MORGAN OFFSHORE WIND PROJECT: GENERATION ASSETS

Environmental Statement

Volume 4, Annex 2.1: Benthic subtidal ecology technical report

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Image of an offshore wind farm

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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.
CLUSTER Analysis	CLUSTER analysis is a statistical method for processing data. It works by organising items into groups, or clusters, on the basis of how closely associated they are.
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 Generation Assets.
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.

Term	Meaning
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.
Morgan Array Area	The area within which the wind turbines, foundations, inter-array cables, interconnector cables, scour protection, cable protection and offshore substation platforms (OSPs) forming part of the Morgan Offshore Wind Project: Generation Assets will be located.
Multivariate	Having or involving a number of independent mathematical or statistical variables.
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.
Special Area of Conservation (SAC)	Special Areas of Conservation (SACs) are areas designated under the European Union (EU) Habitat's Directive to help conserve certain plant and animals species listed in the Directive. Article 3 of the Habitats Directive requires the establishment of a European network of important high-quality conservation sites that will make a significant contribution to conserving the 189 habitat types and 788 species identified in Annexes I and II of the Directive (as amended). The listed habitat types and species are those considered to be most in need of conservation at a European level (excluding birds).
Site of Special Scientific Interest (SSSI)	A Site of Special Scientific Interest (SSSI) is a formal conservation designation, and is defined as an area that is of particular interest to science by reason of any of its flora, fauna, geological, geomorphological or physiographical features.
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
BAC	Background Assessment Concentrations
BAP	Biodiversity Action Plan

Acronym	Description
CCW	Countryside Council Wales
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CMACS	Centre for Marine and Coastal Studies
CSQGs	Canadian Sediment Quality Guidelines
DDV	Drop Down Video
DESNZ	Department for Energy Security and Net Zero
eDNA	Environmental Deoxyribonucleic Acid
EIA	Environmental Impact Assessment
ERL	Effects Range Low
ERM	Effects Range Median
EMODnet	European Marine Observation and Data Network
EUNIS	European Nature Information System
EWG	Expert Working Group
FOCI	Feature of Conservation Interest
IEF	Important Ecological Feature
ISQG	Interim Marine Sediment Quality Guidelines
JNCC	Joint Nature Conservation Committee
LOD	Limit of Detection
MCZ	Marine Conservation Zone
MDS	Multi-Dimensional Scaling
MHWS	Mean High Water Spring
MMEA	Manx Marine Environmental Assessment
MMO	Marine Management Organisation
MNR	Marine Nature Reserve
NBN	National Biodiversity Network
NMBAQC	North East Atlantic Marine Biological Analytical Quality Control
NQ	Not Quantifiable
NRW	Natural Resources Wales
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
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

Acronym	Description
SACFOR	Super Abundant, Abundant, Common, Frequent, Occasional and Rare
SD	Standard Deviation
SEA	Strategic Environmental Assessment
SNCB	Statutory Nature Conservation Body
SSSI	Site of Special Scientific Interest
TEL	Threshold Effect Level
TOC	Total Organic Carbon
WFD	Water Framework Directive
ZoI	Zone of Influence

Units

Unit	Description
°	Degrees
%	Percentage
µm	Micrometre
mm	Millimetre
cm	Centimetre
m	Metre
m^2	Square metre
km	Kilometre
km^2	Square kilometres
nm	Nautical Miles
g	Grams
mg/kg	Milligrams per kilogram
µg/g	Micrograms per gram
ml	Millilitre
l	Litre
^{o}C	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 are located within the east Irish Sea, north of Conwy, Wales, and west of Lancashire, England and 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:

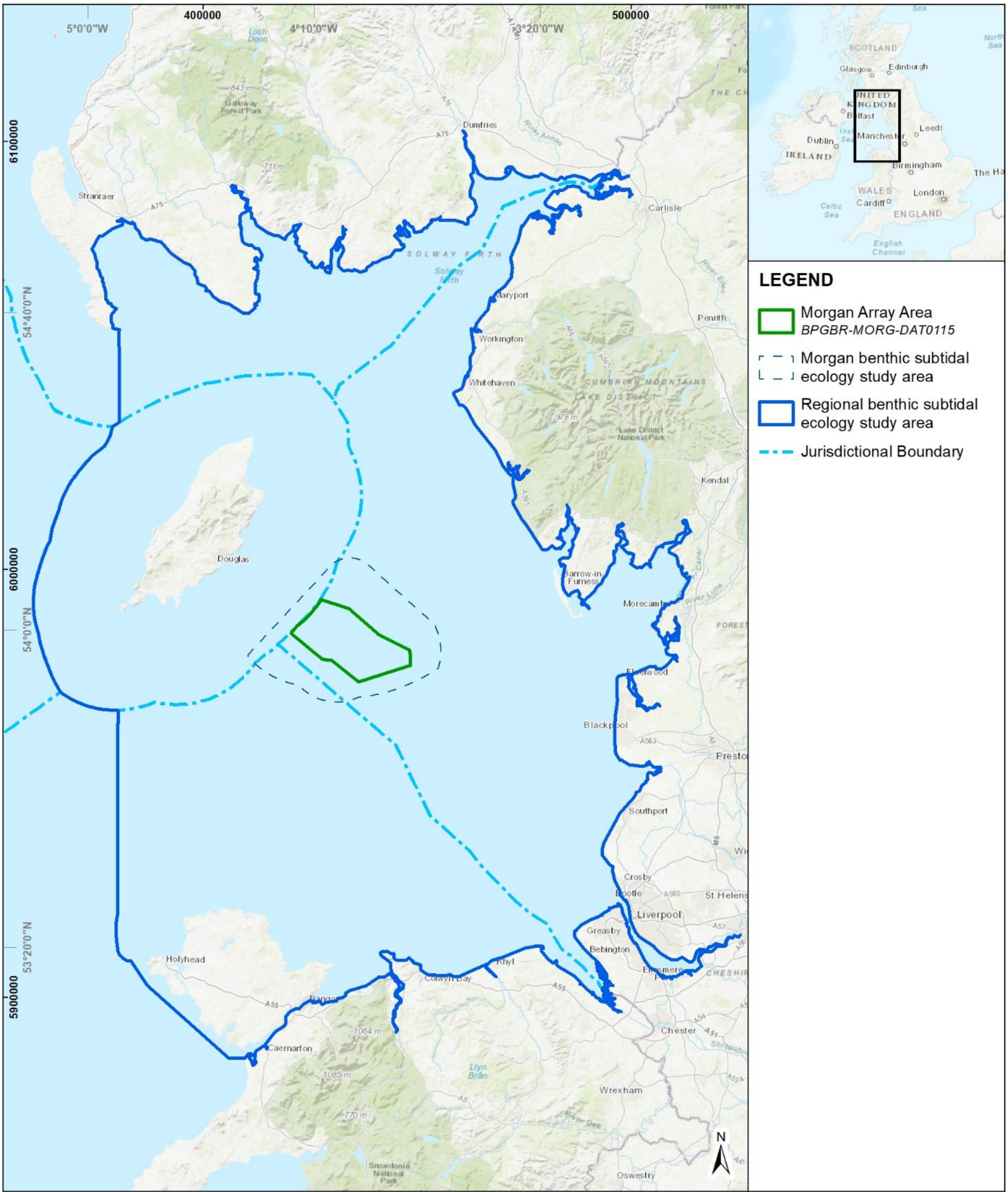
- Section 1.2: Study area – Overview of the study areas that are relevant to the report
- Section 1.3: Consultation – Communication with Statutory Nature Conservation Bodies (SNCBs) and other stakeholders
- Section 1.4: Methodology – Overview of desktop study and site-specific surveys used to inform 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 - Habitat assessments
  - Section 1.7.6: Results - Combined infaunal and epifaunal subtidal biotopes

- 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. The Morgan benthic subtidal ecology study area also includes the area within one tidal excursion around the Morgan Array Area referred to as the Zone of Influence (ZoI). These are the areas within which the site-specific benthic subtidal surveys have been undertaken. The site-specific subtidal 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 Array Area ZoI). The statistical analysis, presented in this technical report, has been undertaken on the combined dataset collected within both the Morgan Array Area (including the ZoI) and the Mona Array Area with the data collected for the Mona Offshore Wind Project used to provide additional context for the data within the Morgan Array Area.
- 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.



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	**Data Sources:** Client	EnBW bp Partners in UK offshore wind rps
Project Name: MORGAN OFFSHORE WIND PROJECT	0 2.5 5 10 15 20 nm 0 5 10 20 30 40 km	**Drawing Number:** RPSE-MG-ES-BEN-004-02
Drawing Title: MORGAN BENTHIC SUBTIDAL ECOLOGY STUDY AREA AND THE REGIONAL BENTHIC SUBTIDAL ECOLOGY STUDY AREA.	**Geodetic Information:** Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@160mmx220mm: 1:1,500,000	

VER	DATE	DETAILS	BY	CHECK
00	11/08/23	First Issue	MJ	TH
02	25/09/23	Revision	MJ	TH

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 matters 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 matters raised during consultation activities undertaken for the Morgan Generation Assets relevant to benthic subtidal ecology.

Date	Consultee and type of response	Comment	Response to comment raised and/or where considered in this technical report
March 2021	Joint Nature Conservation Committee (JNCC), Natural England and Natural Resources Wales (NRW) - email	Provision of initial information on the geophysical and benthic survey for the Morgan Array Area only.	The methods used for the site-specific surveys within the Morgan benthic subtidal ecology study area are presented in section 1.7.1. The site-specific surveys relevant to this technical report are listed in Table 1.4.
May 2021	JNCC, Natural England and NRW - email	Provision of the benthic survey strategy for the Morgan Array Area only.	The methods used for the site-specific surveys within the Morgan benthic subtidal ecology study area are presented in section 1.7.1.
June 2021	JNCC, Natural England 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.	The methods used for the site-specific surveys within the Morgan benthic subtidal ecology study area are presented in section 1.7.1.
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.	Any guidance used to inform this technical report has been listed in section 1.7.1.
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 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.	The methods used for the site-specific surveys within the Morgan benthic subtidal ecology study area are presented in section 1.7.1 and the results are presented in section 1.7.2 to 1.7.6.
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.	The seapen and burrowing megafauna habitats assessments are presented in section 1.7.5.

Date	Consultee and type of response	Comment	Response to comment raised and/or where considered in this technical report
		JNCC also notes the presence of habitat which is being categorised as 'low' resemblance to stony reef habitat and provided guidance to ensure JNCC Report 6562 published in September 2020 is considered in the assessment of this habitat.	The stony reef assessments are presented in section 1.7.5 with the full data provided in Appendix B. This assessment has been undertaken in accordance with the Irving (2009) and Golding *et al*. (2020) guidance.
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.	The methods used for the site-specific surveys within the Morgan benthic subtidal ecology study area are presented in section 1.7.1.
	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).	The sampling approach is described in section 1.7.1 and has been designed using a combination of desktop data and site specific geophysical data to ensure coverage all of potential habitats in the Morgan benthic subtidal ecology study area.
	JNCC - email	Requested clarification as to whether the number of stations specified is for both Morgan Generation Assets and Mona Offshore Wind Project 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.	The number of stations assessed for the Morgan Generation Assets has been stated in section 1.7.1. The stony reef assessments are presented in section 1.7.5 with the full data provided in Appendix B.

Date	Consultee and type of response	Comment	Response to comment raised and/or where considered in this technical report
	Natural England – email	Natural England welcomed the wide scope of the 2022 survey area including the ZoI. Any maps should include all relevant designated sites. Natural England 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.	Figure 1.4 shows all the relevant designated sites within the regional benthic subtidal and intertidal ecology study area. Desktop data regarding the habitats which may be expected in the Morgan benthic subtidal ecology study area can be found in section 1.5 as well as Figure 1.2 and Figure 1.3. The sampling strategy for the 2022 survey considered this desktop data and was further refined by site specific geophysical data to capture the full range of habitats within the Morgan benthic subtidal ecology study area.
	Marine Management Organisation (MMO) – EWG meeting response	The MMO requests confirmation that the benthic grab samples collected in relation to the developments will be processed to the recommended national processing guidelines (Worsfold and Hall, 2010) and that the resultant data will be made available as soon as possible.	The macrofaunal analysis was undertaken by Thomson Ecology to North East Atlantic Marine Biological Analytical Quality Control (NMBAQC) processing guidelines (Worsfold and Hall, 2010). The full data is available on request.
		The MMO noted that the sampling stations should be suitably located and representative to allow ground truthing of the indicative habitats. Should habitats encountered differ from those expected based on the geophysical data acquired then we would expect to see an increase in sample stations to ensure that all potential habitats are sampled and mapped. The stations should ensure sampling of all habitats and particularly transitions between habitats.	The sample stations were located to sample the full range of habitats expected to occur in the Morgan Array Area and ZoI. The survey scope was kept flexible to allow for the addition of sample stations if necessary.
		The MMO requested clarity on whether the 50 stations for co-located camera and sediment sampling across the Morgan and Mona Array Areas and ZOIs were the combined total for both projects or 50 stations per project. JNCC recommended that the number of sample sites not be capped at 50 and should instead be based on geophysical evidence.	As noted above, the scope of works was kept flexible so that sample stations could be added based on the geophysical data.

Date	Consultee and type of response	Comment	Response to comment raised and/or where considered in this technical report
May 2022	Isle of Man Department of Infrastructure – Scoping Opinion	The Territorial Sea Committee 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 of the Scoping Report (Subtidal Ecology) contains information that would improve upon the data provided, including in sections 4.1.4.18 (*S. spinulosa*) and 4.1.4.19 (*Modiolus reefs*).	The MMEA has been used as a source in the desktop study baseline characterisation (section 1.5).
		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.	The regional benthic subtidal ecology study area (Figure 1.1) has been amended to include the Isle of Man's territorial waters.
		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.	The MMEA as well as other sources has been used in the desktop study baseline characterisation as well as the identification of designated sites (section 1.5 and 1.6.4 respectively).
	NRW – Scoping Opinion	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).	The Lle Geo-portal and the DataMapWales have both been used to define the baseline for the regional benthic subtidal and intertidal ecology study area (section 1.5).
		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.	All references to cobble reef have been removed and replaced with stony reef within this technical report.

Date	Consultee and type of response	Comment	Response to comment raised and/or where considered in this technical report
June 2022	The Planning Inspectorate – Scoping Opinion	The regional benthic subtidal study area includes 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 regional benthic subtidal ecology study area (Figure 1.1) has been amended to include the Isle of Man's territorial waters.
		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.	The stony reef assessments are presented in section 1.7.5 with the full data provided in Appendix B. This assessment has been undertaken in accordance with the Irving (2009) and Golding *et al*. (2020) guidance.
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.	The results for the site-specific surveys within the Morgan benthic subtidal ecology study area are presented in section 1.7.2 to 1.7.6. The methodology used to determine the low resemblance stony reef has been defined in section 1.7.1. No rocky reef was identified within the Morgan benthic subtidal ecology study area.
March 2023	Benthic ecology, fish and shellfish and physical process EWG meeting 3	The Centre for Environment, Fisheries and Aquaculture Science (Cefas) highlighted they may have queries later in terms of where the grab imagery data and eDNA will be shown.	The drop down video (DDV) imagery data has been included in the epifaunal analysis (section 1.7.4) and the eDNA analysis is included in Appendix H, the full data is available on request.
June 2023	MMO – Section 42 Consultation on the Preliminary Environmental Information Report (PEIR)	The MMO considers that the 'seapens and burrowing megafauna' sensitive habitat is present in the Morgan benthic subtidal ecology study area and should be scoped in to assessments.	The assessment for seapens and burrowing megafauna habitat can be found in section 1.7.5, the results of this assessment have led to this habitat being added as an IEF (Table 1.19)

Date	Consultee and type of response	Comment	Response to comment raised and/or where considered in this technical report
		The MMO recommends more information should be provided to compare the observed presence of characteristic species of the 'fragile sponge and anthozoan communities on rocky habitats', to any quantitative thresholds referenced in the definition of this habitat. If such thresholds are not defined or the available data doesn't allow a comparison to such thresholds, then it is appropriate to be precautionary and assume that this habitat is present in the areas, even where only a low abundance has been observed.	An assessment regarding 'fragile sponge and anthozoan communities on rocky habitats' can be found in section 1.7.5 and the full image analysis for stations where sponges and anthozoans were identified can be found in Appendix B.
		The MMO noted that Thomson Environmental Consultants are not validated by the MMO to undertake particle size analysis (PSA) in support of marine licences, and therefore these results cannot be considered for purposes of dredge and disposal operations.	The PSA analysis was conducted by Kenneth Pye Associates Ltd. and Ocean Ecology (both MMO validated laboratories).
		The MMO noted that some inconsistencies regarding sediment contamination data e.g. the number of samples taken and the number presented.	Inconsistencies regarding the sediment chemistry analysis have been addressed. Analysis is presented in section 1.7.2 and full data is presented in Appendix F.
	The Isle of Man Department of Infrastructure	The Isle of Man Department of Infrastructure would draw the applicant's attention to 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. More detail will be provided below in respect of specific areas of the MMEA that should be reviewed.	The MMEA has been used as a source in the desktop study baseline characterisation (section 1.5).
	Natural England – Section 42 Consultation on PEIR	Natural England noted that further surveys were undertaken in summer 2022, but no results are currently included in the technical report. It would have been beneficial for the survey locations to be included as a figure in the report. They have reserved the right to change their comments and position during the Environmental Statement consultation, subject to the outcome of further data analysis.	The analysis of data collected in the Morgan Array Area ZoI in 2022 have been added to the analysis in section 1.7 to define the baseline characterisation for the Morgan benthic subtidal ecology study area. The full data is available on request.

Date	Consultee and type of response	Comment	Response to comment raised and/or where considered in this technical report
		Natural England noted that there is no indication of how the geophysical data was used to inform the positioning of the sample stations or any indication of the bedforms encountered and how they may have related to the ecology or have been used to create the habitat map. Natural England advised that details of geophysical surveys, and correlation of the geophysical data is included with benthic ecology data to provide confidence in the mapped outputs.	Information regarding the use of geophysical information to support the sampling regime has been added to section 1.7.1. Furthermore a summary of the results of the geophysical data has been added to section 1.7.2.
		Natural England advised that details of geophysical surveys, and correlation of the geophysical data is included with benthic ecology data to provide confidence in the mapped outputs. They noted there is no legend to explain the colours within the Morgan Array Area in Figure 1.21. They asked that a legend is included for all the features displayed in the map in Figure 1.21.	Information regarding the use of geophysical information to support the sampling regime has been added to section 1.7.1. Furthermore a summary of the results of the geophysical data has been added to section 1.7.2. Legends have been included for all figures in this report.
		Natural England welcomes the inclusion of the Mona survey results, which help to provide context to the results within Morgan benthic study area.	Infauna and epifauna data collected within the Mona Array Area is included in the infaunal and epifaunal analysis presented in sections 1.7.3 and 1.7.4.
July 2023	Benthic ecology, fish and shellfish and physical process EWG meeting 4	The meeting presented the some of the most prominent section 42 responses and how they will be addressed in the Environmental Statement. This included comments regarding the PSA analysis and sediment contamination data.	The relevant benthic ecology section 42 responses have been recorded above in this table along with how they have been addressed in this technical report.

1.4 Methodology

1.4.1 Overview

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 and a benthic subtidal survey of the Morgan Array Area and ZoI (i.e. the Morgan benthic subtidal ecology study area) was undertaken in 2022. The results of these surveys have been used to characterise the Morgan benthic subtidal ecology study area, for the purposes of informing the benthic subtidal ecology EIA chapter (Volume 2, Chapter 2: Benthic subtidal ecology of the Environmental Statement).

1.4.1.3 The subtidal benthic ecology surveys of the Morgan benthic subtidal ecology study area consisted of grab sampling and 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 2021 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 Morgan Array Area (in 2021) and ZoI (in 2022) and the Mona Array Area (in 2021). Since the submission of the PEIR for the Morgan Generation Assets, there has been a refinement of the Morgan Array Area. The result of this is that some of the 2021 sample stations which were previously located in the Morgan Array Area now fall within the Morgan Array Area ZoI. The data collected for the Morgan Generation Assets has been used to provide additional context for the data within the Morgan benthic subtidal ecology study 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
Mona Offshore Wind Project, Volume 6, Annex 2.1: Benthic subtidal and intertidal ecology technical report of the Environmental Statement	Mona Offshore Wind Ltd.	2024	Mona Offshore Wind Ltd.
Morecambe Offshore Windfarm: Generation Assets PEIR, Volume 1, Chapter 9: Benthic ecology	Morecambe Offshore Windfarm Ltd.	2023	Morecambe Offshore Windfarm Ltd.
Data Map Wales	Welsh Government	2023	Welsh Government
Awel y Môr Environmental Impact Assessment, Volume 2, Chapter 5: Benthic Subtidal and Intertidal Ecology	RWE	2022	RWE
The National Biodiversity Network (NBN) Gateway	https://nbnatlas.org/	Accessed April 2022	https://nbnatlas.org/
European Marine Observation and Data Network (EMODnet) broadscale seabed habitat map for Europe (EUSeaMap)	EMODnet-Seabed Habitats	2019	EMODnet-Seabed Habitats
Subtidal Ecology. In: Manx Marine Environmental Assessment (2nd Ed).	The Government of the Isle of Man	2018	Lara Howe

Title	Source	Year	Author
Coastal Ecology. In: Manx Marine Environmental Assessment (2nd Ed).	The Government of the Isle of Man	2018	Lara Howe
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	Burbo Bank Offshore Wind Farm Benthic and Annex I Habitat Pre-construction Survey Field Report
Rhiannon Wind Farm Preliminary Environmental Information Chapter 9 Benthic Ecology	Celtic Array Ltd	2014	Celtic Array Ltd
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
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
A Review of the Contaminant Status of the Irish Sea	Cefas	2005	Cefas
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)
Phase I- Intertidal Survey- Standard Report'	Countryside Council for Wales	2004	Countryside Council for Wales
North Hoyle offshore windfarm Environmental Statement	Innogy NWP offshore Ltd.		North Hoyle offshore windfarm Environmental Statement
Broadscale seabed survey to the east of the Isle of Man	Holt et al.	1997	Holt *et al*.
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), produced by Department for Energy Security and Net Zero (DESNZ), Offshore Petroleum Regulator for Environment and Decommissioning (OPRED), and Department for Business, Energy & Industrial Strategy (DBEIS) (2023), included 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 (DESNZ *et al*., 2023). 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 (2005-2008), EUSeaMap2 (found on EMODnet) 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 sand ripples. The sand waves and sand 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 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 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 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 Mona Offshore Wind Project is located in the south of the regional benthic subtidal ecology study area (Figure 1.3). Baseline characterisation surveys of the Mona Array Area and ZoI determined that the sediment ranged from sandy gravel to slightly gravelly muddy sand with most samples classified as gravelly muddy sand (Mona Offshore Wind Ltd., 2024). Within the Mona Offshore Cable Corridor the sediment was predominantly classified as either gravelly muddy sand or sand, becoming finer closer to the coast (Mona Offshore Wind Project Ltd., 2024).

1.5.1.8 The Morecambe Offshore Windfarm is located in the east of the regional benthic subtidal ecology study area (Figure 1.3). Baseline characterisation surveys for the of the Morecambe Offshore Windfarm determined that the most common sediment type was muddy sand but sediment types ranged from slightly gravelly sand to sandy mud (Morecambe Offshore Windfarm Ltd., 2023). Sediment composition at all stations was dominated by sand with sample stations in the west and south west of the survey area being slightly coarser than those in the east (Morecambe Offshore Windfarm Ltd., 2023)

1.5.1.9 The proposed Awel y Môr offshore wind farm, also in the south of the regional benthic subtidal ecology study area, undertook site specific baseline characterisation surveys in 2022 (RWE, 2022). The survey identified the seafloor in the southeast of the array area was characterised by numerous sandwaves and megaripples, while the west of the site was relatively flat and featureless (RWE, 2022). Sandwaves were reported to be actively mobile and migrating. In the west of the survey area sediments contained a sand, gravel and a small fines fraction (RWE, 2022). In the east of the array area, sandwaves and megaripples were evident and were formed by sands with a low gravel content (RWE, 2022).

1.5.1.10 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).

1.5.1.11 The subtidal sediments in the southwest of the regional benthic subtidal ecology study area, as determined by baseline characterisation surveys for the Rhiannon 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).

1.5.1.12 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.

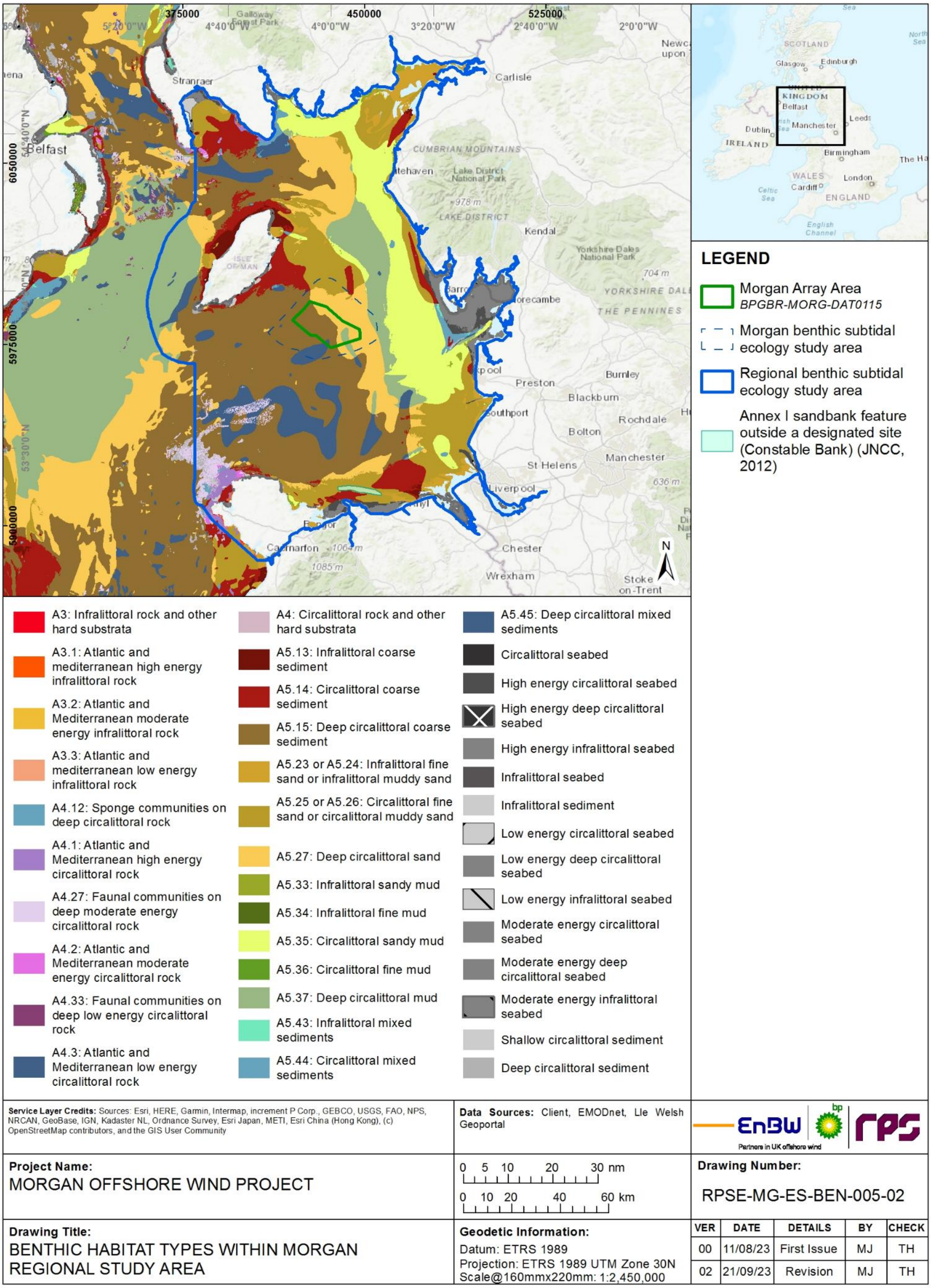


Figure 1.2: Benthic habitats (EMODNet, 2019) within the regional benthic subtidal ecology study area.

Sediment contamination

1.5.1.13 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.

1.5.1.14 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 Effect Levels (TEL). Additionally two metals (lead and mercury) were present in excess of the Canadian Probable Effect Levels (PEL). The Canadian 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/Canadian TEL. No metals were in excess of ISQG/Canadian TEL below 1.5 m. Six of these samples were collected in the Burbo Bank offshore wind farm array area (6.4 km 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.

1.5.1.15 Site-specific surveys for Awel y Môr found total Polycyclic Aromatic Hydrocarbons (PAH) concentrations were higher in the array area than the median concentration recorded from the Strategic Environmental Assessment 6 (SEA6) (Cefas, 2005) Irish Sea surveys (0.0237 µg/g) at six stations; however, the median value from the site specific survey was broadly comparable to the SEA6 median value (RWE, 2022). The bioavailable metals concentrations in sediments were all below their respective Cefas ALs (RWE, 2022).

1.5.1.16 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/Canadian TEL thresholds but below the Canadian 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 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 and Farago, 1997).

1.5.1.17 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/Canadian 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 0.5 mg/kg wet weight in the early 1970s, to approximately 0.2 mg/kg 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).

1.5.1.18 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 Canadian 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 Canadian 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 Canadian PEL thresholds (Burbo Bank (Seascape Energy Ltd, 2002), North Hoyle (RWE, 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. 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.

1.5.1.19 Of the 40 stations sampled for sediment chemistry (metals, organotins, PCBs and PAHs) for the Mona Offshore Wind Project, none exceeded the relevant Cefas AL2, Canadian PEL, Effects Range Median (ERM) or Effects Range Low (ERL) thresholds where these exist (Mona Offshore Wind Ltd, 2024). In the Mona Array Area and ZoI two sample stations exceeded Cefas Action Level 1 (AL1) for arsenic but was below the Cefas Action Level 2 (AL2) threshold, and all but one sample station exceeded the Canadian Threshold Effect Levels (TEL) but was below the Probable Effect Level (PEL) for arsenic. Furthermore, one sample station exceeded the Cefas AL1 for cadmium but was below Cefas AL2. In the Mona Offshore Cable Corridor the concentrations of arsenic exceeded Cefas AL1 at three sample stations and 17 stations were above the Canadian TEL however all were below Cefas AL2 and the Canadian PEL. No samples exceeded the relevant Cefas ALs or the Canadian TEL or PEL for PCBs. Levels of PAHs were below the relevant Canadian TEL and PEL levels, or ERM and ERL thresholds. Concentrations of organotins where below the limit of detection (LOD) at all stations.

1.5.1.20 The Morgan and Morecambe Offshore Wind Farms: Transmission Assets (hereafter referred to as the Transmission Assets) also completed sediment chemistry analysis at 39 stations (Morecambe Offshore Windfarm Ltd and Morgan Offshore Wind Ltd, 2023). No contaminants were present at levels exceeding the Cefas AL2 or the Canadian PEL thresholds where these exist. Concentrations of nickel exceeded the Cefas AL1 at one station (but was below the Cefas AL2). Concentrations of mercury at seven sites in the nearshore area exceeded the Canadian TEL (but were below the Canadian PEL). Concentrations of arsenic exceeded the Canadian TEL at 17 stations (but were below the Canadian PEL). Concentrations of some PAHs exceeded the Canadian TEL at five stations primarily near the landfall. No other contaminants exceeded any threshold levels.

1.5.1.21 Trace and heavy metal concentrations were overall low across the Morecambe Offshore Windfarm site with none of the metals analysed, except for arsenic, exceeding any of the reference levels (Cefas AL1, Cefas AL2 and Canadian PEL) (Morecambe Offshore Windfarm Ltd., 2023). In general metal concentrations were higher to the east, closer to land than stations located further offshore. Arsenic concentrations exceeded the Canadian TEL at three sample stations. Among all PAHs, naphthalene and pyrene were the ones found to exceed ‘Oslo and Paris Convention for the protection of the marine environment of the North-Eastern Atlantic’ (OSPAR) Background Assessment Concentrations (BAC) reference levels at six stations. None of the other reference levels (Cefas AL1/AL2, ERL/ERM, Canadian TEL and PEL) was exceeded by any of the analysed PAHs.

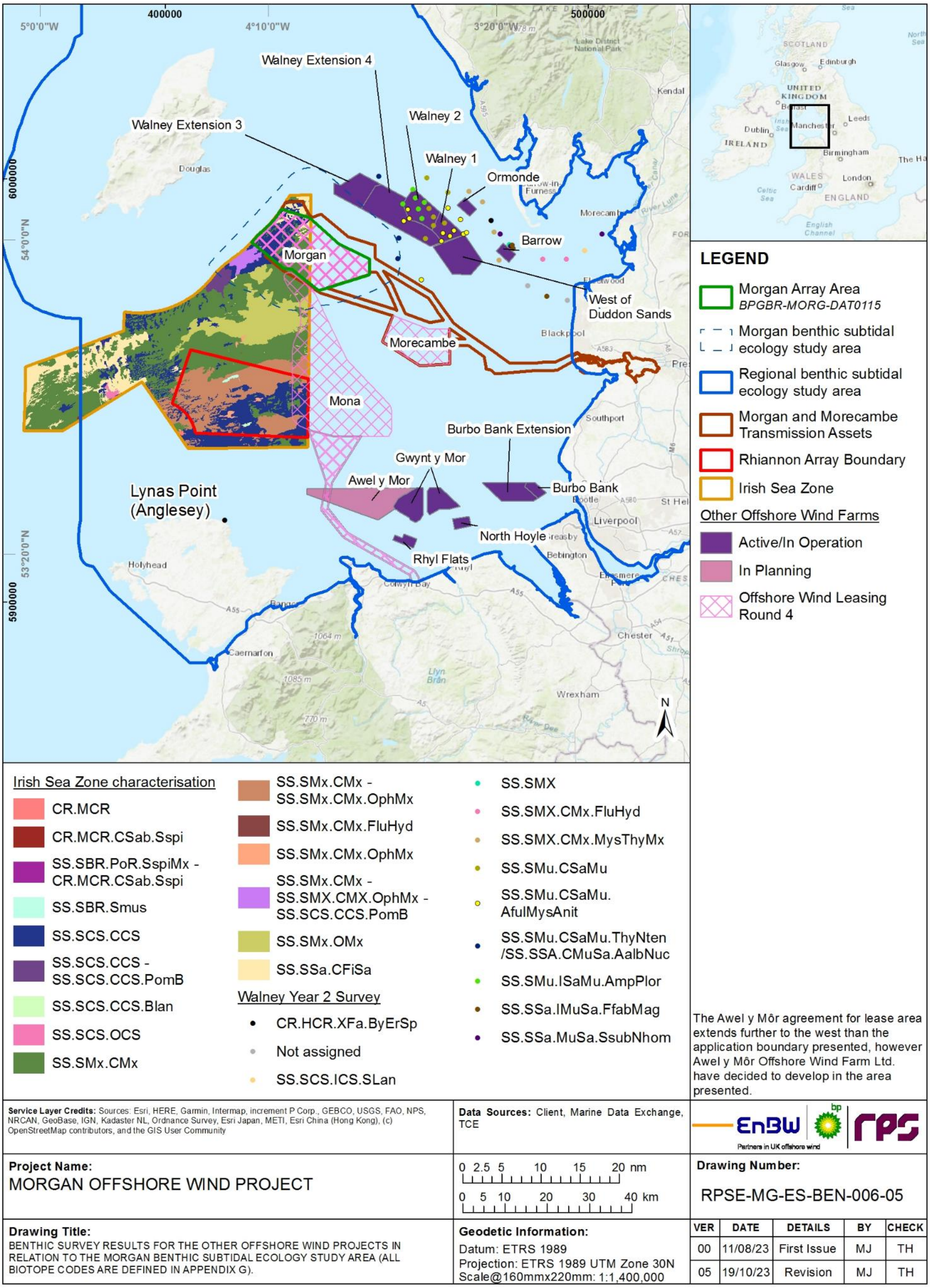


Figure 1.3: Benthic survey results for the other offshore wind projects in relation to the Morgan benthic subtidal ecology study area (all biotope codes are defined in Appendix G).

Subtidal benthic ecology

1.5.1.22 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 G provides the full names for all the biotopes which are presented in Figure 1.3 and discussed in this technical report.

1.5.1.23 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 to 100 m 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 G). 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 to 40 m 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.,* 1972) and the biotope *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (SS.SSa.CMuSa.AalbNuc) (all biotopes codes are defined in full in Appendix G).

1.5.1.24 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.

1.5.1.25 The Burbo Bank offshore wind farm is located approximately 8 km 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 *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand (SS.SSa.IFiSa.NcirBat).

1.5.1.26 The Environmental Statement for this the Burbo Bank offshore wind farm (Dong Energy Ltd, 2013a) 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.

1.5.1.27 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.

1.5.1.28 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).

1.5.1.29 The Rhiannon 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 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 Wind Farm survey area in the central west of the regional benthic subtidal ecology study area (Figure 1.3; Celtic Array Ltd, 2014).

1.5.1.30 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.

1.5.1.31 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 ‘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).

1.5.1.32 The baseline characterisation surveys for the Awel y Môr offshore wind farm showed that the majority of the array area was classified the *Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand (SS.SCS.CCS.PKef) biotope with some areas of higher sand content characterised by the *Branchiostoma* *lanceolatum* in circalittoral coarse sand with shell gravel (SS.SCS.CCS.Blan) biotope and the SS.SSa.IFiSa.NcirBat biotope (RWE, 2022). No Annex I habitats or Annex II species, OSPAR threatened and/ or declining species and habitats, or habitats and species listed under Section 7 of the Environment (Wales) Act 2016, were observed within the array area.

1.5.1.33 In the east of the regional benthic subtidal ecology study area, baseline characterisation surveys were also conducted for Morecambe Offshore Windfarm Generation Assets (Morecambe Offshore Windfarm, 2023). These surveys identified two biotopes, *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand (SS.SSa.CFiSa.ApriBatPo) and *Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud (SS.SMu.CSaMu.AfilKurAnit).

1.5.1.34 In the south of the regional benthic subtidal ecology study area, the Mona Offshore Wind Project was characterised by grab sampling and DDV in 2021 and 2022 (Mona Offshore Wind Ltd., 2024). The Mona Array Area was primarily characterised by the polychaete-rich deep Venus community in offshore mixed sediments (SS.SMx.OMx.PoVen) biotope with areas of SS.SCS.CCS. The Mona Array Area ZoI also contained small areas characterised by the circalittoral mixed sediment (SS.SMx.CMx) and *Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment (SS.SMx.CMx.KurThyMx) biotopes in the southeast of the Mona Array Area ZoI. The SS.SMx.CMx biotope and the SS.SSa.CFiSa biotope were also identified in the southeast of the Mona Array Area ZoI. In the southwest of the Mona Array Area ZoI, brittlestar beds were recorded at two stations and the communities were characterised by the SS.SMx.CMx.OphMx biotope. In the Mona Offshore Cable Corridor the SS.SMx.OMx.PoVen biotope was dominant in the north, in the area adjacent to the Mona Array Area. The central section, to the north of Constable Bank, was dominated by the SS.SSa.CFiSa biotope. In the area of overlap with Constable Bank, the sediments and communities were characterised by the SS.SMx.CMx and SS.SSa.IFiSa.NcirBat biotopes. In the area of overlap with the Menai Strait and Conwy Bay SAC, and also the part of the Mona Offshore Cable Corridor to the south of the SAC, the communities were characterised by the SS.SMx.CMx.KurThyMx, SS.SSa.IFiSa.NcirBat and SS.SCS.CCS biotopes. The section of the Mona Offshore Cable Corridor approaching the coast was defined by muddy sand and mixed sediments which were characterised by communities typical of the SS.SSa.IMuSa.FfabMag biotope.

1.5.1.35 Within the Mona benthic subtidal and intertidal ecology study area Annex I low resemblance stony reef was identified five sample stations within the Mona Array Area and ZoI (Mona Offshore Wind Ltd., 2024). The habitat assessment noted the presence of burrows at 54 stations within the Mona benthic subtidal and intertidal ecology study area. Whilst no sea pens were observed, the presence of burrows was classified as ‘frequent’ or above at 37 stations; therefore, it was concluded that these stations showed some similarity to the ‘sea pen and burrowing megafauna communities’ habitat as defined by OSPAR. Annex I stony reef assessments identified four stations which were classified as Annex I low resemblance stony reef located in the west of the Mona Array Area. In the Mona Array Area and ZoI only one station in the north was classified as Annex I low resemblance stony reef. An assessment for sponge dominated habitat was also undertaken for the Mona Offshore Wind Project but no stations were found to represent the fragile sponge and anthozoan communities on subtidal rocky habitat.

1.5.1.36 The site-specific survey data for the Transmission Assets, collected in 2022, showed that the benthic communities were dominated by the SS.SMu.CSaMu.LkorPpel biotope in the west, with the SS.SMu.CSaMu.AfilKurAnit biotope being present throughout the centre of the Transmission Assets survey area (Morecambe Offshore Windfarm Ltd. and Morgan Offshore Wind Ltd, 2023). The infaunal communities graded into the SS.SSa.CMuSa.AalbNuc biotope in the nearshore area, and SS.SSa.IFiSa interspersed with SS.SSa.CMuSa.AalbNuc, approaching the landfall. The epifaunal analysis indicated the presence of SS.SSa.CMuSa throughout the majority of the Transmission Assets survey area. Circalittoral mixed sediments and circalittoral fine sands were also noted in areas corresponding to infaunal biotopes associated with these sediment types, and therefore most epifaunal biotopes assigned were consistent with the underlying infaunal biotope. The exception is in the north east of the Morgan Generation Assets, where a high SACFOR (Super abundant, Abundant, Common, Frequent, Occasional, Rare) abundance of *O. ophiura* indicated the presence of the biotope SS.SMx.CMx.OphMx.

1.5.1.37 No Annex I reefs (biogenic or geogenic) were recorded within the Transmission Assets. Sandy sediments in less than 20 m of water occurred within the Transmission Assets survey area but were considered unlikely to qualify as a Habitats Directive Annex I ‘sandbanks which are slightly covered by seawater all of the time’ habitat (Morecambe Offshore Windfarm Ltd and Morgan Offshore Wind Ltd, 2023). The habitat assessment noted the presence of burrows at 22 stations within the Transmission Assets survey area. Whilst no sea pens were observed, the presence of burrows was classified as ‘frequent’ or above at 13 stations; therefore, it was concluded that these stations showed some similarity to the ‘sea pen and burrowing megafauna communities’ habitat as defined by OSPAR. Evidence of hard substrate Porifera was observed at 12 stations, but no stations were considered to represent the fragile sponge and anthozoan communities on subtidal rocky habitat.

1.5.1.38 The baseline characterisation for the Morecambe Offshore Windfarm, in the east of the regional benthic subtidal ecology study area, identified two different biotopes (Morecambe Offshore Windfarm Ltd., 2023). The majority of the Morecambe Offshore Windfarm was characterised by the SS.SSa.CFiSa.ApriBatPo biotope transitioning to SS.SMu.CSaMu.AfilKurAnit in the west. Within the circalittoral muddy sand sediments which occurred across the majority of the central and east regions of the Morecambe Offshore Windfarm, burrows were identified. Areas where megafaunal burrows were present matched the criteria required to be classified as the OSPAR/Feature of Conservation Interest (FOCI) habitat ‘Seapens and burrowing megafauna’. No seapens were identified in the survey however they are not required for the allocation of this habitat based on JNCC’s interpretation of the OSPAR habitat definition (Robson, 2014). No clear pattern in the distribution of burrow density was identified in the data, with areas of higher and lower burrow density interspersed throughout the windfarm site. No areas of potential Annex I reef were identified in DDV imagery and therefore no formal reef assessments were conducted.

1.5.1.39 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 BAP priority species, the sea anemone *Edwardsia timida*, were also recorded. Ocean quahog *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.

1.5.1.40 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 Wind Farm coinciding with the central west area of the regional benthic subtidal ecology study area. The stony reefs identified have ‘reefiness’ classifications (stony 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 Wind Farm which was assigned a high ‘reefiness’ (Celtic Array Ltd., 2014). *Sabellaria spinulosa* reefs were identified 20 km northwest of the Rhiannon Wind Farm 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 Wind Farm but a small area of low to moderate ‘reefiness’ *S. spinulosa* reef of 0.22 km^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 Wind Farm array area (in the central west area of the regional benthic subtidal ecology study area).

1.5.1.41 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 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, 1998a). The Bangor University benthic survey in 2008 indicated that seabed dominated by brittlestar beds is widespread in Manx waters.

1.5.1.42 One individual of *A. 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).

1.5.1.43 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 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 (Figure 1.2), sediments in the Morgan benthic subtidal ecology study area are dominated by a variety of sediment types (EMODnet, 2019). The sediments transition from west to east across the Morgan benthic subtidal ecology study area grading from deep circalittoral coarse sediments to deep circalittoral sands.

Subtidal benthic ecology

1.5.2.2 Site-specific surveys conducted for the Rhiannon Wind Farm benthic ecology 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 Wind Farm 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 (i.e. the north of the Mona Array Area and ZoI) 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 Surveys for the Transmission Assets also included survey locations that overlapped with the Morgan benthic subtidal ecology study area (Morecambe Offshore Windfarm Ltd and Morgan Offshore Wind Ltd, 2023). In the north of the Morgan Array Area, along the border with the Morgan Array Area ZoI the SS.SMu.CSaMu.LkorPpel biotope was dominant and extended to the edge of the Morgan benthic subtidal ecology study area. In the northwest edge of the Transmission Assets, in the overlap with the Morgan Array Area ZoI, there were also small sections of SS.SMx.CMx.KurThyMx and *Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment (SS.SMx.CMx.OphMx). In the south of the Transmission Assets survey area which is within the Morgan benthic subtidal ecology study area, the SS.SMx.OMx.PoVen biotope was also identified (Morecambe Offshore Windfarm Ltd and Morgan Offshore Wind Ltd, 2023).

1.6 Designated sites

1.6.1 Overview

1.6.1.1 There are a number of sites of nature conservation importance, which are designated for relevant benthic subtidal ecology features within the regional benthic subtidal ecology study area. The designated sites are described in Table 1.3 and shown in Figure 1.4. Those sites located within the ZoI of the Morgan Generation Assets 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	Distance from the Morgan Array Area (km)	Relevant qualifying features
West of Copeland MCZ	8.8	• Subtidal coarse sediment • Subtidal sand • Subtidal mixed sediment.
West of Walney MCZ	9.3	• Subtidal sand • Subtidal mud • Seapen and burrowing megafauna communities.
Langness Marine Nature Reserve (MNR)	17.0	• Eelgrass meadow • Intertidal mud • Kelp forest • Sea caves.
Little Ness MNR	20.4	• Horse mussel reef • Maerl.
Douglas Bay MNR	22.3	• Beaumont's nudibranch (*Cumanotus beaumonti*) • Maerl beds • Rocky reef • Kelp forest.
Laxey Bay MNR	22.4	• Eel grass meadow • Rocky reef • Sandy seabed • Maerl • Ocean quahog (*Arctica islandica*) • Common whelk.

Designated site	Distance from the Morgan Array Area (km)	Relevant qualifying features
Ramsey Bay MNR	27.4	• Maerl beds • Eelgrass meadows • Horse mussel reefs • Rocky shore and reef.
Fylde MCZ	29.2	• Subtidal sand • Subtidal mud.
Shell Flat and Lune Deep SAC	29.6	• Sandbanks which are slightly covered by sea water all the time • Reefs.
Baie y Carrickey MNR	30.3	• Rocky reef • Sea caves • Kelp forest • Eelgrass meadows.
Morecambe Bay SAC	36.6	• Estuaries • 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 • *Salicornia* and other annuals colonising mud and sand • Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) • Reefs.
Calf of Man and Wart Bank MNR	35.9	• Rocky reef • Sand banks • Kelp forest.
Niarbyl Bay MNR	36.8	• 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	Distance from the Morgan Array Area (km)	Relevant qualifying features
West Coast MNR	38.7	• Rocky reef • Intertidal blue mussel • Mixed soft sediment • Kelp forest • Burrowing anemone (*Edwardsia timida*).
Cumbria Coast MCZ	47.9	• Intertidal under boulder communities • *Sabellaria alveolata* reefs.
Ribble Estuary Site of Special Scientific Interest (SSSI)	50.9	• Intertidal mudflats • Intertidal sandflats.
Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC	60.2	• 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.
Pen Y Gogarth/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	65.8	• Caves and overhangs • Moderately exposed rock • Rockpools • Soft piddock bored substrata • Under-boulders.
Luce Bay and Sands SAC	69.4	• 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.
Aber Dyfrdwy/Dee Estuary SAC	70.0	• Estuaries • Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) • Mudflats and sandflats not covered by seawater at low tide.
Dee Estuary Ramsar site	70.0	• Ramsar criterion 1 - Extensive intertidal mud and sand flats with large expanses of saltmarsh towards the head of the estuary.

Designated site	Distance from the Morgan Array Area (km)	Relevant qualifying features
Traeth/Pensarn SSSI	72.4	• Coastal vegetated shingle ridge.
Allonby Bay MCZ	81.4	• Blue mussel beds • *Sabellaria alveolata* reefs.
Solway Firth SAC	87.6	• 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, 29.6 km 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 20 m 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 36.6 km 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, 2022a). 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, 2022a).

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 60.2 km 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 and Conwy Bay 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 (2022b) 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, 2022b). In very shallow waters relatively species-rich sandy communities are dominated by polychaetes (JNCC, 2022b).

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 69.4 km 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, 2022c). The sediments within Luce Bay range from boulders to highly mobile sands, which support rich plant and animal communities typical of a large bay in southwest Scotland (JNCC, 2022c). The shallow depths of the bay (0 to 10 m) 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 felina* 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, 70 km southeast of the Morgan Array Area at its closest point.

1.6.1.11 The Aber Dyfrdwy/Dee Estuary SAC covers an area of 158.05 km^2 (JNCC,2022d). 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.

Dee Estuary Ramsar site

1.6.1.12 The Dee Estuary Ramsar site is located on the north Wales coast in the southeast of the east Irish sea, 70 km southeast of the Morgan Array Area at its closest point.

1.6.1.13 The Dee Estuary Ramsar site covers an area of 143.02 km^2 (Ramsar, 2012). This site is classified under criterion 1 for extensive intertidal mud and sandflats with large expanses of saltmarsh towards the head of the estuary (Ramsar, 2012). Much of the upper part of the estuary consists of muddy fine sand dominated by *Hediste diversicolor* and *Macoma balthica*. The sediment flats in the outer estuary also have fine muddy sands but here they are dominated by *Cerastoderma edule* and *Arenicola marina*. Where water movement is greater the sediments tend to be coarser and sandier, with *Nephtys* sp. and *Bathyporeia* sp. It also supports some nationally scarce biotopes including *Sabellaria alveolata* reefs around Hilbre Island and piddock beds (*Barnea candida*) on Holocene clay banks within the estuary (Ramsar 2012).

Solway Firth SAC

1.6.1.14 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 87.6 km 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.

1.6.1.15 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 – Marine Conservation Zones (MCZs)

West of Copeland MCZ

1.6.2.1 West of Copeland MCZ is located in the east Irish sea, 8.8 km north of the Morgan Array Area and it covers an area of 158 km^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, 2019a). 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, 2019a). 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, 2019a).

1.6.2.2 The majority of the MCZ is characterised by the subtidal coarse sediments feature, which dominates the west border and central section, primarily at a depth of 20 to 30 m. This feature is surrounded and interspersed by a patchy distribution of the subtidal sands feature, covering most of the northwest and south of the MCZ in the 20 to 50 m depth range, with a relatively small portion of the south being covered by the subtidal coarse sediments feature (Defra, 2019a; EMODnet, 2019). The northeast border of the MCZ is largely characterised by subtidal mixed sediments interspersed with patches of the subtidal coarse sediment and subtidal sand features. This range of habitats support a variety of communities, with common species being the clam *Chamelea gallina* and razor clams *Ensis ensis*, which are found within all designated feature habitats.

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 9.3 km northeast of the Morgan Array Area at its closest point. The MCZ covers an area of 388 km^2 most of which is in inshore waters, but with a small section crossing the 12 nm boundary into offshore waters (Defra, 2016a).

This site is notable as it is part of a network of mud-based sea pen and burrowing megafaunal habitats in this region (Defra, 2016a). All of the designated features (subtidal sand, subtidal mud and sea pens and burrowing megafauna communities) are currently recovering to favourable condition (Defra, 2016a; JNCC, 2018).

1.6.2.4 The MCZ provides important protected habitats to worms, molluscs, sea urchins and Crustaceans, and the subtidal sands support high densities of burrowing brittlestars, along with flatfish. The sea pens are colonial cnidarians which thrive within the subtidal mud habitats protected within the MCZ boundary, while also providing habitats for brittlestars *A. filiformis*, horseshoe worms *Phoronid* species, polychaete worms *Scalibregma inflatum* and *Nephtys hombergii*, bivalves *M. bidentata* and *A. nitida* and the burrowing crustaceans *Callianassa subterranean* and *Goneplax rhomboides* (CMACS, 2013). The subtidal sands act as habitats for the same polychaete and echinoderm species, differing by also providing habitats to the bivalves *K. bidentata*, and *Chamelea striatula*, and crustaceans *Corystes cassivelaunus* (The Centre for Environment, 2007).

1.6.2.5 Most of the substrate is subtidal muds, with exception of the north east corner, where a relatively small area of subtidal sands are present and limited to the shallowest region of the MCZ. The sea-pen and burrowing megafauna communities feature also covers the majority of the site with the seapens *Virgularia mirabilis* found sparsely throughout the entire site, but mainly focused along the south boundaries of the designated area (Titan Environmental Surveys, 2005). Burrowing megafauna, such as *Nephrops norvegicus* and *C. subterranea,* and worms - such as the echiuran, or spoon-worm *Maxmuelleria lankesteri* (Hughes, 1998b) exist almost uniformly across the entire site, except for the subtidal sands in the north east, which host burrowing brittlestars and some species of flatfish.

1.6.2.6 Site-specific infaunal grab sample surveys carried out in 2016 and 2018 (Mitchell *et al*., 2023) broadly supported these findings. Specifically, the 2018 survey found 89 sites comprised subtidal muds, and 11 comprised subtidal sand in the north east of the designated area. Infaunal analysis indicated the site to be dominated by a mix of

SS.SSa.CMuSa.AalbNuc, SS.SMu.CSaMu.AfilKurAnit, and burrowing megafauna and *M. lankesteri* in circalittoral mud (SS.SMu.CFiMu.MegMax). The designated habitat assessment indicated that all subtidal mud sites throughout the MCZ contained species indicative of the seapen and burrowing megafauna communities, aligning with previous surveys within this area (Titan Environmental Surveys, 2005).

Fylde MCZ

1.6.2.7 Fylde MCZ is located in Liverpool Bay, between 3 and 20 km off the Fylde coast and Ribble estuary. The site is located 29.2 km from the Morgan Array (Figure 1.4). The MCZ protects an area of approximately 260 km^2 and was originally designated in 2013 to protect 156 km^2 of subtidal sands, with this updated in 2016 to also include 104 km^2 of subtidal muds. The depth of the seabed within the site ranges from almost being exposed on low tide (just 35 cm depth) to 22 m at its deepest part (Defra, 2013). The site is located in proximity to the Shell Flat and Lune Deep SAC and is co-located within the Liverpool Bay Special Protection Area.

1.6.2.8 Both broadscale habitat features are considered to be good representatives of these habitats in the east of the Liverpool Bay area, with the general management approach recommended to maintain both habitat types in favourable condition. There are pockets of mud present in small areas across the rest of the site (Environment Agency, 2015).

1.6.2.9 The MCZ acts as a protected habitat for crabs, brittle stars, a rich community of bivalve molluscs such as the razor shell *Pharus legumen* and *A. alba* (Kaiser *et al*., 2006), polychaetes primarily within the genera *Nephtys* and *Pholoe*, and demersal flatfish species including sole *Solea solea* and plaice *P. platessa* (Natural England, 2016).

1.6.2.10 The habitats within the Fylde MCZ were characterised in a baseline survey of the area by Natural England (Miller and Green, 2017). Specifically, this found that subtidal sand substrate dominated approximately the south three fifths of sampled sites, largely as a result of sediment outflows from the Ribble estuary to the southeast. The benthic community is characterised by a variety of species, ranging from a low-abundance bivalve-dominated community including *Corbula gibba*, *C. striatula* and *Dosinia* spp. to a mixed polychaete and bivalve community which includes *Ophelia* sp., *K. bidentata* and *Glycera tridactyla* (Environment Agency, 2015). Subtidal muds dominated the north two fifths, with an overall trend of increasing mud percentage moving north within the MCZ.

1.6.2.11 Multivariate analysis of the 2017 grab sample data showed significantly increased biodiversity in the north of the MCZ compared to the south. The biotopes *Glycera lapidum* in impoverished infralittoral mobile gravel and sand/*Morella* spp. with venerid bivalves in infralittoral gravelly sand biotope (SS.SCS.ICS.Glap/ SS.SCS.ICS.MoeVen) covered a large proportion of the south part of the MCZ in association with the sandy substrates. The number and variety of biotopes increased further north, with the SS.SMu.CSaMu.AfilMysAnit biotope dominating the subtidal muds, with this being geographically and statistically grouped alongside the SS.SSa.CMuSa.AalbNuc biotope, with these two biotopes having been recognised as grading into one another (Envision Mapping Ltd., 2015. Occasional sites characterised as *Echinocardium cordatum* and *Ensis* spp. in lower shore and shallow sublittoral slightly muddy fine sand (SS.SSa.IMuSa.EcorEns) have also been noted in the northwest of the MCZ.

Cumbria Coast MCZ

1.6.2.12 The Coast of Cumbria MCZ is located on the west coast of England, within the county of Cumbria. The MCZ is 47.9 km north east of the Morgan Array Area at its closest point. The MCZ is an inshore site that stretches for approximately 27 km along the coast of Cumbria and in total it covers an area of 22 km^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, *S. 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).

1.6.2.13 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).

Allonby Bay MCZ

1.6.2.14 The Allonby Bay MCZ is located on the west coast of England, within the county of Cumbria. The MCZ is 81.4 km 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 40 km^2 (Defra, 2016b). This site is notable for large areas of reefs, including *S. alveolata* reefs and blue mussel beds (Defra, 2016b). 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 – Site of Special Scientific Interest (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 50.9 km from the Morgan Array Area. This SSSI is 92.26 km^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, as well as overlapping with the Salter's Bank unit designated for the presence of favourable status littoral sediments (Natural England, 2008). The Ribble Estuary is intersected by numerous water channels with extensive sandbanks in the outer estuary such as Foulnaze Bank which is in the middle of the outer estuary (Natural England, 2015). 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 63.1 km from the Morgan Array Area. Pen Y Gogarth/Great Ormes Head SSSI covers an area of 3.03 km^2 (Countryside Council Wales (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 63.7 km from the Morgan Array Area. Aber Afon/Conwy SSSI covers an area of 12.95 km^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 65.8 km from the Morgan Array Area. Creigiau Rhiwledyn/Little Ormes Head SSSI covers an area of 0.36 km^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 72.4 km from the Morgan Array Area. Traeth Pensarn SSSI covers an area of 51.67 km^2, of which 42.46 km^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 Mean High Water Spring (MHWS) mark.

1.6.4 National designations – Marine Nature Reserves (MNRs)

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, 17.0 km from the Morgan Array Area at its closest point. Langness MNR is 88.67 km^2, or 10.67% of the 0 to 3 nm 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 12 m, 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, 20.4 km from the Morgan Array Area at its closest point. Little Ness MNR is relatively small at 10 km^2, but one of the most important sites because of its very high species diversity (DEFA, 2022b).

1.6.4.4 The Little Ness MNR encompasses a variety of habitats including horse mussel reefs and maerl beds (DEFA, 2022b). 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, 2022b). 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, 22.3 km from the Morgan Array Area at its closest point. Douglas Bay MNR covers an area of 4.6 km^2 (DEFA, 2022c).

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, 2022c). 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, 2022c).

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, 22.4 km from the Morgan Array Area at its closest point. Laxey Bay MNR is approximately 4 km^2 in size which equates to around 0.5% of the 0 to 3 nm area, or 1% of the reserves network (DEFA, 2022d).

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, 2022d). This MNR supports ocean quahog *A. islandica* and common whelk *Buccinum undatum* which is one of the five commercially fished species around the Isle of Man (DEFA, 2022d).

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, 27.4 km from the Morgan Array Area at its closest point. Ramsey Bay MNR covers an area of around 97 km^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, 2022e).

1.6.4.10 Horse mussels can reach 15 cm 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, 2022e).

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, 30.3 km from the Morgan Array Area at its closest point. Baie ny Carrickey MNR covers an area of 11.37 km^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, 2022f).

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, 2022f).

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, 35.9 km from the Morgan Array Area at its closest point. The Calf of Man and Wart Bank MNR is 20.15 km^2, or 2.4% of the 0 to 3 nm inshore zone (DEFA, 2022g).

1.6.4.14 The Calf of Man and Wart Bank MNR encompasses habitats such as rocky reefs and kelp forests (DEFA, 2022g). This MNR also contains sandbanks composed of sandy sediment and influenced by the waves and tide resulting in a dynamic habitat of mounds and sand ripples (DEFA, 2022g). 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, 36.8 km 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 5.66 km^2 and makes up just over 1% of the reserves network (DEFA, 2022h).

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, 2022h). 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, 2022h).

Port Erin Bay MNR

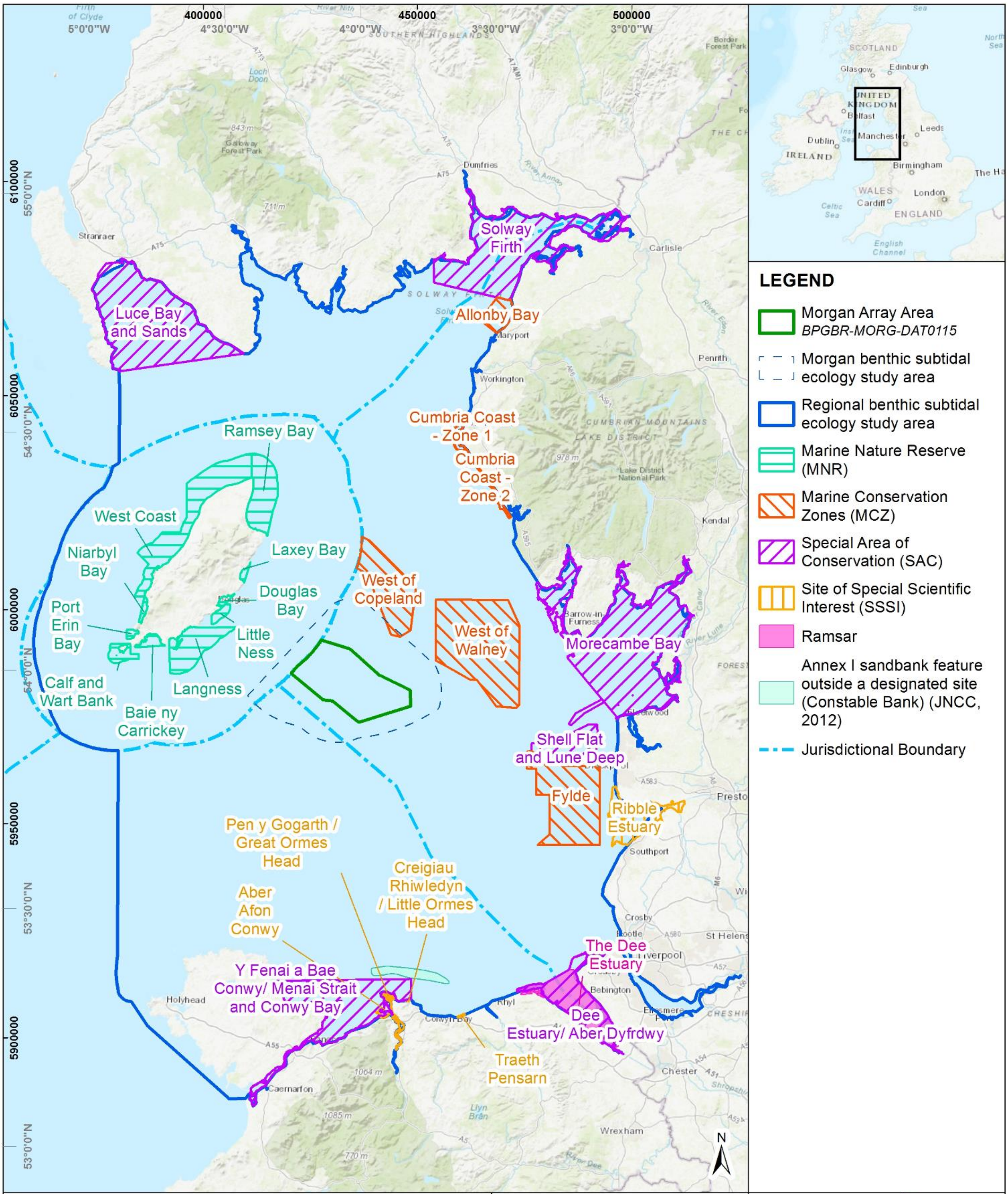
1.6.4.17 The Port Erin Bay MNR is located to the west of the Isle of Man and northwest of the Morgan Generation Assets, 36.8 km from the Morgan Array Area at its closest point. Port Erin Bay MNR is relatively small at approximately 4.5 km^2. Facing due west, the bay acts as a funnel for wind and wave from the Irish Sea and these forces have produced one of the best sandy beaches on the island (DEFA, 2022i).

1.6.4.18 The Port Erin Bay MNR encompasses habitats such as rocky reefs, kelp forest and brittlestar beds (DEFA, 2022i), all of which take advantage of the site being closed for fishing since 1989 (DEFA, 2022i). 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, 38.7 km from the Morgan Array Area at its closest point. The West Coast MNR is the largest of the nature reserves at around 185 km^2, which equates to 43% of the protected area network (DEFA, 2022j).

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, 2022j). 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, 2022j). The main habitat within this MNR is mixed soft sediment which is inhabited by scallops and whelks as well as the burrowing sea anemone (*E. timida*) (DEFA, 2022j).



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

Data Sources: Client, NaturalEngland, JNCC, NRW

Partners in UK offshore wind

Project Name:
MORGAN OFFSHORE WIND PROJECT

0 2.5 5 10 15 20 nm
0 5 10 20 30 40 km

Drawing Number:
RPSE-MG-ES-BEN-001-03

Drawing Title:
DESIGNATED SITES WITH BENTHIC ECOLOGY FEATURES IN THE REGIONAL BENTHIC SUBTIDAL ECOLOGY STUDY AREA.

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:1,500,000

VER	DATE	DETAILS	BY	CHECK
00	26/04/23	First Issue	NA	TH
03	09/04/24	Revision	LM	MK

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 further benthic subtidal survey was undertaken in 2022 to characterise the Morgan Array Area ZoI and to resample the Morgan Array Area within the Morgan benthic subtidal ecology study area (resampling of seven stations sampled during the 2021 survey was undertaken to enable understanding of temporal changes in community types 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. The full data is available on request.

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 Morgan benthic subtidal ecology study area (i.e. the Morgan Array Area and ZoI) and the Mona Array Area with the data collected for the Mona Offshore Wind Project used to provide additional context for the data within the Morgan benthic subtidal ecology study area.

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 surveys to establish bathymetry, seabed sediment and identify seabed features.	XOcean Ltd	June 2021 to March 2022	Volume 4, Annex 1.1: Physical processes technical report of the Environmental Statement. Summary provided in paragraphs 1.7.2.1 to 1.7.2.3.
	Morgan Array Area	High resolution side scan sonar and multibeam bathymetry	Gardline Ltd.	June to September 2021	
Benthic subtidal surveys	Morgan Array Area	Grab and DDV sampling.	Gardline Ltd.	8 August 2021-20 September 2021	Section 1.7.1
	Morgan Array Area and ZoI	Grab and DDV sampling.	Gardline Ltd.	01 April 2022 – 14 August 2022	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) within the Morgan benthic subtidal ecology study area. Site-specific subtidal surveys were also undertaken in 2022 to characterise the Morgan Array Area ZoI. The sampling strategies were designed to adequately sample the area to provide data for baseline characterisation. The survey designs were discussed and agreed with Natural England, JNCC and NRW (Table 1.1). The benthic subtidal surveys for the Morgan benthic subtidal ecology study area were undertaken by Gardline Limited (Gardline) in June to September 2021 and April to August 2022 respectively. The surveys were conducted onboard the vessels Ocean Resolution in 2021 and Ocean Observer and Titan Endeavour in 2022.

1.7.1.2 The 2021 subtidal survey comprised 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. The intention of the sampling strategy was to characterise the benthic communities associated with all broadscale habitats and identify any potentially sensitive features. Upon acquisition of the geophysical data, the provisional targets were adjusted to target representative habitats and to provide coverage to assess the current condition of any potentially sensitive features evident in the geophysical data. Upon receipt of the geophysical dataset acquired by XOcean, three proposed stations (ENV07, ENV13 and ENV27) were adjusted in the Morgan Array Area.

1.7.1.3 Upon completion of the 2021 survey, 35 stations had been successfully sampled with an additional two DDV only stations within the Morgan Array Area and ZoI (Figure 1.5). Since the submission of the PEIR for the Morgan Generation Assets, there has been a refinement of the Morgan Array Area. The result of this is that six of the 2021 sample stations which were previously located in the Morgan Array Area now fall within the Morgan Array Area ZoI.

1.7.1.4 The 2022 survey was comprised 11 sample stations located within the Morgan Array Area and 15 sample stations located within the Morgan Array Area ZoI. Of the stations sampled in the Morgan Array Area seven were locations previously sampled in 2021, resampling was conducted to enable comparison between years and to determine if there had been any temporal changes in the communities present. All of the stations sampled in the 2022 comprised combined grab and DDV sampling (Figure 1.5). The Morgan Array Area and ZoI 2022 sample locations were proposed based upon publicly available data prior to any survey acquisition such as EMODnet data (Figure 1.2) to ensure sample stations were spread across a variety of habitats. Detailed geophysical data was reviewed during the field acquisition to refine the final sampling station locations and to determine sampling intensity.

Grab sampling

1.7.1.5 A total of 248 single grab samples were retained from 273 deployments of a 0.1 m^2 mini-Hamon grab during the 2021 survey, of which 104 were within the Morgan Array Area at 35 sample stations (noting that six of these stations now fall in the Morgan Array Area ZoI following refinement to the Morgan Array Area post-PEIR) (sampling (Figure 1.5). The Morgan Array Area and ZoI 2022 sample locations were proposed based upon publicly available data prior to any survey acquisition such as EMODnet data (Figure 1.2) to ensure sample stations were spread across a variety of habitats. Detailed geophysical data was reviewed during the field acquisition to refine the final sampling), to ensure adequate data coverage for both infaunal and epifaunal communities at each location. During the 2022 subtidal survey 52 grab samples were collected using a 0.1 m^2 mini-Hamon grab from 26 sample stations within the Morgan Array Area and ZoI (Figure 1.5).

1.7.1.6 Macrofaunal, particle size and eDNA (see Appendix H) samples were collected from all stations. Samples for chemical analysis were collected at 11 stations within the Morgan Array Area in the 2021 surveys (noting that six of these stations now fall in the Morgan Array Area ZoI following refinement to the Morgan Array Area post-PEIR) and

13 samples for chemical analysis were collected in the Morgan Array Area and ZoI in the 2022 surveys (of the 2022 sediment chemistry sample stations two were resampled stations which were also sampled in 2021).

1.7.1.7 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 (<2 cm 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 l 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
- Two separate grab samples from each station were collected for infaunal macroinvertebrate identification. Each faunal sample was washed with seawater and transferred to a 0.5 mm sieve, and 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 50 ml cores were taken to a depth of 5 cm. If this sediment was homogenised, a sample of approximately 40 g in 2021 and >30 g in 2022 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^{o}C prior to analysis.

Drop down video

1.7.1.8 All stations sampled by grab in the Morgan benthic subtidal ecology study area in the 2021 and 2022 surveys were also surveyed with DDV. In the 2021 survey a minimum of 70 seabed photographs and 27 minutes of footage collected at each station at appropriate intervals including stations which had two attempts. In the 2022 survey a minimum of 22 seabed photographs and 12 minutes of footage were collected at each station at intervals of 10 to 15 seconds, including stations which had multiple attempts. In the 2021 and 2022 surveys 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 video camera. Initially the survey was conducted with the C-Tecnics CT3022 camera system though this encountered a timing issue with its flash gun in the 2021 survey and the pictures were found to be out of focus in the 2022 survey so was swapped to the back-up Kongsberg OE14- 208 system after completion of the first sample stations.

1.7.1.9 In the 2021 survey a total of 9,216 photos were taken using the stills camera system across 97 stations. All of the photographs were taken less than 64 m from the target location. On average, photographs were taken 29 m (±14 standard deviation (SD) from their target locations. For the 2022 survey a total of 5,191 photos were taken using the stills camera system across 108 stations of which 26 where within the Morgan benthic subtidal ecology study area.

1.7.1.10 In the 2021 survey a further seven sample stations ENV72, ENV73 and ENV90 to ENV94 were added to the 28 original locations within the Morgan Array Area and ZoI 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. No additional stations were added in the 2022 survey campaign.

1.7.1.11 The camera investigations were in line with the epibiota monitoring operational and interpretation guidelines (Hitchin *et al*., 2015; Turner *et al*., 2016). 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

1.7.1.12 During the 2021 survey campaign 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.

1.7.1.13 In the 2021 survey campaign 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.

1.7.1.14 In the 2021 survey campaign 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 seven sample stations (ENV72, ENV73 and ENV90 to ENV94) were proposed to be added to the 28 original locations within the Morgan Array Area and ZoI 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.

1.7.1.15 In the 2021 survey four sample stations were sampled by DDV only (ENV72, ENV73, ENV76 and ENV79). These stations were DDV only because they were located in areas with potential stony features which would have been unsuitable for grab sampling or were identified as having potentially sensitive features, including stony reef and herring spawning habitat and which would have been damaged by grab sampling.

1.7.1.16 No adjustments or limitations were noted regarding sampling for the 2022 subtidal survey campaign.

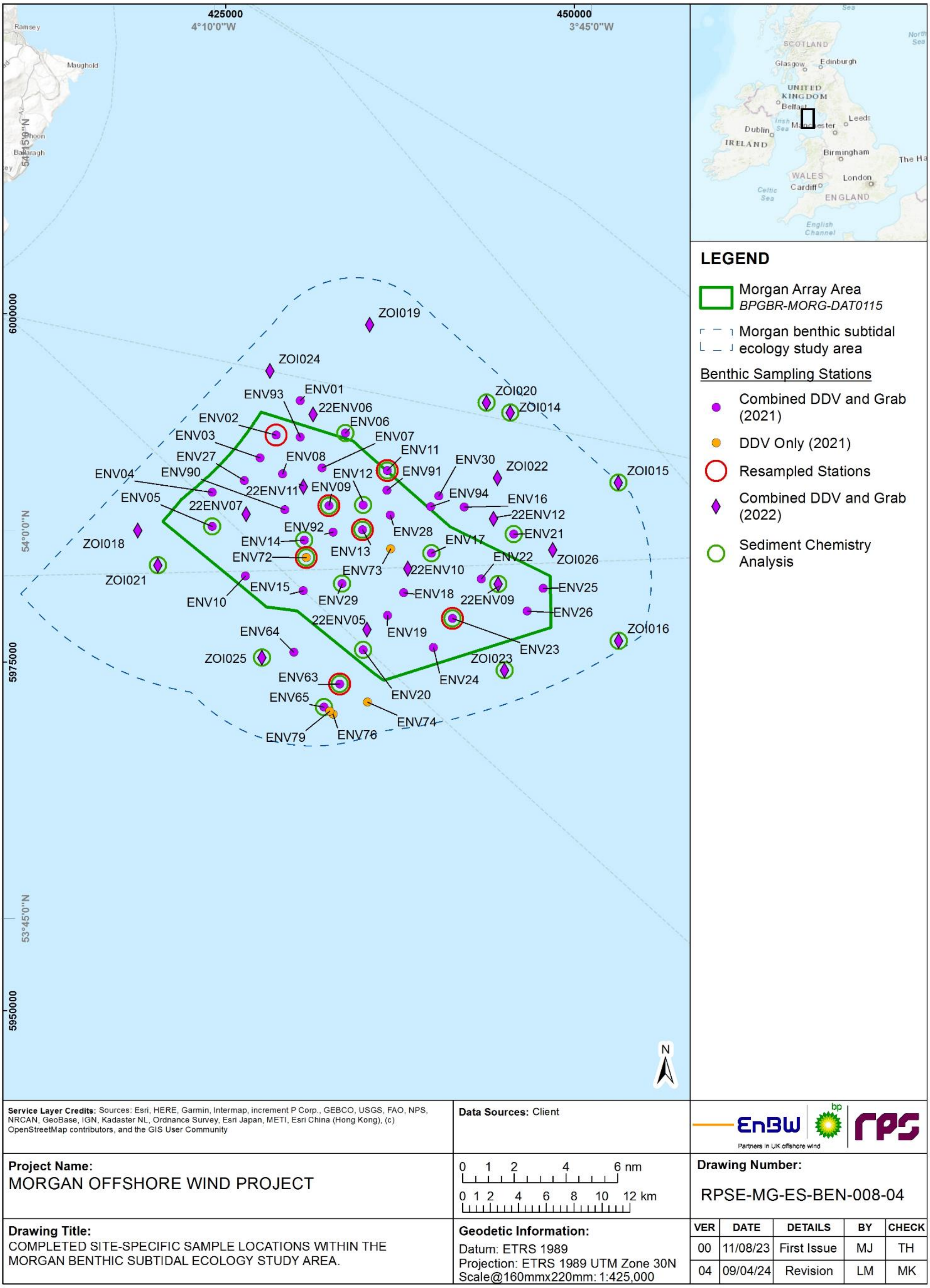


Figure 1.5: Completed site-specific sample locations within the Morgan benthic subtidal ecology study area.

Sample analysis

Benthic infaunal analysis

1.7.1.17 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 0.5 mm 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). The benthic macrofaunal identification was undertaken by Thomson Ecology to NMBAQC processing guidelines (Worsfold and Hall, 2010).

1.7.1.18 Additionally, eDNA samples were taken from two grabs at each sampling location where possible (see Appendix I). If the sediment was undisturbed, two 50 ml cores were taken to a depth of 5 cm. If this sediment was homogenised, a sample of approximately 40 g 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. DNA analysis was undertaken by NatureMetrics.

Sediment characteristic analysis

1.7.1.19 PSA was carried out by Kenneth Pye Associates Ltd. and Ocean Ecology (both MMO validated laboratories), in accordance with 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 63 mm to <1 µm and were all assigned to a Wentworth classification (Wentworth, 1922). 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

1.7.1.20 As part of the subtidal survey, sediment samples were taken for the purpose of sediment chemistry analysis (Figure 1.5). Sediment chemistry stations were selected with consideration of the likely sediments, predicted habitats and previous survey locations, along with observed bathymetric features. Sediment hydrocarbon, metals, total organic carbon (TOC), organotins and PCB analyses were carried out by SOCOTEC UK. 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

- PCBs
- Organotins
- PAHs.

Data analysis

Sediment characterisation analysis

1.7.1.21 The PSA data were categorised using the Folk classification which groups particles into mud, sand and gravel (mud 2 mm) 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

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

1.7.1.23 Sediment chemistry data were also compared to the Canadian Sediment Quality Guidelines (CSQG) (CCME, 2001). These thresholds give an indication on the degree of contamination and the likely impact on marine ecology. For each contaminant, the guidelines provide a Canadian TEL, which is the minimal effect range at which adverse effects rarely occur and a Canadian PEL, which is the probable effect range within which adverse effects frequently occur. For PAHs the best estimates of the potential toxicity of in marine sediments are ERL and ERM concentrations for total low molecular weight, total high molecular weight and total PAHs (Neff, 2004).

Macrofaunal analysis

1.7.1.24 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).

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

1.7.1.26 Macrofauna was defined as organisms that are normally larger that the mesh size of the sieve used to separate them from the sediment. 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 0.5 mm or less was used to separate organisms from sediments; otherwise, these organisms were noted to be present, but not enumerated.

1.7.1.27 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. 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

1.7.1.28 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.

1.7.1.29 Juveniles of some species were recorded in the raw infaunal data including species such as *Aphroditidae, Liocarcinus, Solecurtidae, Mytilidae, Asteroidea, Echinoidea, Dendrochirotida, Ophiuroidea, Spatangoida*, *Pisidia longicornis*, *Corystes cassivelaunus*, *Lucinoma borealis* and *Sthenelais boa*. Juveniles were however excluded from the multivariate analysis as they represented a very minor fraction of the infaunal taxon and abundance for the 2021 survey data. Juveniles were left in for the analysis of the 2022 Morgan Array Area ZoI data as a RELATE test found they did not skew the data.

1.7.1.30 All fish species were removed prior to analysis and discussed separately and within Volume 4, Annex 3.1: Fish and shellfish ecology technical report of the Environmental Statement.

1.7.1.31 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.

1.7.1.32 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. The full data is available on request.

Univariate analysis

1.7.1.33 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.

1.7.1.34 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 (wet 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

1.7.1.35 The benthic infaunal grab data and combined DDV and grab epifaunal data were analysed using the PRIMER v7 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. The Morgan Array Area ZoI data has been incorporated and analysed together with the Morgan Array Area data as well as the Mona Array Area dataset to provide a comprehensive characterisation (and updated characterisation since the PEIR) of the Morgan benthic subtidal ecology study area.

1.7.1.36 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.

1.7.1.37 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).

1.7.1.38 CLUSTER analysis and ANOSIM test were conducted on a merged dataset of the 2021 and 2022 Morgan Array Area data including the resampled stations to determine how similar the two datasets were and if there had been any change in community between the survey dates.

Biotope allocation

1.7.1.39 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 preliminary infaunal and epifaunal biotopes were plotted over the results of the geophysical surveys (see section 1.7.2) for the Morgan subtidal ecology study area. The geophysical data (i.e. sediment classification and seabed features) were used to map the distribution, extent and boundaries of each biotope resulting in the generation of preliminary infaunal and epifaunal biotope maps. The infaunal and epifaunal biotope allocations were combined to provide a final combined biotope map.

Habitat analyses

Seapens and burrowing megafauna communities assessment

1.7.1.40 The seapens and burrowing megafauna habitat is described by OSPAR as 'Plains of fine mud, at water depths ranging from 15 to 200 m 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*'.

1.7.1.41 Guidance by the JNCC (2014) 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, 2014).

1.7.1.42 The clarifications (JNCC, 2014) 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 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.

1.7.1.43 The JNCC (2014) guidance also states that the habitat occurs predominantly in fine mud sediments. However, some examples of this habitat have been identified in areas of sandy muds. As such, where there is clear evidence of the relevant biological assemblages (burrowing megafauna and in some examples, sea-pens), such habitats can be classified as 'Sea-pen and burrowing megafauna communities' regardless of the grain size composition of the sediment (JNCC, 2014).

1.7.1.44 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 are not necessarily definitive of the habitats condition.

Annex I stony reef assessment

1.7.1.45 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 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	<0.064 mm	0.064-<5 m	≥5 m
Extent	≤25 m^2	>25 m^2	>25 m^2	>25 m^2
Biota	Dominated by infaunal species			>80% of species present composed of epifaunal species

1.7.1.46 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*. (2015), which is considered in line with Golding *et al*. (2020) recommendations as part of assessing the composition of stony reefs in Table 1.5.

1.7.1.47 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.

Fragile sponge and anthozoan communities on rocky habitats assessment

1.7.1.48 Recent attempts to formally quantify a threshold as to what density of sponges define a deep-sea sponge habitat have been made by the DNV (2013) and the JNCC (Henry and Roberts, 2014). The DNV approach is based upon assessment of the percentage cover of sponges in each image. Only images with >10% sponge cover (High) are thought to constitute an OSPAR deep-sea sponge aggregation (DNV, 2013). This approach is useful as a field guide as to whether an aggregation may occur though is subject to a lot of variation due to differences in camera height above and angle to the seabed.

1.7.1.49 Imagery acquired during the site-specific survey was acquired using a drop-down camera system, therefore it was subjected to wave effects which varied the camera height above the seabed which may have altered the still imagery field of view. Consequently, any determination of habitats by this approach should be considered as a coarse indication of the habitat's presence.

1.7.1.50 Further, evidence of the species communities being present that are listed in biotopes that constitute 'fragile sponge and anthozoan communities on rocky habitats' (MarLIN, 2015) were also assessed to define the habitat.

1.7.2 Results – sediment analysis

Results – sediment characteristics (geophysical survey)

1.7.2.1 Across the Morgan Array Area side scan sonar reflectivity was relatively homogenous. Environmental and geotechnical sampling indicated that seabed sediments predominantly comprised gravelly sand, with varying amounts of associated shell fragments. This aligns with the grab sampling PSA data which showed the Morgan Array Area to be dominated by gravelly muddy sand and gravelly sand (paragraph 1.7.2.4).

1.7.2.2 In the Morgan Array Area, sonar reflectivity in the east of the area was lower, and the ground truthing results showed sediments comprised predominantly shelly sand. Megaripples were present across much of the seabed in this area. Across the central Morgan benthic subtidal ecology study area, sandwaves were present and were associated with an increased gravel content in the sediments. In the west of the Morgan Array Area, an increased sonar reflectivity resulted from an increased gravel content.

1.7.2.3 Geophysical surveys were not conducted throughout the Morgan Array Area ZoI however surveys for the Transmission Assets crossed some of the north, south and east of the Morgan Array Area ZoI (Morecambe Offshore Windfarm Ltd and Morgan Offshore Wind Ltd, 2023). These surveys found the seabed typically undulated with gradients <2°, with steeper gradients associated with outcrops of the underlying geology in the northeast of the Morgan Array Area ZoI. Sand ripples were present at seabed over the majority of the Transmission Assets including within the Morgan Array Area ZoI, with patches of featureless seabed. The seabed sediments in areas of sand ripples were generally characterised as clayey sand, with patches of slightly gravelly clayey sand in areas of subcrop. Where the seabed was featureless sediments were composed of clayey sand in the north of the Morgan Array Area ZoI and slightly gravelly clayey sand in the south of the Morgan Array Area ZoI.

Results – physical sediment characteristics (PSA)

1.7.2.4 The subtidal benthic sediments across the Morgan Array Area within 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 the majority of the samples in the Morgan Array Area classified as gravelly muddy sand or gravelly sand (Figure 1.6). Across the Morgan Array Area ZoI sediments ranged from muddy sandy gravel to gravelly muddy sand, with the majority of samples classified as sand. Of all the samples in the Morgan benthic subtidal ecology study area, the majority were classified as gravelly sand (36.51%), gravelly muddy sand (30.16%) and sand (19.05%), representing the three most common sediment types through-out the Morgan benthic subtidal ecology study area. The sediments in the west of the Morgan Array Area were typically gravelly muddy sands and muddy sandy gravels which graded into to gravelly sands in the centre of the Morgan Array Area and then muddy sands and sands in the east of the Morgan Array Area ZoI. These findings are consistent with the results of the geophysical surveys which identified an increased gravel content in the west and sand based sediment with a notable clay content in the east (see paragraphs 1.7.2.2 and 1.7.2.3). 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.

1.7.2.5 The percentage sediment composition (i.e. mud ≤0.63 mm; sand <2 mm; gravel ≥2 mm) at each grab sample station in the Morgan benthic subtidal ecology study area is presented in Figure 1.7 and Appendix A. Across all sample stations in the Morgan benthic subtidal ecology study area, the average percentage sediment composition was 12.52% gravel, 79.53% sand and 7.95% mud. The average composition of sediment across Morgan benthic subtidal ecology study area were very similar. Across the Morgan benthic subtidal ecology study 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 and particularly the southwest of the Morgan Array Area ZoI. These findings are consistent with the results of the geophysical surveys which also identified coarse sediments in the west and fine sediments predominantly in the east (paragraph 1.7.2.2). The sample stations with the highest percentage composition of mud were generally found along the central and west section of the Morgan Array Area and the northeast of the Morgan Array Area ZoI (Figure 1.6).

1.7.2.6 Sediments across the Morgan benthic subtidal ecology study area were typically poorly sorted or very poorly sorted, and a small number of samples were classified as moderately sorted. Two sample stations in the Morgan Array Area ZoI (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). One sample in the Morgan Array Area ZoI (ZOI021) was classified as extremely poorly sorted, this station was classified as muddy sandy gravel with 32.06% gravel, 53.55% sand and 14.39% mud (Figure 1.7 and Appendix A).

Comparison between Morgan Array Area 2021 and 2022 survey

1.7.2.7 In the 2022 site-specific surveys seven sample stations which had been sampled in the 2021 site-specific survey were resampled (Figure 1.5) (resampling was undertaken to enable comparison between years and to determine if there had been any temporal changes in the communities present within the Morgan benthic subtidal ecology study area). Additionally, five new sample stations were added to the Morgan Array Area for the 2022 site specific survey (Figure 1.5) (further sample stations were added to the Morgan Array Area in the 2022 site specific survey to capture any temporal changes in community type).

1.7.2.8 Of the resampled stations one sample station had the same Folk modified sediment classification as was assigned from the 2021 analysis, the other samples only showed minor variation in their classification from 2021 to 2022 (e.g. changing from gravelly muddy sand to gravelly sand). All the sediments were sand based, as they was observed in the 2021 survey.

1.7.2.9 The Folk modified sediment classifications for the new sample stations in the Morgan Array Area did not result in the identification of any new sediment classifications beyond what was identified in 2021. The sediments identified were all sand based and the majority were classified as gravelly sands which was prevalent in the Morgan Array Area in the 2021 site specific survey.

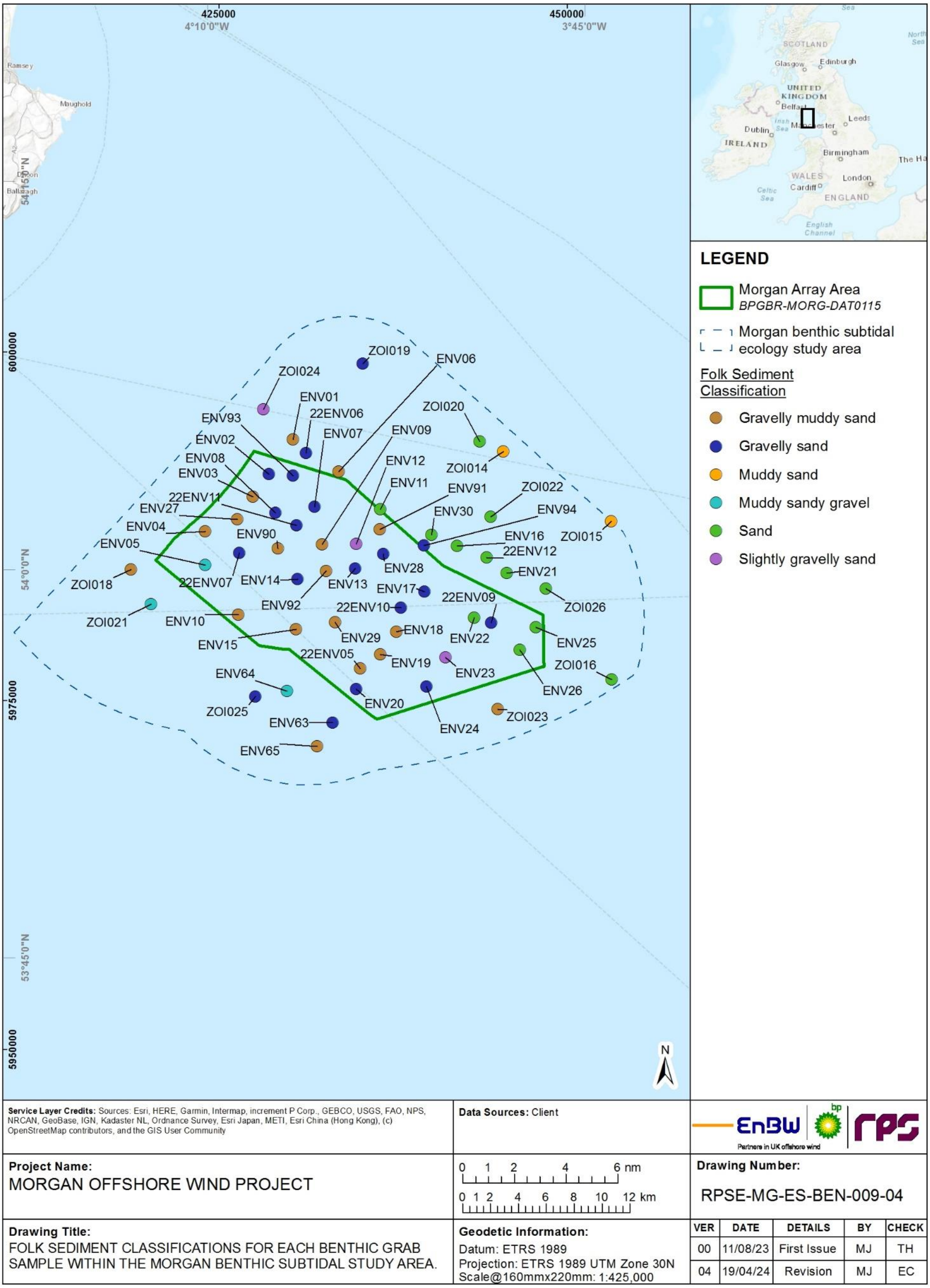
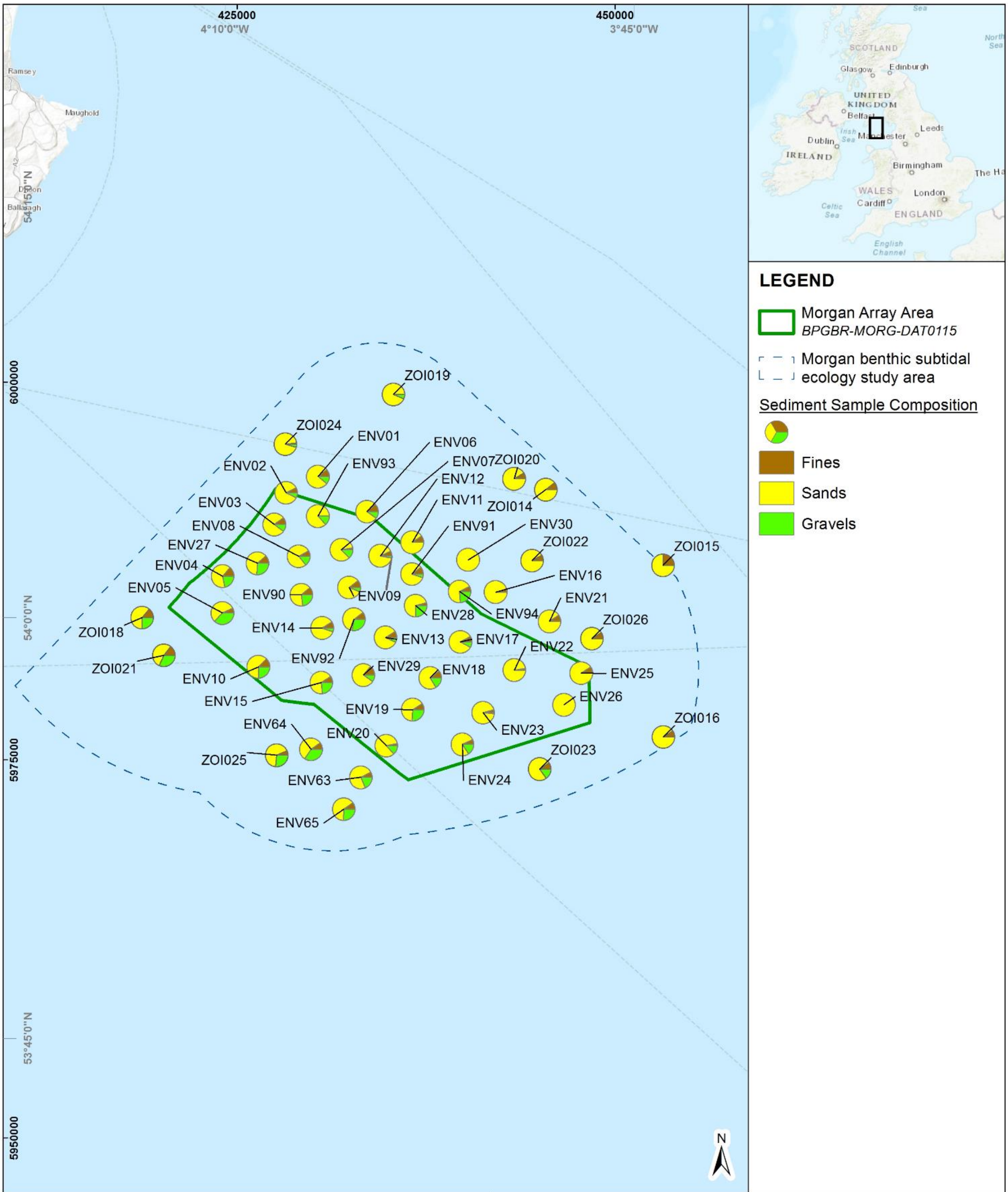


Figure 1.6: Folk sediment classifications for each benthic grab sample within the Morgan benthic subtidal study area.



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

Data Sources: Client

Partners in UK offshore wind

Project Name:
MORGAN OFFSHORE WIND PROJECT

0 1 2 4 6 nm
0 1 2 4 6 8 10 12 km

Drawing Number:
RPSE-MG-ES-BEN-010-03

Drawing Title:
SEDIMENT COMPOSITION (FROM PSA) AT EACH BENTHIC GRAB SAMPLE LOCATION WITHIN THE MORGAN BENTHIC SUBTIDAL STUDY AREA.

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:425,000

VER	DATE	DETAILS	BY	CHECK
00	11/08/23	First Issue	MJ	TH
03	09/04/24	Revision	LM	MK

Figure 1.7: Sediment composition (from PSA) at each benthic grab sample location within the Morgan benthic subtidal study area.

Results - Sediment contamination

Metals

1.7.2.10 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.

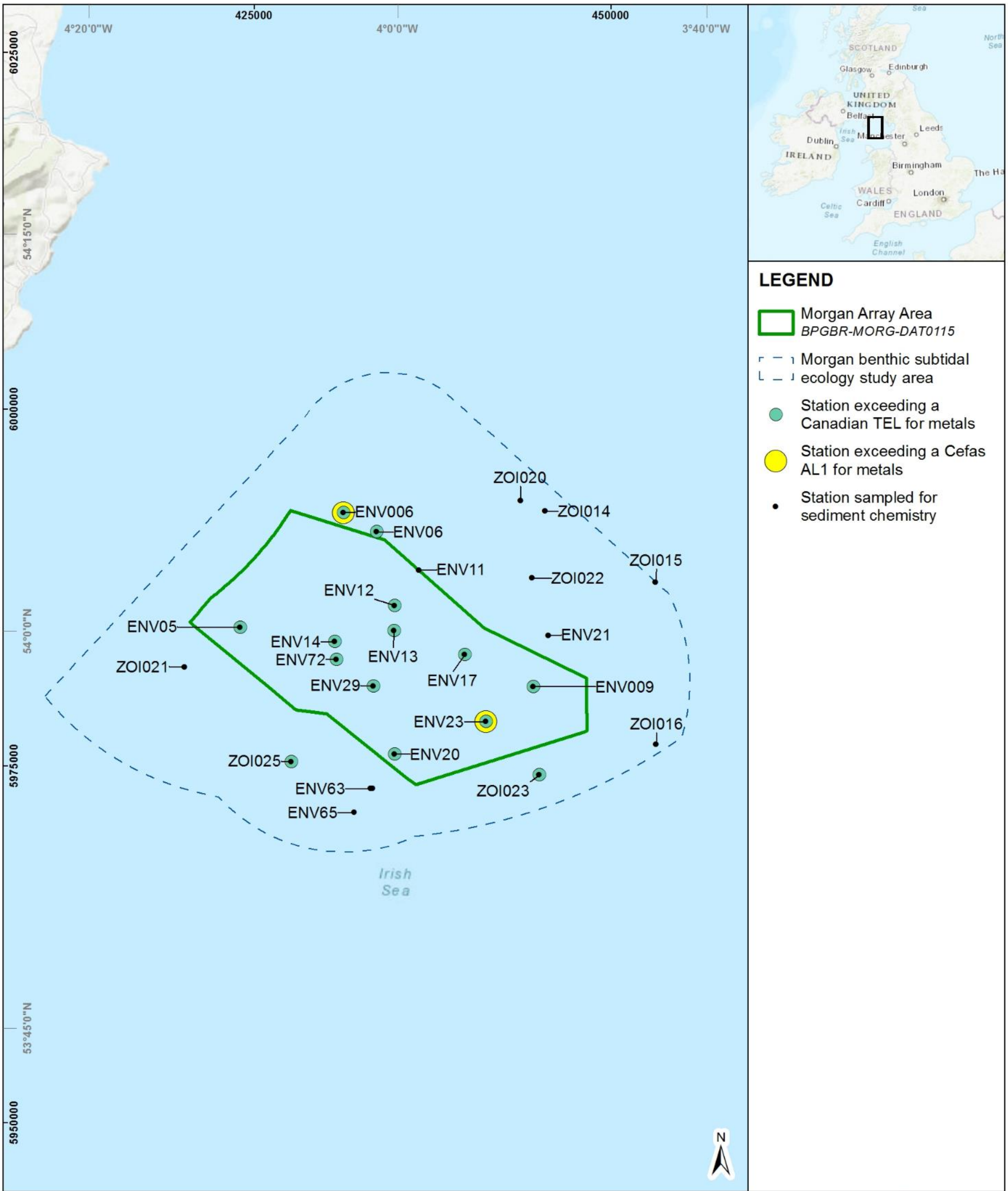
1.7.2.11 Table 1.6 presents the levels of metals that were recorded in the sediment samples collected from 11 stations in the Morgan Array Area and the 13 stations within the Morgan Array Area ZoI. The results showed that, on the whole, levels of metal contamination were very low across the Morgan subtidal ecology study area and, with a few exceptions which are discussed below, were below the relevant Cefas ALs and Canadian thresholds.

1.7.2.12 The sediment chemistry results for the Morgan benthic subtidal ecology study area, presented in Table 1.6, show that levels of cadmium, chromium, copper, nickel, lead, mercury and zinc did not exceed the relevant Cefas AL1 or the Canadian TEL in any of the samples.

1.7.2.13 Concentrations of arsenic marginally exceeded the Cefas AL1 (20 mg/kg) at one station in the Morgan Array Area (ENV23) and two stations in the Morgan Array Area ZoI (22ENV06 and ENV65) (Figure 1.8) but were well below the Cefas AL2 (Figure 1.8). Within the Morgan Array Area 10 sample stations exceeded the Canadian TEL for arsenic, as did seven sample stations in the Morgan Array Area ZoI however all were below the Canadian PEL.

Comparison of Morgan Array Area 2021 and 2022 data

1.7.2.14 Two stations from the 2021 survey were resampled for sediment chemistry in the 2022 survey (ENV13 and ENV63) (Figure 1.8). The results of the 2022 survey identified only minimal changes from 2021 to 2022. At station ENV13 in the Morgan Array Area there was a small increase in the concentrations of all metals except for mercury which decreased slightly (Figure 1.8). At sample station ENV63 in the Morgan Array Area ZoI, changes were again minimal between 2021 and 2022 with six metals increasing in concentration and two decreasing. None of these changes in concentration led to any metals exceeding their relevant thresholds apart from arsenic which remains over the Canadian TEL but below the Cefas AL1 at this station.



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

Data Sources: Client,

Project Name: MORGAN OFFSHORE WIND PROJECT

0 1 2 4 6 nm
0 1 2 4 6 8 10 12 km

Drawing Number: RPSE-MG-ES-BEN-013-02

Drawing Title: STATIONS SAMPLED FOR SEDIMENT CHEMISTRY WITHIN THE MORGAN BENTHIC SUBTIDAL ECOLOGY STUDY AREA AND STATIONS AT WHICH A CONTAMINANT EXCEEDED THE CEFAS AL1 AND/OR CANADIAN TEL.

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:450,000

VER	DATE	DETAILS	BY	CHECK
00	30/08/23	First Issue	NA	TH
02	16/10/23	Revision	MJ	TH

Figure 1.8: Stations sampled for sediment chemistry within the Morgan benthic subtidal ecology study area and stations at which a contaminant exceeded the Cefas AL1 and/or Canadian TEL.

Table 1.6: Concentrations of metals recorded in sediments within the Morgan benthic subtidal ecology study area[1].

Stations and thresholds	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
Threshold: Cefas AL1 (mg/kg)	20	0.4	40	40	50	0.3	20	130
Threshold: Cefas AL2 (mg/kg)	100	5	400	400	500	3	200	800
Threshold: Canadian TEL (mg/kg)	7.24	0.7	52.3	18.7	30.2	0.13	N/A	124
Threshold: Canadian PEL (mg/kg)	41.6	4.2	160	108	112	0.7	-	271
Morgan Array Area								
2021 stations and resampled stations								
ENV05	11.4	0.10	17.3	7.3	10.9	0.05	14.1	29.5
ENV12	12.5	0.04	7.9	4.7	10.4	0.05	6.8	18.5
ENV13	11.8 (2021) 15.2 (2022)	0.05 (2021) 0.07 (2022)	8.2 (2021) 12.5 (2022)	5.0 (2021) 6.6 (2022)	11.1 (2021) 14.4 (2022)	0.04 (2021) 0.02 (2022)	7.3 (2021) 11.1 (2022)	21.5 (2021) 31.4 (2022)
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
ENV29	13.3	0.08	10.9	5.7	15.3	0.06	9.5	25.6
2022 stations								
ENV11	5.1	0.16	6.6	7.2	6.5	0.04	5.2	34.7
ENV23	27.5	0.07	9.3	5.7	15.5	0.01	8.8	28.8
ENV72	17.5	0.07	12.0	6.6	9.3	0.01	13.6	23.8
22ENV09	16.4	0.07	14.3	7.3	10.0	0.02	10.8	29.8
Morgan Array Area ZoI								
2021 stations								
ENV06	14.1	0.06	10.0	5.9	14.5	0.05	8.6	28.7
ENV21	5.3	0.04	7.4	4.3	8.1	0.06	5.3	21.0

[1] Where contaminant levels exceed the relevant thresholds, the cells are shaded with the relevant colours (i.e. samples that exceed Cefas AL1 are coloured yellow, samples that exceed Cefas AL2 are coloured red, samples that exceed Canadian TEL are coloured turquoise and samples that exceed Canadian PEL are coloured purple. Where a sample exceeds two thresholds the higher threshold has been used to determine the colour).

Stations and thresholds	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
ENV63	9.9 (2021) 12.0 (2022)	0.05 (2021) 0.07 (2022)	9.4 (2021) 10.1 (2022)	6.3 (2021) 6.8 (2022)	10.0 (2021 12.0 (2022)	0.07 (2021) 0.01 (2022)	8.3 (2021) 8.6 (2022)	27.2 (2021) 27.0 (2022)
ENV65	20.2	0.08	11.4	5.6	10.6	0.05	10.3	31.4
2022 stations								
22ENV06	23.5	0.08	14.8	7.9	13.7	0.02	13.9	30.6
ZOI14	4.3	0.05	10.0	7.1	9.2	0.03	9.2	28.0
ZOI15	4.3	0.10	13.8	8.3	13.3	0.07	13.3	40.8
ZOI16	5.3	0.04	7.9	5.9	8.7	0.02	8.7	27.6
ZOI20	6.1	0.05	8.1	5.4	9.7	0.04	9.7	39.5
ZOI21	7.1	0.08	13.7	7.4	9.0	0.01	9.0	31.0
ZOI22	5.3	<0.04	8.8	6.1	8.1	<0.01	8.1	24.5
ZOI23	10.9	0.04	10.8	6.3	12.6	<0.01	12.6	28.4
ZOI25	12.7	<0.04	15.3	7.1	9.4	<0.01	9.4	30.4

Organotins

1.7.2.15 Organotins are a large class of organometallic compounds which contain tin-carbon bonds. They are also an important environmental contaminant associated with agricultural, industrial and biomedical activities (Okoro *et al*., 2014). Organotins are toxic to many marine organisms even at very low concentrations. High concentrations can cause shell deformities in oysters and impair reproduction (Alzieu *et al*., 1982).

1.7.2.16 The 2021 site specific survey found organotin concentrations across the Morgan benthic subtidal ecology study area were below LOD at all stations surveyed.

1.7.2.17 The 2022 site specific survey found organotin concentrations across the Morgan benthic subtidal ecology study area were below LOD at all stations surveyed.

Polychlorinated biphenyls (PCBs)

1.7.2.18 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.

1.7.2.19 Table 1.7 presents the total PCBs and the total of the ICES-7 PCBs that were recorded in the sediment samples collected from 11 stations in the Morgan Array Area and the 13 stations within the Morgan Array Area ZoI. The full results for the individual PCBs are presented in Appendix F.

1.7.2.20 The results show that levels of PCBs were typically recorded below the LOD across the Morgan benthic subtidal ecology study area with the exception of two stations (ENV05 and ZOI15) (Figure 1.8). The levels of the total ICES-7 PCBs were however below the relevant Cefas AL1 (0.01 mg/kg) at these stations and levels of total PCBs were also below the Cefas AL1 (0.02 mg/kg) and Cefas AL2 (0.2 mg/kg) as shown in Table 1.7.

Comparison between Morgan Array Area 2021 and 2022 survey

1.7.2.21 Two stations from the 2021 survey were resampled for sediment chemistry in the 2022 survey (ENV13 and ENV63) (Figure 1.8). There was no change in the levels of PCBs between 2021 and 2022 with the concentration being below the LOD in both years at both sample stations (Table 1.7).

Table 1.7: Concentrations of total PCBs and ICES-7 PCBs in sediments within the Morgan benthic subtidal ecology study area[2].

Stations and thresholds	Total PCBs	Total ICES-7 PCBs
Units	mg/kg	mg/kg
Threshold: Cefas AL1 (mg/kg)	0.02	0.01
Threshold: Cefas AL2 (mg/kg)	0.2	N/A
Threshold: Canadian TEL (mg/kg)	21.5	N/A
Threshold: Canadian PEL (mg/kg)	189	N/A
Morgan Array Area		
2021 stations and resampled stations		
ENV05	0.00439	0.00195
ENV12	Not Quantifiable (NQ)	NQ
ENV13	NQ (2021) NQ (2022)	NQ (2021) NQ (2022)
ENV14	NQ	NQ
ENV17	NQ	NQ
ENV20	NQ	NQ
ENV29	NQ	NQ
2022 stations		
ENV11	NQ	NQ
ENV23	NQ	NQ
ENV72	NQ	NQ
22ENV09	NQ	NQ
Morgan Array Area ZoI		
2021 stations		

[2] Where contaminant levels exceed the relevant thresholds, the cells are shaded with the relevant colours (i.e. samples that exceed Cefas AL1 are coloured yellow, samples that exceed Cefas AL2 are coloured red, samples that exceed Canadian TEL are coloured turquoise and samples that exceed Canadian PEL are coloured purple. Where a sample exceeds two thresholds the higher threshold has been used to determine the colour).

Stations and thresholds	Total PCBs	Total ICES-7 PCBs
ENV06	NQ	NQ
ENV21	0.1	NQ
ENV63	NQ (2021) NQ (2022)	NQ (2022) NQ (2022)
ENV65	NQ	NQ
2022 stations		
22ENV06	NQ	NQ
ZOI14	NQ	NQ
ZOI15	0.00049	0.00037
ZOI16	NQ	NQ
ZOI20	NQ	NQ
ZOI21	NQ	NQ
ZOI22	NQ	NQ
ZOI23	NQ	NQ
ZOI25	NQ	NQ

Polycyclic aromatic hydrocarbons (PAHs)

1.7.2.22 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.

1.7.2.23 Table 1.8 presents the concentrations of PAHs that were recorded in the sediment samples collected from the 11 stations in the Morgan Array Area and the 13 stations within the Morgan Array Area ZoI. Table 1.8 presents those PAHs for which a threshold is available with the full results for the individual PAHs, including those without Canadian thresholds, presented in Appendix F.

1.7.2.24 Total PAH concentrations ranged from 60 µg/kg to 363 µg/kg across the Morgan benthic subtidal ecology study area (see Appendix F). Concentrations of all PAHs in samples in the Morgan benthic subtidal ecology study area were below the relevant Canadian TEL (where one is specified). PAH concentrations were also well below their respective ERL values, indicating toxic effects to fauna from PAHs is unlikely.

Comparison between Morgan Array Area 2021 and 2022 survey

1.7.2.25 Two of the sample locations within the Morgan benthic subtidal ecology study area were resampled as a result of the 2022 site specific survey campaign. The results of resampling at ENV13 (Figure 1.8) found that concentrations of eight PAHs had increased, concentrations of two PAHs had remained the same and concentrations of one PAH had decreased. The results of resampling at ENV63 (Figure 1.8) found that concentrations of seven PAHs had increased and concentrations of five PAHs had remained the same. Despite these changes all PAHs remained below their respective Canadian TEL and PEL as well as their respective ERL and ERM.

Table 1.8: Concentrations of PAHs (µg/kg) in sediments within the Morgan benthic subtidal ecology study area[3].

	Acenaphthene (µg/kg)	Acenaphthylene (µg/kg)	Anthracene (µg/kg)	Benzo[a]anthracene (µg/kg)	Benzo[a]pyrene (µg/kg)	Chrysene (µg/kg)	Dibenzo[ah]anthracene (µg/kg)	Fluoranthene (µg/kg)	Fluorene (µg/kg)	Naphthalene (µg/kg)	Phenanthrene (µg/kg)	Pyrene (µg/kg)
Canadian TEL (µg/kg)	6.71	5.87	46.9	74.8	88.8	108	6.22	113	21.2	34.6	86.7	153
Threshold: Canadian PEL (µg/kg)	88.9	128	245	693	763	846	135	1,494	144	391	544	1,398
Threshold: ERL (µg/kg)	16	44	85.3	261	430	384	63.4	600	19	160	240	665
Threshold: ERM (µg/kg)	500	640	110	1,600	1,600	2,800	260	5,100	540	2,100	1,500	2,600
Morgan Array Area												
2021 stations and resampled stations												
ENV05	<1	<1	<1	3	3	4	1	4	1	3	5	4
ENV12	<1	<1	<1	2	3	3	1	4	<1	2	3	3

[3] Where contaminant levels exceed the relevant thresholds, the cells are shaded with the relevant colours (i.e. samples that exceed Canadian TEL are coloured turquoise, samples that exceed Canadian PEL are coloured purple, samples that exceed ERL are coloured orange and samples that exceed ERM are coloured pink. Where a sample exceeds two thresholds the higher threshold has been used to determine the colour).

	Acenaphthene (µg/kg)	Acenaphthylene (µg/kg)	Anthracene (µg/kg)	Benzo[a]anthracene (µg/kg)	Benzo[a]pyrene (µg/kg)	Chrysene (µg/kg)	Dibenzo[ah]anthracene (µg/kg)	Fluoranthene (µg/kg)	Fluorene (µg/kg)	Naphthalene (µg/kg)	Phenanthrene (µg/kg)	Pyrene (µg/kg)
ENV13	<1 (2021) <1 (2022)	<1 (2021) <1 (2022)	<1 (2021) 1 (2022)	3 (2021) 5 (2022)	4 (2021) 10 (2022)	4 (2021) 6 (2022)	1 (2021) 2 (2022)	5 (2021) 8 (2022)	<1 (2021) 2 (2022)	3 (2021) 2 (2022)	4 (2021) 8 (2022)	5 (2021) 7 (2022)
ENV14	<1	<1	<1	3	4	5	1	5	1	3	5	5
ENV17	<1	<1	<1	4	5	5	2	6	1	3	6	6
ENV20	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	<1
ENV29	<1	<1	<1	4	5	6	2	7	1	3	7	6
2022 stations												
ENV11	<1	<1	<1	2	3	3	<1	4	<1	1	4	3
ENV23	<1	<1	<1	1	1	1	<1	2	<1	<1	3	2
ENV72	<1	<1	<1	4	4	5	1	6	2	3	7	6
22ENV09	<1	<1	<1	3	5	5	1	6	1	3	6	7
Morgan Array Area ZoI												
2021 stations												
ENV06	<1	<1	<1	3	4	5	2	5	1	3	5	5
ENV21	<1	<1	<1	3	4	4	1	5	<1	2	4	5
ENV63	<1 (2021) <1 (2022)	<1 (2021) <1 (2022)	<1 (2021) <1 (2022)	2 (2021) 3 (2022)	3 (2021) 3 (2022)	3 (2021) 4 (2022)	<1 (2021) 1 (2022)	3 (2021) 5 (2022)	<1 (2021) 1 (2022)	3 (2021) 3 (2022)	4 (2021) 7 (2022)	3 (2021) 5 (2022)
ENV65	<1	<1	<1	2	3	3	<1	4	<1	2	4	3

	Acenaphthene (µg/kg)	Acenaphthylene (µg/kg)	Anthracene (µg/kg)	Benzo[a]anthracene (µg/kg)	Benzo[a]pyrene (µg/kg)	Chrysene (µg/kg)	Dibenzo[ah]anthracene (µg/kg)	Fluoranthene (µg/kg)	Fluorene (µg/kg)	Naphthalene (µg/kg)	Phenanthrene (µg/kg)	Pyrene (µg/kg)
2022 stations												
22ENV06	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
ZOI14	<1	<1	1	4	6	5	2	8	2	3	7	8
ZOI15	2	2	4	14	20	15	5	25	4	7	20	26
ZOI16	<1	<1	<1	3	4	4	1	5	<1	2	4	5
ZOI20	<1	<1	<1	2	3	3	1	4	<1	2	4	4
ZOI21	<1	<1	<1	3	4	4	1	6	1	3	7	6
ZOI22	<1	<1	<1	2	3	3	<1	4	1	2	4	4
ZOI23	<1	<1	<1	3	3	4	<1	5	1	3	8	5
ZOI25	<1	<1	<1	3	3	3	<1	5	1	2	7	4

1.7.3 Results – infaunal analysis

Summary statistics

1.7.3.1 A total of 404 taxa were recorded during the 2021 survey in the Morgan benthic subtidal ecology study area and a total of 355 taxa were recorded during the 2022 surveys campaign in the Morgan benthic subtidal ecology study area. Of these, 155 taxa were colonial or taxa whose abundance could not be enumerated, and therefore were recorded as present in the 2021 survey campaign. In the 2022 site campaign 210 were colonial or taxa whose abundance could not be enumerated. These taxa were removed from the infaunal numerical and statistical analysis but were included in the epifaunal numerical analysis (section 1.7.4).

1.7.3.2 A total of 10,088 individuals representing 470 enumerated taxa were recorded across both site-specific surveys. Of these, juveniles accounted for 358 individuals from 13 taxa representing 3.54% of the total number of individuals and 2.77% 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 3.1: Fish and shellfish ecology technical report of the Environmental Statement.

1.7.3.3 Of the 480 total taxa enumerated from the site-specific survey data, none were observed at all stations. A total of 146 taxa (31.06%) were recorded as single individuals; these rarely recorded taxa were distributed across the Morgan benthic subtidal ecology study area. A total of 367 taxa (78.08%) 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, 2001). 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.

1.7.3.4 Juveniles were recorded from stations across the Morgan benthic subtidal ecology study area from taxa including Mollusca, Echinodermata, Crustacea and Annelida. The five most abundant juvenile taxa were within the Annelida (*Aphroditidae* juveniles and *Sthenelais boa* juveniles) and Echinodermata (*Spatangoida* juveniles, *Ophiuroidea* juveniles and *Dendrochirotida* juveniles). Juveniles of these five taxa made up 84.85% of the total number of juvenile individuals.

1.7.3.5 Sample station ENV10 recorded the highest numbers of juvenile individuals (24; mainly *Ophiuroidea* and *Echinidea*) as well as the highest number of juvenile taxa (8) alongside ENV15. 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.

1.7.3.6 As discussed in paragraph 1.7.3.1, 155 taxa in the 2021 site specific survey and 210 taxa in the 2022 site specific survey 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. Sample station ZOI18 recorded the highest number of colonial/encrusting taxa.

1.7.3.7 Initially the dataset was divided into the five major taxonomic groups: Annelida (Polychaeta), Crustacea, Mollusca, Echinodermata and 'Other'. 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*)
- Seven taxa of Sipuncula (Sipuncula, *Golfingiidae, Golfingia (Golfingia) elongata, Golfingia (Golfingia) vulgaris vulgaris, Nephasoma (Nephasoma) minutum, Thysanocardia procera* 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 Arthropoda (*Pycnogonida*)
- One taxa of Priapulida (*Priapulus caudatus*)
- One taxa of Nemertea (*Nemertea*).

1.7.3.8 The absolute and proportional contributions of these five taxonomic groups to the overall community structure is summarised in Table 1.9 whilst biomass values by gross taxonomic groups are presented in Figure 1.14 and discussed in paragraph 1.7.3.38. The full data is available on request.

Table 1.9: Contribution of gross taxonomic groups recorded in the infaunal grab samples.

Group	Individual Abundance	Proportional Contribution	Taxa Abundance	Proportional Contribution
Annelida	5,418	53.71	222	46.25%
Crustacea	1,649	16.35	112	23.33%
Mollusca	1,544	15.31	95	19.79%
Echinodermata	580	5.75	27	5.63%
Other	897	8.89	24	5.00%
Total	**10,088**	**100.00**	**480**	**100.00**

1.7.3.9 The faunal communities were generally dominated by Annelida (n=5,418) which contributed 53.71% of the total number of individuals followed by Crustacea (n=1,649) and Mollusca (n=1,554) which contributed 16.35% and 15.31% of the total number of individuals respectively. Number of taxa were also dominated by Annelida which contributed 46.25% 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 three sample stations (ZOI15, ZOI22 and ENV17) with proportion ranging from 36.96 to 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. At sample stations ZOI15 and ZOI22 Mollusca made up the highest proportion of individuals accounting for 41.13% and 37.04% of the total individuals respectively.

1.7.3.10 In terms of biomass however Mollusca were dominant, with Mollusca providing the highest proportion of the biomass at 42.86% of sample stations. Annelida contributed the second highest proportion of biomass at the greatest number of sample stations (n=32, 30.36%). Echinodermata contributed the highest proportion of the biomass (97.28%) at the sample station with the highest total biomass (ZOI22). At the highest biomass station the peanut worm (*Nephasoma minutum)* made up the highest proportion of the biomass. The polychaete *N. minutum* can reach up to 1.5 cm in length (Barnes, 2008). The next two highest biomass sample stations (ENV14 and ENV03) 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*).

1.7.3.11 The most abundant individuals generally belonged to Annelida with the polychaete *Scalibregma inflatum* being overall the most abundant species with a total of 936 individuals recorded. These individuals were distributed throughout the Morgan benthic subtidal ecology study area with no one sample station skewing the abundance. The highest abundance of *S. inflatum* occurred at sample station 22ENV09 in the east of the Morgan Array Area.

1.7.3.12 The species with the second highest abundance was the polychaete *Poecilochaetus serpens* with 424 individuals. These individuals were distributed throughout the Morgan benthic subtidal ecology study area with no one sample station skewing the abundance. The highest abundance of *P. serpens* occurred at sample station ENV94 in the area surveyed in the north of the Morgan Array Area ZoI. Sample station ZOI25, in the southwest of the Morgan Array Area ZoI, recorded the highest total number of individuals (333) across only 99 taxa. Sample station ZOI25 recorded the highest number of taxa (99) with the next highest being sample stations 22ENV06 (90 taxa) and ENV65 (80 taxa), both of which can be found in the south of the Morgan Array Area ZoI.

Multivariate community analysis

1.7.3.13 The results of the CLUSTER analysis, 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.

1.7.3.14 The results of the hierarchical clusters analysis of the square root transformed infaunal dataset (excluding juveniles) together with the SIMPROF test identified 33 faunal groups that were statistically dissimilar, based on the SIMPROF test. Of these faunal groups, 12 were represented by a single outlier sample station (Figure 1.9 and Table 1.10). The 2D MDS plot is presented in Figure 1.10 and the low stress value (0.18) 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.

1.7.3.15 Based on the multivariate analysis of the 2021 and 2022 site-specific data Faunal group A showed the lowest Bray-Curtis similarity of 21.08%, while Faunal group S showed the highest Bray-Curtis similarity (58.04%), of all Faunal groups that contained more than one sample station. Faunal groups S and F showed the lowest Bray-Curtis dissimilarity (50.65%).

1.7.3.16 Samples within the south and west of the Morgan Array Area, as well as those in the southwest of the Morgan Array Area ZoI extending along the west and north edge of the Morgan Array Area, within the Morgan benthic subtidal ecology study area clustered together in Faunal groups E, AB, AC, AD, AF and AG as well as some stations being in Faunal groups M and U. This cluster also included a sample station in the centre of the Morgan Array Area in Faunal group U. 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 E, AB, AC, AD, AF and AG as well as some stations in Faunal groups M and U were assigned the polychaete-rich deep *Venus* community in offshore mixed sediments (SS.SMx.OMx.PoVen) biotope (Figure 1.11).

1.7.3.17 In the north and centre of the Morgan Array Area and north of the Morgan Array Area ZoI, samples within the Faunal groups F and R as well as some stations in Faunal groups A, E and G 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 1.10). Samples within these Faunal groups were assigned the 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 in the Mona Array Area ZoI 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 1.11).

1.7.3.18 In the centre of the Morgan Array Area, one station in Faunal group I was found to be on sandwave crests which were composed of mixed sediments and characterised by a variety of bivalves and polychaetes such as *Leptochiton asellus* as well as Nemertea. As a result one station in Faunal group I 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 1.11).

1.7.3.19 The sediments along north boundary and east side of the Morgan benthic subtidal ecology study area were characterised by samples in Faunal groups K and N as well as some stations in Faunal group M. The sediments in this section of the Morgan benthic subtidal ecology study area were characterised by sand and muddy sands. The communities in these faunal groups were also characterised by polychaetes and bivalves but included species which are adapted to sandy habitats. Based on the distinct nature of the faunal community and the sediment type these Faunal groups were allocated the SS.SMu.CSaMu.LkorPpel biotope.

1.7.3.20 The one sample station within Faunal group H (ZOI21) was in the southwest of the Morgan Array Area ZoI and was characterised by mixed sediments and diverse communities but with a particularly large abundance of *Ophiothrix fragilis,* with 49 individuals identified in the grab sample. Therefore the infaunal community was allocated the SS.SMx.CMx.OphMx biotope. This conclusion is supported by data collected for the Rhiannon Wind Farm (Figure 1.3) (Celtic Array Ltd, 2014) which also identified the SS.SMx.CMx.OphMx biotope in this region of the Morgan Array Area ZoI, however it was identified in combination with *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles (SS.SCS.CCS.PomB) biotope. The SS.SCS.CCS.PomB biotope may not have been identified by surveys in the Morgan benthic subtidal ecology study area due to the highly targeted nature of the sampling in the Morgan Array Area ZoI.

1.7.3.21 Samples clustered within Faunal groups B and C were also associated with sediments sampled to the east and north of the Morgan Array Area ZoI and were characterised by muddy sand sediments and diverse communities with no distinguishable characteristic species associated with any other biotopes identified. The infaunal community was dominated by polychaetes and crustaceans such as *K. bidentata* and *Bathyporeia tenuipes*. As a result Faunal groups B and C were allocated the circalittoral muddy sand (SS.SSa.CMuSa) biotope.

1.7.3.22 Samples in Faunal group D were found in the of northeast of the Morgan Array Area ZoI. These sample stations were characterised by sandy sediments with a notable muddy element. These sample stations were also characterised by a greater number of echinoderms such as *K. bidentata* which resulted in these samples being allocated the biotope SS.SMu.CSaMu.AfilKurAnit.

1.7.3.23 The Faunal groups J and AE and a sample station in Faunal group AD had finer sediments and were characterised by a greater number of echinoderms such as *Echinocyamus pusillus* as well as the bivalve *Abra* which resulted in these samples being allocated the biotope SS.SSa.CFiSa.EpusOborApri. This conclusion is supported by data collected for the Rhiannon Wind Farm (Figure 1.3) (Celtic Array Ltd, 2014) which identified the broader SS.SSa.CFiSa biotope in the north of the Morgan Array Area ZoI (Figure 1.3).

1.7.3.24 The sediments and infaunal communities within the samples collected in the wider regional benthic subtidal ecology study area to the south of the Morgan benthic subtidal ecology study 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 sample stations in Faunal groups O, S, V, W, X, Y, Z, AA and AB as well as stations in Faunal group U all of which were characterised predominantly as mixed sediment (Table 1.10). 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 1.11).

1.7.3.25 Sediments in samples collected in the wider regional benthic subtidal ecology study area to the south of the Morgan benthic subtidal ecology study area (i.e. within the Mona Array Area) clustered in Faunal groups G and Q 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 in the 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 1.11).

1.7.3.26 The faunal community at a few sample stations within Faunal group T were characterised by the bivalve *K. 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 benthic subtidal ecology study 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.

1.7.3.27 The samples in Faunal group P as well as a station in Faunal group M were also associated with sediments sampled to the south of the Morgan benthic subtidal ecology study 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 P as well as a station in Faunal group M were allocated the SS.SMx.CMx biotope.

1.7.3.28 The Faunal groups identified in the SIMPER analysis were used together with the raw data to assign six preliminary biotopes (Table 1.10; Figure 1.11). Although *S. spinulosa* was recorded in samples in Faunal group H (not in the top 50% of abundant species), abundance was no higher than three at each sample station and no aggregations qualifying as a reef forming structure were recorded in any of the areas surveyed, including within the Morgan Array Area and no *S. spinulosa* reef assessment was required. Full SIMPER analysis results are presented in Appendix C.

Table 1.10: 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	ZOI19	37 to 38	Coarse sediments	*Abra, Scoloplos armiger, Echinocyamus pusillus, Spio, Bivalvia*	SS.SSa.CFiSa.EpusOborApri	Faunal group A showed the highest Bray Curtis dissimilarity with Faunal group H (94.96%) due a lack of common species. Faunal group A showed the lowest Bray Curtis dissimilarity with Faunal group C (79.24%) due to both having species such as *Scalibregma inflatum* and *Kurtiella bidentata*.
	ENV22		Sand and muddy sand		SS.SCS.CCS	
	ENV28		Coarse sediment		SS.SCS.CCS	
B	ZOI16	33 to 42	Sand and muddy sand	*Sthenelais limicola, Tellimya ferruginosa, Kurtiella bidentata, Phoronis, Bathyporeia tenuipes, Nephtys, Pectinariidae*	SS.SSa.CMuSa	Faunal group B showed the highest Bray Curtis dissimilarity with Faunal group G (95.46%) due a lack of common species. Faunal group B showed the lowest Bray Curtis dissimilarity with Faunal group E (75.51%) due to both having species such as *Scalibregma inflatum* and *Pectinariidae*.
	ZOI20		Sand and muddy sand			
	ZOI26		Sand and muddy sand			
C	ZOI22	45	Sand and muddy sand	*Thracioidea, Kurtiella bidentata, Abra, Megaluropus agilis, Bathyporeia tenuipes, Poecilochaetus serpens*	SS.SSa.CMuSa	N/A
D	ZOI14	34 to 58	Sand and muddy sand	*Kurtiella bidentata, Lumbrineris aniara, Pectinariidae, Tellimya ferruginosa, Amphiura filiformis, Sthenelais limicola, Nucula, Echinocardium cordatum*	SS.SMu.CSaMu.AfilKurAnit	Faunal group D showed the highest Bray Curtis dissimilarity with Faunal group G (94.26%) due a lack of common species. Faunal group D showed the lowest Bray Curtis dissimilarity with Faunal group E (66.49%) due to both having species such as *Scalibregma inflatum* and *Scoloplos armiger.*
	ZOI15		Mud and sandy mud			
E	22ENV09	37 to 43	Coarse sediment		SS.SCS.CCS	

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ZOI23		Mixed sediments	*Pectinariidae, Scalibregma inflatum, Kurtiella bidentata, Scoloplos armiger, Pholoe baltica, Pseudopolydora pulchra, Amphiura filiformis, Echinocyamus pusillus, Lumbrineris aniara*	SS.SMx.OMx.PoVen	Faunal group E showed the highest Bray Curtis dissimilarity with Faunal group F (94.81%) due a lack of common species. Faunal group D showed the lowest Bray Curtis dissimilarity with Faunal group E (66.49%) due to both having species such as *Scalibregma inflatum* and *Scoloplos armiger.*
F	ENV07	36 to 38	Coarse sediment	*Syllis, Grania, Goniadidae*	SS.SCS.CCS	N/A
G	ENV43	38 to 48	Coarse sediment	*Pisione remota, Hesionura elongata, Polygordius, Aonides paucibranchiata, Grania, Nemertea*	SS.SCS.CCS	Faunal group G showed the highest Bray Curtis dissimilarity with Faunal group B (95.46%) due a lack of common species. Faunal group G showed the lowest Bray Curtis dissimilarity with Faunal group AD (74.08%) due to both having species such as *Pisione remota* and *Aonides paucibranchiata.*
	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			
H	ZOI21	41 to 42	Mixed sediments	*Polynoidae, Serpulidae, Spirobranchus triqueter, Ericthonius, Anomiidae, Ophiothrix fragilis, Phoronis, Spirobranchus lamarcki*	SS.SMx.CMx.OphMx	N/A

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
I	ENV50	41	Mixed sediment	*Pholoe baltica, Dialychone, Leptochiton asellus, Kurtiella bidentata*	SS.SMx.OMx	N/A
J	22ENV12	35 to 38	Sand and muddy sand	*Scoloplos armiger, Scolelepis bonnieri, Abra alba, Echinocyamus pusillus, Nemertea*	SS.SSa.CFiSa.EpusOborApri	N/A
K	ENV16	34 to 41	Sand and muddy sand	*Spiophanes bombyx, Scoloplos armiger, Lagis koreni, Poecilochaetus serpens, Sthenelais limicola, Amphiuridae*	SS.SMu.CSaMu.LkorPpel	Faunal group K showed the highest Bray Curtis dissimilarity with Faunal group H (95.14%) due a lack of common species. Faunal group K showed the lowest Bray Curtis dissimilarity with Faunal group J (65.93%) due to both having species such as *Lagis koreni* and *Spiophanes bombyx.*
	ENV21		Sand and muddy sand			
	ENV25		Sand and muddy sand			
	ENV26		Sand and muddy sand			
L	ENV09	41 to 42	Mixed sediment	*Lagis koreni, Urothoe marina, Pholoe baltica, Sthenelais limicola, Poecilochaetus serpens, Ampharete lindstroemi agg.*	SS.SMx.OMx	N/A
M	ENV11	35 to 51	Sand and muddy sand	*Poecilochaetus serpens, Lagis koreni, Scalibregma inflatum, Owenia, Scoloplos armiger, Sthenelais limicola*	SS.SMu.CSaMu.LkorPpel	Faunal group M showed the highest Bray Curtis dissimilarity with Faunal group F (91.18%) due a lack of common species. Faunal group M showed the lowest Bray Curtis dissimilarity with Faunal group R (60.05%) due to both having species such as *Poecilochaetus serpens* and *Aoridae.*
	ENV18		Mixed sediment		SS.SMx.CMx	
	ENV23		Mixed sediments		SS.SMx.OMx.PoVen	
	ENV30		Sand and muddy sand		SS.SMu.CSaMu.LkorPpel	
	ENV91		Mixed sediment		SS.SMu.CSaMu.LkorPpel	

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ENV94		Coarse sediment		SS.SMu.CSaMu.LkorPpel	
N	ENV92	38 to 40	Mixed sediment	*Polynoidae, Pholoe inornata, Lumbrineris aniara agg., Scalibregma inflatum, Caulleriella alata, Spirobranchus triqueter, Ophiothrix fragilis*	SS.SMu.CSaMu.LkorPpel	N/A
O	ENV69	41 to 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, Ericthonius punctatus*	SS.SMx.OMx.PoVen	Faunal group O showed the highest Bray Curtis dissimilarity with Faunal group J (92.54%) due a lack of common species. Faunal group O showed the lowest Bray Curtis dissimilarity with Faunal group AC (66.39%) due to both having species such as *Scalibregma inflatum* and *Ericthonius punctatus.*
	ENV84		Mixed sediment			
P	ENV82	36 to 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	N/A
Q	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	N/A

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
R	ENV12	39 to 43	Sand and muddy sand	*Lagis koreni, Scalibregma inflatum, Ampharete lindstroemi agg., Owenia, Abra, Echinocyamus pusillus, Nemertea, Spio symphyta, Aoridae, Phoronis, Pholoe baltica*	SS.SCS.CCS	Faunal group R showed the highest Bray Curtis dissimilarity with Faunal group F (94.75%) due a lack of common species. Faunal group R showed the lowest Bray Curtis dissimilarity with Faunal group T (51.56%) due to both having species such as *Urothoe* and *Poecilochaetus serpens.*
	ENV13		Coarse sediment			
S	ENV33	40 to 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	Faunal group S showed the highest Bray Curtis dissimilarity with Faunal group F (89.28%) due a lack of common species. Faunal group R showed the lowest Bray Curtis dissimilarity with Faunal group AA (50.65%) due to both having species such as *Ampelisca provincialis* and *Ampharete lindstroemi* agg.
	ENV34		Mixed sediment			
	ENV35		Mixed sediment			
T	ENV40	35 to 40	Mixed sediment	*Ampharete lindstroemi agg., Nemertea, Scalibregma inflatum, Kurtiella bidentata, Lagis koreni, Pholoe baltica, Polycirrus, Paradoneis lyra, Owenia, Photis longicaudata, Tanaopsis graciloides, Platyhelminthes, Eteone cf. longa*	SS.SMx.CMx.KurThyMx	Faunal group T showed the highest Bray Curtis dissimilarity with Faunal group AD (82.22%) due a lack of common species. Faunal group T showed the lowest Bray Curtis dissimilarity with Faunal group S (50.16%) due to both having species such as *Phoronis* and *Ampharete lindstroemi* agg.
	ENV45		Mixed sediment			
U	ENV01	37 to 45	Mixed sediment	*Poecilochaetus serpens, Nemertea, Urothoe elegans, Scalibregma inflatum, Lysidice unicornis, Lagis koreni, Pholoe baltica, Pholoe inornata, Ampharete lindstroemi agg.,*	SS.SMx.OMx.PoVen	Faunal group U showed the highest Bray Curtis dissimilarity with Faunal group F (91.48%) due a lack of common species. Faunal group U showed the lowest Bray Curtis dissimilarity with Faunal group Z (56.10%) due to both having species
	ENV04		Mixed sediment			
	ENV05		Mixed sediment			
	ENV10		Mixed sediment			

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ENV14		Coarse sediment	*Phoronis, Spiophanes bombyx, Chaetozone zetlandica, Ampelisca, Ophelina acuminata, Pista lornensis, Cirrophorus branchiatus, Ampelisca spinipes, Pseudopolydora pulchra, Urothoe*		such as *Leptochiton asellus* and *Ampharete lindstroemi* agg.
	ENV15		Mixed sediment			
	ENV19		Mixed sediment			
	ENV27		Mixed sediment			
	ENV59		Coarse sediment			
	ENV63		Coarse sediment			
	ENV64		Mixed sediment			
V	ENV32	41	Mixed sediment	*Lysidice unicornis, Praxillella affinis, Ophelina acuminata, Scalibregma inflatum, Urothoe marina*	SS.SMx.OMx.PoVen	N/A
W	ENV39	39 to 46	Mixed sediment	*Scalibregma inflatum, Golfingia (Golfingia) elongata, Unciola planipes, Owenia, Echinocyamus pusillus, Syllis, garciai/mauretanica, Phoronis, Nereididae, Nemertea, Golfingiidae, Ampharete lindstroemi agg., Syllis, Lagis koreni, Eulalia mustela, Mediomastus fragilis, Paraonidae, Paradoneis ilvana*	SS.SMx.OMx.PoVen	Faunal group W showed the highest Bray Curtis dissimilarity with Faunal group A (91.07%) due a lack of common species. Faunal group W showed the lowest Bray Curtis dissimilarity with Faunal group AA (54.75%) due to both having species such as *Syllis* and *Pholoe baltica.*
	ENV42		Mixed sediment			

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
X	ENV53	43 to 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	N/A
Y	ENV31	40 to 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*	SS.SMx.OMx.PoVen	Faunal group Y showed the highest Bray Curtis dissimilarity with Faunal group J (91.57%) due a lack of common species. Faunal group Y showed the lowest Bray Curtis dissimilarity with Faunal group U (61.63%) due to both having species such as *Leptochiton asellus* and *Aonides paucibranchiata.*
	ENV36		Mixed sediment			
	ENV37		Mixed sediment			
	ENV41		Mixed sediment			
	ENV47		Mixed sediment			
	ENV97		Mixed sediment			
Z	ENV60	38 to 43	Coarse 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, Scoloplos armiger, Eteone cf. Longa, Parexogone hebes, Terebellides*	SS.SMx.OMx.PoVen	Faunal group Z showed the highest Bray Curtis dissimilarity with Faunal group C (91.63%) due a lack of common species. Faunal group Z showed the lowest Bray Curtis dissimilarity with Faunal group U (56.10%) due to both having species such as *Leptochiton asellus* and *Ampharete lindstroemi* agg.
	ENV61		Mixed sediment			
	ENV65		Mixed sediment			

<table>
<tr><th>Simprof group</th><th>Station</th><th>Depth range (m)</th><th>EUNIS Folk classification</th><th>Characterising infaunal taxa according to SIMPER analysis</th><th>Biotope</th><th>Comments</th></tr>
<tr><td rowspan="11">AA</td><td>ENV38</td><td rowspan="11">39 to 47</td><td>Mixed sediment</td><td rowspan="11">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</td><td rowspan="11">SS.SMx.OMx.PoVen</td><td rowspan="11">Faunal group AA showed the highest Bray Curtis dissimilarity with Faunal group F (93.40%) due a lack of common species. Faunal group AA showed the lowest Bray Curtis dissimilarity with Faunal group U (57.15%) due to both having species such as Scalibregma inflatum and Ampharete lindstroemi agg.</td></tr>
<tr><td>ENV48</td><td>Mixed sediment</td></tr>
<tr><td>ENV49</td><td>Mixed sediment</td></tr>
<tr><td>ENV51</td><td>Mixed sediment</td></tr>
<tr><td>ENV52</td><td>Mixed sediment</td></tr>
<tr><td>ENV54</td><td>Mixed sediment</td></tr>
<tr><td>ENV55</td><td>Mixed sediment</td></tr>
<tr><td>ENV56</td><td>Coarse sediment</td></tr>
<tr><td>ENV71</td><td>Mixed sediment</td></tr>
<tr><td>ENV86</td><td>Mixed sediment</td></tr>
<tr><td>ENV88</td><td>Mixed sediment</td></tr>
<tr><td rowspan="3">AB</td><td>ENV29</td><td rowspan="3">39 to 42</td><td>Mixed sediment</td><td rowspan="3">Nemertea, Ampharete lindstroemi agg., Phascolion (Phascolion) strombus strombus, Parexogone hebes, Syllis, Golfingiidae, Poecilochaetus serpens, Cirrophorus branchiatus, Podarkeopsis, Cheirocratus</td><td rowspan="3">SS.SMx.OMx.PoVen</td><td rowspan="3">Faunal group AB showed the highest Bray Curtis dissimilarity with Faunal group F (92.48%) due a lack of common species. Faunal group AB showed the lowest Bray Curtis dissimilarity with Faunal group Z (58.98%) due to both having species such as Leptochiton asellus and Phoronis.</td></tr>
<tr><td>ENV62</td><td>Mixed sediment</td></tr>
<tr><td>ENV95</td><td>Sand and muddy sand</td></tr>
<tr><td rowspan="4">AC</td><td>ENV02</td><td rowspan="4">35 to 41</td><td>Coarse sediment</td><td rowspan="4">Nemertea, Echinocyamus pusillus, Goniadella gracilis, Poecilochaetus serpens, Scalibregma inflatum, Owenia, Pholoe baltica, Polynoidae, Golfingiidae, Kurtiella bidentata,</td><td rowspan="4">SS.SMx.OMx.PoVen</td><td rowspan="4">Faunal group AC showed the highest Bray Curtis dissimilarity with Faunal group J (95.49%) due a lack of common species. Faunal group AC showed the lowest Bray Curtis dissimilarity with Faunal group U (65.41%) due to both</td></tr>
<tr><td>ENV03</td><td>Mixed sediment</td></tr>
<tr><td>ENV06</td><td>Coarse sediment</td></tr>
<tr><td>ENV08</td><td>Coarse sediment</td></tr>
</table>

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ENV17		Coarse sediment	*Bivalvia, Pholoe inornata, Aonides paucibranchiata, Nereididae*		having species such as *Kurtiella bidentata* and *Lagis koreni.*
	ENV20		Coarse sediment			
	ENV24		Coarse sediment			
	ENV90		Mixed sediment			
AD	22ENV11	35 to 43	Coarse sediments	*Grania, Goniadella gracilis, Aonides paucibranchiata, Echinocyamus pusillus, Goniadidae, Pisione remota, Nemertea, Obtusella intersecta, Spisula, Caulleriella alata*	SS.SMx.OMx.PoVen	Faunal group AD showed the highest Bray Curtis dissimilarity with Faunal group D (90.23%) due a lack of common species. Faunal group AD showed the lowest Bray Curtis dissimilarity with Faunal group AE (66.75%) due to both having species such as *Kurtiella bidentata* and *Aonides paucibranchiata.*
	ZOI24		Coarse sediments		SS.SSa.CFiSa.EpusOborApri	
AE	22ENV10	37 to 39	Coarse sediments	*Echinocyamus pusillus, Obtusella intersecta, Kurtiella bidentata, Nemertea, Thracioidea, Abra alba, Asbjornsenia pygmaea*	SS.SSa.CFiSa.EpusOborApri	N/A
AF	22ENV05	41 to 49	Mixed sediment	*Nemertea, Paradoneis lyra, Ascidiacea, Sipuncula, Syllis armillaris, Echinocyamus pusillus, Leiochone, Lysidice unicornis, Spisula, Pseudopolydora pulchra, Gnathiid indet., Cirrophorus branchiatus, Aonides paucibranchiata, Grania, Obtusella intersecta, Pholoe inornata. Kurtiella bidentata, Tharyx killariensis, Abra*	SS.SMx.OMx.PoVen	Faunal group AF showed the highest Bray Curtis dissimilarity with Faunal group F (90.32%) due a lack of common species. Faunal group AF showed the lowest Bray Curtis dissimilarity with Faunal group AE (63.74%) due to both having species such as *Kurtiella bidentata* and *Asbjornsenia pygmaea.*
	22ENV06		Coarse sediments			
	ZOI17		Coarse sediments			
	ZOI25		Coarse sediments			
AG	22ENV07	41 to 44	Coarse sediments		SS.SMx.OMx.PoVen	

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ZOI18		Mixed sediments	*Lumbrineris aniara, Pholoe inornata, Syllis armillaris, Ampelisca spinipes, Nemertea, Lysidice unicornis, Leptochiton asellus, Glycera lapidum, Caulleriella alata, Dialychone dunerificta, Anomiidae*		Faunal group AG showed the highest Bray Curtis dissimilarity with Faunal group B (86.31%) due a lack of common species. Faunal group AG showed the lowest Bray Curtis dissimilarity with Faunal group AF (63.74%) due to both having species such as *Kurtiella bidentata* and *Asbjornsenia pygmaea.*

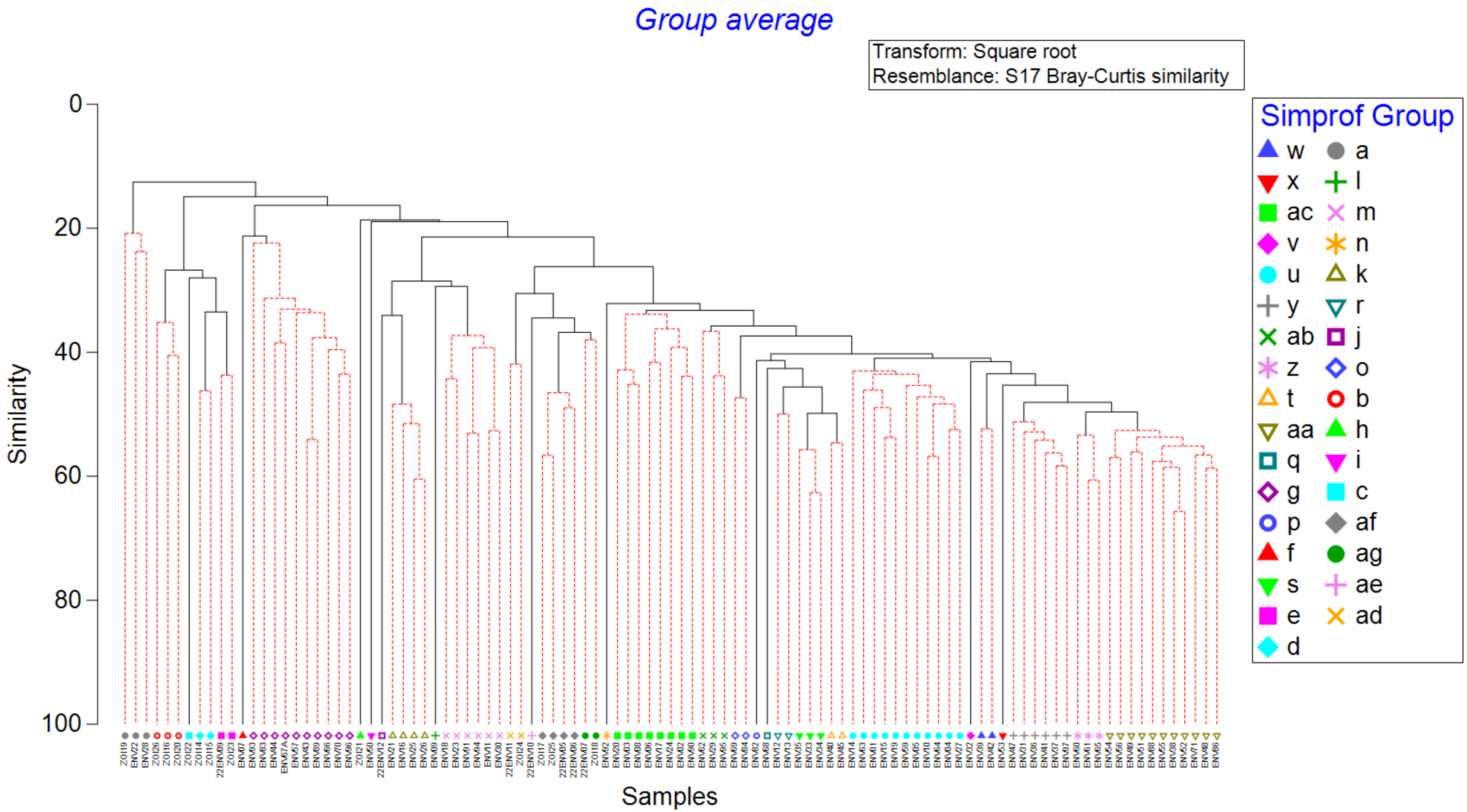


Figure 1.9: Dendrogram of infaunal communities from benthic grab samples.

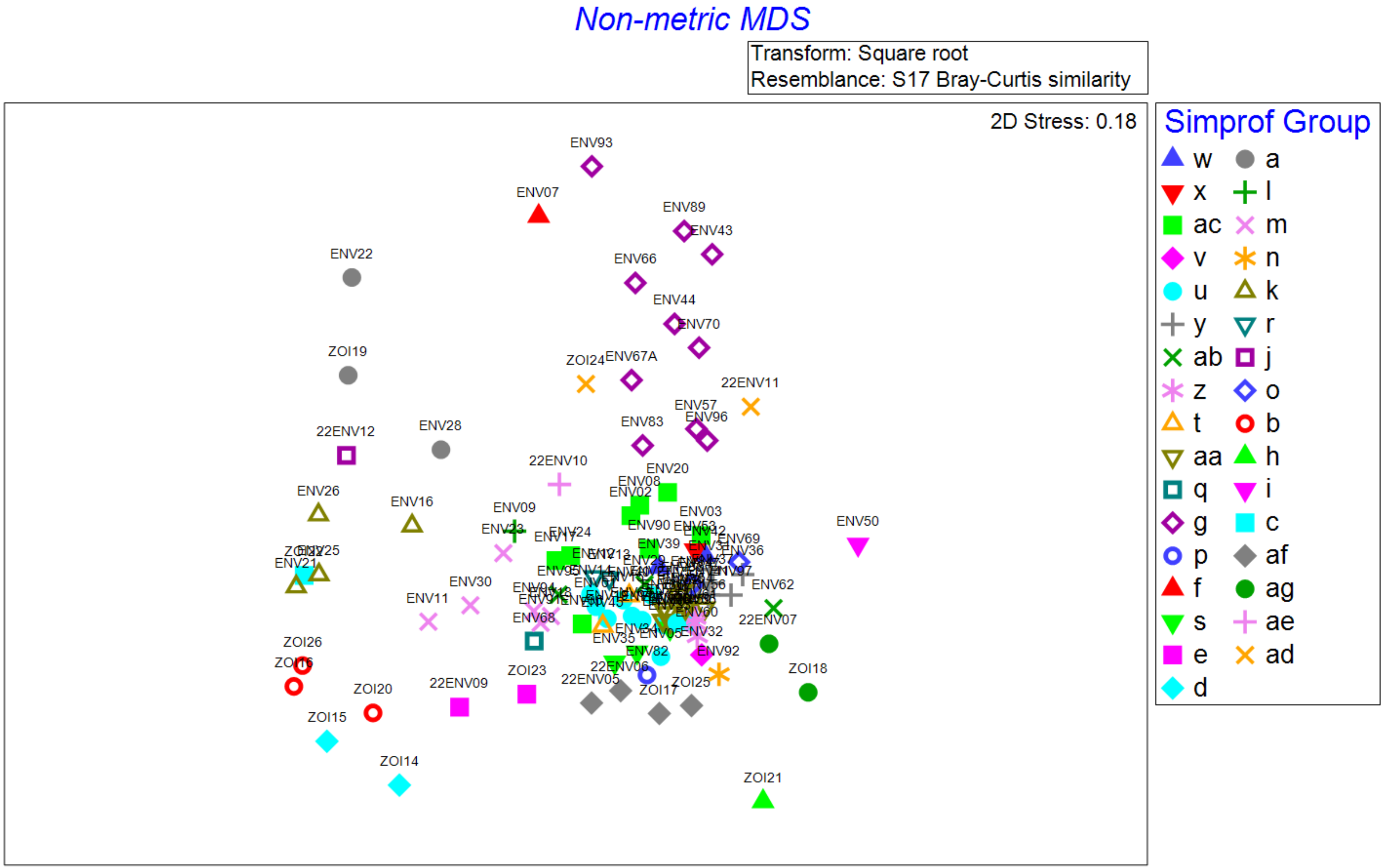


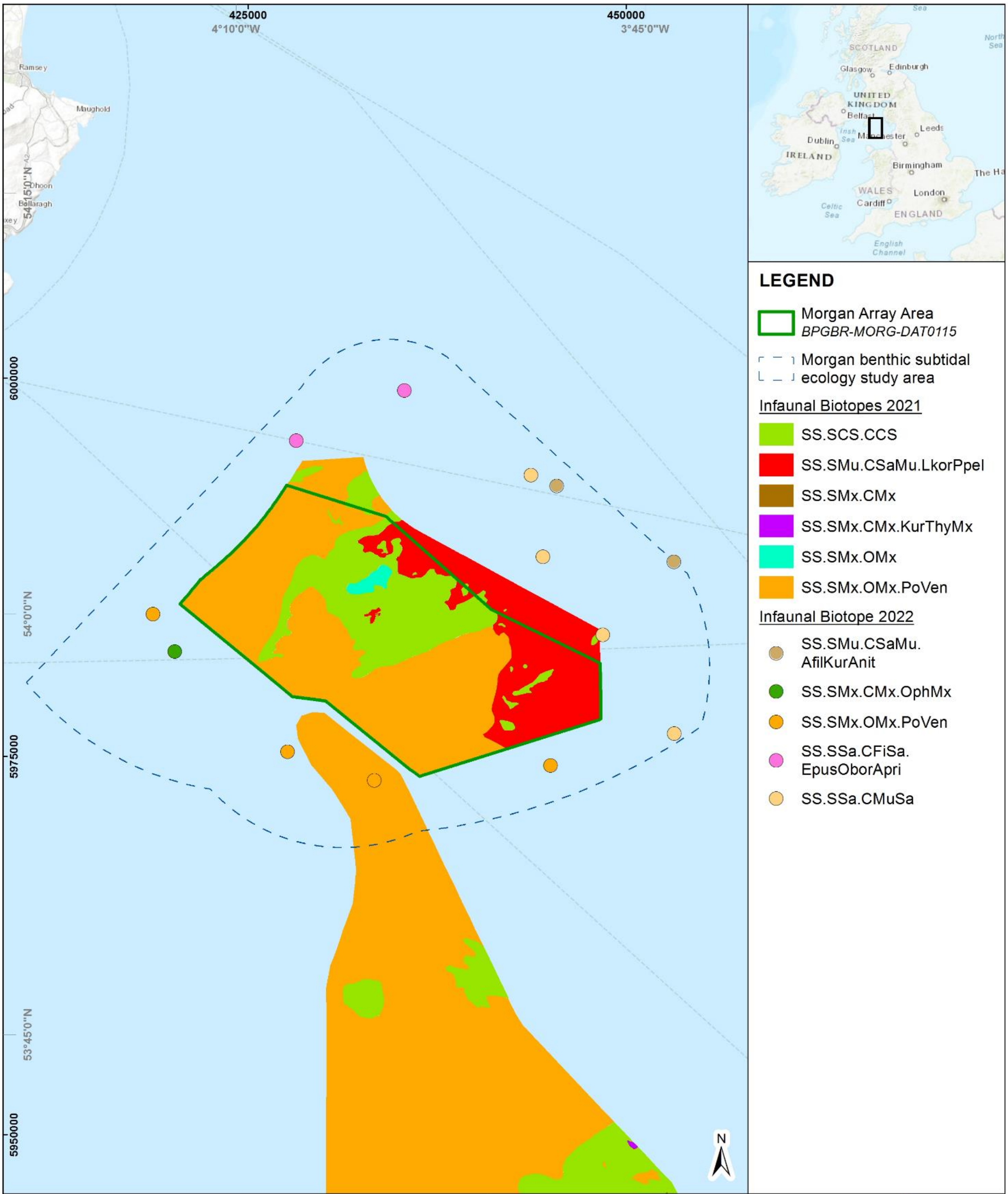
Figure 1.10: 2D MDS plot of infaunal communities from grab samples.

Table 1.11: 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, 22ENV09	38 to 48	Sand and muddy sand/Coarse sediment	*Scoloplos armiger, Abra, Echinocyamus pusillus, Hesionura elongata, Nemertea, Owenia, Pholoe*	Centre and north Morgan Array Area as well as the north of the Morgan Array Area ZoI. Across the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area (i.e. Mona Offshore Wind Project).
SS.SMx.OMx	ENV09	42 to 43	Mixed sediment	*Nemertea, Glycera lapidum, Leptochiton asellus, Syllis,*	Centre of the Morgan Array Area.
SS.SMu.CSaMu.LkorPpel	ENV92, ENV16, ENV21, ENV25, ENV26, ENV91, ENV94, ENV11, ENV30	34 to 51	Mixed sediment/Sand and muddy sand/Coarse sediment	*Spiophanes bombyx, Scalibregma inflatum, Lagis koreni, Abra, Nemertea, Owenia, Pholoe baltica, Pholoe inornata*	Northeast Morgan Array Area as well as the northeast of the Morgan Array Area ZoI.

Preliminary infaunal biotope	Grab sample stations	Water depth range	Sediment classification	Characterising species	Geographic location
SS.SMx.OMx.PoVen	ENV23, ENV69, ENV84, ENV33, ENV34, ENV35, ENV01, ENV04, ENV05, ENV10, ENV14, ENV15, 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, ZOI17, ZOI18, ZOI23, ZOI25, 22ENV05, 22ENV06, 22ENV07, 22ENV11	39 to 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 north, south and west of the Morgan Array Area ZoI. Across the wider regional benthic subtidal ecology study area to the south of the Morgan Array Area. (i.e. Mona Offshore Wind Project).
SS.SMx.CMx.OphMx	ZOI21	41 to 2	Mixed sediments	*Polynoidae, Serpulidae, Spirobranchus triqueter, Ericthonius, Anomiidae, Ophiothrix fragilis, Phoronis, Spirobranchus lamarcki*	Southwest of the Morgan Array Area ZoI.
SS.SSa.CMuSa	ZOI16, ZOI20, ZOI26, ZOI22	33 to 45	Sand and muddy sand	*Kurtiella bidentata, Phoronis, Bathyporeia tenuipes, Nephtys, Abra, Megaluropus agilis*	East and north of the Morgan Array Area ZoI.
SS.SMu.CSaMu.AfilKurAnit	ZOI14, ZOI15	34 to 58	Sand and muddy sand/Mud and sandy mud	*Kurtiella bidentata, Lumbrineris aniara, Pectinariidae, Amphiura filiformis, Echinocardium cordatum*	Northeast of the Morgan Array Area ZoI.

Preliminary infaunal biotope	Grab sample stations	Water depth range	Sediment classification	Characterising species	Geographic location
SS.SSa.CFiSa.EpusOborApri	ZOI19, ZOI24, 22ENV10, 22ENV12	31 to 36	Sand and muddy sand/Coarse sediments	*Echinocyamus pusillus, Abra, Spisula, Scoloplos armiger, Goniadella gracilis, Hesionura elongata*	North of the Morgan Array Area ZoI.
SS.SMx.CMx	ENV18, ENV82	36 to 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 benthic subtidal ecology study area (i.e. Mona Offshore Wind Project).
SS.SMx.CMx.KurThyMx	ENV40, ENV45	37 to 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 (i.e. Mona Offshore Wind Project).



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Data Sources: Client, Guardline, EMODnet, Seabed Habitats (2021)

Project Name:
MORGAN OFFSHORE WIND PROJECT

0 1 2 4 6 nm
0 1 2 4 6 8 10 12 km

Drawing Number:
RPSE-MG-ES-BEN-011-03

Drawing Title:
PRELIMINARY INFAUNAL BIOTOPES RECORDED FROM GRAB SAMPLES ACROSS THE MORGAN BENTHIC SUBTIDAL ECOLOGY STUDY AREA

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:425,000

VER	DATE	DETAILS	BY	CHECK
00	11/08/23	First Issue	MJ	TH
03	09/04/24	Revision	LM	MK

Figure 1.11: Preliminary infaunal biotopes recorded from grab samples across the Morgan benthic subtidal ecology study area (all biotope codes are defined in Appendix G).

Comparison between Morgan Array Area 2021 and 2022 survey

1.7.3.29 To determine if there had been any measurable shift in the communities in the Morgan Array Area between the 2021 and 2022 surveys, seven stations were resampled in 2022 (DDV and grab sampling data) so that the abiotic and biotic conditions could be compared. Analysis of the infaunal grab sample data from these stations suggested some dissimilarity in the infaunal communities. A CLUSTER analysis, including a SIMPROF test, did not group the 2021 and 2022 sample stations of the same location together. The results of the SIMPER analysis identified three separate groups with the 2021 and 2022 sample points were largely clustered apart. The 2021 samples all clustered in one group and the 2022 samples were largely clustered in another group with a single station outlier (ENV11 from 2022). A SIMPER test on these clusters showed a dissimilarity between the two main groups of 72.9%.

1.7.3.30 An ANOSIM test was undertaken which determines if the difference between SIMPROF groups is greater than the difference within SIMPROF groups. The results of this analysis provided an R statistic of 0.79 which suggested that were was a greater difference between Faunal groups than within them. Overall, the conditions within the Morgan benthic subtidal ecology study area are highly changeable as a result of ocean current and tidal influences which can result in the movement of sediment and geophysical features.

Univariate analysis

1.7.3.31 The following univariate statistics were calculated for each benthic infaunal grab sample station: number of species (S), abundance (N), wet 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 1.12 with univariate statistics for individual sites presented in Appendix D.

1.7.3.32 The univariate statistics indicate that the SS.SMx.OMx.PoVen biotope, had the highest number of taxa (75.57 ± 16.94) followed by SS.SMx.CMx.OphMx (74). The SS.SMu.CSaMu.AfilKurAnit biotope had the lowest number of taxa (32.50 ± 4.95). The highest mean number of individuals was associated with SS.SMx.CMx.OphMx (412), SS.SMx.CMx.KurThyMx biotopes (249.50 ± 79.90) and SS.SMx.OMx.PoVen (238.23 ± 95.90) (Table 1.12); this was expected as these biotopes contained the highest number of taxa. The sandy mud biotopes, such as SS.SMu.CSaMu.AfilKurAnit and SS.SMu.CSaMu.LkorPpel, typically had a lower number of taxa compared to the mixed sediment biotopes. The lowest mean number of individuals (91) was recorded in association with the SS.SSa.CFiSa.EpusOborApri biotope.

1.7.3.33 The highest mean diversity score of all the identified biotopes was associated with the biotope SS.SMx.OMx.PoVen (d = 13.73 ± 2.37 and H' = 3.83 ± 0.30) which was expected as this biotope had the highest number of taxa. The SS.SMx.CMx.KurThyMx and SS.SMx.CMx.OphMx biotopes had the next highest mean diversity scores (d = 12.02 ± 0.20 and H' = 3.65 ± 0.05; d = 12.12 and H' = 3.31). The lowest diversity recorded was associated with the SS.SCS.CCS biotope (d = 7.28 ± 2.78 and H' = 2.86 ± 0.59) and the SS.SMu.CSaMu.AfilKurAnit (d = 6.54 ± 0.75 and H' = 2.93 ± 0.70). This was expected as these biotopes also exhibited the lowest numbers 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. The high diversity score associated with the SS.SMx.OMx.PoVen biotope is likely to be driven by the diverse biotic community that inhabits this biotope, which is characterised by a diverse group of polychaetes. Comparatively the SS.SMu.CSaMu.AfilKurAnit biotope is often found in very low energy habitats however this biotope is characterised by a specific community of echinoderms. The biotope has very little structural complexity with most species living in or on the sediment (De-Bastos and Hill, 2016). The specific conditions and community associated with this biotope may result in habitats assigned this biotope having low species 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).

1.7.3.34 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 0.77 and 0.91 for all of the biotopes with the highest value of J' for SS.SSa.CFiSa.EpusOborApri (J'=0.91). 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.SMx.CMx.OphMx biotope (J'=0.77) 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 0.97) which indicates that all of the biotopes are represented by a wide diversity of species.

Table 1.12: Mean (± standard deviation) univariate statistics for the preliminary infaunal benthic biotopes.

Biotope	S	N	Biomass (g)	d	J'	H'	λ
SS.SCS.CCS	36.00 ±18.31	140.47 ± 107.20	0.58±0.92	7.28 ± 2.78	0.82 ± 0.12	2.86 ± 0.59	0.90 ± 0.09
SS.SMx.OMx	50.50 ± 20.51	128.00 ± 106.77	4.55 ±7.15	10.42 ±2.27	0.90 ± 0.09	3.45 ± 0.03	0.96 ± 0.03
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	75.57 ±16.94	238.23 ± 95.90	13.73 ±2.36	13.73 ± 2.37	0.89 ± 0.05	3.83 ± 0.30	0.97 ± 0.03
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
SS.SMu.CSaMu.AfilKurAnit	32.50 ± 4.95	123 ± 25.46	2.29 ± 4.75	6.54 ± 0.75	0.84 ± 0.02	2.93 ± 0.7	0.92 ± 0.01
SS.SSa.CMuSa	37.25 ± 6.70	100 ± 46.43	8.55 ± 7.91	7.96 ± 0.69	0.88 ± 0.04	3.16 ± 0.10	0.94 ± 0.02

Biotope	S	N	Biomass (g)	d	J'	H'	λ
SS.SSa.CFiSa.EpusOborApri	37.00 ± 21.00	91.33 ± 73.70	3.12 ± 6.65	7.96 ± 3.61	0.91 ± 0.03	3.19 ± 0.37	0.96 ± 0.004
SS.SMx.CMx.OphMx	74	412	6.72 ±14.03	12.12	0.77	3.31	0.93

1.7.3.35 Figure 1.12 to Figure 1.14 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 benthic subtidal ecology study area, from the benthic infaunal grabs.

1.7.3.36 As shown in Figure 1.12, the proportions of the number of taxa in each major taxonomic group were similar across the biotopes and mirrored the patterns observed in the mean abundance, as described in paragraph 1.7.3.37, with Annelida and Crustacea making up the highest proportion of the taxa in the majority of biotopes. Crustaceans also made up a significant proportion of the taxa in the SS.SMx.CMx.OphMx, SS.SSa.CMuSa and SS.SSa.CFiSa.EpusOborApri. All major taxonomic groups were represented in all biotopes. The proportion of Crustacea in the number of taxa in each biotope was 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.

1.7.3.37 Figure 1.13 shows the distribution of the taxonomic groups within each biotopes. The mixed sediment biotopes (SS.SMx.CMx, SS.SMx.CMx.OphMx SS.SMx.CMx.KurThyMx and SS.SMx.OMx.PoVen) as well as SS.SCS.CCS exhibited particularly high numbers of Annelida taxa and individuals, also with large numbers of Crustacea and Other taxa (this group includes taxa such as Cnidaria, Chordata, Foraminifera and Hemichordata). These biotopes also exhibited the highest number of individuals overall (with a range of 216 to 412). 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 and SS.SMx.CMx.OphMx which were represented by a single sample station each and therefore may not be representative of these biotopes as a whole. This shows that SS.SMx.CMx.KurThyMx had 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.

1.7.3.38 Biomass was considerably higher in association with the SS.SSa.CMuSa, SS.SMx.CMx.OphMx, SS.SMx.OMx and SS.SMx.CMx biotopes, although noting that these were represented by a few or only one sample station. Biomass for the SS.SMx.CMx.KurThyMx biotope and the SS.SMx.OMx.PoVen biotope was dominated by Mollusca. The biomass for SS.SMx.CMx.OphMx and SS.SMx.OMx biotopes was dominated by echinoderms. For the SS.SMx.CMx.OphMx biotope *O. fragilis* was the dominant echinoderm species. For the SS.SMx.OMx biotope the heart urchin *Spatangoida* was the dominant echinoderm species. SS.SSa.CMuSa was dominated by the Other taxa, this was due to communities at station ZOI22 being dominated by two species of peanut worm, which can reach 1.5 cm in length (Barnes, 2008). 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 1.14). Biomass per taxonomic group for each sample station is presented in Appendix D.

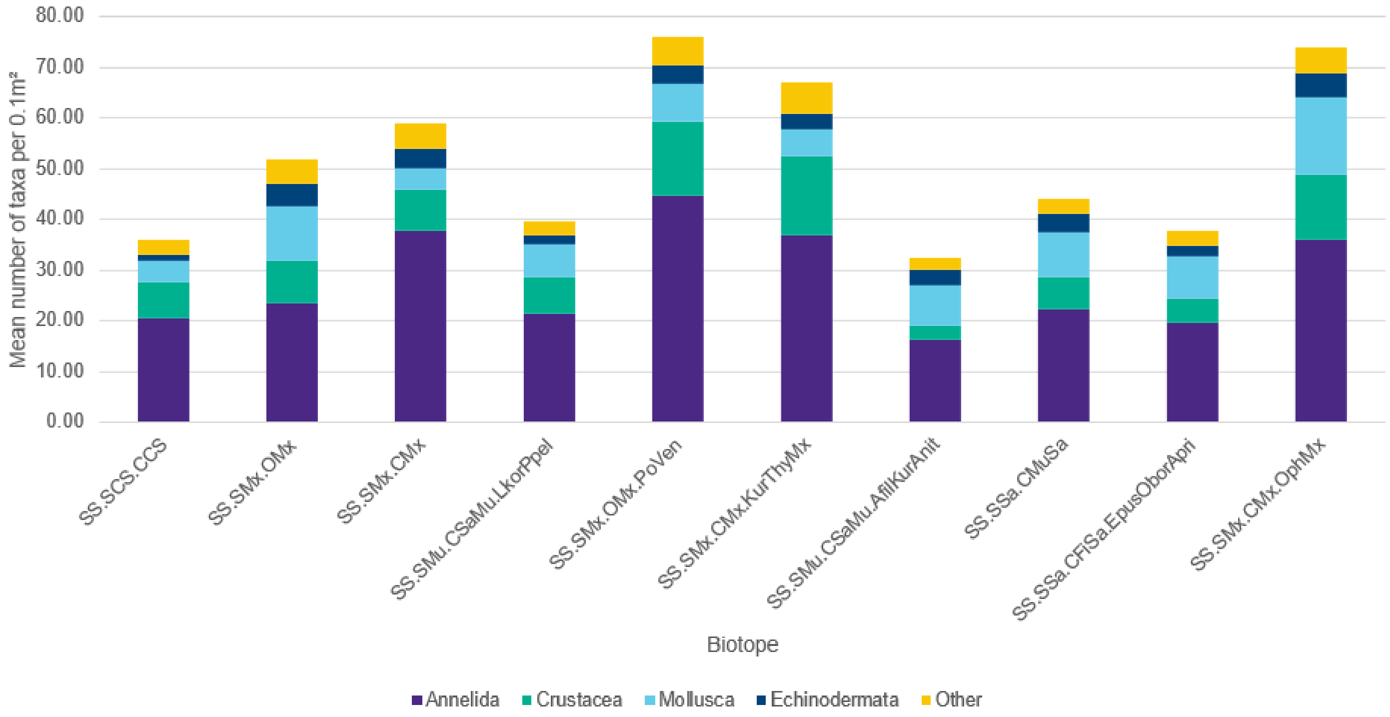


Figure 1.12: Mean abundance of taxa (per 0.1 m²) per taxonomic group for each infaunal biotope.

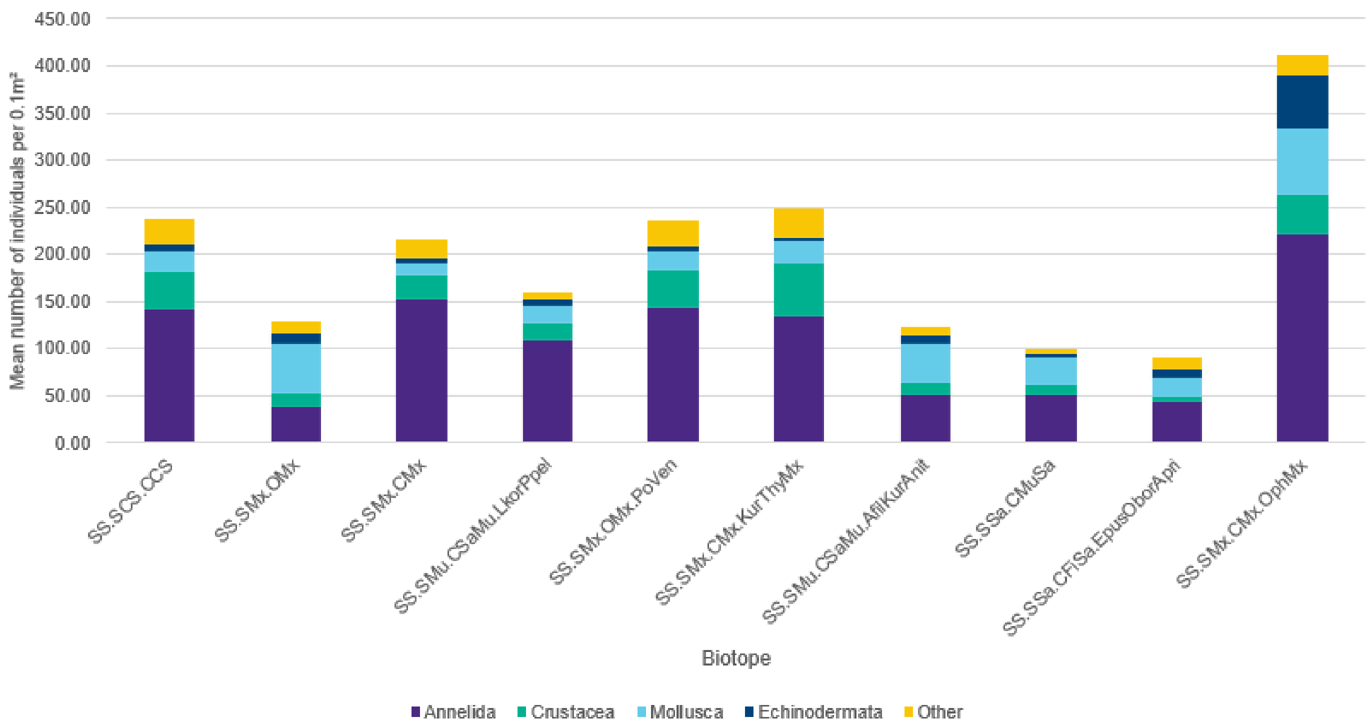


Figure 1.13: Mean abundance of individuals (per 0.1 m²) per taxonomic group for each infaunal biotope.

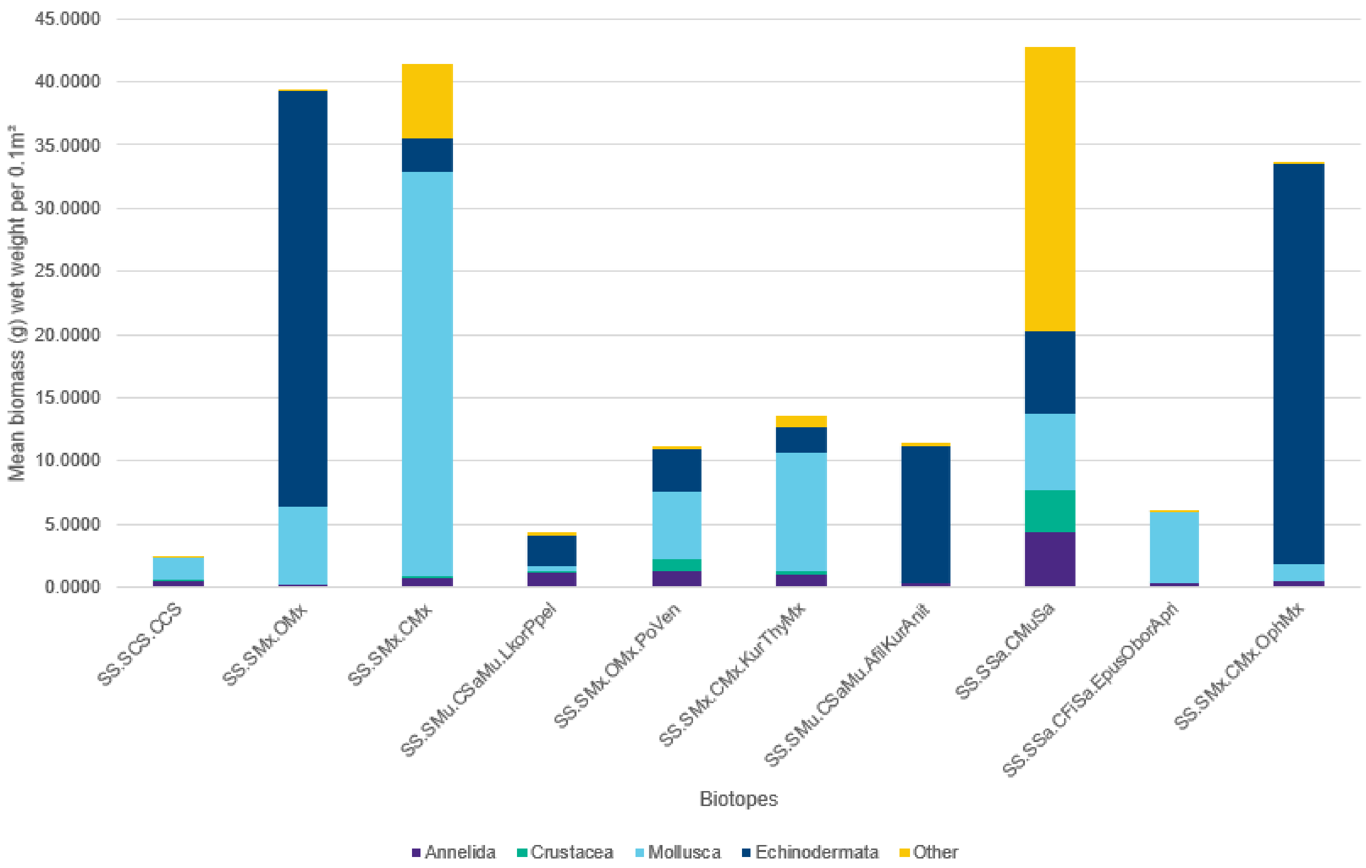


Figure 1.14: Mean biomass (per 0.1 m^2) per taxonomic group for each infaunal biotope.

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 the Morgan Array Area ZoI, the sediments were observed to be mainly composed of sands of varying sizes (fine to coarse) with some areas also having shell fragments or pebbles. One station of sandy gravel was also observed in the east of the Morgan Array Area ZoI. In the Morgan Array Area, high numbers of epifaunal species were recorded in association with the coarser sediments (coarse and mixed sediments). Epifaunal species recorded in the Morgan Array Area were dominated by annelids and cnidarians with low numbers of molluscs and chordates. In the Morgan Array Area *Ophiura* sp. was the most abundant taxa and was associated with every sediment type (Figure 1.15). In the Morgan Array Area ZoI, the epifaunal communities were composed of fewer taxa and were typically dominated by echinoderms however the polychaete *Serpulidae* was the most abundant across all stations.

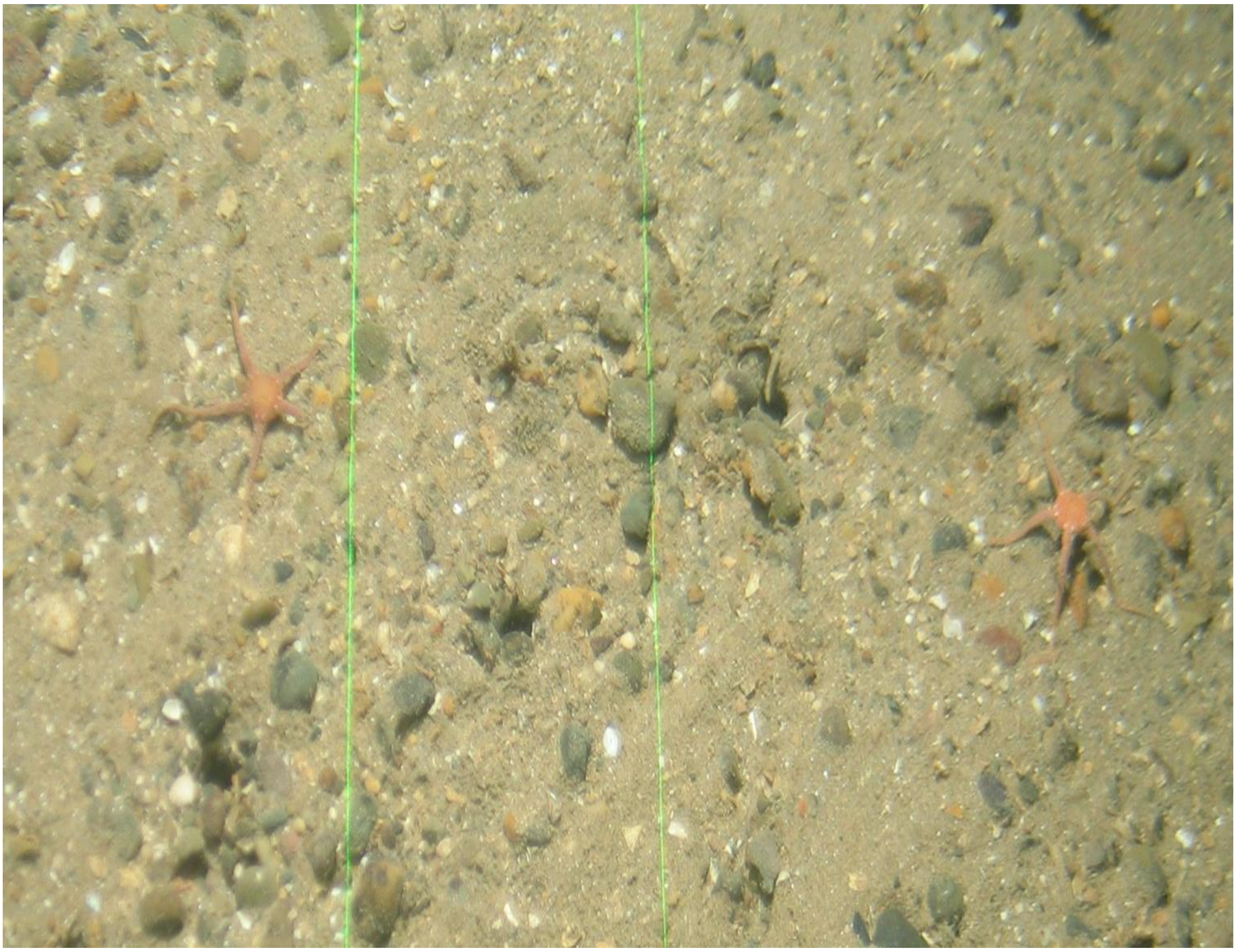


Figure 1.15: *Ophiura* sp. on mixed sediment at sample station ENV04.

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 Morgan Array Area included *Paguroidea*, *A. digitatum*, *Tubularia*, and Nematoda. Across the Morgan Array Area ZoI, the community composition observed from the DDV footage was similarly homogeneous however with a few prominent characterising species. Some of the most prominent species across the Morgan Array Area ZoI included *A. digitatum*, *Ceriantharia*, and *Ophiura albida* (Figure 1.16). Another notable species observed consistently in the DDV imagery across the Morgan benthic subtidal ecology study area were scallops (*Pectinidae*) with the greatest abundances identified in the Morgan Array Area ZoI (e.g. 35 were identified in imagery for ZOI25).

Figure 1.16: *Ophiura* sp. on mixed sediment at sample station ZOI21.

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 498 taxa and two categories of burrows and waste casts were recorded from the 154 infaunal grabs and DDV stations sampled during the site-specific benthic surveys in the Morgan benthic subtidal ecology study area. Of the total 498 taxa, *A. digitatum*, *Ophiura* sp., *Paguroidea*, *Nematoda* and fauna turf were recorded across the most sample stations in the 2021 and 2022 site specific survey. Of the taxa identified within the Morgan benthic subtidal ecology study area, 202 taxa occurred at less than three sample stations. Sample station ENV90 recorded the highest number of epifaunal taxa (west Morgan Array Area), with sample station ENV06 (north Morgan Array Area ZoI) 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 1.13). 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. The communities recorded in each of the habitats described resulted in the allocation of high level biotopes largely guided by sediment type. Full results of the multivariate analysis are presented in Appendix C.

1.7.4.5 The results of the hierarchical cluster analysis of the square root transformed epifaunal dataset (Table 1.13) together with the SIMPROF test identified 21 Faunal groups (Figure 1.17) that were statistically dissimilar, based on the SIMPROF test. The 2D MDS plot is presented in Figure 1.18 and the low stress value (0.12) 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 Faunal group U, which was composed of stations only in the Morgan Array Area ZoI, showed distinct clustering away from other Faunal groups (Table 1.13). The three stations in Faunal group J showed tight clustering with a Bray-Curtis similarity of 78.17%. Faunal group D was the largest SIMPROF group identified (43 sample stations) with a Bray-Curtis similarity of 51.04%. The difference in Faunal groups is discussed in the following paragraphs.

1.7.4.7 Faunal groups A, D, E, O, P, Q, R and S as well as sample stations in Faunal groups B, C, N and T were located within the west of the Morgan benthic subtidal ecology study area. These stations were associated with mixed sediments and communities characterised by a variety of polychaetes, crustaceans and echinoderms. These groups and sample stations were assigned the SS.SMx.CMx biotope from the epifaunal data (Figure 1.19).

1.7.4.8 Faunal groups L and M, as well as sample stations in Faunal groups B, C and F, 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 L and M, as well as sample stations in Faunal groups B, C and F were allocated the SS.SCS.CCS biotope.

1.7.4.9 Faunal group U, as well as sample stations in Faunal group N, had sample stations distributed throughout the west section of the Morgan Array area and along the north boundary of the Morgan Array Area. Sample stations in Faunal group N and U were characterised by sand and muddy sand sediments. The associated communities recorded from the epifaunal data were largely characterised by echinoderms and crustaceans such as *O. ophiura* and *Pagurus bernhardus*. Therefore, on the basis of the epifaunal data, Faunal group U, as well as sample stations in Faunal group N, were allocated the SS.SSa.CMuSa biotope. Similarly, to the patterns observed in the infaunal multivariate analysis, the epifaunal analysis showed a transition in the epifaunal communities associated with the coarser sediment in the west of the Morgan benthic subtidal ecology study area to the communities associated with finer sediments in the east of the Morgan benthic subtidal ecology study area.

1.7.4.10 Sample stations in the wider regional benthic subtidal ecology study area located to the south of the Morgan benthic subtidal ecology study area (i.e. within the Mona Array Area) were associated with Faunal groups A, D, E, G, H, I, J and K, as well as sample stations in Faunal group N. 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 A, D, E, G, H, I, J and K, as well as sample stations in Faunal group N resulted in the majority of the wider regional benthic subtidal ecology study area to the south of the Morgan benthic subtidal ecology study area (i.e. within the Mona Array Area) being allocated the SS.SMx.CMx biotope (Figure 1.19).

1.7.4.11 These results are largely supported by the survey results of the baseline characterisation surveys undertaken for the Rhiannon Wind Farm (Figure 1.3) (Celtic Array Ltd, 2014) which characterised the area coinciding with the west the Morgan Array Area and southwest of the Morgan Array Area ZoI. These surveys identified mixed sediment biotopes (e.g. SS.SMx.CMx) in the west of the Morgan Array Area and also the SS.SCS.CCS biotope in the northwest of the Morgan Array Area. Finally although the Rhiannon Wind Farm survey did not extend far in to the north of the Morgan Array Area or east in to the Morgan Array Area ZoI the data collected does suggest finer sediments and biotopes such as SS.SSa.CFiSa were more prevalent in these areas as found during the site specific surveys for the Morgan Array Area ZoI.

1.7.4.12 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 1.13). Figure 1.19 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 1.13: 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
A	ENV09	34 to 42	Mixed sediment	*Nematoda, Copepoda*, Faunal turf, *Ophiura, Serpulidaem, Amphipoda, Paguroidea*, Animalia tubes	SS.SMx.CMx	Faunal group A showed the highest Bray Curtis dissimilarity with Faunal group O (96.03%) due a lack of common species. Faunal group A showed the lowest Bray Curtis dissimilarity with Faunal group E (58.00%) due to both having similar abundances of *Decapoda* and *Penetrantia*.
	ENV23		Sand and muddy sand			
	ENV40		Mixed sediment			
	ENV43		Coarse sediment			
	ENV45		Mixed sediment			
	ENV67		Sand and muddy sand			
	ENV68		Sand and muddy sand			
	ENV70		Coarse sediment			
	ENV95		Sand and muddy sand			
B	ENV14	36 to 45	Coarse sediment	*Euclymeninae, Nematoda, Scoloplos armiger, Decapoda, Penetrantia, Alcyonium digitatum*	SS.SMx.CMx	Faunal group B showed the highest Bray Curtis dissimilarity with Faunal group Q (96.30%) due a lack of common species. Faunal group B showed the lowest Bray Curtis dissimilarity with Faunal group E (57.55%) due to both having similar abundances of *Euclymeninae* and *Sertulariidae*.
	ENV28		Coarse sediment		SS.SCS.CCS	
C	ENV01	35 to 45	Mixed sediment	Burrows, *Sertulariidae, Hydrallmania falcata, Copepoda, Schizomavella*, Faunal turf	SS.SMx.CMx	Faunal group C showed the highest Bray Curtis dissimilarity with Faunal group U (95.22%) due a lack of common species. Faunal group C showed the lowest Bray Curtis dissimilarity with Faunal group D (58.22%) due to both having similar abundances of *Nematoda* and *Porella concinna*.
	ENV08		Coarse sediment		SS.SMx.CMx	
	ENV94		Coarse sediment		SS.SCS.CCS	

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
D	ENV04	40 to 49	Mixed sediment	*Nematoda, Serpulidae, Sertulariidae, Hydrallmania falcata, Copepoda, Alcyonium digitatum, Ophiura, Pectinidae, Decapoda*	SS.SMx.CMx	Faunal group D showed the highest Bray Curtis dissimilarity with Faunal group U (95.05%) due a lack of common species. Faunal group D showed the lowest Bray Curtis dissimilarity with Faunal group E (58.22%) due to both having similar abundances of *Hydrallmania falcata* and *Sertulariidae*.
	ENV05		Mixed sediment			
	ENV10		Mixed sediment			
	ENV15		Mixed sediment			
	ENV20		Coarse sediment			
	ENV27		Mixed sediment			
	ENV29		Mixed sediments			
	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			

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ENV51		Mixed sediments			
	ENV52		Mixed sediments			
	ENV53		Mixed sediments			
	ENV54		Mixed sediments			
	ENV55		Mixed sediments			
	ENV56		Coarse sediments			
	ENV57		Coarse sediment			
	ENV59		Mixed sediments			
	ENV60		Mixed sediments			
	ENV61		Mixed sediments			
	ENV62		Coarse sediments			
	ENV63		Mixed sediments			
	ENV64		Mixed sediment			
	ENV65		Mixed sediment			
	ENV71		Mixed sediment			
	ENV82		Mixed sediment			
	ENV84		Mixed sediment			
	ENV86		Mixed sediments			
	ENV88		Mixed sediments			
	ENV90		Mixed sediment			
	ENV92		Mixed sediment			

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ENV97		Mixed sediment			
E	ENV02	37 to 51	Coarse sediment	*Nematoda, Copepoda, Decapoda, Penetrantia, Alcyonium digitatum, Amphipoda*, Faunal turf, *Serpulidae*	SS.SMx.CMx	Faunal group E showed the highest Bray Curtis dissimilarity with Faunal group O (94.92%) due a lack of common species. Faunal group E showed the lowest Bray Curtis dissimilarity with Faunal group D (56.06%) due to both having similar abundances of *Hydrallmania falcata* and *Sertulariidae*.
	ENV03		Mixed sediment			
	ENV06		Mixed sediment			
	ENV12		Mixed sediment			
	ENV13		Sand and muddy sand			
	ENV17		Coarse sediment			
	ENV18		Coarse sediment			
	ENV19		Coarse sediment			
	ENV24		Mixed sediment			
	ENV39		Mixed sediment			
	ENV69		Coarse sediment			
F	ENV66	36 to 41	Coarse sediment	*Nematoda, Serpulidae*, Faunal turf, Animalia tubes	SS.SCS.CCS	Faunal group F showed the highest Bray Curtis dissimilarity with Faunal group P (95.74%) due a lack of common species. Faunal group F showed the lowest Bray Curtis dissimilarity with Faunal group G (59.47%) due to both having similar abundances of *Alcyonium digitatum* and *Paguroidea*.
	ENV83		Mixed sediment		SS.SMx.CMx	
	ENV89		Coarse sediment		SS.SCS.CCS	
G	ENV72	36 to 41	Mixed sediment	*Serpulidae, Tubularia, Alcyonium digitatum, Pectinidae, Echinoidea, Pagurus bernhardus*, Faunal turf	SS.SMx.CMx	Faunal group G showed 100% Bray Curtis dissimilarity with Faunal groups Q, P, S, T, U, R and O due a lack of common species. Faunal
	ENV75		Coarse sediment			
	ENV77		Mixed sediment			

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ENV78		Coarse sediment			group G showed the lowest Bray Curtis dissimilarity with Faunal group I (45.91%) due to both having similar abundances of *Ophiura* and *Serpulidae*.
H	ENV73	36 to 38	Mixed sediment	*Serpulidae, Alcyonium digitatum, Ophiura, Echinoidea, Pectinidae*, Faunal turf	SS.SMx.CMx	N/A
I	ENV58	38 to 39	Mixed sediment	*Echinoidea, Ophiura, Serpulidae, Actiniaria, Alcyonium digitatum, Pectinidae*	SS.SMx.CMx	N/A
J	ENV74	38 to 41	Mixed sediment	*Serpulidae, Alcyonium digitatum, Ophiura, Echinoidea, Pectinidae,* Faunal turf	SS.SMx.CMx	Faunal group G showed 100% Bray Curtis dissimilarity with Faunal groups Q, P, S, T, U, R and O due a lack of common species. Faunal group G showed the lowest Bray Curtis dissimilarity with Faunal group I (30.66%) due to both having similar abundances of *Actiniaria* and *Ceriantharia*.
	ENV76		Mixed sediment			
	ENV79		Mixed sediment			
K	ENV46	38 to 42	Mixed sediment	*Serpulidae, Alcyonium digitatum, Ophiothrix fragilis, Ophiura*, Faunal turf, *Pectinidae, Actiniaria, Pagurus bernhardus*	SS.SMx.CMx	Faunal group G showed 100% Bray Curtis dissimilarity with Faunal groups Q, P, S, T, U, R and O due a lack of common species. Faunal group G showed the lowest Bray Curtis dissimilarity with Faunal group I (34.61%) due to both having similar abundances of *Echinoidea* and *Ophiothrix fragilis.*
	ENV80		Mixed sediment			
	ENV81		Mixed sediment			
	ENV85		Mixed sediment			
L	ENV07	36 to 48	Coarse sediment		SS.SCS.CCS	

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ENV93		Coarse sediment	Burrows, *Nematoda, Polygordius, Serpulidae, Alcyonium digitatum*		Faunal group L showed the highest Bray Curtis dissimilarity with Faunal group O (97.99%) due a lack of common species. Faunal group L showed the lowest Bray Curtis dissimilarity with Faunal group H (58.92%) due to both having similar abundances of *Tubularia* and *Alcyonium digitatum*.
M	ENV11	42 to 48	Sand and muddy sand	*Nematoda, Decapoda, Sertularella*, Faunal turf, *Ophiura, Actiniaria*	SS.SCS.CCS	Faunal group M showed the highest Bray Curtis dissimilarity with Faunal group R (97.46%) due a lack of common species. Faunal group M showed the lowest Bray Curtis dissimilarity with Faunal group H (57.91%) due to both having similar abundances of *Ophiothrix fragilis* and *Ophiocomina nigra*.
	ENV91		Mixed sediment			
N	ENV16	34 to 41	Sand and muddy sand	Faunal turf, *Ophiura, Phoronis, Paguroidea, Amphipoda, Astropecten irregularis*	SS.SSa.CMuSa	Faunal group N showed the highest Bray Curtis dissimilarity with Faunal group Q (97.98%) due a lack of common species. Faunal group N showed the lowest Bray Curtis dissimilarity with Faunal group H (57.91%) due to both having similar abundances of *Nematoda* and *Amphiura filiformis*.
	ENV21		Sand and muddy sand		SS.SSa.CMuSa	
	ENV22		Sand and muddy sand		SS.SSa.CMuSa	
	ENV25		Sand and muddy sand		SS.SSa.CMuSa	
	ENV26		Sand and muddy sand		SS.SSa.CMuSa	
	ENV30		Sand and muddy sand		SS.SMx.CMx	
	ENV44		Coarse sediment		SS.SMx.CMx	
O	ZOI18	41 to 42	Mixed sediments		SS.SMx.CMx	

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ZOI21		Mixed sediments	*Serpulidae stet., Alcyonium digitatum, Ophiura albida inc., Ophiothrix fragilis inc., Ceriantharia stet., Actiniaria indet.*		Faunal group P showed 100% Bray Curtis dissimilarity with Faunal groups K, I, F, G and H due a lack of common species. Faunal group P showed the lowest Bray Curtis dissimilarity with Faunal group R (46.20%) due to both having similar abundances of *Serpulidae* and *Tubularia indivisa*.
P	22ENV06	41	Coarse sediments	*Pectinidae, Scaphopoda, Ophiura albida, Tubularia indivisa, Nemertesia antennina, Hydrozoa, Ceriantharia, Alcyonium digitatum, Actiniaria, Paguroidea, Serpulidae*	SS.SMx.CMx	N/A
Q	22ENV05	41	Mixed sediments	*Serpulidae, Alcyonium digitatum, Paguroidea, Echinoidea, Scaphopoda*	SS.SMx.CMx	N/A
R	ZOI17	45	Coarse sediments	*Serpulidae stet., Alcyonium digitatum, Pectinidae stet., Ophiura albida inc., Echinoidea indet., Suberites indet., Psolus phantapus inc., Asterias rubens, Ophiura ophiura inc., Pecten maximus*	SS.SMx.CMx	Faunal group P showed 100% Bray Curtis dissimilarity with Faunal groups K, I, J, F, G and H due a lack of common species. Faunal group P showed the lowest Bray Curtis dissimilarity with Faunal group Q (39.34%) due to both having similar abundances of *Pectinidae* and *Ophiura albida*.
	ZOI25		Coarse sediments			
S	22ENV07	43 to 44	Coarse sediments		SS.SMx.CMx	

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	22ENV11		Coarse sediments	*Serpulidae stet., Alcyonium digitatum, Pectinidae stet., Paguroidea stet., Nematoda*		Faunal group P showed 100% Bray Curtis dissimilarity with Faunal groups K, I, J and H due a lack of common species. Faunal group P showed the lowest Bray Curtis dissimilarity with Faunal group S (53.32%) due to both having similar abundances of *Ophiura albida* and *Serpulidae*.
T	22ENV09	32 to 43	Coarse sediments	Tubularia indivisa inc., *Alcyonium digitatum, Ophiura ophiura inc., Paguroidea stet., Serpulidae stet., Psolus phantapus inc.*	SS.SMx.CMx	Faunal group T showed 100% Bray Curtis dissimilarity with Faunal groups J, G and H due a lack of common species. Faunal group T showed the lowest Bray Curtis dissimilarity with Faunal group P (58.35%) due to both having similar abundances of *Ceriantharia* and *Actiniaria*.
	22ENV10		Coarse sediments			
	ZOI23		Mixed sediments			
	ZOI24		Sand and muddy sand			
U	22ENV12	32 to 58	Sand and muddy sand	*Ophiura ophiura inc., Astropecten irregularis, Nematoda, Paguroidea stet., Leptothecata*	SS.SSa.CMuSa	Faunal group T showed 100% Bray Curtis dissimilarity with Faunal groups K, I, J, G and H due a lack of common species. Faunal group T showed the lowest Bray Curtis dissimilarity with Faunal group T (77.59%) due to both having similar abundances of *Tubularia indivisa* and *Pectinidae*.
	ZOI14		Sand and muddy sand			
	ZOI15		Mud and sandy mud			
	ZOI16		Sand and muddy sand			
	ZOI19		Sand and muddy sand			
	ZOI20		Mixed sediments			
	ZOI22		Sand and muddy sand			

Simprof group	Station	Depth range (m)	EUNIS Folk classification	Characterising infaunal taxa according to SIMPER analysis	Biotope	Comments
	ZOI26		Sand and muddy sand			

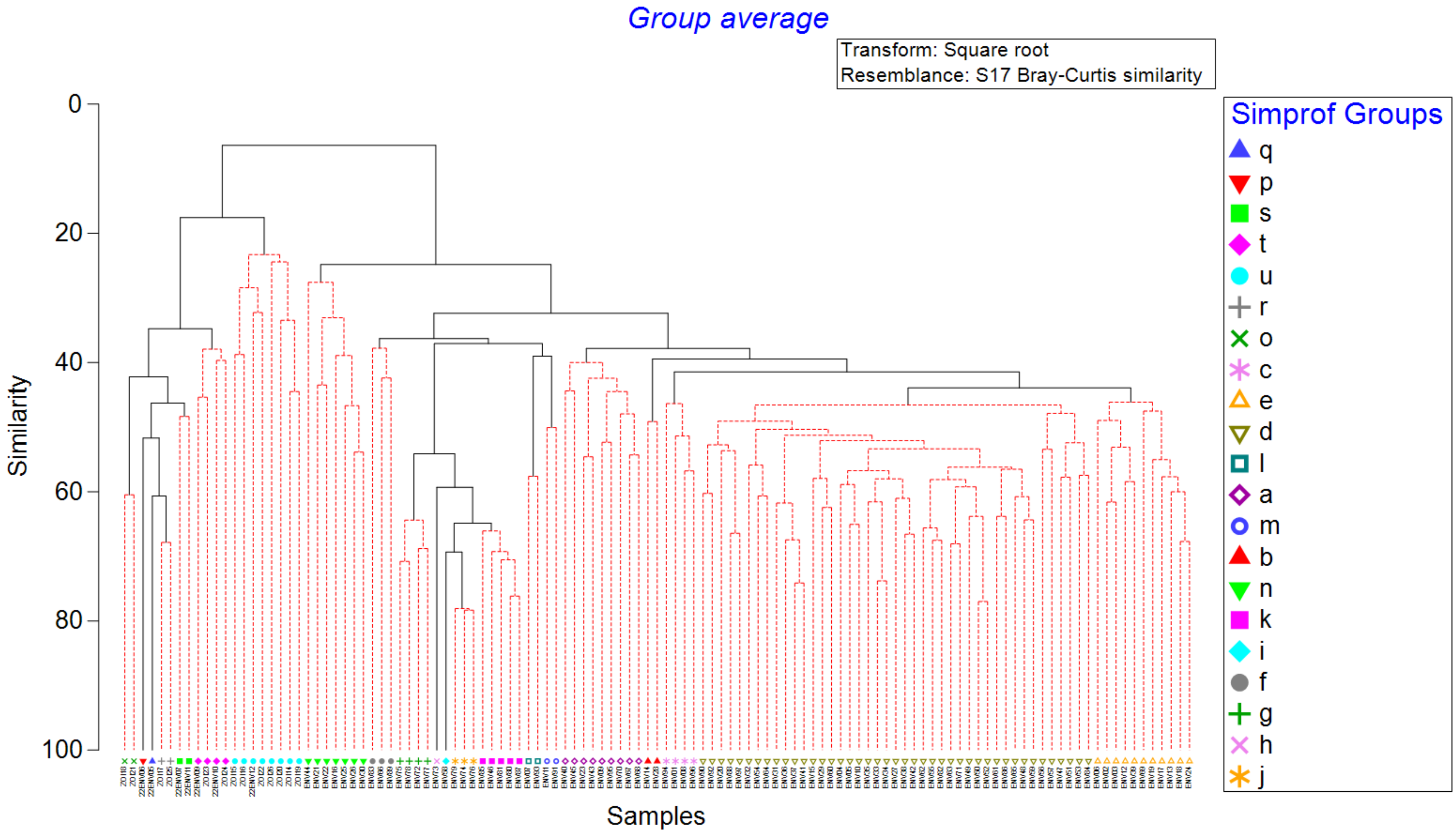


Figure 1.17: Dendrogram of epifaunal communities (from DDV and epifaunal component of grab data).

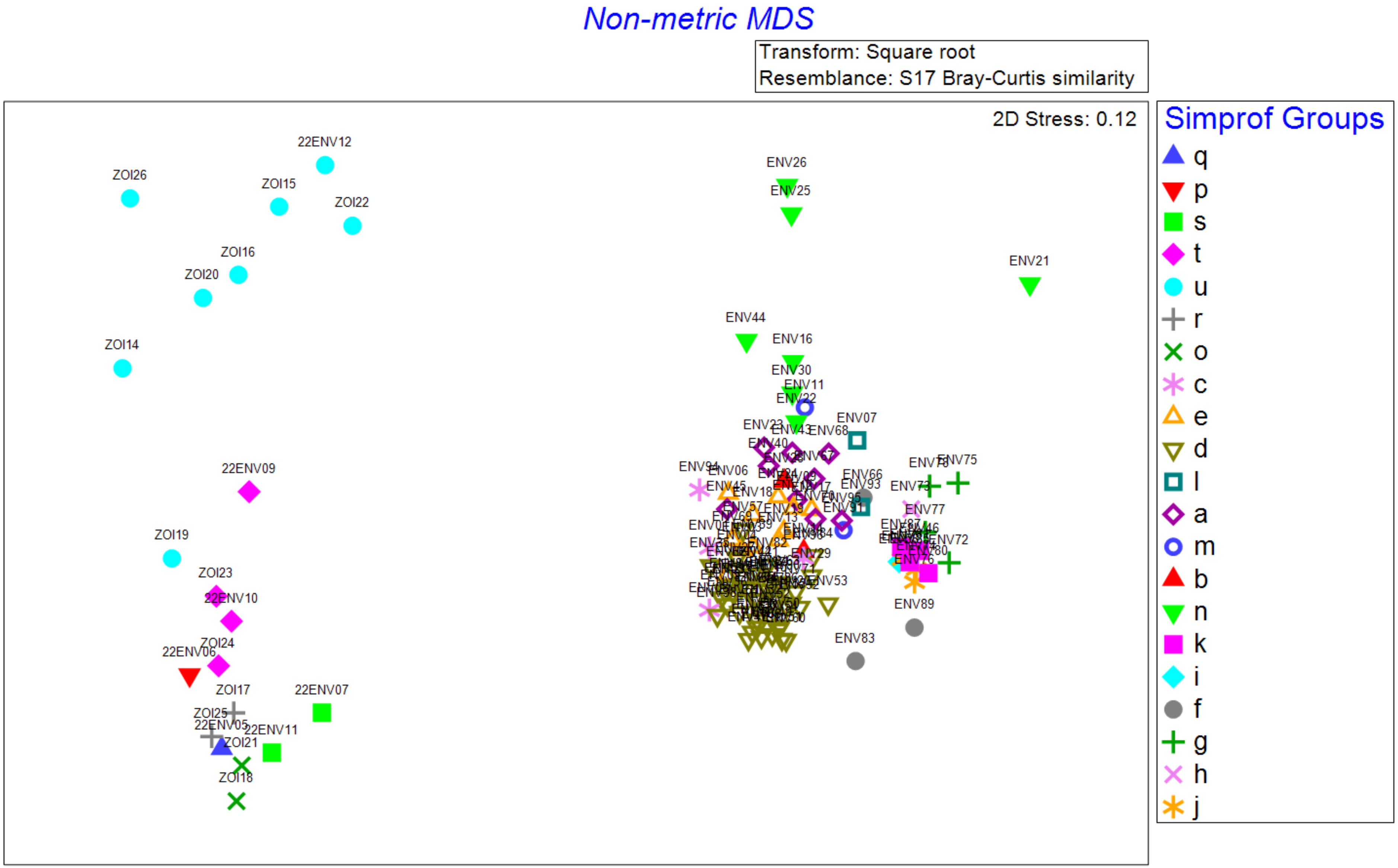
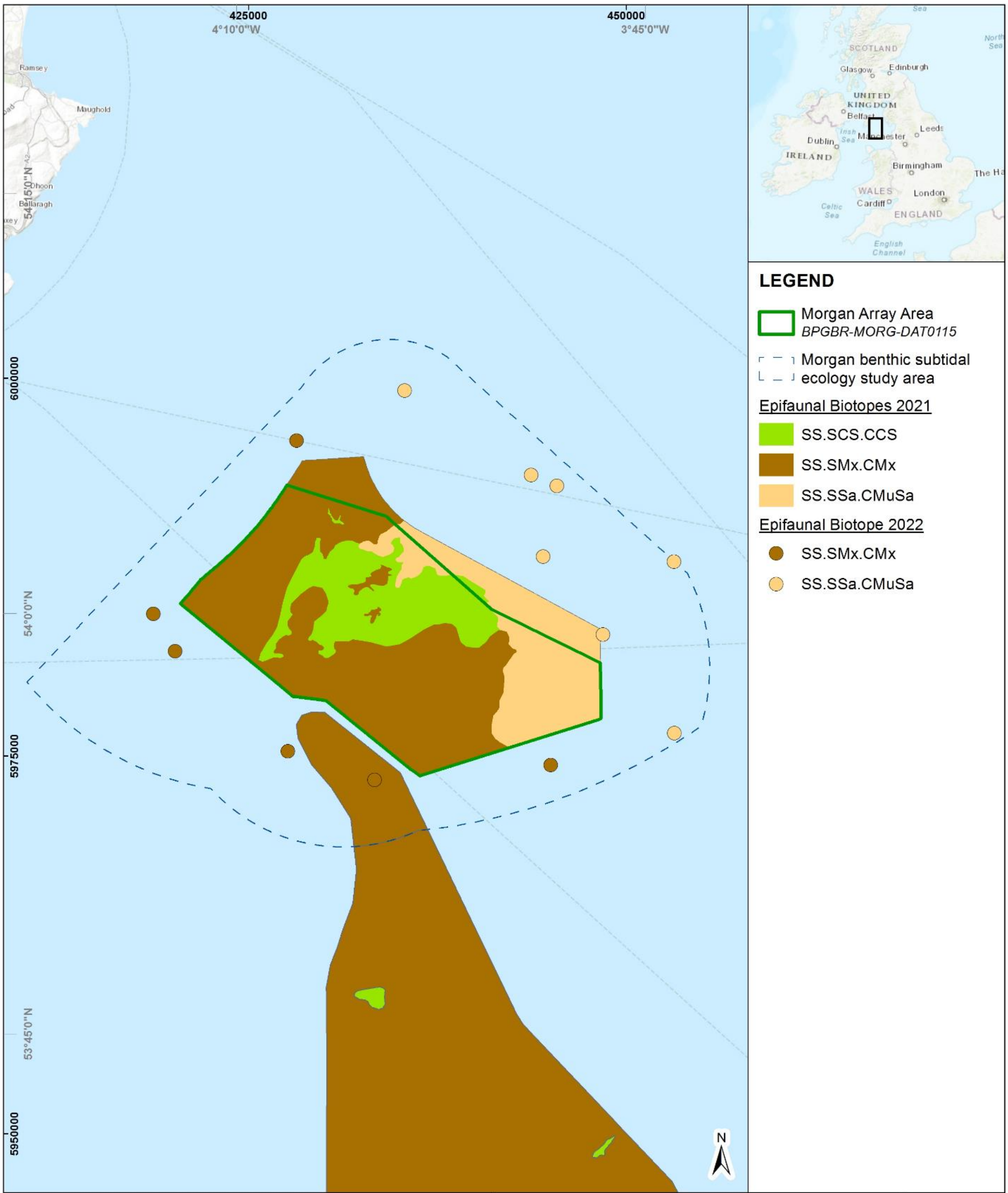


Figure 1.18: 2D MDS plot of epifaunal communities (from DDV and epifaunal component of grab data).

Table 1.14: 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, ZOI17, ZOI18, ZOI21, ZOI23, ZOI24, ZOI25, 22ENV05, 22ENV06, 22ENV09, 22ENV10, 22ENV11	37 to 51	Sand and muddy sand, mixed sediment, coarse sediment	*Nematoda,* faunal turf*, Amphipoda, Paguroidea, Ophiura, Terebellidae, Animalia Tubes, Alcyonium digitatum, Tubularia, 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 benthic subtidal ecology study area. Across the wider regional benthic subtidal ecology study area to the south of the Morgan benthic subtidal ecology study area (i.e. the Mona Offshore Wind Project).
SS.SCS.CCS	ENV07, ENV13, ENV14, ENV17, ENV28, ENV66,	36 to 51	Coarse sediment, mixed sediment	*Animalia Tubes, Serpulidae, Pagurus prideaux, Bryozoan,* Burrows, *Actiniaria, Adamsia palliata,*	Centre of the Morgan Array Area.

Preliminary epifaunal biotopes	Sample station	Water depth range (m)	Sediment classification	Characterising taxa accounting for up to 50% of cumulative similarity (SIMPER)	Geographic location
	ENV78, ENV89, ENV91, ENV93, ENV94			*Alyconium digitatum, Ophiura, Pectinidae, Scaphapoda, Nematoda,* faunal turf, *Tubularia, Ceriantharia, Actinopterygii, Decapoda, Ophiuroidea, Terebellidae, Ascidiacea*	Across the wider regional benthic subtidal ecology study area to the south of the Morgan benthic subtidal ecology study area (i.e. the Mona Offshore Wind Project).
SS.SSa.CMuSa	ENV11, ENV12, ENV16, ENV21, ENV22, ENV25, ENV26, ENV30, ZOI14, ZOI15, ZOI16, ZOI20, ZOI22, ZOI26, 22ENV12	32 to 58	Sand and muddy sand, mud and sandy mud	Faunal turf, *Ophiura, Paguroidea, Astropecten irregularis, Ceriantharia, Alcyonium digitatum, Pagurus bernhardus, Phoronis*	East of the Morgan Array Area. Across the north and east of the Morgan Array Area ZoI.



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

Data Sources: Client, Guardline

Project Name:
MORGAN OFFSHORE WIND PROJECT

0 1 2 4 6 nm
0 1 2 4 6 8 10 12 km

Drawing Number:
RPSE-MG-ES-BEN-012-03

Drawing Title:
PRELIMINARY EPIFAUNAL BIOTOPES IDENTIFIED FROM DDV AND EPIFAUNAL COMPONENT OF THE GRAB SAMPLES WITHIN THE MORGAN BENTHIC SUBTIDAL ECOLOGY STUDY AREA FROM THE SITE-SPECIFIC SURVEYS

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:425,000

VER	DATE	DETAILS	BY	CHECK
00	11/08/23	First Issue	MJ	TH
03	09/04/24	Revision	LM	MK

Figure 1.19: Preliminary epifaunal biotopes identified from DDV and epifaunal component of the grab samples within the Morgan benthic subtidal ecology study area from the site-specific surveys (all biotope codes are defined in Appendix G).

Comparison between Morgan Array Area 2021 and 2022 data

1.7.4.13 To determine if there had been any measurable shift in the communities in the Morgan Array Area between the 2021 and 2022 surveys, seven stations were resampled in 2022 (DDV and grab sampling data) so that the abiotic and biotic conditions could be compared. Analysis of the epifaunal grab sample data from these stations suggested some dissimilarity in the epifaunal communities. A CLUSTER analysis, including a SIMPROF test, did not group the 2021 and 2022 sample stations of the same location together. The results of the SIMPER analysis identified four separate groups with the 2021 and 2022 sample points largely clustered apart. The 2021 samples all clustered in one group and the 2022 samples were clustered in three groups with two groups containing single sample stations. A SIMPER test on these clusters showed a dissimilarity between the two main groups of 97.55%.

1.7.4.14 An ANOSIM test was undertaken which determines if the difference between SIMPROF groups is greater than the difference within SIMPROF groups. The results of this analysis provided an R statistic of 0.90 which suggested that were was a greater difference between Faunal groups than within them. Overall, the conditions within the Morgan benthic subtidal ecology study area are highly changeable allowing for community shift over time however due to the broad biotopes assigned to these sample stations it is reasonable that they can be assigned different cluster groups with varying communities but still be allocated the same biotope.

Univariate analysis

1.7.4.15 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 1.15, with univariate statistics for individual sites presented in Appendix E

1.7.4.16 The biotope SS.SMx.CMx had the highest number of taxa (46.39 ± 8.76) and mean number of individuals (33.99 ± 52.41; Table 1.15); 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 taxa was recorded in association with the SS.SSa.CMuSa biotope (24.38 ± 11.46). The lowest mean number of individuals was recorded in association with the SS.SCS.CCS biotope (12.81 ± 6.97). Overall, the highest number of taxa were recorded at biotopes with greater proportions of coarse substrate and the lowest numbers were recorded in muddy sand sediment habitats.

1.7.4.17 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 = 18.08 ± 11.12 and H' = 2.93 ± 0.24). This was expected, as these biotopes had the highest number of taxa and were characterised by coarser substrate. The communities associated with the SS.SSa.CMuSa biotope had the lowest mean diversity score (d = 10.58 ± 7.15, H' = 2.28 ± 0.44). Overall, the highest diversity was recorded at biotopes with coarser substrate and the lowest was recorded in sand sediment habitats.

1.7.4.18 Pielou's evenness (J') scores showed limited variation across the epifaunal biotopes. Mean J' was 0.76, 0.70 and 0.74 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 0.94 to 1.05, 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 1.15: Mean (± standard deviation) univariate statistics for epifaunal biotopes (from DDV and grab data).

Biotope	S	N	d	J'	H'	λ
SS.SMx.CMx	46.39 ± 8.76	33.99 ± 52.41	18.08 ± 11.12	0.76 ± 0.05	2.93 ± 0.24	1.04 ± 0.31
SS.SCS.CCS	42.55 ± 11.80	12.81 ± 6.97	19.63 ± 9.44	0.70 ± 0.09	2.60 ± 0.44	1.05 ± 0.30
SS.SSa.CMuSa	24.38 ± 11.46	23.85 ± 22.08	10.58 ± 7.15	0.74 ± 0.10	2.28 ± 0.44	0.94 ± 0.13

1.7.5 Results – habitat assessments

Seapens and burrowing megafauna communities assessment

1.7.5.1 Across the Morgan benthic subtidal ecology study area small pencil burrows were observed in the site-specific surveys. Although no seapens were observed during the site-specific surveys, the JNCC (2013) guidance stipulates that the 'seapens and burrowing megafauna communities' habitat can occur without seapens. Additionally the sediment within the Morgan benthic subtidal ecology study area is considered unlikely to be consistent with this habitat as it is predominantly gravelly muddy sand whereas the seapens and burrowing megafauna habitat is characterised by circalittoral fine mud. However as a precaution an analysis of this habitat was undertaken for the stations where burrows were recorded across the Morgan benthic subtidal ecology study area.

1.7.5.2 The assessment 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. The burrowing fauna which formed the burrows were rarely sighted during the survey to confirm the burrow inhabitants; therefore, burrows could not confidently be attributed to any of the classified 'megafauna' species within the 'seapen and burrowing megafauna community' habitat classification. As such, and in keeping with the JNCC report (JNCC, 2013) recommendations, caution should be applied when interpreting these density results as they are not necessarily definitive of the habitats condition.

1.7.5.3 At the 36 stations where burrows were observed, the maximum burrow density varied from 0.02 burrows per m^2 at station ZOI22 in the Morgan Array Area ZoI to 6.62 burrows per m^2 at ENV73 within the Morgan Array Area ZoI. It should be noted that the maximum burrow density is considered to be highly precautionary. This is because total burrows per image were not recorded, rather burrows were assigned a range (i.e. 1 to 5, 6 to 10 etc.) and, to determine the maximum burrow density, the top end of the range bracket was used to obtain the maximum total number of burrows and from that the density then calculated.

1.7.5.4 The majority of burrows were very small and in the 0 to 1 cm size range category with 73% of images from the Morgan benthic subtidal ecology study area falling within this range (see Figure 1.20 for example images). Burrow density was not identified as greater than ‘frequent’ on the SACFOR scale at any station across the Morgan benthic subtidal ecology study area. Within the Morgan Array Area 18 of stations subject to an assessment for the presence of this habitat had an average SACFOR abundance of ‘frequent’, and in the Morgan Array Area ZoI this was less with six stations recording an average SACFOR abundance of ‘frequent’. The average burrow SACFOR per station is presented in Table 1.16.

1.7.5.5 Very few burrows were observed at stations where soft sediment (i.e. fine muds) was dominant (Table 1.16). In combination with an absence of associated fauna and gravelly sediment, it was concluded that these areas have only a negligible resemblance to the ‘seapens and burrowing megafauna communities’ habitat. However, in order to adopt a precautionary approach and on the basis that burrows were observed at an average SACFOR of ‘frequent’ at 24 stations (see Table 1.16 and Figure 1.21), these stations have, for the purposes of the assessment, been assumed to represent the ‘seapens and burrowing megafauna communities’ habitat. It should be noted however, that no seapens were recorded in the Morgan benthic subtidal ecology study area and, as shown in Table 1.16. The sediment within the Morgan benthic subtidal ecology study area is considered unlikely to be consistent with this habitat as it is predominantly gravelly muddy sand whereas the seapens and burrowing megafauna habitat is typically characterised by circalittoral fine mud. It is notable that seven stations in the Morgan Array Area were resampled during the 2022 survey but at those stations where burrows were observed in the 2021 survey, no burrows were visible in the imagery during the 2022 survey. This approach of assuming that the ‘seapens and burrowing megafauna communities’ habitat is present is therefore deemed to be highly precautionary.

1.7.5.6 The full results of the seapens and burrowing megafauna habitat assessment can be found in Table 1.16 with some DDV images of stations assigned an average SACFOR abundance of ‘frequent’ presented in Figure 1.20. As mentioned however in paragraph 1.7.5.1 this conclusion is precautionary as no seapens were observed across the Morgan benthic subtidal ecology study area and the sediment type is unlikely to be compatible with this habitat.

1.7.5.7 During imagery analysis, burrowing fauna not associated with the ‘seapens and burrowing megafauna communities’ habitat locations were observed across the Morgan benthic subtidal ecology study area including *Ceriantharia* and *Ensis* (an abundance of 686 and 200 respectively across the Morgan benthic subtidal ecology study area). There was also no evidence of any species associated with ‘seapens and burrowing megafauna communities’ habitat supporting the conclusion that it is highly unlikely that any habitat across the Morgan benthic subtidal ecology survey area constitutes anything other than a negligible resemblance to the ‘seapens and burrowing megafauna communities’ habitat. However, as stated above, for the purposes of the assessment a precautionary approach has been adopted which assumes that this habitat could be present (with the absence of seapens) at all stations shown in Figure 1.21 where the average burrow SACFOR was frequent or greater.

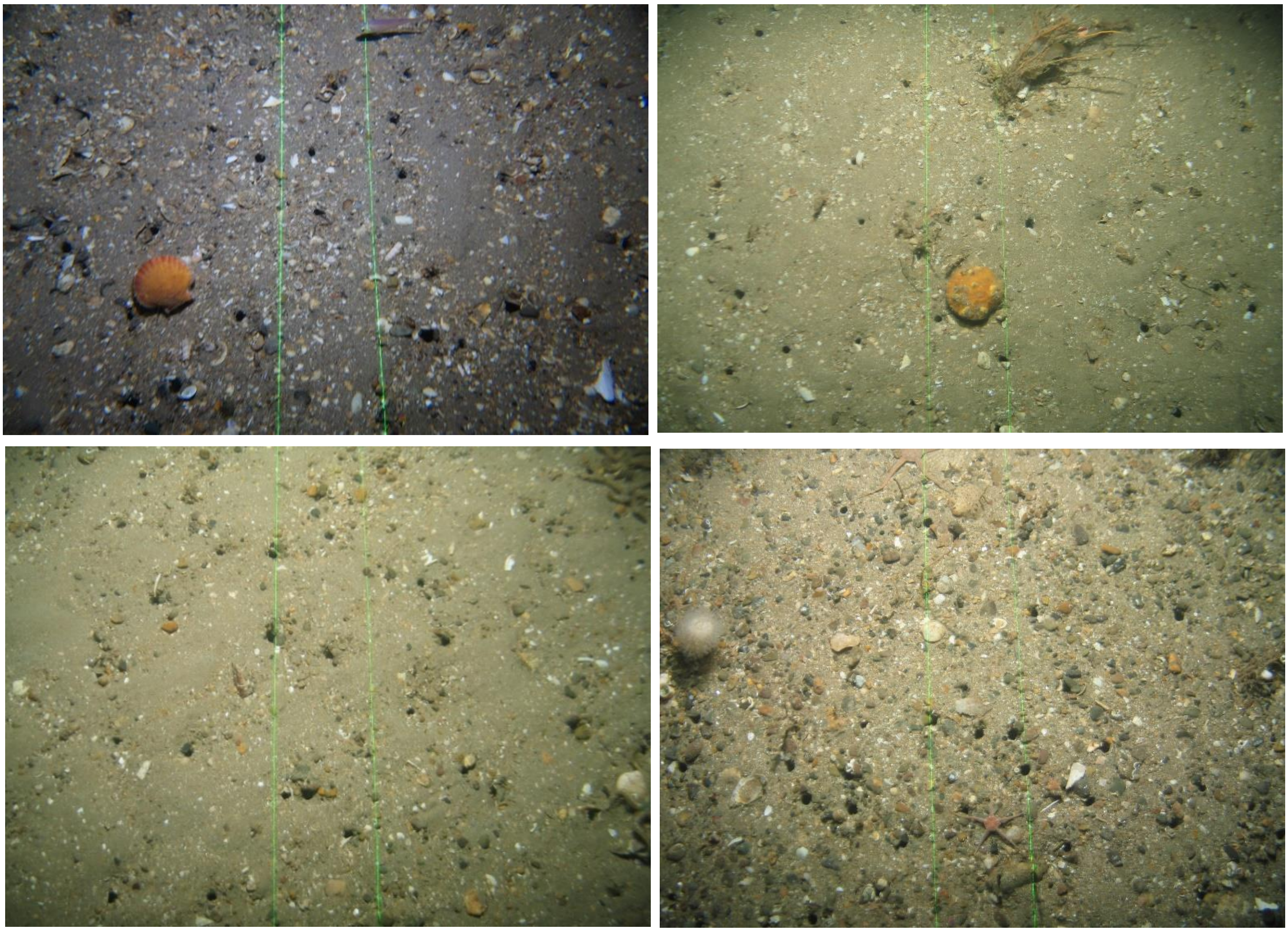


Figure 1.20: DDV images of stations with an average SACFOR abundance of 'frequent' (top left: ENV01, top right: ENV07, bottom left: ENV73 and bottom right: ENV90).

Table 1.16: Seapens and burrowing megafauna assessment within the Morgan benthic subtidal ecology study area.

Station	Total images	Camera transect length (m)	Estimated area investigated (m^2)	Folk sediment classification	Number of burrows				Maximum density m^2	Size of burrows			Average size (cm)	Average SACFOR
					1 to 5	6 to 10	11+	Max Total		0 - 1	1.1 - 3	3 +		
Morgan Array Area														
ENV02 (2021)	102	261	135.80	Gravelly sand	35	19	10	475	3.50	61	2	0	1.0	O
ENV02 (2022)	49	227	223.81	Slightly gravelly sand	0	0	0	0	0	0	0	0	0	N/A
ENV03	77	267	170.17	Gravelly muddy sand	27	29	19	634	3.73	71	4	0	1.0	F
ENV04	100	258	150.86	Gravelly muddy sand	37	40	8	673	4.46	81	4	0	1.0	O
ENV05	84	278	184.97	Muddy sandy gravel	52	30	2	582	3.15	78	6	0	1.0	F
ENV07	97	273	208.27	Gravelly sand	3	1	14	179	0.86	18	0	0	0.9	R
ENV08	104	296	180.41	Gravelly sand	53	8	0	345	1.91	51	10	0	1.2	F
ENV09 (2021)	94	269	178.96	Gravelly muddy sand	36	32	21	731	4.08	21	67	0	2.4	F
ENV09 (2022)	36	254	212.97	Gravelly sand	0	0	0	0	0	0	0	0	0	N/A
ENV10	90	258	145.13	Gravelly muddy sand	67	2	0	355	2.45	46	23	0	1.6	F
ENV11 (2021)	109	331	217.96	Sand	0	0	0	0	0	0	0	0	0	N/A
ENV11 (2022)	49	247	153.32	Sand	0	0	0	0	0	0	0	0	0	N/A
ENV12	91	272	226.66	Slightly gravelly sand	11	5	0	105	0.46	13	3	0	1.3	O

Station	Total images	Camera transect length (m)	Estimated area investigated (m^2)	Folk sediment classification	Number of burrows				Maximum density m^2	Size of burrows			Average size (cm)	Average SACFOR
					1 to 5	6 to 10	11+	Max Total		0 - 1	1.1 - 3	3 +		
ENV13 (2021)	94	281	215.18	Gravelly sand	43	37	14	739	3.43	42	52	0	2.0	F
ENV13 (2022)	57	484	400.68	Gravelly muddy sand	0	0	0	0	0	0	0	0	0	N/A
ENV14	93	278	245.54	Gravelly sand	30	0	0	150	0.61	28	2	0	1.0	O
ENV15	106	292	177.55	Gravelly muddy sand	79	3	0	425	2.39	69	14	0	1.2	F
ENV17	95	275	185.09	Sand	23	36	37	882	4.77	48	48	0	1.9	F
ENV18	92	279	163.11	Gravelly sand	18	48	26	856	5.25	39	53	0	2.1	F
ENV19	81	273	182.01	Gravelly muddy sand	51	28	2	557	3.06	56	25	0	1.5	F
ENV20	104	277	196.79	Gravelly sand	38	1	0	200	1.02	39	0	0	0.9	O
ENV22	95	269	209.32	Sand	0	0	0	0	0	0	0	0	0	N/A
ENV23 (2021)	82	271	169.30	Sand	0	0	0	0	0	0	0	0	0	N/A
ENV23 (2022)	33	332	286.64	Gravelly sand	0	0	0	0	0	0	0	0	0	N/A
ENV24	95	272	173.17	Slightly gravelly sand	66	17	4	539	3.11	65	22	0	1.4	F
ENV25	73	278	169.82	Gravelly sand	0	0	0	0	0	0	0	0	0	N/A
ENV26	83	274	180.98	Sand	0	0	0	0	0	0	0	0	0	N/A
ENV27	84	266	149.91	Sand	81	1	0	415	2.77	79	1	0	0.9	O
ENV28	99	272	228.41	Gravelly muddy sand	11	24	64	999	4.37	48	51	0	1.9	F

Station	Total images	Camera transect length (m)	Estimated area investigated (m^2)	Folk sediment classification	Number of burrows				Maximum density m^2	Size of burrows			Average size (cm)	Average SACFOR
					1 to 5	6 to 10	11+	Max Total		0 - 1	1.1 - 3	3 +		
ENV29	78	274	190.50	Gravelly sand	24	39	15	675	3.54	28	50	0	2.2	F
ENV72 (2021)	89	268	234.62	Gravelly sand with shell fragments	36	10	8	368	1.57	47	7	0	1.2	F
ENV72 (2022)	58	261	135.80	Gravelly sand	0	0	0	0	0	0	0	0	0	N/A
ENV73	143	279	207.17	Gravelly sand with shell fragments.	27	39	77	1372	6.62	88	55	0	1.7	F
ENV90	96	270	213.20	Gravelly muddy sand	6	7	81	991	4.65	35	59	0	2.2	F
ENV91	91	272	210.86	Gravelly muddy sand	40	20	16	576	2.73	68	8	0	1.1	F
ENV92	94	265	285.11	Gravelly muddy sand	11	41	38	883	3.10	42	48	0	2.0	F
ENV93	93	284	274.40	Gravelly sand	34	23	14	554	2.02	69	1	1	1.0	O
22ENV06	56	374	174.63	Gravelly sand	0	0	0	0	0	0	0	0	0	N/A
22ENV07	57	479	375.17	Gravelly sand	0	0	0	0	0	0	0	0	0	N/A
22ENV09	49	266	188.28	Gravelly sand	0	0	0	0	0	0	0	0	0	N/A
22ENV10	48	225	142.89	Gravelly sand	0	0	0	0	0	0	0	0	0	N/A
22ENV11	45	245	177.98	Gravelly sand	0	0	0	0	0	0	0	0	0	N/A
Morgan Array Area ZoI														
ENV01	126	270	160.65	Gravelly muddy sand	40	55	20	970	6.04	97	18	0	1.2	F

Station	Total images	Camera transect length (m)	Estimated area investigated (m^2)	Folk sediment classification	Number of burrows				Maximum density m^2	Size of burrows			Average size (cm)	Average SACFOR
					1 to 5	6 to 10	11+	Max Total		0 - 1	1.1 - 3	3 +		
ENV06	90	272	149.08	Gravelly muddy sand	8	41	41	901	6.04	89	1	0	0.9	O
ENV16	91	270	194.82	Sand	0	0	0	0	0	0	0	0	0	N/A
ENV21	101	314	215.35	Sand	0	0	0	0	0	0	0	0	0	N/A
ENV30	94	268	194.57	Sand	16	0	0	80	0.41	16	0	0	0.9	R
ENV63 (2021)	84	276	186.02	Gravelly sand	73	8	0	445	2.39	72	9	0	1.1	F
ENV63 (2022)	48	1784	956.93	Gravelly sand	0	0	0	0	0	0	0	0	0	N/A
ENV64	70	260	164.85	Muddy sandy gravel	68	4	0	330	2.00	59	3	0	1.0	O
ENV65	75	273	211.05	Gravelly muddy sand	41	32	2	547	2.59	54	19	0	1.4	F
ENV74	97	269	222.46	Gravelly sand	20	52	22	862	3.87	73	21	0	1.3	F
ENV76	105	274	245.90	Coarse, gravelly sand with shell fragments	8	12	10	270	1.10	21	9	0	1.5	F
ENV79	77	273	205.22	Very gravelly sand with shell fragments.	23	39	14	659	3.21	64	12	0	1.2	F
ENV94	85	270	225.75	Gravelly sand	0	0	8	88	0.39	8	0	0	0.9	R
22ENV05	48	328	215.69	Gravelly muddy sand	0	0	0	0	0	0	0	0	0	N/A
22ENV12	42	216	147.67	Sand	0	0	0	0	0	0	0	0	0	N/A

Station	Total images	Camera transect length (m)	Estimated area investigated (m^2)	Folk sediment classification	Number of burrows				Maximum density m^2	Size of burrows			Average size (cm)	Average SACFOR
					1 to 5	6 to 10	11+	Max Total		0 - 1	1.1 - 3	3 +		
ZOI13	49	277	223.81	Slightly gravelly sand	0	0	0	0	0	0	0	0	0	N/A
ZOI14	53	243	189.34	Muddy sand	0	0	0	0	0	0	0	0	0	N/A
ZOI15	41	271	180.40	Muddy sand	NQ	NQ	NQ	16	0.09	NQ	NQ	NQ	2.0	R
ZOI16	61	1853	1377.79	Sand	0	0	0	0	0	0	0	0	0	N/A
ZOI17	48	1784	956.93	Gravelly sand	0	0	0	0	0	0	0	0	0	N/A
ZOI18	55	428	255.37	Gravelly muddy sand	0	0	0	0	0	0	0	0	0	N/A
ZOI19	49	276	228.84	Gravelly sand	0	0	0	0	0	0	0	0	0	N/A
ZOI20	44	222	176.01	Sand	0	0	0	0	0	0	0	0	0	N/A
ZOI21	54	308	257.51	Muddy sandy gravel	0	0	0	0	0	0	0	0	0	N/A
ZOI22	59	261	135.34	Sand	NQ	NQ	NQ	3	0.02	NQ	NQ	NQ	0.8	R
ZOI23	42	243	115.22	Gravelly muddy sand	0	0	0	0	0	0	0	0	0	N/A
ZOI24	56	341	246.05	Slightly gravelly sand	0	0	0	0	0	0	0	0	0	N/A
ZOI25	61	275	201.60	Gravelly sand	0	0	0	0	0	0	0	0	0	N/A
ZOI26	48	214	2425.96	Sand	0	0	0	0	0	0	0	0	0	N/A

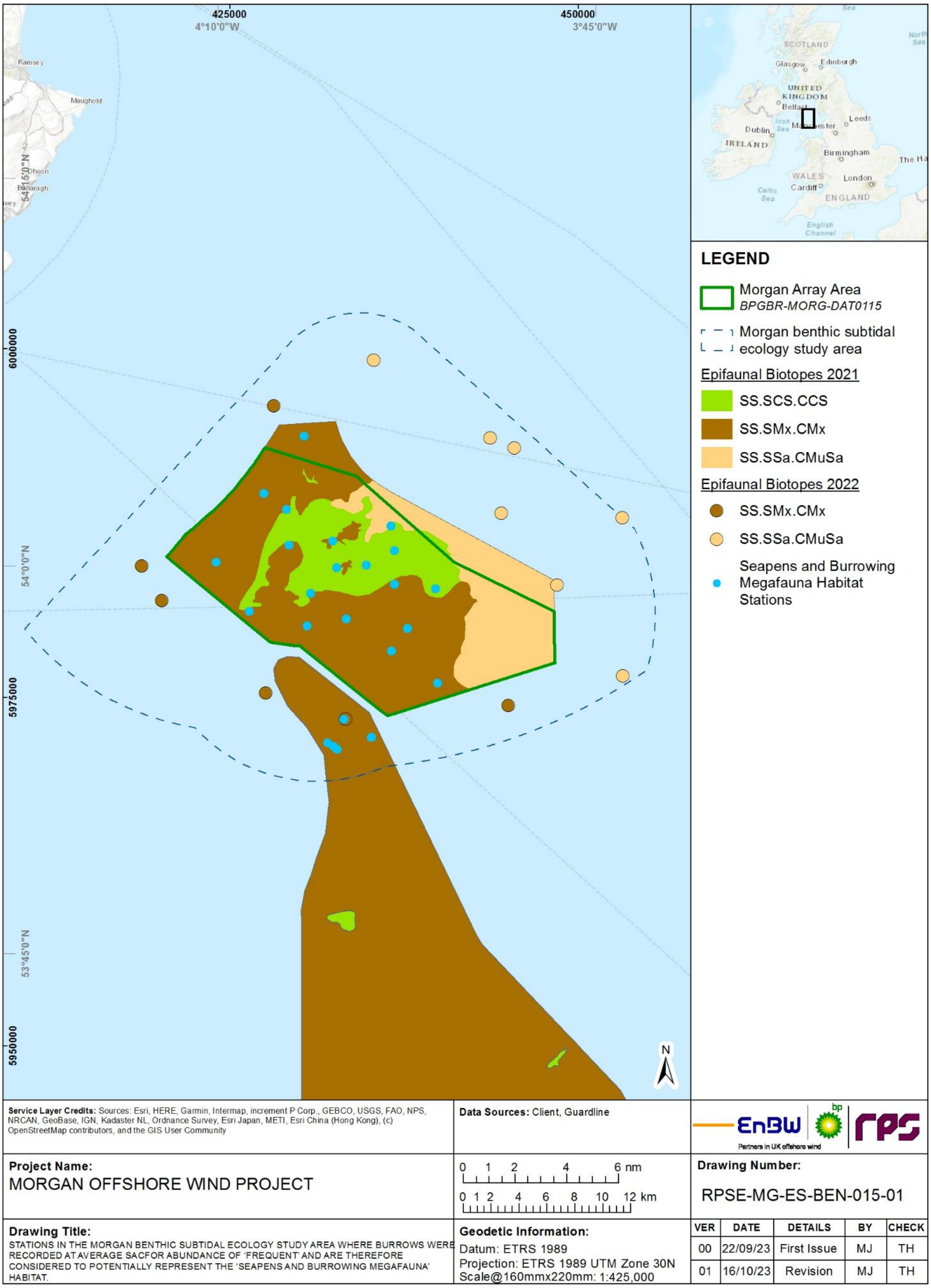


Figure 1.21: Stations in the Morgan benthic subtidal ecology study area where burrows were recorded at average SACFOR abundance of 'Frequent' and are therefore considered to potentially represent the 'seapens and burrowing megafauna' habitat.

Annex I stony reef assessment

1.7.5.8 Seabed imagery indicated potential stony reef at two sample stations (ENV76 and ENV79) in the south of the Morgan Array Area ZoI during the 2021 survey campaign (Figure 1.22 to Figure 1.24). As a result, a full Annex I stony reef assessment was undertaken for these two stations to determine if there was a resemblance to the protected habitat based on criteria set out by Irving (2009) and Golding *et al* (2020). Seabed imagery did not indicate any potential stony reefs within the Morgan Array Area during any of the site-specific surveys.

1.7.5.9 Low resemblance stony reef was recorded in 38 of the 105 images analysed at station ENV76 in the south of the Morgan Array Area ZoI (see Figure 1.22 and Figure 1.24). Station ENV76 occurred along a ridge feature which appeared to be composed of clusters of cobbles (Figure 1.22). The reef height ranged from 0.1 cm to 8.6 cm with the average reef height of 3.93 cm in images where cobbles were observed, and low resemblance reef was identified. The stony reef coverage ranged from 0.33% to 31.86% with an average coverage of 9.59% in images where reef features were observed, and low resemblance reef was identified. Stony reef associated epifauna at this station included *Nemertesia, Tubularia* and faunal turf. On the basis of the above, and in accordance with the Irving (2009) and Golding *et al*. (2020) guidance, the stony reef at ENV76 was considered to represent Annex I low resemblance stony reef (outside a designated site).

1.7.5.10 Low resemblance stony reef was recorded in 14 of the 77 images analysed at station ENV79 located in the south of the Morgan Array Area ZoI and one image was classified as medium resemblance stony reef (see Figure 1.23 and Figure 1.24). Station ENV79 included small, raised relief features in the bathymetry which corresponded with the increased density of cobbles and boulders observed in the imagery (Figure 1.23) but was predominantly composed of a sediment dominated matrix. The reef height ranged from 2.1 cm to 9.3 cm with the average reef height of 4.1 cm in images where reef features were observed, and low resemblance reef was identified. The stony reef coverage ranged from 0.34% to 41.27% with an average coverage of 10.96% in images where reef features were observed, and low resemblance reef was identified. Stony reef associated epifauna at this site included *Nemertesia, Tubularia,* faunal turf*, Metridium dianthus* and *Suberites*. On the basis of the above, and in accordance with the Irving (2009) and Golding *et al*. (2020) guidance, the stony reef at ENV79 was considered to represent Annex I low resemblance stony reef (outside a designated site).

1.7.5.11 No sample stations from the 2022 site specific survey campaign required an assessment for geogenic reef.

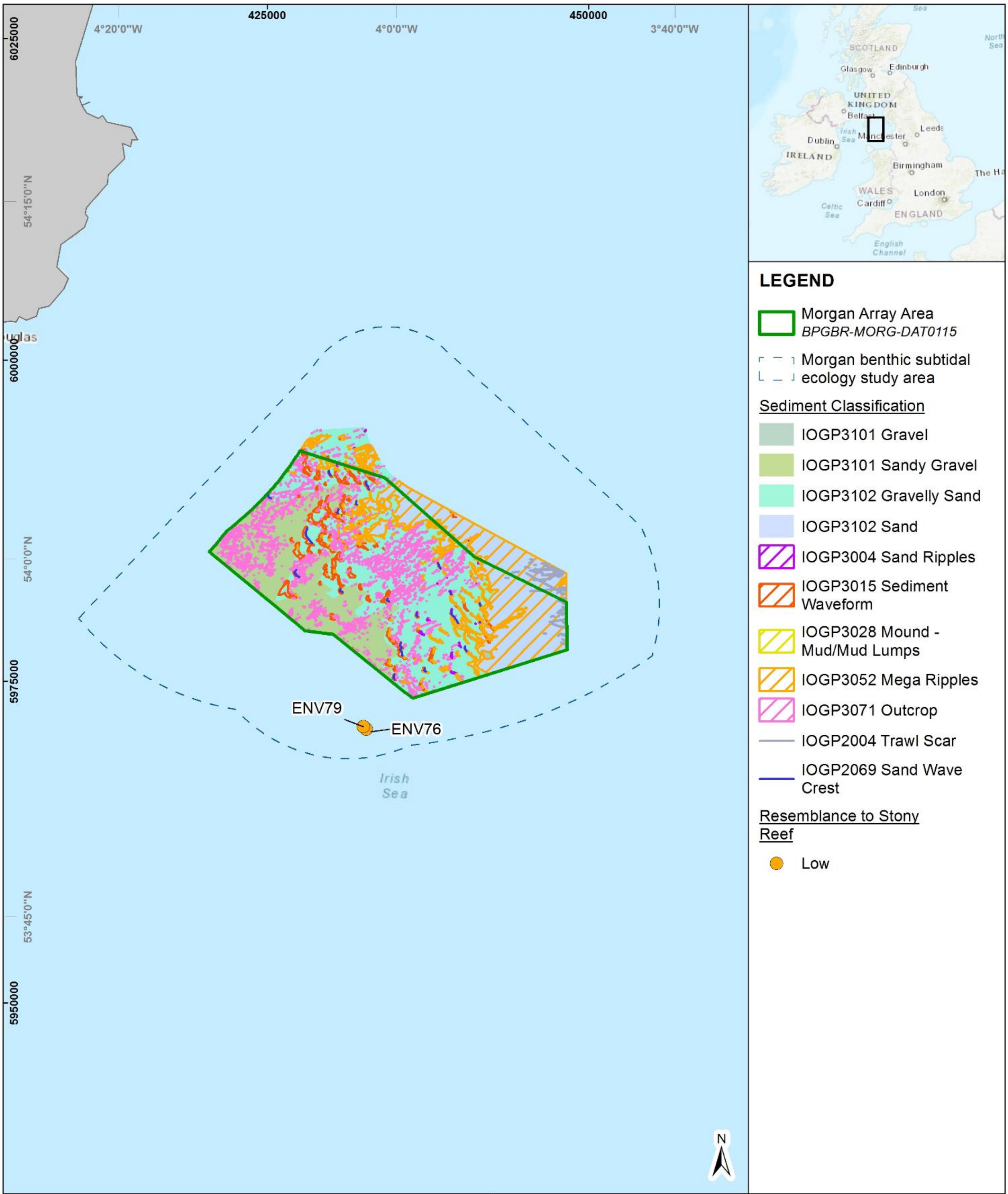
1.7.5.12 In conclusion the stony reef assessments which have been undertaken within the Morgan benthic subtidal ecology study area have been undertaken in accordance with the criteria as set out by Irving (2009) and Golding *et al.* (2020). These assessments have concluded that Annex I low resemblance stony reef was present at two stations within the Morgan Array Area ZoI.

Figure 1.22: Example of typical seabed at sample station ENV76 within the Morgan Array Area ZoI.

Figure 1.23: Example of typical seabed at sample station ENV79 within the Morgan Array Area ZoI.

Table 1.17: Annex I stony reef assessment summary for Morgan Array Area ZoI.

Station	Total Images	Camera Transect Length (m)	Area Investigated (m^2)	Number of Photos with Stony Features	Mean Stony Reef Cover (%)	Range of stony Reef Cover (%)	Range of Reef Height (cm)	Average Reef Height (cm)	Resemblance to Stony Reef	Associated Epifaunal Species	Comments
ENV76	105	274.2	245.9	38	9.59	0.33 to 31.86	0.1 to 8.6	3.93	Low	*Nemertesia*, *Tubularia* and faunal turf	Observations occurred along ridge features targeted by investigation which appeared to be aggregated clusters of cobbles.
ENV79	77	273.5	205.22	21	10.96	0.34 to 41.27	2.1 to 9.3	4.1	Low	*Nemertesia*, *Tubularia*, faunal turf, *Metridium dianthus* and *Suberites*	Small, raised relief features in the bathymetry corresponded with the increased density of cobbles and boulders.



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

Data Sources: Client. Guardline

Project Name:
MORGAN OFFSHORE WIND PROJECT

0 1 2 4 6 nm
0 2.5 5 10 km

Drawing Number:
RPSE-MG-ES-BEN-002-04

Drawing Title:
RESULTS OF THE STONY REEF ASSESSMENTS UNDERTAKEN WITHIN THE MORGAN SUBTIDAL ECOLOGY STUDY AREA

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:500,000

VER	DATE	DETAILS	BY	CHECK
00	09/08/23	First Issue	MJ	TH
04	09/04/24	Revision	LM	MK

Figure 1.24: Results of the stony reef assessments undertaken within the Morgan subtidal ecology study area (based on XOcean 2021 survey).

Fragile sponge and anthozoan communities on subtidal rocky habitats

1.7.5.13 Hard substrate Porifera were observed across the Morgan benthic subtidal ecology study area with 12 stations across the Morgan Array Area and five stations in the Morgan Array Area ZoI showing evidence of Porifera (see Table 1.18). This evidence comprised single/isolated images showing less than 3% of the image, often less than 1%, occupied by lone sponges such as cf. *Polymastia* sp., cf. *Suberites* sp. and cf. *Tethya* sp. Typical densities observed within the images was a sole individual most often found in coarser substrates.

1.7.5.14 At sample station 22ENV07 within the Morgan Array Area (Figure 1.25) 57 stills images were analysed and a sponge (*Suberites*) was recorded in one image at a percentage cover of 2.59% in that one image (Table 1.18). This was the greatest percentage of any image occupied by Porifera across all images analysed across the Morgan benthic subtidal ecology study area. The second highest percentage cover identified in a single image was from station ZOI25in the Morgan Array Area ZoI (Figure 1.26) where, out of 61 stills images analysed, sponges (*Suberites*) were recorded in 13 images and the maximum percentage cover was 1.73% in a single image and the average percentage cover from all images at this station was 0.18% (Table 1.18).

1.7.5.15 At all of the other stations where sponge was recorded in the Morgan benthic subtidal ecology study area, it was limited to a very small number of images at each of these stations (i.e. seven images or less, but typically only one or two). At sample station ZOI13 for example, seven images out of 49 images recorded evidence of hard substrate Porifera but the average percentage cover across the station was very low at <0.2%.

1.7.5.16 Although several of the sponge taxa present (including *P. johnstonia*, *Polymastia* sp., *Suberites* sp., *Raspailia ramosa* and *Tethya* sp.) and non-sponge species (e.g. *Nemertesia* sp. and *A. digitatum*) 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. On the basis of the above, the 'fragile sponge and anthozoan communities on rocky habitat' community was not considered to be present anywhere within the Morgan benthic subtidal ecology study area. The full results of the sponge habitat assessment (i.e. the per image assessment for stations subject to a fragile sponge and anthozoan communities on subtidal rocky habitats assessment) can be found in Appendix B.

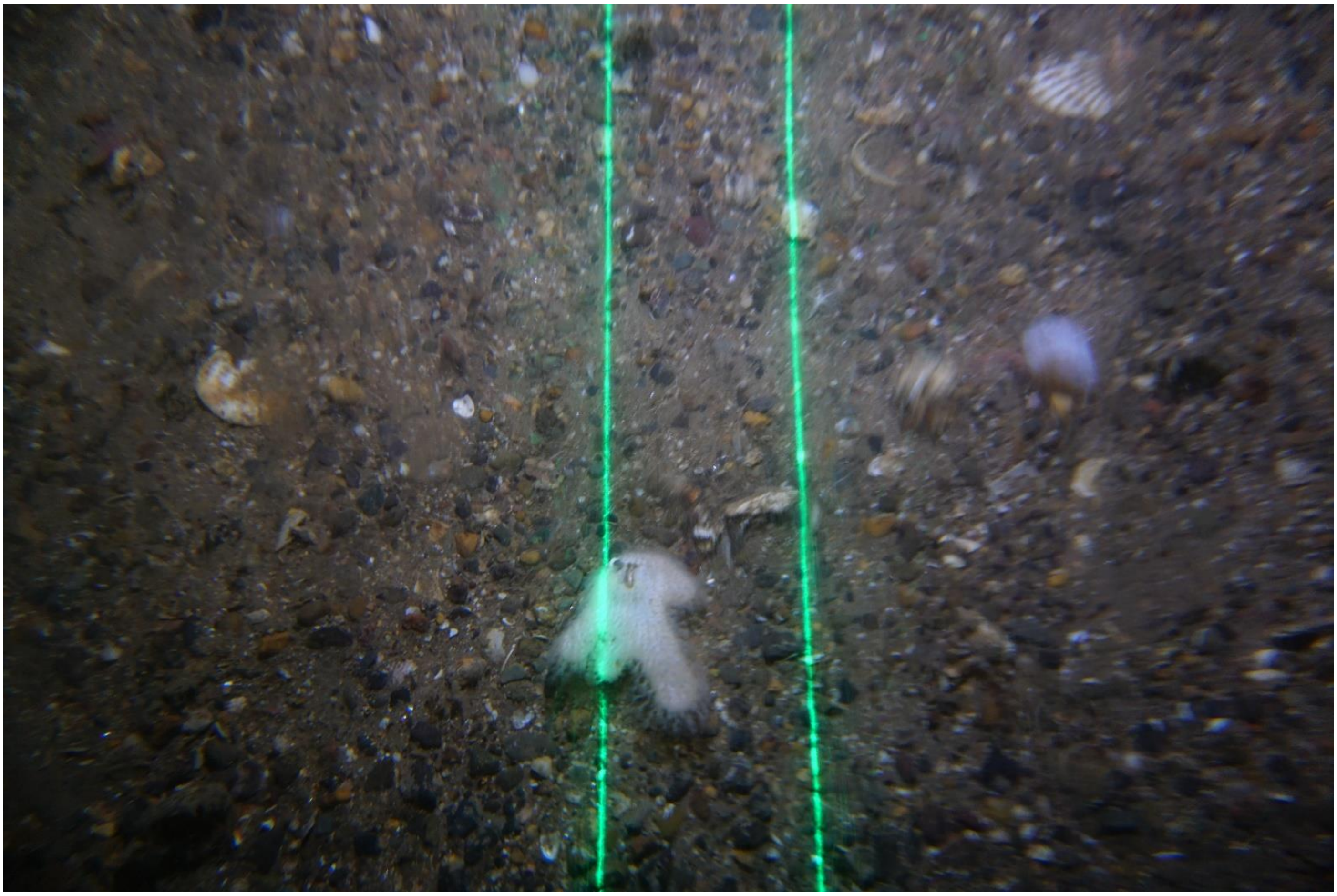


Figure 1.25: Example sponge occurrence at sample station 22ENV07 within the Morgan Array Area ZoI.

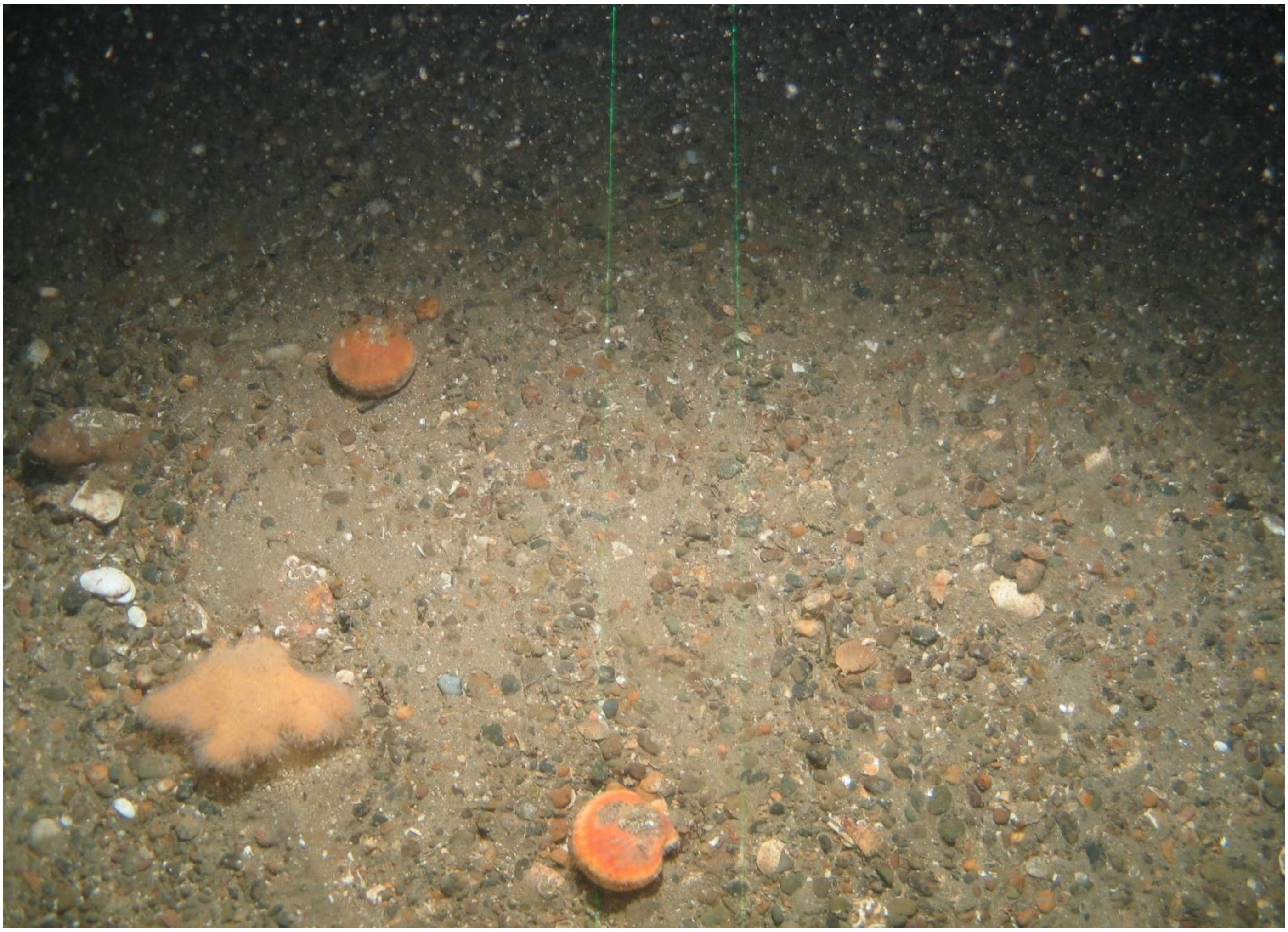


Figure 1.26: Example sponge occurrence at sample station ZOI25 within the Morgan Array Area ZoI.

Table 1.18: Summary of hard substrate Porifera coverage at stations within the Morgan benthic subtidal ecology study area.

Station	Number of Images Assessed with Visibility	Number of Images with Hard Substrate Porifera	Average % coverage of Hard Substrate Porifera	Max % of Hard Substrate Porifera
Morgan Array Area				
ENV02 (2021)	102	6	0.12	0.32
ENV02 (2022)	49	7	0.14	1.61
ENV03	77	0	NA	NA
ENV04	100	0	NA	NA
ENV05	84	1	0.21	0.21
ENV07	97	0	NA	NA
ENV08	104	0	NA	NA
ENV09 (2021)	94	1	0.06	0.06

Station	Number of Images Assessed with Visibility	Number of Images with Hard Substrate Porifera	Average % coverage of Hard Substrate Porifera	Max % of Hard Substrate Porifera
ENV09 (2022)	36	4	0.08	1.62
ENV10	90	0	NA	NA
ENV11 (2021)	109	0	NA	NA
ENV11 (2022)	49	1	0.01	0.30
ENV12	91	0	NA	NA
ENV13 (2021)	94	0	NA	NA
ENV13 (2022)	57	2	0.03	1.04
ENV14	93	1	0.55	0.55
ENV15	106	0	NA	NA
ENV17	95	0	NA	NA
ENV18	92	0	NA	NA
ENV19	81	0	NA	NA
ENV20	104	2	0.30	0.49
ENV22	95	0	NA	NA
ENV23	82	1	0.65	0.65
ENV23 (2022)	33	0	NA	NA
ENV24	95	0	NA	NA
ENV25	73	0	NA	NA
ENV26	83	0	NA	NA
ENV27	84	0	NA	NA
ENV28	99	0	NA	NA
ENV29	78	0	NA	NA
ENV72 (2021)	89	0	NA	NA
ENV72 (2022)	58	1	0.004	0.21
ENV73	143	0	NA	NA
ENV90	96	0	NA	NA
ENV91	91	0	NA	NA
ENV92	94	0	NA	NA
ENV93	93	0	NA	NA
22ENV06	48	5	0.08	1.20
22ENV07	57	1	0.04	2.59
22ENV09	49	0	NA	NA
22ENV10	48	1	0.03	1.23

Station	Number of Images Assessed with Visibility	Number of Images with Hard Substrate Porifera	Average % coverage of Hard Substrate Porifera	Max % of Hard Substrate Porifera
22ENV11	45	0	NA	NA
Morgan Array Area ZoI				
ENV01	126	0	NA	NA
ENV06	90	0	NA	NA
ENV16	91	0	NA	NA
ENV21	101	0	NA	NA
ENV30	94	0	NA	NA
ENV63 (2021)	84	0	NA	NA
ENV63 (2022)	48	5	0.09	1.45
ENV64	70	0	NA	NA
ENV65	75	0	NA	NA
ENV74	97	0	NA	NA
ENV76	105	0	NA	NA
ENV79	77	1	0.09	0.09
ENV94	85	0	NA	NA
22ENV05	56	3	0.06	2.20
22ENV12	42	0	NA	NA
ZOI14	53	0	NA	NA
ZOI15	41	0	NA	NA
ZOI16	61	0	NA	NA
ZOI18	55	0	NA	NA
ZOI19	49	0	NA	NA
ZOI20	44	0	NA	NA
ZOI21	54	0	NA	NA
ZOI22	59	0	NA	NA
ZOI23	42	0	NA	NA
ZOI24	56	6	0.09	1.29
ZOI25	61	13	0.18	1.73
ZOI26	48	0	NA	NA

1.7.6 Results - combined infaunal and epifaunal subtidal biotopes

1.7.6.1 Figure 1.27 presents the combined infaunal and epifaunal biotopes identified across the Morgan benthic subtidal 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.

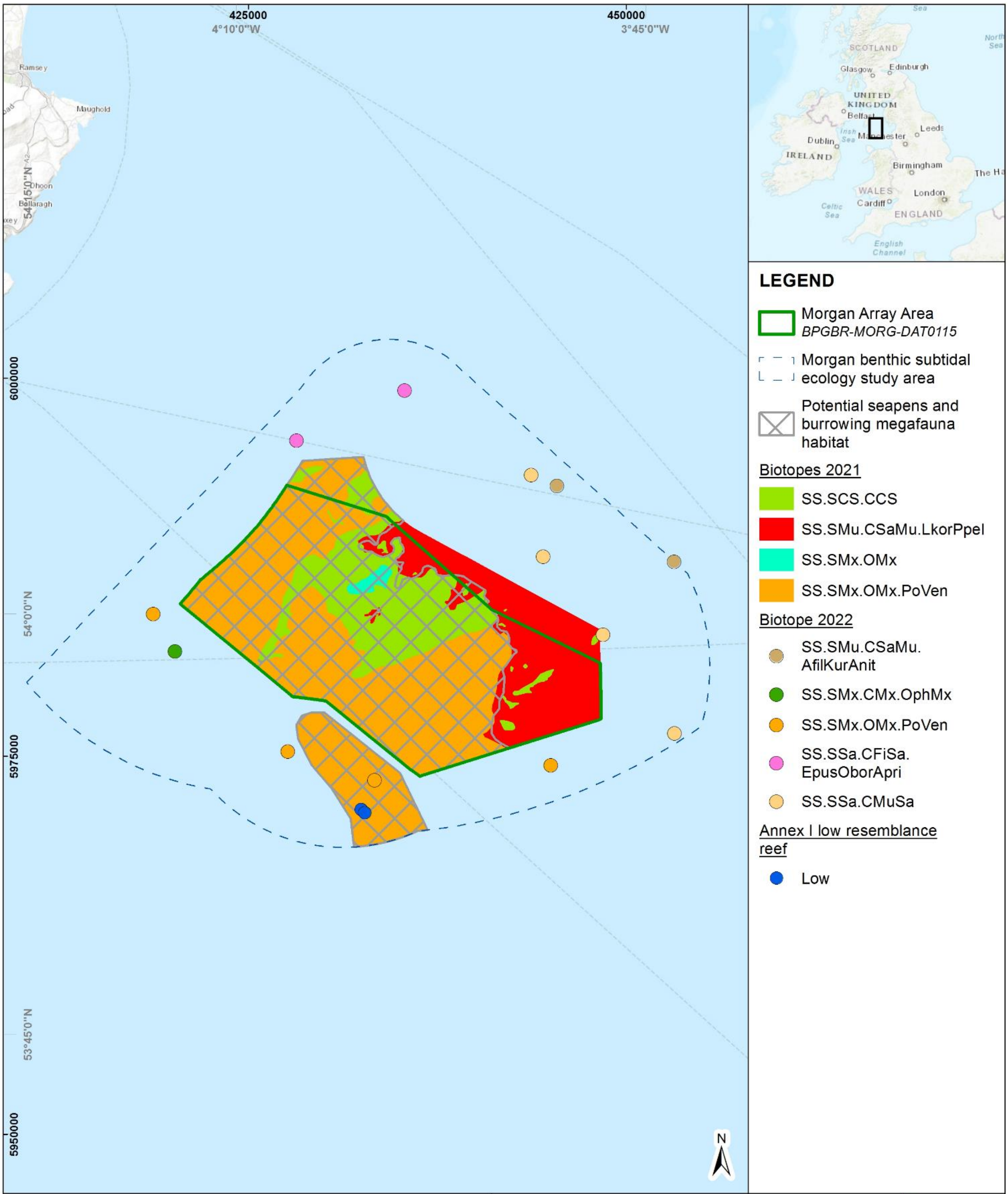
1.7.6.2 The combined biotope map shown in Figure 1.27 confirms many of the patterns described previously for the subtidal communities present in the Morgan benthic subtidal ecology study area when looking at the infaunal and epifaunal data separately. The results of the epifaunal overall supported the more refined classifications resulting from the infaunal analysis.

1.7.6.3 The infaunal and epifaunal biotopes have been combined to assign single biotopes across the Morgan benthic subtidal ecology study 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. To create the biotope maps for the Morgan benthic subtidal ecology study area the sample points were mapped over the geophysical data to ensure that the boundaries between biotopes were aligned with the natural transitions in sediment identified in the geophysical data as well as being mindful of features such as megaripples and sand ripples. The epifaunal data identified a large area of SS.SMx.CMx in the west and most of the south of the Morgan benthic subtidal ecology study area. This was mirrored and expanded upon in the infaunal biotopes which identified SS.SMx.OMx.PoVen across the area mapped from the epifauna as SS.SMx.CMx, with the infaunal communities providing greater insight allowing the identification of a more specific community.

1.7.6.4 Within the Morgan Array Area ZoI the infaunal data also identified an area of SS.SMx.CMx.OphMx at one sample location. The epifaunal analysis identified the SS.SCS.CCS biotope in the centre 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 benthic subtidal ecology study 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. In the north of the Morgan Array Area ZoI infaunal data indicated an area of SS.SSa.CFiSa.EpusOborApri which was assigned based on the greater context provided by infaunal analysis regarding species and sediment composition. In the east of the Morgan Array Area ZoI the communities changed from those typical of the SS.SSa.CMuSa biotope to those associated with the SS.SMu.CSaMu.AfilKurAnit biotope due to the identification of some key infaunal species.

1.7.6.5 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).

1.7.6.6 Based on the habitats assessment presented in section 1.7.5, the potential for the seapens and burrowing fauna habitat to be present across the Morgan benthic subtidal ecology study area was also identified (Figure 1.27). This assessment was primarily based on the abundance of burrows identifies in DDV imagery and is considered to be precautionary. The seapens and burrowing fauna habitat has, however, been mapped as an overlay over the Morgan Array Area and parts of the Morgan Array Area ZoI.



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

Data Sources: Client, Guardline, EMODnet, Seabed Habitats (2021)

Project Name:
MORGAN OFFSHORE WIND PROJECT

0 1 2 4 6 nm
0 1 2 4 6 8 10 12 km

Drawing Number:
RPSE-MG-ES-BEN-014-03

Drawing Title:
COMBINED INFAUNAL AND EPIFAUNAL BIOTOPE MAP OF THE MORGAN BENTHIC SUBTIDAL ECOLOGY STUDY AREA

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:425,000

VER	DATE	DETAILS	BY	CHECK
00	21/09/23	First Issue	MJ	TH
03	09/04/24	Revision	LM	MK

Figure 1.27: Combined infaunal and epifaunal biotope map of the Morgan benthic subtidal ecology study area (all biotope codes are defined in Appendix G).

1.8 Summary

1.8.1.1 The subtidal site-specific surveys consisted of infaunal grab samples and DDV surveys. Subtidal sediments recorded across 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 and sand in the Morgan Array Area ZoI. In the Morgan benthic subtidal ecology study area sediments graded from coarser sediments 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. The Morgan Array Area ZoI was composed of a wide variety of sediment types all of which were dominated by sand with varying proportions of fines and gravels. 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 24 sediment samples from across the Morgan benthic subtidal ecology study area were analysed for sediment chemistry. Overall, levels of contamination were low across the Morgan benthic subtidal ecology study area. Concentrations of most metals were below the Cefas AL1 and the Canadian TEL and all were below the Cefas AL2 and Canadian PEL. The exception was arsenic which exceeded Cefas AL1 at three sample stations however all were below Cefas AL2, and 17 sample stations exceeded Canadian TEL but were below Canadian PEL. No samples were found to exceed the relevant thresholds for PCBs or PAHs in the Morgan benthic subtidal ecology study area. Concentrations of organotins where below the LOD at all stations.

1.8.1.3 The site-specific survey data showed that the benthic communities in the west and south sections of the Morgan benthic subtidal ecology study area were characterised by the polychaete-rich deep Venus community in offshore mixed sediments (SS.SMx.OMx.PoVen) biotope. Additionally in the west, in the Morgan Array Area ZoI, a single station was assigned to the *Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment (SS.SMx.CMx.OphMx) biotope. The centre 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. Further east in the Morgan Array Area ZoI a broader circalittoral muddy sand biotope was prevalent (SS.SSa.CMuSa) which graded into communities characterised by the *Amphiura filiformis*, *Kurtiella bidentata* and *Abra nitida* in circalittoral sandy mud (SS.SMu.CSaMu.AfilKurAnit) biotope at the east edge of the Morgan Array Area ZoI. The habitats and communities in the north of the Morgan Array Area ZoI were characterised by the *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (SS.SSa.CFiSa.EpusOborApri) biotope.

1.8.1.4 The habitat assessment concluded that 24 stations distributed across the Morgan Array Area and the south of the Morgan Array Area ZoI had a negligible resemblance to the ‘seapens and burrowing megafauna communities’ habitat on the basis of the presence of ‘frequent’ burrows on the SACFOR scale. Whilst seapens were not recorded during the site-specific surveys, and whilst the sediment types at these stations was predominantly gravelly muddy sand (and so unlikely to be consistent with this habitat), it was not possible to determine the species which had formed the burrows. Therefore, in order to adopt a precautionary approach, the ‘seapens and burrowing megafauna communities' habitat has been assumed to be potentially present within the Morgan benthic subtidal ecology study area.

1.8.1.5 Annex I stony reef assessments identified two stations which were classified as Annex I low resemblance stony reef in the south of the Morgan Array Area 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 the fragile sponge and anthozoan communities on subtidal rocky 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 1.19). 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 2: Benthic subtidal ecology of the Environmental Statement) and used to assess impacts associated with the construction, operations and maintenance and decommissioning of the Morgan Generation Assets on benthic subtidal ecology.

Table 1.19: IEFs within the regional benthic subtidal ecology study area.

IEF	Description and representative biotopes	Protection status/ Conservation interest	Location	Importance within the regional 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. • SS.SSa.CMuSa • SS.SMu.CSaMu.AfilKurAnit • SS.SMu.CSaMu.LkorPpel • SS.SSa.CFiSa.EpusOborApri.	UK BAP priority habitat Habitat of Principal Importance in England (NERC Act 2006)	In the west of the Morgan benthic subtidal ecology study area (i.e. within the Morgan Generation Assets Red Line Boundary)	National
Subtidal coarse and mixed sediments	Subtidal coarse and mixed sediments characterised by	UK BAP priority habitat	Centre and east of the Morgan benthic subtidal ecology	National

IEF	Description and representative biotopes	Protection status/ Conservation interest	Location	Importance within the regional benthic subtidal ecology study area
with diverse benthic communities	polychaetes, bivalves and mobile crustaceans. • SS.SCS.CCS • SS.SMx.OMx • SS.SMx.OMx.PoVen.	Habitat of Principal Importance in England (NERC Act 2006)	study area (i.e. within the Morgan Generation Assets Red Line Boundary)	
Brittlestar beds	Subtidal mixed sediment dominated by brittlestars which form dense beds. • SS.SMx.CMx.OphMx.	UK BAP priority habitat Habitat of Principal Importance in England (NERC Act 2006)	Southwest of the Morgan Array Area ZoI (i.e. outside the Morgan Generation Assets Red Line Boundary)	National
Annex I low resemblance stony reef (outside an SAC)	Cobbles and boulders with indicator species such as *A. digitatum*, *Nemertesia* sp. and *Tubularia* sp. • CR.HCR.XFa.SpNemAdia.	Annex I habitat outside an SAC	South of the Morgan Array Area ZoI (i.e. outside the Morgan Generation Assets Red Line Boundary)	National
Seapens and burrowing megafauna communities	Plains of fine mud at depths greater than about 15 m may be heavily bioturbated by burrowing megafauna. • SS.SMu.CFiMu.SpnMeg.	UK BAP priority habitat OSPAR habitat Habitat of Principal Importance in England (NERC Act 2006)	Morgan Array Area and south of Morgan Array Area ZoI (i.e. within the Morgan Generation Assets Red Line Boundary)	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 Habitat of Principal Importance in England (NERC Act 2006)	Within wider regional benthic subtidal ecology study area (i.e. outside the Morgan Generation Assets Red Line Boundary)	National
Subtidal sand	Sand seascapes with infaunal polychaetes and bivalves. • SS.SMu.CSaMu.AfilKurAnit • SS.SMx.CMx.KurThyMx.	UK BAP priority habitat Habitat of Principal Importance in England (NERC Act 2006)Protected feature of an MCZ	Within wider regional benthic subtidal ecology study area (i.e. outside the Morgan Generation Assets Red Line Boundary)	National
Sea-pens and burrowing	Fine mud heavily bioturbated by burrowing megafauna; burrows and mounds may form a prominent feature with	OSPAR habitat Habitat of Principal Importance in	Within wider regional benthic subtidal ecology study area (i.e.	National

IEF	Description and representative biotopes	Protection status/ Conservation interest	Location	Importance within the regional benthic subtidal ecology study area
megafauna communities	conspicuous populations of sea pens, typically *Virgularia mirabilis* and *Pennatula phosphorea*. • SS.SMu.CFiMu.SpnMeg.	England (NERC Act 2006) Protected feature of an MCZ	outside the Morgan Generation Assets Red Line Boundary)	
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	Within wider regional benthic subtidal ecology study area (i.e. outside the Morgan Generation Assets Red Line Boundary)	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 Habitat of Principal Importance in England (NERC Act 2006)	Within wider regional benthic subtidal ecology study area (i.e. outside the Morgan Generation Assets Red Line Boundary)	National
Subtidal sand	Sand seascapes with infaunal polychaetes and bivalves. • SS.SMu.CSaMu.AfilKurAnit.	UK BAP priority habitat Habitat of Principal Importance in England (NERC Act 2006) Protected feature of an MCZ	Within wider regional benthic subtidal ecology study area (i.e. outside the Morgan Generation Assets Red Line Boundary)	National

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Appendix A: Seabed sediments

A.1. Results of particle size analysis (Morgan 2021 site specific survey)

Station number	Folk classification	BGS sediment classification (Based on Folk)	Sorting	Major sediment fractions			THC from GC-FID	THC from ultra-violet fluorescence spectroscopy	Total organic carbon
				% Fines	% Sand	% Gravel			
2021 Survey									
ENV01	Gravelly muddy sand	Slightly gravelly sand	Very poor	10.67	78.68	10.65	NC	NC	NC
ENV02	Gravelly sand	Gravelly sand	Poor	7.36	85.32	7.32	NC	NC	NC
ENV03	Gravelly muddy sand	Gravelly sand	Very poor	9.83	79.99	10.19	NC	NC	NC
ENV04	Gravelly muddy sand	Sandy gravel	Very poor	14.12	64.12	21.76	NC	NC	NC
ENV05	Muddy sandy gravel	Sandy gravel	Very poor	6.94	55.89	37.17	4.7	1.5	0.23
ENV06	Gravelly muddy sand	Sandy gravel	Very poor	12.08	77.90	10.03	4.7	1.5	0.24
ENV07	Gravelly sand	Slightly gravelly sand	Poor	2.59	84.46	12.95	NC	NC	NC
ENV08	Gravelly sand	Gravelly sand	Very poor	7.83	78.11	14.06	NC	NC	NC
ENV09	Gravelly muddy sand	Gravelly sand	Poor	10.42	83.54	6.05	NC	NC	NC
ENV10	Gravelly muddy sand	Gravelly sand	Very poor	12.55	62.54	24.91	NC	NC	NC
ENV11	Sand	Slightly gravelly sand	Poor	9.13	90.77	0.10	NC	NC	NC
ENV12	Slightly gravelly sand	Gravelly sand	Poor	6.65	90.36	2.99	3.6	2.1	0.17

Station number	Folk classification	BGS sediment classification (Based on Folk)	Sorting	Major sediment fractions			THC from GC-FID	THC from ultra-violet fluorescence spectroscopy	Total organic carbon
				% Fines	% Sand	% Gravel			
ENV13	Gravelly sand	Gravelly sand	Poor	8.96	84.02	7.02	3.8	2.0	0.18
ENV14	Gravelly sand	Gravelly sand	Poor	8.79	85.55	5.65	4.4	3.7	0.24
ENV15	Gravelly muddy sand	Gravelly sand	Very poor	9.25	67.43	23.31	NC	NC	NC
ENV16	Sand	Sand	Moderate	3.85	95.66	0.48	5.0	2.1	NC
ENV17	Gravelly sand	Slightly gravelly sand	Poor	7.67	84.40	7.93	NC	NC	0.22
ENV18	Gravelly muddy sand	Sandy gravel	Very poor	10.38	72.98	16.64	NC	NC	NC
ENV19	Gravelly muddy sand	Sandy gravel	Very poor	9.00	65.15	25.85	NC	NC	NC
ENV20	Gravelly sand	Muddy sandy gravel	Poor	3.13	83.66	13.21	12.8	<1	0.14
ENV21	Sand	Sand	Poor	9.15	90.79	0.06	8.9	3.7	0.15
ENV22	Sand	Muddy sand	Moderate	2.44	97.25	0.32	NC	NC	NC
ENV23	Slightly gravelly sand	Muddy sand	Poor	3.90	94.35	1.75	NC	NC	NC
ENV24	Gravelly sand	Slightly gravelly sand	Very poor	6.88	77.12	16.00	NC	NC	NC
ENV25	Sand	Sand	Poor	9.23	90.66	0.11	NC	NC	NC
ENV26	Sand	Sand	Moderately well	0.00	99.92	0.08	NC	NC	NC
ENV27	Gravelly muddy sand	Gravelly sand	Very poor	11.45	62.53	26.02	NC	NC	NC
ENV28	Gravelly sand	Slightly gravelly sand	Very poor	4.05	71.09	24.86	NC	NC	NC
ENV29	Gravelly muddy sand	Gravelly sand	Very poor	13.79	76.33	9.88	7.4	2.5	0.28

Station number	Folk classification	BGS sediment classification (Based on Folk)	Sorting	Major sediment fractions % Fines	% Sand	% Gravel	THC from GC-FID	THC from ultra-violet fluorescence spectroscopy	Total organic carbon
ENV30	Sand	Sand	Moderately well	0.00	99.77	0.23	NC	NC	NC
ENV63	Gravelly sand	Muddy sand	Very poor	7.52	73.36	19.12	3.6	2.3	0.18
ENV64	Muddy sandy gravel	Sandy gravel	Very poor	9.81	55.94	34.26	3.7	<1	NC
ENV65	Gravelly muddy sand	Gravelly muddy sand	Very poor	9.65	65.17	25.18	NC	NC	NC
ENV90	Gravelly muddy sand	Gravelly sand	Very poor	11.07	66.13	11.07	NC	NC	NC
ENV91	Gravelly muddy sand	Slightly gravelly sand	Very poor	10.19	84.65	10.19	NC	NC	NC
ENV92	Gravelly muddy sand	Gravelly sand	Very poor	10.30	62.14	10.30	NC	NC	NC
ENV93	Gravelly sand	Slightly gravelly sand	Poor	0.90	85.86	0.90	NC	NC	NC
ENV94	Gravelly sand	Sand	Very poor	7.25	68.73	7.25	NC	NC	NC
2022 Survey									
ENV11	Sand	Slightly gravelly sand	Moderately well	0.47	99.37	0.16	3.8	2.50	0.12
ENV13	Gravelly muddy sand	Gravelly sand	Poor	10.14	84.57	5.29	5.1	5.70	0.21
ENV09	Gravelly sand	Gravelly sand	Poor	4.72	89.51	5.77	NC	NC	NC
22ENV05	Gravelly muddy sand		Very poor	11.15	68.67	20.18	NC	NC	NC
22ENV06	Gravelly sand		Very poor	8.51	78.75	12.73	5.8	4.59	0.22
22ENV07	Gravelly sand		Very poor	6.45	67.40	26.15	NC	NC	NC
ENV23	Gravelly sand	Muddy sand	Poor	1.70	91.64	6.67	1.5	<1	0.19

Station number	Folk classification	BGS sediment classification (Based on Folk)	Sorting	Major sediment fractions			THC from GC-FID	THC from ultra-violet fluorescence spectroscopy	Total organic carbon
				% Fines	% Sand	% Gravel			
22ENV09	Gravelly sand		Very poor	7.59	77.40	15.00	5.6	5.15	0.18
22ENV10	Gravelly sand		Poor	5.86	85.18	8.96	NC	NC	NC
22ENV11	Gravelly sand		Poor	1.79	84.05	14.16	NC	NC	NC
22ENV12	Sand		Poor	6.55	93.37	0.07	NC	NC	NC
ENV02	Slightly gravelly sand	Gravelly sand	Poor	6.83	88.86	4.31	NC	NC	NC
ZOI14	Muddy sand	Slightly gravelly sand	Poor	10.96	89.04	0.00	9.9	5.69	0.22
ZOI15	Muddy sand	Muddy sand	Poor	25.07	74.93	0.00	16.8	37.70	0.36
ZOI16	Sand	Sand	Poor	9.23	90.58	0.19	6.4	3.96	0.14
ZOI17	Gravelly sand	Muddy sandy gravel	Poor	6.35	81.36	12.29	4.0	4.48	0.18
ZOI18	Gravelly muddy sand	Sandy gravel	Very poor	13.89	61.35	24.76	NC	NC	NC
ZOI19	Gravelly sand	Slightly gravelly sand	Poor	0.00	93.50	6.50	NC	NC	NC
ZOI20	Sand	Slightly gravelly sand	Poor	8.43	91.54	0.04	5.1	2.50	0.16
ZOI21	Muddy sandy gravel	Sandy gravel	Extremely poor	14.39	53.55	32.06	4.8	5.36	0.28
ZOI22	Sand	Sand	Poor	7.66	92.27	0.07	4.5	3.22	0.17
ZOI23	Gravelly muddy sand	Muddy sand	Very poor	9.32	75.62	15.06	4.3	5.47	0.24
ZOI24	Slightly gravelly sand	Slightly gravelly sand	Moderate	1.76	93.68	4.56	NC	NC	NC

Station number	Folk classification	BGS sediment classification (Based on Folk)	Sorting	Major sediment fractions			THC from GC-FID	THC from ultra-violet fluorescence spectroscopy	Total organic carbon
				% Fines	% Sand	% Gravel			
ZOI25	Gravelly sand	Gravelly sand	Very poor	6.60	67.12	26.28	4.3	2.06	0.17
ZOI26	Sand	Sand	Poor	9.28	90.62	0.10	NC	NC	NC

A.2. Full PSA analysis results for 2021 survey in Morgan benthic subtidal ecology study area (part 1)

Sample	Easting	Northing	Percentile									Folk and Ward Graphic								
			Phi5	Phi10	Phi16	Phi25	Phi50	Phi75	Phi84	Phi90	Phi95	Mean µm	Mean Phi	Wentworth	Sorting value	Sorting description	Skewness value	Skewness description	Kurtosis value	Kurtosis description
ENV 01	430333	5993745	-1.91	-1.10	-0.35	0.35	1.26	1.96	2.56	4.62	7.00	449.21	1.15	Medium sand	2.1	Very poor	0.09	Symmetrical	2.28	Very leptokurtic
ENV 02	428608	5991267	-1.32	-0.71	-0.05	0.42	1.22	1.83	2.20	2.91	6.15	458.59	1.12	Medium sand	1.7	Poor	0.09	Symmetrical	2.16	Very leptokurtic
ENV 03	427451	5989645	-1.67	-1.02	-0.53	0.09	1.17	2.16	2.83	3.93	6.97	448.58	1.16	Medium sand	2.2	Very poor	0.16	Fine	1.71	Very leptokurtic
ENV 04	424030	5987160	-3.19	-2.55	-1.72	-0.60	1.44	2.34	3.33	6.32	7.87	493.91	1.02	Medium sand	2.9	Very poor	-0.04	Symmetrical	1.54	Very leptokurtic
ENV 05	424020	5984718	-3.36	-3.16	-2.84	-2.03	0.24	1.64	2.06	2.62	6.15	1133.06	-0.18	Very coarse sand	2.7	Very poor	-0.01	Symmetrical	1.06	Mesokurtic
ENV 06	433590	5991426	-2.16	-1.01	0.00	0.41	1.42	2.21	2.87	5.54	7.40	371.36	1.43	Medium sand	2.2	Very poor	0.13	Fine	2.17	Very leptokurtic
ENV 07	431893	5988908	-1.74	-1.24	-0.82	-0.27	0.71	1.57	1.87	2.17	2.70	666.66	0.58	Coarse sand	1.3	Poor	-0.12	Coarse	0.99	Mesokurtic
ENV 08	429063	5988475	-2.20	-1.44	-0.79	0.12	1.11	1.86	2.39	3.13	6.47	535.29	0.90	Coarse sand	2.1	Very poor	0.02	Symmetrical	2.04	Very leptokurtic

Sample	Easting	Northing	Percentile Phi5	Phi10	Phi16	Phi25	Phi50	Phi75	Phi84	Phi90	Phi95	Folk and Ward Graphic Mean µm	Mean Phi	Wentworth	Sorting value	Sorting description	Skewness value	Skewness description	Kurtosis value	Kurtosis description
ENV 09	432398	5986201	-1.23	-0.21	0.25	0.69	1.46	2.09	2.58	4.43	7.21	371.19	1.43	Medium sand	1.9	Poor	0.16	Fine	2.47	Very leptokurtic
ENV 10	426400	5981162	-3.37	-2.77	-2.07	-0.99	1.10	2.13	2.79	5.71	7.52	655.10	0.61	Coarse sand	2.9	Very poor	-0.06	Symmetrical	1.43	Leptokurtic
ENV 11	436576	5988729	0.61	1.02	1.30	1.57	1.95	2.41	2.81	3.58	6.73	246.75	2.02	Fine sand	1.3	Poor	0.35	Very fine	2.97	Very leptokurtic
ENV 12	434849	5986265	-0.64	0.05	0.36	0.78	1.47	1.99	2.41	2.94	5.69	375.73	1.41	Medium sand	1.5	Poor	0.13	Fine	2.14	Very leptokurtic
ENV 13	434800	5984481	-1.36	-0.56	0.11	0.55	1.39	2.09	2.50	3.44	6.88	396.79	1.33	Medium sand	1.8	Poor	0.13	Fine	2.19	Very leptokurtic
ENV 14	430639	5983733	-1.15	-0.07	0.29	0.70	1.46	2.14	2.59	3.35	6.75	367.38	1.44	Medium sand	1.8	Poor	0.16	Fine	2.25	Very leptokurtic
ENV 15	430556	5980121	-3.25	-2.71	-1.97	-0.72	1.08	2.02	2.49	3.42	7.02	690.33	0.53	Coarse sand	2.7	Very poor	-0.10	Coarse	1.54	Very leptokurtic
ENV 16	442096	5986107	0.40	0.81	1.10	1.36	1.77	2.17	2.37	2.50	3.19	298.58	1.74	Medium sand	0.7	Moderate	-0.02	Symmetrical	1.42	Leptokurtic
ENV 17	439762	5982810	-1.75	-0.64	0.04	0.30	1.04	1.93	2.37	2.92	6.32	450.09	1.15	Medium sand	1.8	Poor	0.23	Fine	2.04	Very leptokurtic
ENV 18	437760	5979963	-2.42	-1.64	-1.06	-0.22	1.36	2.13	2.57	4.39	7.03	515.99	0.95	Coarse sand	2.3	Very poor	-0.07	Symmetrical	1.65	Very leptokurtic

Sample	Easting	Northing	Percentile									Folk and Ward Graphic								
			Phi5	Phi10	Phi16	Phi25	Phi50	Phi75	Phi84	Phi90	Phi95	Mean µm	Mean Phi	Wentworth	Sorting value	Sorting description	Skewness value	Skewness description	Kurtosis value	Kurtosis description
ENV 19	436609	5978328	-3.17	-2.74	-2.15	-1.10	1.15	2.03	2.45	3.30	6.99	713.61	0.49	Coarse sand	2.7	Very poor	-0.14	Coarse	1.33	Leptokurtic
ENV 20	434864	5975849	-2.01	-1.28	-0.86	-0.44	0.25	0.91	1.62	2.18	2.74	791.60	0.34	Coarse sand	1.3	Poor	0.07	Symmetrical	1.44	Leptokurtic
ENV 21	445657	5984166	0.72	1.12	1.47	1.64	2.03	2.42	2.75	3.51	6.80	235.77	2.08	Fine sand	1.2	Poor	0.34	Very fine	3.17	Extremely leptokurtic
ENV 22	443326	5980948	0.13	0.30	0.51	0.73	1.31	1.83	2.04	2.30	2.59	410.74	1.28	Medium sand	0.8	Moderate	0.00	Symmetrical	0.92	Mesokurtic
ENV 23	441270	5978119	-0.46	-0.12	0.07	0.21	0.69	1.69	2.13	2.42	3.00	513.17	0.96	Coarse sand	1.0	Poor	0.37	Very fine	0.96	Mesokurtic
ENV 24	439904	5976028	-3.46	-2.16	-1.00	0.19	1.24	2.07	2.37	2.77	6.17	548.00	0.87	Coarse sand	2.3	Very poor	-0.15	Coarse	2.10	Very leptokurtic
ENV 25	447757	5980285	1.16	1.53	1.63	1.78	2.15	2.46	2.78	3.44	6.83	219.53	2.19	Fine sand	1.1	Poor	0.37	Very fine	3.45	Extremely leptokurtic
ENV 26	446613	5978646	0.68	1.08	1.33	1.56	1.88	2.23	2.35	2.44	2.57	276.01	1.86	Medium sand	0.5	Moderately well	-0.18	Coarse	1.17	Leptokurtic
ENV 27	426335	5988006	-3.22	-2.57	-1.97	-1.10	1.10	2.16	2.88	5.15	7.41	628.40	0.67	Coarse sand	2.8	Very poor	-0.04	Symmetrical	1.34	Leptokurtic
ENV 28	436806	5985536	-3.52	-3.09	-2.21	-0.98	0.83	1.71	1.98	2.33	3.04	871.20	0.20	Coarse sand	2.0	Very poor	-0.39	Very coarse	1.00	Mesokurtic

Sample	Easting	Northing	Percentile									Folk and Ward Graphic								
			Phi5	Phi10	Phi16	Phi25	Phi50	Phi75	Phi84	Phi90	Phi95	Mean µm	Mean Phi	Wentworth	Sorting value	Sorting description	Skewness value	Skewness description	Kurtosis value	Kurtosis description
ENV 29	433347	5980618	-1.80	-0.99	-0.19	0.41	1.60	2.47	3.21	6.17	7.74	343.87	1.54	Medium sand	2.3	Very poor	0.12	Fine	1.90	Very leptokurtic
ENV 30	440271	5986893	0.31	0.65	1.02	1.25	1.68	1.97	2.16	2.31	2.43	325.22	1.62	Medium sand	0.6	Moderately well	-0.22	Coarse	1.19	Leptokurtic
ENV 63	433183	5973412	-3.13	-2.45	-1.50	-0.05	1.52	2.10	2.39	2.87	6.31	573.03	0.80	Coarse sand	2.4	Very poor	-0.27	Coarse	1.79	Very leptokurtic
ENV 64	429880	5975699	-3.35	-3.09	-2.67	-1.82	0.56	2.01	2.44	3.82	6.92	927.55	0.11	Coarse sand	2.8	Very poor	-0.01	Symmetrical	1.10	Mesokurtic
ENV 65	432045	5971748	-3.28	-2.73	-1.90	-1.02	1.25	2.13	2.47	3.72	6.95	656.99	0.61	Coarse sand	2.6	Very poor	-0.16	Coarse	1.33	Leptokurtic
ENV 66	433146	5958808	-1.13	-0.61	-0.29	0.02	0.31	0.66	0.84	0.96	1.26	821.18	0.28	Coarse sand	0.6	Moderately well	-0.13	Coarse	1.54	Very leptokurtic
ENV 67	449859	5947111	-0.80	-0.01	0.10	0.24	0.64	1.06	1.33	1.53	1.86	619.41	0.69	Coarse sand	0.7	Moderate	0.01	Symmetrical	1.33	Leptokurtic
ENV 68	452816	5942556	0.06	0.33	0.62	1.01	1.59	1.99	2.31	2.67	6.04	351.82	1.51	Medium sand	1.3	Poor	0.17	Fine	2.50	Very leptokurtic
ENV 69	445014	5945647	-3.21	-2.53	-2.05	-1.23	0.53	1.27	1.98	5.57	7.28	898.07	0.16	Coarse sand	2.6	Very poor	0.00	Symmetrical	1.72	Very leptokurtic
ENV 90	429245	5985927	-3.07	-2.44	-1.84	-0.61	0.80	1.58	2.18	5.06	7.24	768.45	0.38	Coarse sand	2.6	Very poor	-0.03	Symmetrical	1.93	Very leptokurtic

Sample	Easting	Northing	Percentile									Folk and Ward Graphic								
			Phi5	Phi10	Phi16	Phi25	Phi50	Phi75	Phi84	Phi90	Phi95	Mean µm	Mean Phi	Wentworth	Sorting value	Sorting description	Skewness value	Skewness description	Kurtosis value	Kurtosis description
ENV 91	436564	5987302	-1.06	0.05	0.36	0.81	1.55	2.09	2.44	4.18	7.05	366.15	1.45	Medium sand	1.7	Poor	0.11	Fine	2.58	Very leptokurtic
ENV 92	432717	5984307	-4.29	-4.07	-3.41	-1.53	1.02	1.91	2.44	4.25	7.15	987.06	0.02	Coarse sand	3.2	Very poor	-0.22	Coarse	1.36	Leptokurtic
ENV 93	430337	5991128	-1.51	-1.20	-0.91	-0.62	0.09	0.60	0.86	1.06	1.38	992.51	0.01	Coarse sand	0.9	Moderate	-0.12	Coarse	0.97	Mesokurtic
ENV 94	439711	5986142	-3.19	-2.64	-1.94	-0.83	1.18	1.90	2.25	2.69	6.40	706.62	0.50	Coarse sand	2.5	Very poor	-0.20	Coarse	1.44	Leptokurtic

A.3. Full PSA analysis results for 2021 survey in Morgan benthic subtidal ecology study area (part 2)

Station	Mean µm	Mean Phi	Wentworth	Sorting value	Sorting description	Skewness value	Skewness description	Kurtosis value	Kurtosis description	Fines	Sands	Gravels	Modified	Eunis
ENV01	354.40	1.50	Medium sand	2.43	Very poor	1.41	Very fine	6.42	Leptokurtic	10.67	78.68	10.65	Gravelly muddy sand	Mixed sediments
ENV02	384.28	1.38	Medium sand	2.03	Very poor	1.87	Very fine	8.96	Very leptokurtic	7.36	85.32	7.32	Gravelly sand	Coarse sediments
ENV03	365.17	1.45	Medium sand	2.42	Very poor	1.49	Very fine	6.51	Leptokurtic	9.83	79.99	10.19	Gravelly muddy sand	Mixed sediments
ENV04	364.56	1.46	Medium sand	3.12	Very poor	0.87	Fine	4.19	Leptokurtic	14.12	64.12	21.76	Gravelly muddy sand	Mixed sediments
ENV05	878.60	0.19	Coarse sand	2.78	Very poor	1.14	Fine	5.20	Leptokurtic	6.94	55.89	37.17	Muddy sandy gravel	Mixed sediments
ENV06	310.20	1.69	Medium sand	2.57	Very poor	1.32	Very fine	5.86	Leptokurtic	12.08	77.90	10.03	Gravelly muddy sand	Mixed sediments
ENV07	612.53	0.71	Coarse sand	1.66	Poor	1.62	Very fine	11.06	Very leptokurtic	2.59	84.46	12.95	Gravelly sand	Coarse sediments
ENV08	437.85	1.19	Medium sand	2.33	Very poor	1.36	Very fine	7.00	Leptokurtic	7.83	78.11	14.06	Gravelly sand	Coarse sediments
ENV09	290.67	1.78	Medium sand	2.28	Very poor	1.80	Very fine	7.59	Very leptokurtic	10.42	83.54	6.05	Gravelly muddy sand	Mixed sediments

Station	Mean µm	Mean Phi	Wentworth	Sorting value	Sorting description	Skewness value	Skewness description	Kurtosis value	Kurtosis description	Fines	Sands	Gravels	Modified	Eunis
ENV10	469.64	1.09	Medium sand	3.07	Very poor	0.95	Fine	4.37	Leptokurtic	12.55	62.54	24.91	Gravelly muddy sand	Mixed sediments
ENV11	197.22	2.34	Fine sand	1.76	Poor	2.73	Very fine	11.78	Very leptokurtic	9.13	90.77	0.10	Sand	Sand and muddy sand
ENV12	318.97	1.65	Medium sand	1.82	Poor	2.21	Very fine	10.92	Very leptokurtic	6.65	90.36	2.99	Slightly gravelly sand	Sand and muddy sand
ENV13	322.92	1.63	Medium sand	2.23	Very poor	1.74	Very fine	7.93	Very leptokurtic	8.96	84.02	7.02	Gravelly sand	Coarse sediments
ENV14	303.45	1.72	Medium sand	2.15	Very poor	1.86	Very fine	8.71	Very leptokurtic	8.79	85.55	5.65	Gravelly sand	Coarse sediments
ENV15	502.98	0.99	Coarse sand	2.80	Very poor	0.97	Fine	5.11	Leptokurtic	9.25	67.43	23.31	Gravelly muddy sand	Mixed sediments
ENV16	269.50	1.89	Medium sand	1.37	Poor	3.34	Very fine	21.94	Very leptokurtic	3.85	95.66	0.48	Sand	Sand and muddy sand
ENV17	399.79	1.32	Medium sand	2.16	Very poor	1.68	Very fine	8.34	Very leptokurtic	7.67	84.40	7.93	Gravelly sand	Coarse sediments
ENV18	393.60	1.35	Medium sand	2.60	Very poor	1.17	Fine	5.62	Leptokurtic	10.38	72.98	16.64	Gravelly muddy sand	Mixed sediments
ENV19	522.33	0.94	Coarse sand	2.80	Very poor	0.96	Fine	4.91	Leptokurtic	9.00	65.15	25.85	Gravelly muddy sand	Mixed sediments
ENV20	754.27	0.41	Coarse sand	1.74	Poor	1.92	Very fine	11.55	Very leptokurtic	3.13	83.66	13.21	Gravelly sand	Coarse sediments

Station	Mean µm	Mean Phi	Wentworth	Sorting value	Sorting description	Skewness value	Skewness description	Kurtosis value	Kurtosis description	Fines	Sands	Gravels	Modified	Eunis
ENV21	189.44	2.40	Fine sand	1.74	Poor	2.81	Very fine	12.12	Very leptokurtic	9.15	90.79	0.06	Sand	Sand and muddy sand
ENV22	373.60	1.42	Medium sand	1.26	Poor	4.04	Very fine	28.90	Very leptokurtic	2.44	97.25	0.32	Sand	Sand and muddy sand
ENV23	470.16	1.09	Medium sand	1.57	Poor	2.80	Very fine	14.75	Very leptokurtic	3.90	94.35	1.75	Slightly gravelly sand	Sand and muddy sand
ENV24	463.48	1.11	Medium sand	2.44	Very poor	0.83	Fine	6.20	Leptokurtic	6.88	77.12	16.00	Gravelly sand	Coarse sediments
ENV25	172.90	2.53	Fine sand	1.69	Poor	3.00	Very fine	13.11	Very leptokurtic	9.23	90.66	0.11	Sand	Sand and muddy sand
ENV26	281.87	1.83	Medium sand	0.55	Moderately well	-0.99	Coarse	4.99	Leptokurtic	0.00	99.92	0.08	Sand	Sand and muddy sand
ENV27	480.60	1.06	Medium sand	3.00	Very poor	0.99	Fine	4.50	Leptokurtic	11.45	62.53	26.02	Gravelly muddy sand	Mixed sediments
ENV28	731.76	0.45	Coarse sand	2.33	Very poor	0.60	Fine	5.61	Leptokurtic	4.05	71.09	24.86	Gravelly sand	Coarse sediments
ENV29	270.79	1.88	Medium sand	2.70	Very poor	1.21	Fine	5.27	Leptokurtic	13.79	76.33	9.88	Gravelly muddy sand	Mixed sediments
ENV30	334.62	1.58	Medium sand	0.62	Moderately well	-0.96	Coarse	5.31	Leptokurtic	0.00	99.77	0.23	Sand	Sand and muddy sand
ENV63	453.30	1.14	Medium sand	2.52	Very poor	0.75	Fine	5.46	Leptokurtic	7.52	73.36	19.12	Gravelly sand	Coarse sediments

Station	Mean µm	Mean Phi	Wentworth	Sorting value	Sorting description	Skewness value	Skewness description	Kurtosis value	Kurtosis description	Fines	Sands	Gravels	Modified	Eunis
ENV64	678.44	0.56	Coarse sand	2.99	Very poor	0.98	Fine	4.38	Leptokurtic	9.81	55.94	34.26	Muddy sandy gravel	Mixed sediments
ENV65	502.91	0.99	Coarse sand	2.83	Very poor	0.88	Fine	4.71	Leptokurtic	9.65	65.17	25.18	Gravelly muddy sand	Mixed sediments
ENV90	524.07	0.93	Coarse sand	2.83	Very poor	1.23	Fine	5.36	Leptokurtic	11.07	66.13	22.80	Gravelly muddy sand	Mixed sediments
ENV91	288.15	1.80	Medium sand	2.23	Very poor	1.63	Very fine	7.71	Very leptokurtic	10.19	84.65	5.16	Gravelly muddy sand	Mixed sediments
ENV92	645.24	0.63	Coarse sand	3.23	Very poor	0.60	Fine	3.97	Leptokurtic	10.30	62.14	27.56	Gravelly muddy sand	Mixed sediments
ENV93	962.18	0.06	Coarse sand	1.15	Poor	3.35	Very fine	31.46	Very leptokurtic	0.90	85.86	13.24	Gravelly sand	Coarse sediments
ENV94	541.83	0.88	Coarse sand	2.63	Very poor	0.97	Fine	5.74	Leptokurtic	7.25	68.73	24.01	Gravelly sand	Coarse sediments

A.4. Full PSA analysis results for 2021 survey in Morgan benthic subtidal ecology study area (part 3)[4]

Sample	Other central tendency measures						
	Median	Description	1st Local maxima (Mode)	Description	2nd Local maxima	Description	3rd Local maxima	Description
ENV01	1.26	Medium sand	1.50	Medium sand	-0.50	Very coarse sand	7.00	Fine silt
ENV02	1.22	Medium sand	1.50	Medium sand	-0.50	Very coarse sand		
ENV03	1.17	Medium sand	1.50	Medium sand	-3.00	Pebble	7.00	Fine silt
ENV04	1.44	Medium sand	2.00	Medium sand	-3.00	Pebble	-1.00	Granule
ENV05	0.24	Coarse sand	-3.00	Pebble	2.00	Medium sand	-1.50	Granule
ENV06	1.42	Medium sand	2.00	Medium sand	0.50	Coarse sand	-0.50	Very coarse sand
ENV07	0.71	Coarse sand	0.50	Coarse sand	-0.50	Very coarse sand		
ENV08	1.11	Medium sand	1.50	Medium sand	-0.50	Very coarse sand	-3.00	Pebble
ENV09	1.46	Medium sand	2.00	Medium sand	7.00	Fine silt		
ENV10	1.10	Medium sand	2.00	Medium sand	-2.50	Pebble	-0.50	Very coarse sand
ENV11	1.95	Medium sand	2.00	Medium sand	7.00	Fine silt		
ENV12	1.47	Medium sand	2.00	Medium sand				
ENV13	1.39	Medium sand	2.00	Medium sand	-0.50	Very coarse sand	7.00	Fine silt
ENV14	1.46	Medium sand	2.00	Medium sand	-0.50	Very coarse sand	7.50	Very fine silt

[4] The other central tendancy measures is a statistical representation of the sediment size disribution. Some samples will only have a 1st local maximum indicating one sediment size dominstated the sample. The more local maximums which are established the more mixed the sediment at this station will be.

Sample	Other central tendency measures							
	Median	Description	1st Local maxima (Mode)	Description	2nd Local maxima	Description	3rd Local maxima	Description
ENV15	1.08	Medium sand	1.50	Medium sand	-2.50	Pebble	7.00	Fine silt
ENV16	1.77	Medium sand	2.00	Medium sand				
ENV17	1.04	Medium sand	0.50	Coarse sand	-2.50	Pebble		
ENV18	1.36	Medium sand	2.00	Medium sand	0.50	Coarse sand	-0.50	Very coarse sand
ENV19	1.15	Medium sand	2.00	Medium sand	-3.00	Pebble	7.50	Very fine silt
ENV20	0.25	Coarse sand	0.50	Coarse sand	2.50	Fine sand	-3.00	Pebble
ENV21	2.03	Fine sand	2.50	Fine sand	7.00	Fine silt		
ENV22	1.31	Medium sand	2.00	Medium sand				
ENV23	0.69	Coarse sand	0.50	Coarse sand	2.50	Fine sand		
ENV24	1.24	Medium sand	2.00	Medium sand	1.00	Coarse sand	-3.50	Pebble
ENV25	2.15	Fine sand	2.50	Fine sand	7.00	Fine silt		
ENV26	1.88	Medium sand	2.00	Medium sand				
ENV27	1.10	Medium sand	2.00	Medium sand	-1.50	Granule	7.50	Very fine silt
ENV28	0.83	Coarse sand	2.00	Medium sand	0.50	Coarse sand	-3.00	Pebble
ENV29	1.60	Medium sand	2.00	Medium sand	0.50	Coarse sand	-0.50	Very coarse sand
ENV30	1.68	Medium sand	2.00	Medium sand				
ENV63	1.52	Medium sand	2.00	Medium sand	-3.00	Pebble		
ENV64	0.56	Coarse sand	2.00	Medium sand	-3.00	Pebble	0.50	Coarse sand
ENV65	1.25	Medium sand	2.00	Medium sand	0.50	Coarse sand	-3.00	Pebble

Sample	Other central tendency measures							
	Median	Description	1st Local maxima (Mode)	Description	2nd Local maxima	Description	3rd Local maxima	Description
ENV90	0.80	Coarse sand	1.50	Medium sand	-1.50	Granule	7.00	Fine silt
ENV91	1.55	Medium sand	2.00	Medium sand	-0.50	Very coarse sand	7.00	Fine silt
ENV92	1.02	Medium sand	2.00	Medium sand	-4.00	Pebble	0.50	Coarse sand
ENV93	0.09	Coarse sand	0.50	Coarse sand				
ENV94	1.18	Medium sand	2.00	Medium sand	-2.50	Pebble		

A.5. Full PSA analysis results for 2022 survey in Morgan benthic subtidal ecology study area (part 1)

Sample	Easting	Northing	Phi5	Phi10	Phi16	Phi25	Phi50	Phi75	Phi84	Phi90	Phi95	Mean µm (Folk and Ward)	Mean Phi (Folk and Ward)	Wentworth (Folk and Ward)	Sorting value (Folk and Ward)	Sorting description (Folk and Ward)
ENV11	436576	5988729	0.51	0.84	1.12	1.42	1.80	2.18	2.35	2.46	2.78	295.96	1.76	Medium sand	0.65	Moderately well
ENV72	430769	5982471	-1.92	-1.64	-1.40	-1.13	-0.42	0.79	1.16	1.42	1.87	1164.82	-0.22	Very coarse sand	1.22	Poor
ENV13	434800	5984487	-1.07	-0.26	0.31	0.77	1.48	2.14	2.57	4.09	7.17	365.32	1.45	Medium sand	1.81	Poor
ENV09	432396	5986200	-1.17	-0.26	0.23	0.66	1.32	1.83	2.05	2.41	3.62	434.47	1.20	Medium sand	1.18	Poor
22ENV 05	435141	5977322	-3.03	-2.29	-1.55	-0.21	1.28	2.19	2.55	4.92	7.26	590.24	0.76	Coarse sand	2.58	Very poor
22ENV 06	431274	5992764	-2.40	-1.50	-0.44	0.62	1.52	1.98	2.38	2.96	6.66	449.05	1.16	Medium sand	2.08	Very poor
22ENV 07	426470	5985608	-3.22	-2.74	-2.06	-1.12	1.07	1.87	2.26	2.69	5.64	745.32	0.42	Coarse sand	2.42	Very poor
ENV23	441260	5978234	-1.22	-0.76	-0.38	0.04	0.78	1.51	1.87	2.17	2.49	592.42	0.76	Coarse sand	1.13	Poor
22ENV 09	444561	5980579	-2.92	-2.14	-0.64	1.06	1.84	2.33	2.52	2.92	6.16	422.46	1.24	Medium sand	2.17	Very poor

Sample	Easting	Northing	Phi5	Phi10	Phi16	Phi25	Phi50	Phi75	Phi84	Phi90	Phi95	Mean µm (Folk and Ward)	Mean Phi (Folk and Ward)	Wentworth (Folk and Ward)	Sorting value (Folk and Ward)	Sorting description (Folk and Ward)
22ENV 10	438070	5981684	-1.67	-0.91	-0.39	0.24	1.26	1.98	2.33	2.67	5.04	477.97	1.07	Medium sand	1.69	Poor
22ENV 11	430574	5987585	-1.45	-1.20	-0.96	-0.75	-0.05	1.03	1.38	1.70	2.20	918.28	0.12	Coarse sand	1.14	Poor
22ENV 12	444219	5985259	0.78	1.13	1.38	1.58	1.93	2.34	2.49	2.92	5.64	261.91	1.93	Medium sand	1.01	Poor
ENV02	428608	5991267	-0.88	-0.07	0.38	0.81	1.42	1.94	2.33	2.91	5.67	385.29	1.38	Medium sand	1.48	Poor
ZOI14	445418	5992880	1.31	1.63	1.87	2.07	2.37	2.81	3.02	4.44	7.24	186.94	2.42	Fine sand	1.19	Poor
ZOI15	453173	5987872	2.14	2.28	2.44	2.59	2.91	4.01	6.41	7.53	8.60	66.00	3.92	Very fine sand	1.97	Poor
ZOI16	453192	5976521	1.16	1.53	1.63	1.79	2.15	2.44	2.71	3.48	6.82	223.01	2.16	Fine sand	1.13	Poor
ZOI17	433333	5973416	-2.63	-1.46	-0.34	0.77	1.66	2.17	2.40	2.73	5.43	423.23	1.24	Medium sand	1.91	Poor
ZOI18	418704	5984419	-4.10	-3.17	-2.27	-0.96	1.41	2.39	3.24	6.15	7.85	575.53	0.80	Coarse sand	3.19	Very poor
ZOI19	435333	5999183	-1.36	-0.40	0.31	0.89	1.56	1.96	2.16	2.32	2.45	393.10	1.35	Medium sand	1.04	Poor

Sample	Easting	Northing	Phi5	Phi10	Phi16	Phi25	Phi50	Phi75	Phi84	Phi90	Phi95	Mean µm (Folk and Ward)	Mean Phi (Folk and Ward)	Wentworth (Folk and Ward)	Sorting value (Folk and Ward)	Sorting description (Folk and Ward)
ZOI20	443708	5993601	0.95	1.20	1.45	1.67	2.14	2.52	2.85	3.36	6.56	225.47	2.15	Fine sand	1.20	Poor
ZOI21	420146	5981925	-5.87	-5.74	-5.58	-3.65	1.02	2.80	3.82	4.73	7.27	1186.36	-0.25	Very coarse sand	4.34	Extremely poor
ZOI22	444501	5988189	0.76	1.13	1.48	1.71	2.18	2.51	2.81	3.05	6.31	224.82	2.15	Fine sand	1.17	Poor
ZOI23	445008	5974394	-2.60	-1.86	-0.84	0.47	1.57	2.13	2.42	2.99	7.03	483.53	1.05	Medium sand	2.27	Very poor
ZOI24	428189	5995887	-0.93	-0.20	0.24	0.62	1.21	1.69	1.89	2.07	2.41	462.44	1.11	Medium sand	0.92	Moderate
ZOI25	427608	5975313	-3.00	-2.61	-2.02	-1.15	1.23	2.02	2.35	2.70	5.87	697.75	0.52	Coarse sand	2.44	Very poor
ZOI26	448470	5983030	1.03	1.46	1.67	1.95	2.28	2.65	2.89	3.54	6.80	206.00	2.28	Fine sand	1.18	Poor

A.6. Full PSA analysis results for 2022 survey in Morgan benthic subtidal ecology study area (part 2)

Sample	Skewness value (Folk and Ward)	Skewness description (Folk and Ward)	Kurtosis value (Folk and Ward)	Kurtosis Description (Folk and Ward)	Mean µm (Method of Moments)	Mean Phi (Method of Moments)	Wentworth (Method of Moments)
ENV11	-0.12	Coarse	1.23	Leptokurtic	295.97	1.76	Medium sand
ENV72	0.23	Fine	0.81	Platykurtic	1088.51	-0.12	Very coarse sand
ENV13	0.17	Fine	2.46	Very leptokurtic	289.76	1.79	Medium sand
ENV09	-0.12	Coarse	1.67	Very leptokurtic	389.34	1.36	Medium sand
22ENV05	-0.11	Coarse	1.75	Very leptokurtic	415.77	1.27	Medium sand
22ENV06	-0.13	Coarse	2.72	Very leptokurtic	367.10	1.45	Medium sand
22ENV07	-0.21	Coarse	1.21	Leptokurtic	621.14	0.69	Coarse sand
ENV23	-0.05	Symmetrical	1.04	Mesokurtic	570.69	0.81	Coarse sand
22ENV09	-0.31	Very coarse	2.93	Very leptokurtic	340.08	1.56	Medium sand
22ENV10	-0.04	Symmetrical	1.58	Very leptokurtic	418.86	1.26	Medium sand
22ENV11	0.23	Fine	0.84	Platykurtic	853.08	0.23	Coarse sand
22ENV12	0.26	Fine	2.65	Very leptokurtic	216.21	2.21	Fine sand
ENV02	0.12	Fine	2.36	Very leptokurtic	336.24	1.57	Medium sand
ZOI14	0.39	Very fine	3.30	Extremely leptokurtic	142.18	2.81	Fine sand
ZOI15	0.76	Very fine	1.86	Very leptokurtic	68.32	3.87	Very fine sand

Sample	Skewness value (Folk and Ward)	Skewness description (Folk and Ward)	Kurtosis value (Folk and Ward)	Kurtosis Description (Folk and Ward)	Mean µm (Method of Moments)	Mean Phi (Method of Moments)	Wentworth (Method of Moments)
ZOI16	0.35	Very fine	3.54	Extremely leptokurtic	176.11	2.51	Fine sand
ZOI17	-0.26	Coarse	2.35	Very leptokurtic	370.76	1.43	Medium sand
ZOI18	-0.13	Coarse	1.46	Leptokurtic	419.94	1.25	Medium sand
ZOI19	-0.44	Very coarse	1.46	Leptokurtic	428.97	1.22	Medium sand
ZOI20	0.29	Fine	2.73	Very leptokurtic	184.50	2.44	Fine sand
ZOI21	-0.23	Coarse	0.83	Platykurtic	820.12	0.29	Coarse sand
ZOI22	0.22	Fine	2.86	Very leptokurtic	188.15	2.41	Fine sand
ZOI23	-0.17	Coarse	2.39	Very leptokurtic	366.56	1.45	Medium sand
ZOI24	-0.23	Coarse	1.28	Leptokurtic	454.00	1.14	Medium sand
ZOI25	-0.22	Coarse	1.15	Leptokurtic	568.55	0.81	Coarse sand
ZOI26	0.29	Fine	3.35	Extremely leptokurtic	164.30	2.61	Fine sand

A.7. Full PSA analysis results for 2022 survey in Morgan benthic subtidal ecology study area (part 3)

Sample	Sorting value (Method of Moments)	Sorting description (Method of Moments)	Skewness value (Method of Moments)	Skewness description (Method of Moments)	Kurtosis value (Method of Moments)	Kurtosis description (Method of Moments)
ENV11	0.67	Moderately well	-0.28	Symmetrical	5.09	Leptokurtic
ENV72	1.49	Poor	2.07	Very fine	13.15	Very leptokurtic
ENV13	2.23	Very poor	1.79	Very fine	7.82	Very leptokurtic
ENV09	1.68	Poor	2.04	Very fine	12.36	Very leptokurtic
22ENV05	2.78	Very poor	0.99	Fine	5.00	Leptokurtic
22ENV06	2.29	Very poor	1.05	Fine	6.43	Leptokurtic
22ENV07	2.51	Very poor	0.79	Fine	5.05	Leptokurtic
ENV23	1.40	Poor	2.01	Very fine	15.98	Very leptokurtic
22ENV09	2.36	Very poor	0.42	Symmetrical	5.70	Leptokurtic
22ENV10	1.97	Poor	1.43	Very fine	8.16	Very leptokurtic
22ENV11	1.44	Poor	2.36	Very fine	14.91	Very leptokurtic
22ENV12	1.51	Poor	3.28	Very fine	16.27	Very leptokurtic
ENV02	1.82	Poor	1.73	Very fine	9.40	Very leptokurtic
ZOI14	1.72	Poor	2.71	Very fine	10.95	Very leptokurtic
ZOI15	2.19	Very poor	1.87	Very fine	5.89	Leptokurtic
ZOI16	1.65	Poor	2.93	Very fine	12.81	Very leptokurtic
ZOI17	2.14	Very poor	0.74	Fine	6.82	Leptokurtic

Sample	Sorting value (Method of Moments)	Sorting description (Method of Moments)	Skewness value (Method of Moments)	Skewness description (Method of Moments)	Kurtosis value (Method of Moments)	Kurtosis description (Method of Moments)
ZOI18	3.30	Very poor	0.66	Fine	3.86	Leptokurtic
ZOI19	1.19	Poor	-1.87	Very coarse	7.10	Leptokurtic
ZOI20	1.61	Poor	2.85	Very fine	12.57	Very leptokurtic
ZOI21	4.09	Extremely poor	0.09	Symmetrical	2.62	Mesokurtic
ZOI22	1.58	Poor	2.94	Very fine	13.85	Very leptokurtic
ZOI23	2.46	Very poor	1.04	Fine	5.90	Leptokurtic
ZOI24	1.35	Poor	2.19	Very fine	21.22	Very leptokurtic
ZOI25	2.54	Very poor	0.81	Fine	5.05	Leptokurtic
ZOI26	1.64	Poor	2.81	Very fine	12.37	Very leptokurtic

Appendix B: Habitat assessments

B.1. Seapens and burrowing megafauna assessment (Morgan 2021 site specific survey)

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			Average size (cm)	Average SACFOR
					1 to 5	6 to 10	11+	Max total		0 - 1	1.1 - 3	3 +		
ENV01	126	270	0.59	160.65	40	55	20	970	6.04	97	18	0	1.2	F
ENV02	103	261	0.52	135.8	35	19	10	475	3.5	61	2	0	1.0	O
ENV03	77	267	0.64	170.17	27	29	19	634	3.73	71	4	0	1.0	F
ENV04	100	258	0.58	150.86	37	40	8	673	4.46	81	4	0	1.0	O
ENV05	84	278	0.67	184.97	52	30	2	582	3.15	78	6	0	1.0	F
ENV06	90	272	0.55	149.08	8	41	41	901	6.04	89	1	0	0.9	O
ENV07	97	273.2	0.76	208.27	3	1	14	179	0.86	18	0	0	0.9	R
ENV08	104	296	0.61	180.41	53	8	0	345	1.91	51	10	0	1.2	F
ENV09	94	268.9	0.67	178.96	36	32	21	731	4.08	21	67	0	2.4	F
ENV10	90	258	0.56	145.13	67	2	0	355	2.45	46	23	0	1.6	F
ENV11	109	330.7	0.66	217.96	0	0	0	0	0	0	0	0	0	N/A
ENV12	91	272	0.83	226.66	11	5	0	105	0.46	13	3	0	1.3	O
ENV13	94	281.1	0.77	215.18	43	37	14	739	3.43	42	52	0	2.0	F
ENV14	93	277.5	0.88	245.54	30	0	0	150	0.61	28	2	0	1.0	O
ENV15	106	292.1	0.61	177.55	79	3	0	425	2.39	69	14	0	1.2	F

Station	Total images	Camera transect length (m)	Mean swathe width per image (m)	Estimated area investigated (m^2)	Number of burrows 1 to 5	6 to 10	11+	Max total	Maximum density m^2	Size of burrows 0 - 1	1.1 - 3	3 +	Average size (cm)	Average SACFOR
ENV16	91	269.9	0.72	194.82	0	0	0	0	0	0	0	0	0	N/A
ENV17	96	275.3	0.67	185.09	23	36	37	882	4.77	48	48	0	1.9	F
ENV18	92	278.7	0.59	163.11	18	48	26	856	5.25	39	53	0	2.1	F
ENV19	81	272.8	0.67	182.01	51	28	2	557	3.06	56	25	0	1.5	F
ENV20	104	277.1	0.71	196.79	38	1	0	200	1.02	39	0	0	0.9	O
ENV21	101	314.1	0.69	215.35	0	0	0	0	0	0	0	0	0	N/A
ENV22	95	268.9	0.78	209.32	0	0	0	0	0	0	0	0	0	N/A
ENV23	82	271.3	0.62	169.3	0	0	0	0	0	0	0	0	0	N/A
ENV24	200	271.9	0.64	182.19	66	17	4	544	2.99	65	22	0	1.4	F
ENV25	74	278	0.61	169.82	0	0	0	0	0	0	0	0	0	N/A
ENV26	83	273.5	0.66	180.98	0	0	0	0	0	0	0	0	0	N/A
ENV27	84	265.7	0.56	149.91	81	1	0	415	2.77	79	1	0	0.9	O
ENV28	99	271.8	0.84	228.41	11	24	64	999	4.37	48	51	0	1.9	F
ENV29	78	273.6	0.70	190.5	24	39	15	675	3.54	28	50	0	2.2	F
ENV30	94	268.5	0.72	194.57	16	0	0	80	0.41	16	0	0	0.9	R
ENV90	96	270	0.79	213.2	6	7	81	991	4.65	35	59	0	2.2	F
ENV91	91	271.6	0.78	210.86	40	20	16	576	2.73	68	8	0	1.1	F
NV92	94	265.2	1.08	285.11	11	41	38	883	3.1	42	48	0	2.0	F
ENV93	94	284.1	0.97	274.4	34	23	14	554	2.02	69	1	1	1.0	O
ENV94	85	269.5	0.84	225.75	0	0	8	88	0.39	8	0	0	0.9	R

B.2. Seapens and burrowing megafauna assessment (Morgan 2022 site specific survey)

Station	Number of images assessed with visibility	Camera transect length (m)	Mean swathe width (m)	Estimated area investigated (m^2)	Number of burrows	Density (m^2)	Average size (cm)	Average SACFOR
ENV11	49	247	0.62	153.32	0	0	0	NA
ENV72	58	1842	0.80	1474.91	0	0	0	NA
ENV13	57	484	0.83	400.68	0	0	0	NA
ENV09	36	254	0.84	212.97	0	0	0	NA
22ENV05	56	374	0.47	174.63	0	0	0	NA
22ENV06	48	328	0.66	215.69	0	0	0	NA
22ENV07	57	479	0.78	375.17	0	0	0	NA
ENV23	33	332	0.86	286.64	0	0	0	NA
22ENV09	49	266	0.71	188.28	0	0	0	NA
22ENV10	48	225	0.64	142.89	0	0	0	NA
22ENV11	45	245	0.73	177.98	0	0	0	NA
22ENV12	42	216	0.68	147.67	0	0	0	NA
ENV02	49	277	0.81	223.81	0	0	0	NA
ZOI14	53	243	0.78	189.34	0	0	0	NA
ZOI15	41	271	0.67	180.40	16	0.09	2.0	R
ZOI16	61	1853	0.74	1377.79	0	0	0	NA
ENV63	48	1784	0.54	956.93	0	0	0	NA
ZOI18	55	428	0.60	255.37	0	0	0	NA
ZOI19	49	276	0.83	228.84	0	0	0	NA

Station	Number of images assessed with visibility	Camera transect length (m)	Mean swathe width (m)	Estimated area investigated (m^2)	Number of burrows	Density (m^2)	Average size (cm)	Average SACFOR
ZOI20	44	222	0.79	176.01	0	0	0	NA
ZOI21	54	308	0.84	257.51	0	0	0	NA
ZOI22	59	261	0.52	135.34	3	0.02	0.8	R
ZOI23	42	243	0.47	115.22	0	0	0	NA
ZOI24	56	341	0.72	246.05	0	0	0	NA
ZOI25	61	275	0.73	201.60	0	0	0	NA
ZOI26	48	214	11.32	2425.96	0	0	0	NA

B.3. Annex I stony reef assessment summary table (Morgan site specific survey 2021)

Station	Project	Total images	Camera transect length (m)	Mean swathe width per image (m^3)	Area investigated (m^2)	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

Station	Project	Total images	Camera transect length (m)	Mean swathe width per image (m^3)	Area investigated (m^2)	Number of images with stony features	Total reef area	Mean stony reef cover (%)	Max reef height (cm)	Resemblance to 'stony reef'
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
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

B.4. Annex I stony reef assessment full assessment

Station	Sediment classification	Sediment classification	% Coverage of stony reef	Height of reef (cm)	Resemblance of stony reef	Epifaunal presence											
						Serpulidae msp0001	Metridium cf.	Nemertesia 01	Nemertesia 02	Tubularia msp0001	Faunal turf	Pachymati cf.	Polymastia sp.	Suberites cf.	Raspailia ramosa	Tethya sp.	Porifera 01	Porifera 02
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	1.19	2.5	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B3 Cobble and Boulder Area	13.41	8.6	Low	1	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	6.44	3.3	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	3.95	1.9	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	0.52	2.4	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Station	Sediment classification	Sediment classification	% Coverage of stony reef	Height of reef (cm)	Resemblance of stony reef	Epifaunal presence Serpulidae msp0001	Metridium cf.	Nemertesia 01	Nemertesia 02	Tubularia msp0001	Faunal turf	Pachymati cf.	Polymastia sp.	Suberites cf.	Raspailia ramosa	Tethya sp.	Porifera 01	Porifera 02
ENV76	None	B2 Scattered Cobbles	1.91	1.9	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	0.33	1.7	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	0.76	4.1	Low	NA	NA	NA	1	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	1.48	4.3	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Station	Sediment classification	Sediment classification	% Coverage of stony reef	Height of reef (cm)	Resemblance of stony reef	Epifaunal presence											
						Serpulidae msp0001	Metridium cf.	Nemertesia 01	Nemertesia 02	Tubularia msp0001	Faunal turf	Pachymati cf.	Polymastia sp.	Suberites cf.	Raspailia ramosa	Tethya sp.	Porifera 01	Porifera 02
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Station	Sediment classification	Sediment classification	% Coverage of stony reef	Height of reef (cm)	Resemblance of stony reef	Epifaunal presence												
						Serpulidae msp0001	Metridium cf.	Nemertesia 01	Nemertesia 02	Tubularia msp0001	Faunal turf	Pachymati cf.	Polymastia sp.	Suberites cf.	Raspailia ramosa	Tethya sp.	Porifera 01	Porifera 02
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	5.81	3.2	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	0.64	2.1	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	0.67	1.7	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B4 Boulder Area	6.95	6.1	Low	1	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	2.05	3.2	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	4.59	3.2	Low	1	NA	NA	1	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	1.53	2.6	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B3 Cobble and Boulder Area	23.93	5.6	Low	NA	NA	NA	NA	1	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B3 Cobble and Boulder Area	24.69	4.5	Low	1	NA	NA	NA	1	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	10.88	4	Low	1	NA	NA	NA	1	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	13.75	4.9	Low	1	NA	1	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	4.39	4.5	Low	1	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	30.18	8.6	Low	1	NA	NA	NA	1	1	NA	NA	NA	NA	NA	NA	NA

Station	Sediment classification	Sediment classification	% Coverage of stony reef	Height of reef (cm)	Resemblance of stony reef	Epifaunal presence												
						Serpulidae msp0001	Metridium cf.	Nemertesia 01	Nemertesia 02	Tubularia msp0001	Faunal turf	Pachymati cf.	Polymastia sp.	Suberites cf.	Raspailia ramosa	Tethya sp.	Porifera 01	Porifera 02
ENV76	None	B2 Scattered Cobbles	7.82	3.5	Low	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	30.74	6.9	Low	NA	NA	NA	1	1	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	18.32	3.8	Low	1	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	18.34	5.4	Low	1	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B3 Cobble and Boulder Area	15.99	6.4	Low	1	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	6.57	1.7	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	24.61	4	Low	1	NA	NA	NA	1	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	31.86	5.5	Low	1	NA	NA	NA	1	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	6.13	2.8	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	16.77	6.2	Low	1	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	8.78	3.4	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	19.44	5.1	Low	1	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	4.93	3.9	NA	1	NA	NA	NA	1	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	6.62	4.9	Low	1	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	7.77	0.1	Low	1	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	0.85	3.1	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B2 Scattered Cobbles	6.42	4.7	Low	1	NA	NA	NA	1	1	NA	NA	NA	NA	NA	NA	NA

Station	Sediment classification	Sediment classification	% Coverage of stony reef	Height of reef (cm)	Resemblance of stony reef	Epifaunal presence												
						Serpulidae msp0001	Metridium cf.	Nemertesia 01	Nemertesia 02	Tubularia msp0001	Faunal turf	Pachymati cf.	Polymastia sp.	Suberites cf.	Raspailia ramosa	Tethya sp.	Porifera 01	Porifera 02
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	0.72	2.7	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	None	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	0.61	2.2	Low	1	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV76	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Station	Sediment classification	Sediment classification	% Coverage of stony reef	Height of reef (cm)	Resemblance of stony reef	Epifaunal presence												
						Serpulidae msp0001	Metridium cf.	Nemertesia 01	Nemertesia 02	Tubularia msp0001	Faunal turf	Pachymati cf.	Polymastia sp.	Suberites cf.	Raspailia ramosa	Tethya sp.	Porifera 01	Porifera 02
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	None	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	None	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Station	Sediment classification	Sediment classification	% Coverage of stony reef	Height of reef (cm)	Resemblance of stony reef	Epifaunal presence												
						Serpulidae msp0001	Metridium cf.	Nemertesia 01	Nemertesia 02	Tubularia msp0001	Faunal turf	Pachymati cf.	Polymastia sp.	Suberites cf.	Raspailia ramosa	Tethya sp.	Porifera 01	Porifera 02
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	2.65	3.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	0.34	2.4	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B3 Cobble and Boulder Area	14.19	4.5	Low	1	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Station	Sediment classification	Sediment classification	% Coverage of stony reef	Height of reef (cm)	Resemblance of stony reef	Epifaunal presence												
						Serpulidae msp0001	Metridium cf.	Nemertesia 01	Nemertesia 02	Tubularia msp0001	Faunal turf	Pachymati cf.	Polymastia sp.	Suberites cf.	Raspailia ramosa	Tethya sp.	Porifera 01	Porifera 02
ENV79	None	B1 Gravel Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B3 Cobble and Boulder Area	7.64	8.5	Low	1	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B2 Scattered Cobbles	8.37	4.9	NA	1	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B2 Scattered Cobbles	4.56	3.1	NA	1	NA	NA	1	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B2 Scattered Cobbles	6.99	5.2	NA	1	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B2 Scattered Cobbles	5.52	4.2	NA	1	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	1.9	2.4	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B2 Scattered Cobbles	1.71	3.3	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B2 Scattered Cobbles	7.91	4	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Station	Sediment classification	Sediment classification	% Coverage of stony reef	Height of reef (cm)	Resemblance of stony reef	Epifaunal presence												
						Serpulidae msp0001	Metridium cf.	Nemertesia 01	Nemertesia 02	Tubularia msp0001	Faunal turf	Pachymatia cf.	Polymastia sp.	Suberites cf.	Raspailia ramosa	Tethya sp.	Porifera 01	Porifera 02
ENV79	None	B2 Scattered Cobbles	4.71	2.5	Low	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B2 Scattered Cobbles	13.52	2.8	Low	1	NA	NA	NA	1	1	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B3 Cobble and Boulder Area	28.67	3.4	Low	1	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B2 Scattered Cobbles	27.31	4.8	Low	1	NA	NA	NA	1	1	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B2 Scattered Cobbles	16.66	3.5	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B3 Cobble and Boulder Area	25.22	6.4	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B3 Cobble and Boulder Area	41.27	9.3	Medium	1	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B2 Scattered Cobbles	7.96	2.3	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B2 Scattered Cobbles	2.42	2.1	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	0.55	3.2	Low	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ENV79	None	B1 Gravel Area	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

B.5. Hard substrate porifera coverage summary table (Morgan 2021 site specific survey)

Station	Number of images assessed with visibility	Number of images with hard substrate porifera	Average % of hard substrate porifera	Max % of hard substrate porifera
ENV01	126	0	NA	NA
ENV02	102	6	0.12	0.32
ENV03	77	0	NA	NA
ENV04	100	0	NA	NA
ENV05	84	1	0.21	0.21
ENV06	90	0	NA	NA
ENV07	97	0	NA	NA
ENV08	104	0	NA	NA
ENV09	94	1	0.06	0.06
ENV10	90	0	NA	NA
ENV11	109	0	NA	NA
ENV12	91	0	NA	NA
ENV13	94	0	NA	NA
ENV14	93	1	0.55	0.55
ENV15	106	0	NA	NA
ENV16	91	0	NA	NA
ENV17	95	0	NA	NA
ENV18	92	0	NA	NA
ENV19	81	0	NA	NA
ENV20	104	2	0.30	0.49
ENV21	101	0	NA	NA

Station	Number of images assessed with visibility	Number of images with hard substrate porifera	Average % of hard substrate porifera	Max % of hard substrate porifera
ENV22	95	0	NA	NA
ENV23	82	1	0.65	0.65
ENV24	95	0	NA	NA
ENV25	73	0	NA	NA
ENV26	83	0	NA	NA
ENV27	84	0	NA	NA
ENV28	99	0	NA	NA
ENV29	78	0	NA	NA
ENV30	94	0	NA	NA
ENV63	84	0	NA	NA
ENV64	70	0	NA	NA
ENV65	75	0	NA	NA
ENV72	89	0	NA	NA
ENV73	143	0	NA	NA
ENV74	97	0	NA	NA
ENV75	91	0	NA	NA
ENV76	105	0	NA	NA
ENV77	98	0	NA	NA
ENV78	105	1	1.28	1.28
ENV79	77	1	0.09	0.09
ENV90	96	0	NA	NA
ENV91	91	0	NA	NA

Station	Number of images assessed with visibility	Number of images with hard substrate porifera	Average % of hard substrate porifera	Max % of hard substrate porifera
ENV92	94	0	NA	NA
ENV93	93	0	NA	NA
ENV94	85	0	NA	NA

B.6. Hard substrate porifera coverage summary table (Morgan 2021 site specific survey)

Station	Number of images assessed with visibility	Number of images with hard substrate porifera	Average % of hard substrate porifera	Max % of hard substrate porifera
ENV01	126	0	NA	NA
ENV02	102	6	0.12	0.32
ENV03	77	0	NA	NA
ENV04	100	0	NA	NA
ENV05	84	1	0.21	0.21
ENV06	90	0	NA	NA
ENV07	97	0	NA	NA
ENV08	104	0	NA	NA
ENV09	94	1	0.06	0.06
ENV10	90	0	NA	NA
ENV11	109	0	NA	NA
ENV12	91	0	NA	NA
ENV13	94	0	NA	NA
ENV14	93	1	0.55	0.55
ENV15	106	0	NA	NA
ENV16	91	0	NA	NA
ENV17	95	0	NA	NA
ENV18	92	0	NA	NA
ENV19	81	0	NA	NA
ENV20	104	2	0.30	0.49
ENV21	101	0	NA	NA

Station	Number of images assessed with visibility	Number of images with hard substrate porifera	Average % of hard substrate porifera	Max % of hard substrate porifera
ENV22	95	0	NA	NA
ENV23	82	1	0.65	0.65
ENV24	95	0	NA	NA
ENV25	73	0	NA	NA
ENV26	83	0	NA	NA
ENV27	84	0	NA	NA
ENV28	99	0	NA	NA
ENV29	78	0	NA	NA
ENV30	94	0	NA	NA
ENV63	84	0	NA	NA
ENV64	70	0	NA	NA
ENV65	75	0	NA	NA
ENV72	89	0	NA	NA
ENV73	143	0	NA	NA
ENV74	97	0	NA	NA
ENV75	91	0	NA	NA
ENV76	105	0	NA	NA
ENV77	98	0	NA	NA
ENV78	105	1	1.28	1.28
ENV79	77	1	0.09	0.09
ENV90	96	0	NA	NA
ENV91	91	0	NA	NA

Station	Number of images assessed with visibility	Number of images with hard substrate porifera	Average % of hard substrate porifera	Max % of hard substrate porifera
ENV92	94	0	NA	NA
ENV93	93	0	NA	NA
ENV94	85	0	NA	NA

B.7. Hard substrate porifera coverage full data (Morgan 2022 site specific survey)

Station	Number of blank rows	% Coverage of hard substrate porifera	Presence of epifaunal taxa associated with fragile sponge and anthozoan communities on subtidal rocky habitats					
			Antho dichotoma	Suberites indet. 01	Suberites indet. 02	Suberites indet. 03	Porifera indet. 01	Alcyonium digitatum
ENV02	13	NA	NA	NA	NA	NA	NA	1
ENV02		NA	NA	NA	NA	NA	NA	1
ENV02		NA	NA	NA	NA	NA	NA	1
ENV02		0.42	NA	NA	NA	1	NA	1
ENV02		NA	NA	NA	NA	NA	NA	1
ENV02		0.82	NA	NA	NA	1	NA	NA
ENV02		1.27	NA	NA	NA	1	NA	NA
ENV02		NA	NA	NA	NA	NA	NA	1
ENV02		NA	NA	NA	NA	NA	NA	1
ENV02		NA	NA	NA	NA	NA	NA	1
ENV02		1.3	NA	NA	NA	1	NA	1
ENV02		NA	NA	NA	NA	NA	NA	1
ENV02		NA	NA	NA	NA	NA	NA	1
ENV02		1.61	NA	NA	NA	1	NA	1
ENV02		NA	NA	NA	NA	NA	NA	1
ENV02		NA	NA	NA	NA	NA	NA	1
ENV02		NA	NA	NA	NA	NA	NA	1
ENV02		1.01	NA	NA	NA	1	NA	NA
ENV02		NA	NA	NA	NA	NA	NA	1

Station	Number of blank rows	% Coverage of hard substrate porifera	Presence of epifaunal taxa associated with fragile sponge and anthozoan communities on subtidal rocky habitats					
			Antho dichotoma	Suberites indet. 01	Suberites indet. 02	Suberites indet. 03	Porifera indet. 01	Alcyonium digitatum
ENV02		NA	NA	NA	NA	NA	NA	1
ENV02		NA	NA	NA	NA	NA	NA	1
ENV02		NA	NA	NA	NA	NA	NA	1
ENV02		NA	NA	NA	NA	NA	NA	1
ENV09	31	1.62	NA	NA	NA	1	NA	NA
ENV09		0.48	NA	NA	NA	1	NA	NA
ENV09		0.78	NA	NA	NA	1	NA	NA
ENV09		NA	NA	NA	NA	NA	NA	1
ENV09		NA	NA	NA	NA	NA	NA	1
ENV09		0.15	NA	1	NA	NA	NA	NA
ENV11	50	0.3	NA	NA	NA	1	NA	NA
ENV13	35	NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		1.04	NA	NA	NA	1	NA	NA
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1

Station	Number of blank rows	% Coverage of hard substrate porifera	Presence of epifaunal taxa associated with fragile sponge and anthozoan communities on subtidal rocky habitats					
			Antho dichotoma	Suberites indet. 01	Suberites indet. 02	Suberites indet. 03	Porifera indet. 01	Alcyonium digitatum
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		0.71	NA	NA	NA	1	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
ENV13		NA	NA	NA	NA	NA	NA	1
22ENV06	39	1.2	NA	NA	NA	1	NA	1
22ENV06		0.42	NA	NA	NA	1	NA	NA
22ENV06		0.53	NA	NA	NA	1	NA	NA
22ENV06		NA	NA	NA	NA	NA	NA	1
22ENV06		NA	NA	NA	NA	NA	NA	1
22ENV06		NA	NA	NA	NA	NA	NA	1
22ENV06		NA	NA	NA	NA	NA	NA	1
22ENV06		NA	NA	NA	NA	NA	NA	1

Station	Number of blank rows	% Coverage of hard substrate porifera	Presence of epifaunal taxa associated with fragile sponge and anthozoan communities on subtidal rocky habitats					
			Antho dichotoma	Suberites indet. 01	Suberites indet. 02	Suberites indet. 03	Porifera indet. 01	Alcyonium digitatum
22ENV06		0.6	NA	NA	NA	1	NA	NA
22ENV06		NA	NA	NA	NA	NA	NA	1
22ENV06		NA	NA	NA	NA	NA	NA	1
22ENV06		1.09	NA	NA	NA	1	NA	NA
22ENV06		NA	NA	NA	NA	NA	NA	1
22ENV07	48	2.59	NA	NA	NA	1	NA	NA
22ENV07		NA	NA	NA	NA	NA	NA	1
22ENV07		NA	NA	NA	NA	NA	NA	1
22ENV07		NA	NA	NA	NA	NA	NA	1
22ENV07		NA	NA	NA	NA	NA	NA	1
22ENV07		NA	NA	NA	NA	NA	NA	1
22ENV07		NA	NA	NA	NA	NA	NA	1
22ENV07		NA	NA	NA	NA	NA	NA	1
22ENV07		NA	NA	NA	NA	NA	NA	1
22ENV07		NA	NA	NA	NA	NA	NA	1
22ENV07		NA	NA	NA	NA	NA	NA	1
22ENV07		NA	NA	NA	NA	NA	NA	1
22ENV07		NA	NA	NA	NA	NA	NA	1
22ENV07		NA	NA	NA	NA	NA	NA	1
22ENV07		NA	NA	NA	NA	NA	NA	1
22ENV10	42	NA	NA	NA	NA	NA	NA	1

Station	Number of blank rows	% Coverage of hard substrate porifera	Presence of epifaunal taxa associated with fragile sponge and anthozoan communities on subtidal rocky habitats					
			Antho dichotoma	Suberites indet. 01	Suberites indet. 02	Suberites indet. 03	Porifera indet. 01	Alcyonium digitatum
22ENV10		NA	NA	NA	NA	NA	NA	1
22ENV10		NA	NA	NA	NA	NA	NA	1
22ENV10		NA	NA	NA	NA	NA	NA	1
22ENV10		1.23	NA	NA	NA	1	NA	NA
22ENV10		NA	NA	NA	NA	NA	NA	1
ENV63	19	NA	NA	NA	NA	NA	NA	1
ENV63		0.96	NA	NA	NA	1	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		1.45	NA	NA	NA	1	NA	1
ENV63		0.95	NA	NA	NA	1	NA	NA
ENV63		0.42	NA	NA	NA	1	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		0.65	NA	NA	NA	1	NA	NA
ENV63		NA	NA	NA	NA	NA	NA	1

Station	Number of blank rows	% Coverage of hard substrate porifera	Presence of epifaunal taxa associated with fragile sponge and anthozoan communities on subtidal rocky habitats					
			Antho dichotoma	Suberites indet. 01	Suberites indet. 02	Suberites indet. 03	Porifera indet. 01	Alcyonium digitatum
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
ENV63		NA	NA	NA	NA	NA	NA	1
22ENV05	14	NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		2.2	NA	NA	NA	1	NA	NA
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1

Station	Number of blank rows	% Coverage of hard substrate porifera	Presence of epifaunal taxa associated with fragile sponge and anthozoan communities on subtidal rocky habitats					
			Antho dichotoma	Suberites indet. 01	Suberites indet. 02	Suberites indet. 03	Porifera indet. 01	Alcyonium digitatum
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		0.05	NA	NA	1	NA	NA	NA
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1

Station	Number of blank rows	% Coverage of hard substrate porifera	Presence of epifaunal taxa associated with fragile sponge and anthozoan communities on subtidal rocky habitats					
			Antho dichotoma	Suberites indet. 01	Suberites indet. 02	Suberites indet. 03	Porifera indet. 01	Alcyonium digitatum
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		NA	NA	NA	NA	NA	NA	1
22ENV05		0.99	1	NA	NA	NA	NA	1
ZOI24	51	0.7	NA	NA	NA	1	NA	NA
ZOI24		NA	NA	NA	NA	NA	NA	1
ZOI24		1.28	NA	NA	NA	1	NA	1
ZOI24		0.68	NA	NA	NA	1	NA	NA
ZOI24		NA	NA	NA	NA	NA	NA	1
ZOI24		1.29	NA	NA	NA	1	NA	NA

Station	Number of blank rows	% Coverage of hard substrate porifera	Presence of epifaunal taxa associated with fragile sponge and anthozoan communities on subtidal rocky habitats					
			Antho dichotoma	Suberites indet. 01	Suberites indet. 02	Suberites indet. 03	Porifera indet. 01	Alcyonium digitatum
ZOI24		0.45	NA	NA	NA	1	NA	NA
ZOI24		0.53	NA	NA	NA	1	NA	NA
ZOI25	33	NA	NA	NA	NA	NA	NA	1
ZOI25		1.73	NA	NA	NA	1	NA	NA
ZOI25		NA	NA	NA	NA	NA	NA	1
ZOI25		0.56	NA	NA	NA	1	NA	NA
ZOI25		0.59	NA	NA	NA	1	NA	NA
ZOI25		0.6	NA	NA	NA	1	NA	1
ZOI25		NA	NA	NA	NA	NA	NA	1
ZOI25		NA	NA	NA	NA	NA	NA	1
ZOI25		NA	NA	NA	NA	NA	NA	1
ZOI25		0.29	NA	NA	NA	1	NA	NA
ZOI25		1.08	NA	NA	NA	1	NA	1
ZOI25		0.9	NA	NA	NA	1	NA	NA
ZOI25		NA	NA	NA	NA	NA	NA	1
ZOI25		NA	NA	NA	NA	NA	NA	1
ZOI25		NA	NA	NA	NA	NA	NA	1
ZOI25		NA	NA	NA	NA	NA	NA	1
ZOI25		0.93	NA	NA	NA	1	NA	NA
ZOI25		1.41	NA	NA	NA	1	NA	1
ZOI25		0.43	NA	NA	NA	1	NA	1

Station	Number of blank rows	% Coverage of hard substrate porifera	Presence of epifaunal taxa associated with fragile sponge and anthozoan communities on subtidal rocky habitats					
			Antho dichotoma	Suberites indet. 01	Suberites indet. 02	Suberites indet. 03	Porifera indet. 01	Alcyonium digitatum
ZOI25		0.64	NA	NA	NA	1	NA	NA
ZOI25		1.28	NA	NA	NA	1	NA	1
ZOI25		0.54	NA	NA	NA	1	NA	NA
ZOI25		NA	NA	NA	NA	NA	NA	1
ZOI25		NA	NA	NA	NA	NA	NA	1
ZOI25		NA	NA	NA	NA	NA	NA	1
ZOI25		NA	NA	NA	NA	NA	NA	1
ZOI25		NA	NA	NA	NA	NA	NA	1
ZOI25		NA	NA	NA	NA	NA	NA	1
ZOI25		NA	NA	NA	NA	NA	NA	1
ZOI25		NA	NA	NA	NA	NA	NA	1

Appendix C: Benthic multivariate analysis results

C.1. Morgan site specific survey simper analysis (infauna)

SIMPER
Similarity Percentages - species contributions

One-Way Analysis

Data worksheet
Name: Data3
Data type: Abundance
Sample selection: All
Variable selection: All

Parameters
Resemblance: S17 Bray-Curtis similarity
Cut off for low contributions: 70.00%

Factor Groups

Sample	Simprof Group
22ENV05	af
22ENV06	af
ZOI17	af
ZOI25	af
22ENV07	ag
ZOI18	ag
22ENV09	e
ZOI23	e
22ENV10	ae
22ENV11	ad
ZOI24	ad
22ENV12	j
ZOI14	d
ZOI15	d
ZOI16	b
ZOI20	b
ZOI26	b
ZOI19	a
ENV22	a
ENV28	a
ZOI21	h
ZOI22	c
ENV01	u
ENV04	u
ENV05	u

ENV10	u
ENV14	u
ENV15	u
ENV19	u
ENV27	u
ENV59	u
ENV63	u
ENV64	u
ENV02	ac
ENV03	ac
ENV06	ac
ENV08	ac
ENV17	ac
ENV20	ac
ENV24	ac
ENV90	ac
ENV07	f
ENV09	l
ENV11	m
ENV18	m
ENV23	m
ENV30	m
ENV91	m
ENV94	m
ENV12	r
ENV13	r
ENV16	k
ENV21	k
ENV25	k
ENV26	k
ENV29	ab
ENV62	ab
ENV95	ab
ENV31	y
ENV36	y
ENV37	y
ENV41	y
ENV47	y
ENV97	y
ENV32	v
ENV33	s
ENV34	s
ENV35	s
ENV38	aa
ENV48	aa
ENV49	aa
ENV51	aa
ENV52	aa
ENV54	aa
ENV55	aa
ENV56	aa

ENV71	aa
ENV86	aa
ENV88	aa
ENV39	w
ENV42	w
ENV40	t
ENV45	t
ENV43	g
ENV44	g
ENV57	g
ENV66	g
ENV67A	g
ENV70	g
ENV83	g
ENV89	g
ENV93	g
ENV96	g
ENV50	i
ENV53	x
ENV60	z
ENV61	z
ENV65	z
ENV68	q
ENV69	o
ENV84	o
ENV82	p
ENV92	n

Group af
Average similarity: 48.62

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Nemertea	3.61	2.23	6.83	4.59	4.59
Paradoneis lyra	2.81	1.88	7.99	3.86	8.45
Ascidiacea	3.11	1.68	3.08	3.46	11.91
Sipuncula	2.72	1.67	3.85	3.43	15.34
Syllis armillaris	2.43	1.45	4.87	2.98	18.32
Echinocyamus pusillus	2.54	1.44	3.08	2.96	21.28
Leiochone	2.16	1.41	5.22	2.91	24.19
Lysidice unicornis	2.37	1.41	7.12	2.89	27.08
Spisula	2.27	1.33	3.83	2.73	29.81
Pseudopolydora pulchra	2.04	1.32	6.55	2.72	32.52
Gnathiid indet.	1.85	1.25	4.05	2.57	35.09
Cirrophorus branchiatus	2.13	1.02	2.37	2.09	37.19
Aonides paucibranchiata	2.01	0.99	2.62	2.05	39.23
Grania	2.12	0.99	3.59	2.03	41.26
Obtusella intersecta	2.31	0.98	3.81	2.02	43.28
Pholoe inornata	1.95	0.97	2.97	2	45.27
Kurtiella bidentata	3.53	0.96	1.63	1.97	47.24
Tharyx killariensis	1.46	0.88	4.05	1.82	49.06
Abra	1.52	0.87	6.31	1.79	50.85

Pholoe baltica	1.43	0.82	3.29	1.68	52.53
Urothoe elegans	2.55	0.81	4.2	1.66	54.2
Glycera	1.21	0.77	8.44	1.59	55.78
Pista lornensis	1.29	0.77	8.44	1.59	57.37
Ampelisca spinipes	1.72	0.75	0.91	1.55	58.92
Praxillella affinis	1.77	0.75	0.91	1.55	60.47
Spiophanes bombyx	1.1	0.73	15.34	1.49	61.96
Hydroides norvegica	1.25	0.73	15.34	1.49	63.46
Sphaerosyllis hystrix	1.59	0.7	0.91	1.43	64.89
Phoronis	1.49	0.64	0.91	1.31	66.2
Parexogone hebes	1.37	0.63	0.91	1.3	67.49
Spirobranchus triqueter	1.91	0.61	0.72	1.26	68.75
Polycirrus	1.06	0.54	0.91	1.11	69.86
Leptochiton	1.76	0.53	0.79	1.09	70.95

Group ag
Average similarity: 38.03

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Lumbrineris aniara	3.92	3.5	SD=0!	9.21	9.21
Pholoe inornata	2.22	1.94	SD=0!	5.11	14.32
Syllis armillaris	2.22	1.94	SD=0!	5.11	19.43
Ampelisca spinipes	2	1.94	SD=0!	5.11	24.54
Nemertea	3.18	1.94	SD=0!	5.11	29.65
Lysidice unicornis	2.28	1.68	SD=0!	4.43	34.08
Leptochiton asellus	1.98	1.68	SD=0!	4.43	38.5
Glycera lapidum	1.57	1.37	SD=0!	3.61	42.11
Caulleriella alata	1.71	1.37	SD=0!	3.61	45.73
Dialychone dunerificta	1.41	1.37	SD=0!	3.61	49.34
Anomiidae	1.41	1.37	SD=0!	3.61	52.95
Echinocyamus pusillus	1.71	1.37	SD=0!	3.61	56.57
Sphaerosyllis hystrix	1.5	0.97	SD=0!	2.55	59.12
Sphaerosyllis taylori	1.91	0.97	SD=0!	2.55	61.68
Eulalia bilineata	1	0.97	SD=0!	2.55	64.23
Eumida	1	0.97	SD=0!	2.55	66.79
Mediomastus fragilis	1.62	0.97	SD=0!	2.55	69.34
Notomastus	1.21	0.97	SD=0!	2.55	71.9

Group e
Average similarity: 43.71

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Pectinariidae	3.81	3.9	SD=0!	8.92	8.92
Scalibregma inflatum	5.3	3.46	SD=0!	7.91	16.84
Kurtiella bidentata	4	3.46	SD=0!	7.91	24.75
Scoloplos armiger	2.91	2.95	SD=0!	6.75	31.49
Pholoe baltica	2.72	2.55	SD=0!	5.84	37.34
Pseudopolydora pulchra	2.55	2.55	SD=0!	5.84	43.18
Amphiura filiformis	2.44	2.33	SD=0!	5.33	48.51
Echinocyamus pusillus	2	2.09	SD=0!	4.77	53.28
Lumbrineris aniara	1.98	1.81	SD=0!	4.13	57.42

Spiophanes bombyx	2.09	1.81	SD=0!	4.13	61.55
Owenia	2.99	1.81	SD=0!	4.13	65.68
Nemertea	2.19	1.81	SD=0!	4.13	69.81
Malmgrenia	1.57	1.47	SD=0!	3.37	73.18

Group ae
Less than 2 samples in group

Group ad
Average similarity: 41.92

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Grania	3.82	2.96	SD=0!	7.06	7.06
Goniadella gracilis	3.56	2.81	SD=0!	6.7	13.76
Aonides paucibranchiata	4.05	2.81	SD=0!	6.7	20.46
Echinocyamus pusillus	3.07	2.65	SD=0!	6.32	26.78
Goniadidae	2.82	2.48	SD=0!	5.91	32.69
Pisione remota	4.14	2.29	SD=0!	5.47	38.16
Nemertea	2.64	2.29	SD=0!	5.47	43.63
Obtusella intersecta	2.32	1.87	SD=0!	4.47	48.09
Spisula	2.73	1.87	SD=0!	4.47	52.56
Caulleriella alata	1.41	1.32	SD=0!	3.16	55.72
Abra	1.71	1.32	SD=0!	3.16	58.88
Thracioidea	2.29	1.32	SD=0!	3.16	62.03
Nereididae	1.21	0.94	SD=0!	2.23	64.27
Palposyllis prosostoma	1	0.94	SD=0!	2.23	66.5
Sphaerosyllis bulbosa	1.37	0.94	SD=0!	2.23	68.73
Hesionura elongata	2.16	0.94	SD=0!	2.23	70.97

Group j
Less than 2 samples in group

Group d
Average similarity: 46.20

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Kurtiella bidentata	4.46	5.42	SD=0!	11.73	11.73
Lumbrineris aniara	2.19	3.13	SD=0!	6.77	18.5
Pectinariidae	2.99	3.13	SD=0!	6.77	25.27
Tellimya ferruginosa	2.09	3.13	SD=0!	6.77	32.03
Amphiura filiformis	2.28	3.13	SD=0!	6.77	38.8
Sthenelais limicola	1.57	2.55	SD=0!	5.53	44.33
Nucula	1.57	2.55	SD=0!	5.53	49.86
Echinocardium cordatum	1.41	2.55	SD=0!	5.53	55.39
Ophiuroidea (Juvenile)	1.57	2.55	SD=0!	5.53	60.91
Pholoe baltica	1.37	1.81	SD=0!	3.91	64.82
Ophelina acuminata	1	1.81	SD=0!	3.91	68.73
Chaetozone christiei	1	1.81	SD=0!	3.91	72.64

Group b
Average similarity: 36.99

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sthenelais limicola	3.98	6.28	9.15	16.97	16.97
Tellimya ferruginosa	2.67	2.83	4.6	7.66	24.63
Kurtiella bidentata	1.88	2.78	2.94	7.53	32.16
Phoronis	1.28	1.97	2.94	5.32	37.48
Bathyporeia tenuipes	1.55	1.92	6.34	5.18	42.67
Nephtys	1.14	1.7	8.2	4.6	47.27
Pectinariidae	1.55	1.29	0.58	3.5	50.76
Poecilochaetus serpens	1.32	1.12	0.58	3.03	53.79
Abra alba	1.24	1.12	0.58	3.03	56.82
Nucula nitidosa	1.41	1.07	0.58	2.89	59.71
Scalibregma inflatum	1.55	1.04	0.58	2.81	62.52
Pharidae	1.15	0.9	0.58	2.44	64.96
Aricidea (Aricidea) minuta	1.05	0.76	0.58	2.04	67
Phaxas pellucidus	1.05	0.76	0.58	2.04	69.05
Chaetozone christiei	1.41	0.74	0.58	1.99	71.03

Group a
Average similarity: 21.80

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Abra	1.82	6.04	6.02	27.7	27.7
Scoloplos armiger	1.66	4.28	3.3	19.64	47.34
Echinocyamus pusillus	1.61	3.49	6.02	15.99	63.34
Spio	0.67	1.38	0.58	6.34	69.68
Bivalvia	0.67	1.38	0.58	6.34	76.01

Group h
Less than 2 samples in group

Group c
Less than 2 samples in group

Group u
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

Group ac

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

Group f
Less than 2 samples in group

Group l
Less than 2 samples in group

Group m
Average similarity: 40.39

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Poecilochaetus serpens	5.53	5.23	2.7	12.95	12.95
Lagis koreni	4.05	4.1	2.08	10.14	23.09
Scalibregma inflatum	3.59	3.53	7.98	8.74	31.83
Owenia	2.56	2.69	3.78	6.67	38.5
Scoloplos armiger	2.69	2.53	2.1	6.27	44.77
Sthenelais limicola	1.81	2.19	9.2	5.42	50.19
Spiophanes bombyx	2.35	1.95	1.2	4.84	55.03
Nemertea	2.02	1.61	1.15	3.99	59.02
Pseudopolydora pulchra	1.3	1.46	4.74	3.61	62.63
Pholoe baltica	1.5	1.18	1.12	2.93	65.56
Abra	1.35	1.13	1.25	2.79	68.34
Echinocyamus pusillus	1.7	1.09	0.7	2.7	71.04

Group r
Average similarity: 49.97

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Lagis koreni	3.87	3.41	SD=0!	6.82	6.82
Scalibregma inflatum	3.37	3.23	SD=0!	6.47	13.29
Ampharete lindstroemi agg.	2.72	2.64	SD=0!	5.28	18.58
Owenia	2.34	2.41	SD=0!	4.82	23.4
Abra	2.12	2.16	SD=0!	4.31	27.71
Echinocyamus pusillus	2.58	2.16	SD=0!	4.31	32.03
Nemertea	2.73	2.16	SD=0!	4.31	36.34
Spio symphyta	2.09	1.87	SD=0!	3.74	40.08
Aoridae	2.74	1.87	SD=0!	3.74	43.82
Phoronis	1.98	1.87	SD=0!	3.74	47.55
Pholoe baltica	1.71	1.52	SD=0!	3.05	50.6
Goniadella gracilis	1.41	1.52	SD=0!	3.05	53.65
Lysidice unicornis	1.41	1.52	SD=0!	3.05	56.7
Paradoneis lyra	1.57	1.52	SD=0!	3.05	59.75
Aonides paucibranchiata	1.41	1.52	SD=0!	3.05	62.81
Spiophanes bombyx	1.93	1.52	SD=0!	3.05	65.86
Lysilla nivea	1.41	1.52	SD=0!	3.05	68.91
Ampelisca typica	1.83	1.52	SD=0!	3.05	71.96

Group k
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

Group ab
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

Group y
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

Group v
Less than 2 samples in group

Group s
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
Caulleriella alata	1.73	1.09	61.31	1.88	66.17
Eteone cf. longa	1.9	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

Group aa
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

Group w
Average similarity: 52.36

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Scalibregma inflatum	4.85	2.27	SD=0!	4.34	4.34

Golfingia (Golfingia) elongata	3.07	2.14	SD=0!	4.09	8.44
Unciola planipes	2.82	2.01	SD=0!	3.83	12.27
Owenia	2.72	1.86	SD=0!	3.55	15.81
Echinocyamus pusillus	2.64	1.86	SD=0!	3.55	19.36
Syllis garciai/mauretanica	2.64	1.86	SD=0!	3.55	22.91
Phoronis	2.92	1.69	SD=0!	3.24	26.14
Nereididae	2	1.52	SD=0!	2.9	29.04
Nemertea	2.87	1.52	SD=0!	2.9	31.93
Golfingiidae	2.5	1.52	SD=0!	2.9	34.83
Ampharete lindstroemi agg.	2.8	1.52	SD=0!	2.9	37.72
Syllis	2.93	1.31	SD=0!	2.51	40.23
Lagis koreni	1.73	1.31	SD=0!	2.51	42.74
Eulalia mustela	1.57	1.07	SD=0!	2.05	44.78
Mediomastus fragilis	1.83	1.07	SD=0!	2.05	46.83
Paraonidae	1.71	1.07	SD=0!	2.05	48.88
Paradoneis ilvana	1.83	1.07	SD=0!	2.05	50.93
Poecilochaetus serpens	2.12	1.07	SD=0!	2.05	52.97
Aonides paucibranchiata	2.89	1.07	SD=0!	2.05	55.02
Ampelisca typica	1.57	1.07	SD=0!	2.05	57.07
Urothoe marina	1.57	1.07	SD=0!	2.05	59.12
Nucula hanleyi	1.83	1.07	SD=0!	2.05	61.16
Eteone cf. longa	1.41	1.07	SD=0!	2.05	63.21
Dialychone	1.71	1.07	SD=0!	2.05	65.26
Pholoe baltica	3.1	0.76	SD=0!	1.45	66.7
Pholoe inornata	1	0.76	SD=0!	1.45	68.15
Malmgrenia thomsonae	1.72	0.76	SD=0!	1.45	69.6
Glycera lapidum	1.62	0.76	SD=0!	1.45	71.05

Group t
Average similarity: 54.61

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Ampharete lindstroemi agg.	3.92	3.22	SD=0!	5.89	5.89
Nemertea	3.59	2.96	SD=0!	5.42	11.32
Scalibregma inflatum	4.13	2.82	SD=0!	5.17	16.49
Kurtiella bidentata	3.79	2.68	SD=0!	4.9	21.39
Lagis koreni	3.35	2.53	SD=0!	4.62	26.01
Pholoe baltica	3.19	2.36	SD=0!	4.33	30.34
Polycirrus	2	1.79	SD=0!	3.27	33.61
Paradoneis lyra	2.28	1.55	SD=0!	2.83	36.44
Owenia	1.98	1.55	SD=0!	2.83	39.27
Photis longicaudata	1.87	1.55	SD=0!	2.83	42.1
Tanaopsis graciloides	1.87	1.55	SD=0!	2.83	44.94
Platyhelminthes	2.09	1.55	SD=0!	2.83	47.77
Eteone cf. longa	1.87	1.55	SD=0!	2.83	50.6
Urothoe	3.46	1.55	SD=0!	2.83	53.43
Poecilochaetus serpens	2.83	1.26	SD=0!	2.31	55.74
Urothoe elegans	1.41	1.26	SD=0!	2.31	58.06
Megamphopus cornutus	1.57	1.26	SD=0!	2.31	60.37
Aoridae	3.05	1.26	SD=0!	2.31	62.68
Bivalvia	1.71	1.26	SD=0!	2.31	64.99

Cerianthus lloydii	1.71	1.26	SD=0!	2.31	67.3
Glycinde nordmanni	1	0.89	SD=0!	1.63	68.94
Schistomeringos rudolphi	1.21	0.89	SD=0!	1.63	70.57

Group g
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

Group i
Less than 2 samples in group

Group x
Less than 2 samples in group

Group z
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
Scoloplos armiger	1.79	1.24	12.29	2.22	44.9
Eteone cf. longa	1.63	1.24	12.29	2.22	47.12
Parexogone hebes	1.52	1.16	13.36	2.08	49.2
Terebellides	1.41	1.16	13.36	2.08	51.28
Dipolydora caulleryi agg.	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
Nototropis vedlomensis	1.38	0.94	3.46	1.69	62.35
Laonice bahusiensis agg.	1.47	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
Paradoneis lyra	1.24	0.82	13.36	1.47	70.51

Group q
Less than 2 samples in group

Group o
Average similarity: 47.36

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Scalibregma inflatum	7.26	4.05	SD=0!	8.55	8.55
Pholoe baltica	3.15	2.16	SD=0!	4.57	13.12
Urothoe marina	2.9	2.02	SD=0!	4.27	17.39
Paradoneis lyra	3.29	1.87	SD=0!	3.96	21.35
Notomastus	2.44	1.71	SD=0!	3.61	24.96
Aonides paucibranchiata	2.44	1.71	SD=0!	3.61	28.57
Goniadella gracilis	2.22	1.53	SD=0!	3.23	31.8
Leptocheirus hirsutimanus	2.12	1.53	SD=0!	3.23	35.03
Kurtiella bidentata	3.6	1.53	SD=0!	3.23	38.26
Nemertea	2.66	1.53	SD=0!	3.23	41.5
Glycera lapidum	1.87	1.33	SD=0!	2.8	44.29
Lysilla nivea	2.6	1.33	SD=0!	2.8	47.09
Owenia	1.87	1.33	SD=0!	2.8	49.89
Ericthonius punctatus	2.09	1.33	SD=0!	2.8	52.69
Tanaopsis graciloides	2.09	1.33	SD=0!	2.8	55.49
Polynoidae	1.93	1.08	SD=0!	2.28	57.77
Malmgrenia	1.57	1.08	SD=0!	2.28	60.05
Glycera	1.41	1.08	SD=0!	2.28	62.34
Syllis	1.41	1.08	SD=0!	2.28	64.62
Mediomastus fragilis	1.93	1.08	SD=0!	2.28	66.91
Spionidae	1.83	1.08	SD=0!	2.28	69.19
Polycirrus	2.29	1.08	SD=0!	2.28	71.48

Group p
Less than 2 samples in group

Group n
Less than 2 samples in group

C.2. Morgan 2021 site specific survey simper analysis (epifauna)

SIMPER
Similarity Percentages - species contributions

One-Way Analysis

Data worksheet
Name: Data3
Data type: Abundance
Sample selection: All
Variable selection: All

Parameters
Resemblance: S17 Bray-Curtis similarity
Cut off for low contributions: 70.00%

Factor Groups

Sample	Simprof Groups
22ENV05	q
22ENV06	p
22ENV07	s
22ENV11	s
22ENV09	t
22ENV10	t
ZOI23	t
ZOI24	t
22ENV12	u
ZOI14	u
ZOI15	u
ZOI16	u
ZOI19	u
ZOI20	u
ZOI22	u
ZOI26	u
ZOI17	r
ZOI25	r
ZOI18	o
ZOI21	o
ENV01	c
ENV08	c
ENV94	c
ENV96	c
ENV02	e
ENV03	e
ENV06	e
ENV12	e
ENV13	e
ENV17	e

ENV18	e
ENV19	e
ENV24	e
ENV39	e
ENV69	e
ENV04	d
ENV05	d
ENV10	d
ENV15	d
ENV20	d
ENV27	d
ENV29	d
ENV31	d
ENV32	d
ENV33	d
ENV34	d
ENV35	d
ENV36	d
ENV37	d
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ENV56	d
ENV57	d
ENV59	d
ENV60	d
ENV61	d
ENV62	d
ENV63	d
ENV64	d
ENV65	d
ENV71	d
ENV82	d
ENV84	d
ENV86	d
ENV88	d
ENV90	d
ENV92	d
ENV97	d
ENV07	l
ENV93	l

ENV09	a
ENV23	a
ENV40	a
ENV43	a
ENV45	a
ENV67	a
ENV68	a
ENV70	a
ENV95	a
ENV11	m
ENV91	m
ENV14	b
ENV28	b
ENV16	n
ENV21	n
ENV22	n
ENV25	n
ENV26	n
ENV30	n
ENV44	n
ENV46	k
ENV80	k
ENV81	k
ENV85	k
ENV87	k
ENV58	i
ENV66	f
ENV83	f
ENV89	f
ENV72	g
ENV75	g
ENV77	g
ENV78	g
ENV73	h
ENV74	j
ENV76	j
ENV79	j

Group q
Less than 2 samples in group

Group p
Less than 2 samples in group

Group s
Average similarity: 48.35

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Serpulidae stet.	4.89	8.75	SD=0!	18.1	18.1
Alcyonium digitatum	3.94	7.4	SD=0!	15.3	33.4

Pectinidae stet.	3.03	4.68	SD=0!	9.67	43.07
Paguroidea stet.	2.12	3.82	SD=0!	7.9	50.97
Nematoda	1.41	2.7	SD=0!	5.59	56.55
Hydrozoa indet. 01	1.21	1.91	SD=0!	3.95	60.5
Tubularia indivisa inc.	2.44	1.91	SD=0!	3.95	64.45
Anomiidae indet. 01	1.21	1.91	SD=0!	3.95	68.4
Buccinium undatum inc.	1.37	1.91	SD=0!	3.95	72.35

Group t

Average similarity: 39.47

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Tubularia indivisa inc.	2.43	4.26	6.81	10.8	10.8
Alcyonium digitatum	2.01	4.07	6.32	10.31	21.11
Ophiura ophiura inc.	1.97	3.48	1.87	8.82	29.92
Paguroidea stet.	1.47	3.11	3.39	7.87	37.8
Serpulidae stet.	1.76	3.1	5.66	7.85	45.65
Psolus phantapus inc.	1.18	2.45	7.3	6.21	51.85
Sertulariidae	1	2.45	7.3	6.21	58.06
Nematoda	1.1	2.45	7.3	6.21	64.27
Pectinidae stet.	1.98	2.12	0.9	5.36	69.63
Asterias rubens	0.75	1.3	0.9	3.3	72.93

Group u

Average similarity: 26.52

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Ophiura ophiura inc.	2.55	8	1.1	30.15	30.15
Astropecten irregularis	1.53	3.67	0.7	13.85	44
Nematoda	0.63	1.9	0.69	7.16	51.16
Paguroidea stet.	0.73	1.48	0.68	5.58	56.74
Leptothecata	0.5	1.08	0.5	4.09	60.83
Phoronis	0.5	1.08	0.5	4.08	64.91
Actiniaria indet. 01	0.85	0.91	0.49	3.45	68.36
Ceriantharia stet.	1	0.91	0.48	3.42	71.78

Group r

Average similarity: 67.84

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Serpulidae stet.	7.12	7.88	SD=0!	11.62	11.62
Alcyonium digitatum	5.04	5.7	SD=0!	8.4	20.02
Pectinidae stet.	4.89	4.6	SD=0!	6.78	26.8
Ophiura albida inc.	3.72	3.14	SD=0!	4.63	31.43
Echinoidea indet. GL0002	2.24	2.66	SD=0!	3.92	35.35
Suberites indet. 03	2.92	2.66	SD=0!	3.92	39.26
Psolus phantapus inc.	2.12	2.38	SD=0!	3.5	42.77
Asterias rubens	2.09	2.06	SD=0!	3.03	45.8
Ophiura ophiura inc.	1.73	2.06	SD=0!	3.03	48.83
Pecten maximus	1.98	2.06	SD=0!	3.03	51.87

Paguroidea stet.	2.03	1.68	SD=0!	2.48	54.34
Actiniaria indet. 01	1.71	1.68	SD=0!	2.48	56.82
Spatangus purpureus	1.41	1.68	SD=0!	2.48	59.3
Aporrhais pespelecani	1.57	1.68	SD=0!	2.48	61.77
Buccinium undatum inc.	2.29	1.68	SD=0!	2.48	64.25
Scaphopoda stet.	1.71	1.68	SD=0!	2.48	66.73
Myxicola stet.	1.5	1.19	SD=0!	1.75	68.48
Cirripedia stet.	2.3	1.19	SD=0!	1.75	70.23

Group o
Average similarity: 60.49

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Serpulidae stet.	7.21	8.39	SD=0!	13.87	13.87
Alcyonium digitatum	6.12	6.85	SD=0!	11.33	25.2
Ophiura albida inc.	5.87	6.75	SD=0!	11.16	36.36
Ophiothrix fragilis inc.	5.51	6.11	SD=0!	10.1	46.46
Ceriantharia stet.	4.9	3.9	SD=0!	6.44	52.9
Actiniaria indet. 01	1.57	1.66	SD=0!	2.75	55.65
Nemertesia antennina inc.	1.93	1.66	SD=0!	2.75	58.4
Sertulariidae indet. 01	1.93	1.66	SD=0!	2.75	61.14
Paguroidea stet.	1.37	1.18	SD=0!	1.94	63.09
Ascidiacea indet. 01	1	1.18	SD=0!	1.94	65.03
Actiniaria indet. 03	1.21	1.18	SD=0!	1.94	66.97
Asterias rubens	1.5	1.18	SD=0!	1.94	68.92
Buccinium undatum inc.	1.21	1.18	SD=0!	1.94	70.86

Group c
Average similarity: 49.76

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Burrows	1.53	4.68	3.41	9.41	9.41
Sertulariidae	1	4.45	6.99	8.94	18.35
Hydrallmania falcata	1.1	4.45	6.99	8.94	27.29
Copepoda	1	4.45	6.99	8.94	36.23
Schizomavella	1	4.45	6.99	8.94	45.17
Faunalturf	0.69	2.69	2.83	5.4	50.57
Annelida_Serpulidaemsp0001	0.66	2.4	3.5	4.82	55.39
Nematoda	0.85	2.39	0.9	4.81	60.2
Animaliatubes	0.59	2.17	3.91	4.36	64.56
Mollusca_Pectinidae01	0.45	1.64	1.96	3.29	67.85
Cnidaria_Tubulariamsp0001	0.42	1.37	3.36	2.75	70.6

Group e
Average similarity: 49.65

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Nematoda	1.38	6.01	6.61	12.1	12.1
Copepoda	1	4.51	7.93	9.08	21.18
Decapoda	1.01	3.37	1.32	6.78	27.96

Penetrantia	0.89	2.94	1.33	5.92	33.88
Cnidaria_Alcyoniumdigitatum	0.63	2.48	3.51	5	38.88
Amphipoda	0.8	2.3	1	4.63	43.52
Faunalturf	0.57	2.28	4.69	4.59	48.11
Annelida_Serpulidaemsp0001	0.58	1.98	2.73	4	52.11
Euclymeninae	0.71	1.79	0.76	3.6	55.71
Cnidaria_Tubulariamsp0001	0.44	1.56	1.72	3.14	58.85
Animaliatubes	0.4	1.54	3.56	3.1	61.95
Mollusca_Pectinidae01	0.33	1.26	4.36	2.54	64.49
Echinodermata_Ophiurasp	0.29	1.17	4.42	2.35	66.84
Sertulariidae	0.55	1.15	0.6	2.33	69.16
Mollusca_Scaphopoda01	0.26	0.8	1.61	1.61	70.77

Group d
Average similarity: 51.04

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Nematoda	1.35	5.22	5.59	10.23	10.23
Annelida_Serpulidaemsp0001	0.91	3.49	6.09	6.83	17.06
Sertulariidae	1.07	3.37	1.58	6.61	23.66
Hydrallmania falcata	1.02	2.97	1.31	5.81	29.47
Copepoda	0.86	2.82	1.48	5.52	35
Cnidaria_Alcyoniumdigitatum	0.63	2.03	2.44	3.97	38.97
Echinodermata_Ophiurasp	0.63	2	2.99	3.91	42.88
Mollusca_Pectinidae01	0.57	1.94	3.83	3.8	46.67
Decapoda	0.77	1.91	0.95	3.74	50.42
Schizomavella	0.67	1.79	0.89	3.5	53.92
Porella concinna	0.67	1.79	0.89	3.5	57.42
Euclymeninae	0.7	1.45	0.69	2.85	60.26
Amphipoda	0.62	1.21	0.65	2.38	62.64
Cnidaria_Ceriantharia01	0.43	1.13	1.24	2.22	64.87
Faunalturf	0.4	1.09	1.85	2.14	67.01
Penetrantia	0.6	1.03	0.58	2.03	69.04
Echinodermata_Asteriasrubens	0.24	0.82	3.73	1.61	70.65

Group l
Average similarity: 57.62

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Burrows	1.85	11.4	SD=0!	19.79	19.79
Nematoda	1.41	9.77	SD=0!	16.96	36.75
Polygordius	1.21	6.91	SD=0!	11.99	48.74
Annelida_Serpulidaemsp0001	0.74	4.76	SD=0!	8.26	57
Cnidaria_Alcyoniumdigitatum	0.47	3.06	SD=0!	5.31	62.31
Faunalturf	0.4	2.33	SD=0!	4.04	66.35
Mollusca_Pectinidae01	0.33	2.02	SD=0!	3.5	69.85
Echinodermata_Ophiurasp	0.27	1.86	SD=0!	3.22	73.07

Group a
Average similarity: 43.14

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Nematoda	1.23	7.2	5.23	16.68	16.68
Copepoda	0.89	5.06	1.79	11.72	28.4
Faunalturf	0.55	2.76	3.06	6.4	34.8
Echinodermata_Ophiurasp	0.35	1.9	5.8	4.4	39.21
Annelida_Serpulidaemsp0001	0.42	1.78	1.65	4.12	43.33
Amphipoda	0.6	1.72	0.61	3.98	47.31
Arthropoda_Paguroideaindet	0.31	1.68	5.21	3.9	51.21
Animaliatubes	0.28	1.32	3.28	3.06	54.28
Mollusca_Pectinidae01	0.28	1.27	2.07	2.95	57.22
Cnidaria_Tubulariamsp0001	0.31	1.23	1.4	2.86	60.08
Cnidaria_Alcyoniumdigitatum	0.27	1.14	1.51	2.65	62.74
Mollusca_Scaphopoda01	0.25	1.1	1.42	2.56	65.3
Nemertea	0.44	1.03	0.44	2.39	67.68
Annelida_Terebellidae01	0.23	0.99	1.28	2.3	69.99
Arthropoda_cfPagurusbernhardus	0.18	0.74	1.39	1.72	71.71

Group m
Average similarity: 50.06

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Nematoda	1.21	6.13	SD=0!	12.24	12.24
Decapoda	1.21	6.13	SD=0!	12.24	24.47
Sertularella	1	6.13	SD=0!	12.24	36.71
Faunalturf	0.52	3.01	SD=0!	6.02	42.73
Chordata_Actinopterygii01	0.38	2.22	SD=0!	4.44	47.17
Echinodermata_Ophiurasp	0.43	2.12	SD=0!	4.23	51.4
Cnidaria_Actiniaria03	0.32	1.95	SD=0!	3.89	55.28
Cnidaria_Actiniaria01	0.32	1.55	SD=0!	3.1	58.39
Echinodermata_Ophiuroideaindet	0.27	1.44	SD=0!	2.87	61.26
Arthropoda_Paguruspricleaux	0.31	1.44	SD=0!	2.87	64.12
Cnidaria_Adamsiapalliata	0.31	1.44	SD=0!	2.87	66.99
Cnidaria_Alcyoniumdigitatum	0.28	1.17	SD=0!	2.34	69.34
Cnidaria_Ceriantharia01	0.35	1.17	SD=0!	2.34	71.68

Group b
Average similarity: 49.14

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Euclymeninae	1.41	6.39	SD=0!	12.99	12.99
Nematoda	1	4.52	SD=0!	9.19	22.18
Scoloplos armiger	1	4.52	SD=0!	9.19	31.37
Decapoda	1	4.52	SD=0!	9.19	40.56
Penetrantia	1.21	4.52	SD=0!	9.19	49.74
Cnidaria_Alcyoniumdigitatum	0.8	3.6	SD=0!	7.32	57.06
Echinodermata_Ophiurasp	0.45	1.87	SD=0!	3.81	60.87
Annelida_Serpulidaemsp0001	0.56	1.82	SD=0!	3.69	64.57
Cnidaria_Tubulariamsp0001	0.44	1.55	SD=0!	3.16	67.73
Mollusca_Pectinidae01	0.46	1.51	SD=0!	3.06	70.79

Group n
Average similarity: 35.13

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Faunalturf	0.48	4.26	3.19	12.14	12.14
Echinodermata_Ophiurasp	0.42	3.69	2.28	10.5	22.64
Phoronis	0.57	3.02	0.61	8.59	31.23
Arthropoda_Paguroideaindet	0.33	2.83	2.82	8.06	39.29
Amphipoda	0.57	2.59	0.61	7.36	46.66
Echinodermata_Astropectenirregularis	0.21	1.71	1.83	4.86	51.52
Cnidaria_Alcyoniumdigitatum	0.15	1.38	3.24	3.93	55.45
Nemertea	0.43	1.3	0.39	3.7	59.15
Cnidaria_Actiniaria01	0.18	1.27	1.24	3.62	62.77
Arthropoda_Pagurusprideaux	0.22	1.26	1.07	3.6	66.37
Cnidaria_Adamsiapalliata	0.22	1.26	1.07	3.6	69.96
Cnidaria_Ceriantharia01	0.15	1.2	1.39	3.41	73.37

Group k
Average similarity: 68.93

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Annelida_Serpulidaemsp0001	0.97	7.98	40.5	11.57	11.57
Cnidaria_Alcyoniumdigitatum	0.82	6.22	9.08	9.02	20.59
Echinodermata_cfOphiothrixfragilis	0.65	4.57	16.43	6.63	27.22
Echinodermata_Ophiurasp	0.62	4.46	3.97	6.47	33.68
Faunalturf	0.53	3.84	6.37	5.58	39.26
Mollusca_Pectinidae01	0.44	3.32	6.67	4.81	44.08
Cnidaria_Actiniaria01	0.36	2.67	6.58	3.87	47.94
Arthropoda_cfPagurusbernhardus	0.32	2.6	34.49	3.77	51.71
Cnidaria_Hydrozoaindet	0.29	2.05	10.48	2.98	54.69
Cnidaria_Tubulariamsp0001	0.26	1.92	4.52	2.78	57.47
Arthropoda_Cirripedia	0.29	1.83	3.45	2.65	60.12
Mollusca_Buccinidae01	0.24	1.76	7.92	2.55	62.67
Arthropoda_Ebaliasp	0.23	1.74	11.59	2.53	65.2
Echinodermata_Asteriasrubens	0.23	1.63	5.34	2.36	67.57
Echinodermata_cfOphiocominanigra	0.33	1.48	1.16	2.15	69.72
Chordata_Ascidiacea01	0.2	1.39	3.63	2.01	71.73

Group i
Less than 2 samples in group

Group f
Average similarity: 39.33

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Nematoda	1.14	10.29	6.69	26.17	26.17
Annelida_Serpulidaemsp0001	0.65	6.23	6.92	15.85	42.02
Faunalturf	0.39	3.09	8.18	7.87	49.89
Animaliatubes	0.29	2.99	6.28	7.6	57.49

Echinodermata_Ophiurasp	0.24	2.36	6.28	6.01	63.5
Mollusca_Pectinidae01	0.35	2.34	1.74	5.94	69.44
Arthropoda_cfPagurusbernhardus	0.24	2.11	5.23	5.35	74.8

Group g
Average similarity: 66.20

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Annelida_Serpulidaemsp0001	0.62	7.56	5.78	11.41	11.41
Cnidaria_Tubulariamsp0001	0.5	6.7	17.67	10.12	21.53
Cnidaria_Alcyoniumdigitatum	0.47	5.55	13.6	8.38	29.91
Mollusca_Pectinidae01	0.35	4.48	24.54	6.76	36.67
Echinodermata_Echinoidea01	0.34	4.05	4.04	6.11	42.79
Arthropoda_cfPagurusbernhardus	0.28	3.68	11.02	5.56	48.35
Faunalturf	0.32	3.52	3.05	5.32	53.67
Animaliatubes	0.27	3.02	3.6	4.57	58.24
Echinodermata_Ophiurasp	0.26	2.93	3.24	4.42	62.66
Mollusca_Buccinidae01	0.19	2.66	13.84	4.02	66.68
Echinodermata_cfSpatanguspurpureus	0.23	2.62	2.05	3.96	70.65

Group h
Less than 2 samples in group

Group j
Average similarity: 78.17

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Annelida_Serpulidaemsp0001	0.93	10.11	41.45	12.93	12.93
Cnidaria_Alcyoniumdigitatum	0.88	9.49	16.28	12.14	25.07
Echinodermata_Ophiurasp	0.55	6	22.66	7.67	32.75
Echinodermata_Echinoidea01	0.61	5.81	6.32	7.43	40.18
Mollusca_Pectinidae01	0.51	5.26	12.65	6.73	46.9
Faunalturf	0.36	3.58	31.73	4.58	51.48
Cnidaria_Tubulariamsp0001	0.35	3.19	2.77	4.08	55.56
Mollusca_Bivalviaindet	0.35	3.1	6.34	3.97	59.53
Mollusca_Buccinidae01	0.31	3.02	8.53	3.87	63.4
Arthropoda_cfPagurusbernhardus	0.26	2.66	5.7	3.41	66.81
Echinodermata_Asteriasrubens	0.28	2.64	4.53	3.38	70.18

Appendix D: Benthic infaunal data univariate analysis results

D.1. Raw data results of benthic infaunal univariate analysis (2021 and 2022 site specific survey data

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

Station	Preliminary Infaunal Biotope	S	N	Biomass (g)	d	J'	H'	I
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

Station	Preliminary Infaunal Biotope	S	N	Biomass (g)	d	J’	H’	I
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
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

Station	Preliminary Infaunal Biotope	S	N	Biomass (g)	d	J’	H’	I
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
ZOI14	SS.SMu.CSaMu.AfilKurAnit	29	105	11.5505	6.02	0.85	2.88	0.93
ZOI15	SS.SMu.CSaMu.AfilKurAnit	36	141	11.35	7.07	0.83	2.98	0.91
ZOI16	SS.SSa.CMuSa	35	87	8.90	7.61	0.87	3.10	0.93
ZOI17	SS.SMx.OMx.PoVen	79	272	2.05	13.91	0.88	3.83	0.96
ZOI18	SS.SMx.OMx.PoVen	67	157	18.07	13.05	0.92	3.86	0.97
ZOI19	SS.SSa.CFiSa.EpusOborApri	28	63	5.35	6.52	0.92	3.06	0.96
ZOI20	SS.SSa.CMuSa	38	93	4.15	8.16	0.91	3.31	0.96
ZOI21	SS.SMx.CMx.OphMx	74	412	33.60	12.12	0.77	3.31	0.93
ZOI22	SS.SSa.CMuSa	30	55	144.00	7.24	0.91	3.08	0.95
ZOI23	SS.SMx.OMx.PoVen	62	191	2.51	11.61	0.89	3.68	0.97
ZOI24	SS.SSa.CFiSa.EpusOborApri	61	175	6.69	11.62	0.88	3.60	0.96
ZOI25	SS.SMx.OMx.PoVen	99	333	0.86	16.87	0.89	4.10	0.98

Station	Preliminary Infaunal Biotope	S	N	Biomass (g)	d	J’	H’	I
ZOI26	SS.SSa.CMuSa	46	165	14.01	8.81	0.83	3.16	0.92
22ENV05	SS.SMx.OMx.PoVen	78	284	2.27	14	0.79	3.42	0.90
22ENV06	SS.SMx.OMx.PoVen	90	269	3.73	16	0.90	4.06	0.98
22ENV07	SS.SMx.OMx.PoVen	78	193	15.36	15	0.91	3.97	0.98
22ENV09	SS.SCS.CCS	51	249	10.37	9	0.81	3.20	0.93
22ENV10	SS.SMx.OMx	65	204	6.11	12	0.83	3.48	0.94
22ENV11	SS.SMx.OMx.PoVen	70	288	34.77	12	0.86	3.65	0.96
22ENV12	SS.SSa.CFiSa.EpusOborApri	22	36	0.21	6	0.94	2.91	0.96

Appendix E: Benthic epifaunal data multivariate analysis results

E.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; I = 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

Station	Biotope	S	N	d	J'	H'	Lambda
ENV30	SS.SSa.CMuSa	37	7.67	17.67	0.73	2.63	1.04
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
ZOI14	SS.SSa.CMuSa	22	58	5.172	0.8616	2.663	0.9165
ZOI15	SS.SSa.CMuSa	11	35	2.813	0.6383	1.531	0.6353

Station	Biotope	S	N	d	J'	H'	Lambda
ZOI16	SS.SSa.CMuSa	9	32	2.308	0.6986	1.535	0.7137
ZOI17	SS.SMx.CMx	45	182	8.455	0.7755	2.952	0.9039
ZOI18	SS.SMx.CMx	58	261	10.24	0.6842	2.778	0.8903
ZOI19	SS.SSa.CMuSa	32	79	7.095	0.7781	2.697	0.8695
ZOI20	SS.SSa.CMuSa	24	41	6.193	0.9091	2.889	0.9451
ZOI21	SS.SMx.CMx	49	244	8.732	0.6849	2.665	0.8827
ZOI22	SS.SSa.CMuSa	14	21	4.27	0.9084	2.397	0.9238
ZOI23	SS.SMx.CMx	30	86	6.51	0.7691	2.616	0.8714
ZOI24	SS.SMx.CMx	32	96	6.792	0.8081	2.801	0.9037
ZOI25	SS.SMx.CMx	58	252	10.31	0.7422	3.014	0.9058
ZOI26	SS.SSa.CMuSa	16	38	4.124	0.78	2.162	0.8236
22ENV05	SS.SMx.CMx	39	147	8	0.72	2.64	0.86
22ENV06	SS.SMx.CMx	51	180	10	0.86	3.39	0.96
22ENV07	SS.SMx.CMx	46	102	10	0.81	3.12	0.92
22ENV09	SS.SMx.CMx	22	37	6	0.90	2.78	0.93
22ENV10	SS.SMx.CMx	39	71	9	0.93	3.39	0.97
22ENV11	SS.SMx.CMx	30	102	6	0.77	2.62	0.88
22ENV12	SS.SSa.CMuSa	12	21	4	0.84	2.10	0.85
22ENV05	SS.SMx.CMx	39	147	8	0.72	2.64	0.86

Appendix F: Sediment contamination results

F.1. Concentration of PCBs recorded in sediments within the Morgan benthic subtidal ecology study area (part 1)

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
Cefas AL1 (mg/kg)	-	-	-	-	-	-	-	0.01
Cefas AL2 (mg/kg)	-	-	-	-	-	-	-	-
Sample no.								
2021 Site Specific Survey								
ENV05	0.0003	0.0003	0.0004	0.0003	0.0003	0.0003	0.00013	0.00195
ENV06	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV12	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV13	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV14	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV17	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV20	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV21	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV29	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV63	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV65	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
2022 Site Specific Survey								
ENV11	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV72	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV13	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
22ENV06	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV23	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
22ENV09	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ZOI14	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ZOI15	<0.00008	0.00009	0.00009	0.00008	0.0001	<0.00008	<0.00008	0.0004
ZOI16	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ZOI17	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ZOI20	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ

Description (PCBs)	28	52	101	118	138	153	180	Sum of ICES 7
ZOI21	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ZOI22	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ZOI23	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ZOI25	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ

F.2. Concentration of PCBs recorded in sediments within the Morgan benthic subtidal ecology study area (Part 2)

Description (PCBs)	18	31	44	47	49	66	105	110	128	141	149	151	156	158	170	183	187	194	Total PCBs
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**	**mg/kg**	**mg/kg**	**mg/kg**
Cefas AL1 (mg/kg)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.02**
Cefas AL2 (mg/kg)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.2**
2021 Site Specific Survey																			
ENV05	0.00014	0.00037	0.00021	0.00027	0.00018	0.0004	<0.00008	0.00034	<0.00008	<0.00008	0.0003	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	0.00022	0.0004	0.00439
ENV06	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV12	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV13	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV14	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV17	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV20	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ

Description (PCBs)	18	31	44	47	49	66	105	110	128	141	149	151	156	158	170	183	187	194	Total PCBs
ENV21	<0.00008	0.0001	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	0.0001
ENV29	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV63	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008
ENV65	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008
2022 Site Specific Survey																			
ENV11	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV72	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV13	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
22ENV06	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ENV23	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
22ENV09	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ZOI14	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ZOI15	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	0.00012	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	0.0005
ZOI16	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ

Description (PCBs)	18	31	44	47	49	66	105	110	128	141	149	151	156	158	170	183	187	194	Total PCBs
ZOI17	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ZOI20	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ZOI21	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ZOI22	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ZOI23	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ
ZOI25	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	NQ

F.3. Concentration of PAHs recorded in sediments within the Morgan benthic subtidal ecology study area (Part 1)

Description (PAH)	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(a(pyrene	Dibenzo(a,h)anthracene
Units	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Canadian TEL	**34.6**	**5.87**	**6.71**	**20.2**	**86.7**	**46.9**	**113**	**53**	**74.8**	**108**	**88.8**	**6.22**
Canadian PEL	**391**	**128**	**88.9**	**144**	**544**	**245**	**1494**	**875**	**693**	**846**	**763**	**135**
2021 Site Specific Survey												
ENV05	3	<1	<1	1	5	<1	4	4	3	4	3	1
ENV06	3	<1	<1	1	5	<1	5	5	3	5	4	2
ENV12	2	<1	<1	<1	3	<1	4	3	2	3	3	1
ENV13	3	<1	<1	<1	4	<1	5	5	3	4	4	1
ENV14	3	<1	<1	1	5	<1	5	5	3	5	4	1
ENV17	3	<1	<1	1	6	<1	6	6	4	5	5	2
ENV20	<1	<1	<1	<1	1	<1	<1	<1	<1	<1	1	<1
ENV21	2	<1	<1	<1	4	<1	5	5	3	4	4	1
ENV29	3	<1	<1	1	7	<1	7	6	4	6	5	2
ENV36	3	<1	<1	1	6	<1	5	5	3	5	4	1
ENV37	3	<1	<1	1	5	<1	5	4	3	4	4	1

Description (PAH)	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(a(pyrene	Dibenzo(a,h)anthracene
ENV38	3	<1	<1	1	6	<1	7	6	4	5	5	2
ENV39	3	<1	<1	1	6	<1	7	6	4	6	6	2
ENV40	5	<1	<1	2	9	1	10	10	6	8	8	3
ENV47	2	<1	<1	<1	3	<1	3	3	2	3	2	<1
ENV50	3	<1	<1	2	7	<1	6	5	3	6	4	2
ENV51	3	<1	<1	1	6	<1	7	6	4	5	5	2
ENV52	3	<1	<1	1	5	<1	6	6	4	5	5	2
ENV57	1	<1	<1	<1	8	<1	3	3	2	3	1	<1
ENV59	1	<1	<1	<1	3	<1	3	3	2	3	2	<1
ENV63	3	<1	<1	<1	4	<1	3	3	2	3	3	<1
ENV65	2	<1	<1	<1	4	<1	4	3	2	3	3	<1
2022 Site Specific Survey												
ENV11	1	<1	<1	<1	4	<1	4	<1	2	3	3	<1
ENV72	<1	<1	<1	<1	3	<1	2	<1	1	1	1	<1
ENV13	3	<1	<1	2	8	1	8	2	4	6	5	2
22ENV06	3	<1	<1	2	7	<1	6	2	4	5	4	1
ENV23	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
22ENV09	3	<1	<1	1	6	<1	6	2	3	5	5	1
ZOI14	3	<1	<1	2	7	1	8	2	4	5	6	2

Description (PAH)	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(a(pyrene	Dibenzo(a,h)anthracene
ZOI15	7	2	2	4	20	4	25	6	14	15	20	5
ZOI16	2	<1	<1	<1	4	<1	5	1	3	4	4	1
ZOI17	3	<1	<1	1	7	<1	5	1	3	4	3	1
ZOI20	2	<1	<1	<1	4	<1	4	1	2	3	3	1
ZOI21	3	<1	<1	1	7	<1	6	2	3	4	4	1
ZOI22	2	<1	<1	1	4	<1	4	1	2	3	3	<1
ZOI23	3	<1	<1	1	8	<1	5	1	3	4	3	<1
ZOI25	2	<1	<1	1	7	<1	5	<1	3	3	3	<1

F.4. Concentration of PAHs recorded in sediments within the Morgan benthic subtidal ecology study area (Part 2)

Description (PAH)	Benzo[b]fluoranthene	Benzo[e]pyrene	Benzo[ghi]perylene	Benzo[k]fluoranthene	C1-naphthalenes	C1-phenanthrene	C2-naphthalenes	C3-naphthalenes	Indeno[1,2,3-cd]pyrene	Perylene	Total
Units	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
Canadian TEL	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Canadian PEL	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
2021 Site Specific Survey											
ENV05	7	6	6	2	7	7	6	5	7	1	82
ENV06	9	7	7	3	7	7	6	5	9	2	97
ENV12	5	5	4	2	5	4	4	3	6	1	60
ENV13	7	6	6	3	7	6	5	4	8	2	83
ENV14	8	7	7	3	7	7	6	5	8	2	91
ENV17	9	8	8	4	8	8	7	7	9	2	108
ENV20	1	<1	<1	<1	1	2	2	2	1	<1	11
ENV21	8	7	6	3	6	6	6	5	8	1	86
ENV29	11	8	8	4	9	10	10	9	10	2	121
ENV63	5	4	4	2	10	6	8	6	5	<1	72
ENV65	6	4	4	3	6	6	5	5	5	<1	65

Description (PAH)	Benzo[b]fluoranthene	Benzo[e]pyrene	Benzo[ghi]perylene	Benzo[k]fluoranthene	C1-naphthalenes	C1-phenanthrene	C2-naphthalenes	C3-naphthalenes	Indeno[1,2,3-cd]pyrene	Perylene	Total
2022 Site Specific Survey											
ENV11	5	4	4	2	4	5	5	4	4	<1	57
ENV72	2	1	2	<1	3	4	4	4	1	<1	32
ENV13	10	8	8	4	9	11	11	9	9	2	125
22ENV06	8	7	7	3	9	9	10	8	7	2	107
ENV23	<1	<1	<1	<1	1	<1	1	<1	<1	<1	2
22ENV09	8	7	7	3	7	10	10	9	7	2	107
ZOI14	10	9	9	4	9	10	17	10	10	2	136
ZOI15	30	27	26	12	19	24	26	23	28	6	363
ZOI16	6	6	5	2	5	5	7	5	6	1	77
ZOI17	7	6	6	2	8	9	11	9	6	1	98
ZOI20	6	5	5	3	5	5	6	4	6	1	69
ZOI21	8	7	7	3	9	10	12	10	7	2	110
ZOI22	5	5	4	2	6	5	8	6	4	1	71
ZOI23	6	5	5	3	16	11	18	13	5	1	114
ZOI25	5	4	4	2	5	7	7	6	4	<1	71

Appendix G: Species scientific, common names and biotopes

G.1.1.1.1 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.

G.2. 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
Bathyporeia tenuipes	No known common name
Branchiostoma lanceolatum	Common lancet
Brissopsis lyrifera	Heart urchin

Scientific name	Common name
Callianassa subterranean	Mud shrimp/Ghost shrimp
Cancer pagurus	Brown crab
Carcinus maenas	Green shore crab
Cerastoderma edule	Common cockle
Cerianthus lloydii	North Sea tube anenome
Chamelea gallina	Striped venus clam
Chamelea striatula	No known common name
Cirrophorus branchiatus	No known common name
Chondrus crispus	Irish moss
Corallina officinalis	Coral weed
Corophium arenarium	No known common name
Corystes cassivelaunus	Masked crab
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
Glycera tridactyla	No known common name
Glycimeris	Bittersweet clam
Golfingia (Golfingia) elongata	No known common name

Scientific name	Common name
Golfingia (Golfingia) vulgaris	Peanut worm
Goneplax rhomboides	Angular crab
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
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
Maxmuelleria lankesteri	Volcano worm
Modiolus modiolus	Northern horse mussel
Mysella bidentata	No known common name
Mytilus edulis	Common blue mussel
Nephasoma (Nephasoma) minutum	Peanut worm
Nephrops norvegicus	Norway lobster
Nephtys cirrosa	White catworm
Nephtys hombergii	Catworm
Nucella lapillus	Dog whelk
Nucula nitidosa	Shiny nut clam
Obelia bidentata	Double toothed sea fir

Scientific name	Common name
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
Phorcus lineatus	Lined top shell
Pleuronectes platessa	European plaice
Poecilochaetus serpens	No known common name
Pomacea canaliculata	Golden apple snail
Pomatoceros triqueter	Keel worm
Porcellana platycheles	Broad clawed porcelain crab
Porphyra purpurea	Purple laver
Priapulus caudatus	Cactus worm
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
Solea solea	Dover sole

Scientific name	Common name
Stauromedusae	Stalked jellyfish
Steromphala cineraria	Grey top shell
Steromphala umbilicalis	Flat top shell
Sthenelais limicola	No known common name
Syllis armillaris	No known common name
Thia scutellata	Thumbnail crab
Thysanocardia procera	Peanut worm
Ulva intestinalis	Sea lettuce
Urticina feline	Dahlia anemone
Verrucaria maura	Tar lichen
Zostera marina	Eel grass

G.2.1.1.1 The below table includes all the biotope codes referred to in the main body of the text as well as their full biotope names.

G.3. 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

Biotope Code	Biotope full name
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
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.Glap	Glycera lapidum in impoverished infralittoral mobile gravel and 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.CCS.PomB	Pomatoceros triqueter with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles
SLR.MX.MytX	Mytilus edulis beds on littoral mixed substrata

Biotope Code	Biotope full name
SS.SMu.CFiMu.BlyrAchi	Brissopsis lyrifera and Amphiura chiajei in circalittoral mud
SS.SMu.CfiMu.MegMax	Burrowing megafauna and Maxmuelleria lankesteri in circalittoral mud
SS.SSa.CmuSa.AalbNuc	Abra alba and Nucula nitidosa in circalittoral muddy sand or slightly mixed sediment
SS.SMu.CSaMu	Circalittoral sandy mud
SS.SMu.CSaMu.AfilKurAnit	Amphiura filiformis, Kurtiella 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
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
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.CFiSa.EpusOborApri	Echinocyamus pusillus, Ophelia borealis and Abra prismatica in 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 H: Sediment metabarcoding

H.1. Sediment metabarcoding results (2021 survey)

H.1.1 Overview

H.1.1.1.1 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.

H.1.2 Summary statistics

H.1.2.1.1 A total of 2,211 operational taxonomic units (OTUs) were detected across from the site-specific surveys as detailed in Table H.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 H.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

H.1.2.1.2 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.

H.1.2.1.3 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.

H.1.2.1.4 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 H.2. The 'Other' category comprised OTUs which could not be identified to class.

H.1.2.1.5 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 H.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%
Desulfobacteria	3	0.2%	5	0.4%
Desulfobulbia	1	0.1%	2	0.1%
Desulfovibrionia	0	0.0%	1	0.1%

Group	Morgan Survey Area		Mona Survey Area	
	Abundance	Proportional Contribution	Abundance	Proportional Contribution
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%**

H.1.2.1.6 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 both the Morgan benthic subtidal ecology study area and Mona benthic subtidal and intertidal ecology study area detailed in Table H.3. The 'Other' category comprised the OTUs which could not be identified to class.

H.1.2.1.7 *Adenophorea* (n=189 and n=175 OTUs) was the most abundant taxonomic group across both the Morgan benthic subtidal ecology study area and Mona benthic subtidal and intertidal ecology study area 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 and intertidal ecology study area the 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 and intertidal 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 H.3: Contribution of gross sediment infaunal OUT 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%
Other	83	18.6%	67	14.5%
Total	364	100%	394	100%

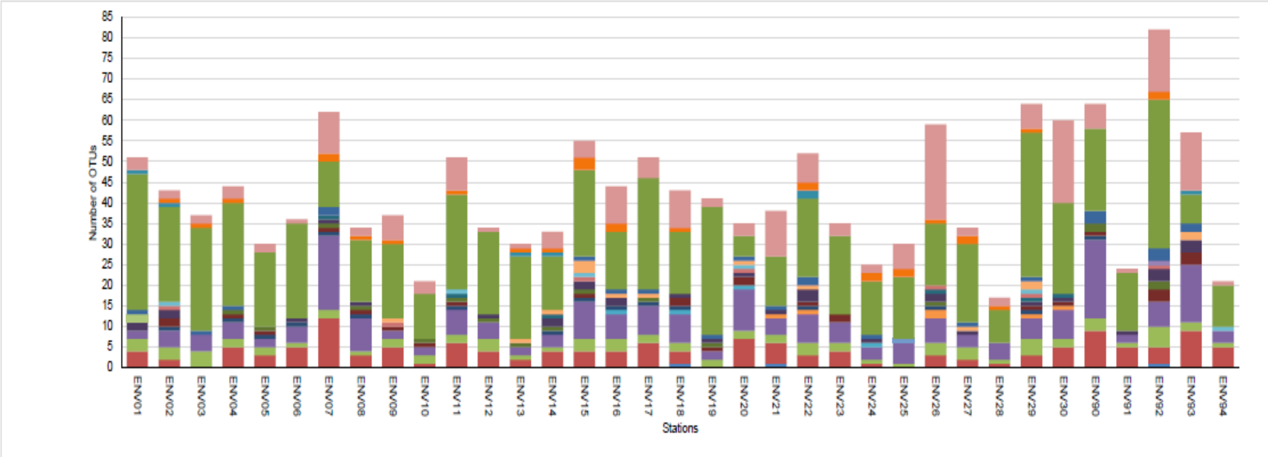


Figure H.1: Contributions of gross sediment infaunal OTU taxonomic groups by samples – Morgan benthic subtidal ecology study area.

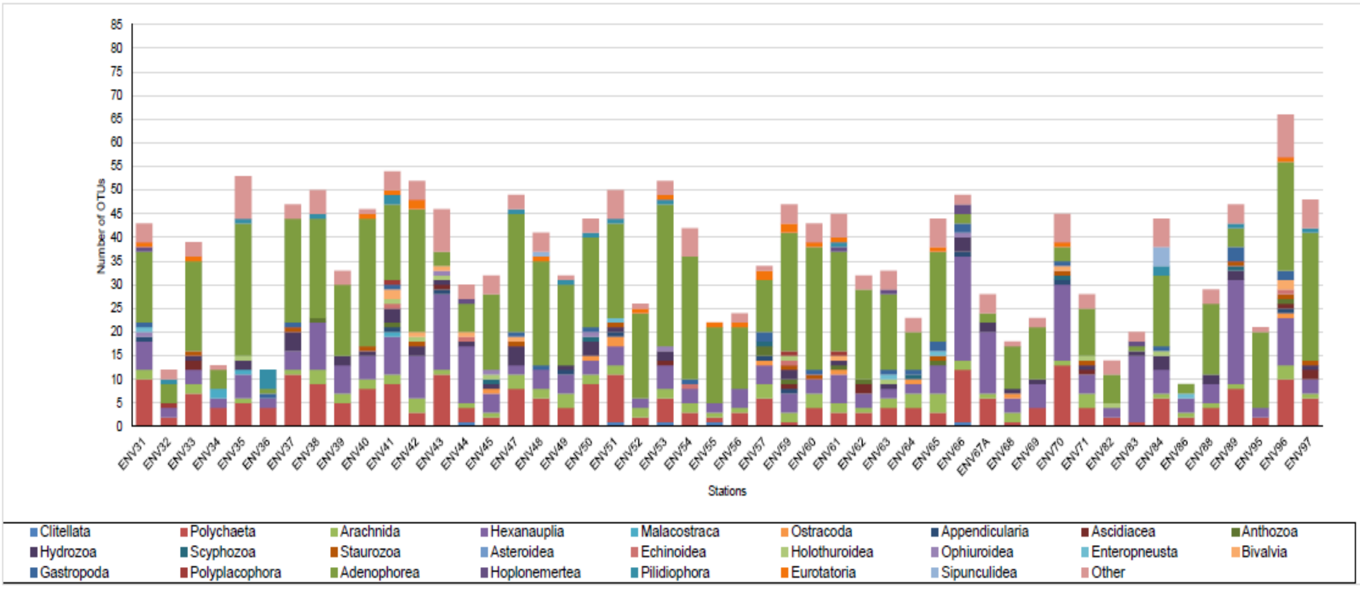


Figure H.2: Contributions of gross sediment infaunal OTU taxonomic groups by samples – Mona benthic subtidal ecology study area.

H.1.2.1.8 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 H.3 while the taxonomic heat trees detailing the discrete faunal taxa OTUs down to the order rank are presented in Figure H.4. 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 H.4.

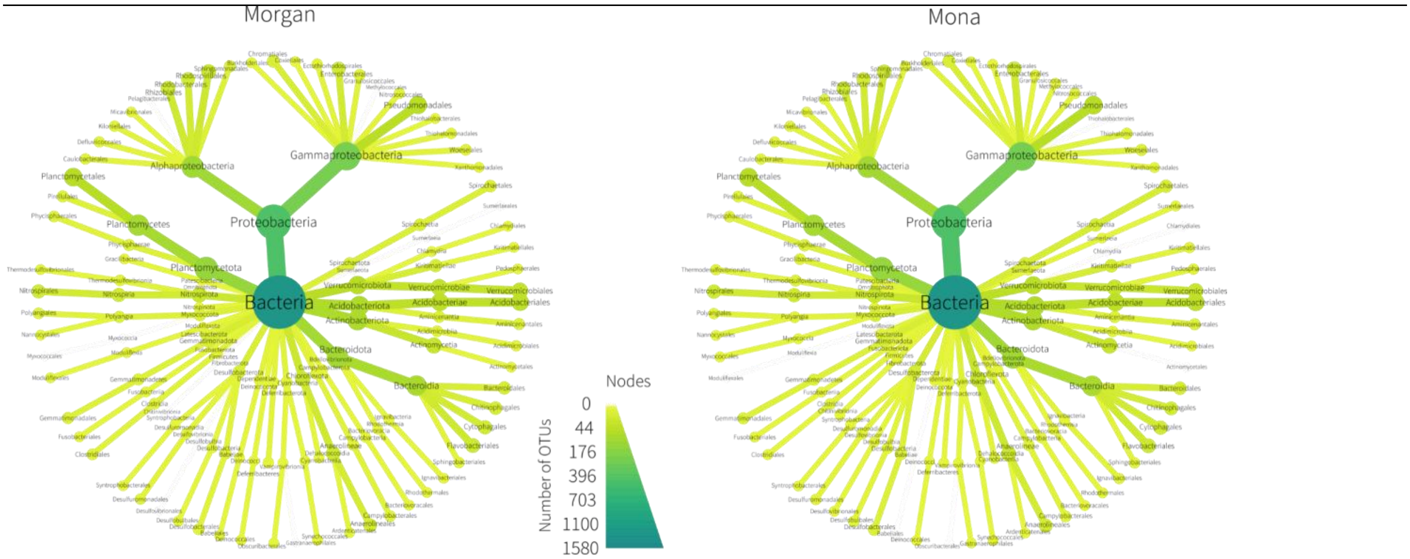


Figure H.3: Sediment bacterial taxonomic heat trees of the number of OTUs per benthic subtidal ecology study area.

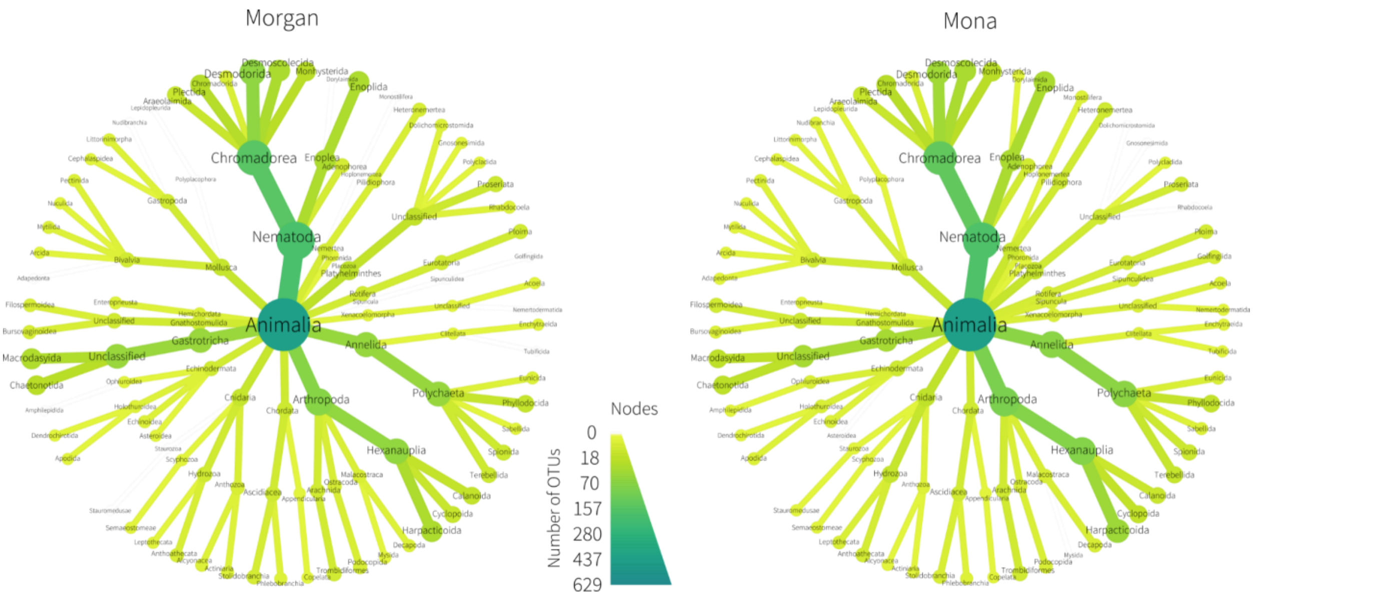


Figure H.4: Sediment infaunal taxonomic heat trees of the number of OTUs per benthic subtidal ecology study area.

Table H.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

H.1.2.1.9 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 H.5, Figure H.6, Figure H.7 and Figure H.8, 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.

H.1.2.1.10 The Sobs curve for the Morgan sediment bacterial data set (Figure H.5) 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.

H.1.2.1.11 Considering the Mona bacterial data set (Figure H.6), 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.

H.1.2.1.12 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).

H.1.2.1.13 The Sobs curve for the Morgan sediment infaunal data set (Figure H.7) 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.

H.1.2.1.14 The Sobs curve for the Mona sediment infaunal data set (Figure H.8) 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.

H.1.2.1.15 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.

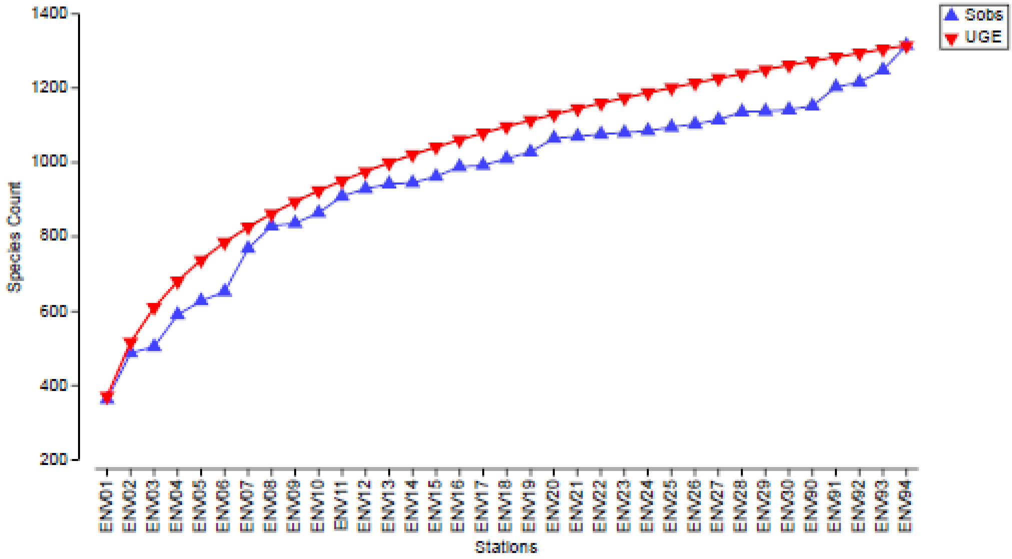


Figure H.5: Sediment bacterial OTU accumulation curve – Morgan benthic subtidal ecology study area.

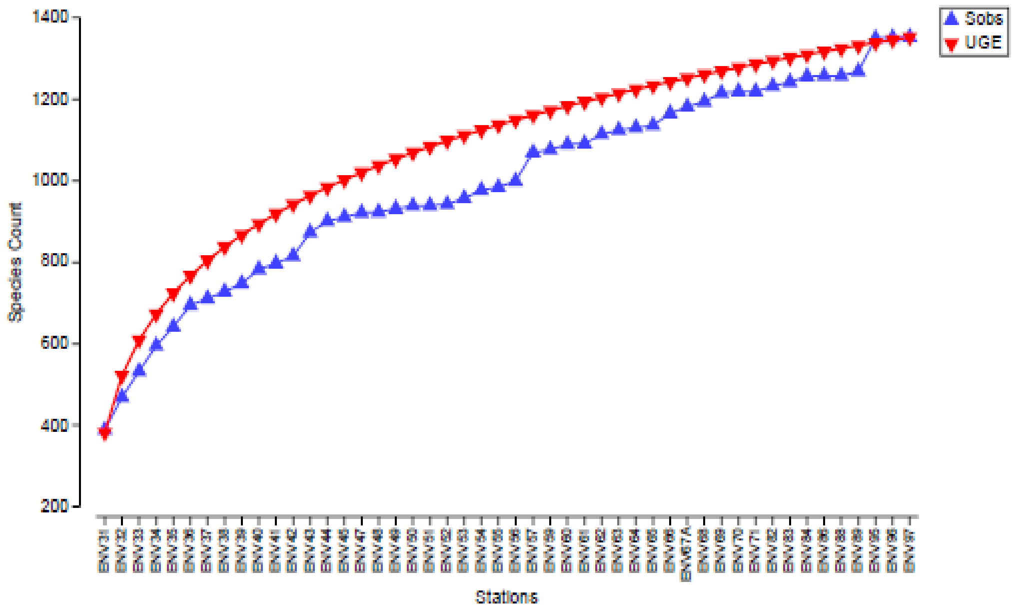


Figure H.6: Sediment bacterial OTU accumulation curve – Mona benthic subtidal ecology study area.

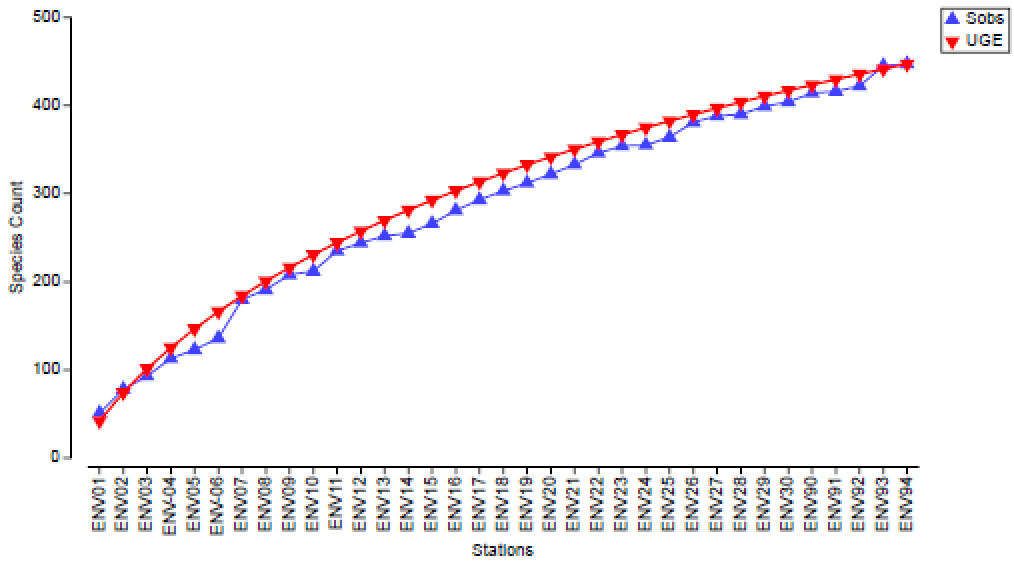


Figure H.7: Sediment infaunal OTU accumulation curve – Morgan benthic subtidal ecology study area.

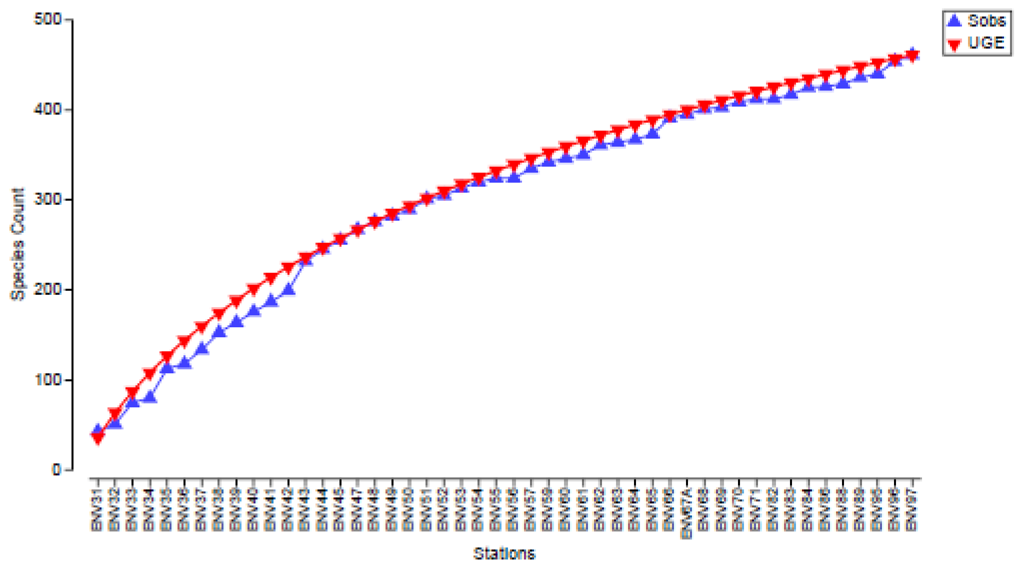


Figure H.8: Sediment infaunal OTU accumulation curve – Mona benthic subtidal ecology study area.

H.1.3 OTU Community Structure using Multivariate Analyses

H.1.3.1.1 The results of the CLUSTER analysis including SIMPROF analysis in the form of a Bray-Curtis similarity dendrogram and nMDS plot based upon standardised data for the sediment bacterial samples are displayed in Figure H.9 and Figure H.10 for the Morgan benthic subtidal ecology study area and in Figure H.11 and Figure H.12 for the Mona benthic subtidal ecology study area. Similarly results of the same analyses on the standardised infauna data are presented in Figure H.13 for the Morgan benthic subtidal ecology study area and in Figure H.14 for the Mona benthic subtidal ecology study area.

H.1.3.1.2 The CLUSTER analysis and resulting dendrogram for the Morgan benthic subtidal ecology study area sediment bacterial OTU data set (Figure H.9) 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.

H.1.3.1.3 The Mona benthic subtidal ecology study area identified 29 SIMPROF groups (Figure H.11) 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).

H.1.3.1.4 The nMDS ordination of the Morgan and Mona sediment bacterial sample data sets (Figure H.10 and Figure H.12) 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.

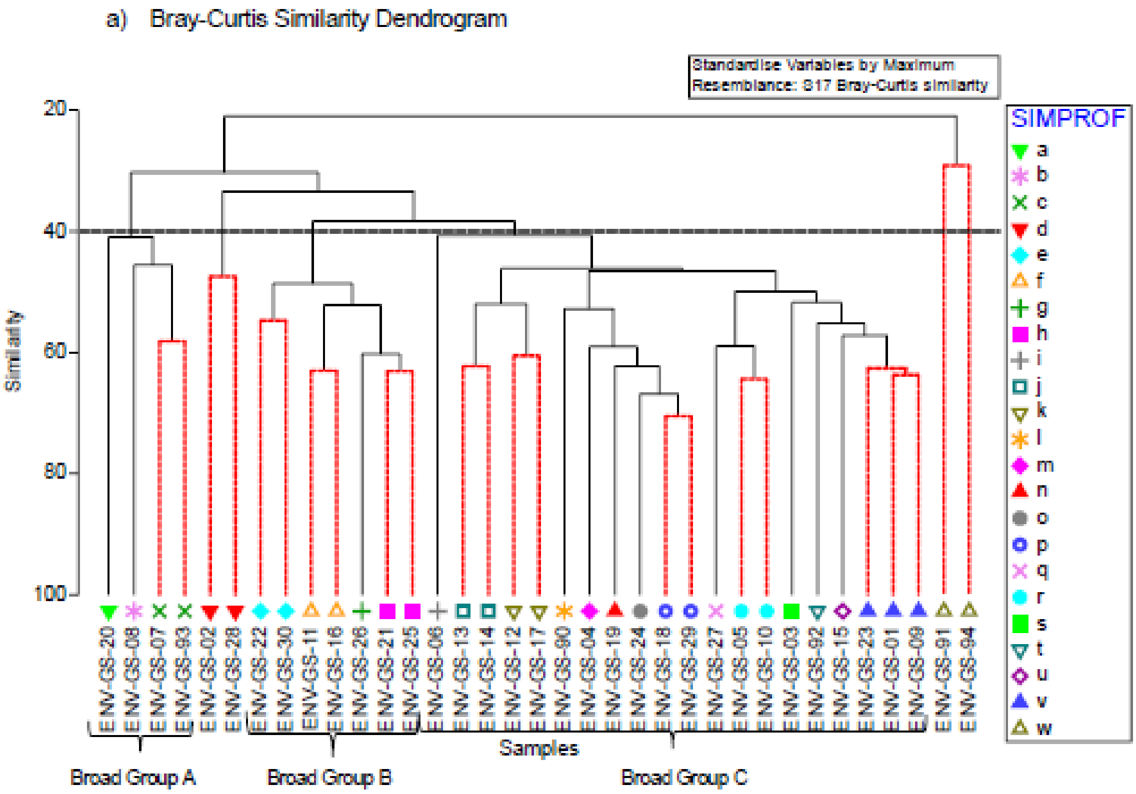


Figure H.9: Multivariate analysis of sediment bacterial OTU data by sample – Morgan benthic subtidal ecology study area.

b) MDS Ordination

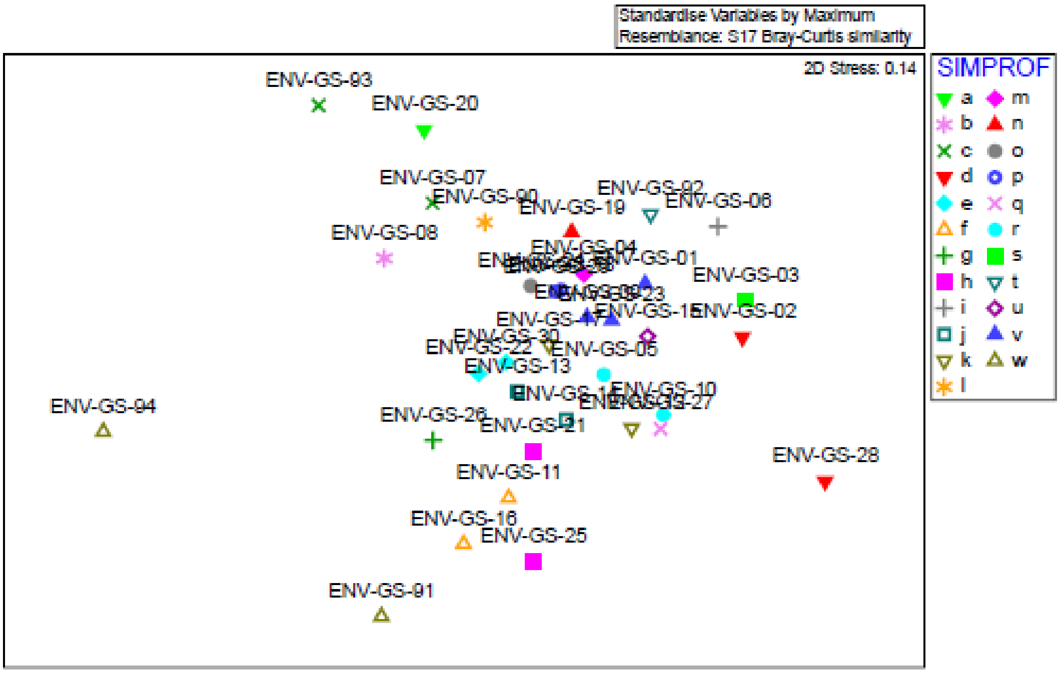


Figure H.10: Multivariate analysis of sediment bacterial OTU data by sample – Morgan benthic subtidal ecology study area.

a) Bray-Curtis Similarity Dendrogram

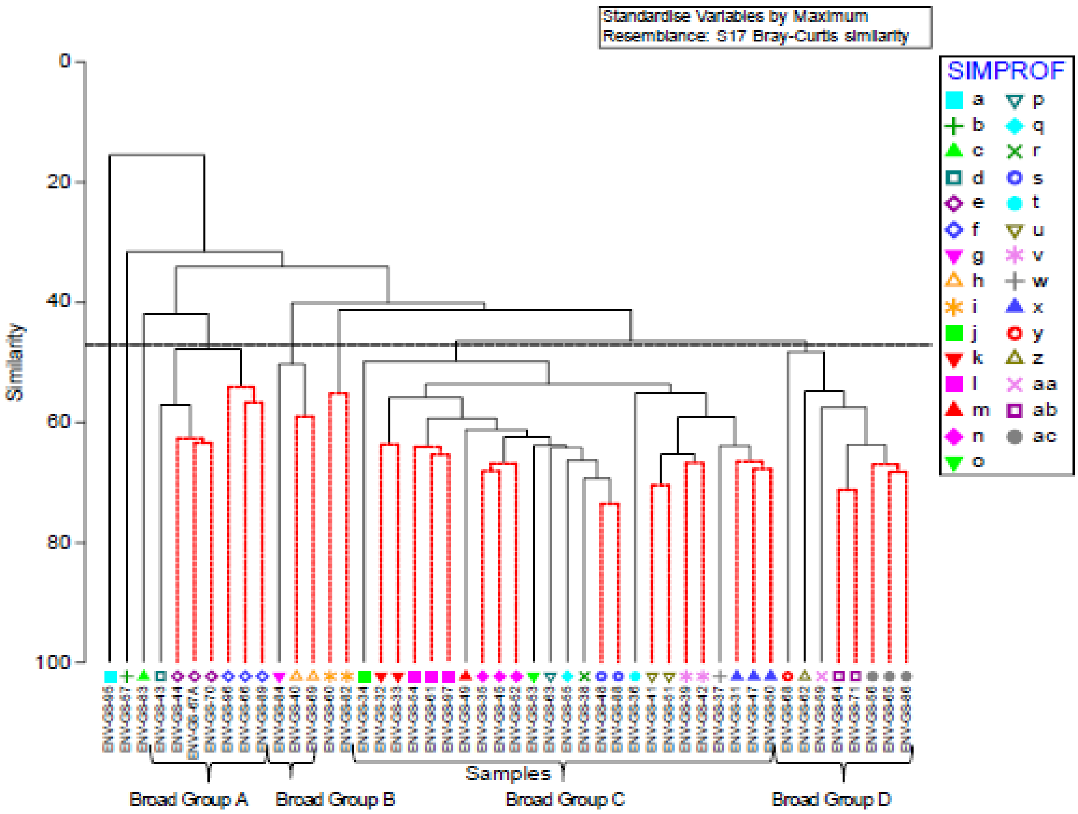


Figure H.11: Multivariate analysis of sediment bacterial OTU data by sample – Mona benthic subtidal ecology study area.

b) MDS Ordination

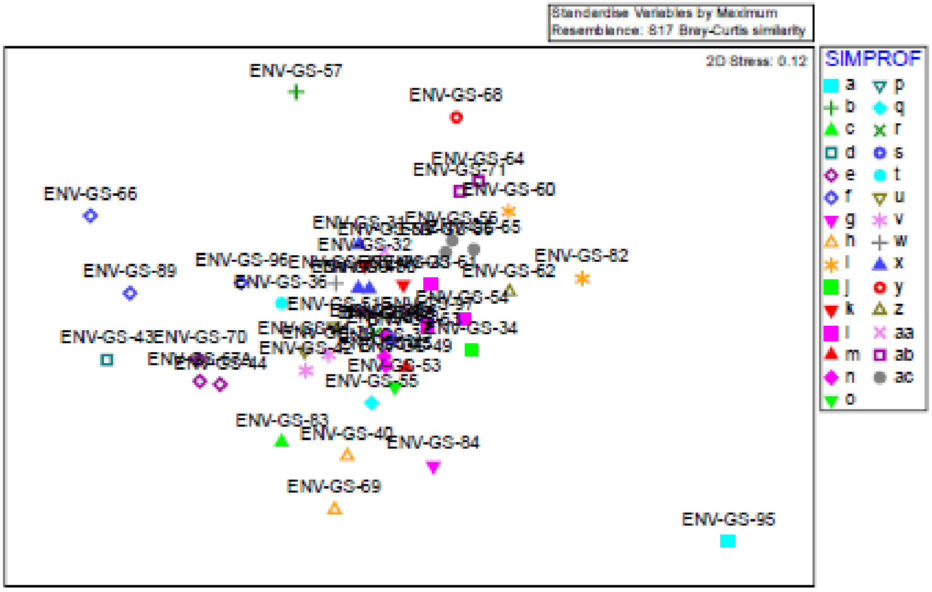


Figure H.12: Multivariate analysis of sediment bacterial OTU data by sample – Mona benthic subtidal ecology study area.

H.1.3.1.5 Examination of the Morgan sediment bacterial sample data set together with results of SIMPER analyses at a group level is presented in Table H.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 H.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).

SIMPROF	Dissimilarity (%)	Groups Influencing Sample Separation
		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)

H.1.3.1.6 Examination of the Mona bacterial sample data set, together with the results of SIMPER analyses at a group level is presented in Table H.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 H.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 cA (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 cA (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)

SIMPROF	Dissimilarity (%)	Taxa Influencing Sample Separation
		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).

H.1.3.1.7 CLUSTER analysis and resulting dendrograms for the Morgan sediment infauna OTU data set (Figure H.13) 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.

H.1.3.1.8 The Mona benthic subtidal ecology study area (Figure H.14) 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.

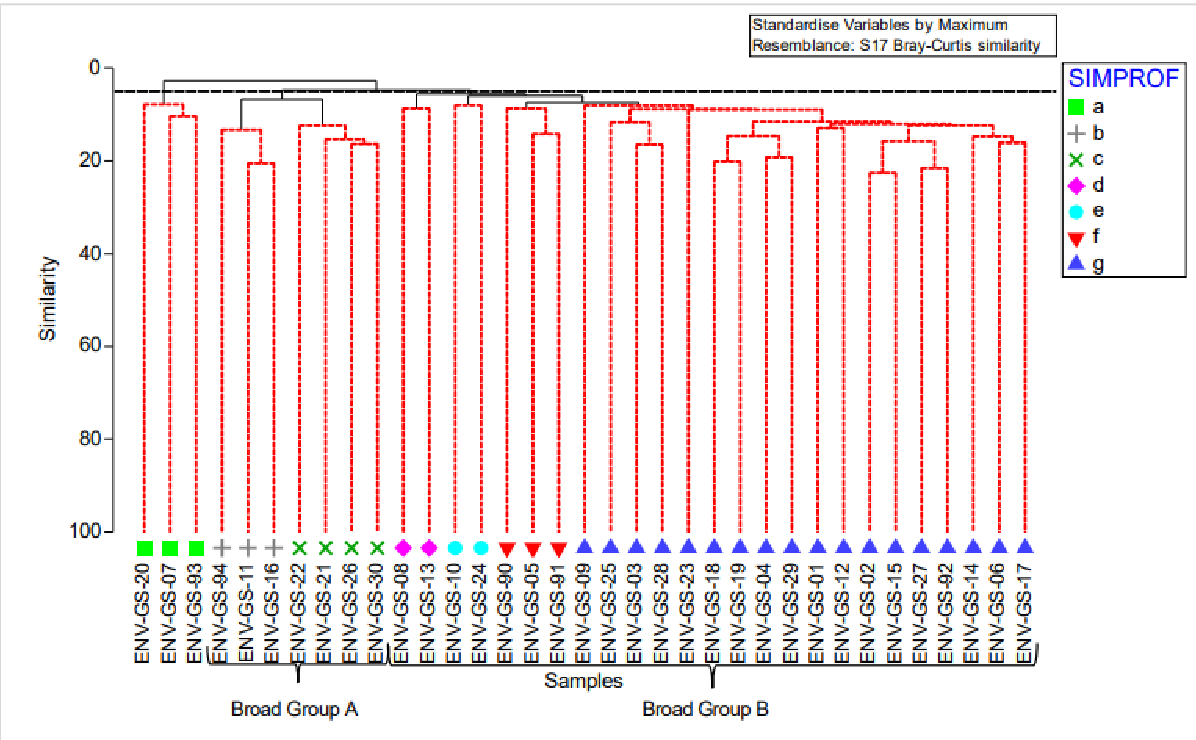


Figure H.13: Bray-Curtis similarity dendrogram of sediment infaunal OTU data by sample – Morgan benthic subtidal ecology study area.

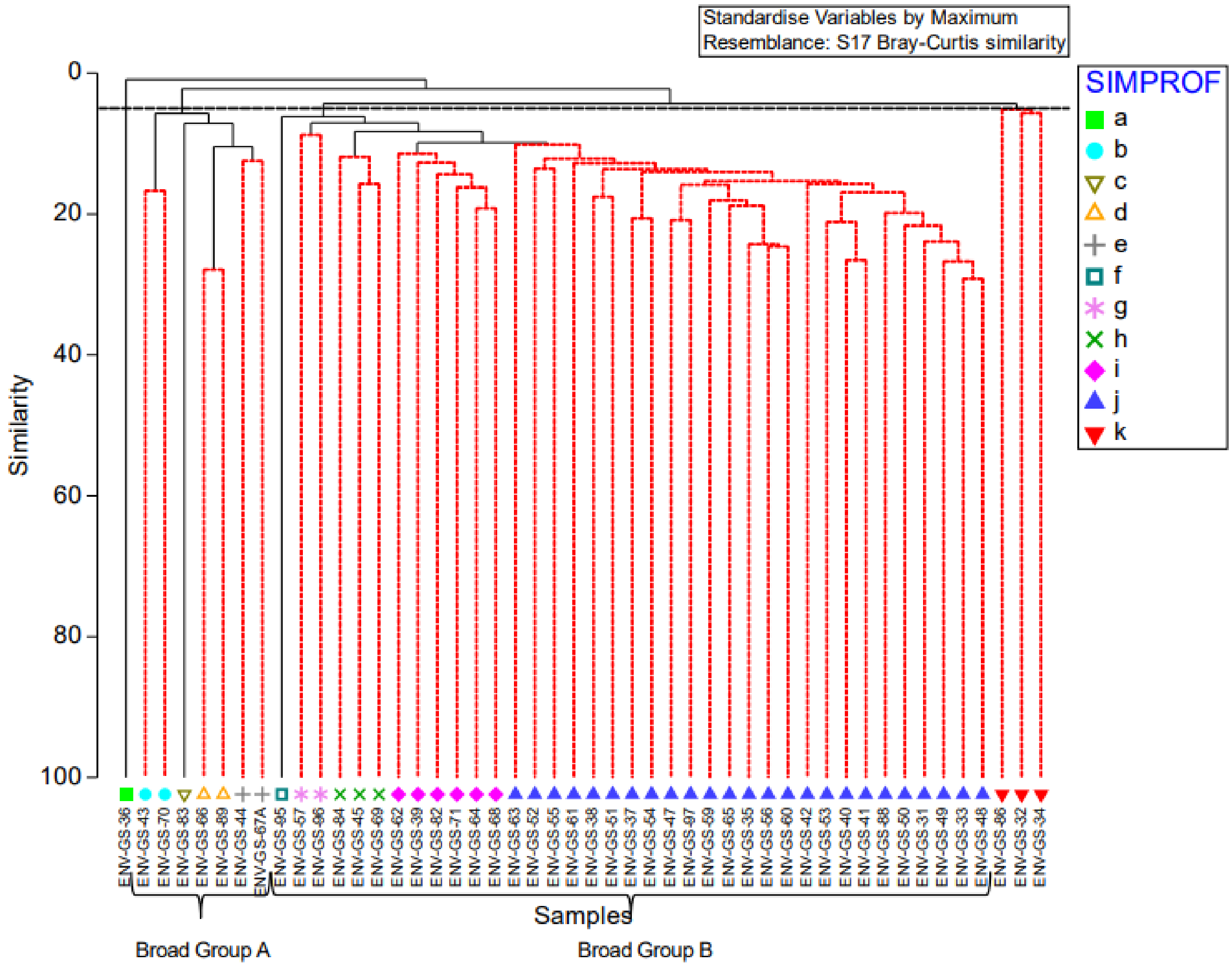


Figure H.14: Bray-Curtis similarity dendrogram of sediment infaunal OTU data by sample – Morgan benthic subtidal ecology study area.

H.1.3.1.9 Examinations of the Morgan sediment infaunal sample data set together with results of SIMPER analysis; presented in Table H.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 H.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).

SIMPROF	Dissimilarity (%)	Taxa Influencing Sample Separation
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)

H.1.3.1.10 Results of the SIMPER analysis (Table H.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 H.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

H.1.4 Multivariate comparison of metabarcoding results to physico-chemical data

H.1.4.1.1 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.

H.1.4.1.2 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 H.15 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.

H.1.4.1.3 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 H.16). 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.

H.1.4.1.4 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.

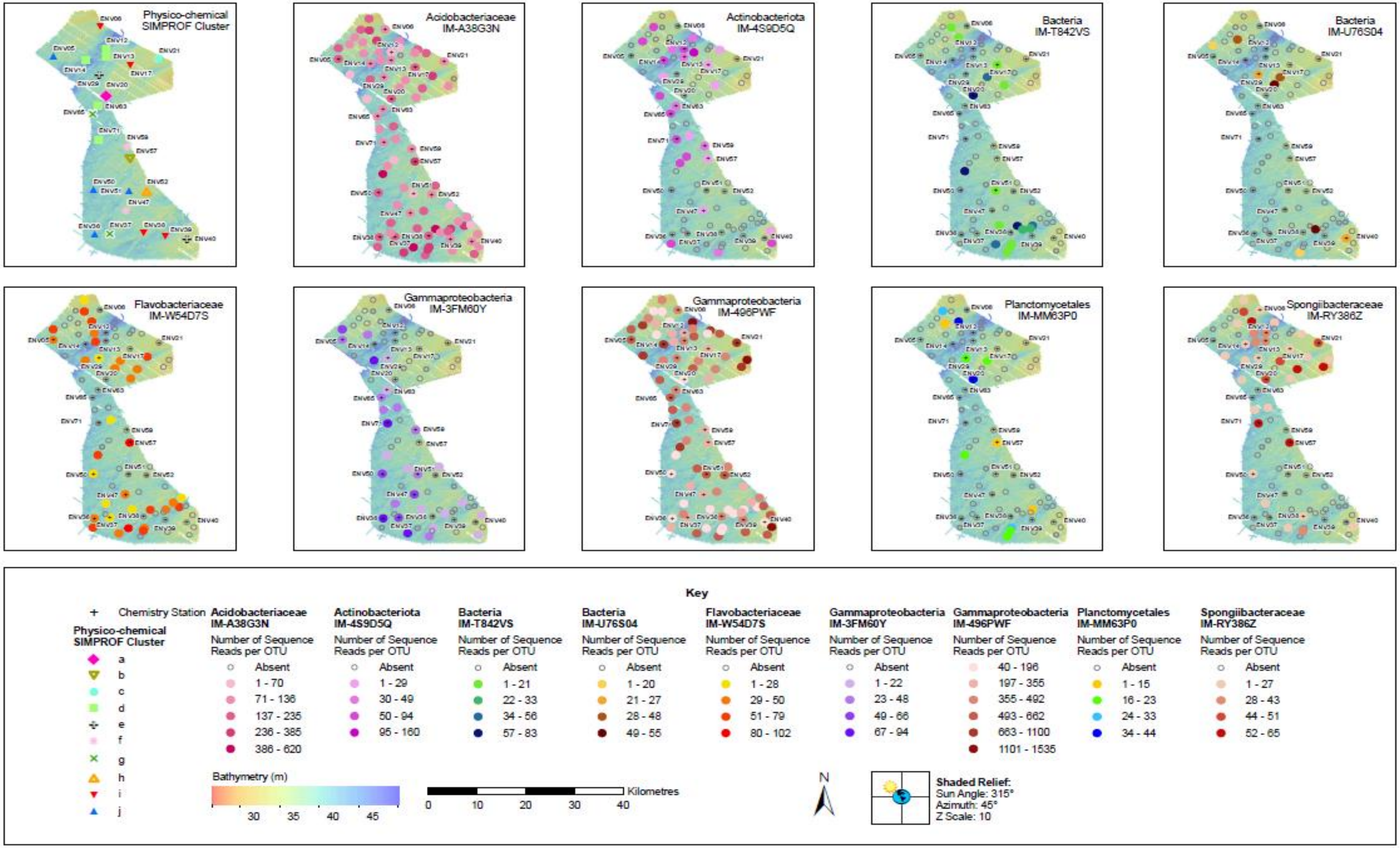


Figure H.15: Geographical overview of bacterial taxa in relation to physico-chemical SIMPROF groups.

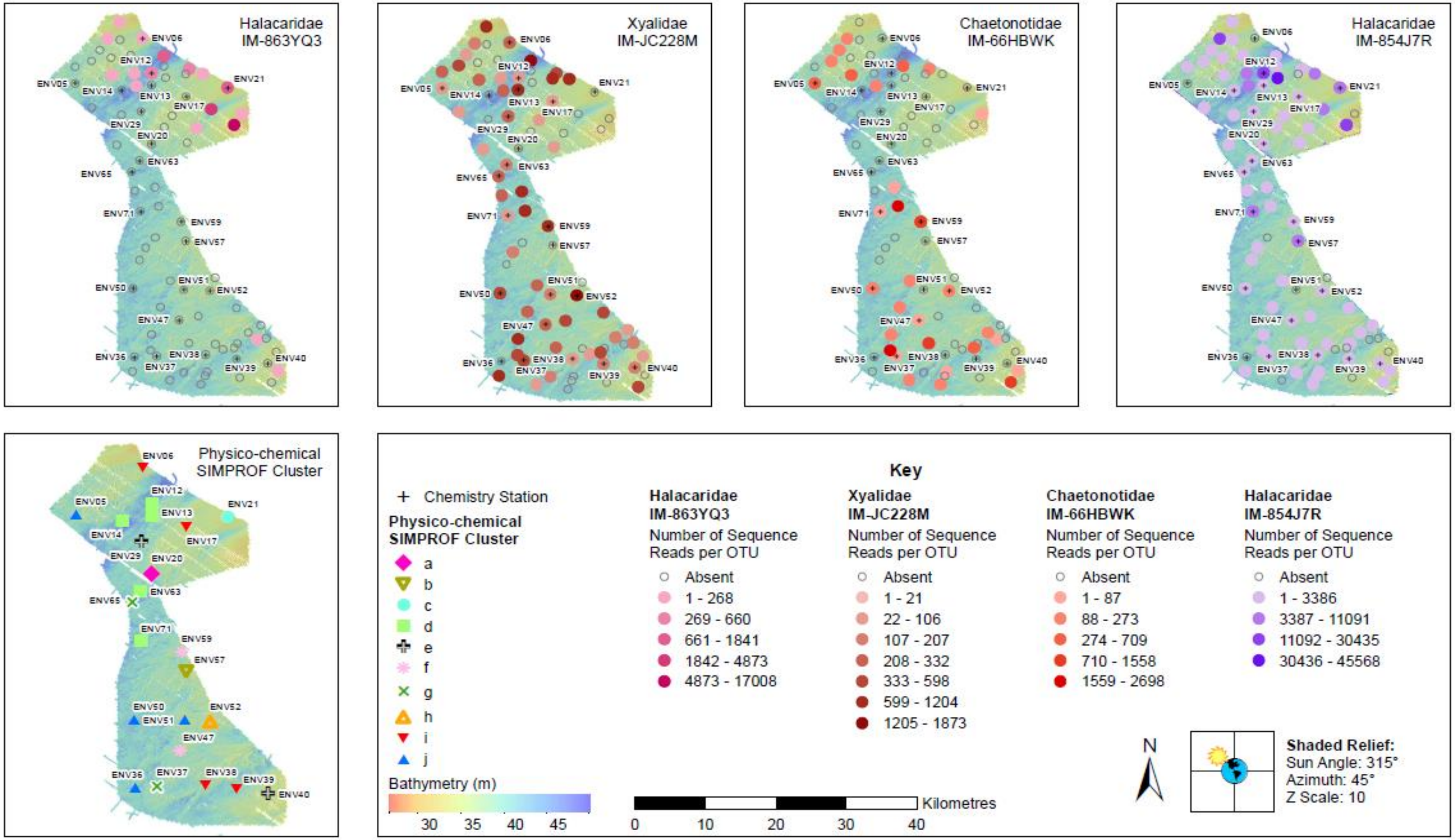


Figure H.16: Geographical overview of bacterial taxa in relation to physico-chemical SIMPROF groups.

H.1.5 Multivariate Comparison of Macrofaunal and Metabarcoding Data Sets

H.1.5.1.1 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.

H.1.5.1.2 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.

H.2. Sediment metabarcoding results (2022 survey)

H.2.1 Overview

H.2.1.1.1 Two samples were collected from 103 stations within the survey area; of which a subset of 52 stations were sent to the laboratory for bacterial and infaunal DNA analysis. The remaining samples were retained as spares.

H.2.2 Summary statistics

H.2.2.1.1 A total of 1906 operational taxonomic units (OTUs) were detected across the survey area, as detailed in Table H.9. Of the 1906 detected OTUs (bacterial and infaunal), a greater percentage of infaunal OTUs were identified to species level (10%) compared to the bacterial OTUs (1%), which may be due to a larger pool of reference material for infaunal OTUs.

Table H.9: OTU detections per target and percentage successfully classified.

Target	Number of OTUs	Percentage of OTUs classified to					
		Phylum	Class	Order	Family	Genus	Species
Bacteria	1409	69%	51%	30%	23%	6%	1%
Infauna	497	100%	81%	88%	75%	35%	10%

H.2.2.1.2 A total of 14 bacterial OTUs (1%) were present in all the sediment samples, while 31% (n=443) occurred in a single sediment sample. The relatively high numbers of widespread taxa and lone taxa across the survey area suggested that the community has been exposed to relatively little disturbance.

H.2.2.1.3 A total of 443 (31%) bacterial OTUs and 225 (45%) infaunal OTUs were present in a single sample across the survey area, with no OTUs either bacterial or infaunal present across all stations, The absence of a consistent community across the survey area, as well as the high proportion (>30%) of rare OTUs suggest the community heterogeneity across the survey area may have been under sampled for the bacterial and infaunal size class. This may be improved by analysis of additional samples or analysis of the second samples acquired at each of the stations, though it is not certain that this would fill all gaps within the community.

H.2.2.1.4 The bacterial data set identified 34 taxonomic groups based on class, with the proportional contributions of these groups to the overall community structure of the survey areas detailed in Table H.10 and graphically presented in Figure 2.6. Bacterial OTUs which could not be successfully identified to class were grouped into the 'Other' category.

H.2.2.1.5 The 'Other' taxonomic group was recorded as the richest within the bacterial data set, accounting for 48.7% (n=686) of OTUs. The second most abundant taxonomic group was the Gammaproteobacteria, 16.4% of OTUs across the survey area. The relative Gammaproteobacteria dominance is likely given it is one of the richest classes within the bacterial phyla (Williams *et al.*, 2010). The dominance of 'Other' within the proportional contributions was partly due to the inability to determine these OTUs further than phylum. When compared with the previous Gardline (2022b) survey, these two classes were also the top two most abundant. Additional classes also showed proportional contributions to that of the previous survey.

Table H.10: Contribution of sediment bacterial taxonomic groups.

NR Not reported

Group	This Study		Gardline (2022b)	
	Abundance	Proportional contribution %	Abundance	Proportional contribution %
Acidobacteriae	46	3.3%	45	3.4%
Aminicenantia	4	0.3%	4	0.3%
Acidimicrobiia	2	0.1%	3	0.2%
Actinomycetia	27	1.9%	28	2.1%
Bacteroidia	81	5.7%	80	6.1%
Ignavibacteria	2	0.1%	1	0.1%
Rhodothermia	1	0.1%	1	0.1%
Calditrichia	3	0.2%	NR	NR
Campylobacteria	4	0.3%	3	0.2%
Anaerolineae	35	2.5%	16	1.2%
Chloroflexia	3	0.2%	NR	NR
Dehalococcoidia	7	0.5%	1	0.1%
Cyanobacteriia	1	0.1%	1	0.1%
Deinococci	1	0.1%	1	0.1%
Babeliae	2	0.1%	1	0.1%
Desulfobacteria	5	0.4%	3	0.2%
Desulfobulbia	1	0.1%	1	0.1%
Fibrobacteria	1	0.1%	NR	NR
Bacilli	2	0.1%	NR	NR

Group	This Study		Gardline (2022b)	
	Abundance	Proportional contribution %	Abundance	Proportional contribution %
Clostridia	9	0.6%	3	0.2%
Fusobacteriia	1	0.1%	1	0.1%
Gemmatimonadetes	4	0.3%	4	0.3%
Latescibacteria	1	0.1%	NR	NR
Moduliflexia	3	0.2%	1	0.1%
Nitrospiria	12	0.9%	14	1.1%
Thermodesulfovibrionia	1	0.1%	3	0.2%
Gracilibacteria	1	0.1%	1	0.1%
Phycisphaerae	11	0.8%	4	0.3%
Planctomycetes	77	5.5%	92	7.0%
Alphaproteobacteria	97	6.9%	105	8.0%
Gammaproteobacteria	231	16.4%	239	18.2%
Spirochaetia	12	0.9%	6	0.5%
Kiritimatiellae	8	0.6%	9	0.7%
Verrucomicrobiae	27	1.9%	33	2.5%
Other	686	48.7%	599	45.6%
Total	**1409**	**100%**	1303	100%

H.2.2.1.6 A total of 27 taxonomic groups based on class were identified from the sediment infaunal data sets with the proportional contribution of these taxonomic groups to the overall structure of the survey area detailed in Table H.11 and graphically presented in Figure H.17. OTUs which could not be identified to class were grouped into an 'Other' category.

H.2.2.1.7 Adenophorea (n=188) was the most abundant taxonomic group across the survey area, accounting for 37.8% of OTUs. The next most abundant groups were 'Other' (n=94, 18.9%) and Hexanaulia (n=71, 14.3%). Seven taxonomic groups (Appendicularia, Asteroidea, Branchiopoda, Enteropneusta, Maxilopoda, Scyphozoa and Trematoda) were represented by a single OTU. When comparing with the previous Gardline (2022b) survey, Adenophorea and Hexanauplia were the two most abundant groups. Branchiopoda and Trematoda were also represented by a single OTU within the comparison survey.

H.2.2.1.8 A greater number of bacterial and infaunal taxonomic groups and individual OTUs were recorded within the current survey than the previous (Gardline, 2022b); however, this cannot be used to conclude that the bacterial or infaunal community within the current survey was more diverse, due to continuing advancements in metabarcoding and additions to the pool of reference material.

Table H.11: Contributions of sediment faunal OTU taxonomic groups.

NR Not reported

Group	This Study		Gardline (2022b)	
	Abundance	Proportional Contribution %	Abundance	Proportional Contribution %
Adenophorea	188	37.8%	189	42.3%
Anthozoa	4	0.8%	4	0.9%
Appendicularia	1	0.2%	1	0.2%
Arachnida	5	1.0%	6	1.3%
Ascidiacea	9	1.8%	7	1.6%
Asteroidea	1	0.2%	1	0.2%
Bivalvia	5	1.0%	6	1.3%
Branchiopoda	1	0.2%	NR	NR
Clitellata	5	1.0%	1	0.2%
Echinoidea	2	0.4%	2	0.4%
Enteropneusta	1	0.2%	2	0.4%
Eurotatoria	7	1.4%	6	1.3%
Gastropoda	7	1.4%	6	1.3%
Hexanauplia	71	14.3%	58	13.0%
Holothuroidea	2	0.4%	2	0.4%
Hoplonemertea	4	0.8%	0	0.0%
Hydrozoa	9	1.8%	7	1.6%
Malacostraca	2	0.4%	3	0.7%
Maxillopoda	1	0.2%	NR	NR
Ophiuroidea	3	0.6%	1	0.2%
Ostracoda	4	0.8%	4	0.9%
Palaeonemertea	2	0.4%	NR	NR
Pilidiophora	4	0.8%	4	0.9%
Polychaeta	60	12.1%	53	11.9%
Scyphozoa	1	0.2%	1	0.2%
Secernentea	3	0.6%	NR	NR
Trematoda	1	0.2%	NR	NR
Other	94	18.9%	83	18.6%
Total	**497**	**100%**	447	100%

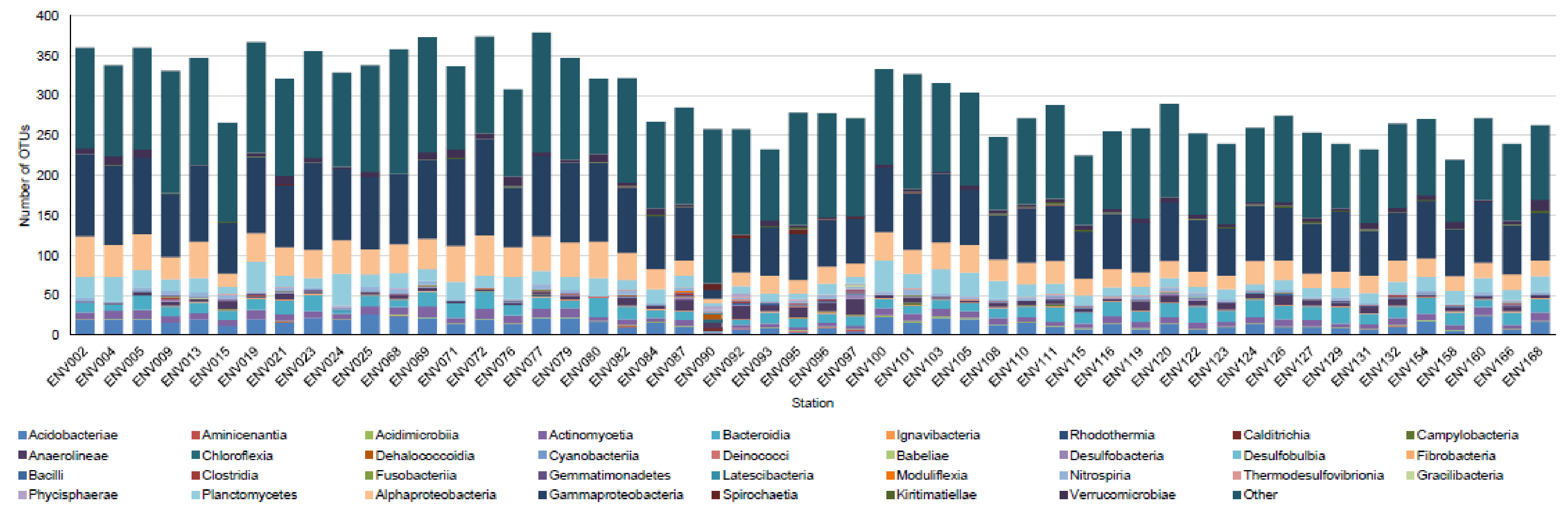


Figure H.17: Contributions of gross sediment bacterial OTU taxonomic groups by samples.

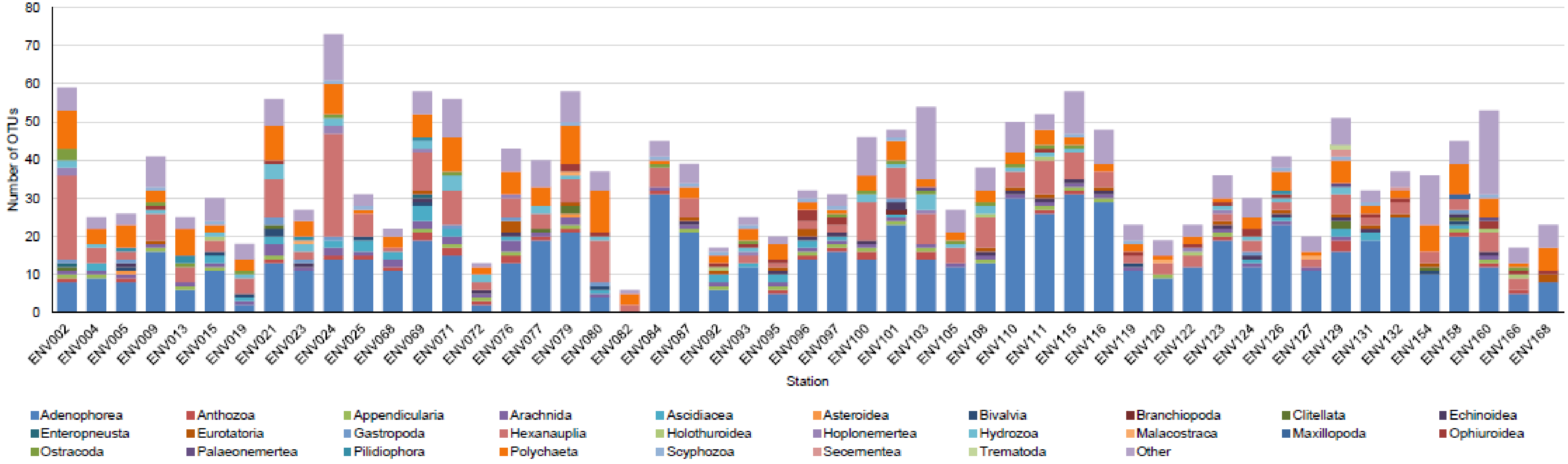


Figure H.18: Contributions of gross sediment infaunal OTU taxonomic groups by samples.

H.2.2.1.9 Comparative taxonomic heat trees detailing the number of OTUs across the survey from bacterial taxa, down to the order rank are presented in Figure H.19 while the taxonomic heat trees detailing the discrete infaunal taxa OTUs down to the order rank are presented in Figure H.20. 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. Labels without nodes represent missing taxa. Summary statistics for the sediment bacterial and infaunal richness are detailed in Table H.12.

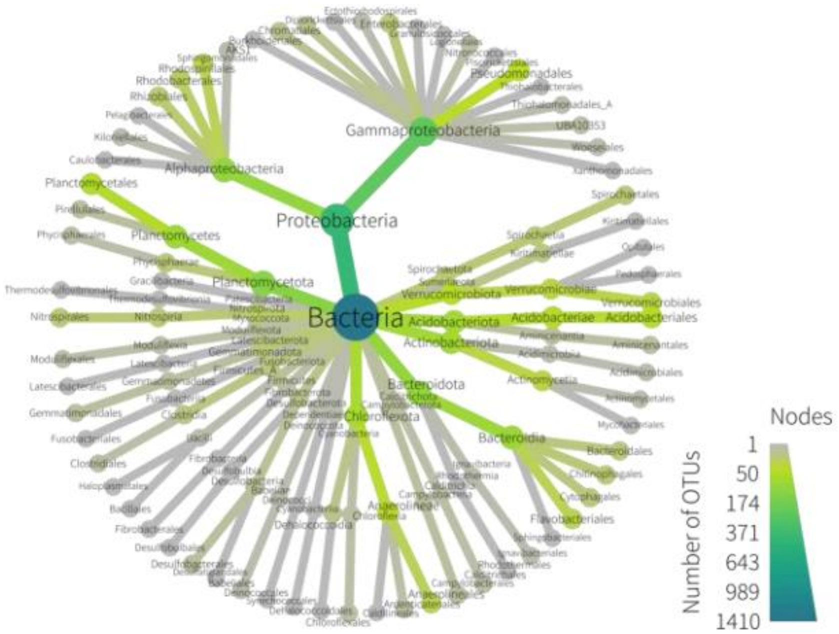


Figure H.19: Sediment bacterial taxonomic heat trees of the number of OTUs.

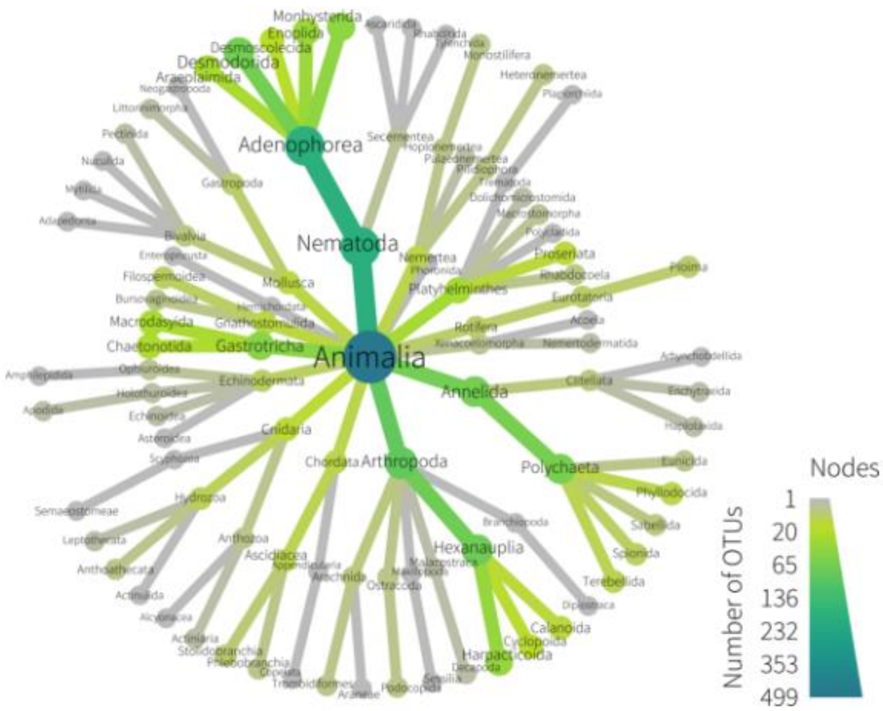


Figure H.20: Sediment infaunal taxonomic heat trees of the number of OTUs.

Table H.12: Summary of sediment OTU richness.

	Bacterial OTUs		Faunal OTUs	
	This Study	Gardline (2022b)	This Study	Gardline (2022b)
Minimum	220	298	6	17
Maximum	379	415	73	82
Mean	295.5	371.4	36.5	42.1
±SD	45.6	31.6	14.7	14.7

H.2.2.1.10 Accumulation plots of OTUs for the sediment bacterial and infaunal data sets for the survey are presented in Figure H.21. Two lines are plotted; the first (plotted in blue and often referred to as a Sobs curve) adds the new taxa to those already recorded, in sample order. The second line (plotted in red and often referred to as the UGE curve) is smooth, as it is an average output based on the samples being added in a random order 999 times (Ugland *et al.*, 2003). 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 the number of OTUs versus expectations.

H.2.2.1.11 The Sobs curve for the sediment bacterial data set (Figure H.21) initially began above the UGE curve indicating that a greater number of OTUs were present than was to be expected, the Sobs curve then continued to follow the curve of the UGE curve until the addition of Station ENV025 where the Sobs curve plateaued. Upon the addition of Station ENV090 the Sobs curve steeply increased where the Sobs curve increased above the UGE curve. Station additions after this followed the curve of the UGE curve.

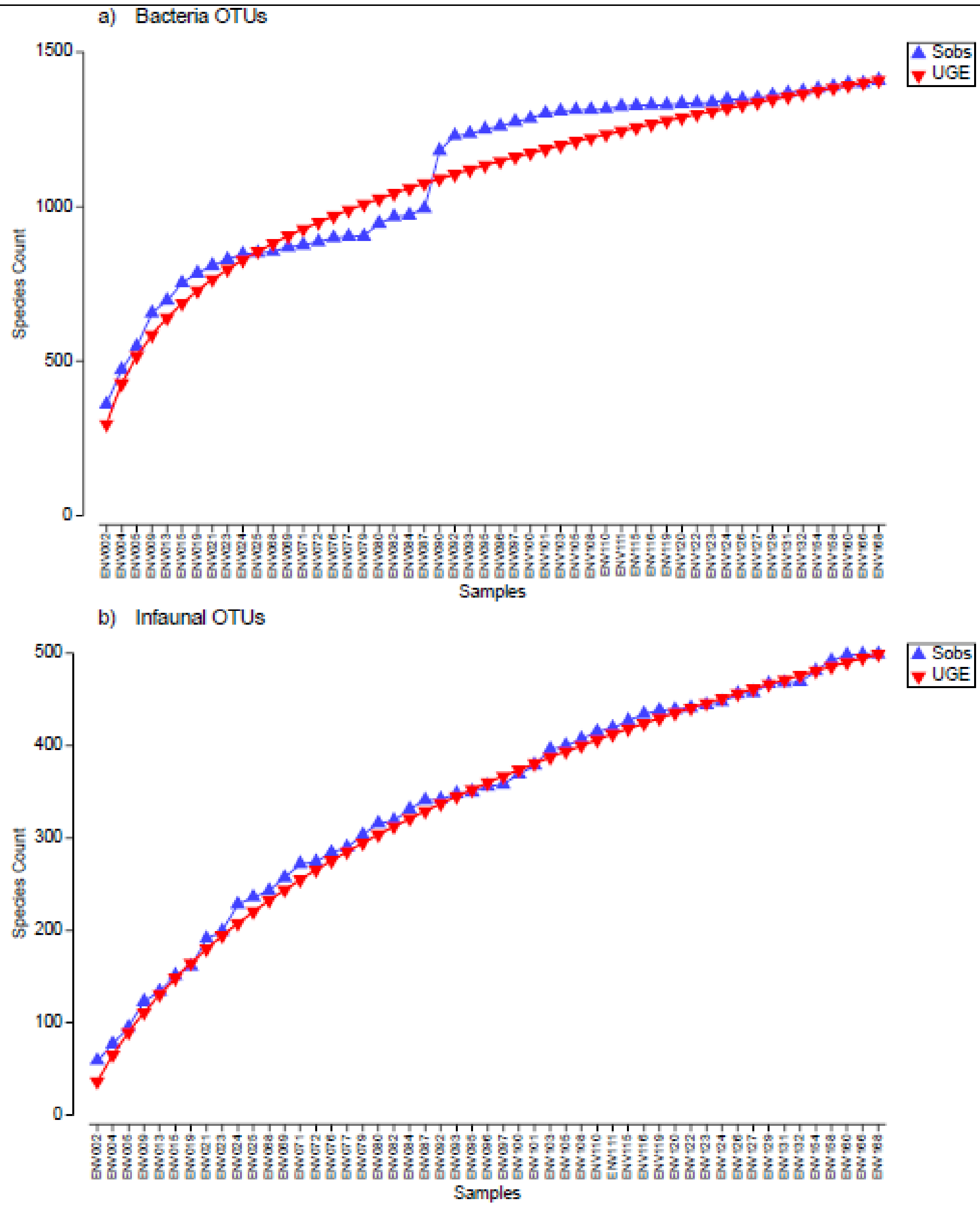


Figure H.21: OTU accumulation curves.

H.2.2.2 OTU community structure using multivariate statistics

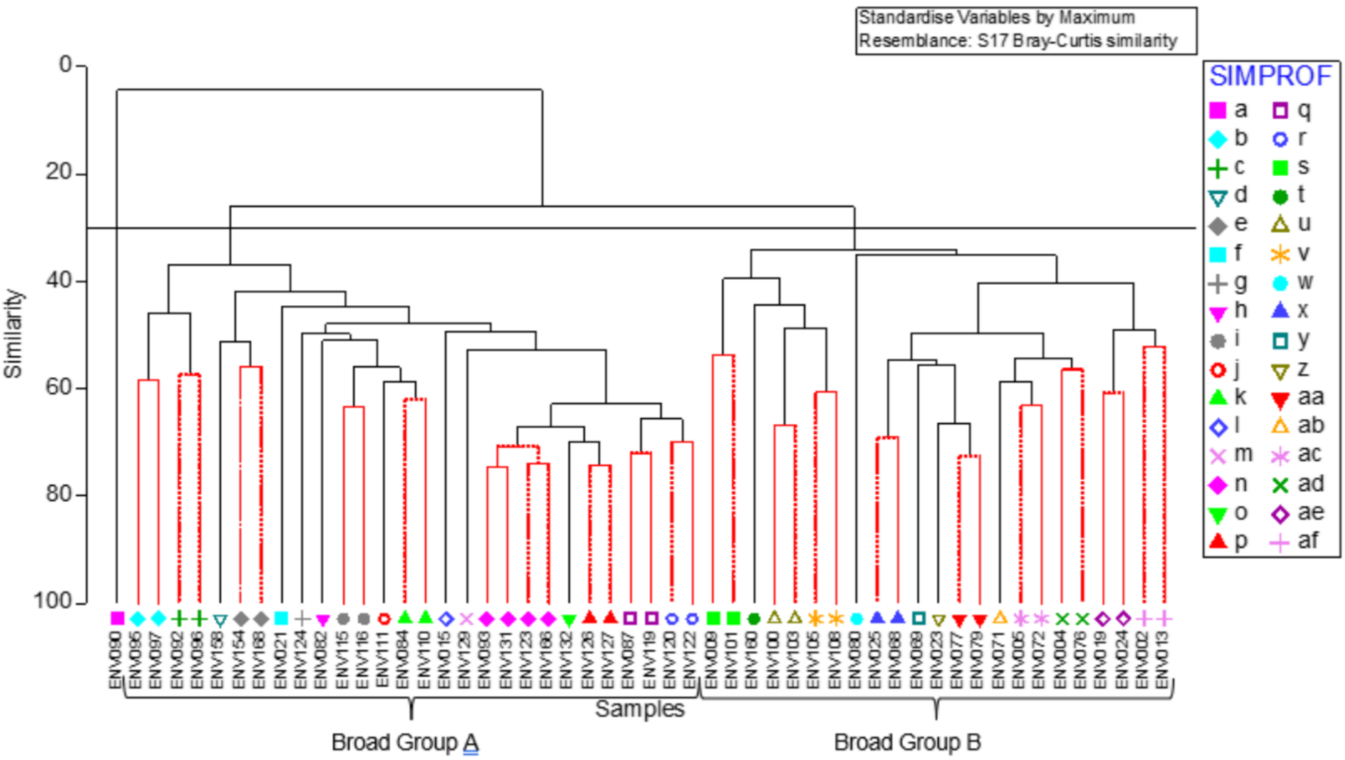
H.2.2.2.1 The results of the CLUSTER analysis including SIMPROF analysis in the form of a Bray-Curtis similarity dendrogram and nMDS plot based upon standardised data for the sediment bacteria samples are displayed in Figure H.22 for the survey area. Similarly results of the same analysis on the standardised infaunal data are presented in Figure H.23.

H.2.2.2.2 The CLUSTER analysis and resulting dendrogram for the sediment bacterial OTU data set (Figure 2.11a) identified 32 groups which comprised 14 outliers (SIMPROF *a, d, f, g, h, j, l, m, o, t, w, y, z* and *ab*), 17 closely associated pairs (SIMPROF *b, c, e, i, k, p, q, r, s, u, v, x, aa, ac, ad, ae* and *af*) and a single cluster (SIMPROF *n*). All samples were considered more dissimilar than similar to one another and grouped at *c.*4% similarity. The generally low similarities are potentially due to the bacterial communities being far richer than equivalent metazoan communities and are less discriminately bound to the sediment given their established variation with both overlying water quality along with direct sediment physico-chemistry (Allison & Martiny, 2008; Frühe *et al.*, 2021). However, they still provide a suitable sensitive receptor to environmental pressures for monitoring impacts (Horton *et al.*, 2019).

H.2.2.2.3 The nMDS ordination of the sediment bacterial data set (Figure H.22) revealed a similar pattern to the cluster analysis with a stress level of 0.1, which can be considered a good two-dimensional representation of rank dis (similarities) and overall pattern observed in the data set.

H.2.2.2.4 Examination of the sediment bacterial data set together with results of SIMPER analyses at a group level is presented in Table H.13. This was restricted to explaining separations where similarity was less than 30% for conciseness. The broad groups identified showed differences due to subtle variations in taxa community structure within a particular SIMPROF groups.

a) Bray-Curtis Similarity Dendrogram



b) MDS Ordination

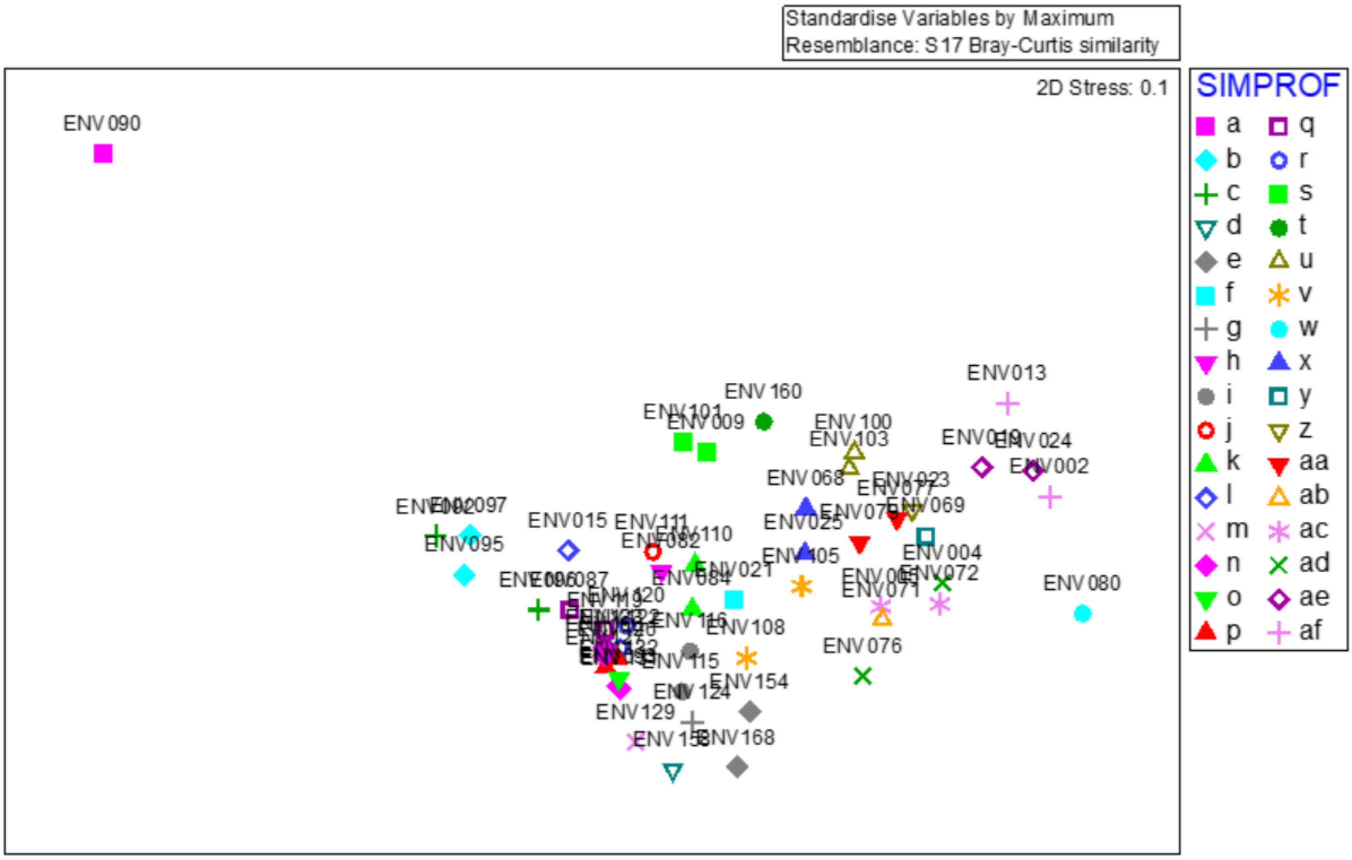


Figure H.22: Multivariate analysis of sediment bacterial OTU data by sample.

Table H.13: Taxa influencing sediment bacteria OTU SIMPROF variation.

Groupings	Dissimilarity (%)	Groups Influencing Separation
SIMPROF a vs remaining	96	• 42 Indeterminate Bacteria OTUs were more abundant in SIMPROF *a* • (*c.* 11.4% of the dissimilarity) • 19 Gammaproteobacteria OTUs were absent from SIMPROF *a* (*c.* 2.2% of the dissimilarity).
Broad Group A vs Broad Group B	74	• 44 Indeterminate Bacteria OTUs were more abundant in Broad Group B (*c.* 6.8% of the dissimilarity) • 34 Gammaproteobacteria OTUs were more abundant in Broad Group B (*c.* 5% of the dissimilarity) • 12 Alphaproteobacteria OTUs were more abundant in Broad Group B (*c.* 1.8% of the dissimilarity) • 12 Bacteroidia OTUs were more abundant in Broad Group B (*c.* 1.7% of the dissimilarity).

H.2.2.2.5 CLUSTER analysis and the resulting dendrograms for the sediment infaunal OTU data set (Figure H.23) identified 22 groups; 7 outliers (SIMPROF *a, b, c, d, i, j* and *u*), 8 closely associated pairs (SIMPROF *g, h, m, n, p, q, r* and *v*) and 7 clusters (SIMPROF *e, f, j, k, l, o* and *s*). All samples were more dissimilar than similar to one another, joining together at c.0.3% similarity.

H.2.2.2.6 Examinations of the sediment infaunal data together with results of SIMPER analyses; presented in Table H.14 highlighted the principal contributors to the grouping and separation of stations. This was restricted to explaining separations where similarity was less than 2.5% for conciseness.

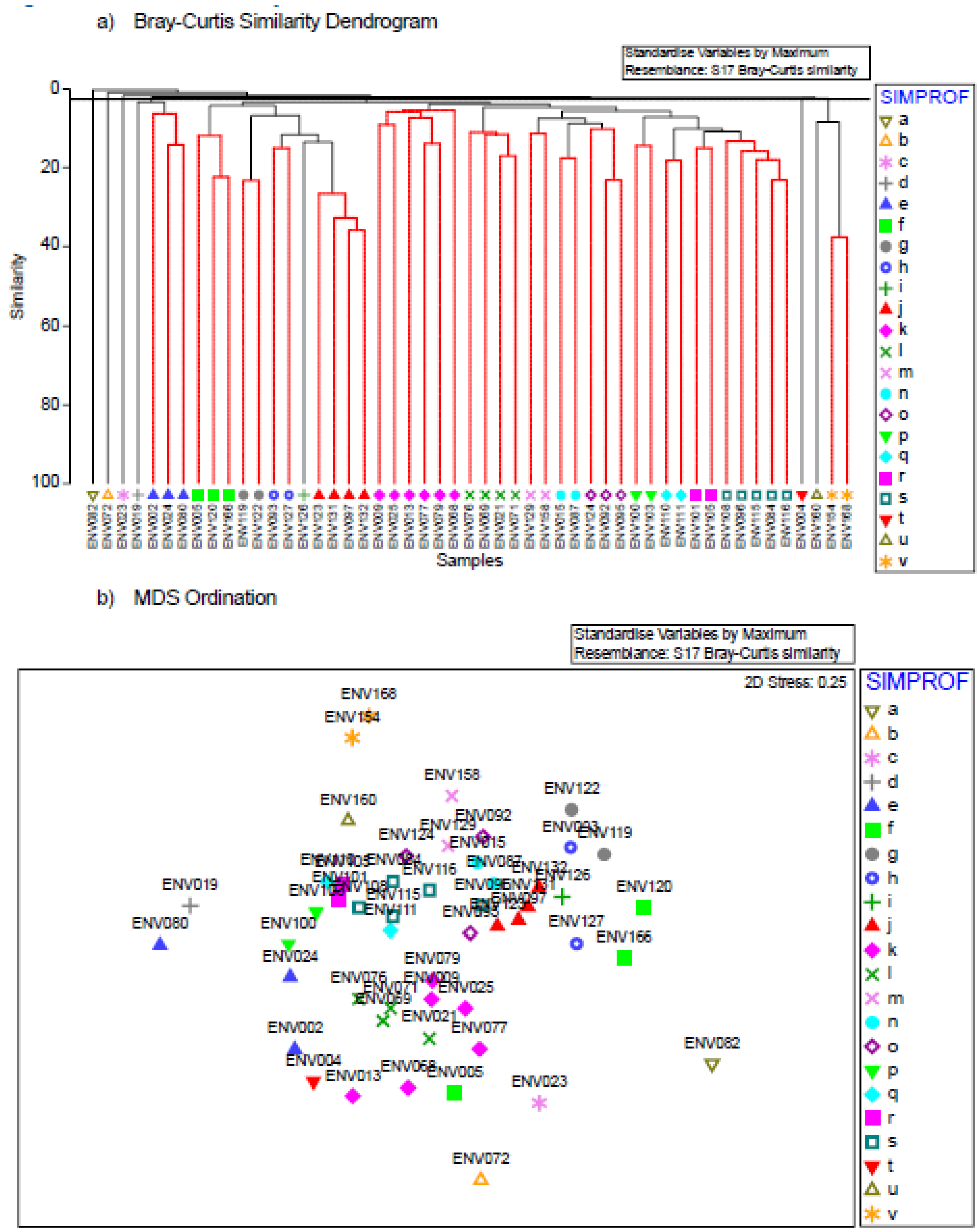


Figure H.23: Multivariate analysis of sediment infaunal OTU data.

Table H.14: Taxa influencing sediment infaunal OTU SIMPROF variation.

SIMPROF	Dissimilarity (%)	Taxa Influencing Separation
SIMPROF *a* vs remaining	99.7	• *Phyllodoce* IM-19H88I was more abundant in SIMPROF *a* (*c*. 9.0% of the dissimilarity) • The absence of 188 infaunal OTUs from SIMPROF *a* contributed *c*. 57.6% of the dissimilarity.
SIMPROF *b* vs SIMPROF *c*, Broad Groups A-C	99.2	• Onuphidae IM-I2992I was unique to SIMPROF b (*c* 7.5% of the dissimilarity) • Acanthogorgiidae IM-6HNE0Q was more abundant in SIMPROF *b* (*c*. 7.5% of the dissimilarity) • The absence of 174 infaunal OTUs from SIMPROF *b* contributed *c*. 49.6% of the dissimilarity.
SIMPROF c vs Broad Groups A-C	98.3	• Callianassidae IM-32VZ5A, Oncholaimidae IM-ELM9Z5 and Oncholaimidae IM-W4UI46 were unique to SIMPROF *c* (*c*. 16.1% of the dissimilarity) • The absence of 129 infaunal OTUs from SIMPROF *c* contributed c. 30.8% of the dissimilarity. • Eight infaunal OTUs were more abundant in SIMPROF *c* (*c*. 17.5% of the dissimilarity) • A total of 16 infaunal OTUs were more abundant in Broad Groups A-C which contributed • *c*. 5.7% of the dissimilarity.
Broad Group A vs Broad Groups B, C	98	• A total of 40 infaunal OTUs were more abundance in Broad Group A which contributed • *c*. 22.7% of the dissimilarity. • The absence of 56 infaunal OTUs from Broad Groups B and C contributed *c*. 38.4% of the dissimilarity. • The absence of 22 infaunal OTUs from Broad Group A contributed *c*. 5.4% of the dissimilarity.
Broad Group C vs Broad Group B	97.9	• A total of 43 infaunal OTUs were more abundance in Broad Group C which contributed • *c*. 29.9% of the dissimilarity. • The absence of 22 infaunal OTUs from Broad Group B contributed *c*. 22.5% of the dissimilarity.

H.2.2.3 Multivariate Comparison of Metabarcoding and Physico-chemical Data Sets

H.2.2.3.1 The bacterial and infaunal OTUs detected throughout the Morgan and Morecambe survey areas were compared to the physico-chemical data to determine if any patterns in the metabarcoding correlated with the environmental factors assessed.

H.2.2.3.2 A RELATE analysis identified no correlation between the sediment bacterial OTUs and physico-chemical variables (r=0.042, p>0.05). BIOENV analyses identified a 26% correlation between the bacterial multivariate pattern and As concentrations, with the inclusion of additional variables having little impact on correlations.

H.2.2.3.3 A RELATE analysis identified no correlation between the sediment infaunal OTUs and physico-chemical variables (r=-0.013, p>0.05). BIOENV analyses identified a 22%

correlation between the infaunal multivariate pattern and mean particle diameter, with the inclusion of additional variables having little impact on correlations.

H.2.2.3.4 Further sampling, including additional stations and replication is required to further investigate the relationship between bacterial and infaunal OTU data and the physico-chemical variables. As a result of the single replication per station the statistical robustness of the analysis patterns is limited, and patterns may be obscured.

H.2.2.4 Multivariate Comparison of Macrofaunal and Metabarcoding Data Sets

H.2.2.4.1 The sediment bacterial and infaunal OTU data sets 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 61% for bacterial OTUs and 45% for infaunal OTUs when compared to the adult abundance data. Similar results were found when comparing to the adult biomass data, with a RELATE analysis identifying a significant correlation of 54% for bacterial OTUs and 42% for infaunal OTUs.

H.2.2.4.2 It is important to note that despite the significant correlations found, only one replicate sample was analysed for macrofauna abundance and biomass and only one replicate sample was used for metabarcoding of bacteria and infauna. In order to better utilise this approach for monitoring and avoid missing taxa present in the environment, more replicate eDNA samples associated with each sample (*i.e.* MFA and MFB) are needed. Additional sample replication would allow for better comparison between data sets, further aid in a more comprehensive characterisation of the macrofaunal communities across the survey area.

H.3. References

Ugland, K.I., Gray, J.S. and Ellingsen, K.E. (2003) The species-accumulation curve and estimation of species richness. Journal of Animal Ecology, 72, pp.888-97.