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Morlais Project
Environmental Statement

Chapter 9: Benthic and Intertidal Ecology

Volume III

Applicant: Menter Môn Morlais Limited
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Chapter 9: Benthic and Intertidal Ecology
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MarineSpace
Making Sense of the Marine Environment ™

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Morlais Project
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Appendix 9.1: Morlais Demonstration Zone (MDZ) Benthic Ecology Characterisation Survey 2018

Volume III

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Appendix 9.1: Morlais Demonstration Zone (MDZ) Benthic Ecology Characterisation Survey 2018

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Morlais Demonstration Zone (MDZ) Benthic Ecology Characterisation Survey 2018

Technical Report

Ref: OEL_MMNMOR0518_TCR

Prepared for

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CONTENTS

1. NON-TECHNICAL SUMMARY

Menter Môn commissioned Ocean Ecology Limited (OEL) to undertake intertidal and subtidal benthic ecology surveys of the Morlais Demonstration Zone (MDZ), its associated buffer area and inshore cable corridor in 2018 to inform a subsequent Environmental Impact Assessment (EIA). The surveys involved the collection of a plethora of marine ecological data including high resolution seabed imagery, grab samples, core samples, quadrat data and aerial imagery to enable the collation of a detailed biotope map of the area of interest. This report presents the results of these surveys, subsequent analysis and resulting biotope mapping for the MDZ and its environs.

Due to the hard nature of the seabed across most of the subtidal survey area, biotope mapping across this zone was largely informed by the results of the seabed imagery analysis and a detailed interpretation of geophysical data available for the site. This area was found to be constituted by a complex assortment of subtidal biotope mosaics dominated by circalittoral and/or infralittoral rock and coarse sediments. All three Annex I reef types (bedrock, stony and biogenic) were noted across this area.

Similar to the subtidal zone, the intertidal survey area was largely characterised by hard substrate meaning the majority of the biotope mapping was informed by quadrat data, UAV imagery and existing biotope mapping. The intertidal survey area was found to support a wide variety of littoral rock biotopes representative of Annex I bedrock reef interspersed with discrete patches of barren shingle and occasional areas of sandy sediment.

2. INTRODUCTION

2.1. Background

The Morlais Demonstration Zone (MDZ) is located to the west of Holy Island, approximately 0.5 km (at the nearest point) off South Stack. The MDZ is one of several marine areas around the UK which have been leased by The Crown Estate to encourage and accelerate marine energy technology and was identified due to its strong tidal regimes and tidal energy potential. Menter Môn, together with their project partners, are developing the MDZ to eventually encompass an up to 240 MW, grid-connected, consented location for tidal energy developers to deploy new tidal array projects. The MDZ will be sub-let into areas for test and demonstration activities of commercial tidal projects connected to the grid by up to nine export cables.

Menter Môn commissioned Ocean Ecology Limited (OEL) to undertake intertidal and subtidal benthic ecology surveys of the MDZ, its associated buffer area and inshore cable corridor in 2018 to inform a subsequent Environmental Impact Assessment (EIA). This report presents the results of these surveys and subsequent data and sample analysis.

2.2. Current Understanding

2.2.1. Biotope Information

2.2.1.1. Intertidal

The intertidal survey area, that spans a small inlet known as 'Abraham's Bosum', consists mainly of steep cliffs and rocky outcrops. Along the stretch of coast, there are six small bays with gradual inclines to the fields. Existing intertidal habitat mapping (MagicMap[1]) suggests the biotopes present within each bay consist of intertidal coarse and mixed sediments with high energy intertidal rock along the cliffs and rocky outcrops.

2.2.1.2. Subtidal

Based on existing subtidal habitat mapping (EMODnet[2]), interpretation of existing geophysical data and sample data collected by Partrac, it is understood that the MDZ is mainly characterised by areas of circalittoral sediments consisting of gravelly sands and sandy gravels with relatively large areas of circalittoral and infralittoral high energy bedrock (Figure 1). An area of small boulders is thought to occur in the north-east of the zone. A potential biogenic habitat is also thought to be present in the south-west corner of the zone.

2.2.2. Subtidal Water Depths

Based on interrogation of admiralty charts and the results of the geophysical survey undertaken by Partrac, it is known that water depth across the MDZ is generally around 40 m. Water depth increases in the north west towards Holyhead Deep and there is a depression to the south in an area known as Careg Hen, where the water depth reaches 56 m.

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[1]http://magic.defra.gov.uk/magicmap.aspx?startTopic=access&chosenLayers=aonbIndex,npkIndex,sssiIndex&sqgridref=NY791620&startScale=25000

[2] http://www.emodnet-seabedhabitats.eu/access-data/launch-map-viewer/

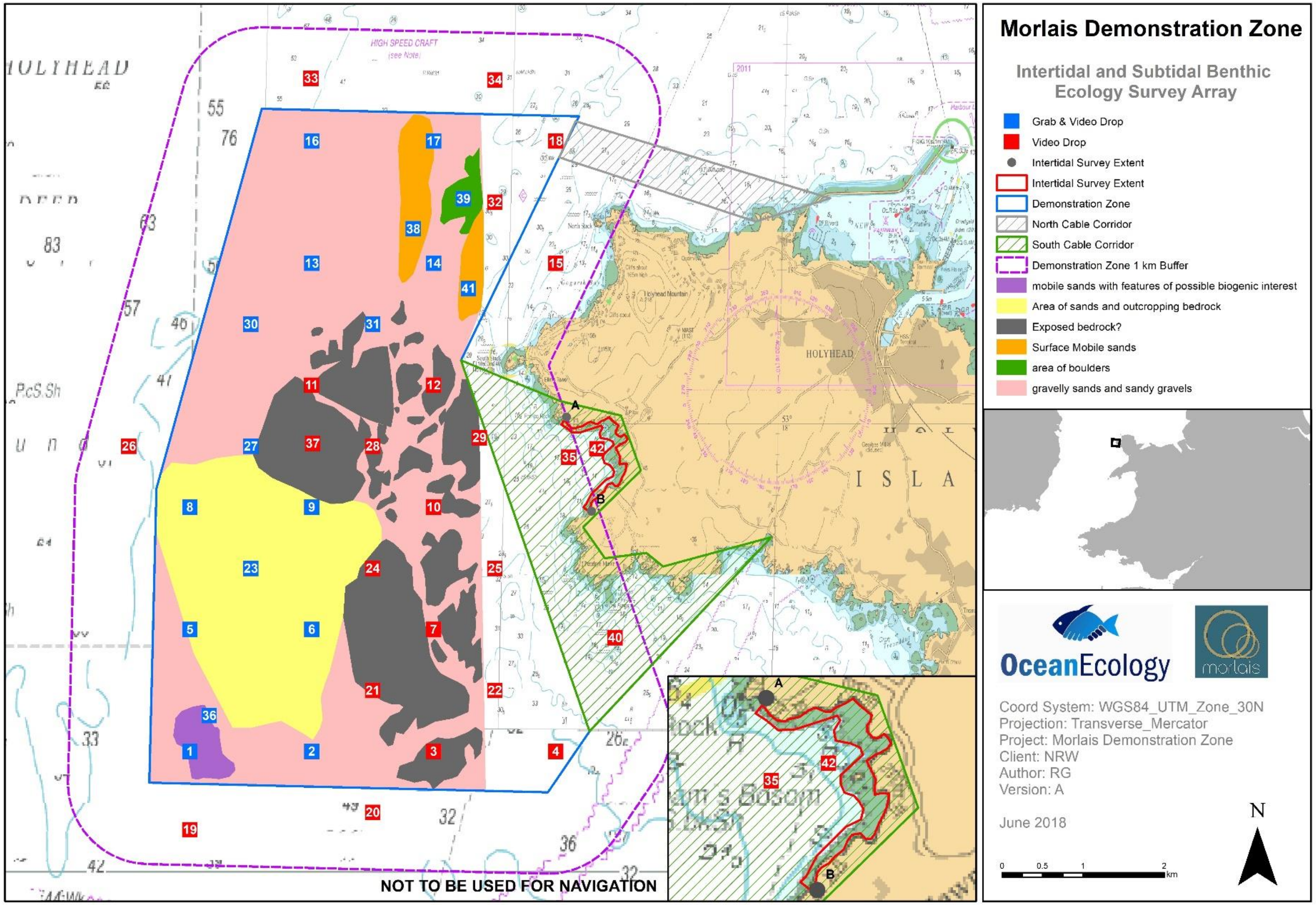

Figure 1 Survey array for MDZ intertidal and subtidal benthic ecology characterisation surveys with existing habitat mapping overlain.

3. METHODS

3.1. Survey Design

3.1.1. Subtidal Survey

The survey array was developed by MarineSpace with reference to appropriate guidelines (Coggan et al. 2007, Hitchin et al. 2015, Turner et al. 2016) to design a benthic ecology characterisation survey to inform the subsequent EIA. The survey array was based around a diamond grid of sampling stations (Figure 1) to allow a seabed biotope map to be produced for the benthic ecology requirements of the EIA.

Based upon an initial interpretation of sidescan sonar backscatter, additional stations were added and located at potential transitions between substrates, at key areas of development (along the cable corridor and Abraham's Bosom), and within a 1 km buffer zone up- and down-stream of the development. OEL then undertook a further review of updated side scan sonar (SSS) and multibeam echo sounder (MBES) data collected in 2018 by Partrac to sense check the proposed survey design.

Forty-two ground-truthing stations were targeted and sampled across the MDZ, buffer area and proposed cable corridors. At every ground-truthing station, a drop-down camera (DDC) was deployed to collect seabed imagery. Grab samples were proposed at 18 stations (based on backscatter interpretation) to collect sediment samples for particle size distribution (PSD) analysis and for in-situ faunal analysis to inform subsequent biotope mapping for the EIA. On review of the DDC footage, it was deemed that only five of these 18 stations were suitable for grab sampling due to the hard substrate present.

3.1.2. Intertidal Survey

The intertidal survey was undertaken in line with guidance in the Marine Monitoring Handbook (Davies et al. 2001b) and CCW Handbook for Marine Intertidal Phase I Survey and Mapping (Wyn et al. 2006). During the walkover survey, biotopes were identified according to the EUNIS classification in line with relevant guidance (Parry 2015) (and correlated to the MNCR biotopes) and where possible boundaries of biotopes were tracked using handheld Garmin E-Trex 10 GPS devices.

The intertidal survey was carried out in two phases across the intertidal area around the proposed cable landfall in Abraham's Bosum to establish the main biotopes present. Firstly, the area was flown using an Unmanned Aerial Vehicle (UAV) at low tide to capture high-resolution aerial imagery that was subsequently used to create orthomosaic mapping of the area of interest. This allowed for key habitats to be targeted during the Phase I intertidal walk over survey conducted during a second visit to ground-truth biotope boundaries and cryptic biotopes. For any soft sediments identified in the UAV mapping and/or walk over survey, a series of quadrat sampling stations were sampled to further inform subsequent biotope mapping.

3.2. Survey Methods

3.2.1. Subtidal Survey

The subtidal survey was undertaken between the 4th and 6th September 2018 in line with Procedural Guideline 3-9 of the Marine Monitoring Handbook: Quantitative sampling of sublittoral sediment biotopes and species using remote-operated grabs (Davies et al. 2001) and the guidelines provided in the Guidelines for the Conduct of Benthic Studies at Marine Aggregate Exaction Sites (Ware et al. 2011).

3.2.2. Survey Vessel

Both benthic grab sampling and DDC deployments were undertaken onboard the survey vessel *Seren Las* operating out of Holyhead Marina (Plate 1). *Seren Las* is a 10 m dedicated survey vessel operated by OEL that can accommodate up to five survey personnel and is a comfortable and stable platform with ample space on the back deck for the processing of grab samples.

The vessel was equipped with a Hemisphere V104s GPS compass system that provided a highly accurate offset position of the sampling equipment when deployed from the stern.

Plate 1 Dedicated survey vessel, *Seren Las.*

3.2.3. Drop-Down Camera

3.2.3.1. Method

Underwater stills photography was undertaken using OEL's freshwater housing camera system onboard the survey vessel *Seren Las* in line with the JNCC/NMBAQC 'Epibiota Remote Monitoring from Digital Imagery: Operation Guidelines' document (Hitchin et al. 2015).

The camera system was deployed from the hydraulic gantry on the aft deck of *Seren Las* (Plate 1). The video system was lowered to the seabed and kept as close to the seabed as possible in order gain a clear image and continuous footage that was recorded to the onboard hard drive. All video footage was reviewed in situ by the lead marine ecologist who was also responsible for capturing images of representative substrate at each station as well as any features of interest.

3.2.4. Benthic Grab Sampling

3.2.4.1. Method

At each pre-determined grab sampling station, a 0.1 m² Day grab was deployed to collect macrobenthic samples and a particle size analysis (PSA) sub-sample. To ensure consistency in sampling, grab samples were screened by the lead marine ecologist and considered unacceptable if:

- The sample was less than 5 L. i.e. the sample represented less than half the 10 L capacity of the grab used or 2.5 L on hard-packed sands.
- The jaws failed to close completely or were jammed open by an obstruction, allowing fines to pass through (washout or partial washout).
- The sample was taken at an unacceptable distance from the target location.
- There was obvious contamination of the sample from sampling equipment, paint chips etc.

The station was abandoned in the event of three failed attempts.

3.2.4.2. Field Notes

A detailed description of each grab was made in the field notes and digital photographs were taken of all samples accompanied by a GPS fix offset to account for the actual deployment position relevant to the position of the GPS receiver above the wheel house. Visual descriptions of sediment were made (using the Folk (1954) classification categories) at the time of sampling. All field notes are provided in Appendix II.

A detailed log was compiled for each sampling station including:

- Number and type of sample;
- Date and time of sampling;
- Depth and/or volume of sample achieved;
- Water depth (in meters);
- Co-ordinates of samples;
- Weather and sea conditions; and
- Sample classification data.

3.2.4.3. Field Sample Processing

Sample processing was undertaken onboard the survey vessel in line with the following methodology:

- Assessment of sample size and acceptability made;
- Photograph of sample with station details and scale bar taken;
- 10% of sample removed for PSD analysis and transferred to labelled foil tray for storage and transport back to the laboratory. Sample containers were clearly labelled internally and externally with date, sample code and project name;
- Sample emptied into 2 mm sieve laid over 4 mm sieve table and washed through gently rinsing with seawater hose;
- Remaining sample for faunal sorting and identification backwashed into a suitable sized sample container using seawater ; and
- In-situ analysis of the remaining sample, identifying all taxa present.

3.2.5. Intertidal Survey

The first phase of the intertidal survey was undertaken during spring tides on 30th August in line with guidance in the Marine Monitoring Handbook (Davies et al. 2001) and CCW Handbook for Marine Intertidal Phase I Survey and Mapping (Wyn et al. 2006).

This included a UAV mapping exercise and a walkover survey to identify biotopes according to the EUNIS classification in line with relevant guidance (Parry 2015) (and correlated to the MNCR biotopes). Where possible boundaries of biotopes were tracked using handheld Garmin E-Trex 10 GPS devices. The distribution of any features of conservation interest were recorded using photographs and GPS fixes where encountered. The presence of any invasive non-native species (INNS) (e.g. *Crepidula fornicata*) was also noted and their location recorded. Other information recorded included general site conditions, sediment surface features, sediment type and characteristics, topography and anthropogenic pressures.

3.2.6. UAV Mapping

UAV mapping of the potential non-HDD cable landfall involved the capture of over 200 high resolution nadir images across a 500 m wide area of the intertidal area. Each flight was planned to achieve a minimum resolution[3] of 5 cm / pixel with an accuracy[4] of 5-10 m and flown by qualified UAV Pilots (RPQs) under a Permission for Commercial Operations (PfCO) granted to OEL by the Civil Aviation Authority (CAA). All flights were conducted in line with relevant CAA regulations (see Cap 722 2015).

3.2.7. Quadrat Sampling

Areas representative of each key hard substrate habitat at different tidal heights were assessed on 14th September 2018 by recording the epibiotal taxa present in randomly placed 0.04 m^2 (0.2 m x 0.2 m) quadrats. Identification was taken to species level where possible and undertaken in the field. Field notes for each quadrat included site description, position, presence of notable fauna and EUNIS biotope designation (see Appendix III).

Areas representative of each key soft sediment habitat were assessed by sampling the upper 10 cm of a 0.04 m^2 (0.2 m x 0.2 m) quadrat using a spade and screened on a 0.5 mm sieve. Any macrobenthos retained on the sieve was identified to species level where possible in the field. The quadrats were then dug to c. 30 cm depth to check for the presence of larger, burrowing species. All soft sediment samples were also subject to a visual inspection and observations of colour, smell, depth of RPD layer, texture and presence of surface features (accretions, algae, fauna, etc.) recorded.

Two high-resolution photographs were taken of each quadrat for future reference. The first was taken from a ‘cross section’ looking across the substrate and the second was taken directly above the quadrat (in plan view). The location of all quadrat samples was recorded using a Garmin E-Trex 10 GPS device.

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[3] Measured as Ground-Sampling Distance (GSD).

[4] Measured as Root Mean Square Errors (RMSE).

Plate 2 Intertidal sampling techniques employed during the benthic ecology characterisation survey in September 2018. a) High resolution aerial image of the upper shore. b) DJI Phantom 4 UAV used to undertake aerial mapping. c) 0.25 m^2 quadrat used to sample hard substrates. d) 0.04 m^2 quadrat used to sample soft sediments.

3.3. Analytical Methods

On arrival to the laboratory, all seabed imagery, macrobenthic data and PSD samples were logged in the project database created in OEL's web-based data management application ABACUS in line with in-house SOPs and OEL's QMS.

3.3.1. Particle Size Distribution (PSD) Analysis

PSD analysis was undertaken by in-house laboratory technicians at OEL's NE Atlantic Marine Biological Quality Control Scheme (NMBAQC) participating and Marine Management Organisation (MMO) validated sediment laboratory. All PSD analysis was undertaken in line with OEL's SOP for PSD analysis corresponding to NMBAQC Best Practice Guidance (Mason 2016).

Frozen sediment samples were first transferred to a drying oven and thawed at 80°C for at least six hours. A small subsample of the whole sampled was then taken for laser analysis, prior to wet sieving over a 1 mm sieve. Before sieving, samples were mixed thoroughly with a spatula and all conspicuous fauna (>1 mm) which appeared to have been alive at the time of sampling were removed from the sample.

Dry Sieving

The >1 mm fraction was then returned to a drying oven and dried at 80°C for at least 24 hours prior to dry sieving.

Once dry, the sediment sample was run through a series of Endecott BS 410 test sieves (nested at intervals of ɸ) using a Retsch AS200 sieve shaker to fractionate the samples into particle size classes. The dry sieve mesh apertures used are given in Table 1.

Table 1 Sieve series employed for Particle Size Distribution (PSD) analysis by dry sieving (mesh size in mm).

Sieve aperture (mm)						
63	32	16	8	4	2	1

The sample was transferred onto the coarsest sieve at the top of the sieve stack which was then shaken for a standardised period of 20 minutes. The sieve stack was then checked to ensure the components of the sample had been fractioned as far down the sieve stack as their diameter would allow. A further 10 minutes of shaking was undertaken if there was evidence that particles had not been properly sorted (e.g. veneers of silt overlying coarse fractions).

Laser Diffraction

The subsample for laser analysis was first sieved over a 1 mm mesh and the <1 mm fraction retained for analysis. The fine fraction residues (<1 mm sediments) were then transferred to a suitable container and allowed to settle for 24 hours before excess water was siphoned from above the sediment surface. The fine fraction was analysed by laser diffraction using a Beckman Coulter LS13 320 particle analyser.

The dry sieve and laser data were then merged for each sample with the results expressed as a percentage of the whole sample. Once the data were merged, PSD statistics and sediment classifications were generated from the percentages of the sediment determined for each sediment fraction using Gradistat v7 software.

Sediment descriptions were defined by their size class based on the Wentworth classification system (Wentworth 1922) (Table 2). Statistics such as mean and median grain size, sorting coefficient, skewness and bulk sediment classes (percentage silt, sand and gravel) were also derived in accordance with the Folk classification (Folk 1954).

Table 2 Classification used for defining sediment type based on the Wentworth Classification System (Wentworth 1922).

Wentworth Scale	Phi Units (φ)	Sediment Types
>64 mm	<-6	Cobble and boulders
32 – 64 mm	-5 to -6	Pebble
16 – 32 mm	-4 to -5	Pebble
8 – 16 mm	-3 to -4	Pebble
4 - 8 mm	-3 to -2	Pebble
2 - 4 mm	-2 to -1	Granule
1 - 2 mm	-1 to 0	Very coarse sand
0.5 - 1 mm	0 - 1	Coarse sand
250 - 500 µm	1 - 2	Medium sand
125 - 250 µm	2 - 3	Fine sand
63 - 125 µm	3 - 4	Very fine sand
31.25 – 63 µm	4 - 5	Very coarse silt
15.63 – 31.25 µm	5 - 6	Coarse silt
7.813 – 15.63 µm	6 - 7	Medium silt
3.91 – 7.81 µm	7 – 8	Fine silt
1.95 – 3.91 µm	8 - 9	Very fine silt
<1.95 µm	<9	Clay

3.3.2. Seabed Imagery Analysis

All seabed imagery analysis was undertaken in line with the JNCC epibiota remote monitoring interpretation guidelines (Hitchin et al. 2015). Determination of sediment type, such as coarse, mixed, sand etc. was facilitated using the adapted Folk sediment trigon (Long 2006) incorporated into a sediment category correlation table. Percentage gravel (boulders, cobbles, shells, granule), sand and mud were used to determine and assign EUNIS broad scale habitats. Where required, EUNIS categories for each of the video and still locations were considered utilising predictive habitat mapping where biotope maps were not available from existing surveys.

3.3.3. UAV Imagery Analysis

Imagery resulting from the UAV extent mapping was 'stitched' together to generate orthomosaic outputs for each intertidal area using licenced processing software. The resulting orthomosics were used as base maps in GIS and to facilitate subsequent biotope mapping.

3.3.4. Biotope Mapping

EUNIS biotopes were identified in line with JNCC guidance on assigning benthic biotopes (Parry 2015) to allow the communities to be mapped and allow comparison with existing data. All biotope determination was undertaken through consideration of the following information:

- Existing biotope mapping (EMODnet);
- Quadrat sediment/substrate descriptions for determination of Broad Scale Habitat (BSH);
- UAV orthomosaic imagery;
- Species information from quadrat sampling for assigning EUNIS Level 4 biotopes and above;
- EUNIS biotope assigned to each station during the analysis of the seabed imagery; and
- Grab sample data (macrobenthic and PSD).

4. RESULTS

4.1. Sampling Progress

A total of 42 subtidal sampling stations were targeted with camera deployments resulting in the collection of 277 still images and over 220 minutes of video footage. It was deemed that only five of the 18 target sampling stations were suitable for grab sampling due to the hard substrate present resulting the in the acquisition of just four grab samples. The dominance of hard substrate in the intertidal zone meant that the majority of intertidal sampling involved 0.25 m^2 quadrat sampling (18 stations) and the collection of just two core samples. The UAV mapping survey resulted in the collection of 243 high resolution nadir images across a 500 m wide area of the intertidal area. A breakdown of all grab and camera sampling is provided in Table 3.

Table 3 Grab and drop-down camera sampling undertaken during the Morlais Demonstration Zone benthic ecology characterisation survey 2018.

Location	Grab Samples (Macrobenthic and PSD Sub-Sample)	Drop Down Camera (DDC) Stations
Demonstration Zone	1	33
Associated Buffer Area	2	6
South Cable Corridor	1	3
Total	**4**	**42**

4.2. Subtidal Sediments

A single sediment sub-sample taken from each of the four grab sites was analysed for full particle size classification. Full sediment data are provided in Appendix V.

4.2.1. Sediment Type

Sediment types, as classified using the Folk triangle (Folk 1954) were converted into BSH types for biotope mapping purposes in line with JNCC guidance (Parry 2015). Sediments could only be recovered at four locations where sediment type was conducive to grab sampling. Samples consisted of Sandy Gravel (sG) and Gravelly Sand (gS), representative of 'coarse sediment' (BSH A5.1) and Sand (S), representative of 'sand and muddy sand' (BSH A5.2). Sediment data was used to support analysis of seabed imagery to better understand the sediment composition at those stations where grab samples were taken (15, 20, 41 and 42).

A summary of Folk (1954) classifications assigned to each sediment sample in relation to its representative EUNIS BSH is presented in Figure 2 and example grab sample images for each of the sampled sediment types is presented in Plate 3.

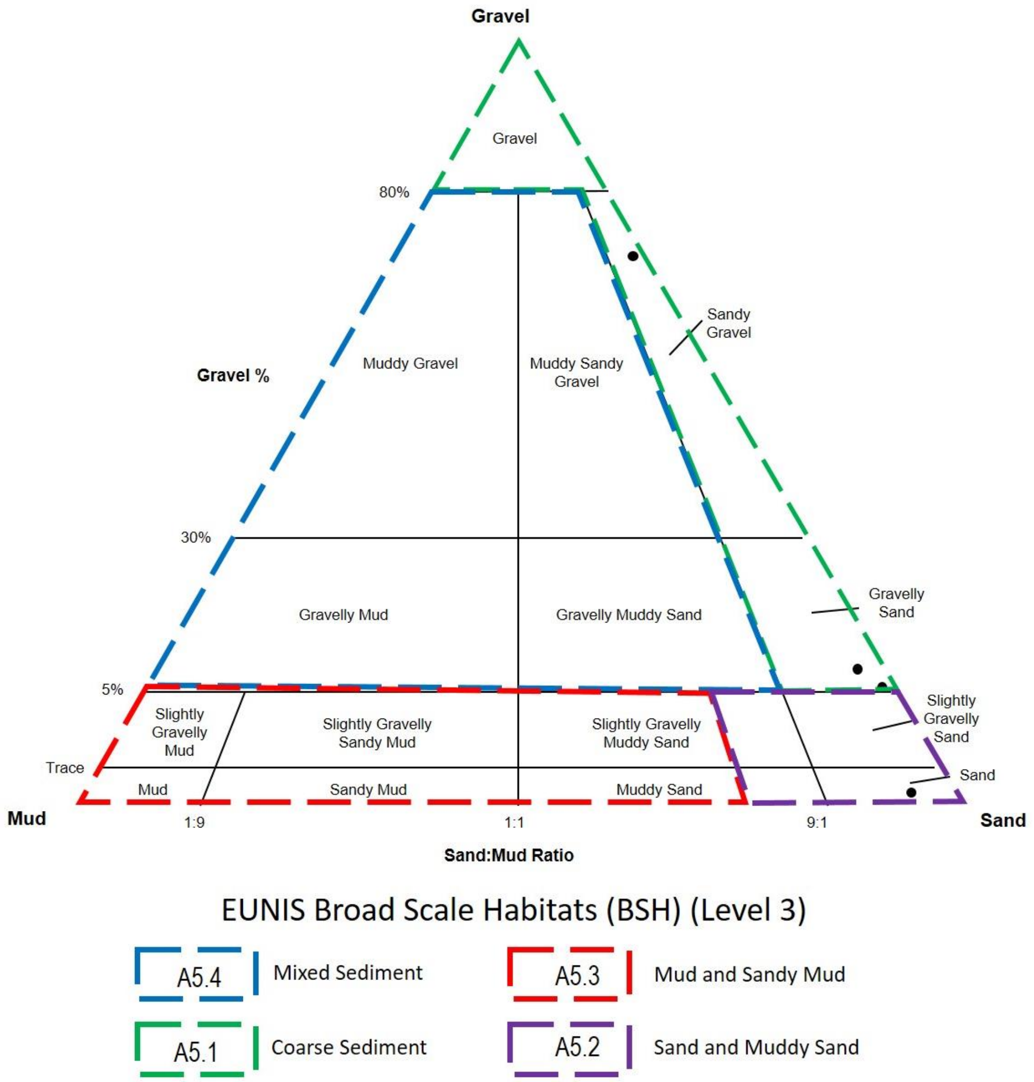

Figure 2 Folk (1954) triangle classifications of sediment gravel percentage and sand to mud ratio (shown by black dots) sampled during the MDZ benthic ecology characterisation survey, overlain by the modified Folk triangle for determination of mobile sediment BSHs under the EUNIS habitat classification system (adapted from Long 2006).

Sandy Gravel	Gravelly Sand	Sand
		
Gravel 72.88% Sand 27.12% Mud 0.00%	Gravel 6.95% Sand 93.05% Mud 0.00%	Gravel 0.00% Sand 96.42% Mud 3.58%

Plate 3 Example images of different sediment types sampled during the MDZ benthic ecology characterisation survey 2018.

4.3. Macrobenthos

Due to the prevalence of hard substrate across the survey area very few grab and core samples were acquired during the subtidal and intertidal surveys demonstrating the limited extent of sediment habitats across MDZ. The few samples that were acquired were seemingly impoverished with a maximum of six taxa and nine specimens recorded in any one sample. The paucity of macrobenthic species was not thought to be a reflection of the biological status of these sediments but a result of processing the samples over a 2 mm mesh (rather than the industry standard 0.5 mm or 1 mm mesh) in the field confounded further by the lack of microscopic examination of smaller residual fractions. The use of the 2 mm mesh sieve resulted in the loss of the majority of macrobenthic species during sample processing leaving low numbers of large bodied species. As a result, the information acquired on the macrobenthic communities of the sediments was of little value for assigning biotopes at EUNIS level 4 or above. The lack of abundance data also meant that it was not possible to conduct any meaningful univariate or multivariate analysis of the data. Despite this the combination of seabed imagery and limited grab sampling is deemed to be sufficient for characterisation of the key marine habitats within the MDZ and its environs. The macrobenthic abundance matrix is provided as Appendix VI. Separation

4.4. Biotope Mapping

A total of 28 intertidal and 15 subtidal EUNIS biotopes were mapped across the survey area based on a comprehensive synthesis of all information collected during the survey and all available existing information including geophysical data and existing biotope mapping. A summary of all intertidal and subtidal biotopes mapped in Figure 3 and Figure 4 are provided in Appendices IX, X and XI.

4.4.1. Subtidal Biotopes

The MDZ and its environs was found to be constituted by a complex assortment of subtidal biotope mosaics dominated by circalittoral and/or infralittoral rock and coarse sediments. The deeper areas of the site were characterised by coarse sediments (A5.14) representative of Annex I stony reef habitat (as per Irving 2009) frequently overlain by varying coverage of *Sabellaria spinulosa* tube aggregations representative of Annex I biogenic reef in some areas (as per Gubbay 2007) (A4.22) (see Appendix XII). The amount of overlying sediment was reduced in the slightly shallower waters in central, southern and northern areas where tide-swept and mixed faunal turf communities (A4.11 / A4.13) representative of Annex I bedrock reef were prevalent. Closer to shore sediment biotopes dominated grading from coarse gravels (A5.14) to subtidal sands (A5.2) in Abraham's Bosum transitioning into macrophyte dominated infralittoral rock in the shallow subtidal and sublittoral fringes across the whole area (A3.1111, A3.1112, A3.2111).

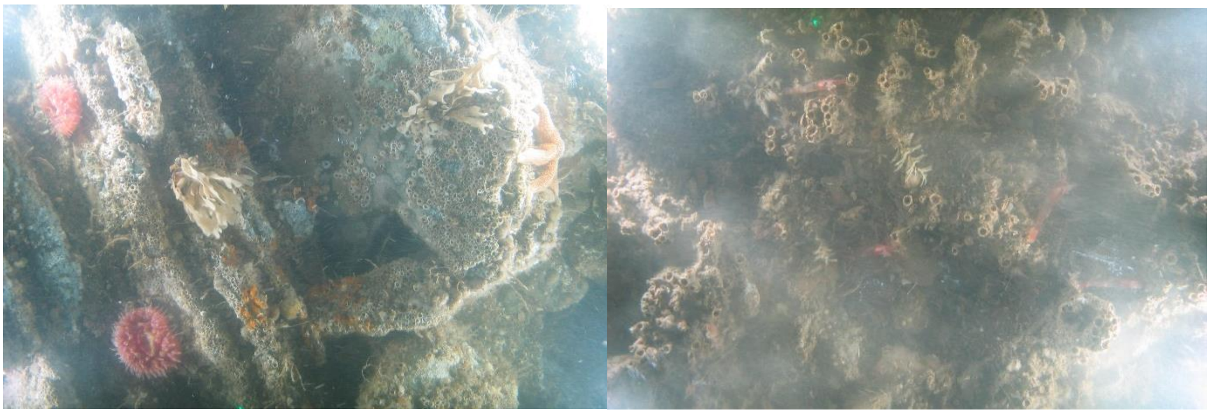

Plate 4. Example seabed imagery collected across the MDZ and environs. Left: Very tide-swept faunal communities (A4.11). Right: Circalittoral *Sabellaria* reefs (on rock) (A5.14).

4.4.2. Intertidal Biotopes

The intertidal survey area was found to support a wide variety of littoral rock biotopes interspersed with discrete patches of barren shingle and occasional areas of sandy sediment. The graduation down the shore followed that of other exposed to moderately exposed shores with notable lichen and barnacle bands (B3.111, A1.112, A1.1131) in the supralittoral and upper-mid shore areas, especially in the more gradually inclining areas within the main bay areas, grading into fucoid and then kelp dominated rock biotopes. Impoverished shingle (A2.111) was recorded in upper shore areas within the bays overlain by a narrow strandline biotope constituted by decomposing seaweed supporting sandhopper (talitrid amphipods) communities (A2.211). The gradation of biotopes observed in the bays was compressed into narrow bands in the southern and northern sections of the survey area due to the steep cliffs and vertical rock faces. All areas of littoral rock biotopes within the intertidal area were representative of Annex I bedrock reef as mapped in Figure 4.

Plate 5. Example quadrat photographs collected during the intertidal walk over survey. Left: *Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock (A1.2141). Right: Barren littoral shingle (A2.111).

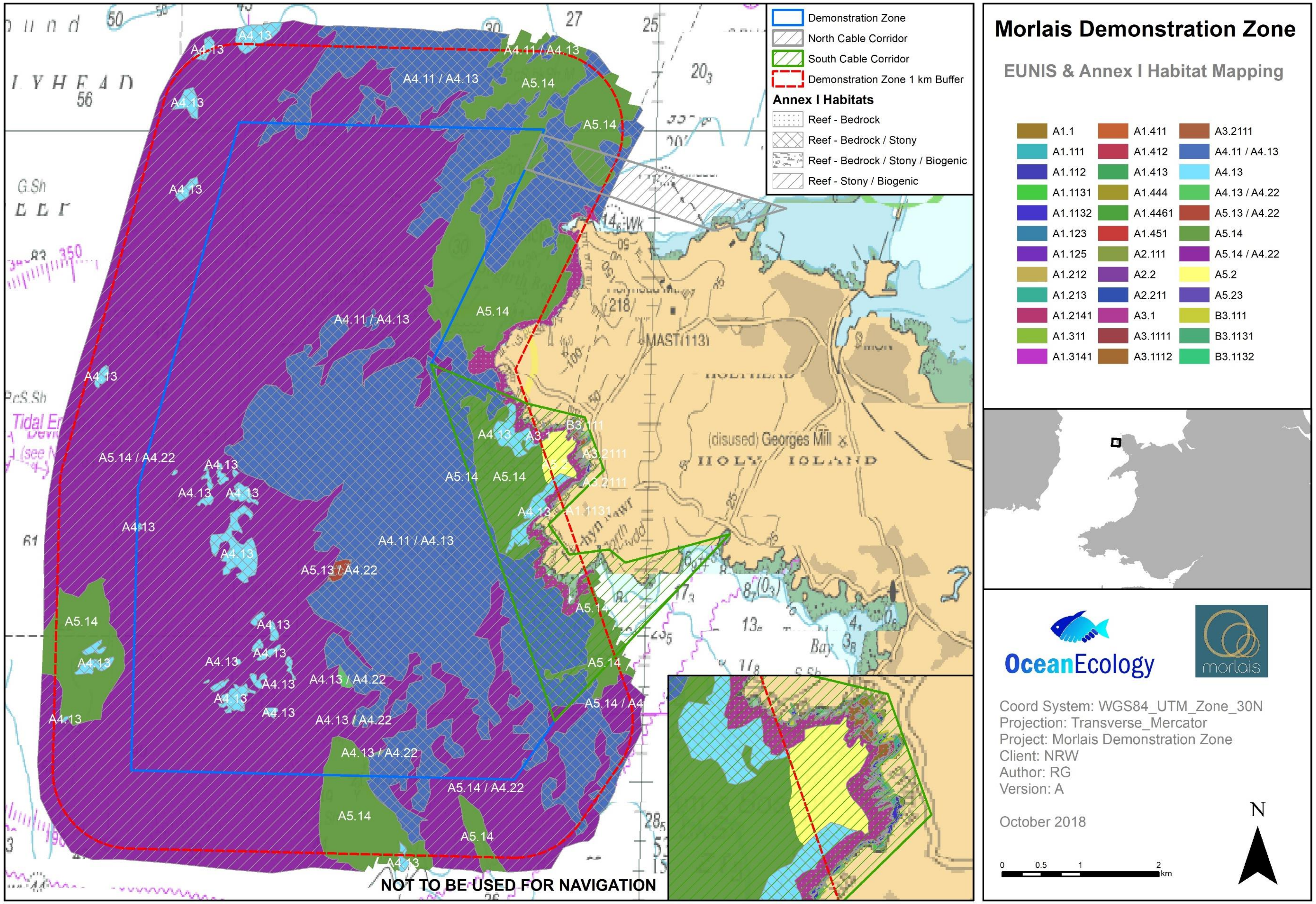

Figure 3 EUNIS and Annex I habitat mapping across the entire MDZ and environs based on the information collected during the benthic characterisation survey conducted in 2018.

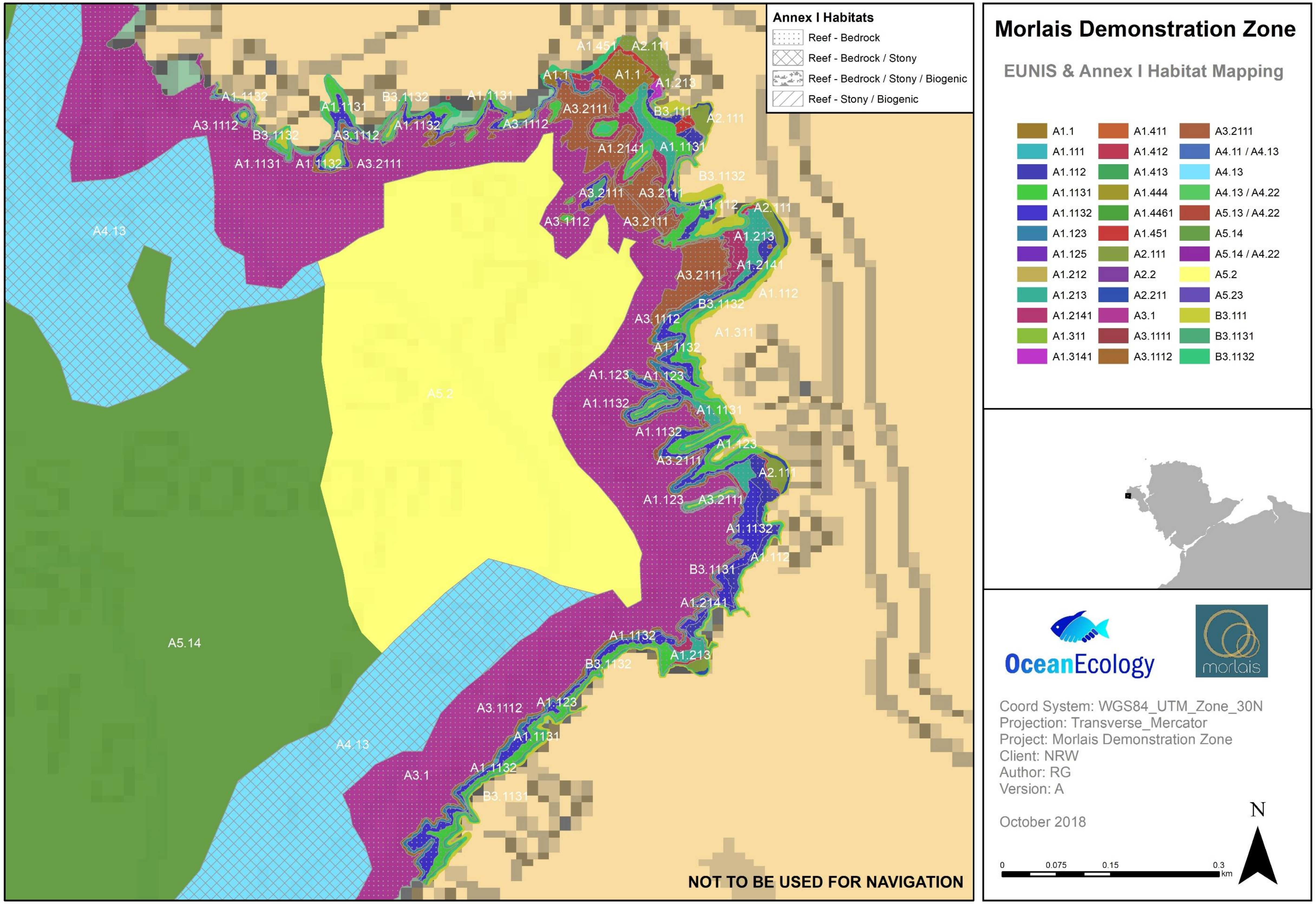

Figure 4 EUNIS and Annex I habitat mapping across the proposed MDZ cable landfall area known as 'Abraham's Bosom' based on the information collected during the benthic characterisation survey conducted in 2018.

5. DISCUSSION

This report presents the findings of intertidal and subtidal benthic ecology surveys of the MDZ, its associated buffer area and inshore cable corridor conducted in 2018 to inform a subsequent EIA. The surveys involved the collection of a plethora of marine ecological data including high resolution seabed imagery, grab samples, core samples, quadrat data and aerial imagery to enable the collation of a detailed biotope map of the area of interest.

Due to the hard nature of the seabed across most of the subtidal survey area, biotope mapping across this zone was largely informed by the results of the seabed imagery analysis and a detailed interpretation of the MBES and SSS data available for the site. This area was found to be constituted by a complex array of subtidal biotope mosaics dominated by circalittoral and/or infralittoral rock and coarse sediments. All three Annex I reef types (bedrock, stony and biogenic) were noted across this area.

Similar to the subtidal zone, the intertidal survey area was largely characterised by hard substrate meaning the majority of the biotope mapping was informed by quadrat data, UAV imagery and existing biotope mapping. The intertidal survey area was found to support a wide variety of littoral rock biotopes representative of Annex I bedrock reef interspersed with discrete patches of barren shingle and occasional areas of sandy sediment.

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