of the characterizing species. The high degree of natural spatial variability within the grab data may have implications for the interpretation of results from this and subsequent surveys. The use of multivariate significance tests, such as ANOSIM and Permanova+, alone may lead to misleading conclusions, and will likely need to be considered within the context of broader ecological frames of control such as that offered by SIMPER, nMDS plots, grab and video data, and biotope classification.

4.4.2 Comparison of Distance from Turbine with Respect to Organic Matter Enrichment and Benthic Communities

The third hypothesis considered in this study concerned sediment organic content and benthic community characteristics as a function of distance from the foundations. With respect to TOC in the surrounding area of the turbines, the null hypothesis is accepted. ANOVA tests between the stations for each turbine study area did not detect any significant differences in TOC levels with distance from foundations This was not unexpected as the fouling communities on foundations may not have developed sufficiently in the time between foundation installation and the commencement of the current field sampling survey and so may not have contributed to the organic composition of adjacent sediments beyond the footprint of the turbine foundations.

In contrast, within the footprint of the turbines, the null hypothesis is rejected, as levels of organic carbon in the sediments within the footprint of Turbine 1 recorded during the Year 2 study were significantly higher than those recorded elsewhere across the study area. With regards to macrofauna, the null hypothesis that there is no impact on distance from the wind farm foundation regarding benthic communities can be accepted with respect to samples collected greater than 30 m from the center point of the turbine foundation. While the numbers of species within the footprint of Turbine 1 was significantly lower than those at Turbines 3 and 5, the null hypothesis may be retained as the identities of the characterizing species, as identified by SIMPER, were broadly comparable indicating no gross change has occurred.

5 Recommendations for Future Monitoring

5.1 Proposed refinements for Year 3 sampling surveys

The Year 3 sampling surveys should consider the following refinements:

- The diver-based grab samples and underwater video should be collected within the footprint of all five turbine foundations. This additional data will allow for better understanding of the gradient along which the extent and rate of changes are occurring across the BIWF. Achieving this task while staying within the same budget and scope of work may require the reallocation of some samples stations. If such is the case, it is recommended the 70 to 90 m distance band be reduced or removed; at least until changes at closer the distance bands (i.e., 30 to 70 m) become apparent.
- The diver-collected grab samples should be more standardized, perhaps through the use of a sampling tool that is able to collect samples of a consistent size. If this is not possible, perhaps the same diver should collect all of the samples to ensure sampling technique is consistent. However, it should be noted that variations in sample size are considered to be a minimal issue for this study. Despite the variations in sample size across the turbines, macrofaunal patterns were still evident. Further, the seabed video and imagery complemented the grab data and were effective at providing an overall viewpoint of the area beneath the turbine foundations (as well as the surrounding area).
- Future diver sampling campaigns should be extended beyond the footprint of the turbine to record any expansion of effects. This may be undertaken by adding additional samples, where re-allocation of sampling resource allows, or by increasing the distance between each diver sampling location. Extensions to the diver surveys should cover the area between 5 and 10 m outside of the footprint of the foundations. This area may be subject to operational effects but is impracticable to sample by vessel-based grab techniques.
- The use of seabed video and/or stills images to inform subsequent diver studies should be considered. From the image data, it may be possible to identify areas or gradients of modified seabed for targeted (stratified) sampling and benthic assessment rather than relying on a fixed sample grid arrangement. This approach will require prior seabed video surveys and image analysis to be conducted the results of which will guide subsequent diver sample location plans.

5.2 Future monitoring

It is important the monitoring be continued over time to track changes in benthic community structure. Monitoring 1-year post installation would permit assessment of any short-term changes whilst continued monitoring over 3 to 5 years and 10 years would permit assessment of effects over medium and longer terms, respectively. Extended monitoring is important for this BIWF study area because it is believed not enough time has elapsed to fully understand the potential effects of an offshore wind farm in the New England region. The alterations that are anticipated are beginning to occur within the footprint of the turbine structures, with Turbine 1 exhibiting the fastest rate of change. And, after two years of monitoring, no appreciable alterations have occurred within the area surrounding the turbines (i.e., > 30 m from the center point under the foundation structure), although such changes are reasonably expected and have been observed at other OWFs in the North Sea for example. As such, this study is still in the process of detecting and quantifying effects caused by the BIWF in the defined study area.

Repeat monitoring studies should continue to employ the same sampling methods to ensure data consistency for comparison. Ideally, subsequent surveys should continue to be undertaken at the same time of year to minimize potential seasonal variations. Although surveys completed within the same season (e.g., winter or summer), as was done in this study, are also adequate for this area, given the habitats and benthic communities are understood to be stable over time. For longer-term studies, it would be beneficial to sample across seasons to investigate any seasonality that may be present in the vicinity of the BIWF. A long term data set would be necessary to discern any seasonal patterns from variability caused by other factors (e.g., year-to-year, BIWF, food-web dynamics).

Although outside the scope of this monitoring study, acoustic data collection and assessment conducted during future benthic monitoring surveys or intervening periods would also be valuable in assessing changes over time by indicating areas of differing reflectivity or alterations in sediment acoustic boundaries.

5.3 Other Parallel Studies

Diver sampling studies are underway to collect quantitative information on fouling communities on the foundations at BIWF. The data may be used to describe the presence of any non-native species, any important species contributing to the overall fouling biomass and the ecosystem services provided (i.e., increased feeding and refugia). The data could also provide useful context for the current benthic monitoring studies. Repeat studies would allow assessment of temporal fluctuations in epifouling communities including any important losses of species and biomass following storm events and which might represent episodic inputs of biomass to the benthos.

Rock or concrete placed on the seabed as cable or scour protection may not provide the same variety of micro-niches or surfaces for attaching epifauna and epiflora compared to the naturally occurring rock and may therefore support comparatively fewer species. Consequently, where imported rock or concrete is used over local hard seabed substrata, a net loss of species diversity may occur within the footprint of the protection material. The current benthic monitoring at BIWF provides opportunity to compare epifaunal communities attaching to the cable protection material with that present on the local natural rock substrates (i.e., at Control Area 1). Diver or remote video inspection may permit a qualitative assessment as to the species variety and species abundance on artificial and natural hard substrata for comparison. Results could help address issues relating to potential habitat loss due to the introduction of scour and cable protection material as part of renewables developments and whether this artificial material offers equivalent habitat quality.

Additionally, development (or adoption) of an “ecosystem” or “quality” index may be useful for future monitoring purposes. For example, the index could describe the relative proportions of species exhibiting different feeding traits (i.e., filter feeders, surface deposit feeders and sub-surface deposit feeders) in each sample as a measure of the benthic quality. High numbers of sub-surface deposit feeders could, for example, be indicative of degraded conditions. Reducing the species data to this kind of index would allow for statistical significance testing of spatial and temporal changes in benthos and importantly will permit assessment of the direction of change (i.e., becoming more degraded or improving). Such an index may be useful in statutory monitoring and compliance assessment at future offshore wind facilities.

Detailed quantitative analysis of the seabed video (float camera) data collected under this program, and development, or adoption, of standard analysis methodologies should be considered. Within the current monitoring at BIWF, the remote (float) camera techniques are beginning to prove a valuable field technique for the acquisition of benthic ecological information over areas which are most likely to be influenced by the operation of the wind farm, close to the turbine foundations, and where other data collection methods are not possible or are restricted by health and safety and cost concerns. So far, the camera work has yielded important qualitative information on sediment alterations and assemblages of mobile epibenthos. Further benthic alterations are forecast in the future, the spatial extents of which remain unknown. Continued use of camera techniques is envisaged throughout the remainder of the RODEO program to document these alterations. Adoption or development of methods which can derive quantitative information from video and stills images will be important to assist future assessment of benthic changes at BIWF. Evaluation of image collections and analysis methods for possible future use in compliance monitoring should also be considered.

6 Conclusions

This study establishes multi-year reference information that can serve as a point of comparison for measuring future change in macrofaunal and sediment characteristics at the BIWF, whether because of human activity or natural processes. Farther offshore wind facilities are planned for the U.S. east coast and a sound knowledge of associated influences on benthic communities will be vital for accurate assessment. Observations of effects at the local level can be used to inform future predictions of potential wider scale and cumulative effects associated with larger, and multiple, offshore wind facilities.

The data acquired from the current two-year study support the following conclusions:

- The study area is characterized by a mixed coarse sediment seabed supporting typical coarse sand macrofauna, as reported within the prior literature. Cluster sampling demonstrated fine scale species heterogeneity (i.e., across tens of meters), most likely attributable to the natural patchiness of the seabed sediment types in the Block Island area. Analysis of the data support the need to employ cluster sampling or similar strategy to account for this fine-scale spatial variability and complex structure of benthic macrofaunal communities. Combined, the cluster samples provide a more comprehensive and statistically robust understanding of the sample stations and the study areas.
- No appreciable change in biotic or abiotic variables with respect to distance was detected in Year 1 or Year 2 in the vessel-based grab samples collected 30 to 90 m from the center point of each turbine. This finding suggests that there are no strong localized benthic effects in the surrounding area due to the presence of the wind farm at this time. At the scale the vessel-based grab samples were collected (i.e., 30 to 90 m from the center of the structure), changes may take a longer period of time to manifest than has already elapsed, or may not occur at all.
- SIMPER and nMDS analyses of the vessel-based grab sample data suggested that benthic community types were generally comparable for the areas surrounding Turbines 1, 3 and 5. The biotopes present were characterized by polychaetes and nematodes within mixed coarse sediment types and were typically of the wider region. Significant differences detected by ANOSIM and Permanova were attributed to differences in species abundances, rather than species composition. Spatial variability in species abundances should be considered in the design of future survey and analysis of these habitats in this area.
- For Turbines 3 and 5, no appreciable change in biotic or abiotic variables was detected in the diver-based grab samples and video footage collected under the footprint of the turbines in Year 2 compared to the vessel-based grab samples collected 30 to 90 m from the center of each turbine in Year 1 and Year 2. This finding that macrofaunal and sediment characteristics are similar within and outside of the turbine structure, further indicates that there are no strong localized benthic effects at Turbines 3 and 5 at this time.
- For Turbine 1, in contrast, substantial changes were evident in both biotic and abiotic characteristics for the grab samples and video footage collected within the footprint of the turbine structure relative to the same data collected in the surrounding area (30 to 90 m from center point of turbine structure). The most notable differences for the area under the turbine were the presence of extremely dense mussels that covered the entire surface of the seafloor, elevated levels of organic content, and the transition to much finer-grained sediment. The reasons why these alterations only occurred at Turbine 1 are unclear at present. Similarly, it remains unclear whether this is a seasonal feature here. Further monitoring will help clarify the temporal characteristics of the observed benthic alterations at Turbine 1 and will identify development of modified seabed conditions across the study area.
- This study is valuable in improving the understanding of changes to macrofaunal and sediment characteristics resulting from wind facility construction and initial operations in the New England region over short time scales (e.g., < 1 to 2 years). For the area surrounding the turbine foundations, this study has recognized that changes are not likely to take place within two years.

Within the footprint of turbine foundations, however, the degree of change can vary. At the BIWF, change is occurring along a geospatial gradient, ranging from minimal changes (i.e., comparatively the same as outside the turbine footprint) to transitioning to a habitat with entirely different characteristics than previously existed. This transformed habitat is characterized by dense mussels, high organic content, and fine sediment. It is anticipated this transition will occur within the footprint of all the turbine structures over time, and potentially expand to the nearby surrounding area. The potential for highly site-specific benthic alterations to occur within wind farm sites, as shown in this study, should be considered in the planning of compliance monitoring programs for future commercial scale offshore wind facilities on the U.S. continental shelf.

References

Anderson, M.J., Gorley, R.N. & Clarke, K.R. (2008). Permanova + for Primer: Guide to software and statistical methods. PRIMER – E Ltd.

Brown, C., Cooper, K., Meadows, W., Limpenny, D., Rees, H. 2002. Small scale mapping of sea-bed assemblages in the eastern English Channel using sidescan sonar and remote sampling techniques. Estuar. Coast. Shelf Sci. 54, pp. 263-278.

Clarke, K.R. and Gorley, R.N. (2015) PRIMER v7: User Manual/Tutorial. PRIMER-E Plymouth.

Clifford, H.T. & Stevenson, W. (1975). An introduction to numerical classification. New York: Academic Press; 1975. p. 229. Coates, D., Vanaverbeke, J. & Vincx, M. (2012). Enrichment of soft sediment macrobenthos around a gravity based foundation on the Thortonbank. In: Degraer, S. et al. (Ed.) Offshore wind farms in the Belgian part of the North Sea: Heading for an understanding of environmental impacts. pp. 41-54.

Coates, D.A., Deschutter, Y., Vincx, M & Vanaverbele, J. (2014). Enrichment and shifts in macrobenthic assemblages in an offshore wind farm in the Belgium part of the North Sea. Mar. Env. Res. 95; 1-12.

Coates D., Vanaverbeke J., Vincx M. (2012) Enrichment of the soft sediment macrobenthos around a gravity based foundation on the Thorntonbank. In: Offshore wind farms in the Belgian part of the North Sea: Heading for an understanding of environmental impacts. Degraer S., Brabant R, Rumes B (eds), Chapter 4, pp 41-54. Royal Belgian Institute for Natural Sciences, Management Unit of the North Sea Mathematical models.

Colson, L., Braeckman, U. & Moens, T. (2017). Effect of turbine presence and type on macrobenthioc communities inside an offshore wind farm. In, S. Degraer, R. Brabant, B. Rumes & L. Vigin (eds.). Environmental impacts of offshore windfarms in the Belgian part of the North Sea: A continued move towards integration and quantification. Brussels: Royal Belgian Institute of Natural Sciences, OD natural Environment, Marine Ecology and Management Section.

Connor, D.W., Allen, J.H. Golding, N., Howell, K.L., Lieberknecht, L.M., Northen, K.O., Reker, J.B. 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05. JNCC, Peterborough. Available online: http://jncc.defra.gov.uk/MarineHabitatClassification (Last accessed 8/29/2017).

CRMC (Coastal Resource Management Council) (2010). Rhode Island Ocean. Special Area Management Plan OCEANSAMP. Volume 2. Technical Reports 4. Benthic Habitat Distribution and Subsurface Geology Selected Sites from the Rhode Island Ocean Special Area Management Study Area. M. LaFrance, E. Shumchenia, J. King, R. Pockalny, B. Oakley S. Pratt and J. Boothroyd. Uni Rhode Island, 2010.

Deepwater Wind. (2012). Block Island Wind Farm and Block Island Transmission System Environmental Report. September 14, 2012.

Dean, W.E., Jr. 1974. Determination of carbonate and organic matter in calcareous sediments and sedimentary rocks by loss-on-ignition: Comparison with other methods. Journal of Sedimentary Petrology, 44: 242-248.

Deevey, G.B. 1952. Hydrographic and biological studies of Block Island Sound. Appendix – The bottom organisms. Bulletin of the Bingham Oceanographic Collection, 13: 114-119.

Eastwood, P., Souissi, S., Rogers, S., Coggan, R., Brown, C. 2006. Mapping seabed assemblages using comparative top-down and bottom-up classification approaches. Can. J. Fish. Aquat. Sci.. 63, 1536-1548.

Eleftheriou, A. (2013). Methods for the study of marine benthos. Fourth edn. Wiley Blackwell.

EMU Limited. (2008a) Kentish Flats Offshore Wind Farm turbine foundation colonization diving survey. Report No. 08/J/1/03/1034/0839 to Kentish Flats Ltd. November 2008.

EMU Limited. (2008b). Barrow Offshore Wind Farm monopile ecological survey. Report No. 08/J/1/03/1321/0825 to Barrow Offshore Wind Ltd. December 2008.

FGDC (1996). FGDC-STD-004. Classification of Wetlands and Deepwater Habitats of the United States. Reston, VA. Federal Geographic Data Committee.

FGDC. (2012). Coastal and marine ecological classification standard. Marine and Coastal Spatial Data 1643 Subcommittee (Federal Geographic Data Committee). FGDC-STD-018-2012. Available online: https://www.fgdc.gov/standards/projects/cmecs-folder/CMECS_Version_06-2012_FINAL.pdf (Last accessed 8/24/2017).

Folk, R.L. (1954). The distinction between grain size and mineral composition in sedimentary rock nomenclature. Journal of Geology 62(4): 344-359.

HDR. 2017. Benthic Monitoring during Wind Turbine Installation and Operation at the Block Island Wind Farm, Rhode Island. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2018-047.

Hewitt, J., Thrush, S., Legendre, P., Funnell, G., Ellis, J., Morrison, M. (2004). Mapping of marine soft-sediment communities: Integrated sampling for ecological interpretation. Ecol. Appl. 14, 1203-1216.

Hyland. J., Balthis, L., Karakassis, I., Magni, P., Petrov, A., Shine, J. Vestergaard, O. & Warwick, R. (2005). Organic carbon content of sediments as an indicator of stress in the marine benthos. Mar. Ecol. Prog.Ser. Vol 295: 91-103.

Kostylev, V., Todd, B., Fader, G., Courtney, R., Cameron, G., Pickrill, R. (2001). Benthic habitat mapping on the Scotian Shelf based on multibeam bathymetry, surficial geology and sea floor photographs. Mar. Ecol. Prog. Ser. 219, 121-137.

LaFrance, M., King, J.W., Oakley, B.A. & Pratt, S. (2014). A comparison of top-down and bottom-up approaches to benthic habitat mapping to inform offshore wind energy development. Continental Shelf Research (2014). http://dx.doi.org/10.1016/j.cer.2014.007.

LaFrance, M., Shumchenia, E., King, J.W., Pockalny, R., Oakley, B. Pratt, S. & Boothroyd, J. (2010). Chapter 4. Benthic habitat distribution and subsurface geology in selected sites from the Rhode Island Ocean Special Area Management Study Area In: Rhode Island OCEAN SAMP. Volume 2. Coastal Resources Management Council, October 12, 2010.

Manoukiana, S., Spagnoloa, A, Scarcellaa, G., Punzoa, E., Angelinib, R. & G.Fabi. (2010). Effects of two offshore gas platforms on soft-bottom benthic communities (northwestern Adriatic Sea, Italy). Mar. Env. Res. 70: 402-410.

Marti J. A. and Walsh D.C. (2013). PERMANOVA, ANOSIM, and the Mantel test in the face of heterogeneous dispersions: What null hypothesis are you testing? https://doi.org/10.1890/12-2010.1.

Normandeau Associates. (2012). Block Island Wind Farm and Block Island Transmission System. Benthic Resources. Prepared for TetraTech. April 2012.

Page, H.M., Dugan, J., & Childress, J. (2005). Role of food subsidies and habitat structure in influencing benthic communities of shell mounds at sites of existing and former offshore oil platforms. MMS OCS Study 2005-001. Coastal Research Centre, Marine Science Institute, University of California, Santa Barbara, California. MMS Cooperative Agreement Number 14-35-0001-31063. p. 32.

Pearson, T.H. & Rosenberg, R. (1978). Macrobenthic succession in relation to organic enrichment of the marine environment. Oceanogr. Mar Biol. Annu Rev. 16: 229-311.

Picken, G.B. (1986). Moray Firth marine fouling communities. In: proceedings of the Royal Society of Edinburgh, 91B, 213-220, 1986.

Pielou, E. C. 1969. An introduction to mathematical ecology. New York: Wiley.RPS ASA (2012). Sediment transport analysis of cable installation for Block Island Wind farm and Block Island Transmission System. RPS ASA Project No. 2011-243Report issued to TetraTech. May 2012.

Reubens, J.T., Alsebai, M. & Moens, T. (2016). Expansion of small scale changes in macrobenthic community inside an offshore windfarm. In, Degraer, R. Brabant, B. Rumes, a7 L. Vigin (eds.). Environmental impacts of offshore wind farms in the Belgium part of the North Sea: Environmental impact monitoring reloaded. Royal Belgian Institute of Natural Sciences: Management Unit of the North Sea Mathematical Models. Marine Ecosystem Management Unit, 287 pp.

Rooper and Zimmermann. (2007). A bottom-up methodology for integrating underwater video and acoustic mapping for seafloor substrate classification. Continental Shelf Research - CONT SHELF RES. 27. 947-957. 10.1016/j.csr.2006.12.006.

Savard, W.L. (1966). The sediments of Block Island Sound. M.S. Thesis, University of Rhode Island. p. 67.

Schröder, A., Orejas, C & Joschko, T. (2006). Benthos in the vicinity of piles: FINO1 (North Sea). In Offshore Wind Energy. Research on Environmental Impacts. Eds J. Koller, J. Koppel and W. Peters. Springer Press ISBN-10, 3-540-34676-7.

Shannon, C. E. & Weaver, W. 1949. The mathematical theory of communication. Urbana: University of Illinois Press.

Simpson, E. H. 1949. Measurement of diversity. Nature, Volume 163, p. 688.

Smith, F.E. 1950. The benthos of Block Island Sound. I. The invertebrates, their quantities and their relations to the fishes. Ph.D. Thesis, Yale University. p. 213.

Smith, J., O'Brien, P., Stark, J., Johnstone, G., Riddle, M. (2015). Integrating multibeam sonar and underwater video data to map benthic habitats in an East Antarctic nearshore environment. Estuar. Coast. Shelf Sci. 164, 520-536.

Spalding MD, Fox HE, Allen GR, Davidson N, Ferdaña ZA, Finlayson M, Halpern BS, Jorge MA, Lombana A, Lourie SA, Martin KD, McManus E, Molnar J, Recchia CA, Robertson J. (2007). Marine Ecoregions of the World: a bioregionalization of coast and shelf areas. BioScience 57: 573-583. URL: http://bioscience.oxfordjournals.org/content/57/7/573.abstract; http://data.unepwcmc.org/datasets/38.

Steimle, F.W. (1982). The Benthic Macroinvertebrates of the Block Island Sound. Estuarine, Coastal and Shelf Science 15: 1-16.

Valente, Raymond & Rhoads, Donald & Germano, Joe & J. Cabelli, Victor. (1992). Mapping of Benthic Enrichment Patterns in Narragansett Bay, Rhode Island. Estuaries and Coasts. 15. 1-17. 10.2307/1352705.

Wentworth, C. K. (1922). A scale of grade and class terms for clastic sediments. Journal of Geology, Volume 30, pp. 377-392.

Wilding, T., Gill, A., Boon, A., Sheehan, E., Dauvin, J-C, Pezy, J-P., O'Beirn, F., Janas, U. Rostin, L & De Mese, I. (2017). Turning off the DRIP ('Data Rich, Information Poor') – rationalizing monitoring with a focus on marine renewable energy developments and the benthos. Renewable and Sustainable Energy Review 74; 848-859.

Wilhelmson, D., Malm. T., & Ohman, M.C. (2006). The influence of offshore wind power on demersal fish. ICES Journal of Marine Science, 63: 775e784 (2006).

Wolfson, A., van Blaricom, G., Davis, N. & Lewbel, G.S. (1979). The marine life of an offshore oil platform, Mar Ecol prog Ser 1:81-89.

Appendix 1. Field Survey Records of Vessed-Based and Diver-Based Data Collection

Vessel-Based Year 1							
Sample ID	**X**	**Y**	**Date**	**Time**	**Depth (m)**	**Grab volume**	**Habitat Description**
T1-7_Rep1	-71.5067	41.1257	20/12/2016	09:13	27.37	1/4	Cobble, gravel, sand; Cobbles caught in jaws of grab
T1-7_Rep2	-71.5067	41.1257	20/12/2016	09:19	27.46	1/4	Cobble, gravel, sand
T1-7_Rep3	-71.5067	41.1257	20/12/2016	09:23	27.40	1/4	Cobble, gravel, sand
T1-8_Rep1	-71.5068	41.1256	20/12/2016	09:26	27.49	1/3	Cobble, gravel, sand
T1-8_Rep2	-71.5067	41.1257	20/12/2016	09:29	27.04	1/4	Cobble, gravel, sand
T1-8_Rep3	-71.5067	41.1257	20/12/2016	09:45	27.46	1/3	Cobble, gravel, sand
T1-3_Rep1	-71.5073	41.1255	20/12/2016	09:58	27.37	1/4	Cobble, gravel, sand
T1-3_Rep2	-71.5073	41.1255	20/12/2016	10:03	27.80	1/4	Cobble, gravel, sand
T1-3_Rep3	-71.5070	41.1255	20/12/2016	10:06	27.34	1/4	Cobble, gravel, sand
T1-2_Rep1	-71.5075	41.1253	20/12/2016	10:13	27.83	1/4	Cobble, gravel, sand
T1-2_Rep2	-71.5075	41.1254	20/12/2016	10:17	27.58	1/4	Cobble, gravel, sand
T1-2_Rep3	-71.5076	41.1254	20/12/2016	10:20	27.61	1/4	Cobble, gravel, sand
T1-4_Rep1	-71.5082	41.1258	20/12/2016	10:30	28.50	3/4	Gravel, sand; GoPro NOT on
T1-4_Rep2	-71.5083	41.1258	20/12/2016	10:35	28.19	1/4	Gravel, sand
T1-4_Rep3	-71.5083	41.1259	20/12/2016	10:38	28.38	1/4	Gravel, sand
T1-9_Rep1	-71.5084	41.1263	20/12/2016	10:41	28.32	1/2	Gravel, sand
T1-9_Rep2	-71.5083	41.1264	20/12/2016	10:48	28.56	1/4	Cobble, gravel, sand
T1-9_Rep3	-71.5083	41.1261	20/12/2016	10:52	28.50	1/2	Cobble, gravel, sand
T1-5_Rep1	-71.5077	41.1264	20/12/2016	10:56	28.29	1/2	Gravel, sand
T1-5_Rep2	-71.5077	41.1264	20/12/2016	11:06	28.25	1/4	Cobble, gravel, sand
T1-5_Rep3	-71.5079	41.1263	20/12/2016	11:10	28.04	3/4	n/a
T1-1_Rep1	-71.5071	41.1261	20/12/2016	11:14	27.68	Full	Sand; Full grab
T1-1_Rep2	-71.5074	41.1259	20/12/2016	11:18	28.13	1/8	Gravel, sand
T1-1_Rep3	-71.5071	41.1260	20/12/2016	11:21	27.92	1/4	Cobble, gravel, sand
T1-6_Rep1	-71.5071	41.1260	20/12/2016	11:27	27.77	1/2	Sand with little cobble and gravel
T1-6_Rep2	-71.5069	41.1260	20/12/2016	11:29	27.92	1/4	Sand with little cobble and gravel
T1-6_Rep3	-71.5070	41.1261	20/12/2016	11:32	27.92	1/8	Cobble, gravel, sand
T3-7_Rep1	-71.5218	41.1152	20/12/2016	11:45	26.43	1/4	Gravel, sand; Grain size tube was not flashed at GoPro before deployment
T3-7_Rep2	-71.5220	41.1153	20/12/2016	11:49	26.40	3/4	Gravel, sand
T3-7_Rep3	-71.5220	41.1153	20/12/2016	11:56	26.49	Full	Gravel, sand
T3-8_Rep1	-71.5223	41.1149	20/12/2016	12:11	26.27	1/2	Gravel, sand
T3-8_Rep2	-71.5222	41.1148	20/12/2016	12:14	26.18	3/4	Gravel, sand
T3-8_Rep3	-71.5222	41.1149	20/12/2016	12:17	26.37	1/2	Gravel, sand
T3-3_Rep1	-71.5216	41.1145	20/12/2016	12:20	25.97	3/4	Gravel, sand

Vessel-Based Year 1							
Sample ID	**X**	**Y**	**Date**	**Time**	**Depth (m)**	**Grab volume**	**Habitat Description**
T3-3_Rep2	-71.5215	41.1145	20/12/2016	12:24	26.09	1/3	Gravel, sand; Mussel shell hash
T3-3_Rep3	-71.5215	41.1145	20/12/2016	12:26	26.15	1/4	Cobble, gravel, sand; Mussel shells (~1"-2")
T3-1_Rep1	-71.5214	41.1145	20/12/2016	12:31	26.21	Full	Gravel, sand; Mussel shell hash
T3-1_Rep2	-71.5216	41.1144	20/12/2016	12:36	25.79	Full	Gravel, sand; Mussel shell hash
T3-1_Rep3	-71.5215	41.1145	20/12/2016	12:39	25.91	Full	Gravel, sand; Mussel shell hash
T3-9_Rep1	-71.5213	41.1141	20/12/2016	12:50	25.36	Full	Gravel, sand
T3-9_Rep2	-71.5209	41.1141	20/12/2016	12:54	25.48	Full	Gravel, sand
T3-9_Rep3	-71.5208	41.1140	20/12/2016	12:57	26.09	Full	Gravel, sand
T3-6_Rep1	-71.5211	41.1142	20/12/2016	13:10	25.76	Full	Gravel, sand
T3-6_Rep2	-71.5212	41.1142	20/12/2016	13:13	25.51	1/2	Gravel, sand
T3-6_Rep3	-71.5211	41.1142	20/12/2016	13:15	25.97	Full	Gravel, sand
T3-4_Rep1	-71.5206	41.1147	20/12/2016	13:19	25.79	1/2	Gravel, sand
T3-4_Rep2	-71.5204	41.1147	20/12/2016	13:22	25.73	Full	Gravel, sand
T3-4_Rep3	-71.5204	41.1147	20/12/2016	13:28	25.88	1/2	Gravel, sand
T3-2_Rep1	-71.5211	41.1150	20/12/2016	13:32	26.21	Full	Sand with little gravel
T3-2_Rep2	-71.5210	41.1151	20/12/2016	13:36	26.30	Full	Sand with little gravel
T3-2_Rep3	-71.5209	41.1150	20/12/2016	13:38	26.15	Full	Sand with little gravel
T3-5_Rep1	-71.5206	41.1154	20/12/2016	13:51	26.52	1/3	n/a
T3-5_Rep2	-71.5207	41.1153	20/12/2016	13:55	26.52	1/4	Cobble, gravel, sand
T3-5_Rep3	-71.5204	41.1155	20/12/2016	13:59	26.52	Full	Sand
T5-9_Rep1	-71.5389	41.1062	20/01/2017	08:38	22.34	Full	Coarse sand
T5-9_Rep2	-71.5387	41.1063	20/01/2017	08:52	22.46	n/a	n/a
T5-9_Rep3	-71.5385	41.1063	20/01/2017	09:01	22.68	Full	Coarse sand
T5-1_Rep1	-71.5382	41.1063	20/01/2017	09:05	22.77	1/2	Coarse sand
T5-1_Rep2	-71.5380	41.1063	20/01/2017	09:08	22.83	1/3	Coarse sand
T5-1_Rep3	-71.5382	41.1063	20/01/2017	09:11	22.62	Full	Coarse sand
T5-6_Rep1	-71.5378	41.1058	20/01/2017	09:15	22.68	Full	Coarse sand
T5-6_Rep2	-71.5377	41.1058	20/01/2017	09:22	22.31	Full	n/a
T5-6_Rep3	-71.5378	41.1058	20/01/2017	09:24	22.19	Full	Coarse sand
T5-7_Rep1	-71.5375	41.1057	20/01/2017	09:29	22.04	1/4	n/a
T5-7_Rep2	-71.5377	41.1057	20/01/2017	09:36	22.16	Full	Coarse sand
T5-7_Rep3	-71.5377	41.1055	20/01/2017	09:40	22.22	1/2	Coarse sand
T5-8_Rep1	-71.5373	41.1055	20/01/2017	09:43	22.59	Full	Coarse sand
T5-8_Rep2	-71.5373	41.1055	20/01/2017	09:50	22.77	1/10	n/a
T5-8_Rep3	-71.5373	41.1055	20/01/2017	09:57	22.49	1/8	Coarse sand
T5-3_Rep1	-71.5370	41.1063	20/01/2017	10:01	23.35	1/10	n/a
T5-3_Rep2	-71.5372	41.1062	20/01/2017	10:04	23.59	1/2	Coarse sand
T5-3_Rep3	-71.5370	41.1063	20/01/2017	10:08	23.44	1/2	Gravel, coarse sand
T5-4_Rep1	-71.5368	41.1063	20/01/2017	10:15	23.93	Full	Finer sand
T5-4_Rep2	-71.5368	41.1067	20/01/2017	10:19	23.90	Full	Finer sand

Vessel-Based Year 1							
Sample ID	**X**	**Y**	**Date**	**Time**	**Depth (m)**	**Grab volume**	**Habitat Description**
T5-4_Rep3	-71.5368	41.1067	20/01/2017	10:20	24.14	Full	Medium sand
T5-5_Rep1	-71.5372	41.1067	20/01/2017	10:30	23.90	3/4	Medium sand
T5-5_Rep2	-71.5372	41.1067	20/01/2017	10:36	23.84	3/4	Medium sand
T5-5_Rep3	-71.5370	41.1067	20/01/2017	10:40	24.14	1/3	n/a
T5-2_Rep1	-71.5373	41.1067	20/01/2017	10:45	23.59	Full	Medium sand
T5-2_Rep2	-71.5373	41.1067	20/01/2017	10:48	23.74	Full	Medium, fine sand
T5-2_Rep3	-71.5373	41.1067	20/01/2017	10:52	24.08	Full	Medium sand
CI-2_Rep1	-71.5407	41.1022	20/01/2017	11:10	21.09	1/8	Cobble, gravel sand; Gravel in jaws of grab
CI-2_Rep2	-71.5407	41.1022	20/01/2017	11:17	21.73	1/8	Cobble, gravel sand; Gravel in jaws of grab
CI-2_Rep3	-71.5407	41.1022	20/01/2017	11:27	21.70	1/10	Very little sand
C1-3_Rep1	-71.5402	41.1012	20/01/2017	11:34	21.67	Over full	Coarse sand; Shell hash
C1-3_Rep2	-71.5402	41.1012	20/01/2017	11:37	21.46	Full	Coarse sand
C1-3_Rep3	-71.5402	41.1012	20/01/2017	11:43	21.82	Full	Coarse sand; Shell hash
C1-4_Rep1	-71.5410	41.1012	20/01/2017	11:56	20.24	1/2	n/a
C1-4_Rep2	-71.5412	41.1012	20/01/2017	12:05	20.57	n/a	Sand, cobble, gravel; not much material
C1-4_Rep3	-71.5410	41.1012	20/01/2017	12:17	20.42	1/4	n/a; Rocks in jaws of grab
C1-1_Rep1	-71.5417	41.1010	20/01/2017	12:23	21.55	n/a	Sand, but mostly shell hash
C1-1_Rep2	-71.5418	41.1010	20/01/2017	12:41	22.31	1/4	Fine sand; Shell hash
C1-1_Rep3	-71.5418	41.1012	20/01/2017	12:45	22.25	1/4	Gravel, fine sand; Shell hash; Rocks in jaws of grab
C2-2_Rep1	-71.5113	41.1098	20/01/2017	12:58	27.25	3/4	Cobble, gravel, sand; Grain size tube was not flashed at GoPro before deployment
C2-2_Rep2	-71.5117	41.1100	20/01/2017	13:07	26.55	Full	Fine sand with gravel
C2-2_Rep3	-71.5115	41.1100	20/01/2017	13:11	26.82	1/2	Coarse sand; Rocks in jaws of grab
C2-1_Rep1	-71.5117	41.1102	20/01/2017	13:15	26.52	Full	Gravel, coarse sand; "muddy water"
C2-1_Rep2	-71.5117	41.1103	20/01/2017	13:18	26.49	1/2	Gravel, coarse sand; Rocks in jaws of grab
C2-1_Rep3	-71.5118	41.1102	20/01/2017	13:22	26.49	1/4	Gravel, sand
C2-4_Rep1	-71.5123	41.1107	20/01/2017	13:25	26.03	1/2	Gravel, coarse sand; Rocks in jaws of grab
C2-4_Rep2	-71.5125	41.1107	20/01/2017	13:35	25.97	n/a	Sand with gravel; Rocks in jaws of grab
C2-4_Rep3	-71.5123	41.1108	20/01/2017	13:38	25.63	1/8	Coarse sand with gravel
C2-3_Rep1	-71.5122	41.1108	20/01/2017	13:42	25.60	1/2	Gravel, sand; Rocks in jaws of grab

Vessel-Based Year 1							
Sample ID	**X**	**Y**	**Date**	**Time**	**Depth (m)**	**Grab volume**	**Habitat Description**
C2-3_Rep2	-71.5120	41.1108	20/01/2017	13:45	26.24	Full	Gravel, sand; Amphipods
C2-3_Rep3	-71.5122	41.1110	20/01/2017	13:48	25.88	1/4	Gravel, coarse sand; Amphipods
C3-1_Rep1	-71.5313	41.1172	21/03/2017	08:38	27.10	1/2	Gravel, sand; Amphipods
C3-1_Rep2	-71.5318	41.1173	21/03/2017	08:48	27.01	1/2	Gravel, finer sand
C3-1_Rep3	-71.5317	41.1173	21/03/2017	08:52	26.70	1/3	Gravel, coarse sand; Rock in jaws of grab
C3-2_Rep1	-71.5303	41.1168	21/03/2017	09:02	26.91	1/4	Gravel, medium sand
C3-2_Rep2	-71.5303	41.1168	21/03/2017	09:08	26.76	1/8	Gravel, sand; Not much material
C3-2_Rep3	-71.5303	41.1168	21/03/2017	09:16	26.82	n/a	Gravel, finer sand; Not much material
C3-3_Rep1	-71.5318	41.1172	21/03/2017	09:23	27.16	1/2	Gravel, medium sand
C3-3_Rep2	-71.5318	41.1172	21/03/2017	09:27	27.01	1/2	Gravel, medium sand
C3-3_Rep3	-71.5318	41.1172	21/03/2017	09:30	27.40	1/2	Gravel, medium sand
C3-4_Rep1	-71.5322	41.1172	21/03/2017	09:33	27.25	1/2	Cobble, sand
C3-4_Rep2	-71.5323	41.1172	21/03/2017	09:39	27.43	1/4	Gravel, fine sand; Rocks in jaws of grab
C3-4_Rep3	-71.5323	41.1172	21/03/2017	09:42	27.34	1/4	Gravel, medium sand
C3-QC	-71.5310	41.1167	21/03/2017	09:50	26.82	Full	Gravel, medium sand; GoPro NOT on
T5-OC	-71.5368	41.1068	21/03/2017	10:00	23.53	Full	Medium sand
T3-QC	-71.5213	41.1150	21/03/2017	10:09	26.37	Full	Gravel, coarse sand
T1-QC	-71.5077	41.1252	21/03/2017	10:17	27.61	1/3	n/a; Rocks in jaws of grab

Vessel-Based Year 2						
Sample ID	X	Y	Date	Depth (m)	Grab volume	Habitat Description
T1-1-R1	41.12622	-71.5074	30/11/2017	27.43	1/4 full	coarse sand, gravel, cobble
T1-1-R2	41.1261	-71.5075	30/11/2017	27.65	1/8 full	coarse sand, cobbles, gravel. No photo taken
T1-1-R3	41.12608	-71.5076	30/11/2017	27.71	1/2 full	cobbles, gravel, coarse sand
T1-2-R1	41.12545	-71.5072	30/11/2017	26.97	1/8 full	cobble, gravel, coarse sand
T1-2-R2	41.12542	-71.5072	30/11/2017	26.82	1/2 full	cobble, gravel, coarse sand
T1-2-R3	41.12542	-71.5074	30/11/2017	27.07	1/4 full	cobble, gravel, coarse sand
T1-3-R1	41.12602	-71.5073	30/11/2017	27.61	1/2 full	cobbles, gravel, coarse sand -> more than has been. Worms present
T1-3-R2	41.12602	-578.25	30/11/2017	27.34	1/10 full	cobbles, gravel, coarse sand
T1-3-R3	41.12597	-71.5072	30/11/2017	27.16	1/4 full	finer sediment - dark grey in color, some shell hash, cobble, gravel, sand
T1-4-R1	41.1257	-71.5068	30/11/2017	26.85	1/4 full	cobble, gravel, coarse sand
T1-4-R2	41.12565	-71.5067	30/11/2017	26.82	1/2 full	cobble, gravel, coarse sand with some barnacles on cobbles, 1 mussel attached to clump of gravel, 1 blade of seagrass
T1-4-R3	41.12563	-71.5067	30/11/2017	26.67	1/8 full	cobble, gravel, coarse sand
T1-5-R1	41.12622	-71.5073	30/11/2017	27.22	1/8 full	cobble, gravel, coarse sand - charged GoPro
T1-5-R2	41.12623	-71.5073	30/11/2017	27.31	1/2 full	mostly coarse sand, little cobble and gravel, some shell hash
T1-5-R3	41.12612	-71.5073	30/11/2017	27.37	1/2 full	coarse sand, lot of cobble and gravel
T1-6-R1	41.12605	-71.5081	30/11/2017	27.61	1/2 full	cobble, gravel, coarse sand
T1-6-R2	41.12592	-71.508	30/11/2017	27.61	1/8 full	cobble, gravel, coarse sand
T1-6-R3	41.12593	-71.5084	30/11/2017	27.65	1/2 full	cobble, gravel, coarse sand
T1-7-R1	41.12552	-71.5083	30/11/2017	27.52	1/2 full	cobble, gravel, coarse sand
T1-7-R2	41.12568	-71.5084	30/11/2017	27.40	1/2 full	cobble, gravel, coarse sand. 1 mature mussel, 2 Astarte clams, 1 crab (let go, picture taken)
T1-7-R3	41.12548	-71.5085	30/11/2017	27.68	1/2 full	cobble, coarse sand, little gravel
T1-8-R1	41.12628	-71.5073	30/11/2017	27.43	1/4 full	cobble, gravel, coarse sand
T1-8-R2	41.12655	-71.5072	30/11/2017	27.37	1/2 full	cobble, gravel, coarse sand
T1-8-R3	41.12635	-71.5071	30/11/2017	27.25	1/2 full	cobble, gravel, coarse sand
T1-9-R1	41.12482	-71.5075	30/11/2017	26.58	1/4 full	cobble, gravel, coarse sand
T1-9-R2	41.12495	-71.5073	30/11/2017	26.52	1/2 full	cobble, gravel, more coarse sand, some shells
T1-9-R3	41.125	-71.5073	30/11/2017	26.79	1/4 full	cobble, gravel, coarse sand
T3-1-R1	41.11498	-71.5206	30/11/2017	25.42	full	very coarse sand with little gravel, 1 sand dollar shell - very close to turbine
T3-1-R2	41.11507	-71.521	30/11/2017	25.48	full	coarse sand, very coarse sand, few worms
T3-1-R3	41.11518	-71.5209	30/11/2017	25.51	full	very coarse sand, coarse sand

Vessel-Based Year 2						
Sample ID	X	Y	Date	Depth (m)	Grab volume	Habitat Description
T3-2-R1	41.1144	-71.5214	30/11/2017	25.02	full	very coarse sand, coarse sand, maybe small gravel, some gravel, 1 large snail
T3-2-R2	41.11135	-71.5214	30/11/2017	25.02	full	very coarse sand, coarse sand, maybe small gravel, some gravel
T3-2-R3	41.11423	-71.5215	30/11/2017	25.05	1/2 full	very coarse sand, coarse sand, maybe small gravel, some gravel
T3-3-R1	41.11492	-71.5206	30/11/2017	25.57	full	very coarse sand, coarse sand, gravel
T3-3-R2	41.11497	-71.5208	30/11/2017	25.66	1/2 full	coarse sand, very coarse sand, gravel, some of the sediment is darker shade gray
T3-3-R3	41.11497	-71.5208	30/11/2017	25.76	full	very coarse sand, coarse sand, gravel
T3-4-R1	41.11427	-71.5212	30/11/2017	24.99	full	coarse sand, some very coarse sand, some gravel
T3-4-R2	41.1142	-71.5211	30/11/2017	24.78	1/2 full	coarse sand, some very coarse sand, some gravel
T3-4-R3	41.11423	-71.521	30/11/2017	24.96	1/2 full	mostly very coarse sand, coarse sand (little gravel)
T3-5-R1	41.11418	-71.5211	30/11/2017	25.05	1/2 full	very coarse sand, coarse sand, gravel, maybe finel gravel.
T3-5-R2	41.11412	-71.5213	30/11/2017	25.12	1/2 full	very coarse sand, coarse sand, some gravel (little)
T3-5-R3	41.1141	-71.521	30/11/2017	25.30	full	very coarse sand, coarse sand, some gravel (little)
T3-6-R1	41.11447	-71.5218	30/11/2017	25.24	full	very coarse sand, small gravel, some gravel
T3-6-R2	41.11447	-71.5221	30/11/2017	25.42	full	very coarse sand, small gravel, some gravel
T3-6-R3	41.11447	-71.5217	30/11/2017	25.24	full	very coarse sand, small gravel, some gravel
T3-7-R1	41.11523	-71.5208	30/11/2017	25.57	full	coarse sand with some gravel -> very coarse sand
T3-7-R2	41.11532	-71.5207	30/11/2017	25.66	full	very coarse sand, very little gravel
T3-7-R3	41.11527	-71.5206	30/11/2017	25.45	1/2 full	coarse sand/very coarse sand
T3-8-R1	41.11483	-71.5222	30/11/2017	25.24	full	very coarse sand, very coarse sand, coarse sand, some gravel, few worms
T3-8-R2	41.1147	-71.5226	30/11/2017	25.66	1/2 full	coarse sand, very coarse sand, gravel (little)
T3-8-R3	41.11472	-71.522	30/11/2017	25.21	full	very coarse sand, coarse sand, some gravel (small)
T3-9-R1	41.11405	-71.5217	30/11/2017	24.78	full	medium sand, coarse sand
T3-9-R2	41.11413	-71.5215	30/11/2017	25.12	1/2 full	medium sand, fine sand, shell hash (fine)
T3-9-R3	41.11408	-71.5214	30/11/2017	24.96	1/2 full	medium sand, fine sand, shell hash (fine)

Vessel-Based Year 2						
Sample ID	**X**	**Y**	**Date**	**Depth (m)**	**Grab volume**	**Habitat Description**
T5-6-R1	41.10675	-71.5373	30/11/2017	23.41	full	coarse sand, very coarse sand, gravel, 1 Astarte clam
T5-6-R2	41.10662	-71.5373	30/11/2017	23.53	1/2 full	very coarse sand, coarse sand, gravel
T5-6-R3	41.10665	-71.5373	30/11/2017	23.50	full	coarse sand, very coarse sand, gravel
T5-7-R1	41.10648	-71.5383	30/11/2017	22.89	1/2 full	coarse sand, very coarse sand, gravel
T5-7-R2	41.10657	-71.5385	30/11/2017	23.29	1/2 full	1 Astarte, coarse sand, very coarse sand, gravel
T5-7-R3	41.1066	-71.5386	30/11/2017	22.56	full	coarse sand, very coarse sand
T5-9-R1	41.10702	-71.5375	30/11/2017	23.44	1/4-1/8 full	very coarse sand, gravel, 1 Astarte clam
T5-9-R2	41.10697	-71.5375	30/11/2017	23.53	full	very coarse sand, coarse sand, gravel, few small cobbles, few worms, some shell fragments
T5-9-R3	41.10697	-71.5375	30/11/2017	23.44	full	coarse sand, very coarse sand, gravel, few small cobbles, 1 Astarte clam
C1-1-R1	41.10642	-71.5303	01/12/2017	23.26	1/3 full	very coarse sand, some gravel, medium brown
C1-1-R2	41.10562	-71.5303	01/12/2017	23.41	full	very coarse sand, full grab, some gravel
C1-1-R3	41.10555	-71.5302	01/12/2017	23.32	1/2 full	very coarse sand, gravel, 2 rocks
C1-2-R1	41.10505	-71.5303	01/12/2017	23.04	1/4 full	sponge and worm present
C1-2-R2	41.10482	-71.5301	01/12/2017	23.01	1/2 full	mostly gravel with very coarse sand, some 1/2 clam shells
C1-2-R3	41.10482	-71.5302	01/12/2017	22.74	1/4 full	mostly large cobble/rock, very coarse sand, some rocks with barnacle
C1-3-R1	41.10433	-71.5302	01/12/2017	22.98	1/2 full	very coarse sand, some gravel
C1-3-R2	41.10435	-71.5303	01/12/2017	22.86	full	very coarse sand and gravel
C1-3-R3	41.10432	-71.5303	01/12/2017	22.86	full	N/A
C2-1-R1	41.11033	-71.5404	01/12/2017	26.33	full	clam (live), worm, very coarse sand, some gravel
C2-1-R2	41.11368	-71.5405	01/12/2017	26.79	1/2 full	very coarse sand, some pebbles/gravel
C2-1-R3	41.11342	-71.5405	01/12/2017	26.40	full	very coarse sand, pebbles (some), worm
C2-2-R1	41.11323	-71.5413	01/12/2017	25.73	full	very coarse sand, some gravel
C2-2-R2	41.11327	-71.5413	01/12/2017	26.03	full	very coarse sand, one large rock, live clam, gravel
C2-2-R3	41.11325	-71.5411	01/12/2017	25.51	full	very coarse sand, little gravel
C2-3-R1	41.114	n/a	01/12/2017	26.85	full	very coarse sand, pebbles (some)
C2-3-R2	41.1141	-71.5404	01/12/2017	26.79	full	very coarse sand
C2-3-R3	41.11402	-71.5404	01/12/2017	27.07	full	very coarse sand, worms
C3-1-R1	41.1239	-71.5162	01/12/2017	28.25	1/3 full	pebbles/shells, surrounded by very coarse sand

Vessel-Based Year 2						
Sample ID	X	Y	Date	Depth (m)	Grab volume	Habitat Description
C3-1-R2	41.12413	-71.5162	01/12/2017	28.01	full	1/2 scallop shell, very coarse sand, some pebbles/cobbles
C3-1-R3	41.12397	-71.5162	01/12/2017	28.41	1/2 full	N/A
C3-2-R1	41.12498	-71.5155	01/12/2017	28.71	1/2 full	very coarse sand, some 1/2 scallop shells
C3-2-R2	41.12488	-71.5154	01/12/2017	28.83	full	very coarse sand, shells
C3-2-R3	41.12495	-71.5155	01/12/2017	28.59	1/2 full	very coarse sand, some pebbles + gravel
C3-3-R1	41.1239	-71.5167	01/12/2017	28.01	1/2 full	mostly gravel, (50/50), very coarse, very coarse sand
C3-3-R2	41.12375	-71.5166	01/12/2017	28.01	1/2 full	clam shells, very coarse gravel, cobbles/pebbles
C3-3-R3	41.12383	-71.5167	01/12/2017	28.25	1/2 full	gravel, pebbles (most), surrounded by very coarse sand
T5-1-R1	41.1061	-71.5381	01/12/2017	22.16	3/4 full	coarse sand, some shell fragments, medium brown sand
T5-1-R2	41.10605	-71.5379	01/12/2017	22.16	full	coarse sand, medium brown
T5-1-R3	41.1063	-71.5381	01/12/2017	22.49	3/4 full	coarse sand, medium brown
T5-2-R1	41.106	-71.537	01/12/2017	22.77	full	larger rocks, very coarse sand, shells
T5-2-R2	41.10642	-71.5372	01/12/2017	22.71	full	very coarse sand, medium brown
T5-2-R3	41.10643	-71.5371	01/12/2017	22.74	2/3 full	N/A
T5-3-R1	41.10555	-71.5376	01/12/2017	21.34	full	coarse sand, medium brown
T5-3-R2	41.1058	-71.5378	01/12/2017	21.43	N/A	coarse sand, medium brown
T5-3-R3	41.10625	-71.5378	01/12/2017	21.85	full	medium brown
T5-4-R1	41.10612	-71.5369	01/12/2017	22.92	1/2 full	mussel 1/2 shells, very coarse sand, 1/2 clam shell, all dead, medium brown
T5-4-R2	41.10627	-71.5368	01/12/2017	23.29	3/4 full	very coarse sand, some shell fragment
T5-4-R3	41.1063	-71.5369	01/12/2017	23.16	N/A	very coarse sand, snail and mussels (dead), 1 intact mussel shell
T5-5-R1	41.10588	-71.5376	01/12/2017	21.73	full	very coarse sand, some gravel, medium brown
T5-5-R2	41.10578	-71.5375	01/12/2017	21.98	1/2 full	very coarse sand, some gravel, medium brown
T5-5-R3	41.10573	-71.5374	01/12/2017	22.59	1/3 full	larger rocks, very coarse sand, shells
T5-8-R1	41.10555	-71.5379	01/12/2017	21.52	1/2 full	N/A
T5-8-R2	41.10625	-71.538	01/12/2017	21.55	full	some cobbles, medium brown
T5-8-R3	41.10582	-71.5382	01/12/2017	21.61	1/3 full	medium coarse

Appendix 2. Results of the Sediment Particle Size Distribution Analysis for Vessel-Based and Diver-Based Data Collection

Vessel-Based Samples Year 1									
Station	% Clay	% Silt	% Coarse Silt	% Very Fine Sand	% Fine Sand	5 Medium Sand	% Coarse Sand	% Very Coarse Sand	TOTAL
T1-1_Rep1	0	0	0	0	5.46	48.62	41.82	4.09	99.99
T1-1_Rep2	0	0	0	0	5.06	58.38	36.10	0.47	100.01
T1-1_Rep3	0	0	0	0	4.44	55.26	39.32	0.97	99.99
T1-2_Rep1	0	0	0	0	6.65	49.27	40.87	3.21	100.00
T1-2_Rep2	0	0	0	0	6.23	49.87	41.31	2.59	100.00
T1-2_Rep3	0	0	0	0.06	15.84	52.23	30.68	1.19	100.00
T1-3_Rep1	0	0	0	0	4.19	47.55	45.03	3.23	100.00
T1-3_Rep2	0	0	0	0	1.83	45.30	49.37	3.49	99.99
T1-3_Rep3	0	0	0	0	13.03	57.88	28.79	0.30	100.00
T1-4_Rep1	0	0	0	0	12.09	55.67	31.15	1.10	100.01
T1-4_Rep2	0	0	0	0	4.39	46.38	44.52	4.70	99.99
T1-4_Rep3	0	0	0	0	3.87	45.56	46.22	4.35	100.00
T1-5_Rep1	0	0	0	0	1.21	40.46	52.38	5.95	100.00
T1-5_Rep2	0	0	0	0	2.19	41.26	49.60	6.95	100.00
T1-5_Rep3	0	0	0	0	1.83	43.11	49.82	5.24	100.00
T1-6_Rep1	0	0	0	0	8.11	62.16	29.66	0.08	100.01
T1-6_Rep2	0	0	0	0	8.54	58.91	32.10	0.46	100.01
T1-6_Rep3	0	0	0	0	4.73	55.74	38.48	1.06	100.01
T1-7_Rep1	0	0	0	0	6.23	52.58	39.56	1.63	100.00
T1-7_Rep2	0	0	0	0	4.77	60.70	34.53	0.00	100.00
T1-7_Rep3	0	0	0	0	5.06	50.22	42.21	2.50	99.99
T1-8_Rep1	0	0	0	0	2.45	39.37	49.80	8.38	100.00
T1-8_Rep2	0	0	0	0	5.37	50.43	41.64	2.56	100.00
T1-8_Rep3	0	0	0	0	3.26	50.26	44.26	2.22	100.00
T1-9_Rep1	0	0	0	0	0.48	31.17	56.02	12.32	99.99
T1-9_Rep2	0	0	0	0	2.05	38.91	50.47	8.57	100.00
T1-9_Rep3	0	0	0	0	4.82	46.51	43.57	5.10	100.00
T3-1_Rep1	0	0	0	0	0.78	31.69	53.89	13.65	100.01
T3-1_Rep2	0	0	0	0	0.90	31.76	53.54	13.80	100.00
T3-1_Rep3	0	0	0	0	0.04	22.00	56.10	21.85	99.99
T3-2_Rep1	0	0	0	0	0.09	25.20	57.86	16.85	100.00
T3-2_Rep2	0	0	0	0	0.88	32.70	53.32	13.10	100.00
T3-2_Rep3	0	0	0	0	0.11	28.24	59.35	12.30	100.00
T3-3_Rep1	0	0	0	0	0.23	27.20	56.57	15.99	99.99
T3-3_Rep2	0	0	0	0	0.66	31.17	53.75	14.41	99.99
T3-3_Rep3	0	0	0	0	0.23	31.61	58.24	9.92	100.00
T3-4_Rep1	0	0	0	0	0.11	25.09	57.10	17.70	100.00
T3-4_Rep2	0	0	0	0	0.64	36.03	55.44	7.90	100.01
T3-4_Rep3	0	0	0	0	0.77	31.32	54.00	13.91	100.00
T3-5_Rep1	0	0	0.03	0.31	1.73	28.77	50.34	18.82	100.00

Vessel-Based Samples Year 1									
Station	% Clay	% Silt	% Coarse Silt	% Very Fine Sand	% Fine Sand	5 Medium Sand	% Coarse Sand	% Very Coarse Sand	TOTAL
T3-5_Rep2	0	0	0.01	1.77	6.97	28.64	45.28	17.34	100.01
T3-5_Rep3	0	0	0	0	0.43	20.97	52.31	26.30	100.01
T3-6_Rep1	0	0	0	0	0.34	33.53	56.79	9.34	100.00
T3-6_Rep2	0	0	0	0	0.88	40.38	53.49	5.25	100.00
T3-6_Rep3	0	0	0	0	0.25	32.75	57.57	9.43	100.00
T3-7_Rep1	0	0	0	0	0	14.57	57.23	28.19	99.99
T3-7_Rep2	0	0	0	0	0.86	30.88	53.39	14.87	100.00
T3-7_Rep3	0	0	0	0	0.25	24.53	55.47	19.75	100.00
T3-8_Rep1	0	0	0	0	0.06	25.25	57.28	17.40	99.99
T3-8_Rep2	0	0	0	0	0.01	21.44	61.34	17.21	100.00
T3-8_Rep3	0	0	0	0	0.27	32.37	57.55	9.81	100.00
T3-9_Rep1	0	0	0	0	0.62	36.56	55.45	7.37	100.00
T3-9_Rep2	0	0	0	0	1.29	37.01	52.22	9.49	100.01
T3-9_Rep3	0	0	0	0	0.44	35.73	56.84	7.00	100.01
T5-1_Rep1	0	0	0	0.17	0.33	19.64	51.77	28.10	100.01
T5-1_Rep2	0	0	0	0.40	0.12	8.65	53.30	37.53	100.00
T5-1_Rep3	0	0	0.16	0.45	3.11	27.67	47.91	20.71	100.01
T5-2_Rep1	0	0	0	0	0.92	25.49	50.87	22.71	99.99
T5-2_Rep2	0	0	0	0	2.93	40.16	46.86	10.06	100.01
T5-2_Rep3	0	0	0	0	1.91	36.04	49.96	12.08	99.99
T5-3_Rep1	0	0	0.07	0.32	1.12	20.82	49.57	28.10	100.00
T5-3_Rep2	0	0	0.10	0.18	1.74	23.31	48.19	26.48	100.00
T5-3_Rep3	0	0	0	0	5.51	36.68	42.64	15.17	100.00
T5-4_Rep1	0	0	0	0	2.86	46.85	45.28	5.01	100.00
T5-4_Rep2	0	0	0	0	6.51	59.18	33.72	0.60	100.01
T5-4_Rep3	0	0	0	0	2.42	38.19	48.50	10.88	99.99
T5-5_Rep1	0	0	0	0	2.60	38.00	48.22	11.18	100.00
T5-5_Rep2	0	0	0	0	3.09	37.73	46.58	12.60	100.00
T5-5_Rep3	0	0	0	0	2.87	51.13	43.89	2.11	100.00
T5-6_Rep1	0	0	0	0	0	12.85	56.42	30.72	99.99
T5-6_Rep2	0	0	0	0	0.02	14.17	52.41	33.40	100.00
T5-6_Rep3	0	0	0	0	0	13.14	54.91	31.95	100.00
T5-7_Rep1	0	0	0	0	0	7.12	55.22	37.66	100.00
T5-7_Rep2	0	0	0	0	4.35	34.84	45.74	15.06	99.99
T5-7_Rep3	0	0	0	0	0.20	19.11	52.65	28.04	100.00
T5-8_Rep1	0	0	0.17	0.25	1.68	23.75	49.20	24.94	99.99
T5-8_Rep2	0	0	0	0	0.02	17.37	57.28	25.33	100.00
T5-8_Rep3	0	0	0	0.80	0.20	11.29	53.54	34.18	100.01
T5-9_Rep1	0	0	0	0	0	13.90	57.78	28.32	100.00
T5-9_Rep2	0	0	0	0	0	2.90	54.81	42.28	99.99
T5-9_Rep3	0	0	0	0	0	7.99	55.47	36.54	100.00
C1-1_Rep1	0	0	0.18	1.31	0.04	20.08	58.01	20.38	100.00
C1-1_Rep2	0	0	0	0	0.32	36.81	56.97	5.90	100.00

Vessel-Based Samples Year 1									
Station	% Clay	% Silt	% Coarse Silt	% Very Fine Sand	% Fine Sand	5 Medium Sand	% Coarse Sand	% Very Coarse Sand	TOTAL
C1-1_Rep3	0	0	0	0	0.05	30.63	62.80	6.53	100.01
C1-2_Rep1	0	0	0	0	0.42	35.79	57.26	6.52	99.99
C1-2_Rep2	0	0	0	0	0.35	30.68	56.80	12.17	100.00
C1-2_Rep3	0	0	0	0	0.03	27.04	60.85	12.08	100.00
C1-3_Rep1	0	0	0	0	0	13.48	57.66	28.85	99.99
C1-3_Rep2	0	0	0	0	0	15.60	63.27	21.13	100.00
C1-3_Rep3	0	0	0	0	0.02	20.82	62.85	16.31	100.00
C1-4_Rep1	0	0	0	0	0.01	23.65	62.76	13.59	100.01
C1-4_Rep2	0	0	0	0	0.03	25.23	61.93	12.81	100.00
C1-4_Rep3	0	0	0	0	0.02	28.69	64.03	7.27	100.01
C2-1_Rep1	0.08	0.90	0	0	0.65	32.78	54.57	11.02	100.00
C2-1_Rep2	0	0	0	0	2.55	37.36	48.90	11.19	100.00
C2-1_Rep3	0	0	0	0	1.86	32.57	50.29	15.27	99.99
C2-2_Rep1	0	0	0	0	0.46	35.85	56.82	6.87	100.00
C2-2_Rep2	0	0	0.22	0.58	1.62	36.29	51.88	9.40	99.99
C2-2_Rep3	0	0.67	0	0	0.08	25.47	57.09	16.69	100.00
C2-3_Rep1	0	0	0.01	0.97	3.13	27.57	49.56	18.76	100.00
C2-3_Rep2	0	0	0.05	0.65	8.07	39.51	43.58	8.14	100.00
C2-3_Rep3	0.22	0.20	0.24	1.48	17.85	39.53	33.39	7.08	99.99
C2-4_Rep1	0	0	0	0.31	13.56	38.08	35.58	12.46	99.99
C2-4_Rep2	0	0	0	0	3.27	41.96	47.82	6.96	100.01
C2-4_Rep3	0	0	0	0	0.36	28.97	56.35	14.33	100.01
C3-1_Rep1	0	0	0	0	3.33	40.86	47.47	8.34	100.00
C3-1_Rep2	0	0	0	0	1.86	43.32	49.80	5.02	100.00
C3-1_Rep3	0	0	0	0	0.76	30.69	54.35	14.19	99.99
C3-2_Rep1	0	0	0	0	4.14	47.16	44.34	4.36	100.00
C3-2_Rep2	0	0	0	0	2.34	47.48	46.95	3.23	100.00
C3-2_Rep3	0	0	0	0	4.65	48.49	43.09	3.77	100.00
C3-3_Rep1	0	0	0	0	6.19	45.50	42.80	5.51	100.00
C3-3_Rep2	0	0.24	0.64	0.11	12.49	50.31	34.41	1.80	100.00
C3-3_Rep3	0	0	0	0	2.05	46.83	48.24	2.87	99.99
C3-4_Rep1	0	0	0	0	6.67	47.67	41.34	4.32	100.00
C3-4_Rep2	0	0	0	0	3.17	44.90	46.71	5.22	100.00
C3-4_Rep3	0	0	0	0	6.10	49.97	41.26	2.67	100.00
T1-QC	0	0	0	0	8.90	53.51	36.29	1.31	100.01
T3-QC	0	0	0	0	0.01	15.08	57.47	27.44	100.00
T5-OC	0	0	0	0	0.70	36.42	55.01	7.86	99.99
C3-QC	0	0	0	0	0.51	28.01	55.13	16.34	99.99

Vessel-Based Samples Year 2									
Station	% Clay	%Silt	% Coarse Silt	% Very Fine Sand	% Fine Sand	% Medium Sand	% Coarse Sand	% Very Coarse Sand	Total
T1-1_R1	0	0	0	0	6.1	57.25	36.64	0.01	100
T1-1_R2	0	0	0	0	4.26	50	45.16	0.58	100
T1-1_R3	0	0	0	0	6.27	50.1	43.01	0.62	100
T1-2_R1	0	0	0	0	8.43	50.15	40.82	0.6	100
T1-2_R2	0	0	0	0	11.17	50.91	37.56	0.36	100
T1-2_R3	0	0	0	0	9.64	50.79	39.1	0.47	100
T1-3_R1	0	0	0	0	6.53	50.21	42.63	0.63	100
T1-3_R2	0	0	0	0	2.72	45.75	50.33	1.19	99.99
T1-3_R3	0	0	0	0	6.38	49.42	43.55	0.64	99.99
T1-4_R1	0	0	0	0	4.56	48.97	45.72	0.75	100
T1-4_R2	0	0	0	0	2.38	46.45	50.17	1.01	100.01
T1-4_R3	0	0	0	0	1.68	44.37	50.51	3.44	100
T1-5_R1	0	0	0	0	5.47	49.96	43.9	0.67	100
T1-5_R2	0	0	0	0	2.36	48.39	47.02	2.23	100
T1-5_R3	0	0	0	0	3.72	46.22	48.78	1.28	100
T1-6_R1	0	0	0	0	7.67	48.97	42.5	0.86	100
T1-6_R2	0	0	0	0	8.88	51.27	39.34	0.51	100
T1-6_R3	0	0	0	0	8.19	51.88	39.42	0.5	99.99
T1-7_R1	0	0	0	0	14.43	56.42	29.14	0	99.99
T1-7_R2	0	0	0	0	7.21	47.57	44.3	0.92	100
T1-7_R3	0	0	0	0	6.63	50.36	42.44	0.58	100.01
T1-8_R1	0	0	0	0	5.05	51.23	43.19	0.53	100
T1-8_R2	0	0	0	0	5.38	49.56	44.31	0.75	100
T1-8_R3	0	0	0	0	8.22	54.82	36.83	0.12	99.99
T1-9_R1	0	0	0	0	8.71	49.35	41.29	0.64	99.99
T1-9_R2	0	0	0	0	2.61	42.35	52.61	2.43	100
T1-9_R3	0	0	0	0	3.47	43.01	51.84	1.69	100.01
T3-1_R1	0	0	0	0	0.02	16.3	53.34	30.34	100
T3-1_R2	0	0	0	0	0.11	31.82	61.69	6.38	100
T3-1_R3	0	0	0	0	0	24.23	67.16	8.6	99.99
T3-2_R1	0	0	0	0	1.78	39.11	52.6	6.51	100
T3-2_R2	0	0	0	0	1.17	39.99	56.22	2.62	100
T3-2_R3	0	0	0	0	0.43	31.53	56.69	11.36	100.01
T3-3_R1	0	0	0	0	0.41	34.79	59.44	5.35	99.99
T3-3_R2	0	0	0	0	0.51	35.38	59.3	4.81	100
T3-3_R3	0	0	0	0	0.07	31.22	63.07	5.64	100
T3-4_R1	0	0	0	0	1.85	43.23	53.19	1.73	100
T3-4_R2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
T3-4_R3	0	0	0	0	2.01	44	52.42	1.57	100
T3-5_R1	0	0	0	0	1.73	40.61	54.54	3.12	100
T3-5_R2	0	0	0	0	1.94	42.11	53.38	2.57	100
T3-5_R3	0	0	0	0	2.96	45.93	49.9	1.21	100

Vessel-Based Samples Year 2									
Station	**% Clay**	**%Silt**	**% Coarse Silt**	**% Very Fine Sand**	**% Fine Sand**	**% Medium Sand**	**% Coarse Sand**	**% Very Coarse Sand**	**Total**
T3-6_R1	0	0	0	0	0.59	38.41	58.03	2.96	99.99
T3-6_R2	0	0	0	0	0.54	36.91	58.35	4.2	100
T3-6_R3	0	0	0	0	1.3	40.61	55.07	3.02	100
T3-7_R1	0	0	0	0	0.09	30.77	62.78	6.37	100.01
T3-7_R2	0	0	0	0	0.11	32.58	61.51	5.8	100
T3-7_R3	0	0	0	0	3.06	40.78	46.28	9.89	100.01
T3-8_R1	0	0	0	0	0.66	31.52	60.48	7.35	100.01
T3-8_R2	0	0	0	0	0.13	33.47	61.26	5.15	100.01
T3-8_R3	0	0	0	0	1.53	35.84	51.74	10.9	100.01
T3-9_R1	0	0	0	0	5.45	52.61	41.61	0.33	100
T3-9_R2	0	0	0	0	6.43	55.17	38.39	0	99.99
T3-9_R3	0	0	0	0	4.73	52.86	42.2	0.22	100.01
T5-1_R1	0	0	0	0	0	25.74	66.52	7.74	100
T5-1_R2	0	0	0	0	0.93	21.57	51.92	25.58	100
T5-1_R3	0	0	0	0	0.33	29.43	62.91	7.33	100
T5-2_R1	0	0	0	0	0.12	31.14	62.62	6.11	99.99
T5-2_R2	0	0	0	0	0.47	30.82	60.77	7.94	100
T5-2_R3	0	0	0	0	1.67	34.83	57.43	6.07	100
T5-3_R1	0	0	0	0	0	23.47	67.6	8.93	100
T5-3_R2	0	0	0	0	2.42	36.14	55.55	5.89	100
T5-3_R3	0	0	0	0	0.61	29.99	60.78	8.63	100.01
T5-4_R1	0	0	0	0	1.89	38.18	55.75	4.18	100
T5-4_R2	0	0	0	0	0.8	33.94	60.22	5.03	99.99
T5-4_R3	0	0	0	0	0.03	24.56	64.86	10.54	99.99
T5-5_R1	0	0	0	0	1.41	34.88	58.48	5.23	100
T5-5_R2	0	0	0	0	0.51	29.54	62.45	7.5	100
T5-5_R3	0	0	0	0	0.08	28.08	63.33	8.51	100
T5-6_R1	0	0	0	0	0.02	27.92	64.83	7.23	100
T5-6_R2	0	0	0	0	0.04	27.25	64.32	8.39	100
T5-6_R3	0	0	0	0	0.34	24.36	55.69	19.61	100
T5-7_R1	0	0	0	0	0	20.39	69.62	9.99	100
T5-7_R2	0	0	0	0	1.49	25.44	51.45	21.61	99.99
T5-7_R3	0	0	0	0	0.02	24.98	64.6	10.4	100
T5-8_R1	0	0	0	0	0.66	31.52	60.48	7.35	100.01
T5-8_R2	0	0	0	0	0.1	29.94	63.56	6.4	100
T5-8_R3	0	0	0	0	1.22	34.25	59.01	5.53	100.01
T5-9_R1	0	0	0	0	0.07	29.91	62.93	7.1	100.01
T5-9_R2	0	0	0	0	0.73	35.66	58.76	4.85	100
T5-9_R3	0	0	0	0	0.15	35.1	60.57	4.18	100
C1-1_R1	0	0	0	0	1.82	30.48	60.48	7.23	100.01
C1-1_R2	0	0	0	0	11.55	45.1	40.6	2.75	100
C1-1_R3	0	0	0	0	5.04	40.9	50.33	3.73	100

Vessel-Based Samples Year 2									
Station	**% Clay**	**%Silt**	**% Coarse Silt**	**% Very Fine Sand**	**% Fine Sand**	**% Medium Sand**	**% Coarse Sand**	**% Very Coarse Sand**	**Total**
C1-2_R1	0	0	0	0	2.49	32.88	56.85	7.77	99.99
C1-2_R2	0	0	0	0	2.99	34.65	56.58	5.78	100
C1-2_R3	0	0	0	0	0	23.18	66.63	10.18	99.99
C1-3_R1	0	0	0	0	0.04	27.12	64.04	8.8	100
C1-3_R2	0	0	0	0	0.2	29.65	63.2	6.95	100
C1-3_R3	0	0	0	0	0.09	29.65	63.18	7.08	100
C2-1_R1	0	0	0	0	0.45	31.23	61.19	7.14	100.01
C2-1_R2	0	0	0	0	0.57	31.84	60.87	6.73	100.01
C2-1_R3	0	0	0	0	0	27.96	65.26	6.78	100
C2-2_R1	0	0	0	0	1.43	39.52	55.66	3.39	100
C2-2_R2	0	0	0	0	1.57	38.13	56.47	3.83	100
C2-2_R3	0	0	0	0	0.08	30.82	62.6	6.49	99.99
C2-3_R1	0	0	0	0	0.01	24.86	63.77	11.36	100
C2-3_R2	0	0	0	0	0.61	33.54	60.44	5.42	100.01
C2-3_R3	0	0.04	0.02	0.05	1.34	21.19	47.86	29.5	100
C3-1_R1	0	0	0	0	0.14	33.78	61.64	4.44	100
C3-1_R2	0	0	0	0	1.09	38.12	56.98	3.81	100
C3-1_R3	0	0	0	0	1.49	37.71	56.22	4.59	100.01
C3-2_R1	0.04	0.53	0.33	0.59	3.91	42.31	49.68	2.62	100.01
C3-2_R2	0	0	0	0	1.05	38.54	56.7	3.71	100
C3-2_R3	0	0	0	0	2.53	38.33	55.06	4.08	100
C3-3_R1	0	0	0	0	0.07	30.75	62.46	6.71	99.99
C3-3_R2	0	0	0	0	0.12	34.17	61.31	4.39	99.99
C3-3_R3	0	0	0	0	1.2	39.18	56.76	2.85	99.99

Diver-Based Samples Year 2									
Station	% Clay	% Silt	% Coarse Silt	% Very Fine Sand	% Fine Sand	% Medium Sand	% Coarse Sand	% Very Coarse Sand	Total
T1-FP1	8.81	12.7	2.33	3.27	4.96	29.45	36.29	2.22	100.01
T1-FP2	9.32	12.3	2.9	4.35	8.76	34.16	27.77	0.42	100.01
T1-FP3	15.23	16.5	2.62	3.7	5.79	28.34	27.2	0.64	100
T1-FP4	11.96	13.4	2.36	3.82	6.25	31.35	30.16	0.69	100.01
T1-FP5	31.64	34.4	6.11	6.96	4.77	7.25	7.86	0.96	99.99
T3-FP1	0	0	0	0	0	20.06	70.18	9.76	100
T3-FP2	0	0	0	0	0	21.6	69.21	9.19	100
T3-FP3	0	0	0	0	0	23.47	68.05	8.48	100
T3-FP4	0	0	0	0	0.88	40.66	56.38	2.08	100
T3-FP5	0	0	0	0	0.46	38.03	58.11	3.4	100
T5-FP1	0	0	0	0	0.01	22.98	65.81	11.2	100
T5-FP2	0	0	0	0	0.06	26.68	63.75	9.51	100
T5-FP3	0	0	0	0	0	23.16	66.71	10.12	99.99
T5-FP4	0	0	0	0	0	18.31	67.29	14.4	100
T5-FP5	0	0	0	0	0.07	26.67	63.06	10.2	100

Appendix 3. Results of the Seabed Video Analysis for Vessel-Based Data Collection

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T1-1_Rep1	27.7	Homogeneous, sand waves, medium sand with little gravel. Very small amount of shell hash	
T1-1_Rep2	28.1	Homogeneous, sand waves, medium sand with little gravel. Very small amount of shell hash	
T1-1_Rep3	27.9	Homogeneous, sand waves, medium sand with some cobble and some gravel. Very small amount of shell hash	
T1-2_Rep1	27.8	Homogeneous, no visible bedform, medium sand with some cobble and some gravel. Cobbles have growth on them (appear to be barnacles). Very small amount of shell hash. Strange white thing present (biological).	

Vessel-Based Samples Year 1

Sample ID	Depth (m)	Sediment Description	Example Photograph
T1-2_Rep2	27.6	Homogeneous, sand waves, medium sand with little cobble and some gravel. Very small amount of shell hash	
T1-2_Rep3	27.6	Homogeneous, no visible bedform, medium sand with some cobble and some gravel. Very small amount of shell hash	
T1-3_Rep1	27.4	Homogeneous, no visible bedform, medium sand with some cobble and some gravel. No shell hash. Strange white thing present (biological).	
T1-3_Rep2	27.8	Homogeneous, no visible bedform, medium sand with some cobble and some gravel. No shell hash	
T1-3_Rep3	27.3	Homogeneous, sand waves, fine to medium sand with some cobble and some gravel. No shell hash	
T1-4_Rep1	28.5	N/A	N/A

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T1-4_Rep2	28.2	Homogeneous, no visible bedform, medium sand with little cobble and some gravel. Very small amount of shell hash	
T1-4_Rep3	28.4	Homogeneous, no visible bedform, medium sand with some cobble and some gravel. Cobbles have growth on them (appear to be barnacles). Very small amount of shell hash	
T1-5_Rep1	28.3	Homogeneous, sand waves, medium to coarse sand with some gravel. Very small amount of shell hash	
T1-5_Rep2	28.2	Homogeneous, sand waves, medium sand with little cobble and some gravel. Very small amount of shell hash	
T1-5_Rep3	28.0	Homogeneous, sand waves, medium sand with some gravel. Very small amount of shell hash	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T1-6_Rep1	27.8	Homogeneous, sand waves, fine to medium sand. Very small amount of shell hash	
T1-6_Rep2	27.9	Homogeneous, sand waves, fine to medium sand. Very small amount of shell hash	
T1-6_Rep3	27.9	Homogeneous, sand waves, fine to medium sand. Very small amount of shell hash	
T1-7_Rep1	27.4	Homogeneous, sand waves, fine to medium sand with little gravel. Very small amount of shell hash. Strange white thing present (biological; in 2nd video from grab attempt that was not successful - "T1-7_Rep_1_Not_Kept")	
T1-7_Rep2	27.5	Homogeneous, no visible bedform, fine to medium sand with some cobble and some gravel. Very small amount of shell hash. Strange white thing present (biological).	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T1-7_Rep3	27.4	Homogeneous, sand waves, fine to medium sand with little cobble and some gravel. Very small amount of shell hash.	
T1-8_Rep1	27.5	Homogeneous, no visible bedform, fine to medium sand with some cobble and some gravel. Very small amount of shell hash.	
T1-8_Rep2	27.0	Homogeneous, sand waves, fine to medium sand with little cobble and some gravel. Very small amount of shell hash.	
T1-8_Rep3	27.5	Homogeneous, sand waves, fine to medium sand with little cobble and some gravel. Some shell hash.	
T1-9_Rep1	28.3	Homogeneous, sand waves, fine to medium sand with little cobble and some gravel. Some shell hash.	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T1-9_Rep2	28.6	1st drop: Homogeneous, sand waves, fine to medium sand with little cobble and some gravel. Some shell hash. 2nd drop: Homogeneous, sand waves, fine to medium sand with little cobble and lot of gravel. Quite a lot of shell hash.	 1st drop  2nd drop
T1-9_Rep3	28.5	Homogeneous, sand waves, fine to medium sand with little cobble and some gravel. Quite a lot of shell hash.	
T3-1_Rep1	26.2	Homogeneous, sand waves, medium to coarse sand with some gravel. Quite a lot of shell hash (blue mussel)	
T3-1_Rep2	25.8	Homogeneous, sand waves, medium to coarse sand with some gravel. Quite a lot of shell hash (blue mussel)	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T3-1_Rep3	25.9	Homogeneous, sand waves, medium to coarse sand with some gravel and cobble. Quite a lot of shell hash (blue mussel - seemingly juvenile shells)	
T3-2_Rep1	26.2	Homogeneous, sand waves, medium sand with little gravel. No shell hash	
T3-2_Rep2	26.3	Homogeneous, sand waves, medium sand with some gravel. Very small amount of shell hash	
T3-2_Rep3	26.1	Homogeneous, sand waves, medium sand with little gravel. Some shell hash (blue mussel)	
T3-3_Rep1	26.0	Homogeneous, no visible bedform, coarse sand with some gravel. Some shell hash	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T3-3_Rep2	26.1	Homogeneous, sand waves, coarse sand with some gravel. Quite a lot of shell hash (blue mussel)	
T3-3_Rep3	26.1	Homogeneous, sand waves, medium to coarse sand with some gravel. A large amount of shell hash (blue mussel)	
T3-4_Rep1	25.8	Homogeneous, sand waves, medium to coarse sand with little gravel. Very small amount of shell hash	
T3-4_Rep2	25.7	Homogeneous, sand waves, medium to coarse sand with some gravel. Very small amount of shell hash	
T3-4_Rep3	25.9	Homogeneous, sand waves, medium to coarse sand with little gravel. Very small amount of shell hash	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T3-5_Rep1	26.5	Homogeneous, sand waves, medium to coarse sand with little gravel. Very small amount of shell hash	
T3-5_Rep2	26.5	Homogeneous, sand waves, medium to coarse sand with little gravel. Very small amount of shell hash	
T3-5_Rep3	26.5	Homogeneous, sand waves, medium to coarse sand with little gravel. Very small amount of shell hash	
T3-6_Rep1	25.7	Homogeneous, sand waves, coarse sand with some gravel. Small amount of shell hash	
T3-6_Rep2	25.5	Homogeneous, sand waves, coarse sand with some gravel. Small amount of shell hash	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T3-6_Rep3	26.0	Homogeneous, sand waves, coarse sand with some gravel. Small amount of shell hash	
T3-7_Rep1	26.4	Homogeneous, sand waves, coarse sand with little gravel. Very small amount of shell hash	
T3-7_Rep2	26.4	N/A	N/A
T3-7_Rep3	26.5	Homogeneous, sand waves, coarse sand with some gravel. Very small amount of shell hash	
T3-8_Rep1	26.3	Homogeneous, sand waves, medium to coarse sand with very little gravel. Some shell hash	
T3-8_Rep2	26.2	Homogeneous, sand waves, medium to coarse sand with very little gravel. Some shell hash	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T3-8_Rep3	26.4	Homogeneous, sand waves, medium to coarse sand. Some shell hash	
T3-9_Rep1	25.3	Homogeneous, sand waves, medium to coarse sand with lot of gravel. Quite a lot of shell hash	
T3-9_Rep2	25.5	Homogeneous, sand waves, medium to coarse sand with some gravel. Some shell hash	
T3-9_Rep3	26.1	Homogeneous, sand waves, medium to coarse sand with lot of gravel. Quite a lot of shell hash	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T5-1_Rep1	22.8	Homogeneous, sand waves, medium to coarse sand with some gravel. Some shell hash. Image "b" attempts to show sand wave features. One clam visible - believed to be *Astarte borealis* or *Astarte castanea*	 Image a  Image b
T5-1_Rep2	22.8	Homogeneous, sand waves, medium to coarse sand with some gravel. Some shell hash. Image "b" attempts to show sand wave features. Several clams visible - believed to be *Astarte borealis* or *Astarte castanea*	 Image a  Image b
T5-1_Rep3	22.6	Homogeneous, sand waves, medium to coarse sand with some gravel. Some shell hash. Several clams visible - believed to be Astarte borealis or Astarte castanea One starfish visible.	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T5-2_Rep1	23.6	Homogeneous, sand waves, medium to coarse sand with little gravel. Very small amount of shell hash. One clam visible - believed to be *Astarte borealis* or *Astarte castanea*	
T5-2_Rep2	23.7	Homogeneous, sand waves, medium to coarse sand with little gravel. Very small amount of shell hash. Several clams visible - believed to be *Astarte borealis* or *Astarte castanea*	
T5-2_Rep3	24.1	Homogeneous, sand waves, medium to coarse sand with little gravel. Very small amount of shell hash. Several clams visible - believed to be *Astarte borealis* or *Astarte castanea*	
T5-3_Rep1	23.3	Homogeneous, sand waves, medium to coarse sand with little gravel. Very small amount of shell hash.	
T5-3_Rep2	23.6	Homogeneous, sand waves, medium to coarse sand with little gravel. Very small amount of shell hash.	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T5-3_Rep3	23.4	Homogeneous, sand waves, medium to coarse sand with little gravel. Very small amount of shell hash.	
T5-4_Rep1	23.9	Homogeneous, sand waves, fine to medium sand. No shell hash.	
T5-4_Rep2	23.9	Homogeneous, sand waves, fine to medium sand. No shell hash. Few small blue mussel shells/fragments	
T5-4_Rep3	24.1	Homogeneous, sand waves, medium to coarse sand with little gravel. Very small amount of shell hash.	

Vessel-Based Samples Year 1

Sample ID	Depth (m)	Sediment Description	Example Photograph
T5-5_Rep1	23.9	1st drop: Homogeneous, sand waves, medium to coarse sand with some gravel. Very small amount of shell hash. 2nd drop: Homogeneous, sand waves, medium to coarse sand with little gravel. Very small amount of shell hash. Several clams visible - believed to be *Astarte borealis* or *Astarte castanea*	 1st drop  2nd drop
T5-5_Rep2	23.8	Homogeneous, sand waves, medium sand. No shell hash. Several clams visible - believed to be *Astarte borealis* or *Astarte castanea*.	
T5-5_Rep3	24.1	Homogeneous, sand waves, medium sand. No shell hash.	
T5-6_Rep1	22.7	Homogeneous, sand waves, medium to coarse sand. Very small amount of shell hash.	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T5-6_Rep2	22.3	1st drop: Homogeneous, sand waves, medium to coarse sand. Few large cobbles / small boulders nearby. Very small amount of shell hash. Several crabs in surrounding area (unknown species). Several clams visible - believed to be Astarte borealis or Astarte castanea 2nd drop: Homogeneous, sand waves, medium to coarse sand. Very small amount of shell hash. Several clams visible - believed to be *Astarte borealis* or Astarte castanea	 1st drop  2nd drop
T5-6_Rep3	22.2	Homogeneous, sand waves, medium to coarse sand. Some shell hash. Several clams visible - believed to be Astarte borealis or *Astarte castanea.*	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T5-7_Rep1	22.0	1st drop: Homogeneous field of medium sand with small boulders and large cobbles (no gravel). Barnacle growth on cobbles and boulders (various densities). Very small amount of shell hash. 2nd drop: Homogeneous, sand waves, medium sand with small boulders and large cobbles (no gravel). Barnacle growth on cobbles and boulders (various densities). Small amount of red algae growth. Very small amount of shell hash.	 1st drop  2nd drop
T5-7_Rep2	22.1	Homogeneous, sand waves, medium sand with few large cobbles and one small boulder with barnacle and red algae growth. Very small amount of shell hash.	
T5-7_Rep3	22.2	Homogeneous, sand waves, medium sand. Some shell hash. Few large cobbles and small boulders in surrounding area / background with some barnacle and red algae growth.	
T5-8_Rep1	22.6	Homogeneous, sand waves, medium sand. Very small amount of shell hash. Few large cobbles and small boulders in surrounding area / background with some barnacle and white algae growth. Several clams visible - believed to be *Astarte borealis* or *Astarte castanea*	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T5-8_Rep2	22.8	Homogeneous, sand waves, medium to coarse sand. Very small amount of shell hash. Several large cobbles and small boulders in surrounding area and background with dense to fairly dense barnacle growth. Some red algae growth coming from seafloor.	
T5-8_Rep3	22.5	Homogeneous, sand waves, medium to coarse sand. Very small amount of shell hash. One small boulder / large cobble with dense barnacle growth. Several clams visible - believed to be *Astarte borealis* or *Astarte* castanea	
T5-9_Rep1	22.3	Homogeneous, sand waves, medium to coarse sand. Very small amount of shell hash. Several clams visible - believed to be Astarte borealis or *Astarte castanea*	
T5-9_Rep2	22.5	Homogeneous, sand waves, medium to coarse sand. Very small amount of shell hash. One small boulder / large cobble with dense barnacle growth. Several clams visible - believed to be *Astarte borealis* or *Astarte castanea*	
T5-9_Rep3	22.7	Homogeneous, sand waves, medium to coarse sand. Some shell hash. Several large cobbles and small boulders in surrounding area and background with dense to fairly dense barnacle growth. Some red algae growth coming from seafloor. Several clams visible - believed to be *Astarte borealis* or *Astarte castanea*	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
C1-1_Rep1	21.5	1st drop (grab not recovered): Homogeneous, dense boulder field. Boulders of various sizes (large to small). Cobbles and gravel between boulders. Dense algae (red and white) growth on boulders. Some shell hash. 2nd drop: Homogeneous, sand waves, medium sand. Some red algae growth coming from seafloor. Dense shell hash - dominating feature.	 1st drop  2nd drop
C1-1_Rep2	22.3	(Have two video clips for this station…. Both are described here; believe second video is where grab was collected). 1st video: Homogeneous, dense cobble and gravel covered seafloor. Some red algae growth on cobbles and gravel. Some shell hash. 2nd video: Homogeneous, fine to medium sand with large cobbles and small boulders and some gravel. Dense shell hash. Dense algae (red and white) growth on cobbles and boulders. Some calcareous red algae present, also. Strange white thing present - quite extensive here.	 1st video  2nd video
C1-1_Rep3	22.2	Homogeneous, mix of gravel and fine to medium sand with large cobbles and small boulders. Some algae (red and white) and barnacle growth on cobbles and boulders. Some shell hash. Few starfish.	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
C1-2_Rep1	21.1	Sand waves, patches of cobble and gravel (one type of patch) and medium to coarse sand (another type of patch). Few small boulders. Barnacle growth on cobbles and boulders. Small amount of red algae growth coming from seafloor. Some shell hash.	
C1-2_Rep2	21.7	1st drop: Homogeneous, no visible bedform, dense boulder (small), cobble and gravel covered seafloor. Dense algae (red and white) growth on boulders and cobbles. Some shell hash. 2nd drop: No visible bedform, mixture of patches of boulders of various sizes (large to small), cobble, and gravel (one type of patch) and medium to coarse sand (another type of patch). Four starfish (three on cobbles, one on small boulder). Strange white thing present (biological; on large boulder). Dense barnacle growth on cobbles and boulders. Some patches on algae growth (red and white; on large boulder). Some shell hash.	 1st drop  2nd drop

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
C1-2_Rep3	21.7	1st drop: Grab landed within what appears to be sand waves with clear distinction between trough and crest. Trough contains small cobbles, gravel, and quite a lot of shell hash. Some cobbles have barnacle growth. Crests contain medium to coarse sand with less shell hash. When grab is retrieved, it is clear grab landed just alongside an extensive area of large boulders (what image "b" is attempting to capture). 2nd drop: Homogeneous mixture of small boulders, cobbles, gravel, and medium to coarse sand. Quite a lot of shell hash. Barnacle growth on boulders and cobbles. Some red and white algae growth. One starfish (on boulder in the background) and one on sand in left side of image. 3rd drop: Homogeneous mixture of small boulders, cobbles, gravel, and medium to coarse sand. Quite a lot of shell hash. Barnacle growth on boulders and cobbles. Some red and white algae growth. One starfish in the background.	 1st drop  2nd drop  3rd drop

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
C1-3_Rep1	21.7	1st drop (grab not recovered): Homogeneous, dense boulder area. Boulders of various sizes (large to small). Cobbles and gravel between boulders. Barnacle and algae (red and white) growth on boulders (of various densities). Very small amount of shell hash. 2nd drop: Homogeneous, sand waves, coarse sand with little gravel. Dense shell hash.	 1st drop  2nd drop
C1-3_Rep2	21.4	Homogeneous, sand waves, coarse sand with some gravel. Some shell hash. Few large cobbles with barnacle growth.	
C1-3_Rep3	21.8	Homogeneous, sand waves, medium to coarse sand with little gravel. Dense shell hash. Several large cobbles and small boulders in surrounding area and background with fairly dense barnacle growth. Some red algae growth.	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
C1-4_Rep1	20.2	1st drop: Homogeneous, mix of boulders, cobble, and gravel with fine to medium sand. No shell hash. Larger cobbles have some barnacle growth. Boulders have dense algae (red and white) growth. One starfish. 2nd drop: Appears to be homogeneous bottom of dense cobbles covered in dense algae (red and white) growth with fine to medium sand between cobbles. No shell hash. 3rd drop: Homogenous, mix of cobbles and gravel on fine to medium sand. Very small amount of shell hash. Some algae (red and white) growth. 4th drop (grab recovered): Homogeneous, sand waves, fine to medium sand (crests) with lot of gravel (troughs). Very small amount of shell hash. Boulders in distant background. One clam visible - believed to be *Astarte borealis* or *Astarte castanea*.	 1^{st} drop  2^{nd} drop  3^{rd} drop  4^{th} drop

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
C1-4_Rep2	20.6	1st drop: Homogeneous, mix of cobble and gravel on fine to medium sand. Very small amount of shell hash. Areas of dense algae (red and white) growth. Some barnacle growth on some cobbles. Boulders in distant background. 2nd drop: Very large boulder with dense barnacle growth, some algae (white) growth, and a few starfish. 3rd drop: Homogeneous, mix of boulders, cobble, and gravel on fine to medium sand. Some shell hash. Dense algae (red and white) growth and some barnacle growth on boulders and cobbles. Several starfish.	 1st drop  2nd drop  3rd drop

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
C1-4_Rep3	20.4	1st drop: Homogeneous, dense mix of cobble and gravel on fine to medium sand. Very small amount of shell hash. Dense algae (red and white) growth on cobbles. Boulders in distant background. 2nd drop: Homogeneous, mix of cobble and gravel on fine to medium sand. No shell hash. Dense algae (red and white) and barnacle growth on cobbles. Few starfish.	 1st drop  2nd drop
C2-1_Rep1	26.5	Homogeneous, no visible bedform, equal mixture of fine to medium sand and gravel. No shell hash.	
C2-1_Rep2	26.5	Homogeneous, sand waves, fine to medium sand with lot of gravel. No shell hash.	
C2-1_Rep3	26.5	Homogeneous, no visible bedform, equal mixture of fine to medium sand and gravel. Few small cobbles. No shell hash.	

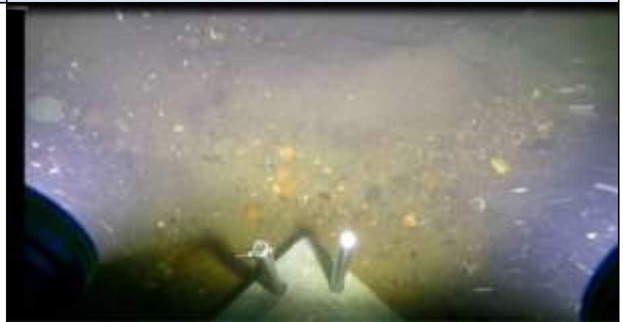
Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
C2-2_Rep1	27.2	Homogeneous, sand waves, fine to medium sand with some gravel and some cobbles. No shell hash. Some barnacle growth on cobbles. Small patch of red algae.	
C2-2_Rep2	26.5	1st drop: Homogeneous, sand waves, mixture of fine to medium sand and gravel. No shell hash. 2nd drop: Homogeneous, no visible bedform, dense gravel seafloor with fine to medium sand. No shell hash.	 1st drop  2nd drop
C2-2_Rep3	26.8	Homogeneous, no visible bedform, medium to coarse sand with some gravel. No shell hash.	
C2-3_Rep1	25.6	Homogeneous, no visible bedform, dense gravel with small cobbles and fine to medium sand. No shell hash, but some large pieces of broken shell. Skate egg case. Appears to be calcareous growth of some sort.	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
C2-3_Rep2	26.2	Homogeneous, no visible bedform, fine to medium sand with lot of gravel. No shell hash, but some large pieces of broken shell.	
C2-3_Rep3	25.9	Homogeneous, no visible bedform, fine to medium sand with lot of gravel. No shell hash, but some large pieces of broken shell.	
C2-4_Rep1	26.0	Homogeneous, sand waves, medium to coarse sand with some gravel. Very small amount of shell hash	
C2-4_Rep2	26.0	1st drop: Homogeneous, sand waves, medium to coarse sand with some cobbles and a lot of gravel. Dense barnacle growth on cobbles. No shell hash. 2nd drop: Homogeneous, no visible bedform, fine to medium sand with some gravel and little cobble. No shell hash. Skate egg case. 3rd drop: Homogeneous, no visible bedform, medium to coarse sand with some gravel. Few cobbles. Very small amount of shell hash.	 1st drop  2nd drop

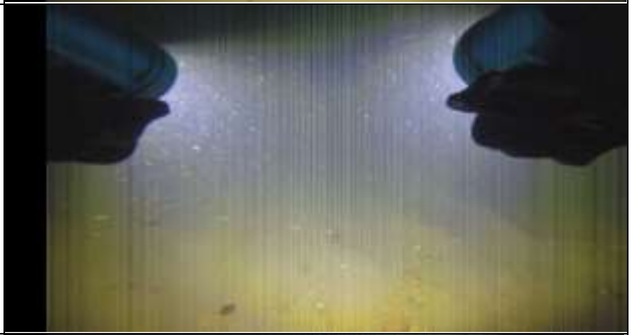
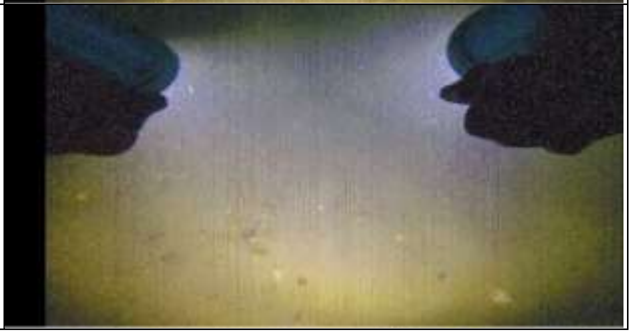
Vessel-Based Samples Year 1

Sample ID	Depth (m)	Sediment Description	Example Photograph
C2-4_Rep3	25.6	Homogeneous, sand waves, medium to coarse sand with some gravel. Very small amount of shell hash.	
C3-1_Rep1	27.1	Homogeneous, sand waves, dense gravel with fine to medium sand and some cobble. Very small amount of shell hash.	
C3-1_Rep2	27.0	Homogeneous, sand waves, fine to medium sand with lot of gravel and some cobble. No shell hash. Some barnacle growth. Few starfish.	
C3-1_Rep3	26.7	Homogeneous, sand waves, fine to medium sand with lot of gravel and some cobble. No shell hash. Some barnacle growth. Few starfish.	
C3-2_Rep1	26.9	Homogeneous, sand waves, fine to medium sand with lot of gravel and some cobble. No shell hash. Some barnacle growth.	

Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
C3-2_Rep2	26.8	Homogeneous, sand waves, fine to medium sand with some gravel and little cobble. No shell hash.	
C3-2_Rep3	26.8	Homogeneous, sand waves, fine to medium sand with a lot of gravel and little cobble. No shell hash. Some barnacle growth.	
C3-3_Rep1	27.1	Homogeneous, sand waves, fine to medium sand with a lot of gravel and little cobble. No shell hash. Some barnacle growth.	
C3-3_Rep2	27.0	Homogeneous, sand waves, fine to medium sand with a lot of gravel and little cobble. No shell hash. Some barnacle growth.	
C3-3_Rep3	27.4	Homogeneous, sand waves, fine to medium sand with a lot of gravel and little cobble. No shell hash. Some barnacle growth.	

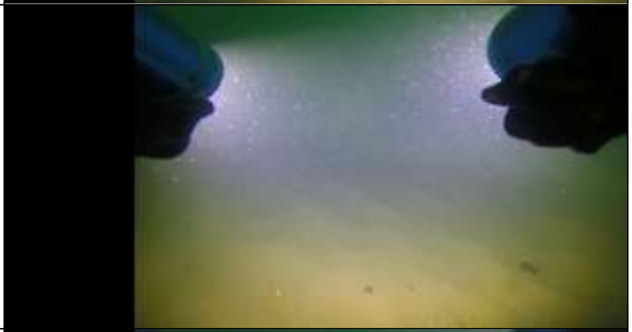
Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
C3-4_Rep1	27.2	Homogeneous, sand waves, fine to medium sand with a lot of gravel and little cobble. No shell hash.	
C3-4_Rep2	27.4	Homogeneous, sand waves, fine to medium sand with a lot of gravel and little cobble. No shell hash. Some barnacle growth.	
C3-4_Rep3	27.3	Homogeneous, sand waves, fine to medium sand with a lot of gravel and little cobble. No shell hash. Some barnacle growth.	
T1-QC	27.6	Homogeneous, sand waves, fine to medium sand with some gravel and little cobble. No shell hash. Some barnacle growth.	
T3-QC	26.4	Homogeneous, sand waves, fine to medium sand with little gravel. No shell hash.	

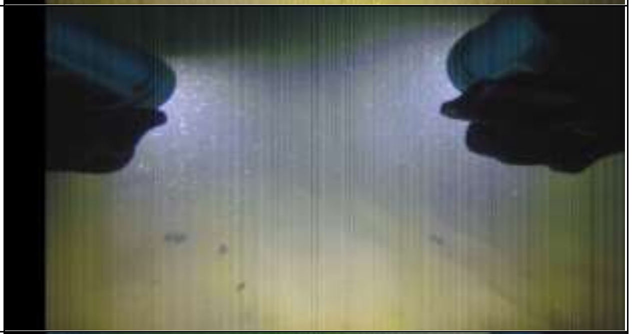
Vessel-Based Samples Year 1			
Sample ID	**Depth (m)**	**Sediment Description**	**Example Photograph**
T5-QC	23.5	Homogeneous, sand waves, fine to medium sand with little gravel and little cobble. Dense barnacle growth on cobbles. No shell hash.	
C3-QC	26.8	N/A	N/A

Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
T1-1_Rep1	27.43	Homogeneous, sand waves (shallow/very low relief), medium sand, few small cobbles. Very small amount of shell hash. Small cluster of blue mussels (appear to be mature; unclear if living).	
T1-1_Rep2	27.65	Homogeneous, sand waves (shallow/very low relief), medium sand, few small cobbles, little gravel. Very small amount of shell hash. Few blue mussels (appear to be mature; unclear if living). *Poor quality video.	
T1-1_Rep3	27.71	Homogeneous, no visible bedform, dense pebble, gravel, and small cobble cover on top of medium-coarse sand. Some shell fragments. Small clusters of barnacles visible on few cobbles. *Poor quality video.	
T1-2_Rep1	26.97	Homogeneous, possible sand waves (shallow/very low relief), medium-coarse sand, few small cobbles, some gravel. Very small amount of shell hash. *Poor quality video.	
T1-2_Rep2	26.82	Homogeneous, possible sand waves (shallow/very low relief) medium-coarse sand, few small cobbles, little gravel. Very small amount of shell hash.*Poor quality video. ** In the failed grab video for this station, the white sponge (Polymastia robusta) is present.	

Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
T1-2_Rep3	27.07	Homogeneous, possible sand waves (shallow/very low relief), medium-coarse sand, few small cobbles, little gravel. Very small amount of shell hash. *Poor quality video.	
T1-3_Rep1	27.61	Homogeneous, no visible bedform, medium-coarse sand, some small cobbles, some gravel. Very small amount of shell hash. *Poor quality video.	
T1-3_Rep2	27.34	Homogeneous, no visible bedform, medium-coarse sand, some small cobbles, some gravel. Very small amount of shell hash.	
T1-3_Rep3	27.16	Homogeneous, no visible bedform, dense pebble, gravel, and small cobble cover on top of medium-coarse sand. Some shell hash. Some mature blue mussel shell halves. Small clusters of barnacles visible on few cobbles.	
T1-4_Rep1	26.85	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, some small cobbles, little gravel. Very small amount of shell hash. *Poor quality video.	

Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
T1-4_Rep2	26.82	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, few small cobbles, little gravel. Very small amount of shell hash. *Poor quality video.	
T1-4_Rep3	26.67	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, few small cobbles, little gravel. Very small amount of shell hash. Possible small cluster of blue mussels (appear to be mature; unclear if living). *Poor quality video. ** The white sponge (Polymastia robusta) is present.	
T1-5_Rep1	27.22	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, some small cobbles, some gravel. Very small amount of shell hash. *Poor quality video. ** In the failed grab video for this station, small cluster of blue mussels and few individual blue mussels scattered throughout frame (appear to be mature; unclear if living).	
T1-5_Rep2	27.31	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, few small cobbles, little gravel. Very small amount of shell hash. Possible small cluster of blue mussels (appear to be mature; unclear if living). *Poor quality video.	
T1-5_Rep3	27.37	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, few small cobbles, some gravel. Very small amount of shell hash. Few small clusters of blue mussels (appear to be mature; one cluster is empty shells, unclear if other two clusters are living). *Poor quality video.	n/a

Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
T1-6_Rep1	27.61	Homogeneous, no visible bedform, medium-coarse sand, some gravel. Very small amount of shell hash. ** In the failed grab video for this station, denser concentration of small cobbles and gravel.	
T1-6_Rep2	27.61	Homogeneous, no visible bedform, medium-coarse sand, some small cobbles, some gravel. Very small amount of shell hash.	
T1-6_Rep3	27.65	Homogeneous, no visible bedform, medium-coarse sand, few small cobbles, little/some gravel. Very small amount of shell hash.	
T1-7_Rep1	27.52	Homogeneous, sand waves (shallow/very low relief), fine-medium sand, few small cobbles, very little gravel. Very small amount of shell hash.	
T1-7_Rep2	27.4	Homogeneous, sand waves (shallow/very low relief), fine-medium sand, few small cobbles, little gravel. Small amount of shell hash and shell fragments. Small cluster of barnacles visible on one cobble. Few individual blue mussels scattered throughout frame (appear to be mature; unclear if living). ** In the failed grab video for this station, small cluster of blue mussels (appear to be mature; unclear if living).	

Vessel-Based Samples Year 2			
Station	Depth (m)	Video Description	Example Photograph
T1-7_Rep3	27.68	Homogeneous, sand waves (shallow/very low relief), fine-medium sand, very few small cobbles, very little gravel. Small amount of shell hash and shell fragments. Small cluster of barnacles visible on one cobble.	
T1-8_Rep1	27.43	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, no cobbles or gravel. Very small amount of shell hash. *Poor quality video.	
T1-8_Rep2	27.37	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, little gravel. Very small amount of shell hash. Small cluster of blue mussels (appear to be mature; unclear if living). *Poor quality video.	
T1-8_Rep3	27.25	Homogeneous, sand waves (shallow/very low relief), fine-medium sand, no cobbles or gravel. Very small amount of shell hash. Few individual blue mussels scattered throughout frame (appear to be mature; unclear if living) *Poor quality video.	
T1-9_Rep1	26.58	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, little gravel. Very small amount of shell hash. Small cluster of blue mussels (appear to be mature; unclear if living). *Poor quality video.	

Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
T1-9_Rep2	26.52	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, few small cobbles, little gravel. Very small amount of shell hash. Small cluster of barnacles visible on one cobble. *Poor quality video.	
T1-9_Rep3	26.79	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, little gravel. Very small amount of shell hash. Few small clusters of blue mussels (appear to be mature; unclear if living). *Poor quality video. ** The white sponge (Polymastia robusta) is present (twice).	
T3-1_Rep1	25.42	Homogeneous, sand waves, medium-coarse sand, no cobbles or gravel. Small amount of shell hash. Few individual blue mussels scattered throughout frame (appear to be mature; unclear if living).	
T3-1_Rep2	25.48	Homogeneous, sand waves, medium-coarse sand, little gravel (and possibly few small cobbles). Very small amount of shell hash.	
T3-1_Rep3	25.51	Homogeneous, sand waves, medium-coarse sand, no cobbles, little gravel. Small amount of shell hash. Few individual blue mussels scattered throughout frame (appear to be mature; unclear if living).	

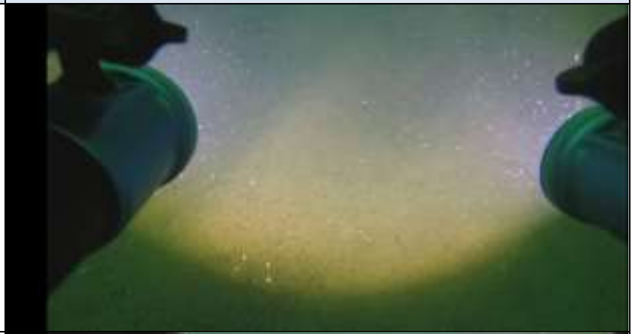
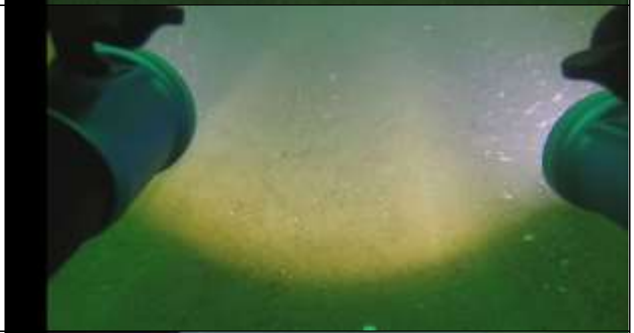
Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
T3-2_Rep1	25.02	Homogeneous, no visible bedform, medium-very coarse sand, no cobbles or gravel. Some shell hash. Few individual blue mussels scattered throughout frame (appear to be mature; appear empty).	
T3-2_Rep2	25.02	Homogeneous, no visible bedform, mostly very coarse sand, little gravel (and possibly few small cobbles). Some shell hash. Few individual blue mussels scattered throughout frame (appear to be mature; appear empty).	
T3-2_Rep3	25.05	Homogeneous, no visible bedform, medium-very coarse sand, no cobbles or gravel. Some shell hash. Few individual blue mussels scattered throughout frame (appear to be mature; appear empty).	
T3-3_Rep1	25.57	Homogeneous, sand waves, medium-coarse sand, no cobbles or gravel. Small amount of shell hash. Small cluster of blue mussels (appear to be mature; some empty; unclear if any living).	
T3-3_Rep2	25.66	Homogeneous, sand waves (shallow/very low relief), medium-very coarse sand, little gravel. Small amount of shell hash. Two small clusters of blue mussels (appear to be mature; some empty; unclear if any living).	

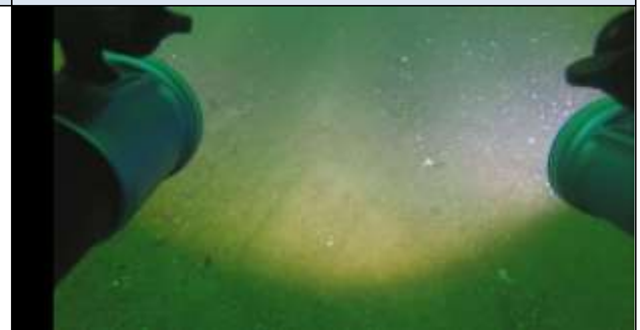
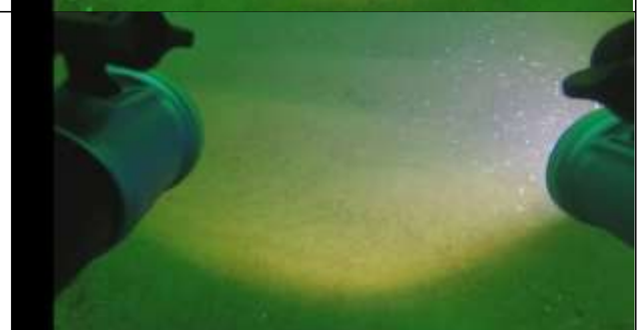
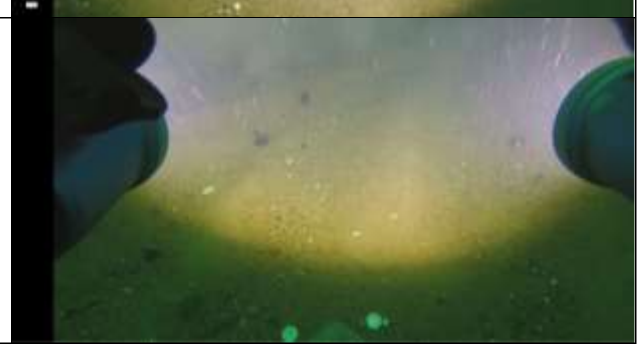
Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
T3-3_Rep3	25.76	Homogeneous, sand waves, medium-coarse sand, no cobbles, little gravel. Small amount of shell hash.	
T3-4_Rep1	24.99	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, no cobbles, very little gravel. Small amount of shell hash.	
T3-4_Rep2	24.78	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, no cobbles, very little gravel. Small amount of shell hash.	
T3-4_Rep3	24.96	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, no cobbles, no gravel. Small amount of shell hash. *Skate (believe) captured swimming away as grab lands	
T3-5_Rep1	25.05	Homogeneous, sand waves (shallow/very low relief), medium-very coarse sand, no cobbles, very little gravel. Small amount of shell hash.	

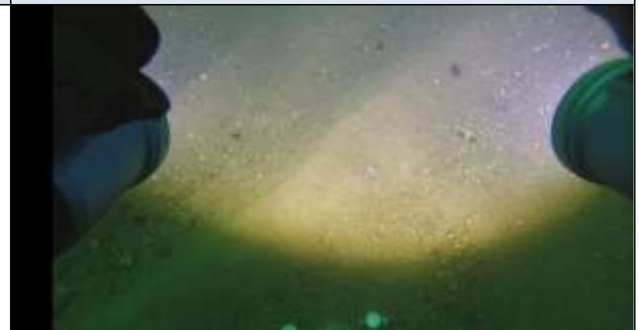
Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
T3-5_Rep2	25.12	Homogeneous, sand waves, medium-very coarse sand, no cobbles, no gravel. Very small amount of shell hash. Small cluster of blue mussels (appear to be mature; unclear if living).	
T3-5_Rep3	25.3	Homogeneous, sand waves, medium-coarse sand, no cobbles, no gravel. Some shell hash. Few individual blue mussels scattered throughout frame (appear to be mature; unclear if living).	
T3-6_Rep1	25.24	Homogeneous, sand waves (shallow/very low relief), medium-very coarse sand, no cobbles, very little gravel. Very small amount of shell hash.	
T3-6_Rep2	25.42	Homogeneous, sand waves (shallow/very low relief), medium-very coarse sand, no cobbles, very little gravel. Small amount of shell hash.	
T3-6_Rep3	25.24	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, no cobbles, very little gravel. Small amount of shell hash. Few individual blue mussels scattered throughout frame (appear to be mature; unclear if living).	

Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
T3-7_Rep1	25.57	Homogeneous, sand waves, medium sand, no cobbles, no gravel. Very small amount of shell hash.	
T3-7_Rep2	25.66	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, no cobbles, very little gravel. Very small amount of shell hash. *In the failed grab video for this station, grab appeared to have landed on/right next to a large cluster of blue mussels (appear to be mature; appear to be living)	
T3-7_Rep3	25.45	Homogeneous, sand waves, medium-coarse sand, no cobbles, no gravel. Very small amount of shell hash. One empty mature blue mussel shell. One half of a large clam shell.	
T3-8_Rep1	25.24	Homogeneous, sand waves (shallow/very low relief), medium-very coarse sand, no cobbles, very little gravel. Some shell hash. One small cluster and few individual blue mussels scattered throughout frame (appear to be mature; some empty shells; unclear if any living).	
T3-8_Rep2	25.66	Homogeneous, sand waves (shallow/very low relief), medium-very coarse sand, no cobbles, no gravel. Very small amount of shell hash. One blue mussle in back of frame (appears to be mature; unclear if living).	

Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
T3-8_Rep3	25.21	Homogeneous, sand waves, medium-very coarse sand, no cobbles, little gravel. Very small amount of shell hash. One empty mature blue mussel shell.	
T3-9_Rep1	24.78	Homogeneous, sand waves, fine-medium sand, no cobbles, no gravel. No shell hash.	
T3-9_Rep2	25.12	Homogeneous, sand waves, fine-medium sand, no cobbles, no gravel. No shell hash.	
T3-9_Rep3	24.96	Homogeneous, sand waves, fine-medium sand, no cobbles, no gravel. No shell hash.	
T5-1_Rep1	22.16	Homogeneous, sand waves, fine-medium sand, no cobbles, no gravel. Very small amount of shell hash. One empty mature blue mussel shell.	

Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
T5-1_Rep2	22.16	Homogeneous, sand waves, fine-medium sand, no cobbles, very little gravel. Very small amount of shell hash.	
T5-1_Rep3	22.49	Homogeneous, sand waves, fine-medium sand, no cobbles, very little gravel. Small amount of shell hash. * In the failed grab video for this station, there are about a dozen empty mature blue mussel shells in the troughs of the sand waves.	
T5-2_Rep1	22.77	Homogeneous, sand waves, medium-very coarse sand, no cobbles, very little gravel. Small amount of shell hash and shell fragments. Few empty mature blue mussel shells.	
T5-2_Rep2	22.71	Homogeneous, sand waves, medium-very coarse sand, no cobbles, very little gravel. Small amount of shell hash and shell fragments. Few empty mature blue mussel shells.	
T5-2_Rep3	22.74	Homogeneous, sand waves, medium-coarse sand, no cobbles, very little gravel. Small amount of shell hash and shell fragments. Few empty mature blue mussel shells. * Unknown object in distance as grab is being lowered.	

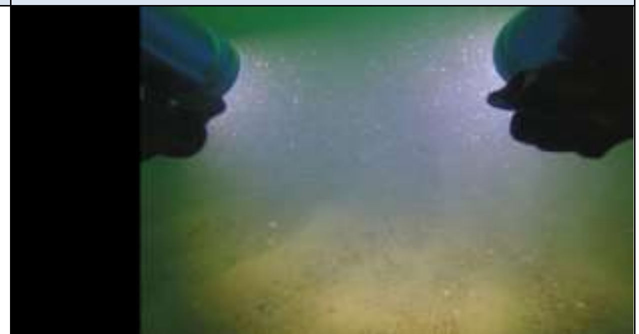
Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
T5-3_Rep1	21.34	Homogeneous, sand waves, medium-coarse sand, one small cobble, very little gravel. Very small amount of shell hash. Few empty mature blue mussel shells.	
T5-3_Rep2	21.43	Homogeneous, sand waves, medium sand, no cobbles, no gravel. Very small amount of shell hash and few shell fragments.	
T5-3_Rep3	21.85	Homogeneous, sand waves, medium sand, no cobbles, no gravel. Very small amount of shell hash. Few empty mature blue mussel shells.	
T5-4_Rep1	22.92	Homogeneous, sand waves, medium-coarse sand, no cobbles, no gravel. Some shell hash. About six blue mussel shells in the trough of the sand wave visible in the frame (appear to be mature; some empty; unclear if any living). * In distance, there are numerous blue mussel shells in the troughs of the sand waves (appear to be mature, unclear if living). Also present is gravel, a few small cobbles, and shell hash/fragments.	
T5-4_Rep2	23.29	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, no cobbles, very little gravel. Some shell hash. About six blue mussel shells in the troughs of the sand waves visible in the frame (appear to be mature; some empty; unclear if any living).	

Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
T5-4_Rep3	23.16	Homogeneous, sand waves, medium-coarse sand, no cobbles, some gravel (mostly in troughs of sand waves). Some shell hash. Few blue mussel shells visible in frame (appear to be mature; some empty; unclear if any living). * Similar pattern in distance - there are numerous blue mussel shells in the troughs of the sand waves (appear to be mature, unclear if living). Also present is gravel, a few small cobbles, and shell hash/fragments.	
T5-5_Rep1	21.73	Homogeneous, sand waves, medium-coarse sand, no cobbles, very little gravel. Some shell hash. One empty mature blue mussel shell. * In the first failed grab video for this station, a few cobbles (and possibly small boulders) are present in frame and in distance. Small cluster of barnacles visible on cobbles. Video also shows sand waves (shallow/very low relief), medium-coarse sand, no gravel, small amount of shell hash. ** In the second failed grab video for this station, clump of red algae is present, along with sand waves (shallow/very low relief), medium-coarse sand, no cobble, no gravel, small amount of shell hash.	
T5-5_Rep2	21.98	Homogeneous, sand waves (shallow/very low relief), medium-coarse sand, no cobbles, very little gravel. Small amount of shell hash.	
T5-5_Rep3	22.59	Homogeneous, sand waves, medium-coarse sand, no cobbles, very little gravel. Very small amount of shell hash.	

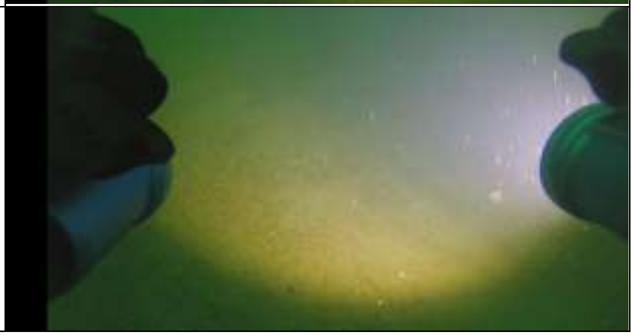
Vessel-Based Samples Year 2

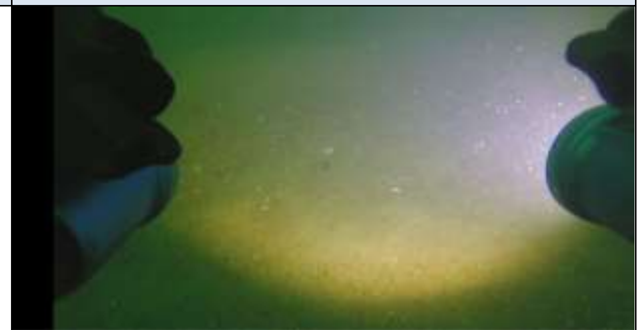
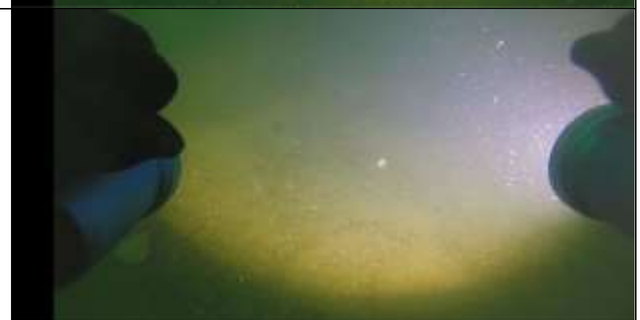
Station	Depth (m)	Video Description	Example Photograph
T5-6_Rep1	23.41	Homogeneous, sand waves (shallow/very low relief), medium-very coarse sand, no cobbles, very little gravel. Some shell hash and shell fragments.	
T5-6_Rep2	23.53	Homogeneous, sand waves, medium-very coarse sand, no cobbles, very little gravel. Some shell hash. Few empty mature blue mussel shells. *In the failed grab video for this station, no well defined sand waves and denser gravel concentration with few small cobbles	
T5-6_Rep3	23.5	Homogeneous, sand waves (shallow/very low relief), medium-very coarse sand, no cobbles, very little gravel. Some shell hash. One empty mature blue mussel shell (not visible in screen shot).	
T5-7_Rep1	22.89	Homogeneous, sand waves, medium-very coarse sand, no cobbles, very little gravel. Some shell hash. Few empty mature blue mussel shells.	
T5-7_Rep2	23.29	Homogeneous, sand waves, medium-very coarse sand, no cobbles, very little gravel. Small amount of shell hash. Few empty mature blue mussel shells.	

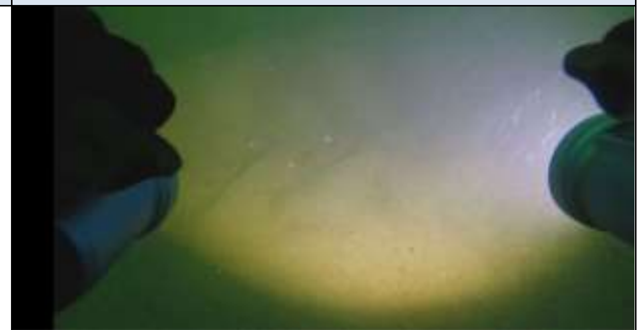
Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
T5-7_Rep3	22.56	Homogeneous, sand waves, medium-very coarse sand, no cobbles, very little gravel. Small amount of shell hash. One mature blue mussel shell (unclear if living).	
T5-8_Rep1	21.52	In first frame: Homogeneous, sand waves, medium-coarse sand, no cobbles, very little gravel. Small amount of shell hash. Few empty mature blue mussel shells. In second frame (camera moves few feet forward): Homogeneous, sand waves, medium-coarse sand, few small cobbles, little gravel. Small amount of shell hash. Barnacles visible on the cobbles.	
T5-8_Rep2	21.55	Homogeneous, sand waves (shallow/very low relief), medium sand, few large cobbles/small boulders, no gravel. Very small amount of shell hash. Cobbles/boulders have barnacles present. * In distance, more large cobbles/small boulders are visible.	
T5-8_Rep3	21.61	Homogeneous, sand waves, medium-coarse sand, one cobble, very little gravel. Small amount of shell hash. Cobble has barnacles on it. Few clumps of red algae present. * In distance, more cobbles/small boulders are visible.	
T5-9_Rep1	23.44	Homogeneous, sand waves, medium-very coarse sand, few small cobbles, some gravel. Some shell hash. Few empty mature blue mussel shells. *One red brick in middle of frame.	

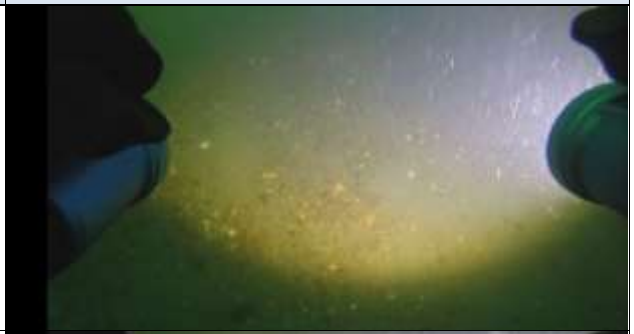
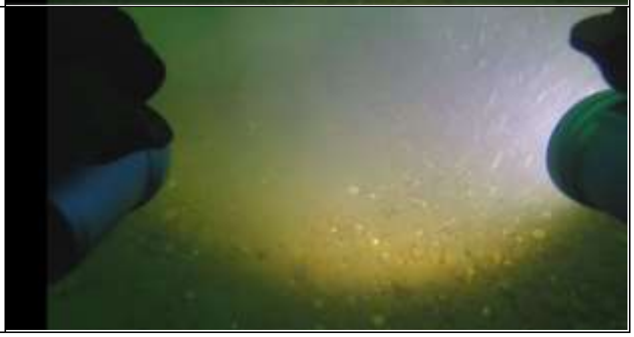
Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
T5-9_Rep2	23.53	Homogeneous, sand waves, medium-very coarse sand, no cobbles, little gravel. Some shell hash.	
T5-9_Rep3	23.44	Homogeneous, sand waves, medium-very coarse sand, few small cobbles, little gravel. Some shell hash.	
C1-1_Rep1	23.26	Homogeneous, appears to be shallow, broad-scale sand waves with clear distinction between trough and crest. Trough contains lot of cobbles (small to large), lot of gravel, and some shell hash. Some rocks have small amount of barnacle growth. One rock has one clump of red algae attached. Crests contain medium - very coarse sand with no cobbles, very little gravel, and some shell hash. * In the failed grab video for this station, sediment is medium-very coarse sand with some gravel, no cobbles, no visible bedform. But, cobbles (and possibly small boulders) visible in distance.	
C1-1_Rep2	23.41	Homogeneous, appears to be shallow, broad-scale sand waves. Trough contains cobbles (small to medium), gravel, and very coarse sand. Crests composed of medium-very coarse sand. No barnacles visible.	

Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
C1-1_Rep3	23.32	Area is somewhat patchy. No visible bedform, cobbles (small to large) and small boulders scattered on top of medium-very coarse sand. Some patches of dense gravel/cobble concentrations. Larger rocks have barnacles. One small boulder has clumps of red algae present.	
C1-2_Rep1	23.04	Homogeneous, sand waves. Medium sand on crests. In troughts, very coarse sand, little gravel, and some shell hash. One cobble with small amount of barnacle growth. Clumps of red algae throughout frame. * The white sponge (Polymastia robusta) is present. ** Same description for seafloor in the distance. *** In the failed grab video for this station, similar description applies, but a few small boulders are also present.	
C1-2_Rep2	23.01	Grab sampler jumped around several times. In all frames: Homogeneous, sand waves (shallow/very low relief), medium-very coarse sand, few cobbles/small boulders, little gravel, some shell hash. Some rocks have barnacles. Some small clumps of red algae.	
C1-2_Rep3	22.74	Homogeneous, no visible bedform, few small boulders, some cobbles (small to large), little gravel, some shell hash. Some rocks have barnacles. Few small clumps of red algae scattered throughout frame. * Same description for seafloor in the distance. ** In the failed video for this station: Homogeneous, sand waves (shallow/very low relief), medium-very coarse sand, no cobble, litel gravel, some shell hash and shell fragments, small clumps of red algae scattered throughout frame. *** The white sponge (Polymastia robusta) is present - perhaps most extensive one yet.	

Vessel-Based Samples Year 2			
Station	Depth (m)	Video Description	Example Photograph
C1-3_Rep1	22.98	Homogeneous, sand waves, few small boulders, few cobbles (small to large), little gravel, lot of shell hash and shell fragments. Some rocks have barnacles. Few small clumps of red algae scattered throughout frame. *Station is on the edge of an area with a dense concentration of cobbles and small boulders.	
C1-3_Rep2	22.86	Homogeneous, sand waves, medium-very coarse sand, no cobbles, very little gravel, some shell hash. Few clumps of red algae. *Few small fish present in video (have also seen these in a few other videos -- either station T5-4, -5 or -8, or within C1-1, -2, or -3). ** Few small boulders in distance.	
C1-3_Rep3	22.86	Homogeneous, sand waves, medium-coarse sand, few cobbles (small to large), very little gravel, some shell hash. Some rocks have barnacles. Few clumps of red algae. * Similar description for seafloor in the distance; possibly few small boulders mixed in.	
C2-1_Rep1	26.33	Homogeneous, no well-defined bedform, medium-coarse sand, no cobbles, little gravel. Small amount of shell hash.	
C2-1_Rep2	26.79	Homogeneous, no well-defined bedform, medium-coarse sand, no cobbles, no gravel. Small amount of shell hash.	

Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
C2-1_Rep3	26.4	Homogeneous, no well-defined bedform, medium-coarse sand, no cobbles, no gravel. Small amount of shell hash. One clam visible - believed to be Astarte borealis or Astarte castanea (unclear if living)	
C2-2_Rep1	25.73	Homogeneous, no well-defined bedform, medium-coarse sand, no cobbles, very little gravel. Small amount of shell hash. * Object in bottom left corner is a clam shell fragment.	
C2-2_Rep2	26.03	Homogeneous, no well-defined bedform, medium-coarse sand, no cobbles, no gravel. Small amount of shell hash. * Possible few blue mussel shells in bottom of frame (appear to be mature; unclear if living).	
C2-2_Rep3	25.51	Homogeneous, sand waves (shallow/very low relief), medium-very coarse sand, no cobbles, very little gravel. Small amount of shell hash. *One empty clam shell visible - believed to be Astarte borealis or Astarte castanea. **Unknown yellow and white object in frame.	
C2-3_Rep1	26.85	Homogeneous, sand waves (shallow/very low relief), medium sand, no cobbles, no gravel. Very small amount of shell hash. Half of one large clam shell.	
C2-3_Rep2	26.79	n/a	n/a

Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
C2-3_Rep3	27.07	Homogeneous, no well-defined bedform, medium sand, no cobbles, no gravel. No shell hash. *One clam visible - believed to be Astarte borealis or Astarte castanea (in upper left corner of frame).	
C3-1_Rep1	28.25	Homogeneous, no visible bedform, dense gravel cover on top of medium-very coarse sand with few small cobbles. Very small amount of shell hash and shell fragments. (Note: Grain size tube in video calls this station C3-5-R1)	
C3-1_Rep2	28.01	Homogeneous, no visible bedform, dense gravel cover on top of medium-very coarse sand with few small cobbles. Very small amount of shell hash and shell fragments. (Note: Grain size tube in video calls this station C3-5-R2)	
C3-1_Rep3	28.41	Homogeneous, no visible bedform, dense gravel cover on top of medium-very coarse sand with few small cobbles. Very small amount of shell hash and shell fragments. (Note: Grain size tube in video calls this station C3-5-R3)	
C3-2_Rep1	28.71	Homogeneous, no visible bedform, medium-coarse sand, few cobbles, lot of gravel. Small amount of shell hash and shell fragments. (Note: Grain size tube in video calls this station C3-4-R1)	

Vessel-Based Samples Year 2			
Station	**Depth (m)**	**Video Description**	**Example Photograph**
C3-2_Rep2	28.83	Homogeneous, no visible bedform, medium-coarse sand, few cobbles, lot of gravel. Small amount of shell hash and shell fragments. (Note: Grain size tube in video calls this station C3-4-R2)	
C3-2_Rep3	28.59	Homogeneous, no visible bedform, medium-coarse sand, few cobbles, some gravel. Small amount of shell hash and shell fragments. (Note: Grain size tube in video calls this station C3-4-R3)	
C3-3_Rep1	28.01	Homogeneous, sand waves (shallow/very low relief), medium-very coarse sand, no cobbles, some gravel. Small amount of shell hash and shell fragments.	
C3-3_Rep2	28.01	Homogeneous, no visible bedform, medium-very coarse sand, no cobbles, lot of gravel. Small amount of shell hash and shell fragments.	
C3-3_Rep3	28.25	Homogeneous, no visible bedform, dense gravel cover on top of medium-very coarse sand with few small cobbles. Small amount of shell hash and shell fragments.	

Appendix 4. Camera Field Notes for Float and Diver-Towed Missions

Float Missions Year 1								
Site Name		**Latitude**	**Longitude**	**Date**	**Time**	**Data Directory**	**# Images**	**Notes**
C1-1	Drop	41 06 9.4256 N	071 32 25.5741 W	6/28/17	10:30:50	stereo_surv_1419	BW 334	
	Recover	41 06 9.4306 N	071 32 47.2654 W	6/28/17	11:00:24		Color 334	
C1-2	Drop	41 06 4.3487 N	071 32 21.2024 W	6/28/17	11:24:54	stereo_surv_1519	BW 573	
	Recover	41 06 1.8616 N	071 33 0.7179 W	6/28/17	12:09:27		Color 571	
C3-1	Drop	41 07 0.4035 N	071 31 46.4251 W	6/28/17	12:33:44	stereo_surv_1627	BW 625	
	Recover	41 06 58.2207 N	071 31 59.061 W	6/28/17	13:06:26		Color 625	
C3-2	Drop	41 07 2.2434 N	071 31 43.0546 W	6/28/17	13:24:59	stereo_surv_1716	BW 896	
	Recover	41 06 56.7147 N	071 31 49.3558 W	6/28/17	14:07:22		Color 847	
C2-1	Drop	41 06 39.4243 N	071 30 42.5795 W	6/28/17	14:31:01	stereo_surv_1824	BW 1023	
	Recover	41 06 33.0584 N	071 30 38.9662 W	6/28/17	15:18:57		Color 1023	
T3-1	Drop	41 06 55.4611 N	071 31 16.9588 W	8/9/17	8:53:46	stereo_surv_1251	BW 673	
	Recover	41 06 52.3003 N	071 31 30.807 W	8/9/17	9:25:59		Color 675	
T3-2	Drop	41 06 51.018 N	071 31 13.4758 W	8/9/17	9:41:59	stereo_surv_1337	BW 639	
	Recover	41 06 47.4895 N	071 31 26.7836 W	8/9/17	10:13:50		Color 639	
T1-1	Drop	41 07 34.4225 N	071 30 25.8154 W	8/9/17	10:31:17	stereo_surv_1426	BW 585	
	Recover	41 07 30.9421 N	071 30 38.9035 W	8/9/17	11:03:24		Color 601	
T1-2	Drop	41 07 31.1076 N	071 30 26.2505 W	8/9/17	11:39:21	stereo_surv_1529	BW 453	8-bit
	Recover	41 07 27.7819 N	071 30 35.8594 W	8/9/17	12:11:19		Color 0	
T5-4	Drop	41 06 24.4283 N	071 32 15.5297 W	8/9/17	12:31:01	stereo_surv_1627	BW 96	8-bit
	Recover	41 06 23.0000 N	071 32 16.1562 W	8/9/17	12:47:01		Color 0	
T5-1	Drop	41 06 22.0583 N	071 32 16.6649 W	8/9/17	12:52:15	stereo_surv_1646	BW 424	8-bit
	Recover	41 06 12.3688 N	071 32 17.7263 W	8/9/17	13:24:10		Color 0	
T5-2	Drop	41 06 22.1883 N	071 32 14.7691 W	8/9/17	13:43:23	stereo_surv_1735	BW 140	Dying strobe
	Recover	41 06 10.3441 N	071 32 15.2148 W	8/9/17	14:15:14		Color 311	Dying strobe
T5-3	Drop	41 06 22.1547 N	071 32 17.4531 W	8/9/17	14:29:54	stereo_surv_1824	BW 79	Dying strobe
	Recover	41 06 15.0901 N	071 32 18.5089 W	8/9/17	14:49:47		Color 149	Dying strobe
T3-3	Drop	41 06 52.3902 N	071 31 17.2978 W	8/9/17	15:03:19	stereo_surv_1859	BW 67	Dying strobe
	Recover	41 06 44.5542 N	071 31 17.0274 W	8/9/17	15:23:12		Color 142	Dying strobe
T1-3	Drop	41 07 31.9203 N	071 30 28.5224 W	8/9/17	15:35:48	stereo_surv_1932	BW 64	Dying strobe
	Recover	41 07 27.4791 N	071 30 28.9664 W	8/9/17	15:55:27		Color 116	Dying strobe

Float and Diver-Towed Missions Year 2								
Site Name		Latitude	Longitude	Date	Time	Data Directory	# Images	Notes
T3-1 Float	Drop	41.115304 N	071.520978 W	5/17/2018	11:07:00	stereo_surv_1458	BW 609	Images partially lighted by strobe
	Recover	41.114735 N	071.522693 W	5/17/2018	11:29:00		Color 510	
T3-2 Float	Drop	41.114305 N	071.520333 W	5/17/2018	1:20	stereo_surv_1714	BW 519	
	Recover	41.112508 N	071.520647 W	5/17/2018	1:43		Color 365	
T3 Diver	Drop	41.114846 N	071.52117 W	5/17/2018	12:09	stereo_surv_1551	BW 733	
	Recover	41.114846 N	071.52117 W	5/17/2018	12:37		Color 688	
C1-1 Float	Drop	41 06 18.2813 N	071 31 47.4121 W	6/12/2018	7:26:26	stereo_surv_1126	BW 474	
	Recover	41 06 20.0263 N	071 31 55.3527 W	6/12/2018	7:53:14		Color 452	
C1-2 Float	Drop	41 06 19.0185 N	071 31 45.9851 W	6/12/2018	8:14:59	stereo_surv_1215	BW 1,384	Strobe not working for part of mission
	Recover	41 06 17.8844 N	071 31 51.3523 W	6/12/2018	8:41:19		Color 454	
C2-1 Float	Drop	41 06 49.4877 N	071 32 24.1619 W	6/12/2018	9:28:57	stereo_surv_1328	BW 1,296	Strobe not used
	Recover	41 06 46.089 N	071 32 24.6876 W	6/12/2018	9:54:38		Color 934	
C2-2 Float	Drop	41 06 51 N	071 32 26.6641 W	6/12/2018	9:58:16			Strobe not used
	Recover	41 06 48.333 N	071 32 25.1485 W	6/12/2018	10:25:15			
C3-1 Float	Drop	41 07 29.5037 N	071 30 58.0635 W	6/12/2018	10:45:55	stereo_surv_1445	BW 915	
	Recover	41 07 25.3768 N	071 30 52.8953 W	6/12/2018	11:12:29		Color 915	
C3-2 Float	Drop	41 07 29.1298 N	071 30 59.2409 W	6/12/2018	11:16:16			
	Recover	41 07 23.0487 N	071 30 54.2445 W	6/12/2018	11:42:47			
T5-1 Float	Drop	41 06 21.5111 N	071 32 15.8619 W	6/15/2018	8:00:46	stereo_surv_1157	BW 908	
	Recover	41 06 17.7585 N	071 32 43.0275 W	6/15/2018	8:26:37		Color 901	
T5-2 Float	Drop	41.106395 N	071.537976 W	6/15/2018	8:35:00			
	Recover	41 06 20.3184 N	071 32 41.7113 W	6/15/2018	9:00:57			
T1-1 Float	Drop	41 07 32.1352 N	071 30 25.1301 W	6/15/2018	9:18:43	stereo_surv_1318	BW 774	
	Recover	41 07 29.8859 N	071 30 43.7418 W	6/15/2018	9:44:51		Color 766	
T1-2 Float	Drop	41 07 34 N	071 30 25.7292 W	6/15/2018	9:50:49			
	Recover	41 07 31.9699 N	071 30 39.2763 W	6/15/2018	10:10:36			
T1 Diver	Drop	41.125636 W	071.50749 W	6/15/2018	10:43	stereo_surv_1430	BW 504	
	Recover	41.125636 W	071.50749 W	6/15/2018	11:07		Color 1,503	
T5 Diver	Drop	41.106209 N	071.537636 W	6/15/2018	11:52	stereo_surv_1546	BW 508	
	Recover	41.106209 N	071.537636 W	6/15/2018	12:15		Color 508	

Appendix 5. Results of the Sediment Organic Analysis for Vessel-Based and Diver-Based Data Collection

Vessel-Based Samples Year 1			
Sample ID	Date	Total Organic (%)	Organic Carbon (%)
T1-1_1	12/20/2016	0.52	0.23
T1-1_2	12/20/2016	0.42	0.18
T1-1_3	12/20/2016	0.31	0.14
T1-2_1	12/20/2016	0.21	0.09
T1-2_2	12/20/2016	0.12	0.05
T1-2_3	12/20/2016	0.19	0.08
T1-3_1	12/20/2016	0.37	0.16
T1-3_2	12/20/2016	0.41	0.18
T1-3_3	12/20/2016	0.27	0.12
T1-4_1	12/20/2016	0.45	0.20
T1-4_2	12/20/2016	0.60	0.26
T1-4_3	12/20/2016	0.37	0.16
T1-5_1	12/20/2016	0.36	0.15
T1-5_2	12/20/2016	0.32	0.14
T1-5_3	12/20/2016	0.44	0.19
T1-6_1	12/20/2016	0.07	0.03
T1-6_2	12/20/2016	0.49	0.21
T1-6_3	12/20/2016	0.50	0.21
T1-7_1	12/20/2016	0.13	0.06
T1-7_2	12/20/2016	0.27	0.12
T1-7_3	12/20/2016	0.34	0.15
T1-8_1	12/20/2016	0.37	0.16
T1-8_2	12/20/2016	0.24	0.10
T1-8_3	12/20/2016	0.13	0.06
T1-9_1	12/20/2016	0.41	0.18
T1-9_2	12/20/2016	0.25	0.11
T1-9_3	12/20/2016	0.32	0.14
T3-1_1	12/20/2016	0.34	0.15
T3-1_2	12/20/2016	0.25	0.11
T3-1_3	12/20/2016	0.52	0.22
T3-2_1	12/20/2016	0.06	0.03
T3-2_2	12/20/2016	0.45	0.19
T3-2_3	12/20/2016	0.39	0.17
T3-3_1	12/20/2016	1.00	0.43
T3-3_2	12/20/2016	0.22	0.10
T3-3_3	12/20/2016	0.42	0.18
T3-4_1	12/20/2016	0.38	0.16
T3-4_2	12/20/2016	0.52	0.23
T3-4_3	12/20/2016	0.82	0.35
T3-5_1	12/20/2016	0.71	0.31

Vessel-Based Samples Year 1			
Sample ID	Date	Total Organic (%)	Organic Carbon (%)
T3-5_2	12/20/2016	0.19	0.08
T3-5_3	12/20/2016	0.69	0.30
T3-6_1	12/20/2016	0.32	0.14
T3-6_3	12/20/2016	0.42	0.18
T3-6_2	12/20/2016	0.53	0.23
T3-7_1	12/20/2016	0.06	0.03
T3-7_2	12/20/2016	0.31	0.13
T3-7_3	12/20/2016	0.44	0.19
T3-8_1	12/20/2016	0.53	0.23
T3-8_2	12/20/2016	0.38	0.16
T3-8_3	12/20/2016	0.49	0.21
T3-9_1	12/20/2016	0.31	0.14
T3-9_2	12/20/2016	0.47	0.20
T3-9_3	1/20/2017	0.39	0.17
T5-1_1	1/20/2017	0.70	0.30
T5-1_2	1/20/2017	0.64	0.27
T5-1_3	1/20/2017	0.66	0.29
T5-2_1	1/20/2017	0.38	0.17
T5-2_2	1/20/2017	0.35	0.15
T5-2_3	1/20/2017	0.31	0.13
T5-3_1	1/20/2017	0.21	0.09
T5-3_2	1/20/2017	0.42	0.18
T5-3_3	1/20/2017	0.66	0.29
T5-4_1	1/20/2017	0.38	0.17
T5-4_2	1/20/2017	0.29	0.13
T5-4_3	1/20/2017	0.33	0.14
T5-5_1	1/20/2017	0.52	0.23
T5-5_2	1/20/2017	0.33	0.14
T5-5_3	1/20/2017	0.28	0.12
T5-6_1	1/20/2017	0.13	0.06
T5-6_2	1/20/2017	0.41	0.18
T5-6_3	12/20/2016	0.49	0.21
T5-7_1	1/20/2017	0.71	0.31
T5-7_2	1/20/2017	0.91	0.39
T5-7_3	1/20/2017	0.40	0.17
T5-8_1	1/20/2017	0.36	0.16
T5-8_2	1/20/2017	0.30	0.13
T5-8_3	1/20/2017	0.61	0.26
T5-9_1	1/20/2017	0.41	0.18
T5-9_2	1/20/2017	0.87	0.37
T5-9_3	1/20/2017	0.60	0.26
C1-1_1	1/20/2017	1.04	0.45
C1-1_2	1/20/2017	0.47	0.20

Vessel-Based Samples Year 1			
Sample ID	Date	Total Organic (%)	Organic Carbon (%)
C1-1_3	1/20/2017	0.61	0.26
C1-2_1	1/20/2017	0.46	0.20
C1-2_2	1/20/2017	0.35	0.15
C1-2_3	1/20/2017	0.40	0.17
C1-3_1	1/20/2017	0.00	0.00
C1-3_2	1/20/2017	0.37	0.16
C1-3_3	1/20/2017	0.36	0.16
C1-4_1	1/20/2017	0.40	0.17
C1-4_2	1/20/2017	0.65	0.28
C1-4_3	1/20/2017	0.59	0.25
C2-1_1	1/20/2017	0.24	0.10
C2-1_2	12/20/2017	0.29	0.13
C2-1_3	1/20/2017	0.33	0.14
C2-2_1	1/20/2017	0.35	0.15
C2-2_2	1/20/2017	0.35	0.15
C2-2_3	1/20/2017	0.48	0.21
C2-3_1	1/20/2017	0.74	0.32
C2-3_2	1/20/2017	0.47	0.20
C2-3_3	1/20/2017	0.74	0.32
C2-4_1	1/20/2017	0.39	0.17
C2-4_2	1/20/2017	0.26	0.11
C2-4_3	1/20/2017	0.16	0.07
C3-1_1	3/21/2017	0.29	0.12
C3-1_2	3/21/2017	0.85	0.37
C3-1_3	3/21/2017	0.46	0.20
C3-2_1	3/21/2017	0.69	0.30
C3-2_2	3/21/2017	0.42	0.18
C3-2_3	3/21/2017	0.28	0.12
C3-3_1	3/21/2017	0.54	0.23
C3-3_2	3/21/2017	0.44	0.19
C3-3_3	3/21/2017	0.32	0.14
C3-4_1	3/21/2017	0.32	0.14
C3-4_2	3/21/2017	0.33	0.14
C3-4_3	3/21/2017	0.46	0.20
T1-QC	3/21/2017	0.58	0.25
T3-QC	3/21/2017	0.46	0.20
T5-QC	3/21/2017	0.64	0.28
C3-QC	3/21/2017	0.35	0.15

Vessel-Based Samples Year 2			
Sample ID	**Date**	**Total Organic (%)**	**Organic Carbon (%)**
C1-1 R1	01/12/2017	0.76	0.33
C1-1 R2	01/12/2017	0.48	0.21
C1-1 R3	01/12/2017	0.18	0.08
C1-2 R1	01/12/2017	0.86	0.37
C1-2 R2	01/12/2017	0.48	0.21
C1-2 R3	01/12/2017	0.79	0.34
C1-3 R1	01/12/2017	0.61	0.26
C1-3 R2	01/12/2017	0.54	0.23
C1-3 R3	01/12/2017	0.57	0.25
C2-1 R1	01/12/2017	0.26	0.11
C2-1 R2	01/12/2017	0.35	0.15
C2-1 R3	01/12/2017	0.40	0.17
C2-1 R3 (Duplicate)	01/12/2017	0.42	0.18
C2-2 R1	01/12/2017	0.44	0.19
C2-2 R2	01/12/2017	1.08	0.46
C2-2 R3	01/12/2017	0.42	0.18
C2-3 R1	01/12/2017	0.19	0.08
C2-3 R2	01/12/2017	0.54	0.23
C2-3 R3	01/12/2017	0.51	0.22
C3-3 R1	01/12/2017	0.40	0.17
C3-3 R2	01/12/2017	0.46	0.20
C3-3 R3	01/12/2017	0.54	0.23
C3-4 R1	01/12/2017	0.45	0.19
C3-4 R2	01/12/2017	0.43	0.19
C3-4 R3	01/12/2017	0.83	0.36
C3-5 R1	01/12/2017	0.42	0.18
C3-5 R2	01/12/2017	0.63	0.27
C3-5 R3	01/12/2017	0.38	0.17
T1-1 R1	30/11/2017	0.74	0.32
T1-1 R2	30/11/2017	0.19	0.08
T1-1 R3	30/11/2017	0.07	0.03
T1-2 R1	30/11/2017	0.63	0.27
T1-2 R2	30/11/2017	0.30	0.13
T1-2 R3	30/11/2017	0.53	0.23
T1-3 R1	30/11/2017	0.34	0.15
T1-3 R2	30/11/2017	0.41	0.18
T1-3 R3	30/11/2017	0.57	0.24
T1-4 R1	30/11/2017	0.56	0.24
T1-4 R2	30/11/2017	0.51	0.22
T1-4 R3	30/11/2017	0.21	0.09
T1-5 R1	30/11/2017	0.63	0.27
T1-5 R1 (Duplicate)	30/11/2017	0.49	0.21
T1-5 R2	30/11/2017	0.67	0.29
T1-5 R3	30/11/2017	1.21	0.52
T1-6 R1	30/11/2017	0.13	0.06
T1-6 R2	30/11/2017	0.55	0.24

Vessel-Based Samples Year 2			
Sample ID	Date	Total Organic (%)	Organic Carbon (%)
T1-6 R3	30/11/2017	0.34	0.15
T1-7 R1	30/11/2017	0.44	0.19
T1-7 R2	30/11/2017	0.36	0.16
T1-7 R3	30/11/2017	0.68	0.29
T1-8 R1	30/11/2017	0.16	0.07
T1-8 R2	30/11/2017	0.37	0.16
T1-8 R3	30/11/2017	0.50	0.21
T1-9 R1	30/11/2017	0.27	0.12
T1-9 R2	30/11/2017	0.75	0.32
T1-9 R3	30/11/2017	0.37	0.16
T3-1 R1	30/11/2017	0.41	0.18
T3-1 R2	30/11/2017	0.62	0.27
T3-1 R3	30/11/2017	0.51	0.22
T3-2 R1	30/11/2017	0.51	0.22
T3-2 R2	30/11/2017	0.33	0.14
T3-2 R3	30/11/2017	0.26	0.11
T3-3 R1	30/11/2017	0.06	0.03
T3-3 R2	30/11/2017	0.47	0.20
T3-3 R3	30/11/2017	0.52	0.23
T3-4 R1	30/11/2017	0.55	0.24
T3-4 R2	30/11/2017		
T3-4 R3	30/11/2017	0.31	0.14
T3-5 R1	30/11/2017	0.39	0.17
T3-5 R2	30/11/2017	0.52	0.23
T3-5 R3	30/11/2017	0.51	0.22
T3-6 R1	30/11/2017	0.51	0.22
T3-6 R2	30/11/2017	0.39	0.17
T3-6 R3	30/11/2017	0.53	0.23
T3-7 R1	30/11/2017	0.57	0.25
T3-7 R2	30/11/2017	0.41	0.18
T3-7 R3	30/11/2017	0.53	0.23
T3-8 R1	30/11/2017	0.40	0.17
T3-8 R2	30/11/2017	0.28	0.12
T3-8 R3	30/11/2017	0.40	0.17
T3-9 R1	30/11/2017	0.54	0.23
T3-9 R1 (Duplicate)	30/11/2017	0.14	0.06
T3-9 R2	30/11/2017	0.55	0.24
T3-9 R3	30/11/2017	0.40	0.17
T5-1 R1	01/12/2017	0.52	0.22
T5-1 R2	01/12/2017	0.63	0.27
T5-1 R3	01/12/2017	0.47	0.20
T5-2 R1	01/12/2017	0.14	0.06
T5-2 R2	01/12/2017	0.50	0.20
T5-2 R3	01/12/2017	1.73	0.75
T5-2 R3 (Duplicate)	01/12/2017	0.60	0.26
T5-3 R1	01/12/2017	0.21	0.09

Vessel-Based Samples Year 2			
Sample ID	**Date**	**Total Organic (%)**	**Organic Carbon (%)**
T5-3 R2	01/12/2017	0.59	0.25
T5-3 R3	01/12/2017	0.50	0.22
T5-4 R1	01/12/2017	0.41	0.18
T5-4 R2	01/12/2017	0.06	0.03
T5-4 R3	01/12/2017	0.19	0.08
T5-5 R1	01/12/2017	0.48	0.21
T5-5 R2	01/12/2017	0.20	0.09
T5-5 R3	01/12/2017	0.46	0.20
T5-6 R1	30/11/2017	0.59	0.25
T5-6 R2	30/11/2017	0.37	0.16
T5-6 R3	30/11/2017	0.45	0.19
T5-7 R1	30/11/2017	0.27	0.12
T5-7 R2	30/11/2017	0.52	0.23
T5-7 R3	30/11/2017	0.65	0.28
T5-8 R1	01/12/2017	0.39	0.17
T5-8 R2	01/12/2017	0.33	0.14
T5-8 R3	01/12/2017	0.61	0.26
T5-8 R3 (Duplicate)	01/12/2017	0.48	0.21
T5-9 R1	30/11/2017	0.44	0.19
T5-9 R2	30/11/2017	0.37	0.16
T5-9 R3	30/11/2017	0.27	0.12

Diver-Based Samples Year 2			
Sample ID	**Date**	**Total Organic (%)**	**Organic Carbon (%)**
Turbine 1 sample 1	08/06/2018	1.73	0.75
Turbine 1 sample 2	08/06/2018	2.27	0.98
Turbine 1 sample 3	08/06/2018	1.95	0.84
Turbine 1 sample 4	08/06/2018	1.30	0.56
Turbine 1 sample 5	08/06/2018	5.40	2.33
Turbine 3 sample 1	17/05/2018	0.60	0.26
Turbine 3 sample 2	17/05/2018	0.51	0.22
Turbine 3 sample 3	17/05/2018	0.75	0.33
Turbine 3 sample 4	17/05/2018	0.61	0.26
Turbine 3 sample 5	17/05/2018	0.25	0.11
Turbine 5 sample 1	07/06/2018	0.00	0.00
Turbine 5 sample 1 (Duplicate)	07/06/2018	0.34	0.15
Turbine 5 sample 2	07/06/2018	0.91	0.39
Turbine 5 sample 3	07/06/2018	0.52	0.22
Turbine 5 sample 4	07/06/2018	0.00	0.00
Turbine 5 sample 5	07/06/2018	0.15	0.06

Appendix 6. BIWF Macrofaunal Abundance Species Lists for Vessel-Based and Diver-Based Data Collection

Species List Year 1 (Winter 2016-2017) of Vessel-Based Grab Samples

Species	T1-1rep1	T1-1rep2	T1-1rep3	T1-2rep1	T1-2rep2	T1-2rep3	T1-3rep1	T1-3rep2	T1-3rep3	T1-4rep1	T1-4rep2
ACTINIARIA											
Actinaria spp											
ARTHROPOPDA											
Amphipoda											
Ampelisca vadorum											
Aeginina longicornis											
Byblis serrata	1									6	
Caprella equilibra											
Caprella penantis											
Caprella unica											
Corophium spp									10		
Dulchia sp											
Erichthonius rubricornis									79		
Gammaropsis maculata									3		
Hippomedon serratus	1										
Ischyrocerus anguipes											1
Jassa marmorata											
Lembos websteri											
Leptocheirus pinguis										1	
Luconacia incerta									5		
Melita dentata											
Microdeutopus anomalus					1						
Monoculodes sp											
Parametopella cypris											
Phoxocephalus holbolli											
Pleustidae sp											
Pontogenia inermis											
Proboloides holmesi											
Protohaustorius wigleyi		1	1					2			

Species	T1-1rep1	T1-1rep2	T1-1rep3	T1-2rep1	T1-2rep2	T1-2rep3	T1-3rep1	T1-3rep2	T1-3rep3	T1-4rep1	T1-4rep2
Psammonyx nobilis											
Pseudunciola obliquua											
Rhepoxynuis epistomus	1			1				3			
Siphonoecetes smithianus											
Stenopleustes gracilis											
Stenothoe minuta									2		
Unciola irrorata					2	4	7	3	4	1	1
Cumacea											
Diastylis sp					1						
Pseudoleptocuma minor										1	
Decapoda											
Cancer borealis											
Cancer sp juv. ?*irroratus*											1
Crangon septemspinosa											
Pagurus annulipes											
Isopoda											
Chiridotea sp *caeca*				1							
Chiridotea tuftsi		1			1						
Edotea triloba	1										
Erichsonella filiformis											
Politolana polita											
Pycnogonida											
Nymphon stromi											
Sessilia											
Balanus amphitrite				1	22	20			33		
Tanaidacea											
Leptochelia savignyi											
Tanaissus psammophilus	8		1	3		1		1			

Species	T1-1rep1	T1-1rep2	T1-1rep3	T1-2rep1	T1-2rep2	T1-2rep3	T1-3rep1	T1-3rep2	T1-3rep3	T1-4rep1	T1-4rep2
ECHINODERMATA											
Asteroidea											
Asterias spp											
Echinoidea											
Echinarachnius parma											
Holothuroidea											
Cucumaria sp											
Ophiuroidea											
Axiognathus squamatus											
MOLLUSKA											
Bivalvia											
Anadera transversa											
Anomia spp (juveniles)											
Astarte borealis	1										
Astarte castanea											
Cerastoderma pinnulatum											
Crassinella mactracea											
Crenella decussata											
Cyclocardia borealis										2	
Ensis directus											
Lyonsia arenosa	2		1							9	
Lyonsia hyalina											
Mytilus edulis						1			8		1
Nucula tenuis											
Pandora gouldiana											
Spisula solidissima	1		1					2			1
Tellina agilis			1			1				1	
Gastropoda											
Crepidula fornicata					1			1	2	1	
Crepidula plana									8		

Species	T1-1rep1	T1-1rep2	T1-1rep3	T1-2rep1	T1-2rep2	T1-2rep3	T1-3rep1	T1-3rep2	T1-3rep3	T1-4rep1	T1-4rep2
Euspira heros	1										
Euspira triseriata			1								
Ilyanassa trivittata									1		
Retusa obtusa											
Turbonilla sp											
Polyplacophora											
Chaetopleura apiculata											
ANNELIDA											
Oligochaeta											
Oligochaeta spp			1								
Polychaeta											
Ampharete arctica											
Aricidea catherinae	1			1						8	
Asabellides oculata											
Asychis elongata											
Autolytus prolifer											
Cirrophorus sp					2						
Dipolydora sp										2	
Dodecaceria coralii											
Drilonereis magna	1										
Ephesiella minuta										1	
Eumida sanguinea						1			3		
Exogone hebes	1			1	4	1		1		1	1
Exogone naidina											
Glycera americana											
Glycera dibranchiata											
Goniadella gracilis	7		7	4	3	15	9	11		12	14
Harmothoe sp						1					
Lepidonotus squamatus									1		
Lumbrinereis acuta	7		3	1		3	2	1	1	17	1
Lumbrinereis fragilis	1		3			3		2	1	2	2
Maldanidae spp	1					1				3	

Species	T1-1rep1	T1-1rep2	T1-1rep3	T1-2rep1	T1-2rep2	T1-2rep3	T1-3rep1	T1-3rep2	T1-3rep3	T1-4rep1	T1-4rep2
Marphysa bellii						1					
Megalona sp										1	
Microphthalmus sckelkowii											
Monticellina baptisteae	1				1		2		1	4	
Mystides sp											
Nephtys bucera	2	1	1	2	3	8	1	1	2	8	5
Nephtys ciliata											
Nereis arenaceodonta											
Nereis zonata											
Odontosyllis fulgurans	1										1
Ophelia denticulata											
Ophioglycera gigantea											
Owenia fusiformis											
Paranaitis speciosa											
Paraonis sp						1					1
Parapionosyllis longicirrata	6		4	1	1	1		2			3
Parougia caeca	1					1					
Phyllodoce arenae											
Phyllodoce maculata											
Pisione sp											
*Pista*sp (juveniles)											
Polycirrus eximius										1	
Polydora sp				1							
*Polygordius*spp	5	1	1	7	5		5	10	2	4	12
Potamilla reniformis				1							
Proceraea ?fasciata						2			2		
Sabellaria vulgaris		1		1	6	31		15	225	26	5
Scalibregma inflatum											
Sigalion arenicola								1	1		
Sphaerosyllis erinaceus				3						3	
Spio setosa											
Spiochaetopterus oculatus						1			1		
Spiophanes bombyx						1				1	
Spirorbis spp											
Syllides sp											

Species	T1-1rep1	T1-1rep2	T1-1rep3	T1-2rep1	T1-2rep2	T1-2rep3	T1-3rep1	T1-3rep2	T1-3rep3	T1-4rep1	T1-4rep2
Travisia carnea											
Typosyllis coronuta											
OTHER (PHYLUM: sp(p)**)**											
CHORDATA: *Gobiosoma bosci*											
COPEPODA: Harpacticoid spp	1		1	1		1	1				
NEMERTEA: *Cerebratulus lacteus*									1		
NEMERTEA: Nemertea spp	1			1						1	1
NEMATODA: Nematoda spp	42	2	18	9		22	4	18	2	11	5
Number of Species	**25**	**6**	**15**	**18**	**14**	**23**	**8**	**16**	**24**	**26**	**17**
Total Number of Organisms	**96**	**7**	**45**	**40**	**53**	**122**	**31**	**74**	**398**	**128**	**56**

Species List Year 1 (Winter 2016-2017) of Vessel-Based Grab Samples (continued)

Species	T1-4rep3	T1-5rep1	T1-5rep2	T1-5rep3	T1-6rep1	T1-6rep2	T1-6rep3	T1-7rep1	T1-7rep2	T1-7rep3	T1-8rep1
ACTINIARIA											
Actinaria spp											
ARTHROPOPDA											
Amphipoda											
Ampelisca vadorum											
Aeginina longicornis											
Byblis serrata			1								
Caprella equilibra					1						
Caprella penantis											
Caprella unica											
Corophium spp											
Dulchia sp											
Erichthonius rubricornis					1	1			1		
Gammaropsis maculata											
Hippomedon serratus											
Ischyrocerus anguipes											
Jassa marmorata											
Lembos websteri											
Leptocheirus pinguis											
Luconacia incerta					2						
Melita dentata											
Microdeutopus anomalus											
Monoculodes sp											
Parametopella cypris			1		3						
Phoxocephalus holbolli											
Pleustidae sp											
Pontogenia inermis											
Proboloides holmesi											
Protohaustorius wigleyi					1						
Psammonyx nobilis											
Pseudunciola obliquua					1	1					
Rhepoxynuis epistomus				1	2		1	1	1		1

Species	T1-4rep3	T1-5rep1	T1-5rep2	T1-5rep3	T1-6rep1	T1-6rep2	T1-6rep3	T1-7rep1	T1-7rep2	T1-7rep3	T1-8rep1
Siphonoecetes smithianus											
Stenopleustes gracilis											
Stenothoe minuta											
Unciola irrorata	9	11	2	1				1		5	11
Cumacea											
Diastylis sp											
Pseudoleptocuma minor											
Decapoda											
Cancer borealis											
Cancer sp juv. ?*irroratus*											
Crangon septemspinosa											
Pagurus annulipes											
Isopoda											
Chiridotea sp *caeca*								1			
Chiridotea tuftsi					1						
Edotea triloba							1				
Erichsonella filiformis											
Politolana polita											
Pycnogonida											
Nymphon stromi											
Sessilia											
Balanus amphitrite										10	
Tanaidacea											
Leptochelia savignyi											
Tanaissus psammophilus			1		1	1	1				
ECHINODERMATA											
Asteroidea											
Asterias spp											

Species	T1-4rep3	T1-5rep1	T1-5rep2	T1-5rep3	T1-6rep1	T1-6rep2	T1-6rep3	T1-7rep1	T1-7rep2	T1-7rep3	T1-8rep1
Echinoidea											
Echinarachnius parma											
Holothuroidea											
Cucumaria sp											
Ophiuroidea											
Axiognathus squamatus											
MOLLUSKA											
Bivalvia											
Anadera transversa											
Anomia spp (juveniles)											
Astarte borealis					2	1					
Astarte castanea				1							
Cerastoderma pinnulatum		1									
Crassinella mactracea											
Crenella decussata											
Cyclocardia borealis											
Ensis directus											
Lyonsia arenosa		2		4							
Lyonsia hyalina											
Mytilus edulis					3						
Nucula tenuis											
Pandora gouldiana											
Spisula solidissima					3	1					
Tellina agilis		1	2					1			
Gastropoda											
Crepidula fornicata											
Crepidula plana											
Euspira heros											
Euspira triseriata											
Ilyanassa trivittata											

Species	T1-4rep3	T1-5rep1	T1-5rep2	T1-5rep3	T1-6rep1	T1-6rep2	T1-6rep3	T1-7rep1	T1-7rep2	T1-7rep3	T1-8rep1
Retusa obtusa											
Turbonilla sp											
Polyplacophora											
Chaetopleura apiculata											
ANNELIDA											
Oligochaeta											
Oligochaeta spp						1					
Polychaeta											
Ampharete arctica											
Aricidea catherinae		4		2							
Asabellides oculata		1									
Asychis elongata											
Autolytus prolifer											
Cirrophorus sp	2	5		1	1		1				
Dipolydora sp											
Dodecaceria coralii											
Drilonereis magna					1	1		1			
Ephesiella minuta											
Eumida sanguinea										1	
Exogone hebes		1	1	2	1						
Exogone naidina											
Glycera americana											
Glycera dibranchiata											
Goniadella gracilis		10	6	20	1	5	1	7		2	9
Harmothoe sp											
Lepidonotus squamatus											
Lumbrinereis acuta	3	2		23	2	4		1			1
Lumbrinereis fragilis		2		3	1	1	1				
Maldanidae spp	1	13		2	2			1		1	1
Marphysa bellii		1		1							
Megalona sp		2									
Microphthalmus sckelkowii											

Species	T1-4rep3	T1-5rep1	T1-5rep2	T1-5rep3	T1-6rep1	T1-6rep2	T1-6rep3	T1-7rep1	T1-7rep2	T1-7rep3	T1-8rep1
Monticellina baptisteae	1	3		2	1	3	2	1	1		2
Mystides sp											
Nephtys bucera	3	4	1	1	1	2	2	1			1
Nephtys ciliata											
Nereis arenaceodonta											
Nereis zonata											
Odontosyllis fulgurans		1	1								
Ophelia denticulata											
Ophioglycera gigantea											
Owenia fusiformis											
Paranaitis speciosa											
Paraonis sp		1									
Parapionosyllis longicirrata	1	2	4	2	1						
Parougia caeca		1									
Phyllodoce arenae											
Phyllodoce maculata											
Pisione sp		6									
*Pista*sp (juveniles)											
Polycirrus eximius		1	1								
Polydora sp											3
*Polygordius*spp	4	14	16		1			3		1	5
Potamilla reniformis											
Proceraea ?fasciata											
Sabellaria vulgaris	14	1	2							24	1
Scalibregma inflatum											
Sigalion arenicola		1			1	1					1
Sphaerosyllis erinaceus		3	1	1					1		
Spio setosa											
Spiochaetopterus oculatus			1			1					
Spiophanes bombyx		1			1						
Spirorbis spp											
Syllides sp											
Travisia carnea											
Typosyllis coronuta											

Species	T1-4rep3	T1-5rep1	T1-5rep2	T1-5rep3	T1-6rep1	T1-6rep2	T1-6rep3	T1-7rep1	T1-7rep2	T1-7rep3	T1-8rep1
OTHER (PHYLUM: sp(p)**)**											
CHORDATA: *Gobiosoma bosci*											
COPEPODA: Harpacticoid spp	2			2	1				2		1
NEMERTEA: *Cerebratulus lacteus*											
NEMERTEA: Nemertea spp		7		1							
NEMATODA: Nematoda spp	4	15	13	18	8	2	4	3	8	3	7
Number of Species	**11**	**29**	**16**	**19**	**27**	**15**	**9**	**12**	**6**	**8**	**13**
Total Number of Organisms	**44**	**117**	**54**	**88**	**45**	**26**	**14**	**22**	**14**	**47**	**44**

Species List Year 1 (Winter 2016-2017) of Vessel-Based Grab Samples (continued)

Species	T1-8rep2	T1-8rep3	T1-9rep1	T1-9rep2	T1-9rep3	T3-1rep1	T3-1rep2	T3-1rep3	T3-2rep1	T3-2rep2	T3-2rep3
ACTINIARIA											
Actinaria spp									1		
ARTHROPOPDA											
Amphipoda											
Ampelisca vadorum			1	1							
Aeginina longicornis											
Byblis serrata											
Caprella equilibra											
Caprella penantis											
Caprella unica											
Corophium spp				1							
Dulchia sp											
Erichthonius rubricornis											
Gammaropsis maculata											
Hippomedon serratus											
Ischyrocerus anguipes											
Jassa marmorata											
Lembos websteri											
Leptocheirus pinguis											
Luconacia incerta											
Melita dentata											
Microdeutopus anomalus											
Monoculodes sp											
Parametopella cypris											
Phoxocephalus holbolli											
Pleustidae sp											
Pontogenia inermis											
Proboloides holmesi											
Protohaustorius wigleyi											
Psammonyx nobilis											
Pseudunciola obliquua											

Species	T1-8rep2	T1-8rep3	T1-9rep1	T1-9rep2	T1-9rep3	T3-1rep1	T3-1rep2	T3-1rep3	T3-2rep1	T3-2rep2	T3-2rep3
Rhepoxynuis epistomus					1						
Siphonoecetes smithianus											
Stenopleustes gracilis											
Stenothoe minuta											
Unciola irrorata	3	9	2	21	3	3			1	2	
Cumacea											
Diastylis sp											
Pseudoleptocuma minor											
Decapoda											
Cancer borealis											
Cancer sp juv. ?*irroratus*											
Crangon septemspinosa											
Pagurus annulipes											
Isopoda											
Chiridotea sp *caeca*			1					1			
Chiridotea tuftsi											
Edotea triloba		2				1					
Erichsonella filiformis											
Politolana polita					1	1					2
Pycnogonida											
Nymphon stromi											
Sessilia											
Balanus amphitrite								1			
Tanaidacea											
Leptochelia savignyi											
Tanaissus psammophilus	2			1	1						

Species	T1-8rep2	T1-8rep3	T1-9rep1	T1-9rep2	T1-9rep3	T3-1rep1	T3-1rep2	T3-1rep3	T3-2rep1	T3-2rep2	T3-2rep3
ECHINODERMATA											
Asteroidea											
Asterias spp											
Echinoidea											
Echinarachnius parma											
Holothuroidea											
Cucumaria sp											
Ophiuroidea											
Axiognathus squamatus											
MOLLUSKA											
Bivalvia											
Anadera transversa											
Anomia spp (juveniles)											
Astarte borealis										1	
Astarte castanea							1				
Cerastoderma pinnulatum											
Crassinella mactracea											
Crenella decussata											
Cyclocardia borealis											
Ensis directus											
Lyonsia arenosa		1	1		1		2	1	1	2	1
Lyonsia hyalina											
Mytilus edulis				1				1	1		3
Nucula tenuis											
Pandora gouldiana											
Spisula solidissima		1				2	1	1	1	2	
Tellina agilis		1		1	1						
Gastropoda											
Crepidula fornicata			1			1		2			

Species	T1-8rep2	T1-8rep3	T1-9rep1	T1-9rep2	T1-9rep3	T3-1rep1	T3-1rep2	T3-1rep3	T3-2rep1	T3-2rep2	T3-2rep3
Crepidula plana											
Euspira heros											
Euspira triseriata											
Ilyanassa trivittata											
Retusa obtusa											
Turbonilla sp											
Polyplacophora											
Chaetopleura apiculata											
ANNELIDA											
Oligochaeta											
Oligochaeta spp					1		2			1	
Polychaeta											
Ampharete arctica											
Aricidea catherinae		4	4	3	1	2	3	12		12	7
Asabellides oculata											
Asychis elongata											
Autolytus prolifer											
Cirrophorus sp			5	2		7	4	1	8	14	1
Dipolydora sp											
Dodecaceria coralii											
Drilonereis magna											
Ephesiella minuta											
Eumida sanguinea				1			2			2	
Exogone hebes		2			2						
Exogone naidina											
Glycera americana						1					
Glycera dibranchiata											
Goniadella gracilis		9	10	7	1	14	7	9	12	11	5
Harmothoe sp											
Lepidonotus squamatus											
Lumbrinereis acuta		6	18	3	6	21	27	18	15	23	29

Species	T1-8rep2	T1-8rep3	T1-9rep1	T1-9rep2	T1-9rep3	T3-1rep1	T3-1rep2	T3-1rep3	T3-2rep1	T3-2rep2	T3-2rep3
Lumbrinereis fragilis		1	3			4	3	2			4
Maldanidae spp			8	1	4	3	2	4		6	3
Marphysa bellii						3	1	1			1
Megalona sp				1	1						
Microphthalmus sckelkowii						3	2				
Monticellina baptisteae		2	2	2	2		1	3	3	2	3
Mystides sp									2		
Nephtys bucera	1		1	3	2						
Nephtys ciliata											
Nereis arenaceodonta											
Nereis zonata											
Odontosyllis fulgurans			1			1	1		1	2	3
Ophelia denticulata											
Ophioglycera gigantea											
Owenia fusiformis											
Paranaitis speciosa											
Paraonis sp			2	1	1						
Parapionosyllis longicirrata		3	2	3	5	2	4		5	8	6
Parougia caeca						3	5		2	6	8
Phyllodoce arenae											
Phyllodoce maculata											
Pisione sp		1		5		29	13	115	29	30	21
*Pista*sp (juveniles)											
Polycirrus eximius				1		4	5	12	13	20	40
Polydora sp											
*Polygordius*spp	5	8	18	12	31	21	25	27	15	8	1
Potamilla reniformis											
Proceraea ?fasciata											
Sabellaria vulgaris		1	3	26							
Scalibregma inflatum											
Sigalion arenicola									2		2
Sphaerosyllis erinaceus			3	1	9	3	2			6	6
Spio setosa											1
Spiochaetopterus oculatus			1								

Species	T1-8rep2	T1-8rep3	T1-9rep1	T1-9rep2	T1-9rep3	T3-1rep1	T3-1rep2	T3-1rep3	T3-2rep1	T3-2rep2	T3-2rep3
Spiophanes bombyx											
Spirorbis spp											
Syllides sp		1	1								
Travisia carnea											
Typosyllis coronuta											
OTHER (PHYLUM: sp(p)**)**											
CHORDATA: *Gobiosoma bosci*											
COPEPODA: Harpacticoid spp				1	1		1			6	
NEMERTEA: *Cerebratulus lacteus*										1	
NEMERTEA: Nemertea spp			2	2	1		2	1	2	1	1
NEMATODA: Nematoda spp	2	12	10	5	15	43	88	62	73	58	50
Number of Species	**5**	**17**	**23**	**25**	**22**	**22**	**24**	**19**	**19**	**23**	**22**
Total Number of Organisms	**13**	**64**	**100**	**106**	**91**	**172**	**204**	**274**	**187**	**224**	**198**

Species List Year 1 (Winter 2016-2017) of Vessel-Based Grab Samples (continued)

Species	T3-4rep1	T3-4rep2	T3-4rep3	T3-5rep1	T3-5rep2	T3-5rep3	T3-6rep1	T3-6rep2	T3-6rep3	T3-7rep1	T3-7rep2
ACTINIARIA											
Actinaria spp								1			
ARTHROPOPDA											
Amphipoda											
Ampelisca vadorum											
Aeginina longicornis											
Byblis serrata											
Caprella equilibra											
Caprella penantis											
Caprella unica											
Corophium spp											
Dulchia sp											
Erichthonius rubricornis											
Gammaropsis maculata											
Hippomedon serratus											
Ischyrocerus anguipes											
Jassa marmorata											
Lembos websteri											
Leptocheirus pinguis											
Luconacia incerta											
Melita dentata											
Microdeutopus anomalus											
Monoculodes sp											
Parametopella cypris											
Phoxocephalus holbolli											
Pleustidae sp											
Pontogenia inermis											
Proboloides holmesi											
Protohaustorius wigleyi											
Psammonyx nobilis						1					
Pseudunciola obliquua											
Rhepoxynuis epistomus											
Siphonoecetes smithianus							1				
Stenopleustes gracilis											
Stenothoe minuta											

Species	T3-4rep1	T3-4rep2	T3-4rep3	T3-5rep1	T3-5rep2	T3-5rep3	T3-6rep1	T3-6rep2	T3-6rep3	T3-7rep1	T3-7rep2
Unciola irrorata	6	1	10	7	5	1	1	6	2	8	1
Cumacea											
Diastylis sp											
Pseudoleptocuma minor											
Decapoda											
Cancer borealis											
Cancer sp juv. ?*irroratus*											
Crangon septemspinosa											
Pagurus annulipes											
Isopoda											
Chiridotea sp *caeca*		1			1	3	1		3	1	1
Chiridotea tuftsi											
Edotea triloba											
Erichsonella filiformis											
Politolana polita											
Pycnogonida											
Nymphon stromi											
Sessilia											
Balanus amphitrite											
Tanaidacea											
Leptochelia savignyi											
Tanaissus psammophilus							1			1	
ECHINODERMATA											
Asteroidea											
Asterias spp											
Echinoidea											
Echinarachnius parma				1							
Holothuroidea											
Cucumaria sp									1		

Species	T3-4rep1	T3-4rep2	T3-4rep3	T3-5rep1	T3-5rep2	T3-5rep3	T3-6rep1	T3-6rep2	T3-6rep3	T3-7rep1	T3-7rep2
Ophiuroidea											
Axiognathus squamatus											
MOLLUSKA											
Bivalvia											
Anadera transversa											
Anomia spp (juveniles)											
Astarte borealis			1								
Astarte castanea									1		
Cerastoderma pinnulatum					1						
Crassinella mactracea											
Crenella decussata											
Cyclocardia borealis											
Ensis directus											
Lyonsia arenosa		2		1	2		1				2
Lyonsia hyalina											
Mytilus edulis											1
Nucula tenuis											
Pandora gouldiana											
Spisula solidissima											
Tellina agilis								1			2
Gastropoda											
Crepidula fornicata									1		
Crepidula plana											
Euspira heros								1			
Euspira triseriata											
Ilyanassa trivittata											
Retusa obtusa											
Turbonilla sp		1									
Polyplacophora											
Chaetopleura apiculata											
ANNELIDA											
Oligochaeta											
Oligochaeta spp	2						2	1			1

Species	T3-4rep1	T3-4rep2	T3-4rep3	T3-5rep1	T3-5rep2	T3-5rep3	T3-6rep1	T3-6rep2	T3-6rep3	T3-7rep1	T3-7rep2
Polychaeta											
Ampharete arctica											
Aricidea catherinae	4	7	2	2	5	3	4	14	26	6	5
Asabellides oculata											
Asychis elongata											
Autolytus prolifer											
Cirrophorus sp	3	3	7	1	2	9	3	5	5	6	17
Dipolydora sp											
Dodecaceria coralii											
Drilonereis magna							1				
Ephesiella minuta											
Eumida sanguinea				1				1		3	1
Exogone hebes						1					
Exogone naidina											
Glycera americana											
Glycera dibranchiata	1										
Goniadella gracilis	5	5	3	3	2	16	10	2	4		3
Harmothoe sp											
Lepidonotus squamatus											
Lumbrinereis acuta	9	31	7		4	8	16	18	34	6	5
Lumbrinereis fragilis	2	1		1				2	1		
Maldanidae spp	12	4	4	3	2	10	3	14	6		4
Marphysa bellii				1					1		
Megalona sp											
Microphthalmus sckelkowii											
Monticellina baptisteae			2		4	1		4	2		1
Mystides sp					1			4	1		1
Nephtys bucera											
Nephtys ciliata											
Nereis arenaceodonta											
Nereis zonata											
Odontosyllis fulgurans	1				2			12	3	1	8
Ophelia denticulata											
Ophioglycera gigantea											
Owenia fusiformis					1						
Paranaitis speciosa											
Paraonis sp						1			1		

Species	T3-4rep1	T3-4rep2	T3-4rep3	T3-5rep1	T3-5rep2	T3-5rep3	T3-6rep1	T3-6rep2	T3-6rep3	T3-7rep1	T3-7rep2
Parapionosyllis longicirrata	3	1	5	2	1	1		13	2		6
Parougia caeca				1	1			4	3		4
Phyllodoce arenae											
Phyllodoce maculata											
Pisione sp	18	15	9	5	2	23	32	23	37	3	24
*Pista*sp (juveniles)											
Polycirrus eximius	40	23	21	57	1	36	5	24	48	140	51
Polydora sp							2	7	2		
*Polygordius*spp	14	5	14	12	17	10	10	24	36	11	19
Potamilla reniformis											
Proceraea ?fasciata											
Sabellaria vulgaris											
Scalibregma inflatum			1								
Sigalion arenicola	1			3		2	2	1	1		1
Sphaerosyllis erinaceus			1		1	1		15	2		8
Spio setosa								2			
Spiochaetopterus oculatus				1							
Spiophanes bombyx											
Spirorbis spp											
Syllides sp				1							
Travisia carnea								2			
Typosyllis coronuta											
OTHER (PHYLUM: sp(p)**)**											
CHORDATA: *Gobiosoma bosci*											
COPEPODA: Harpacticoid spp				1	1			2			6
NEMERTEA: *Cerebratulus lacteus*		2					2			1	
NEMERTEA: Nemertea spp	2		1			2		2	2	2	
NEMATODA: Nematoda spp	8	8	20	16	6	18	10	66	123	3	106
Number of Species	**17**	**16**	**16**	**20**	**21**	**19**	**19**	**28**	**26**	**14**	**24**
Total Number of Organisms	**131**	**110**	**108**	**120**	**62**	**147**	**107**	**271**	**348**	**192**	**278**

Species List Year 1 (Winter 2016-2017) of Vessel-Based Grab Samples (continued)

Species	T3-7rep3	T3-8rep1	T3-8rep2	T3-8rep3	T3-9rep1	T3-9rep2	T3-9rep3	T5-1rep1	T5-1rep2	T5-1rep3	T5-2rep1
ACTINIARIA											
Actinaria spp			2								
ARTHROPOPDA											
Amphipoda											
Ampelisca vadorum										1	
Aeginina longicornis											
Byblis serrata										1	
Caprella equilibra											
Caprella penantis											
Caprella unica											
Corophium spp											
Dulchia sp											
Erichthonius rubricornis											
Gammaropsis maculata											
Hippomedon serratus											
Ischyrocerus anguipes											
Jassa marmorata									1		
Lembos websteri											
Leptocheirus pinguis											
Luconacia incerta											
Melita dentata											
Microdeutopus anomalus											
Monoculodes sp				1							
Parametopella cypris											
Phoxocephalus holbolli						1					
Pleustidae sp											
Pontogenia inermis											
Proboloides holmesi											
Protohaustorius wigleyi											
Psammonyx nobilis											
Pseudunciola obliquua											
Rhepoxynuis epistomus											
Siphonoecetes smithianus											
Stenopleustes gracilis											
Stenothoe minuta											

Species	T3-7rep3	T3-8rep1	T3-8rep2	T3-8rep3	T3-9rep1	T3-9rep2	T3-9rep3	T5-1rep1	T5-1rep2	T5-1rep3	T5-2rep1
Unciola irrorata	2	4		19		9	3	2	2	1	
Cumacea											
Diastylis sp											
Pseudoleptocuma minor											
Decapoda											
Cancer borealis											
Cancer sp juv. ?*irroratus*											
Crangon septemspinosa											
Pagurus annulipes											
Isopoda											
Chiridotea sp *caeca*	3	1	1	1	4	1	1			1	2
Chiridotea tuftsi											
Edotea triloba											
Erichsonella filiformis											
Politolana polita											
Pycnogonida											
Nymphon stromi											
Sessilia											
Balanus amphitrite		1									
Tanaidacea											
Leptochelia savignyi											
Tanaissus psammophilus											
ECHINODERMATA											
Asteroidea											
Asterias spp											
Echinoidea											
Echinarachnius parma											
Holothuroidea											
Cucumaria sp											

Species	T3-7rep3	T3-8rep1	T3-8rep2	T3-8rep3	T3-9rep1	T3-9rep2	T3-9rep3	T5-1rep1	T5-1rep2	T5-1rep3	T5-2rep1
Ophiuroidea											
Axiognathus squamatus											
MOLLUSKA											
Bivalvia											
Anadera transversa											
Anomia spp (juveniles)											
Astarte borealis			1			1					
Astarte castanea									2	4	
Cerastoderma pinnulatum											
Crassinella mactracea											
Crenella decussata											
Cyclocardia borealis											
Ensis directus											
Lyonsia arenosa	2	1	2	2			4		1	1	
Lyonsia hyalina											
Mytilus edulis		1						2			
Nucula tenuis											
Pandora gouldiana											
Spisula solidissima	1	1	1		2						1
Tellina agilis				1							
Gastropoda											
Crepidula fornicata											
Crepidula plana											
Euspira heros								1		1	
Euspira triseriata											
Ilyanassa trivittata		2									
Retusa obtusa											
Turbonilla sp											
Polyplacophora											
Chaetopleura apiculata											
ANNELIDA											
Oligochaeta											
Oligochaeta spp	1		1								

Species	T3-7rep3	T3-8rep1	T3-8rep2	T3-8rep3	T3-9rep1	T3-9rep2	T3-9rep3	T5-1rep1	T5-1rep2	T5-1rep3	T5-2rep1
Polychaeta											
Ampharete arctica											
Aricidea catherinae	6	5	8	5		5		1			2
Asabellides oculata											
Asychis elongata											
Autolytus prolifer											
Cirrophorus sp	16	5	14	15	1	7	4	2	3	1	3
Dipolydora sp											
Dodecaceria coralii											
Drilonereis magna											
Ephesiella minuta											
Eumida sanguinea			1			1	1	3	3	4	
Exogone hebes							1				
Exogone naidina											
Glycera americana										1	
Glycera dibranchiata											
Goniadella gracilis	3	3	6	7	12	6	5	7			7
Harmothoe sp											
Lepidonotus squamatus											
Lumbrinereis acuta	23	10	33	17	15	15	26	15	17	1	24
Lumbrinereis fragilis		2	5	1		1	1		3	3	1
Maldanidae spp	6	4	11	7		8	1	1			1
Marphysa bellii											
Megalona sp											
Microphthalmus sckelkowii				1							
Monticellina baptisteae	2			1	2	2					1
Mystides sp	1							1	1		1
Nephtys bucera											
Nephtys ciliata											
Nereis arenaceodonta										1	
Nereis zonata											
Odontosyllis fulgurans	2		1	4							
Ophelia denticulata											
Ophioglycera gigantea											
Owenia fusiformis	1										
Paranaitis speciosa											
Paraonis sp				1							

Species	T3-7rep3	T3-8rep1	T3-8rep2	T3-8rep3	T3-9rep1	T3-9rep2	T3-9rep3	T5-1rep1	T5-1rep2	T5-1rep3	T5-2rep1
Parapionosyllis longicirrata	11	4	8	5	2	1		1	2		3
Parougia caeca	3	3	3	1	2				2	6	
Phyllodoce arenae		1									
Phyllodoce maculata											
Pisione sp	21	27	46	20	10	8	11	19	15		8
*Pista*sp (juveniles)								1			
Polycirrus eximius	34	35	40	44	6	56	33	18	30	1	21
Polydora sp											
*Polygordius*spp	36	5	45	19	11	7	6	15	105	312	20
Potamilla reniformis											
Proceraea ?fasciata											
Sabellaria vulgaris		4						1			
Scalibregma inflatum				1			1				
Sigalion arenicola	3		2			3	2	1	1		4
Sphaerosyllis erinaceus	1			3							
Spio setosa											
Spiochaetopterus oculatus											
Spiophanes bombyx											
Spirorbis spp											
Syllides sp	1										
Travisia carnea				1					1	1	
Typosyllis coronuta								1			1
OTHER (PHYLUM: sp(p)**)**											
CHORDATA: *Gobiosoma bosci*											
COPEPODA: Harpacticoid spp			1			1	1				1
NEMERTEA: *Cerebratulus lacteus*	1		1			1					
NEMERTEA: Nemertea spp	3	2					4			1	
NEMATODA: Nematoda spp	38	87	128	56	19	17	6	30	24	42	60
Number of Species	**25**	**22**	**23**	**24**	**12**	**20**	**18**	**19**	**17**	**19**	**18**
Total Number of Organisms	**221**	**208**	**361**	**233**	**86**	**151**	**111**	**122**	**213**	**384**	**161**

Species List Year 1 (Winter 2016-2017) of Vessel-Based Grab Samples (continued)

Species	T5-2rep2	T5-2rep3	T5-3rep1	T5-3rep2	T5-3rep3	T5-4rep1	T5-4rep2	T5-4rep3	T5-5rep1	T5-5rep2	T5-5rep3
ACTINIARIA											
Actinaria spp					1						
ARTHROPOPDA											
Amphipoda											
Ampelisca vadorum											
Aeginina longicornis											
Byblis serrata											1
Caprella equilibra											
Caprella penantis											
Caprella unica											
Corophium spp											
Dulchia sp											
Erichthonius rubricornis											
Gammaropsis maculata											
Hippomedon serratus									1		1
Ischyrocerus anguipes											
Jassa marmorata											
Lembos websteri											
Leptocheirus pinguis											
Luconacia incerta											
Melita dentata											
Microdeutopus anomalus											
Monoculodes sp		1				1		1	1		
Parametopella cypris											
Phoxocephalus holbolli											
Pleustidae sp											
Pontogenia inermis											
Proboloides holmesi											
Protohaustorius wigleyi											
Psammonyx nobilis											
Pseudunciola obliquua						7	6		1		1
Rhepoxynuis epistomus						2	3		2	1	3
Siphonoecetes smithianus											
Stenopleustes gracilis											
Stenothoe minuta											

Species	T5-2rep2	T5-2rep3	T5-3rep1	T5-3rep2	T5-3rep3	T5-4rep1	T5-4rep2	T5-4rep3	T5-5rep1	T5-5rep2	T5-5rep3
Unciola irrorata		1									
Cumacea											
Diastylis sp											
Pseudoleptocuma minor	1										
Decapoda											
Cancer borealis											
Cancer sp juv. ?*irroratus*											
Crangon septemspinosa											
Pagurus annulipes											
Isopoda											
Chiridotea sp *caeca*	3	2				1	1	1		1	
Chiridotea tuftsi											
Edotea triloba											1
Erichsonella filiformis											
Politolana polita	1						1		1	2	
Pycnogonida											
Nymphon stromi											
Sessilia											
Balanus amphitrite											
Tanaidacea											
Leptochelia savignyi											
Tanaissus psammophilus		1				20	15	1	1	3	5
ECHINODERMATA											
Asteroidea											
Asterias spp											
Echinoidea											
Echinarachnius parma						1					
Holothuroidea											
Cucumaria sp											

Species	T5-2rep2	T5-2rep3	T5-3rep1	T5-3rep2	T5-3rep3	T5-4rep1	T5-4rep2	T5-4rep3	T5-5rep1	T5-5rep2	T5-5rep3
Ophiuroidea											
Axiognathus squamatus											
MOLLUSKA											
Bivalvia											
Anadera transversa											
Anomia spp (juveniles)											
Astarte borealis							2				
Astarte castanea	1								2	1	
Cerastoderma pinnulatum											
Crassinella mactracea											
Crenella decussata											
Cyclocardia borealis											
Ensis directus											
Lyonsia arenosa						2			1		
Lyonsia hyalina											
Mytilus edulis			1		2						
Nucula tenuis											
Pandora gouldiana											
Spisula solidissima	1	1				5	1	1			
Tellina agilis											2
Gastropoda											
Crepidula fornicata											
Crepidula plana											
Euspira heros											
Euspira triseriata											
Ilyanassa trivittata											
Retusa obtusa											
Turbonilla sp											
Polyplacophora											
Chaetopleura apiculata											
ANNELIDA											
Oligochaeta											
Oligochaeta spp											

Species	T5-2rep2	T5-2rep3	T5-3rep1	T5-3rep2	T5-3rep3	T5-4rep1	T5-4rep2	T5-4rep3	T5-5rep1	T5-5rep2	T5-5rep3
Polychaeta											
Ampharete arctica						1					
Aricidea catherinae					16						
Asabellides oculata										1	
Asychis elongata											
Autolytus prolifer											
Cirrophorus sp		3		2	6	1		1	1	1	
Dipolydora sp											
Dodecaceria coralii											
Drilonereis magna											
Ephesiella minuta											
Eumida sanguinea				1	4						
Exogone hebes											
Exogone naidina											
Glycera americana	1								1		
Glycera dibranchiata											
Goniadella gracilis	13	6	2	1	18	7	4	8	11	5	3
Harmothoe sp											
Lepidonotus squamatus											
Lumbrinereis acuta	26	28	6	16	61	4	4	14	8	2	
Lumbrinereis fragilis		1		4	11	1		2			
Maldanidae spp			1	1	1	6	2	3	1	1	1
Marphysa bellii					6						
Megalona sp	1								1		
Microphthalmus sckelkowii											
Monticellina baptisteae	1	2				1	1		2	1	
Mystides sp	1		1	1	2	2			1		1
Nephtys bucera						3	1		1	1	1
Nephtys ciliata											
Nereis arenaceodonta											
Nereis zonata											
Odontosyllis fulgurans											
Ophelia denticulata					2						
Ophioglycera gigantea											
Owenia fusiformis			1			1					
Paranaitis speciosa											
Paraonis sp							1				

Species	T5-2rep2	T5-2rep3	T5-3rep1	T5-3rep2	T5-3rep3	T5-4rep1	T5-4rep2	T5-4rep3	T5-5rep1	T5-5rep2	T5-5rep3
Parapionosyllis longicirrata	3	3			14	3	1		3	2	1
Parougia caeca	2				6	1					1
Phyllodoce arenae											
Phyllodoce maculata											
Pisione sp	22	3	3	24	43	3	1	9	6	2	1
*Pista*sp (juveniles)											
Polycirrus eximius	3	3	6	37	98	2			4	1	
Polydora sp											
*Polygordius*spp	20	18	6	3	15	3	2	3	4	2	2
Potamilla reniformis											
Proceraea ?fasciata											
Sabellaria vulgaris											
Scalibregma inflatum											
Sigalion arenicola							1			1	
Sphaerosyllis erinaceus										1	
Spio setosa											
Spiochaetopterus oculatus											
Spiophanes bombyx					1						
Spirorbis spp											
Syllides sp						2					1
Travisia carnea				2							
Typosyllis coronuta	1		1							1	
OTHER (PHYLUM: sp(p)**)**											
CHORDATA: *Gobiosoma bosci*											
COPEPODA: Harpacticoid spp			1								
NEMERTEA: *Cerebratulus lacteus*	1										
NEMERTEA: Nemertea spp	1					1	2	1		1	
NEMATODA: Nematoda spp	140	86	6	10	55	96	80	16	72	36	60
Number of Species	**20**	**15**	**12**	**12**	**19**	**26**	**19**	**13**	**22**	**21**	**17**
Total Number of Organisms	**243**	**159**	**35**	**102**	**362**	**177**	**129**	**61**	**126**	**67**	**86**

Species List Year 1 (Winter 2016-2017) of Vessel-Based Grab Samples (continued)

Species	T5-6rep1	T5-6rep2	T5-6rep3	T5-7rep1	T5-7rep2	T5-7rep3	T5-8rep1	T5-8rep2	T5-8rep3	T5-9rep1	T5-9rep2
ACTINIARIA											
Actinaria spp											
ARTHROPOPDA											
Amphipoda											
Ampelisca vadorum											
Aeginina longicornis											
Byblis serrata											
Caprella equilibra				6							
Caprella penantis											
Caprella unica				1							
Corophium spp		1		7							
Dulchia sp											
Erichthonius rubricornis		7		31							
Gammaropsis maculata		5		33							1
Hippomedon serratus											
Ischyrocerus anguipes											
Jassa marmorata		4		5		5			3		
Lembos websteri											
Leptocheirus pinguis											
Luconacia incerta				1							
Melita dentata											
Microdeutopus anomalus											
Monoculodes sp						1					
Parametopella cypris											
Phoxocephalus holbolli											
Pleustidae sp											
Pontogenia inermis				2							
Proboloides holmesi											1
Protohaustorius wigleyi											
Psammonyx nobilis											
Pseudunciola obliquua											
Rhepoxynuis epistomus											
Siphonoecetes smithianus											
Stenopleustes gracilis											
Stenothoe minuta											

Species	T5-6rep1	T5-6rep2	T5-6rep3	T5-7rep1	T5-7rep2	T5-7rep3	T5-8rep1	T5-8rep2	T5-8rep3	T5-9rep1	T5-9rep2
Unciola irrorata											
Cumacea											
Diastylis sp											
Pseudoleptocuma minor											
Decapoda											
Cancer borealis											
Cancer sp juv. ?*irroratus*											
Crangon septemspinosa										1	
Pagurus annulipes											
Isopoda											
Chiridotea sp *caeca*	1	2			4	2	2				1
Chiridotea tuftsi											
Edotea triloba				1							
Erichsonella filiformis											
Politolana polita		1									
Pycnogonida											
Nymphon stromi											
Sessilia											
Balanus amphitrite				8							
Tanaidacea											
Leptochelia savignyi											
Tanaissus psammophilus											
ECHINODERMATA											
Asteroidea											
Asterias spp					1						
Echinoidea											
Echinarachnius parma											
Holothuroidea											
Cucumaria sp											

Species	T5-6rep1	T5-6rep2	T5-6rep3	T5-7rep1	T5-7rep2	T5-7rep3	T5-8rep1	T5-8rep2	T5-8rep3	T5-9rep1	T5-9rep2
Ophiuroidea											
Axiognathus squamatus											
MOLLUSKA											
Bivalvia											
Anadera transversa				2							
Anomia spp (juveniles)				3							
Astarte borealis											
Astarte castanea		3	1	1	3					4	8
Cerastoderma pinnulatum											
Crassinella mactracea		1									
Crenella decussata											
Cyclocardia borealis											
Ensis directus											
Lyonsia arenosa		1									
Lyonsia hyalina											
Mytilus edulis			2	4			1		4	1	
Nucula tenuis							3				
Pandora gouldiana											
Spisula solidissima		1				1					
Tellina agilis											
Gastropoda											
Crepidula fornicata											
Crepidula plana									1		
Euspira heros											
Euspira triseriata											
Ilyanassa trivittata											
Retusa obtusa											
Turbonilla sp											
Polyplacophora											
Chaetopleura apiculata											
ANNELIDA											
Oligochaeta											
Oligochaeta spp											

Species	T5-6rep1	T5-6rep2	T5-6rep3	T5-7rep1	T5-7rep2	T5-7rep3	T5-8rep1	T5-8rep2	T5-8rep3	T5-9rep1	T5-9rep2
Polychaeta											
Ampharete arctica											
Aricidea catherinae					1						1
Asabellides oculata											
Asychis elongata											
Autolytus prolifer											
Cirrophorus sp	1		2		3					4	2
Dipolydora sp											
Dodecaceria coralii	1										
Drilonereis magna											
Ephesiella minuta											
Eumida sanguinea		2			7	1	2		1	2	7
Exogone hebes											
Exogone naidina											
Glycera americana											
Glycera dibranchiata											
Goniadella gracilis	8	3	11	1	3	2	2	1		4	6
Harmothoe sp											
Lepidonotus squamatus											
Lumbrinereis acuta	23		16		18	7	14	7	1	11	29
Lumbrinereis fragilis	2	1					1			1	
Maldanidae spp											
Marphysa bellii											
Megalona sp											
Microphthalmus sckelkowii			1								
Monticellina baptisteae	1				3						1
Mystides sp	1	4	3			1	1	1		4	2
Nephtys bucera											
Nephtys ciliata											
Nereis arenaceodonta											
Nereis zonata											
Odontosyllis fulgurans											
Ophelia denticulata											
Ophioglycera gigantea											
Owenia fusiformis											
Paranaitis speciosa											
Paraonis sp											

Species	T5-6rep1	T5-6rep2	T5-6rep3	T5-7rep1	T5-7rep2	T5-7rep3	T5-8rep1	T5-8rep2	T5-8rep3	T5-9rep1	T5-9rep2
Parapionosyllis longicirrata	4		1		5	1	5	2		7	6
Parougia caeca	1	1			2		1			6	6
Phyllodoce arenae				1							
Phyllodoce maculata											
Pisione sp	37	37	50	1	11	6	22	12	7	30	40
*Pista*sp (juveniles)				1							
Polycirrus eximius	50	54	63	7	63	55	70	36	15	55	77
Polydora sp											
*Polygordius*spp	33	24	15	16	50	1	33	14	20	30	68
Potamilla reniformis											
Proceraea ?fasciata				1							
Sabellaria vulgaris											
Scalibregma inflatum											
Sigalion arenicola		1	1								2
Sphaerosyllis erinaceus	1				1						1
Spio setosa											
Spiochaetopterus oculatus											
Spiophanes bombyx											
Spirorbis spp											
Syllides sp											
Travisia carnea							3				
Typosyllis coronuta		1	1		2						1
OTHER (PHYLUM: sp(p)**)**											
CHORDATA: *Gobiosoma bosci*											
COPEPODA: Harpacticoid spp		1	2				1				1
NEMERTEA: *Cerebratulus lacteus*	2										1
NEMERTEA: Nemertea spp		2	1				2				1
NEMATODA: Nematoda spp	68	90	80	4	50	26	52	4	4	64	148
Number of Species	**16**	**23**	**16**	**22**	**17**	**13**	**17**	**8**	**9**	**15**	**23**
Total Number of Organisms	**234**	**247**	**250**	**137**	**227**	**109**	**215**	**77**	**56**	**224**	**411**

Species List Year 1 (Winter 2016-2017) of Vessel-Based Grab Samples (continued)

Species	T5-9rep3	C1-1rep1	C1-1rep2	C1-1rep3	C1-2rep1	C1-2rep2	C1-2rep3	C1-3rep1	C1-3rep2	C1-3rep3	C1-4rep1
ACTINIARIA											
Actinaria spp											
ARTHROPOPDA											
Amphipoda											
Ampelisca vadorum			2		1						
Aeginina longicornis											
Byblis serrata											
Caprella equilibra					1						
Caprella penantis			2		1						2
Caprella unica							2				1
Corophium spp			3	1			1				4
Dulchia sp											
Erichthonius rubricornis			8				1				6
Gammaropsis maculata			15				3			1	8
Hippomedon serratus											
Ischyrocerus anguipes											
Jassa marmorata	1		2				2				1
Lembos websteri			2	1							1
Leptocheirus pinguis											
Luconacia incerta											2
Melita dentata											
Microdeutopus anomalus											
Monoculodes sp											
Parametopella cypris											
Phoxocephalus holbolli			1								3
Pleustidae sp											
Pontogenia inermis			4								1
Proboloides holmesi			4								4
Protohaustorius wigleyi											
Psammonyx nobilis											
Pseudunciola obliquua											
Rhepoxynuis epistomus											
Siphonoecetes smithianus											
Stenopleustes gracilis											
Stenothoe minuta											

Species	T5-9rep3	C1-1rep1	C1-1rep2	C1-1rep3	C1-2rep1	C1-2rep2	C1-2rep3	C1-3rep1	C1-3rep2	C1-3rep3	C1-4rep1
Unciola irrorata	1	1		10	3		3				2
Cumacea											
Diastylis sp											
Pseudoleptocuma minor											
Decapoda											
Cancer borealis			1								
Cancer sp juv. ?*irroratus*											
Crangon septemspinosa											
Pagurus annulipes		3	1								
Isopoda											
Chiridotea sp *caeca*	1	3		1	1			1	1	2	
Chiridotea tuftsi											
Edotea triloba											
Erichsonella filiformis			1								
Politolana polita											
Pycnogonida											
Nymphon stromi											1
Sessilia											
Balanus amphitrite		1		28	27	30	50				3
Tanaidacea											
Leptochelia savignyi											
Tanaissus psammophilus		4		4							
ECHINODERMATA											
Asteroidea											
Asterias spp						2					
Echinoidea											
Echinarachnius parma											
Holothuroidea											
Cucumaria sp											

Species	T5-9rep3	C1-1rep1	C1-1rep2	C1-1rep3	C1-2rep1	C1-2rep2	C1-2rep3	C1-3rep1	C1-3rep2	C1-3rep3	C1-4rep1
Ophiuroidea											
Axiognathus squamatus											
MOLLUSKA											
Bivalvia											
Anadera transversa											
Anomia spp (juveniles)			2	1	1		1			1	3
Astarte borealis											
Astarte castanea	4	2						4	3		1
Cerastoderma pinnulatum		2		1							
Crassinella mactracea		2									
Crenella decussata		2		1				1		1	
Cyclocardia borealis											
Ensis directus											
Lyonsia arenosa		1									
Lyonsia hyalina											
Mytilus edulis							1				
Nucula tenuis								1			
Pandora gouldiana		1									
Spisula solidissima		1						1		2	1
Tellina agilis											
Gastropoda											
Crepidula fornicata				2	1						6
Crepidula plana											
Euspira heros											
Euspira triseriata	1										
Ilyanassa trivittata											
Retusa obtusa											
Turbonilla sp											
Polyplacophora											
Chaetopleura apiculata											
ANNELIDA											
Oligochaeta											
Oligochaeta spp											

Species	T5-9rep3	C1-1rep1	C1-1rep2	C1-1rep3	C1-2rep1	C1-2rep2	C1-2rep3	C1-3rep1	C1-3rep2	C1-3rep3	C1-4rep1
Polychaeta											
Ampharete arctica											
Aricidea catherinae	1			1							
Asabellides oculata											
Asychis elongata											
Autolytus prolifer											
Cirrophorus sp	4	1									
Dipolydora sp											
Dodecaceria coralii											
Drilonereis magna											
Ephesiella minuta											
Eumida sanguinea	4	6	1	3	1	1	2	13	4	6	3
Exogone hebes			2								
Exogone naidina											
Glycera americana											
Glycera dibranchiata											
Goniadella gracilis	1	6	1	4				1	4	1	2
Harmothoe sp											
Lepidonotus squamatus											
Lumbrinereis acuta	33	4		3				4	3	4	
Lumbrinereis fragilis		1		1					1		
Maldanidae spp											2
Marphysa bellii											
Megalona sp											
Microphthalmus sckelkowii											
Monticellina baptisteae	1	1		1							
Mystides sp											
Nephtys bucera											
Nephtys ciliata											
Nereis arenaceodonta											
Nereis zonata			1								
Odontosyllis fulgurans			7								
Ophelia denticulata										1	
Ophioglycera gigantea											
Owenia fusiformis											
Paranaitis speciosa											
Paraonis sp											

Species	T5-9rep3	C1-1rep1	C1-1rep2	C1-1rep3	C1-2rep1	C1-2rep2	C1-2rep3	C1-3rep1	C1-3rep2	C1-3rep3	C1-4rep1
Parapionosyllis longicirrata	4	5		2					1	9	2
Parougia caeca	5	1									
Phyllodoce arenae											
Phyllodoce maculata			1								
Pisione sp	22	15	3	6	1			8	23	20	3
*Pista*sp (juveniles)			7	1							5
Polycirrus eximius	94	27		6	2			29	26	14	6
Polydora sp											
*Polygordius*spp	26	17	4	12	2			10	20	9	3
Potamilla reniformis			1								1
Proceraea ?fasciata			1								3
Sabellaria vulgaris						1	2			1	
Scalibregma inflatum											
Sigalion arenicola											
Sphaerosyllis erinaceus	2	1									1
Spio setosa											
Spiochaetopterus oculatus											
Spiophanes bombyx				1							
Spirorbis spp			650	1						1	8
Syllides sp				1							
Travisia carnea		1			1				5		3
Typosyllis coronuta					1				1	1	
OTHER (PHYLUM: sp(p)**)**											
CHORDATA: *Gobiosoma bosci*											1
COPEPODA: Harpacticoid spp	8	1	2								
NEMERTEA: *Cerebratulus lacteus*											
NEMERTEA: Nemertea spp		1		1				1			1
NEMATODA: Nematoda spp	98	32	58	18	6	4	12	48	24	44	12
Number of Species	**19**	**28**	**28**	**26**	**15**	**5**	**12**	**13**	**13**	**17**	**34**
Total Number of Organisms	**311**	**143**	**787**	**112**	**50**	**38**	**80**	**122**	**116**	**118**	**106**

Species List Year 1 (Winter 2016-2017) of Vessel-Based Grab Samples (continued)

Species	C1-4rep2	C1-4rep3	C2-1rep1	C2-1rep2	C2-1rep3	C2-2rep1	C2-2rep2	C2-2rep3	C2-3rep1	C2-3rep2	C2-3rep3
ACTINIARIA											
Actinaria spp						2					
ARTHROPOPDA											
Amphipoda											
Ampelisca vadorum	1		5	20	4		128	32	50	101	45
Aeginina longicornis					1				1		
Byblis serrata				3				3		10	8
Caprella equilibra											
Caprella penantis		23									
Caprella unica	5	10									
Corophium spp	17	20							3		
Dulchia sp											
Erichthonius rubricornis	6	8							3		
Gammaropsis maculata	2	23				1			2		
Hippomedon serratus											
Ischyrocerus anguipes	1										
Jassa marmorata	1	12									
Lembos websteri	23	2									
Leptocheirus pinguis											
Luconacia incerta		2				1	1		1		
Melita dentata											
Microdeutopus anomalus											
Monoculodes sp											
Parametopella cypris											
Phoxocephalus holbolli	9					3	1	1			
Pleustidae sp		1									
Pontogenia inermis		1									
Proboloides holmesi	5	9									
Protohaustorius wigleyi											
Psammonyx nobilis											
Pseudunciola obliquua											
Rhepoxynuis epistomus											
Siphonoecetes smithianus											
Stenopleustes gracilis											
Stenothoe minuta		3									

Species	C1-4rep2	C1-4rep3	C2-1rep1	C2-1rep2	C2-1rep3	C2-2rep1	C2-2rep2	C2-2rep3	C2-3rep1	C2-3rep2	C2-3rep3
Unciola irrorata	5	7	23	14	9	5	42	9	22	10	8
Cumacea											
Diastylis sp											
Pseudoleptocuma minor	2	6									
Decapoda											
Cancer borealis											
Cancer sp juv. ?*irroratus*											
Crangon septemspinosa											
Pagurus annulipes		1						1			
Isopoda											
Chiridotea sp *caeca*			2			3		1			
Chiridotea tuftsi			1								
Edotea triloba			1				2				
Erichsonella filiformis		1									
Politolana polita											
Pycnogonida											
Nymphon stromi											
Sessilia											
Balanus amphitrite	15	38							1		
Tanaidacea											
Leptochelia savignyi		1									
Tanaissus psammophilus	1		1			2					
ECHINODERMATA											
Asteroidea											
Asterias spp											
Echinoidea											
Echinarachnius parma											
Holothuroidea											
Cucumaria sp											

Species	C1-4rep2	C1-4rep3	C2-1rep1	C2-1rep2	C2-1rep3	C2-2rep1	C2-2rep2	C2-2rep3	C2-3rep1	C2-3rep2	C2-3rep3
Ophiuroidea											
Axiognathus squamatus	4										
MOLLUSKA											
Bivalvia											
Anadera transversa									1	1	
Anomia spp (juveniles)	2	5					1		3		
Astarte borealis											
Astarte castanea						1					
Cerastoderma pinnulatum			1				5				
Crassinella mactracea											
Crenella decussata		1									
Cyclocardia borealis											
Ensis directus											
Lyonsia arenosa			1	1		3	4	2	3	1	3
Lyonsia hyalina									1		
Mytilus edulis											
Nucula tenuis			2		1						
Pandora gouldiana		1		2					1		1
Spisula solidissima		1	1	1	2	1		1		1	
Tellina agilis							3		2		2
Gastropoda											
Crepidula fornicata		4		1				1			
Crepidula plana											
Euspira heros											
Euspira triseriata											
Ilyanassa trivittata			3					1	1		
Retusa obtusa	2										
Turbonilla sp											
Polyplacophora											
Chaetopleura apiculata	1										
ANNELIDA											
Oligochaeta											
Oligochaeta spp			24								

Species	C1-4rep2	C1-4rep3	C2-1rep1	C2-1rep2	C2-1rep3	C2-2rep1	C2-2rep2	C2-2rep3	C2-3rep1	C2-3rep2	C2-3rep3
Polychaeta											
Ampharete arctica											
Aricidea catherinae			17	3	4	2	7	6	2	2	
Asabellides oculata											
Asychis elongata			1								
Autolytus prolifer						1					
Cirrophorus sp			3	1	5	4	2		1		
Dipolydora sp				2	1		2		1		
Dodecaceria coralii											
Drilonereis magna											
Ephesiella minuta											
Eumida sanguinea	1	4	1	2		1					
Exogone hebes				2							
Exogone naidina											
Glycera americana			2				1			2	1
Glycera dibranchiata											
Goniadella gracilis		3	16	7	10	8	14	3	4	6	5
Harmothoe sp	2										
Lepidonotus squamatus	1										
Lumbrinereis acuta			69	18	1	4	19	18	8	17	10
Lumbrinereis fragilis			9	5	8	3	8	5	7	19	5
Maldanidae spp			9	13	5	4	7	2	4	2	2
Marphysa bellii			10	3			5	2	8	10	4
Megalona sp											
Microphthalmus sckelkowii		1									
Monticellina baptisteae			5	1		4	2		2	2	2
Mystides sp											
Nephtys bucera						1			1	1	3
Nephtys ciliata				1							
Nereis arenaceodonta											
Nereis zonata	1										
Odontosyllis fulgurans	1										
Ophelia denticulata											
Ophioglycera gigantea										1	
Owenia fusiformis											
Paranaitis speciosa									1		
Paraonis sp									1	1	

Species	C1-4rep2	C1-4rep3	C2-1rep1	C2-1rep2	C2-1rep3	C2-2rep1	C2-2rep2	C2-2rep3	C2-3rep1	C2-3rep2	C2-3rep3
Parapionosyllis longicirrata		3	11	5	5	3	1				
Parougia caeca			6								
Phyllodoce arenae			2	1	1						
Phyllodoce maculata											
Pisione sp		5	24	31	8	6	23	12			
*Pista*sp (juveniles)	16	7							1		
Polycirrus eximius		6	13	14	9	2	19	28	3	2	1
Polydora sp	1										
*Polygordius*spp	2	3	2	14	8	8	17	5	8		2
Potamilla reniformis		1							1		
Proceraea ?fasciata	9	3									
Sabellaria vulgaris	4		2	3		41	7		11	2	3
Scalibregma inflatum				2			1				
Sigalion arenicola						1					
Sphaerosyllis erinaceus			7		1	5	1				
Spio setosa						1					
Spiochaetopterus oculatus			1			1			1		
Spiophanes bombyx											
Spirorbis spp	16	50									
Syllides sp			4			1		2			
Travisia carnea		1									
Typosyllis coronuta						2					
OTHER (PHYLUM: sp(p)**)**											
CHORDATA: *Gobiosoma bosci*											
COPEPODA: Harpacticoid spp	2	6				2					
NEMERTEA: *Cerebratulus lacteus*				1		1					
NEMERTEA: Nemertea spp						1				1	
NEMATODA: Nematoda spp	72	38	120	90	24	66	20	10	20	8	14
Number of Species	**31**	**37**	**34**	**28**	**19**	**35**	**27**	**21**	**34**	**21**	**18**
Total Number of Organisms	**230**	**311**	**399**	**261**	**107**	**195**	**343**	**145**	**180**	**200**	**119**

Species List Year 1 (Winter 2016-2017) of Vessel-Based Grab Samples (continued)

Species	C2-4rep1	C2-4rep2	C2-4rep3	C3-1rep1	C3-1rep2	C3-1rep3	C3-2rep1	C3-2rep2	C3-2rep3	C3-3rep1	C3-3rep2
ACTINIARIA											
Actinaria spp				1							
ARTHROPOPDA											
Amphipoda											
Ampelisca vadorum				19	3	5				1	1
Aeginina longicornis											
Byblis serrata					1	1					
Caprella equilibra											
Caprella penantis											
Caprella unica											
Corophium spp					1						
Dulchia sp								1			
Erichthonius rubricornis											
Gammaropsis maculata											
Hippomedon serratus											
Ischyrocerus anguipes											
Jassa marmorata											
Lembos websteri											
Leptocheirus pinguis											
Luconacia incerta											
Melita dentata				2						1	
Microdeutopus anomalus											
Monoculodes sp	1										
Parametopella cypris											
Phoxocephalus holbolli											
Pleustidae sp											
Pontogenia inermis											
Proboloides holmesi											
Protohaustorius wigleyi											
Psammonyx nobilis					1						
Pseudunciola obliquua											
Rhepoxynuis epistomus										1	1
Siphonoecetes smithianus											
Stenopleustes gracilis											
Stenothoe minuta											

Species	C2-4rep1	C2-4rep2	C2-4rep3	C3-1rep1	C3-1rep2	C3-1rep3	C3-2rep1	C3-2rep2	C3-2rep3	C3-3rep1	C3-3rep2
Unciola irrorata	7	1	3	17	13	5	2		1	2	4
Cumacea											
Diastylis sp											
Pseudoleptocuma minor										2	
Decapoda											
Cancer borealis											
Cancer sp juv. ?*irroratus*											
Crangon septemspinosa											
Pagurus annulipes											
Isopoda											
Chiridotea sp *caeca*						1	1				1
Chiridotea tuftsi	1	1								1	
Edotea triloba											1
Erichsonella filiformis											
Politolana polita											
Pycnogonida											
Nymphon stromi											
Sessilia											
Balanus amphitrite				8	35		1	3		1	
Tanaidacea											
Leptochelia savignyi											
Tanaissus psammophilus				2	16		3	6	1	9	13
ECHINODERMATA											
Asteroidea											
Asterias spp											
Echinoidea											
Echinarachnius parma											
Holothuroidea											
Cucumaria sp											

Species	C2-4rep1	C2-4rep2	C2-4rep3	C3-1rep1	C3-1rep2	C3-1rep3	C3-2rep1	C3-2rep2	C3-2rep3	C3-3rep1	C3-3rep2
Ophiuroidea											
Axiognathus squamatus											
MOLLUSKA											
Bivalvia											
Anadera transversa			1								
Anomia spp (juveniles)											
Astarte borealis											
Astarte castanea											
Cerastoderma pinnulatum											
Crassinella mactracea											
Crenella decussata					3		1			1	
Cyclocardia borealis					1						
Ensis directus											1
Lyonsia arenosa			1		6	1	3			5	2
Lyonsia hyalina											1
Mytilus edulis				2		4	1	1		3	2
Nucula tenuis					1					1	
Pandora gouldiana					1						
Spisula solidissima		1	1	1	2	2		2			2
Tellina agilis	1										
Gastropoda											
Crepidula fornicata											
Crepidula plana											
Euspira heros											
Euspira triseriata											
Ilyanassa trivittata											
Retusa obtusa											
Turbonilla sp											
Polyplacophora											
Chaetopleura apiculata											
ANNELIDA											
Oligochaeta											
Oligochaeta spp											

Species	C2-4rep1	C2-4rep2	C2-4rep3	C3-1rep1	C3-1rep2	C3-1rep3	C3-2rep1	C3-2rep2	C3-2rep3	C3-3rep1	C3-3rep2
Polychaeta											
Ampharete arctica											
Aricidea catherinae	1		1	3	2	1			1		2
Asabellides oculata					1						
Asychis elongata											
Autolytus prolifer											
Cirrophorus sp	2		1								
Dipolydora sp				3	3	2				4	1
Dodecaceria coralii											
Drilonereis magna											
Ephesiella minuta											
Eumida sanguinea					1	1				1	
Exogone hebes				1		2	1			3	1
Exogone naidina											
Glycera americana	2										
Glycera dibranchiata											
Goniadella gracilis	4	1	1	44	42	21	18	5	1	27	58
Harmothoe sp					1						
Lepidonotus squamatus				1							
Lumbrinereis acuta	13	1	1	12	11	16	15	4		11	16
Lumbrinereis fragilis	4	2	1			2	2			1	
Maldanidae spp	2	1	2	2	3	5				3	2
Marphysa bellii	3	1		5		1					3
Megalona sp											
Microphthalmus sckelkowii											
Monticellina baptisteae	1			4	2	1	3	1		5	2
Mystides sp											
Nephtys bucera	6	1	1	2	2	3				1	
Nephtys ciliata											
Nereis arenaceodonta											
Nereis zonata											
Odontosyllis fulgurans											
Ophelia denticulata											
Ophioglycera gigantea											
Owenia fusiformis											
Paranaitis speciosa											
Paraonis sp							1			1	1

Species	C2-4rep1	C2-4rep2	C2-4rep3	C3-1rep1	C3-1rep2	C3-1rep3	C3-2rep1	C3-2rep2	C3-2rep3	C3-3rep1	C3-3rep2
Parapionosyllis longicirrata			1	2	4	1	1			2	2
Parougia caeca			1	1						1	1
Phyllodoce arenae											
Phyllodoce maculata											
Pisione sp				1		1					
*Pista*sp (juveniles)											
Polycirrus eximius		2	2	1	2						
Polydora sp											
*Polygordius*spp	9	3	8	17	2	16	5	1	1	11	11
Potamilla reniformis						1					
Proceraea ?fasciata											
Sabellaria vulgaris		1	1		3	3		10		9	
Scalibregma inflatum											
Sigalion arenicola											1
Sphaerosyllis erinaceus	1	2	1	2			1			4	4
Spio setosa				1							
Spiochaetopterus oculatus										1	
Spiophanes bombyx											
Spirorbis spp											
Syllides sp											
Travisia carnea											1
Typosyllis coronuta											
OTHER (PHYLUM: sp(p)**)**											
CHORDATA: *Gobiosoma bosci*											
COPEPODA: Harpacticoid spp			3		1					1	
NEMERTEA: *Cerebratulus lacteus*				1							
NEMERTEA: Nemertea spp	2				1	1				1	1
NEMATODA: Nematoda spp	12	12	10	8	24	6	4	2		20	48
Number of Species	**18**	**14**	**19**	**27**	**30**	**25**	**17**	**11**	**5**	**31**	**28**
Total Number of Organisms	**72**	**30**	**41**	**163**	**189**	**103**	**63**	**36**	**5**	**135**	**184**

Species List Year 1 (Winter 2016-2017) of Vessel-Based Grab Samples (continued)

Species	C3-3rep3	C3-4rep1	C3-4rep2	C3-4rep3	T1-QC	T3-QC	T5-QC	C3-QC
ACTINIARIA								
Actinaria spp								1
ARTHROPOPDA								
Amphipoda								
Ampelisca vadorum	2	1	1	2				
Aeginina longicornis								
Byblis serrata		2	1	1	1	1		
Caprella equilibra								
Caprella penantis								
Caprella unica								
Corophium spp			1					
Dulchia sp								
Erichthonius rubricornis			2					
Gammaropsis maculata								
Hippomedon serratus								
Ischyrocerus anguipes			3	1				
Jassa marmorata								
Lembos websteri								
Leptocheirus pinguis								
Luconacia incerta								
Melita dentata								
Microdeutopus anomalus								
Monoculodes sp								
Parametopella cypris								
Phoxocephalus holbolli								
Pleustidae sp								
Pontogenia inermis								
Proboloides holmesi								
Protohaustorius wigleyi					3			1
Psammonyx nobilis								
Pseudunciola obliquua								
Rhepoxynuis epistomus							2	
Siphonoecetes smithianus								
Stenopleustes gracilis			1					
Stenothoe minuta								

Species	C3-3rep3	C3-4rep1	C3-4rep2	C3-4rep3	T1-QC	T3-QC	T5-QC	C3-QC
Unciola irrorata	4	3	3			5	1	3
Cumacea								
Diastylis sp								
Pseudoleptocuma minor							1	
Decapoda								
Cancer borealis								
Cancer sp juv. ?*irroratus*								
Crangon septemspinosa								
Pagurus annulipes								
Isopoda								
Chiridotea sp *caeca*							1	
Chiridotea tuftsi								
Edotea triloba								
Erichsonella filiformis								
Politolana polita		1					2	
Pycnogonida								
Nymphon stromi								
Sessilia								
Balanus amphitrite	2		102		32		9	
Tanaidacea								
Leptochelia savignyi								
Tanaissus psammophilus	3	3	2	3	1		7	2
ECHINODERMATA								
Asteroidea								
Asterias spp								
Echinoidea								
Echinarachnius parma								
Holothuroidea								
Cucumaria sp								

Species	C3-3rep3	C3-4rep1	C3-4rep2	C3-4rep3	T1-QC	T3-QC	T5-QC	C3-QC
Ophiuroidea								
Axiognathus squamatus								
MOLLUSKA								
Bivalvia								
Anadera transversa								
Anomia spp (juveniles)								
Astarte borealis								
Astarte castanea							1	
Cerastoderma pinnulatum		1						
Crassinella mactracea								1
Crenella decussata				1				
Cyclocardia borealis								
Ensis directus								
Lyonsia arenosa	2	2		2		2	4	1
Lyonsia hyalina								
Mytilus edulis		1	18	2	3	6	15	
Nucula tenuis								
Pandora gouldiana								
Spisula solidissima		3	2				6	1
Tellina agilis		1				1		
Gastropoda								
Crepidula fornicata								
Crepidula plana								
Euspira heros								
Euspira triseriata								
Ilyanassa trivittata			1					
Retusa obtusa								
Turbonilla sp								
Polyplacophora								
Chaetopleura apiculata								
ANNELIDA								
Oligochaeta								
Oligochaeta spp								

Species	C3-3rep3	C3-4rep1	C3-4rep2	C3-4rep3	T1-QC	T3-QC	T5-QC	C3-QC
Polychaeta								
Ampharete arctica								
Aricidea catherinae						6		
Asabellides oculata				1				
Asychis elongata								
Autolytus prolifer								
Cirrophorus sp		1				11	1	
Dipolydora sp	1	1						
Dodecaceria coralii								
Drilonereis magna								1
Ephesiella minuta								
Eumida sanguinea			3	1			1	
Exogone hebes	2	5	1	2				
Exogone naidina				1				
Glycera americana						1		
Glycera dibranchiata								1
Goniadella gracilis	22	32	10	14	6	13	4	23
Harmothoe sp								
Lepidonotus squamatus								
Lumbrinereis acuta	17	19	6	16	3	25	12	15
Lumbrinereis fragilis	3		1		1	3	1	
Maldanidae spp		1	1	1		4		1
Marphysa bellii		1						
Megalona sp								
Microphthalmus sckelkowii								
Monticellina baptisteae	2	1		1		1		3
Mystides sp								
Nephtys bucera	1	5	1		3		3	1
Nephtys ciliata								
Nereis arenaceodonta								
Nereis zonata								
Odontosyllis fulgurans								
Ophelia denticulata								
Ophioglycera gigantea								
Owenia fusiformis								
Paranaitis speciosa								
Paraonis sp	2			1				

Species	C3-3rep3	C3-4rep1	C3-4rep2	C3-4rep3	T1-QC	T3-QC	T5-QC	C3-QC
Parapionosyllis longicirrata	4	7	1			7	1	
Parougia caeca				1		4	2	
Phyllodoce arenae								
Phyllodoce maculata								
Pisione sp						42	1	1
*Pista*sp (juveniles)								
Polycirrus eximius						31		
Polydora sp								
*Polygordius*spp	1	7	10	9	14	20	4	
Potamilla reniformis					1			
Proceraea ?fasciata								
Sabellaria vulgaris	1		29	6	6		35	
Scalibregma inflatum								
Sigalion arenicola				2				
Sphaerosyllis erinaceus	1	1	1	1		4		
Spio setosa								
Spiochaetopterus oculatus								
Spiophanes bombyx								
Spirorbis spp								
Syllides sp	2							
Travisia carnea				1				
Typosyllis coronuta		1		1				
OTHER (PHYLUM: sp(p)**)**								
CHORDATA: *Gobiosoma bosci*								
COPEPODA: Harpacticoid spp			4					
NEMERTEA: *Cerebratulus lacteus*					1			
NEMERTEA: Nemertea spp	1					1	1	
NEMATODA: Nematoda spp	44	46	27	10	2	42	28	4
Number of Species	**20**	**24**	**25**	**24**	**14**	**21**	**24**	**16**
Total Number of Organisms	**117**	**146**	**232**	**81**	**77**	**230**	**143**	**60**

Species List Year 2 (Winter 2017) of Vessel-Based Grab Samples

Species	T1-1rep1	T1-1rep2	T1-1rep3	T1-2rep1	T1-2rep2	T1-2rep3	T1-3rep1	T1-3rep2	T1-3rep3	T1-4rep1	T1-4rep2	T1-4rep3
ACTINIARIA												
Actinaria spp												
ARTHROPOPDA												
Amphipoda												
Ampelisca vadorum			2						1			
Byblis serrata												
Caprella linearis									4			
Gammaropsis maculata									2			
Hippomedon serratus												
Jassa marmorata									1			
Luconacia incerta												
Melita dentata									1			
Microdeutopus anomalus												
Monoculodes sp								1				
Phoxocephalus holbolli			1						1		1	
Pontogenia inermis						1						
Protohaustorius wigleyi										1		2
Psammonyx nobilis												
Pseudunciola obliquua	1											
Rhepoxynuis epistomus	1										1	1
Unciola irrorata	1	2	30	1			3	1			1	10
Brachypoda												
hutchinsoniella macracantha												
Cumacea												
Diastylis sp			1			1	1					
oxyurostylis smithi												
Petalosarsia declivis												
Pseudoleptocuma minor												
Decapoda												
Cancer borealis									1			
Cancer irroratus											1	
Crangon septemspinosa												
Pagurus acadianus												
Pagurus annulipes					1							
Panopeus herbstii							1					
Pasiphaea sp.												

Species	T1-1rep1	T1-1rep2	T1-1rep3	T1-2rep1	T1-2rep2	T1-2rep3	T1-3rep1	T1-3rep2	T1-3rep3	T1-4rep1	T1-4rep2	T1-4rep3
Pinnotheres maculatus									2			
Isopoda												
Asellota sp									1			
Chiridotea caeca												
Chiridotea tuftsi												
Edotea triloba												
Idotea phosphorea												
Politolana polita												
Ptilanthura tenuis												
Mysidacea												
Heteromysis formosa			2									
Mysidopsis bigelowi												
Sessilia												
Balanus amphitrite			1					1				
Tanaidacea												
Tanaissus psammophilus	6	1		1	1	1					1	
ECHINODERMATA												
Holothuroidea												
Cucumaria frondosa												
Leptosynapta sp												
MOLLUSKA												
Bivalvia												
Astarte borealis		1										
Astarte spp					1							
Cerastoderma pinnulatum												
Crassinella lunulata												
Crenella decussata	1											
Cyclocardia borealis												
Ensis directus												
Lyonsia arenosa				1		2				1	1	
Mytilus edulis							1		3		1	
Nucula tenuis												
Pitar morrhuanus				1								
Spisula solidissima	2	1		2	1	1				5	2	2
Tellina agilis												
Gastropoda												
Bittiolum varium												
Crepidula plana												

Species	T1-1rep1	T1-1rep2	T1-1rep3	T1-2rep1	T1-2rep2	T1-2rep3	T1-3rep1	T1-3rep2	T1-3rep3	T1-4rep1	T1-4rep2	T1-4rep3
Crucibulum striatum		1										
Epitonium multistriatum												
Euspira heros												
Euspira triseriata												
Ilyanassa trivittata												
Mangelia sp												
Polinices immaculatus												
Onoba sp												
Testudinalia testudinalis												
ANNELIDA												
Oligochaeta												
Oligochaeta spp				1				1				3
Polychaeta												
Ampharete arctica												
Aricidea catherinae	1	3	2		2						1	
Asabellides oculata												
Brania wellfleetensis												
Capitella sp												
Caulleriella venefica	2	2	3	1		4	1		5		2	2
Cirrophorus lyra			1				1			1	1	
Cirrophorus furcatus		3	1	1						1	4	
Dipolydora sp									1			
Drilonereis longa												
Drilonereis magna												
Eteone lactea				1								
Eumida sanguinea												
Exogone hebes	2	1	2		2	1	3		1	1	4	3
Glycera americana							1					
Glycera dibranchiata												
Goniadella gracilis	3	11	10	9	6	23	17	3	2	5	15	9
Harmothoe sp												
Leitoscoloplos robustus			1			1			2			
Lumbrinereis acuta	7	6	5	3	1	12	14	2		1	7	2
Lumbrinereis fragilis	4		3	2		1	3		2		3	
Maldanidae spp	1					2	1					
Marphysa bellii												
Megalona sp												
Microphtalmus sckelkowwi												

Species	T1-1rep1	T1-1rep2	T1-1rep3	T1-2rep1	T1-2rep2	T1-2rep3	T1-3rep1	T1-3rep2	T1-3rep3	T1-4rep1	T1-4rep2	T1-4rep3
Monticellina baptisteae	3	3	1	2	2	3	2	2			3	3
Nephtys spp		1	1		1	1						
Ophelia denticulata												3
Orbinidae sp.												
Paranaitis speciosa												
Paraonis spp												
Parapionosyllis longicirrata	3	11	7	2	7		2	5		3	22	31
Parougia caeca							1				1	1
Phyllodoce arenae												
Pisione sp											2	
Polycirrus eximius			2									
Polydora spp						1						
Polygordius spp	5	22	35	18	16	16	13	11	42	17	18	11
Potamilla reniformis												
Proceraea sp												
Pseudomystides sp												
Sabellaria vulgaris												
Scalibregma inflatum	1					1						
Scolelepis bousfieldi												
Scolelepis squamata												
Sigalion arenicola		1								1		
Sphaerosyllis erinaceus	1	2	3					3		1	10	3
Spio filicornis												
Spio setosa												
Spiochaetopterus oculatus												
Spiophanes bombyx			1							1	1	
Spiroris borealis												
Syllides longocirratus		4	1				1				2	7
Syllis gracilis												
Travisia carnea												
Typosyllis(*Syllis*) *cornuta*												
OTHER (PHYLUM: sp(p)**)**												
COPAPODA: Harpacticoid spp								1		3		1
NEMERTEA: *Cerebratulus lacteus*												
NEMERTEA: Nemertea spp	12	2	3	1								2
NEMATODA: Nematoda spp	18	20	12	68	90	52	90	60	38	28	88	30
PORIFERA: *Polymastia robusta*												
SIPUNCULOIDEA: *Golfingia* sp												

Species	T1-1rep1	T1-1rep2	T1-1rep3	T1-2rep1	T1-2rep2	T1-2rep3	T1-3rep1	T1-3rep2	T1-3rep3	T1-4rep1	T1-4rep2	T1-4rep3
No. species	**20**	**20**	**25**	**17**	**13**	**18**	**18**	**12**	**18**	**15**	**25**	**19**
Total Number of Organisms	**75**	**98**	**131**	**115**	**131**	**124**	**156**	**91**	**110**	**70**	**193**	**126**

Species List Year 2 (Winter 2017) of Vessel-Based Grab Samples (continued)

Species	T1-5rep1	T1-5rep2	T1-5rep3	T1-6rep1	T1-6rep2	T1-6rep3	T1-7rep1	T1-7rep2	T1-7rep3	T1-8rep1	T1-8rep2	T1-8rep3
ACTINIARIA												
Actinaria spp								1				
ARTHROPOPDA												
Amphipoda												
Ampelisca vadorum	1			1	1				1			
Byblis serrata												
Caprella linearis												
Gammaropsis maculata												
Hippomedon serratus												
Jassa marmorata												
Luconacia incerta												
Melita dentata												
Microdeutopus anomalus												
Monoculodes sp				1								
Phoxocephalus holbolli												
Pontogenia inermis												
Protohaustorius wigleyi							1			1		2
Psammonyx nobilis												
Pseudunciola obliquua									1			2
Rhepoxynuis epistomus		1								3	1	1
Unciola irrorata	5		2	2	1	2	2	5	2		12	
Brachypoda												
hutchinsoniella macracantha												
Cumacea												
Diastylis sp								1				
oxyurostylis smithi				1								
Petalosarsia declivis												
Pseudoleptocuma minor												
Decapoda												
Cancer borealis												
Cancer irroratus											1	
Crangon septemspinosa												
Pagurus acadianus												
Pagurus annulipes												
Panopeus herbstii												
Pasiphaea sp.												

Species	T1-5rep1	T1-5rep2	T1-5rep3	T1-6rep1	T1-6rep2	T1-6rep3	T1-7rep1	T1-7rep2	T1-7rep3	T1-8rep1	T1-8rep2	T1-8rep3
Pinnotheres maculatus												
Isopoda												
Asellota sp												
Chiridotea caeca			1								1	2
Chiridotea tuftsi							1					
Edotea triloba											2	
Idotea phosphorea												
Politolana polita												
Ptilanthura tenuis								1				
Mysidacea												
Heteromysis formosa												
Mysidopsis bigelowi												
Sessilia												
Balanus amphitrite												3
Tanaidacea												
Tanaissus psammophilus	1	3	4	2	1	1	1	2	2		2	2
ECHINODERMATA												
Holothuroidea												
Cucumaria frondosa												
Leptosynapta sp												
MOLLUSKA												
Bivalvia												
Astarte borealis								1				
Astarte spp												
Cerastoderma pinnulatum												
Crassinella lunulata												
Crenella decussata												
Cyclocardia borealis		1					1	1				
Ensis directus				1								
Lyonsia arenosa				1					1			
Mytilus edulis								1				1
Nucula tenuis						1		1				
Pitar morrhuanus												
Spisula solidissima		2	1	4		2		4	2		5	1
Tellina agilis						1						
Gastropoda												
Bittiolum varium												
Crepidula plana												

Species	T1-5rep1	T1-5rep2	T1-5rep3	T1-6rep1	T1-6rep2	T1-6rep3	T1-7rep1	T1-7rep2	T1-7rep3	T1-8rep1	T1-8rep2	T1-8rep3
Crucibulum striatum												
Epitonium multistriatum												
Euspira heros												
Euspira triseriata												
Ilyanassa trivittata												
Mangelia sp											1	
Polinices immaculatus												
Onoba sp												
Testudinalia testudinalis	1											
ANNELIDA												
Oligochaeta												
Oligochaeta spp	1	1			4							
Polychaeta												
Ampharete arctica					1							
Aricidea catherinae						1	3	2			1	
Asabellides oculata												
Brania wellfleetensis												
Capitella sp												
Caulleriella venefica		10		2	1	1		1	1			5
Cirrophorus lyra		1				1	2	3	5		1	
Cirrophorus furcatus		1		1			1				8	
Dipolydora sp	1					1						
Drilonereis longa						1						
Drilonereis magna												
Eteone lactea						1						
Eumida sanguinea												
Exogone hebes	4	3	3	3	1	5	3	4	7	1	10	1
Glycera americana					1			1				
Glycera dibranchiata												
Goniadella gracilis	18	15	16	18	10	22	8	12	12	4	28	2
Harmothoe sp												
Leitoscoloplos robustus							1		1			
Lumbrinereis acuta	3	8	3	20	10	23	6	11	8	1	9	3
Lumbrinereis fragilis	1	4	2	1	2	7	1	1	2			
Maldanidae spp		1			1	2	1	3			1	
Marphysa bellii											1	
Megalona sp			1									
Microphtalmus sckelkowwi												

Species	T1-5rep1	T1-5rep2	T1-5rep3	T1-6rep1	T1-6rep2	T1-6rep3	T1-7rep1	T1-7rep2	T1-7rep3	T1-8rep1	T1-8rep2	T1-8rep3
Monticellina baptisteae	1	1	1	2	1	3	3	1	3		4	
Nephtys spp				3	2	1	2	1	2		2	1
Ophelia denticulata												
Orbinidae sp.												
Paranaitis speciosa												
Paraonis spp			1		1							
Parapionosyllis longicirrata	3	15	3	8		3	4	9	20	2	29	
Parougia caeca		1		1	3	2	1	1	2		2	
Phyllodoce arenae												
Pisione sp											1	
Polycirrus eximius								1				
Polydora spp									1			
Polygordius spp	8	11	22	29	39	18	3	39	53	4	32	5
Potamilla reniformis												
Proceraea sp												
Pseudomystides sp							1					
Sabellaria vulgaris												
Scalibregma inflatum						2	1					
Scolelepis bousfieldi		1										
Scolelepis squamata												
Sigalion arenicola							1			2	1	
Sphaerosyllis erinaceus		3	4	2		1	1	2	8		6	1
Spio filicornis						1						
Spio setosa		1							1			
Spiochaetopterus oculatus				1								
Spiophanes bombyx				1	2	2	1				4	
Spiroris borealis												
Syllides longocirratus		1	1								4	
Syllis gracilis												
Travisia carnea												
Typosyllis(*Syllis*) *cornuta*												
OTHER (PHYLUM: sp(p)**)**												
COPAPODA: Harpacticoid spp	10		2			1			8	4		
NEMERTEA: *Cerebratulus lacteus*			1						2			1
NEMERTEA: Nemertea spp	1			1								
NEMATODA: Nematoda spp	42	110	195	110	8	68	60	58	910	10	360	50
PORIFERA: *Polymastia robusta*												
SIPUNCULOIDEA: *Golfingia* sp												

Species	T1-5rep1	T1-5rep2	T1-5rep3	T1-6rep1	T1-6rep2	T1-6rep3	T1-7rep1	T1-7rep2	T1-7rep3	T1-8rep1	T1-8rep2	T1-8rep3
No. Species	16	22	18	24	19	27	25	27	24	10	27	17
Total Number of Organisms	101	195	263	216	90	174	110	168	1055	32	529	83

Species List Year 2 (Winter 2017) of Vessel-Based Grab Samples (continued)

Species	T1-9rep1	T1-9rep2	T1-9rep3	T3-1rep1	T3-1rep2	T3-1rep3	T3-2rep1	T3-2rep2	T3-2rep3	T3-3rep1	T3-3rep2	T3-3rep3
ACTINIARIA												
Actinaria spp												
ARTHROPOPDA												
Amphipoda												
Ampelisca vadorum	2		1									
Byblis serrata												
Caprella linearis												
Gammaropsis maculata												
Hippomedon serratus												
Jassa marmorata												
Luconacia incerta		1										
Melita dentata												
Microdeutopus anomalus												
Monoculodes sp			1									
Phoxocephalus holbolli										1		
Pontogenia inermis												
Protohaustorius wigleyi												
Psammonyx nobilis												
Pseudunciola obliquua												
Rhepoxynuis epistomus												
Unciola irrorata	2	2	3	4		1	7	5	5		1	2
Brachypoda												
hutchinsoniella macracantha												
Cumacea												
Diastylis sp												
Oxyurostylis smithi												
Petalosarsia declivis												
Pseudoleptocuma minor							1					
Decapoda												
Cancer borealis												
Cancer irroratus												
Crangon septemspinosa												
Pagurus acadianus												
Pagurus annulipes												
Panopeus herbstii												
Pasiphaea sp.												

Species	T1-9rep1	T1-9rep2	T1-9rep3	T3-1rep1	T3-1rep2	T3-1rep3	T3-2rep1	T3-2rep2	T3-2rep3	T3-3rep1	T3-3rep2	T3-3rep3
Pinnotheres maculatus												
Isopoda												
Asellota sp												
Chiridotea caeca					4	5			1	3	1	
Chiridotea tuftsi												
Edotea triloba		2					1					
Idotea phosphorea												
Politolana polita					1					4		
Ptilanthura tenuis												
Mysidacea												
Heteromysis formosa												
Mysidopsis bigelowi				1		1						
Sessilia												
Balanus amphitrite												1
Tanaidacea												
Tanaissus psammophilus		2										
ECHINODERMATA												
Holothuroidea												
Cucumaria frondosa												
Leptosynapta sp				1								
MOLLUSKA												
Bivalvia												
Astarte borealis												
Astarte spp												
Cerastoderma pinnulatum												
Crassinella lunulata												
Crenella decussata	1		1						1			
Cyclocardia borealis												
Ensis directus												
Lyonsia arenosa		1										
Mytilus edulis												
Nucula tenuis												
Pitar morrhuanus												
Spisula solidissima	2	8	2	1	1		2	1	2	1		1
Tellina agilis												
Gastropoda												
Bittiolum varium												
Crepidula plana												

Species	T1-9rep1	T1-9rep2	T1-9rep3	T3-1rep1	T3-1rep2	T3-1rep3	T3-2rep1	T3-2rep2	T3-2rep3	T3-3rep1	T3-3rep2	T3-3rep3
Crucibulum striatum												
Epitonium multistriatum												
Euspira heros							1					
Euspira triseriata									1			
Ilyanassa trivittata									1			
Mangelia sp												
Polinices immaculatus								1				
Onoba sp												
Testudinalia testudinalis												
ANNELIDA												
Oligochaeta												
Oligochaeta spp		1								2		
Polychaeta												
Ampharete arctica												1
Aricidea catherinae	3		2	15	13		9	4	31	19	8	11
Asabellides oculata												
Brania wellfleetensis												
Capitella sp				1							8	
Caulleriella venefica	2	2	1	1						1		1
Cirrophorus lyra	1		1	1			1		1	1	1	1
Cirrophorus furcatus				13	6	11	6	17	7	24	4	5
Dipolydora sp					1							
Drilonereis longa												
Drilonereis magna												
Eteone lactea							1					
Eumida sanguinea												
Exogone hebes	2	2	2									
Glycera americana							1	1				
Glycera dibranchiata			1						1			
Goniadella gracilis	4	19	2	1	3	2	9	15	10	8	6	8
Harmothoe sp												
Leitoscoloplos robustus												
Lumbrinereis acuta	4	3	3	10	27	10	17	19	38	58	13	23
Lumbrinereis fragilis				4	2		4	6	2		4	3
Maldanidae spp				1	2		3		3		1	2
Marphysa bellii				3					1			1
Megalona sp												
Microphtalmus sckelkowwi											1	

Species	T1-9rep1	T1-9rep2	T1-9rep3	T3-1rep1	T3-1rep2	T3-1rep3	T3-2rep1	T3-2rep2	T3-2rep3	T3-3rep1	T3-3rep2	T3-3rep3
Monticellina baptisteae	1		1	1	3	1	2	3	4	7	3	4
Nephtys spp	1	1	1									
Ophelia denticulata												1
Orbinidae sp.												
Paranaitis speciosa												
Paraonis spp									1			
Parapionosyllis longicirrata	13	7	8	34	26	14	15	5	43	35	4	22
Parougia caeca	4		2	16	17	23	4	3	19	34	2	26
Phyllodoce arenae												
Pisione sp				18	37	33	33	10	42	50	16	56
Polycirrus eximius				47	56	37	25	29	16	61	11	29
Polydora spp												
Polygordius spp	18	13	23	18	17	25	27	31	45	23	28	29
Potamilla reniformis									1			
Proceraea sp												
Pseudomystides sp				3	2	12	1			9	1	3
Sabellaria vulgaris												
Scalibregma inflatum					1							
Scolelepis bousfieldi												
Scolelepis squamata												
Sigalion arenicola	1		1			1						
Sphaerosyllis erinaceus	5		3	30	16	18		9	16	23	8	11
Spio filicornis												
Spio setosa												
Spiochaetopterus oculatus												
Spiophanes bombyx										2		
Spiroris borealis												
Syllides longocirratus		1		5	2	4	4	5	16	3	4	8
Syllis gracilis												
Travisia carnea						1						1
Typosyllis(*Syllis*) *cornuta*												
OTHER (PHYLUM: sp(p)**)**												
COPAPODA: Harpacticoid spp			2	12	7	8				10	5	4
NEMERTEA: *Cerebratulus lacteus*					3						2	1
NEMERTEA: Nemertea spp	2		1	1			4		1	3		
NEMATODA: Nematoda spp	130	45	90	640	340	180	600	800	510	960	220	830
PORIFERA: *Polymastia robusta*												
SIPUNCULOIDEA: *Golfingia* sp												

Species	T1-9rep1	T1-9rep2	T1-9rep3	T3-1rep1	T3-1rep2	T3-1rep3	T3-2rep1	T3-2rep2	T3-2rep3	T3-3rep1	T3-3rep2	T3-3rep3
No. species	19	16	22	26	23	19	24	18	27	24	23	27
Total Number of Organisms	198	110	152	882	587	387	778	964	819	1342	352	1085

Species List Year 2 (Winter 2017) of Vessel-Based Grab Samples (continued)

Species	T3-4rep1	T3-4rep2	T3-4rep3	T3-5rep1	T3-5rep2	T3-5rep3	T3-6rep1	T3-6rep2	T3-6rep3	T3-7rep1	T3-7rep2	T3-7rep3
ACTINIARIA												
Actinaria spp												
ARTHROPOPDA												
Amphipoda												
Ampelisca vadorum		1		1		2			2			
Byblis serrata												
Caprella linearis												
Gammaropsis maculata												
Hippomedon serratus												
Jassa marmorata								1				
Luconacia incerta												
Melita dentata												
Microdeutopus anomalus												
Monoculodes sp												
Phoxocephalus holbolli												
Pontogenia inermis												
Protohaustorius wigleyi												
Psammonyx nobilis										1		1
Pseudunciola obliquua												
Rhepoxynuis epistomus							1					
Unciola irrorata	1	2	4	8	2	8	2	4	3			
Brachypoda												
hutchinsoniella macracantha												
Cumacea												
Diastylis sp												
Oxyurostylis smithi												
Petalosarsia declivis												
Pseudoleptocuma minor											1	1
Decapoda												
Cancer borealis												
Cancer irroratus												
Crangon septemspinosa												
Pagurus acadianus												
Pagurus annulipes												
Panopeus herbstii												
Pasiphaea sp.												

Species	T3-4rep1	T3-4rep2	T3-4rep3	T3-5rep1	T3-5rep2	T3-5rep3	T3-6rep1	T3-6rep2	T3-6rep3	T3-7rep1	T3-7rep2	T3-7rep3
Pinnotheres maculatus												
Isopoda												
Asellota sp												
Chiridotea caeca		1		1	2	2		1	1	1		
Chiridotea tuftsi												
Edotea triloba												
Idotea phosphorea												
Politolana polita			1								1	
Ptilanthura tenuis												
Mysidacea												
Heteromysis formosa												
Mysidopsis bigelowi												
Sessilia												
Balanus amphitrite												
Tanaidacea												
Tanaissus psammophilus							1					
ECHINODERMATA												
Holothuroidea												
Cucumaria frondosa												
Leptosynapta sp												
MOLLUSKA												
Bivalvia												
Astarte borealis												
Astarte spp								1			1	
Cerastoderma pinnulatum												
Crassinella lunulata												
Crenella decussata												
Cyclocardia borealis												
Ensis directus												
Lyonsia arenosa												
Mytilus edulis												
Nucula tenuis											3	
Pitar morrhuanus												
Spisula solidissima			3			1	1			1	3	
Tellina agilis												
Gastropoda												
Bittiolum varium												
Crepidula plana												

Species	T3-4rep1	T3-4rep2	T3-4rep3	T3-5rep1	T3-5rep2	T3-5rep3	T3-6rep1	T3-6rep2	T3-6rep3	T3-7rep1	T3-7rep2	T3-7rep3
Crucibulum striatum												
Epitonium multistriatum												
Euspira heros												
Euspira triseriata												
Ilyanassa trivittata												
Mangelia sp												
Polinices immaculatus			1									
Onoba sp						1						
Testudinalia testudinalis												
ANNELIDA												
Oligochaeta												
Oligochaeta spp	2		2			2			2			
Polychaeta												
Ampharete arctica				1								
Aricidea catherinae	14	8	24	6	7	14	8	9	7	5	6	2
Asabellides oculata					1							
Brania wellfleetensis												
Capitella sp	1											
Caulleriella venefica		1					1					
Cirrophorus lyra	2					2			4		1	
Cirrophorus furcatus	12	9	18	6	15	6	17	7	6	8	1	6
Dipolydora sp	1										2	
Drilonereis longa								1				
Drilonereis magna											1	
Eteone lactea												
Eumida sanguinea	1									1		
Exogone hebes	1		3						1			
Glycera americana								1				
Glycera dibranchiata												
Goniadella gracilis	17	2	5	4	9	3	12	5	10	6	10	6
Harmothoe sp												
Leitoscoloplos robustus												
Lumbrinereis acuta	44	24	32	20	19	19	14	5	25	23	9	9
Lumbrinereis fragilis		1		3	1	2		1	1		1	
Maldanidae spp	2	2	2	3		1	1	3	3	1		1
Marphysa bellii	3											
Megalona sp									1			
Microphtalmus sckelkowwi												1

Species	T3-4rep1	T3-4rep2	T3-4rep3	T3-5rep1	T3-5rep2	T3-5rep3	T3-6rep1	T3-6rep2	T3-6rep3	T3-7rep1	T3-7rep2	T3-7rep3
Monticellina baptisteae	4	7	3	4	5		2		4	1	1	1
Nephtys spp												
Ophelia denticulata		2										
Orbinidae sp.												
Paranaitis speciosa												
Paraonis spp						1						
Parapionosyllis longicirrata	33	4	54	19	24	49	15	5	11	15	10	18
Parougia caeca	5	5	16	5		9	7	8	3	28	22	9
Phyllodoce arenae												
Pisione sp	36	19	33	28	19	27	24	15		33	30	21
Polycirrus eximius	59	57	45	31	34	62	10	13	26	15	31	21
Polydora spp												
Polygordius spp	14	10	40	6	37	17	24	35	37	9	26	15
Potamilla reniformis												
Proceraea sp												
Pseudomystides sp	4	2	5	3	1	4	8	1	1	3	6	3
Sabellaria vulgaris												
Scalibregma inflatum				1								
Scolelepis bousfieldi												
Scolelepis squamata			1									
Sigalion arenicola	1							1		1	1	
Sphaerosyllis erinaceus	19		38	15	16	22	8	4	4	23	5	15
Spio filicornis												1
Spio setosa	1	1				1						
Spiochaetopterus oculatus												
Spiophanes bombyx												
Spiroris borealis												
Syllides longocirratus	7	2	22	4	9	13	8	1	2	10	7	4
Syllis gracilis												
Travisia carnea						2		2				
Typosyllis(*Syllis*) *cornuta*												
OTHER (PHYLUM: sp(p)**)**												
COPAPODA: Harpacticoid spp	8	8	2	5	1	3	2	12	14	8	18	6
NEMERTEA: *Cerebratulus lacteus*	1	2					4					
NEMERTEA: Nemertea spp	1		3	1				1	1	1	3	
NEMATODA: Nematoda spp	1200	60	680	510	1004	720	850	720	740	580	990	450
PORIFERA: *Polymastia robusta*												
SIPUNCULOIDEA: *Golfingia* sp												

Species	T3-4rep1	T3-4rep2	T3-4rep3	T3-5rep1	T3-5rep2	T3-5rep3	T3-6rep1	T3-6rep2	T3-6rep3	T3-7rep1	T3-7rep2	T3-7rep3
No. Species	**28**	**23**	**24**	**23**	**18**	**26**	**22**	**25**	**24**	**22**	**26**	**20**
Total Number of Organisms	**1494**	**230**	**1037**	**685**	**1206**	**993**	**1020**	**857**	**909**	**774**	**1190**	**591**

Species List Year 2 (Winter 2017) of Vessel-Based Grab Samples (continued)

Species	T3-8rep1	T3-8rep2	T3-8rep3	T3-9rep1	T3-9rep2	T3-9rep3	T5-1rep1	T5-1rep2	T5-1rep3	T5-2rep1	T5-2rep2	T5-2rep3
ACTINIARIA												
Actinaria spp										1		
ARTHROPOPDA												
Amphipoda												
Ampelisca vadorum		1										
Byblis serrata					1							
Caprella linearis												
Gammaropsis maculata												
Hippomedon serratus				1		1						
Jassa marmorata												
Luconacia incerta												
Melita dentata												
Microdeutopus anomalus												
Monoculodes sp												
Phoxocephalus holbolli												
Pontogenia inermis												
Protohaustorius wigleyi				1	5	2						
Psammonyx nobilis												
Pseudunciola obliquua												
Rhepoxynuis epistomus				1		2						
Unciola irrorata	2	1	7			1	1	2	4		2	3
Brachypoda												
hutchinsoniella macracantha												
Cumacea												
Diastylis sp												
Oxyurostylis smithi												
Petalosarsia declivis												
Pseudoleptocuma minor												
Decapoda												
Cancer borealis												
Cancer irroratus												
Crangon septemspinosa												
Pagurus acadianus												
Pagurus annulipes												
Panopeus herbstii												
Pasiphaea sp.												

Species	T3-8rep1	T3-8rep2	T3-8rep3	T3-9rep1	T3-9rep2	T3-9rep3	T5-1rep1	T5-1rep2	T5-1rep3	T5-2rep1	T5-2rep2	T5-2rep3
Pinnotheres maculatus												
Isopoda												
Asellota sp												
Chiridotea caeca	1	3		1	2	3		4	2			1
Chiridotea tuftsi					1							
Edotea triloba	1							1				
Idotea phosphorea												
Politolana polita				2	2	2	1					
Ptilanthura tenuis												
Mysidacea												
Heteromysis formosa												
Mysidopsis bigelowi												
Sessilia												
Balanus amphitrite												
Tanaidacea												
Tanaissus psammophilus				3	1	8						
ECHINODERMATA												
Holothuroidea												
Cucumaria frondosa												
Leptosynapta sp												
MOLLUSKA												
Bivalvia												
Astarte borealis												
Astarte spp			1				1	1			2	
Cerastoderma pinnulatum												
Crassinella lunulata												
Crenella decussata										1		
Cyclocardia borealis												
Ensis directus												
Lyonsia arenosa				1								
Mytilus edulis										1	2	
Nucula tenuis	2											
Pitar morrhuanus												1
Spisula solidissima	1	1			1			1		4	3	
Tellina agilis												
Gastropoda												
Bittiolum varium												
Crepidula plana												

Species	T3-8rep1	T3-8rep2	T3-8rep3	T3-9rep1	T3-9rep2	T3-9rep3	T5-1rep1	T5-1rep2	T5-1rep3	T5-2rep1	T5-2rep2	T5-2rep3
Crucibulum striatum												
Epitonium multistriatum												
Euspira heros												
Euspira triseriata												
Ilyanassa trivittata												
Mangelia sp												
Polinices immaculatus											1	
Onoba sp												
Testudinalia testudinalis												
ANNELIDA												
Oligochaeta												
Oligochaeta spp	2		1									
Polychaeta												
Ampharete arctica												
Aricidea catherinae	3	7	23		1		5	1	2	25	9	2
Asabellides oculata												
Brania wellfleetensis												
Capitella sp												1
Caulleriella venefica					1	5						
Cirrophorus lyra			1									
Cirrophorus furcatus	11	13	11	6	1		5	3	3	3		3
Dipolydora sp			1									
Drilonereis longa												
Drilonereis magna												
Eteone lactea												
Eumida sanguinea			2						1			
Exogone hebes				2	2	1						
Glycera americana	1			1								
Glycera dibranchiata			1									
Goniadella gracilis	5	4	6	7	3	1	4	2	1	4	8	2
Harmothoe sp												
Leitoscoloplos robustus												
Lumbrinereis acuta	16	21	24	6	11	1	18	7	27	31		27
Lumbrinereis fragilis	2		3			1	1	2	1	3	1	
Maldanidae spp	1	1	7				1			1		
Marphysa bellii							2			3	1	3
Megalona sp												
Microphtalmus sckelkowwi	1	1					1		1			

Species	T3-8rep1	T3-8rep2	T3-8rep3	T3-9rep1	T3-9rep2	T3-9rep3	T5-1rep1	T5-1rep2	T5-1rep3	T5-2rep1	T5-2rep2	T5-2rep3
Monticellina baptisteae	5	4	6	1	3		1	1	3	4		
Nephtys spp						1						
Ophelia denticulata		1		2					1		1	
Orbinidae sp.												
Paranaitis speciosa												
Paraonis spp				1								
Parapionosyllis longicirrata	8	37	64	9	42	11	11	3	17	116	34	16
Parougia caeca	25	9	28	2	14	7	15	12	38	34	49	13
Phyllodoce arenae												
Pisione sp	43	44	62	1	1		30	19	37	46	47	13
Polycirrus eximius	28	33	61	1			18	11	22	42	26	32
Polydora spp												
Polygordius spp	26	29	30	7	13	1	30	7	19	28	25	37
Potamilla reniformis												
Proceraea sp												
Pseudomystides sp		1	2	4	7	1	9	3	8	8	5	2
Sabellaria vulgaris												
Scalibregma inflatum			1									
Scolelepis bousfieldi												
Scolelepis squamata				2								
Sigalion arenicola					1	1				1		1
Sphaerosyllis erinaceus	4	18	54	4	1		13	1	15	51	41	7
Spio filicornis												
Spio setosa												
Spiochaetopterus oculatus												
Spiophanes bombyx			1			1						
Spiroris borealis												
Syllides longocirratus	2	1	9		19		5	1	2	6	8	2
Syllis gracilis												
Travisia carnea			5						1	5	3	2
Typosyllis(*Syllis*) *cornuta*												
OTHER (PHYLUM: sp(p)**)**												
COPAPODA: Harpacticoid spp	3	8	2	6	2	3	15	6		26	14	
NEMERTEA: *Cerebratulus lacteus*						1						
NEMERTEA: Nemertea spp	2	2	2					1		2	3	1
NEMATODA: Nematoda spp	700	460	810	210	410	40	480	800		1116	800	
PORIFERA: *Polymastia robusta*												
SIPUNCULOIDEA: *Golfingia* sp												

Species	T3-8rep1	T3-8rep2	T3-8rep3	T3-9rep1	T3-9rep2	T3-9rep3	T5-1rep1	T5-1rep2	T5-1rep3	T5-2rep1	T5-2rep2	T5-2rep3
No. Species	**25**	**23**	**28**	**25**	**24**	**22**	**22**	**22**	**20**	**25**	**22**	**20**
Total Number of Organisms	**895**	**700**	**1225**	**282**	**545**	**95**	**667**	**889**	**205**	**1562**	**1085**	**169**

Species List Year 2 (Winter 2017) of Vessel-Based Grab Samples (continued)

Species	T5-3rep1	T5-3rep2	T5-3rep3	T5-4rep1	T5-4rep2	T5-4rep3	T5-5rep1	T5-5rep2	T5-5rep3	T5-6rep1	T5-6rep2	T5-6rep3
ACTINIARIA												
Actinaria spp						1						
ARTHROPOPDA												
Amphipoda												
Ampelisca vadorum												
Byblis serrata												
Caprella linearis												
Gammaropsis maculata												
Hippomedon serratus												
Jassa marmorata												
Luconacia incerta												
Melita dentata												
Microdeutopus anomalus												
Monoculodes sp												
Phoxocephalus holbolli												
Pontogenia inermis												
Protohaustorius wigleyi												
Psammonyx nobilis												
Pseudunciola obliquua												
Rhepoxynuis epistomus												
Unciola irrorata	2	2		4	3	1	2			2	5	5
Brachypoda												
hutchinsoniella macracantha												
Cumacea												
Diastylis sp												
Oxyurostylis smithi												
Petalosarsia declivis											1	
Pseudoleptocuma minor						1	1					
Decapoda												
Cancer borealis												
Cancer irroratus												
Crangon septemspinosa												
Pagurus acadianus												
Pagurus annulipes												
Panopeus herbstii												
Pasiphaea sp.												

Species	T5-3rep1	T5-3rep2	T5-3rep3	T5-4rep1	T5-4rep2	T5-4rep3	T5-5rep1	T5-5rep2	T5-5rep3	T5-6rep1	T5-6rep2	T5-6rep3
Pinnotheres maculatus												
Isopoda												
Asellota sp												
Chiridotea caeca	7	1	2	2	5	1	1		2	2	1	2
Chiridotea tuftsi												
Edotea triloba												
Idotea phosphorea												
Politolana polita							1					
Ptilanthura tenuis												
Mysidacea												
Heteromysis formosa												
Mysidopsis bigelowi												
Sessilia												
Balanus amphitrite												
Tanaidacea												
Tanaissus psammophilus							1					
ECHINODERMATA												
Holothuroidea												
Cucumaria frondosa												
Leptosynapta sp		1			2		2					
MOLLUSKA												
Bivalvia												
Astarte borealis												
Astarte spp				1			1			1		
Cerastoderma pinnulatum												
Crassinella lunulata												
Crenella decussata												
Cyclocardia borealis												
Ensis directus												
Lyonsia arenosa		1				1	1					
Mytilus edulis		1				1		2				
Nucula tenuis												
Pitar morrhuanus												
Spisula solidissima		3		2	1		2	2	2	1		
Tellina agilis												
Gastropoda												
Bittiolum varium				1								
Crepidula plana						7						

Species	T5-3rep1	T5-3rep2	T5-3rep3	T5-4rep1	T5-4rep2	T5-4rep3	T5-5rep1	T5-5rep2	T5-5rep3	T5-6rep1	T5-6rep2	T5-6rep3
Crucibulum striatum												
Epitonium multistriatum												
Euspira heros												
Euspira triseriata												
Ilyanassa trivittata												
Mangelia sp												
Polinices immaculatus				1								
Onoba sp												
Testudinalia testudinalis												
ANNELIDA												
Oligochaeta												
Oligochaeta spp					1							
Polychaeta												
Ampharete arctica										1		
Aricidea catherinae	4	16	4	8	15	5	2		2	2	6	2
Asabellides oculata												
Brania wellfleetensis												
Capitella sp						3						
Caulleriella venefica		1										
Cirrophorus lyra									1	1		
Cirrophorus furcatus	1	8	1	2	5	3	1	4	1	2	1	2
Dipolydora sp												
Drilonereis longa												
Drilonereis magna												
Eteone lactea												
Eumida sanguinea												
Exogone hebes												
Glycera americana												
Glycera dibranchiata												
Goniadella gracilis	8	1	1	5	9	5	7	4	2	9	2	2
Harmothoe sp												
Leitoscoloplos robustus												
Lumbrinereis acuta	22	27	10	15	32	18	12	14	3	6	20	18
Lumbrinereis fragilis			1					2			1	
Maldanidae spp				2	1			2				1
Marphysa bellii				2	1		3	2		1	2	1
Megalona sp												
Microphtalmus sckelkowwi			1		1							

Species	T5-3rep1	T5-3rep2	T5-3rep3	T5-4rep1	T5-4rep2	T5-4rep3	T5-5rep1	T5-5rep2	T5-5rep3	T5-6rep1	T5-6rep2	T5-6rep3
Monticellina baptisteae	3	3		4	7	1		2	1	1	1	
Nephtys spp												
Ophelia denticulata						1						
Orbinidae sp.												
Paranaitis speciosa												
Paraonis spp												
Parapionosyllis longicirrata	32	43	14	21	102	32	17	40	7	4	10	19
Parougia caeca	22	27	8	8	46	14	28	36	24	1	3	10
Phyllodoce arenae												
Pisione sp	30	28	18	17	29	28	72	52	14	22	24	30
Polycirrus eximius	47	46	21	26	27	17	41	36	5	21	50	32
Polydora spp												
Polygordius spp	9	10	17	15	14	16	46	32	7	28	17	8
Potamilla reniformis												
Proceraea sp												
Pseudomystides sp	3	6	3	1	5	6	11	4	4	2	5	7
Sabellaria vulgaris												
Scalibregma inflatum												
Scolelepis bousfieldi												
Scolelepis squamata												
Sigalion arenicola		1				1		2				
Sphaerosyllis erinaceus	18	15	5	17	114	11	14	18	6			5
Spio filicornis												
Spio setosa												
Spiochaetopterus oculatus												
Spiophanes bombyx	1											
Spiroris borealis						1						
Syllides longocirratus	5	7		1	21	3	5		1			
Syllis gracilis												
Travisia carnea	1	2	1	3	2	3	12	14	2			1
Typosyllis(*Syllis*) *cornuta*												
OTHER (PHYLUM: sp(p)**)**		3										
COPAPODA: Harpacticoid spp	30		4	3	32	3	7	24		6		18
NEMERTEA: *Cerebratulus lacteus*												1
NEMERTEA: Nemertea spp	1	1		1	1	1	2	2	1	2	2	
NEMATODA: Nematoda spp	540	190	410	228	980	330	440	580	240	180	90	280
PORIFERA: *Polymastia robusta*												
SIPUNCULOIDEA: *Golfingia* sp					1							

Species	T5-3rep1	T5-3rep2	T5-3rep3	T5-4rep1	T5-4rep2	T5-4rep3	T5-5rep1	T5-5rep2	T5-5rep3	T5-6rep1	T5-6rep2	T5-6rep3
No. species	**20**	**25**	**17**	**25**	**26**	**28**	**26**	**21**	**19**	**21**	**18**	**19**
Total Number of Organisms	**786**	**444**	**521**	**390**	**1457**	**515**	**732**	**874**	**325**	**295**	**241**	**444**

Species List Year 2 (Winter 2017) of Vessel-Based Grab Samples (continued)

Species	T5-7rep1	T5-7rep2	T5-7rep3	T5-8rep1	T5-8rep2	T5-8rep3	T5-9rep1	T5-9rep2	T5-9rep3	C1-1rep1	C1-1rep2	C1-1rep3
ACTINIARIA												
Actinaria spp	3		1									
ARTHROPOPDA												
Amphipoda												
Ampelisca vadorum							3			5	5	6
Byblis serrata								1				
Caprella linearis												
Gammaropsis maculata						1						
Hippomedon serratus												
Jassa marmorata												
Luconacia incerta												
Melita dentata												
Microdeutopus anomalus			1									
Monoculodes sp												
Phoxocephalus holbolli												
Pontogenia inermis												
Protohaustorius wigleyi												
Psammonyx nobilis				1								
Pseudunciola obliquua												
Rhepoxynuis epistomus												
Unciola irrorata	5	5	1	1	4		6	13	5	12	6	8
Brachypoda												
hutchinsoniella macracantha												
Cumacea												
Diastylis sp												
Oxyurostylis smithi												
Petalosarsia declivis												
Pseudoleptocuma minor					1						1	1
Decapoda												
Cancer borealis												
Cancer irroratus	1				1							
Crangon septemspinosa												
Pagurus acadianus					1							
Pagurus annulipes												
Panopeus herbstii												
Pasiphaea sp.												

Species	T5-7rep1	T5-7rep2	T5-7rep3	T5-8rep1	T5-8rep2	T5-8rep3	T5-9rep1	T5-9rep2	T5-9rep3	C1-1rep1	C1-1rep2	C1-1rep3
Pinnotheres maculatus												
Isopoda												
Asellota sp												
Chiridotea caeca	2	1			2	4		2				
Chiridotea tuftsi												
Edotea triloba					1						1	1
Idotea phosphorea												
Politolana polita												
Ptilanthura tenuis												
Mysidacea												
Heteromysis formosa												
Mysidopsis bigelowi												
Sessilia												
Balanus amphitrite						17						
Tanaidacea												
Tanaissus psammophilus					1			1			2	
ECHINODERMATA												
Holothuroidea												
Cucumaria frondosa												
Leptosynapta sp				4								
MOLLUSKA												
Bivalvia												
Astarte borealis												
Astarte spp		1			1		1	2	1			
Cerastoderma pinnulatum												
Crassinella lunulata												
Crenella decussata				2						3	2	
Cyclocardia borealis												
Ensis directus												
Lyonsia arenosa											2	
Mytilus edulis	1				1	5		1				
Nucula tenuis							1					
Pitar morrhuanus												
Spisula solidissima				2	4			1			2	1
Tellina agilis												
Gastropoda												
Bittiolum varium				1							2	
Crepidula plana												

Species	T5-7rep1	T5-7rep2	T5-7rep3	T5-8rep1	T5-8rep2	T5-8rep3	T5-9rep1	T5-9rep2	T5-9rep3	C1-1rep1	C1-1rep2	C1-1rep3
Crucibulum striatum												
Epitonium multistriatum												
Euspira heros												
Euspira triseriata												
Ilyanassa trivittata												
Mangelia sp												
Polinices immaculatus						1	1					
Onoba sp												
Testudinalia testudinalis												
ANNELIDA												
Oligochaeta												
Oligochaeta spp			4	1		1		1	1			1
Polychaeta												
Ampharete arctica	1							1		2		
Aricidea catherinae	7		9	2	3	1	2	9	9	8	5	4
Asabellides oculata												
Brania wellfleetensis			1									
Capitella sp												
Caulleriella venefica					3							
Cirrophorus lyra	1								1			2
Cirrophorus furcatus	4		5	2	1			4	1			
Dipolydora sp		1										
Drilonereis longa												
Drilonereis magna												
Eteone lactea												
Eumida sanguinea	4			1				1	1			
Exogone hebes					1							
Glycera americana	1	1						1				
Glycera dibranchiata												
Goniadella gracilis	3	3	2	5	6	2	1	3	11		8	3
Harmothoe sp												
Leitoscoloplos robustus												
Lumbrinereis acuta	46	14	10	7	14	1	12	14	16	8	7	11
Lumbrinereis fragilis	1	3						1	1	2	1	2
Maldanidae spp	1		1					1		2		1
Marphysa bellii		2	2		1			1	3	2		
Megalona sp												
Microphtalmus sckelkowwi						1					1	

Species	T5-7rep1	T5-7rep2	T5-7rep3	T5-8rep1	T5-8rep2	T5-8rep3	T5-9rep1	T5-9rep2	T5-9rep3	C1-1rep1	C1-1rep2	C1-1rep3
Monticellina baptisteae	5		2	2	2			2	4	1		
Nephtys spp					1							
Ophelia denticulata												
Orbinidae sp.					1							
Paranaitis speciosa												
Paraonis spp												
Parapionosyllis longicirrata	85	4	44	19	19	15	1	5	11		3	16
Parougia caeca	4	4	36	17	7	7		19	1		8	4
Phyllodoce arenae												
Pisione sp	37	21	48	30	11	17	26	17	23	15	20	29
Polycirrus eximius	55	15	69	53	50	56	4	26	28	25	23	22
Polydora spp											1	
Polygordius spp	43	240	16	18	11	4	11	20	14	4	10	6
Potamilla reniformis						1						
Proceraea sp									1			
Pseudomystides sp	5		2	18	1	2		4	3			
Sabellaria vulgaris						2						
Scalibregma inflatum												
Scolelepis bousfieldi												
Scolelepis squamata								1				
Sigalion arenicola			1	1				1	1			
Sphaerosyllis erinaceus	2		21	5	7	13		4	2	3	1	7
Spio filicornis											1	
Spio setosa												
Spiochaetopterus oculatus												
Spiophanes bombyx				1							1	
Spiroris borealis	4											
Syllides longocirratus	1		2	1	6	3			1	2		5
Syllis gracilis											1	
Travisia carnea		10	3		5	2		1		1	4	4
Typosyllis(*Syllis*) *cornuta*												
OTHER (PHYLUM: sp(p)**)**												
COPAPODA: Harpacticoid spp	8	1	8			4	7	2	2			2
NEMERTEA: *Cerebratulus lacteus*												90
NEMERTEA: Nemertea spp	3		2	1	3		2	7		1	4	3
NEMATODA: Nematoda spp	530	620	580	250	630	170	30	170	310	48	72	
PORIFERA: *Polymastia robusta*												
SIPUNCULOIDEA: *Golfingia* sp												

Species	T5-7rep1	T5-7rep2	T5-7rep3	T5-8rep1	T5-8rep2	T5-8rep3	T5-9rep1	T5-9rep2	T5-9rep3	C1-1rep1	C1-1rep2	C1-1rep3
No. Species	**28**	**17**	**25**	**25**	**31**	**23**	**15**	**32**	**24**	**18**	**27**	**23**
Total Number of Organisms	**863**	**946**	**871**	**445**	**800**	**330**	**108**	**337**	**451**	**144**	**194**	**229**

Species List Year 2 (Winter 2017) of Vessel-Based Grab Samples (continued)

Species	C1-2rep1	C1-2rep2	C1-2rep3	C1-3rep1	C1-3rep2	C1-3rep3	C2-1rep1	C2-1rep2	C2-1rep3	C2-2rep1	C2-2rep2	C2-2rep3
ACTINIARIA												
Actinaria spp	1											
ARTHROPOPDA												
Amphipoda												
Ampelisca vadorum				1		1	6	3	1	1	4	2
Byblis serrata												
Caprella linearis												
Gammaropsis maculata												
Hippomedon serratus												
Jassa marmorata												
Luconacia incerta												
Melita dentata												
Microdeutopus anomalus												
Monoculodes sp												
Phoxocephalus holbolli												
Pontogenia inermis												
Protohaustorius wigleyi												
Psammonyx nobilis												
Pseudunciola obliquua												
Rhepoxynuis epistomus												
Unciola irrorata	2	11	3	3	9	2	6	16		7	21	7
Brachypoda												
hutchinsoniella macracantha												
Cumacea												
Diastylis sp												
Oxyurostylis smithi				1								
Petalosarsia declivis												
Pseudoleptocuma minor					1							
Decapoda												
Cancer borealis												
Cancer irroratus												
Crangon septemspinosa										1		
Pagurus acadianus												
Pagurus annulipes				1								
Panopeus herbstii												
Pasiphaea sp.	1											

Species	C1-2rep1	C1-2rep2	C1-2rep3	C1-3rep1	C1-3rep2	C1-3rep3	C2-1rep1	C2-1rep2	C2-1rep3	C2-2rep1	C2-2rep2	C2-2rep3
Pinnotheres maculatus												
Isopoda												
Asellota sp												
Chiridotea caeca		1		1		1		2		2	1	4
Chiridotea tuftsi												
Edotea triloba		1		1			1	1	1	1		
Idotea phosphorea				1								
Politolana polita												
Ptilanthura tenuis												
Mysidacea												
Heteromysis formosa												
Mysidopsis bigelowi												
Sessilia												
Balanus amphitrite												
Tanaidacea												
Tanaissus psammophilus	1											
ECHINODERMATA												
Holothuroidea												
Cucumaria frondosa												
Leptosynapta sp		2		1	3		1		2			
MOLLUSKA												
Bivalvia												
Astarte borealis												
Astarte spp		1		1			1					
Cerastoderma pinnulatum						1						
Crassinella lunulata					2							
Crenella decussata		4	4	3	4	2						1
Cyclocardia borealis												
Ensis directus												
Lyonsia arenosa	1	1	1	2	1							3
Mytilus edulis												1
Nucula tenuis									1			
Pitar morrhuanus						1						
Spisula solidissima		6		1	1	1	5	1	2	5	3	10
Tellina agilis												
Gastropoda												
Bittiolum varium												2
Crepidula plana												

Species	C1-2rep1	C1-2rep2	C1-2rep3	C1-3rep1	C1-3rep2	C1-3rep3	C2-1rep1	C2-1rep2	C2-1rep3	C2-2rep1	C2-2rep2	C2-2rep3
Crucibulum striatum												
Epitonium multistriatum			1									
Euspira heros												
Euspira triseriata												
Ilyanassa trivittata												
Mangelia sp												
Polinices immaculatus				1								
Onoba sp												
Testudinalia testudinalis												
ANNELIDA												
Oligochaeta												
Oligochaeta spp		1		2	7	2			2			2
Polychaeta												
Ampharete arctica						1			1		1	
Aricidea catherinae		3		1	2	3	20	16	34	21	17	19
Asabellides oculata						1						
Brania wellfleetensis									1			3
Capitella sp												
Caulleriella venefica												
Cirrophorus lyra		1		2	1	4	2	7			1	3
Cirrophorus furcatus		2			3		22	29	17	9	12	10
Dipolydora sp												
Drilonereis longa												
Drilonereis magna												
Eteone lactea												
Eumida sanguinea				2	1			2		1	1	1
Exogone hebes	1											
Glycera americana	1	1										
Glycera dibranchiata												
Goniadella gracilis	1	5	1	6		5	14	3	2	2	3	5
Harmothoe sp											1	
Leitoscoloplos robustus												
Lumbrinereis acuta		21		5	36	13	33	31	55	67	17	56
Lumbrinereis fragilis		1					1		2	2	1	2
Maldanidae spp				1	1		8	2	7	3		5
Marphysa bellii			1		1	1	1		4	6	1	3
Megalona sp												
Microphtalmus sckelkowwi		1			2		3	1				

Species	C1-2rep1	C1-2rep2	C1-2rep3	C1-3rep1	C1-3rep2	C1-3rep3	C2-1rep1	C2-1rep2	C2-1rep3	C2-2rep1	C2-2rep2	C2-2rep3
Monticellina baptisteae		1						2	4	8	2	6
Nephtys spp												
Ophelia denticulata							1					
Orbinidae sp.	1											
Paranaitis speciosa		1										
Paraonis spp												
Parapionosyllis longicirrata	1	39	4	1	16	18	31	16	73	83	37	87
Parougia caeca		6	1	1	14	6	22	8	15	35	19	12
Phyllodoce arenae												
Pisione sp	1	42	16	28	104	29	32	43	29	30	49	75
Polycirrus eximius	6	37	8	19	29	36	103	64	89	65	35	140
Polydora spp										1	1	
Polygordius spp	1	11	2	17	32	16	37	68	30	27	36	35
Potamilla reniformis												
Proceraea sp				1								
Pseudomystides sp					6		2		2	5	3	8
Sabellaria vulgaris				4								
Scalibregma inflatum												
Scolelepis bousfieldi												
Scolelepis squamata												1
Sigalion arenicola									1			
Sphaerosyllis erinaceus		34	4	5	28	49	22	2	90	59	18	44
Spio filicornis									1			
Spio setosa												
Spiochaetopterus oculatus												
Spiophanes bombyx			1			1	2				1	
Spiroris borealis				2								4
Syllides longocirratus	1	5		1	5	5	12	3	10	12	8	15
Syllis gracilis								1			1	1
Travisia carnea	1	11	10	12	13	20	1			2		
Typosyllis(*Syllis*) *cornuta*									1		**1**	
OTHER (PHYLUM: sp(p)**)**												
COPAPODA: Harpacticoid spp	8			10	24	40	28	13	36	23	18	44
NEMERTEA: *Cerebratulus lacteus*							1					
NEMERTEA: Nemertea spp	2	6		1	2	4		2		3	2	3
NEMATODA: Nematoda spp	116	860	66	210	210	180	690	360	1240	990	1140	720
PORIFERA: *Polymastia robusta*	1											
SIPUNCULOIDEA: *Golfingia* sp												

Species	C1-2rep1	C1-2rep2	C1-2rep3	C1-3rep1	C1-3rep2	C1-3rep3	C2-1rep1	C2-1rep2	C2-1rep3	C2-2rep1	C2-2rep2	C2-2rep3
No. species	**19**	**29**	**15**	**34**	**28**	**27**	**29**	**25**	**29**	**28**	**30**	**34**
Total Number of Organisms	**148**	**1116**	**123**	**349**	**558**	**443**	**1108**	**696**	**1753**	**1471**	**1455**	**1334**

Species List Year 2 (Winter 2017) of Vessel-Based Grab Samples (continued)

Species	C2-3rep1	C2-3rep2	C2-3rep3	C3-3rep1	C3-3rep2	C3-3rep3	C3-2rep1	C3-2rep2	C3-2rep3	C3-3rep1	C3-3rep2	C3-3rep3
ACTINIARIA												
Actinaria spp												
ARTHROPOPDA												
Amphipoda												
Ampelisca vadorum		2		1	2	2	2		5	1	2	1
Byblis serrata						1						
Caprella linearis												
Gammaropsis maculata												
Hippomedon serratus												
Jassa marmorata												
Luconacia incerta												
Melita dentata												
Microdeutopus anomalus												
Monoculodes sp												
Phoxocephalus holbolli						1						
Pontogenia inermis												
Protohaustorius wigleyi												
Psammonyx nobilis												
Pseudunciola obliquua												
Rhepoxynuis epistomus												
Unciola irrorata	1	2		6	5	13		7	23	11	5	8
Brachypoda												
hutchinsoniella macracantha	1											
Cumacea												
Diastylis sp												
Oxyurostylis smithi									1			
Petalosarsia declivis												
Pseudoleptocuma minor												
Decapoda												
Cancer borealis												
Cancer irroratus				1						1		
Crangon septemspinosa												
Pagurus acadianus												
Pagurus annulipes											1	
Panopeus herbstii												
Pasiphaea sp.												

Species	C2-3rep1	C2-3rep2	C2-3rep3	C3-3rep1	C3-3rep2	C3-3rep3	C3-2rep1	C3-2rep2	C3-2rep3	C3-3rep1	C3-3rep2	C3-3rep3
Pinnotheres maculatus												
Isopoda												
Asellota sp												
Chiridotea caeca	3						1	1	1			
Chiridotea tuftsi												
Edotea triloba												
Idotea phosphorea												
Politolana polita												
Ptilanthura tenuis												
Mysidacea												
Heteromysis formosa												
Mysidopsis bigelowi												
Sessilia												
Balanus amphitrite												
Tanaidacea												
Tanaissus psammophilus		1										
ECHINODERMATA												
Holothuroidea												
Cucumaria frondosa	1											
Leptosynapta sp												
MOLLUSKA												
Bivalvia												
Astarte borealis												
Astarte spp												
Cerastoderma pinnulatum												
Crassinella lunulata												
Crenella decussata												
Cyclocardia borealis	1											
Ensis directus												
Lyonsia arenosa												
Mytilus edulis												
Nucula tenuis						1						
Pitar morrhuanus												
Spisula solidissima	4	2		2		2	1	2		1	2	1
Tellina agilis												1
Gastropoda												
Bittiolum varium												
Crepidula plana												

Species	C2-3rep1	C2-3rep2	C2-3rep3	C3-3rep1	C3-3rep2	C3-3rep3	C3-2rep1	C3-2rep2	C3-2rep3	C3-3rep1	C3-3rep2	C3-3rep3
Crucibulum striatum												
Epitonium multistriatum												
Euspira heros												
Euspira triseriata												
Ilyanassa trivittata							1					
Mangelia sp												
Polinices immaculatus		1										
Onoba sp												
Testudinalia testudinalis												
ANNELIDA												
Oligochaeta												
Oligochaeta spp					1				1			
Polychaeta												
Ampharete arctica				1	2						1	
Aricidea catherinae	5	3	27	4		9	6	13	8	1	15	5
Asabellides oculata												
Brania wellfleetensis												
Capitella sp												
Caulleriella venefica				1								
Cirrophorus lyra			1	2	1	1			2	1		2
Cirrophorus furcatus	7	19	6	2	13	20	2	2	1	2	9	6
Dipolydora sp							2					1
Drilonereis longa								1				
Drilonereis magna												
Eteone lactea												
Eumida sanguinea	1											
Exogone hebes				3		2	6	3	2	1		
Glycera americana			1	1		1				1	1	
Glycera dibranchiata												
Goniadella gracilis	3	5	3		5	14	11	7	10	2	6	8
Harmothoe sp											1	
Leitoscoloplos robustus												
Lumbrinereis acuta	8	12	60	21	23	28	32	2	7	18	30	21
Lumbrinereis fragilis	3	1	2	6	6	4	8	9	6	4	8	7
Maldanidae spp	4	1	3	4	3	2	4	6	4	1	4	6
Marphysa bellii	2	1	2	3	2	5	5	1	4	1		6
Megalona sp												
Microphtalmus sckelkowwi	2											

Species	C2-3rep1	C2-3rep2	C2-3rep3	C3-3rep1	C3-3rep2	C3-3rep3	C3-2rep1	C3-2rep2	C3-2rep3	C3-3rep1	C3-3rep2	C3-3rep3
Monticellina baptisteae	3		6	2	5	12	3	2	1	3	4	1
Nephtys spp							1					
Ophelia denticulata												
Orbinidae sp.												
Paranaitis speciosa												
Paraonis spp												
Parapionosyllis longicirrata	43	3	18	5	5	4	11	3	20	1	54	10
Parougia caeca	6	2	3		3	2	9	1	3		4	2
Phyllodoce arenae							1				1	1
Pisione sp	52	12	33	6	6	3	10	10	10	5	11	4
Polycirrus eximius	63	34	84	2	2		6	5	3		4	1
Polydora spp					2							
Polygordius spp	18	11	12	13	16	14	70	4	62	14	39	35
Potamilla reniformis									1			
Proceraea sp												
Pseudomystides sp												
Sabellaria vulgaris												
Scalibregma inflatum	1							1	2			
Scolelepis bousfieldi												
Scolelepis squamata												
Sigalion arenicola	1											
Sphaerosyllis erinaceus	25	5	21	1	43	3	3	3	74	3	102	59
Spio filicornis												
Spio setosa												
Spiochaetopterus oculatus												
Spiophanes bombyx	1						3		1		1	
Spiroris borealis												
Syllides longocirratus	14		2	2	7	2	1	2	4		14	3
Syllis gracilis												
Travisia carnea		1										
Typosyllis(*Syllis*) *cornuta*												
OTHER (PHYLUM: sp(p)**)**												
COPAPODA: Harpacticoid spp	18	0	12		4		2	1	22		10	10
NEMERTEA: *Cerebratulus lacteus*												
NEMERTEA: Nemertea spp		1		1	1		2	1	1	1		1
NEMATODA: Nematoda spp	1120	660	910	30	360	280	126	192	300	54	360	480
PORIFERA: *Polymastia robusta*												
SIPUNCULOIDEA: *Golfingia* sp												

Species	C2-3rep1	C2-3rep2	C2-3rep3	C3-3rep1	C3-3rep2	C3-3rep3	C3-2rep1	C3-2rep2	C3-2rep3	C3-3rep1	C3-3rep2	C3-3rep3
No. species	**28**	**22**	**19**	**24**	**23**	**24**	**27**	**24**	**28**	**21**	**25**	**25**
Total Number of Organisms	**1411**	**779**	**1206**	**120**	**517**	**426**	**329**	**279**	**579**	**127**	**689**	**680**

Species List Year 2 (Summer 2017) of Diver-Based Grab Samples

Species	T1-FP1	T1-FP2	T1-FP3	T1-FP4	T1-FP5	T3-FP1	T3-FP2	T3-FP3	T3-FP4	T3-FP5	T5-FP1	T5-FP2	T5-FP3	T5-FP4	T5-FP5
Amphipoda															
Ampelisca agassizi													7		
Ampelisca vadorum												1			
Byblis serrata							3	4	6			7	68	12	9
Caprella linearis										1					
Corophium spp															2
Gammaropsis maculata								1				1			1
Jassa marmorata								1			2	11			3
Leptocheirus pinguis								1							
Monoculodes sp								1	1						
Photis sp												1			
Pontogenia inermis								1			1	2			5
Unciola irrorata		3	3	13		5		20		1	15	49	12	15	23
Cumacea															
Diastylis sp												1			
Decapoda															
Cancer borealis					2										
Cancer irroratus			1		1										
Crangon septemspinosa												1			
Pagurus acadianus			1	1											
Pagurus annulipes						1									
Pinnotheres maculatus		1													
Isopoda															
Chiridotea caeca								1				2	2		
Politolana polita							1	2				2	2	1	
Sessilia															
Balanus amphitrite	79	7	17	19	8	46	1	6	12	11	13	6	1		17
MOLLUSKA															
Bivalvia															
*Aequipecten irradians**									1		2	1			
Anomia simplex		1				1									
Astarte spp											3	4	1	1	
Crassinella lunulata											1				
Crenella decussata												1			
Lyonsia arenosa								1				1	1		
Mytilus edulis	15	33	11	7	23	7	1	12	2	7	80	118	29	23	300

Species	T1-FP1	T1-FP2	T1-FP3	T1-FP4	T1-FP5	T3-FP1	T3-FP2	T3-FP3	T3-FP4	T3-FP5	T5-FP1	T5-FP2	T5-FP3	T5-FP4	T5-FP5
Spisula solidissima												1			2
Tellina agilis										1					
Gastropoda															
Crepidula plana	1														
Euspira heros			2												
ANNELIDA															
Polychaeta															
Ampharete arctica		1					1							1	1
Aricidea albatrossae									1			1			
Aricidea catherinae									1			3	2	1	3
Capitella sp		3		1		1				1					
Caulleriella venefica												1			
Dipolydora sp		3		4											
Eteone longa	1	3		1											
Eulalia viridis					1										
Eumida sanguinea								1			1		1		
Glycera dibranchiata													2		
Goniadella gracilis		1	1				4	1	2		2	2	2	1	9
Harmothoe sp	3	7	1	2	7			2		1					
Leitoscoloplos robustus			1	1											
Lepidonotus squamatus		2													
Lumbrinereis acuta							1	2			8	10	3	1	3
Lumbrinereis fragilis	14	16	4	10	1	2	1	7	6		3	8	9	10	8
Maldanidae spp											1				
Marphysa bellii												1			1
Microphtalmus sckelkowii		1													2
Monticellina baptisteae								2	1				2		
Nephtys spp												1			
Nereis arenaceodonta								1					1		
Ophioglycera gigantea			1	1							1		1		
Parapionosyllis longicirrata							1	4	2			7	13	2	
Parougia caeca		6					4	1	2		2	7	10		
Phyllodoce maculata	1														
Pisione sp						2	1	5		1	5	12	11	13	12
Polycirrus eximius			1			1		1			1	5	2		1
Polydora spp														1	
Polygordius spp						1	5	3	7	3	5	66	18	16	13
Sigalion arenicola														1	

Species	T1-FP1	T1-FP2	T1-FP3	T1-FP4	T1-FP5	T3-FP1	T3-FP2	T3-FP3	T3-FP4	T3-FP5	T5-FP1	T5-FP2	T5-FP3	T5-FP4	T5-FP5
Sphaerosyllis erinaceus													2		
Spirorbis borealis														1	
Harpacticoid spp													2		
Nemertea spp						1		1		1			2		
Nematoda spp	2	40	24	12	2	3	2	12	1	3	340	380	280	320	300
Turbellaria sp							3								1
No. Species	**8**	**16**	**13**	**12**	**8**	**12**	**14**	**26**	**14**	**11**	**19**	**32**	**27**	**17**	**21**
Total No. Individuals	**116**	**128**	**68**	**72**	**45**	**71**	**29**	**94**	**45**	**31**	**486**	**714**	**486**	**420**	**716**

Note: *Aequipecten irradians/Placopecten magellanicus (juveniles)

Appendix 7. Summary Macrofaunal Species Statistics for Vessel-Based Data Collection

Vessel-Based Samples Year 1						
Sample ID	**No. Species (S)**	**No. individuals (N)**	**Richness (d)**	**Eveness (J')**	**Diversity (H'(loge))**	**Dominance (1-λ)'**
T1-1_1	25	96	5.258	0.698	2.247	0.790
T1-1_2	6	7	2.569	0.976	1.748	0.952
T1-1_3	15	45	3.678	0.767	2.078	0.812
T1-2_1	18	40	4.608	0.870	2.516	0.910
T1-2_2	14	53	3.274	0.777	2.051	0.804
T1-2_3	23	122	4.579	0.734	2.303	0.860
T1-3_1	8	31	2.038	0.879	1.829	0.839
T1-3_2	16	74	3.485	0.801	2.220	0.864
T1-3_3	24	398	3.842	0.489	1.554	0.634
T1-4_1	26	128	5.152	0.831	2.706	0.913
T1-4_2	17	56	3.975	0.818	2.318	0.876
T1-4_3	11	44	2.643	0.847	2.030	0.845
T1-5_1	29	117	5.880	0.863	2.905	0.935
T1-5_2	16	54	3.760	0.783	2.171	0.845
T1-5_3	19	88	4.020	0.744	2.191	0.840
T1-6_1	27	45	6.830	0.929	3.063	0.958
T1-6_2	15	26	4.297	0.924	2.502	0.935
T1-6_3	9	14	3.031	0.931	2.045	0.912
T1-7_1	12	22	3.559	0.874	2.172	0.883
T1-7_2	6	14	1.895	0.754	1.352	0.681
T1-7_3	8	47	1.818	0.705	1.467	0.690
T1-8_1	13	44	3.171	0.833	2.136	0.867
T1-8_2	5	13	1.559	0.919	1.479	0.808
T1-8_3	17	64	3.847	0.863	2.444	0.904
T1-9_1	23	100	4.777	0.840	2.634	0.908
T1-9_2	25	106	5.146	0.788	2.536	0.882
T1-9_3	22	91	4.655	0.753	2.328	0.843
T3-1_1	22	172	4.080	0.776	2.398	0.873
T3-1_2	24	204	4.325	0.665	2.113	0.777
T3-1_3	19	274	3.207	0.625	1.841	0.756
T3-2_1	19	187	3.441	0.707	2.083	0.803
T3-2_2	23	224	4.065	0.804	2.522	0.885
T3-2_3	22	198	3.971	0.753	2.328	0.860
T3-3_1	23	212	4.107	0.669	2.098	0.810
T3-3_2	23	327	3.800	0.642	2.012	0.753
T3-3_3	19	139	3.648	0.782	2.303	0.861
T3-4_1	17	131	3.282	0.810	2.296	0.860
T3-4_2	16	110	3.191	0.787	2.181	0.849
T3-4_3	16	108	3.204	0.852	2.363	0.890
T3-5_1	20	120	3.969	0.655	1.963	0.745
T3-5_2	21	62	4.846	0.855	2.604	0.900
T3-5_3	19	147	3.607	0.795	2.342	0.877
T3-6_1	19	107	3.852	0.793	2.336	0.863

Vessel-Based Samples Year 1						
Sample ID	**No. Species (S)**	**No. individuals (N)**	**Richness (d)**	**Eveness (J')**	**Diversity (H'(loge))**	**Dominance (1-λ)'**
T3-6_2	28	271	4.820	0.808	2.693	0.901
T3-6_3	26	348	4.272	0.661	2.153	0.820
T3-7_1	14	192	2.473	0.456	1.203	0.462
T3-7_2	24	278	4.087	0.681	2.163	0.804
T3-7_3	25	221	4.446	0.781	2.514	0.894
T3-8_1	22	208	3.934	0.666	2.058	0.777
T3-8_2	23	361	3.736	0.682	2.137	0.820
T3-8_3	24	233	4.219	0.762	2.421	0.877
T3-9_1	12	86	2.469	0.868	2.156	0.872
T3-9_2	20	151	3.787	0.751	2.249	0.828
T3-9_3	18	111	3.610	0.765	2.211	0.841
T5-1_1	19	122	3.747	0.762	2.244	0.865
T5-1_2	17	213	2.984	0.614	1.741	0.715
T5-1_3	19	384	3.025	0.275	0.810	0.328
T5-2_1	18	161	3.346	0.703	2.032	0.805
T5-2_2	20	243	3.459	0.530	1.587	0.641
T5-2_3	15	159	2.762	0.583	1.578	0.664
T5-3_1	12	35	3.094	0.883	2.193	0.892
T5-3_2	12	102	2.378	0.721	1.793	0.783
T5-3_3	19	362	3.055	0.758	2.233	0.854
T5-4_1	26	177	4.830	0.601	1.957	0.689
T5-4_2	19	129	3.704	0.540	1.590	0.600
T5-4_3	13	61	2.919	0.799	2.050	0.846
T5-5_1	22	126	4.342	0.588	1.819	0.661
T5-5_2	21	67	4.757	0.659	2.006	0.707
T5-5_3	17	86	3.592	0.493	1.395	0.511
T5-6_1	16	234	2.750	0.690	1.914	0.817
T5-6_2	23	247	3.993	0.629	1.972	0.788
T5-6_3	16	250	2.717	0.656	1.817	0.787
T5-7_1	22	137	4.268	0.775	2.394	0.869
T5-7_2	17	227	2.949	0.712	2.016	0.818
T5-7_3	13	109	2.558	0.612	1.569	0.684
T5-8_1	17	215	2.979	0.675	1.913	0.800
T5-8_2	8	77	1.611	0.738	1.534	0.721
T5-8_3	9	56	1.987	0.787	1.730	0.785
T5-9_1	15	224	2.587	0.737	1.997	0.820
T5-9_2	23	411	3.655	0.621	1.948	0.794
T5-9_3	19	311	3.136	0.647	1.905	0.787
C1-1_1	28	143	5.440	0.773	2.575	0.887
C1-1_2	28	787	4.049	0.261	0.870	0.312
C1-1_3	26	112	5.298	0.790	2.574	0.889
C1-2_1	15	50	3.579	0.663	1.796	0.697
C1-2_2	5	38	1.100	0.478	0.770	0.371
C1-2_3	12	80	2.510	0.568	1.413	0.588
C1-3_1	13	122	2.498	0.698	1.791	0.770
C1-3_2	13	116	2.524	0.782	2.006	0.839
C1-3_3	17	118	3.354	0.721	2.042	0.808

Vessel-Based Samples Year 1						
Sample ID	**No. Species (S)**	**No. individuals (N)**	**Richness (d)**	**Eveness (J')**	**Diversity (H'(loge))**	**Dominance (1-λ)'**
C1-4_1	34	106	7.076	0.923	3.256	0.961
C1-4_2	31	230	5.517	0.757	2.600	0.870
C1-4_3	37	311	6.272	0.814	2.938	0.925
C2-1_1	34	399	5.510	0.727	2.563	0.863
C2-1_2	28	261	4.852	0.730	2.433	0.846
C2-1_3	19	107	3.852	0.872	2.567	0.908
C2-2_1	35	195	6.448	0.710	2.525	0.836
C2-2_2	27	343	4.454	0.714	2.354	0.827
C2-2_3	21	145	4.019	0.801	2.440	0.883
C2-3_1	34	180	6.355	0.769	2.712	0.886
C2-3_2	21	200	3.775	0.632	1.923	0.722
C2-3_3	18	119	3.557	0.777	2.245	0.826
C2-4_1	18	72	3.975	0.868	2.509	0.908
C2-4_2	14	30	3.822	0.818	2.159	0.834
C2-4_3	19	41	4.847	0.855	2.518	0.901
C3-1_1	27	163	5.104	0.779	2.568	0.883
C3-1_2	30	189	5.533	0.759	2.581	0.886
C3-1_3	25	103	5.178	0.821	2.642	0.903
C3-2_1	17	63	3.862	0.796	2.256	0.854
C3-2_2	11	36	2.791	0.875	2.099	0.871
C3-2_3	5	5	2.485	1.000	1.609	1.000
C3-3_1	31	135	6.116	0.819	2.813	0.915
C3-3_2	28	184	5.177	0.669	2.229	0.818
C3-3_3	20	117	3.990	0.705	2.112	0.803
C3-4_1	24	146	4.615	0.708	2.251	0.832
C3-4_2	25	232	4.406	0.639	2.055	0.769
C3-4_3	24	81	5.234	0.819	2.603	0.903
T1-QC	14	77	2.993	0.741	1.955	0.785
T3-QC	21	230	3.678	0.808	2.460	0.890
T5-QC	24	143	4.634	0.777	2.470	0.878
C3-QC	16	60	3.664	0.718	1.990	0.790

Vessel-Based Samples Year 2						
Sample	No. Species	No. Individuals	Richness (d')	Eveness (J')	Diveristy (H')	Dominance (1-λ)
T1-1rep1	20	75	4.401	0.8454	2.533	0.898
T1-1rep2	20	98	4.144	0.807	2.418	0.8811
T1-1rep3	25	131	4.923	0.7531	2.424	0.8604
T1-2rep1	17	115	3.372	0.5466	1.549	0.6226
T1-2rep2	13	131	2.461	0.4785	1.227	0.511
T1-2rep3	18	124	3.527	0.6538	1.89	0.7671
T1-3rep1	18	156	3.366	0.5582	1.613	0.6426
T1-3rep2	12	91	2.439	0.5353	1.33	0.5499
T1-3rep3	18	110	3.617	0.6228	1.8	0.7351
T1-4rep1	15	70	3.295	0.7029	1.903	0.7764
T1-4rep2	25	193	4.56	0.6458	2.079	0.7623
T1-4rep3	19	126	3.722	0.7943	2.339	0.8632
T1-5rep1	16	101	3.25	0.7045	1.953	0.7804
T1-5rep2	22	195	3.983	0.5758	1.78	0.6643
T1-5rep3	18	263	3.051	0.3943	1.14	0.4401
T1-6rep1	24	216	4.279	0.5808	1.846	0.7076
T1-6rep2	19	90	4	0.7035	2.071	0.7825
T1-6rep3	27	174	5.04	0.6662	2.196	0.8035
T1-7rep1	25	110	5.106	0.6245	2.01	0.6941
T1-7rep2	27	168	5.074	0.6801	2.242	0.8159
T1-7rep3	24	1055	3.304	0.2264	0.7196	0.2529
T1-8rep1	10	32	2.597	0.8845	2.037	0.8629
T1-8rep2	27	529	4.146	0.4395	1.449	0.5265
T1-8rep3	17	83	3.621	0.6019	1.705	0.6309
T1-9rep1	19	198	3.404	0.5019	1.478	0.5563
T1-9rep2	16	110	3.191	0.7082	1.963	0.7838
T1-9rep3	22	152	4.18	0.5357	1.656	0.6252
T3-1rep1	26	882	3.686	0.3977	1.296	0.4664
T3-1rep2	23	587	3.451	0.5478	1.718	0.6451
T3-1rep3	19	387	3.021	0.6756	1.989	0.7548
T3-2rep1	24	778	3.455	0.3539	1.125	0.4003
T3-2rep2	18	964	2.474	0.3005	0.8686	0.3084
T3-2rep3	27	819	3.876	0.4943	1.629	0.599
T3-3rep1	24	1342	3.194	0.4171	1.325	0.4807
T3-3rep2	23	352	3.752	0.5283	1.656	0.5976
T3-3rep3	27	1085	3.72	0.348	1.147	0.4093
T3-4rep1	28	1494	3.694	0.3004	1.001	0.351
T3-4rep2	23	230	4.046	0.7341	2.302	0.8483
T3-4rep3	24	1037	3.312	0.4817	1.531	0.5595

Vessel-Based Samples Year 2						
Sample	No. Species	No. Individuals	Richness (d')	Eveness (J')	Diveristy (H')	Dominance (1-λ)
T3-5rep1	23	685	3.369	0.3936	1.234	0.4399
T3-5rep2	18	1206	2.396	0.2945	0.8513	0.3041
T3-5rep3	26	993	3.623	0.3925	1.279	0.4659
T3-6rep1	22	1020	3.031	0.2892	0.8938	0.3035
T3-6rep2	25	857	3.554	0.2655	0.8547	0.2917
T3-6rep3	24	909	3.376	0.2988	0.9497	0.3337
T3-7rep1	22	774	3.157	0.3868	1.196	0.4327
T3-7rep2	26	1190	3.53	0.2747	0.895	0.3055
T3-7rep3	20	591	2.977	0.3837	1.149	0.4153
T3-8rep1	25	895	3.531	0.3309	1.065	0.3831
T3-8rep2	23	700	3.358	0.4725	1.482	0.5559
T3-8rep3	28	1225	3.797	0.4513	1.504	0.5514
T3-9rep1	25	282	4.254	0.4049	1.303	0.4425
T3-9rep2	24	545	3.65	0.3602	1.145	0.4256
T3-9rep3	22	95	4.611	0.7139	2.207	0.7978
T5-1rep1	22	667	3.229	0.4239	1.31	0.4753
T5-1rep2	22	889	3.093	0.1889	0.5838	0.1894
T5-1rep3	20	205	3.569	0.7893	2.365	0.8849
T5-2rep1	25	1562	3.264	0.4021	1.294	0.4799
T5-2rep2	22	1085	3.005	0.392	1.212	0.4489
T5-2rep3	20	169	3.704	0.7742	2.319	0.8715
T5-3rep1	20	786	2.85	0.4617	1.383	0.518
T5-3rep2	24	441	3.777	0.657	2.088	0.7803
T5-3rep3	17	521	2.558	0.3577	1.014	0.3759
T5-4rep1	25	390	4.023	0.555	1.787	0.6443
T5-4rep2	26	1457	3.432	0.4343	1.415	0.5337
T5-4rep3	28	515	4.324	0.4854	1.618	0.5785
T5-5rep1	26	732	3.79	0.5047	1.644	0.6193
T5-5rep2	21	874	2.953	0.48	1.461	0.5481
T5-5rep3	19	325	3.112	0.4069	1.198	0.4468
T5-6rep1	21	295	3.517	0.515	1.568	0.6078
T5-6rep2	18	241	3.099	0.6885	1.99	0.7954
T5-6rep3	19	444	2.953	0.5209	1.534	0.5873
T5-7rep1	28	863	3.994	0.4698	1.565	0.6022
T5-7rep2	17	946	2.335	0.3689	1.045	0.5055
T5-7rep3	25	871	3.545	0.4421	1.423	0.5423
T5-8rep1	25	445	3.936	0.5379	1.731	0.6599
T5-8rep2	31	800	4.488	0.3149	1.081	0.3747
T5-8rep3	23	330	3.794	0.5777	1.811	0.6976

Vessel-Based Samples Year 2						
Sample	No. Species	No. Individuals	Richness (d')	Eveness (J')	Diveristy (H')	Dominance (1-λ)
T5-9rep1	15	108	2.99	0.7753	2.099	0.8394
T5-9rep2	32	337	5.326	0.6013	2.084	0.7271
T5-9rep3	24	451	3.763	0.4435	1.41	0.518
C1-1rep1	18	144	3.421	0.7653	2.212	0.8366
C1-1rep2	27	194	4.936	0.7256	2.391	0.8304
C1-1rep3	23	229	4.049	0.7183	2.252	0.811
C1-2rep1	19	148	3.602	0.3626	1.068	0.3827
C1-2rep2	29	1116	3.99	0.3364	1.133	0.401
C1-2rep3	15	123	2.909	0.6306	1.708	0.6855
C1-3rep1	34	349	5.636	0.5073	1.789	0.6247
C1-3rep2	28	558	4.269	0.6623	2.207	0.8078
C1-3rep3	27	443	4.267	0.6608	2.178	0.7988
C2-1rep1	29	1108	3.994	0.492	1.657	0.5979
C2-1rep2	25	696	3.667	0.5815	1.872	0.7057
C2-1rep3	29	1753	3.749	0.3946	1.329	0.4904
C2-2rep1	28	1471	3.702	0.4426	1.475	0.5366
C2-2rep2	30	1455	3.982	0.3252	1.106	0.3823
C2-2rep3	34	1334	4.586	0.5341	1.884	0.6855
C2-3rep1	28	1411	3.723	0.307	1.023	0.3651
C2-3rep2	21	779	3.004	0.2579	0.7851	0.2792
C2-3rep3	19	1206	2.537	0.3726	1.097	0.4216
C3-1rep1	21	127	4.129	0.6763	2.059	0.7808
C3-1rep2	25	689	3.672	0.5612	1.806	0.6929
C3-1rep3	25	680	3.68	0.4102	1.32	0.4901
C3-2rep1	27	329	4.486	0.6588	2.171	0.7946
C3-2rep2	24	279	4.084	0.4704	1.495	0.5208
C3-2rep3	28	579	4.244	0.5573	1.857	0.6994
C3-3rep1	24	120	4.804	0.8099	2.574	0.8877
C3-3rep2	23	517	3.521	0.44	1.38	0.5046
C3-3rep3	24	426	3.799	0.4855	1.543	0.5579

The Department of the Interior Mission

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Bureau of Ocean Energy Management

As a bureau of the Department of the Interior, the Bureau of Ocean Energy primary responsibilities are to manage the mineral resources located on the nation's Outer Continental Shelf in an environmentally sound and safe manner.

The BOEM Environmental Studies Program

The mission of the Environmental Studies Program is to provide the information needed to predict, assess, and manage impacts from offshore energy and marine mineral exploration, development, and production activities on human, marine, and coastal environments.