Supporting Information
Screening for Appropriate Assessment

NISA
North Irish Sea Array

Appendix 4
Cable Route Benthic Survey Report

Statkraft
CIP Copenhagen Infrastructure Partners
GoBe APEM Group
ARUP

NISA Benthic Ecology Baseline

Cable Route Benthic Survey Report

25 January 2023

Statkraft

Document history

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Issue	Date	Revision Details
A	13/02/2023	First Issue
B	10/03/2023	Second Issue
C	06/04/2023	Final Issue

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Acronym	Definition
AL	Action Level
ANOSIM	Analysis of Similarity
BGS	British Geological Society
CCW	Countryside Council for Wales
DBT	Dibenzothiophene
DDV	Drop Down Video
DGPS	Differential Geographic Positioning System
ECC	Export Cable Corridor
EIAR	Environmental Impact Assessment Report
EMODnet	European Marine Observation and Data Network
EUNIS	European nature information system
FNU	Formazin Nephelometric Units
FOCI	Features of Conservation Interest
GPS	Global Positioning System
ISEQ	Interim Sediment Quality Guidelines
LOI	Loss on Ignition
JAMP	Joint Assessment and Monitoring Programme
JNCC	Joint Nature Conservation Committee
MarLIN	Marine Life Information Network
MEDIN	Marine Environmental Data and Information Network
MNCR	Marine Nature Conservation Review
MNNS	Marine Non-Native Species
NMDS	Non-Metric Multi-Dimensional Scaling
NIS	Natura Impact Statement
NISA	North Irish Sea Array
NISA Ltd	North Irish Sea Array Windfarm Limited
NMBAQC	National Marine Biological Analytical Quality Control
OCP	Organochlorine Pesticides
OS	Ordnance Survey
OSPAR	Oslo and Paris Conventions
OWF	Offshore Wind Farm
PAH	Polyaromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PEL	Permissible Exposure Limit
PSA	Particle Size Analysis
QC	Quality Control
ROV	Remotely Operated Vehicle

SACFOR	Super Abundant, Abundant, Common, Frequent, Occasional, Rare
SIMPER	Similarity Percentages Breakdown
SIMPROF	Similarity Profile Analysis
TBT	Tributyltin
TDP	Taxonomic Discrimination Protocol
TDS	Total Dissolved Solids
TEL	Threshold Effects Level
THC	Total Hydrocarbon Content
TOC	Total Organic Carbon
UKAS	United Kingdom Accreditation Service
UKBAP	UK Biodiversity Action Plan
WoRMS	Word Register of Marine Species

1. Introduction

1.1. Project Background

North Irish Sea Array Windfarm Limited (NISA Ltd) are pursuing the development of North Irish Sea Array (NISA) Offshore Wind Farm (OWF) located between 7-17km off the coast of the counties of Dublin, Meath, and Louth in the Republic of Ireland. The proposed OWF once operational, would have the capacity to provide renewable energy for approximately 500,000 – 700,000 homes.

Natural Power Consultants Ltd (Natural Power), were appointed to manage and execute the delivery of benthic intertidal and subtidal ecological surveys covering the NISA OWF Export Cable Corridor (ECC). The purpose of the survey was to map and characterise the distribution and extent of marine benthic biological communities and habitats within the OWF ECC to validate existing benthic ecology datasets and provide robust site-specific baseline characterisation to inform the Environmental Impact Assessment Report (EIAR) and Natura Impact Statement (NIS) consent requirements.

In December 2019, NISA Ltd submitted a Foreshore Licence application for site investigation works, which included benthic surveying of the OWF cable route as one of the planned work schedules to be licenced. The licence was granted on 12th September 2022 (Licence Number: FS007358), and Natural Power conducted an intertidal survey on the 27th September 2022 and offshore benthic survey between 28th September 2022 – 1st October 2022.

1.2. Document Purpose

This report has been produced in order to provide NISA Ltd with the findings of the benthic intertidal and subtidal ecological surveys covering the NISA OWF ECC in order to meet the specific objectives of the survey:

- To characterise the benthic subtidal and intertidal environment that is present across the footprint of the NISA OWF ECC and potential landfall location;
- To identify the occurrence and distribution of any habitats or species of conservation importance; and
- To identify the occurrence and distribution of any marine non-native species (MNNS)

2. Baseline Benthic Survey Design

2.1. Intertidal

A Phase I intertidal survey was undertaken to identify habitats present at the proposed landfall location for the NISA OWF in line with the Department of Communications, Climate Action and Environment (2018) Guidance for Marine Baseline Assessment and Monitoring Activities for Offshore Renewable Energy Activities, Part II. Publicly available data suggested the intertidal area and the proposed landfall consisted mainly of rocky shore habitat interspersed with areas of sediment shore habitat (Figure 2.1). As such ten indicative sediment sampling stations were identified in areas of sediment and selected to be representative of the upper, middle and lower shore environment. The southwest section of the proposed cable corridor is not covered by the Foreshore Licence and as such no samples were to be collected from this area (Figure 2.1). However, a walkover survey was conducted, with visible species recorded and photographs taken to allow the biotopes to be mapped to as fine a degree as possible considering the lack of infauna and Particle Size Analysis (PSA) samples in this area.

The extent and distribution of intertidal biotopes in the vicinity of the proposed ECC were recorded and mapped using the in-situ ACE biotope mapping techniques outlined in Procedural Guideline No 3-2 of the Marine Monitoring Handbook (Hiscock, 2001) for areas of rocky shore, Procedural Guideline 3-6 of the Marine Monitoring Handbook (Dalkin & Barnett 2001) for soft sediment sampling and the Countryside Council for Wales (CCW) Handbook for Marine Intertidal Phase I Survey and Mapping (Wyn, 2000). This survey method allows both rocky shore areas and sediment shore areas to be surveyed through a combination of walk-over surveys and sediment sampling.

Project:

North Irish Sea Array (NISA) Offshore Wind Farm

Title:

Figure 2.1: NISA OWF Phase 1 Intertidal Survey

Key

- Survey area
- Sediment sampling station
- Mean high water spring
- Low water mark

Scale @ A3: 1:5,000

Coordinate System: TM75/ Irish Grid
Graticules: WGS84

0 50 100 150 200 m

N

Date: 03-04-23	Prepared by: RF	Checked by: ME
Ref: IE202180_M_105_B		

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2.2. Subtidal

The locations of benthic grab and visual imagery stations have been based upon existing publicly available data sets describing potential existing seabed substrates and habitat biotopes within the ECC:

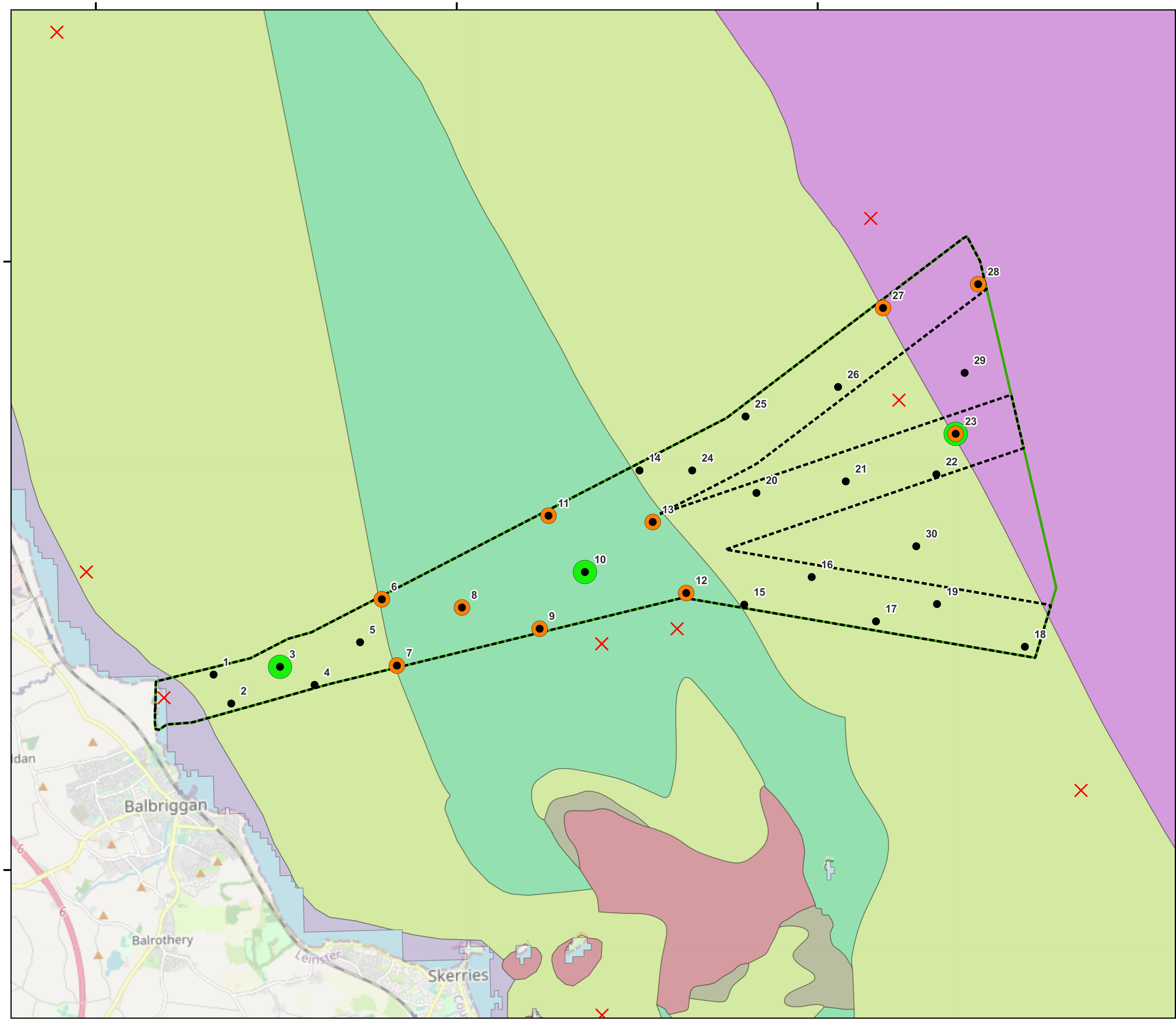
- British Geological Society (BGS) Folk Sediment Classifications (1989);
- INFOMAR Seabed Substrate (2018);
- EUSeamap Substrate Type (2021);
- EUSeamap MSFD Benthic Broad Habitat Types (2021); and
- European Marine Observation and Data Network (EMODnet) Bathymetry Mean Depth.

Visual imagery sampling was undertaken prior to benthic grabbing and the footage assessed in situ to identify any areas of sensitive reef habitat. If reef habitat had been identified at any of the sampling stations, no subsequent benthic grab sampling would have occurred at that location. Figure 2.2 shows the proposed sampling stations and predicted sediment types. INFOMAR seabed substrate (2018) data suggests the area consists of sandy mud / muddy sand, with no data available out to circa 7.5 km from shore. EUSeamap 2021 substrate type data has no data out to circa 1.3 km along the cable corridor. Thereafter the data suggests the sediment ranges from sand to muddy sand, to sand and then to sandy mud, along the ECC from the shore to the array area.

Thirty benthic grab and visual imagery stations have been identified and are considered sufficient to achieve the aims of the survey, they are distributed proportionately across the sediment types as follows:

- 18 stations in Sand;
- 8 stations in Muddy sand; and
- 4 stations in Sandy mud.

Sample stations were derived using a random stratified sampling approach for each of the substrate types given above, whilst avoiding areas of known wrecks and areas where the water depth is too shallow to safely operate the survey vessel. Sampling stations have mainly been positioned along the potential cable routes, though samples are also positioned between the routes. Given the homogeneity of the substrate type across the cable routes this is deemed adequate coverage to characterise the benthic habitat across the entire study area. A subset of ten benthic sampling stations were identified for contaminants samples, situated in finer sediment where this type of analysis provides better results. Three water quality sampling stations were also identified for turbidity sampling, this was measured in situ. Water quality sampling stations have been positioned near shore, mid-way along the cable route and near the array to provide an even distribution, and at benthic grab stations for provision of associated PSA data.



Project:

North Irish Sea Array (NISA) Offshore Wind Farm

Title:

Figure 2.2: NISA OWF Export Cable Subtidal Benthic Survey

Key

- Indicative cable 500 m buffer
- Survey area
- Cable route sampling stations
- Contaminants sampling stations
- Water quality sampling stations
- Wreck

Benthic habitat (EUSeaMap 2021)

- Coarse substrate
- Muddy sand
- Rock or other hard substrata
- Sand
- Sandy mud
- Seabed

Scale @ A3: 1:70,000

Coordinate System: TM75/ Irish Grid
Graticules: WGS84

0 1 2 3 4 km

N

Date: 09-03-23	Prepared by: RF	Checked by: ME
Ref: IE202180_M_104_B		

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3. Survey Methodology

3.1. Intertidal Survey

The Phase 1 intertidal survey was performed by two experienced ecologists, during the low water phase of spring tides. Surveys were undertaken on dates chosen to maximise daylight over the low water period.

In areas of rocky or hard substrata, found within the boundaries of the survey area, a walkover was conducted whereby ten hard substrate stations were selected at random within the area of hard substrate. A quadrat was positioned and faunal and algal species within were identified to species level wherever possible (identified in the field), with abundances recorded on the SACFOR scale (Superabundant, Abundant, Common, Frequent, Occasional and Rare) (Hiscock, 1996) and a photograph of the rocky substrata taken. The extent of biotopes/habitats identified were recorded using a hand-held Global Positioning System (GPS) and marked on Ordnance Survey (OS) maps or aerial photographs of the shore.

At the ten sediment sampling stations, sediment characteristics and any conspicuous infauna present were recorded, as well as the coordinates of the station and time of sampling. The following samples were collected:

- A photograph taken as a record of the station;
- A sample of up to 1l/1kg of sediment taken by digging an area of $0.02m^2$ for PSA and Total Organic Carbon (TOC); and
- Infauna sample, by digging twice, an area of $0.02m^2$ to a depth of 20-25cm, (avoiding areas of standing water) and sieved through a 1 mm mesh sieve to extract any fauna, which was then preserved in 4% buffered formalin solution.

All data collected during the intertidal surveys were transcribed and information on habitats and species collated in an excel spreadsheet (including up to date species nomenclature, abundance, and physical parameters such as PSA, and depth).

The biotope/habitat assessment also utilised aerial imagery to highlight the extent of certain features for example rocky outcrops and seaweed communities, to allow accurate habitat mapping from the resulting data. Any species of conservation importance, anthropogenic features or MNNS were recorded, and care taken to map their extent.

3.2. Drop Down Video (DDV) Survey

DDV transects were conducted at 30 locations in the designated survey area using Joint Nature Conservation Committee (JNCC) protocol (Davies *et al*., 2001; JNCC, 2018) and the more current Epibiota Remote Monitoring from Digital Imagery: Operational Guidelines (Hitchin *et al*., 2015), with stations selected to cover all survey types and habitats. Additionally, if reef features had been encountered, assessments were made using the currently available guidance notes i.e., Gubbay (2007) and Limpenny *et al*. (2010) for potential *Sabellaria* reefs, and Golding *et al.* (2020) and Irving (2009) for potential cobble reefs.

All sample locations were sampled using an observation class Remotely Operated Vehicle (ROV). The ROV recorded video footage within the unit at 4K resolution which was viewed in real time at the surface during deployment, with a minimum of two - three minutes of video footage collected at each sample station. During deployment, whilst recording video imagery, ‘frame captures’ were collected using a remote controller, with a minimum of three still images being captured. The ROV system was manoeuvred manually by a surveyor using a remote controller. The system was equipped with laser points (approximately 10cm apart) to provide an indication of scale, and also video LED flood lights (6000 lumens) to provide illumination of the seabed.

Surveys were undertaken during appropriate tides/weather conditions to allow optimum visual imagery capture. At each station, the immediate survey area was checked for obstructions e.g., static gear. The ROV was prepared for deployment while the vessel moved into position to start the drop. The vessel approached the sample location identified and positioned itself so that wind and tide caused the vessel to drift away from the equipment whilst deployed.

The feed/image was reviewed as the data was collected to enable the confirmation image quality and any seabed features recorded.

Notes on the visible sediment conditions, seabed features and fauna were made in-situ together with Differential Geographic Positioning System (DGPS) position, water depth and date/time. Positions were fixed at the start and end of each deployment and a continuous log of GPS data was recorded whilst the camera was deployed. The ROV was recovered to the vessel and the haul line was coiled into a box to ensure it did not tangle for any subsequent deployments and to avoid trip hazards. The vessel then moved to the next sampling station. The ROV was also used to check suitability and ensure no Annex I habitats were present at benthic grab stations prior to grabbing.

3.3. Subtidal Grab Survey

The benthic subtidal grab survey was undertaken at 30 sampling stations in the survey area, in order to collect information on the physical nature of the seafloor and the composition of the infauna, as per Limpenny *et al.* (2010), Coggan *et al*. (2007), and JNCC Marine Monitoring Handbook Procedural Guidance 3-5 (Holt & Sanderson, 2001).

Benthic sampling was undertaken using a 0.1 m^2 Day grab. At each sampling station the grab was deployed, and once fired on the seabed, recovered. After successful grabs were recovered, providing each grab sample was deemed acceptable by the lead surveyor (according to the relevant protocols), the samples were fully described (sediment and biological characterisation) and a photograph taken. Up to three failed attempts per sampling station were allowed, prior to abandoning the sampling station. The sample was deemed unacceptable if; the sample represented less than half the total capacity, the grab had not struck the seabed in a flat area resulting in an incomplete sample, or the grab jaws were not fully closed. All locations where a grab failed were recorded using GPS positions.

At each station a separate grab was deployed for collecting samples for PSA, TOC and at ten stations samples for contaminants analysis were collected, from an undisturbed sediment surface. Samples were taken with the appropriate metal or plastic scoop and transferred to appropriate containers for transportation in a cool box prior to analysis. PSA and TOC samples were stored in cool boxes with ice packs and contaminants samples were stored in accordance with the guidelines for sampling / storage of sediments for chemical analyses (from OSPAR JAMP guidelines for monitoring contaminants in sediments) (Cronin *et al*., 2006).

Each acceptable benthic fauna sample was sieved on board through a 1 mm sieve, larger rocks/shells were placed directly into the sample pot. The sieved residues were then gently backwashed into sealable containers and preserved by adding borax buffered 4-5% saline formalin solution. Each sample was labelled clearly on the lid and an additional waterproof label placed in the container which recorded the client, survey name, date, area, station number and grab number.

On successful completion of the work at that sampling station, the vessel moved to the next station where the procedure was repeated until all stations were sampled. A full survey log was maintained throughout the survey detailing time of sampling, GPS position, number of attempts required, station number, water depth, physical characteristics of the sample, digital image number and presence of any other relevant features.

3.4. Water Quality

Turbidity measurements were collected at various depths, at three sampling locations, distributed near shore, mid-way along the ECC. A sonde with turbidity and depth sensors was deployed over the side of the vessel using a rope and measurements recorded throughout the depth profile. Measurements were received in a handheld device via a data cable fitted to the sonde. Turbidity measurements were recorded at 5m increments from the surface to the near seabed. Each of the sampling locations has a corresponding benthic grab station to allow the suspended particulate matter to be associated with a PSA sample.

4. Sample Analysis

4.1. Benthic Faunal Sample Analysis

All biota was extracted and identified according to the National Marine Biological Analytical Quality Control (NMBAQC) Taxonomic Discrimination Protocol (TDP) (Worsfold *et al*., 2010). Samples were washed with tap water through sieves to remove the preserving agent, with different sized sieves used to aid in sorting. To further aid sorting and to avoid damage to specimens, light organic matter and fauna were elutriated (floated off) and sorted separately. The larger retained contents were sorted in a white sorting tray, whilst smaller fauna were sorted under a stereomicroscope.

Fauna were identified to the lowest taxonomic level practicable using appropriate keys and references and enumerated. Species that were present as juveniles were differentiated from adults where possible. Colonial organisms were recorded as present or absent. Broken or damaged specimens that may not be fully identified were described as 'Taxa Indet.' (indeterminate). Juvenile specimens not displaying adult characteristics necessary for identification to species were described as 'Taxa juv.', and groups not generally identified to species because of taxonomic or morphological reasons were recorded as Taxa sp. Data was recorded in a species matrix in an excel spreadsheet, and subject to internal and external Quality Control (QC) as per the NMBAQC Benthic Invertebrate Scheme.

4.2. PSA and TOC Analyses

PSA were determined to fractions ranging between <63 mm to >63 µm, using NMBAQC methodology which utilises stacked sieves for >1 mm fraction and laser granulometry for the <1 mm fraction. Sediment samples were processed through stacked sieves at particle size diameters of 0.5 phi intervals over the range 64 mm to 63 µm (Wentworth Scale), sieve sizes are provided in table 4.1. The sieves were shaken for 15 minutes, and the contents of each sieve subsequently weighed.

The classification system used for sediment type and sorting index were carried out according to the methods of Buchanan *et al*. (1984). For reporting purposes, the PSA results per sampling station were expressed as a cumulative percentage of each particle size passing through each sieve. These percentages were then converted to absolute percentages retained on each sieve.

All samples were analysed for TOC through Loss on Ignition (LOI) whereby each sample is weighed before being heated to a high temperature (105^{o}C) until all the carbon dioxide from carbonates is burned off and the sample is weighed again. The difference in weights is the LOI which is then converted to TOC using a conversion factor.

Table 4.1: The classification of sediment particle size ranges into size classes (adapted from Buchanan, 1984).

Range of Particle Size	Classification	Phi Unit
<63µm	Silt/Clay	>4 Ø
63-125 µm	Very Fine Sand	4 Ø, 3.5 Ø
125-250 µm	Fine Sand	3 Ø, 2.5 Ø
250-500 µm	Medium Sand	2 Ø, 1.5 Ø
500-1000 µm	Coarse Sand	1 Ø, 1.5 Ø

Range of Particle Size	Classification	Phi Unit
1000-2000 µm (1 – 2mm)	Very Coarse Sand	0 Ø, -0.5 Ø
2000 – 4000 µm (2 – 4mm)	Very Fine Gravel	-1 Ø, -1.5 Ø
4000 -8000 µm (4 – 8mm)	Fine Gravel	-2 Ø, -2.5 Ø
8 -64 mm	Medium, Coarse & Very Coarse Gravel	-3 Ø to -5.5 Ø
64 – 256 mm	Cobble	-6 Ø to -7.5 Ø
>256 mm	Boulder	< -8 Ø

4.3. Contaminants Analysis

Samples were analysed for the Marine Institute full suite of analyses as detailed in the Material Analysis Reporting Form by a United Kingdom Accreditation Service (UKAS) accredited laboratory and the results compared against Cefas and Irish Action levels (Cronin *et al.,*2006) and Canadian guideline levels (CMME, 2001), where levels exist for each contaminant. The contaminants samples were analysed for include:

- Nine heavy metals;
- Polychlorinated biphenyls (PCBs) (ICES 7);
- Sixteen Polyaromatic Hydrocarbons (PAHs); and
- Tributyltin (TBT) and Dibenzothiophene (DBT)

4.4. DDV Imagery Analysis

DDV and still images were reviewed, processed, and analysed in accordance with current guidelines, such as the standards for analysis in visual seabed surveys (BS EN 16260:2012) and Turner *et al*. (2016). The imagery has also been reviewed for features of conservation interest, including Annex I reef assessment following the appropriate JNCC guidance notes (Gubbay, 2007; Irving, 2009; Golding *et al*., 2020). The main purpose of the analysis of the imagery was to identify what fauna and broadscale habitats exist in a video record or still image, provide quantitative and semi-quantitative data and to note where one substrate type changes to another. The results of analyses are described in this report and provided in MS Excel spreadsheet proformas, along with image reference collections for each habitat and taxon recorded, and video clips for each broadscale habitat and biotope.

The DDV footage was initially viewed rapidly (x4 speed) in order to segment it into sections representing different broadscale habitats. The start and end points of each segment were logged, and each segment treated as a separate record and subsequently subjected to more detailed analysis. Brief changes in substrate type lasting less than 5 m were considered as incidental patches are recorded as part of the habitat description, or as a ‘habitat mosaic’.

The DDV footage was then viewed at normal or slower than normal speed, noting the physical and biological characteristics, such as substrate type and percent cover (in line with current guidelines), seabed character, conspicuous taxa, and life forms along with any modifiers or visible impacts present. Taxa were identified to the most detailed taxonomic level possible and recorded with abundance counts for erect species and percent cover estimated visually for colonial/encrusting species, as well as categories based upon the Marine Nature Conservation Review (MNCR) SACFOR abundance scale (Hiscock, 1996). Where appropriate, any relevant features of conservation interest or Annex 1 habitats were noted at each sample location. Quantification of epifauna was performed manually for DDV analysis and recorded directly in a proforma spreadsheet.

Enumeration of taxa from still images was undertaken within BIIGLE[1], with abundance counts for solitary and erect taxa added as point annotations. Where percentage covers of colonial/encrusting taxa were recorded from still images, taxa were identified with point annotations in BIIGLE[1], and percentage cover categories (associated with

[1] BIIGLE - Next generation image and video annotation - BIIGLE

SACFOR) added as a second label. Annotations from BIIGLE[1] were exported in Excel spreadsheets and translated into the results proforma spreadsheet as required.

All data were recorded as each DDV clip or still image was analysed and an EMODnet / Marine Environmental Data and Information Network (MEDIN) compliant proforma spreadsheet was used to input imagery data and metadata, with reference to the latest species dictionary from the World Register of Marine Species (WoRMS) database.

A reference collection was built as the analysis progressed with good quality images for each taxon identified, noted and collated to aid consistency and quality of analysis, with the taxon or species clearly highlighted. In addition to a species/taxon reference collection, a habitat/biotope reference collection was also built with images and video clips of each habitat or biotope.

4.4.1. Annex I Assessment

The DDV footage has been reviewed and analysed in accordance with current guidance to identify any potential Annex 1 habitats. Where rock was recorded within DDV footage current assessment methods for biogenic or stony reefs were used (Turner *et al*., 2016; Gubbay, 2007; Irving, 2009; Golding *et al*., 2020).

5. Data Analysis

5.1. Intertidal

All data collected during the intertidal surveys were transcribed and information on habitats and species collated in an excel spreadsheet (including up to date species nomenclature, abundance, and physical parameters such as PSA). Data was assessed following the JNCC Marine Habitat Classification for Britain and Ireland (Parry M.E.V 2019) and biotopes assigned to each station.

The data was examined in order to identify any species or habitats of conservation interest. This includes, Habitats Directive Annex I habitats, UK Priority Marine Habitats and Species[2] UKBAP List species, rare/scarce species and habitats) using the Marine Life Information Network (MarLIN) resource. The data was also examined to identify any MNNS species present in the area.

5.2. Benthic Grab Analysis

All data collected from surveys, including up to date species nomenclature in accordance with the WoRMs database, abundance, and physical parameters such as PSA, and depth were collated in excel spreadsheets. Based on PSA results, each sampling station was assigned a folk classification using the Folk Ternary diagram provided in the JNCC guidance (Parry, 2015). The percentage composition of gravel, sand and mud was calculated for each sampling station.

A suite of statistical analyses on the data collected from the grab survey work were undertaken using the “vegan” package in R, with some univariate indices calculated manually in R. General R packages used in the statistical analysis and production of outputs were: "tidyverse", "magrittr", "ggpubr","janitor","taxize","rstatix", "readxl","bookdown","pander","plotrix", "cluster", “clustig”, "factoextra", "ggrepel", "dendextend", and "patchwork".

5.2.1. Univariate Statistics

The following species diversity indices were calculated for the benthic infaunal and epibenthic species data:

- Number of Species (S): the number of species present in a sample, with no indication of relative abundances;
- Number of individuals (n): total number of individuals counted;
- Species Diversity - Shannon-Wiener index (H’): measures the uncertainty in predicting the identity of the next species withdrawn from a sample;
- Species Richness - Margalef’s index (d): a measure of the number of species present for a given number of individuals. The higher the index, the greater the diversity;
- Simpson’s indexes (1-λ): a measure of the probability of choosing two individuals from a sample that are different species. D = 0 (minimum diversity), D = 1.0 (maximum diversity); and
- Pielou’s evenness (J’): shows how evenly the individuals in a sample are distributed. J’ is a range of zero to one. The less variation in the samples, the higher J’ is.

These univariate indices enable the reduction of large datasets into useful metrics, which can be used to describe community structures.

5.2.2. Multivariate Statistics

Multivariate analysis is an effective method for detecting subtle changes in benthic community datasets. Multivariate analysis was undertaken in R, on the whole dataset, including individual replicates. Due to the partially skewed

[2] Available from https://jncc.gov.uk/our-work/uk-bap-priority-habitats/

nature of the fauna data, and its varying abundances, a square root transformation was applied to normalise the data distribution, reducing dominant effects of highly abundant taxa.

A Bray-Curtis resemblance matrix was applied to the transformed infauna data. Non-Metric Multidimensional Scaling (NMDS) plots were produced to examine the similarity between sampling stations. The similarity profile analysis (SIMPROF) routine was utilised to determine the statistically significant groups (i.e., samples that would naturally group as communities). One-way Analysis of Similarity (ANOSIM) revealed whether there were any statistically significant results and, if significant, the Similarity Percentages (SIMPER) was used to provide information on the main species driving the groupings, which would aid in determining community structure and biotopes.

5.3. Biotope Assignment

5.3.1. Intertidal

Intertidal biotopes were assigned according to the Marine Habitat Classification for Britain and Ireland (Connor *et al.,* 2004) from the walk over surveys, aerial imagery and infaunal data, depending on the substrate sampled, using expert judgement in line with the relevant guidance (Parry, 2019) and JNCC comparative tables[3].

5.3.2. Subtidal

Infauna survey results groupings and characterising species were identified through the SIMPROF, NMDS and SIMPER analyses and these were used in combination with the PSA results and physical characteristics (such as depth and zone) to classify the grab sample station biotopes according to the Marine Habitat Classification for Britain and Ireland (Connor *et al*., 2004) and European nature information system (EUNIS) Marine Habitats Classification (2022).

DDV samples were assigned habitat classifications based on species present according to the most current classification. Where appropriate, broadscale habitats, Features of Conservation Interest (FOCI) or Habitats Directive Annex I Habitat were also assigned to each sampling station and still image. Guidance notes provided by JNCC report 546 (Parry, 2015) were used to assist this process.

Infauna (grab) and epibenthic (DDV) biotope classifications were incorporated into an Excel spreadsheet alongside physical characteristics such as depth and PSA, and final benthic habitats assigned to each sampling station. The majority of infauna and epibenthic habitat assignment at a sampling station were consistent or complimentary. At the DDV transect stations, where no benthic grabs were taken, the DDV classification was carried forward. Classification was supported by use of JNCC comparative tables and guidance (Parry, 2019).

[3] Available from https://hub.jncc.gov.uk/assets/62a16757-e0d1-4a29-a98e-948745804aec

6. Intertidal Results

The intertidal area of the ECC, Bremore Bay Beach, is a mix of boulders and rock outcrops with shingle and sand at the top of the shore. This is bordered on the north (Coney Hill Bay Beach) and south by two sandy areas. The survey was carried out on the 26th of September 2022 by two surveyors. Ten pre-determined sediment sampling stations for infauna were spread across the sediment part of the shore. Station 1 was abandoned, whilst 2 and 3 were re-located. This area was subtidal and as such could not be accessed even at low water on a spring tide. Station 5 was also abandoned as it was not of suitable substrate for sediment sampling. Another ten stations were sampled on hard substrate for epibiota. Locations of all stations are shown in Figure 6.5 and coordinates provided in Appendix A (Table A1) with the full species lists in Appendix B (Table B1 and B2) and sampling station photographs in Appendix C.

6.1. Infauna

In total 470 individuals were found within the nine infauna samples, representing 44 unique taxa. Henceforth, where ‘species’ is referred to, this is in relation to a unique taxon. Table 6.1 shows the top eleven most abundant species found within the infaunal samples.

Table 6.1: Eleven most abundant species and intertidal stations at which they were present

Species	Total Abundance	Stations
Corophium volutator	114	6, 7, 8
Macomangulus tenuis	47	2, 3, 4, 7, 9
Capitella sp. complex	39	2, 3, 4, 6, 7
Harpacticoida	31	2
Nematoda	28	2, 6, 8
Scolelepis (Scolelepis) squamata	28	8
Gammarus sp. (damaged)	24	2, 4
Pygospio elegans	20	4, 6, 7
Scoloplos armiger	14	6
Spio martinensis	13	2, 3, 4
Peringia ulvae	13	6, 7

Stations 2 and 6 (Figures 6.1 and 6.2) contained the greatest number of individuals, 117 and 209, respectively. The number of individuals at stations 3 (Figure 6.1), 4, 7 and 8 ranged between 28-42, whilst stations 9 and 10 only contained 3 and 1 individuals respectively.

Station 2 was the most diverse sample, containing 21 species, whilst stations 3, 4 and 5 contained 10-14 species. The remaining samples contained less than 7 species each.

Figure 6.1: Station 3 - facing southwest (left) and facing east (right)

Figure 6.2: Station 6 - facing south (left) and facing north (right)

6.2. Epibiota

In total 23 species of epibiota across the ten hard substrate sampling stations were recorded.

Station 11 towards the south of the site was on the lower shore and consisted of boulders on top of coarse gravel and sand. The station was situated in a slightly lower area than the bedrock/boulders at either site. The brown algae *Fucus serratus* was dominant, with *Laminaria hyperborea* and *Desmarestia aculeata* also present. Barnacles (*Cirripedia* sp.) were common underneath the algae on boulders. A lot of drift red seaweed was also present, likely due to the lower area where the station was situated.

Station 12 was also on the lower shore, near the low water mark. *Fucus vesiculosus* was dominant with an animal community comprised of barnacles (*Cirripedia* sp.), whelks (*Nucella lapillus*), limpets (*Patella vulgata*) and flat periwinkles (*Littorina obtusata*) on the large boulders beneath.

Station 13 was again on the lower shore, near the low water mark and comprised of large boulders on top of bedrock. *F. serratus* was dominant with *Laminaria hyperborea* present and an understory of red algae (*Mastocarpus stellatus, Palmaria palmata* and encrusting calcareous reds). The animal community was richer at this station with calcareous tubes of (*Spirobranchus* sp.), barnacles, whelks and periwinkles (*Littorina littorea*) present.

Station 14 (Figure 6.3) was towards the top of the shore. This area was slightly sheltered from the bedrock lower down on the shore with the substrate consisting of compacted coarse sediments and gravel, underneath small boulders. *Ascophyllum nodosum* was dominant with *F. vesiculosus* also common. Barnacles were also present on the larger stones.

Station 15 (Figure 6.3) was at the top of the shore and representative of a similar substrate as station 14 but devoid of any an animal community or fucoid algae. *Ulva* sp. was the only species present.

Figure 6.3: Station 14 (left) and station 15 (right)

Station 16 was situated mid shore and was a similar substrate to station 14 with the presence of slightly larger boulders. *A. nodosum* was dominant with *F. vesiculosus* and *F.serratus* also present. *Vertebrata lanosa* and hydroids where epiphytic on the fucoid algae, whilst red species (*Polysiphona* sp., Gelidium pusillum and encrusting calcareous reds) formed the understory. Limpets and whelks were also frequent.

Station 17 was also situated mid shore consisting of large boulders. *F. vesiculosus* was dominant with some occasional *F. serratus.* The understory was animal dominated with barnacles, limpets and periwinkles present beside the algae, *M. stelllatus* and encrusting calcareous reds.

Station 18 was mid shore with boulders on top of bedrock. This was dominated by *F. vesiculosus* with a well-developed understory of smaller algae (*Cladostephus spongiosus, Ulva sp., M. stellatus, G. pusillum, Cladophora* sp., and encrusting calcareous reds). Barnacles were common and two shore crabs were present (*Carcinus maenas)*.

Station 19 was situated mid shore on bedrock. *A. nodosum,* with ephiphytic *V. lanosa*, and *F. vesiculosus* were dominant. An understory of *G. pusillum, C. spongiosus* and *Cladophora sp*. with abundance barnacles were present.

Station 20 was at the top of the shore and representative of a sand and gravel community where the upper shingle shore merged with the sand of Bremore Bay Beach. *Ulva* sp. was the only species present.

6.3. PSA and TOC

PSA and TOC analysis was undertaken on a sample from each sediment sampling station. Where these could be obtained, the substrata consisted of sand with smaller portions of gravel and mud (Folk, 1954). Figure 6.4 demonstrates the sediment type across the survey area. The full list of the percentages of each particle size and TOC results is provided in Appendix D (Table D1).

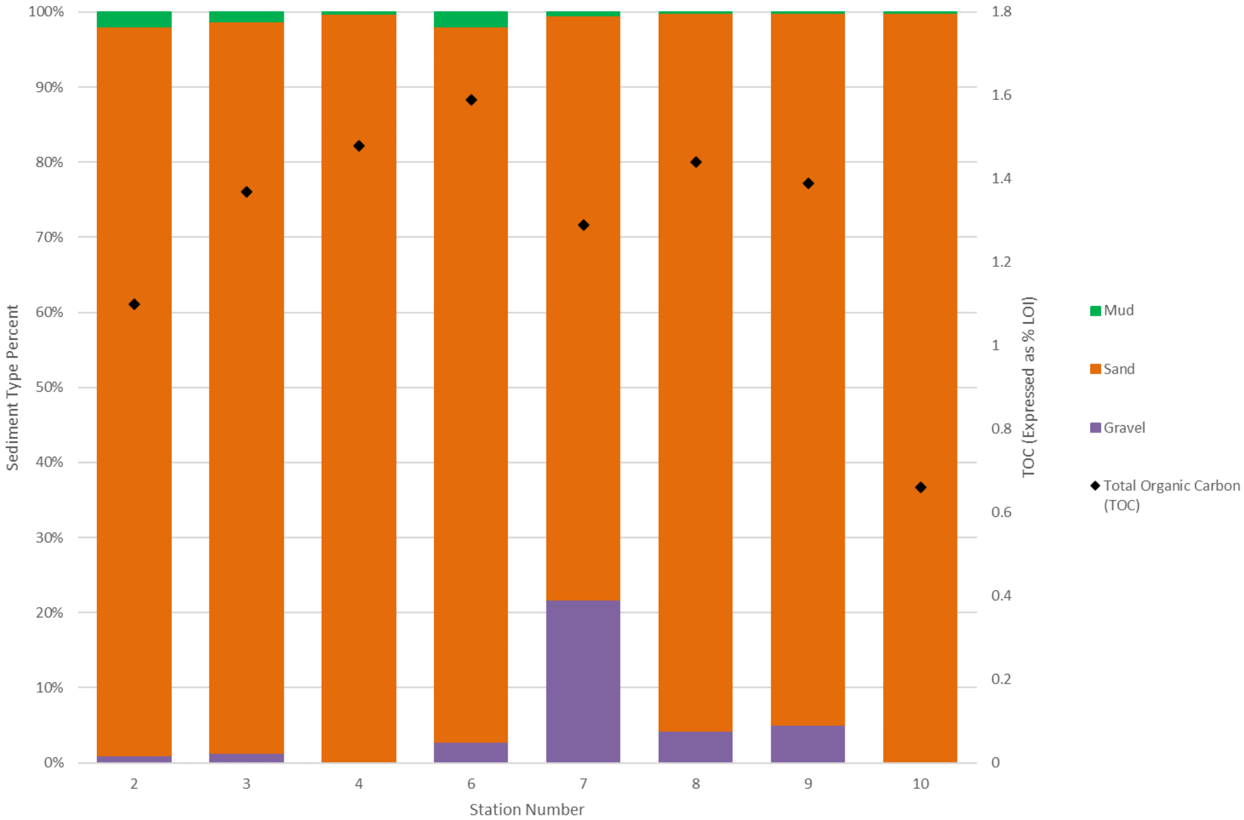

Figure 6.4 PSA and TOC at intertidal stations

6.4. Biotope Assignment

Epibiotic characterising species were incorporated into an Excel spreadsheet alongside physical characteristics such as height on shore and PSA or substrate type, and benthic habitats assigned to each sampling station. A total of ten biotopes were classified across the NISA intertidal survey area. The most common biotopes found were *Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock (LR.MLR.BF.FVesB) and polychaetes and *Macomangulus tenuis* in littoral fine sand (LS.LSa.FiSa.Po.Mten). The biotope barren littoral shingle (LS.LCS.Sh.BarSh) was observed in a long stretch of the upper shore. All biotopes are provided in Table 6.2 and full biotope descriptions in Appendix E.

Table 6.2: Intertidal Biotope Assisgnment

Final Biotope	MNCR Classification Description	Location/Stations
LS.LCS.Sh.BarSh	Barren littoral shingle	Upper shore
LS.LSa.FiSa	Polychaete/amphipod-dominated fine sand shores	9, 10
LS.LSa.FiSa.Po	Polychaetes in littoral fine sand	6, 7
LS.LSa.FiSa.Po.Mten	Polychaetes and *Macomangulus tenuis* in littoral fine sand	2, 3, 4
LS.LSa.MoSa.AmSco.Sco	*Scolelepis* spp. in littoral mobile sand	8
LR.MLR.BF.FVesB	*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock	17, 18, 19
LR.LLR.F.Fves.FS	*Fucus vesiculosus* on full salinity moderately exposed to sheltered mid eulittoral rock	12
LR.MLR.BF.Fser.Bo	*Fucus serratus* and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders	11, 13
LR.LLR.F.Asc.X	*Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata	14, 16
LR.FLR.Eph.Ulv	*Ulva* spp. on freshwater-influenced and/or unstable upper eulittoral rock	15, 20

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Figure 6.5: Biotope Classification in the Intertidal Survey Area

Key

- Survey area

Hard substrate sampling stations

- LR.FLR.Eph.Ulv
- LR.LLR.F.Asc.X
- LR.LLR.F.Fves.FS
- LR.MLR.BF.Fser.Bo
- LR.MLR.BF.FVesB

Sediment sampling stations

- LS.LSa.FiSa.Po
- LS.LSa.FiSa.Po.Mten
- LS.LSa.MoSa.AmSco.Sco

Biotopes

- LR.FLR.Eph.Ulv
- LR.LLR.F.Asc.X
- LS.LCS.Sh.BarSh
- LS.LSa.FiSa
- LS.LSa.FiSa.Po.Mten
- Moasic of LR.MLR.BF.FVesB / LR.LLR.F.Fves.FS / LR.MLR.BF.Fser.Bo
- LS.LSa.FiSa.Po

Esri World Imagery contributers: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

Scale @ A3: 1:5,500

Coordinate System: TM75/ Irish Grid
Graticules: WGS84

0 75 150 225 300 m

N

Date: 03-04-23	Prepared by: RF	Checked by: ME
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7. Subtidal Results

The subtidal benthic survey campaign was carried out between the 27th of September – 1st October 2022. Grab samples were recovered at all 30 stations for faunal analysis and sediment PSA. Sediment grab samples were also recovered at ten stations for contaminants analysis. In addition, three samples were taken for water quality analysis. All stations sampled can be seen in Figure 2.2 while the station coordinates and depths are shown in Appendix A (Table A2).

7.1. DDV

A total of 30 underwater imagery samples were collected from 30 sample stations where grab samples were also taken and a total of 90 still images were captured from the video footage.

The results from the analysis of the video footage and still imagery showed that the seabed at all stations were comprised of soft sediments with a notable silt component. The majority of stations sampled within the NISA ECC area were recorded as the broadscale habitat 'Subtidal Mud', with burrows (including complex burrow systems e.g., *Nephrops*) observed. At four of the stations furthest inshore, muddy sand substrate with smaller burrows was recorded as the broadscale habitat 'Subtidal Sand'. Burrow size ranges and counts are provided in Appendix F and G.

Epifauna was sparse throughout the area, with the most abundant taxa observed being brittle stars (*Ophiuroidea*) found at the majority of stations. Other epifauna observed include fish (*Callionymidae, Pleuronectiformes, Gadidae*, *Triglidae*), starfish (*Asterias rubens, Asteroidea*), crustacea (*Brachyura, Paguridae, Nephrops norvegicus*), anemones (*Adamsia palliata, Ceriantharia*), along with some instances of bivalves (siphons, *Pectinidae*) and tube worms (*Sabellidae, Terrebellidae, Chaetopteridae*). No *Sabellaria* sp. individuals were recorded in either the stills or video analysis.

Within the imagery collected at the NISA ECC, the substrate recorded consistently scored 'Not Reef' for composition, elevation, and extent (Gubbay S. (2007)) with no occurrences of hard substrate cobbles or rock) identified to support epifauna typical of reef biota (Golding *et al.,* 2020; Irving R, 2009). All the stations sampled within the underwater imagery survey of the NISA ECC have therefore been assessed as 'Not Reef'. Sample station images and stills, including analysis proformas can be found in Appendix F and G. No Annex I habitats or MNNS were identified from the video and stills analysis. Litter was identified at stations 12 and 16.

7.2. Infauna

In total 6,736 individuals were found within the 30 infaunal samples, representing 249 unique taxa (the full species list is provided in Appendix B – Table B3). Henceforth, where 'species' is referred to, this is in relation to a unique taxon. No species of conservation importance were identified from the samples, although *Sabellaria spinulosa* was identified at four stations abundances were low and not indicative of *Sabellaria reef*. No MNNS species were identified from the samples within the ECC. Table 7.1 shows the top ten most abundant species found within the infaunal samples.

Table 7.1: Ten most abundant species and subtidal stations at which they were present

Species	Total Abundance	Stations
Amphiura filiformis	877	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 30
Kurtiella bidentata	447	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 24, 25, 27, 30
Turritellinella tricarinata	367	5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 30
Nucula nitidosa	265	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 20, 21, 23, 24, 25, 30
Diplocirrus glaucus	215	3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30
Sabellaria spinulosa	192	9, 13,15, 24
Phoronis sp	182	1, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 24, 25, 26, 27, 28, 29, 30,
Phaxas pellucidus	167	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 19, 20, 21, 24, 25, 28, 30
Amphiuridae	147	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 18, 19, 20, 24, 25, 26, 27, 30
Abra sp	127	1, 2, 3, 4, 5, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 24, 25, 28, 29, 30

7.2.1. Diversity

Number of taxa ranged from 15 (Station 29) to 74 (Station 5). Number of individuals ranged from 25 (Station 29) to 555 (Station 15). Richness ranged from 4.35 (Station 29) to 13.32 (Station 5). Evenness and diversity are high and relatively consistent across the sampling area. Richness, numbers of taxa and individuals are generally higher in stations closer to shore area where the sediment has a slightly lower silt and gravel concentration (Figure 7.1). Diversity results are shown in Figure 7.1 and Appendix H.

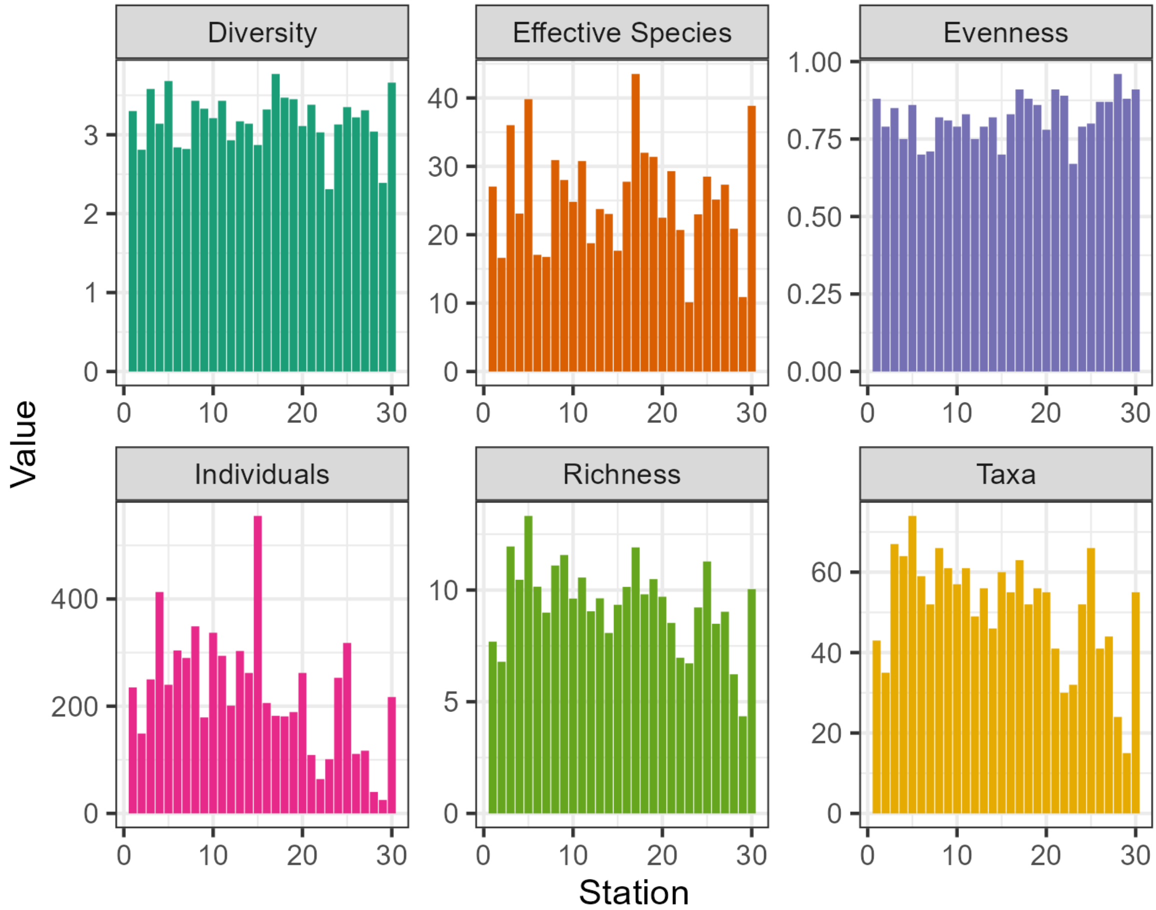

Figure 7.1: Univariate diversity indices at benthic grab sampling stations

7.2.2. Biomass

Taxa from all stations sampled were separated in the main faunal groupings for biomass measurements to be made. For each benthic grab faunal station, the biomass of each major faunal groups, as a proportion of overall biomass, is shown in Figure 7.2. Near shore stations are dominated by proportions of Mollusca and Annelida (segmented worms). The stations in the middle of the ECC tend to be dominated by Echinodermata. Moving further offshore stations become dominated by Mollusca. The two stations furthest from shore were dominated almost exclusively by Annelida (segmented worms).

7.3. PSA and TOC

PSA was undertaken on a sample from each sampling station and TOC analysis performed on finer sediments. The survey area consisted of sand with small portions of silt and gravel and were classified as muddy Sand, Sand and gravelly Sand (Folk, 1954). These portions were slightly higher at stations further offshore. Figures 7.3 and 7.4 demonstrate the sediment type across the survey area. The full list of the percentages of each particle size and TOC results is provided in Appendix D (Table D2).

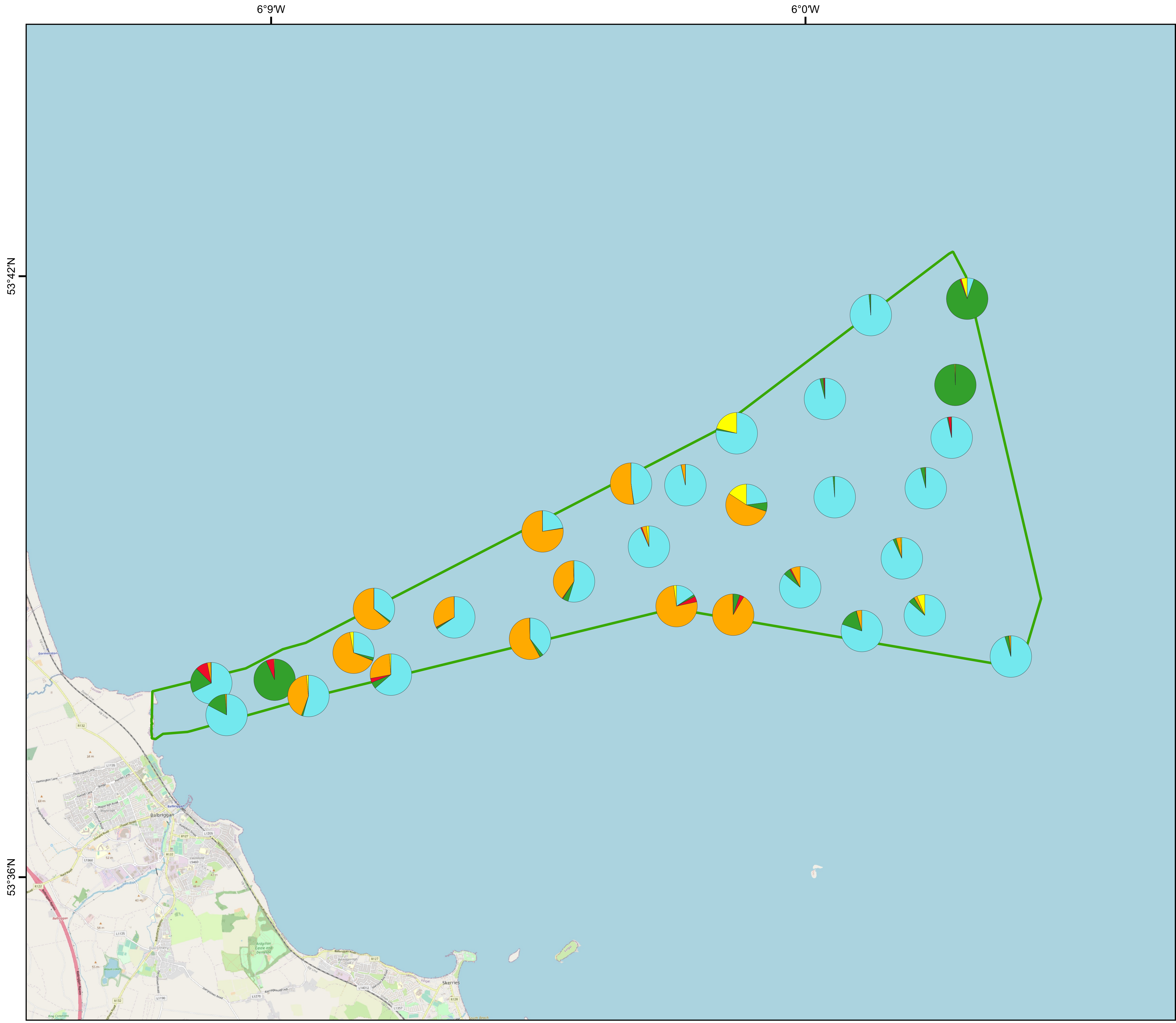

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Figure 7.2: Grab Station Proportions of Faunal Groupings

Key

Survey area

Faunal biomass

- Mollusca
- Annelida
- Arthropoda
- Echinodermata
- Other

Scale @ A3: 1:70,000

Coordinate System: TM75/ Irish Grid
Graticules: WGS84

0 1 2 3 4 km

N

Date: 09-03-23	Prepared by: RF	Checked by: ME
Ref: IE202180_M_107_A		

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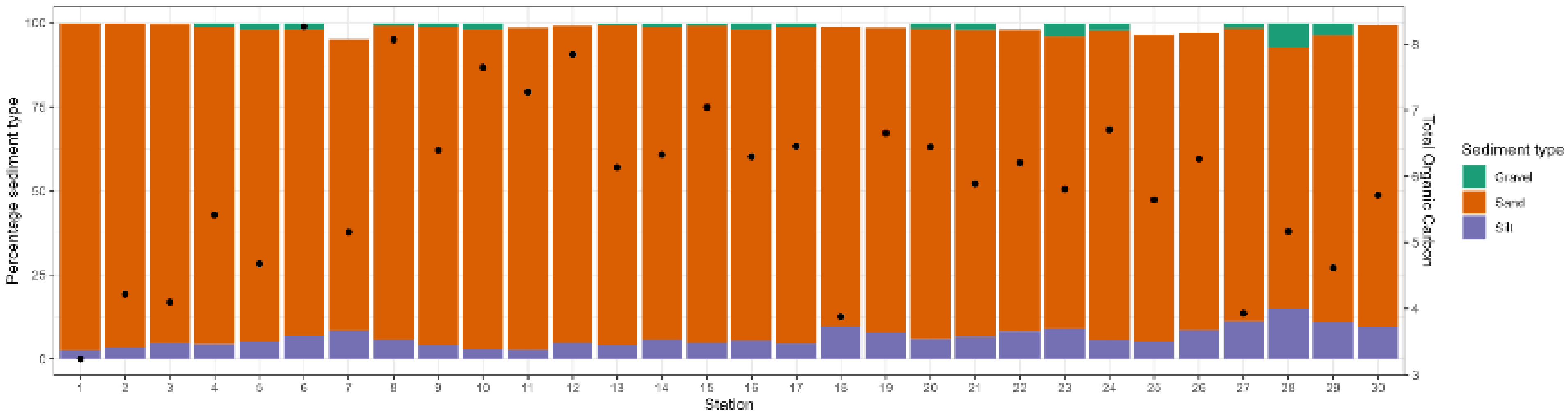

Figure 7.3. PSA and TOC at subtidal stations

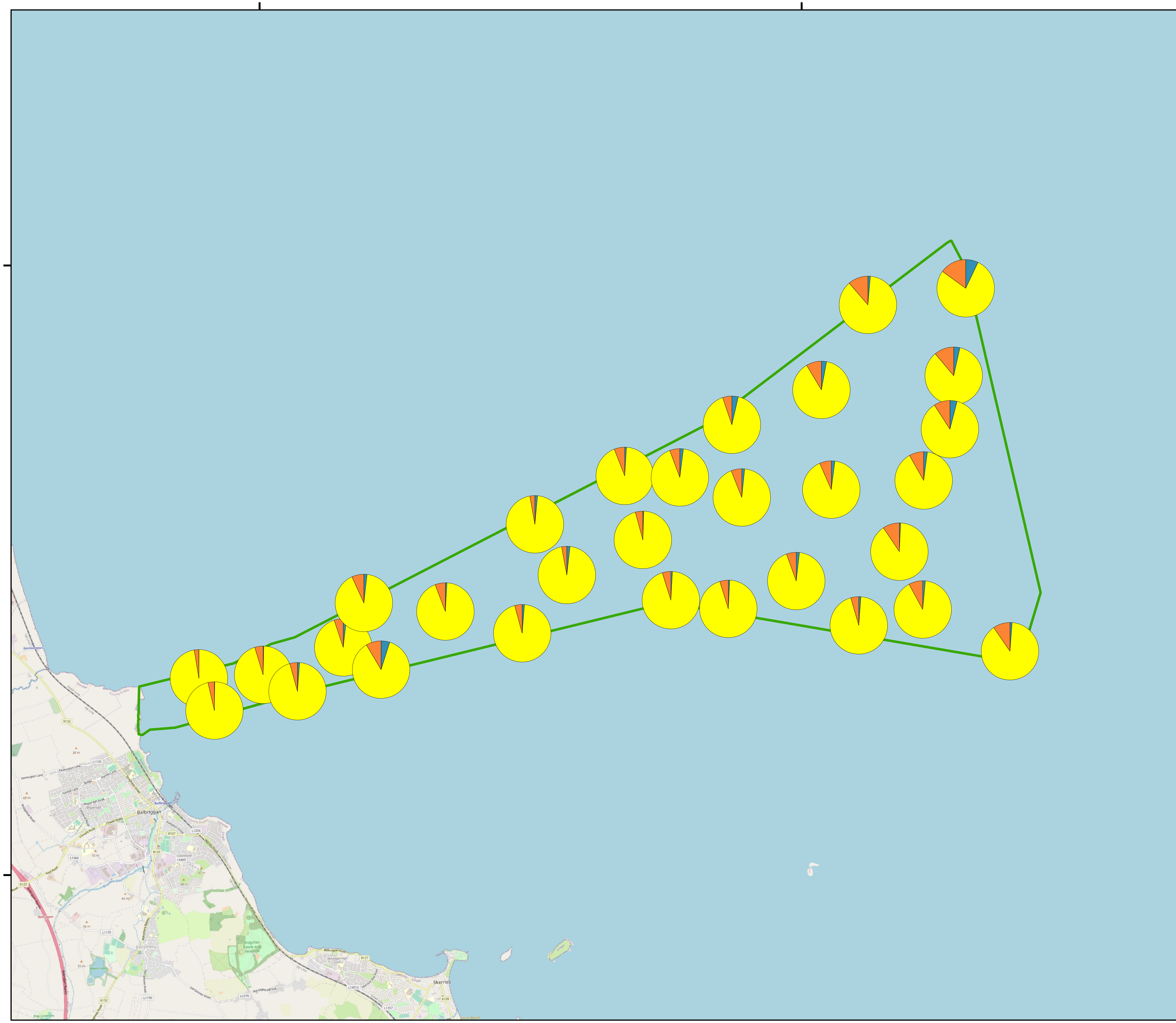

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Figure 7.4: Grab Station Proportions of Sediment Groupings

Key

Survey area

Propotions of sediment groupings

% Gravel

% Sand

% Mud

© OpenStreetMap contributors

Scale @ A3: 1:70,000

Coordinate System: TM75/ Irish Grid
Graticules: WGS84

0 1 2 3 4 km

N

Date: 09-03-23	Prepared by: RF	Checked by: ME
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7.4. Community Analysis

SIMPROF found 12 statistically significant groups of stations based on relatedness of species composition (Figure 7.5) Groups d, e, g, I, j and k contain a single sampling station and groups a, c and l consist of only two sampling stations (Table 7.3). It is unlikely that each grouping represents a distinct biotope type, however the relatively large number of groupings may be reflective of the heterogeneity of the environment and the transitional change from one habitat to another across the ECC.

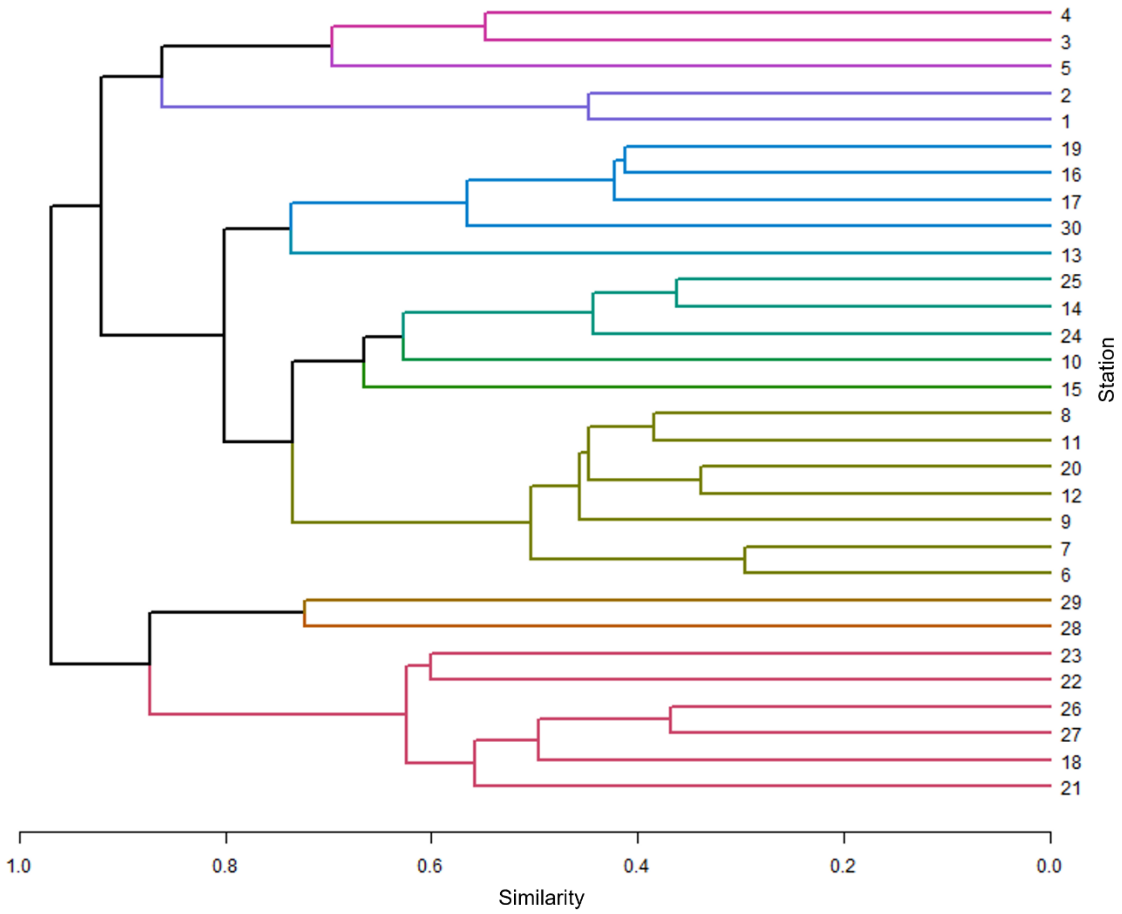


Figure 7.5. Station groupings discovered through clustering analysis of benthic sampling stations

Table 7.2: Station groupings discovered through SIMPROF analysis of benthic sampling stations

Groupings	Stations
a	28; 29
b	18; 21; 26; 27; 30
c	22; 23
d	13
e	15
f	6; 7; 8; 9; 11; 12
g	10
h	14; 16; 17; 19; 20; 24; 25
i	1
j	2
k	5
l	3; 4

The species driving the groupings in Table 7.2 are provided in table 7.3. Stations were grouped by the Folk classification to determine whether species composition varied between Folk classes. (Figure 7.6). When species assemblages were compared between Folk classifications by ANOSIM (Figure 7.7), a significant result was found (p = 0.001, R = 0.409).This illustrates the importance of sediment type in the resulting species assemblages and overall benthic community.

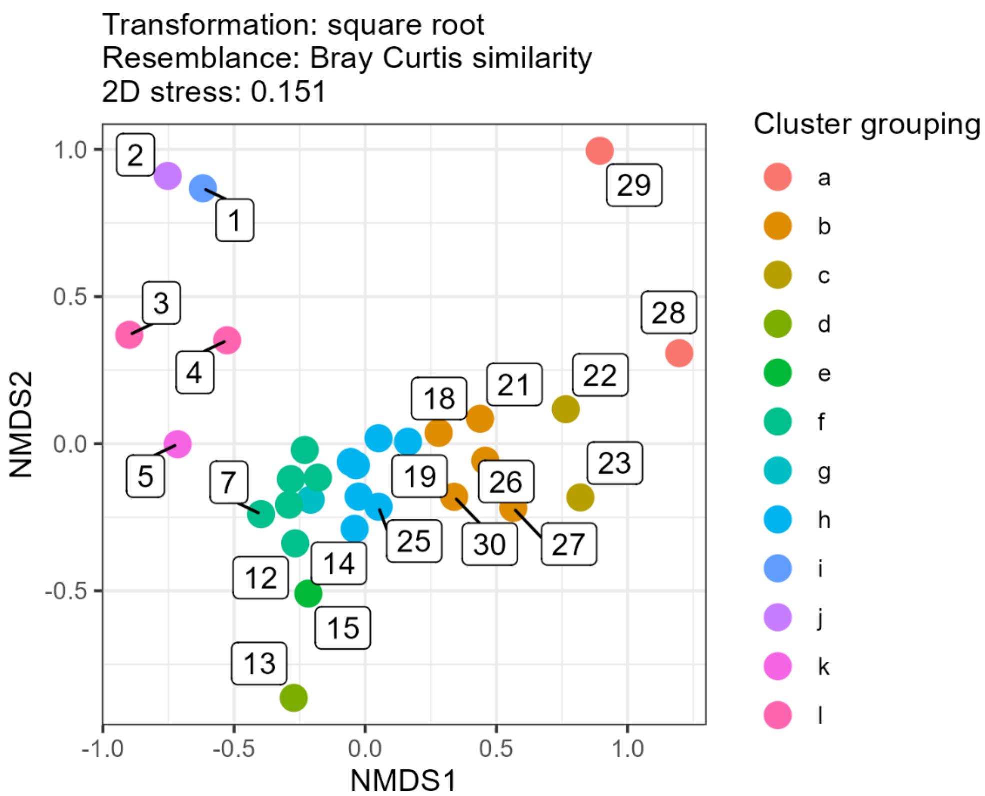


Figure 7.6: NMDS plot showing clustering of stations based on species composition.

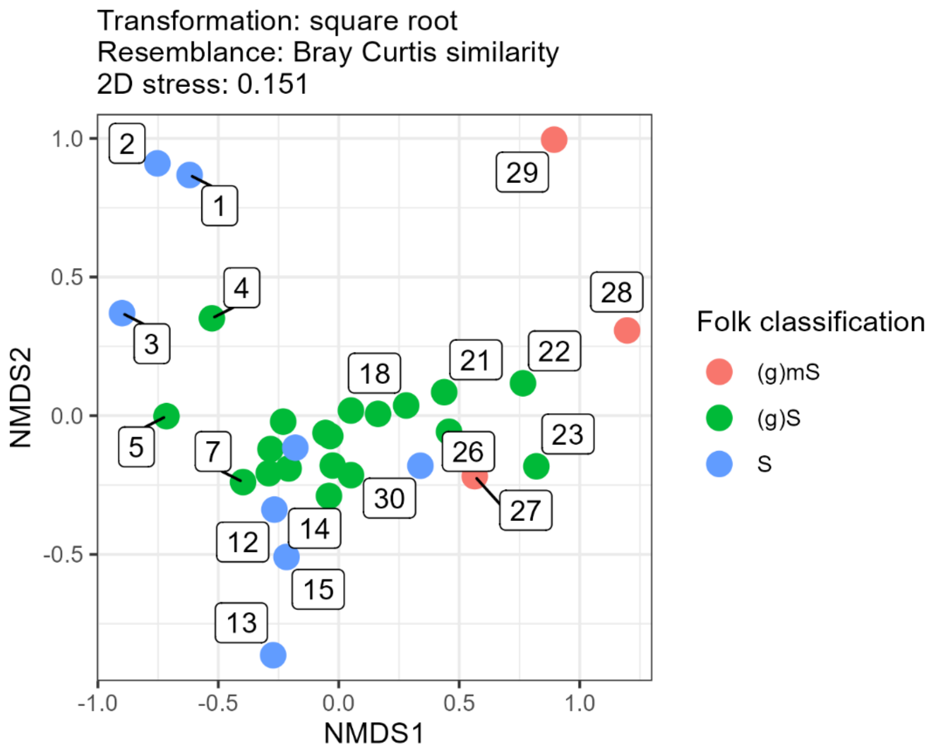


Figure 7.7: NMDS plot showing clustering of stations based on species composition, coloured by the Folk classification of the station

7.5. Contaminants

At ten stations, samples were collected and analysed for a range of contaminants. Contaminants levels were assessed against Irish (Cronin *et al*., 2006), Canadian (CCME, 2001) and Cefas action level guidelines.

When metals were assessed against the guidelines, no contaminants were above the upper guidelines (Cefas Action Level 2 (AL2), the Irish Upper Action Level (AL) or the Canadian Permissible Exposure Limit (PEL)). At stations 6, 7 and 28, Arsenic was above the Irish Lower AL but not Cefas Action Level 1 (AL1) or the Canadian Interim Sediment Quality Guidelines / Threshold Effects Level (ISEQ/TEL). Levels of Cadmium were above all lower guidelines at station 6, but below the upper guidelines, whilst levels at station 7 were above the Cefas AL1 but not the Irish Lower AL and Canadian ISEQ/TEL. Levels of Chromium were above Cefas AL1 at station 6, 7, 27 and 28, but below the Irish Lower AL and Canadian ISEQ/TEL. At station 6, lead was above the Canadian ISEQ/TEL, but below the Cefas AL1 and Irish Lower AL. Levels of Zinc were above all lower guidelines at station 6, but below the upper guidelines. The levels of remaining metals in the sediment samples; Copper, Nickel and Mercury, were below all guidelines assessed against.

Levels of Polyaromatic Hydrocarbons (($\sum PAH^{16}$) and Total Hydrocarbon Content (THC) at all stations were below Cefas AL1 and the Irish Lower AL. As Canadian guidelines do not specify a sum of the 16 PAHs, each PAH was assessed its own guideline where available. Of the thirteen PAH assessed, only station 7 exceeded the ISEQ/TEL for Dibenz(a,h)anthracene and 2-Methylnaphthalene but not the PEL.

Levels of Organotins, Polychlorinated biphenyls ($\sum PCB^{7}$) and Organochlorine pesticides (OCP) were below all guidelines assessed against.

A full breakdown of contaminant results can be found in Appendix I.

7.6. Biotope Assignment

7.6.1. Infaunal/sediment analysis

SIMPER was run to determine species contributing greatest variation between Folk classifications and the five top contributors to the SIMPROF station groupings are provided in Table 7.3.

Table 7.3: Average contributions of species most similar between station groupings, according to SIMPER

Station Grouping	Most Influential Species Driving Similarity	Folk Sediment Classification	Approx. Depth Range (m)
a	*Varicorbula gibba; Abra sp.; Diplocirrus glaucus; Levinsenia gracilis; Ancistrosyllis groenlandica*	Gravelly Muddy Sand	35
b	*Turritellinella tricarinata; Diplocirrus glaucus; Phoronis sp.; Levinsenia gracilis; Abra sp.*	Gravelly Sand / Sand	35
c	*Turritellinella tricarinata; Levinsenia gracilis; Amphiura filiformis; Diplocirrus glaucus; Nephtys sp.*	Gravelly Sand	30
d	*Spirobranchus; Sabellaria spinulosa; Spirobranchus lamarcki; Turritellinella tricarinata; Amphiura filiformis*	Sand	24
e	*Sabellaria spinulosa; Kurtiella bidentata; Amphiura filiformis; Nucula nitidosa; Phoronis sp.*	Sand	39
f	*Amphiura filiformis; Kurtiella bidentata; Scalibregma inflatum; Pholoe baltica; Turritellinella tricarinata*	Gravelly Sand / Sand	19
g	*Kurtiella bidentata; Tryphosa crenata; Nemertea sp.; Cylichna cylindracea; Nucula sp.*	Gravelly Sand	23
h	*Amphiura filiformis; Kurtiella bidentata; Turritellinella tricarinata; Diplocirrus glaucus; Phoronis sp.*	Gravelly Sand	33
i	*Ophiura sp.; Ampelisca brevicornis; Nephtys; Spio symphyta; Magelona filiformis*	Sand	7
j	*Nucula nitidosa; Ophiura sp.; Spiophanes bombyx; Melinna palmata; Spio symphyta*	Sand	7
k	*Nematoda sp.; Phaxas pellucidus; Prionospio fallax; Thracia phaseolina; Tubulanus polymorphus*	Gravelly Sand	13
l	*Nucula nitidosa; Phaxas pellucidus; Abra alba; Nucula sp.; Amphiuridae*	Gravelly Sand / Sand	11

Depth varies across the ECC from the infralittoral habitats closer to shore and circalittoral habitats closer to the array area. Table 7.3 shows the importance of depth as well as sediment type in determining the benthic communities therein. For example. Groups i and j, and d and e, are all present in habitats defined as Sand (as per Folk, 1989), however different species are driving the groupings. Groups i and j are in relatively shallow waters and the grouping is driven by, (amongst others provided in the table above) the brittle star species *Ophiura* sp. Groups d and e, which are also in habitats defined as Sand (Folk, 1989), tube forming polychaete species and the brittle star *Amphiura filiformis* drive the groupings. Group d is driven partly by the scour tolerant *Spirobranchus* sp. family. The terebellid species *Diplocirrus glaucus* is influential in driving the species groupings of groups a and b where the sediment type is gravelly muddy Sand or gravelly sand (Folk, 1989). Overall, there is considerable overlap between groups in terms of fauna, with limited variation in sediment type.

7.6.2. DDV analysis

A total of three habitats/biotopes were observed at the sample stations surveyed in the NISA ECC, which were 'Seapens and burrowing megafauna in circalittoral fine mud' (SS.SMu.CFiMu.SpnMeg), 'Circalittoral sandy mud' (SS.SMu.CSaMu) and 'Infralittoral muddy sand' (SS.SSa.IMuSa). The biotope 'Seapens and burrowing megafauna in circalittoral fine mud' (SS.SMu.CFiMu.SpnMeg) was recorded at stations where burrows were clearly observed in sufficient density (>0.1 m^2 for burrows over 3 cm), the presence of burrowing megafauna (*Nephrops norvegicus*) was observed at four stations. However, seapens were not present in any of the video sample stations. The substrates observed were homogenous in nature, and segmentation due to changes in habitat were not required for any of the video samples collected. The habitats/biotopes that were identified within the NISA ECC are summarised in Table 7.4 and the DDV sample station images and stills and DDV analysis proformas in Appendix G.

Table 7.4: DDV Biotope Assisgnment

Biotope	MNCR Classification Description	Stations
SS.SMu.CFiMu.SpnMeg	Seapens and burrowing megafauna in circalittoral fine mud	5, 6, 7, 8, 11, 16, 17, 18, 19, 29, 21, 22, 23, 25, 26, 27, 28, 29, 30
SS.SMu.CSaMu	Circalittoral sandy mud	9, 10, 12, 13, 14, 15, 24
SS.SSa.IMuSa	Infralittoral muddy sand	1, 2, 3, 4

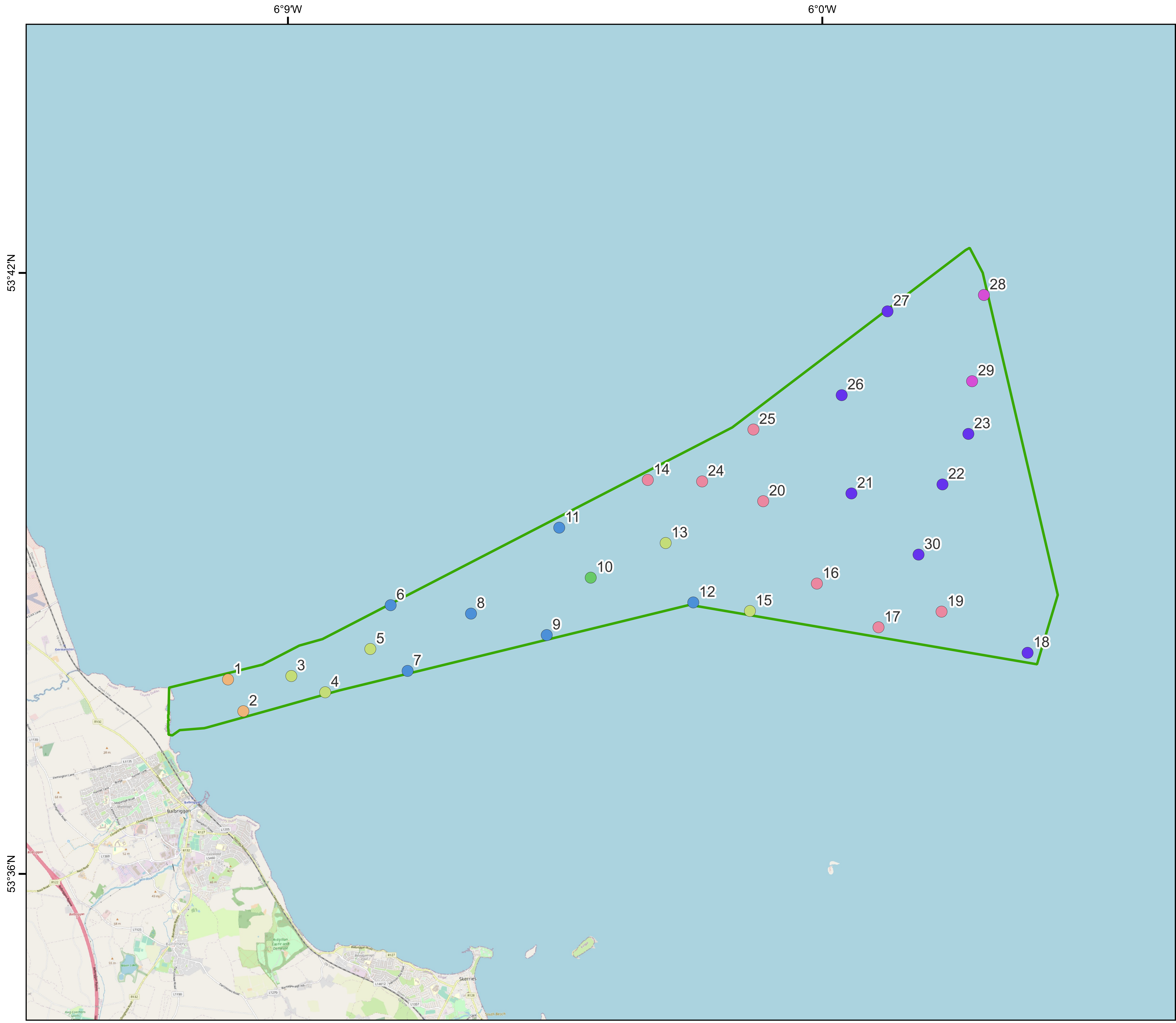
7.6.3. Final Biotope Classification

Infauna (grab) characterising species were incorporated into an Excel spreadsheet alongside epibenthic (DDV) biotope classifications, physical characteristics such as depth and PSA, and final benthic habitats assigned to each sampling station. A total of seven biotopes were classified across the NISA survey area. The majority of infauna and epibenthic habitat assignment at a sampling station were consistent or complimentary The most common biotopes found were Circalittoral sandy mud (SS.SMu.CSaMu) and A*mphiura filiformis*, *Kurtiella bidentata* and *Abra nitida* in circalittoral sandy mud (SS.SMu.CSaMu.AfilKurAnit). Seven stations were classified as SS.SMu.CSaMu as their species composition did not match any biotopes of that zone and sediment type. This is also true SS.SSa.CFiSa which only contained one station and couldn't be taken to a higher level as no biotopes of that zone and sediment type matched it species composition. All biotopes are provided in Table 7.5 and full biotope descriptions in Appendix E.

Table 7.5: Subtidal Biotope Assisgnment

Final Biotope	MNCR Classification Description	EUNIS (2022) equivalent	Stations
SS.SSa.IMuSa.FfabMag	*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	MB5236	1, 2,
SS.SMx.CMx.KurThyMx	*Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment	MC4213	28, 29
SS.SMu.CSaMu	Circalittoral sandy mud	MC6	18, 21, 22, 23, 26, 27, 30
SS.SSa.CMuSa.AalbNuc	*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	MC5214	3, 4, 5, 13, 15
SS.SMu.CSaMu.AfilEten	*Amphiura filiformis* and *Ennucula tenuis* in circalittoral and offshore sandy mud	MC6213	6, 7, 8, 9, 11, 12
SS.SSa.CFiSa	Circalittoral fine sand	MC5	10
SS.SMu.CSaMu.AfilKurAnit	*Amphiura filiformis, Kurtiella bidentata* and *Abra nitida* in circalittoral sandy mud	MC6211	14, 16, 17, 19, 20, 24, 25

Disparities between DDV and grab benthic biotope assignation occurred due to the incorporation of PSA analysis where it was considered that data from the benthic grab gave a better representation of sediment characteristics. However, it was also important to consider infaunal and epibenthic communities in assigning the final biotopes. Although the DDV biotopes assigned included the biotope SS.SMu.CFiMu.SpnMeg (seapens and burrowing megafauna in circalittoral fine mud), no seapens were observed at these stations and the PSA data classified no stations as fine mud, a requirement of this biotope. The final biotopes demonstrate the change in habitats from the infralittoral muddy sand habitat nearshore to the circalittoral sandy muds along the cable route with some mixed sediment biotope states near the array area. Full biotope descriptions in Appendix E.



Project:

North Irish Sea Array (NISA) Offshore Wind Farm

Title:

Figure 7.8: Biotope Classification Over the Subtidal Benthic Survey Area

Key

Survey area

Biotope code

- SS.SMu.CSaMu
- SS.SMu.CSaMu.AfilEten
- SS.SMu.CSaMu.AfilKurAnit
- SS.SMx.CMx.KurThyMx
- SS.SSa.CFiSa
- SS.SSa.CMuSa.AalbNuc
- SS.SSa.IMuSa.FfabMag

Scale @ A3: 1:70,000

Coordinate System: TM75/ Irish Grid
Graticules: WGS84

0 1 2 3 4 km

N

Date: 09-03-23	Prepared by: RF	Checked by: SM
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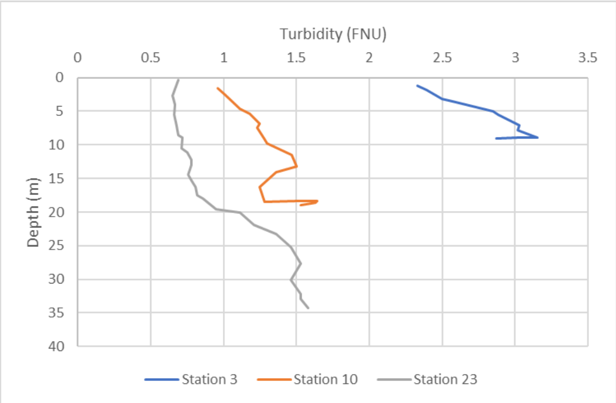
7.7. Water Quality

Water samples were taken at 3 sites across the ECC - near shore (Station 3), mid-way along the cable route (Station 10) and near the array (Station 23).

Turbidity is an optical parameter and is defined as the clarity of the water sample. Formazin Nephelometric Units (FNU) are used to represent turbidity readings captured using an 860 nm light (near IR) with a 90-degree detection angle. The near shore station has the greatest turbidity, whilst the station near the array is the least turbid. Turbidity at all three stations increases slightly with depth (Figure 7.9).

Total Dissolved Solids (TDS) refers to the fraction of particles and ions, including metals, minerals, and salts, that can pass through a filter with a 2 µm pore size. The TDS measurement represents the total concentration of these dissolved solids in a given volume. TDS increases across the stations from near shore to near the array whilst there is only a slight increase at depth at each station (Figure 7.9).



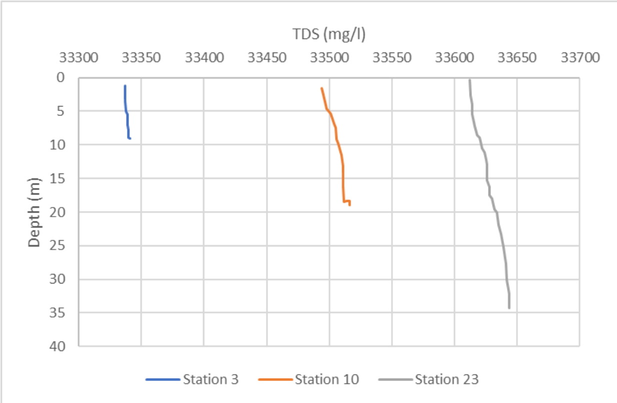


Figure 7.9: Depth profiles for Turbidity (FNU) and Total Dissolved Solids (TDS) at three stations across the survey area

8. Discussion

The intertidal area surveyed near Bremore Bay Beach consisted of boulders and rock outcrops with shingle and sand at the top of the shore. This was bordered on the north (Coney Hill Bay Beach) and south by two sandy areas. Ten biotopes were found across they survey area.

A band of barren shingle was present at the top of the shore (LS.LCS.Sh.BarSh) apart from at Coney Hill Bay Beach. Generally, this type of sediment supports virtually no macrofauna due to the mobile and freely draining substratum. Below this, a band of sand was situated between the shingle and the coarser sediments of the mid shore, extending to join the substrate of Bremore Bay Beach. Most sediment stations sampled consisted of fine sand, with biotopes recorded as polychaete/amphipod-dominated fine sand shores (LS.LSa.FiSa) and polychaetes in littoral fine sand (LS.LSa.FiSa.Po). One station was recorded with the biotope *Scolelepis* spp. in littoral mobile sand (LS.LSa.MoSa.AmSco.Sco) due to larger proportion of *Scolelepis (Scolelepis) squamata* compared to the few other species recorded at this station. These stations were species poor and are likely a transitional area between the barren shingle at the top of the shore and the macroalgae dominated coarser substrate of the mid shore. The habitat at Coney Hill Bay Beach was homogeneous fine sand with occasional worm casts of *Arenicola marina*. Stations here were more species rich and as such the biotope was recorded as *Macomangulus tenuis* in littoral fine sand (LS.LSa.FiSa.Po.Mten).

In this transitional area at the top of the shore the biotope - *Ulva* spp., on freshwater-influenced and/or unstable upper eulittoral rock (LR.FLR.Eph.Ulv) occurred in two areas which was consistent with the unstable substrate and opportunistic nature of the species.

The majority of the shore surveyed consisted of boulders and compacted coarse sediment with some areas of bedrock. A few areas of taller barnacle dominated bedrock occurred in the mid shore which created slight shelter for the *Ascophylum nodosum* biotope - *Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata (LR.LLR.F.Asc.X). Fucoid biotopes covered the rest of the shore with the most common being, *Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock (LR.MLR.BF.FVesB). Whelks, limpets, and periwinkles were common underneath the algae. On the lower shore there was a lack of a well-developed under story algal community due to the lack of suitable substrate.

The subtidal benthic ecology depicts a relatively homogeneous environment with seven biotopes classified across the ECC. The sediment types consisted of sand with small portions of silt and gravel. The typical community structure is characterised by a range of species including polychaetes, bivalves, amphipods, hydroids and bryozoans. In the near shore area, the community was dominated by brittle stars, amphipods, polychaete worms and bivalves. The biotopes identified were *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand (SS.SSa.IMuSa.FfabMag) and *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (SS.SSa.CMuSa.AalbNuc) were present.

The middle of the survey areas was dominated by the brittle star, *Amphiura filiformis* on circalittoral sandy mud. The biotope identified was *Amphiura filiformis* and *Ennucula tenuis* in circalittoral and offshore sandy mud (SS.SMu.CSaMu.AfilEten). One station in this area was identified as circalittoral fine sand (SS.SSa.CFiSa) but a community structure could not be identified. Further from shore the biotope *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (SS.SSa.CMuSa.AalbNuc) was again present, but dominated by *Sabellaria spinulosa* with bivalves and the brittle star, *A. filiformis*. Although *S. spinulosa* was present, abundances were relatively low in the infaunal samples, and no *S. spinulosa* was present in the visual survey analysis. Furthermore, visual survey analysis following the Gubbay S. (2007) guidance for identifying reefs found no biogenic reefs were present in the ECC area.

Closer to the array area the community is characterised circalittoral sandy mud. High numbers of *A. filiformis,* bivalves and *Turritellinella tricarinata* characterised the biotope as A*. filiformis, Kurtiella bidentata* and *Abra nitida* in circalittoral sandy mud (SS.SMu.CSaMu.AfilKurAnit). This community usually occurs in muddy sand in moderately deep water but here it is likely to be a shallow water variant. The remaining stations in this area were not identified to a higher biotope level due to the community not matching one single biotope. The community was species rich and dominated by the Augur shell (*Turritellinella tricarnata),* and the polychaetes*, Levinsernia gracillis* and *Diplocirrus glacus* with other polychaetes, brittle star and bivalves present. The Augur shell is common on muddy sediments in shallow water but can be found down to 200 m. *L. gracillis* tends to be found in deep water, so little is known about the species.

Stations closest to the array area contained a greater portion of gravel and mud, with the biotope, *K. bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment (SS.SMx.CMx.KurThyMx) being identified. The community was particularly species poor with highest number of individuals being bivalves.

No Annex I features were identified during the ECC benthic survey campaign. Whilst the reef forming species *Sabellaria spinulosa* were found at several stations in the cable route area, abundances were relatively low, and no stations were classified as *Sabellaria spinulosa* reef. No MNNS species were identified during the ECC benthic survey campaign.

Contaminated sediment results showed low levels of chemical contaminants at stations sampled within the cable route area. The majority of contaminants levels at sampled stations were below the Irish Lower AL, Cefas AL1 and Canadian Interim Sediment Quality Guidelines.

Water quality results indicated higher levels of turbidity and total dissolved solids at the shallower nearshore station, decreasing along the ECC and lowest at the near-array station, where depth increases. This is to be expected as shallower stations are more exposed to wave action.

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Appendices

A. Sampling Locations

Table A1: Intertidal Sampling Locations

Sampling Station	Latitude	Longitude	Samples Taken
1	53.6282	-6.1866	None (station in subtidal - abandoned)
2	53.6278	-6.1876	None (Station in subtidal- moved)
2 (new)	53.6278	-6.1883	PSA; Fauna;
3	53.6277	-6.1865	None (Station in subtidal - moved)
3 (new)	53.6274	-6.1878	PSA; Fauna;
4	53.6272	-6.1890	PSA; Fauna;
5	53.6262	-6.1852	PSA; Fauna;
6	53.6258	-6.1881	PSA; Fauna;
7	53.6239	-6.1877	PSA; Fauna;
8	53.6235	-6.1883	PSA; Fauna;
9	53.6227	-6.1880	PSA; Fauna;
10	53.6227	-6.1874	PSA; Fauna;
11	53.6233	-6.1855	Photograph
12	53.6236	-6.1854	Photograph
13	53.6262	-6.1852	Photograph
14	53.6258	-6.1879	Photograph
15	53.6254	-6.1884	Photograph
16	53.6244	-6.1872	Photograph
17	53.6239	-6.1870	Photograph
18	53.6229	-6.1869	Photograph
19	53.6229	-6.1874	Photograph
20	53.6226	-6.1881	Photograph

Table A2: Subtidal Sampling Locations

Sampling Station	Latitude	Longitude	Approximate Depth (m)	Samples Taken
1	53.631	-6.172	6.5	Fauna; PSA
2	53.626	-6.168	6.5	Fauna; PSA
3	53.632	-6.154	10	Fauna; PSA; Water Quality
4	53.629	-6.144	11.2	Fauna; PSA
5	53.636	-6.132	12.5	Fauna; PSA
6	53.643	-6.125	15.4	Fauna; PSA; Contaminants
7	53.632	-6.121	15.1	Fauna; PSA; Contaminants
8	53.641	-6.103	18	Fauna; PSA; Contaminants
9	53.637	-6.082	20.7	Fauna; PSA; Contaminants
10	53.647	-6.069	22.6	Fauna; PSA; Water Quality
11	53.655	-6.078	21.5	Fauna; PSA; Contaminants
12	53.642	-6.041	24.7	Fauna; PSA; Contaminants
13	53.652	-6.048	23.5	Fauna; PSA; Contaminants
14	53.663	-6.053	22	Fauna; PSA
15	53.641	-6.025	39	Fauna; PSA
16	53.645	-6.006	38.3	Fauna; PSA
17	53.637	-5.989	37	Fauna; PSA
18	53.632	-5.947	35.3	Fauna; PSA
19	53.640	-5.971	36	Fauna; PSA
20	53.659	-6.020	40	Fauna; PSA
21	53.660	-5.996	34	Fauna; PSA
22	53.661	-5.970	31.7	Fauna; PSA
23	53.669	-5.962	28	Fauna; PSA; Contaminants; Water Quality
24	53.662	-6.037	31	Fauna; PSA
25	53.671	-6.023	28	Fauna; PSA
26	53.676	-5.998	31	Fauna; PSA
27	53.690	-5.984	33.3	Fauna; PSA; Contaminants
28	53.692	-5.957	34	Fauna; PSA; Contaminants
29	53.678	-5.961	36	Fauna; PSA
30	53.649	-5.977	41	Fauna; PSA

B. Species List

Table B1: Intertidal Infauna Species List

Species	AphiaID	Sampling Station							
		2	3	4	6	7	8	9	10
CNIDARIA	1267								
HYDROZOA	1337								
ANTHOATHECATA	13551								
Corynidae	1599								
Coryne muscoides	117469	P							
NEMATODA	799								
Nematoda	799	5			22		1		
ANNELIDA	882								
POLYCHAETA	883								
PHYLLODOCIDA	892								
Sigalionidae	943								
Sigalion mathildae	131072	1		1					
Phyllodocidae	931								
Phyllodocidae (partial/damaged)	931	1							
Eteone longa	130616			1	6				
Eumida sp. (damaged)	335309			2					
Eumida bahusiensis	130641		1						
Hypereteone foliosa	152250		1						
Phyllodoce mucosa	334512		1						
Glyceridae	952								
Glycera sp. (damaged)	129296	1							
Nephtyidae	956								
Nephtys sp. (damaged)	129370		2	1					
Nephtys cirrosa	130357	4							1
Nephtys kersivalensis	130363		1						
ORBINIIDA	884								
Orbiniidae	902								
Scoloplos armiger	130537				14				
Paraonidae	903								
Aricidea (Arcidea) minuta	730747				1				
SPIONIDA	889								
Spionidae	913								
Spionidae (juv)	913	8							
Pygospio elegans	131170			1	12	7			

Species	AphiaID	Sampling Station							
		2	3	4	6	7	8	9	10
Scolelepis (Scolelepis) squamata	157566						28		
Spio martinensis	131185	3	9	1					
Magelonidae	914								
Magelona filiformis	130268		2	1					
CAPITELLIDA	890								
Capitellidae	921								
Capitella sp. complex	129211	10	4	2	19	4			
Arenicolidae	922								
Arenicola marina	129868				5				
SABELLIDA	901								
Oweniidae	975								
Owenia borealis	329882		1						
OLIGOCHAETA	2036								
HAPLOTAXIDA	2118								
TUBIFICIDA	1511829								
Tubificinae	137344								
Tubificoides benedii	137571			1	3				
Enchytraeidae	2038								
Enchytraeidae	2038						2		
ARTHROPODA	1065								
CHELICERATA	1274								
ARACHNIDA	1300								
ACARI	292684								
Acari (indet)	292684	1							
PYCNOGONIDA	1302								
PANTOPODA	1358								
Ammotheidae	1562								
Achelia echinata	134599	1		1					
CRUSTACEA	1066								
HEXAPODA	1278								
Neanuridae	118097								
Anurida maritima	118139	3							
COPEPODA	1080								
HARPACTICOIDA	1102								
Harpacticoida	1102	31							
MALACOSTRACA	1071								
AMPHIPODA	1135								

Species	AphiaID	Sampling Station							
		2	3	4	6	7	8	9	10
Atylidae	146525								
Nototropis swammerdamei	488966	6		3					
Pontoporeiidae	101406								
Bathyporeia sp. (damaged)	101742				4				
Gammaridae	101383								
Gammarus sp. (damaged)	101537	22		2					
Gammarus locusta	102281	7							
Isaeidae	101388								
Microprotopus maculatus	102380	4							
Corophiidae	101376								
Corophium volutator	102101				109	3	2		
Caprellidae	101361								
Pariambus typicus	101857					1			
CUMACEA	1137								
Bodotriidae	110378								
Cumopsis goodsir	110465	1							
DECAPODA	1130								
Crangonidae	106782								
Crangon crangon	107552			1	1				
BRACHYURA	106673								
Brachyura (juv)	106673				1				
Carcinidae	557511								
Carcinus maenas	107381							1	
INSECTA	1307								
DIPTERA	118088								
Chironomidae	118100								
Chironomidae larvae	118100						1		
MOLLUSCA	51								
GASTROPODA	101								
LITTORINIMORPHA	382213								
Hydrobiidae	120								
Peringia ulvae	151628				2	11			
BIVALVIA	105								
MYTILIDA	210								
Mytilidae	211								
Mytilidae (juv)	211	1							

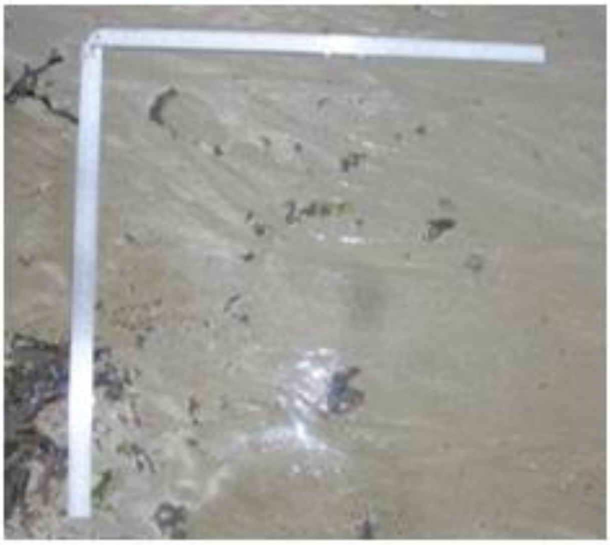
Species	AphiaID	Sampling Station							
		2	3	4	6	7	8	9	10
IMPARIDENTIA	869600								
CARDIIDA	869602								
Tellinidae	235								
Macomangulus tenuis	878470	6	20	18		1		2	
Limecola balthica	880017	1			10	1			

Table B2: Intertidal hard substrate sampling station species list

Sampling Station	Species	Abundance (if required)					
		S	A	C	F	O	R
11	*Laminaria hyperborea*						
	Fucus serratus						
	Desmarestia aculeata						
	Cirripedia sp			✓			
12	Fucus vesiculosus						
	Cirripedia sp				✓		
	Nucella lapillus					✓	
	Patella vulgata					✓	
	Littorina obtusata					✓	
13	Mastocarpus stellatus						
	Laminaria hyperborea						
	Fucus serratus						
	Palmaria palmata						
	Encrusting calcareous reds						
	Steromphala umbilicalis						✓
	Cirripedia sp		✓				
	Patella vulgata					✓	
	Littorina littorea						✓
	Nucella lapillus					✓	
14	*Ascophyllum nodosum*						
	Fucus vesiculosus						
	Cirripedia sp					✓	
	Littorina littorea				✓		
15	*Ulva* sp.						
16	*Ascophyllum nodosum*						
	Fucus vesiculosus						
	Vertebrata lanosa						
	Fucus serratus						
	Gelidium pusillum						
	Polysiphonia sp.						
	Encrusting calcareous reds						

Sampling Station	Species	Abundance (if required)					
		S	A	C	F	O	R
	Hydroids						
	Patella vulgata				✓		
	Nucella lapillus				✓		
17	*Fucus vesiculosus*						
	Fucus serratus						
	Mastercarpus stellatus						
	Encrusting calcareous reds						
	Patella vulgata				✓		
	Cirripedia sp			✓			
	Littorina littorea					✓	
19	*Fucus vesiculosus*						
	Cladostephus spongiosus						
	Encrusting calcareous reds						
	Ulva sp.						
	Mastercarpus stellatus						
	Gelidium pusillum						
	Cladophora sp.						
	Cirripedia sp		✓				
	Carcinus maenas				✓		
19	*Ascophyllum nodosum*						
	Fucus vesiculosus						
	Vertebrata lanosa						
	Gelidium pusillum						
	Cladophora sp.						
	Cladostephus spongiosus						
	Cirripedia sp	✓					
	Patella vulgata				✓		
	Littorina littorea					✓	
20	*Ulva* sp.						

C. Intertidal Sampling Station Photographs

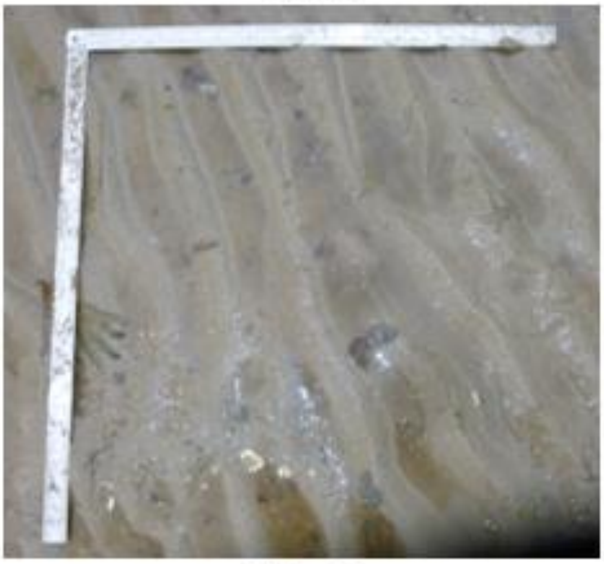


Station 2

Station 3

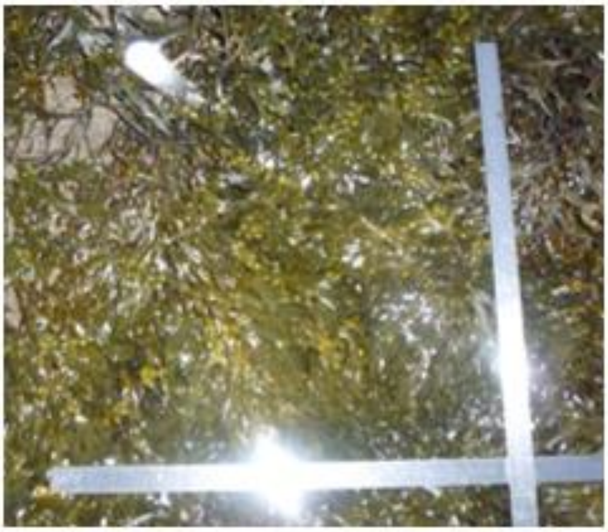
Station 4

Station 6

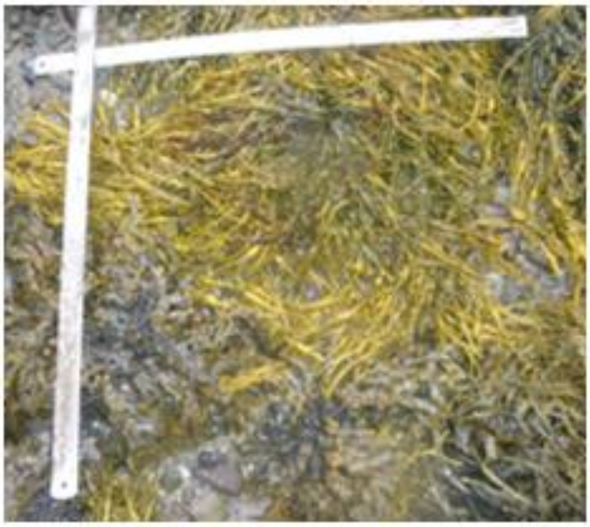


Station 7

Station 11



Station 12

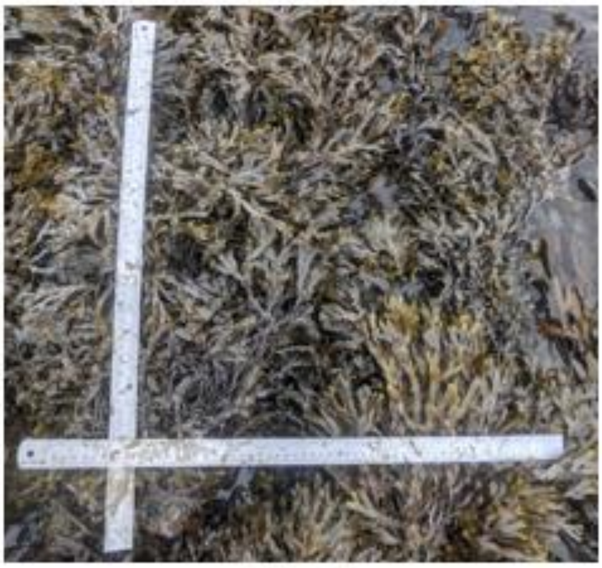


Station 13

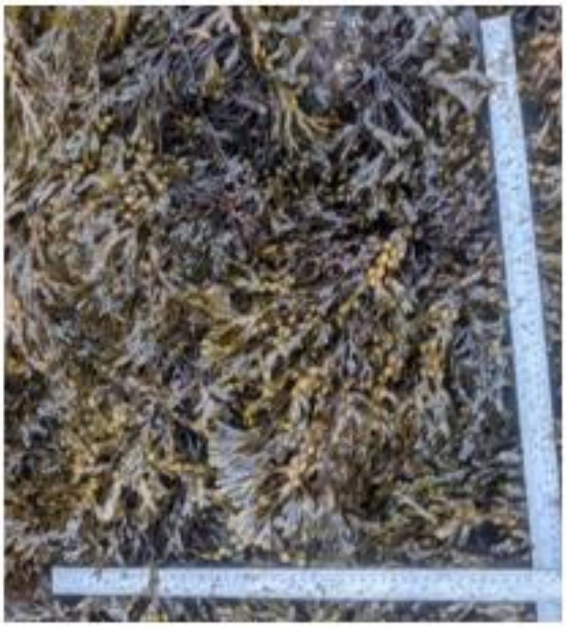
Station 14

Station 15

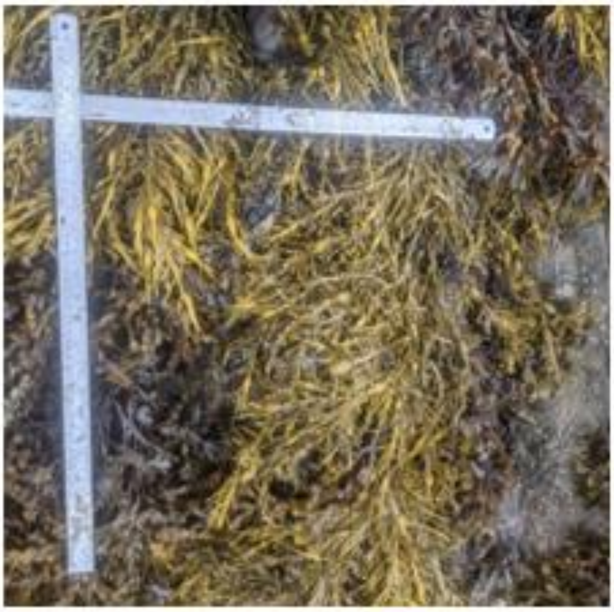
Station 16



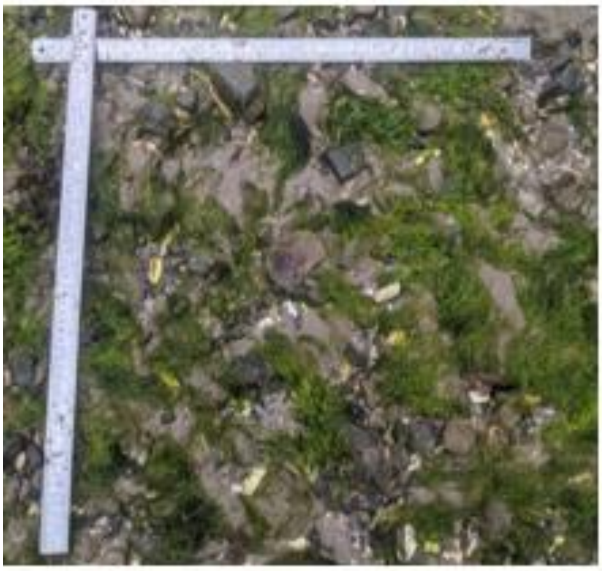
Station 17



Station 18



Station 19



Station 20

D. PSA and TOC Results

Table D1: Intertidal PSA and TOC Results

Station	Range of Particle Size									PSA Folk Classification	TOC (expressed as LOI)
	>8mm	4-8mm	2-4mm	1-2mm	0.5-1µm	0.25-0.5µm	125-250 µm	62.5 -125µm	<62.5 µm		
2	0	0.8	0.2	0.1	0.5	1.9	76.2	18.4	1.9	(gravelly) Sand	1.1
3	0	0.6	0.7	0.8	1.2	1.6	64.8	29	1.2	(gravelly) Sand	1.37
4	0	0	0.2	0.4	1.4	2.5	88.1	7.1	0.2	Sand	1.48
6	0	1.8	1	0.9	1.7	1.9	66.8	23.9	1.9	(gravelly) Sand	1.59
7	7.5	3.1	11.1	5.4	3.8	3.8	55.2	9.7	0.5	Gravelly Sand	1.29
8	0	2	2.3	4.4	5.2	7.6	74.8	3.5	0.1	(gravelly) Sand	1.44
9	0	1.8	3.3	2.4	2	3.8	82.9	3.7	0.1	Gravelly Sand	1.39
10	0	0	0.2	0.7	1.1	1.6	90.6	5.7	0.1	Sand	0.66

Table D2: Subtidal PSA and TOC Results

Station	Range of Particle Size									PSA Folk Classification	TOC (expressed as LOI)
	>8mm	4-8mm	2-4mm	1-2mm	0.5-1µm	0.25-0.5µm	125-250 µm	62.5 -125µm	<62.5 µm		
1	0	0	0.1	0.9	2.3	2.6	61.2	30.3	2.6	Sand	3.24
2	0	0	0.2	0.7	2.6	2.6	43.3	47.1	3.6	Sand	4.22
3	0	0	0.4	1.1	3	3.7	38.5	48.7	4.7	Sand	4.1
4	0	0.3	0.9	3.1	4.5	4.3	51.4	31.2	4.3	(gravelly) Sand	5.42
5	0	0.7	1.1	2.9	4	4.4	54	27.7	5.1	(gravelly) Sand	4.68
6	0	0.3	1.5	7	7.3	7.1	56	14	6.8	(gravelly) Sand	8.27
7	0	1.5	3.4	5.5	3.9	4.6	50.9	21.8	8.5	(gravelly) Sand	5.16
8	0	0.1	0.8	2.2	2.1	2.3	73.9	12.8	5.8	Sand	8.07

Station	Range of Particle Size									PSA Folk Classification	TOC (expressed as LOI)
	>8mm	4-8mm	2-4mm	1-2mm	0.5-1µm	0.25-0.5µm	125-250 µm	62.5 -125µm	<62.5 µm		
9	0	0.2	1.1	4.7	5.7	7.6	67.3	9.2	4.2	(gravelly) Sand	6.4
10	0	0.3	1.5	4.8	5.3	5.4	70.7	9.1	2.9	(gravelly) Sand	7.65
11	0	0.2	1.3	5	6	7.4	68.7	8.7	2.8	(gravelly) Sand	7.28
12	0	0.2	0.7	2.7	2.8	2.7	71.4	14.7	4.8	Sand	7.85
13	0	0	0.5	1.8	2.7	3.4	67.2	20.1	4.2	Sand	6.14
14	0	0.2	0.8	3.7	3.8	3.9	57	24.6	5.9	(gravelly) Sand	6.33
15	0	0.2	0.6	2.3	3.8	4.2	71.2	12.8	4.8	Sand	7.05
16	0	0.5	1.3	3.9	5.1	5	63.2	15.5	5.5	(gravelly) Sand	6.3
17	0	0.3	0.9	3.9	5.4	5.7	61.3	18	4.5	(gravelly) Sand	6.46
18	0	0.4	0.8	1.7	4.6	4.1	42.9	36	9.6	(gravelly) Sand	3.88
19	0	0.9	0.6	3.1	3.4	2.8	50.7	30.7	7.9	(gravelly) Sand	6.66
20	0	0.4	1.2	4.3	5.8	5.3	61.2	15.8	6	(gravelly) Sand	6.45
21	0	0.5	1.5	4.5	5.5	5	56.3	20.1	6.6	(gravelly) Sand	5.89
22	0	0.2	1.9	5.9	6.9	5.9	39.3	31.8	8.2	(gravelly) Sand	6.21
23	0	1.3	2.7	7	7.3	5.5	30.9	36.1	9.1	(gravelly) Sand	5.81
24	0	0.3	1.7	3.3	3.5	4.1	64.7	16.6	5.7	(gravelly) Sand	6.71
25	0	1.3	2.3	5.6	6.1	5.6	53.6	20.4	5.2	(gravelly) Sand	5.65
26	0	0.9	2	5.8	6.5	5.2	48.1	23	8.6	(gravelly) Sand	6.27
27	0	1.1	0.3	2.4	5.3	3.9	29.5	46.1	11.3	(gravelly) muddy Sand	3.93
28	0	2.2	4.9	7.8	7	5.3	19.4	38.4	15	gravelly muddy Sand	5.17
29	0	1	2.5	7.8	8.4	5.7	23.5	39.9	11.1	(gravelly) muddy Sand	4.62
30	0	0.1	0.6	3.9	5.1	4.5	47	29.5	9.4	Sand	5.72

E. Biotope Descriptions

LR.LLR.F.Asc.X - *Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata

Sheltered to extremely sheltered full salinity mixed substrata (cobbles, boulders and pebbles on sediment) characterised by a canopy formed by a mosaic of the wracks *Ascophyllum nodosum* and *Fucus vesiculosus*. The red seaweed *Vertebrata lanosa* can often be found as an epiphyte on the *A. nodosum*. The mussel *Mytilus edulis* often occurs in clumps, and provides further suitable substrata for the attachment of fucoids and red and green seaweeds such as Polysiphonia spp. and Ulva intestinalis or the barnacle *Semibalanus balanoides*. Winkles are common and Littorina littorea and Littorina may occur in high densities, while species such as the limpet *Patella vulgata*, the crab *Carcinus maenas* and the whelk *Nucella lapillus* may occur on and around the boulders. Gammarids can be found underneath the boulders or among the seaweeds, while tube-forming spirorbids are found on the boulders, shells or on the *F. vesiculosus*. Infaunal species including the polychaetes *Arenicola marina* and *Lanice conchilega* may occur in the sediment between the cobbles**.**

LR.LLR.F.Fves.FS - *Fucus vesiculosus* on full salinity moderately exposed to sheltered mid eulittoral rock

Moderately exposed to sheltered mid eulittoral bedrock and large boulders characterised by a dense canopy of the wrack *Fucus vesiculosus* (Abundant to Superabundant). Beneath the seaweed canopy the rock surface has a sparse covering of the barnacle *Semibalanus balanoides* and the limpet *Patella vulgata*. The mussel *Mytilus edulis* is confined to pits and crevices. A variety of winkles including *Littorina littorea, Littorina saxatilis* and the whelk *Nucella lapillus* are found beneath the seaweeds, whilst *Littorina* graze on the fucoid fronds. The calcareous tube-forming polychaete *Spirorbis spirorbis* may also occur epiphytically on the fronds. In areas of localised shelter the wrack *Ascophyllum nodosum* may occur, though never at high abundance. Damp cracks and crevices often contain patches of the red seaweed *Mastocarpus stellatus* and even the wrack *Fucus serratus* may be present. The crab *Carcinus maenas* may be present in pools or among the boulders.

LR.MLR.BF.FVesB - *Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock

Exposed to moderately exposed mid eulittoral bedrock and boulders are frequently characterised by a mosaic of the barnacle Semibalanus balanoides and the wrack Fucus vesiculosus. The limpet *Patella vulgata* and the whelk *Nucella lapillus* are typically present, whilst the anemone *Actinia equina* and small individuals of the mussel *Mytilus edulis* are confined to crevices. Underneath the *F. vesiculosus* is a community of red seaweeds, including *Corallina officinalis, Mastocarpus stellatus* and *Osmundea pinnatifida*, usually with the winkles *Littorina littorea* and *Littorina* spp. present. Opportunistic seaweeds such as *Ulva intestinalis* may occur in patches recently cleared on the rock or growing on the *M. edulis*.

LR.MLR.BF.Fser.Bo - *Fucus serratus* and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders

Exposed to moderately exposed lower eulittoral boulders with the wrack Fucus serratus community of a high species richness as the presence of the boulders increases the micro-habitat diversity. The upper surfaces of the boulders are colonised by a very similar fauna to the other F. serratus biotopes, including species such as the limpet *Patella vulgata*, the whelk *Nucella lapillus*, the anemone *Actinia equina* and the barnacle *Semibalanus balanoides*. The shaded sides of the boulders are, depending on environmental conditions, often colonised by a variety of foliose red seaweeds, including *Mastocarpus stellatus, Lomentaria articulata, Osmundea pinnatifida, Palmaria palmata* and *Chondrus crispus*. Coralline algae such as *Corallina officinalis* and coraline crusts, as well as the green seaweeds *Ulva intestinalis* and *Ulva lactuca*, can be found underneath the *F. serratus* canopy or in patches on the boulders. The species composition underneath the boulders varies considerably depending on the underlying substratum. On muddy shores the fauna living under the boulders may be limited to a few infaunal species, such as the polychaete *Cirratulus cirratus*. Where more space is available beneath the boulders there may be a rich assemblage of animals. Characteristic mobile species include the crabs *Porcellana platycheles* and *Carcinus maenas*. Also present on and beneath the boulders are the tube-forming polychaete *Spirobranchus triqueter*, spirorbid polychaetes and a few winkles such as *Littorina* and *Littorina littorea* or even the top shell *Steromphala cineraria*. Encrusting colonies of the sponge *Halichondria panicea* are also typical of the undersides of boulders, while the hydroid *Dynamena pumila* colonies can be found on the *F. serratus* fronds. The richest examples of this biotope also contain a variety of brittle stars, ascidians and small hydroids.

LS.LCS.Sh.BarSh - Barren littoral shingle

Shingle or gravel shores, typically with sediment particle size ranging from 4 - 256 mm, sometimes with some coarse sand mixed in. This biotope is normally only found on exposed open coasts in fully marine conditions. Such shores tend to support virtually no macrofauna in their very mobile and freely draining substratum. The few individuals that may be found are those washed into the habitat by the ebbing tide, including the occasional amphipod or small polychaete.

LS.LSa.FiSa - Polychaete/amphipod-dominated fine sand shores

Shores of clean, medium to fine and very fine sand, with no coarse sand, gravel or mud present. Shells and stones may occasionally be present on the surface. The sand may be duned or rippled as a result of wave action or tidal currents. The degree of drying between tides is limited, and the sediment usually remains damp throughout the tidal cycle. Typically, no anoxic layer is present. Fine sand shores support a range of species including amphipods and polychaetes. On the lower shore, and where sediments are stable, bivalves such as *Macomangulus tenuis* may be present in large numbers.

LS.LSa.FiSa.Po - Polychaetes in littoral fine sand

Moderately exposed or sheltered beaches of medium and fine, usually clean, sand, though the sediment may on rare occasions contain a small silt and clay fraction. The sediment is relatively stable, remains damp throughout the tidal cycle, and contains little organic matter. It is often rippled and typically lacks an anoxic sub-surface layer. Where an anoxic layer is present, it occurs at a depth below 10 cm and tends to be patchy. The biotope occurs mainly on the lower part of the shore, and relatively frequently on the mid shore. It is only rarely present above mid shore level, except where coastal defences cause backwash onto the upper shore. Conditions are usually fully marine, though the biotope can also occur in open lower estuarine conditions. The infaunal community is dominated by a range of polychaete species such as *Nephtys cirrosa, Paraonis fulgens, Spio* spp., *Pygospio elegans*, *Ophelia rathkei* and Scoloplos armiger. The presence of polychaetes may be seen as coloured burrows running down from the surface of the sediment, and Arenicola marina casts may be present on the sediment surface. The amphipods *Bathyporeia* spp. and *Pontocrates arenarius* frequently occur, and nemerteans are often present.

LS.LSa.FiSa.Po.Mten - Polychaetes and *Macomangulus tenuis* in littoral fine sand

This biotope occurs on the mid and lower shore on moderately wave-exposed and sheltered coasts, with predominantly fine sand which remains damp throughout the tidal cycle. The sediment is often rippled, and an anoxic layer may occasionally occur below a depth of 10 cm, though it is often patchy. The infaunal community is dominated by the abundant bivalve *Macomangulus tenuis* together with a range of polychaetes. The presence of polychaetes may be seen as coloured burrows running down from the surface of the sediment. Polychaetes that are characterising for this biotope include *Nephtys cirrosa, Paraonis fulgens* and *Spio filicornis*. Burrowing amphipods *Bathyporeia* spp. may occur in some samples of this biotope.

LS.LSa.MoSa.AmSco.Sco - *Scolelepis* spp. in littoral mobile sand

Exposed and moderately exposed shores of fully marine mobile clean sand, with particle sizes ranging from coarse to very fine. The sediment is not always well sorted, and may contain a subsurface layer of gravel or shell debris. Usually no anoxic layer is present. The mobility of the sediment leads to a species-poor community, dominated by the polychaetes *Scolelepis (Scolelepis) squamata* and *S. foliosa*. The amphipod *Bathyporeia pilosa* may be present. Further species that may be present in this sub-biotope include the amphipods *B. pelagica* and *Haustorius arenarius*, and the isopod *Eurydice pulchra*. The lugworm *Arenicola marina* may also occur.

SS.SMu.CSaMu - Circalittoral sandy mud

Circalittoral, cohesive sandy mud, typically with over 20% silt/clay, generally in water depths of over 10 m, with weak or very weak tidal streams. This habitat is generally found in deeper areas of bays and marine inlets or offshore from less wave exposed coasts. Seapens such as *Virgularia mirabilis* and brittle stars such as *Amphiura* spp. are particularly characteristic of this habitat whilst infaunal species include the tube building polychaetes *Lagis koreni* and *Owenia fusiformis*, and deposit feeding bivalves such as *Kurtiella bidentata* and *Abra* spp.

SS.SMu.CSaMu.AfilEten - *Amphiura filiformis* and *Ennucula tenuis* in circalittoral and offshore sandy mud

In cohesive and non-cohesive sandy mud, off moderately exposed coasts in deep water dense populations of *Amphiura filiformis* with the bivalve *Ennucula tenuis* may occur. This biotope together with SS.SMu.CSaMu.AfilKurAnit, SS.SMu.CSaMu.ThyEten and SS.SSa.OSa.OfusAfil may be part of the *Amphiura filiformis* dominated infralittoral etage described by Glemarec (1973) and part of the 'off-shore muddy sand association' described by other workers (Jones 1951; Mackie 1990). Other species characteristic of this biotope may include the echinoderms *Ophiura albida* and *Echinocardium flavescens* and the bivalve *Kurtiella bidentata*. *Phaxas pellucidus, Owenia fusiformis* and *Virgularia mirabilis* may also be present. At the sediment surface the hydroid *Sertularia argentea* may be present although only at very low abundances. Variations of this biotope exist in the northern North Sea (SS.SMu.CSaMu.AfilKurAnit) and it is possible that more than one entity exists for this biotope. Collectively the biotopes SS.SMu.CSaMu.ThyEten, SS.SMu.CSaMu.AfilKurAnit, SS.SMu.CSaMu.AfilEten, SS.SMu.OMu.PjefThyAfil, and SS.SSa.OSa.OfusAfil, may form the *Amphiura* dominated components of the 'off-shore muddy sand association' described by other workers (Jones 1951; Thorson 1957; Mackie 1990) and the infralittoral etage described by Glemarec (1973).

SS.SMu.CSaMu.AfilKurAnit - *Amphiura filiformis, Kurtiella bidentata* and *Abra nitida* in circalittoral sandy mud

Cohesive sandy mud off wave exposed coasts with weak tidal streams can be characterised by super-abundant *Amphiura filiformis* with *Kurtiella bidentata* and *Abra nitida*. This community occurs in muddy sands in moderately deep water (Hiscock 1984; Picton *et al*., 1994) and may be related to the 'offshore muddy sand association' described by other workers (Jones 1951; Thorson 1957; Mackie 1990). This community is also characterised by the sipunculid *Thysanocardia procera* and the polychaetes *Nephtys incisa, Phoronis* sp. and *Pholoe* sp., with cirratulids, such as *Notomastus latericeus* or *Mediomastus fragilis*, and terebellids, such as *Polycirrus plumosus* or *Diplocirrus glaucus*, also common in some areas. Other taxa such as *Nephtys hombergii, Echinocardium cordatum, Nucula nitidosa, Callianassa subterranea* and *Eudorella truncatula* may also occur in offshore examples of this biotope. Additionally, several variants of this biotope can be described in transitionary environments between biotopes such as SS.SMx.CMx.KurThyMx where coarser material is present, SS.SSa.OSa.OfusAfil in sandier environments offshore or SS.SMu.ISaMu.MelMagThy in shallower waters. Collectively the biotopes SS.SMu.CSaMu.ThyEten, SS.SMu.CSaMu.AfilKurAnit, SS.SMu.CSaMu.AfilEten, SS.SMu.OMu.PjefThyAfil, and SS.SSa.OSa.OfusAfil, may form the Amphiura dominated components of the 'off-shore muddy sand association' described by other workers (Jones 1951; Thorson 1957; Mackie 1990) and the infralittoral etage described by Glemarec (1973).

SS.SSa.CFiSa - Circalittoral fine sand

Clean fine sands with less than 5% silt/clay in deeper water, either on the open coast or in tide-swept channels of marine inlets in depths of over 15-20 m. The habitat may also extend offshore and is characterised by a wide range of echinoderms (in some areas including the pea urchin *Echinocyamus pusillus*), polychaetes and bivalves. This habitat is generally more stable than shallower, infralittoral sands and consequently supports a more diverse community.

SS.SSa.CMuSa.AalbNuc - *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment

Non-cohesive muddy sands or slightly shelly/gravelly muddy sand characterised by the bivalves *Abra alba* and *Nucula nitidosa*. Other important taxa include *Nephtys* spp., *Chaetozone setosa* and *Spiophanes bombyx* with

Fabulina fabula also common in many areas. The echinoderms *Ophiura albida* and *Asterias rubens* may also be present. The epibiotic biotope SS.SSa.IMuSa.EcorEns may overlap this biotope. This biotope is part of the *Abra* community defined by Thorson (1957) and the infralittoral etage described by Glemarec (1973). In organically enriched variants of this biotope, there may be higher occurrences of amphipods, such as *Bathyporeia tenuipes*, *Perioculodes longimanus,* and *Urothoe elegans*.

SS.SMx.CMx.KurThyMx - *Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment

In moderately exposed or sheltered, circalittoral muddy sands and gravels a community characterised by the bivalves *Thyasira* spp. (often *Thyasira flexuosa*), *Kurtiella bidentata* and *Prionospio fallax* may develop. Infaunal polychaetes such as *Hilbigneris gracilis, Chaetozone setosa* and *Scoloplos armiger* are also common in this community whilst amphipods such as *Ampelisca* spp. and the cumacean *Eudorella truncatula* may also be found in some areas. The brittle star *Amphiura filiformis* may also be abundant at some sites. Conspicuous epifauna on larger pebbles or shell gravel may include hydroids, encrusting bryozoans *Escharella* spp. particularly *Escharella immersa, Disporella hispida,* and, in shallower waters, maerl (*Phymatolithon calcareum*), although at very low abundances and not forming maerl beds. In some sheltered areas, organic enrichment of this biotope increases the occurrence of species such as *Ophryotrochasp., Scoloplos sp., Mediomastus fragilis, Lumbrineris sp*., Capitellids and *Tubificoides pseudogaster.*

SS.SSa.IMuSa.FfabMag - *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand

In stable, fine, compacted sands and slightly muddy sands in the infralittoral and littoral fringe, communities dominated by venerid bivalves such as *Chamelea gallina* occur. This biotope may be characterised by a prevalence of *Fabulina fabula* and *Magelona mirabilis* or other species of *Magelona* (e.g. M*. filiformis*). Other taxa, including the amphipod *Bathyporeia* spp. and polychaetes such as *Chaetozone setosa, Spiophanes bombyx* and *Nephtys* spp. are also commonly recorded. In some areas the bivalve *Spisula elliptica* may also occur in this biotope in low numbers. The community is relatively stable in its species composition, however, numbers of Magelona *and F. fabulina* tend to fluctuate. Around the Scilly Isles numbers of *F. fabulina* in this biotope are uncommonly low whilst these taxa are often found in higher abundances in muddier communities (presumably due to the higher organic content). In deeper, offshore variants of this biotope, although still present, there is a reduction in the component species *F. fabula*, whilst *Magelona filiformis, Bathyporeia* spp., annelid and nemertean worms, and *Amphiuridae* may be more common. Consequently, it may be better to revise this biotope on the basis of less ubiquitous taxa such as key amphipod species (E.I.S. Rees pers. comm. 2002) although more data is required to test this. SS.SSa.IMuSa.FfabMag and SS.SCS.ICS.MoeVen are collectively considered to be the 'shallow Venus community' or 'boreal off-shore sand association' of previous workers (see Petersen 1918; Jones 1950; Thorson 1957). These communities have been shown to correlate well with particular levels of current induced 'bed-stress' (Warwick & Uncles 1980). The 'Arctic Venus Community' and 'Mediterranean Venus Community' described to the north and south of the UK (Thorson 1957) probably occur in the same habitat and appears to be the same biotope described as the Ophelia borealis community in northern France and the central North Sea (Künitzer *et al*., 1992). Sites with this biotope may undergo transitions in community composition. The epibiotic biotopes SS.SSa.IMUSa.EcorEns and SS.SSa.IMuSa.AreISa may also overlay this biotope in some areas.

F. DDV Sample Station Images and Stills

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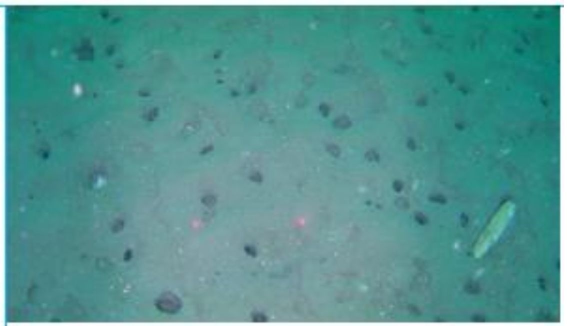

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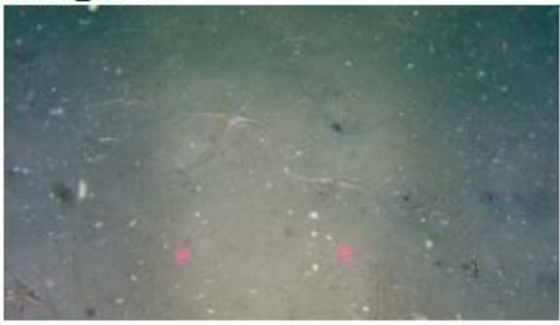

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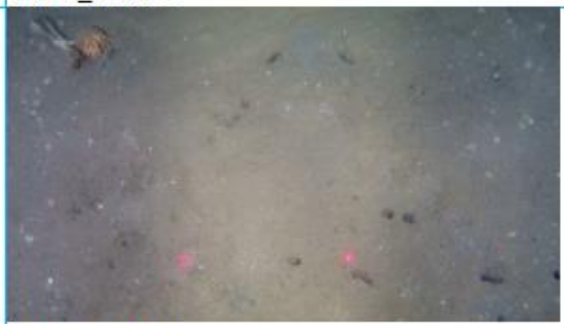

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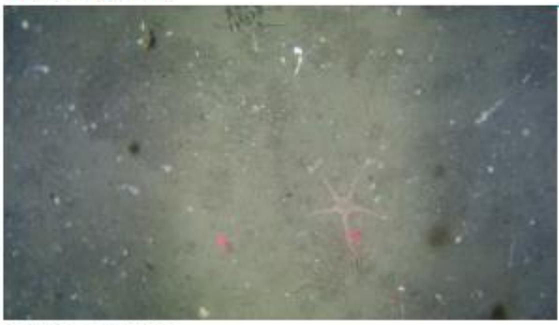

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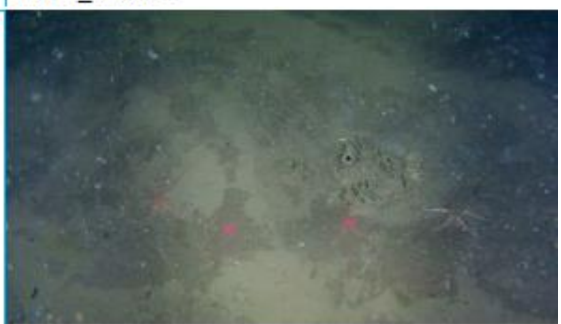

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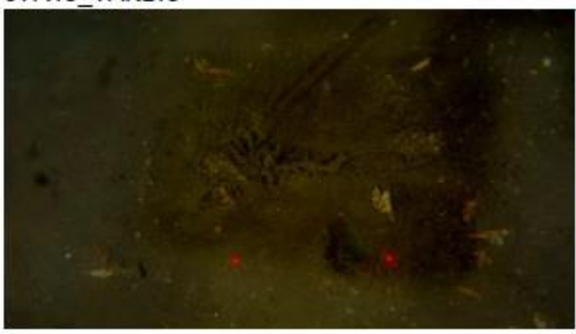
STN12_TAKE14

STN13_TAKE13

STN14_TAKE12



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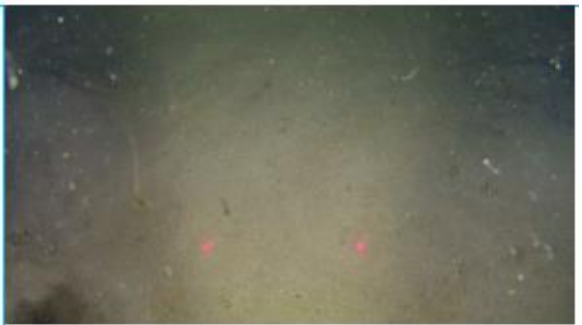

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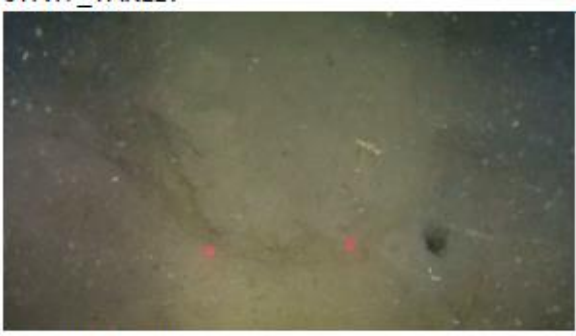

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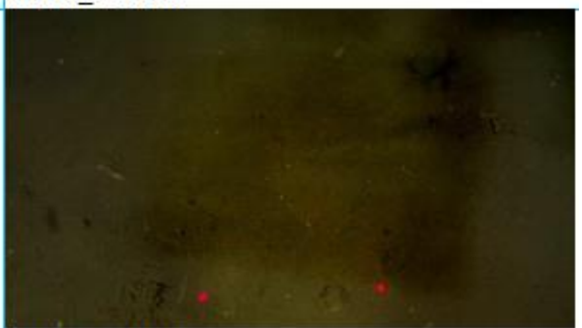

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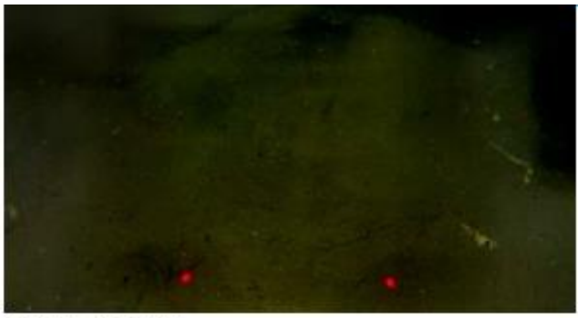
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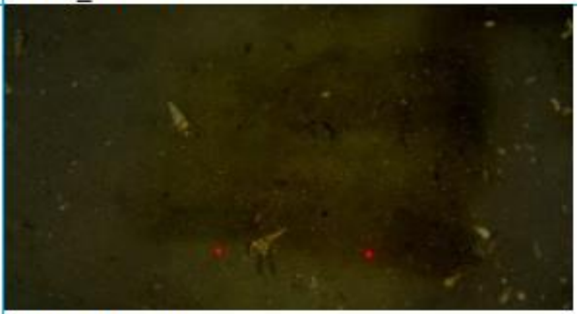
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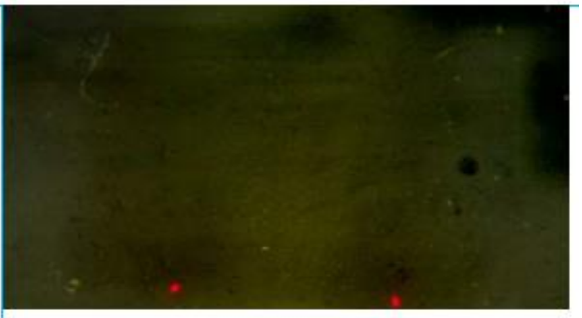
STN25_TAKE26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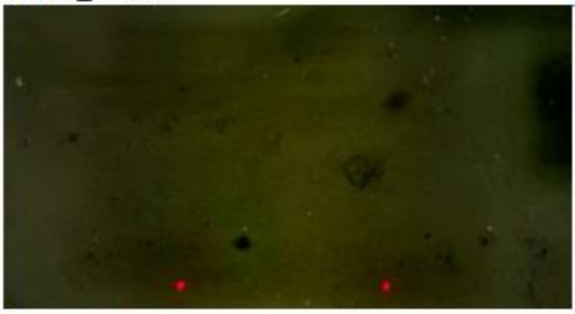
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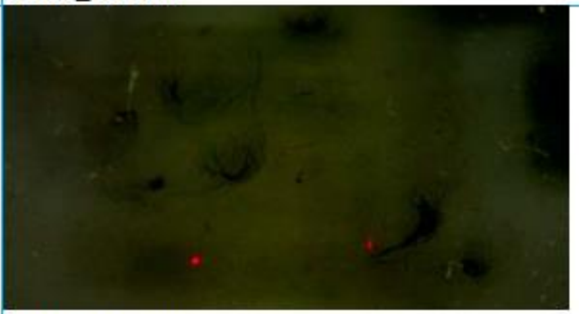
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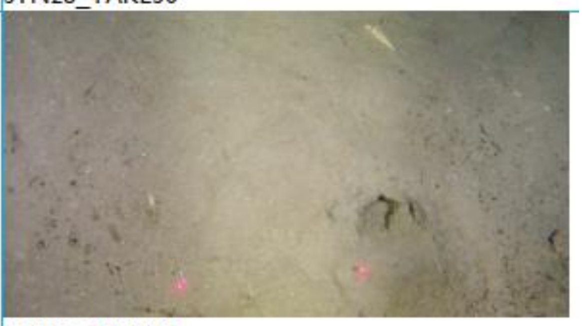
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G. DDV Analysis Proformas

See accompanying Excel documents:

- 2021-1036-NPC-NISA_UWIMAGERY_EXPORT ROUTE_Stills_Analysis_Proforma_20221104
- 2021-1036-NPC-NISA_UWIMAGERY_EXPORT ROUTE_Video_Analysis_Proforma_20221104

H. Faunal Univariate Results

Table G1: Subtidal Benthic grab sampling stations univariate measures of community structure.

Station	No. Taxa	No. Individuals	Shannon-Wiener Diversity	Richness	Evenness	Effective Species Number
1	43	235	3.30	7.69	0.88	27.04
2	35	149	2.81	6.79	0.79	16.62
3	67	250	3.58	11.95	0.85	36.02
4	64	413	3.14	10.46	0.75	23.10
5	74	240	3.68	13.32	0.86	39.82
6	59	304	2.84	10.15	0.70	17.06
7	52	290	2.82	8.99	0.71	16.75
8	66	349	3.43	11.10	0.82	30.92
9	61	179	3.33	11.57	0.81	28.00
10	57	337	3.21	9.62	0.79	24.80
11	61	294	3.43	10.56	0.83	30.77
12	49	201	2.93	9.05	0.75	18.76
13	56	303	3.17	9.63	0.79	23.75
14	46	262	3.14	8.08	0.82	23.04
15	60	555	2.87	9.34	0.70	17.66
16	55	206	3.32	10.14	0.83	27.75
17	63	182	3.77	11.91	0.91	43.51
18	52	181	3.47	9.81	0.88	31.99
19	56	189	3.45	10.49	0.86	31.39
20	55	262	3.11	9.70	0.78	22.49
21	41	109	3.38	8.53	0.91	29.30
22	30	64	3.03	6.97	0.89	20.70
23	32	101	2.31	6.72	0.67	10.12
24	52	253	3.13	9.22	0.79	22.98
25	66	318	3.35	11.28	0.80	28.50
26	41	111	3.22	8.49	0.87	25.14
27	44	117	3.31	9.03	0.87	27.32
28	24	40	3.04	6.23	0.96	20.88
29	15	25	2.39	4.35	0.88	10.88
30	55	217	3.66	10.04	0.91	38.85

I. Contaminants Analysis

Table H1: Metal levels within sediment samples

Metal (mg/kg)	Sampling Station										Cefas		Irish		Canadian	
	6	7	8	9	11	12	13	23	27	28	AL1	AL2	Lower AL	Upper AL	ISQG/TEL	PEL
Arsenic	8.3	8.2	6.7	7.2	6.3	6.4	6.1	6.7	6.8	7.7	20	100	9	70	7.24	41.6
Cadmium	2.8	0.7	0.2	0.2	0.15	0.16	0.14	0.15	0.17	0.16	0.4	5	0.7	4.2	0.7	4.2
Chromium	46.8	45.9	39.1	36.8	36.1	35.8	39.7	39.2	42.3	49.9	40	400	120	370	52.3	160.0
Copper	13.0	10.0	7.2	7.7	6.5	6.6	6.7	7.8	8.3	9.7	40	400	40	110	18.7	108
Lead	36.9	24.2	18.5	20.6	17.3	17.8	17.8	18.6	19.7	21.9	50	500	60	218	30.2	112
Mercury	0.05	0.04	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.04	0.3	3	0.2	0.7	0.13	0.7
Nickel	14.8	15.8	12.4	13.3	11.8	11.9	12.1	15.0	15.5	18.5	20	200	21	60	none	none
Zinc	187	81.8	54.5	57.5	48.7	44.3	44.5	48.5	52.3	59.9	130	800	160	410	124	271
Aluminium	22200	25100	21500	20500	19500	21200	20800	24900	26200	30900	none	none	none	none	none	none
Lithium	23.0	26.4	21.7	20.9	19.8	20.9	21.0	25.1	26.2	32.1	none	none	none	none	none	none

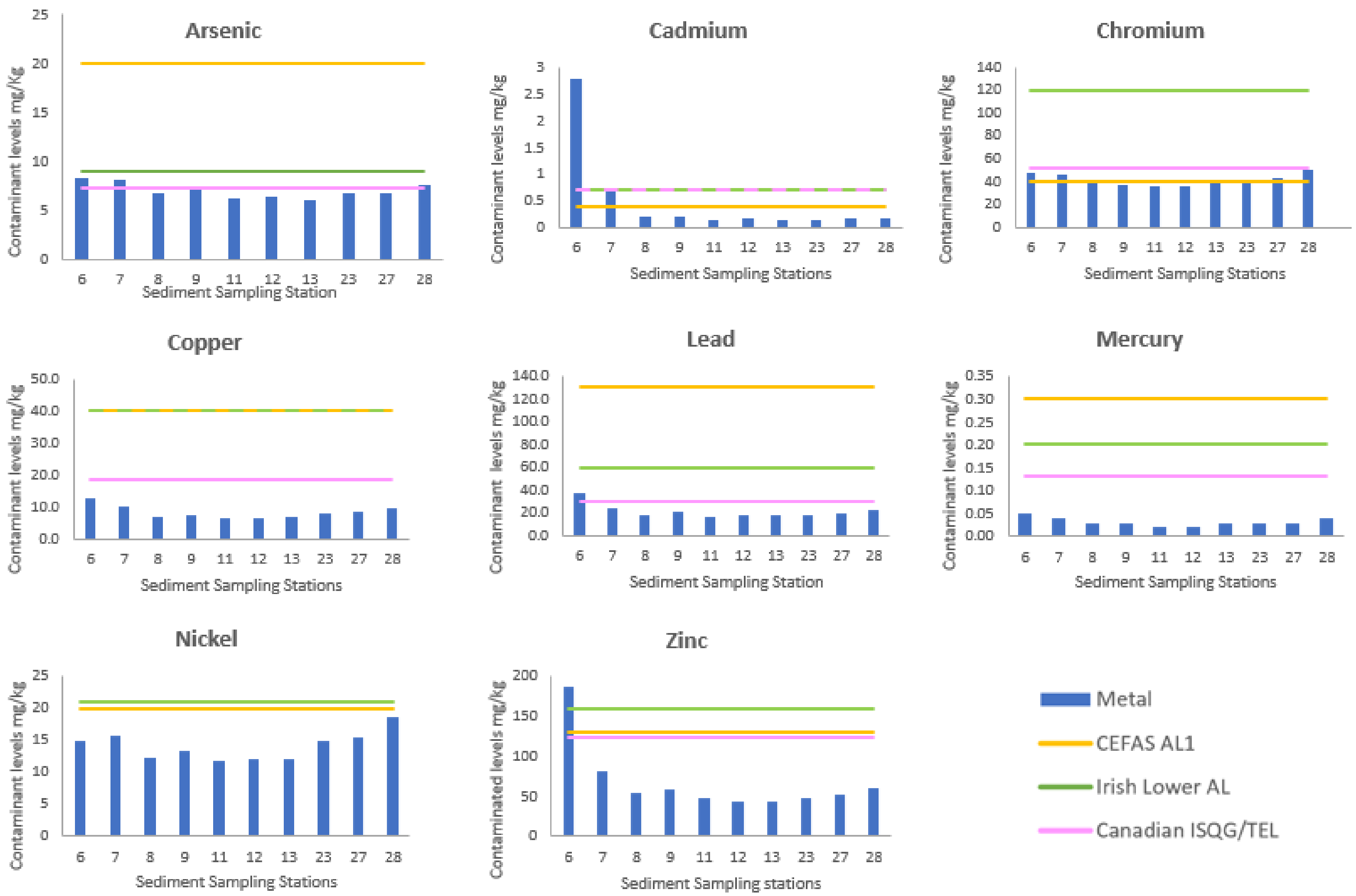

Figure H1: Metal levels within sediment samples compared to Cefas Action Level 1 (AL1), Irish Lower Action Level (AL) and Canadian Interim Sediment Quality Guidelines / Threshold Effects Level (ISQG/TEL).

Table H2: Levels of Organotins within sediment samples

Sampling Station	6	7	8	9	11	12	13	23	27	28
SOCOTEC Ref:	MAR015 88.001	MAR015 88.002	MAR015 88.003	MAR015 88.004	MAR015 88.005	MAR015 88.006	MAR015 88.007	MAR015 88.008	MAR015 88.009	MAR015 88.010
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Dibutyltin (DBT) (µg/Kg)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tributyltin (TBT) (µg/Kg)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Table H3: Levels of Poly Aromatic Hydrocarbons (PAH) and Total Hydrocarbon Content (THC) within sediment samples

PAH and THC (ug/Kg)	Sampling Station										Cefas		Irish		Canadian	
	6	7	8	9	11	12	13	23	27	28	AL1	AL2	Lower AL	Upper AL	ISQG/TEL	PEL
ACENAPTH	2.82	4.47	1.68	2.52	1.24	1.69	1.72	2.44	2.07	2.59	-	-	-	-	6.71	88.9
ACENAPHY	2.20	12.4	2.13	2.01	1.11	1.64	4.17	2.22	2.19	2.26	-	-	-	-	5.87	128
ANTHRACN	6.10	20.6	3.64	3.24	2.75	2.97	9.61	3.88	3.20	4.75	-	-	-	-	46.9	245
BAA	10.0	46.3	6.51	6.36	4.16	5.93	25.6	8.20	8.22	9.96	-	-	-	-	74.8	693
BAP	10.5	50.6	8.36	8.70	5.45	8.04	29.0	10.5	11.4	11.1	-	-	-	-	88.8	763
BBF	16.8	56.8	13.0	12.6	8.50	12.5	25.0	20.4	18.8	26.3	-	-	-	-	-	-
BENZGHIP	14.0	40.2	11.6	11.1	9.23	9.44	19.3	18.8	17.5	19.9	-	-	-	-	-	-
BKF	19.6	49.9	14.3	15.7	6.36	11.5	20.8	14.7	17.4	22.1	-	-	-	-	-	-
CHRYSENE	14.4	51.3	9.17	10.5	5.67	10.4	29.9	14.5	14.0	16.6	-	-	-	-	108	846
DBENZAH	2.48	7.77	2.42	2.23	1.47	1.75	3.93	2.60	2.52	3.64	-	-	-	-	6.22	135
FLUORANT	18.9	86.6	12.1	12.9	8.16	11.8	66.6	16.9	17.1	20.0	-	-	-	-	113	1494
FLUORENE	5.84	11.9	4.09	5.75	3.09	4.88	6.92	5.71	5.61	6.88	-	-	-	-	21.2	144
INDPYR	16.3	44.3	12.9	11.2	6.52	10.1	19.3	17.9	17.0	20.8	-	-	-	-	20.2	201
NAPTH	10.6	15.7	10.7	9.46	6.52	7.57	8.62	11.5	12.3	13.5	-	-	-	-	34.6	391
PHENANT	24.6	79.7	15.7	15.8	10.9	13.7	45.3	20.7	22.4	28.0	-	-	-	-	86.7	544
PYRENE	17.6	86.4	11.1	11.6	7.48	11.2	56.5	14.8	15.2	18.4	-	-	-	-	153	1398
Sum of PAH's	193	665	139	142	89	125	372	186	187	227	3712	-	4000	-	-	-
THC	18500	37800	16800	20800	16300	11500	15400	16700	13300	19300	100,000	-	1,000,000	-	-	-

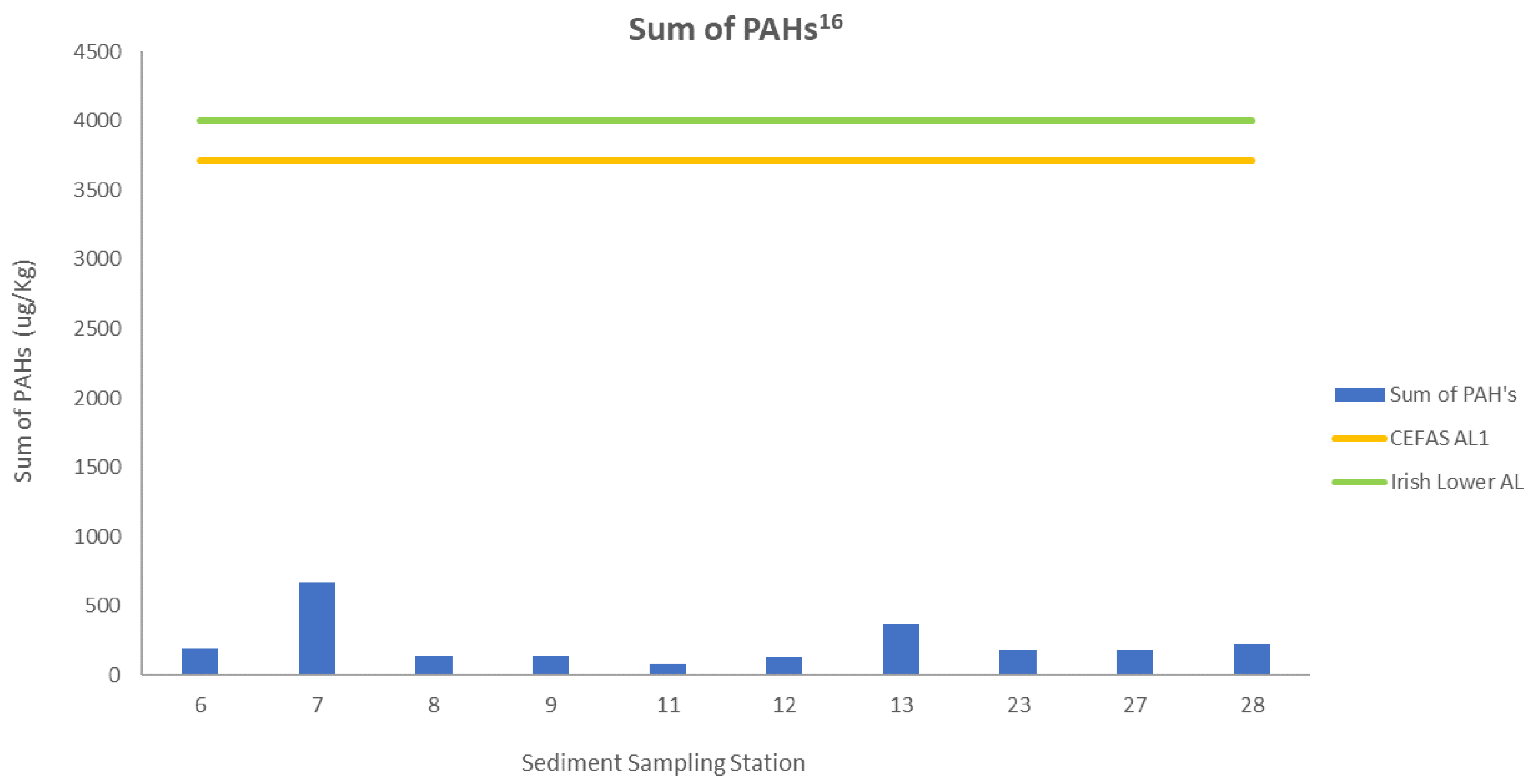

Figure H2: Sum of PAH[16] within sediment samples compared to Cefas Action Level 1 (AL1) and the Irish Lower Action Level (AL)

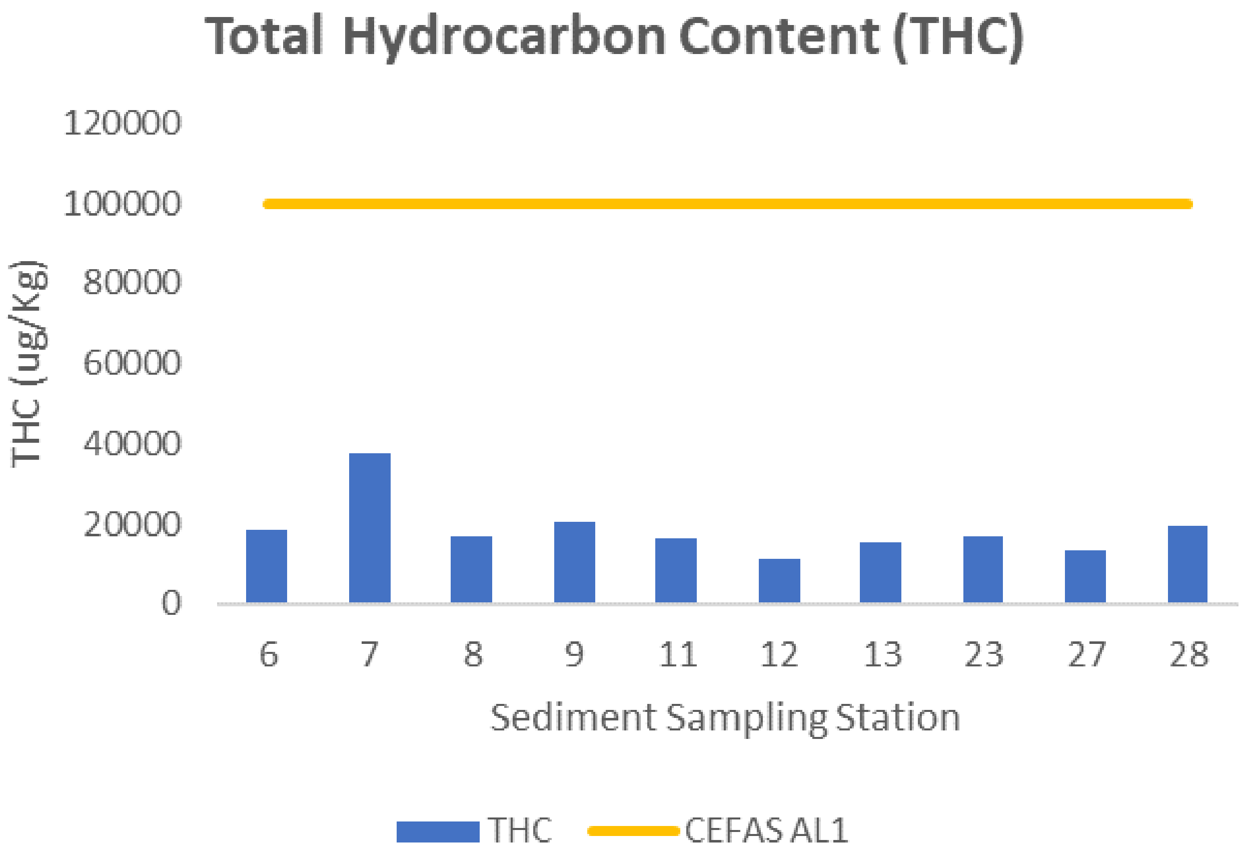

Figure H3: Total Hydrocarbon Content (THC) within sediment samples

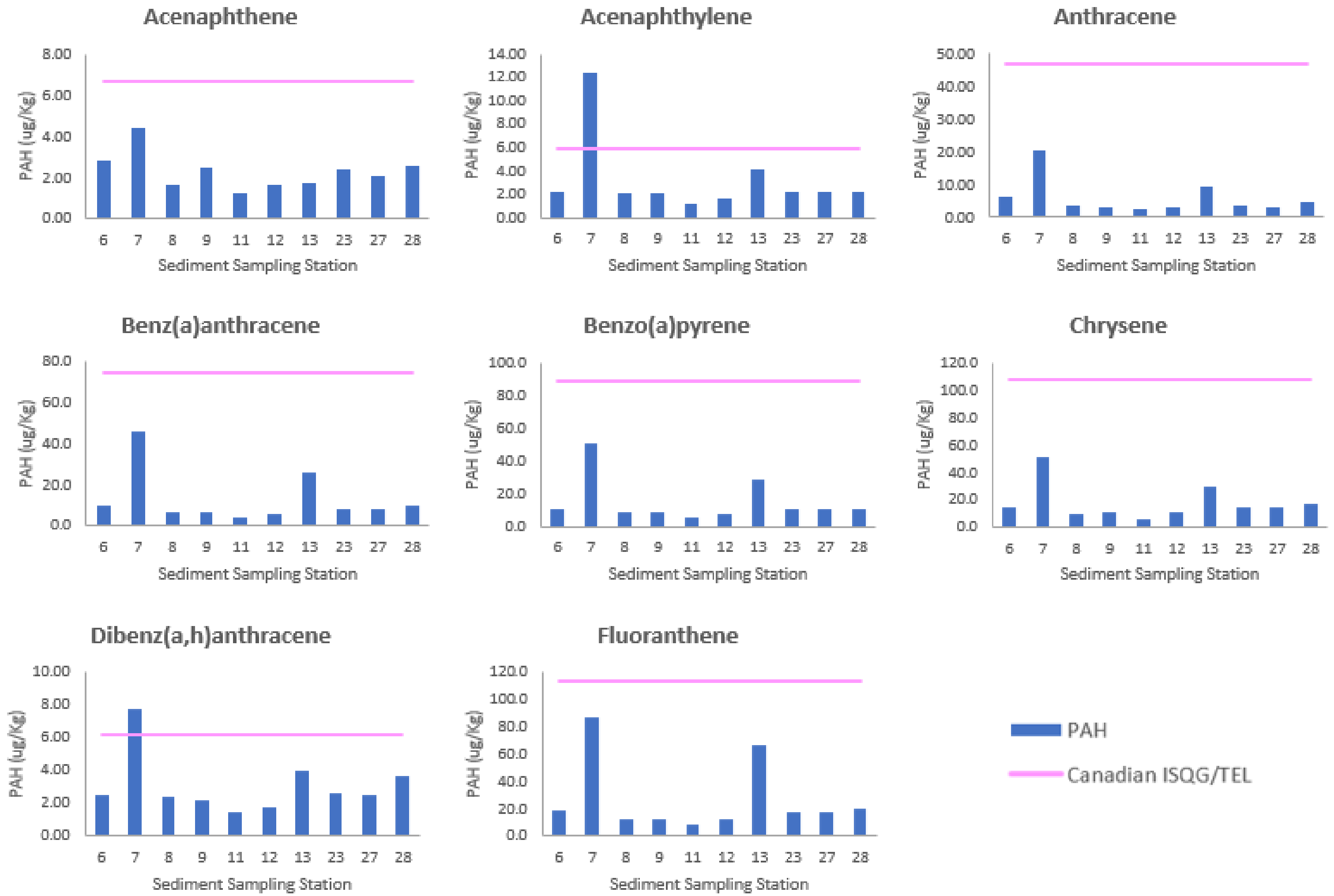

Figure H4: Levels of PAH's compared to the Canadian ISQG/TEL

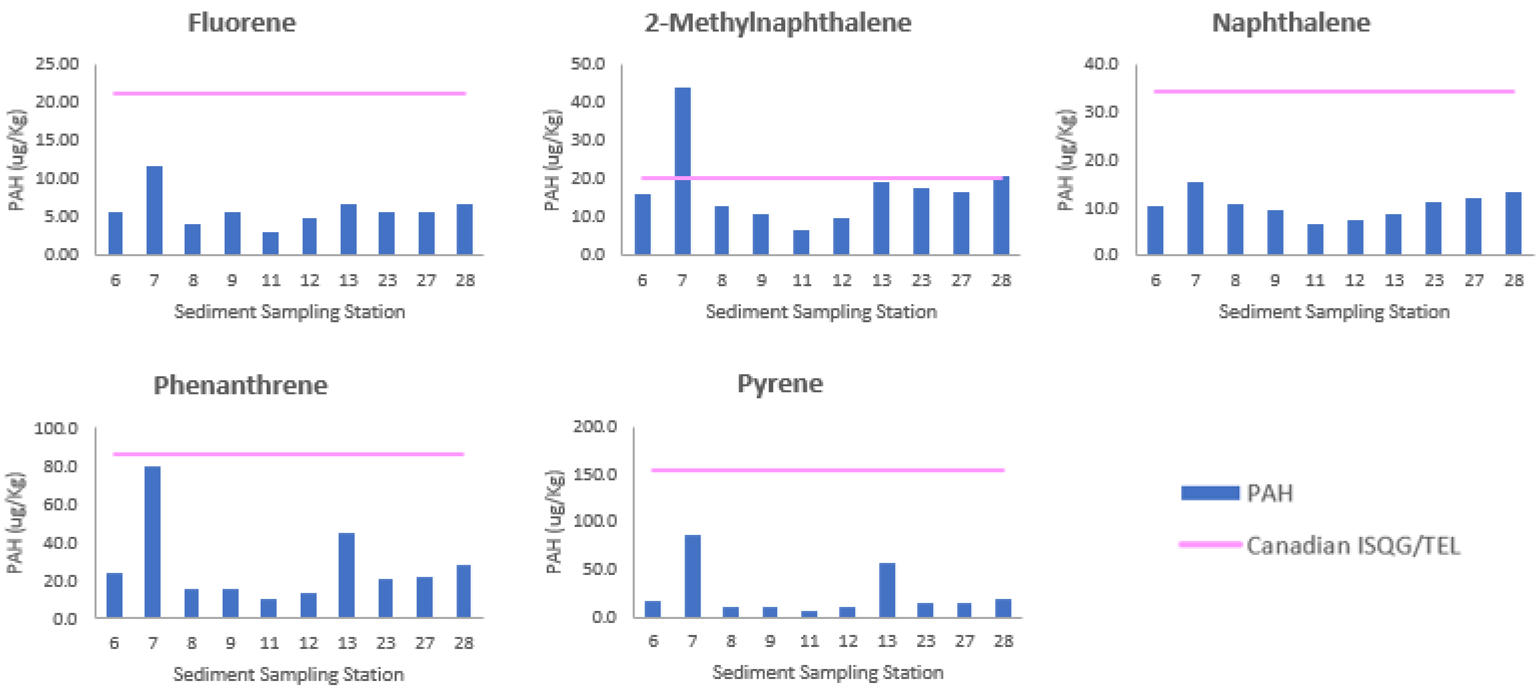

Figure H5: Levels of PAH's compared to the Canadian ISQG/TEL

Table H4: Levels of Polychlorinated biphenyls (PCB) within sediment samples

PCB (µg/Kg)	Sampling Station										Cefas AL1 (ug/Kg)	Ireland's Lower AL (ug/Kg)	Canadian ISQG/TEL (ug/Kg)
	6	7	8	9	11	12	13	23	27	28			
PCB28	0.10	0.12	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	-	1	-
PCB52	0.10	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	-	1	-
PCB101	0.09	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	-	1	-
PCB118	0.08	0.09	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	-	1	-
PCB138	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	-	1	-
PCB153	0.09	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	-	1	-
PCB180	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	-	1	-
Sum of PCBs	0.46	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10	7	21.5

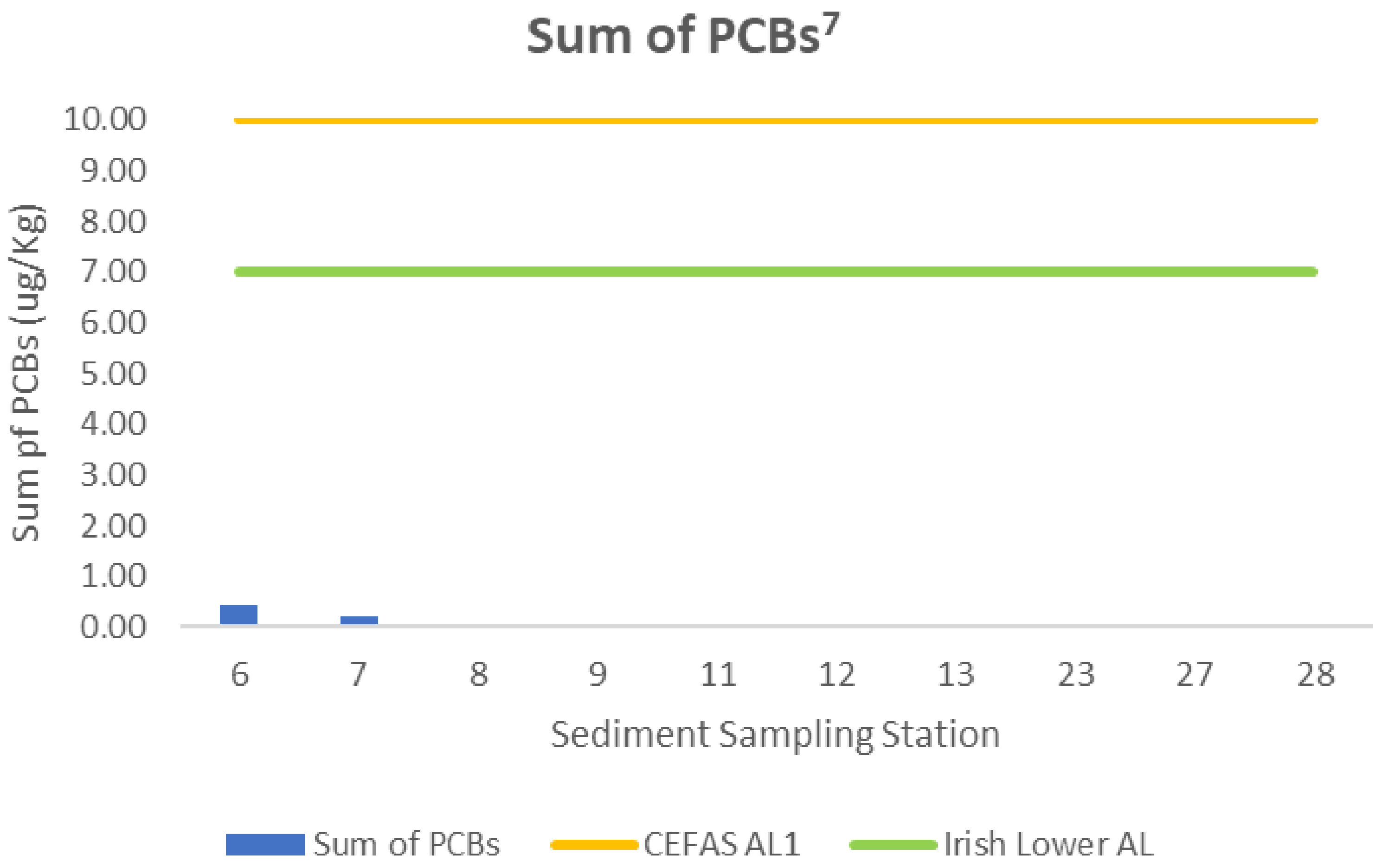

Figure H6: Sum of PCBs7 within sediment samples compared to Cefas Action Level 1 and Ireland's Lower Action Level

Table H5: Levels of Organochlorine pesticides (OCP) within sediment samples

OCP (µg/Kg)	Sampling Station										Cefas AL1 (ug/Kg)	Ireland's Lower AL (ug/Kg)	Canadian ISQG/TEL (ug/Kg)
	6	7	8	9	11	12	13	23	27	28			
AHCH	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-
BHCH	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-
GHCH	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-
DIELDRIN	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.15	<0.1	5	-	1.19
HCB	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-
DDE	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-
DDT	0.40	0.21	0.21	0.76	0.66	<0.1	0.49	<0.1	0.16	0.96	-	-	-
DDD	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-

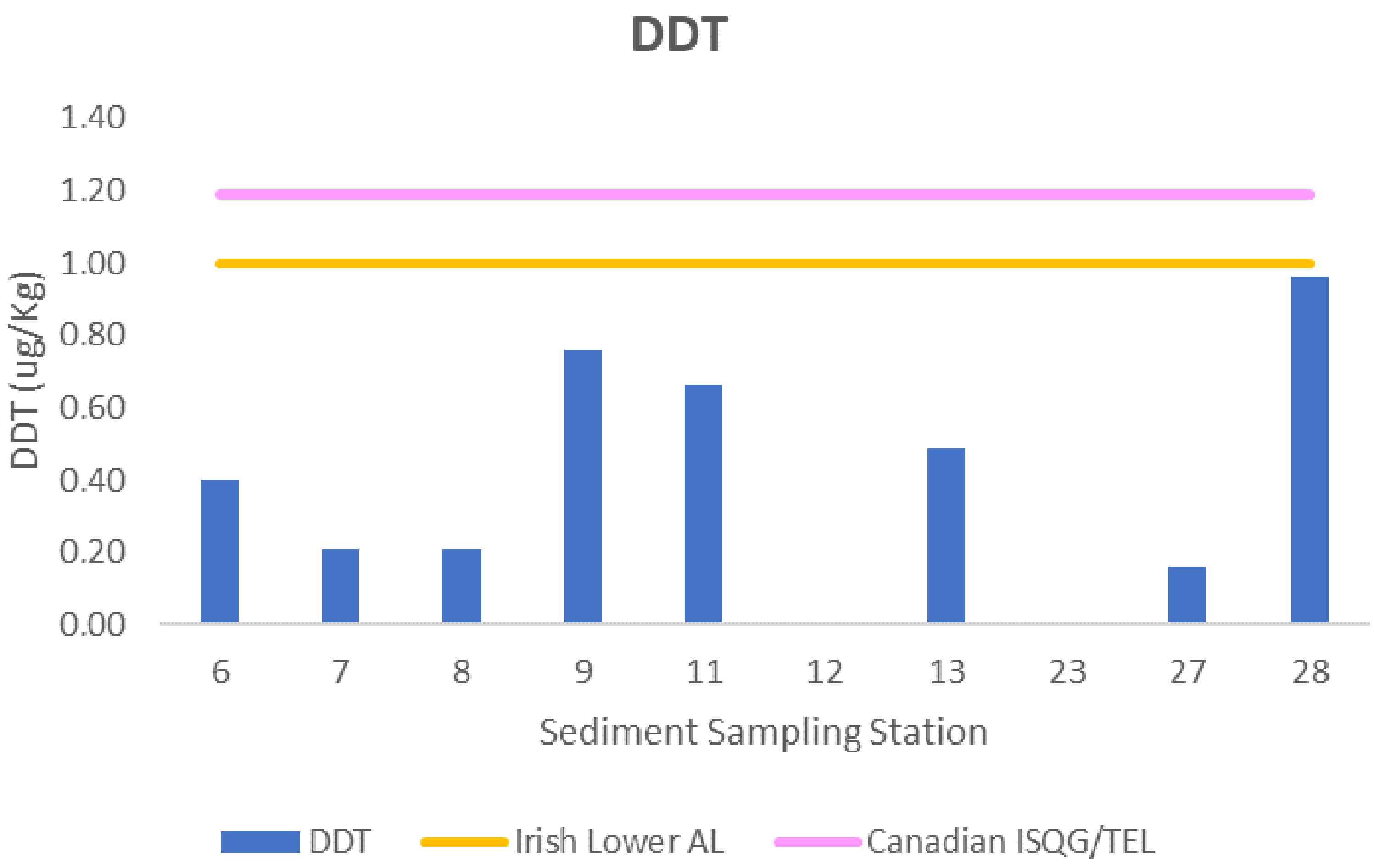

Figure H7: Levels of DDT within sediment samples compared to the Irish Lower Action Level (AL) and the Canadian ISQG/TEL.

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