Partners in UK offshore wind

MORGAN OFFSHORE WIND PROJECT GENERATION ASSETS

Preliminary Environmental Information Report

Volume 4, annex 7.1: Benthic subtidal ecology technical report


Image of an offshore wind farm

April 2023
FINAL

Document status

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Glossary

Term	Meaning
Annelida	An invertebrate belonging to the phylum annelid. Also known as the ringed worms or segmented worms, are a large phylum, including ragworms, earthworms, and leeches.
Benthic Ecology	Benthic ecology encompasses the study of the organisms living in and on the sea floor, the interactions between them and impacts on the surrounding environment
Biotope	The combination of physical environment (habitat) and its distinctive assemblage of conspicuous species.
Bivalve	A large class of molluscs, also known as pelecypods. They have a hard calcareous shell made of two parts or 'valves'.
Circalittoral	The subzone of the rocky sublittoral below that dominated by algae (i.e. the infralittoral), and dominated by animals.
Crustacean	An invertebrate belonging to the subphylum of Crustacea, of the phylum Arthropoda. Includes crabs, lobsters, shrimps, barnacles and sand hoppers.
Diamicton	A general term used to describe a non-sorted or poorly sorted, sometimes non-calcareous, terrigenous or marine sediment containing a wide range of particle sizes derived from a broad origin.
Echinoderm	An invertebrate animal belonging to the phylum Echinodermata that includes sea stars, brittle stars, feather stars, sea urchins and sea cucumbers.
Environmental DNA	Genetic material obtained directly from environmental samples (soil, sediment, water, etc.) without any obvious signs of biological source material.
Epifauna	Animals living on the surface of the seabed.
Eulittoral	Applied to the habitat formed on the lower shore of an aquatic ecosystem, below the littoral zone. The marine eulittoral zone is marked by the presence of barnacles.
Evidence Plan	The Evidence Plan is a mechanism to agree upfront what information the Applicant needs to supply to the Planning Inspectorate as part of the Development Consent Order (DCO) applications for the Morgan Offshore Wind Project.
Evidence Plan Expert Working Group (EWG)	Expert working groups set up with relevant stakeholders as part of the Evidence Plan process.
Faunal Group	A collections of sample stations identified by Simprof tests to similar enough to each other and dissimilar enough to other sample stations to be considered a distinct group.
Habitat	The environment that a plant or animal lives in.
Infauna	The animals living in the sediments of the seabed.
Infralittoral	A subzone of the sublittoral in which upward-facing rocks are dominated by erect algae.
Intertidal area	The area between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS).
Landfall	The area in which the offshore export cables make landfall and is the transitional area between the offshore cabling and the onshore cabling.
Littoral	Residing within the littoral zone which extends from the high water mark, which is rarely inundated, to shoreline areas that are permanently submerged.
Mollusc	Invertebrate animal belonging to the phylum Mollusca that includes the snails, clams, chitons, tooth shells, and octopi.
Multivariate	Having or involving a number of independent mathematical or statistical variables.
The Northern Wales and Irish Sea Bidding Area	The Northern Wales and Irish Sea Bidding Area was one of four Bidding Areas identified by The Crown Estate through the Offshore Wind Leasing Round 4 process.
Polyaromatic hydrocarbons	A class of chemicals that occur naturally in coal, crude oil, and gasoline.
Polychlorinated biphenyls	They belong to a broad family of human-created organic chemicals known as chlorinated hydrocarbons. Although most were banned in 1986, they linger on in detectable levels in animals, fish and humans.
Porifera	A phylum of aquatic invertebrate animals that comprises the sponges.
SIMPER	Calculates the contribution of each species (%) to the dissimilarity between each two groups.
Simprof	A series of similarity profile permutation tests run on biotic data which looks for statistically significant evidence of genuine clusters of sites which were previously unstructured.
Species	A group of living organisms consisting of similar individuals capable of exchanging genes or interbreeding.
Sublittoral	Area extending seaward of low tide to the edge of the continental shelf.
Subtidal	Area extending from below low tide to the edge of the continental shelf.
Univariate	Analysis of one variable, with the purpose being to understand the distribution of values for a single variable.

Acronyms

Acronym	Description
AL1/AL2	Action Level 1/Action Level 2
BAP	Biodiversity Action Plan
BEIS	Department for Business, Energy and Industrial Strategy
CCW	Countryside Council Wales
CEA	Cumulative Effect Assessment
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CMACS	Centre for Marine and Coastal Studies
CSQGs	Canadian Sediment Quality Guidelines
DDV	Drop Down Video
EIA	Environmental Impact Assessment

Acronym	Description
EMODnet	European Marine Observation and Data Network
ISQG	Interim Marine Sediment Quality Guidelines
JNCC	Joint Nature Conservation Committee
MCZ	Marine Conservation Zone
MDS	Multi-Dimensional Scaling
MNR	Marine Nature Reserve
NBN	National Biodiversity Network
NE	Natural England
NMBAQC	North East Atlantic Marine Biological Analytical Quality Control
NRW	Natural Resources Wales
OSPAR	Oslo and Paris Conventions
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PEIR	Preliminary Environmental Information Report
PEL	Probable Effect Level
PSA	Particle Size Analysis
SAC	Special Areas of Conservation
SEA	Strategic Environmental Assessment
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TEL	Threshold Effect Level

Units

Unit	Description
%	Percentage
mm	Millimetre
cm	Centimetre
m	Metre
km	Kilometre
m^2	Square metre
km^2	Square kilometres
g	Grams
mg/kg	Milligrams per kilogram
µg/g	Micrograms per gram
ml	Millilitre
l	Litre
ºC	Degrees Celsius

1 BENTHIC SUBTIDAL ECOLOGY TECHNICAL REPORT

1.1 Introduction

1.1.1.1 This benthic subtidal ecology technical report provides a detailed baseline characterisation of the benthic subtidal ecology (e.g. species, communities and habitats) associated with the Morgan Offshore Wind Project: Generation Assets (hereafter referred to as the Morgan Generation Assets). The Morgan Generation Assets is located within the east Irish Sea, north of Conwy, Wales, and west of Lancashire, England. The Morgan Generation Assets is located southeast of the Isle of Man.

1.1.1.2 Data was collected through a detailed desktop study of the existing resources available for benthic subtidal ecology within the regional benthic subtidal ecology study area, incorporating site-specific survey data and data from third party organisations.

1.1.1.3 The aim of this technical report is to provide a robust baseline characterisation of the benthic subtidal ecology resources within the defined study areas (see section 1.2) against which the potential impacts of the Morgan Generation Assets can be assessed. To support the assessment of effects in the Environmental Impact Assessment (EIA), the ecological information presented in this technical report was used to identify a number of Important Ecological Features (IEFs). Benthic IEFs were determined based on the conservation, ecological, and commercial importance of each identified feature within the Morgan Generation Assets and therefore within the Morgan benthic subtidal ecology study area.

1.1.1.4 This technical report is structured as follows:

- Section 1.2: Study area – Overview of the study areas that are relevant to the report
- Section 1.3: Consultation – Communication with statutory nature conservation bodies (SNCBs) and other stakeholders
- Section 1.4: Methodology – Overview of desktop study and site-specific surveys used to inform the baseline
- Section 1.5: Desktop study baseline characterisation – Details the results of the desktop study
  - Section 1.5.1: Regional benthic subtidal ecology study area
  - Section 1.5.2: Benthic subtidal ecology study area
- Section 1.6: Designated sites – Details the sites of nature conservation importance, which are designated for benthic ecology features, within the regional benthic subtidal ecology study area
- Section 1.7: Site-specific survey baseline characterisation – Details the results of the site-specific surveys
  - Section 1.7.1: Methodology
  - Section 1.7.2: Results - Sediment analysis
  - Section 1.7.3: Results - Infaunal analysis
  - Section 1.7.4: Results - Epifaunal analysis
  - Section 1.7.5: Results - Combined infaunal and epifaunal subtidal biotopes
  - Section 1.7.6: Results - Habitat assessments
- Section 1.8: Summary.

1.2 Study area

1.2.1.1 For the purposes of the benthic subtidal ecology assessment, two study areas have been defined:

- The Morgan benthic subtidal ecology study area has been defined as the area encompassing the Morgan Array Area. It also includes one tidal excursion around the Morgan Array Area known as the Zone of Influence (ZOI). These are the areas within which the site-specific surveys have been undertaken. To date, only the site-specific survey within the Morgan Array Area has been completed and was available to inform the benthic subtidal ecology baseline characterisation for the purposes of the Preliminary Environmental Information Report (PEIR). The surveys within the Morgan benthic subtidal ecology study area were undertaken in conjunction with the site-specific benthic surveys for the neighbouring Mona Offshore Wind Project (which partially overlapped with the Morgan ZOI). The statistical analysis, presented in this technical report, has been undertaken on the combined dataset collected within both the Morgan and Mona Array Areas with the data collected for the Mona Offshore Wind Project used to provide additional context for the data within the Morgan Array Area. Further site-specific surveys were undertaken in the summer 2022 to include the Morgan ZOI (Figure 1.1). This benthic subtidal ecology technical report will therefore be updated with this additional data for the final Environmental Statement.
- The regional benthic subtidal ecology study area for the Morgan Generation Assets encompasses the wider east Irish Sea habitats and includes the neighbouring consented offshore wind farms and designated sites (Figure 1.1). It has been characterised by desktop data and provides a wider context to the site-specific data collected within the Morgan benthic subtidal ecology study area.

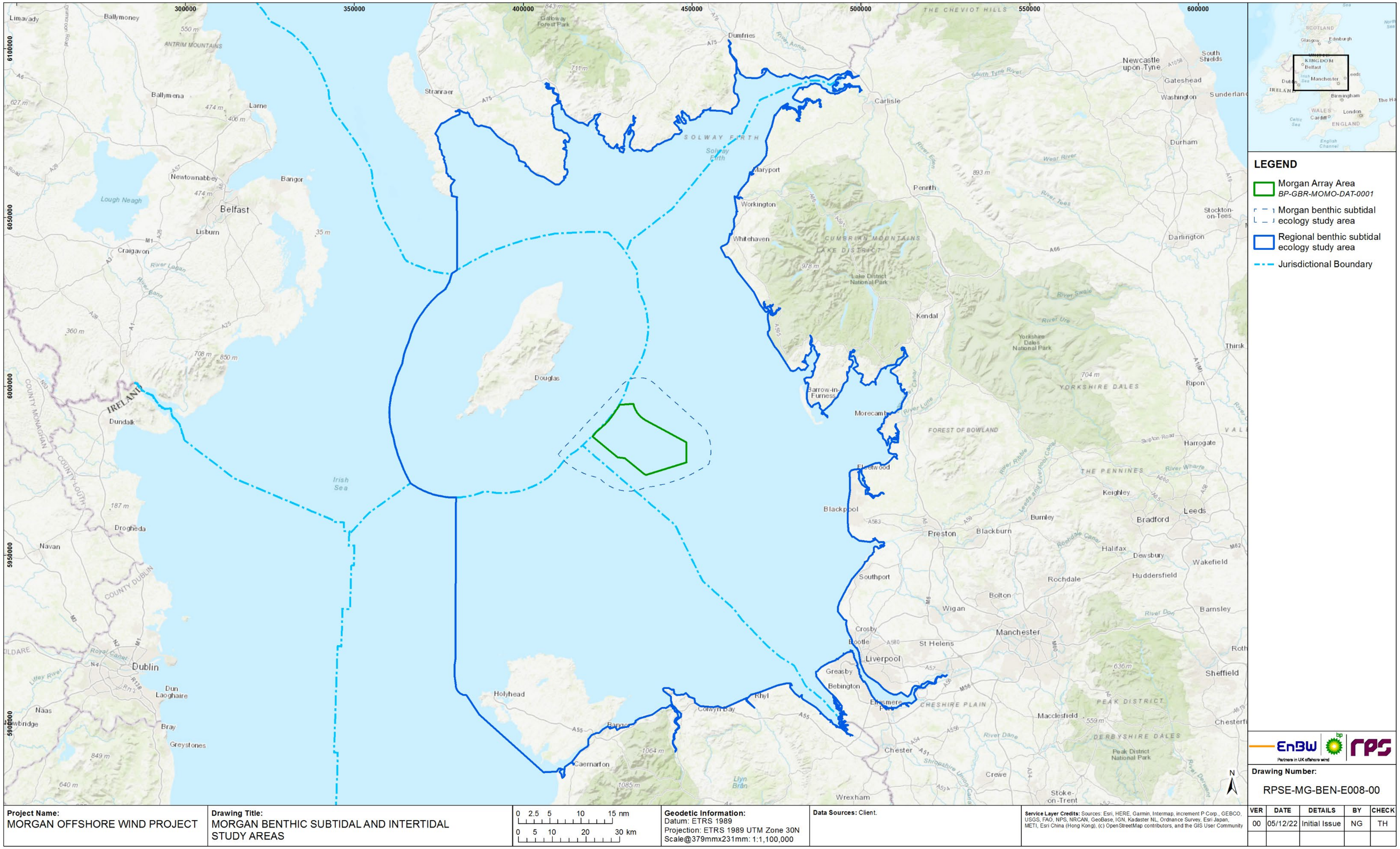


Figure 1.1: Morgan benthic subtidal ecology study area and the regional benthic subtidal ecology study area.

1.3 Consultation

1.3.1.1 A summary of the key issues raised during consultation activities undertaken to date specific to benthic subtidal ecology is presented in Table 1.1 below.

Table 1.1: Summary of key consultation topics raised during consultation activities undertaken for the Morgan Generation Assets relevant to benthic subtidal ecology.

Date	Consultee and type of response	Topics
March 2021	Joint Nature Conservation Committee (JNCC), Natural England (NE) and Natural Resources Wales (NRW) - email	Provision of initial information on the geophysical and benthic survey for the Morgan Array Area only, the aerial bird and marine mammal surveys, met ocean surveys and other information.
May 2021	JNCC, NE and NRW - email	Provision of the benthic survey strategy for the Morgan Array Area only.
June 2021	JNCC, NE and NRW – email/meeting	Provision of the updated benthic survey strategy and summary of changes. Benthic survey scope meeting. Provision of updated survey plan and final meeting minutes incorporating stakeholder comments.
December 2021	RPS - email	Provision of various guidance documents on Water Framework Directive (WFD), Marine Mammal (MM) and benthic topics. High level comments on the cable routing study.
February 2022	Benthic ecology, fish and shellfish and physical process Expert Working Group (EWG) meeting	The purpose of this meeting was to introduce the project, discuss the remit of the EWG and Ways of Working. Also discussed were the ongoing surveys and preliminary results from these. Historic feedback received from Statutory Nature Conservation Bodies (SNCBs) on the surveys and approach to addressing these comments (e.g. filling any potential data gaps) as part of the wider baseline characterisation for the relevant topics was also discussed.
March 2022	NRW - email	NRW benthic specialists with input from WFD and water quality specialist is sufficient to review the benthic survey scope of work.
March 2022	JNCC – EWG Meeting Response	JNCC note the presence and initial analysis of sea-pen and burrowing megafauna communities within the array area and welcome the opportunity to review the assessment of this feature. JNCC provided information which may prove useful in further analysis. JNCC also notes the presence of habitat which is being categorised as “low” resemblance to rocky reef habitat and provided guidance to ensure JNCC Report 6562 published in September 2020 is considered in the assessment of this habitat.
April 2022	RPS - email	Provision of the Survey Scope of Work for the Morgan 2022 Benthic Ecology Subtidal Survey covering the Morgan ZOI for the Array Area.
April 2022	NRW - email	NRW recommend one sample station per habitat increasing accordingly depending on the coverage of the habitat. NRW broadly agree with the sample spacing but advise that frequency increase in the nearshore/intertidal. NRW welcome the avoidance of sensitive habitats (i.e. Sabellaria spinulosa reef, Sabellaria alveolata reef, Modiolus etc.) encountered during grab sampling. Recommend moving grab sample (e.g. 50m based on habitat sensitivity or survey specificity).
April 2022	JNCC - email	Requested clarification as to whether the number of stations specified is for both Morgan and Mona or will apply separately to each. JNCC requested information on low resemblance reefs be shared. JNCC appreciate Ocean quahogs Arctica islandica being returned to the sea and recommend return to suitable habitat.
April 2022	NE – email	NE welcomed the wide scope of the 2022 survey area including the ZOI. Any maps should include all relevant designated sites. NE also requested a map of the expected habitats within the 2022 survey area and the sample stations should be arranged to ground truth this information. Supported the use of video and stills to assess habitats. Welcomed the avoidance of sensitive habitats and the collection of environmental DNA (eDNA) information.
April 2022	MMO – EWG Meeting Response	The MMO requests confirmation that the benthic grab samples collected in relation to the developments will be processed to the recommend national processing guidelines (Worsfold and Hall, 2010) and that the resultant data will be made available as soon as possible.
May 2022	Isle of Man Department of Infrastructure – Scoping Opinion	The TSC would draw the applicant's attention to the Manx Marine Environmental Assessment (MMEA) which provides a useful overview of the Island's marine environment and should be taken into account as part of both the transboundary and possibly also the cumulative impacts assessment as part of this application. Specifically chapter 3.3 (Subtidal Ecology) contains information that would improve upon the data provided, including in sections 4.1.4.18 (Sabellaria spinulosa) and 4.1.4.19 (Modiolus reefs).

Date	Consultee and type of response	Topics
		The regional benthic subtidal ecology study area (Figure 4.1): The straight line seems rather arbitrary from an effects perspective. It appears odd that the southwest part of the Manx territorial sea has not been included. This appears to be neither an ecological or jurisdictional- based boundary decision and warrants further clarification.
		Given the inclusion of a substantial part of the Manx territorial sea, and a request for complete inclusion, there are no datasets or reports indicated for the area of the Manx territorial sea.
May 2022	Natural Resources Wales	NRW (A) would add the following data sources to Parts 2 & 3: Table 4.1 Summary of key desktop datasets and reports: • Lle Geo-Portal for Wales: Lle - Home (gov.wales) • Data Map Wales: Home | DataMapWales (gov.wales).
		Please note that all reference to 'Cobble reef' should be amended to 'Stony reef' as this is the correct habitat name/definition under the Habitats Directive.
June 2022	The Planning Inspectorate – Scoping Opinion	The regional benthic subtidal study area include a straight-line boundary on the west edge which appears arbitrary from an effects perspective. The study area should sufficiently encompass the full extent of any receptors likely to be significantly affected.
		The Scoping Report states that from initial analysis of data, the Morgan Potential Array Area is unlikely to have more than a low resemblance to the habitat 'sea pen and burrowing megafauna communities'. There is a possible presence of two areas that show a low resemblance to a 'rocky reef' habitat. The Applicant's attention is directed to JNCC Report No 656: Refining the criteria for defining areas with a 'low resemblance' to Annex I stony reef', which may be useful for the determination of such habitat.
June 2022	Natural England – Scoping Opinion	We advise that there may be additional data available from; Channel Coast Observatory, North West and North Wales Shoreline Management Plan, and Environment Agency LiDAR data. Review and include in Environmental Statement.
December 2022	Benthic ecology, fish and shellfish and physical process EWG meeting 2	The meeting presented the result of the baseline characterisation and the preliminary outputs of the impact assessment. NRW provided updated guidance for Wales on when low resemblance rocky reef should be considered as Annex I features.

1.4 Methodology

1.4.1.1 A desktop review has been undertaken to inform the baseline for benthic subtidal ecology, including a review of a number of academic reports and reports from surveys undertaken to support other project consents. These provide further context to the site-specific surveys.

1.4.1.2 A benthic subtidal survey of the Morgan Array Area was undertaken in 2021. The results of these surveys have been used to characterise the Morgan Array Area, within the Morgan benthic subtidal ecology study area, for the purposes of informing the benthic subtidal ecology EIA chapter (volume 2, chapter 7: Benthic subtidal ecology of the PEIR). The site-specific surveys undertaken in the summer of 2022 to include the Morgan ZOI will complete the benthic subtidal characterisation and will be reported in full for the final Environmental Statement.

1.4.1.3 The subtidal ecology surveys of the Morgan Array Area consisted of grab sampling and drop-down video (DDV) sampling. Analysis of results included multivariate and univariate statistical analyses as well as descriptions of the raw data. As outlined in section 1.2, the surveys within the Morgan Array Area were undertaken in conjunction with the site-specific benthic surveys for the neighbouring Mona Offshore Wind Project. The statistical analysis, presented in this technical report, has been undertaken on the combined dataset collected within both the Mona and Morgan Array Areas with the data collected for the Mona Offshore Wind Project used to provide additional context for the data within the Morgan Array Area.

1.4.1.4 Detailed methodologies for all site-specific surveys and analyses are presented in section 1.7.1.

1.4.2 Desktop study

1.4.2.1 Information on benthic subtidal ecology within the regional benthic subtidal ecology study area and the Morgan benthic subtidal ecology study area was collected through a detailed desktop review of existing studies and datasets. These are summarised at Table 1.2: below.

Table 1.2: Summary of key desktop sources.

Title	Source	Year	Author
Lle Geo-Portal for Wales	Welsh Government	2021	Welsh Government
EMODnet broadscale seabed habitat map for Europe (EUSeaMap)	EMODnet-Seabed Habitats	2019	EMODnet-Seabed Habitats
The National Biodiversity Network (NBN) Gateway	https://nbnatlas.org/	Accessed April 2022	https://nbnatlas.org/
Subtidal Ecology. In: Manx Marine Environmental Assessment (2nd Ed).	The Government of the Isle of Man	2018	Lara Howe
Coastal Ecology. In: Manx Marine Environmental Assessment (2nd Ed).	The Government of the Isle of Man	2018	Lara Howe
Marine Phase 1 Intertidal Habitat Survey	Natural Resources Wales	2005	Natural Resources Wales
A Review of the Contaminant Status of the Irish Sea	JNCC	2005	Untitled (publishing.service.gov.uk)
Rhiannon Offshore Wind Farm Preliminary Environmental Information Chapter 9 Benthic Ecology	Celtic Array Ltd	2014	Celtic Array Ltd
Gwynt y Môr offshore wind farm Marine Benthic Characterisation Survey	Gwynt y Môr offshore wind farm Ltd	2005	Centre for Marine and Coastal Studies (CMACS)
Ormonde Offshore Wind Farm Year 1 post-construction benthic monitoring technical survey report (2012 survey)	RPS Energy	2012	CMACS
Walney Offshore Wind Farm Year 1 postconstruction benthic monitoring technical survey report (2012 survey)	Walney Offshore Wind Farms (UK) Ltd/DONG Energy	2012	CMACS
Burbo Bank Offshore Wind Farm Benthic and Annex I Habitat Pre-construction Survey Field Report	Burbo Bank Offshore Wind Farms (UK) Ltd/DONG Energy	2015	CMACS
Phase I- Intertidal Survey- Standard Report'	Countryside Council for Wales	2004	Countryside Council for Wales
Burbo Bank Extension Offshore Wind Farm Environmental Statement Volume 2 – chapter 12: Subtidal and Intertidal Benthic Ecology	Dong Energy Ltd	2013	Dong Energy Ltd
Volume 1 Environmental Statement Walney Extension, chapter 10: Benthic Ecology	Dong Energy Ltd	2013	Dong Energy Ltd
Broadscale seabed survey to the east of the Isle of Man	Holt et al.	1997	Holt et al.
North Hoyle offshore windfarm Environmental Statement	Innogy NWP offshore Ltd.	2002	Innogy
Awel y Môr Environmental Impact Assessment Scoping Report	Innogy AYM offshore Ltd.	2020	Innogy
Offshore benthic communities of the Irish Sea	Mackie	1990	Mackie

1.5 Desktop study baseline characterisation

1.5.1 Regional benthic subtidal ecology study area

Subtidal sediments

1.5.1.1 The Offshore Energy Strategic Environmental Assessment (SEA) (2022) compiled a baseline of the offshore benthic environment around the UK. The SEA process aims to help inform licensing and leasing decisions by considering the environmental implications of the proposed plan/programme and the potential activities which could result from their implementation (Offshore Energy SEA, 2022). The benthic baseline information for the Offshore Energy SEA 4 was created from an amalgamation of sources such as Jones *et al.* (2004a-f), MESH (2004-2008), EUSeaMap2 (released in 2016) and EMODnet (2019). Offshore Energy SEA 4 divided the UKs exclusive economic zone into regional seas to characterise them; the regional benthic subtidal ecology study area lies within regional sea 6, the Irish Sea. It identified that the offshore seabed in the east Irish Sea, within the regional benthic subtidal ecology study area, is predominantly sedimentary, mainly of glacial origin, consisting mostly of sands and muddy sands, coarse and mixed sediments. In deeper sections tide-swept circalittoral mixed sediments were identified, in the south of the regional benthic subtidal ecology study area. In the nearshore, along the north Wales coast, the sediment is largely sandy mud or muddy sand (where it has been defined). Similar sediments are located along the west coast of England.

1.5.1.2 A large broadscale subtidal survey carried out in 1997 by the University of Liverpool, on behalf of bp (Holt *et al*., 1997), used side scan sonar and video survey methods to characterise the benthos in the region east of the Isle of Man within the regional benthic subtidal ecology study area. The survey showed the area to be relatively uniform, consisting of fine and medium sands with varying proportions of stones and shells. The surveys also identified widespread areas of fine scale sand waves or ripples. The sand waves and ripples identified consisted of much coarser sands, stones and gravel often with very large proportions of dead shell material. Muddy sediments were recorded in only a few patches in the regional benthic subtidal ecology study area, the largest of which were to the west of the Isle of Man.

1.5.1.3 The European Marine Observation and Data Network (EMODnet) broad-scale habitat map for Europe (EUSeaMap) presents the European Nature Information System (EUNIS) habitat classifications for the Irish Sea (Figure 1.2). The subtidal sediments of the regional benthic subtidal ecology study area have been recorded by the EMODnet (2019) as being dominated by deep circalittoral coarse sediment, offshore circalittoral sand, circalittoral mixed sediment and offshore circalittoral mud which is characteristic of the Irish Sea (EMODnet, 2019). The EMODnet broad-scale habitat map predicts large areas of high energy infralittoral habitat at the mouth of the river Mersey, the river Dee and river Conwy in the south and southeast of the regional benthic subtidal ecology study area, as well as the river Kent, river Leven, river Lune and the river Duddon in the east around Morecambe Bay. High energy infralittoral habitat is also predicted in Luce Bay and Wigtown Bay in the north of the regional benthic subtidal ecology study area. There is also a large area of infralittoral sand at the entrance of the Solway Firth which is determined to be a moderate energy environment (EMODnet, 2019). Deep circalittoral coarse sediments were recorded to the south and east of the Isle of Man, while infralittoral coarse sediments were recorded to the north of the Isle of Man (EMODnet, 2019). A mix of circalittoral coarse sediments and infralittoral coarse sediments were present in the east and west of the Isle of Man (EMODnet, 2019).

1.5.1.4 Surveys conducted by the Gwynt y Môr offshore wind farm, Burbo Banks offshore wind farm and Burbo Bank Extension (Figure 1.3) were located in the south of the regional benthic subtidal ecology study area. Pre-construction and post-construction monitoring and baseline characterisation surveys were undertaken for these projects between 2010 and 2012. These surveys characterised the sediments in the south of the regional benthic subtidal ecology study area as being dominated by circalittoral sand and coarse sediment, as well as muddy sand and sandy mud further inshore towards the north Wales coast (CMACS, 2011; SeaScape Energy, 2011; Dong Energy Ltd, 2013a). These areas of circalittoral sand in the south of the regional benthic subtidal ecology study area were interspersed with areas of circalittoral rock around the northwest coast of Anglesey (EMODnet, 2019).

1.5.1.5 The EMODnet seabed map (2019) shows subtidal sediments along the north Wales coast as being dominated by circalittoral fine sand and circalittoral muddy sands in a high energy environment, with areas of coarse sediment closer to shore around the Great Orme headland, interspersed with sections of infralittoral rock close to shore on the east and west sides of the Great Orme headland. A larger area of coarse sediment is mapped north of Colwyn Bay which extends slightly east of Rhyl (shown in Figure 1.2; EMODnet, 2019).

1.5.1.6 The proposed, and now dropped, Rhiannon offshore wind farm was to be located in the east of the regional benthic subtidal ecology study area (Figure 1.3). Baseline characterisation surveys in 2010 and 2012 for the Rhiannon offshore wind farm identified two large sandbanks off Lynas point, north Anglesey and in the east of the regional benthic subtidal ecology study area. These were composed of very well sorted mobile sand that remained submerged at all times (Celtic Array Ltd, 2014). The banks consist of medium and coarse sands with minimal mud or gravel content (Celtic Array Ltd, 2014). These banks were considered to be examples of the Annex I habitat sandbanks which are slightly covered by sea water at all times (Celtic Array Ltd, 2014).

1.5.1.7 The Walney and Ormonde offshore wind farms are located in the east of the regional benthic subtidal ecology study area (Figure 1.3). Pre-construction and post-construction monitoring, and baseline characterisation surveys were undertaken for these projects between 2009 and 2014. Surveys conducted for Ormonde offshore wind farm and Walney offshore wind farm (Figure 1.3) found the subtidal sediments in the east of the regional benthic subtidal ecology study area were dominated by circalittoral sandy mud or circalittoral muddy sand (CMACS, 2012a; CMACS, 2012b; CMACS, 2012c; CMACS, 2013; CMACS, 2014). The 1-year post-construction surveys (2012) for the Ormonde offshore wind farm recorded a higher percentage of mud further offshore and a lower percentage of mud in the southerly inshore areas (CMACS, 2012a). East of Morecambe Bay in the east of the regional benthic subtidal ecology study the sediment becomes coarser than at the Ormonde offshore wind farm. During the 1 year post-construction monitoring of Walney offshore wind farm in 2013, the Walney array area was shown to be dominated by sandy mud with sediments transitioning to coarse sediment further offshore and inshore of the array area (CMACS, 2013).

1.5.1.8 The subtidal sediments in the southwest of the regional benthic subtidal ecology study area, as determined by baseline characterisation surveys for the Rhiannon offshore wind farm, have been recorded as being dominated by sandy gravels or gravelly sand, generally coarse sediments with generally low mud content (Celtic Array Ltd, 2014).

1.5.1.9 The Isle of Man territorial waters also fall within the regional benthic subtidal ecology study area. A marine environmental assessment was undertaken by Howe (2018a) to bring together subtidal surveys which have been conducted around the Isle of Man to create an extensive characterisation of the subtidal environment. The subtidal habitats to the west of the island were shown to be predominantly mixed gravel, mixed stone and mixed sand seabed which extended to the north and the south with a small area of sand/muddy sand in the southeast. The seabed located to the southwest of the island comprises an extensive area of mud/fine sand. The EUSeaMap (Figure 1.2) is aligned with data from Howe (2018a) showing that sediment around the Isle of Man is made of coarse material with sections of fine sand in the southeast as well as the northeast.

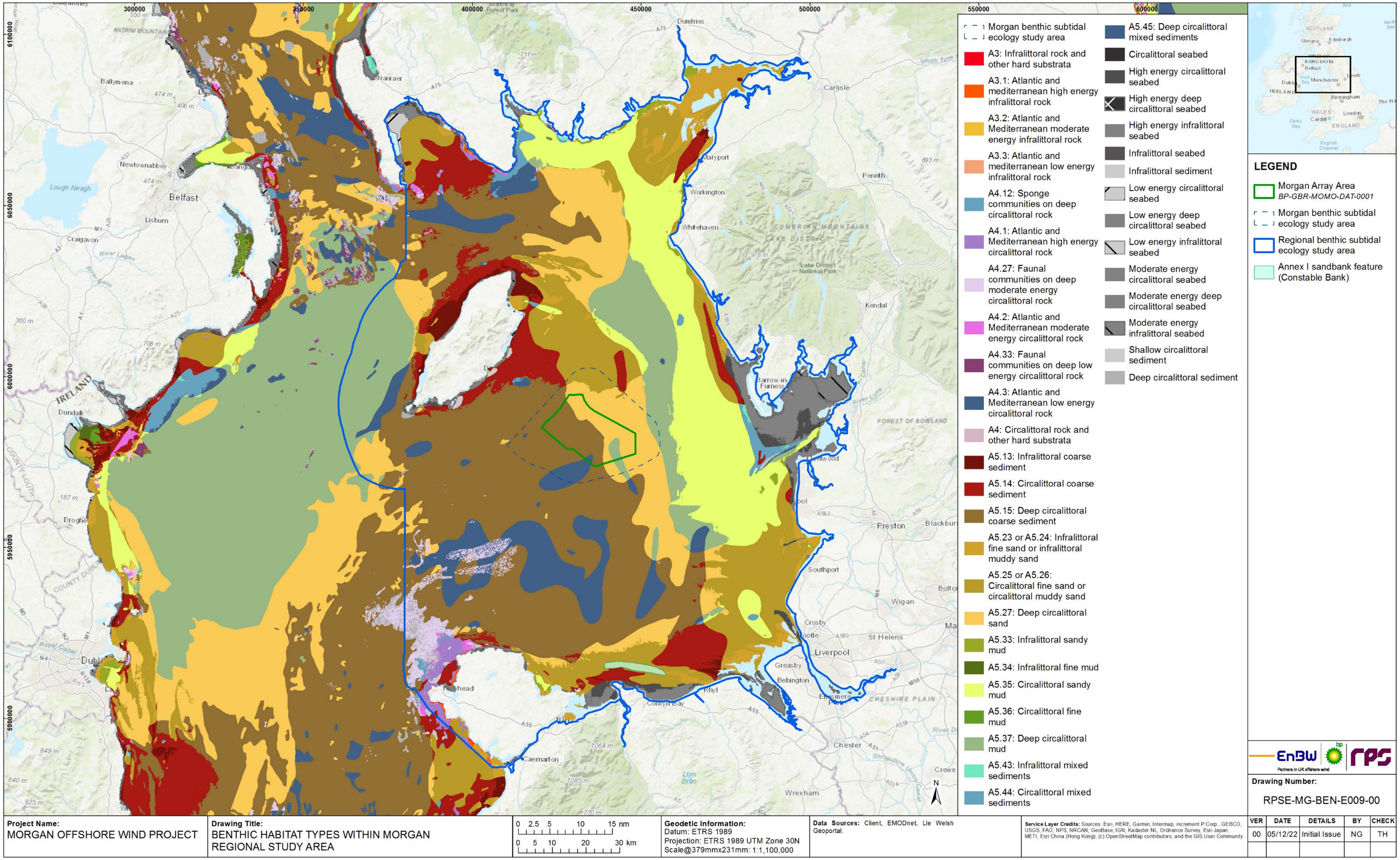


Figure 1.2: Benthic habitats (EMODNet, 2019) within the regional benthic subtidal ecology study area.

Sediment contamination

1.5.1.10 Metals occur naturally in the marine environment. Generally elevated contaminant concentrations, such as metals, in the Irish Sea can originate from natural mineralisation or anthropogenic sources (Cefas, 2005). Rowlatt and Lovell (1994) recorded elevated levels of metals in the northeast Irish Sea, which is attributed to inputs from the industrial areas of northwest England for example, Merseyside and Lancashire.

1.5.1.11 Pre-construction surveys conducted for the Burbo Bank offshore wind farm (CMACS, 2005a) identified that seven of the nine core samples across the array area contained metals at, or above, Interim marine Sediment Quality Guidelines (ISQG) levels/Canadian threshold effects levels (TEL). Additionally two metals (lead and mercury) were present in excess of the Canadian probable effect levels (PEL). The PEL establishes the concentration range within which adverse effects frequently occur (CCME, 2001). A greater proportion of surface sediment samples, especially in the top metre, contained metals above ISQG/TEL. No metals were in excess of ISQG/TEL below 1.5m. Six of these samples were collected in the Burbo Bank offshore wind farm array area (6.4km from the Sefton coastline) and three in the export cable corridor. The pre-construction site investigation survey concluded that as the contamination occurred in the upper metre of the seabed they would be naturally mobile and therefore any additional works from offshore wind farms would not mobilise any sediment not naturally mobile.

1.5.1.12 Arsenic has regularly been recorded at elevated levels in the east Irish Sea (e.g. Camacho-Ibar *et al*., 1992). Arsenic was recorded above ISQG/TEL thresholds but below the PEL at four sites across the Walney offshore wind farm array area as part of the benthic baseline characterisation surveys (Dong Energy Ltd, 2013b) as well as across the former Rhiannon offshore wind farm site (Centrica Plc and Dong Energy Ltd, 2014). Studies have found that such elevated arsenic levels were not attributable to anthropogenic sources, the source is considered to be weathering of glaciated regions of north Wales and the Lake District (e.g. Thornton *et al*., 1975).

1.5.1.13 Benthic characterisation surveys for the Walney offshore wind farm Environmental Statement (Dong Energy, 2013b) in the north of the regional benthic subtidal ecology study area also identified one sample of mercury above ISQG/TEL levels. Mercury levels were thought to be reducing in the years leading up to 1993 based in samples from the muscles of plaice *Pleuronectes platessa*, reducing from a mean value of the order of 0.5mg kg^{-1} wet weight in the early 1970s, to approximately 0.2mg kg^{-1} in 1991 (Leah *et al*., 1993). These reductions are due to reduced discharge into the Mersey estuary by the chloro-alkali chemical industry (Dong Energy, 2013b).

1.5.1.14 Surveys at Burbo Bank Extension (Dong Energy Ltd, 2013a) in the southeast of the regional benthic subtidal ecology study area (see Figure 1.3) found no contaminants were present above PEL however the array area had elevated levels of iron, aluminium, arsenic, copper, zinc and lead above natural background levels, no contaminant was present above PEL. These results are consistent with the results from surveys for other wind farms in the area which also found elevated levels of the same metals but no exceedances of PEL thresholds (Burbo Bank (Seascape Energy Ltd, 2002), North Hoyle (Innogy, 2002), and Gwynt y Môr (CMACS, 2005b)). The Environmental Statement for Burbo Bank Extension (Dong Energy Ltd, 2013a) found no organochlorine and organophosphorus pesticides were present at detectable levels and no sample at any depth contained polychlorinated biphenyls (PCBs) in excess of the ISQC level. Polycyclic aromatic hydrocarbons (PAHs) were present above the limit of detection in only one sample from a single depth in the southwest of the Burbo Bank offshore wind farm.

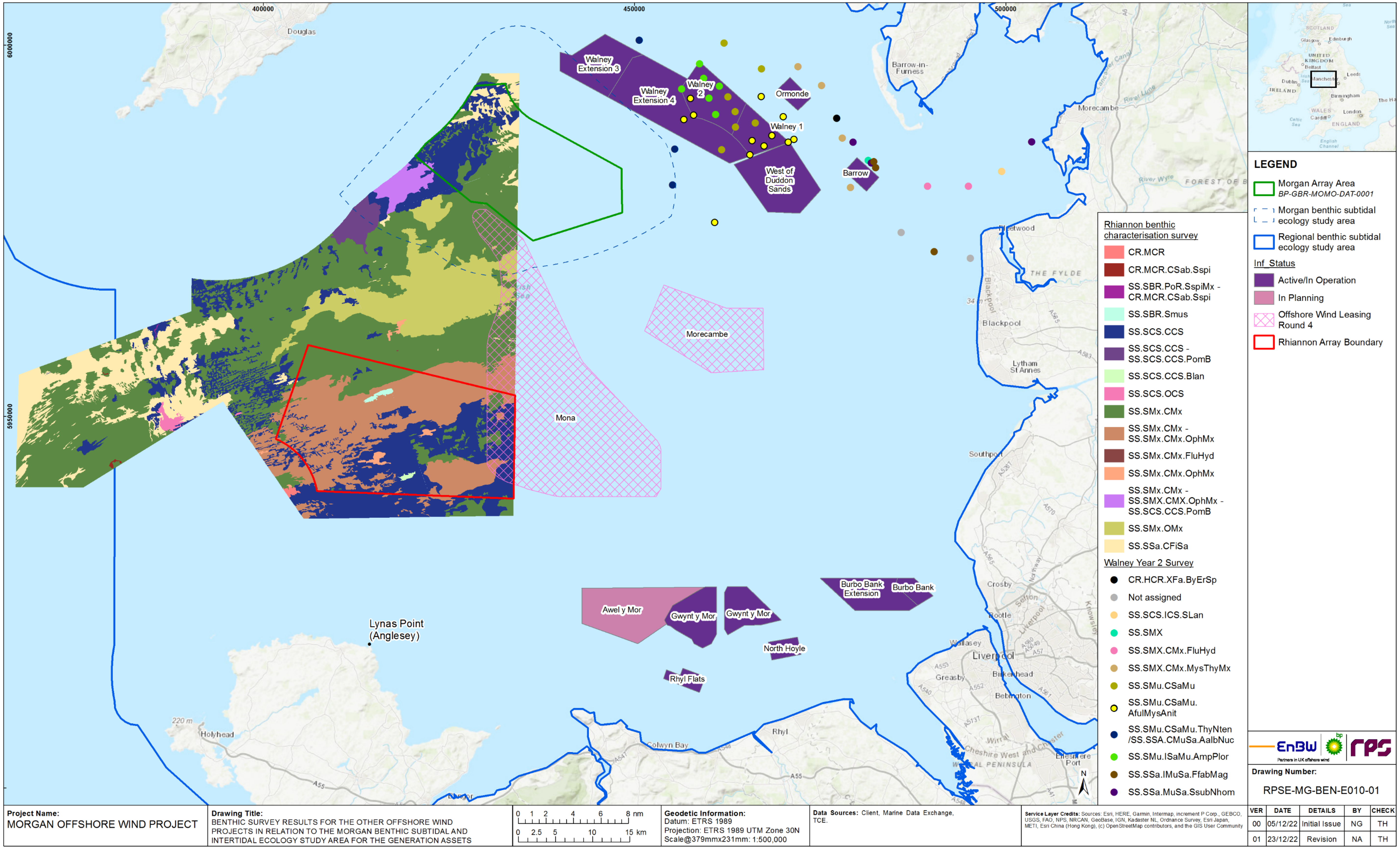


Figure 1.3: Benthic survey results for the other offshore wind projects in relation to the Morgan benthic subtidal ecology study area (all biotope codes are defined in Appendix H).

Subtidal benthic ecology

1.5.1.15 Figure 1.3 displays all the mapped subtidal ecology data available from the offshore wind farms which fall within the regional benthic subtidal ecology study area. Appendix H provides the full names for all the biotopes which are presented in Figure 1.3 to enable a better understanding of the habitats being represented.

1.5.1.16 The subtidal benthic communities of the regional benthic subtidal ecology study area were characterised by its sedimentary habitats, Mackie (1990) describes most of the east Irish Sea as being dominated by *Venus* communities. Deep *Venus* communities were characterised by occurrence at depths of 40 – 100m in coarse sand/gravel/shell sediments and for containing species such as *Spatangus purpureus, Glycimeris*, *Asarte sulcata* and venus clams (Mackie, 1990) (full list of species common names can be found in Appendix H). Deep *Venus* communities are present in the central and west sections of the regional benthic subtidal ecology study area (Mackie, 1990). Much of the inshore area of the regional benthic subtidal ecology study area can be characterised by shallow *Venus* communities on nearshore sand, tending to occur in waters 5-40m deep, with strong currents and sand. Mackie (1990) also identified pockets of *Abra* communities along the north Wales coastline as well as in the east of the regional benthic subtidal ecology study area. These communities are dominated by the bivalve species *Abra alba* and the polychaete worm *Lagis koreni* (Rees *et al.,* 1977) and the biotope *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (SS.SSa.CMuSa.AalbNuc).

1.5.1.17 The Gwynt y Môr (Figure 1.3) pre-construction benthic monitoring surveys (CMACS, 2011) identified the *Moerella* sp. with venerid bivalves in infralittoral gravelly sand (SS.SCS.ICS.MoeVen) biotope and the circalittoral fine sand (SS.SSa.CFiSa) biotope as the most extensively distributed biotopes throughout the survey site. These biotopes are common and widespread biotopes in the local area (i.e. Liverpool Bay and northeast Irish Sea). The biotope *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand (SS.SSa.IFiSa.NcirBat) was identified at a few locations within the Gwynt y Môr site but was more dominant at the inshore export cable route and inshore west reference sites. The *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods (SS.SSa.IMuSa.FfabMag) biotope was also described at stations on the south side of the array area, close to the Welsh coast.

1.5.1.18 The Burbo Bank offshore wind farm is located approximately 8km to the east of Gwynt y Môr offshore wind farm (Figure 1.3). The Environmental Statement for the original Burbo Bank offshore wind farm (SeaScape Energy, 2011) confirms the biotopes found at the extension site. The array area was dominated by the SS.SSa.IMuSa.FfabMag with a small section of SS.SSa.CMuSa.AalbNuc identified in the east of the array area. The wider area around the array area was classified as SS.SSa.IFiSa.NcirBat.

1.5.1.19 The Environmental Statement for this the Burbo Bank offshore wind farm (Figure 1.3) reported a variety of biotopes. The south section of the array area was dominated by the *Amphiura filiformis*, *Kurtiella bidentata* and *Abra nitida* in circalittoral sandy mud (SS.SMu.CSaMu.AfilKurAnit) biotope with a large proportion of the north section characterised by the SS.SCS.ICS.MoeVen biotope. The west of the array was characterised by combinations of the biotopes *Lagis koreni* and *Phaxas pellucidus* in circalittoral sandy mud (SS.SMU.CSaMu.LkorPpel) and SS.SSa.CMuSa.AalbNuc. The cable corridor, which extends across the mouth of the river Dee, largely consisted of the SS.SSa.IFiSa.NcirBat biotope.

1.5.1.20 Surveys conducted by CMACS (2009) at Walney offshore wind farm (Figure 1.3) found that SS.SMu.CSaMu.AfilKurAnit (in the east of the site) and *Thyasira sp.* and *Ennucula tenuis* in circalittoral sandy mud (SS.SMu.CSaMu.ThyEten) (in the west of the site where sediment has a higher gravel content) were the main biotopes in the survey area. Along the export cable corridor the biotopes SS.SMu.CSaMu.AfilKurAnit and SS.SSa.IMuSa.FfabMag were recorded.

1.5.1.21 Nearby Ormonde offshore wind farm (Figure 1.3) reported very similar results in its Environmental Statement which covered an area in the east of the regional benthic subtidal ecology study area from Duddon sands to the Lune deep. The Environmental Statement found the array area itself to be mostly composed of SS.SMu.CSaMu.AfilKurAnit with bands of SS.SMu.CSaMu.LkorPpel and SS.SSa.CMuSa.AalbNuc with increasing proximity to the coast (Unicomarine Ltd, 2005).

1.5.1.22 The Rhiannon offshore wind farm was proposed to be located in the west of the regional benthic subtidal ecology study area (Figure 1.3). The dominant biotopes were circalittoral coarse sediment (SS.SCS.CCS) and *Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment (SS.SMx.CMx.OphMx). The SS.SMx.CMx.OphMx biotope consists of circalittoral sediments dominated by brittlestars forming dense beds, living on boulder, gravel or sedimentary substrate. Large patches of circalittoral fine sand (SS.SSa.CFiSa) were recorded further west and to the north of the Rhiannon offshore wind farm survey area in the central west of the regional benthic subtidal ecology study area (Figure 1.3 Celtic Array Ltd, 2014).

1.5.1.23 The nationally scarce *Thia scutellata* has been recorded in the south of the regional benthic subtidal ecology study area (Clark, 1986; Rees 2001; Moore, 2002). This small crab inhabits a specific habitat of loose, well-sorted medium sands into which it can easily burrow. This species was recorded during benthic surveys for the Burbo Bank, Burbo Bank Extension and the Gwynt y Môr offshore wind farms.

1.5.1.24 The Walney offshore wind farm (Figure 1.3) overlaps with a number of protected species which are protected by designated areas. There is an Annex I stony reef within the Shell Flats and Lune Deep Special Area of Conservation (SAC) (reefs are a designated feature of the SAC) which is located inshore of the Walney offshore wind farm array area in the central east section of the regional benthic subtidal ecology study area (Dong Energy Ltd, 2013b). Stony reefs have also been identified at a few sample locations along the export cable corridor of Walney extension and within Morecambe Bay, all were classified as low 'reefiness' (Dong Energy Ltd., 2013b). The habitat burrowed mud was also recorded in the east of the Walney offshore wind farm array area and is listed as a UK Biodiversity Action Plan (BAP) habitat as well as an 'Oslo-Paris convention for the protection of the marine environment of the North-Eastern Atlantic' (OSPAR) habitat under 'seapens and burrowing megafauna'. This biotope has also been recorded in the Ormonde offshore wind farm, West of Duddon offshore wind farm, and Walney offshore wind farm extension. The sample sites where the burrowed mud biotope has been found within the Ormonde and Walney offshore wind farms are both located within the West of Walney Marine Conservation Zone (MCZ) zone, west of the Ormonde offshore wind farm, and is designated for the protection of sea pens and burrowing megafauna among other features. Although no sea pens were recorded at the sample sites within the Walney offshore wind farms during the post-construction monitoring surveys, evidence of burrowing megafauna was present (CMACS, 2014).

1.5.1.25 The Isle of Man territorial waters also fall within the regional benthic subtidal ecology study area. A marine environmental assessment was undergone by Howe (2018a) to bring together subtidal surveys which have been conducted around the Isle of Man to create an extensive characterisation of the subtidal environment. Howe (2018a) describes White's (2011) analysis of 7325 seabed images from a 2008 benthic survey around the Isle of Man and identified 20 different biotopes. Some of the most common included *Brissopsis lyrifera* and *Amphiura chiajei* in circalittoral mud (SS.SMu.CFiMu.BlyrAchi) which was recorded over a broad area in the southwest of the Isle of Man. *Cerianthus lloydii* with the *Nemertesia* spp. and other hydroids in circalittoral muddy mixed sediment (SS.SMx.CMx.ClloMx.Nem) biotope characterising an extensive area of the southwest of the Isle of Man. The sediments to the north of the island were characterised by biotopes typical of mixed sediment and sand-based habitats. Intermittently around the island there are also a number of rocky biotopes including sparse sponges, *Nemertesia* spp. and *Alcyonidium diaphanum* on circalittoral mixed substrata (CR.HCR.XFa.SpNemAdia) and faunal and algal crusts on exposed to moderately wave-exposed circalittoral rock (CR.MCR.EcCr.FaAlCr). Three main habitats of international conservation interest were identified during the survey, horse mussel reefs, maerl beds and Ross worm habitats (*Sabellaria spinulosa*), all of which are OSPAR priority habitats (OSPAR 2008-16). Individuals of the UK Biodiversity Action Plan (BAP) priority species, the sea anemone *Edwardsia timida*, were also recorded. *Arctica islandica*, a threatened or declining species in the North Sea region as defined by the OSPAR Convention, has long been known to populate Laxey Bay in the east of the Isle of Man, as well as in Niarbyl Bay and Port Erin Bay. *Zostera marina* meadows are an important nursery area for many marine species (Davison and Hughes 1998) and play an important role as a marine carbon sink. In recent years, eelgrass has only been recorded in four sites in Isle of Man waters spread along the east coast of the island.

1.5.1.26 Areas of stony and rocky reefs have also been identified within and around the Rhiannon wind farm array area and all of which are present in the northwest of the Rhiannon offshore wind farm coinciding with the central west area of the regional benthic subtidal ecology study area. The stony and rocky reefs identified have 'reefiness' classifications (rocky reef criteria of Irving *et al*. (2009) and redescribed for stony reef in Limpenny *et al*. (2010)) of low to moderate. Additionally, there was an area of Annex I rocky reef composed of bedrock occurring entirely within the Rhiannon offshore wind farm which was assigned a high 'reefiness' (Celtic Array Ltd., 2014). Sabellaria *spinulosa* reefs were identified 20km northwest of the Rhiannon array area (in the central west part of the regional benthic subtidal ecology study area) with some small areas closer. All were deemed to be of low or low to medium 'reefiness' when assessed against the criteria proposed by Gubbay (2007). The Gwynt y Môr pre-construction benthic survey recorded seven *S. spinulosa* individuals across five stations out of a total of 126 stations overall, however no reefs were identified in these pre-construction site investigation surveys (CMACS, 2011). No Annex I *S. spinulosa* reefs were recorded within the Rhiannon Offshore Wind Farm but a small area of low to moderate 'reefiness' *S. spinulosa* reef of $0.22km^2$ in extent was recorded within the export cable area and one small area of low 'reefiness' was associated with less coarse sediments 20km to the northwest of the Rhiannon offshore wind farm array area (in the central west area of the regional benthic subtidal ecology study area).

1.5.1.27 Bangor University conducted benthic habitat survey of waters around the Isle of Man in 2008 and recorded *S. spinulosa* to the south of Manx waters, the habitat had not previously been formally recorded. The coast of the Isle of Man from Peel round to Maughold Head is primarily rocky, creating rocky reef habitat subtidally. The rocky reef habitats of the Isle of Man are deemed to be of high diversity. There are also extensive *Modiolus* reefs around the Isle of Man with recent surveys identifying clusters of reefs at the north and south points of the island (Howe, 2018a). Other notable habitats around the Isle of Man include extensive sandbanks off the north coast. Under the EU Habitats Directive, subtidal mobile sandbanks are included under "Sandbanks which are slightly covered by seawater at all times". Additionally brittlestar beds were identified as important biogenic habitats in the UK Marine SAC review in the 1990s (Hughes 1998). The Bangor University benthic survey in 2008 indicated that seabed dominated by brittlestar beds is widespread in Manx waters.

1.5.1.28 One individual of *Arctica islandica* which is on the OSPAR threatened species list was recorded in a grab sample which was taken for the baseline characterisation surveys for the Walney Extension offshore wind farm (Dong Energy Ltd, 2013b).

1.5.1.29 Desktop baseline information from Celtic Array Ltd (2014) shows that there is an Annex I sandbank within the regional benthic subtidal ecology study area. Side scan sonar data from Rhiannon offshore wind farm also showed that in the far southwest of the regional benthic subtidal ecology study area there are numerous *Modiolus modiolus* reefs (class 2 reefs) (Celtic Array Ltd, 2014).

1.5.2 Morgan benthic subtidal ecology study area

Subtidal sediments

1.5.2.1 Based on the EUSeaMap, sediments in the Morgan benthic subtidal ecology study area were dominated by a variety of sediment types (EMODnet, 2019). Transitioning from west to east across the Morgan Array Area the sediments grade from deep circalittoral coarse sediments to deep circalittoral sands.

Subtidal benthic ecology

Morgan subtidal benthic ecology

1.5.2.2 Site-specific surveys conducted for the Rhiannon offshore wind farm benthic ecology preliminary environmental information report (PEIR) (Celtic Array Ltd, 2014) overlap with the west side of the Morgan benthic subtidal ecology study area.

1.5.2.3 Within the Rhiannon PEIR site-specific survey area which overlaps with the Morgan benthic subtidal ecology study area six biotopes where identified (Celtic Array Ltd, 2014) (Figure 1.3). In the central north of the Morgan benthic subtidal ecology study area SS.SSa.CFiSa and SS.SCS.CCS are the most common biotopes. Further south, west of the centre of the Morgan benthic subtidal ecology study area SS.SMx.CMx with some areas of SS.SMx.OMx along the other border of the Morgan benthic subtidal ecology study area. In the southwest of the Morgan benthic subtidal ecology study area sections of SS.SCS.CCS/*Spirobranchus triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles (SS.SCS.CCS.PomB) and SS.SMx.CMx/SS.SMx.CMx.OphMx/SS.SCS.CCS.PomB.

1.5.2.4 Additionally a marine environmental assessment of the subtidal ecology around the Isle of Man (MMEA, 2018) showed that in the northwest of the Morgan benthic subtidal ecology study area the seabed was dominated by SS.SCS.CCS, *Cerianthus. lloydii* with *Nemertesia* spp. and other hydroids in circalittoral mixed sediment (SS.SMx.CMx.ClloMx.Nem) and SS.SMx.CMx.OphMx. The Isle of Man marine environmental assessment also recorded *M. modiolus* and *S. spinulosa* within the northwest and *A. islandica* within the north of the Morgan benthic subtidal ecology study area.

1.5.2.5 Desktop baseline information from Celtic Array Ltd (2014) shows that the Morgan benthic subtidal ecology study area both contained rocky reefs within their boundaries.

1.6 Designated sites

1.6.1.1 There are a number of sites of nature conservation importance, which are designated for benthic ecology features within the regional benthic subtidal ecology study area. Designated sites with relevant benthic ecology qualifying features and which occur within the regional benthic subtidal ecology study area are described in Table 1.3 and shown in Figure 1.4. The internationally and nationally designated sites have been characterised in sections 1.6.1 and 1.6.2 respectively.

Table 1.3: Summary of designated sites within the regional benthic subtidal ecology study area and relevant qualifying interest features.

Designated Site	Closest Distance from the Morgan Array Area (km)	Relevant Features of Interest
West of Copeland Marine Conservation Zone (MCZ)	7.3	• Subtidal coarse sediment • Subtidal sand • Subtidal mixed sediment.
West of Walney MCZ	7.5	• Subtidal sand • Subtidal mud.
Langness Marine Nature Reserve (MNR)	16.75	• Eelgrass meadow; • Intertidal mud • Kelp forest • Sea caves.
Little Ness MNR	20.41	• Horse mussel reef • Maerl.
Douglas Bay MNR	22.22	• Beaumont's nudibranch (*Cumanotus beaumonti*) • Maerl beds • Rocky reef • Kelp forest.
Laxey Bay MNR	22.42	• Eel grass meadow • Rocky reef • Sandy seabed • Maerl • Ocean quahog (Arctica islandica) • Common whelk.
Ramsey Bay MNR	26.42	• Maerl beds • Eelgrass meadows • Horse mussel reefs • Rocky shore and reef.
Fylde MCZ	29.2	• Subtidal sand • Subtidal mud.
Shell Flat and Lune Deep Special Area of Conservation (SAC)	29.6	• Sandbanks which are slightly covered by sea water all the time • Reefs.
Baie y Carrickey MNR	30.19	• Rocky reef • Sea caves • Kelp forest • Eelgrass meadows.
Morecambe Bay SAC	35.4	• Mudflats and sandflats not covered by seawater at low tide • Large shallow inlets and bays • Sandbanks slightly covered by sea water at all times • Large shallow inlets and bays • Coastal lagoon • Atlantic salt meadows • Reefs.
Calf of Man and Wart Bank MNR	35.77	• Rocky reef • Sand banks • Kelp forest.
Niarbyl Bay MNR	36.71	• Rocky reef • Kelp forest • Sea caves • Intertidal blue mussel beds • Ocean quahog (*Arctica islandica*).
Port Erin Bay MNR	36.8	• Rocky reef • Brittlestar beds • Kelp forest • Stalked jellyfish • Flame shell

Designated Site	Closest Distance from the Morgan Array Area (km)	Relevant Features of Interest
West Coast MNR	38.55	• Rocky reef • Intertidal blue mussel • Mixed soft sediment • Kelp forest • Burrowing anemone (*Edwardsia timida*).
Cumbria Coast MCZ	44.4	• Intertidal under boulder communities • *Sabellaria* alveolate reefs.
Ribble Estuary Site of Special Scientific Interest (SSSI)	50.8	• Intertidal mudflats • Sandbanks.
Menai Strait and Conwy Bay SAC	60.1	• Sandbanks which are slightly covered by sea water all the time • Mudflats and sandflats not covered by seawater at low tide • Submerged or partially submerged sea caves • Large shallow inlets and bays • Reefs.
Great Ormes Head SSSI	63.1	• Caves and overhangs • Moderately exposed rock • Rockpools • Soft piddock bored substrata • Under boulders
Aber Afon/Conwy SSSI	63.7	• Coastal plain estuary ecology.
Creigiau Rhiwledyn/Little Ormes Head SSSI	65.5	• Caves and overhangs • Moderately exposed rock • Rockpools • Soft piddock bored substrata • Under-boulders.
Luce Bay and Sands SAC	68.05	• Large shallow inlets and bays • Sandbanks which are slightly covered by sea water all the time • Mudflats and sandflats not covered by seawater at low tide • Reefs
Dee Estuary/Aber Dyfrdwy SAC	70	• Mudflats and sandflats not covered by seawater at low tide.
Traeth Pensarn SSSI	72.4	• Sandbanks • Shingle ridge.
Allonby Bay MCZ	78.48	• Blue mussel beds • *Sabellaria* alveolate reefs.
Solway Firth SAC	84.32	• Sandbanks which are slightly covered by sea water all the time • Reefs

1.6.1 International designations

Shell Flats and Lune Deep SAC

1.6.1.1 The Shell Flats and Lune Deep SAC is located on the north boundary of Fylde MCZ in the east Irish sea, 29.6km southeast of the Morgan Array Area at its closest point.

1.6.1.2 Shell Flat sandbank runs northeast from the south corner of the site. The bank is an example of a Banner Bank, which are generally only a few kilometres in length with an elongated pear/sickle-shaped form, located in water depths less than 20m below chart datum (Natural England, 2012). This feature is designated as a sandbank which is slightly covered by seawater all the time. Lune Deep is designated for its reef habitat which represents a good example of boulder and bedrock reef (Natural England, 2012). The presence of stony reef, cobbles and small boulders supporting tide-swept fauna including hydroids, bryozoans, anemones and sponges.

Morecambe Bay SAC

1.6.1.3 The Morecambe Bay SAC is located on the west coast of England, in the county of Lancashire. The site is located 35.4km east of the Morgan Array Area at its nearest point to the Morgan Generation Assets. The variation in physical and environmental conditions throughout the site, including rock and soft sediment types, water clarity and exposure to tidal currents and wave action result in a wide range of habitats and associated marine communities.

1.6.1.4 This SAC is designated for numerous Annex I habitats throughout the subtidal and intertidal environment. One of the key habitats being the estuaries in this area, within the SAC four rivers contribute to the estuary resulting in the largest single area of continuous intertidal mudflats and sandflats in the UK and the best example of muddy sandflats on the west coast (JNCC, 2022c). Mudflats and sandflats not covered by seawater at low tide is another Annex I habitat that this SAC is designated for. Furthermore the Morecambe Bay is the second-largest embayment in the UK, after the Wash and as such, it has also been designated for its large shallow inlets and bays habitat (JNCC, 2022c).

Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC

1.6.1.5 The Menai Strait and Conwy Bay SAC is located in northwest Wales, between mainland Wales and the island of Anglesey. The site is located 60.1km from the Morgan Array Area. The variation in physical and environmental conditions throughout the site, including rock and sediment type, water clarity and exposure to tidal currents and wave action result in a wide range of habitats and associated marine communities.

1.6.1.6 For the qualifying habitats (sandbanks which are slightly covered by sea water all the time, mudflats and sandflats not covered by seawater at low tide, submerged or partially submerged sea caves and reefs), the SAC is considered to be one of the best areas in the UK for mudflats and sandflats not covered by seawater at low tide, reefs, and sandbanks which are slightly covered by seawater all the time. The features are distributed throughout the SAC with no single feature occupying the entire SAC and with features overlapping in some locations. According to the most recent condition assessment (NRW, 2018), three features of the SAC are considered to be in favourable condition (sandbanks which are slightly covered by sea water all the time, mudflats and sandflats not covered by seawater at low tide, and reefs) and the large shallow inlets and bays feature is in unfavourable condition.

1.6.1.7 Within the Menai Strait SAC the sandbanks which are slightly covered by seawater all the time and reefs are notable features. The reef feature is further defined by the JNCC (2022a) as rocky reefs dominated by communities of filter feeders such as sponges. The sandbanks vary from stable muddy sands in areas with weak tidal streams to relatively clean well-sorted and rippled sand where tidal streams were stronger (JNCC, 2022a). In very shallow waters relatively species-rich sandy communities are dominated by polychaetes (JNCC, 2022a).

Luce Bay and Sands SAC

1.6.1.8 The Luce Bay and Sands SAC is located on the southwest coast of Scotland. The site is located 68.05km from the Morgan Array Area at its nearest point to the Morgan Generation Assets. The variation in physical and environmental conditions throughout the site, including rock and soft sediment types, water clarity and exposure to tidal currents and wave action result in a wide range of habitats and associated marine communities.

1.6.1.9 In the marine environment this SAC is designated for one Annex I feature, large shallow inlets and bays, of which Luce Bay and Sands is a high quality example (JNCC, 2022d). The JNCC (2002d) describe the sediments within Luce Bay as ranging from boulders to highly mobile sands, which support rich plant and animal communities typical of a large bay in southwest Scotland. The shallow depths of the bay (0-10m) contain major sandbanks along the west and north shores. Most of the intertidal area of the bay comprises small boulders on sandy sediment. Some larger boulders on the lower shores have spaces beneath and between them which provide shelter for false Irish moss *Mastocarpus stellatus* and allowing for under-boulder communities to develop, including ascidians, sponges and crustose coralline algae. In the subtidal area communities of sparse kelp *Laminaria hyperborea* and sea-oak *Halidrys siliquosa*, red algae and the dahlia anemone *Urticina feline* have been identified. Much of the central part of Luce Bay consists of slightly deeper-water that support a rich community of polychaete worms, bivalves, echinoderms, brittlestars, particularly Ophiura spp.

Aber Dyfrdwy/Dee Estuary SAC

1.6.1.10 The Aber Dyfrdwy/Dee Estuary SAC is located on the north Wales coast in the southeast of the east Irish sea, 70km southeast of the Morgan Array Area at its closest point.

1.6.1.11 The Aber Dyfrdwy/Dee Estuary SAC covers an area of 158.05km^2 (JNCC,2022b). This site is designated for three main features: mudflats and sandflats not covered by seawater at low tide, *Salicornia* and other annuals colonising mud and sand and Atlantic salt meadows *Glauco-Puccinellietalia maritimae*. Other Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site include estuaries and various dune habitats. The majority of these features are in good conditions and targets are currently in place to maintain this condition.

Solway Firth SAC

1.6.1.12 The Solway Firth SAC is located on the west coast boarder between England and Scotland and is formed by the river Solway. It is one of the least-industrialised and most natural large estuaries in Europe (JNCC, 2022e). The site is located 84.32km from the Morgan Array Area at its nearest point to the Morgan Generation Assets. The variation in physical and environmental conditions throughout the site, including rock and soft sediment types, water clarity and exposure to tidal currents and wave action result in a wide range of habitats and associated marine communities.

1.6.1.13 This SAC is designated for numerous Annex I habitat including sandbanks which are slightly covered by sea water all the time, estuaries and mudflats and sandflats not covered by seawater at low tide (JNCC, 2022e). The sandbanks in the Solway Firth are mainly composed of gravelly and clean sands, due to the very dynamic nature of the estuary. The dominant species of the infaunal communities comprise different annelid worms, crustaceans, molluscs and echinoderms, depending on the nature of the substrate. As a very natural estuary with limited industrialisation highly mobile, predominantly sandy intertidal flats have been able to form on the west coast. The Solway Firth contains the third-largest area of continuous littoral mudflats and sandflats in the UK.

1.6.2 National designations - MCZ

West of Copeland MCZ

1.6.2.1 West of Copeland MCZ is located in the east Irish sea, 7.3km north of the Morgan Array Area and it covers an area of 158km^2. The seabed within the West of Copeland MCZ is predominantly composed of a mix of subtidal sediments from fine sand through to coarse sediment (Defra, 2019). It is these sedimentary habitats which are the protected features of this site (subtidal sand, subtidal coarse sediment and subtidal mixed sediment). The subtidal sand habitat is in favourable condition, but the subtidal coarse and subtidal mixed sediments are recovering to favourable condition (Defra, 2019).

1.6.2.2 This range of habitats supports a wide variety of species including bivalve molluscs (such as venus clams and razor clams), worms, sea urchins, anemones, starfish, crabs and sea mats (Defra, 2019).

West of Walney MCZ

1.6.2.3 West of Walney MCZ Is located in the Irish Sea, off the coast of Cumbria and to the west of Walney Island. The MCZ is 7.5km northeast of the Morgan Array Area at its closest point. The MCZ covers an area of 388km^2 most of which is in inshore waters, but with a small section crossing the 12 nautical mile (nm) boundary into offshore waters (Defra 2016).
This site is notable as it is part of a network of mud-based sea pen and burrowing megafaunal habitats in this region (Defra 2016). All of the designated features (subtidal sand, subtidal mud and sea pens and burrowing megafauna communities) are currently recovering to favourable condition (Defra 2016).

1.6.2.4 The seabed mud is an important habitat for animals such as worms, cockles, urchins and sea cucumbers. Other larger animals, such as mud shrimps and even fish, live within this habitat and burrow into the mud. This creates networks of burrows which shelter organisms like worms and brittlestars. The mud also provides a habitat for sea-pens, which are tall and luminous animals, which live in groups and get their name because they look like quill pens. The sand on the seabed is also an important habitat for flat fish, sand eels and worms living within it.

Fylde MCZ

1.6.2.5 Fylde MCZ is located in Liverpool Bay, between 3 and 20km off the Fylde coast and Ribble estuary. The site is located 29.2km from the Morgan Array (Figure 1.4). The MCZ protects an area of approximately 260km^2. The depth of the seabed within the site ranges from almost being exposed on low tide (just 35 cm depth) to 22m at its deepest part (Defra, 2013).

1.6.2.6 The site was chosen for its extensive subtidal sediment habitats (subtidal sand and subtidal mud are the designated features) which are considered to be a good representation of the seabed habitats and communities found in the eastern side of Liverpool Bay. This habitat is known is support rich bivalve and mollusc populations. Fylde MCZ is situated next to Shell Flat and Lune Deep SAC and the MCZ offers an extended protection beyond the SAC for rich areas of seabed outside of the SAC including habitats such as sandbanks which are slightly covered by sea water all the time and reefs (bedrock reefs and stony reefs). The seabed in this area is highly productive and supports communities of animals such as crabs, starfish, shrimp-like crustaceans and bivalve shellfish, including the commonly found *Nucula nitidosa*, *Pharus legumen* and *A. alba* (Defra, 2013).

Allonby Bay MCZ

1.6.2.7 The Allonby Bay MCZ is located on the west coast of England, within the county of Cumbria. The MCZ is 78.48km northwest of the Morgan Array Area at its closest point. The MCZ is an inshore site on the English side of the Solway Firth and in total it covers an area of 40km^2 (Defra, 2022c). This site is notable for large areas of reefs, including *S. alveolata* reefs and blue mussel beds (Defra, 2022c). All of the designated habitat features of this MCZ (intertidal rock, *S. alveolata* reefs, intertidal biogenic reefs/sand and muddy sand/coarse sediment, subtidal biogenic reefs, subtidal coarse/sand/mixed sediment, moderate energy infralittoral rock and peat and clay exposures) are currently being maintained to preserve their favourable status (Defra, 2022c).

1.6.3 National designations - SSSI

Ribble Estuary SSSI

1.6.3.1 The Ribble Estuary SSSI is located on the Irish Sea coast of the counties of Lancashire and Merseyside. The site is located 50.8km from the Morgan Array Area. This SSSI is 92.26km^2 in area and also contains the Ribble Marshes National Nature Reserve.

1.6.3.2 The estuary and in particular its extensive sand flats, mud flats and salt marshes, is especially important for migratory birds. A survey in the north of the site (Natural England, 2015), near Lytham-St-Annes, found the upper shore to be characterised by sandy habitat with a range of polychaete species and amphipods. The fauna in sediments on the lower shore area identify high numbers of juvenile brittlestars and fragments of hydroids and bryozoans. A large number of empty razor shells *Ensis* spp. were also present scattered over the sediment surface.

1.6.3.3 The Ribble Estuary is a highly dynamic environment subject to a range of environmental influences including wave and wind action as well as flow from the Ribble river channel. The locations of channels and surface features of the sandflats can vary weekly and seasonal variation in the faunal communities occurs both within and across years.

Pen Y Gogarth/Great Ormes Head SSSI

1.6.3.4 Pen Y Gogarth/Great Ormes Head SSSI is located on the north Wales coastline and overlaps the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC. The site is located 63.1km from the Morgan Array Area. Pen Y Gogarth/Great Ormes Head SSSI covers an area of 3.03km^2 (CCW, 2013). This site is notable for having the largest extent of moderately exposed rock, supporting a complete zonation of marine biotopes, as well as specialised and nationally scarce flora and fauna, most typically associated with rock pool, cave and limestone rock habitats found between the Great Orme and the Solway Firth (CCW, 2013).

Aber Afon/Conwy SSSI

1.6.3.5 Aber Afon/Conwy SSSI is located on the north Wales coastline, at the mouth of the river Conwy and overlapping with the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC. The site is located 63.7km from the Morgan Array Area. Aber Afon/Conwy SSSI covers an area of 12.95km^2 (CCW, 2003). This site is notable as a high-quality example of an intertidal estuarine community (CCW, 2003). The site supports nationally important 'piddock' communities on; eulittoral peat, eulittoral firm clay with *Mytilus edulis*, lower eulittoral soft rock with *Fucus serratus* and sublittoral fringe soft rock with *Laminaria digitata* (CCW, 2003). In addition the site supports specialised communities of shallow pools on mixed substrata with hydroids, ephemeral algae and *Littorina littorea* (CCW, 2003).

Creigiau Rhiwledyn/Little Ormes Head SSSI

1.6.3.6 Creigiau Rhiwledyn/Little Ormes Head SSSI is located on the north Wales coastline and overlaps the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC. The site is located 65.5km from the Morgan Array Area. Creigiau Rhiwledyn/Little Ormes Head

SSSI covers an area of 0.36km^2 (CCW, 2002). This site is notable for various marine biological features including specialised and nationally scarce cave, rockpool, overhang and rock-boring bivalve biotopes (physical habitats and their associated community of species including animals and plants) within the intertidal zone (CCW, 2002).

Traeth Pensarn SSSI

1.6.3.7 Traeth Pensarn SSSI is located on the north Wales coastline and is located 72.4km from the Morgan Array Area. Traeth Pensarn SSSI covers an area of 51.67km^2, of which 42.46km^2 is within the intertidal zone (82%). This site is notable for its coastal vegetated shingle beach as well as exposed sand and littoral sediment. All designated features of this site are located above the MHWS mark.

1.6.4 National designations - MNR

Langness MNR

1.6.4.1 The Langness MNR is located to the southeast of the Isle of Man and northwest of the Morgan Generation Assets, 16.75km from the Morgan Array Area at its closest point. Langness MNR is 88.67km^2, or 10.67% of the 0-3nm inshore zone, and is the third largest MNR (DEFA, 2022a).

1.6.4.2 The Langness MNR is important for a variety of fauna including sea birds and seals as well as benthic species such as grooved topshell *Jujubinus striatus* and the bivalve *Loripes lucinalis*, (DEFA, 2022a). The site also home to seagrass meadows growing at depths between 5 and 12m, as well as kelp forests (DEFA, 2022a). At the coast there is also a series of small subtidal caves which are thought to be nursery sites for lobsters.

Little Ness MNR

1.6.4.3 The Little Ness MNR is located to the east of the Isle of Man and northwest of the Morgan Generation Assets, 20.41km from the Morgan Array Area at its closest point. Little Ness MNR is relatively small at 10km^2, but one of the most important sites because of its very high species diversity (DEFA, 2022i).

1.6.4.4 The Little Ness MNR encompasses a variety of habitats including horse mussel reefs and maerl beds (DEFA, 2022i). This site also has an important population of critically endangered European eels where young eels can be found in spring before travelling up rivers (DEFA, 2022i). As a result of this rich benthic environment a variety of seabird and marine mammals can also be found in this area.

Douglas Bay MNR

1.6.4.5 The Douglas Bay MNR is located to the east of the Isle of Man and northwest of the Morgan Generation Assets, 22.22km from the Morgan Array Area at its closest point. Douglas Bay MNR covers an area of only 4.6km^2 (DEFA, 2022b).

1.6.4.6 This MNR encompasses an area of maerl bed, a red coralline seaweed which creates a fine layer over the seabed. This habitat attracts a high diversity of species including shellfish and anemones, as well as being a refuge for juvenile queen scallops and whelks which are commercially important to the Isle of Man (DEFA, 2022b). Rocky reefs and kelp forests are also found in this MNR. Beaumont's nudibranch is an important species in this MNR due to its limited range only occurring between the UK and Norway (DEFA, 2022b).

Laxey Bay MNR

1.6.4.7 The Laxey Bay MNR is located to the east of the Isle of Man and northwest of the Morgan Generation Assets, 22.42km from the Morgan Array Area at its closest point. Laxey Bay MNR is approximately 4km^2 in size which equates to around 0.5% of the 0-3nm area, or 1% of the reserves network (DEFA, 2022c).

1.6.4.8 The Laxey Bay MNR is one of the smallest MNRs around the Isle of Man however it contains a wide variety of benthic habitats such as seagrass meadows, rocky reefs, sandy seabed and maerl beds (DEFA, 2022c). This MNR supports Ocean quahog *Arctica islandica* and common whelk *Buccinum undatum* which is one of the five commercially fished species around the Isle of Man (DEFA, 2022c).

Ramsey Bay MNR

1.6.4.9 The Ramsey Bay MNR is located to the northeast of the Isle of Man and northwest of the Morgan Generation Assets, 26.42km from the Morgan Array Area at its closest point. Ramsey Bay MNR covers an area of around 97km^2, half of which is highly protected. Designated in 2011 as the island's first MNR, it is divided into five zones, four of which are highly protected for important habitats, such as horse mussel reef and eelgrass meadow (DEFA, 2022f).

1.6.4.10 Horse mussels can reach 15cm in length and attach to the seabed with threadlike hairs. Over time the number of mussels increases, and they can form a reef structure with highly a complex three-dimensional structure which can be colonised by sponges, tube worms, soft corals and barnacles. Rocky reefs are also present in the intertidal and subtidal environment (DEFA, 2022f).

Baie y Carrickey MNR

1.6.4.11 The Baie y Carrickey MNR is located to the south of the Isle of Man and west of the Morgan Generation Assets, 30.19km from the Morgan Array Area at its closest point. Baie ny Carrickey MNR covers an area of 11.37km^2 and was originally established as a fishery-restricted area in 2012 to reduce gear conflict between scallopers and pot fishermen and protect rocky reefs (DEFA, 2022d).

1.6.4.12 The Baie y Carrickey MNR encompasses an area of rocky reef, kelp forest and seagrass meadows as well as sea caves which all contribute to its designated status (DEFA, 2022d).

Calf of Man and Wart Bank MNR

1.6.4.13 The Calf of Man and Wart Bank MNR is located to the southwest of the Isle of Man and west of the Morgan Generation Assets, 35.77km from the Morgan Array Area at its closest point. The Calf of Man and Wart Bank MNR is 20.15km^2, or 2.4% of the 0-3nm inshore zone (DEFA, 2022e).

1.6.4.14 The Calf of Man and Wart Bank MNR encompasses habitats such as rocky reefs and kelp forests (DEFA, 2022e). This MNR also contains sandbanks composed of sandy sediment and influenced by the waves and tide resulting in a dynamic habitat of mounds and ripples (DEFA, 2022e). This habitat is home to sandeels which are an important prey species for a number of marine mammals and seabirds.

Niarbyl Bay MNR

1.6.4.15 The Niarbyl Bay MNR is located to the west of the Isle of Man and northwest of the Morgan Generation Assets, 36.71km from the Morgan Array Area at its closest point. First established as a Fisheries Closed Area for scallop reseeding trials in 2009, this MNR is 5.66km^2 and makes up just over 1% of the reserves network (DEFA, 2022g).

1.6.4.16 The Niarbyl Bay MNR encompasses habitats such as rocky reefs, kelp forest and sea caves as well as intertidal blue mussel beds (DEFA, 2022g). The Ocean quahog is also an important feature of this MNR due to the coarse gravel habitats found in the south of the site (DEFA, 2022g).

Port Erin Bay MNR

1.6.4.17 The Port Erin Bay MNR is located to the west of the Isle of Man and northwest of the Mona Offshore Wind Project, 36.8km from the Morgan Array Area at its closest point. Port Erin Bay MNR is relatively small at just under 4.5km^2. Facing due west, the bay acts as a funnel for wind and wave from the Irish Sea and these forces have produced one of the best sandy beaches on the island (DEFAj).

1.6.4.18 The Port Erin Bay MNR encompasses habitats such as rocky reefs, kelp forest and brittlestar beds (DEFA, 2022j), all of which take advantage of the site being closed for fishing since 1989 (DEFA, 2022j). The site is also notable for having stalked jellyfish *Stauromedusae* which are rare across the British Isles as well as the Flame shell *Limaria hians* which is a species of marine clam named for its fiery orange colours.

West Coast MNR

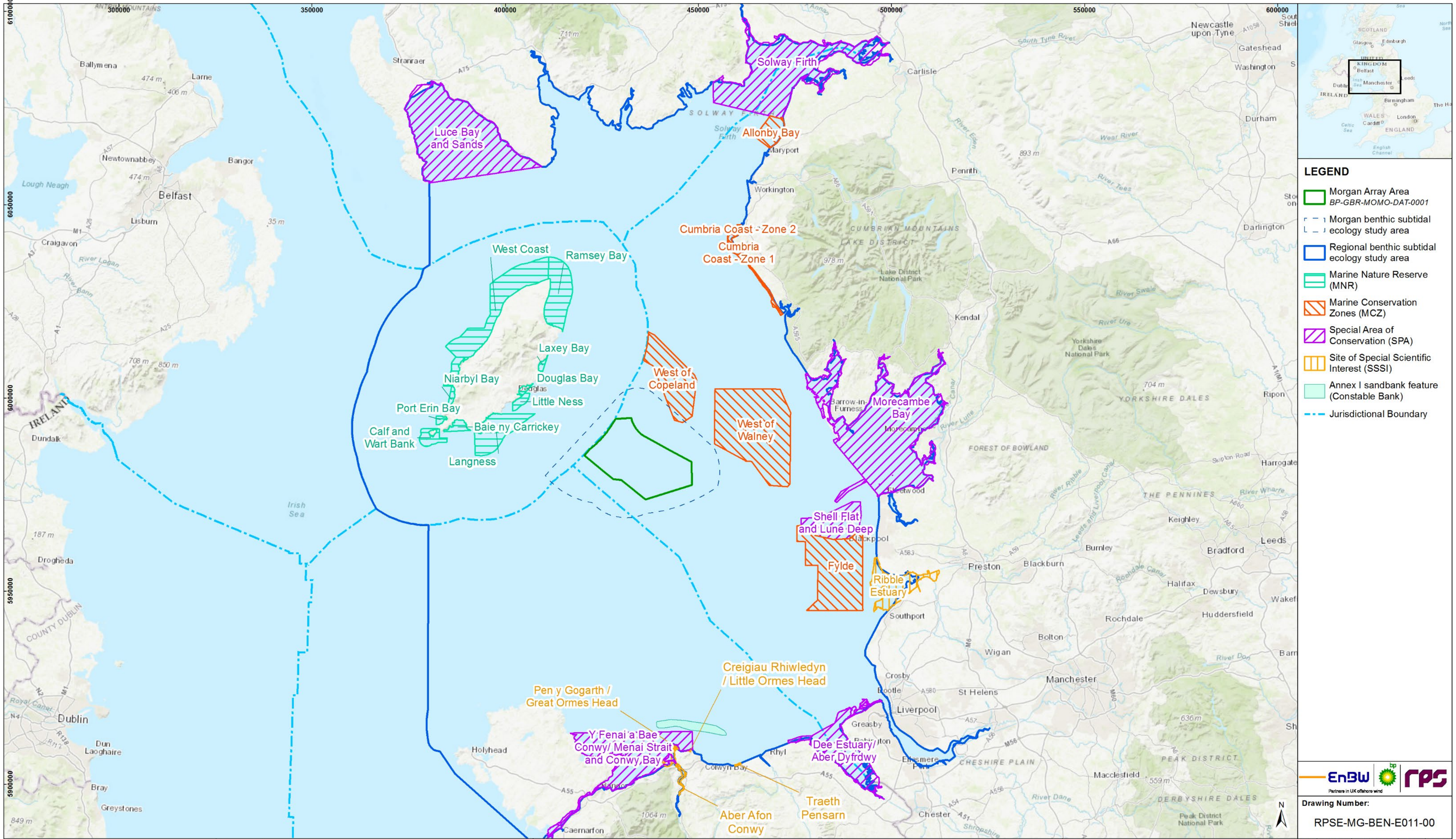
1.6.4.19 The West Coast MNR is located to the west of the Isle of Man and northwest of the Morgan Generation Assets, 38.55km from the Morgan Array Area at its closest point. The West Coast MNR is the largest of the nature reserves at around 185km^2, which equates to 43% of the protected area network (DEFA, 2022h).

1.6.4.20 The West Coast MNR has a distinctive physical environment as a result of the strong tidal currents around the Point of Ayre (DEFA, 2022h). The seabed is composed of sand deposits as well as rock fragments as a result of the glacial history of this area. These sediments have enabled the creation of rocky reefs, intertidal mussel beds and kelp beds (DEFA, 2022h). The main habitat within this MNR is mixed soft sediment which is inhabited by scallops and whelks as well as the burrowing sea anemone (*Edwardsia timida*) (DEFA, 2022h).

Cumbria Coast MCZ

1.6.4.21 The Coast of Cumbria MCZ is located on the west coast of England, within the county of Cumbria. The MCZ is 44.4km northeast of the Morgan Array Area at its closest point. The MCZ is an inshore site that stretches for approximately 27km along the coast of Cumbria and in total it covers an area of 22km^2 (Defra, 2019b). This site is notable as it is an extensive and important example of intertidal rocky shore habitats and associated communities on the sedimentary coast of northwest England (Defra, 2019b). All of the designated habitat features of this MCZ (high energy intertidal rock, *Sabellaria alveolata* reefs, intertidal biogenic reefs, intertidal sand and muddy sand, intertidal underboulder communities, moderate energy infralittoral rock and peat and clay exposures) are currently being maintained to preserve their favourable status (Defra, 2019b).

1.6.4.22 The diverse physical habitat at this MCZ helps to support this wide variety of designated features. The extensive intertidal boulder and cobble reefs within the site support good examples of nationally important *S. alveolata* reefs (Defra, 2019b). Where this habitat extends towards and below the low water mark examples of under-boulder communities are prevalent supporting unusual algae and mobile animals such as long-clawed porcelain crabs, sea slugs and brittlestars shelter among sponges (Defra, 2019b).



Project Name:	Drawing Title:	Geodetic Information:	Data Sources:	VER	DATE	DETAILS	BY	CHECK
MORGAN OFFSHORE WIND PROJECT	MORGAN BENTHIC SUBTIDAL AND INTERTIDAL STUDY AREAS	Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@379mmx231mm: 1:1,000,000	Client, JNCC, Natural England	00	05/12/22	Initial Issue	NG	TH

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Figure 1.4: Designated sites with benthic ecology features in the regional benthic subtidal ecology study area.

1.7 Site-specific subtidal survey baseline characterisation

1.7.1.1 A benthic subtidal survey was undertaken in 2021 to characterise the Morgan Array Area within the Morgan benthic subtidal ecology study area. A summary of these surveys is outlined in Table 1.4 with full detailed results of the benthic subtidal surveys presented in sections 1.7.2 to 1.7.6.

1.7.1.2 As outlined in section 1.2, the surveys within the Morgan Array Area were undertaken in conjunction with the site-specific benthic surveys for the neighbouring Mona Offshore Wind Project. The statistical analysis, presented in this technical report, has been undertaken on the combined dataset collected within both the Mona subtidal and intertidal ecology study area and Morgan benthic subtidal ecology study area with the data collected for the Mona Offshore Wind Project used to provide additional context for the data within the Morgan Array Area.

1.7.1.3 Further surveys were undertaken in summer 2022 to characterise the Morgan ZOI. This benthic subtidal ecology technical report will therefore be updated with this additional data for the final Environmental Statement.

Table 1.4: Summary of surveys undertaken to inform benthic subtidal ecology.

Title	Survey Extent	Overview of Survey	Survey Contractor	Date	Reference to Further Information
Pre-construction site investigation surveys	Morgan Array Area	Geophysical survey to establish bathymetry, seabed sediment and identify seabed features.	XOcean Ltd	June 2021 to March 2022	XOCEAN (2022)
Pre-construction site investigation surveys	Morgan Array Area	High resolution side scan sonar and multibeam bathymetry	Gardline Ltd.	June to September 2021	Volume 4, annex 6.1: Physical processes technical report of the PEIR
Benthic Subtidal Survey	Morgan Array Area	Grab samples and DDV sampling.	Gardline Ltd.	8 August 2021-20 September 2021	Section 1.7.1

1.7.1 Methodology

Sample collection

1.7.1.1 The 2021 site-specific subtidal survey was undertaken across the Morgan Array Area (and the Mona Array Area) only within the Morgan benthic subtidal ecology study area. The sampling strategy was designed to adequately sample the area to provide data for baseline characterisation. The survey design was discussed and agreed with NE, JNCC and NRW (Table 1.1). The benthic subtidal survey for the Morgan Array Area was undertaken by Gardline Limited (Gardline) in June to September 2021. The survey was conducted onboard the vessel *Ocean Resolution.*

1.7.1.2 The 2021 subtidal survey was composed of 37 sample stations located in the Morgan Array Area (two of which were DDV only, the rest were combined grab and DDV) (Figure 1.5). An additional 60 sample locations (nine of which were DDV only) were collected within the neighbouring Mona Array Area during the same survey.

1.7.1.3 Upon completion of the survey, 35 stations had been successfully sampled with an additional two DDV only stations within the Morgan Array Area (Figure 1.5). An additional 60 sample locations, with an additional nine DDV only stations, were successfully sampled within the neighbouring Mona Array Area during the same survey.

1.7.1.4 The benthic site-specific subtidal surveys for the Morgan ZOI around the Array Area were undertaken in summer 2022 (paragraph 1.4.1.2) and the results will be incorporated in the final version of this report for the final Environmental Statement but will not be included in the PEIR.

Grab sampling

1.7.1.5 A total of 248 single grab samples were retained from 273 deployments of a $0.1m^2$ mini-Hamon grab, of which 104 were within the Morgan Array Area at 35 sample stations (Figure 1.5), to ensure adequate data coverage for both infaunal and epifaunal communities at each location. Macrofaunal, particle size and environmental DNA (eDNA; see Appendix I) samples were collected from all stations. Samples for chemical analysis were collected at ten of the stations within the Morgan Array Area.

1.7.1.6 Initial processing of all mini Hamon grab samples was undertaken aboard the survey vessel in line with the following methodology:

- Assessment of sample size and acceptability made
- Photograph of sample with station details, scale bar taken and described prior to sub-sampling
- Surficial (<2cm depth) sediments were taken directly from the mini-Hamon grab for chemical and biological analysis
- One sediment grab was obtained which was divided into six sub-samples; two approximately 1 litre samples for chemical analysis, and a spare, particle size analysis (PSA) with a spare taken using a plastic scoop and placed into plastic zip-lock bags. Sample emptied onto 1mm sieve net laid over 4mm sieve table and washed through using gentle rinsing with seawater hose
- Two separate grab samples from each station were collected for infaunal macroinvertebrate identification. Each faunal sample was washed with seawater and transferred to a 0.5mm sieve, finer sediment fractions were washed from the sample using an auto-sieve
- The sieve residue was transferred to a uniquely labelled sample jar using scoops and/or funnels and fixed with formaldehyde solution (less than 20% formalin)
- eDNA samples were taken from two grabs at each sampling location. If the sediment was undisturbed, two 50ml cores were taken to a depth of 5cm. If this sediment was homogenized, a sample of approximately 40g was taken as a

small scoop from various points in the decanted sample. These samples were then stored in an airtight bag shielded from ultraviolet light and stored at less then -18°C prior to analysis.

Drop down video

1.7.1.7 All 35 sample stations in the Morgan Array Area were surveyed with DDV with a minimum of 70 seabed photographs and 27 minutes of footage collected at each station at appropriate intervals including stations which had two attempts. Environmental seabed images were taken by means of a digital stills shallow water camera system with a dedicated strobe and video lamp, mounted within a stainless-steel frame. Video footage was also acquired throughout all stations using a high definition (HD) video camera. Initially the survey was conducted with the C-Tecnics CT3022 camera system though this encountered a timing issue with its flash gun so was swapped to the back-up Kongsberg OE14- 208 system after completion of the first sample station (ENV01). A total of 9,216 photos were taken using the stills camera system across 97 stations. All of the photographs were taken less than 64m from the target location. On average, photographs were taken 29m (±14SD) from their target locations.

1.7.1.8 A further 7 sample stations ENV72, ENV73 and ENV90 to ENV94were added to the 28 original locations within the Morgan Array Area comprising 2 camera-only stations to target boulder areas and 5 co-located camera and grab stations to target additional features of interest in the newly reviewed data.

1.7.1.9 The images were captured remotely using the surface control unit and stored on the camera’s internal memory card. Video footage was overlaid with time, position and depth, and recorded directly onto the PC hard drive. On completion, photographs were downloaded onto a computer. All hard disk drives were labelled with the relevant job details, write-protected and stored.

Survey limitations

1.7.1.10 Due to operational weather conditions and advised client priorities to maximise weather windows, the original locations of sample stations ENV05 and ENV10 were relocated due to anomalies, so the DDV and grab station positions differ slightly.

1.7.1.11 One sample station within the Morgan Array Area (ENV30) was also relocated during the survey due to lying within, or in close proximity to, exclusion zones for cables.

1.7.1.12 During the surveys a number of stations were added to ensure adequate coverage of the survey area and its features. Further, from reviews of this additional data such as the geophysical data which was used to inform the micro siting of sample locations, additional stations were selected to cover features not already targeted. As a consequence, a further 7 sample stations (ENV72, ENV73 and ENV90 to ENV94) were proposed to be added to the 28 original locations within the Morgan Array Area comprising two camera-only stations to target boulder areas and five co-located camera and grab stations to target additional features of interest in the newly reviewed data such as the geophysical data.

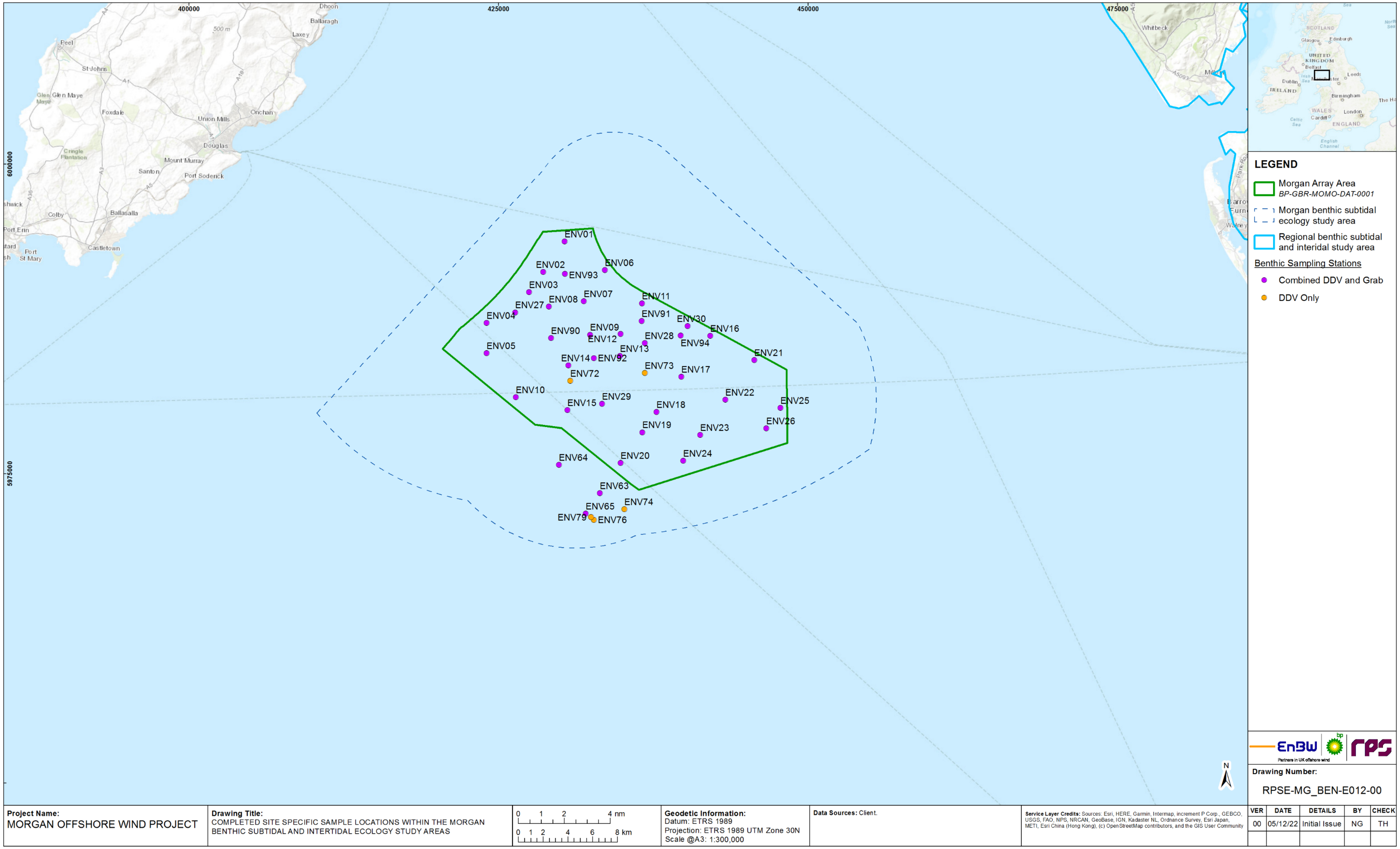


Figure 1.5: Completed site-specific sample locations within the Morgan Array Area within the Morgan benthic subtidal ecology study area (from 2021 subtidal survey).

Sample analysis

Benthic infaunal analysis

1.7.1.13 Two separate grab samples from each station were collected for infaunal macroinvertebrate identification. For each faunal sample the entire contents of a single grab were washed into a clean plastic tray using seawater and then transferred to a 0.5mm sieve. Finer sediment fractions were washed from the sample using an auto-sieve, which sprayed a low-powered seawater jet onto the underside of the sieve. The sieve residue was transferred to uniquely labelled sample jars using a scoop and/or funnel, making sure that none of the sample was lost or trapped in the sieve mesh. Sieved samples were immediately fixed with a known concentration of formaldehyde solution ('formalin', less than 20%). The formalin in the sample pots was subsequently diluted to a concentration of approximately 4%. One of the faunal samples (normally those identified as A) were worked up as a matter of course and a second retained as a spare (sample B).

1.7.1.14 Additionally, eDNA samples were taken from two grabs at each sampling location where possible (see Appendix I). If the sediment was undisturbed, two 50ml cores were taken to a depth of 5cm. If this sediment was homogenized, a sample of approximately. 40g was taken as small scoops from various points in the decanted sample. These were then combined in and stored in an airtight bag shielded from UV light and stored at less than -18°C prior to analysis.

Sediment characteristic analysis

1.7.1.15 Particle size analysis (PSA) was carried out by Thomson Environmental Consultants in accordance with North East Atlantic Marine Biological Analytical Quality Control (NMBAQC) methods for diamictons (Mason, 2016). No dispersants were used, and the sediment was not treated to remove carbonates or organic matter prior to analysis. The sieve sizes ranged from 63mm to <1µm and were all assigned to a Wentworth classification (Wentworth, 1922a). The results present particle size distributions in terms of mean phi, fraction percentages (i.e., gravel, sand and fines), sorting (mixture of sediment sizes) and skewness (weighting of sediment fractions above and below the mean sediment size) and kurtosis (degree of peakedness of a distribution) (Folk and Ward, 1957). The sediment samples were additionally classified using the modified Folk triangle classification and the EUNIS classification. These classifications use the sand:mud ratio and the percentage of gravel (Folk, 1954; Parry, 2019).

Sediment chemistry analysis

1.7.1.16 As part of the subtidal survey, sediment samples were taken for the purpose of sediment chemistry analysis (Figure 1.5). Sediment hydrocarbon, metals, total organic carbon (TOC), organotins and PCB analyses were carried out by SOCOTEC. Samples were transferred to an appropriate sample container, labelled and sent to a suitable qualified laboratory for analysis. Samples were analysed for the following contaminants:

- metals
- polychlorinated biphenyl (PCB)
- total organic carbon (TOC)
- organotins
- polycyclic aromatic hydrocarbons (PAH).

Data analysis

Sediment characterisation analysis

1.7.1.17 The PSA data were categorised using the Folk classification which groups particles into mud, sand and gravel (mud 2mm) and the relative proportion of each used to ascribe the sediment to one of 15 classes (e.g. slightly gravelly sand, muddy sand etc.) (Folk, 1954; Long, 2006). These classifications were then used to describe the data in the analysis. Proportions of mud, sand and gravel, as well as the Folk and Ward sorting coefficient, were also used to describe the sediment data. The Folk and Ward sorting coefficient describes the extent of deviation from lognormality of the particle size distribution (i.e. the variation in particle size with a sample).

Sediment chemistry analysis

1.7.1.18 The results of the sediment chemistry analysis were compared to the Cefas Action Levels (Als) (Cefas, 1994). Cefas Action Level 1 (AL1) and Action Level 2 (AL2) give an indication of how suitable the sediments are for disposal at sea. Contaminant levels which are below AL1 are of no concern and are unlikely to influence the marine licensing decision while those above AL2 are considered unsuitable for disposal at sea. Those between AL1 and AL2 would require further consideration before a licensing decision can be made.

1.7.1.19 Sediment chemistry data were also compared to the Canadian Sediment Quality Guidelines (CSQG; CCME, 2001), which give an indication on the degree of contamination and the likely impact on marine ecology. For each contaminant, the guidelines provide threshold effects levels (TEL), which is the minimal effect range at which adverse effects rarely occur and a probable effect level (PEL), which is the probable effect range within which adverse effects frequently occur.

Macrofaunal analysis

1.7.1.20 Destructive sampling techniques and sieving may damage delicate benthic organisms. It is, therefore, commonplace for fragmented organisms to be found in faunal samples. The following conditions were applied to the recording of damaged specimens and fragments:

- Fragments that constituted a major component of an individual, that unequivocally represented the presence of an entire organism, and that could be identified to species level, were recorded and included with other counts of that species
- Fragments that constituted a significant component of an individual, that unequivocally represented the presence of an entire organism, but that could not be identified to species by virtue of their incompleteness, were recorded to the lowest possible taxonomic level

- Fragments that did not unequivocally represent the presence of an entire organism were ignored (e.g. *Ophiura* arms, *Echinocardium* shell fragments, etc).

1.7.1.21 Recorded fragments, therefore, represent discrete observations of individuals that were present at the time of sampling and were included in the analysed data set.

1.7.1.22 Macrofauna was defined as organisms that are normally larger that the mesh size of the sieve used to separate them from the sediment (Gardline, 2018). Meiofaunal organisms, such as the *Ostracoda* and *Copepoda*, which would not be consistently sampled, were not recorded. Due to their generally small size (in fully marine environments), species from the *Oligochaeta*, *Tardigrada* and *Gnathostomulida* were only enumerated when a sieve with a mesh size of 0.5mm or less was used to separate organisms from sediments; otherwise, these organisms were noted to be present, but not enumerated.

1.7.1.23 Planktonic organisms, such as *Mysidacea* were not recorded. The presence of nektonic species, such as fish, was recorded, but were not enumerated. Colonial, stoloniferous and encrusting epibenthic species were identified but not enumerated. With the exception of discrete sea pen *Pennatulacea* colonies, only solitary tunicates and cnidarians were enumerated and included in statistical analyses. Colonial tunicates and cnidarians were identified but not enumerated. The testate amoeba *Astrorhiza* sp. Was the only foram (amoeba-like, single-celled organisms) routinely enumerated. When found, the presence of Porifera sponges was recorded, but not identified to lower taxonomic levels, enumerated, or included in statistical analyses. Where *Gnathiidae* were recorded, those individuals not identified to species level were grouped as a single indeterminate *Gnathiidae* entry. In accordance with our in-house guidelines the following organisms were not identified to species, but were enumerated and included in the data set for analyses at a higher taxonomic level:

- *Nemertea* – identified to phylum
- *Platyhelminthes* – identified to phylum
- *Oligochaeta* – identified to genus
- *Phoronida* – identified to genus
- *Cephalochordata* – identified to subphylum
- *Hemichordata* – identified to phylum.

Data Rationalisation

1.7.1.24 The benthic infaunal and epifaunal datasets were initially transformed to down-weight the species with the highest abundances for multivariate community analysis. The analysis of the infaunal community was made using the enumerated taxa only dataset to avoid skewing the results with the encrusting/colonial taxa recorded as 'present'; these taxa were combined with the DDV data and analysed separately.

1.7.1.25 Juveniles of some species were recorded in the raw infaunal data including species such as *Aphroditidae*, *Liocarcinus*, *Solecurtidae* and *Mytilidae*. Juveniles were however excluded from the multivariate analysis as they represented a very minor fraction of the infaunal taxon and abundance.

1.7.1.26 All fish species were removed prior to analysis and discussed separately and within volume 2, chapter 8: Fish and shellfish technical report of the PEIR.

1.7.1.27 Colonial/encrusting taxa within the grab samples, which were recorded only as present, were combined with the DDV data and given an abundance of 1 or 0 respectively to enable them to be included in a separate multivariate analysis. The combined DDV and grab epifaunal dataset was square root transformed.

1.7.1.28 The epifaunal data that were recorded as present/absent, and therefore removed from the infaunal grab data analysis, were combined with the epifaunal data from the DDV.

Univariate analysis

1.7.1.29 The untransformed benthic infaunal data, and combined DDV and grab epifaunal data were summarised to highlight the number of individuals and number of taxa recorded. Analysis was also undertaken to identify the percentage composition of the major taxonomic groups within each sample station, the percentage contribution of each taxonomic group to the total number of taxa and to the total number of individuals.

1.7.1.30 A number of univariate indices were calculated to further describe the untransformed infaunal and epifaunal data, including: S = number of species; N = abundance; B = Biomass (ash free dry mass); d = Margalef's index of Richness; J' = Pielou's Evenness index; H' = Shannon-Wiener Diversity index; λ = Simpson's index of Dominance for each identified biotope.

Multivariate community analysis

1.7.1.31 The benthic infaunal grab data and combined DDV and grab epifaunal data were analysed using the PRIMER v6 software (Clarke and Gorley, 2006). As outlined in section 1.2, the multivariate community analysis, presented in this technical report, has been undertaken on the combined dataset collected within both the Morgan and Mona Array Areas with the data collected for the Mona Offshore Wind Project used to provide additional context for the data within the Morgan Array Area.

1.7.1.32 To determine the relative similarities between stations, the benthic infaunal and epifaunal community structure were investigated using CLUSTER analysis (hierarchical agglomerative clustering). Separate multivariate analyses were undertaken on the infaunal and epifaunal datasets however the same methodology was used. This used the Bray Curtis similarity coefficient to assess the similarity of sites based on the faunal components. The procedure produces a dendrogram indicating the relationships between sites based on the similarity matrix and uses a Similarity Profile (SIMPROF) test (at a 5% significance level) to test whether the differences between the clusters are significant.

1.7.1.33 Similarity Percentages (SIMPER) analyses were subsequently undertaken on the infaunal and two epifaunal datasets to identify which species best explained the similarity within groups and the dissimilarity between groups identified in the cluster analysis. The similarity matrix was also used to produce a multi-dimensional scaling (MDS) ordination plot to show, on a two or three-dimensional representation, the relatedness of the communities (at each site) to one another. Full methods for the application of both the hierarchical clustering and the MDS analysis are given in Clarke and Warwick (2001).

Biotope allocation

1.7.1.34 The results of the cluster analyses and associated SIMPER outputs were reviewed alongside the raw, untransformed data to assign preliminary biotopes (Connor et al., 2004). Using the clusters identified, several sites within a cluster and, where appropriate several clusters, were assigned to a single biotope, where possible, based on relatedness and presence/absence of key indicator species for a particular biotope. The infaunal and epifaunal biotopes were plotted out over the results of the geophysical surveys for the Morgan subtidal ecology study area to map the area and extent of each habitat across sediment types/features and presented in the biotope map. The infaunal and epifaunal biotope allocations were combined to provide a combined biotope map.

Habitat analyses

Seapens and burrowing megafauna communities' assessment

1.7.1.35 The seapens and burrowing megafauna habitat is described by OSPAR as 'Plains of fine mud, at water depths ranging from 15-200m or more, which are heavily bioturbated by burrowing megafauna with burrows and mounds typically forming a prominent feature of the sediment surface. The habitat may include conspicuous populations of seapens, typically *Virgularia mirabilis* and *Pennatula phosphorea*'.

1.7.1.36 Guidance by the JNCC (2014b) clarifies how to identify this habitat and suggests that burrowed areas of mud should be deemed to be a 'sea pen and burrowing megafauna communities' habitat regardless of the presence of sea pens if multiple sightings of burrows and/or mounds attributable to the relevant species are observed. Habitats can be classed as 'sea pen and burrowing megafauna communities' regardless of the grain size composition of the sediment (JNCC, 2014b).

1.7.1.37 The clarifications (JNCC, 2014b) advocate utilising seabed video imagery and/or photographs to confirm the presence of burrows or mounds and sea pens, where present. The density classifications as laid out by the Marine Nature Conservation Review (MNCR) SACFOR (Super abundant, Abundant, Common, Frequent, Occasional, Rare) scale (JNCC, 2013) were used to quantify these defining features. The overall density of burrows was assessed in order to consider whether their density was a 'prominent' feature of the sediment surface and potentially indicative of a sub-surface complex gallery burrow system.

1.7.1.38 The overall or average burrow densities were calculated for each target using the total area covered by the seabed imagery (average image swathe width x camera transect length). In total, analysis was conducted of 9,320 fixes. It should be noted that there was no attempt to ascertain species due to the inherent complexities of detail needed (ICES, 2011) which is not available with the data acquired. As such and in line with the JNCC report (JNCC, 2013) recommendations, a degree of caution should be applied to these density results as they aren't necessarily definitive of the habitats condition.

Annex I reef assessment

1.7.1.39 A multi-criteria scoring system was used to assess the characteristics of areas of potential stony reef. Each characteristic was scored as low, medium or high; with spatial extent (m^2), substratum composition (% cover) and elevation (m) as the primary characteristics, as defined by Irving (2009); see Table 1.5.

Table 1.5: Stony/Bedrock reef criteria.

Characteristics	Resemblance to 'Stony Reef'			
	NOT a 'Stony Reef'	Low	Medium	High
Composition	<10% cobbles/boulders	10 - <40% cobbles/boulders	40-<95% cobbles/boulders	≥95% cobbles/boulders
		Matrix supported: dominated by sediment	Clast supported: dominated by cobbles/boulders	Clast supported: dominated by cobbles/boulders
Elevation	Flat seabed	<0.064mm	0.064-<5m	≥5m
Extent	≤25m2	>25m2	>25m2	>25m2
Biota	Dominated by infaunal species			>80% of species present composed of epifaunal species

1.7.1.40 The patchiness of potential reef sites was also considered including aspects such as average percentage cover; and the presence or absence of key biota. This approach is similar to that developed by Jenkins *et al*. (2018), which is considered in line with JNCC (2020) recommendations as part of assessing the composition stony reefs in Table 1.5.

1.7.1.41 The more recent guidance by Golding *et al*. (2020) on refining the criteria for defining areas with a 'low resemblance' to Annex I stony reef were also considered in the analysis.

1.7.2 Results – sediment analysis

Results – physical sediment characteristics

Morgan benthic subtidal ecology study area

1.7.2.1 The subtidal benthic sediments across the Morgan Array Area with the Morgan benthic subtidal ecology study area were classified into sediment types according to the Folk classification. Sediments ranged from gravelly sand to muddy sandy gravel, with 40% of the samples classified as gravelly muddy sand (Figure 1.6). Of the samples, 31% were classified as gravelly sand and 20% were classified as sand, representing the three most common sediment types through-out the Morgan Array Area. With increasing distance offshore the sediments graded into gravelly muddy sand in the west of the Morgan Array Area. According to the simplified Folk Classification (Long, 2006), most stations were classified as mixed or coarse sediments with areas of mixed sediment and sand and muddy sand sediment.

1.7.2.2 The percentage sediment composition (i.e. mud ≤0.63mm; sand <2mm; gravel ≥2mm) at each grab sample station in the Morgan Array Area is presented in Figure 1.7 and Appendix A. Across all sample stations in the Morgan Array Area, the average percentage sediment composition was 14.90% gravel, 77.26% sand and 7.84% mud. Across the Morgan Array Area sand made up the highest proportion of the sediment composition. The sediment composition also showed a higher percentage of gravels within the central and west section of the Morgan Array Area in comparison to the east section of the Morgan Array Area. The sample stations with the highest percentage composition of mud were generally found along the central and west section of the Morgan Array Area (Figure 1.7).

1.7.2.3 Sediments across the Morgan Array Area were typically very poorly sorted (49% of samples) or poorly sorted (37% of samples), a small area (8.57%) of samples were classified as moderately sorted. Two sample stations (ENV26 and ENV30) were moderately well sorted, this station was classified as sand with 0.08% gravel, 99.92% sand and 0.00% mud, and 0.23% gravel, 99.77% sand and 0.00% mud respectively (Figure 1.7 and Appendix A).

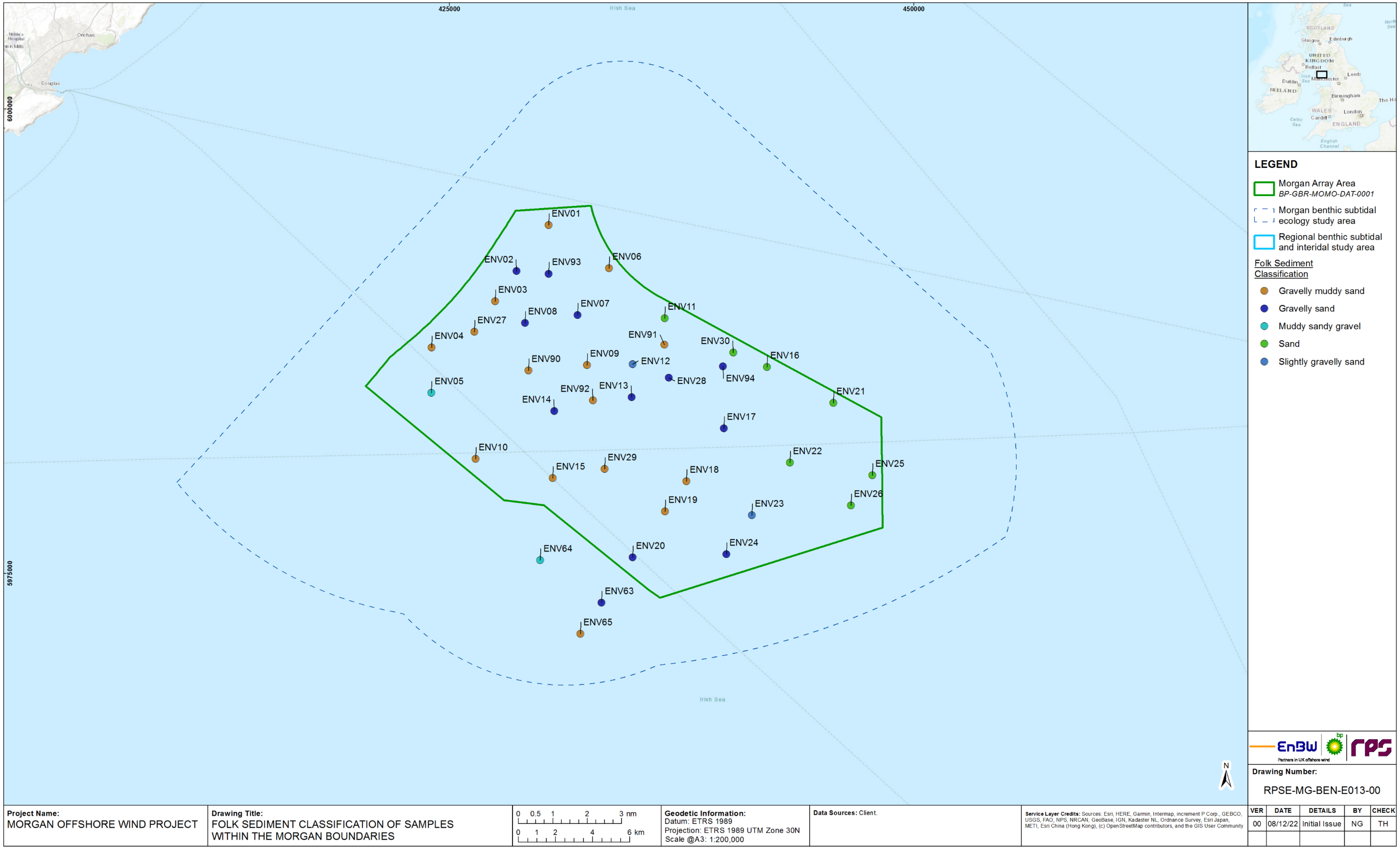
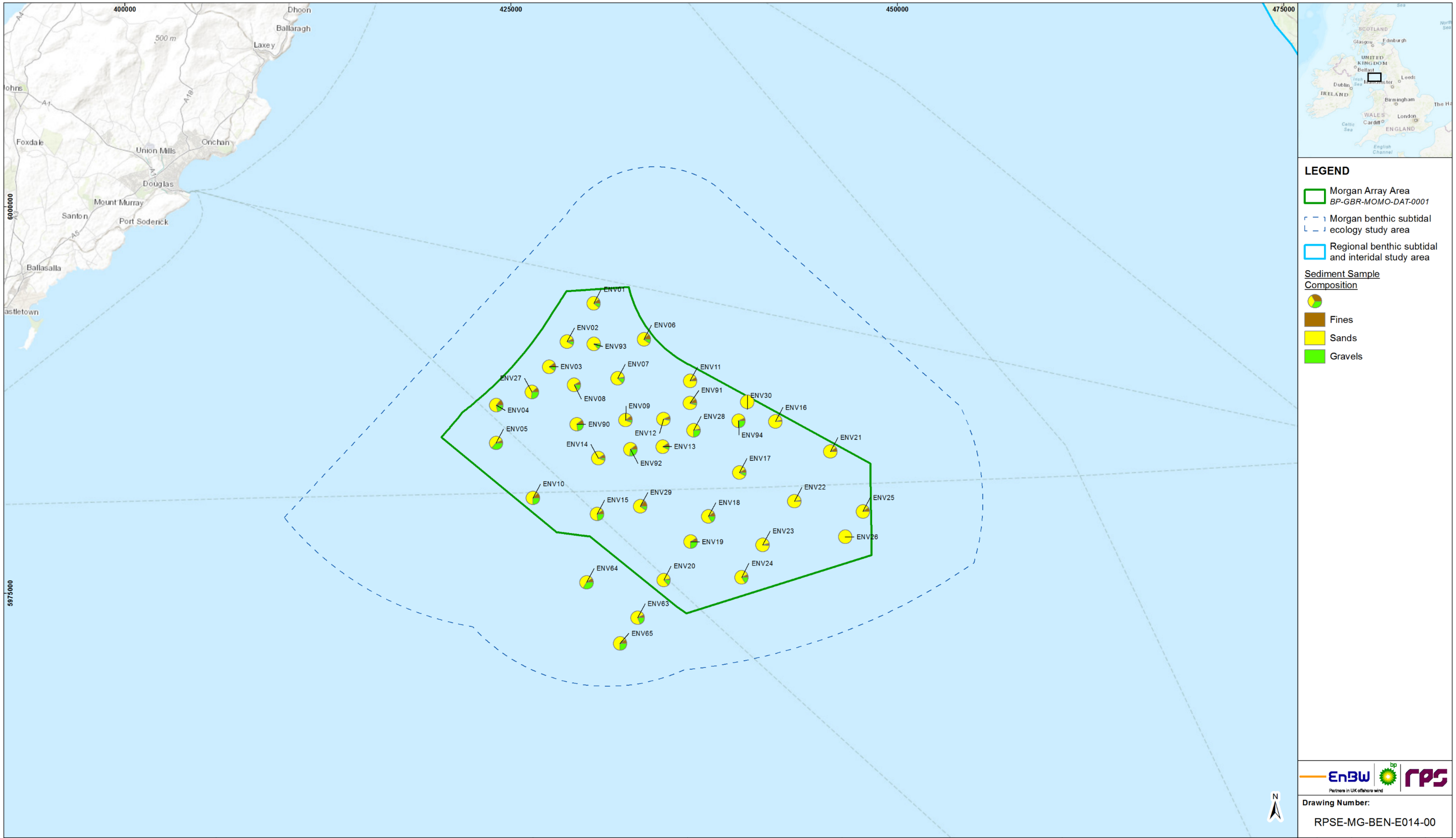


Figure 1.6: Folk sediment classifications for each benthic grab sample (from 2021 subtidal survey).



Project Name:	Drawing Title:	Scale	Geodetic Information:	Data Sources:	Service Layer Credits:
MORGAN OFFSHORE WIND PROJECT	SEDIMENT COMPOSITION OF SAMPLES WITHIN THE MORGAN BOUNDARIES	0 0.5 1 2 3 4 nm; 0 1 2 4 6 8 km	Datum: ETRS 1989; Projection: ETRS 1989 UTM Zone 30N; Scale @A3: 1:250,000	Client.	Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Figure 1.7: Sediment composition (from PSA) at each benthic grab sample location (from 2021 subtidal survey).

Sediment Contamination

1.7.2.4 Table 1.6 presents the levels of metals that were recorded in the sediment samples within the Morgan Array Area. Where contaminants exceeded the Cefas ALs their cells have been highlighted with the corresponding colour. Where contaminant levels exceed the Canadian TEL the contaminant level has been marked with an asterisk (*).

1.7.2.5 In summary, no contaminants were found to exceed Cefas AL1 or AL2. Arsenic levels at 8 sample stations in the Morgan Array Area marginally exceeded Canadian TEL (Table 1.6).

Metals

1.7.2.6 Heavy metals are readily adsorbed by sediments which can lead to metals accumulating to concentrations far higher than the surrounding environment. These sediments can become re-suspended through bioturbation or through physical processes/disturbances. Metals will tend to accumulate in these fine-grained sediments and can become bioavailable to marine organisms through ingestion. The uptake of heavy metals by marine organisms can lead to bioaccumulation through trophic levels leading to apex organisms accumulating metals to adverse and toxic levels. This could result in significant adverse effects including mortality, impaired reproduction, reduced growth, alterations in metabolism as a result of oxidative stress and disruption to the food chain.

1.7.2.7 The sediment chemistry results, presented in Table 1.6, showed that the majority of the metal contaminants did not exceed the Canadian TEL, with the exception of arsenic at all but one station which marginally exceeded the Canadian TEL. Metal concentrations within the sediment across the Morgan benthic subtidal ecology study area were all well below the Canadian PEL, Cefas AL1 and AL2.

Table 1.6: Concentrations of metals recorded in sediments within the Morgan benthic subtidal ecology study area.

Description (metals)	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
Units	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
Detection Limit	1	0.1	0.5	2	2	0.01	0.5	3
Cefas AL1 (mg/kg)	20	0.4	40	40	50	0.3	20	130
Cefas Al2 (mg/kg)	100	5	400	400	500	3	200	800
Canadian TEL (mg/kg)	7.2	0.7	52.3	18.7	30.2	0.13	15.9	124
Canadian PEL (mg/kg)	41.6	4.2	160	108	112	0.7	-	271
Sample no.								
Morgan benthic subtidal ecology study area								
ENV05	11.4*	0.10	17.3	7.3	10.9	0.05	14.1	29.5
ENV06	14.1*	0.06	10.0	5.9	14.5	0.05	8.6	28.7
ENV12	12.5*	0.04	7.9	4.7	10.4	0.05	6.8	18.5
ENV13	11.8*	0.05	8.2	5.0	11.1	0.04	7.3	21.5
ENV14	8.4*	0.05	8.3	4.9	10.1	0.04	7.6	21.0
ENV17	18.0*	0.07	10.5	5.4	14.4	0.05	9.1	28.7
ENV20	18.7*	0.10	10.4	5.2	9.0	0.06	10.9	21.2
ENV21	5.3	0.04	7.4	4.3	8.1	0.06	5.3	21.0
ENV29	13.3*	0.08	10.9	5.7	15.3	0.06	9.5	25.6

Polychlorinated biphenyls (PCBs)

1.7.2.8 PCBs are toxic to fish and other aquatic organisms. Reproductive and developmental problems have been observed in fish at low PCB concentrations, with the early life stages being most susceptible. There is growing evidence linking PCBs and similar compounds with reproductive and immuno-toxic effects in wildlife, including effects on seals and other marine mammals. Due to their persistence and lipophilic nature, PCBs have the potential to bioaccumulate, particularly in lipid rich tissue such as fish liver. Bioaccumulation of PCBs is recorded in fish, birds and marine mammals with known sublethal toxicological effects. Accumulation of PCBs in sediments poses a potential hazard to sediment-dwelling organisms.

1.7.2.9 Levels of PCBs, for all samples, were found to be under the respective Cefas ALs. All samples were also below the limit of detection except sample station ENV05 where PCB levels were detectable but below both Cefas ALs and Canadian TEL/PEL (Appendix G).

Polycyclic aromatic hydrocarbons (PAHs)

1.7.2.10 PAHs enter the environment through a number of sources, these include road run-off, sewage, atmospheric circulation and from historical industrial discharge. Once in the environment, PAHs exert a strong affinity for organic carbon and as such organic sediment in rivers can act as a substantial sink. Due to the high affinity for organic carbon, once ingested by fauna the PAHs cause oxidative stress and lead to adverse effects in the organism. Most species have a limited ability to metabolise PAHs and as a result can bioaccumulate to toxic levels.

1.7.2.11 Across all PAHs, levels were consistently very low (mostly just above the limit of detection) across all samples. Concentrations of PAHs in all samples were found to be below Cefas AL1 and the CSQGs (Appendix G).

1.7.3 Results – infaunal analysis

Summary statistics

1.7.3.1 A total of 589 taxa were recorded during the site-specific surveys. Of these, 155 taxa were colonial or taxa whose abundance could not be enumerated, and therefore were recorded as present. These taxa were removed from the infaunal numerical and statistical analysis but were included in the epifaunal numerical analysis (section 1.7.4). A total of 17,887 individuals representing 431 enumerated taxa were recorded during the site-specific surveys. Of these, juveniles accounted for 325 individuals from 12 taxa representing 1.82% of the total number of individuals and 2.78% of the total number of taxa recorded. Two of the recorded taxa were bony fish species (true gobies *Gobiidae* and ray finned fish *Actinopterygii*) and represented eight individuals. As fish are highly mobile species, they were removed from the statistical analysis but are discussed in volume 4, annex 8.1: Fish and shellfish technical report of the PEIR.

1.7.3.2 Of the 431 total taxa enumerated from the site-specific survey data, none were observed at all stations. A total of 55 taxa (12.76%) were recorded as single individuals; these rarely recorded taxa were distributed across the Morgan benthic subtidal ecology study area. A total of 226 taxa (52.44%) were represented by <10 individuals. It is generally accepted that ecological communities which are frequently subjected to local disturbance or contamination events will be dominated by a limited number of tolerant taxa, which will be represented in high individual abundances (Clarke and Warwick, 2006). The relatively high numbers of single and low abundance species recorded in this survey could suggest a reasonably diverse community that has been subjected to relatively limited disturbance or contamination.

1.7.3.3 Juveniles were recorded from stations across the Morgan Array Area from taxa including Mollusca, Echinodermata, Crustacea and Annelida. The five most abundant juvenile taxa were within the Mollusca (*Lutraria oblonga* juveniles and *Mytilidae* juveniles) and Echinodermata (*Echinidea* juveniles, *Ophiuroidea* juveniles and *Dendrochirotida* juveniles). Juveniles of these five taxa made up 84% of the total number of juvenile individuals.

1.7.3.4 Sample station ENV84 (in the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area) was the only sample station that recorded all five of the highest abundance juvenile taxa. Sample station ENV54 recorded the highest numbers of juvenile individuals (16; mainly *Ophiuroidea* and *Echinidea*) as well as the highest number of juvenile taxa (7). In addition to juvenile taxa, Decapoda megalopa and zoea were recorded. Decapoda megalopa was recorded at the majority of sample stations and zoea were recorded at sample stations ENV03 and ENV64, however all juveniles were excluded from further analysis as they represent a very small proportion of the overall enumerated taxa.

1.7.3.5 As discussed in paragraph 1.7.3.1, 155 taxa were recorded only as present; these taxa were dominated by Annelida, Crustacea and Bryozoa. Of these taxa, Nematoda were present across the greatest number of sample stations. ENV38 (in the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area) recorded the highest number of colonial/encrusting taxa.

1.7.3.6 Initially the dataset was divided into the five major taxonomic groups: Annelida (Polychaeta), Crustacea, Mollusca, Echinodermata and 'Others'. The 'Other' group comprised of:

- Seven taxa of Cnidaria (Cnidaria, Actiniaria, *Edwardsiidae, Edwardsiaclaparedii, Adamsia palliata, Pennatula phosphorea* and *Cerianthus lloydii*)
- Three taxa of Chordata (*Ascidiacea, Dendrodoa grossularia* and *Polycarpa fibrosa*)
- Three taxa of Sipuncula (Sipuncula, *Golfingiidae, Golfingia (Golfingia) elongata* and *Phascolion (Phascolion) strombus strombus*)
- One taxa of Foraminifera (*Astrorhiza*)
- One taxa of Hemichordata (*Enteropneusta*)
- One taxa of Phronida (*Phoronis*)
- One taxa of Platyhelminthes (*Platyhelminthes*)
- One taxa of Nemertea (*Nemertea*).

1.7.3.7 The absolute and proportional contributions of these five taxonomic groups to the overall community structure is summarised in Table 1.7 whilst biomass values by gross taxonomic groups are presented in Appendix D.

Table 1.7: Contribution of gross taxonomic groups recorded in the infaunal grab samples.

Group	Individual Abundance	Proportional Contribution	Taxa Abundance	Proportional Contribution
Annelida	10,649	59.53	198	45.94
Crustacea	3,323	18.58	110	25.52
Mollusca	1,532	8.56	78	18.10
Echinodermata	662	3.70	26	6.03
Other	1,721	9.62	19	4.41
Total	**17,7887**	**100.00**	**431**	**100.00**

1.7.3.8 the faunal communities were generally dominated by Annelida (n=10,649) and Crustacea (n=3,323) which contributed 59.53% and 18.58% of the total number of individuals respectively. Number of taxa were also dominated by Annelida which contributed 45.94% of the total number of taxa. At individual sample stations, gross taxonomic group proportions reflected these results, with Annelida making up the highest proportion of the taxa at all sample stations. Annelida made up the highest proportion of individuals at all but two sample stations (ENV17 and ENV67A) with proportion ranging from 36.96 - 86.76% of the total individuals. At sample stations ENV17 and ENV67A Crustacea made up the highest proportion of individuals, accounting for 54.06% and 48.67% of the total individuals respectively.

1.7.3.9 The biomass data reflected the dominance of Annelida with respect to the number of individuals and number of taxa, with Annelida providing the highest proportion of the biomass at 37.35% of sample stations. Crustacea contributed the second highest proportion of biomass at the greatest number of sample stations (n=30, 36.14%). Echinodermata contributed the highest proportion of the biomass (95.52%) at the sample station with the highest total biomass (ENV59). This is due to Echinodermata being able to grow to a larger body size than most Annelida therefore are likely to have a higher weight per individual. At the highest biomass station purple heart urchins (e.g. *S. purpureus*) made up the highest proportion of the biomass. The next three highest biomass sample stations (ENV14, ENV03 and ENV82) were all dominated by Mollusca which are also able to grow to large body sizes, these stations were dominated by a variety of bivalves (e.g. *Laevicardium crissum*, *Ensis magnus* and *Dosinia lupinus*).

1.7.3.10 The most abundant individuals generally belonged to Annelida with the polychaete *Scalibregma inflatum* being overall the most abundant species with a total of 896 individuals recorded. These individuals were distributed throughout the Morgan Array Area with no one sample station skewing the abundance. The highest abundance of *S. inflatum* occurred at sample station ENV84 in the southeast of the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area (i.e. within the Mona Array Area).

1.7.3.11 The species with the second highest abundance was the polychaete *Ampharete lindstroemi* with 704 individuals. These individuals were distributed throughout the Morgan Array Area with no one sample station skewing the abundance. The highest abundance of *A. lindstroemi* occurred at sample station ENV34 in the area surveyed to the south of the Morgan Array Area (i.e. southeast Mona Array Area). Sample station ENV34 recorded the highest total number of individuals (479) across only 85 taxa. Sample station ENV56 recorded the highest number of taxa (123) with the next highest being sample stations ENV86 (113 taxa) and ENV54 (107 taxa), all of which were located in the area surveyed to the south of the Morgan Array Area, corresponding to the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area (i.e. within the Mona Array Area).

Multivariate community analysis

1.7.3.12 The results of the cluster analyses, SIMPROF tests and SIMPER analyses were used, together with the raw untransformed infaunal data, to assign preliminary infaunal biotopes to each sample station. In several instances, clusters that were identified as significantly different from each other in the SIMPROF tests were assigned the same biotope code. This was based on a review of the SIMPER results which indicated that the differences between the groups could be explained by differences in abundances of characterising species rather than the presence/absence of key species.

1.7.3.13 The results of the hierarchical clusters analysis of the square root transformed infaunal dataset (excluding juveniles) together with the SIMPROF test identified 25 faunal groups that were statistically dissimilar, based on the SIMPROF test. Of these faunal groups, eight were represented by a single sample station (Figure 1.8). The 2D MDS plot is presented in Figure 1.9 and the low stress value (0.16) indicates that this is a good representation of the data. The 3D MDS plot has not been presented as the 2D MDS plot presents a clearer representation of the data. Faunal group B exhibited the greatest distance between itself and all the other faunal groups with too few samples to generate a Bray-Curtis similarity value. The other single sample faunal groups include D (ENV50), E (ENV92) G (ENV82), H (ENV68), M (ENV32), O (ENV53), and U (ENV09). Faunal group A (SIMPROF a) showed the lowest Bray-Curtis similarity of 23.75%, while faunal group J (SIMPROF j) showed the highest Bray-Curtis similarity (58.04%) of all Faunal groups that contained more than one sample station. Faunal groups J and K showed the lowest Bray-Curtis dissimilarity (50.16%). Faunal groups J and R (SIMPROF J and R) also showed a higher similarity with each other than with the other Faunal groups with Bray-Curtis dissimilarity of 50.65%. Faunal groups R and Q (SIMPROF R and Q) also showed a higher similarity with each other than with the other Faunal groups, with Bray-Curtis dissimilarity of 50.34%.

1.7.3.14 Samples within the south and west of the Morgan Array Area within the Morgan benthic subtidal ecology study area clustered together in Faunal groups L and T. The mixed sediments associated with these groups were characterised by a variety of polychaetes as well as a small number of bivalves. Samples within Faunal groups L and T were assigned the polychaete-rich deep *Venus* community in offshore mixed sediments (SS.SMx.OMx.PoVen) biotope (Figure 1.10).

1.7.3.15 In the centre of the Morgan Array Area, samples within the Faunal groups A, C and I were associated with coarse sediments and varied infaunal communities characterised by bivalves, polychaetes and echinoderms including species such as *Echinocyamus pusillus* and *Scoloplos armiger* (Table 1.8). Samples within these Faunal groups were assigned the circalittoral coarse sediment (SS.SCS.CCS) biotope. The SS.SCS.CCS biotope was recorded in samples across a large central section of the Morgan Array Area as well as in smaller sections further north where the mixed sediment SS.SMx.OMx.PoVen habitat is interspersed by coarse sediments and specific features which have also been designated as SS.SCS.CCS (Figure 1.10). In the middle of the Morgan Array Area, Faunal group D occupies a specific geophysical feature which is composed of mixed sediments and characterised by a variety of bivalves and polychaetes such as *Leptochiton asellus* as well as Nemertea. As a result Faunal group D and the geophysical feature associated with it were assigned the SS.SMx.OMx biotope. The central section of the Morgan Array Area is transitional, demonstrating the change in sediments across the Morgan Array Area with sediments becoming finer moving from west to east (Figure 1.10).

1.7.3.16 The sediments along north boundary and east side of the Morgan Array Area were characterised by samples in Faunal groups E, V, X and Y. The sediments in this section of the Morgan Array Area were characterised by sand and muddy sands. The communities in these faunal groups were also composed of polychaetes and bivalves but included species which are adapted to sandy habitats such as SS.SMu.CSaMu.LkorPpel. Based on the distinct nature of the faunal community and the sediment type these Faunal groups were allocated the SS.SMu.CSaMu.LkorPpel biotope. The SS.SMu.CSaMu.LkorPpel biotope in the east section of the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area (i.e. within the Mona Array Area) is interspersed with small areas of coarse sediments characterised by the SS.SCS.CCS biotope (Figure 1.10). This further demonstrates the transitional nature of the Morgan Array Area, which is characterised by similar but distinct communities dominated by polychaetes and bivalves.

1.7.3.17 The sediments and infaunal communities within the samples collected in wider regional benthic subtidal ecology study area to the south of the Morgan Array Area (i.e. within the Mona Array Area) were largely homogenous. The samples from the north, central and the boundary in the south of the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area (i.e. within the Mona Array Area) were associated with the Faunal groups D, J, M, N, O, P, R and S all of which were characterised predominantly as mixed sediment (Figure 1.6). These faunal groups were characterised of a variety of taxa, but all were dominated by polychaetes such as *Glycera lapidum*, *Aonides paucibranchiata* and *Laonice bahusiensis*. All samples within these groups were allocated the SS.SMx.OMx.PoVen biotope which covers the majority of the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area (i.e. within the Mona Array Area) (Figure 1.10).

1.7.3.18 Sediments in samples collected in the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area (i.e. within the Mona Array Area) clustered in Faunal group C and were characterised by coarse sediments and taxa such as polychaetes and bivalves. Samples in this area were allocated the SS.SCS.CCS biotope, which was mapped as a band extending from east to west wider regional benthic subtidal ecology study area to the south of the Morgan Array Area (i.e. within the Mona Array Area), broadening in the east (Figure 1.10). In the southeast of the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area (i.e. within the Mona Array Area), a few Faunal groups were associated with specific, localised, geophysical features with distinct sediment types and faunal communities. The sample stations in Faunal group K were associated with sediment waveforms and mega ripples, and predominantly mixed sediments. The faunal community in Faunal group K was characterised by the bivalve *Kurtiella bidentata* as well as polychaetes such as *S. inflatum*, *L. koreni* and *Polycirrus*. This combination of factors led to the allocation of the *Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment (SS.SMx.CMx.KurThyMx) biotope to a small section in the southeast of the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area (i.e. within the Mona Array Area). Whilst some other key species which characterise this biotope were missing (e.g. *Thyasira* sp.), this biotope was considered to be the best fit and possibly representing a transition community.

1.7.3.19 Samples clustered within Faunal group W were also associated with sediments sampled to the south of the Morgan Array Area (i.e. within the Mona Array Area)and were characterised by mixed sediments and diverse communities with no distinguishable characteristic species associated with any other biotopes identified. The infaunal community was dominated by polychaetes, bivalves and echinoderm such as *L. koreni* and *E. pusillus*. As a result faunal group W was allocated the SS.SMx.CMx biotope.

1.7.3.20 The Faunal groups identified in the SIMPER analysis were used together with the raw data to assign six preliminary biotopes (Table 1.8;Figure 1.10). Although *S. spinulosa* was recorded in samples in Faunal group P (not in the top 50% of abundant species), no aggregations qualifying as a reef forming structure were recorded in any of the areas surveyed, including within the Morgan Array Area. The full Annex I reef assessment is presented in Appendix B. The full SIMPER analysis results are presented in Appendix C and Appendix D.

Table 1.8: Simprof groups and biotope classifications for the infaunal dataset.

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
A	ENV22	40 - 45	Sand and muddy sand	*Abra, Scoloplos armiger, Spio, Bivalvia, Echinocyamus pusillus*	SS.SCS.CCS	Faunal group A showed the highest Bray Curtis dissimilarity with Faunal group F (91.47%) due to the presence of 27 species out of a possible 101 species, including characteristic species *Abra* and *S. armiger* which were not present in Faunal group F.
	ENV28		Coarse sediment			
B	ENV07	42	Coarse sediment	*Grania, Syllis, Goniadidae*	SS.SCS.CCS	
C	ENV43	38 - 48	Coarse sediment	*Pisione remota, Hesionura elongata, Polygordius, Aonides paucibranchiata, Grania, Nemertea*	SS.SCS.CCS	It was distinct from the other Faunal groups due to the presence and abundance of these characterising species as well as the absence of Nemertea and Polygordius which distinguished it from Faunal group B. Faunal group C showed the lowest Bray-Curtis dissimilarity with Faunal group D (76.89%).
	ENV44		Coarse sediment			
	ENV57		Coarse sediment			
	ENV66		Coarse sediment			
	ENV67A		Sand and muddy sand			
	ENV70		Coarse sediment			
	ENV83		Sand and muddy sand			
	ENV89		Coarse sediment			
	ENV93		Coarse sediment			
	ENV96		Coarse sediment			
D	ENV50	42 - 43	Mixed sediment	*Dialychone, Kurtiella bidentata, Echinocyamus pusillus, Pholoe baltica, Glycera lapidum, Nereididae, Syllis, Syllis armillaris agg., Schistomeringos rudolphi, Lysidice unicornis, Lumbrineris aniara agg., Notomastus, Paraonidae, Paradoneis lyra, Ampharete lindstroemi agg., Hydroides norvegica, Ebalia tumefacta, Leptochiton asellus, Thracia villosiuscula, Leptosynapta, Phoronis, Nemertea, Golfingia (Golfingia) elongata*	SS.SMx.OMx	
E	ENV92	38 - 41	Mixed sediment	*Pholoe inornata, Polynoidae, Oxydromus flexuosus, Lumbrineris aniara agg., Scalibregma inflatum, Dipolydora coeca agg., Caulleriella alata, Polycirrus, Spirobranchus triqueter, Tryphosa nana, Ophiothrix fragilis, Cerianthus lloydii*	SS.SMu.CSaMu.LkorPpel	
F	ENV69	41 - 42	Mixed sediment	*Scalibregma inflatum, Pholoe baltica, Urothoe marina, Paradoneis lyra, Notomastus, Aonides paucibranchiata, Goniadella gracilis, Leptocheirus hirsutimanus, Kurtiella bidentata, Nemertea, Glycera lapidum, Lysilla nivea, Owenia*	SS.SMx.OMx.PoVen	It was distinct from the other Faunal groups due to the presence and abundance of these characterising species as well as the absence of *C. lloydii* and *Tryphosa nana* which distinguished it from Faunal group E. Faunal group F showed the lowest Bray-Curtis dissimilarity with Faunal group E (65.74%).
	ENV84		Mixed sediment			
G	ENV82	36 - 38	Mixed sediment	*Pholoe, Scalibregma inflatum, Ampharete lindstroemi agg., Photis longicaudata, Kurtiella bidentata, Cerianthus lloydii, Mediomastus fragilis, Leiochone, Spiophanes bombyx, Chaetozone zetlandica, Sabellaria spinulosa, Grania*	SS.SMx.CMx	
H	ENV68	43	Sand and muddy sand	*Pholoe baltica, Eteone cf. longa, Scalibregma inflatum, Ampharete lindstroemi agg., Lagis koreni, Urothoe elegans, Abra, Nemertea*	SS.SCS.CCS	
I	ENV12	43 - 44	Sand and muddy sand		SS.SCS.CCS	It was distinct from the other Faunal groups due to the presence and abundance of these characterising species as well as the absence

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ENV13		Coarse sediment	*Lagis koreni, Scalibregma inflatum, Ampharete lindstroemi agg., Owenia, Abra, Echinocyamus pusillus, Nemertea, Spio symphyta, Aoridae, Phoronis, Pholoe baltica*		of *Eteone cf. longa, C. lloydii* and *Mediomastus fragilis* which distinguished it from Faunal group K. Faunal group I showed the lowest Bray-Curtis dissimilarity with Faunal group K (51.56%).
J	ENV33	40 - 46	Mixed sediment	*Ampharete lindstroemi agg., Poecilochaetus serpens, Ampelisca provincialis, Phoronis, Nemertea, Pholoe baltica, Owenia, Scalibregma inflatum, Cerianthus lloydii, Spiophanes bombyx, Chaetozone zetlandica, Photis longicaudata, Cirrophorus branchiatus, Leiochone*	SS.SMx.OMx.PoVen	It was distinct from the other Faunal groups due to the presence and abundance of these characterising species as well as the absence of *A. provincialis* which distinguished it from Faunal group K. Faunal group J showed the lowest Bray-Curtis dissimilarity with Faunal group K (50.16%).
	ENV34		Mixed sediment			
	ENV35		Mixed sediment			
K	ENV40	37 - 41	Mixed sediment	*Ampharete lindstroemi agg., Nemertea, Scalibregma inflatum, Kurtiella bidentata, Lagis koreni, Pholoe baltica, Polycirrus, Eteone cf. longa, Paradoneis lyra, Owenia, Urothoe, Photis longicaudata, Tanaopsis graciloides*	SS.SMx.CMx.KurThyMx	It was distinct from the other Faunal groups due to the presence and abundance of these characterising species as well as the absence of *Ampelisca provincialis* which distinguished it from Faunal group J. Faunal group K showed the lowest Bray-Curtis dissimilarity with Faunal group J (50.16%).
	ENV45		Mixed sediment			
L	ENV01	39 - 51	Mixed sediment	*Poecilochaetus serpens, Nemertea, Urothoe elegans, Scalibregma inflatum, Lysidice unicornis, Lagis koreni, Pholoe baltica, Pholoe inornata, Ampharete lindstroemi agg., Phoronis, Spiophanes bombyx, Chaetozone zetlandica, Ampelisca, Ophelina acuminata, Pista lornensis, Cirrophorus branchiatus, Ampelisca spinipes, Pseudopolydora pulchra, Urothoe*	SS.SMx.OMx.PoVen	It was distinct from the other Faunal groups due to the presence and abundance of these characterising species including species such as *Lagis koreni* and *Phoronis* which distinguished it from Faunal group M. Faunal group L showed the lowest Bray-Curtis dissimilarity with Faunal group R (57.15%).
	ENV04		Mixed sediment			
	ENV05		Mixed sediment			
	ENV10		Mixed sediment			
	ENV14		Coarse sediment			
	ENV15		Mixed sediment			
	ENV19		Mixed sediment			
	ENV27		Mixed sediment			
	ENV59		Coarse sediment			
	ENV63		Coarse sediment			
	ENV64		Mixed sediment			
M	ENV32	47 - 48	Mixed sediment	*Praxillella affinis, Ophelina acuminata, Scalibregma inflatum, Aonides paucibranchiata, Ampharete lindstroemi agg., Urothoe, Urothoe marina, Nemertea, Ampelisca provincialis, Dialychone,*	SS.SMx.OMx.PoVen	
N	ENV39	39 - 46	Mixed sediment	*Scalibregma inflatum, Golfingia (Golfingia) elongata, Unciola planipes, Syllis garciai/mauretanica, Owenia, Echinocyamus pusillus, Phoronis, Nereididae, Ampharete lindstroemi agg., Nemertea, Golfingiidae, Syllis, Lagis koreni, Eteone cf. longa, Eulalia mustela, Mediomastus fragilis, Paraonidae*	SS.SMx.OMx.PoVen	It was distinct from the other Faunal groups due to the presence and abundance of these characterising species including species such as *Golfingia (Golfingia) elongata*, *Pholoe baltica* and *Syllis garciai/mauretanica* which distinguished it from Faunal group O. Faunal group N showed the lowest Bray-Curtis dissimilarity with Faunal group O (56.18%).
	ENV42		Mixed sediment			
O	ENV53	43 - 44	Mixed sediment	*Terebelliformia, Leptocheirus hirsutimanus, Ampharete lindstroemi agg., Aonides paucibranchiata, Glycera lapidum, Mediomastus fragilis, Laonice bahusiensis agg., Unciola planipes, Leptochiton asellus, Nemertea*	SS.SMx.OMx.PoVen	
P	ENV31	40 - 48	Mixed sediment	*Nemertea, Scalibregma inflatum, Aonides paucibranchiata, Ampharete lindstroemi agg., Leptochiton asellus, Dialychone, Pholoe inornata, Golfingiidae, Pholoe baltica, Leiochone, Glycera lapidum, Laonice bahusiensis agg., Goniadella gracilis, Serpulidae, Lysidice unicornis, Eulalia mustela, Notomastus, Jasmineira caudata, Owenia, Paraonidae, Syllis garciai/mauretanica*	SS.SMx.OMx.PoVen	It was distinct from the other Faunal groups due to the presence and abundance of these characterising species as well as the absence of Urothoe which distinguished it from Faunal group R. Faunal group P showed the lowest Bray-Curtis dissimilarity with Faunal group R (51.28%). Faunal group P was allocated a preliminary biotope based on the infaunal data of SS.SMx.OMx.PoVen however there was a lack of venerid bivalves in the top 50% of species in terms of
	ENV36		Mixed sediment			
	ENV37		Mixed sediment			
	ENV41		Mixed sediment			
	ENV47		Mixed sediment			

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ENV97		Mixed sediment			abundance in this group which are typically a key feature of this biotope.
Q	ENV60	41 - 49	Mixed sediment	*Ampharete lindstroemi agg., Nemertea, Leptochiton asellus, Aonides paucibranchiata, Pholoe inornata, Cirrophorus branchiatus, Lysidice unicornis, Phoronis, Ophelina acuminata, Praxillella affinis, Chaetozone zetlandica, Golfingiidae, Pholoe baltica, Euchone pararosea, Eteone cf. longa, Scoloplos armiger, Parexogone hebes, Dipolydora caulleryi agg.*	SS.SMx.OMx.PoVen	
	ENV61		Mixed sediment			
	ENV65		Mixed sediment			
R	ENV38	39 - 47	Mixed sediment	*Scalibregma inflatum, Nemertea, Ampharete lindstroemi agg., Pholoe baltica, Aonides paucibranchiata, Phoronis, Cirrophorus branchiatus, Lysidice unicornis, Leptochiton asellus, Ophelina acuminata, Polycirrus, Ampelisca, Poecilochaetus serpens, Paradoneis ilvana, Chaetozone zetlandica, Urothoe marina, Urothoe, Laonice bahusiensis agg., Dialychone, Lagis koreni, Nototropis vedlomensis, Aricidea (Acmira) cerrutii*	SS.SMx.OMx.PoVen	It was distinct from the other Faunal groups due to the presence and abundance of these characterising species including *Paradoneis ilvana* and *Kurtiella bidentata* which distinguish it from Faunal group Q. Faunal group P showed the lowest Bray-Curtis dissimilarity with Faunal group Q (50.34%). Faunal group R was allocated a preliminary biotope based on the infaunal data of SS.SMx.OMx.PoVen however there was a lack of venerid bivalves in the top 50% of species in terms of abundance in this group which are typically a key feature of this biotope.
	ENV48		Mixed sediment			
	ENV49		Mixed sediment			
	ENV51		Mixed sediment			
	ENV52		Mixed sediment			
	ENV54		Mixed sediment			
	ENV55		Mixed sediment			
	ENV56		Coarse sediment			
	ENV71		Mixed sediment			
	ENV86		Mixed sediment			
	ENV88		Mixed sediment			
S	ENV29	41 - 48	Mixed sediment	*Nemertea, Ampharete lindstroemi agg., Phascolion (Phascolion) strombus strombus, Parexogone hebes, Syllis, Golfingiidae, Poecilochaetus serpens, Cirrophorus branchiatus, Podarkeopsis*	SS.SMx.OMx.PoVen	It was distinct from the other Faunal groups due to the presence and abundance of these characterising species as well as the absence of *Ophiothrix fragilis* and *Spirobranchus triqueter* which distinguished it from Faunal group E. Faunal group S showed the lowest Bray-Curtis dissimilarity with Faunal group Q (58.98%).
	ENV62		Mixed sediment			
	ENV95		Sand and muddy sand			
T	ENV02	39 - 43	Coarse sediment	*Nemertea, Echinocyamus pusillus, Goniadella gracilis, Poecilochaetus serpens, Scalibregma inflatum, Owenia, Pholoe baltica, Polynoidae, Golfingiidae, Kurtiella bidentata, Bivalia, Pholoe inornata, Aonides paucibranchiata, Nereididae*	SS.SMx.OMx.PoVen	It was distinct from the other Faunal groups due to the presence and abundance of these characterising species which distinguished it from Faunal group B. Faunal group T showed the lowest Bray-Curtis dissimilarity with Faunal group I (62.81%).
	ENV03		Mixed sediment			
	ENV06		Mixed sediment			
	ENV08		Coarse sediment			
	ENV17		Coarse sediment			
	ENV20		Coarse sediment			
	ENV24		Coarse sediment			
	ENV90		Mixed sediment			
U	ENV09	43	Mixed sediment	*Lagis koreni, Urothoe marina, Pholoe baltica, Sthenelais limicola, Spionidae, Caulleriella alata, Ampharete lindstroemi agg., Aoridae, Gnathiidae, Bivalvia, Tellimya ferruginosa,*	SS.SMx.OMx	
V	ENV16	34 - 41	Sand and muddy sand	*Spiophanes bombyx, Scoloplos armiger, Lagis koreni, Poecilochaetus serpens, Sthenelais limicola, Amphiuridae, Abra, Bathyporeia elegans*	SS.SMu.CSaMu.LkorPpel	It was distinct from the other Faunal groups due to the presence and abundance of these characterising species as well as the absence of *Scalibregma inflatum*, *Ampharete lindstroemi* aggregations and *Kurtiella bidentata* which distinguished it from Faunal group K. Faunal group V showed the lowest Bray-Curtis dissimilarity with
	ENV21		Sand and muddy sand			

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ENV25		Sand and muddy sand			Faunal group X (71.37%). Faunal group V was allocated a preliminary biotope based on the infaunal data of SS.SMu.CSaMu.LkorPpel. This allocation was largely based on the high abundance of *L. koreni* at these stations as well as its proximity to station Y which is also assigned SS.SMu.CSaMu.LkorPpel.
	ENV26		Sand and muddy sand			
W	ENV18	37 - 38	Mixed sediment	*Lagis koreni, Echinocyamus pusillus, Scalibregma inflatum, Poecilochaetus serpens, Sthenelais limicola, Bivalvia, Paraonidae*	SS.SMx.CMx	It was distinct from the other Faunal groups due to the presence and abundance of these characterising species as well as the absence of *Ampharete lindstroemi* aggregations and Aoridae which distinguish it from Faunal group K. Faunal group W showed the lowest Bray-Curtis dissimilarity with Faunal group K (62.66%). Faunal group W was allocated a preliminary biotope based on the infaunal data of SS.SMx.CMx: circalittoral mixed sediment. This allocation was based on the sediment type and the diverse faunal community which made it difficult to assign a more specific biotope. Additionally this biotope sits at the edge of the Mona Array Area where a change in sediment is likely to occur.
X	ENV91	42 - 51	Mixed sediment	*Poecilochaetus serpens, Scalibregma inflatum, Spiophanes bombyx, Aoridae, Nemertea, Owenia, Scoloplos armiger, Sthenelais limicola, Lagis Koreni*	SS.SMu.CSaMu.LkorPpel	It was distinct from the other Faunal groups due to the presence and abundance of these characterising species as well as the absence of *Ophiothrix fragilis* and *Spirobranchus triqueter* which distinguish it from Faunal group E. Faunal group X showed the lowest Bray-Curtis dissimilarity with Faunal group Y (60.72%). Faunal group X was allocated a preliminary biotope based on the infaunal data of SS.SMu.CSaMu.LkorPpel. This allocation is also based on the prevalence of *L. koreni* as well as other characteristic species as well as its proximity to other faunal groups with similar infaunal communities which resemble SS.SMu.CSaMu.LkorPpel.
	ENV94		Coarse sediment			
Y	ENV11	43 - 50	Sand and muddy sand	*Lagis koreni, Poecilochaetus serpens, Spiophanes bombyx, Pholoe baltica, Scalibregma inflatum*	SS.SMu.CSaMu.LkorPpel	It was distinct from the other Faunal groups due to the presence and abundance of these characterising species as well as the absence of Urothoe and Aoridae which distinguish it from Faunal group K. Faunal group Y showed the lowest Bray-Curtis dissimilarity with Faunal group H (60.07%). Faunal group Y was allocated a preliminary biotope based on the infaunal data of SS.SMu.CSaMu.LkorPpel. This allocation is also based on the prevalence of *L. koreni* as well as other characteristic species as well as its proximity to other faunal groups with similar infaunal communities which resemble SS.SMu.CSaMu.LkorPpel.
	ENV30		Sand and muddy sand			

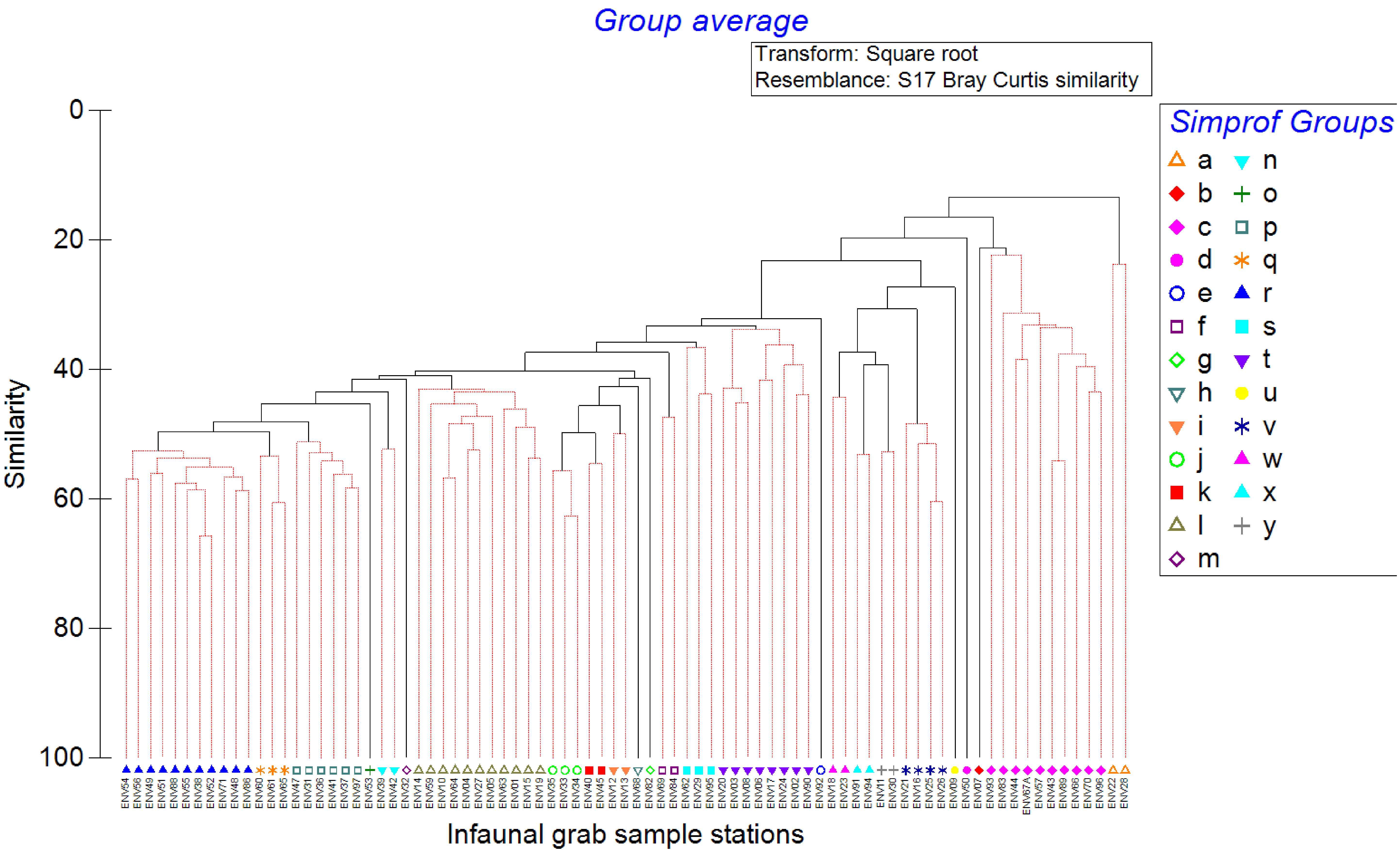

Figure 1.8: Dendrogram of infaunal communities from benthic grab samples.

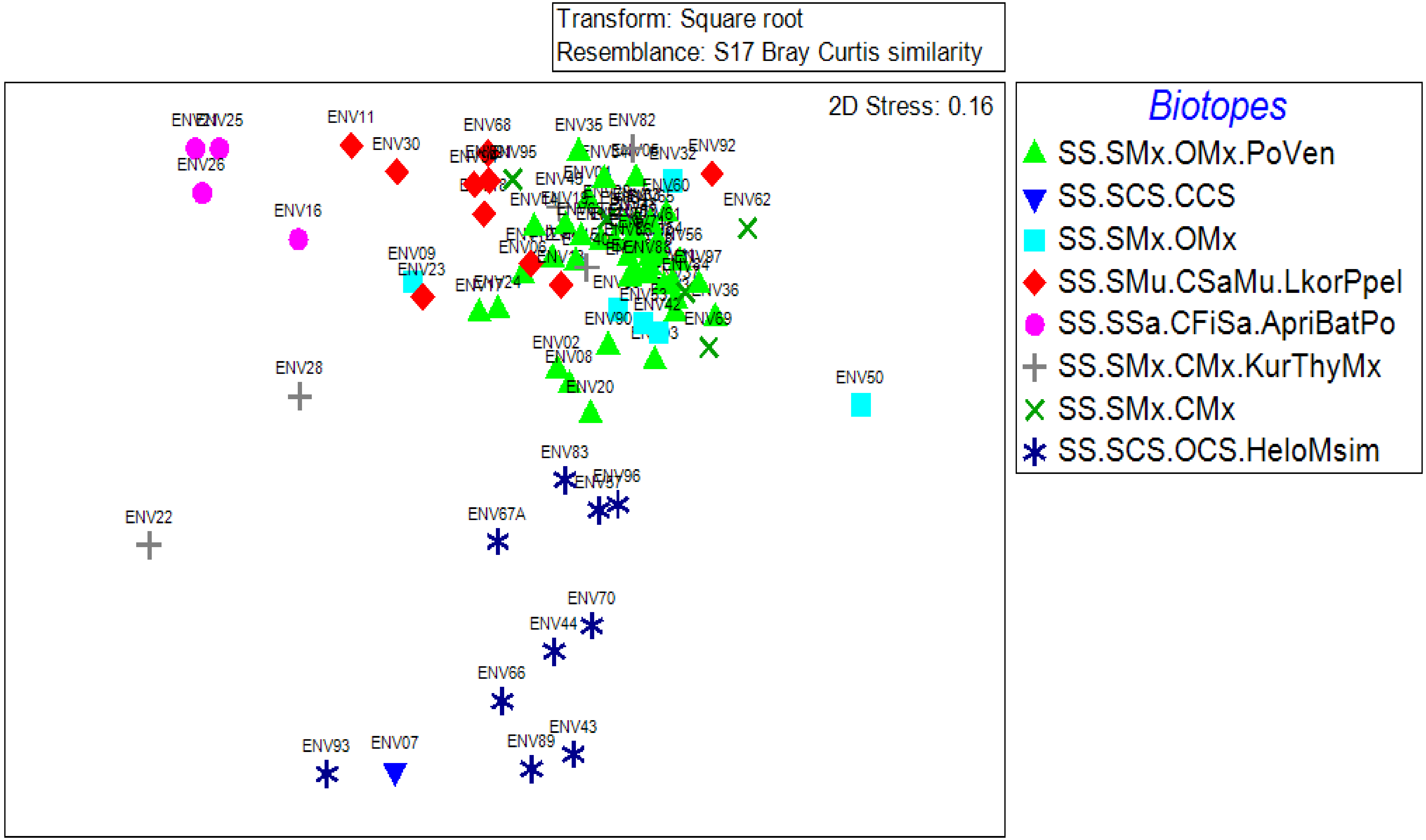

Figure 1.9: 2D MDS plot of infaunal communities from grab samples.

Table 1.9: Summary of infaunal biotopes identified from grab samples.

Preliminary infaunal biotope	Grab sample stations	Water depth range	Sediment classification	Characterising species	Geographic location
SS.SCS.CCS	ENV22, ENV28, ENV07, ENV43, ENV44, ENV57, ENV66, ENV67A, ENV70, ENV83, ENV89, ENV93, ENV96, ENV68, ENV12, ENV13	38 - 48	Sand and muddy sand/Coarse sediment	*Scoloplos armiger, Abra, Echinocyamus pusillus, Hesionura elongata, Nemertea, Owenia, Pholoe*	Central Morgan Array Area Across the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area
SS.SMx.OMx	ENV09	42 - 43	Mixed sediment	*Nemertea, Glycera lapidum, Leptochiton asellus, Syllis,*	Central Morgan Array Area
SS.SMx.CMx	ENV82	36 - 38	Mixed sediment/Sand and muddy sand	*Scalibregma inflatum, Kurtiella bidentata, Mediomastus fragilis, Spiophanes bombyx, Chaetozone*	Across the wider regional benthic subtidal ecology study area to the southeast of the Morgan Array Area
SS.SMu.CSaMu.LkorPpel	ENV92, ENV16, ENV21, ENV25, ENV26, ENV91, ENV94, ENV11, ENV30, ENV23	34 - 51	Mixed sediment/Sand and muddy sand/Coarse sediment	*Spiophanes bombyx, Scalibregma inflatum, Lagis koreni, Abra, Nemertea, Owenia, Pholoe baltica, Pholoe inornata*	North central and west Morgan Array Area
SS.SMx.OMx.PoVen	ENV69, ENV84, ENV33, ENV34, ENV35, ENV01, ENV04, ENV05, ENV10, ENV14, ENV15, ENV18, ENV19, ENV27, ENV59, ENV63, ENV64, ENV32, ENV39, ENV42, ENV53, ENV31, ENV36, ENV37, ENV41, ENV47, ENV97, ENV60, ENV61, ENV65, ENV38, ENV48, ENV49, ENV50, ENV51, ENV52, ENV54, ENV55, ENV56, ENV71, ENV86, ENV88, ENV29, ENV62, ENV95, ENV02, ENV03, ENV06, ENV08, ENv17, ENV20, ENV24, ENV90	39 - 51	Mixed sediment/Coarse sediment/Sand and muddy sand	*Scalibregma inflatum, Aonides paucibranchiata, Glycera lapidum, Mediomastus fragilis, Laonice bahusiensis, Ampharete lindstroemi, Pholoe, Ampelisca, Nemertea, Unciola planipes, Echinocyamus pusillus, Pholoe inornata*	West and south-central Morgan Array Area Across the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area
SS.SMx.CMx.KurThyMx	ENV40, ENV45	37 - 41	Mixed sediment	*Nemertea, Scalibregma inflatum, Pholoe and Owenia*	Across the wider regional benthic subtidal ecology study area to the southeast of the Morgan Array Area

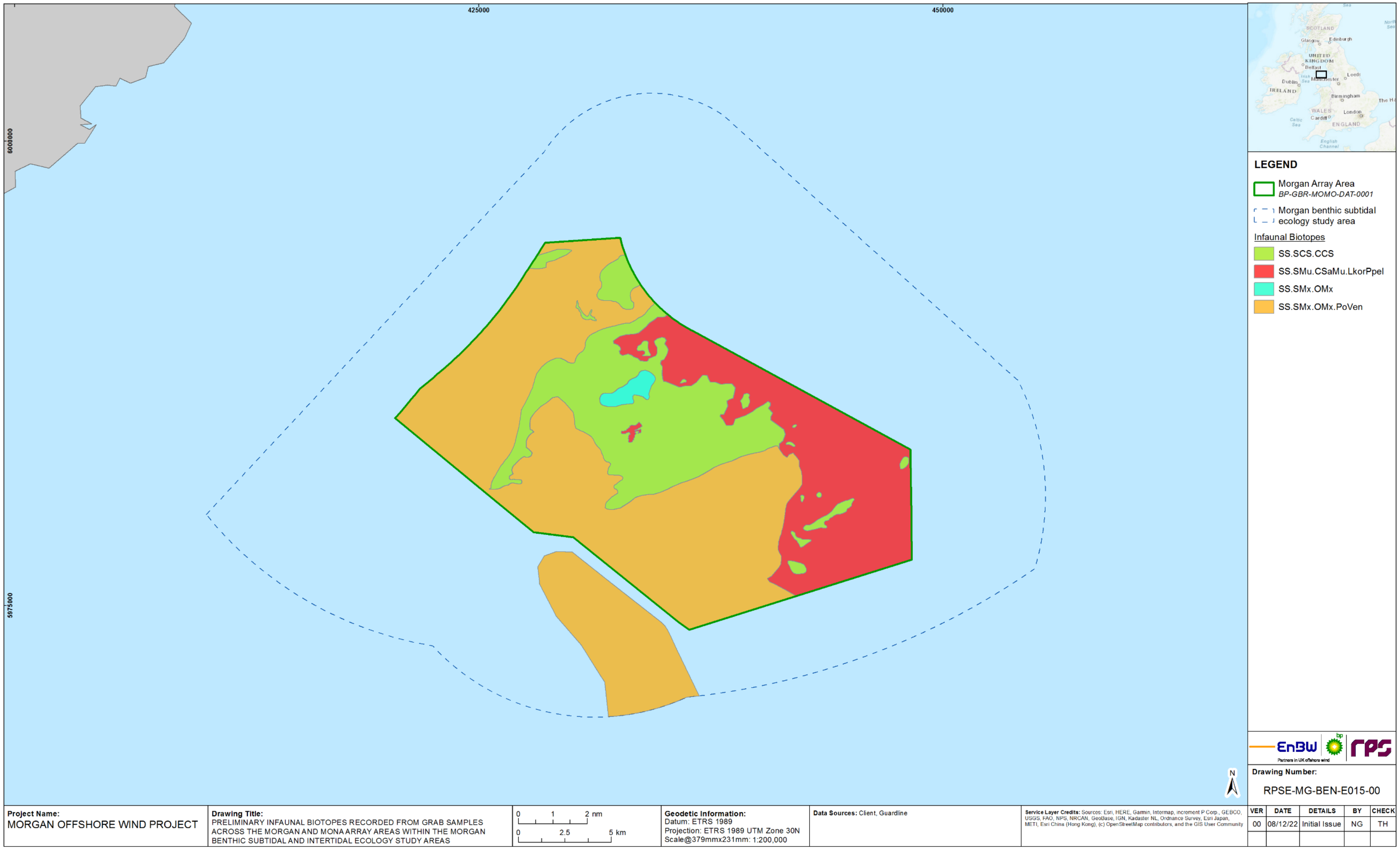

Figure 1.10: Preliminary infaunal biotopes recorded from grab samples across the Morgan Array Area (based on 2021 subtidal survey data) (all biotope codes are defined in Appendix H).

Univariate analysis

1.7.3.21 The following univariate statistics were calculated for each benthic infaunal grab sample station: number of species (S), abundance (N), ash free dry mass in grams (g), Margalef's index of Richness (d), Pielou's Evenness index (J'), Shannon-Wiener Diversity index (H') and Simpson's index of Dominance (λ). The mean of each of these indices was then calculated for each of the preliminary infaunal biotopes identified from the infaunal data and these are summarised in Table 1.10 with univariate statistics for individual sites presented in Appendix D.

1.7.3.22 The univariate statistics indicate that the SS.SMx.OMx.PoVen biotope, had the highest number of taxa (75.32 ± 17.63). The SS.SCS.CCS biotope had the lowest number of taxa (35.06 ± 16.81). The highest mean number of individuals was associated with SS.SMx.CMx.KurThyMx (249.50 ± 79.90) and SS.SMx.OMx.PoVen biotopes (236.7 ± 100.5),Table 1.10); this was expected as they contained the highest number of taxa. The only muddy sand biotope, SS.SMu.CSaMu.LkorPpel, had a low number of taxa (39.80 ± 13.74). The lowest mean number of individuals (53) was recorded in the SS.SMx.OMx biotope, although it should be noted that this biotope was associated with only a single sample. The low number of taxa was recorded in association with the SS.SCS.CCS biotope (35.06±16.81).

1.7.3.23 The highest mean diversity score of all the identified communities was associated with the biotope SS.SMx.OMx.PoVen (d = 13.69 ± 2.46 and H' = 3.84 ± 0.31) which was expected as this biotope had the highest number of taxa. The SS.SMx.CMx.KurThyMx biotope had the second highest mean diversity score (d = 12.02 ± 0.20 and H' = 3.65 ± 0.05). The lowest diversity recorded was associated with the SS.SCS.CCS biotope (d = 7.17 ± 2.82 and H' = 2.84 ± 0.60). This was expected as this biotope has the lowest number of taxa and second lowest number of individuals. The SS.SCS.CCS biotope is associated with coarse sediments which may suggest high energy current in these areas as well as an exposed aspect, leading to greater disturbance than in other communities, potentially explaining the reduced diversity of these communities. This biotope is known to be found in tide swept areas and in tidal channels (JNCC, 2015), which also suggests a high level of disturbance within this biotope which can result in lower diversity. Overall the mixed sediment habitats had higher biodiversity than the coarse or sandy mud-based habitats; this was expected due to the greater habitat diversity provided by the mixed sediment environment compared to the other sediment types therefore supporting a higher number of species. For example, the SS.SMu.CSaMu.LkorPpel biotope which was associated with sand and mud based sediments had one of the lowest mean diversity scores (d = 7.63 ± 2.27 and H' = 3.03 ± 0.28).

1.7.3.24 Pielou's evenness scores (J') and the Simpson's index of Dominance (λ) scores were similar across all the biotopes. Values of J' were between 0.83 and 0.96 for all of the biotopes with the highest value of J' for SS.SMx.OMx (J'=0.96). This indicated an even distribution of abundances among taxa and that this biotope was not dominated by a high number of individuals within a small number of species. Values of J' were lowest for the SS.SCS.CCS and SS.SMx.CMx biotopes (J'=0.83 ± 0.12; J'=0.83, respectively) which shows that although this value is slightly lower it shows a very small range which indicates the same even distribution of abundances among taxa and that this biotope was not dominated by a high number of individuals within a small number of species. Values for λ showed the same range (0.90 to 0.98) which indicates that all of the biotopes are represented by a wide diversity of species.

Table 1.10: Mean (± standard deviation) univariate statistics for the preliminary infaunal benthic biotopes.

Biotope	S	N	Biomass (g)	d	J'	H'	λ
SS.SCS.CCS	35.06 ±16.81	133.68 ± 106.89	0.48±0.72	7.17 ± 2.82	0.83 ± 0.12	2.84 ± 0.60	0.90 ± 0.09
SS.SMx.OMx	36	53	7.88 ± 14.28	8.82	0.96	3.43	0.98
SS.SMx.CMx	59	216	41.46 ± 13.44	10.79	0.83	3.39	0.94
SS.SMu.CSaMu.LkorPpel	39.80 ±13.74	160.40 ± 58.91	0.86 ± 0.95	7.63 ± 2.27	0.84 ± 0.06	3.03 ± 0.28	0.92 ± 0.03
SS.SMx.OMx.PoVen	75.32 ±17.63	236.70 ± 100.50	19.20 ± 30.66	13.69 ± 2.46	0.90 ± 0.05	3.84 ± 0.31	0.97 ± 0.04
SS.SMx.CMx.KurThyMx	67 ±2.83	249.50 ± 79.90	2.71 ± 3.77	12.02 ± 0.20	0.90 ± 0.02	3.65 ± 0.05	0.96 ± 0.002

1.7.3.25 Figure 1.11 to Figure 1.13 show the mean number of taxa, individuals, abundance, and biomass for each of the major faunal groups (i.e. Annelida, Crustacea, Mollusca, Echinodermata and Other) in each of the biotopes identified, within the Morgan and Mona benthic subtidal and intertidal ecology study areas, from the benthic infaunal grabs.

1.7.3.26 The biotopes SS.SMx.CMx.KurThyMx and SS.SMx.OMx.PoVen were dominated by Annelida, also with large numbers of Crustacea and Other taxa (this group includes taxa such as Cnidaria, Chordata, Foraminifera and Hemichordata). These biotopes exhibited the highest number of individuals (249.50 ± 79.90 and 236.70 ± 100.50 respectively). Overall the mixed sediment biotopes (SS.SMx.OMx.PoVen, SS.SMx.CMx.KurThyMx and SS.SMx.CMx) had high abundances of taxa, with the exception of SS.SMx.OMx which was represented by a single sample station and therefore may not be representative of its biotope as a whole. Figure 1.11 shows the distribution of the taxonomic groups within each biotopes. This shows that SS.SMx.CMx.KurThyMx has a higher proportion of Crustacea compared with the other biotopes. This was due to the relatively small number of species which characterised this biotope which resulted in the 20 crustacean taxa having a large impact on the number of taxa but low impact on the biomass.

1.7.3.27 As shown in Figure 1.12, the proportions of the number of taxa in each major taxonomic groups are similar across the biotopes and mirror the patterns observed in the mean abundance, as described in paragraph 1.7.3.26, with Annelida and Crustacea making up the highest proportion of the taxa associated with each biotope. All major taxonomic groups were represented in all biotopes. The proportion of Crustacea in the number of taxa in each biotope is slightly greater than the proportion of Crustacea in the number of individuals for all biotopes, highlighting that each of the Crustacea taxa are represented by a small number of individuals.

1.7.3.28 Biomass was considerably higher in association with the SS.SMx.OMx and SS.SMx.CMx biotopes, although noting that these were represented by only a single sample station, and also more generally for the mixed sediment biotopes. Biomass for the SS.SMx.CMx.KurThyMx biotope and the SS.SMx.OMx.PoVen biotope was dominated by Mollusca. The muddy sand communities associated with the SS.SMu.CSaMu.LkorPpel biotope had an overall lower mean biomass and were dominated by Echinodermata. Annelida made up a smaller proportion of the total biomass in each biotope, which is expected due to the small size of Annelida (Figure 1.13). Biomass per taxonomic group for each sample station is presented in Appendix D.

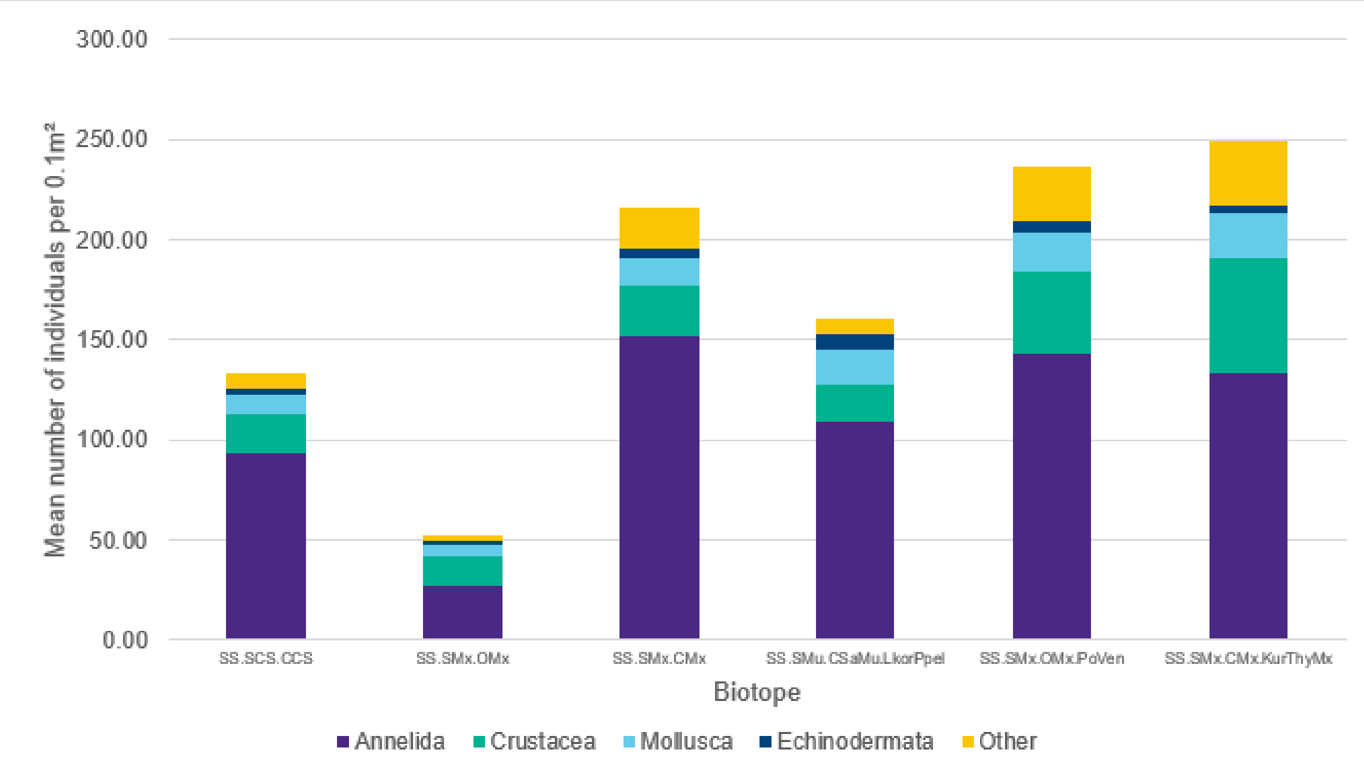

Figure 1.11: Mean abundance of individuals (per 0.1m^2) per taxonomic group for each infaunal biotope.

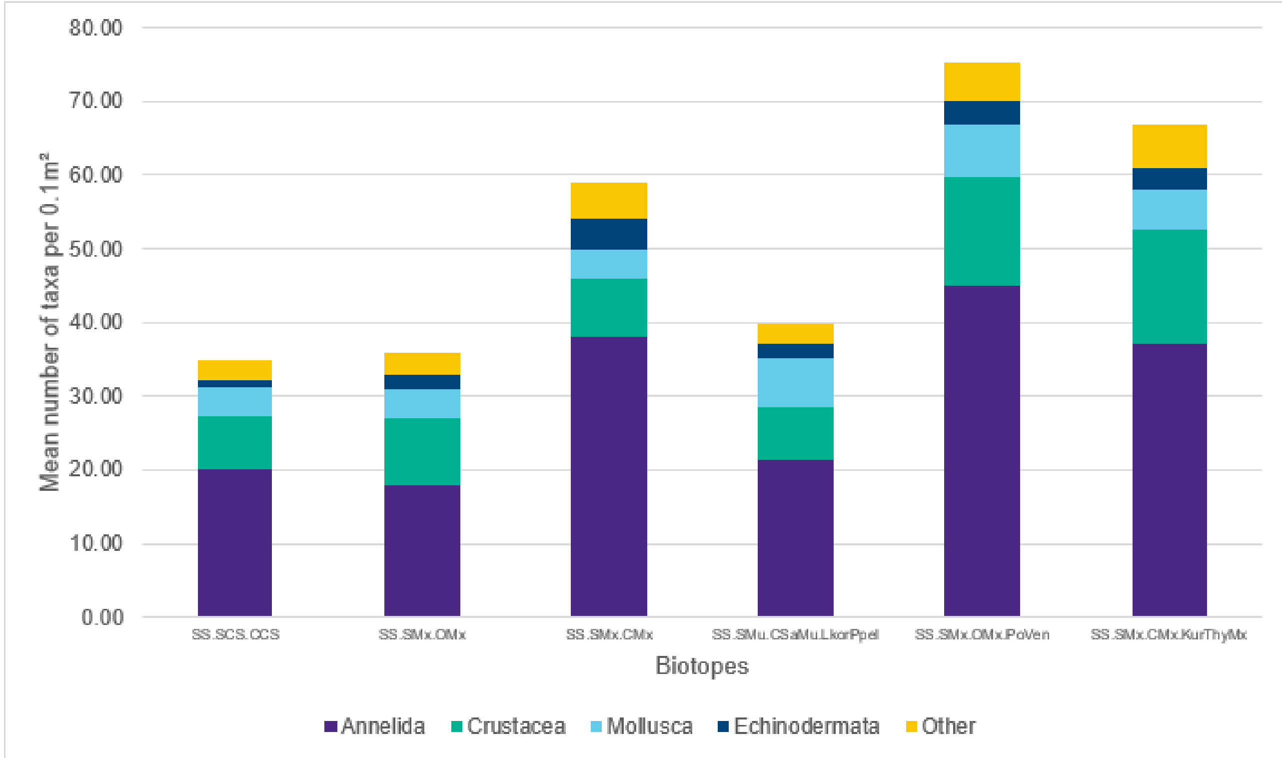

Figure 1.12: Mean number of taxa (per 0.1m^2) per taxonomic group identified for each infaunal biotope.

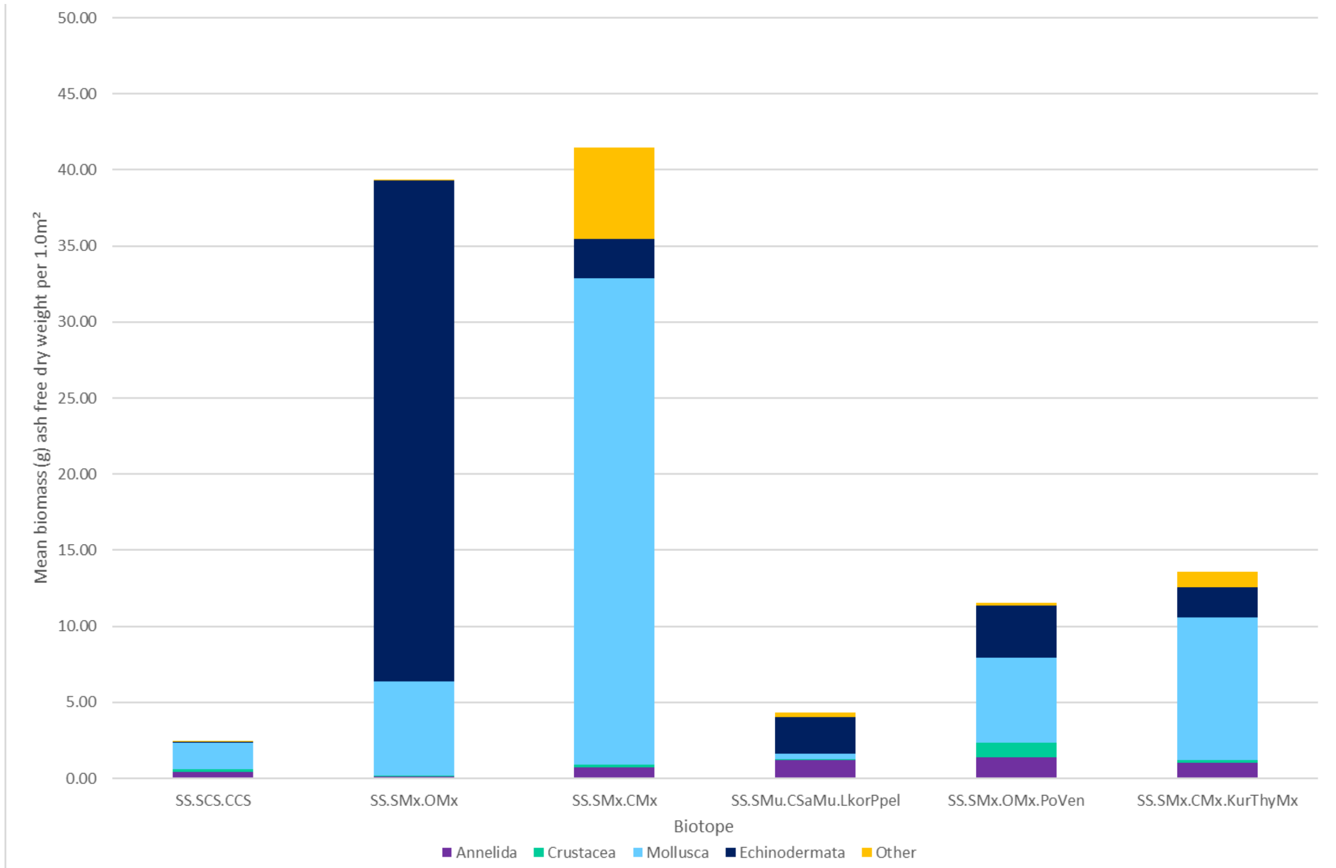

Figure 1.13: Mean biomass (per 0.1m^2) per taxonomic group for each infaunal biotope.

1.7.4 Results – epifaunal analysis

Seabed imagery

1.7.4.1 The sediments recorded in the seabed imagery largely comprised of an amalgamation of subtidal mixed sediments and coarse sediments with some circalittoral fine sands within the Morgan Array Area. In general, high numbers of epifaunal species were recorded in association with the coarser sediments (coarse and mixed sediments). Epifaunal species recorded were dominated by Annelida and Cnidarians with low numbers of Molluscs and Chordata. *Ophiura* sp. was the most abundant taxa and was associated with every sediment type (Figure 1.14).

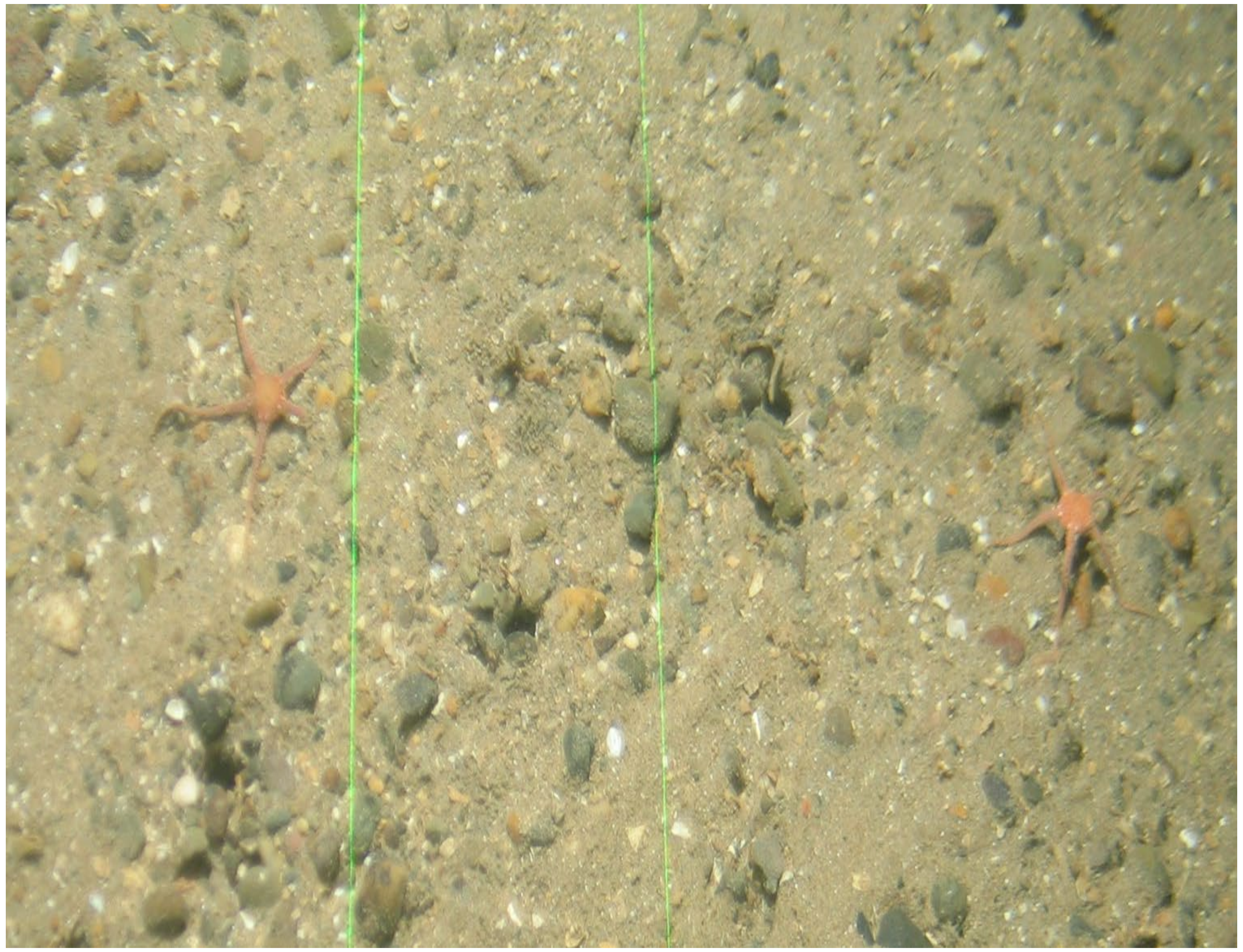

Figure 1.14: *Ophiura* sp. on mixed sediment at sample station ENV04.

1.7.4.2 Across the Morgan Array Area the community composition observed from the DDV footage was similar between the coarse, mixed and sandy and muddy sediment. Some of the most prominent species across the array area include *Paguroidea*, *Alcyonium digitatum*, *Tubulariam*, and nematoda.

Summary statistics

1.7.4.3 The epifaunal data that were recorded as present/absent, and therefore removed from the infaunal grab data analysis, were combined with the epifaunal data from the DDV. A total of 258 taxa and two categories of burrows and waste casts were recorded from the 97 infaunal grabs and DDV stations sampled during the site-specific benthic survey. Of the total 147 taxa, *Ophiura* sp. and faunal turf were recorded across all sample stations. *A. digitatum* were also highly common, with 96 sample stations recording them. Of the taxa identified within the Morgan Array Area and wider regional benthic subtidal ecology study area to the south of the Morgan Array Area, 69 taxa occurred at only one sample station. Sample station ENV90 recorded the highest number of epifaunal taxa (west Morgan Array Area), with sample station ENV06 (north Morgan Array Area) recording the highest number of burrows.

Multivariate community analysis

1.7.4.4 The results of the cluster analysis, SIMPROF test and SIMPER analysis were used, together with the raw untransformed data, to assign preliminary epifaunal biotopes to sample stations based on the dataset which combined the DDV data and the epibenthic component of the grab samples (Table 1.11). In several instances, clusters that were identified as significantly different from each other in the SIMPROF tests were assigned the same biotope code. This was based on a review of the SIMPER results which indicated that the differences between the groups could be explained by differences in abundances of characterising species rather than the presence/absence of key species. Full results of the multivariate analysis are presented in Appendix E.

1.7.4.5 The results of the hierarchical cluster analysis of the fourth root transformed epifaunal dataset (Figure 1.15) together with the SIMPROF test identified 11 Faunal groups that were statistically dissimilar, based on the SIMPROF test. The 2D MDS plot is presented in Figure 1.16 and the low stress value (0.23) indicates that this is a good representation of the data. The 3D MDS plot has not been presented as the 2D MDS plot presents a clearer representation of the data.

1.7.4.6 The SIMPROF test identified 11 Faunal groups that were statistically dissimilar (see Figure 1.15 and Table 1.10). Faunal group A (ENV11, ENV16, ENV21, ENV25, ENV26) showed distinct clustering away from other Faunal groups. Faunal groups I, J, K and L showed a higher degree of similarity to each other than to the other Faunal groups. Faunal groups D and E showed tight clustering with Bray-Curtis similarity of 69.60% and 67.88% respectively. Faunal group J was the largest Simprof group identified (39 sample stations) with a Bray-Curtis similarity of 55.51%. The difference in Faunal groups is discussed in the following paragraphs.

1.7.4.7 Sample stations associated with Faunal groups C, I, J and K were located within the Morgan Array Area and in the west of the Morgan Array Area. These stations were associated with mixed sediments and communities characterise by a variety of polychaetes, crustaceans and echinoderms. This group was assigned the SS.SMx.CMx biotope from the epifaunal data (Figure 1.17). Faunal groups B, F and L had sample stations in the centre of the Morgan Array Area and were all characterised by coarse sediments and communities of polychaetes, echinoderms and crustacea with some bryozoans such as *Serpulidae, Pagurus prideaux* and *A. digitatum*. The habitats represented in this faunal group are varied and did not contain the characteristic species which would lead to a more specific biotope allocation. Therefore, on the basis of the epifaunal data, Faunal groups B, F and L were allocated the SS.SCS.CCS biotope.

1.7.4.8 Faunal group A has sample stations distributed through the west section of the Morgan Array area and along the north boundary of the Morgan Array Area. Sample stations in Faunal group A were characterised by sand and muddy sand sediments. The associated communities recorded from the epifaunal data were largely characterised by Echinoderms and Crustacea such as *A. digitatum* and *Pagurus bernhardus*. Similarly to the infaunal multivariate analysis, the biotopes with the Morgan Array Area demonstrated a transition of sediments and communities, from the west to the east of the Morgan Array Area the sediments become finer and the communities shift to accommodate this change. The varied communities in each of the habitats described has meant that allocation of biotopes has been high level and largely guided by sediment type.

1.7.4.9 Sample stations in the wider regional benthic subtidal ecology study area located to the south of the Morgan Array Area (i.e. within the Mona Array Area) were associated with Faunal groups C, D, G, H, I, J and K. These sample stations were largely characterised by mixed sediments. The faunal communities in these sample stations were characterised by taxa such as polychaetes, echinoderms and crustacea which included *Tubularia, Ophiura,* and *Paguroidea.* These faunal groups were allocated the SS.SMx.CMx biotope. The wide distribution of the sample stations in Faunal groups C, D, G, H, I, J and K resulted in the majority of the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area (i.e. within the Mona Array Area) being allocated the SS.SMx.CMx biotope (Figure 1.17).

1.7.4.10 The Faunal groups presented in the SIMPER analysis and the raw data were used to assign three preliminary epifaunal biotopes to the site-specific survey data (Table 1.11). Figure 1.17 presents the preliminary epifaunal biotopes assigned across the Morgan benthic subtidal ecology study area from the analyses of the epifaunal component of the grab data and DDV.

Table 1.11: Simprof groups and biotope classifications for the epifaunal dataset (from DDV and epifaunal component of grab data).

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
Group A	ENV16	34 - 41	Sand and muddy sand	Faunal Turf, *Ophiura, Paguroidea, Astropecten irregularis, ceriantharia, Alcyonium digitatum, Pagurus bernhardus, Phoronis*	SS.SSa.CMuSa	Faunal group A showed high Bray-Curtis dissimilarity with Faunal group G (71.32%). Faunal group G did not record *Porella concinna*, *Serpulidae*, and Decapoda which were present in Faunal group A. Faunal group A showed low Bray-Curtis dissimilarity with Faunal group C (60.97%). Faunal group A did record lower abundances of Nematoda, *Pectinidae*, and *Sabellidae* as well as an absence of *Serpulidae* compared to Faunal group C.
	ENV21		Sand and muddy sand			
	ENV22		Sand and muddy sand			
	ENV25		Sand and muddy sand			
	ENV26		Sand and muddy sand			
Group B	ENV94	42 - 43	Coarse sediment	Animalia Tubes, *Serpulidae, Pagurus prideaux, Bryozoan,* Burrows, *Actiniaria, Adamsia palliata, Alcyonium digitatum, Ophiura, Pectinidae, Scaphapoda*	SS.SCS.CCS	
Group C	ENV23	37 - 47	Sand and muddy sand	*Nematoda,* Faunal Turf, *Amphipoda, Paguroidea, Ophiura, Terebellidae, Animalia Tubes, Alcyonium digitatum, Tubularia, Pectinidae, Copepoda, Pagurus bernhardus*	SS.SMx.CMx	Faunal group C did not show a particularly high Bray-Curtis dissimilarity to one Faunal group. Faunal group C showed low Bray-Curtis dissimilarity with Faunal group I (53.68%). Faunal group I did record lower abundances of Decapoda, *Euclymeninae*, *Penetrantia* and *Sertulariidea* compared to Faunal group C.
	ENV30		Sand and muddy sand			
	ENV40		Mixed sediment			
	ENV43		Coarse sediment			
	ENV44		Coarse sediment			
	ENV45		Mixed sediment			
	ENV67		Sand and muddy sand			
	ENV68		Sand and muddy sand			
Group D	ENV72	36 - 41	Mixed sediment	*Serpulidae, Alcyonium digitatum, Tubularia, Pectinidae, Echinoidea, Pagurus bernhardus,* Faunal turf, *Animalia tubes, Ophiura, Buccinidae, Spatangus purpureus*	SS.SMx.CMx	Faunal group D showed relatively high Bray-Curtis dissimilarity with Faunal group A (67.94%). Faunal group A did not record *Amphiura filiformis, Eunicidae* or burrows which were present in Faunal group D. Faunal group D showed low Bray-Curtis dissimilarity with Faunal group E (41.46%). Faunal group E recorded an absence of *Spatangus purpureus* compared to Faunal group D. Faunal group E showed higher abundance of *Ophiothrix fragilis*, *Actiniaria* and *Ophiura*.
	ENV75		Coarse sediment			
	ENV77		Mixed sediment			
	ENV78		Coarse sediment			
Group E	ENV46	43 - 45	Mixed sediment	*Serpulidae, Alcyonium digitatum, Ophiura, Pectinidae,* Faunal Turf, *Ophiothrix fragilis, Pagurus bernhardus, Tubularia, Buccinidae, Actinaria, Asteria rubens, Cirripedia*	SS.SMx.CMx	Faunal group E showed relatively high Bray-Curtis dissimilarity with Faunal group A (67.11%). Faunal group A did not record *Phoronis, Echinoidea, Ophiocomina nigra, Hydrozoa* and *Echinoidea* which were present in Faunal group E. Faunal group E showed low Bray-Curtis dissimilarity with Faunal group F (51.04%). Faunal group E recorded an absence of Nematoda, Decapoda and *Sertularella* compared to Faunal group F. Faunal group E showed higher abundance of *Ophiothrix fragilis*, *Ophiocomina nigra* and *Serpulidae*.
	ENV58		Mixed sediment			
	ENV73		Mixed sediment			
	ENV74		Mixed sediment			
	ENV76		Mixed sediment			
	ENV79		Mixed sediment			
	ENV80		Mixed sediment			
	ENV81		Mixed sediment			

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ENV85		Mixed sediment			
	ENV87		Mixed sediment			
Group F	ENV11	40 - 51	Sand and muddy sand	*Nematoda,* Faunal Turf, *Ophiura, Tubularium, Alcyonium digitatum, Ceriantharia, Actinopterygii, Serpulidae, Decapoda, Animalia tubes, Ophiuroidea, Pectinidae, Terebellidae, Actiniaria*	SS.SCS.CCS	Faunal group A did not record Decapoda*, Seroulidae, Phronis* and *Sertularella* which were present in Faunal group F. Faunal group E showed low Bray-Curtis dissimilarity with Faunal group F (51.04%). Faunal group E recorded an absence of Nematoda, Decapoda and *Sertularella* compared to Faunal group E.
	ENV28		Coarse sediment			
	ENV91		Mixed sediment			
	ENV93		Coarse sediment			
Group G	ENV20	38 - 43	Coarse sediment	*Porella concinna, Nematoda, Serpulidae, Pectinidae,* Faunal Turf, *Tubularia, Animalia tubes, Pagurus bernhardus, Ophiura, Bivalvia, Echinoidea*	SS.SMx.CMx	Faunal group G showed relatively high Bray-Curtis dissimilarity with Faunal group B (65.59%). Faunal group G did not record *Amphiura filiformis, Hydrallmania falcata*, *Eunicidae* and burrows which were present in Faunal group B. Faunal group G showed low Bray-Curtis dissimilarity with Faunal group D (52.32%). Faunal group G recorded Nematoda, *Porella coninna*, Decapoda and *Schizomavella* and which where comparatively absent in Faunal group D.
	ENV70		Coarse sediment			
	ENV83		Sand and muddy sand			
Group H	ENV57	38	Coarse sediment	*Serpulidae, Terebellidea, Paguroidea, Alcyonium digitatum, Echinoidea, Nematoda, Eucratea loricata, Ophiura, Adamsia palliata*	SS.SMx.CMx	
Group I	ENV02	37 - 51	Coarse sediment	*Nematoda, Copepoda, Alyconium digitatum,* Faunal Turf, *Serpulidae, Decapoda, Tubularia, Pectinidae, Ophiura, Animalia Tubes, Penetrantia, Euclymeninae*	SS.SMx.CMx	Faunal group I showed relatively high Bray-Curtis dissimilarity with Faunal group A (66.59%). Faunal group A did not record Decapoda, *Serpulidae, Euclymeninae* and *Hydrozoa* which were present in Faunal group I. Faunal group I showed low Bray-Curtis dissimilarity with Faunal group J (50.73%). Faunal group J recorded higher abundances *Hydrallmania falcata, Porella concinna, Schizomavella* and *Penetrantia* compared to Faunal group I.
	ENV03		Mixed sediment			
	ENV06		Mixed sediment			
	ENV09		Mixed sediment			
	ENV12		Sand and muddy sand			
	ENV13		Coarse sediment			
	ENV14		Coarse sediment			
	ENV17		Coarse sediment			
	ENV18		Mixed sediment			
	ENV19		Mixed sediment			
	ENV24		Coarse sediment			
	ENV39		Mixed sediment			
	ENV69		Mixed sediment			
	ENV84		Mixed sediment			
Group J	ENV04	40 - 49	Mixed sediment	*Nematoda, Serpulidae, Sertulariidae, Hydrallmania falcata, Ophiura,*	SS.SMx.CMx	Faunal group J showed relatively high Bray-Curtis dissimilarity with Faunal group A (71.26%). Faunal group A did not record Decapoda, *Serpulidae, Porella concinna Schizomavella* and Decapoda which were present
	ENV05		Mixed sediment			

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ENV10		Mixed sediment	*Copepoda, Pectinidae, Alcyonium digitatum, Porella concinna, Ceriantharia,* Faunal Turf, *Schizomavella, Decapoda, Asteria rubens*		in Faunal group J. Faunal group H showed low Bray-Curtis dissimilarity with Faunal group J (53.44%). Faunal group J recorded absences *Glycinde nordmanni*, and *Eulalia Mustela* compared to Faunal group H.
	ENV27		Mixed sediment			
	ENV29		Mixed sediment			
	ENV31		Mixed sediment			
	ENV32		Mixed sediment			
	ENV33		Mixed sediment			
	ENV34		Mixed sediment			
	ENV35		Mixed sediments			
	ENV36		Mixed sediments			
	ENV37		Mixed sediments			
	ENV38		Mixed sediments			
	ENV41		Mixed sediment			
	ENV42		Mixed sediment			
	ENV47		Mixed sediments			
	ENV48		Mixed sediments			
	ENV49		Mixed sediments			
	ENV50		Mixed sediments			
	ENV51		Mixed sediments			
	ENV52		Mixed sediments			
	ENV53		Mixed sediments			
	ENV54		Mixed sediments			
	ENV55		Mixed sediments			
	ENV56		Coarse sediments			
	ENV59		Coarse sediment			
	ENV60		Mixed sediments			
	ENV61		Mixed sediments			
	ENV62		Mixed sediments			
	ENV63		Coarse sediments			
	ENV64		Mixed sediments			
	ENV65		Mixed sediment			
	ENV71		Mixed sediment			
	ENV82		Mixed sediment			

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ENV86		Mixed sediment			
	ENV88		Mixed sediment			
	ENV90		Mixed sediment			
	ENV92		Mixed sediment			
	ENV97		Mixed sediment			
Group K	ENV01	39 - 48	Mixed sediment	*Nematoda, Copepoda, Faunal Turf, Serpulidae, Pectinidae, Animalia Tubes, Schizomavella, Sertulariidae, Hydrallmania falcata, Tubularia, Alcyonium digitatum*	SS.SMx.CMx	Faunal group K showed relatively high Bray-Curtis dissimilarity with Faunal group A (70.17%). Faunal group A did not record *Serpulidae, Schizomavella, Cirripedia* and burrows which were present in Faunal group K. Faunal group K showed low Bray-Curtis dissimilarity with Faunal group J (50.32%). Faunal group K recorded an absence of *Euclymeninae, Amphipoda*, and *Penetrantia* as well as lower abundance of Decapoda and *Porella concinna* in comparison with Faunal group J.
	ENV08		Coarse sediment			
	ENV15		Mixed sediment			
	ENV95		Sand and muddy sand			
	ENV96		Coarse sediment			
	ENV08		Coarse sediment			
Group L	ENV07	36 - 41	Coarse sediment	*Nematoda, Serpulidae,* Faunal Turf, *Ophiura, Pectinidae, Paguroidea, Alcyonium digitatum, Pagurus bernhardus, Ascidiacea*	SS.SCS.CCS	Faunal group L showed relatively high Bray-Curtis dissimilarity with Faunal group A (79.62%). Faunal group A did not record *Serpulidae, Ophiuridae* and burrows which were present in Faunal group L. Faunal group L showed low Bray-Curtis dissimilarity with Faunal group D (54.56%). Faunal group D recorded an absence of Nematoda, *Hydrallmania falcata, Spio, Ophiuridae* and *Psammechinus miliaris* comparison with Faunal group L.
	ENV66		Coarse sediment			
	ENV89		Coarse sediment			

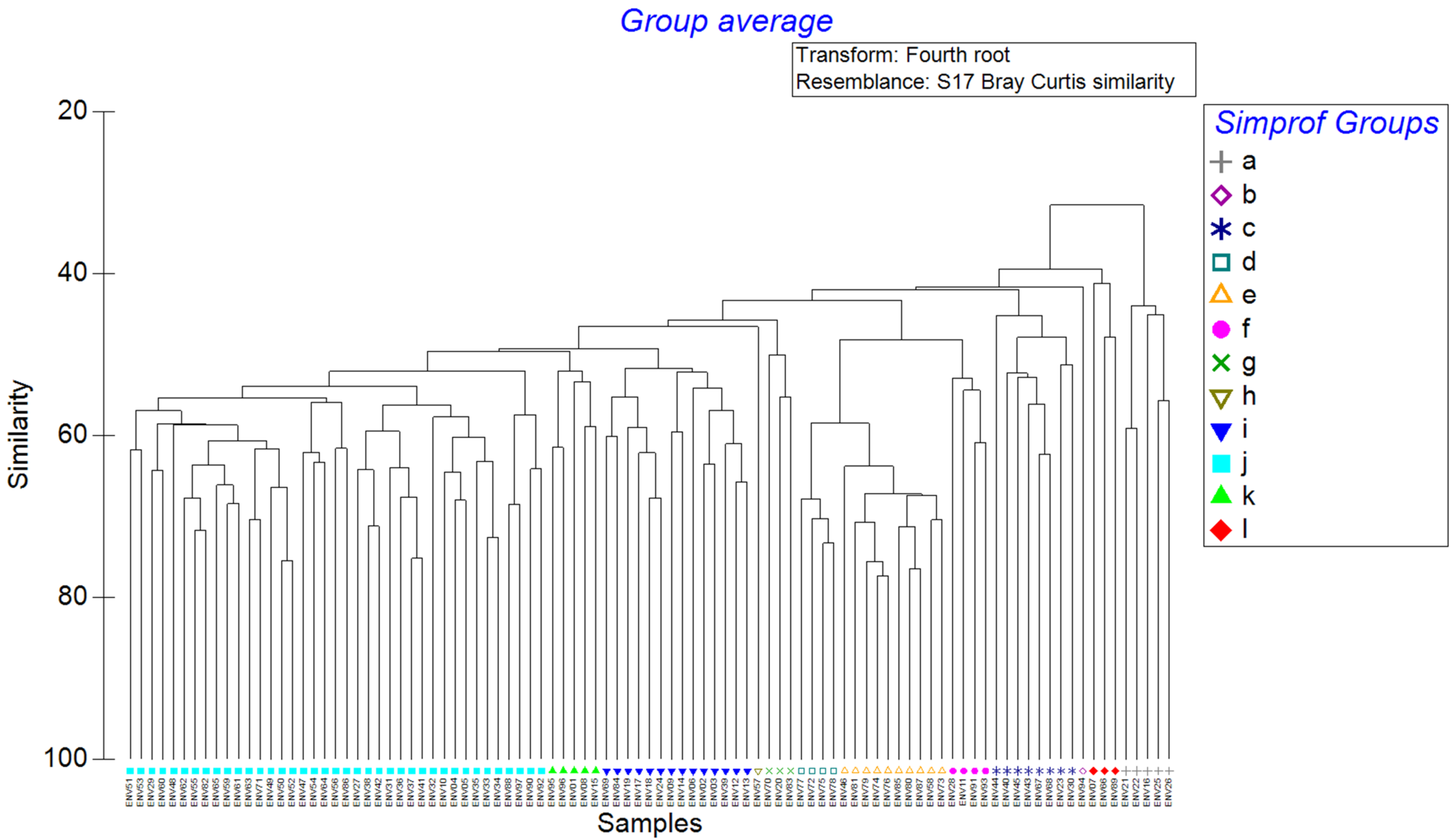

Figure 1.15: Dendrogram of epifaunal communities (from DDV and epifaunal component of grab data).

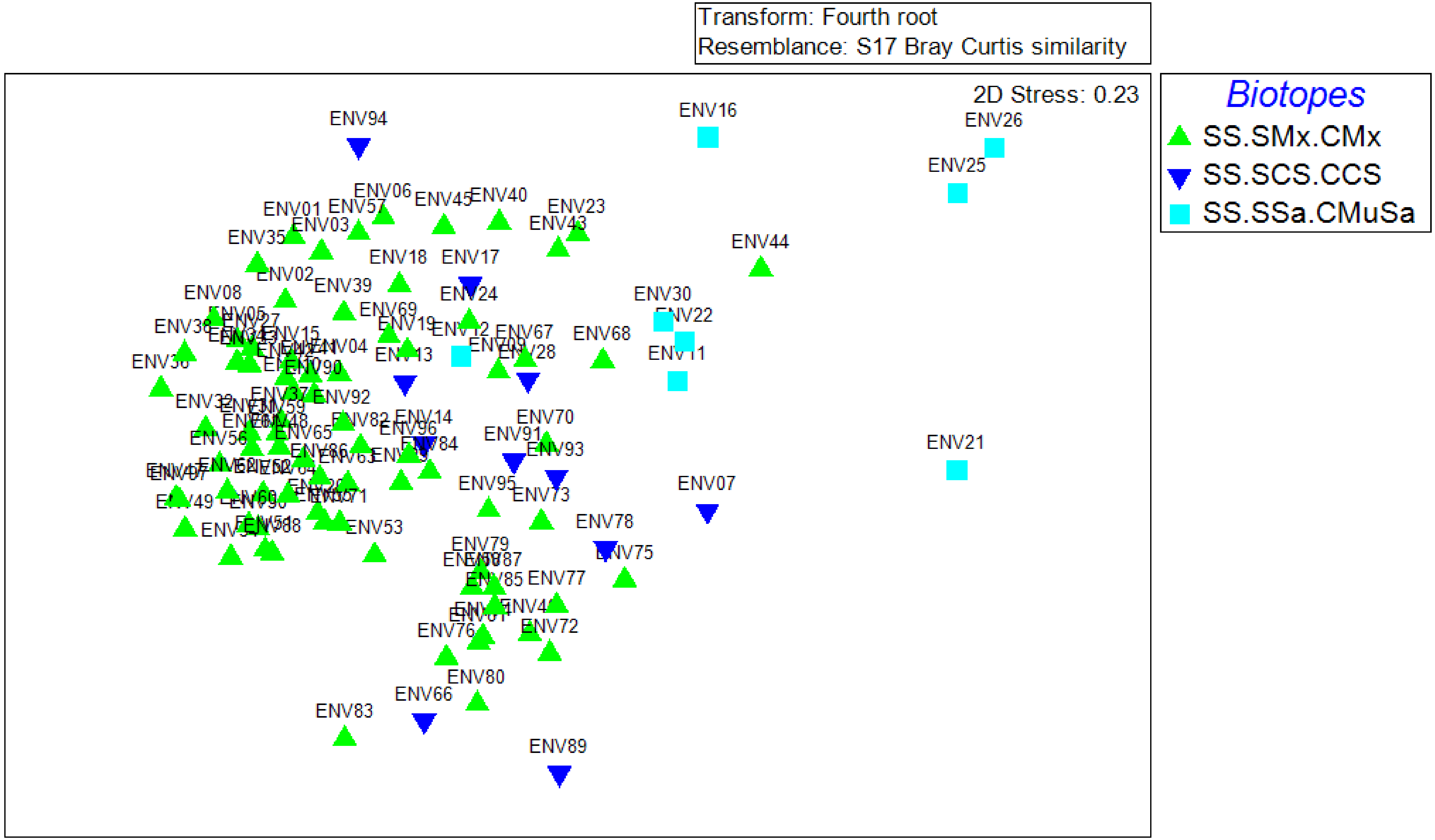

Figure 1.16: 2D MDS plot of epifaunal communities (from DDV and epifaunal component of grab data).

Table 1.12: Summary of preliminary epifaunal biotopes identified from the site-specific surveys (from DDV and epifaunal component of grab data).

Preliminary epifaunal biotopes	Sample station	Water depth range (m)	Sediment classification	Characterising taxa accounting for up to 50% of cumulative similarity (SIMPER)	Geographic location
SS.SMx.CMx	ENV01, ENV02, ENV03, ENV04, ENV05, ENV06, ENV08, ENV09, ENV10, ENV15, ENV18, ENV19, ENV20, ENV23, ENV24, ENV27, ENV29, ENV31, ENV32, ENV33, ENV34, ENV35, ENV36, ENV27, ENV38, ENV39, ENV40, ENV41, ENV42, ENV43, ENV44, ENV45, ENV46, ENV47, ENV48, ENV49, ENV50, ENV51, ENV52, ENV53, ENV54, ENV55, ENV56, ENV57, ENV58, ENV59, ENV60, ENV61, ENV62, ENV63, ENV64, ENV65, ENV67, ENV68, ENV69, ENV70, ENV71, ENV72, ENV73, ENV74, ENV75, ENV76. ENV77, ENV79, ENV80, ENV81, ENV82, ENV83, ENV84, ENV85, ENV86, ENV87, ENV88, ENV90, ENV90, ENV92, ENV95, ENV96, ENV97	37 - 51	Sand and muddy sand, mixed sediment, coarse sediment	*Nematoda,* faunal turf, *Amphipoda, Paguroidea, Ophiura, Terebellidae, Animalia Tubes, Alcyonium digitatum, Tubulariam, Pectinidae, Copepoda, Pagurus bernhardus, Serpulidae, Echinoidea, Buccinidae, Spatangus purpureus, Ophiothrix fragilis, Actinaria, Asteria rubens, Cirripedia, Paguroidea, Eucratea loricata, Adamsia palliata, Penetrantia, Euclymeninae, Sertulariidae, Hydrallmania falcata, Schizomavella*	Across the west and south of the Morgan Array Area. Across the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area.
SS.SCS.CCS	ENV07, ENV13, ENV14, ENV17, ENV28, ENV66, ENV78, ENV89, ENV91, ENV93, ENV94	36 - 51	Coarse sediment, mixed sediment	*Animalia Tubes, Serpulidae, Pagurus prideaux, Bryozoan,* Burrows, *Actiniaria, Adamsia palliata, Alyconium digitatum, Ophiura, Pectinidae, Scaphapoda, Nematoda,* faunal turf, *Tubularium, Ceriantharia, Actinopterygii, Decapoda, Ophiuroidea, Terebellidae, Ascidiacea*	Small areas in the centre and south of the Morgan Array Area. Across the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area.
SS.SSa.CMuSa	ENV11, ENV12, ENV16, ENV21, ENV22, ENV25, ENV26, ENV30	34 – 41	Sand and muddy sand.	Faunal turf, *Ophiura, Paguroidea, Astropecten irregularis, ceriantharia, Alcyonium digitatum, Pagurus bernhardus, Phoronis*	North central and east Morgan Array Area.

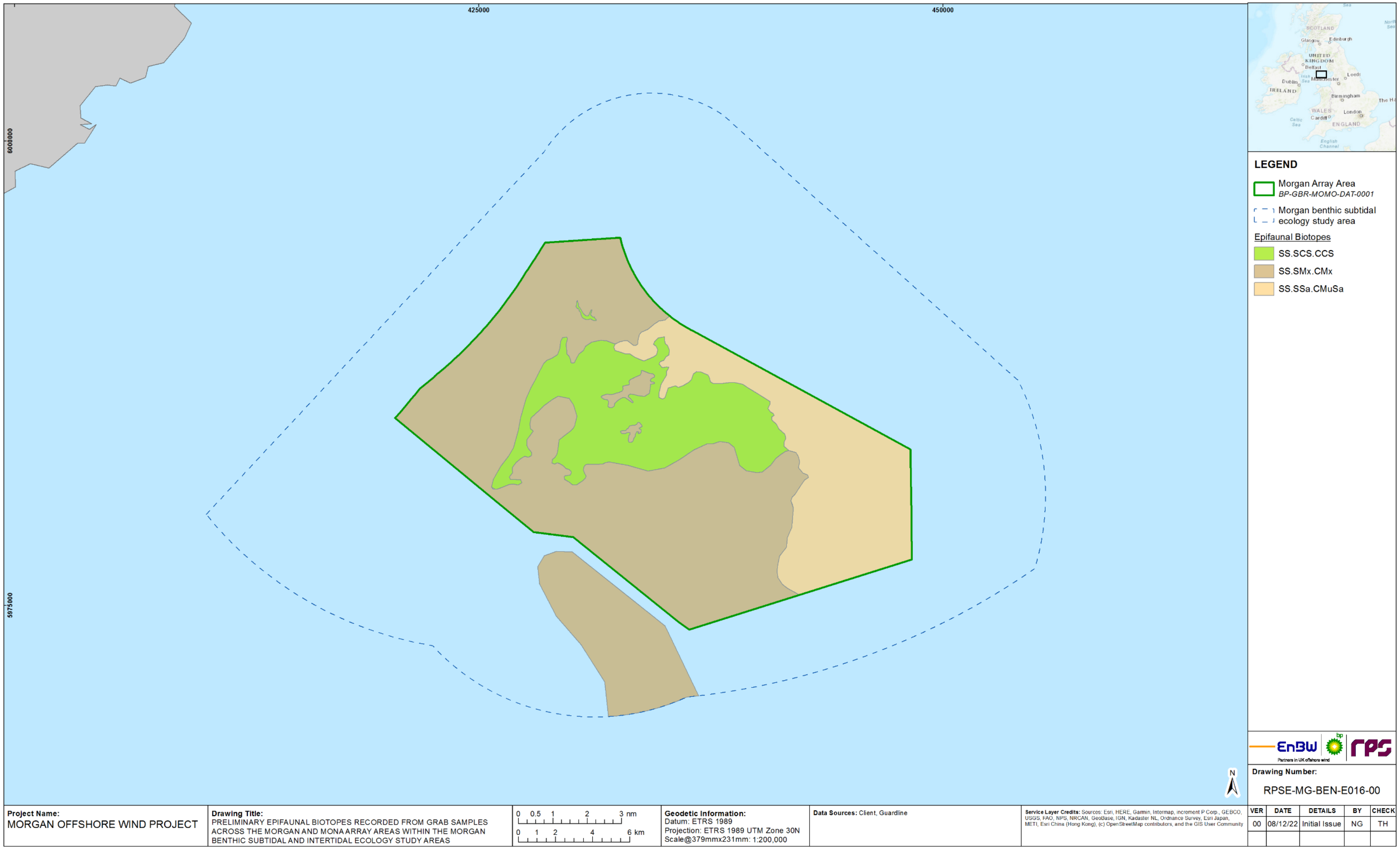

Figure 1.17: Preliminary epifaunal biotopes identified from DDV and epifaunal component of the grab samples within the Morgan Array Area from the site-specific surveys (based on 2021 subtidal survey).

Univariate analysis

1.7.4.11 The following univariate statistics were calculated for the combined epibenthic dataset (i.e. epibenthic components of the grabs and DDV data) for each sample station: number of species (S), abundance (N), Margalef's index of Richness (d), Pielou's Evenness index (J'), Shannon-Wiener Diversity index (H') and Simpson's index of Dominance (λ). The mean of each of these indices was then calculated for each of the biotopes identified from the epifaunal data and these are summarised in Table 1.13, with univariate statistics for individual sites presented in Appendix E.

1.7.4.12 The biotope SS.SMx.CMx had the highest number of taxa (47.13 ± 8.09). The highest mean number of individuals was also recorded in association with SS.SMx.CMx (16.66 ± 7.83; Table 1.13); this was expected as this biotope is composed of mixed sediments with cobbles and pebbles which provide substrate for epifauna to attach to. The high number of individuals associated with this biotope were due to high abundances of annelids and crustaceans as well as faunal turf. The lowest mean number of individuals was recorded in biotope circalittoral muddy sand (SS.SSa.CMuSa). Overall, the highest number of individuals and taxa were recorded at biotopes with greater proportions of coarse substrate and the lowest numbers were recorded in sand sediment habitats.

1.7.4.13 The highest mean diversity scores were associated with the SS.SCS.CCS biotope (d = 19.63 ± 9.44 and H' = 2.60 ± 0.44) and the SS.SMx.CMx (d = 19.59 ± 11.19 and H' = 2.94 ± 0.23). This was expected, as these biotopes had the highest number of taxa and were characterised by coarser substrate. The biotope SS.SSa.CMuSa had the lowest mean diversity score (d = 16.71 ± 4.60, H' = 2.32 ± 0.38). Overall, the highest diversity was recorded at biotopes with coarser substrate and the lowest was recorded in sand sediment habitats.

1.7.4.14 Pielou's evenness (J') scores showed limited variation across the epifaunal biotopes. Mean J' was 0.77, 0.70 and 0.68 at SS.SMx.CMx, SS.SCS.CCS and SS.SSa.CMuSa, respectively, indicating a relatively even distribution of abundance among taxa in these biotopes. This was expected, as all of these biotopes show a relatively similar level of abundance. The Simpson's index of Dominance (λ) was also similar for all the biotopes, ranging from 1.04 to 1.06, indicating that these biotopes have a similar number of species as well as there being a similar abundance of each species. Simpson's index of Dominance was lowest at SS.SSa.CMuSa indicating that this biotope had a slightly more even distribution of taxa.

Table 1.13: Mean (± standard deviation) univariate statistics for epifaunal biotopes (from DDV and grab data).

Biotope	S	N	d	J'	H'	λ
SS.SMx.CMx	47.13 ± 8.09	16.66 ± 7.83	19.59 ± 11.19	0.77 ± 0.05	2.94 ± 0.23	1.06 ± 0.33
SS.SCS.CCS	42.55 ± 11.80	12.82 ± 6.97	19.63 ± 9.44	0.70 ± 0.09	2.60 ± 0.44	1.05 ± 0.30
SS.SSa.CMuSa	31.25 ± 10.57	6.79 ± 2.79	16.71 ± 4.60	0.68 ± 0.05	2.32 ± 0.38	1.04 ± 0.06

1.7.5 Results - combined infaunal and epifaunal subtidal biotopes

1.7.5.1 Figure 1.18 presents the combined infaunal and epifaunal biotopes identified across the Morgan Array Area within the Morgan benthic subtidal and intertidal ecology study area. The method of classifying combined, holistic biotope codes was informed by the preliminary infaunal and epifaunal biotopes, the characterising species for these biotopes (as highlighted by the SIMPER analysis) and environmental variables (e.g. sediment type and water depth) at each site. The quantitative benthic infaunal grab dataset was prioritised when combined the datasets, due to this being the most standardised dataset. The DDV footage, the results of the analysis of the epifaunal component of the grab data were then used to identify any subtle differences in epifaunal communities.

1.7.5.2 The infaunal and epifaunal biotopes have been combined to assign single biotopes across the Morgan Array Area (i.e. no biotope mosaics were mapped), due to the typically sparse epifaunal communities characterising these areas as well as due to the epifaunal biotopes corroborating what was found in the infaunal biotope analysis. Where DDV data only was taken, these infaunal biotopes have been taken as the final biotopes.

1.7.5.3 The epifauna data identified a large area of SS.SMx.CMx in the west and most of the south of the Morgan Array Area. This was mirrored and expanded upon in the infaunal biotopes which identified SS.SMx.OMx.PoVen across the SS.SMx.CMx area, with the infaunal communities providing greater insight allowing the identification of a more specific community. The epifaunal analysis identified the SS.SCS.CCS biotope in the centre east of the Morgan Array Area. This same biotope was identified in the infaunal analysis but also contained an area mapped as SS.SMx.OMx in the centre of this area. The majority of the east of the Morgan Array Area was identified by the epifaunal analysis as SS.SSa.CMuSa, which was further defined as SS.SMu.CSaMu.LkorPpel in the infaunal analysis, again showing the deeper level of classification provided by the infaunal analysis but supported by the epifaunal and sediment analysis. The area of SS.SMu.CSaMu.LkorPpel was interspersed with smaller areas of SS.SCS.CCS.

1.7.5.4 In the area surveyed to the south of the Morgan Array Area, the epifaunal communities were predominantly characterised by the SS.SMx.CMx biotope. This provides support to the dominant infaunal biotopes recorded in the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area which was SS.SMx.OMx.PoVen with additional small areas of SS.SMx.CMx.KurThyMx and SS.SMx.CMx. In addition to the sediment type and general community identified by the epifaunal analysis, the infaunal analysis yielded a more specific community allowing a more detailed level of classification. The epifaunal data in the in the wider regional benthic subtidal ecology study area located to the south of the Morgan Array Area also identified areas of SS.SCS.CCS. These were mirrored and expanded upon in the infaunal biotopes, with SS.SCS.CCS forming a band from east to west in the centre of the area corresponding to the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area (i.e. within the Mona Array Area).

1.7.5.5 The combined biotope map show in Figure 1.18 confirms many of the patterns described previously for the subtidal communities present in the Morgan benthic subtidal ecology study area. The results of the epifaunal overall supported the more refined classifications resulting from the infaunal analysis.

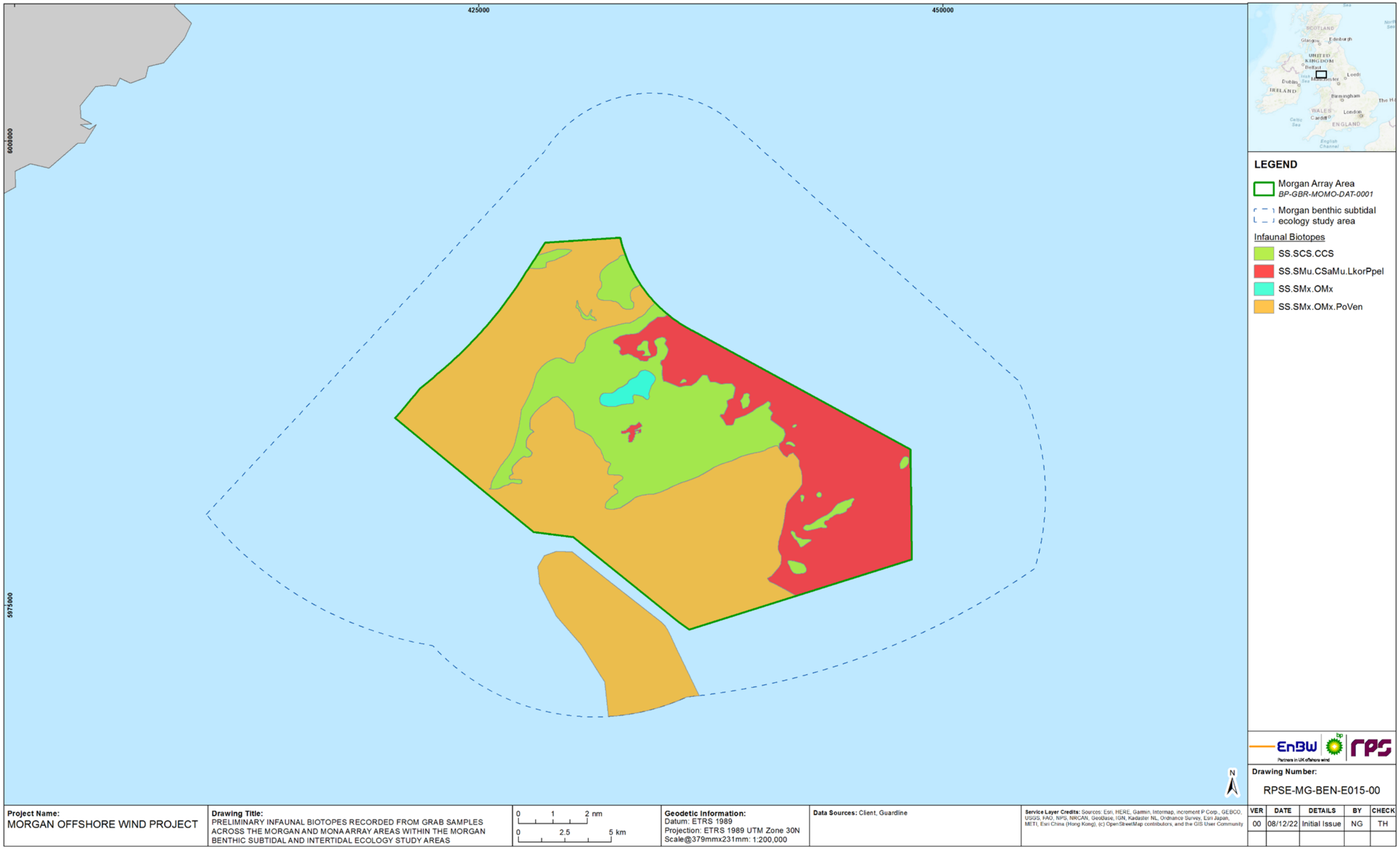

Figure 1.18: Combined infaunal and epifaunal biotope map of the Morgan benthic subtidal ecology study area (based on 2021 subtidal survey).

1.7.6 Results – habitat assessments

Seapens and burrowing megafauna communities' assessment

1.7.6.1 Across the Morgan Array Area small pencil burrows were observed in the site-specific surveys. Although no seapens were observed the JNCC (2013) guidance stipulates that 'sea pen and burrowing megafauna communities' habitat can occur without sea pens. As a result an analysis of this habitat was undertaken by determining the density of burrows and their abundance which was then categorised using the SACFOR classification. This assessed whether the density of the burrows makes them a prominent feature of the sediment surface and therefore an indication of the sub-surface complex burrowing communities. No attempt was made to determine the species which formed the burrows as this is a complex and detailed process the information for which is not available in the data acquired. As such, and in keeping with the JNCC report (JNCC, 2013) recommendations, caution should be applied when interpreting theses density results as they aren't necessarily definitive of the habitats condition.

1.7.6.2 The density of burrows varied from 0.39 burrows per m^2 at ENV94 to 6.62 burrows per m^2 at ENV73 within the Morgan Array Area. The majority of burrows were the 0-1 cm size range category with 43% of images from the Morgan Array Area falling within this range. Burrow abundance was not identified as greater than 'frequent' on the SACFOR scale at any station across the Morgan Array Area. Very few burrows were observed at stations where soft sediment was dominant. In combination with an absence of associated fauna and gravelly sediment, it was concluded that these areas have only a negligible resemblance to the 'sea pen and burrowing megafauna communities' habitat. The full results of the seapens and burrowing megafauna assessment can be found in Appendix B.

1.7.6.3 During imagery analysis burrowing fauna not associated with the 'sea pen and burrowing megafauna communities' habitat locations were observed across the Morgan Array Area including *Ceriantharia*. There was also no evidence of any species associated with 'sea pen and burrowing megafauna communities' habitat supporting the conclusions the determination that it is highly unlikely that any habitat across the Morgan survey area constitutes anything other than a negligible resemblance to the 'sea pen and burrowing megafauna communities' habitat.

Geogenic reef assessment

1.7.6.4 Seabed imagery indicated potential low resemblance stony reef in two sample stations within the Morgan ZOI during the 2021 survey campaign (Figure 1.19 and Figure 1.20). These sample stations were identified as part of surveys within the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area (i.e. within the Mona Array Area). As a result, an Annex I stony reef assessment was undertaken to determine if there was a resemblance to the protected habitat based on criteria set out by Irving (2009). Seabed imagery did not indicate any potential stony reefs within the Morgan Array Area.

1.7.6.5 Both of the stations that were subject to assessment in the Morgan ZOI, the resemblance to stony reef was determined to be low where cobbles and boulders were found (Table 1.14 and Figure 1.23). Both stations were clearly matrix supported, showed little change in relief, and were composed of patchy areas within larger areas of gravel. When images meeting one or more reef criteria were encountered in a few images or with large areas separating the image station they were overall determined to have no resemblance. Both stations within the Morgan ZOI were classified as low resemblance to Annex I stony reef, and this was often a reflection of a wider geophysical feature nearby as the quality observed was low (Figure 1.23).

1.7.6.6 Additionally, this was supported by the epifaunal coverage which showed only a small increase between areas of cobble and boulders compared to the surrounding habitats. Some species which are considered to be strong indicators of reef were observed (e.g. *A. digitatum, Nemertesia* sp. and *Tubularia* sp.) but these species were also found outside the areas of cobbles and boulders and tends to be seen more generally across areas of gravelly sediment types throughout the survey area.

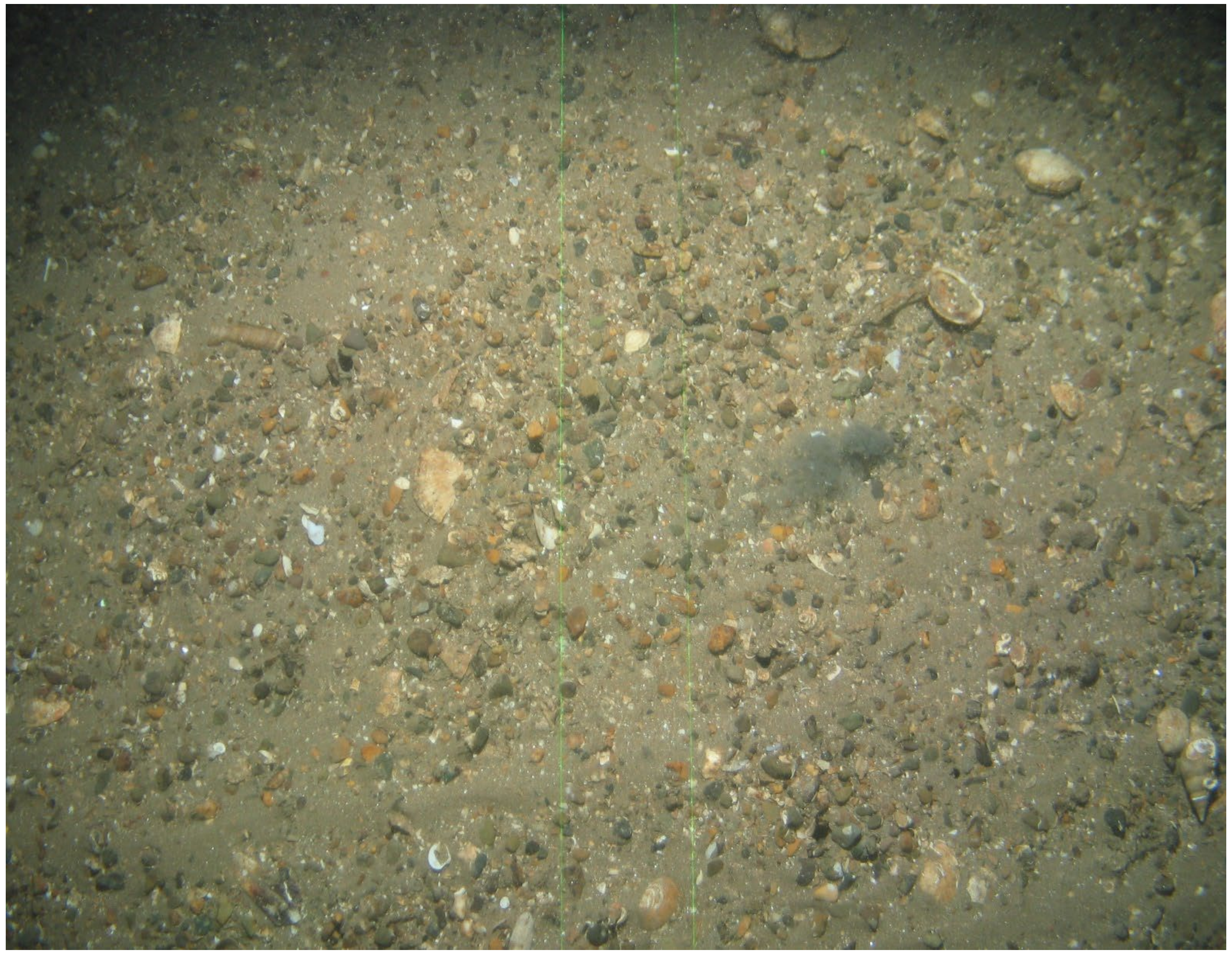

Figure 1.19: Example of typical seabed at sample station ENV79 within the Morgan Array Area.

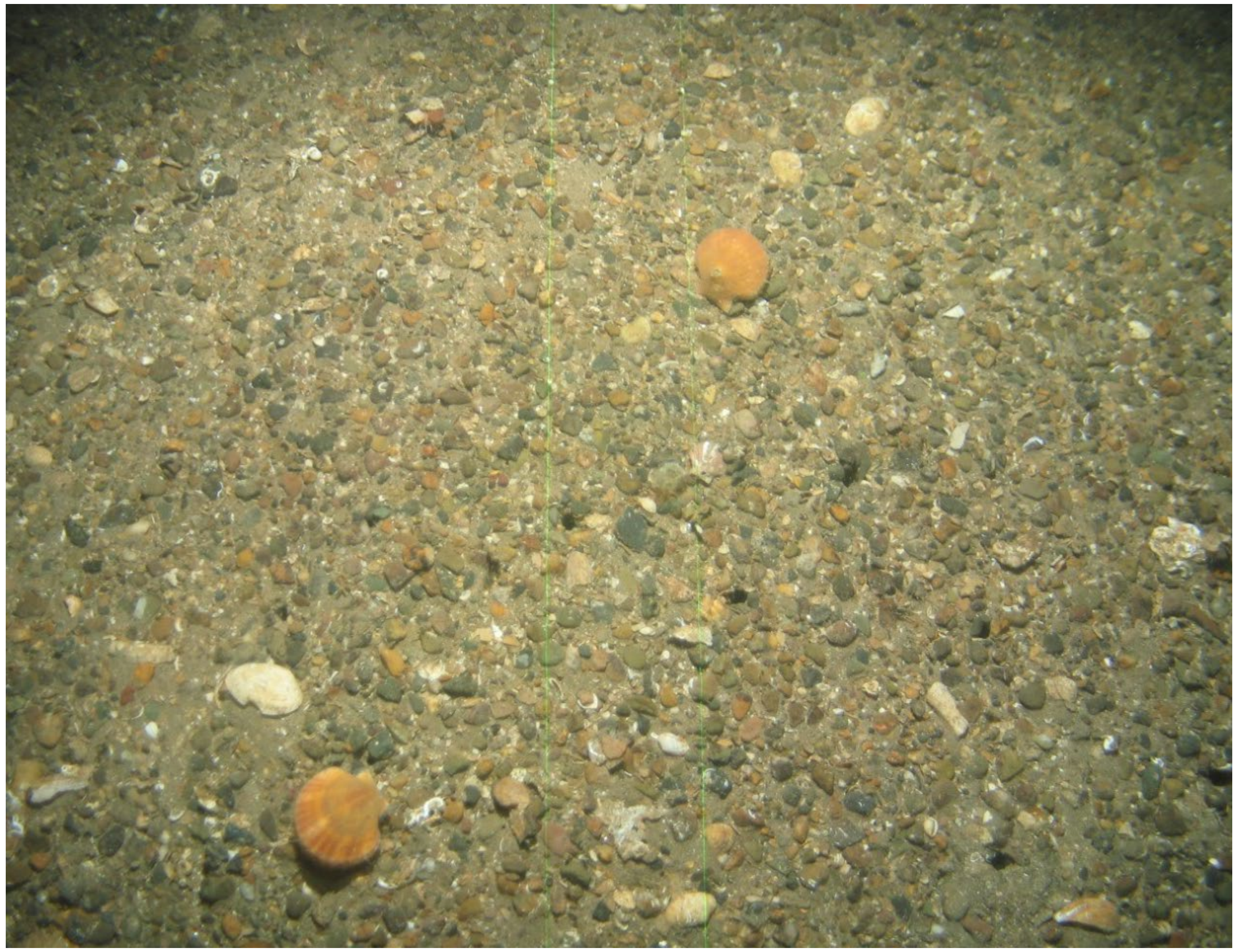

Figure 1.20: Example of typical seabed at sample station ENV76 within the Morgan Array Area.

Table 1.14: Annex I stony reef assessment summary for Morgan ZOI.

Station	Total Images	Camera Transect Length (m)	Mean swathe width per image (m)	Area Investigated (m2)	Number of Photos with Stony Features	Mean Stony Reef Height (cm)	Max Reef Height (cm)	Resemblance to 'Stony Reef'	Comments
ENV76	105	274.2	0.9	245.9	41	10	8.6	Low	Observations occur along ridge features targeted by investigation which appear to be aggregated clusters of cobbles.
ENV79	77	273.5	0.75	205.22	21	11	9.3	Low	Small, raised relief features in the bathymetry correspond with the increased density of cobbles and boulders.

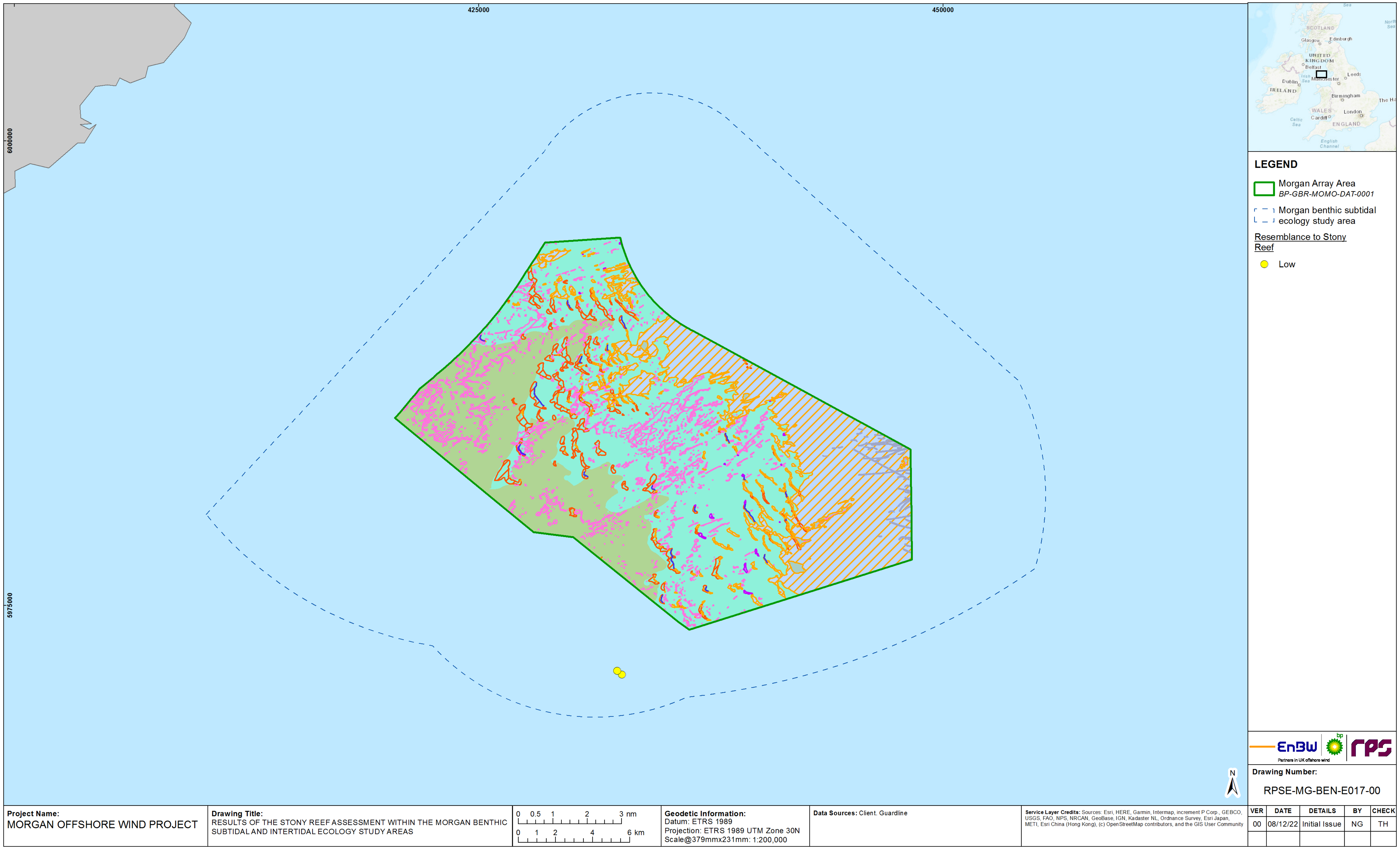

Figure 1.21: Results of the stony reef assessments undertaken within the Morgan subtidal ecology study area (based on XOcean 2021 survey).

Sponge dominated habitat

1.7.6.7 Hard substrate Porifera were observed across the Morgan Array Area with six stations across the Morgan Array Area showing evidence of Porifera. This evidence largely comprised images showing less than 1% of the image occupied by lone sponges such as cf. *Polymastia* sp., cf. *Suberites* sp. and cf. *Tethya* sp. (Figure 1.22). Typical densities observed within the images was a sole individual most often found in coarser substrates. Sample station ENV23 (Figure 1.23) had images with the greatest percentage occupied by Porifera, 0.65% of a single image containing hard substrate Porifera. Although several of the sponge species present and non-sponge species (e.g. *Nemertesia* sp.) are listed within the fragile sponge and anthozoan communities on rocky habitats (JNCC, 2008; JNCC, 2014) they were only recorded at very low abundances and were therefore not considered to represent this habitat. The full results of the sponge habitat assessment can be found in Appendix B.

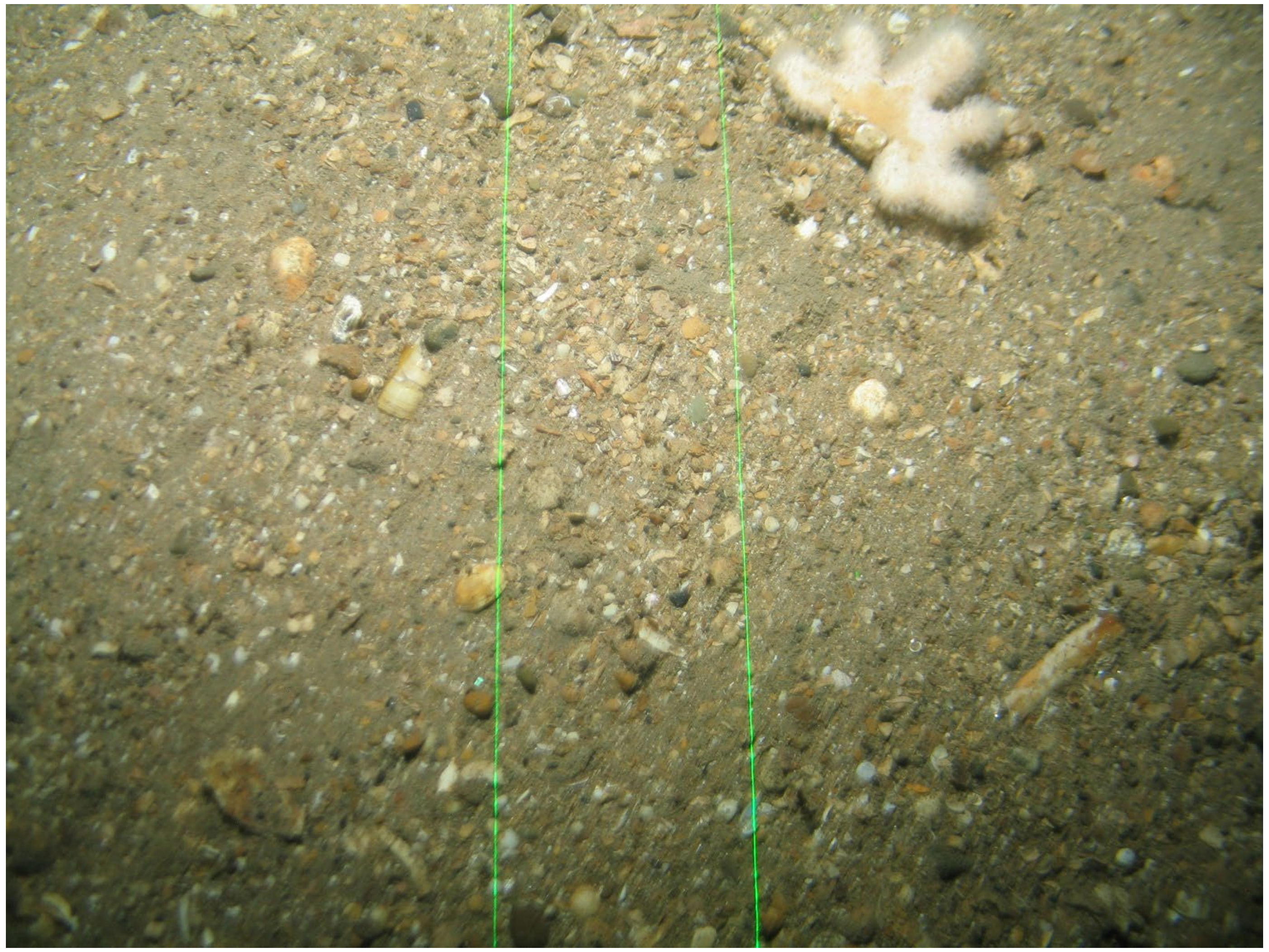

Figure 1.22: Example sponge occurrence at sample station ENV02 within the Morgan Array Area.

Figure 1.23: Example sponge occurrence at sample station ENV23 within the Morgan Array Area.

1.8 Summary

1.8.1 Morgan summary

1.8.1.1 The subtidal site-specific surveys consisted of infaunal grab samples and DDV surveys. Subtidal sediments recorded across the Morgan Array Area within the Morgan benthic subtidal ecology study area ranged from muddy sandy gravel to gravelly muddy sand with most samples classified as gravelly muddy sand. In the Morgan Array Area sediments graded from coarser in the west to finer sediments in the east. The Morgan Array Area was predominantly gravelly muddy sand interspersed with areas of muddy sandy gravel and gravelly sand. This aligned with the desktop data which indicated coarse sediments, sand and mixed sediments across the Morgan benthic subtidal ecology study area (EMODnet, 2019).

1.8.1.2 A total of 31 sediment samples from across the Morgan Array Area were analysed for sediment chemistry. Level of contamination were low and no samples were found to exceed the Cefas AL1 and AL2 for PCBs in the Morgan Array Area. Arsenic levels at eight sample stations marginally exceeded Canadian TEL in the Morgan Array Area. Concentrations of all other metals were below the Cefas AL1 and AL2 and the relevant Canadian TEL/PEL. The site-specific survey data showed that the benthic communities in the north, west and south sections of the Morgan Array Area were characterised by the polychaete-rich deep Venus community in offshore mixed sediments (SS.SMx.OMx.PoVen) biotope. The central area of the Morgan Array Area was characterised by circalittoral coarse sediment (SS.SCS.CCS) with a small area characterised by offshore circalittoral mixed sediment (SS.SMx.OMx). The east and most of the north edge of the Morgan Array Area were characterised by muddier sediments and the *Lagis koreni* and *Phaxas pellucidus* in circalittoral sandy mud (SS.SMu.CSaMu.LkorPpel) biotope.

1.8.1.3 The habitat assessment concluded that habitats across the Morgan Array Area were highly unlikely to have anything other than a negligible resemblance, at best, to the ‘sea pen and burrowing megafauna communities’ habitat. Geogenic reef assessments for Annex I stony reefs found two stations classified as low resemblance stony reef located to the south of the Morgan Array Area (i.e. in the ZOI). No areas of stony reef were identified in the Morgan Array Area. An assessment for sponge dominated habitat was also undertaken but no stations were found to represent this habitat.

1.8.2 Important ecological features

1.8.2.1 In accordance with the best practice guidelines (CIEEM, 2019), for the purposes of the benthic subtidal ecology EIA, IEFs have been identified and all potential impacts of the Morgan Generation Assets will be assessed against the IEFs to determine whether or not they are significant. The IEFs of an area are those that are considered to be important and potentially affected by the Morgan Generation Assets (Table 1.15). Importance may be assigned due to quality or extent of habitats, habitat or species rarity or the extent to which they are threatened (CIEEM, 2019). Species and habitats are considered IEFs if they have a specific biodiversity importance recognised through international or national legislation or through local, regional or national conservation plans (e.g. Annex I habitats under the Habitats Directive, OSPAR, National Biodiversity Plan or the Marine Strategy Framework Directive).

1.8.2.2 The biotopes present across the Morgan benthic subtidal ecology study area have been grouped into broad habitat/community types. The identified IEFs will be taken forward for assessment within the benthic subtidal ecology EIA Report (volume 2, chapter 7: Benthic subtidal ecology of the PEIR) and used to assess impacts associated with the construction, operations and maintenance and decommissioning of the Morgan Generation Assets on benthic subtidal ecology.

Table 1.15: IEFs within the Morgan benthic subtidal ecology study area.

IEF	Description and representative biotopes	Protection status/ Conservation interest	Importance within the Morgan benthic subtidal ecology study area
Subtidal habitats			
Subtidal sand and muddy sand sediments with benthic communities dominated by *Lagis koreni* and other polychaetes.	Sand and muddy sand, characterised by tube building polychaete *Lagis koreni*, and other polychaetes such as *Mediomastus fragilis* and *Spiophanes bombyx*, as well as bivalves and arthropods. Identified within the Morgan Array Area. SS.SMu.CSaMu.LkorPpel.	UK Biodiversity Action Plan (BAP) priority habitat, Environment (Wales) Act 2016: Section 7	National
Subtidal coarse and mixed sediments with diverse benthic communities	Subtidal coarse and mixed sediments characterised by polychaetes, bivalves and mobile crustaceans. Identified within the Morgan Array Area. • SS.SCS.CCS • SS.SMx.OMx • SS.SMx.OMx.PoVen.	UK BAP priority habitat, Environment (Wales) Act 2016: Section 7	National
Low resemblance stony reef	Cobbles and boulders with indicator species such as *A. digitatum*, *Nemertesia* sp. and *Tubularia* sp. Identified within the ZOI to the south of the Morgan Array Area. CR.HCR.XFa.SpNemAdia.	Potential Annex I habitat outside an SAC	National
West of Walney MCZ			
Subtidal mud	Muds and sandy muds in extremely sheltered areas with very weak tidal currents. High numbers of polychaetes, bivalve and echinoderms such as urchins and brittle stars. SS.SMu.CSaMu.AfilKurAnit	UK BAP priority habitat Protected feature of an MCZ	National

IEF	Description and representative biotopes	Protection status/ Conservation interest	Importance within the Morgan benthic subtidal ecology study area
Subtidal sand	Sand seascapes with infaunal polychaetes and bivalves. • SS.SMu.CSaMu.AfilKurAnit SS.SMx.CMx.KurThyMx	UK BAP priority habitat Protected feature of an MCZ	National
Sea-pens and burrowing megafauna communities	Fine mud heavily bioturbated by burrowing megafauna; burrows and mounds may form a prominent feature with conspicuous populations of sea pens, typically *Virgularia mirabilis* and *Pennatula phosphorea*. SS.SMu.CFiMu.SpnMeg	OSPAR habitat, UK BAP priority habitat Protected feature of an MCZ	National
West of Copeland MCZ			
Subtidal coarse sediment	Coarse sand and gravel or shell fragments. Largely characterised by infaunal communities include bristleworms, sand mason worms, burrowing anemones and bivalves. SS.SCS.CCS	UK BAP priority habitat Protected feature of an MCZ	National
Subtidal mixed sediment	A range of different types of sediments. Animals found here include worms, bivalves, starfish and urchins, anemones, sea firs and sea mats. • SS.SMx.OMx SS.SMx.OMx.PoVen	Protected feature of an MCZ	National
Subtidal sand	Sand seascapes with infaunal polychaetes and bivalves. SS.SMu.CSaMu.AfilKurAnit	UK BAP priority habitat Protected feature of an MCZ	National

1.9 References

Allison, S.D. and Martiny, J.B.H., 2008. Resistance, resilience, and redundancy in microbial communities. Proceedings of the National Academy of Sciences of the United States of America, 12 August. pp.11512-19.

Antill, R. and Pérez-Domínguez, R. (2021) *Morecambe Bay SAC Intertidal Reef Surveys 2015: Final Report.* APEM Scientific Report for Natural England. 115 pp.

APEM (2015) Ribble Estuary SSSI / Ribble and Alt SPA Intertidal sediments condition monitoring, Available at: [Ribble Estuary SSSI / Ribble & Alt SPA Intertidal sediments condition monitoring - IPENS022 (naturalengland.org.uk)](), Accessed on: 21 March 2022

Bamber, R.N. (1988) *'A survey of the intertidal soft-sediment fauna of the Mersey Estuary'*, March 1987. Unpublished, Central Electricity Generating Board (Reports Group Report no: RD/L/3338/R88).

Callaway, R. (2003) Long-term effects of imitation polychaete tubes on benthic fauna: they anchor *Mytilus edulis* (L.) banks. *Journal of Experimental Marine Biology and Ecology*, 283: 115-132.

Callaway, R. (2006) Tube worms promote community change. *Marine Ecology Progress Series*, 308: 49- 60.

Camacho-Ibar, V.F., Wrench, J.J., and Head, P.C. (1992) *Contrasting behaviour of arsenic and mercury in Liverpool Bay sediments, Estuarine, Coastal and Shelf Science*, Volume 34, Issue 1, Pages 23-36, ISSN 0272-7714

CCME (2001) Canadian environmental quality guidelines for the protection of aquatic life, CCME water quality index: technical report, 1.0.

CCW (2007) The biodiversity and conservation of the shores of Wales – results from a 10 year intertidal survey of Wales, Accessed on: 09 June 2022, Available at: Intertidal Survey FINAL.qxd (researchgate.net)

CEC. (1999) Interpretation Manual – EUR 15.

CEC. (2007) Interpretation Manual of European Union Habitats.

Cefas (2005) A Review of the Contaminant Status of the Irish Sea, Available at: untitled (publishing.service.gov.uk), Accessed on: 19th April 2022

Cefas (2014) Classification of Bivalve Mollusc Production Areas in England and Wales: Sanitary Survey Report Colwyn Bay, Available at: CLASSIFICATION OF BIVALVE MOLLUSC (cefas.co.uk), Accessed on: 12th April 2022

Celtic Array Ltd. (2014) *Preliminary Environmental Information Chapter 9 Benthic Ecology*, Accessed on: 08 March 2022

CIEEM (2019) Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine, Version 1.1 – Updated September 2019.

Clarke R. and Gorley R.N. (2006) PRIMER version 6: user manual/tutorial. PRIMER-E, Plymouth, UK, p192.

Clarke, K.R. and Warwick, R.M. (2001) Change in Marine Communities: An Approach to Statistical Analysis and Interpretation. Second Edition, PRIMER-E, Plymouth.

CMACS (2002). Final report to Total Fina Elf by the Centre for Marine and Coastal Studies. Isle of Man intertidal surveys and guide to habitat mapping and GIS. CMACS/PEML.

CMACS (2005a) *Burbo Banks Offshore Wind Farm Pre-construction Contaminants Investigation*, Accessed on: 07 March 2022

CMACS (2005b) *Gwynt y Môr offshore wind farm Marine Benthic Characterisation Survey*. A report to NPower renewables (Gwynt y Môr offshore wind farm Environmental Impact Assessment).

CMACS (2009) *Walney and Ormonde Offshore Windfarm Benthic Survey Report*, Accessed on: 07 March 2022

CMACS (2011) *Gwynt y Môr Offshore Wind Farm baseline pre-construction benthic survey report (2010 survey)*. Report to Gwynt y Môr OWF Ltd. July 2011, Accessed on: 07 March 2022

CMACS (2012a) *Ormonde Offshore Wind Farm Year 1 post-construction benthic monitoring technical survey report (2012 survey).* Report to RPS Energy, Accessed on: 07 March 2022

CMACS (2012b) *Walney Offshore Wind Farm Year 1 postconstruction benthic monitoring technical survey report (2012 survey).* Report to Walney Offshore Wind Farms (UK) Ltd/DONG Energy. July 2012.

CMACS (2013) *Walney Offshore Wind Farm Year 1 postconstruction benthic monitoring technical survey report (2013 survey).* Report to Walney Offshore Wind Farms (UK) Ltd/DONG Energy, Accessed on: 08 March 2022

CMACS (2014) *Walney Offshore Wind Farm Year 3 postconstruction benthic monitoring technical survey report (2014 survey).* Report to Walney Offshore Wind Farms (UK) Ltd/DONG Energy, Accessed on: 08 March 2022

CMACS (2015) *Benthic and Annex I Habitat Pre-construction Survey Field Report*, Report to Burbo Bank Offshore Wind Farms (UK) Ltd/DONG Energy

Connor, D.W., Allen, J.H., Golding, N., Howell, K.L., Lieberknecht, L.M., Northen, K.O. and Reker, J.B. (2004) The Marine Habitat Classification for Britain and Ireland. Version 04.05, JNCC, Peterborough.

Connor, D.W., Dalkin, M.J., Hill, T.O., Holt, R.H.F, and Sanderson, W.G. (1997) *Marine biotope classification for Britain and Ireland*. Vol 2. Sublittoral biotopes. Version 97.06. JNCC Report No 230. Joint Nature Conservation Committee, Peterborough.

Countryside Council for Wales (CCW) (2002) SITE OF SPECIAL SCIENTIFIC INTEREST CITATION CONWY CREIGIAU RHIWLEDYN/LITTLE ORMES HEAD, Accessed December 2022, Available at https://naturalresources.wales/media/653420/SSSI_0844_Citation_EN001acd7.pdf.

Countryside Council for Wales (CCW) (2003) SITE OF SPECIAL SCIENTIFIC INTEREST CITATION CONWY ABER AFON CONWY, Accessed December 2022, Available at https://www.cofnod.org.uk/resources/sssi/2545/SSSI_2545_Citation_EN001.pdf.

Countryside Council for Wales (CCW) (2004) '*Phase I- Intertidal Survey- Standard Report'*, 11.55.2 Arfon Clwyd to Llanddulas.

Countryside Council for Wales (CCW) (2013) Great Ormes Head - Pen Y Gogarth ACA management plan, Accessed December 2022, Available at https://naturalresources.wales/media/672382/Great%20Orme%20SAC%20Management%20Plan%2017.04.08%20English.pdf

Cumbria Biological Data Network (2010) Coastal Intertidal Habitats, Accessed: 09 June 2020 Available at: Habitats for Evidence Base (cbdc.org.uk)

Davies, J., Baxter, J., Bradley, M., Connor, D., Khan, J., Murray, E., Sanderson, W., Turnbull, C. and Vincent, M. (2001) *Marine Monitoring Handbook*. JNCC, Peterborough.

Davison D.M. and Hughes D. J. (1998) Zostera Biotopes (volume I). An overview of dynamics and sensitivity characteristics for conservation management of marine SACs. Scottish Association for Marine Science (UK Marine SACs Project). 95pp.

DEFA (2022a) Langness Marine Nature Reserve Guide, Accessed December 2022, Available at: https://www.gov.im/media/1376789/langness-mnr-guide.pdf

DEFA (2022b) Douglas Bay Marine Nature Reserve Guide, Accessed December 2022, Available at: https://www.gov.im/media/1366090/douglas-bay-guide.pdf

DEFA (2022c) Laxey Bay Marine Nature Reserve Guide, Accessed December 2022, Available at: https://www.gov.im/media/1376791/laxey-bay-mnr-guide.pdf

DEFA (2022d) Baie y Carrickey Marine Nature Reserve Guide, Accessed December 2022, Available at: https://www.gov.im/media/1376783/baie-ny-carrickey-mnr-guide.pdf

DEFA (2022e) Calf of Man and Wart Bank Marine Nature Reserve Guide, Accessed December 2022, Available at: https://www.gov.im/media/1376785/calf-wart-bank-mnr-guide.pdf

DEFA (2022f) Ramsey Bay Marine Nature Reserve Guide, Accessed December 2022, Available at: https://www.gov.im/media/1376799/ramsey-bay-mnr-guide.pdf

DEFA (2022g) Niarbyl Bay Marine Nature Reserve Guide, Accessed December 2022, Available at: https://www.gov.im/media/1376796/niarbyl-bay-mnr-spotter-sheet.pdf

DEFA (2022h) West Coast Marine Nature Reserve Guide, Accessed December 2022, Available at: https://www.gov.im/media/1376801/west-coast-mnr-guide.pdf

DEFA (2022i) Little Ness Marine Nature Reserve Guide, Accessed December 2022, Available at: https://www.gov.im/media/1376793/little-ness-mnr-guide.pdf

DEFA (2022j) Port Erin Bay Marine Nature Reserve Guide, Accessed December 2022, Available at: https://www.gov.im/media/1376797/port-erin-bay-mnr-guide.pdf

Defra (2013) *Fylde Marine Conservation Zone Fact Sheet*. Accessed on: 25 July 2022, Available at: Marine conservation zone 2013 designation: Fylde - GOV.UK (www.gov.uk)

Defra (2016) West of Walney Marine Conservation Zone – Factsheet, Accessed on: 27 July 2022, Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/492471/mcz-west-walney-factsheet.pdf

Defra (2019) West of Copeland Marine Conservation Zone – Factsheet, Accessed on; 27 July 2022, Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/915435/mcz-west-copeland-2019.pdf

Defra (2022c) Allonby Bay Marine Conservation Zone, Accessed December 2022, Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/492326/mcz-allonby-bay-factsheet.pdf

Defra (2021) *Cumbria Coast Marine Conservation Zone Factsheet*, Available at: Cumbria Coast Marine Conservation Zone factsheet (publishing.service.gov.uk), Accessed on: 18 March 2022

Dong Energy Ltd (2013a) *Environmental Statement Volume 2 – Chapter 12: Subtidal and Intertidal Benthic Ecology*, Report to Burbo Bank Extension Offshore Wind Farms (UK) Ltd/DONG Energy, Accessed on: 08 March 2022

Dong Energy Ltd (2013b) *Volume 1 Environmental Statement Walney Extension, Chapter 10: Benthic Ecology*, Report to Walney Offshore Wind Farms (UK) Ltd/DONG Energy, Accessed on: 08 March 2022

European Marine Observation Data Network (EMODnet) (2019) Seabed Habitats Initiative. Financed by the European Union under Regulation (EU) No 508/2014 of the European Parliament and of the Council of 15 May 2014 on the European Maritime and Fisheries Fund. Available at: www.emodnetseabedhabitats.eu. Accessed on: 08 March 2021

Frühe, L., Dully, V., Forster, D., Keeley, N.B., Laroche, O., Pochon, X., Robinson, S., Wilding, T.A. and Thorsten, S., 2021. Global Trends of Benthic Bacterial Diversity and Community Composition Along Organic Enrichment Gradients of Salmon Farms. Available at: https://doi.org/10.3389/fmicb.2021.637811.

Garwood, P. and Foster-Smith, R. (1991) *'Intertidal survey from Rhos Point to New Brighton'*, Nature Conservancy Council (CSD Report no: 1,194).

Golding, N., Albrecht, J. and McBreen, F. (2020) Refining the criteria for defining areas with a 'low resemblance' to Annex I stony reef. JNCC Report No. 656.

Gubbay, S. (2007) *Defining and Managing Sabellaria spinulosa Reefs*; Report of an interagency workshop. JNCC report No.405, Accessed on: 08 March 2022

Hendrick , V. and Foster-Smith, R. (2006) *Sabellaria spinulosa* reef: A scoring system for evaluating 'reefiness' in the context of the Habitats Directive. J*ournal of the Marine Biological Association of the United Kingdom*. 86. 665 - 677. 10.1017/S0025315406013555.

Holt, T. J., Rees, E. I., Hawkins, S. J. and Seed, R. (1998) *Biogenic Reefs (volume IX). An overview of dynamic and sensitivity characteristics for conservation management of marine SACs*. Scottish Association for Marine Science (UK Marine SACs Project). 170 Pages.

Holt, T.J., Shalla, S.H.A., and Brand, A.R. (1997) *Broadscale seabed survey to the east of the Isle of Man.* A report to British Petroleum, Exploration Team

Horton, D.J., Theis, K.R., Uzarski, D.G. and Learman, D.R., 2019. Microbial community structure and microbial networks correspond to nutrient gradients within coastal wetlands of the Laurentian Great Lakes. FEMS Microbiology Ecology, 95(4), pp.https://doi.org/10.1093/femsec/fiz033.

Howe V.L. (2018a) *Subtidal Ecology. In: Manx Marine Environmental Assessment (2nd Ed).* Isle of Man Government. pp 48.

Howe V.L. (2018b) *Coastal Ecology. In: Manx Marine Environmental Assessment (2nd Ed).* Isle of Man Government. pp 24

Hughes D.J. (1998) *Subtidal brittlestar beds (volume IV). An overview of dynamics and sensitivity characteristics for conservation management of marine SACs*. Scottish Association for Marine Science (UK Marine SACs Project). 78 Pages.

Innogy (2002) North Hoyle offshore windfarm environmental statement, 2002. Innogy NWP offshore Ltd.

Innogy (2020) Awel y Môr Environmental Impact Assessment Scoping Report

Irving, R. (2009) *The identification of the main characteristics of stony reef habitats under the Habitats Directive.* Summary report of an inter-agency workshop 26-27 March 2008.

Jenkins, C., Eggleton, J., Albrecht, J., Barry, J., Duncan, G., Golding, N. and O'Connor, J. (2015) North Norfolk Sandbank and Saturn Reef cSAC/SCI Management Investigation Report.

JNCC/Cefas Partnership Report Series No. 7, JNCC, Peterborough, ISSN 2051-6711. http://hub.jncc.gov.uk/asserts/e1cafa60-03e5-411a-96b6-d7fed00dccb0

JNCC (2003) *Handbook for Phase 1 habitat survey - a technique for environmental audit.* JNCC, Peterborough.

JNCC (2008) *UK BAP Priority Habitat Descriptions (Sublittoral Rock) (2008).* Available at: https://hub.jncc.gov.uk/assets/0a9b6b43-4827-44a4-ab06-0f94d5ad6b93, Accessed on: 03 May 2022.

JNCC (2013) *SACFOR abundance scale used for both littoral and sublittoral taxa from 1990 onwards.* Available at: https://mhc.jncc.gov.uk/media/1009/sacfor.pdf, Accessed on: 03 May 2022.

JNCC (2014) *Monitoring, assessment and reporting of UK benthic habitats: A rationalised list.* Available at: https://hub.jncc.gov.uk/assets/fb82e7cc-8ee2-494b-8af7-2360d809dee9, Accessed on: 03 May 2022.

JNCC (2015) *The Marine Habitat Classification for Britain and Ireland Version 22.04. [Accessed 26.05.2022]* Available at: https://mhc.jncc.gov.uk/.

JNCC (2022a) Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay SAC, Accessed August 2022, Available at: https://sac.jncc.gov.uk/site/UK0030202

JNCC (2022b) Aber Dyfrdwy / Dee Estuary SAC, Accessed December 2022, Available at: https://sac.jncc.gov.uk/site/UK0030131

JNCC (2022c) Morecambe Bay SAC, Accessed December 2022, Available at: https://sac.jncc.gov.uk/site/UK0013027

JNCC (2022d) Luce Bay and Sands SAC, Accessed December 2022, Available at: https://sac.jncc.gov.uk/site/UK0013039

JNCC (2022e) Solway Bay SAC, Accessed December 2022, Available at: https://sac.jncc.gov.uk/site/UK0013025

Judd, A.G. (2005) The distribution and extent of 'submarine structures formed by leaking gas' and other seabed features (reefs) relevant to the 'Habitats Directive'. Technical Report produced for SEA6 Strategic Environmental Assessment of the Irish Sea.

Kenyon and Cooper (2015) Sand banks, sand transport and offshore wind farms, Accessed on 29 July 2022, Available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjdwsHU2Z35AhUJfMAKHcYcA2g4ChAWegQIBBAB&url=https%3A%2F%2Fwww.vliz.be%2Fimisdocs%2Fpublications%2Focrd%2F253773.pdf&usg=AOvVaw38qfvp2P2ubNrVmsSKOH3c

Leah, R.T., Collings, S.E., Johnson, M.S. and Evans, S.J. (1993) *Mercury in plaice (Pleuronectes platessa) from the sludge dispoal ground of Liverpool Bay*. Marine Pollution Bulltin, 26 (8), pp 436 – 439.

Limpenny, D.S., Foster-Smith, R.L., Edwards, T.M., Hendrick, V.J., Diesing, M., Eggleton, J.D., Meadows, W.J., Crutchfield, Z., Pfeifer, S. and Reach, I.S. (2010) *Best methods for identifying and evaluating Sabellaria spinulosa and cobble reef.* Accessed on: 09 March 2022

Long (2006) *BGS detailed explanation of seabed sediment modified Folk classification*. Available from: https://webarchive.nationalarchives.gov.uk/20101014090013/http://www.searchmesh.net/PDF/GMHM3_Detailed_expl anation_of_seabed_sediment_classification.pdf. Accessed on: 17 July 2022

Mackie, A.S.Y. (1990) *Offshore benthic communities of the Irish Sea*. In The Irish Sea: an environmental review. Part 1. Nature conservation, ed. Irish Sea Study Group, Liverpool University Press, pp 169 – 218, Accessed on: 10 March 2022

Maddock, A. ed (2008) *UK Biodiversity Action Plan Priority Habitat Descriptions - Sabellaria alveolata Reefs.*

MMEA (2018) Manx Marine Environmental Assessment: Ecology/Biodiversity- Subtidal Ecology, Available at: DRAFT_Subtidal.Ecology_v3_27072012_finalisingLH (gov.im), Accessed on: 07 April 2022.

Moore, J. (2002) *An atlas of marine biodiversity action plan species and habitats and species of conservation concern in Wales*. 2nd Edition. CCW contract science report no 509. Accessed on: 09 March 2022

Natural England (2012) *Shell Flat & Lune Deep candidate Special Area of Conservation - Formal advice under Regulation 35(3) of The Conservation of Habitats and Species Regulations 2010*, Accessed on: 27 July 2022, Available at: http://publications.naturalengland.org.uk/publication/3270764

Natural England (2015) *Ribble Estuary SSSI / Ribble & Alt SPA Intertidal sediments condition monitoring*. Accessed on: 25 July 2022, Available at: http://publications.naturalengland.org.uk/publication/6272061418766336

Natural Resources Wales (2015) Marine Character Areas (MCA 02) - Colwyn Bbay & Rhyl Flats, Accessed on 29 July 2022, Available at: https://cdn.cyfoethnaturiol.cymru/media/674480/mca-02-colwyn-bay-and-rhyl-flats-final.pdf?mode=pad&rnd=131502219930000000

Natural Resources Wales (2016) *Marine Phase 1 Intertidal Habitat Survey*

Natural Resources Wales (2019) *Y Fenai a Bae Conwy / Menai trait and Conwy Bay Special Area of Conservation Indicative site level feature condition assessments 2018.* Accessed on: 25 July 2022, Available at: Menai Strait and Conwy Bay Special Area of Conservation (cyfoethnaturiol.cymru)

Natural Resources Wales (2019) Be*nthic habitat assessment guidance for marine developments and activities A guide to characterising and monitoring Sabellaria reefs.* Guidance note: GN030d.

North West and North Wales Coastal Group (2011) North West England and North Wales Shoreline Management Plan SMP2 - Main SMP2 Document, Accessed on: 26 July 2022, Available at: http://www.hoylakevision.org.uk/wp-content/uploads/2012/11/SMP2Main.pdf

npower renewables Ltd (2005) *Gwynt y Mor Offshore Windfarm, Environmental Statement, Chapters 6 - The existing biological environment,* Accessed on: 10 March 2022

Offshore Energy Strategic Environmental Assessment (SEA) (2016a) *OESEA3 Environmental Report: Future Leasing/Licensing for Offshore Renewable Energy, Offshore Oil & Gas, Hydrocarbon Gas and Carbon Dioxide Storage and Associated Infrastructure*, Available at: DECC OESEA3 ER (publishing.service.gov.uk), Accessed on: 09 March 2022

Offshore Energy Strategic Environmental Assessment (SEA) (2016b) *Appendix 1 Environmental Baseline*, Available at: Microsoft Word - A3a2 Benthos Final 260109.doc (publishing.service.gov.uk), Accessed on: 09 March 2022

Rabaut, M., Guilini, K., Van Hoey, G., Vincx, M. and Degraer, S. (2007) A bio-engineered soft-bottom environment: The impact of Lanice conchilega on the benthic species-specific densities and community structure. *Estuarine Coastal and Shelf Science*, 75: 525-536.

Rabaut, M. (2009) *Lanice conchilega, fisheries and marine conservation: Towards an ecosystem approach to marine management*. Ghent University (UGent), PhD thesis, 354 pp.

Rabaut, M., Vincx, M. and Degraer, S. (2009) Do *Lanice conchilega* (sandmason) aggregations classify as reefs? Quantifying habitat modifying effects. *Helgoland Marine Research*, 63: 37-46.

Rees, E.I.S, Walker, A.J.M., and Ward, A.R. (1972) *Benthic fauna in relation to sludge disposal. In Out of Sight: Out of mind. Report of a working party on the disposal of sludge in Liverpool Bay,* Volume 2: Appendices. Department of the Environment, London, pp 229 – 343

Rees, E.I.S. (2001) *Habitat specialization by Thia scutellata (Decapoda: Brachyura) off Wales*. Journal of the marine Biological Association of the United Kingdom. 81, pp 697-698. Accessed on: 09 March 2022

Rees EIS (2005) Assessment of the status of horse mussel (Modiolus modiolus) beds in the Irish Sea off NW Anglesey. A report for the Department of Trade and Industry, UK.

Rees, E.I.S. (2009) Assessment of Modiolus modiolus beds in the OSPAR area. OSPAR Background Document for Modiolus modiolus beds prepared for JNCC. Available at http://www.OSPAR.org/html_documents/OSPAR/html/p00425_bdc%20version%20uk_modiolus.pdf Accessed on: 08 March 2022

Rowlatt, S. M., and Lovell, D. R. (1994) *Lead, zinc and chromium in sediment around England and Wales*. Marine Pollution Bulletin. 28:828-830.

Seascape Energy Ltd. (2002) Burbo offshore wind farm Environmental Statement. 324pp.

SeaScape Energy (2011) *Burbo offshore wind farm, third post-construction benthic grab survey report (2009 survey)*. Report prepared by Centre for Marine and Coastal Studies Ltd (CMACS), Accessed on: 07 March 2022

Solway Firth Partnership (2021) *Intertidal rock, sediments and biodiversity*, Available at: Intertidal rock, sediments and biodiversity | Solway Review (solwayfirthpartnership.co.uk), Accessed on: 18 March 2022

Thornton, I., and Farago, M. (1997) *The geochemistry of arsenic.* In: Abernathy C.O., Calderon R.L., Chappell W.R. (eds) Arsenic. Springer, Dordrecht.

TLSB. (2017) *Tidal Lagoon Swansea Bay Adaptive Environmental Management Plan*.

Unicomarine Ltd (2005) *Results of benthic sampling (macrofauna and sediment composition) at the proposed Ormonde Development Project windfarm site and cable route, in the vicinity of Morecambe Bay*

Wentworth, C. K. (1922) A Scale of Grade and Class Terms for Clastic Sediments. *The Journal of Geology*. 30 (5): 377–392.

White S. (2011) Biotope distribution and susceptibility to fishing pressure. MSc Thesis, Bangor University.

Wilding, T.A., Nickell, L.A., Gontyarek, S., and Sayer, M.D.J. (2005a) Synthesis of information on the benthos of area SEA 6. Report for the Department of Trade and Industry.

Wilding, T.A., Duncan, J., Nickell, L.A., Hughes, D.J., Gontyarek S., Black, K.D., and Sayer, M.D.J. (2005b) Synthesis of information on the benthos of SEA 6 Clyde Sea area. Report for the Department of Trade and Industry

Williams, K.P., Gillespie, J.J., Sobral, B.W.S., Nordburg, E.K., Snyder, E.E., Shallom, J.M. and Dickerson, A.W. (2010) Phylogeny of Gammaproteobacteria. Journal of Bacteriology, 192(9), pp.2305-14.

Wyn, G. and Brazier, P. (2001) *Procedural Guideline No. 3-1 - In situ intertidal biotope recording*. In Davies J., Baxter J., Bradley M., Connor D., Khan J., Murray E., Sanderson W., Turnbull C. and Vincent M. (2001). *Marine Monitoring Handbook*. JNCC, Peterborough.

Wyn, G., Brazier, P., Birch, K., Bunker, A., Cooke, A., Jones, M., Lough, N., McMath, A. and Roberts, S. (2006) *Handbook for Marine Intertidal Phase 1 Biotope Mapping Survey*. Countryside Council for Wales, Bangor.

Appendix A: Seabed sediments

Table A 1: Results of Particle Size Analysis (Morgan).

Station Number	Folk Classification	Sorting	Major Sediment Fractions		
			%Fines	%Sand	% Gravel
ENV01	Gravelly muddy sand	Very poor	10.67	78.68	10.65
ENV02	Gravelly sand	Poor	7.36	85.32	7.32
ENV03	Gravelly muddy sand	Very poor	9.83	79.99	10.19
ENV04	Gravelly muddy sand	Very poor	14.12	64.12	21.76
ENV05	Muddy sandy gravel	Very poor	6.94	55.89	37.17
ENV06	Gravelly muddy sand	Very poor	12.08	77.90	10.03
ENV07	Gravelly sand	Poor	2.59	84.46	12.95
ENV08	Gravelly sand	Very poor	7.83	78.11	14.06
ENV09	Gravelly muddy sand	Poor	10.42	83.54	6.05
ENV10	Gravelly muddy sand	Very poor	12.55	62.54	24.91
ENV11	Sand	Poor	9.13	90.77	0.10
ENV12	Slightly gravelly sand	Poor	6.65	90.36	2.99
ENV13	Gravelly sand	Poor	8.96	84.02	7.02
ENV14	Gravelly sand	Poor	8.79	85.55	5.65
ENV15	Gravelly muddy sand	Very poor	9.25	67.43	23.31
ENV16	Sand	Moderate	3.85	95.66	0.48
ENV17	Gravelly sand	Poor	7.67	84.40	7.93
ENV18	Gravelly muddy sand	Very poor	10.38	72.98	16.64
ENV19	Gravelly muddy sand	Very poor	9.00	65.15	25.85
ENV20	Gravelly sand	Poor	3.13	83.66	13.21
ENV21	Sand	Poor	9.15	90.79	0.06
ENV22	Sand	Moderate	2.44	97.25	0.32
ENV23	Slightly gravelly sand	Poor	3.90	94.35	1.75
ENV24	Gravelly sand	Very poor	6.88	77.12	16.00
ENV25	Sand	Poor	9.23	90.66	0.11
ENV26	Sand	Moderately well	0.00	99.92	0.08
ENV27	Gravelly muddy sand	Very poor	11.45	62.53	26.02
ENV28	Gravelly sand	Very poor	4.05	71.09	24.86
ENV29	Gravelly muddy sand	Very poor	13.79	76.33	9.88
ENV30	Sand	Moderately well	0.00	99.77	0.23
ENV90	Gravelly muddy sand	Very poor	11.07	66.13	22.80
ENV91	Gravelly muddy sand	Poor	10.19	84.65	5.16
ENV92	Gravelly muddy sand	Very poor	10.30	62.14	27.56
ENV93	Gravelly sand	Moderate	0.90	85.86	13.24
ENV94	Gravelly sand	Very poor	7.25	68.73	24.01

Appendix B: Habitat assessments

Table B 1: Seapens and Burrowing Megafauna Assessment (Morgan).

Station	Total Images	Camera Transect Length (m)	Mean swathe width per image (m)	Estimated area investigated (m^2)	Number of Burrows				Maximum density m^2	Size of Burrows			SACFOR Range
					1 to 5	6 to 10	11+	Max Total		0 - 1	1.1 - 3	3 +	
ENV01	127	270.2	0.59	160.65	40	55	20	970	6.04	97	18	0	O to F
ENV02	103	260.6	0.52	135.8	35	19	10	475	3.5	61	2	0	O to F
ENV03	77	267.2	0.64	170.17	27	29	19	634	3.73	71	4	0	O to F
ENV04	100	258	0.58	150.86	37	40	8	673	4.46	81	4	0	O to F
ENV05	84	277.9	0.67	184.97	52	30	2	582	3.15	78	6	0	O to F
ENV06	90	272	0.55	149.08	8	41	41	901	6.04	89	1	0	O to F
ENV07	97	273.2	0.76	208.27	3	1	14	179	0.86	18	0	0	R to O
ENV08	104	296.1	0.61	180.41	53	8	0	345	1.91	51	10	0	O to F
ENV09	94	268.9	0.67	178.96	36	32	21	731	4.08	21	67	0	O to F
ENV10	90	257.8	0.56	145.13	67	2	0	355	2.45	46	23	0	O to F
ENV11	109	330.7	0.66	217.96	0	0	0	0	0	0	0	0	-
ENV12	91	272	0.83	226.66	11	5	0	105	0.46	13	3	0	R to O
ENV13	94	281.1	0.77	215.18	43	37	14	739	3.43	42	52	0	O to F
ENV14	93	277.5	0.88	245.54	30	0	0	150	0.61	28	2	0	R to O
ENV15	106	292.1	0.61	177.55	79	3	0	425	2.39	69	14	0	O to F
ENV16	91	269.9	0.72	194.82	0	0	0	0	0	0	0	0	-
ENV17	96	275.3	0.67	185.09	23	36	37	882	4.77	48	48	0	O to F
ENV18	92	278.7	0.59	163.11	18	48	26	856	5.25	39	53	0	O to F
ENV19	81	272.8	0.67	182.01	51	28	2	557	3.06	56	25	0	O to F
ENV20	104	277.1	0.71	196.79	38	1	0	200	1.02	39	0	0	O to F
ENV21	101	314.1	0.69	215.35	0	0	0	0	0	0	0	0	-
ENV22	95	268.9	0.78	209.32	0	0	0	0	0	0	0	0	-
ENV23	82	271.3	0.62	169.3	0	0	0	0	0	0	0	0	-
ENV24	200	271.9	0.67	182.19	66	17	4	544	2.99	65	22	0	O to F
ENV25	74	278	0.61	169.82	0	0	0	0	0	0	0	0	-
ENV26	83	273.5	0.66	180.98	0	0	0	0	0	0	0	0	-
ENV27	84	265.7	0.56	149.91	81	1	0	415	2.77	79	1	0	O to F
ENV28	99	271.8	0.84	228.41	11	24	64	999	4.37	48	51	0	O to F

Station	Total Images	Camera Transect Length (m)	Mean swathe width per image (m)	Estimated area investigated (m^2)	Number of Burrows				Maximum density m^2	Size of Burrows			SACFOR Range
					1 to 5	6 to 10	11+	Max Total		0 - 1	1.1 - 3	3 +	
ENV29	78	273.6	0.7	190.5	24	39	15	675	3.54	28	50	0	O to F
ENV30	94	268.5	0.72	194.57	16	0	0	80	0.41	16	0	0	R to O
ENV72	89	268.5	0.87	234.62	36	10	8	368	1.57	47	7	0	O to F
ENV73	143	278.9	0.74	207.17	27	39	77	1372	6.62	88	55	0	O to F
ENV90	96	270	0.79	213.2	6	7	81	991	4.65	35	59	0	O to F
ENV91	91	271.6	0.78	210.86	40	20	16	576	2.73	68	8	0	O to F
NV92	94	265.2	1.08	285.11	11	41	38	883	3.1	42	48	0	O to F
ENV93	94	284.1	0.97	274.4	34	23	14	554	2.02	69	1	1	O to F
ENV94	85	269.5	0.84	225.75	0	0	8	88	0.39	8	0	0	R to O
Minimum	74	257.8	0.52	135.8	3	1	2	80	0.39	8	1	1	R and F
Maximum	200	330.7	1.08	285.11	81	55	81	1372	6.62	97	67	1	
Average	97	275.5	0.71	194.88	27	17	15	468	2.5	42	17	0	
SD	21	13.7	0.12	33.61	23	17	21	363	1.96	30	22	0	

Table B 2: Annex I Stony Reef Assessment (Morgan).

Station	Project	Total Images	Camera Transect Length (m)	Mean swathe width per image (m^3)	Area Investigated	Number of Images with Stony Features	Total Reef Area	Mean Stony Reef Cover (%)	Max Reef Height (cm)	Resemblance to 'Stony Reef'
ENV01	Morgan	127	270.2	0.59	160.65	0	0	0	0	None
ENV02	Morgan	103	260.6	0.52	135.80	0	0	0	0	None
ENV03	Morgan	77	267.2	0.64	170.17	0	0	0	0	None
ENV04	Morgan	100	258.0	0.58	150.86	0	0	0	0	None
ENV05	Morgan	84	277.9	0.67	184.97	0	0	0	0	None
ENV06	Morgan	90	272.0	0.55	149.08	0	0	0	0	None
ENV07	Morgan	97	273.2	0.76	208.27	0	0	0	0	None
ENV08	Morgan	104	296.1	0.61	180.41	0	0	0	0	None
ENV09	Morgan	94	268.9	0.67	178.96	0	0	0	0	None
ENV10	Morgan	90	257.8	0.56	145.13	0	0	0	0	None
ENV11	Morgan	109	330.7	0.66	217.96	0	0	0	0	None
ENV12	Morgan	91	272.0	0.83	226.66	0	0	0	0	None
ENV13	Morgan	94	281.1	0.77	215.18	0	0	0	0	None
ENV14	Morgan	93	277.5	0.88	245.54	0	0	0	0	None
ENV15	Morgan	106	292.1	0.61	177.55	0	0	0	0	None
ENV16	Morgan	91	269.9	0.72	194.82	0	0	0	0	None
ENV17	Morgan	96	275.3	0.67	185.09	0	0	0	0	None
ENV18	Morgan	92	278.7	0.59	163.11	0	0	0	0	None
ENV19	Morgan	81	272.8	0.67	182.01	0	0	0	0	None
ENV20	Morgan	104	277.1	0.71	196.79	0	0	0	0	None
ENV21	Morgan	101	314.1	0.69	215.35	0	0	0	0	None
ENV22	Morgan	95	268.9	0.78	209.32	0	0	0	0	None
ENV23	Morgan	82	271.3	0.62	169.30	0	0	0	0	None
ENV24	Morgan	96	271.9	0.64	173.17	0	0	0	0	None
ENV25	Morgan	74	278.0	0.61	169.82	0	0	0	0	None
ENV26	Morgan	83	273.5	0.66	180.98	0	0	0	0	None
ENV27	Morgan	84	265.7	0.56	149.91	0	0	0	0	None
ENV28	Morgan	99	271.8	0.84	228.41	0	0	0	0	None
ENV29	Morgan	78	273.6	0.70	190.50	0	0	0	0	None
ENV30	Morgan	94	268.5	0.72	194.57	0	0	0	0	None
ENV72	Morgan	89	268.5	0.87	234.62	0	0	0	0	None
ENV73	Morgan	143	278.9	0.74	207.17	0	0	0	0	None

Station	Project	Total Images	Camera Transect Length (m)	Mean swathe width per image (m^3)	Area Investigated	Number of Images with Stony Features	Total Reef Area	Mean Stony Reef Cover (%)	Max Reef Height (cm)	Resemblance to 'Stony Reef'
ENV76	Morgan ZOI	105	274.2	0.90	245.90	41	2	9.59	8.6	Low
ENV79	Morgan ZOI	77	273.5	0.75	205.22	21	1	10.96	9.3	Low
ENV90	Morgan	96	270.0	0.79	213.20	0	0	0	0	None
ENV91	Morgan	91	271.6	0.78	210.86	0	0	0	0	None
ENV92	Morgan	94	265.2	1.08	285.11	0	0	0	0	None
ENV93	Morgan	94	284.1	0.97	274.40	0	0	0	0	None
ENV94	Morgan	85	269.5	0.84	225.75	0	0	0	0	None

Table B 3: Hard Substrate Porifera Coverage.

Station	Average % of hard substrate Porifera	Max % of hard substrate Porifera
Morgan		
ENV02	0.12	0.32
ENV05	0.21	0.21
ENV09	0.06	0.06
ENV14	0.55	0.55
ENV20	0.3	0.49
ENV23	0.65	0.65
ENV79	0.09	0.09

Appendix C: Benthic infaunal data multivariate analysis results

SIMPER
Similarity Percentages - species contributions

One-Way Analysis

Data worksheet
Name: Square Root(2)
Data type: Abundance
Sample selection: All
Variable selection: All

Parameters
Resemblance: S17 Bray Curtis similarity
Cut off for low contributions: 90.00%

Factor Groups

Sample	Simprov 2
ENV01	l
ENV04	l
ENV05	l
ENV10	l
ENV14	l
ENV15	l
ENV19	l
ENV27	l
ENV59	l
ENV63	l
ENV64	l
ENV02	t
ENV03	t
ENV06	t
ENV08	t
ENV17	t
ENV20	t
ENV24	t
ENV90	t
ENV07	b
ENV09	u
ENV11	y
ENV30	y
ENV12	i
ENV13	i
ENV16	v
ENV21	v
ENV25	v
ENV26	v
ENV18	w
ENV23	w
ENV22	a
ENV28	a
ENV29	s
ENV62	s
ENV95	s
ENV31	p
ENV36	p
ENV37	p
ENV41	p
ENV47	p
ENV97	p
ENV32	m
ENV33	j
ENV34	j
ENV35	j
ENV38	r
ENV48	r
ENV49	r
ENV51	r
ENV52	r
ENV54	r
ENV55	r
ENV56	r
ENV71	r
ENV86	r
ENV88	r
ENV39	n
ENV42	n
ENV40	k
ENV45	k
ENV43	c
ENV44	c
ENV57	c
ENV66	c
ENV67A	c
ENV70	c
ENV83	c
ENV89	c
ENV93	c
ENV96	c
ENV50	d
ENV53	o

ENV60	q
ENV61	q
ENV65	q
ENV68	h
ENV69	f
ENV84	f
ENV82	g
ENV91	x
ENV94	x
ENV92	e

Group l
Average similarity: 45.15

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Poecilochaetus serpens	2.51	2.19	4.54	4.84	4.84
NEMERTEA	2.57	2.09	2.02	4.63	9.47
Urothoe elegans	2.1	1.82	3.16	4.04	13.51
Scalibregma inflatum	2.17	1.56	2.33	3.45	16.96
Lysidice unicornis	1.79	1.45	1.94	3.21	20.18
Lagis koreni	1.87	1.33	1.55	2.94	23.12
Pholoe baltica	1.61	1.24	1.94	2.75	25.87
Pholoe inornata	1.57	1.17	1.7	2.6	28.47
Ampharete lindstroemi agg.	1.82	1.16	1.53	2.58	31.05
Phoronis	1.71	1.14	1.31	2.53	33.57
Spiophanes bombyx	1.57	1.14	1.73	2.52	36.09
Chaetozone zetlandica	1.67	1.12	1.25	2.47	38.56
Ampelisca	1.38	0.99	1.25	2.19	40.75
Ophelina acuminata	1.23	0.92	1.29	2.05	42.79
Pista lornensis	1.21	0.85	1.24	1.88	44.67
Cirrophorus branchiatus	1.28	0.78	0.95	1.72	46.39
Ampelisca spinipes	1.32	0.77	0.96	1.71	48.1
Pseudopolydora pulchra	1.06	0.77	1.27	1.7	49.8
Urothoe	1.52	0.76	0.94	1.68	51.48
Golfingiidae	1.19	0.71	1.29	1.56	53.05
Ampelisca typica	1.14	0.7	0.97	1.56	54.6
Sabellidae	0.96	0.69	1.32	1.52	56.12
Aonides paucibranchiata	1.08	0.68	0.97	1.5	57.62
Leptochiton asellus	1.14	0.63	0.94	1.4	59.02
Spirobranchus triqueter	1.09	0.62	0.93	1.37	60.39
Lumbrineris aniara agg.	1.16	0.61	0.93	1.34	61.73
Echinocyamus pusillus	1.33	0.61	0.72	1.34	63.07
Paradoneis lyra	1.21	0.58	0.77	1.29	64.37
Owenia	0.96	0.58	0.96	1.29	65.66
Glycera lapidum	0.94	0.58	0.96	1.29	66.94
Kurtiella bidentata	1.28	0.57	0.73	1.26	68.2
Syllis armillaris agg.	0.99	0.54	0.75	1.19	69.4
Caulleriella alata	0.84	0.53	0.98	1.18	70.58
Gnathiidae	0.84	0.53	0.99	1.16	71.75
Scoloplos armiger	0.97	0.5	0.75	1.1	72.85
Megamphopus cornutus	0.93	0.47	0.74	1.04	73.88
BIVALVIA	0.92	0.46	0.75	1.02	74.91
Gnathia oxyuraea	0.87	0.45	0.76	1	75.9
Polynoidae	0.87	0.44	0.75	0.97	76.87
Spio symphyta	0.94	0.43	0.74	0.96	77.83
Othomaera othonis	0.78	0.42	0.76	0.94	78.77
Laonice bahusiensis agg.	0.78	0.4	0.77	0.9	79.67
Parexogone hebes	0.76	0.39	0.77	0.87	80.54
Phyllodocidae	0.64	0.38	0.78	0.83	81.37
Syllis	0.86	0.36	0.6	0.8	82.17
Praxillella affinis	0.8	0.32	0.59	0.71	82.88
Nototropis vedlomensis	0.72	0.31	0.6	0.69	83.57
Paraonidae	0.8	0.29	0.46	0.65	84.22
Polycirrus	0.73	0.29	0.47	0.63	84.85
TEREBELLIFORMIA	0.61	0.28	0.6	0.62	85.47
Tharyx killariensis	0.62	0.28	0.6	0.61	86.09
Sthenelais limicola	0.58	0.27	0.61	0.61	86.69
Euclymeninae	0.8	0.25	0.45	0.55	87.24
Leiochone	0.7	0.23	0.46	0.51	87.76
Urothoe marina	0.67	0.23	0.44	0.51	88.27
Ampharetidae	0.69	0.21	0.45	0.47	88.74
Phascolion (Phascolion) strombus strombus	0.67	0.2	0.46	0.44	89.17
Terebellides	0.58	0.2	0.46	0.43	89.6
Cheirocratus	0.53	0.2	0.46	0.43	90.04

Group t
Average similarity: 36.44

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
NEMERTEA	2.02	1.92	4.59	5.27	5.27
Echinocyamus pusillus	2.28	1.88	1.6	5.15	10.42
Goniadella gracilis	1.86	1.58	1.66	4.33	14.75
Poecilochaetus serpens	1.94	1.49	2.92	4.1	18.84
Scalibregma inflatum	2.01	1.44	1.44	3.95	22.79
Owenia	1.62	1.43	3.13	3.92	26.71
Pholoe baltica	2.01	1.34	1.26	3.69	30.39
Polynoidae	1.5	1.28	4.51	3.51	33.91
Golfingiidae	1.97	1.2	0.93	3.29	37.19
Kurtiella bidentata	2.43	1.2	0.85	3.28	40.47
BIVALVIA	1.69	1.19	1.5	3.26	43.73
Pholoe inornata	1.54	1.01	1.54	2.78	46.51
Aonides paucibranchiata	1.26	0.74	0.99	2.03	48.54
Nereididae	1.11	0.69	0.99	1.89	50.44
Glycera lapidum	1.18	0.68	1	1.87	52.31

Phoronis	1.1	0.67	1.01	1.84	54.14
THRACIOIDEA	1.11	0.64	1.01	1.76	55.9
Phascolion (Phascolion) strombus strombus	1.2	0.64	0.72	1.75	57.66
Syllis	1.16	0.62	1.02	1.71	59.37
Asclerocheilus	0.84	0.56	1.04	1.53	60.9
Abra	1.13	0.52	0.68	1.44	62.33
Lagis koreni	1.52	0.5	0.62	1.37	63.71
AMPHIPODA	0.87	0.45	0.71	1.24	64.95
Ampelisca spinipes	0.78	0.43	0.7	1.19	66.14
Lysidice unicornis	0.82	0.43	0.72	1.17	67.31
Timoclea ovata	1.05	0.43	0.66	1.17	68.47
Moerella donacina	0.84	0.4	0.71	1.1	69.57
Ampelisca	0.75	0.4	0.73	1.09	70.67
Nucula	0.63	0.39	0.73	1.08	71.75
Urothoe marina	1.02	0.33	0.44	0.9	72.65
Syllis armillaris agg.	0.88	0.32	0.5	0.88	73.53
Pista lornensis	0.83	0.31	0.49	0.85	74.38
Grania	0.9	0.31	0.48	0.84	75.23
Syllis parapari	1.01	0.29	0.5	0.79	76.02
Asbjornsenia pygmaea	0.75	0.27	0.47	0.73	76.75
Spirobranchus triqueter	0.68	0.26	0.5	0.72	77.47
Spiophanes bombyx	0.59	0.25	0.51	0.69	78.16
Gnathia oxyuraea	0.64	0.25	0.51	0.68	78.84
Ampharetidae	0.55	0.25	0.51	0.67	79.52
Eteone cf. longa	0.64	0.24	0.51	0.67	80.18
Ophelia	0.59	0.24	0.51	0.66	80.84
Notomastus	0.55	0.23	0.51	0.64	81.48
Leiochone	0.55	0.23	0.51	0.63	82.11
Leucothoe incisa	0.55	0.22	0.51	0.61	82.73
Lanice conchilega	0.55	0.22	0.51	0.61	83.33
Pisidia longicornis	0.59	0.22	0.51	0.6	83.93
Hydroides norvegica	0.5	0.21	0.51	0.58	84.51
Aricidea (Acmira) cerrutii	0.64	0.2	0.34	0.54	85.05
Nototropis vedlomensis	0.78	0.19	0.33	0.52	85.57
Pista mediterranea	0.78	0.19	0.33	0.52	86.09
Caulleriella alata	0.59	0.16	0.33	0.43	86.52
Pseudopolydora pulchra	0.55	0.14	0.33	0.39	86.91
Guernea (Guernea) coalita	0.48	0.13	0.34	0.36	87.28
Thracia	0.38	0.13	0.34	0.36	87.64
Serpulidae	0.38	0.13	0.34	0.35	87.99
Glycinde nordmanni	0.43	0.13	0.34	0.35	88.34
Parexogone hebes	0.55	0.13	0.34	0.35	88.69
Praxillella affinis	0.48	0.12	0.34	0.34	89.03
NUDIBRANCHIA	0.43	0.12	0.34	0.34	89.37
Dipolydora coeca agg.	0.52	0.12	0.33	0.34	89.7
Spio symphyta	0.43	0.12	0.34	0.33	90.04

Group b

Less than 2 samples in group

Group u

Less than 2 samples in group

Group y

Average similarity: 52.67

Species	Av.Abund	Av.Sim	Sim/SD	Contrib %	Cum.%
Lagis koreni	6.03	8.78	#######	16.66	16.66
Poecilochaetus serpens	5.43	8.08	#######	15.35	32.01
Spiophanes bombyx	3.05	4.04	#######	7.67	39.69
Pholoe baltica	2.81	3.74	#######	7.11	46.79
Scalibregma inflatum	2.81	3.74	#######	7.11	53.9
Scoloplos armiger	3.52	3.42	#######	6.49	60.38
Owenia	2.73	3.06	#######	5.8	66.19
Sthenelais limicola	1.71	2.16	#######	4.1	70.29
Glycera lapidum	1.71	2.16	#######	4.1	74.39
Abra	2.12	2.16	#######	4.1	78.49
Abra alba	1.57	2.16	#######	4.1	82.6
Aricidea (Aricidea) minuta	1.37	1.53	#######	2.9	85.5
Pseudopolydora pulchra	1	1.53	#######	2.9	88.4
Spio symphyta	1.62	1.53	#######	2.9	91.3

Group i

Average similarity: 49.97

Species	Av.Abund	Av.Sim	Sim/SD	Contrib %	Cum.%
Lagis koreni	3.87	3.41	#######	6.82	6.82
Scalibregma inflatum	3.37	3.23	#######	6.47	13.29
Ampharete lindstroemi agg.	2.72	2.64	#######	5.28	18.58

Owenia	2.34	2.41	#######	4.82	23.4
Abra	2.12	2.16	#######	4.31	27.71
Echinocyamus pusillus	2.58	2.16	#######	4.31	32.03
NEMERTEA	2.73	2.16	#######	4.31	36.34
Spio symphyta	2.09	1.87	#######	3.74	40.08
Aoridae	2.74	1.87	#######	3.74	43.82
Phoronis	1.98	1.87	#######	3.74	47.55
Pholoe baltica	1.71	1.52	#######	3.05	50.6
Goniadella gracilis	1.41	1.52	#######	3.05	53.65
Lysidice unicornis	1.41	1.52	#######	3.05	56.7
Paradoneis lyra	1.57	1.52	#######	3.05	59.75
Aonides paucibranchiata	1.41	1.52	#######	3.05	62.81
Spiophanes bombyx	1.93	1.52	#######	3.05	65.86
Lysilla nivea	1.41	1.52	#######	3.05	68.91
Ampelisca typica	1.83	1.52	#######	3.05	71.96
Glycera lapidum	1.21	1.08	#######	2.16	74.11
Syllis armillaris agg.	1	1.08	#######	2.16	76.27
Lumbrineris aniara agg.	1	1.08	#######	2.16	78.43
Cirrophorus branchiatus	1.37	1.08	#######	2.16	80.59
Poecilochaetus serpens	3.19	1.08	#######	2.16	82.74
Caulleriella alata	1.37	1.08	#######	2.16	84.9
Polycirrus	1.37	1.08	#######	2.16	87.06
Pista lornensis	1.37	1.08	#######	2.16	89.21
Ampelisca spinipes	1	1.08	#######	2.16	91.37

Group v

Average similarity: 51.44

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Spiophanes bombyx	2.99	5.17	12.7	10.05	10.05
Scoloplos armiger	2.93	5.12	8.07	9.96	20.01
Lagis koreni	3.26	5.06	10.84	9.84	29.85
Poecilochaetus serpens	2.98	4.32	2.23	8.39	38.24
Sthenelais limicola	2.21	3.8	7.26	7.39	45.63
Amphiuridae	2.44	3.46	2.18	6.72	52.35
Nephtys cirrosa	1.8	2.88	2.48	5.6	57.95
Scolelepis bonnieri	1.46	2.38	4.3	4.63	62.58
Gari fervensis	1.79	2.36	6.18	4.58	67.16
NEMERTEA	1.21	2.09	6.55	4.07	71.23
Bathyporeia	1.98	2.05	0.9	3.99	75.22
Abra	1.79	1.93	0.91	3.76	78.98
Phaxas pellucidus	1.49	1.79	0.91	3.47	82.45
Bathyporeia elegans	2.13	1.74	0.85	3.39	85.84
Owenia	1.1	1.11	0.87	2.15	87.99
Phyllodoce rosea	0.96	1.09	0.9	2.13	90.12

Group w

Average similarity: 44.27

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Lagis koreni	3.76	4.73	#######	10.68	10.68
Echinocyamus pusillus	2.88	3.66	#######	8.27	18.95
Scalibregma inflatum	2.53	3.34	#######	7.55	26.5
Poecilochaetus serpens	2.85	3.34	#######	7.55	34.05
Sthenelais limicola	1.73	2.59	#######	5.85	39.89
BIVALVIA	1.73	2.59	#######	5.85	45.74
Paraonidae	1.57	2.11	#######	4.77	50.52
Pseudopolydora pulchra	1.41	2.11	#######	4.77	55.29
Owenia	2.51	2.11	#######	4.77	60.06
Urothoe elegans	1.57	2.11	#######	4.77	64.84
Kurtiella bidentata	1.57	2.11	#######	4.77	69.61

Pholoe baltica	1.21	1.49	#######	3.38	72.99
Ophelina acuminata	1	1.49	#######	3.38	76.37
Scoloplos armiger	2.44	1.49	#######	3.38	79.74
Pista lornensis	1.37	1.49	#######	3.38	83.12
Ampelisca	1.21	1.49	#######	3.38	86.5
Phaxas pellucidus	1	1.49	#######	3.38	89.87
Asbjornsenia pygmaea	1.5	1.49	#######	3.38	93.25

Group a
Average similarity: 23.75

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Abra	1.73	7.18	#######	30.22	30.22
Scoloplos armiger	1.62	4.14	#######	17.45	47.66
Spio	1	4.14	#######	17.45	65.11
BIVALVIA	1	4.14	#######	17.45	82.55
Echinocyamus pusillus	1	4.14	#######	17.45	100

Group s
Average similarity: 39.03

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
NEMERTEA	2.82	3.75	9.36	9.62	9.62
Ampharete lindstroemi agg.	2.82	3.35	3.01	8.58	18.2
Phascolion (Phascolion) strombus strombus	1.79	2.14	44.95	5.48	23.69
Parexogone hebes	1.61	2.01	9.36	5.14	28.83
Syllis	1.41	2.01	9.36	5.14	33.97
Golfingiidae	2.49	1.93	2.6	4.95	38.92
Poecilochaetus serpens	1.94	1.93	1.94	4.95	43.87
Cirrophorus branchiatus	1.66	1.72	4.53	4.42	48.29
Podarkeopsis	1.28	1.63	3.39	4.18	52.47
Cheirocratus	1.28	1.62	3.82	4.16	56.62
Lumbrineris aniara agg.	1.62	1.59	10.39	4.08	60.7
Pholoe baltica	1.14	1.42	9.36	3.64	64.34
Pholoe inornata	1.14	1.42	9.36	3.64	67.98
Scoloplos armiger	1.14	1.42	9.36	3.64	71.61
Scalibregma inflatum	1.49	1.14	0.58	2.93	74.54
Lagis koreni	1.41	1.02	0.58	2.62	77.17
Aonides paucibranchiata	1.7	1.02	0.58	2.61	79.78
Leiochone	1.32	0.72	0.58	1.85	81.62
Syllis armillaris agg.	0.94	0.59	0.58	1.51	83.13
Phyllodoce rosea	0.67	0.51	0.58	1.31	84.44
AMPHIPODA	0.8	0.51	0.58	1.31	85.75
Gnathiidae	0.67	0.51	0.58	1.31	87.07
Echinocyamus pusillus	0.91	0.51	0.58	1.31	88.38
Schistomeringos rudolphi	0.8	0.49	0.58	1.26	89.64
Ampharetidae	1.15	0.49	0.58	1.26	90.89

Group p
Average similarity: 53.39

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
NEMERTEA	3.73	2.42	15.23	4.53	4.53
Scalibregma inflatum	3.53	2.18	6.82	4.08	8.61
Aonides paucibranchiata	3	1.74	3.26	3.27	11.87
Ampharete lindstroemi agg.	2.61	1.65	5.39	3.08	14.96
Leptochiton asellus	3.1	1.6	1.98	3	17.96
Dialychone	2.59	1.52	3.52	2.85	20.81
Pholoe inornata	2.57	1.45	3.36	2.72	23.53
Golfingiidae	2.29	1.41	5.01	2.64	26.17
Pholoe baltica	2.38	1.3	4.99	2.43	28.6
Leiochone	2.2	1.24	4.17	2.32	30.92
Glycera lapidum	1.92	1.2	5.51	2.24	33.17
Laonice bahusiensis agg.	2.39	1.15	2.46	2.15	35.32
Goniadella gracilis	1.97	1.07	2.92	2	37.32
Serpulidae	1.76	1.05	9.43	1.96	39.29
Lysidice unicornis	1.76	0.96	2.7	1.8	41.09
Eulalia mustela	1.69	0.93	3.37	1.75	42.83
Notomastus	1.4	0.91	5.53	1.7	44.53
Jasmineira caudata	1.6	0.89	3.21	1.67	46.2
Owenia	1.48	0.88	3.49	1.64	47.84
Paraonidae	1.84	0.87	1.25	1.63	49.48
Syllis garciai/mauretanica	1.68	0.85	1.35	1.6	51.08
Chaetozone zetlandica	1.38	0.85	3.71	1.59	52.67
Megamphopus cornutus	1.67	0.84	3.15	1.57	54.24
Ampelisca	1.56	0.84	2.8	1.56	55.8
Echinocyamus pusillus	1.81	0.82	1.29	1.54	57.34
Lumbrineris aniara agg.	1.43	0.78	6.01	1.46	58.8
Grania	1.68	0.77	1.25	1.44	60.24
Syllis	1.57	0.75	1.27	1.4	61.63
Poecilochaetus serpens	1.19	0.73	9.71	1.36	63
Cirrophorus branchiatus	1.64	0.7	1.18	1.32	64.32

Phoronis	1.68	0.68	1.12	1.27	65.59
Syllis armillaris agg.	1.48	0.64	1.31	1.2	66.79
Nototropis vedlomensis	1.52	0.62	1.24	1.15	67.94
Ophelina acuminata	1.22	0.61	1.27	1.14	69.08
Spirobranchus triqueter	1.4	0.59	1.23	1.1	70.18
Polynoidae	1.24	0.58	1.27	1.09	71.27
Apherusa bispinosa	1.7	0.52	1.11	0.98	72.25
Aricidea (Acmira) cerrutii	1.4	0.51	0.78	0.96	73.21
Urothoe marina	1.24	0.51	0.79	0.96	74.17
Sabellaria spinulosa	1.02	0.5	1.31	0.93	75.1
Scolelepis	1.08	0.48	1.28	0.9	76
Polycirrus	1.27	0.47	0.77	0.88	76.88
Cerianthus lloydii	0.97	0.47	1.34	0.87	77.76
Nereididae	0.97	0.47	1.34	0.87	78.63
Ampelisca typica	1.02	0.47	1.34	0.87	79.51
Phyllodocidae	0.97	0.35	0.76	0.66	80.16
Spio	0.97	0.35	0.76	0.66	80.82
Protodorvillea kefersteini	0.97	0.35	0.78	0.65	81.48
Ebalia	0.93	0.33	0.77	0.62	82.09
TEREBELLIFORMIA	0.99	0.32	0.77	0.6	82.69
Sphaerosyllis cf. taylori	0.86	0.31	0.78	0.58	83.28
Terebellides	0.86	0.31	0.76	0.58	83.86
Phascolion (Phascolion) strombus strombus	0.8	0.31	0.78	0.58	84.44
Lagis koreni	0.79	0.29	0.78	0.55	84.99
Ophiura albida	0.67	0.29	0.78	0.55	85.54
Spirobranchus lamarcki	0.83	0.29	0.78	0.54	86.08
Dipolydora caulleryi agg.	0.86	0.29	0.78	0.54	86.62
NUDIBRANCHIA	1.01	0.29	0.77	0.53	87.15
Anoplodactylus petiolatus	0.74	0.29	0.78	0.53	87.69
Scalibregma celticum	0.8	0.28	0.78	0.53	88.22
Gammaropsis maculata	0.86	0.28	0.78	0.53	88.75
Steromphala	1	0.27	0.79	0.51	89.26
Myrianida	0.74	0.27	0.79	0.51	89.77
Eteone cf. longa	0.79	0.27	0.79	0.51	90.27

Group m
Less than 2 samples in group

Group j
Average similarity: 58.04

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Ampharete lindstroemi agg.	6.6	3.36	4.57	5.79	5.79
Poecilochaetus serpens	4.15	2.49	13.08	4.29	10.08
Ampelisca provincialis	4.98	2.44	3.31	4.2	14.28
Phoronis	4.45	2.44	8.86	4.2	18.48
NEMERTEA	4.03	2.42	37.69	4.16	22.64
Pholoe baltica	4.92	2.18	1.96	3.75	26.39
Owenia	3.74	2	61.31	3.44	29.83
Scalibregma inflatum	3.79	1.99	14.04	3.43	33.26
Cerianthus lloydii	2.94	1.75	11.18	3.01	36.27
Spiophanes bombyx	3.08	1.73	5.03	2.98	39.26
Chaetozone zetlandica	2.87	1.66	9.38	2.86	42.12
Photis longicaudata	3.01	1.63	9.96	2.8	44.92
Cirrophorus branchiatus	2.91	1.63	11.71	2.8	47.73
Leiochone	2.76	1.63	14.04	2.8	50.53
Lagis koreni	3.6	1.55	1.92	2.67	53.2
Praxillella affinis	2.9	1.46	18.26	2.51	55.71
Aonides paucibranchiata	2.37	1.41	61.31	2.43	58.14
Paradoneis lyra	2.58	1.26	61.31	2.18	60.32
Ampelisca spinipes	2.13	1.15	9.96	1.98	62.3
Kurtiella bidentata	2.41	1.15	2.67	1.98	64.28
Eteone cf. longa	1.9	1.09	61.31	1.88	66.17
Caulleriella alata	1.73	1.09	61.31	1.88	68.05
Parexogone hebes	1.52	0.89	61.31	1.54	69.59
Podarkeopsis	1.67	0.84	2.31	1.45	71.04
Aricidea (Acmira) cerrutii	1.94	0.84	2.39	1.45	72.48
Laonice bahusiensis agg.	1.28	0.72	4.77	1.24	73.72
Spio symphyta	1.28	0.72	4.77	1.24	74.96
Lysidice unicornis	1.38	0.72	5.12	1.24	76.2
Nototropis vedlomensis	1.38	0.72	5.12	1.24	77.43
Mediomastus fragilis	1	0.63	61.31	1.09	78.52
Pseudopolydora pulchra	1	0.63	61.31	1.09	79.61
Ampelisca	1.14	0.63	61.31	1.09	80.7
Acidostoma neglectum	1	0.63	61.31	1.09	81.79
Aoridae	1.67	0.63	61.31	1.09	82.87
Lysilla nivea	1.48	0.41	0.58	0.71	83.59
Glycinde nordmanni	1.24	0.37	0.58	0.64	84.23
PLATYHELMINTHES	1.15	0.36	0.58	0.63	84.85
Urothoe	1.46	0.36	0.58	0.62	85.47
Urothoe marina	1.32	0.36	0.58	0.62	86.09
Euclymene oerstedii agg.	1.05	0.3	0.58	0.52	86.61
Spiochaetopterus	0.94	0.3	0.58	0.52	87.13
Galathowenia	1.22	0.3	0.58	0.51	87.65
Pholoe inornata	1.14	0.29	0.58	0.5	88.15
Polycirrus	1.05	0.29	0.58	0.5	88.66
Megamphopus cornutus	1.05	0.29	0.58	0.5	89.16
Phyllodoce rosea	0.8	0.21	0.58	0.37	89.53
Spiophanes kroyeri	0.67	0.21	0.58	0.37	89.9
Euchone	0.67	0.21	0.58	0.37	90.27

Group r
Average similarity: 54.57

Species	Av.Abund	Av.Sim	Sim/SD	Contrib %	Cum.%
Scalibregma inflatum	4.67	2.45	4.1	4.48	4.48
NEMERTEA	4.12	2.38	5.97	4.37	8.85
Ampharete lindstroemi agg.	4.05	2.13	3	3.9	12.75
Pholoe baltica	3.25	1.66	3.67	3.04	15.79
Aonides paucibranchiata	2.88	1.66	4.55	3.04	18.83
Phoronis	2.97	1.39	3.28	2.55	21.37
Cirrophorus branchiatus	2.39	1.26	3.51	2.32	23.69
Lysidice unicornis	2.19	1.25	5.32	2.29	25.98
Leptochiton asellus	2.61	1.24	1.91	2.27	28.26
Ophelina acuminata	2.18	1.16	3.1	2.12	30.38
Polycirrus	2.22	1.15	3.27	2.1	32.48
Ampelisca	2.46	1.13	2.59	2.07	34.55
Poecilochaetus serpens	2.21	1.06	2.42	1.93	36.48
Paradoneis ilvana	1.99	1.02	3.56	1.86	38.35
Chaetozone zetlandica	1.77	0.94	3.12	1.71	40.06
Urothoe marina	1.79	0.89	2.79	1.62	41.69
Urothoe	1.81	0.88	1.96	1.61	43.3
Laonice bahusiensis agg.	1.92	0.88	1.67	1.61	44.91
Dialychone	2.01	0.84	1.2	1.53	46.44
Lagis koreni	1.66	0.84	3.44	1.53	47.97
Nototropis vedlomensis	1.57	0.83	4.16	1.52	49.49
Aricidea (Acmira) cerrutii	1.78	0.81	1.81	1.49	50.98
Praxillella affinis	1.74	0.81	1.67	1.48	52.46
Glycera lapidum	1.54	0.8	1.71	1.47	53.93
Owenia	1.39	0.74	1.89	1.36	55.29
Terebellides	1.43	0.69	1.91	1.27	56.56
Cerianthus lloydii	1.66	0.69	1.27	1.26	57.83
Pholoe inornata	1.43	0.67	1.88	1.22	59.05
Serpulidae	1.35	0.67	1.76	1.22	60.27
Kurtiella bidentata	1.78	0.62	1.06	1.14	61.41
Dipolydora caulleryi agg.	1.18	0.61	1.9	1.12	62.53
Polynoidae	1.23	0.56	1.27	1.03	63.56
Echinocyamus pusillus	1.4	0.56	1.23	1.02	64.58
Ampelisca typica	1.29	0.53	0.97	0.97	65.55
Paradoneis lyra	1.54	0.53	0.91	0.96	66.51
Goniadella gracilis	1.1	0.51	1.27	0.94	67.45
AMPHIPODA	1.1	0.5	1.29	0.92	68.37
Leiochone	1.16	0.5	1.27	0.91	69.27
Mediomastus fragilis	1.09	0.48	1.31	0.88	70.16
Lysilla nivea	1.16	0.47	0.97	0.85	71.01
PLATYHELMINTHES	1.2	0.46	0.95	0.85	71.86
Ampelisca diadema	1.19	0.43	0.87	0.78	72.64
Megamphopus cornutus	1.32	0.43	0.92	0.78	73.42
Spirobranchus triqueter	1.15	0.42	0.9	0.78	74.2
TEREBELLIFORMIA	1.21	0.42	0.92	0.76	74.96
Golfingiidae	1.05	0.41	0.95	0.75	75.72
Syllis garciai/mauretanica	1.04	0.4	0.97	0.73	76.45
Lumbrineris aniara agg.	1.13	0.4	0.74	0.73	77.17
Caulleriella alata	1.1	0.4	0.96	0.73	77.9
Podarkeopsis	1.06	0.39	0.98	0.72	78.62
Pista lornensis	1.02	0.39	0.97	0.71	79.33
Scoloplos armiger	0.94	0.38	0.96	0.7	80.04
Photis longicaudata	1.32	0.36	0.68	0.67	80.7
Paraonidae	1.36	0.36	0.67	0.66	81.37
Unciola planipes	1.25	0.36	0.7	0.65	82.02
Amphipholis squamata	0.88	0.35	0.99	0.65	82.67
Spiophanes bombyx	1.09	0.35	0.76	0.64	83.31
Jasmineira caudata	0.93	0.3	0.76	0.55	83.86
Eteone cf. longa	0.95	0.29	0.74	0.53	84.39
Cheirocratus	0.89	0.28	0.76	0.52	84.91
Ampelisca spinipes	0.9	0.28	0.76	0.51	85.42
Phascolion (Phascolion) strombus strombus	0.78	0.28	0.76	0.51	85.93
Syllis armillaris agg.	0.82	0.26	0.77	0.47	86.4
Ampelisca provincialis	1.14	0.26	0.56	0.47	86.87
NUDIBRANCHIA	0.76	0.25	0.77	0.45	87.32
Schistomeringos rudolphi	0.72	0.22	0.6	0.4	87.72
Urothoe elegans	0.72	0.21	0.59	0.39	88.11
Tanaopsis graciloides	0.84	0.21	0.58	0.38	88.49
ENTEROPNEUSTA	0.7	0.2	0.59	0.37	88.86
Euchone	0.66	0.2	0.59	0.37	89.23
Gnathiidae	0.79	0.2	0.58	0.37	89.6
Nereididae	0.72	0.2	0.6	0.36	89.96
Glycinde nordmanni	0.74	0.19	0.59	0.36	90.31

Group n
Average similarity: 52.36

Species	Av.Abund	Av.Sim	Sim/SD	Contrib %	Cum.%
Scalibregma inflatum	4.85	2.27	#######	4.34	4.34
Golfingia (Golfingia) elongata	3.07	2.14	#######	4.09	8.44
Unciola planipes	2.82	2.01	#######	3.83	12.27
Syllis garciai/mauretanica	2.64	1.86	#######	3.55	15.81
Owenia	2.72	1.86	#######	3.55	19.36
Echinocyamus pusillus	2.64	1.86	#######	3.55	22.91
Phoronis	2.92	1.69	#######	3.24	26.14
Nereididae	2	1.52	#######	2.9	29.04

Ampharete lindstroemi agg.	2.8	1.52	#######	2.9	31.93
NEMERTEA	2.87	1.52	#######	2.9	34.83
Golfingiidae	2.5	1.52	#######	2.9	37.72
Syllis	2.93	1.31	#######	2.51	40.23
Lagis koreni	1.73	1.31	#######	2.51	42.74
Eteone cf. longa	1.41	1.07	#######	2.05	44.78
Eulalia mustela	1.57	1.07	#######	2.05	46.83
Mediomastus fragilis	1.83	1.07	#######	2.05	48.88
Paraonidae	1.71	1.07	#######	2.05	50.93
Paradoneis ilvana	1.83	1.07	#######	2.05	52.97
Poecilochaetus serpens	2.12	1.07	#######	2.05	55.02
Aonides paucibranchiata	2.89	1.07	#######	2.05	57.07
Dialychone	1.71	1.07	#######	2.05	59.12
Ampelisca typica	1.57	1.07	#######	2.05	61.16
Urothoe marina	1.57	1.07	#######	2.05	63.21
Nucula hanleyi	1.83	1.07	#######	2.05	65.26
Pholoe baltica	3.1	0.76	#######	1.45	66.7
Pholoe inornata	1	0.76	#######	1.45	68.15
Malmgrenia thomsonae	1.72	0.76	#######	1.45	69.6
Glycera lapidum	1.62	0.76	#######	1.45	71.05
Goniadella gracilis	1.72	0.76	#######	1.45	72.5
Streptosyllis websteri	1	0.76	#######	1.45	73.94
Prosphaerosyllis cf. tetralix	1.21	0.76	#######	1.45	75.39
Pseudomystides limbata	1.21	0.76	#######	1.45	76.84
Lysidice unicornis	1.62	0.76	#######	1.45	78.29
Ophelina acuminata	1.5	0.76	#######	1.45	79.73
Cirrophorus branchiatus	1.37	0.76	#######	1.45	81.18
Asclerocheilus	1	0.76	#######	1.45	82.63
Laonice bahusiensis agg.	1.5	0.76	#######	1.45	84.08
Chaetozone zetlandica	1	0.76	#######	1.45	85.52
Diplocirrus stopbowitzi	1.72	0.76	#######	1.45	86.97
Leucothoe incisa	1	0.76	#######	1.45	88.42
Urothoe	1.37	0.76	#######	1.45	89.87
Leptocheirus hirsutimanus	1.37	0.76	#######	1.45	91.31

Group k
Average similarity: 54.61

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Ampharete lindstroemi agg.	3.92	3.22	#######	5.89	5.89
NEMERTEA	3.59	2.96	#######	5.42	11.32
Scalibregma inflatum	4.13	2.82	#######	5.17	16.49
Kurtiella bidentata	3.79	2.68	#######	4.9	21.39
Lagis koreni	3.35	2.53	#######	4.62	26.01
Pholoe baltica	3.19	2.36	#######	4.33	30.34
Polycirrus	2	1.79	#######	3.27	33.61
Eteone cf. longa	1.87	1.55	#######	2.83	36.44
Paradoneis lyra	2.28	1.55	#######	2.83	39.27
Owenia	1.98	1.55	#######	2.83	42.1
Urothoe	3.46	1.55	#######	2.83	44.94
Photis longicaudata	1.87	1.55	#######	2.83	47.77
Tanaopsis graciloides	1.87	1.55	#######	2.83	50.6

PLATYHELMINTHES	2.09	1.55	#######	2.83	53.43
Poecilochaetus serpens	2.83	1.26	#######	2.31	55.74
Urothoe elegans	1.41	1.26	#######	2.31	58.06
Aoridae	3.05	1.26	#######	2.31	60.37
Megamphopus cornutus	1.57	1.26	#######	2.31	62.68
BIVALVIA	1.71	1.26	#######	2.31	64.99
Cerianthus lloydii	1.71	1.26	#######	2.31	67.3
Glycinde nordmanni	1	0.89	#######	1.63	68.94
Schistomeringos rudolphi	1.21	0.89	#######	1.63	70.57
Mediomastus fragilis	1.62	0.89	#######	1.63	72.21
Leiochone	1.21	0.89	#######	1.63	73.84
Ophelina acuminata	1.21	0.89	#######	1.63	75.48
Paraonidae	1.21	0.89	#######	1.63	77.11
Aricidea (Acmira) cerrutii	1.21	0.89	#######	1.63	78.75
Aonides paucibranchiata	1.37	0.89	#######	1.63	80.38
Pseudopolydora pulchra	1.21	0.89	#######	1.63	82.02
Spiophanes bombyx	1.21	0.89	#######	1.63	83.65
Diplocirrus stopbowitzi	1	0.89	#######	1.63	85.29
Pista lornensis	1.21	0.89	#######	1.63	86.92
Nototropis vedlomensis	1.21	0.89	#######	1.63	88.56
Ampelisca typica	1.21	0.89	#######	1.63	90.19

Group c
Average similarity: 32.41

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Pisione remota	3.55	4.87	1.17	15.02	15.02
Hesionura elongata	2.4	3.07	2.3	9.46	24.48
Polygordius	2.81	2.69	1.26	8.29	32.78
Aonides paucibranchiata	2.29	2.59	1.76	8	40.78
Grania	1.9	2.38	1.62	7.34	48.11
NEMERTEA	1.77	2.23	1.61	6.87	54.98
Goniadella gracilis	1.75	1.73	0.78	5.35	60.33
Unciola planipes	1.88	1.4	0.86	4.33	64.67
Glycera lapidum	1.31	1.4	1.13	4.32	68.99
Eurydice truncata	1.07	1.09	0.62	3.37	72.35
Spio	1.16	0.67	0.5	2.07	74.43
Echinocyamus pusillus	0.82	0.67	0.67	2.06	76.48
Spio symphyta	0.86	0.63	0.67	1.94	78.42
Abra	1	0.61	0.52	1.9	80.31
Aoridae	1.03	0.51	0.5	1.58	81.89
Ampelisca	0.62	0.42	0.51	1.31	83.2
Syllis garciai/mauretanica	0.65	0.41	0.51	1.28	84.48
Eulalia mustela	0.68	0.4	0.52	1.22	85.7
Polycirrus	0.5	0.38	0.51	1.17	86.87
Maerella tenuimana	0.48	0.3	0.35	0.93	87.8
Schistomeringos neglecta	0.7	0.29	0.37	0.88	88.68
Syllis	0.77	0.29	0.36	0.88	89.57
Paraonidae	0.51	0.23	0.38	0.71	90.27

Group d
Less than 2 samples in group

Group o
Less than 2 samples in group

Group q
Average similarity: 55.82

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Ampharete lindstroemi agg.	4.07	3.16	19.43	5.67	5.67
NEMERTEA	3.36	2.36	13.84	4.24	9.9
Leptochiton asellus	3.53	2.27	6.28	4.06	13.97
Aonides paucibranchiata	2.55	1.86	5.02	3.33	17.3
Pholoe inornata	2.3	1.76	8.3	3.15	20.45
Cirrophorus branchiatus	2.69	1.76	8.3	3.15	23.6
Lysidice unicornis	2.29	1.44	3.1	2.57	26.18
Phoronis	2.44	1.42	3.53	2.55	28.73
Ophelina acuminata	1.9	1.42	13.36	2.54	31.27
Praxillella affinis	1.95	1.32	5.02	2.36	33.63
Chaetozone zetlandica	1.88	1.31	6.28	2.35	35.97
Golfingiidae	1.72	1.25	5.06	2.25	38.22
Pholoe baltica	1.79	1.24	8.3	2.23	40.45
Euchone pararosea	1.72	1.24	8.3	2.23	42.68
Eteone cf. longa	1.63	1.24	12.29	2.22	44.9

Scoloplos armiger	1.79	1.24	12.29	2.22	47.12
Parexogone hebes	1.52	1.16	13.36	2.08	49.2
Dipolydora caulleryi agg.	1.41	1.16	13.36	2.08	51.28
Terebellides	1.41	1.16	13.36	2.08	53.35
Leiochone	1.75	1.09	2.41	1.95	55.3
Lagis koreni	1.49	1.04	2.38	1.86	57.16
Glycera lapidum	1.58	1.02	3.1	1.82	58.97
Poecilochaetus serpens	1.28	0.94	3.46	1.69	60.66
Laonice bahusiensis agg.	1.47	0.94	3.46	1.69	62.35
Nototropis vedlomensis	1.38	0.94	3.46	1.69	64.04
Schistomeringos rudolphi	1.28	0.93	5.02	1.67	65.7
Scalibregma inflatum	1.55	0.93	5.02	1.67	67.37
Owenia	1.47	0.93	5.02	1.67	69.04
Lumbrineris aniara agg.	1.24	0.82	13.36	1.47	70.51
Paradoneis lyra	1.24	0.82	13.36	1.47	71.97
Caulleriella alata	1.14	0.82	13.36	1.47	73.44
Spirobranchus triqueter	1.24	0.82	13.36	1.47	74.91
Cheirocratus	1.24	0.82	13.36	1.47	76.38
Othomaera othonis	2	0.82	13.36	1.47	77.85
Cerianthus lloydii	1.24	0.82	13.36	1.47	79.32
Euclymene oerstedii agg.	1.61	0.53	0.58	0.96	80.27
TEREBELLIFORMIA	1.41	0.51	0.58	0.92	81.19
Ampharetidae	1.41	0.51	0.58	0.92	82.11
Aricidea (Acmira) cerrutii	1.15	0.46	0.58	0.83	82.94
Serpulidae	1.39	0.44	0.58	0.8	83.74
Eumida	0.94	0.42	0.58	0.75	84.49
Syllis	0.94	0.36	0.58	0.65	85.14
Galathea intermedia	1.22	0.36	0.58	0.65	85.79
Pisidia longicornis	0.94	0.36	0.58	0.65	86.44
BIVALVIA	0.94	0.36	0.58	0.65	87.09
Protodorvillea kefersteini	0.67	0.3	0.58	0.53	87.62
Thelepus cincinnatus	0.67	0.3	0.58	0.53	88.15
Sabellidae	0.91	0.3	0.58	0.53	88.68
Ampelisca typica	0.91	0.3	0.58	0.53	89.21
Gnathiidae	0.67	0.3	0.58	0.53	89.74
Phyllodoce lineata	0.67	0.27	0.58	0.48	90.22

Group h
Less than 2 samples in group

Group f
Average similarity: 47.36

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Scalibregma inflatum	7.26	4.05	#######	8.55	8.55
Pholoe baltica	3.15	2.16	#######	4.57	13.12
Urothoe marina	2.9	2.02	#######	4.27	17.39
Paradoneis lyra	3.29	1.87	#######	3.96	21.35
Notomastus	2.44	1.71	#######	3.61	24.96
Aonides paucibranchiata	2.44	1.71	#######	3.61	28.57
Goniadella gracilis	2.22	1.53	#######	3.23	31.8
Leptocheirus hirsutimanus	2.12	1.53	#######	3.23	35.03
Kurtiella bidentata	3.6	1.53	#######	3.23	38.26
NEMERTEA	2.66	1.53	#######	3.23	41.5
Glycera lapidum	1.87	1.33	#######	2.8	44.29
Lysilla nivea	2.6	1.33	#######	2.8	47.09
Owenia	1.87	1.33	#######	2.8	49.89
Ericthonius punctatus	2.09	1.33	#######	2.8	52.69
Tanaopsis graciloides	2.09	1.33	#######	2.8	55.49
Polynoidae	1.93	1.08	#######	2.28	57.77
Malmgrenia	1.57	1.08	#######	2.28	60.05
Glycera	1.41	1.08	#######	2.28	62.34
Syllis	1.41	1.08	#######	2.28	64.62
Lumbrineris aniara agg.	2.12	1.08	#######	2.28	66.91
Mediomastus fragilis	1.93	1.08	#######	2.28	69.19
Spionidae	1.83	1.08	#######	2.28	71.48
Polycirrus	2.29	1.08	#######	2.28	73.76
Aoridae	1.57	1.08	#######	2.28	76.05
Upogebia deltaura	1.83	1.08	#######	2.28	78.33
PLATYHELMINTHES	1.41	1.08	#######	2.28	80.62

Podarkeopsis	1	0.77	#######	1.62	82.23
Nereididae	1.5	0.77	#######	1.62	83.85
Cirrophorus branchiatus	1.21	0.77	#######	1.62	85.46
Chaetozone zetlandica	1.21	0.77	#######	1.62	87.08
Ampharete lindstroemi agg.	1.21	0.77	#######	1.62	88.69
Pista mediterranea	1.21	0.77	#######	1.62	90.31

Group g
Less than 2 samples in group

Group x
Average similarity: 53.09

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Poecilochaetus serpens	8.3	7.9	#######	14.89	14.89
Scalibregma inflatum	5.42	4.6	#######	8.67	23.56
Spiophanes bombyx	3.3	3.17	#######	5.97	29.53
Aoridae	2.45	2.59	#######	4.87	34.4
NEMERTEA	2.72	2.59	#######	4.87	39.27
Owenia	2.44	2.36	#######	4.45	43.72
Scoloplos armiger	2.12	2.11	#######	3.98	47.7
Sthenelais limicola	1.98	1.83	#######	3.45	51.14
Lagis koreni	2.37	1.83	#######	3.45	54.59
Lumbrineris aniara agg.	1.93	1.49	#######	2.81	57.4
Ampharete lindstroemi agg.	1.83	1.49	#######	2.81	60.21
Glycera alba	1	1.06	#######	1.99	62.2
Glycera fallax	1.21	1.06	#######	1.99	64.19
Glycinde nordmanni	1.21	1.06	#######	1.99	66.18
Podarkeopsis	1.5	1.06	#######	1.99	68.17
Phyllodoce lineata	1.21	1.06	#######	1.99	70.16
Aricidea (Aricidea) minuta	1.37	1.06	#######	1.99	72.15
Aonides paucibranchiata	1.37	1.06	#######	1.99	74.14
Pseudopolydora pulchra	1.5	1.06	#######	1.99	76.13
Polycirrus	1.37	1.06	#######	1.99	78.12
Nototropis vedlomensis	1.21	1.06	#######	1.99	80.11
Ampelisca	1	1.06	#######	1.99	82.1
Urothoe elegans	1.37	1.06	#######	1.99	84.09
Cheirocratus	1	1.06	#######	1.99	86.08
Gnathiidae	1.72	1.06	#######	1.99	88.06
Paguridae	1.21	1.06	#######	1.99	90.05

Group e
Less than 2 samples in group

Appendix D: Benthic infaunal data univariate analysis results

Table D 1: Raw Data Results of Benthic Infanal Univariate Analysis.

S = number of species; N = abundance; B = Biomass (ash free dry mass in grams); d = Margalef's index of Richness; J' = Pielou's Evenness index; H' = Shannon-Wiener Diversity index; l = Simpson's index of Dominance.

Station	Preliminary Infaunal Biotope	S	N	Biomass (g)	d	J'	H'	λ
ENV01	SS.SMx.OMx.PoVen	67	187	3.56	12.62	0.89	3.76	0.97
ENV02	SS.SMx.OMx.PoVen	70	146	10.39	13.85	0.92	3.91	0.98
ENV03	SS.SMx.OMx.PoVen	66	185	58.97	12.45	0.90	3.77	0.97
ENV04	SS.SMx.OMx.PoVen	49	119	2.56	10.04	0.94	3.65	0.98
ENV05	SS.SMx.OMx.PoVen	71	158	15.70	13.83	0.94	3.99	0.98
ENV06	SS.SMx.OMx.PoVen	77	284	21.97	13.45	0.87	3.77	0.97
ENV07	SS.SCS.CCS	17	23	0.20	5.10	0.95	2.69	0.96
ENV08	SS.SMx.OMx.PoVen	57	133	5.64	11.45	0.93	3.76	0.98
ENV09	SS.SMx.OMx	36	53	39.38	8.82	0.96	3.43	0.98
ENV10	SS.SMx.OMx.PoVen	78	200	5.05	14.53	0.94	4.09	0.98
ENV11	SS.SMu.CSaMu.LkorPpel	32	137	2.13	6.30	0.79	2.72	0.89
ENV12	SS.SCS.CCS	54	196	1.87	10.04	0.88	3.52	0.96
ENV13	SS.SCS.CCS	63	179	2.49	11.95	0.87	3.60	0.96
ENV14	SS.SMx.OMx.PoVen	61	124	62.98	12.45	0.95	3.92	0.98
ENV15	SS.SMx.OMx.PoVen	74	156	4.90	14.46	0.91	3.90	0.97
ENV16	SS.SMu.CSaMu.LkorPpel	26	112	0.98	5.30	0.82	2.67	0.90
ENV17	SS.SMx.OMx.PoVen	52	273	1.41	9.09	0.60	2.36	0.73
ENV18	SS.SMx.OMx.PoVen	53	128	3.43	10.72	0.88	3.49	0.96
ENV19	SS.SMx.OMx.PoVen	74	196	1.92	13.83	0.92	3.96	0.98
ENV20	SS.SMx.OMx.PoVen	66	151	0.77	12.96	0.94	3.92	0.98
ENV21	SS.SMu.CSaMu.LkorPpel	28	101	0.88	5.85	0.90	3.01	0.95
ENV22	SS.SCS.CCS	18	30	0.22	5.00	0.93	2.68	0.95
ENV23	SS.SMu.CSaMu.LkorPpel	38	115	0.83	7.80	0.89	3.22	0.95
ENV24	SS.SMx.OMx.PoVen	54	135	16.21	10.80	0.90	3.57	0.97
ENV25	SS.SMu.CSaMu.LkorPpel	33	128	0.98	6.60	0.86	3.02	0.94
ENV26	SS.SMu.CSaMu.LkorPpel	29	110	0.56	5.96	0.89	3.00	0.94
ENV27	SS.SMx.OMx.PoVen	73	195	3.30	13.65	0.92	3.97	0.98
ENV28	SS.SCS.CCS	24	30	0.65	6.76	0.96	3.06	0.98
ENV29	SS.SMx.OMx.PoVen	52	136	1.16	10.38	0.92	3.62	0.97
ENV30	SS.SMu.CSaMu.LkorPpel	36	223	2.60	6.47	0.82	2.93	0.92
ENV31	SS.SMx.OMx.PoVen	71	193	14.97	13.30	0.91	3.86	0.97
ENV32	SS.SMx.OMx.PoVen	60	161	5.47	11.61	0.91	3.71	0.97
ENV33	SS.SMx.OMx.PoVen	97	364	4.88	16.28	0.88	4.01	0.97
ENV34	SS.SMx.OMx.PoVen	81	468	5.22	13.01	0.81	3.56	0.95
ENV35	SS.SMx.OMx.PoVen	82	434	4.18	13.34	0.81	3.58	0.95
ENV36	SS.SMx.OMx.PoVen	98	281	4.32	17.20	0.91	4.16	0.98
ENV37	SS.SMx.OMx.PoVen	86	293	5.83	14.96	0.90	4.02	0.98
ENV38	SS.SMx.OMx.PoVen	87	349	4.01	14.69	0.88	3.93	0.97
ENV39	SS.SMx.OMx.PoVen	86	346	7.00	14.54	0.86	3.82	0.96
ENV40	SS.SMx.CMx.KurThyMx	65	193	5.44	12.16	0.88	3.69	0.97
ENV41	SS.SMx.OMx.PoVen	102	291	17.31	17.80	0.92	4.26	0.98
ENV42	SS.SMx.OMx.PoVen	75	213	2.33	13.80	0.92	3.96	0.98
ENV43	SS.SCS.CCS	22	90	23.14	4.67	0.73	2.25	0.83
ENV44	SS.SCS.CCS	29	65	0.12	6.71	0.95	3.18	0.97
ENV45	SS.SMx.CMx.KurThyMx	69	306	21.70	11.88	0.85	3.61	0.96
ENV47	SS.SMx.OMx.PoVen	98	292	13.03	17.09	0.90	4.14	0.98
ENV48	SS.SMx.OMx.PoVen	92	437	4.15	14.97	0.87	3.91	0.97
ENV49	SS.SMx.OMx.PoVen	91	320	25.10	15.60	0.85	3.85	0.96
ENV50	SS.SMx.OMx.PoVen	23	38	0.48	6.05	0.95	2.99	0.97
ENV51	SS.SMx.OMx.PoVen	87	226	6.75	15.87	0.93	4.16	0.98
ENV52	SS.SMx.OMx.PoVen	91	367	6.01	15.24	0.87	3.91	0.97
ENV53	SS.SMx.OMx.PoVen	80	193	4.11	15.01	0.92	4.04	0.98
ENV54	SS.SMx.OMx.PoVen	98	331	14.96	16.72	0.90	4.15	0.98
ENV55	SS.SMx.OMx.PoVen	95	340	3.37	16.13	0.87	3.97	0.97
ENV56	SS.SMx.OMx.PoVen	115	428	27.96	18.81	0.89	4.24	0.98
ENV57	SS.SCS.CCS	53	129	1.39	10.70	0.90	3.57	0.97
ENV59	SS.SMx.OMx.PoVen	71	145	88.08	14.07	0.94	4.01	0.98
ENV60	SS.SMx.OMx.PoVen	70	194	7.08	13.10	0.92	3.92	0.98
ENV61	SS.SMx.OMx.PoVen	91	277	1.30	16.00	0.90	4.04	0.98

Station	Preliminary Infaunal Biotope	S	N	Biomass (g)	d	J'	H'	λ
ENV62	SS.SMx.OMx.PoVen	57	144	0.42	11.27	0.90	3.66	0.97
ENV63	SS.SMx.OMx.PoVen	63	158	4.67	12.25	0.93	3.85	0.98
ENV64	SS.SMx.OMx.PoVen	64	181	11.05	12.12	0.90	3.76	0.97
ENV65	SS.SMx.OMx.PoVen	80	209	4.91	14.79	0.91	3.98	0.98
ENV66	SS.SCS.CCS	19	148	0.16	3.60	0.64	1.89	0.72
ENV67	SS.SCS.CCS	42	149	0.42	8.19	0.77	2.88	0.89
ENV68	SS.SCS.CCS	52	466	2.17	8.30	0.58	2.30	0.75
ENV69	SS.SMx.OMx.PoVen	69	249	7.78	12.32	0.88	3.72	0.96
ENV70	SS.SCS.CCS	42	140	0.51	8.30	0.84	3.14	0.94
ENV71	SS.SMx.OMx.PoVen	78	221	9.31	14.26	0.92	4.00	0.98
ENV82	SS.SMx.CMx	59	216	41.46	10.79	0.83	3.39	0.94
ENV83	SS.SCS.CCS	43	85	3.65	9.45	0.93	3.51	0.97
ENV84	SS.SMx.OMx.PoVen	77	393	29.87	12.72	0.82	3.56	0.94
ENV86	SS.SMx.OMx.PoVen	104	330	2.92	17.76	0.89	4.11	0.98
ENV88	SS.SMx.OMx.PoVen	88	247	7.95	15.79	0.90	4.02	0.98
ENV89	SS.SCS.CCS	15	68	0.13	3.32	0.81	2.19	0.85
ENV90	SS.SMx.OMx.PoVen	65	146	24.66	12.84	0.91	3.78	0.97
ENV91	SS.SMu.CSaMu.LkorPpel	59	258	4.98	10.44	0.79	3.21	0.92
ENV92	SS.SMu.CSaMu.LkorPpel	64	190	26.49	12.01	0.88	3.64	0.96
ENV93	SS.SCS.CCS	15	122	0.13	2.91	0.67	1.82	0.73
ENV94	SS.SMu.CSaMu.LkorPpel	53	230	2.59	9.56	0.73	2.91	0.86
ENV95	SS.SMx.OMx.PoVen	39	83	1.73	8.60	0.91	3.35	0.96
ENV96	SS.SCS.CCS	53	219	1.73	9.65	0.79	3.15	0.92
ENV97	SS.SMx.OMx.PoVen	87	297	10.06	15.10	0.89	3.96	0.97

Appendix E: Benthic epifaunal data multivariate analysis results

SIMPER
Similarity Percentages - species contributions

One-Way Analysis

Data worksheet
Name: Fourth root(2)
Data type: Abundance
Sample selection: All
Variable selection: All

Parameters
Resemblance: S17 Bray Curtis similarity
Cut off for low contributions: 90.00%

Factor Groups

	Simprov
Sample	3
ENV01	k
ENV08	k
ENV15	k
ENV95	k
ENV96	k
ENV02	i
ENV03	i
ENV06	i
ENV09	i
ENV12	i
ENV13	i
ENV14	i
ENV17	i
ENV18	i
ENV19	i
ENV24	i
ENV39	i
ENV69	i
ENV84	i
ENV04	j
ENV05	j
ENV10	j
ENV27	j
ENV29	j
ENV31	j
ENV32	j
ENV33	j
ENV34	j
ENV35	j
ENV36	j
ENV37	j
ENV38	j
ENV41	j
ENV42	j
ENV47	j
ENV48	j
ENV49	j
ENV50	j
ENV51	j
ENV52	j
ENV53	j
ENV54	j
ENV55	j
ENV56	j
ENV59	j
ENV60	j
ENV61	j
ENV62	j
ENV63	j
ENV64	j
ENV65	j
ENV71	j
ENV82	j
ENV86	j
ENV88	j
ENV90	j
ENV92	j
ENV97	j
ENV07	l
ENV66	l
ENV89	l
ENV11	f
ENV28	f
ENV91	f
ENV93	f
ENV16	a
ENV21	a
ENV22	a
ENV25	a
ENV26	a
ENV20	g
ENV70	g
ENV83	g
ENV23	c
ENV30	c

ENV40	c
ENV43	c
ENV44	c
ENV45	c
ENV67	c
ENV68	c
ENV46	e
ENV58	e
ENV73	e
ENV74	e
ENV76	e
ENV79	e
ENV80	e
ENV81	e
ENV85	e
ENV87	e
ENV57	h
ENV72	d
ENV75	d
ENV77	d
ENV78	d
ENV94	b

Group k
Average similarity: 53.99

Species	Av.Abund	Av.Sim	Sim/SD	Contrib %	Cum. %
NEMATODA	1.08	3.64	9.74	6.74	6.74
COPEPODA	1	3.58	8.45	6.63	13.37
Faunal turf	0.82	2.73	4.31	5.06	18.43
Serpulidae sp 0001	0.82	2.71	5.13	5.01	23.44
Pectinidae 01	0.71	2.37	11.44	4.39	27.83
Animaliatubes	0.69	2.18	3.31	4.05	31.88
Schizomavella	0.8	2.03	1.15	3.77	35.64
Sertulariidae	0.8	2.03	1.15	3.77	39.41
Hydrallmania falcata	0.84	2.03	1.15	3.77	43.18
Tubulariam sp 0001	0.63	1.97	7.91	3.65	46.82
Alcyonium digitatum	0.67	1.97	7.94	3.64	50.47
Ophiura sp	0.58	1.9	3.94	3.52	53.99
Asteria rubens	0.44	1.52	10.13	2.81	56.8
cf Pagurus bernhardus	0.44	1.4	4.57	2.59	59.39
Cirripedia	0.45	1.39	4.22	2.57	61.96
Sabellidae 01	0.45	1.39	7.77	2.57	64.53
Buccinidae 01	0.4	1.27	6.96	2.36	66.89
Nemertesia 02	0.38	1.14	5.52	2.12	69
Scaphopoda 01	0.44	1.03	1.01	1.92	70.92
Burrows	0.72	1	0.61	1.86	72.78
Hydrozoa indet	0.37	0.97	1.16	1.8	74.57
Actiniaria 01	0.38	0.94	1.14	1.75	76.32

Bivalvia siphons	0.35	0.87	1.1	1.61	77.93
Actiniaria 03	0.36	0.83	1.12	1.53	79.46
Paguroidea indet	0.4	0.81	1.09	1.49	80.95
Ascidiacea 01	0.33	0.78	1.06	1.45	82.41
Ensis sp	0.36	0.71	1.11	1.32	83.72
Terebellidae01	0.26	0.67	1.13	1.25	84.97
Inachus 01	0.26	0.62	1.15	1.15	86.13
Callionymus lyra	0.25	0.62	1.15	1.15	87.28
Actinopterygii 01	0.28	0.43	0.6	0.81	88.08
Sabella sp	0.24	0.39	0.62	0.71	88.8
Folliculinidae	0.4	0.38	0.32	0.7	89.5
Ophiuroidea indet	0.24	0.38	0.6	0.7	90.2

Group i
Average similarity: 53.94

Species	Av.Abund	Av.Sim	Sim/SD	Contrib %	Cum. %
NEMATODA	1.16	4.14	7.99	7.67	7.67
COPEPODA	0.93	3.1	2.34	5.74	13.42
Alcyonium digitatum	0.77	2.56	5.74	4.75	18.17
Faunal turf	0.75	2.52	5.99	4.67	22.84
Serpulidae sp 0001	0.77	2.48	4.54	4.6	27.44
DECAPODA	0.87	2.33	1.21	4.32	31.77
Tubulariam sp 0001	0.65	2.01	2.26	3.72	35.49
Pectinidae 01	0.6	1.98	6.02	3.68	39.17
Ophiura sp	0.56	1.91	5.77	3.53	42.7
Animaliatubes	0.59	1.9	4.83	3.53	46.23
Penetrantia	0.75	1.76	0.97	3.27	49.5
Euclymeninae	0.7	1.52	0.79	2.82	52.32
Scaphopoda 01	0.49	1.49	2.2	2.76	55.08
Bivalvia siphons	0.45	1.49	5.22	2.76	57.84
Paguroidea indet	0.48	1.4	2.14	2.59	60.43
Asteria rubens	0.39	1.31	7.22	2.43	62.86
Hydrozoa indet	0.39	1.13	2.21	2.09	64.95
Sertulariidae	0.57	1.1	0.66	2.04	66.99
AMPHIPODA	0.6	1.08	0.66	2	68.99
Buccinidae 01	0.38	1.05	1.54	1.94	70.93
Ceriantharia 01	0.45	1.02	1.08	1.89	72.82
Actiniaria 01	0.37	0.99	1.51	1.84	74.66
Sabellidae 01	0.39	0.93	1.14	1.72	76.38
Ensis sp	0.37	0.84	1.16	1.55	77.93
cf Pagurus bernhardus	0.35	0.83	1.19	1.54	79.48
Pagurus prideaux	0.33	0.82	1.19	1.51	80.99
Adamsia palliata	0.33	0.82	1.19	1.51	82.5
Ophiuroidea indet	0.29	0.68	0.95	1.26	83.76
Cirripedia	0.27	0.61	0.96	1.14	84.9
Nemertesia 02	0.27	0.59	0.96	1.1	85.99
Ascidiacea 01	0.27	0.53	0.78	0.98	86.98
Callionymus lyra	0.24	0.5	0.79	0.93	87.9

Triglidaem sp 001	0.22	0.47	0.79	0.88	88.78
Sabella sp	0.21	0.37	0.65	0.69	89.47
Cliona	0.36	0.37	0.35	0.69	90.16

Group j
Average similarity: 55.51

Species	Av.Abund	Av.Sim	Sim/SD	Contrib %	Cum. %
NEMATODA	1.16	3.52	9.04	6.33	6.33
Serpulidae sp 0001	0.96	2.92	8.67	5.26	11.59
Sertulariidae	0.98	2.54	1.71	4.57	16.17
Hydrallmania falcata	0.97	2.49	1.71	4.49	20.66
Ophiura sp	0.8	2.26	5.87	4.08	24.73
COPEPODA	0.86	2.21	1.55	3.98	28.72
Pectinidae 01	0.76	2.2	6.88	3.96	32.68
Alcyonium digitatum	0.78	2.16	4.3	3.88	36.56
Porella concinna	0.72	1.57	1.01	2.84	39.4
Ceriantharia 01	0.63	1.54	1.87	2.78	42.18
Faunal turf	0.6	1.53	4.08	2.77	44.94
Schizomavella	0.69	1.46	0.94	2.63	47.57
DECAPODA	0.73	1.45	0.94	2.61	50.18
Asteria rubens	0.49	1.43	7.16	2.57	52.75
Euclymeninae	0.67	1.21	0.76	2.18	54.93
Buccinidae 01	0.43	1.17	2.67	2.1	57.03
cf Pagurus bernhardus	0.46	1.17	1.85	2.1	59.14
Animaliatubes	0.46	1.12	2.18	2.03	61.16
AMPHIPODA	0.62	1.06	0.71	1.9	63.06
Ebalia sp	0.41	0.98	1.84	1.77	64.83
Sabellidae 01	0.41	0.95	1.62	1.71	66.55
Echinoidea 01	0.47	0.91	0.89	1.65	68.19
Actiniaria 01	0.39	0.91	1.67	1.63	69.82
Cirripedia	0.37	0.84	1.37	1.52	71.34
Ascidiacea 01	0.35	0.81	1.38	1.45	72.8
Penetrantia	0.55	0.78	0.58	1.41	74.2
Paguroidea indet	0.35	0.76	1.16	1.37	75.58
Folliculinidae	0.49	0.69	0.54	1.24	76.82
Hydrozoa indet	0.33	0.66	1.15	1.2	78.02
Scaphopoda 01	0.34	0.65	1.05	1.16	79.18
Bivalvia indet	0.36	0.64	0.76	1.15	80.33
Calliostomatidae	0.29	0.59	1.08	1.07	81.4
Bivalvia siphons	0.29	0.59	1.08	1.06	82.45
Ensis sp	0.31	0.58	0.92	1.05	83.5
Ophiuroidea indet	0.28	0.52	0.87	0.93	84.43
Cliona	0.41	0.49	0.44	0.88	85.32
Disporella hispida	0.41	0.49	0.44	0.87	86.19
Tubulariam sp 0001	0.29	0.48	0.86	0.87	87.06
Inachus 01	0.26	0.45	0.81	0.81	87.87
Actiniaria 05	0.27	0.45	0.75	0.81	88.68
Adamsia palliata	0.25	0.45	0.81	0.81	89.48
Pagurus prideaux	0.24	0.42	0.76	0.76	90.25

Group I
Average similarity: 43.50

Species	Av.Abund	Av.Sim	Sim/SD	Contrib %	Cum. %
NEMATODA	1.13	6.93	7.55	15.93	15.93
Serpulidae sp 0001	0.82	5.18	10.31	11.9	27.84
Faunal turf	0.57	3.57	11.04	8.2	36.03
Ophiura sp	0.5	3.21	8.63	7.37	43.41
Pectinidae 01	0.57	2.97	3.74	6.83	50.23
Paguroidea indet	0.56	2.89	6.59	6.63	56.87
Alcyonium digitatum	0.57	2.8	2.86	6.43	63.3
cf Pagurus bernhardus	0.45	2.75	7.83	6.32	69.62
Ascidiacea 01	0.32	2.09	7.83	4.8	74.42
Animaliatubes	0.36	1.34	0.58	3.08	77.5
Scaphopoda 01	0.34	1.03	0.58	2.36	79.86
Cirripedia	0.32	0.88	0.58	2.03	81.89
Buccinidae 01	0.27	0.82	0.58	1.88	83.77
Asteria rubens	0.24	0.81	0.58	1.85	85.62
Echinoidea 01	0.25	0.8	0.58	1.83	87.45
Diodora graeca	0.26	0.8	0.58	1.83	89.28
Gastropoda indet	0.25	0.8	0.58	1.83	91.11

Group f
Average similarity: 54.80

Species	Av.Abund	Av.Sim	Sim/SD	Contrib %	Cum. %
NEMATODA	1.09	3.8	7.35	6.93	6.93
Faunal turf	0.77	2.58	8.41	4.71	11.65
Ophiura sp	0.63	2.1	10.45	3.83	15.48
Tubulariam sp 0001	0.63	1.97	7.07	3.59	19.07
Alcyonium digitatum	0.66	1.95	6.14	3.56	22.63
Ceriantharia 01	0.61	1.9	8.38	3.46	26.09
Actinopterygii 01	0.58	1.86	2.76	3.4	29.49
Serpulidae sp 0001	0.67	1.82	2.45	3.31	32.8
DECAPODA	0.8	1.76	0.91	3.21	36.02
Animaliatubes	0.63	1.72	2.8	3.15	39.16
Ophiuroidea indet	0.57	1.63	7.49	2.97	42.13
Paguroidea indet	0.53	1.6	4.55	2.92	45.05
Pectinidae 01	0.51	1.55	4.24	2.83	47.88
Terebellidae01	0.43	1.48	6.6	2.71	50.59
Actiniaria 01	0.48	1.47	4.66	2.69	53.28
Buccinidae 01	0.41	1.38	9.41	2.52	55.8
Pagurus prideaux	0.45	1.36	3.88	2.49	58.28
Adamsia palliata	0.45	1.36	3.88	2.49	60.77
Gadidae 01	0.38	1.31	5.91	2.38	63.16
Hydrozoa indet	0.38	1.29	9.53	2.35	65.51

Nemertesia 01	0.39	1.22	7.81	2.22	67.72
Nemertesia 02	0.39	1.22	7.81	2.22	69.94
Astropecten irregularis	0.37	1.22	7.81	2.22	72.16
Asteria rubens	0.35	1.19	12.51	2.17	74.33
cf Pagurus bernhardus	0.37	0.8	0.91	1.46	75.79
Sabellidae 01	0.4	0.76	0.89	1.39	77.18
Annelidatube indet	0.33	0.76	0.91	1.39	78.57
Bivalvia siphons	0.32	0.75	0.89	1.37	79.93
Triglidaem sp 001	0.29	0.7	0.88	1.29	81.22
Ascidiacea 01	0.31	0.67	0.91	1.23	82.44
Sertularella	0.5	0.64	0.41	1.17	83.61
Ensis sp	0.24	0.62	0.91	1.13	84.74
Actiniaria 05	0.29	0.62	0.89	1.13	85.88
Scaphopoda 01	0.31	0.62	0.89	1.13	87.01
ANTHOATHECATA	0.55	0.61	0.41	1.11	88.12
Cirripedia	0.3	0.6	0.88	1.1	89.22
Bonellia viridis	0.24	0.6	0.9	1.1	90.31

Group a
Average similarity: 46.95

Species	Av.Abund	Av.Sim	Sim/SD	Contrib %	Cum. %
Faunal turf	0.68	5.16	28.05	10.99	10.99
Ophiura sp	0.68	4.99	6.6	10.64	21.63
Paguroidea indet	0.59	4.24	12.61	9.03	30.66
Astropecten irregularis	0.49	3.42	4.45	7.29	37.95
Ceriantharia 01	0.41	2.93	6.52	6.23	44.18
Alcyonium digitatum	0.39	2.9	10.22	6.18	50.36
cf Pagurus bernhardus	0.35	2.6	16.63	5.54	55.9
Phoronis	0.6	2.38	0.62	5.07	60.97
Actiniaria 01	0.37	2.02	1.16	4.29	65.26
Pagurus prideaux	0.41	1.95	1.1	4.16	69.42
Adamsia palliata	0.41	1.95	1.1	4.16	73.58
Ophiuroidea indet	0.31	1.76	1.15	3.74	77.31
Annelidatube indet	0.32	1.73	1.16	3.69	81
Bivalvia siphons	0.32	1.66	1.14	3.53	84.53
Gobiidae 01	0.26	0.86	0.61	1.83	86.36
AMPHIPODA	0.4	0.82	0.32	1.75	88.11
Scaphopoda 01	0.22	0.81	0.62	1.73	89.84
Sabella sp	0.22	0.78	0.62	1.67	91.51

Group g
Average similarity: 51.86

Species	Av.Abund	Av.Sim	Sim/SD	Contrib %	Cum. %
Porella concinna	1	4.34	8.07	8.38	8.38
NEMATODA	1.06	4.34	8.07	8.38	16.75
Serpulidae sp 0001	0.88	3.53	10.75	6.8	23.55

Pectinidae 01	0.62	2.59	5.16	5	28.55
Faunal turf	0.64	2.47	6.77	4.77	33.32
Tubulariam sp 0001	0.68	2.21	2.22	4.26	37.58
Animaliatubes	0.57	2.12	8.5	4.09	41.66
cf Pagurus bernhardus	0.5	2.1	5.85	4.04	45.71
Ophiura sp	0.5	2.05	7.35	3.95	49.66
Bivalvia indet	0.57	2.03	10.69	3.92	53.58
Echinoidea 01	0.49	1.93	8.45	3.71	57.29
Scaphopoda 01	0.49	1.89	2.82	3.64	60.94
Cirripedia	0.47	1.7	5.04	3.27	64.21
Ensis sp	0.44	1.62	8.45	3.12	67.33
Callionymus lyra	0.37	1.61	8.18	3.1	70.44
Paguroidea indet	0.42	1.55	7.31	2.98	73.42
Schizomavella	0.67	1.38	0.58	2.65	76.07
Escharella immersa	0.67	1.38	0.58	2.65	78.72
Disporella hispida	0.67	1.38	0.58	2.65	81.38
Ascidiacea 01	0.33	1.36	8.45	2.63	84
AMPHIPODA	0.67	1.32	0.58	2.54	86.54
DECAPODA	0.73	1.32	0.58	2.54	89.08
Buccinidae 01	0.29	0.69	0.58	1.34	90.42

Group c
Average similarity: 49.66

Species	Av.Abund	Av.Sim	Sim/SD	Contrib %	Cum. %
NEMATODA	1.12	4.66	8.81	9.38	9.38
Faunal turf	0.72	2.77	5.38	5.58	14.96
AMPHIPODA	0.77	2.31	1.05	4.66	19.62
Paguroidea indet	0.57	2.27	7.11	4.57	24.19
Ophiura sp	0.56	2.25	10.13	4.52	28.71
Terebellidae01	0.54	2.11	4.83	4.25	32.97
Animaliatubes	0.52	2.03	6.3	4.1	37.06
Alcyonium digitatum	0.49	1.8	4.76	3.63	40.69
Tubulariam sp 0001	0.51	1.66	1.6	3.34	44.03
Pectinidae 01	0.43	1.52	6.1	3.06	47.09
COPEPODA	0.63	1.5	0.73	3.01	50.1
cf Pagurus bernhardus	0.38	1.46	9.54	2.93	53.04
Sabellidae 01	0.36	1.46	13.32	2.93	55.97
Gobiidae 01	0.44	1.39	1.52	2.81	58.78
Actiniaria 01	0.42	1.34	1.49	2.69	61.47
Serpulidae sp 0001	0.44	1.28	1.55	2.57	64.04
Annelidatube indet	0.39	1.25	1.63	2.52	66.56
Adamsia palliata	0.37	1.2	1.57	2.42	68.98
Pagurus prideaux	0.37	1.2	1.58	2.42	71.4
Inachus 01	0.35	1.16	1.61	2.34	73.73
Ceriantharia 01	0.42	1.11	1.02	2.24	75.97
Hydrozoa indet	0.35	0.94	1.01	1.88	77.86
Scaphopoda 01	0.34	0.86	1.01	1.74	79.59
Asteria rubens	0.3	0.85	1.05	1.7	81.3

Callionymus lyra	0.28	0.8	1.04	1.62	82.91
Ophiuroidea indet	0.25	0.57	0.72	1.14	84.06
Ascidiacea 01	0.22	0.54	0.73	1.09	85.15
cf Psammechinus miliaris	0.28	0.54	0.71	1.08	86.23
Actiniaria 03	0.2	0.5	0.73	1.01	87.24
Echinoidea 01	0.25	0.48	0.72	0.97	88.21
NEMERTEA	0.38	0.45	0.34	0.91	89.12
Penetrantia	0.4	0.44	0.34	0.88	90

Group e
Average similarity: 67.88

Species	Av.Abund	Av.Sim	Sim/SD	Contrib %	Cum. %
Serpulidae sp 0001	0.95	4.54	7.19	6.69	6.69
Alcyonium digitatum	0.9	4.32	8.31	6.37	13.05
Ophiura sp	0.74	3.31	4.7	4.88	17.94
Pectinidae 01	0.68	3.16	7.27	4.66	22.59
Faunal turf	0.67	2.99	7.03	4.41	27
cf Ophiothrix fragilis	0.7	2.9	6.07	4.28	31.27
cf Pagurus bernhardus	0.54	2.53	10.44	3.72	35
Tubulariam sp 0001	0.54	2.37	4.6	3.49	38.49
Buccinidae 01	0.5	2.32	6.76	3.42	41.91
Actiniaria 01	0.51	2.25	6.91	3.31	45.22
Asteria rubens	0.49	2.14	4.44	3.15	48.36
Cirripedia	0.48	2.07	4.83	3.06	51.42
Hydrozoa indet	0.47	2.02	5.13	2.98	54.4
Ebalia sp	0.44	1.91	6.09	2.81	57.21
Calliostomatidae	0.4	1.85	7.72	2.72	59.92
Ascidiacea 01	0.39	1.7	7.91	2.51	62.44
Ceriantharia 01	0.45	1.64	1.84	2.41	64.85
Echinoidea 01	0.47	1.47	1.02	2.16	67.01
Nemertesia 02	0.38	1.44	1.85	2.12	69.12
cf Ophiocomina nigra	0.45	1.42	1.22	2.09	71.21
Callionymus lyra	0.34	1.38	1.87	2.04	73.25
Bivalvia indet	0.37	1.21	1.14	1.78	75.03
Actiniaria 03	0.37	1.16	1.21	1.71	76.74
Actiniaria 05	0.35	1.16	1.25	1.71	78.46
Ensis sp	0.33	1.13	1.19	1.66	80.11
Pagurus prideaux	0.3	1.09	1.26	1.6	81.71
Adamsia palliata	0.3	1.09	1.26	1.6	83.31
Paguroidea indet	0.33	1.08	1.26	1.59	84.9
Ophiuroidea indet	0.35	1.07	1.24	1.57	86.47
cf Metridium dianthus	0.31	0.79	0.87	1.17	87.64
Gastropoda indet	0.25	0.75	0.92	1.1	88.74
Sabella sp	0.26	0.73	0.91	1.08	89.82
Actinopterygii 01	0.29	0.67	0.69	0.99	90.81

Group h
Less than 2 samples in group

Group d
Average similarity: 69.60

Species	Av.Abund	Av.Sim	Sim/SD	Contrib %	Cum. %
Serpulidae sp 0001	0.78	5.2	11.47	7.47	7.47
Tubulariam sp 0001	0.71	4.91	29.95	7.05	14.52
Alcyonium digitatum	0.68	4.46	24.47	6.41	20.93
Pectinidae 01	0.59	4.01	37.95	5.76	26.69
Echinoidea 01	0.57	3.79	7.9	5.45	32.14
cf Pagurus bernhardus	0.53	3.64	19.46	5.22	37.37
Faunal turf	0.56	3.52	6.92	5.05	42.42
Animaliatubes	0.51	3.27	7.61	4.7	47.12
Ophiura sp	0.5	3.21	7.05	4.61	51.73
Buccinidae 01	0.44	3.09	24.07	4.44	56.17
cf Spatangus purpureus	0.47	2.99	4.23	4.29	60.47
Ensis sp	0.44	2.58	4.49	3.7	64.17
Bivalvia indet	0.39	2.55	21.29	3.66	67.83
Ophiuroidea indet	0.37	2.42	10.37	3.47	71.3
Asteria rubens	0.35	2.4	12.12	3.45	74.74
Actiniaria 01	0.34	2.34	23.55	3.36	78.1
Nudibranchia 01	0.32	2.31	21.47	3.32	81.42
Pagurus prideaux	0.33	1.51	0.91	2.16	83.58
Adamsia palliata	0.32	1.45	0.91	2.09	85.67
Cirripedia	0.36	1.43	0.87	2.06	87.73
Paguroidea indet	0.29	1.3	0.91	1.86	89.59
Calliostomatidae	0.27	1.19	0.91	1.71	91.3

Group b
Less than 2 samples in group

Groups k & i
Average dissimilarity = 50.38

Appendix F: Benthic epifaunal data univariate analysis results

Table F 1: Raw Data Results of Benthic Epifaunal Univariate Analysis.

S = number of species; N = abundance; B = Biomass (ash free dry mass in grams); d = Margalef's index of Richness; J' = Pielou's Evenness index; H' = Shannon-Wiener Diversity index; λ = Simpson's index of Dominance

Station	Biotope	S	N	d	J'	H'	Lambda
ENV01	SS.SMx.CMx	60	23.65	18.65	0.69	2.82	0.93
ENV02	SS.SMx.CMx	59	25.74	17.86	0.77	3.15	0.98
ENV03	SS.SMx.CMx	42	21.51	13.36	0.65	2.42	0.88
ENV04	SS.SMx.CMx	56	25.84	16.91	0.73	2.93	0.96
ENV05	SS.SMx.CMx	55	31.85	15.60	0.79	3.16	0.97
ENV06	SS.SMx.CMx	58	30.67	16.65	0.68	2.78	0.90
ENV07	SS.SCS.CCS	34	12.49	13.07	0.65	2.28	0.94
ENV08	SS.SMx.CMx	46	18.72	15.36	0.83	3.19	1.01
ENV09	SS.SMx.CMx	43	11.46	17.22	0.69	2.61	0.98
ENV10	SS.SMx.CMx	58	24.59	17.80	0.79	3.21	0.99
ENV11	SS.SSa.CMuSa	43	6.95	21.66	0.69	2.61	1.04
ENV12	SS.SSa.CMuSa	49	12.49	19.01	0.76	2.96	1.02
ENV13	SS.SCS.CCS	47	18.88	15.66	0.73	2.83	0.98
ENV14	SS.SCS.CCS	41	15.88	14.47	0.75	2.78	0.98
ENV15	SS.SMx.CMx	52	18.53	17.47	0.78	3.09	1.00
ENV16	SS.SSa.CMuSa	26	5.87	14.13	0.66	2.15	1.03
ENV17	SS.SCS.CCS	41	12.32	15.93	0.71	2.65	0.98
ENV18	SS.SMx.CMx	35	18.52	11.65	0.78	2.76	0.97
ENV19	SS.SMx.CMx	40	19.26	13.18	0.78	2.86	0.98
ENV20	SS.SMx.CMx	46	18.96	15.29	0.79	3.04	0.99
ENV21	SS.SSa.CMuSa	25	2.89	22.61	0.58	1.88	1.15
ENV22	SS.SSa.CMuSa	28	4.73	17.38	0.68	2.27	1.08
ENV23	SS.SMx.CMx	36	13.05	13.63	0.74	2.66	0.98
ENV24	SS.SMx.CMx	43	15.57	15.30	0.75	2.80	0.98
ENV25	SS.SSa.CMuSa	23	7.19	11.15	0.68	2.13	0.98
ENV26	SS.SSa.CMuSa	19	6.00	10.05	0.65	1.93	0.96
ENV27	SS.SMx.CMx	42	19.13	13.89	0.83	3.09	1.00
ENV28	SS.SCS.CCS	54	21.11	17.38	0.78	3.11	0.99
ENV29	SS.SMx.CMx	51	13.31	19.32	0.73	2.86	1.00
ENV30	SS.SSa.CMuSa	37	7.67	17.67	0.73	2.63	1.04

Station	Biotope	S	N	d	J'	H'	Lambda
ENV31	SS.SMx.CMx	50	18.67	16.74	0.78	3.03	0.99
ENV32	SS.SMx.CMx	43	20.26	13.96	0.78	2.93	0.98
ENV33	SS.SMx.CMx	53	29.33	15.39	0.81	3.23	0.99
ENV34	SS.SMx.CMx	55	26.45	16.49	0.80	3.21	0.99
ENV35	SS.SMx.CMx	61	26.37	18.34	0.80	3.29	0.99
ENV36	SS.SMx.CMx	46	23.94	14.17	0.81	3.12	0.99
ENV37	SS.SMx.CMx	46	20.35	14.94	0.79	3.04	0.99
ENV38	SS.SMx.CMx	60	33.01	16.87	0.83	3.41	0.99
ENV39	SS.SMx.CMx	47	20.14	15.32	0.81	3.10	1.00
ENV40	SS.SMx.CMx	38	16.61	13.17	0.76	2.76	0.98
ENV41	SS.SMx.CMx	49	24.28	15.05	0.82	3.18	0.99
ENV42	SS.SMx.CMx	49	22.60	15.39	0.80	3.13	0.99
ENV43	SS.SMx.CMx	48	12.86	18.40	0.73	2.82	1.00
ENV44	SS.SMx.CMx	44	11.94	17.34	0.69	2.61	0.99
ENV45	SS.SMx.CMx	44	14.03	16.28	0.72	2.74	0.99
ENV46	SS.SMx.CMx	48	5.10	28.86	0.75	2.92	1.13
ENV47	SS.SMx.CMx	47	22.97	14.68	0.79	3.03	0.98
ENV48	SS.SMx.CMx	55	23.48	17.11	0.81	3.26	1.00
ENV49/1	SS.SMx.CMx	43	19.32	14.18	0.79	2.96	0.99
ENV50	SS.SMx.CMx	48	17.06	16.57	0.76	2.95	0.99
ENV51	SS.SMx.CMx	51	21.63	16.27	0.80	3.13	0.99
ENV52	SS.SMx.CMx	46	20.75	14.84	0.79	3.01	0.99
ENV53	SS.SMx.CMx	46	13.02	17.53	0.74	2.83	0.99
ENV54	SS.SMx.CMx	46	19.27	15.21	0.78	2.98	0.99
ENV55	SS.SMx.CMx	41	15.06	14.75	0.78	2.91	1.00
ENV56	SS.SMx.CMx	52	21.26	16.68	0.78	3.08	0.99
ENV57	SS.SMx.CMx	44	16.14	15.46	0.76	2.89	0.99
ENV58	SS.SMx.CMx	49	4.41	32.33	0.77	3.01	1.18
ENV59	SS.SMx.CMx	53	21.27	17.01	0.80	3.17	1.00
ENV60	SS.SMx.CMx	49	19.59	16.14	0.81	3.16	1.00
ENV61	SS.SMx.CMx	53	23.73	16.42	0.80	3.19	0.99
ENV62	SS.SMx.CMx	44	18.93	14.62	0.80	3.01	0.99
ENV63	SS.SMx.CMx	46	17.02	15.88	0.78	2.98	0.99
ENV64	SS.SMx.CMx	40	18.54	13.36	0.75	2.77	0.97

Station	Biotope	S	N	d	J'	H'	Lambda
ENV65	SS.SMx.CMx	42	17.93	14.20	0.82	3.05	1.00
ENV66	SS.SCS.CCS	31	5.03	18.57	0.60	2.05	0.97
ENV67/1	SS.SMx.CMx	50	7.82	23.83	0.68	2.68	1.03
ENV68	SS.SMx.CMx	45	5.59	25.57	0.59	2.24	0.98
ENV69	SS.SMx.CMx	52	21.47	16.63	0.77	3.04	0.99
ENV70	SS.SMx.CMx	40	9.90	17.01	0.69	2.55	0.99
ENV71	SS.SMx.CMx	50	16.85	17.35	0.75	2.94	0.99
ENV72	SS.SMx.CMx	29	2.64	28.84	0.78	2.61	1.43
ENV73	SS.SMx.CMx	47	3.38	37.79	0.74	2.86	1.29
ENV74	SS.SMx.CMx	32	3.47	24.89	0.74	2.55	1.22
ENV75	SS.SMx.CMx	30	1.32	104.83	0.85	2.89	3.82
ENV76	SS.SMx.CMx	36	4.27	24.12	0.73	2.63	1.16
ENV77	SS.SMx.CMx	32	2.49	33.97	0.80	2.76	1.50
ENV78	SS.SCS.CCS	31	1.90	46.56	0.84	2.88	1.94
ENV79	SS.SMx.CMx	37	3.81	26.94	0.73	2.63	1.20
ENV80	SS.SMx.CMx	45	4.37	29.82	0.77	2.91	1.18
ENV81	SS.SMx.CMx	48	4.36	31.92	0.76	2.95	1.18
ENV82	SS.SMx.CMx	45	16.49	15.70	0.75	2.84	0.98
ENV83	SS.SMx.CMx	34	8.99	15.03	0.74	2.60	1.02
ENV84	SS.SMx.CMx	39	12.04	15.27	0.74	2.71	0.99
ENV85	SS.SMx.CMx	45	6.11	24.31	0.73	2.76	1.08
ENV86	SS.SMx.CMx	60	20.12	19.66	0.79	3.22	1.00
ENV87	SS.SMx.CMx	48	4.78	30.04	0.77	2.99	1.16
ENV88	SS.SMx.CMx	52	21.03	16.74	0.80	3.17	1.00
ENV89	SS.SCS.CCS	23	5.33	13.15	0.62	1.95	0.96
ENV90	SS.SMx.CMx	67	25.11	20.47	0.77	3.25	0.99
ENV91	SS.SCS.CCS	59	14.03	21.96	0.70	2.86	0.98
ENV92	SS.SMx.CMx	64	22.86	20.13	0.80	3.33	1.00
ENV93	SS.SCS.CCS	52	9.98	22.17	0.53	2.10	0.85
ENV94	SS.SCS.CCS	55	24.00	16.99	0.79	3.17	0.99
ENV95	SS.SMx.CMx	42	9.10	18.56	0.74	2.76	1.03
ENV96	SS.SMx.CMx	42	9.25	18.43	0.72	2.68	1.02
ENV97	SS.SMx.CMx	67	23.88	20.80	0.78	3.27	0.99

Appendix G: Sediment contamination results

Table G 1: Concentration of PCBs Recorded in Sediments Within the Morgan Benthic Subtidal Ecology Study Area.

Description (PCBs)	28	52	101	118	138	153	180	Sum of ICES 7
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MS AL1 (mg/kg)	-	-	-	-	-	-	-	0.01
MS AL2 (mg/kg)	-	-	-	-	-	-	-	-
Sample no.								
ENV05	0.25	0.25	0.42	0.3	0.3	0.3	0.13	1.95
ENV06	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0
ENV12	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0
ENV13	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0
ENV14	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0
ENV17	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0
ENV20	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0
ENV21	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0
ENV29	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0

Table G 2: Concentrations of PAHs.

Description (PAH)	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a(pyrene	Indeno(1,2,3 - c,d)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
Units	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
MS AL1	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
MS AL2	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
Canadian TEL	**0.0346**	**0.00587**	**0.00671**	**0.0212**	**0.0867**	**0.0469**	**0.0346**	**0.00587**	**0.00671**	**0.0212**	**0.0867**	**0.0469**	**0.0888**	**n/a**	**0.00622**	**n/a**
Canadian PEL	**0.391**	**0.128**	**0.0889**	**0.144**	**0.544**	**0.245**	**0.391**	**0.128**	**0.0889**	**0.144**	**0.544**	**0.245**	**0.763**	**n/a**	**0.135**	**n/a**
ENV05	0.003	<0.001	<0.001	0.001	0.005	<0.001	4	4	3	4	7	2	0.003	0.007	0.001	0.006
ENV06	0.003	<0.001	<0.001	0.001	0.005	<0.001	5	5	3	5	9	3	0.004	0.009	0.002	0.007
ENV12	0.002	<0.001	<0.001	<0.001	0.003	<0.001	4	3	2	3	5	2	0.003	0.006	0.001	0.004
ENV13	0.003	<0.001	<0.001	<0.001	0.004	<0.001	5	5	3	4	7	3	0.004	0.008	0.001	0.006
ENV14	0.003	<0.001	<0.001	0.001	0.005	<0.001	5	5	3	5	8	3	0.004	0.008	0.001	0.007
ENV17	0.003	<0.001	<0.001	0.001	0.006	<0.001	6	6	4	5	9	4	0.005	0.009	0.002	0.008
ENV20	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<1	<1	<1	<1	1	<1	0.001	0.001	<0.001	<0.001
ENV21	0.002	<0.001	<0.001	<0.001	0.004	<0.001	5	5	3	4	8	3	0.004	0.008	0.001	0.006
ENV29	0.003	<0.001	<0.001	0.001	0.007	<0.001	7	6	4	6	11	4	0.005	0.0010	0.002	0.008
ENV36	0.003	<0.001	<0.001	0.001	0.006	<0.001	5	5	3	5	8	2	0.004	0.007	0.001	0.006
ENV37	0.003	<0.001	<0.001	0.001	0.005	<0.001	5	4	3	4	7	3	0.004	0.007	0.001	0.006
ENV38	0.003	<0.001	<0.001	0.001	0.006	<0.001	7	6	4	5	10	4	0.005	0.009	0.002	0.008
ENV39	0.003	<0.001	<0.001	0.001	0.006	<0.001	7	6	4	6	10	3	0.006	0.010	0.002	0.008
ENV40	0.005	<0.001	<0.001	0.002	0.009	0.001	10	10	6	8	14	6	0.008	0.014	0.003	0.012
ENV47	0.002	<0.001	<0.001	<0.001	0.003	<0.001	3	3	2	3	5	2	0.002	0.004	<0.001	0.004
ENV50	0.003	<0.001	<0.001	0.002	0.007	<0.001	6	5	3	6	10	3	0.004	0.008	0.002	0.007
ENV51	0.003	<0.001	<0.001	0.001	0.006	<0.001	7	6	4	5	10	4	0.005	0.009	0.002	0.008
ENV52	0.003	<0.001	<0.001	0.001	0.005	<0.001	6	6	4	5	10	4	0.005	0.009	0.002	0.008
ENV57	0.001	<0.001	<0.001	<0.001	0.008	<0.001	3	3	2	3	3	<1	0.001	0.002	<0.001	0.003
ENV59	0.001	<0.001	<0.001	<0.001	0.003	<0.001	3	3	2	3	4	2	0.002	0.003	<0.001	0.003
ENV63	0.003	<0.001	<0.001	<0.001	0.004	<0.001	3	3	2	3	5	2	0.003	0.005	<0.001	0.004
ENV65	0.002	<0.001	<0.001	<0.001	0.004	<0.001	4	3	2	3	6	3	0.003	0.005	<0.001	0.004
ENV71	0.002	<0.001	<0.001	<0.001	0.003	<0.001	3	3	2	3	4	2	0.002	0.004	<0.001	0.004

Appendix H: Species scientific, common names and biotopes

The below table contains all common names for the latin species which have been referred to in the main text of this benthic subtidal ecology technical report.

Table H 1: Latin and common names.

Scientific name	Common name
Abra alba	White furrow shell
Abra nitida	Glossy furrow shell
Acanthocardia aculeata	Spiny cockle
Acanthocardia echinata	European prickly cockle
Acteon tornatilis	lathe acteon
Actinia equina	Beadlet anenome
Adamsia palliata	Cloak anenome
Alcyonidium diaphanum	Deadman's fingers anenome
Ammophila arenaria	Marram grass
Ampharete lindstroemi	No known common name
Amphiura chiajei	Heart urchin
Amphiura filiformis	Bristle worm
Aonides paucibranchiata	No known common name
Arctica islandica	Ocean quahog
Arenicola defodiens	Black lug worm
Arenicola marina	Lug worm
Asarte sulcata	Furrowed asarte
Ascophyllum nodosum	Knotted wrack
Asterias rubens	Common starfish
Asterina gibbosa	Cushion star
Austrominius modestus	Modest barnacle
Balanus crenatus	Wrinkled barnacle
Barnea candida	White piddock
Bathyporeia pelagica	Sand digger shrimp
Bathyporeia pilosa	Sand digger shrimp
Branchiostoma lanceolatum	Common lancet
Brissopsis lyrifera	Heart urchin
Cancer pagurus	Brown crab
Carcinus maenas	Green shore crab
Cerastoderma edule	Common cockle
Cerianthus lloydii	North Sea tube anenome
Chamelea gallina	Striped venus clam
Chondrus crispus	Irish moss
Corallina officinalis	Coral weed
Corophium arenarium	No known common name
Dendrodoa grossularia	Baked bean ascidian
Donax vittatus	Banded wedge shell
Dosinia lupinus	Smooth artemis
Dumontia contorta	No known common name
Echinocardium cordatum	Sea potato
Echinocyamus pusillus	Pea urchin
Edwardsia timida	Worm anenome
Elminius modestus	Common rock barnacle
Ennucula tenuis	Smooth nutclam
Ensis magnus	Razor clam
Ensis siliqua	Pod razor
Euspira catena	Large necklace shell
Euspira nitida	Common necklace shell
Eurydice pulchra	Speckled sea louse
Fabulina fabula	Bean-like tellin
Fucus serratus	Toothed wrack
Fucus spiralis	Spiral wrack
Fucus vesiculosus	Bladder wrack
Glauco-Puccinellietalia maritimae	Atlantic salt meadow
Glycera lapidum	No known common name
Glycimeris	Bittersweet clam
Golfingia (Golfingia) elongata	No known common name
Halidrys siliquosa	Sea-oak
Hediste diversicolor	Rag worm
Hymeniacidon perleve	Crumb-of-bread sponge
Kurtiella bidentata	Two-toothed Mantagu shell
Laevicardium crissum	Norwegian egg cockle
Lagis koreni	Trumpet worm

Scientific name	Common name
Laminaria digitata	Oar weed
Laminaria hyperborea	Cuvie
Lanice conchilega	Sand mason worm
Laonice bahusiensis	No known common name
Leptochiton asellus	No known common name
Limaria hians	Flame shell
Lipophrys pholis	Common blenny
Littorina littorea	Common periwinkle
Loripes lucinalis	No known common name
Lutraria oblonga	Oblong otter shell
Leymus arenarius	Lyme grass
Macoma balthica	Baltic tellin
Macomangulus tenuis	Thin tellin
Mactra stultorum	Edible salt water clam
Magelona mirabilis	Bristle worm
Mastocarpus stellatus	False irish moss
Modiolus modiolus	Northern horse mussel
Mytilus edulis	Common blue mussel
Nephtys cirrosa	White catworm
Nucella lapillus	Dog whelk
Nucula nitidosa	Shiny nut clam
Obelia bidentata	Double toothed sea fir
Ophiocomina nigra	Black brittlestar
Ophiothrix fragilis	Common brittlestar
Ostrea edulis	European flat oyster
Owenia fusiformis	Tube worm
Pagurus prideaux	Prideaux's hermit crab
Pagurus bernhardus	Common hermit crab
Patella vulgata	Common limpet
Pennatula phosphorea	Phosphorescent sea pen
Pharus legumen	Razor shell
Phascolion (Phascolion) strombus strombus	Peanut worm
Phaxas pellucidus	Transparent razor shell
Petromyzon marinus	Sea lamprey

Scientific name	Common name
Phorcus lineatus	Lined top shell
Pomacea canaliculata	Golden apple snail
Pomatoceros triqueter	Keel worm
Porcellana platycheles	Broad clawed porcelain crab
Porphyra purpurea	Purple laver
Pygospio elegans	No known common name
Sabellaria alveolata	Honeycomb worm
Sabellaria spinulosa	Ross worm
Sagartia troglodytes	Cave-dwelling anenome
Salicornia	Glasswort
Scalibregma inflatum	T-headed worm
Scolelepis foliosa	No known common name
Scolelepis squamata	No known common name
Scoloplos armiger	Armoured bristle worm
Scrobicularia plana	Peppery furrow shell
Semibalanus balanoides	Common rock barnacle
Spatangus purpureus	Purple heart urchin
Spio martinensis	No known common name
Spirobranchus triqueter	Tube worm
Stauromedusae	Stalked jellyfish
Steromphala cineraria	Grey top shell
Steromphala umbilicalis	Flat top shell
Thia scutellata	Thumbnail crab
Ulva intestinalis	Sea lettuce
Urticina feline	Dahlia anemone
Verrucaria maura	Tar lichen
Zostera marina	Eel grass

The below table includes all the biotope codes referred to in the main body of the text as well as their full biotope names.

Table H 2: Biotope code.

Biotope Code	Biotope full name
CR.MCR	Moderate energy circalittoral rock
CR.MCR.CSab.Sspi	*Sabellaria spinulosa* encrusted circalittoral rock
CR.MCR.EcCr.FaAlCr	Faunal and algal crusts on exposed to moderately wave-exposed circalittoral rock
CR.MCR.SfR.Pid	Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay
CR.HCR.XFa.ByErSp	Bryozoan turf and erect sponges on tide-swept circalittoral rock
CR.HCR.XFa.SpNemAdia	Sparse sponges, *Nemertesia* spp. and *Alcyonidium diaphanum* on circalittoral mixed substrata
ELR.MB.Bpat	Barnacles and *Patella* spp. on exposed or moderately exposed, or vertical sheltered eulittoral rock
ELR.MB.BPat.Sem	*Semibalanus balanoides*, *Patella vulgata* and Littorina spp. on exposed to moderately exposed or vertical sheltered eulittoral rock
ELR.MB.MytB	*Mytilus edulis* and barnacles on very exposed eulittoral rock
LGS.S.AEur	*Eurydice pulchra* in littoral mobile sand
LGS.S.AP.P	Amphipods and *Scolelepis* spp. in littoral medium-fine sand
LGS.S.Lan	*Lanice conchilega* in littoral sand
LGS.Sh.BarSh	Barren littoral shingle
LR.L.YG	Yellow and grey lichens on supralittoral rock
LR.R	Littoral rock
LR.FLR.Eph.BLitX	Barnacles and *Littorina* sp. on unstable eulittoral mixed substrata
LR.FLR.Eph.EphX	Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata
LR.FLR.Eph.UlvPor	*Porphyra purpurea* and *Ulva* sp. on sand-scoured mid or lower eulittoral rock
LR.FLR.Lic.Ver	*Verrucaria maura* on littoral fringe rock
LR.HLR.MusB.Sem	*Semibalanus balanoides* on exposed to moderately exposed or vertical sheltered eulittoral rock
LR.HLR.MusB.Sem.LitX	*Semibalanus balanoides* and *Littorina* spp. on exposed to moderately exposed eulittoral boulders and cobbles
LR.LLR.F.Fspi	*Fucus spiralis* on sheltered upper eulittoral rock
LR.Rkp.H	Hydroids, ephemeral seaweeds and *Littorina littorea* in shallow eulittoral mixed substrata pools
LS.LBR.LMus.Myt.Mx	*Mytilus edulis* beds on littoral mixed substrata
LS.LBR.Sab.Salv	*Sabellaria alveolata* reefs on sand-abraded eulittoral rock

Biotope Code	Biotope full name
LS.LCS.Sh.BarSh	Barren littoral shingle
LS.LSa.FiSa	Polychaete/amphipod-dominated fine sand shores
LS.LSa.MoSa	Barren or amphipod-dominated mobile sand shores
LS.LSa.MuSa	Polychaete/bivalve-dominated muddy sand shores
LS.LSa.MuSa.Lan	*Lanice conchilega* in littoral sand
LS.LSa.MuSa.MacAre	*Macoma balthica* and *Arenicola marina* in littoral muddy sand
LS.LSa.St.Tal	Talitrids on the upper shore and strand-line
MLR.Eph.Ent	*Ulva* spp. on freshwater-influenced and/or unstable upper eulittoral rock
MLR.Eph.EntPor	*Porphyra purpurea* and *Ulva* spp. on sand-scoured mid or lower eulittoral rock
SLR.FX.BLlit	Barnacles and *Littorina* spp. on unstable eulittoral mixed substrata
SS.SBR.PoR.SspiMx	*Sabellaria spinulosa* on stable circalittoral mixed sediment
SS.SBR.Smus	Sublittoral mussel beds (on sublittoral sediment)
SS.SCS.CCS	Circalittoral coarse sediment
SS.SCS.CCS.Blan	*Branchiostoma lanceolatum* in circalittoral coarse sand with shell gravel
SS.SCS.ICS.MoeVen	*Moerella* sp. with venerid bivalves in infralittoral gravelly sand
SS.SCS.ICS.SLan	Dense *Lanice conchilega* and other polychaetes in tide-swept infralittoral sand and mixed gravelly sand
SS.SCS.OCS	Offshore circalittoral coarse sediment
SS.SCS.PomB	*Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles
SS.SMu.CFiMu.BlyrAchi	*Brissopsis lyrifera* and *Amphiura chiajei* in circalittoral mud
SS.SMu.CSaMu	Circalittoral sandy mud
SS.SMu.CSaMu.AfilKurAnit	*Amphiura filiformis*, *Kurtiella bidentata* and *Abra nitida* in circalittoral sandy mud
SS.SMu.CSaMu.AfilMysAnit	*Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud
SS.SMu.CSaMu. LkorPpel	*Lagis koreni* and *Phaxas pellucidus* in circalittoral sandy mud
SS.SMu.CSaMu.ThyEten	*Thyasira sp.* and *Ennucula tenuis* in circalittoral sandy mud
SS.SMu.CSaMu.ThyNten	*Thyasira* spp. and *Ennucula tenuis* in circalittoral sandy mud
SLR.MX.MytX	*Mytilus edulis* beds on littoral mixed substrata
SS.SMx	Sublittoral mixed sediment
SS.SMx.CMx	Circalittoral mixed sediment
SS.SMx.CMx.ClloMx.Nem	*Cerianthus lloydii* with the *Nemertesia* spp. and other hydroids in circalittoral muddy mixed sediment
SS.SMx.CMx.FluHyd	*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment

Biotope Code	Biotope full name
SS.SMx.CMx.KurThyMx	*Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment
SS.SMx.CMx.OphMx	*Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment
SS.SMx.CMx.MysThyMx	Kurtiella bidentata and Thyasira spp. in circalittoral muddy mixed sediment
SS.SMx.OMx	Offshore circalittoral mixed sediment
SS.SMx.OMx.PoVen	Polychaete-rich deep Venus community in offshore mixed sediments
SS.SSa.CFiSa	Circalittoral fine sand
SS.SSa.CMuSa.AalbNuc	*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment
SS.SSa.IFiSa.NcirBat	*Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand
SS.SSa.IMuSa.Ecor.Ens	*Echinocardium cordatum* and *Ensis* spp. in lower shore and shallow sublittoral slightly muddy fine sand
SS.SSa.IMuSa.FfabMag	*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand
SS.SMu.ISaMu.AmpPlor	*Ampelisca* spp., *Photis longicaudata* and other tube-building amphipods and polychaetes in infralittoral sandy mud

Appendix I: Sediment Metabarcoding

I.1.1 Sediment Metabarcoding Results

I.1.1.1 Overview

1.9.1.1 Two samples were collected from 35 sample stations within the Morgan Array Area with one being analysed in the laboratory and the second retained as a spare. During the site-specific surveys, samples were also collected from 48 stations within the Mona Array Area.

I.1.1.2 Summary Statistics

1.9.1.2 A total of 2211 operational taxonomic units (OTUs) were detected across from the site-specific surveys as detailed in Table I 1. Of the 2211 detected OTUs (bacterial and infaunal), a greater percentage of infaunal OTUs were identified to species level (9%) compared to the bacterial OTUs (1%) possibly related to a larger pool of reference material for infaunal OTUs.

Table I 1: OTU Detections per Target and Percentage Successfully Classified.

Target	Number of OTUs	Phylum (%)	Class (%)	Order (%)	Family (%)	Genus (%)	Species (%)
Bacteria	1582	72	53	31	21	6	1
Infauna	629	100	82	89	78	33	9

1.9.1.3 From the 1,582 bacterial OTUs detected in the sediment samples, 1,315 (83%) were detected in the Morgan sample stations whilst 1352 (85%) were detected in the Mona sample stations. Bacteria OTUs were similar between both survey areas with 69% (1085) shared across both survey areas. In terms of all the bacterial OTUs, 17% (230) were unique to the Morgan benthic subtidal ecology study area while 20% (267) were unique to Mona benthic subtidal ecology study area. A total of 35 bacterial OTUs (3%) were present in all Morgan sediment samples compared to 32 (2%) across the Mona samples. Generally, the proportion of bacterial OTUs occurring in a single sample only were similar between both survey areas with 27% of OTUs (n=355) in the Morgan sediment samples and 24% (n=326) in the Mona sediment samples. The relatively high numbers of widespread taxa and lone taxa across the Morgan and Mona benthic subtidal ecology study areas suggested that the community has been subjected to relatively little disturbance.

1.9.1.4 Overall, 629 infaunal OTUs were detected across both survey areas with a higher percentage of faunal OTUs detected at the Mona benthic subtidal ecology study area (73%; n=461) compared to the Morgan benthic subtidal ecology study area (71%; n=447). A total of 199 (45%) infaunal OTUs were present in a single sample across the Morgan samples, similar to the 198 (43%) infaunal OTUs across the Mona samples. However, in contrast to the bacterial data set no OTUs were detected in every sample. The absence of consistent community as well as the high proportion (>40%) of rare OTUs suggest the community heterogeneity across the survey area may have been under sampled for the infaunal size class. This may be improved by analysis of the second samples acquired at each station though it's not certain that it will fill all community gaps.

1.9.1.5 The bacterial data sets identified 40 taxonomic groups based on class with the proportional contributions of these taxonomic groups to the overall structure of the Morgan and Mona benthic subtidal ecology study areas detailed in Table I 2. The 'Other' category comprised OTUs which could not be identified to class.

1.9.1.6 The most abundant taxonomic group across the Morgan and Mona benthic subtidal ecology study areas (n=599 and n=622) was the 'Other' which accounted for 45.6% and 46.0% of OTUs, respectively. The second most abundant taxonomic group was the Gammaproteobacteria class (n=239 and n=247 OTUs) and accounted for 18.2% and 18.3% of OTUs, respectively. As previously mentioned, Gammaproteobacteria dominance is likely given it is one of the richest classes within the bacterial phyla (Williams et al., 2010). The relative dominance of 'Other' within the proportional contributions was partly due to the inability to determine these OTUs further than phylum.

Table I 2: Contribution of Gross Sediment Bacterial OTU Taxonomic Groups.

Group	Morgan Survey Area		Mona Survey Area	
	Abundance	Proportional Contribution	Abundance	Proportional Contribution
Acidobacteriae	45	3.4%	46	3.4%
Aminicenantia	4	0.3%	4	0.3%
Acidimicrobiia	3	0.2%	2	0.1%
Actinomycetia	28	2.1%	26	1.9%
Bacteroidia	80	6.1%	82	6.1%
Ignavibacteria	1	0.1%	2	0.1%
Rhodothermia	1	0.1%	1	0.1%
Bacteriovoracia	1	0.1%	1	0.1%
Campylobacteria	3	0.2%	3	0.2%
Anaerolineae	16	1.2%	20	1.5%
Dehalococcoidia	1	0.1%	2	0.1%
Cyanobacteriia	1	0.1%	1	0.1%
Vampirovibrionia	1	0.1%	1	0.1%
Deferribacteres	2	0.2%	1	0.1%
Deinococci	1	0.1%	1	0.1%
Babeliae	1	0.1%	0	0.0%

Group	Morgan Survey Area		Mona Survey Area	
	Abundance	Proportional Contribution	Abundance	Proportional Contribution
Desulfobacteria	3	0.2%	5	0.4%
Desulfobulbia	1	0.1%	2	0.1%
Desulfovibrionia	0	0.0%	1	0.1%
Desulfuromonadia	2	0.2%	2	0.1%
Syntrophobacteria	1	0.1%	1	0.1%
Chitinivibrionia	0	0.0%	1	0.1%
Clostridia	3	0.2%	2	0.1%
Fusobacteriia	1	0.1%	1	0.1%
Gemmatimonadetes	4	0.3%	4	0.3%
Moduliflexia	1	0.1%	0	0.0%
Myxococcia	0	0.0%	1	0.1%
Polyangia	4	0.3%	3	0.2%
Nitrospiria	14	1.1%	15	1.1%
Thermodesulfovibrionia	3	0.2%	4	0.3%
Gracilibacteria	1	0.1%	3	0.2%
Phycisphaerae	4	0.3%	5	0.4%
Planctomycetes	92	7.0%	93	6.9%
Alphaproteobacteria	105	8.0%	100	7.4%
Gammaproteobacteria	239	18.2%	247	18.3%
Spirochaetia	6	0.5%	9	0.7%
Sumerlaeia	0	0.0%	1	0.1%
Chlamydiia	1	0.1%	0	0.0%
Kiritimatiellae	9	0.7%	10	0.7%
Verrucomicrobiae	33	2.5%	27	2.0%
Other	599	45.6%	622	46.0%
Total	1315	100%	1352	100%

1.9.1.7 A total of 26 taxonomic groups based on class were identified from the sediment infaunal data sets with the proportional contributions of these taxonomic groups to the overall structure of the Morgan and Mona benthic subtidal ecology study areas detailed in Table I 3. The 'Other' category comprised the OTUs which could not be identified to class.

1.9.1.8 *Adenophorea* (n=189 and n=175 OTUs) was the most abundant taxonomic group across the Morgan and Mona benthic subtidal ecology study areas and accounted for 51.9% and 44.4% of OTUs, respectively. The second most abundant group across the Morgan benthic subtidal ecology study area was the 'Others group (n=83, 18.6%) while across the Mona benthic subtidal ecology study areathe second most abundant group was Hexanauplia (n=76, 19.3%). Four taxonomic groups were represented by a single OTU across the Morgan benthic subtidal ecology study area while five represented by a single OTU across the Mona benthic subtidal ecology study area. One taxonomic group was unique to the Morgan data set (*Asteroidea*) whilst three were unique to the Mona data set (*Staurozoa*, *Polyplacophora*, *Hoplonemertea*).

Table I 3: Contribution of Gross Sediment Infaunal OTU Taxonomic Groups.

Group	Morgan Survey Area		Mona Survey Area	
	Abundance	Proportional Contribution	Abundance	Proportional Contribution
Clitellata	1	0.3%	2	0.5%
Polychaeta	53	14.6%	65	16.5%
Arachnida	6	1.6%	7	1.8%
Hexanauplia	58	15.9%	76	19.3%
Malacostraca	3	0.8%	4	1.0%
Ostracoda	4	1.1%	3	0.8%
Appendicularia	1	0.3%	1	0.3%
Ascidiacea	7	1.9%	6	1.5%
Anthozoa	4	1.1%	2	0.5%
Hydrozoa	7	1.9%	12	3.0%
Scyphozoa	1	0.3%	1	0.3%
Staurozoa	0	0.0%	1	0.3%
Asteroidea	1	0.3%	0	0.0%
Echinoidea	2	0.5%	2	0.5%
Holothuroidea	2	0.5%	3	0.8%
Ophiuroidea	1	0.3%	3	0.8%
Enteropneusta	2	0.5%	1	0.3%
Bivalvia	6	1.6%	6	1.5%
Gastropoda	6	1.6%	5	1.3%
Polyplacophora	0	0.0%	1	0.3%
Adenophorea	189	51.9%	175	44.4%
Hoplonemertea	0	0.0%	2	0.5%
Pilidiophora	4	1.1%	7	1.8%
Eurotatoria	6	1.6%	5	1.3%
Sipunculidea	0	0.0%	4	1.0%

Group	Morgan Survey Area		Mona Survey Area	
	Abundance	Proportional Contribution	Abundance	Proportional Contribution
Other	83	18.6%	67	14.5%
Total	364	100%	394	100%

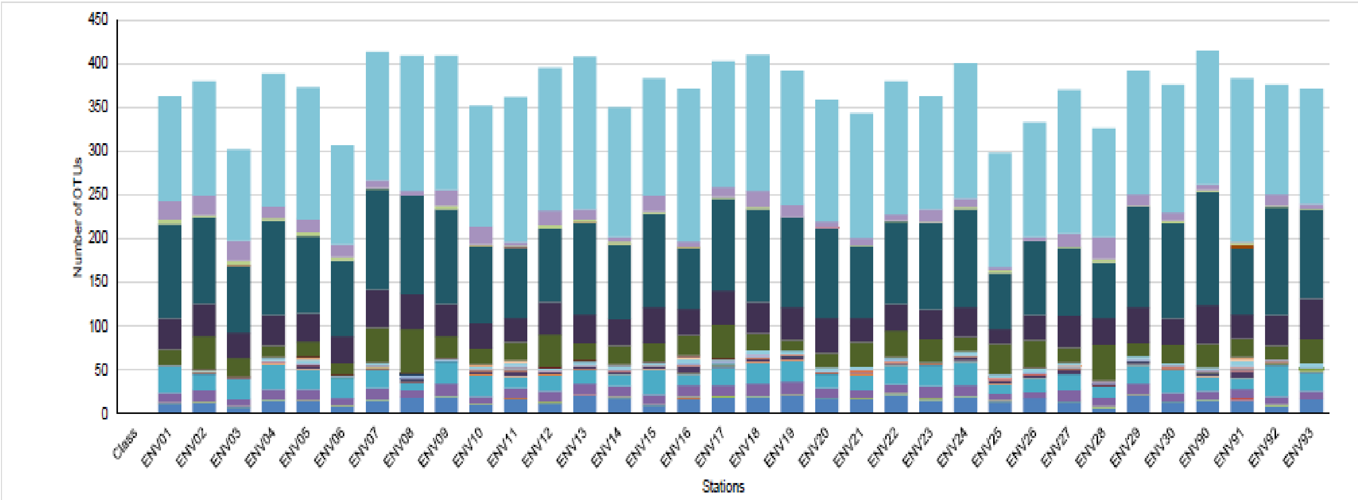

Figure I 1: Contributions of Gross Sediment Bacterial OTU Taxonomic Groups by Samples – Morgan Benthic Subtidal Ecology Study Area.

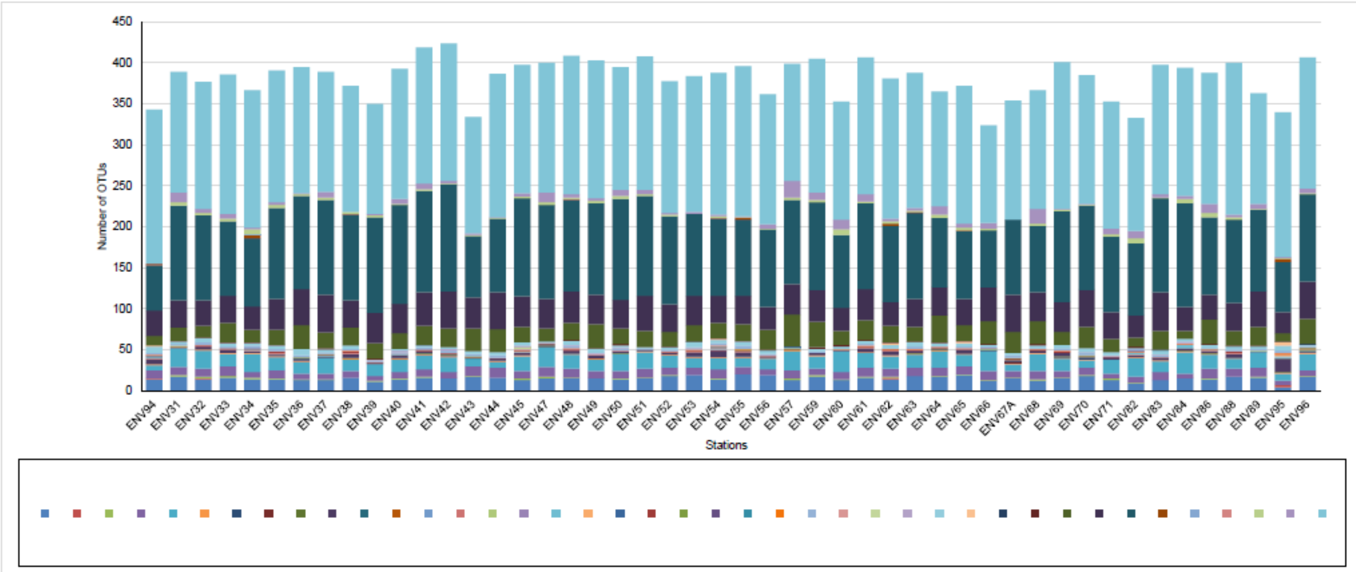

Figure I 2: Contributions of Gross Sediment Bacterial OTU Taxonomic Groups by Samples – Mona Benthic Subtidal Ecology Study Area.

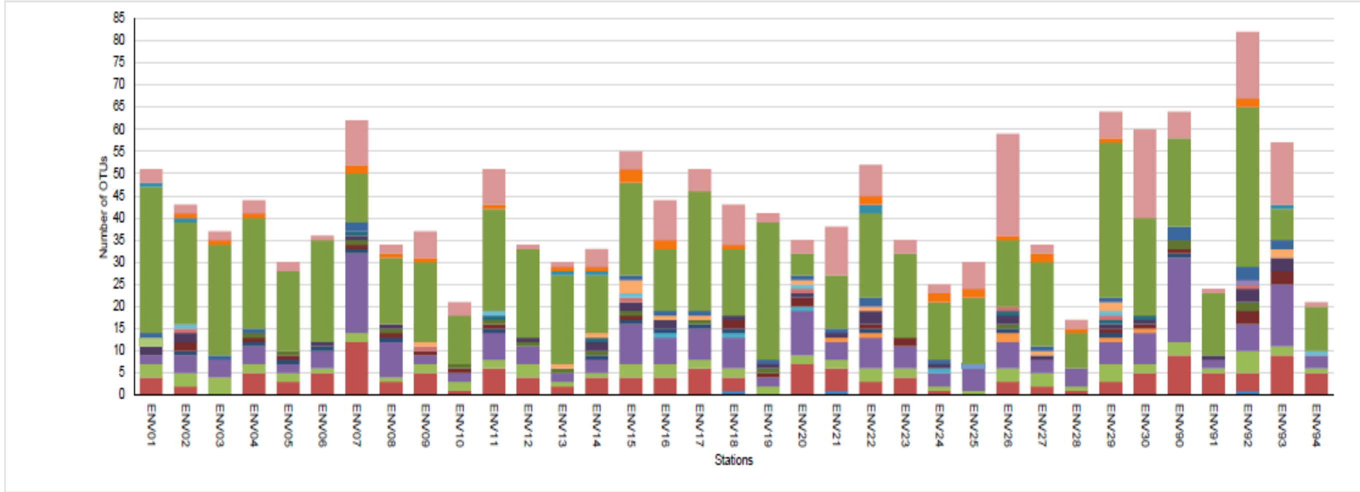

Figure I 3: Contributions of Gross Sediment Infaunal OTU Taxonomic Groups by Samples – Morgan Benthic Subtidal Ecology Study Area.

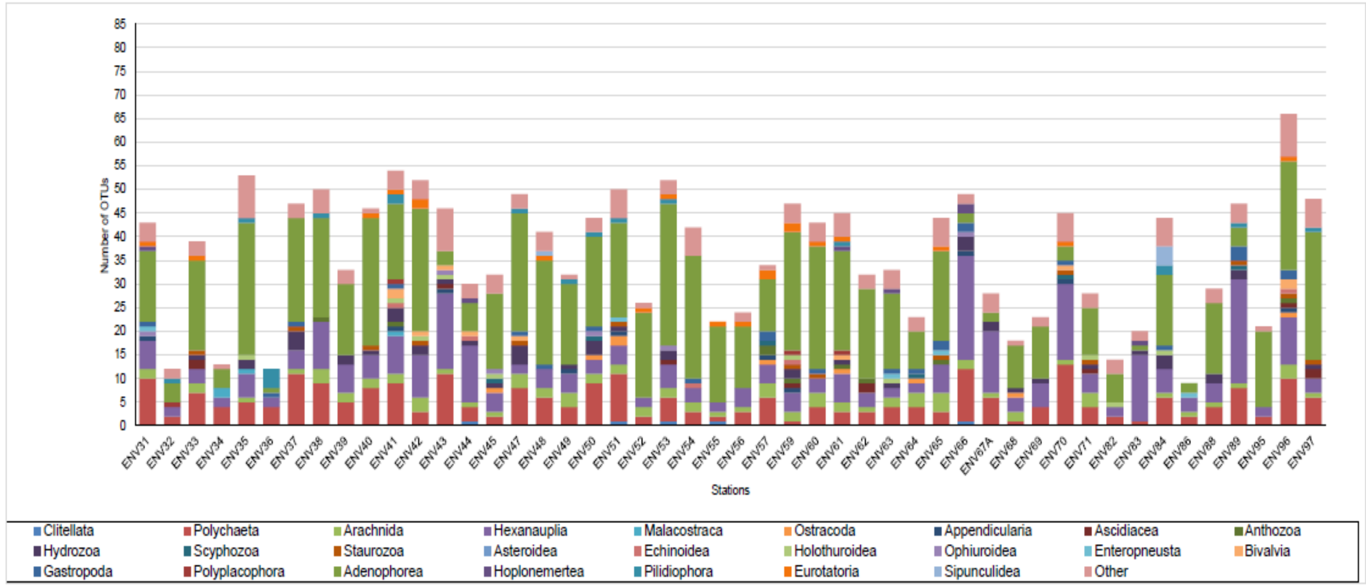

Figure I 4: Contributions of Gross Sediment Infaunal OTU Taxonomic Groups by Samples – Mona Benthic Subtidal Ecology Study Area.

1.9.1.9 Comparative taxonomic heat trees detailing the number of OTUs across the Morgan and Mona benthic subtidal ecology study areas from bacterial taxa down to the order rank are presented in Figure I 5 while the taxonomic heat trees detailing the discrete faunal taxa OTUs down to the order rank are presented in Figure I 6. The nodes (circles) represent a taxon whilst the lines detail the hierarchical relationships between taxa. The colour scale and relative width of the nodes represent the number of OTUs for each taxon in the combined dataset for each survey area. Labels without nodes represent missing taxa. Summary statistics for the sediment bacterial and infaunal richness are detailed in Table I 4.

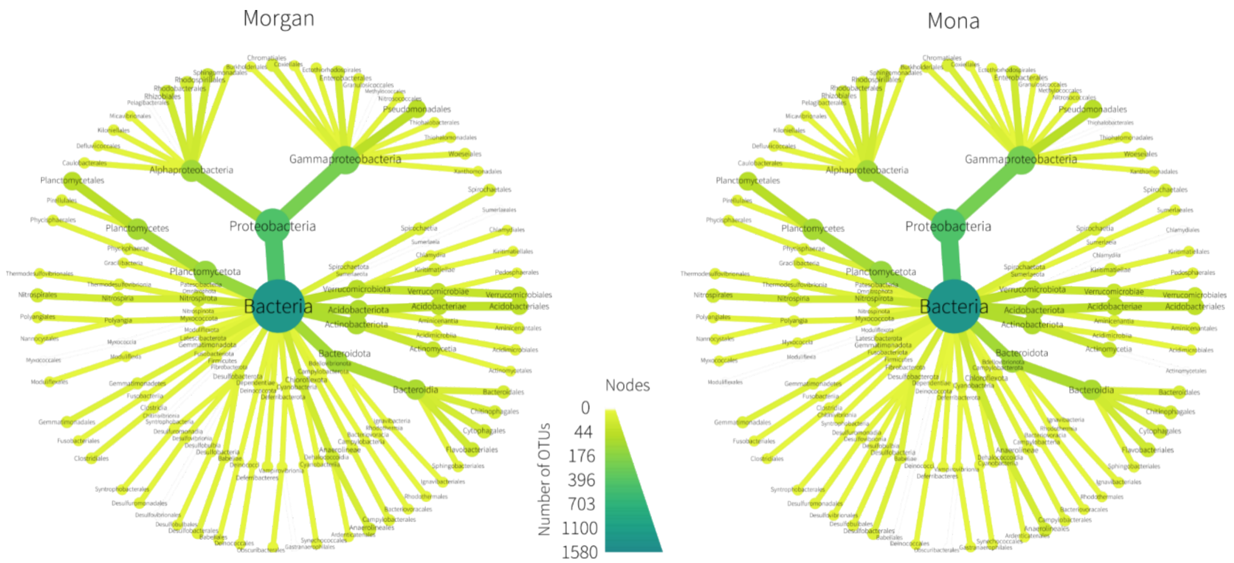

Figure I 5: Sediment Bacterial Taxonomic Heat Trees of the Number of OTUs per Benthic Subtidal Ecology Study Area.

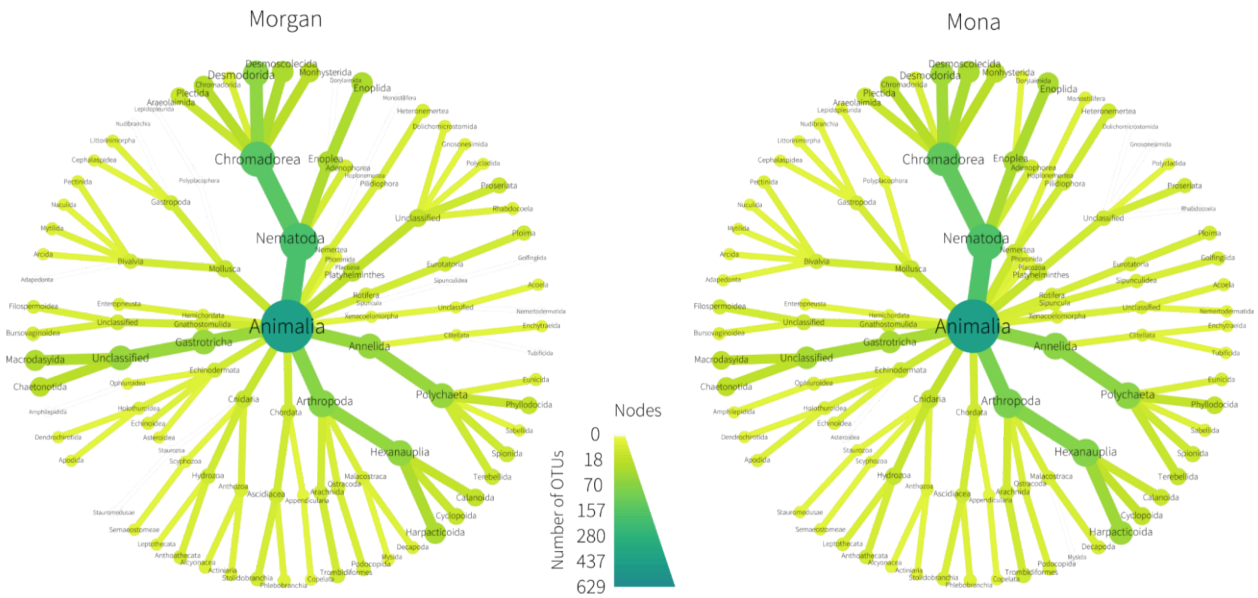

Figure I 6: Sediment Infaunal Taxonomic Heat Tress of the Number of OTUs per Benthic Subtidal Ecology Study Area.

Table I 4: Summary of Sediment Bacterial and Infaunal Richness.

	Bacterial		Faunal	
	Morgan Survey Area	Mona Survey Area	Morgan Survey Area	Mona Survey Area
Minimum	298	324	17	9
Maximum	415	424	82	66
Mean	371.4	382.3	42.1	36.1
±SD	31.6	23.0	14.7	13.6

1.9.1.10 Accumulation plots of OTUs for the sediment bacterial and infaunal data sets for both the Morgan and Mona benthic subtidal ecology study areas are presented in, Figure I 8, Figure I 9 and Figure I 10, respectively. Sharp changes in the slope of the species in order of observation (Sobs) curve reflect notable changes in community between stations. Further, the relation of the Sobs curve to that of the permutated average of samples (such as the UGE curve generated average after 999 random sample combinations) can reflect number of OTUs versus expectations.

1.9.1.11 The Sobs curve for the Morgan sediment bacterial data set (Figure I 7) steeply increased with the addition of ENV02. The curve steepened again with the addition of ENV07. Following this the Sobs curve closely matches that of the UGE curve. It also reveals that Stations ENV04 to ENV06 form a similar group with a low quantity of OTUs with comparatively little changes in community between them, though still notably below the expected rate of change in community.

1.9.1.12 Considering the Mona bacterial data set (Figure I 8), the Sobs curve steadily increased with addition of samples there where two steep increases with the addition of ENV43 and ENV59. Following this the Sobs curve closely matched that of the UGE curve until the addition of ENV95 when the Sobs curve rose above the UGE curve indicating a greater number of OTUs were present that was expected. There are several plateaus (including ENV44 to ENV53 and ENV57 to ENV61) within the Mona dataset indicating groups of stations with more similar OTUs than the rate of change indicated by the UGE curve.

1.9.1.13 The Sobs and UGE curves of the sediment bacterial data OTU accumulation plots for both the Morgan and Mona benthic subtidal ecology study areas continued to rise with the addition of the last samples. This reflected that further samples across the Morgan and Mona benthic subtidal ecology study areas may elicit additional OTUs to those reported during the current sampling campaign though the rate of increases were low (<8 OTUs in Morgan and <16 OTUS in Mona added with the last UGE stations)

1.9.1.14 The Sobs curve for the Morgan sediment infaunal data set (Figure I 9) initially began above the UGE which indicated that a greater number of OTUs were present in ENV01 than was to be expected. Following the addition of ENV03 the Sobs curve falls below the UGE and steadily increased with the addition of samples. This suggested that the number of OTUs reported for subsequent samples were in line with the wider area and no shift in the community was present.

1.9.1.15 The Sobs curve for the Morgan sediment infaunal data set (Figure I 10) initially began above the UGE which indicated that a greater number of OTUs were present in ENV31 than was to be expected. Following the addition of ENV32 the Sobs curve falls below the UGE and steadily increased with the addition of samples. This suggested that the number of OTUs reported for subsequent samples were in line with the wider area and no shift in the community was present.

1.9.1.16 The Sobs and UGE curves of the sediment infaunal data OTU accumulation plots for both the Morgan and Mona benthic subtidal ecology study areas continued to rise with the addition of the last samples This reflected that further samples across the Morgan and Mona benthic subtidal ecology study areas may elicit additional OTUs to those reported during the current sampling campaign. Rates of increase towards the end were low with <6 OTUs added to UGE in the Morgan benthic subtidal ecology study area and <5 in the Mona benthic subtidal ecology study area.

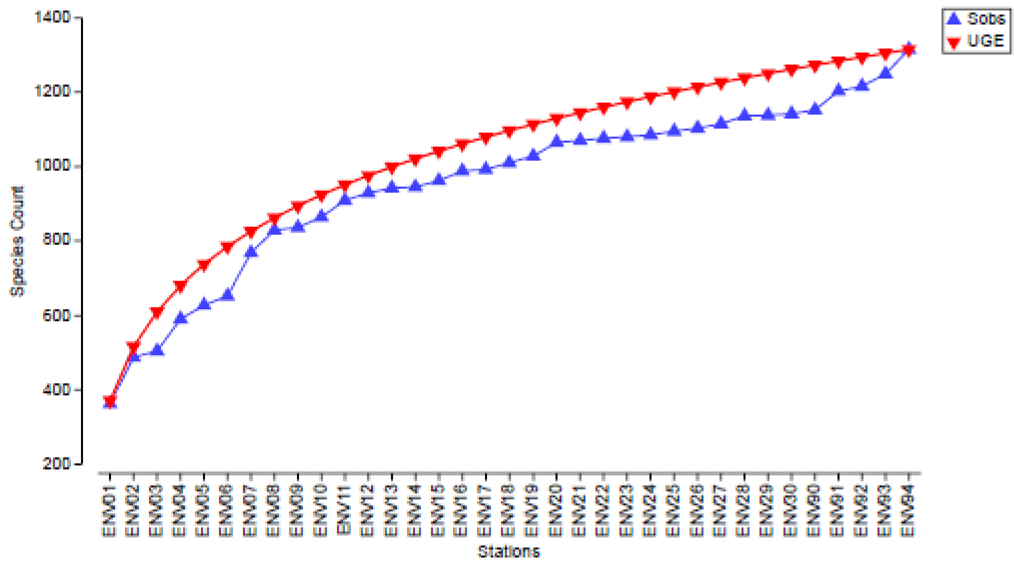

Figure I 7: Sediment Bacterial OTU Accumulation Curve – Morgan Benthic Subtidal Ecology Study Area.

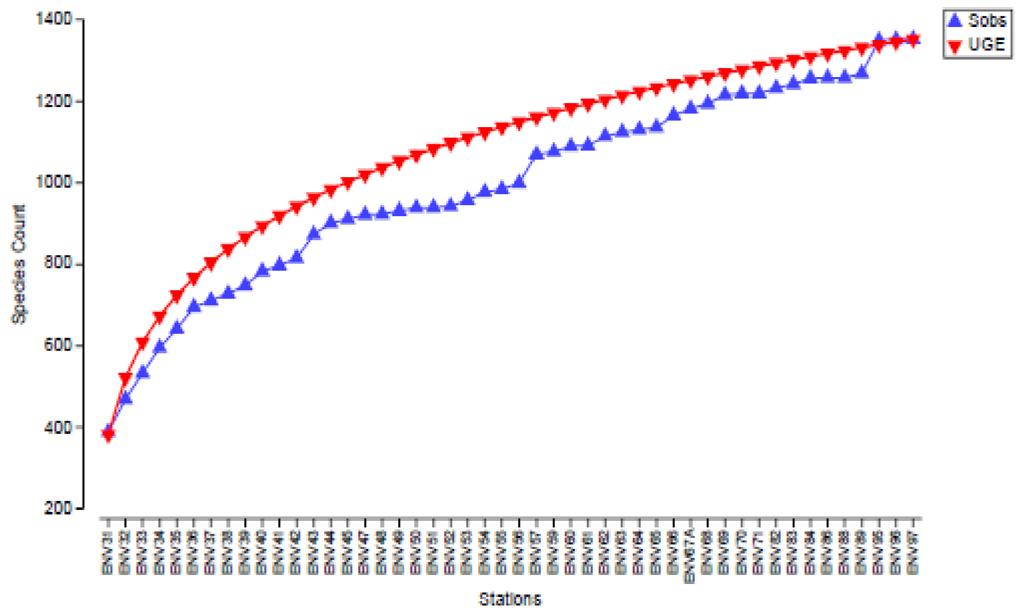

Figure I 8: Sediment Bacterial OTU Accumulation Curve – Mona Benthic Subtidal Ecology Study Area.

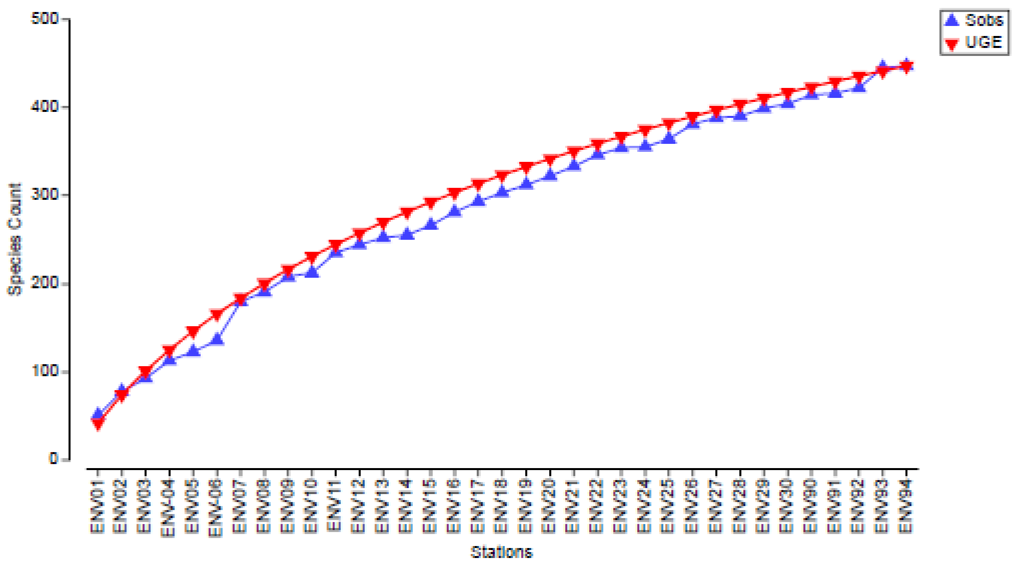

Figure I 9: Sediment Infaunal OTU Accumulation Curve – Morgan Benthic Subtidal Ecology Study Area.

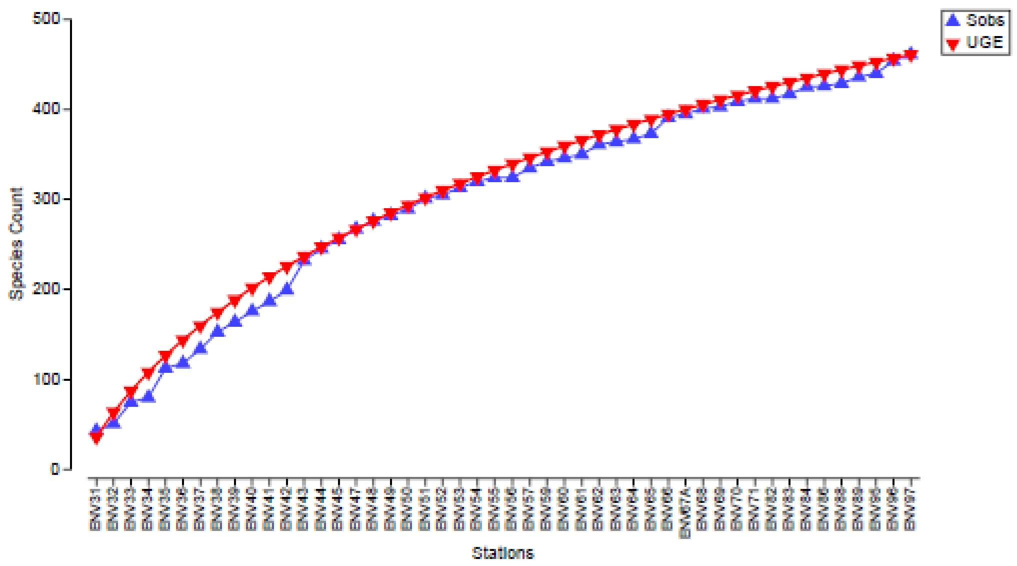

Figure I 10: Sediment Infaunal OTU Accumulation Curve – Mona Benthic Subtidal Ecology Study Area.

I.1.1.3 OTU Community Structure using Multivariate Analyses

1.9.1.17 The results of the CLUSTER analysis including SIMPROF analysis in the form of a Bray-Curtis similarity dendrogram and nMDS plot based upon standardise data for the sediment bacterial samples are displayed in Figure I 11 and Figure I 12 for the Morgan benthic subtidal ecology study area and in Figure I 13 and Figure I 14 for the Mona benthic subtidal ecology study area. Similarly results of the same analyses on the standardised Infauna data are presented in Figure I 15 for the Morgan benthic subtidal ecology study area and in Figure I 16 for the Mona benthic subtidal ecology study area.

1.9.1.18 The CLUSTER analysis and resulting dendrogram for the Morgan benthic subtidal ecology study area sediment bacterial OTU data set (Figure I 11) identified 23 groups which comprised 12 outliers (SIMPROF *a, b, g, i, l, m, n, o, q, s, t* and *u*), 10 closely associated pairs (SIMPROF *c, d, e, f, h, j, k, p, r* and w) and a single cluster (SIMPROF *v*). All samples were considered more dissimilar than similar to one another and grouped at c.21% similarity.

1.9.1.19 The Mona benthic subtidal ecology study area identified 29 SIMPROF groups (Figure I 13) including 16 outliers (SIMPROF *a, b, c, d, g, j, m, o, p, q, r, t, w, y, z* and *aa*) 7 closely associated groups (SIMPROF h, i, k, s, u, v and ab) and 6 clusters (SIMPROF *e, f, l, n, x* and *ac*). Like the Morgan benthic subtidal ecology study area, all samples were more dissimilar than similar to one another grouping at c.16%. The generally low similarities are potentially relating to the bacterial communities are far richer than equivalent larger metazoan communities and also less discriminately bound to the sediment given their established variation with both overlying water quality along with direct sediment physico-chemistry (Allison and Martiny, 2008; Frühe *et al*., 2021). However, they still provide a suitable sensitive receptor to environmental pressures for monitoring impacts (Horton *et al*., 2019).

1.9.1.20 The nMDS ordination of the Morgan and Mona sediment bacterial sample data sets (Figure I 12 and Figure I 14) revealed a similar pattern to the cluster analysis, with a stress level of 0.14 and 0.12 respectively, the ordinations can be considered a useful two-dimensional representation of rank dis(similarities) and overall pattern observed in the data sets.

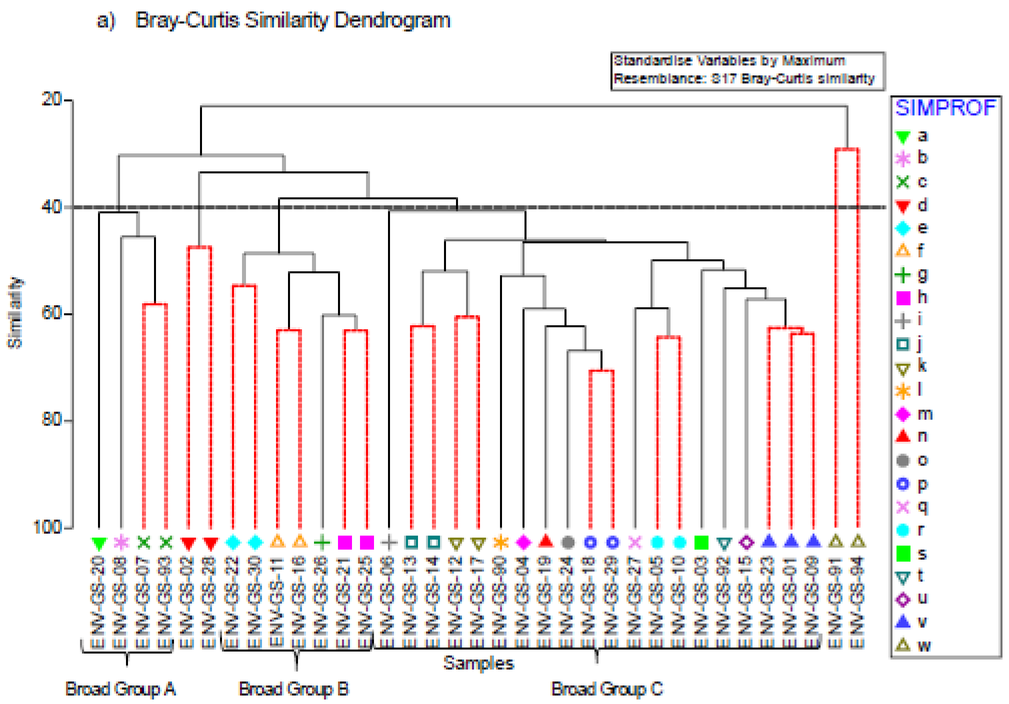

Figure I 11: Multivariate Analysis of Sediment Bacterial OTU Data by Sample – Morgan Benthic Subtidal Ecology Study Area.

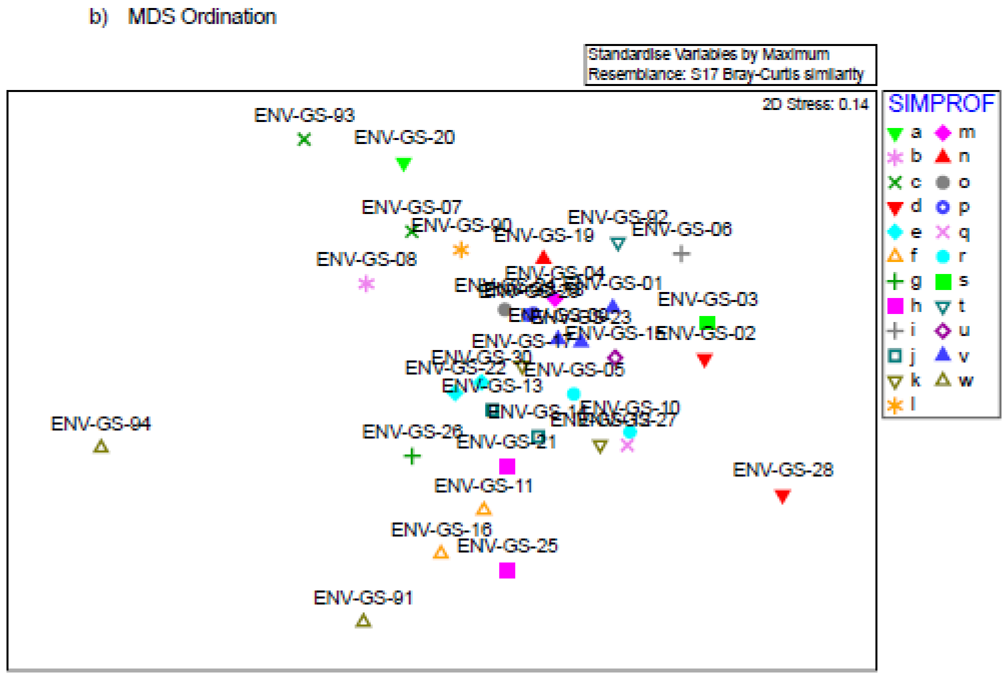

Figure I 12: Multivariate Analysis of Sediment Bacterial OTU Data by Sample – Morgan Benthic Subtidal Ecology Study Area.

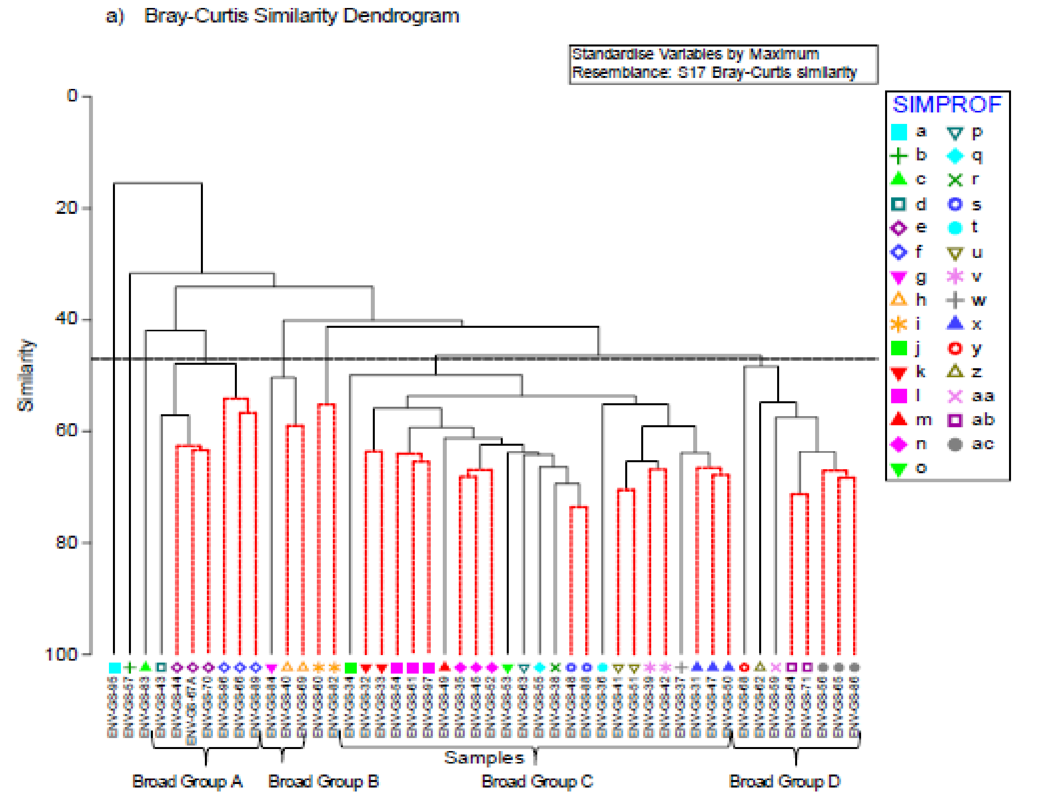

Figure I 13: Multivariate Analysis of Sediment Bacterial OTU Data by Sample – Mona Benthic Subtidal Ecology Study Area.

b) MDS Ordination

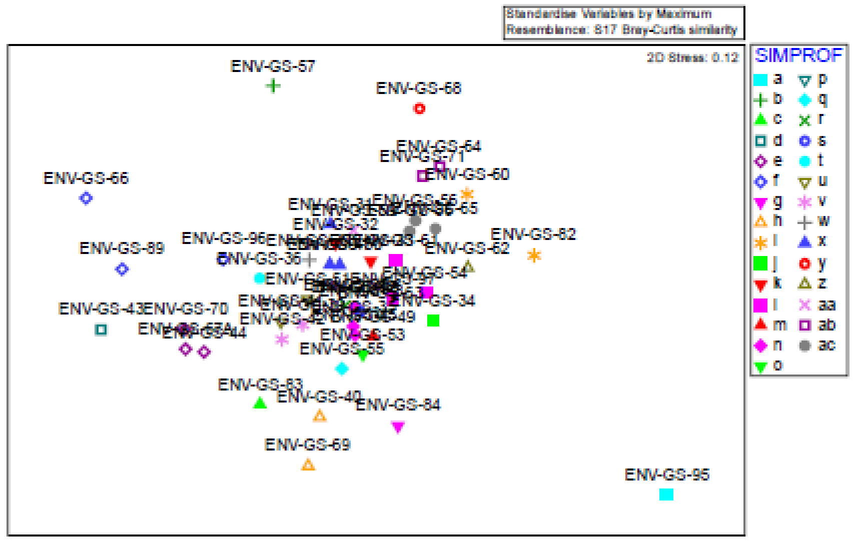

Figure I 14: Multivariate Analysis of Sediment Bacterial OTU Data by Sample – Mona Benthic Subtidal Ecology Study Area.

1.9.1.21 Examination of the Morgan sediment bacterial sample data set together with results of SIMPER analyses at a group level is presented in Table I 5. This was restricted to explaining the separations where similarity was less than 40% for conciseness and includes the principal contributors to the grouping and separation of the samples. The analysis suggested that differences in SIMPROF groups and further the broad groups were largely due to the variations in abundances/absences of the OTUs from the dominant groups particularly from Gammaproteobacteria Alphaproteobacteria and Planctomycetes.

Table I 5: Taxa Influencing Sediment Bacteria OTU SIMPROF Variation – Morgan Benthic Subtidal Ecology Study Area.

SIMPROF	Dissimilarity (%)	Groups Influencing Sample Separation
SIMPROF w vs a-v	79	• 51 Indeterminate Bacteria OTUs were unique to SIMPROF w (c.10.2% of the dissimilarity) whilst 44 were more abundant in SIMPROF w (c.8.8% of the dissimilarity). • 18 Proteobacteria OTUs were unique to SIMPROF w (c.3.4% of the dissimilarity) whilst 13 were more abundant in SIMPROF w (c.2.6% of the dissimilarity). • 10 Gammaproteobacteria OTUs were unique to SIMPROF w (c.1.9% of the dissimilarity) whilst 6 were more abundant in SIMPROF w (c.1.1% of the dissimilarity) and 10 were more abundant in SIMPROF groups a-v (c.1.7% of the dissimilarity).
Broad Group A vs SIMPROF groups d-v	70	• 12 Indeterminate Bacteria OTUs were unique to Broad Group A (c.2.3% of the dissimilarity) whilst 46 were more abundant in Broad Group A (c.7.8% of the dissimilarity). • 10 Gammaproteobacteria OTUs were unique to Broad Group A (c.1.7% of the dissimilarity) whilst 52 were more abundant in Broad Group A (c.9.1% of the dissimilarity) and 12 were more abundant in SIMPROF groups d-v (c.1.7% of the dissimilarity). • 25 Alphaproteobacteria were more abundant in SIMPROF groups a-c (c.4.2% of the dissimilarity).
SIMPROF d vs Broad Group B and C	67	• 23 Planctomycetes OTUs were more abundant in SIMPROF d (c.7.5% of the dissimilarity) • 8 Indeterminate Bacteria OTUs were unique to SIMPROF d (c.1.8% of the dissimilarity) whilst 27 were more abundant in SIMPROF d (c.5.9% of the dissimilarity). • 23 Alphaproteobacteria OTUs were more abundant in SIMPROF d (c.5.6% of the dissimilarity) • 7 Gammaproteobacteria OTUs were unique to SIMPROF d (c.1.5% of the dissimilarity) whilst 23 were more abundant in SIMPROF d (c.5.4% of the dissimilarity)
Broad Group B vs Broad Group C	62	• 44 Indeterminate Bacteria OTUs were more abundant in Broad Group B (c.9.0% of the dissimilarity) whilst 16 were more abundant in Broad Group C (c.3.0% of the dissimilarity). • 22 Indeterminate Bacteria OTUs were more abundant in Broad Group B (c.4.3% of the dissimilarity) whilst 31 were more abundant in Broad Group C (c.5.6% of the dissimilarity). • 12 Planctomycetes OTUs were more abundant in SIMPROF d (c.2.8% of the dissimilarity)

1.9.1.22 Examination of the Mona bacterial sample data set, together with the results of SIMPER analyses at a group level is presented in Table I 6. This was restricted to explaining separations where similarity was less than 47% for conciseness. SIMPROF groups a, b and c were outliers due to the occurrence of several bacterial taxa not present in the other groups. The broad groups identified showed differences due to subtle variations in taxa community structure within particular SIMPROF groups.

Table I 6: Taxa Influencing Sediment Bacteria OTU SIMPROF Variation – Mona Benthic Subtidal Ecology Study Area.

SIMPROF	Dissimilarity (%)	Taxa Influencing Sample Separation
SIMPROF a vs rest	85	• 41 Indeterminate Bacteria OTUs were unique to SIMPROF *a* (*c*.13.1% of the dissimilarity) whilst 31 were more abundant in SIMPROF *a* (*c*.8.6% of the dissimilarity). • 6 Proteobacteria OTUs were unique to SIMPROF *a* (*c*.1.9% of the dissimilarity) whilst 10 were more abundant in SIMPROF *a* (*c*.3.0% of the dissimilarity). • Anaerolineae OTUs were unique to SIMPROF *a* (*c*.2.9% of the dissimilarity) whilst 5 were more abundant in SIMPROF *a* (*c*.1.1% of the dissimilarity).
SIMPROF b vs Broad Groups A, B, C, D and SIMPROF i and c	68	• 12 Gammaproteobacteria OTUs were unique to SIMPROF *b* (*c*.4.3% of the dissimilarity) whilst 29 were more abundant in SIMPROF *b* (*c*.8.4% of the dissimilarity). • 9 Indeterminate Bacteria OTUs were unique to SIMPROF *b* (*c*.3.2% of the dissimilarity) whilst 26 were more abundant in SIMPROF *b* (*c*.7.7% of the dissimilarity). • 4 Planctomycetes OTUs were unique to SIMPROF *b* (*c*.1.4% of the dissimilarity) whilst 11 were more abundant in SIMPROF *b* (*c*.3.2% of the dissimilarity).
SIMPROF c and Broad Group A vs Broad Groups B, C, D and SIMPROF i	67	• 24 Alphaproteobacteria OTUs were more abundant in Group c*A* (*c*.4.3% of the dissimilarity) and 8 were more abundant in Group BCDi (*c*.1.1% of the dissimilarity) • 34 Gammaproteobacteria were more abundant in Group c*A* (*c*.5.7% of the dissimilarity) and 34 were more abundant in Group BCDi (*c*.5.1% of the dissimilarity) • 44 Indeterminate Bacteria OTUs were more abundant in Group cA (*c*.7.7% of the dissimilarity) and 23 were more abundant in Group BCDi (*c*.3.5% of the dissimilarity) • 16 Planctomycetes OTUs were more abundant in Group cA (*c*.3.1% of the dissimilarity)
SIMPROF c vs Broad Group A	58	• 9 Indeterminate Bacteria OTUs were unique to SIMPROF *c* (*c*.3.2% of the dissimilarity) whilst 21 were more abundant in SIMPROF *c* (*c*.5.4% of the dissimilarity). • 5 Alphaproteobacteria OTUs were unique to SIMPROF *c* (*c*.2.2% of the dissimilarity) whilst 8 were more abundant in SIMPROF *c* (*c*.2.2% of the dissimilarity). • 10 Gammaproteobacteria OTUs were unique to SIMPROF *c* (*c*.4.1% of the dissimilarity) whilst 29 were more abundant in SIMPROF *c* (*c*.9.0% of the dissimilarity).
Broad Group B vs SIMPROF i and Broad Groups C and D	61	• 6 Gammaproteobacteria OTUs were unique to Group B (*c*.1.0% of the dissimilarity) whilst 54 were more abundant in Group B (*c*.11.4% of the dissimilarity) • 12 Indeterminate Bacteria OTUs were unique to Group B (*c*.2.0% of the dissimilarity) whilst 39 were more abundant in Group B (*c*.8.2% of the dissimilarity). • 13 Verrucomicrobiae were more abundant in Group B (*c*.0.7% of the dissimilarity).
SIMPROF i vs Broad Groups C and D	60	• 22 Gammaproteobacteria OTUs were more abundant to SIMPROF *i* (*c*.4.8% of the dissimilarity) whilst 14 were more abundant in Group CD (*c*.2.7% of the dissimilarity) • 4 Indeterminate Bacteria OTUs were unique to SIMPROF *i* (*c*.1.2% of the dissimilarity) whilst 36 were more abundant in SIMPROF *i* (*c*.9.8% of the dissimilarity). • 13 Bacteroidia were more abundant in SIMPROF *i* (*c*.3.3% of the dissimilarity).
Broad Group C vs D	55	• 25 Gammaproteobacteria OTUs were more abundant in Group D (*c*.4.6% of the dissimilarity) whilst 28 were more abundant in Group C (*c*.5.2% of the dissimilarity) • 42 Indeterminate Bacteria OTUs were more abundant in Group D (*c*.8.5% of the dissimilarity) whilst 21 were more abundant in Group C (*c*.3.9% of the dissimilarity) • 15 Alphaproteobacteria were more abundant in SIMPROF *i* (c.2.8% of the dissimilarity). • 13 Planctomycetes were more abundant in SIMPROF *i* (c.2.4% of the dissimilarity).

1.9.1.23 CLUSTER analysis and resulting dendrograms for the Morgan sediment infauna OTU data set (Figure I 15) identified seven groups; which comprised two closely associated pairs (SIMPROF d and e) and five clusters (SIMPROF *a, b, c, f* and *g*). All samples were more dissimilar than similar to one another and grouped at c.2.7% similarity.

1.9.1.24 The Mona benthic subtidal ecology study area (Figure I 16) identified eleven SIMPROF groups comprising three outliers (SIMPROF *a, c* and *f*), four closely associated groups (SIMPROF *b, d, e*, and *g*) and four clusters (SIMPROF *h, i, j* and *k*). Similar to the Morgan survey area, all samples were more dissimilar than similar to one another; grouping together at *c*.2% similarity.

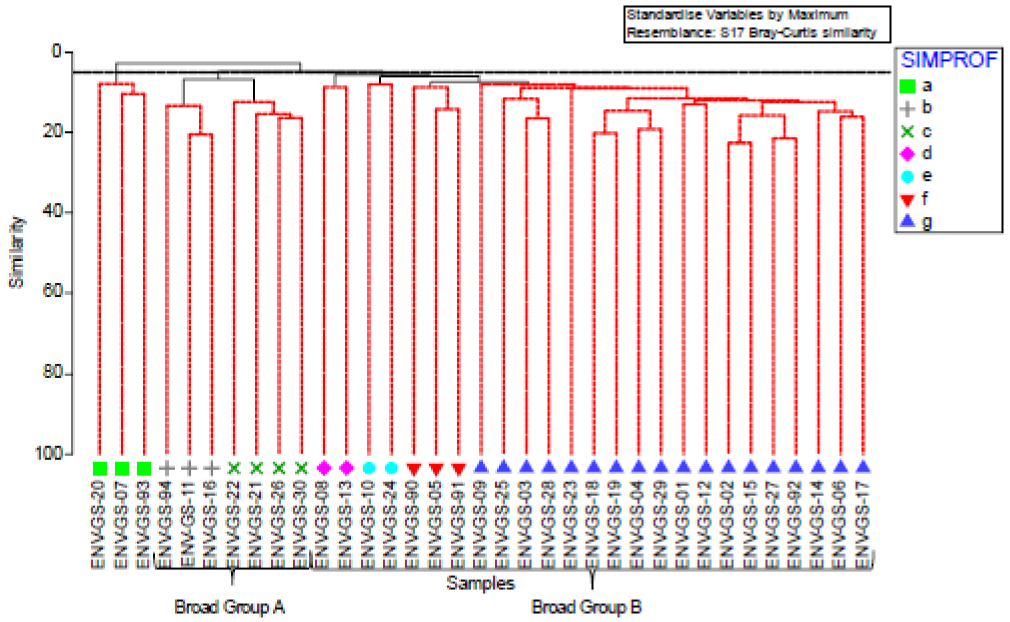

Figure I 15: Bray-Curtis Similarity Dendrogram of Sediment Infaunal OTU Data by Sample – Morgan Benthic Subtidal Ecology Study Area.

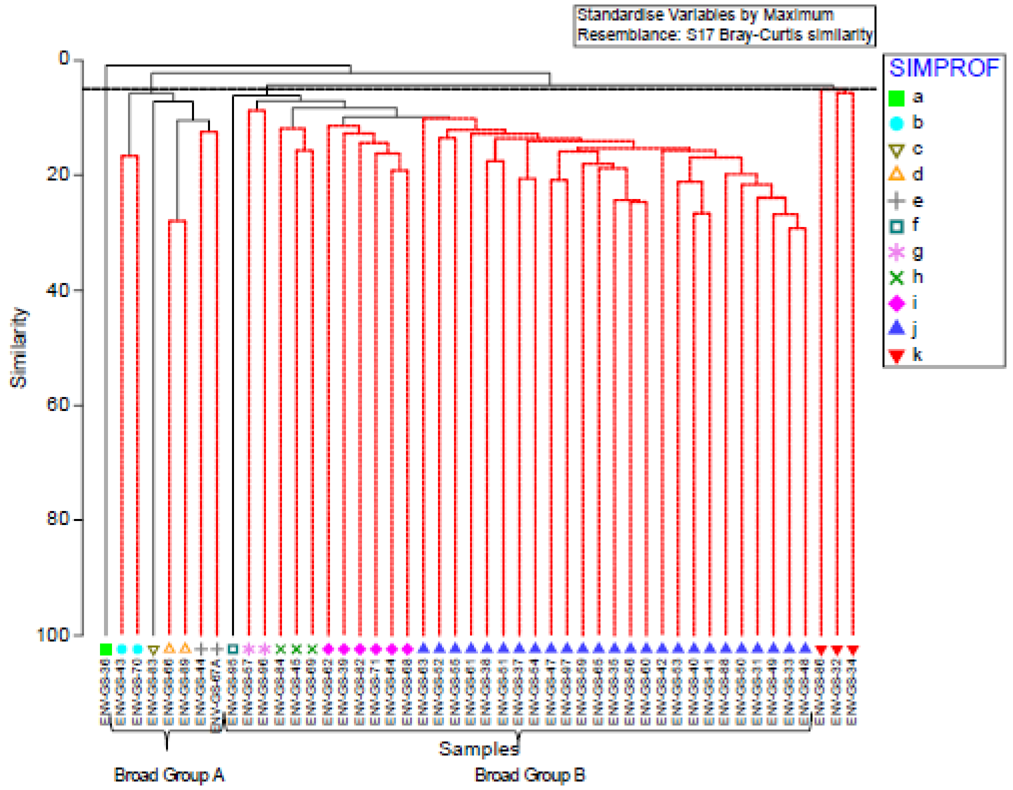

Figure I 16: Bray-Curtis Similarity Dendrogram of Sediment Infaunal OTU Data by Sample – Morgan Benthic Subtidal Ecology Study Area.

1.9.1.25 Examinations of the Morgan sediment infaunal sample data set together with results of SIMPER analysis; presented in Table I 7, along with the principal contributors to the grouping and separation of the samples. The analysis suggested that differences in SIMPROF groups and the Broad Groups were largely due to the subtle differences in the infaunal community.

Table I 7: Taxa Influencing Sediment Infauna OTU SIMPROF Variation – Morgan Benthic Subtidal Ecology Study Area.

SIMPROF	Dissimilarity (%)	Taxa Influencing Sample Separation
SIMPROF a vs Broad Group A and B	98	Mesonerilla_IM-211R6N, Mytilidae_IM-P18O8Y, Cyclopoida_IM- 45PX6J and Harpacticoida_IM-9BK8SI were more abundant in SIMPROF a (c.4.9% of the dissimilarity) whilst Nerillidium gracile and Spio_IM-6W06R6 were unique to Groups A and B (c.2.0% of the dissimilarity).
Broad Group A vs Broad Group B	95	Ixonema_IM-J3RK8Q, Spio_IM-X7S00O, and Lauratonematidae_IM- 8TAQB0 were unique to Group A (c.3.0% of the dissimilarity) whilst Harpacticoida_IM-98G22P and Laxus_IM-2NM2IQ were more abundant in Group A (c.2.1% of the dissimilarity) Temora longicornis was less abundant at Group A (c.1.1% of the dissimilarity)

1.9.1.26 Results of the SIMPER analysis (Table I 8) for the Mona infaunal sample data set highlighted that SIMPROF a were outliers due to the presence of taxa not present in the other SIMPROF groups. Differences between Broad Groups A, B and SIMPROF k were similarly due to higher abundances and presence of several taxa. The broad groups identified showed differences due to subtle changes in the infaunal taxa contributions and presences and absences within particular SIMPROF groups.

Table I 8: Taxa Influencing Sediment Infauna OTU SIMPROF Variation – Morgan Benthic Subtidal Ecology Study Area.

SIMPROF	Dissimilarity (%)	Taxa Influencing Sample Separation
SIMPROF *a* vs SIMPROF *b-k*	99	• *Odontosyllis fulgurans*, Lineidae_IM-A93VO3, Lineidae_IM-197QT8 and Lineidae_IM-V6NR6Z were unique to SIMPROF *a* (*c*.21.3% of the dissimilarity) whilst Aricidea_IM-1L75U0 was more abundant in SIMPROF *a* (*c*.3.1% of the dissimilarity) Calanoida_IM-J7MI8C and *Temora longicornis* were more abundance in SIMPROF *b-k* (*c*.2.4% of the dissimilarity) whilst Desmoscolecidae_IM-04EB95 was unique to SIMPROF *b-k* (*c*.0.8% of the dissimilarity).
Broad Group A vs Broad Group B and SIMPROF *k*	98	• Harpacticoida_IM-9BK8SI, Parameiropsidae_IM-3WL810, Harpacticoida_IM-Q1XWI6 and Argestidae_IM-43AS6P were unique to Group A (*c*.4.4% of the dissimilarity) whilst Ameira_IM-QY3076 was more abundant in Group A (*c*.1.0% of the dissimilarity) Calanoida_IM-J7MI8C and *Temora longicornis* were more abundant in Group B (*c*.2.7% of the dissimilarity)
Broad Group B vs SIMPROF *k*	96	• Desmodorida_IM-2TWXL3, Dorvilleidae_IM-4BCCG8 and Haplognathiidae_IM-1M0V63 were unique to SIMPROF *k* (*c*.5.5% of the dissimilarity) whilst Terebellidae_IM-2QCW27 was more abundant in SIMPROF *k* (*c*.2.0% of the dissimilarity) Calanoida_IM-J7MI8C and *Temora longicornis* were more abundant in Group B

I.1.1.4 Multivariate Comparison of Metabarcoding Results to Physico-chemical Data

1.9.1.27 The bacterial and infaunal OTUs detected throughout both Morgan and Mona benthic subtidal ecology study areas were compared to the physico-chemical data to determine if any patterns correlated.

1.9.1.28 A RELATE analysis identified a 48.5% significant correlation between the sediment bacterial OTUs and physico-chemical variables. BV STEP analyses further identified nine bacterial taxa groups (Acidobacteriaceae_IM-A38G3N, Actinobacteriota_IM-4S9D5Q, Flavobacteriaceae_IM-W54D7S, Planctomycetales_IM-MM63P0, Spongiibacteraceae_IM-RY386Z, Gammaproteobacteria_IM-496PWF, Gammaproteobacteria_IM-3FM60Y, Bacteria_IM-T842VS, Bacteria_IM-U76S04) which best explained the correlation. Figure I 17 illustrates the distribution patterns of these taxa across the benthic subtidal ecology study areas in relation to the physico-chemical SIMPROF clusters identified. Their geographic distribution in relation to the physico-chemical SIMPROF clusters indicates a potential overlap linking to the environmental driver defining those cluster discussed in Section 2.8.1. Bacteria_IM-T842VS for example, is predominantly distributed within the sandwave areas indicating a possible association with SIMPROF groups I and j.

1.9.1.29 A RELATE analysis between the infaunal I data set and the physico-chemical variables identified a 41% significant correlation. Sixteen taxa (Sabellariidae_IM-WO1H6H, Nerillidae_IM-P7281C, Halacaridae_IM-854J7R, Halacaridae_IM-863YQ3, Leptosynapta_IM-471WYT, Chaetonotidae_IM-66HBWK, Microlaimus honestus, Desmodorida_IM-7Z5D37, Oxystominidae_IM-84F6F2, Calyptronema_IM-QS27I8, Terschellingia longicaudata, Xyalidae_IM-JC228M, Lineidae_IM-97F94L, Lumbrineridae_IM-KH2BT9, Capitellidae_IM-0GX3E3 and Argestidae_IM-V085H7) which best explains the correlation were identified with a BV STEP analysis. Of the sixteen taxa, four (Xyalidae_IM-JC228M, Halacaridae_IM-854J7R, Halacaridae_IM-863YQ3 and Chaetonotidae_IM-66HBWK) best illustrate this correlation through their geographic distribution in relation to the physico-chemical SIMPROF clusters identified (Figure I 18). Xyalidae_IM-JC228M and Halacaridae_IM-854J7R both had a broad distribution across the survey area, whilst the distributions of Halacaridae_IM-863YQ3 and Chaetonotidae_IM-66HBWK indicated potential association with the SIMPROF groups I and j in the shallower sandwave areas.

1.9.1.30 Further investigation into the relationship between bacterial and infaunal OTUs and physico-chemical variables would require further sampling, however, no further sampling will be undertaken in the Morgan and Mona Array Area. This is because the results of this analysis are considered to be sufficient for the purposes of baseline characterisation.

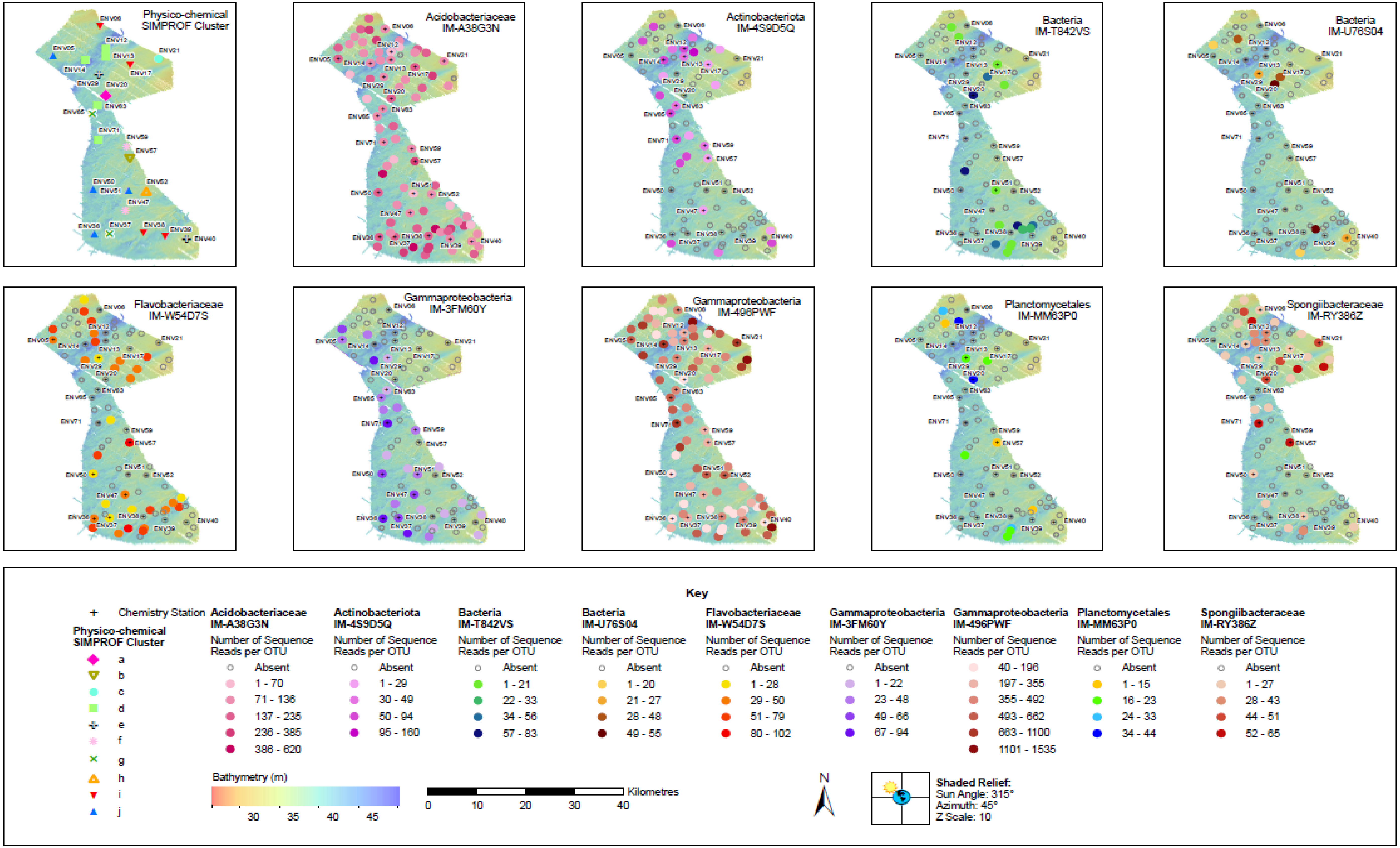

Figure I 17: Geographical Overview of Bacterial taxa in Relation to Physico-Chemical SIMPROF Groups.

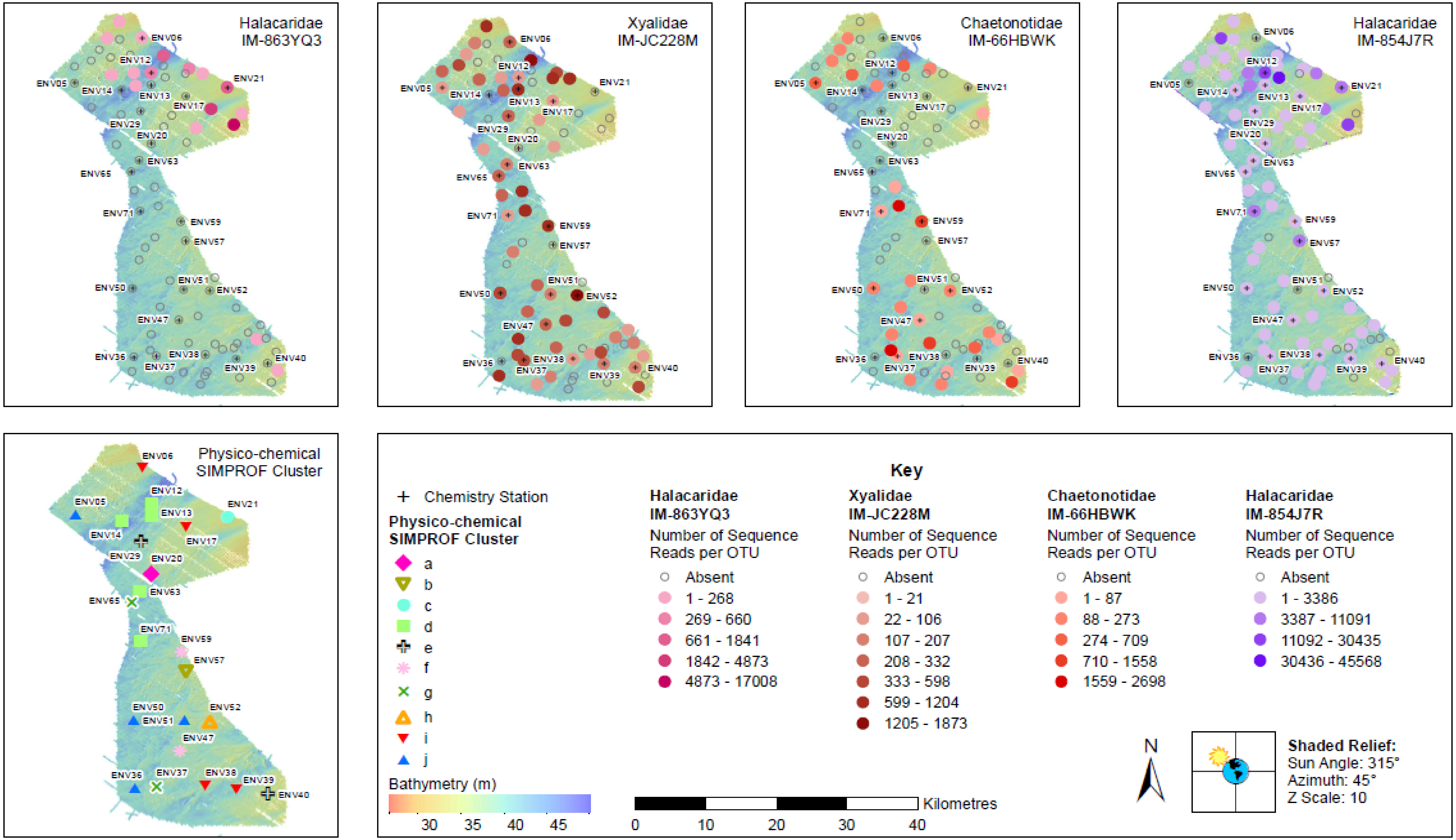

Figure I 18: Geographical Overview of Infaunal Taxa in Relation to Physico-Chemical SIMPROF Groups.

I.1.1.5 Multivariate Comparison of Macrofaunal and Metabarcoding Data Sets

1.9.1.31 The sediment bacterial and infaunal OTU data sets, from the combined survey areas, were compared to the adult macrofaunal abundance and biomass data to determine if there was any correlation. As expected, a RELATE analysis identified a significant correlation of 50% for bacterial OTUs and 52% for infaunal OTUs when comparted to the adult macrofauna abundance data. Similar results were found for biomass data, indicating a 40% significant correlation for bacteria OTUs and 44% for infaunal OTUs.

1.9.1.32 It is important to note that despite the significant correlations found, only one macrofauna replicate sample was used for metabarcoding of bacteria and infauna. This is, however, considered to be sufficient for the purposes of baseline characterisation for the Morgan and Mona Array Areas.