Geotech, Env & Reconnaissance Surveys

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REVISION HISTORY

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Rev.	Date	Reason for revision	Changes from the previous version
1.0	16/02/2024	For Client Review	N/A

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DEFINITIONS AND ABBREVIATIONS

Table 1: Abbreviations used in this document

Acronym	Description	Acronym	Description
AMBI	AZTI Marine Biotic Index	MESH	Mapping European Seabed Habitats
APEM	Atlantic Frontier Environmental Network	MHW	Mean High-water
BAC	Background Assessment Concentration	MNCR	Marine Nature Conservation Review
BDC	Biodiversity Committee	MPA	Marine Protected Area
BC	Background Concentration	MSH	Marine Sampling Holland
BGS	British Geological Survey	MSL	Mean Sea Level
BSL	Benthic Solutions Limited	N	North
CAM	Camera	N/A	Not Applicable
CBD	Conservation of Biological Diversity	NE	Northeast
CCME	Canadian Council of Ministers of the Environment	NS	No Sample
CEMP	Coordinated Environmental Monitoring Programme	NDIR	Nondispersive Infrared
CLUSTER	hierarchical agglomerative clustering	NMBAQC	NE Atlantic Marine Biological Analytical Quality Control
CPI	Carbon Preference Index	NOROG	Norwegian Oil and Gas
CPT	Cone Penetrometer Test	nMDS	Non-metric multi-dimensional scaling
CTD	Conductivity Temperature Density	NW	Northwest
CV	Coefficient of Variation	OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
DH	Dual head	PAH	Polycyclic Aromatic Hydrocarbon
DO	Dissolved Oxygen	PC	Physio-chemistry
DVV	Dual Van Veen Sampler	PCA	Principal component analysis
E	East	PEL	Probable Effect Level
EBS	Environmental Baseline Survey	PMF	Priority Marine Features
EC	European Commission	PPM	Parts Per Million
EMODnet	European Marine Observation and Data Network	PRIMER	Plymouth Routines in Multivariate Ecological Research
ENV	Environmental	PSA	Particle size Analysis
EOL	End of Line	PSD	Particle Size Distribution
EOX	Extractable Organic Halogens	RPL	Route Proposed Location
ERL	Effect Range Low	S	South
ERM	Effect Range Median	SAC	Special Area of Conservation
EU	European Union	SAP	Species Action Plan
EUBS	European Union Biodiversity Strategy	SBF	Seabed Features
EUNIS	European University Information Systems organisation	SCI	Site of Community Importance
F1, F2 and F3	Fauna grab samples 1, 2 and 3	SD	Standard Definition
FOCI	Features of Conservation Interest	SE	Southeast
GC-FID	Gas Chromatography/ Flame Ionization Detection	SIC	Single Ion Current

Acronym	Description	Acronym	Description
GC-MS	Gas Chromatography/Mass Spectrometry	SIMPROF	Similarity profiling analysis
GEOxyz	GEOxyz Offshore UK Limited	SOL	Start of Line
GIS	Geographic Information System	SPA	Special Protection Areas
HAP	Habitat Action Plan	SSS	Side Scan Sonar
HAS	Habitat Assessment Survey	SW	Southwest
HC	Hydrocarbons	TEL	Threshold Effect Level
HD	High Definition	THC	Total Hydrocarbon Content
HM	Heavy Metals	TOC	Total Organic Carbon
HVDC	High Voltage Direct Current	TOM	Total Organic Matter
ICP-MS	Abstract Inductively coupled plasma mass spectrometry	TMSS	Thermally localized Multistage Solar Still
ICP-OES	Inductively coupled plasma optical emission spectroscopy	TPH	Total Petroleum Hydrocarbons
IQI	Infaunal Quality Index	UKAS	United Kingdom Accreditation Service
ISO	International Standards Operation	UK BAP	United Kingdom Biodiversity Action Plan
IMS	Industrial Methylated Spirit	UTC	Universal Time Coordinated
JNCC	Joint Nature Conservation Committee	UTM 29	Universal Transverse Mercator – Zone 29
LED	Light-emitting Diode	UTM 30	Universal Transverse Mercator – Zone 30
LOI	Loss on Ignition	WGS84	World Geodetic System 1984
MBES	Multi Beam Echo Sounder		
MCZ	Marine Conservation Zone		

Where abbreviations used in this document are not included in this list, it may be assumed that they are either equipment brand names or company names.

1 EXECUTIVE SUMMARY

An environmental baseline survey (EBS) and habitat assessment survey (HAS) were carried out by GEOxyz, in association with Benthic Solutions Limited (BSL) for Xlinks along the UK section of the proposed cable route spanning Morocco to the UK. This report details the habitat investigation and environmental survey operations conducted along the route between the 29th of August and 10th of October 2023 aboard the Geo Ocean III.

The UK offshore route survey utilised geophysical data along the survey route, with water depths ranging from 129 m to 10 m below MSL. The seabed was primarily described as an extensive, thin sedimentary cover overlying a smoothed bedrock surface was often thin to negligeable (<1 m thickness). The sedimentary cover was primarily characterised as gravelly SAND with megaripple bedforms. Along the route, the gravelly SAND and SAND sedimentary cover rarely exceeded 1 m except when crossing the Celtic sand bank, in narrow infillings of paleochannels and upwards of block U37, when approaching the nearshore section (<10 m depth). The nature of bedrock was expected to change along the route, with Tertiary and Secondary rocks (chalk terrains) southwards of block U23, and Primary rocks to the north. Rocks outcrops were delineated along the route (12.7 %) between blocks U09 and U11 (chalk and locally primary rocks), as well as between blocks U33 and U34 (Primary rocks).

Particle size analysis indicated a highly heterogeneous sediment type across the survey area; there was however a general sand dominance. The heterogeneity of the sediment within the samples was reflected in the variation in the sorting coefficient, with stations ranging from moderately well-sorted to very poorly sorted. The variation of sediment characteristics was apparent between the different sections of the proposed route and the three habitat zones seen, reflecting the diverse nature of the seabed. Total organic carbon and organic matter levels were low throughout the survey area, reflecting the ambient conditions for this region of the Celtic Sea. The TOC levels for the survey were also low and reflected background levels along the proposed cable route, in some locations where there was a higher fines content present, TOC was slightly elevated.

Total hydrocarbon content (THC) was consistently low along the proposed cable route, although did increase in the nearshore section of the scope, in line with the expected levels of terrestrial runoff in the various regions along the route. The GC traces were characterised by signatures typically attributed to general contamination from terrestrial runoff and shipping activity and showed no evidence of contamination from oil and gas exploration and production. The carbon preference index (mean 2.81 ± 1.60 SD) indicated a dominance of biogenic inputs to the survey area. Extractable Organic Halogens (EOX) were varied, ranging from <0.2 $mg.kg^{-1}$ to 118 $mg.kg^{-1}$ across the survey area, in general stations with a higher gravel content saw higher EOX levels. Total polycyclic aromatic hydrocarbon (PAH) levels were highly variable throughout the survey area, evidenced by a coefficient of variance of 302.23 %.

In keeping with the hydrocarbon data, metal concentrations were low throughout and were generally considered to reflect the ambient conditions along the cable route. Arsenic and nickel were the only metals to exceed their respective OSPAR ERM and ERL values at 20 stations and eight stations, respectively. Tin concentrations were higher than the CCME TEL at 11 stations, the majority of which were located in the shallowest section of the proposed cable route.

A total of 22,006 infauna individuals were recorded along the proposed route survey area. Species richness and faunal abundance showed high variability throughout the area (often driven by the species within the Annelida phylum), which showed a strong positive correlation to the proportion of fines throughout the survey area. Overall, the diversity indices results were high. When averaged out according to Level 3/4 EUNIS habitat assignments, species abundance and richness, as well as the richness and diversity indices, were overall highest at stations classed as 'Atlantic Offshore Circalittoral Mixed Sediment' (MD42). This is in accordance with the higher availability of muds, sands and hard substrate. Sands dominated habitats, especially those in shallower waters, usually had the lowest faunal abundance and richness averages, and displayed the highest evenness index averages (Pielou). Stations classed as 'Atlantic Circalittoral Sand (MC52) had exceptionally high faunal abundance, completed to other sands dominated habitats, due to the ubiquitous *Echinocyamus pusillus* and *Abra prismatica*.

Further analysis using the multivariate interpretation revealed 11 cluster groupings for the macrofaunal community when sliced at a Bray-Curtis similarity percentage of 35 % at station level, showed a strong correlation to the level 5 habitat assignments along the route (as well as impoverished versions of a same habitat). The presence and richness of colonial epifauna was driven by the availability of hard substratum within more mixed areas, though these could often not be sampled by the grabs, and their presence is better assessed through camera ground-truthing.

Seabed habitats were identified primarily using a combination of geophysical data and video assessment ground-truthing. The complex habitat variations along the route revealed a mosaic of sediment classifications, demonstrating varying contributions of fines, sands, and gravels, with different densities of pebbles, cobbles, and boulders observed throughout the survey area. A total of eight EUNIS level 3/4 habitats were assigned along the route including classifications assigned due to depth related changes. Two habitats were most dominant, oscillating between each along the route; MD32/SS.SCS.OCS 'Offshore Circalittoral Coarse Sediment' and MD52/SS.SSa.OSa 'Offshore Circalittoral Sand'. Sediment composition within 'Offshore Circalittoral Coarse Sediment' varied the most with mosaics of gravels, pebbles and cobbles interchanging within sand dominated habitats. Dominant sessile fauna across these biotopes included hydrozoan and bryozoan turfs, dead man's fingers (*Alcyonium digitatum*), Actiniaria and Porifera. While mobile species such as brittle stars (Ophiuroidea), squat lobsters (Munididae) and hermit crabs (*Pagurus* sp.). Habitats with a greater degree of fines were observed towards the southern end of the route comprising muddy sands and gravelly muddy sand. Fauna was mainly dominated by species associated with burrows such as Caridean shrimp (Caridea) and the Norway lobster (*Nephrops norvegicus*), indicating a conformance towards the OSPAR habitat 'Seapen and Burrowing Megafauna Communities'. In transects assessed for burrows(UK_09, UK_10, UK_14 and UK_15), SACFOR densities of small and large burrows were categorised as 'Common' and 'Frequent', where no large burrows were observed in UK_13.

Sediments observed in UK_51 comprised small patches of rubble *Sabellaria spinulosa* tubes over a coarse sand dominated habitat. The macrofaunal community present in the samples acquired at UK_51 and UK_34 can be closely linked to the EUNIS level five biotope '*Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment' (MC2211/SS.SBR.PoR.SspiMx).

The presence of cobbles, boulders and outcropping bedrock across the route indicated the presence of potential Annex I Geogenic reefs, categorised further into 'Rocky Reef' or 'Stony Reef'. A large outcropping bedrock feature towards the northern extent of the route was ground-truthed by three video transects (UK_47, UK_48 and UK_49), within each transect the reef characteristics fluctuated between 'Rocky Reefs' and 'Rocky reefs partially covered' due to the presence of sand veneers. A total of 52 patches were grouped within the 'Rocky Reefs' and 'Rocky reefs partially covered' sections, of which 11 patches resulted in a classification of 'Rocky Reef with Low Biodiversity', 31 were categorised as 'Reef with Sand Veneer' with the remaining ten patches evidenced 'No Reef'. A secondary, rocky reef features was observed in UK_14. Only six still images contained rocky outcrop or mobile hard substrate, with majority of the epifaunal coverage made up of hydrozoan/bryozoan turf therefore indicating characteristics of an Annex I 'Rocky Reef with Low Biodiversity' habitat.

The presence of mobile hard substrate necessitated a stony reef assessment, to establish the potential occurrence of Annex I stony reef in the survey area. The analysis of 124 images taken along five camera transects indicated that the majority of the survey area did not show any evidence of stony reef. Only 25 % of the images showed a low to medium level of reefiness, while no high reef structures were identified. When considering epifaunal coverage, only 20 % of stills remained as ‘Low Reef’ and ‘Medium Reef’, of which these areas were grouped into patches. A total of four patches of ‘Low Reef’ were identified in terms of overall reefiness (structure vs. epifaunal coverage vs. extent), spread across three transects but with two sections represented by only single still images. In line with the Irving (2009) stony reef guidance, all such areas of ‘Low Reef’ are unlikely to be classified as Annex I stony reef without strong justification. Accordingly, the aforementioned areas of ‘Low Reef’ were further evaluated to determine whether any such justification was warranted by assessing whether they met the reef biotope/species characteristics outlined by Golding *et al*. (2020). However, the abundance of key reef species was sporadic with UK_45 recording one desirable reef species and the patchy occurrences of cobbles and boulders, and therefore epifaunal coverage, in UK_19 led to the delineation of ‘No Reef’, Possible Low Reef’ and ‘Low Resemblance Reef’ patches. Consequently, these areas did not demonstrate strong justification for Annex I protection, indicating that their low-quality characteristics and limited presence do not warrant such designation.

Key and desirable reef species were more abundant across UK_50, with occurrences of species such as *Alcyonium digitatum, Abietinaria abietina* and *Halecium halecinum,* the grouping of stills resulted in the delineation of ‘Low Resemblance Reef’ with a strong justification to warrant Annex I protection.

Sponges were evident across the survey area, primarily associated with areas of cobbles/boulders along the route. In order to assess the potential occurrence of the 'deep-sea sponge aggregations' Priority Marine Feature (PMF) and OSPAR habitat, the NOROG assessment method was applied. The majority of stills assessed contained no evidence of sponges and were assigned the ‘No Sponge’ category and a total of 17 patches were categorised into ‘Category 1’ with a sponge density of less than 0.5 m^2. Consequently, there is no strong justification for the 'deep-sea sponge aggregations' Priority Marine Feature (PMF) habitat, listed as threatened and/or declining by OSPAR, to be considered as present in the surveyed area.

There was no evidence of *A*. *islandica* siphons or *A. fragilis* on any video footage or still photographs within the survey area. The UK BAP habitat subtidal sands and gravel habitat is present across the entirety of the Xlinks route, and most likely occur in in areas of the route classified under ‘Atlantic Offshore Circalittoral Coarse Sediment.

2 INTRODUCTION

2.1 PROJECT OVERVIEW

The Xlinks Morocco-UK Power project will be a new electricity generation facility entirely powered by solar and wind energy combined with a battery storage facility. Located in Morocco's renewable energy rich region of Guelmim Oued Noun, it will cover an approximate area of 1500 km^2 and will be connected exclusively to Great Britain via 3800 km of High Voltage Direct Current (HVDC) subsea cables. An overview of the route is provided in Figure 1. In anticipation of the development of the cables, Xlinks required a reconnaissance survey along the proposed route, spanning from South Morocco to the UK. The process of completing reconnaissance surveys along the full route requires a staged approach per country and adherence to the permitting requirements of each. This survey and the following report are dedicated to the UK segment of the cable route, encompassing both offshore and nearshore waters. Water depths along this section of the proposed cable route range from 10 m to 129 m below Mean Sea Level (MSL).

Geotechnical and environmental surveys along the UK section of the route were carried out by GEOxyz, with Benthic Solutions Limited (BSL) supporting the environmental scope and Marine Sampling Holland (MSH) supporting the geotechnical scope. Survey operations were carried out aboard the *Geo Ocean III* between the 29th of August and the 10th of October 2023. The geotechnical survey included vibrocore testing and cone penetrometer tests (CPT). Geotechnical tests were undertaken at 45 sampling locations, 38 of which were co-located with environmental stations. Where vibrocore testing failed to achieve sufficient sediment, a grab sample was obtained using the most appropriate sampling device for the sediment type (Dual Van Veen Sampler for sand and soft sediments, Hamon Grab for gravel and coarse sediments).

The environmental survey was required to characterise the marine habitats, including identifying any protected habitats, as well as gather additional information on the physico-chemical and biological environment within the survey area. This report is focused on the habitat investigation and environmental baseline survey operations conducted within the UK sector of the Xlinks cable route.

Figure 1: Project location overview

2.2 SCOPE OF WORK

The survey included characterisation of the benthos and investigation of the sediment physico-chemistry (PC) to provide an understanding of the baseline conditions along the cable route.

The main objectives of the environmental baseline survey and habitat investigation were to:

- Undertake a review of the acquired geophysical data within the survey area to preliminarily identify all habitats for further investigation and characterisation.
- Acquire baseline data of sediment PC, biological characteristics, and water column profile data along the cable route.
- Characterise the benthic environment across the sites to assign habitat types to biotope level according to the JNCC/EUNIS habitat classification system.
- Identify habitats and species of potential conservation interest, defined as those listed in Annex I of the EC Habitats Directive, the OSPAR List of Threatened and/or Declining Species and Habitats, the UK Post-2010 Biodiversity Framework (formerly the UK Biodiversity Action Plan Priority Habitat descriptions).

2.3 REPORTING STRUCTURE

The following reports will be provided by BSL, relating to the habitat assessment and environmental baseline surveys conducted across the Xlinks route areas:

- 6050H-837-OR-02 (ENV): Environmental Fieldwork Report - UK
- **6050H-837-RR-05: Environmental Report - UK (This Report)**

2.4 BACKGROUND INFORMATION

2.4.1 Background Information on the Xlinks Route

The start of the proposed Xlinks cable route is situated approximately 50 km off the north coast of Cornwall, crossing six UKCS Blocks (104, 94, 93, 85, 84 and 75). The Xlinks Morocco-UK Power Project is considered the 'first of its kind' as it will generate 10.5 GW of zero carbon electricity from the sun and wind to deliver 3.6 GW of reliable energy for an average of 20+ hours a day. This is enough to provide low-cost, clean power to over seven million British homes by 2030. Once complete, the project will be capable of supplying eight percent of Great Britain's electricity needs. Four cables, each 3800 km long form the twin 1.8 GW HVDC subsea cable systems that will follow the shallow water route from the Moroccan site to a grid location in Great Britain, passing Portugal, Spain, and France.

2.4.2 Existing Information Relating to the Xlinks Survey Route

a Geophysical Data

Analogue geophysical data was acquired by GEOxyz during the UK section survey. The offshore section, in water depths exceeding 10 metres, was undertaken by the Geo Ocean IV vessel. For the Xlinks cable route survey, the Geo Ocean IV was mobilised with the equipment listed below in Table 2. A reconnaissance interpretation report of the entire Xlinks route (inclusive of the UK sector) was made available to the BSL office in order complete the ground-truthing camera and grab datasets (GEOxyz Ref: 5260H-837-RIR).

Table 2: Geo Ocean IV relevant offshore geophysical equipment

System	Manufacturer - Model	Equipment specifications
MBES water depth (<250 m)	EM2040c (dual head)	Freq: 200 – 400 kHz Focus: 0.4° x 0.7° at 400 kHz
MBES water depth (>250 m)	Reson 7160	Nominal frequency: 44 kHz Swath coverage: 4x water depth
Side scan sonar	Edgetech 4200	300/ 600 kHz
Sub-bottom profiler	Innomar SES2000 Medium 100	Primary frequency: 85 – 115 kHz Vertical resolution: 1-5 cm

The survey scope required 51 grab sampling locations, all of which were to be ground-truthed by short camera transects prior to grabbing. The selection of further camera transects across the survey area followed an 'intelligent design', whereby station selection was based on the acquired geophysical data to ensure adequate representation of all sediment types within the survey area, as well as any features of interest. The acquired geophysical data reviewed onshore and offshore by BSL personnel predominantly consistent of MBES and backscatter data.

The geophysical data were reviewed onboard by BSL personnel to confirm the selection of camera transects targeting any habitat boundaries across the survey area to ensure comprehensive seabed features and habitat mapping could be obtained, with particular attention paid to the investigation of potential Annex I habitats protected under the EC habitats Directive.

Position accuracy of the side scan sonar dataset during the survey was generally between ±0.1-0.5 m. MBES has been used to improve the positioning of contacts picked from SSS data and features such as depressions, scars etc. wherever possible.

The following datasets were available for review during the preparation of this report:

- Bathymetric data was acquired using a dual head EM2040c (dual head)which was reduced and processed offshore to provide a digital terrain model (0.1 m x 0.1 m bin size) where major as well as minor bathymetric features and minor bathymetric changes could be identified and highlighted. This included the identification of debris/obstructions within the survey area (e.g., seabed scars, possible anthropogenic debris) and seabed infrastructure (e.g., existing pipelines).
- Side scan sonar data was acquired using an Edgetech 4200 with a frequency of 300 kHz/600 kHz operating between 50/100 m per channel range. Changes in sediment type and hardness, along with features observed through low level relief and discrete objects could be delineated.

2.4.3 Reference Sources

a OSPAR Background Concentrations and Background Assessment Concentrations

To monitor progress towards 'background conditions' in the marine environment, OSPAR developed a range of background concentrations (BCs) and background assessment concentrations (BACs) for use as reference levels throughout the OSPAR marine area. BCs are concentrations of contaminants derived from analysis of core samples to reflect pre-industrial, pristine, background levels for the OSPAR area (OSPAR, 2009). BACs have been statistically derived from BCs and represent the level above which concentrations can be considered to be significantly higher than the relevant BC, with concentrations said to be near background if they are below their corresponding BAC (OSPAR, 2008). In the current report, reference to BCs and BACs has been made after normalisation of metals and PAHs using the method described in detail in the corresponding results sections and Appendix I.

b OSPAR Effect Range Low and Effect Range Median Levels

In order to assign a level of context for toxicity, an approach used by Long *et al*. (1995), to characterise contamination in sediments will be used in this report. 'Effect range low' (ERL) levels were defined as concentration of metals at which adverse effects were reported in 10 % of the data reviewed, whilst 'effect range median' (ERM) levels were defined as the concentrations at which 50 % of studies reported harmful effects. The ERLs and ERMs have been used to evaluate the ecological significance of heavy and trace metal concentrations within the survey area.

c CCME Probable Effect Levels and Threshold Effect Levels

The Canadian Council of Ministers of the Environment (CCME, 2001) produced sediment quality guidelines as broadly protective tools to support the functioning of healthy aquatic ecosystems. Based on field research programmes that have demonstrated associations between chemicals and biological effects lower and upper thresholds were established. The 'threshold effect levels' (TEL) is considered the lower threshold within which adverse effects rarely occur. The 'probable effect levels' (PEL) is considered the upper threshold within which adverse effects frequently occur. Between the TEL and PEL, is the possible effect range within which adverse effects occasionally occur. The TELs and PELs have been used to evaluate the ecological significance of heavy and trace metal concentrations within the survey area.

d EMODnet Predicted Habitat Distributions

A comparison has been made to further aid interpretation with the predicted seabed habitat distribution data produced by the European marine observation and data network (EMODnet). EMODnet is a long-term marine data initiative developed through a stepwise approach to collect data and build on existing databases to provide access to European marine data across seven discipline-based themes: bathymetry, geology, seabed habitats, chemistry, biology, physics, and human activities (EMODnet, 2024). The broad-scale seabed habitat map is a predictive delineation of habitats within all European seas to the EUNIS classification system (EMODnet, 2022). Formulated through international (OSPAR, 2008) and national monitoring programs in collaboration with European projects such as MESH or Mesh Atlantic, the predicted seabed habitat map can be a useful resource in confidently assigning biotopes within a given survey area (Figure 2).

2.4.4 Legislative Background

a UK Post-2010 Biodiversity Framework

The 'UK Post-2010 Biodiversity Framework' was published in July 2012 to succeed the UK BAP and 'Conserving Biodiversity – the UK Approach' and is the result of a change in strategic thinking following the publication of the CBDs 'Strategic Plan for Biodiversity 2011-2010' and the launch of the EU Biodiversity Strategy (EUBS) in May 2011. All the 1,150 species, 391 Species Action Plans (SAPs) and 45 Habitat Action Plans (HAPs) included in the UKBAP were incorporated into the framework Key UK BAP. Habitats that may occur in an open water marine environment that are relevant to the survey site are as follows:

- Cold-water Coral Reefs
- Fragile Sponge and Anthozoan Communities on Subtidal Rocky Habitats
- Blue and Horse Mussel Beds
- Mud Habitats in Deep Water
- Subtidal Sands and Gravels
- Carbonate Mounds

b OSPAR Commission

At its Biodiversity Committee (BDC) meeting in 2003, OSPAR agreed to proceed with a programme to collate existing data on the distribution of 14 key habitats as part of a wider programme to develop measures for their protection and conservation. The UK agreed to compile the relevant data for its marine waters and submit these for collation into composite maps on the distribution of each habitat type across the whole OSPAR area. The Joint Nature Conservation Committee (JNCC) are coordinating the work.

Key OSPAR habitats that may occur in an open water marine environment are essentially the same as listed under the UK Post-2010 Biodiversity Framework, with the 'Mud Habitats in Deep Water' listed as 'Seapens & Burrowing Megafauna Communities'. The OSPAR habitat and species of most relevance to the Xlinks survey area are, 'Sea-pen and burrowing megafauna communities', '*Desmophyllum pertusum* Reefs', 'Carbonate mounds' and 'ocean quahog'.

c European Habitats Directive

The United Kingdom is a signatory of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1979). The European Community Habitats Directive was adopted in 1992 to meet their obligations under the convention. The provisions of the Directive require Member States to introduce a range of measures, including the protection of species listed in the Annexes; to undertake surveillance of habitats and species and produce a report every six years on the implementation of the Directive. The 189 habitats listed in Annex I of the Directive and the 788 species listed in Annex II, are to be protected by means of a network of sites. Each Member State is required to prepare and propose a national list of sites, which will be evaluated in order to form a European network of Sites of Community Importance (SCIs). These will eventually be designated by Member States as Special Areas of Conservation (SACs), and along with Special Protection Areas (SPAs) classified under the EC Birds Directive (2009), form a network of protected areas known as Natura 2000. The Directive was amended in 1997 by a technical adaptation Directive and latterly by the Environment Chapter of the Treaty of Accession 2003.

The implementation of the Habitats Directive (92/43/EEC) in offshore waters commenced in 2000 and highlighted a number of potential habitats for which SACs may be selected in UK offshore waters. The Annex I habitats of particular relevance to this region of UK waters are as follows:

- Sub-tidal reefs (e.g. biogenic reefs formed by *Sabellaria spinulosa*, *Modiolus modiolus* and rocky reefs formed from iceberg scour or moraine deposits).
- Sandbanks which are slightly covered by sea water all the time.

The Habitats Directive introduced the precautionary principle to protect sensitive areas whereby projects can only be permitted where no adverse effect on the integrity of the site can be shown.

Following the UK's exit from the European Union (EU), new regulations have been put into effect that have transposed the land and marine aspects of the Habitats Directive (Council Directive 92/43/EEC) and Wild Birds Directive (Directive 2009/147/EC). It is important to note that following the UK's exit from the EU, habitat and species protection and standards are implemented in the same or an identical way and there is no change in terms of policy. Amendments to parts of the 2017 regulations were applied by the 'Conservation of Habitats and Species (EU exit) Regulations 2019' which became operable from the 1st of January 2021 (GOV.UK, 2022).

Main changes to the regulation include:

- The creation of a national site network within the UK territory comprising the protected sites already designated under the Nature Directives, and any further sites designated under these regulations.
- The establishment of management objectives for the national site network (the 'network objectives').
- A duty for appropriate authorities to manage and where necessary adapt the national site network as a whole to achieve the network objectives.
- An amended process for the designation of Special Areas of Conservation (SACs).
- Arrangements for reporting on the implementation of the regulations, given that the UK no longer provides reports to the European Commission.
- Arrangements replacing the European Commission's functions with regard to the imperative reasons of overriding public interest test where a plan or project affects a priority habitat or species, and.
- Arrangements for amending the schedules to the Regulations and the annexes to the Nature Directives that apply to the UK.

The amendments to the legislation were applied to ensure that the regulations continued to function after leaving the EU. Most of these changes involved transferring functions from the European Commission to the appropriate authorities in England and Wales. All other processes or terms in the 2017 regulations remain unchanged and existing guidance is still relevant (GOV.UK, 2022).

2.4.5 Habitat Investigation

a Habitat Classification

A marine biotope classification system for British waters was developed by Connor *et al*. (2004) from data acquired during the JNCC Marine Nature Conservation Review (MNCR) and subsequently revised by Parry *et al*. (2015) to provide improved classification of deep-sea habitats. The resultant combined JNCC (2015) classification system is analogous with the European Nature Information Service Habitat Classification (EUNIS, 2022), which has compiled habitat information from across Europe into a single database. The two classification systems are both based around the same hierarchical analysis. Initially abiotic habitats are defined at four levels. Biological communities are then linked to these (at two lower levels) to produce a biotope classification (Connor *et al*., 2004; EUNIS, 2022).

Habitat descriptions have been interpreted from the side scan sonar (SSS) and bathymetric (MBES) data 'Atlantic Infralittoral Rock' (EUNIS: MB12; JNCC: IR.HIR), 'Atlantic Infralittoral Sand' (EUNIS: MB52; JNCC: SS.SSa.IFiSa), Atlantic Circalittoral Coarse Sediment (EUNIS: MC32; JNCC: SS.SCS.CCS), Atlantic Circalittoral Sand (EUNIS: MC52; JNCC: SS.SSa.CFiSa or SS.SSa.CMuSa), 'Atlantic Offshore Circalittoral Sand' (EUNIS: MD52; JNCC: SS.SSa.OSa), 'Faunal Turf Communities on Atlantic Circalittoral Rock' (EUNIS: MC121; JNCC: CR.HCR.Xfa), 'Atlantic Offshore Circalittoral Coarse Sediment' (EUNIS: MD32; JNCC: SS.SCS.OCS), 'Atlantic Offshore Circalittoral Mixed Sediment (EUNIS: MD42; JNCC: SS.SMx.OMx) (EMODnet, 2021).

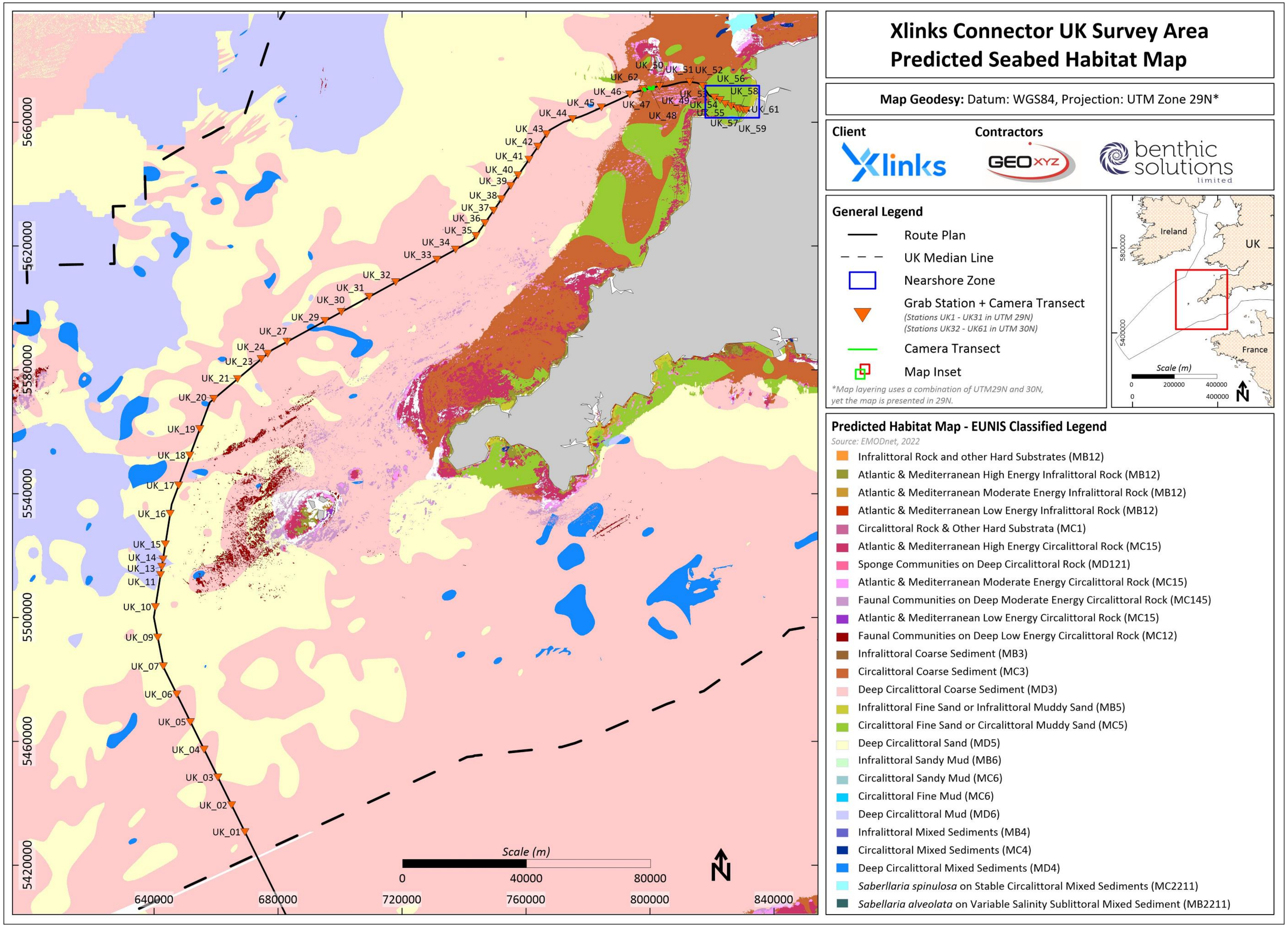


Figure 2: EMODnet predicted seabed habitats map in relation to the Xlinks survey route

b Potential Habitat / Species Sensitivities

The Xlinks cable route survey corridor crosses the 'Bristol Channel Approaches' Special Area of Conservation (SAC), which is designated for the protection of Annex II harbour porpoise (*Phocoena phocoena*). The next closest protected area is the 'South West Approaches to the Bristol Channel' Marine Conservation Zone (MCZ), which lies 289 m to the east of the survey corridor and is characterised by the presence of two broad scale marine habitats ('Subtidal coarse sediment' and 'Subtidal sand') that support various burrowing species of worms, anemones, sea urchins, and razor clams. The SACs and Marine Conservation Zones (MCZs) closest to the Xlinks survey area and the primary features for which they were designated are summarised below in Table 3 and displayed geographically in Figure 3.

Table 3: Key aspects of nearby protected areas

SAC/ MPA	Designated Site	Designation Year	Site Area (km^2)	Closest Distance to Survey Site	Key Aspects
SAC	Bristol Channel Approaches/ Dynesfeydd Môr Hafren	2019	5,850	Route Crosses	Designated for the protection of the Annex II species *Phocoena 23hocoena* (harbour porpoise).
	Haig Fras	2015	476	49.5 km W	Designated around an isolated underwater granite rock outcrop, supporting the Annex I habitat 'Reefs'.
	West Wales Marine/ Gorllewin Cymru Forol	2019	7,376	48.3 km N	Designated for the protection of the Annex II species *Phocoena 23hocoena* (harbour porpoise).
MCZ	Southwest Approaches to the Bristol Channel	2019	1,128	289 m E	Designated for the protection of two broad-scale marine habitats that support a variety of species which bury into the seabed such as, worms, anemones, sea urchins, and razor clams.
	East of Haig Fras	2019	400	1.4 km NW	Includes seven designated features, as well as the habitat of conservation importance 'Sea-pen and burrowing megafauna communities' and the species of conservation importance Fan mussel (*Atrina fragilis*).
	Cape Bank	2019	474	23.1 km SE	Designated to protect two broad-scale habitats that support bristleworms, burrowing anemones and venus clams (*Chamelea gallina*), as well as a rocky reef system with high biodiversity.
	Greater Haig Fras	2016	2,041	43.2 km W	Designated to protect the surrounding areas of the Haig Fras SAC, with a diverse range of sediment types supporting burrows organisms.
	South of Celtic Deep	2019	278	40.7 km N	Protects highly heterogenous seabed, which allows a range of species to thrive, such as starfish and haddock.
	North-East of Haig Fras	2019	464.3	38.5 km NW	Protects habitats that typically supports by these habitats include bivalve molluscs, sponges, anemones, worm species, echinoderms and crustaceans.
SPA	Skomer, Skokholm and the Seas off Pembrokeshire/ Sgomer, Sgogwm a Moroedd Penfro	2017	1,668	48.3 km N	Designated to protect a number of seabirds (European storm-petrel (*Hydrobates pelagicus*), Manx shearwater (*Puffinus puffinus*), Atlantic puffin (*Fratercula arctica*), and lesser black-backed gull (*Larus fuscus*), red-billed chough (*Pyrrhocorax pyrrhocorax*), short-eared owl (*Asio flammeus*)

c Protected Habitat Assessment

The most likely Annex I habitats to occur in the offshore waters west of Cornwall are rocky habitats including bedrock and stony reefs. Biogenic reefs, formed of the Ross worm (*Sabellaria spinulosa*), have been recorded in the shallower areas near the cable route and therefore have the potential to occur within the survey area.

Based on the features that were granted protection in the above areas, the habitats, and species of particular relevance to this region of UK waters are:

- Stony reef (EC Habitats Directive Annex I, UKBAP Priority Habitat).
- Sea-Pen and Burrowing Megafauna Communities (OSPAR Threatened and/or Declining Habitat)
- Sensitive and Priority Species, including:
    - Ocean quahog – *Arctica islandica* (Species FOCI, OSPAR Threatened and/or Declining Species).
    - Ross worm – *Sabellaria spinulosa* (Species FOCI, OSPAR Threatened and/or Declining Species, EC Habitats Directive Annex I)

d Legislative Species Protection Assessment

The epifauna taxa recorded from review of the underwater video footage were inputted into a database developed by BSL staff which identifies any species that are afforded protection under several legislative conventions/directives implemented in the UK, including the UK Post-2010 Biodiversity Framework.

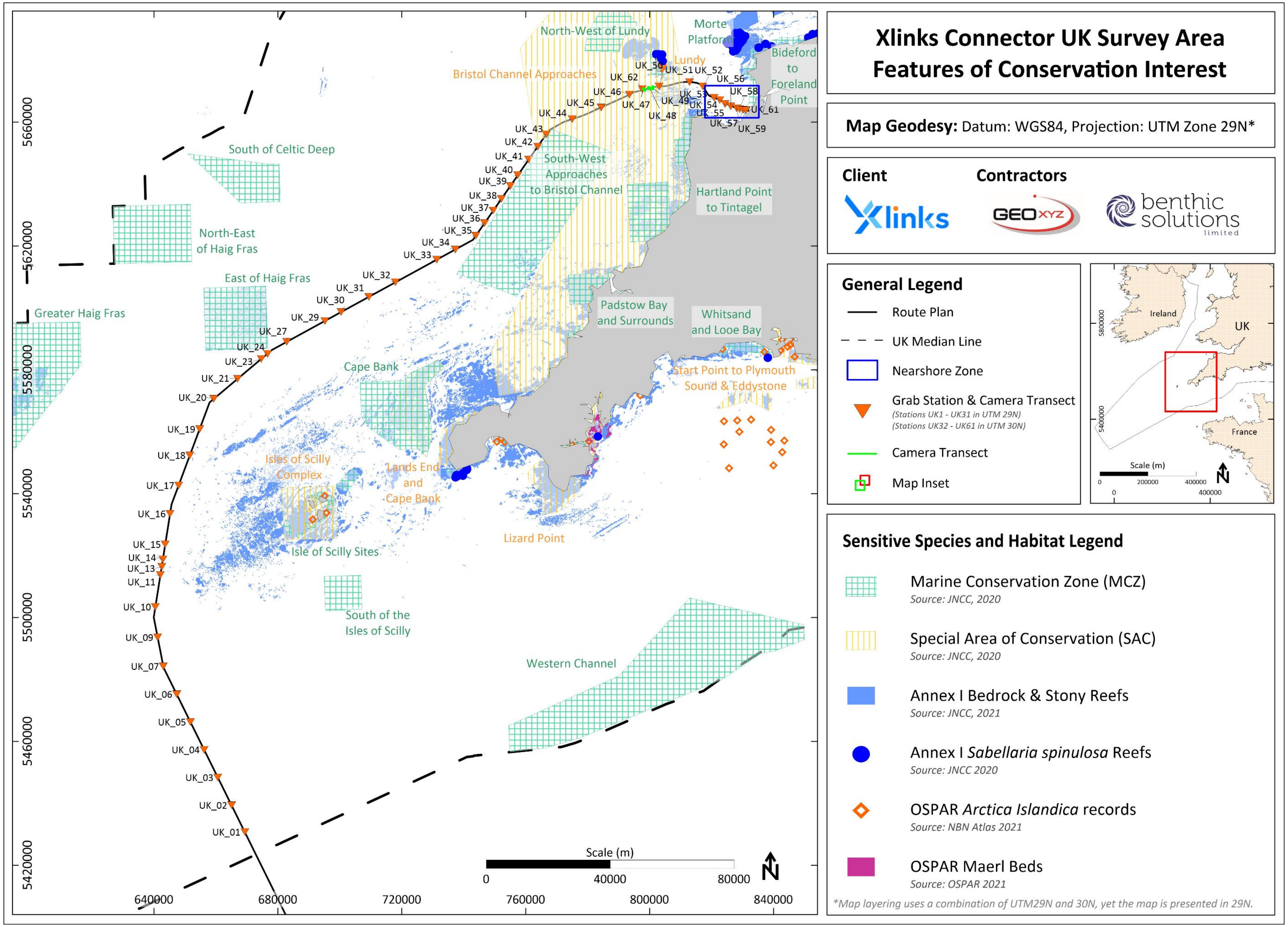


Figure 3: Location of features of conservation interest in relation to the Xlinks survey route

3 FIELD SURVEY AND ANALYTICAL METHODS

3.1 GEODETIC PARAMETERS

3.1.1 Horizontal Reference

The horizontal datum for the project is World Geodetic System 1980. More information on the geodetics including any conversions that may be required can be found in the Geodetic Convention Report (5260H-837-GCR-01).

For this project, projections to local grid coordination systems differ at certain locations along the route proposed locations (RPL). The locations for changing from one system to the next are defined below in Table 4 and the projection parameters are defined in Table 5.

Table 4: RPL crossing UTM zone borders

UTM Zone Change Location	Latitude (°) (WGS84)	Longitude (°) (WGS84)	Block Switch
1. Spain (Near coast) 29 to 30	43° 40’ 40.08” N	6° 0’ 0” W	S69-S70
2. France (Offshore) 30 to 29	47° 59’ 50.88” N	6° 0’ 0” W	F70-F71
3. UK (Offshore) 29 to 30	50° 33’ 38.33” N	6° 0’ 0” W	U22-U23

Table 5: Geodetic parameters

Local Datum Project Geodetic Parameters	
Datum	World Geodetic System 1984 (WGS84)
Spheroid	WGS84
Semi-Major Axis	a = 6378137.000 m
Semi-Minor Axis	b = 6356752.3142 m
First Eccentricity Squared	e2 = 0.006694379990
Inverse Flattening	1/f = 298.257223563
Project projection parameters (UTM Zone 29N)	
EPSG Map Projection Code	32629
Projection	UTM
Central Meridian	09° West
Latitude of Origin	0°
False Easting	500000.00m
False Northing	0.00m
Scale Factor at Central Meridian	0.9996
Units	Metres
Project projection parameters (UTM Zone 30N)	
EPSG Map Projection Code	32630
Projection	UTM
Central Meridian	03° West
Latitude of Origin	0°
False Easting	500000.00m
False Northing	0.00m
Scale Factor at Central Meridian	0.9996
Units	Metres

3.1.2 Vertical Reference

Offshore bathymetric data will be reduced to metres below mean sea level (MSL) using the DTU21 model, with depths of below zero being reported as negative downwards.

3.2 ENVIRONMENTAL GROUND-TRUTHING AND SAMPLING

The environmental sampling strategy was outlined in the project execution plan (Doc Ref: 6050H-837-PEP-01-2.0) prior to the commencement of the survey. Any amendments to the environmental data acquisition were agreed with the client before initiating the sampling process.

The scope of the Xlinks Interconnector project required seabed sampling at 51 stations along the cable route. Stations were ground-truthed by short camera transects prior to grabbing, allowing for the identification of potential hazards, whilst also allowing habitats and potential sensitivities to be assessed.

Stations were positioned along the RPL, the majority of deeper section were spaced approximately 10 km away from each other, where the sediment type was expected to be relatively consistent based on EMODnet predicted habitats and review of the low reflectivity geophysical data. Numerous existing cable routes and their associated 500 m buffer zones meant that stations were not always exactly 10 km apart. Where Marine Protected Areas (MPAs) were located in close proximity to the cable route, sample station spacing was reduced to approximately 5 km. This was applicable for one station close to the East of Haigh Fras MPA and nine stations close to the edge of the Southwest Approaches to Bristol Channel MPA. In the nearshore section of the RPL, sampling stations were reduced to 2 km and 1 km spacing to ensure comprehensive coverage of the expected highly variable habitat types, based on the EMODnet predicted habitats and review of geophysical data.

Two deployments of the DVV grab, and four deployments of the Hamon grab were required to obtain four grab samples at each environmental station. A single grab sample was acquired for physico-chemical subsampling and three for macrofaunal processing. The fauna samples were sieved over a 0.5 mm mesh sieve using a *Wilson* Auto-siever.

Environmental sampling attempts were conducted at 48 of the 51 proposed grab locations, resulting in a full suite of samples (PC, F1, F2, and F3). No grab samples were acquired at UK_ENV_GRAB_29 and UK_ENV_GRAB_32 after repeated failed attempts, and UK_ENV_GRAB_50 was not attempted due to the transect indicating large cobbles and boulders throughout. UK_ENV_GRAB_19 was attempted but no F3 sampled was acquired after multiple attempts. Details of the acquired samples can be found in Table 6, represented graphically in Figure 4, and described in the deck logs (Appendix P).

Environmental benthic stations underwent the following sampling/sub-sampling:

- 1 x 0.1 m^2 physico-chemical replicate, subsampled for particle size distribution (PSD), heavy and trace metals (HM), and hydrocarbons (HC) at a single surface depth strata of 0-5 cm.
- 3 x 0.1 m^2 macro-invertebrate replicate samples processed over a 0.5 cm aperture sieve in the field.

All grab stations were ground-truthed by camera transects with their orientation determined by weather and current conditions. Additional video and stills data were also acquired to facilitate the habitat assessment. Operations were carried out using an STR Seabug camera system mounted on a specialist BSL sled equipped with a separate strobe, and LED lamps. A total of 61 transects were conducted over the survey area. A summary of the surveyed transects and acquired video and photography data is provided in Table 7 and displayed in Figure 4. The survey field operations are detailed in Appendix H, with the deck observations provided in Appendix P, and camera transect logs in Appendix Q.

Water sampling stations, in which conductivity (salinity), temperature, pressure (depth), dissolved oxygen (DO) and turbidity profiles were acquired, were spaced approximately every three stations in the deeper offshore sections of the cable route, with sampling station spacing decreasing to every station in water depths of less than 50 m to account for increased mixing and changes in water masses and their characteristics in the shallower water (Table 8).

Table 6: Summary of grab station sample acquisition

Geodetics: WGS84, UTM Zone 29 & 30N							
Station	Date	Easting (m)	Northing (m)	PC	F1	F2	F3
UTM Zone 29N							
UK_ENV_GRAB_01	07/09/2023	669 305	5 430 723	✓	✓	-	-
		669 304	5 430 725	-	-	✓	✓
UK_ENV_GRAB_02	06/09/2023	665 043	5 439 379	✓	-	-	-
		665 041	5 439 378	-	✓	✓	-
		665 040	5 439 377	-	-	-	✓
UK_ENV_GRAB_03	06/09/2023	660 611	5 448 341	✓	✓	-	-
		660 612	5 448 341	-	-	✓	✓
UK_ENV_GRAB_04	06/09/2023	656 184	5 457 306	✓	✓	-	-
		656 189	5 457 303	-	-	✓	✓
UK_ENV_GRAB_05	05/09/2023	651 758	5 466 273	✓	✓	-	-
		651 759	5 466 274	-	-	✓	✓
UK_ENV_GRAB_06	07/09/2023	647 333	5 475 239	✓	✓	-	-
		647 333	5 475 238	-	-	✓	✓
UK_ENV_GRAB_07	07/09/2023	643 014	5 484 238	✓	✓	-	-
		643 018	5 484 241	-	-	✓	✓
UK_ENV_GRAB_09	11/09/2023	641 214	5 493 593	✓	✓	-	-
		641 213	5 493 595	-	-	✓	✓
UK_ENV_GRAB_10	11/09/2023	640 446	5 503 420	✓	✓	-	-
		640 448	5 503 421	-	-	✓	✓
UK_ENV_GRAB_11	11/09/2023	642 088	5 513 767	✓	✓	-	-
		642 085	5 513 768	-	-	✓	✓
UK_ENV_GRAB_13	12/09/2023	642 500	5 516 392	✓	✓	-	-
		642 499	5 516 397	-	-	✓	✓
UK_ENV_GRAB_14	12/09/2023	642 896	5 518 772	✓	✓	-	-
		642 898	5 518 771	-	-	✓	✓
UK_ENV_GRAB_15	12/09/2023	643 640	5 523 645	✓	✓	-	-
		643 642	5 523 644	-	-	✓	✓
UK_ENV_GRAB_16	13/09/2023	645 198	5 533 521	✓	✓	-	-
		645 196	5 533 522	-	-	✓	✓
UK_ENV_GRAB_17	13/09/2023	647 954	5 542 678	✓	✓	-	-
		647 955	5 542 681	-	-	✓	✓
UK_ENV_GRAB_18	13/09/2023	651 587	5 552 411	✓	✓	-	-
		651 584	5 552 413	-	-	✓	✓
UK_ENV_GRAB_19	13/09/2023	654 737	5 560 859	✓	✓	-	-

Geodetics: WGS84, UTM Zone 29 & 30N							
Station	Date	Easting (m)	Northing (m)	PC	F1	F2	F3
	14/09/2023	654 738	5 560 860	-	-	✓	X
UK_ENV_GRAB_20	14/09/2023	659 311	5 570 630	✓	✓	-	-
		659 309	5 570 626	-	-	✓	✓
UK_ENV_GRAB_21	14/09/2023	666 961	5 577 072	✓	✓	-	-
		666 962	5 577 075	-	-	✓	✓
UK_ENV_GRAB_23	15/09/2023	674 612	5 583 521	✓	✓	-	-
		674 612	5 583 520	-	-	✓	✓
UK_ENV_GRAB_24	15/09/2023	676 659	5 585 205	-	✓	-	-
		676 657	5 585 207	✓	-	-	-
		676 659	5 585 208	-	-	✓	-
		676 659	5 585 207	-	-	-	✓
UK_ENV_GRAB_27	15/09/2023	682 876	5 589 061	✓	✓	-	-
		682 873	5 589 058	-	-	✓	✓
UK_ENV_GRAB_29	07/10/2023	-	-	X	X	X	X
UK_ENV_GRAB_30	07/10/2023	700 412	5 598 675	✓	✓	-	-
		700 415	5 598 675	-	-	✓	✓
UK_ENV_GRAB_31	07/10/2023	709 398	5 603 593	✓	✓	-	-
		709 403	5 603 595	-	-	✓	-
		709 401	5 603 593	-	-	-	✓
UTM Zone 30N							
UK_ENV_GRAB_32	05/10/2023	-	-	X	X	X	X
UK_ENV_GRAB_33	04/10/2023	307 102	5 614 023	✓	✓	-	-
		307 102	5 614 023	-	-	✓	-
		307 102	5 614 022	-	-	-	✓
UK_ENV_GRAB_34	04/10/2023	313 311	5 616 799	✓	-	-	-
		313 312	5 616 799	-	✓	-	-
		313 311	5 616 800	-	-	✓	-
		313 310	5 616 799	-	-	-	✓
UK_ENV_GRAB_35	04/10/2023	320 268	5 620 686	✓	✓	-	-
		320267	5 620 686	-	-	✓	✓
UK_ENV_GRAB_36	04/10/2023	323 458	5 624 564	✓	✓	-	-
		323 459	5 624 564	-	-	✓	✓
UK_ENV_GRAB_37	02/10/2023	326 560	5 628 346	✓	-	-	-
	03/10/2023	326 566	5 628 346	-	✓	-	-
		326 566	5 628 347	-	-	✓	-
		326 565	5 628 346	-	-	-	✓
UK_ENV_GRAB_38	02/10/2023	329 445	5 631 854	✓	-	-	-
		329 444	5 631 855	-	✓	-	-
		329 445	5 631 855	-	-	✓	✓
UK_ENV_GRAB_39	02/10/2023	332 744	5 635 864	✓	✓	-	-

Geodetics: WGS84, UTM Zone 29 & 30N							
Station	Date	Easting (m)	Northing (m)	PC	F1	F2	F3
		332 745	5 635 863	-	-	✓	✓
UK_ENV_GRAB_40	17/09/2023	335 401	5 639 100	✓	✓	-	-
		335 403	5 639 104	-	-	✓	✓
UK_ENV_GRAB_41	17/09/2023	339 260	5 643 795	✓	✓	-	-
		339 260	5 643 798	-	-	✓	✓
UK_ENV_GRAB_42	17/09/2023	342 539	5 647 788	✓	-	-	-
		342 541	5 647 790	-	✓	✓	-
		342 543	5 647 791	-	-	-	✓
UK_ENV_GRAB_43	16/09/2023	345 612	5 651 524	-	✓	-	-
		345 611	5 651 527	✓	-	✓	-
		345 610	5 651 528	-	-	-	✓
UK_ENV_GRAB_44	17/09/2023	354 381	5 655 710	✓	-	-	-
		354 382	5 655 710	-	✓	✓	-
		354 383	5 655 713	-	-	-	✓
UK_ENV_GRAB_45	16/09/2023	363 966	5 658 703	✓	-	-	-
	02/10/2023	363 975	5 658 708	-	✓	✓	-
		363 978	5 658 706	-	-	-	✓
UK_ENV_GRAB_46	16/09/2023	373 369	5 662 122	✓	✓	-	-
		373 368	5 662 122	-	-	✓	✓
UK_ENV_GRAB_50*	30/09/2023	383 134	5 663 972	X	X	X	X
UK_ENV_GRAB_51	30/09/2023	393 049	5 664 558	✓	-	-	-
		393 046	5 664 558	-	✓	-	-
		393 048	5 664 559	-	-	✓	-
		393 048	5 664 558	-	-	-	✓
UK_ENV_GRAB_52	29/09/2023	397 174	5 662 863	✓	-	-	-
		397 177	5 662 865	-	✓	-	-
		397 178	5 662 867	-	-	✓	-
		397 177	5 662 865	-	-	-	✓
UK_ENV_GRAB_53	23/09/2023	400 525	5 658 885	✓	✓	-	-
		400 526	5 658 884	-	-	✓	✓
UK_ENV_GRAB_54	29/09/2023	402 315	5 657 965	✓	✓	-	-
		402 315	5 657 964	-	-	✓	✓
UK_ENV_GRAB_55	29/09/2023	403 847	5 656 561	✓	✓	-	-
		403 847	5 656 562	-	-	✓	-
		403 846	5 656 560	-	-	-	✓
UK_ENV_GRAB_56	29/09/2023	405 644	5 655 693	✓	✓	-	-
		405 644	5 655 693	-	-	✓	✓
UK_ENV_GRAB_57	29/09/2023	407 491	5 654 938	✓	✓	-	-
		407 491	5 654 938	-	-	✓	✓

Geodetics: WGS84, UTM Zone 29 & 30N							
Station	Date	Easting (m)	Northing (m)	PC	F1	F2	F3
UK_ENV_GRAB_58	29/09/2023	408 392	5 654 495	✓	✓	-	-
		408 392	5 654 495	-	-	✓	✓
UK_ENV_GRAB_59	23/09/2023	409 501	5 654 205	-	✓	✓	-
		409 499	5 654 206	✓	-	-	✓
UK_ENV_GRAB_61	23/09/2023	410 477	5 653 987	-	✓	✓	-
		410 478	5 653 987	✓	-	-	✓

Notes:
PC = Physico-chemistry (particle size analysis, organic matter and carbon, extractable halogens, hydrocarbons including total hydrocarbon content and polycyclic aromatic hydrocarbons, heavy and trace metals)
F1/F2/F3 = Macrofaunal sample replicates 1, 2, 3
''= grab not attempted due to unsuitable sediment and potentially sensitive habitat*

Table 7: Summary of camera transect acquisition

Geodetics: WGS84, UTM Zones 29 & 30N							
Transect		Easting (m)	Northing (m)	Date	Time (UTC)	Video footage (mm:ss)	No. Stills
UTM Zone 29N							
UK_ENV_TR_01	SOL	669 326	5 430 682	07/09/2023	00:24	06:45	26
	EOL	669 288	5 430 768		00:31		
UK_ENV_TR_02	SOL	665 045	5 439 348	06/09/2023	19:41	06:52	24
	EOL	665 006	5 439 420		19:48		
UK_ENV_TR_03	SOL	660 639	5 448 322	06/09/2023	14:47	09:02	21
	EOL	660 612	5 448 383		14:56		
UK_ENV_TR_04	SOL	656 207	5 457 293	06/09/2023	09:56	05:03	14
	EOL	656 172	5 457 362		10:01		
UK_ENV_TR_05	SOL	651 801	5 466 246	06/09/2023	00:48	08:33	23
	EOL	651 745	5 466 192		00:57		
UK_ENV_TR_06	SOL	647 339	5 475 222	07/09/2023	08:40	05:53	18
	EOL	647 300	5 475 299		08:46		
UK_ENV_TR_07	SOL	643 020	5 484 220	07/09/2023	13:51	06:50	26
	EOL	643 009	5 484 305		13:58		
UK_GT_TR_08	SOL	642 924	5 484 700	10/09/2023	19:34	05:26	18
	EOL	642 911	5 484 781		19:40		
UK_ENV_TR_09	SOL	641 229	5 493 521	11/09/2023	03:24	09:39	31
	EOL	641 197	5 493 663		03:34		
UK_ENV_TR_10	SOL	640 453	5 503 465	11/09/2023	07:15	05:01	17
	EOL	640 447	5 503 386		07:20		
UK_ENV_TR_11	SOL	642 095	5 513 812	11/09/2023	15:03	07:59	29
	EOL	642 075	5 513 741		15:11		
UK_GT_TR_12	SOL	642 448	5 516 112	11/09/2023	20:15	05:05	22
	EOL	642 439	5 516 034		20:20		
UK_ENV_TR_13	SOL	642 491	5 516 352	11/09/2023	23:32	05:12	18

Geodetics: WGS84, UTM Zones 29 & 30N							
Transect		Easting (m)	Northing (m)	Date	Time (UTC)	Video footage (mm:ss)	No. Stills
	EOL	642 503	5 516 431		23:38		
UK_ENV_TR_14	SOL	642 900	5 518 826	12/09/2023	06:04	07:26	31
	EOL	642 892	5 518 721		06:11		
UK_ENV_TR_15	SOL	643 652	5 523 701	12/09/2023	08:59	09:23	28
	EOL	643 637	5 523 613		09:08		
UK_ENV_TR_16	SOL	645 189	5 533 472	13/09/2023	06:02	07:48	25
	EOL	645 206	5 533 567		06:10		
UK_ENV_TR_17	SOL	647 943	5 542 647	13/09/2023	12:16	04:20	16
	EOL	647 965	5 542 709		12:20		
UK_ENV_TR_18	SOL	651 573	5 552 377	13/09/2023	18:24	05:41	23
	EOL	651 599	5 922 025		18:29		
UK_ENV_TR_19	SOL	654 721	5 560 817	13/09/2023	23:16	07:08	23
	EOL	654 755	5 560 902		23:23		
UK_ENV_TR_20	SOL	659 343	5 570 658	14/09/2023	07:04	07:40	23
	EOL	659 290	5 570 612		07:12		
UK_ENV_TR_21	SOL	666 936	5 577 052	14/09/2023	15:16	06:36	24
	EOL	666 984	5 577 094		15:23		
UK_GT_TR_22	SOL	672 164	5 581 437	14/09/2023	20:29	06:30	19
	EOL	672 224	5 581 491		20:35		
UK_ENV_TR_23	SOL	674 644	5 583 539	15/09/2023	00:53	05:57	18
	EOL	674 578	5 583 488		00:59		
UK_ENV_TR_23_R1 *	SOL	674 644	5 583 544	15/09/2023	01:34	05:33	17
	EOL	674 586	5 583 491		01:40		
UK_ENV_TR_24	SOL	676 691	5 585 235	15/09/2023	06:09	06:34	20
	EOL	676 634	5 585 186		06:16		
UK_GT_TR_25	SOL	682 008	5 588 584	15/09/2023	12:26	06:02	21
	EOL	681 939	5 588 545		12:32		
UK_GT_TR_26	SOL	682 151	5 588 664	15/09/2023	12:12	04:13	14
	EOL	682 095	5 588 634		12:17		
UK_ENV_TR_27	SOL	682 833	5 589 038	15/09/2023	17:40	04:26	7
	EOL	682 878	5 589 064		17:44		
UK_ENV_TR_27_R1 *	SOL	682 909	5 589 079	15/09/2023	17:59	04:47	13
	EOL	682 850	5 589 045		18:04		
UK_GT_TR_28	SOL	684 384	5 589 875	15/09/2023	19:40	06:12	18
	EOL	684 454	5 589 915		19:47		
UK_ENV_TR_29	SOL	695 197	5 595 810	07/10/2023	13:54	07:21	23
	EOL	698 143	5 595 781		14:01		
UK_ENV_TR_30	SOL	700 435	5 598 686	07/10/2023	09:54	06:18	18
	EOL	700 387	5 598 659		10:00		
UK_ENV_TR_31	SOL	709 435	5 603 614	07/10/2023	03:08	06:01	20

Geodetics: WGS84, UTM Zones 29 & 30N							
Transect		Easting (m)	Northing (m)	Date	Time (UTC)	Video footage (mm:ss)	No. Stills
	EOL	709 379	5 603 582		03:14		
UTM Zone 30N							
UK_ENV_TR_32	SOL	293 266	5 607 843	05/10/2023	01:58	03:08	3
	EOL	293 237	5 607 832		02:01		
UK_ENV_TR_32_R1 *	SOL	293 263	5 607 844	05/10/2023	02:08	18:09	49
	EOL	293 199	5 607 816		02:29		
UK_ENV_TR_33	SOL	307 140	5 614 038	04/10/2023	19:33	07:25	15
	EOL	307 076	5 614 011		19:40		
UK_ENV_TR_34	SOL	313 339	5 616 809	04/10/2023	14:06	10:27	4
	EOL	313 330	5 616805		14:16		
UK_ENV_TR_34_R1 *	SOL	313 342	5 616 810	04/10/2023	14:38	06:39	21
	EOL	313 288	5 616 786		14:45		
UK_ENV_TR_35	SOL	320 293	5 620 717	04/10/2023	11:42	07:13	17
	EOL	320 253	5 620 665		11:49		
UK_ENV_TR_36	SOL	320 291	5 620 714	04/10/2023	05:06	07:13	23
	EOL	320 253	5 620 664		05:14		
UK_ENV_TR_37	SOL	326 537	5 628 317	02/10/2023	21:47	07:13	17
	EOL	326 577	5 628 369		21:55		
UK_ENV_TR_38	SOL	329 465	5 631 882	02/10/2023	18:52	06:50	17
	EOL	329 427	5 631 832		18:59		
UK_ENV_TR_39	SOL	332 721	5 635 837	02/10/2023	12:47	07:15	19
	EOL	332 763	5 635 887		12:54		
UK_ENV_TR_40	SOL	335 431	5 639 132	17/09/2023	17:33	05:43	20
	EOL	335 380	5 639 074		17:38		
UK_ENV_TR_41	SOL	339 231	5 643 760	17/09/2023	13:03	05:58	21
	EOL	339 278	5 643 820		13:09		
UK_ENV_TR_42	SOL	342 562	5 647 820	17/09/2023	10:50	08:23	19
	EOL	342 520	5 647 765		10:59		
UK_ENV_TR_43	SOL	345 576	5 651 486	16/09/2023	11:28	09:58	26
	EOL	345 628	5 651 546		11:38		
UK_ENV_TR_44	SOL	354 426	5 655 719	17/09/2023	01:02	05:32	18
	EOL	354 350	5 655 704		01:07		
UK_ENV_TR_45	SOL	364 004	5 658 718	16/09/2023	22:20	06:27	19
	EOL	363 931	5 658 692		22:27		
UK_ENV_TR_46	SOL	373 333	5 662 108	16/09/2023	18:08	09:35	18
	EOL	373 398	5 662 135		18:13		
UK_ENV_TR_47	SOL	377 921	5 663 141	02/10/2023	01:46	29:00	93
	EOL	378 182	5 663 179		02:15		
UK_ENV_TR_48	SOL	380 939	5 663 934	01/10/2023	07:24	34:10	102
	EOL	380 795	5 663 643		07:58		

Geodetics: WGS84, UTM Zones 29 & 30N							
Transect		Easting (m)	Northing (m)	Date	Time (UTC)	Video footage (mm:ss)	No. Stills
UK_ENV_TR_49	SOL	381 297	5 663 946	30/09/2023	12:05	29:54	88
	EOL	381 357	5 663 728		12:35		
UK_ENV_TR_50	SOL	383 096	5 663 978	30/09/2023	09:06	11:27	30
	EOL	383 165	5 663 970		09:17		
UK_ENV_TR_51	SOL	393 014	5 664 561	29/09/2023	00:17	07:53	22
	EOL	393085	5 664 553		00:25		
UK_ENV_TR_52	SOL	397 149	5 662 888	29/09/2023	20:30	08:46	31
	EOL	397 200	5 662 843		20:39		
UK_ENV_TR_53	SOL	400 553	5 658 871	23/09/2023	18:14	07:04	29
	EOL	400 502	5 658 897		18:21		
UK_ENV_TR_54	SOL	402 349	5 657 944	29/09/2023	16:25	09:37	24
	EOL	402 291	5 657 979		16:35		
UK_ENV_TR_55	SOL	403 871	5 656 541	29/09/2023	14:47	06:31	23
	EOL	403 825	5 656 580		14:54		
UK_ENV_TR_56_R1 *	SOL	405 680	5 655 682	29/09/2023	04:27	08:12	20
	EOL	405 612	5 655 703		04:35		
UK_ENV_TR_57	SOL	407 533	5 654 916	29/09/2023	07:54	01:20	4
	EOL	407 533	5 654 916		07:55		
UK_ENV_TR_57_R1 *	SOL	407 518	5 654 924	29/09/2023	13:01	07:28	6
	EOL	407 464	5 654 950		13:09		
UK_ENV_TR_58	SOL	408 415	5 654 482	29/09/2023	11:29	07:20	19
	EOL	408 365	5 654 506		11:36		
UK_ENV_TR_59	SOL	409 542	5 654 194	23/09/2023	09:03	00:46	3
	EOL	409 542	5 654 194		09:04		
UK_ENV_TR_59_R1 *	SOL	409 545	5 654 196	23/09/2023	13:06	25:41	34
	EOL	409 474	5 654 209		13:32		
UK_ENV_TR_61	SOL	410 505	5 653 948	23/09/2023	09:59	79:12	35
	EOL	410 465	5 653 999		11:28		

Notes:
UTC = Universal Coordinated Time
SOL = Start of Line
EOL = End of Line
''= line rerun due to camera troubleshooting or low visibility*

Table 8: Acquired CTD profiles

Geodetics: WGS84, UTM Zone 29 & 30N				
Station	Easting (m)	Northing (m)	Depth (m)	Date
UTM Zone 29N				
UK_ENV_CTD_01	669 288	5 430 768	127	07/09/23
UK_ENV_CTD_04	656 172	5 457 362	123	06/09/23
UK_ENV_CTD_07	643 009	5 484 305	122	07/09/23
UK_ENV_CTD_11	642 075	5 513 741	117	11/09/23

Geodetics: WGS84, UTM Zone 29 & 30N				
Station	Easting (m)	Northing (m)	Depth (m)	Date
UK_ENV_CTD_15	643 637	5 523 613	114	12/09/23
UK_ENV_CTD_18	651 599	5 922 025	108	13/09/23
UK_ENV_CTD_21	666 984	5 577 094	100	14/09/23
UK_ENV_CTD_27	682 878	5 589 064	98	15/09/23
UK_ENV_CTD_31	709 379	5 603 582	90	07/10/23
UTM Zone 30N				
UK_ENV_CTD_34	313 288	5 616 785	78	04/10/23
UK_ENV_CTD_37	326 577	5 628 369	77	02/10/23
UK_ENV_CTD_40	335 380	5 639 074	75	17/09/23
UK_ENV_CTD_43	345 628	5 651 546	73	16/09/23
UK_ENV_CTD_46	373 398	5 662 135	61	16/09/23
UK_ENV_CTD_52	397 200	5 662 843	47	29/09/23
UK_ENV_CTD_53	400 526	5 658 884	31	23/09/23
UK_ENV_CTD_54	402 290	5 657 979	23	29/09/23
UK_ENV_CTD_55	403 825	5 656 579	21	29/09/23
UK_ENV_CTD_56	405 612	5 655 702	23	29/09/23
UK_ENV_CTD_57	407 533	5 654 916	20	23/09/23
UK_ENV_CTD_58	408 366	5 654 506	11	29/09/23
UK_ENV_CTD_59	409 542	5 654 194	13	23/09/23
UK_ENV_CTD_61	410 465	5 653 999	10	23/09/23
Notes: *CTD = Conductivity, temperature and depth multi-parameter profiler*				

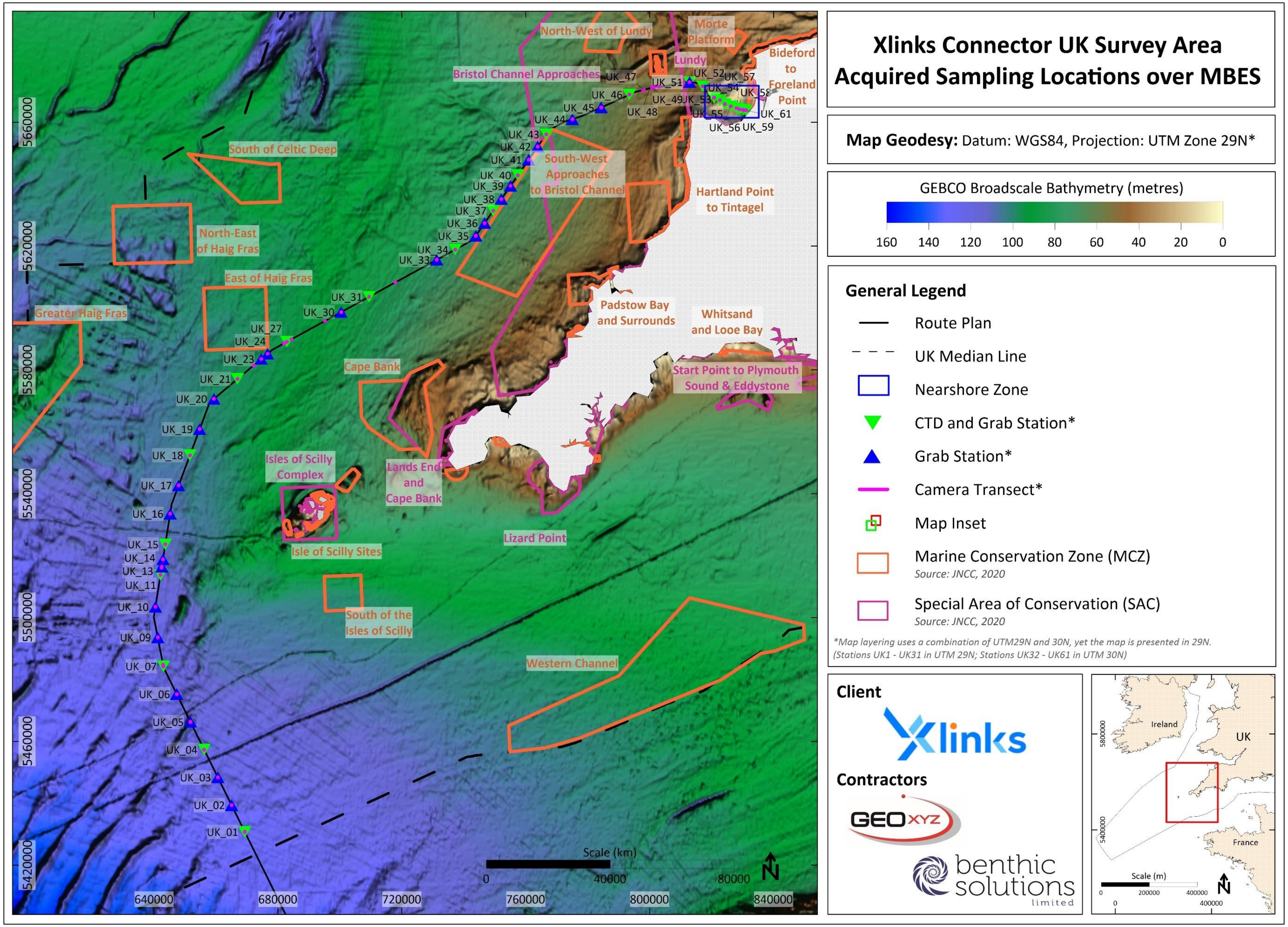


Figure 4: Survey overview chart

3.3 SEDIMENT SAMPLE ANALYSES

The recovered benthic samples were correctly stored prior to demobilisation and transportation of the material to the analytical laboratories. Correct storage involved the freezing of all physico-chemical samples on recovery and transportation back to the BSL warehouse to be forwarded to a laboratory, remaining frozen at all times. The material acquired during the survey was analysed at the following laboratories:

- BSL: Particle size Analysis
- APEM: Macro-invertebrate Analysis
- Socotec: Sediment Chemistry

The analytical methods used for the current survey are summarised below in Table 9, with further detail provided in Appendix I.

Table 9: Summary of analytical methods

Determinant	Detection Limits	Accreditation	Laboratory Technique
Particle Size Distribution	N/A	NMBAQC**	Wet sieving and laser diffraction (Malvern Mastersizer) to whole and half phi intervals, respectively
Moisture Content	0.20 %	UKAS	Documented in-house method, oven drying @ 105 °C, No TMSS
Total Organic Carbon	0.02 %	ISO 17025 & UKAS	Documented in-house method with carbonate removal and sulphurous acid/combustion at 1600 °C/NDIR, WSLM59
Total Organic Matter (TOM)	0.20 %	ISO 17025 & UKAS	Loss on Ignition (LOI) at 440 °C
Heavy Metals	Various	ISO 17025, UKAS (Most Metals)	Aqua regia extraction followed by ICP-MS or ICP-OES.
Total Petroleum Hydrocarbons (TPH)	1 $\mu g.kg^{-1}$	UKAS	Method using marine specification by GC-FID, TPHFIDUS
Aliphatic hydrocarbons	1 $\mu g.kg^{-1}$	UKAS	Method using marine specification by GC-FID, TPHFIDUS
Polycyclic Aromatic Hydrocarbons (PAH) (EPA list of 19 potentially hazardous compounds and DTI parent and alkylated PAH list)	1 $\mu g.kg^{-1}$	ISO 17025 & UKAS for EPA 16 and DTI Parent PAHs	Documented in-house method using DTI specification involving solvent extraction and clean up followed by GC-MS.
Benthic Macrofauna	n/a	NMBAQC**	Biological identification of 500 µm fractions with univariate and multivariate analyses. Two of three replicates processed.

Notes:
DTI = Former 'Department of Trade and Industry'
**Detection limit is the lowest quantity of a substance that can be distinguished from the absence of that substance (a blank value) with a stated confidence level.*
***NMBAQC is not strictly an accreditation but provides external quality assurance for particle size and macrofaunal analysis*

4 ENVIRONMENTAL BASELINE SURVEY RESULTS AND DISCUSSION

4.1 BATHYMETRY

The following description of the bathymetry along the proposed Xlinks UK route was adapted from the 'Xlinks Cable Project Lot1 2022 – Reconnaissance Interpretation Report' (5260H-837-RIR) as the 'Draft Geophysical Survey Interpretation Report – UK' (6050H-837-RR-02) was not available prior to issuing this report. Bathymetric description within the aforementioned report was based on a combination of EMODnet regional broadscale bathymetry data and multibeam bathymetry data acquired by GEOxyz along the route centre line.

EMODNet broadscale bathymetry data for the survey corridor indicated:

- The southern part of the route (from KP0 to KP165) shows water depths ranging from 125 m to 100 m and intersected downwards at approximately KP80 in the area of the Celtic Banks formations.
- The northern part of the route gradually shoals from 100 m to 75 m water depth (KP165 to KP255), then tends to stay parallel to the 75 m isobath from KP255 to KP300 after which the depth shoals further toward the nearshore section.
- The nearshore section enters Bideford Bay (also known as Barnstaple Bay), in the County of Devon, south of the Bristol channel at the mouth of the River Severn and south of the River Taw.

The MBES bathymetry data acquired during the GEOxyz reconnaissance survey of route centre line indicated water depths along the cable route (excluding the nearshore section) to range between -131.4 and -17.2 m MSL. The seabed gradient was typically very gentle with a mean slope of 0.6°.

Some specific bathymetric features highlighted on the reconnaissance survey centre line data:

- Between KP46 and KP51, a large topographic mound of 10 m in amplitude was observed and corresponded to the northern termination of one of the Celtic Banks.
- Between KP100.25 and 103.3, moderate seabed roughness was observed that ended with a topographic scarp 1 m in amplitude with a 10° slope.
- Upwards of KP165, slopes with values close to / exceeding 5° were regularly observed and corresponded to topographic features of transverse bedforms.
- Between KP331 to 338.3, slopes locally exceed 5° to 10° and presented high structured morphology.
- KP356.6, at -40 m MSL, corresponded to an inflection point in the bathymetric cross-section marking the limit between the gentle shelf and the entrance to Bideford Bay.

4.2 SEABED FEATURES

4.2.1 Reconnaissance Survey – Centre Line MBES and SBP Only

The following description of the seabed features along the proposed Xlink UK route was adapted from the Xlinks 'Cable Project Lot1 2022 – Reconnaissance Interpretation Report' (5260H-837-RIR). Description of seabed features within the aforementioned report was based on a combination of British Geological Survey (BGS) information and interpretation of sub-bottom profile (SBP), multibeam bathymetry and backscatter data acquired by GEOxyz along the route centre line.

For the majority of the cable corridor study, the seabed was described using acoustic data, whilst also relying on bibliographic information (when available). The reflectivity, aided by MBES data, was used to delineate seabed features. These were described using IOGP classifications, with new specific codes added to be concordant with the observations.

Over most of the survey area, the sedimentary cover was described by the BGS as "extensive sheets of less than 1 m thickness overlying a comparatively smoothed bedrock surface. Thicker sediments occurred in sand bank and ridges areas". These sediments were described as sand, sandy gravel, and gravelly sand.

Bedforms describe the different morphological features formed by sediment mobility related to the action of near-bottom currents. Near-bottom currents are defined as hydrodynamical flow related to the action of waves, tides, and fluvial processes. Bedforms can be positive or negative topographic features, corresponding respectively to the accumulation of sediments or erosional processes forming topographic depression. The two main types of bedforms described along the route survey area were:

- Transversal bedforms, with crests perpendicular to the flow
- Longitudinal bedforms, with crests parallel to the flow.

Bedforms were assigned based on the Van Rijn (1989) classification tabulated below (Table 10):

Table 10: Nomenclature for transversal bedform classification

Bedform classification	Height (m)	Wavelength (m)
Ripples	0.06	<0.6 m
Megaripples	2	0.6 to 20 m
Dune/ sandwaves	H>2 m	>20 m
Large sandwaves	3	-
Very large sandwaves	15	-

Bedforms were commonly observed over the survey area and described as sheet deposits, sand patches, gravel waves and sand waves. The distribution and orientation of the main bedforms were interpreted as reflecting the recent storm conditions.

4.2.2 Geophysical Survey – Full Survey Corridor MBES and SSS

The 'Draft Geophysical Survey Interpretation Report – UK' (6050H-837-RR-02) was not available prior to issuing the environmental report. However, the seabed features had been interpreted and mapped using the additional MBES bathymetry, backscatter and side scan sonar data acquired across the full survey corridor.

Areas of seabed within the UK survey corridor were assigned to one of the following seabed classifications:

- Rock: Type A (U1A of Primary sedimentary rocks)
- Rock: Type B (U1C of Tertiary Chalk)
- Fine SAND
- Sandy GRAVEL
- Gravelly SAND
- Medium SAND
- Muddy fine SAND
- GRAVEL, PEBBLE
- Pebbly gravelly SAND
- PEBBLE, BOULDER/ GRAVEL, PEBBLE, COBBLE
- Gravelly muddy fine SAND

The interpreted seabed features along the proposed UK route survey area are displayed in Figure 5 to Figure 8, which show ten representative sections of the route. The seabed features are further described within Section **Error! Reference source not found.**, with respect to the habitat classifications that correspond to each seabed feature type. The full interpreted seabed features will be described and displayed within the 'Draft Geophysical Survey Interpretation Report – UK' (6050H-837-RR-02).

4.3 SHALLOW GEOLOGY

The following description of the seabed features along the proposed Xlinks UK route was adapted from the Xlinks 'Cable Project Lot1 2022 – Reconnaissance Interpretation Report' (5260H-837-RIR) as the 'Draft Geophysical Survey Interpretation Report – UK' (6050H-837-RR-02) was not available prior to issuing this report. The description of the shallow geology within the aforementioned report was based on a combination of British Geological Survey (BGS) information and interpretation of Innomar SES-2000 sub-bottom profiler data acquired by GEOxyz along the route centre line.

The British Geological Survey (BGS) describes the solid geology across the UK sector as quite variable, including Primary, Secondary and Tertiary rocks formations. The Primary formations consist of sedimentary rocks such as mudstones, shales, slates, and sandstones. These are observed onshore and expected to extend between 50 km and 100 km from the shore. Secondary rocks (formed during the Trias age) are very discrete across this area of the continental shelf, limited to discrete observations 30 km off the Hartland point. Tertiary rocks are observed offshore bordering the Primary rocks and consist of sedimentary rocks such as Chalk (upper Cretaceous), Limestone (Eocene) and Mudstone/Siltstone (Miocene).

The analysis of SBP data collected along the RPL indicated the sedimentary cover of the top of Bedrock was thin or absent. The acoustic facies of the seabed below this veneer of sand were variable and interpreted, in combination with BGS datasets, as potential changes in types of bedrock. The BGS indicated “hard substrate” areas along the route where the rock was expected to be exposed at the surface.

Three main geological sections were described for the cable route:

- From Block U01 to U06, the solid geology was expected to be Tertiary rocks consisting of Limestone (Eocene) and Mudstone/Siltstone (Miocene). These were found along 25 % of the proposed route.
- From Block U07 to U23, the solid geology was expected to be Chalk except between Block U10 and U11, expected to probably consist of Primary rocks. This was found along 35 % of the proposed route.
- From Block U24 to the nearshore, the solid geology was expected to consist of Primary rocks. This quite transparent facies was found along 40% of the proposed route.

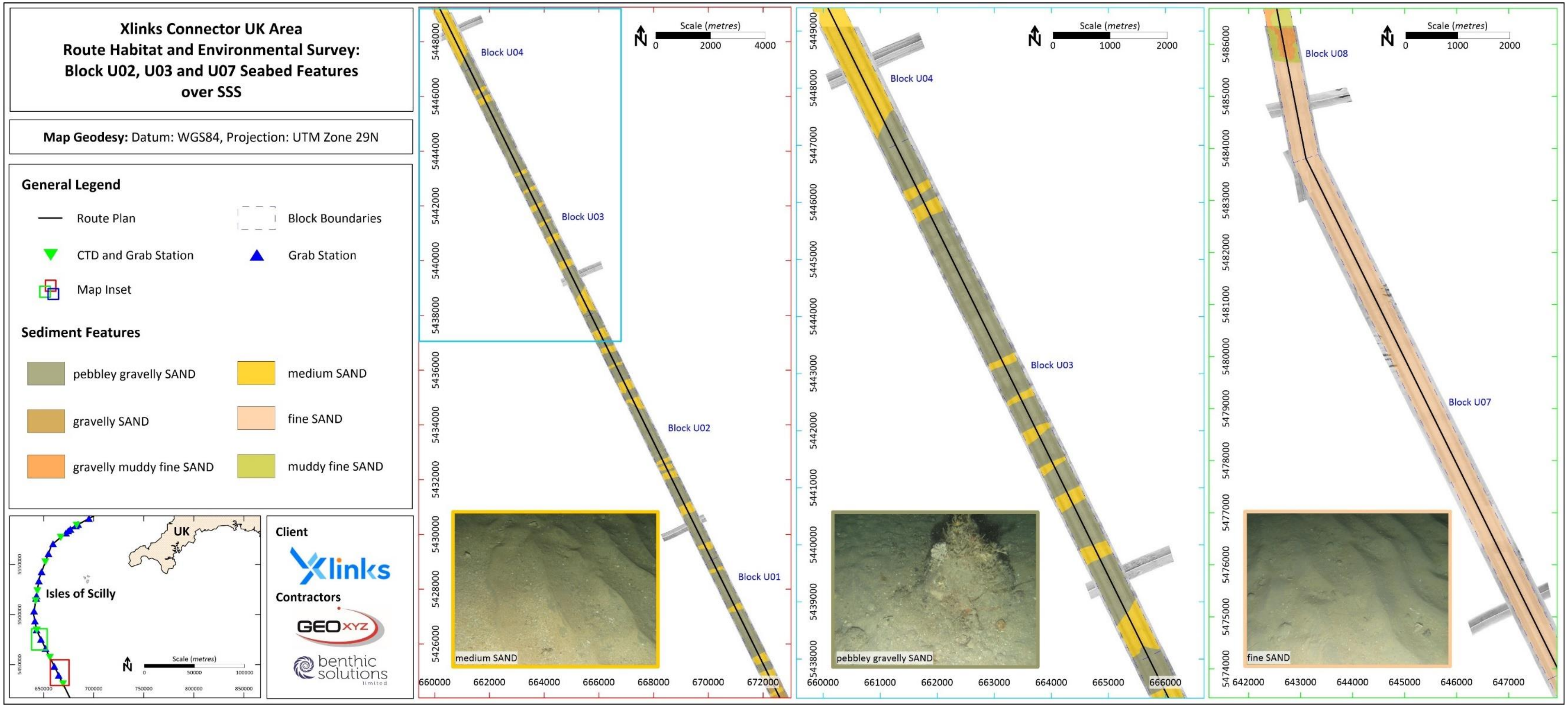


Figure 5: Seabed features over SSS for Xlinks UK block U02 to U07

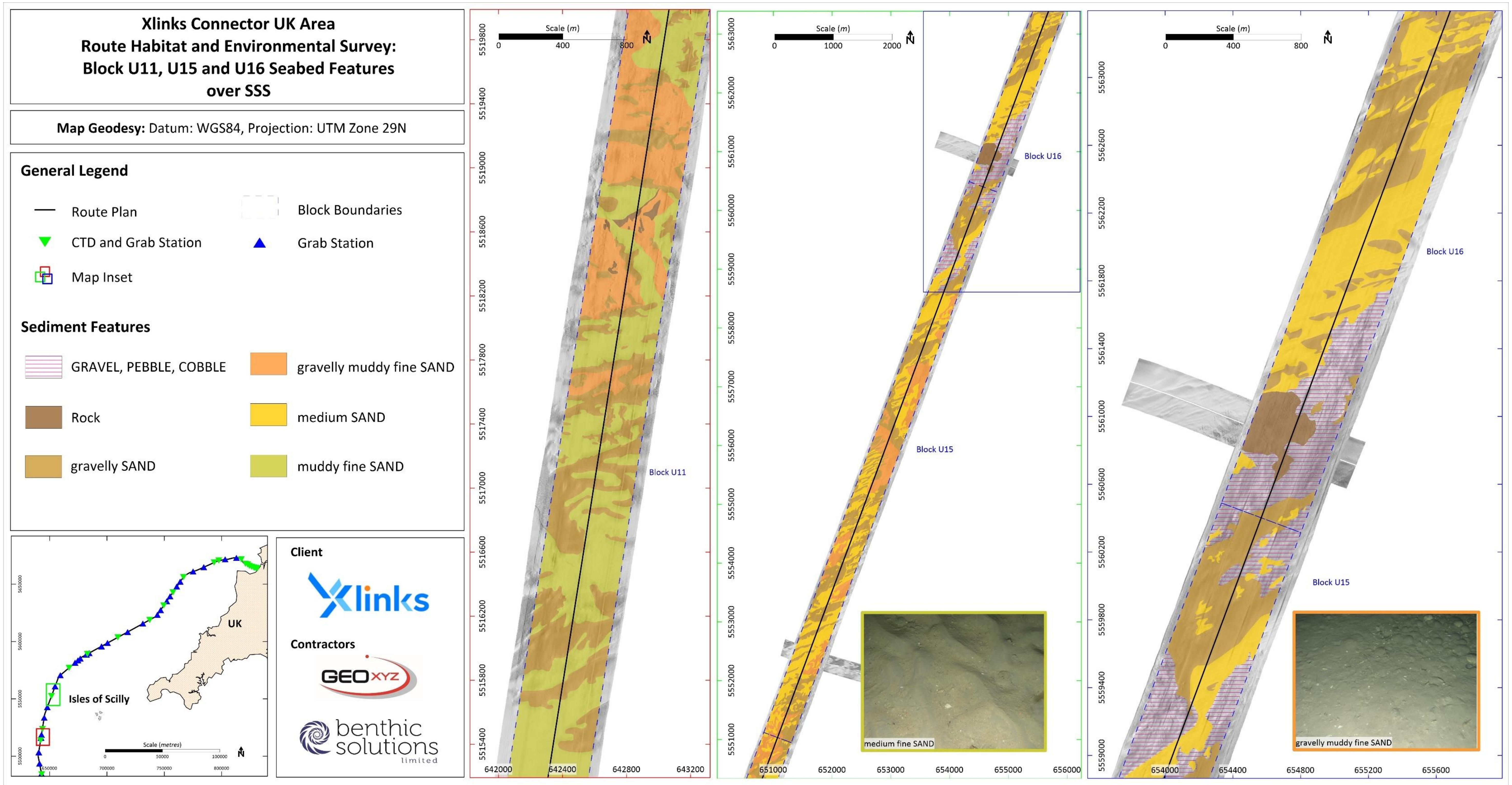


Figure 6: Seabed features over SSS for Xlinks UK blocks U11, U15 and U16

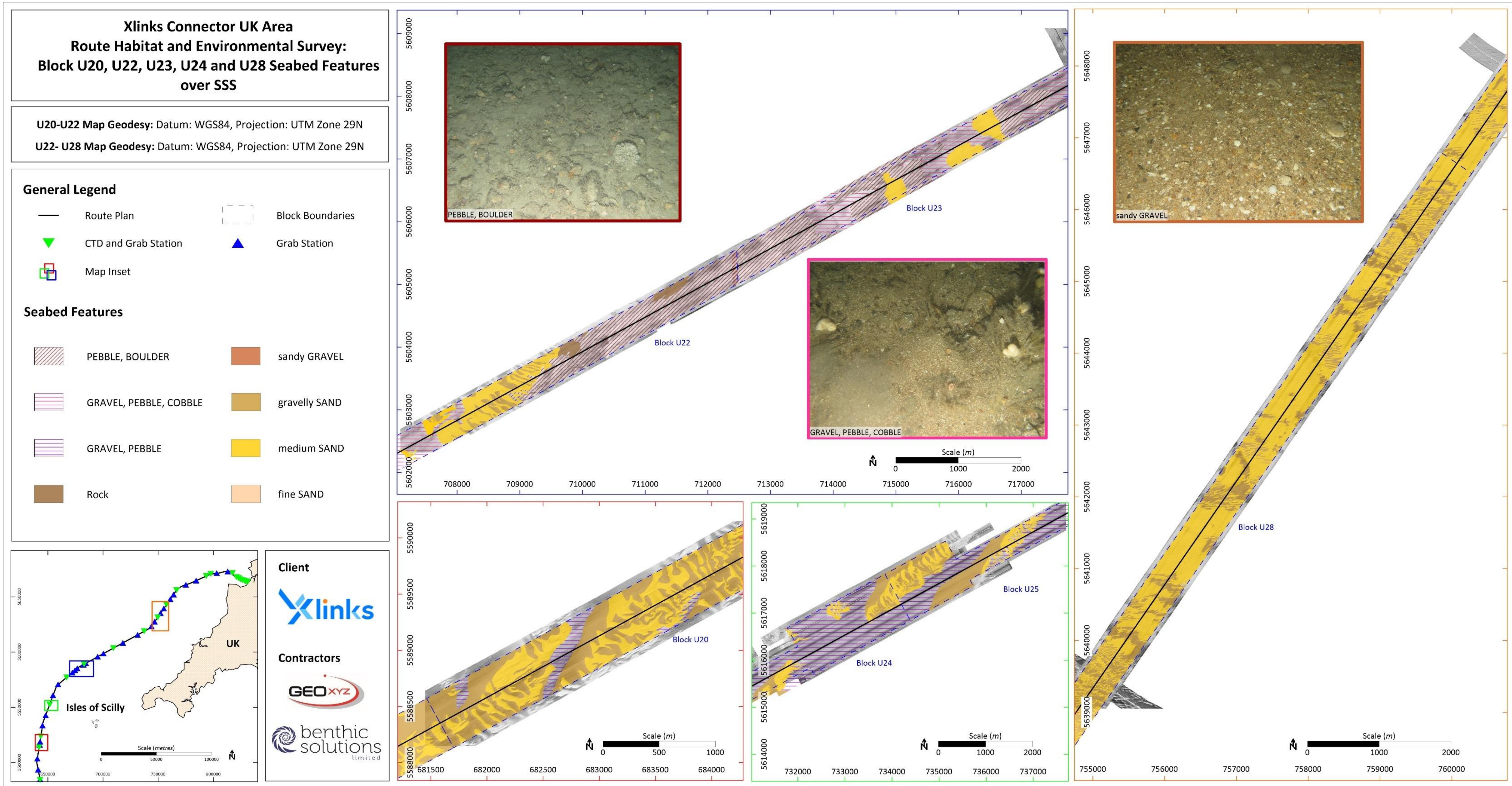


Figure 7: Seabed features over SSS for Xlinks blocks U20, U22, U23, U24 and U28

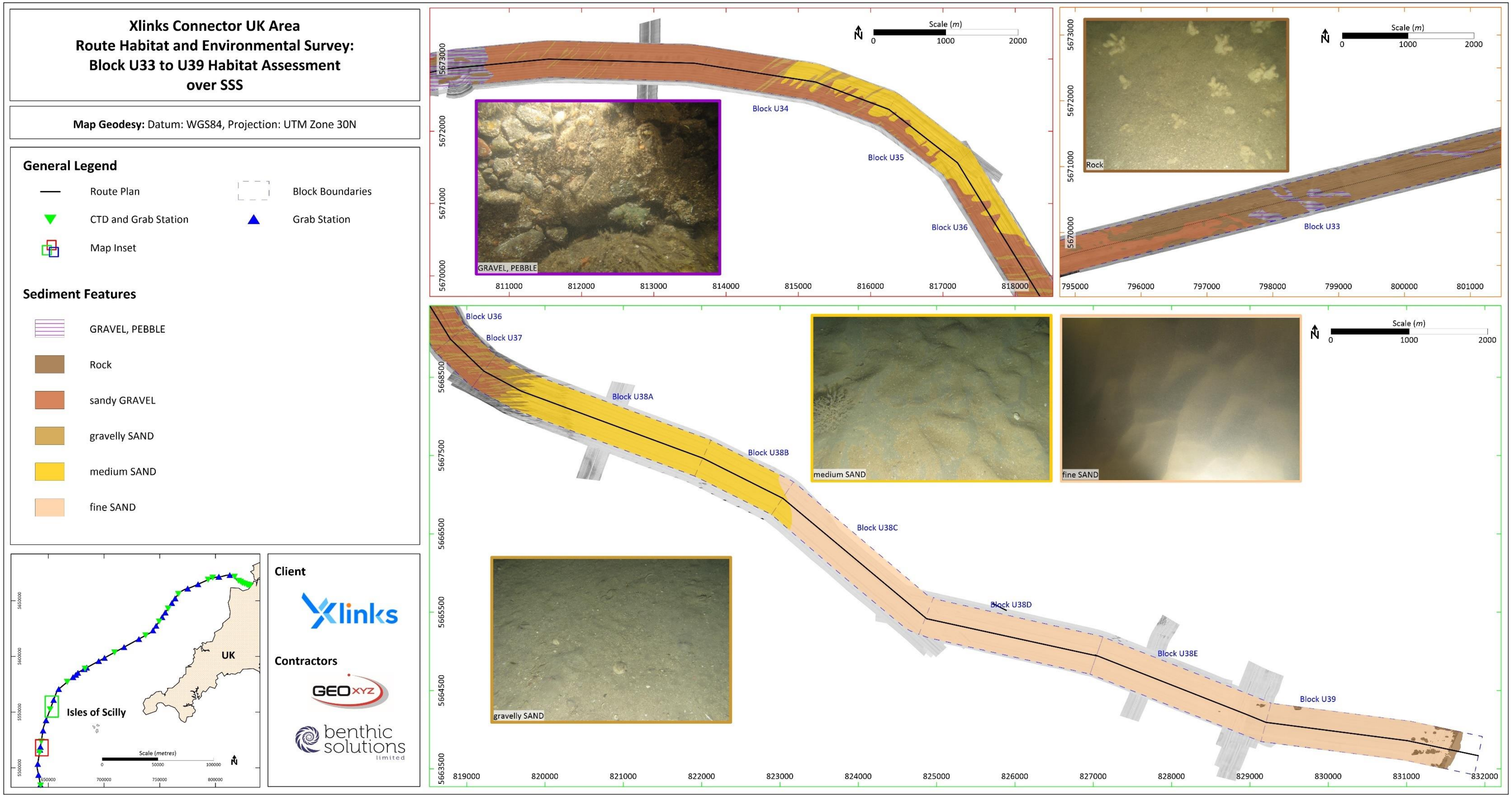


Figure 8: Seabed features over SSS for Xlinks UK blocks U33 to U39

4.4 PARTICLE SIZE DISTRIBUTION

The particle size interpretation of sediments from the EBS conducted along the UK sector of the proposed cable route was based on observations made from the acoustic data, seabed photography and videography, as well as from the analytical results of the surface sediments. These were acquired at the 48 grab sampling stations along the survey cable route area (Table 6). Material for particle size analysis was recovered from the surface 5 cm of the grab samples and was analysed by BSL upon return of the samples to Norfolk, UK (laboratory methods provided in Appendix I). The sediment characteristics for each station are listed in Table 11 and individual particle size distribution plots are presented in Appendix J.

4.4.1 General Description

Grab sample sediments were variable and were described by 12 Munsell colours, ranging from dark olive brown (2.5Y 3/1) to olive brown (2.5Y 6/6). They ranged from fine sand to coarse gravelly sand with pebbles, cobbles and shell fragments present within the matrix.

No grab samples were acquired at UK_29 and UK_32 after repeated failed attempts, and UK_50 was not attempted as the camera transect at this station indicated the presence of large cobbles and boulders throughout, showing potential resemblance to Annex I stony reef habitat. In addition, repeated sampling attempts were required at a further 11 stations (UK_13, UK_19, UK_20, UK_24, UK_31, UK_33, UK_37, UK_43, UK_45, UK_51, and UK_52) due to the coarse, cobbly and pebbly sediment matrices present. In some cases, grab sampling points had to be relocated by 30 m in order to achieve a good sample.

The results of the particle size analysis revealed a highly heterogeneous sediment type across the survey area. The seabed sediments showed a sand dominance (mean 82.01 % ± 17.32 SD) with moderate but variable proportions of gravel (mean 9.42 % ±14.86 SD) and slightly lower fines (mean 8.59 % ± 11.82 SD).

Proportions of sand were highest at station UK_54 (100 %) and lowest at UK_52 (35.6 %). Sand contributed over 90% of the total sediment matrix at 46 % of the stations sampled. The sand dominance within the survey area was consistent with the dominant mapped habitat classification of 'Offshore Circalittoral Sand (SS.SSa.OSa/MD52) by the EMODnet predicted habitat distributions map for the proposed cable route (Figure 2).

Gravel was variable throughout the survey area, highest at stations UK_37 and UK_52 where proportions were higher than that of sand (51.3% and 63.9%, respectively). Review of the seabed footage and sample photographs revealed a complex mosaic of fine sands, sand, sandy gravel, gravelly sand, frequent cobbles, and occasional boulders (Appendix Q). The variation in proportions of gravel was evidenced by a high coefficient of variation (CV) of 158.2 %. Proportion of gravel followed an inverse relationship with proportions of sand, likely due to the minimal fines proportion, which was shown by a highly significant negative spearman's correlation between sands and gravel ($\rho(48)=-0.621$, $p<0.001$; Appendix S).

Proportions of fines were the lowest throughout the survey area, ranging from 0 % at station UK_54 to 44 % at station UK_19. The majority of stations (33 out of 48 stations) were characterised by proportions of less than 6 % fines. On occasion, areas with cobbles and boulders tended to have higher proportions of fines due to settlement and protection from scour.

A significant Spearman correlation was observed between water depth and proportions of fines ($\rho(48)=0.572$, $p<0.001$).

The Folk (1954) and Wentworth (1922) classifications for each station are listed in Table 11. The Wentworth classification assigns a single sediment class based on the mean particle size and is appropriate for well sorted modal sediments, dominated by a narrow range of sediment particle sizes. The Folk classification provides a more representative description for poorly sorted sediments, encompassing a range of particle sizes as it considers the relative proportions of mud (<63 µm), sand (63 µm-2 mm) and gravel (>2 mm) fractions (Figure 9 to Figure 11). For the purposes of this study, the modified Folk classification produced by the British Geological Survey has been used (Long, 2006).

The samples collected from the survey area were represented by eight Folk classifications with the most frequently assigned (12 stations) being 'Slightly Gravelly Sand' (Folk, 1954). The greater proportions of fines at stations UK_06, UK_16, UK_20, and UK_24 led to the designation as 'Gravelly Muddy Sand' at these stations, while the high sand content and moderate fines led to the classification of 'Muddy Sandy Gravel' at stations UK_09, UK_11, UK_12, UK_57 and UK_58. The Wentworth classification scale identified six different sediment classifications, ranging from 'Very fine Sand' to 'Pebble' (Table 11). The heterogeneity of the sediment within the samples was reflected in the variation in the sorting coefficient (CV: 52.7 %; Table 11), with stations ranging from moderately well sorted to very poorly sorted (mean 1.57 ± 0.83 SD).

Differences in the sediment composition across the survey area were further evident when the stations were grouped by the seven assigned level 4 EUNIS habitat classifications. The four assigned 'Sand' habitats (MB52/SS.SSa.IFiSa 'Atlantic Infralittoral Sand', MC52/SS.SSa.IFiSa 'Atlantic Circalittoral Sand', MC52/SS.SSa.CMuSa 'Atlantic Circalittoral Sand', MD52/SS.SSa.OSa 'Atlantic Offshore Circalittoral Sand') were all sand-dominated, with mean sand content ranging from 70.85 % to 99.05 % but variable fines and gravel content. Note: there are two assigned MC52 'Atlantic Circalittoral Sand' habitats as these are differentiated in the JNCC (2015) habitat classification system (SS.SSa.CFiSa 'Circalittoral Fine Sand' and SS.SSa.CMuSa 'Circalittoral Muddy Sand') and in previous versions of the EUNIS system but not in the latest EUNIS (2022) system. MC52/SS.SSa.IFiSa 'Atlantic Circalittoral Sand' (Fine Sand) was the most sand-dominated habitat, at 99.05 % sand. Mean fines contents were higher for areas of MD52/SS.SSa.OSa 'Atlantic Offshore Circalittoral Sand' (4.31 %), MB52/SS.SSa.IFiSa 'Atlantic Infralittoral Sand' (Fine Sand) (11.72 %) and MC52/SS.SSa.CMuSa 'Atlantic Circalittoral Sand' (Muddy Sand) (28.67 %). All of the aforementioned sand-dominated habitats had minimal mean gravel content of <1 %, except for MD52/SS.SSa.OSa 'Atlantic Offshore Circalittoral Sand' (4.11 %).

The two coarse sediment habitats (MC32/SS.SCS.CCS 'Atlantic Circalittoral Coarse Sediment' and MD32/SS.SCS.OCS 'Atlantic Offshore Circalittoral Coarse Sediment') had lower mean sand content (45.44 % and 75.12 %), with fairly high mean gravel content (53.55 % and 21.26 %) and low mean fines (1.01 % and 3.62 %). The final mixed sediment habitat (MD42/SS.SMx.OMx 'Atlantic Offshore Circalittoral Mixed Sediment'), as expected, showed a more varied sediment type, with means of 26.09 %, 68.29 % and 5.62 % for fines, sand and gravel, respectively.

Table 11: Summary of surface particle characteristics

Station	Water Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	Mean Sediment Size		Wentworth Classification	Sorting Coefficient	Sorting Classification	Fines	Sands	Gravel	BGS Modified Folk Classification
			(mm)	(Phi)				(%)	(%)	(%)	
UK_01	129	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.54	0.88	Coarse Sand	1.78	Poorly Sorted	4.47	80.82	14.71	Gravelly Sand
UK_02	127	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.36	1.46	Medium Sand	0.98	Moderately Sorted	3.59	92.86	3.55	Sl. Gravelly Sand
UK_03	122	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.35	1.51	Medium Sand	1.07	Poorly Sorted	3.52	91.16	5.33	Gravelly Sand
UK_04	123	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.29	1.80	Medium Sand	1.00	Poorly Sorted	5.23	93.17	1.61	Sl. Gravelly Sand
UK_05	114	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.12	3.04	V.Fine Sands	2.59	Very Poorly Sorted	22.40	74.85	2.76	Sl. Gravelly Muddy Sand
UK_06	121	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	0.28	1.82	Medium Sand	1.96	Poorly Sorted	11.69	79.50	8.80	Gravelly Muddy Sand
UK_07	123	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	0.25	1.99	Medium Sand	1.40	Poorly Sorted	9.32	88.41	2.27	Sl. Gravelly Sand
UK_09	123	Circalittoral Sand (MC52/SS.SMu.CMuSa)	0.07	3.88	V.Fine Sands	2.49	Very Poorly Sorted	33.04	66.71	0.25	Muddy Sand
UK_10	120	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	0.08	3.65	V.Fine Sands	2.75	Very Poorly Sorted	33.26	63.89	2.85	Sl. Gravelly Muddy Sand
UK_11	117	Circalittoral Sand (MC52/SS.SMu.CMuSa)	0.08	3.60	V.Fine Sands	2.56	Very Poorly Sorted	29.52	70.12	0.37	Muddy Sand
UK_13	113	Circalittoral Sand (MC52/SS.SMu.CMuSa)	0.11	3.16	V.Fine Sands	2.53	Very Poorly Sorted	23.45	75.72	0.84	Muddy Sand
UK_14	114	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	0.09	3.54	V.Fine Sands	2.63	Very Poorly Sorted	29.08	68.74	2.19	Sl. Gravelly Muddy Sand
UK_15	114	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	0.08	3.65	V.Fine Sands	2.55	Very Poorly Sorted	29.19	69.80	1.01	Sl. Gravelly Muddy Sand
UK_16	111	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	0.62	0.69	Coarse Sand	2.39	Very Poorly Sorted	12.35	72.36	15.29	Gravelly Muddy Sand
UK_17	111	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.46	1.11	Medium Sand	0.96	Moderately Sorted	3.83	95.35	0.82	Sand
UK_18	109	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.47	1.08	Medium Sand	1.02	Poorly Sorted	3.75	95.19	1.06	Sl. Gravelly Sand
UK_19	104	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	0.10	3.27	V.Fine Sands	3.82	Very Poorly Sorted	44.00	39.39	16.61	Gravelly Mud
UK_20	102	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.17	2.56	Fine Sand	3.33	Very Poorly Sorted	23.61	63.92	12.47	Gravelly Muddy Sand
UK_21	100	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	0.72	0.48	Coarse Sand	0.91	Moderately Sorted	2.63	94.21	3.16	Sl. Gravelly Sand
UK_23	100	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	0.72	0.47	Coarse Sand	1.35	Poorly Sorted	3.72	87.14	9.14	Gravelly Sand
UK_24	100	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	0.77	0.39	Coarse Sand	2.78	Very Poorly Sorted	12.93	60.67	26.40	Gravelly Muddy Sand
UK_27	99	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	0.94	0.09	Coarse Sand	1.32	Poorly Sorted	3.86	82.59	13.55	Gravelly Sand
UK_30	93	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	0.73	0.45	Coarse Sand	1.12	Poorly Sorted	0.61	89.99	9.41	Gravelly Sand
UK_31	88	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	0.56	0.83	Coarse Sand	1.09	Poorly Sorted	0.73	94.63	4.65	Sl. Gravelly Sand
UK_33	80	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	1.39	-0.48	V.Coarse Sand	1.20	Poorly Sorted	0.00	79.29	20.71	Gravelly Sand
UK_34	78	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	1.64	-0.72	V.Coarse Sand	2.13	Very Poorly Sorted	1.79	50.14	48.07	Sandy Gravel

Station	Water Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	Mean Sediment Size		Wentworth Classification	Sorting Coefficient	Sorting Classification	Fines	Sands	Gravel	BGS Modified Folk Classification
			(mm)	(Phi)				(%)	(%)	(%)	
UK_35	74	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.47	1.08	Medium Sand	0.72	Moderately Sorted	0.30	99.28	0.42	Sand
UK_36	76	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.55	0.86	Coarse Sand	0.96	Moderately Sorted	0.41	96.03	3.56	Sl. Gravelly Sand
UK_37	76	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	1.68	-0.75	V.Coarse Sand	1.96	Poorly Sorted	0.23	48.49	51.27	Sandy Gravel
UK_38	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.48	1.07	Medium Sand	1.18	Poorly Sorted	0.41	93.31	6.29	Gravelly Sand
UK_39	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.38	1.39	Medium Sand	0.81	Moderately Sorted	0.00	98.83	1.17	Sl. Gravelly Sand
UK_40	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.37	1.42	Medium Sand	0.91	Moderately Sorted	0.85	98.24	0.91	Sand
UK_41	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.34	1.57	Medium Sand	0.94	Moderately Sorted	0.39	98.26	1.36	Sl. Gravelly Sand
UK_42	74	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.35	1.50	Medium Sand	1.30	Poorly Sorted	1.56	94.48	3.96	Sl. Gravelly Sand
UK_43	73	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.30	1.73	Medium Sand	1.11	Poorly Sorted	0.55	96.90	2.56	Sl. Gravelly Sand
UK_44	70	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.31	1.67	Medium Sand	1.35	Poorly Sorted	2.34	90.87	6.79	Gravelly Sand
UK_45	65	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.28	1.84	Medium Sand	0.99	Moderately Sorted	0.42	94.92	4.67	Sl. Gravelly Sand
UK_46	61	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	1.17	-0.22	V.Coarse Sand	1.71	Poorly Sorted	0.98	66.85	32.18	Sandy Gravel
UK_51	52	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	1.31	-0.39	V.Coarse Sand	2.37	Very Poorly Sorted	1.57	55.28	43.15	Sandy Gravel
UK_52	47	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	4.04	-2.01	Pebble	2.64	Very Poorly Sorted	0.46	35.60	63.95	Sandy Gravel
UK_53	31	Circalittoral Sand (MC52/SS.SSa.CFiSa)	0.33	1.58	Medium Sand	0.66	Moderately Well Sorted	0.90	99.03	0.07	Sand
UK_54	22	Circalittoral Sand (MC52/SS.SSa.CFiSa)	0.27	1.90	Medium Sand	0.57	Moderately Well Sorted	0.00	99.96	0.04	Sand
UK_55	24	Circalittoral Sand (MC52/SS.SSa.CFiSa)	0.23	2.10	Fine Sand	0.65	Moderately Well Sorted	0.25	99.65	0.09	Sand
UK_56	22	Circalittoral Sand (MC52/SS.SSa.CFiSa)	0.21	2.23	Fine Sand	0.73	Moderately Sorted	2.30	97.57	0.13	Sand
UK_57	20	Infralittoral Sand (MB52/SS.SSa.CFiSa)	0.07	3.85	V.Fine Sand	2.00	Poorly Sorted	30.74	68.95	0.32	Muddy Sand
UK_58	18	Infralittoral Sand (MB52/SS.SSa.CFiSa)	0.12	3.03	V.Fine Sand	0.87	Moderately Sorted	11.58	88.37	0.05	Muddy Sand
UK_59	13	Infralittoral Sand (MB52/SS.SSa.IFiSa)	0.14	2.81	Fine Sand	0.56	Moderately Well Sorted	2.25	97.63	0.12	Sand
UK_61	10	Infralittoral Sand (MB52/SS.SSa.IFiSa)	0.15	2.78	Fine Sand	0.59	Moderately Well Sorted	2.33	97.59	0.08	Sand
Mean			**0.53**	**1.57**	**Medium Sand**	**1.57**	**Poorly Sorted**	**8.59**	**82.0**	**9.40**	**Sl. Gravelly Sand**
SD			**0.66**	**1.36**	-	**0.83**	-	**11.82**	**17.32**	**14.86**	-
CV (%)			**122.9**	**87.0**	-	**52.7**	-	**137.5**	**21.1**	**158.2**	-
Minimum			**0.07**	**-2.01**	**Pebble**	**0.56**	**Moderately Well Sorted**	**0.00**	**35.60**	**0.04**	-
Maximum			**4.04**	**3.88**	**V.Fine Sands**	**3.82**	**Very Poorly Sorted**	**44.00**	**99.96**	**63.95**	-

Station	Water Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	Mean Sediment Size		Wentworth Classification	Sorting Coefficient	Sorting Classification	Fines	Sands	Gravel	BGS Modified Folk Classification
			(mm)	(Phi)				(%)	(%)	(%)	
Habitat Comparison											
Atlantic Infralittoral Sand (MB52/SS.SSa.IFiSa)		**Mean**	**0.12**	**3.11**	**V.Fine Sand**	**1.00**	**Poorly Sorted**	**11.72**	**88.14**	**0.14**	**Muddy Sand**
		SD	**0.04**	**0.50**		**0.68**		**13.41**	**13.51**	**0.12**	
		CV (%)	**29.4**	**16.1**		**67.5**		**114.4**	**15.3**	**83.9**	
Atlantic Circalittoral Sand (Fine Sand) (MC52/SS.SSa.CFiSa)		**Mean**	**0.26**	**1.96**	**Medium Sand**	**0.66**	**Moderately Well Sorted**	**0.86**	**99.05**	**0.09**	**Sand**
		SD	**0.05**	**0.28**		**0.07**		**1.03**	**1.06**	**0.04**	
		CV (%)	**20.3**	**14.4**		**10.0**		**119.1**	**1.1**	**41.9**	
Atlantic Circalittoral Sand (Muddy Sand) (MC52/SS.SSa.CMuSa)		**Mean**	**0.09**	**3.55**	**V.Fine Sand**	**2.53**	**Very Poorly Sorted**	**28.67**	**70.85**	**0.49**	**Muddy Sand**
		SD	**0.02**	**0.36**		**0.04**		**4.85**	**4.55**	**0.31**	
		CV (%)	**25.8**	**10.3**		**1.5**		**16.9**	**6.4**	**63.4**	
Atlantic Offshore Circalittoral Sand (MD52/SS.SSa.OSa)		**Mean**	**0.36**	**1.58**	**Medium Sand**	**1.27**	**Poorly Sorted**	**4.31**	**91.58**	**4.11**	**Sl. Gravelly Sand**
		SD	**0.11**	**0.57**		**0.70**		**7.46**	**9.46**	**3.14**	
		CV (%)	**32.2**	**35.9**		**54.9**		**173.0**	**10.3**	**76.5**	
Atlantic Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)		**Mean**	**2.68**	**-1.20**	**Fine Sand**	**2.51**	**Very Poorly Sorted**	**1.01**	**45.44**	**53.55**	**Sandy Gravel**
		SD	**1.93**	**1.15**		**0.19**		**0.79**	**13.92**	**14.70**	
		CV (%)	**72.0**	**-95.2**		**7.5**		**77.6**	**30.6**	**27.5**	
Atlantic Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)		**Mean**	**0.99**	**0.11**	**Coarse Sand**	**1.63**	**Poorly Sorted**	**3.62**	**75.12**	**21.26**	**Gravely Sand**
		SD	**0.41**	**0.56**		**0.61**		**4.65**	**16.74**	**16.59**	
		CV (%)	**41.2**	**506.3**		**37.2**		**128.4**	**22.3**	**78.0**	
Atlantic Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)		**Mean**	**0.15**	**2.99**	**Granule**	**2.52**	**Very Poorly Sorted**	**26.09**	**68.29**	**5.62**	**Gravelly Muddy Sand**
		SD	**0.09**	**0.85**		**0.82**		**13.26**	**16.66**	**6.05**	
		CV (%)	**63.8**	**28.5**		**32.5**		**50.8**	**24.4**	**107.5**	

Note:
SD = Standard Deviation
CV = Coefficient of Variation – the Standard Deviation expressed as a proportion of the mean
'Sl.' = Slightly
'V,' = Very

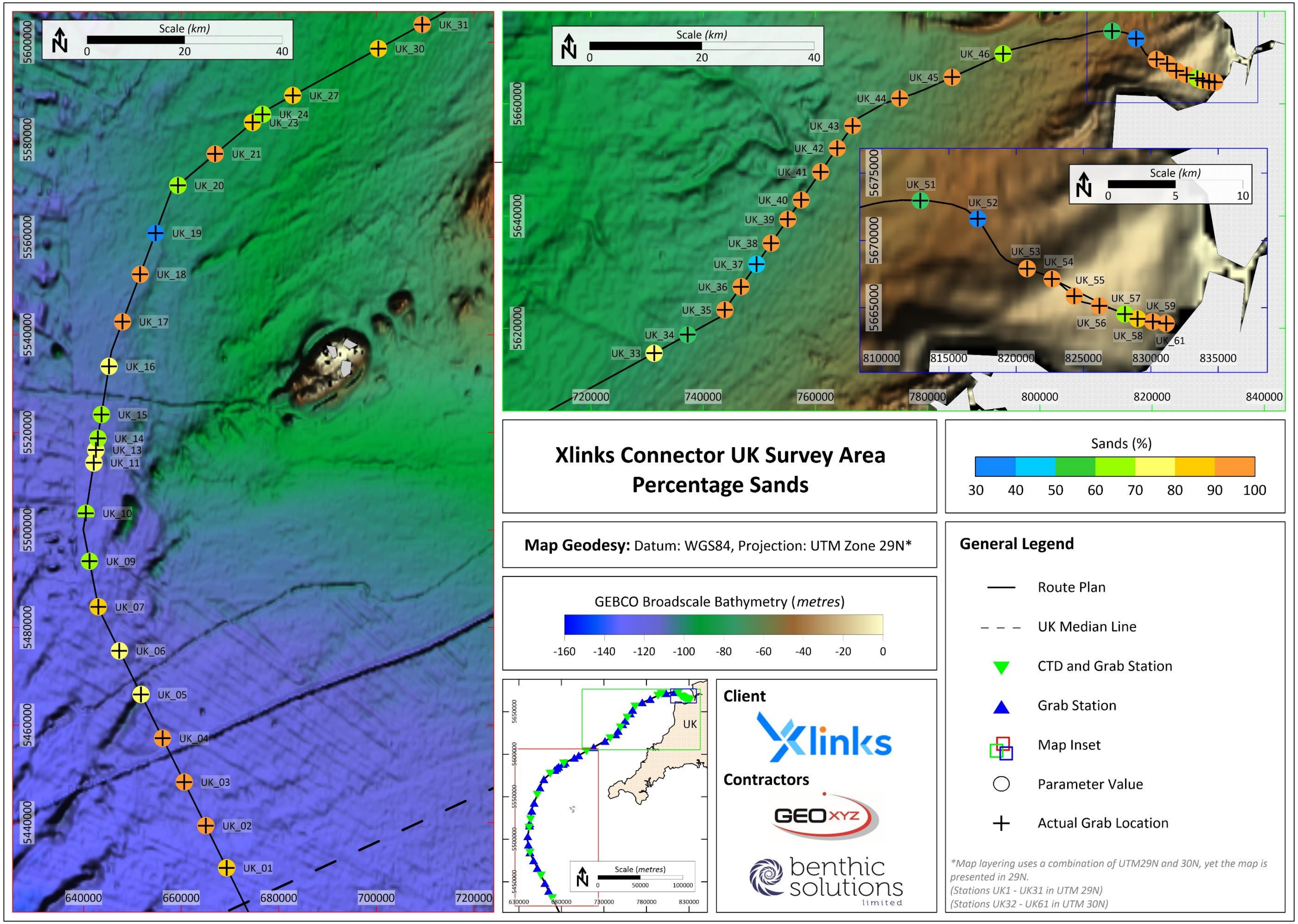


Figure 9: Percentage of sand

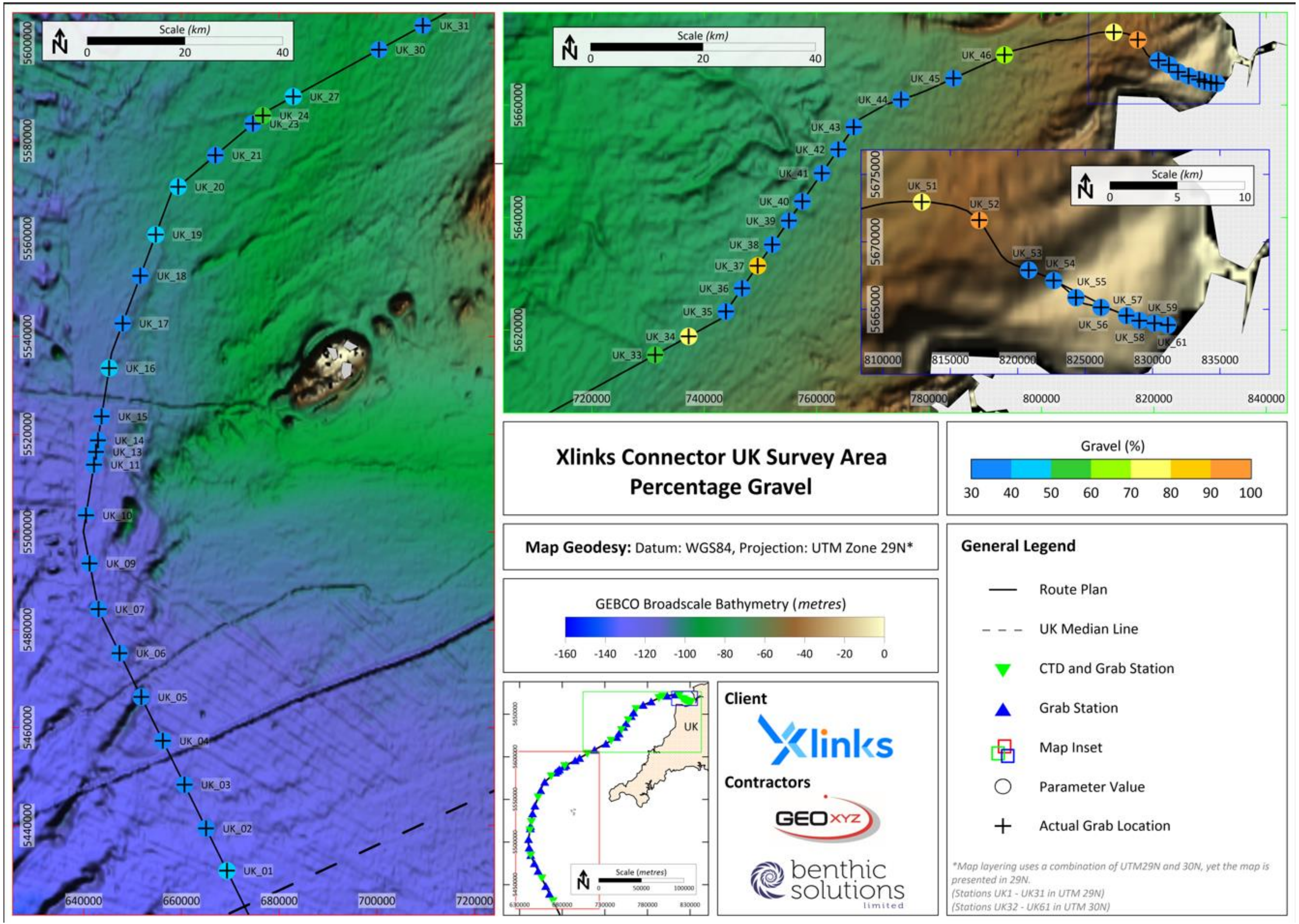


Figure 10: Percentage of gravel

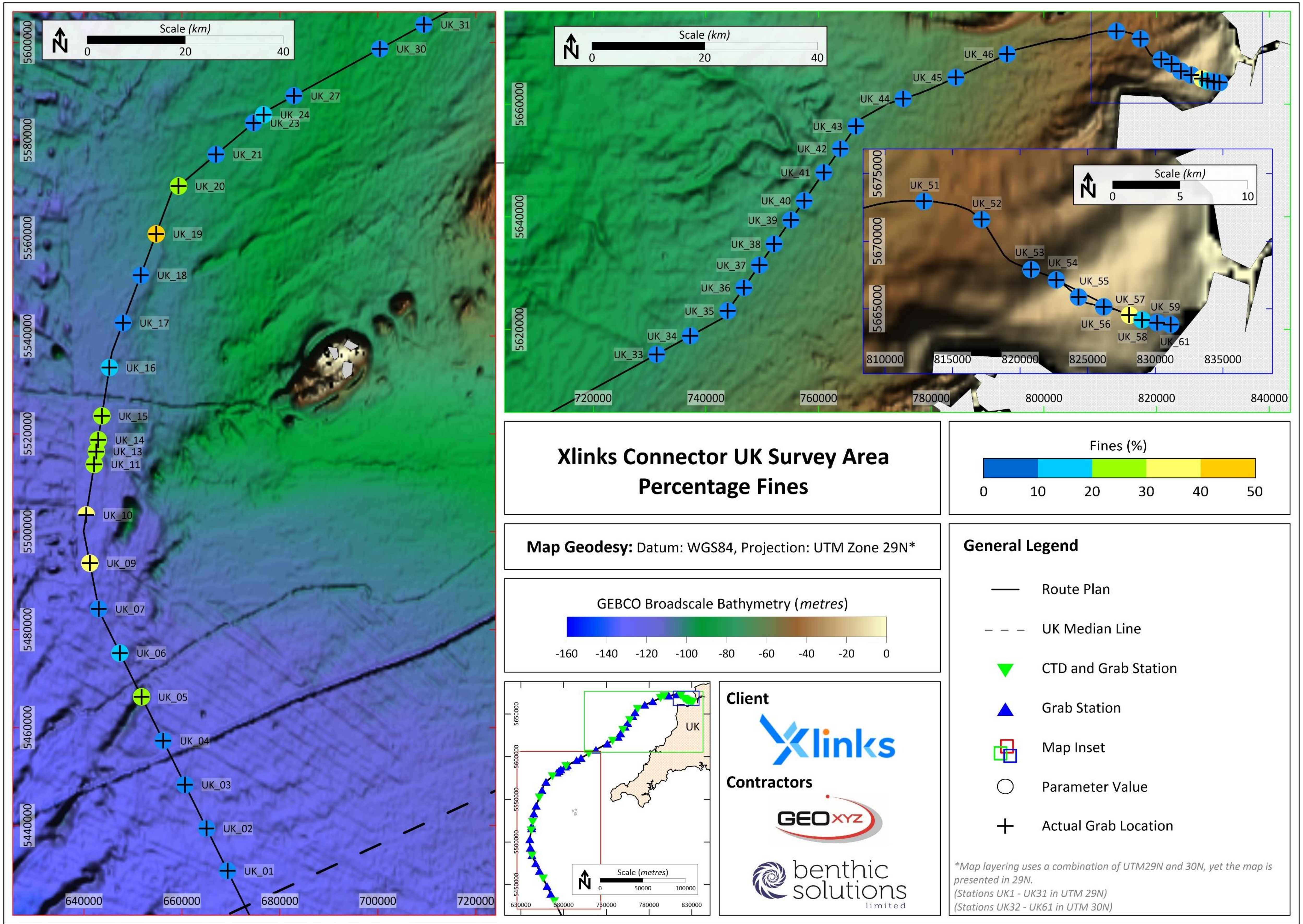


Figure 11: Percentage of fines

4.4.2 Multivariate Analyses

The particle size distribution of sediments across the survey area were subjected to further detailed investigation by multivariate analysis using the Plymouth Routines in Multivariate Ecological Research software (PRIMER 7.0.17; Clarke *et al.*, 2014) to elucidate any spatial trends within the data.

Similarity dendrograms were generated by hierarchical agglomerative clustering (CLUSTER) using particle size data (phi) to illustrate similarities/differences between stations using the Euclidean distance dissimilarity measure. The dendrogram produced by cluster analysis is shown in Figure 12 with red lines denoting statistically similar stations and black lines revealing significant differences. Similarity profiling analysis (SIMPROF) indicated the presence of 16 significantly different (p<0.05) clusters; however, this was thought to have over-differentiated the dataset. Due to the over differentiation in the previous dendrogram, a slice was overlain at a Euclidean distance of 30 to group the stations at a higher level (Figure 13). The stations grouped together at a Euclidean distance of 30 showed reasonable agreement with JNCC level four habitat types (Figure 14). Based on Figure 13 and Figure 14 habitat types with a finer sediment composition were grouped towards the left of the plot, getting gradually coarser in general, towards the right. The slice split the dataset into seven significantly different cluster groups, as follows:

- Cluster '*a*': this cluster was made up of four stations, likely characterised by high fines content of the sediment. The four stations in this cluster (UK_57, UK_58, UK_59, UK_61) were the only stations categorised as 'Infralittoral Fine Sand'.
- Cluster '*b*': this was the primary cluster for the survey dataset, comprising the highest number of stations. The majority of stations in this cluster had the level 4 EUNIS habitat assignment of MD52/SS.SSa.OSa 'Atlantic Offshore Circalittoral Sand', as well as two stations being represented by MC52/SS.SSa.CMuSa 'Atlantic Circalittoral Sand (Muddy Sand)' and another two stations being represented by MC52/SS.SSa.CFiSa 'Atlantic Circalittoral Sand'. Though level four assignments did vary slightly in this cluster, they were all characterised by significant sand content.
- Cluster '*c':* stations mark a transitional section of the route where the sediments/habitats frequently alternated between two level four EUNIS habitat types, MC52/SS.SSa.CMuSa 'Atlantic Circalittoral Sand (Muddy Sand)' and MD42/SS.SMx.OMx 'Atlantic Offshore Circalittoral Mixed Sediment' with an MC52/SS.SSa.CFiSa 'Atlantic Circalittoral Sand (Fine Sand)' delineation at the northern end of this section/cluster of stations.
- Cluster '*d*': this cluster comprised coarser sediment types, including four stations of MD32/SS.SCS.OCS 'Atlantic Offshore Circalittoral Coarse Sediment' and four of 'Atlantic Offshore Circalittoral Sand'.
- Cluster '*e*': cluster '*e*' consisted of exclusively stations assigned with MD32/SS.SCS.OCS 'Atlantic Offshore Circalittoral Coarse Sediment' as their level four JNCC habitat assignment, and comprised of stations UK_34, UK_37, UK_46, UK_51.
- Cluster '*f*': this cluster consisted of increasingly coarse sediment, with three stations assigned to MD32/SS.SCS.OCS 'Atlantic Offshore Circalittoral Coarse Sediment', and one assigned to 'Atlantic Circalittoral Coarse Sand' (UK_51).
- Cluster '*g*': this cluster comprised only one station, UK_52, and is assigned the JNCC level four habitat 'Atlantic Circalittoral Coarse Sediment' and was characterised by the coarsest sediment type found in the survey area. This was the only cluster where only one station is present, which is likely due to station UK_52 displaying the highest gravels content of all stations (63.9 %). Review of the sample photographs also revealed a high pebble content in this sample.

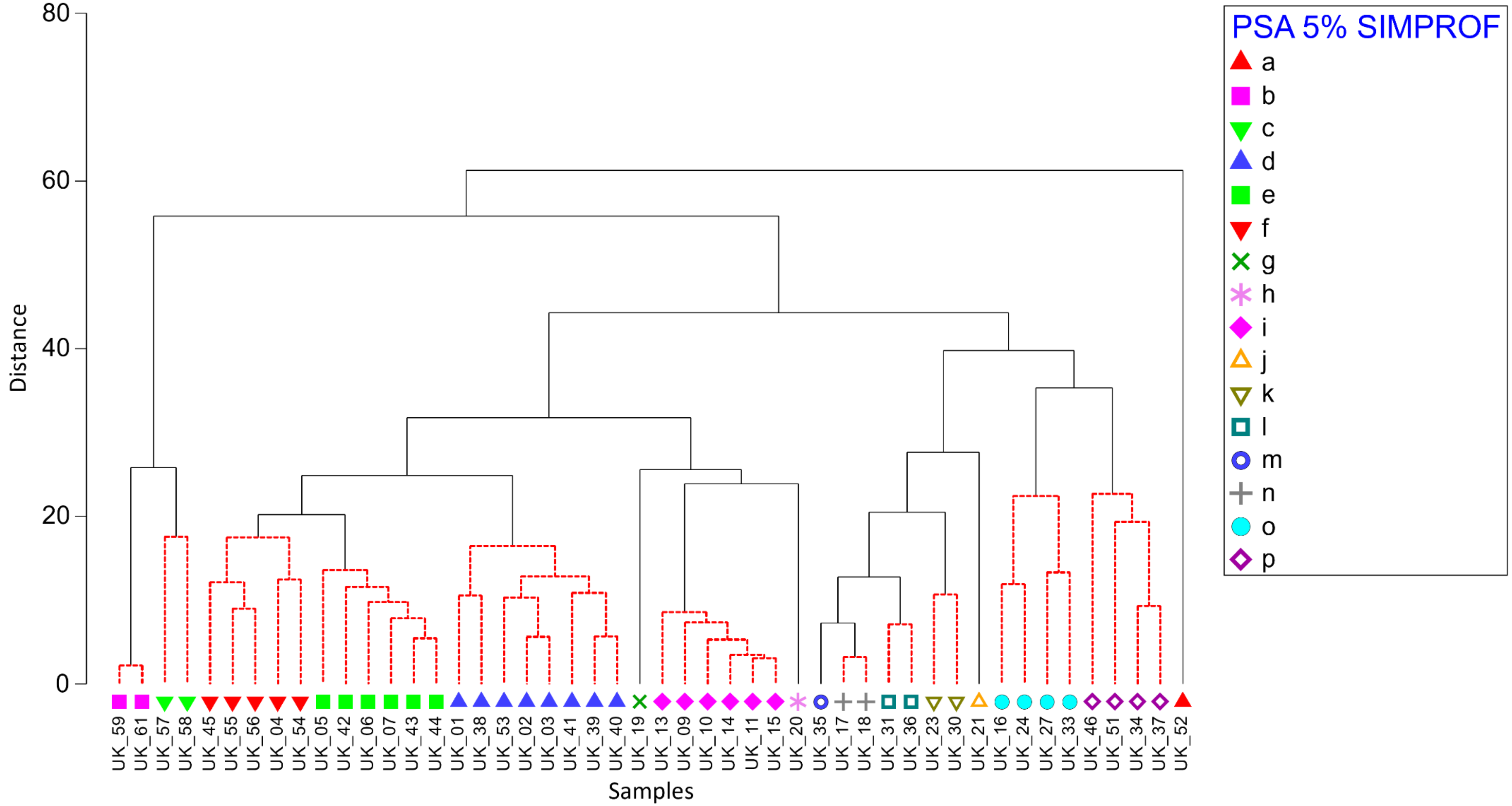


Figure 12: Particle size analysis similarity dendrogram

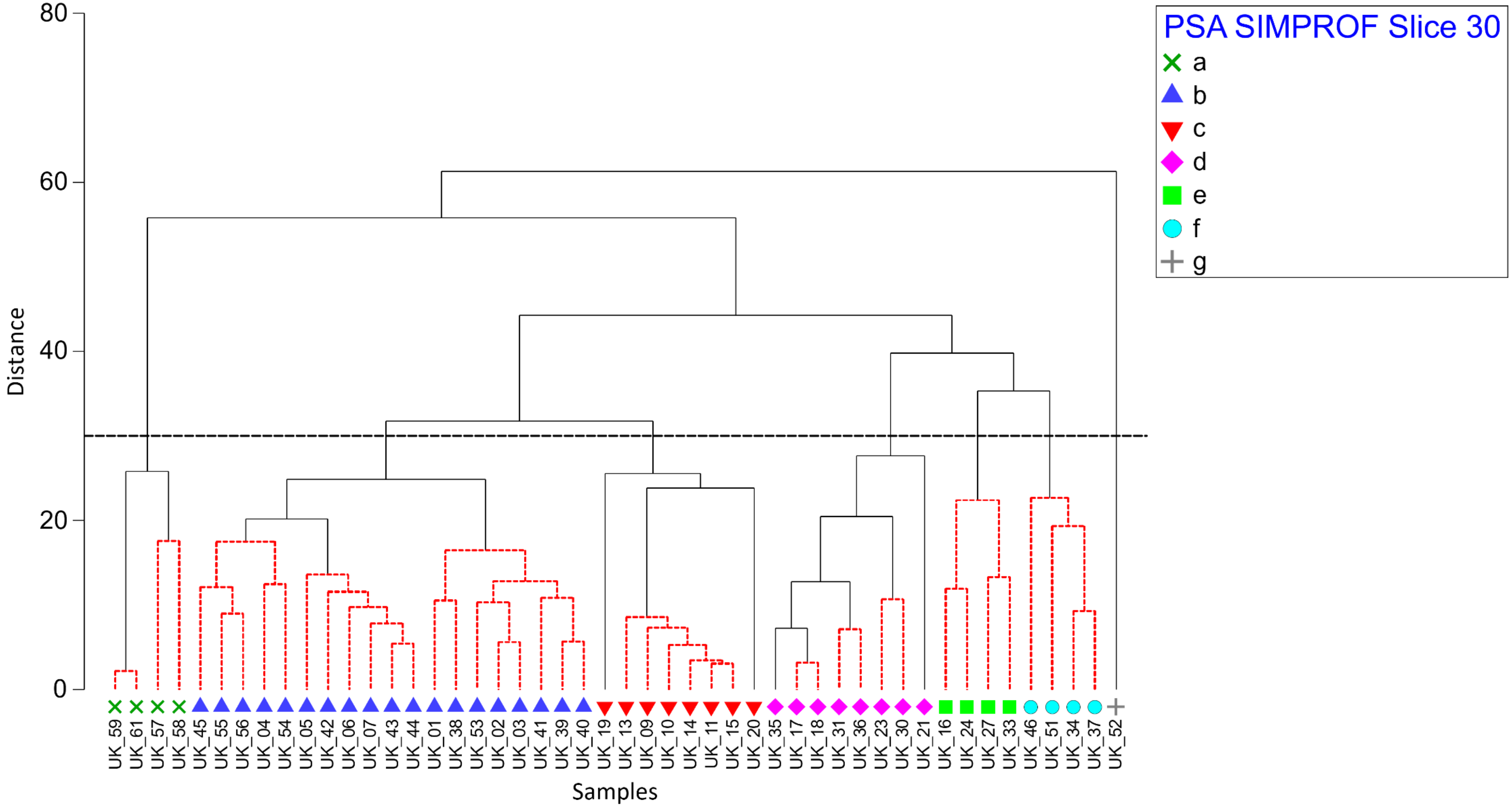


Figure 13: Particle size analysis similarity dendrogram with a slice overlain at Euclidean distance of 30

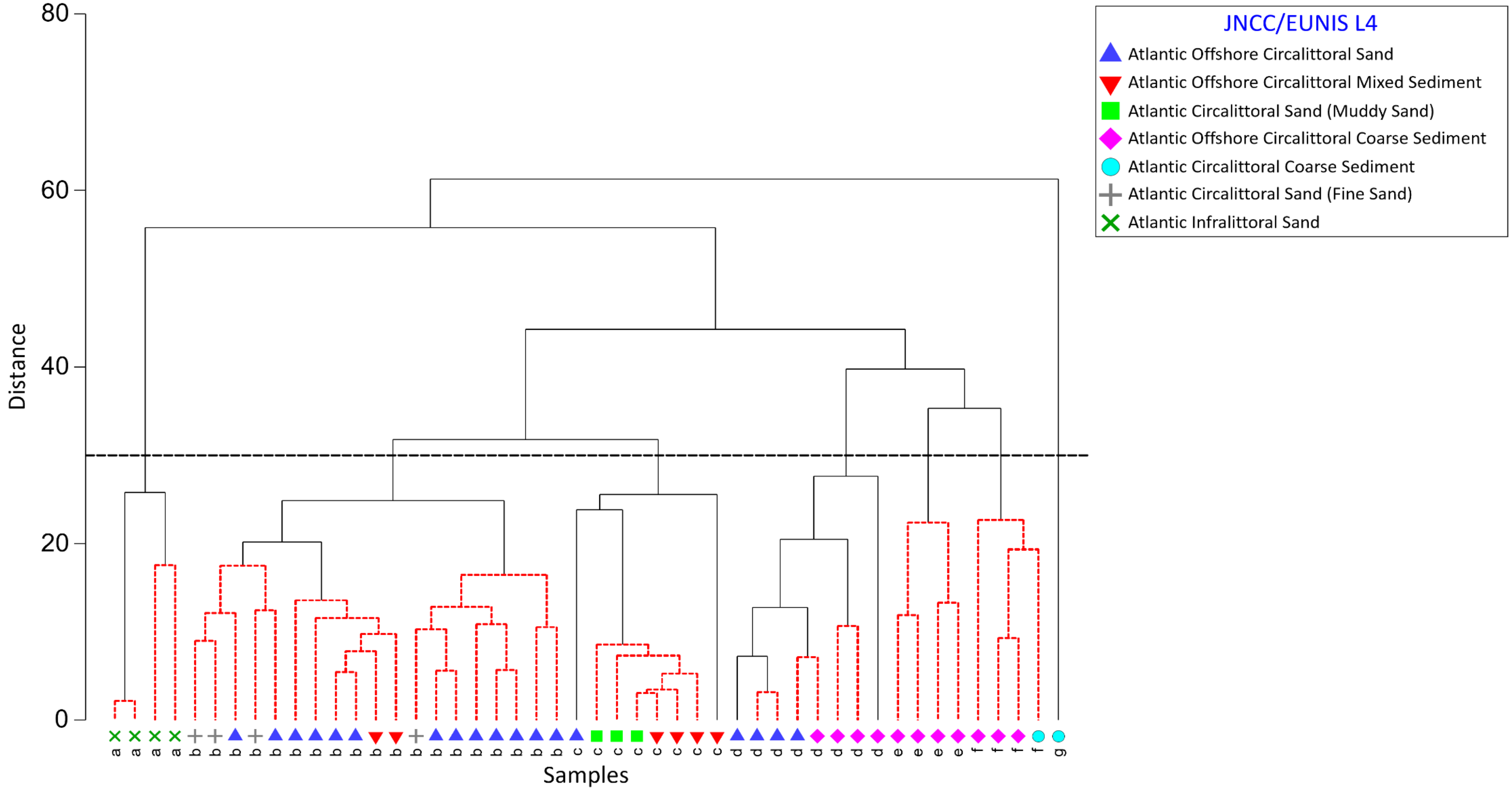


Figure 14: Particle size analysis similarity dendrogram with EUNIS L3/4 Habitats and a slice overlain at Euclidean distance of 30

Similarities between the stations were also displayed as a 2-dimensional non-metric multi-dimensional scaling (nMDS) ordination (Figure 15), which showed not only the grouping of the stations into seven clusters at a low stress level of 0.08. There was variable intra-cluster variability within the level four EUNIS clusters. Clusters displaying the most variation included 'Circalittoral Coarse Sediment' and 'Offshore Circalittoral Mixed Sediment', both showing a scattered, spread-out multivariate distribution likely as a result of stations being located on a crossover region, or a boundary of the sediment type mosaic seen along the cable route.

A principal component analysis (PCA) was carried out on the proportional whole phi sieve fraction data for each survey station (Figure 16). The resultant PCA plot shows the distribution of each station along axes formed by the two principal components (PC1 and PC2) which together describe the largest proportion of overall variability in the particle size fraction dataset. The plot indicated that the varying proportions of phi fractions 1 (coarse sand), 2 (medium sand) and 3 (fine sand) were principally responsible for the differences in sediment composition across the proposed cable route survey area, as shown by the longer eigenvectors for these phi fractions. Differentiation of cluster '*a*' was due to the high fines content of the sediment and the habitat assignment of 'Infralittoral Fine Sand'. Cluster '*b*' was the primary cluster of the survey site, the majority of stations in which have the level four EUNIS habitat assignment of MD52/SS.SSa.OSa 'Atlantic Offshore Circalittoral Sand', having a high proportion of fine sand present (phi 3). Cluster '*c*' was situated between clusters '*a*' and '*b*' likely due to containing four stations categorised as MC52/SS.SSa.CMuSa 'Atlantic Circalittoral Sand (Muddy Sand)' as well as some stations classed as MD42/SS.SMx.OMx 'Atlantic Offshore Circalittoral Mixed Sediment', thus cluster '*c*' serves as a 'middle ground' between the two, as such. Clusters '*d*', '*e*', '*f*', and '*g*', are all located relatively close to one another on the PCA plot, likely as a result of these clusters, and their associated stations containing a higher proportion of coarse sediment particles, and being distributed around and above 'Coarse Sand' on the phi scale (phi 1). Stations within these clusters were classed as either MD32/SS.SCS.OCS 'Atlantic Offshore Circalittoral Coarse Sediment' or MD52/SS.SSa.OSa 'Atlantic Offshore Circalittoral Sand'.

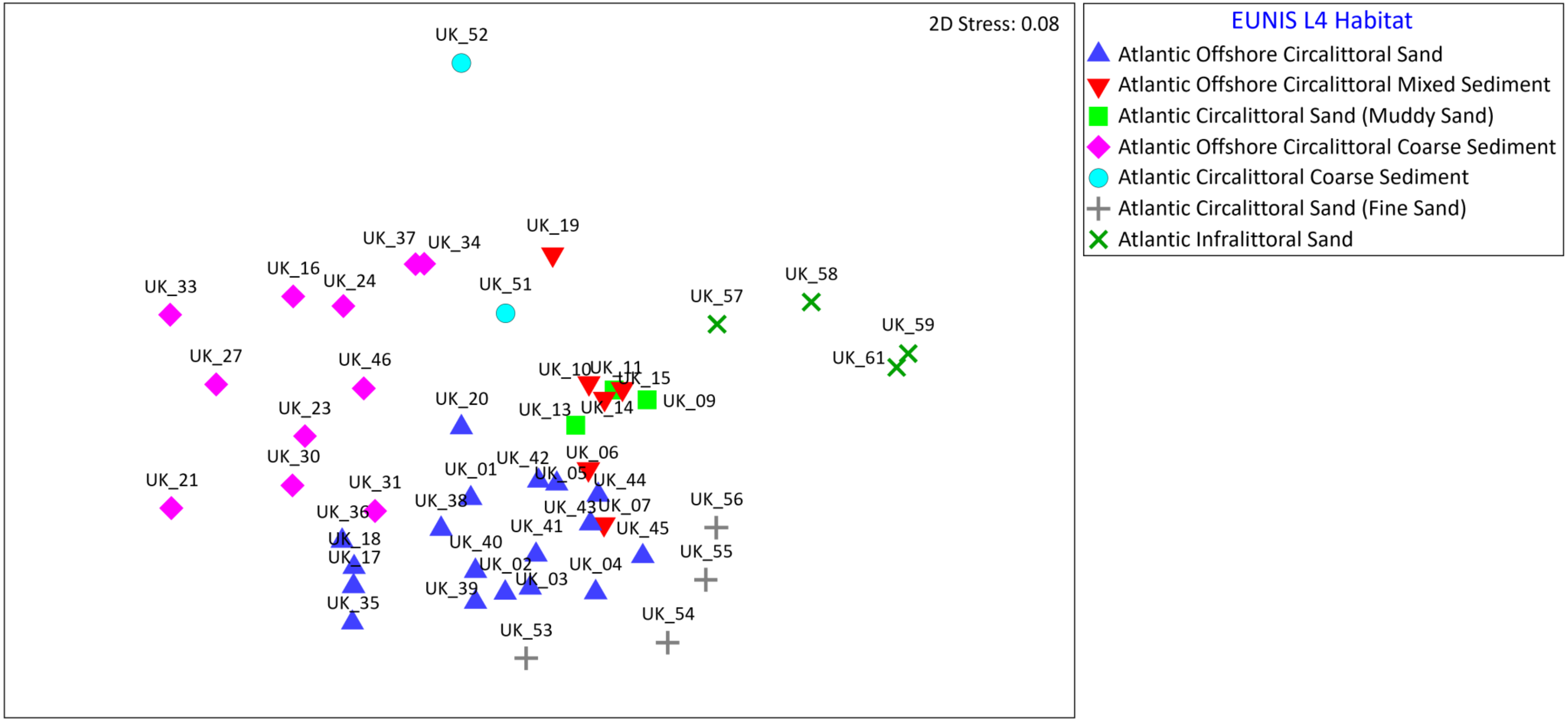


Figure 15: Particle size distribution nMDS plot Showing EUNIS L3/4 Habitats

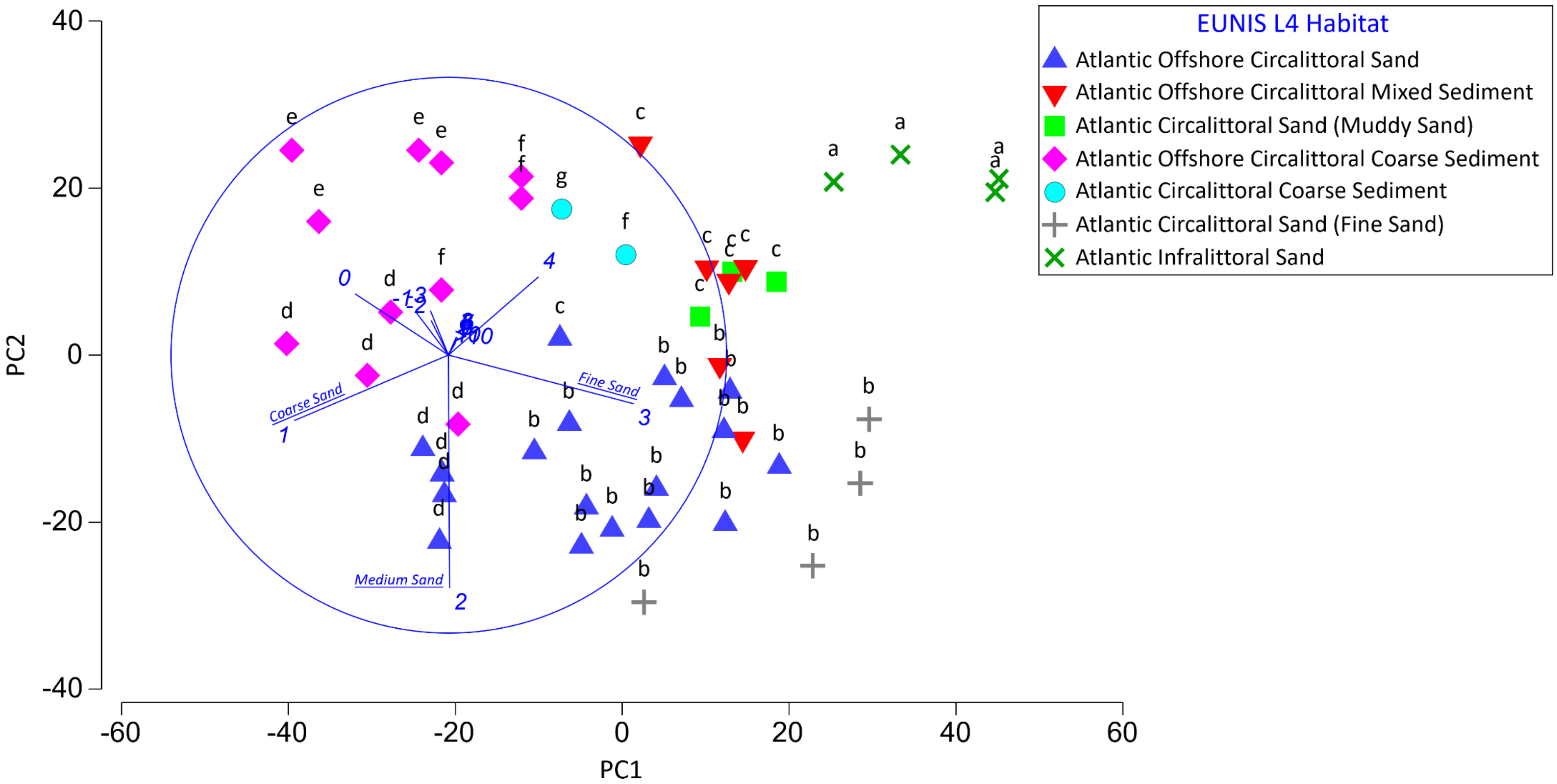


Figure 16: Particle size analysis principal components analysis

A comparison of the full particle size distribution dataset using Wentworth (1922) size categories split into the seven clusters described above is shown in Figure 17 along with example seabed and grab sample photographs. The plot illustrates the subtle differences in sediment composition between the clusters. Cluster '*a*' consists of four stations, with a sharp peak at 3-phi, indicating that the cluster, and stations within the cluster consist of mostly fine sand particles. Cluster '*b*' shows a clear unimodal distribution, however this slightly differs from Cluster '*c*', which, although this also has a unimodal distribution, the peak of this cluster is closer to 3 phi, indicating the presence of fine sand drove the separation between the two clusters. Cluster '*d*'s unimodal distribution peaked at approximately 0.5-1 phi, demonstrating that the sediment in this cluster was of a coarse nature. Cluster '*e*' displayed a distinct unimodal distribution, peaking at 0 phi, indicative of very coarse sand. Cluster '*f*' has an interesting distribution in sediment size; there is no clear peak, each of the four stations within the cluster appear to have slightly different maximums, however there is no data past 4 phi (very fine sand), implying that this cluster has a distribution typical to that of mixed sediments, categorised by the phi range -2 to 3. Cluster '*g*', comprised of station UK_52 had a peak in its distribution at -3 phi, indicative of a high pebble content.

The geographical distribution of clusters is displayed over MBES in Figure 18, which highlights a clear spatial distribution of clusters along the survey corridor.

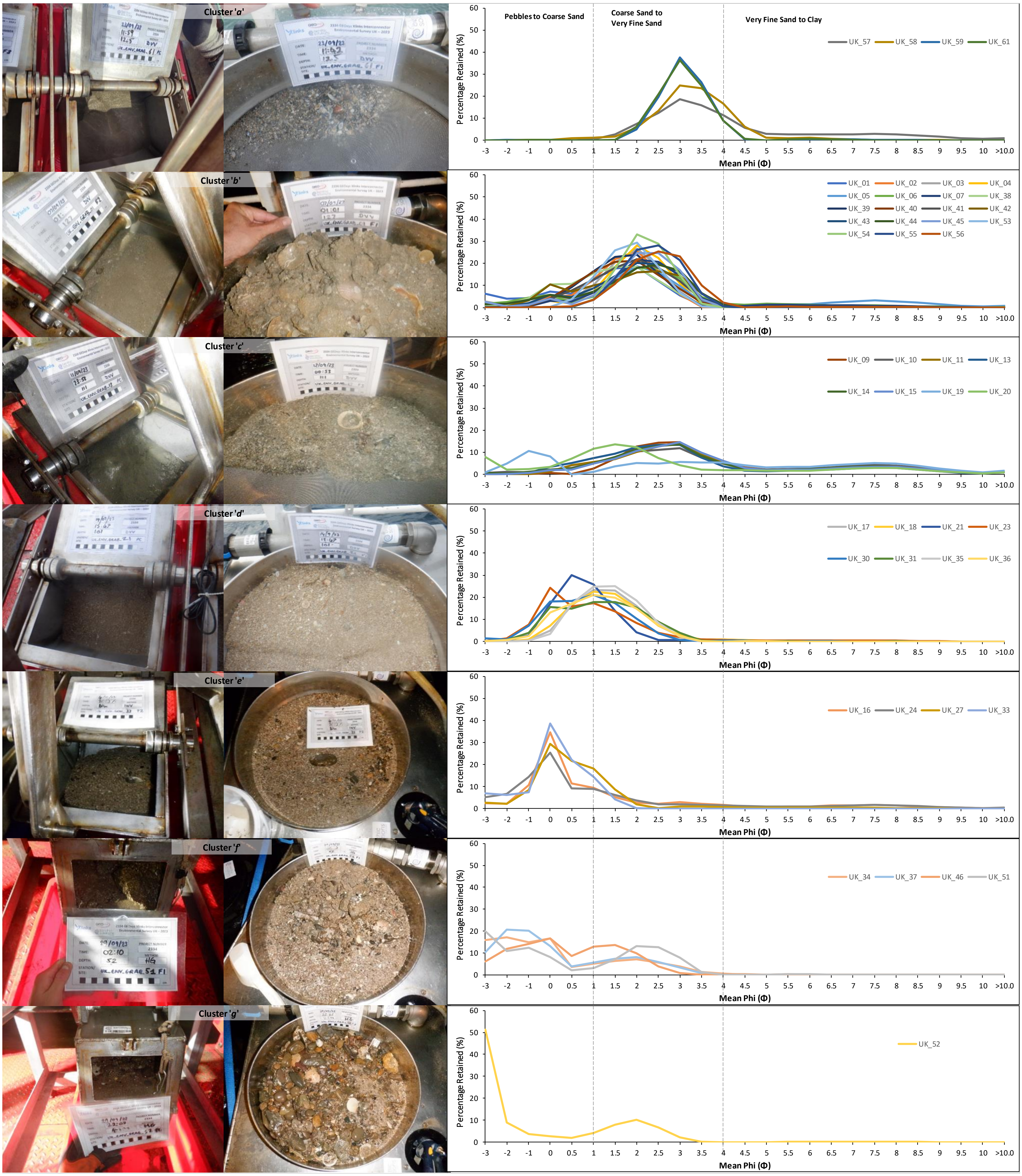


Figure 17: Particle size distribution for the different clusters *'a', 'b', 'c', 'd', 'e', 'f'* and *'g'* with example photographs (left) of the seabed and faunal samples (centre)

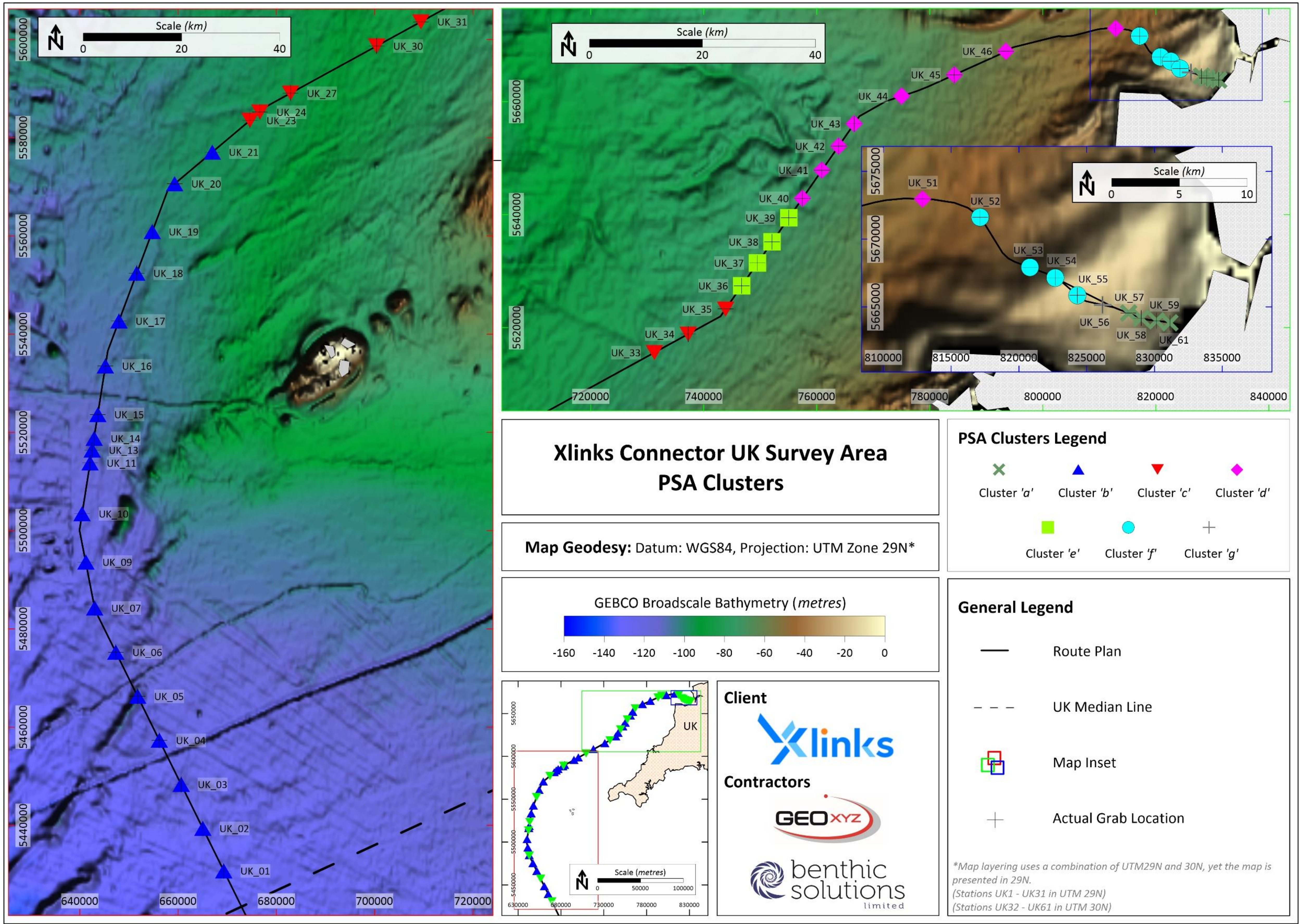


Figure 18: Multivariate PSD cluster distribution over MBES

4.5 TOTAL ORGANIC MATTER / CARBON AND MOISTURE CONTENT

The EBS sediment samples were analysed for total organic matter (TOM), total organic carbon (TOC) and moisture content. The results are presented in Table 12. TOC represents the proportion of biological material and organic detritus within substrates. The method is less susceptible to the interference sometimes recorded using crude simple combustion techniques, such as analysing TOM by loss on ignition (LOI).

TOM content ranged from 1.60 % at UK_43 to 6.20 % at UK_19 (mean 2.65 % ± 0.88 SD Table 12, Figure 19). The mean value of TOM content was 2.65 %, indicating that these are background levels of TOM for the survey site. The TOM value at station UK_19 was considerably higher than the majority of other stations in the survey site, which is likely to be due to the high fines content also found at this station.

TOC in surface sediments is an important source of food for benthic fauna (Snelgrove & Butman, 1994), however, an overabundance may lead to species richness and abundance reductions due to oxygen depletion. The TOC results were low throughout the survey area, ranging from 0.26 % at UK_34 to 1.19 % at UK_19 (mean 0.50 % ± 0.21 SD; Table 12, Figure 20). Station UK_19 and UK_57 saw higher TOC values, 1.19 % M/M and 0.96 % M/M respectively, which was due to the high fines content found at this site. Increases in TOC reflect natural increases in physical factors (i.e., fines) and common co-varying environmental factors through greater sorption on increased sediment surface areas (Thompson and Lowe, 2004). There was a significant correlation between TOC and percentage fines ($\rho(48)=0.666$, $p>0.001$). Terrestrially derived carbon from runoff and fluvial systems, combined with primary production from sources such as phytoplankton blooms, contribute to the TOC levels recorded in sediments. Allochthonous and autochthonous sources will be present throughout the survey area. TOC levels showed a strong positive correlation with TOM ($\rho(48)=0.869$, $p>0.001$), as would typically be expected.

Moisture content was fairly consistent across all sample stations, as evidenced by the coefficient of variance of 7.32 %. Moisture content ranged from 13.6 % at station UK_33 to 49.0 % at station UK_19, reflecting the general sand dominance of seabed sediments, with the dominant mapped habitat classification of MD52/SS.SSa.OSa 'Atlantic Offshore Circalittoral Sand' being predicted by EMODnet to occur along the proposed cable route (Table 12), which will drain more freely than fines-dominated sediments after recovery of grab samples.

In terms of broadscale changes in organic matter, carbon and moisture content, the levels were clearly higher at stations characterised by sediments with higher fines content (Table 12 and Table 11). Stations classified as MC52/SS.SSa.CMuSa 'Atlantic Circalittoral Sand (Muddy Sand)' showed the highest mean fines (28.67 %), TOM (3.9 %) and moisture content (39.0 %), and the second highest TOC (0.78 %), whereas stations classified as MD42/SS.SMx.OMx 'Atlantic Offshore Circalittoral Mixed Sediment' showed the highest mean TOC (0.80 %) and the second highest TOM (3.7 %) and moisture content (36.1 %). There was little difference evident between the levels of TOM, TOC and moisture content at stations classified as other habitat types.

Table 12: Total organic matter/carbon and moisture content

Station	Water Depth (m)	EUNIS/JNCC Habitat (‘Atlantic’ Prefix Excluded for Brevity)	Total Organic Matter	Total Organic Carbon	Moisture Content
			(% M/M)	(% M/M)	(% M/M)
UK_01	129	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	2.6	0.50	30.3
UK_02	127	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.8	0.43	22.4
UK_03	122	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.7	0.35	33.5
UK_04	123	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.8	0.32	30.3
UK_05	114	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	2.5	0.51	33.5
UK_06	121	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	3.0	0.68	31.1
UK_07	123	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	2.2	0.55	31.6
UK_09	123	Circalittoral Sand (MC52/SS.SSa.CMuSa)	3.7	0.83	37.8
UK_10	120	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	3.4	0.81	34.0
UK_11	117	Circalittoral Sand (MC52/ SS.SSa.CMuSa)	4.0	0.83	41.5
UK_13	113	Circalittoral Sand (MC52/ SS.SSa.CMuSa)	3.9	0.69	37.8
UK_14	114	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	4.0	0.86	35.8
UK_15	114	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	3.2	0.72	35.2
UK_16	111	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	2.3	0.54	16.0
UK_17	111	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	2.6	0.61	29.6
UK_18	109	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	3.1	0.55	35.5
UK_19	104	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	6.2	1.19	49.0
UK_20	102	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	3.2	0.63	27.9
UK_21	100	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	3.8	0.46	21.3
UK_23	100	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	2.6	0.44	20.0
UK_24	100	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	2.3	0.40	20.4
UK_27	99	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	2.3	0.33	14.8
UK_30	93	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	2.4	0.43	25.2
UK_31	88	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	2.8	0.45	30.6
UK_33	80	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	2.4	0.40	13.6
UK_34	78	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	2.1	0.26	14.8
UK_35	74	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	2.5	0.41	27.7
UK_36	76	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	2.7	0.53	32.6
UK_37	76	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	2.0	0.33	19.2
UK_38	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	2.5	0.49	26.3
UK_39	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.8	0.38	24.2
UK_40	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	2.1	0.42	31.6
UK_41	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.9	0.34	28.9
UK_42	74	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.9	0.38	30.2
UK_43	73	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.6	0.29	30.3
UK_44	70	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.7	0.30	20.6
UK_45	65	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.8	0.27	24.5
UK_46	61	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	1.9	0.27	13.9
UK_51	52	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	2.3	0.44	27.8
UK_52	47	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	1.8	0.32	22.4
UK_53	31	Circalittoral Sand (MC52/SS.SSa.CFiSa)	2.4	0.40	25.5
UK_54	22	Circalittoral Sand (MC52/SS.SSa.CFiSa)	2.4	0.42	27.0

Station	Water Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	Total Organic Matter	Total Organic Carbon	Moisture Content
			(% M/M)	(% M/M)	(% M/M)
UK_55	24	Circalittoral Sand (MC52/SS.SSa.CFiSa)	2.6	0.41	29.3
UK_56	22	Circalittoral Sand (MC52/SS.SSa.CFiSa)	2.7	0.45	29.3
UK_57	20	Infralittoral Sand (MB52/SS.SSa.CFiSa)	4.2	0.96	33.1
UK_58	18	Infralittoral Sand (MB52/SS.SSa.CFiSa)	3.9	0.85	31.5
UK_59	13	Infralittoral Sand (MB52/SS.SSa.IFiSa)	2.4	0.35	28.9
UK_61	10	Infralittoral Sand (MB52/SS.SSa.IFiSa)	2.4	0.37	28.0
Mean			**2.7**	**0.50**	**28.0**
SD			**0.9**	**0.21**	**7.3**
CV (%)			**33.0**	**40.8**	**26.1**
Minimum			**1.6**	**0.26**	**13.6**
Maximum			**6.2**	**1.19**	**49.0**
Habitat Comparison					
Atlantic Infralittoral Sand (MB52/SS.SSa.IFiSa)		**Mean**	**3.2**	**0.63**	**30.4**
		SD	**1.0**	**0.32**	**2.3**
		CV (%)	**29.8**	**50.3**	**7.7**
Atlantic Circalittoral Sand (Fine Sand) (MC52/SS.SSa.CFiSa)		**Mean**	**2.5**	**0.42**	**27.8**
		SD	**0.2**	**0.02**	**1.9**
		CV (%)	**5.9**	**5.1**	**6.7**
Atlantic Circalittoral Sand (Muddy Sand) (MC52/SS.SSa.CMuSa)		**Mean**	**3.9**	**0.78**	**39.0**
		SD	**0.2**	**0.08**	**2.1**
		CV (%)	**4.0**	**10.3**	**5.5**
Atlantic Offshore Circalittoral Sand (MD52/SS.SSa.OSa)		**Mean**	**2.2**	**0.43**	**28.9**
		SD	**0.5**	**0.12**	**3.9**
		CV (%)	**23.4**	**27.0**	**13.6**
Atlantic Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)		**Mean**	**2.1**	**0.38**	**25.1**
		SD	**0.4**	**0.08**	**3.8**
		CV (%)	**17.2**	**22.3**	**15.2**
Atlantic Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)		**Mean**	**2.4**	**0.39**	**19.1**
		SD	**0.5**	**0.09**	**5.3**
		CV (%)	**21.1**	**21.9**	**27.8**
Atlantic Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)		**Mean**	**3.7**	**0.80**	**36.1**
		SD	**1.4**	**0.22**	**6.6**
		CV (%)	**37.4**	**27.3**	**18.2**

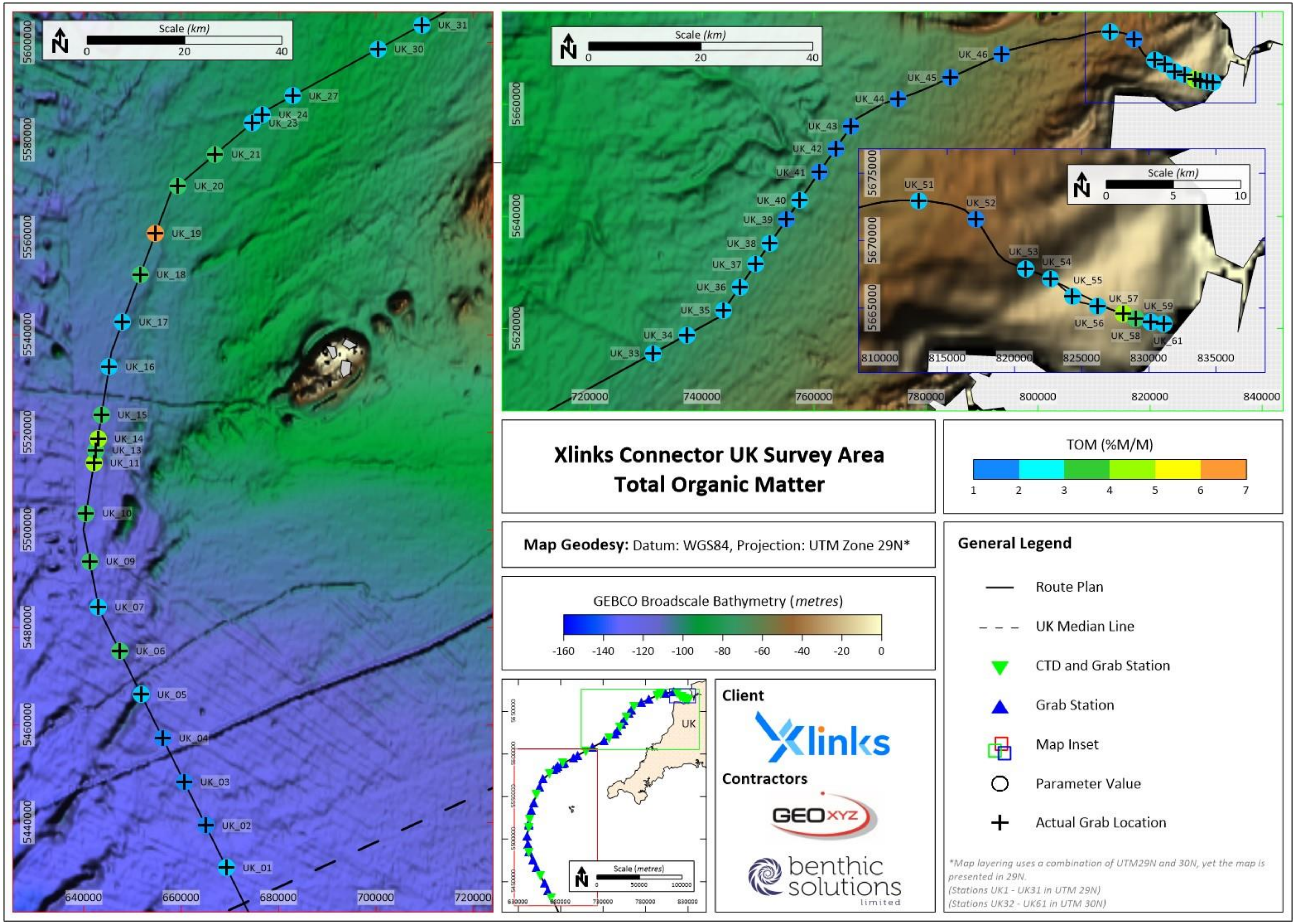


Figure 19: Total organic matter

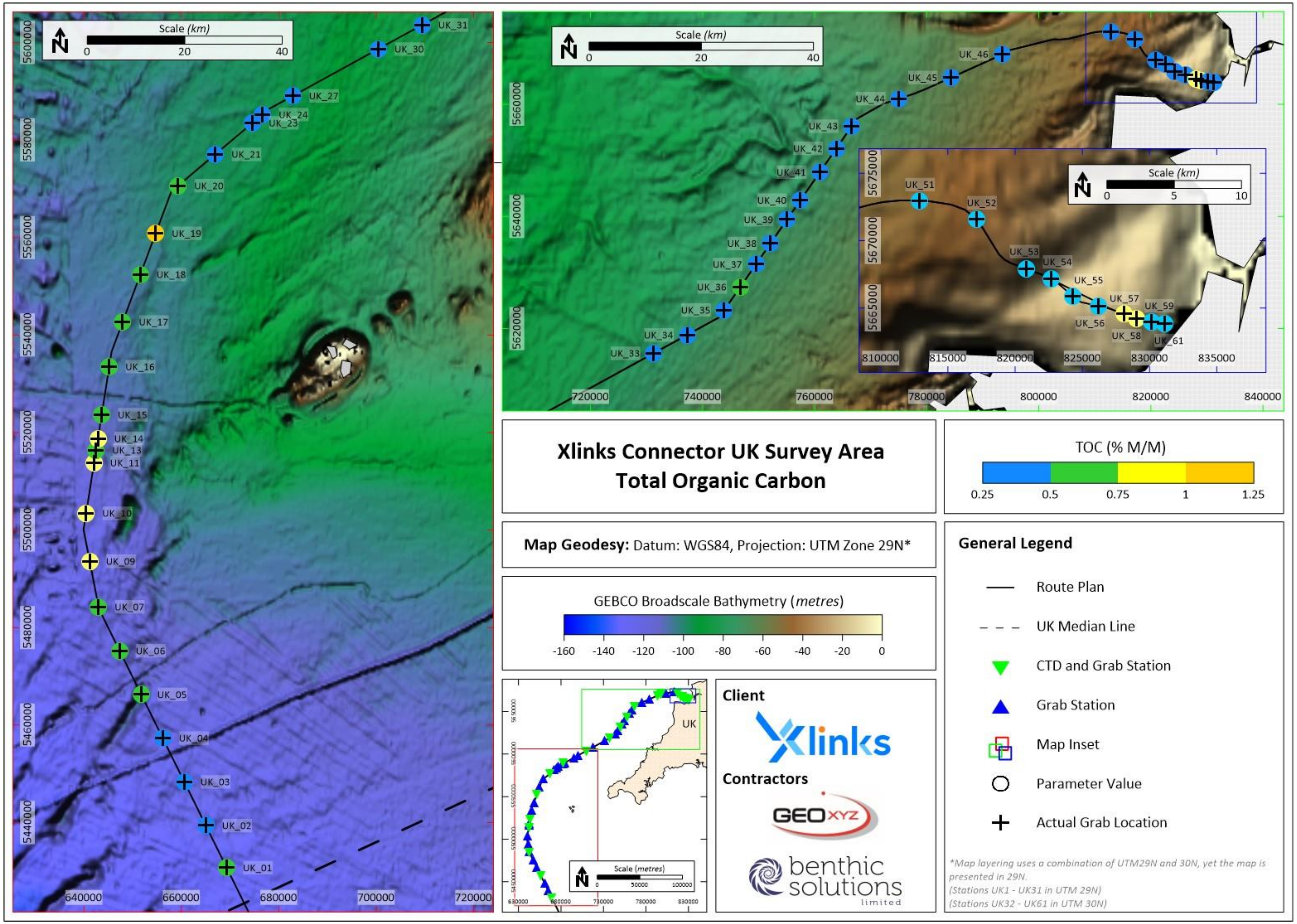


Figure 20: Total organic carbon

4.6 SEDIMENT HYDROCARBONS

Results for hydrocarbon analyses are summarised and tabulated as total hydrocarbon concentrations (THC) and total n-alkane and homologue ratios in Table 13, with individual alkanes (nC_{10}-nC_{37}) listed in Appendix K. An example gas chromatogram is presented in Figure 23 showing the aliphatic hydrocarbon trace for station UK_20 with the remainder presented in Appendix L. Chromatograms are labelled with every second n-alkane, the isoprenoid hydrocarbon, pristane, along with the internal standards heptamethylnonane (A), 1-chlorooctadecane (B) and squalane (C).

4.6.1 Total Hydrocarbon Content

The THC of the sediments, measured by integration of all non-polarised components within the GC trace, was varied across the site, with values ranging from 0.47 $mg.kg^{-1}$ at UK_35 to 23.23 $mg.kg^{-1}$ at UK_57 (mean 4.98 $mg.kg^{-1}$ ± 6.24 SD; Table 13). These results are considered to be indicative of background conditions in this region. There was a significant positive correlation between THC and percent fines ($\rho(48)=0.713$, $p<0.001$), however, there was a significant negative correlation with the percent sands ($\rho(48)=-0.353$, $p<0.01$). Where fines are more prevalent, hydrocarbons are more likely to be retained in the substrate (i.e. a sink), in comparison to areas where coarser sediments dominate, due to the increased potential for sorption onto the grains (Thompson and Lowe, 2004). It is for this reason, as well as the increased inputs of terrigenous material in the shallower, coastal waters, that THC values were slightly elevated at stations located In, and in close proximity to the bay.

a Saturate / Aliphatic Hydrocarbons

All the sampling stations were analysed for n-alkanes using gas chromatography with flame ionisation detection (GC-FID). The results are summarised in Table 13 and are individually listed in Appendix L, which gives a breakdown of consecutive n-alkane content from nC_{10} through to nC_{37}, together with the isoprenoid hydrocarbons pristane (Pr) and phytane (Ph). The total saturate alkane concentrations are illustrated in Figure 22 and an example gas chromatogram is provided in Figure 23.

Total n-alkane concentrations were low and ranged from 0.00 $mg.kg^{-1}$ at station UK_35 to 0.59 $mg.kg^{-1}$ at station UK_58 (Table 13, Figure 22). The proportions of alkanes were also low ranged and ranged from 0.31 % to 3.21 % (Table 13).

Inspection of the individual gas chromatograms for all stations showed no hydrocarbon signatures other than those typically seen for background sediments (Figure 23 ; Appendix L). Traces included an unresolved complex mixture (UCM) spanning the majority of the trace (nC_{10} to nC_{37}), and the majority of stations showed no notable hydrocarbon peaks. UCM is composed of a complex mixture of hydrocarbons that remain after substantial weathering and biodegradation (McDougall, 2000). Hydrocarbons in the weight range nC_{24} to nC_{37} commonly originate from terrestrial plant sources (Harborne, 1999), or they may represent the residue of highly weathered and biodegraded petrogenic material including natural seeps, shipping discharges, or oil and gas exploration and extraction (McDougall, 2000; Bouloubassi *et al.,* 2001).

Where sediment changes were observed between stations, differences were seen in the pattern of peaks displayed. For example, station UK_10 sees a larger increase in even-carbon dominated n-alkanes in the range of nC_{24}-nC_{32} when compared to station UK_09, likely linking to the transition in sediment types from MC52/SS.sMu.cMuSa 'Atlantic Circalittoral Sand (Muddy Sand)' to 'Atlantic Offshore Circalittoral Mixed Sediment' (MD42/SS.SMx.OMx). Furthermore, station UK_51 showed a different UCM signature, with significant peaks seen at nC_{20} and at all following even numbered n-alkanes up to nC_{34}. However, station UK_51 is the only station where

Sabellaria spinulosa rubble was found, *Sabellaria spinulosa* is a filter feeding polychaete removing organic particulate matter from the water column, the excrement from this process builds up below the crust formed by the organisms, increasing both fines and hydrocarbon content at the site. Similar hydrocarbon signatures have been noted in the vicinity of both relic and live *S. spinulosa* aggregations during previous surveys undertaken by BSL.

Table 13: Summary of hydrocarbon concentrations

Station	Water Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	THC	Total n-alkanes	Carbon Preference Index	Pristane / Phytane Ratio	Petrogenic / Biogenic Ratio	Proportion of Alkanes	Total PAHs	NPD	Extractable Organic Halogens
			(mg.kg-1)	(mg.kg-1)				(%)	(µg.kg-1)	(µg.kg-1)	(mg.kg-1)
UK_01	129	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	4.02	0.02	6.87	-	0.08	0.58	4.99	0.00	30.9
UK_02	127	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.71	0.01	1.56	-	0.00	0.44	0.00	0.00	34.0
UK_03	122	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.13	0.01	3.98	-	0.00	0.52	0.00	0.00	<0.20
UK_04	123	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	2.84	0.04	1.28	-	0.03	1.37	112	13.1	<0.20
UK_05	114	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.80	0.03	3.18	-	0.27	1.49	54.1	7.56	<0.20
UK_06	121	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	5.81	0.06	2.81	-	0.12	0.95	114	16.1	42.1
UK_07	123	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	3.21	0.03	8.28	-	0.09	0.87	7.08	0.00	65.6
UK_09	123	Circalittoral Sand (MC52/SS.SSa.CMuSa)	8.75	0.13	2.69	-	0.14	1.45	186	49.5	20.6
UK_10	120	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	20.2	0.08	2.17	-	0.09	0.39	131	25.3	68.0
UK_11	117	Circalittoral Sand (MC52/SS.SSa.CMuSa)	9.84	0.10	2.25	-	0.16	1.06	188	47.4	87.8
UK_13	113	Circalittoral Sand (MC52/SS.SSa.CMuSa)	9.26	0.10	1.79	-	0.14	1.09	123	31.4	107.
UK_14	114	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	8.97	0.11	2.33	-	0.27	1.28	296	161	<0.20
UK_15	114	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	8.98	0.10	2.37	3.69	0.16	1.16	216	52.4	118
UK_16	111	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	2.48	0.03	3.72	-	0.08	1.14	33.6	11.5	<0.20
UK_17	111	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.34	0.02	0.97	-	0.00	1.63	7.76	1.44	<0.20
UK_18	109	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.98	0.01	-	-	0.16	0.60	12.0	1.56	<0.20
UK_19	104	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	17.4	0.19	1.61	6.79	0.24	1.09	456	153	<0.20
UK_20	102	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	6.04	0.07	1.89	-	0.15	1.13	134	38.3	<0.20
UK_21	100	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	1.51	0.03	1.67	-	0.48	2.31	35.8	12.5	21.8
UK_23	100	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	0.97	0.03	3.17	-	0.18	3.03	35.5	14.6	29.6
UK_24	100	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	1.59	0.05	2.81	-	0.15	2.97	90.6	30.1	<0.20
UK_27	99	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	1.03	0.03	1.63	-	0.18	3.21	43.3	17.2	<0.20
UK_30	93	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	0.89	0.02	4.58	-	0.12	1.71	2.98	2.98	<0.20
UK_31	88	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	2.95	0.03	2.60	-	0.13	0.96	44.9	21.4	<0.20

Station	Water Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	THC (mg.kg^{-1})	Total n-alkanes (mg.kg^{-1})	Carbon Preference Index	Pristane / Phytane Ratio	Petrogenic / Biogenic Ratio	Proportion of Alkanes (%)	Total PAHs (µg.kg^{-1})	NPD (µg.kg^{-1})	Extractable Organic Halogens (mg.kg^{-1})
UK_33	80	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	0.75	0.01	8.28	-	0.00	1.26	11.8	7.95	<0.20
UK_34	78	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	1.37	0.02	3.32	-	0.00	1.21	11.4	6.06	<0.20
UK_35	74	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.47	0.00	-	-	0.00	0.38	0.00	0.00	31.0
UK_36	76	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.90	0.01	1.78	-	0.35	1.64	48.3	38.1	<0.20
UK_37	76	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	1.08	0.00	1.96	-	0.00	0.31	0.00	0.00	21.4
UK_38	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.63	0.01	2.04	-	0.00	1.82	0.00	0.00	<0.20
UK_39	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.53	0.00	-	-	0.00	0.69	0.00	0.00	25.3
UK_40	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.52	0.03	2.00	-	0.05	1.74	17.7	8.94	21.4
UK_41	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	0.54	0.01	2.59	-	0.00	1.42	0.00	0.00	22.2
UK_42	74	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.51	0.02	2.82	-	0.14	1.56	23.0	9.48	24.1
UK_43	73	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	1.46	0.02	3.89	-	0.28	1.47	63.8	23.9	26.2
UK_44	70	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	2.88	0.05	2.81	-	0.30	1.66	319	109	26.2
UK_45	65	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	2.72	0.05	1.98	-	0.17	1.71	55.5	18.2	24.4
UK_46	61	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	1.55	0.05	2.62	-	0.45	3.19	120	41.1	115
UK_51	52	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	18.4	0.22	1.17	-	0.14	1.22	7366	1122	42.4
UK_52	47	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	0.80	0.02	1.70	-	0.39	2.25	35.6	17.8	94.4
UK_53	31	Circalittoral Sand (MC52/SS.SSa.CFiSa)	1.19	0.03	3.98	-	0.21	2.45	193	52.0	96.4
UK_54	22	Circalittoral Sand (MC52/SS.SSa.CFiSa)	1.53	0.01	3.22	-	0.30	0.61	27.5	5.48	27.0
UK_55	24	Circalittoral Sand (MC52/SS.SSa.CFiSa)	1.74	0.01	3.94	-	0.42	0.37	10.3	1.51	<0.20
UK_56	22	Circalittoral Sand (MC52/SS.SSa.CFiSa)	16.2	0.41	1.46	1.93	0.45	2.55	110	30.6	107
UK_57	20	Infralittoral Sand (MB52/SS.SSa.CFiSa)	23.2	0.55	1.71	0.88	0.62	2.37	2047	495	30.9
UK_58	18	Infralittoral Sand (MB52/SS.SSa.CFiSa)	22.7	0.59	1.65	1.32	0.84	2.59	1549	440	<0.20
UK_59	13	Infralittoral Sand (MB52/SS.SSa.IFiSa)	6.50	0.06	2.97	4.43	0.59	0.98	109	26.9	33.8
UK_61	10	Infralittoral Sand (MB52/SS.SSa.IFiSa)	4.29	0.03	2.50	4.11	0.59	0.65	59.7	15.3	67.9
Mean			**4.98**	**0.07**	**2.81**	**3.31**	**0.20**	**1.43**	**302**	**66.2**	**50.4**
SD			**6.24**	**0.13**	**1.60**	**2.08**	**0.19**	**0.79**	**1103**	**183**	**33.6**

Station	Water Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	THC (mg.kg^{-1})	Total n-alkanes (mg.kg^{-1})	Carbon Preference Index	Pristane / Phytane Ratio	Petrogenic / Biogenic Ratio	Proportion of Alkanes (%)	Total PAHs (µg.kg^{-1})	NPD (µg.kg^{-1})	Extractable Organic Halogens (mg.kg^{-1})
CV (%)			**125.3**	**171.0**	**57.0**	**62.8**	**96.4**	**55.1**	**364.9**	**276.1**	**66.6**
Minimum			**0.47**	**0.00**	**0.97**	**0.88**	**0.00**	**0.31**	**0.00**	**0.00**	**20.6**
Maximum			**23.23**	**0.59**	**8.28**	**6.79**	**0.84**	**3.21**	**7366**	**1122**	**118**
Habitat Comparison											
Atlantic Infralittoral Sand (MB52/SS.SSa.IFiSa)		**Mean**	**14.2**	**0.31**	**2.21**	**2.69**	**0.66**	**1.65**	**941**	**244**	**44.2**
		SD	**10.2**	**0.30**	**0.64**	**1.85**	**0.12**	**0.97**	**1,010**	**259**	**20.6**
		CV (%)	**71.8**	**98.5**	**28.9**	**68.7**	**18.6**	**59.2**	**107**	**106**	**46.6**
Atlantic Circalittoral Sand (Fine Sand)(MC52/SS.SSa.CFiSa)		**Mean**	**5.16**	**0.11**	**3.15**	**-**	**0.34**	**1.50**	**85.1**	**22.4**	**76.8**
		SD	**7.31**	**0.20**	**1.18**	**-**	**0.11**	**1.16**	**84.1**	**23.6**	**43.5**
		CV (%)	**142**	**174**	**37.4**	**-**	**32.7**	**77.8**	**98.7**	**105**	**56.6**
Atlantic Circalittoral Sand (Muddy Sand) (MC52/SS.SSa.CMuSa)		**Mean**	**9.28**	**0.11**	**2.24**	**-**	**0.15**	**1.20**	**166**	**42.8**	**71.8**
		SD	**0.55**	**0.01**	**0.45**	**-**	**0.01**	**0.21**	**36.9**	**9.89**	**45.4**
		CV (%)	**5.9**	**12.4**	**20.0**	**-**	**9.1**	**17.8**	**22.2**	**23.1**	**63.2**
Atlantic Offshore Circalittoral Sand (MD52/SS.SSa.OSa)		**Mean**	**1.89**	**0.02**	**2.64**	**-**	**0.11**	**1.21**	**47.3**	**15.0**	**26.6**
		SD	**1.39**	**0.02**	**0.92**	**-**	**0.13**	**0.48**	**81.9**	**27.7**	**2.9**
		CV (%)	**73.8**	**81.5**	**34.7**	**-**	**115**	**39.7**	**173**	**185**	**11.1**
Atlantic Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)		**Mean**	**9.58**	**0.12**	**1.43**	**-**	**0.26**	**1.74**	**3,700**	**570**	**68.4**
		SD	**12.4**	**0.15**	**0.38**	**-**	**0.17**	**0.73**	**5,183**	**781**	**36.8**
		CV (%)	**130**	**121**	**26.3**	**-**	**65.4**	**41.9**	**140**	**137**	**53.8**
Atlantic Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)		**Mean**	**1.47**	**0.03**	**3.31**	**-**	**0.16**	**1.94**	**39.1**	**15.0**	**47.0**
		SD	**0.68**	**0.01**	**1.87**	**-**	**0.16**	**1.04**	**36.9**	**12.1**	**45.5**
		CV (%)	**46.6**	**54.4**	**56.7**	**-**	**102**	**53.8**	**94.5**	**80.7**	**97.0**
Atlantic Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)		**Mean**	**10.7**	**0.09**	**3.26**	**5.24**	**0.16**	**0.96**	**204**	**68.0**	**73.4**
		SD	**6.63**	**0.06**	**2.49**	**2.19**	**0.08**	**0.31**	**158**	**71.0**	**31.9**
		CV (%)	**61.7**	**59.4**	**76.4**	**41.7**	**48.2**	**33.0**	**77.5**	**105**	**43.5**

Station	Water Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	THC	Total n-alkanes	Carbon Preference Index	Pristane / Phytane Ratio	Petrogenic / Biogenic Ratio	Proportion of Alkanes	Total PAHs	NPD	Extractable Organic Halogens
			(mg.kg^{-1})	(mg.kg^{-1})				(%)	(µg.kg^{-1})	(µg.kg^{-1})	(mg.kg^{-1})
Reference Levels											
OSPAR (2009) THC Threshold			**50**	-	-	-	-	-	-	-	-
EGASPIN (2002) Target Value			**50**	-	-	-	-	-	-	-	-
EGASPIN (2002) Intervention Value			**5,000**	-	-	-	-	-	-	-	-

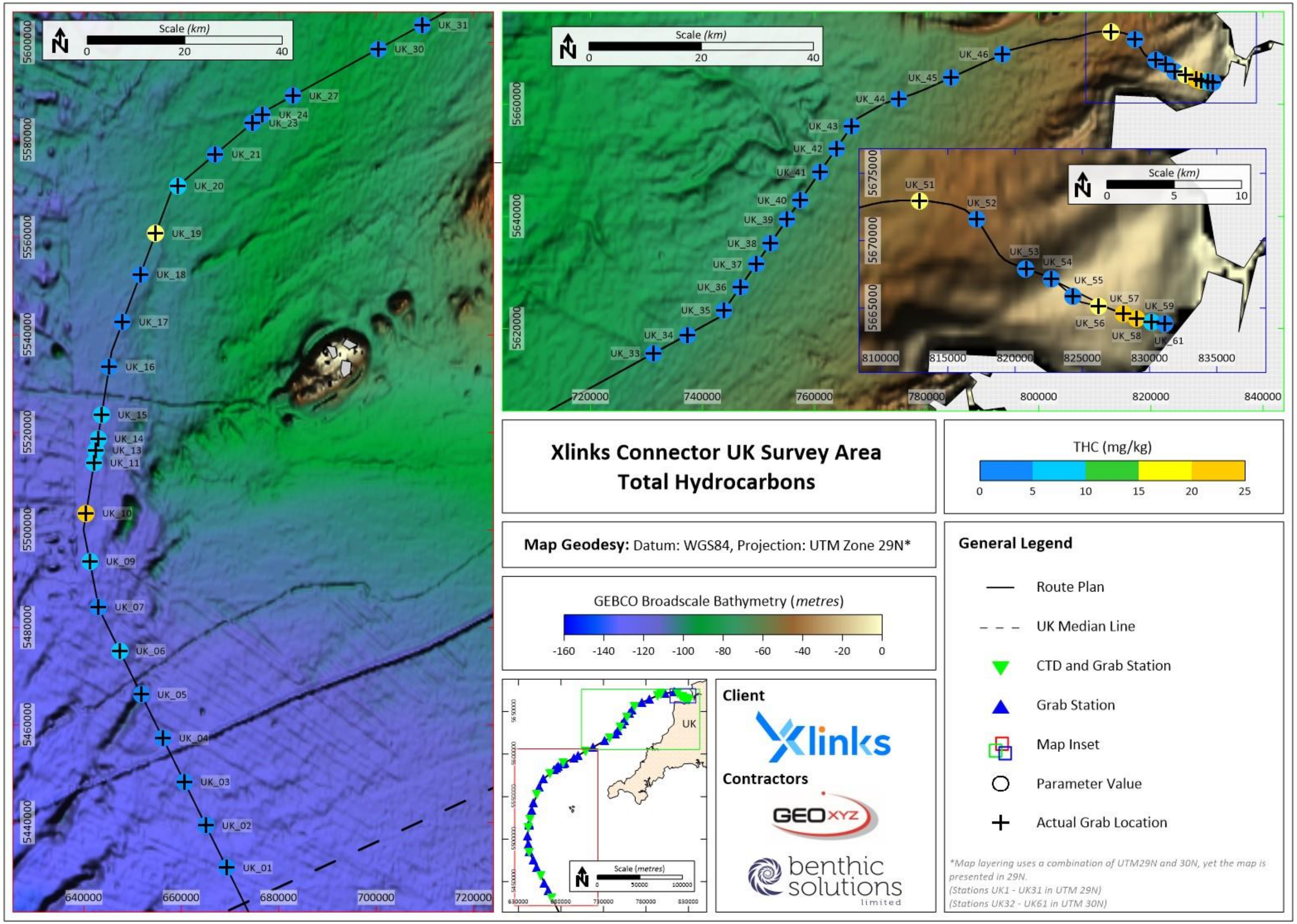


Figure 21: Total hydrocarbon content

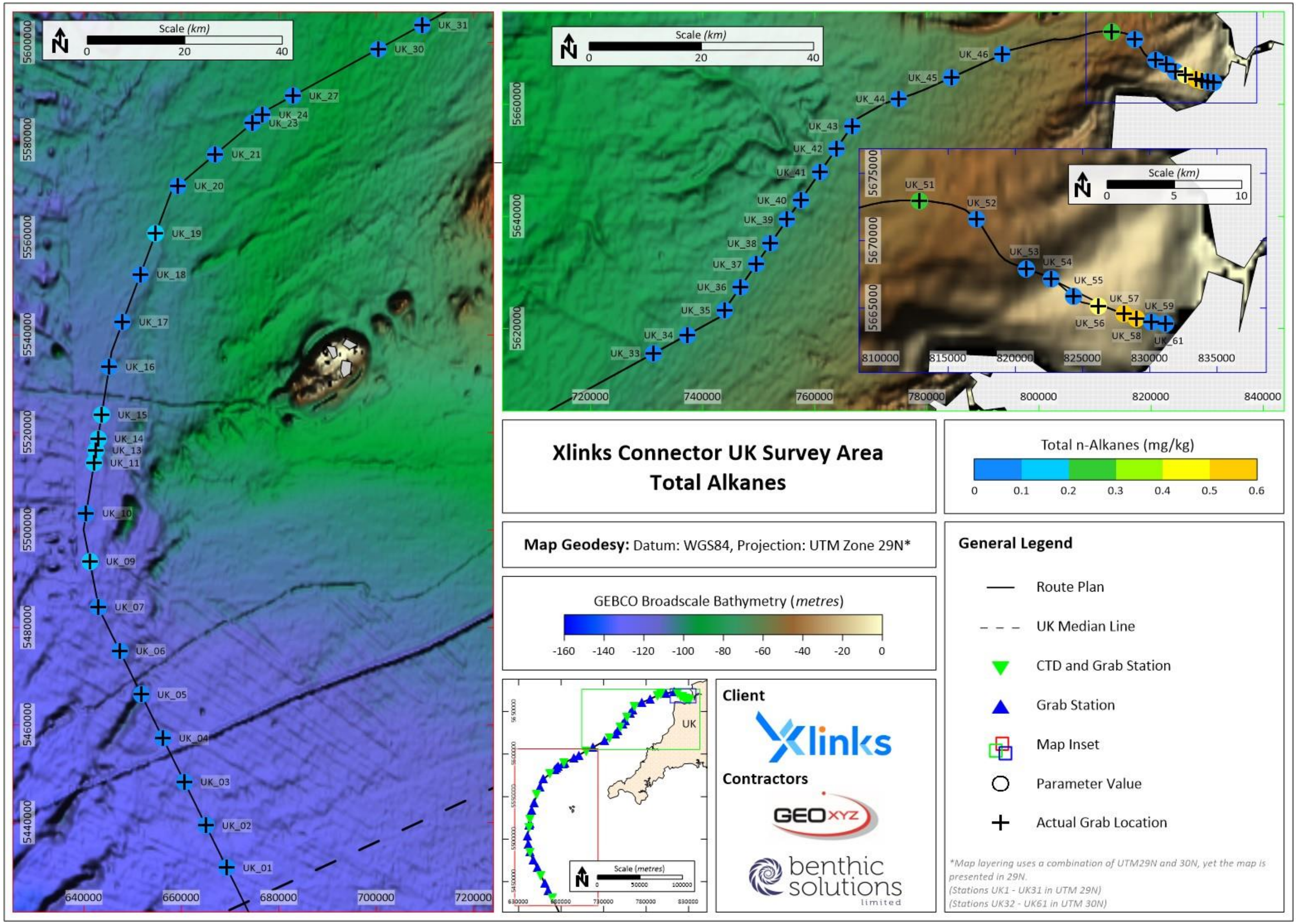


Figure 22: Total saturate alkanes

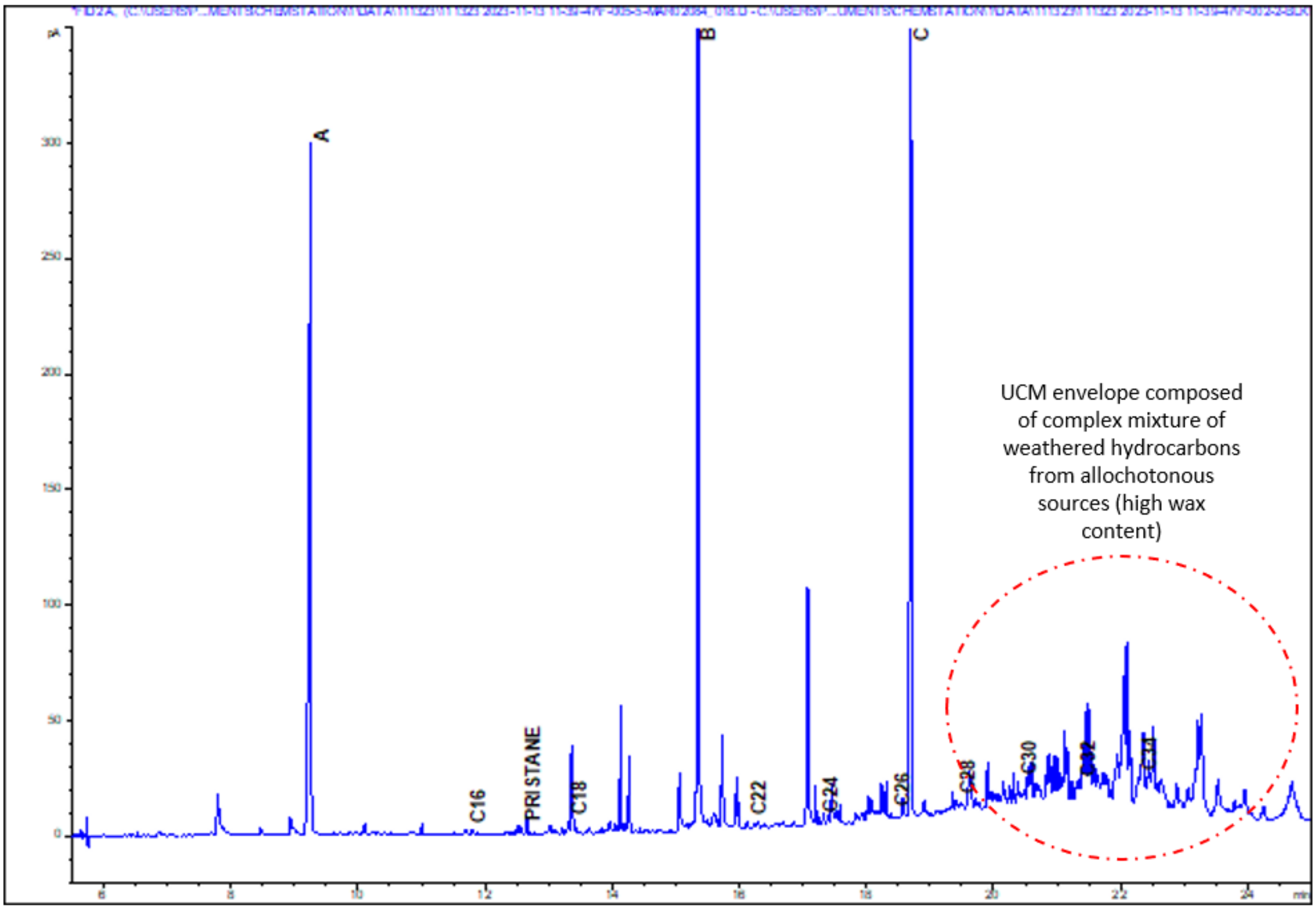


Figure 23: Example gas chromatogram for saturate hydrocarbon analysis (UK_20)

b Carbon Preference Index

The carbon preference index (CPI) is associated with the preference for biogenic n-alkanes (i.e., that of a preference for odd-carbon numbered homologues, particularly around nC_{27-33} (Sleeter *et al*., 1980), derived from fatty acids, alcohols, esters and land plant waxes. The CPI for the full saturate range (nC_{10} to nC_{37}; Appendix K; Table 13) ranged from 0.97 at UK_17 to 8.28 at UK_07 and UK_33, with a mean of 2.81 ± 1.60 SD. These results indicate a dominance of biogenic, odd-carbon numbered alkanes in the survey area which are likely to be mostly terrigenous in origin. Generally speaking, higher values of CPI were seen at the shallower nearshore stations, which is due to the increased terrigenous this area sees in comparison to deeper offshore stations. The unusually high CPI ratios for stations UK_07 (8.28) and UK_33 (8.28) are due to the generally low levels of alkanes at these stations. As such, many of the generally lower concentration even-carbon numbered alkanes were below the limit of detection, thereby overemphasising the concentrations of odd alkanes and producing erroneously high CPI ratios at these stations.

c Pristane / Phytane (Pr/Ph) Ratio

Pristane and phytane are isoprenoid alkanes commonly found as constituents within crude oils (Berthou and Friocourt, 1981). However, in biogenic environments, only pristane is commonly found in the marine environment as it is naturally biosynthesised as a product of the phytol moiety of chlorophyll. Phytane is generally absent or only present at low levels in uncontaminated natural systems (Blumer and Snyder, 1965). This ratio can be taken as an indication of a depositional environment (Peters *et al*., 2005). The presence of both isoprenoids at similar levels is typically taken as an indication of petroleum contamination. The Pr/Ph ratio across the site survey area could only be calculated for seven stations (Table 13). The Pr/Ph mean ratio across the seven stations with ratios was 3.31 ± 2.08 SD.

The generally high ratios denote a dominance of the more biogenic pristane within the survey area. This, together with the remaining concentrations of phytane being below the limit of detection (<1 µg.kg^{-1}), indicates the dominance of pristane and a general biogenic influence from potential planktonic and terrestrial inputs (Moustafa and Morsi, 2012).

It should be noted that pristane/phytane ratios can often be difficult to interpret due to their erratic nature and should be used mainly to substantiate other interpretations. The use of the ratio in interpretative discourse is open to criticism, mainly owing to the natural occurrence of phytane in some older sediments and the confusing variety of sedimentary pristane induced by the variability of phytoplankton numbers (Blumer and Snyder, 1965).

d Extractable Organic Halogens

Halogen organic compounds are formed in the environment by both natural and anthropogenic processes. Natural processes include the formation of these compounds during combustion, fires and volcanic eruptions but also from synthesis carried out by fungi, algae, sponges and lichens, while anthropogenic sources include chemical oxidation, disinfection, and coagulation with chlorine-containing compounds (Wlodarczyk-Makula and Wiśniowska, 2019). Extractable organic halogens (EOX) have been reported to be higher near industrial areas and large urban agglomerations and shown to correlate well with TOC (Niemirycz et al., 2005).

The results of EOX analysis are presented in Table 13, with EOX additionally illustrated in Figure 24. EOX concentrations were varied and ranged from <0.2 mg.kg^{-1} to 118 mg.kg^{-1} across the survey area, with 19 stations below the LOD (<0.2 mg.kg^{-1}). In general, stations displaying a higher gravel content had a higher EOX value. Additionally, at deeper offshore stations EOX concentrations were low or below the LOD with the exception of stations UK_13, and UK_15 with concentrations of 107 mg.kg^{-1} and 118 mg.kg^{-1} respectively. It is unclear why these two stations displayed these elevated EOX levels, however both are located in the vicinity of the Scilly Isles, thus pollution from the Isles could have been the cause, although there is always the possibility that natural variation in seabed sediments was also the cause. As the cable route transitioned into shallower water and areas closer to land, EOX values began to increase, though there were still some stations in this section of the route that were below the LOD. Station UK_56 displayed a high value of 107 mg.kg^{-1}; this station also had a high THC and total n-alkanes value, which was thought to be due to high fines content and proximity to shore.

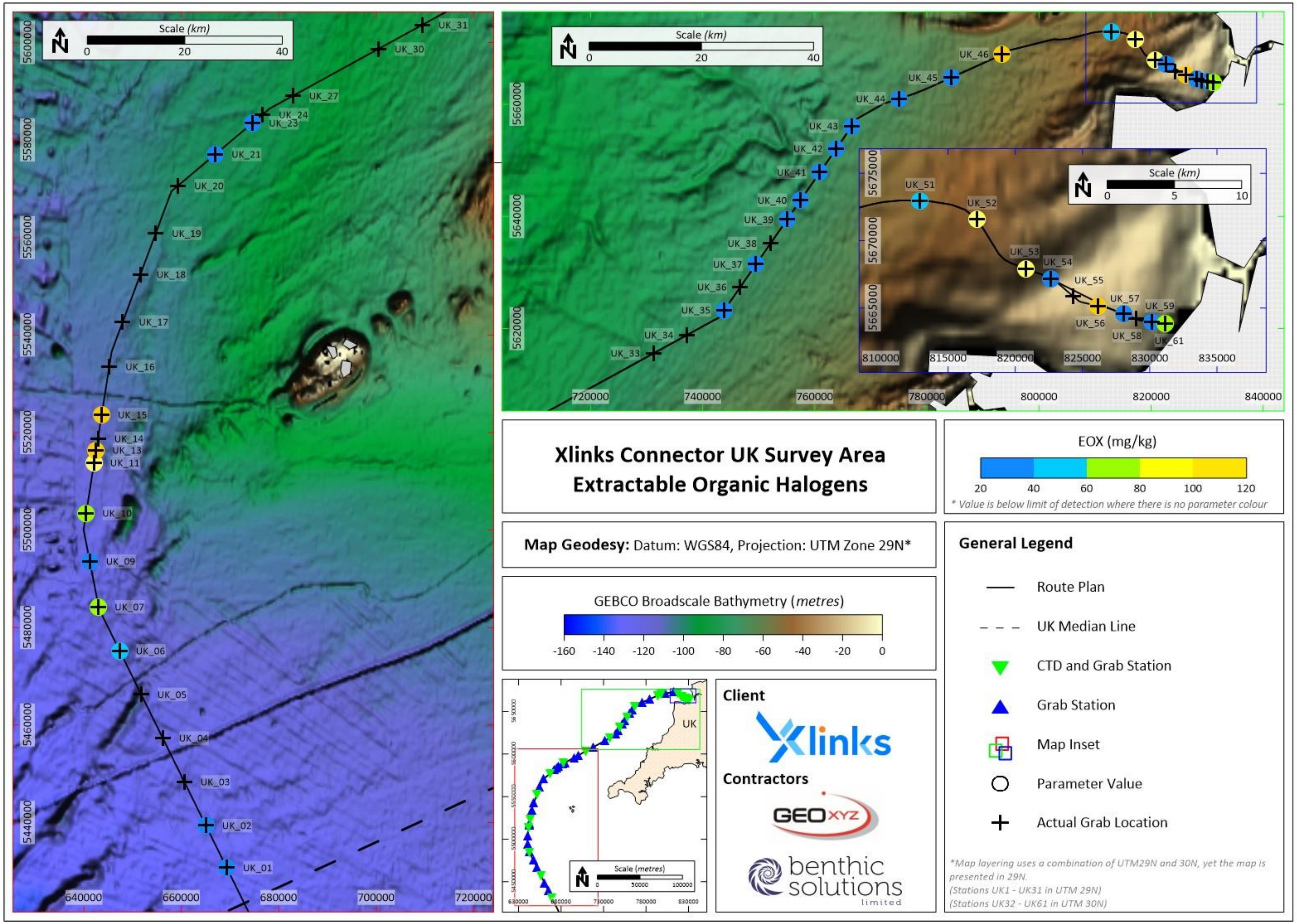


Figure 24: Extractable organic halogens

4.6.2 Polycyclic Aromatic Hydrocarbons

a Non-normalised Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs) were analysed at each station using gas chromatography-mass spectrometry (GC-MS). Results of the single ion current (SIC) analyses are summarised in Table 13 and detailed in Appendix M and N, showing concentrations for both parent compounds and their alkyl derivatives.

PAHs and their alkyl derivatives have been recorded in a wide range of marine sediments (Laflamme and Hites, 1978), with most compounds produced from what is thought to be pyrolytic sources. These include the combustion of organic material such as forest fires (Youngblood and Blumer, 1975), the burning of fossil fuels and, in the case of offshore oil fields, flare stacks. The resulting PAHs, rich in the heavier weight 4-6 ring aromatics, are normally transported to the sediments via atmospheric fallout or river runoff. Another PAH source is petroleum hydrocarbon, often associated with localised drilling activities. These are rich in the lighter, more volatile 2 and 3 ring PAHs (NPD; naphthalene (128), phenanthrene, anthracene (178) and dibenzothiophene (DBT) with their alkyl derivatives.

Total PAH levels were highly variable across the survey site and ranged from 0.0 $\mu g.kg^{-1}$ across six stations (UK_02, UK_03, UK_35, UK_37, UK_38, UK_39, UK_41) to 7365.74 $\mu g.kg^{-1}$ at station UK_51 (mean: 302.23 $\mu g.kg^{-1}$ ± 1102.83 SD) (Figure 26). The variability in levels was further evidenced by the high coefficient of variance, 302.23%. The NPD PAH fraction followed a similar trend to that of total PAH levels, and generally were higher where high total PAH levels were seen, implying that the total PAHs were driven by the NPD content. Concentrations ranged from 0.0 $\mu g.kg^{-1}$ at nine stations to 112.67 $\mu g.kg^{-1}$ at UK_51 (mean: 66.19 $\mu g.kg^{-1}$ ± 182.77 SD) (Figure 27). For both total PAHs and NPD content, station UK_51 displayed the highest levels, this could be due to its proximity to the coastline and thus the potential for increased terrigenous influences, however considering surrounding stations do not exhibit the same trend, the presence of *Sabellaria spinulosa* rubble is likely the cause, particularly when considering its influence in elevated THC readings. The majority of stations demonstrated NPD fractions that accounted for <50% of the PAHS, representing hydrocarbons of a slightly petrogenic and mixed influences.

Further information on the source(s) of PAH in the surface sediments may be obtained from a study of their alkyl homologue distributions (i.e., the degree of methyl and ethyl substitution of the parent compounds). Pyrolytically derived PAHs are predominantly unalkylated, whereas PAHs derived from petrogenic sources are formed at relatively low temperatures (<150 °C) and contain mainly alkylated species. The proportion of 2-6 ring PAH comprising unalkylated parent compounds also reflects whether the source is petrogenic or pyrolytic. As illustrated in Figure 25, sampling stations showed similar PAH source assignments with PAHs derived from mixed and petrogenic sources.

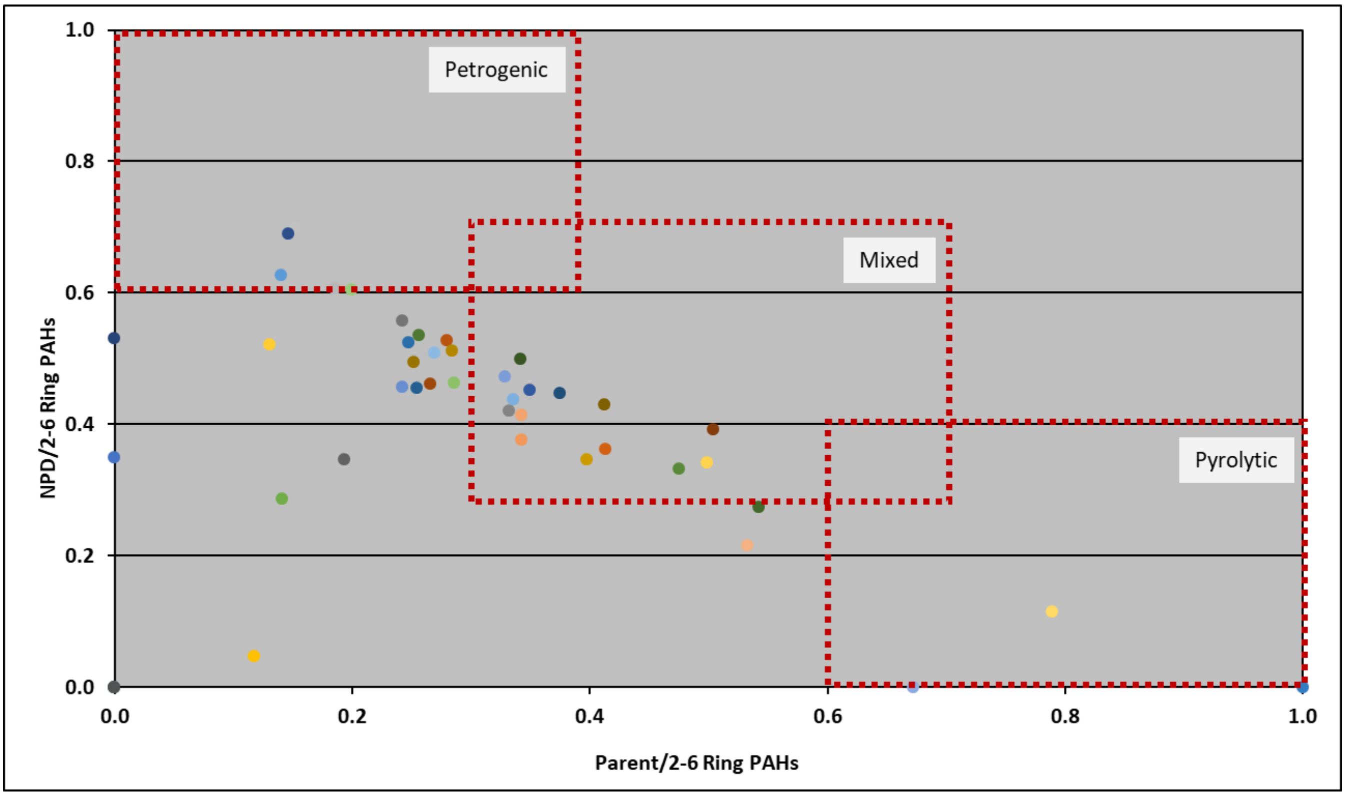


Figure 25: Polycyclic aromatic hydrocarbons source assignment

b Normalised Polycyclic Aromatic Hydrocarbons

Normalised PAH concentrations were calculated to allow comparison to OSPAR (2014) background concentrations (BCs) and background assessment concentrations (BACs). BCs are concentrations of contaminants derived from the analysis of core samples to reflect pre-industrial background levels for the OSPAR area. BACs have been statistically derived from BCs and represent the level above which concentrations are significantly higher than the relevant BC (OSPAR, 2008b). Contaminants tend to show a much higher affinity to fine particulate matter (OSPAR, 2009b) due to the increased adsorption capacity of organic matter and clay minerals. For sites where there is variability in grain size between stations, effects due to point sources of contamination will at least partly be obscured by grain size differences.

Total PAH concentrations normalised to 2.5 % TOC content are displayed in Appendix O, along with OSPAR BCs and BACs, and OSPAR effect range low (ERL) and effect range median (ERM) thresholds. ERLs are defined as the lowest concentration producing adverse effects in 10 % of studies, whilst ERMs are the levels at which harmful effects are expected in 50 % of studies. Normalised PAHs were incalculable at most stations due to concentrations below the detection limit (<1 µg.kg^{-1}). Stations that were calculable were not above their respective OSPAR BCs (2014), OSPAR BAC (2014) and OSPAR ERL (2014) values.

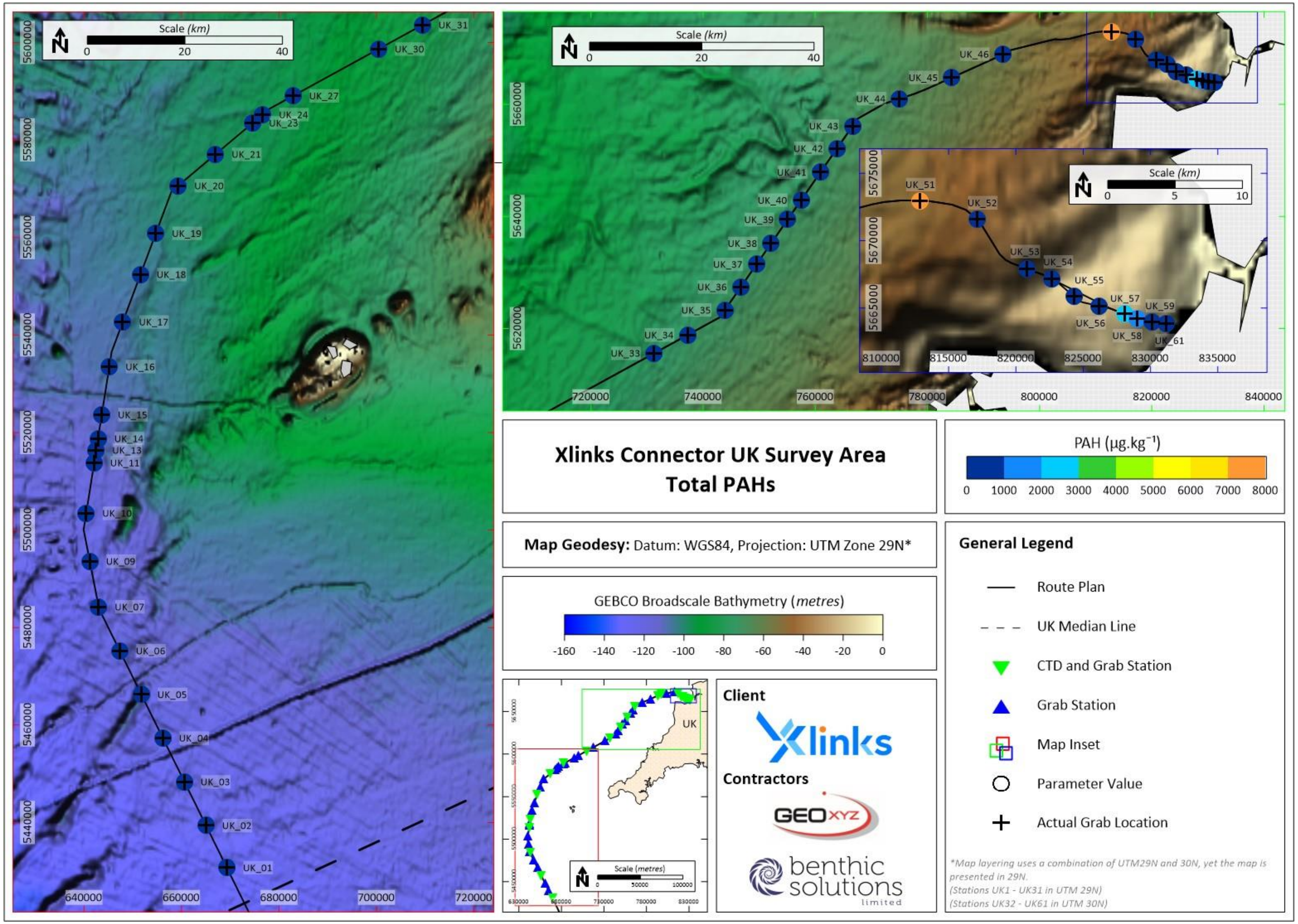


Figure 26: Total polycyclic aromatic hydrocarbons (2-6 ring)

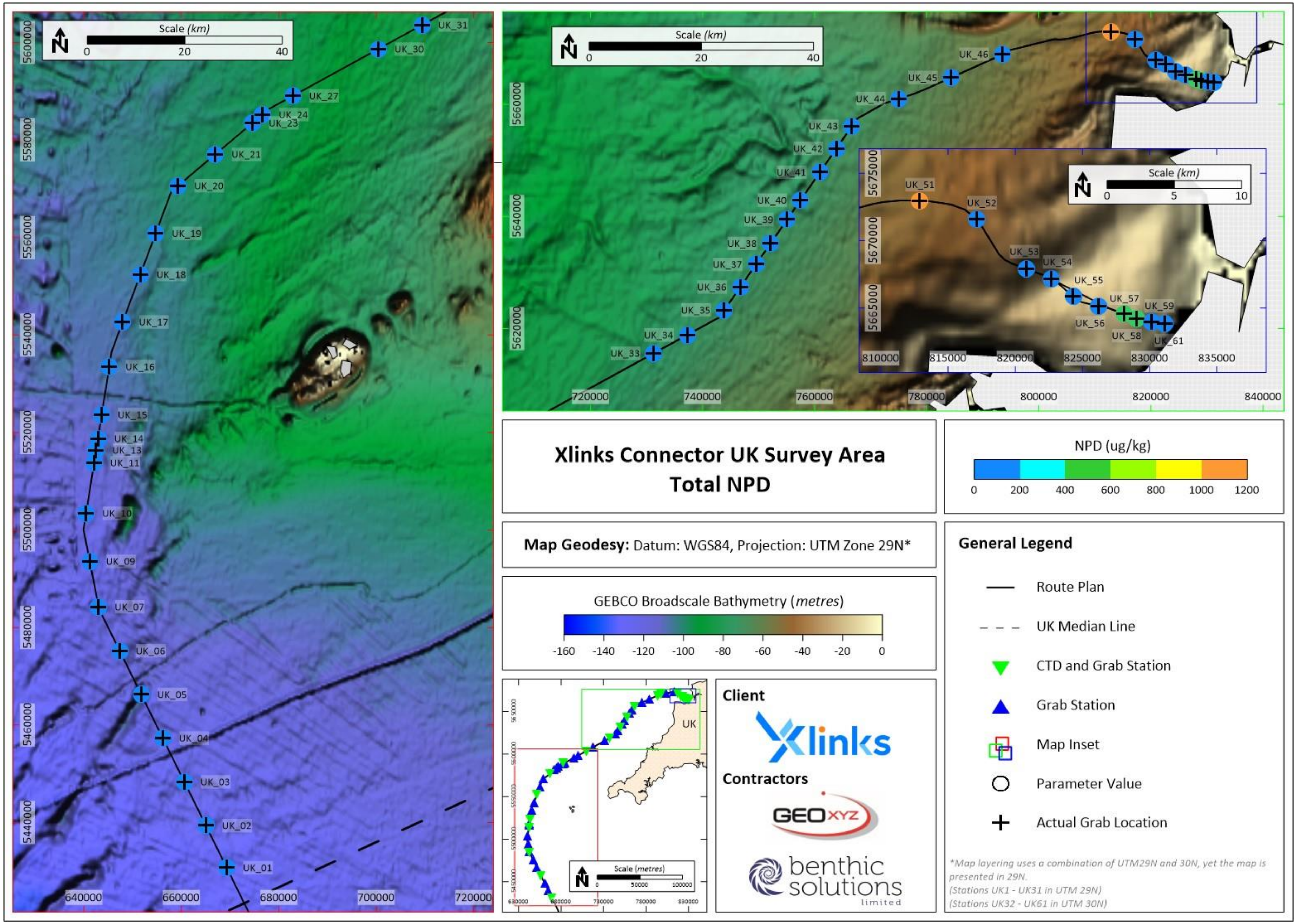


Figure 27: Total naphthalene, phenanthrene, anthracene and dibenzothiophene (NPD)

4.7 HEAVY AND TRACE METALS

4.7.1 Non-normalised Heavy Metals

Results for heavy metals analysis are given in Table 14 and Figure 28 to Figure 31. All the metals analysed arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), (aluminium (Al), iron (Fe), lithium (Li), tin (Sn), magnesium (Mg) underwent a hydrofluoric/boric acid digestion for the total extraction of sediment metals.

The bioavailability of metals to marine organisms is complex, as sediment granulometry and the interface between water and sediment all affect the bioavailability and subsequent toxicity. Therefore, even if a metal is found in higher concentrations, it does not necessarily follow that this will have a detrimental effect on the environment if present in an insoluble state. Historically, several extraction techniques have been applied to the analysis of metals, with the most common applying to a hydrofluoric/perchloric extraction for total metals and a weaker nitric or aqua regia extraction. The latter techniques have shown a close correlation to metal burdens in the tissues of benthic organisms (Luoma and Davies, 1983; Bryan and Langston, 1992). However, the relationship between metal digestion techniques and the associated bioavailability to organisms is poorly understood, and research is ongoing.

Metals occur naturally in the marine environment and are widely distributed in dissolved and sedimentary forms. Some are essential to marine life, while others may be toxic to numerous organisms (Paez-Osuna and Ruiz-Fernandez, 1995). Rivers, coastal discharges and the atmosphere are the principal modes of entry for most metals into the marine environment (Schaule and Patterson, 1983), with anthropogenic inputs occurring primarily as components of industrial and municipal wastes.

Trace metal contaminants in the marine environment tend to form associations with the non-residual phases of mineral matter, such as Fe and Mn oxides and hydroxides, metal sulphides, organics and carbonates. Metals associated with these non-residual phases are prone to various environmental interactions and transformations (physical, chemical and biological), potentially increasing their biological availability (Tessier *et al.,* 1979). Residual trace metals are defined as those which are part of the sediment's silicate matrix and are located mainly in the lattice structures of the component minerals. Non-residual trace metals are not part of the silicate matrix and have been incorporated into the sediment from aqueous solution by processes such as adsorption and organic complexes and may include trace metals originating from sources of pollution. Therefore, in monitoring trace metal contamination of the marine environment, it is important to distinguish these more mobile metals from the residual metals held tightly in the sediment lattice (Chester and Voutsinou, 1981), which are of comparatively little environmental significance.

Metals are generally not harmful to organisms at concentrations normally found in marine sediments and some, like zinc, may be essential for normal metabolism. However, they can become toxic above a critical threshold. In order to assign a level of context for toxicity, an approach used by Long *et al.* (1995) to characterise contamination in sediments will be used here. These researchers reviewed field and laboratory studies and identified nine metals that were observed to have ecological or biological effects on organisms. They defined 'effect range low' (ERL) values as the lowest metal concentration that produced adverse effects in 10 % of the data reviewed. Meanwhile, 'effect range median' (ERM) values designate the level at which half of the studies reported harmful effects. Consequently, metal concentrations recorded below the ERL value are not expected to elicit adverse effects, while levels above the ERM value are likely toxic to some marine life.

Metal concentrations, overall, were consistently low across the survey area, with the exception of arsenic which was slightly elevated. Many heavy and trace metals displayed a similar pattern of distribution, as evidenced by significant ($p<0.05$) and highly significant ($p<0.01$) correlations between many metals (Appendix S).

All analysed metals apart from arsenic and nickel exhibited concentrations below the OSPAR ERM and ERL values. There were 20 stations above the OSPAR ERL values (8.20 $mg.kg^{-1}$) for arsenic across the survey area, and a further eight stations above the Cefas cAL1 value (20 $mg.kg^{-1}$) (Table 14). Tin concentrations were higher than the CCME TEL (0.05 $mg.kg^{-1}$) at 11 stations, the majority of which were located in the shallowest section of the proposed cable route. Additionally, three stations (UK_52, UK_59 and UK_61) exceeded the CCME TEL value (15.9 $mg.kg^{-1}$) for Nickel concentration (Table 14), however these were only slightly elevated, all of which were over the threshold by between 1.1 and 2.4 $mg.kg^{-1}$. Considering the proximity of stations over the reference values Tin and Nickel all located in nearshore section of the proposed cable route, thus this elevation is likely due to the sediment type change seen in this area, or due to the proximity to land and the subsequent potential for increased anthropogenic pollution. However, considering no other heavy metal concentrations exceeded the reference values, the observed concentrations are likely to reflect natural background for this region in the Celtic Sea.

Overall, the physical nature of the sediment did have an effect on the concentrations of the heavy and trace metals. Negative correlations were observed between arsenic, lead, mercury, nickel, iron and magnesium, and percent fines. Negative correlations were also observed between all metals and percent gravel. There were also positive correlations observed between arsenic, lead, mercury, iron and magnesium and percent sand. The correlations with sand and gravel are consistent with the heterogeneous sand-dominated nature of the seabed.

Table 14: Total heavy and trace metal concentrations

Station	Water Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Aluminium	Iron	Lithium	Tin
			$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$
UK_01	129	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	5.5	0.1	5.2	1.9	4.4	0.02	4.0	1,310	4,070	6.4	<0.5
UK_02	127	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	5.5	0.0	8.0	1.2	4.6	0.02	4.5	1,460	6,090	6.6	<0.5
UK_03	122	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	6.7	0.1	10.6	1.4	7.8	0.02	5.7	1,500	6,980	6.2	<0.5
UK_04	123	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	7.1	0.1	10.7	1.4	5.3	0.02	5.6	1,600	6,760	6.7	<0.5
UK_05	114	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	4.2	0.1	8.5	1.7	4.8	0.02	5.1	2,000	5,300	9.6	<0.5
UK_06	121	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	3.5	0.1	8.7	2.3	5.3	0.02	5.5	2,800	5,080	13.4	<0.5
UK_07	123	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	3.2	0.1	6.3	1.4	4.2	0.04	4.3	1,790	4,210	8.4	<0.5
UK_09	123	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	2.4	0.1	7.7	2.4	4.9	0.02	5.6	3,010	4,520	15.5	<0.5
UK_10	120	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	3.1	0.1	9.0	2.3	4.5	0.03	5.6	3,580	5,060	16.5	<0.5
UK_11	117	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	2.1	0.1	7.5	2.6	3.8	0.06	5.6	2,350	3,940	11.4	<0.5
UK_13	113	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	4.6	0.1	9.1	2.8	6.9	<0.01	7.0	3,320	6,470	17.2	<0.5
UK_14	114	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	2.6	0.1	9.3	7.1	5.3	<0.01	7.2	4,090	5,840	19.3	<0.5
UK_15	114	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	2.5	0.1	8.2	2.7	4.8	<0.01	6.5	2,950	4,830	15.0	<0.5
UK_16	111	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	5.1	0.1	5.7	1.1	3.4	<0.01	4.3	1,710	7,050	9.8	<0.5
UK_17	111	Circalittoral Sand (MC52/SS.SSa.CFiSa)	5.9	0.1	8.2	1.5	5.5	<0.01	5.1	1,850	7,630	10.2	<0.5
UK_18	109	Circalittoral Sand (MC52/SS.SSa.CFiSa)	4.3	0.1	6.6	1.7	5.8	<0.01	5.4	1,740	5,910	10.0	<0.5
UK_19	104	Circalittoral Sand (MC52/SS.SSa.CFiSa)	2.4	0.1	8.1	4.3	6.1	0.03	10.8	3,960	5,740	17.7	0.5
UK_20	102	Circalittoral Sand (MC52/SS.SSa.CFiSa)	4.5	0.1	7.9	2.4	6.1	0.01	6.1	3,150	6,360	15.1	<0.5
UK_21	100	Infralittoral Sand (MB52/SS.SSa.CFiSa)	17.8	0.1	6.4	1.5	13.9	<0.01	6.6	1,750	8,270	8.5	<0.5
UK_23	100	Infralittoral Sand (MB52/SS.SSa.CFiSa)	9.5	0.1	5.8	1.3	9.8	<0.01	4.3	1,290	8,630	8.3	<0.5
UK_24	100	Infralittoral Sand (MB52/SS.SSa.IFiSa)	8.7	0.0	7.6	2.5	5.5	<0.01	7.3	3,070	12,000	14.1	<0.5
UK_27	99	Infralittoral Sand (MB52/SS.SSa.IFiSa)	18.5	0.1	5.8	1.4	11.5	<0.01	5.1	1,810	12,800	8.5	<0.5
UK_30	93	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	9.3	0.1	4.4	1.1	7.1	<0.01	4.1	1,070	6,160	7.4	<0.5
UK_31	88	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	12.6	0.1	6.5	2.1	10.6	0.02	5.7	1,970	8,010	10.2	<0.5
UK_33	80	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	17.2	0.1	5.9	2.3	10.1	0.03	10.7	2,680	12,500	14.8	<0.5
UK_34	78	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	12.2	0.1	9.4	3.8	7.1	<0.01	12.7	5,390	19,100	29.6	<0.5
UK_35	74	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	10.9	0.1	5.4	1.3	5.4	<0.01	5.0	1,280	5,210	8.7	<0.5

Station	Water Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Aluminium	Iron	Lithium	Tin
			$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$
UK_36	76	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	9.4	0.1	5.4	1.8	6.3	<0.01	5.1	1,340	4,420	9.4	<0.5
UK_37	76	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	15.0	0.1	10.1	4.1	6.0	<0.01	9.8	3,990	15,900	20.9	<0.5
UK_38	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	9.3	0.1	6.1	1.7	5.8	<0.01	4.1	1,300	4,400	8.1	<0.5
UK_39	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	10.0	0.1	5.9	1.1	4.4	0.01	4.0	1,290	5,720	7.6	<0.5
UK_40	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	11.5	0.0	6.7	1.5	6.2	<0.01	5.1	1,360	6,220	8.5	<0.5
UK_41	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	14.0	0.1	8.1	1.5	7.0	<0.01	4.6	1,530	7,280	8.7	<0.5
UK_42	74	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	16.6	0.1	7.3	1.8	8.1	<0.01	5.7	1,910	8,870	10.8	<0.5
UK_43	73	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	19.1	0.1	8.5	2.3	9.1	<0.01	7.4	2,090	10,000	11.1	0.5
UK_44	70	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	20.6	0.1	7.2	2.2	10.7	<0.01	5.9	2,170	10,900	10.9	0.5
UK_45	65	Circalittoral Sand (MC52/SS.SSa.CFiSa)	18.7	<0.04	6.8	2.6	11.8	<0.01	5.6	1,930	10,200	9.6	0.5
UK_46	61	Circalittoral Sand (MC52/SS.SSa.CFiSa)	38.7	0.1	6.9	3.0	12.5	<0.01	10.0	3,300	16,200	17.6	<0.5
UK_51	52	Circalittoral Sand (MC52/SS.SSa.CFiSa)	23.2	0.0	7.1	4.6	15.8	<0.01	11.4	3,310	15,200	17.2	<0.5
UK_52	47	Circalittoral Sand (MC52/SS.SSa.CFiSa)	23.1	0.1	13.5	9.0	13.3	0.04	16.8	4,210	16,100	24.2	<0.5
UK_53	31	Infralittoral Sand (MB52/SS.SSa.CFiSa)	40.0	<0.04	8.4	3.9	19.0	0.05	12.7	5,060	20,400	30.0	<0.5
UK_54	22	Infralittoral Sand (MB52/SS.SSa.CFiSa)	40.6	<0.04	9.7	4.9	19.2	0.04	14.8	5,570	23,200	34.0	0.5
UK_55	24	Infralittoral Sand (MB52/SS.SSa.IFiSa)	34.4	0.1	10.2	4.4	17.9	0.04	14.4	5,460	21,100	33.7	0.6
UK_56	22	Infralittoral Sand (MB52/SS.SSa.IFiSa)	24.2	0.1	10.6	4.2	17.8	0.05	14.4	5,640	19,800	35.5	0.8
UK_57	20	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	12.6	0.1	12.9	7.0	18.5	0.09	14.9	7,480	18,600	43.1	1.4
UK_58	18	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	13.8	0.1	12.8	7.8	19.7	0.09	15.6	6,780	19,200	41.1	1.3
UK_59	13	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	17.2	0.1	13.2	7.9	19.3	0.07	17.8	6,870	22,600	43.9	0.8
UK_61	10	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	16.4	0.1	13.4	6.5	18.0	0.05	18.3	6,870	23,000	42.7	0.7
Mean			**12.9**	**0.1**	**8.2**	**3.0**	**9.2**	**0.0**	**8.0**	**2,999**	**10,288**	**16.5**	**0.7**
Standard Deviation			**10.0**	**0.0**	**2.3**	**2.0**	**5.2**	**0.0**	**4.2**	**1,769**	**6,073**	**11.0**	**0.3**
CV (%)			**77.5**	**32.2**	**28.1**	**68.2**	**56.1**	**60.8**	**52.9**	**59**	**59**	**66.6**	**44.3**
Minimum			**2.1**	**0.0**	**4.4**	**1.1**	**3.4**	**0.0**	**4.0**	**1,070**	**3,940**	**6.2**	**0.5**
Maximum			**40.6**	**0.1**	**13.5**	**9.0**	**19.7**	**0.1**	**18.3**	**7,480**	**23,200**	**43.9**	**1.4**

Station	Water Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)		Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Aluminium	Iron	Lithium	Tin
				$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$
Habitat Comparison														
Atlantic Infralittoral Sand (MB52/SS.SSa.IFiSa)			**Mean**	15.0	0.1	13.1	7.3	18.9	0.08	16.7	7,000	20,850	42.7	1.1
			Standard Deviation	2.2	0.0	0.3	0.7	0.8	0.02	1.7	323	2,271	1.2	0.4
			CV (%)	14.4	12.4	2.1	9.2	4.1	25.5	9.9	4.6	10.9	2.8	33.4
Atlantic Circalittoral Sand (Fine Sand) (MC52/SS.SSa.CFiSa)			**Mean**	34.8	0.1	9.7	4.4	18.5	0.05	14.1	5,433	21,125	33.3	0.6
			Standard Deviation	7.6	0.0	1.0	0.4	0.7	0.01	0.9	259	1,482	2.3	0.2
			CV (%)	21.8	0.0	9.8	9.7	3.9	12.8	6.6	4.8	7.0	7.0	24.1
Atlantic Circalittoral Sand (Muddy Sand) (MC52/SS.SSa.CMuSa)			**Mean**	3.0	0.1	8.1	2.6	5.2	0.04	6.1	2,893	4,977	14.7	-
			Standard Deviation	1.4	0.0	0.9	0.2	1.6	0.03	0.8	495	1,325	3.0	-
			CV (%)	45.0	34.0	10.8	7.7	30.2	70.7	13.3	17.1	26.6	20.3	-
Atlantic Offshore Circalittoral Sand (MD52/SS.SSa.OSa)			**Mean**	10.2	0.1	7.4	1.7	6.6	0.02	5.2	1,712	6,796	9.1	0.5
			Standard Deviation	5.5	0.0	1.6	0.4	2.1	0.01	0.8	481	2,030	2.1	0.0
			CV (%)	54.0	34.7	21.6	24.7	31.9	32.0	15.4	28.1	29.9	22.8	0.0
Atlantic Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)			**Mean**	23.2	0.0	10.3	6.8	14.6	0.04	14.1	3,760	15,650	20.7	-
			Standard Deviation	0.1	0.0	4.5	3.1	1.8	-	3.8	636	636	4.9	-
			CV (%)	0.3	15.7	43.9	45.8	12.1	-	27.1	16.9	4.1	23.9	-
Atlantic Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)			**Mean**	15.0	0.1	6.8	2.2	8.9	0.03	7.3	2,548	11,511	13.6	-
			Standard Deviation	8.9	0.0	1.7	1.1	3.3	0.01	3.0	1,304	4,258	6.9	-
			CV (%)	59.8	24.7	24.8	48.3	36.8	28.3	41.0	51.2	37.0	50.5	-
Atlantic Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)			**Mean**	2.9	0.1	8.3	3.4	5.0	0.03	6.7	3,195	5,127	15.1	0.5
			Standard Deviation	0.4	0.0	1.1	2.1	0.7	0.01	2.3	863	603	3.9	-
			CV (%)	15.4	31.4	12.9	61.7	13.5	27.2	34.0	27.0	11.8	25.6	-
Reference Levels														
OSPAR (2014) ERL				**8.20**	**1.20**	**81.00**	**34.00**	**46.70**	**0.15**	**20.90**	-	-	-	-
NOAA (2008) ERM				**70.00**	**9.60**	**370.00**	**270.00**	**218.00**	**0.71**	**51.60**	-	-	-	-
CCME (2001) TEL				**7.24**	**0.68**	**52.30**	**34.00**	**30.24**	**0.13**	**15.90**	-	-	-	**0.05**
CCME (2001) PEL				**41.60**	**9.60**	**160.00**	**108.00**	**218.00**	**0.70**	**42.80**	-	-	-	-
Cefas (2015) cAL1				**20.00**	**0.40**	**40.00**	**40.00**	**50.00**	**0.30**	**20.00**	-	-	-	-
Cefas (2015) cAL2				**50.00**	**2.00**	**400.00**	**400.00**	**50.00**	**3.00**	**200.00**	-	-	-	-

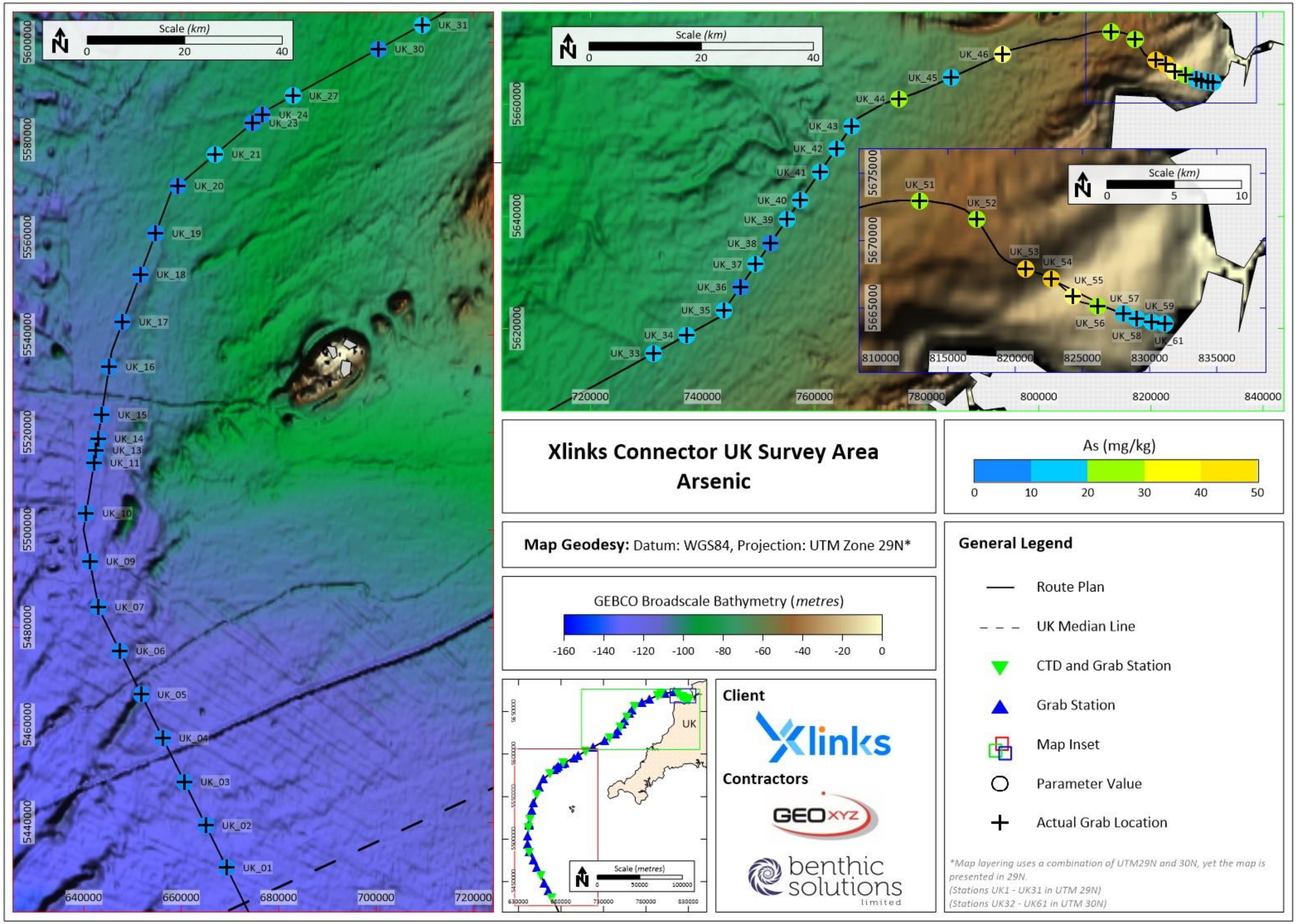


Figure 28: Concentration of arsenic

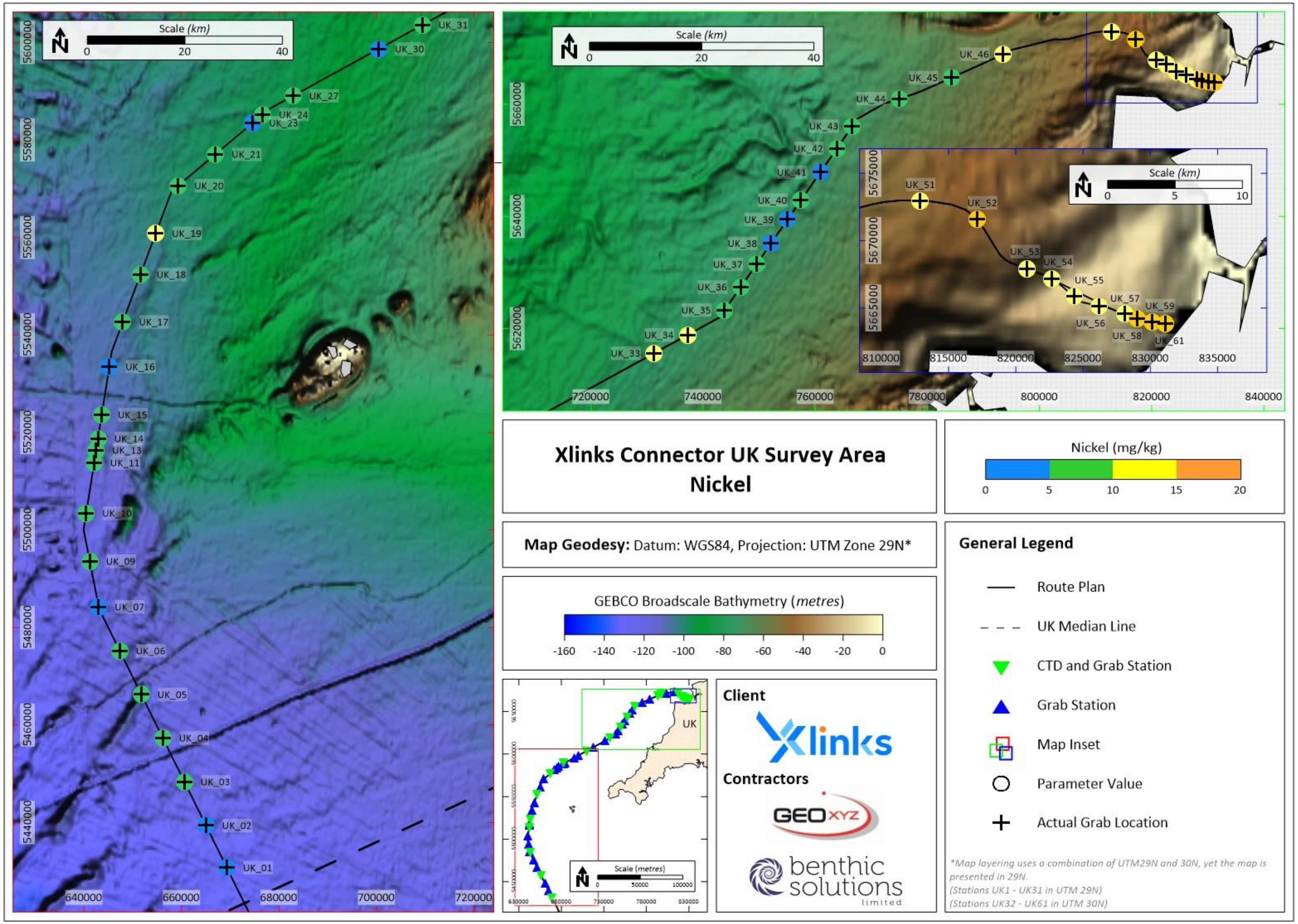


Figure 29: Concentration of nickel

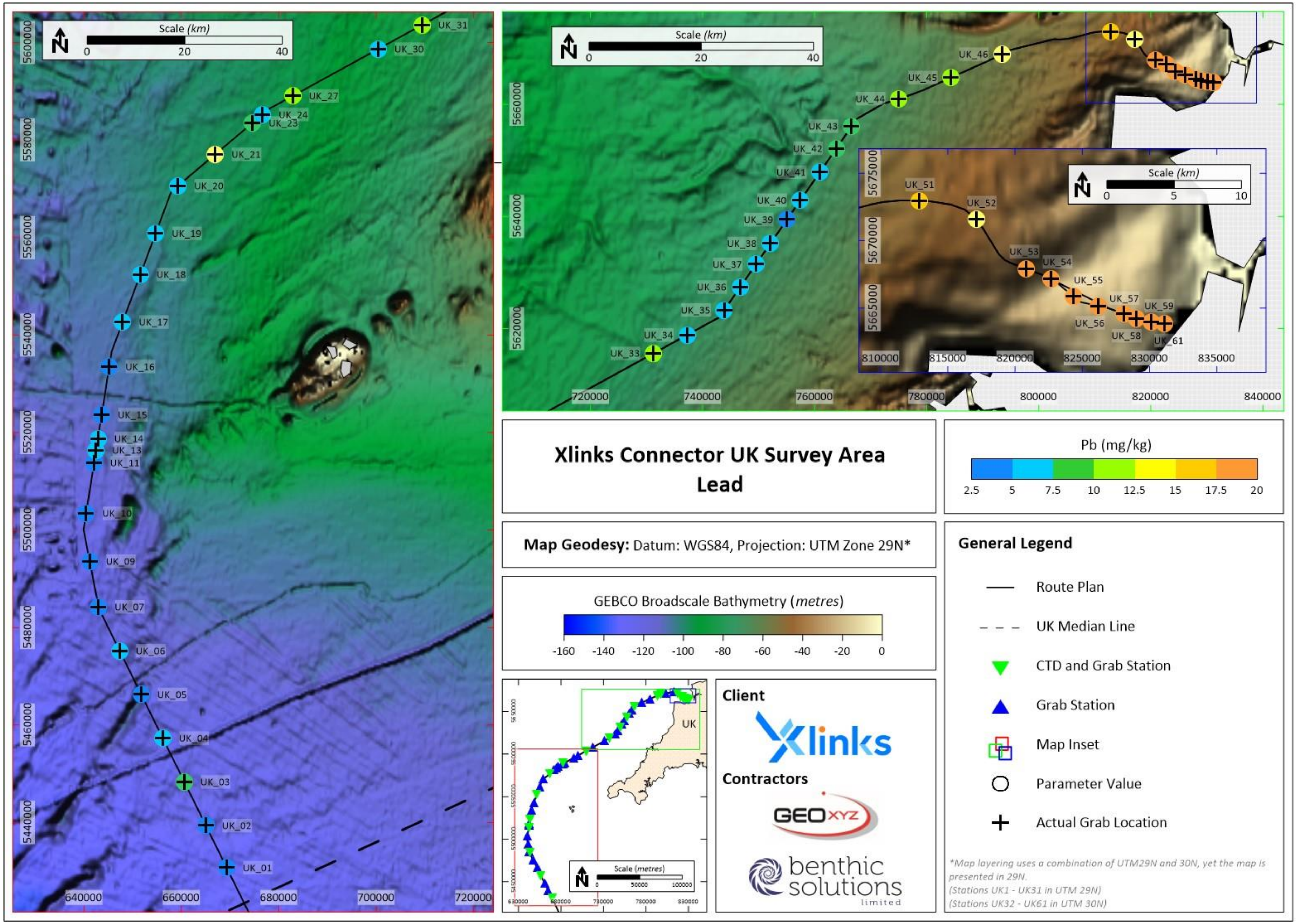


Figure 30: Concentration of lead

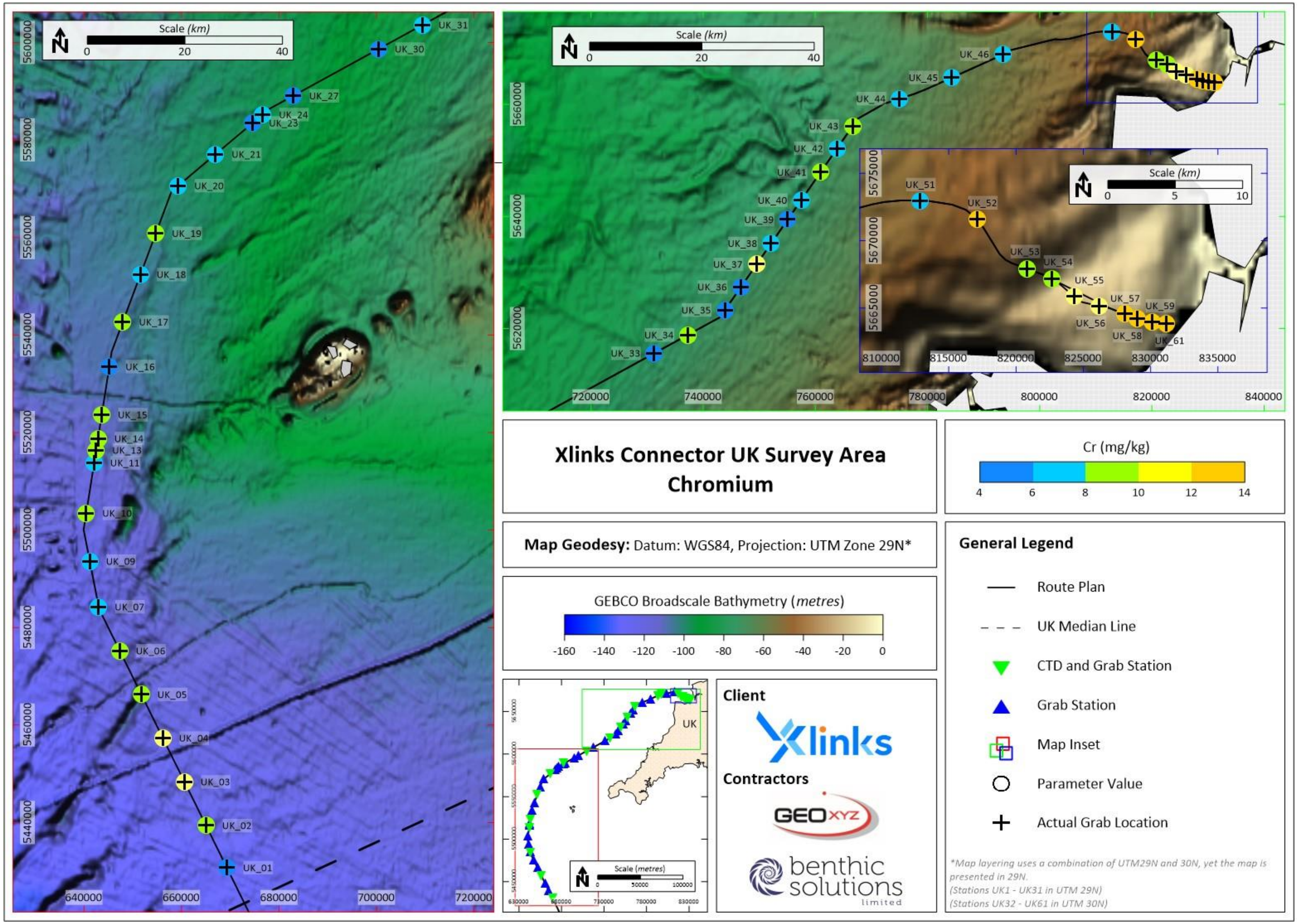


Figure 31: Concentration of chromium

4.7.2 Normalised Heavy Metals

Normalised heavy and trace metal data were calculated to allow comparison to OSPAR background concentrations (BCs) and background assessment concentrations (BACs; OSPAR, 2014). BCs have been derived from analysis of sub-surface core samples to quantify pristine, pre-industrial metal concentrations, while BACs provide threshold concentrations below which contaminants can be considered at background levels (OSPAR, 2009b). The normalisation of metals was undertaken using the current Coordinated Environmental Monitoring Programme (CEMP) normalisation procedure, involving the use of pivot values (OSPAR, 2009b). Some metals were environmentally inadmissible as the concentration of the normaliser contaminant was less than the normaliser pivot values and, as such, have been represented by '-'. Cadmium, mercury and tin could not be normalised at every station within the survey area as some concentrations were below their respective limits of detection. Any normalised results returning a negative or any values higher than the possible maximum concentrations are regarded as environmentally inadmissible by OSPAR CEMP guidance and, as such, were also excluded.

Metal concentrations were normalised to 5.8% aluminium and are displayed in Table 15, along with OSPAR BC and BACs. Normalised arsenic concentrations exceeded the respective OSPAR BC (15 $mg.kg^{-1}$) at four stations. Lead was above the OSPAR BC (15 $mg.kg^{-1}$) at 20 stations and was above the OSPAR BAC (25 $mg.kg^{-1}$) at seven stations. Nickel was also above its OSPAR BAC level of 0.07 $mg.kg^{-1}$ at 12 stations. However, there were no clear spatial patterns to the elevated concentration of these metals, suggesting the disparity is due to natural variations in the seabed sediment.

As the purpose of normalisation is to reduce sediment-induced variability in metal concentrations, the application of this normalisation method was of limited value for the proposed cable route. Furthermore, OSPAR notes that normalisation to aluminium may cause inconsistency when sediment is derived from glacial erosion of igneous rocks which may provide significant quantities of available aluminium.

Table 15: Normalised total heavy and trace metal concentrations

Station	Water Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	Arsenic	Chromium	Copper	Lead	Mercury	Nickel	Aluminium	Iron	Lithium	Tin
			$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$
UK_01	129	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	3.3	40.0	6.8	24.9	-	4.0	58,000	-	9.1	NC
UK_02	127	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	3.2	30.5	9.3	24.4	-	2.2	58,000	-	8.4	NC
UK_03	122	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	-	21.4	8.6	13.2	-	-	58,000	-	9.8	NC
UK_04	123	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	-	21.2	8.7	22.1	-	-	58,000	-	8.1	NC
UK_05	114	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	7.9	29.5	7.8	24.4	-	-	58,000	-	-	NC
UK_06	121	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	10.9	29.9	5.8	23.5	-	-	58,000	-	-	NC
UK_07	123	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	11.5	37.1	8.8	26.3	-	2.9	58,000	-	2.0	NC
UK_09	123	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	15.4	34.2	5.4	25.4	-	-	58,000	-	-	NC
UK_10	120	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	13.0	29.9	6.0	28.0	-	-	58,000	-	-	NC
UK_11	117	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	16.0	33.8	4.5	28.6	-	-	58,000	-	-	NC
UK_13	113	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	6.6	29.1	3.8	17.7	NC	-	58,000	-	-	NC
UK_14	114	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	15.7	29.4	-	25.4	NC	-	58,000	-	-	NC
UK_15	114	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	15.0	32.1	4.2	25.7	NC	-	58,000	-	-	NC
UK_16	111	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	4.6	39.1	9.8	29.0	NC	2.9	58,000	-	-	NC
UK_17	111	Circalittoral Sand (MC52/SS.SSa.CFiSa)	1.7	30.4	8.4	21.7	NC	0.0	58,000	-	-	NC
UK_18	109	Circalittoral Sand (MC52/SS.SSa.CFiSa)	7.5	36.0	7.7	20.5	NC	-	58,000	-	-	NC
UK_19	104	Circalittoral Sand (MC52/SS.SSa.CFiSa)	16.4	34.5	-	21.7	-	-	58,000	-	-	-
UK_20	102	Circalittoral Sand (MC52/SS.SSa.CFiSa)	7.0	33.7	5.4	20.8	-	-	58,000	-	-	NC
UK_21	100	Infralittoral Sand (MB52/SS.SSa.CFiSa)	-	36.7	8.4	-	NC	-	58,000	-	1.6	NC
UK_23	100	Infralittoral Sand (MB52/SS.SSa.CFiSa)	-	37.9	8.9	6.2	NC	3.0	58,000	-	2.5	NC
UK_24	100	Infralittoral Sand (MB52/SS.SSa.IFiSa)	-	34.7	5.0	23.1	NC	-	58,000	-	-	NC
UK_27	99	Infralittoral Sand (MB52/SS.SSa.IFiSa)	-	39.0	8.8	-	NC	0.0	58,000	-	1.6	NC
UK_30	93	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	-	42.3	9.5	15.5	NC	3.7	58,000	-	5.6	NC
UK_31	88	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	-	36.8	6.3	3.1	-	-	58,000	-	-	NC
UK_33	80	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	-	40.6	5.7	4.7	-	-	58,000	-	-	NC
UK_34	78	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	-	31.4	-	18.7	NC	-	58,000	-	-	NC
UK_35	74	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	-	39.3	8.9	21.5	NC	0.5	58,000	-	1.1	NC

Station	Water Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	Arsenic	Chromium	Copper	Lead	Mercury	Nickel	Aluminium	Iron	Lithium	Tin
			$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$	$mg.kg^{-1}$
UK_36	76	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	-	39.4	7.2	18.4	NC	0.2	58,000	-	-	NC
UK_37	76	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	-	25.7	-	22.2	NC	-	58,000	-	-	NC
UK_38	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	-	36.9	7.5	20.1	NC	3.7	58,000	-	3.2	NC
UK_39	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	-	37.6	9.6	24.9	-	4.0	58,000	-	4.9	NC
UK_40	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	-	34.9	8.2	18.7	NC	0.2	58,000	-	1.8	NC
UK_41	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	-	30.3	8.3	16.1	NC	1.9	58,000	-	1.0	NC
UK_42	74	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	-	33.7	7.4	12.3	NC	-	58,000	-	-	NC
UK_43	73	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	-	29.6	5.6	8.6	NC	-	58,000	-	-	-
UK_44	70	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	-	34.6	6.0	2.7	NC	-	58,000	-	-	-
UK_45	65	Circalittoral Sand (MC52/SS.SSa.CFiSa)	-	35.6	4.5	-	NC	-	58,000	-	-	-
UK_46	61	Circalittoral Sand (MC52/SS.SSa.CFiSa)	-	38.1	3.0	-	NC	-	58,000	-	-	NC
UK_51	52	Circalittoral Sand (MC52/SS.SSa.CFiSa)	-	37.3	-	-	NC	-	58,000	-	-	NC
UK_52	47	Circalittoral Sand (MC52/SS.SSa.CFiSa)	-	10.8	-	-	-	-	58,000	-	-	NC
UK_53	31	Infralittoral Sand (MB52/SS.SSa.CFiSa)	-	35.6	-	-	-	-	58,000	-	-	NC
UK_54	22	Infralittoral Sand (MB52/SS.SSa.CFiSa)	-	30.2	-	-	-	-	58,000	-	-	-
UK_55	24	Infralittoral Sand (MB52/SS.SSa.IFiSa)	-	27.4	-	-	-	-	58,000	-	-	-
UK_56	22	Infralittoral Sand (MB52/SS.SSa.IFiSa)	-	25.6	-	-	-	-	58,000	-	-	-
UK_57	20	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	-	13.7	-	-	-	-	58,000	-	-	-
UK_58	18	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	-	14.2	-	-	-	-	58,000	-	-	-
UK_59	13	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	-	11.8	-	-	-	-	58,000	-	-	-
UK_61	10	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	-	10.5	-	-	-	-	58,000	-	-	-
Reference Values												
OSPAR (2014) BC			**15**	**60**	**20**	**15**	**-**	**0.05**	**90**	**-**	**-**	**-**
OSPAR (2014) BAC			**25**	**81**	**27**	**25**	**-**	**0.07**	**122**	**-**	**-**	**-**

4.8 WATER COLUMN PROFILING

The structure of the water column was surveyed using a multi-parameter seawater profiler across the survey area. The profiler was fitted with sensors for conductivity (salinity), temperature, pressure (depth), dissolved oxygen (DO), pH, and turbidity. A total of 23 seawater profiles, spaced at approximately every three stations apart, were acquired during this sampling campaign. The multi-profiler was deployed attached to the Seabug camera frame allowing vertical water profiles to be acquired at the same time as camera transects, improving operational efficiency. At each station, the unit was submerged at the surface and allowed to acclimate to ambient sea conditions for approximately two minutes before deploying to the seabed and recovering the unit at a rate of approximately 0.5 m/s. Of note, the pH value at UK_ENV_CTD_31 typically differed to the other stations as the backup CTD was used. As a result, an offset of -0.2 has been applied so the pH values are more comparable. The data extremes for the water profiles are summarised in Table 16, with the full water profiles illustrated in Figure 32, Figure 33, Figure 34 and Figure 35.

Table 16: Seawater profile extremities for the survey area

Station	Extreme	Water Depth (m)	Conductivity (mS.cm^{-1})	Salinity (PSU)	pH (mV)	Temperature (°C)	Dissolved Oxygen (% sat.)	Turbidity* (FTU)
UK_ENV_CTD_01	Min.	0.0	40.4	0.0	8.2	11.8	89.7	-0.1
	Max.	127.9	47.1	36.1	8.3	18.7	104.5	3.9
UK_ENV_CTD_04	Min.	0.0	0.0	0.0	8.2	11.6	88.0	0.0
	Max.	123.2	47.1	36.2	8.2	19.4	102.0	1.1
UK_ENV_CTD_07	Min.	0.8	40.0	35.3	8.1	11.3	86.4	0.0
	Max.	121.2	47.1	35.7	8.2	18.8	103.4	1.4
UK_ENV_CTD_11	Min.	0.2	0.0	0.0	8.3	11.3	78.9	0.1
	Max.	118.0	47.5	35.6	8.2	19.3	93.5	2.3
UK_ENV_CTD_15	Min.	0.8	16.6	11.3	8.2	11.3	83.3	0.0
	Max.	111.1	46.9	35.6	8.4	11.1	100.7	1.7
UK_ENV_CTD_18	Min.	1.4	0.7	0.4	8.2	11.3	85.8	0.0
	Max.	108.2	46.9	35.6	8.3	18.6	106.0	1.0
UK_ENV_CTD_21	Min.	0.6	0.2	0.1	8.2	11.4	85.4	0.1
	Max.	101.1	46.6	4.8	8.3	18.5	105.9	4.8
UK_ENV_CTD_27	Min.	0.7	6.9	11.6	8.2	11.7	84.7	0.0
	Max.	100.1	46.6	18.4	8.3	18.3	103.3	0.8
UK_ENV_CTD_31	Min.	0.1	0.0	0.0	8.4	13.1	81.5	-0.2
	Max.	87.6	44.3	35.4	8.5	16.3	98.6	114.8
UK_ENV_CTD_34	Min.	0.4	44.4	35.2	8.3	16.2	95.7	0.1
	Max.	74.7	44.5	35.3	8.3	16.3	100.6	1.2
UK_ENV_CTD_37	Min.	0.3	44.5	35.3	8.2	16.3	92.0	0.2
	Max.	75.6	44.6	35.3	8.2	16.3	93.3	2.1
UK_ENV_CTD_40	Min.	0.3	42.9	35.3	8.2	14.5	83.5	0.0
	Max.	77.1	45.1	35.5	8.3	16.8	99.8	0.7
UK_ENV_CTD_43	Min.	1.0	43.0	35.2	8.2	14.7	85.1	0.0
	Max.	69.4	45.9	35.5	8.3	17.8	101.5	0.9

Station	Extreme	Water Depth (m)	Conductivity (mS.cm⁻¹)	Salinity (PSU)	pH (mV)	Temperature (°C)	Dissolved Oxygen (% sat.)	Turbidity* (FTU)
UK_ENV_CTD_46	Min.	0.4	0.2	0.1	8.2	15.8	84.8	0.1
	Max.	63.2	46.4	35.5	8.3	18.2	103.5	3.1
UK_ENV_CTD_52	Min.	0.0	40.4	30.9	8.2	17.2	98.4	3.8
	Max.	46.1	45.4	35.2	8.2	17.2	99.1	125.7
UK_ENV_CTD_53	Min.	0.1	45.5	35.0	8.3	17.6	102.9	1.6
	Max.	29.5	45.6	35.1	8.3	17.6	103.5	3.0
UK_ENV_CTD_54	Min.	0.2	45.3	35.1	8.2	17.3	98.0	3.2
	Max.	23.5	45.3	35.1	8.2	17.3	98.7	34.0
UK_ENV_CTD_55	Min.	0.1	45.2	35.0	8.3	17.3	96.3	3.8
	Max.	23.7	45.2	35.0	8.3	17.3	98.4	18.1
UK_ENV_CTD_56	Min.	0.0	45.1	35.0	8.2	17.3	94.8	3.0
	Max.	25.5	45.2	35.0	8.3	17.3	95.6	31.3
UK_ENV_CTD_57	Min.	0.0	44.6	34.5	8.2	17.3	85.3	5.8
	Max.	18.6	45.4	34.9	8.3	17.6	90.7	39.2
UK_ENV_CTD_58	Min.	0.4	44.6	34.6	8.3	17.2	99.8	6.3
	Max.	13.3	44.8	34.8	8.3	17.2	101.4	13.1
UK_ENV_CTD_59	Min.	0.4	44.0	34.1	8.3	17.0	87.8	6.0
	Max.	9.2	45.4	34.9	8.3	17.6	92.1	66.8
UK_ENV_CTD_61	Min.	0.1	44.6	34.5	8.3	17.3	94.9	17.3
	Max.	11.5	45.1	34.8	8.3	17.4	69.0	25.8
Reference Values								
CCME (1987) Marine Water Quality Guideline		-	-	-	**7.0-8.7**	-	-	-

Notes:
FTU = Formazin Turbidity Unit
PSU = Practical Salinity Unit

The temperature profiles of stations situated in offshore, deeper waters showed a clear thermocline present at ~30 m deep, with temperatures averaging at approximately 16 °C. The surface thermal maxima was seen at a temperature of 19.4 °C, recorded at station UK_ENV_CTD_04. The Gulf Stream is a warm, fast-flowing Atlantic Ocean current that originates in the Gulf of Mexico and flows up the eastern coastline of the United States, then veers East, flowing toward Northwest Europe as the North Atlantic Current. The Gulf Stream, in combination with the season of the survey and the shallow water depth, is a likely explanation for the warm surface temperatures seen across the survey area. Where stations were situated further offshore, the thermocline was more prevalent, with water temperature declining rapidly after this, from ~18 °C to ~11 °C once stabilised at depth. Due to stormy weather encountered during the survey, it is thought the water became more mixed; the thermocline which was present UK_ENV_CTD_43 and UK_ENV_CTD_46 on the 16th September 2023 was no longer present at the deeper and further offshore UK_ENV_CTD_34 and UK_ENV_CTD_37 on the 4th and 2nd of October 2023. From station UK_ENV_CTD_31 and above, the water depth became shallower at each additional site as the proposed cable route got closer to land, as a result of this the thermocline became less prevalent and the entire water column was deemed to be well mixed. All stations showed comparable temperature profiles.

Salinity remained relatively constant through the water column at stations located in deeper offshore waters, there was no clear halocline present; salinity very gradually increased from around 35.4 PSU to 35.7 PSU. Most stations at the shallower stations also demonstrated this trend, with the exception of UK_ENV_CTD_43 and UK_ENV_CTD_46 which both showed an increase in salinity at 15 m depth, from 35.4 PSU to 35.8 PSU before returning to 35.4 PSU at around 28 m depth. At these two stations, a thermocline was present at a similar depth, thus the slight change in mixing could be because of a resultant small halocline. At station UK_ENV_CTD_59 the salinity in the first 5 m of the water column was considerably lower than other stations in close proximity, approximately 34.2 PSU before decreasing to 25 PSU at around 10 m depth. It is worth noting that this station could be experiencing the effects of freshwater river outflow from the nearby River Taw, particularly when considering the stormy weather encountered during the survey and thus the likely increased runoff and river flow as a result of this.

The maximum depth of the water column profiled across the survey area is ~128 m; this depth is not considered to be deep enough for the presence of deep-water masses due to the lack of deep water circulation seen in shelf seas. As previously mentioned, the North Atlantic Current of the Gulf Stream influences the water column in the survey area and is likely one of the causes of the warm surface temperature seen. Furthermore, shelf sea seasonal stratification is also likely to influence the water profiles' characteristics, as data collection took place during September, a month well known to display some of the warmest surface temperatures annually due to surface waters absorbing solar radiation across the summer months.

At stations located in deeper offshore waters, the dissolved oxygen (DO) profile showed the top 30 m of the water column remained relatively stable, followed by a sharp decrease from around 100 % DO to approximately 90 % DO at about 35 m, after which reduction in DO became more gradual to a minimum of approximately 80 % DO at depths in excess of 60 m. This reflected the pattern seen in the thermocline. Below this depth, the DO remained stable. At stations located in shallower waters, the DO was stable through the water column with little to no fluctuation seen at approximately 100-106 % saturation; the super-saturation seen at these sites could be due to excessive photosynthetic activity caused by the presence of phytoplankton in surface waters.

The pH profile showed variation across sampling stations and followed the trend of stratification in deeper offshore waters, and well mixed, consistent readings through the water column at shallower stations, where more mixing occurs. At the deeper offshore stations (Figure 32), pH profiles followed those of temperature and dissolved oxygen whereby pH was elevated in surface waters (up to 30 m), ranging from 8.2 to 8.4, below the thermocline this slightly decreased to 8.1 where it remained constant to the seabed. At the stations located in shallower waters, where the water column was well mixed, pH remained relatively constant through the profile, fluctuating between stations between 8.2 and 8.3. All stations indicated pH values within the range of the CCME 1987 reference values (7.0-8.7), which is indicative of a healthy ecosystem. However, CCME values are based on data from Canadian lakes and therefore should be taken with caution in the context of the current survey.

Turbidity is a measure of the amount of cloudiness or haziness in seawater caused by individual particles too small to be seen without magnification**.** Turbidity remained fairly low across stations situated in offshore, deeper waters, with occasional increases through spot readings of suspended material. However, at the shallower nearshore stations, turbidity varied widely, ranging from 0 FTU to ~66 FTU at the bottom of the water column. The increase with depth seen at these stations, most notably at UK_ENV_CTD_57 was likely due to sediment resuspension from strong seabed currents during periods of bad weather.

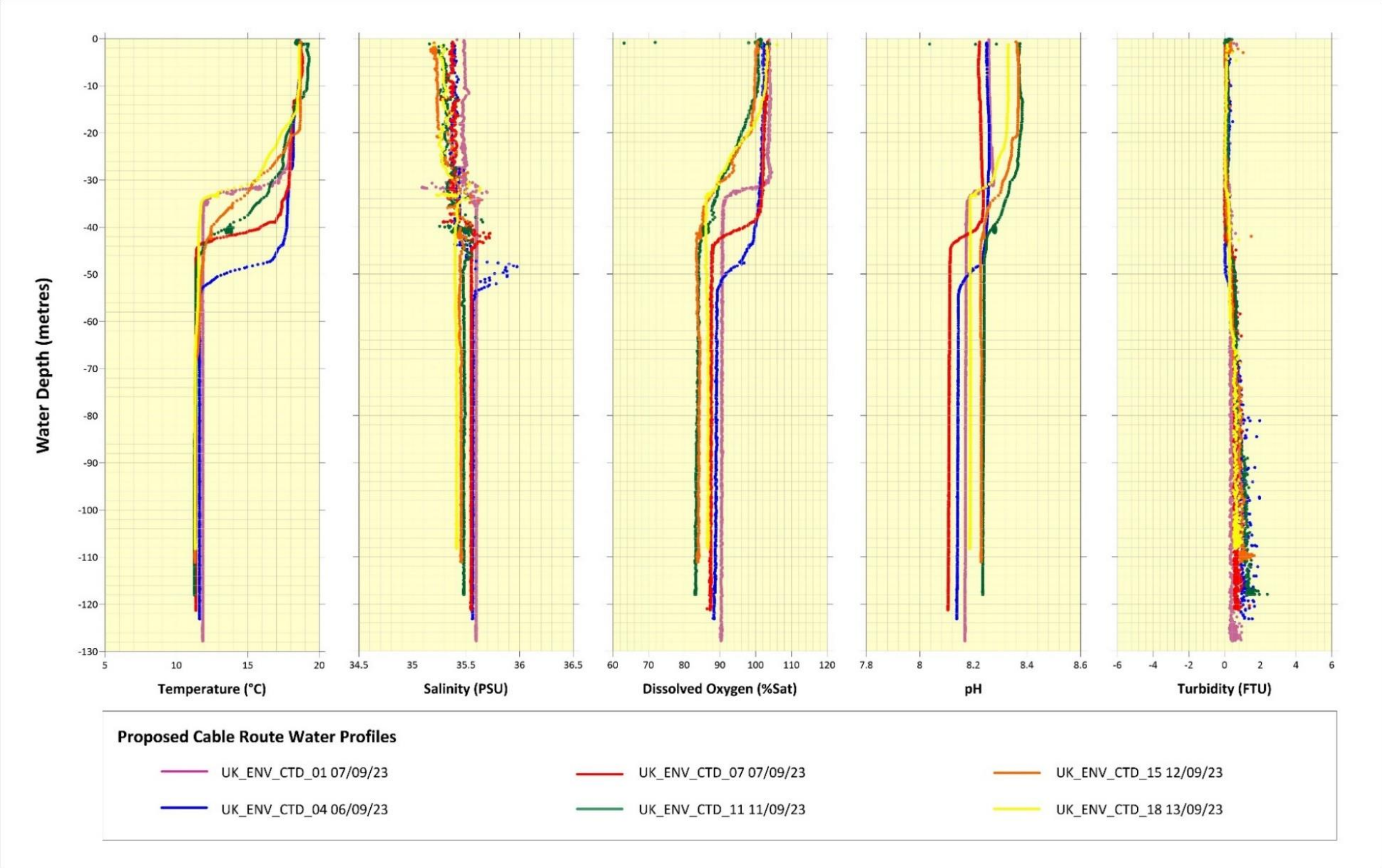


Figure 32: CTD profiles from stations UK_ENV_CTD_01 to UK_ENV_CTD_18

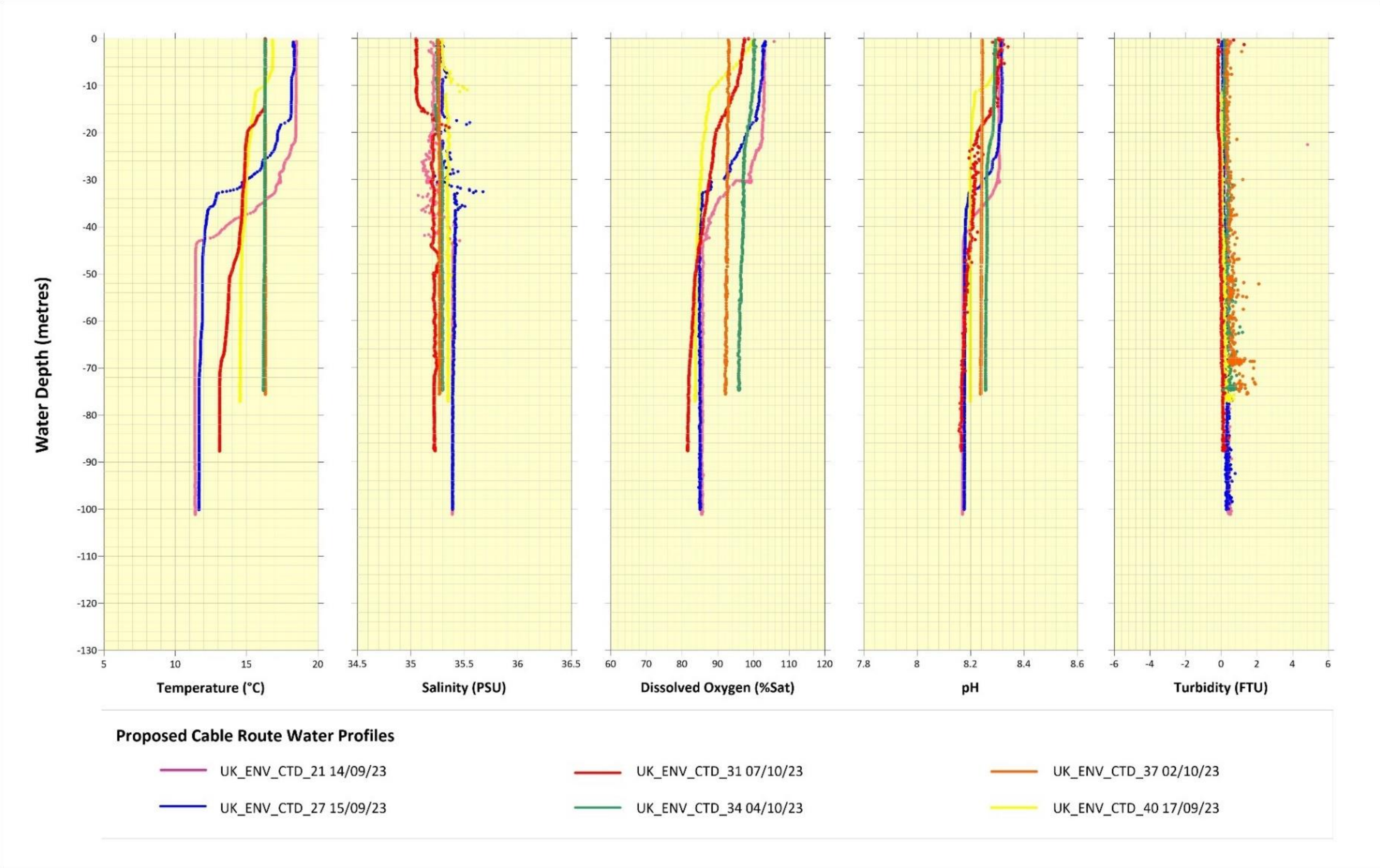


Figure 33: CTD profiles from stations UK_ENV_CTD_21 to UK_ENV_CTD_40

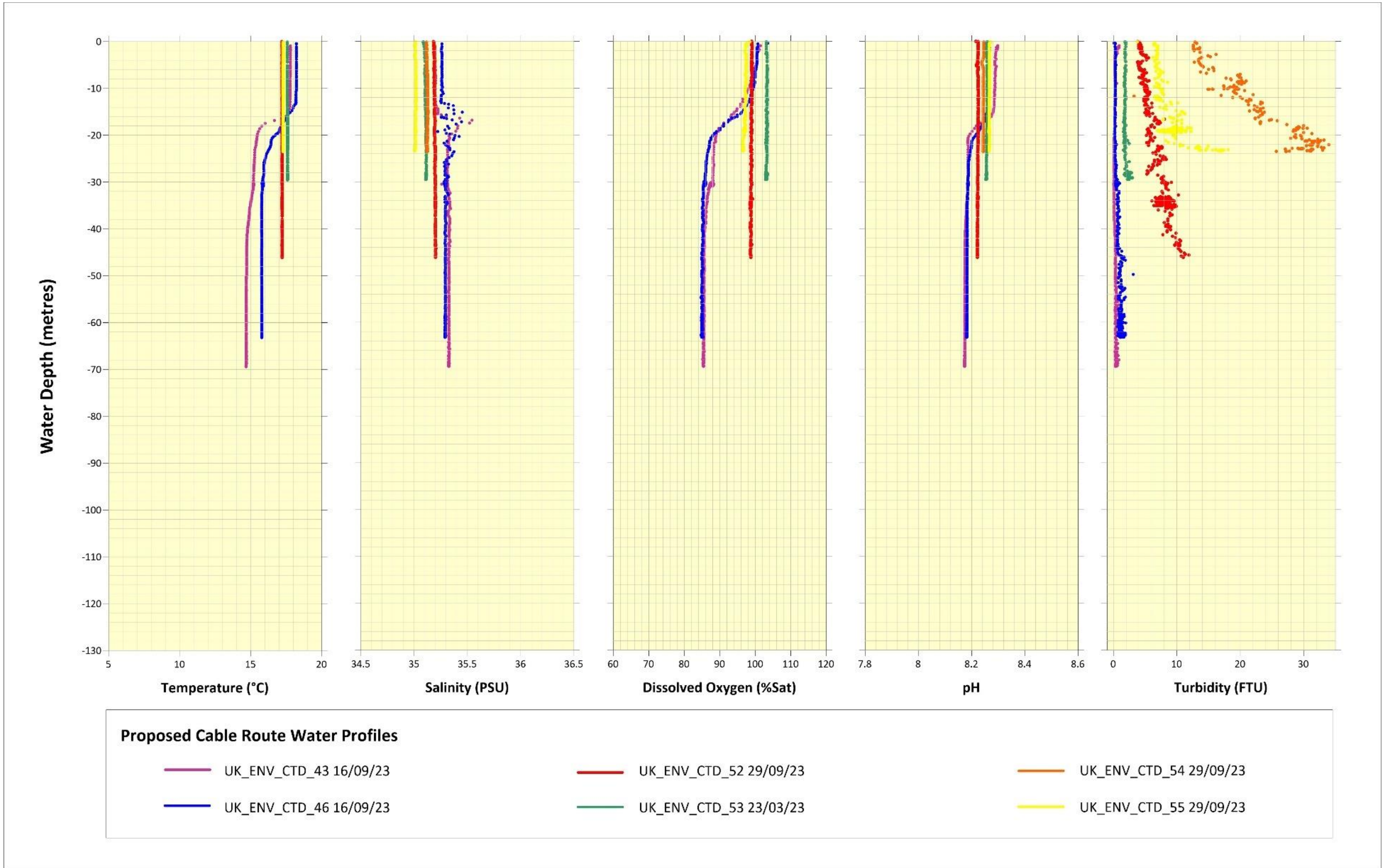


Figure 34: CTD profiles from stations UK_ENV_CTD_43 to UK_ENV_CTD_55

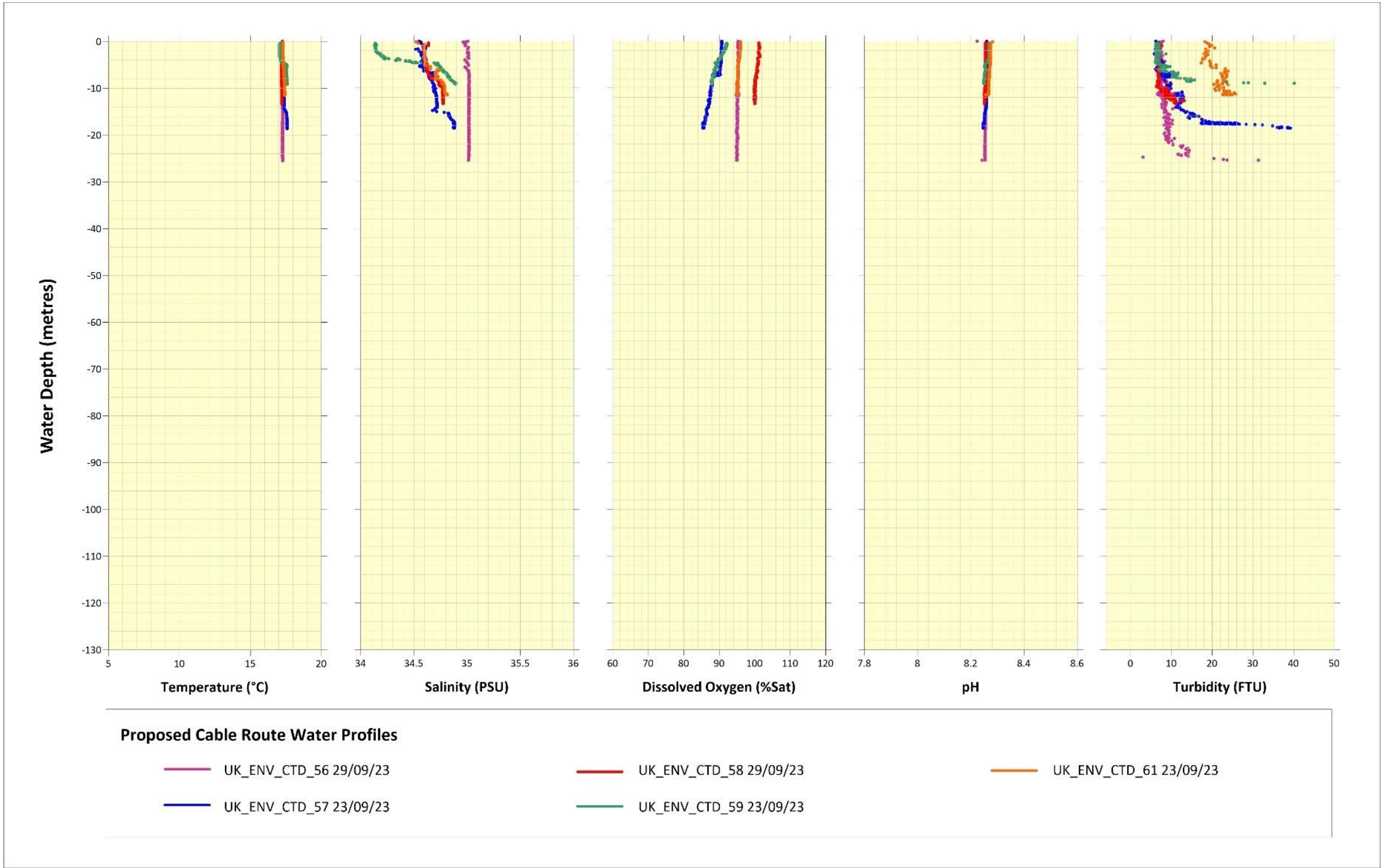


Figure 35: CTD profiles from stations UK_ENV_CTD_56 to UK_ENV_CTD_61

4.9 MACROFAUNAL ANALYSIS

Macrofaunal analysis was conducted on 96 grab replicates obtained at 48 baseline stations along the proposed UK route survey area. Macrofaunal samples were processed in the field over a 0.5 mm mesh sieve, with two replicates analysed per station.

For this assessment, epifaunal species have been separated into two categories: solitary epifauna and colonial epifauna. Solitary epifauna includes specimens that, although epifaunal in nature, are recorded in low counts. As such, solitary epifauna is often considered less ecologically important components of the marine benthos; this survey consisted of 17 species solitary species corresponding to five species of Cnidaria, four species of Annelida, four species of Chordata, two species of Arthropoda and one species of Porifera. Colonial epifauna included encrusting epifauna, typically recorded in high counts or as presence/absence. For this survey, they included 19 species of Cnidaria, 14 species of Bryozoa, three species of Entoprocta, one species of Porifera and one species of Chordata. Colonial epifauna have been omitted from this section of the analysis as they can only assessed on a presence/absence basis and they are discussed separately in Section 4.9.3.

Subsequent macrofaunal taxonomy of all recovered fauna identified 22,006 individuals (infauna and solitary epifauna) from the 96 samples analysed. Faunal data for each grab sample replicate are listed in Appendix R, whilst univariate analyses are summarised in Table 17 by replicate and Table 18 by station. Of the 593 taxa recorded, 17 were solitary epifauna, 55 were colonial epifauna and 521 were infauna. The infaunal taxa consisted of 247 annelid taxa accounting for 43.6 % of the total individuals. Echinodermata were represented by 18 taxa, accounting for 19.6 % of total individuals. Mollusca were represented by 103 species, accounting for 12.1 % of individuals. Arthropods were represented by 146 species, accounting for 9.3 % of individuals. All other groups (Foraminifera, Nematoda, Nemertea, Platyhelminthes, Phoronida, Hemichordata, Chordata) were represented by seven species, accounting for 13.8 % of the total individuals.

The ‘as sampled’ species accumulation curve (Figure 36) shows a relatively consistent and steady increase in fauna with every new grab. This analysis estimated the maximum species accumulation (Chao expected curve) for the survey to be 663 species, compared to the actual 538 infaunal species recorded during the survey. The number of species recorded exceeded the representative portion of the population (i.e. 67 % or 444 species) meaning no additional replicates would be required to sample 2/3 of the macrofaunal community.

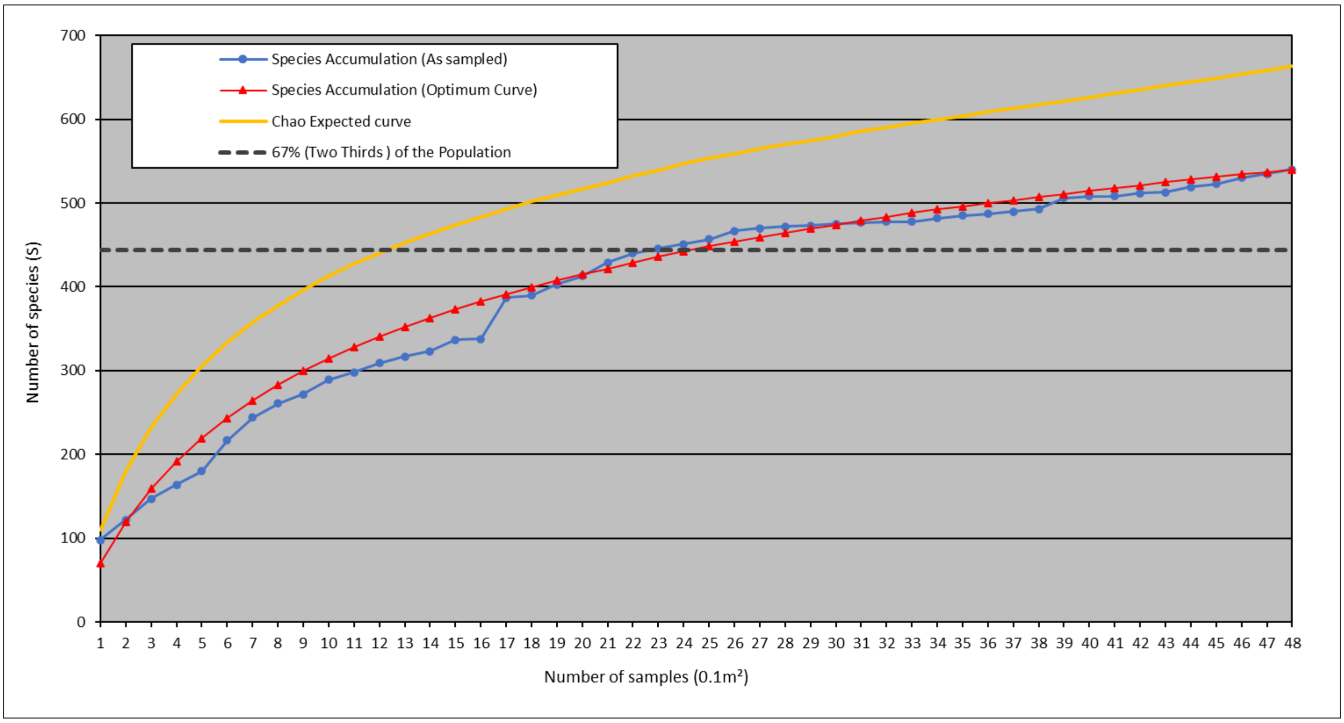


Figure 36: Species accumulation curve of the survey area

With the exception of species that have been intentionally grouped into higher taxonomic levels (e.g. Nemertea, Nematoda and Platyhelminthes), the majority of adult specimens were identified to genus level or lower (~90 %). A total of 53 juvenile taxa were recorded during the current survey area, it was not possible to ascribe these specimens to a particular species at this stage in their lifecycle and as such have been usually grouped to order level. Juveniles are often excluded from community analyses due to their high mortality prior to reaching maturity and difficulties in distinguishing species of the same genus. Consequently, they tend to induce a recruitment spike at certain times of the year due to rapid settlement and colonisation but are essentially an ephemeral part of the population masking the underlying trends within the mature adults.

Nematoda have been included in the macrofaunal analysis, as they can often serve as indicators of organic enrichment. However, as Nematoda vary in size, the estimates of their abundance may not be entirely accurate, with some likely to have passed through the 0.5 mm sieve during macrofauna sample processing.

4.9.1 Primary and Univariate Parameters

The primary and univariate parameters for all stations are listed by replicate in Table 17, by station in Table 18 and presented in Figure 37 to Figure 39.

The number of individuals per 0.1 m^2 were variable across the survey area, ranging from 11 per 0.1 m^2 for sample replicate UK_52_F1 to 931 per 0.1 m^2 for sample replicate UK_27_F2 (Table 17). The number of species per 0.1 m^2 replicate varied from 6 species per 0.1 m^2 for sample replicate UK_52_F1 to 101 species per 0.1 m^2 for sample replicate UK_19_F1. The station abundance per 0.2 m^2 (analysed by combining the results of both replicates) ranged from 30 individuals per 0.2 m^2 at station UK_54 to 1,365 individuals per 0.2 m^2 at station UK_27 (Figure 38). The number of species per station ranged from 21 at UK_53 to 139 at station UK_19 (Figure 37). When averaged out according to EUNIS level 4 classifications, stations assigned as 'Atlantic Offshore Circalittoral Mixed Sediment' (MD42) had the highest mean number of macrofaunal individuals (880), accompanied by a moderately low coefficient of variance (42.53 %). These results are in accordance with the increase in habitat availability of mud, sand and hard substrate. Lower average species richness was found in more uniform, sandy areas, classed 'Atlantic Circalittoral Sand' (MC52), with an average macrofaunal abundance of 85 individuals. However, not all sands dominated habitats displayed low faunal abundance, as high numbers of species such as *Echinocyamus pusillus* and *Abra prismatica* contributed to higher numbers for the 'Atlantic Circalittoral Sand' (MC52) habitat, with an average 676 individuals pr station, and a low coefficient of variation of 52.46 %.

Variations in species richness throughout the survey area showed a significant positive correlation to depth, as well as varying strongly significant correlations with variations in sediment characteristics (Appendix P). These results were in line with the heterogeneous sediment type along the proposed route survey area. There was a strong significant positive correlation between the proportion of fines and species richness ($\varrho(48)=0.556$, $p<0.001$) as well as with species abundance ($\varrho(48)=0.605$, $p<0.001$). These were mirrored by the strong negative correlation between the proportion of sands and species richness ($\varrho(48)=-0.638$, $p<0.001$) as well as with species abundance ($\varrho(48)=-0.528$, $p<0.001$). When averaged out according to EUNIS level 4 classifications, stations assigned as 'Atlantic Offshore Circalittoral Mixed Sediment' (MD42) had the highest mean number of species, 113, accompanied by a relatively low coefficient of variance (21.38 %). These results are in accordance with the increase in habitat availability of mud, sand and hard substrate. Lower average species richness was found in shallower sandy areas, classed as 'Atlantic Infralittoral Sand' (MB52) and 'Atlantic Circalittoral Sand' (MC52), with an average species number of 49 and 23 respectively. These habitats displayed moderately low coefficients of variance with 18.18 % and 25.31 %, in line with the uniform high sands content (88-99 %) found within these stations.

The Margalef index, a measure of species richness, ranged from 2.09 for replicate UK_52_F1 to 15.86 for replicate UK_19_F1 (Table 17). At station level (0.2 m^2) , Margalef's richness index ranged from 5.29 at UK53 to 19.7 at station UK_19 (Table 18). Evenness, assessed using Pielou's index, was lowest at station UK_42 (0.353) and highest at UK_54 (0.970). Sand dominated level 4 EUNIS habitat displayed higher evenness, with stations pertaining to the 'Atlantic Circalittoral Sand' classification displaying an average of 0.890, compared to those stations classed as 'Atlantic Offshore Circalittoral Coarse Sediment' (MD32), which displayed an average of 0.700.

Diversity values represented by the Shannon Wiener Diversity index ($\log^2$), which combines both species richness and evenness, ranged from bad to high diversity at replicate and station level, following the thresholds values outlined in Dauvin *et al* (2012), whereby values >4.00 indicate high diversity; between 3.00 and 4.00 indicate good diversity, between 2.00 and 3.00 indicate moderate diversity and between 1.00 and 2.00 indicate bad diversity, whilst values <1.00 indicate poor diversity. Simpson's Diversity (1-Lambda') index was variable within the survey area, ranging from a minimum of 0.411 at UK_45 to 0.977 at UK_54, with an average of 0.897 ± 0.09 SD, indicating a generally diverse macrofaunal community (Figure 39). When averaged out according to EUNIS level 4 classifications, sand dominated and mixed sediment stations displayed higher Simpson's diversity, with EUNIS habitat averages ranging from 0.907 to 0.946 (with low coefficients of variation, ranging from 1.1 % to 4.7 %). Though still moderately high, stations classed as MD32/SS.SCS.CCS 'Atlantic Offshore Circalittoral Coarse Sediment' displayed a mean Simpson's diversity of 0.873 (with a coefficient of variation of 8.4 %).

The Infaunal Quality Index (IQI) is a multi-metric index composed of three individual components, the AZTI Marine Biotic Index (AMBI), the Simpson's Dominance ($1-\lambda$) and the number of taxa (S), which together describe the ecological health of the biological quality element of the macrofauna. Each metric is normalised to a reference value, which is the expected value for that metric in the habitat type being assessed when there is minimal or no disturbance due to human activities. Almost all sample replicates and stations were considered to have either

"High / Good" (>0.75) or "Good / Moderate" (0.64-0.74) ecological status by IQI analysis. Only sample replicate UK_37_F2 was classed as only "Moderate" with a score of 0.63 (Table 17; WFD UKTAG, 2014).

Overall, the following results displayed a high diversity and variably distributed community across the proposed route survey area, with variations in spatial patterns correlating significantly to sediment characteristics and level 4 EUNIS habitat classifications.

Table 17: Univariate faunal parameters by replicate (per 0.1 m²)

Sample	Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	Number of Species (S)	Number of Individuals (N)	Richness (Margalef)	Evenness (Pielou's)	Shannon Wiener Diversity	Simpson's Diversity (1-Lambda')	IQI	Ecological Status (v4)
UK_01_F1	128.9	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	84	290	14.64	0.874	3.87	0.970	0.79	HIGH
UK_01_F2			53	136	10.58	0.862	3.42	0.948	0.78	HIGH
UK_02_F1	126.7	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	33	59	7.84	0.902	3.16	0.948	0.79	HIGH
UK_02_F2			37	97	7.86	0.868	3.13	0.941	0.77	HIGH
UK_03_F1	122.3	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	48	110	9.99	0.847	3.28	0.931	0.81	HIGH
UK_03_F2			53	180	10.01	0.823	3.27	0.930	0.82	HIGH
UK_04_F1	122.9	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	31	143	6.04	0.700	2.41	0.807	0.79	HIGH
UK_04_F3			43	137	8.53	0.849	3.20	0.941	0.78	HIGH
UK_05_F2	113.9	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	31	58	7.38	0.936	3.21	0.963	0.77	HIGH
UK_05_F3			32	68	7.34	0.901	3.12	0.951	0.79	HIGH
UK_06_F1	121.1	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	82	361	13.75	0.869	3.83	0.965	0.78	HIGH
UK_06_F2			66	224	12.01	0.872	3.66	0.962	0.73	GOOD
UK_07_F2	122.6	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	79	402	13.01	0.750	3.28	0.913	0.82	HIGH
UK_07_F3			75	280	13.13	0.857	3.70	0.963	0.79	HIGH
UK_09_F1	123.3	Circalittoral Sand (MC52/SS.SSa.CMuSa)	66	307	11.35	0.799	3.35	0.933	0.85	HIGH
UK_09_F2			59	217	10.78	0.859	3.50	0.958	0.80	HIGH
UK_10_F1	120.2	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	36	127	7.225	0.831	2.98	0.926	0.77	HIGH
UK_10_F2			57	275	9.97	0.791	3.20	0.933	0.85	HIGH
UK_11_F1	117.4	Circalittoral Sand (MC52/SS.SSa.CMuSa)	79	492	12.58	0.764	3.34	0.935	0.89	HIGH
UK_11_F2			81	512	12.82	0.809	3.56	0.951	0.91	HIGH
UK_13_F2	113.1	Circalittoral Sand (MC52/SS.SSa.CMuSa)	63	380	10.44	0.732	3.03	0.901	0.91	HIGH
UK_13_F3			64	280	11.18	0.820	3.41	0.937	0.85	HIGH
UK_14_F2	113.8	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	94	644	14.38	0.788	3.58	0.949	0.88	HIGH
UK_14_F3			81	522	12.78	0.783	3.44	0.942	0.86	HIGH
UK_15_F1	114.3	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	83	629	12.72	0.780	3.45	0.942	0.88	HIGH
UK_15_F3			98	714	14.76	0.745	3.42	0.938	0.86	HIGH

Sample	Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	Number of Species (S)	Number of Individuals (N)	Richness (Margalef)	Evenness (Pielou's)	Shannon Wiener Diversity	Simpson's Diversity (1-Lambda')	IQI	Ecological Status (v4)
UK_16_F1	111.4	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	62	437	10.03	0.676	2.79	0.850	0.78	HIGH
UK_16_F2			56	192	10.46	0.826	3.32	0.933	0.76	HIGH
UK_17_F2	110.9	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	52	188	9.739	0.681	2.69	0.821	0.86	HIGH
UK_17_F3			41	156	7.921	0.810	3.01	0.923	0.85	HIGH
UK_18_F1	108.8	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	42	209	7.675	0.702	2.62	0.817	0.83	HIGH
UK_18_F2			32	215	5.772	0.614	2.13	0.716	0.82	HIGH
UK_19_F1	104.1	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	101	547	15.86	0.771	3.56	0.925	0.73	GOOD
UK_19_F2			84	556	13.13	0.776	3.44	0.945	0.80	HIGH
UK_20_F1	102.4	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	43	112	8.901	0.819	3.08	0.919	0.81	HIGH
UK_20_F2			49	211	8.969	0.815	3.17	0.936	0.78	HIGH
UK_21_F1	100.4	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	44	328	7.423	0.616	2.33	0.757	0.81	HIGH
UK_21_F2			55	511	8.659	0.580	2.33	0.807	0.87	HIGH
UK_23_F2	99.7	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	53	381	8.75	0.715	2.84	0.881	0.73	GOOD
UK_23_F3			60	495	9.509	0.635	2.60	0.842	0.73	GOOD
UK_24_F1	99.7	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	75	486	11.96	0.752	3.25	0.921	0.74	GOOD
UK_24_F2			72	436	11.68	0.677	2.90	0.874	0.75	GOOD
UK_27_F1	98.8	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	63	434	10.21	0.641	2.66	0.817	0.83	HIGH
UK_27_F2			76	931	10.97	0.621	2.69	0.849	0.82	HIGH
UK_30_F1	92.7	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	55	561	8.531	0.557	2.23	0.771	0.83	HIGH
UK_30_F3			67	340	11.32	0.725	3.05	0.896	0.84	HIGH
UK_31_F2	88.3	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	36	103	7.552	0.828	2.97	0.912	0.83	HIGH
UK_31_F3			47	152	9.156	0.718	2.76	0.821	0.84	HIGH
UK_33_F2	79.7	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	52	166	9.977	0.862	3.40	0.951	0.79	HIGH
UK_33_F3			32	75	7.18	0.902	3.13	0.951	0.71	GOOD
UK_34_F1	77.7	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	60	223	10.91	0.821	3.36	0.926	0.74	GOOD
UK_34_F2			71	218	13	0.889	3.79	0.972	0.68	GOOD
UK_35_F1	74.3	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	21	74	4.647	0.839	2.56	0.902	0.77	HIGH
UK_35_F2			23	117	4.62	0.728	2.28	0.845	0.79	HIGH
UK_36_F2	75.8		43	201	7.92	0.667	2.51	0.780	0.83	HIGH

Sample	Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	Number of Species (S)	Number of Individuals (N)	Richness (Margalef)	Evenness (Pielou's)	Shannon Wiener Diversity	Simpson's Diversity (1-Lambda')	IQI	Ecological Status (v4)
UK_36_F3		Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	38	160	7.29	0.740	2.69	0.868	0.82	HIGH
UK_37_F1	76.0	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	51	127	10.32	0.904	3.56	0.968	0.69	GOOD
UK_37_F2			41	125	8.284	0.916	3.40	0.965	0.63	MODERATE
UK_38_F2	75.4	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	33	100	6.949	0.873	3.05	0.939	0.74	GOOD
UK_38_F3			39	85	8.553	0.909	3.33	0.959	0.76	HIGH
UK_39_F1	74.9	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	23	49	5.653	0.828	2.60	0.881	0.78	HIGH
UK_39_F2			25	59	5.886	0.766	2.47	0.828	0.81	HIGH
UK_40_F2	75.4	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	38	110	7.872	0.849	3.09	0.923	0.81	HIGH
UK_40_F3			35	87	7.613	0.876	3.11	0.929	0.79	HIGH
UK_41_F1	75.0	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	35	68	8.058	0.903	3.21	0.953	0.82	HIGH
UK_41_F2			35	127	7.019	0.741	2.64	0.832	0.80	HIGH
UK_42_F1	74.2	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	38	130	7.601	0.720	2.62	0.808	0.79	HIGH
UK_42_F2			49	203	9.034	0.7103	2.76	0.826	0.79	HIGH
UK_43_F2	73.5	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	41	107	8.56	0.804	2.98	0.880	0.79	HIGH
UK_43_F3			55	132	11.06	0.871	3.49	0.946	0.82	HIGH
UK_44_F1	70.4	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	40	104	8.397	0.841	3.10	0.929	0.76	HIGH
UK_44_F2			41	110	8.51	0.887	3.29	0.955	0.73	GOOD
UK_45_F1	65.4	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	24	87	5.15	0.622	1.98	0.688	0.77	HIGH
UK_45_F2			38	358	6.292	0.296	1.08	0.329	0.77	HIGH
UK_46_F2	60.6	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	68	379	11.28	0.658	2.77	0.785	0.74	GOOD
UK_46_F3			58	336	9.799	0.545	2.21	0.646	0.74	GOOD
UK_51_F1	52.4	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	79	406	12.99	0.765	3.34	0.900	0.74	GOOD
UK_51_F2			68	239	12.23	0.830	3.50	0.948	0.73	GOOD
UK_52_F1	46.6	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	6	11	2.085	0.934	1.67	0.873	0.66	GOOD
UK_52_F2			21	48	5.166	0.848	2.58	0.889	0.67	GOOD
UK_53_F1	31.2	Circalittoral Sand (MC52/SS.SSa.CFiSa)	10	12	3.622	0.979	2.25	0.970	0.77	HIGH
UK_53_F2			15	32	4.04	0.864	2.34	0.889	0.76	HIGH
UK_54_F1	21.6		10	13	3.509	0.958	2.21	0.949	0.68	GOOD

Sample	Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	Number of Species (S)	Number of Individuals (N)	Richness (Margalef)	Evenness (Pielou's)	Shannon Wiener Diversity	Simpson's Diversity (1-Lambda')	IQI	Ecological Status (v4)
UK_54_F2		Circalittoral Sand (MC52/SS.SSa.CFiSa)	13	17	4.235	0.977	2.51	0.971	0.75	HIGH
UK_55_F1	23.6	Circalittoral Sand (MC52/SS.SSa.CFiSa)	20	32	5.482	0.937	2.81	0.956	0.69	GOOD
UK_55_F3			14	21	4.27	0.944	2.49	0.948	0.71	GOOD
UK_56_F1	22.3	Circalittoral Sand (MC52/SS.SSa.CFiSa)	23	94	4.842	0.835	2.62	0.907	0.69	GOOD
UK_56_F2			26	117	5.25	0.824	2.68	0.901	0.68	GOOD
UK_57_F1	20.1	Infralittoral Sand (MB52/SS.SSa.CFiSa)	39	279	6.748	0.696	2.55	0.854	0.71	GOOD
UK_57_F2			19	107	3.852	0.714	2.10	0.813	0.67	GOOD
UK_58_F1	18.5	Infralittoral Sand (MB52/SS.SSa.CFiSa)	38	257	6.668	0.741	2.70	0.875	0.71	GOOD
UK_58_F2			41	225	7.385	0.856	3.18	0.941	0.69	GOOD
UK_59_F1	13.5	Infralittoral Sand (MB52/SS.SSa.CFiSa)	38	186	7.08	0.806	2.93	0.929	0.69	GOOD
UK_59_F3			41	178	7.719	0.809	3.01	0.924	0.73	GOOD
UK_61_F1	10.1	Infralittoral Sand (MB52/SS.SSa.CFiSa)	27	220	4.821	0.808	2.66	0.908	0.66	GOOD
UK_61_F2			32	202	5.84	0.847	2.94	0.936	0.66	GOOD
Mean			**47.9**	**233.7**	**8.8**	**0.825**	**2.90**	**0.893**	**0.78**	**-**
Standard Deviation			**21.5**	**180.9**	**3.0**	**0.101**	**0.52**	**0.127**	**0.06**	**-**
Coefficient of Variance (%)			**44.8**	**77.4**	**33.8**	**13.8**	**17.0**	**9.9**	**7.94**	**-**
Minimum			**6**	**11**	**2.085**	**0.2956**	**1.08**	**0.3293**	**0.63**	**-**
Maximum			**101**	**931**	**15.86**	**0.9788**	**3.87**	**0.9717**	**0.91**	**-**

IQI Score:
≥0.75 = High / Good; 0.64 - 0.74 = Good / Moderate; 0.45 - 0.63 = Moderate / Poor; ≤ 0.44= Poor / Bad

Table 18: Univariate faunal parameters by station (per 0.2 m²)

Station	Depth (m)	EUNIS/JNCC Habitat (‘Atlantic’ Prefix Excluded for Brevity)	Number of Species (S)	Number of Individuals (N)	Richness (Margalef)	Evenness (Pielou's)	Shannon Wiener Diversity	Simpson’s Diversity (1-Lambda')	IQI	Ecological Status (v4)
UK_01	128.9	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	98	426	16.02	0.859	5.68	0.970	0.79	HIGH
UK_02	126.7	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	58	156	11.29	0.883	5.17	0.962	0.79	HIGH
UK_03	122.3	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	74	290	12.88	0.815	5.06	0.935	0.81	HIGH
UK_04	122.9	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	56	280	9.76	0.753	4.37	0.899	0.79	HIGH
UK_05	113.9	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	51	126	10.34	0.884	5.01	0.956	0.77	HIGH
UK_06	121.1	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	106	585	16.48	0.850	5.72	0.968	0.78	HIGH
UK_07	122.6	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	117	682	17.78	0.766	5.26	0.941	0.82	HIGH
UK_09	123.3	Circalittoral Sand (MC52/SS.SSa.CMuSa)	94	524	14.85	0.790	5.17	0.947	0.85	HIGH
UK_10	120.2	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	69	402	11.34	0.770	4.70	0.933	0.77	HIGH
UK_11	117.4	Circalittoral Sand (MC52/SS.SSa.CMuSa)	110	1004	15.77	0.768	5.20	0.948	0.89	HIGH
UK_13	113.1	Circalittoral Sand (MC52/SS.SSa.CMuSa)	90	660	13.71	0.740	4.83	0.929	0.91	HIGH
UK_14	113.8	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	122	1166	17.14	0.758	5.21	0.946	0.88	HIGH
UK_15	114.3	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	126	1343	17.35	0.736	5.11	0.941	0.88	HIGH
UK_16	111.4	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	81	629	12.41	0.699	4.43	0.880	0.78	HIGH
UK_17	110.9	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	69	344	11.64	0.715	4.37	0.884	0.86	HIGH
UK_18	108.8	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	55	424	8.92	0.620	3.58	0.769	0.83	HIGH
UK_19	104.1	Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)	139	1103	19.73	0.761	5.42	0.946	0.73	HIGH
UK_20	102.4	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	69	323	11.77	0.787	4.81	0.934	0.81	HIGH
UK_21	100.4	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	70	839	10.25	0.585	3.58	0.805	0.81	HIGH
UK_23	99.7	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	83	876	12.11	0.630	4.01	0.859	0.73	GOOD
UK_24	99.7	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	106	922	15.38	0.686	4.62	0.902	0.74	HIGH
UK_27	98.8	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	99	1365	13.58	0.605	4.01	0.850	0.83	HIGH
UK_30	92.7	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	86	901	12.49	0.594	3.81	0.826	0.83	HIGH
UK_31	88.3	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	69	255	12.27	0.739	4.51	0.865	0.83	HIGH
UK_33	79.7	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	63	241	11.31	0.858	5.12	0.954	0.79	HIGH
UK_34	77.7	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	101	441	16.42	0.836	5.57	0.959	0.74	HIGH
UK_35	74.3	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	32	191	5.90	0.751	3.75	0.881	0.77	HIGH
UK_36	75.8	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	60	361	10.02	0.676	3.99	0.834	0.83	HIGH

Station	Depth (m)	EUNIS/JNCC Habitat ('Atlantic' Prefix Excluded for Brevity)	Number of Species (S)	Number of Individuals (N)	Richness (Margalef)	Evenness (Pielou's)	Shannon Wiener Diversity	Simpson's Diversity (1-Lambda')	IQI	Ecological Status (v4)
UK_37	76	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	68	252	12.12	0.878	5.34	0.968	0.69	GOOD
UK_38	75.4	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	55	185	10.34	0.862	4.98	0.950	0.74	HIGH
UK_39	74.9	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	37	108	7.68	0.770	4.01	0.853	0.78	HIGH
UK_40	75.4	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	54	197	10.03	0.825	4.75	0.924	0.81	HIGH
UK_41	75	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	53	195	9.86	0.777	4.45	0.886	0.82	HIGH
UK_42	74.2	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	65	333	11.02	0.690	4.16	0.819	0.79	HIGH
UK_43	73.5	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	70	239	12.60	0.818	5.01	0.920	0.79	HIGH
UK_44	70.4	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	59	214	10.81	0.846	4.98	0.949	0.76	HIGH
UK_45	65.4	Offshore Circalittoral Sand (MD52/SS.SSa.OSa)	48	445	7.70	0.353	1.97	0.411	0.77	HIGH
UK_46	60.6	Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)	85	715	12.78	0.584	3.74	0.724	0.74	HIGH
UK_51	52.4	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	107	645	16.31	0.768	5.17	0.923	0.74	HIGH
UK_52	46.6	Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)	25	59	5.88	0.835	3.88	0.891	0.66	GOOD
UK_53	31.2	Circalittoral Sand (MC52/SS.SSa.CFiSa)	21	44	5.28	0.866	3.80	0.913	0.77	HIGH
UK_54	21.6	Circalittoral Sand (MC52/SS.SSa.CFiSa)	22	30	6.17	0.969	4.32	0.977	0.68	GOOD
UK_55	23.6	Circalittoral Sand (MC52/SS.SSa.CFiSa)	24	53	5.79	0.937	4.29	0.957	0.69	GOOD
UK_56	22.3	Circalittoral Sand (MC52/SS.SSa.CFiSa)	35	211	6.35	0.787	4.03	0.907	0.69	GOOD
UK_57	20.1	Infralittoral Sand (MB52/SS.SSa.CFiSa)	42	386	6.88	0.669	3.60	0.843	0.71	GOOD
UK_58	18.5	Infralittoral Sand (MB52/SS.SSa.CFiSa)	59	482	9.38	0.786	4.62	0.930	0.71	GOOD
UK_59	13.5	Infralittoral Sand (MB52/SS.SSa.IFiSa)	54	364	8.98	0.778	4.48	0.929	0.69	GOOD
UK_61	10.1	Infralittoral Sand (MB52/SS.SSa.IFiSa)	41	422	6.61	0.785	4.20	0.924	0.66	GOOD
Mean			**70.4**	**467.5**	**11.5**	**0.812**	**4.53**	**0.915**	**0.78**	**HIGH**
Standard Deviation			**29.1**	**342.5**	**3.6**	**0.141**	**0.73**	**0.166**	**0.06**	**-**
Coefficient of Variance (%)			**41.4**	**73.3**	**31.7**	**14.2**	**15.6**	**10.1**	**7.8**	**-**
Minimum			**21**	**30**	**5.285**	**0.3534**	**1.974**	**0.4114**	**0.66**	**GOOD**
Maximum			**139**	**1365**	**19.7**	**0.9695**	**5.721**	**0.977**	**0.91**	**HIGH**

Station	Depth (m)	EUNIS/JNCC Habitat (‘Atlantic’ Prefix Excluded for Brevity)	Number of Species (S)	Number of Individuals (N)	Richness (Margalef)	Evenness (Pielou's)	Shannon Wiener Diversity	Simpson’s Diversity (1-Lambda')	IQI	Ecological Status (v4)
Habitat Comparison										
Atlantic Infralittoral Sand (MB52/SS.SSa.IFiSa)		**Mean**	**49**	**414**	**7.97**	**0.755**	**4.23**	**0.907**	**0.69**	**GOOD**
		SD	**9**	**52**	**1.42**	**0.057**	**0.45**	**0.042**	**0.02**	**-**
		CV (%)	**18.2**	**12.5**	**17.8**	**7.6**	**10.6**	**4.7**	**3.41**	**-**
Atlantic Circalittoral Sand (Fine Sand) (MC52/SS.SSa.CFiSa)		**Mean**	**26**	**85**	**5.90**	**0.890**	**4.12**	**0.939**	**0.71**	**GOOD**
		SD	**6**	**85**	**0.47**	**0.081**	**0.24**	**0.034**	**0.03**	**-**
		CV (%)	**25.3**	**100.4**	**8.0**	**9.1**	**5.9**	**3.6**	**1.64.**	**-**
Atlantic Circalittoral Sand (Muddy Sand) (MC52/SS.SSa.CMuSa)		**Mean**	**98**	**729**	**14.78**	**0.768**	**5.08**	**0.942**	**0.88**	**HIGH**
		SD	**11**	**247**	**1.03**	**0.023**	**0.21**	**0.011**	**0.03**	**-**
		CV (%)	**10.8**	**33.9**	**7.0**	**2.9**	**4.1**	**1.1**	**3.5**	**-**
Atlantic Offshore Circalittoral Sand (MD52/SS.SSa.OSa)		**Mean**	**59**	**269**	**10.48**	**0.761**	**4.45**	**0.875**	**0.80**	**HIGH**
		SD	**12**	**100**	**1.85**	**0.127**	**0.79**	**0.131**	**0.03**	**-**
		CV (%)	**19.5**	**37.3**	**17.6**	**16.7**	**17.8**	**15.0**	**3.7**	**-**
Atlantic Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)		**Mean**	**66**	**352**	**11.14**	**0.802**	**4.53**	**0.908**	**0.70**	**GOOD**
		SD	**58**	**414**	**7.43**	**0.048**	**0.92**	**0.022**	**0.06**	**-**
		CV (%)	**87.9**	**117.7**	**66.7**	**6.0**	**20.3**	**2.5**	**8.1**	**-**
Atlantic Offshore Circalittoral Coarse Sediment (MD32/SS.SCS.OCS)		**Mean**	**83**	**676**	**12.83**	**0.700**	**4.44**	**0.873**	**0.77**	**HIGH**
		SD	**15**	**355**	**1.75**	**0.113**	**0.68**	**0.073**	**0.05**	**-**
		CV (%)	**17.6**	**52.5**	**13.6**	**16.2**	**15.2**	**8.4**	**6.3**	**-**
Atlantic Offshore Circalittoral Mixed Sediment (MD42/SS.SMx.OMx)		**Mean**	**113**	**880**	**16.63**	**0.773**	**5.24**	**0.946**	**0.81**	**HIGH**
		SD	**24**	**374**	**2.81**	**0.040**	**0.34**	**0.012**	**0.06**	**-**
		CV (%)	**21.4**	**42.5**	**16.9**	**5.2**	**6.4**	**1.3**	**7.6**	**-**

IQI Score:
≥0.75 = High / Good; 0.64 - 0.74 = Good / Moderate; 0.45 - 0.63 = Moderate / Poor; ≤ 0.44= Poor / Bad

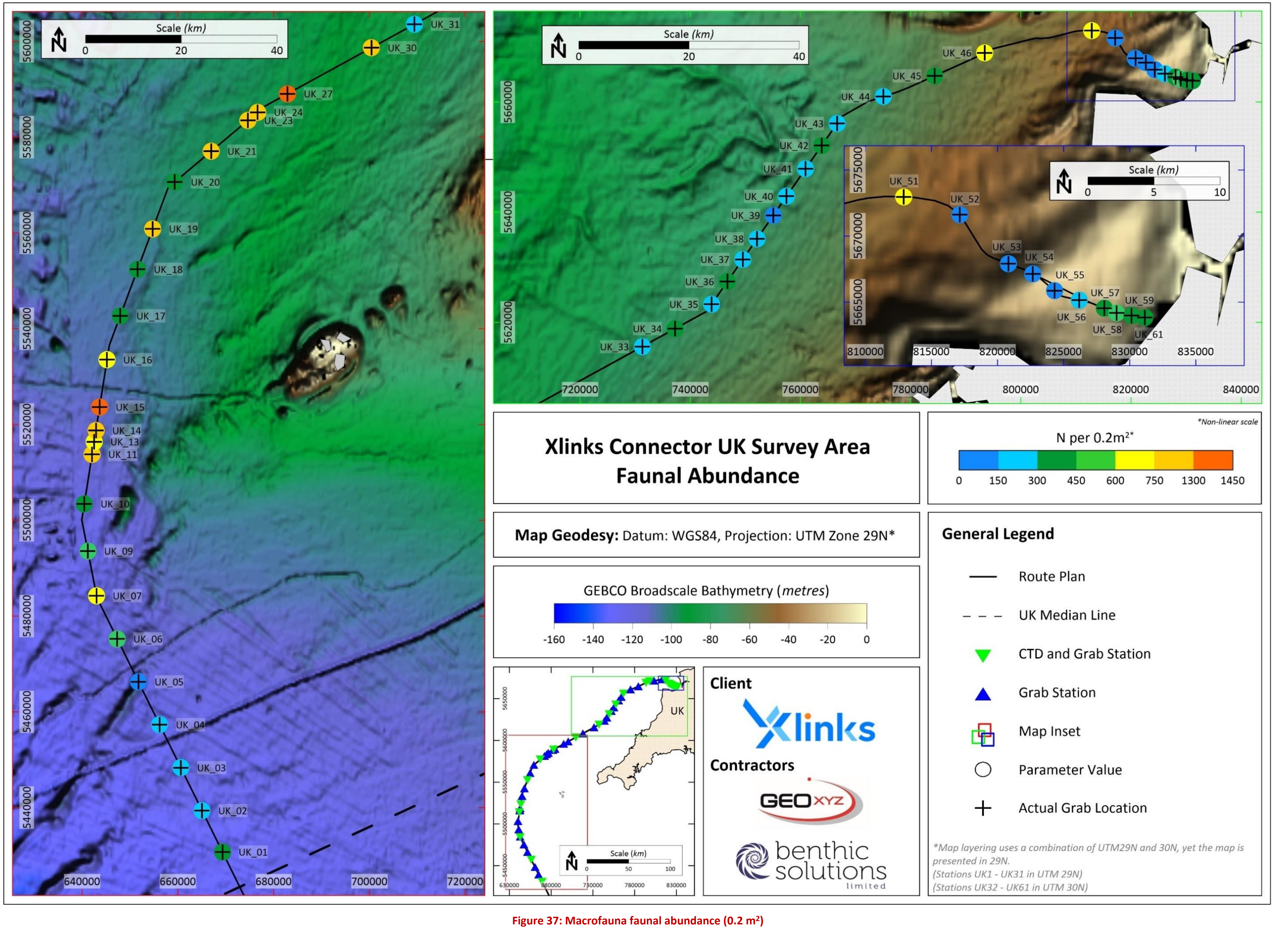


Figure 37: Macrofauna faunal abundance (0.2 m²)

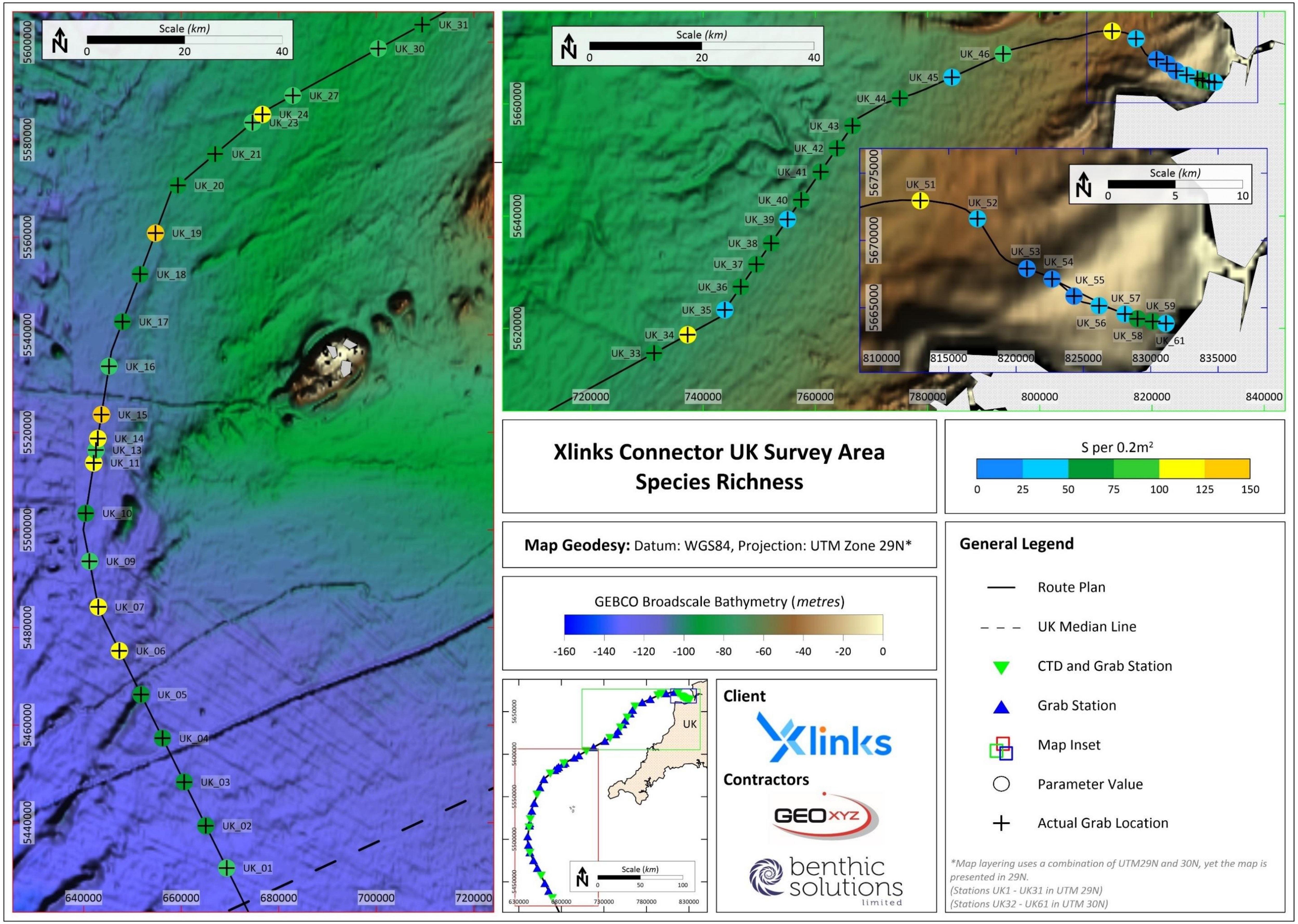


Figure 38: Macrofauna species richness (0.2 m²)

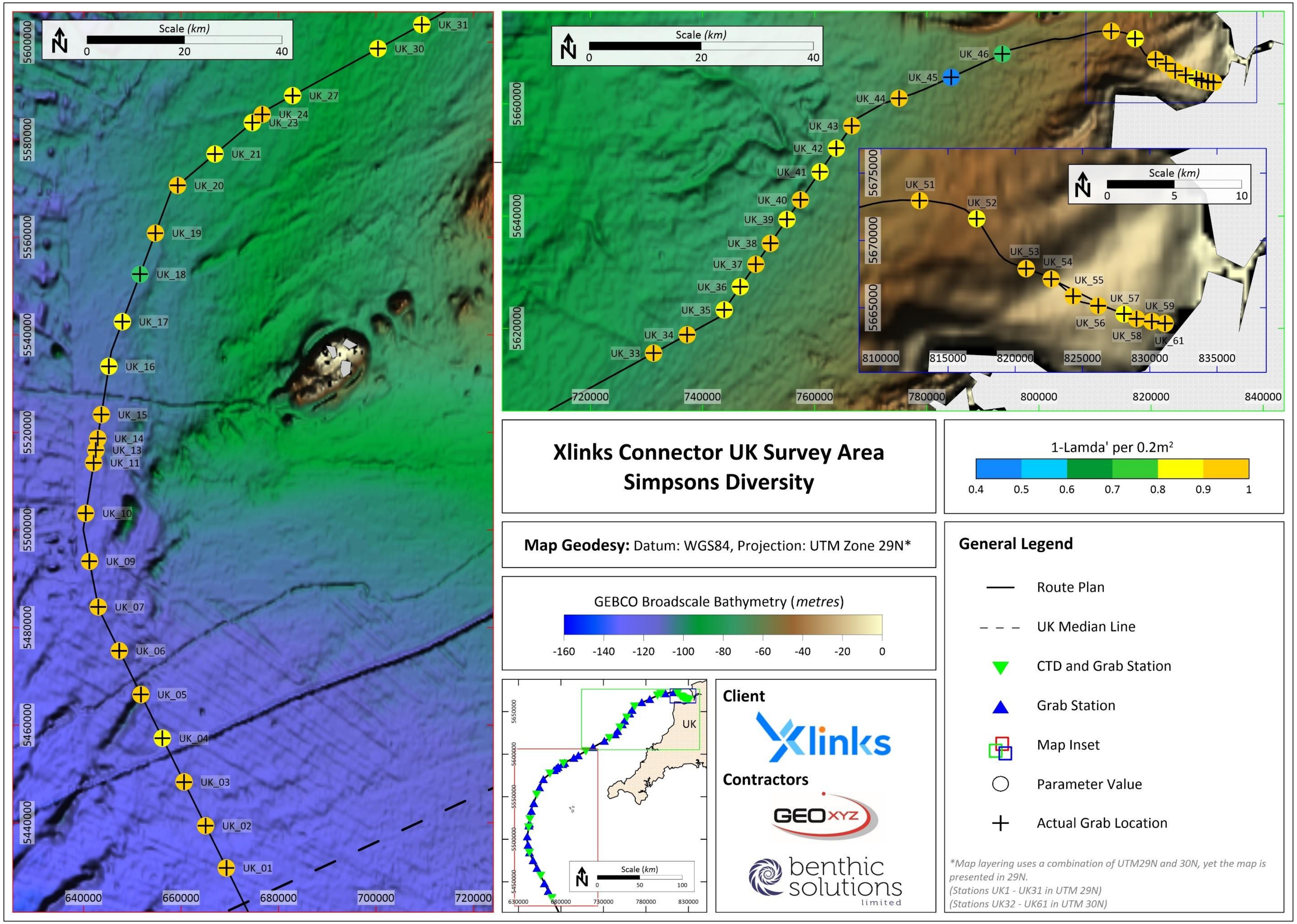


Figure 39: Macrofauna Simpson's diversity (1-lambda') per 0.2 m²

4.9.2 Multivariate Analysis

To thoroughly examine the macrofaunal community, multivariate analysis was performed on the replicate and station data using Plymouth Routines in Multivariate Ecological Research software (PRIMER 7.0.17; Clarke *et al.*, 2014) to illustrate data trends. Unlike univariate or derived diversity indices, multivariate analyses preserve the identity of the different species by assigning a similarity or dissimilarity between the samples based on differences in the abundances of constituent species. All data were squared-root transformed prior to analysis to down-weight the influence of any dominant species between sample similarities/dissimilarities.

a Hierarchical Agglomerative Clustering – Group Average Method

A similarity dendrogram was created using hierarchical agglomerative clustering (CLUSTER) and is presented for all replicates (Figure 40). SIMPROF analysis highlighted the presence of 29 significantly different ($p<0.05$) clusters comprising one or more sample replicates (0.1 m^2) which were differentiated by black branches on the dendrogram. Sample replicates displayed inter-sample Bray Curtis similarities of between approximately 20 % to 75 %. Nearly all of the sample replicates from the same station grouped within the same cluster except for UK_02, UK_31, UK_52 and UK_57.

The macrofauna dataset was pooled to station level (0.2 m^2) to better characterise broad-scale spatial variation in species assemblages within the survey area. A further similarity dendrogram was produced (Figure 41) following hierarchical agglomerative clustering. At a station level, the SIMPROF test revealed the presence of 24 significantly different structural groupings. This was thought to have over-differentiated the dataset so to provide a more relevant interpretation of the survey dataset, a slice was overlain of the SIMPROF clusters at a similarity of 35 %. The slice split the dataset into 11 significantly different cluster groups. The high number of macrofaunal clusters was expected giving the heterogeneous nature of the seabed along the route survey area, and clusters are thought to reflect the variable level 5 EUNIS habitat classifications.

Table 19: Summary of Slice 35 SIMPROF station groupings

SIMPROF Group	Similarity (%)	Stations	Interpretation
‘a’	40.87	UK_01, UK_02, UK_03, UK_04, UK_17, UK_18, UK_20, UK_39, UK_40, UK_41, UK_42, UK_43, UK_44	This cluster comprised thirteen stations. These stations were assigned the Folk Classifications of Sand, Gravelly Sand and Slightly Gravelly Sand. Distributed along the majority of the route, these stations had higher proportions of sands aligning with cluster ‘*b*’ from the multivariate particle size analysis. Moderate levels of species richness and faunal abundance were recorded, comprising mainly polychaetes with Nematoda, Nemertea and a dominance of *Echinocyamus pusillus* and the bivalve *Abra prismatica.*
‘b’	42.78	UK_16, UK_21, UK_23, UK_24, UK_27, UK_30, UK_31, UK_33, UK_36, UK_37, UK_38, UK_46	This cluster was similar to the macrofaunal community observed in cluster ‘*a*’. The twelve stations within this cluster also displayed a similar spatial distribution but comprised a higher proportion of coarse sands and gravels in comparison. Folk classifications included Gravelly Sand, Slightly Gravelly Sand, Gravelly Muddy Sand and Sandy Gravel. In general, these stations had higher faunal abundances and species richness than cluster ‘*a*’. Similar to cluster ‘*a*’, the macrofauna community mainly comprised Nematoda and *E. pusillus* but included the presence of polychaetes such as *Protodorvillea kefersteini*.
‘c’	-	UK_35	This cluster comprised a single station, UK_35, with similar macrofaunal composition to clusters ‘*a*’ and ‘*b*’, yet with significantly lower abundances. The species poor station was also dominated by Nematoda and *E. pusillus* and represents an impoverished version of the macrofaunal assemblage associated with this sediment type along the route.
‘d’	41.47	UK_34 UK_51	This cluster comprised two stations that recorded relatively high species richness, mainly polychaetes but with a particular dominance of the ross worm, *Sabellaria spinulosa,* not observed in other stations. The macrofaunal composition of the cluster showed similarities to clusters ‘*a*’, ‘*b*’ and ‘*c*’, and could be considered to represent the variable coarse sediment macrofaunal assemblages present along the route.
‘e’	-	UK_45	A Folk classification of Slightly Gravelly Sand and relatively low/ no abundance of many previous characterising species, resulted in the macrofaunal communities of UK_45, making up this cluster. Dominating species included the ubiquitous *E. pusillus* but with the additional presence of species such as *Amphiura filiformis* and *Ophelia celtica*, differentiating this station from others along the route.
‘f’	-	UK_05	The impoverished macrofaunal community recorded at UK_05 resulted in the clustering out of this station from all others along the route. Assigned to the Folk classification of Slightly Gravelly Muddy Sand, dominating species included *Lumbrineris cingulata* and *Spiophanes kroyeri*, despite the relatively low abundances of these species.
‘g’	-	UK_19	Although showing similar characteristics to stations within cluster ‘*h*’, from a gravelly, muddy sand seabed, U_19 displayed a generally lower species richness and abundance, causing the differentiation of this station.
‘h’	50.40	UK_06, UK_07, UK_09, UK_10, UK_11, UK_13, UK_14, UK_15	This cluster contained eight stations primarily composed of fine, mixed sediments, specifically Gravelly Muddy Sand and Muddy Sand, characterised by the polychaetes *Magelona minuta* and *Ampharete falcata*, in addition to Nematoda and Nemertea.
‘i’	42.79	UK_56, UK_57, UK_58, UK_59, UK_61	Comprising stations exclusively located within the nearshore section of the route, in water depths of less than 22 m, the Folk classifications of these stations included Sand and Muddy Sand. In general, species richness and faunal abundances were relatively low with a dominance of bivalves such as *Nucula nitidosa* and *Abra alba.*
‘j’	-	UK_52	A significantly low abundance and species diversity defined the macrofaunal community within this cluster, comprising a single station, UK_52. The high proportion of pebbles observed at this station resulted in a smaller sample size and contributed to the limited faunal composition.
‘k’	42.16	UK_53, UK_54, UK_55	This final cluster consisted of three stations situated in the nearshore zone, in depths of between 22 m and 31 m. The sand dominated habitat resulted in relatively low species diversities and faunal abundances across these stations, being characterised by low numbers of *Megaluropus agilis, E. pusillus* and Nemertea.

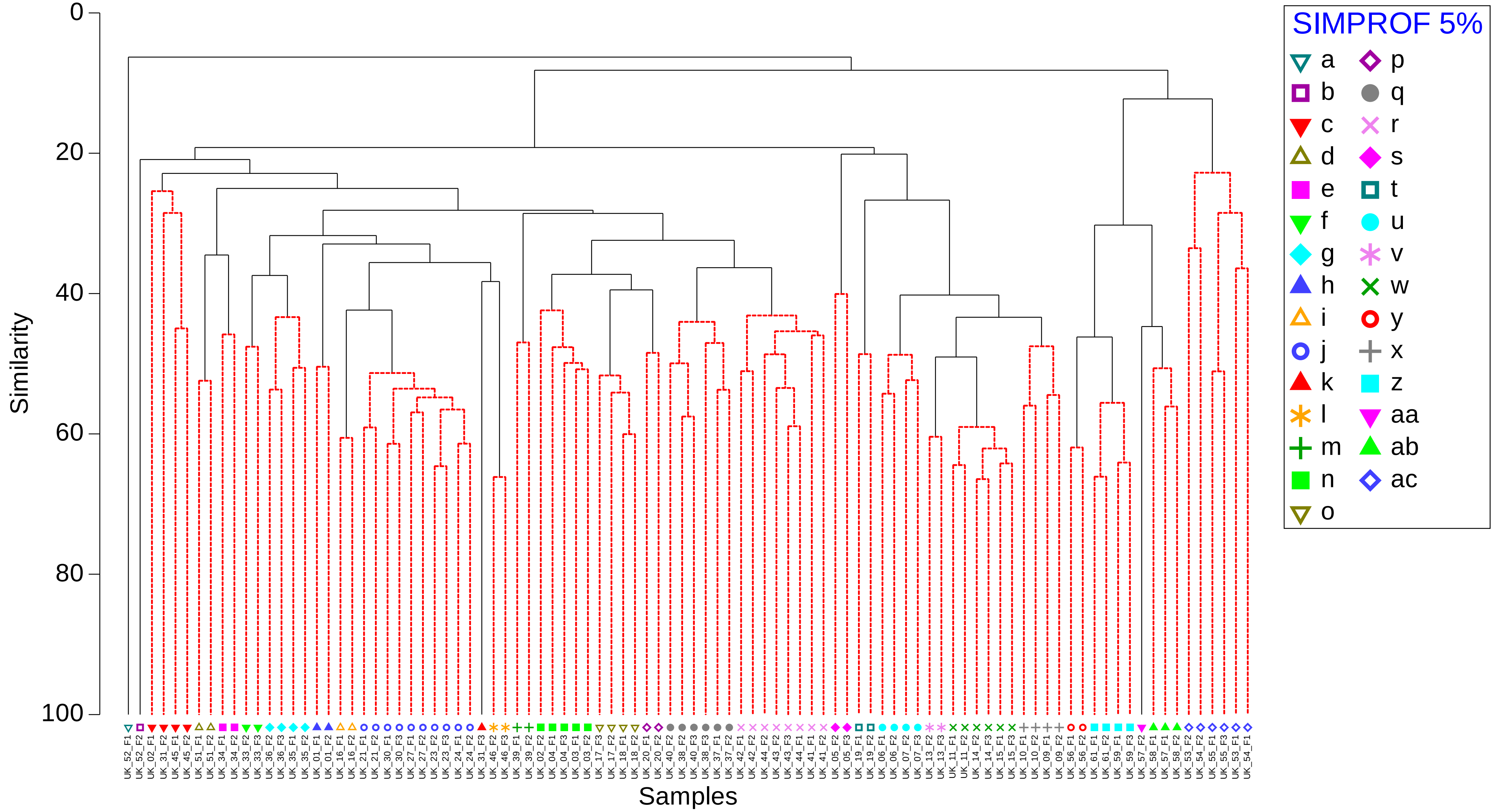


Figure 40: Dendrogram of macrofaunal replicates (per 0.1 m^2)

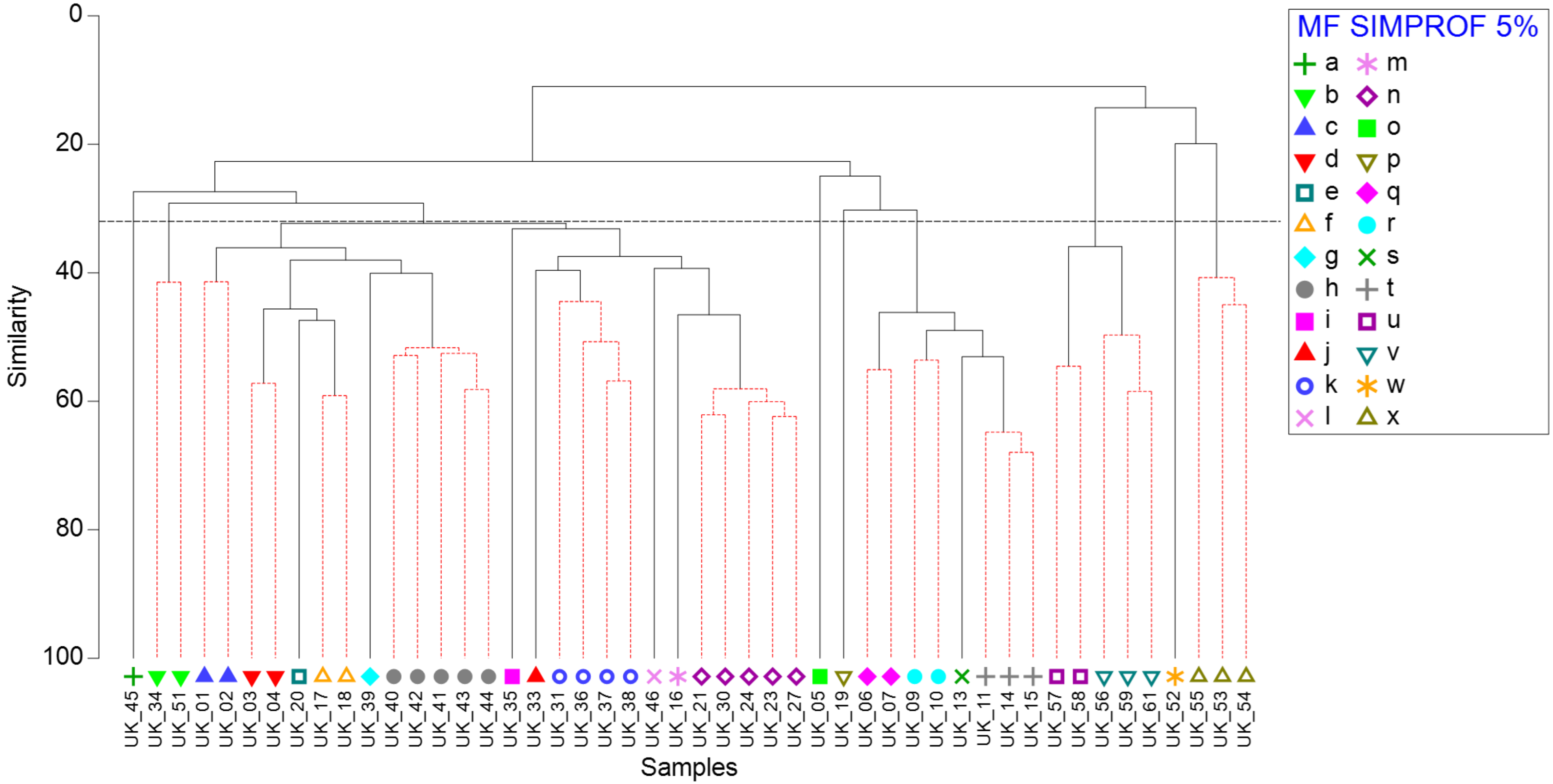


Figure 41: Dendrogram of macrofaunal stations (per 0.2 m²)

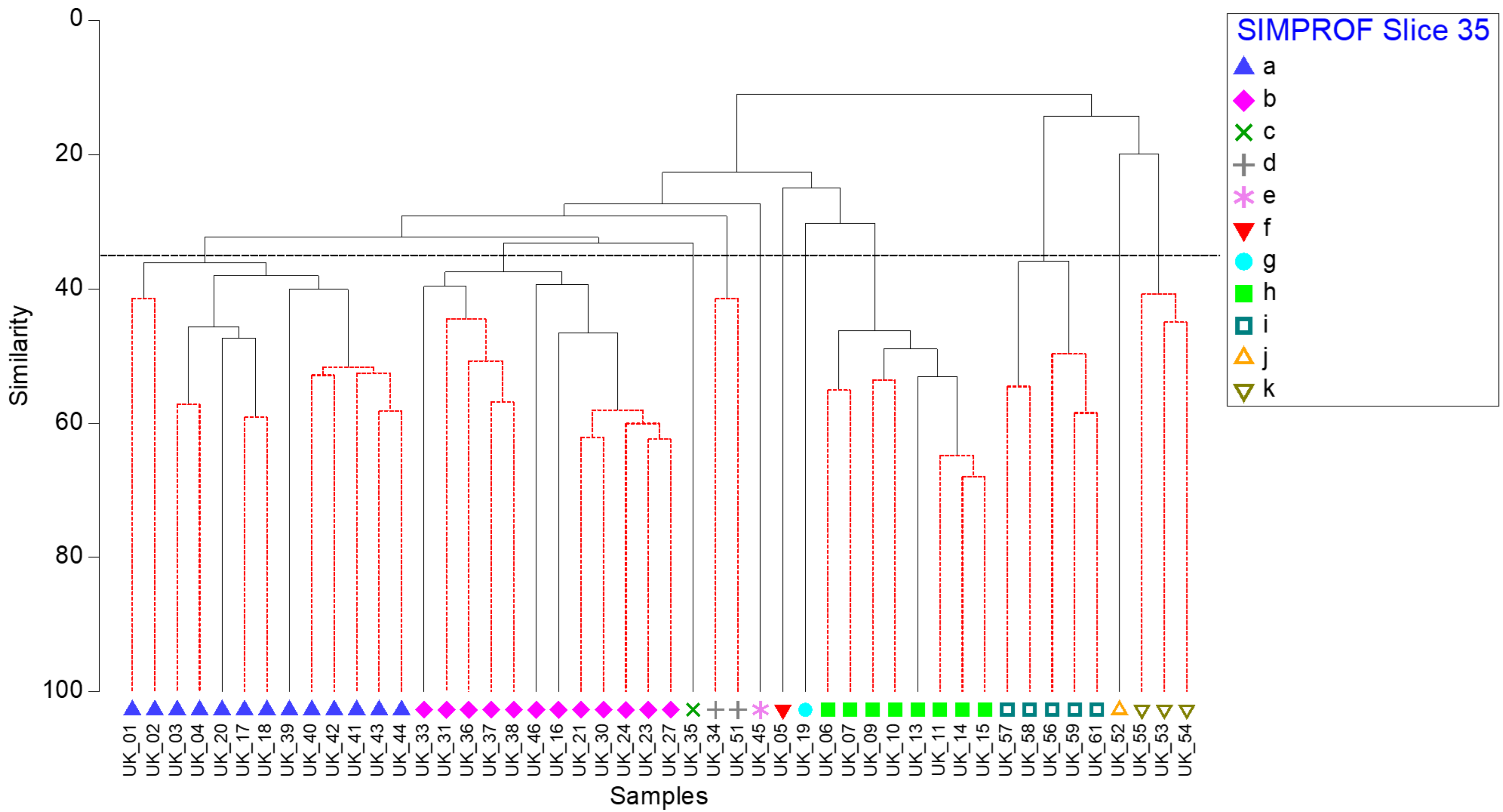


Figure 42: Dendrogram of macrofaunal stations with a slice at a Bray-Curtis similarity of 35 %

b Non-metric Multi-dimensional Scaling (nMDS) Ordination

Similarities in the macrofaunal communities recorded across the survey area are presented in Figure 42 at station level with a 35 % Bray-Curtis similarity slice, as 2-dimensional non-metric multi-dimensional scaling (nMDS) ordination. At a station level, the nMDS plot illustrated the 11 SIMPROF groupings described in Table 19 at a low stress value of 0.12, revealing a good representation (Figure 41). Cluster '*a*' demonstrated some intra-cluster variation, with station UK_39 ordinating closer to cluster '*e*'. Similarly, cluster '*b*' also showed some intra-cluster variability, with station UK_16 ordinating closed to cluster *'d'*. Despite the aforementioned variability within clusters '*a*' and '*b*', both of these clusters showed high similarity between each other.

All other clusters showed a clearer separation on the nMDS plot, which was expected given the substantial habitat variability observed across the site. The geographical distribution of the 11 SIMPROF clusters is displayed over regional bathymetry data in Figure 44.

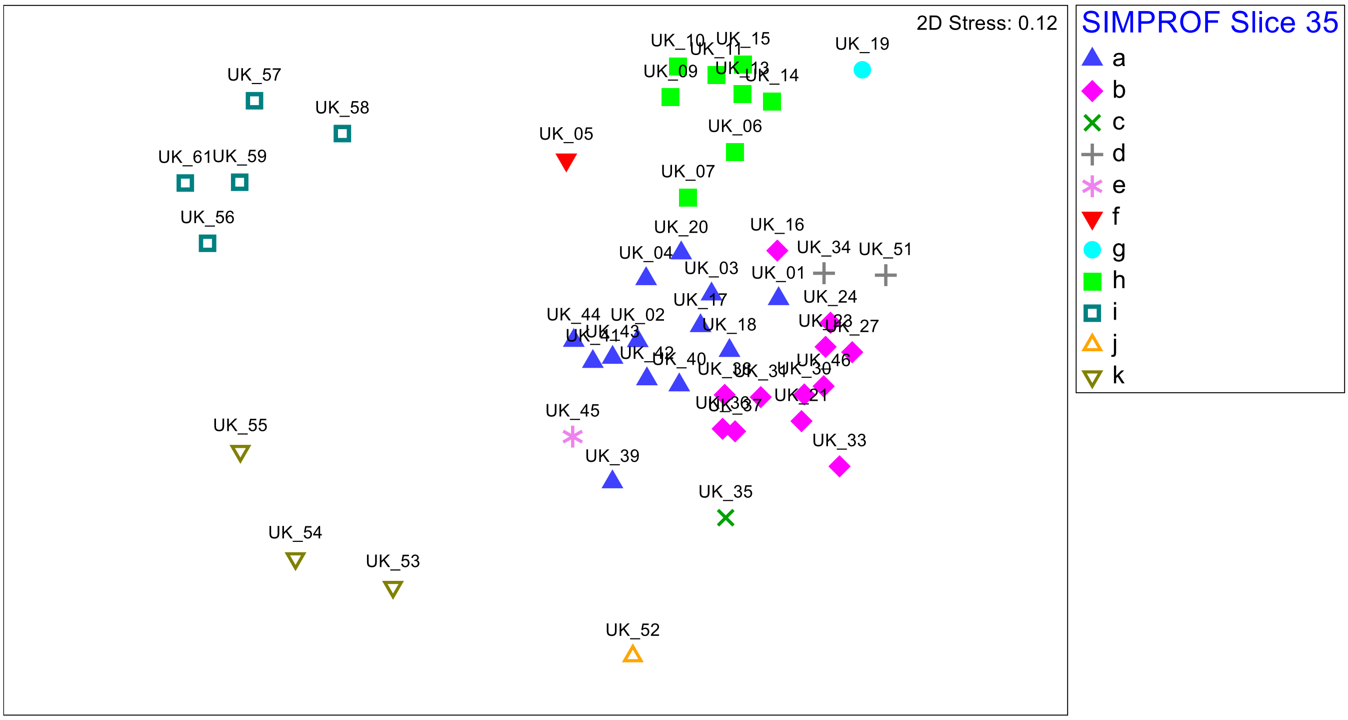


Figure 43: nMDS ordination plot of macrofaunal stations (per 0.2 m²)

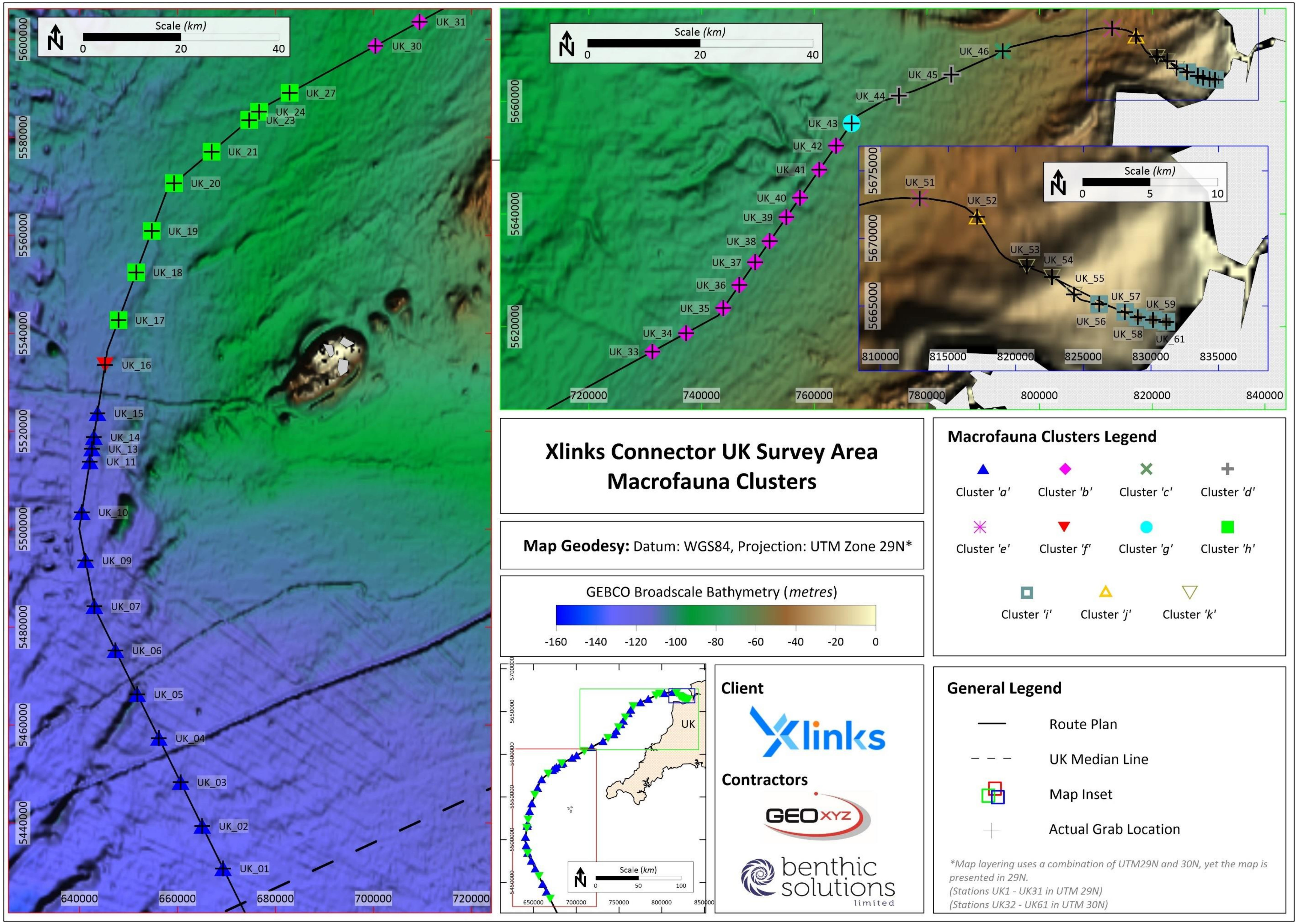


Figure 44: Macrofauna SIMPROF groups

c Correlation with Environmental Variables

To assess whether the observed differences in community composition were a result of any relationships between the biological community and environmental parameters, such as sediment composition or the concentrations of metals or hydrocarbons, a series of RELATE tests (correlation tests) were performed.

A RELATE test between the macrofaunal and full particle size distribution (PSD) similarity matrices recorded a sample statistic of (ϱ=0.564 p>0.1), indicating that a significant correlation exists between the two, which was expected given the heterogenous nature of the seabed along the route survey corridor, and the strong link between the EUNIS habitat classifications and macrofaunal clustering.

Further RELATE tests were carried out between the macrofaunal dataset and separate subsets of organic matter/carbon (TOM and TOC), hydrocarbon parameters and metal concentrations to further investigate any potential relationships between the benthic macrofauna and physico-chemical characteristics. Although subsequent relate tests found no significant relationships between the macrofaunal community data and organic matter/carbon (ϱ=0.179 p>0.05), normalised THC variables showed a significant correlation with the macrofaunal clustering (ϱ=0.435 p<0.1), as did the heavy metal variables (ϱ=0.586 p<0.1). These results were expected as the heavy metal and hydrocarbon results were found to correlate to the proportions of fines across the survey area.

d Inter-cluster Variation in Community Composition

To investigate the differing macrofaunal communities described by the identified multivariate clusters, the ranges of primary and derived univariate diversity indices for stations grouped within each cluster were calculated and are summarised in Table 20.

Table 20: Overview of univariate parameters per SIMPROF cluster

SIMPROF Cluster	Number of species (S)		Number of individuals (N)		Richness (Margalef)		Pielou's Evenness		Simpsons Diversity (1-Lambda')		Shannon Wiener Diversity	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
a	51	126	126	1,343	9.76	17.78	0.734	0.885	0.898	0.970	4.38	5.72
b	32	101	108	901	5.90	16.42	0.594	0.878	0.820	0.968	3.76	5.57
*c**	85	-	715	-	12.78	-	0.585	-	0.725	-	3.75	-
d	48	59	214	445	7.71	10.81	0.847	0.353	0.411	0.949	1.97	4.98
*e**	107	-	645	-	16.39	-	0.768	-	0.923	-	5.18	-
*f**	81	-	629	-	12.41	-	0.700	-	0.881	-	4.44	-
*g**	70	-	239	-	12.60	-	0.819	-	0.921	-	5.02	-
h	55	139	323	1,365	8.93	19.70	0.585	0.788	0.769	0.947	3.59	5.42
i	35	59	211	482	6.35	9.39	0.669	0.787	0.844	0.931	3.91	4.63
*j**	25	-	59	-	5.89	-	0.836	-	0.892	-	3.99	-
k	21	24	30	53	5.29	6.17	0.867	0.970	0.913	0.977	3.81	4.32

Note:
**Cluster made up of a single station*

Differences in the relative phyletic composition of macrofaunal communities were explored by plotting the average percentage contribution of major phyla to the overall number of individuals and number of species within each cluster (Figure 45 and Figure 46). The results showed that cluster *'a', 'c', 'd', 'f', 'g' and 'h'* were dominated by Annelida, with proportions ranging from 59.7 % within cluster *'g'* to 43.8 % within cluster *'a'.* This was expected in light of the higher fines percentages found at these stations. Cluster '*b*' displayed a high percentage of both Annelida (37.8 %) and Mollusca (28.4 %). Cluster *'e'* showed a strong dominance of Echinodermata, driven by the ubiquitous sea pea *Echinocyamus pusillus*, as well as high numbers of *Amphiura filiformis* and *Ophelia celtica*. Cluster '*i*' had high proportions of Annelida (33.2 %), Arthropoda (22.6 %) and Mollusca (39.0 %), though faunal abundances at the exclusively nearshore stations within this grouping were relatively low. Cluster '*j',* made up exclusively of station UK_52, had high proportions of both Annelida (37.3 %) and Echinodermata (30.5 %), though generally displayed significantly low abundances, influenced by a high proportion of pebbles at the site contributing to limited faunal composition. Finally, cluster '*k*', composed exclusively of shallow, nearshore stations with relatively low faunal abundances, displayed similar proportions of Annelida, Arthropoda and Mollusca (29.7 %, 25.0 % and 23.4 % respectively). Solitary epifauna proportions were low along the route for all groupings (ranging from 0.0 % to 3.4 %), except for cluster '*d*', with 23.6 %, due to the presence of reef-building ross worm *Sabellaria spinulosa.* Abundances of individuals grouped with the 'other' phyla category varied widely along the route, from 20.9 % for cluster *'c'* to 1.6 % for cluster *'d'*. Variability in the proportions of 'other' phyla were primarily driven by numbers of Nematoda and Nemertea.

In terms of the contribution of phyla to the numbers of species, all clusters showed a dominance of Annelida, ranging from 77.8 % for cluster *'c'* to 46.7 % for cluster *'e'*. Although cluster *'i'* had the highest proportion of Arthropoda contributing to its species richness (31.4 %), it was closely followed by cluster 'h' (32.7 %), which had the highest average number of species recoded (70) within the grouping. Mollusca were moderately well represented, with proportions ranging from 11.1 % for clusters *'c'* and *'j',* to 31.4 % within cluster *'i'*, due to the presence of bivalves such as *Nucula nitidosa* and *Abra alba* at these stations with otherwise relatively low overall faunal abundances and diversities. Echinodermata proportions were relatively low across all clusters, ranging from 2.8 % within cluster *'h'* to an average contribution of 8.9 % within the 'Slightly gravelly sand' stations of cluster *'e'*. Colonial epifauna were present in all clusters throughout the route, accounting for between 2. 6% of the taxa within the gravelly muddy sand cluster *'f',* and 29.6 % of the taxa within cluster *'j',* which sampled a large proportion of pebbles and therefore had a higher availability of hard substratum to colonise.

Table 21 and Table 22 presents the top ten characterising taxa in each cluster together with their percentage contribution to the overall similarity within the cluster. The results indicate that although *Echinocyamus pusillus* was ubiquitous throughout the route survey area, and both Nemertea and Nematoda were widespread, most clusters displayed varied species within their top 10 abundances. Although the sea pea *E. pusillus* was widespread, it was present in varying abundances, ranging from an average abundance of 170.6 within cluster *'b'* to 18.0 within cluster *'j'*, which could be considered one on the drivers for some of the groupings. Other drivers are therefore more likely to be based on the presence or absence of species, which most likely depend on the sediment type, such as the availability of hard substratum in the form of gravel, pebbles and cobbles, the dominance of sands as well as the proportion of fines, intrinsically linked to the dominance of Annelida.

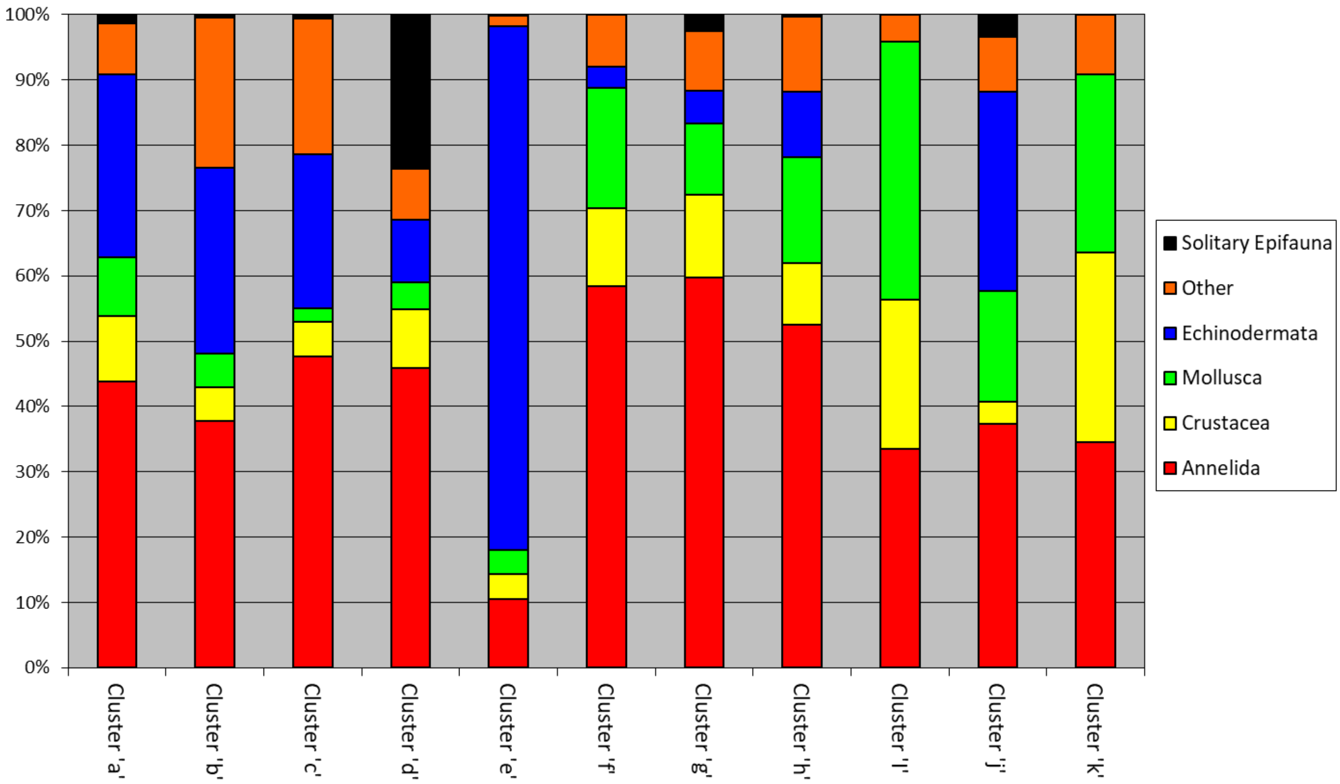


Figure 45: Average contribution of each phylum to total faunal abundance for each cluster

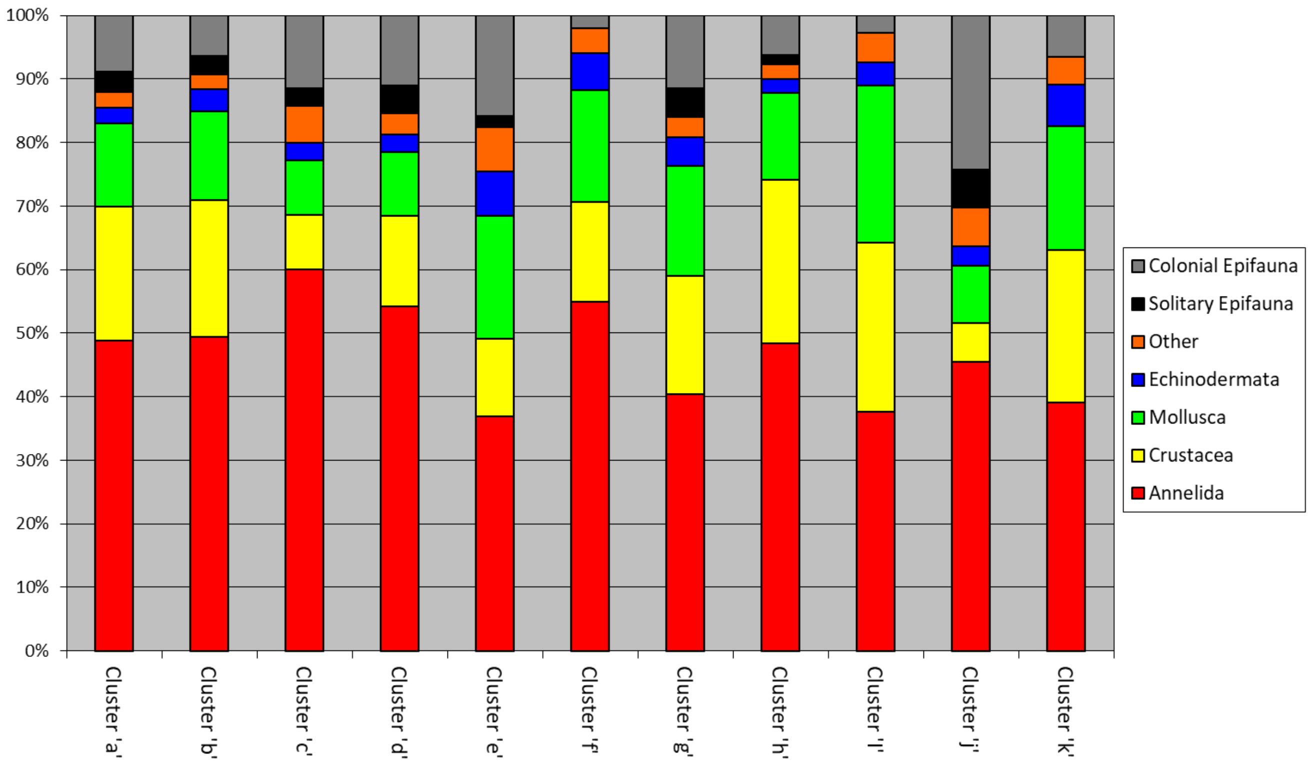


Figure 46: Average contribution of each phylum to total number of species for each cluster

Table 21: Top ten species abundances for clusters 'a', 'b', 'c', 'd', 'e' and 'f'

Top 10 Specie	Cluster 'a' (Similarity: 40.87%)			Cluster 'b' (Similarity: 42.78%)			Cluster 'c' (*less than two stations*)			Cluster 'd' (Similarity: 41.47%)			Cluster 'e'(*less than two stations*)			Cluster 'f'(*less than two stations*)		
	Species	Av. Abundance	Contribution (%)	Species	Av. Abundance	Contribution (%)	Species	Av. Abundance	Contribution (%)	Species	Av. Abundance	Contribution (%)	Species	Abundance	Contribution (%)	Species	Abundance	Contribution (%)
1	*Echinocyamus pusillus*	70.2	40.9	*Echinocyamus pusillus*	170.6	36.2	*Echinocyamus pusillus*	44.0	23.0	*Sabellaria spinulosa*	69	156	*Sabellaria spinulosa*	112.5	31.0	*Lumbrineris cingulata*	20.0	15.9
2	Nemertea	10.9	7.3	Nematoda	119	14.9	Nematoda	36.0	18.9	*Echinocyamus pusillus*	26	61	*Echinocyamus pusillus*	43.5	11.7	*Spiophanes kroyeri*	9.0	7.1
3	*Abra prismatica*	9.2	5.1	Nemertea	20.5	5.1	Polygordius	27.0	14.1	Nemertea	22	19	Nemertea	20.5	8.5	Nematoda	8.0	6.4
4	*Exogone verugera*	14.2	4.8	Polygordius	33.4	4.9	*Streptodonta pterochaeta*	16.0	8.9	*Syllidia armata*	2	34	Notomastus	13.5	5.8	*Varicorbula gibba*	8.0	6.4
5	*Glycera lapidum.*	4.7	2.3	*Goniadella gracilis*	16.2	4.2	*Grania*	9.0	4.7	Nematoda	9	25	*Mediomastus fragilis*	11.5	4.9	*Sthenelais limicola*	6.0	4.7
6	Nematoda	6.3	2.2	Grania	24.9	3.5	*Eurydice truncata*	5.0	2.6	Notomastus	13	14	Nematoda	17.0	4.0	Aoridae	5.0	4.0
7	*Scoloplos armiger*	3.8	2.0	*Glycera lapidum.*	11.8	3.42	*Glycera oxycephala*	5.0	2.6	*Aurospio banyulensis*	15	8	*Lumbrineris cingulata*	9.0	3.6	*Cylichna cylindracea*	5.0	4.0
8	Edwardsiidae	7.7	2.0				*Limnodriloides*	5.0	2.6	*Mediomastus fragilis*	12	11	*Aurospio banyulensis*	11.5	3.6	*Galathowenia oculata*	3.0	2.4
9	*Ophelia borealis*	3.9	1.9				Edwardsiidae	4.0	2.1	*Galathea intermedia*	18	0				*Eumida sanguinea*	3.0	2.4
10	Notomastus	4.4	1.9				*Hesionura elongata*	4.0	2.1	*Lumbrineris cingulata agg.*	8	10				*Exogone verugera*	3.0	2.4

Dark blue shading = *shared taxa across 8 clusters* *Light blue shading= Shared taxa across 7 clusters* *Orange shading = shared taxa across 6 clusters*

Table 22: Top ten species abundances for clusters 'g', 'h', 'i', 'j' and 'k'

Top 10 Specie	Cluster 'g' (*less than two stations*)			Cluster 'h' (Similarity: 50.40%)			Cluster 'i' (Similarity: 42.79%)			Cluster 'j' (*less than two stations*)			Cluster 'k' (Similarity: 42.16%)		
	Species	Av. Abundance	Contribution (%)	Species	Av. Abundance	Contribution (%)	Species	Av. Abundance	Contribution (%)	Species	Av. Abundance	Contribution (%)	Species	Abundance	Contribution (%)
1	*Spiophanes kroyeri*	199.0	18.0	*Echinocyamus pusillus*	75	15.9	*Nucula nitidosa*	31.2	13.1	*Echinocyamus pusillus*	18.0	30.5	*Megaluropus agilis*	3.3	20.0
2	Nematoda	71.0	6.4	*Magelona minuta*	73.8	8.9	*Abra alba*	49.4	13.0	*Diplodonta rotundata*	6.0	10.2	*Echinocyamus pusillus*	5.0	15.8
3	*Chaetopterus*	69.0	6.3	Nematoda	51.5	7.1	*Magelona johnstoni*	28.8	12.6	Nemertea	4.0	6.8	Nemertea	2.3	8.9
4	*Ampharete octocirrata*	53.0	4.8	*Ampharete falcata*	51.1	6.9	*Chaetozone christiei*	28.4	10.5	*Hesionura elongata*	3.0	5.1	*Nephtys cirrosa*	1.7	8.9
5	Aurospio banyulensis	48.0	4.4	*Varicorbula gibba*	44.4	5.5	*Pseudocuma (Pseudocuma) longicorne*	30.4	7.48	*Asbjornsenia pygmaea*	3.0	5.1	*Spisula subtruncata*	2.7	8.6
6	*Nucula nucleus*	44.0	4.0	Nemertea	30.8	5.2	*Bathyporeia tenuipes*	21.8	7.3	*Paradoneis lyra*	2.0	3.4	*Spio decorata*	2.0	6.7
7	*Metaphoxus simplex*	40.0	3.6	Edwardsiidae	24.9	4.3	Nemertea	11.0	5.5	*Polycirrus*	2.0	3.4	*Perioculodes longimanus*	1.0	6.7
8	*Echinocyamus pusillus*	36.0	3.3	*Abra nitida*	25.5	4.0	*Fabulina fabula*	12.4	2.9	*Aricidea (Acmira) cerrutii*	2.0	3.4			
9	*Terebellides*	35.0	3.1	*Galathowenia oculata*	18.3	2.5				*Eusyllis blomstrandi*	2.0	3.4			
10	*Eudorella truncatula*	27.0	2.5	*Eudorella truncatula*	15.5	2.5				*Dipolydora* Type B	2.0	3.4			

Dark blue shading = *shared taxa across 8 clusters* *Light blue shading= Shared taxa across 7 clusters* *Orange shading = shared taxa across 6 clusters*

Table 23: Dissimilarity percentages (SIMPER) for macrofauna dataset

	Cluster a		Cluster b		Cluster c		Cluster d		Cluster e		Cluster f		Cluster g		Cluster h		Cluster i		Cluster j	
Cluster k	Average dissimilarity 89.85%		Average dissimilarity 94.71%		Average dissimilarity 90.57%		Average dissimilarity 95.21%		Average dissimilarity 94.80%		Average dissimilarity 92.81%		Average dissimilarity 98.08%		Average dissimilarity 96.66%		Average dissimilarity 92.57%		Average dissimilarity 80.18%	
	Echinocyamus pusillus	20.05	Echinocyamus pusillus	22.75	Echinocyamus pusillus	16.74	Sabellaria spinulosa	18.49	Echinocyamus pusillus	68.97	Lumbrineris cingulate	11.92	Spiophanes kroyeri	17.38	Echinocyamus pusillus	8.64	Abra alba	11.08	Echinocyamus pusillus	12.97
	Exogone verugera	4.0	Nematoda	13.13	Nematoda	15.02	Echinocyamus pusillus	6.25	-	-	Spiophanes kroyeri	5.36	Nematoda	6.11	Magelona minuta	7.88	Magelona johnstoni	7.74	Diplodonta rotundata	5.97
	Abra prismatica	3.05	Polygordius	4.15	Polygordius	11.59	Nemertea	3.25	-	-	Varicorbula gibba	4.77	Chaetopterus	6.02	Varicorbula gibba	5.75	Nucula nitidosa	7.59	Timoclea ovata	3.34
	Nemertea	2.71	Grania	3.13	Streptodonta pterochaeta	6.87	Syllidia armata	2.68	-	-	Nematoda	4.15	Ampharete octocirrata	4.63	Ampharete falcata	5.68	Chaetozone christiei	7.53	Megaluropus agilis	3.28
	Lumbrineris cingulata	2.17	Nemertea	2.99	Grania	3.72	Nematoda	2.57	-	-	Sthenelais limicola	3.36	Aurospio banyulensis	4.19	Nematoda	5.25	Pseudocuma longicorne	6.31	Hesionura elongata	2.66
Cluster a			Average dissimilarity 72.09%		Average dissimilarity 69.71%		Average dissimilarity 76.34%		Average dissimilarity 73.30%		Average dissimilarity 80.43%		Average dissimilarity 86.96%		Average dissimilarity 78.66%		Average dissimilarity 93.46%		Average dissimilarity 80.07%	
			Echinocyamus pusillus	13.04	Echinocyamus pusillus	0.99	Sabellaria spinulosa	13.48	Echinocyamus pusillus	38.97	Echinocyamus pusillus	16.47	Spiophanes kroyeri	13.14	Magelona minuta	6.18	Echinocyamus pusillus	10.74	Echinocyamus pusillus	14.65
			Nematoda	10.06	Nematoda	2.46	Echinocyamus pusillus	4.72	Exogone verugera	1.85	Lumbrineris cingulata	4.35	Chaetopterus	13.84	Ampharete falcata	4.44	Abra alba	7.49	Exogone verugera	3.81
			Polygordius	3.01	Polygordius	2.94	Syllidia armata	2.02	Amphiura filiformis	1.75	Exogone verugera	2.88	Nematoda	5.53	Echinocyamus pusillus	4.35	Nucula nitidosa	4.94	Abra prismatica	2.87
			Grania	2.21	Streptodonta pterochaeta	4.6	Exogone verugera	1.66	Nemertea	1.21	Nemertea	2.7	Ampharete octocirrata	13.89	Varicorbula gibba	4.33	Magelona johnstoni	4.9	Nemertea	2.09
			Exogone verugera	1.7	Exogone verugera	0.95	Nematoda	1.61	Abra prismatica	1.13	Varicorbula gibba	2.01	Aurospio banyulensis	10.06	Nematoda	3.86	Chaetozone christiei	4.67	Lumbrineris cingulata	2.06
Cluster b					Average dissimilarity 70.13%		Average dissimilarity 75.08%		Average dissimilarity 66.99%		Average dissimilarity 90.61%		Average dissimilarity 84.31%		Average dissimilarity 79.43%		Average dissimilarity 96.40%		Average dissimilarity 86.66%	
					Echinocyamus pusillus	13.88	Sabellaria spinulosa	10.22	Echinocyamus pusillus	21.66	Echinocyamus pusillus	20.37	Spiophanes kroyeri	11.87	Echinocyamus pusillus	8.25	Echinocyamus pusillus	15.54	Echinocyamus pusillus	19.49
					Nematoda	11.25	Echinocyamus pusillus	10.22	Nematoda	8.71	Nematoda	11.11	Echinocyamus pusillus	7.1	Nematoda	7.11	Nematoda	9.42	Nematoda	12.84
					Polygordius	3.73	Nematoda	7.77	Polygordius	2.65	Polygordius	3.68	Nematoda	5.97	Magelona minuta	4.92	Abra alba	5.4	Polygordius	4.04
					Streptodonta pterochaeta	2.31	Polygordius	2.46	Grania	1.99	Lumbrineris cingulata	3.29	Chaetopterus	4.14	Ampharete falcata	3.43	Nucula nitidosa	3.54	Grania	3.1
					Nemertea	2.21	Grania	1.77	Nemertea	1.7	Nemertea	2.91	Ampharete octocirrata	3.18	Varicorbula gibba	3.4	Magelona johnstoni	3.45	Nemertea	2.63
Cluster c							Average dissimilarity 81.01%		Average dissimilarity 83.33%		Average dissimilarity 90.54%		Average dissimilarity 87.48%		Average dissimilarity 82.21%		Average dissimilarity 97.42%		Average dissimilarity75.20	
							Sabellaria spinulosa	14.79	Echinocyamus pusillus	46.7	Echinocyamus pusillus	13.25	Spiophanes kroyeri	15.38	Magelona minuta	6.63	Abra alba	8.35	Nematoda	14.0
							Polygordius	3.75	Nematoda	5.35	Nematoda	8.83	Chaetopterus	5.33	Ampharete falcata	4.77	Echinocyamus pusillus	8.04	Polygordius	10.8
							Nematoda	2.79	Polygordius	4.25	Polygordius	8.52	Ampharete octocirrata	4.1	Varicorbula gibba	4.74	Nematoda	6.45	Echinocyamus pusillus	10.4
							Nemertea	2.46	Streptodonta pterochaeta	2.52	Lumbrineris cingulata	5.99	Aurospio banyulensis	3.71	Echinocyamus pusillus	3.35	Nucula nitidosa	5.53	Streptodonta pterochaeta	6.4
							Echinocyamus pusillus	2.44			Streptodonta pterochaeta	5.05	Nucula nucleus	3.4	Nematoda	3.21	Magelona johnstoni	5.53	Grania	3.6
Cluster d									Average dissimilarity 85.01%		Average dissimilarity 88.24%		Average dissimilarity 78.20%		Average dissimilarity 79.20%		Average dissimilarity 95.35%		Average dissimilarity 87.40%	
									Echinocyamus pusillus	30.62	Sabellaria spinulosa	16.2	Spiophanes kroyeri	12.1	Sabellaria spinulosa	8.62	Sabellaria spinulosa	12.02	Sabellaria spinulosa	17.98
									Sabellaria spinulosa	11.05	Echinocyamus pusillus	5.94	Sabellaria spinulosa	6.03	Magelona minuta	4.94	Abra alba	5.23	Echinocyamus pusillus	3.85
									Nemertea	1.91	Nemertea	3.17	Chaetopterus	4.18	Varicorbula gibba	3.41	Echinocyamus pusillus	4.64	Nemertea	2.87
									Syllidia armata	1.67	Syllidia armata	2.38	Nematoda	3.32	Ampharete falcata	3.21	Nucula nitidosa	3.43	Syllidia armata	2.61
									Nematoda	1.45	Notomastus	1.9	Ampharete octocirrata	3.2	Echinocyamus pusillus	2.88	Magelona johnstoni	3.32	Magelona minuta	1.25
Cluster e											Average dissimilarity 92.99%		Average dissimilarity 93.02%		Average dissimilarity 84.11%		Average dissimilarity 96.54%		Average dissimilarity 89.29%	
											Echinocyamus pusillus	59.37	Echinocyamus pusillus	19.7	Echinocyamus pusillus	23.15	Echinocyamus pusillus	42.26	Echinocyamus pusillus	64.09
											Lumbrineris cingulata	3.15	Spiophanes kroyeri	12.86	Magelona minuta	5.29	Abra alba	5.70	-	-
											Amphiura filiformis	2.28	Nematoda	4.46	Ampharete falcata	3.79	Nucula nitidosa	3.80	-	-
											Spiophanes kroyeri	1.58	Chaetopterus	4.46	Varicorbula gibba	3.67	Chaetozone christiei	3.62	-	-
											-	-	Ampharete octocirrata	3.42	Nematoda	3.53	Magelona johnstoni	3.56	-	-
Cluster f													Average dissimilarity 91.05%		Average dissimilarity 85.40%		Average dissimilarity 93.61%		Average dissimilarity 95.68%	
													Spiophanes kroyeri	15.46	Echinocyamus pusillus	8.1	Abra alba	9.4	Lumbrineris cingulata	10.81
													Chaetopterus	5.61	Magelona minuta	7.12	Magelona johnstoni	6.35	Echinocyamus pusillus	8.65
													Nematoda	5.13	Ampharete falcata	4.88	Nucula nitidosa	6.27	Spiophanes kroyeri	4.86
													Ampharete octocirrata	4.31	Varicorbula gibba	4.42	Chaetozone christiei	6.07	Varicorbula gibba	4.32
													Aurospio banyulensis	3.91	Nematoda	3.99	Pseudocuma longicorne	5.37	Nematoda	3.78
Cluster g															Average dissimilarity 77.09%		Average dissimilarity 96.07%		Average dissimilarity 95.52%	
															Spiophanes kroyeri	10.45	Spiophanes kroyeri	13.47	Spiophanes kroyeri	17.13
															Chaetopterus	3.73	Nematoda	4.78	Nematoda	6.02
															Magelona minuta	3.48	Chaetopterus	4.69	Chaetopterus	5.94
															Ampharete octocirrata	2.76	Ampharete octocirrata	3.6	Ampharete octocirrata	4.56
															Aurospio banyulensis	2.5	Abra alba	3.27	Aurospio banyulensis	4.13
Cluster h																	Average dissimilarity 92.97%		Average dissimilarity 92.23%	
																	Echinocyamus pusillus	6.48	Magelona minuta	7.71
																	Magelona minuta	5.42	Echinocyamus pusillus	6.71
																	Abra alba	4.35	Varicorbula gibba	5.61
																	Ampharete falcata	4.05	Ampharete falcata	5.56
																	Nematoda	3.87	Nematoda	5.15
Cluster i																			Average dissimilarity 97.49%	
																			Abra alba	10.82
																			Magelona johnstoni	7.54
																			Chaetozone christiei	7.33
																			Nucula nitidosa	7.28
																			Pseudocuma longicorne	6.1

4.9.3 Epifaunal and Other Biological Groups

Across the UK sector sampling stations, 53 taxa were considered to be epifaunal, which belonged to a broad range of phyla. These taxa were not statistically assessed within the infauna data analysis, as they were quantified on a presence/absence basis. Due to the presence/absence scale to which colonial epifaunal species were identified, for the purpose of this chart and to highlight the epifaunal richness, where epifaunal species were recorded as present, this was given the numerical value of one (1) to represent the colony. The distribution of epifaunal assemblages across the survey area is represented in Figure 47. The analysis indicated that infauna were dominant across the survey area, with colonial epifauna making up a moderate part of the community. Infaunal and epifaunal species are listed separately in Appendix O.

Proportions of colonial epifauna were driven by the availability of surface for epifaunal attachment which was higher in cluster '*j*' as it contained a station with high proportions of pebble. However, grab sampling often fails to recover coarse material, especially larger pebbles, cobbles and boulders colonised by epifauna; therefore, it is important to not only assess epifauna through physical samples but to also analyse video footage (see Section 4.10).

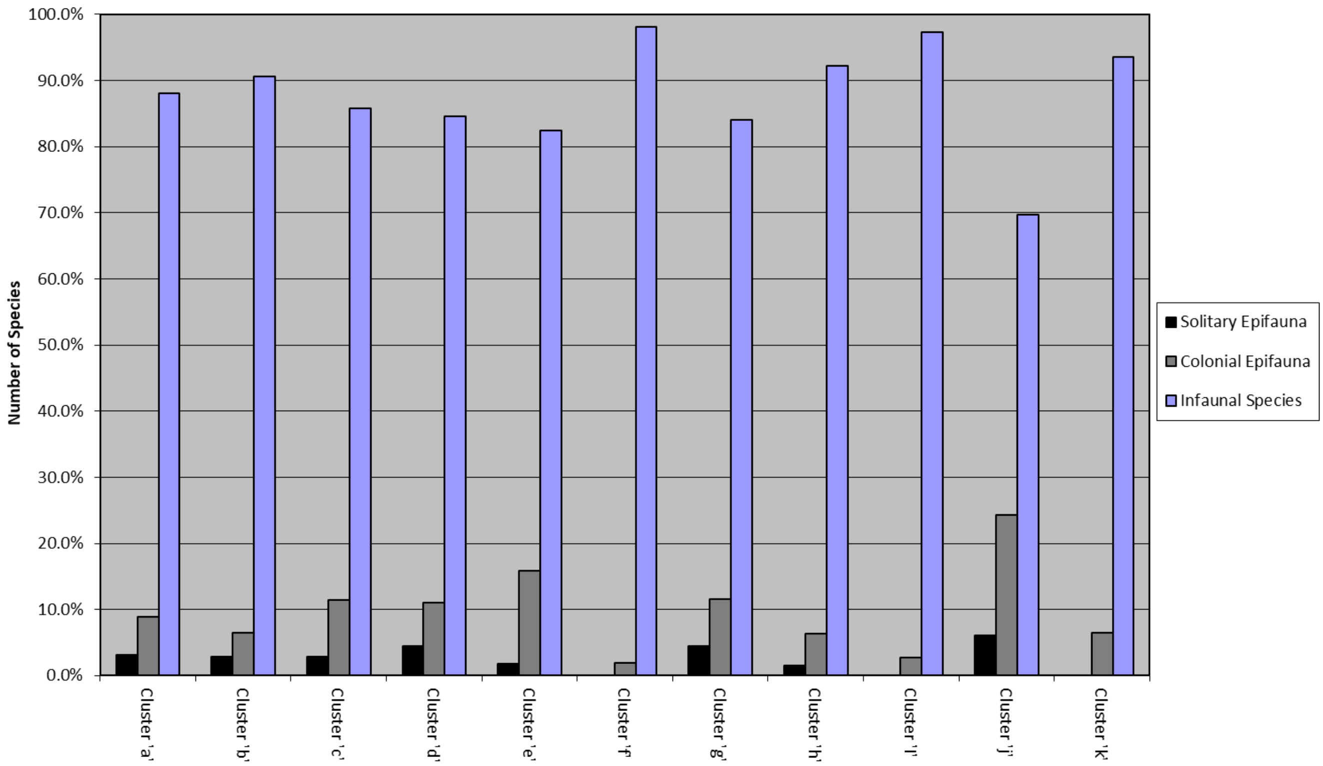


Figure 47: Epifaunal versus infaunal richness

4.10 ENVIRONMENTAL HABITATS

The identification of seabed habitats combined a detailed review of the route SSS and bathymetry data with video and camera ground-truthing from 61 locations. The analysis also utilised field observations, onsite inspection of grab samples, and particle size analysis (PSA) data from 48 collocated stations.

Based on the route-wide dataset, the complex seabed comprised variable sediment compositions incorporating mosaics of fines, sands, gravelly sands, pebbles, cobbles and outcropping bedrock. Across the whole route a total of eight level 3/4 EUNIS and nine level 3/4 JNCC habitat types were identified (Table 24). A dominance of the JNCC/EUNIS habitat classification of MB52/SS.SSa.IFiSa 'Infralittoral Fine Sand' was observed in the shallower nearshore region of the route, progressing to the deeper depth band of MC52/SS.SSa.CFiSa 'Circalittoral Fine Sand' in waters deeper than 20 m. Ribbons and areas of MC32/SS.SCS.CCS 'Circalittoral Coarse Sediment' were also observed due to a presence of gravel and pebbles or rubble of *Sabellaria spinulosa* tubes (Table 24, Figure 51).

As the route moved away from Barnstaple Bay and into the Celtic Sea, a dominance of two oscillating broad scale sediment types was observed. The JNCC/EUNIS habitat classifications of MD32/SS.SCS.OCS 'Offshore Circalittoral Coarse Sediment' and MD52/SS.SSa.OSa 'Offshore Circalittoral Sand' alternate along the route with varying compositions of sediment within each delineation. Areas of outcropping bedrock were present and categorised under the JNCC/EUNIS habitat classification of CR.HCR/MD12 'High Energy Circalittoral Rock' with a further delineation into 'Mixed Faunal Turf Communities' (MC121/ CR.HCR.Xfa) in areas confidently ground truthed.

Two habitats, principally observed towards the southern end of the route; MC52.SS.SSa.CMuSa 'Circalittoral Muddy Sand' and MD42/SS.SMx.OMx 'Offshore Circalittoral Mixed Sediment', also oscillated between the two sediment compositions. 'Offshore Circalittoral Mixed Sediment' was assigned to areas of muddy sand with varying influences of gravel, pebble and cobble.

Example images of all conspicuous fauna within the survey area are presented in Figure 48, while example seabed images for each transect are provided in Appendix W.

Table 24: Summarised habitat classification

	Geophysical Seabed Description *	Habitat Classification	2022 JNCC Classification	2022 EUNIS Classification	Lowest JNCC 2022 Classification Level 3 or 4/**Level 5 (Bold)**	Lowest EUNIS 2022 Classification Level3 or 4/**Level 5 (Bold)**
	Rock: Type A (U1A of Primary sedimentary rocks)	-*	Level 3: High Energy Infralittoral Rock (IR.HIR)	Level 3: Atlantic Infralittoral Rock (MB12)	High Energy Infralittoral Rock (IR.HIR)	Atlantic Infralittoral Rock (MB12)
	Fine SAND	Fine Sand	Level 4: Infralittoral Fine Sand (SS.SSa.IFiSa)	Level 3: Atlantic Infralittoral Sand (MB52)	***Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (SS.SSa.CMuSa.AalbNuc)**	***Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (MC5214)**
					Infralittoral mobile clean sand with sparse fauna (SS.SSa.IFiSa.IMoSa)	**Sparse fauna in Atlantic infralittoral mobile clean sand (MB5231)**
	Sandy GRAVEL	Sandy GRAVEL (*Sabellaria* rubble)	Level 4: Circalittoral Coarse Sediment (SS.SCS.CCS)	Level 3: Atlantic Circalittoral Coarse Sediment (MC32)	***Sabellaria spinulosa* on stable circalittoral mixed sediment (SS.SBR.PoR.SspiMx)**	***Sabellaria spinulosa* on stable circalittoral mixed sediment (MC2211)**
	Gravelly SAND	(Slightly) Gravelly Sand			Circalittoral Coarse Sediment (SS.SCS.CCS)	Atlantic Circalittoral Coarse Sediment (MC32)
	Medium SAND	Slightly Gravelly Pebbly Sand			Circalittoral Coarse Sediment (SS.SCS.CCS)	Atlantic Circalittoral Coarse Sediment (MC32)
	Medium SAND	Fine Sand	Level 4: Circalittoral Fine Sand (SS.SSa.CFiSa)	Level 3: Atlantic Circalittoral Sand (MC52)	***Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (SS.SSa.CMuSa.AalbNuc)**	***Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (MC5214)**
					Infralittoral mobile clean sand with sparse fauna (SS.SSa.IFiSa.IMoSa)	**Infralittoral mobile clean sand with sparse fauna (MB5231)**
	Muddy fine SAND	Muddy Sand	Level 4: Circalittoral Muddy Sand (SS.SSa.CMuSa)		**Polychaete-rich deep Venus community in offshore mixed sediments (SS.SMx.OMx.PoVen)**	**Polychaete-rich deep Venus community in offshore mixed sediments (MD4211)**
	Fine SAND	(Slightly Gravelly) Muddy Sand				

	Geophysical Seabed Description *	Habitat Classification	2022 JNCC Classification	2022 EUNIS Classification	Lowest JNCC 2022 Classification Level 3 or 4/**Level 5 (Bold)**	Lowest EUNIS 2022 Classification Level3 or 4/**Level 5 (Bold)**
Increasing Water Depth	Rock: Type A (U1A of Primary sedimentary rocks)	Sand	Level 4: Offshore Circalittoral Sand (SS.SSa.OSa)	Level 3: Atlantic Offshore Circalittoral Sand (MD52)	***Owenia fusiformis* and *Amphiura filiformis* in offshore circalittoral sand or muddy sand (SS.SSa.OSa.OfusAfil)**	***Owenia fusiformis* and *Amphiura filiformis* in deep circalittoral sand or muddy sand (MD5212)**
					***Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (SS.SSa.CFiSa.EpusOborApri)**	***Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (MC5211)**
					Infralittoral mobile clean sand with sparse fauna (SS.SSa.IFiSa.IMoSa)	**Sparse fauna in Atlantic infralittoral mobile clean sand (MB5231)**
	Rock: Type A (U1A of Primary sedimentary rocks)	-	Level 4: Mixed faunal turf communities (CR.HCR.Xfa)	Level 4: Faunal turf communities on Atlantic circalittoral rock (MC121)	**Bryozoan turf and erect sponges on tide-swept circalittoral rock (CR.HCR.XFa.ByErSp)**	**Bryozoan turf and erect sponges on tide-swept Atlantic circalittoral rock (MC1213)**
		Sandy Gravel	Level 4: Offshore Circalittoral Coarse Sediment (SS.SCS.OCS)	Level 3: Atlantic Offshore Circalittoral Coarse Sediment (MD32)	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS)	Atlantic Offshore Circalittoral Coarse Sediment (MD32)
	Rock: Type B (U1C of Tertiary Chalk)	Gravelly Sand (Veneer over Rock)	Level 4: Offshore Circalittoral Coarse Sediment (SS.SCS.OCS)	Level 3: Atlantic Offshore Circalittoral Coarse Sediment (MD32)	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS)	Atlantic Offshore Circalittoral Coarse Sediment (MD32)
	Gravelly SAND	Gravelly Sand			***Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (SS.SSa.CFiSa.EpusOborApri)**	***Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (MC5211)**
					***Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand (SS.SCS.CCS.Pkef)**	***Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand (MC3213)**
		Gravelly Sand/ Shingle			Offshore Circalittoral Coarse Sediment (SS.SCS.OCS)	Atlantic Offshore Circalittoral Coarse Sediment (MD32)

	Geophysical Seabed Description *	Habitat Classification	2022 JNCC Classification	2022 EUNIS Classification	Lowest JNCC 2022 Classification Level 3 or 4/**Level 5 (Bold)**	Lowest EUNIS 2022 Classification Level3 or 4/**Level 5 (Bold)**
Increasing Water Depth	Rock: Type A (U1A of Primary sedimentary rocks)	Pebbly Cobbley Sandy Gravel			***Spirobranchus triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles (SS.SCS.CCS.SpiB)**	***Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles (MC3211)**
		Pebbley Gravelly Sand			***Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand (SS.SCS.CCS.Pkef)**	***Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand (MC3213)**
	Pebbley gravelly SAND				***Sabellaria spinulosa* on stable circalittoral mixed sediment (SS.SBR.PoR.SspiMx)**	***Sabellaria spinulosa* on stable circalittoral mixed sediment (MC2211)**
	Sandy GRAVEL				Offshore Circalittoral Coarse Sediment (SS.SCS.OCS)	Atlantic Offshore Circalittoral Coarse Sediment (MD32)
	PEBBLE, BOULDER/ GRAVEL, PEBBLE, COBBLE	Cobbley Pebbley Gravelly Sand			***Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (SS.SSa.CFiSa.EpusOborApri)**	***Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (MC5211)**
	Rock: Type B (U1C of Tertiary Chalk)	Cobbley Gravelly Pebbley Muddy Sand +(Veneer over rock)	Level 4: Offshore Circalittoral Mixed Sediment (SS.SMx.OMx)	Level 3: Atlantic Offshore Circalittoral Mixed Sediment (MD42)	Offshore Circalittoral Mixed Sediment (SS.SMx.OMx)	Atlantic Offshore Circalittoral Mixed Sediment (MD42)
	Gravelly muddy fine SAND	Gravelly Muddy Sand			**Polychaete-rich deep Venus community in offshore mixed sediments (SS.SMx.OMx.PoVen)**	**Polychaete-rich deep Venus community in offshore mixed sediments (MD4211)**

Note:
** 'Geophysical Seabed Descriptions' are ordered according to their occurrence with increasing depth, from the top to the bottom of the table. As such, some descriptions are repeated due to their occurrence at different water depths along the route, where they may be classified as different 'Habitat Classification' and level 4/5 EUNIS/JNCC classifications.*

Figure 48: Species examples from seabed photographs

Examples of Conspicuous Fauna

Octopus
(Octopoda)

Hermit crab with cloak anemone
(*Pagurus prideaux* with *Adamsia palliata*)

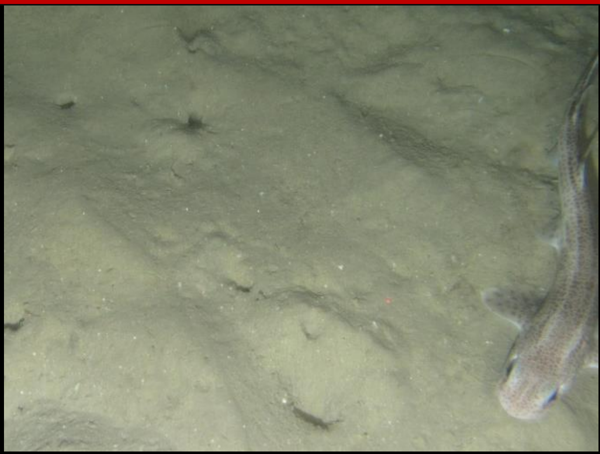
Devonshire cup coral
(*Caryophyllia smithii*)

Burrowing anemone
(*Mesacmaea mitchellii*)

Little cuttlefish
(*Sepiola atlantica*)

Serpent star
(Ophiura ophiura)

Examples of Conspicuous Fauna



Lesser spotted dogfish
(*Scyliorhinus canicula*)

Common whelk
(*Buccinum undatum*)

Deeplet anemone with shrimp and squat lobster
(*Bolocera tuediae* with Caridea and Munididae)

Edible sea urchin
(*Echinus esculentus*)

Red gurnard
(*Aspitrigla cuculus)*

Sponges
(Porifera spp.)

Examples of Conspicuous Fauna

Seven-armed starfish
(*Luidia ciliaris*)

Dead man's fingers
(*Alcyonium digitatum)*

Flat fish and boar fish
(Pleuronectidae and *Capros aper)*

Brittle star
(Ophiuroidea)

4.10.1 Habitat Classification

Habitats were identified using a combination of field observations, detailed review of video footage, still images and newly acquired geophysical data. SSS data showed varying low to high reflectivity along the survey route, indicating a complexly heterogeneous seabed. The variety of habitats predominantly consisted of sands and gravels with varying compositions of fines, pebbles, cobbles and boulders. A large patch of high reflectivity situated towards the northern most extent of the route correlated to a large area of rocky outcrop, additional smaller patches were also observed sporadically along the route (Figure 57 to Figure 60). It is important to note that habitat classifications will differ from the seabed features identified for the geophysical aspect of the survey, as they are required for different purposes and use different sediment classification nomenclature.

a High Energy Infralittoral Rock (MB12/IR.HIR) – no seabed ground-truthing

Elevated high reflectivity patches located at the start of the route were delineated using previously acquired nearshore geophysical data, identified as 'Rock' this habitat corresponded to the EUNIS/ JNCC habitat classification MB12/IR.HIR 'High Energy Infralittoral Rock'. A habitat that often supports a mix of macroalgal communities with a dominance of kelp and its associated faunal matrix, typically described as "Rocky habitats in the infralittoral zone subject to exposed to extremely exposed wave action or strong tidal streams".

Within this survey, no ground-truthed evidence confirmed the presence of this biotope. While transect UK_61 appeared to traverse a rocky area of high reflectivity, video footage revealed no evidence of hard substrate. It is possible to hypothesise sedimentation events occurring over this patch between the acquisition of both datasets, attributed to the highly mobile fine sands observed in the surrounding habitats.

Extent mapping of the habitat is presented in Figure 57 to Figure 60.

b Infralittoral Fine Sand (MB52/SS.SSa.IFiSa)

In the shallow (<20 m) nearshore zone, rippled fine sands overlay coastal 'Infralittoral Rock', present in transects UK_61 to UK_57 and spanning blocks U39 to U38E, this habitat is described by the JNCC (2022) as "*Clean sands which occur in shallow water, either on the open coast or in tide-swept channels of marine inlets*". While the seabed features delineation of this 'fine sand' habitat spans blocks U39 through to U38B, this area crosses a depth boundary related to the EUNIS/JNCC habitat classification system and therefore, habitats in waters shallower than 20 m are defined under the 'Infralittoral' classification, with habitats situated between 20 and 50 m assigned to 'Circalittoral' classifications.

Limited faunal observations were expected within this biotope, recording only mobile species. Sparse occurrences minimally included Crustacea such as *Pagurus* sp. and *Macropodia* sp., Gastropoda (likely *Buccinum undatum*) and Ophiuroidea.

Visual identification of the habitat present and associated fauna proved restrictive, a combination of naturally high water column turbidity due to the convergence of two rivers near Barnstaple Bay, a flurry of storms close to the period of sampling and the impact of vessel dynamic positioning in shallow waters, all contributed to severely limited visibility within the ground-truthing footage. However, the presence of fine to medium sands coupled with low abundance and diversity of epifauna confidently corresponds to the level three EUNIS habitat classification MB52 describing 'Atlantic Infralittoral sand' corresponding with the level four JNCC classification SS.SSa.IFiSa, 'Infralittoral Fine Sand', which is within the expected depth range (0 – 20 m) for this biotope.

Analysis of the infauna data revealed high abundances of the bivalves *Abra alba* and *Nucula nitidosa* within this biotope, demonstrating characteristics of the EUNIS level 5 biotope '*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment' (MC5214). While this level 5 habitat is often recorded in circalittoral muddy sands or slightly mixed sediments, it is likely the habitat observed within these blocks is a shallower Infralittoral variant. The high abundance of bivalves, including *Fabulina fabula,* coupled with the presence of polychaetes of *Magelona* spp*.,* revealed the potential presence of a secondary level five biotope; *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in Atlantic infralittoral compacted fine muddy sand' (MB5236). However, the absence of the habitat defining species *Magelona mirabilis,* and the high abundance of characterising bivalves showing a higher degree of similarity towards MC5214, suggesting a strong justification for the classification of MC5214 to this biotope.

Examples of seabed images for this habitat are provided in Figure 49, while the extent is mapped in Figure 57 to Figure 60.

Figure 49: Examples of 'Infralittoral Fine Sand' habitat

c Atlantic Circalittoral Sand (MC52/SS.SSa.IFiSa & SS.SSa.CMuSa)

Circalittoral Fine Sand (MC52/SS.SSa.IFiSa)

Similar to infralittoral fine sands, the slightly deeper (>20 m) habitat of blocks 38B and 38C were dominated by rippled medium sands, as observed in transects UK_53 to UK_56, and therefore categorised under the EUNIS habitat MC52 'Atlantic Circalittoral Sand' corresponding with the level four JNCC habitat SS.SSa.CFiSa 'Circalittoral Fine Sand'. Described by the JNCC as "C*lean fine sands with less than 5 % silt/clay in deeper water, either on the open coast or in tide-swept channels of marine inlets in depths of over 15-20 m*". A sparse faunal community similar to the infralittoral fine sands habitat recorded a few hermit crabs (*Pagurus* sp.) and an unidentified fish (Actinopterygii) impacted by the restricted visibility in the area.

A review of the macrofaunal data revealed a depth-related change in communities within the circalittoral fine sand habitat. The infauna associated with grab UK_56 indicated a similarity to the previously characterised level five biotope of '*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment' (MC5214), albeit with a reduced presence of the habitat defining species, *Abra alba* and *Nucula nitidosa,* when compared to similar grabs closer to shore, indicating an impoverished community. The remaining stations, UK_55, UK_54 and UK_53, recorded no or a low presence of level five biotope defining species *Echinocyamus pusillus, Ophelia borealis,* *Abra prismatica*, *Siphonoecetes* sp. or *Bathyporeia elegans*, suggesting the most suitable EUNIS level five biotope to describe this area is 'Infralittoral mobile clean sand with sparse fauna' (MB5231) associated with the JNCC habitat SS.SSa.IFiSa.IMoSa.

Examples of seabed images for this habitat are provided in Figure 50, while the extent is mapped in Figure 57 to Figure 60.

Circalittoral Fine Sand (MC52/SS.SSa.CFiSa)

UK_ENV_TR_53_0025

UK_ENV_TR_53_0024

Figure 50: Examples of 'Circalittoral Fine Sand' habitat

Circalittoral Muddy Sand (MC52/SS.SSa.CMuSa)

Habitats dominated by non-cohesive muddy sands, with occasional influences of slightly coarse sediments, were observed towards the southern end of the route sporadically stretching from blocks U07 to U12, in water depths ranging from approximately 110 to 125 m. The surface sediments were often characterised by rippling and bioturbation, "lebensspuren", with burrows and animal tracks documented in all transects assigned to 'muddy sand' (UK_09, 11 and 13). This habitat supports animal-dominated communities characterised by a wide variety of polychaetes, bivalves, and echinoderms. Described by the JNCC as "*Circalittoral non-cohesive muddy sands with the silt content of the substratum typically ranging from 5 % to 20 %. These circalittoral habitats tend to be more stable than their infralittoral counterparts and as such support a richer infaunal community*".

Due to the homogeneous muddy sand with minimal hard substrate, fauna observed on the seabed photographs and video were limited to Ophiuroidea (likely *Ophiura ophiura*), Pectinidae and a bobtail squid (*Sepiola atlantica*) with sporadic sightings of Actinopterygii including *Scyliorhinus canicula, Sebastes* sp. and Pleuronectiformes. The observations of Crustacea, specifically burrowing macrofauna, including the squat lobster (*Munida rugosa*), Caridean shrimp (Caridea) and the Norway lobster (*Nephrops norvegicus*), were indicative of faunal communities present in the OSPAR habitat of 'Seapens and Burrowing Megafauna' and as such further assessment into the assignment of this habitat was conducted and discussed in Section 4.10.2d.

The presence of fine and muddy sands, with minimal abundance and diversity of epifauna is consistent with the level three EUNIS habitat classification MC52 describing 'Atlantic circalittoral sand', corresponding with the level 4 JNCC classification SS.SSa.CMuSa 'Circalittoral Muddy Sand'. While examining possible level five biotope classifications for habitats within blocks U06 to U12, it was noted that the seabed showed some similarity to MD4211 'Polychaete-rich deep *Venus* community in offshore circalittoral mixed sediment' due to the presence of characterising species such as the polychaetes Nemertea, *Glycera lapidum*, *Aonides paucibranchiata*, *Notomastus* and *Ampharete* sp.

Example images are given in Figure 52 and the expected extent of the habitat 'Atlantic circalittoral sand' (MC52) is mapped in Figure 57 to Figure 60.

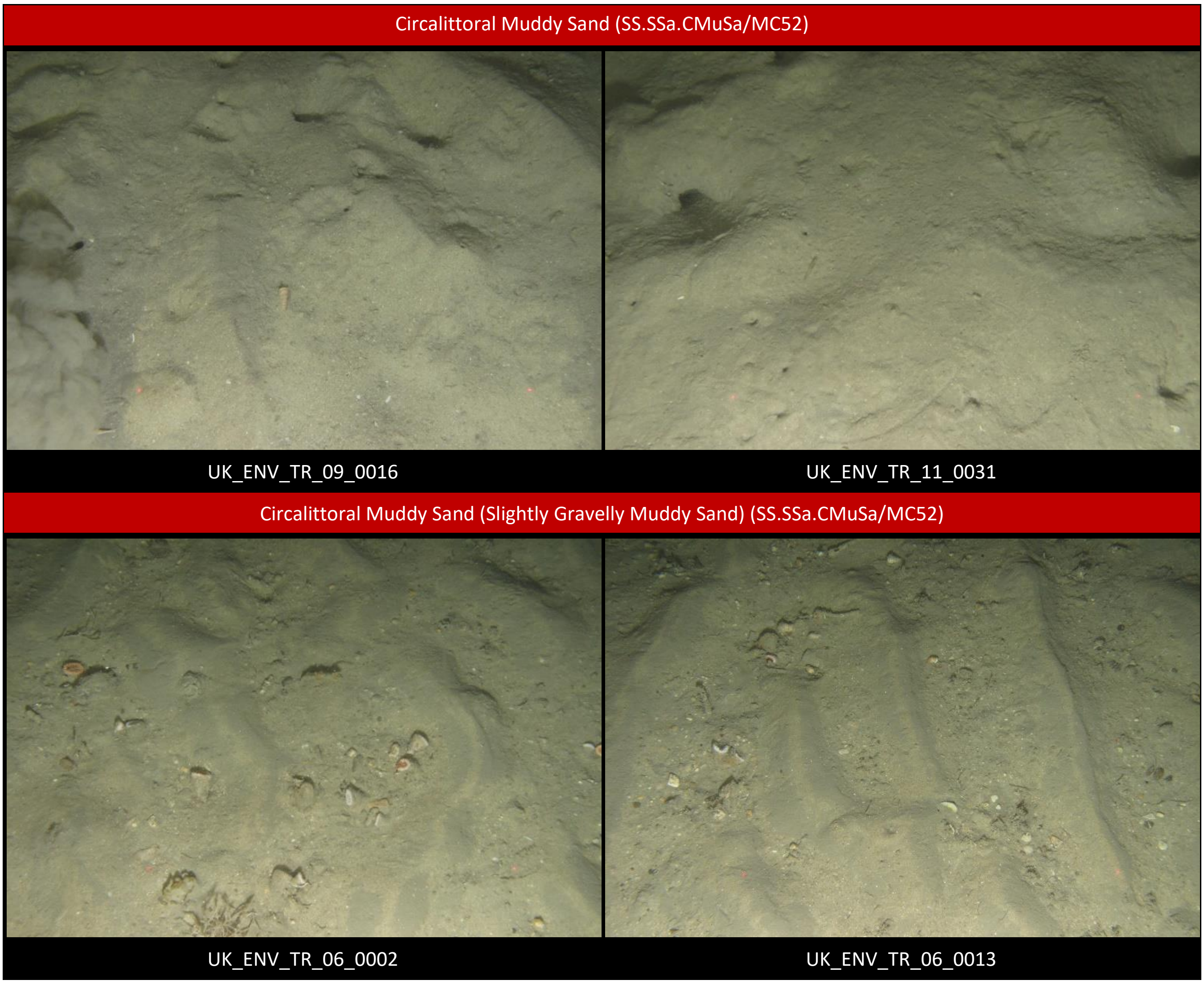


Figure 51: Examples of 'Circalittoral Muddy Sand' habitat variants

d Atlantic Circalittoral Coarse Sediment (MC32/SS.SCS.CCS)

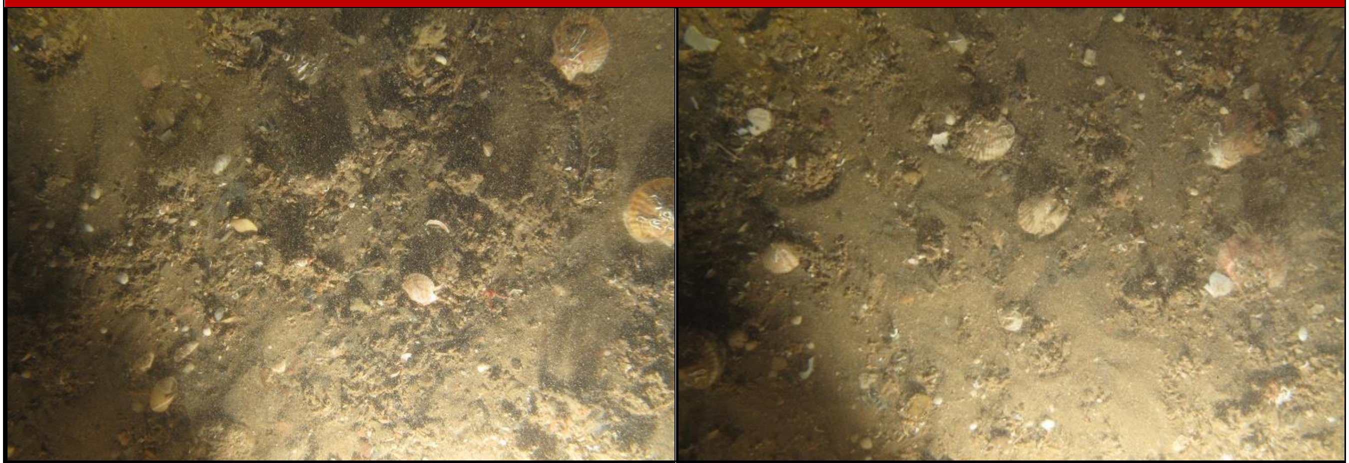
A dominance of poorly sorted coarse sands with variable densities of shell fragments, gravels and pebbles was observed between water depths of 35 m and 50 m within blocks U38A, U37, U36, U35 and U34. Described by the JNCC as "*Tide-swept circalittoral coarse sands, gravel and shingle generally in depths of over 15-20 m*", this level four habitat of 'Circalittoral Coarse Sediment' corresponds with the level three EUNIS habitat MC32 'Atlantic circalittoral coarse sediment'. This broad-scale coarse sediment habitat incorporated three variants: 'Gravelly sand', 'Sandy Gravel (*Sabellaria* rubble)' and 'Slightly Gravelly Pebbley Sand'. The first two variants included ribbons of rippled 'Gravelly sand' intersecting a coarse sand-dominated background sediment comprising small patches of rubble *Sabellaria spinulosa* tubes, assigned as 'Sandy Gravel (*Sabellaria* rubble)'. Small clusters of *S. spinulosa* were only present within ground-truthing in transect UK_51, with *S. spinulosa* rubble also documented in the PSA data of UK_51 and UK_52; where further investigation into the potential for Annex I Biogenic reef status is documented in Section 4.10.2c.

The macrofaunal community recorded at UK_51 can be closely linked to the EUNIS level five biotope '*Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment' (MC2211/SS.SBR.PoR.SspiMx) which occurs when loose agglomeration of tubes form on a low-lying matrix of sand, gravel and mud (JNCC, 2022). This form of *S. spinulosa* habitat tends to exhibit a high diversity of epifaunal species to the accretion of tubes stabilising the underlying sediment increasing the availability of sessile epifaunal attachment. The complex seabed surface made up of shell fragments, *Sabellaria* tubes and pebbles supported this increased biodiversity especially when compared to the shallower fine sand habitats previously observed. Sessile fauna included species within Actiniaria such as *Stomphia coccinea*, Bryozoa and Hydrozoan including Haleciidae and sea beard (*Nemertesia antennina*). Mobile Crustacea were of highest abundance and diversity, observations included Brachyura such as *Macropodia rostrata*, Decapoda including *Pisidia longicornis* as well as hermit crabs (*Pagurus* sp.) and Caridean shrimp (Caridea). Other mobile fauna included scallops (Pectinidae) and brittlestars (Ophiuridae, possibly *Ophiura albida*).

A large patch of coarse sediments situated towards the eastern side of blocks U36, U35 and U34, interpreted as 'medium SAND' in the seabed feature analysis, comprised 'slightly gravelly pebbly sand' when ground-truthed in UK_52. This variant recorded sparse observations of fauna compared to other variants within this habitat, limited to sea beard (*Nemertesia antennina*), hermit crabs (*Pagurus* sp.) and Serpulidae tubes, likely *Spirobranchus* sp. Similarly, the infaunal abundances remained low in the grab data associated with UK_52 limiting the confidence to assign of any level five biotope to this area.

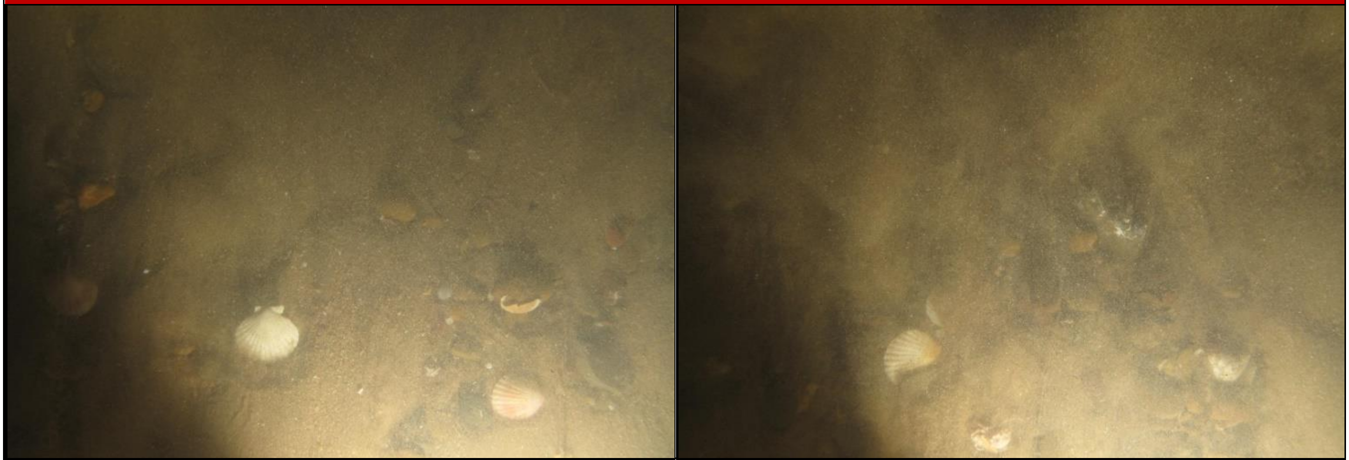
Example images are given in Figure 51 and the expected extent of the habitat MC32 'Atlantic circalittoral coarse sediment' is mapped in Figure 57 to Figure 60.

Circalittoral Coarse Sediment (*Sabellaria* rubble) (SS.SCS.CCS/MC32)



UK_ENV_TR_51_0013 | UK_ENV_TR_51_0018

Circalittoral Coarse Sediment (Slightly Gravelly Pebbly Sand) (SS.SCS.CCS/MC32)



UK_ENV_TR_52_0017 | UK_ENV_TR_52_0016

Figure 52: Examples of 'Circalittoral Coarse Sediment' habitat variants

e Atlantic Offshore Circalittoral Sand (MD52/ SS.SSa.OSa)

Habitats dominated by sands and fine sands, occasionally rippled, were observed throughout the majority of the route oscillating between areas of coarse sands and gravels between blocks U12 and U33, also observed between U01 to U06 towards the southern section of the route. Slight varying influences from the adjacent coarser habitats were observed in transition zones between sediment types. Classified as ‘Medium sand’ in the seabed features, these habitats corresponded with the EUNIS habitat MD52 ‘Atlantic Offshore Circalittoral Sand’ corresponding to the JNCC SS.SSa.OSa ‘Offshore Circalittoral Sand’ habitat. The biotope is described by the JNCC (2022) as “*Offshore (deep) circalittoral habitats with fine sands and non-cohesive muddy sands. That are likely to be more stable than their shallower counterparts and are characterised by a diverse range of polychaetes, amphipods, bivalves, and echinoderms. This habitat is generally found in water depths of over 20 m and potentially down to 200 m.*” Cobbles and boulders were rarely present, with slightly more observations concentrated to transects in the northern part of the route.

Fauna observed on the seabed photographs and videos varied with moderate diversity and abundance of mobile species, including several arthropods such as the brown crab (*Cancer pagurus*), hermit crabs (*Pagurus* sp.) and Brachyura). Echinoderms included a number of Asteroidea *(Marthasterias glacialis, Astropecten irregularis* and *Luidia ciliaris*), taxa in Ophiuroidea, likely *Ophiura albida* as well as an individual purple heart urchin *(Spatangus purpureus*). Sightings of Octopoda and Cephalopoda were also recorded in this habitat. Many Chordata species were also observed within this habitat notably flatfish (Pleuronectiformes) and boar fish (*Capros aper*), as well as unidentified Actinopterygii. Epifaunal taxa in Actiniaria (*Bolocera tuediae* and *Hormathia digitata*), Cnidaria (Cerianthidae and *Caryophyllia* sp.), Hydrozoa (Plumularioidea) and Porifera were also noted sporadically within this habitat potentially linked to the shallow underlying rock observed in the subsurface geology.

Three level five biotopes have potential to exist within the ‘Atlantic Offshore Circalittoral Sand’ habitats along this route, further review of the macrofauna data revealed a dominance of the level five biotope MC5211 ‘*Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand’, corresponding to the JNCC habitat SS.SSa.CFiSa.EpusOborApri. The habitat characterising species, *Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica*, were recorded across the ‘Atlantic Offshore Circalittoral Sand’ habitat. The remaining two potential level five habitats included MD5212 ‘*Owenia fusiformis* and *Amphiura filiformis* in offshore circalittoral sand or muddy sand', recorded at station UK_45, and MB5231 'Sparse fauna in Atlantic infralittoral mobile clean sand', assigned to station UK_05 due to the presence of a relatively impoverished faunal community.

Example images are given in Figure 54 and the observed extent of the habitat 'Atlantic Offshore Circalittoral sand' (MD52) is mapped in Figure 57 to Figure 60.

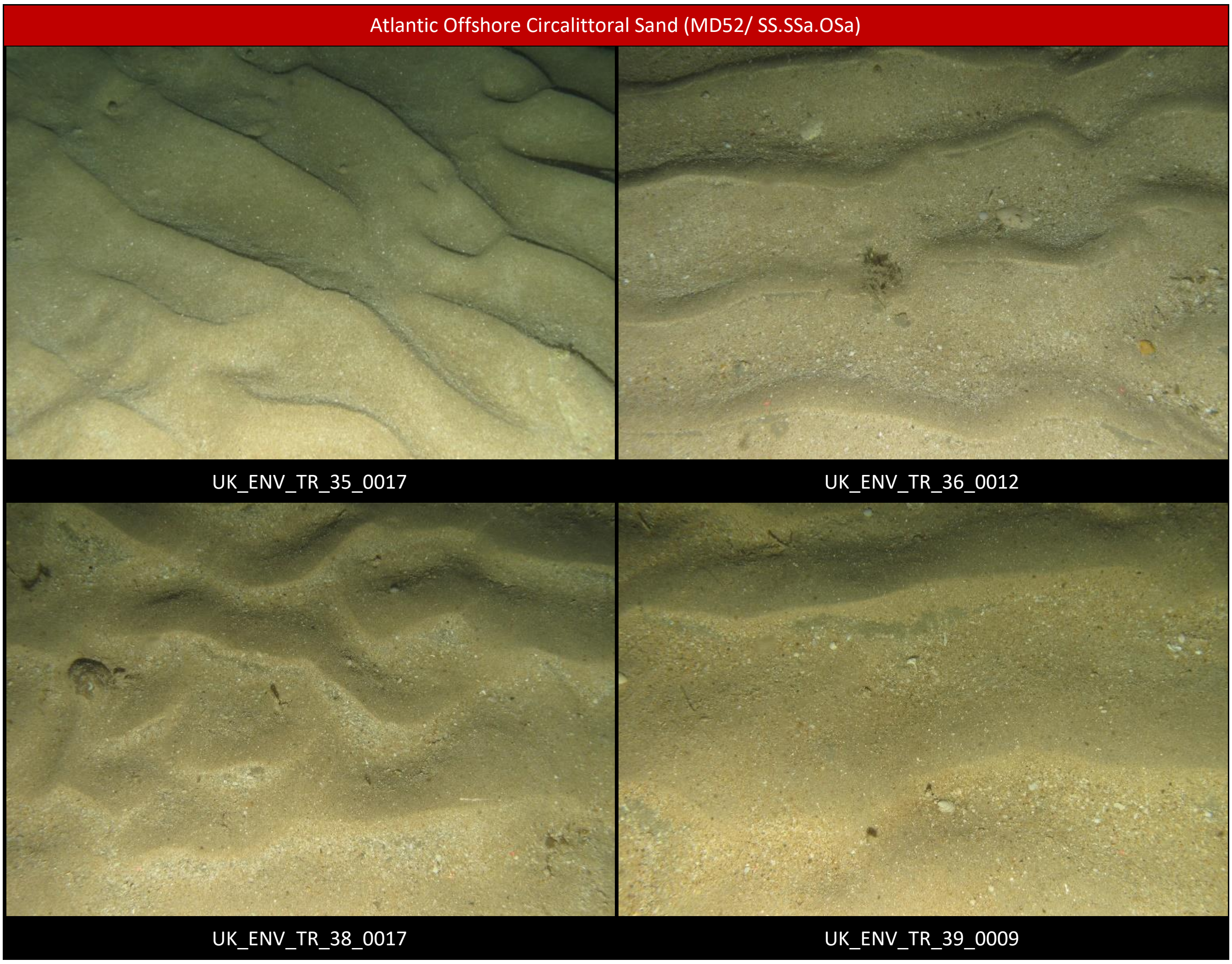


Figure 53: Examples of 'Atlantic Offshore Circalittoral Sand' habitat variants

f Mixed Faunal Turf Communities (MC121/ CR.HCR.XFa)

Habitats characterised by outcropping bedrock with sporadic cobbles and boulders were most prominent along camera transects with Blocks U33 and U34. The distinct topographic elevation associated with these ground-truthed locations (UK_47, 48 and 49) was also identified in the bathymetry towards the southern end of Block U26. The hard subsurface geology outcropped along these sections form elevated rocky ridges often with veneers of sandy gravel interspersed by areas of cobbles and boulders. This biotope complex is characterised by the JNCC as exposed circalittoral bedrock and boulders with a diverse range hydroids, sponges and soft corals often forming dense faunal turfs.

The greater diversity and abundance of sessile organisms observed due to an increase in hard substrate availability of outcropping rock included aggregations and singular Actiniaria such as *Metridium senile* and *Cylista* sp., cup corals (*Caryophyllia inornata* and *Caryophyllia smithii*), *Spirobranchus* sp., barnacles (likely *Semibalanus* sp.) and erect and encrusting Porifera including, but not limited to, *Cliona celata*, *Stelligera stuposa, Axinella* sp., *Axinella* *dissimilis* and *Adreus fascicularis.* Dense turfs of Hydrozoa comprising *Tubularia* sp., *Nemertesia antennina,* Haleciidae and *Abietinaria abietina* were common in this habitat. The bryozoans *Pentapora foliacea, Porella compressa,* (possible) *Cellaria* sp., and the soft coral *Alcyonium digitatum* were regularly observed attached to cobbles and outcropping rock. Mobile fauna associated with this habitat comprised common occurrences of Crustacea and Echinodermata, including hermit crabs (*Pagurus* sp.), spider crabs (*Macropodia rostrata* and *Hyas* sp.), squat lobster (Munididae), brown crab (*Cancer pagurus*), spiny starfish (*Marthasterias glacialis*), common urchins (*Echinus esculentus*), brittle stars (Ophiuroidea) and Crinoidea (Antedonidae). Chordata were occasionally observed and included the small-spotted catshark (*Scyliorhinus canicular*) and gurnards (Triglidae).

An outcropping scarp feature located within Block U11, traversed by transect UK_14, was distinctively different in the geophysical data and ground-truthing from the previously identified rocky habitats. Faunal assemblages were less abundant and diverse, mainly limited to hydrozoan/bryozoan turf including *Nemertesia antennina* and *Abietinaria abietina* and few Porifera, with the overlaying and surrounding sediment dominated by fine and muddy sands. Despite the differences in these two features the presence of these faunal assemblages indicates a conformance towards the level four EUNIS classification of MC121 'Faunal turf communities on Atlantic circalittoral rock', corresponding with the JNCC classification CR.HCR.XFa 'Mixed Faunal Turf Communities'.

A total of nine level five biotopes exist within the 'Mixed faunal turf communities' habitat, the epifaunal compositions described on the hard substrate matrices in UK_47, UK_48 and UK_49, closely lend themselves to the level five EUNIS habitat of 'Bryozoan turf and erect sponges on tide-swept Atlantic circalittoral rock' (MC1213), corresponding to the JNCC habitat 'Bryozoan turf and erect sponges on tide-swept circalittoral rock' (CR.HCR.XFa.ByErSp). Characterising epifaunal diversity observed throughout included Bryozoans such as dead man's fingers (*Alcyonium digitatum*), *Crisularia plumosa* and *Pentapora foliacea*, the Devonshire cup coral (*Caryophyllia smithii*), sea beard (*Nemertesia antennina*), painted top shells (*Calliostoma zizyphinum*) and Actiniaria including (*Urticina felina*). Porifera communities across this habitat comprised *Axinella* sp. (likely *Axinella dissimilis*), *Haliclona* spp. (likely *H. urceolus* and *H. oculata*) and *Cliona celata* as well as multiple unidentifiable encrusting sponges.

The occurrence of fauna covered cobbles and outcropping rock warrants further investigation as potential Annex I geogenic stony reef or rocky reef habitats (discussed further in 4.10.2a). Example images are given in Figure 53 and the expected extent of the habitat 'Faunal turf communities on Atlantic circalittoral rock' (MC121) is mapped in Figure 57 to Figure 60.

Faunal turf communities on Atlantic circalittoral rock (MC121)

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UK_ENV_TR_47_0015

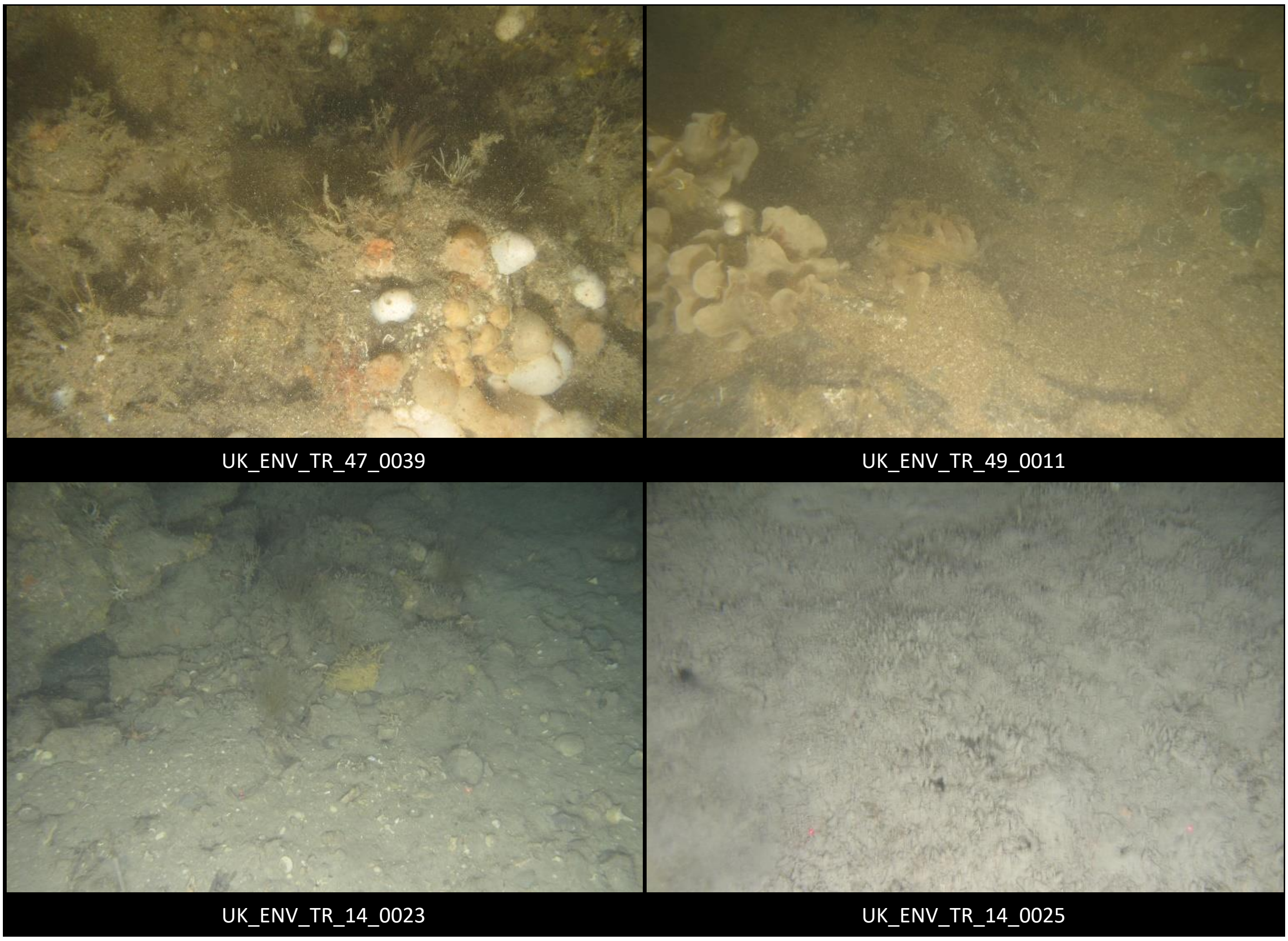

Figure 54: Examples of 'Faunal turf communities on Atlantic circalittoral rock' and their associated fauna

g Atlantic Offshore Circalittoral Coarse Sediment (MD32/ SS.SCS.OCS)

Coarse sediments, dominated by sands and varying components of coarse sands, gravels, pebbles and cobbles were ubiquitous along the route, oscillating between mobile sand habitats the intermittent influences of coarse sediments made for complex habitat matrices. These coarse sediment compositions span the whole route, found in most blocks deeper than 50m, except for U08. U09, U10, U30 and U31. This broad biotope is described by the JNCC (2022) as "*Offshore (deep) circalittoral habitats with coarse sands and gravel or shell. Such habitats are quite diverse compared to shallower versions of this biotope and are generally characterised by robust infaunal polychaete and bivalve species.*". Sediment composition in areas assigned to the EUNIS habitat MD32 'Atlantic Offshore Circalittoral Coarse Sediment', ranged from gravelly sands to sandy gravel to pebbly, cobbly sandy gravel.

The most common composition of coarse sediments was mainly sands and gravels with occasional pebbles, described as 'Gravelly sand' and 'Pebbley gravelly sand', sporadically covering the majority of the route from blocks U01 to U06, U12 to U29, U32 and U33; Table 24; Figure 57 to Figure 60). The route mosaics between these coarse sediments and the previously described 'Sand' habitats, the proximity of these two sediments regularly influenced a transitional habitat between them. Fauna observed in the video footage were relatively consistent with regular observations of Bryozoa including Haleciidae, Tubuliporidae, a possible *Omalosecosa ramulosa* and Hydrozoa such as Plumularioidea. Other sessile species included Porifera such as *Polymastia* sp. and *Axinella* sp. (likely *Axinella dissimilis*), Actiniaria and keel worms (Serpulidae). Mobile Arthropoda were also observed and included spider crabs (*Maja squinado*), unidentifiable crabs (Brachyura) and hermit crabs (*Pagurus* sp.). Mobile Chordata were occasionally recorded and included gurnards (Triglidae) and *Sebastes* sp. A variety of echinoderms were also observed, with species present within Ophiuroidea, numerous starfish including *Asterias rubens, Stichastrella rosea* and *Luidia ciliaris*, common heart urchin (*Echinocardium cordatum*) and purple heart urchin (*Spatangus purpureus*).

The macrofaunal communities present at stations within these sediment compositions showed a variable conformance towards two level 5 biotopes. Many stations in this habitat (UK_21, UK_23, UK_24, UK_27 and UK_46) recorded numerous polychaete species including *Protodorvillea kefersteini* and *Glycera lapidum* with species also observed within Notomastus, Nemertea and Nematoda. This species composition shows similarities to the MC3213 biotope, '*Protodorvillea kefersteini* and other polychaetes in impoverished Atlantic circalittoral mixed gravelly sand', corresponding to the JNCC level five of SS.SCS.CCS.Pkef '*Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand'. Relatively low abundances of similar species compositions were observed at UK_30, UK_33 and UK_34, representing an impoverished variation of this level five biotope. The remaining stations (UK_16 and UK_37) showed some conformity to the EUNIS level five biotope MC5211 '*Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand', corresponding to the JNCC habitat SS.SSa.CFiSa.EpusOborApri. However, the impoverished species abundances reduce confidence in the assignment of this biotope.

The most complex and coarse matrix of this habitat was situated towards the northern extent of the route, ground-truthed in transects UK_47, UK_48, UK_49 and UK_50, it comprised cobbles, pebbles, sands and gravels with the occasional presence of boulders, labelled as 'Gravel, Pebble' in the seabed features. This habitat is located in blocks U33 and U34 adjacent to the outcropping rock previously described in section 4.10f, the characteristics of these habitats show similarities to the Annex I Rocky Reef habitat, and as a result further assessment into the criteria associated with this potential reef designation is detailed in Section 4.10.2a.

The increased availability of hard substrate influenced the epifaunal diversity, with common occurrences of hydrozoans such as *Nemertesia antennina, Nemertesia ramosa* and *Tubularia indivisa*, bryozoans included *Alcyonidium diaphanum, Bicellariella ciliata* and *Pentapora facialis*. Other sessile taxa comprised Serpulidae worms (*Spirobranchus* sp.), barnacles (*Balanus* sp.), Actiniaria (*Metridium senile*) and Porifera (*Axinella* sp., likely *Axinella dissimilis*). Mobile Crustacea and Echinodermata included hermit crabs (*Pagurus* sp.), *Macropodia rostrata, Hyas* sp., *Marthasterias glacialis* and Ophiuroidea. The colonising epifaunal communities within this habitat show good conformity to the level five EUNIS biotope MC3211 '*Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles', corresponding to the JNCC biotope labelled SS.SCS.CCS.SpiB '*Spirobranchus triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles'. Please note, despite the use of the genus '*Pomatoceros*' in the biotope classification designed by EUNIS, the genus is no longer accepted within taxonomy and the correct genus for this species and biotope is '*Spirobranchus*'.

An area described as 'Shingle', containing very coarse sands and shell fragments with a minimal fines component, was observed within the ground-truthing along transect UK_12 (Figure 55). A sporadic coverage of similar high reflectivity signatures within block U11 were apparent within the geophysical data and identified in the seabed feature mapping (Figure 5 to Figure 8). Very few species were observed with taxa limited to mobile fauna including Caridean shrimp (Caridea), brittlestars (Ophiuroidea), hermit crabs (*Pagurus* sp.) and Actinopterygii (Pleuronectiformes and *Sebastes* sp.). The sediment characterises do conform to the level four EUNIS MD32 habitat, however, the lack of conspicuous fauna and infaunal data prevents further delineation into a level five biotope.

Example images are given in Figure 55 and the observed extent of the habitat MD32 'Atlantic Circalittoral Coarse Sediment' is presented in Figure 57 to Figure 60.

Offshore Circalittoral Coarse Sediment (Gravelly Sand) (MD32/SS.SCS.OCS)

UK_ENV_TR_27_0003

UK_ENV_TR_30_0007

Offshore Circalittoral Coarse Sediment (Pebbley Gravelly Sand) (MD32/SS.SCS.OCS)

UK_ENV_TR_34_0009

UK_ENV_TR_24_0003

Offshore Circalittoral Coarse Sediment (Pebbley Cobbley Sandy Gravel) (MD32/SS.SCS.OCS)

UK_ENV_TR_50_0030

UK_ENV_TR_48_0064

Offshore Circalittoral Coarse Sediment (Shingle) (MD32/SS.SCS.OCS)

UK_ENV_TR_12_0014

UK_ENV_TR_12_0016

Figure 55: Examples of "Offshore Circalittoral Coarse Sediment' habitat variations

h Atlantic Offshore Circalittoral Mixed Sediment (MD42/ SS.SMx.OMx)

Sediments dominated by muddy sands with influences of gravels, pebbles and cobbles were classified as MD42 'Atlantic Offshore Circalittoral Mixed Sediment'. The corresponding JNCC biotope SS.SMx.OMx of 'Offshore Circalittoral Mixed Sediment' is describes as *"Slightly muddy mixed gravelly sand and stones or shell, and such habitats are often highly diverse, with a high number of infaunal polychaete and bivalve species. Animal communities in this biotope are closely related to offshore gravels and coarse sands".*

The fluctuation of two 'muddy sand' dominated habitats, differentiated by the influence of coarse sediments, was observed towards the southern end of the route, between blocks U07 and U15. The habitats comprising an increased gravel component, identified in transects UK_06, UK_07, UK_08, UK_10, UK_14 and UK_15, were classified into the EUNIS MD42 habitat. While stations assigned to this habitat show varied percentages of gravels based on the PSD dataset, there is likely a sediment compositional influence dependent on sampling acquisition of a peak or trough in the occurrence of seabed rippling, where troughs tend to contain coarser fragments when compared with peaks, and therefore grab sampling cannot always reflect the composition of the whole habitat.

The epifaunal observations from the video ground-truthing recorded burrowing Actiniaria (likely *Mesacmaea mitchellii* and *Bolocera tuediae*), Ophiuroidea (likely *Ophiura ophiura*), Porifera and Bryozoan/Hydrozoan turf. Larger fauna included multiple Actinopterygii (Pleuronectiformes, pollack (*Pollachius pollachius*) and *Sebastes* sp.) and a bobtail squid (*Sepiola atlantica*). This habitat supported similar infaunal communities to the adjacent muddy sand habitats characterised by a wide variety of polychaetes, bivalves, and echinoderms. In particular, the presence of taxa such as Nemertea, *Glycera lapidum*, *Aonides paucibranchiata*, Notomastus and *Ampharete* sp. shows some similarity to MD4211 'Polychaete-rich deep Venus community in offshore circalittoral mixed sediment' the level five EUNIS biotope.

A more complex mosaic of mixed sediments was recorded across blocks U16 and U17, within transects UK_19 and UK_20, comprising matrices of cobbles, pebbles, gravel and muddy sand with occasional boulders. The increased opportunity for epifaunal colonisation resulted in a greater abundance and diversity of taxa observed within this habitat. Fauna observed within this habitat included cup corals such as *Caryophyllia smithii and Caryophyllia inornata*, numerous species of Porifera such as *Axinella* sp. (possibly *Axinella dissimili*s), Hymedesmiidae, possible *Amphilectus fucorum, Stelligera stuposa* and *Suberites* sp. The presence of echinoderms were recorded in relatively higher abundances in this habitat, in particular Ophiuroidea (likely *Ophiocomina nigra* and *Ophiura albida*), urchins (Echinus esculentus) and Asteroidea.

Example images are given in Figure 56 and the observed extent of the EUNIS habitat MD42 'Atlantic Offshore Circalittoral Mixed Sediment is mapped in Figure 57 to Figure 60.

Atlantic Offshore Circalittoral Mixed Sediment (Gravelly Muddy Sand) (MD42/SS.SMx.OMx)

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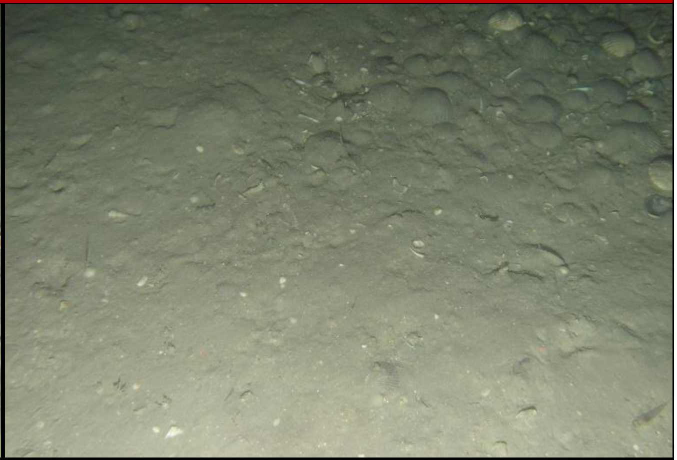


UK_ENV_TR_10_0013

Atlantic Offshore Circalittoral Mixed Sediment (Cobbley Gravelly Pebbley Muddy Sand) (MD42/ SS.SMx.OMx)

UK_GT_TR_20_0006

UK_ENV_TR_20_0009

Figure 56: Examples of "Offshore Circalittoral Mixed Sediment" habitat variations

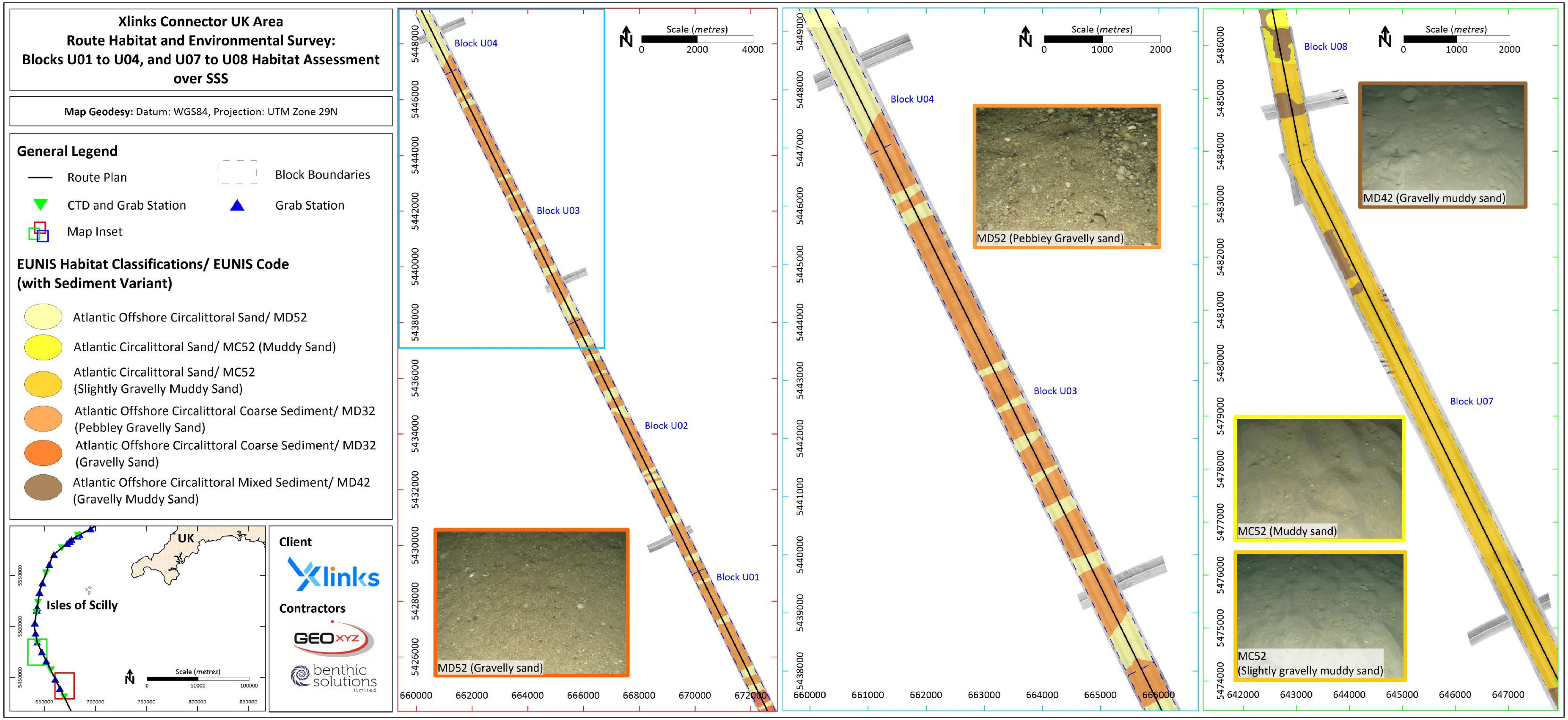


Figure 57: Habitat assessment for blocks U01 to U04 and U07 along the survey area proposed cable route

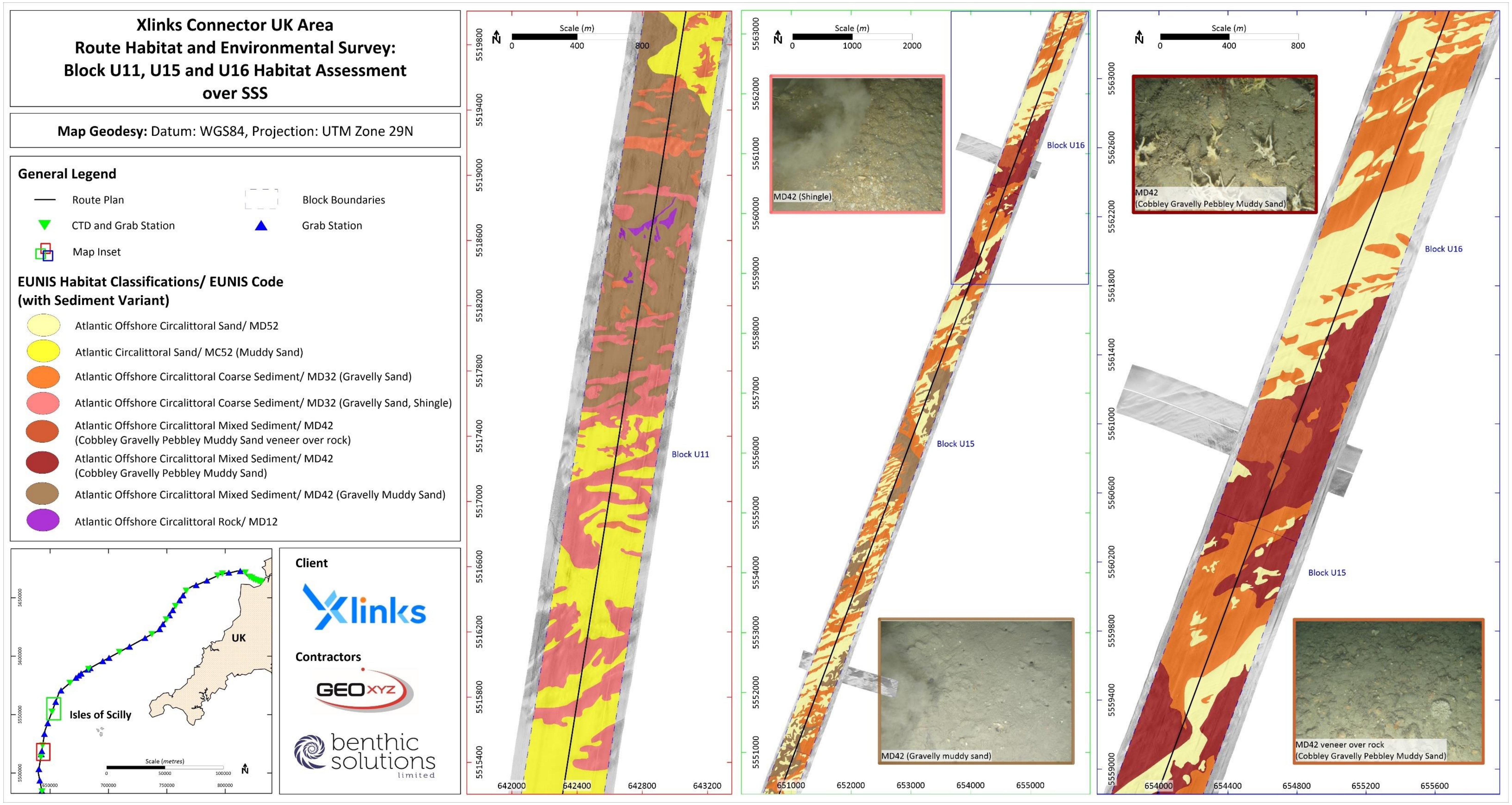


Figure 58: Habitat assessment for blocks U11, U15 and U16 along the survey area proposed cable route

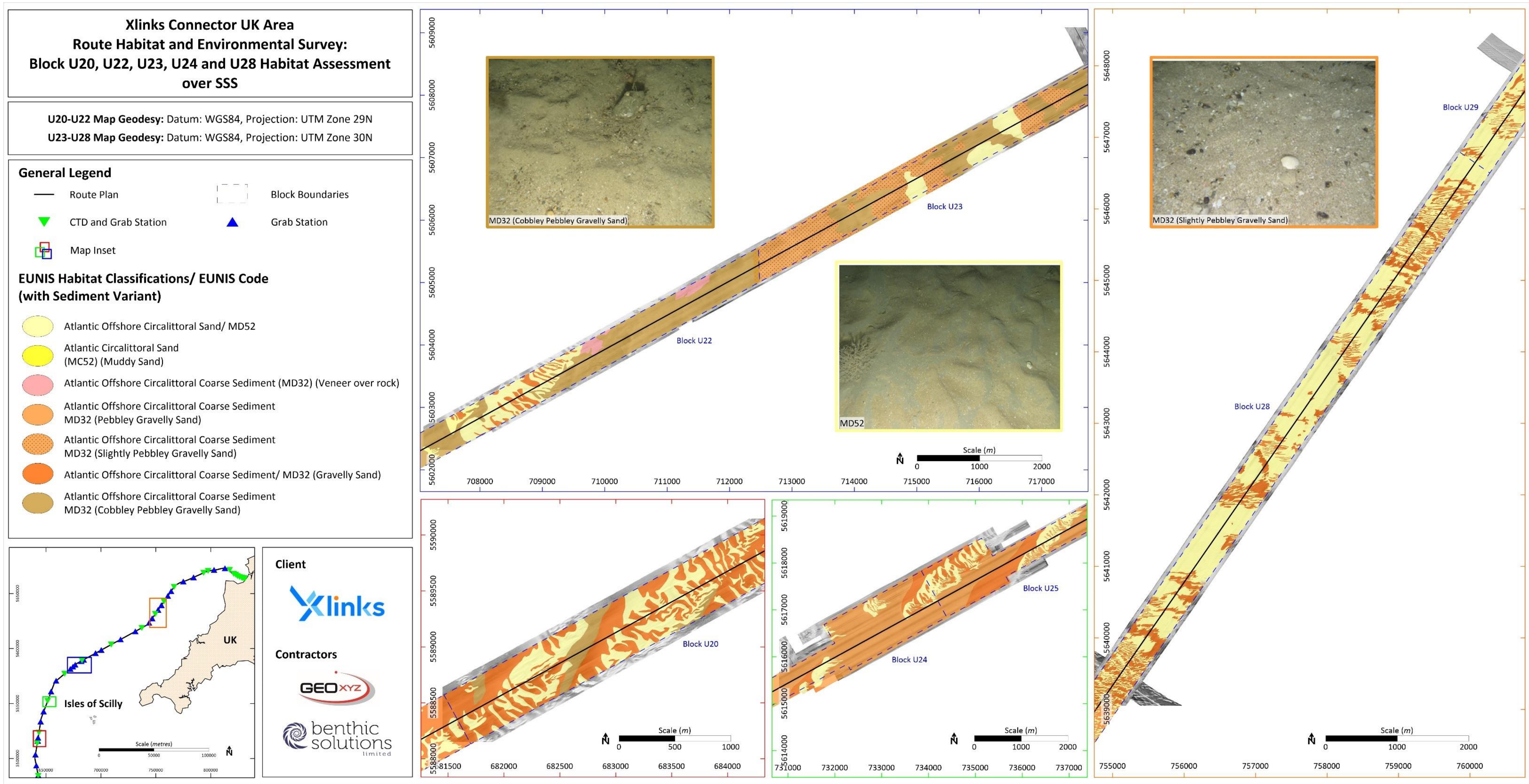


Figure 59: Habitat assessment for blocks U20, U22 to U24, and U28 along the survey area proposed cable route

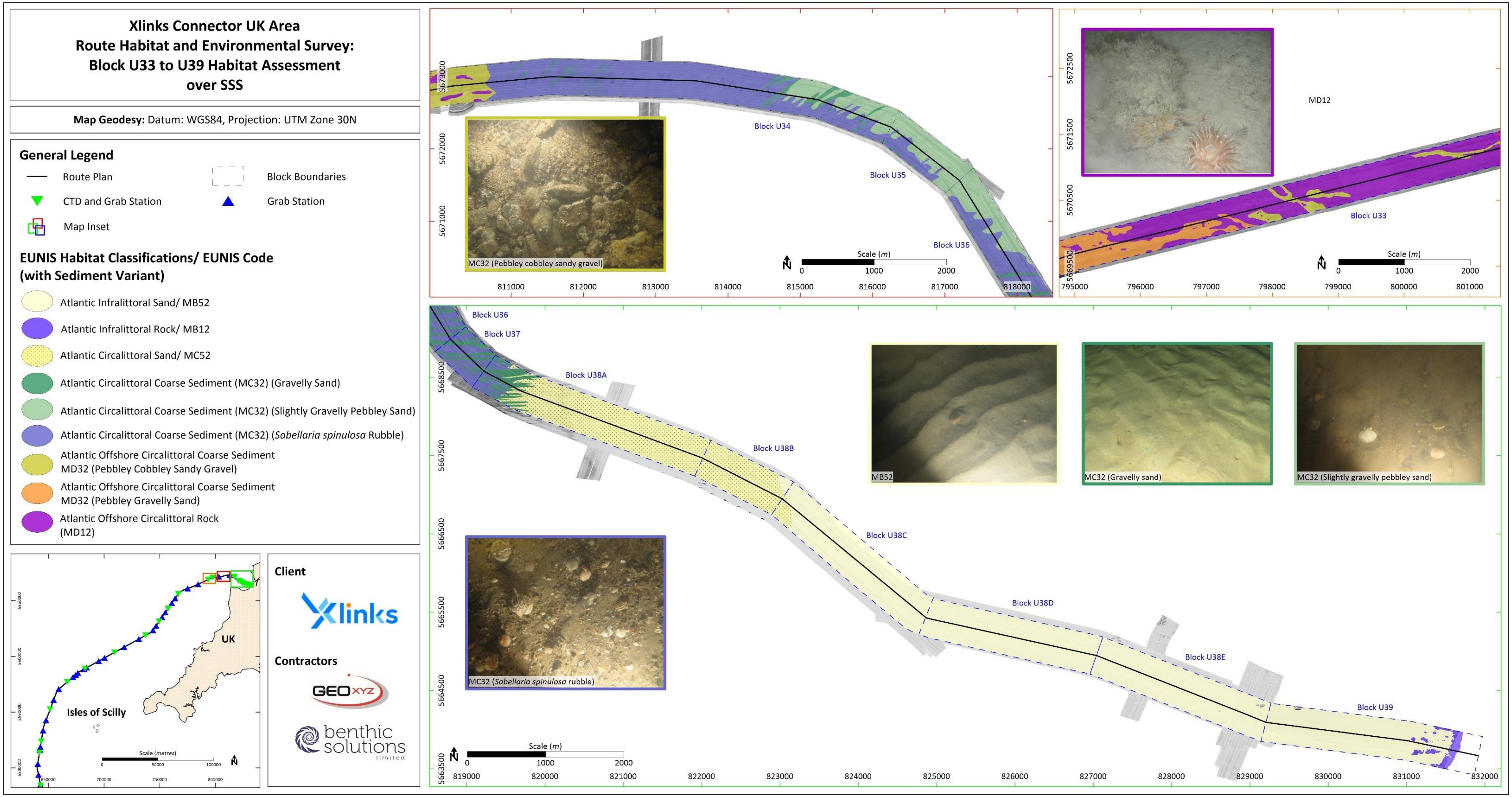


Figure 60: Habitat assessment for blocks U33 to U39 along the survey area proposed cable route

4.10.2 Potential Sensitive Species and Habitats

As previously discussed, there are several potentially sensitive habitats and species which are known to occur within this region of the UK seas, including:

- Geogenic Reefs (EC Habitats Directive Annex I, UKBAP Priority Habitat).
- Biogenic Reefs *Sabellaria spinulosa* (EC Habitats Directive Annex I, UKBAP Priority Habitat)
- Seapens and burrowing megafauna (OSPAR Habitat)
- Deep-Sea Sponge aggregations
- Ocean quahog (*Arctica islandica*).
- Subtidal Sands and Gravels (UK Post-2010 Biodiversity Framework Habitat).
- Fan Mussel (*Atrina fragilis*)

These habitats and species are listed by one or more International Conventions, European Directives or UK Legislation. Note: while European Directives are no longer directly relevant following the UK's exit from the European Union, UK legislation implementing these Directives is still applicable and there has not yet been any policy change (GOV.UK, 2022).

a Annex I Geogenic Reefs - Rocky Reefs

Areas of bedrock, both exposed and covered in a veneer of sand, were observed along the length of the survey corridor with varying compositions of pebbles, cobbles and boulders. These features necessitated further investigations to assess whether they could be classified as Annex I geogenic reefs (which encompasses both stony and rocky reefs).

Bedrock is normally an unbroken solid rock, often found in underlying sediments in the marine environment. When exposed as an outcrop on the seabed, it is classed as a subtidal bedrock reef and can often be found in matrices of cobbles and boulders (Parry, 2019). Subtidal bedrock communities can vary according to factors such as rock type, topographical features (e.g. vertical rock walls, gully and canyon systems and outcrops from sediment) and exposure to wave action and tidal currents (Parry, 2019). In deeper waters, found similarly within blocks U33 to U34 and , where light levels are slightly lower, habitats tend to be dominated by faunal communities, typically sponges, soft corals, hydroids, anemones, echinoderms and bryozoans (as opposed to the shallower dominance of kelp and seaweed communities).

The geogenic reef assessments were based on the HD still images captured during the camera transects to assess changes in coverage of outcropping rock, as well as both the coverage and density of pebbles, cobbles and boulders. The biodiversity and presence of key and desirable species listed by Golding *et al.* (2020) within these geogenic reefs were then assessed in order to be categorised, as summarised within Table 25.

The proportion of visible bedrock and the epifaunal coverage, including and excluding hydrozoan/bryozoan turf, was recorded. If a veneer of sand was present and the stills contained less than 10 % bedrock, then the area was classified as 'Rocky Reef partially covered'. If key species of erect epifauna (Appendix T) are present, the area was classified as 'Reef with sand veneer'. If erect epifauna were not visible, but other reef or 'desirable' species were recorded (Appendix D; Golding *et al*. (2020)), the area was classified as 'Possible reef with sand veneer'. This sand mobility, leaving periodically bare surfaces for establishment of rocky epifauna, is a key feature of veneers. Not all species which might settle when the sediment is absent can survive when it returns, with species thriving within this environment mainly limited to various *Polymastia* sponges, soft corals and sea fans (CCW, 2009).

Any stills with over 50 % of bedrock and visible epifauna were assigned as 'Rocky reef', under Annex I Reef habitats. They were then categorised as high (>40 %) or low (<40 %) biodiversity, based on the coverage or absence of erect turf such as *Alcyonidium digitatum, Cliona celata* and *Flustra foliacea*, or the amount of key and other desirable reef species, as listed by Golding *et al.* (2020). A gap in the Golding *et al*. (2020) assessment negates an assignment for coverage between 10 % and 50 %. To address this gap, BSL applied a precautionary principle by adopting the Golding *et al.* (2020) assessment for '>50 % bedrock' to areas of '10-50 % bedrock', which would otherwise have not been assessed. When such bedrock proportions were identified within stills, along with visible epifauna, these were assigned as Annex I rocky reef, and then categorised as high or low biodiversity based on percentage coverage of key or erect faunal species. The resulting assessment is tabulated below in Table 25**Error! Reference source not found.**. When view of the seabed/ bedrock was limited due to increased turbidity and backscatter in the water column exact coverage percentages were not possible to estimate, therefore the category boundaries (>50 %, >10 % and <10 %) were utilised instead.

Table 25: Criteria for annex I rocky reefs (after Golding *et al.,* 2020)

Bedrock Composition	Limited to no fauna present	Some reef species present	Erect key species present
<10 % Bedrock	Not a Reef	Possible reef with sand veneer	Reef with sand veneer
10-50 % Bedrock	Rocky Reef with Low Biodiversity	Rocky Reef with Low Biodiversity	Rocky Reef with High Biodiversity*
>50 % Bedrock	Rocky Reef with Low Biodiversity	Rocky Reef with Low Biodiversity	Rocky Reef with High Biodiversity*
Note: **Epifaunal coverage >40%*			

Two distinctly different areas of outcropping bedrock were identified in the geophysical data with sections further ground-truthed and assessed using the high-definition video and stills data. Firstly, a scarp feature was observed in block U11, and rocky reef assessment conducted on underwater stills acquired along transect UK_14. The area of the outcropping scarp featured few cobbles and boulders over 'Gravelly muddy sand' with epifaunal coverage limited to Hydrozoan/ Bryozoan turf and few Porifera. The area of scarp delineated by the seabed features covered approximately 7,400 m² of seabed. Out of the 31 still images assessed for this feature, six contained rocky outcrop or hard substrate, of which composition exceeded 10 % in four stills. When excluding turf biodiversity coverage fell below 40 % indicating characteristics of Annex I 'Rocky Reef with Low Biodiversity' (Figure 61 and Table 26).

Large areas of outcropping rock situated in the northern section of the route (blocks U33 and U34) also necessitated a rocky reef assessment. In total, 234 images were reviewed along three transects (UK_47, UK_48 and UK_49) that contained areas of potential rocky reef. Out of these images, 48 (20.2 %) contained no evidence of rocky reef. In terms of rocky reef composition, 149 images, had greater than 10 % bedrock coverage, of which 92 stills had coverage of greater than 50 %. These stills were initially classified as 'Rocky Reef'. Of the remaining stills, 41 had a bedrock coverage was less than 10 % conforming to the category 'Rocky Reef partially covered', and the remaining eight images had >10 % coverage yet significant sand veneer and were also categorised into 'Rocky Reef partially covered'.

Substrate epifaunal coverage greater than 40 % was recorded in 102 (72 %) stills, with only 39 stills recording less than 40 % coverage, and therefore 72 % of stills were classed as 'Annex I Rocky Reef with High Biodiversity'. However, when excluding hydrozoan/bryozoan turf, which is regarded as low ecological value by Golding *et al.*

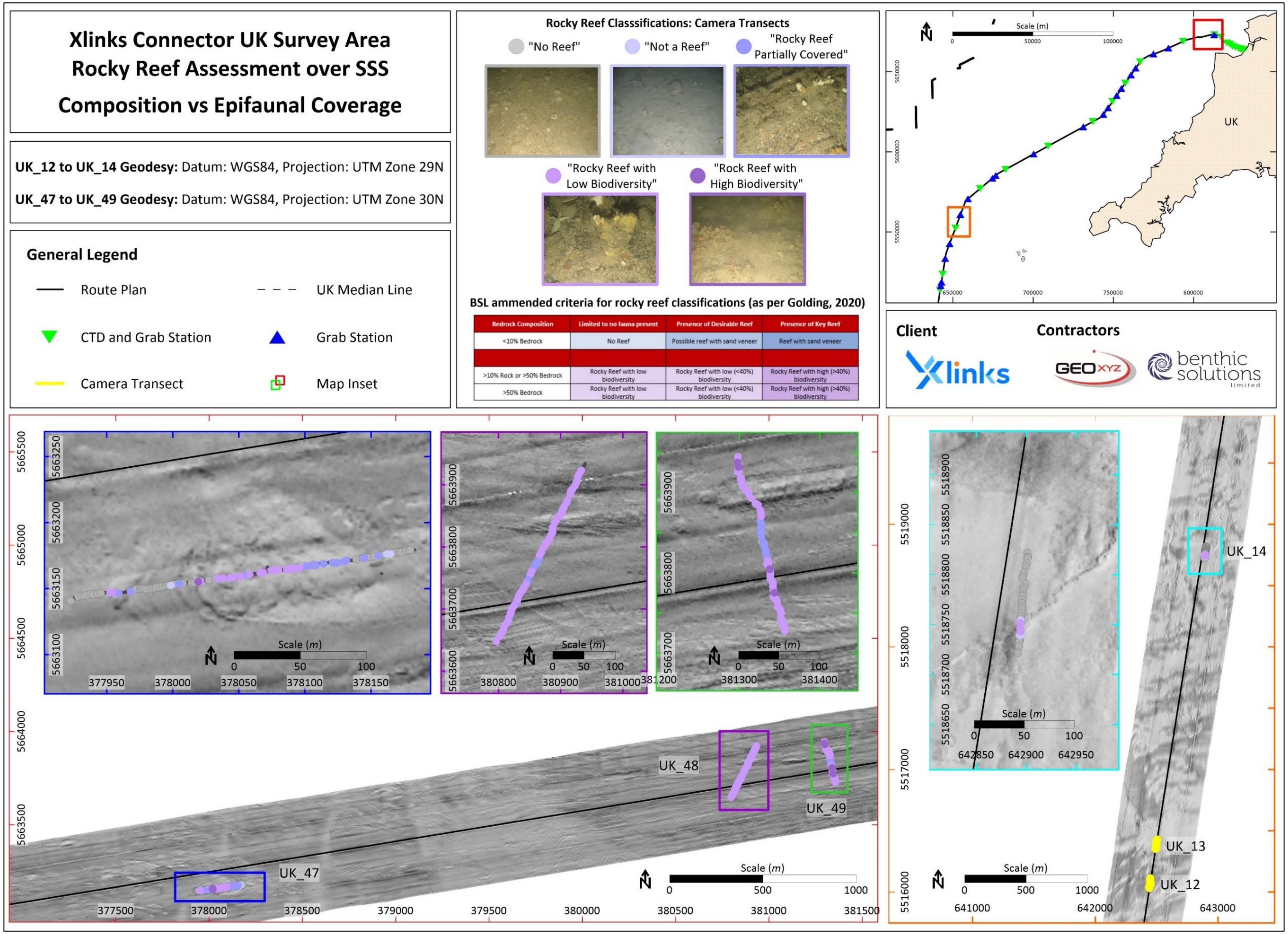
(2020), just five stills (4 %) recorded epifaunal coverage of over 40 % and the remaining 136 stills contained less than 40 % coverage, classed as 'Annex I Rocky Reef with Low Biodiversity' (Table 26).

Table 26: Summary of rocky reef image analysis

Transect	No Reef		Not a Reef		Poss. Reef with Sand Veneer		Reef with Sand Veneer		Rocky Reef with low (<40%) biodiversity		Rocky Reef with high (>40%) biodiversity	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
UK_14	25	80.6	2	6.5	0	0	0	0	4	12.9	0	0
UK_47	44	53.7	3	3.7	3	3.7	12	14.6	18	21.9	1	1.2
UK_48	2	2.4	0	0	4	4.8	12	14.5	65	78.3	0	0
UK_49	1	1.4	0	0	12	16.4	3	4.1	53	72.6	4	5.5
Total	72	-	5	-	19	-	27	-	140	-	5	-

When considering further classifications of 'Rocky Reefs partially covered' the presence and/ or absence of key species is important. A total of 28 stills recorded the presence of one or more key reef species including *Alcyonium digitatum, Pentapora foliacea, Abietinaria abietina* and *Nemertesia antennina*, resulting in a 'Reef with Sand Veneer' classification. Stills that contained one or more desirable reef species were assigned to 'Possible Reef with Sand Veneer', of which 19 stills conformed to this category. The two remaining stills resulted in a 'No Reef' classification as a result of no presence of a singular key or desirable species.

To further this classification, stills were grouped together by 'Rocky Reef' and 'Rocky Reef partially covered' within habitat boundaries (Appendix T). Out of 31 sections, 11 were categorised into 'Annex I Rocky Reef with Low Biodiversity' and eight were categorised into 'Reef with Sand Veneer'. A remaining 12 areas were classified as 'No Reef' where no key or desirable species were recorded. Full details of this assessment are provided in Appendix T, with the extent mapping delineated in Figure 61.



Bedrock Composition	Limited to no fauna present	Presence of Desirable Reef	Presence of Key Reef
<10% Bedrock	No Reef	Possible reef with sand veneer	Reef with sand veneer
>10% Rock or >50% Bedrock	Rocky Reef with low biodiversity	Rocky Reef with low (<40%) biodiversity	Rocky Reef with high (>40%) biodiversity
>50% Bedrock	Rocky Reef with low biodiversity	Rocky Reef with low (<40%) biodiversity	Rocky Reef with high (>40%) biodiversity

Figure 61: Rocky reef assessment (composition vs epifaunal coverage)

b Annex I Geogenic Reefs - Stony Reef

Varying numbers of boulders or clusters of cobbles and boulders (not associated with bedrock) were recorded in five camera transects along the route (UK_19, UK_32, UK_40, UK_45 & UK_50). Habitats observed within these transects varied from sand to matrices of gravels, pebbles, cobbles in sands and muddy sands. These transects were, therefore, investigated further to assess whether any areas have the potential to be classified as Annex I stony reef.

The seabed camera ground-truthing data were assessed for potential stony reef using the criteria proposed by Irving (2009). This breaks down the assessment criteria measures of 'quality' or 'reefiness' as outlined in Table 27. This is based on hard substrate being present which is not flat to the seabed, where >10 % composition of the sediment matrix are cobbles or boulders, and this substrate extends across a minimum area of 25 m^2.

The stony reef assessment for the current survey was based on acquired underwater high-definition stills taken along the camera transect, with the occasional screenshot acquired from the high-definition video footage when visibility was limited in the still. Each image was assessed for changes in the composition (i.e., percent coverage) and elevation of cobbles and boulders. In addition, the epifauna coverage on the cobble and boulder fraction of the seabed was assessed, both including and excluding hydrozoan/bryozoan turf, which is regarded as low ecological value by Golding *et al.* (2020). Each section of the transects where cobbles or boulders were detected was then analysed and categorised according to its composition, elevation, biota cover and extent.

The assessment of the extent of hard substrate coverage from available geophysical data was challenging due to variations in data quality and uncertainties regarding textural changes associated with cobble and boulder coverage. As a result, a precautionary approach was taken to estimate the extent, assuming a circular shape for each patch and using the straight-line distance between similar stony reef features in still images as the diameter of the circle. However, due to data resolution limitations, it was not possible to differentiate and map the precise seabed area covered by hard substrate.

Note: the original Irving (2009) biota criteria cannot be practically applied without acquiring high volume samples of reef matrix to identify all fauna and establish the relative richness of infaunal and epifaunal taxa, which would require non-standard sampling equipment and would damage any potential reef. As such, modified biota assessment thresholds were applied to assess the coverage of epifauna: Not a Reef = <10 %; Low = 10–40 %; Medium = 40- 80 %; and High = >80 %.

Table 27: Summary of resemblance to a stony reef as summarised in Irving (2009)

Measure of 'Reefiness'	Not a Reef	Low[(c)]	Medium	High
Composition[(a)]	<10 %	10-40 %	40-95 %	>95 %
Elevation[(b)]	Flat seabed	<64 mm	64 mm-5 m	>5 m
Extent (m^2)	<25 m^2	>25 m^2	>25 m^2	>25 m^2
Biota	Dominated by infauna			>80 % of species are epifauna

(a) *Diameter of cobbles / boulders being greater than 64 mm. Percentage cover relates to a minimum area of 25 m^2. This 'composition' characteristic also includes 'patchiness.'*
(b) *Minimum height (64 mm) relates to minimum size of constituent cobbles. This characteristic could also include 'distinctness' from the surrounding seabed.*
(c) When determining if the seabed is considered as Annex I stony reef, a 'low' scored in any category, would require a strong justification for this area to be considered as contributing to the Marine Natura site network of qualifying reefs in terms of the EC Habitats Directive.

The Irving (2009) stony reef protocol was split into separate assessments of reef 'structure' using a method developed by BSL staff. The first reef 'structure' matrix is based on the percentage coverage or composition of cobbles/boulders and assessed against the corresponding cobble/boulder elevation above the surrounding sea (Table 28). The results of this assessment are presented in Table 28 and Table 29, with full details of the assessment with Appendix T.

Table 28: Stony reef structure matrix: elevation vs. composition (After Irving, 2009)

Reef Structure Matrix			Elevation			
			Flat	<64 mm	64 mm-5 m	>5 m
			Not a Reef	Low	Medium	High
Composition	<10%	Not a reef	Not a Reef	Not a Reef	Not a Reef	Not a Reef
	10-40 %	Low	Not a Reef	Low	Low	Low
	40-95 %	Medium	Not a Reef	Low	Medium	Medium
	>95 %	High	Not a Reef	Low	Medium	High

The stills taken during the Xlinks UK survey that were analysed for stony reef assessment displayed range of sediment characteristics, from cobbles and gravel to sand (a complete log of the assessment per still is provided in Appendix T).

In total, 124 images were reviewed along the five transects that contained areas of potential stony reef (Table 29). Of the 124 images reviewed, 60 (48.4 %) contained no evidence of stony reef. In terms of stony reef composition or percentage cover for all stills, 32 (25.8 %) classed as 'Not a Reef', 17 (13.7 %) as 'Low Reef', 15 (12.1 %) as 'Medium Reef' and none as 'High Reef' (Table 29). In terms of elevation, 60 (48.4 %) were classed as 'Not a Reef', none as 'Low Reef', 64 (51.6 %) as 'Medium Reef' and none as 'High Reef'. When both composition and elevation were considered, by examining reef 'structure', 32 (25.8 %) classed as 'Not a Reef', 17 (13.7 %) as 'Low Reef', 15 (12.1 %) as 'Medium Reef' and none as 'High Reef' (Table 29). This equates to a total of 32 images (25.8 %) showing appreciable reefiness of 'Low Reef' and 'Medium Reef'.

Table 29: Summary of stony reef image analysis

'Reefiness' of Video Screengrabs	No Stony Reef		Not a Reef		Low		Medium		High	
	No.	%	No.	%	No.	%	No.	%	No.	%
Composition (% cover)	60	48.4	32	25.8	17	13.7	15	12.1	0	0
Elevation			60	48.4	0	0	64	51.6	0	0
Reef Structure (Composition vs Elevation)			32	25.8	17	13.7	15	12.1	0	0

The average reef structure (composition vs elevation) was determined for each reef section along each transect. Reef sections were defined as continuous sections of transect showing consistent stony reef characteristics, the extent of which was delineated, on a precautionary basis, by the still photograph either side of stills showing consistent habitat/reef type. However, due to the variable sediment type and quality of geophysical for delineating sections, sections were divided into two approximate groups: 'Low Reef' and 'Medium Reef' were grouped, while areas classified as 'Not a Reef' and 'No Reef' were grouped. In cases where continuous areas of 'No Reef' or 'Not a Reef' images were interspersed with images classified as 'Low Reef', the sections were averaged to encompass the entire area. A total of ten grouped sections over the five transects were averaged for composition and elevation. The stills assessed within UK_32 and UK_40 were both averaged over the whole transect, resulting in a 'Not a Reef' classification. Stills within transect UK_50 were also grouped across the whole transect, leading to a 'Medium Reef' delineation. A total of four sections were grouped in UK_19, two of which were classified as 'Low Reef' and the other two as 'Not a Reef'. Finally, transect UK_45, had one still of 'Low Reef' with a section of 'No Reef' prior to this still and a section categorised as 'Not a Reef' after (Appendix T).

The reef structure (composition vs. elevation) results formed part of the second 'reef structure' assessment, which considers the percentage cover of epifauna colonising the cobble and boulders. Although regarded as being of low ecological value on stony reefs by Golding *et al.* (2020), epifaunal coverage was quantified as total epifauna, including bryozoan/hydrozoan turf (Table 30). The mean reefiness (structure vs. epifaunal coverage) was calculated per reef section for each camera transect showing the presence of cobbles, boulders and scarp using total epifauna coverage (including bryozoan/hydrozoan turf) as a worst-case scenario of reef habitats in the area.

Four segments were classified as 'Low Reef' or 'Medium Reef', the analysis indicated eight patches that were considered 'No Reef' or 'Not a Reef' due to their lack of epifaunal coverage (including faunal turf). If the lower ecological value of hydrozoan/bryozoan turf (Golding *et al.,* 2020) was excluded from the assessment, areas assigned as 'Medium Reefs' were reduced to 'Not a Reef', highlighting the importance of epifaunal coverage to reefiness. Instances of 'Low Reef' related to areas of the seabed described as containing pebbles, cobbles and gravel. The highest recorded coverage, excluding turf, was 20% within a specific patch which contained a single image (UK_ENV_TR_45_0011.JPG), with a high number of Boarfish (*Capros aper*) on sandy sediments (SS.SSa.OSa Offshore Circalittoral Sand), while an additional 56 % was covered by faunal turf. The estimated linear extent of this patch was determined as 7.9 metres using a precautionary approach as the reef section only contained an individual still (Appendix T).

Table 30: Stony reef structure matrix: structure vs. epifaunal coverage (Modified Irving, 2009)

Reef Structure Matrix			Reef Structure			
			Not a Reef	Low	Medium	High
Epifaunal Coverage	<10%	Not a reef	Not a Reef	Not a Reef	Not a Reef	Not a Reef
	10-40%	Low	Not a Reef	Low	Low	Low
	40-80%	Medium	Not a Reef	Low	Medium	Medium
	>80%	High	Not a Reef	Low	Medium	High

Identified reef patches could not be reliably mapped from the geophysical data due to the lack of distinct SSS or MBES signatures associated with these areas. As such, approximations of extent were made from the measured length of continuous reef along the transect, by assuming that reefs occupied circular areas of seabed (i.e. the straight-line distance between known locations of reef stills equates to the diameter of a circle, the area of which is calculated using πr^2). As for calculation of the linear extent of habitat/reef sections, areas were calculated on a precautionary basis with the circular patch diameter equating to the distance between the still photograph either side of the stills characterised as consistent habitat/reef type.

Utilising the Irving (2009) guidance, areas of seabed classified as 'Not a Reef', based on reef structure (composition vs. elevation vs. epifaunal coverage) would still be 'Not a Reef' regardless of whether the extent was <25 m^2 or

>25 m^2 (Table 31). As such, areas were only calculated for patches of potential stony reef showing mean reefiness (structure vs. epifauna coverage) indicating 'Low Reef' structure.

The results are mapped in Figure 62 and indicated four occurrences of 'Low Reef' in terms of overall reefiness (structure vs. epifaunal cover (including turf) vs. extent), two of which were singular stills. 'Low Reef' occurred on three transects (UK_19, UK_45 and UK_50) while there were no 'Medium Reef' occurrences across the survey area.

Table 31: Overall stony reefiness matrix (structure vs. epifaunal coverage vs. extent)

Overall Reefiness Matrix			Reef Structure (incl. Composition, Elevation and Epifaunal Coverage)			
			Not a Reef	Low	Medium	High
Extent (m^2)	<25	Not a Reef	Not a Reef	Not a Reef	Not a Reef	Not a Reef
	>25	Low - High	Not a Reef	Low	Medium	High

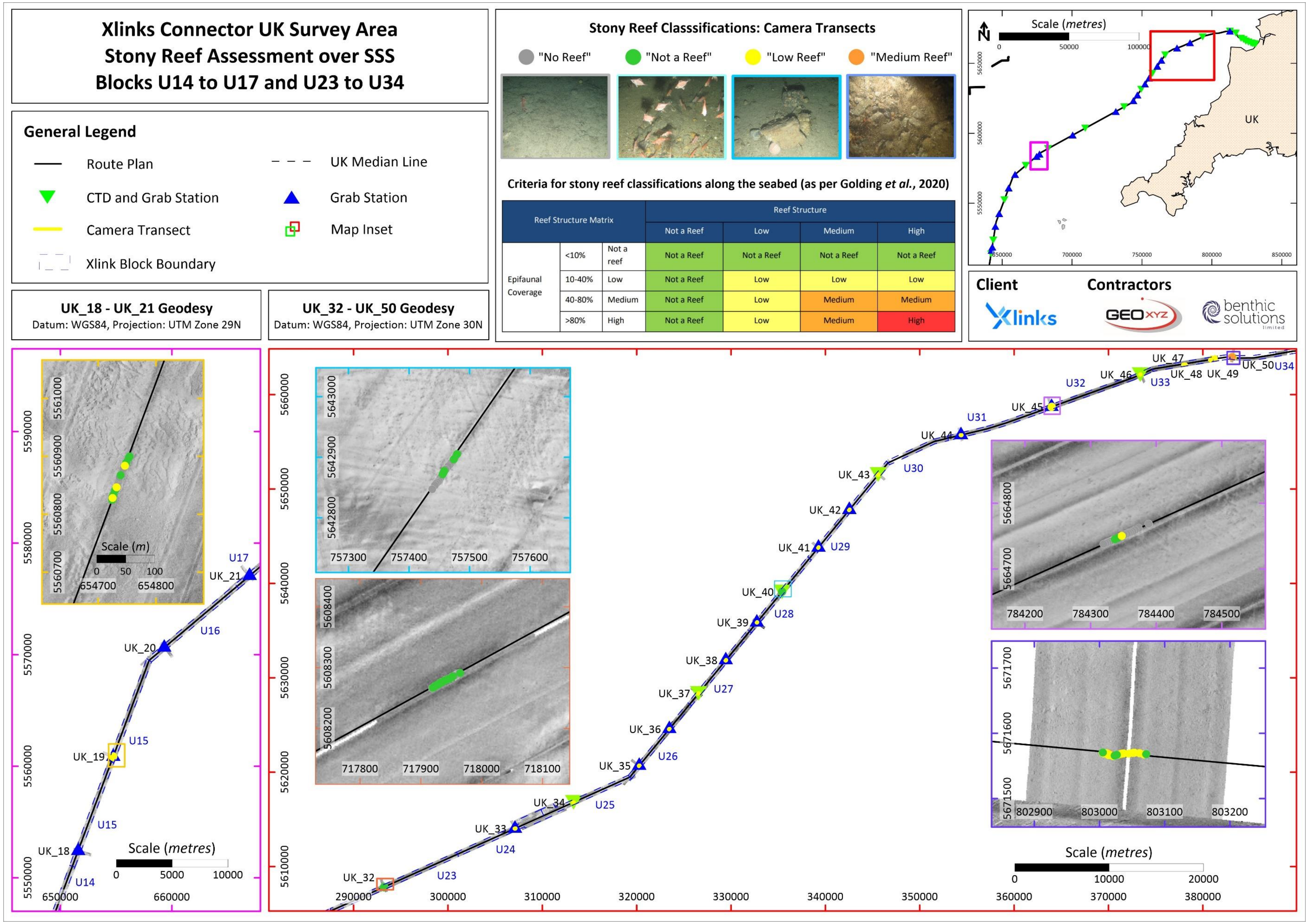


Figure 62: Mean reefiness (structure vs. extent vs. epifauna coverage) assessment for the survey area

One of the key principles to be considered for an area when assessing its 'resemblance' to Annex I stony reef is stability; areas of consolidated and patchy hard substrate may not fulfil the composition requirements of the Annex I stony reef criteria by Irving (i.e. not having the required percentage of cobbles and boulders, but stability allows a diverse and 'reef-like' epifaunal community to develop (Golding *et al*., 2020).

The transects where initial Annex I stony reef assessment were conducted and exhibited overall 'Low Reef' (structure vs epifaunal coverage vs. extent) were further investigated to establish whether hard substrate areas still corresponded to reef-like structures based on the epifauna present. This involved the assignment of 'reef biotopes', the identification of key species and the richness of 'reef species' according to the criteria outlined in Golding *et al*. (2020) (summarised in Table 32).

Table 32: Biota criteria for defining 'low resemblance' stony reef (Golding *et al*., 2020)

Reef	Stage 1	Stage 2	Stage 3
	Reef Biotopes	Key Reef Species Count	Reef Species Count
Reef	Reef biotope	≥3	>20
Possible reef	Possible reef biotope	>1 and <3	>5 and <20
Not reef	Non-reef biotope	0	<5

The 'Low Reef' transects examined exhibited predominantly non-reef characteristics since they did not match the key reef biotopes listed in Golding *et al*. (2020). Two biotopes listed in Golding *et al*. (2020) (SS.SMx.CMx 'Circalittoral Mixed Sediment' and SS.SCS.CCS 'Circalittoral Coarse Sediment') showed similarity to the biotopes identified in the habitat assessment (SS.SMx.OMx 'Offshore Circalittoral Mixed Sediment' and SS.SCS.OCS 'Offshore Circalittoral Coarse Sediment'), which could be considered a possible reef biotope although they are found in deeper waters than the biotopes listed by Golding *et al*. (2020). Only three segments across two transects were assigned the SS.SMx.OMx habitat, with the remainder assigned as 'Offshore Circalittoral Coarse Sediment' (SS.SCS.OCS) or 'Offshore Circalittoral Sand' (SS.SSa.OSa).

To evaluate the presence of reef species, epifauna from the 30 still photographs were reviewed along the four identified sections along three transects designated as 'Low Reef' by overall stony reefiness matrix (structure vs. epifaunal coverage vs. extent; UK_19, UK_45 and UK_50). Due to the precautionary approach applied, two of the four sections only contained one still image. Several taxa classified as significant 'Key Reef' species by Golding *et al.* (2020), such as feather hydroids (*Nemertesia* sp., *Tubularia* sp. and *Abietinaria abietina*) were observed in the stills. The presence/abundance of key reef species within transect UK_45 was generally low, with just one desirable reef species (*Spirobranchus* sp.) recorded resulting in a delineation of 'Low Reef' with 'no strong justification to warrant Annex I protection'. Two sections assigned 'Low Reef' within transect UK_19 recorded moderate species diversity, with occurrences of key species such as *Corynactis viridis*, *Tubularia* sp. and *Haliclona oculata* and desirable reef species such as *Cellaria sinuosa*, *Metridium senile* and *Echinus esculentus*. Due to the presence of four key reef species and two desirable reef species, one section categorised as 'Possible Low Reef' with 'no strong justification to warrant Annex I protection', and another section as 'Low Resemblance Reef with a strong justification to warrant Annex I protection'. The irregular patches of relatively small 'Low Reef' designated in the 'Cobbley Gravelly Pebbley Muddy Sand' of UK_19 are considered largely low-quality due to the dominance of epifaunal turf and lack of diverse erect epifaunal colonies. Therefore, the areas warrant 'no strong justification for Annex I protection'.

Transect UK_50 recorded the highest abundance of epifauna with six key reef species (including *Pentapora foliacea*, *Alcyonium digitatum* and *Abietinaria abietina*) and four desirable reef species (including *Caryophyllia smithii*, *Halecium halecinum* and *Antedon bifida*), resulting in the delineation of 'Low Resemblance Reef with a strong justification to warrant Annex I protection' for this transect. When overlaid on the delineated seabed features, UK_50 is situated within a large area designated as 'Pebbley Cobbley Sandy Gravel' where stony reef features can be considered supportive of diverse epifaunal communities with the potential to warrant Annex I protection.

c Annex I Biogenic reefs - Sabellaria spinulosa Reefs

Sabellaria spinulosa is a tube-building polychaete worm and can occur as isolated individuals, small aggregations, thin crust-like veneers, or when in large numbers can form hard reef-like structures which can act to stabilise the surrounding seabed (Gibb *et al.,* 2014). As their tubes are built of sand, a high suspended sediment content is essential for growth of reef like structures and the mobile sandy seabed within the survey area may provide this.

The presence of *S. spinulosa* was noted on a singular camera transect (UK_51), where clusters of *S. spinulosa* tubes were observed and therefore further investigation into the potential of an Annex I Biogenic reefs classification was conducted. An assessment of 'reefiness' as described by Gubbay (2007) and presented in Table 33 was performed to describe the habitat, focusing on transects where S. spinulosa was recorded during review of video footage and stills photographs. Changes in S. spinulosa 'elevation' (average tube height in cm) and patchiness (percentage cover) were noted during review of camera ground-truthing data.

Table 33: *Sabellaria spinulosa* 'reefiness' criteria as outlined by Gubbay (2007)

Measure of 'Reefiness'	Not a Reef	Low	Medium	High
Elevation (average tube height, cm)	<2	2-5	5-10	>10
Area (m^2)	<25	25-10,000	10,000–1,000,000	>1,000,000
Patchiness (%Cover)	<10	10-20	20-30	>30

To apply the Gubbay (2007) protocol to the acquired data, this was further split into separate assessments of reef 'structure' and overall 'reefiness' (Table 33 and Table 34). The advantage of this method is that it provides a way of combining the three criteria for reefiness: 'elevation' (average tube height in cm), 'area' (m^2) and patchiness (percentage cover). Using this method, patches of S. spinulosa aggregations can be classified as 'Not a reef', 'Low', 'Medium' or 'High' reefiness. This method was initially devised by BSL staff and later approved by the JNCC in 2010 (see Jenkins et al. (2015) for an example of application by JNCC and Cefas).

To quantify the 'reefiness' of heterogeneous patches of S. spinulosa, the frequency of still under water imagery was assessed and quantified to allow for adequate coverage without bias towards areas of greater environmental interest. Each accepted underwater still was assessed for Sabellaria patchiness and tube elevation, which were then combined to assess reef structure. The first stage is the assessment of reef structure from the patchiness (i.e. percent coverage) and tube elevation reefiness levels, these measures being loosely correlated due to the tendency for Sabellaria tubes to grow upwards when present at higher densities (Table 34).

Table 34: *Sabellaria* reef structure matrix (after Gubbay, 2007)

Reef Structure Matrix			Elevation (cm)			
			<2	2 to 5	5 to 10	>10
			Not a Reef	Low	Medium	High
Patchiness	<10 %	Not a Reef	Not a Reef	Not a Reef	Not a Reef	Not a Reef
	10-20 %	Low	Not a Reef	Low	Low	Low
	20-30 %	Medium	Not a Reef	Low	Medium	Medium
	>30 %	High	Not a Reef	Low	Medium	High

The underwater imagery and HD video indicated a sparse and patchy distribution of *S. spinulosa* along transect UK_51, which would not be considered reef forming due to the lack of significant tube elevation (<2 cm).

Out of the 18 images reviewed, *S. spinulosa* rubble was observed in all, with patchiness ranging from 2 to 27 % and elevation ranging from 1 to 2.5 cm. A total of four images were classed as potential 'Low Reef' with the remaining classed as 'Not a Reef'. The overall patchiness of the clusters indicated that the *S. spinulosa* aggregations were not reef forming, and the low-lying nature of the tubes influenced the 'Not a Reef' classification. In addition, the lack of unique SSS/MBES features associated with the *S. spinulosa* aggregations in this area made it impossible to delineate the extent of the habitat within this section of the route. As such, the reef structure matrix of each accepted underwater image was overlain across the camera track and indicates the low variability in *S. spinulosa* coverage and elevation across the transect. The minimal presence of *S. spinulosa* reef, indicates presence of the '*S. spinulosa* on stable circalittoral mixed sediment' (SS.SBR.PoR.SspiMx/MC2211) habitat occurring in this section of the route.

d Seapen and Burrowing Megafauna Communities

In order to determine whether burrowed areas observed in the survey area should be classified as OSPAR 'Seapen and burrowing megafauna communities', a combination of environmental factors and faunal information are considered in the assessment below, as outlined in JNCC (2014). The OSPAR definition of 'Seapen and Burrowing Megafauna Communities' is as follows:

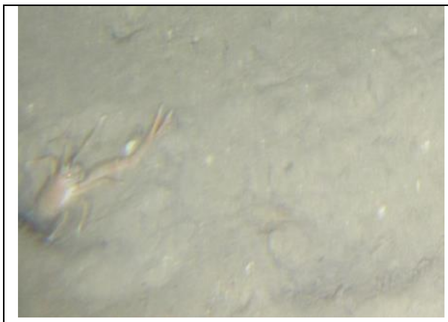
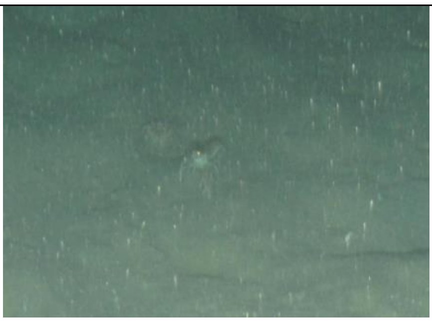
"Plains of fine mud, at water depths ranging from 15–200 m or more, which are heavily bioturbated by burrowing megafauna; burrows and mounds may form a prominent feature of the sediment surface with conspicuous populations of seapens, typically *Virgularia mirabilis* and *Pennatula phosphorea*. The burrowing crustaceans present may include *Nephrops norvegicus, Calocaris macandreae or Callianassa subterranea*. The burrowing activity of megafauna creates a complex habitat, providing deep oxygen penetration. This habitat occurs extensively in sheltered basins of fjords, sea lochs, voes and in deeper offshore waters such as the North Sea and Irish Sea basins and the Bay of Biscay" (OSPAR, 2010).

For a habitat to be classified as 'Seapen and Burrowing Megafauna Communities' the presence of burrowing macrofauna is an essential element, while seapens (e.g. *V. mirabilis, P. phosphorea*) may, and by extension may not, be present (JNCC, 2014). No seapens were observed within the survey area, therefore this assessment was solely conducted on burrowing megafauna.

According to JNCC (2014) guidance, the key determinant for classification of 'Seapen and Burrowing Megafauna Communities' is the presence of burrowing species or burrows at a SACFOR density of at least 'Frequent'. However, application of the SACFOR scale is dependent on the size of the fauna being assessed (Table 35). The

Norway lobster, *Nephrops norvegicus* was observed within two transects (UK_09 and UK_11) in close proximity to burrows (Table 35).

Table 35: Burrowing megafauna observed within the survey area

		
UK_ENV_TR_14_0017 *Munida rugosa*	UK_ENV_TR_09_0026 *Nephrops norvegicus*	UK_ENV_TR_09_0014 Caridean shrimp

The density of the burrow opening at the seabed was quantified using the video footage and still images from each camera transect to provide further information on the potential abundances of burrowing fauna. Using the laser scale set at 3.3 cm distance within the video footage, the visible seabed area was estimated to calculate the number of burrows per m^2. Still images captured at approximately 20 second intervals along the transect were assessed to provide an assessment of the burrows present.

In order to apply the SACFOR scale (Table 36).the burrows were divided into two size groups and assessed independently, with smaller burrows likely to be inhabited by burrowing fauna (such as *Maera loveni, Callianassa subterranea, Processa nouveli, Philocheras bispinosus,* and *Amphiura chiajei*) of 1 to 3 cm length and larger burrows likely inhabited by fauna of 3 to 15 cm in diameter burrows length (for example *N. norvegicus* and *Upogebia deltaura*). Due to the lack of observed burrowing fauna present within the survey area, it was not possible to differentiate the burrows of different species. As such, it was necessary to count all visible burrow holes, which is likely to overestimate the total number of burrowing megafauna by including other small body-sized burrowing fauna, such as polychaetes. However, *Chaetopterus* sp. burrows which have a distinctive pale coloured tube protruding from soft substrate were not counted as part of the burrowing megafauna assessment.

Table 36: SACFOR abundance scale

Cover (%)	Crust/ Meadow	Massive/ Turf	<1 cm	1-3 cm	3-15 cm	>15 cm	Density	
>80%	S		S				>1/0.001 m² (1x1 cm)	>10,000/m²
40-79%	A	S	A	S			1-9/0.001 m²	1000-9999/m²
20-39%	C	A	C	A	S		1-9 / 0.01 m² (10 x 10 cm)	100-999/m²
10-19%	F	C	F	C	A	S	1-9 / 0.1 m²	10-99/m²
5-9%	O	F	O	F	C	A	1-9/m²	
1-5% or density	R	O	R	O	F	C	1-9 / 10 m² (3.16 x 3.16 m)	0.1 to 0.9/m²
<1% or density		R		R	O	F	1-9 / 100 m² (10 x 10 m)	0.01 to 0.09/m²
					R	O	1-9 / 1000 m² (31.6 x 31.6 m)	
						R	<1 / 1000 m² (100 x 100 m)	
							<1 / 10000 m² (1 km²)	

Colour Code for SACFOR Abundance Classification					
Superabundant	Abundant	Common	Frequent	Occasional	Rare

The assessment was carried out on six transects within the survey area. The results of this assessment showed that where small burrows were present, they were categorised at a SACFOR density 'Common' or 'Frequent' (Table 37). There were no large burrows seen in UK_ENV_TR_13, therefore the SACFOR abundance scale could not be used on large burrows in this transect. As all six transects had a burrow (small or large) density of ≥0.2 m², these sections of transects in the Xlinks UK sector demonstrate the presence of the OSPAR 'Seapen and Burrowing Megafauna Communities' (JNCC, 2014).

Table 37: SACFOR assessment results

Transect	Level 4 EUNIS Habitat Classification	Small Burrows (per m²)		Large Burrows (per m²)	
UK_ENV_TR_09	Circalittoral Muddy Sand	11.20	C	2.25	C
UK_ENV_TR_10	Offshore Circalittoral Mixed Sediment	16.39	C	0.70	F
UK_ENV_TR_11	Circalittoral Muddy Sand	21.51	C	0.23	F
UK_ENV_TR_13	Circalittoral Muddy Sand	1.68	F	0.00	No burrows
UK_ENV_TR_14	Offshore Circalittoral Mixed Sediment	13.73	C	0.96	F
UK_ENV_TR_15	Offshore Circalittoral Mixed Sediment	11.00	C	1.01	C

Colour Code for SACFOR Abundance Classification					
Superabundant	Abundant	Common	Frequent	Occasional	Rare

e Deep-sea Sponge Aggregations

The habitat "Deep-sea sponge aggregations" is listed in the OSPAR "List of Threatened and/or Declining Species and Habitats" and is currently considered under threat and/or decline in all OSPAR areas where it occurs (OSPAR, 2008). The sponge aggregations along the route were assessed using the NOROG (2019) criteria. Using these criteria, sponge coverage for each section of habitat was logged as a running category and classified using the following four categories: Single Individual or Rare, Scattered, Common and High (Table 38).

Table 38: Criteria for sponge classifications along the seabed (as per NOROG, 2019)

Sponges (hard/softbottom)	Seabed coverage	Comment
Single individual	<1%	As single point
Rare	<1%	Running category
Scattered	1-5%	Running category
Common	5-10%	Running category
High	>10%	Running category

High resolution still images taken along the transect were further analysed against the NOROG guidelines, each image was assessed for sponge percentage cover and then grouped into habitat sections and the average seabed sponge coverage was calculated for each area of section. The results for the stony reef assessment of all assessed camera transects are provided in Appendix V. The assessment of the high-definition stills indicated a varied distribution of sponges with concentrated abundances sporadically recorded along the route (Table 39). Out of 405 images reviewed for sponge aggregations, no areas showed evidence of 'High' density sponge aggregations. A total of 294 images (72.5 %) had no sponges present, 17 (4.2 %) showed a 'Single individual', 41 (10.1 %) were classed as 'Rare', 7 (11.6 %) were categorised as 'Scattered' and six still images had sponge coverage between 5 and 10 % to be classed as 'Common'.

Table 39: Summary of sponge classification image results (after NOROG, 2019)

Seabed coverage by Sponges of Video Screengrabs	No Sponges		Single Point		Rare		Scattered		Common		High	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Percentage cover (%)	294	72.5	17	4.20	41	10.1	47	11.6	6	1.48	0	0.0

A review of the results by camera transect (Appendix V) revealed that sponge occurrences were strongly associated with areas of cobbles, boulders and outcropping bedrock. Where sponges did occur, they were mainly classified as 'Scattered' or 'Rare'. A variety of sponge species were present within these areas, encrusting sponges and erect growth forms were abundant throughout the route. Many species of Porifera were unidentifiable however ground-truthing identified the presence of the golf ball sponge (*Tethya aurantium*), *Cliona celata*, *Stelligera stuposa* and species within *Axinella* (likely *Axinella dissimilis*) and *Haliclona* (possibly *Haliclona urceolus*).

No sections of the video transect were observed to have sufficient sponge coverage to be classified as areas of the EUNIS habitat 'Sponge communities on Atlantic upper bathyal mud with Atlantic upper bathyal rock' (ME122) or as potential deep-sea sponge habitat (OSPAR, 2010). The NOROG (2019) sponge density classifications for each seabed still image and camera transect are mapped in Figure 63, Figure 64 and Figure 65.

Xlinks Connector UK Survey Area Sponge Coverage Assessment Blocks U01 to U07 over SSS

Map Geodesy: Datum: WGS84, Projection: UTM Zone 29N

Inset Maps Scale (*metres*)
0 50 100

General Legend

- Route Plan
- UK Median Line
- Xlink Block Boundary
- CTD and Grab Station
- Grab Station
- Camera Transect
- Map Inset

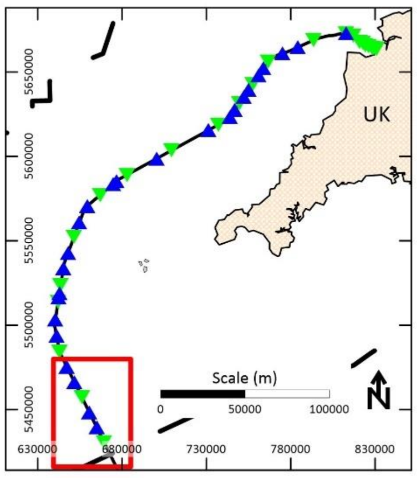
Sponge Classsifications: Camera Transects

"No Sponges" "Single Individual" "Rare"

"Scattered" "Common"

Criteria for sponge classifications along the seabed (as per NOROG, 2019)

Sponges (hard/softbottom)	Seabed coverage	Comment
Single individual	<1%	As single point
Rare	<1%	Running category
Scattered	1-5%	Running category
Common	5-10%	Running category
High	>10%	Running category



Client

Contractors

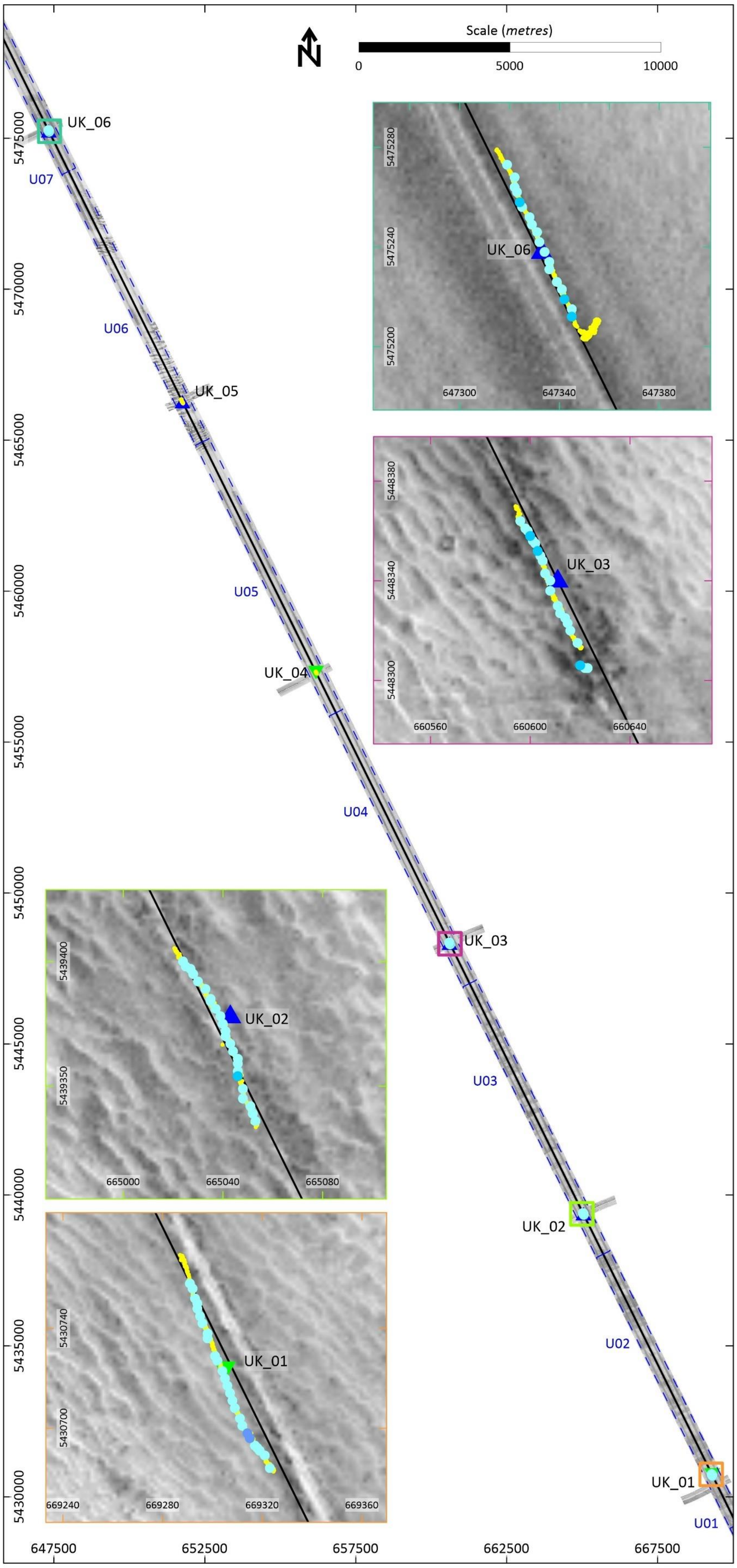
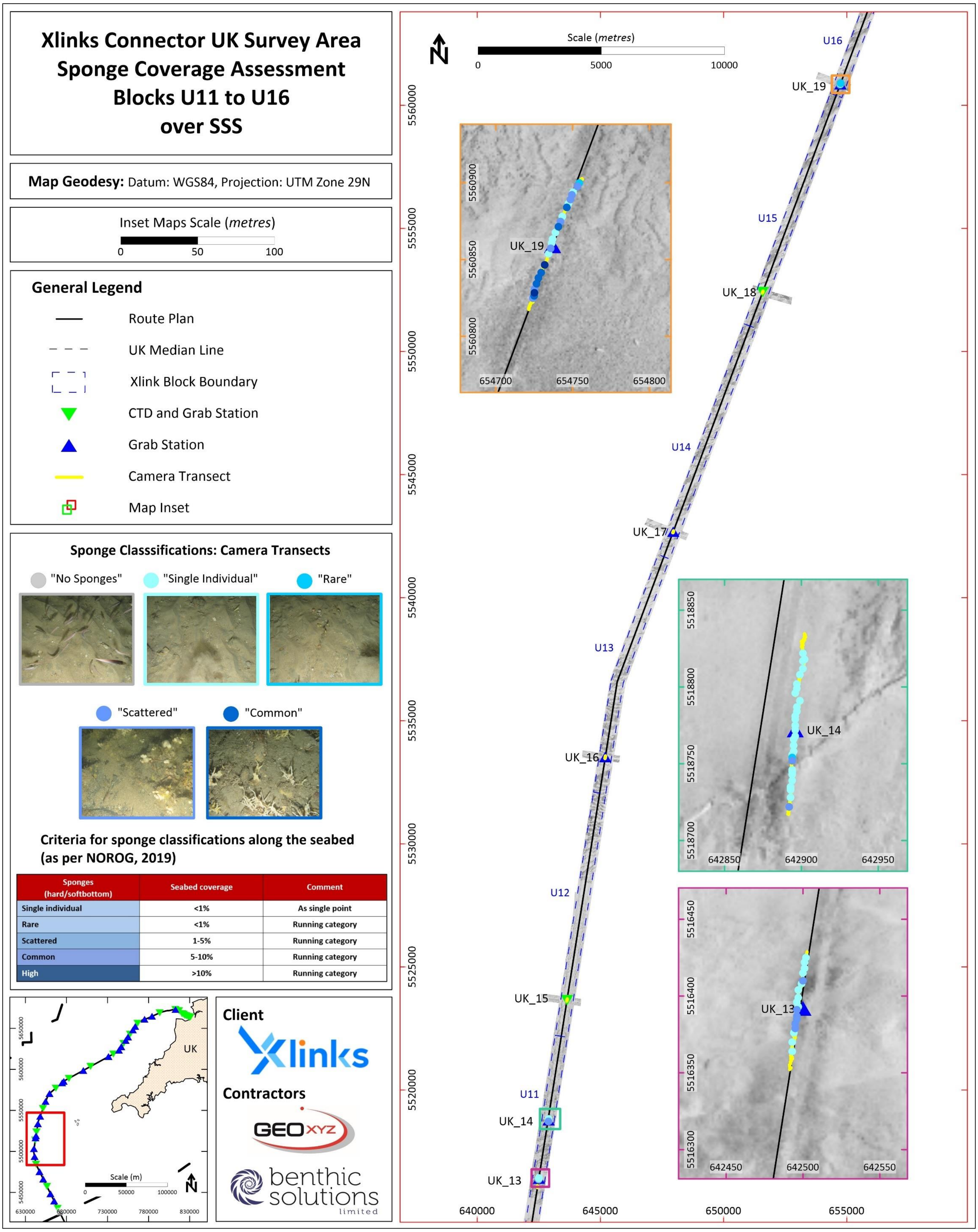
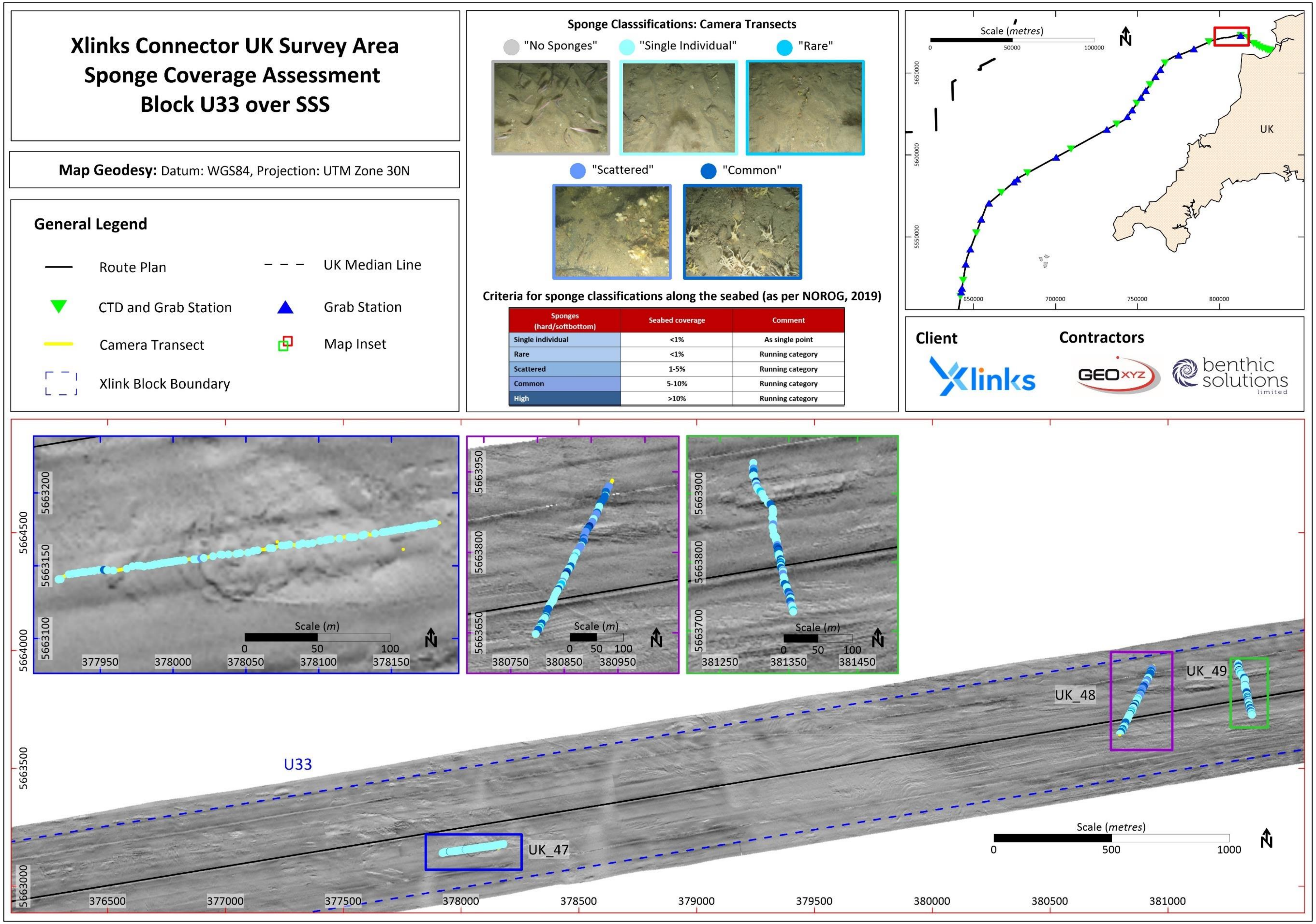


Figure 63: Recorded sponge distributions across stations U01 to U07 (after NOROG, 2019).



Sponges (hard/softbottom)	Seabed coverage	Comment
Single individual	<1%	As single point
Rare	<1%	Running category
Scattered	1-5%	Running category
Common	5-10%	Running category
High	>10%	Running category

Figure 64: Recorded sponge distributions across blocks U11 to U16 (after NOROG, 2019).



Sponges (hard/softbottom)	Seabed coverage	Comment
Single individual	<1%	As single point
Rare	<1%	Running category
Scattered	1-5%	Running category
Common	5-10%	Running category
High	>10%	Running category

Figure 65: Recorded sponge distributions across block U33 (after NOROG, 2019)

f Ocean Quahog (Arctica islandica)

The ocean quahog (*Arctica islandica*) bivalve species is afforded protected status under the OSPAR Commission due to its inclusion on the OSPAR list of threatened and/or declining species in the Greater North Sea area as a priority species (OSPAR, 2008; 2009). This species is also listed as an MCZ FOCI for both inshore and offshore protection (JNCC and Natural England, 2016). Ocean quahog grow very slowly, and are at particular risk from bottom fishing gear, and, like other slow-growing animals, once their numbers have been reduced their populations can take a long time to recover.

No living adult specimens (>5 cm shell size) of ocean quahog and no evidence of distinct *A. islandica* siphons was seen on any of the video footage or still photographs within the survey area. Whilst *A. islandica* are distinctive due to their size, texture and shape, these features generally become more evident when the shell diameter exceeds 5cm. Juvenile specimens (<5 cm shell size) are difficult to distinguish to the naked eye from other bivalve species during field operations, and so are reviewed during the taxonomy phase under the microscope. No juvenile *A. islandica* were recorded within the macrofaunal data of the survey area.

g Subtidal Sands and Gravels

The subtidal sands and gravel habitat is a priority habitat under the UK BAP and occurs in a wide variety of marine environments where sediments like sand, gravel and cobblestone accumulate. The habitat is home to a variety of species including polychaetes, crustaceans and fish which rely on the habitat for breeding, feeding and shelter. Offshore examples of these habitats are considered more diverse due to the reduction in natural disturbance and are characterised by a range of anemones, polychaetes, bivalves, amphipods as well as mobile and sessile epifauna. These areas support internationally important fish and shellfish fisheries and provides important ecosystem services by improving water quality and acting as a carbon sink. This habitat is at risk from pollutants in riverine discharge, trawling and dredging activities and aggregate extraction.

Upon review of the high-definition video and stills data, in addition to the particle size data it was evident that mosaics of habitats characterised by the subtidal sands and gravel habitat were present along the survey corridor. As can be inferred from the survey ground-truthing, the subtidal sand and gravel habitat is present across the entirety of the Xlinks route, and most likely occur in areas assigned to ‘Atlantic Offshore Circalittoral Coarse Sediment (MD32/ SS.SCS.OCS).

h Fan Mussel (Atrina fragilis)

The UK Sector of the Xlinks interconnector route borders the ‘East of Haig Fras’ MCZ which is designated for a number of habitats and fauna, amongst them the Fan mussel *A. fragilis.* The Fan mussel is a long-lived, burrowing bivalve living in habitats ranging from gravel/shingle to sandy mud. Historically, the byssus threads of pinnids (of the family Pinnidae) in the Mediterranean were harvested for their delicate byssus threads to make ‘Sea silk’, glues and the ‘Cloth of Gold’ (a historic textile) although the community structure of UK fan mussels is less understood (Tyler-Walters & Wilding, 2022).

The long-lived, slow growing nature and significant decline of the *A. fragilis* population are the reason for their protection under the UKBAP Priority Species List, SPIe, Species FOCI, Wildlife and Countryside Act 1981.

No conspicuous individuals were observed on the video footage nor were recorded in the macrofauna analysis of this survey.

4.10.3 Legislative Species Protection

To assess if any species afforded legislative protection in the UK were present within the survey area, the epifauna data recorded from the subtidal underwater video assessment were run through a listed species database developed by BSL staff. Species recorded in the survey area which have designated legislative protection included:

- Common/European Eel (*Anguilla anguilla*) (UKBAP, OSPAR, SPIe, IUCN Global Red List)
- Ling (*Molva molva*) (UKBAP, SPIe)
- Plaice (*Pleuronectes platessa*) (UKBAP, SPIe, IUCN Global Red List)
- Fireworks anemone (*Pachycerianthus multiplicatus*) (UKBAP, FOCI)
- Small Spotted Catshark (*Scyliorhinus canicular*) (IUCN Global Red List)
- Edible Sea Urchin (*Echinus esculentus*) (IUCN Global Red List)
- Cranch's Spider Crab (*Achaeus cranchii*) (Great Britain Rarity Status 'Nationally Rare')
- Thumbnail Crab (*Thia scutellata*) (Great Britain Rarity Status 'Nationally Scarce')
- Amphipod (*Apherusa ovalipes*) (Great Britain Rarity Status 'Nationally Scarce')

Four species observed in the survey area are listed under the UK Biodiversity Action Plan (UKBAP). The UKBAP aimed to identify habitats and species in an area and highlight threats and protect the area, therefore improving biodiversity. The common eel, the lingcod, the plaice and the fireworks anemone are listed under the UKBAP, which outlines detailed plans for their conservation. Three of these species (common eel, ling and plaice) are also listed under the Species (and Habitats) of Principle Importance England (SPIe), listing species and habitats critical to biodiversity conservation. Public bodies in England have a legal duty to consider biodiversity conservation in their normal activities.

One species, the common eel (*A. Anguilla)*, was added to the OSPAR List of Threatened and/or Declining Species in 2008, with aims to identify species and habitats in need of protection. This species has experienced a significant decline in population due to anthropogenic and natural factors and therefore has been placed on this list.

The fireworks anemone (*P. multiplicatus*) is the only species identified in the survey area that is listed as a Feature of Conservation Interest (FOCI), which identifies marine features (species and habitats) that are currently threatened, rare or declining.

Two previously mentioned species, the common eel and the plaice, as well as the small spotted catshark (*S. canicular*) and the edible sea urchin (*E. esculentus*) are all listed on the IUCN Global Red List. The plaice and small spotted catshark are listed as 'Least Concern (LC)', the edible sea urchin as 'Near Threatened (NT)' and the common eel as 'Critically Endangered (CR)'.

Three species, identified from macrofaunal analysis, were listed under the Great Britain Rarity Status list, with the Cranch's spider crab granted status of 'Nationally Rare', and the thumbnail crab and the amphipod *A. ovalipes* granted status of 'Nationally Scarce'. The Great Britain Rarity Status list is a provisional list of rare and scarce marine species found in Great Britain; however, this list is not based on IUCN criteria (Sanderson, 1996).

5 CONCLUSION

An environmental baseline survey (EBS) and habitat assessment survey (HAS) were carried out by GEOxyz, in association with Benthic Solutions Limited (BSL) for Xlinks along the UK section of the proposed cable route spanning from Morocco to the UK. This report details the habitat investigation and environmental survey operations conducted along the UK section of the route between the 29th of August and 10th of October 2023 aboard the Geo Ocean III.

The UK offshore route survey utilised geophysical data along the survey route, with water depths ranging from 129 m to 10 m below MSL. Available geophysical data included MBES bathmetry, backscatter and sub-bottom profiler data acquired along the route centre line during an initial reconnaissance survey and subsequent full coverage of MBES bathymetry, backscatter and side scan sonar data. Also available was full interpreted seabed features (SBF) mapping for the UK survey corridor.

The seabed was primarily described as an extensive, thin sedimentary cover overlying a smoothed bedrock surface was often thin to negligeable (<1 m thickness). The sedimentary cover was primarily characterized as gravelly SAND with superimposed sandy megaripple bedforms. Bedforms southwards of Xlinks block U16 were most probably inherited features (stable in present-day hydrodynamic conditions) while those observed northwards were present-day mobile features caused by recent storms. Along the route, the gravelly SAND and SAND sedimentary cover rarely exceeded 1 m except when crossing the Celtic sand bank, in narrow infillings of paleochannels and upwards of block U37, when approaching the nearshore section (<10 m depth). The nature of bedrock was expected to change along the route, with Tertiary and Secondary rocks (chalk terrains) southwards of block U23, and Primary rocks to the north. Rocks outcrops were delineated along the route (12.7 %) between blocks U09 and U11 (chalk and locally primary rocks), as well as between blocks U33 and U34 (Primary rocks).

Particle size analysis indicated a highly heterogeneous sediment type across the survey area; there was however a general sand dominance. The samples collected in the survey area were represented by eight Folk classifications with most (12 stations) assigned as 'Slightly Gravelly Sand'. Where stations were located in shallower water, fines content increased, leading to the designations of these stations to 'Sand' and 'Muddy Sand'. The heterogeneity of the sediment within the samples was reflected in the variation in the high sorting coefficient across the survey. No grab samples were acquired at UK_29 and UK_32 after repeated failed attempts, and UK_50 was not attempted due to the transect indicating large cobbles and boulders throughout. The stations that had no samples obtained exhibited a diverse composition of seabed sediments that were challenging for grabbing.

Furthermore, total organic carbon and organic matter levels were low throughout the survey area, reflecting the ambient conditions for this region of the Celtic Sea. There was a positive correlation between TOC and the proportion of fines ($p>0.01$). The results for THC were consistently low along the proposed cable route, although higher concentrations were evident in the nearshore section of the survey corridor, likely a result of terrestrial runoff. A review of gas chromatography traces showed a homogeneous uncontaminated sediment along the cable route survey area, with most stations showing only minor input of terrigenous biogenic plant waxes, consistent with the location of the Celtic Sea. The carbon preference index and pristane/phytane ratio all recorded values indicative of predominantly biogenic inputs across the survey area. Total PAHs were highly variable through the survey area, driven by the NPD fraction.

Concentrations of heavy metals were low throughout. Arsenic was the only metal alongside nickel to exceed any of its respective reference values. It exceeded the OSPAR ERL values (8.20 $mg.kg^{-1}$) across 20 stations and eight stations respectively along the route. When using the CCME TEL reference values, Tin was considered to be above the threshold (0.05 $mg.kg^{-1}$) at 11 stations. However, this appeared to be a result of natural variation as there was no evidence of elevated barium concentrations. Metal concentrations were normalised to 52 ppm aluminium which revealed no spatial pattern of distribution and with most metals exaggerated or environmentally inadmissible. Due to the limited variation in fine sediment, the application of metal normalisation is of limited value for the survey area.

A total of 22,006 infauna individuals were recorded along the proposed route survey area. Species richness and faunal abundance showed high variability throughout the area (often driven by the species within the Annelida phylum), which showed a strong positive correlation to the proportion of fines throughout the survey area. Overall, the diversity indices results were high. When averaged according to level 3 EUNIS habitat assignments, species abundance and richness, as well as the richness and diversity indices, were overall highest at stations classed as 'Atlantic Offshore Circalittoral Mixed Sediment' (MD42). This is in accordance with the higher availability of muds, sands and hard substrate. Sands dominated habitats, especially those in shallower waters, usually had the lowest faunal abundance and richness averages, and displayed the highest evenness index averages (Pielou). Stations classed as 'Atlantic Circalittoral Sand (MC52) had exceptionally high faunal abundance, completed to other sands dominated habitats, due to the ubiquitous *Echinocyamus pusillus* and *Abra prismatica.* Further analysis using the multivariate interpretation revealed 11 cluster groupings for the macrofaunal community when sliced at a Bray-Curtis similarity percentage of 35 % at station level, showed a strong correlation to the EUNIS level 5 habitat assignments along the route (as well as impoverished versions of a same habitat). The presence and richness of colonial epifauna was driven by the availability of hard substratum within more mixed areas, though these could often not be sampled by the grabs, and their presence is better assessed through camera ground-truthing.

Seabed habitats were identified primarily using a combination of geophysical data and video assessment ground-truthing. The complex habitat variations along the route revealed a mosaic of sediment classifications, demonstrating varying contributions of fines, sands and gravels, with different densities of pebbles, cobbles, and boulders observed throughout the survey area. A total of eight level 3/4 EUNIS and nine level 3/4 JNCC habitats were assigned along the route including classifications assigned due to depth related changes. A dominance of the JNCC/EUNIS habitat classification of MB52/SS.SSa.IFiSa 'Infralittoral Fine Sand' was observed in the shallower nearshore region of the route, progressing to the deeper depth band of MC52/SS.SSa.CFiSa 'Circalittoral Fine Sand' in waters deeper than 20 m. Ribbons and areas of MC32/SS.SCS.CCS 'Circalittoral Coarse Sediment' were also observed due to a presence of gravel and pebbles or rubble of *Sabellaria spinulosa* tubes. As the route moved away from Barnstaple Bay and into the Celtic Sea, a dominance of two oscillating broad scale sediment types was observed. The JNCC/EUNIS habitat classifications of MD32/SS.SCS.OCS 'Offshore Circalittoral Coarse Sediment' and MD52/SS.SSa.OSa 'Offshore Circalittoral Sand' alternate along the route with varying compositions of sediment within each delineation. Areas of outcropping bedrock were present and categorised under the JNCC/EUNIS habitat classification of CR.HCR/MD12 'High Energy Circalittoral Rock' with a further delineation into 'Mixed Faunal Turf Communities' (MC121/ CR.HCR.Xfa) in areas confidently ground truthed. Two habitats, principally observed towards the southern end of the route; MC52.SS.SSa.CMuSa 'Circalittoral Muddy Sand' and MD42/SS.SMx.OMx 'Offshore Circalittoral Mixed Sediment', also oscillated between the two sediment compositions. 'Offshore Circalittoral Mixed Sediment' was assigned to areas of muddy sand with varying influences of gravel, pebble and cobble.

The presence of cobbles, boulders and outcropping bedrock across the route indicated the presence of potential Annex I geogenic reefs, categorised further into 'Rocky Reef' or 'Stony Reef'. A large outcropping bedrock feature towards the northern extent of the route was ground-truthed by three video transects (UK_47, UK_48 and UK_49), within each transect the reef characteristics fluctuated between 'Rocky Reefs' and 'Rocky reefs partially covered' due to the presence of sand veneers. A total of 52 patches were grouped within the 'Rocky Reefs' and 'Rocky reefs partially covered' sections, of which 11 patches resulted in a classification of 'Rocky Reef with Low Biodiversity', 31 were categorised as 'Reef with Sand Veneer' with the remaining ten patches evidenced 'No Reef'. A secondary, rocky reef features was observed in UK_14. Only six still images contained rocky outcrop or mobile hard substrate, with majority of the epifaunal coverage made up of hydrozoan/bryozoan turf therefore indicating characteristics of an Annex I 'Rocky Reef with Low Biodiversity' habitat.

The presence of hard substrate necessitated a stony reef assessment, to establish the potential occurrence of Annex I stony reef in the survey area. The analysis of 124 images taken along five camera transects indicated that the majority of the survey area did not show any evidence of stony reef. Only 25 % of the images showed a Low to Medium level of reefiness, while no High reef structures were identified. When considering epifaunal coverage, only 20 % of stills remained as 'Low Reef' and 'Medium Reef', of which these areas were grouped into patches. A total of four patches of 'Low Reef' were identified in terms of overall reefiness (structure vs. epifaunal coverage vs. extent), spread across three transects but with two sections represented by only single still images. Areas of 'Low Reef' were further evaluated by assessing whether they met the reef biotope/species characteristics outlined by Golding *et al*. (2020). The abundance of key reef species was sporadic with UK_45 recording one desirable reef species and the patchy occurrences of cobbles and boulders, and therefore epifaunal coverage, in UK_19 led to the delineation of 'No Reef', Possible Low Reef' and 'Low Resemblance Reef' patches. Consequently, these areas did not demonstrate strong justification for Annex I protection, indicating that their low-quality characteristics and limited presence do not warrant such designation. Key and desirable reef species were more abundant across UK_50, with occurrences of species such as *Alcyonium digitatum, Abietinaria abietina* and *Halecium halecinum,* the grouping of stills resulted in the delineation of 'Low Resemblance Reef' with a strong justification to warrant Annex I protection.

Sediments observed in UK_51 comprised small patches of rubble *Sabellaria spinulosa* tubes over a coarse sand dominated habitat, but which did not categorise as an Annex I feature. The macrofaunal community present in the samples acquired at UK_51 and UK_34 can be closely linked to the EUNIS level five biotope '*Sabellaria spinulosa* on stable Atlantic circalittoral mixed sediment' (MC2211/SS.SBR.PoR.SspiMx).

The results of burrowing megafauna assessment showed that where small burrows were present, they were categorised at a SACFOR density 'Common' or 'Frequent'. There were no large burrows seen in UK_ENV_TR_13, therefore the SACFOR abundance scale could not be used on large burrows in this transect. As all six transects had a burrow (small or large) density of ≥0.2 m^2, these sections of transects in the Xlinks UK sector demonstrate the presence of the OSPAR 'Seapen and Burrowing Megafauna Communities'.

Sponges were evident across the survey area, primarily associated with areas of cobbles/boulders along the route. Where sponges did occur, they were mainly classified as 'Scattered' or 'Rare'. Consequently, there is no strong justification for the OSPAR listed 'deep-sea sponge aggregations' present in the surveyed area.

There was no evidence of *A. islandica* siphons or *A. fragilis* on any video footage or still photographs within the survey area. The UK BAP habitat subtidal sands and gravel habitat is present across the entirety of the Xlinks route, and most likely occur in in areas of the route classified under 'Atlantic Offshore Circalittoral Coarse Sediment.

6 REFERENCES

Bern Convention, 1979. Convention on the Conservation of European Wildlife and Natural Habitats. (19 September 1979).

Connor, D., Allen, J., Golding, N., Howell, K., Lieberknecht, L., Northern, K., Reker, J. 2004. The Marine Habitat Classification for Britain and Ireland. Version 04.05. Introduction.

CCW, 2009. Countryside Council for Wales. Pen Llyn a'r Sarnau European Marine Site – Advice in fulfilment of regulation 33 of the conservation (natural habitats, &c) regulations 1994.

Dauvin, J.C. *et al.* 2012. Response of different benthic indices to diverse human pressures, Ecological Indicators, 12(1), pp. 143–153. doi:10.1016/j.ecolind.2011.03.019.

EMODnet, 2021. European Marine Observation Data Network (EMODnet) Seabed Habitats Project: Spatial Data Downloads. [Date accessed: 29/11/2023]. Available from: https://www.emodnet-seabedhabitats.eu/access-data/download-data/

EMODnet, 2022. European Marine Observation Data Network (EMODnet) Seabed Habitats Project: Spatial Data Downloads. [Date accessed: 29/11/2023]. Available from: https://www.emodnet-seabedhabitats.eu/access-data/download-data/

EUNIS, 2022. EUNIS habitat classification 2022. [Date accessed: 29/11/2023]. Available from: https://www.eea.europa.eu/data-and-maps/data/eunis-habitat-classification.

Irving, R. 2009. The identification of the main characteristics of stony reef habitats under the Habitats Directive: Summary report of an inter-agency workshop 26–27 March 2008, JNCC Report No. 432, JNCC, Peterborough, ISSN 0963-8091.

Golding, N., Albrecht, J. and McBreen, F. 2020. Refining the criteria for defining areas with a 'low resemblance' to Annex I stony reef; Workshop Report. JNCC Report No. 656. JNCC, Peterborough, ISSN 0963-8091.

GOV.UK, 2022. Changes to the Habitats Regulations 2017. [Date accessed: 29/11/2023] Available at: https://www.gov.uk/government/publications/changes-to-the-habitats-regulations-2017/changes-to-the-habitats-regulations-2017.

Gubbay, S. 2007. Defining and managing Sabellaria spinulosa reefs: Report of an inter-agency workshop 1-2 May, 2007. JNCC Report No. 405. pp 22.

Habitats Directive (European Community), 2002, 2007. Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora.

JNCC, 2014. JNCC clarifications on the habitat definitions of two habitat Features of Conservation Importance. Joint Nature Conservation Committee. 14pp.

JNCC and Natural England, 2016. Review of the MCZ Features of Conservation Importance. May 2016. 43pp.

JNCC (2022) The Marine Habitat Classification for Britain and Ireland Version 22.04. [Date accessed: 29/11/2023]. Available from: https://mhc.jncc.gov.uk/

JNCC, 2023. Bristol Channel Approaches MPA (last updated March 2023) JNCC. Available at: https://jncc.gov.uk/our-work/bristol-channel-approaches-mpa/

Niemirycz, E., Kaczmarczyk, A., Błażejowski, J. 2005. Extractable Organic Halogens (EOX) in Sediments from Selected Polish Rivers and Lakes – A Measure of the Quality of the Inland Water Environment. Chemosphere. 61: 1. Pp 92-97.

NOROG, 2019. Handbook, species and habitats of environmental concern. Mapping, Risk Assessment, Mitigation and Monitoring. – In relation to Oil and Gas activities

OSPAR, 2008. Descriptions of habitats on the OSPAR list of threatened and/or declining species and habitats. OSPAR Convention for the Protection of the Marine Environment of the North-east Atlantic. Reference Number: 2008-07. 8pp.

OSPAR, 2009. Background Document for ocean quahog *Arctica islandica*. Biodiversity Series. Publication Number: 407/2009. OSPAR Commission, London.

OSPAR, 2010. Background Document for Seapen and Burrowing Megafauna Communities. OSPAR Commission Biodiversity Series. 27pp.

Parry, M.E.V., K.L. Howell, B.E. Narayanaswamy, B.J. Bett, D.O.B. Jones, D.J. Hughes, N. Piechaud, H. Ellwood, N. Askew, C. Jenkins and E. Manca. 2015. A Deep-sea Section for the Marine Habitat Classification of Britain and Ireland. JNCC report 530. In: JNCC. 2015. The Marine Habitat Classification for Britain and Ireland Version 15.03 [Online].

Parry, M.E.V., 2019. Guidance on Assigning Benthic Biotopes using EUNIS or the Marine Habitat Classification of Britian and Ireland (Revised 2019). JNCC Report 546.

Sanderson, W. 1996 *Rare marine benthic flora and fauna in Great Britain: the development of criteria for assessment*. Joint Nature Conservation Committee Report, no. 240, Joint Nature Conservation Committee, Peterborough.

Wlodarczyk-Makula, M and Wiśniowska, E. 2019. Halogenated Organic Compounds in Water and in Wastewater. Civil and Environmental Engineering Reports. DOI: 10.2478/ceer-2019-0057. Pp 12

Appendix A – GEO OCEAN III

GEO OCEAN III

Offshore Survey & Support Vessel

SUPPORT ACTIVITIES / VESSEL CAPABILITIES

The GEO OCEAN III is a multi-disciplined DP II offshore survey vessel. With her specifically selected equipment and capabilities for the North Sea survey and light construction support activities, she is the ideal candidate for our Oil & Gas and Renewables clients.

The vessel is equipped with 56 berths, Offshore crane, Survey and ROV systems. Equipment can be rapidly deployed using the large Stern A-Frame, crane or through the 6 x6 m moonpool via the dedicated A-frame and 30t AHC winch. All together making the Geo Ocean III a dynamic platform for subsea operations.

GEOxyz | T: +32 (0) 56 70 68 48 | info@geoxyz.eu | www.geoxyz.eu

GEO OCEAN III

Offshore Survey & Support Vessel

TECHNICAL SPECIFICATION

General

Name	Geo Ocean III
Flag	Luxembourg
Port Registry	Luxembourg
Call Sign	LXGP
IMO Number	9285586
Classification	LLOYDS - HULL – MACH
Vessel Type	Survey Vessel SV
Special Service:	Fire fighting ship / Fire fighting 1 Waterspray / Oil Recovery / Stand by rescue
Unrestricted navigation	AUT-UMS - ALM - DYNAPOS-AM/AT-R; SDS

Dimensions and Construction

Builder	De Hoop
Built	2004
LOA	77,30 m
Width Moulded	18 m
Depth Moulded	7,40 m
Draft min. / max.	3,80 m/6,10 m
Gross Tonnage	3,722
Moonpool	6 m x 6m

Accommodation

Total Berths	56 persons
Total Cabins	32
Single cabins	8 x 1 person
Double cabins	24 x 2 persons
Offices	1 x Dedicated Online 1 x Dedicated Offline / Conference room 1 x Client Office 1 x OCM Office 1 x 3rd Party Office
Hospital	1 x Hospital
Other Facilities	Galley, Large Mess room, 2 x day room, Gymnasium, Dirty Mess

Capacities & delivery Rates

Main Deck area:	670 m²
Hangar Deck:	290 m²
Mezzanine Deck Area:	268 m²
Max Deck Loading	Main Deck 5t/m² Mezzanine Deck 2t/m²
Max Deck Load	1,300 t @ 1m above deck
Fuel oil (capacity - transfer):	1,105m³ - 100m³/h @ 8bars
Drill or Water ballast (capacity - transfer):	1,350m³ - 40m³/h @ 4.5bars
Antiheeling (capacity - transfer):	250m³ - 2 x 500m³/h
Fresh water (capacity - transfer):	495 m3 - 40 m³/h @ 4.5bars
Oil recovery:	324 m³
Foam:	24 m³

Safety Equipment

Fi-Fi:	Class 1
Pumps:	2 x 1,200m³/h
Monitors:	2 x 1,200m³/h
Fast Rescue Craft:	1 x Seabear 23 MKII
Rescue capacity:	150 persons in tropical area

MACHINERY & PERFORMANCE

Propulsion - Machinery

Main propulsion:	2 x 1,800 kW FP Azimuth thrusters
Main Engines:	4 x 1360kW Caterpillar
Tunnel thrusters:	1 x Insert manufacturer 780 kW
Fwd Azimuth	1 x Rolls Royce 600kW retractable

SPEED & CONSUMPTION (Information only)

Service Speed	10 kts
Max Speed	12 kts

Fuel consumption

Stand-by in port:	2t/day
Survey Speed:	7t/day
DPII:	6t/day

Deck Equipment and Cranes

Main Crane:	SMST telescopic 40t @ 9m - 6t @ 23.5m
Winch Capacity:	40t / 40t - 200m
Deck Crane	4.5t @9m Man-riding
Stern A- Frame :	54t @ 8m outreach
Max launching Dims	8m clearance up / 10m wide opening
Offshore capacity:	54t @ 8m outreach
Winch Capacity	30t / 30t - 1,500m - AHC
Moonpool A-Frame	30t
Winch Capacity	30t / 30t - 1,500m - AHC
Tuggers:	1 x 10t & 1 x 30t
Capstans:	2 x 5t
Deck Service Air Supply:	66 m³/h @ 8 bars
Deck Power Supply:	3 x 265 kW - 480 VAC /60Hz

Navigation and Dynamic Positioning

DP System:	GE DP21 + IJS
Type:	DP 2
Reference 1:	DGPS 1 Fugro Seastar 9205
Reference 2:	DGPS 2 Fugro Seastar 9205
Reference 3:	G4 and XP2 corrections USBL
Reference 4:	Kongsberg Fan Beam
Primary Heading/motion/INS	POSMV 320 Ocean Master
Secondary Heading/motion/INS	POSMV 320 Ocean master
Subsea Positioning	Sonardyne Ranger 2 c/w 6G HPT 5000

Survey Suite and Offline software

Survey Suite	QINSY EIVA
Offline Software	QINSy, NaviSuite, Beamworks, Oasis Montaj (UXO marine), Visual works, Autodesk, Arc GIS,
Video Distribution	4k ultra high definition
Audio comms	Canford clear comms

Survey Sensors

MBES	Hull Mounted (Optional Dual head) R2Sonic 2024 UHR
Single Beam	XXXXXXX
Sound Velocity Sensor	Valeport Swift
Sidescan Sonar	Edgetech 2200
Sub Bottom Profiler	Silas, Depending on requirements

Subsea Equipment

WROV	1 x 150HP WROV
IROV	Mezzanine deck configured for rapid mobilisation 1 x Seaeye Cougar
Vibrocorer	3/6m electric/hydraulic systems as required
CPT	Optional 1.5 – 20t systems (Neptune or Manta type as required)

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APPENDIX B – BSL DOUBLE GRAB

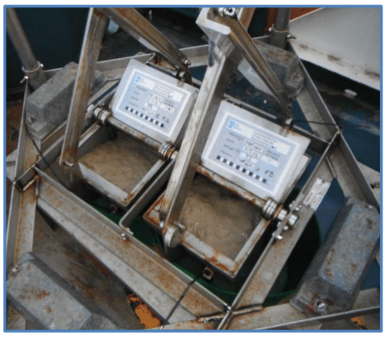
benthic solutions limited

BSL DOUBLE GRAB

- **General Specifications**
  - **2 x 0.1m^2 Sample Area**
  - **Total Stainless Steel Construction**
  - **Adjustable weight**
  - **Proven performance in 2000m depth**
  - **Flat Pack for Air Freighting**

- **Services**

The BSL Double Grab was designed and built by BSL in 2007 to carry out more efficient grab sampling operations in very deep waters. It is also routinely used for projects where multiple replicates are required or where both chemical and biological analysis are needed from the same deployment. This multi-purpose sampling tool is ideal for shallow water and deep water operations alike, halving the ship-time required to acquire sample replicates in moderate water depths.

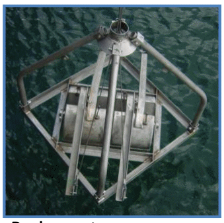


Recovery

Grab stand and sample trays

Made of stainless steel, the grab can be ballasted with additional lead weights, for operations in deeper waters, strong currents or compacted sediments. The two pairs of extended stainless steel arms increase the leverage on closure to the buckets, but these can be fouled by coarser gravels.

Both buckets have hinged doors fully enclosing the samples on recovery but allowing the scientist access to the undisturbed sample prior to emptying the sampler. Each bucket has the capacity to collect samples of approximately 15L.



Deployment

Direct access to sample

Shipping weight	200kg
Shipping dimension	0.4*to 1.2 x 1 x 0.2m
Specifications	920 x 920 x 1000mm

**if sampler is dismantled for freighting*

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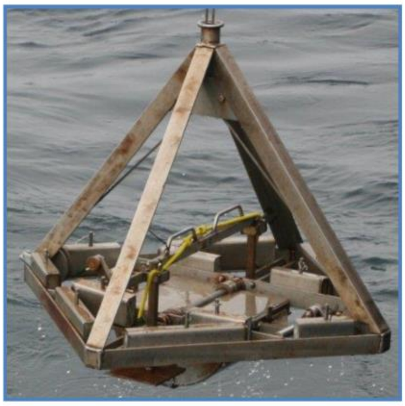
APPENDIX C – DAY GRAB

benthic solutions limited

BSL MODIFIED DAY GRAB

- **General Specifications**
  - 0.1m^2 Sample Area
  - Total Stainless Steel Construction
  - Adjustable weight
  - Compact Design
  - Proven performance in 1000m depth
  - Modified for One Man Operation



- **Services**

Day grabs comprise of two stainless bucket sections which are mounted within a stainless-steel frame. On contact with the seabed, a trigger bar is pushed upwards via pressure plates allowing the buckets to close under the gravity of the unit through a pulley system forcing the buckets closed. This controlled contact and closure once on the seabed helps ensure sample disturbance is minimised. The top of the grab is covered by two catch-closed inspection doors also made of stainless steel. The doors allow direct access to the sample inside the grab when closed, and protect the sample from the grab movement through the water column during recovery.

Our Day grab sampler (offset design) was originally modified by BSL's principle scientist in the early 1990s to improve penetration and reduce sample disturbance and contamination. These grabs are fitted with additional but removable stainless steel coated lead weights which can provide better penetration in more compacted substrates, but can also be removed to prevent over-penetration of the sampler in softer sediments.

A further extended bucket lip reduces sediment washout during retrieval. The unit can be supplied with a stand allowing for easy sample access and handling. A further modification that was made provided an efficient closure system to allow arming by a single person. This modified Day grab has become the standard operating tool for the North Sea.

The grab is relatively simple to operate in almost any water depth. The (0.1m^2) grabs have been constructed with stainless steel throughout making this grab ideal for accurate assessment of the chemical properties of sea floor sediments.

Shipping weight	250 kg
Shipping dimension	1.5m x 1m x 1m
Specifications	800 x 800 x 850mm

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APPENDIX D – HAMON GRAB

benthic solutions limited

Mini-HAMON GRAB

- **General Specifications**

- $0.1m^2$ Sample Area
- Stainless Steel Bucket Construction
- Proven performance in both deep and shallow waters
- Excellent for coarse sediments
- Inspection hatch for direct sub-sampling

- **Services**

Benthic Solutions Limited owns and operates several $0.1m^2$ Mini-Hamon grabs, which are ideal for obtaining bulk samples in mixed sands and gravels, as well as for sampling benthic macrofauna (approved by CEFAS). This relative small grab was modified from the larger $0.2m^2$ unit used in the aggregate industry for use during inshore environmental assessments in mixed sediments.

The Hamon Grab comprises of a stainless steel box shaped sampling scoop mounted in a triangular frame. Upon contact with the seabed tensioned wires are released which causes the sampling bucket to pivot through 90° pushing seabed sediment into the bucket in a single direction. On completion of its travel the open end of the bucket comes against a rubber sealed steel plate which stops the sediment escaping during recovery. The surface area of seabed covered during the travel of this bucket is approximately $1000cm^2$ and achieves a penetration of typically 15-20cm.

On recovery the grab is landed onto a rectangular base from where access can be gained to the inside of the bucket via an inspection hatch added to the back of the sampler. Whilst in the stand, the grab sample can easily be emptied into a sampling container located under the frame.

Shipping weight	120-200kg
Shipping dimension	1 x 1 x 1.5m
Sample area	$0.1m^2$

These grabs are used for the collection of samples from coarse (diamicton sands and gravel) where glacial deposits are common or in areas of high energy environments. Note that there is some minor disturbance to the structure of the sample (particularly in granular sediments) so it is not the preferred sampling tool for detailed physico-chemical sub-sampling where the in situ structure needs to be maintained. The sampler is regularly used for macro-invertebrate and particle size analysis.

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APPENDIX E – *WILSON* AUTO-SIEVER

WILSON AUTOSIEVER

***Best practice** for benthic samples**

- **General Specifications**

The *Wilson* Autosiever is a semi-automated sieving table for reducing benthic sediment samples offshore in a routine and controlled manner.

- Reduces time consuming and laborious sample handling in the field
- Reduces personnel numbers required for benthic processing
- Reduces damage to biological material during processing
- Well proven field performance on benthic surveys worldwide
- Standardises sample processing
- Robust stainless-steel construction that dismantles for storage or freighting
- New design with adjustable height

- **Services**

The *Wilson* Autosiever (WAS) was initially designed in the late 1980s by Ian Wilson (BSL Director), but was implemented from the early 1990s as the preferred benthic processing tool for all sampling operations by a major UK based environmental survey contractor. The system was subsequently commercialised and made available for purchase to other operators and users following the success of the trial at an NMBAQC workshop in 1997*.

The WAS system was designed to standardise all sieving operations between surveys and personnel, increasing the efficiency of the sample handling and processing without compromising the quality of the biology recovered.

Its simple yet unique and revolutionary design enables its employment from small vessels and large ships alike and in a variety of different sediment conditions, ranging from coarse heterogenic substrates down to soft clays and silts.

Cited as *best practice* for biological processing*, the WAS system has become the preferred tool for a large number of organisations that routinely carry out benthic surveys. Systems are currently being employed around the world (including UK, Ireland, Norway, Netherlands, Germany, France, Australia, Africa and South America) by a multitude of different users including survey companies, fish farms, government institutes and agencies, laboratories, universities and environmental consultancies.

* Proudfoot, R.K., Elliott, M, Dyer, M.F., Barnett, B.E, Allen, J.H., Proctor, N.L, Cutts, N.D., Nikitik, C., Turner, G. Breen, J. Hemmingway, K.L.and Mackie, T., 1997. Collection and Processing of macrobenthic samples from soft sediments; a best practice review. Proceedings of the Humber Benthic Field Methods Workshop, Hull University.

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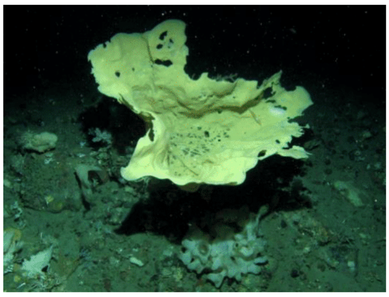
APPENDIX F – BSL UNDERWATER CAMERA – STR SEABUG

benthic solutions limited

UNDERWATER CAMERA – Seabug
Seabed Monitoring & Underwater Real-time Footage

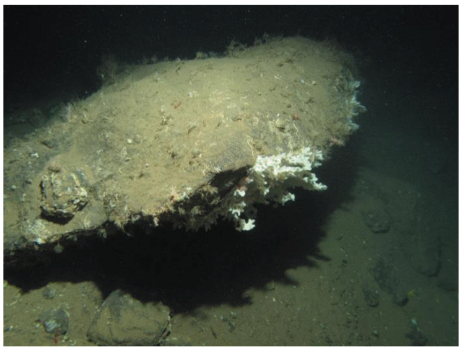
- **General Specifications**
  - Flexible deployment scenarios
  - Depth rated to 3500m
  - Digital streaming target video
  - Video overlay on video data
  - Uses vessel existing sonar cabling



- **Services**

The deep water camera system is based on a Sonar Equipment Services Seabug which was developed in conjunction with Benthic Solutions Limited in 2010. The system is based upon 14.7 megapixel digital stills cmera operated from the surface via a single armoured coaxial or twisted pair cable. Typically, this utilises an existing sonar cable on the survey vessel through a multiport multiplexer carrier system to a control consol.

The system provides continuous targeting video data streamed to the surface where a computer is used to trigger the stills camera system remotely as required. These systems are fitted with inbuilt strobe units which can be deployed in a drop-down frame mounted configuration, or towed seabed sled (pictured). Seabed video is illuminated by 4 or 6 dedicated LED lamps with the camera orientated at an oblique or a downward looking aspect.



The system provides a very high quality digital image and is an ideal tool for ground truthing, habitat mapping and detailed seabed classification surveys from vessels in water depths in excess of 3km. Examples of previous projects include regional deep water surveys looking at iceberg keel scar, deep water coral and sponge communities and regional environmental habitat mapping assessments.

Shipping weight	200kg *
Shipping dimension	2 x 1 x 0.2m *
Specifications	2 x 1 x 1m *

**as multiple configurations are available, values shown indicate the maximum*

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APPENDIX G – RBR CTD SENSORS

benthic solutions limited

RBR Multiprobe – Maestro / Concerto

- **General Specifications**
  - Multi-Channel Logger
  - Deep-water, up to 6000m
  - Support long deployments
  - Can be mounted on ROV or deployed on its frame
  - Fast USB-C download/WiFi ready
  - Up to 16Hz sampling/240m readings
  - Twist activation
  - Realtime communication with USB, RS-232, or RS-485

Services

The RBR*maestro* multi-channel logger supports 3-13 sensors, offers flexible measurement schedules, sampling up to 16 Hz, large memory, ample power for extended deployments, and fast USB-C download for large data sets.

- Conductivity
- Temperature
- Depth (pressure)
- Turbidity
- pH
- Dissolved oxygen
- Redox

RBR has been designing and manufacturing oceanographic instruments since 1973.

RBR standard loggers can measure up to 10 parameters. Numerous configuration options allow for maximum customisation for measurement needs. In addition to conductivity, temperature and depth sensors, many others, including third party sensors can be used with RBR recorders.

ISO 9001 REGISTERED FIRM

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APPENDIX H – FIELD OPERATIONS AND SURVEY METHODS

Appendix A to D presents a summary of the different equipment and methods employed during the survey field operations. For additional information, please refer to the Environmental Field Report (BSL, 2023).

SEABED PHOTOGRAPHY AND VIDEO

Seabed video footage was acquired at a total of 61 locations across the survey area to provide ground-truthing of sediments indicated in the acoustic data. The 61 camera transects were carried out using the STR Seabug camera systems mounted within a frame equipped with a separate strobe and LED lamps. The Seabug acquired high resolution seabed images and recorded video in both high definition (HD) and standard definition (SD) for general biotope and habitat mapping purposes.

Once at the seabed, the camera was moved along the length of the transect at a speed of 0.3 to 0.5 knots. Still photographs were captured remotely using a surface control unit via a soft towed umbilical to the camera system. The stills were uploaded in real-time and saved to the camera and a laptop via specialist software. Live video footage, overlaid with the date, time, position and site details were viewed in real-time. The live video stream was used to assist with targeting of the stills camera. HD footage was saved internally by the video camera; data was downloaded at the end of each day of camera operations and backed-up onto a hard drive.

GRAB SAMPLING

A DVV acquiring 2 x 0.1 m^2 samples per deployment was to be used at stations along the Xlinks route survey area. When using the DVV, two successful deployments were required at each grab sampling.

Three consecutive 'no sample' deployments were agreed to be the maximum number of attempts at any location before moving to a more suitable location (up to 50 m from the original location while remaining in an area ground-truthed with underwater imagery) and reattempting. If one more attempt failed, no further reattempts would be carried out. However, if any samples were acquired within the first four deployments a fifth and final deployment was warranted.

Pre-deployment procedures included the cleaning of the inner stainless grab buckets, cable and shackles so that they were generally grease free. Samples were subject to quality control upon recovery and were flagged if they did not meet the following requirements:

- Water above sample is undisturbed;
- Bucket closure is complete (no sediment washout);
- Grab penetration was sufficient to maintain a seal at the base;
- Sampler was retrieved perfectly upright and had not been fouled in any way;
- Inspection/access doors had closed properly enclosing the sample;
- No disruption of the sample through striking the side of the vessel;
- No contamination in the sample by other sampling equipment;
- Sample was taken inside the acceptable target range;
- Sample size ca. 40% of the sampler`s capacity;

- No hagfish (*Myxine glutinosa*) and/or mucus coagulants.

Once deemed acceptable by the marine scientist, the overlying supernatant water was to be drained into the sample tray. A digital photograph of the sample was to be taken in situ with a waterproof deck-slate. A full sediment description was to be recorded including the following:

- Sediment description (colour);
- Surface description (burrows, tubes, casts, bioturbation, uneven etc.);
- Odour (presence of anoxic conditions, presence of H_2S);
- Conspicuous fauna;
- Vertical structure (obvious horizons, depth of loose surface layer etc.);
- Presence of anthropogenic substances (oil contamination/cuttings etc.);
- Other factors or comments relating to quality of sample (including reasons for no samples, weather conditions, etc.).

Field processing was conducted on board by BSL scientists after they had been subjected to the afore mentioned quality control and accepted. Sub-sampling of physico-chemical parameters was undertaken from the grab samples with the following material retrieved from the surface sediments (0-2 cm) for later analysis:

- Heavy & trace metals and Total Organic Carbon & Matter subsamples (including additional barium samples where required and spares) were taken using a solvent-cleaned plastic scoop and placed in labelled doubled lined Ziplock plastic bag;
- Hydrocarbon analysis subsamples (and spares) were taken using a solvent-cleaned metal scoop and placed in labelled 120 ml pre-washed foil capped glass jars;
- Particle size analysis (PSA) subsamples were taken using a plastic scoop and placed in labelled doubled lined Ziplock plastic bag;
- Subsamples for eDNA (were taken using a clean metal eDNA scoop and placed in labelled 50ml Falcon centrifuge tubes.

The preservation of materials was undertaken using standard techniques. All physico-chemical samples were stored in appropriate containers and immediately frozen and stored (<-18 °C) on board the vessel for later transportation (frozen) to the laboratory upon demobilisation in the UK and onward transport for laboratory analysis.

Each macrofaunal sample was to be sieved using a 0.5 mm mesh on a *Wilson* Auto-siever. The residual sieve contents were to be photographed, described and subsequently transferred to storage containers. Sieved samples were immediately fixed with approximately 4-5% formalin. The macrofauna samples were to be stored at room temperature.

APPENDIX I – DATA PRESENTATION, LABORATORY AND STATISTICAL ANALYSES

PARTICLE SIZE DISTRIBUTION

The samples recovered from each site were analysed by BSL who participate in the Northeast Atlantic Marine Biological Analytical Quality Control Scheme (NMBAQC) for PSA analysis.

The sample was homogenised and split into a small sub-sample for laser diffraction and the remaining material was sieved through stainless steel sieves with mesh apertures of 8000 µm, 4000 µm, 2000 µm and 1000 µm. In most cases almost the entire sample would pass through the sieve stack, but any material retained on the sieve, such as small shells, shell fragments and stones were removed, and the weight was recorded.

The smaller sub-sample was wet screened through a 1000 µm sieve and determined using a Malvern Mastersizer 2000 particle sizer according to Standard Operating Procedures (SOP). The results obtained by a laser sizer have been previously validated by comparison with independent assessment by wet sieving (Hart, 1996). The range of sieve sizes, together with their Wentworth classifications, is given in Table I.1. For additional quality control, all datasets were run through the Mastersizer in triplicate and the variations in sediment distributions assessed to be within the 95% percentile.

The separate assessments of the fractions above and below 1000 µm were combined using a computer programme. This followed a manual input of the sieve results for fractions 16 mm-8 mm, 8 mm-4 mm, 4 mm-2 mm and 2 mm-1 mm fractions and the electronic data captured by the Mastersizer below 1000µm.

This method defines the particle size distributions in terms of Phi mean, median, fraction percentages (i.e. coarse sediments, sands and fines), sorting (mixture of sediment sizes) and skewness (weighting of sediment fractions above and below the mean sediment size; Folk 1954).

Formulae and classifications for particle calculations made are given below:

- **Graphic Mean (M)** - a very valuable measure of average particle size in Phi units (Folk and Ward, 1957).

$$M = \frac{\text{ø}16 + \text{ø}50 + \text{ø}84}{3}$$

Where *M = The graphic mean particle size in Phi*
ø = the Phi size of the 16th, 50th and 84th percentile of the sample

Table I.1: Phi and sieve apertures with Wentworth classifications

Microns (µm)		Phi (ϕ)		Sediment Description	
Aperture	Sediment Retained	Aperture	Sediment Retained		
4000	≥ 4000	-2	-2 < -1	Pebble	Gravel
2000	2000 < 4000	-1	-1 < -0.5	Granule	
1400	1400 < 2000	-0.5	-0.5 < 0	Very Coarse Sand	Sands
1000	1000 < 1400	0	0 < 0.5		
710	710 < 1000	0.5	0.5 < 1	Coarse Sand	
500	500 < 710	1	1 < 1.5		
355	355 < 500	1.5	1.5 < 2	Medium Sand	
250	250 < 355	2	2 < 2.5		
180	180 < 250	2.5	2.5 < 3	Fine Sand	
125	125 < 180	3	3 < 3.5		
90	90 < 125	3.5	3.5 < 4	Very Fine Sand	
63	63 < 90	4	4 < 4.5		
44	44 < 63	4.5	4.5 < 5	Coarse Silt	Fines (Silts)
31.5	31.5 < 44	5	5 < 5.5		
22	22 < 31.5	5.5	5.5 < 6	Medium Silt	
15.6	15.6 < 22	6	6 < 6.5		
11	11 < 15.6	6.5	6.5 < 7	Fine Silt	
7.8	7.8 < 11	7	7 < 7.5		
5.5	5.5 < 7.8	7.5	7.5 < 8	Very Fine Silt	
3.9	3.9 < 5.5	8	8 < 9		
2	2 < 3.9	9	9 <10	Clay	Fines (Clays)
1	1 < 2	10	≥ 10		

- **Sorting (D)** – the inclusive graphic standard deviation of the sample is a measure of the degree of sorting (Table I.2).

$$D = \frac{ø84 + ø16}{4} + \frac{ø95 + ø5}{6.6}$$

where *D = the inclusive graphic standard deviation*

ø = the Phi size of the 84th, 16th, 95th and 5th percentile of the sample

Table I.2: Sorting classifications

Sorting Coefficient (Graphical Standard Deviation)	Sorting Classifications
0 < 0.35	Very well sorted
0.35 < 0.50	Well sorted
0.50 < 0.71	Moderately well sorted
0.71 < 1	Moderately sorted
1 < 2	Poorly sorted
2 < 4	Very poorly sorted
4 +	Extremely poorly sorted

- **Skewness (S)** – the degree of asymmetry of a frequency or cumulative curve (Table I.3).

$$S = \frac{\text{ø}84 + \text{ø}16 - (\text{ø}50)}{2(\text{ø}84 - \text{ø}16)} + \frac{\text{ø}95 + \text{ø}5 - 2(\text{ø}50)}{2(\text{ø}95 - \text{ø}5)}$$

where *S = the skewness of the sample*
ø = the Phi size of the 84th, 16th, 50th, 95th and 5th percentile of the sample

Table I.3: Skewness classifications

Skewness Coefficient	Mathematical Skewness	Graphical Skewness
+1 > +0.30	Strongly positive	Strongly coarse skewed
+0.30 > +0.10	Positive	Coarse skewed
+0.10 > -0.10	Near symmetrical	Symmetrical
-0.10 > -0.30	Negative	Fine skewed
-0.30 > -1	Strongly negative	Strongly fine skewed

- **Graphic Kurtosis (K) –** The degree of peakedness or departure from the 'normal' frequency or cumulative curve (Table I.4).

$$K = \frac{\text{ø}95 - \text{ø}5}{2.44(\text{ø}75 - \text{ø}25)}$$

Where *K = Kurtosis*
ø = the Phi size of the 95th, 5th, 75th and 25th percentile of the sample

Table I.4: Kurtosis classifications

Kurtosis Coefficient	Kurtosis Classification	Graphical meaning
0.41 < 0.67	Very Platykurtic	Flat-peaked; the ends are better sorted than the centre
0.67 < 0.90	Platykurtic	
0.90 < 1.10	Mesokurtic	Normal; bell shaped curve
1.11 < 1.50	Leptokurtic	Curves are excessively peaked; the centre is better sorted than the ends.
1.50 < 3	Very Leptokurtic	
3 +	Extremely Leptokurtic	

SEDIMENT TOC AND TOM

Organic and carbon sediments are analysed using a combination of tests. These include Total Carbon (TC), analysed using a known weight of dried soil and combusted at 1,600°C and the amount of carbon determined by infra-red detection and TOC (see below). In addition to the standard accreditation as outlined below, additional analytical quality control (AQC), is carried out with every batch where a soil of known value is determined (every batch of 20 samples or part thereof). Blank determinations are also carried out routinely where required.

Total Inorganic Carbon (TIC) is determined by calculation: TC –TOC = TIC

TOC was analysed using an Eltra combustion method. This method is used for total carbon analysis of dried, crushed rock powder and environmental soil samples. The samples are previously treated with 10% HCl to remove inorganic carbon (Carbonates) before washing to remove residual acids and further dried. The Carbon Analyser heats the sample in a flow of oxygen and any carbon present is converted to carbon dioxide which is measured by infra-red absorption. The percentage carbon is then calculated with respect to the original sample weight. The range for the method is 0.02% - 100% and is accredited under the UKAS accreditation scheme.

TOM was analysed using 1g of air dried and ground sample (<200µm) placed in a crucible and dried in an oven at 50±2.5°C until constant weight was achieved. The final sample weight was recorded to the nearest 0.01% and the sample was allowed to cool in a desiccator. The sample was then placed in a muffle furnace and heated to 440±25°C for 4 hours. The crucible was removed from the furnace and allowed to cool to room temperature in a desiccator. The crucible was then reweighed and the percentage loss on ignition calculated. This test is reported to 0.2%.

The mols of hydrochloric acid neutralised by the sample are calculated from the difference in the titre added to the blank and the sample. This is converted into the equivalent mass of carbonate present in the sample. Results are expressed as percent carbonate.

HYDROCARBON CONCENTRATIONS (TOTAL HYDROCARBON CONCENTRATIONS AND ALIPHATICS)

General Precautions

High purity solvents were used throughout the analyses. Solvent purity was assessed by evaporating an appropriate volume to 1ml and analysing the concentrate by GC for general hydrocarbons, target n-alkanes and aromatics. All glassware and extraction sundries were cleaned prior to use by thorough rinsing with hydrocarbon-free deionised water followed by two rinses with dichloromethane. All glassware was heated in a high temperature oven at 450°C for 6 hours.

Extraction Procedure for Hydrocarbons

Each analytical sample (15±0.1g) was spiked with an internal standard solution containing the following components: aliphatics - heptamethylnonane, 1-chlorooctadecane and squalane. The sample was then wet vortex extracted using three successive aliquots of DCM/Methanol. The extracts were combined, and water partitioned to remove the methanol and any excess water from the sample.

Solvent extracts were chemically dried and then reduced to approximately 1ml using a Kuderna Danish evaporator with micro-Snyder.

Column fractionation for Aliphatic and Aromatic Fractions

The concentrated extract was transferred to a pre-conditioned flash chromatography column containing approximately 1g of activated Silica gel. The compounds were eluted with 3ml of Pentane/DCM (2:1). An aliquot of the extract was then taken and analysed for total hydrocarbon (THC) content and individual n-alkanes by large volume injection GC-FID.

Quality Control Samples

The following quality control samples were prepared with the batches of sediment samples:

- A method blank comprising 15±0.1g of baked anhydrous sodium sulphate (organic free) treated as a sample.
- A matrix matched standard sample consisting of 15±0.1g baked sand spiked with Florida mix and treated as sample.
- A sample duplicate - any one sample from the batch, dependent upon available sample mass, analysed in duplicate.

Hydrocarbon Analysis

Analysis of total hydrocarbons and aliphatics was performed by using an Agilent 6890 with an FID detector. Appropriate column and GC conditions were used to provide sufficient chromatographic separation of all analytes and the required sensitivity.

Carbon Preference Index

The carbon preference index is calculated as follows:

$$CPI = \frac{\text{odd homologues } (nC_{11} \text{ to } nC_{35})}{\text{even homologues } (nC_{10} \text{ to } nC_{34})}$$

Petrogenic/Biogenic or (P/B) Ratio

The Petrogenic/Biogenic Ratio is calculated as follows:

$$P/B \text{ Ratio} = \frac{P = \text{sum of } nC_{10} \text{ to } nC_{20}}{B = \text{sum of } nC_{21} \text{ to } nC_{35}}$$

Calibration and Calculation

GC techniques require the use of internal standards in order to obtain quantitative results. The technique requires addition of non-naturally occurring compounds to the sample, allowing correction for varying recovery.

Target analytes concentrations were calculated by comparison with the nearest eluting internal standards. A relative response factor was applied to correct the data for the differing responses of target analytes and internal standards. Response factors were established prior to running samples, from solutions containing USEPA (16) PAHs + dibenzothiophene (DBT) for the GC-MS, Florida mix (even n-alkanes nC_{10}-nC_{40}) for individual GC-FID targets and a diesel/mineral oil mix for total oil determination.

The mean detection limits used for the sediment total hydrocarbons and n-alkanes were:

1. n-alkane - 1ng.g^{-1} (ppb)
2. Total Hydrocarbons - 100ng.g^{-1} (ppb)

HEAVY AND TRACE METAL CONCENTRATIONS

Sediment samples were homogenised and a 50g portion of each sample was air dried at room temperature. Each sample was then ground down to a fine powder (<100µm) by hand using a metal free mortar and pestle. A clean sand sample was hand ground prior to preparation of the field samples as a blank.

Sample Digestion Procedure

Total Metals by ICPOES (Hydrofluoric /Boric acid Extractable Metals – All metals

Approximately 0.20g of the sediment sample was accurately weighed and placed in a polytetrafluoroethylene (PTFE) bottle and 2.5mls of hydrofluoric acid was added. The bottle was then placed in an oven at 105±5°C for approximately 30 minutes and then allowed to air cool in a fume cupboard. A further 65mls of 4% boric acid was then added to the bottle and the contents were then mixed thoroughly and placed in a polypropylene flask. The solution was then made up to 100ml with deionised water and analysed by ICP-OES.

The filtrate was then analysed by ICP-OES and/or ICP-MS.

Microwave Assisted Digestion Procedure

The air-dried and ground sediment sample is digested with concentrated hydrofluoric/nitric acids and hydrogen peroxide in a Teflon digestion vessel. The microwave digestion process involves a two-stage extraction process. The digest is made up to 100ml in a Gradplex flask.

The mean detection limits are given in Table I.5 for microwave-assisted hydrofluoric acid (HF) digestions.

Table I.5: Heavy metals - mean detection limits (MDL)

Analyte	Unit	MDL
As	mg/Kg (Dry Weight)	0.14
Cd	mg/Kg (Dry Weight)	0.03
Cr	mg/Kg (Dry Weight)	1
Co	mg/Kg (Dry Weight)	0.4
Cu	mg/Kg (Dry Weight)	0.7
Pb	mg/Kg (Dry Weight)	0.6
Mn	mg/Kg (Dry Weight)	1
Hg	mg/Kg (Dry Weight)	0.01
Ni	mg/Kg (Dry Weight)	0.4
Sn	mg/Kg (Dry Weight)	0.5
V	mg/Kg (Dry Weight)	1
Zn	mg/Kg (Dry Weight)	3.5
Al	mg/Kg (Dry Weight)	1750
Ba	mg/Kg (Dry Weight)	7.2
Be	mg/Kg (Dry Weight)	0.2
Fe	mg/Kg (Dry Weight)	860
Li	mg/Kg (Dry Weight)	2
As	mg/Kg (Dry Weight)	0.14
Cd	mg/Kg (Dry Weight)	0.03

ICP-MS	ICP-OES

Mercury Digestion Procedure

Approximately 1g of the sediment was accurately weighed and transferred to a beaker. Hydrogen peroxide (10ml of 30 volumes) was added, and the covered sample left to digest for 0.5 hour in the fume cupboard. 10ml of nitric acid was added and the sample placed on the hotplate for 1 hour.

After digestion, the sample was filtered through a Whatman 542 filter paper into a 100ml standard flask. The watch-glass and beaker were rinsed thoroughly, transferring the washings to the filter paper. The filter paper was rinsed until the volume was approximately 90ml. Subsequently, the filter funnel was rinsed into the flask and then the flask was made up to 100ml volume and mixed well. The filtrate was then analysed by ICP-MS.

Analytical Methodology

Inductively Coupled-Plasma Optical Emission Spectrometry

The instrument is calibrated using dilutions of the 1ml (=10mg) spectroscopic solutions. The final calibration solutions are matrix matched with the relevant acids. The calibration line consists of five standards.

Inductively Coupled Plasma- Mass Spectrometry

The instrument is calibrated using dilutions of the 1ml (=10mg) spectroscopic solutions. The calibration line consists of seven standards.

The analytes are scaled against internal standards to take account of changes in plasma conditions as a result of matrix differences for standards and samples. The internal standards have a similar mass and ionisation properties to the target metals.

MACRO-INVERTEBRATE ANALYSIS

Methodology

All macrofaunal determination was carried out inhouse by the BSL specialist taxonomist team. The BSL specialist taxonomist team are comprised three senior individuals who possess a wealth of experience in macrofaunal identification in temperate deep-water environments.

Benthic sediment samples were thoroughly washed with freshwater on a 500µm sieve to remove traces of formalin, placed in gridded, white trays and then hand sorted by eye followed by binocular microscope, to remove all fauna. Sorted organisms were preserved in 70% IMS and 5% glycerol. Where possible, all organisms were identified to species level according to appropriate keys for the region. Colonial and encrusting organisms were recorded by presence alone and, where colonies could be identified as a single example, these were also recorded, although these datasets have not been considered in the overall statistical analysis of the material. The presence of anthropogenic components was also recorded where relevant.

All taxa were distinguished to species level and identified to at least family level where possible and many of the species that could not be fully identified were separated putatively. Nomenclature for species names were allocated either when identity was confirmed, allocated as “cf.” when apparently identifying to a known species but confirmation was not possible (for example, incomplete specimens or descriptions), or allocated as “aff.” when close to but distinct from a described species. The terms “indet.” refers to being unable to identify to a lower taxon and “juv” as a juvenile to that species, genus or family.

Quality Assurance

BSL is committed to total quality control from the start of a project to its completion. All samples taken or received by the company were given a unique identification number. All analytical methods were carried out according to recognised standards for marine analyses. All taxonomic staff are fully qualified to post-doctorate level. Documentation is maintained that indicates the stage of analysis that each sample has reached. A full reference collection of all specimens has been retained for further clarification of putative species groups where/if required. BSL is a participant in the NMBAQC quality assurance scheme.

Digital datasets are kept for all sites in the form of excel spreadsheets (by sample and by station) on BSL's archive computer. This system is duplicated onto a second archive drive in case of electronic failure. These datasets will be stored in this way for a minimum of 3 years or transferred to storage disk (data CD or DVD).

Biological Data Standardisation and Analyses

In accordance with OSPAR Commission (2004) guidelines, all species falling into juvenile, colonial, planktonic of meiofaunal taxa are excluded from the full analyses within the dataset (this is discussed further within the text of Section 4.8). This helps to reduce the variability of data undertaken during different periods within the year, or where minor changes may occur or where some groups may only be included in a non-quantitative fashion, such as presence/absence. Certain taxa, such as the Nematoda, normally associated with meiofauna, were included where individuals greater than 10mm were recorded. The following primary and univariate parameters were calculated for all data by stations and sample (Table F.6).

Table F.6: Primary and univariate parameter calculations

Variable	Parameter	Formula	Description
Total Species	S	Number of species recorded	Species richness
Total Individuals	N	Number of individuals recorded	Sample abundance
Shannon-Wiener Index	H(s)	$H(s) = -\sum_{i=1}^{s} (Pi)(\log_2 Pi)$ where s = number of species & Pi = proportion of total sample belonging to *i*th species.	Diversity: using both richness and equitability, recorded in log 2.
Simpsons Diversity	1-Lambda	$Lambda = \sum \left\| \frac{ni(ni-1)}{N(N-1)} \right\|$ where ni = number of individuals in the *i*th species & N = total number of individuals	Evenness, related to dominance of most common species (Simpson, 1949)
Pielou's Equitability	J	$J = \frac{H(s)}{(\log S)}$ where s = number of species & H(s) = Shannon-Wiener diversity index.	Evenness or distribution between species (Pielou, 1969)
Margalef's Richness	D_{Mg}	$D_{Mg} = \frac{(S-1)}{(\log N)}$ where s = number of species & N = number of individuals.	Richness derived from number of species and total number of individuals (Clifford and Stevenson, 1975)

In addition to univariate methods of analysis, data for both sample replicates and stations were analysed using multivariate techniques. These serve to reduce complex species-site data to a form that is visually interpretable. A multivariate analysis was based on transformed data (square root) to detect any improved relationships when effects of dominance were reduced. The basis for multivariate analyses was based upon the software PRIMER (Plymouth Routines in Multivariate Ecological Research).

Similarity Matrices and Hierarchical Agglomerative Clustering (CLUSTER)

A similarity matrix is used to compare every individual sample replicate and/or stations with each other. The coefficient used in this process is based upon Bray Curtis (Bray and Curtis, 1957), considered to be the most suitable for community data. These are subsequently assigned into groups of replicates and/or stations according to their level of similarity and clustered together based upon a Group Average Method into a dendrogram of similarity.

Non-metric Multidimensional Scaling (nMDS)

nMDS is currently widely used in the analysis of spatial and temporal change in benthic communities (e.g. Warwick and Clarke, 1991). The recorded observations from data were exposed to computation of triangular matrices of similarities between all pairs of samples. The similarity of every pair of sites was computed using the Bray-Curtis index on transformed data. Clustering was undertaken by a hierarchical agglomerative method using group average sorting, and the results are presented as a dendrogram and as a two-dimensional ordination plot. The degree of distortion involved in producing an ordination gives an indication of the adequacy of the nMDS representation and is recorded as a stress value as outlined in Table I.7.

Table I.7: Inference from nMDS stress values

nMDS Stress	Adequacy of Representation for Two-Dimensional Plot
≤0.05	Excellent representation with no prospect of misinterpretation.
>0.05 to 0.1	Good ordination with no real prospect of a misleading interpretation.
>0.1 to 0.2	Potentially useful 2-d plot, though for values at the upper end of this range too much reliance should not be placed on plot detail; superimposition of clusters should be undertaken to verify conclusions.
>0.2 to 0.3	Ordination should be treated with scepticism. Clusters may be superimposed to verify conclusions, but ordinations with stress values >2.5 should be discarded. A 3-d ordination may be more appropriate.
>0.3	Ordination is unreliable with points close to being arbitrarily placed in the 2-d plot. A 3-d ordination should be examined.

Similarity Percentages Analysis (SIMPER)

The nMDS clustering program is used to analyse differences between sites. SIMPER enables those species responsible for differences to be identified by examining the contribution of individual species to the similarity measure.

Bioaccumulation Curve

Bioaccumulation Curve Estimates are undertaken using Chao-1 (S*1). This is a formula that estimates how many additional species would be needed to sample all of the asymptotic species richness of a region, based on the samples acquired. It calculates this by comparing the number of species that occur in one sample with those that occur in two samples where;

$S^{*}_{1} = S_{obs} + (a^2/2b)$

$\mathbf{S_{obs}}$ is the number of species observed

a is the number of species observed just once

b is the number of species observed just twice

Relationship Testing (RELATE)

A non-parametric Mantel test that looks at the relationship between two matrices (often biotic and environmental). This shows the degree of seriation, an alternative to cluster analysis, which looks for a sequential pattern in community change. The test computes Spearman's rank correlation coefficient (ρ) between the corresponding elements of each pair of matrices to produce a correlation statistic present between the two datasets, the significance of the correlation determined by a permutation procedure (Clarke and Gorley, 2006).

Analysis of Similarity (ANOSIM)

Non-parametric, multivariate test often used in community ecology that calculates Bray-Curtis coefficient (for biological data) or Euclidean distance (for environmental data) based on permutations of ranked data. It produces an R value which is an effect level on a scale of 0-1; R=1 where all differences between sites are greater than any differences within site, R=0 when there is no separation between groups. P value (<5%) is the likelihood of arriving at that R value by chance, this significance value is determined by a permutation procedure (Clarke and Gorley, 2006).

Similarity Profile (SIMPROF)

Analyses data for significant clusters that show evidence of a multivariate pattern in data that are a priori unstructured, i.e., single samples from each site, this differs from the ANOSIM tests which permutes data based on a grouping factor such as 'site' or 'year'. The test works by comparing samples which have been ranked and ordered by resemblance against an expected profile which is obtained by permuting random species (variables) across the set of samples, a mean of 1000 permutations is taken to produce an expected result for null structure with rare and common species displaying the same pattern. If the actual data deviates outside the 95% limits of the expected profile, then there is evidence for significant structure and vice versa. The 'significant structure' is well represented on a dendrogram which will also show the clusters containing that lack significant differentiation (null structure; Clarke and Gorley, 2006).

NORMALISATION

Normalisation is a procedure used here to correct concentrations for the influence of the natural variability in sediment composition (i.e., grain size, organic matter and mineralogy). Natural and anthropogenic contaminants tend to show a much higher affinity to fine particulate matter compared to coarse (OSPAR, 2009) due to the increased adsorption capacity of organic matter and clay minerals. In sites where there is variability in grain size between stations, effects of sources of contamination will at least partly be obscured by grain size differences.

Normalisation can be performed through linear regression or by simple contaminant/normaliser ratios.

Linear regression normalisation takes into account the possible presence of contaminants and co-factors. The binding capacity of the sediments can be related to the content of fines (primary co-factor) in the sediments. The level of fines can be represented by the contents of major elements of the clay fraction such as aluminium (secondary co-factor). Figure I.1 represents the general model for normalisation of the contaminants.

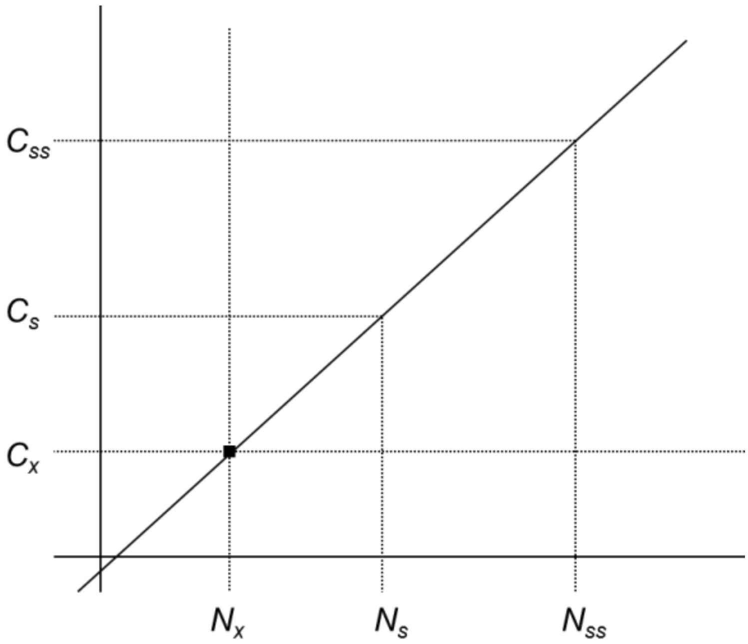


Figure I.1: Relation between the contaminant C and the cofactor N

Cx and Nx represent the contaminant and the co-factor contents, respectively, in pure sand. The regression line will always originate from this point and pivot depending on the sampled contaminant concentrations (Cs and Ns). These 'pivot values' are derived from statistical analysis of contaminant concentrations in pure sand.

The linear relationship between the pivot point and the sampled concentrations allows determination of the contaminant content for any preselected co-factor content (Nss) by interpolation and extrapolation. When comparing to the OSPAR BCs and BACs the secondary cofactors for normalisation are 50ppm of Li for metals and 2.5% TOC when normalising organics. The slope of the regression line (PL) can be represented by Equation 1, which can then be re-arranged to give the contaminant content Css that is normalised to Nss in Equation 2.

$$PL = \frac{dC}{dN} = \frac{C_s - C_x}{N_s - N_x} = \frac{C_{ss} - C_x}{N_{ss} - N_x}$$

Equation 1: Slope of the regression line expressed in terms of N_{ss}

$$C_{ss} = (C_s - C_x)\frac{N_{ss} - N_x}{N_s - N_x} + C_x$$

Equation 2: Rewritten equation giving the contaminant content C_{ss} normalised to N_{ss}

Normalisation of Metals

This method is limited by the sampled concentration of the contaminant. If a measured concentration falls below the Cx 'pivot value' for that metal or if the concentration of Li falls below the Nx 'pivot value', the method will give a skewed result (often a negative concentration). The pivot values for the contaminants are given in Table I.8.

Table I.8: Pivot values for metals (HF acid digest) with OSPAR background concentrations (CSEMP, 2013)

Metal	Li	Al	As	Cd	Cr	Cu	Hg	Ni	Pb	Z
N_x or C_x (µg.g^{-1})	7	14,000	5	0.03	13	3	0	4	9	13

If a metal is found to be below these values, the normalised result is considered environmentally inadmissible (OSPAR; 2008) and must be excluded from the assessment.

APPENDIX J – PARTICLE SIZE DISTRIBUTION

2334 GEOxyz Xlinks-UK sector PSD

2334 GEOxyz Xlinks-UK sector PSD

APPENDIX K – TOTAL ALIPHATIC CONCENTRATIONS BY STATION (μg.kg^{-1})

Station	UK_01	UK_02	UK_03	UK_04	UK_05	UK_06	UK_07	UK_09
nC10	<1	<1	<1	<1	<1	<1	<1	<1
nC11	<1	<1	<1	<1	<1	<1	<1	<1
nC12	<1	<1	<1	<1	<1	<1	<1	<1
nC13	<1	<1	<1	<1	<1	<1	<1	<1
nC14	<1	<1	<1	<1	<1	<1	<1	<1
nC15	<1	<1	<1	<1	<1	<1	<1	<1
nC16	<1	<1	<1	<1	<1	<1	<1	1.5
nC17	1.8	<1	<1	1.0	3.5	3.9	2.3	6.0
Pristane	2.0	<1	1.2	3.6	3.3	8.0	4.0	6.3
nC18	<1	<1	<1	<1	2.2	<1	<1	4.0
Phytane	<1	<1	<1	<1	<1	<1	<1	<1
nC19	<1	<1	<1	<1	<1	1.8	<1	2.3
nC20	<1	<1	<1	<1	<1	<1	<1	1.2
nC21	<1	<1	<1	<1	<1	<1	<1	1.6
nC22	<1	<1	<1	<1	<1	<1	<1	<1
nC23	<1	1.0	<1	1.1	1.4	1.3	<1	1.9
nC24	<1	<1	<1	<1	<1	3.4	1.2	3.3
nC25	1.6	<1	<1	1.6	1.4	2.9	2.1	3.1
nC26	<1	<1	<1	1.4	<1	2.6	<1	5.2
nC27	3.6	<1	<1	3.2	1.9	5.3	2.5	15.5
nC28	<1	<1	<1	1.1	<1	1.6	<1	4.4
nC29	7.2	2.6	2.2	3.9	6.8	15.7	7.4	27.1
nC30	<1	1.4	<1	1.4	1.1	2.4	1.8	3.4
nC31	4.1	<1	1.5	5.3	3.8	6.1	5.0	19.2
nC32	1.4	1.6	1.2	6.2	1.7	2.9	<1	3.3
nC33	<1	1.0	1.0	3.7	1.7	1.5	4.2	4.0
nC34	1.6	<1	<1	5.4	1.4	1.5	<1	3.9
nC35	2.1	<1	<1	2.0	<1	2.2	1.3	9.8
nC36	<1	<1	<1	1.6	<1	<1	<1	4.1
nC37	<1	<1	<1	<1	<1	<1	<1	1.5
Total Oil	**4018.6**	**1710.9**	**1127.2**	**2837.0**	**1803.3**	**5811.7**	**3208.1**	**8746.2**
Total n-alkanes	**23.3**	**7.6**	**5.9**	**38.9**	**26.9**	**55.0**	**27.9**	**126.4**

Station	UK_10	UK_11	UK_13	UK_14	UK_15	UK_16	UK_17	UK_18
nC10	<1	<1	<1	<1	<1	<1	<1	<1
nC11	<1	<1	<1	<1	<1	<1	<1	<1
nC12	<1	<1	<1	<1	<1	<1	<1	<1
nC13	<1	<1	<1	<1	<1	<1	<1	<1
nC14	<1	<1	<1	1.3	<1	<1	<1	<1
nC15	<1	<1	1.0	1.9	1.1	<1	<1	<1
nC16	<1	2.2	1.3	3.0	1.9	<1	<1	<1
nC17	3.2	4.6	5.1	5.3	4.9	2.1	<1	1.7
Pristane	4.8	8.1	7.5	17.1	6.0	1.5	1.0	1.2
nC18	1.1	4.0	2.1	6.3	1.6	<1	<1	<1
Phytane	<1	<1	<1	<1	1.6	<1	<1	<1
nC19	2.4	3.7	2.1	5.0	3.0	<1	<1	<1
nC20	<1	<1	1.0	1.7	1.7	<1	<1	<1
nC21	1.1	1.9	<1	2.3	3.0	<1	<1	<1
nC22	<1	<1	1.7	<1	1.0	<1	<1	<1
nC23	2.3	2.4	1.5	3.1	3.2	<1	1.3	<1
nC24	1.1	2.2	2.1	2.5	2.0	<1	1.6	<1
nC25	3.1	3.1	3.8	6.6	5.5	1.3	1.0	<1
nC26	2.6	5.5	7.4	4.8	8.4	1.3	<1	<1
nC27	6.1	10.6	12.1	12.8	9.6	3.3	<1	<1
nC28	4.8	4.9	6.0	3.8	3.9	1.2	<1	<1
nC29	18.7	27.5	20.3	27.9	26.4	7.2	5.3	5.5
nC30	5.6	3.9	8.9	6.8	1.9	1.5	2.2	<1
nC31	9.1	13.3	13.1	11.6	9.8	5.8	1.2	2.8
nC32	4.2	3.6	3.1	2.7	2.8	2.0	2.8	<1
nC33	4.7	5.1	4.6	3.7	3.6	2.8	1.9	1.9
nC34	4.1	5.8	1.4	<1	2.2	<1	2.0	<1
nC35	2.8	<1	1.4	<1	2.8	<1	<1	<1
nC36	1.2	<1	1.5	1.7	3.4	<1	2.5	<1
nC37	<1	<1	<1	<1	<1	<1	<1	<1
Total Oil	**20161.1**	**9841.1**	**9264.0**	**8969.3**	**8978.6**	**2481.8**	**1338.6**	**1983.9**
Total n-alkanes	**78.0**	**104.4**	**101.1**	**114.8**	**103.8**	**28.4**	**21.9**	**11.8**

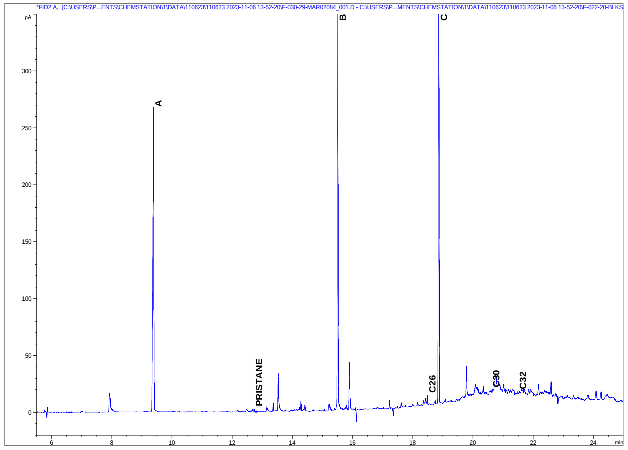
Station	UK_19	UK_20	UK_21	UK_23	UK_24	UK_27	UK_30	UK_31
nC10	<1	<1	<1	<1	<1	<1	<1	<1
nC11	<1	<1	<1	<1	<1	<1	<1	<1
nC12	<1	<1	<1	<1	<1	<1	<1	<1
nC13	<1	<1	<1	<1	<1	<1	<1	<1
nC14	1.8	<1	<1	<1	<1	<1	<1	<1
nC15	5.8	<1	<1	<1	<1	<1	<1	<1
nC16	4.9	1.5	<1	<1	<1	1.1	<1	<1
nC17	10.4	3.2	4.3	4.5	3.6	2.6	1.6	2.0
Pristane	10.8	2.1	2.5	2.3	3.4	1.5	1.8	1.6
nC18	7.9	2.1	1.7	<1	1.5	1.3	<1	1.3
Phytane	1.6	<1	<1	<1	<1	<1	<1	<1
nC19	3.5	1.8	<1	<1	<1	<1	<1	<1
nC20	2.5	<1	5.2	<1	1.2	<1	<1	<1
nC21	<1	<1	2.9	<1	1.5	<1	<1	2.1
nC22	2.0	<1	<1	<1	<1	<1	<1	1.2
nC23	4.1	<1	1.7	1.2	1.8	1.1	1.8	<1
nC24	3.8	2.5	<1	<1	<1	4.2	<1	<1
nC25	13.3	2.6	<1	1.9	3.0	1.5	2.3	1.2
nC26	4.3	2.6	<1	<1	<1	<1	<1	<1
nC27	15.4	4.5	1.0	1.6	5.1	1.6	<1	1.3
nC28	6.6	3.2	1.5	1.6	<1	1.4	<1	<1
nC29	32.4	18.2	7.6	6.4	8.3	4.9	3.5	5.9
nC30	22.0	2.2	2.8	3.2	4.5	1.4	1.6	2.2
nC31	22.4	8.0	3.1	4.5	6.6	4.8	2.1	2.7
nC32	6.5	2.7	1.8	2.3	2.0	2.0	<1	1.5
nC33	6.3	1.8	<1	2.3	2.2	2.6	<1	3.2
nC34	4.8	3.6	<1	<1	1.8	1.3	1.1	<1
nC35	3.6	4.2	1.1	<1	2.7	1.4	1.1	2.0
nC36	5.7	3.2	<1	<1	1.4	<1	<1	1.7
nC37	<1	<1	<1	<1	<1	<1	<1	<1
Total Oil	**17361.6**	**6035.1**	**1507.8**	**970.3**	**1593.0**	**1032.1**	**887.6**	**2947.6**
Total n-alkanes	**189.9**	**67.9**	**34.9**	**29.4**	**47.3**	**33.2**	**15.2**	**28.3**

Station	UK_33	UK_34	UK_35	UK_36	UK_37	UK_38	UK_39	UK_40
nC10	<1	<1	<1	<1	<1	<1	<1	<1
nC11	<1	<1	<1	<1	<1	<1	<1	<1
nC12	<1	<1	<1	<1	<1	<1	<1	<1
nC13	<1	<1	<1	<1	<1	<1	<1	<1
nC14	<1	<1	<1	<1	<1	<1	<1	<1
nC15	<1	<1	<1	<1	<1	<1	<1	<1
nC16	<1	<1	<1	<1	<1	<1	<1	1.3
nC17	<1	<1	<1	1.5	<1	<1	<1	<1
Pristane	<1	<1	<1	2.4	<1	<1	<1	<1
nC18	<1	<1	<1	2.4	<1	<1	<1	<1
Phytane	<1	<1	<1	<1	<1	<1	<1	<1
nC19	<1	<1	<1	<1	<1	<1	<1	<1
nC20	<1	<1	<1	<1	<1	<1	<1	<1
nC21	<1	<1	<1	<1	<1	<1	<1	<1
nC22	<1	<1	<1	<1	<1	<1	<1	<1
nC23	1.7	1.4	<1	1.3	<1	<1	<1	1.2
nC24	<1	<1	<1	<1	<1	<1	<1	<1
nC25	<1	<1	<1	<1	<1	<1	<1	<1
nC26	<1	<1	<1	<1	<1	<1	<1	<1
nC27	<1	1.3	<1	<1	<1	1.2	<1	2.6
nC28	<1	<1	<1	<1	1.1	<1	<1	1.2
nC29	2.8	6.0	1.7	4.3	2.2	3.0	2.5	7.1
nC30	<1	2.0	<1	1.6	<1	2.3	<1	3.2
nC31	2.5	2.4	<1	2.4	<1	2.2	1.1	1.5
nC32	1.0	1.8	<1	1.3	<1	1.5	<1	<1
nC33	1.4	1.7	<1	<1	<1	1.4	<1	2.2
nC34	<1	<1	<1	<1	<1	<1	<1	1.7
nC35	<1	<1	<1	<1	<1	<1	<1	3.0
nC36	<1	<1	<1	<1	<1	<1	<1	1.4
nC37	<1	<1	<1	<1	<1	<1	<1	<1
Total Oil	**751.6**	**1371.7**	**465.0**	**904.5**	**1076.2**	**627.7**	**525.6**	**1523.3**
Total n-alkanes	**9.5**	**16.6**	**1.7**	**14.9**	**3.3**	**11.4**	**3.6**	**26.5**

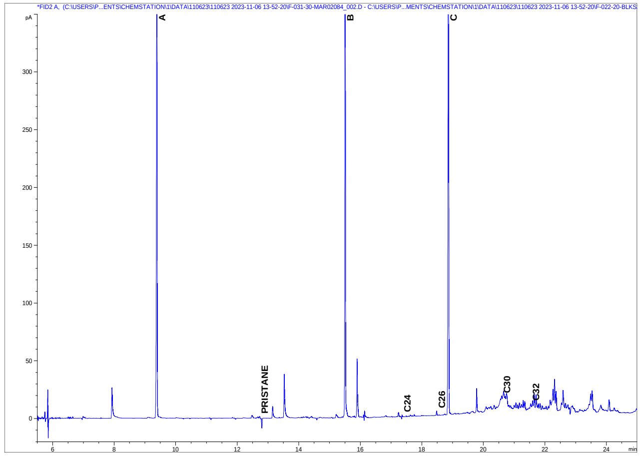
Station	UK_41	UK_42	UK_43	UK_44	UK_45	UK_46	UK_51	UK_52
nC10	<1	<1	<1	<1	<1	<1	<1	<1
nC11	<1	<1	<1	<1	<1	<1	<1	<1
nC12	<1	<1	<1	<1	<1	<1	<1	<1
nC13	<1	<1	<1	<1	<1	<1	3.1	<1
nC14	<1	<1	<1	<1	<1	1.0	1.7	<1
nC15	<1	<1	<1	1.2	<1	2.3	3.1	<1
nC16	<1	<1	<1	3.8	1.1	1.3	3.3	<1
nC17	<1	1.5	2.2	2.6	2.6	3.7	6.7	2.4
Pristane	1.1	1.7	3.0	2.5	4.3	4.4	6.2	2.5
nC18	<1	1.4	2.5	<1	1.6	4.8	<1	1.5
Phytane	<1	<1	<1	<1	<1	<1	<1	<1
nC19	<1	<1	<1	1.6	1.4	2.1	4.8	<1
nC20	<1	<1	<1	1.9	<1	<1	5.3	1.2
nC21	<1	<1	<1	<1	1.1	1.3	3.2	<1
nC22	<1	<1	<1	<1	<1	<1	3.6	<1
nC23	<1	<1	<1	<1	<1	<1	14.9	<1
nC24	<1	<1	<1	<1	<1	<1	15.0	<1
nC25	<1	<1	<1	7.2	1.1	1.2	<1	<1
nC26	<1	<1	<1	1.0	1.5	1.6	5.3	<1
nC27	<1	4.8	2.1	3.6	3.4	5.2	14.6	2.1
nC28	<1	<1	<1	2.1	1.1	2.3	6.1	<1
nC29	2.0	6.3	7.7	10.2	10.9	11.2	9.1	2.8
nC30	1.1	2.7	1.9	2.1	3.9	1.4	39.9	1.3
nC31	1.7	1.2	2.2	7.0	4.5	6.3	37.4	2.8
nC32	1.0	2.0	<1	1.6	2.7	1.2	11.3	1.6
nC33	1.8	2.1	1.5	1.9	2.1	2.5	19.1	1.2
nC34	<1	<1	<1	<1	2.3	<1	10.0	1.2
nC35	<1	1.5	1.3	<1	3.9	<1	4.8	<1
nC36	<1	<1	<1	<1	1.4	<1	2.1	<1
nC37	<1	<1	<1	<1	<1	<1	<1	<1
Total Oil	**538.7**	**1508.3**	**1460.7**	**2878.2**	**2716.2**	**1548.6**	**18360.2**	**796.7**
Total n-alkanes	**7.6**	**23.5**	**21.4**	**47.7**	**46.5**	**49.4**	**224.3**	**17.9**

Station	UK_53	UK_54	UK_55	UK_56	UK_57	UK_58	UK_59	UK_61
nC10	<1	<1	<1	<1	<1	<1	<1	<1
nC11	<1	<1	<1	<1	<1	<1	<1	<1
nC12	<1	<1	<1	<1	<1	<1	<1	<1
nC13	<1	<1	<1	7.2	<1	10.4	<1	<1
nC14	<1	<1	<1	11.6	12.5	32.1	<1	<1
nC15	1.1	<1	<1	14.8	35.9	47.4	4.9	<1
nC16	1.2	<1	<1	18.1	40.4	51.8	5.5	1.1
nC17	1.6	1.1	1.9	26.1	34.7	35.7	5.7	3.9
Pristane	2.0	1.7	2.0	9.5	34.9	40.9	5.9	4.1
nC18	<1	1.0	<1	16.8	48.2	53.3	3.2	2.3
Phytane	<1	<1	<1	4.9	39.8	30.9	1.3	1.0
nC19	1.1	<1	<1	22.6	19.3	19.3	2.9	1.7
nC20	<1	<1	<1	10.2	20.7	18.3	1.5	1.1
nC21	<1	<1	<1	7.3	23.9	14.7	1.3	2.0
nC22	<1	<1	<1	12.1	8.6	10.7	<1	<1
nC23	1.2	<1	<1	22.4	18.9	16.3	<1	<1
nC24	<1	<1	<1	31.9	17.4	15.3	<1	<1
nC25	7.4	<1	<1	74.6	53.3	37.1	7.3	3.0
nC26	1.5	<1	<1	44.8	11.0	12.5	1.7	1.1
nC27	2.3	2.2	1.5	46.7	49.2	54.5	4.7	3.2
nC28	1.7	1.2	1.3	16.3	19.6	14.6	2.6	1.2
nC29	2.9	2.5	1.8	16.3	60.8	79.4	12.0	3.9
nC30	<1	<1	<1	3.0	9.5	4.7	1.7	1.1
nC31	4.4	1.3	<1	4.9	37.5	42.8	7.1	1.9
nC32	1.4	<1	<1	2.6	6.6	3.1	<1	<1
nC33	1.3	<1	<1	2.1	12.1	6.0	1.9	<1
nC34	<1	<1	<1	<1	8.2	3.7	<1	<1
nC35	<1	<1	<1	<1	2.1	1.9	<1	<1
nC36	<1	<1	<1	<1	<1	1.0	<1	<1
nC37	<1	<1	<1	<1	<1	<1	<1	<1
Total Oil	**1185.6**	**1532.3**	**1743.7**	**16163.8**	**23234.7**	**22681.0**	**6496.9**	**4287.0**
Total n-alkanes	**29.0**	**9.4**	**6.5**	**412.6**	**550.3**	**586.4**	**63.9**	**27.7**

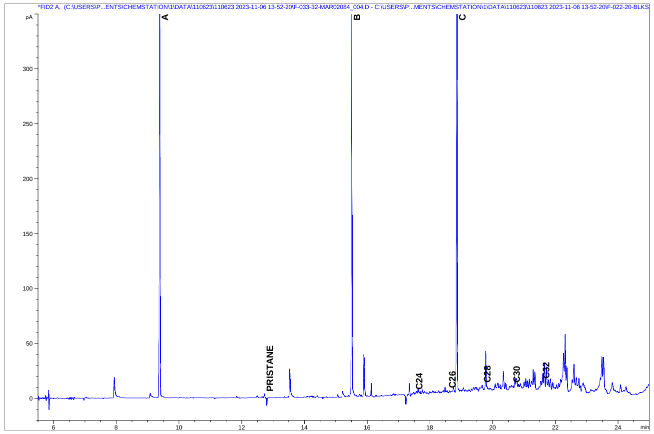
APPENDIX L – GC FID TRACES (SATURATES)



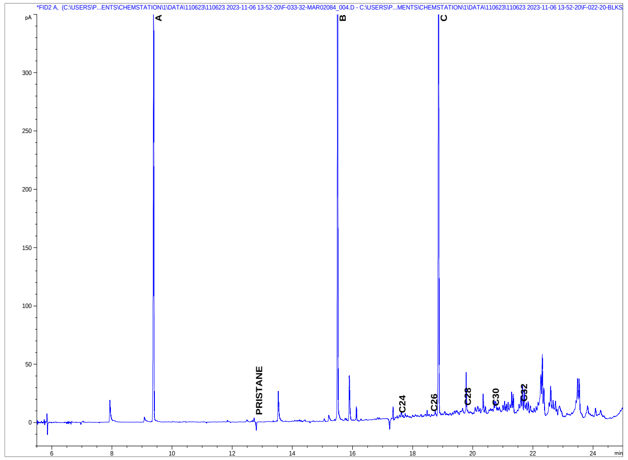
UK_01



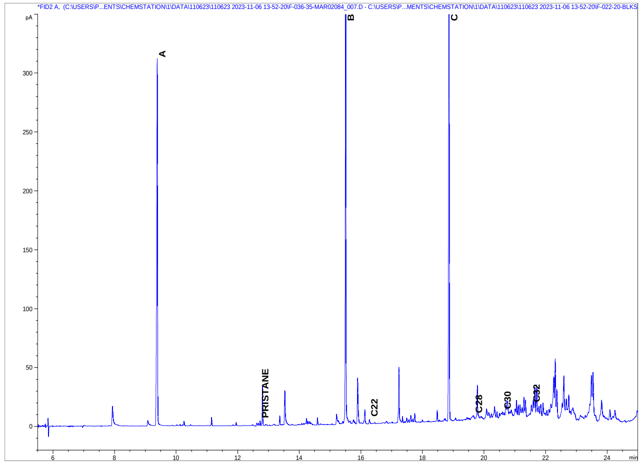
UK_02



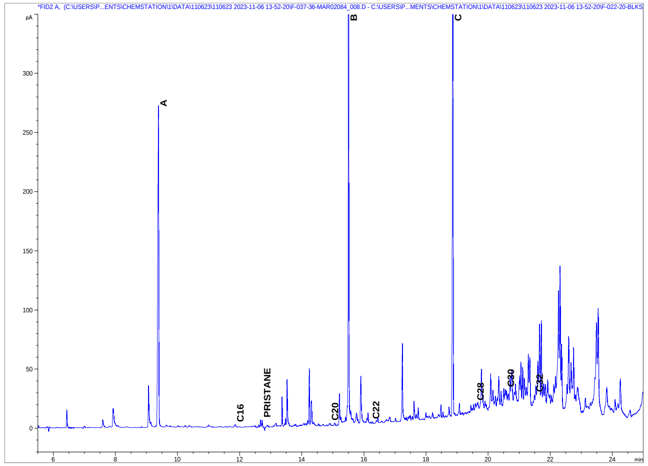
UK_04



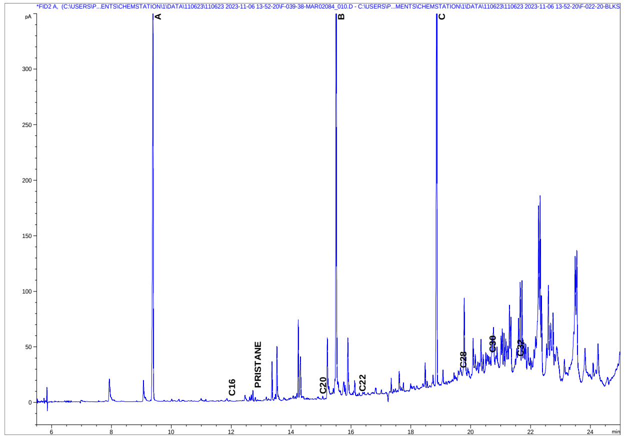
UK_05



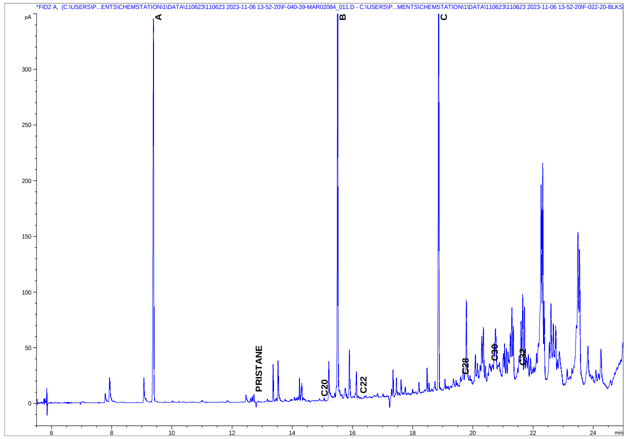
UK_07



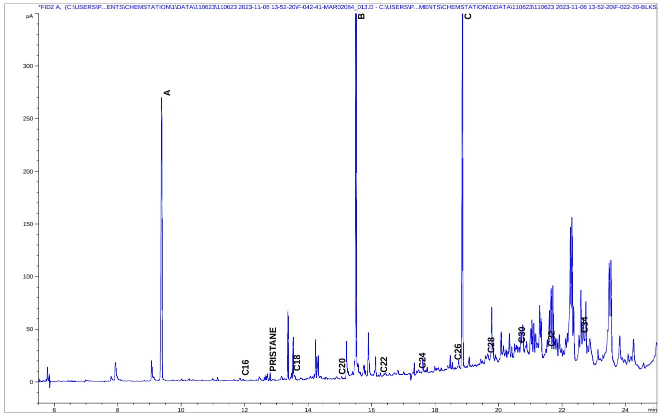
UK_09



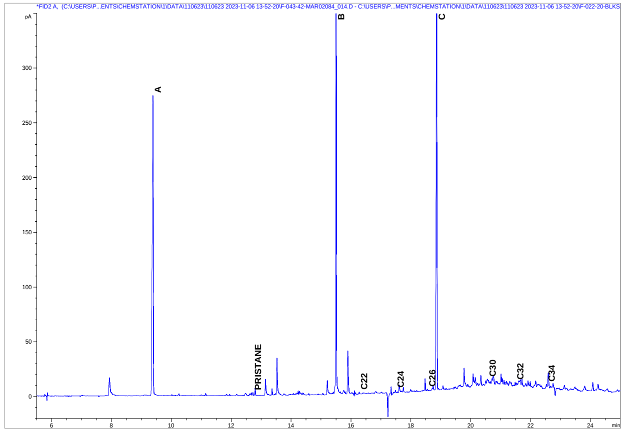
UK_11



UK_13



UK_15



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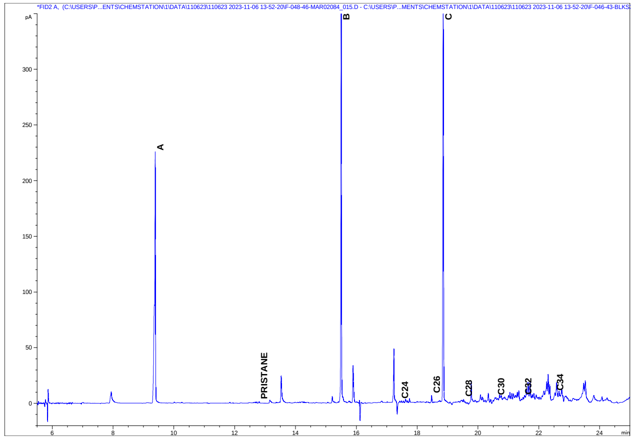

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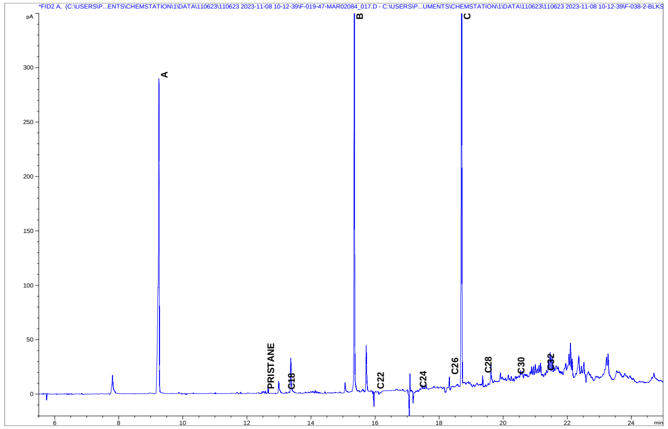

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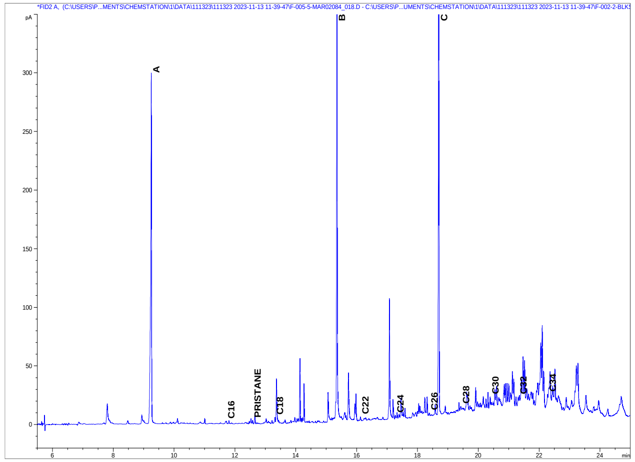

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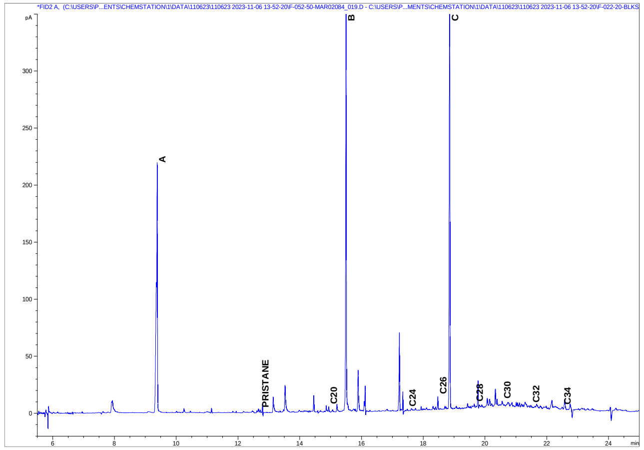

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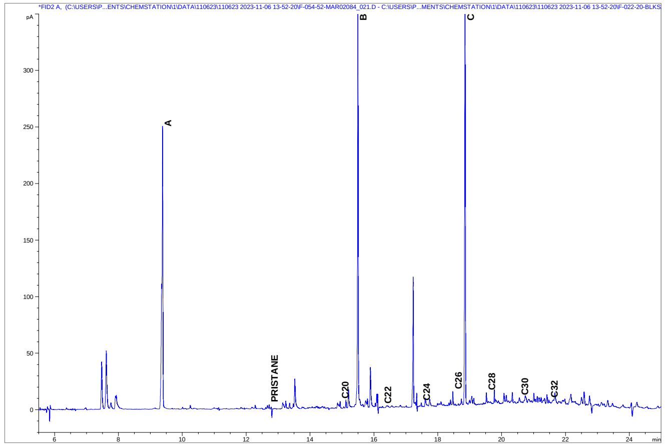

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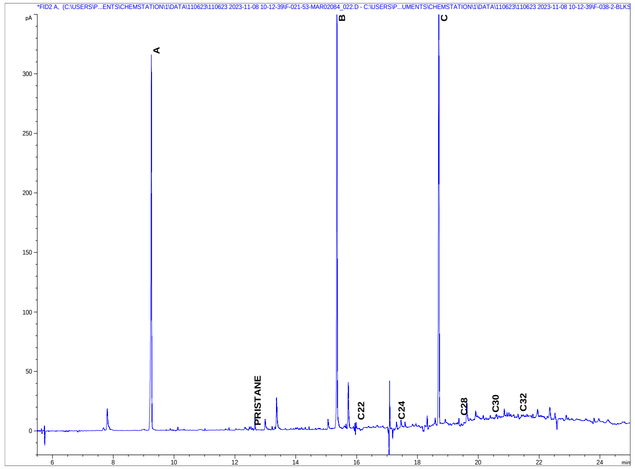

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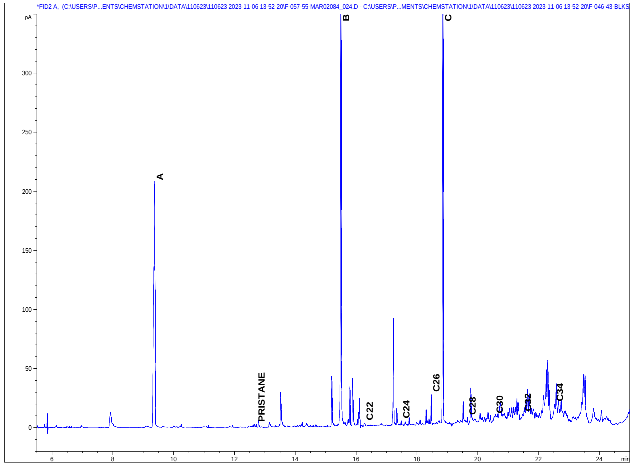

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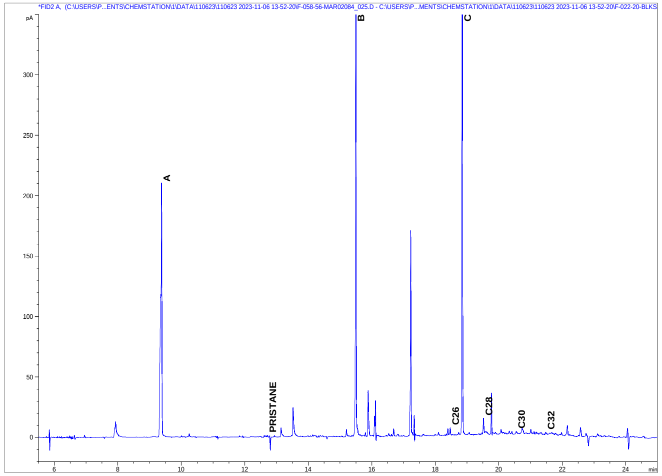

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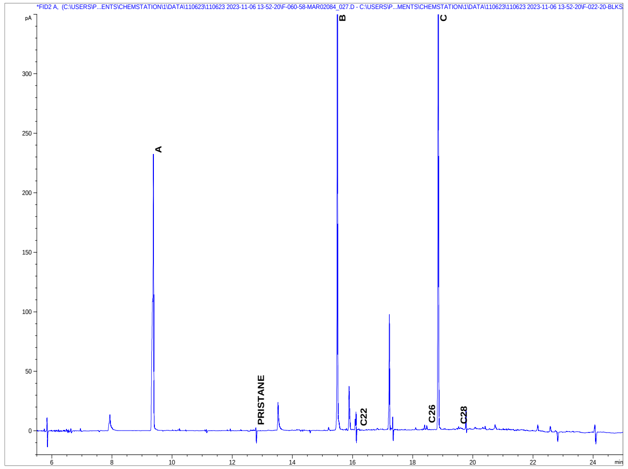

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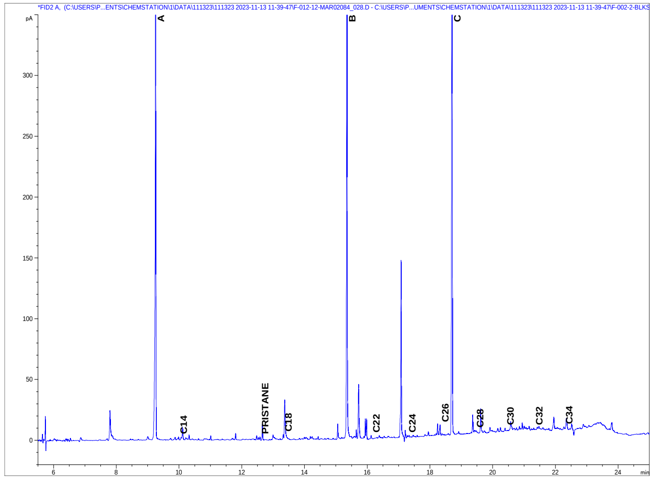

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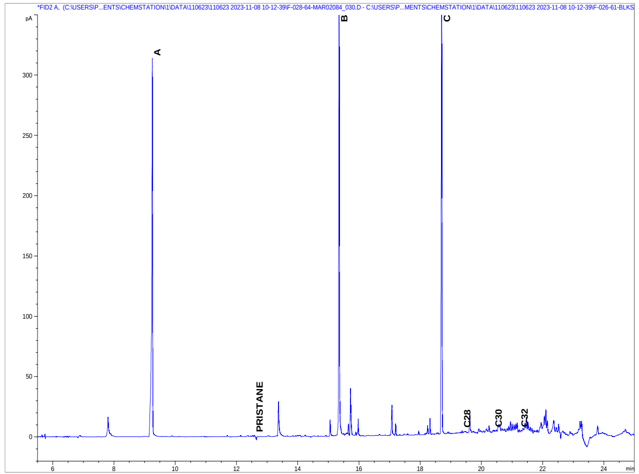

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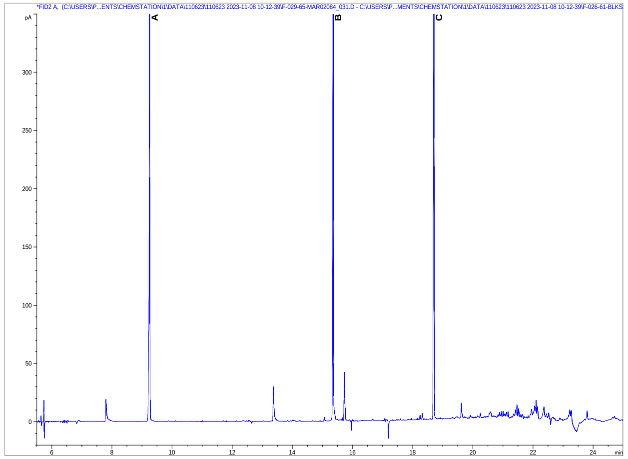

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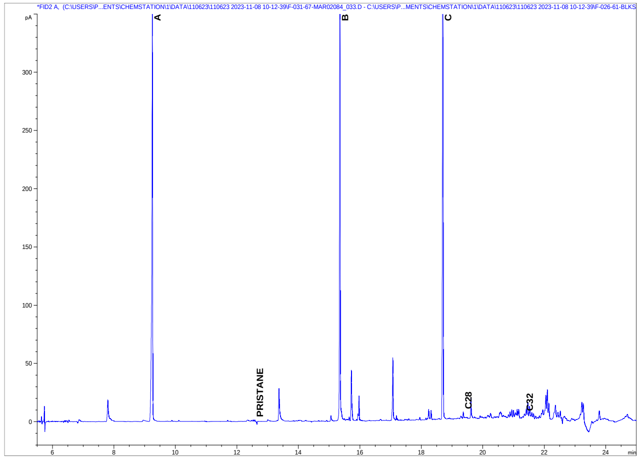

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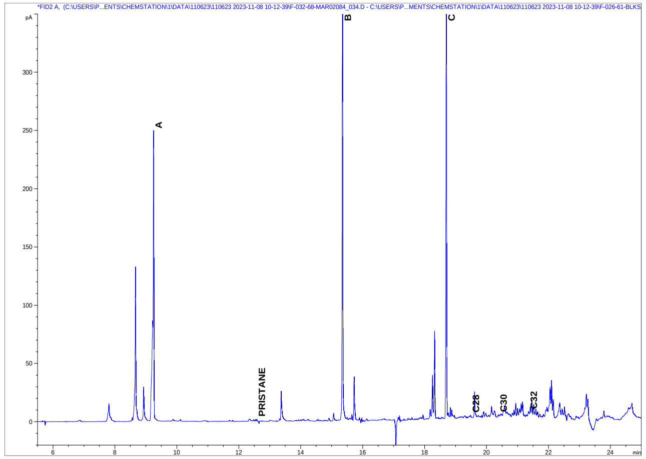

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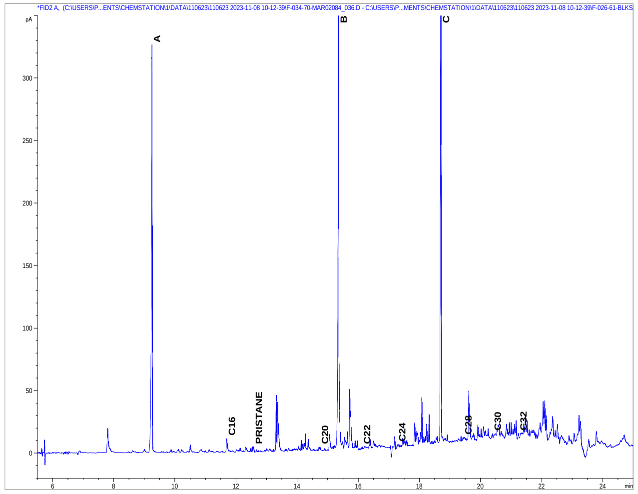

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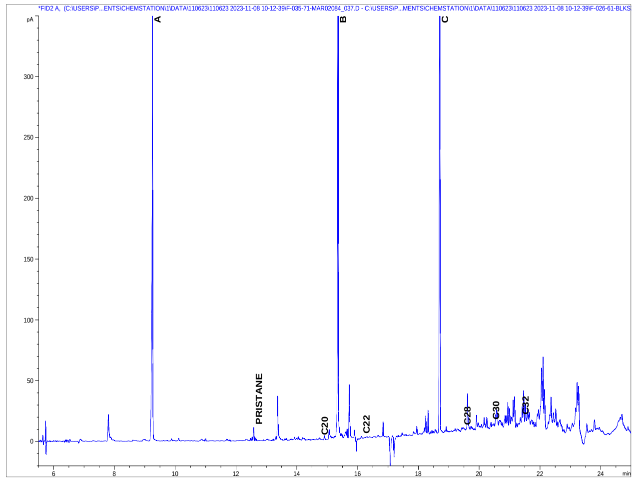

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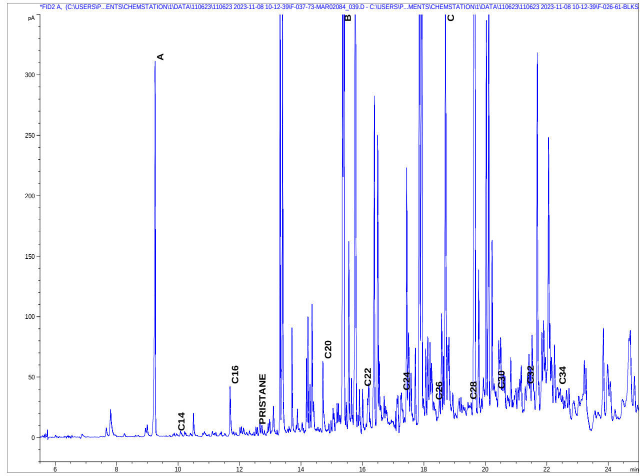

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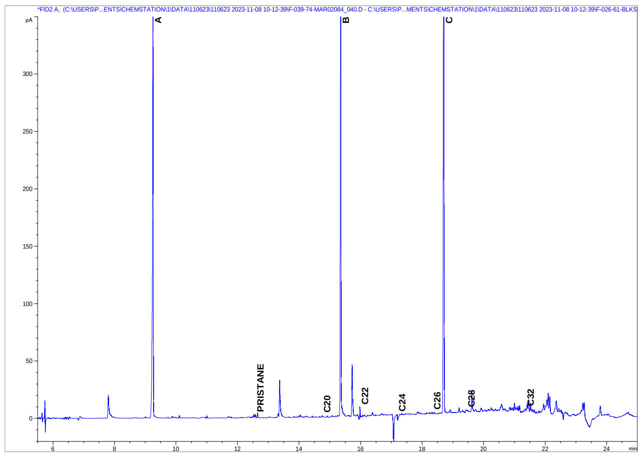

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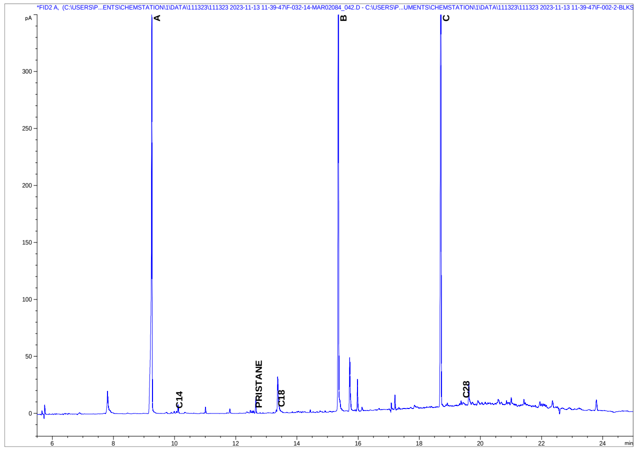

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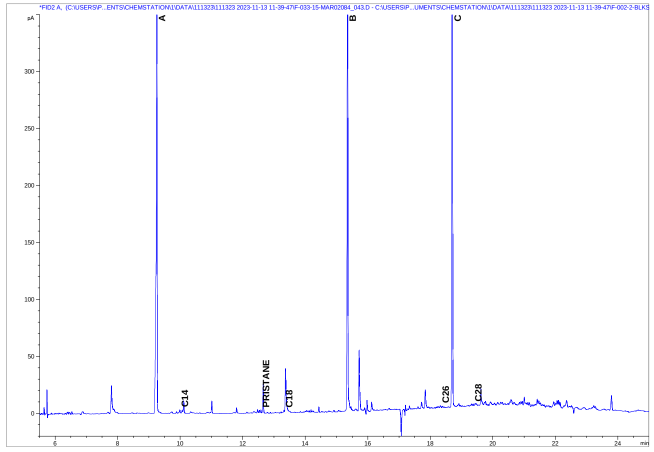

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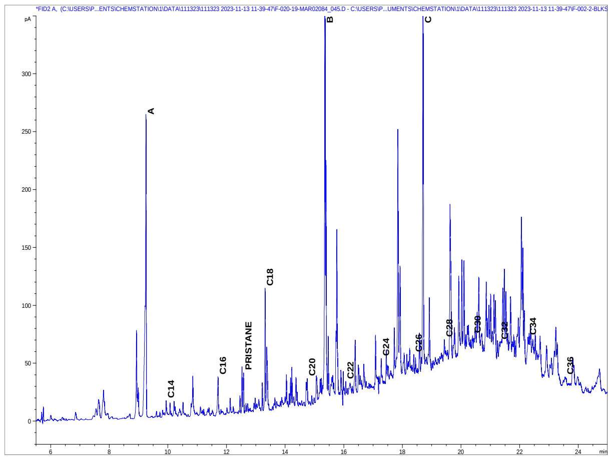
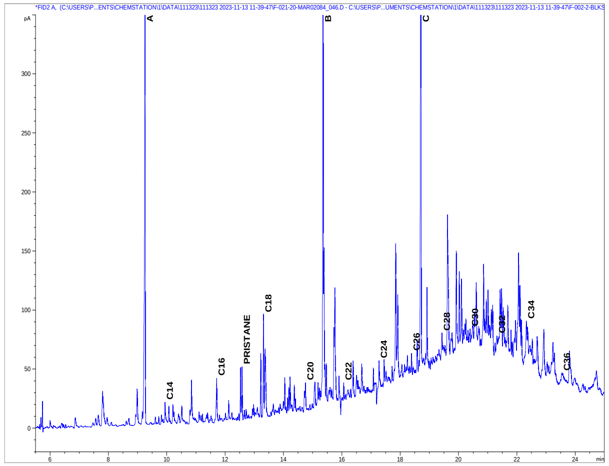
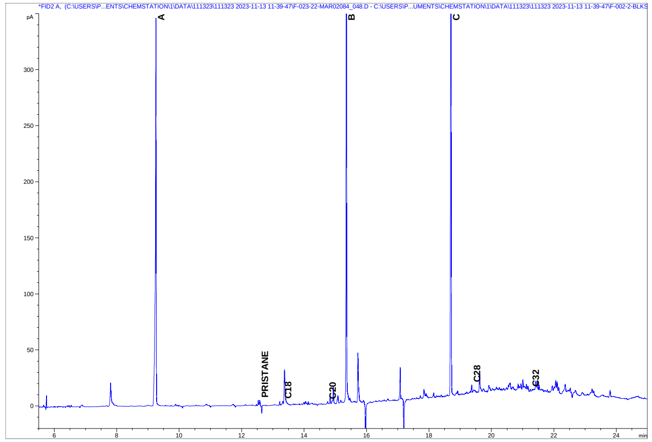
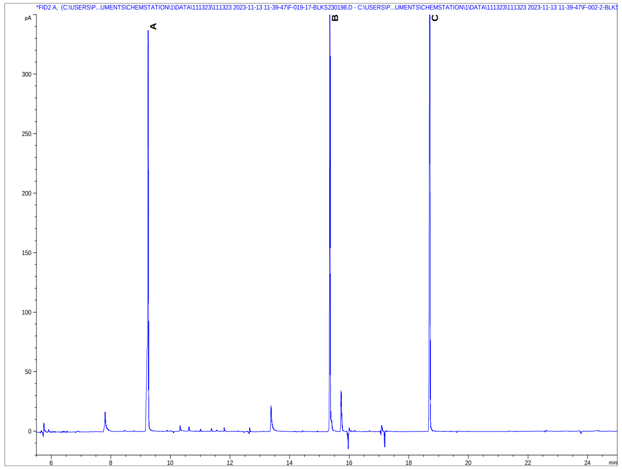
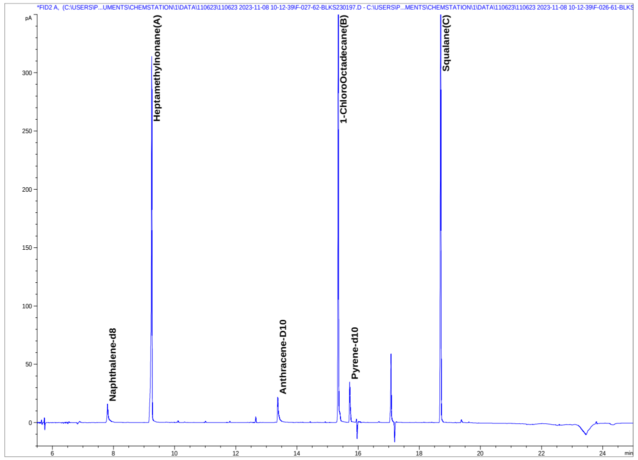
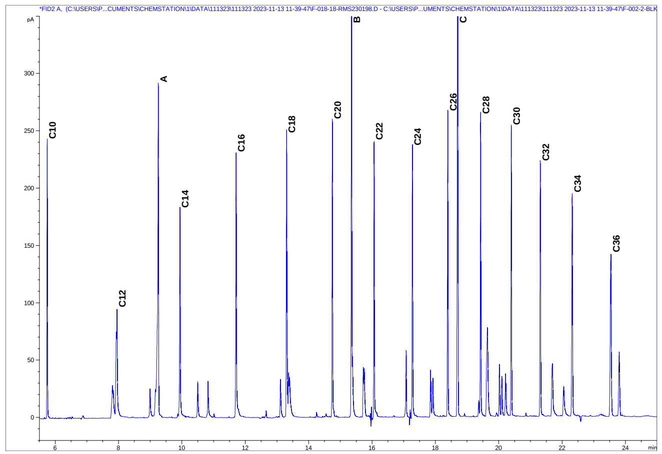
		
UK_57	UK_58	UK_61
		
QC Blank	QC Blank (Labelled)	Reference Material

APPENDIX M – POLYCYCLIC AROMATIC HYDROCARBON CONCENTRATIONS (µg.kg^{-1})

Station	UK_01	UK_02	UK_03	UK_04	UK_06	UK_07	UK_09	UK_10
Naphthalene	<1	<1	<1	<1	<1	<1	<1	2.8
C1 Naphthalenes	<1	<1	<1	3.2	<1	2.6	<1	6.8
C2 Naphthalenes	<1	<1	<1	2.9	<1	3.2	<1	7.4
C3 Naphthalenes	<1	<1	<1	2.3	<1	2.0	<1	4.9
C4 Naphthalenes	<1	<1	<1	<1	<1	<1	<1	2.1
Sum Naphthalenes	0.0	0.0	0.0	8.4	0.0	7.7	0.0	24.1
Phenanthrene / Anthracene	0.0	0.0	0.0	0.0	3.9	2.2	0.0	8.3
C1 178	<1	<1	<1	1.5	2.1	2.9	<1	7.5
C2 178	<1	<1	<1	1.5	1.6	3.3	<1	6.5
C3 178	<1	<1	<1	1.8	<1	<1	<1	3.2
Sum 178	0.0	0.0	0.0	4.7	7.6	8.4	0.0	25.5
Dibenzothiophene	<1	<1	<1	<1	<1	<1	<1	<1
C1 Dibenzothiophenes	<1	<1	<1	<1	<1	<1	<1	<1
C2 Dibenzothiophenes	<1	<1	<1	<1	<1	<1	<1	<1
C3 Dibenzothiophenes	<1	<1	<1	<1	<1	<1	<1	<1
Sum Dibenzothiophenes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fluoranthene / pyrene	0.0	0.0	0.0	0.0	10.6	4.2	0.0	14.6
C1 202	<1	<1	<1	3.5	2.8	2.9	<1	5.9
C2 202	<1	<1	<1	15.8	1.6	7.5	<1	5.6
C3 202	<1	<1	<1	16.8	<1	10.6	<1	4.5
Sum 202	0.0	0.0	0.0	36.1	15.0	25.2	0.0	30.6
Benzoanthracene / chrysene	0.0	0.0	0.0	0.0	6.4	2.5	0.0	9.0
C1 228	<1	<1	<1	7.1	2.0	4.8	<1	5.8
C2 228	<1	<1	<1	18.3	<1	7.7	<1	4.5
Sum 228	0.0	0.0	0.0	25.4	8.4	14.9	0.0	19.3
Benzofluoranthenes / benzopyrenes	0.0	0.0	0.0	5.2	11.7	14.6	1.9	31.1
C1 252	1.6	<1	<1	13.2	3.8	12.4	1.8	12.0
C2 252	1.6	<1	<1	16.9	2.4	14.9	1.5	11.2
Sum 252	3.2	0.0	0.0	35.3	17.9	41.9	5.2	54.2
Dibenzoanthracene / Indenopyrene /Benzoperylene	1.7	0.0	0.0	0.0	5.2	11.4	1.9	25.6
C1 276	<1	<1	<1	<1	<1	2.0	<1	4.3
C2 276	<1	<1	<1	1.8	<1	2.6	<1	2.8
Sum 276	1.7	0.0	0.0	1.8	5.2	16.0	1.9	32.7
Total 2-6 ring PAH (Total PAHs)	**5.0**	**0.0**	**0.0**	**111.7**	**54.1**	**114.1**	**7.1**	**186.4**
Sum of NPD fraction	**0.0**	**0.0**	**0.0**	**13.1**	**7.6**	**16.1**	**0.0**	**49.5**
NPD/4-6 ring PAH ratio	**-**	**-**	**-**	**0.1**	**0.2**	**0.2**	**-**	**0.4**

Station	UK_11	UK_13	UK_14	UK_15	UK_16	UK_17	UK_18	UK_19
Naphthalene	3.4	2.3	6.7	3.3	<1	<1	<1	10.8
C1 Naphthalenes	7.6	5.4	31.9	8.1	2.5	<1	1.6	22.6
C2 Naphthalenes	7.1	5.3	31.6	7.8	2.1	<1	<1	19.4
C3 Naphthalenes	4.9	3.3	24.7	5.7	1.4	<1	<1	13.3
C4 Naphthalenes	1.9	<1	10.2	2.1	<1	<1	<1	5.1
Sum Naphthalenes	24.9	16.3	105.1	27.0	6.0	0.0	1.6	71.1
Phenanthrene / Anthracene	5.7	3.7	14.1	7.2	1.5	1.4	0.0	24.8
C1 178	7.2	5.1	16.1	8.3	2.0	<1	<1	20.4
C2 178	6.5	4.5	13.6	6.9	1.9	<1	<1	18.0
C3 178	3.1	1.9	7.6	3.0	<1	<1	<1	7.9
Sum 178	22.5	15.2	51.4	25.4	5.5	1.4	0.0	71.2
Dibenzothiophene	<1	<1	<1	<1	<1	<1	<1	2.2
C1 Dibenzothiophenes	<1	<1	2.0	<1	<1	<1	<1	3.4
C2 Dibenzothiophenes	<1	<1	2.2	<1	<1	<1	<1	3.3
C3 Dibenzothiophenes	<1	<1	<1	<1	<1	<1	<1	2.0
Sum Dibenzothiophenes	0.0	0.0	4.2	0.0	0.0	0.0	0.0	10.9
Fluoranthene / pyrene	13.2	5.8	9.8	16.5	1.3	1.5	0.0	37.5
C1 202	5.6	3.3	8.2	6.7	<1	<1	<1	13.9
C2 202	5.5	3.8	9.1	6.7	1.4	<1	<1	16.1
C3 202	4.5	3.2	7.1	5.9	<1	<1	<1	10.5
Sum 202	28.8	16.1	34.2	35.8	2.7	1.5	0.0	78.1
Benzoanthracene / chrysene	9.8	5.0	7.6	10.8	0.0	0.0	0.0	24.9
C1 228	6.2	3.9	6.6	6.1	1.4	<1	<1	14.3
C2 228	5.6	3.7	6.4	7.9	1.2	<1	<1	10.9
Sum 228	21.6	12.5	20.5	24.8	2.7	0.0	0.0	50.1
Benzofluoranthenes / benzopyrenes	34.3	22.2	27.1	36.0	6.3	1.6	2.0	66.6
C1 252	13.0	9.3	11.8	14.7	2.8	1.6	2.2	24.4
C2 252	11.6	8.0	12.3	15.6	2.6	<1	1.9	19.1
Sum 252	58.8	39.5	51.3	66.4	11.6	3.2	6.2	110.1
Dibenzoanthracene / Indenopyrene /Benzoperylene	29.0	18.6	23.1	28.5	5.1	1.6	4.2	47.1
C1 276	<1	3.2	3.8	4.8	<1	<1	<1	7.3
C2 276	2.8	2.1	2.8	3.5	<1	<1	<1	10.6
Sum 276	31.7	23.9	29.6	36.9	5.1	1.6	4.2	64.9
Total 2-6 ring PAH (Total PAHs)	**188.3**	**123.5**	**296.4**	**216.1**	**33.6**	**7.8**	**12.0**	**456.3**
Sum of NPD fraction	**47.4**	**31.4**	**160.7**	**52.4**	**11.5**	**1.4**	**1.6**	**153.2**
NPD/4-6 ring PAH ratio	**0.3**	**0.3**	**1.2**	**0.3**	**0.5**	**0.2**	**0.1**	**0.5**

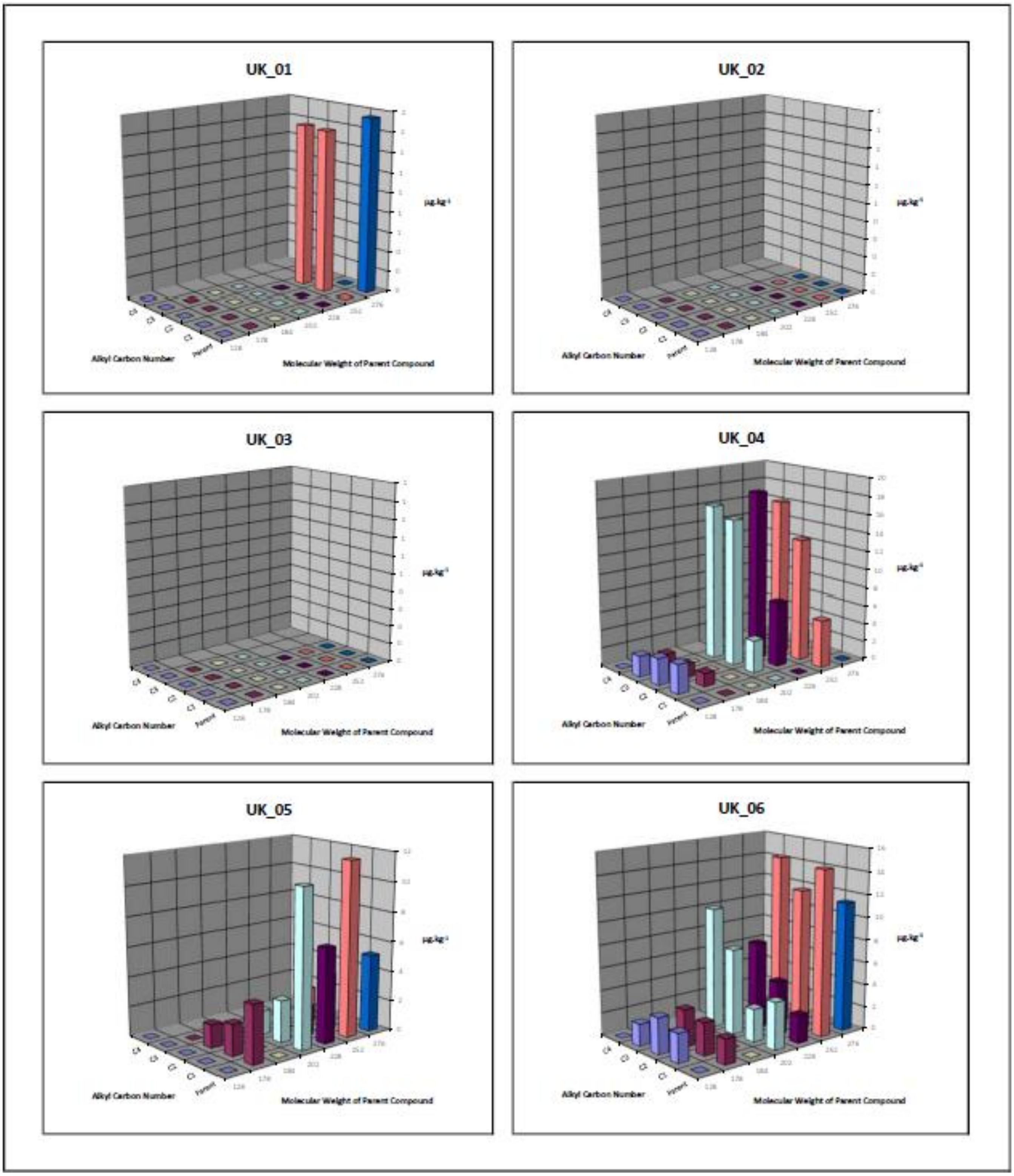
Station	UK_20	UK_21	UK_23	UK_24	UK_27	UK_30	UK_31	UK_33
Naphthalene	2.9	1.5	1.3	2.6	1.5	<1	2.0	<1
C1 Naphthalenes	6.0	2.2	2.6	4.6	3.0	1.6	4.2	1.8
C2 Naphthalenes	5.9	1.7	2.4	4.2	3.0	1.4	3.7	1.6
C3 Naphthalenes	4.0	<1	1.9	2.8	2.0	<1	2.1	<1
C4 Naphthalenes	1.5	<1	<1	<1	<1	<1	<1	<1
Sum Naphthalenes	20.2	5.5	8.3	14.3	9.5	3.0	12.1	3.4
Phenanthrene / Anthracene	4.8	2.9	1.9	4.9	2.1	0.0	2.7	1.3
C1 178	5.9	2.2	2.4	4.8	2.9	<1	3.5	1.7
C2 178	5.2	1.9	2.2	4.3	2.7	<1	3.2	1.6
C3 178	2.2	<1	<1	1.8	<1	<1	<1	<1
Sum 178	18.1	7.0	6.4	15.8	7.7	0.0	9.3	4.6
Dibenzothiophene	<1	<1	<1	<1	<1	<1	<1	<1
C1 Dibenzothiophenes	<1	<1	<1	<1	<1	<1	<1	<1
C2 Dibenzothiophenes	<1	<1	<1	<1	<1	<1	<1	<1
C3 Dibenzothiophenes	<1	<1	<1	<1	<1	<1	<1	<1
Sum Dibenzothiophenes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fluoranthene / pyrene	10.0	4.5	1.4	7.9	1.4	0.0	1.6	0.0
C1 202	4.6	1.7	1.5	3.5	1.5	<1	1.8	<1
C2 202	3.8	1.3	1.7	3.6	2.1	<1	1.9	1.1
C3 202	3.5	<1	<1	2.6	1.6	<1	1.5	<1
Sum 202	21.9	7.4	4.6	17.6	6.6	0.0	6.8	1.1
Benzoanthracene / chrysene	8.4	1.7	1.3	5.6	1.5	0.0	1.7	0.0
C1 228	4.3	1.6	1.4	3.3	1.8	<1	1.8	<1
C2 228	3.2	1.3	1.3	2.3	1.3	<1	<1	<1
Sum 228	15.9	4.7	4.0	11.2	4.6	0.0	3.5	0.0
Benzofluoranthenes / benzopyrenes	21.9	3.6	3.7	12.5	5.3	0.0	3.9	0.0
C1 252	7.3	2.2	2.5	5.4	3.1	<1	2.9	1.4
C2 252	7.5	2.1	2.2	4.1	2.8	<1	2.8	1.4
Sum 252	36.7	7.9	8.4	22.0	11.1	0.0	9.6	2.8
Dibenzoanthracene / Indenopyrene /Benzoperylene	15.9	3.3	3.8	6.9	3.8	0.0	3.7	0.0
C1 276	2.4	<1	<1	1.4	<1	<1	<1	<1
C2 276	2.7	<1	<1	1.3	<1	<1	<1	<1
Sum 276	21.1	3.3	3.8	9.6	3.8	0.0	3.7	0.0
Total 2-6 ring PAH (Total PAHs)	**133.9**	**35.8**	**35.5**	**90.6**	**43.3**	**3.0**	**44.9**	**11.8**
Sum of NPD fraction	**38.3**	**12.5**	**14.6**	**30.1**	**17.2**	**3.0**	**21.4**	**7.9**
NPD/4-6 ring PAH ratio	**0.4**	**0.5**	**0.7**	**0.5**	**0.7**	**-**	**0.9**	**2.0**

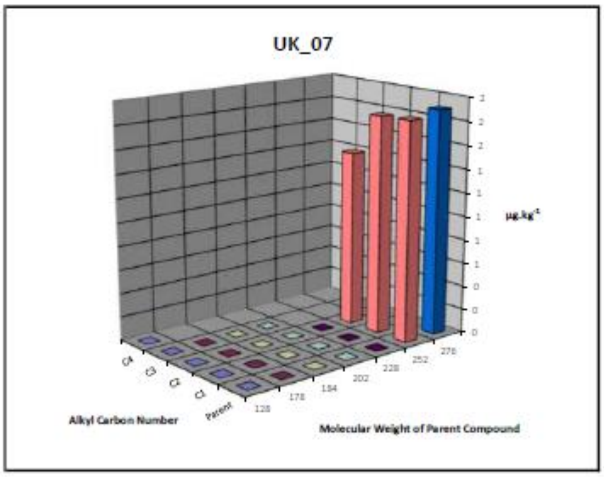
Station	UK_34	UK_35	UK-36	UK_37	UK_38	UK_39	UK_40	UK_41
Naphthalene	<1	<1	2.8	<1	<1	<1	<1	<1
C1 Naphthalenes	1.6	<1	11.3	<1	<1	<1	1.9	<1
C2 Naphthalenes	1.6	<1	7.1	<1	<1	<1	1.8	<1
C3 Naphthalenes	<1	<1	3.9	<1	<1	<1	<1	<1
C4 Naphthalenes	<1	<1	<1	<1	<1	<1	<1	<1
Sum Naphthalenes	3.2	0.0	25.0	0.0	0.0	0.0	3.7	0.0
Phenanthrene / Anthracene	0.0	0.0	4.2	0.0	0.0	0.0	1.6	0.0
C1 178	1.3	<1	5.4	<1	<1	<1	1.8	<1
C2 178	1.5	<1	3.6	<1	<1	<1	1.8	<1
C3 178	<1	<1	<1	<1	<1	<1	<1	<1
Sum 178	2.8	0.0	13.1	0.0	0.0	0.0	5.2	0.0
Dibenzothiophene	<1	<1	<1	<1	<1	<1	<1	<1
C1 Dibenzothiophenes	<1	<1	<1	<1	<1	<1	<1	<1
C2 Dibenzothiophenes	<1	<1	<1	<1	<1	<1	<1	<1
C3 Dibenzothiophenes	<1	<1	<1	<1	<1	<1	<1	<1
Sum Dibenzothiophenes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fluoranthene / pyrene	0.0	0.0	0.0	0.0	0.0	0.0	3.7	0.0
C1 202	<1	<1	<1	<1	<1	<1	<1	<1
C2 202	<1	<1	2.2	<1	<1	<1	<1	<1
C3 202	<1	<1	2.0	<1	<1	<1	<1	<1
Sum 202	0.0	0.0	4.2	0.0	0.0	0.0	3.7	0.0
Benzoanthracene / chrysene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C1 228	<1	<1	1.8	<1	<1	<1	<1	<1
C2 228	<1	<1	<1	<1	<1	<1	<1	<1
Sum 228	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0
Benzofluoranthenes / benzopyrenes	1.2	0.0	0.0	0.0	0.0	0.0	1.7	0.0
C1 252	1.5	<1	2.1	<1	<1	<1	1.9	<1
C2 252	1.4	<1	2.1	<1	<1	<1	<1	<1
Sum 252	4.1	0.0	4.2	0.0	0.0	0.0	3.6	0.0
Dibenzoanthracene / Indenopyrene /Benzoperylene	1.2	0.0	0.0	0.0	0.0	0.0	1.5	0.0
C1 276	<1	<1	<1	<1	<1	<1	<1	<1
C2 276	<1	<1	<1	<1	<1	<1	<1	<1
Sum 276	1.2	0.0	0.0	0.0	0.0	0.0	1.5	0.0
Total 2-6 ring PAH (Total PAHs)	**11.4**	**0.0**	**48.3**	**0.0**	**0.0**	**0.0**	**17.7**	**0.0**
Sum of NPD fraction	**6.1**	**0.0**	**38.1**	**0.0**	**0.0**	**0.0**	**8.9**	**0.0**
NPD/4-6 ring PAH ratio	**1.1**	**-**	**3.7**	**-**	**-**	**-**	**1.0**	**-**

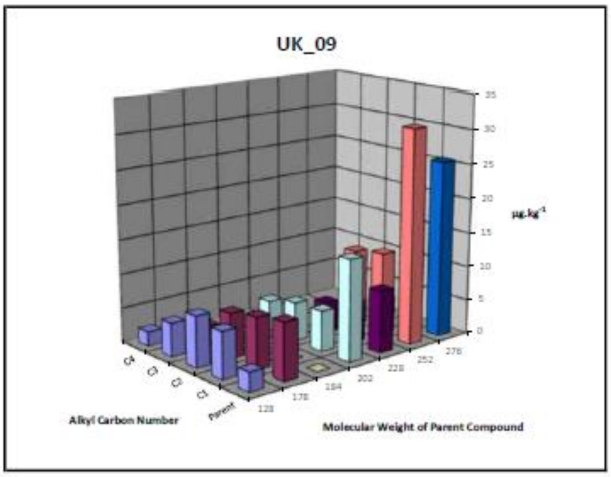
Station	UK_42	UK_43	UK_44	UK_45	UK_46	UK_51	UK_52	UK_53
Naphthalene	<1	2.0	6.1	1.9	3.6	14.9	2.1	1.9
C1 Naphthalenes	2.1	4.3	10.3	3.5	7.1	22.6	4.0	3.3
C2 Naphthalenes	1.6	3.6	7.8	3.0	5.7	15.1	2.7	3.0
C3 Naphthalenes	<1	2.5	4.7	1.9	3.5	15.5	1.9	2.4
C4 Naphthalenes	<1	<1	1.5	<1	1.3	4.8	<1	<1
Sum Naphthalenes	3.7	12.4	30.5	10.3	21.1	72.8	10.7	10.6
Phenanthrene / Anthracene	2.4	3.3	50.6	2.6	6.6	722.1	2.6	23.3
C1 178	1.9	3.4	13.6	2.9	6.2	171.8	2.6	9.7
C2 178	1.5	3.3	7.4	2.4	4.8	75.6	1.9	5.9
C3 178	<1	1.5	2.9	<1	2.4	18.4	<1	2.5
Sum 178	5.8	11.5	74.5	8.0	20.0	987.9	7.1	41.4
Dibenzothiophene	<1	<1	2.2	<1	<1	22.3	<1	<1
C1 Dibenzothiophenes	<1	<1	1.4	<1	<1	18.7	<1	<1
C2 Dibenzothiophenes	<1	<1	<1	<1	<1	14.7	<1	<1
C3 Dibenzothiophenes	<1	<1	<1	<1	<1	5.2	<1	<1
Sum Dibenzothiophenes	0.0	0.0	3.7	0.0	0.0	60.9	0.0	0.0
Fluoranthene / pyrene	4.7	6.5	58.4	4.7	9.7	1958.0	3.3	35.6
C1 202	<1	2.6	17.0	2.0	5.2	418.4	1.4	10.8
C2 202	<1	2.6	6.8	1.8	5.1	93.8	1.5	5.2
C3 202	<1	1.8	3.2	1.7	3.3	28.2	1.4	2.9
Sum 202	4.7	13.6	85.4	10.2	23.3	2498.4	7.7	54.6
Benzoanthracene / chrysene	1.9	5.0	24.9	3.7	9.4	1238.2	1.6	18.6
C1 228	1.5	2.3	7.5	2.0	4.6	163.1	1.5	6.9
C2 228	<1	<1	4.0	1.3	2.8	35.5	<1	3.5
Sum 228	3.3	7.3	36.5	7.0	16.8	1436.8	3.2	29.0
Benzofluoranthenes / benzopyrenes	3.3	9.1	42.8	8.7	16.4	1420.2	1.6	29.2
C1 252	2.2	3.3	13.8	3.4	6.7	267.7	2.2	10.1
C2 252	<1	2.7	6.9	2.6	5.6	66.2	1.8	5.2
Sum 252	5.5	15.1	63.4	14.7	28.7	1754.1	5.5	44.4
Dibenzoanthracene / Indenopyrene /Benzoperylene	0.0	3.9	18.5	5.3	7.0	475.7	1.4	10.8
C1 276	<1	<1	4.6	<1	1.5	63.9	<1	2.4
C2 276	<1	<1	1.4	<1	1.7	15.2	<1	<1
Sum 276	0.0	3.9	24.5	5.3	10.2	554.8	1.4	13.2
Total 2-6 ring PAH (Total PAHs)	**23.0**	**63.8**	**318.6**	**55.5**	**120.0**	**7365.7**	**35.6**	**193.2**
Sum of NPD fraction	**9.5**	**23.9**	**108.8**	**18.2**	**41.1**	**1121.7**	**17.8**	**52.0**
NPD/4-6 ring PAH ratio	**0.7**	**0.6**	**0.5**	**0.5**	**0.5**	**0.2**	**1.0**	**0.4**

Station	UK_54	UK_55	UK_56	UK_57	UK_58	UK_59	UK_61
Naphthalene	<1	<1	2.8	31.7	33.3	2.7	1.6
C1 Naphthalenes	<1	<1	4.3	52.7	55.6	4.0	2.3
C2 Naphthalenes	<1	<1	3.9	46.5	47.4	3.3	2.0
C3 Naphthalenes	<1	<1	2.8	36.0	34.2	2.2	1.4
C4 Naphthalenes	<1	<1	1.0	13.5	14.4	<1	<1
Sum Naphthalenes	0.0	0.0	14.8	180.4	185.0	12.3	7.3
Phenanthrene / Anthracene	2.2	1.5	6.6	130.0	92.5	4.2	2.9
C1 178	1.5	<1	4.0	69.2	58.6	3.9	2.6
C2 178	1.8	<1	3.5	52.1	48.4	4.1	2.4
C3 178	<1	<1	1.7	27.2	24.7	2.4	<1
Sum 178	5.5	1.5	15.8	278.5	224.2	14.6	8.0
Dibenzothiophene	<1	<1	<1	8.6	7.0	<1	<1
C1 Dibenzothiophenes	<1	<1	<1	10.5	8.9	<1	<1
C2 Dibenzothiophenes	<1	<1	<1	11.8	10.2	<1	<1
C3 Dibenzothiophenes	<1	<1	<1	5.2	4.7	<1	<1
Sum Dibenzothiophenes	0.0	0.0	0.0	36.1	30.8	0.0	0.0
Fluoranthene / pyrene	5.3	3.8	16.0	328.5	204.8	13.0	8.4
C1 202	1.6	<1	4.9	91.8	66.9	4.4	2.6
C2 202	<1	<1	3.7	56.6	45.4	3.0	2.3
C3 202	<1	<1	2.3	34.6	30.6	2.7	1.5
Sum 202	6.9	3.8	26.9	511.4	347.8	23.0	14.7
Benzoanthracene / chrysene	2.0	0.0	9.5	213.2	141.5	8.6	5.0
C1 228	<1	<1	3.6	66.6	48.4	3.6	2.2
C2 228	<1	<1	2.3	46.7	35.8	3.0	1.8
Sum 228	2.0	0.0	15.4	326.5	225.7	15.2	9.0
Benzofluoranthenes / benzopyrenes	5.9	3.3	18.5	368.1	258.2	19.9	10.4
C1 252	2.2	1.7	5.7	94.8	80.7	5.5	2.9
C2 252	1.6	<1	3.2	48.7	53.9	4.6	2.4
Sum 252	9.7	5.0	27.4	511.6	392.8	30.0	15.7
Dibenzoanthracene / Indenopyrene /Benzoperylene	3.4	0.0	8.2	159.0	115.3	10.1	4.9
C1 276	<1	<1	1.2	25.1	19.7	1.8	<1
C2 276	<1	<1	<1	18.8	8.1	1.7	<1
Sum 276	3.4	0.0	9.4	202.8	143.0	13.6	4.9
Total 2-6 ring PAH (Total PAHs)	**27.5**	**10.3**	**109.6**	**2047.3**	**1549.3**	**108.6**	**59.7**
Sum of NPD fraction	**5.5**	**1.5**	**30.6**	**494.9**	**440.0**	**26.9**	**15.3**
NPD/4-6 ring PAH ratio	**0.2**	**0.2**	**0.4**	**0.3**	**0.4**	**0.3**	**0.3**

APPENDIX N – POLYCYCLIC AROMATIC HYDROCARBON: PARENTS COMPOUNDS AND ALKYL DERIVATIVES




UK_07
Alkyl Carbon Number
Molecular Weight of Parent Compound
µg.kg⁻¹


UK_09
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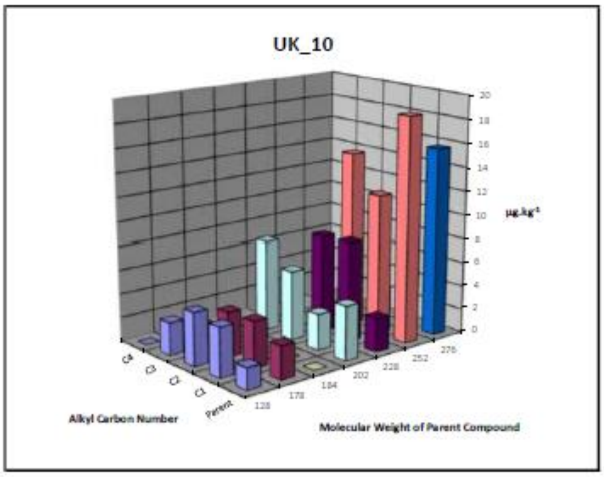
µg.kg⁻¹


UK_10
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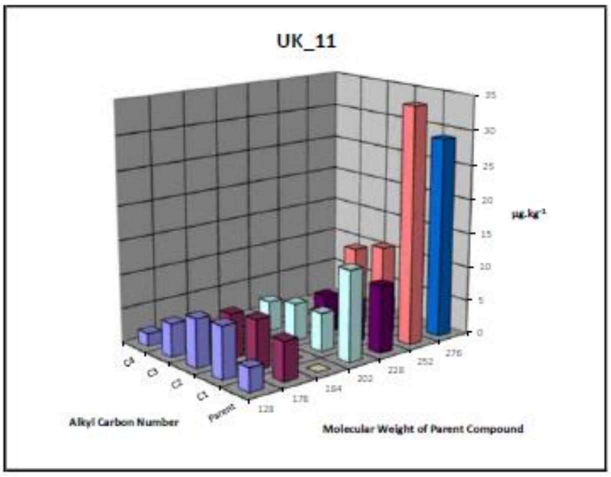
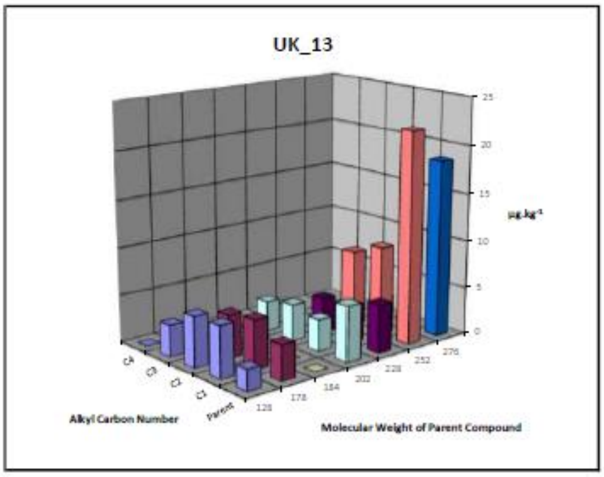
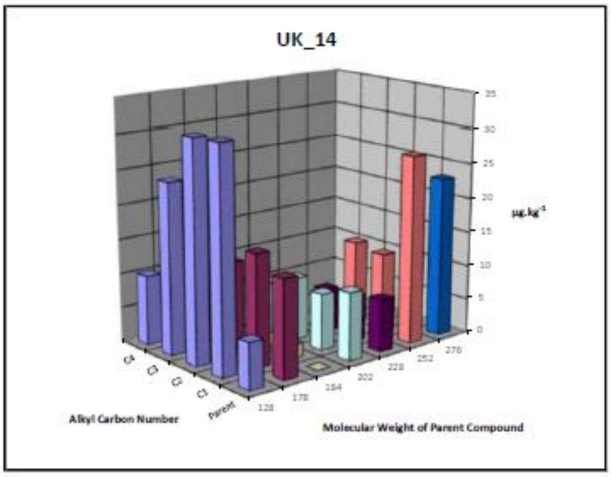
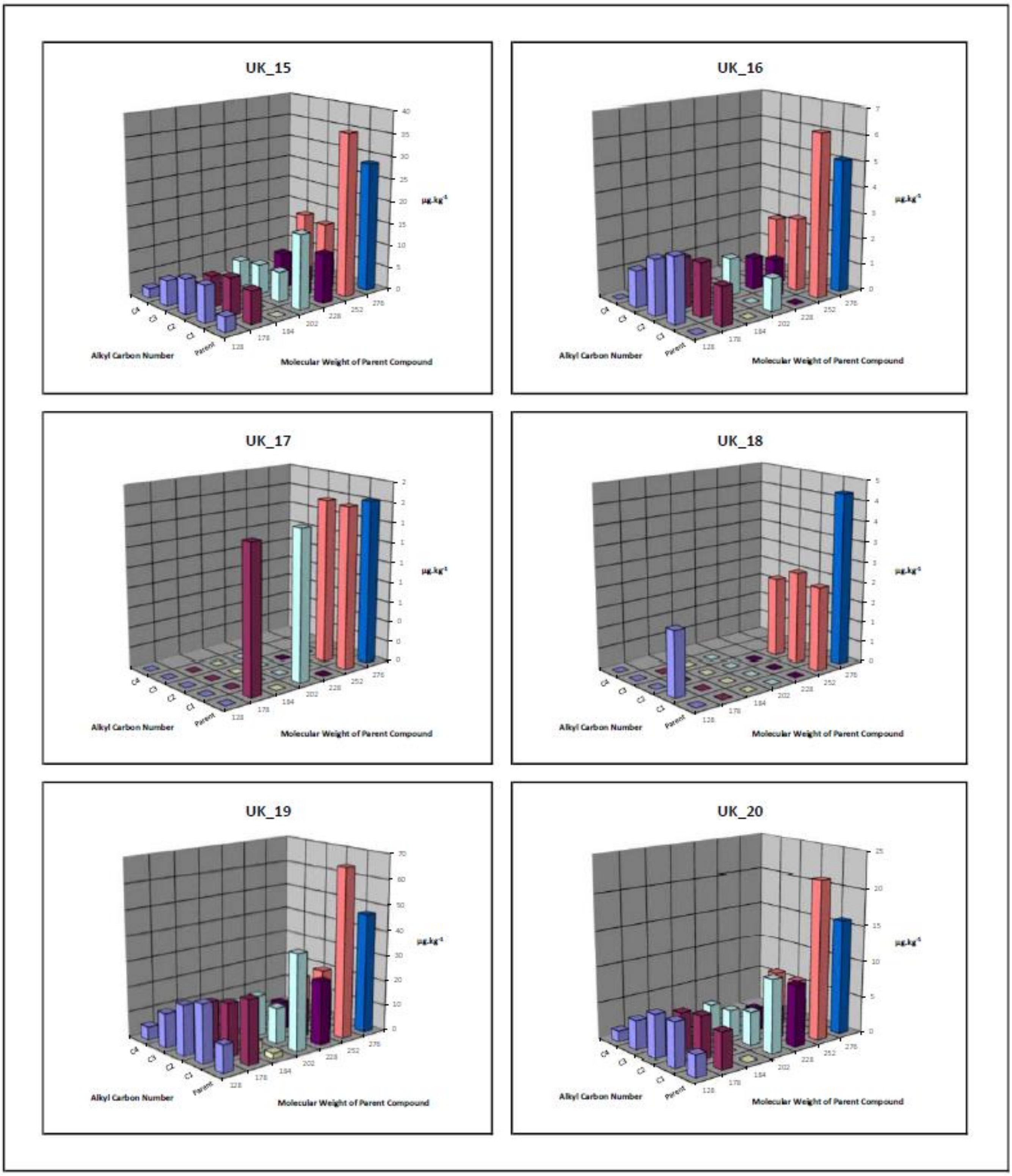
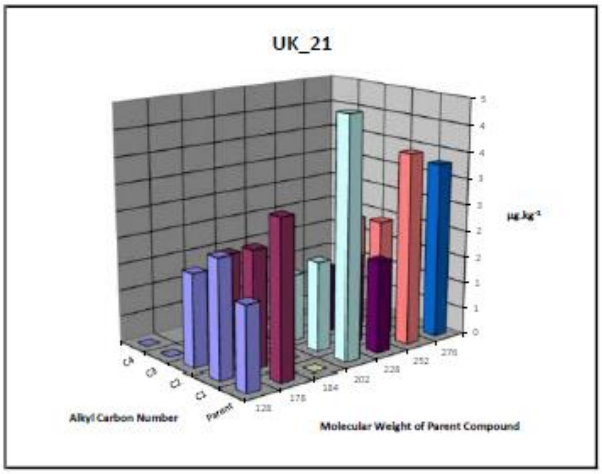
Molecular Weight of Parent Compound
µg.kg⁻¹

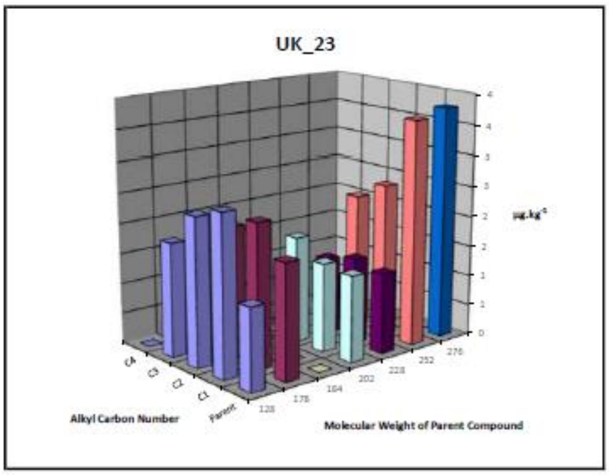

UK_11
Alkyl Carbon Number
Molecular Weight of Parent Compound
µg.kg⁻¹

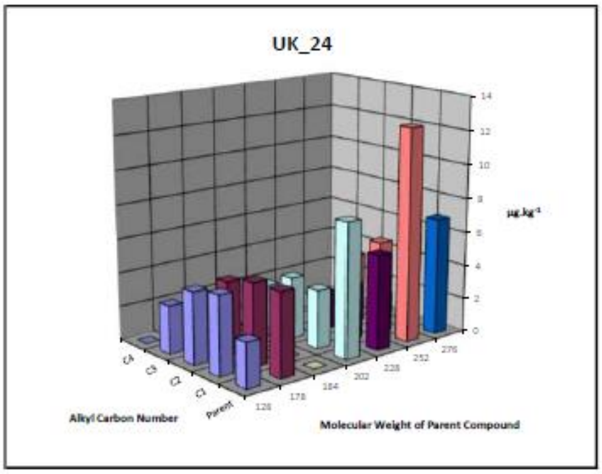

UK_13
Alkyl Carbon Number
Molecular Weight of Parent Compound
µg.kg⁻¹

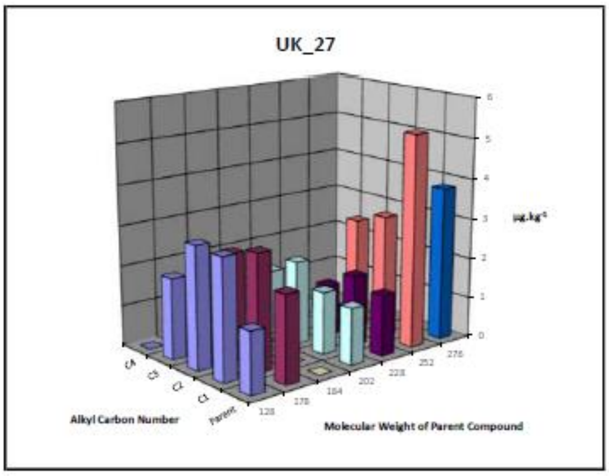

UK_14
Alkyl Carbon Number
Molecular Weight of Parent Compound
µg.kg⁻¹

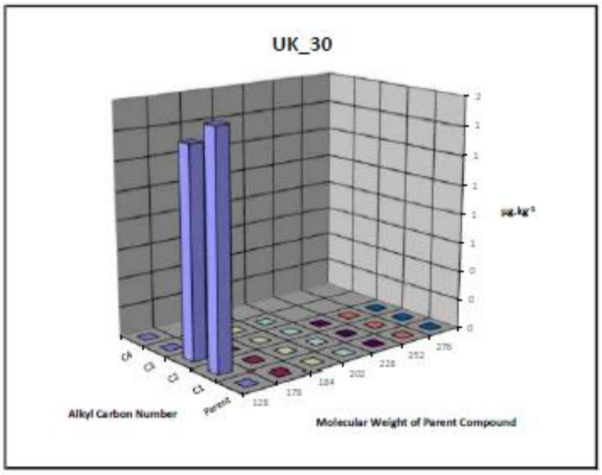

UK_15
µg.kg⁻¹
Alkyl Carbon Number
Molecular Weight of Parent Compound
UK_16
µg.kg⁻¹
Alkyl Carbon Number
Molecular Weight of Parent Compound
UK_17
µg.kg⁻¹
Alkyl Carbon Number
Molecular Weight of Parent Compound
UK_18
µg.kg⁻¹
Alkyl Carbon Number
Molecular Weight of Parent Compound
UK_19
µg.kg⁻¹
Alkyl Carbon Number
Molecular Weight of Parent Compound
UK_20
µg.kg⁻¹
Alkyl Carbon Number
Molecular Weight of Parent Compound

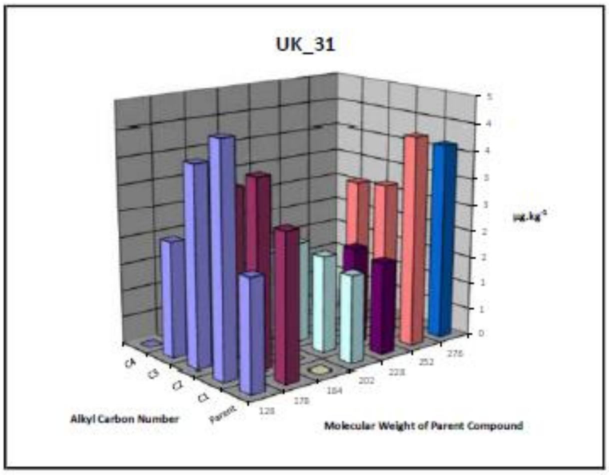

UK_21
µg.kg-1
Alkyl Carbon Number
Molecular Weight of Parent Compound

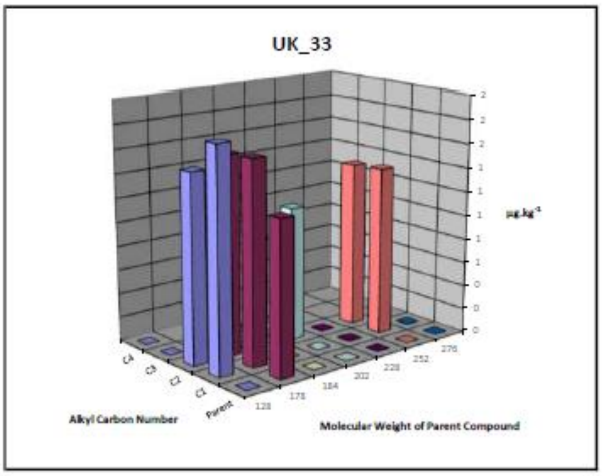

UK_23
µg.kg-1
Alkyl Carbon Number
Molecular Weight of Parent Compound

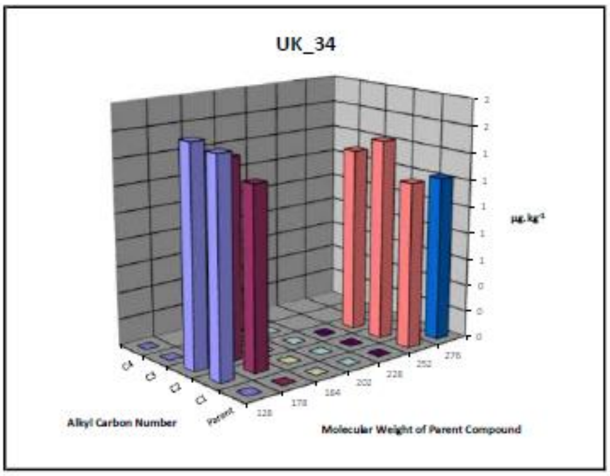

UK_24
µg.kg-1
Alkyl Carbon Number
Molecular Weight of Parent Compound

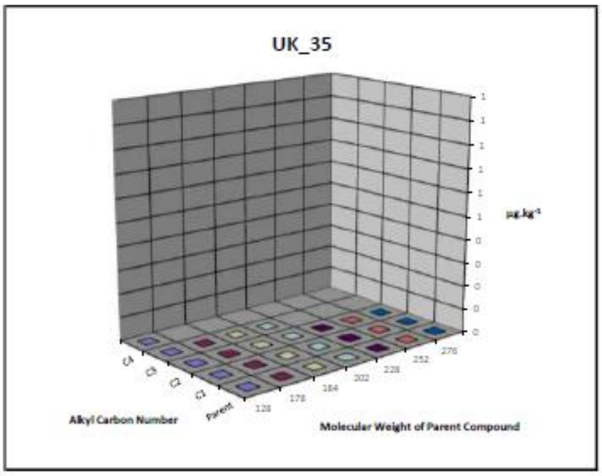

UK_27
µg.kg-1
Alkyl Carbon Number
Molecular Weight of Parent Compound


UK_30
µg.kg-1
Alkyl Carbon Number
Molecular Weight of Parent Compound


UK_31
µg.kg-1
Alkyl Carbon Number
Molecular Weight of Parent Compound


UK_33
µg.kg-1
Alkyl Carbon Number
C4
C3
C2
C1
Parent
128
178
184
202
228
252
276
Molecular Weight of Parent Compound


UK_34
µg.kg-1
Alkyl Carbon Number
C4
C3
C2
C1
Parent
128
178
184
202
228
252
276
Molecular Weight of Parent Compound


UK_35
µg.kg-1
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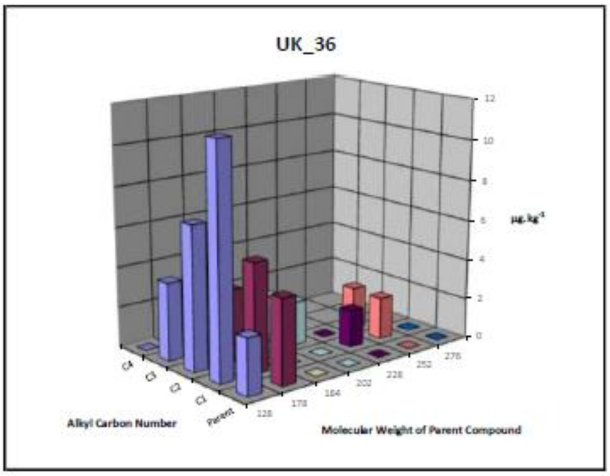
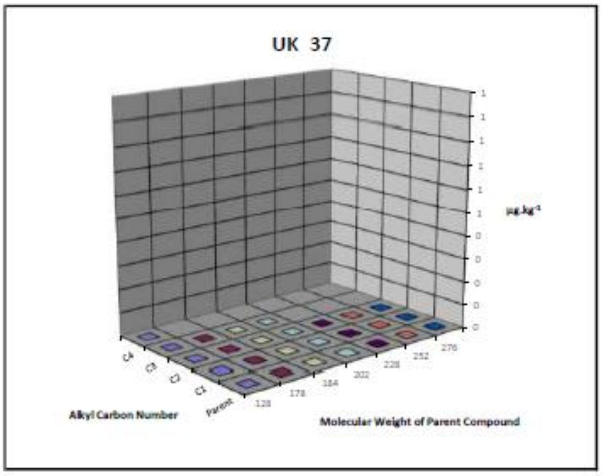
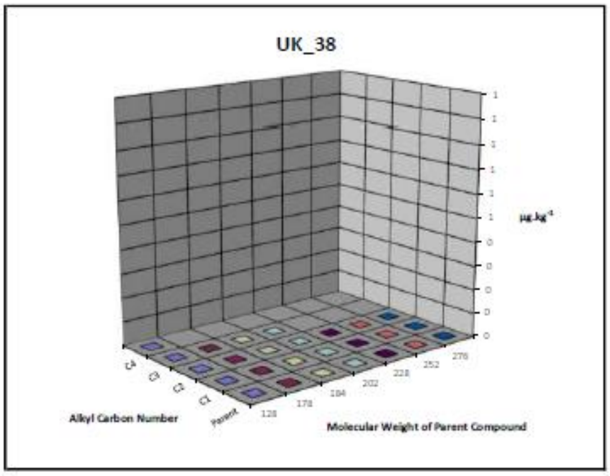
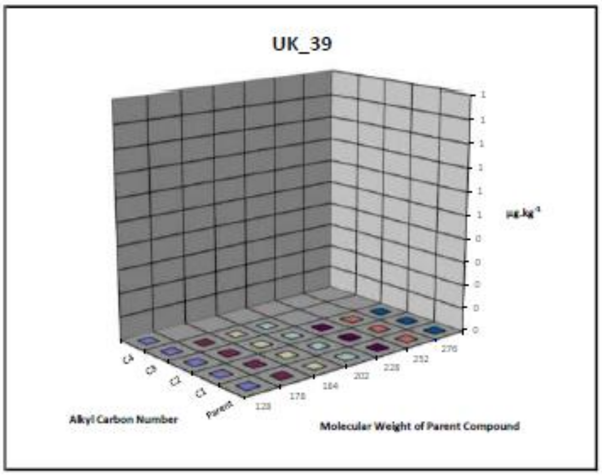
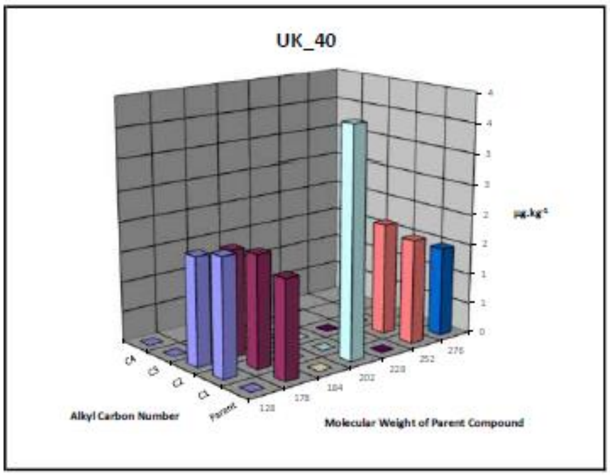
C3
C2
C1
Parent
128
178
184
202
228
252
276
Molecular Weight of Parent Compound

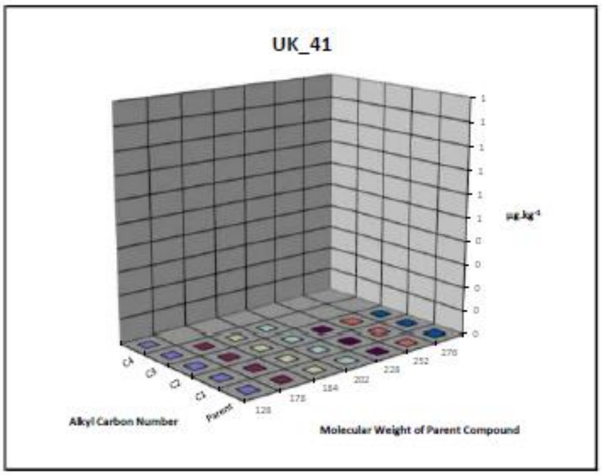

UK_36
12
10
8
6
4
2
0
µg.kg-1
Alkyl Carbon Number
C4
C3
C2
C1
Parent
128
178
184
202
228
252
276
Molecular Weight of Parent Compound

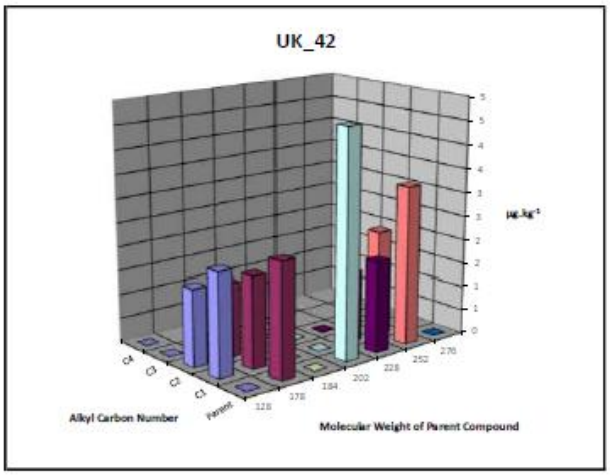

UK_37
µg.kg-1
Alkyl Carbon Number
C4
C3
C2
C1
Parent
128
178
184
202
228
252
276
Molecular Weight of Parent Compound

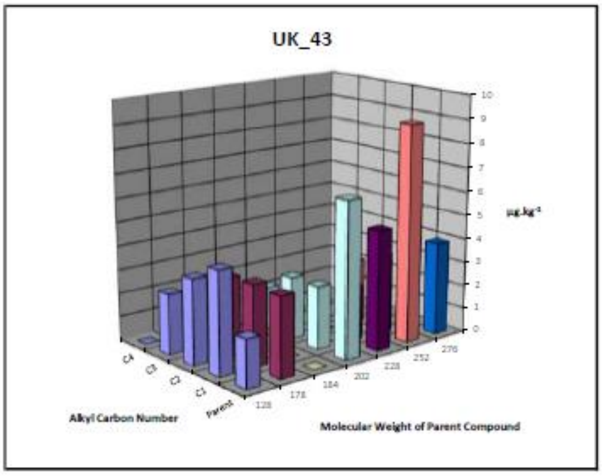

UK_38
µg.kg-1
Alkyl Carbon Number
C4
C3
C2
C1
Parent
128
178
184
202
228
252
276
Molecular Weight of Parent Compound

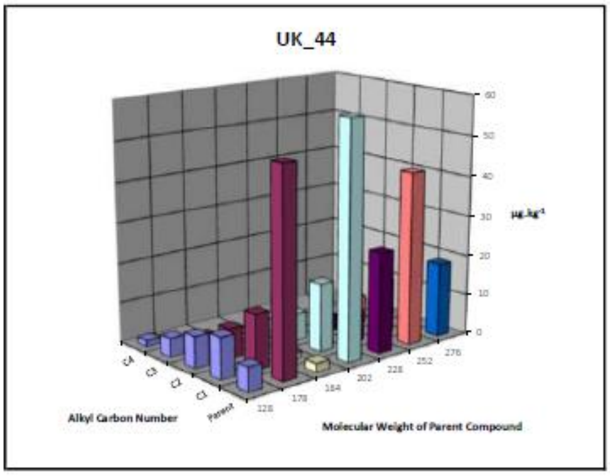

UK_39
µg.kg-1
C4
C3
C2
C1
Parent
128
178
184
202
228
252
276
Alkyl Carbon Number
Molecular Weight of Parent Compound

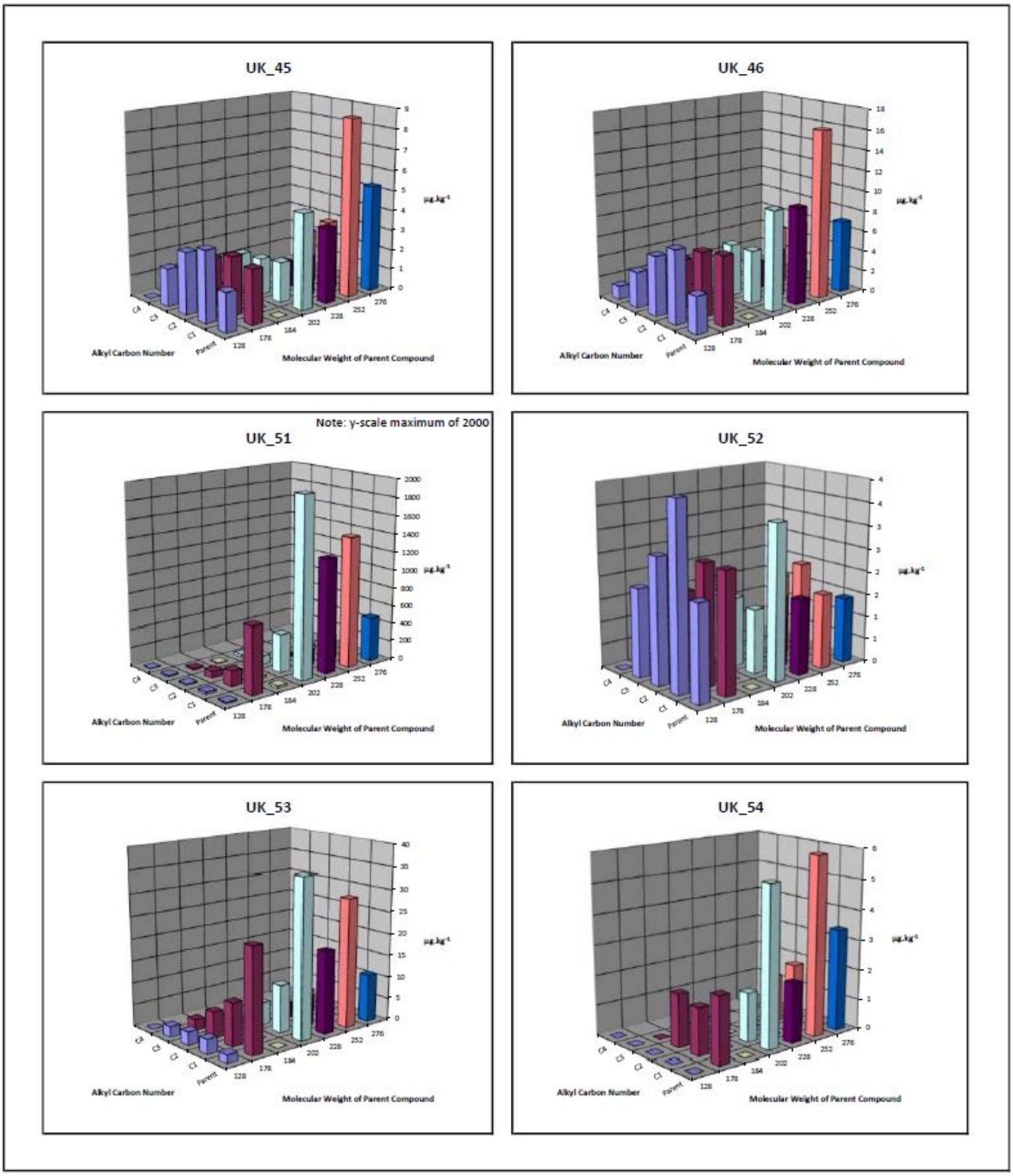

UK_40
µg.kg-1
C4
C3
C2
C1
Parent
128
178
184
202
228
252
276
Alkyl Carbon Number
Molecular Weight of Parent Compound

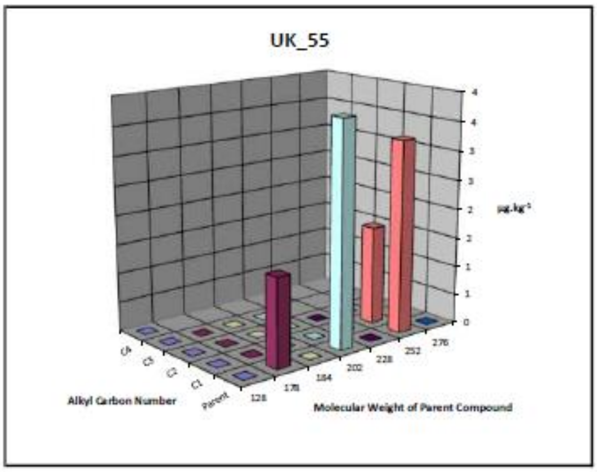

UK_41
µg.kg-1
C4
C3
C2
C1
Parent
128
178
184
202
228
252
276
Alkyl Carbon Number
Molecular Weight of Parent Compound

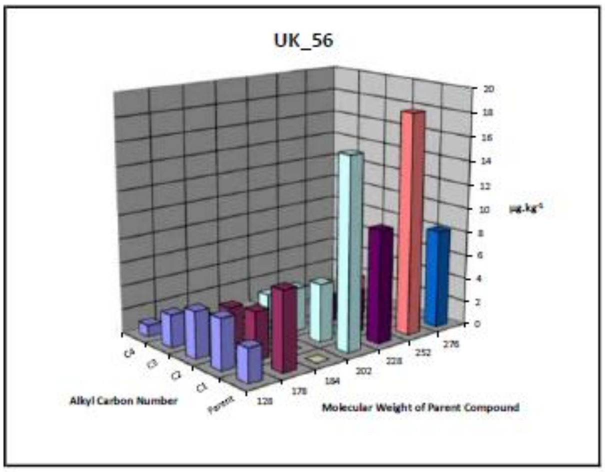

UK_42
µg.kg-1
C4
C3
C2
C1
Parent
128
178
184
202
228
252
276
Alkyl Carbon Number
Molecular Weight of Parent Compound

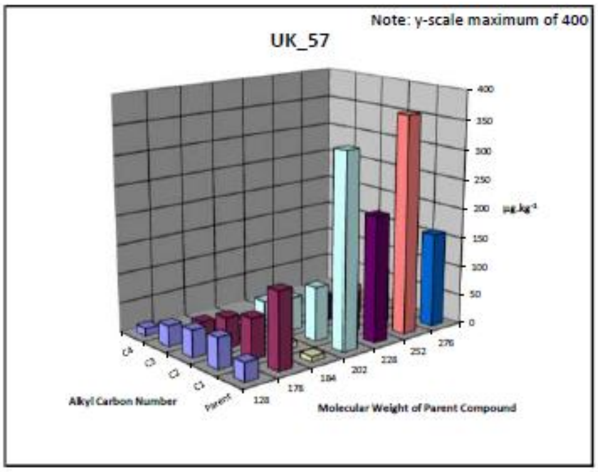

UK_43
0
1
2
3
4
5
6
7
8
9
10
µg.kg-1
C4
C3
C2
C1
Parent
128
178
184
202
228
252
276
Alkyl Carbon Number
Molecular Weight of Parent Compound

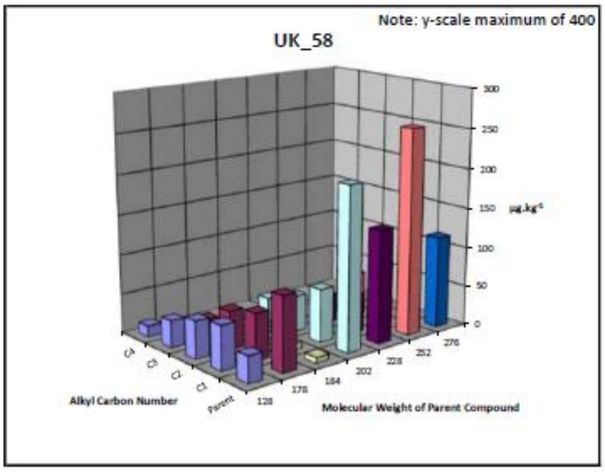

UK_44
0
10
20
30
40
50
60
µg.kg-1
C4
C3
C2
C1
Parent
128
178
184
202
228
252
276
Alkyl Carbon Number
Molecular Weight of Parent Compound

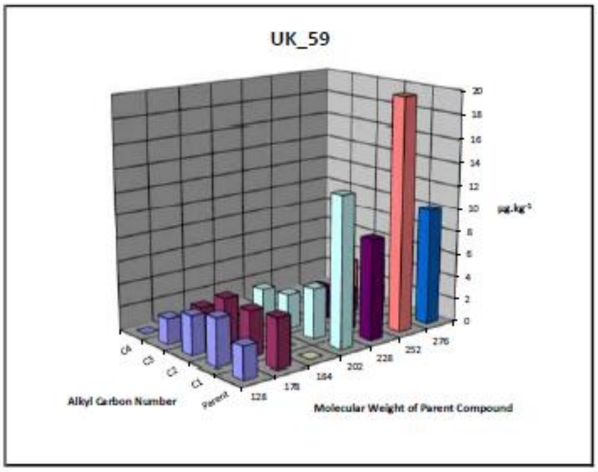

UK_45
Alkyl Carbon Number
Molecular Weight of Parent Compound
UK_46
Alkyl Carbon Number
Molecular Weight of Parent Compound
Note: y-scale maximum of 2000
UK_51
Alkyl Carbon Number
Molecular Weight of Parent Compound
UK_52
Alkyl Carbon Number
Molecular Weight of Parent Compound
UK_53
Alkyl Carbon Number
Molecular Weight of Parent Compound
UK_54
Alkyl Carbon Number
Molecular Weight of Parent Compound

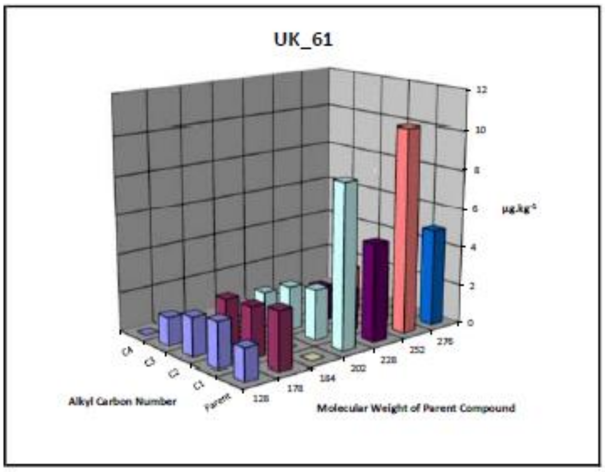

UK_55
µg.kg-1
Alkyl Carbon Number
Molecular Weight of Parent Compound


UK_56
µg.kg-1
Alkyl Carbon Number
Molecular Weight of Parent Compound


Note: y-scale maximum of 400
UK_57
µg.kg-1
Alkyl Carbon Number
Molecular Weight of Parent Compound


Note: y-scale maximum of 400
UK_58
µg.kg-1
Alkyl Carbon Number
Molecular Weight of Parent Compound


UK_59
µg.kg-1
Alkyl Carbon Number
Molecular Weight of Parent Compound


UK_61
µg.kg-1
Alkyl Carbon Number
Molecular Weight of Parent Compound

APPENDIX O – NORMALISED POLYCYCLIC AROMATIC HYDROCARBONS

Station	Water Depth (m)	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Dibenzothiophene	Anthracene	Fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluoranthene	Benzo[k]fluoranthene	Benzo[e]pyrene	Benzo[a]pyrene	Perylene	Indeno[123,cd]pyrene	Dibenzo[a,h]anthracene	Benzo[ghi]perylene
UK_01	128.8	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.3	NC	NC
UK_02	126.7	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
UK_03	122.2	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
UK_04	122.8	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.2	NC	0.3	0.2	NC	NC	NC	NC
UK_05	113.8	NC	NC	NC	NC	0.8	NC	NC	1.2	0.9	0.6	0.7	0.7	0.6	0.5	0.6	NC	0.6	NC	0.5
UK_06	121.1	NC	NC	NC	NC	0.6	NC	NC	0.7	0.4	NC	0.7	1.5	1.0	1.0	0.5	NC	1.8	NC	1.3
UK_07	122.6	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.4	NC	NC	NC	NC	0.4	NC	NC
UK_09	123.2	0.9	NC	NC	NC	2.8	NC	NC	2.9	2.0	1.2	1.8	3.9	3.0	2.0	1.4	NC	4.7	0.6	3.2
UK_10	120.2	0.6	NC	NC	NC	0.9	NC	NC	0.9	0.5	NC	0.9	2.3	1.7	1.3	0.7	NC	3.1	NC	2.0
UK_11	117.4	1.1	NC	NC	NC	1.9	NC	NC	2.7	1.7	1.3	2.0	4.4	3.1	2.2	1.6	NC	5.2	0.7	3.7
UK_13	113.0	0.6	NC	NC	NC	1.0	NC	NC	1.0	0.6	0.5	0.9	2.5	1.8	1.2	0.7	NC	3.1	NC	2.1
UK_14	113.7	2.3	NC	NC	0.8	4.3	NC	0.6	2.1	1.3	1.0	1.6	3.8	2.6	1.8	1.1	NC	4.3	0.6	3.0
UK_15	114.3	1.0	NC	NC	0.5	2.1	NC	NC	2.8	1.9	1.3	1.8	3.8	3.0	2.0	1.5	NC	4.4	0.6	3.2
UK_16	111.4	NC	NC	NC	NC	0.3	NC	NC	0.3	NC	NC	NC	0.6	0.4	0.3	NC	NC	0.7	NC	0.4
UK_17	110.8	NC	NC	NC	NC	0.4	NC	NC	0.4	NC	NC	NC	0.4	NC	NC	NC	NC	0.4	NC	NC
UK_18	108.7	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.4	NC	NC	NC	NC	0.5	NC	0.4
UK_19	104.0	5.1	NC	1.4	2.4	10.3	1.1	1.5	10.5	7.4	4.6	7.3	11.9	8.3	6.4	5.1	1.1	11.9	1.8	8.7
UK_20	102.3	0.7	NC	NC	0.4	1.2	NC	NC	1.5	1.0	0.9	1.3	2.1	1.5	1.1	0.9	NC	2.1	0.4	1.5
UK_21	100.4	0.3	NC	NC	NC	0.5	NC	NC	0.5	0.4	NC	0.3	0.4	0.3	NC	NC	NC	0.3	NC	0.3
UK_23	99.7	0.2	NC	NC	NC	0.3	NC	NC	0.2	NC	NC	0.2	0.4	0.3	NC	NC	NC	0.4	NC	0.3

Station	Water Depth (m)	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Dibenzothiophene	Anthracene	Fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluoranthene	Benzo[k]fluoranthene	Benzo[e]pyrene	Benzo[a]pyrene	Perylene	Indeno[123,cd]pyrene	Dibenzo[a,h]anthracene	Benzo[ghi]perylene
UK_24	99.7	0.4	NC	NC	NC	0.8	NC	NC	0.7	0.5	0.4	0.5	0.7	0.5	0.4	0.4	NC	0.6	NC	0.5
UK_27	98.8	0.2	NC	NC	NC	0.3	NC	NC	0.2	NC	NC	0.2	0.3	0.2	0.2	NC	NC	0.3	NC	0.2
UK_30	92.7	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
UK_31	88.3	0.4	NC	NC	NC	0.5	NC	NC	0.3	NC	NC	0.3	0.4	0.3	NC	NC	NC	0.4	NC	0.3
UK_33	79.6	NC	NC	NC	NC	0.2	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
UK_34	77.6	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	0.1	NC	NC	NC	NC	0.1	NC	NC
UK_35	74.2	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
UK_36	75.7	0.6	NC	NC	NC	0.9	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
UK_37	75.9	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
UK_38	75.4	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
UK_39	74.9	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
UK_40	75.3	NC	NC	NC	NC	0.3	NC	NC	0.3	0.3	NC	NC	0.3	NC	NC	NC	NC	0.2	NC	NC
UK_41	75.0	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
UK_42	74.1	NC	NC	NC	NC	0.4	NC	NC	0.4	0.3	NC	0.3	0.3	0.2	NC	NC	NC	NC	NC	NC
UK_43	73.4	0.2	NC	NC	NC	0.4	NC	NC	0.4	0.3	0.2	0.3	0.3	0.3	0.2	0.2	NC	0.2	NC	0.2
UK_44	70.4	0.7	1.2	0.2	NC	4.5	0.3	1.6	4.3	2.7	1.6	1.4	1.3	1.5	0.8	1.5	0.3	1.2	0.2	0.9
UK_45	65.3	0.2	NC	NC	NC	0.3	NC	NC	0.3	0.2	0.2	0.2	0.3	0.2	0.2	0.2	NC	0.3	NC	0.3
UK_46	60.6	0.4	NC	NC	0.2	0.6	NC	0.1	0.6	0.5	0.4	0.6	0.6	0.4	0.4	0.4	NC	0.4	NC	0.4
UK_51	52.3	2.6	4.4	NC	7.5	66.0	3.9	61.1	223.2	121.5	100.3	117.6	81.5	57.1	45.9	65.5	18.3	40.4	10.4	33.0
UK_52	46.6	0.3	NC	NC	NC	0.3	NC	NC	0.2	0.2	NC	0.2	0.2	NC	NC	NC	NC	0.2	NC	NC
UK_53	31.2	0.3	NC	0.3	0.5	3.1	NC	0.7	3.2	2.5	1.4	1.6	1.3	1.1	0.9	1.3	0.3	0.9	NC	0.8
UK_54	21.6	NC	NC	NC	NC	0.4	NC	NC	0.6	0.3	NC	0.3	0.4	0.3	0.3	NC	NC	0.3	NC	0.3

Station	Water Depth (m)	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Dibenzothiophene	Anthracene	Fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluoranthene	Benzo[k]fluoranthene	Benzo[e]pyrene	Benzo[a]pyrene	Perylene	Indeno[123,cd]pyrene	Dibenzo[a,h]anthracene	Benzo[ghi]perylene
UK_55	23.5	NC	NC	NC	NC	0.2	NC	NC	0.4	0.2	NC	NC	0.3	0.2	NC	NC	NC	NC	NC	NC
UK_56	22.3	0.5	NC	NC	0.2	1.0	NC	0.2	1.6	1.3	0.7	1.0	1.0	0.8	0.7	0.8	0.2	0.7	NC	0.7
UK_57	20.0	12.2	3.0	4.8	8.0	38.4	3.3	11.5	70.8	55.3	37.3	44.6	40.9	33.1	27.1	40.3	9.5	28.7	5.9	26.4
UK_58	18.4	11.3	3.0	4.1	6.5	24.3	2.4	7.2	38.5	31.1	21.6	26.5	25.4	20.8	17.4	24.2	5.9	18.3	3.9	17.0
UK_59	13.4	0.4	NC	NC	NC	0.6	NC	NC	1.1	0.8	0.5	0.7	0.9	0.7	0.6	0.6	0.2	0.7	NC	0.7
UK_61	10.1	0.2	NC	NC	NC	0.4	NC	NC	0.7	0.5	0.3	0.4	0.5	0.4	0.4	0.3	NC	0.4	NC	0.4

APPENDIX P – SAMPLE LOG SHEETS

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
1	SVP_USBL_CAL	Swift		21:40	05/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
2	USBL_CAL	CAM & CTD		21:50	05/09/2023	-	-	-	0-2	-	-	Boulder located - 3 attempts made as troubles with camera overlay due to running external feed to vessel screens
									2-5	-	-	
									5-10	-	-	
3	UK_ENV_TR_05	Seabug	114	00:08	06/09/2023	-	-	-	0-2	-	-	Camera tilted further down after this deployment
									2-5	-	-	
									5-10	-	-	
4	UK_ENV_GRAB_05	DVV	112	01:54	06/09/2023	40 40	PC F1	Full suite 1L	0-2	2.5Y 5/2	Slightly silty fine sand with shell debris	No obvious layering. F1: Ophiuroidea, urchin fragments, tube worm
									2-5	2.5Y 5/2	Slightly silty fine sand with shell debris	
									5-10	2.5Y 5/2	Slightly silty fine sand with shell debris	
5	UK_ENV_GRAB_05	DVV	123	02:48	06/09/2023	75 75	F2 F3	1L 1L	0-2	2.5Y 5/2	Slightly silty fine sand with shell debris	F2: Ophiuroidea, urchin fragments, tube worms F3: Tube worms
									2-5	2.5Y 5/2	Slightly silty fine sand with shell debris	
									5-10	2.5Y 5/2	Slightly silty fine sand with shell debris	
6	UK_ENV_TR_04	Seabug & CTD Maestro	123	09:40	06/09/2023	-	-	-	0-2	-	-	CTD attached to camera
									2-5	-	-	
									5-10	-	-	
7	UK_ENV_GRAB_04	DVV	123	10:29	06/09/2023	70 70	PC F1	Full suite 3L	0-2	2.5Y 5/2	Slightly silty fine sand with shell debris	No obvious layering F1: Shell fragments
									2-5	2.5Y 5/2	Slightly silty fine sand with shell debris	
									5-10	2.5Y 5/2	Slightly silty fine sand with shell debris	
8	UK_ENV_GRAB_04	DVV	123	10:56	06/09/2023	70 70	F2 F3	1L 3L	0-2	2.5Y 4/2	Slightly silty fine sand with shell debris	F1: Sea potato, shell fragments, Polychaete F2: Shell fragments, worms
									2-5	2.5Y 4/2	Slightly silty fine sand with shell debris	
									5-10	2.5Y 4/2	Slightly silty fine sand with shell debris	
9	UK_ENV_TR_03	Seabug	122	14:51	06/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
10	UK_ENV_GRAB_03	DVV	122	15:15	06/09/2023	60 60	PC F1	Full suite 3L	0-2	2.5Y 4/3	Slightly silty fine sand with shell debris	No obvious layering F1: Quill worm, shell hash
									2-5	2.5Y 4/3	Slightly silty fine sand with shell debris	
									5-10	2.5Y 4/3	Slightly silty fine sand with shell debris	
11	UK_ENV_GRAB_03	DVV	122	15:46	06/09/2023	50 50	F2 F3	3L 3L	0-2	2.5Y 4/3	Slightly silty fine sand with shell debris	F2: Starfish, brittle star, worms F3: No obvious fauna, shell debris
									2-5	2.5Y 4/3	Slightly silty fine sand with shell debris	
									5-10	2.5Y 4/3	Slightly silty fine sand with shell debris	
12	UK_ENV_TR_02	Seabug	127	19:41	06/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
									5-10	-	-	
13	UK_ENV_GRAB_02	DVV	127	20:07	06/09/2023	0 40	NS F1	3L	0-2	2.5Y 4/3	Slightly silty fine sand with shell debris and some gravel	NS: Stone in jaw - almost complete washout F1: Lots of shell debris
									2-5	2.5Y 4/3	Slightly silty fine sand with shell debris and some gravel	
									5-10	2.5Y 4/3	Slightly silty fine sand with shell debris and some gravel	
14	UK_ENV_GRAB_02	DVV	127	20:20	06/09/2023	40 40	PC F2	Full suite 3L	0-2	2.5Y 4/3	Slightly silty fine sand with shell debris, some gravel, and a cobble	F2: Cobble, Polychaetes - poss. *Lanice conchilega*
									2-5	2.5Y 4/3	Slightly silty fine sand with shell debris, some gravel, and a cobble	
									5-10	2.5Y 4/3	Slightly silty fine sand with shell debris and some gravel	
15	UK_ENV_GRAB_02	DVV	127	20:45	06/09/2023	50	F3	3L	0-2	2.5Y 4/3	Slightly silty fine sand with shell debris and some gravel	F3: Shell debris
									2-5	2.5Y 4/3	Slightly silty fine sand with shell debris and some gravel	
									5-10	2.5Y 4/3	Slightly silty fine sand with shell debris and some gravel	
16	UK_ENV_TR_01	Seabug & CTD Maestro	129	00:05	07/09/2023	-	-	-	0-2	-	-	CTD attached to camera
									2-5	-	-	
									5-10	-	-	
17	UK_ENV_GRAB_01	DVV	127	01:01	07/09/2023	50 80	PC F1	Full suite 2 x 5L	0-2	2.5Y 5/3	Coarse sand with shell debris	Shell debris
									2-5	2.5Y 5/3	Coarse sand with shell debris	
									5-10	2.5Y 5/3	Coarse sand with shell debris	
18	UK_ENV_GRAB_01	DVV	127	01:28	07/09/2023	80 80	F2 F3	5L 5L	0-2	2.5Y 5/3	Coarse sand with shell debris	Shell debris, crab
									2-5	2.5Y 5/3	Coarse sand with shell debris	
									5-10	2.5Y 5/3	Coarse sand with shell debris	
19	UK_ENV_TR_06	Seabug	121	08:20	07/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
20	UK_ENV_GRAB_06	DVV	121	09:24	07/09/2023	70 70	PC F1	Full Suite 3L	0-2	2.5Y 4/1	Silty sand	Hermit crab, ophiuroid, cup coral, hydroid
									2-5	2.5Y 4/1	Silty sand	
									5-10	2.5Y 4/1	Silty sand	
21	UK_ENV_GRAB_06	DVV	121	09:48	07/09/2023	70 70	F2 F3	3L 3L	0-2	2.5Y 4/1	Silty sand	Shell debris Shell debris
									2-5	2.5Y 4/1	Silty sand	
									5-10	2.5Y 4/1	Silty sand	

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
22	Uk_ENV_TR_07	Seabug & CTD Maestro	123		07/09/2023	-	-	-	0-2 2-5 5-10	- - -	- - -	CTD attached to camera
23	UK_ENV_GRAB_07	DVV	123	14:21	07/09/2023	40 40	PC F1	Full Suite 1L	0-2 2-5 5-10	2.5Y 4/2 2.5Y 4/2 2.5Y 4/2	Silty sand with shell debris Silty sand with shell debris Silty sand with shell debris	No obvious layering F1: Brittle star, *Phaxus pelucidus*, worms
24	UK_ENV_GRAB_07	DVV	123	14:48	07/09/2023	60 40	F2 F3	1L 3L	0-2 2-5 5-10	2.5Y 4/2 2.5Y 4/2 2.5Y 4/2	Silty sand with shell debris Silty sand with shell debris Silty sand with shell debris	F2: *Nephtys*, shell debris F3: Urchin, worms
25	UK_GT_GRAB_01	DVV	129	18:56	09/09/2023	50 50	GEOTEC H	1 bag kept and frozen	0-2 2-5 5-10	2.5Y 5/3 2.5Y 5/3 2.5Y 5/3	Slightly muddy sand Slightly muddy sand Slightly muddy sand	Sample provided to Geotechnical technicians
26	UK_GT_GRAB_02	DVV	127	21:50	09/09/2023	70 60	GEOTEC H	1 bag kept and frozen	0-2 2-5 5-10	2.5Y 5/2 2.5Y 5/2 2.5Y 5/2	Slightly muddy sand Slightly muddy sand Slightly muddy sand	Sample provided to Geotechnical technicians
27	UK_GT_GRAB_06	DVV	121	14:19	10/09/2023	50 50	GEOTEC H	1 bag kept and frozen	0-2 2-5 5-10	2.5Y 4/1 2.5Y 4/1 2.5Y 4/1	Silty sand Silty sand Silty sand	Sample provided to Geotechnical technicians
28	UK_GT_TR_08	Seabug	125	19:34	10/09/2023	-	-	-	0-2 2-5 5-10	- - -	- - -	For Geotech Ground Truthing
29	UK_ENV_TR_09	Seabug	123	03:09	11/09/2023	-	-	-	0-2 2-5 5-10	- - -	- - -	-
30	UK_ENV_GRAB_09	DVV	122	03:55	11/09/2023	50 50	PC F1	Full suite, 1 x 1L Bucket	0-2 2-5 5-10	2.5Y 6/2 2.5Y 6/2 2.5Y 6/2	Muddy Sand Muddy Sand Muddy Sand	Cup coral, shell fragments
31	UK_ENV_GRAB_09	DVV	122	04:22	11/09/2023	50 50	F2 F3	1 x 1 L Bucket, 1 x 1L Bucket	0-2 2-5 5-10	2.5Y 6/2 2.5Y 6/2 2.5Y 6/2	Muddy Sand Muddy Sand Muddy Sand	Shell fragments
32	UK_ENV_TR_10	Seabug	120	07:00	11/09/2023	-	-	-	0-2 2-5 5-10	- - -	- - -	-
33	UK_ENV_GRAB_10	DVV	120	07:45	11/09/2023	60 60	PC F1	Full suite, 1 x 3L Bucket	0-2 2-5 5-10	2.5Y 5/1 2.5Y 5/1 2.5Y 5/1	Fine silty sand Fine silty sand Fine silty sand	Shells, shell fragments, hermit
34	UK_ENV_GRAB_10	DVV	120	08:09	11/09/2023				0-2	2.5Y 5/1	Fine silty sand	Polychaete, amphipod, scaphopod

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
						60 60	F2 F3	1 x 3 L Bucket, 1 x 3L Bucket	2-5	2.5Y 5/1	Fine silty sand	
									5-10	2.5Y 5/1	Fine silty sand	
35	UK_ENV_TR_11	Seabug & CTD Maestro	118	15:03	11/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
36	UK_ENV_GRAB_11	DVV	118	15:28	11/09/2023	70 60	PC F1	Full suite 3L	0-2	2.5Y 5/1	Very silty fine sand	Shrimp, *P. pelucidus*
									2-5	2.5Y 5/1	Very silty fine sand	
									5-10	2.5Y 5/1	Very silty fine sand	
37	UK_ENV_GRAB_11	DVV	118	15:56	11/09/2023	60 60	F2 F3	3L 3L	0-2	2.5Y 5/1	Very silty fine sand	F2: Shrimp, Actiniaria, Amphipoda F3: Polychaetes
									2-5	2.5Y 5/1	Very silty fine sand	
									5-10	2.5Y 5/1	Very silty fine sand	
38	UK_GT_TR_12	Seabug	109	20:15	11/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
39	UK_ENV_TR_13	Seabug	112	23:30	11/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
40	UK_ENV_GRAB_13	DVV	111	23:50	11/09/2023	40 40	PC F1	Full suite 1L	0-2	2.5Y 5/1	Fine muddy sand	Ophiuroid, hydroid
									2-5	2.5Y 5/1	Fine muddy sand	
									5-10	2.5Y 5/1	Fine muddy sand	
41	UK_ENV_GRAB_13	DVV	111	00:22	12/09/2023	10 10	NS NS	-	0-2	2.5Y 5/1	Fine muddy sand	Poor sediment retention
									2-5	2.5Y 5/1	Fine muddy sand	
									5-10	2.5Y 5/1	Fine muddy sand	
42	UK_ENV_GRAB_13	DVV	111	00:37	12/09/2023	0 10	NS NS	-	0-2	2.5Y 5/1	Fine muddy sand	Moving 5m along transect, poor sediment retention
									2-5	2.5Y 5/1	Fine muddy sand	
									5-10	2.5Y 5/1	Fine muddy sand	
43	UK_ENV_GRAB_13	DVV	111	00:53	12/09/2023	90 90	F2 F3	5L 5L	0-2	2.5Y 5/1	Fine muddy sand	Squat lobster
									2-5	2.5Y 5/1	Fine muddy sand	
									5-10	2.5Y 5/1	Fine muddy sand	
44	UK_ENV_TR_14	Seabug	113	05:50	12/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
45	UK_ENV_GRAB_14	DVV	113	06:34	12/09/2023	70 70	PC F1	Full suite 1L	0-2	2.5Y 5/1	Fine silty muddy sand	Shell fragments
									2-5	2.5Y 5/1	Fine silty muddy sand	
									5-10	2.5Y 5/1	Fine silty muddy sand	
46	UK_ENV_GRAB_14	DVV	113	06:56	12/09/2023				0-2	2.5Y 5/1	Fine silty muddy sand	Polychaetes, crab, brittle star

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
						90 90	F2 F3	3L 3L	2-5	2.5Y 5/1	Fine silty muddy sand	
									5-10	2.5Y 5/1	Fine silty muddy sand	
47	UK_ENV_TR_15	Seabug & CTD Maestro	114	08:35	12/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
48	UK_ENV_GRAB_15	DVV	114	09:27	12/09/2023	70 80	PC F1	Full suite 3L	0-2	2.5Y 5/1	Fine silty muddy sand	No grab number on deck slates
									2-5	2.5Y 5/1	Fine silty muddy sand	
									5-10	2.5Y 5/1	Fine silty muddy sand	
49	UK_ENV_GRAB_15	DVV	114	09:47	12/09/2023	90 90	F2 F3	1L 3L	0-2	2.5Y 5/1	Fine silty muddy sand	No grab number on deck slates
									2-5	2.5Y 5/1	Fine silty muddy sand	
									5-10	2.5Y 5/1	Fine silty muddy sand	
50	UK_ENV_TR_16	Seabug	111	06:02	13/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
51	UK_ENV_GRAB_16	DVV	111	06:19	13/09/2023	90 90	PC F1	Full suite 2 x 5L	0-2	2.5Y 4/3	Shelly coarse sand	Polychaetes
									2-5	2.5Y 4/3	Shelly coarse sand	
									5-10	2.5Y 4/3	Shelly coarse sand	
52	UK_ENV_GRAB_16	DVV	111	06:47	13/09/2023	70 50	F2 F3	2 x 5L 1 x5L, 1 x 1L	0-2	2.5Y 4/3	Shelly coarse sand	Polychaetes, *Gammarus*, heart urchin
									2-5	2.5Y 4/3	Shelly coarse sand	
									5-10	2.5Y 4/3	Shelly coarse sand	
53	UK_ENV_TR_17	Seabug	111		13/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
54	UK_ENV_GRAB_17	DVV	111	12:39	13/09/2023	70 50	PC F1	Full suite 3L	0-2	2.5Y 4/3	Coarse sand with some shell	No obvious layering F1: Paguridae, Ophiuroidea, polychaetes, shrimp
									2-5	2.5Y 4/3	Coarse sand with some shell	
									5-10	2.5Y 4/3	Coarse sand with some shell	
55	UK_ENV_GRAB_17	DVV	111	13:02	13/09/2023	70 70	F2 F3	3L 3L	0-2	2.5Y 4/3	Coarse sand with some shell	F2: Polychaetes F3: Polychaetes including Teribellidae
									2-5	2.5Y 4/3	Coarse sand with some shell	
									5-10	2.5Y 4/3	Coarse sand with some shell	
56	UK_ENV_TR_18	Seabug & CTD Maestro	108	18:23	13/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
57	UK_ENV_GRAB_18	DVV	108	18:45	13/09/2023	50 50	PC F1	Full suite 5L	0-2	2.5Y 4/3	Coarse sand with some shell debris	F1: Brittle stars, Amphipoda
									2-5	2.5Y 4/3	Coarse sand with some shell debris	
									5-10	2.5Y 4/3	Coarse sand with some shell debris	
58	UK_ENV_GRAB_18	DVV	108	19:07	13/09/2023	50 50	F2 F3	3L 3L	0-2	2.5Y 4/3	Coarse sand with some shell debris	F2: Brittle stars F3: Brittle stars
									2-5	2.5Y 4/3	Coarse sand with some shell debris	

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
									5-10	2.5Y 4/3	Coarse sand with some shell debris	
59	UK_ENV_TR_19	Seabug	104	23:16	13/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
60	UK_ENV_GRAB_19	DVV	102	23:42	13/09/2023	40 40	PC F1	Full suite (no EOX 2) 1L	0-2	2.5Y 4/1	Muddy fine silty sand with shell and hard worm cast debris	Small samples taken due to coarse nature, brittle stars, hydroids, polychaetes. Not enough sediment for 10cm probe readings. Seemed to be a relatively thin veneer of sediment above what was likely a hard rocky bottom
									2-5	2.5Y 4/1	Muddy fine silty sand with shell and hard worm cast debris	
									5-10	2.5Y 4/1	Muddy fine silty sand with shell and hard worm cast debris	
61	UK_ENV_GRAB_19	DVV	103	00:04	14/09/2023	40 10	F2 NS	1L	0-2	2.5Y 4/1	Muddy fine silty sand with shell and hard worm cast debris	Seemed to be a thin relatively thin veneer of sediment above what was likely a hard rocky bottom
									2-5	2.5Y 4/1	Muddy fine silty sand with shell and hard worm cast debris	
									5-10	2.5Y 4/1	Muddy fine silty sand with shell and hard worm cast debris	
62	UK_ENV_GRAB_19	DVV	103	00:19	14/09/2023	0 10	NS NS	-	0-2	2.5Y 4/1	Muddy fine silty sand with shell and hard worm cast debris	Pebble in jaw
									2-5	2.5Y 4/1	Muddy fine silty sand with shell and hard worm cast debris	
									5-10	2.5Y 4/1	Muddy fine silty sand with shell and hard worm cast debris	
63	UK_ENV_GRAB_19	DVV	103	00:30	14/09/2023	0 0	NS NS	-	0-2	2.5Y 4/1	Boulder	Large, colonised boulder in jaw. Fauna includes crinoid, hydroid, polychaetes, bryozoan, porifera. Colonising fauna removed for lab ID and stored in a 1L bucket labelled 'Fauna removed from boulder'
									2-5	2.5Y 4/1	Boulder	
									5-10	2.5Y 4/1	Boulder	
64	UK_ENV_GRAB_19	DVV	103	00:42	14/09/2023	0 5	NS NS	-	0-2	2.5Y 4/1	Muddy fine silty sand with shell and hard worm cast debris	Small amount of sediment retention, very coarse rocky sediment, no more sampling attempts due to this - likely Hamon grab would not have been more successful. NO F3 sample.
									2-5	2.5Y 4/1	Muddy fine silty sand with shell and hard worm cast debris	
									5-10	2.5Y 4/1	Muddy fine silty sand with shell and hard worm cast debris	
65	UK_ENV_GT_19	DVV	104	04:23	14/09/2023	20 40	Geotech	-	0-2	-	-	Handed over to geotechs for their analysis
									2-5	-	-	
									5-10	-	-	

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
66	UK_ENV_TR_20	Seabug	102	07:02	14/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
67	UK_ENV_GRAB_20	DVV	102	07:29	14/09/2023	50 40	NS NS	-	0-2	2.5Y 4/1	Slightly silty shelly sand	Cobbles in both jaws causing washout
									2-5	2.5Y 4/1	Slightly silty shelly sand	
									5-10	2.5Y 4/1	Slightly silty shelly sand	
68	UK_ENV_GRAB_20	DVV	102	07:43	14/09/2023	40 40	PC F1	Full suite, 1 x 3L Bucket	0-2	2.5Y 4/1	Slightly silty shelly sand	-
									2-5	2.5Y 4/2	Darker grey clay like layer	
									5-10	2.5Y 4/2	Darker grey clay like layer	
69	UK_ENV_GRAB_20	DVV	102	08:10	14/09/2023	40 40	NS NS	-	0-2	2.5Y 4/1	Slightly silty shelly sand	Cobbles in both jaws causing washout
									2-5	2.5Y 4/1	Slightly silty shelly sand	
									5-10	2.5Y 4/1	Slightly silty shelly sand	
70	UK_ENV_GRAB_20	DVV	102	08:32	14/09/2023	50 50	F2 F3	3L 5L	0-2	2.5Y 4/1	Slightly silty shelly sand	-
									2-5	2.5Y 4/1	Slightly silty shelly sand	
									5-10	2.5Y 4/1	Slightly silty shelly sand	
71	UK_ENV_TR_21	Seabug & CTD Maestro	101	15:04	14/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
72	UK_ENV_GRAB_21	DVV	101	15:44	14/09/2023	0 0	NS NS	-	0-2	-	-	Triggered in the water column
									2-5	-	-	
									5-10	-	-	
73	UK_ENV_GRAB_21	DVV	101	15:47	14/09/2023	50 50	PC F1	Full suite 5L	0-2	2.5Y 6/4	Very coarse sand with some shell debris	F1: worms including *Nephtys*
									2-5	2.5Y 6/4	Very coarse sand with some shell debris	
									5-10	2.5Y 6/4 & 2.5Y 3/1	Very coarse sand with some shell debris. Small isolated dark patch of finer material - 2.5Y 3/1	
74	UK_ENV_GRAB_21	DVV	101	16:17	14/09/2023	70 40	F2 F3	2 x 5L 5L	0-2	2.5Y 6/4	Very coarse sand with some shell debris	F2: large Echinoid - *Spatangus purpureus*, polychaetes F3: Polychaetes, quill worm Note. Grab opened before grab photo for water drainage
									2-5	2.5Y 6/4	Very coarse sand with some shell debris	
									5-10	2.5Y 6/4	Very coarse sand with some shell debris	
75	UK_GT_TR_22	Seabug	97	20:29	14/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
76	UK_ENV_TR_23	Seabug	99	00:45	15/09/2023	-	-	-	0-2	-	-	Transect reran due to SD not recording
									2-5	-	-	

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
									5-10	-	-	
77	UK_ENV_TR_23_R 1	Seabug	99	01:45	15/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
78	UK_ENV_GRAB_23	DVV	99	01:55	15/09/2023	60 50	PC F1	Full suite 5L & 3L	0-2	2.5Y 5/2	Shelly coarse sand	Starfish
									2-5	2.5Y 5/2	Shelly coarse sand	
									5-10	2.5Y 5/2	Shelly coarse sand	
79	UK_ENV_GRAB_23	DVV	99	02:15	15/09/2023	90 90	F2 F3	2 x 5L 2 x 5L	0-2	2.5Y 5/2	Shelly coarse sand	Echinoderms
									2-5	2.5Y 5/2	Shelly coarse sand	
									5-10	2.5Y 5/2	Shelly coarse sand	
80	UK_ENV_TR_24	Seabug	99	06:00	15/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
81	UK_ENV_GRAB_24	DVV	99	06:32	15/09/2023	70 NS	F1 NS	5L &1L	0-2	2.5Y 5/2	Shelly coarse sand	Polychaete on surface
									2-5	2.5Y 5/2	Shelly coarse sand	
									5-10	2.5Y 5/2	Shelly coarse sand	
82	UK_ENV_GRAB_24	DVV	99	06:46	15/09/2023	70 NS	PC NS	Full suite	0-2	2.5Y 5/2	Shelly coarse sand	No sample due to sediment washout. Lots of shell debris, echinoderm fragment
									2-5	2.5Y 5/2	Shelly coarse sand	
									5-10	2.5Y 5/2	Shelly coarse sand	
83	UK_ENV_GRAB_24	DVV	99	07:04	15/09/2023	50 50	NS NS	-	0-2	2.5Y 5/2	Shelly coarse sand	Pebbles in jaw causing washout
									2-5	2.5Y 5/2	Shelly coarse sand	
									5-10	2.5Y 5/2	Shelly coarse sand	
84	UK_ENV_GRAB_24	DVV	99	07:14	15/09/2023	0 0	NS NS	-	0-2	2.5Y 5/2	Shelly coarse sand	Pebbles in jaw causing washout
									2-5	2.5Y 5/2	Shelly coarse sand	
									5-10	2.5Y 5/2	Shelly coarse sand	
84	UK_ENV_GRAB_24	DVV	99	07:34	15/09/2023	0 40	NS NS	-	0-2	2.5Y 5/2	Shelly coarse sand	Cobbles in both jaws causing washout, switching to Hamon Grab
									2-5	2.5Y 5/2	Shelly coarse sand	
									5-10	2.5Y 5/2	Shelly coarse sand	
85	UK_ENV_GRAB_24	HG	99	07:57	15/09/2023	80	F2	2 x 5L	0-2	2.5Y 5/2	Shelly coarse sand	-
									2-5	2.5Y 5/2	Shelly coarse sand	
									5-10	2.5Y 5/2	Shelly coarse sand	
86	UK_ENV_GRAB_24	HG	99	08:12	15/09/2023	60	F3	1 x 5L & 1 x 3L	0-2	2.5Y 5/2	Shelly coarse sand	-
									2-5	2.5Y 5/2	Shelly coarse sand	
									5-10	2.5Y 5/2	Shelly coarse sand	
87	UK_GT_CAM_25/2 6	Seabug	98	12:13	15/09/2023	-	-	-	0-2	-	-	Subsea transit between 26 and 25
									2-5	-	-	
									5-10	-	-	

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
88	UK_ENV_TR_27_R 1	Seabug & CTD Maestro	98	17:41	15/09/2023	-	-	-	0-2	-	-	Camera crash - restart transect from EOL
									2-5	-	-	
									5-10	-	-	
89	UK_ENV_GRAB_27	DVV	98	18:18	15/09/2023	80 80	PC F1	Full suite 2 x 5L, 1 x12L	0-2	2.5\Y 5/2	Very coarse sand with shell material and a small amount of fine content	Amphipoda and polychaetes
									2-5	2.5Y 5/2	Very coarse sand with shell material and a small amount of fine content	
									5-10	2.5Y 5/2 with 2.5Y 3/2	Very coarse sand with shell material and an increased, darker fines content	
90	UK_ENV_GRAB_27	DVV	98	18:39	15/09/2023	10 5	NS NS	-	0-2	-	Lots of shells	Stones in jaws causing severe washout. One large Echinoid caught in jaws
									2-5	-	-	
									5-10	-	-	
91	UK_ENV_GRAB_27	DVV	98	18:50	15/09/2023	70 70	F2 F3	2 x 5L, 1 x 3L 3 x 5L	0-2	2.5\Y 5/2	Very coarse sand with shell material and a small amount of fine content	F2: Sea potato F3: Brittle star
									2-5	2.5Y 5/2	Very coarse sand with shell material and a small amount of fine content	
									5-10	2.5Y 5/2 with 2.5Y 3/2	Very coarse sand with shell material and an increased, darker fines content	
92	UK_GT_TR_28	Seabug	98	19:41	15/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
93	UK_ENV_TR_43	Seabug & CTD Maestro	73	11:27	16/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
94	UK_ENV_GRAB_43	DVV	73	11:59	16/09/2023	0 0	NS NS	-'	0-2	-	-	Very large cobble in one side - no other material - cobble encrusted with hydroids, and several crustaceans including squat lobsters Other grab caught stones in the jaws
									2-5	-	-	
									5-10	-	-	
95	UK_ENV_GRAB_43	DVV	73	12:09	16/09/2023	40 0	F1 NS	1L	0-2	2.5Y 5/3	Silty fine sand with some gravel and shell content	Sea potatoes, Polychaetes
									2-5	2.5Y 5/3	Silty fine sand with some gravel and shell content	
									5-10	2.5Y 5/3	Silty fine sand with some gravel and shell content	
96	UK_ENV_GRAB_43	DVV	73	12:23	16/09/2023			-	0-2	-	-	

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
						0 0	NS NS		2-5	-	-	No samples, triggered in water column - relatively rough conditions with some large rolling waves. Likely triggered on entry to the water
									5-10	-	-	
97	UK_ENV_GRAB_43	DVV	73	12:32	16/09/2023	50 50	PC F2	Full suite 3L	0-2	2.5Y 5/3	Silty fine sand with some gravel and shell content	Quill worm, Terebellid
									2-5	2.5Y 5/3	Silty fine sand with some gravel and shell content	
									5-10	2.5Y 5/3	Silty fine sand with some gravel and shell content	
98	UK_ENV_GRAB_43	DVV	73	12:51	16/09/2023	50	F3	3L	0-2	2.5Y 5/3	Silty fine sand with some gravel and shell content	Brachyura, worms
									2-5	2.5Y 5/3	Silty fine sand with some gravel and shell content	
									5-10	2.5Y 5/3	Silty fine sand with some gravel and shell content	
99	UK_ENV_TR_46	Seabug & CTD Maestro	60	18:09	16/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
100	UK_ENV_GRAB_46	DVV	60	18:28	16/09/2023	70 40	PC F1	Full suite 5L	0-2	2.5Y 4/3	Very coarse sand with gravel and some fine material	(F1 opened slightly before picture). Sediment too coarse for Redox and pH readings No obvious fauna
									2-5	2.5Y 4/3	Very coarse sand with gravel and some fine material	
									5-10	2.5Y 4/3	Very coarse sand with gravel and some fine material	
101	UK_ENV_GRAB_46	DVV	60	18:46	16/09/2023	50 50	F2 F3	5L, 1L 5L, 3L	0-2	2.5Y 4/3	Very coarse sand with gravel and some fine material	F2: No obvious fauna F3: Amphipoda
									2-5	2.5Y 4/3	Very coarse sand with gravel and some fine material	
									5-10	2.5Y 4/3	Very coarse sand with gravel and some fine material	
102	UK_ENV_TR_45	Seabug	61	22:10	16/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
103	UK_ENV_GRAB_45	DVV	61	22:47	16/09/2023	50 NS	PC	Full suite	0-2	2.5Y 3/3	Coarse sand with gravel and shell debris	Fishing rope/line stuck in grab. Secondary fishing line observed in water, so ops suspended on station until daylight hours. NEED F1, F2 F3 FROM
									2-5	2.5Y 3/3	Coarse sand with gravel and shell debris	
									5-10	2.5Y 3/3	Coarse sand with gravel and shell debris	

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
												THIS STATION. Sediment too coarse for Redox and pH readings
104	UK_ENV_TR_44	Seabug	67	00:50	17/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
105	UK_ENV_GRAB_44	DVV	67	01:25	17/09/2023	60 NS	PC	Full suite	0-2	2.5Y 3/3	Coarse sand with gravel and shell debris	Polychaete casts on surface. No sample gravel caught in jaws
									2-5	2.5Y 3/3	Coarse sand with gravel and shell debris	
									5-10	2.5Y 3/3	Coarse sand with gravel and shell debris	
106	UK_ENV_GRAB_44	DVV	67	01:51	17/09/2023	50 50	F1 F2	5L 5L	0-2	2.5Y 3/3	Coarse sand with gravel and shell debris	-
									2-5	2.5Y 3/3	Coarse sand with gravel and shell debris	
									5-10	2.5Y 3/3	Coarse sand with gravel and shell debris	
107	UK_ENV_GRAB_44	DVV	67	02:11	17/09/2023	60	F3	3L	0-2	2.5Y 3/3	Coarse sand with gravel and shell debris	-
									2-5	2.5Y 3/3	Coarse sand with gravel and shell debris	
									5-10	2.5Y 3/3	Coarse sand with gravel and shell debris	
108	UK_ENV_TR_42	Seabug	74	10:40	17/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
109	UK_ENV_GRAB_42	DVV	74	11:23	17/09/2023	40 20	PC NS	Full suite -	0-2	2.5Y 4/3 & 2.5Y 5/2	Fine sand with shell and small amount of gravel. Small darker sports of finer material	No sample due to stone caught in jaws and washout
									2-5	2.5Y 4/3	Fine sand with shell and small amount of gravel. Small darker sports of finer material	
									5-10	2.5Y 4/3	Fine sand with shell and small amount of gravel. Small darker sports of finer material	
110	UK_ENV_GRAB_42	DVV	74	11:40	17/09/2023	50 50	F1 F2	5L 5L	0-2	2.5Y 4/3	Fine sand with shell and small amount of gravel. Small darker sports of finer material	F1: Bivalves F2: Polychaetes, bivalves including *Gari*
									2-5	2.5Y 4/3	Fine sand with shell and small amount of gravel. Small darker sports of finer material	
									5-10	2.5Y 4/3	Fine sand with shell and small amount of gravel. Small darker sports of finer material	
111	UK_ENV_GRAB_42	DVV	74	11:59	17/09/2023	50	F3	5L	0-2	2.5Y 4/3	Fine sand with shell and small amount of gravel. Small darker sports of finer material	F3: Brittle star, Polychaetes, Bivalves including: *Gari*, *Nucula*,

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
									2-5	2.5Y 4/3	Fine sand with shell and small amount of gravel. Small darker sports of finer material	
									5-10	2.5Y 4/3	Fine sand with shell and small amount of gravel. Small darker sports of finer material	
112	UK_ENV_TR_41	Seabug	75	13:03	17/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
113	UK_ENV_GRAB_41	DVV	75	13:20	17/09/2023	80 80	PC F1	Full suite 3L	0-2	2.5Y 4/3	Fine sand	F1: Bivalves, Sea potato, Polychaetes
									2-5	2.5Y 4/3	Fine sand	
									5-10	2.5Y 4/3	Fine sand	
114	UK_ENV_GRAB_41	DVV	75	13:41	17/09/2023	70 70	F2 F3	3L 3L	0-2	2.5Y 4/3	Fine sand	F2: Polychaetes, Sea potato F3: Polychaetes
									2-5	2.5Y 4/3	Fine sand	
									5-10	2.5Y 4/3	Fine sand	
115	UK_ENV_TR_40	Seabug	76	13:03	17/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
116	UK_ENV_GRAB_40	DVV	76	17:54	17/09/2023	50 40	PC F1	Full suite 1L	0-2	2.5Y 5/3	Fine sand	*Pagurus*, sea potato
									2-5	2.5Y 5/3	Fine sand	
									5-10	2.5Y 5/3	Fine sand	
117	UK_ENV_GRAB_40	DVV	76	18:17	17/09/2023	NS NS	-	-	0-2	-	-	Grab just took surface scrapings, likely landed on hard material
									2-5	-	-	
									5-10	-	-	
118	UK_ENV_GRAB_40	DVV	76	18:28	17/09/2023	50 40	F2 F3	3L 3L	0-2	2.5Y 5/3	Fine sand with shell material	F2: worms F3: worms
									2-5	2.5Y 5/3	Fine sand with shell material	
									5-10	2.5Y 5/3	Fine sand with shell material	
119	UK_ENV_TR_57	Seabug & CTD Maestro	20	03:04	23/09/2023	-	-	-	0-2	-	-	Line aborted due to extremely turbid water and no visibility. Switching camera systems to Freshwater Lense
									2-5	-	-	
									5-10	-	-	
120	UK_ENV_TR_57_R1	FWL-Seabug Camera System	20	08:54	23/09/2023	-	-	-	0-2	-	-	No visibility, line aborted
									2-5	-	-	
									5-10	-	-	
121	UK_ENV_TR_59	FWL-Seabug	14	10:02	23/09/2023	-	-	-	0-2	-	-	No visibility, line aborted
									2-5	-	-	
									5-10	-	-	

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
		Camera System										
122	UK_ENV_TR_59	CTD Maestro	14	10:13	23/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
123	UK_ENV_TR_61	FWL-Seabug Camera System	11	10:20	23/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
124	UK_ENV_GRAB_61	DVV	10.1	11:42	23/09/2023	60 60	F1 F2	1L 1L	0-2	2.5Y 4/1	Dark grey very fine silty sand	Deck slate has wrong depth. Bivalves and worms
									2-5	2.5Y 4/1	Dark grey very fine silty sand	
									5-10	2.5Y 4/1	Dark grey very fine silty sand	
125	UK_ENV_GRAB_61	DVV	10.1	11:59	23/09/2023	60 40	PC F3	Full suite 1L	0-2	2.5Y 4/1	Dark grey very fine silty sand	Bivalves and worms
									2-5	2.5Y 4/1	Dark grey very fine silty sand	
									5-10	2.5Y 4/1	Dark grey very fine silty sand	
126	UK_ENV_TR_59_R 1	FWL-Seabug Camera System	14	13:06	23/09/2023	-	-	-	0-2			
									2-5			
									5-10			
127	UK_ENV_GRAB_59	DVV	14	13:45	23/09/2023	60 40	F1 F2	1L 1L	0-2	2.5Y 4/1	Dark grey very fine silty sand	Whelk Bivalves and worms
									2-5	2.5Y 4/1	Dark grey very fine silty sand	
									5-10	2.5Y 4/1	Dark grey very fine silty sand	
128	UK_ENV_GRAB_59	DVV	14	13:56	23/09/2023	60 50	PC F3	Full suite 1L	0-2	2.5Y 4/1	Dark grey very fine silty sand	Bivalves and worms
									2-5	2.5Y 4/1	Dark grey very fine silty sand	
									5-10	2.5Y 4/1	Dark grey very fine silty sand	
129	UK_ENV_TR_53	FWL-Seabug Camera System & CTD Maestro	31	18:14	23/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
130	UK_ENV_GRAB_53	DVV	31	20:17	23/09/2023	70 70	PC F1	Full suite 1L	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
131	UK_ENV_GRAB_53	DVV	31	20:42	23/09/2023	70 50	F2 F3	1L 1L	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
132	UK_ENV_TR_56	FWL-Seabug Camera System & CTD Maestro	22	04:15	29/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
132	UK_ENV_TR_56_R 1	FWL-Seabug Camera System & CTD Maestro	22	04:27	29/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
133	UK_ENV_GRAB_56	DVV	22	05:05	29/09/2023	40 40	PC F1	Full suite 1L	0-2	2.5Y 4/3	Dark grey fine silty sand	Annelida, Sea Potato
									2-5	2.5Y 4/3	Dark grey fine silty sand	
									5-10	2.5Y 4/3	Dark grey fine silty sand	
134	UK_ENV_GRAB_56	DVV	22	05:37	29/09/2023	40 40	F2 F3	1L 1L	0-2	2.5Y 4/3	Dark grey fine silty sand	F2: Annelida, Bivalvia, Brittle star, Sea Potato F3: Annelida, Bivalvia, Pharidae, Sea Mouse, Sea Potato
									2-5	2.5Y 4/3	Dark grey fine silty sand	
									5-10	2.5Y 4/3	Dark grey fine silty sand	
135	UK_GT_TR_60	FWL-Seabug Camera System & CTD Maestro	10	07:07	29/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
136	UK_ENV_TR_58	FWL-Seabug Camera System & CTD Maestro	19	11:30	29/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
137	UK_ENV_GRAB_58	DVV	19	11:57	29/09/2023	60 60	PC F1	Full suite 1L	0-2	2.5Y 4/3	Dark grey fine silty sand	-
									2-5	2.5Y 4/2	Dark grey fine silty sand	
									5-10	2.5Y 4/2	Dark grey fine silty sand	
138	UK_ENV_GRAB_58	DVV	19	12:16	29/09/2023	60 60	F2 F3	1L 1L	0-2	2.5Y 4/3	Dark grey fine silty sand	-
									2-5	2.5Y 4/2	Dark grey fine silty sand	
									5-10	2.5Y 4/2	Dark grey fine silty sand	
139			18	13:00	29/09/2023	-	-	-	0-2			No visibility on the video

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
	UK_ENV_TR_57_R 1	FWL-Seabug Camera System							2-5			
									5-10			
140	UK_ENV_GRAB_57	DVV	18	13:27	29/09/2023	95 95	PC F1	Full suite 1L	0-2	2.5Y 4/3	Dark grey fine silty sand	Thysarid mollusc shells
									2-5	2.5Y 4/2	Dark grey fine silty sand	
									5-10	2.5Y 4/2	Dark grey fine silty sand	
141	UK_ENV_GRAB_57	DVV	18	13:31	29/09/2023	95 60	F2 F3	1L 1L	0-2	2.5Y 4/3	Dark grey fine silty sand	Thysarid mollusc shells
									2-5	2.5Y 4/2	Dark grey fine silty sand	
									5-10	2.5Y 4/2	Dark grey fine silty sand	
142	UK_ENV_TR_55	FWL-Seabug Camera System & CTD Maestro	23	14:46	29/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
143	UK_ENV_GRAB_55	DVV	23	15:14	29/09/2023	70 70	PC F1	Full suite 1L	0-2	2.5y 4/2	Sand	Polychaetes
									2-5	2.5y 4/2	Sand	
									5-10	2.5y 4/2	Sand	
144	UK_ENV_GRAB_55	DVV	23	15:37	29/09/2023	50 0	F2 NS	1L	0-2	2.5y 4/2	Sand	Polychaetes and Urchin
									2-5	2.5y 4/2	Sand	
									5-10	2.5y 4/2	Sand	
145	UK_ENV_GRAB_55	DVV	23	15:45	29/09/2023	80	F3	1L	0-2	2.5y 4/2	Sand	Polychaetes
									2-5	2.5y 4/2	Sand	
									5-10	2.5y 4/2	Sand	
146	UK_ENV_TR_54	FWL-Seabug Camera System & CTD Maestro	22	16:20	29/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
147	UK_ENV_GRAB_54	DVV	22	16:59	29/09/2023	80 80	PC F1	Full suite 1L	0-2	2.5y 4/2	Sand	-
									2-5	2.5y 4/2	Sand	
									5-10	2.5y 4/2	Sand	
148	UK_ENV_GRAB_54	DVV	22	17:21	29/09/2023	90 90	F2 F3	1L 1L	0-2	2.5y 4/2	Sand	-
									2-5	2.5y 4/2	Sand	
									5-10	2.5y 4/2	Sand	

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
149	UK_ENV_TR_52	FWL-Seabug Camera System & CTD Maestro	46	20:20	29/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
150	UK_ENV_GRAB_52	DVV	46	21:00	29/09/2023	0 0	NS NS	-	0-2	-	-	Grab misfire (i.e. the no sample was not due to the sediment type)
									2-5	-	-	
									5-10	-	-	
151	UK_ENV_GRAB_52	DVV	46	21:15	29/09/2023	2 2	NS NS	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
152	UK_ENV_GRAB_52	DVV	46	21:20	29/09/2023	0 5	NS NS	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
153	UK_ENV_GRAB_52	HG	46	21:55	29/09/2023	0	NS	-	0-2	-	-	Grab did not trigger
									2-5	-	-	
									5-10	-	-	
154	UK_ENV_GRAB_52	HG	46	22:02	29/09/2023	40	PC	Full suite	0-2	2.5Y 4/3	Gravelly Sand	Sediment not suitable for redox/pH probe
									2-5	2.5Y 4/3	Gravelly Sand	
									5-10	2.5Y 4/3	Gravelly Sand	
155	UK_ENV_GRAB_52	HG	46	22:18	29/09/2023	40	F1	5L	0-2	2.5Y 4/3	Gravelly Sand	-
									2-5	2.5Y 4/3	Gravelly Sand	
									5-10	2.5Y 4/3	Gravelly Sand	
156	UK_ENV_GRAB_52	HG	46	22:30	29/09/2023	40	F2	1L 5L	0-2	2.5Y 4/3	Gravelly Sand	-
									2-5	2.5Y 4/3	Gravelly Sand	
									5-10	2.5Y 4/3	Gravelly Sand	
157	UK_ENV_GRAB_52	HG	46	22:41	29/09/2023	60	F3	3L 5L	0-2	2.5Y 4/3	Gravelly Sand	-
									2-5	2.5Y 4/3	Gravelly Sand	
									5-10	2.5Y 4/3	Gravelly Sand	
158	UK_ENV_TR_51	FWL-Seabug Camera System & CTD Maestro	52	00:07	30/09/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
159	UK_ENV_GRAB_51	DVV	52	00:51	30/09/2023			-	0-2	-	-	Wash out - stones in jaws

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
						0 0	NS NS		2-5 5-10	- -	- -	
160	UK_ENV_GRAB_51	DVV	52	00:57	30/09/2023	0 0	NS NS	-	0-2 2-5 5-10	- - -	- - -	Sampler triggered in the water column
161	UK_ENV_GRAB_51	DVV	52	01:00	30/09/2023	0 0	NS NS	-	0-2 2-5 5-10	- - -	- - -	-
162	UK_ENV_GRAB_51	DVV	52	01:10	30/09/2023	0 0	NS NS	-	0-2 2-5 5-10	- - -	- - -	-
163	UK_ENV_GRAB_51	HG	52	01:35	30/09/2023	0	NS	-	0-2 2-5 5-10	- - -	- - -	-
164	UK_ENV_GRAB_51	HG	52	01:50	30/09/2023	40	PC	Full suite	0-2 2-5 5-10	2.5Y 3/3 2.5Y 3/3 2.5Y 3/3	Gravelly Silty Sand Gravelly Silty Sand Gravelly Silty Sand	Sediment not suitable for redox/pH probe
165	UK_ENV_GRAB_51	HG	52	02:10	30/09/2023	80	F1	5L 3L	0-2 2-5 5-10	2.5Y 3/3 2.5Y 3/3 2.5Y 3/3	Gravelly Silty Sand Gravelly Silty Sand Gravelly Silty Sand	Brachyura, Paguridae
166	UK_ENV_GRAB_51	HG	52	02:24	30/09/2023	40	F2	5L 3L	0-2 2-5 5-10	2.5Y 3/3 2.5Y 3/3 2.5Y 3/3	Gravelly Silty Sand Gravelly Silty Sand Gravelly Silty Sand	No sieve photos
167	UK_ENV_GRAB_51	HG	52	02:37	30/09/2023	40	F3	5L	0-2 2-5 5-10	2.5Y 3/3 2.5Y 3/3 2.5Y 3/3	Gravelly Silty Sand Gravelly Silty Sand Gravelly Silty Sand	No sieve photos
168	UK_ENV_TR_50	FWL-Seabug Camera System	56	09:00	30/09/2023	-	-	-	0-2 2-5 5-10	- - -	- - -	Transect indicated that there is no clear area for sampling or geotech. Move onto the next transect and abandon the sampling location.
169	UK_ENV_TR_49	Seabug Camera System	58	11:50	30/09/2023	-	-	-	0-2 2-5 5-10	- - -	- - -	-
170	UK_ENV_TR_48	Seabug Camera System	58	11:57	01/10/2023	-	-	-	0-2 2-5 5-10	- - -	- - -	-
171	UK_ENV_TR_47		51	01:29	02/10/2023	-	-	-	0-2	-	-	-

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
		Seabug Camera System							2-5	-	-	
									5-10	-	-	
172	UK_ENV_GRAB_45	DVV	65	04:40	02/10/2023	5 10	NS NS	-	0-2	2.5Y 3/3	Coarse sand with gravel and shell debris	Wash out - stones in jaws
									2-5	2.5Y 3/3	Coarse sand with gravel and shell debris	
									5-10	2.5Y 3/3	Coarse sand with gravel and shell debris	
173	UK_ENV_GRAB_45	DVV	65	04:52	02/10/2023	5 10	NS NS	-	0-2	2.5Y 3/3	Coarse sand with gravel and shell debris	Wash out - stones in jaws
									2-5	2.5Y 3/3	Coarse sand with gravel and shell debris	
									5-10	2.5Y 3/3	Coarse sand with gravel and shell debris	
174	UK_ENV_GRAB_45	DVV	65	05:03	02/10/2023	30 30	F1 F2	1L 1L	0-2	2.5Y 3/3	Coarse sand with gravel and shell debris	F2: Paguridae
									2-5	2.5Y 3/3	Coarse sand with gravel and shell debris	
									5-10	2.5Y 3/3	Coarse sand with gravel and shell debris	
175	UK_ENV_GRAB_45	DVV	65	05:14	02/10/2023	5 5	NS NS	-	0-2	2.5Y 3/3	Coarse sand with gravel and shell debris	Wash out - stones in jaws
									2-5	2.5Y 3/3	Coarse sand with gravel and shell debris	
									5-10	2.5Y 3/3	Coarse sand with gravel and shell debris	
176	UK_ENV_GRAB_45	DVV	65	05:23	02/10/2023	40	F3	1L, 1L	0-2	2.5Y 3/3	Coarse sand with gravel and shell debris	No grab photo, photo taken was of NS grab
									2-5	2.5Y 3/3	Coarse sand with gravel and shell debris	
									5-10	2.5Y 3/3	Coarse sand with gravel and shell debris	
177	UK_ENV_TR_39	Seabug Camera System	75	12:30	02/10/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
178	UK_ENV_GRAB_39	DVV	75	13:08	02/10/2023	90 90	PC F1	Full suite 3L	0-2	2.5Y 6/6	Medium Sand	-
									2-5	2.5Y 6/6	Medium Sand	
									5-10	2.5Y 6/6	Medium Sand	
179	UK_ENV_GRAB_39	DVV	75	13:33	02/10/2023	80 80	F2 F3	3L 3L	0-2	2.5Y 6/6	Medium Sand	-
									2-5	2.5Y 6/6	Medium Sand	
									5-10	2.5Y 6/6	Medium Sand	
180	UK_ENV_TR_38	Seabug Camera System	75	18:45	02/10/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
181	UK_ENV_GRAB_38	DVV	75	19:43	02/10/2023	0 0	NS NS	-	0-2	2.5Y 6/6	Medium Sand	-
									2-5	2.5Y 6/6	Medium Sand	
									5-10	2.5Y 6/6	Medium Sand	
182	UK_ENV_GRAB_38	DVV	75	19:49	02/10/2023	50 0	PC NS	-	0-2	2.5Y 6/6	Medium Sand	-
									2-5	2.5Y 6/6	Medium Sand	
									5-10	2.5Y 6/6	Medium Sand	
183	UK_ENV_GRAB_38	DVV	75	20:05	02/10/2023			3L	0-2	2.5Y 6/6	Medium Sand	-

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
						40 10	F1 NS		2-5	2.5Y 6/6	Medium Sand	
									5-10	2.5Y 6/6	Medium Sand	
184	UK_ENV_GRAB_38	DVV	75	20:22	02/10/2023	50 50	F2 F3	3L 3L	0-2	2.5Y 6/6	Medium Sand	-
									2-5	2.5Y 6/6	Medium Sand	
									5-10	2.5Y 6/6	Medium Sand	
185	UK_ENV_TR_37	Seabug Camera System	76		02/10/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
186	UK_ENV_GRAB_37	DVV	76	22:17	02/10/2023	0 0	NS NS	-	0-2	-	-	Stones in jaws
									2-5	-	-	
									5-10	-	-	
187	UK_ENV_GRAB_37	DVV	76	22:23	02/10/2023	0 0	NS NS	-	0-2	-	-	Stones in jaws
									2-5	-	-	
									5-10	-	-	
188	UK_ENV_GRAB_37	HG	76	22:53	02/10/2023	40	PC	-	0-2	2.5Y 5/3	Silty sandy gravel with shell debris	Sediment not suitable for redox/pH probe
									2-5	2.5Y 5/3	Silty sandy gravel with shell debris	
									5-10	2.5Y 5/3	Silty sandy gravel with shell debris	
189	UK_ENV_GRAB_37	HG	76	05:22	03/10/2023	40	F1	5L, 3L	0-2	2.5Y 5/3	Silty sandy gravel with shell debris	-
									2-5	2.5Y 5/3	Silty sandy gravel with shell debris	
									5-10	2.5Y 5/3	Silty sandy gravel with shell debris	
190	UK_ENV_GRAB_37	HG	76	05:36	03/10/2023	40	F2	5L	0-2	2.5Y 5/3	Silty sandy gravel with shell debris	-
									2-5	2.5Y 5/3	Silty sandy gravel with shell debris	
									5-10	2.5Y 5/3	Silty sandy gravel with shell debris	
191	UK_ENV_GRAB_37	HG	76	05:49	03/10/2023	0	NS	-	0-2	2.5Y 5/3	Silty sandy gravel with shell debris	Stones in jaws
									2-5	2.5Y 5/3	Silty sandy gravel with shell debris	
									5-10	2.5Y 5/3	Silty sandy gravel with shell debris	
192	UK_ENV_GRAB_37	HG	76	05:59	03/10/2023	40	F3	5L	0-2	2.5Y 5/3	Silty sandy gravel with shell debris	-
									2-5	2.5Y 5/3	Silty sandy gravel with shell debris	
									5-10	2.5Y 5/3	Silty sandy gravel with shell debris	
193	UK_ENV_TR_36	Seabug Camera System	76	03:33	04/10/2023	-	-	-	0-2	-	-	Camera malfunction - corrupted .in file Recovered to deck
									2-5	-	-	
									5-10	-	-	
194	UK_ENV_TR_36	Seabug Camera System	76	04:59	04/10/2023	-	-	-	0-2	-	-	Overlay malfunction at seabed, no beacon data recorded
									2-5	-	-	
									5-10	-	-	
195	UK_ENV_GRAB_36	DVV	76	05:44	04/10/2023	70 60	PC F1	Full suite 5L, 5L	0-2	2.5Y 5/3	Coarse sand with shell debris	-
									2-5	2.5Y 5/3	Coarse sand with shell debris	

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
									5-10	2.5Y 5/3	Coarse sand with shell debris	
196	UK_ENV_GRAB_36	DVV	76	06:16	04/10/2023	60 50	F2 F3	5L 3L	0-2	2.5Y 5/3	Coarse sand with shell debris	F2: Annelida F3: Annelida
									2-5	2.5Y 5/3	Coarse sand with shell debris	
									5-10	2.5Y 5/3	Coarse sand with shell debris	
197	UK_ENV_TR_35	Seabug Camera System	74	11:40	04/10/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
198	UK_ENV_GRAB_35	DVV	74	12:08	04/10/2023	80 80	PC F1	Full suite 3L, 1L	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
199	UK_ENV_GRAB_35	DVV	74	12:30	04/10/2023	90 80	F2 F3	5L 5L	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
200	UK_ENV_TR_34	Seabug Camera System and CTD	78	14:00	04/10/2023	-	-	-	0-2	-	-	Data monitor froze so no overlay position was displaying on the video - camera transect restarted and named UK_ENV_TR_34_R1
									2-5	-	-	
									5-10	-	-	
201	UK_ENV_GRAB_34	HG	78	15:04	04/10/2023	40	PC	Full suite	0-2	2.5Y 5/3	Sandy gravel	Sediment not suitable for redox or pH. Hamon grab used due to coarse sediment observed on the camera.
									2-5	2.5Y 5/3	Sandy gravel	
									5-10	2.5Y 5/3	Sandy gravel	
202	UK_ENV_GRAB_34	HG	78	15:19	04/10/2023	40	F1	5L	0-2	2.5Y 5/3	Sandy gravel	-
									2-5	2.5Y 5/3	Sandy gravel	
									5-10	2.5Y 5/3	Sandy gravel	
203	UK_ENV_GRAB_34	HG	78	15:30	04/10/2023	20	NS	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
204	UK_ENV_GRAB_34	HG	78	15:38	04/10/2023	40	F2	5L	0-2	2.5Y 5/3	Sandy gravel	-
									2-5	2.5Y 5/3	Sandy gravel	
									5-10	2.5Y 5/3	Sandy gravel	
205	UK_ENV_GRAB_34	HG	78	15:49	04/10/2023	40	F3	5L	0-2	2.5Y 5/3	Sandy gravel	-
									2-5	2.5Y 5/3	Sandy gravel	
									5-10	2.5Y 5/3	Sandy gravel	
206	UK_ENV_TR_33	Seabug Camera System	80	19:"0	04/10/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
207	UK_ENV_GRAB_33	DVV	80	20:05	04/10/2023	70 40	PC F1	Full suite 5L, 5L	0-2	2.5Y 5/3	Gravelly Coarse Sand	Sediment not suitable for redox or pH.
									2-5	2.5Y 5/3	Gravelly Coarse Sand	

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
									5-10	2.5Y 5/3	Gravelly Coarse Sand	
208	UK_ENV_GRAB_33	DVV	80	20:25	04/10/2023	0 0	NS NS	-	0-2 2-5 5-10	- - -	- - -	Triggered in the water column
209	UK_ENV_GRAB_33	DVV	80	20:28	04/10/2023	0 0	NS NS	-	0-2 2-5 5-10	- - -	- - -	Triggered in the splash zone
210	UK_ENV_GRAB_33	DVV	80	20:31	04/10/2023	0 0	NS NS	-	0-2 2-5 5-10	- - -	- - -	Triggered in the splash zone
211	UK_ENV_GRAB_33	DVV	80	20:37	04/10/2023	40 0	F2 NS	3L	0-2 2-5 5-10	2.5Y 5/3 2.5Y 5/3 2.5Y 5/3	Gravelly Coarse Sand Gravelly Coarse Sand Gravelly Coarse Sand	-
212	UK_ENV_GRAB_33	DVV	80	20:49	04/10/2023	0 0	NS NS	-	0-2 2-5 5-10	- - -	- - -	-
213	UK_ENV_GRAB_33	DVV	80	20:57	04/10/2023	40	F3	3L	0-2 2-5 5-10	2.5Y 5/3 2.5Y 5/3 2.5Y 5/3	Gravelly Coarse Sand Gravelly Coarse Sand Gravelly Coarse Sand	-
214	UK_ENV_TR_32	Seabug Camera System	85	01:50	05/10/2023	-	-	-	0-2 2-5 5-10	- - -	- - -	Fish obscuring view - try repeat transect labelled UK_ENV_TR_32_R1
215	UK_ENV_GRAB_32	DVV	85	02:44	05/10/2023	0 5	NS NS	-	0-2 2-5 5-10	2.5Y 4/2 2.5Y 4/2 2.5Y 4/2	Silty sandy gravel with cobbles Silty sandy gravel with cobbles Silty sandy gravel with cobbles	-
216	UK_ENV_GRAB_32	DVV	85	02:55	05/10/2023	0 0	NS NS	-	0-2 2-5 5-10	2.5Y 4/2 2.5Y 4/2 2.5Y 4/2	Silty sandy gravel with cobbles Silty sandy gravel with cobbles Silty sandy gravel with cobbles	-
217	UK_ENV_GRAB_32	HG	85	07:07	05/10/2023	<5	NS	-	0-2 2-5 5-10	2.5Y 4/2 2.5Y 4/2 2.5Y 4/2	Silty sandy gravel with cobbles Silty sandy gravel with cobbles Silty sandy gravel with cobbles	-
218	UK_ENV_GRAB_32	HG	85	07:15	05/10/2023	<5	NS	-	0-2 2-5 5-10	2.5Y 4/2 2.5Y 4/2 2.5Y 4/2	Silty sandy gravel with cobbles Silty sandy gravel with cobbles Silty sandy gravel with cobbles	-
219	UK_ENV_GRAB_32	HG	85	07:25	05/10/2023	<5	NS	-	0-2 2-5 5-10	2.5Y 4/2 2.5Y 4/2 2.5Y 4/2	Silty sandy gravel with cobbles Silty sandy gravel with cobbles Silty sandy gravel with cobbles	-

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
220	UK_ENV_GRAB_32	HG	85	07:36	05/10/2023	<5	NS	-	0-2	2.5Y 4/2	Silty sandy gravel with cobbles	-
									2-5	2.5Y 4/2	Silty sandy gravel with cobbles	
									5-10	2.5Y 4/2	Silty sandy gravel with cobbles	
221	UK_ENV_TR_31	Seabug Camera System and CTD	88	03:00	07/10/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
222	UK_ENV_GRAB_31	HG	88	03:33	07/10/2023	<5	NS	-	0-2	2.5Y 5/3	Coarse sand with shell debris & gravel	-
									2-5	2.5Y 5/3	Coarse sand with shell debris & gravel	
									5-10	2.5Y 5/3	Coarse sand with shell debris & gravel	
223	UK_ENV_GRAB_31	HG	88	03:43	07/10/2023	0	NS	-	0-2	2.5Y 5/3	Coarse sand with shell debris & gravel	-
									2-5	2.5Y 5/3	Coarse sand with shell debris & gravel	
									5-10	2.5Y 5/3	Coarse sand with shell debris & gravel	
224	UK_ENV_GRAB_31	HG	88	03:53	07/10/2023	<5	NS	-	0-2	2.5Y 5/3	Coarse sand with shell debris & gravel	-
									2-5	2.5Y 5/3	Coarse sand with shell debris & gravel	
									5-10	2.5Y 5/3	Coarse sand with shell debris & gravel	
225	UK_ENV_GRAB_31	HG	88	04:02	07/10/2023	0	NS	-	0-2	2.5Y 5/3	Coarse sand with shell debris & gravel	-
									2-5	2.5Y 5/3	Coarse sand with shell debris & gravel	
									5-10	2.5Y 5/3	Coarse sand with shell debris & gravel	
226	UK_ENV_GRAB_31	HG	88	04:16	07/10/2023	<5	NS	-	0-2	2.5Y 5/3	Coarse sand with shell debris & gravel	Switched to DVV
									2-5	2.5Y 5/3	Coarse sand with shell debris & gravel	
									5-10	2.5Y 5/3	Coarse sand with shell debris & gravel	
227	UK_ENV_GRAB_31	DVV	88	04:39	07/10/2023	30 20	PC F1	Full suite 3L	0-2	2.5Y 5/3	Coarse sand with shell debris & gravel	-
									2-5	2.5Y 5/3	Coarse sand with shell debris & gravel	
									5-10	2.5Y 5/3	Coarse sand with shell debris & gravel	
228	UK_ENV_GRAB_31	DVV	88	04:57	07/10/2023	20 0	F2 NS	1L	0-2	2.5Y 5/3	Coarse sand with shell debris & gravel	No sieve photos
									2-5	2.5Y 5/3	Coarse sand with shell debris & gravel	
									5-10	2.5Y 5/3	Coarse sand with shell debris & gravel	
229	UK_ENV_GRAB_31	DVV	88	05:09	07/10/2023	20	F3	1L	0-2	2.5Y 5/3	Coarse sand with shell debris & gravel	-
									2-5	2.5Y 5/3	Coarse sand with shell debris & gravel	
									5-10	2.5Y 5/3	Coarse sand with shell debris & gravel	
230	UK_ENV_CTD_31	CTD	88	07:36	07/10/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
231	UK_ENV_TR_30	Seabug Camera System	93	09:38	07/10/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	

St#	Station	Sampler Used	Water Depth (m)	Time	Date	Volume Recovered %/depth (cm)	Sample Name	Container Type	Sediment Characteristic			Conspicuous fauna/comments
									Stratification (cm)	Colour	Sediment Description	
232	UK_ENV_GRAB_30	DVV	93	10:14	07/10/2023	70 80	PC F1	Full suite 5L 3L	0-2	2.5Y 5/3	Coarse sand with shell debris	-
									2-5	2.5Y 5/3	Coarse sand with shell debris	
									5-10	2.5Y 5/3	Coarse sand with shell debris	
233	UK_ENV_GRAB_30	DVV	93	10:28	07/10/2023	60 60	F2 F3	5L 5L 3L	0-2	2.5Y 5/3	Coarse sand with shell debris	-
									2-5	2.5Y 5/3	Coarse sand with shell debris	
									5-10	2.5Y 5/3	Coarse sand with shell debris	
234	UK_ENV_TR_29		93	13:45	07/10/2023	-	-	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
235	UK_ENV_GRAB_29	DVV	93	14:14	07/10/2023	5 5	NS NS	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
236	UK_ENV_GRAB_29	HG	93	14:35	07/10/2023	0	NS	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
237	UK_ENV_GRAB_29	HG	93	14:44	07/10/2023	5	NS	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	
238	UK_ENV_GRAB_29	HG	93	14:54	07/10/2023	0	NS	-	0-2	-	-	-
									2-5	-	-	
									5-10	-	-	

APPENDIX Q – CAMERA TRANSECT LOG SHEET

Station	Date	Time (UTC)	Easting (m)	Northing (m)	Distance (m)	Water Depth (m)	Sediment Type	Taxa Observed	EUNIS/JNCC Habitat Classification
UK_05	06/09/2023	00:48:35	651 780	5 466 222	27	113.58	Rippled gravelly coarse sands	Bryozoan/Hydrozoan turf	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	06/09/2023	00:50:23	651 765	5 466 244		113.86			
	06/09/2023	00:50:23	651 765	5 466 244	69	113.86	Rippled sands	Bryozoan/Hydrozoan turf	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	06/09/2023	00:55:15	651 732	5 466 304		113.76			
	06/09/2023	00:55:15	651 732	5 466 304	32	113.76	Rippled gravelly coarse sands	Actiniaria, *Atelecyclus rotundatus*, Bryozoan/Hydrozoan turf, Ophiuroidea, *Pagurus* sp., Serpulidae	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	06/09/2023	00:57:11	651 722	5 466 334		113.92			
UK_04	06/09/2023	09:56:37	656 198	5 457 281	65	120.74	Rippled sands with minor shell debris in troughs	Bryozoan/Hydrozoan turf, Cephalopoda, Cerianthidae, *Hyalinoecia tubicola*, Porifera	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	06/09/2023	10:01:10	656 168	5 457 339		118.52			
UK_03	06/09/2023	14:47:09	660 620	5 448 306	69	116.80	Rippled sands with minor shell debris in troughs. Singular boulder	Bryozoan/Hydrozoan turf, Octopoda, Porifera	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	06/09/2023	14:56:01	660 594	5 448 370		117.82			
UK_02	06/09/2023	19:41:25	665 053	5 439 334	80	124.67	Rippled gravelly sands with moderate shell debris and pebbles in troughs. Occasional cobbles and boulders	Actiniaria, Bryozoan/Hydrozoan turf, Haleciidae, *Macropodia rostrata*, Majidae, *Pagurus* sp., Plumularioidea, Porifera, Sabellidae, *Sebastes* sp., Tubuliporidae	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	06/09/2023	19:48:24	665 020	5 439 407		125.34			
UK_01	07/09/2023	00:24:28	669 326	5 430 682	94	124.07	Rippled gravelly sands with moderate shell debris and pebbles in troughs. Occasional cobbles and boulders	Actiniaria, Actinopterygii, Bryozoan/Hydrozoan turf, *Caryophyllia* sp., *Omalosecosa ramulosa* (Possible), *Pagurus* sp., Porifera, Serpulidae, Triglidae	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	07/09/2023	00:31:13	669 288	5 430 768		125.29			
UK_06	07/09/2023	08:40:26	647 346	5 475 209	80	119.24	Rippled gravelly muddy sands with minor shell debris in troughs. Singular boulder	Bryozoan/Hydrozoan turf, Callionymidae, *Caryophyllia* sp., Ophiuroidea, Pectinidae, Porifera	Offshore Circalittoral Mixed Sediment (SS.SMx.OMx/MD42)
	07/09/2023	08:46:13	647 313	5 475 282		115.32			
UK_07	07/09/2023	13:50:54	643 021	5 484 206	67	119.83	Rippled gravelly muddy sands with minor shell debris in troughs	Actiniaria, Bryozoan/Hydrozoan turf, *Caryophyllia* sp.	Offshore Circalittoral Mixed Sediment (SS.SMx.OMx/MD42)
	07/09/2023	13:57:49	643 014	5 484 273		118.91			
UK_08	10/09/2023	19:34:31	642 925	5 484 701	81	118.37	Slightly gravelly muddy rippled sand with moderate shell debris	Actiniaria, Actinopterygii, *Brachyura* sp., Bryozoan/Hydrozoan turf, *Caryophyllia* sp., *Mesacmaea mitchellii*, Ophiuroidea, *Pagurus* sp., Pleuronectiformes, Sabellidae	Offshore Circalittoral Mixed Sediment (SS.SMx.OMx/MD42)
	10/09/2023	19:39:55	642 912	5 484 781		118.41			
UK_09	11/09/2023	03:24:38	641 220	5 493 513	138	120.52	Sandy mud with minor shell debris	Actiniaria, Actinopterygii, Bryozoan/Hydrozoan turf, Caridea, *Mesacmaea mitchellii*, *Ophiura Ophiura*, Ophiuroidea, *Scyliorhinus canicula*, *Sebastes* sp., *Sepiola atlantica*	Circalittoral Muddy Sand (SS.SSa.CMuSa/ MC52)
	11/09/2023	03:34:06	641 186	5 493 647		120.47			
UK_10	11/09/2023	07:14:57	640 463	5 503 474	74	115.90	Gravelly Muddy Sand. Singular cobble & boulder	Actinopterygii, Echinoidea, *Mesacmaea mitchellii*	Offshore Circalittoral Mixed Sediment (SS.SMx.OMx/MD42)
	11/09/2023	07:19:58	640 457	5 503 400		115.62			
UK_11	11/09/2023	15:03:12	642 095	5 513 812	74	115.73	Muddy Sand with minor shell debris	Caridea, *Nephrops norvegicus*	Circalittoral Muddy Sand (SS.SSa.CMuSa/ MC52)
	11/09/2023	15:11:08	642 075	5 513 741		115.96			
UK_12	11/09/2023	20:15:27	642 448	5 516 112	79	108.77	Gravelly coarse sands/ shingle with high proportions of shell debris	Caridea, Ophiuroidea, *Pagurus* sp., Pleuronectiformes, *Sebastes* sp.	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	11/09/2023	20:20:28	642 439	5 516 034		108.73			
UK_13	11/09/2023	23:32:50	642 491	5 516 352	77	112.97	Rippled muddy sand	*Bolocera tuediae*, *Brachyura* sp., Bryozoan/Hydrozoan turf, Caridea, *Mesacmaea mitchellii*, *Ophiura ophiura*, *Pagurus* sp., Pleuronectiformes, Porifera, *Scyliorhinus canicula*	Circalittoral Muddy Sand (SS.SSa.CMuSa/ MC52)
	11/09/2023	23:37:53	642 503	5 516 429		113.35			
UK_14	12/09/2023	06:04:48	642 900	5 518 826	69	113.88	Gravelly muddy sand with minor shell debris. Rare cobbles	Actiniaria, Bryozoan/Hydrozoan turf, *Mesacmaea mitchellii*, Munididae, Octopoda, Pleuronectiformes	Offshore Circalittoral Mixed Sediment (SS.SMx.OMx/MD42)
	12/09/2023	06:09:30	642 895	5 518 757		113.85			
	12/09/2023	06:09:30	642 895	5 518 757	20	113.85	Gravelly muddy sand with minor shell debris, cobbles, boulders & exposed scarp	*Amphilectus fucorum*, Asteroidea, *Bolocera tuediae*, *Brachyura* sp., Bryozoan/Hydrozoan turf, *Buccinum undatum*, Caridea, *Caryophyllia* sp., Haleciidae, *Molva molva*, Munididae, *Nemertesia* sp., *Omalosecosa ramulosa* (Possible), Plumularioidea, Porifera, Serpulidae	Offshore Circalittoral Mixed Sediment (SS.SMx.OMx/MD42)
	12/09/2023	06:10:55	642 893	5 518 737		112.85			
	12/09/2023	06:10:55	642 893	5 518 737	16	112.85	Gravelly muddy sand with minor shell debris.	Actiniaria, Bryozoan/Hydrozoan turf, *Mesacmaea mitchellii*, *Pollachius pollachius*, Porifera	Offshore Circalittoral Mixed Sediment (SS.SMx.OMx/MD42)
	12/09/2023	06:11:54	642 892	5 518 721		112.76			
UK_15	12/09/2023	08:59:04	643 652	5 523 701	89	109.32	Muddy sand with minor shell debris	Actiniaria, *Brachyura* sp., Bryozoan/Hydrozoan turf, *Caryophyllia* sp., Echinoidea, *Mesacmaea mitchellii*, Octopoda, Pectinidae, *Sepiola atlantica*	Offshore Circalittoral Mixed Sediment (SS.SMx.OMx/MD42)
	12/09/2023	09:08:26	643 637	5 523 613		108.41			

Station	Date	Time (UTC)	Easting (m)	Northing (m)	Distance (m)	Water Depth (m)	Sediment Type	Taxa Observed	EUNIS/JNCC Habitat Classification
UK_16	13/09/2023	06:02:52	645 189	5 533 472	10	111.51	Coarse gravelly sand with high proportions of shell debris and rare cobbles	*Mesacmaea mitchellii*, Serpulidae	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	13/09/2023	06:04:24	645 189	5 533 482		111.38			
	13/09/2023	06:04:24	645 189	5 533 482	23	111.38	Rippled coarse sands	Actiniaria, *Cancer pagurus*, *Pagurus* sp.	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	13/09/2023	06:06:03	645 192	5 533 505		111.25			
	13/09/2023	06:06:03	645 192	5 533 505	64	111.25	Slightly muddy gravelly sand with high proportions of shell debris in troughs	Bryozoan/Hydrozoan turf	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	13/09/2023	06:10:39	645 206	5 533 567		111.51			
UK_17	13/09/2023	12:16:30	647 943	5 542 647	66	107.24	Rippled sand with minor shell debris	Caridea, Cephalopoda, Pleuronectiformes	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	13/09/2023	12:20:48	647 965	5 542 709		107.33			
UK_18	13/09/2023	18:24:00	651 573	5 552 377	78	106.65	Rippled sand with minor shell debris	*Pagurus* sp., Pleuronectiformes	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	13/09/2023	18:29:39	651 599	5 552 451		106.63			
UK_19	13/09/2023	23:16:41	654 721	5 560 817	91	99.43	Gravelly muddy sand with moderate shell debris. Variable cobbles and boulders	Actiniaria, Asteroidea, *Axinella* sp., *Bolocera tuediae*, *Brachyura* sp., Bryozoan/Hydrozoan turf, Caridea, *Caryophyllia* sp., *Cellaria* sp., *Echinus esculentus*, *Hyas* sp., *Hymedesmiidae*, Munididae, *Pagurus* sp., *Pachycerianthus multiplicatus*, Pectinidae, *Pleuronectiform es*, Plumularioidea, Porifera, Sabellidae, *Sebastes* sp., Serpulidae, *Stelligera stuposa*, *Suberites* sp., Triglidae	Offshore Circalittoral Mixed Sediment (SS.SMx.OMx/MD42)
	13/09/2023	23:23:49	654 756	5 560 902		98.75			
UK_20	14/09/2023	07:04:39	659 342	5 570 658	33	102.23	Gravelly sand muddy with moderate shell debris and pebbles. Abundant cobbles and boulders	Actiniaria, Bryozoan/Hydrozoan turf, *Caryophyllia* sp., *Cellaria* sp., *Echinus esculentus*, Munididae, *Ophiocomina nigra*, *Ophiura albida*, Ophiuroidea, Plumularioidea	Offshore Circalittoral Mixed Sediment (SS.SMx.OMx/MD42)
	14/09/2023	07:08:22	659 318	5 570 635		102.35			
	14/09/2023	07:08:22	659 318	5 570 635	37	102.35	Muddy rippled sand with minor shell debris in troughs	Asteroidea, *Caryophyllia* sp., Octopoda, *Ophiura albida*	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	14/09/2023	07:12:17	659 289	5 570 612		102.39			
UK_21	14/09/2023	15:16:44	666 936	5 577 052	64	98.99	Rippled coarse sand with high proportions of shell debris	Actiniaria, *Asterias rubens*, Asteroidea, Bryozoan/Hydrozoan turf, *Luidia ciliaris*, Ophiuroidea, *Spatangus purpureus*	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	14/09/2023	15:23:16	666 984	5 577 094		99.60			
UK_22	14/09/2023	20:29:23	672 164	5 581 437	65	96.22	Rippled sand. Occasional cobbles and boulders	*Bolocera tuediae*, *Capros aper*, Caridea, *Caryophyllia* sp., *Neptunea despecta*, *Pagurus* sp., *Pleuronectiform es*, *Spatangus purpureus*	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	14/09/2023	20:34:03	672 213	5 581 480		96.46			
	14/09/2023	20:34:03	672 213	5 581 480	16	96.46	Gravelly coarse sand with high proportions of shell debris	*Capros aper*	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	14/09/2023	20:35:04	672 224	5 581 491		96.19			
UK_23	15/09/2023	01:34:47	674 640	5 583 541	12	99.73	Gravelly coarse sand with high proportions of shell debris and pebbles	Serpulidae	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	15/09/2023	01:36:04	674 631	5 583 534		99.51			
	15/09/2023	01:36:04	674 631	5 583 534	17	99.51	Rippled coarse sand	*Brachyura* sp., Hydrozoa, *Pagurus* sp.	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	15/09/2023	01:37:18	674 619	5 583 522		99.59			
	15/09/2023	01:37:18	674 619	5 583 522	44	99.59	Gravelly coarse sand with high proportions of shell debris and pebbles.	Actinopterygii, *Echinocardium cordatum*	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	15/09/2023	01:40:09	674 587	5 583 492		99.75			
UK_24	15/09/2023	06:09:57	676 691	5 585 236	75	98.32	Rippled gravelly sand with high proportions of shell debris and pebbles in troughs	Actiniaria, Actinopterygii, Decapoda, *Echinus esculentus*, Hydrozoa, Pectinidae, Serpulidae, *Spatangus purpureus*	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	15/09/2023	06:16:00	676 634	5 585 187		98.71			
UK_25	15/09/2023	12:26:57	682 008	5 588 584	31	98.55	Gravelly coarse sand with high proportions of shell debris intersected by minor sand waves	Actinopterygii, *Pagurus* sp.	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	15/09/2023	12:29:59	681 981	5 588 569		98.48			
	15/09/2023	12:29:59	681 981	5 588 569	28	98.48	Rippled sand	-	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	15/09/2023	12:31:43	681 956	5 588 555		98.46			
	15/09/2023	12:31:43	681 956	5 588 555	20	98.46	Gravelly coarse sand with high proportions of shell debris intersected by minor sand waves	-	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	15/09/2023	12:32:56	681 939	5 588 545		98.52			
UK_26	15/09/2023	12:13:01	682 149	5 588 663	19	98.69	Gravelly coarse sand with high proportions of shell debris	Actinopterygii, *Pagurus* sp., *Stichastrella rosea*	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	15/09/2023	12:14:30	682 132	5 588 654		98.44			
	15/09/2023	12:14:30	682 132	5 588 654	29	98.44	Rippled sand	Actinopterygii, Gastropoda, Sabellidae	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	15/09/2023	12:16:30	682 106	5 588 640		98.58			
	15/09/2023	12:16:30	682 106	5 588 640	13	98.58	Gravelly coarse sand with high proportions of shell debris intersected by minor sand waves	Actinopterygii, Pleuronectiformes	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	15/09/2023	12:17:04	682 095	5 588 634		98.71			

Station	Date	Time (UTC)	Easting (m)	Northing (m)	Distance (m)	Water Depth (m)	Sediment Type	Taxa Observed	EUNIS/JNCC Habitat Classification
UK_27	15/09/2023	17:59:22	682 909	5 589 089	74	97.69	Gravelly coarse sand with moderate shell debris	Actinopterygii, *Astropecten irregularis*, Callionymidae, *Pagurus* sp., *Stichastrella rosea*	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	15/09/2023	18:04:05	682 850	5 589 045		98.61			
UK_28	15/09/2023	19:41:40	684 388	5 589 876	46	97.93	Rippled gravelly coarse sand with high proportions of shell debris and pebbles in troughs	Actiniaria, *Bolocera tuediae*, Octopoda, *Porania pulvillus*	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	15/09/2023	19:44:55	684 428	5 589 900		97.86			
	15/09/2023	19:44:55	684 428	5 589 900	7	97.86	Rippled sand with minor shell debris	Actiniaria, *Bolocera tuediae*, Callionymidae, Octopoda, *Porania pulvillus*	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	15/09/2023	19:45:36	684 435	5 589 903		97.80			
	15/09/2023	19:45:36	684 435	5 589 903	24	97.80	Rippled gravelly coarse sand with high proportions of shell debris and pebbles in troughs	-	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	15/09/2023	19:47:33	684 455	5 589 915		97.87			
UK_43	16/09/2023	11:28:11	345 576	5 651 486	79	67.68	Rippled sand with slightly coarser sand in troughs. Occasional cobble	Actiniaria, *Bolocera tuediae*, *Brachyura* sp., *Caryophyllia* sp., *Marthasterias glacialis*, *Pagurus* sp., Plumularioidea	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	16/09/2023	11:38:05	345 628	5 651 546		68.44			
UK_46	16/09/2023	18:08:35	373 333	5 662 108	70	61.55	Pebbly Gravelly Sand with high proportions of shell debris	*Brachyura* sp., Bryozoan/Hydrozoan turf, *Maja squinado*, Ophiuroidea, Pectinidae, *Scyliorhinus canicula*, Triglidae	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	16/09/2023	18:13:26	373 398	5 662 135		61.48			
UK_45	16/09/2023	22:20:49	364 005	5 658 719	78	61.75	Rippled sand with slightly coarser sand and minor shell debris in troughs. Rare cobbles	Actiniaria, *Alcyonium digitatum*, Bryozoan/Hydrozoan turf, *Capros aper*, *Echinus esculentus*, *Lanice conchilega*, *Marthasterias glacialis*, Ophiuroidea, *Pagurus* sp., Pleuronectiformes, Serpulidae	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	16/09/2023	22:27:18	363 931	5 658 693		61.64			
UK_44	17/09/2023	01:02:08	354 427	5 655 720	78	65.04	Rippled sand with slightly coarser sand and minor shell debris in troughs. Rare cobbles	Actiniaria, Actinopterygii, *Capros aper*, Cephalopoda, Hydrozoa, *Lanice conchilega*, Ophiuroidea, *Pagurus* sp.	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	17/09/2023	01:07:41	354 350	5 655 704		64.76			
UK_42	17/09/2023	10:50:49	342 562	5 647 820	69	68.60	Rippled sand with slightly coarser sand in troughs. Rare cobbles	Actiniaria, *Alcyonidium diaphanum*, Bryozoan/Hydrozoan turf, *Pagurus* sp., Sabellidae	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	17/09/2023	10:59:10	342 520	5 647 765		68.73			
UK_41	17/09/2023	13:03:50	339 231	5 643 760	5	75.01	Rippled sand	Bryozoan/Hydrozoan turf, Pleuronectiformes, Triglidae	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	17/09/2023	13:04:23	339 234	5 643 764		75.15			
	17/09/2023	13:04:23	339 234	5 643 764	14	75.15	Rippled sand with slightly coarser sand in troughs.	Ophiuroidea	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	17/09/2023	13:05:29	339 243	5 643 774		75.00			
	17/09/2023	13:05:29	339 243	5 643 774	12	75.00	Rippled sand	-	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	17/09/2023	13:06:17	339 250	5 643 784		75.21			
	17/09/2023	13:06:17	339 250	5 643 784	11	75.21	Rippled sand with slightly coarser sand in troughs.	Actinopterygii, *Pagurus* sp., Porifera	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	17/09/2023	13:07:04	339 257	5 643 793		75.09			
	17/09/2023	13:07:04	339 257	5 643 793	13	75.09	Rippled sand	*Astropecten irregularis*	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	17/09/2023	13:07:52	339 265	5 643 803		75.05			
	17/09/2023	13:07:52	339 265	5 643 803	21	75.05	Rippled sand with slightly coarser sand in troughs.	*Astropecten irregularis*, *Pagurus* sp.	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	17/09/2023	13:09:12	339 278	5 643 820		75.08			
UK_40	17/09/2023	17:33:23	335 431	5 639 132	77	75.09	Rippled sand with slightly coarser sand in troughs. Abundant cobbles and boulders	Actiniaria, Actinopterygii, *Brachyura* sp., Bryozoan/Hydrozoan turf, Callionymidae, *Cancer pagurus*, *Cellaria* sp.	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	17/09/2023	17:38:59	335 380	5 639 074		75.85			
UK_61	23/09/2023	09:59:55	410 505	5 653 948	101	10.44	Rippled sand	*Pagurus* sp.	Infralittoral Fine Sand (SS.SSa.IFiSa/MB52)
	23/09/2023	10:53:26	410 442	5 654 027		13.45			
	23/09/2023	10:57:54	410 441	5 654 029	23	12.30	Rippled sand	-	Infralittoral Fine Sand (SS.SSa.IFiSa/MB52)
	23/09/2023	11:21:07	410 457	5 654 012		13.31			
	23/09/2023	11:28:15	410 466	5 654 000	7	9.32	Rippled sand	-	Infralittoral Fine Sand (veneer over rock) (SS.SSa.IFiSa/MB52)
	23/09/2023	11:30:42	410 469	5 653 994		13.22			
UK_59	23/09/2023	13:06:23	409 545	5 654 197	71	15.32	Rippled sand	*Pagurus* sp.	Infralittoral Fine Sand (SS.SSa.IFiSa/MB52)
	23/09/2023	13:32:05	409 475	5 654 209		15.27			
UK_53	23/09/2023	18:14:05	400 553	5 658 872	56	31.03	Rippled sand	Actinopterygii, *Pagurus* sp.	Circalittoral Fine Sand (SS.SSa.CFiSa/MC52)
	23/09/2023	18:21:09	400 503	5 658 897		31.40			
UK_56	29/09/2023	04:27:43	405 680	5 655 682	71	23.47	Rippled sand	Ophiuroidea, *Pagurus* sp., Terebellidae	Infralittoral Fine Sand (SS.SSa.IFiSa/MB52)
	29/09/2023	04:35:56	405 612	5 655 703		23.31			

Station	Date	Time (UTC)	Easting (m)	Northing (m)	Distance (m)	Water Depth (m)	Sediment Type	Taxa Observed	EUNIS/JNCC Habitat Classification
UK_60	29/09/2023	07:07:17	410 381	5 654 014	80	10.60	Rippled sand	Gastropoda	Infralittoral Fine Sand (SS.SSa.IFiSa/MB52)
	29/09/2023	07:34:08	410 305	5 654 038		10.75			
UK_58	29/09/2023	11:29:20	408 415	5 654 482	55	8.81	Rippled sand	Ophiuroidea	Infralittoral Fine Sand (SS.SSa.IFiSa/MB52)
	29/09/2023	11:36:41	408 365	5 654 506		11.49			
UK_57	29/09/2023	13:01:37	407 518	5 654 924	60	13.27	Seabed not visible due to turbidity	-	Infralittoral Fine Sand (SS.SSa.IFiSa/MB52)
	29/09/2023	13:09:05	407 464	5 654 950		14.08			
UK_55	29/09/2023	14:47:40	403 871	5 656 541	60	20.73	Rippled sand	*Macropodia rostrata*, *Pagurus* sp.	Infralittoral Fine Sand (SS.SSa.IFiSa/MB52)
	29/09/2023	14:54:10	403 825	5 656 580		21.25			
UK_54	29/09/2023	16:25:57	402 349	5 657 944	68	22.09	Rippled sand	-	Circalittoral Fine Sand (SS.SSa.CFiSa/MC52)
	29/09/2023	16:35:33	402 291	5 657 979		23.04			
UK_52	29/09/2023	20:30:19	397 149	5 662 888	68	44.85	Rippled slightly muddy gravelly sand with pebbles and moderate shell debris. (Very mobile)	*Nemertesia* sp., *Pagurus* sp.	Circalittoral Coarse Sediment (SS.SCS.CCS/MC32)
	29/09/2023	20:39:06	397 200	5 662 843		43.36			
UK_51	30/09/2023	00:19:18	393 024	5 664 561	62	49.23	Gravelly (*Sabellaria* rubble) sand with moderate shell debris and pebbles	Actiniaria, Brachyura, Bryozoan/Hydrozoan turf, Caridea, Haleciidae, *Macropodia rostrata*, Munididae, *Nemertesia* sp., *Ophiura albida*, *Pagurus* sp., Pectinidae, *Pisidia longicornis*, *Stomphia coccinea*	Circalittoral Coarse Sediment (SS.SCS.CCS/MC32)
	30/09/2023	00:25:39	393 085	5 664 553		48.29			
UK_50	30/09/2023	09:06:12	383 096	5 663 978	69	54.59	Pebbly Cobbley Sandy Gravel matrix with occasional boulders	Actiniaria, Actinopterygii, Antedonidae, *Brachyura* sp., Bryozoan/Hydrozoan turf, *Caryophyllia* sp., Haleciidae, *Macropodia rostrata*, *Marthasterias glacialis*, Munididae, *Nemertesia* sp., *Pentapora facialis*, Porifera, Rajidae, *Scyliorhinus canicula*, *Tubularia* sp.	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	30/09/2023	09:17:40	383 165	5 663 970		54.68			
UK_49	30/09/2023	12:05:48	381 298	5 663 944	79	57.51	Fauna covered cobbly rocky outcrop with veneer of sandy gravel and pebbles	Actiniaria, Actinopterygii, *Alcyonidium diaphanum*, *Brachyura* sp., Bryozoan/Hydrozoan turf, *Echinus esculentus*, Haleciidae, *Macropodia rostrata*, *Marthasterias glacialis*, Munididae, *Nemertesia* sp., *Pagurus* sp., *Pentapora facialis*, Porifera, *Tubularia* sp.	Mixed faunal turf communities (CR.HCR.Xfa)
	30/09/2023	12:17:02	381 326	5 663 871		57.38			
	30/09/2023	12:17:02	381 326	5 663 871	108	57.38	Frequent outcropping of bedrock intermixed with pebbly cobbly sandy gravel	Actiniaria, *Alcyonidium diaphanum*, Bryozoan/Hydrozoan turf, Haleciidae, *Macropodia rostrata*, Munididae, *Pagurus* sp., Porifera	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	30/09/2023	12:29:55	381 348	5 663 765		57.05			
	30/09/2023	12:29:55	381 348	5 663 765	39	57.05	Fauna covered rocky outcrops with veneer of sandy gravel and pebbles	Actiniaria, *Alcyonidium diaphanum*, *Brachyura* sp., Bryozoan/Hydrozoan turf, *Echinus esculentus*, Haleciidae, *Macropodia rostrata*, *Marthasterias glacialis*, Munididae, *Nemertesia* sp., *Pagurus* sp., *Pentapora facialis*, Porifera	Mixed faunal turf communities (CR.HCR.Xfa)
	30/09/2023	12:35:16	381 357	5 663 728		56.83			
UK_48	01/10/2023	07:24:12	380 939	5 663 934	137	57.20	Large fauna covered rocky outcrops with veneer of sandy gravel, pebbles, and cobbles	Actiniaria, Actinopterygii, *Alcyonidium diaphanum*, *Anguilla anguilla*, Antedonidae, *Brachyura* sp., Bryozoan/Hydrozoan turf, *Caryophyllia* sp., Cephalopoda, Gastropoda, Haleciidae, Hydrozoa, *Macropodia rostrata*, *Marthasterias glacialis*, Munididae, *Nemertesia* sp., Pectinidae, *Pentapora facialis*, *Porella compressa*, Porifera, *Scyliorhinus canicula*, *Stelligera stuposa*	Mixed faunal turf communities (CR.HCR.Xfa)
	01/10/2023	07:38:48	380 880	5 663 811		57.53			
	01/10/2023	07:38:48	380 880	5 663 811	85	57.53	Sporadic outcropping of bedrock intermixed with pebbly cobbly sandy gravel	Actiniaria, *Alcyonidium diaphanum*, *Axinella* sp., Bryozoan/Hydrozoan turf, *Caryophyllia* sp., Haleciidae, Hydrozoa, *Macropodia rostrata*, *Nemertesia* sp., *Pentapora facialis*, Porifera	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	01/10/2023	07:47:21	380 841	5 663 735		57.08			
	01/10/2023	07:47:21	380 841	5 663 735	103	57.08	Large fauna covered rocky outcrops with veneer of sandy gravel, pebbles, and cobbles	Actiniaria, Actinopterygii, *Alcyonidium diaphanum*, *Anguilla anguilla*, Antedonidae, *Atelecyclus rotundatus*, *Brachyura* sp., Bryozoan/Hydrozoan turf, *Caryophyllia* sp., Gastropoda, Haleciidae, Hydrozoa, *Hyas* sp., *Macropodia rostrata*, Munididae, *Nemertesia* sp., *Pentapora facialis*, *Porella compressa*, Porifera, *Stelligera stuposa*	Mixed faunal turf communities (CR.HCR.Xfa)
	01/10/2023	07:58:21	380 795	5 663 643		56.46			

Station	Date	Time (UTC)	Easting (m)	Northing (m)	Distance (m)	Water Depth (m)	Sediment Type	Taxa Observed	EUNIS/JNCC Habitat Classification
UK_47	02/10/2023	01:46:29	377 921	5 663 141	32	56.97	Gravelly sand with high proportions of shell debris	Actiniaria, Actinopterygii, *Alcyonium digitatum*, *Brachyura* sp., Bryozoan/Hydrozoan turf, Haleciidae, *Macropodia rostrata*, *Marthasterias glacialis*, *Metridium senile*, Munididae, *Nemertesia* sp., Ophiuroidea, *Pagurus* sp., Porifera, Triglidae	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	02/10/2023	01:50:09	377 952	5 663 147		56.68			
	02/10/2023	01:50:09	377 952	5 663 147	23	56.68	Fauna covered rocky outcrop with veneer of gravelly sand	-	Mixed faunal turf communities (CR.HCR.Xfa)
	02/10/2023	01:52:32	377 975	5 663 150		56.29			
	02/10/2023	01:52:32	377 975	5 663 150	30	56.29	Gravelly sand with high proportions of shell debris	-	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	02/10/2023	01:55:47	378 005	5 663 154		56.20			
	02/10/2023	01:55:47	378 005	5 663 154	154	56.20	Large fauna covered rocky outcrops with veneer of gravelly sand and shell debris.	Actiniaria, Actinopterygii, *Alcyonium digitatum*, Antedonidae, *Brachyura* sp., Bryozoan/Hydrozoan turf, Cephalopoda, *Echinus esculentus*, *Macropodia rostrata*, *Marthasterias glacialis*, *Metridium senile*, Munididae, Ophiuroidea, *Pagurus* sp., *Pentapora facialis*, Porifera, Triglidae	Mixed faunal turf communities (CR.HCR.Xfa)
	02/10/2023	02:12:11	378 158	5 663 175		56.58			
	02/10/2023	02:12:11	378 158	5 663 175	25	56.58	Sandy gravel with high proportions of shell debris and pebbles	Actiniaria, Actinopterygii, *Alcyonium digitatum*, Antedonidae, *Brachyura* sp., Bryozoan/Hydrozoan turf, Cephalopoda, *Echinus esculentus*, *Macropodia rostrata*, *Marthasterias glacialis*, *Metridium senile*, Munididae, Ophiuroidea, *Pagurus* sp., *Pentapora facialis*, Porifera, Triglidae	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	02/10/2023	02:15:04	378 182	5 663 179		56.45			
UK_39	02/10/2023	12:48:41	332 727	5 635 844	6	75.29	Rippled sand	Bryozoan/Hydrozoan turf	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	02/10/2023	12:49:23	332 730	5 635 849		75.20			
	02/10/2023	12:49:23	332 730	5 635 849	16	75.20	Rippled sand with slightly coarser sand in troughs.	Bryozoan/Hydrozoan turf	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	02/10/2023	12:51:05	332 741	5 635 860		75.16			
	02/10/2023	12:51:05	332 741	5 635 860	22	75.16	Rippled sand	-	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	02/10/2023	12:53:37	332 755	5 635 877		75.36			
	02/10/2023	12:53:37	332 755	5 635 877	13	75.36	Rippled sand with slightly coarser sand in troughs.	Bryozoan/Hydrozoan turf	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	02/10/2023	12:54:46	332 763	5 635 887		75.55			
UK_38	02/10/2023	18:52:48	329 465	5 631 882	63	75.53	Rippled sand with minor shell debris in troughs	Actinopterygii, Bryozoan/Hydrozoan turf, Ophiuroidea, Triglidae	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	02/10/2023	18:59:36	329 427	5 631 832		74.81			
UK_37	02/10/2023	21:47:50	326 537	5 628 317	66	71.41	Rippled sand with minor gravel and pebbles in troughs. Occasional cobbles and boulders	Actiniaria, Actinopterygii, Bryozoan/Hydrozoan turf, *Marthasterias glacialis*, Triglidae	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	02/10/2023	21:55:01	326 577	5 628 369		73.32			
UK_36	04/10/2023	05:08:02	323 470	5 624 577	21	75.82	Rippled sand with minor shell debris in troughs. Occasional cobbles and boulder	Actiniaria, Bryozoan/Hydrozoan turf, Caridea, *Macropodia rostrata*, *Pagurus* sp., *Scyliorhinus canicula,* Serpulidae, Triglidae	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	04/10/2023	05:10:39	323 454	5 624 564		75.79			
	04/10/2023	05:10:39	323 454	5 624 564	6	75.79	Rippled sand	-	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	04/10/2023	05:11:16	323 451	5 624 559		75.80			
	04/10/2023	05:11:16	323 451	5 624 559	12	75.80	Rippled sand with minor shell debris in troughs. Occasional cobbles and boulder	Actinopterygii, Bryozoan/Hydrozoan turf, Caridea	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	04/10/2023	05:12:30	323 444	5 624 549		75.79			
	04/10/2023	05:12:30	323 444	5 624 549	9	75.79	Rippled sand	Actiniaria, *Pagurus* sp., Sabellidae	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	04/10/2023	05:13:39	323 436	5 624 544		75.80			
UK_35	04/10/2023	11:42:17	320 293	5 620 717	66	70.42	Rippled sand	Actinopterygii, Asteroidea, *Brachyura* sp., Bryozoan/Hydrozoan turf, *Hormathia digitata*, *Macropodia rostrata*, *Marthasterias glacialis*, *Pagurus* sp.	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	04/10/2023	11:49:36	320 253	5 620 665		70.09			
UK_34	04/10/2023	14:38:37	313 342	5 616 810	59	71.92	Slightly muddy pebbly gravelly sand. Occasional cobbles.	Actinopterygii, Asteroidea, Bryozoan/Hydrozoan turf, *Marthasterias glacialis*, *Nemertesia* sp., *Pagurus* sp., Pectinidae, Triglidae	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	04/10/2023	14:45:12	313 288	5 616 786		72.83			
UK_33	04/10/2023	19:33:04	307 140	5 614 038	69	78.19	Rippled pebbly gravelly coarse sand with high proportions of shell debris	Actinopterygii, *Capros aper*, *Marthasterias glacialis*, *Pagurus* sp., Pectinidae, Pleuronectiformes, Triglidae	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	04/10/2023	19:40:26	307 076	5 614 011		78.19			
UK_32	05/10/2023	02:08:42	293 263	5 607 844	70	79.32	Pebbly sandy gravel with high proportions of shell debris. Common cobbles and boulders.	Actinopterygii, Asteroidea, Bryozoan/Hydrozoan turf, *Capros aper*, *Caryophyllia* sp., Echinoidea, Lophidae, *Pagurus* sp.	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	05/10/2023	02:29:02	293 199	5 607 816		80.20			
UK_31	05/10/2023	03:08:17	709 435	5 603 614	64	84.13	Slightly Pebbly Gravelly sand with moderate shell debris. Frequent cobbles.	Actiniaria, Actinopterygii, Bryozoan/Hydrozoan turf, *Capros aper*, Caridea, *Caryophyllia* sp., *Cellaria* sp., *Hyalinoecia tubicola*, *Nemertesia* sp., Octopoda, Ophiuroidea, *Pagurus* sp., Pleuronectiformes, *Stichastrella rosea*	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	05/10/2023	03:14:19	709 379	5 603 582		84.51			

Station	Date	Time (UTC)	Easting (m)	Northing (m)	Distance (m)	Water Depth (m)	Sediment Type	Taxa Observed	EUNIS/JNCC Habitat Classification
UK_30	07/10/2023	09:54:14	700 435	5 598 686	25	92.98	Rippled coarse sand with high proportions of shell debris.	Bryozoan/Hydrozoan turf, Gastropoda, Terebellidae, *Urticina* sp.	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	07/10/2023	09:57:17	700 413	5 598 674		92.74			
	07/10/2023	09:57:17	700 413	5 598 674	22	92.74	Rippled Sand	-	Offshore Circalittoral Sand (SS.SSa.OSa/MD52)
	07/10/2023	09:59:27	7003 94	5 598 663		93.07			
	07/10/2023	09:59:27	700 394	5 598 663	8	93.07	Rippled coarse sand with high proportions of shell debris.	Bryozoan/Hydrozoan turf, Pleuronectiformes	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	07/10/2023	10:00:32	700 387	5 598 659		93.12			
UK_29	05/10/2023	13:54:12	695 197	5 595 810	61	89.01	Pebbly gravelly sand with high proportions of shell debris. Abundant cobbles and boulders.	Asteroidea, Bryozoan/Hydrozoan turf, *Caryophyllia* sp., *Cellaria* sp., Octopoda, Pectinidae	Offshore Circalittoral Coarse Sediment (SS.SCS.OCS/MD32)
	05/10/2023	14:01:36	695 143	5 595 781		83.89			

APPENDIX R – MACROFAUNAL SPECIES LIST

2334 Infauna Matrix.pdf

2334 Epifauna & Others Matrix.pdf

APPENDIX S – SPEARMAN'S RANK CORRELATIONS

Spearman's Correlation Coefficient (Two-tailed)	
Number of Data Points	48
p=0.05, 95% Significant	0.285
p=0.01, 99% Significant	0.370
p=0.001, 99.9% Significant	0.465

	Water Depth (m)	Mean (mm)	Sorting	Skewness	Kurtosis	% Fines	% Sands	% Gravel	Total Organic Carbon (% dwt)	Total Organic Matter (% w/w)	Moisture Content (%)	Total Oil (mg.kg-1)	Total n alkanes (mg.g-1)	Carbon Preference Index	P/B Ratio	Proportion of Alkanes (%)	Total PAHs (µg.kg-1)	NPD PAHs (µg.kg-1)	Arsenic (mg.kg-1)	Cadmium (mg.kg-1)	Chromium (mg.kg-1)	Copper (mg.kg-1)	Lead (mg.kg-1)	Mercury (mg.kg-1)	Nickel (mg.kg-1)	Aluminium (mg.kg-1)	Iron (mg.kg-1)	Lithium (mg.kg-1)	Tin (mg.kg-1)	Magnesium (mg.kg-1)	Number of Species (S)	Number of Individuals (N)	Richness (Margalef)	Evenness (Pielou's)	Shannon Wiener Diversity	Simpsons Diversity (1-Lambda')
Water Depth (m)		-0.107	0.498	0.238	0.458	0.572	-0.377	0.228	0.413	0.210	0.347	0.126	0.033	0.059	-0.477	-0.299	-0.110	-0.213	-0.825	0.201	-0.253	-0.501	-0.814	-0.686	-0.587	-0.443	-0.759	-0.544	-0.648	-0.404	0.602	0.365	0.632	-0.054	0.503	0.272
Mean (mm)			-0.077	-0.309	-0.097	-0.551	-0.057	0.670	-0.536	-0.485	-0.732	-0.682	-0.513	0.081	-0.327	0.193	-0.508	-0.382	0.392	-0.386	-0.461	-0.317	0.106	-0.316	-0.175	-0.383	0.202	-0.328	-0.676	-0.382	0.032	-0.062	0.021	-0.117	-0.190	-0.275
Sorting				0.427	0.093	0.623	-0.912	0.563	0.364	0.266	0.196	0.346	0.426	-0.043	-0.053	0.045	0.384	0.355	-0.542	0.131	-0.024	0.131	-0.456	-0.289	-0.041	0.128	-0.373	0.073	-0.283	-0.312	0.655	0.490	0.681	-0.102	0.478	0.214
Skewness					0.016	0.559	-0.414	-0.199	0.436	0.439	0.262	0.316	0.335	-0.214	0.134	-0.021	0.292	0.246	-0.421	0.400	0.330	0.206	-0.278	0.270	0.139	0.344	-0.091	0.335	0.818	0.176	0.124	0.242	0.075	-0.116	0.038	0.046
Kurtosis						0.367	0.014	0.051	0.163	0.002	0.032	0.075	0.068	0.162	-0.045	0.085	-0.022	-0.129	-0.321	-0.030	-0.166	-0.414	-0.265	-0.314	-0.353	-0.319	-0.248	-0.448	0.009	-0.317	0.189	0.212	0.183	-0.130	0.077	0.018
% Fines							-0.558	-0.056	0.666	0.561	0.536	0.713	0.713	-0.210	0.187	0.039	0.582	0.467	-0.700	0.339	0.178	0.080	-0.395	-0.025	-0.033	0.194	-0.362	0.092	0.394	-0.064	0.556	0.605	0.512	-0.224	0.336	0.140
% Sands								-0.621	-0.273	-0.229	-0.028	-0.353	-0.449	0.156	0.022	-0.089	-0.384	-0.375	0.394	-0.098	-0.091	-0.264	0.274	0.158	-0.143	-0.270	0.157	-0.205	-0.064	0.314	-0.638	-0.528	-0.638	0.079	-0.463	-0.227
% Gravel									-0.275	-0.311	-0.474	-0.260	-0.112	0.050	-0.281	0.117	-0.148	-0.085	-0.017	-0.297	-0.351	-0.166	-0.167	-0.554	-0.159	-0.228	-0.077	-0.258	-0.678	-0.610	0.453	0.256	0.484	-0.104	0.238	-0.012
Total Organic Carbon (% dwt)										0.869	0.674	0.576	0.482	-0.214	0.111	-0.113	0.371	0.308	-0.682	0.553	-0.036	0.080	-0.367	0.096	-0.132	0.087	-0.517	0.106	0.487	0.320	0.338	0.367	0.295	-0.115	0.266	0.182
Total Organic Matter (% w/w)											0.578	0.545	0.525	-0.232	0.303	-0.036	0.453	0.422	-0.471	0.729	0.045	0.290	-0.092	0.291	0.113	0.276	-0.287	0.316	0.603	0.482	0.261	0.403	0.177	-0.179	0.104	0.108
Moisture Content (%)												0.567	0.357	-0.125	0.138	-0.267	0.354	0.264	-0.599	0.459	0.252	0.150	-0.292	0.030	-0.030	0.102	-0.502	0.078	0.310	0.374	0.194	0.165	0.200	-0.022	0.285	0.162
Total Oil (mg.kg-1)													0.823	-0.271	0.424	-0.128	0.749	0.632	-0.321	0.342	0.391	0.508	-0.019	0.335	0.353	0.551	-0.039	0.467	0.676	0.213	0.302	0.404	0.277	-0.046	0.323	0.232
Total n alkanes (mg.g-1)														-0.383	0.522	0.368	0.902	0.854	-0.194	0.279	0.238	0.459	0.108	0.390	0.334	0.485	0.030	0.430	0.453	0.100	0.396	0.577	0.314	-0.297	0.128	-0.048
Carbon Preference Index															-0.116	-0.229	-0.303	-0.326	0.016	-0.184	-0.204	-0.157	-0.073	-0.105	-0.118	-0.123	-0.016	-0.096	-0.357	-0.107	0.062	-0.091	0.133	0.254	0.165	0.241
P/B Ratio																0.389	0.645	0.661	0.339	0.173	0.312	0.581	0.583	0.735	0.571	0.547	0.425	0.543	0.900	0.229	-0.135	0.188	-0.249	-0.189	-0.365	-0.213
Proportion of Alkanes (%)																	0.328	0.432	0.325	-0.201	-0.118	0.040	0.378	0.402	0.077	0.011	0.269	0.022	0.264	-0.083	0.003	0.197	-0.084	-0.364	-0.396	-0.472
Total PAHs (µg.kg-1)																		0.962	-0.055	0.291	0.325	0.585	0.228	0.441	0.501	0.592	0.141	0.561	0.246	0.165	0.257	0.408	0.183	-0.175	0.072	-0.011
NPD PAHs (µg.kg-1)																			0.037	0.274	0.252	0.596	0.319	0.497	0.527	0.568	0.205	0.575	0.265	0.185	0.246	0.413	0.158	-0.257	-0.021	-0.127
Arsenic (mg.kg-1)																				-0.400	0.134	0.293	0.825	0.458	0.484	0.273	0.818	0.300	-0.027	0.032	-0.537	-0.419	-0.555	0.112	-0.490	-0.255
Cadmium (mg.kg-1)																					0.096	0.229	-0.097	-0.051	0.077	0.193	-0.211	0.260	0.542	0.521	0.113	0.251	0.062	-0.223	-0.022	0.010
Chromium (mg.kg-1)																						0.661	0.339	0.475	0.713	0.759	0.477	0.666	0.815	0.288	-0.254	-0.220	-0.221	0.382	0.137	0.322
Copper (mg.kg-1)																							0.518	0.750	0.876	0.916	0.522	0.912	0.706	0.428	-0.076	0.038	-0.089	0.229	0.114	0.269
Lead (mg.kg-1)																								0.624	0.696	0.500	0.849	0.512	0.673	0.234	-0.420	-0.183	-0.479	0.002	-0.459	-0.241
Mercury (mg.kg-1)																									0.707	0.762	0.590	0.745	0.904	0.576	-0.278	0.157	-0.403	-0.204	-0.409	-0.213
Nickel (mg.kg-1)																										0.899	0.744	0.878	0.691	0.304	-0.173	-0.057	-0.204	0.196	-0.032	0.140
Aluminium (mg.kg-1)																											0.611	0.960	0.783	0.391	-0.091	0.021	-0.094	0.252	0.108	0.284
Iron (mg.kg-1)																												0.603	0.562	0.115	-0.408	-0.220	-0.434	0.096	-0.360	-0.138
Lithium (mg.kg-1)																													0.762	0.524	-0.145	-0.007	-0.161	0.200	0.020	0.201
Tin (mg.kg-1)																														0.883	-0.378	0.109	-0.504	-0.165	-0.382	-0.281
Magnesium (mg.kg-1)																															-0.346	-0.191	-0.346	0.081	-0.146	0.029
Number of Species (S)																																0.831	0.970	-0.313	0.572	0.153
Number of Individuals (N)																																	0.707	-0.648	0.158	-0.188
Richness (Margalef)																																		-0.159	0.694	0.283
Evenness (Pielou's)																																			0.525	0.825
Shannon Wiener Diversity																																				0.818

APPENDIX T – GEOGENIC REEF ASSESSMENTS

Appendix T Rocky Reef Assessment.xlsx Appendix T Stony Reef Assessment.xlsx

List of Key Reef Species as per Golding et al., 2020

Some epibiota are dependent on particularly stable substrata and are therefore valuable indicators of Reef habitats (Key Species). Species in Table 3 are derived from an analysis of those typical reef species that are recorded only rarely on pebble, gravel and sediment habitats. This table contains some species that are not good indicators. The species in Table 4 are selected based on a SIMPER analysis of data from the Sarnau in mid-Wales, taking those species of sufficient abundance and most influencing the differences between substratum clusters (i.e. rock vs sediment). The species in Table 5 are derived from a combination of species from the Primer analysis of Sarnau data and species from the biotope biological comparative tables, selecting those species that are not found in pebble, gravel and sediment habitats.

Table 3 First trial of Key Species

Amphilectus fucorum	*Calliblepharis ciliata*	*Laminaria hyperborea*
Cliona celata	*Phyllophora* species	*Laminaria digitata*
Nemertesia antennina	*Dilsea carnosa*	*Halidrys siliquosa*
Alcyonium digitatum	*Chondrus crispus*	*Dictyota dichotoma*
Balanus crenatus		
Pentapora foliacea		
Botryllus schlosseri		
Clavelina lepadiformis		
Semibalanus balanoides		

Table 4 Second trial of Key Species

Abietinaria abietina	*Calliblepharis ciliata*	*Saccharina latissima*
Aglaophenia pluma	*Ceramium spp*	*Laminaria digitata*
Alcyonium digitatum	*Chondria dasyphylla*	*Laminaria hyperborea*
Amphilectus fucorum	*Chondrus crispus*	*Fucus serratus*
Ascidiella scabra	*Corallina officinalis*	*Cutleria multifida*
Botryllus schlosseri	*Cordylecladia erecta*	*Sphacelaria*
Electra pilosa	*Cryptopleura ramosa*	*Cladostephus spongiosus*
Flustrellidra hispida	*Furcellaria lumbricalis*	*Ulva spp*
Leucandra ananas	*Jania rubens*	
Patella vulgata	*Mastocarpus stellatus*	
Perophora listeri	*Phyllophora crispa*	
Semibalanus balanoides	*Phyllophora pseudoceranoides*	
Vesicularia spinosa	*Plocamium cartilagineum*	
	Polysiphonia fucoides	
	Pterothamnion crispum	
	Rhodomela confervoides	
	Rhodophyllis divaricata	

Table 5 Third trial of Key Species

Based on SIMPER analysis of the Sarnau data, taking those species of sufficient abundance and most influencing the differences between substratum clusters.

Hemimycale columella	*Bicellariella*	*Ceramium diaphanum*
Myxilla	*Bicellariella ciliata*	*Ceramium pallidum*
Myxilla incrustans	*Bugula*	*Chondrus crispus*
Leucandra ananas	*Bugula flabellata*	*Corallina*
Pachymatisma johnstoni	*Bugula plumosa*	*Corallina officinalis*
Suberites	*Bugula turbinata*	*Halurus flosculosus*
Suberites carnosus	*Crisia*	*Jania*
Suberites ficus	*Crisia denticulata*	*Jania rubens*
Suberitidae	*Crisia eburnea*	*Mastocarpus stellatus*
Tubularia	*Crisidia*	*Phyllophora pseudoceranoides*
Tubularia indivisa	*Crisidia cornuta*	*Alaria esculenta*
Abietinaria abietina	*Crisiidae*	*Fucus serratus*

Caryophyllia inornata	*Flustrellidra hispida*	*Laminaria*
Corynactis viridis	*Polyclinidae*	*Laminaria digitata*
Semibalanus	*Polyclinum aurantium*	*Laminaria hyperborea*
Semibalanus balanoides	*Perophora listeri*	*Laminaria ochroleuca*
Patella pellucida		
Patella ulyssiponensis		
Patella vulgata		

List of Key Reef-Associated Species as per Golding *et al.*, 2020

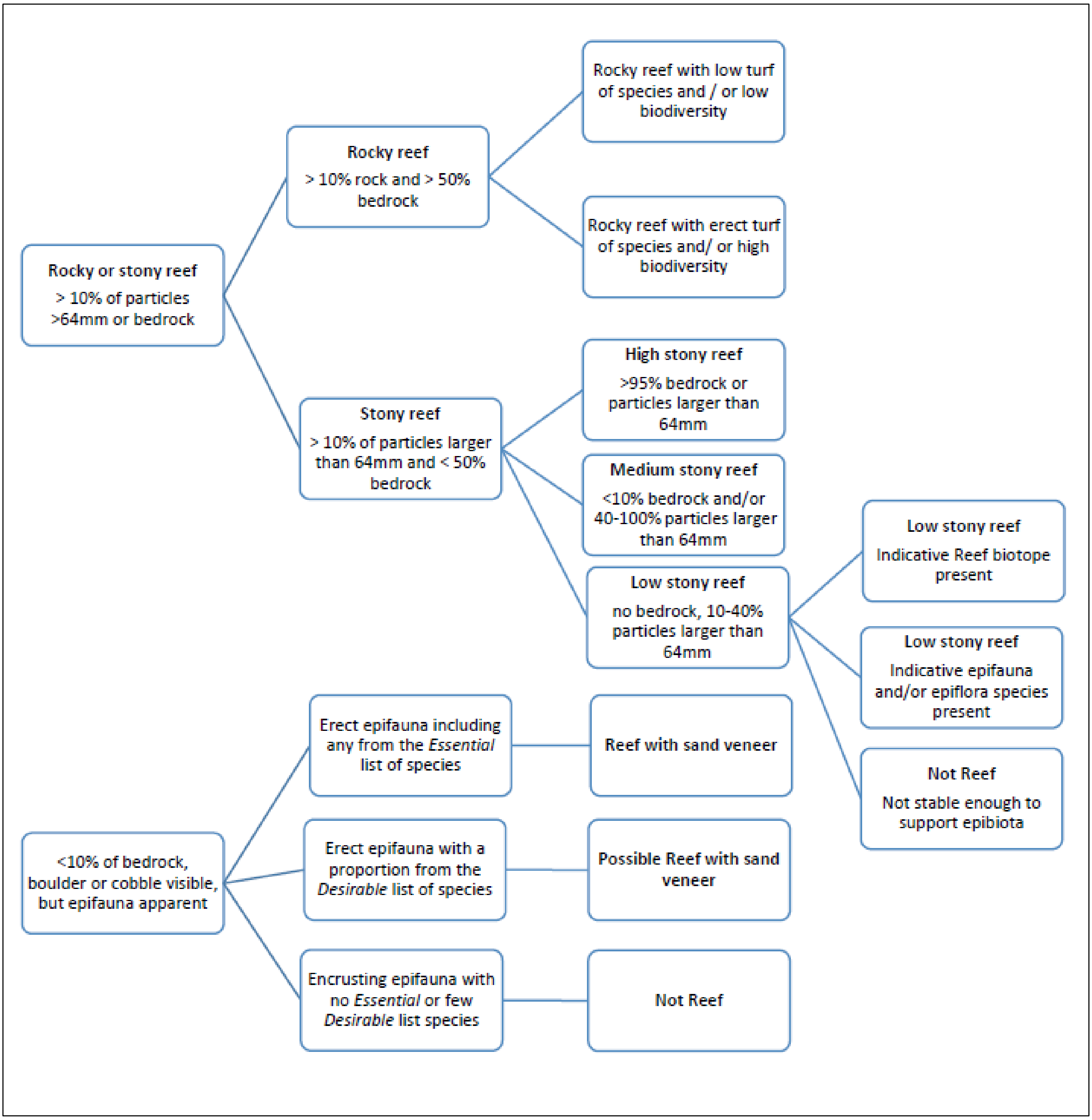
The biotope biological comparison tables published by JNCC can be used to identify Reef-Species. Species from all infralittoral and circalittoral biotopes that are characterised as boulder or cobble that are not found in sediment biotopes can be selected. The spreadsheet Stony reef biotopes Biotopes Species matrix shows an interim assessment of species, which have been classified on a scale of 1 to 5 according to their affiliation to rock habitats or sediment habitats (scour and stability assessment also attempted).

Using BIOTIC, biotope biological comparative tables and a considerable amount of expert judgement, the species from xx samples have been assessed as follows.

Table 6 Assessment of 'lifestyles' of species

Tag	Number of species	Reasoning
Reef	573	Species that are typically associated with rocky habitats.
LifeForm	7	Higher Taxa that provide some useful information to evaluating Reef.
Biog	8	Species that characterise biogenic reef habitats.
Wide	200	Species that are typically associated with hard substrata, but are not reliably associated with just stable Reef habitats.
Surface	242	Surface dwellers that may or may not be associated with Reef, they have little dependency on rocky substrata and are often living on other biota.
Mobile	198	Mobile species that readily move between habitats and so not reliably associated with Reef.
HighTaxon	59	Taxa at a high level of resolution that are not useful in assigning habitats as Reef.
Sedi	88	Species that are typically associated with sediment habitats.
Infauna	125	Species typically associated with the sediment, as infauna.

Flow Diagram for Defining Reef Features



APPENDIX U - BURROWING MEGAFAUNA ASSESSMENT

Appendix U
Burrowing Megafauna

APPENDIX V - DEEP-SEA SPONGE AGGREGATIONS

Appendix V Deepsea Sponge Aggregations

APPENDIX W – SAMPLE AND SEABED PHOTOGRAPHS

2334 UK 29N Photopages.pdf

2334 Xlinks UK 30N Photopages.pdf

APPENDIX X – SERVICE WARRANTY

This report, with its associated works and services, has been designed solely to meet the requirements of the contract agreed with you, our client. If used in other circumstances, some or all the results may not be valid, and we can accept no liability for such use. Such circumstances include different or changed objectives, use by third parties, or changes to, for example, site conditions or legislation occurring after completion of the work. In case of doubt, please consult Benthic Solutions Limited. Please note that all charts, where applicable should not be used for navigational purposes.