

Across-Wales intertidal SAC monitoring, Pen Llyn a'r Sarnau SAC August 2014. NRW

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Crynodeb Gweithredol

Mae Cyfarwydddeb Cynefinoedd yn cyfleu y dylai rheolaeth o Ardaloedd Cadwraeth Arbennig (ACA) ceisio cyflawni'r **statws cadwraethol ffafriol** o nodweddion cynefinoedd a rhywogaethau a restrir yn ei Atodiad 1 ac Atodiad 11. Mae'n ofynnol i Cyfoeth Naturiol Cymru (CNC) i gyflwyno gwybodaeth yn rheolaidd am statws cadwraeth ffafriol nodweddion safle ar gyfer pob Ardal Cadwraeth Arbennig yng Nghymru. I wneud hyn, mae CNC wedi datblygu rhaglen o **fonitro cyflwr nodwedd**. Mae CNC wedi pennu cytundeb gyda Aquatic Survey & Monitoring Ltd. (ASML) i ddatblygu a rheoli'r rhaglen ar gyfer nodweddion rhynglanwol yr ACA ar gyfer cyfnod 2007 i 2019, drwy weithio fel tîm gyda staff CNC.

Mae ACA Pen Llyn a'r Sarnau wedi cael ei ddynodi ar gyfer pum cynefin Atodiad 1 a phedwar o rhai is. Prif nodweddion diddordeb rhynglanwol yw *Aberoedd* a'u gwastadeddau llaid, gwastadeddau tywod a riffiau cyfansoddol, Cilfachau eang bas a baeau gyda gwelyau *Zostera*, poblogaethau o *Pectenogammarus* deudroediog sy'n byw yn y graen, pidogau mewn clai a chymunedau o glogfeini is y lan a Riffiau, yn arbennig riffiau biogenig o *Sabellaria alveolata*. Ardaloedd o ddiddordeb penodol ar gyfer yr adroddiad hwn yw gwaddodion rhynglanwol ac ardaloedd creigiog ym Mae Tremadog, a phoblogaethau *Pectenogammarus* ym Mhwllheli. Mae'r adroddiad hwn yn disgrifio'r arolygon a gynhaliwyd yn yr ardaloedd hynny ym mis Awst 2014.

Yn 2014 fe ddarganfuwyd fod yr ardaloedd o lyngyren ddiliau *Sabellaria alveolata* riff yn Llandanwg a Gorllewin Afon Dwyfor wedi gostwng yn aruthrol, ar ôl cael ei effeithio gan stormydd yn ystod gaeaf 2013/2014. Fe effeithiwyd fwyaf ar Orllewin Afon Dwyfor gyda gostyngiad o 67% o'r ardal riff. Roedd y patrwm o fewn y rhywogaethau cysylltiedig ar y riffiau hefyd yn un oedd yn gostwng mewn niferoedd.

Canfuwyd fod yna niferoedd cymharol iach o *Pectenogammarus planicrurus* (berdys deudroediog sy'n byw yn y graen) yn y graen yn Marian-y-De ger Pwllheli o fewn y parth helaeth oedd yn cael ei fonitro ar y lan.

Fe samplwyd aber datblygiad Glaslyn/Dwryd ac fe welwyd fod y cymunedau yn y gwaddodion yn isel mewn amrywiaeth. Fodd bynnag fe welwyd y niferoedd mwyaf o is-ddosbarthiadau ac unigolion yng nghanol aber y Dwryd ac aber yr afon Glaslyn. Nid oedd yn syndod fod y gymuned hon yn frith o gregyn deuglawr, deudroediaid a mwydod gwrychog spionid.

Ym Mhorth Oer, welwyd nifer iach o is-ddosbarthiadau yng nghwadradau monitro lleoliad penodedig yn 2014 fel yn 2013. Cofnodwyd pum deg chwech o is-ddosbarthiadau o gymharu â 51 yn 2013. Roedd sefyllfa llygad maharen ym Mhorth Oer wedi newid ychydig yn 2014, gyda gostyngiad sylweddol yn y dwysedd ar y lan uchaf, nodwedd y gellir ei briodoli o bosibl i ddwyyster stormydd y gaeaf blaenorol. Bu dwysedd glannau isaf a chanolig yn gymharol sefydlog. Fe ostyngwyd maint y boblogaeth o lygad maharen bach yng nghanol y glannau.

Fe welwyd gostyngiad o 15-40% mewn gorchudd y gragen long ar dri uchder o'r glannau, sydd o bosibl yn atgyfnerthu theori effaith stormydd.

Mae monitro cymunedau gwaddod trawsluniau ar aber y Mawddach yn dangos bod mwd a thywod mwdlyd yn tueddu i gael eu rheoli gan fwydod gwrychog gwasgaredig, a chymunedau folysgaid, tra bod y tywod symudol ar orsafoedd y lan isaf yn gymharol ddiffygiol, gan ei fod yn agored i halltedd cyson cyfnewidiol a gwaddodion symudol, oherwydd ffrydiau llanw cryf dyddiol. Ni ymddengys fod unrhyw wahaniaethau sylweddol yn ystadegau'r cymunedau isfilodaidd nodwyd rhwng yr adegau samplu yn 2012 a 2014.

Executive Summary

The Habitats Directive establishes that the management of Special Areas of Conservation (SACs) should aim to achieve the **favourable conservation status** of habitat and species features listed within its Annex I and Annex II. For SACs in Wales, Natural Resources Wales (NRW) is required to report on a regular basis on favourable conservation status of site features. To do this, NRW has developed a programme of **feature condition monitoring**. Aquatic Survey & Monitoring Ltd. (ASML) have been contracted by NRW to develop and manage the monitoring programme for the intertidal features in marine SACs for the period 2007 to 2019; working as a team with NRW staff.

Pen Llyn a'r Sarnau SAC is designated for five Annex 1 habitats and four subsidiary ones. The major features of intertidal interest are *Estuaries* and their constituent mudflats, sandflats and reefs, *Large shallow inlets and bays* with intertidal *Zostera* beds, populations of the shingle-dwelling amphipod *Pectenogammarus*, piddocks in clay and lower shore boulder communities and *Reefs*, particularly biogenic reefs of *Sabellaria alveolata*. Specific areas of interest for this report are the intertidal sediments and rocky areas in Tremadog Bay, and the populations of *Pectenogammarus* at Pwllheli. This report describes surveys carried out in those areas in August 2014.

In 2014 the areas of honeycomb worm *Sabellaria alveolata* reef at both Llandanwg and West of Afon Dwyfor were found to have decreased dramatically, having apparently been affected by the winter storms of 2013/2014. The impact at West Afon Dwyfor was the most marked with a decrease in reef area of 67%. The pattern within the associated species on these reefs was also one of decreasing abundance.

Pectenogammarus planicrurus (a shingle dwelling amphipod shrimp) at Marian-Y-De near Pwllheli were found in relatively healthy numbers in the shingle within the extensive zone monitored on the shore.

The Glaslyn/Dwryrd estuary complex was sampled and the community in the sediment was found to be of low diversity. However the greatest number of taxa and individuals were found in the mid-estuary of the Dwryrd and mouth of the Glaslyn. This community was unsurprisingly dominated by bivalves, amphipods and spionid polychaete worms.

At Porth Oer, a healthy number of taxa were encountered in the fixed location monitoring quadrats in 2014 as in 2013. Fifty six taxa were recorded compared to 51 in 2013. The limpet population at Porth Oer had changed slightly in 2014, with a dramatic decrease in density in the upper shore, a feature possibly attributable to the intensity of the storms of the previous winter. The middle and lower shores' density remained relatively stable. In the middle shore the size classes of small limpets within the population were also reduced.

Barnacle cover at all three shore heights at Porth Oer showed a 15-40% decrease, possibly reinforcing the storm impact theory.

The sediment community monitoring transects on the Mawddach estuary show that the muds and muddy sands tend to be dominated by sparse polychaete, and molluscan communities, whilst the mobile sands of the lower shore stations are relatively depauperate, being exposed to constantly fluctuating salinity and mobile sediments, due to the strong tidal streams on a daily basis. There appear to be no significant differences in the infaunal community statistics noted between the sampling occasions of 2012 and 2014.

1. Introduction

1.1 Background

The Habitats Directive establishes that the management of Special Areas of Conservation (SACs) should aim to achieve the favourable conservation status of habitat and species features. In the case of SACs, the features are the habitats and/or species listed in Annex I and Annex II of the Habitats Directive for which the individual site has been selected.

The Natural Resources Wales (NRW) has a statutory duty to produce advice under Regulation 33 of the Habitats Regulations 1994, which states:

“As soon as possible after a site becomes a European marine site, [NRW / EN] shall advise other relevant authorities as to – the conservation objectives for that site, and any operations which may cause deterioration of natural habitats or ... disturbance of species, for which the site has been designated.”

This Regulation 33 advice package is the foundation for feature condition monitoring, which is required in order for NRW to fulfil its function of reporting on whether features are in favourable conservation status. NRW staff are developing Regulation 33 packages and the associated performance indicators.

NRW developed a programme of intertidal monitoring work across Wales during 2004 and 2005. These surveys were managed and implemented for NRW by the Institute of Estuarine and Coastal Studies (IECS, University of Hull). These projects focused on a wide range of sensitive habitats such as *Zostera*, muddy gravels, caves, rock pools, algal dominated rocky shores, *Sabellaria* reefs, under-boulders, and various rare habitats and species.

Aquatic Survey & Monitoring Ltd. (ASML) have been contracted by NRW to continue development and management of the intertidal monitoring programme for each marine SAC for the period 2006 to 2019, working as a team with NRW HQ and NRW Regional staff.

1.2 Pen Llyn a'r Sarnau SAC

Pen Llyn a'r Sarnau SAC (Figure 1) is designated for five Annex 1 habitats and four subsidiary ones, listed in Table 1. Of these, estuaries and their constituent mudflats, sandflats and reefs, large shallow inlets and bays with intertidal *Zostera* beds, populations of the shingle-dwelling amphipod *Pectenogammarus*, piddocks in clay and lower shore boulder communities and Reefs, particularly biogenic reefs of *Sabellaria alveolata* are the main habitats of interest within the intertidal areas of the SAC. Conservation objectives for these habitats are given in the Regulation 33 advice for the SAC (CCW 2009).

Phase 1 surveys of intertidal habitats in the SAC were carried out between 1999 and 2003 (Brazier *et al.* 2007), providing detailed mapping of the intertidal biotopes with some information on characterising species. Previous data exists on the intertidal habitats and communities present at many sites in the SAC, particularly the Mawddach Estuary where monitoring trials as part of the LIFE programme were carried out in 1999 and 2000 (Mercer 1999; Sanderson *et al.* 2001).

The present report deals with features within Tremadog Bay, on the Llyn peninsula and the continued presence of a gravel-dwelling amphipod (*Pectenogammarus planicrurus*) at Pwllheli.

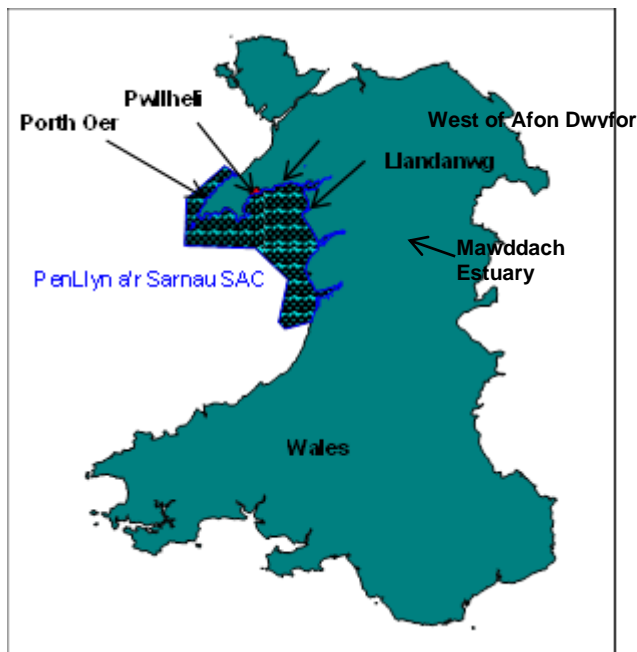


Figure 1 Pen Llyn a'r Sarnau SAC and work area. © Crown Copyright and database right 2016. Ordnance Survey. Licence number 100019741.

Table 1 Annex 1 habitats in Pen Llyn a'r Sarnau SAC

Annex I habitats that are a primary reason for selection of this site	Sandbanks which are slightly covered by sea water all the time
	Coastal lagoons
	Large shallow inlets and bays
	Reefs
	Estuaries
Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site	Mudflats and sandflats not covered by seawater at low tide
	Salicornia and other annuals colonising mud and sand
	Atlantic salt meadows (<i>Glauco-Puccinellietalia maritimae</i>)
	Submerged or partially submerged sea caves

1.3 Estuaries

Pen Llyn a'r Sarnau has representative examples of bar-built estuaries in north-west Wales, and includes the Glaslyn/Dwryd, Mawddach and Dyfi estuaries. There is a continuous gradient between the clean sands near the entrance to the sea and the mud or muddy sands in the sheltered extremes of the estuaries. The intertidal sandflats support communities of burrowing invertebrates, including dense populations of polychaete worms, crustaceans, bivalve molluscs and gastropod molluscs. Saltmarsh fringing the shores of the estuaries, and the saltmarsh creeks and pools, are important habitat features for juvenile fish (JNCC website).

All three estuarine systems in the SAC were visited by CCW staff during September 2006 to evaluate the likely impacts of the opening of the cockle fishery. Major channel changes in the Glaslyn/Dwryd Estuary, apparently due to natural processes, meant that the main cockle bed had gone. The saltmarsh boundaries were broadly similar to those recorded by the 1997 intertidal survey in the area surveyed on the south side of the estuary (Morfa Harlech). NNR photo monitoring points were used to assess this. There was little change noted in the channel positions in the Mawddach and the cockle bed was still evident. There had however been an expansion of the *Salicornia* spp. boundary onto the mudflats by as much as 200m in the area surveyed (pers. comm. G. Wyn, CCW). The coverage of *Spartina* sp. remained similar to the 1997 boundary in the area surveyed. The cockle bed was in poor condition with few large cockles and extensive growths of algae. It was thought that this could be due to the hot summer. The boundaries of the higher saltmarsh in the Dyfi were broadly similar to those in 1997. *Salicornia* spp. encroachment in the area surveyed was up to 500 m in places (Pers comm., G. Wyn, CCW). The cockle bed was in poor condition with banks of cockle shells mixed in with live cockles.

It was concluded that there had been major changes in all three estuaries since the 1997 survey, with major changes in channel morphology in the Glaslyn/Dwryd Estuary and encroachment of pioneer saltmarsh onto the mudflats in the Mawddach and Dyfi Estuaries. The reasons for these changes were not known but in the absence of any other evidence appeared to be due to natural fluctuations in water flow and temperature.

Proposals to construct a surfing reef at Borth, south of the Dyfi Estuary, and to improve the harbour facilities at Aberdyfi, including dredging, have created concerns for the integrity of the estuary.

1.4 Reefs

Intertidal reefs in Pen Llyn a'r Sarnau SAC include areas of bedrock and boulder/cobble habitats and many areas are characterised by biogenic reef formed by the honeycomb reef worm *Sabellaria alveolata*.

Surveys of intertidal habitats in the SAC were carried out in the SAC in 1996 and 2003 (Brazier *et al.* 2007), providing detailed mapping of the intertidal biotopes with some information on the characterising species.

Sabellaria reefs are designated as a Biodiversity Action Plan Habitat (c.f. www.ukbap.org.uk) and Nationally Important Biotopes (JNCC 1996). Surveys of *Sabellaria* reefs in the SAC were carried out for CCW in 2004 and 2005 (Boyes & Allen 2008) and in 2008, 2009, 2010, 2012 and 2013 (Mercer 2010a, b, Mercer 2011, Mercer 2013 and Mercer 2016).

1.5 Presence of *Pectenogammarus* at Pwllheli

Pectenogammarus planicrurus is the only amphipod which is a permanent resident of shingle beaches and it was found on the steep gravel/pebble beach fronting the Promenade at Pwllheli (LGS.Pec biotope) during Phase 1 surveys undertaken by CCW during June 1996. IECS was commissioned in 2004 to identify and map the presence and extent of *P. planicrurus* along the beach, establishing whether the amphipod was restricted to a localised habitat or was present along the entire length of Pwllheli beach. In addition, they estimated its abundance and took core samples for Particle Size Analysis (PSA) across the full extent of the biotope (Hemingway *et*

al. 2004). 61 stations were sampled and the amphipods were found to be present at 53 of these and abundant at 21 stations, using a SACFOR scale. The animals can be observed in the shingle in the lower half of the beach in the vicinity of the surf zone, when a small scrape reveals standing water. Further monitoring of the amphipod has been undertaken by ASML since 2007 (Howson *et al.* 2009; Mercer 2010a, b; Mercer 2011, Mercer 2013 and Mercer 2016).

1.6 Survey objectives

Table 2 Tasks selected by NRW for study by ASML in the SAC in 2014

Feature / attribute	Site(s)	Task
<i>Pectenogammarus</i> populations (LGS.Pec) - presence	Marian-y-de at Pwllheli	To monitor the population of this scarce 'shingle beach specific' amphipod species.
Intertidal Reef – quality	Porth Oer rocky shore	To re-survey the fixed monitoring quadrats in the upper, mid and lower shore stations at Porth Oer.
<i>Sabellaria alveolata</i> - distribution, quality and associated species	Llandanwg and West of Afon Dwyfor rocky shores.	To re-map the boundary of the <i>Sabellaria</i> reefs and to re-survey, with quadrats, the transects established and surveyed in 2009 - 2013.
Estuaries	Mawddach & Glaslyn/Dwryrd estuaries	To re-survey the sediment shore <i>in situ</i> and coring sites established in 1999 & 2008 respectively
Open coast	East Criccieth, Black Rock sands, Morfa Harlech and Morfa Dyffryn	To quantitatively sample the infauna of the middle and lower shore sediment biotopes

The survey of the *Pectenogammarus* populations (LGS.Pec) was intended primarily to confirm the continued presence of the species at Pwllheli whilst repeating work carried out by IECS in 2004 (Hemingway *et al.* 2004) and ASML in 2007 (Howson *et al.* 2009), 2008 (Mercer 2010a) and 2009 (Mercer 2010b). The *Sabellaria alveolata* work planned was to repeat the 2009, 2010, 2011, 2012 and 2013 quadrat work carried out by CCW/NRW and ASML at the two main sites in the SAC (Llandanwg and West of Afon Dwyfor). The intertidal reef work at Porth Oer aimed to re-survey the fixed quadrats on this rocky shore on the Llyn Peninsula, utilising the methods developed for the existing monitoring sites in the Pembrokeshire Coast SAC and Skomer Island Marine Protected Area. The Mawddach quantitative sediment sampling sites were established in 1999 and the work in 2014 repeated the coring exercise. Whilst the *in situ* grid sampling sediment work helped to re-map the channel positions on the Glaslyn / Dwryrd and the location of the littoral sediment biotopes within the sediments of the estuaries.

2 Methods

2.1 Survey planning, logistics and risk assessment

Development of a survey strategy and methodology for the 2014 tasks was carried out by ASML and NRW. Logistical planning for the 2014 survey was carried out by ASML and a draft Survey Plan and Risk Assessment was prepared and distributed to all the surveyors in advance of the survey. This plan once finalised included information on the survey location, personnel, work scope and plan, logistics, tide tables, potential hazards, assessment of risk from those hazards, actions/measures to minimise risk, contact details for emergency services, personnel and next of kin. The team was based at a house in Prenteg (Ty Glaslyn) near to Porthmadog. This house is located in an ideal location for work all over the PLAS SAC, the WiFi, off-road parking and spacious inside and outside accommodation proved again to be beneficial to the survey.

Field survey equipment was provided by both ASML and NRW; this included handheld GPS receivers (various makes and models, all set to British National Grid and OSGB36 datum), digital cameras (various makes and models, all set to high resolution and local time), gridded quadrats (various sizes), tape measures, first aid kits. Microscopes, identification guides, laptop computers, laser printer and other field laboratory equipment were also provided by both ASML and NRW. GIS mapping software (MapInfo), Microsoft Office software and various other utilities were used for daily survey planning, data entry, downloading GPS data and digital photographs and cataloguing files.

Field work was carried out during five days of spring tides, 10th to 14th August 2014, by a team of up to seven marine biological surveyors (see field log, Appendix 1). Weather conditions were fair for the week's survey work.

2.2 *Sabellaria* reef surveys

The modified Boyes & Allen (2008) methodology for *Sabellaria* monitoring was again used for the 2014 Pen Llyn a'r Sarnau SAC survey. A rationale for the modified methodology is given below. The proforma recording form used in the field is presented in Appendix 2.

2.2.1 Rationale

Extent and distribution of *Sabellaria* reef in Wales has clearly been increasing in recent years and this may be related to climate change. Monitoring both extent and overall condition at selected sites is therefore very relevant to SAC condition. The quadrat survey methodology developed for Pen Llyn a'r Sarnau SAC (Boyes & Allen 2008) and adapted by ASML in 2007, 2008 and 2009 provides good quality, repeatable data in a relatively short timescale. Hence these methods were considered appropriate in 2014.

Good condition of *Sabellaria* reef is listed as a Conservation Objective of the Pen Llyn a'r Sarnau SAC. The Performance Indicators recommended below are focussed on the value that the *Sabellaria* reef provides to the biological condition of the communities of fauna and flora. Mature *Sabellaria* reef tends to increase sub-habitat diversity (including abundance of overhangs, crevices, pools etc.) and consequently increases species diversity on the shore. However there is no simple correlation with age and condition of the reef. Measures of sub-habitat diversity

and/or species diversity may therefore provide information on the biological condition, but measures of the condition of the reef itself may provide information on its viability.

Many of the measures described in Boyes & Allen (2008) to record attributes in a 4 m² quadrat are very subjective and difficult to estimate with any accuracy or repeatability. Photographs are likely to provide better comparative information. Measures of species diversity were well defined, but protocols were adapted for the *Sabellaria* reef habitat. Quadrats provide the simplest repeatable recording unit, but fixed quadrats were not thought to be feasible, especially as much of the underlying boulder substratum is potentially mobile during rough weather. The best quadrat size for rapid deployment and recording, limiting the effects of small scale heterogeneity (in the typical large boulder/cobble habitats present) and for practical use in the field is considered to be 0.25 m² (0.5 m x 0.5 m). A larger size quadrat would be cumbersome in the large boulder habitat and larger quadrats are also known to be inefficiently searched. Due to the fragile nature of the habitat/biotope it is vitally important that the condition of the *Sabellaria alveolata* reefs are not being degraded by the act of monitoring itself, an issue that can occur in similar fragile biotopes.

2.2.2 Site and transect locations

The Llandanwg and West Afon Dwyfor *Sabellaria* reef transects were re-surveyed in 2014, having been surveyed by ASML in 2009, 2010, 2012 and 2013.

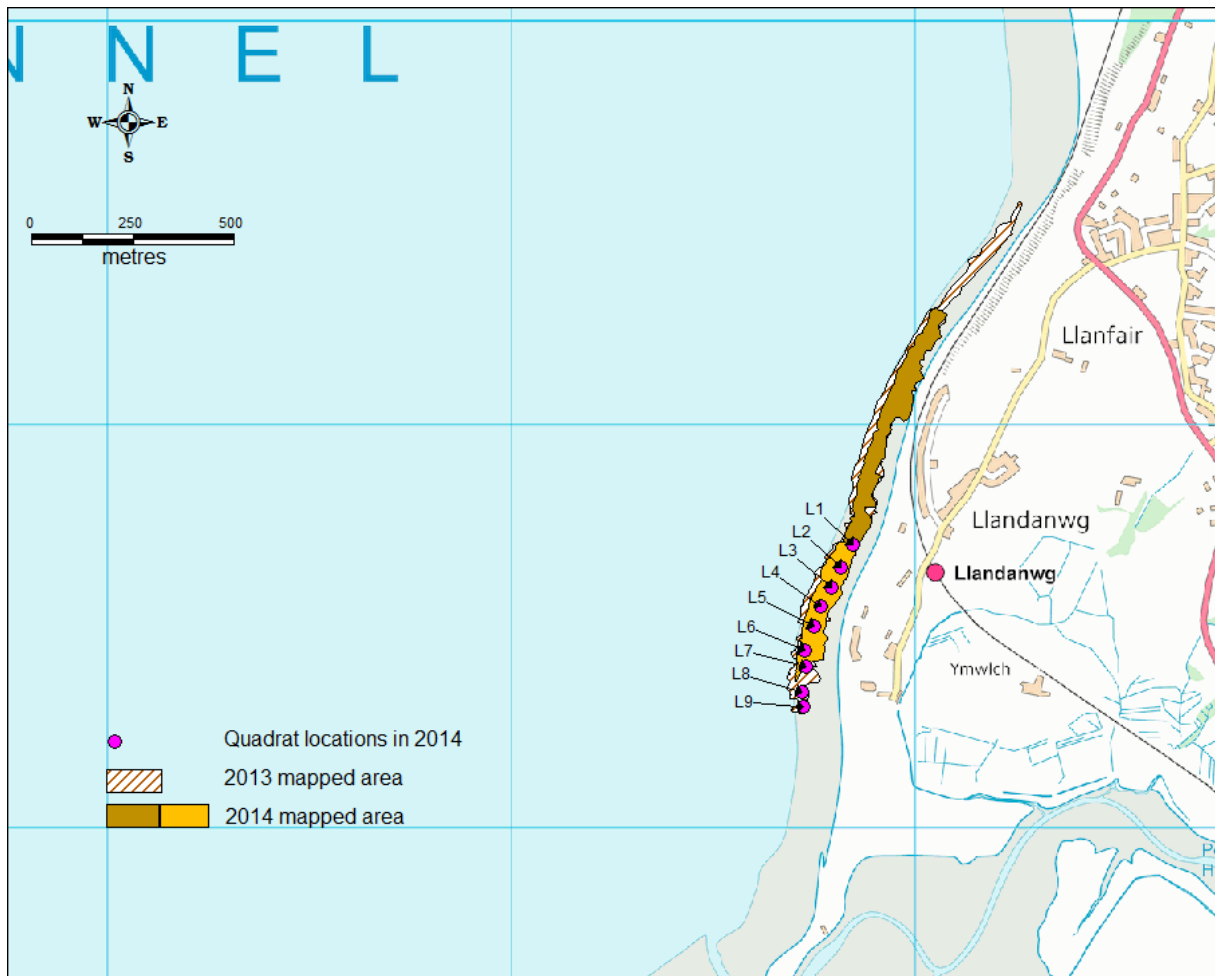


Figure 2 Location of the *Sabellaria alveolata* reef quadrat sites at Llandanwg. © Crown Copyright and database right 2016. Ordnance Survey. Licence number 100019741.

Existing 2013 maps of *Sabellaria* reef in these areas (originally using GIS data from CCW Phase 1 survey and IECS survey) were used to orientate the work area in 2014. At both Llandanwg and West Afon Dwyfor the survey task was to re-survey the areas surveyed by quadrat in 2009, 2010, 2012 and 2013. The *Sabellaria* reef in the vicinity of the quadrat sites was also mapped from the upper limit of *Sabellaria* on the shore, to the lower limit of access on the shore, as dictated by the height of the low tide. These mapped areas can be seen to be very similar to the 2013 areas, as can be seen in Figure 1 Figure 2 and Figure 3. On the shore, the GPS receivers were used by the survey teams to navigate to the correct, central position for each survey area within the 'quadrat zone' described in 2009, within the *Sabellaria* reef.

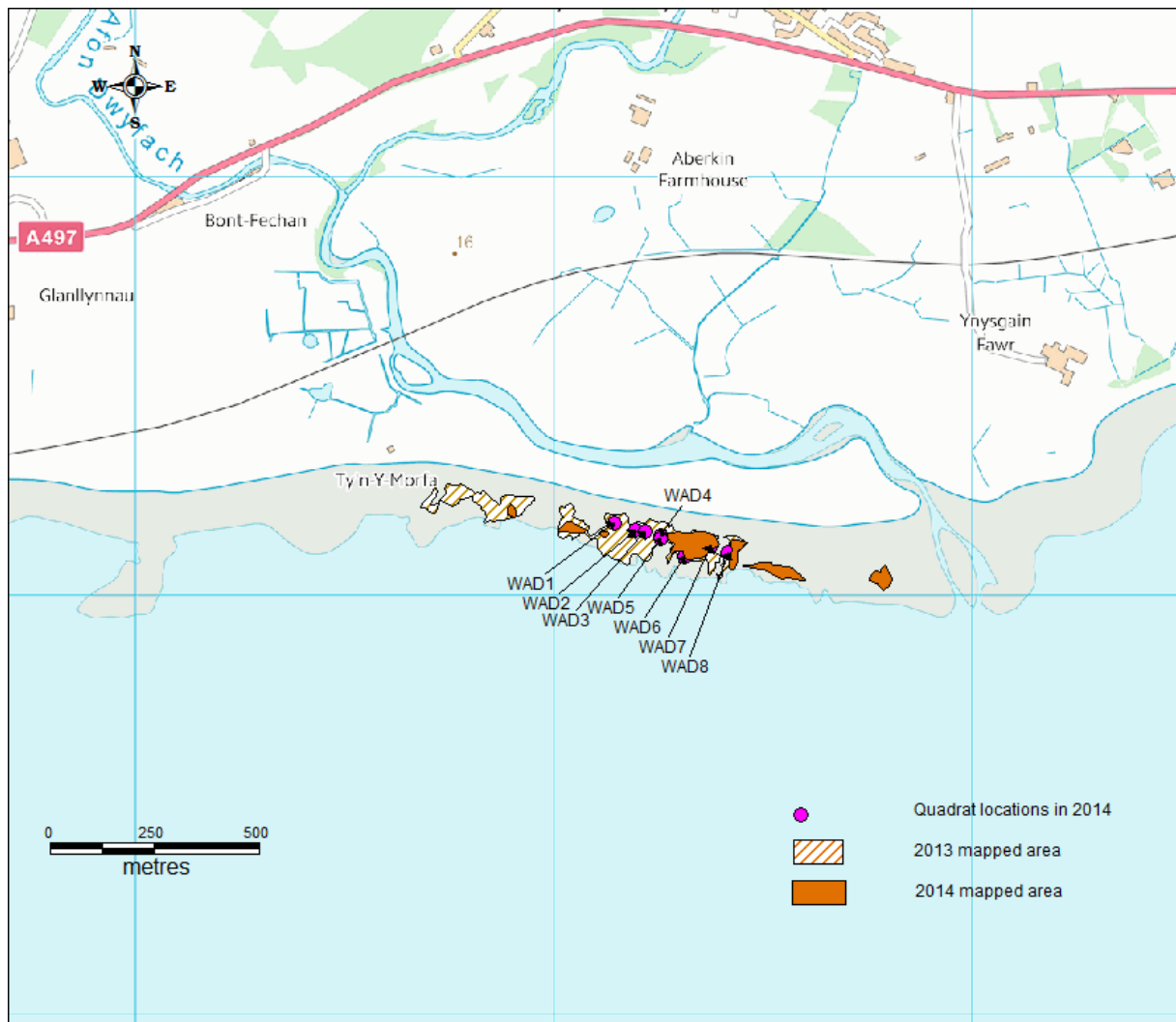


Figure 3 Location of the *Sabellaria alveolata* reef quadrat sites at West of Afon Dwyfor. © Crown Copyright and database right 2016. Ordnance Survey. Licence number 100019741.

2.2.3 Quadrat survey methods

At each quadrat station, surveyors established an origin at the centre of an imaginary 20 m x 20 m grid i.e. at co-ordinate location (10 m,10 m) (x,y) and then the surveyors proceeded to survey 15 random quadrats. 5 of these quadrats were surveyed in detail, recording some biotope properties and all species present. In the other 10 quadrats just the abundance of total *Sabellaria* reef and live *Sabellaria* reef were recorded. To minimise trampling, these 15 random positions were generated by

assigning a random x-value and random y-value using Microsoft Excel random number generator and these were converted into coordinates on a waterproof map of the grid. The co-ordinates were then surveyed on the 20 m x 20 m field grid travelling from one to the other by following the 'map' and not returning to the origin each time. Estimates were made of the percentage cover of standing water, total *Sabellaria*, live *Sabellaria* and a small selection of key species/taxa in each quadrat. Other typical fauna and flora (listed on the proforma) were then searched for and recorded. No estimation of abundance was required for these species (to speed up the recording), but rapid estimates of algal cover and some other major cover organisms such as *Mytilus edulis* were made. The presence of any other species that were seen and could be reliably identified *in situ* was then recorded in the blank rows available on the proforma (Appendix 2). Specimens of notable species that could not be reliably identified *in situ* were taken for laboratory identification (a field laboratory was set up in the accommodation). At each quadrat position, a gridded 0.25 m² quadrat (0.5 m x 0.5 m) was placed on the point of the surveyor's toe without them looking at the substratum. Digital photographs were taken of each detailed quadrat to illustrate habitat and condition of *Sabellaria* reef. The photographs were taken in plan-view, so that the quadrat filled the frame and the photograph number was recorded against quadrat number. The mapped *Sabellaria* reefs and quadrat stations at Llandanwg and West of Afon Dwyfor are shown in Figures 2 and 3.

2.2.4 Station locations

The surveyors used GPS receivers to navigate to the origin of each quadrat station on each transect. Field rucksacks were placed at this central position for easy orientation. Quadrat station positions for the 2014 *Sabellaria* reef surveys are presented in Table 3 below and the original transect locations (from 2009) are presented in Table 4 for continual reference only.

Table 3 Quadrat stations on the transects at Llandanwg and West of Afon Dwyfor, 10th and 11th August 2014

Site	Station Code	Transect	Zone	Surveyors	Easting	Northing	Main Quadrats	Extra Quadrats
Llandanwg	L1	L1	B	TM	256845	328703	5	10
Llandanwg	L2	L2	B	CH/AB	256813	328644	5	10
Llandanwg	L3	L3	B	TM	256791	328597	5	10
Llandanwg	L4	L4	B	CH/AB	256763	328548	6	10
Llandanwg	L5	L5	C	TM	256748	328501	5	10
Llandanwg	L6	L6	B	TM	256725	328441	5	10
Llandanwg	L7	L7	B	CH/AB	256726	328400	5	10
Llandanwg	L8	L8	B	CH/AB	256718	328338	5	10
W Afon Dwyfor	WAD1	C3	B	BW/RS	247143	337174	5	10
W Afon Dwyfor	WAD2	C4	A	LK	247191	337155	5	10
W Afon Dwyfor	WAD3	C5	B	BW/RS	247217	337153	5	10
W Afon Dwyfor	WAD5	C6B	A	LK/MD	247252	337134	5	10
W Afon Dwyfor	WAD6	C7	D	LK/BW/MD	247312	337093	5	10
W Afon Dwyfor	WAD7	C8	A	LK/BW	247376	337120	5	10
W Afon Dwyfor	WAD8	C9	B	LK/BW	247414	337103	5	10

Sabellaria alveolata reef extent

The extent of the *Sabellaria* reef at Llandanwg and West of Afon Dwyfor were mapped in 2014 using the track function of handheld GPS units. In 2014 a large area

of the bed beyond the survey area at Llandanwg was mapped, as was the bed to the east of the quadrats at West of Afon Dwyfor because time allowed. In each case the methodology was standardised as described below.

The surveyor walked along the edge of the area with the GPS automatically recording a track fix every few seconds (typically 5 seconds). A '5 m rule' was applied – i.e. if a loop in the margin of the reef was more than 5 m across, it was walked around; but if it was less than 5 m it was ignored. It was also sometimes necessary to cross small gaps in the reef in order to include notable outlying patches. In places, quite large gaps were crossed, but the surveyor would then return to the main reef via the same access route and make a note with a waypoint to this effect.

Table 4 Full transect locations at Llandanwg and West of Afon Dwyfor for the transects surveyed in 2009 - presented for reference only

Site	Transect (new code)	Transect (old code)	Zones	Top Easting	Top Northing	Bottom Easting	Bottom Northing
Llandanwg	LT01	L1	3	256860	328696	256823	328705
Llandanwg	LT03	L3	2	256816	328597	256780	328605
Llandanwg	LT04	L4	2	256791	328543	256748	328548
Llandanwg	LT05	L5	4	256772	328499	256739	328501
Llandanwg	LT06	L6	2	256766	328440	256715	328445
Llandanwg	LT07	L7	2	256742	328401	256716	328397
Llandanwg	LT08	L8	2	256735	328345	256705	328331
Llandanwg	LT09	L9	2	256729	328302	256712	328301
W Afon Dwyfor	WADT01	C3	5	247139	337205	247115	337122
W Afon Dwyfor	WADT02	C4	1	247184	337194	247192	337112
W Afon Dwyfor	WADT05	C6	3	247226	337208	247211	337085
W Afon Dwyfor	WADT06	C7	5	247334	337157	247304	337049
W Afon Dwyfor	WADT07	C8	1	247377	337148	247361	337076
W Afon Dwyfor	WADT08	C9	3	247425	337145	247393	337054

Full results of the *Sabellaria alveolata* surveys are presented in Appendix 3 (Llandanwg) and Appendix 4 (W of Afon Dwyfor).

2.3 *Pectenogammarus* surveys

Populations of the amphipod *Pectenogammarus planicrurus* are known to be present in intertidal shingle at Marian-y-de at Pwllheli. Visits were made to the site at 13:00hrs and 14.00hrs (2 hours before low water respectively) on 10th and 11th August 2014, to determine if populations of the amphipod were still thriving. The amphipods are found by locating the appropriate habitat (shingle) on the shore below mid tide level, making a small scrape in the shingle just above the surf zone, as the tide is falling and then looking for the amphipods swimming in the small pool of water created. This was repeated three times at each of the same two sites (P10 and P23) surveyed in 2007, 2008 and 2009, 2010, 2012 and 2013. In 2014 these sites we both re-surveyed along with a suite of further survey sites to the east and west. All sites surveyed in 2014 are shown in Figure 4 and the results are presented in section 3.2.

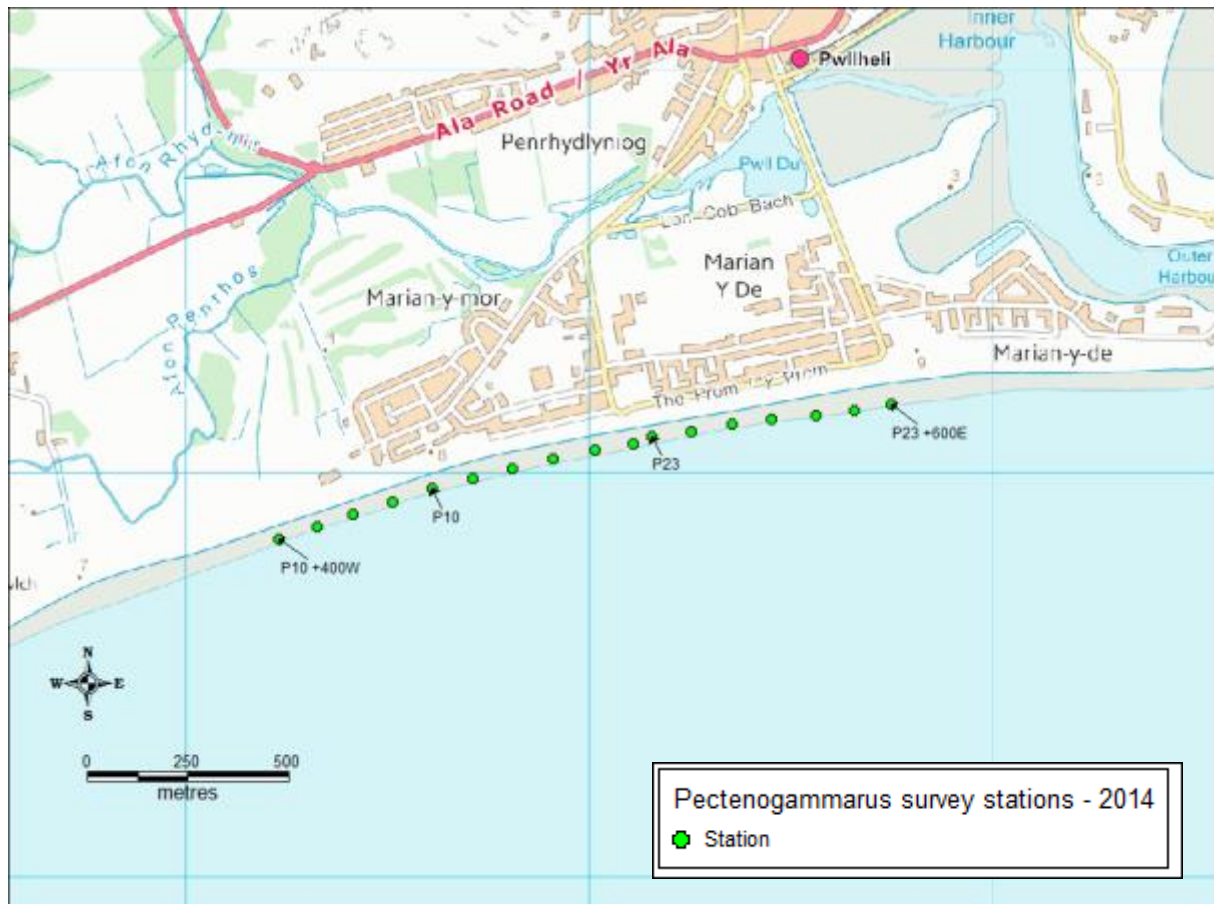


Figure 4 *Pectenogammarus planicrurus* sampling locations in 2014. © Crown Copyright and database right 2016. Ordnance Survey. Licence number 100019741.

2.4 Quantitative and semi-quantitative sampling of the Glaslyn/Dwryrd sediments

Existing maps of the Glaslyn/Dwryrd sediment flats (GIS data from CCW Phase 1 survey) were used to re-visit 9 quantitative intertidal, infaunal core sites and 25 *in situ* sediment monitoring grid sites. All 34 sites were first selected in 2008 when a set of 90+ in-situ grid stations were created in a GIS project. The 34 sediment monitoring sites sampled on Wednesday 13th August 2014 are shown on Figure 5.

Three infaunal core samples were taken from each of the 9 quantitative sites using a 0.01 m² intertidal corer. At each site the cores were all taken within a radius of approximately 5 m from the central grid point mark; and randomly placed without reference to the surface features (with eyes closed). Each core was then sieved *in situ* over a 0.5 mm mesh and the sieve contents were transferred to a suitably labelled pot or plastic bag. These samples were later taken back to the survey base and preserved in 10% formalin.

A sample of the sediment was also taken from each of these stations for granulometric analysis. The sample was usually taken from the side of one of the corer holes, to a depth of at least 5 cm, labelled and double bagged.

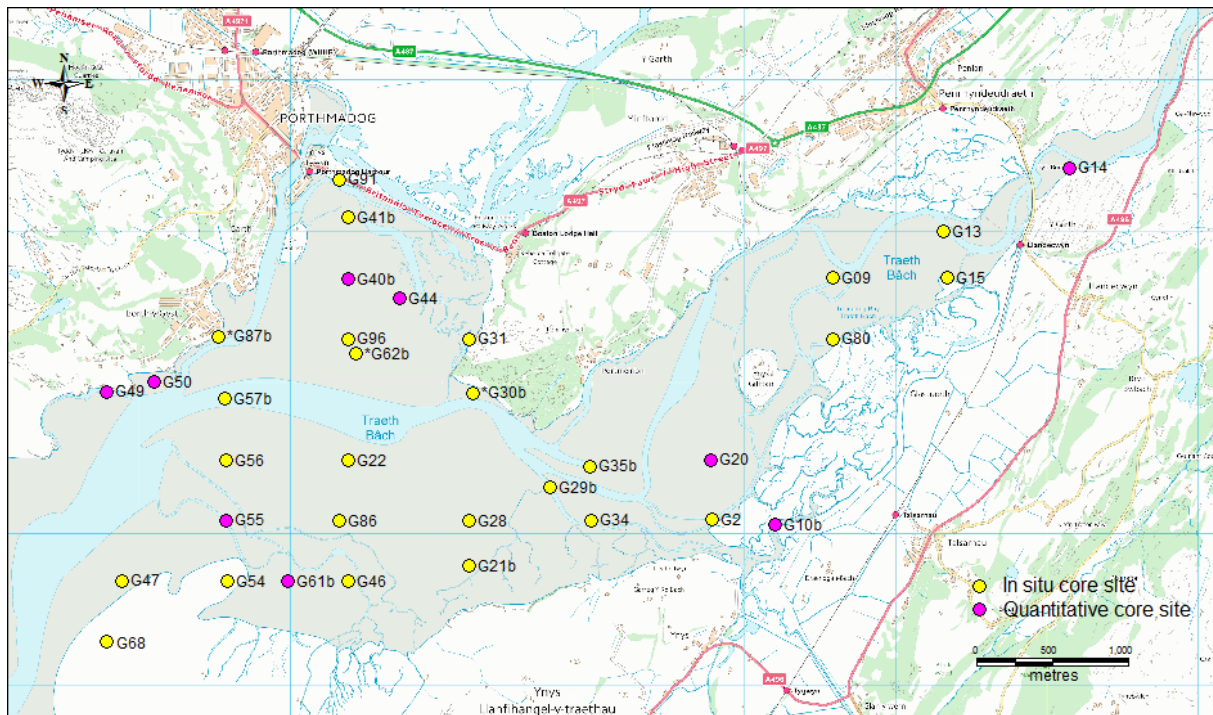


Figure 5 Quantitative coring stations on the Glaslyn /Dwyrdd in 2014. Yellow – *in situ* recording, purple – repeat replicate, full infaunal analysis. © Crown Copyright and database right 2016. Ordnance Survey. Licence number 100019741.

The samples for macrofauna and granulometry analyses were later taken to the NRW offices at the end of the survey for later transfer to a macrobenthic analytical laboratory to be processed under a separate framework contract.

The reduced tranche of 23 grid sites were uploaded into Garmin GPS units, which were then used in conjunction with coloured, waterproof aerial photographs of the estuary, in order to locate each of the stations.

On site, three survey teams each navigated to a selection of stations and carried out an *in situ* assessment of the sediment biotope.

Records of conspicuous species and surface sediment features were made from each station within a circle of 1m radius around the central core sample position.

Key features to record were:

- Sediment description, with the aid of a grain size comparator and magnifying glass (e.g. well sorted Medium Sand, muddy very fine Sand, gravelly medium Sand, fine Sand / very fine Sand).
- Sediment softness - on a scale of 1 to 5 (1 = very hard / rock, 5 = ankle depth or more).
- Depth (cm) of black layer (redox potential discontinuity layer)
- Abundance of common epifaunal and floral taxa e.g. *Arenicola* casts and Green algae.
- Abundance of common infaunal taxa e.g. cockles, ragworm and amphipod shrimps.

These assessments were made in part from the single 0.01 m² core sample that was taken at each survey station unless the station happened to lie on a rocky outcrop, in a drainage channel or in a pool greater than ~5 cm deep.

The core sample was sieved through a 0.5 mm mesh sieve in a nearby pool and the sieve contents were inspected closely with the aid of a magnifying glass. As far as possible all visible animals were identified and counted by the surveyor with the most infaunal taxonomic experience in the pair. A simple photographic guide to the most common species/taxa present was carried by each pair of surveyors as an aide memoire. Specimens of animals that a surveyor could not recognise, but which were frequent and were distinctly marked or shaped, were collected for later inspection under microscopes at the survey base. The names and counts of all conspicuous species/taxa were recorded on a waterproof paper recording form. A copy of this form is presented in Appendix 2, whilst the full quantitative core site's results are also presented in Appendix 5.

The quality and thoroughness of the species records and counts appeared generally high, but it was unavoidably reduced when large amounts of coarse sediment, such as bivalve shell material, or allochthonous organic material was present within the sediment.

Any other conspicuous species seen were recorded, usually with estimates of their abundance. A suite of other notable physical features were also recorded and photographs were taken to illustrate the substrata and habitat features.

2.5 Porth Oer rocky shore quadrat surveys

During low tide on 10th and 12th of August 2014, the Porth Oer shore was visited by the field team and the 12 permanent quadrats were relocated, photographed and surveyed. Each quadrat's locating screws were found using the 'relocation photographs' within each shore zone (see Mercer (2013) for relocation details). The quadrats were originally sited in homogeneous areas of inclined rock, avoiding rock pools and large fissures where possible. The data were recorded on a form modified from Boyes *et al.* (2008). This form and its instructions are presented in Appendix 2, whilst the full quadrat results are presented in Appendix 8.

2.5.1 Permanent Quadrat Recording (cell counts)

Within each 1 m² quadrat presence/absence data were recorded for all conspicuous species using a 25 cell grid (i.e. 20 cm x 20 cm cells). This gave a frequency score of between 0 and 25 for each species. Organisms were identified to species level where possible with specimens, collected from outside the quadrat, being returned to the laboratory for verification where necessary. Species within the following taxa were aggregated for cell counts: barnacles, limpets, flat winkles, rough winkles, amphipods, *Verrucaria* spp (except *Verrucaria mucosa*).

Only algae whose stipes were within the quadrat were counted. This requires algae growing outside the quadrat to be separated to facilitate an accurate measure of abundance. Epiphytes on macroalgae were recorded from the cell in which the macro-alga was attached. Care was taken to minimize disturbance of mobile invertebrates when macro-algal species were moved.

2.5.2 Limpet Counts

Limpet abundance (all species aggregated) was recorded from 5 random 20 cm x 20 cm cells within each quadrat to allow the estimation of mean limpet abundance for all three zones at the survey site.

2.5.3 Limpet Monitoring

Up to 200 limpets (minimum 100) were systematically selected within the middle shore zone. All limpets encountered were measured to ensure a representative population sample was collected without bias. The longest basal shell length was measured in mm using vernier callipers. These data are used to construct a population profile for the site in Section 3.5.3.

2.5.4 Barnacle Abundance

Percentage cover of barnacles (all species aggregated) was recorded from 5 random 20 cm x 20 cm cells within each quadrat to allow the estimation of mean barnacle abundance for all three zones at the survey site.

2.6 Mawddach estuary sediment sampling

Existing maps of the Mawddach estuary sediment flats and GIS data from NRW were used to relocate three, permanent, sediment, infaunal monitoring transects on Tuesday 12th August 2014.

Four infaunal community sampling transects were set up in 1999 that run out from the high water mark towards low water in the middle of the Mawddach estuary. These transects run across the sediment flats. There are two originating from the south shore and two from the north shore and originally the sediment beyond the lower saltmarsh was sampled at 25 m intervals, to the lower water mark. The locations, bearings and transits of the transects are shown in table 5 below. Only Transects 1-3 were sampled in 2014 and these only selectively, sampling in mud, muddy-sand and sand if these facies were present. Three stations were sampled on transects 1 and 2 and four stations were sampled on transect 3, as shown in Figure 6.

Table 5 Mawddach sediments - infaunal monitoring transects

Transect number and relative location	Bearing	Stake origin. (OSGB)	End point (OSGB)	Transit description from the origin stake.	Additional marks
1 (South western)	308°	265333 (E) 316404 (N)	264958 (E) 316540 (N)	White house on the Barmouth road with the central chimney.	White paint on rock
2 (South eastern)	274°	265632 (E) 316767 (N)	264897 (E) 316882 (N)	White house on the Barmouth road with the central chimney.	White paint on rock
3 (North western)	145°	264120 (E) 317202 (N)	264729 (E) 316620 (N)	The 4 windowed, gable ended house at Garth Isaf.	White paint on rock
4 (North eastern)	140°	264276 (E) 317242 (N)	264691 (E) 316936 (N)	Outcrop of rock forming the origin of Transect 1 (east of Garth Isaf).	White paint on the stone embankment

The transects were located using GPS receivers and a reduced set of stations were sampled by coring. Descriptions of the transects and summary results are presented in section 3.

At each station, the sediments were described and photographed and a batch of 3 x 0.01 m² core samples and a granulometry sample were collected from each station. All cores were taken from within a circle of radius 5 m. These cores were sieved in the field over a 0.5 mm mesh and later, back at the survey base, the residues were fixed with 10% formaldehyde solution. The nature of the infaunal community found in these sediment cores was deduced through laboratory analysis by Hebog Environmental Ltd. following the conclusion of the field survey. Results of the laboratory analyses and the field description survey are described in Section 3.6, discussed in section 4 and presented in their raw form in Appendix 6.

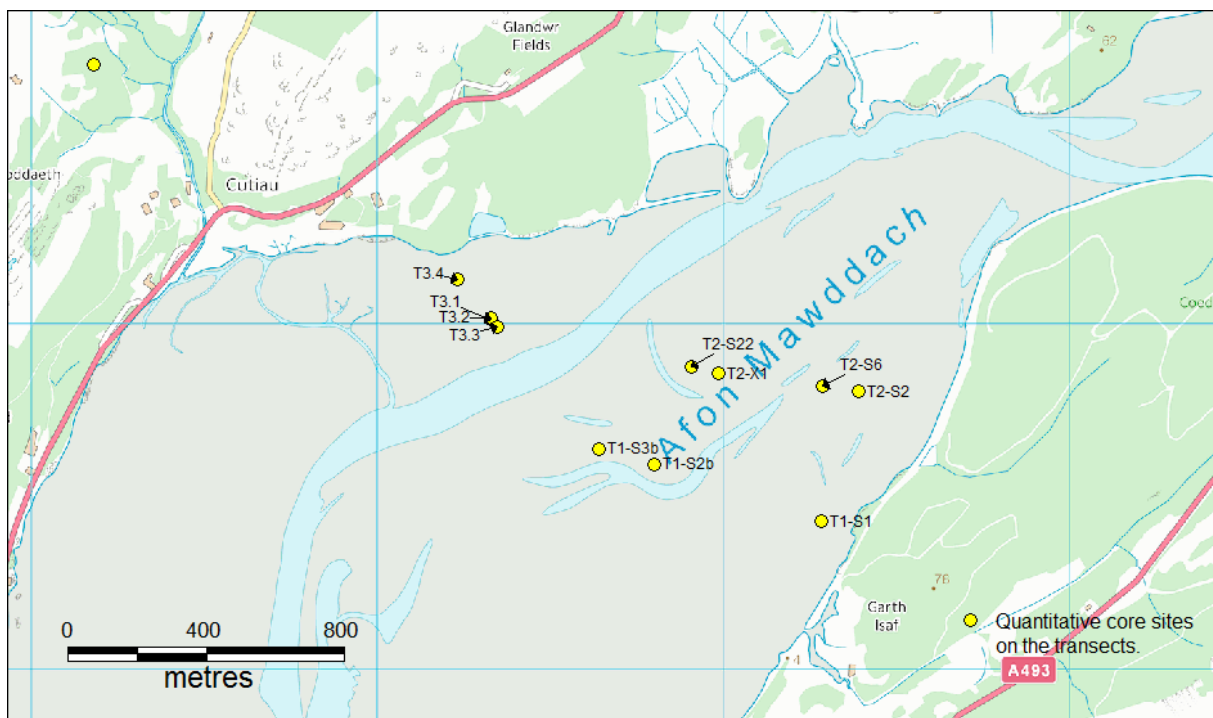


Figure 6 Mawddach Estuary sediment sampling sites in 2014. © Crown Copyright and database right 2016. Ordnance Survey. Licence number 100019741.

2.7 Open coast sampling

In addition to the estuary surveys, core samples were taken from 4 selected open coast beach sites for both standard laboratory analysis of the macrobenthic infaunal biotope and for the sediment granulometry. The four locations were on beaches previously sampled in Tremadog Bay in 2009. They were selected by NRW in order to provide a geographical spread to the sampling. The surveyors navigated to the stations at low water on the early morning low tide of 14th August, using the handheld GPS units from the relevant car parks. Table 6 presents the locations of the open coast infaunal core sampling. At each site, the sediment was described and photographed, a sediment particle size distribution sample was taken and then 5 x 0.01 m² infaunal cores (depth 150 mm) were collected and sieved over a 0.5 mm mesh. Samples were then returned to base where they were catalogued, fixed and labelled.

Table 6 Open coast sampling locations in Tremadog Bay, 14/08/2014.

Site	Surveyor	Description	Long	Lat	East	North
Harlech	AB/TD	Upper shore No cores taken	-4.13485	52.8701	256405	332429
Harlech	AB/TD	Mid shore 5 x 0.01 m ² cores	-4.13647	52.8699	256295	332404
Harlech	AB/TD	Lower shore 5 x 0.01 m ² cores	-4.13786	52.8693	256199	332346
Morfa Dyffryn	AB/TD	Lower shore 5 x 0.01 m ² cores	-4.12519	52.7827	256768	322688
Morfa Dyffryn	AB/TD	Mid shore 5 x 0.01 m ² cores	-4.12461	52.783	256808	322725
Morfa Dyffryn	AB/TD	Upper shore 5 x 0.01 m ² cores	-4.12366	52.7835	256874	322770
East Criccieth	TM/CH	Mid shore 5 x 0.01 m ² cores	-4.20826	52.9154	251660	337670
East Criccieth	TM/CH	Lower shore 5 x 0.01 m ² cores	-4.20826	52.9154	251620	337618
Black Rock Sands	TM/CH	Lower shore 5 x 0.01 m ² cores	-4.18392	52.9071	253228	336642
Black Rock Sands	TM/CH	Mid shore 5 x 0.01 m ² cores	-4.18311	52.9077	253285	336710

Results of the macrobenthic infaunal analysis performed by Hebog Environmental are presented in Appendix 7.

2.8 Photography

Photographs were taken with the following cameras:

Panasonic Lumix digital camera. These jpg files have the prefix 'TM'.

Canon Eos. These jpg files have the prefix 'CMH'

Fujifilm XP. These jpg files have the prefix 'LK'

Cannon D10 digital camera. These jpg files have the prefix 'BW', 'MD' and 'LK'.

All the .jpg photograph files were renamed according to the following convention:

Date (year month day) underscore, Photographers Initials (up to 5 letters) underscore Site / Station underscore and photograph number underscore 'Any-other-useful-info'.

e.g. 20140811_TSM_Llandanwg_L2_0013.JPG

The photographs are catalogued in the relevant spreadsheet data files, including a hyperlink that allows the photographs to be opened directly from the Excel file (when stored in the appropriate sub-directory). The photograph catalogue is included as Appendix 4.

2.9 Data collation, analysis and mapping

All data were entered into Microsoft Excel spreadsheet files during the course of the survey, usually by the individual surveyors who had collected it. Species names are according to Howson and Picton (1997), except for the lichens which are according to Dobson and Dalby (1997). A series of checks were then made to ensure that all the data were in appropriate formats with no errors.

Raw data were stored in the following files:

PLAS_14_Rockyshore_Porth_Oer_Data.xls
 PLAS_14_Sabellaria_Station_Data.xls
 PLAS_13_Glaslyn_Dwryd_sediment_Data
 PLAS_14_Mawddach_sediment_Data
 PLAS_14_PhotoLog.xls

The site location positions and survey tracks were also downloaded from the handheld GPS receiver units on a daily basis. The daily GPS downloads were converted to *MapInfo Tab* files and then displayed in GIS for data collation and map production. All relevant species and habitat data have been entered into Marine Recorder.

3 Results

Field work was carried out during the five days of spring tides. A team of four experienced marine biological surveyors from ASML and NRW took part in the day to day surveys. The core team of Tom Mercer, Christine Howson, Lucy Kay and Ben Wray were ably assisted by Tim Dixon, the field assistant from ASML and Molly Duggan, a very capable 'Sandwich Student' from NRW. Figure 1 shows the locations of the survey areas. Appendix 3 to 8 tabulates the recorded field data and Appendix 9 catalogues the photographs taken.

3.1 Sabellaria data

Figures 2 and 3 show the locations and numbers of the survey transects and quadrat stations at Llandanwg and West of Afon Dwyfor respectively. Tables 7, 8 and 9 summarise and compare the data collected. The full data are tabulated in Appendix 3 and 4.

In order to compare the reef growth performance or indeed shrinkage year on year, the areas of *Sabellaria* reef at both Llandanwg and West Afon Dwyfor were mapped. At Llandanwg the area of the reef to the south of Transect 1 was calculated in 2012, 2013 and 2014. The same was done for the West of Afon Dwyfor reef between the transect at WAD8 and the NGR Easting line SH 247000. Table 7 presents these data.

Table 7 Comparisons between the 2012, 2013 and 2014 *Sabellaria* reef areas at Llandanwg and West Afon Dwyfor

Area (Ha)	2012	2013	2014	Change from 2013 to 2014
Llandanwg	1.795	2.371	1.826	-23.0%
West Afon Dwyfor	2.382	2.6702	0.8734	-67.3%

The areas of reef at both survey locations can be seen to have decreased between 2013 and 2014 indicating that the *Sabellaria* polychaetes were dramatically affected by the winter storms of 2013/2014, with the impact at West Afon Dwyfor being most marked.

Table 8 Conspicuous core taxa recorded within the *Sabellaria alveolata* quadrats at Llandanwg

Taxon	Data Type	Llandanwg 2012		Llandanwg 2013		Llandanwg 2014	
		% Frequency of occurrence	Mean % cover	% Frequency of occurrence	Mean % cover	% Frequency of occurrence	Mean % cover
<i>Sabellaria alveolata</i> (total)	T%	60.0	20.9	69.0	16.9	50.0	10.6
<i>Sabellaria alveolata</i> (live)	%	60.0	6.8	67.0	6.9	40.0	4.2
Cirripedia (total)	*T%	66.0	3.5	47.0	0.9	40.0	3.8
<i>Mytilus edulis</i>	*P	59.0	4.3	29.0	0.3	12.5	0.1
Algae (total)	*T%	98.0	68.4	91.0	63.8	95.0	47.2
Chlorophycota	*T%	71.0	5.4	69.0	20.5	77.5	8.5
<i>Fucus serratus</i>	*%	68.0	29.4	67.0	27.9	47.5	17.9
<i>Fucus vesiculosus</i>	*%	76.0	37.7	82.0	27.4	62.5	21.3

Table 9 Conspicuous core taxa recorded within the *Sabellaria alveolata* quadrats at West Afon Dwyfor

Taxon	Data Type	West of Afon Dwyfor 2012		West of Afon Dwyfor 2013		West of Afon Dwyfor 2014	
		% Frequency of occurrence	Mean % cover	% Frequency of occurrence	Mean % cover	% Frequency of occurrence	Mean % cover
<i>Sabellaria alveolata</i> (total)	T%	43.0	6.7	38.0	4.4	31.4	4.8
<i>Sabellaria alveolata</i> (live)	%	33.0	1.5	30.0	2.0	13.3	1.2
Cirripedia (total)	*T%	70.0	0.2	89.0	0.9	85.7	0.7
<i>Mytilus edulis</i>	*P	7.0	0.0	0.0	0.0	0.0	0.0
Algae (total)	*T%	97.0	58.0	100.0	60.7	91.4	35.0
Chlorophycota	*T%	33.0	0.3	40.0	1.4	14.3	0.3
<i>Fucus serratus</i>	*%	57.0	14.3	97.0	49.7	42.9	7.6
<i>Fucus vesiculosus</i>	*%	93.0	43.5	40.0	1.4	88.6	26.0

The tables above show that both the frequency of occurrence and mean percentage cover of *Sabellaria* reef area at Llandanwg were reduced within the bed. This was also the case at West Afon Dwyfor.

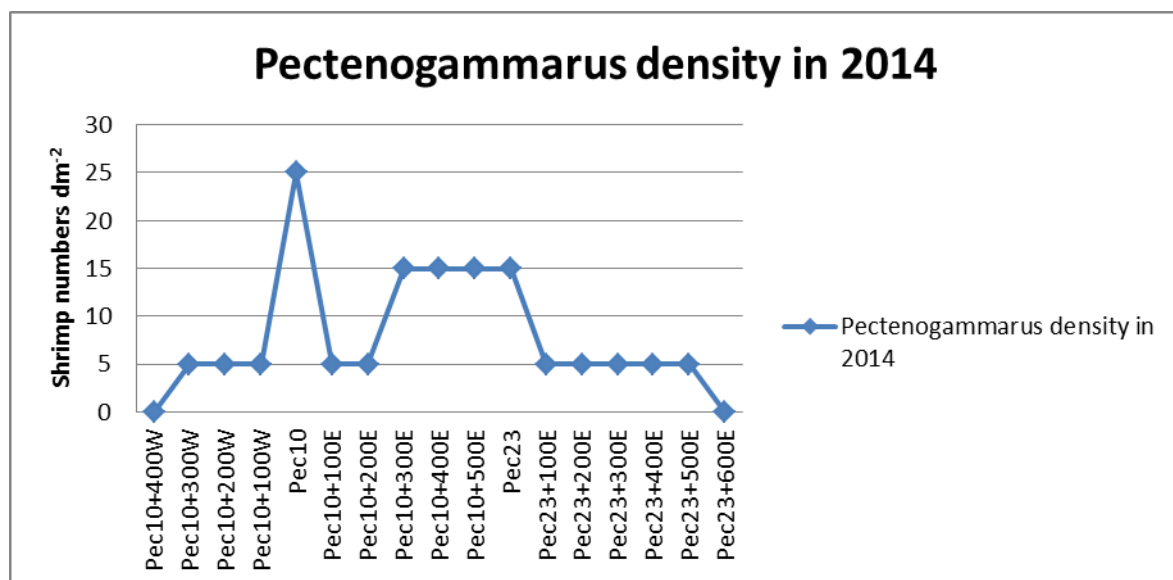
At Llandanwg all dominant taxa were reduced in abundance, with the exception of Cirripedia, which increased. This may have been due to increased juveniles colonising newly created space following the storms. Whilst at West Afon Dwyfor, the dominant taxa also tended to reduce, with the exception of *Fucus vesiculosus*, which apparently increased considerably and *F. serratus* which decreased considerably.

3.2 *Pectenogammarus* at Marian-y-de

Seventeen stations on the shingle beach at Pwllheli were surveyed for the presence of the amphipod *Pectenogammarus planicrurus* (Stations are shown on Figure 4). Numerous individuals were found within the shingle scrapes as presented in Table 10 and shown on Figure 7.

Table 10 Abundance of *Pectenogammarus planicrurus* in the shingle.

Station	Easting	Northing	No. of <i>Pectenogammarus</i> / dm ²	Graphical score
Pec10+400W	236228	333836	None present	0
Pec10+300W	236324	333866	Less than 10 <i>Pectenogammarus</i> dm ⁻²	5
Pec10+200W	236413	333897	Less than 10 <i>Pectenogammarus</i> dm ⁻²	5
Pec10+100W	236511	333929	Less than 10 <i>Pectenogammarus</i> dm ⁻²	5
Pec10	236608	333961	More than 20 <i>Pectenogammarus</i> dm ⁻²	25
Pec10+100E	236710	333986	Less than 10 <i>Pectenogammarus</i> dm ⁻²	5
Pec10+200E	236806	334010	Less than 10 <i>Pectenogammarus</i> dm ⁻²	5
Pec10+300E	236908	334034	10 - 20 <i>Pectenogammarus</i> per dm ⁻²	15
Pec10+400E	237014	334055	10 - 20 <i>Pectenogammarus</i> per dm ⁻²	15
Pec10+500E	237108	334074	10 - 20 <i>Pectenogammarus</i> per dm ⁻²	15
Pec23	237154	334090	10 - 20 <i>Pectenogammarus</i> per dm ⁻²	15
Pec23+100E	237251	334101	Less than 10 <i>Pectenogammarus</i> dm ⁻²	5
Pec23+200E	237353	334120	Less than 10 <i>Pectenogammarus</i> dm ⁻²	5
Pec23+300E	237452	334135	Less than 10 <i>Pectenogammarus</i> dm ⁻²	5
Pec23+400E	237560	334143	Less than 10 <i>Pectenogammarus</i> dm ⁻²	5
Pec23+500E	237656	334155	Less than 10 <i>Pectenogammarus</i> dm ⁻²	5
Pec23+600E	237748	334170	None present	0

Figure 7 Density of *Pectenogammarus planicrurus* across the shore at Marian-Y-De in 2014

The results show that *Pectenogammarus planicrurus* is fairly evenly distributed across the coarse sand and shingle shore within the suitable habitat at Pwllheli and numbers remain at a healthy level.

3.3 Quantitative sampling of the Glaslyn/Dwyrhyd estuarine sediments

The 27 samples collected from the 9 core sites re-visited in 2014, were sent for taxonomic analysis to an NMBAQC laboratory. The results of this taxonomic analysis are presented in Appendix 5. Once the data were 'cleaned' - removing juveniles, damaged specimens and amalgamating taxa such as *Hediste diversicolor* with Nereididae, the results were run through PRIMER 6 (Plymouth Routines In Multivariate Ecological Research). This statistical analysis package consists

primarily of a wide range of univariate, graphical and multivariate routines for analysing arrays of species-by-samples data to investigate the community ecology.

Table 11 Mean univariate statistics for the replicate infaunal core data from the Glaslyn/Dwryd in 2013 and 2014

Station	S		N		d		J'		H'(loge)		1-Lambda'	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
G 10b	6	3	34	5	1.45	1.76	0.73	0.98	1.27	0.80	0.68	0.95
G 14	2	1	2	2	0.78	1.24	0.62	0.86	0.56	0.32	0.50	0.70
G 20	8	6	123	32	1.38	1.48	0.51	0.68	1.04	1.19	0.48	0.60
G 40	3	3	4	4	0.93	1.40	0.60	0.94	0.74	0.73	0.51	0.73
G 44	7	12	45	282	1.59	1.90	0.78	0.51	1.51	1.22	0.76	0.62
G 49	5	8	9	123	1.98	1.45	0.92	0.35	1.48	0.72	0.85	0.30
G 50	2	3	32	4	0.38	1.76	0.40	0.99	0.30	1.14	0.16	0.96
G 55	1	3	1	7	-	1.31	-	0.90	-	0.81	-	0.75
G 61	6	8	67	97	1.11	1.61	0.70	0.55	1.17	1.17	0.60	0.52

- S – Mean taxa
- N – Mean total individuals: The mean number of individuals per core from all three cores per site.
- d – Mean Margalef's richness for all three cores per site. $(S-1)/\log(N)$ - it is a measure of the number of taxa present, making some allowance for the number of individuals.
- J' – Mean Pielou's evenness from all three cores per site - this is a measure of equitability, a measure of how evenly the individuals are distributed among the different taxa.
- H'(loge) – Mean Shannon-Wiener diversity index from all three cores per site
- 1-Lambda' - Mean Simpson's diversity index from all three cores per site

Table 11 shows that the greatest numbers of taxa, individuals, Richness and Shannon-Weiner diversity were found at G44, in mid-estuary and in the middle shore on the Glaslyn, seaward of the railway bund. However both Pielou's Evenness and Simpson's diversity were highest at G50 and G10b, in both the mouth and the mid-estuary saltmarsh of the Glaslyn / Dwryd system. Both these sites were characterised by very few taxa and individuals.

The particle size distribution analysis for these samples is shown in Table 12 and confirms all samples to be dominated by fine and very fine sands, with significant proportions of mud found only at G44 and G61.

Table 12 Particle size distribution - percentage fractional data

Site		G10b	G14	G20	G40	G44	G49	G50	G55	G61
Medium pebble (gravel)	> 8 mm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16
Small pebble (gravel)	4-8 mm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Granule	2-4 mm	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.04	0.04
Sand - very coarse	1-2000 μ m	0.01	0.01	0.02	0.00	0.01	0.01	0.01	0.05	0.08
Sand - coarse	500-1000 μ m	0.01	0.02	0.01	0.01	0.04	0.03	0.05	0.08	0.10
Sand - medium	250-500 μ m	0.30	0.39	0.18	0.86	0.21	0.24	5.19	0.70	0.82
Sand - fine	125-250 μ m	45.39	45.08	44.22	53.02	45.54	49.49	63.76	47.85	45.86
Sand - very fine	63-125 μ m	53.29	53.31	54.38	45.52	50.51	48.82	30.07	49.41	49.86
Silt & Clay	< 63 μ m	1.00	1.18	1.18	0.58	3.67	1.40	0.93	1.87	3.09

3.4 Semi-quantitative survey of the Glaslyn Dwyrdd sediments' conspicuous species and sediment features by in situ assessment.

The *in situ* sediment core, habitat and community assessment results are presented in Table 13 below. The results present a picture of a typical, fine-sand and muddy-sand estuary with a low diversity infaunal community.

Conspicuous species present, noted on and in the surface of the sands, included the species listed below:-

Arenicola marina
Cerastoderma edule adults
Cerastoderma edule juveniles
Epipsammic diatoms
Corophium species
Peringia ulvae
Scrobicularia plana
Fucus vesiculosus
Ulva species

Table 13 *In situ* sediment core - conspicuous species

Taxon	G14	G34	G35b	G20	G2	G10b	G49	G50	G87b	G91	G40q	G96	*G62b	*G30b	G31	G44	G41q	G13	G15	G09	G80	G68	G47	G56	G57b	G22	G29B	G28	G21B	G46	G86	G55	G54	G611	
Polychaeta																									P	P									
<i>Hediste diversicolor</i>										3						2			15		10							1		2	1				
<i>Nephtys</i> sp.				1			5					2	1									2		P								1			
<i>Scoloplos armiger</i>														1												P									
Spionidae indet.			30	5	3		50	10	10	40	10					100		15		10								100			2		P	P	
<i>Arenicola marina</i>			1				2			4						8											10	10	10		5	1	1		
<i>Bathyporeia</i> sp.		3	1	2	3			2	1			10	15	15		20		5		70					P								P		
<i>Corophium</i> sp.					20	1	20								10				>100	20	>100									P		P	P		
Isopoda indet.						1																		P											
<i>Cyathura</i>															1																				
<i>Eurydice</i> sp.		2		1																					2	P									
<i>Carcinus maenas</i>																2																			
<i>Peringia ulvae</i>				>2000												50	>50																	>200	
<i>Macoma balthica</i>								3			3															P			2		3				
<i>Macoma balthica</i> juv				1			1									5																			
<i>Angulus tenuis</i>																												P				1	P		
<i>Cerastoderma edule</i> juv		1	1									2				12												9		2	5	1	1	1	
<i>Cerastoderma edule</i>												12	8																2	3					
<i>Scrobicularia plana</i>																					15	1													
	fS	fS	fS	MfS	fS	MfS	fS	fS	fS	vS	fS	fS	fS	fS	vMfS	fS	fS	vS	vS	fS	vS	fS	fS	fS	fS	fS	fS	fS	fS	fS	MfS	fS	fS	fS	fS
	LS.LSa.MoSa	LS.LSa.MoSa	LS.LSa.MuSa.CerPo	LS.LMu.MEst.NhomMacStr	LS.LSa.MuSa.BatCare	LS.LSa.MuSa.BatCare	LS.LSa.MuSa.MacAre	LS.LMu.MEst.NhomMacStr	LS.LMu.MEst.NhomMacStr	LS.LSa.MuSa.MacAre	LS.LMu.MEst.NhomMacStr	LS.LSa.MuSa.CerPo	LS.LSa.MuSa.CerPo	LS.LSa.MoSa.AmSco	LS.LMp.Sm	LS.LSa.MuSa.CerPo	LS.LMu.MEst.NhomMacStr	LS.LSa.MuSa.BatCare	LS.LMu.UEst.Hed.Cvol	LS.LMu.MEst.HedMacSc	LS.LMu.MEst.HedMacSc	LS.LSa.MoSa	LS.LSa.MoSa	LS.LSa.MoSa	LS.LSa.MoSa	LS.LSa.MoSa	LS.LSa.MoSa	LS.LSa.MuSa.MacAre	LS.LSa.MuSa.CerPo	LS.LSa.MuSa.MacAre	LS.LSa.MuSa.CerPo	LS.LSa.MuSa.CerPo	LS.LSa.FiSa.Po.Ncir	LS.LSa.MuSa.BatCare	LS.LSa.MuSa.BatCare

Table 13 presents the conspicuous species noted in the contents of the sieved *in situ* cores. Red figures are those dominant organisms observed on the surface of the sediments, but not noted in the core residues. With these combined data, tentative biotopes are presented. In general the estuaries are dominated by relatively depauperate fine sand communities of invertebrates.

3.5 Porth Oer Rocky shore quadrats

The 12 rocky shore quadrats were surveyed and photographed on 10th and 12th August 2014 and the results which are summarised below are fully presented in Appendix 8.

3.5.1 Littoral taxa abundance data

The 56 taxa that were recorded in the quadrats are summarised in Table 14. In 2013, 51 taxa were recorded.

Table 14 Species/taxa recorded in the fixed quadrats at Porth Oer in August 2014

MCS Code	MCS Species name	MCS Code	MCS Species name	MCS Code	MCS Species name
C005230	Hymeniacion perleve	ZM07510	Lomentaria articulata	ZM06710	Catenella caespitosa
D011510	Actinia equina	ZM07950	Aglaothamnion hookeri	ZM08830	Plumaria plumosa
D12370	Cereus pedunculatus	ZM09900	Membranoptera alata		Plocamium maggsiae
R000210	Cirripedia	ZM11125	Polysiphonia harveyi	ZR02810	Leathesia difformis
R000720	Chthamalus montagui	ZM11400	Boergesenella thuyoides	ZR00030	Ectocarpaceae
R000730	Chthamalus stellatus	ZM11080	Polysiphonia fibrata	ZR01670	Ralfsia verrucosa
R001080	Semibalanus balanoides	ZM01161?	Audouinella purpurea	ZR06750	Fucus spiralis
S017890	Ligia oceanica	ZM01770	Nemalion helminthoides	ZR06810	Pelvetia canaliculata
W001300	Patella spp	ZM06710	Catenella caespitosa	ZR06870	Himantalia elongata
W002520	Melarhapha neritoides	ZM07510	Lomentaria articulata	ZS03380	Cladophora sp.
W002600	Littorina saxatilis	ZM07950	Aglaothamnion hookeri	ZS03400	Cladophora albida
W016500	Mytilus edulis	ZM00830	Porphyra		Red crust indet. (dark)
	Littorina neglecta	ZM10800	Osmundea pinnatifida	ZS02400	Ulva sp. (flat)
Q000820	Prostigmata (mites)	ZM10780	Osmundea hybrida	ZS02400	Ulva intestinalis
	Lipura	ZM11170	Polysiphonia fucoides	ZS03271?	Chaetomorpha ligustica
ZM00010	RHODOPHYCOTA (filamentous)	ZM08070	Ceramium sp.	-	Pyrenocollema on limpets & barnacles
ZM04000	Corallinaceae	ZM08091	Ceramium botryocarpum	-	Caloplaca marina
ZM04010	Corallina officinalis	ZM08110	Ceramium ciliatum	-	Verrucaria black
ZM06050	Mastocarpus stellatus	ZM08190	Ceramium echionotum	-	Verrucaria green
ZM07940	Callithamnion granulatum	ZM08240	Ceramium shuttleworthianum		

3.5.2 Limpet density count data

Table 15 Random limpet counts and their densities in the fixed quadrats at Porth Oer 2014

Year	2014				2014				2014			
Zone	Upper shore				Middle shore				Lower shore			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4
1	0	0	0	0	7	6	4	8	14	12	15	13
2	0	0	0	0	18	9	6	8	14	20	14	21
3	0	0	0	0	8	9	5	5	16	24	15	5
4	0	1	0	2	14	10	4	9	10	13	18	25
5	0	1	4	3	9	12	9	7	9	22	13	19
Mean no. (m ⁻²)	13.75				208.75				390			
% change from 2013	-62.07%				+3.73%				-8.50%			

Table 15 shows how the limpet population changed between 2013 and 2014 in the fixed quadrats at Porth Oer. Both the upper and lower shores showed a significant decrease in limpet density, but the middle shore showed a slight increase.

3.5.3 Middle shore limpet population data

Table 16 Maximum length measurements of 100+ randomly selected limpets on the middle shore

2014 limpet spp. size data for the Porth Oer mid shore											
17	18	23	19	21	23	25	29	19	21	23	
22	14	13	13	21	24	30	24	13	18	26	
26	17	18	25	19	25	20	16	32	19	20	
20	20	16	22	28	25	17	14	19	20	22	
19	16	17	15	22	18	26	20	25	22	24	
16	16	21	17	22	18	24	18	25	26		
18	23	20	28	20	15	17	24	19	29		
17	24	23	25	34	20	23	20	30	23		
27	15	19	34	16	18	21	23	16	20		
17	15	14	28	18	16	12	26	24	22		
2014 Mean limpet size =20.9 mm (n=105)						Change from 2013 = +1.5%					
2013 Mean limpet size = 20.6 mm (n=120)											

Table 16 shows a very slight increase in mean size of limpet between 2013 and 2014 in the middle shore, a fact illustrated by the histograms presented in Figure 8 which illustrates a loss of smaller limpets in the cohort.

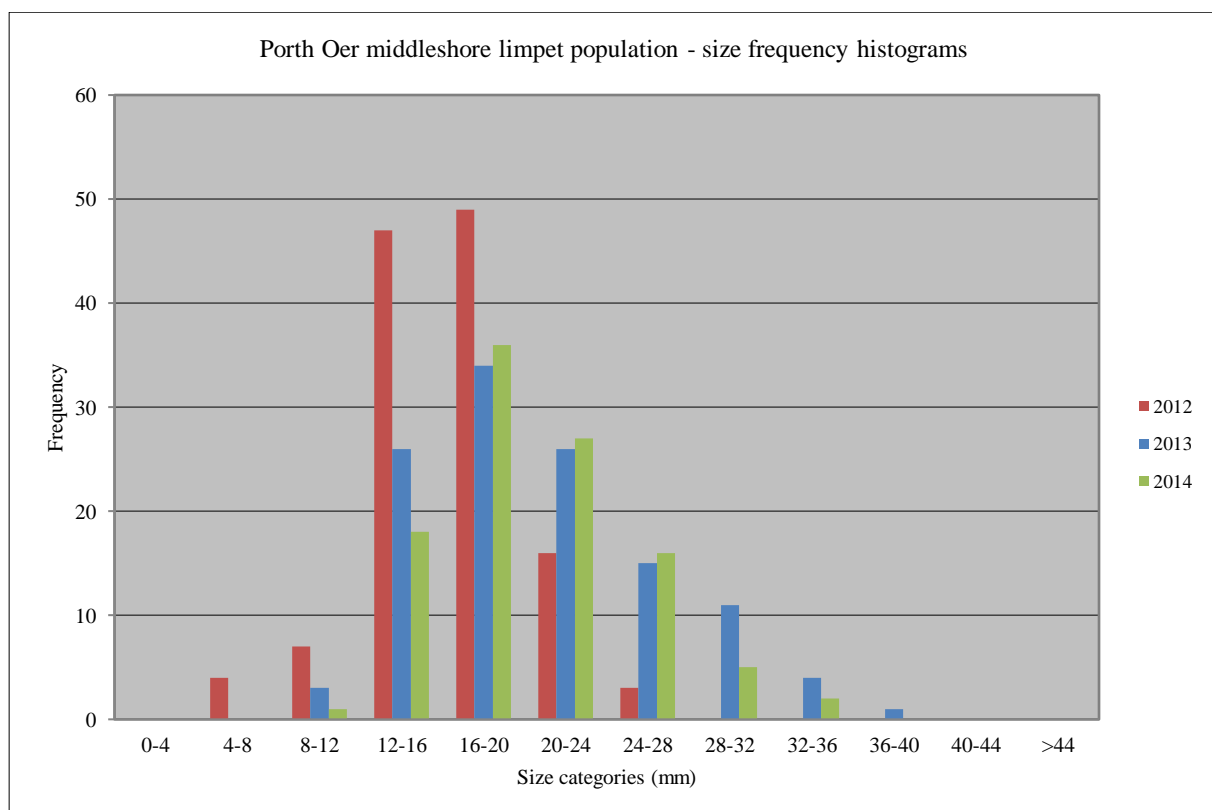


Figure 8 Size frequency histograms for the middle shore limpet population at Porth Oer

3.5.4 Cirripedia population abundance data

Table 17 Percentage cover of all barnacle species in 5 random cells within the fixed quadrats

Year	2014				2014				2014			
Zone	Upper shore				Middle shore				Lower shore			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4
1	0	0	0	0	30	80	50	50	10	25	45	40
2	0	0	0	0	20	90	45	50	15	10	60	60
3	0	0	0	0	25	70	50	50	15	25	45	20
4	0	0.25	0.25	0.25	30	60	40	60	15	10	45	60
5	0	0.25	0	0.25	60	70	55	45	20	20	25	70
Mean %. (m ⁻²)	0.06%				51.5%				31.75			
% change from 2013	-37.5%				-14.9%				-15.1%			

Table 17 shows a decrease in population density of the barnacle species in the upper, middle and lower shore, with the largest percentage fall being shown in the upper shore in a similar pattern to the limpet population.

3.6 Mawddach sediments

3.6.1 Quantitative sampling of the Mawddach estuary sediments

Thirty three samples were collected from 11 core sites on monitoring transects 1, 2 and 3 in the Mawddach estuary in 2014. These sites were last sampled in 2012. The sieved core residues were sent for taxonomic analysis to an NMBAQC laboratory. The results of this taxonomic analysis are presented in Appendix 6. Once the data were 'cleaned' - removing juveniles, damaged specimens and amalgamating taxa such as *Hediste diversicolor* with Nereididae, the results were run through PRIMER 6 (Plymouth Routines In Multivariate Ecological Research). This statistical analysis package consists primarily of a wide range of univariate, graphical and multivariate routines for analysing arrays of species-by-samples data to investigate the relationships within the infaunal community ecology.

Table 18 Mean univariate statistics for the replicate infaunal core data from the Mawddach in 2012 and 2014

Station	S		N		d		J'		H'(loge)		1-Lambda'	
	2012	2014	2012	2014	2012	2014	2012	2014	2012	2014	2012	2014
T1-1	9	7	102	15	1.89	2.32	0.71	0.95	1.60	1.90	0.68	0.90
T1-2	6	6	23	34	1.71	1.41	0.62	0.72	1.15	1.29	0.55	0.67
T1-3	2	2	7	7	0.68	0.68	0.82	0.95	0.67	0.78	0.50	0.60
T2-X1	-	4	-	10	-	1.33	-	0.82	-	1.14	-	0.68
T2-2	2	6	7	14	0.68	1.76	0.82	0.90	0.67	1.49	0.50	0.78
T2-6	7	7	161	14	1.18	2.15	0.39	0.87	0.76	1.64	0.34	0.81
T2-22	5	1	120	1	0.79	0.48	0.42	0.33	0.58	0.23	0.31	0.33
T3-1	2	5	34	11	0.35	1.67	0.34	0.94	0.38	1.51	0.22	0.84
T3-2	5	8	109	23	0.87	2.37	0.69	0.88	1.11	1.86	0.63	0.85
T3-3	5	1	45	2	1.05	0.50	0.54	0.33	0.85	0.36	0.46	0.30
T3-4	7	8	25	26	1.78	2.16	0.77	0.92	1.45	1.91	0.73	0.86

- S – Mean taxa.
- N – Mean total individuals: The mean number of individuals per core from all three cores per site.
- d – Mean Margalef's richness for all three cores per site. $(S-1)/\log(N)$ - it is a measure of the number of taxa present, making some allowance for the number of individuals.
- J' – Mean Pielou's evenness from all three cores per site - this is a measure of equitability, a measure of how evenly the individuals are distributed among the different taxa.
- H'(loge) – Mean Shannon-Wiener diversity index from all three cores per site.
- 1-Lambda' - Mean Simpson's diversity index from all three cores per site.

The particle size distribution analysis for these samples is shown in Table 19. The data confirm that the sampling locations along the transects running from mud at the upper sites, adjacent to the salt marshes, through muddy-sand to sand adjacent to the river channels.

Table 19 Particle size distributions expressed as percentage fractional data from an analysis by dry sieving. Sediment samples from the Mawddach infaunal monitoring transects.

Site		T1-S1	T1-S2	T1-S2b	T2-S2	T2-S6	T2-S22	T2-X1	T3-1	T3-2	T3-3	T3-4
Medium pebble (gravel)	> 8 mm	0	0	0	0	0	0	0	0	0	0	0
Small pebble (gravel)	4-8 mm	0	0	0	0	0	0	0	0	0	0	0
Granule	2-4 mm	0.02	0	0	0.01	0.02	0	0	0	0.03	0	0.01
Sand - very coarse	1-2000 µm	0.05	0	0.02	0.05	0.13	0.04	0.01	0.11	0.01	0	0.04
Sand - coarse	500-1000 µm	0.09	0.03	0.03	0.23	0.36	0.06	0.02	0.41	0.04	0.02	0.09
Sand - medium	250-500 µm	0.25	0.59	1.98	0.49	1.07	0.92	0.39	0.51	0.48	1.72	0.28
Sand - fine	125-250 µm	19.41	87.06	79.57	6.89	34.51	81.03	76.12	3.70	60.08	69.41	1.10
Sand - very fine	63-125 µm	39.87	9.31	13.04	37.16	34.37	14.90	19.80	28.97	27.28	26.92	34.43
Silt & Clay	< 63 µm	40.31	3.01	5.35	55.16	29.54	3.06	3.66	66.31	12.08	1.92	64.04
Sediment description		Sandy mud	Fine sand	Fine sand	Sandy mud	Muddy fine sand	Fine sand	Fine sand	Sandy mud	Muddy fine sand	Fine sand	Sandy mud

Table 18 which compares the infaunal univariate community statistics for the transect stations in 2012 and 2014 generally shows no pattern. The major point of observation to be made is that the abundance of infauna in 2014, tended to be lower at most stations, than in 2012 and as the number of taxa were relatively stable, consequently the diversity indices (H' and 1-Lambda) are higher in 2014 than in 2012.

Table 20 presents the mean infaunal data calculated from the 3 cores taken at each station. Tentative biotopes have been allocated to these community data and are also presented. The muds and muddy sands tend to be dominated by sparse ragworm, spionid polychaetes, oligochaetes, gastropods *Peringia ulvae* and bivalves *Scrobicularia plana*, whilst the mobile sands of the lower shore stations are relatively barren, being exposed to constantly fluctuating salinity, mobile sediments and strong water movements on a daily basis.

Table 20 Biotope assessment based on the infaunal taxa found in the Mawddach monitoring transect cores

Taxa \ Station	T1-1	T1-2	T1-3	T2-1	T2-2	T2-6	T2-22	T3-1	T3-2	T3-3	T3-4	
Nematoda										1		
Nereididae Juvenile					2						4	
<i>Hediste diversicolor</i>	6				4	3		1			12	
<i>Pygospio elegans</i>	1	102		24		1	1	9	54		2	
<i>Streblospio shrubsolii</i>	6										4	
Tubificidae						1			3			
<i>Heterochaeta costata</i>								3	2		6	
<i>Tubificoides benedii</i>											48	
Enchytraeidae						2		5	3			
<i>Bathyporeia pilosa</i>			13									
<i>Corophium volutator</i>						1			1			
<i>Cyathura carinata</i>	10	9		1	9	5		3	6	1	17	
<i>Eurydice pulchra</i>			14									
<i>Peringia ulvae</i>	10	296		10	47	46		6	37		24	
Pelecypoda	1				1				1			
<i>Cerastoderma edule</i>		1										
<i>Macoma balthica</i>		1										
<i>Scrobicularia plana</i>	2	3		1	3	1			3		3	
	LS.LMu.MEst.HedMacScr	LS.LSa.MuSa.CerPo	LS.LSa.MoSa.AmSco.Eur	LS.LMu.MEst.HedMacScr	LS.LMu.MEst.HedMacScr	LS.LMu.MEst.HedMacScr	LS.LMu.MEst.HedMacScr	LS.LSa.MoSa.OI.VS	LS.LMu.MEst.HedMacScr	LS.LMu.MEst.HedMacScr	LS.LSa.MoSa.OI.VS	LS.LMu.MEst.HedMacScr

Comparison of those stations that are repeated (accounting for movement of river channels) are presented in Table 21

Table 21 Comparison of biotopes at each station in years 2004, 2012 and 2014

Station	2004 biotope (old codes)	2012 biotope	2014 biotope	Biotope change
T1-1	LMU.HedScr	LS.LMu.UEst.Hed.Cvol	LS.LMu.MEst.HedMacScr	=
T1-2	LMS.MacAre	LS.LSa.MoSa.AmSco.Eur	LS.LSa.MuSa.CerPo	= increase cockle
T1-3	LMS.MacAre.Mare	LS.LSa.FiSa.Po	LS.LSa.MoSa.AmSco.Eur	Sandier character
T1-4	LGS.AP.P	LS.LSa.FiSa.Po.Pful	-	=
T2-1	LMS.MacAre	-	LS.LMu.MEst.HedMacScr	Muddier character
T2-2	LMS.MacAre	LS.LMu.UEst.Hed.Cvol	LS.LMu.MEst.HedMacScr	Muddier character
T2-6	LMS.MacAre	LS.LMu.UEst.Hed.Cvol	LS.LMu.MEst.HedMacScr	Muddier character
T2-22	LMS.MacAre	LS.LSa.FiSa.Po	LS.LSa.MoSa.OI.VS	Sandy / river channel?
T3-1	LMU.HedScr	LS.LMu.MEst.HedMacScr	LS.LMu.MEst.HedMacScr	=
T3-2	LMS.Pcer	LS.LMu.MEst.HedMacScr	LS.LMu.MEst.HedMacScr	Muddier character
T3-3	LMS.Pcer	LS.LSa.FiSa.Po	LS.LSa.MoSa.OI.VS	Sandy / river channel?
T3-4	LMS.Pcer / LMS.MacAre	(LS.LMu.MEst.HedMacScr)	LS.LMu.MEst.HedMacScr	Muddier character
T4-1	LMU.HedScr	LS.LMu.UEst.Hed.Cvol	-	Muddier character

The granulometric data for transects 1 and 2 show an increased portion of mud content (T1 = 5%, T2 = 10% on average), with a proportionate reduction in coarse and medium sand fractions. At transect 3, on the other (north) side of the estuary, the reverse is true, with on average 5% less mud present. This reflects the current nature of the estuary channel, which has been erosive on the north side and depositional on the south side of the estuary at this location.

3.7 Open coast sampling

The open coast samples were analysed by an NMBAQC laboratory. The results are shown in Appendix 7.

Table 22 Mean univariate statistics for the replicate infaunal core data from the open coast

Location	Station	S	N	d	J'	H'(loge)	1-Lambda'
Morfa Dyffryn	MD-LS	4	5	1.75	0.96	1.22	0.89
Morfa Dyffryn	MD-MS	1	2	0.43	0.36	0.25	0.30
Morfa Harlech	MH-LS	3	4	1.49	0.77	1.01	0.72
Morfa Harlech	MH-MS	2	3	0.86	0.58	0.64	0.52
East Criccieth	EC-MS	2	5	0.99	0.75	0.75	0.61
East Criccieth	EC-LS	10	42	2.36	0.80	1.80	0.79
Black Rock Sands	BRS-LS	6	9	2.17	0.94	1.61	0.88
Black Rock Sands	BRS-MS	3	14	0.79	0.67	0.71	0.47

- S – Mean taxa.
- N – Mean total individuals: The mean number of individuals per core from all three cores per site.
- d – Mean Margalef's richness for all three cores per site. $(S-1)/\log(N)$ - it is a measure of the number of taxa present, making some allowance for the number of individuals.
- J' – Mean Pielou's evenness from all three cores per site - this is a measure of equitability, a measure of how evenly the individuals are distributed among the different taxa.
- H'(loge) – Mean Shannon-Wiener diversity index from all three cores per site.
- 1-Lambda' - Mean Simpson's diversity index from all three cores per site.

4 Discussion

- In 2014 the areas of *Sabellaria alveolata* reef at both survey locations, Llandanwg and West of Afon Dwyfor can be seen to have decreased dramatically, having apparently been affected by the winter storms of 2013/2014. The impact at West Afon Dwyfor was the most marked with a decrease in reef area of 67%. The pattern within the associated species was also one of decreasing abundance.
- *Pectenogammarus planicrurus* at Marian-Y-De were found in relatively healthy numbers within the extensive zone monitored.
- The Glaslyn/Dwryd infaunal cores again revealed a low diversity infaunal invertebrate community, with the greatest number of taxa and individuals this year in the mid-estuary and mouth of the Glaslyn. This community was unsurprisingly still dominated by bivalves, amphipods and spionids.
- No dramatic changes were identified in the univariate data calculated for the infaunal communities at the mid and upper estuary monitoring stations. Some characteristics fluctuated at the mouth where the sediment is regularly mobilised and regular changes in the community structure are to be expected.
- At Porth Oer, a similar number of taxa were encountered in the quadrats in 2014 as in 2013 (56 compared to 51).
- The limpet population at Porth Oer had changed slightly in 2014, with a dramatic decrease in density in the upper shore, a feature possibly again

attributable to the storms of the previous winter. The middle and lower shores apparently remaining relatively stable. There was also a slight increase in limpet size in the middle shore.

- Barnacle cover at all three shore heights showed a 15-40% decrease, possibly reinforcing the storm impact theory.
- The monitoring transects on the Mawddach show that the muds and muddy sands tend to be dominated by sparse ragworm, spionid polychaetes, oligochaetes, *Peringia ulvae* and *Scrobicularia plana*, whilst the mobile sands of the lower shore stations are relatively barren, being exposed to constantly fluctuating salinity and strong water movements on a daily basis. There appear to be no significant differences in the infaunal univariate statistics noted between the sampling occasions of 2012 and 2014.

Consideration of the changes in biotopes over time, based on analysis of the infauna, suggest that there is a shift, in general, to biotopes characterised by mud preferring species. In 2012, there was a greater density of *Corophium* which influenced the biotopes assigned. Some stations clearly go through dramatic changes, where river channels or sand bars shift. It is recommended that, if there are ephemeral features at the relocated station, a more representative sampling station is used by moving to one side of the feature, trying to keep to the same shore height.

The importance of balancing sample stations on both sides of the estuary is evident in the data, that show the differing nature of the environment on the north and south sides.

- The results from the sediment infaunal analyses would benefit from further trend analysis over the years that they have been sampled. This would provide a better single baseline against which to measure future records from the estuaries and the open coast.
- The results of the rocky reef can be difficult to interpret from a single visit per year, due to short term changes such as in Cirripedia density not being taken into account. The use of 5 year rolling means may prove a useful analysis to smooth out inter-annual variability. This would allow recognition of major shifts in community type over time.

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Appendix 1 Field Log:

Field Diary NRW PLAS Survey August 2014

Saturday, August 9th 2014

Travel to Prenteg, Gwynedd; Survey base Ty Glaslyn; Prenteg

Personnel: TM: Tom Mercer (ASML), CH: Christine Howson (ASML), TD: Tim Dixon (Edinburgh University), BR: Ben Wray (NRW), LK: Lucy Kay (NRW), MD: Mollie Duggan (NRW).

Sunday, August 10, 2014

Low Tide: 3:45 PM GMTDT 0.8m

Squally and wet.

Pectenogammarus surveys at Pwllheli; *Sabellaria* at West Afon Dwyfor and the rocky shore at Porth Oer.

TM unpacks gear and shops for the survey.

All team assemble at Ty Glaslyn at 10.00.

Survey briefing over coffee, then prepare for *Sabellaria* surveys at West Afon Dwyfor (WAD), *Pectenogammarus* survey at Pwllheli and rocky shore survey at Porth Oer (PO).

1230 and 1300 Teams depart. BW, LK and MD work on *Sabellaria* at WAD. TM, TD, AB and CH go to Marian- y-De, where the team carry out a *Pectenogammarus* survey at PE10 and 23 and at 100m intervals both between and beyond PE23 to the east for 500m.

Then the team travelled on to Porth Oer Rocky Shore. Weather squally and both major surveys have to be abandoned and remained unfinished on the day due to foul weather and the risk of dangerous waves on the rocky shore.

1600 Team returns home and work up photos and data.

1900 ASML and AB eat at the Union Inn – Tremadog

2030 ASML and AB return to Ty Glaslyn and continue with data processing.

Monday, August 11, 2014

Low Tide: 4:37 PM GMTDT 0.7

Bright and sunny and windy.

Surveys of *Sabellaria* quadrats at Llandanwg and West Afon Dwyfor and further *Pectenogammarus* sites west of Pwllheli.

0700 TM sorts sheets, GPS and Cameras and packs ready for survey

1000 BW, LK and MD arrive at Ty Glaslyn to enter data from previous day.

1145 LK, BW and MD leave for Pwllheli to recommence *Pectenogammarus* surveys to the west of PE10, then back to WAD to finish *Sabellaria* survey.

1245 TM, TD, AB and CH, travel to Llandanwg to survey *Sabellaria*.

1800 Teams finish *Sabellaria* surveys and depart shore. NRW travelling staff return to Bangor, whilst AB and ASML return to Ty Glaslyn. ASML cook and eat in.

1930 ASML and AB begin evening work-up of algal data, specimens and photographs from the *Sabellaria* quadrats

2310 TD and CH retire, closely followed by AB.
2350 TM retires to bed

Tuesday, August 12, 2014

Low Tide: 5:24 PM GMTDT 0.5

Fine with a southerly wind.

Surveys of the sediment transects in the Mawddach Estuary and Porth Oer's rocky shore.

0630 TM up and sorts out datasheets and admin for the day

0930 NRW team arrives. Work on data input from Monday and sort work programs for the day.

1245 TM, TD, MD, BW and LK travel to Penmaenpool at the top of the Mawddach to meet Matt and Rees at 13.30. Following introductions and survey briefing:-

TM and TD survey north side T3 core sites. LK and MD survey T2 on the south side and BW, MG and RE survey T1, repositioning 2 sites due to channel movements.

1500 CH and AB travel to Porth Oer and complete the rocky shore quadrats, finishing at 18.35.

2000 All team eat at the Golden Fleece in Tremadog

2130 ASML team and AB begin evening work-up of algal data, specimens and photographs from the rocky shore quadrats

2300 TD and CH retire, closely followed by AB.

2400 TM retires to bed

Wednesday, August 13, 2014

Low Tide: 6:07 PM GMTDT 0.5

Initially wet with occasional drizzle then brightening up all day.

Sediment surveys on the Glaslyn /Dwryd estuary

0715 TM gets up and fixes Mawddach infaunal core samples in full protective gear. Then TM sorts out recording sheets, data and admin for the day.

0930 NRW team arrives. All carry on photo labelling and entering data onto memory sticks. Work programs sorted for the day.

1345 TM and AB travel to Glan y Mor (Morfa Harlech) on the Dwryd estuary and survey the south western part, covering 13 sites and taking in 2 quantitative core sites. TD and BW travel to the mouth of the estuary at Borth y Gest and Porthmadog and survey 10 sites, taking in 4 quantitative core sites, while LK and MD travel to Pont Briwet and survey the sites at the head of the estuary, taking in 3 core sites.

2000 All return to Ty Glaslyn and eat meal prepared by Christine who had missed the fieldwork with Laryngitis.

2130 ASML team and AB begin evening work-up, continuing with specimens and photographs from the rocky shore quadrats

2300 TD, CH and AB retire, closely followed TM

Thursday, August 14, 2014

Low Tide: 6:32 AM GMTDT 0.4

Fine and bright little wind

Surveys of the open coast sediments and the Dwyryd Estuary

0500 ASML Team and AB rise early and travel to open coast sites; AB and TD to Morfa Dyffryn and Morfa Harlech and TM and CH to East Criccieth and Blackrock Sands
Samples were taken from existing middle and lower shore sites, taking 5 cores and a grain size distribution sample at each.

0530 BW and MD travel to the north side of the Dwyryd estuary to finish the *in situ* core work; covering the remaining 4 sites.

1000 All teams arrive back at Ty Glaslyn and eat communal breakfast together –very civilized!

1100 TM labels and fixes all the remaining infaunal core samples taken, whilst the rest of the team spend the remainder of the day entering and QA 'ing the week's data.

1700 NRW (BW and MD) return to Bangor.

1900 ASML and AB eat at the Union Inn, Tremadog and then return to Ty Glaslyn to pack up the house.

Friday, August 15, 2014

Team disperses at 0745-0830. TM drives to Bangor to drop off infaunal samples with BW at the NRW offices, arriving at 0830. TM then heads off to Co. Durham. AB leaves Ty Glaslyn at 0900 for Pembrokeshire, as do CH and TD who travel up to Edinburgh.

Appendix 2 Recording forms

Sabellaria Quadrat recording form

PLAS 2014 SAC: Sabellaria quadrats.

Site:

Stn. No.:

Surveyors: Date: Time at start: Conditions:

GPS: GPS WayPt: OS Grid Ref: SN Camera:

Quadrat No.	1	2	3	4	5	Quadrat No.	1	2	3	4	5
Photo No.											
Standing water %											
Sabellaria reef %											
Live Sabellaria %											
Cirripedia %											
Mytilus edulis %											
Algae %											
Fucus serratus %											
Fucus vesic. %											
Chlorophycota %											
Porifera											
Actinia equina											
Pomatoceros											
Semibalanus											
Elminius modestus											
Pagurids											
Patella vulgata											
Gibbula cineraria											
Gibbula umbilicalis											
Littorina mar/obt											
Littorina littorea											
Nucella lapillus											
Chondrus crispus											
Corallina											
Corallinaceae											
Dumontia contorta											
Gelidium latifolium											
Mastocarpus											
Osmundea hybrida											
Osmundea pinn.											
Rhodo. (dk red enc.)											
Rhodophycota (fil)											
Dictyota dic.						Quadrat No.	6	7	8	9	10
Phaeophycota (enc)						Sabellaria reef %					
Chaetomorpha						Live Sabellaria %					
Cladophora rup.											
Enteromorpha						Quadrat No.	11	12	13	14	15
Ulva lactuca						Sabellaria reef %					
Verrucaria (green)						Live Sabellaria %					

TSM 09/08/14

Rocky shore Quadrat recording form

PLAS 2014 SAC: Rockyshore quadrats - Porth Oer: Surveyors:..... Date:.....

Time at start:..... Conditions: Camera: Stn. No.:.....

Porth Oer		Upper shore				Mid shore				Lower shore			
MCS	Zone Quadrat No. Species Name	1	2	3	4	1	2	3	4	1	2	3	4
		Fauna											
C04840	Hymeniacion perleve												
D11510	Actinia equina												
D11680	Urticina felina												
P02770	Eulalia viridis												
P23040	Pomatoceros triqueter												
Q00820	Prostigmata												
R00210	Cirripedia												
R01130	Balanus perforatus												
R01200	Elminius modestus												
S26900	Carcinus maenas												
	Gammaridae												
W01300	Patella												
W01930	Gibbula cineraria												
W01950	Gibbula umbilicalis												
W02520	Melarhappe neritoides												
W02580	Littorina neglecta												
W02600	Littorina saxatilis												
W08170	Nucella lapillus												
W16500	Mytilus edulis												
	Anurida maritima												
ZM00010	Rhodophycota (filamentous)												
ZM00830	Porphyra												
ZM02420	Palmaria palmata												
ZM03840	Corallinaceae												
ZM04040	Corallina officinalis												
ZM06040	Mastocarpus (Petrocoelis)												
ZM06050	Mastocarpus stellatus												
ZM07510	Lomentaria articulata												
ZM08070	Ceramium strictum												
	Ceramium shuttleworthianum												
	Polysiphonia atlantica												
	Polysiphonia harveyi												
	Ploccamium maggsiae												
	Aglaothamnium hookeri												
ZM10800	Osmundea pinnatifida												
	Membranoptera												
	Ectocarpaceae												
	Himanthalia elongata												
ZR02470	Elachista												
ZR06760	Fucus vesiculosus Var. linearis												
ZS02110	Enteromorpha												
ZS03270	Chaetomorpha ligustica												
ZS03380	Cladophora												

Rocky shore Quadrat recording form continued.

PLAS 2014 SAC: Rockyshore quadrats - Porth Oer: Surveyors:..... Date:.....

Time at start:.....Conditions: Camera: Stn. No.:.....

		Upper shore				Mid shore				Lower shore			
		1	2	3	4	1	2	3	4	1	2	3	4
MCS	Species Name												
	Verrucaria black.												
	Verrucaria green												

Limpet monitoring (Middle zone 100-200) maximum length measurements												

	1	2	3	4	1	2	3	4	1	2	3	4
Barnacle species abundance photos (5x5 tick when complete)	5	5	5	5	5	5	5	5	5	5	5	5
	1	2	3	4	1	2	3	4	1	2	3	4
Barnacle abundance (5x20 percentage all spp)												
	1	2	3	4	1	2	3	4	1	2	3	4
Limpet abundance (All Zones - 5x20 counts)												

In situ sediment assessment recording sheet.

Glaslyn/Dwyrdd & Mawddach 2014: *In-situ* sediment records - Date:..... Surveyors:.....

Conditions: GPS/Camera: Time: Start: End:

Station	Sediment	Species
G/D..... Time: Photos:..... Sorting (Well/ poor 1-5): Firmness (hard-soft 1 – 5): Surface relief (even/uneven 1-5): Grid Ref: SH East:..... North:.....	Mud very muddy gravelly shelly very fine medium coarse Sand Gravel Shell Pebble Cobble Bould. Rock Sorting (Well/ poor 1-5): Firmness (hard-soft 1 – 5): Surface relief (even/uneven 1-5): Stability (stable/mobile 1-5) Waves >10cm Ripples <10cm Sub surf coarse Subsurface mud/clay Black layer cm: Standing water %: Sed' in sieve: Insignif. Significant Lots	Conspicuous (No. per m ²): Cockles >20mm <20mm Arenicola Lanice Hediste Zostera % Ent. % Green ct % <hr/> Sieve (No. per core): Cockles >20mm <20mm Macoma Hydrobia Scrobs >20mm <20mm Hediste Nephtys Scoloplos Spionids Polychaete Bathyporeia Corophium Carcinus
G/D..... Time: Photos:..... Sorting (Well/ poor 1-5): Firmness (hard-soft 1 – 5): Surface relief (even/uneven 1-5): Grid Ref: SH East:..... North:.....	Mud very muddy gravelly shelly very fine medium coarse Sand Gravel Shell Pebble Cobble Bould. Rock Sorting (Well/ poor 1-5): Firmness (hard-soft 1 – 5): Surface relief (even/uneven 1-5): Stability (stable/mobile 1-5) Waves >10cm Ripples <10cm Sub surf coarse Subsurface mud/clay Black layer cm: Standing water %: Sed' in sieve: Insignif. Significant Lots	Conspicuous (per m ²): Cockles >20mm <20mm Arenicola Lanice Hediste Zostera % Ent. % Green ct % <hr/> In sieve: Cockles >20mm <20mm Macoma Hydrobia Scrobs >20mm <20mm Hediste Nephtys Scoloplos Spionids Polychaete Bathyporeia Corophium Carcinus
G/D..... Time: Photos:..... Sorting (Well/ poor 1-5): Firmness (hard-soft 1 – 5): Surface relief (even/uneven 1-5): Grid Ref: SH East:..... North:.....	Mud very muddy gravelly shelly very fine medium coarse Sand Gravel Shell Pebble Cobble Bould. Rock Sorting (Well/ poor 1-5): Firmness (hard-soft 1 – 5): Surface relief (even/uneven 1-5): Stability (stable/mobile 1-5) Waves >10cm Ripples <10cm Sub surf coarse Subsurface mud/clay Black layer cm: Standing water %: Sed' in sieve: Insignif. Significant Lots	Conspicuous (per m ²): Cockles >20mm <20mm Arenicola Lanice Hediste Zostera % Ent. % Green ct % <hr/> In sieve: Cockles >20mm <20mm Macoma Hydrobia Scrobs >20mm <20mm Hediste Nephtys Scoloplos Spionids Polychaete Bathyporeia Corophium Carcinus
G/D..... Time: Photos:..... Sorting (Well/ poor 1-5): Firmness (hard-soft 1 – 5): Surface relief (even/uneven 1-5): Grid Ref: SH East:..... North:.....	Mud very muddy gravelly shelly very fine medium coarse Sand Gravel Shell Pebble Cobble Bould. Rock Sorting (Well/ poor 1-5): Firmness (hard-soft 1 – 5): Surface relief (even/uneven 1-5): Stability (stable/mobile 1-5) Waves >10cm Ripples <10cm Sub surf coarse Subsurface mud/clay Black layer cm: Standing water %: Sed' in sieve: Insignif. Significant Lots	Conspicuous (per m ²): Cockles >20mm <20mm Arenicola Lanice Hediste Zostera % Ent. % Green ct % <hr/> In sieve: Cockles >20mm <20mm Macoma Hydrobia Scrobs >20mm <20mm Hediste Nephtys Scoloplos Spionids Polychaete Bathyporeia Corophium Carcinus

Mud – M, Sand – S, Gravel – G, very –v, muddy-m, gr-gravelly, Shelly -sh, coarse-c, medium- med, fine-f, Sorting – Well to poor 1-5; Black layer depth in cm; Surface relief – even/uneven (1-5); Firmness- firm/soft (1-5); Stability – stable/mobile(1-5); Waves/ Dunes>10cm-W; Ripples <10cm-R; Subsurface coarse- ssC, Subsurface mud/clay – ssM.

Appendix 3 *Sabellaria* quadrat data – Llandanwg 11/8/2014

Transect No.	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3
Zone	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Surveyors	TM	TM	TM	TM	TM	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	TM	TM	TM	TM	TM
Camera	LUMIX	LUMIX	LUMIX	LUMIX	LUMIX	Fuji	Fuji	Fuji	Fuji	Fuji	LUMIX	LUMIX	LUMIX	LUMIX	LUMIX
Photo No.	354	355	356	357	358	1104	1106	1107	1108	1112	345	346	347	348	349
Photo No.2						1105			1111						
Standing water %	2	1	0	0	0	40	12	65	0	0	0	0	45	0	0.5

Checklist spp.

<i>Sabellaria alveolata</i> (total)	T%	0	76	20	0	0	4	30	0	36	0	90	0	0	0	78
<i>Sabellaria alveolata</i> (live)	%	0	20	20	0	0	0	15	0	12	0	40	0	0	0	12
Cirripedia (total)	T%	0	0	0	0.25	0	0	0	0	0	0	8	0.25	0.25	80	4
<i>Mytilus edulis</i>	%	0	0.25	0	0	0	0	0	0	0.25	0	0	0	0	0	1
Algae (total)	T%	85	37	70	48	22	90	45	40	80	24	41	100	75	2	76
<i>Fucus serratus</i>	%	10	0	0	0	0	0	30	12	40	0	0	6	50	0	12
<i>Fucus vesiculosus</i>	%	68	5	50	30	22	60	15	0	0	24	0	100	5	0	64
Chlorophycota	T%	8	8	20	4	0	45	10	4	65	0	40	2	9	1	0.5

<i>Porifera</i>	P															
<i>Actinia equina</i>								P					P			
<i>Pomatoceros</i>	P															
<i>Semibalanus balanoides</i>	%											P	P		P	P
<i>Elminius modestus</i>	%											P	P		P	P
Paguridae	P															
<i>Patella vulgata</i>	P				p							p	p		p	
<i>Gibbula cineraria</i>	P															
<i>Gibbula umbilicalis</i>	P															
<i>Littorina obtusata (/mariae)</i>	P					p							p	p		p
<i>Littorina littorea</i>	P															
<i>Nucella lapillus</i>	P															

<i>Chondrus crispus</i>	%															
<i>Corallina officinalis</i>	%															
Corallinaceae	T%															
<i>Dumontia contorta</i>	%															
<i>Gelidium latifolium</i>	%															

Intertidal SAC monitoring, Pen Llyn a'r Sarnau SAC August 2014. NRW Evidence Report No: 75

Transect No.	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	
Zone	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Surveyors	TM	TM	TM	TM	TM	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	TM	TM	TM	TM	TM	
<i>Mastocarpus stellatus</i>	%															
<i>Osmundea hybrida</i>	%															
<i>Osmundea pinnatifida</i>	%															
Rhodophycota (dk red crust)	T%		0.25	0.25							0.25	0.25	3			
Rhodophycota (fil)	T%															
<i>Dictyota dichotoma</i>	%															
Phaeophyceae (crust)	%			0.25							0.25	0.25	3	0.25	0.25	
Chromophycota (crust)	T%															
<i>Chaetomorpha</i>	%		20	4												
<i>Cladophora</i>	%	4														
<i>Ulva tubular</i>	%	4									40	0.25	5	1	0.25	
<i>Ulva flat</i>	%	0.25	0.25									0.25			0.25	
<i>Verrucaria</i> (green)	%															

Other spp.

Acarina	P															
<i>Actinia fragacea</i>	P															
<i>Alcyonidium mytili</i>	%															
<i>Alcyonidium polyoum</i>	P															
<i>Arenicola marina</i>	P															
<i>Arenicola marina</i>						P										
<i>Ascidella scabra</i>																
<i>Asterias rubens</i>	P															
<i>Balanus crenatus</i>	%															
Bryozoa (enc.)	%															
<i>Carcinus maenas</i>	P					P			P							
<i>Chthamalus montagui</i>	%															
Cirratulidae	P															
Cirripedia juv.				p									p	p	p	
<i>Dynamena pumila</i>	P															
<i>Electra pilosa</i>	%															
<i>Eulalia viridis</i>	P															
<i>Flustrellidra hispida</i>	P															

Intertidal SAC monitoring, Pen Llyn a'r Sarnau SAC August 2014. NRW Evidence Report No: 75

Transect No.	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3
Zone	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Surveyors	TM	TM	TM	TM	TM	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	TM	TM	TM	TM	TM
<i>Gammaridae</i>	P														
<i>Halichondria</i>	P														
<i>Hydrozoa</i>	P														
<i>Hymeniacidon perleve</i>	P														
<i>Idotea granulosa</i>	P														
<i>Lanice conchilega</i>	P														
<i>Littorina neglecta</i>	P														
<i>Littorina saxatilis</i>	P														p
<i>Melarhappe neritoides</i>	P														p
<i>Mytilus edulis (juv)</i>	%														
Nemertea (indet.)	P														
<i>Obelia</i>	P														
<i>Ophiopholis aculeata</i>															
<i>Pagurus bernhardus</i>															
<i>Palaemon serratus</i>															P
Palaemonidae	P														
<i>Patella depressa</i>															
<i>Phorcus lineatus</i>	P														
Polyplacophora	P														
<i>Pomatoschistus</i> sp.															
<i>Porcellana platycheles</i>	P														
Spirorbidae	P														
<i>Tapes rhomboides</i>	P														
<i>Umbonula</i>	P														

<i>Ahnfeltia plicata</i>	%															P
<i>Ceramium</i>	%															
<i>Ceramium botryocarpum</i>	%															
<i>Ceramium echionotum</i>	%															P
<i>Ceramium gaditanum</i>	%															
<i>Ceramium pallidum</i>	%															
<i>Ceramium virgatum</i>	%															
<i>(nodulosum)</i>	%															P

Intertidal SAC monitoring, Pen Llyn a'r Sarnau SAC August 2014. NRW Evidence Report No: 75

Transect No.	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	
Zone	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Surveyors	TM	TM	TM	TM	TM	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	TM	TM	TM	TM	TM	
<i>Chaetomorpha ligustica</i>																
Chaetomorpha linum																
<i>Chlorophycota (fil)</i> %																
Chondria dasyphylla																
Cladophora hutchinsiae												2	4			
Cladophora laetevirens						P		P								
<i>Cladophora rupestris</i> %																
<i>Cladophora sericea</i> %																
<i>Cladostephus spongiosus</i> %	0	0.5	0.25	0	0		P				0.5	10				
<i>Cordylecladia erecta</i> %																
<i>Cystoclonium purpureum</i> %																
Dictyota spiralis																
<i>Dumontia contorta</i>																
Ectocarpaceae %																
<i>Elachista fucicola</i> %			0.25	0.25												0.25
Filamentous red indet																
Fucaceae (sporelings) %				4							0.25			1	0.25	
Gelidium sp.																
<i>Gracilaria gracilis</i> %																
Green bobble weed? %																
<i>Gymnogongrus griffithsiae</i> %																
<i>Hildenbrandia</i> %							P									3
Limpet lichen																
<i>Mastocarpus stellatus</i>																
<i>Palmaria palmata</i> %																
<i>Polysiphonia</i> %																
<i>Polysiphonia fucooides</i> %																
<i>Polysiphonia harveyi</i>								P								
<i>Polysiphonia stricta</i> %																
Porphyra purpurea %																
<i>Ptilothamnion sphaericum</i> %																
Pyrenocollema																
<i>Ralfsia verrucosa</i> %																
Rhodomela confervoides								P								
<i>Rhodothamniella floridula</i> %		24	20	10			P	P	P			80	36			1

Intertidal SAC monitoring, Pen Llyn a'r Sarnau SAC August 2014. NRW Evidence Report No: 75

Transect No.	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3
Zone	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Surveyors	TM	TM	TM	TM	TM	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	TM	TM	TM	TM	TM
<i>Sargassum muticum</i>	%														
<i>Sphacelaria plumosa</i>	%					P									
<i>Spongomorpha</i>	%														
<i>Stypocaulon scoparium</i>	%														
<i>Ulva compressa</i>	%														
<i>Ulva intestinalis</i>							P	P	P						
<i>Ulva lactuca</i>	%				P	P		P	P						
<i>Verrucaria</i> (black)	%														

Sabellaria quadrat data – Llandanwg 11/8/2014 - continued

Transect No.	4	4	4	4	4	5	5	5	5	5	6	6	6	6	6
Zone	B	B	B	B	B	C	C	C	C	C	B	B	B	B	B
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Surveyors	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM
Camera	FUJI	FUJI	FUJI	FUJI	FUJI	LUMIX	LUMIX	LUMIX	LUMIX	LUMIX	LUMIX	LUMIX	LUMIX	LUMIX	LUMIX
Photo No.	1094	1095	1097	1100	1102	340	341	342	343	344	335	336	337	338	339
Photo No.2		1096	1098	1101											
Standing water %	25	30	2	35	100	0	2	93	3	0	8	0	77	0.25	11

Checklist spp.

<i>Sabellaria alveolata</i> (total)	T%	80	44	30	0	0	2	18	0	1	0	0	64	0	0	27
<i>Sabellaria alveolata</i> (live)	%	4	30	10	0	0	0.25	0	0	0.25	0	0	54	0	0	10
Cirripedia (total)	T%	1	0.25	2	0	0	19	30	0	0.25	0	0	4	0	0	0.25
<i>Mytilus edulis</i>	%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5
Algae (total)	T%	15	75	95	50	24	70	7	0.25	60	3	0	38	22	50	84
<i>Fucus serratus</i>	%	0	45	70	40	24	45	0	0	60	0	0	3	0	0	84
<i>Fucus vesiculosus</i>	%	2	30	35	0	0	35	0	0	0	3	0	28	22	50	0
Chlorophycota	T%	8	9	5	10	0	1	6	0.25	3	0	0	7	0	2	0.5

<i>Porifera</i>	P															
<i>Actinia equina</i>							p	p								
<i>Pomatoceros</i>	P															
<i>Semibalanus balanoides</i>	%	P	P	P			p	p		p			p			p
<i>Elminius modestus</i>	%						p	p		p			p			p
Paguridae	P															
<i>Patella vulgata</i>	P	P	P	P			p	p		p						p
<i>Gibbula cineraria</i>	P															
<i>Gibbula umbilicalis</i>	P						p	p								
<i>Littorina obtusata</i> (<i>/mariae</i>)	P			P			p						p			
<i>Littorina littorea</i>	P															
<i>Nucella lapillus</i>	P															P

<i>Chondrus crispus</i>	%																0.25
<i>Corallina officinalis</i>	%																
Corallinaceae	T%																
<i>Dumontia contorta</i>	%																

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Transect No.	4	4	4	4	4	5	5	5	5	5	6	6	6	6	6
Zone	B	B	B	B	B	C	C	C	C	C	B	B	B	B	B
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Surveyors	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM
<i>Gelidium latifolium</i>	%														
<i>Mastocarpus stellatus</i>	%														
<i>Osmundea hybrida</i>	%														
<i>Osmundea pinnatifida</i>	%														
Rhodophycota (dk red crust)	T%											1			
Rhodophycota (fil)	T%											1			
<i>Dictyota dichotoma</i>	%														
Phaeophyceae (crust)	%					0.25			4						
Chromophycota (crust)	T%														
<i>Chaetomorpha</i>	%														
<i>Cladophora</i>	%														
<i>Ulva tubular</i>	%					1	6	0.25	3		7				
<i>Ulva flat</i>	%						0.25								0.25
<i>Verrucaria</i> (green)	%														2

Other spp.

Acarina	P														
<i>Actinia fragacea</i>	P														
<i>Alcyonidium mytili</i>	%														
<i>Alcyonidium polyoum</i>	P														
<i>Arenicola marina</i>	P								p						
<i>Arenicola marina</i>															
<i>Ascidiella scabra</i>															
<i>Asterias rubens</i>	P									p					
<i>Balanus crenatus</i>	%														
Bryozoa (enc.)	%														
<i>Carcinus maenas</i>	P	P	P	P					p						p
<i>Chthamalus montagui</i>	%														
Cirratulidae	P														
Cirripedia juv.															
<i>Dynamena pumila</i>	P														
<i>Electra pilosa</i>	%														
<i>Eulalia viridis</i>	P														p

Intertidal SAC monitoring, Pen Llyn a'r Sarnau SAC August 2014. NRW Evidence Report No: 75

Transect No.	4	4	4	4	4	5	5	5	5	5	6	6	6	6	6		
Zone	B	B	B	B	B	C	C	C	C	C	B	B	B	B	B		
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5		
Surveyors	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	
<i>Flustrellidra hispida</i>	P																P
<i>Gammaridae</i>	P																
<i>Halichondria</i>	P																
<i>Hydrozoa</i>	P																
<i>Hymeniacidon perleve</i>	P																
<i>Idotea granulosa</i>	P																
<i>Lanice conchilega</i>	P																
<i>Littorina neglecta</i>	P																
<i>Littorina saxatilis</i>	P																
<i>Melarhapse neritoides</i>	P																
<i>Mytilus edulis (juv)</i>	%																
Nemertea (indet.)	P																
<i>Obelia</i>	P																
<i>Ophiopholis aculeata</i>																	
<i>Pagurus bernhardus</i>																	
<i>Palaemon serratus</i>																	p
<i>Palaemonidae</i>	P																
<i>Patella depressa</i>																	
<i>Phorcus lineatus</i>	P																
<i>Polyplacophora</i>	P																
<i>Pomatoschistus</i> sp.																	
<i>Porcellana platycheles</i>	P																
<i>Spirorbidae</i>	P																
<i>Tapes rhomboides</i>	P																
<i>Umbonula</i>	P																
<i>Ahnfeltia plicata</i>	%																
<i>Ceramium</i>	%		P														
<i>Ceramium botryocarpum</i>	%		P														
<i>Ceramium echionotum</i>	%																
<i>Ceramium gaditanum</i>	%																
<i>Ceramium pallidum</i>	%																
<i>Ceramium virgatum</i> (<i>nodulosum</i>)	%					P											

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Transect No.	4	4	4	4	4	5	5	5	5	5	6	6	6	6	6	
Zone	B	B	B	B	B	C	C	C	C	C	B	B	B	B	B	
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Surveyors	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	
<i>Chaetomorpha ligustica</i>																P
Chaetomorpha linum	P															
<i>Chlorophycota (fil)</i>	%															
Chondria dasyphylla																
Cladophora hutchinsiae		P		P												
Cladophora laetevirens																
<i>Cladophora rupestris</i>	%															
<i>Cladophora sericea</i>	%															
<i>Cladostephus spongiosus</i>	%		P													
<i>Cordylecladia erecta</i>	%															
<i>Cystoclonium purpureum</i>	%															
Dictyota spiralis																
<i>Dumontia contorta</i>																
Ectocarpaceae	%															
<i>Elachista fucicola</i>	%					0.25	0.25		0.25							
Filamentous red indet																
Fucaceae (sporelings)	%						1									
Gelidium sp.																
<i>Gracilaria gracilis</i>	%															
Green bobble weed?	%															
<i>Gymnogongrus griffithsiae</i>	%															
<i>Hildenbrandia</i>	%											3				2
Limpet lichen																
<i>Mastocarpus stellatus</i>																
<i>Palmaria palmata</i>	%															
<i>Polysiphonia</i>	%															
<i>Polysiphonia fucoides</i>	%															
<i>Polysiphonia harveyi</i>																
<i>Polysiphonia stricta</i>	%															
<i>Porphyra purpurea</i>	%															
<i>Ptilothamnion sphaericum</i>	%															
Pyrenocollema																
<i>Ralfsia verrucosa</i>	%		P													
Rhodomela confervoides					P											
<i>Rhodothamniella floridula</i>	%			P	P											

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Transect No.	4	4	4	4	4	5	5	5	5	5	6	6	6	6	6	
Zone	B	B	B	B	B	C	C	C	C	C	B	B	B	B	B	
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Surveyors	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	
<i>Sargassum muticum</i>	%															
<i>Sphacelaria plumosa</i>	%															
<i>Spongomorpha</i>	%															
<i>Stypocaulon scoparium</i>	%															
<i>Ulva compressa</i>	%															
<i>Ulva intestinalis</i>		P	P	P	P											
<i>Ulva lactuca</i>	%	P	P	P	P											
<i>Verrucaria</i> (black)	%															

Sabellaria quadrat data – Llandanwg 11/8/2014 - continued

Transect No.	7	7	7	7	7	8	8	8	8	8
Zone	B	B	B	B	B	B	B	B	B	B
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5
Surveyors	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH
Camera	FUJI	FUJI	FUJI	FUJI	FUJI	FUJI	FUJI	FUJI	FUJI	FUJI
Photo No.	1084	1086	1087	1089	1091	1113	1115	1116	1117	1118
Photo No.2	1085		1088	1090	1092	1114				
Standing water %	65	0	0	0	4	30	0	0	0	0

Checklist spp.

<i>Sabellaria alveolata</i> (total)	T%	0	8	5	0	12	1	0.25	0	0	30
<i>Sabellaria alveolata</i> (live)	%	0	0.25	0.25	0	4	0	0.25	0	0	4
Cirripedia (total)	T%	0	2	1	0	0	0	0	0	0	0
<i>Mytilus edulis</i>	%	0	0	0	0	1	0	0	0	0	0
Algae (total)	T%	40	20	75	50	95	50	20	25	0	85
<i>Fucus serratus</i>	%	0	0	0	50	92	0	16	25	0	0
<i>Fucus vesiculosus</i>	%	20	6	75	0	3	45	0	0	0	55
Chlorophycota	T%	20	14	12	0.25	0	10	16	1	0	70

<i>Porifera</i>	P										
<i>Actinia equina</i>											
<i>Pomatoceros</i>	P										
<i>Semibalanus balanoides</i>	%		P	P							P
<i>Elminius modestus</i>	%		P	P							
Paguridae	P										
<i>Patella vulgata</i>	P		P	P				P			P
<i>Gibbula cineraria</i>	P										
<i>Gibbula umbilicalis</i>	P			P							
<i>Littorina obtusata</i> (/mariae)	P			P							P
<i>Littorina littorea</i>	P		P								
<i>Nucella lapillus</i>	P		P								

<i>Chondrus crispus</i>	%										
<i>Corallina officinalis</i>	%										
Corallinaceae	T%										
<i>Dumontia contorta</i>	%										
<i>Gelidium latifolium</i>	%										

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Transect No.	7	7	7	7	7	8	8	8	8	8
Zone	B	B	B	B	B	B	B	B	B	B
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5
Surveyors	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH
<i>Mastocarpus stellatus</i>	%									
<i>Osmundea hybrida</i>	%									
<i>Osmundea pinnatifida</i>	%									
Rhodophycota (dk red crust)	T%									
Rhodophycota (fil)	T%									
<i>Dictyota dichotoma</i>	%									
Phaeophyceae (crust)	%			P						
Chromophycota (crust)	T%									
<i>Chaetomorpha</i>	%									
<i>Cladophora</i>	%									
<i>Ulva tubular</i>	%									
<i>Ulva flat</i>	%									
<i>Verrucaria</i> (green)	%									

Other spp.

Acarina	P									
<i>Arenicola marina</i>	P					P				
<i>Arenicola marina</i>										
<i>Ascidella scabra</i>										
Cirripedia juv.										
<i>Dynamena pumila</i>	P				P					
<i>Electra pilosa</i>	%									
<i>Eulalia viridis</i>	P									
<i>Flustrellidra hispida</i>	P				P					
<i>Lanice conchilega</i>	P									
<i>Littorina neglecta</i>	P									
<i>Littorina saxatilis</i>	P									
<i>Palaemon serratus</i>		P								
<i>Ahnfeltia plicata</i>	%									
Chlorophycota (fil)	%									
Chondria dasyphylla										
<i>Cladophora hutchinsiae</i>		P	P					P		

Intertidal SAC monitoring, Pen Llyn a'r Sarnau SAC August 2014. NRW Evidence Report No: 75

Transect No.	7	7	7	7	7	8	8	8	8	8
Zone	B	B	B	B	B	B	B	B	B	B
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5
Surveyors	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH	AB/CMH
<i>Dumontia contorta</i>										
Ectocarpaceae	%									
<i>Elachista fucicola</i>	%	P		P						
<i>Gymnogongrus griffithsiae</i>	%									
<i>Hildenbrandia</i>	%			P		1				
<i>Mastocarpus stellatus</i>										
<i>Palmaria palmata</i>	%									
<i>Polysiphonia</i>	%									
<i>Ralfsia verrucosa</i>	%							P		
Rhodomela confervoides										
<i>Rhodothamniella floridula</i>	%									P
<i>Ulva intestinalis</i>		P			P		P		P	
<i>Ulva lactuca</i>	%					P				P
<i>Verrucaria</i> (black)	%									

Appendix 4 *Sabellaria* quadrat data – West Afon Dwyfor 11/08/2014

Transect No.	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3
Zone	B	B	B	B	B	A	A	A	A	A	B	B	B	B	B
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	BW,	BW,	BW,	BW,	BW,						BW,R	BW,R	BW,R	BW,R	BW,R
Surveyors	RS	RS	RS	RS	RS	LK	LK	LK	LK	LK	S	S	S	S	S
Photo No.	48	49	51	53	54	4240	4241	4243	4246	4248	39	41	43	45	47
Photo No.2		50	52		55		4242		4247	4249	40	42	44	46	
Standing water %	0	93	0	0	0	96	49	50	86	76	80	57	95	65	72

Checklist spp.

<i>Sabellaria alveolata</i> (total)	T%	0	0	0	0	0	0	0	0.25	3	3	0	0	0.25	0
<i>Sabellaria alveolata</i> (live)	%	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0
Cirripedia (total)	T%	0	0	5	2	1	0	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25
<i>Mytilus edulis</i>	%	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae (total)	T%	1	13	21	30	54	0	14	0	41	9	47	83	91	53
<i>Fucus serratus</i>	%	0	7	0	0	0	0	0	1	0	3	46	17	14	0
<i>Fucus vesiculosus</i>	%	1	5	21	30	54	0	0	31	5	44	38	74	36	0
Chlorophycota	T%	0	0	0	0	0	0	0	6	0	0	0	0	0	0

<i>Porifera</i>	P														
<i>Actinia equina</i>			P												
<i>Pomatoceros</i>	P		P												
<i>Semibalanus balanoides</i>	%		P	P	P			P	P	P	P	P	P	P	P
<i>Elminius modestus</i>	%														
Paguridae	P														
<i>Patella vulgata</i>	P			P	P										
<i>Gibbula cineraria</i>	P	P			P					P	P	P	P		
<i>Gibbula umbilicalis</i>	P		P		P			P	P	P	P	P	P		
<i>Littorina obtusata</i> (/mariae)	P	P	P	P				P	P	P	P	P	P	P	P
<i>Littorina littorea</i>	P		P					P	P	P	P	P	P	P	P
<i>Nucella lapillus</i>	P				P					P					

<i>Chondrus crispus</i>	%								0.25	0.25		0.25			
<i>Corallina officinalis</i>	%								0.25			0.25		0.25	
Corallinaceae	T%												5		
<i>Dumontia contorta</i>	%											0.25?	0.25?		
<i>Gelidium latifolium</i>	%								0.25?						
<i>Mastocarpus stellatus</i>	%								2	2		0.25			
<i>Osmundea hybrida</i>	%														
<i>Osmundea pinnatifida</i>	%									0.25					

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Transect No.	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	
Zone	B	B	B	B	B	A	A	A	A	A	B	B	B	B	B	
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Surveyors	BW, RS	BW, RS	BW, RS	BW, RS	BW, RS	LK	LK	LK	LK	LK	BW,R S	BW,R S	BW,R S	BW,R S	BW,R S	
Rhodophycota (dk red crust)	T%				0.25	0.25					0.25	1	0.25	0.25	0.25	0.25
Rhodophycota (fil)	T%									2	1					
<i>Dictyota dichotoma</i>	%															
Phaeophyceae (crust)	%		0.25													
Chromophycota (crust)	T%															
<i>Chaetomorpha</i>	%															
<i>Cladophora</i>	%															
<i>Ulva tubular</i>	%									0.25						
<i>Ulva flat</i>	%									0.25						
<i>Verrucaria</i> (green)	%											0.25				

Other spp.

Acarina	P
<i>Actinia fragacea</i>	P
<i>Alcyonidium mytili</i>	%
<i>Alcyonidium polyoum</i>	P
<i>Arenicola marina</i>	P
<i>Asciidiella scabra</i>	
<i>Asterias rubens</i>	P
<i>Balanus crenatus</i>	%
Bryozoa (enc.)	%
<i>Carcinus maenas</i>	P
<i>Chthamalus montagui</i>	%
Cirratulidae	P
Cirripedia juv.	
<i>Dynamena pumila</i>	P
<i>Electra pilosa</i>	%
<i>Eulalia viridis</i>	P
<i>Flustrellidra hispida</i>	P
Gammaridae	P
<i>Halichondria</i>	P
Hydrozoa	P
<i>Hymeniacidon perleve</i>	P
<i>Idotea granulosa</i>	P
<i>Lanice conchilega</i>	P
<i>Littorina neglecta</i>	P

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Transect No.	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	
Zone	B	B	B	B	B	A	A	A	A	A	B	B	B	B	B	
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Surveyors	BW, RS	BW, RS	BW, RS	BW, RS	BW, RS	LK	LK	LK	LK	LK	BW,R S	BW,R S	BW,R S	BW,R S	BW,R S	
<i>Littorina saxatilis</i>	P		P		P											
<i>Melarhappe neritoides</i>	P															
<i>Mytilus edulis (juv)</i>	%															
Nemertea (indet.)	P															
<i>Obelia</i>	P										P					
<i>Ophiopholis aculeata</i>																
<i>Pagurus bernhardus</i>																
<i>Palaemon serratus</i>																
Palaemonidae	P	P							P	P	P	P	P	P	P	
<i>Patella depressa</i>																
<i>Phorcus lineatus</i>	P			P		P			P	P						
Polyplacophora	P															
<i>Pomatoschistus</i> sp.									P				P			
<i>Porcellana platycheles</i>	P															
Spirorbidae	P															
<i>Tapes rhomboides</i>	P															
<i>Umbonula</i>	P															
<hr/>																
<i>Ahnfeltia plicata</i>	%															
<i>Ceramium</i>	%								2	0.25						
<i>Ceramium botryocarpum</i>	%															
<i>Ceramium echionotum</i>	%															
<i>Ceramium gaditanum</i>	%															
<i>Ceramium pallidum</i>	%															
<i>Ceramium virgatum</i> (<i>nodulosum</i>)	%															
<i>Chaetomorpha ligustica</i>																
<i>Chaetomorpha linum</i>									2	0.25						
<i>Chlorophycota (fil)</i>	%															
<i>Cladostephus spongiosus</i>	%											0.25				
<i>Cordylecladia erecta</i>	%															
<i>Cystoclonium purpureum</i>	%															
<i>Dictyota spiralis</i>																
<i>Dumontia contorta</i>																
Ectocarpaceae	%								1							
<i>Elachista fucicola</i>	%								0.25							
Filamentous red indet																
Fucaceae (sporelings)	%		1	P		P			0.25	1	P	0.25				

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Transect No.	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	
Zone	B	B	B	B	B	A	A	A	A	A	B	B	B	B	B	
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Surveyors	BW, RS	BW, RS	BW, RS	BW, RS	BW, RS	LK	LK	LK	LK	LK	BW,R S	BW,R S	BW,R S	BW,R S	BW,R S	
Gelidium sp.																
<i>Gracilaria gracilis</i>	%															
Green bobble weed?	%															
<i>Gymnogongrus griffithsiae</i>	%															
<i>Hildenbrandia</i>	%											0.25	0.25	0.25		
Limpet lichen																
<i>Mastocarpus stellatus</i>																
<i>Palmaria palmata</i>	%															
<i>Polysiphonia</i>	%										1					
<i>Polysiphonia fucoides</i>	%															
<i>Polysiphonia harveyi</i>									2	1						
<i>Polysiphonia stricta</i>	%															
<i>Verrucaria</i> (black)	%				0.25						0.25					

Sabellaria quadrat data – West Afon Dwyfor 11/08/2014 - continued

Transect No.	5	5	5	5	5	6	6	6	6	6	7	7	7	7	7
Zone	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Surveyors	LK,MD	LK,MD	LK,MD	LK,MD	LK,MD	LK,BW, MD	LK,BW, MD	LK,BW, MD	LK,BW, MD	LK,BW, MD	LK,BW	LK,BW	LK,BW	LK,BW	LK,BW
Photo No.	4230	4231	4236	4237	4238	23	25	32	34	36	13	15	17	19	21
Photo No.2		4233			4239	24	26	33	35		14	16	18	20	22
Standing water %	96	80	0	6	32	0	0	80	92	80	0	21	23	0	0

Checklist

spp.

<i>Sabellaria</i>																
<i>alveolata(total)</i>	T%	0	0	0.25	0	0	18	38	0.25	0	0.25	0.25	93	8	33	8
<i>Sabellaria alveolata</i> (live)	%	0	0	0	0	0	0	0.25	0	0	0	0	65	7	1	1
Cirripedia (total)	T%	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	1	0.25	0.25	0.25	1
<i>Mytilus edulis</i>	%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae (total)	T%	6	22	1	2	75	34	40	16	7	92	29	67	44	97	75
<i>Fucus serratus</i>	%	5	0	0	0	30	0	0	0	2	29	1	13	42	10	45
<i>Fucus vesiculosus</i>	%	1	19	1	2	73	34	37	16	5	48	29	25	2	87	30
Chlorophycota	T%	0.25	0	0	0	0	0	0	0	0	0	0	5	0	0.25	0.25

<i>Porifera</i>	P		p				p										p
<i>Actinia equina</i>					P					P							
<i>Pomatoceros</i>	P								P		P						
<i>Semibalanus balanoides</i>	%	P	P	P	P	P	P	P	P	P	P	p	p	p	p	p	p
<i>Elminius modestus</i>	%			P	P	p											
Paguridae	P												P				
<i>Patella vulgata</i>	P				P					P	P		P		P	P	
<i>Gibbula cineraria</i>	P	P								P	P						
<i>Gibbula umbilicalis</i>	P		P	P		P	P	P	P	P	P	P	P	P	P	P	P
<i>Littorina obtusata</i> (/mariae)	P			P		P	P					P	P			P	P
<i>Littorina littorea</i>	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
<i>Nucella lapillus</i>	P						P									P	P

<i>Chondrus crispus</i>	%					0.25					1						
<i>Corallina officinalis</i>	%		1			0.25			0.25	0.25	5						

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Transect No.	5	5	5	5	5	6	6	6	6	6	7	7	7	7	7
Zone	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
						LK,BW, MD	LK,BW, MD	LK,BW, MD	LK,BW, MD	LK,BW, MD	LK,BW	LK,BW	LK,BW	LK,BW	LK,BW
Surveyors	LK,MD	LK,MD	LK,MD	LK,MD	LK,MD										
Corallinaceae	T%	0.25			0.25					1					
<i>Dumontia contorta</i>	%									0.25					
<i>Gelidium latifolium</i>	%				0.25?										
<i>Mastocarpus stellatus</i>	%	0.25	3		22										
<i>Osmundea hybrida</i>	%		0.25	0.25											
<i>Osmundea pinnatifida</i>	%	0.25			0.25		0.25					0.25			
Rhodophycota (dk red crust)	T%	2	0.25	0.25	0.25		1	0.25	0.25	0.25	0.25		0.25		
Rhodophycota (fil)	T%		0.25		0.25		8		0.25						
<i>Dictyota dichotoma</i>	%														
Phaeophyceae (crust)	%				0.25										
Chromophycota (crust)	T%				P										
<i>Chaetomorpha</i>	%														
<i>Cladophora</i>	%														0.25
<i>Ulva tubular</i>	%											0.25			
<i>Ulva flat</i>	%											0.25		0.25	
<i>Verrucaria</i> (green)	%			0.25											

Other spp.

Acarina	P														
Bryozoa (enc.)	%														
<i>Carcinus maenas</i>	P				P						P			P	
<i>Chthamalus montagui</i>	%														
<i>Halichondria</i>	P														2
<i>Hydrozoa</i>	P				P				0.25						
<i>Hymeniacidon perleve</i>	P					0.25									
<i>Idotea granulosa</i>	P														
<i>Lanice conchilega</i>	P		P		P										
<i>Littorina neglecta</i>	P														
<i>Littorina saxatilis</i>	P										P	P			
<i>Melarhapha neritoides</i>	P														
<i>Mytilus edulis</i> (juv)	%														
Nemertea (indet.)	P														

Intertidal SAC monitoring, Pen Llyn a'r Sarnau SAC August 2014. NRW Evidence Report No: 75

Transect No.	5	5	5	5	5	6	6	6	6	6	7	7	7	7	7
Zone	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Surveyors	LK,MD	LK,MD	LK,MD	LK,MD	LK,MD	LK,BW, MD	LK,BW, MD	LK,BW, MD	LK,BW, MD	LK,BW, MD	LK,BW	LK,BW	LK,BW	LK,BW	LK,BW
<i>Obelia</i>	P	0.25	0.25					0.25	0.25	0.25					
<i>Ophiopholis aculeata</i>															
<i>Pagurus bernhardus</i>															
<i>Palaemon serratus</i>															
Palaemonidae	P	P	P		P			P	P	P		P			
<i>Patella depressa</i>															P
<i>Phorcus lineatus</i>	P		P	P	P	P							P	P	P
Polyplacophora	P														
<i>Pomatoschistus</i> sp.					P					P					
<i>Porcellana platycheles</i>	P														
Spirorbidae	P														P
<i>Tapes rhomboides</i>	P														
<i>Umbonula</i>	P														
<i>Ahnfeltia plicata</i>	%														
<i>Ceramium</i>	%		0.25												
<i>Chondria dasyphylla</i>									0.25						
<i>Cladophora hutchinsiae</i>															
<i>Cladophora laetevirens</i>															
<i>Cladophora rupestris</i>	%														
<i>Cladophora sericea</i>	%														
<i>Cladostephus spongiosus</i>	%	0.25				8					1				1
<i>Cordylecladia erecta</i>	%														
<i>Cystoclonium purpureum</i>	%														
<i>Dictyota spiralis</i>									0.25						
<i>Dumontia contorta</i>															
Ectocarpaceae	%		0.25												
<i>Elachista fucicola</i>	%		0.25												
Filamentous red indet			0.25						0.25						
Fucaceae (sporelings)	%		0.25		0.25	1		0.25	0.25		6				0.25
<i>Gelidium</i> sp.															
<i>Gracilaria gracilis</i>	%														
Green bobble weed?	%	0.25	0.25	0.25	0.25	0.25					0.25sp				
<i>Gymnogongrus</i>	%														

Intertidal SAC monitoring, Pen Llyn a'r Sarnau SAC August 2014. NRW Evidence Report No: 75

Transect No.	5	5	5	5	5	6	6	6	6	6	7	7	7	7	7
Zone	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Quadrat No. (replicate)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Surveyors	LK,MD	LK,MD	LK,MD	LK,MD	LK,MD	LK,BW, MD	LK,BW, MD	LK,BW, MD	LK,BW, MD	LK,BW, MD	LK,BW	LK,BW	LK,BW	LK,BW	LK,BW
<i>griffithsiae</i>															
<i>Hildenbrandia</i>	%														
Limpet lichen									0.25						
<i>Mastocarpus stellatus</i>															
<i>Palmaria palmata</i>	%														
<i>Polysiphonia</i>	%														
<i>Polysiphonia fucoides</i>	%									0.25					
<i>Polysiphonia harveyi</i>															
<i>Polysiphonia stricta</i>	%														
<i>Porphyra purpurea</i>	%														
<i>Ptilothamnion sphaericum</i>	%														
Pyrenocollema									0.25						
<i>Ralfsia verrucosa</i>	%														
<i>Ulva intestinalis</i>															
<i>Ulva lactuca</i>	%										0.25				0.25
<i>Verrucaria</i> (black)	%														

Sabellaria quadrat data – West Afon Dwyfor 11/08/2014 - continued

Transect No.	8	8	8	8	8
Zone	A	A	A	A	A
Quadrat No. (replicate)	1	2	3	4	5
Surveyors	LK, BW	LK, BW	LK, BW	LK, BW	LK, BW
Photo No.	3	5	7	9	11
Photo No.2	4	6	8	10	12
Standing water %	0	0	0	0	0

Checklist spp.

<i>Sabellaria alveolata</i> (total)	T%	0	0	0	0	0
<i>Sabellaria alveolata</i> (live)	%	0	0	0	0	0
Cirripedia (total)	T%	2	1	4	1	2
<i>Mytilus edulis</i>	%	0	0	0	0	0
Algae (total)	T%	32	43	30	17	39
<i>Fucus serratus</i>	%	0	0	0	0	0
<i>Fucus vesiculosus</i>	%	32	43	30	17	39
Chlorophycota	T%	0	0	0	0	0

<i>Porifera</i>	P					
<i>Actinia equina</i>						
<i>Pomatoceros</i>	P	P				
<i>Semibalanus balanoides</i>	%	P	P	P	P	P
<i>Elminius modestus</i>	%					
Paguridae	P					
<i>Patella vulgata</i>	P	P	P	P		
<i>Gibbula cineraria</i>	P					
<i>Gibbula umbilicalis</i>	P	P	P	P	P	
<i>Littorina obtusata</i> (/mariae)	P	P	P	P	P	P
<i>Littorina littorea</i>	P	P	P	P		P
<i>Nucella lapillus</i>	P	P		P	P	

Rhodophycota (dk red crust)	T%					
Rhodophycota (fil)	T%					
<i>Dictyota dichotoma</i>	%					
Phaeophyceae (crust)	%	0.25			1	
<i>Verrucaria</i> (green)	%	0.25	1			0.25

Intertidal SAC monitoring, Pen Llyn a'r Sarnau SAC August 2014. NRW Evidence Report No: 75

Transect No.	8	8	8	8	8
Zone	A	A	A	A	A
Quadrat No. (replicate)	1	2	3	4	5
Surveyors	LK, BW	LK, BW	LK, BW	LK, BW	LK, BW

Other spp.

<i>Phorcus lineatus</i>	P		P	P	P
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Green bobble weed?	%		0.25	0.25	
--------------------	---	--	------	------	--

1

¹ WAD quadrat station, Transect 8 blank rows removed – few species due to storm damage.

Appendix 5 Glaslyn Dwyryd - quantitative intertidal infaunal core results

Glaslyn / Dwyryd intertidal cores Replicate 0.01m² intertidal cores, sieved over 0.5mm mesh - Results ordered from upper estuary to the mouth.

Taxa	G14 rep 1	G14 rep 2	G14 rep 3	G10b rep 1	G10b rep 2	G10b rep 3	G20 rep 1	G20 rep 2	G20 rep 3	G44 rep 1	G44 rep 2	G44 rep 3	G40b rep 1	G40b rep 2	G40b rep 3	G61b rep 1	G61b rep 2	G61b rep 3	G55 rep 1	G55 rep 2	G55 rep 3	G50 rep 1	G50 rep 2	G50 rep 3	G49 rep 1	G49 rep 2	G49 rep 3	
Nemertea												2																
Nematoda			1				4	4	5		1						3	2								1		
Eteone longa										1	1															6	6	8
Anaitides mucosa									1		1	3																
Hediste diversicolor				1					1		1	3														1	1	
Nephtys cirrosa													1	1						1				1		1	1	
Scoloplos armiger																			4							1	1	
Pygospio elegans	1						1	4	1	138	102	130				14	7	6								132	80	94
Scolecopsis squamata										1																		
Spio martinensis																							2					
Streblospio shrubsolii			1																									
Magelona mirabilis													1															
Psammodrillus balanoglossoides										1	1									1	2							
Capitella capitata species complex										2	7	1											1					
Enchytraeidae								1								4	2	3										
Mysidae													1															
Bathyporeia pilosa		1	3				4	4	1							7	12	11										1
Haustorius arenarius											1											1	-1					
Corophium											4											1				4	5	
Corophium arenarium			2	1		1				3	2															3		2
Cyathura carinata	1									2	10																	
Eurydice affinis																3	8	3										
Eurydice pulchra			2		1				1	1	1		1							3	1					1		1
Crangon crangon											1																	
Carcinus maenas Juvenile									1																			
DOLICHOPODIDAE																1		1										
Hydrobia ulvae	3		2				7	30	24	114	99	152		2		79	45	74								8	1	5
Mytilus edulis Juvenile																										2		
Cerastoderma edule										15	18	21				1	1			1				1				1
Tellina tenuis										1			2	4					3	4		1	2	1	3	1	1	
Macoma balthica							2	1	2	2	4					1	1											
Scrobicularia plana																										1		
Mya arenaria Juvenile									1																			

Appendix 6 Mawddach - quantitative intertidal infaunal core results from the fixed monitoring transects

Replicate	T1-1.1	T1-1.2	T1-1.3	T1-2b.1	T1-2b.2	T1-2b.3	T1-3b.1	T1-3b.2	T1-3b.3	T2-X1.1	T2-X1.2	T2-X1.3	T2-2.1	T2-2.2	T2-2.3	T2-6.1	T2-6.2	T2-6.3
Taxa																		
Nematoda																		
Eteone longa	1					1						1						
Anatides mucosa				1														
Nereididae_Juvenile		1												5	2		1	
Hediste diversicolor	6	9	4										3	3	5	1	4	3
Pygospio elegans			3	79	137	90				3	17	52			1	1	1	
Streblospio shrubsolei	6	5	6												1			
Capitella capitata spp complex																		
Heteromastus filiformis																		
Tubificidae																	2	
Heterochaeta costata																		1
Tubificoides benedii			1															
Enchytraeidae																1	4	
Bathyporeia Juvenile										1								
Bathyporeia pilosa							11	11	16									
Haustorius arenarius								1										
Corophiidae		1														1		
Corophium volutator																		
Cyathura carinata	10	6	15	7	12	9				1	2	1	8	7	13	6	3	6
Eurydice pulchra							30	5	8									
Crangon crangon				1														
Portunidae Juvenile															1			1
Dolichopodidae Larvae															1		1	
Hydrobia ulvae	4	12	14	273	301	314				19	10	1	111	5	26	16	18	105
Alderia modesta																		
Pelecypoda	1	1	2		1										3			
Mytilus edulis Juvenile																		
Cerastoderma edule						2												
Macoma balthica					1	2					1							
Scrobicularia plana	4		3	8		2				3			7	2	1			3
Mya arenaria Juvenile		1																

Mawddach - quantitative intertidal infaunal core results - continued

	T2-22.1	T2-22.2	T2-22.3	T3-1.1	T3-1.2	T3-1.3	T3-2.1	T3-2.2	T3-2.3	T3-3.1	T3-3.2	T3-3.3	T3-4.1	T3-4.2	T3-4.3
Replicate															
Taxa															
Nematoda												2			
Eteone longa								1							
Anaitides mucosa															
Nereididae_Juvenile													12		
Hediste diversicolor				2			1						15	7	13
Pygospio elegans	1		1	7	5	14	42	22	99	1			5		
Streblospio shrubsolii								1					8	3	
Capitella capitata spp complex								1							
Heteromastus filiformis							1								
Tubificidae								8	1						
Heterochaeta costata				10			3		2				6	9	3
Tubificoides benedii													46	68	30
Enchytraeidae					5	10		2	7						
Bathyporeia Juvenile															
Bathyporeia pilosa			1												
Haustorius arenarius															
Corophiidae															
Corophium volutator									2						
Cyathura carinata				3	1	5	5	4	9			2	21	10	20
Eurydice pulchra												1			
Crangon crangon				1											
Portunidae Juvenile														1	
Dolichopodidae Larvae															
Hydrobia ulvae				6	13		6	17	89				57	13	3
Alderia modesta				1											
Pelecypoda							3							1	
Mytilus edulis Juvenile						1									
Cerastoderma edule															
Macoma balthica															
Scrobicularia plana							2	3	3				3	4	2
Mya arenaria Juvenile															

Appendix 7 Open coast - quantitative intertidal infaunal core results

Tremadog Bay - Open coast 2014	MD-LS					MD-MS					MH-LS					MH-MS					EC-MS					EC-LS					BRS-LS					BRS-MS			
Taxa	rep 1	rep 2	rep 3	rep 4	rep 5	rep 1	rep 2	rep 3	rep 4	rep 5	rep 1	rep 2	rep 3	rep 4	rep 5	rep 1	rep 2	rep 3	rep 4	rep 5	rep 1	rep 2	rep 3	rep 4	rep 5	rep 1	rep 2	rep 3	rep 4	rep 5	rep 1	rep 2	rep 3	rep 4	rep 5	rep 1	rep 2	rep 3	rep 4
Tubulanus polymorphus																																							
Polynoidae_Juvenile																																							
Eteone longa																																							
Anaitides mucosa																																							
Eumida_Juvenile																																							
Nephtys cirrosa	1		2	1	1						1			1	1																								
Paraonis fulgens											1	1																											
Scolecopsis squamata			1			1	1	3	1							1	2																						
Spio decorata				1																																			
Spio martinensis	1		1	2																																			
Spiophanes bombyx	1	1	2	1							1	1		3	1																								
Magelona filiformis																																							
Magelona johnstoni																																							
Capitella capitata																																							
Owenia borealis																																							
Gastrosaccus spinifer																																							
Pontocrates altamarinus																																							
Pontocrates arenarius																																							
Bathyporeia elegans				1																																			
Bathyporeia guilliamsoniana																																							
Bathyporeia pelagica																																							
Haustorium arenarium																																							
Eurydice pulchra											2	1	1		1																								
Lekanesphaera levi																																							
Crangon crangon	1																																						
Anapagurus chiroacanthus																																							
Portunus latipes																																							
Hydrobia ulvae																																							
Pelecypoda																																							
Angulus tenuis		1			3																																		
Donax vittatus																																							
Echinocardium cordatum																																							
Hemichordata																																							

Appendix 8 Porth Oer Rocky shore quadrat data

Location (Site)	PO-U1	PO-U2	PO-U3	PO-U4	PO-M1	PO-M2	PO-M3	PO-M4	PO-L1	PO-L2	PO-L3	PO-L4
Sample (Station)	Upper	Upper	Upper	Upper	Mid	Mid	Mid	Mid	Low	Low	Low	Low
Date	10/8/2014	10/8/2014	10/8/2014	10/8/2014	10/8/2014	10/8/2014	12/8/2014	12/8/2014	12/8/2014	12/8/2014	12/8/2014	12/8/2014
Replicate (Quadrat)	US1	US2	US3	US4	MS1	MS2	MS3	MS4	LS1	LS2	LS3	LS4
Surveyors	TM/TD	TM/TD	TM/TD	TM/TD	CMH/AB	CMH/AB	CMH/AB	CMH/AB	CMH/AB	CMH/AB	CMH/AB	CMH/AB
Photos	3871	3872	3873	3874	1080	1082	1119	1128	1120	1121	1122	1123, 1124
Time Start	15:20	15:40	16:03	16:16	15:20		15:45		15:45			
Time Finish	15:35	15:55	16:15	16:30		17:00		18:35				18:35
Taxon												
Hymeniacion perleve									1			
Actinia equina						4	4	5				
Prostigmata (mites)	1						P					
Cirripedia	3	6	10	16	25	25	25	25	25	25	25	25
Chthamalus montagui	3	6	10	16	25	25	25	25	25	25	25	25
Chthamalus stellatus					1	6	6	8	0	0	0	7
Semibalanus balanoides			1	2	25	25	25	25	25	25	25	25
Ligia oceanica	1											
Patella spp		6	8	14	25	25	25	25	25	25	25	25
Melarhaphe neritoides	3	4	9	5	4	25	25	25	5	0	2	0
Littorina saxatilis	5	4	11	7	4		2	1				
Mytilus edulis							8	1				
Littorina neglecta					25	6	25	25	25	25	23	25
RHODOPHYCOTA (filamentous)						2				18	25	
Audouinella purpurea		7	3	5								
Nemalion helminthoides							1		10	12	7	11
Corallinaceae						8	11	11	20	20	25	21
Corallina officinalis						7	6	6	23	25	25	22
Mastocarpus stellatus									2	12	9	1
Plocamium maggsiae									1	2	2	1
Catenella caespitosa	11	18	20	11								
Lomentaria articulata										4		
Aglaothamnion hookeri									1	2	12	5
Ceramium shuttleworthianum					1	1	1			1		1
Membranoptera alata										2	2	
Osmundea pinnatifida					1		2	5	13	14	11	8
Polysiphonia harveyi											P	
Ectocarpaceae						1						
Ralfsia verrucosa					25	25	25	25	25	25	25	25

Location (Site)	PO-U1	PO-U2	PO-U3	PO-U4	PO-M1	PO-M2	PO-M3	PO-M4	PO-L1	PO-L2	PO-L3	PO-L4
Boergeseniella thuyoides										3	1	
Fucus spiralis	6											
Pelvetia canaliculata	22	17	1									
Himanthalia elongata									2	4	7	2
Ulva intestinalis		8		2		8	24		3			
Ulva sp. (flat)						1	3		2	16	21	21
Chaetomorpha ligustica						1		3			5	3
Pyrenocollema (lichen)	3	6	10	16	P	P	P	P	P	P	P	P
Caloplaca marina			4									
Verrucaria black	25	25	25	25	25	25	25	25			13	17
Verrucaria green		2		10							1	
Prostigmata (mites)					1							
Ceramium sp.						1						
Fine red algae?						1						
Osmundea hybrida						2						
Lipura maritima							P	P		P	P	P
Porphyra							1					
Cladophora sp.								3				
Cladophora albida							1					1
Plumaria plumosa									1			
Red algal crust (dark)									10	25	10	13
Cereus pedunculatus										1		
Polysiphonia fucoides										1	3	
Leathesia difformis											2	
Ceramium ciliatum									1			3
Callithamnion granulatum									1		1	
Ceramium botryocarpum											1	1
Polysiphonia fibrata											1	1
Ceramium echionotum											1	

Appendix 9 Pen Llyn Ar Sarnau photograph log

Filename	Photo	Site	Transect	Zone	Stn	Replicate	Notes
20140810_TD_PorthOer_03871	TD	Porth Oer		Upper shore	US	1	Photo of quadrat
20140810_TD_PorthOer_03872	TD	Porth Oer		Upper shore	US	2	Photo of quadrat
20140810_TD_PorthOer_03873	TD	Porth Oer		Upper shore	US	3	Photo of quadrat
20140810_TD_PorthOer_03874	TD	Porth Oer		Upper shore	US	4	Photo of quadrat
20140810_PorthOer_CMH_1079	CMH	Porth Oer					View of rough sea on lower shore
20140810_PorthOer_CMH_1080	CMH	Porth Oer		Midshore	MS	1	Photo of quadrat
20140810_PorthOer_CMH_1082	CMH	Porth Oer		Midshore	MS	2	Photo of quadrat
20140811_TD_Llandanwg_1373.JPG	TD	Llandanwg		Sabellaria boundary			Mid beach, eroded Sabellaria with live patches around edges of large boulders
20140811_TD_Llandanwg_1374.JPG	TD	Llandanwg		Sabellaria boundary			"
20140811_TD_Llandanwg_1375.JPG	TD	Llandanwg		Sabellaria boundary			"
20140811_TD_Llandanwg_1376.JPG	TD	Llandanwg		Sabellaria boundary			Old algae covered Sabellaria in the upper beach at the western end of the area
20140811_TD_Llandanwg_1377.JPG	TD	Llandanwg		Sabellaria boundary			Sparse patches of Sabellaria behind boulders on open sand patches at eastern end of area
20140811_TD_Llandanwg_1378.JPG	TD	Llandanwg		Sabellaria boundary			Lots of small patches of live Sabellaria on the lower beach at the eastern end
20140811_TD_Llandanwg_1379.JPG	TD	Llandanwg		Sabellaria boundary			Lower beach area. Mounds of live Sabellaria
20140811_TD_Llandanwg_1380.JPG	TD	Llandanwg		Sabellaria boundary			Lower beach at western end. Very sparse patches
20140810_BW_WAD_0001	BW	WAD		Cottage			
20140810_BW_WAD_0002	BW	WAD		Cottage			
20140810_BW_WAD_0003	BW	WAD		Sabellaria	WAD8	1	Quadrat
20140810_BW_WAD_0004	BW	WAD		Sabellaria	WAD8	1	Quadrat
20140810_BW_WAD_0005	BW	WAD		Sabellaria	WAD8	2	Quadrat
20140810_BW_WAD_0006	BW	WAD		Sabellaria	WAD8	2	Quadrat
20140810_BW_WAD_0007	BW	WAD		Sabellaria	WAD8	3	Quadrat
20140810_BW_WAD_0008	BW	WAD		Sabellaria	WAD8	3	Quadrat
20140810_BW_WAD_0009	BW	WAD		Sabellaria	WAD8	4	Quadrat
20140810_BW_WAD_0010	BW	WAD		Sabellaria	WAD8	4	Quadrat
20140810_BW_WAD_0011	BW	WAD		Sabellaria	WAD8	5	Quadrat
20140810_BW_WAD_0012	BW	WAD		Sabellaria	WAD8	5	Quadrat
20140810_BW_WAD_0013	BW	WAD		Sabellaria	WAD7	1	Quadrat

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140810_BW_WAD_0014	BW	WAD		Sabellaria	WAD7	1	Quadrat
20140810_BW_WAD_0015	BW	WAD		Sabellaria	WAD7	2	Quadrat
20140810_BW_WAD_0016	BW	WAD		Sabellaria	WAD7	2	Quadrat
20140810_BW_WAD_0017	BW	WAD		Sabellaria	WAD7	3	Quadrat
20140810_BW_WAD_0018	BW	WAD		Sabellaria	WAD7	3	Quadrat
20140810_BW_WAD_0019	BW	WAD		Sabellaria	WAD7	4	Quadrat
20140810_BW_WAD_0020	BW	WAD		Sabellaria	WAD7	4	Quadrat
20140810_BW_WAD_0021	BW	WAD		Sabellaria	WAD7	5	Quadrat
20140810_BW_WAD_0022	BW	WAD		Sabellaria	WAD7	5	Quadrat
20140810_BW_WAD_0023	BW	WAD		Sabellaria	WAD6	1	Quadrat
20140810_BW_WAD_0024	BW	WAD		Sabellaria	WAD6	1	Quadrat
20140810_BW_WAD_0025	BW	WAD		Sabellaria	WAD6	2	Quadrat
20140810_BW_WAD_0026	BW	WAD		Sabellaria	WAD6	2	Quadrat
20140810_BW_WAD_0027	BW	WAD		Sabellaria	WAD6		Surveyors
20140810_BW_WAD_0028	BW	WAD		Sabellaria	WAD6		Surveyors
20140810_BW_WAD_0029	BW	WAD		Sabellaria	WAD6		Site
20140810_BW_WAD_0030	BW	WAD		Sabellaria	WAD6		Site
20140810_BW_WAD_0031	BW	WAD		Sabellaria	WAD6		Site
20140811_BW_WAD_0032	BW	WAD		Sabellaria	WAD6	3	Quadrat
20140811_BW_WAD_0033	BW	WAD		Sabellaria	WAD6	3	Quadrat
20140811_BW_WAD_0034	BW	WAD		Sabellaria	WAD6	4	Quadrat
20140811_BW_WAD_0035	BW	WAD		Sabellaria	WAD6	4	Quadrat
20140811_BW_WAD_0036	BW	WAD		Sabellaria	WAD6	5	Quadrat
20140811_BW_WAD_0037	BW	WAD		Sabellaria	WAD 3		
20140811_BW_WAD_0038	BW	WAD		Sabellaria	WAD 3		
20140811_BW_WAD_0039	BW	WAD		Sabellaria	WAD 3	1	Quadrat
20140811_BW_WAD_0040	BW	WAD		Sabellaria	WAD 3	1	Quadrat
20140811_BW_WAD_0041	BW	WAD		Sabellaria	WAD 3	2	Quadrat
20140811_BW_WAD_0042	BW	WAD		Sabellaria	WAD 3	2	Quadrat
20140811_BW_WAD_0043	BW	WAD		Sabellaria	WAD 3	3	Quadrat
20140811_BW_WAD_0044	BW	WAD		Sabellaria	WAD 3	3	Quadrat
20140811_BW_WAD_0045	BW	WAD		Sabellaria	WAD 3	4	Quadrat
20140811_BW_WAD_0046	BW	WAD		Sabellaria	WAD 3	4	Quadrat
20140811_BW_WAD_0047	BW	WAD		Sabellaria	WAD 3	5	Quadrat
20140811_BW_WAD_0048	BW	WAD		Sabellaria	WAD1	1	Quadrat
20140811_BW_WAD_0049	BW	WAD		Sabellaria	WAD1	2	Quadrat
20140811_BW_WAD_0050	BW	WAD		Sabellaria	WAD1	2	Quadrat

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140811_BW_WAD_0051	BW	WAD		Sabellaria	WAD1	3	Quadrat
20140811_BW_WAD_0052	BW	WAD		Sabellaria	WAD1	3	Quadrat
20140811_BW_WAD_0053	BW	WAD		Sabellaria	WAD1	4	Quadrat
20140811_BW_WAD_0054	BW	WAD		Sabellaria	WAD1	5	Quadrat
20140811_BW_WAD_0055	BW	WAD		Sabellaria	WAD1	5	Quadrat
20140811_AB_Llandanwg_1084.JPG	AB	Llandanwg			7	1	Quadrat
20140811_AB_Llandanwg_1085.JPG	AB	Llandanwg			7	1	Quadrat
20140811_AB_Llandanwg_1086.JPG	AB	Llandanwg			7	2	Quadrat
20140811_AB_Llandanwg_1087.JPG	AB	Llandanwg			7	3	Quadrat
20140811_AB_Llandanwg_1088.JPG	AB	Llandanwg			7	3	Quadrat
20140811_AB_Llandanwg_1089.JPG	AB	Llandanwg			7	4	Quadrat
20140811_AB_Llandanwg_1090.JPG	AB	Llandanwg			7	4	Quadrat
20140811_AB_Llandanwg_1091.JPG	AB	Llandanwg			7	5	Quadrat
20140811_AB_Llandanwg_1092.JPG	AB	Llandanwg			7	5	Quadrat
20140811_AB_Llandanwg_1093.JPG	AB	Llandanwg			4		Live Sabellaria reef
20140811_AB_Llandanwg_1094.JPG	AB	Llandanwg			4	1	Quadrat
20140811_AB_Llandanwg_1095.JPG	AB	Llandanwg			4	2	Quadrat
20140811_AB_Llandanwg_1096.JPG	AB	Llandanwg			4	2	Quadrat
20140811_AB_Llandanwg_1097.JPG	AB	Llandanwg			4	3	Quadrat
20140811_AB_Llandanwg_1098.JPG	AB	Llandanwg			4	3	Quadrat
20140811_AB_Llandanwg_1099.JPG	AB	Llandanwg			4		Cladophora
20140811_AB_Llandanwg_1100.JPG	AB	Llandanwg			4	4	Quadrat
20140811_AB_Llandanwg_1101.JPG	AB	Llandanwg			4	4	Quadrat
20140811_AB_Llandanwg_1102.JPG	AB	Llandanwg			4	5	Quadrat
20140811_AB_Llandanwg_1103.JPG	AB	Llandanwg			?		Live Sabellaria reef
20140811_AB_Llandanwg_1104.JPG	AB	Llandanwg			2	1	Quadrat
20140811_AB_Llandanwg_1105.JPG	AB	Llandanwg			2	1	Quadrat
20140811_AB_Llandanwg_1106.JPG	AB	Llandanwg			2	2	Quadrat
20140811_AB_Llandanwg_1107.JPG	AB	Llandanwg			2	3	Quadrat
20140811_AB_Llandanwg_1108.JPG	AB	Llandanwg			2	4	Quadrat
20140811_AB_Llandanwg_1109.JPG	AB	Llandanwg			2		New Sabellaria on old reef
20140811_AB_Llandanwg_1110.JPG	AB	Llandanwg			2		New Sabellaria on old reef
20140811_AB_Llandanwg_1111.JPG	AB	Llandanwg			2	4	Quadrat
20140811_AB_Llandanwg_1112.JPG	AB	Llandanwg			2	5	Quadrat
20140811_AB_Llandanwg_1113.JPG	AB	Llandanwg			8	1	Quadrat
20140811_AB_Llandanwg_1114.JPG	AB	Llandanwg			8	1	Quadrat
20140811_AB_Llandanwg_1115.JPG	AB	Llandanwg			8	2	Quadrat

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140811_AB_Llandanwg_1116.JPG	AB	Llandanwg			8	3	Quadrat
20140811_AB_Llandanwg_1117.JPG	AB	Llandanwg			8	4	Quadrat
20140811_TM_Llandanwg_335.JPG	TM	Llandanwg			6	1	quadrat
20140811_TM_Llandanwg_336.JPG	TM	Llandanwg			6	2	quadrat
20140811_TM_Llandanwg_337.JPG	TM	Llandanwg			6	3	quadrat
20140811_TM_Llandanwg_338.JPG	TM	Llandanwg			6	4	quadrat
20140811_TM_Llandanwg_339.JPG	TM	Llandanwg			6	5	quadrat
20140811_TM_Llandanwg_340.JPG	TM	Llandanwg			5	1	quadrat
20140811_TM_Llandanwg_341.JPG	TM	Llandanwg			5	2	quadrat
20140811_TM_Llandanwg_342.JPG	TM	Llandanwg			5	3	quadrat
20140811_TM_Llandanwg_343.JPG	TM	Llandanwg			5	4	quadrat
20140811_TM_Llandanwg_344.JPG	TM	Llandanwg			5	5	quadrat
20140811_TM_Llandanwg_345.JPG	TM	Llandanwg			3	1	quadrat
20140811_TM_Llandanwg_346.JPG	TM	Llandanwg			3	2	quadrat
20140811_TM_Llandanwg_347.JPG	TM	Llandanwg			3	3	quadrat
20140811_TM_Llandanwg_348.JPG	TM	Llandanwg			3	4	quadrat
20140811_TM_Llandanwg_349.JPG	TM	Llandanwg			3	5	quadrat
20140811_TM_Llandanwg_350.JPG	TM	Llandanwg					Building Sabellaria colony between Sites 1 and 3
20140811_TM_Llandanwg_351.JPG	TM	Llandanwg					Building Sabellaria colony between Sites 1 and 3
20140811_TM_Llandanwg_352.JPG	TM	Llandanwg					Building Sabellaria colony between Sites 1 and 3
20140811_TM_Llandanwg_353.JPG	TM	Llandanwg					Building Sabellaria colony between Sites 1 and 3
20140811_TM_Llandanwg_354.JPG	TM	Llandanwg			1	1	quadrat
20140811_TM_Llandanwg_355.JPG	TM	Llandanwg			1	2	quadrat
20140811_TM_Llandanwg_356.JPG	TM	Llandanwg			1	3	quadrat
20140811_TM_Llandanwg_357.JPG	TM	Llandanwg			1	4	quadrat
20140811_TM_Llandanwg_358.JPG	TM	Llandanwg			1	5	quadrat
20140811_TM_Llandanwg_359.JPG	TM	Llandanwg			9		View east at site 9 highlighting inundation
20140811_TM_Llandanwg_360.JPG	TM	Llandanwg			9		View south at site 9 highlighting inundation
20140811_TM_Llandanwg_361.JPG	TM	Llandanwg			9		View west at site 9 highlighting inundation
20140811_TM_Llandanwg_362.JPG	TM	Llandanwg			9		View north at site 9 highlighting inundation
20140811_TM_Llandanwg_363.JPG	TM	Llandanwg			9		New colony at site 9 surrounded by inundating sand

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140811_TM_Llandanwg_364.JPG	TM	Llandanwg			9		Eroded colony at site 9
20140811_TM_Llandanwg_365.JPG	TM	Llandanwg			9		Embryonic colony at site 9
20140811_TM_Llandanwg_366.JPG	TM	Llandanwg			9		Sand inundation at site 9
20140812_TM_Mawddach_0367.JPG	TM	Mawddach	T3	Salt marsh	3.4		Coring T3.4
20140812_TM_Mawddach_0368.JPG	TM	Mawddach	T3	Salt marsh	3.4		Coring T3.4
20140812_TM_Mawddach_0369.JPG	TM	Mawddach	T3	Salt marsh	3.4		Coring T3.4
20140812_TM_Mawddach_0370.JPG	TM	Mawddach	T3	Salt marsh	3.4		Core T3.4
20140812_TM_Mawddach_0371.JPG	TM	Mawddach	T3	Upper shore	3.1		Core hole at T3.1
20140812_TM_Mawddach_0372.JPG	TM	Mawddach	T3	Upper shore	3.1		View west T3.1
20140812_TM_Mawddach_0373.JPG	TM	Mawddach	T3	Upper shore	3.1		View north T3.1
20140812_TM_Mawddach_0374.JPG	TM	Mawddach	T3	Upper shore	3.1		View north east with Littorina littorea aggregations on the flats in the foreground
20140812_TM_Mawddach_0375.JPG	TM	Mawddach	T3	Upper shore	3.1		Core fracture face with oxygenated Hediste tubes evident
20140812_TM_Mawddach_0376.JPG	TM	Mawddach	T3	Middle shore	3.2		Coring T3.2
20140812_TM_Mawddach_0377.JPG	TM	Mawddach	T3	Middle shore	3.2		Coring T3.2
20140812_TM_Mawddach_0378.JPG	TM	Mawddach	T3	Middle shore	3.2		Core hole T3.2
20140812_TM_Mawddach_0379.JPG	TM	Mawddach	T3	Middle shore	3.3		Core holes at T3.3
20140812_TM_Mawddach_0380.JPG	TM	Mawddach	T3	Middle shore	3.3		Core holes at T3.3 in fine sand beneath the eroding fossil saltmarsh layer
20140812_TM_Mawddach_0381.JPG	TM	Mawddach	T3	Middle shore	3.3		Core hole at T3.3
20140812_TM_Mawddach_0382.JPG	TM	Mawddach	T3	Middle shore	3.3		View west along the eroding fossil saltmarsh clay edge at T3.3
20140812_AB_PorthOer_1119.JPG	AB	Porth Oer		Middle shore	3		quadrat
20140812_AB_PorthOer_1120.JPG	AB	Porth Oer		lower shore	1		quadrat
20140812_AB_PorthOer_1121.JPG	AB	Porth Oer		lower shore	2		quadrat
20140812_AB_PorthOer_1122.JPG	AB	Porth Oer		lower shore	3		quadrat
20140812_AB_PorthOer_1123.JPG	AB	Porth Oer		lower shore	4		quadrat
20140812_AB_PorthOer_1124.JPG	AB	Porth Oer		lower shore	4		quadrat
20140812_AB_PorthOer_1125.JPG	AB	Porth Oer		lower shore			Nemalion
20140812_AB_PorthOer_1127.JPG	AB	Porth Oer		lower shore			Corallina turf
20140812_AB_1128.JPG	AB	Porth Oer		middle shore	4		quadrat
20140812_LK_Mawddach_4257	LK	Mawddach	T2	Close to edge of saltmarsh	2.2		Coring T2.2
20140812_LK_Mawddach_4258	LK	Mawddach	T2	Close to edge of saltmarsh	2.2		Sediment surface at T2.2

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140812_LK_Mawddach_4259	LK	Mawddach	T2	Close to edge of saltmarsh	2.2		Representative core hole T2.2
20140812_LK_Mawddach_4260	LK	Mawddach	T2	Close to edge of saltmarsh	2.2		Representative core T2.2
20140812_LK_Mawddach_4261	LK	Mawddach	T2	Upper shore?	2.6		Coring T2.6
20140812_LK_Mawddach_4262	LK	Mawddach	T2	Upper shore?	2.6		Sediment surface at T2.6
20140812_LK_Mawddach_4263	LK	Mawddach	T2	Upper shore?	2.6		Representative core hole T2.6
20140812_LK_Mawddach_4264	LK	Mawddach	T2	Upper shore?	2.6		Representative core T2.6
20140812_LK_Mawddach_4265	LK	Mawddach	T2	Upper shore?	2.6		Burrow holes in sediment T2.6
20140812_LK_Mawddach_4266	LK	Mawddach	T2	Upper shore?	2.6		Sand binding green algae on sediment surface at T2.6
20140812_LK_Mawddach_4267	LK	Mawddach	T2	Lower shore			Channel edge and eroding old anoxic sediment
20140812_LK_Mawddach_4268	LK	Mawddach	T2	Lower shore			Waiting for the tide to go out by line of old eroding anoxic sediment
20140812_LK_Mawddach_4269	LK	Mawddach	T2	Lower shore			Eroding old anoxic sediment
20140812_LK_Mawddach_4270	LK	Mawddach	T2	Lower shore			Still waiting for the tide to go out Coring at extra station in middle of substantial area of fine sand with Arenicola
20140812_LK_Mawddach_4271	LK	Mawddach	T2	Middle shore	2.X1		Extra coring station in middle of substantial area of fine sand with Arenicola
20140812_LK_Mawddach_4272	LK	Mawddach	T2	Middle shore	2.X1		Sediment surface at extra coring station
20140812_LK_Mawddach_4273	LK	Mawddach	T2	Middle shore	2.X1		Spionid tubes at extra coring station
20140812_LK_Mawddach_4274	LK	Mawddach	T2	Middle shore	2.X1		Representative core hole at extra coring station
20140812_LK_Mawddach_4275	LK	Mawddach	T2	Middle shore	2.X1		Representative core at extra coring station
20140812_LK_Mawddach_4276	LK	Mawddach	T2	Middle shore	2.X1		Coring as close to station 22 as possible to get (about 20m away from actual station which was in the channel)
20140812_LK_Mawddach_4277	LK	Mawddach	T2	Lower shore	2.22B		Sediment surface at core station
20140812_LK_Mawddach_4278	LK	Mawddach	T2	Lower shore	2.22B		T2.22B Sediment surface at core station
20140812_LK_Mawddach_4279	LK	Mawddach	T2	Lower shore	2.22B		T2.22B
20140812_LK_Mawddach_4280	LK	Mawddach	T2	Lower shore	2.22B		Representative core hole at T2.22B
20140812_LK_Mawddach_4281	LK	Mawddach	T2	Lower shore	2.22B		Representative core at T2.22B
20140812_LK_Mawddach_4282	LK	Mawddach	T2	Lower shore	2.22B		Coring at T2.22B

Filename	Photo	Site	Transect	Zone	Stn	Rep-licate	Notes
20140812_BW_Mawddach_56	BW	Mawddach	T1		S1	Core	
20140812_BW_Mawddach_57	BW	Mawddach	T1		S1	Surveyors	
20140812_BW_Mawddach_58	BW	Mawddach	T1		S1	Surveyors	
20140812_BW_Mawddach_59	BW	Mawddach	T1		S1	Surveyors	
20140812_BW_Mawddach_60	BW	Mawddach	T1		S1	Saltmarsh	
20140812_BW_Mawddach_61	BW	Mawddach	T1		S1	Surveyors	
20140812_BW_Mawddach_62	BW	Mawddach	T1		S1	Core	
20140812_BW_Mawddach_63	BW	Mawddach	T1		S3b	Core	
20140812_BW_Mawddach_64	BW	Mawddach	T1		S3b	Shore	
20140812_BW_Mawddach_65	BW	Mawddach	T1		S3b	Shore	
20140812_BW_Mawddach_66	BW	Mawddach	T1		S3b	Shore	
20140812_BW_Mawddach_67	BW	Mawddach	T1		S3b	Surveyors	
20140812_BW_Mawddach_68	BW	Mawddach	T1		S3b	Surveyors	
20140812_BW_Mawddach_69	BW	Mawddach	T1		S2b	Surveyors	
20140812_BW_Mawddach_70	BW	Mawddach	T1		S2b	Core	
20140812_BW_Mawddach_71	BW	Mawddach	T1		S2b	Surveyors	
20140812_BW_Mawddach_72	BW	Mawddach	T1		S2b	Surveyors	
20140810_MD_WAD_4076	MD	WAD		Sabellaria extent tracking			Large rock represents the start point of the Sabellaria extent mapping. The large rock represents the limit of the Sabellaria (at the Criccieth castle end of the beach).
20140810_MD_WAD_4077	MD	WAD		Sabellaria extent tracking			Large rock represents the start point of the Sabellaria extent mapping. The large rock represents the limit of the Sabellaria (at the Criccieth castle end of the beach).
20140810_MD_WAD_4078	MD	WAD		Sabellaria extent tracking			Large rock represents the start point of the Sabellaria extent mapping. The large rock represents the limit of the Sabellaria (at the Criccieth castle end of the beach).
20140810_MD_WAD_4079	MD	WAD		Sabellaria extent tracking			Large rock represents the start point of the Sabellaria extent mapping. The large rock represents the limit of the Sabellaria (at the Criccieth castle end of the beach).
20140810_MD_WAD_4080	MD	WAD		Sabellaria extent tracking			Movement up shore (landwards) from the large rock (start point). Waypoint represents the extent limit of Sabellaria up shore from the start point.

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140810_MD_WAD_4081	MD	WAD		Sabellaria extent tracking			Movement up shore (landwards) from the large rock (start point). Waypoint represents the extent limit of Sabellaria up shore from the start point.
20140810_MD_WAD_4082	MD	WAD		Sabellaria extent tracking			Movement up shore (landwards) from the large rock (start point). Waypoint represents the extent limit of Sabellaria up shore from the start point.
20140810_MD_WAD_4083	MD	WAD		Sabellaria extent tracking			Movement up shore (landwards) from the large rock (start point). Waypoint represents the extent limit of Sabellaria up shore from the start point.
20140810_MD_WAD_4084	MD	WAD		Sabellaria extent tracking			Seaward end of dense patch of Sabellaria.
20140810_MD_WAD_4085	MD	WAD		Sabellaria extent tracking			Seaward end of dense patch of Sabellaria.
20140810_MD_WAD_4086	MD	WAD		Sabellaria extent tracking			Seaward end of dense patch of Sabellaria.
20140810_MD_WAD_4087	MD	WAD		Sabellaria extent tracking			Seaward end of dense patch of Sabellaria.
20140810_MD_WAD_4088	MD	WAD		Sabellaria extent tracking			From W004 walked up the shore (landwards) - no Sabellaria present between W004 and W005, and no Sabellaria present at W005.
20140810_MD_WAD_4089	MD	WAD		Sabellaria extent tracking			From W004 walked up the shore (landwards) - no Sabellaria present between W004 and W005, and no Sabellaria present at W005.
20140810_MD_WAD_4090	MD	WAD		Sabellaria extent tracking			From W004 walked up the shore (landwards) - no Sabellaria present between W004 and W005, and no Sabellaria present at W005.
20140810_MD_WAD_4091	MD	WAD		Sabellaria extent tracking			From W004 walked up the shore (landwards) - no Sabellaria present between W004 and W005, and no Sabellaria present at W005.
20140810_MD_WAD_4092	MD	WAD		Sabellaria extent tracking			Start of another patch of Sabellaria within the larger and denser patch of Sabellaria in this area.
20140810_MD_WAD_4093	MD	WAD		Sabellaria extent tracking			Start of another patch of Sabellaria within the larger and denser patch of

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140810_MD_WAD_4094	MD	WAD		Sabellaria extent tracking			Sabellaria in this area. Small patch of Sabellaria (<1m) on rock face.
20140810_MD_WAD_4095	MD	WAD		Sabellaria extent tracking			Beginning of another patch of Sabellaria.
20140810_MD_WAD_4096	MD	WAD		Sabellaria extent tracking			Beginning of another patch of Sabellaria.
20140810_MD_WAD_4097	MD	WAD		Sabellaria extent tracking			Seaward limit of the patch of Sabellaria on the shore.
20140810_MD_WAD_4098	MD	WAD		Sabellaria extent tracking			From the seaward limit of the patch of Sabellaria (marked by W010), walked landwards (up the shore) until reaching W011. W011 indicates a clear break between patches of Sabellaria (sandy habitat).
20140810_MD_WAD_4099	MD	WAD		Sabellaria extent tracking			From the seaward limit of the patch of Sabellaria (marked by W010), walked landwards (up the shore) until reaching W011. W011 indicates a clear break between patches of Sabellaria (sandy habitat).
20140810_MD_WAD_4100	MD	WAD		Sabellaria extent tracking			From the seaward limit of the patch of Sabellaria (marked by W010), walked landwards (up the shore) until reaching W011. W011 indicates a clear break between patches of Sabellaria (sandy habitat).
20140810_MD_WAD_4101	MD	WAD		Sabellaria extent tracking			Beginning of another patch of Sabellaria - less dense than the patches of Sabellaria between W001-W006.
20140810_MD_WAD_4102	MD	WAD		Sabellaria extent tracking			Jellyfish washed up on the rocks.
20140810_MD_WAD_4103	MD	WAD		Sabellaria extent tracking			Sandy habitat between rocky patches - no Sabellaria present.
20140810_MD_WAD_4104	MD	WAD		Sabellaria extent tracking			Rocky/Pebble habitat with dense patches of Fucus spp. attached. No Sabellaria present.
20140810_MD_WAD_4105	MD	WAD		Sabellaria extent tracking			Rocky/Pebble habitat with dense patches of Fucus spp. attached. Lots of standing water (approx. 60%). No Sabellaria present.
20140810_MD_WAD_4106	MD	WAD		Sabellaria extent tracking			End of the rocky/pebble habitat - beginning of sandy habitat.
20140810_MD_WAD_4107	MD	WAD		Sabellaria extent tracking			Relatively isolated and small patch of Sabellaria in sandy habitat.

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140810_MD_WAD_4108	MD	WAD		Sabellaria extent tracking			Relatively isolated and small patch of Sabellaria in sandy habitat.
20140810_MD_WAD_4109	MD	WAD		Sabellaria extent tracking			Relatively isolated and small patch of Sabellaria in sandy habitat.
20140810_MD_WAD_4110	MD	WAD		Sabellaria extent tracking			Sabellaria patch on rock within rocky habitat.
20140810_MD_WAD_4111	MD	WAD		Sabellaria extent tracking			Another patch of Sabellaria on a rock within sparsely distributed patches of Sabellaria. Nowhere near as dense as presence towards the extreme limit (W001).
20140810_MD_WAD_4112	MD	WAD		Sabellaria extent tracking			Another patch of Sabellaria on a rock within sparsely distributed patches of Sabellaria. Nowhere near as dense as presence towards the extreme limit (W001).
20140810_MD_WAD_4113	MD	WAD		Sabellaria extent tracking			Sabellaria patch on rock within rocky habitat (within sparse distribution of Sabellaria).
20140810_MD_WAD_4114	MD	WAD		Sabellaria extent tracking			Patches of Sabellaria on rocks within rocky habitat.
20140810_MD_WAD_4115	MD	WAD		Sabellaria extent tracking			End of rocky habitat - marking the beginning/re-commence of the sandy habitat.
20140810_MD_WAD_4116	MD	WAD		Sabellaria extent tracking			End of rocky habitat - marking the beginning/re-commence of the sandy habitat.
20140810_MD_WAD_4117	MD	WAD		Sabellaria extent tracking			End of rocky habitat - marking the beginning/re-commence of the sandy habitat.
20140810_MD_WAD_4118	MD	WAD		Sabellaria extent tracking			Beginning of rocky habitat/ end of sandy habitat - Sabellaria present at this Waypoint (W025).
20140810_MD_WAD_4119	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria.
20140810_MD_WAD_4120	MD	WAD		Sabellaria extent tracking			Evidence of previous Sabellaria reef - tending to be crusting and with few porches present which indicates live worms.
20140810_MD_WAD_4121	MD	WAD		Sabellaria extent tracking			Evidence of previous Sabellaria reef - tending to be crusting and with few porches present which indicates live worms.
20140810_MD_WAD_4122	MD	WAD		Sabellaria extent tracking			Sabellaria patch.
20140810_MD_WAD_4123	MD	WAD		Sabellaria extent tracking			Sabellaria patch. Walked from W029 to W030 - No Sabellaria present

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
							between these two Waypoints. Rocky habitat with dense patched of Fucus spp. attached.
20140810_MD_WAD_4124	MD	WAD		Sabellaria extent tracking			Sabellaria patch. Walked from W029 to W030 - No Sabellaria present
20140810_MD_WAD_4125	MD	WAD		Sabellaria extent tracking			between these two Waypoints. Rocky habitat with dense patched of Fucus spp. attached.
20140810_MD_WAD_4126	MD	WAD		Sabellaria extent tracking			Sabellaria present.
20140810_MD_WAD_4127	MD	WAD		Sabellaria extent tracking			Sabellaria present.
20140810_MD_WAD_4128	MD	WAD		Sabellaria extent tracking			Start of patchy distribution of Sabellaria.
20140810_MD_WAD_4129	MD	WAD		Sabellaria extent tracking			Start of patchy distribution of Sabellaria.
20140810_MD_WAD_4130	MD	WAD		Sabellaria extent tracking			Start of patchy distribution of Sabellaria.
20140810_MD_WAD_4131	MD	WAD		Sabellaria extent tracking			Start of patchy distribution of Sabellaria.
20140810_MD_WAD_4132	MD	WAD		Sabellaria extent tracking			Start of patchy distribution of Sabellaria.
20140810_MD_WAD_4133	MD	WAD		Sabellaria extent tracking			Start of patchy distribution of Sabellaria.
20140810_MD_WAD_4134	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria.
20140810_MD_WAD_4135	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria.
20140810_MD_WAD_4136	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria.
20140810_MD_WAD_4137	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria.
20140810_MD_WAD_4138	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria.
20140810_MD_WAD_4139	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria.
20140810_MD_WAD_4140	MD	WAD		Sabellaria extent tracking			Evidence of previous Sabellaria reef - tending to be crusting and with few porches present which indicates live worms.
20140810_MD_WAD_4141	MD	WAD		Sabellaria extent tracking			Sabellaria patches becoming less dense - more evidence of previous worm existence. Crusting and few porches present indicating less live animals.
20140810_MD_WAD_4142	MD	WAD		Sabellaria extent tracking			Sabellaria patches becoming less dense - more evidence of previous worm existence. Crusting and few porches present indicating less live animals.
20140810_MD_WAD_4143	MD	WAD		Sabellaria extent tracking			Natural break between the dense

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140810_MD_WAD_4144	MD	WAD		Sabellaria extent tracking			patches of Sabellaria. Patch of Sabellaria.
20140810_MD_WAD_4145	MD	WAD		Sabellaria extent tracking			Continuation of the sparse and patchy distribution of Sabellaria.
20140810_MD_WAD_4146	MD	WAD		Sabellaria extent tracking			No Sabellaria present.
20140810_MD_WAD_4147	MD	WAD		Sabellaria extent tracking			No Sabellaria present.
20140810_MD_WAD_4148	MD	WAD		Sabellaria extent tracking			No Sabellaria present.
20140810_MD_WAD_4149	MD	WAD		Sabellaria extent tracking			No Sabellaria present.
20140810_MD_WAD_4150	MD	WAD		Sabellaria extent tracking			No Sabellaria present - W042 marks the end of the sandy habitat and the beginning of the rocky/pebble habitat.
20140810_MD_WAD_4151	MD	WAD		Sabellaria extent tracking			No Sabellaria present - W042 marks the end of the sandy habitat and the beginning of the rocky/pebble habitat.
20140810_MD_WAD_4152	MD	WAD		Sabellaria extent tracking			Middle of the rocky/pebble habitat - no Sabellaria present.
20140810_MD_WAD_4153	MD	WAD		Sabellaria extent tracking			Middle of the rocky/pebble habitat - no Sabellaria present.
20140810_MD_WAD_4154	MD	WAD		Sabellaria extent tracking			Sabellaria present in small patches (<1m).
20140810_MD_WAD_4155	MD	WAD		Sabellaria extent tracking			End of small patches of Sabellaria.
20140810_MD_WAD_4156	MD	WAD		Sabellaria extent tracking			End of small patches of Sabellaria.
20140810_MD_WAD_4157	MD	WAD		Sabellaria extent tracking			Beginning of another sandy habitat.
20140810_MD_WAD_4158	MD	WAD		Sabellaria extent tracking			Beginning of another sandy habitat.
20140810_MD_WAD_4159	MD	WAD		Sabellaria extent tracking			Sabellaria present in small patches (<1m).
20140810_MD_WAD_4160	MD	WAD		Sabellaria extent tracking			Sabellaria present in small patches (<1m).
20140810_MD_WAD_4161	MD	WAD		Sabellaria extent tracking			Patchy Sabellaria, marking the end of the sandy habitat and the beginning of another rocky/pebble habitat.
20140810_MD_WAD_4162	MD	WAD		Sabellaria extent tracking			Patchy Sabellaria, marking the end of the sandy habitat and the beginning of another rocky/pebble habitat.
20140810_MD_WAD_4163	MD	WAD		Sabellaria extent tracking			End of the sandy habitat, and beginning of another rocky/pebble habitat - near the house (opposite end of Criccieth castle).
20140810_MD_WAD_4164	MD	WAD		Sabellaria extent tracking			End of the sandy habitat, and beginning of another rocky/pebble habitat - near the house (opposite end

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140810_MD_WAD_4165	MD	WAD		Sabellaria extent tracking			of Criccieth castle). End of the sandy habitat, and beginning of another rocky/pebble habitat - near the house (opposite end of Criccieth castle). End of the sandy habitat, and beginning of another rocky/pebble habitat - near the house (opposite end of Criccieth castle). 100% standing water - no Sabellaria present.
20140810_MD_WAD_4166	MD	WAD		Sabellaria extent tracking			Sandy habitat - no Sabellaria present.
20140810_MD_WAD_4167	MD	WAD		Sabellaria extent tracking			End of the sandy habitat, and beginning of the rocky/pebble habitat. No Sabellaria present.
20140810_MD_WAD_4168	MD	WAD		Sabellaria extent tracking			End of the sandy habitat, and beginning of the rocky/pebble habitat. No Sabellaria present.
20140810_MD_WAD_4169	MD	WAD		Sabellaria extent tracking			No Sabellaria present - habitat is rocky with dense Fucus spp.
20140810_MD_WAD_4170	MD	WAD		Sabellaria extent tracking			No Sabellaria present - habitat is rocky with dense Fucus spp.
20140810_MD_WAD_4171	MD	WAD		Sabellaria extent tracking			End of rocky/pebble habitat, marking the beginning of the sandy habitat. No Sabellaria present up to this Waypoint.
20140810_MD_WAD_4172	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria.
20140810_MD_WAD_4173	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria.
20140810_MD_WAD_4174	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria.
20140810_MD_WAD_4175	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria.
20140810_MD_WAD_4176	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria.
20140810_MD_WAD_4177	MD	WAD		Sabellaria extent tracking			End of patchy distribution of Sabellaria, marking the beginning of the sandy habitat.
20140810_MD_WAD_4178	MD	WAD		Sabellaria extent tracking			Patchy distribution of Sabellaria.
20140810_MD_WAD_4179	MD	WAD		Sabellaria extent tracking			Patchy distribution of Sabellaria.
20140810_MD_WAD_4180	MD	WAD		Sabellaria extent tracking			Patchy distribution of Sabellaria.
20140810_MD_WAD_4181	MD	WAD		Sabellaria extent tracking			Evidence of previous Sabellaria reef - tending to be crusting and with few porches present which indicates live worms.
20140810_MD_WAD_4182	MD	WAD		Sabellaria extent tracking			Relatively isolated patch of Sabellaria.
20140810_MD_WAD_4183	MD	WAD		Sabellaria extent tracking			Relatively isolated patch of Sabellaria.
20140810_MD_WAD_4184	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria (<1m).
20140810_MD_WAD_4185	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria (<1m).
20140810_MD_WAD_4186	MD	WAD		Sabellaria extent tracking			

Filename	Photo	Site	Transect	Zone	Stn	Rep-licate	Notes
20140810_MD_WAD_4187	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria (<1m).
20140810_MD_WAD_4188	MD	WAD		Sabellaria extent tracking			Patch of Sabellaria (<1m). Marks the end of the sandy habitat, and the beginning of the rocky/pebble habitat. Some Sabellaria present.
20140810_MD_WAD_4189	MD	WAD		Sabellaria extent tracking			Marks the end of the sandy habitat, and the beginning of the rocky/pebble habitat. Some Sabellaria present.
20140810_MD_WAD_4190	MD	WAD		Sabellaria extent tracking			Rocky/Pebble habitat with dense patches of Fucus spp. attached. No Sabellaria present.
20140810_MD_WAD_4191	MD	WAD		Sabellaria extent tracking			Rocky/Pebble habitat with dense patches of Fucus spp. attached. No Sabellaria present.
20140810_MD_WAD_4192	MD	WAD		Sabellaria extent tracking			No Sabellaria present.
20140810_MD_WAD_4193	MD	WAD		Sabellaria extent tracking			No Sabellaria present.
20140810_MD_WAD_4194	MD	WAD		Sabellaria extent tracking			No Sabellaria present.
20140810_MD_WAD_4195	MD	WAD		Sabellaria extent tracking			Patchy Sabellaria.
20140810_MD_WAD_4196	MD	WAD		Sabellaria extent tracking			Patchy Sabellaria.
20140810_MD_WAD_4197	MD	WAD		Sabellaria extent tracking			Sabellaria present in frequent and dense patches.
20140810_MD_WAD_4198	MD	WAD		Sabellaria extent tracking			Sabellaria present in frequent and dense patches.
20140810_MD_WAD_4199	MD	WAD		Sabellaria extent tracking			Sabellaria present in frequent and dense patches.
20140810_MD_WAD_4200	MD	WAD		Sabellaria extent tracking			Sabellaria present in frequent and dense patches.
20140810_MD_WAD_4201	MD	WAD		Sabellaria extent tracking			Sabellaria present in frequent and dense patches.
20140810_MD_WAD_4202	MD	WAD		Sabellaria extent tracking			Sabellaria present in frequent and dense patches.
20140810_MD_WAD_4203	MD	WAD		Sabellaria extent tracking			Sabellaria present in frequent and dense patches.
20140810_MD_WAD_4204	MD	WAD		Sabellaria extent tracking			Sabellaria present in frequent and dense patches.
20140810_MD_WAD_4205	MD	WAD		Sabellaria extent tracking			Sabellaria present in frequent and dense patches.
20140810_MD_WAD_4206	MD	WAD		Sabellaria extent tracking			Sabellaria present in frequent and dense patches.
20140810_MD_WAD_4207	MD	WAD		Sabellaria extent tracking			Sabellaria present in frequent and dense patches.
20140810_MD_WAD_4208	MD	WAD		Sabellaria extent tracking			Sabellaria present in frequent and dense patches.
20140810_MD_WAD_4209	MD	WAD		Sabellaria extent tracking			Sabellaria present in frequent and dense patches.

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140810_MD_WAD_4210	MD	WAD		Sabellaria extent tracking			Sabellaria present in frequent and dense patches. End of dense and patchy distribution of Sabellaria - W071 marks the start point of the recording of extent.
20140810_MD_WAD_4211	MD	WAD		Sabellaria extent tracking			
20140811_LK_WAD_4230	LK	WAD		Sabellaria	WAD 5	1	Quadrat
20140811_LK_WAD_4231	LK	WAD		Sabellaria	WAD 5	2	Quadrat
20140811_LK_WAD_4233	LK	WAD		Sabellaria	WAD 5	2	Quadrat
20140811_LK_WAD_4234	LK	WAD		Sabellaria	WAD 5		
20140811_LK_WAD_4235	LK	WAD		Sabellaria	WAD 5		
20140811_LK_WAD_4236	LK	WAD		Sabellaria	WAD 5	3	Quadrat
20140811_LK_WAD_4237	LK	WAD		Sabellaria	WAD 5	4	Quadrat
20140811_LK_WAD_4238	LK	WAD		Sabellaria	WAD 5	5	Quadrat
20140811_LK_WAD_4239	LK	WAD		Sabellaria	WAD 5	5	Quadrat
20140811_LK_WAD_4240	LK	WAD		Sabellaria	WAD 2	1	Quadrat
20140811_LK_WAD_4241	LK	WAD		Sabellaria	WAD 2	2	Quadrat
20140811_LK_WAD_4242	LK	WAD		Sabellaria	WAD 2	2	Quadrat
20140811_LK_WAD_4243	LK	WAD		Sabellaria	WAD 2	3	Quadrat
20140811_LK_WAD_4246	LK	WAD		Sabellaria	WAD 2	4	Quadrat
20140811_LK_WAD_4247	LK	WAD		Sabellaria	WAD 2	4	Quadrat
20140811_LK_WAD_4248	LK	WAD		Sabellaria	WAD 2	5	Quadrat
20140811_LK_WAD_4249	LK	WAD		Sabellaria	WAD 2	5	Quadrat
20140811_MD_PWLLHELI_PEC_4250	MD	PWLLHELI		PEC	WPC10		Sediment
20140811_MD_PWLLHELI_PEC_4251	MD	PWLLHELI		PEC			Surveyors searching
20140811_MD_PWLLHELI_PEC_4252	MD	PWLLHELI		PEC			Surveyors searching
20140811_MD_PWLLHELI_PEC_4253	MD	PWLLHELI		PEC	WP10		Sediment
20140811_MD_PWLLHELI_PEC_4254	MD	PWLLHELI		PEC	WP10		Sediment
20140811_MD_PWLLHELI_PEC_4255	MD	PWLLHELI		PEC			Shore
20140811_MD_PWLLHELI_PEC_4212	MD	PWLLHELI		PEC			Shore
20140811_MD_PWLLHELI_PEC_4213	MD	PWLLHELI		PEC			Surveyors on shore
20140811_MD_PWLLHELI_PEC_4214	MD	PWLLHELI		PEC			Surveyors searching
20140811_MD_PWLLHELI_PEC_4215	MD	PWLLHELI		PEC			Surveyors searching
20140811_MD_PWLLHELI_PEC_4216	MD	PWLLHELI		PEC			Surveyors searching
20140811_MD_PWLLHELI_PEC_4217	MD	PWLLHELI		PEC			Surveyors searching
20140811_MD_PWLLHELI_PEC_4218	MD	PWLLHELI		PEC			Surveyors searching
20140811_MD_PWLLHELI_PEC_4219	MD	PWLLHELI		PEC			Shore
20140811_MD_PWLLHELI_PEC_4220	MD	PWLLHELI		PEC			Surveyors
20140811_MD_PWLLHELI_PEC_4221	MD	PWLLHELI		PEC	WP003		Sediment

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140811_MD_PWLLHELI_PEC_4222	MD	PWLLHELI		PEC	WP003		Sediment
20140811_MD_PWLLHELI_PEC_4223	MD	PWLLHELI		PEC	WP003		Sediment
20140811_MD_PWLLHELI_PEC_4224	MD	PWLLHELI		PEC	WP004		Sediment
20140811_MD_PWLLHELI_PEC_4225	MD	PWLLHELI		PEC	WP004		Sediment
20140811_MD_PWLLHELI_PEC_4226	MD	PWLLHELI		PEC			Shore
20140811_MD_PWLLHELI_PEC_4228	MD	PWLLHELI		PEC	WP005		Sediment
20140811_MD_PWLLHELI_PEC_4229	MD	PWLLHELI		PEC	WP005		Sediment
20140811_MD_WAD_0825	MD	WAD		Sabellaria extent tracking			Start point - patches of live Sabellaria. First signs of distinguished abundance of Sabellaria - mostly dead but some live.
20140811_MD_WAD_0826	MD	WAD		Sabellaria extent tracking			Patches of dead reef.
20140811_MD_WAD_0827	MD	WAD		Sabellaria extent tracking			Patches of dead reef.
20140811_MD_WAD_0828	MD	WAD		Sabellaria extent tracking			No Sabellaria.
20140811_MD_WAD_0829	MD	WAD		Sabellaria extent tracking			Patches of sand but no Sabellaria - live or dead.
20140811_MD_WAD_0830	MD	WAD		Sabellaria extent tracking			Areas where you would expect Sabellaria to be present, but there is none.
20140811_MD_WAD_0831	MD	WAD		Sabellaria extent tracking			Areas where you would expect Sabellaria to be present, but there is none.
20140811_MD_WAD_0832	MD	WAD		Sabellaria extent tracking			Beginning of sandy habitat - no Sabellaria.
20140811_MD_WAD_0833	MD	WAD		Sabellaria extent tracking			Beginning of sandy habitat - no Sabellaria.
20140811_MD_WAD_0834	MD	WAD		Sabellaria extent tracking			Large patch of Sabellaria - approximately 10m2 - mix of live and dead Sabellaria but mostly dead.
20140811_MD_WAD_0835	MD	WAD		Sabellaria extent tracking			Large patch of Sabellaria - approximately 10m2 - mix of live and dead Sabellaria but mostly dead.
20140811_MD_WAD_0836	MD	WAD		Sabellaria extent tracking			Large patch of Sabellaria - approximately 10m2 - mix of live and dead Sabellaria but mostly dead.
20140811_MD_WAD_0837	MD	WAD		Sabellaria extent tracking			Large patch of Sabellaria - approximately 10m2 - mix of live and dead Sabellaria but mostly dead.
20140811_MD_WAD_0838	MD	WAD		Sabellaria extent tracking			Large patch of Sabellaria - approximately 10m2 - mix of live and dead Sabellaria but mostly dead.
20140811_MD_WAD_0839	MD	WAD		Sabellaria extent tracking			Large patch of dead Sabellaria - very close to W087.
20140811_MD_WAD_0840	MD	WAD		Sabellaria extent tracking			

Filename	Photo	Site	Transect	Zone	Stn	Rep-licate	Notes
20140811_MD_WAD_0841	MD	WAD		Sabellaria extent tracking			Dead Sabellaria. No Sabellaria from the previous WP - entering sandy habitat on the low shore.
20140811_MD_WAD_0842	MD	WAD		Sabellaria extent tracking			Washed up starfish.
20140811_MD_WAD_0843	MD	WAD		Sabellaria extent tracking			Washed up starfish.
20140811_MD_WAD_0844	MD	WAD		Sabellaria extent tracking			Washed up starfish.
20140811_MD_WAD_0845	MD	WAD		Sabellaria extent tracking			Dead Sabellaria.
20140811_MD_WAD_0846	MD	WAD		Sabellaria extent tracking			Sabellaria porches present.
20140811_MD_WAD_0847	MD	WAD		Sabellaria extent tracking			Sabellaria porches present.
20140811_MD_WAD_0848	MD	WAD		Sabellaria extent tracking			Nice live Sabellaria reef (similar to condition on the extreme western limit of the Sabellaria).
20140811_MD_WAD_0849	MD	WAD		Sabellaria extent tracking			Live patches of Sabellaria (approx. 1m2) - very dense.
20140811_MD_WAD_0850	MD	WAD		Sabellaria extent tracking			Live patches of Sabellaria (approx. 1m2) - very dense.
20140811_MD_WAD_0851	MD	WAD		Sabellaria extent tracking			Live Sabellaria.
20140811_MD_WAD_0852	MD	WAD		Sabellaria extent tracking			Sabellaria patches but not as 'live' as previous WP's have shown in this area.
20140811_MD_WAD_0853	MD	WAD		Sabellaria extent tracking			Live Sabellaria in patches.
20140811_MD_WAD_0854	MD	WAD		Sabellaria extent tracking			
20140813_LK_GlaslynDwryrd_4284	LK	Glaslyn Dwryrd			G14		general
20140813_LK_GlaslynDwryrd_4285	LK	Glaslyn Dwryrd			G14		general
20140813_LK_GlaslynDwryrd_4286	LK	Glaslyn Dwryrd			G14		Sediment surface
20140813_LK_GlaslynDwryrd_4287	LK	Glaslyn Dwryrd			G14		core hole
20140813_LK_GlaslynDwryrd_4288	LK	Glaslyn Dwryrd			G14		core
20140813_LK_GlaslynDwryrd_4289	LK	Glaslyn Dwryrd			G14		general
20140813_LK_GlaslynDwryrd_4290	LK	Glaslyn Dwryrd			G34		general
20140813_LK_GlaslynDwryrd_4291	LK	Glaslyn Dwryrd			G34		Sediment surface
20140813_LK_GlaslynDwryrd_4292	LK	Glaslyn Dwryrd			G34		core
20140813_LK_GlaslynDwryrd_4293	LK	Glaslyn Dwryrd			G34		sieve contents

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140813_LK_GlaslynDwryrd_4294	LK	Glaslyn Dwryrd			35B	general	
20140813_LK_GlaslynDwryrd_4295	LK	Glaslyn Dwryrd			35B	core hole	
20140813_LK_GlaslynDwryrd_4296	LK	Glaslyn Dwryrd			35B	core	
20140813_LK_GlaslynDwryrd_4297	LK	Glaslyn Dwryrd			35B	sieve contents	
20140813_LK_GlaslynDwryrd_4298	LK	Glaslyn Dwryrd			35B	sieve contents	
20140813_LK_GlaslynDwryrd_4299	LK	Glaslyn Dwryrd			35B	ripples	
20140813_LK_GlaslynDwryrd_4300	LK	Glaslyn Dwryrd			G20	coring	
20140813_LK_GlaslynDwryrd_4301	LK	Glaslyn Dwryrd			G20	general	
20140813_LK_GlaslynDwryrd_4302	LK	Glaslyn Dwryrd			G20	Sediment surface	
20140813_LK_GlaslynDwryrd_4303	LK	Glaslyn Dwryrd			G20	core	
20140813_LK_GlaslynDwryrd_4304	LK	Glaslyn Dwryrd			G20	Sediment surface	
20140813_LK_GlaslynDwryrd_4305	LK	Glaslyn Dwryrd			G20	ripples	
20140813_LK_GlaslynDwryrd_4306	LK	Glaslyn Dwryrd			G2	general	
20140813_LK_GlaslynDwryrd_4307	LK	Glaslyn Dwryrd			G2	general	
20140813_LK_GlaslynDwryrd_4308	LK	Glaslyn Dwryrd			G2	core hole	
20140813_LK_GlaslynDwryrd_4309	LK	Glaslyn Dwryrd			G2	core	
20140813_LK_GlaslynDwryrd_4310	LK	Glaslyn Dwryrd			G2	Sediment surface	
20140813_LK_GlaslynDwryrd_4311	LK	Glaslyn Dwryrd			G2	general	
20140813_LK_GlaslynDwryrd_4312	LK	Glaslyn Dwryrd			G2	sieve contents	
20140813_LK_GlaslynDwryrd_4313	LK	Glaslyn Dwryrd			G2	sieve contents	
20140813_LK_GlaslynDwryrd_4314	LK	Glaslyn Dwryrd			G2	sieve contents	

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140813_LK_GlaslynDwryrd_4315	LK	Dwryrd Glaslyn			G2	sieve contents	
20140813_LK_GlaslynDwryrd_4316	LK	Dwryrd Glaslyn			G2	sieve contents	
20140813_LK_GlaslynDwryrd_4317	LK	Dwryrd Glaslyn			G2	sieve contents	
20140813_LK_GlaslynDwryrd_4318	LK	Dwryrd Glaslyn			G10B(2)	Sediment surface	
20140813_LK_GlaslynDwryrd_4319	LK	Dwryrd Glaslyn			G10B(2)	core	
20140813_LK_GlaslynDwryrd_4320	LK	Dwryrd Glaslyn			G10B(2)	general	
20140813_LK_GlaslynDwryrd_4321	LK	Dwryrd Glaslyn			G10B(2)	general	
20140813_LK_GlaslynDwryrd_4322	LK	Dwryrd Glaslyn			G10B(2)	ripples	
20140813_LK_GlaslynDwryrd_4323	LK	Dwryrd Glaslyn			G10B(2)	ripples	
20140813_LK_GlaslynDwryrd_4324	LK	Dwryrd Glaslyn			G10B(2)	ripples	
20140813_LK_GlaslynDwryrd_4325	LK	Dwryrd Glaslyn			G10B(2)	general	
20140813_LK_GlaslynDwryrd_4326	LK	Dwryrd Glaslyn				general	
20140813_LK_GlaslynDwryrd_4327	LK	Dwryrd Glaslyn				general	
20140813_LK_GlaslynDwryrd_4328	LK	Dwryrd Glaslyn				general	
20140813_LK_GlaslynDwryrd_4329	LK	Dwryrd Glaslyn				general	
20140813_LK_GlaslynDwryrd_4330	LK	Dwryrd Glaslyn				general	
20140813_LK_GlaslynDwryrd_4331	LK	Dwryrd East				general	
20140814_CH_EastCriccieth_MS_0236.jpg	CH	Criccieth East		Middle shore		Core Extracting	
20140814_CH_EastCriccieth_MS_0237.jpg	CH	Criccieth East		Middle shore		Midshore site	
20140814_CH_EastCriccieth_MS_0238.jpg	CH	Criccieth		Middle shore		Midshore site	

Filename	Photo	Site	Transect	Zone	Stn	Rep-licate	Notes
20140814_CH_EastCriccieth_MS_0239.jpg	CH	East Criccieth		Middle shore			Shells on surface
20140814_CH_EastCriccieth_MS_0240.jpg	CH	East Criccieth		Middle shore			Core in sieve
20140814_AB_MorfaDyffryn_LS_1129.JPG	AB	Morfa Dyffryn		Lower shore			General
20140814_AB_MorfaDyffryn_LS_1130.JPG	AB	Morfa Dyffryn		Lower shore			Core
20140814_AB_MorfaDyffryn_LS_1131.JPG	AB	Morfa Dyffryn		Lower shore			Ripples
20140814_AB_MorfaDyffryn_MS_1132.JPG	AB	Morfa Dyffryn		Middle shore			Core
20140814_AB_MorfaDyffryn_MS_1133.JPG	AB	Morfa Dyffryn		Middle shore			general
20140814_AB_MorfaDyffryn_US_1134.JPG	AB	Morfa Dyffryn		Upper shore			profile
20140814_AB_MorfaDyffryn_US_1135.JPG	AB	Morfa Dyffryn		Upper shore			general and shingle ridge
20140814_AB_MorfaDyffryn_US_1136.JPG	AB	Morfa Dyffryn		Upper shore			shingle ridge
20140814_AB_MorfaHarlech_LS_1137.JPG	AB	Morfa Harlech		Lower shore			core
20140814_AB_MorfaHarlech_LS_1138.JPG	AB	Morfa Harlech		Lower shore			general with Tim
20140814_AB_MorfaHarlech_LS_1139.JPG	AB	Morfa Harlech		Lower shore			general
20140814_AB_MorfaHarlech_MS_1140.JPG	AB	Morfa Harlech		Middle shore			core
20140814_AB_MorfaHarlech_MS_1141.JPG	AB	Morfa Harlech		Middle shore			general
20140814_AB_MorfaHarlech_US_1142.JPG	AB	Morfa Harlech		Upper shore			profile
20140814_AB_MorfaHarlech_US_1143.JPG	AB	Morfa Harlech		Upper shore			general
20140813_BW_GlaslynDwryrd_0073.JPG	BW	Glaslyn Dwryrd			G49		core
20140813_BW_GlaslynDwryrd_0074.JPG	BW	Glaslyn Dwryrd			G49		general
20140813_BW_GlaslynDwryrd_0075.JPG	BW	Glaslyn Dwryrd			G50		core
20140813_BW_GlaslynDwryrd_0076.JPG	BW	Glaslyn Dwryrd			G50		general
20140813_BW_GlaslynDwryrd_0077.JPG	BW	Glaslyn Dwryrd			G87b		sieve contents
20140813_BW_GlaslynDwryrd_0078.JPG	BW	Glaslyn Dwryrd			G91		sieve contents

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140813_BW_GlaslynDwryrd_0079.JPG	BW	Glaslyn Dwryrd			G91		General
20140813_BW_GlaslynDwryrd_0080.JPG	BW	Glaslyn Dwryrd			G91		sediment surface
20140813_BW_GlaslynDwryrd_0081.JPG	BW	Glaslyn Dwryrd			G40Q		core
20140813_BW_GlaslynDwryrd_0082.JPG	BW	Glaslyn Dwryrd			G96		core hole
20140813_BW_GlaslynDwryrd_0083.JPG	BW	Glaslyn Dwryrd			G96		sediment surface
20140813_BW_GlaslynDwryrd_0084.JPG	BW	Glaslyn Dwryrd			G62b		core
20140813_BW_GlaslynDwryrd_0085.JPG	BW	Glaslyn Dwryrd			G62b		general
20140813_BW_GlaslynDwryrd_0086.JPG	BW	Glaslyn Dwryrd			G30b		core
20140813_BW_GlaslynDwryrd_0087.JPG	BW	Glaslyn Dwryrd			G30b		general
20140813_BW_GlaslynDwryrd_0088.JPG	BW	Glaslyn Dwryrd			G30b		sieve contents
20140813_BW_GlaslynDwryrd_0089.JPG	BW	Glaslyn Dwryrd			G31		core
20140813_BW_GlaslynDwryrd_0090.JPG	BW	Glaslyn Dwryrd			G31		general
20140813_BW_GlaslynDwryrd_0091.JPG	BW	Glaslyn Dwryrd			G31		general
20140813_BW_GlaslynDwryrd_0092.JPG	BW	Glaslyn Dwryrd			G31		general
20140813_BW_GlaslynDwryrd_0093.JPG	BW	Glaslyn Dwryrd			G31		sieve contents
20140813_BW_GlaslynDwryrd_0094.JPG	BW	Glaslyn Dwryrd			G31		sieve contents
20140813_BW_GlaslynDwryrd_0095.JPG	BW	Glaslyn Dwryrd			G31		sieve contents
20140813_BW_GlaslynDwryrd_0096.JPG	BW	Glaslyn Dwryrd			G31		sieve contents
20140813_BW_GlaslynDwryrd_0097.JPG	BW	Glaslyn Dwryrd			G31		sieve contents
20140813_BW_GlaslynDwryrd_0098.JPG	BW	Glaslyn Dwryrd			G31		sieve contents

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140813_BW_GlaslynDwryrd_0099.JPG	BW	Glaslyn Dwryrd			G44		core
20140813_BW_GlaslynDwryrd_0100.JPG	BW	Glaslyn Dwryrd			G44		general
20140813_BW_GlaslynDwryrd_0101.JPG	BW	Glaslyn Dwryrd			G44		general
20140813_BW_GlaslynDwryrd_0102.JPG	BW	Glaslyn Dwryrd			G41Q		core
20140813_BW_GlaslynDwryrd_0103.JPG	BW	Glaslyn Dwryrd			G41Q		core
20140813_BW_GlaslynDwryrd_0104.JPG	BW	Glaslyn Dwryrd			G41Q		core hole
20140813_BW_GlaslynDwryrd_0105.JPG	BW	Glaslyn Dwryrd			G41Q		general
20140814_BW_GlaslynDwryrd_0106.JPG	BW	Glaslyn Dwryrd			G13		core
20140814_BW_GlaslynDwryrd_0107.JPG	BW	Glaslyn Dwryrd			G13		sediment surface
20140814_BW_GlaslynDwryrd_0108.JPG	BW	Glaslyn Dwryrd			G13		sieve contents
20140814_BW_GlaslynDwryrd_0109.JPG	BW	Glaslyn Dwryrd			G13		general
20140814_BW_GlaslynDwryrd_0110.JPG	BW	Glaslyn Dwryrd			G13		general
20140814_BW_GlaslynDwryrd_0112.JPG	BW	Glaslyn Dwryrd			G15		core
20140814_BW_GlaslynDwryrd_0113.JPG	BW	Glaslyn Dwryrd			G15		core hole
20140814_BW_GlaslynDwryrd_0114.JPG	BW	Glaslyn Dwryrd			G15		sieve contents
20140814_BW_GlaslynDwryrd_0125.JPG	BW	Glaslyn Dwryrd			G09		coring
20140814_BW_GlaslynDwryrd_0126.JPG	BW	Glaslyn Dwryrd			G09		coring
20140814_BW_GlaslynDwryrd_0127.JPG	BW	Glaslyn Dwryrd			G09		core
20140814_BW_GlaslynDwryrd_0128.JPG	BW	Glaslyn Dwryrd			G09		core hole
20140814_BW_GlaslynDwryrd_0131.JPG	BW	Glaslyn Dwryrd			G09		general
20140814_BW_GlaslynDwryrd_0132.JPG	BW	Glaslyn Dwryrd			G09		sieve contents

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140814_BW_GlaslynDwryrd_0136.JPG	BW	Dwryrd Glaslyn			G80		general
20140814_BW_GlaslynDwryrd_0137.JPG	BW	Dwryrd Glaslyn			G80		core
20140814_BW_GlaslynDwryrd_0138.JPG	BW	Dwryrd Glaslyn			G80		core hole
20140814_BW_GlaslynDwryrd_0139.JPG	BW	Dwryrd Glaslyn			G80		general
20140814_BW_GlaslynDwryrd_0140.JPG	BW	Dwryrd Glaslyn			G80		general
20140814_BW_GlaslynDwryrd_0141.JPG	BW	Dwryrd Glaslyn			G80		sieve contents
20140814_BW_GlaslynDwryrd_0142.JPG	BW	Dwryrd Glaslyn			G80		sieve contents
20140813_TM_GlaslynDwryrd_0383.JPG	TM	Dwryrd Glaslyn			G68	in situ	Coring
20140813_TM_GlaslynDwryrd_0384.JPG	TM	Dwryrd Glaslyn			G68	in situ	Coring
20140813_TM_GlaslynDwryrd_0385.JPG	TM	Dwryrd Glaslyn			G68	in situ	Coring
20140813_TM_GlaslynDwryrd_0386.JPG	TM	Dwryrd Glaslyn			G47	in situ	Coring
20140813_TM_GlaslynDwryrd_0387.JPG	TM	Dwryrd Glaslyn			G47	in situ	Core hole
20140813_TM_GlaslynDwryrd_0388.JPG	TM	Dwryrd Glaslyn			G47	in situ	Habitat
20140813_TM_GlaslynDwryrd_0389.JPG	TM	Dwryrd Glaslyn					Rainbow over Port Merion
20140813_TM_GlaslynDwryrd_0390.JPG	TM	Dwryrd Glaslyn					Rainbow over Port Merion
20140813_TM_GlaslynDwryrd_0391.JPG	TM	Dwryrd Glaslyn			G56	in situ	Core
20140813_TM_GlaslynDwryrd_0392.JPG	TM	Dwryrd Glaslyn			G56	in situ	Habitat
20140813_TM_GlaslynDwryrd_0393.JPG	TM	Dwryrd Glaslyn			G56	in situ	Habitat
20140813_TM_GlaslynDwryrd_0394.JPG	TM	Dwryrd Glaslyn			G57b	in situ	Core
20140813_TM_GlaslynDwryrd_0395.JPG	TM	Dwryrd Glaslyn			G57b	in situ	Habitat

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140813_TM_GlaslynDwryrd_0396.JPG	TM	Glaslyn Dwryrd			G57b	in situ	Habitat
20140813_TM_GlaslynDwryrd_0397.JPG	TM	Glaslyn Dwryrd			G22	in situ	Core
20140813_TM_GlaslynDwryrd_0398.JPG	TM	Glaslyn Dwryrd			G22	in situ	Habitat
20140813_TM_GlaslynDwryrd_0399.JPG	TM	Glaslyn Dwryrd			G22	in situ	Habitat
20140813_TM_GlaslynDwryrd_0400.JPG	TM	Glaslyn Dwryrd			G29b	in situ	Core
20140813_TM_GlaslynDwryrd_0401.JPG	TM	Glaslyn Dwryrd			G29b	in situ	Habitat
20140813_TM_GlaslynDwryrd_0402.JPG	TM	Glaslyn Dwryrd			G29b	in situ	Habitat
20140813_TM_GlaslynDwryrd_0403.JPG	TM	Glaslyn Dwryrd			G28	in situ	Core
20140813_TM_GlaslynDwryrd_0404.JPG	TM	Glaslyn Dwryrd			G28	in situ	Habitat
20140813_TM_GlaslynDwryrd_0405.JPG	TM	Glaslyn Dwryrd			G28	in situ	Habitat
20140813_TM_GlaslynDwryrd_0406.JPG	TM	Glaslyn Dwryrd			G21b	in situ	Core
20140813_TM_GlaslynDwryrd_0407.JPG	TM	Glaslyn Dwryrd			G21b	in situ	Core
20140813_TM_GlaslynDwryrd_0408.JPG	TM	Glaslyn Dwryrd			G21b	in situ	Habitat
20140813_TM_GlaslynDwryrd_0409.JPG	TM	Glaslyn Dwryrd			G46	in situ	Core
20140813_TM_GlaslynDwryrd_0410.JPG	TM	Glaslyn Dwryrd			G46	in situ	Habitat
20140813_TM_GlaslynDwryrd_0411.JPG	TM	Glaslyn Dwryrd			G46	in situ	Habitat
20140813_TM_GlaslynDwryrd_0412.JPG	TM	Glaslyn Dwryrd			G86	in situ	Core
20140813_TM_GlaslynDwryrd_0413.JPG	TM	Glaslyn Dwryrd			G86	in situ	Habitat
20140813_TM_GlaslynDwryrd_0414.JPG	TM	Glaslyn Dwryrd			G86	in situ	Habitat
20140813_TM_GlaslynDwryrd_0415.JPG	TM	Dwryrd			G55	Cores	Coring
20140813_TM_GlaslynDwryrd_0416.JPG	TM	Glaslyn			G55	Cores	Coring

Filename	Photo	Site	Transect	Zone	Stn	Rep- licate	Notes
20140813_TM_GlaslynDwryrd_0417.JPG	TM	Dwryrd Glaslyn			G55	Cores	Habitat
20140813_TM_GlaslynDwryrd_0418.JPG	TM	Dwryrd Glaslyn			G55	Cores	Core
20140813_TM_GlaslynDwryrd_0419.JPG	TM	Dwryrd Glaslyn			G54	in situ	Core
20140813_TM_GlaslynDwryrd_0420.JPG	TM	Dwryrd Glaslyn			G54	in situ	Core hole
20140813_TM_GlaslynDwryrd_0421.JPG	TM	Dwryrd Glaslyn			G54	in situ	Habitat
20140813_TM_GlaslynDwryrd_0422.JPG	TM	Dwryrd Glaslyn			G61	Cores	Core
20140813_TM_GlaslynDwryrd_0423.JPG	TM	Dwryrd Glaslyn			G61	Cores	Habitat
20140813_TM_GlaslynDwryrd_0424.JPG	TM	Dwryrd Glaslyn			G61	Cores	Habitat
20140813_TM_GlaslynDwryrd_0425.JPG	TM	Dwryrd Glaslyn			G61	Cores	Habitat
20140813_TM_GlaslynDwryrd_0426.JPG	TM	Dwryrd Glaslyn			G61	Cores	Habitat
20140813_TM_GlaslynDwryrd_0427.JPG	TM	Dwryrd Glaslyn			G61	Cores	Habitat
20140813_TM_GlaslynDwryrd_0428.JPG	TM	Dwryrd Glaslyn			G61	Cores	Habitat
20140813_TM_GlaslynDwryrd_0429.JPG	TM	Dwryrd Glaslyn			G61	Cores	Sieving
20140813_TM_GlaslynDwryrd_0430.JPG	TM	Dwryrd					Geese over Morfa Harlech

Appendix 10 Data Archive

Data outputs associated with this project are archived as Project No 41, Media No 1525 on server-based storage at Natural Resources Wales.

The data archive contains:

- [A] The final report in Microsoft Word and Adobe PDF formats.
- [B] A series of GIS layers on which the maps in the report are based with a series of word documents detailing the data processing and structure of the GIS layers
- [C] A series of spreadsheets named: PLAS 2014 Porth Oer bedrock Data.xls; PLAS 2014 Sabellaria Quads Data.xls; PLAS 2014 Glaslyn Dwryd sediment Data; PLAS 2014 Mawddach sediment Data; PLAS 2014 open coast sediment Data; PLAS 2014 PhotoLog.xls in Microsoft Excel 2000 format with metadata.
- [D] A full set of images produced in jpg format.

Metadata for this project is publicly accessible through Natural Resources Wales' Library Catalogue <http://194.83.155.90/olibcgj> by searching 'Dataset Titles'. The metadata is held as record no [NRW to insert this number]



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