HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

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Wylfa Newydd Project

Porth-y-pistyll Biotope Mapping

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Executive Summary

The mapping surveys of Porth-y-pistyll showed a mosaic of rocky and sedimentary communities characteristic of the north Anglesey coastline, with stable fucoid communities on the shore, large swathes of kelp forest and park in the infralittoral zone, and a variety of mixed and soft sediment sublittoral communities. Largely considered a sheltered bay, it is occasionally subjected to strong northerly winds and consequent wave impacts, with the potential to markedly affect the resident marine communities.

Among the intertidal biotopes recorded several priority features were noted, the largest of which was the blue mussel bed at Porth y Felin. Many of the subtidal biotopes recorded are on the Section 42 list for Wales, including the large expanse of infralittoral sandy mud in the centre of the bay. Although the priority features recorded are not considered particularly important examples of the habitats, the mixture and diversity of the marine biotopes give rise to an area rich in fauna and flora, the heterogeneous topography allowing a variety of communities to flourish.

A comparison with NRW (Natural Resources Wales) intertidal data from 2003 found that the bay had experienced a fair degree of change, much of this considered a response to natural biological and physical impacts. The largest changes in the biotopes were recorded in and around the sedimentary habitats. The potential for waves to move these substrata, was clearly demonstrated with several areas previously recorded as rocky biotopes (NRW, 2003) now ascribed sedimentary biotope classifications. However, significant changes were also recorded elsewhere such as the replacement of an *Ascophyllum nodosum* biotope with fucoid and barnacle biotopes as well as the change in recorded *Laminaria digitata* extent and the converse appearance of a large band of *Laminaria hyperborea.* The coincidence of the intertidal survey with very low spring tides possibly allowed the surveyors in 2014 to observe a greater area of the low shore than was visible in 2003, explaining the significant increase in the extent of kelp communities across the bay.

Many rockpools were recorded from the low to high shore at Porth-y-pistyll and Cerrig Brith, the majority of which were described as ‘seaweed and sediment floored pools’. Surveys of the rockpools found them to be rich in flora and fauna, especially in the mid and upper shore. The depth of some of the mid and upper shore pools created a stable physical and chemical environment with many species present that are normally associated with the infralittoral zone e.g. kelp and foliose red algae.

The subtidal and intertidal surveys within Porth-y-pistyll bay and the adjacent coastline recorded four non-native species, three red algae and the brown alga *Sargassum muticum*. The latter species represents the first confirmed record of the invasive *S. muticum* along the northern coastline of Anglesey.

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Contents

1 Introduction

1.1 Overview

Horizon Nuclear Power Wylfa Ltd (hereafter referred to as Horizon) is currently planning to develop a new nuclear power station at Wylfa Head, Anglesey as identified in the National Policy Statement for Nuclear Power Generation (EN-6). The Wylfa Newydd Project (the Project) comprises the proposed new nuclear power station, including the reactors, associated plant and ancillary structures and features, together with all of the development needed to support its delivery, such as highway improvements, worker accommodation and specialist training facilities. The Project will require a number of applications to be made under different legislation to different regulators. As a nationally significant infrastructure project under the Planning Act 2008, the construction and operation must be authorised by a development consent order.

Jacobs UK Ltd (Jacobs) was commissioned by Horizon to undertake a full ecological survey programme within the vicinity of the proposed new nuclear power station on Anglesey (the Power Station). This work has included the gathering of baseline data to inform the various applications, assessments and permits that will be submitted for approval to construct and operate the Power Station and Associated Development[1].

This report specifically details the findings of the intertidal and subtidal biotope surveys carried out in 2014. A number of technical terms and abbreviations are used. Key terms are capitalised and explained with their acronyms within the text. References to legislation are to that legislation as in force at the time of the publication of this report.

1.2 The Wylfa Newydd Project and Study Area

The Project includes the Power Station and Associated Development. The Power Station includes two UK Advanced Boiling Water Reactors to be supplied by Hitachi-GE Nuclear Energy Ltd, associated plant and ancillary structures and features. In addition to the reactors, development on the Power Station Site (the indicative area of land and sea within which the majority of the permanent Power Station buildings, plant and structures would be situated) will include steam turbines, control and service buildings, operational plant, radioactive waste storage buildings, ancillary structures, offices and coastal developments. The coastal developments will include a Cooling Water System (CWS) and breakwater, and a Marine Off-Loading Facility (MOLF).

[1] Development needed to support delivery of the Power Station is referred to as Associated Development. This includes highway improvements along the A5025, park and ride facilities for construction workers, Logistics Centre, Temporary Workers' Accommodation, specialist training facilities, Horizon's Visitor Centre and media briefing facilities.

1.3 The Wylfa Newydd Development Area

The Wylfa Newydd Development Area (the indicative areas of land and sea, including the Power Station Site, the Wylfa NPS Site[2] and the surrounding areas that would be used for the construction and operation of the Power Station) covers an area of approximately 409 ha. It is bounded to the north by the coast and the existing Magnox power station (the Existing Power Station). To the east, it is separated from Cemaes by a narrow corridor of agricultural land. The A5025 and residential properties define part of the south-east boundary, with a small parcel of land spanning the road to the north-east of Tregele. To the south and west, the Wylfa Newydd Development Area abuts agricultural land, and to the west it adjoins the coastal hinterland.

The Wylfa Newydd Development Area includes the headland south of Mynydd-y-Wylfa candidate local wildlife site. There are two designated sites for nature conservation within the Wylfa Newydd Development Area: the Tre'r Gof Site of Special Scientific Interest (SSSI) and the Anglesey Terns/Morwenoliaid Ynys Môn Special Protection Area. There is also a candidate Special Area of Conservation (cSAC) that has been submitted to the European Commission, but not formally adopted (North Anglesey Marine/Gogledd Môn Forol cSAC). The Wylfa Newydd Development Area is within 1 km of the Cae Gwyn SSSI, Cemlyn Bay Special Area of Conservation (SAC) and SSSI[3].

The open coast location of north Anglesey is characterised by strong tidal flows (>1.5 m s^{-1}) and a seabed that slopes steeply to a depth of approximately 25-30 m. The substrata comprise a mix of bedrock, boulders and cobbles and sediments including gravel and sands in variable proportions.

The infralittoral coastline around north Anglesey comprises a diverse habitat assemblage characteristic of a moderately exposed, western UK rocky coastline and dominated by macrophytic algae.

Porth-y-pistyll bay is sheltered from the prevailing south-westerly wind with predominantly rocky intertidal and subtidal habitats interspersed with small patches of sandy sediment. Porth-y-pistyll is delineated by the rocky headland Cerrig Brith, separating Porth-y-pistyll from Cemlyn Bay to the west and by Porth y Gwartheg to the east (Figure 1.1).

The physical topography varies across the bay and contains both sheltered (e.g. Porth y Felin) and exposed (e.g. Cerrig Brith) areas with a range of tide-induced currents. These features create a diverse array of habitats from the supralittoral down to the circalittoral.

Numerous rock pools are located along the western and southern coastline of Porth-y-pistyll. The intertidal habitat in this area is considered of high ecological quality by Natural Resources Wales (NRW, formerly the Countryside Council for Wales (CCW)) with diverse algal communities and the presence of the relatively uncommon rock pool biotope 'seaweeds in sediment-floored eulittoral pools'.

[2] The site identified on Anglesey by the National Policy Statement for Energy EN-6/NPS EN-6 as potentially suitable for the deployment of a new nuclear power station.
[3] Note that the format of names for designated and conservation sites are consistent with JNCC guidance.

1.4 Study Aims

The objective of the intertidal and subtidal biotope surveys is to characterise the environment and collect baseline data to inform the various applications, assessments and permits required for the Project.

As part of the Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) the need for detailed knowledge of temporal and spatial data in and around Porth-y-pistyll bay has been identified.

Although a number of benthic surveys (see below) have been carried out in Porth-y-pistyll, gaps exist in the benthic data. The aim of this work was to produce high resolution biotope maps of both the subtidal and intertidal environments providing detailed pictorial representation of the communities present as well as providing evidence of any temporal change. In addition to the mapping, several rockpools were also surveyed.

The results from both the intertidal and subtidal work were used in tandem with historical survey data (see Doggett *et al*., 2013, Nikitik *et al.*, 2013) and in the case of the intertidal survey, to augment the biotope study carried out by NRW (2003). Data from the ongoing intertidal benthic work (see Nikitik *et al*., 2014) also assisted in biotope ascription of the sedimentary habitats.

In addition to the mapping work, further characterisation of the subtidal community composition of the bay used Marine Nature Conservation Review (MNCR) phase II surveys.

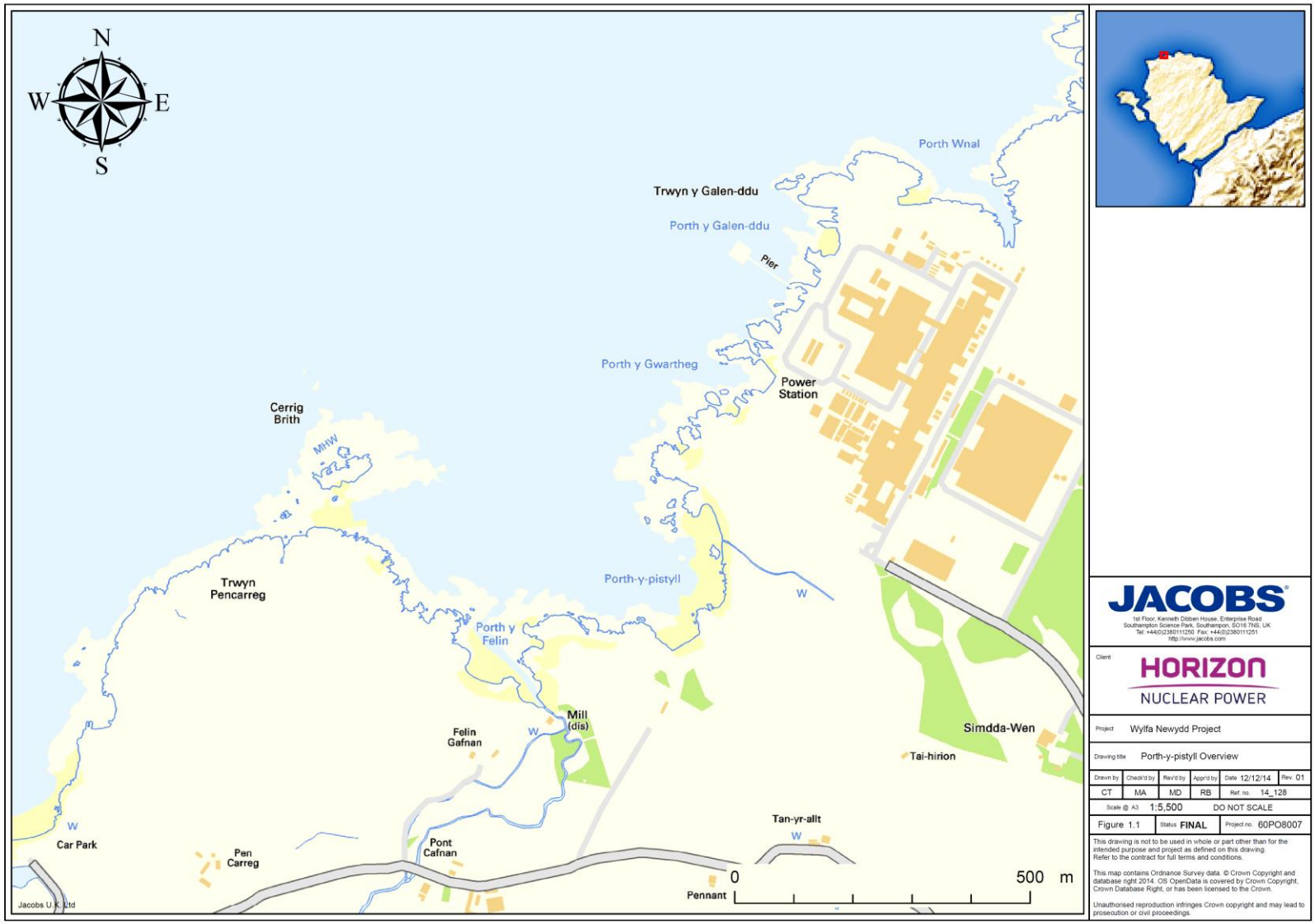

Figure 1.1: Overview of Porth-y-pistyll bay, north coast of Anglesey. The Existing Power Station is shown.

2 Methodology

The Porth-y-pistyll survey work comprised two key elements:

- intertidal biotope validation and rockpool surveys; and
- subtidal dive survey using a combination of rapid assessment and MNCR phase II surveys.

2.1 Intertidal Biotope Validation Survey

Work was carried out between 14 - 18 July 2014 to encompass a suitable spring tide cycle within the summer months.

The survey methodologies used were based on '*Procedural Guideline No. 3-1: In situ intertidal biotope recording*' (Wyn *et al*., 2000) and are summarised below. In 2003 NRW carried out a detailed biotope survey along the north Anglesey coast, incorporating Porth-y-pistyll bay (Figure 3.1). This study and the mapping outputs were then used to assist the two intertidal surveyors and determine presence/absence of ascribed biotopes and changes in their extent. In effect the survey was used to verify the location and presence of ecological communities previously identified over ten years ago by NRW (2003), and to provide an up-to-date pictorial representation of the marine biotopes in the bay.

2.1.1 Biotope mapping

Two intertidal surveyors experienced with the Joint Nature Conservation Committee (JNCC) biotope classifications (Connor *et al*., 2004) formed the survey team. Work commenced several hours before spring low tide along the upper shore of the bay, working down to the low shore as the tide receded.

The intertidal area from Cerrig Brith in the west, around the bay of Porth-y-pistyll to a point just south of the Existing Power Station CWS intake (Porth y Gwartheg) was surveyed. Surveyors could not access areas that exceeded a depth of 0.5 m but the particularly low spring tides generally enabled excellent coverage of the low shore by foot. The exception was a very small area covering the most northerly outcrops at Cerrig Brith, (not previously mapped by NRW) which were biotoped from approximately 15 m away using binoculars. The use of binoculars at this one location circumvented the need for full immersion and was considered a safer option.

Surveyors were equipped with Ordnance Survey maps, the NRW 2003 biotope map, a mobile mapper (with GPS) uploaded with relevant OS maps and NRW 2003 biotope map, a handheld GPS, binoculars and waterproof camera. The entire intertidal area of Porth-y-pistyll was walked by surveyors and notes were made and edits drawn, either directly onto maps, or digitally into the mobile mapper.

To provide some idea of the changes in the extent, biotope coverage has been assessed as 2D. It is not possible to calculate the 3D coverage and therefore the actual size of many of the biotopes will be larger than approximated.

Features of interest such as rockpools, crevices, overhangs and/or notable patches less than 5 m by 5 m were fixed by GPS, target notes made and photos taken.

Where applicable these target features were ascribed biotope codes. The GPS location of any Invasive Non-Native Species was also recorded.

Photos were taken of several of the intertidal biotopes, along with features of interest and points where a notable discrepancy between the historic (NRW, 2003) biotope data and the present survey were found (see Appendix A). Where the boundaries of biotopes were found to vary from that previously recorded, the limits were walked by surveyors and recorded by GPS for later transfer to GIS. During the survey it was found that the majority of the intertidal biotopes previously listed by NRW in 2003 were present, with the characterising flora/fauna of these biotopes confirmed by the surveyors. Key physical (e.g. wave exposure, depth range and substratum) and biological (e.g. species presence and abundance) characteristics were recorded from the biotopes to allow determination and in most cases validation of historically ascribed habitats. To assist in assignation of sedimentary biotopes, intertidal particle size analysis (PSA) data were used (Nikitik *et al*., 2013 and 2014).

2.1.2 Rockpools

During the course of the biotope survey the locations of rockpools greater than 1 m^2 were fixed and target notes made. Once the biotope survey was complete the surveyors returned to survey five of 20 rockpools recorded as target notes, working down the shore as low spring tide approached. Rockpools were selected on the basis of accessibility (during tidal window) and, in most cases, the presence of significant sediment flooring. The exception to the last selection criteria was rockpool number 2 (see below) which was largely bedrock with approximately 5% sand covering. The five rockpools surveyed were considered to be representative of the diversity of rockpools observed within Porth-y-pistyll.

At each rockpool (>1 m^2 in size), the GPS position and dimensions were recorded and photographs taken. Composition of the substratum was noted along with aspect and exposure. Detailed records were made of biota in each rockpool and the percentage cover or density of dominant taxa estimated.

A hand net was used to catch fish by working the net around the base of weed and into cracks and crevices as outlined in '*Procedural Guideline No. 4-4 Sampling fish in rockpools*' (Wilding *et al*., 2001).

2.1.3 Post-survey analysis

The mapping was discussed by the surveyors at the end of each survey day and features drawn on to maps for clarity. Data from the mobile mapper and handheld GPS were uploaded and all photos transferred to appropriate data storage facilities. All positional data were derived from the GPS and given in World Geodetic System (WGS) as WGS84 co-ordinates. Biotope ascriptions given in the original NRW biotope map were all converted from version 97.06 to the more recent version 04.05 (Connor *et al*., 2004) (Appendix B). The 04.05 biotope codes are used throughout this report.

Following all edits to the NRW (2003) biotope map the changes were digitised into a GIS database (ArcGIS v10.2.1), allowing biotopes and target notes to be clearly presented. All areas GPS tracked by surveyors were likewise uploaded into GIS, digitised onto the map and ascribed biotopes accordingly. All the assignations were called biotopes for clarity, as each is detailed separately in the JNCC classification (see Connor *et al*., 2004); although some of those recorded are of low resolution

and are better considered as broad habitats, potentially containing one or more biotope complexes e.g. LR.FLR.Rkp.

Once in GIS the coverage of each biotope was measured in square metres to allow comparisons between biotope extent in 2003 and that recorded in summer 2014, giving an idea of the dominant communities within the bay.

2.2 Subtidal Survey

The diving operations were led by Marine Ecological Solutions Ltd (MES), a specialised diving contractor. All diving operations were carried out in accordance with the Health and Safety Diving at Work Regulations 1997 (DWR 97) and the ACOP L107 Approved Code of Practice for Scientific and Archaeological Diving Projects.

To present a complete picture of the bay all the habitat data collected from previous years' diving surveys (2011 and 2012) were amalgamated with those collected in 2014. These surveys were carried out from 6–15 June 2011, 19–28 June 2012 and 14–19 June 2014 with a view to encompassing as much of the neap tides as was feasible and to complete during slack water conditions.

The 2014 study was centred within and adjacent to Porth-y-pistyll bay using qualified and experienced scientific divers to carry out all elements of the *in situ* surveys. All transects were geo-referenced using surface marker buoys equipped with GPS units to track the divers' progress along the sea bed. The GPS tracks were recorded on the diving log and the waypoints were later downloaded into MapInfo files and imported into a GIS database (ArcGIS v10.2.1). All positions were derived from the GPS and given in World Geodetic System (WGS) as WGS84 coordinates.

Subtidal surveys consisted of:

- rapid assessment (RA) dives covering 100-200 m, recording dominant habitats and characterising flora/fauna observed in each; and
- Marine Nature Conservation Review (MNCR) Phase II style 30 m transects, designed to gather detailed data on habitats and species in different sectors of the survey area.

The combination of these two survey techniques provided detailed information on spatial habitat cover for the tracks followed, which was then supplemented with habitat data gathered in 2011 and 2012 and interpolated to produce a subtidal habitat map of Porth-y-pistyll bay, and the adjacent coastline.

Using the predicted subtidal biotope map produced in 2012 (Doggett *et al*., 2013) provisional positions for the RA and MNCR transects in 2014 were given within the bay and mouth of Porth-y-pistyll, and also around Cerrig Brith to the west of the bay. These positions were modified during the course of the survey as new data became available to give a total of twelve RA and eight MNCR sites (Table 2.1).

Table 2.1: Rapid assessment (RA) and MNCR (S) survey transects in and adjacent to Porth-y-pistyll bay, 2014.

Site	Geographical region
RA1 & RA2	West Cerrig Brith
RA3	North east Cerrig Brith
RA4	Porth-y-pistyll (inner bay/mouth)
RA6	East Porth-y-pistyll (mouth)
RA7	Porth-y-Gwartheg
RA8	West Porth-y-pistyll (inner bay)
RA9	South-east Porth-y-pistyll (inner bay)
RA10	West Porth-y-pistyll (inner bay)
RA11	South-west Porth-y-pistyll (inner bay)
RA13	South-east Porth-y-pistyll (inner bay)
RA14	South Porth-y-pistyll (inner bay)
S1 & S2	West Cerrig Brith
S3	North Cerrig Brith
S8	Porth y Gwartheg
S9	South-west Porth-y-pistyll (inner bay)
S10	South-east Porth-y-pistyll (inner bay)
S11	South-east Porth-y-pistyll (inner bay)
S12	North Cerrig Brith

Transects outside of the bay:

RA1, RA2, RA3, RA7, S1, S2, S3, S8, S12, PP6

2.2.1 Rapid Assessment

Historically several RA transects were carried out within Porth-y-pistyll bay in 2011 and 2012, as the continuation of MNCR phase II surveys. The defined focus of the 2014 survey allowed much greater coverage of Porth-y-pistyll resulting in 12 RA transects in or adjacent to the bay. This survey activity focussed on covering large distances (100-200 m) across the sea bed, whilst making notes on characteristic biota and substrata.

During the RA transects the surveyors maintained a gap between each other, broadening the width of the visible transect and providing a high degree of confidence to the ascribed communities within a 6 m band. By planning the transects to cover multiple depth contours, and where possible varied substrata, a single dive encompassed several habitats, giving an idea of preferred depth ranges for the various subtidal communities in the bay but also allowing the surveyors to predict the presence of communities, based on the substrata types recorded previously.

As each new (or repeated) habitat was observed, the time was noted by surveyors; this allowed the positions of each habitat to be marked on the GPS tracks following the survey. Data records were further supplemented by video footage and photos.

2.2.2 MNCR Phase II

To provide more detailed biological and physical information, at several sites a MNCR Phase II survey was carried out, normally as a perpendicular intersection of the rapid assessment transects. The survey methodologies used were based on the standard MNCR methodologies which use the *in situ* identification of conspicuous seabed fauna and flora to describe the marine habitats and communities present on the sea bed. Further details of these methodologies are given in Hiscock (1996). A summary of the methods, highlighting techniques and features that were specific to these surveys, is given below. Details of the habitats were recorded on to MNCR subtidal *pro forma* along with the abundances of species observed (Appendix C).

A weighted 30 m tape-transect was laid out along the sea bed on a pre-defined start point and subsequent bearing. Two surveyors swam along the tape recording all taxa seen within 2 m to the left and right of the transect line, depending on the position of the surveyor. If time allowed, upon the completion of the 30 m transects, the surveyors continued along the predetermined bearing to further record the communities and habitats at a broadscale level, enabling additional biotopes to be assigned at specific points along the continued transect.

2.2.3 Recording Forms, Specimens and Photographs

The start and end times for the beginning and finish of each habitat encountered were noted on every *pro forma*. Descriptions for each habitat (physical and biological) were recorded along with the quantitative biota data. The number of biotopes encountered at each site ranged from two to five. The completed recording forms were then quality-checked.

Specimens collected for further identification were identified using microscopy and specialised taxonomic literature, and some were preserved and referenced to aid future identification of species for the ongoing survey work.

Photographs were taken to illustrate the habitats and communities present across the sites. Photographs and video taken during the surveys were downloaded and labelled appropriately.

2.2.4 Infaunal Cores

Subtidal cores were taken from several locations in the bay where the sediment was deep enough to allow cores to penetrate 15 cm or more. Once collected the material was washed over a 1 mm (BS410) sieve, with all material retained on the sieve fixed in a 4% formaldehyde solution. An additional core was taken at each site for particle size analysis (PSA).

In the laboratory faunal samples were first drained over a 125 µm sieve to remove the formalin and elutriate some of the fauna, thereby reducing damage to the organisms. Following this the samples were washed over stacked sieves of 4, 2 and 1 mm to facilitate the removal of fauna from the residue. Subsequently, all fauna were picked from the residue fractions and specimens identified and enumerated. Fauna were identified to species level where possible using the most up to date keys and low or high powered microscopes where appropriate. Nomenclature followed that of the World Register of Marine Species (WoRMS).

Knowing the faunal composition and sediment type is essential for ascription of high level biotope complexes in soft sediment.

2.2.5 Data Management and Analysis

For the purposes of this report each separately ascribed biological feature was called a biotope, as each is detailed separately in the JNCC marine classification (see Connor *et al*., 2004); even though a number of the features recorded in this survey are of low resolution and are better considered as broad habitats e.g. mixed faunal turf communities (CR.MCR.XFa).

Following assignation of biotopes to each of the broad habitats recorded, an indicative habitat map was created. This used time-stamped surveyor observations, along with photographs and corresponding video footage of each transect surveyed.

The position of each habitat type was marked on the GPS tracks; these could then be interpolated between each track. The results of a side scan sonar survey by Titan Environmental Surveys Ltd (Ibrahim, 2012) was also used to help determine the physical nature and depth at a given location when interpolating between tracks, and enhanced the accuracy of this process. The resulting biotope map covered habitats up to the infralittoral fringe which complemented the results of the intertidal biotope survey described below.

2.2.6 Limitations of subtidal survey methodologies

A number of limitations are inherent with biotope mapping and are generally recognised by the scientific community, such as the confusion in assigning biotopes based on biological similarities in community even though there are recognisable differences in physical variables (e.g. Parry, 2013). The varied substrata recorded during the subtidal surveys often made discrete biotope ascription difficult and it should be noted that many of the mapped biotope areas featured a blend of substrata, but which is deemed to contain general physical and biological features most consistent with the biotope ascribed.

Another issue with the subtidal mapping was the restricted view of the habitat(s). For example, the visibility in the bay did not extend beyond 3 m and was often between 1-2 m; whilst this did not prevent accurate identification of taxa and the immediate habitats it limited the extent of the surveyors' observations. In temperate and deep waters the limited range of visible habitat is commonly an issue, resulting in predictive ascription of the adjacent communities based on observed biological and physical features in the locations surveyed.

3 Results

3.1 Intertidal Biotope Validation Survey

3.1.1 Porth-y-pistyll biotopes

Over the duration of the 2014 survey a total of 37 intertidal biotopes (including all target notes) were recorded throughout the bay, from Cerrig Brith in the east to Porth Gwartheg in the west, covering a total of 16.8 hectares. This compared to 30 biotopes covering 16.2 hectares in 2003 (NRW). A list of all the biotopes found in 2003 and 2014 are given (as described in Connor *et al.,* 2004) (Table 3.1). The most dominant communities, in terms of extent, were the same in both years with *Fucus serratus, Ascophyllum nodosum and Laminaria digitata* biotopes accounting for more than 40% of the intertidal assemblages.

Many of the biotopes showed a significant change in coverage when compared to those recorded in 2003, as well as seven biotopes being recorded in 2014 which were not present in 2003 (see Table 3.2 and Section 3.1.3).

Figure 3.1 gives an overview of the NRW biotope map (2003) for Porth-y-pistyll, while Figure 3.2 shows the distribution of these biotopes throughout Porth-y-pistyll bay in 2014. A list of all target notes made during the biotope survey is provided (Table 3.3).

3.1.2 Conservation Features

The following features recorded from Porth-y-pistyll are on the Section 42 list of habitats and species of principal importance in Wales:

- *Fucus serratus* and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders (LR.MLR.BF.Fser.Bo);
- *Fucus ceranoides* on reduced salinity eulittoral rock (LR.LLR.FVS.Fcer);
- coastal saltmarsh (LS.LMp.Sm); and
- *Mytilus edulis* (blue mussel) beds on littoral mixed substrata (LS.LBR.LMus.Myt.Mx).

The feature LR.MLR.BF.Fser.Bo was recorded as a target note (<5 m^2) on the west side of Cerrig Brith (Figure 3.2 and Table 3.3). The other features covered 0.68 (*Mytilus edulis*), 0.18 (*Fucus ceranoides*) and 0.14 (saltmarsh) hectares and were located adjacent to one another in Porth y Felin (Figure 3.2).

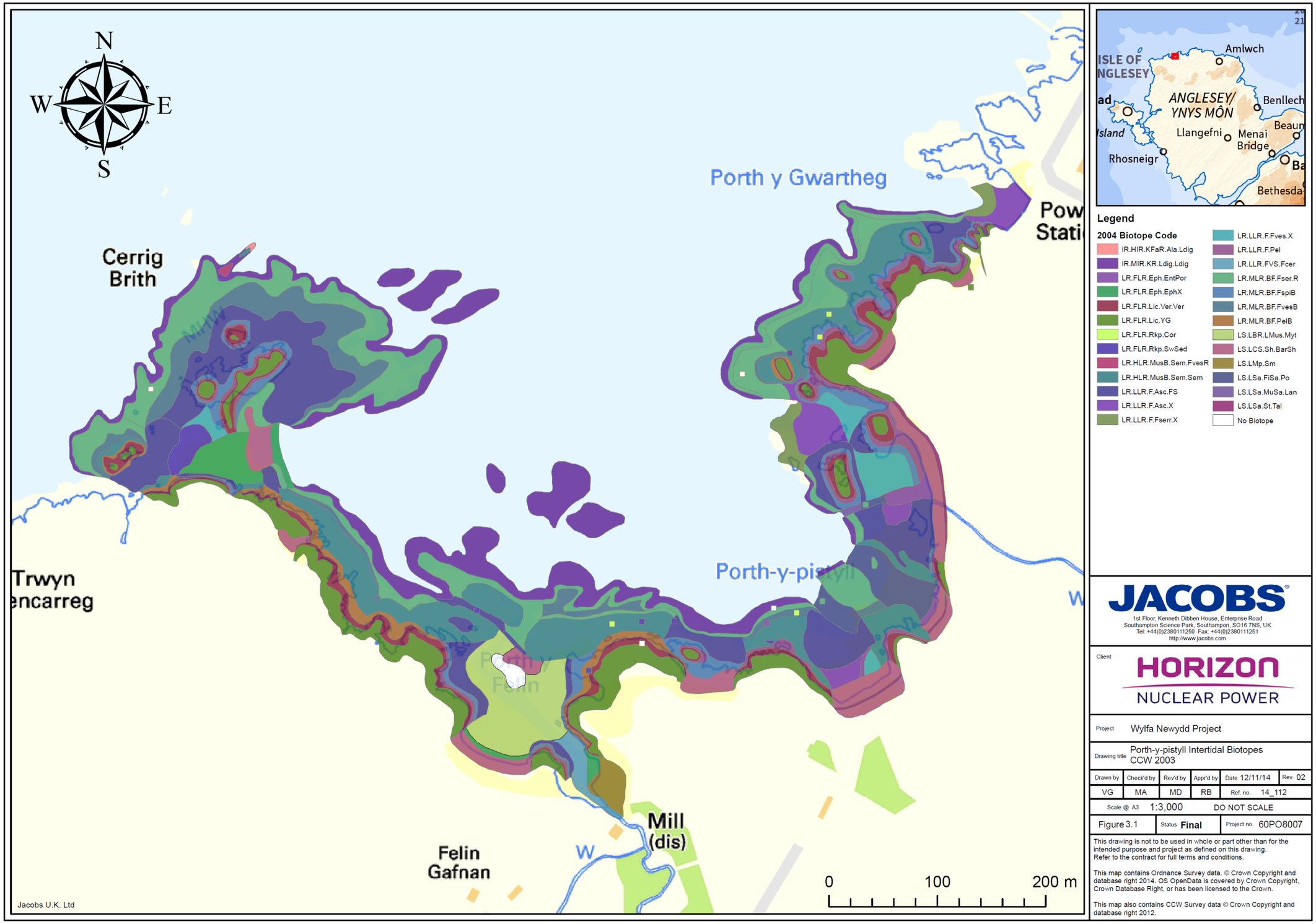

Figure 3.1: Cropped map of the intertidal biotopes at Porth-y-pistyll bay, as produced by CCW (now NRW) in 2003. The biotope codes have all been converted to the 2004 classification according to Connor *et al*. (2004). Small squares depict target note features.

Table 3.1: All biotopes recorded in 2003 and 2014 along with their descriptions (according to Connor *et al*., 2004)

Biotope code 2004	Description
IR.HIR.KFaR.Ala.Ldig *	*Alaria esculenta* and *Laminaria digitata* on exposed sublittoral fringe bedrock
IR.LIR.K.Lsac.Ldig**	*Laminaria saccharina* and *Laminaria digitata* on sheltered sublittoral fringe rock
IR.MIR.KR.Ldig.Ldig	*Laminaria digitata* on moderately exposed sublittoral fringe rock
IR.MIR.KR.Lhyp	*Laminaria hyperborea* and foliose red seaweeds on moderately exposed infralittoral rock
LR.FLR.CvOv.SpR.Den	Sponges, shade-tolerant red seaweeds and *Dendrodoa grossularia* on wave-surged overhanging lower eulittoral bedrock and caves
LR.FLR.CvOv.SpR	Sponges and shade-tolerant red seaweeds on overhanging lower eulittoral bedrock and in cave entrances
LR.FLR.CvOv	Littoral caves and overhangs
LR.FLR.Eph.EntPor	*Porphyra purpurea* and *Enteromorpha* spp. on sand-scoured mid or lower eulittoral rock
LR.FLR.Eph.EphX	Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata
LR.FLR.Lic.Ver.Ver	*Verrucaria maura* on very exposed to very sheltered upper littoral fringe rock
LR.FLR.Lic.YG	Yellow and grey lichens on supralittoral rock
LR.FLR.Rkp.Cor	Coralline crust-dominated shallow eulittoral rockpools
LR.FLR.Rkp.FK	Fucoids and kelp in deep eulittoral rockpools
LR.FLR.Rkp.G	Green seaweeds (*Enteromorpha* spp. and *Cladophora* spp.) in shallow upper shore rockpools
LR.FLR.Rkp	Rockpools
LR.FLR.Rkp.SwSed	Seaweeds in sediment-floored eulittoral rockpools
LR.HLR.FR.Mas	*Mastocarpus stellatus* and *Chondrus crispus* on very exposed to moderately exposed lower eulittoral rock
LR.HLR.MusB.Sem.FvesR	*Semibalanus balanoides*, *Fucus vesiculosus* and red seaweeds on exposed to moderately exposed eulittoral rock
LR.HLR.MusB.Sem.Sem	*Semibalanus balanoides, Patella vulgata* and *Littorina* spp. on exposed to moderately exposed or vertical sheltered eulittoral rock
LR.LLR.F.Asc.FS	*Ascophyllum nodosum* on full salinity mid eulittoral rock
LR.LLR.F.Asc.X	*Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata
LR.LLR.F.Fserr.FS	*Fucus serratus* on full salinity sheltered lower eulittoral rock’
LR.LLR.F.Fserr.X	*Fucus serratus* on full salinity lower eulittoral mixed substrata
LR.LLR.F.Fves.X	*Fucus vesiculosus* on mid eulittoral mixed substrata
LR.LLR.F.Pel	*Pelvetia canaliculata* on sheltered littoral fringe rock
LR.LLR.FVS.Fcer	*Fucus ceranoides* on reduced salinity eulittoral rock
LR.MLR.BF.Fser	*Fucus serratus* on moderately exposed lower eulittoral rock
LR.MLR.BF.Fser.Bo	*Fucus serratus* and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders
LR.MLR.BF.Fser.R	*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock
LR.MLR.BF.FspiB	*Fucus spiralis* on exposed to moderately exposed upper

Biotope code 2004	Description
	eulittoral rock
LR.MLR.BF.FvesB	*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock
LR.MLR.BF.PelB	*Pelvetia canaliculata* and barnacles on moderately exposed littoral fringe rock
LS.LBR.LMus.Myt.Mx	*Mytilus edulis* beds on littoral mixed substrata
LS.LCS.Sh.BarSh	Barren littoral shingle
LS.LMp.Sm	Saltmarsh
LS.LSa.FiSa.Po	Polychaetes in littoral fine sand
LS.LSa.MoSa	Barren or amphipod dominated mobile sand shores
LS.LSa.MuSa.Lan	*Lanice conchilega* in littoral sand
LS.LSa.St.Tal	Talitrids on the upper shore and strand-line

* Biotope is thought present but access could not be achieved during the 2014 survey

**Biotope was originally described by intertidal surveyors as IR.HIR.KSed.Lsac then, following analysis of the subtidal biotope data, changed to IR.LIR.K.Lsac.Ldig.

Table 3.2: Intertidal biotopes recorded in 2003 and 2014 from Porth-y-pistyll bay, north Anglesey. Biotopes <5 m^2 are listed as target notes (TN). Entries highlighted red were not recorded from the bay in 2003. All codes are according to Connor *et al.* (2004).

Biotope code	Approx. area 2014 (sq m)	Approx. area 2003 (sq m)	Extent change (sq m)
IR.HIR.KFaR.Ala.Ldig	Not recorded	36.6	-36.6
IR.LIR.K.Lsac.Ldig	TN	Not recorded	NA
IR.MIR.KR.Ldig.Ldig	18292.4	20221.0	-1928.6
IR.MIR.KR.Lhyp	2135.6	Not recorded	2135.6
LR.FLR.CvOv.SpR.Den	Not recorded	TN	NA
LR.FLR.CvOv.SpR	TN	Not recorded	NA
LR.FLR.CvOv	TN	Not recorded	NA
LR.FLR.Eph.EntPor	1339.3	920.4	418.9
LR.FLR.Eph.EphX	1854.1	2967.2	-1113.1
LR.FLR.Lic.Ver.Ver	7424.0	7564.7	-140.8
LR.FLR.Lic.YG	13056.9	13338.8	-281.8
LR.FLR.Rkp.Cor	TN	TN	NA
LR.FLR.Rkp.FK	TN	TN	NA
LR.FLR.Rkp.G	TN	TN	NA
LR.FLR.Rkp	TN	TN	NA
LR.FLR.Rkp.SwSed	809.6	1024.2	-214.6
LR.HLR.FR.Mas	770.1	Not recorded	770.1
LR.HLR.MusB.Sem.FvesR	259.4	84.1	175.3
LR.HLR.MusB.Sem.Sem	15392.8	18551.0	-3158.1
LR.LLR.F.Asc.FS	19912.3	21575.2	-1662.9
LR.LLR.F.Asc.X	6343.1	3960.7	2382.4
LR.LLR.F.Fserr.FS	138.5	Not recorded	138.5
LR.LLR.F.Fserr.X	2057.6	1454.8	602.8
LR.LLR.F.Fves.X	3037.3	3215.0	-177.7
LR.LLR.F.Pel	5032.8	4917.4	115.4
LR.LLR.FVS.Fcer	1837.9	1022.0	815.9
LR.MLR.BF.Fser	189.5	Not recorded	189.5
LR.MLR.BF.Fser.Bo	TN	TN	NA
LR.MLR.BF.Fser.R	24726.9	23028.2	1698.7
LR.MLR.BF.FspiB	4827.8	6323.4	-1495.6
LR.MLR.BF.FvesB	12051.6	8674.6	3377.0
LR.MLR.BF.PelB	4948.4	3021.34	1927.06
LS.LBR.LMus.Myt.Mx	6859.5	6457.4	402.1
LS.LCS.Sh.BarSh	9508.6	8222.1	1286.5
LS.LMp.Sm	1410.1	1132.4	277.7
LS.LSa.FiSa.Po	1787.1	3516.5	-1729.4
LS.LSa.MoSa	1215.6	Not recorded	1215.6
LS.LSa.MuSa.Lan	109.8	109.8	0.0
LS.LSa.St.Tal	809.2	809.2	0.0
*No biotope ascribed**	0.0	508.0	-508.0
Total area recorded	**168137.8**	**162656.04**	**5481.86**

*In 2003 an area of 508 sq. metres in the middle of the bay was not ascribed a biotope. For the purposes of calculating the entire area recorded in 2003 and 2014 this value has been acknowledged.

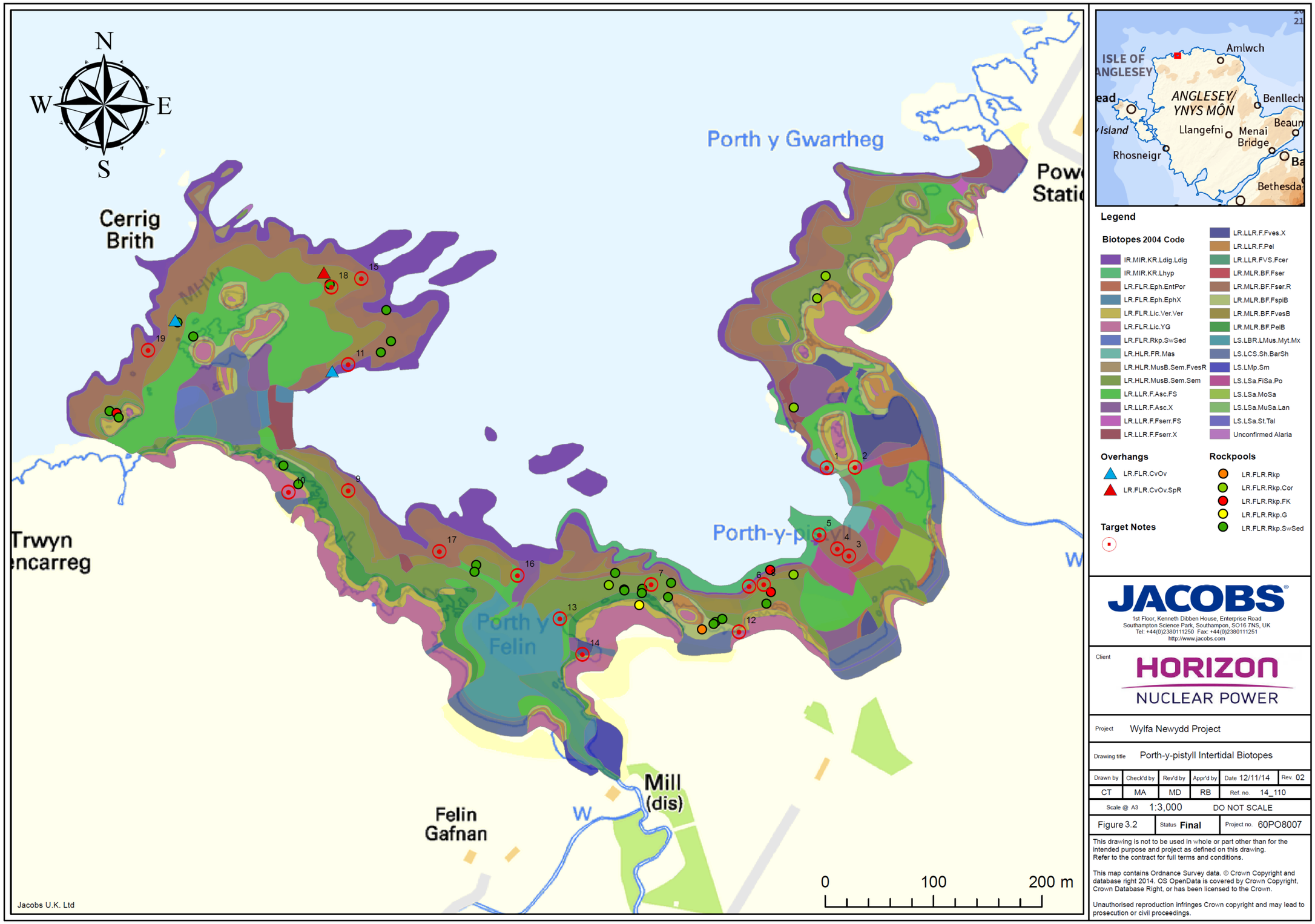

Figure 3.2: Intertidal biotopes and features identified at Porth-y-pistyll bay in 2014. All codes are according to Connor *et al*. (2004). Details of target notes are given below.

Table 3.3: Target notes recorded during intertidal survey of Porth-y-pistyll in 2014 and depicted in Figure 3.2.

Target no.	Details
1	*Sargassum muticum*
2	Old pipe
3	*Sargassum muticum*
4	*Sargassum muticum*
5	*Sargassum muticum*
6	Rotting drift algae
7	*Blindingia* spp.
8	LR.FLR.Eph.EntPor
9	*Enteromorpha* spp.
10	Maritime flora
11	*Enteromorpha* spp.
12	Old discharge pipe
13	Manmade boulder wall
14	Manmade boulder wall
15	Rock channel
16	Driftweed channel
17	Driftweed channel
18	*Sargassum muticum*
19	LR.MLR.BF.Fser.Bo

No species with conservation designations were recorded; however, the invasive non-native alga *Sargassum muticum* was recorded at five locations along the bay, four in the south-east corner and one at a rockpool on Cerrig Brith (Figure 3.3).

Figure 3.3: The invasive non-native alga *Sargassum muticum* in a rockpool at Cerrig Brith.

3.1.3 Changes to extent and presence

Modifications made to the original Porth-y-pistyll biotope map (NRW, 2003) were, for the most part, reflected by relatively small changes in biotope extent, often by <5 m. However, a number of changes were more distinct with the location of a given biotope and/or the boundary being >5 m distant from that previously recorded e.g. the seaward expansion of the *Laminaria digitata* boundary (IR.MIR.KR.Ldig.Ldig) along the north eastern edge of Cerrig Brith; the seaward expansion of the *Fucus vesiculosus* biotope (LR.MLR.BF.FvesB) on the lower western shore of Porth-y-pistyll; the shifting of a *Fucus serratus* biotope (LR.MLR.BF.Fser.R) at numerous locations around the bay, often subsuming parts of one or more adjacent biotopes (Table 3.2).

In Porth y Felin, increases in extent coverage for the *Mytilus edulis* bed (LS.LBR.LMus.Myt.Mx) and *Fucus ceranoides* biotope (LR.LLR.FVS.Fcer) were recorded as 0.04 and 0.08 ha respectively. The *Mytilus edulis* bed contained an area not previously assigned a code (see NRW, 2003; Figure 1.1); although in 2014 much of this area was recorded as a continuation of the mussel bed, as was the historic patch of barren shingle to the north-east.

Just to the east of the mussel bed, in Porth y Felin, there was a notable loss in extent to the biotope '*Fucus spiralis* on exposed to moderately exposed upper eulittoral rock' (LR.MLR.BF.FspiB), with a consequential increase in coverage of the biotopes '*Pelvetia canaliculata* and barnacles on moderately exposed littoral fringe rock' (LR.MLR.BF.PelB); and '*Pelvetia canaliculata* on sheltered littoral fringe rock' (LR.LLR.F.Pel). Within the bay a number of other *Fucus spiralis* (LR.MLR.BF.FspiB) zones had either disappeared or showed a sizeable loss in previously recorded extent. For example, the patch immediately to the west of the mussel bed had been completely replaced by *Pelvetia canaliculata* (LR.LLR.F.Pel); on Cerrig Brith the movement of shingle and shells had covered up much of the *Fucus spiralis* area described in 2003; and on the eastern side of the bay encroachment of the biotope *Fucus vesiculosus* on mid eulittoral mixed substrata (LR.LLR.F.Fves.X) had reduced the extent of *Fucus spiralis.*

Along the southern intertidal region of the bay the biotope '*Ascophyllum nodosum* on full salinity mid eulittoral rock' (LR.LLR.F.Asc.FS) had been completely replaced by fucoid (LR.MLR.BF.FvesB) and barnacle (LR.HLR.MusB.Sem.Sem) assemblages. However, the biotope '*Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata' (LR.LLR.F.Asc.X) increased in coverage in several areas of the bay, including Cerrig Brith and the eastern side of the bay.

Eight biotopes were recorded in 2014 that had not been observed previously from the bay (Table 3.2), several of which were target notes (<5 m^2). These included a small patch of *Saccharina latissima* (Lsac.Ldig) (synonymous as *Laminaria saccharina*) visible below the surface water, and the overhang communities LR.FLR.CvOv.SpR and LR.FLR.CvOv. Two new *Fucus serratus* biotopes also represented small coverages of the shore, in contrast to the biotopes LR.HLR.FR.Mas, LS.LSa.MoSa and IR.MIR.KR.Lhyp which covered 770.1, 1215.6 and 2135.6 ha. respectively.

The mobile sand biotope (LS.LSa.MoSa), largely devoid of fauna, was recorded in an area previously described as 'polychaetes in littoral fine sand' (LS.LSa.FiSa.Po) in 2003). The biotope '*Mastocarpus stellatus* and *Chondrus crispus* on very exposed to moderately exposed lower eulittoral rock' (FR.Mas) was found in several areas

along the eastern shore. Several patches of the invasive non-native alga *Sargassum muticum* were found within the FR.Mas biotope and the adjacent area. In addition to these newly recorded biotopes, a large band of *Laminaria hyperborea* forest (IR.MIR.KR.Lhyp) running along part of the eastern and much of the southern coastal margin, was recorded. Much of the *L. hyperborea* followed the contour previously given for the *L. digitata* (NRW, 2003) and, where it did not completely replace *L. digitata*, extended into the historic *L. digitata* biotope creating a much narrower strip of *L. digitata* (Figure 3.1 and Figure 3.2).

Observations showed that sediment had shifted in several parts of the bay. Within the intertidal channel connecting Cerrig Brith to the mainland the barren littoral shingle biotope (LS.LCS.Sh.BarSh) had extended north and east. Furthermore, an area previously marked as 'Polychaetes in littoral fine sand' (LS.LSa.FiSa.Po), in the south-eastern corner of the bay, was split into several distinct biotopes (LR.HLR.FR.Mas, LS.LSa.FiSa.Po, LR.FLR.Eph.EntPor and LS.LSa.MoSa) and the noticeable shifting of sandy sediment recorded.

A clear temporal change was observed in the extent of LR.HLR.MusB.Sem.Sem which had decreased by approx. 0.3 ha. Much of this biotope had been replaced by LR.MLR.BF.PelB, in the south-west of the bay, and LR.MLR.BF.FVesB, along the south-west and eastern coastlines. The LR.MLR.BF.PelB community showing a significant increase in extent of almost 0.2 ha.

From Porth y Gwartheg in the east, the presence of the two biotopes '*Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata' (LR.LLR.F.Asc.X) and '*Fucus serratus* on full salinity lower eulittoral mixed substrata' (LR.LLR.F.Fserr.X) within the sheltered embayment, adjacent to the intakes was confirmed. The area north of the Existing Power Station CWS intake (i.e. north of the biotopes AscX and FserrX) was not mapped (see Section 2.1.1), therefore the presence of the biotope *'Alaria esculenta* and *Laminaria digitata* on exposed sublittoral fringe bedrock' IR.HIR.KFaR.Ala.Ldig was not confirmed. Furthermore, the northerly tip of a rocky outcrop on Cerrig Brith could not be reached in 2014 due to the state of the tide, so confirmation of the *A. esculenta* biotope at this point was not possible.

3.1.4 Rockpools

In total, 77 taxa were recorded from the five pools surveyed (Table 3.4). Of these taxa a reduced taxa list of 72 was given once all those taxa that could represent another entry already listed were removed i.e. Amphipod spp., Crab indet., Fish juv, Paguridae spp. and Serpulidae spp. Entries such as filamentous green and filamentous red were known not to contain an alga already identified.

Table 3.4: List of all taxa recorded from rockpools surveyed in Porth-y-pistyll bay, north Anglesey.

	Rockpool				
Taxa	**1**	**2**	**3**	**4**	**5**
Acrosorium venulosum		■			
Actinia equina	■		■		
Amphipoda spp.		■		■	
Anemonia viridis	■		■	■	
Ascophyllum nodosum			■	■	
Aurelia aurita	■				
Blenniidae spp.	■	■			
Bryopsis plumosa				■	
Bryozoan crust				■	
Calliblepharis ciliata	■		■		
Carcinus maenas				■	
Ceramium nodulosum		■			
Ceramium spp. (1)	■	■	■	■	■
Ceramium spp. (2)	■			■	■
Chondrus crispus	■	■	■	■	■
Chrysaora hysoscella					
Cirripedia spp.	■	■	■		
Cladophora rupestris	■		■	■	
Cladophora spp.	■	■			■
Corralina officinalis	■	■	■	■	
Crab indet.		■			
Cryptopleura ramosa				■	■
Cystoclonium purpureum	■	■			
Desmarestia viridis					
Dictyota spiralis	■	■	■	■	
Elachista spp.		■			
Enteromorpha spp.	■	■			
Filamentous green	■				
Filamentous red					■
Fish juv.			■		
Fucus serratus		■		■	■
Fucus vesiculosus		■		■	
Furcellaria lumbricalis	■		■		■
Gammaridae spp.	■				

Taxa	1	2	3	4	5
Gibbula cineraria	■		■		■
Gibbula umbilicalis	■		■		■
Gracilaria gracilis	■				
Halidrys siliquosa			■	■	
Halurus flosculosus		■	■		■
Heterosiphonia plumosa/japonica			■		
Hildenbrandia rubra	■		■	■	
Hypoglossum hypoglossoides		■			
Laminaria digitata		■	■		■
Laurencia pinnatifida			■	■	■
Leathesia difformis	■				
Lithophyllum incrustans	■	■	■	■	■
Littorina littorea	■		■	■	
Littorina obtusata	■			■	
Lomentaria articulata			■		
Mastocarpus stellatus			■		
Membranoptera alata					■
Mysidae spp.			■		■
Ophiuridae spp.				■	
Paguridae spp.	■			■	■
Pagurus bernhardus	■	■	■		
Palaemon serratus	■		■	■	■
Palmaria palmata		■			■
Patella vulgata	■	■	■	■	
Pelvetia canaliculata	■				
Plocamium spp.					■
Polynoidae spp.				■	
Polyplacophora spp.				■	
Pomatoceros spp.				■	
Porphyra umbilicalis		■	■		
Pterocladiella capillacea	■	■	■	■	
Pylaiella cf. littoralis			■		
Ralfsia verrucosa	■				
Rissoidae spp.			■		
Saccharina latissima					■
Scytosiphon lomentaria			■	■	
Serpulidae spp.				■	
Sphaerococcus coronopifolius					■
Spirorbis spirorbis	■	■		■	
Spongomorpha spp.	■	■	■	■	
Spongonema tomentosum					■
Symphodus melops					■
Ulva lactuca		■			■

The richest rockpools in terms of taxa (using reduced taxa list) were rockpool 1 and 3 (S=35) and, by comparison, the poorest rockpool 5 (S=25) (Table 3.5).

Table 3.5: Biological and physical characteristics of rockpools surveyed. The number of taxa is denoted by 'S'.

		Rockpool				
		1	**2**	**3**	**4**	**5**
Biological	**S**	35	28	35	32	25
	No. flora	20	21	24	18	19
	No. fauna	15	7	11	14	6
Physical	**Shore zone**	Upper	Upper Mid	Mid	Mid /Low	Low
	Depth	0.8	1	0.8	0.3	0.6
	Area	16 m^2	5 m^2	5 m^2	4 m^2	70 m^2
	Rockpool biotope complex	SwSed	FK	SwSed	SwSed	SwSed

All rockpools were dominated by flora with between S=18 to S=24 taxa in each. A greater variation was observed with fauna richness from the pools (S=6 to S=15). The most commonly recorded taxa were the algae *Chondrus crispus, Ceramium* spp. (1) and *Lithophyllum incrustans* which were found in all rockpools. Of the fauna, both the shrimp *Palaemon serratus* and the common limpet *Patella vulgata* were recorded from four of the pools.

The rockpools surveyed were located in a variety of zones (high, mid and low shore) across the bay (Figure 3.4). The rockpools were seaweed and sediment floored (LR.FLR.Rkp.SwSed) except rockpool 2 (LR.FLR.Rkp.FK) which was dominated by *Laminaria digitata* (Table 3.5). The extensive seaweed and sediment-floored rockpool (0.08 hectares), in the channel between Cerrig Brith and the mainland, was mapped in 2014 and showed a loss in extent of 0.02 hectares when compared to the area recorded in 2003 (Figure 3.1 and Figure 3.2).

Rockpool 1

Rockpool 1 was a stepped pool, effectively of two sections, one shallow (max. depth 20 cm), the other considerably deeper (max depth 80 cm) and with a mixture of sediment covering the bottom (Figure 3.5). It was situated on the upper shore, close to the supralittoral zone).

The shallow pool was carpeted in bleached *Lithophyllum incrustans* with a thick growth of the green alga *Spongomorpha* spp., covering approximately 75% of the pool surface. Beneath this alga the flora were predominantly *Chondrus crispus* and *Corallina officinalis*.

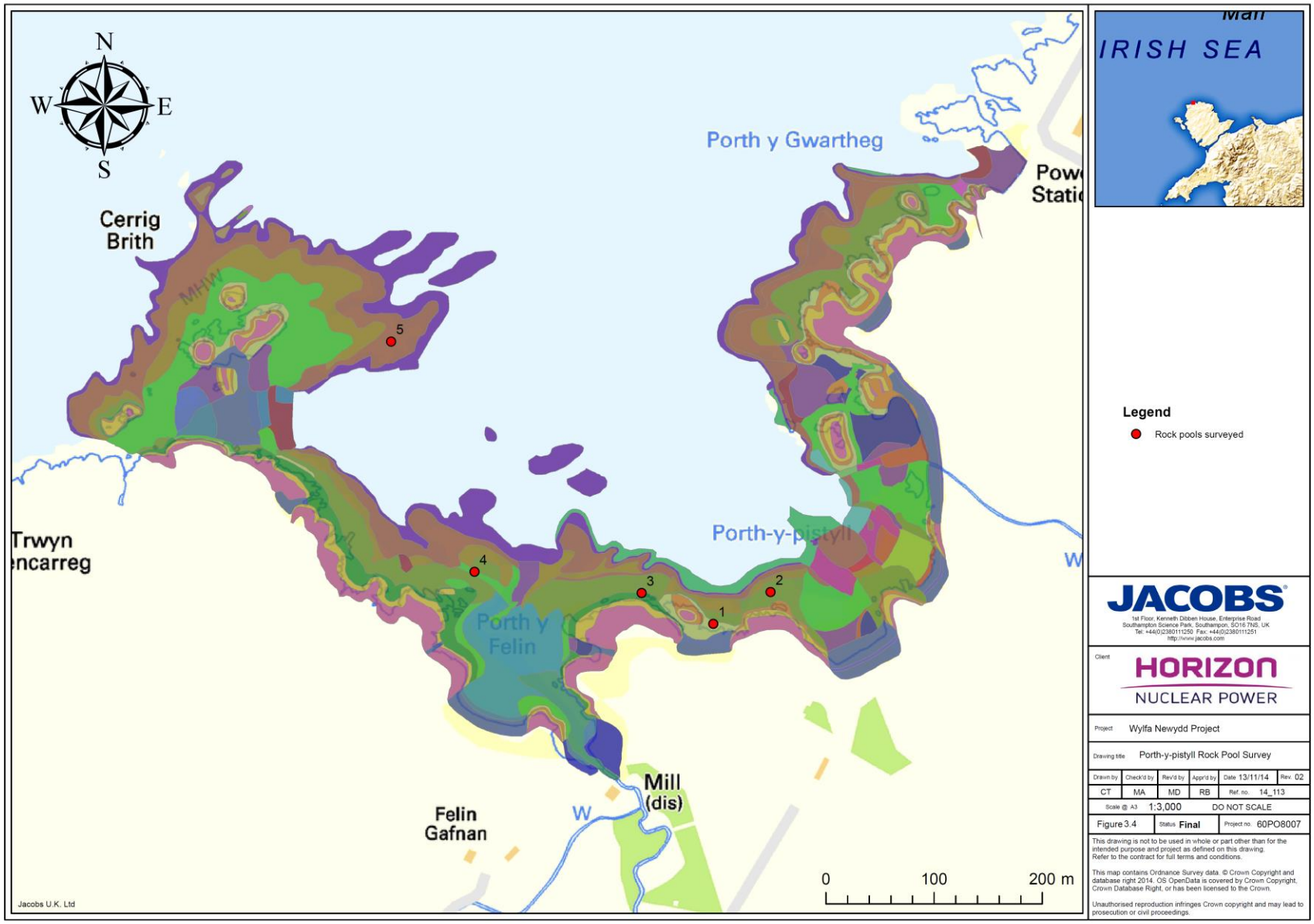

Figure 3.4: Rockpools surveyed in Porth-y-pistyll bay, north Anglesey.

Within the deeper section of the pool the *Spongomorpha* spp. was only evident along the edges. The dominant algae here were *Chondrus crispus* (5%), *Corallina officinalis* (10%), *Ceramium* spp., *Dictyota spiralis* (40%), *Pterocladiella capillacea* (10%). This section of the pool was floored with cobbles, pebbles and gravel.

The fauna of both sections of the pool were dominated by littorinids (*Littorea littorea*) and trochids (*Gibbula umbilicalis* and *G. cineraria*). Also present were two species of jellyfish (*Aurelia aurita* and *Chrysaora hysoscella*) and a juvenile blenny (Blenniidae spp.).

Figure 3.5: Rockpool 1. A seaweed and sediment-floored rockpool in Porth-y-pistyll bay, north Anglesey.

Rockpool 2

Situated between the upper and mid shore zones, rockpool 2 had a very small covering of fine sand and silt (approximately 5%) and was dominated by *Laminaria digitata* (80%) with dense *Ceramium* spp. (10%), *Corralina officinalis* (10%) and *Enteromorpha* spp. (5%). Fucoids were also present with both *Fucus serratus* and *F. vesiculosus* recorded (Figure 3.6). The pool was assigned the biotope code LR.FLR.Rkp.FK.

The faunal community was comparatively sparse with a few limpets, gastropods and crustaceans recorded. However, several algae were recorded here and nowhere else in the intertidal zone, including *Acrosorium venulosum, Elachista* spp. and *Hypoglossum hypoglossoides.*

Figure 3.6: Rockpool 2. A kelp dominated rockpool in Porth-y-pistyll bay, north Anglesey.

Rockpool 3

A long, narrow pool located in the mid shore, with two small boulders at one end and a mixture of cobbles, gravel and sand covering the bedrock (Figure 3.7). The pool contained a rich flora community dominated by *Chondrus crispus* (15%), *Halidrys siliquosa* (10%) and filamentous green algae (5%). The edges of the pool were festooned in filamentous reds, such as *Scytosiphon lomentaria,* many of which were growing as epiphytes.

Figure 3.7: Rockpool 3. A seaweed and sediment-floored rockpool in Porth-y-pistyll bay, north Anglesey.

Rockpool 4

Situated in the mid to low shore, within the *Ascophyllum nodosum* zone, this rockpool contained a varied mixture of cobbles, pebbles and gravel with a thin covering of muddy sand in the centre (Figure 3.8). The pool had a rich flora (S=14) dominated by filamentous reds (35%) and the species *Chondrus crispus* (10%) and *Ascophyllum nodosum* (5%). The fauna was dominated by littorinids and, to a lesser extent, trochids.

Figure 3.8: Rockpool 4. A seaweed and sediment-floored rockpool in Porth-y-pistyll bay, north Anglesey.

Rockpool 5

Surrounded on all sides by the biotope LR.MLR.BF.Fser.R (*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock) this large rockpool was located in the low shore on the east side of Cerrig Brith (Figure 3.9). The rockpool was floored with mixed sediment (cobbles, gravel and sand) and interspersed with occasional boulders.

The flora in the pool was dominated by *Ulva lactuca* (30%) and *Ceramium* spp. (30%) along with *Palmaria palmata*, *Chondrus crispus* and fucoids. Faunal richness was low (S=6), although high abundances of crustaceans and trochids were observed.

Figure 3.9: Rockpool 5. A seaweed and sediment-floored rockpool on Cerrig Brith. Porth-y-pistyll bay, north Anglesey.

3.2 Subtidal Biotope Survey

3.2.1 Habitats and Taxa

The 2014 subtidal biotope survey recorded a total of 21 biotopes, many of which are best considered as broad habitats (Figure 3.10). Several biotopes encountered were better depicted following the intertidal mapping work on account of their intertidal locations i.e. LR.HLR.FR.Mas, LR.LLR.F.Asc.X, LR.MLR.BF.Fser.R and IR.MIR.KR.Ldig (Figure 3.2).

Over the three subtidal survey years (2011, 2012, and 2014) 23 biotopes were recorded from the bay and the adjacent coastal area (Table 3.6). All the biotopes recorded in previous years were observed in 2014 with the exception of '*Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata' (LR.LLR.F.Asc.X) and 'Infralittoral coarse sediment' (SS.SCS.ICS), these communities being associated with shallow water and the intertidal zone. Mapping of the dive transects showed that many of the subtidal sites overlapped with the intertidal zone (Figure 3.11). Further details on each of the sites surveyed around Porth-y-pistyll are provided (Appendix D), along with photographic images of the habitats.

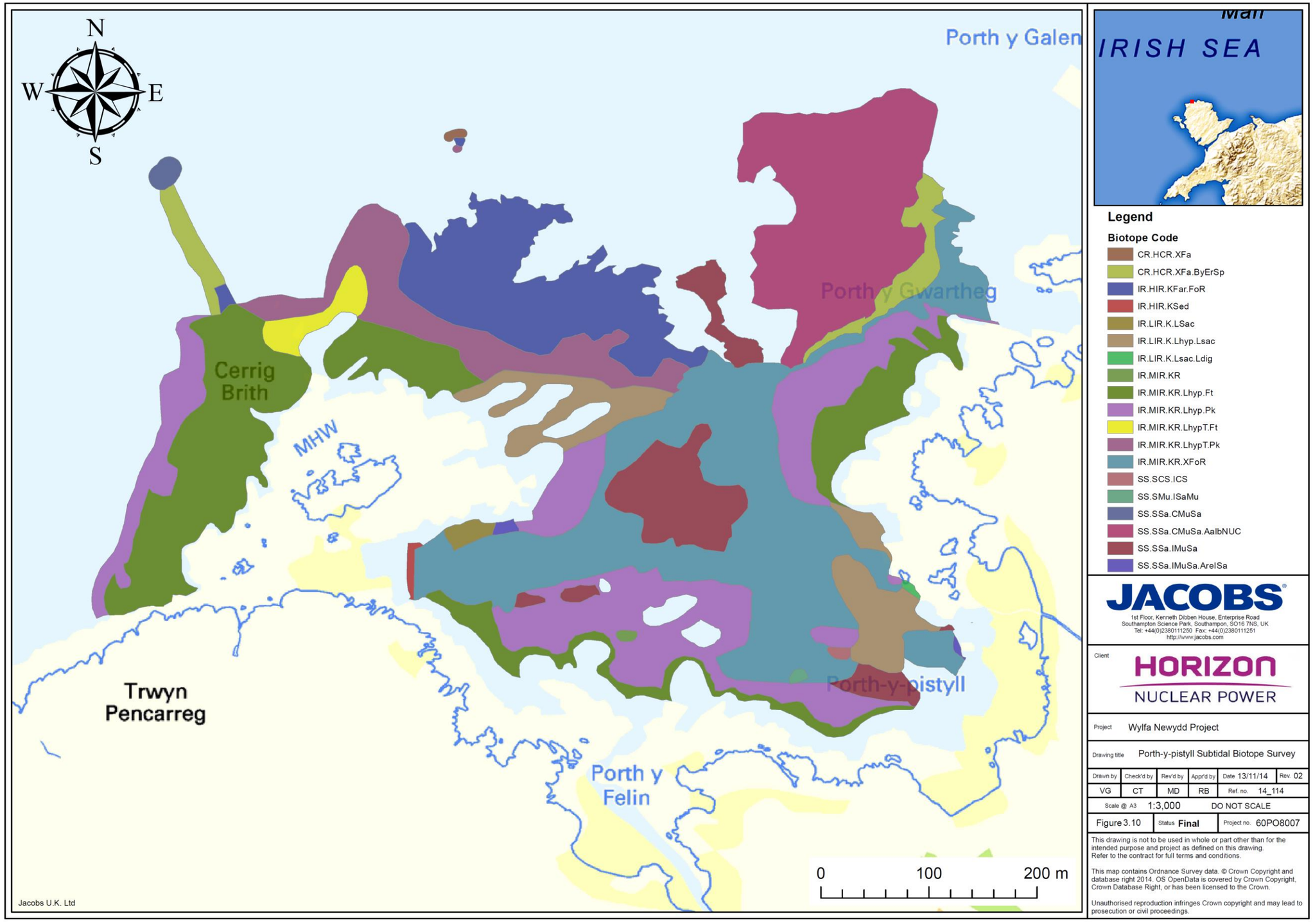

Figure 3.10: Subtidal biotopes of Porth-y-pistyll bay and adjacent coastline, north Anglesey, 2014.

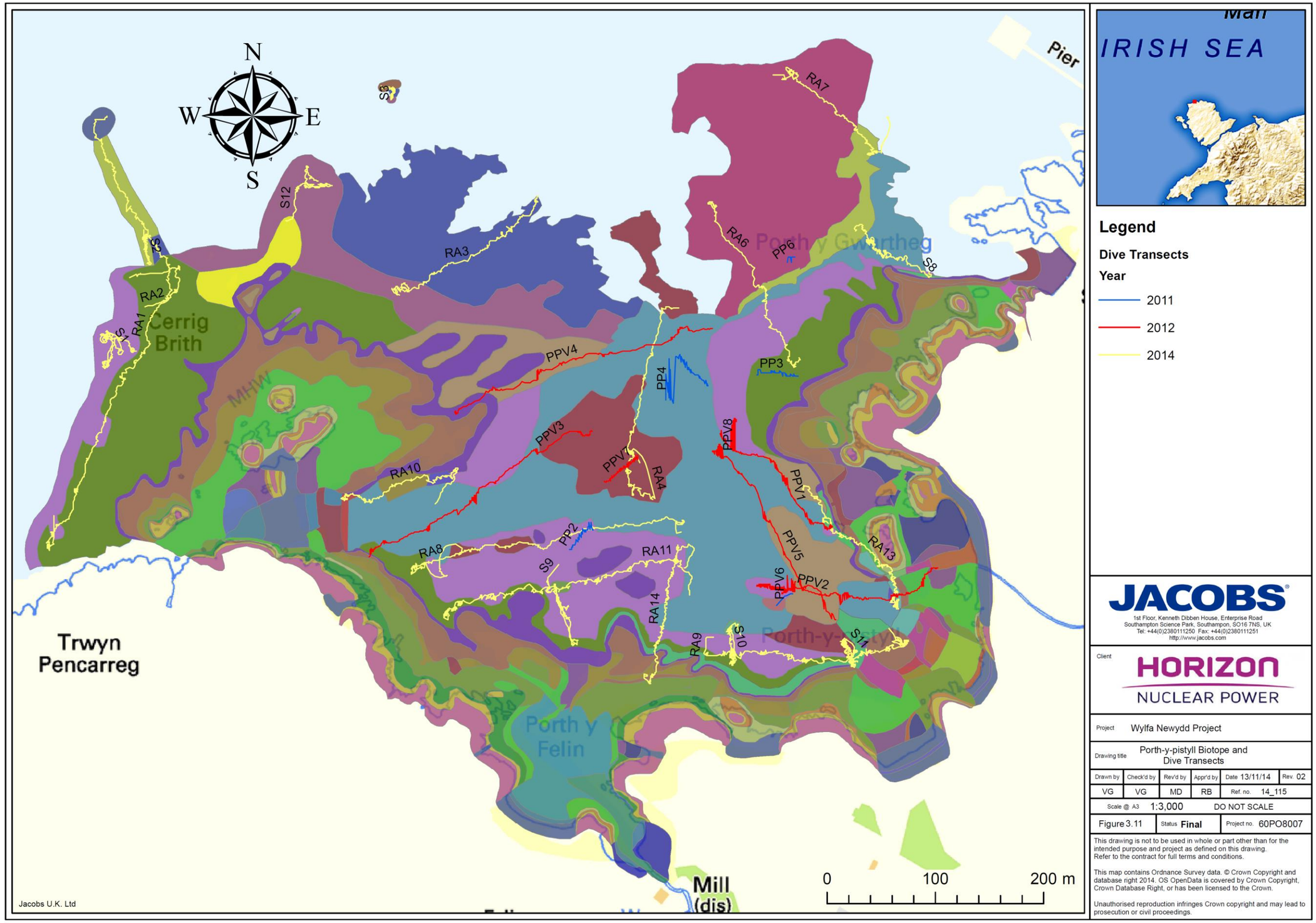

Figure 3.11: Subtidal dive transects for 2011, 2012 and 2014 in Porth-y-pistyll bay, north Anglesey. Intertidal biotopes corresponding to Figure 3.2 are also presented.

Table 3.6: Biotopes assigned to subtidal benthic survey data obtained in 2011, 2012 and 2014. Transects where each habitat was recorded are given. Biotope codes and names according to the National Marine Biotope Classification (Connor *et al*., 2004).

Biotope Code	Biotope Name	Sites Recorded
CR.HCR.XFa	Mixed faunal turf communities	S3
CR.HCR.XFa.ByErSp	Bryozoan turf and erect sponges on tide-swept circalittoral rock	PP6, RA2, RA6, RA7, S2
IR.HIR.KFaR.FoR	Foliose red seaweeds on exposed lower infralittoral rock	PPV5, RA2, RA3, RA11, S3
IR.HIR.KSed	Sand or gravel-affected or disturbed kelp and seaweed communities	RA10
IR.LIR.K.Lhyp.Lsac.Pk	Mixed *Laminaria hyperborea* and *Laminaria saccharina* park on very sheltered lower infralittoral rock	PPV4, PPV5, PPV5, RA13
IR.LIR.K.Lsac	*Laminaria saccharina* on very sheltered infralittoral rock	RA10
IR.MIR.KR	Kelp with red seaweeds (moderate energy infralittoral rock)	RA11, S9
IR.MIR.KR.Ldig*	*Laminaria digitata* on moderately exposed sublittoral fringe rock	PPV1, PPV4, RA8, RA10, RA14
IR.MIR.KR.Lhyp.Ft	*Laminaria hyperborea* forest and foliose red seaweeds on moderately exposed upper infralittoral rock	PP3S1, PPV3S1, RA1, RA2, RA8, RA9, RA11, RA14
IR.MIR.KR.Lhyp.Pk	*Laminaria hyperborea* park and foliose red seaweeds on moderately exposed lower infralittoral rock.	PP2, PPV6, PPV6, PPV8, RA1, RA2, RA6, RA8, RA9, RA10, RA11, S1
IR.MIR.KR.LhypT.Ft	*Laminaria hyperborea* forest, foliose red seaweeds and a diverse fauna on tide-swept upper infralittoral rock	S12
IR.MIR.KR.LhypT.Pk	*Laminaria hyperborea* park with hydroids, bryozoans and sponges on tide-swept lower infralittoral rock	RA3, S3, S12
IR.MIR.KR.Lsac.Ldig	*Laminaria saccharina* and *Laminaria digitata* on sheltered sublittoral fringe rock	RA13
IR.MIR.KR.XFoR	Dense foliose red seaweeds on silty, moderately exposed infralittoral rock.	PP1, PP4, PPV1, PPV2, PPV3, PPV4, PPV7, RA4, RA8, RA13, RA14
LR.HLR.FR.Mas	*Mastocarpus stellatus* and *Chondrus crispus* on very exposed to moderately exposed lower eulittoral rock	RA13
LR.LLR.F.Asc.X	*Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata.	PPV2
LR.MLR.BF.Fser.R	*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock.	RA9, RA11, RA13, RA14
SS.SCS.ICS	Infralittoral coarse sediment.	PP1
SS.SMu.ISaMu	Infralittoral sandy mud	S10
SS.SSa.CMuSa	Circalittoral muddy sand.	RA2
SS.SSa.CMuSa.AalbNuc	*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment.	RA4, RA6, RA7
SS.SSa.IMuSa	Infralittoral muddy sand.	PP6, PPV3,

Biotope Code	Biotope Name	Sites Recorded
		PPV7, RA4, RA8, RA9, S11
SS.SSa.IMuSa.AreISa	*Arenicola marina* in infralittoral fine sand or muddy sand.	PPV2, RA10, RA13

*Originally ascribed as IR.MIR.KR.Ldig it is considered that this feature was actually kelp forest and is hence synonymous with IR.MIR.KR.Ldig.Ldig (Table 3.1).

Porth-y-pistyll consists of a mosaic of subtidal and infralittoral habitats with a wide range of substrata; from bedrock and boulders to muddy sand and gravel. The most consistently recorded biotopes were those characterised by kelp species, particularly *Laminaria hyperborea* and *L. digitata* which dominated much of the infralittoral fringe in and around the outer margin of the bay. However, in terms of overall coverage the subtidal survey area was dominated by the biotope 'dense foliose red seaweeds on moderately exposed, silted, stable infralittoral rock' (IR.MIR.KR.XFoR) covering approximately 5 ha. (Table 3.7), most of which was within the bay. The next most dominant communities consisted of kelp biotopes, with large swathes of the shallow coastline consisting of either *L. hyperborea* park or forest. The biotope '*Laminaria digitata* on moderately exposed sublittoral fringe rock' (IR.MIR.KR.Ldig.Ldig) was ubiquitous along the coastal fringe of all the areas surveyed; however, the extent of the *L. digitata* biotope was best displayed during the intertidal biotope survey, being considered an infralittoral fringe community rather than truly sublittoral (Figure 3.2).

The broad habitat 'infralittoral muddy sand' (SS.SSa.IMuSa) dominated the sedimentary communities within the bay, while outside the bay the muddy sand biotope complex '*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment' (SS.SSa.CMuSa.AalbNuc) covered almost 3 ha.

Table 3.7: Biotopes recorded (according to Connor *et al*., 2004) during 2011, 2012 and 2014 dive surveys of Porth-y-pistyll. Approximate extent of the biotopes is given.

Biotope	Area (sq. m)
CR.HCR.XFa	166.0
CR.HCR.XFa.ByErSp	5726.3
IR.HIR.KFar.FoR	22894.7
IR.HIR.KSed	347.9
IR.LIR.K.Lhyp.Lsac	12153.0
IR.LIR.K.LSac	796.9
IR.LIR.K.Lsac.Ldig	129.8
IR.MIR.KR	172.0
IR.MIR.KR.Lhyp.Ft	38597.2
IR.MIR.KR.Lhyp.Pk	36202.2
IR.MIR.KR.LhypT.Ft	2614.4
IR.MIR.KR.LhypT.Pk	14098.8
IR.MIR.KR.XFoR	49983.2
SS.SCS.ICS	205.1
SS.SMu.ISaMu	166.4
SS.SSa.CMuSa	674.0
SS.SSa.CMuSa.AalbNuc	29044.8
SS.SSa.IMuSa	13647.1
SS.SSa.IMuSa.AreISa	330.1

Where possible the ascription of sedimentary biotopes was aided by the collection of benthic cores for infaunal and particle size analyses the results of which are given in Appendix E. However, at several locations in the bay the sediment consisted of a thin veneer covering the bedrock sea bed, hence preventing quantitative collection of cores.

Analysis of faunal cores at the northern ends of RA6 and 7 (Figure 3.11) showed a muddy sand substrate, with a small gravel component at RA7. Although faunal abundance was noticeably greater at RA6 (n=323) the same number of discrete taxa (S=33) were recorded from both sites (Appendix E). RA6 and RA7 were assigned the biotope SS.SSa.CMuSa.AalbNuc '*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment'.

Faunal cores from the northern ends of site S10 and S11 (Figure 3.11), recorded sediment compositions as 'sandy mud' and 'gravelly muddy sand', respectively. The faunal community in S10, though similar in overall abundance to S11 (n=97 and 153 respectively) contained a number of species not found in S11 (see Appendix E). These sites were assigned the biotopes 'infralittoral sandy mud' (SS.SMu.ISaMu) and 'infralittoral muddy sand' (SS.SSa.IMuSa).

From the dive transects (MNCR and RA) carried out in 2014 a total of 203 taxa was recorded. Red algae (Rhodophyta) was the dominant phylum accounting for more than 25% of all taxa. Considering only the sites surveyed *within* the bay (Section 2.2) in 2014, this figure was further reduced to 117.

Over the three survey periods (2011, 2012 and 2014) a pooled list of 278 taxa was recorded from the bay and proximal margins (Appendix F). Despite a general dominance in fauna, the phylum Rhodophyta consistently recorded the highest number of taxa with values varying slightly from 54 taxa in 2011, 53 in 2012 and 51 in 2014. Within the margins of the bay the dominance of red algae was more pronounced varying from approximately 30% in 2011 to 42% in 2014 as a percentage of all taxa recorded. The dense floral community in the bay itself was indicated by the proliferation of brown algae in the infralittoral fringe and red algae in the shallow infralittoral, with several species of algae recorded at every site in each year, including the brown alga *Dictyota dichotoma*, and the red algae *Cryptopleura ramosa, Delessaria sanguinea* and *Heterosiphonia plumosa*. Among the fauna the most commonly recorded were the sea star *Asterias rubens* and the tunicate *Clavelina lepadiformis*. Numbers of fish taxa were notably higher in 2011 (S=10) and 2012 (S=12) when compared to 2014 (S=5).

3.2.2 Non-native Species

Although no species with conservation designations were recorded several non-native species were identified over the duration of the three subtidal surveys:

- the red alga *Asparagopsis armata*;
- the red alga *Heterosiphonia japonica*; and
- the red alga *Anotrichium furcellatum*.

Heterosiphonia japonica was found at three sites in 2011 (PP1, 2 and 4) and at one site in 2012 (PPV7) and 2014 (S10). It was recorded as either 'rare' or 'present' on the SACFOR scale in 2011 and 2012, and occasional in 2014.

Asparagopsis armata was recorded in fairly high densities in all three years particularly 2012, when it was recorded as ‘super abundant’ at PPV5. The non-native red alga *Anotrichium furcellatum* was recorded for the first time in 2014, but to the north-west of Cerrig Brith, outside the bay.

4 Discussion

The marine biotopes recorded within Porth-y-pistyll bay, from Cerrig Brith in the west to just south of Porth y Gwartheg in the east represented a diverse range of communities and were generally representative of those typically found along the Anglesey coastline (e.g. Brazier *et al*., 2007). Among the communities found were a number of marine habitats recognised for their contribution to UK and Welsh biodiversity. Several non-native species were recorded during the biotope surveys, the most notable being *Sargassum muticum* (Japanese wireweed); representing the first confirmed recording of this species on the north coast of Anglesey.

4.1 Intertidal

The rocky shore was, for the most part, characterised by clear zonations of species assemblages, particularly in the more sheltered areas of the bay. Delineated stands of fucoids in the lower, mid- and upper-shore were observed, along with areas dominated by fauna on the more exposed rocky outcrops. The vertical succession along the rocky substrata could be generally typified by lichens and *Pelvetia canaliculata* in the upper shore, *Ascophyllum nodosum* and *Fucus* spp. in the mid shore and *Fucus serratus* and *Laminaria digitata* in the infralittoral zone. Within these broad zones were areas characterised by barnacles and limpets, possibly indicative of increased wave exposure and in some cases, representing a stage in the natural cyclical succession of intertidal shores.

Four intertidal habitats recorded in the bay were of special conservation significance and detailed on the Section 42 list for Wales (Section 3.1.2). An intertidal underboulder community (LR.MLR.BF.Fser.Bo) was recorded as a single target note (< 5 m^2) on the western edge of Cerrig Brith in 2003 and confirmed in 2014. It is possible that this community may be more extensive on the western margin but due to time constraints a more in-depth assessment of the area could not be carried out. The other three features, *Mytilus edulis* bed, *Fucus ceranoides* and coastal saltmarsh communities were all found in the south-eastern corner of the bay, at Porth y Felin. Occupying 0.68, 0.18 and 0.14 hectares respectively the features did not represent particularly large examples, yet their location in the bay adds to the overall diversity of species and habitats.

There is some evidence to suggest that the mussel bed at Porth y Felin may once have been artificially maintained, as there are several man-made boulder walls in the area (see Appendix A) although historical evidence of these man-made features points towards the possibility of this area being used as a quay. Whether this was once a natural bed before the introduction of the walls is unknown; however, the commercial management of this mussel bed has long ceased. The allocation of 'blue mussel beds on sediment' as a conservation feature is dependent on the feature being regarded as 'natural' and it is considered since the bed is still in existence that it be regarded as such.

Over the last decade it was found that the blue mussel bed had reduced in extent along the southern margins but increased in northerly extent. The result was a net increase of 0.04 hectares (approximately 6%). The loss of blue mussel bed in the south was to the benefit of the adjoining *Fucus ceranoides* community which showed >75% increase in extent. The two key species of these communities can co-exist under similar environmental conditions but the notable loss of mussel community in the south of Porth y Felin is possibly indicative of anthropogenic impact. *Fucus ceranoides* is often found on stable substrata such as bedrock and

boulders, however, the fucoids clearly extended on to a mixed substratum of cobbles, gravel and sand at Porth y Felin; a habitat more commonly associated with blue mussels.

There is anecdotal evidence from a local landowner to suggest that deliberate, unauthorised removal of the mussels has taken place in the recent past (Hayward, pers. comm.). This activity, albeit considered infrequent, has the potential to change the extent and health of the bed and may account for the relatively large changes recorded here since 2003. Despite the overall extent of the mussel bed increasing as a consequence of their northerly expansion, this is also partly due to the confirmation of the mussel bed on an area not previously biotoped (Figure 3.1 and Figure 3.2). Similarly, the increase in nearby saltmarsh is mainly the result of the newly ascribed area of land immediately west of the watercourse; this had not been ascribed any biotope in 2003.

Changes as a direct or indirect result of anthropogenic impact cannot be quantified within this report, although it is believed that the bay currently experiences fairly little in the way of direct anthropogenic impact. To the north of the bay lies the Existing Power Station CWS intake and beyond Porth y Gwartheg the CWS outfall. Within the bay proper there is a small amount of lobster potting that occurs. Although a pipe was located on the south-eastern shore of the bay, it is disused. Two watercourses flow into Porth-y-pistyll; the Afon Cafnan, which enters at Porth y Felin, and Nant Porth-y-pistyll which enters at the eastern edge of the bay. However, the physicochemical parameters measured have not raised any concerns (North and Daly, 2014), and it is thought that the freshwater runoff in to the bay allows the formation of natural estuarine communities such as the *Fucus ceranoides* and ephemeral *Enteromorpha* spp. biotopes.

The biotopes assigned by NRW (2003) did not always reflect those recorded in 2014, in terms of the biotope ascribed and/or the extent. However, it was generally found that where the previously described biotope did not match that recorded in 2014, it was adjacent or in close proximity to the newly ascribed. An additional 0.55 ha. of biotoped habitat was added to the intertidal map of Porth-y-pistyll as compared with that recorded in 2003. Aside from two relatively small areas in Porth y Felin that were not originally mapped in 2003 (i.e. saltmarsh habitat and blue mussel bed) the additional intertidal area is a result of a substantial increase in kelp community observed in the infralittoral fringe zone. The very low spring tides in 2014 revealed large areas of kelp not previously observed in 2003, consisting of a combination of *Laminaria digitata, L. hyperborea* and a very small stand of *Saccharina latissima*.

It is thought that many of the minor changes observed in biotope extent could be attributable, in part, to GPS accuracy rather than indicating definite shifts in the biotope(s); the GPS often losing confidence at resolutions lower than approximately 5 m. Yet, the boundaries of biotopes are rarely clear cut and represent a degree of subjectivity for the surveyor i.e. where one biotope ends and another begins, the transition of these biotopes often being a gradual change rather than a defined boundary line. Within these transitional zones the biological features present are at their natural limits as a result of biological, physical or chemical influences or a combination of these. Hence very slight changes in abiotic and biotic factors have the potential to shift the boundaries of a community.

To provide some idea of the changes in the extent, biotope coverage has been assessed as 2D. Owing to the 3D nature of biotopes, this approach underestimates the actual size of the biotopes however; it is important to have some measure of the

extent to give a better understanding of the dominant communities and changes either spatially or temporally. The approximate values given in this study have allowed distinct changes to be identified, yet it should also be remembered that the highly heterogeneous topography of this shore provides considerably more habitat space than is evident from the maps, with sloping, steep and vertical rock faces throughout the bay.

A few of the differences in biotope presence and extent observed over the 11-year period are thought to reflect the dynamic nature of the intertidal biotopes; especially at the transitional boundaries. In some instances these changes are considered the result of the physical environment with, for example, the shifting of mobile sandy sediment along the shore by wave and wind action. The overall character of a biotope is strongly determined by abiotic influences and some are, by their very nature, more prone to change than others, a good example being some of the moderately exposed littoral sediment biotopes in the south-eastern corner of the bay. Under natural conditions these habitats can regularly experience cyclical succession, with certain biotopes disappearing and reappearing over time (as detailed below).

The intertidal sedimentary habitats in Porth-y-pistyll consisted of relatively little mud, leading to assignation of sand and gravel communities, suggestive of a moderate level of wave exposure. These types of sedimentary habitat are prone to seasonal changes, with winter storms providing the energy to shift sediment around. Indeed, when the bay is considered as a whole, some of the largest observed changes in intertidal biotope extent and/or presence occurred in pockets of the bay containing sedimentary substrata, particularly the south-eastern corner of the bay and within the adjoining piece of land connecting Cerrig Brith.

During the 2014 survey a number of ephemeral biotopes were recorded in the area of mobile sand in the south-eastern corner of the bay. The aspect and exposure of this corner of the bay is thought to have a major influence on these biotopes, with possible seasonal changes, such as sediment accretion and erosion, as well as changes following storm events. Therefore, the observed change in biotopes here i.e. the single biotope recorded in 2003 (LS.LSa.FiSa.Po) being split into four distinct biotopes (LR.HLR.FR.Mas, LS.LSa.FiSa.Po, LR.FLR.Eph.EntPor, LS.LSa.MoSa) (Figure 3.2) is thought the result of wave action.

Due to the shelter afforded by the coastline at Porth-y-pistyll, waves only approach from the west-north-west through to the north-east, with a predominant north westerly wave direction (73% calm conditions encountered) (Titan, 2011). Although generally infrequent, the potential for strong winds to approach from the north-west provides the means for mobilising the soft sediment in the south-eastern region of the bay; the flatter, moderately exposed shoreline allowing highly dynamic communities to flourish.

The appearance of the newly ascribed biotope '*Mastocarpus stellatus* and *Chondrus crispus* on very exposed to moderately exposed lower eulittoral rock' (LR.HLR.FR.Mas) in the south-eastern region of the bay covers several areas previously assigned to different biotopes (NRW, 2003) (i.e. LR.MLR.BF.Fser.R; IR.MIR.KR.Ldig.Lig; LR.LLR.F.Asc.FS and LS.LSa.FiSa.Po). The presence of the biotope LR.HLR.FR.Mas is normally suggestive of moderate wave exposures, this already being highlighted by the presence of ephemeral sedimentary biotopes (see above) in this region of the bay. Ascription of the LR.HLR.FR.Mas biotope was not straightforward but the scarcity of fucoids and absence of kelp, whilst containing a number of red algae species synonymous with this biotope (e.g. *Chondrus crispus*,

Laurencia pinnatifida and *Palmaria palmata*). This area was characterised by boulders and cobbles on sediment and for this reason seemed at conflict with the previously ascribed biotope LS.LSa.FiSa.Po; though some degree of overlap could be seen with LR.LLR.F.Asc.FS and LR.MLR.BF.Fser.R. Along the southern and eastern infralittoral margins of the bay relatively dense kelp communities are present, with breaks only in those areas consisting of LR.HLR.FR.Mas communities. Despite suitable substrata (boulders and cobbles) available for holdfast attachment by kelp these breaks in the kelp biotopes were instead dominated by a variety of red and green algae.

By contrast to the south-eastern corner of Porth-y-pistyll bay, the area of interconnecting land between Cerrig Brith and the mainland initially appears very sheltered from both the prevailing wind (south-westerly) and also winds/waves approaching from west-north-west clockwise to east-north-east, at least during a low to mid tide. Yet, the substratum of mixed shingle, stones and shells is clearly mobilised during storm events from the west, as observed by the notable shifting of the biotopes in this area e.g. the barren shingle covering areas previously described as rocky biotopes. Despite much of Cerrig Brith being discernible over low water, during high water only a few rocky outcrops are observable. It is considered that storm events coinciding with high water and winds from a direction west, clockwise to east allows an opportunity for mobilisation of the sediment in this channel.

Some of the biotopes found are considered relatively stable, particularly when situated in sheltered parts of the rocky shore. Sheltered conditions favour the growth of fucoid algae and allow development of a more or less total and permanent canopy (Hartnoll and Hawkins, 1985). The topographical heterogeneity of the bay, combined with its generally north-facing aspect provides a combination of exposed and sheltered habitats. Within the more sheltered regions of the bay large swathes of *Ascophyllum nodosum* were recorded.

Ascophyllum nodosum is a long-lived species (15-20 years), displaying slow growth rates and poor recruitment. Its establishment tends to indicate a relatively stable biotope; however, following removal of this fucoid it can take many years for recolonisation to occur (Holt *et al*., 1997). In their work on fucoid recolonisation of cleared areas at Port Erin, Knight and Parke (1950) observed that even eight years after the original clearance there was still no sign of the establishment of an *A. nodosum* population. Throughout the bay several patches of *A. nodosum* had appeared in the 2014 survey, while a notably large patch in the centre of the bay had been replaced by communities characterised by *Fucus vesiculosus* and barnacles (LR.MLR.BF.FvesB) and limpets and barnacles (LR.HLR.MusB.Sem.Sem), with no sign of *A. nodosum* in any of the adjacent areas.

The relatively poor recruitment of *Ascophyllum nodosum* means that recoverability from effects is generally low (Hill and White, 2008). However, being an intertidal species it is considered reasonably tolerant to small changes in physical factors such as emersion times, air and water temperatures and changes in turbidity. Yet, observations have shown that *A. nodosum* is sensitive to wave impacts and physical disturbance (e.g. Knight and Parke, 1950), and even prolonged periods of hot weather (Schonbeck and Norton, 1978).

Following an increase in wave exposure and removal of *A. nodosum* from the shore, work by Hill and White (2008) found that *Fucus vesiculosus* is the likely replacement for the niche, a species that normally occupies an area on the shore just higher than *A. nodosum*. However, the similar expansion of *Pelvetia canaliculata* communities into this region suggests that they can also colonise the niche left behind by *A.*

nodosum. Despite not knowing the exact cause for the loss of *A. nodosum* community, its longevity in a stable environment and good resistance to herbivory (mature plants) point towards a physical rather than biological factor; with a combination of direct removal from wave action followed by the prevention of recolonisation by interspecific competition.

The often more localised and cyclical successions displayed by biotic interactions in littoral communities are not readily evident in the above example. However, biological factors are thought to play a more significant role in the loss of biotope extent for LR.HLR.MusB.Sem.Sem. This biotope is found in moderately exposed locations and during 2003 it was recorded on the sloped and fissured bedrock along the western and eastern sides of Porth-y-pistyll. However, in 2014 it was observed that much of the flatter area of habitat previously ascribed to LR.HLR.MusB.Sem.Sem was now composed of *Fucus vesiculosus* and barnacle communities, particularly on the eastern side of the bay. Equally, higher up the shore, areas of LR.HLR.MusB.Sem.Sem had been replaced by *Pelvetia canaliculata* communities (LR.MLR.BF.PelB).

The littoral community of fucoids, barnacles and limpets on moderately exposed shores is generally considered unstable, existing in a state of dynamic equilibrium in which biological or physical changes can create quite drastic effects on the pattern of the community (Southward and Southward, 1978). The increase in seaweed cover, shown by the coverage of *Fucus vesiculosus* on the mid shore and *Pelvetia canaliculata* on the upper shore highlights the natural variability of these fucoid-barnacle mosaics in Porth-y-pistyll. During periods of significant wave impacts, such as storm events, the seaweed can be displaced, freeing up areas for limpet and barnacle attachment, the converse being true for periods of less severe weather. Moreover, the biological interactions such as grazing pressure can profoundly affect the establishment of fucoid communities whilst stochastic events like the supply of settling propagules is a major factor in the continuation of these communities (Hawkins and Hartnoll, 1982).

Unlike many of the other biotopes, all historic patches of *Fucus spiralis* showed a loss in extent, with no new patches being recorded elsewhere in the bay. *F. spiralis* is considered less sensitive to physical effects than *Ascophyllum nodosum*, whilst displaying rapid rates of recruitment on previously cleared areas (Holt *et al*., 1997; White, 2008). The loss in *F. spiralis* extent on Cerrig Brith is clearly the indirect result of strong wave action, with the mobilisation of the adjacent shingle bed covering much of the historic location of this biotope; however, the replacement of *F. spiralis* with *Pelvetia canaliculata* biotopes at Porth y Felin and, on the eastern side of Porth-y-pistyll, with *F. vesiculosus* is not easily explained.

Porth y Felin is a particularly sheltered region of the bay, ruling out the possibility of wave impacts even at high tide. Interestingly Dring (1982) states how *Pelvetia canaliculata* is able to survive on lower levels of nutrients than *F. spiralis*, a trait that allows it to do very well in the upper shore of sheltered environments. In addition, high numbers of littorinids and patellids were observed around Porth y Felin, these grazers known to exert significant controlling influences on the algal vegetation. The above factors possibly being the cause of *F. spiralis* loss in this sheltered cove. The replacement by *Fucus vesiculosus* on the eastern side of the bay is likely the result of interspecific competition between these fucoids, as although *F. spiralis* was present in the *F. vesiculosus* biotope, it was noticeably less abundant.

Other notable changes in extent were the appearance of the previously unrecorded kelp *Laminaria hyperborea*. The observed presence of >0.2 ha. of *L. hyperborea*

biotope since 2003 is particularly significant. A ubiquitous species along rocky coasts of the UK, *L. hyperborea* is fairly tolerant of wave exposure and moderate currents and firmly established along much of the north Anglesey coastline. Its ecological niche sits alongside but below the depth of the congeneric *L. digitata*, the latter species being associated with the infralittoral fringe. The *L. hyperborea* biotope given from the intertidal survey was IR.MIR.KR.Lhyp; although only the top half of the stipes were visible due to the depth of the water and for this reason there was no discernment between park or forest. During the subtidal survey the surveyors were able to access this biotope and view underwater, allowing ascription of forest or park biotopes in many cases (Section 4.2).

At the shoreward edge of the *L. hyperborea* community in Porth-y-pistyll, there is a clear crossover with *L. digitata*, making individual discernment of the two species difficult unless at very low water. The survey in July 2014 coincided with a perigean spring tide (when the full moon coincides with the point at which the moon is closest to the earth), creating larger than usual spring tides and allowing observations of those communities normally immersed over the standard spring tidal range. Generally considered a subtidal community, the often proximal location of *L. hyperborea* to the shore means it can be visible on low spring tides in the bay. Although truly subtidal communities are omitted from intertidal surveys the *L. hyperborea* biotopes are considered one of a number of typical rocky *shore* communities in the UK (e.g. Wyn *et al*., 2000). *L. hyperborea* is a perennial species living up to 20 years and displaying a rapid growth rate, particularly in the first five years (Tyler-Walters, 2007) and hence shows good recovery following displacement (Kain, 1979). Though conceivable that *L. hyperborea* was not present in 2003 it seems unlikely when the habitat is suitable and it is so common along the north Anglesey coast. The almost continuous band of *L. hyperborea*, around the eastern and southern coastline of the bay (Figure 3.2), would not have been missed by the surveyors (NRW, 2003) if visible. It is therefore considered that this community was not readily observable during the spring tides of the 2003 biotope survey.

Presence of the kelp *Alaria esculenta* could not be confirmed in 2014. The survey did not extend beyond the CW intakes, hence the historic patch of *A. esculenta* just north of the intakes was not observed. Likewise, the exposed northerly tip of Cerrig Brith could not be accessed by intertidal surveyors in 2014. It was recorded in a rockpool on the western side of Cerrig Brith in 2014 (Trigg and Doggett, pers. obs.) and has also been recorded from Wylfa Head (Doggett *et al*., 2013). As a species tolerant to wave exposure its presence at the north eastern mouth of the bay and on the north edge of Cerrig Brith is hardly surprising. However, a combination of tidal state and water depth did not provide suitable conditions for surveying this biotope and for this reason it was not recorded in the 2014 surveys.

The kelp *Saccharina latissima* (syn. *Laminaria saccharina*) community was recorded from the east side of the bay a relatively short distance south of the *A. esculenta* recorded in 2003 (Figure 3.2). Originally recorded as '*Laminaria saccharina* and/or *Saccorhiza polyschides* on exposed infralittoral rock' (IR.HIR.KSed.Lsac) this was then changed to '*Laminaria saccharina* and *Laminaria digitata* on sheltered sublittoral fringe rock' (IR.MIR.KR.Lsac.Ldig) following *in situ* assessment by divers. *Saccharina latissima* has a preference for sheltered environments and is usually absent from exposed shores (e.g. Hawkins and Harkin, 1985). The presence of both *Alaria esculenta* and *Saccharina latissima* within such a short distance provides evidence that the bay supports a variety of communities indicative of different exposure types, but also confuses the issue regarding exposure in the eastern and south-eastern margins of the bay, both of which are thought to experience moderate levels of wave activity. However, *Saccharina latissima* is an opportunistic species,

able to colonise rapidly and grow quickly (Kain, 1975) with a tendency to attach to cobbles and boulders. As a short-lived perennial (2-5 years) its ecological strategy allows quick colonisation of scoured and/or mobilised substrata. Its presence, close to the south-eastern corner may indicate that this area, though occasionally subject to strong wave action has in the last few years remained relatively unaffected by wave impacts, possibly also explaining why several clumps of *Sargassum muticum* were observed attached to cobbles in the south-eastern corner of the bay.

The presence of *Sargassum muticum* in the bay was limited to a few locations in the south-eastern corner and at one point on Cerrig Brith. The algae was not particularly abundant and although found in a large rockpool on Cerrig Brith, did not warrant ascription to the rockpools with *Sargassum muticum* biotope. The greatest accumulation of *S. muticum* was recorded from the south-eastern part of the bay but only as small patches of a few plants, rather than any significant coverage (see target notes). Many of the plants were unattached; however, a few individuals were found attached to cobbles. Normally associated with sheltered environments its presence is not completely unsurprising with confirmed records of this invasive species from Holyhead marina and Borthwen Bay (Marine Conservation Society – Sea Search surveys). However, it has not been recorded previously from the adjacent north Anglesey coastline or during the *in situ* dive surveys of the bay (Doggett *et al*., 2013; Section 3.2.2).

That some of the *Sargassum muticum* plants were attached in the south-eastern corner suggests that natural physical effects such as wave action and sand scour are infrequent enough to allow establishment of this species. The peripatetic trait of *S. muticum* is such that when attached to cobbles it can essentially be picked up, along with the source of attachment, and moved around in currents or waves, thus allowing dispersal of the species (see Strong *et al*., 2006).

A two-year time lag has been observed between the first occurrence of drifting plants in a previously uncolonised area and the establishment of attached populations, with a further two-year time lag before populations expand extensively (Karlsson and Loo, 1999). It is unknown how the *S. muticum* might affect the local communities in the bay, especially since the physical effects of wave action are so variable; although work by Andrew and Viejo in northern Spain (1998), has indicated that *S. muticum* is unlikely to disrupt the ecology of low shore communities on exposed shores. If *S. muticum* is able to establish in the most sheltered regions of the bay then it could conceivably have an effect upon the native flora and fauna.

4.1.1 Rockpools

Rockpools were numerous in the bay, particularly along the southern and western margins. The majority of rockpools were ‘seaweed and sediment-floored’ (LR.FLR.Rkp.SwSed), although several other rockpool complexes were found. The feature ‘seaweed and sediment-floored’, found in many of the rockpools in this bay, is considered relatively uncommon and the numerous pools recorded in Porth-y-pistyll are thought to add ecological value to the bay. Although generally found in the mid to low shore, the topography of the bay has allowed the formation of several sediment-floored pools in the upper shore.

The presence of so many rockpools emphasises the undulating and ragged coastline of the bay. The numerous cracks, crevices, plateaus and shelves provide the means to collect and hold the water as the tide recedes, along with a suitable habitat for many species of flora and fauna. Many of the pools are reasonably deep (>0.3 m) providing a more stable physical and chemical environment than shallow

pools, and allowing species to proliferate in areas of the shore normally outside of their ecological niche (e.g. Lewis, 1964).

The variation in taxa richness was not great between the rockpools surveyed (S=25 to S=35), yet approximately a third of the taxa were only recorded once. However, the rockpools surveyed were at slightly different heights on the shore, from the upper to infralittoral zone and hence subjected to different physical and chemical conditions. Indeed, it is generally accepted that no two rockpools exhibit exactly the same physio-chemical conditions, the result being large spatial variation in community structure, even between adjacent pools at the *same* shore height (Ganning, 1971; Metaxas and Scheibling, 1993).

Tyler-Walters (2005) suggests that the most characteristic feature of sediment-floored biotopes are sediment-tolerant red algae such as *Furcellaria lumbricalis*, *Polyides rotundus*, *Ahnfeltia plicata* and *Rhodothamniella floridula*; of these species only *F. lumbricalis* was found (rockpool 1, 3 and 5). Yet, it is also noted that shallow rockpools with cobble and pebble floors, along with an underlying layer of sediment, often support red algal tufts such as *Ceramium* spp. (Tyler-Walters, 2005). *Ceramium* spp. were ubiquitous in the rockpool surveys at all shore heights, as was the scour tolerant *Chondrus crispus.* The latter species is commonly associated with rockpools and offers a suitable habitat for many epiphytic algae *e.g. Ceramium nodulosum, Lomentaria articulata* and *Membranoptera alata.* Much like the habitat provided by larger macroalgae such as *Laminaria digitata* and fucoids, the presence of these scour-tolerant species permits a more diverse community to develop in the rockpools.

Rockpools allow some sublittoral fringe or lower shore species to extend their range up the shore due to the removal of desiccation stress (Lewis, 1964), and this was evidenced by the number of red algae and the presence of kelp in some mid and upper rockpools at Porth-y-pistyll. The depth of rockpool 1 (0.8 m) is thought to be a key factor in the diversity of this upper shore pool, as a number of red algal species were present that would not normally be found in the upper intertidal zone, as well as a wide variety of fauna. A recent study by Martins *et al.* (2007) found that depth was more important than area in explaining species diversity and community composition in both early successional and mature pools, possibly explaining why this pool and the other deep pools (rockpool 2 and 3) contained the highest number of algae. However, the differences in shore height and the presence of sediment are also considered key factors in the community assemblage. As might be expected the low shore rockpool 5 was the least diverse, the community here being more reminiscent of that found in the infralittoral zone rather than providing a habitat that potentially allowed colonisation by organisms from different shore heights. The resident time of the water in this low shore pool is considerably less than that of the mid and upper shore; therefore the pool is more likely to correspond to sublittoral physical conditions than those found higher on the shore. Possibly explaining why the community here was less populated by opportunistic organisms, such as the green algae which were dominant members of the mid and upper shore rockpool communities.

The largest rockpool in the bay was in the coarse gravel channel between Cerrig Brith and the mainland. Covering approximately 0.08 ha. in 2014 the rockpool had decreased by ~20% in size since 2003 (NRW). Unlike the other pools recorded this rockpool was dominated by a coarse sedimentary substratum of gravel and pebbles, with occasional boulders throughout. The constant shifting of the mobile sediment in this area of the bay (as evidenced previously) will undoubtedly cause changes in the extent of this pool and is likely to give rise to a highly dynamic community, as

demonstrated by the large patches of opportunistic green algae along the pool edges and adjacent margins.

4.2 Subtidal

The subtidal biotopes recorded in the bay were synonymous with the geographical region, covering a mixture of rocky and sedimentary habitats. Within the bay the gradation of biotopes from the infralittoral fringe to the sublittoral sediments can be generally described as *Laminaria digitata* communities leading down to dense forests of *Laminaria hyperborea* and on to sparser, but even more extensive, *L. hyperborea* parks. Within the middle of the bay were large patches of 'dense foliose red seaweeds on silty, moderately exposed infralittoral rock' (IR.MIR.KR.XFoR) and to a lesser extent 'infralittoral muddy sand' (SS.SSa.IMuSa), there also being several smaller patches of sedimentary habitat along the shallower margins e.g. in the south-west and south-east corners.

Estimates for the coverage of the dominant subtidal biotopes in Porth-y-pistyll bay showed that the community IR.MIR.KR.XFoR occupied approximately half the subtidal area of the bay, much of the remaining seabed being covered by *L. hyperborea* forest and park approximately 10% and 25% respectively. Although the real estimates are rather crude it is useful in understanding the importance of the kelp habitats as their associated communities make up much of the flora and fauna contained in the bay.

A rich understorey of red algae is usually found within *Laminaria hyperborea* forests and parks; the kelp stipes and rock surfaces festooned in epiphytes (e.g. Connor *et al*., 2004). The biotope IR.MIR.KR.XFoR, though not associated with quite such a rich community as that observed on *L. hyperborea* forests and parks, nevertheless contained dense turfs of red seaweed interspersed with silt tolerant fauna. The high proportion of red algae recorded in the bay (> 40% of all taxa) is undoubtedly indicative of the niches provided by the above mentioned communities; the remaining sedimentary habitats increasing the floral diversity of the bay.

Many additional taxa were recorded outside the bay, the strong currents and rocky substrata, particularly along Cerrig Brith, ensuring a good supply of nutrients and food to the benthic assemblages, as evidenced by the rich communities observed in the tideswept kelp communities to the north of this point. Beyond the kelp several circalittoral habitats were recorded, these accounting for many of the faunal taxa not present within Porth-y-pistyll, with an increase in bryozoan, ascidian and sponge taxa recorded from these areas.

The biota diversity of the bay was notably higher in previous years (in 2011, S=162; in 2012, S=153) than 2014 (S=117); however, the greater number of transects covered in 2011 and 2012, as well as the spatial variability of these transects means the data are not comparable. Despite this, the amalgamation of three years' worth of data provides a good indication of the characteristic fauna and flora of this area.

Previous work (Doggett *et al*., 2013) recorded extensive patches of driftweed along the south-eastern coastline of the bay. In 2014 these large patches of unattached weed were not observed during the subtidal work, although several target notes were made in the 2014 intertidal survey of accumulating driftweed along the western coastline of the bay (see Figure 3.2). It is thought that the relative shelter afforded by the bay can result in the accumulation of weed, but the absence of the extensive patches seen in 2012 point towards this being a stochastic feature of the bay rather

than an annual event. The occasional storm event approaching from a northerly bearing (Section 4.1) may be a determining factor in the presence of the driftweed.

Many of the subtidal biotopes recorded in and around the bay are contained within the priority habitats on the Section 42 list for Wales. These include the habitats 'infralittoral coarse sediment' (SS.SCS.ICS); 'infralittoral muddy sand' (SS.SSa.IMuSa) and the related biotope complex '*Arenicola marina* in infralittoral fine sand or muddy sand' (SS.SSa.IMuSa.AreISa); 'circalittoral muddy sand' (SS.SSa.CMuSa) and the related biotope complex '*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment' (SS.SSa.CMuSa.AalbNuc). Also present was the biotope complex 'Bryozoan turf and erect sponges on tide-swept circalittoral rock' (CR.HCR.XFa.ByErSp) which is recognised as part of the broader Section 42 habitat 'Fragile Sponge and Anthozoan Communities on Rocky Habitats' as well as being an Annex I habitat under 'Reefs'.

As priority marine habitats for Wales those biotopes listed above are considered to have key contributory roles to national biodiversity. Of the priority habitats recorded in the bay the comparatively large extent of SS.SSa.IMuSa (1.4 ha) and its associated biotope complex SS.SSa.IMuSa.AreISa (0.03 ha) add to the ecological value of the bay. Outside Porth-y-pistyll the circalittoral habitats CR.HCR.XFa.ByErSp and SS.SSa.CMuSa.AalbNuc also accounted for large areas (0.6 ha. and 2.9 ha. respectively). It is considered that the circalittoral habitats represent relatively small areas of these features along the north Anglesey coastline and previous work has recorded better examples, in terms of species richness, of CR.HCR.XFa.ByErSp to the east of the bay (e.g. Llanbadrig Head) (see Doggett *et al*., 2013).

4.2.1 Limitations of survey methodology

Considering the survey limitations outlined in section 2.2.6, knowledge of the bathymetry and substrata in the area helped guide predictions of the biotopes, and much of the mapping (post-survey) was carried out by following known depth contours (Titan, 2011; Appendix G), with the prime example being the kelp forests and parks which bounded the bay and its external margins in the photic zone. In deeper water the predictions are less reliable; however, consideration of the biotope complexes IR.HIR.KFar.FoR and SS.SSa.CMuSa.AalbNuc on the outer margins of the bay, though covering large expanses of bed, are felt to be reasonably accurate based on known physical features in these areas i.e. substrata, current and depth. These features combined with the ground-truthing of *in situ* observations and faunal cores were considered reliable enough for biotope ascription of these complexes. Where the physical data was unknown or less reliable, gaps in the mapping occurred. To the north of Cerrig Brith an MNCR transect (S3) identified three biotopes in relatively close proximity, consequently it was felt that predictive biotope ascription in the adjacent area would be unreliable due to the heterogeneity of this region.

In some instances the relatively low level of classification ascribed (e.g. the patch of muddy sand in the centre of the bay, SS.SSa.IMuSa), meant a higher level of confidence. The difficulties in viewing the sublittoral habitat occasionally resulted in these low levels of classification, though it was mainly a consequence of the communities observed fitting better with the broader habitat type descriptions. The fairly limited number of sublittoral biotope complexes and biotopes (EUNIS level 4 and 5 habitats) described by the Marine Habitat Classification (Connor *et al*., 2004) can encourage pigeon-holing of communities and where uncertainty with assignation arose, the communities were ascribed to a lower level.

As mentioned above, the inevitable requirement to predict the extent and presence of the subtidal communities was unavoidable, yet the measures imposed during the survey helped reduce the subjectivity of the predictive mapping. Discussions between all surveyors were carried out prior, during and post survey to reduce the level of inter-surveyor variability and provide an informed approach to the assignations.

Many of the biotopes recorded are not permanently subtidal and are best considered as part of the infralittoral fringe zone, covering areas immersed/emersed during spring tides. The 2014 intertidal biotope survey (see above) provides a more precise representation of much of the infralittoral, both inside the bay and on the peripheral margins; however, in many cases the crossover of the subtidal transects with the intertidal survey supplements, and confirms the presence of biotopes along with their characterising species. The inherent difficulties of intertidal surveying at the limits of low water include time limitations and the often projected seaward limits of identified intertidal biotopes. Observations from the subtidal surveys have specifically allowed the greater delineation of kelp extent, as in some cases the intertidal records represented only a glimpse of a much larger community. For example, the *Saccharina latissima* biotopes, though they could be seen to some degree at low water were better delineated by the subtidal records. Ascription of the *Laminaria hyperborea* biotope (IR.MIR.KR.Lhyp) in the intertidal survey relied upon land-based work and it is now considered that this habitat is better described as forest, merging with the biotope identified during the subtidal work (i.e. IR.MIR.KR.Lhyp.Ft) rather than forming a discrete and different biotope.

When deciding upon the biotope community *in situ* observations are preferable; observations from land of a predominantly subtidal community at spring low water are not considered as useful as observations from within the water column. Aside from the greater resolution of characterising species, some of the physical factors affecting a biotope may be difficult to gauge until fully immersed, for example, the degree of tidal current. In particular, the subtidal survey allowed a reliable and detailed assessment of the predominantly subtidal kelp communities found throughout the area; and the assignation of ‘tide-swept’ where appropriate.

Conversely, it is felt that mapping of the *Laminaria digitata* community was, for the most part, better carried out from shore. *L. digitata* inhabits the zone directly above (shallower than) the *Laminaria hyperborea*, specifically prohibiting dive surveys at mid to low tides. The extensive *Laminaria digitata* biotope observed subtidally was initially assigned as IR.MIR.KR.Ldig due to the surveyors only reaching the seaward fringe of this community. This was later changed to the forest code IR.MIR.KR.Ldig.Ldig following analysis of the intertidal data.

Where the subtidal surveys clearly overlapped with littoral habitats the subtidal survey data was used as a general guide rather than a definitive representation, the mapping of these specific habitats using the data produced by the intertidal survey. In some cases this resulted in slight differences in biotope ascription, such as the beginning of transect RA13 which was found to overlap with several littoral biotopes before reaching the infralittoral zone. The differences in biotope ascription between surveys were most evident with the very shallow sedimentary habitats observed over the subtidal survey, which in several cases were found to be wrongly ascribed as either littoral or sublittoral until post analysis of the intertidal data.

4.2.2 Non-native invasive species

Three non-native invasive species were recorded by surveyors; all of these were red algae. The species *Asparagopsis armata* and *Heterosiphonia japonica* have been

previously recorded from the bay (Doggett *et al*., 2013); however, the presence of *Anotrichium furcellatum* to the north of Cerrig Birth represents the most northerly record in UK waters, the other records being from Dorset, Cornwall and Milford Haven (National Biodiversity Network (NBN) Gateway, 2014). It most likely has a wider distribution but potentially goes under-recorded given its cryptic morphology. Despite this alga not being found within the bay it is likely to be present considering its proximity to the bay and previous records in the UK coming from sheltered environments. In contrast the alga *Asparagopsis armata* is now considered naturalised in UK waters and is fairly ubiquitous around the west coasts of England, Scotland and Ireland. It has a more limited distribution in Wales and this record represents one of just a handful of confirmed records (NBN Gateway, 2014). Over the last few years, records of *Heterosiphonia japonica* have increased, this species being recorded from south of England to the north-west coast of Scotland. The precise vector for these invasive species is unknown; however, they are often associated with ship movements (ballast water) and the unintentional introduction of non-native shellfish such as the Pacific oyster *Crassostrea gigas.* The fairly limited commercial activity in the bay and adjacent waters possibly indicates a spread of these species along the coastline rather than a direct introduction. The NBN gateway (2014) does not list any of these species as previously recorded from Anglesey.

5 Conclusion

The combination of the intertidal and subtidal work revealed a diverse mix of marine and estuarine communities in the bay with a total of 55 discrete biotopes, 12 of which were 'broad habitats'. A number of these communities represent priority habitats to Wales (Section 42), the mixture of these littoral, infralittoral and circalittoral communities culminating in a diverse assemblage of habitats and species in and around the bay. Individually the priority habitats are neither large in extent nor particularly rich in species, but the presence of so many in one area is noteworthy.

Although considered a sheltered bay, it is clear that parts of the bay have a higher degree of wave exposure than others. While Cerrig Brith's habitats might be expected to contain those communities characteristic of exposed conditions, the presence of very irregular bedrock formations creates a range of sheltered channels and plateaus allowing relatively stable *Ascophyllum nodosum* and, to a lesser extent, *Fucus vesiculosus* habitats to adorn the bedrock and boulders. Other parts of the bay showed some increase in the level of disturbance (e.g. south-eastern corner) and it is thought that occasional wave impacts in these areas have the potential to remove algae and increase scour by the mobilisation of sediment.

Temporal variation of the intertidal communities was clearly demonstrated, with transitions probably resulting from a combination of biotic and abiotic factors, whilst spatial variation was best shown by distinct zonation bands along the intertidal shoreline. However, spatial variation in community as a result of changes in level of exposure was not so well defined. The presence of an *Alaria esculenta* biotope at a couple of locations is a classic indicator of wave exposure; and changes in communities recorded in the south-eastern region and especially the even more sheltered southern shore point towards infrequent but major wave impacts. Yet the bay is generally thought of as sheltered and this is largely reflected by the presence of intertidal and subtidal communities characteristic of low wave exposure. For this reason it is believed that the infrequent wave impacts, though possibly occurring just once or twice a year or, in the case of the southern shore, over even greater temporal cycles, have the potential to bring about significant and discernible ecological changes to the bay.

The surveys have shown that observing the biological components of the bay allows a greater understanding of the physical effects experienced. As Lewis (1964) suggests, the physical factors of wave exposure and topography can cause striking biological differences in a relatively small area. The heterogeneity of the bay provides a myriad of different physical conditions, supporting diverse marine communities, characteristic of the north Anglesey coastline.

It is thought that all the rockpools surveyed, and many of those recorded represented 'mature' pools i.e. they had a well-developed community of species suited to the particular physical and chemical conditions of their pool. The sediment-floored rockpools recorded from the bay did not contain particularly large amounts of fine sediment and sand, instead being largely made up of gravel, pebbles and cobbles with small amounts of fine-grained material. The high faunal and floral diversity recorded from the pools adds credence to their ecological importance, especially those from the mid and upper shore.

This report has used the Marine Habitat Classification (Connor *et al*., 2004) to assign biotopes throughout the intertidal and subtidal zones surveyed. In doing so the interchange between habitat and biotope in the Porth-y-pistyll mapping report is often blurred, in numerous instances the Connor *et al* (2004) classification assigning a 'biotope' code to communities that are in effect 'broad habitats'. This is particularly noticeable in the subtidal mapping which contained a number of 'broad habitats' which are considered, for the purposes of this report, as 'biotopes'. The relative difficulties with subtidal as opposed to intertidal mapping (see Discussion) are acknowledged and give rise to a generally lower level of resolution. Despite this, it is considered that the biotope mapping presented in this report offers a detailed pictorial representation of Porth-y-pistyll, showing both the variety and extent of the marine communities. Although no immediate future work is proposed, it is felt that the interpretation of new data in this area, primarily in the subtidal, will continue to update the maps provided.

6 References

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Appendix A Intertidal Features

The following pictures are a selection of the habitats observed in addition to several target notes:

Pelvetia canaliculata on sheltered littoral fringe rock, eastern shore of Porth-y-pistyll.

Verrucaria maura on bedrock, eastern shore of Porth-y-pistyll.

Fucus vesiculosus and *F. spiralis* on bedrock, eastern shore of Porth-y-pistyll.

Ascophyllum nodosum on bedrock and boulders.

Sargassum muticum on FR.Mas biotope (target note 1). South-eastern corner of Porth-y-pistyll.

FR.Mas community in south-eastern corner of Porth-y-pistyll.

Disused pipe in south-eastern corner of Porth-y-pistyll (target note 2).

Patch of sand binding algae (*Rhodothamniella floridula*). Southern shore of Porth-y-pistyll.

Patch of rotting drift algae (target note 6). Southern shore of Porth-y-pistyll.

Upper shore in south-western corner of Porth-y-pistyll.

Edge of saltmarsh facing north. Porth y Felin embayment in south-western corner of Porth-y-pistyll.

Man-made boulder wall and embayment in south-western corner of Porth-y-pistyll (target note 14).

Patch of *Blindingia* spp. (target note 7). Porth-y-pistyll.

Barren and mobile shingle at Cerrig Brith. Western shore of Porth-y-pistyll.

Sargassum muticum in rockpool on Cerrig Brith (target note 18). West shore of Porth-y-pistyll.

Sponges, bryozoans and encrusting red algae on overhang at Cerrig Brith. Porth-y-pistyll.

Appendix B Biotopes recorded – Intertidal Surveys

Table B1: Historic biotope ascriptions used within original NRW (2003) map of Porth-y-pistyll and their new codes according to Connor *et al*., 2004.

97.06 Code	04.05 Code ascribed by NRW for Porth-y-pistyll
IR.EIR.KFaR.Ala.Ldig	IR.HIR.KFaR.Ala.Ldig
IR.MIR.KR.Ldig.Ldig	IR.MIR.KR.Ldig.Ldig
LR.ELR.MB.BPat.Fvesl	LR.HLR.MusB.Sem.FvesR
LR.ELR.MB.BPat.Sem	LR.HLR.MusB.Sem.Sem (Records with sparse red algae reassigned to Sem.FvesR; records on unstable boulders/cobbles reassigned to Sem.LitX)
LS.LGS.S.AP.P	Discontinued; records for this area all reassigned to LS.LSa.FiSa.Po
LS.LGS.S.Lan	LS.LSa.MuSa.Lan
LS.LGS.S.Tal	LS.LSa.St.Tal
LS.LGS.Sh.BarSh	LS.LCS.Sh.BarSh
LS.LMU.Sm	LS.LMp.Sm
LR.L.Ver.Ver	LR.FLR.Lic.Ver.Ver
LR.L.YG	LR.FLR.Lic.YG
LR.Rkp.Cor	LR.FLR.Rkp.Cor
LR.Rkp.FK	LR.FLR.Rkp.FK
LR.Rkp.G	LR.FLR.Rkp.G
LR.Rkp.SwSed	LR.FLR.Rkp.SwSed
LR.Rkp.FK.Sar	LR.FLR.Rkp.FK.Sar
LR.MLR.BF.Fser.Fser	LR.LLR.F.Fserr.FS (Moderately exposed records reassigned to Fser.R)
LR.MLR.BF.Fser.Fser.Bo	LR.MLR.BF.Fser.Bo
LR.MLR.BF.Fser.R	LR.MLR.BF.Fser.R
LR.MLR.BF.FvesB	LR.MLR.BF.FvesB
LR.MLR.BF.PelB	LR.MLR.BF.PelB
LR.MLR.Eph.Ent	LR.FLR.Eph.Ent
LR.MLR.Eph.EntPor	LR.FLR.Eph.EntPor
LR.SLR.F.Asc.Asc	LR.LLR.F.Asc.FS
LR.SLR.F.Fspi	LR.MLR.BF.FspiB **OR** LR.LLR.F.Fspi **OR** LR.LLR.FVS.FspiVS (Split into three on basis of wave exposure and salinity regime)
LR.SLR.F.Pel	LR.LLR.F.Pel **OR** LR.LLR.FVS.PelVS (Split into two biotopes on basis of salinity regime)
LR.SLR.FX.AscX	LR.LLR.F.Asc.X
LR.SLR.FX.EphX	LR.FLR.Eph.EphX
LR.SLR.FX.FcerX	LR.LLR.FVS.Fcer (Merged with Fcer; differing substrata not significant to community)
LR.SLR.FX.FserX	LR.LLR.F.Fserr.X
LR.SLR.FX.FvesX	LR.LLR.F.Fves.X **OR** LR.LLR.FVS.FvesVS (Split on the basis of salinity regime; variable salinity records combined with those of Fves)
LR.SLR.Mx.MytX	LS.LBR.LMus.Myt

Appendix C MNCR *pro forma* for recording subtidal features

C1: MNCR *pro forma*

Survey no. ____
Site no. ____
Field site no. ____

MARINE NATURE CONSERVATION REVIEW

SUBLITTORAL HABITAT (DETAILED)

JOINT NATURE CONSERVATION COMMITTEE

Site name:

Hab. no.	Position within site (extensive sites only)	No. of cores	Sieved vol. (l)	Infaunal sample no.	Granul. sample no.

SURVEYORS

DEPTH LIMITS (m)

- Upper (from sea level)
- Lower "
- Upper (from chart datum)
- Lower "

DEPTH BAND (✓)

- 0-5 m
- 5-10 m
- 10-20 m
- 20-30 m
- 30-50 m
- >50 m

ZONE (✓)

- Sublittoral fringe
- Infralittoral
  - upper
  - lower
- Circalittoral
  - upper
  - lower
- Not applicable

EXTENT OF RECORD (✓)

- Multiple habitats (whole area)
- Zone / depth band
- Restricted feature

SURVEY QUALITY (✓)

Flora	Fauna	
		Thorough
		Adequate
		Incomplete

SUBSTRATUM (%)

- Bedrock
- Boulders
  - very large >1024 mm
  - large 512-1024 mm
  - small 256-512 mm
- Cobbles 64-256 mm
- Pebbles 16-64 mm
- Gravel 4-16 mm
  - stone
  - shell
  - dead maerl
  - live maerl
- Sand
  - coarse 1-4 mm
  - medium 0.25-1 mm
  - fine 0.063-0.25 mm
- Mud <0.063 mm
- Shells (empty)
- Artificial
  - metal
  - concrete
  - wood
- Trees / branches
- Algae
- .....

100 Total

INCLINATION (%)

- Overhangs
- Vertical faces (80-100°)
- Very steep faces (40-80°)
- Upper faces (0-40°)
- Underboulders

100 Total

FEATURES - ROCK (1-5)

- Surface relief (even-rugged)
- Texture(smooth-pitted)
- Stability (stable-mobile)
- Scour (none-scoured)
- Silt (none-silted)
- Fissures >10mm (none-many)
- Crevices <10mm (none-many)
- Boulder/cobble/pebble shape (rounded-angular)

(✓)

- Gully
- Cave
- Tunnel
- Rockmill
- Boulder/cobble - on rock
- Boulder/cobble - on sediment
- Boulder holes
- Sediment on rock

FEATURES - SEDIMENT (1-5)

- Surface relief (even-uneven)
- Firmness (firm-soft)
- Stability (stable-mobile)
- Sorting (well-poor)

(✓)

- Mounds / casts
- Burrows / holes
- Tubes
- Algal mat
- Waves / dunes (>10 cm high)
- Ripples(<10 cm high)
- Subsurface black layer
- Subsurface coarse layer
- Subsurface clay / mud
- Surface silt / flocculent

MODIFIERS (✓)

- Freshwater runoff
- Wave exposure - wave surged
- - sheltered
- Tidal streams - accelerated
- - decelerated
- Grazing
- Shading
- Pollution

ASSESSMENT (1-5)

- Representativeness(atyp/tran/typ)
- Naturalness (unnat.-nat.)
- Extent (limit.-exten.)
- Species richness (low-high)
- Abundance/biomass(low-high)

MAIN COVER OR CHARACTERISING SPECIES / TAXA

Abund.	Species / taxon

PORIFERA		:CALCAREA
C80		Clathrina coriacea
cla lac		Clathrina lacunosa
leu com		Leucosolenia complicata
scy cil		Scypha ciliata
gra com		Grantia compressa
		:DEMOSPONGIA
osc lob		Oscarella lobularis
der buc		Dercitus bucklandi
pac joh		Pachymatisma johnstonia
tet aur		Tethya aurantium
sub car		Suberites carnosus
sub fic		Suberites ficus
pol bol		Polymastia boletiformis
pol mam		Polymastia mamillaris
cli cel		Cliona celata
ste rig		Stelligera rigida
ste stu		Stelligera stuposa
axi dis		Axinella dissimilis
axi inf		Axinella infundibuliformis
hal bow		Halichondria bowerbanki
hal pan		Halichondria panicea
cio pen		Ciocalypta penicillus
hym per		Hymeniacidon perleve
C5420		Mycale sp.
myc rot		Mycale rotalis
esp fuc		Esperiopsis fucorum
hym pau		Hymedesmia paupertas
pho fic		Phorbas fictitius
hem col		Hemimycale columella
C6420		Myxilla sp.
myx inc		Myxilla incrustans
iop nig		Iophonopsis nigricans
iop hyn		Iophon hyndmani
ras his		Raspailia hispida
ras ram		Raspailia ramosa
C8540		Haliclona sp.
hal fis		Haliclona fistulosa
hal ocu		Haliclona oculata
C8630		Haliclona simulans
hal urc		Haliclona urceolus
hal vis		Haliclona viscosa
dys fra		Dysidea fragilis
apl sul		Aplysilla sulfurea
hal duj		Halisarca dujardini
C9200		Porifera indet. (crusts)
CNIDARIA		:SCYPHOZOA
hal aur		Haliclystus auricula
aur aur		Aurelia aurita (scyphistomae)
		:HYDROZOA
cor nut		Corymorpha nutans
tub ind		Tubularia indivisa
tub lar		Tubularia larynx
D2290		Eudendrium sp.
bou ram		Bougainvillia ramosa
hyd ech		Hydractinia echinata
laf dum		Lafoea dumosa
hal bea		Halecium beanii
hal hal		Halecium halecinum
D5500		Aglaophenia sp.
agl plu		Aglaophenia pluma
agl tub		Aglaophenia tubulifera
gym mon		Gymnangium montagui
hal cat		Halopteris catharina
kir pin		Kirchenpaueria pinnata
nem ant		Nemertesia antennina
nem ram		Nemertesia ramosa
plu set		Plumularia setacea
pol fru		Polyplumaria frutescens
abi abi		Abietinaria abietina
abi fil		Abietinaria filicula
dip ros		Diphasia rosacea
hyd fal		Hydrallmania falcata
thu thu		Thuiaria thuja
ser gay		Sertularella gayi
ser pol		Sertularella polyzonias
ser arg		Sertularia argentea
ser cup		Sertularia cupressina
D7280		Obelia sp.
obe dic		Obelia dichotoma
obe gen		Obelia geniculata
obe lon		Obelia longissima
rhi ver		Rhizocaulus verticillatus
		:ANTHOZOA
sar ros		Sarcodictyon roseum
alc dig		Alcyonium digitatum
alc glo		Alcyonium glomeratum
swi pal		Swiftia pallida
eun ver		Eunicella verrucosa
fun qua		Funiculina quadrangularis
vir mir		Virgularia mirabilis
pen pho		Pennatula phosphorea
cer llo		Cerianthus lloydii
pac mul		Pachycerianthus multiplicatus
epi cou		Epizoanthus couchii
iso sul		Isozoanthus sulcatus
D11390		Protanthea simplex
act equ		Actinia equina
ane vir		Anemonia viridis
urt fel		Urticina felina
urt equ		Urticina eques
ant bal		Anthopleura ballii
aur het		Aureliania heterocera
aip mut		Aiptasia mutabilis
met sen		Metridium senile
D12310		Sagartia elegans
sag tro		Sagartia troglodytes
cer ped		Cereus pedunculatus
act sph		Actinothoe sphyrodeta
sag lac		Sagartiogeton laceratus
sag und		Sagartiogeton undatus
ada car		Adamsia carciniopados
pea cyl		Peachia cylindrica
hal chr		Halcampa chrysanthellum
edw cla		Edwardsia claparedii
cor vir		Corynactis viridis
car smi		Caryophyllia smithii
PLATYHELMINTHES		
pro vit		Prostheceraeus vittatus
NEMERTEA		
tub ann		Tubulanus annulatus
G620		Cerebratulus sp.
lin lon		Lineus longissimus
SIPUNCULA		
pha str		Phascolion strombi
ECHIURA		
ama edd		Amalosoma eddystonense
max lan		Maxmuelleria lankesteri
ANNELIDA		:POLYCHAETA
P10		Polychaeta indet. (tubes)
aph acu		Aphrodita aculeata
ale gel		Alentia gelatinosa
P970		Harmothoe sp.
P1330		Lepidonotus squamatus
oph fle		Ophiodromus flexuosus
P12740		Polydora sp.
P13750		Chaetopterus variopedatus
are mar		Arenicola marina
sab spi		Sabellaria spinulosa
P20000		Terebellidae indet.
eup neb		Eupolymnia nebulosa
lan con		Lanice conchilega
bis vol		Bispira volutacornis
P21660		Chone sp.
myx inf		Myxicola infundibulum
sab pav		Sabella pavonina
pom lam		Pomatoceros lamarcki
pom tri		Pomatoceros triqueter
ser ver		Serpula vermicularis
fil imp		Filograna implexa
pro tub		Protula tubularia
sal dys		Salmacina dysteri
P23550		Spirorbidae indet.
CHELICERATA		:PYCNOGONIDA
Q		
CRUSTACEA		:CIRRIPEDIA to ISOPODA
R640		Verruca stroemia
bal bal		Balanus balanus
bal cre		Balanus crenatus
bos ang		Boscia anglica
S460		Mysidae indet.
S1660		Amphipoda indet. (tubes)
dyo por		Dyopedos porrectus (whips)
S10700		Caprellidae indet.
		:DECAPODA
S21690		Caridea indet. (prawns/shrimps)
pal ser		Palaemon serratus
pan mon		Pandalus montagui
cra cra		Crangon crangon
hom gam		Homarus gammarus
nep nor		Nephrops norvegicus
S23780		Calocaris macandreae (burrows)
S23900		Callianassa subterranea (burrows)
S24140		Palinurus elephas
S24440		Paguridae indet.
ana hyn		Anapagurus hyndmanni
pag ber		Pagurus bernhardus
pag cua		Pagurus cuanensis
pag pri		Pagurus prideaux
S24710		Pagurus pubescens
S24840		Galathea sp.
gal int		Galathea intermedia
gal nex		Galathea nexa
gal squ		Galathea squamifera
S24900		Galathea strigosa
mun rug		Munida rugosa
pis lon		Pisidia longicornis
por pla		Porcellana platycheles
eba tub		Ebalia tuberosa
maj squ		Maja squinado
hya ara		Hyas araneus
hya coa		Hyas coarctatus
S25760		Inachus dorsettensis
ina pha		Inachus phalangium
mac ros		Macropodia rostrata
S26200		Corystes cassivelaunus
ate rot		Atelecyclus rotundatus
can pag		Cancer pagurus
lio dep		Liocarcinus depurator
lio pus		Liocarcinus pusillus
nec pub		Necora puber
car mae		Carcinus maenas
xan inc		Xantho incisus

MOLLUSCA		**:POLYPLACOPHORA**
W500		Polyplacophora indet.
lep ase		Leptochiton asellus
ton mar		Tonicella marmorea
ton rub		Tonicella rubra
		:GASTROPODA
ema fis		Emarginula fissura
tec tes		Tectura testudinalis
tec vir		Tectura virginea
hel pel		Helcion pellucidum
mar hel		Margarites helicinus
juj mil		Jujubinus miliaris
gib mag		Gibbula magus
gib tum		Gibbula tumida
gib cin		Gibbula cineraria
W2000		Calliostoma zizyphinum
tur com		Turritella communis
lac vin		Lacuna vincta
apo pes		Aporrhais pespelecani
cre for		Crepidula fornicata
tri arc		Trivia arctica
W7380		Trivia monacha
pol pol		Polinices polianus
oce eri		Ocenebra erinacea
nuc lap		Nucella lapillus
buc und		Buccinum undatum
nep ant		Neptunea antiqua
hin ret		Hinia reticulata
hin inc		Hinia incrassata
		:OPISTHOBRANCHIA
phi ape		Philine aperta
ely vir		Elysia viridis
W11020		Aplysia punctata
ple mem		Pleurobranchus membranaceus
tri hom		Tritonia hombergii
den fro		Dendronotus frondosus
W12720		Doto sp.
gon nod		Goniodoris nodosa
onc mur		Onchidoris muricata
aca pil		Acanthodoris pilosa
pol fae		Polycera faeroensis
W13630		Polycera quadrilineata
lim cla		Limacia clavigera
cad lae		Cadlina laevis
arc pse		Archidoris pseudoargus
jor tom		Jorunna tomentosa
jan cri		Janolus cristatus
cor bro		Coryphella browni
cor lin		Coryphella lineata
fla ped		Flabellina pedata
eub tri		Eubranchus tricolor
fac bos		Facelina bostoniensis
aeo pap		Aeolidia papillosa
		:PELECYPODA
myt edu		Mytilus edulis
mod mod		Modiolus modiolus
lim hia		Limaria hians
ost edu		Ostrea edulis
chl dis		Chlamys distorta
W18000		Chlamys varia
aeq ope		Aequipecten opercularis
pec max		Pecten maximus
pod pat		Pododesmus patelliformis
ast sul		Astarte sulcata
W20220		Ensis sp.
ens arc		Ensis arcuatus
arc isl		Arctica islandica
cir cas		Circomphalus casina
cha gal		Chamelea gallina
cla fas		Clausinella fasciata
dos exo		Dosinia exoleta
dos lup		Dosinia lupinus
mya tru		Mya truncata
hia arc		Hiatella arctica
		:CEPHALOPODA
sep atl		Sepiola atlantica
ele cir		Eledone cirrhosa
BRACHIOPODA		
neo ano		Neocrania anomala
ter ret		Terebratulina retusa
BRYOZOA		
Y30		Crisiidae indet.
cri cor		Crisidia cornuta
cri den		Crisia denticulata
cri ebu		Crisia eburnea
alc dia		Alcyonidium diaphanum
alc hir		Alcyonidium hirsutum
ves spi		Vesicularia spinosa
euc lor		Eucratea loricata
mem mem		Membranipora membranacea
ele pil		Electra pilosa
flu fol		Flustra foliacea
cha pap		Chartella papyracea
sec sec		Securiflustra securifrons
bug fla		Bugula flabellata
bug plu		Bugula plumosa
bug tur		Bugula turbinata
bic cil		Bicellariella ciliata
Y8360		Scrupocellaria sp.
scr rep		Scrupocellaria reptans
Y8410		Scrupocellaria scruposa
Y8110		Cellaria sp.
cel fis		Cellaria fistulosa
cel sin		Cellaria sinuosa
umb lit		Umbonula littoralis
esc coc		Escharoides coccinea
por com		Porella compressa
pen fol		Pentapora foliacea
sch lin		Schizomavella linearis
Y3770		Parasmittina trispinosa
cel pum		Cellepora pumicosa
oma ram		Omalosecosa ramulosa
Y8880		Bryozoa indet. (crusts)
PHORONIDA		
pho hip		Phoronis hippocrepia
ECHINODERMATA		**:CRINOIDEA**
ant bif		Antedon bifida
ant pet		Antedon petasus
ZB220		Leptometra celtica
		:ASTEROIDEA
lui cil		Luidia ciliaris
ast irr		Astropecten irregularis
por pul		Porania pulvillus
ast gib		Asterina gibbosa
ans pla		Anseropoda placenta
sol end		Solaster endeca
cro pap		Crossaster papposus
ZB1640		Henricia sp.
hen ocu		Henricia oculata
hen san		Henricia sanguinolenta
ast rub		Asterias rubens
lep mue		Leptasterias muelleri
ZB2000		Marthasterias glacialis
		:OPHIUROIDEA
ZB2350		Ophiothrix fragilis
oph nig		Ophiocomina nigra
ZB2780		Ophiopholis aculeata
amp bra		Amphiura brachiata
amp chi		Amphiura chiajei
amp fil		Amphiura filiformis
ZB2920		Amphiura chiajei/filiformis
amp squ		Amphipholis squamata
oph aff		Ophiura affinis
oph alb		Ophiura albida
oph oph		Ophiura ophiura
		:ECHINOIDEA
psa mil		Psammechinus miliaris
ech esc		Echinus esculentus
ech cor		Echinocardium cordatum
		:HOLOTHURIOIDEA
hol for		Holothuria forsskåli
pso pha		Psolus phantapus
neo mix		Neopentadactyla mixta
thy fus		Thyone fusus
thy ros		Thyone roscovita
paw sax		Pawsonia saxicola
ocn lac		Ocnus lacteus
asl lef		Aslia lefevrei
ZB4640		Leptopentacta elongata
lab dig		Labidoplax digitata
TUNICATA		**:ASCIDIACEA**
ZD60		Clavelina lepadiformis
pyc aur		Pycnoclavella aurilucens
dis ros		Distaplia rosea
ZD320		Polyclinidae indet.
ZD340		Polyclinum aurantium
syn pul		Synoicum pulmonaria
mor arg		Morchellium argus
sid ele		Sidnyum elegans
sid tur		Sidnyum turbinatum
apl nor		Aplidium nordmanni
ZD640		Aplidium punctum
ZD680		Didemnidae indet.
ZD860		Didemnum maculosum
dip lis		Diplosoma listerianum
dip spo		Diplosoma spongiforme
lis per		Lissoclinum perforatum
cio int		Ciona intestinalis
dia vio		Diazona violacea
ZD1350		Corella parallelogramma
asc asp		Ascidiella aspersa
asc sca		Ascidiella scabra
asc con		Ascidia conchilega
asc men		Ascidia mentula
asc vir		Ascidia virginea
pha mam		Phallusia mammillata
ZD1720		Styela clava
pol pom		Polycarpa pomaria
pol scu		Polycarpa scuba
den gro		Dendrodoa grossularia
dis var		Distomus variolosus
sto soc		Stolonica socialis
bot sch		Botryllus schlosseri
bot lea		Botrylloides leachi
bol ech		Boltenia echinata
pyu mic		Pyura microcosmus
pyu squ		Pyura squamulosa

mol man		Molgula manhattensis

PISCES		
scy can		Scyliorhinus canicula (dogfish)
con con		Conger conger (conger eel)
dip bim		Diplecogaster bimaculata (two-spotted clingfish)
lop pis		Lophius piscatorius (angler)
ZG1500		Gadidae indet.
ZG1960		Molva molva (ling)
ZG2080		Pollachius pollachius (pollack)
pol vir		Pollachius virens (saithe)
tri lus		Trisopterus luscus (bib)
tri min		Trisopterus minutus (poor cod)
gas acu		Gasterosteus aculeatus (three-spined stickleback)
ZG3510		Spinachia spinachia (fifteen-spined stickleback)
ZG3760		Syngnathus acus (greater pipefish)
myo sco		Myoxocephalus scorpius (bull rout)
tau bub		Taurulus bubalis (sea scorpion)
ago cat		Agonus cataphractus (pogge)
cen exo		Centrolabrus exoletus (rock cook)
cre mel		Crenilabrus melops (corkwing)
cte rup		Ctenolabrus rupestris (goldsinny)
lab ber		Labrus bergylta (ballan wrasse)
lab mix		Labrus mixtus (cuckoo wrasse)
par gat		Parablennius gattorugine (tompot blenny)
chi asc		Chirolophis ascanii (Yarrell's blenny)
lum lum		Lumpenus lumpretaeformis (snake blenny)
pho gun		Pholis gunnellus (butterfish)
amm tob		Ammodytes tobianus (sand eel)
cal lyr		Callionymus lyra (common dragonet)
cal ret		Callionymus reticulata (reticulated dragonet)
ZG7050		Gobiidae indet.
gob nig		Gobius niger (black goby)
gob fla		Gobiusculus flavescens (two-spotted goby)
les fri		Lesueurigobius friesii (Fries' goby)
ZG7400		Pomatoschistus sp.
pom min		Pomatoschistus minutus (sand goby)
pom pic		Pomatoschistus pictus (painted goby)
tho eph		Thorogobius ephippiatus (leopard-spotted goby)
phr nor		Phrynorhombus norvegicus (Norwegian topknot)
zeu pun		Zeugopterus punctatus (topknot)
ZG8770		Pleuronectidae indet. (juveniles)
ple pla		Pleuronectes platessa (plaice)

CYANOPHYTA		
ZL2		Beggiatoa sp.

RHODOPHYTA :COMPSOPOGONALES to AHNFELTIALES		
por coc		Porphyropsis coccinea
ZM830		Porphyra sp.
ZM880		Porphyra miniata
ZM970		Audouinella sp.
sci int		Scinaia interrupta
ZM2040		Asparagopsis armata (Falkenbergia)
bon asp		Bonnemaisonia asparagoides
bon ham		Bonnemaisonia hamifera
ZM2110		Trailliella intricata
gel lat		Gelidium latifolium
pal pal		Palmaria palmata
ahn pli		Ahnfeltia plicata

:CORALLINALES		
ZM3840		Corallinaceae indet. (crusts)
cor off		Corallina officinalis
lit cor		Lithothamnion corallioides
lit gla		Lithothamnion glaciale
phy cal		Phymatolithon calcareum

:GIGARTINALES		
cru pel		Cruoria pellita
cal cil		Calliblepharis ciliata
cal jub		Calliblepharis jubata
cys pur		Cystoclonium purpureum
ZM6930		Rhodophyllis divaricata
ZM6940		Rhodophyllis divaricata var. werneri
dil car		Dilsea carnosa
dud ver		Dudresnaya verticillata
dum con		Dumontia contorta
fur lum		Furcellaria lumbricalis
hal lig		Halarachnion ligulatum
cho cri		Chondrus crispus
gra fil		Grateloupia filicina
ZM3220		Callophyllis cristata
cal lac		Callophyllis laciniata
kal ren		Kallymenia reniformis
mer mic		Meredithia microphylla
mas ste		Mastocarpus stellatus
ZM3640		Peyssonnelia sp.
coc tru		Coccotylus truncata
ery tra		Erythrodermis traillii
gym cre		Gymnogongrus crenulatus
phy cri		Phyllophora crispa
phy pse		Phyllophora pseudoceranoides
sch nic		Schottera nicaeensis
ste int		Stenogramme interrupta
plo car		Plocamium cartilagineum
pol rot		Polyides rotundus
sph cor		Sphaerococcus coronopifolius

:GRACILARIALES		
gra ver		Gracilaria verrucosa

:RHODYMENIALES		
cor ere		Cordylecladia erecta
rho ard		Rhodymenia ardissonei
rho del		Rhodymenia delicatula
rho hol		Rhodymenia holmesii
rho pse		Rhodymenia pseudopalmata
chy ver		Chylocladia verticillata
lom art		Lomentaria articulata
lom cla		Lomentaria clavellosa
lom orc		Lomentaria orcadensis

:CERAMIALES		
ant cru		Antithamnion cruciatum
ant spi		Antithamnionella spirographidis
ZM7760		Aglaothamnion sp.
ZM8010		Callithamnion tetragonum
ZM8070		Ceramium sp.
cer nod		Ceramium nodulosum
cer str		Ceramium strictum
com thu		Compsothamnion thuyoides
gri cor		Griffithsia corallinoides
hal flo		Halurus flosculosus
hal equ		Halurus equisetifolius
plu plu		Plumaria plumosa
pte plu		Pterothamnion plumula
pti gun		Ptilota gunneri
sph mul		Sphondylothamnion multifidum
acr ven		Acrosorium venulosum
apo rus		Apoglossum ruscifolium
cry ram		Cryptopleura ramosa
del san		Delesseria sanguinea
dra het		Drachiella heterocarpa
dra spe		Drachiella spectabilis
ery lac		Erythroglossum laciniatum
har bon		Haraldiophyllum bonnemaisonii
hyp hyp		Hypoglossum hypoglossoides
mem ala		Membranoptera alata
nit pun		Nitophyllum punctatum
phy rub		Phycodrys rubens
pol hil		Polyneura bonnemaisonii
rad thy		Radicilingua thysanorhizans
het plu		Heterosiphonia plumosa
bro bys		Brongniartella byssoides
cho das		Chondria dasyphylla
odo den		Odonthalia dentata
ZM11010		Polysiphonia sp.
ZM11050		Polysiphonia elongata
pol fuc		Polysiphonia fucoides
ZM11160		Polysiphonia nigra
pol str		Polysiphonia stricta
pte par		Pterosiphonia parasitica
rho con		Rhodomela confervoides
rho lyc		Rhodomela lycopodioides
ZM11540		Rhodophyta indet. (non-calc. crusts)

CHRYSOPHYTA		
ZQ1		Diatoms - colonial
ZQ2		Diatoms - film

PHAEOPHYTA		
ZR30		Ectocarpaceae indet.
pse ext		Pseudolithoderma extensum
ZR5480		Asperococcus sp.
asp fis		Asperococcus fistulosus
asp tur		Asperococcus turneri
ZR5960		Dictyosiphon sp.
sti rhi		Stilophora rhizodes
cho fla		Chordaria flagelliformis
eud vir		Eudesme virescens
ZR3540		Mesogloia vermiculata
cut mul		Cutleria multifida
ZR3900		Cutleria multifida (Aglaozonia)
ZR4120		Sphacelaria sp.
hal fil		Halopteris filicina
cla spo		Cladostephus spongiosus
dic mem		Dictyopteris membranacea
ZR4570		Dictyota dichotoma
tao ato		Taonia atomaria
spo ped		Sporochnus pedunculatus
des acu		Desmarestia aculeata
des lig		Desmarestia ligulata
des vir		Desmarestia viridis
art vil		Arthrocladia villosa
ZR6250		Chorda filum
ZR6310		Laminaria sp. (sporelings)
lam dig		Laminaria digitata
lam hyp		Laminaria hyperborea
lam och		Laminaria ochroleuca
lam sac		Laminaria saccharina
sac pol		Saccorhiza polyschides
ala esc		Alaria esculenta
sar mut		Sargassum muticum
ZR7050		Cystoseira sp.
hal sil		Halidrys siliquosa
ZR7190		Phaeophyta indet. (crusts)

CHLOROPHYTA		
ZS2110		Enteromorpha sp.
ZS2400		Ulva sp.
ZS3310		Chaetomorpha linum
cha mel		Chaetomorpha melagonium

ZS3380		Cladophora sp.
bry plu		Bryopsis plumosa
ZS3990		Derbesia sp. (Halicystis)
ZS4140		Codium sp.
ANGIOSPERMAE		
zos mar		Zostera marina
ZX7		Ruppia sp.

Mark Abundance only in box
(Superabundant, Abundant, Common,
Frequent, Occasional, Rare, Present)

Note Specimen, Photograph or ? for
uncertain identification to left of box

Table C2: MNCR SACFOR abundance scale (obtained from the JNCC). The following denote abundance - S=Superabundant, A=Abundant, C=Common, F=Frequent, O=Occasional, R=Rare.

NB. Read notes below prior to use of scale

Growth form	Size of individuals/colonies							
% cover	Crust/meadow	Massive/Turf	<1cm	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 / 10m2 (3.16 x 3.16 m)	
<1% or density		R		R	O	F	1-9 / 100 m2 (10 x 10 m)	
					R	O	1-9 / 1000 m2 (31.6 x 31.6 m)	
						R	<1/1000 m2	

The MNCR cover/density scales adopted from 1990 provide a unified system for recording the abundance of marine benthic flora and fauna in biological surveys. The following notes should be read before their use:

1. Whenever an attached species covers the substratum and percentage cover can be estimated, that scale should be used in preference to the density scale.

2. Use the massive/turf percentage cover scale for all species, excepting those given under crust/meadow.

3. Where two or more layers exist, for instance foliose algae overgrowing crustose algae, total percentage cover can be over 100% and abundance grade will reflect this.

4. Percentage cover of littoral species, particularly the fucoid algae, must be estimated when the tide is out.

5. Use quadrats as reference frames for counting, particularly when density is borderline between two of the scale.

6. Some extrapolation of the scales may be necessary to estimate abundance for restricted habitats such as rockpools.

7. The species (as listed above) take precedence over their actual size in deciding which scale to use.

8. When species (such as those associated with algae, hydroid and bryozoan turf or on rocks and shells) are incidentally collected (i.e. collected with other species that were superficially collected for identification) and no meaningful abundance can be assigned to them, they should be noted as present (P).

Appendix D Subtidal Transects in and around Porth-y-pistyll

PP1 Porth-y-pistyll 2011

Situation	South-east corner of bay.
Physical Parameters	Survey depth: 1.6 m to 2.8 m below chart datum (bcd). Tidal streams: Weak Wave exposure: Moderately exposed
Habitat 1 – PP1S1 **SS.SCS.ICS**	Infralittoral coarse/medium sand with shell gravel (1.7 m bcd to 2.8 m bcd). Rare *Arenicola* casts, *Urticina felina* and *Cereus pedunculatus*. Scoured cobbles covered in pink encrusting algae, *Corallina officinalis* and barnacles. 100% cover of driftweed including kelp (*Laminaria saccharina*, *Alaria esculenta*), *Heterosiphonia japonica, Fucus serratus* and *Halidrys siliquosa.*
Habitat 2 – PP1S2 **IR.MIR.KR.XFoR**	Infralittoral medium and small boulders with one very large boulder from 1.6 m bcd to 2.6 m bcd. Upper faces of boulders covered in mixed red algae turf. Sediment between the boulders covered in driftweed.
No images.	

PPV1 Porth-y-pistyll 2012

Situation	Southeast corner of bay.
Physical Parameters	Survey depth: 0.2 m to 2.9 m bcd. Tidal streams: Weak Wave exposure: Moderately exposed
Habitat 1 – PPV1S1 **IR.MIR.KR.Ldig.Ldig**	Upper infralittoral rock with small boulders and cobbles from 0.2 m bcd to 1.1 m bcd. Dense kelp (*Laminaria digitata*) with coralline algae. Very sparse faunal community.
Habitat 2 – PPV1S2 **IR.MIR.KR.XFoR**	Upper infralittoral bedrock, boulders and some coarse sediment from 1.1 m bcd to 2.9 m bcd. Dense mat of red algae predominantly made up of *Asparagopsis armata*, *Furcellaria lumbricalis, Acrosorium venulosum* and *Cryptopleura ramosa*. Very limited faunal community.

Cobbles with *Furcellaria lumbricalis* and coralline algae.

Dense red algae covering rock with *Laminaria hyperborea*.

PPV2 Porth-y-pistyll 2011

Situation	Centre of bay
Physical Parameters	Survey depth: 1.1 m bcd to 3.1 m bcd Tidal streams: Weak Wave exposure: Moderately exposed
Habitat 1 – PP2S1 **IR.MIR.KR.Lhyp.Pk**	Lower infralittoral bedrock with small boulders with sandy areas and some sand on rock from 1.4 m bcd to 3.4 m bcd. Low edges to about 1 m high. All with a dense cover of foliose red algae (*Plocamium cartilagineum, Cryptopleura ramosa, Rhodophyllis divaricata* and *Heterosiphonia plumosa*) with *Dictyota dichotoma.* Scattered kelp at 6 m on bedrock ledges.
No images.	

PPV2 Porth-y-pistyll 2012

Situation	Centre of bay – East of Porth-y-pistyll
Physical Parameters	Survey depth: 3.1 m acd to chart datum Tidal streams: Weak Wave exposure: Moderately exposed
Habitat 1 – PPV2S1 **LR.LLR.F.Asc.X**	Intertidal boulder community with large areas of muddy sand at 2.8 m acd. Boulders covered in dense *Ascophyllum nodosum* and occasional *Fucus serratus*. *Arenicola marina* and *Lanice conchilega* in muddy sand patches.
Habitat 2– PPV2S2 **SS.SSa.IMuSa.ArelSa**	Coarse to medium upper infralittoral sand patches at 2.1 m acd to 0.1 m acd. Super-abundant *Lanice* along with common *Arenicola marina*.
Habitat 3 – PPV2S3 **IR.MIR.KR.XFoR**	Sublittoral fringe of boulders, pebbles and coarse sand at 3.1 m acd to cd. Boulders with abundant red filamentous and foliose algae, including *Ceramium* sp., *Heterosiphonia plumosa*, *Brongniartella byssoides* and *Hypoglossum hypoglossoides*.

Ascophyllum nodosum – Habitat 1

Arenicola casts and *Lanice conchilega* – Habitat 2


Red algae on boulders with coarse sands – Habitat 3.

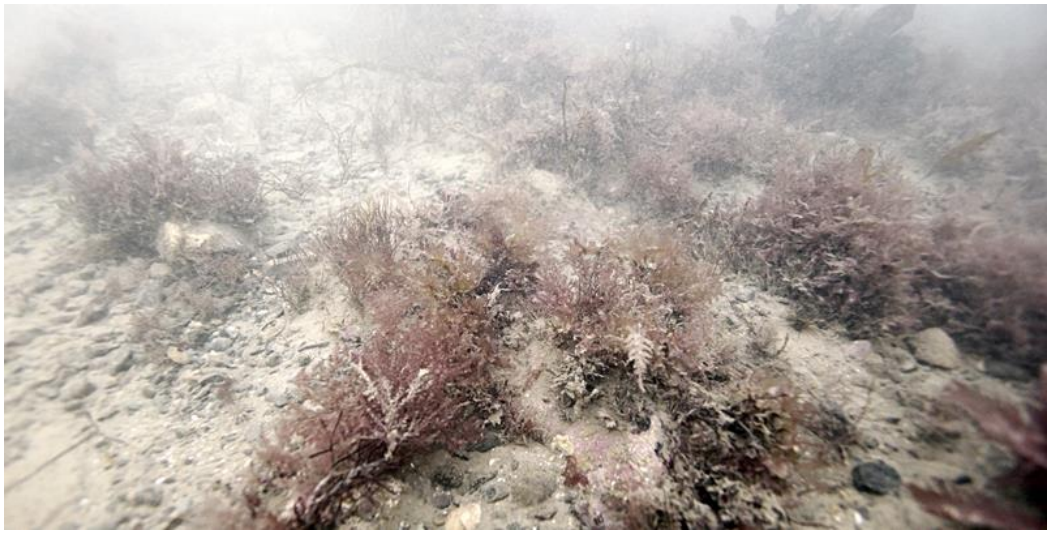
PP3 Porth-y-pistyll 2011

Situation	North-east edge of bay
Physical Parameters	Survey depth: 2.5 m bcd to 3.5 m bcd Tidal streams: Weak Wave exposure: Moderately exposed
Habitat 1 - PP3S1 **IR.MIR.KR.Lhyp.Ft**	Upper infralittoral shallow bedrock bay with runnel gullies, boulders and mobile small boulders and cobbles from 3.3 m bcd to 4.3 m bcd. *Laminaria hyperborea* forest with dense understorey of red and brown algae and sparse fauna. *Musculus* sp. common throughout habitat, even on verticals. Silty environment.
No images.	

PPV3 Porth-y-pistyll 2012

Situation	West of Porth-y-pistyll
Physical Parameters	Survey depth: 3.5 m acd to 6.7 m bcd Tidal streams: Weak Wave exposure: Sheltered
Habitat 1 – PPV3S1 **IR.MIR.KR.Lhyp.Ft**	Sublittoral fringe of steep bedrock with some boulders at 3.5 m acd to 0.5 m bcd. Dense *Laminaria hyperborea* with a sparse mix of red algae including *Chondrus crispus* and *Furcellaria lumbricalis*.
Habitat 2 – PPV3S2 **IR.MIR.KR.XFoR**	Upper infralittoral mixture of cobbles and gravel with sandy gravel at 1.5 m bcd to 6.7 m bcd. Abundant filamentous reds with common foliose reds such as *Heterosiphonia plumosa* and *Chylocladia verticillata*.
Habitat 3 – PPV3S3 **SS.SSa.IMuSa**	Upper infralittoral mix of boulders with gravel and fine sand at 4.1 m bcd. Relatively sparse community dominated by *Laminaria hyperborea* and driftweed.

Dense red algae beneath the kelp (*Laminaria hyperborea*) and a lesser-spotted dogfish.



Habitat 3 – mix of gravel and sand with sparse algae.

PP4 Porth-y-pistyll 2011

Situation	North edge of bay
Physical Parameters	Survey depth: 3.5 m bcd Tidal streams: Weak Wave exposure: Moderately exposed
Habitat 1 **IR.MIR.KR.XFoR**	Large and small boulders and cobbles firmly embedded in fine muddy sand. Sparse fauna (including *Clavelina lepadiformis* and *Ophiura albida*) and foliose red and brown algae. Drift algae present comprising *Laminaria* sp., *Alaria esculenta*, *Fucus* spp., plastics and much foliose red algae.

	
Thyone sp. on fine muddy sand.	*Ciona intestinalis* and *Clavelina lepadiformis.*

PPV4 Porth-y-pistyll 2012

Situation	North edge of bay
Physical Parameters	Survey depth: 3.5 m bcd Tidal streams: Strong Wave exposure: Exposed
Habitat 1 – PPV4S1 **IR.MIR.KR.Ldig.Ldig**	Upper infralittoral upward facing bedrock at 1.5 m acd. Forest of *Laminaria digitata* with patches of abundant *Fucus serratus* and an understorey of red algae including: *Cryptopleura ramosa*, *Polysiphonia elongata* and *Chondrus crispus*.
Habitat 2 – PPV4S2 **IR.LIR.K.Lhyp.Lsac.Pk**	Upper infralittoral sloping bedrock with patches of gravel, sands and small boulders from 1.2 m bcd to 2.8 m bcd. Very silted habitat with *Laminaria hyperborea* park, mixture of brown algae and common reds.
Habitat 3 – PPV4S3 **IR.MIR.KR.XFoR**	Lower infralittoral upward facing bedrock with mixture of cobbles and small boulders on coarse sand from 3 m bcd to 7.5m bcd. Cobbles and boulders covered in pink encrusting algae and sparse red algae such as *Heterosiphonia plumosa, Brongniartella byssoides* and *Plocamium cartilagineum. Cerianthus lloydii* are frequent in the sandy substratum.
No images.	

PPV5 Porth-y-pistyll 2012

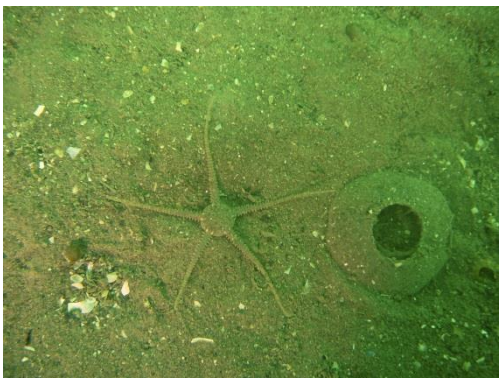
Situation	South-east corner of bay
Physical Parameters	Survey depth: 0.7 m acd to 3.6 m bcd Tidal streams: Weak Wave exposure: Sheltered
Habitat 1 – PPV5S1 **IR.HIR.KFaR.FoR**	Lower infralittoral mixed sediment consisting of boulders, cobbles, and pebbles overlying muddy sand from 3.6 m bcd to 1.8 m bcd. Sparse faunal community. The flora was dominated by coralline crusts, *Heterosiphonia plumosa* and *Calliblepharis ciliata*
Habitat 2 – PPV5S2 **IR.LIR.K.Lhyp.Lsac.Pk**	Upper infralittoral habitat with bedrock outcrops characterised by *Laminaria hyperborea* from 2.0 m bcd to 0.6 m acd. Kelp increased in abundance as depth decreased. The red algae *Brongniartella byssoides, Heterosiphonia plumosa* and *Asparagopsis armata* made up a high proportion of the flora component.
Habitat 3 – PPV5S3 **IR.LIR.K.Lhyp.Lsac.Pk**	Sublittoral fringe with a mixture of boulders and bedrock covered by a thin layer of silt from 0.6 m acd to 0.7 m acd. Extremely high densities of the non-native red alga *Asparagopsis armata* along with characteristic kelp species (*Laminaria hyperborea* and *Saccharina latissima*).

Corda filum and mixed red algae.

Cerianthus lloydii in coarse sediment between areas of algal growth.

PP6 Porth-y-pistyll 2011

Situation	Just north of bay
Physical Parameters	Survey depth: 6 m to 9 m bcd Tidal streams: Weak Wave exposure: Sheltered
Habitat 1 – PP6S1 **SS.SSa.IMuSa**	Circalittoral muddy sand with ripples at 8.5 m bcd. Surrounding rock outcrops and large to very large boulders. Dominant animals include *Ophiura albida* with occasional *Lanice conchilega* and *Pagurus* spp.
Habitat 2 – PP6S2 **CR.HCR.Xfa.ByErSp**	Upper circalittoral bedrock at 6 m bcd to 9 m bcd, heavily silted, sloping into sandy mud. Dominant cover of *Musculus discors* crusts with interspersed solitary sea squirts (*Polycarpa pomaria* and *Molgula* sp.) and sponges (*Raspailia hispida, Stelligera rigida* and *Leucosolenia complicata*). Sparse red algae.



Ophiura albida (left) and *Euspira* eggs (right) on sandy mud.

Guancha lacunosa on heavily silted bedrock.

PPV6 Porth-y-pistyll 2012

Situation	Just north of bay
Physical Parameters	Survey depth: 1.3 m bcd to 1.8 m bcd Tidal streams: Weak Wave exposure: Sheltered
Habitat 1 – PPV6S1 **IR.MIR.KR.Lhyp.Pk**	Upper infralittoral patchy bedrock covered in sediment with small boulders and patches of coarse sand from 1.3 m bcd to 1.8 m bcd. Predominant community of driftweed consisting of several species of red algae of which *Heterosiphonia plumosa* and *Cryptopleura ramosa* were abundant. Attached to the rock were a number of seaweeds including *Furcellaria lumbricalis* and *Chondrus crispus*. All algae were covered in fine silt.
Habitat 2 – PPV6S2 **IR.MIR.KR.Lhyp.Pk**	Upper infralittoral bedrock and boulders from 1.3 m bcd to 1.8 m with small areas of pebbles and coarse sediment. Dense mixture of red and brown algae dominated by *Heterosiphonia plumosa*, *Brongniartella byssoides* and *Asparagopsis armata*. Abundant *Musculus discors* though faunal community low in diversity.

Hermaea bifida on dense drift weed.

Chondrus crispus growing on hard substrate.

PPV7 Porth-y-pistyll 2012

Situation	Middle of the bay
Physical Parameters	Survey depth: 0.1 m bcd to 5.7 m bcd Tidal streams: Weak Wave exposure: Sheltered
Habitat 1 – PPV7S1 **IR.MIR.KR.XFoR**	Lower infralittoral with small boulders, cobbles and pebbles overlying sand from 4.9 m bcd to 5.4 m bcd. Predominant community of red algae attached to the hard substrata though no species was particularly dominant. Algae included *Heterosiphonia plumosa* *Cryptopleura ramosa*, *Furcellaria lumbricalis* and *Chondrus crispus.*
Habitat 2 – PPV7S2 **SS.SSa.IMuSa**	Lower infralittoral muddy sand with occasional pebbles from 4.9 m bcd to 5.4 m bcd. Habitat was characterised by sparse faunal community which included *Lanice conchilega*, *Ophiura* sp. and *Cerianthus lloydii*. Occasional tufts of algae were found, these mainly represented by the species *Cystoclonium purpureum*, *Polysiphonia nigra* and *Cryptopleura ramosa*.

Coarse sand and gravel interspersed with cobbles and boulders and sparse red algae.

PPV8 Porth-y-pistyll 2012

Situation	Eastern side of the bay
Physical Parameters	Survey depth: 0.8 m bcd to 3.3 m bcd Tidal streams: Weak Wave exposure: Sheltered
Habitat 1 – PPV8S1 **IR.MIR.KR.Lhyp.Pk**	Upper infralittoral bedrock ridge from 0.8 m bcd to 3.3 m bcd. Fairly dense *Laminaria hyperborea* with thick covering of red algae dominated by *Acrosorium venulosum, Plocamium cartilagineum*, *Cryptopleura ramosa* and *Heterosiphonia plumosa*. Faunal community was quite sparse with the exception of juvenile *Musculus discors* which were present in much of the algae.

Calliblepharis ciliata.

Anemonia viridis.

 Mixed red algae including *Brongniartella byssoides* and *Cryptopleura ramosa*.	 Mixed red algae and kelp.

RA1 and S1 Cerrig Brith 2014

Situation	West of Cerrig Brith
Physical Parameters	Survey depth: 6.5 to 10.8 m below sea level (bsl) 1100h Tidal streams: Moderate Wave exposure: Moderate
Habitat 1 - IR.MIR.KR.Lhyp.Ft **Habitat 2 - IR.MIR.KR.Lhyp.Pk**	Undulating, mainly upward-facing, heavily silted bedrock with vertical faces on boulders. Mosaic of kelp park and kelp forest habitats (continually changing from one to the other) with a filamentous and foliose red algae understorey. *Laminaria hyperborea* with *Plocamium cartilagineum, Dilsea carnosa, Phycodrys rubens, Delessaria sanguinea, Cryptopleura ramosa, Calliblepharis ciliata, Nitophyllum punctatum, Brongniartella byssoides, Membranoptera alata* and *Desmarestia aculeata.* Fauna included *Clavelina lepadiformis, Aplidium punctum, Alcyonidium diaphanum.*
No images.	

RA2 and S2 Cerrig Brith 2014

Situation	West of Cerrig Brith
Physical Parameters	Survey depth: 7 – 15 m bsl 1100h Tidal streams: Moderate Wave exposure: Moderate
Habitat 1 – SS.SSa.CMuSa	Sublittoral coarse sand with a muddy fraction. Fauna included *Ophiura albida* and *Urticina* spp. with no obvious burrows.
Habitat 2 – CR.HCR.Xfa.ByErSp	Transition zone of mixed sediment (including *O. albida, Cerianthus lloydii, Lanice conchilega, Asterias rubens* amongst cobbles, pebbles and gravel) into a circalittoral boulder and bedrock slope. The bedrock slope was characterised by *Flustra foliacea, Alcyonium digitatum, Tubularia indivisa, Asterias rubens, Nemertesia antennina, Pawsonia* spp.*, Abietinaria abeitina, Bugula* spp., *Morchellium argus, Aplidium punctum, Clavelina lepadiformis, Sagartia elegans, Tethya citrina, Raspailia ramosa, Polymastia boletiformis, Stelligera rigida, Dysidea fragilis and Axinella infundibuliformis.* Some sparse *Antedon bifida.*
Habitat 3 – IR.HIR.KFaR.FoR	Lower infralittoral zone to a Heterosiphonia plumosa and P*locamium cartilagineum* dominated community which also included *Sycon ciliatum, Leucosolenia* spp.*, Dilsea carnosus and Delessaria sanguinea*.
Habitat 4 – IR.MIR.KR.Lhyp.Pk	Upper infralittoral boulder/bedrock slope with *Laminaria hyperborea*

	park with understorey of dense filamentous and foliose red algae including *Plocamium cartilagineum*, *Heterosiphonia plumosa, Membranoptera alata, Phyllophora crispus, Dictyota dichotoma, Hypoglossum hypoglossoides.*
Habitat 5 - IR.MIR.KR.Lhyp.Ft	Upper infralittoral boulder/bedrock slope with *Laminaria hyperborea* forest with understorey of dense filamentous and foliose red algae. No time available to make further notes.
No images.	

RA3 Cerrig Brith 2014

Situation	North-east of Cerrig Brith
Physical Parameters	Survey depth: 6.5 – 12 m bsl 1100h Tidal streams: Moderate Wave exposure: Moderate
Habitat 1 – IR.MIR.KR.LhypT.Pk	Silted infralittoral bedrock and small boulders dominated by *Laminaria hyperborea* park with a dense understorey of red algae including *Plocamium cartilagineum*. Much of this area had small gullies with vertical walls forming Habitat 2.
Habitat 2 – IR.HIR.KFaR.FoR	Shaded vertical walls within Habitat 1 with sparser red algae and dominated by more shade-tolerant species including *Meredithia microphylla, Hypoglossum hypoglossoides, Acrosorium venulosum, Schottera nicaeensis* and *Rhodophyllis* spp.
Habitat 3 – IR.HIR.KFaR.FoR, grading into CR.HCR.XFa at depth	Deeper areas with bedrock outcrops and small boulders with sparser red algal community dominated by *Plocamium cartilagineum* and *Heterosiphonia plumosa*. Becoming more circalittoral with depth and increasing faunal turf species – *Morchellium argus*, Crissids, *Alcyonidium diaphanum, Sycon ciliate, Botryllus schlosseri, Molgula* spp.
No images.	

S3 Cerrig Brith 2014

Situation	North-northeast of Cerrig Brith
Physical Parameters	Survey depth: 10.4 – 11.4 m bsl Tidal streams: Moderate Wave exposure: Moderate
Habitat 1 and 2 – CR.HCR.XFa becoming IR.HIR.KFaR.FoR	Silted bedrock and boulders. Possibly the transition zone between the upper circalittoral and lower infralittoral with a *Flustra*-dominated community moving toward that with an increasing density of red algae, particularly *Plocamium cartilagineum*. Many short branching and cushion sponges throughout the transect and *Bugula* spp. and *Alcyonidium diaphanum* common. Lots of *Molgula* spp. beneath the layer of silt.
Habitat 3 – IR.MIR.KR.LhypT.Pk	Not surveyed but observed at the landward end of the transect.
No images.	

S12 Cerrig Brith 2014

Situation	North of Cerrig Brith
Physical Parameters	Survey depth: 8.1 – 9.3 m bsl Tidal streams: Moderate Wave exposure: Moderate
Habitat 1 –	Tide-swept, fissured bedrock with small gullies and crevices dominated

IR.MIR.KR.LhypT.Pk	by silted and sparse kelp (*Laminaria hyperborea*) park. A dense understorey of red algae, sponge, ascidians and *Polydora* tubes. Understorey dominated by *Heterosiphonia plumosa, Plocamium cartilagineum* and *Cryptopleura ramosa.*
No images.	

RA4 Porth-y-pistyll 2014

Situation	Outer Porth-y-pistyll – middle
Physical Parameters	Survey depth: 8.8 – 9.2 m bsl Tidal streams: Moderate Wave exposure: Moderate
Habitat 1 – SS.SSa.IMuSa	Muddy sand gently sloping from 8.8 – 9.2 m bsl with small boulders with red foliose and filamentous algae including *Delessaria sanguinea, Chondrus crispus, Furcellaria lumbricalis, Dictyota dichotoma, Dilsea carnosa, Plocamium cartilagineum, Hypoglossum hypoglossoides*. High density of infaunal polychaete worms (casts) and anemones (*Cerianthus lloydii* and *Urticina* spp.) present. Depth of sediment ca. 7 cm overlaying gravel, drifting kelp present on occasion.
Habitat 2 – SS.SSa.CMuSa.AalbNuc	Combination of muddy sand with cobbles and small, silted boulders covered in sparse red foliose and filamentous red algae, *Delessaria sanguinea* and *Halecium* spp.. *Ophiura albida* present in sediment.
Habitat 3 – IR.MIR.KR.XFoR	Bedrock outcrop rising to 2 m above the seabed with small boulders around the base. Covered in red algae with occasional epifauna including *Meredithia microphylla, Palmaria palmate, Drachiella heterocarpa, Alcyonidium diaphanum, Aplidium punctum,* Crissids, *Dercitus bucklandi, Clavelina lepadiformis*.
No images.	

RA6 Porth-y-pistyll 2014

Situation	Outer Porth-y-pistyll – east
Physical Parameters	Survey depth: 7.3 – 14.7 m bsl 1300h Tidal streams: Moderate Wave exposure: Moderate
Habitat 1 – SS.SSa.CMuSa.AalbNuc	Mud with *Asterias rubens, Ophiura albida, Amphiura filiformis* (dominant) abundant on the surface. Flat and otherwise featureless (14.7-13.7 m bsl).
Habitat 2 – CR.HCR.XFa.ByErSp	Steeply sloping, heavily silted bedrock (40° - 60°) with sparse turf of bryozoan and short, branching sponges. *Bugula spp., Vesicularia spinulosa,* Crissids, *Alcyonidium diaphanum, Sertularia polyzonias, Stelligera rigida, Raspailia ramosa, Pachymatisma johnstonia, Dysidea fragilis, sponge crusts, Sycon ciliatum, Raspailia hispida, Alcyonium digitatum, Clavelina lepadiformis, Ciona intestinalis, Aplidium punctum, Hypoglossum hypoglossoides, Schottera nicaeensis*.
Habitat 3 – IR.MIR.ICR.XFoR	Dense red algae on bedrock with *Delessaria sanguinea* and *Plocamium cartilagineum* dominant. Other species included *Furcellaria lumbricalis, Heterosiphonia plumosa, Rhodymenia pseudopalmata, Rhodymenia holmesii, Bispira volutacornis, Bugula flabellata, Isozooanthus sulcata, Leucosolenia* spp., *Pawsonia saxatilis*, sponge crusts.
Habitat 4 – IR.MIR.KR.Lhyp.Pk	*Laminaria hyperborea* increasing in density up steeply sloping bedrock with an understorey of red algae including *Plocamium cartilagineum, Furcellaria lumbricalis, Cryptopleura ramosa, Acrosorium venulosum, Heterosiphonia plumose, Delessaria sanguinea, Membranoptera alata, Dilsea carnosus, Drachiella* sp., *Palmaria palmata, Dictyota dichotoma, Halidrys siliquosa, Anemonia viridis, Rhodymenia ardissonei.*
No images.	

RA7 Porth-y-pistyll 2014

Situation	Outer Porth-y-pistyll – east
Physical Parameters	Survey depth: 12.3 – 16.3 m bsl 1300h Tidal streams: Moderate Wave exposure: Moderate
Habitat 1 – SS.SSa.CMuSa.AalbNuc	Slightly sandy mud with patches of shell gravel veneer on the surface. Flat topography. Characterising species were *Ophiura albida*, *Ophiura ophiura*, *Amphiura filiformis*, *Pagurus* spp., *Asterias rubens* and juvenile flatfish
Habitat 2 – CR.HCR.XFa.ByErSp	Low-lying muddy, silted rocky reef gradually increasing in gradient up to steeply sloping and vertical bedrock characterised by sponges, hydroids, bryozoan and sparse red algae. Characterising species were *Antedon bifida*, *Nemertesia antennina*, *Raspailia hispida*, *Halecium halecinum*, *Stelligera stuposa*, *Dysidea fragilis*, *Molgula* spp., *Bugula* spp., *Actinothoe sphyrodeta*, Phoronids, *Isozoanthus sulcatus*.
No images.	

S8 Porth-y-pistyll 2014

Situation	Outer Porth-y-pistyll – east
Physical Parameters	Survey depth: 4.6 – 7.2 m bsl Tidal streams: Moderate Wave exposure: Moderate
Habitat 1 – IR.MIR.KR.XFoR	Heavily silted upper circalittoral – lower infralittoral fringe with sparse red algal cover dominated by *Rhodymenia pseudopalmata* and *Rhodymenia holmesii* with *Schottera nicaeensis* in patches on verticals. *Halecium halecinum* common and frequent sponges including *Suberites carnosus*.
Habitat 2 – IR.HIR.KSed.XKScrR	Silted bedrock with frequent Halidrys siliquosa and *Laminaria* sporelings. Otherwise similar to Habitat 1.
Habitat 3 – SS.SCS.CCS	Soft muddy sand overlying gravel. Numerous *Cerianthus lloydii* throughout with occasional cirratulid tentacles visible above the substratum. Bivalve siphons were sparsely distributed as were small, silted *Suberites carnosus*. The substratum was bordered by bedrock and interspersed with small to medium boulders. Similar in form to the transition zone between Hab 1 and Hab 2 on RA7 above.
No images.	

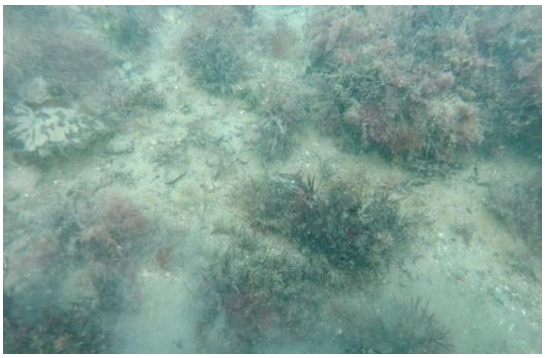
RA8 Porth-y-pistyll 2014

Situation	Inner Porth-y-pistyll – west
Physical Parameters	Survey depth: 3.0 – 7.0 m bsl Tidal streams: Weak Wave exposure: Moderate
Habitat 1 – IR.MIR.KR.Ldig	*Laminaria digitata* forest in shallow (<3 m) depth on bedrock, rapidly dropping away to boulder/cobble habitat. Extensive coralline crusts and *Gibbula cineraria*.
Habitat 2 IR.MIR.KR.XFoR	Boulder/cobble habitat, highly silted and dominated by red algae – *Heterosiphonia plumosa*, *Furcellaria lumbricalis*, coralline crusts, *Asparagopsis armata*, *Dictyota dichotoma*, *Osmundea* sp., *Erythroglossum laciniatum*, *Acrosorium venulosum*, *Rhodophyllis divaricata*, *Brongniartella byssoides*, *Cystoclonium purpureum*.
Habitat 3 - IR.MIR.KR.Lhyp.Pk	Larger boulders and bedrock outcrops supporting stands of kelp park with associated red algae – *Heterosiphonia plumosa*, *Delessaria sanguinea*, *Membranoptera alata*, *Phycodrys rubens*, *Palmaria palmata*, *Plocamium cartilagineum*, *Halurus flosculosus*.

Habitat 4 - SS.SSa.IMuSa	Occasional extensive areas of muddy/sandy sediment >10 cm deep over bedrock, supporting fewer algae including *Plocamium cartilagineum*, *Furcellaria lumbricalis* and more burrowing species such as *Sabella pavonina*, *Hinia reticulata*, *Cerianthus lloydii*, *Abra alba*, Paguridae sp..
Habitat 5 - IR.MIR.KR.Lhyp.Ft	Occasional stands of *Laminaria hyperborea* kelp park.

Mixed red algae just below kelp park.

Mixed red algae and sparse kelp.

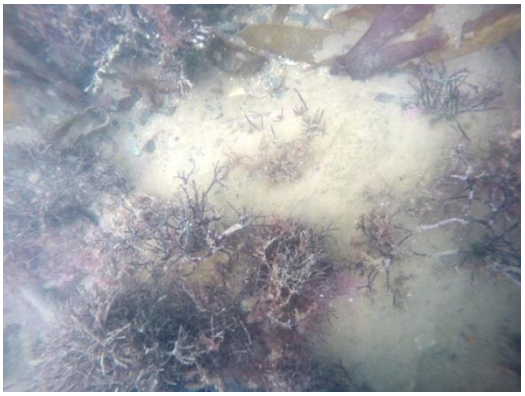


Mixed sediment with *Chondrus* and *Heterosiphonia*.

Laminaria hyperborea forest.

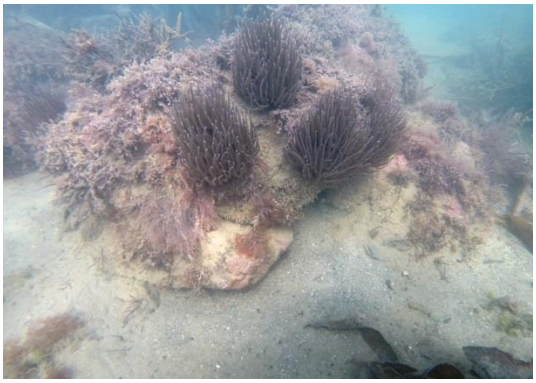
S9 Porth-y-pistyll 2014

Situation	Inner Porth-y-pistyll – west
Physical Parameters	Survey depth: 1.8 – 2.7 m bsl Tidal streams: Weak Wave exposure: Moderate
Habitat 1 – LR.HLR.FR.Mas	Mixed coarse sediment with gravel, pebbles, cobbles and sparse small boulders overlaying bedrock. Mixed red algae (dominated by *Chondrus crispus*, *Furcellaria lumbricalis*, *Heterosiphonia plumosa*) growing through sediment or on rocks with abundance *Corallina* sp. and pink encrusting algae. Area closest to the shore was covered with dead/broken *L. hyperborea* and fucoids but not considered a different habitat as the substrate was the same.
Habitat 2 – IR.MIR.KR.Lhyp.Pk	Low-lying, heavily silted infralittoral bedrock with some steep/vertical faces. Sparse *L. hyperborea* park with dense understorey or red algae dominated by *Heterosiphonia plumosa*, *Osmundea* sp. and coralline encrusting algae. Also notable high quantities of amphipod/*Polydora* tubes on vertical faces.

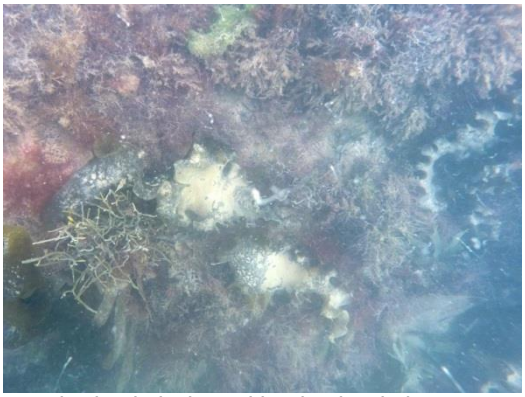
 Mixed sediment with *Chondrus, Furcellaria* and *Heterosiphonia*.	 Broken and heavily silted *L. hyperborea* and fucoids.

RA9, S10 and S11 Porth-y-pistyll 2014

Situation	Inner Porth-y-pistyll – east
Physical Parameters	Survey depth: 1.5 – 4.8 m bsl Tidal streams: Weak Wave exposure: Moderate
Habitat 1 – LR.MLR.BF.Fser.R	Bedrock with *Fucus serratus* (approximately 70% cover) with *Osmundea* sp., *Chondrus crispus*, *Laminaria digitata*, *Mastocarpus stellatus*, *Ulva lactuca*, *Ceramium* sp., *Anemonia viridis*, *Palmaria palmata*, *Elachista* sp., *Lomentaria articulata*.
Habitat 2 – IR.MIR.KR.Lhyp.Pk	Bedrock and boulders supporting *Laminaria hyperborea* park with foliose and filamentous algae including but not limited to *Chondrus crispus*, *Plocamium cartilagineum*, *Heterosiphonia plumosa*, *Brongniartella byssoides*, *Furcellaria lumbricalis*, *Cryptopleura ramosa*, *Asparagopsis armata*, , *Palmaria palmata*, *Delessaria sanguinea*, *Ulva lactuca*, *Gastroclonium ovatum*, *Nitophyllum punctatum*.
Habitat 3 – SS.SSa.ISaMu	Sandy mud with *Arenicola marina* (1-9 per m^2)
Habitat 4 – SS.SSa.IMuSa	Muddy sand with sparse life including *Arenicola marina* (1-9 per m^2), *Lanice conchilega* and *Cerianthus lloydii*.
Habitat 5 – IR.MIR.KR.Lhyp.Ft	Silted sublittoral fringe or bedrock and boulders with *Laminaria hyperborea* forest with understorey of foliose and filamentous reds characterised by *Heterosiphonia plumosa*, coralline crusts, *Palmaria palmata*. Distinctive lack of faunal epiphytes but diverse algae community.
Habitat 6 – IR.MIR.KR.XFoR	Dense filamentous and foliose red algae on large and small boulders. Dominated by *Heterosiphonia plumosa*, *Furcellaria lumbricalis* and *Asparagopsis armata*.
 *Fucus serratus*, *Chondrus crispus*, *Ulva lactuca* and *Palmaria palmata.*	 Muddy sands with *Arenicola* casts.

 *Laminaria hyperborea* park with red algae understorey.	 Dense red algae on large and small boulders.

RA10 Porth-y-pistyll 2014

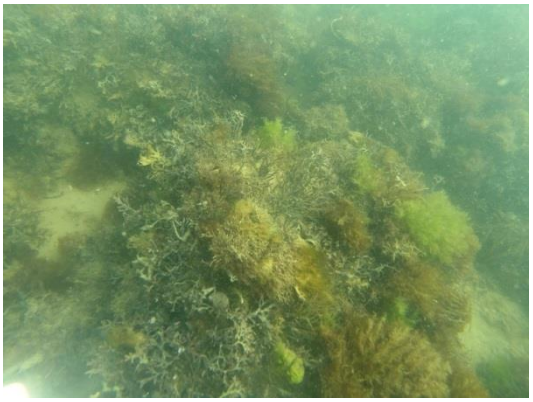
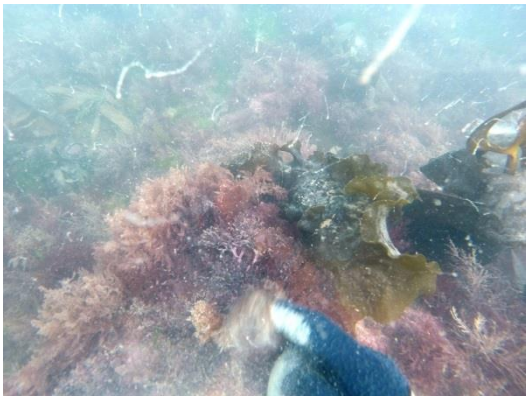
Situation	Inner Porth-y-pistyll – west
Physical Parameters	Survey depth: 1.3 – 4.8 m bsl Tidal streams: weak Wave exposure: sheltered
Habitat 1 – IR.HIR.KSed	Small boulders, cobbles, pebbles and gravel dominated by *Chondrus crispus*. Other algae include (but not limited to) *Laurencia pinnatifida*, *Cystoclonium purpureum*, *Osmundea* sp., *Palmaria palmata*, *Nitophyllum punctatum*, *Heterosiphonia plumosa*, *Porphyra umbilicalis*, *Dumontia contorta*, *Colpomenia peregrina*, *Gracilaria gracilis*.
Habitat 2 – IR.MIR.KR.Ldig.Ldig	Bedrock with *Laminaria digitata* and understorey of red algae dominated by *Heterosiphonia plumosa* and *Furcellaria lumbricalis* and also including *Plocamium cartilagineum*, *Ceramium* sp., *Chondrus crispus*, *Asparagopsis armata*, *Nitophyllum punctatum*, *Cystoclonium purpureum*, *Acrosorium venulosum*, *Halidrys siliquosa*, *Dictyota spiralis*.
Habitat 3 – IR.MIR.KR.Lhyp.Pk	Sparse *Laminaria hyperborea* park with understorey of red algae dominated by *Heterosiphonia plumosa* and *Furcellaria lumbricalis*. Also present were *Cystoclonium purpureum*, *Membranoptera alata*, *Hypoglossum hypoglossoides*, *Nitophyllum punctatum*, *Callophyllis laciniata*, *Polysiphonia* sp., *Ptilota gunneri*.
Habitat 4 – IR.LIR.K.Lsac	*Saccharina latissima* on silty, boulders cobbles and pebbles with red algae (e.g. *Asparagopsis armata*, *Delessaria sanguinea* and *Dilsea carnosus*) and dead *L. hyperborea* and fucoids.
Habitat 5 – SS.SSa.IMuSa.AreISa	Sandy/muddy areas with sparse algae (mainly *Furcellaria lumbricalis* with *Chondrus crispus*, *Heterosiphonia plumosa*, *Polysiphonia* sp., *Plocamium cartilagineum*, *Dictyota dichotoma* and *Dumontia contorta*) and *Lanice conchilega* and *Cerianthus lloydii*.
 Mixed sediments dominated by *Chondrus crispus*.	 *Saccharina latissima* with mixed red algae.

RA11 Porth-y-pistyll 2014

Situation	Inner Porth-y-pistyll – west
Physical Parameters	Survey depth: 3.5 – 6.5 m bsl Tidal streams: Weak Wave exposure: Moderate
Habitat 1 – IR.MIR.KR.Lhyp.Ft	Undulating fissured bedrock with occasional gullies and patches of cobbles/gravel. *Laminaria hyperborea* forest with understorey of red foliose and filamentous algae including *Palmaria palmata*, *Cryptopleura ramosa*, *Heterosiphonia plumosa, Plocamium cartilagineum, Asparagopsis armata*.
Habitat 2 – LR.MLR.BF.Fser.R	Undulating fissured bedrock with occasional gullies and patches of cobbles/gravel. *Fucus serratus* (approximately 70%) and *Laminaria digitata* (approximately 15%). Pink encrusting algae on rock with *Palmaria palmata* and *Saccharina latissima*.
Habitat 3 – IR.MIR.KR.Lhyp.Pk	Undulating fissured bedrock with occasional gullies and patches of cobbles/gravel. *Laminaria hyperborea* park with understorey of red foliose and filamentous algae including *Heterosiphonia plumosa*, *Cryptopleura ramosa*, *Phycodrys rubens*, *Halurus flosculosus*, *Delessaria sanguinea*, *Ptilota gunneri* and *Corallina officinalis*.
Habitat 4 – IR.HIR.KFaR.FoR	Foliose and filamentous red algae growing on cobbles, pebbles and small boulders including *Heterosiphonia plumosa*, *Cystoclonium purpureum*, *Furcellaria lumbricalis* and *Chondrus crispus*.
No images.	

RA13 Porth-y-pistyll 2014

Situation	Inner Porth-y-pistyll – east
Physical Parameters	Survey depth: 1.7 – 5.0 m bsl Tidal streams: Weak Wave exposure: Moderate
Habitat 1 – LR.HLR.FR.Mas	Silted intertidal boulders dominated by *Chondrus crispus*, *Ulva lactuca* and coralline crusts. Also present – *Osmundea* sp., *Dumontia contorta*, *Ascophyllum nodosum*, *Pterocladiella capillacea*, *Colpomenia peregrina*, *Cladostephus spongiosus*, *Anemonia viridis*.
Habitat 2 – LS.LSa.MuSa.MacAre	Intertidal mud dominated by *Arenicola* and interspersed with boulders forming habitat 1. Also present – *Cerianthus lloydii*, *Buccinum undatum*, *Lanice conchilega.*
Habitat 3 – LR.MLR.BF.Fser.R	Lower intertidal silted boulders and bedrock dominated by *Fucus serratus*, *Palmaria palmata* and coralline crusts.
Habitat 4 – LR.HLR.FR.Mas	Embedded cobbles on sublittoral fringe rock dominated by *Chondrus crispus* and *Ulva lactuca*.
Habitat 5 – IR.LIR.K.Lsac.Ldig	Heavily silted sheltered sublittoral fringe rock dominated by *Laminaria digitata* forest with rare *Saccharina latissima.* Also present – coralline crusts, *Fucus serratus*, barnacles.
Habitat 6 – IR.MIR.KR.XFoR	Shallow sublittoral boulders and bedrock dominated by diverse mixed algae including (but not limited to) coralline crusts, *Corallina officinalis*, *Rhodophyllis divaricata*, *Asparagopsis armata*, *Dumontia contorta*, *Cryptopleura ramosa*, *Heterosiphonia plumosa* and *Heterosiphonia japonica*.
Habitat 7 – IR.LIR.K.Lhyp.Lsac	Bedrock and boulders supporting *Laminaria hyperborea* forest with coralline crusts, *Palmaria palmata*, *Heterosiphonia plumosa*, *Saccharina latissima*, *Anemonia viridis*.

 Boulders dominated by *Chondrus crispus* and *Ulva* sp.	 *Laminaria hyperborea* and *Saccharina latissima* with dense red algae.

RA14 Porth-y-pistyll 2014

Situation	Inner Porth-y-pistyll – middle
Physical Parameters	Survey depth: 2.9 – 7.0 m bsl Tidal streams: Weak Wave exposure: Moderate
Habitat 1 – LR.MLR.BF.Fser.R	Intertidal bedrock and boulders with fucoids – *Fucus serratus*, *F. vesiculosus*, *Ascophyllum nodosum*, *Pterocladiella capillacea*, pink encrusting algae, barnacles, limpets.
Habitat 2 – IR.MIR.KR.Ldig	Intertidal bedrock and boulders with *Laminaria digitata* forest with an understorey of red algae including *Furcellaria lumbricalis*, *Heterosiphonia plumosa*, *Corallina officinalis* and coralline crusts.
Habitat 3 – IR.MIR.KR.Lhyp.Ft	Infralittoral with *Laminaria hyperborea* forest with understorey of red algal turf including *Membranoptera alata*, *Palmaria palmata*, *Phycodrys rubens*, *Delessaria sanguinea*, *Dilsea carnosus*, *Plocamium cartilagineum*, *Heterosiphonia plumosa*, *Calliblepharis ciliata* and *Furcellaria lumbricalis*.
Habitat 4 – IR.MIR.KR.XFoR	Subtidal mixed ground of pebbles, cobbles and bedrock outcrops with sparse *Laminaria hyperborea* and mixed red algae including *Furcellaria lumbricalis*, *Chondrus crispus*, *Drachiell /Rhodophyllis* sp., *Acrosorium venulosum*, *Delessaria sanguinea* and encrusting pink algae.
No images.	

Appendix E Infaunal cores

Table E1: Results of infaunal cores at sites RA6, RA7 and S10, S11 given as count abundance data. Porth-y-pistyll bay, north Anglesey, June 2014.

TAXA	RA7_C01	RA7_C02	RA7_C03	RA6_C01	RA6_C02	RA06_C03	S10_C01	S10_C02	S10_C03	S11_C01	S11_C02	S11_C03
NEMATODA	1		1			1		1	2		3	1
Aphroditidae #juv..	2			1								
Polynoidae indet.				1	1				1	1	1	1
Pholoe inornata						1						
Pholoe baltica				2			1		2			
Sthenelais #juv.		1										
Sthenelais limicola			1		2							
Eteone longa						1						
Phyllodoce mucosa						2					1	
Eumida sanguinea												1
Sphaerodorum flavum				1								
Exogone verugera						1						
Nephtys juv.		1					1			3		
Scoloplos armiger				1		1			1		1	
Aricidea indet.		2										
Poecilochaetus serpens	1											
Malacoceros fuliginosus			1									1
Pseudopolydora #juv.				1								
Pseudopolydora antennata							1					
Pseudopolydora pulchra		2			2							
Pygospio elegans					1	1						
Paraspio decorata	1	1										
Spiophanes bombyx	1	3		1						1		
Magelona johnstoni	1											
Caulleriella alata	1						1	1				1
Chaetozone gibber	1		3									
Chaetozone setosa			1									
Cirriformia tentaculata										5	21	30
Capitella spp.						1						5
Mediomastus fragilis		2		17	2	4	1		4		1	
Notomastus spp.				1						5	15	11
Notomastus #juv.										2	15	
Arenicolidae #juv.				1				2				
Arenicola marina								7		1	1	2
Euclymene oerstedii		2										
Ophelina acuminata	14	5	2	18		3						3
Scalibregma inflatum	7	2	6	59	14	25	9	4	9			
Owenia fusiformis					1							
Pectinariidae #juv.	1	1						2	2			
Lanice conchilega										1		

	RA7_C01	RA7_C02	RA7_C03	RA6_C01	RA6_C02	RA06_C03	S10_C01	S10_C02	S10_C03	S11_C01	S11_C02	S11_C03
Tubificoides benedii				1								2
Tubificoides pseudogaster #agg										2	2	
COPEPODA		1										8
MYODOCOPODIA				2			1					
Harpina # juv.	1	1		1								
Harpinia serrata					1							
Ampelisca brevicornis											1	
Gammaropsis nitida		1										
Pariambus typicus	1	1	1		6	1	1					
Tanaopsis graciloides			2	3			1		7			
CUMACEA #indet.	2			3								
Nannastacidae		1							1		1	
Cumella #pygmaea					1							
BRACHYURA #larvae											1	
Rissoidae #indet.								1				
Hinia reticulata									2			
Nuculidae	2	5	3	1			3	1	1			
Nuculidae #juv.	2	12		1			2					
Mytilus edulis #juv.											1	
Thyasira flexuosa			1									
Kurtiella bidentata		1				1			3			
Phaxas pellucidus # juv.		1	1	2								1
Tellina (Fabulina) fabula		1										
Abra alba	2		1	48	42	33	8	4	9			
Abra alba #juv.	1											
Phoronis spp.	1					3						
Amphiuridae #juv.					1							
Amphiura filiformis		1										
Ophiuridae #juv.					1							
Ophiura albida				1	1	1						

Appendix F Subtidal Taxa List

Table F1: Complete taxa list for Porth-y-pistyll bay and adjacent coastal area. Taxa divided in to kingdom (green), phyla (blue) and, in several cases, class (red).

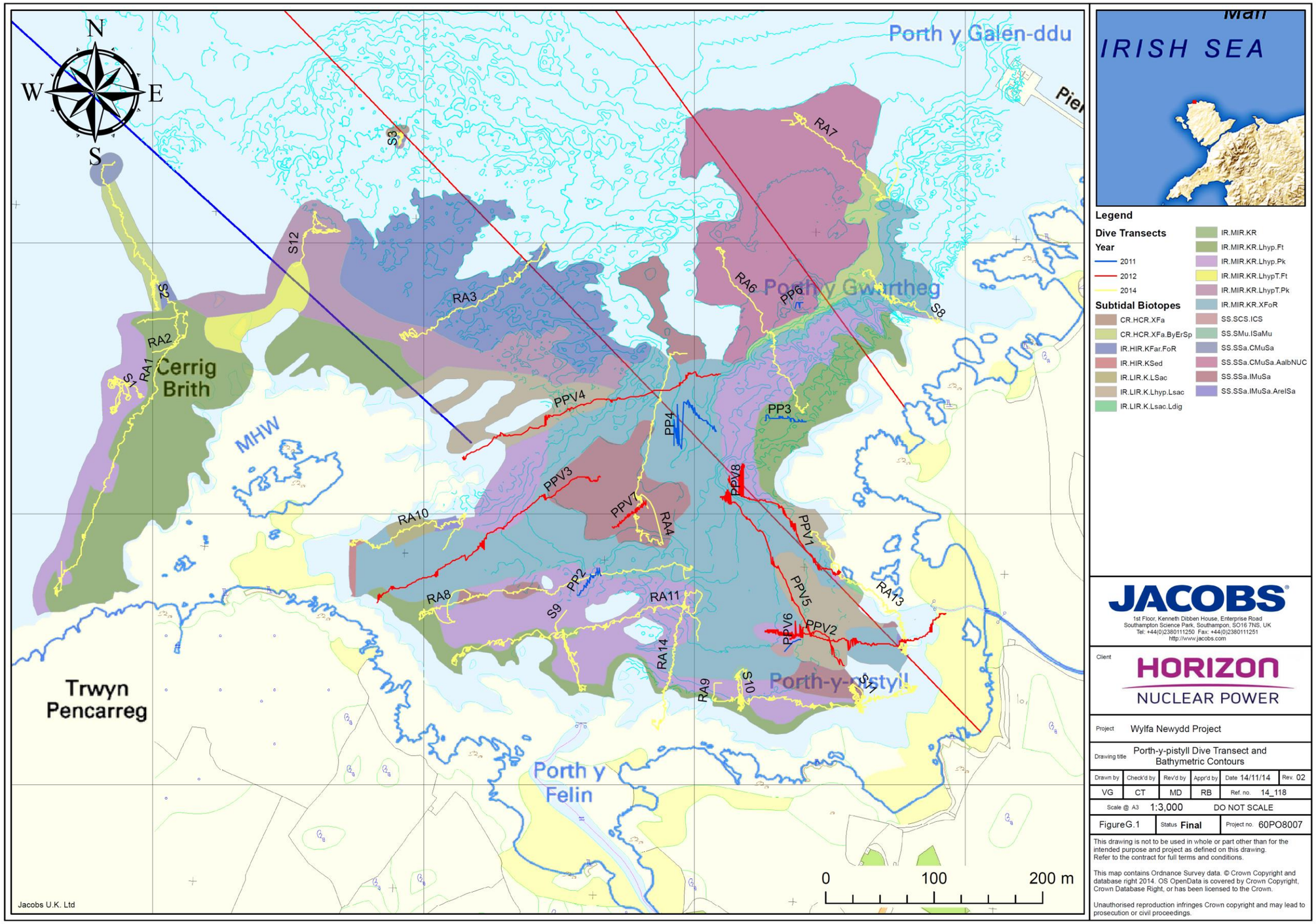
Rhizaria	*Obelia* spp.	Caridea indet.
Foraminifera	*Sertularella polyzonias*	Cirripedia spp.
Forams	*Sertularia argentea*	*Crangon crangon*
Animalia	*Tubularia* spp.	*Homarus gammarus*
Porifera	Anthozoa	*Inachus phalangium*
Axinella dissimilis	*Actinia equina*	*Inachus* spp.
Clathrina coriacea	*Actinothoe sphyrodeta*	*Macropodia rostrata*
Cliona celata	*Adamsia carcinopados*	*Macropodia* spp.
Dercitus bucklandi	*Alcyonium digitatum*	*Maja squinado*
Dysidea fragilis	*Anemonia* indet.	Mysidae spp.
Esperiopsis fucorum	*Anemonia viridis*	*Necora puber*
Grantia compressa	*Aulactinia verrucosa*	*Paguridae* indet.
Guancha lacunosa	*Aurelia aurita*	*Pagurus bernhardus*
Guancha spp.	*Cereus pedunculatus*	*Pagurus prideaux*
Halichondria spp.	*Cerianthus lloydii*	*Pagurus* spp.
Hemimycale columella	*Epizoanthus couchii*	*Palaemon serratus*
Hymeniacidon perleve	*Isozoanthus sulcatus*	*Palaemon* spp.
Iophon spp.	*Metridium senile*	*Philocheras trispinosus*
Leucosolenia complicata	*Sagartia* spp.	*Pisidia* spp.
Mycale spp.	*Urticina felina*	Chelicerata
Pachymatisma johnstonia	*Urticina* spp.	Pycnogonid indet.
Polymastia boletiformis	Platyhelminthes	Mollusca
Polymastia penicillus	*Prostheceraeus vittatus*	*Abra alba*
Porifera indet. (crusts)	Nemertea	*Abra* spp.
Porifera indet.	*Lineus longissimus*	*Aequipecten opercularis*
Raspailia hispida	Annelida	*Anomia* spp.
Raspailia ramosa	*Aphrodita aculeata*	*Aplysia punctata*
Sycon ciliata	*Arenicola marina*	*Archidoris pseudoargus*
Stelligera rigida	*Bispira volutacornis*	*Buccinum undatum*
Stelligera stuposa	*Cirratulidae*	*Cadlina laevis*
Suberites carnosus	*Eulalia* (eggs)	*Calliostoma zizyphinum*
Suberites ficus	*Eulalia viridis*	*Chlamys varia*
Tethya aurantium	*Lanice conchilega*	*Gibbula cineraria*
Tethya citrina	*Polychaeta* indet.	*Gibbula* spp.
Cnidaria	*Polydora* spp.	*Gibbula tumida*
Hydrozoa	*Pomatoceros* spp.	*Goniodoris nodosa*
Abietinaria abietina	*Sabella pavonina*	*Helcion pellucidum*
Aglaophenia pluma	*Sabella* spp.	*Hinia reticulata*
Aglaophenia spp.	*Sabellaria spinulosa*	*Janolus cristatus*
Dynamena spp.	*Sabellidae* indet.	*Limacia clavigera*
Eudendrium spp.	*Spirorbidae* indet.	*Littorina littorea*
Halecium halecium	*Terebellidae* indet.	*Musculus discors*
Hydrallmania falcata	Arthropoda	*Nudibranch* (eggs)
Kirchenpaueria halecioides	Amphipoda indet. (tubes)	Opisthobranchia indet.
Kirchenpaueria pinnata	*Balanus* spp.	*Patella* spp.
Nemertesia antennina	*Cancer pagurus*	*Patella vulgata*
Obelia geniculata	*Carcinus maenas*	*Polycera faeroensis*

Polycera quadrilineata	*Clavelina lepadiformis*	*Corallina officinalis*
Polycera spp.	*Dendrodoa* spp.	Corallinaceae indet. (crusts)
Polyplacophora indet.	*Didemnidae* indet.	*Cryptopleura ramosa*
Rissoidae spp.	*Diplosoma listerianum*	*Cystoclonium purpureum*
Trivia arctica	*Diplosoma spongiforme*	*Delesseria sanguinea*
Phoronida	*Lissoclinum perforatum*	*Dilsea carnosa*
Phoronis hippocrepia	*Molgula* spp.	*Drachiella* spp.
Bryozoa	*Morchellium argus*	*Drachiella heterocarpa*
Alcyonidium diaphanum	*Polycarpa pomaria*	*Dudresnaya verticillata*
Alcyonidium hirsutum	*Polycarpa* spp.	*Erythroglossum laciniatum*
Bryozoa indet. (crusts)	*Pycnoclavella aurilucens*	*Erythroglossum* spp.
Bugula flabellata	*Sidnyum turbinatum*	*Furcellaria lumbricalis*
Bugula plumosa	Actinopterygii	*Gastroclonium ovatum*
Bugula spp.	*Callionymus reticulata*	*Gracilaria gracilis*
Bugula turbinata	*Callionymus* sp.	*Gracilaria* spp.
Cellaria spp.	*Crenilabrus melops*	*Gracilaria verrucosa*
Crisiidae indet.	Gadidae indet.	Gracilariales spp.
Electra pilosa	*Gobius niger*	*Griffithsia corallinoides*
Eucratea loricata	*Gobius paganellus*	*Halarachnion ligulatum*
Flustra foliacea	*Gobiusculus flavescens*	*Halurus equisetifolius*
Membranipora membranacea	*Labrus bergylta*	*Halurus flosculosus*
Scrupocellaria spp.	*Parablennius gattorugine*	*Heterosiphonia japonica*
Vesicularia spinosa	*Pleuronectes platessa*	*Heterosiphonia plumosa*
Echinodermata	Pleuronectidae indet. (juveniles)	*Hypoglossum hypoglossoides*
Amphipholis squamata	*Pomatoschistus minutus*	*Kallymenia reniformis*
Amphiura chiajei/filiformis	*Pomatoschistus pictus*	*Lomentaria articulata*
Antedon bifida	*Pomatoschistus* spp.	*Lomentaria clavellosa*
Asterias rubens	*Scyliorhinus canicula*	*Mastocarpus stellatus*
Asterina phylactica	*Taurulus bubalis*	*Membranoptera alata*
Henricia spp.	*Thorogobius ephippiatus*	*Meredithia microphylla*
Holothurian indet.	Plantae	*Monosporus pedicellatus*
Leptasterias muelleri	Rhodophyta	*Nitophyllum punctatum*
Ophiothrix fragilis	*Acrosorium venulosum*	*Osmundea osmunda*
Ophiura albida	*Anotrichium furcellatum*	*Osmundea pinnatifida*
Ophiura ophiura	*Apoglossum ruscifolium*	*Osmundea* spp.
Ophiuroidae indet.	*Asparagopsis armata*	*Palmaria palmata*
Pawsonia saxicola	*Boergeseniella thuyoides*	*Phycodrys rubens*
Thyone spp.	*Bonnemaisonia asparagoides*	*Phyllophora crispa*
Chordata	*Brongniartella byssoides*	*Phyllophora pseudoceranoides*
Ascidiacea	*Calliblepharis ciliata*	*Phyllophora sicula*
Aplidium punctum	*Calliblepharis jubata*	*Plocamium cartilagineum*
Ascidia conchilega	*Callithamnion*	*Plumaria plumosa*
Ascidia mentula	*Callophyllis laciniata*	*Plumularia setacea*
Ascidiella spp.	*Ceramium* spp.	*Polyides rotundus*
Botrylloides leachi	*Chondrus crispus*	*Polysiphonia devoniensis*
Botryllus schlosseri	*Chylocladia verticillata*	*Polysiphonia elongata*
Ciona intestinalis	*Compsothamnion thuyoides*	*Polysiphonia fucoides*

Polysiphonia nigra
Polysiphonia spp.
Polysiphonia stricta
Pterocladiella spp.
Pterothamnion crispum
Pterothamnion plumula
Ptilota gunneri
Rhodomela confervoides
Rhodophyllis divaricata
Rhodophyta indet. (non calc crusts)
Rhodymenia ardissonei
Rhodymenia divaricata
Rhodymenia holmesii
Rhodymenia pseudopalmata
Schottera nicaeensis
Sphaerococcus coronopifolius
Sphondylothamnion multifidum
Stenogramme interrupta
Ochrophyta
Ascophyllum nodusum
Brown enrusting indet.
Chorda filum
Cladostephus spongiosus
Colpomenia peregrina
Desmarestia aculeata
Desmarestia ligulata
Desmarestia viridis
Dictyota dichotoma
Dictyota spiralis
Ectocarpaceae indet.
Fucus serratus
Fucus spiralis
Halidrys siliquosa
Halopteris filicina
Laminaria digitata
Laminaria hyperborea
Laminaria saccharina
Laminaria spp. (sporlings)
Petalonia fascia
Petalonia spp.
Small brown filamentous
Sphacelaria spp.
Spongonema spp.
Stypocaulon scoparium
Chlorophyta
Bryopsis plumosa
Chaetomorpha spp.
Cladophora spp.
Ulva intestinalis
Ulva lactuca
Ulva spp.

Appendix G Bathymetric map of Porth-y-pistyll

G.1. Map showing bathymetric contours of Porth-y-pistyll (generated by Titan, 2011), subtidal biotopes and dive transects from 2011, 2012 and 2014.



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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Drawing title: Porth-y-pistyll Dive Transect and Bathymetric Contours

Drawn by	Check'd by	Rev'd by	Appr'd by	Date	Rev.
VG	CT	MD	RB	14/11/14	02

Ref. no. 14_118

Scale @ A3 1:3,000 DO NOT SCALE

Figure G.1 Status **Final** Project no. 60PO8007