Cyfoeth Naturiol Cymru
Natural Resources Wales

Intertidal monitoring, Pen Llyn a'r Sarnau SAC August 2013

Tom Mercer
Aquatic Survey & Monitoring Ltd.

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Mae ACA Pen Llŷn a'r Sarnau wedi'i dynodi ar sail ei haberoedd a'i gwastadeddau llaid, ei gwastadeddau tywod a'u riffiau; ei baeau a'i chilfachau bas mawr sydd â gwlâu *Zostera*; ei phoblogaethau o'r deudroediad *Pectenogammarus* sy'n byw mewn graean, y pidogau mewn clai rhynglanwol a'r cymunedau clogfeini ar y traeth is, yn arbennig y riffiau biogenig *Sabellaria alveolata*. Caiff y nodweddion hyn eu monitro gan ASML ar ran Cyfoeth Naturiol Cymru (CNC), sydd â dyletswydd statudol i lunio cyngor dan Reoliad 35 (Rheoliad 33 gynt) Rheoliadau Cynefinoedd 1994.

Yn 2013:

- cafodd riffiau rhynglanwol, a nodweddir gan rîff biogenig a ffurfiwyd gan lyngyr diliau *Sabellaria alveolata*, eu harolygu yng Ngorllewin Afon Dwyfor a Llandanwg gyda nifer o gwadratau mesur. Ymhellach, cafodd yr ardal lle y ceir *Sabellaria alveolata* ei mapio a'i chymharu â blynyddoedd blaenorol. Ymddengys fod yr ardaloedd lle y ceir riffiau *Sabellaria alveolata* yn lleoliadau'r ddau arolwg wedi cynyddu rhwng 2012 a 2013.
- cafodd poblogaethau *Pectenogammarus* (LGS.Pec), sef deudroediad anfynych sy'n byw'n benodol ar lannau graeanog, eu harolygu ger Pwllheli a chymharwyd eu helaethrwydd â blynyddoedd blaenorol. Gwelwyd bod y poblogaethau yn 2013 yn weddol debyg i'r poblogaethau yn 2012.
- cafodd biotopau gwaddodion aberoedd Dyfi a Glaslyn/Dwyryd eu harolygu, o ran ansawdd a maint.
- cafodd biotopau gwaddodion Dyfi eu hasesu o ran ansawdd a maint. Arweiniodd hyn at restr o fiotopau gwaddodion i'w hasesu yn y dyfodol. Cafodd samplau isfilodol meintiol eu dadansoddi a chyfrifwyd amrywiaeth o ystadegau cymunedol un-newidyn. Gellir defnyddio'r rhain hefyd i'w cymharu yn y dyfodol.
- cafodd samplau isfilodol meintiol Glaslyn/Dwyryd eu dadansoddi a chyfrifwyd amrywiaeth o ystadegau cymunedol un-newidyn. Gellir defnyddio'r rhain i'w cymharu yn y dyfodol.
- cafodd y cwadratau monitro sefydlog yng ngorsafoedd y traethau uchaf, canol ac is ym Mhorth Oer eu harolygu a'u cymharu â chanlyniadau 2012. Lluniwyd rhestr o rywogaethau ar gyfer y cwadratau monitro sefydlog. Gwelwyd bod dwysedd y llygaid meheryn wedi cynyddu yng nghwadratau'r traethau uchaf ac isaf, ac wedi gostwng tipyn bach yng nghwadratau'r traeth canol. Roedd maint cymedrig llygaid meheryn y traeth canol wedi cynyddu 25%. Roedd dwysedd y cregyn llong hefyd wedi cynyddu tipyn bach yn y traethau canol ac uchaf, ac wedi gostwng rhywfaint yn y traeth is.

Bydd yr holl ganlyniadau'n cael eu defnyddio mewn gwaith monitro yn y dyfodol.

Executive Summary

Pen Llyn a'r Sarnau SAC is designated for its 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 intertidal clay and lower shore boulder communities and reefs, particularly the biogenic reefs of *Sabellaria alveolata*. These features are monitored by ASML on behalf of Natural Resources Wales (NRW), which has a statutory duty to produce advice under Regulation 35 (formerly Regulation 33) of the Habitats Regulations 1994.

In 2013:

- Intertidal reefs, characterised by biogenic reef formed by the honeycomb reef worm *Sabellaria alveolata* were surveyed at West Afon Dwyfor and Llandanwg with multiple quantitative quadrats. The area occupied by the *Sabellaria alveolata* reef was also mapped and compared to previous years. The areas of *Sabellaria alveolata* reef at both survey locations appeared to increase between 2012 and 2013.
- *Pectenogammarus* populations (LGS.Pec), a scarce, shingle shore specific amphipod, was surveyed near Pwllheli and its abundance compared to previous years. It was found to be broadly similar in 2013 compared to 2012.
- the sediment biotopes of the Dyfi & Glaslyn/Dwyryd estuaries were surveyed both qualitatively and quantitatively respectively.
- the Dyfi sediment biotopes were assessed qualitatively in situ and quantitatively. This produced a list of sediment biotopes for future assessment. Whilst the quantitative infaunal samples were analysed and a range of univariate community statistics were calculated. These can also be used for comparison in the future.
- the Glaslyn/Dwyryd quantitative infaunal samples were analysed and a range of univariate community statistics were calculated. These can be used for comparison in the future.
- the fixed monitoring quadrats in the upper, mid and lower shore stations at Porth Oer were surveyed and compared to 2012's results. A species list was produced for the fixed monitoring quadrats. The limpet density was found to have risen in the upper and lower shore monitoring quadrats and fallen slightly in the middle shore quadrats. Correspondingly the mean size of middle shore limpets had increased by 25%. Barnacle cover had also increased slightly in the middle and upper shore, and fallen slightly in the lower shore.

All results will be monitored against in the future.

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 35 (formerly 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 35 advice package is the foundation for feature condition monitoring, which is required in order for NRW to fulfil its function of reporting on the favourable conservation status of the features. NRW continues to develop the Regulation 35 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 35 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. Map based upon Ordnance Survey material © Crown copyright. All rights reserved. NRW, 100019741 2016.

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 (*Glauco-Puccinellietalia maritimae*)
	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/Dwyryd, 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/Dwyryd 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 200 m in the area surveyed (pers. comm. G. Wyn, NRW). 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 (G. Wyn, pers comm NRW). 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/Dwyryd 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.

An offshore reef was constructed at Borth in 2011/2012, south of the Dyfi estuary, which may have consequences for the integrity of the estuary. Swansea University are currently looking at long term beach evolution (up to 2030) and numerical modelling of erosion and accretion north of Borth.

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 2009, 2010 and 2012 (Mercer 2010; Mercer 2010b; Mercer 2011).

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 (LS.LCS.Sh.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 an 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 2010; Mercer 2010b; Mercer 2011).

1.6. Survey objectives

Table 2 Tasks selected by NRW for study by ASML in the SAC in 2013

Feature / attribute	Site(s)	Task
Sabellaria alveolata - distribution, quality and associated species	Llandanwg and West of Afon Dwyfor rocky shores	To re-map the boundary of the *Sabellaria* reefs and re-survey with quadrats the transects established and surveyed in 2009 - 2012.
Pectenogammarus populations (LGS.Pec) - presence	Marian-y-de at Pwllheli	To monitor the population of this scarce 'shingle beach specific' amphipod species.
Estuaries	Dyfi & Glaslyn/Dwyryd estuaries	To re-survey the sediment shore *in situ* and at the coring sites established in 2007 & 2008 respectively
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.

The *Sabellaria alveolata* work planned was to repeat the 2009, 2010, 2011 and 2012 quadrat work carried out by CCW 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 this monitoring site on the Llyn Peninsula utilising the methods developed for the existing monitoring sites in the Pembrokeshire Coast SAC. 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 2010) and 2009 (Mercer 2010b). The Dyfi quantitative sediment sampling sites were established in 2007 and this work in 2013 repeated the coring exercise. Whilst the *in situ* grid sampling sediment work helped to re-map the river Dyfi channel position and the location of the littoral sediment biotopes within the estuary sediments.

2. Method

2.1. Survey planning, logistics and risk assessment

Development of a survey strategy and methodology for the 2013 tasks was carried out by ASML and CCW. Logistical planning for the 2013 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 Harlech (Hafod y Morfa). Whilst located in an ideal location for work all over the PLAS SAC, the lack of WiFi proved to be a slight negative issue.

Field survey equipment was provided by both ASML and CCW; 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 CCW. 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, 19th to 23rd August 2013, by a team of up to eight 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 2013 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 can provide good quality, repeatable data in a relatively short timescale. These methods were considered appropriate in 2013.

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 m^2 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 obviously 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 m^2 (0.5 m x 0.5 m). A larger size quadrat would be cumbersome in the large boulder habitat and it would also be inefficiently searched.

The methodology of Boyes & Allen (2008) provided data for eight quadrats spaced over a large area of shore, which provides an inadequate amount of data for monitoring change in this habitat due to its high natural spatial and temporal variability (high risk of both type I and type II errors[1]). Greater replication of quadrat data can be achieved by reducing the number of attributes recorded and using measures that are simpler/quicker to collect. In particular, recording abundance of all conspicuous species with cell frequencies in a 1 m^2 quadrat can take too long. For many species in this habitat it also provides more precision than is necessary, because of the high natural spatial and temporal variability in their abundance. Rapid estimates of percentage cover are much quicker to record for algae and other ground covering species, whereas 'presence' only is adequate for mobile faunal species. If presence of a species is recorded in a large number of random quadrats, this provides a robust and ecologically relevant measure of its abundance at a site. However the available data provide fewer options for statistical analysis of change. Some saving in time and a considerable reduction in habitat heterogeneity can also be achieved by concentrating the quadrats on just a few (e.g. 3) selected transects within each site. 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 2013, having been surveyed by ASML in 2009, 2010 and 2012:

[1] If a null hypothesis is incorrectly rejected, when it should in fact be accepted, it is called a **Type I error** (also known as a false positive). A **Type II error** (also known as a false negative), occurs when a null hypothesis is incorrectly accepted when it should in fact be rejected.

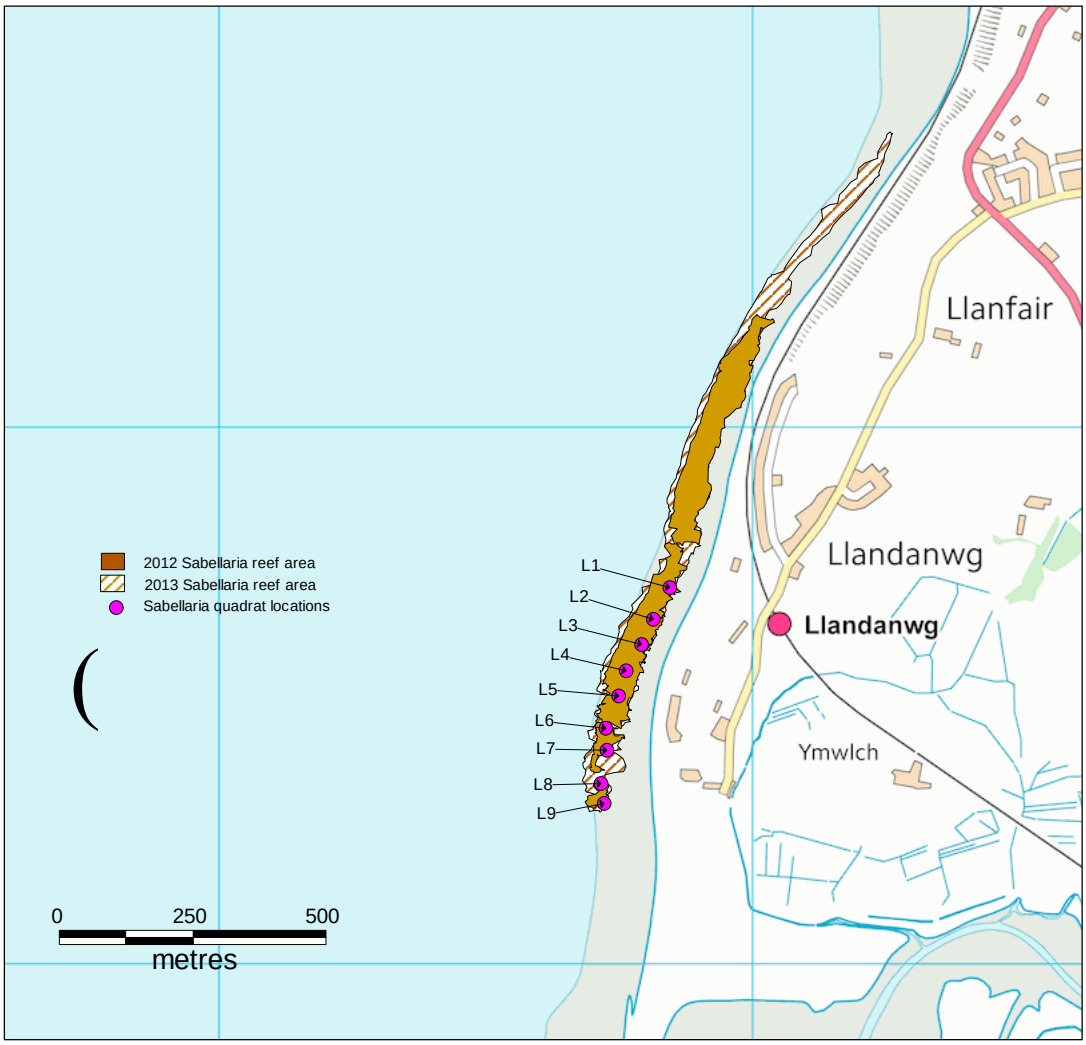

Figure 2. Location of the *Sabellaria alveolata* reef and quadrat sites at Llandanwg. Map based upon Ordnance Survey material © Crown copyright. All rights reserved. NRW, 100018813 2016

Existing 2012 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 2013. At both Llandanwg and West Afon Dwyfor the survey task was to re-survey the areas surveyed by quadrat in 2009, 2010 and 2012. 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. The mapped areas were very similar to the 2012 areas, as can be seen on Figure 2, but more time was available to extend the mapping exercise to the north and take in all of the bed in question, before the boulder beach gives way to the sands of Morfa Harlech. On the shore, the GPS units 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.

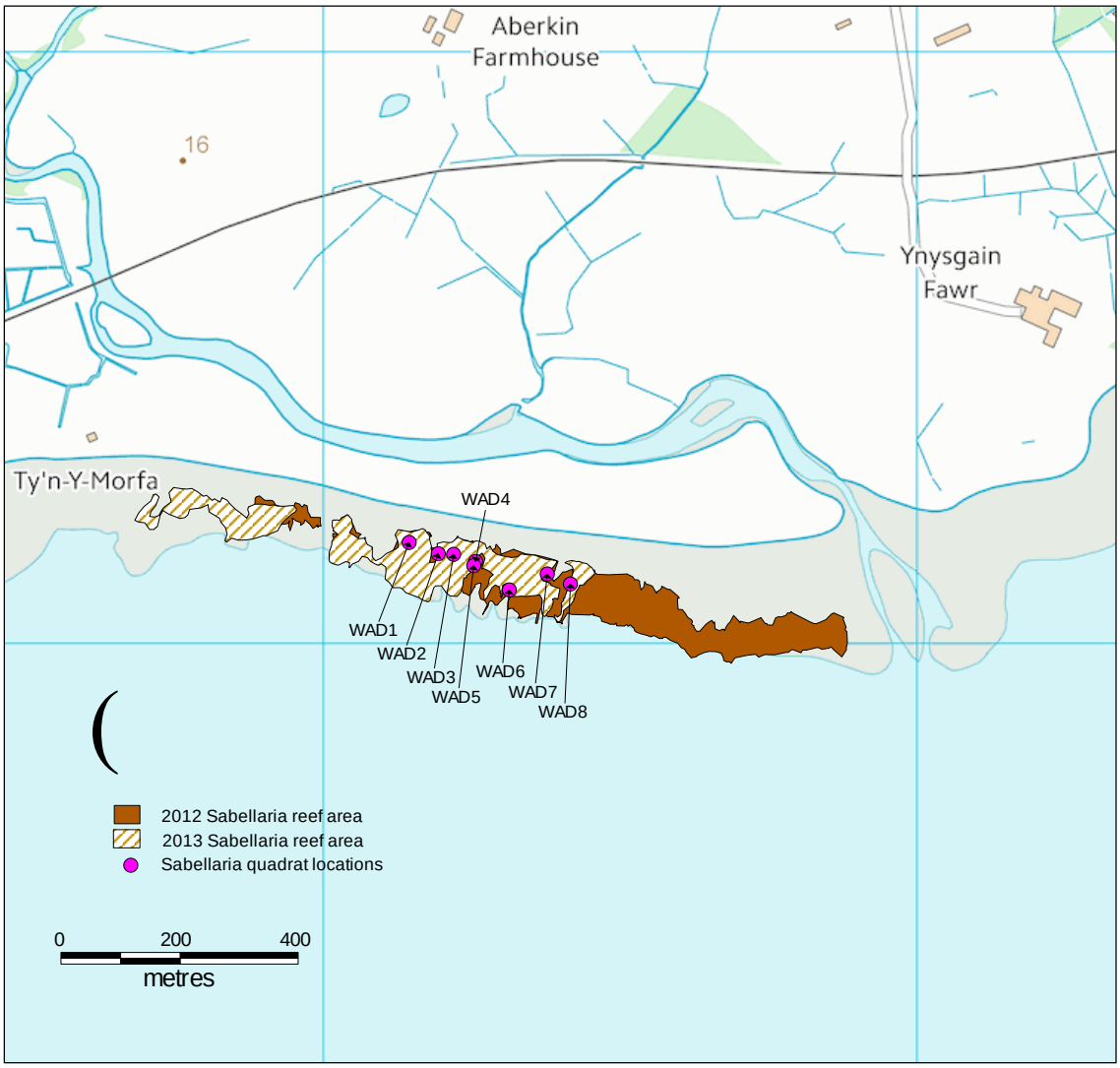

Figure 3 Location of the *Sabellaria alveolata* reef quadrat sites at West of Afon Dwyfor. Map based upon Ordnance Survey material © Crown copyright. All rights reserved. NRW, 100019741 2016.

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 location 10 m, 10 m (x,y) and then the surveyors proceeded to survey the initial 5 random quadrats in detail. To minimise trampling, 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 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. 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 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). The 5 detailed quadrats were followed by a further 10 quadrats, assessing just the total *Sabellaria* reef percentage cover and the live *Sabellaria* percentage cover. This added additional sample replication for *Sabellaria* cover to account for the high variability and provide for a more robust statistical analysis.

At each quadrat position, a gridded 0.25 m^2 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 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 2013 Sabellaria reef surveys are presented in Table 3 below and the original transect locations (from 2009) are presented in Table 4 for reference only.

2.2.5. Sabellaria alveolata reef extent

The extent of the *Sabellaria* reef at Llandanwg and West of Afon Dwyfor were mapped in 2013 using the track function of handheld GPS units. In 2013 the whole of the bed at Llandanwg was mapped, whilst at West of Afon Dwyfor the bed west of WAD8 for 750 m was mapped, as time allowed.

Table 3 Quadrat stations on the transects at Llandanwg and West of Afon Dwyfor, 20th and 22nd August 2013

Site	Station Code	Transect	Zone	Surveyors	Easting	Northing	Main Quadrats	Extra Quadrats
Llandanwg	L1	L1	B	CH/LK/RS	256845	328703	5	10
Llandanwg	L2	L2	B	CH/LK/RS	256813	328644	5	10
Llandanwg	L3	L3	B	CH/LK/RS	256791	328597	5	10
Llandanwg	L4	L4	B	CH/LK/RS	256763	328548	6	10
Llandanwg	L5	L5	C	CH/LK/RS	256748	328501	5	10
Llandanwg	L6	L6	B	TM/CH	256725	328441	5	10
Llandanwg	L7	L7	B	TM/CH	256726	328400	5	10
Llandanwg	L8	L8	B	TM/CH	256718	328338	5	10
Llandanwg	L9	L9	B	TM/CH	256721	328301	5	10
W Afon Dwyfor	WAD1	C3	B	PB/CJ	247143	337174	5	10
W Afon Dwyfor	WAD2	C4	A	LK/BS	247191	337155	5	10
W Afon Dwyfor	WAD3	C5	B	PB/CJ	247217	337153	5	10
W Afon Dwyfor	WAD5	C6B	A	PB/CJ	247252	337134	5	10
W Afon Dwyfor	WAD6	C7	D	LK/BS	247312	337093	5	10
W Afon Dwyfor	WAD7	C8	A	PB/CJ	247376	337120	5	10
W Afon Dwyfor	WAD8	C9	B	LK/BS	247414	337103	5	10

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 again 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

2.3. Pectenogammarus surveys

Populations of the amphipod *Pectenogammarus planicrurus* are known to be present in intertidal shingle at Marian-y-de at Pwllheli. A visit was made to the site at 12:30hrs (low water) on 19/08/2013, to determine whether there were still populations of the amphipod there. The amphipods are found by locating the appropriate habitat (shingle) on the shore at the time of low water, making a small scrape in the shingle just above the surf zone, (i.e. on the lower half of the shore) and then looking for 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 and 2012. These *Pectenogammarus* survey sites are shown in Figure 4 and the results are presented in section 3.2.

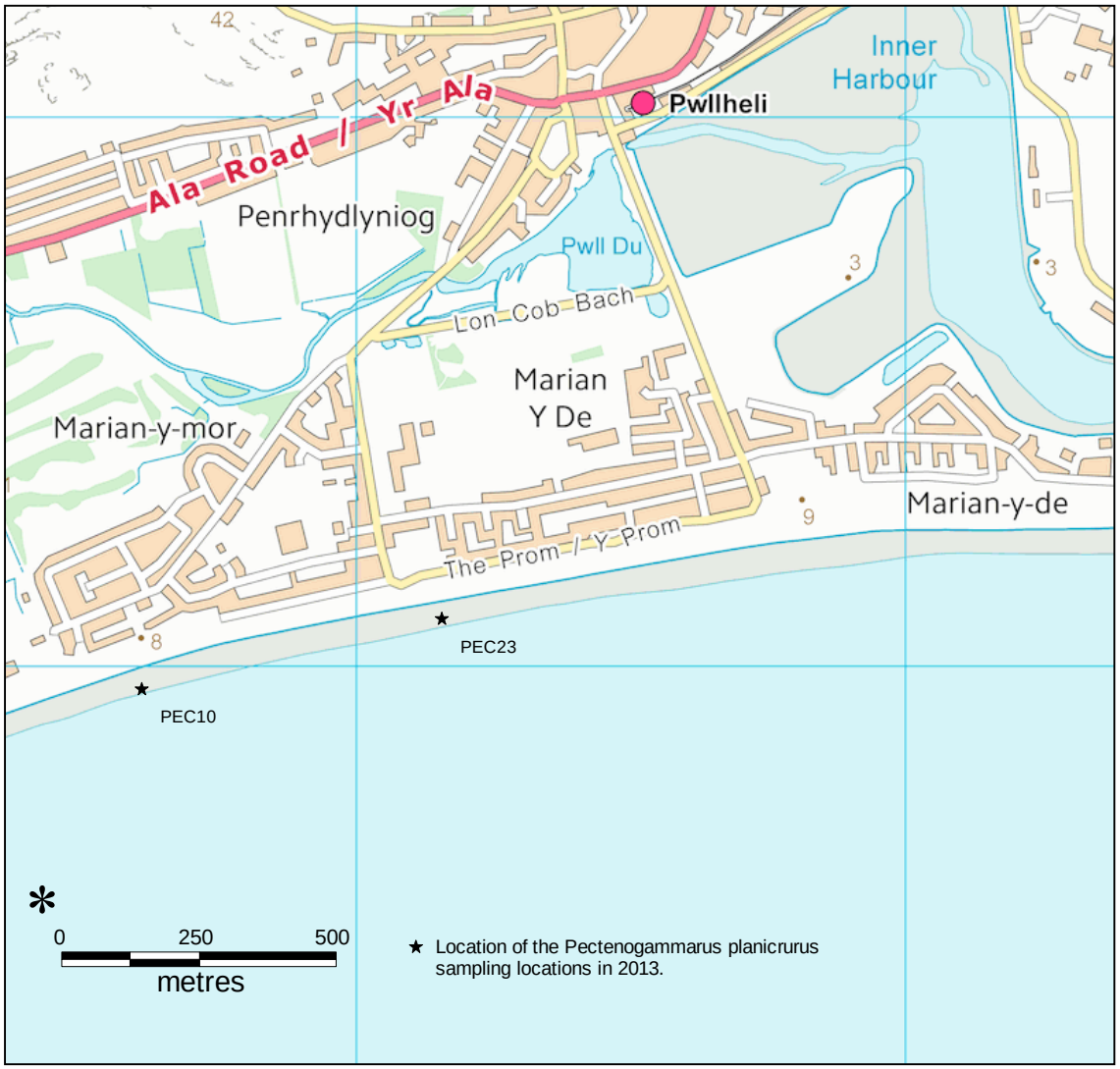

Figure 4 *Pectenogammarus planicrurus* sampling locations in 2012. Map based upon Ordnance Survey material © Crown copyright. All rights reserved. NRW, 100019741 2016.

2.4. Quantitative sampling of the Glaslyn/Dwyryd sediments

Existing maps of the Glaslyn/Dwyryd sediment flats (GIS data from CCW Phase 1 survey) were used to re-visit 9 quantitative core sites first selected in 2008 from the 90+ grid stations. These are shown in Figure 5.

Three core samples were taken from each of the selected sampling stations in 2013, using a 0.01 m^2 corer. The cores were 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 transferred to a suitable labelled pot or plastic bag. These samples were then taken back to the survey base and preserved in 10% formalin.

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

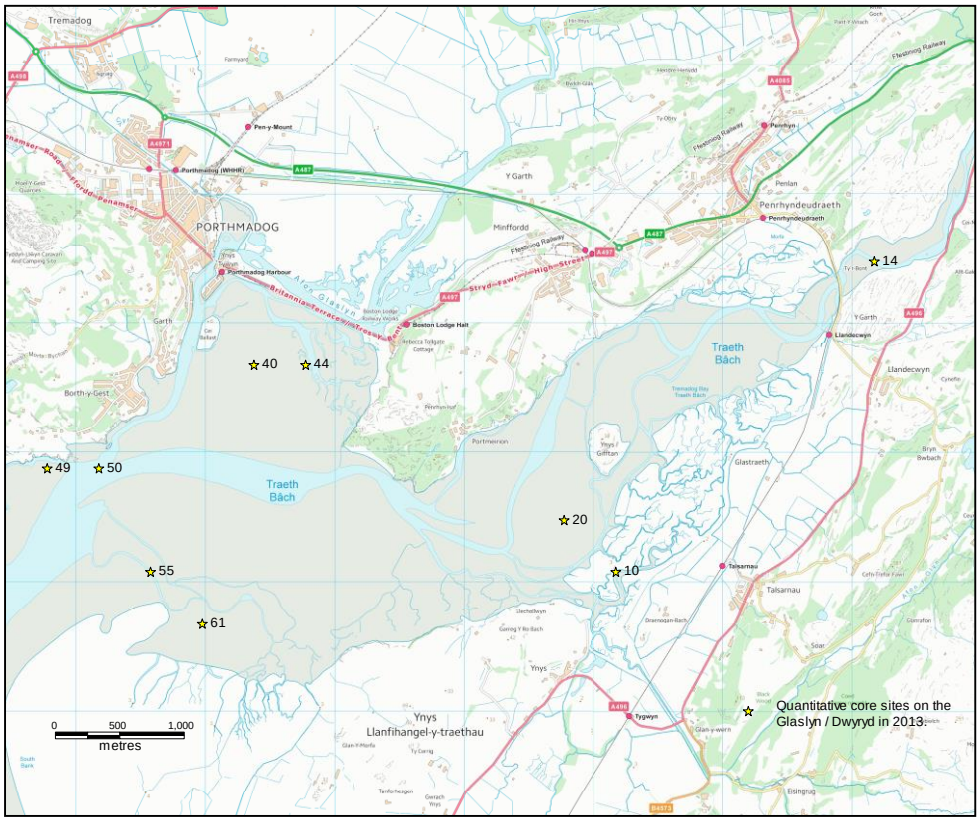

Figure 5 Quantitative coring stations on the Glaslyn /Dwyryd in 2013. Map based upon Ordnance Survey material © Crown copyright. All rights reserved. NRW, 100019741 2016.

These samples for macrofauna and granulometry analyses were given to the CCW officers at the end of the survey for later transfer to a macrobenthic analytical laboratory.

2.5. Porth Oer rocky shore quadrat surveys

At low tide on 19/08/2013, the Porth Oer shore was visited by the field team and the 12 fixed quadrats were relocated, photographed and surveyed. Each quadrat's locating screws were found using the 'relocation photographs' within each shore zone (see Appendix 1). The quadrats were originally sited in homogeneous areas of inclined rock, avoiding rockpools 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 3.

2.5.1. Permanent Quadrat Recording (cell counts)

Within each 1 m^2 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

macroalga was attached. Care was taken to minimize disturbance of mobile invertebrates when macroalgal 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.

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. Dyfi Estuary sediment sampling

Existing maps of the Dyfi estuary sediment flats (GIS data from CCW Phase 1 survey) sampling grid were used to select sampling stations.

A reduced tranche of 30 grid points were selected from the original 120, first surveyed in 2007. These were uploaded into Garmin GPS units, which were used in conjunction with coloured, waterproof aerial photographs of the estuary, in order to locate the points. Figure 6 shows the stations selected.

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

At 9 of the sediment sites three cores and a granulometry sample were taken for quantitative analysis of the infaunal. These are also shown in Figure 6.

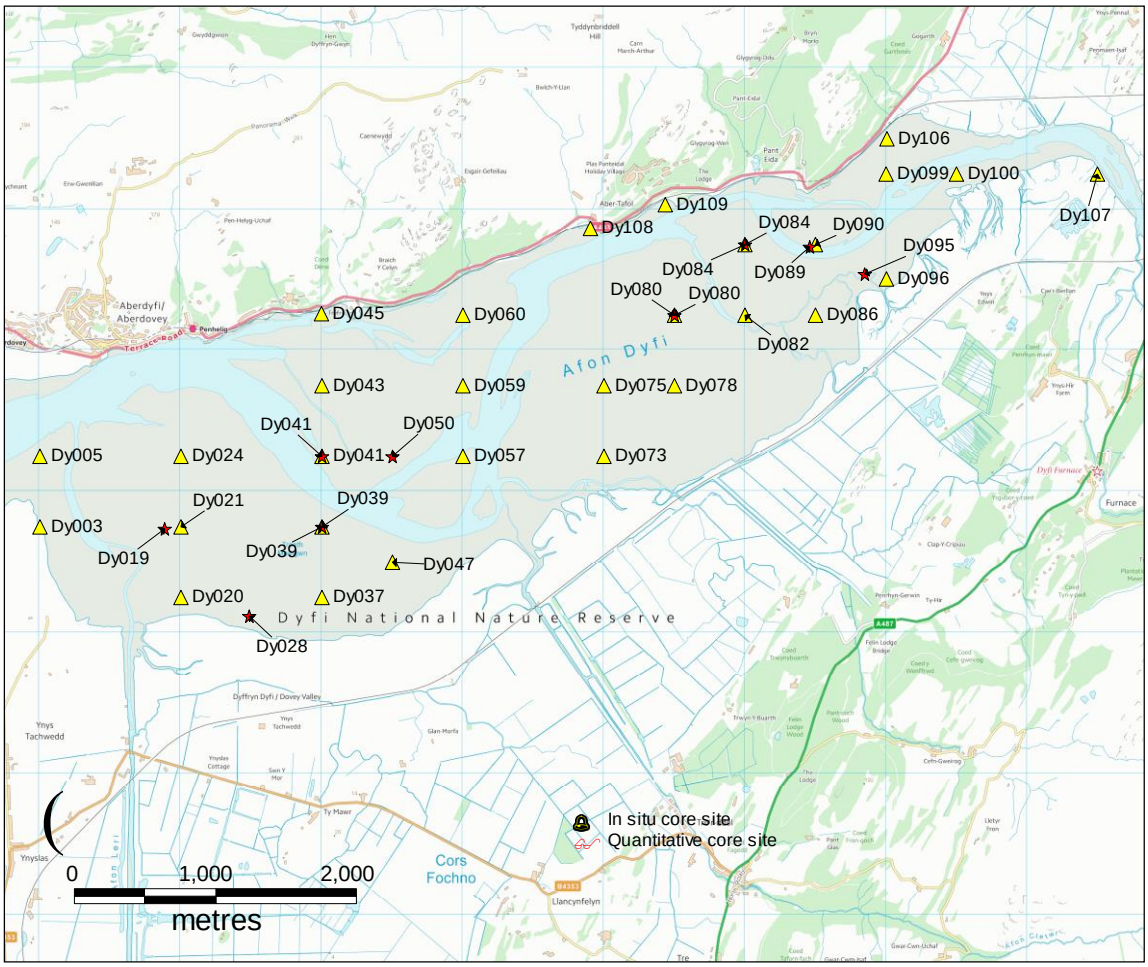

Figure 6 Dyfi estuary sediment sampling sites in 2013. Map based upon Ordnance Survey material © Crown copyright. All rights reserved. NRW, 100019741 2016.

2.6.1. Conspicuous species / features by *in situ* assessment

Records of conspicuous species and surface sediment features were made from each station within a circle of 1m radius around the 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 = firm, 5 = ankle depth or more).
- Depth of black layer (redox layer)
- Abundance of common epifaunal and floral taxa e.g. *Arenicola* casts and green algae.
- Abundance of common infaunal taxa e.g. Cockles, ragworms and amphipod shrimps.

These assessments were made in part from a single 0.01 m^2 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 most experienced

surveyor in the pair. A simple photographic guide to the most common species/taxa present was carried by the 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 already presented in Appendix 2, whilst the full sediment site results are presented in Appendix 3.

The quality and thoroughness of the species records and counts appeared generally high, but 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. The other notable physical features were also recorded and photographs were taken to illustrate the substrata and habitat features.

2.6.2. Quantitative sampling of the Dyfi sediments

Nine of the sediment sites above were selected for quantitative sampling (also shown in Figure 6).

At each of these 3 core samples were taken using a 0.01 m^2 corer. The cores were 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 transferred to a suitable labelled pot or plastic bag. A sample of the sediment was also taken from each station for granulometry analysis. This 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.

These samples were then taken back to the survey base and the faunal residues were preserved in 10% formalin.

Again the Dyfi samples for macrofauna and granulometry analyses were given to the CCW officers at the end of the survey for later transfer to an external macrobenthic analytical laboratory.

2.7. Photography

Photographs were taken with the following cameras:

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

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 'DPB', 'CJ' and 'BS'.

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. 20120721_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.

2.8. 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_13_Rockyshore_Porth_Oer_Data.xls

PLAS_13_Sabellaria_Station_Data.xls

PLAS_13_Glaslyn_Dwyryd_sediment_Data

PLAS_13_Dyfi_sediment_Data

PLAS_13_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 to a standard GIS format 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, 19th to 23rd August 2013. A team of five experienced marine biological surveyors from ASML and CCW took part in the day to day surveys. The core team of Tom Mercer, Christine Howson, Paul Brazier, Lucy Kay and Ben Wray were ably assisted by a field assistant from ASML, Joe Mercer and two very capable 'Sandwich Student' staff from CCW, Chloe Jennings and Ben Strachan. Figure 1 shows the locations of the survey areas. Appendix 3 tabulates the recorded field data and Appendix 4 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 5, 6 and 7 summarise and compare the data collected. The full data are tabulated in Appendix 3.

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 unit of reef to the south of Transect 1 was calculated in both 2012 and 2013. The same was done for the West of Afon Dwyfor reef between the transect at WAD8 and the NGR Easting line SH 247000. Table 5 presents this data.

Table 5 A comparison between the 2012 and 2013 *Sabellaria* reef areas at Llandanwg and West Afon Dwyfor

Area	2012	2013	Percentage change
Llandanwg	1.79 Ha	2.37 Ha	+32.1%
West Afon Dwyfor	2.38 Ha	2.67 Ha	+12.1%

The areas of reef at both survey locations can be seen to have increased between 2012 and 2013 indicating that the *Sabellaria* polychaetes were possibly building reef habitat during the 12 months between these surveys.

Table 6 Conspicuous core taxa recorded within the *Sabellaria alveolata* quadrats at Llandanwg

Taxon	Data Type	Llandanwg 2012		Llandanwg 2013	
		% Frequency of occurrence	Mean % cover	% Frequency of occurrence	Mean % cover
Sabellaria alveolata (total)	*T%*	60	20.9	69	16.93
Sabellaria alveolata (live)	*%*	60	6.75	67	6.86
Cirripedia (total)	**T%*	66	3.52	47	0.89
Mytilus edulis	**P*	59	4.30	29	0.31
Algae (total)	**T%*	98	68.44	91	63.78
Chlorophycota	**T%*	71	5.35	69	20.46
Fucus serratus	**%*	68	29.40	67	27.89
Fucus vesiculosus	**%*	76	37.71	82	27.42

Table 7 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	
		% Frequency of occurrence	Mean % cover	% Frequency of occurrence	Mean % cover
Sabellaria alveolata (total)	*T%*	43	6.66	38	4.42
Sabellaria alveolata (live)	*%*	33	1.46	30	2.03
Cirripedia (total)	**T%*	70	0.2	89	0.92
Mytilus edulis	**P*	7	0	0	0.00
Algae (total)	**T%*	97	58	100	60.71
Chlorophycota	**T%*	33	0.3	40	1.43
Fucus serratus	**%*	57	14.30	97	49.71
Fucus vesiculosus	**%*	93	43.47	40	1.43

The tables above show that while the overall 32% increase in *Sabellaria* reef area at Llandanwg, the mean % cover of live *Sabellaria* in the quadrats grew by only 1.6%. Whereas at West Afon Dwyfor, the 12% boundary increase was supported by a 39% live *Sabellaria* increase in the quadrats.

At Llandanwg all dominant taxa tended to reduce in abundance, with the exception of green algae, which increased. At West Afon Dwyfor, the dominant taxa all increased, with the exception of mussels which were absent and *Fucus vesiculosus*, which decreased considerably.

3.2. *Pectenogammarus* at Marian-y-de

Two stations on the shingle beach at Pwllheli were again re-surveyed for the presence of the amphipod *Pectenogammarus planicrurus* (Stations P10, P23; Figure 4). This occurred at 12:30 hrs (approximately 2 hours before low water on the 19th August 2013). Numerous individuals were found within the shingle scrapes as presented in Table 8.

Table 8 Abundance of *Pectenogammarus planicrurus* in the shingle.

Station	Grid Ref. of stations	No. of *Pectenogammarus* / dm^2
10[2]	SH 36608 33961	<10
23	SH 37154 34090	10-20

The results are not dissimilar to those recorded in 2012, with a slightly greater density recorded at station 23 than was found in 2012.

3.3. Quantitative sampling of the Glaslyn/Dwyryd sediments

The 27 samples collected from the 9 core sites re-visited in 2013, were sent for taxonomic analysis to an NMBAQC laboratory. The results of this taxonomic analysis are presented in Appendix 3. Once the data were 'cleaned' - removing juveniles, damaged specimens and amalgamating taxa such as *Hediste diversicolor* with Nereiidae, then 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 from community ecology.

Table 9 Mean univariate statistics for the replicate infaunal core data from the Glaslyn/Dwyryd in 2013

Station	S	N	d	J'	H'(loge)	1-Lambda'
G 10	6 (4-8)	34 (13-49)	1.451	0.731	1.273	0.677
G 14	2 (0-3)	2 (0-4)	0.784	0.622	0.559	0.500
G 20	8 (6-9)	123 (120-126)	1.384	0.514	1.040	0.484
G 40	3 (1-4)	4 (1-7)	0.928	0.597	0.736	0.505
G 44	7 (7)	45 (35-58)	1.587	0.778	1.514	0.755
G 49	5 (4-6)	9 (6-15)	1.981	0.921	1.477	0.851
G 50	2 (1-3)	32 (28-37)	0.377	0.404	0.296	0.155
G 55	1 (0-1)	1 (0-1)	-	-	-	-
G 61	6 (4-8)	67 (64-70)	1.108	0.697	1.173	0.604

- S – Mean taxa: taxa with non zero counts. (Range shown in brackets)
- N – Mean total individuals: The mean number of individuals per core from all three cores per site. (Range shown in brackets).
- 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 9 shows that the greatest numbers of taxa were found at G20, in mid-estuary and in the midshore on the Dwyryd, as were the greatest number of individuals.

[2] Hemingway, K.L. & S. Boyes (2004)

However the greatest 'richness', 'evenness' and diversity were found at G44, midshore Glaslyn and G49 in the mouth of the Glaslyn. G50 and G55 also in the mouth of the system were effectively barren, clean, mobile sands with little or no infaunal life.

3.4. Porth Oer Rocky shore quadrats

The 12 rocky shore quadrats were surveyed and photographed on 19th August 2013 and the results are summarised below and are fully presented in Appendix 3.

3.4.1. Littoral taxa abundance data

51 taxa were recorded in the quadrats. These are summarised in Table 10 and are fully presented in Appendix 3.

Table 10 Species/taxa recorded in the fixed quadrats at Porth Oer in August 2013

MCS Code	MCS Species name	MCS Code	MCS Species name
C005230	Hymeniacidon perleve	ZM06300	Plocamium cartilagineum
C04840	Halichondria panicea	ZM06710	Catenella caespitosa
D011510	Actinia equina	ZM07510	Lomentaria articulata
Q000820	Prostigmata	ZM07940	Callithamnion granulatum
R000210	Cirripedia	ZM07950	Aglaothamnion hookeri
R000720	Chthamalus montagui	ZM08071	Ceramium strictum
R000730	Chthamalus stellatus	ZM08240	Ceramium shuttleworthianum
R001080	Semibalanus balanoides	ZM08820	Plumaria elegans
R001200	Elminius modestus	ZM09900	Membranoptera alata
S001660	AMPHIPODA	ZM10800	Osmundea pinnatifida
S017890	Ligia oceanica	ZM11020	Polysiphonia atlantica
W001300	Patella spp	ZM11300	Polysiphonia stricta
W002480	Littorina spp	ZM11400	Boergeseniella thuyoides
W002520	Melarhaphe neritoides	ZR01670	Ralfsia verrucosa
W002600	Littorina saxatilis	ZR06310	Laminaria digitata
W016500	Mytilus edulis	ZR06750	Fucus spiralis
W02500	Littorina littorea	ZR06810	Pelvetia canaliculata
W08170	Nucella lapillus	ZR06870	Himanthalia elongata
	Anurida maritima	ZS02110	Ulva sp. (tubes)
ZM00010	RHODOPHYTA	ZS02400	Ulva sp. (flat)
ZM01161	Audouinella purpurea	ZS03271	Chaetomorpha ligustica
ZM01770	Nemalion helminthoides	ZS03380	Cladophora sp.
ZM03760	Hildenbrandia		Caloplaca marina
ZM04000	Corallinaceae		Verrucaria
ZM04010	Corallina officinalis		Pyrenocollema
ZM06050	Mastocarpus stellatus		

3.4.2. Limpet density count data

Table 11 Random limpet counts and their densities in the fixed quadrats at Porth Oer 2013

Year	**2013**				**2013**				**2013**			
Zone	**Upper shore**				**Middle shore**				**Lower shore**			
Quadrat	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
1	0	1	13	0	12	9	7	6	14	22	21	20
2	0	1	0	0	15	10	8	5	9	11	18	27
3	0	0	0	0	13	6	6	3	13	23	20	15
4	0	0	6	0	9	12	4	6	18	18	9	16
5	0	0	0	8	12	8	4	6	5	19	18	25
Mean no. (m^{-2})	36.25				201.25				426.25			
% change from 2012	+69				-5				+20			

Table 11 shows how the limpet population changed between 2012 and 2013 in the fixed quadrats at Porth Oer. Both the upper and lower shores showed a significant increase in limpet density, but the midshore showed a decrease.

3.4.3. Midshore limpet population data

Table 12 Maximum length measurements of 100+ randomly selected limpets on the midshore

2013 limpet spp. size data for the Porth Oer mid shore											
23.6	20.2	18.0	23.2	24.9	19.1	22.3	24.5	23.2	14.3	16.7	17.4
18.2	28.4	17.8	31.6	14.1	18.1	22.7	26.1	24.4	16.1	23.7	29.0
24.2	28.9	18.0	32.3	14.0	19.5	26.2	22.4	14.0	23.6	14.6	28.1
20.7	35.9	24.4	26.2	9.6	15.6	15.5	18.4	22.3	22.2	31.2	29.3
17.5	26.3	20.3	22.8	28.9	15.2	22.8	15.6	16.5	17.1	15.1	13.8
18.1	29.8	20.3	29.0	29.7	12.0	24.0	16.9	21.1	13.9	20.2	17.8
27.9	14.5	19.7	24.4	20.2	14.4	20.3	13.2	14.0	15.5	17.3	23.6
26.4	16.6	18.6	15.6	33.2	19.8	20.0	11.1	14.0	18.6	16.4	18.0
36.8	26.1	20.2	26.6	22.4	17.4	13.2	16.0	15.2	16.7	20.0	14.1
12.9	20.1	17.6	33.0	18.1	24.8	18.2	14.8	14.5	22.3	19.0	17.7
Mean limpet size = 20.6 mm (n=120)						Change from 2012 = +25%					

Table 12 shows a significant increase in mean size of limpet between 2012 and 2013 in the midshore, a fact illustrated by the histograms presented in Figure 7.

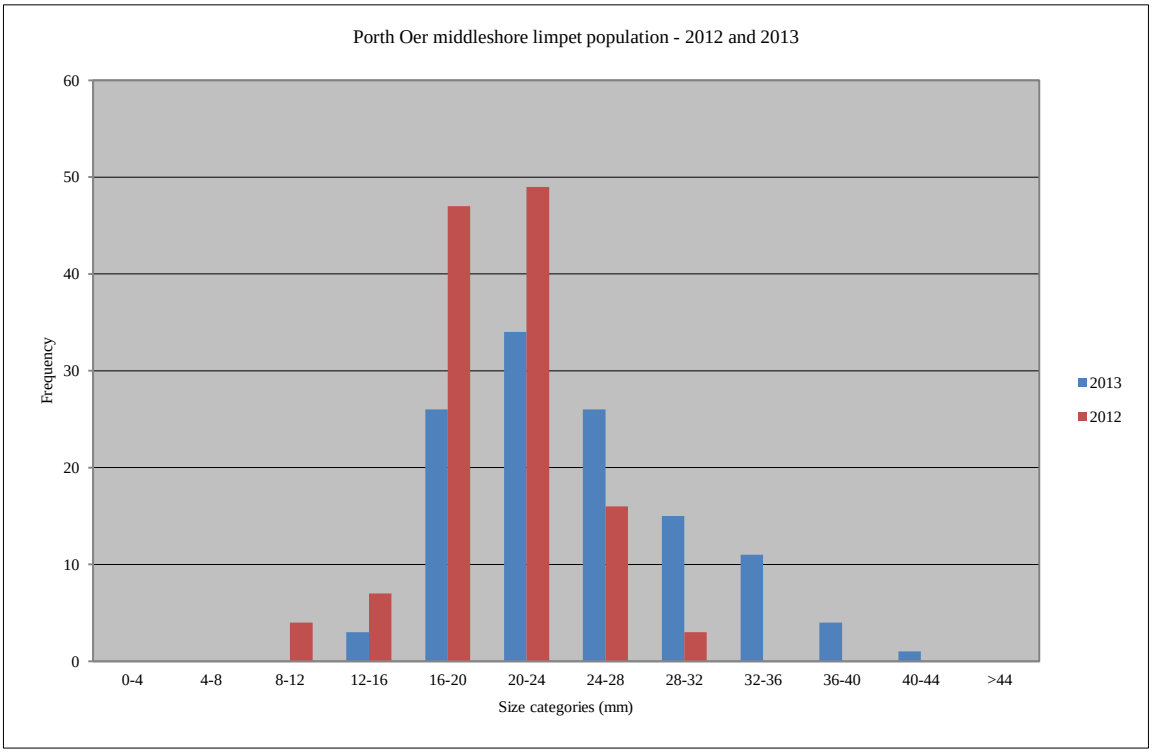

Figure 7 Size frequency histograms for the midshore limpet population at Porth Oer

3.5. Cirripedia population abundance data

Table 13 Percentage cover of all barnacles in 5 random cells within the fixed quadrats

Year	2013				2013				2013			
Zone	Upper shore				Middle shore				Lower shore			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4
1	0	0.25	0.25	0	40	80	75	75	20	25	70	80
2	0	0.25	0	0.25	40	65	70	55	25	15	50	10
3	0	0	0	0.25	30	75	70	40	18	10	80	80
4	0	0	0.25	0	25	80	80	70	35	35	30	45
5	0	0.25	0.25	0	30	75	70	65	10	25	5	80
Mean %. (m^{-2})	0.1				60.5				37.4			
% Change since 2012	+14				+19				-18			

Table 13 shows an increase in population density in the barnacles in the upper and midshore, and a fall in density in the lower shore.

3.6. Dyfi sediments

3.6.1. Conspicuous species and sediment features by *in situ* assessment

The *in situ* sediment core, habitat and community assessment results are presented in Table 14 below. The results present a picture of a typical sandy and muddy/sand estuary with a low diversity infaunal community. Several areas contain commercially viable cockle beds and both diversity and biomass tend to increase when the mud fraction in the sediment increases towards the upper midshore in the outer, sheltered areas of the system, on the southern shore, such as at stations Dy39, Dy47 and Dy80.

Table 14 *In situ* sediment core and habitat assessment – taxa

Name (WoRMS)	Qualifier	45B	108	109	106B	107	100	99	84	80	82	86	89	95	59
Polychaeta			1												
Hediste diversicolor			4		1	10		1		7		15	1	1	
Scoloplos armiger															
Spionidae	tubes		1					>1000	<10	100	10	10	100		
Bathyporeia															1
Haustorius arenarius		1													
Corophium				1		20	30	5		1	3			100	
Cyathura						1		1		2		15			
Eurydice															
Peringia ulvae									1	5		5			
Cerastoderma edule	<20mm									7					
Cerastoderma edule	>20mm														
Angulus tenuis															
Macoma balthica	juvs									1					
Macoma balthica								2					2		
Scrobicularia plana juv	<20mm		5							10		2			
Scrobicularia plana	>20mm				1							3	2		
Ulva sp.															
Sediment characteristics[3]		fS	fsM	fsM	fsM	vfsM	fS	fS	fS	mfS	fS	fsM	fS	mfS	fshS
Proposed Biotope		LS.LSa.MoSa	LS.LMu.MEst.HedMacScr	LS.LSa.MuSa.BatCare	LS.LMu.MEst.HedMacScr	LS.LMu.UEst.Hed.Cvol	LS.LMu.UEst.Hed.Cvol	LS.LMu.MEst.HedMac	LS.LMu.MEst.HedMac	LS.LMu.MEst.HedMacScr	LS.LSa.MuSa.BatCare	LS.LMu.MEst.HedMacScr	LS.LMu.MEst.HedMac	LS.LMu.UEst.Hed.Cvol	LS.LSa.MoSa

[3] Mud–M, Sand–S, Gravel–G, very–v, muddy-m, gr-gravelly, Shelly-sh, coarse-c, medium-med, fine-f

Table 14 (continued) *In situ* sediment core and habitat assessment – taxa

Name (WoRMS)	Qualifier	60	57	73	75	78	3	5	20	19	24	39	47	37	28
Polychaeta															
Hediste diversicolor				7								2	1		
Scoloplos armiger									5						
Spionidae	tubes		<10		<10	<10				10		10	50		1
Bathyporeia										10	7				
Haustorius arenarius															
Corophium						>100									9
Cyathura				1											
Eurydice			1				1				5				
Peringia ulvae												46	150		
Cerastoderma edule	<20mm		1									24	3	1	
Cerastoderma edule	>20mm											19			2
Angulus tenuis			2												
Macoma balthica	juvs	3	4						1				12		
Macoma balthica				2	1							3			2
Scrobicularia plana juv	<20mm			1								23		1	
Scrobicularia plana	>20mm			1								5			
Ulva sp.						P									
Sediment characteristics[4]		fS	fS	mfS	fS	vfshS	grfS	medcs hS	fS	medS	fS	mfS	mfS	fS	fS
Proposed Biotope		LS.LSa.MuSa.MacAre	LS.LSa.MuSa.MacAre	LS.LMu.MEst.HedMac	LS.LSa.MuSa.MacAre	LS.LMu.UEst.Hed.Cvol	LS.LSa.MoSa.AmSco.Eur	LS.LSa.MoSa.BarSa	LS.LSa.MuSa.MacAre	LS.LSa.MoSa	LS.LSa.MoSa	LS.LSa.MuSa.CerPo	LS.LSa.MuSa.CerPo	LS.LSa.MuSa.CerPo	LS.LMu.MEst.HedMac

3.6.2. Quantitative sampling of the Dyfi sediment

The 27 samples collected from the 9 core sites re-visited in 2013, were sent for taxonomic analysis to an NMBAQC laboratory. The results of this taxonomic analysis are presented in Appendix 3. Once the data were 'cleaned' - removing juveniles, damaged specimens and amalgamating taxa such as Hediste diversicolor with Nereiidae, then 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 from community ecology.

[4] Mud–M, Sand–S, Gravel–G, very–v, muddy-m, gr-gravelly, Shelly-sh, coarse-c, medium-med, fine-f

Table 15 Mean univariate statistics for the replicate infaunal core data from the Dyfi in 2013

Station	S	N	d	J'	H'(loge)	1-Lambda'
DY19	3 (2-4)	8 (6-11)	1.01	0.81	0.90	0.59
DY28	10 (7-13)	46 (33-58)	2.33	0.75	1.69	0.77
DY39	10 (8-12)	318 (219-458)	1.56	0.40	0.90	0.39
DY41	3 (2-5)	8 (4-11)	1.20	0.84	0.98	0.65
DY50	2 (1-2)	2 (1-2)	1.44	1.00	0.69	1.00
DY80	10 (8-12)	388 (325-446)	1.46	0.56	1.27	0.63
DY84	2 (2-3)	21 (12-29)	0.44	0.31	0.25	0.13
DY89	9 (8-10)	417 (306-495)	1.33	0.34	0.75	0.34
DY95	6 (5-7)	419 (284-650)	0.84	0.31	0.56	0.29

- S – Mean taxa: taxa with non zero counts. (Range shown in brackets)
- N – Mean total individuals: The mean number of individuals per core from all three cores per site. (Range shown in brackets).
- d – Mean Margalef's richness for all three cores per site. (S-1)/Log(N) - 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 results shown in Table 15 support the earlier observations that stations DY39 and DY80 support both high numbers of taxa and abundance of infauna. DY28 also has a high compliment of taxa, but low abundance and this combination gives it the greatest statistical richness and diversity. DY84 on the other-hand has very few taxa or abundance and is consequently the station with the lowest statistical richness, evenness and diversity.

4. Discussion

- The picture illuminated by the *Sabellaria* reef monitoring is slightly confusing. However, there were measured increases in the reef areas in 2013. At Llandanwg there was an increase at the southern end of the monitoring area, as shown by Figure 2, though a lower tidal height at low tide on the day of the Llandanwg survey probably flatters the increase in reef area figures. At West Afon Dwyfor there was an increase in area at the western end of the monitored reef, and a reduction at the eastern end. Both areas however, show a very slight increase in live *Sabellaria* reef.
- *Pectenogammarus planicrurus* at Marian-Y-De were found in healthy numbers at the two sites monitored.
- The Glaslyn/Dwyryd infaunal cores revealed a low diversity infaunal invertebrate community, with the greatest number of taxa and individuals in mid-estuary and in the midshore on the Dwyryd. This community was unsurprisingly dominated by cockles, amphipods and spionids. In places at the mouth of the system where the sands are mobilised daily, they are effectively barren. The 'inner most' site (G14) is not truly *euryhaline / upper estuary* as it contains taxa such as *Bathyporeia sp*.

  Univariate data has been calculated for the infaunal community at 9 stations, against which monitoring can take place in the future.

- At Porth Oer, a similar number of taxa were encountered in the quadrats in 2013 as in 2012 (51 compared to 49) and the limpet population appeared relatively stable, with slight increases in numbers of limpets in the lower and upper shore quadrats, balanced by a decrease in the midshore. However the mean size of limpet increased in the midshore from 2012-2013 and this may account for the density decrease, due to increased competition between bigger limpets.
- Both the *in situ* assessment and the quantitative coring in the Dyfi estuary reveal a low diversity system, due in part to the high sand content. No rare or endangered species were encountered, but the univariate measures calculated for the infaunal cores provide a baseline from which monitoring can take place in the future.

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Appendix 1 Field Log

Field Diary NRW PLAS Survey August 2013

Sunday, August 18, 2013

Travel to Harlech – Assemble at Hafod y Morfa at 20.00

Survey base Hafod y Morfa; Harlech
Personnel: TM: Tom Mercer (ASML), CH: Christine Howson (ASML), JEM: Joe Mercer (Newcastle University), BW: Ben Wray (NRW), PB: Paul Brazier (NRW), LK: Lucy Kay (NRW), CJ: Chloe Jennings(NRW), BS: Ben Strachan (NRW).

Monday, August 19, 2013

Bright and sunny and still. Survey of Porth Oer rocky shore quadrats and Pwllheli Pectenogammarus sites.

0800: TM sorts equipment and packs ready for survey
1045: TM, CH and JEM leave for rendezvous with LK and BW at Asda in Pwllheli.
1130: TM, JEM, shop for stuff and LK, BW and CH leave for Porth Oer and commence survey.
11.00: PB BS, and CJ Commence coring at the Glaslyn/Dwyryd 2008 core sites
1230: TM and JEM complete Pectenogammarus survey at Marian-y-De
1300: TM and JEM join others at Porth Oer and start survey.
1645: All finish survey and return to respective cars. ASML return to Harlech; NRW return to Bangor.
1900: TM, CH and JEM eat in Harlech pub.
2015: Team set up and identify specimens with microscopes, label photos and enter data.
2300: Team retire to bed

Tuesday, August 20, 2013

Fine with a southerly wind.
0630: TM up and sorts data and admin for the day
1030: NRW team arrive. Work programmes sorted for the day.
1145: TM, JEM and BW travel to Aberdovey. Survey north side core sites. Survey 4 sites, repositioning 2 sites due to channel movements.
1230: PB, CJ and BS finish off coring on the Glaslyn.
1230: CH,LK and RS survey Llandanwg Sabellaria.
1745: Team reassembles at Hafod y Morfa and process data, photographs and specimens.
1930: Go in search of food. Eat at the Harlech Tandoori,
2145: Return to Hafod y Morfa

Wednesday, August 21, 2013

Dull and wet with occasional drizzle.
0715: TM up and sorts recording sheets, data and admin for the day
1030: NRW team arrives. All carry on photo labelling and entering data onto memory sticks. Work programmes sorted for the day.
1145: TM, JEM and BW travel to Ynys Hir at the head of the Dovey estuary. Survey from Ynys Hir, taking in 4 quantitative core sites. CH and LK travel to the mid estuary at Craig-y-penrhyn and survey there, taking in 2 core sites, while PB, BS and CJ travel to Ynyslas and survey the sites at the mouth of the estuary, taking in 3 core sites. LK and CH delayed by the drainage channels and decide to walk out to the east at Ynys Hir, so TM, BW and JEM wait for them and then return them to their car at 20.00hrs. All this party eat at Joe's Diner - the chippy in Machynlleth. Whilst the rest eat at the Cross Foxes near Cader Idris
22.00: Return to Harlech and retire to bed

Thursday, August 22, 2013

0715: TM up and sorts recording sheets, data and admin for the day
1020: NRW team arrive. Carry on photo labelling and entering data logs. Work programmes sorted for the day.
1300: PB,LK, BW, CJ and BS travel to West of Afon Dwyfor to survey the sites there. BW maps bed.
1400: TM, CH and JEM travel to Llandanwg to finish the remaining sites. JEM maps the boundary of the bed.
1730: CH, TM and JEM return to Harlech. Begin data entry and photo labeling. 1900: Go into Harlech and eat at Plas in Harlech. Joined by BW, CJ and BS.
2130: Return to Morfa Hafod and retire

Friday, August 23, 2013

Team arrive at 10.00. Sort and label photos and data all day. QA data and pack up house. NRW staff sort core samples for onward transport to Bangor and then leave at 17.00. JEM leaves at 20.00hrs

Saturday, August 24, 2013.

0700: TM and CH leave Harlech and return to Bollihope and Ormiston.

Appendix 2 Survey proformae

PLAS 2013 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
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.					
Phaeophycota (enc)					
Chaetomorpha					
Cladophora rup.					
Enteromorpha					
Ulva lactuca					
Verrucaria (green)					

Quadrat No.	1	2	3	4	5

Quadrat No.	6	7	8	9	10
Sabellaria reef %					
Live *Sabellaria* %					

Quadrat No.	11	12	13	14	15
Sabellaria reef %					
Live *Sabellaria* %					

Glaslyn/Dwyryd & Dyfi 2013: *In-situ* sediment records **Date:**.................... **Surveyors:**..............................

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

Station	Sediment	Species
G/D................... **Time:** .... **Photos:**................... .... **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 % **Sieve (No. per core):** Cockles >20mm <20mm Macoma Hydrobia Scrobs >20mm <20mm Hediste Nephtys Scoloplos Spionids Polychaete Bathyporeia Corophium Carcinus
G/D................... **Time:** .... **Photos:**................... .... **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 % **In sieve:** Cockles >20mm <20mm Macoma Hydrobia Scrobs >20mm <20mm Hediste Nephtys Scoloplos Spionids Polychaete Bathyporeia Corophium Carcinus
G/D................... **Time:** .... **Photos:**................... .... **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 % **In sieve:** Cockles >20mm <20mm Macoma Hydrobia Scrobs >20mm <20mm Hediste Nephtys Scoloplos Spionids Polychaete Bathyporeia Corophium Carcinus
G/D................... **Time:** .... **Photos:**................... .... **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 % **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.

PLAS 2013 SAC: Rockyshore quadrats. Site:Porth Oer ... Conditions:……..… Date:……..

Surveyors:…….. Time at start:……..Time finish:……Camera:……

Porth Oer

Zone		Upper shore				Mid shore				Lower shore			
	Quadrat No.	1	2	3	4	1	2	3	4	1	2	3	4
MCS	Species Name	Fauna											
C04840	Halichondria panicea												
D11510	Actinia equina												
D11680	Urticina felina												
P02770	Eulalia viridis												
P20310	Lanice conchilega												
P23040	Pomatoceros triqueter												
Q00820	Prostigmata (mites)												
R00210	Cirripedia												
R01130	Balanus perforatus												
R01200	Elminius modestus												
S26900	Carcinus maenas												
W01300	Patella												
W01930	Gibbula cineraria												
W01950	Gibbula umbilicalis												
W02520	Melarhaphe 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												
ZM10800	Osmundea pinnatifida												
ZR02470	Elachista												
ZR06680	Fucus												
ZR06760	Fucus vesiculosus Var. linearis												
ZS02110	Enteromorpha												
ZS03270	Chaetomorpha												
ZS03380	Cladophora												
	Verrucaria spp.												

PLAS 2013 SAC: Rockyshore quadrats. Site:Porth Oer ... Conditions:……..…. Date:……..

Surveyors:…….…. Time at start:……..Time finish:…….Camera:……..…

Limpet monitoring (Middle zone 100-200)																			
Longest length (mm)																			

Barnacle species abundance photos	1	2	3	4	1	2	3	4	1	2	3	4
	5	5	5	5	5	5	5	5	5	5	5	5
(5x5 quadrat tick when complete) (✓)												

Random Numbers (1-25)					

Barnacle abundance (%)	Upper				Middle				Lower			
	1	2	3	4	1	2	3	4	1	2	3	4
(5 of the 20x20 cells selected at random)												

Limpet abundance	Upper				Middle				Lower			
	1	2	3	4	1	2	3	4	1	2	3	4
(All Zones - 5x20x20 cell counts)												

Appendix 3 *Sabellaria* quadrat data

Llandanwg		L1	L1	L1	L1	L1	L2	L2	L2	L2	L2	L3	L3	L3	L3	L3
Quadrat No. (replicate)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Surveyors		CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS
Camera		EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D
Photo No.		4994	4995	4997	4998	5000	5001	5002	5004	5005	5006	5007	5008	5009	5010	5011
Date		20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013
Standing water %		0	70	20	20	4	10	6	60	0	0	32	0	4	0	0
Checklist spp.																
Sabellaria alveolata (total)	**T%**	25	55	18	90	75	80	90	4	0	3	4	16	0	0	0
Sabellaria alveolata (live)	**%**	20	7	16	80	60	60	15	3	0	1	1	4	0	0	0
Cirripedia (total)	**T%**	0	0.25	0	0.25	1	0	0.25	0	0	0	0	5	0.25	0	0
Mytilus edulis	**%**	0	5	0	0.25	0	0.25	0.25	0	0	2	0	0	0	0.25	0
Algae (total)	**T%**	90	95	95	100	70	75	70	75	28	92	80	100	20	95	2
Fucus serratus	**%**	40	30	30	20	0	36	30	90	3	8	50	30	18	95	2
Fucus vesiculosus	**%**	5	95	98	100	55	10	60	12	25	8	25	100	4	0	0
Chlorophycota	**T%**	80	1	24	2	65	75	60	60	0.25	70	12	0	13	0.25	0
Actinia equina	**P**		P	P			P						P			
Pomatoceros	**P**															
Semibalanus balanoides	**%**		P		P	P		P					P	P		
Elminius modestus	**%**												P			
Patella vulgata	**P**															
Gibbula cineraria	**P**															
Littorina obtusata	**P**															
Nucella lapillus	**P**				P								P			

Llandanwg		L1	L1	L1	L1	L1	L2	L2	L2	L2	L2	L3	L3	L3	L3	L3
Quadrat No. (replicate)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Verrucaria (green)	**%**															
Rhodophycota (dk red crust)	**T%**		P		P	P							P			
Corallinaceae	**T%**															
Mastocarpus stellatus	**%**															
Chondrus crispus	**%**															
Chromophycota (crust)	**T%**		P													
Ulva tubular	**%**															
Ulva flat	**%**	P	P	P	P	P	P	P	P		P	P				
Chaetomorpha linum	**%**															
Cladophora rupestris	**%**															
Other spp.																
Dynamena pumila	**P**															
Arenicola marina	**P**									P		P		P		P
Lanice conchilega	**P**															
Chthamalus montagui	**P**					P										
Idotea granulosa	**P**															
Palaemonidae	**P**				P		P	P	P							
Palaemon serratus	**P**															
Carcinus maenas	**P**	P	P	P	P	P		P	P			P				
Littorina saxatilis	**P**															
Mytilus edulis (juv)	**%**															
Lipophrys pholis	**P**															
Sand eel	**P**															
Porphyra	**%**															
Rhodothamniella floridula	**%**	P	P	P	P	P	P	P	P		P	P	P			
Palmaria palmata	**%**															
Hildenbrandia	**%**															

Llandanwg		L1	L1	L1	L1	L1	L2	L2	L2	L2	L2	L3	L3	L3	L3	L3
Quadrat No. (replicate)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Gracilaria gracilis	%											P				
Ahnfeltia plicata	%															
Gymnogongrus crenulatus	%															
Polyides rotundus	%															
Furcellaria lumbricalis	%															
Cystoclonium purpureum	%															
Ceramium botryocarpum	%															
Ceramium cimbricum	%															
Ceramium nodulosum	%					P						P				
Ceramium shuttleworthianum	%															
Polysiphonia atlantica	%					P										
Polysiphonia fucoides	%			P								P				
PHAEOPHYCEAE	%															
Ralfsia verrucosa	%															
Cladostephus spongiosus	%	P				P	P		P		P	P				
Fucales	%										P					
Ulva compressa	%	P	P	P	P	P	P	P	P	P	P	P		P	P	
Cladophora albida	%															

Llandanwg		L4	L4	L4	L4	L4	L5	L5	L5	L5	L5	L6	L6	L6	L6	L6
Quadrat No. (replicate)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Surveyors		CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/LK/RS	CH/TM	CH/TM	CH/TM	CH/TM	CH/TM
Camera		EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D
Photo No.		5012	5013	5014	5015	5016	5017	5018	5019	5021	5022	5023	5024	5025	5026	5027
Date		20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	20/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013
Standing water %		0	75	36	50	0	70	0	0	0	0	0	0	60	25	50
Checklist spp.																
Sabellaria alveolata (total)	**T%**	12	10	88	1	16	12	20	12	100	40	9	0	40	50	25
Sabellaria alveolata (live)	**%**	3	4	30	1	5	1	10	4	35	25	4	0	30	20	10
Cirripedia (total)	**T%**	0.25	0	0	0	3	0	2	1	0	4	0.25	0	0.25	0.25	4
Mytilus edulis	**%**	0.25	0	1	0	0.25	0	0	0	2	1	0	0	0.25	1	0
Algae (total)	**T%**	80	95	98	96	65	99	95	57	95	95	100	20	80	100	60
Fucus serratus	**%**	60	70	90	60	25	75	85	0	40	8	20	0	20	100	10
Fucus vesiculosus	**%**	10	40	0	52	0	0	0	40	70	94	100	20	80	0	0
Chlorophycota	**T%**	40	20	0.25	0.25	20	1	0.25	30	1	0.25	15	0	4	1	12
Actinia equina	**P**								P		P					
Pomatoceros	**P**															p
Semibalanus balanoides	**%**	P				P		P	P		P	p	p	p	p	p
Elminius modestus	**%**	P						P	P		P					p
Patella vulgata	**P**	P				P		P	P					p	p	
Gibbula cineraria	**P**						P									
Littorina obtusata	**P**					P			P			p				
Nucella lapillus	**P**						P									
Verrucaria (green)	**%**											p				
Rhodophycota (dk red crust)	**T%**	P	P	P	P	P	P	P	P		P	p		p	p	
Corallinaceae	**T%**				P											p
Mastocarpus stellatus	**%**							P	P						p	

Llandanwg		L4	L4	L4	L4	L4	L5	L5	L5	L5	L5	L6	L6	L6	L6	L6
Quadrat No. (replicate)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Chondrus crispus	**%**					P										p
Chromophycota (crust)	**T%**					P	P		P							
Ulva tubular	**%**											p		p	p	p
Ulva flat	**%**	P	P	P		P	P		P	P	P	p		p		p
Chaetomorpha linum	**%**															
Cladophora rupestris	**%**															
Other spp.																
Dynamena pumila	**P**														p	
Arenicola marina	**P**		P									p		p	p	
Lanice conchilega	**P**															p
Chthamalus montagui	**P**															
Idotea granulosa	**P**					P										
Palaemonidae	**P**		P				P							p		
Palaemon serratus	**P**															
Carcinus maenas	**P**	P	P			P		P		P	P			p		
Littorina saxatilis	**P**						P									
Mytilus edulis (juv)	**%**															
Lipophrys pholis	**P**													p		
Sand eel	**P**															
Porphyra	**%**		P													
Rhodothamniella floridula	**%**	P	P			P			P	P	P			p	p	p
Palmaria palmata	**%**					P										p
Hildenbrandia	**%**													p		
Gracilaria gracilis	**%**		P		P											
Ahnfeltia plicata	**%**				P			P								p
Gymnogongrus crenulatus	**%**									P						
Polyides rotundus	**%**		P		P											
Furcellaria lumbricalis	**%**															p

Llandanwg		L4	L4	L4	L4	L4	L5	L5	L5	L5	L5	L6	L6	L6	L6	L6
Quadrat No. (replicate)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Cystoclonium purpureum	%															
Ceramium botryocarpum	%					P										
Ceramium cimbricum	%				P											
Ceramium nodulosum	%															p
Ceramium shuttleworthianum	%															p
Polysiphonia atlantica	%									P						
Polysiphonia fucoides	%				P					P						p
PHAEOPHYCEAE	%															
Ralfsia verrucosa	%											p			p	
Cladostephus spongiosus	%	P				P				P						p
Fucales	%											p			p	
Ulva compressa	%	P	P			P	P	P	P	P	P					
Cladophora albida	%		P		P											

Llandanwg		L7	L7	L7	L7	L7	L8	L8	L8	L8	L8	L9	L9	L9	L9	L9
Quadrat No. (replicate)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Surveyors		CH/TM	CH/TM	CH/TM	CH/TM	CH/TM	CH/TM	CH/TM	CH/TM	CH/TM	CH/TM	CH/TM	CH/TM	CH/TM	CH/TM	CH/TM
Camera		EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D	EOS450D
Photo No.		5032	5033	5034	5035	5036	5037	5038	5039	5040	5041	5042	5043	5044	5047	5048
Date		22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013
Standing water %		0	0	100	0	0	0	0	0	60	70	30	0	25	20	0
Checklist spp.																
Sabellaria alveolata (total)	T%	0	0	0	0	0	0	0	8	4	4	4	0	40	2	0
Sabellaria alveolata (live)	%	0	0	0	0	0	0	0	8	4	1	2	0	25	0	0
Cirripedia (total)	T%	0	0	0	0	0	0	0	0.25	0	3	2	0	2	10	1
Mytilus edulis	%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae (total)	T%	30	0	30	0	60	0	0	35	92	60	80	48	45	48	20

Llandanwg		L7	L7	L7	L7	L7	L8	L8	L8	L8	L8	L9	L9	L9	L9	L9
Fucus serratus	**%**	0	0	0	0	50	0	0	15	10	0	0	0	35	0	0
Fucus vesiculosus	**%**	28	0	30	0	10	0	0	6	0	4	20	30	0	0	3
Chlorophycota	**T%**	2	0	0	0	0	0	0.25	16	80	20	80	20	30	45	20
Actinia equina	**P**															
Pomatoceros	**P**															
Semibalanus balanoides	**%**								p		p	p		p	p	p
Elminius modestus	**%**										p	p		p	p	p
Patella vulgata	**P**										p			p		
Gibbula cineraria	**P**															
Littorina obtusata	**P**															
Nucella lapillus	**P**															
Verrucaria (green)	**%**							p	p			p				
Rhodophycota (dk red crust)	**T%**							p	p	p		p				
Corallinaceae	**T%**															
Mastocarpus stellatus	**%**								p							
Chondrus crispus	**%**															
Chromophycota (crust)	**T%**															
Ulva tubular	**%**	p						p	p		p	p	p	p	p	p
Ulva flat	**%**								p	p	p	p			p	
Chaetomorpha linum	**%**								p						p	p
Cladophora rupestris	**%**										p					
Other spp.																
Dynamena pumila	**P**															
Arenicola marina	**P**	p										p				
Lanice conchilega	**P**									p	p					
Chthamalus montagui	**P**															
Idotea granulosa	**P**															

Llandanwg		L7	L7	L7	L7	L7	L8	L8	L8	L8	L8	L9	L9	L9	L9	L9
Palaemonidae	**P**															
Palaemon serratus	**P**													p		
Carcinus maenas	**P**												p		p	
Littorina saxatilis	**P**															
Mytilus edulis (juv)	**%**										p	p				
Lipophrys pholis	**P**															
Sand eel	**P**					p										
Porphyra	**%**														p	p
Rhodothamniella floridula	**%**													p	p	
Palmaria palmata	**%**															
Hildenbrandia	**%**														p	
Gracilaria gracilis	**%**															
Ahnfeltia plicata	**%**									p				p		
Gymnogongrus crenulatus	**%**															
Polyides rotundus	**%**															
Furcellaria lumbricalis	**%**															
Cystoclonium purpureum	**%**									p	p					
Ceramium botryocarpum	**%**															
Ceramium cimbricum	**%**															
Ceramium nodulosum	**%**									p	p	p		p		
Ceramium shuttleworthianum	**%**															
Polysiphonia atlantica	**%**															
Polysiphonia fucoides	**%**									p	p			p		
PHAEOPHYCEAE	**%**								p							
Ralfsia verrucosa	**%**															
Cladostephus spongiosus	**%**															
Fucales	**%**															
Ulva compressa	**%**															
Cladophora albida	**%**										p					

West Afon Dwyfor		WAD1	WAD1	WAD1	WAD1	WAD1	WAD2	WAD2	WAD2	WAD2	WAD2	WAD3	WAD3	WAD3	WAD3	WAD3
Quadrat No. (replicate)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Surveyors		PB, CJ	PB, CJ	PB, CJ	PB, CJ	PB, CJ	LK, BS	LK, BS	LK, BS	LK, BS	LK, BS	PB, CJ	PB, CJ	PB, CJ	PB, CJ	PB, CJ
Camera		Canon D16	Canon D16	Canon D16	Canon D16	Canon D16	Fujifilm XP	Fujifilm XP	Fujifilm XP	Fujifilm XP	Fujifilm XP	Canon D10	Canon D10	Canon D10	Canon D10	Canon D10
Photo No.		837	843	847	856	858	551	552	553	554	555	801	808	813	825	832
Photo No.2												802	809	814	826	833
Date		22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013
Standing water %		0	0	0	0	0	27	0	4	8	100	0	88	35	60	3
Checklist spp.																
Sabellaria alveolata (total)	T%	0	0.25	0	11	29	1	20	0.25	0.25	0	11	0	0	2	25
Sabellaria alveolata (live)	%	0	0.25	0	1	16	1	0.25	0.25	0	0	5	0	0	0.25	20
Cirripedia (total)	T%	1	0.25	1	0.25	0.25	0.25	0.25	0.25	0.25	0	0.25	0.25	0.25	0	0
Mytilus edulis	%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae (total)	T%	48	26	45	97	98	87	70	81	95	97	92	36	83	93	89
Fucus serratus	%	0	0	0	28	47	27	3	35	35	0	13	12	12	10	1
Fucus vesiculosus	%	48	26	45	90	90	60	62	46	77	88	90	13	79	83	88
Chlorophycota	T%	0	0	0	0.25	1	0	2	0	0.25	1	0.25	0.25	0.25	0	1
Porifera	P						p									
Actinia equina	P			p												
Pomatoceros	P			p			P				P			p		
Semibalanus balanoides	%	p	p	p	p	p	P	P	P	P		p	p	p		
Elminius modestus	%	p	p	p								p				
Paguridae	P															
Patella vulgata	P	p			p		P	P		P				p	p	p
Gibbula cineraria	P												p			
Gibbula umbilicalis	P		p	p	p	p	P	P	P	P		p	p	p	p	p
Littorina obtusata (/mariae)	P	p	p		p	p	P	P		P				p		p
Littorina littorea	P		p			p	P		P	P	P	p	p	p	p	p
Nucella lapillus	P	p				p										p
Verrucaria (green)	%	8						0.25								
Rhodophycota (dk red crust)	T%						0.25		0.25	0.25		0.25			0.25	0.25
Rhodophycota (fil)	T%					0.25										

West Afon Dwyfor		WAD1	WAD1	WAD1	WAD1	WAD1	WAD2	WAD2	WAD2	WAD2	WAD2	WAD3	WAD3	WAD3	WAD3	WAD3
Quadrat No. (replicate)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Dumontia contorta	%															
Corallinaceae	T%						P	0.25				0.25	0.25		1	
Corallina officinalis	%						P						0.25	0.25	0.25	
Mastocarpus stellatus	%									0.25						
Chondrus crispus	%			0.25			P		P		P	0.25		0.25	1	0.25
Osmundea hybrida	%									0.25	0.25	0.25	0.25	0.25		0.25
Chromophycota (crust)	T%		0.25	0.25	0.25	0.25						0.25	2	2	1	
Ulva tubular	%									0.25						
Ulva flat	%							0.25		0.25	0.25	0.25	0.25			0.25
Chaetomorpha	%															
Chaetomorpha linum	%												0.25	0.25	0.25	
Cladophora rupestris	%															
Other spp.																
Halichondria panicea	P						P									
Hydrozoa	P						P			P						
Gonothyraea loveni	P														p	
Arenicola marina	P		p													
Lanice conchilega	P															
Spirorbidae	P						P			P	P	p				
Palaemon serratus	P						P				P					
Palaemonidae	P						P				P		p			
Carcinus maenas	P					p				P						p
Patella ulyssiponensis	P						P									
Osilinus lineatus	P	p	p			p			P				p			
Littorina saxatilis	P								P							
Electra pilosa	%										P					
Lipophrys pholis	P												p		p	
Verrucaria (black)	%			0.25												1
Ceramium sp.	%							0.25					0.25			
Ceramium gaditanum	%												1			
Osmundea osmunda										0.25						
Polysiphonia	%													0.25		

West Afon Dwyfor		WAD1	WAD1	WAD1	WAD1	WAD1	WAD2	WAD2	WAD2	WAD2	WAD2	WAD3	WAD3	WAD3	WAD3	WAD3
Quadrat No. (replicate)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Polysiphonia elongata											0.25					
Polysiphonia harveyi					0.25					0.25	0.25		0.25			
Polysiphonia fucoides	%									0.25	0.25					
Phaeophyceae (fuzz)													2			
Phaeophycota (Enc)	%								0.25		0.25					
Ectocarpaceae	%										0.25					
Elachista fucicola	%	0.25										0.25	2			
Sphacelaria plumosa	%												0.25			
Cladostephus spongiosus	%				0.25			0.25		0.25	0.25	8				0.25
Fucoid sporelings	%		0.25	0.25	0.25	1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Sargassum muticum	%										0.25					
Ulva compressa	%							0.25		0.25	0.25					
Ulva intestinalis					0.25	0.25	0.25	0.25					0.25			0.25
Ulva prolifera																
Ulva pseudocurvata					0.25	0.25										
Cladophora										0.25						
Cladophora albida																
Codium																
Small Green Dots																

West Afon Dwyfor		WAD5	WAD5	WAD5	WAD5	WAD5	WAD6	WAD6	WAD6	WAD6	WAD6	WAD7	WAD7	WAD7	WAD7	WAD7
Quadrat No. (replicate)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Surveyors		PB, CJ	PB, CJ	PB, CJ	PB, CJ	PB, CJ	LK, BS	LK, BS	LK, BS	LK, BS	LK, BS	PB, CJ	PB, CJ	PB, CJ	PB, CJ	PB, CJ
Camera		Canon D10	Canon D10	Canon D10	Canon D10	Canon D10	Fujifilm XP	Fujifilm XP	Fujifilm XP	Fujifilm XP	Fujifilm XP	Canon D10	Canon D10	Canon D10	Canon D10	Canon D10
Photo No.		767	773	780	792	794	543	544	548	549	550	735	744	748	757	761
Photo No.2		768	774	781	793	795						736	745	748	758	762
Date		22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013
Standing water %		75	100	98	96	0	0	0	0	0	18	0	40	0	0	4
Checklist spp.																
Sabellaria alveolata (total)	**T %**	0	0	0.25	0	0	0	0	0	0	0.25	0	38	3	21	68
Sabellaria alveolata (live)	**%**	0	0	0.25	0	0	0	0	0	0	0.25	0	36	2	2	28
Cirripedia (total)	**T %**	0.25	0	0.25	0.25	2	0.25	4	7	5	0.25	2	0.25	0.25	0.25	0.25
Mytilus edulis	**%**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae (total)	**T %**	70	15	58	89	2	26	63	15	29	98	16	78	14	85	49
Fucus serratus	**%**	3	0	0	87	0	26	0	0	0	0	0	0	0	2	9
Fucus vesiculosus	**%**	69	6	47	2	2	0	63	15	29	98	15	78	14	83	7
Chlorophycota	**T %**	0	0	0	0.25	0	0	0	0	0	0	0	0.25	0	5	38
Porifera	**P**															
Actinia equina	**P**												p			
Pomatoceros	**P**		p		p		P		P	P	P					
Semibalanus balanoides	**%**	p		p	p	p	P		P	P	P	p	p	p	p	p
Elminius modestus	**%**				p	p						p	p	p	p	
Paguridae	**P**		p		p											
Patella vulgata	**P**			p						P			p			
Gibbula cineraria	**P**		p	p	p											
Gibbula umbilicalis	**P**	p	p			p	P			P	P	p	p	p	p	p
Littorina obtusata (/mariae)	**P**	p		p							P	p		p	p	
Littorina littorea	**P**	p	p	p	p	p		P		P	P		p	p	p	
Nucella lapillus	**P**					p		P		P	P					
Verrucaria (green)	**%**	1				9									0.25	
Rhodophycota (dk red crust)	**T %**	1			1		0.25	1	0.25	0.25	0.25		0.25		0.25	

West Afon Dwyfor		WAD5	WAD5	WAD5	WAD5	WAD5	WAD6	WAD6	WAD6	WAD6	WAD6	WAD7	WAD7	WAD7	WAD7	WAD7
Quadrat No. (replicate)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Rhodophycota (fil)	**T %**	0.25		0.25												0.25
Dumontia contorta	**%**			0.25	0.25											
Corallinaceae	**T %**	1	1	3	0.25						0.25					
Corallina officinalis	**%**	0.25	0.25	2	0.25											
Mastocarpus stellatus	**%**															
Chondrus crispus	**%**	4	6	13	0.25								0.25		0.25	
Osmundea hybrida	**%**	1	1	0.25	1								0.25			
Chromophycota (crust)	**T %**		3	3	0.25							0.25	1		0.25	
Ulva tubular	**%**															
Ulva flat	**%**														4	0.25
Chaetomorpha	**%**														1	
Chaetomorpha linum	**%**	0.25		0.25	0.25								0.25			
Cladophora rupestris	**%**														0.25	
Other spp.																
Halichondria panicea	**P**															
Hydrozoa	**P**															
Gonothyraea loveni	**P**	p	p	p	p								p		p	
Arenicola marina	**P**															
Lanice conchilega	**P**													p		
Spirorbidae	**P**				p						1				p	p
Palaemon serratus	**P**															
Palaemonidae	**P**	p	p	p	p								p			
Carcinus maenas	**P**									P			p			
Patella ulyssiponensis	**P**															
Osilinus lineatus	**P**		p	p	p	p										p
Littorina saxatilis	**P**						P	P			P					
Electra pilosa	**%**															
Lipophrys pholis	**P**															
Verrucaria (black)	**%**	1			0.25									1		1
Ceramium sp.	**%**														0.25	
Ceramium gaditanum	**%**															

West Afon Dwyfor		WAD5	WAD5	WAD5	WAD5	WAD5	WAD6	WAD6	WAD6	WAD6	WAD6	WAD7	WAD7	WAD7	WAD7	WAD7
Quadrat No. (replicate)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Osmundea osmunda																
Polysiphonia	**%**	0.25											0.25			
Polysiphonia elongata																
Polysiphonia harveyi			0.25		0.25											
Polysiphonia fucoides	**%**				1								0.25			
Phaeophyceae (fuzz)																
Phaeophycota (Enc)	**%**						0.25			0.25	0.25					
Ectocarpaceae	**%**															
Elachista fucicola	**%**	1	1	1	0.25								0.25		0.25	
Sphacelaria plumosa	**%**	0.25											0.25		0.25	
Cladostephus spongiosus	**%**								0.25				0.25		7	
Fucoid sporelings	**%**	0.25	0.25	0.25	0.25	0.25		1			0.25		1		2	0.25
Sargassum muticum	**%**															
Ulva compressa	**%**															
Ulva intestinalis													0.25		2	38
Ulva prolifera																0.25
Ulva pseudocurvata													0.25		0.25	
Cladophora																
Cladophora albida													1			
Codium													0.25			
Small Green Dots								0.25		0.25	0.25					

West Afon Dwyfor		WAD8	WAD8	WAD8	WAD8	WAD8
Quadrat No. (replicate)		1	2	3	4	5
Surveyors		LK, BS	LK, BS	LK, BS	LK, BS	LK, BS
Camera		Fujifilm XP	Fujifilm XP	Fujifilm XP	Fujifilm XP	Fujifilm XP
Photo No.		538	539	540	541	542
Date		22/08/2013	22/08/2013	22/08/2013	22/08/2013	22/08/2013
Standing water %		0	0	34	0	0
Checklist spp.						
Sabellaria alveolata (total)	**T%**	0	0.25	1	0	0
Sabellaria alveolata (live)	**%**	0	0.25	0.25	0	0
Cirripedia (total)	**T%**	2	0.25	0.25	1	2
Mytilus edulis	**%**	0	0	0	0	0
Algae (total)	**T%**	54	82	67	20	58
Fucus serratus	**%**	0	36	20	0	0
Fucus vesiculosus	**%**	54	48	47	20	58
Chlorophycota	**T%**	0	0	0.25	0	0
Porifera	**P**					
Actinia equina	**P**					
Pomatoceros	**P**					
Semibalanus balanoides	**%**	P	P	P	P	P
Elminius modestus	**%**	P				
Paguridae	**P**					
Patella vulgata	**P**	P	P	P		
Gibbula cineraria	**P**					
Gibbula umbilicalis	**P**	P	P	P	P	
Littorina obtusata (/mariae)	**P**	P	P	P		P
Littorina littorea	**P**		P		P	P
Nucella lapillus	**P**					P
Verrucaria (green)	**%**					
Rhodophycota (dk red crust)	**T%**	1	1	0.25	0.25	
Rhodophycota (fil)	**T%**					
Dumontia contorta	**%**					
Corallinaceae	**T%**					
Corallina officinalis	**%**					

West Afon Dwyfor		WAD8	WAD8	WAD8	WAD8	WAD8
Quadrat No. (replicate)		1	2	3	4	5
Mastocarpus stellatus	**%**					
Chondrus crispus	**%**		P			
Osmundea hybrida	**%**					
Chromophycota (crust)	**T%**					
Ulva tubular	**%**					
Ulva flat	**%**			0.25		
Chaetomorpha	**%**					
Chaetomorpha linum	**%**					
Cladophora rupestris	**%**					
Other spp.						
Halichondria panicea	**P**					
Hydrozoa	**P**					
Gonothyraea loveni	**P**					
Arenicola marina	**P**					
Lanice conchilega	**P**					
Spirorbidae	**P**					
Palaemon serratus	**P**					
Palaemonidae	**P**			P		
Carcinus maenas	**P**			P		
Patella ulyssiponensis	**P**			P		
Osilinus lineatus	**P**		P	P	P	
Littorina saxatilis	**P**	P	P			P
Electra pilosa	**%**					
Lipophrys pholis	**P**					
Verrucaria (black)	**%**					
Ceramium sp.	**%**					
Ceramium gaditanum	**%**					
Osmundea osmunda	**%**					
Polysiphonia	**%**					
Polysiphonia elongata	**%**					
Polysiphonia harveyi	**%**					
Polysiphonia fucoides	**%**			0.25		

West Afon Dwyfor		WAD8	WAD8	WAD8	WAD8	WAD8
Quadrat No. (replicate)		1	2	3	4	5
Phaeophyceae (fuzz)	**%**					
Phaeophycota (Enc)	**%**			1		
Ectocarpaceae	**%**					
Elachista fucicola	**%**					
Sphacelaria plumosa	**%**					
Cladostephus spongiosus	**%**					
Fucoid sporelings	**%**					
Sargassum muticum	**%**					
Ulva compressa	**%**					

Appendix 4 Glaslyn / Dwyryd Quantitative infaunal core results

Taxa	Modifier	G10A	G10B	G10C	G14A	G14A	G14C	G20A	G20B	G20C	G40A	G40B	G40C
NEMATODA					1			5		1			
Terebellidae	dam.												
Eteone longa	agg.		1										
Tubificoides pseudogaster	agg.			2									
Enchytraeidae		22	1	5						2			
POLYCHAETA	dam.												
Nereididae	juv.			7	1			1		1			
Hediste diversicolor		21	6	12									
Nephtys cirrosa												1	
Orbiniidae	dam.												
Paraonis fulgens											2		
Spionidae	dam.												
Pygospio elegans		1		2				8	8	16	P		
Spio martinensis													
Psammodrilus balanoglossoides													
Capitellidae	dam.												
Capitella													
Arenicola	dam.												
Maldanidae	dam.												
DECAPODA	dam.												
Urothoe poseidonis													
Bathyporeia	dam.				1								
Bathyporeia pilosa				2	1		2	85	91	83			
Haustorius arenarius								1					
Corophium	juv.												
Corophium arenarium				1				18	9	17			
Eurydice	dam.												
Eurydice	juv.											1	
Eurydice pulchra								1	1				
PELECYPODA	dam.												
Mytilidae	juv.												
Cerastoderma edule	juv.			1				6	3	1			
Cerastoderma edule													
Tellina tenuis											2	4	1
Macoma balthica		1											
Hydrobia ulvae		3	5	8			1	1	8	3			

COLLEMBOLA												1	
Dolichopodidae	larva	1											
Number of Taxa		6	4	9	4	0	2	9	6	8	3	4	1
Total Abundance		49	13	40	4	0	3	126	120	124	4	7	1

Glaslyn / Dwyryd Quantitative infaunal core results (continued)

Taxa	Modifier	G44A	G44B	G44C	G49A	G49B	G49C	G50A	G50B	G50C	G55A	G55B	G55B	G61A	G61B	G61C
NEMATODA															2	
Terebellidae	dam.															
Eteone longa	agg.	1														
Tubificoides pseudogaster	agg.											1				
Enchytraeidae									P							
POLYCHAETA	dam.															
Nereididae	juv.															
Hediste diversicolor																
Nephtys cirrosa						1	2									
Orbiniidae	dam.															
Paraonis fulgens																
Spionidae	dam.													P		
Pygospio elegans		16	16	10	1					1					1	2
Spio martinensis						1										
Psammodrilus balanoglossoides		P					2									
Capitellidae	dam.		P													
Capitella		1		2	1											
Arenicola	dam.															
Maldanidae	dam.															
DECAPODA	dam.			P												
Urothoe poseidonis											1					
Bathyporeia	dam.															
Bathyporeia pilosa									5	2				39	38	40
Haustorius arenarius																
Corophium	juv.														1	
Corophium arenarium														1	3	
Eurydice	dam.															
Eurydice	juv.		2	1				23	27	28				5	10	7
Eurydice pulchra								5	4	1				5		
PELECYPODA	dam.						1									
Mytilidae	juv.		1													
Cerastoderma edule	juv.		2	3		1	1							6	1	

Taxa	Modifier	G44A	G44B	G44C	G49A	G49B	G49C	G50A	G50B	G50C	G55A	G55B	G55B	G61A	G61B	G61C
Cerastoderma edule		14	10	3	1											
Tellina tenuis					1		3									
Macoma balthica		2	2	4	1											
Hydrobia ulvae		23	9	11	1	3	7							10	13	15
COLLEMBOLA																
Dolichopodidae	larva														1	
Number of Taxa		7	8	8	6	4	6	2	4	4	1	1	0	7	9	4
Total Abundance		57	42	34	6	6	16	28	36	32	1	1	0	66	70	64

Appendix 5 Particle size data for the Glaslyn /Dwyryd quantitative coring stations

Analysis by Dry Sieving										
% Fractional Data										
Site		**GO10c**	**GO14**	**GO20**	**GO40**	**GO44**	**GO49**	**GO50**	**GO55**	**GO61**
Medium pebble (gravel)	> 8 mm	0	0	0	0	0	0	0	0	0
Small pebble (gravel)	4-8 mm	0	0	0.32	0	0.26	0	0	0.14	0
Granule	2-4 mm	0.02	0.01	0.01	0	0.27	0.02	0.06	0.08	0.03
Sand - very coarse	1-2000 µm	0.06	0.01	0.01	0	0.06	0.04	0.12	0.07	0.21
Sand - coarse	500-1000 µm	0.18	0.01	0.02	0.02	0.03	0.05	0.43	0.24	1.09
Sand - medium	250-500 µm	3.26	0.20	0.35	5.22	0.63	2.93	28.52	4.53	7.31
Sand - fine	125-250 µm	71.60	59.51	70.68	91.10	77.12	82.72	65.58	82.83	73.66
Sand - very fine	63-125 µm	19.60	38.63	25.74	2.49	18.91	11.81	4.23	9.38	12.35
Silt & Clay	< 63 µm	5.29	1.64	2.87	1.16	2.71	2.44	1.06	2.72	5.37

Appendix 6 Porth Oer Rocky shore data

	Sample (Station)	Upper	Upper	Upper	Upper	Mid	Mid	Mid	Mid	Low	Low	Low	Low
	Replicate (Quadrat)	US1	US2	US3	US4	MS1	MS2	MS3	MS4	LS1	LS2	LS3	LS4
	Surveyors	TM / JM	TM / JM	TM / JM	TM / JM	TM / JM	TM / JM	TM / JM	TM / JM	CH / LK / BW	CH / LK / BW	CH / LK / BW	CH / LK / BW
	Photos	1,451	1,452	1,453	1,454	1446	1447	1448	1450	4,988	4989	4990, 91	4992, 93
	Time Start	17:50											
	Time Finish	19:58											
MCS Code	**Fauna**												
C05230	Hymeniacidon perleve						6	4	2	1			
C04840	Halichondria panicea									3	2	2	
D11510	Actinia equina						4	7	5			2	1
P02770	Eulalia viridis												
P23020	Pomatoceros												
Q00820	Prostigmata	P	P	P	P	P	P	P	P	P			
R00210	Cirripedia		9	12	17	25	25	25	25	25	25	25	25
R00720	Chthamalus montagui		9	12	17	25	25	25	25	7	5	5	6
R00730	Chthamalus stellatus					11	15	17	18	5	5	9	8
R01080	Semibalanus balanoides					23	25	25	25	25	25	25	25
R01200	Elminius modestus										2		1
S01660	AMPHIPODA							P	P	p		p	p
S17890	Ligia oceanica	17	6		1								
W01300	Patella		7	10	11	25	25	25	25	25	25	25	25
W02480	Littorina	2	4	17	9	25	25	25	25	22	20	22	25
W02520	Melarhaphe neritoides			3	1	17	11	25	25		1		
W02600	Littorina saxatilis	2	4	17	9	12		9	18	22	20	22	25
W16500	Mytilus edulis					2	1	0	4			1	
W08170	Nucella lapillus						1						
W02500	Littorina littorea		5										
	Anurida maritima					25	25	25	25	9	4		
	Petrobius maritimus												
	Algae												
ZM00010	RHODOPHYCOTA	16	25	4			6	7	13				
ZM01370	Audouinella purpurea		12										
ZM01770	Nemalion helminthoides									2	4	7	3

	Sample (Station)	Upper	Upper	Upper	Upper	Mid	Mid	Mid	Mid	Low	Low	Low	Low
	Replicate (Quadrat)	US1	US2	US3	US4	MS1	MS2	MS3	MS4	LS1	LS2	LS3	LS4
ZM03760	Hildenbrandia	16	25	4			3	2	7		3		1
ZM03840	Corallinaceae						10	11	16	25	25	25	21
ZM04040	Corallina officinalis						5	7	5	24	25	25	22
ZM06050	Mastocarpus stellatus								2	3	10	12	5
ZM06310	Plocamium cartilagineum									2	3	10	5
ZM06710	Catenella caespitosa	22	17	22	6								
ZM07510	Lomentaria articulata										1	1	
ZM07950	Aglaothamnion hookeri									1	2	1	
ZM08250	Ceramium strictum									1			1
ZM08240	Ceramium shuttleworthianum								3	1	1	1	3
ZM09900	Membranoptera alata									1	3	4	3
ZM10800	Osmundea pinnatifida					1	3	2	6	6	17	14	9
ZM11020	Polysiphonia atlantica										1	1	
ZM11125	Polysiphonia harveyi												
ZR00030	Ectocarpaceae												
ZR01670	Ralfsia verrucosa						16	5	4	15	20	14	12
ZM11400	Boergeseniella thuyoides										2		1
ZR06320	Laminaria digitata									3			
ZR06750	Fucus spiralis	2	7										
ZR06810	Pelvetia canaliculata	25	22	1									
ZR06870	Himanthalia elongata									3	9	10	4
ZS02110	Ulva (tubular)		3				3	4	1	2	4	4	3
ZS02400	Ulva (flat)						2			1			1
ZS03270	Chaetomorpha ligustica												3
ZS03560	Cladophora rupestris												
ZM08820	Plumaria elegans									1	1		
ZS03380	Cladophora											2	
ZM07940	Callithamnion granulatum									2	4	1	
ZM11300	Polysiphonia stricta										1		
	Verrucaria	25	25	25	25	25	25	25	25	25	22	20	23
	Pyrenocollema		9	12	17	25	25	25	25	25	9	9	9
	Caloplaca marina	3											

Appendix 7 Dyfi Quantitative infaunal core results

MCS	Binomial	Modifier	D19A	D19B	D19C	D28A	D28B	D28C	D39A	D39B	D39C	D41A	D41B	D41C	D50A	D50B	D50C
G1	NEMERTEA								1								
HD1	NEMATODA				2	1	3	1					1				
P1179	Terebellidae	dam.													P		
P118	*Eteone longa*	agg.				1											
P1490	*Tubificoides benedii*						1	2									
P1498	*T. pseudogaster*	agg.					1			1							
P1501	Enchytraeidae					3	9	24									
P2	POLYCHAETA	dam.															
P458	Nereididae	juv.							1	2							
P462	*Hediste diversicolor*									3	1						
P655	Orbiniidae	dam.															
P720	Spionidae	dam.															
P753	*Polydora cornuta*																
P776	*Pygospio elegans*		1	1	4	9	19	15	15	13	2						
P783	*Scolelepis squamata*												1				
P799	*Streblospio shrubsolii*																
P903	Capitellidae	dam.															
P906	Capitella					1	1										
P917	*Heteromastus filiformis*					1		1	3		2						
P929	Arenicola	dam.															
P938	Maldanidae	dam.															
S1276	DECAPODA	dam.															
S1569	Portunidae	juv.								1							
S457	*Bathyporeia pilosa*		3	6	5	1							3		1		
S605	Corophium	dam.						1									
S605	Corophium	juv.					1										
S609	*Corophium arenarium*					11	10	13									
S616	*Corophium volutator*												1				
S805	*Cyathura carinata*					1	1		8	8	7						
S841	Eurydice	dam.															
S850	Eurydice	juv.	1									8	4	1	1	1	1
S854	*Eurydice pulchra*											1		1			
S868	Sphaeromatidae	juv.												1			
W1691	Mytilidae	juv.				1			6	1							
W1961	*Cerastoderma edule*	juv.								4	5						
W1961	*Cerastoderma edule*					1	1		24	11	12						

MCS	Binomial	Modifier	D19A	D19B	D19C	D28A	D28B	D28C	D39A	D39B	D39C	D41A	D41B	D41C	D50A	D50B	D50C
W2012	*Tellina tenuis*																1
W2029	*Macoma balthica*					1		3	1	2	1						
W2068	*Scrobicularia plana*	juv.							19								
W2068	*Scrobicularia plana*								4	19	28						
W334	*Rissoa parva*								1								
W385	*Hydrobia ulvae*					1			373	213	161	2		1			
	Staphylinidae		1														
	Dolichopodidae	larva							2								
	Number of Taxa		4	2	3	13	10	8	13	12	9	3	5	4	3	1	2
	Total Abundance		6	7	11	33	47	60	458	278	219	11	10	4	2	1	2

Dyfi Quantitative infaunal core results (continued)

MCS	Binomial	Modifier	D80A	D80B	D80C	D84A	D84B	D84C	D89A	D89B	DY89C	DY95A	DY95B	DY95C
G1	NEMERTEA		1											P
HD1	NEMATODA			1										1
P1179	Terebellidae	dam.												
P118	*Eteone longa*	agg.					P							
P1490	*Tubificoides benedii*													
P1498	*T. pseudogaster*	agg.		2					1					
P1501	Enchytraeidae											8	45	87
P2	POLYCHAETA	dam.												
P458	Nereididae	juv.		1	1					2				
P462	*Hediste diversicolor*		11	9	8				2	1	3	12	6	2
P655	Orbiniidae	dam.												
P720	Spionidae	dam.												
P753	*Polydora cornuta*			1										
P776	*Pygospio elegans*		243	194	142			P	418	210	390		P	
P783	*Scolelepis squamata*													
P799	*Streblospio shrubsolii*		1	2	5									
P903	Capitellidae	dam.												
P906	Capitella					1								
P917	*Heteromastus filiformis*													
P929	Arenicola	dam.												
P938	Maldanidae	dam.												
S1276	DECAPODA	dam.												
S1569	Portunidae	juv.												
S457	*Bathyporeia pilosa*													
S605	Corophium	dam.												
S605	Corophium	juv.												1
S609	*Corophium arenarium*								3	2	5			
S616	*Corophium volutator*			2					4	3	2	299	557	188
S805	*Cyathura carinata*		12	20	24				10	6	12	1		
S841	Eurydice	dam.												
S850	Eurydice	juv.												
S854	*Eurydice pulchra*													
S868	Sphaeromatidae	juv.												
W1691	Mytilidae	juv.			1									
W1961	*Cerastoderma edule*	juv.	3	2	3				3	2	2			
W1961	*Cerastoderma edule*		8	8	3									
W2012	*Tellina tenuis*													

MCS	Binomial	Modifier	D80A	D80B	D80C	D84A	D84B	D84C	D89A	D89B	DY89C	DY95A	DY95B	DY95C
W2029	*Macoma balthica*			1	1	1			7	13	11		1	
W2068	*Scrobicularia plana*	juv.												
W2068	*Scrobicularia plana*		14	16	21				2		2			
W334	*Rissoa parva*													
W385	*Hydrobia ulvae*		153	133	116	27	22	11	45	67	24	2	40	3
	Staphylinidae													
	Dolichopodidae	larva												2
	Number of Taxa		9	14	11	3	2	2	10	9	9	5	6	8
	Total Abundance		446	392	325	29	22	11	495	306	451	322	649	284

Appendix 8 Particle size data for the Dyfi quantitative coring stations

Analysis by Dry Sieving										
% Fractional Data										
Site		**DY19**	**DY28**	**DY39**	**DY41**	**DY50**	**DY80**	**DY84**	**DY87**	**DY95**
Medium pebble (gravel)	> 8 mm	0	0	0	0	0	0	0	0	0
Small pebble (gravel)	4-8 mm	0	0	0.06	0	0	0	0	0	0
Granule	2-4 mm	0	0	0.21	0.10	0	1.46	0.01	0.05	0
Sand - very coarse	1-2000 µm	0.02	0.02	0.17	0.28	0.01	0.31	0.01	0.03	0.02
Sand - coarse	500-1000 µm	0.29	0.04	0.12	0.80	0.03	0.17	0.01	0.03	0.04
Sand - medium	250-500 µm	9.94	0.18	1.99	21.71	4.11	0.71	0.26	0.10	0.18
Sand - fine	125-250 µm	77.43	32.31	20.86	69.74	92.77	60.11	83.11	52.93	18.02
Sand - very fine	63-125 µm	9.39	52.20	32.81	6.16	2.04	20.07	14.20	34.37	30.55
Silt & Clay	< 63 µm	2.93	15.26	43.78	1.21	1.03	17.16	2.40	12.49	51.20

Appendix 9 Photographic catalogue

Filename	Time	Photographer	Site	Zone	Stn	Notes
20130819_TSM_Pwllheli_0097.JPG	12:12:56	TSM	Pwllheli	Pectenogammarus	PE10	PE10 Pwllheli substrate
20130819_TSM_Pwllheli_0098.JPG	12:13:06	TSM	Pwllheli	Pectenogammarus	PE10	PE10 Pwllheli substrate
20130819_TSM_Pwllheli_0099.JPG	12:19:44	TSM	Pwllheli	Pectenogammarus	PE23	PE23 Pwllheli viewed west
20130819_TSM_Pwllheli_0100.JPG	12:19:50	TSM	Pwllheli	Pectenogammarus	PE23	PE23 Pwllheli viewed north
20130819_TSM_Pwllheli_0101.JPG	12:20:08	TSM	Pwllheli	Pectenogammarus	PE23	PE23 Pwllheli substrate
20130819_TSM_Porth_Oer_0102.JPG	13:34:52	TSM	Porth Oer	Mid shore	Q4	Fixed quadrat in situ
20130819_TSM_Porth_Oer_0103.JPG	14:05:48	TSM	Porth Oer	Mid shore	Q3	Fixed quadrat in situ
20130819_TSM_Porth_Oer_0104.JPG	14:24:40	TSM	Porth Oer	Mid shore	Q2	Fixed quadrat in situ
20130819_TSM_Porth_Oer_0105.JPG	14:42:14	TSM	Porth Oer	Mid shore	Q1	Fixed quadrat in situ
20130819_TSM_Porth_Oer_0106.JPG	15:01:34	TSM	Porth Oer	Mid shore	M	Coralline Pool
20130819_TSM_Porth_Oer_0107.JPG	15:01:42	TSM	Porth Oer	Mid shore	M	Coralline Pool - Site of the Corallina sample
20130819_TSM_Porth_Oer_0108.JPG	15:01:52	TSM	Porth Oer	Mid shore	M	Surveyor in the mid shore at Porth Oer
20130819_TSM_Porth_Oer_0109.JPG	15:34:12	TSM	Porth Oer	Uppershore	Q4	Fixed quadrat in situ
20130819_TSM_Porth_Oer_0110.JPG	15:47:14	TSM	Porth Oer	Uppershore	Q3	Fixed quadrat in situ
20130819_TSM_Porth_Oer_0111.JPG	16:02:24	TSM	Porth Oer	Uppershore	Q2	Fixed quadrat in situ
20130819_TSM_Porth_Oer_0112.JPG	16:20:44	TSM	Porth Oer	Uppershore	Q1	Fixed quadrat in situ
20130819_CMH_PorthOer_4988.JPG	13:48:00	CMH	Porth Oer	Lower shore	Q1	Fixed quadrat in situ
20130819_CMH_PorthOer_4989.JPG	14:44:00	CMH	Porth Oer	Lower shore	Q2	Fixed quadrat in situ
20130819_CMH_PorthOer_4990.JPG	15:22:00	CMH	Porth Oer	Lower shore	Q3	Fixed quadrat in situ
20130819_CMH_PorthOer_4991.JPG	15:22:00	CMH	Porth Oer	Lower shore	Q3	Fixed quadrat in situ
20130819_CMH_PorthOer_4992.JPG	15:57:00	CMH	Porth Oer	Lower shore	Q4	Fixed quadrat in situ
20130819_CMH_PorthOer_4993.JPG	15:58:00	CMH	Porth Oer	Lower shore	Q4	Fixed quadrat in situ
20130819_CJ_Dwyryd_Glaslyn_585_View.JPG	19/08/13 12:58:14	CJ	Dwyryd Glaslyn			Train view
20130819_CJ_Dwyryd_Glaslyn_586_G044.JPG	19/08/13 13:09:54	CJ	Dwyryd Glaslyn		G044	Sediment surface
20130819_CJ_Dwyryd_Glaslyn_587_G044.JPG	19/08/13 13:10:26	CJ	Dwyryd Glaslyn		G044	Hole
20130819_CJ_Dwyryd_Glaslyn_588_G044.JPG	19/08/13 13:11:02	CJ	Dwyryd Glaslyn		G044	Sieve contents
20130819_CJ_Dwyryd_Glaslyn_589_G044.JPG	19/08/13 13:16:10	CJ	Dwyryd Glaslyn		G044	Core
20130819_CJ_Dwyryd_Glaslyn_590_G044.JPG	19/08/13 13:17:04	CJ	Dwyryd Glaslyn		G044	Sieve contents
20130819_CJ_Dwyryd_Glaslyn_591_G040.JPG	19/08/13 13:29:10	CJ	Dwyryd Glaslyn		G040	Cores
20130819_CJ_Dwyryd_Glaslyn_592_G040.JPG	19/08/13 13:29:18	CJ	Dwyryd Glaslyn		G040	Sediment surface
20130819_CJ_Dwyryd_Glaslyn_593_G040.JPG	19/08/13 13:31:44	CJ	Dwyryd Glaslyn		G040	Sieve contents
20130819_CJ_Dwyryd_Glaslyn_594_G040.JPG	19/08/13 13:31:48	CJ	Dwyryd Glaslyn		G040	Sieve contents
20130819_CJ_Dwyryd_Glaslyn_595_G040.JPG	19/08/13 13:35:58	CJ	Dwyryd Glaslyn		G040	Core
20130819_CJ_Dwyryd_Glaslyn_596_G040.JPG	19/08/13 13:37:02	CJ	Dwyryd Glaslyn		G040	Sieve contents

Filename	Time	Photographer	Site	Zone	Stn	Notes
20130819_CJ_Dwyryd_Glaslyn_597_G049.JPG	19/08/13 14:31:26	CJ	Dwyryd Glaslyn		G049	Core
20130819_CJ_Dwyryd_Glaslyn_598_G049.JPG	19/08/13 14:31:32	CJ	Dwyryd Glaslyn		G049	Core
20130819_CJ_Dwyryd_Glaslyn_599_G049.JPG	19/08/13 14:31:38	CJ	Dwyryd Glaslyn		G049	Sediment surface
20130819_CJ_Dwyryd_Glaslyn_600_G049.JPG	19/08/13 14:32:46	CJ	Dwyryd Glaslyn		G049	Sieve contents
20130819_CJ_Dwyryd_Glaslyn_601_G049.JPG	19/08/13 14:38:26	CJ	Dwyryd Glaslyn		G049	Hole
20130819_CJ_Dwyryd_Glaslyn_602_G049.JPG	19/08/13 14:39:02	CJ	Dwyryd Glaslyn		G049	Sieve contents
20130819_CJ_Dwyryd_Glaslyn_603_G050.JPG	19/08/13 14:51:54	CJ	Dwyryd Glaslyn		G050	Core
20130819_CJ_Dwyryd_Glaslyn_604_G050.JPG	19/08/13 14:52:00	CJ	Dwyryd Glaslyn		G050	Hole
20130819_CJ_Dwyryd_Glaslyn_605_G050.JPG	19/08/13 14:52:06	CJ	Dwyryd Glaslyn		G050	Sediment surface
20130819_CJ_Dwyryd_Glaslyn_606_G050.JPG	19/08/13 14:52:16	CJ	Dwyryd Glaslyn		G050	Paul Coring
20130819_CJ_Dwyryd_Glaslyn_607_G050.JPG	19/08/13 14:54:06	CJ	Dwyryd Glaslyn		G050	Sieve contents
20130819_CJ_Dwyryd_Glaslyn_608_G050.JPG	19/08/13 14:55:10	CJ	Dwyryd Glaslyn		G050	Sieve contents
20130819_CJ_Dwyryd_Glaslyn_609_View_Borth_y_Gest.JPG	19/08/13 15:11:06	CJ	Dwyryd Glaslyn			View
20130819_CJ_Dwyryd_Glaslyn_610_View_Borth_y_Gest.JPG	19/08/13 15:11:14	CJ	Dwyryd Glaslyn			View
20130819_CJ_Dwyryd_Glaslyn_611_View_Borth_y_Gest.JPG	19/08/13 15:11:34	CJ	Dwyryd Glaslyn			View
20130819_CJ_Dwyryd_Glaslyn_612_View_Borth_y_Gest.JPG	19/08/13 15:13:10	CJ	Dwyryd Glaslyn			View
20130819_CJ_Dwyryd_Glaslyn_613_Pont_Briwet.JPG	19/08/13 15:38:46	CJ	Dwyryd Glaslyn			Sediment curtains
20130819_CJ_Dwyryd_Glaslyn_614_Pont_Briwet.JPG	19/08/13 15:39:02	CJ	Dwyryd Glaslyn			Sediment curtains
20130819_CJ_Dwyryd_Glaslyn_615_Pont_Briwet.JPG	19/08/13 15:39:06	CJ	Dwyryd Glaslyn			Sediment curtains
20130819_CJ_Dwyryd_Glaslyn_616_Pont_Briwet.JPG	19/08/13 15:39:12	CJ	Dwyryd Glaslyn			Sediment curtains
20130819_CJ_Dwyryd_Glaslyn_617_G014.JPG	19/08/13 15:45:42	CJ	Dwyryd Glaslyn		G014	Core
20130819_CJ_Dwyryd_Glaslyn_618_G014.JPG	19/08/13 15:45:46	CJ	Dwyryd Glaslyn		G014	Sediment surface
20130819_CJ_Dwyryd_Glaslyn_619_G014.JPG	19/08/13 15:52:24	CJ	Dwyryd Glaslyn		G014	View
20130819_CJ_Dwyryd_Glaslyn_620_Pont_Briwet.JPG	19/08/13 15:53:36	CJ	Dwyryd Glaslyn			Sediment surface
20130819_CJ_Dwyryd_Glaslyn_621_Pont_Briwet.JPG	19/08/13 15:55:36	CJ	Dwyryd Glaslyn			Sediment curtain with human scale
20130819_CJ_Dwyryd_Glaslyn_622_Pont_Briwet.JPG	19/08/13 15:56:00	CJ	Dwyryd Glaslyn			Sediment curtain
20130819_CJ_Dwyryd_Glaslyn_623_Pont_Briwet.JPG	19/08/13 15:56:08	CJ	Dwyryd Glaslyn			Sediment curtain
20130819_CJ_Dwyryd_Glaslyn_624_Pont_Briwet.JPG	19/08/13 15:56:50	CJ	Dwyryd Glaslyn			Sediment curtain
20130819_CJ_Dwyryd_Glaslyn_625_Pont_Briwet.JPG	19/08/13 15:56:58	CJ	Dwyryd Glaslyn			Sediment curtain
20130819_CJ_Dwyryd_Glaslyn_626_Pont_Briwet.JPG	19/08/13 16:00:44	CJ	Dwyryd Glaslyn			Sediment curtain
20130819_CJ_Dwyryd_Glaslyn_628_Pylon.JPG	19/08/13 16:03:56	CJ	Dwyryd Glaslyn			Sediment curtain with sinking pylon
20130820_TSM_Dyfi_0113.JPG	14:00:00	TSM	Dyfi	Grid - in situ	DY045b	Core and hole
20130820_TSM_Dyfi_0114.JPG	14:00:00	TSM	Dyfi	Grid - in situ	DY045b	Core, hole and view west
20130820_TSM_Dyfi_0115.JPG	14:46:00	TSM	Dyfi	Grid - in situ	DY108	Core, hole and sediment surface at DY 108
20130820_TSM_Dyfi_0116.JPG	15:33:00	TSM	Dyfi	Grid - in situ	DY109	Core, hole and sediment surface at DY 109

Filename	Time	Photographer	Site	Zone	Stn	Notes
20130820_TSM_Dyfi_0117.JPG	15:33:00	TSM	Dyfi	Grid - in situ	DY109	Core, hole and sediment surface at DY 109 - note *Vaucheria* mat
20130820_TSM_Dyfi_0118.JPG	15:59:00	TSM	Dyfi	Grid - in situ	DY106b	Core, hole and sediment surface at DY 106b
20130820_TSM_Dyfi_0119.JPG	15:59:00	TSM	Dyfi	Grid - in situ	DY106b	Sediment surface at DY 106b - note Scrobicularia
20130820_TSM_Dyfi_0120.JPG	15:59:00	TSM	Dyfi	Grid - in situ	DY106b	Sediment surface at DY 106b - note Scrobicularia
20130820_TSM_Dyfi_0121.JPG	15:59:00	TSM	Dyfi	Grid - in situ	DY106b	Sieving core at eroding channel edge - DY 106b
20130820_TSM_Dyfi_0122.JPG	15:59:00	TSM	Dyfi	Grid - in situ	DY106b	Sieving core at eroding channel edge - DY 106b
20130820_CMH_Llandanwg_4994.JPG	20/08/13 13:30:12	CMH	Llandanwg	Sabellaria	LL01_Q1	Quadrat
20130820_CMH_Llandanwg_4995.JPG	20/08/13 13:44:16	CMH	Llandanwg	Sabellaria	LL01_Q2	Quadrat
20130820_CMH_Llandanwg_4996.JPG	20/08/13 13:44:50	CMH	Llandanwg	Sabellaria	LL01	View
20130820_CMH_Llandanwg_4997.JPG	20/08/13 13:56:54	CMH	Llandanwg	Sabellaria	LL01_Q3	Quadrat
20130820_CMH_Llandanwg_4998.JPG	20/08/13 14:08:22	CMH	Llandanwg	Sabellaria	LL01_Q4	Quadrat
20130820_CMH_Llandanwg_4999.JPG	20/08/13 14:18:20	CMH	Llandanwg	Sabellaria	LL01	Quadrat not completed because pool too deep
20130820_CMH_Llandanwg_5000.JPG	20/08/13 14:24:12	CMH	Llandanwg	Sabellaria	LL01_Q5	Quadrat
20130820_CMH_Llandanwg_5001.JPG	20/08/13 14:39:32	CMH	Llandanwg	Sabellaria	LL02_Q1	Quadrat
20130820_CMH_Llandanwg_5002.JPG	20/08/13 14:47:28	CMH	Llandanwg	Sabellaria	LL02_Q2	Quadrat
20130820_CMH_Llandanwg_5003.JPG	20/08/13 14:53:30	CMH	Llandanwg	Sabellaria	LL02_Q3	Quadrat
20130820_CMH_Llandanwg_5004.JPG	20/08/13 14:53:44	CMH	Llandanwg	Sabellaria	LL02_Q3	Quadrat
20130820_CMH_Llandanwg_5005.JPG	20/08/13 15:07:52	CMH	Llandanwg	Sabellaria	LL02_Q4	Quadrat
20130820_CMH_Llandanwg_5006.JPG	20/08/13 15:10:42	CMH	Llandanwg	Sabellaria	LL02_Q5	Quadrat
20130820_CMH_Llandanwg_5007.JPG	20/08/13 15:20:36	CMH	Llandanwg	Sabellaria	LL03_Q1	Quadrat
20130820_CMH_Llandanwg_5008.JPG	20/08/13 15:30:24	CMH	Llandanwg	Sabellaria	LL03_Q2	Quadrat
20130820_CMH_Llandanwg_5009.JPG	20/08/13 15:37:28	CMH	Llandanwg	Sabellaria	LL03_Q3	Quadrat
20130820_CMH_Llandanwg_5010.JPG	20/08/13 15:41:14	CMH	Llandanwg	Sabellaria	LL03_Q4	Quadrat
20130820_CMH_Llandanwg_5011.JPG	20/08/13 15:45:16	CMH	Llandanwg	Sabellaria	LL03_Q5	Quadrat
20130820_CMH_Llandanwg_5012.JPG	20/08/13 15:54:06	CMH	Llandanwg	Sabellaria	LL04_Q1	Quadrat
20130820_CMH_Llandanwg_5013.JPG	20/08/13 16:02:20	CMH	Llandanwg	Sabellaria	LL04_Q2	Quadrat
20130820_CMH_Llandanwg_5014.JPG	20/08/13 16:13:22	CMH	Llandanwg	Sabellaria	LL04_Q3	Quadrat
20130820_CMH_Llandanwg_5015.JPG	20/08/13 16:21:00	CMH	Llandanwg	Sabellaria	LL04_Q4	Quadrat
20130820_CMH_Llandanwg_5016.JPG	20/08/13 16:32:00	CMH	Llandanwg	Sabellaria	LL04_Q5	Quadrat
20130820_CMH_Llandanwg_5017.JPG	20/08/13 16:50:38	CMH	Llandanwg	Sabellaria	LL05_Q1	Quadrat
20130820_CMH_Llandanwg_5018.JPG	20/08/13 16:59:04	CMH	Llandanwg	Sabellaria	LL05_Q2	Quadrat
20130820_CMH_Llandanwg_5019.JPG	20/08/13 17:06:16	CMH	Llandanwg	Sabellaria	LL05_Q3	Quadrat
20130820_CMH_Llandanwg_5020.JPG	20/08/13 17:13:44	CMH	Llandanwg	Sabellaria	LL05	Quadrat not completed because pool too deep
20130820_CMH_Llandanwg_5021.JPG	20/08/13 17:15:56	CMH	Llandanwg	Sabellaria	LL05_Q4	Quadrat
20130820_CMH_Llandanwg_5022.JPG	20/08/13 17:23:14	CMH	Llandanwg	Sabellaria	LL05_Q5	Quadrat

Filename	Time	Photographer	Site	Zone	Stn	Notes
20130821_TSM_Dyfi_0123.JPG	22/08/13 15:03:24	TSM	Dyfi		DY107	Sieving in creek DY107
20130821_TSM_Dyfi_0124.JPG	22/08/13 15:17:16	TSM	Dyfi		DY107	Sieving in creek DY107
20130821_TSM_Dyfi_0125.JPG	22/08/13 15:27:24	TSM	Dyfi		DY100	3 cores in a sieve DY100
20130821_TSM_Dyfi_0126.JPG	22/08/13 15:42:18	TSM	Dyfi		DY100	Habitat shot at DY100
20130821_TSM_Dyfi_0127.JPG	22/08/13 15:52:12	TSM	Dyfi		DY099	Close up of sediment DY099
20130821_TSM_Dyfi_0128.JPG	22/08/13 16:14:10	TSM	Dyfi		DY099	3 cores in a sieve DY099
20130821_TSM_Dyfi_0129.JPG	22/08/13 16:23:36	TSM	Dyfi		DY084	Core in sieve DY084
20130821_TSM_Dyfi_0130.JPG	22/08/13 16:30:10	TSM	Dyfi		DY084	Core in sieve DY084
20130821_TSM_Dyfi_0131.JPG	22/08/13 16:30:30	TSM	Dyfi		DY084	Sieving at water's edge DY084
20130821_TSM_Dyfi_0132.JPG	22/08/13 16:30:54	TSM	Dyfi		DY084	Habitat shot at DY084
20130821_TSM_Dyfi_0133.JPG	22/08/13 16:37:00	TSM	Dyfi		DY084	Core in sieve DY084
20130821_TSM_Dyfi_0134.JPG	22/08/13 16:45:58	TSM	Dyfi		DY080	Coring at DY080
20130821_TSM_Dyfi_0135.JPG	22/08/13 16:50:44	TSM	Dyfi		DY080	Close up of Hediste burrows DY080
20130821_TSM_Dyfi_0136.JPG	22/08/13 17:33:18	TSM	Dyfi		DY080	Core in sieve at DY080
20130821_TSM_Dyfi_0137.JPG	22/08/13 17:46:38	TSM	Dyfi		DY080	Core in sieve at DY080
20130821_TSM_Dyfi_0138.JPG	22/08/13 18:02:20	TSM	Dyfi		DY080	Core in sieve at DY080
20130821_TSM_Dyfi_0139.JPG	22/08/13 18:10:34	TSM	Dyfi		DY082	3 cores in a sieve DY082
20130821_TSM_Dyfi_0140.JPG	22/08/13 18:25:52	TSM	Dyfi		DY082	Habitat shot at DY082
20130821_TSM_Dyfi_0141.JPG	22/08/13 14:53:20	TSM	Dyfi		DY082	Sieving at DY082
20130821_TSM_Dyfi_0142.JPG	22/08/13 14:55:08	TSM	Dyfi		DY086	3 cores in a sieve at DY086
20130821_TSM_Dyfi_0143.JPG	22/08/13 14:56:08	TSM	Dyfi		DY086	Close up of core hole DY086
20130821_TSM_Dyfi_0144.JPG	22/08/13 14:56:28	TSM	Dyfi		DY089	Core in sieve DY089
20130821_TSM_Dyfi_0145.JPG	22/08/13 14:57:10	TSM	Dyfi		DY089	Core in sieve DY089
20130821_TSM_Dyfi_0146.JPG	22/08/13 14:57:28	TSM	Dyfi		DY089	Close up of habitat DY089
20130821_TSM_Dyfi_0147.JPG	22/08/13 15:03:44	TSM	Dyfi		DY089	Core in sieve DY089
20130821_TSM_Dyfi_0148.JPG	22/08/13 15:04:14	TSM	Dyfi		DY095	Habitat shot at DY095
20130821_TSM_Dyfi_0149.JPG	22/08/13 15:06:32	TSM	Dyfi		DY095	Close up of habitat and algal matts DY095
20130821_TSM_Dyfi_0150.JPG	22/08/13 15:06:58	TSM	Dyfi		DY095	Core in sieve DY095
20130821_TSM_Dyfi_0151.JPG	22/08/13 15:07:34	TSM	Dyfi		DY095	Core in sieve DY095
20130821_TSM_Dyfi_0152.JPG	22/08/13 15:08:54	TSM	Dyfi		DY095	Packing up at the end of the day at DY095
20130821_TSM_Dyfi_0153.JPG	22/08/13 15:27:40	TSM	Dyfi		DY095	Coring at DY095
20130821_TSM_Dyfi_0154.JPG	22/08/13 15:28:32	TSM	Dyfi		DY095	Core in sieve DY095
20130821_TSM_Dyfi_0155.JPG	22/08/13 15:29:10	TSM	Dyfi		DY095	Close up of core hole at DY095
20130822_LK_WAD_538_ST8_Q1.JPG	22/08/13 15:29:34	LK BS	WAD		WAD 8	Full Quadrat Count
20130822_LK_WAD_539_ST8_Q2.JPG	22/08/13 15:35:52	LK BS	WAD		WAD 8	Full Quadrat Count

Filename	Time	Photographer	Site	Zone	Stn	Notes
20130822_LK_WAD_540_ST8_Q3.JPG	22/08/13 15:37:12	LK BS	WAD		WAD 8	Full Quadrat Count
20130822_LK_WAD_541_ST8_Q4.JPG	22/08/13 15:39:14	LK BS	WAD		WAD 8	Full Quadrat Count
20130822_LK_WAD_542_ST8_Q5.JPG	22/08/13 15:39:34	LK BS	WAD		WAD 8	Full Quadrat Count
20130822_LK_WAD_543_ST6_Q1.JPG	22/08/13 15:41:34	LK BS	WAD		WAD 6	Full Quadrat Count
20130822_LK_WAD_544_ST6_Q2_a.JPG	22/08/13 15:42:08	LK BS	WAD		WAD 6	Full Quadrat Count
20130822_LK_WAD_545_ST6_Q2_b.JPG	22/08/13 15:43:32	LK BS	WAD		WAD 6	Green Algal Photo ID ?
20130822_LK_WAD_546_ST6_Q2_c.JPG	22/08/13 15:44:50	LK BS	WAD		WAD 6	Green Algal Photo ID ?
20130822_LK_WAD_547_ST6_Q2_d.JPG	22/08/13 15:54:42	LK BS	WAD		WAD 6	Green Algal Photo ID ?
20130822_LK_WAD_548_ST6_Q3.JPG	22/08/13 15:55:00	LK BS	WAD		WAD 6	Full Quadrat Count
20130822_LK_WAD_549_ST6_Q4.JPG	22/08/13 15:56:04	LK BS	WAD		WAD 6	Full Quadrat Count
20130822_LK_WAD_550_ST6_Q5.JPG	22/08/13 15:56:52	LK BS	WAD		WAD 6	Full Quadrat Count
20130822_LK_WAD_551_ST2_Q1.JPG	22/08/13 16:05:48	LK BS	WAD		WAD 2	Full Quadrat Count
20130822_LK_WAD_552_ST2_Q2.JPG	22/08/13 16:06:00	LK BS	WAD		WAD 2	Full Quadrat Count
20130822_LK_WAD_553_ST2_Q3.JPG	22/08/13 16:17:20	LK BS	WAD		WAD 2	Full Quadrat Count
20130822_LK_WAD_554_ST2_Q4.JPG	22/08/13 16:17:52	LK BS	WAD		WAD 2	Full Quadrat Count
20130822_LK_WAD_555_ST2_Q5.JPG	22/08/13 16:18:54	LK BS	WAD		WAD 2	Full Quadrat Count
20130822_DPB_WAD_733_ST7_Q6_a.JPG	22/08/13 16:20:28	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_734_ST7_Q6_b.JPG	22/08/13 16:29:14	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_735_ST7_Q1_a.JPG	22/08/13 16:29:28	PB CJ	WAD		WAD 7	Full Quadrat Count
20130822_DPB_WAD_736_ST7_Q1_b.JPG	22/08/13 16:31:04	PB CJ	WAD		WAD 7	Full Quadrat Count
20130822_DPB_WAD_737_ST7_Q7_a.JPG	22/08/13 16:31:38	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_738_ST7_Q7_b.JPG	22/08/13 16:32:34	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_739_ST7_Q8_a.JPG	22/08/13 16:33:58	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_740_ST7_Q8_b.JPG	22/08/13 16:42:26	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_742_ST7_Q9_a.JPG	22/08/13 16:42:32	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_743_ST7_Q9_b.JPG	22/08/13 16:42:38	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_744_ST7_Q2_a.JPG	22/08/13 16:43:20	PB CJ	WAD		WAD 7	Full Quadrat Count
20130822_DPB_WAD_745_ST7_Q2_b.JPG	22/08/13 16:44:04	PB CJ	WAD		WAD 7	Full Quadrat Count
20130822_DPB_WAD_746_ST7_Q10_a.JPG	22/08/13 16:45:28	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_747_ST7_Q10_b.JPG	22/08/13 16:51:36	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_748_ST7_Q3_a.JPG	22/08/13 16:52:08	PB CJ	WAD		WAD 7	Full Quadrat Count
20130822_DPB_WAD_749_ST7_Q3_b.JPG	22/08/13 16:52:50	PB CJ	WAD		WAD 7	Full Quadrat Count
20130822_DPB_WAD_750_ST7_Q11_a.JPG	22/08/13 16:53:20	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_752_ST7_Q11_b.JPG	22/08/13 16:53:48	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_753_ST7_Q12_a.JPG	22/08/13 16:54:24	PB CJ	WAD		WAD 7	Sabellaria Checks

Filename	Time	Photographer	Site	Zone	Stn	Notes
20130822_DPB_WAD_754_ST7_Q12_b.JPG	22/08/13 16:54:54	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_755_ST7_Q13_a.JPG	22/08/13 16:55:18	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_756_ST7_Q13_b.JPG	22/08/13 16:56:16	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_757_ST7_Q4_a.JPG	22/08/13 16:56:44	PB CJ	WAD		WAD 7	Full Quadrat Count
20130822_DPB_WAD_758_ST7_Q4_b.JPG	22/08/13 16:57:12	PB CJ	WAD		WAD 7	Full Quadrat Count
20130822_DPB_WAD_759_ST7_Q14_a.JPG	22/08/13 16:58:10	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_760_ST7_Q14_b.JPG	22/08/13 17:05:20	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_761_ST7_Q5_a.JPG	22/08/13 17:08:46	PB CJ	WAD		WAD 7	Full Quadrat Count
20130822_DPB_WAD_762_ST7_Q5_b.JPG	22/08/13 17:09:42	PB CJ	WAD		WAD 7	Full Quadrat Count
20130822_DPB_WAD_763_ST7_Q15_a.JPG	22/08/13 17:10:22	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_764_ST7_Q15_b.JPG	22/08/13 17:16:26	PB CJ	WAD		WAD 7	Sabellaria Checks
20130822_DPB_WAD_765_ST5_Q6_a.JPG	22/08/13 17:16:52	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_766_ST5_Q6_b.JPG	22/08/13 17:17:28	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_767_ST5_Q1_a.JPG	22/08/13 17:19:14	PB CJ	WAD		WAD 5	Full Quadrat Count
20130822_DPB_WAD_768_ST5_Q1_b.JPG	22/08/13 17:24:02	PB CJ	WAD		WAD 5	Full Quadrat Count
20130822_DPB_WAD_769_ST5_Q7_a.JPG	22/08/13 17:24:28	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_770_ST5_Q7_b.JPG	22/08/13 17:25:12	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_771_ST5_Q8_a.JPG	22/08/13 17:25:36	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_772_ST5_Q8_b.JPG	22/08/13 17:26:36	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_773_ST5_Q2_a.JPG	22/08/13 17:39:54	PB CJ	WAD		WAD 5	Full Quadrat Count
20130822_DPB_WAD_774__ST5_Q2_b.JPG	22/08/13 17:40:36	PB CJ	WAD		WAD 5	Full Quadrat Count
20130822_DPB_WAD_775_ST5_a.JPG	22/08/13 17:41:44	PB CJ	WAD		WAD 5	ID ?
20130822_DPB_WAD_776_ST5_b.JPG	22/08/13 17:42:34	PB CJ	WAD		WAD 5	ID ?
20130822_DPB_WAD_777_ST5_Q9_a.JPG	22/08/13 17:47:32	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_778_ST5_Q9_b.JPG	22/08/13 17:49:10	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_780_ST5_Q3_a.JPG	22/08/13 17:49:30	PB CJ	WAD		WAD 5	Full Quadrat Count
20130822_DPB_WAD_781_ST5_Q3_b.JPG	22/08/13 17:50:10	PB CJ	WAD		WAD 5	Full Quadrat Count
20130822_DPB_WAD_782_ST5_Q10_a.JPG	22/08/13 17:50:58	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_783_ST5_Q10_b.JPG	22/08/13 17:52:16	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_784_ST5_Q11_a.JPG	22/08/13 17:52:32	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_785_ST5_Q11_b.JPG	22/08/13 17:53:04	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_786_ST5_Q12_a.JPG	22/08/13 17:54:08	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_787_ST5_Q12_b.JPG	22/08/13 17:54:50	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_788_ST5_Q13_a.JPG	22/08/13 17:55:54	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_789_ST5_Q13_b.JPG	22/08/13 17:56:36	PB CJ	WAD		WAD 5	Sabellaria Checks

Filename	Time	Photographer	Site	Zone	Stn	Notes
20130822_DPB_WAD_790_ST5_Q14_a.JPG	23/08/13 11:33:34	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_791_ST5_Q14_b.JPG	23/08/13 10:15:20	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_792_ST5_Q4_a.JPG	22/08/13 18:02:26	PB CJ	WAD		WAD 5	Full Quadrat Count
20130822_DPB_WAD_793__ST5_Q4_b.JPG	22/08/13 18:03:20	PB CJ	WAD		WAD 5	Full Quadrat Count
20130822_DPB_WAD_794_ST5_Q5_a.JPG	22/08/13 18:03:44	PB CJ	WAD		WAD 5	Full Quadrat Count
20130822_DPB_WAD_796_ST5_Q5_b.JPG	22/08/13 18:10:52	PB CJ	WAD		WAD 5	Full Quadrat Count
20130822_DPB_WAD_797_ST5_Q15_a.JPG	22/08/13 18:15:48	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_798__ST5_Q15_b.JPG	22/08/13 18:16:40	PB CJ	WAD		WAD 5	Sabellaria Checks
20130822_DPB_WAD_799_ST3_Q6_a.JPG	22/08/13 18:17:04	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_800_ST3_Q6_b.JPG	22/08/13 18:21:44	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_801_ST3_Q1_a.JPG	22/08/13 18:21:58	PB CJ	WAD		WAD 3	Full Quadrat Count
20130822_DPB_WAD_803_ST3_Q1_b.JPG	22/08/13 18:22:58	PB CJ	WAD		WAD 3	Full Quadrat Count
20130822_DPB_WAD_804_ST3_Q7_a.JPG	22/08/13 18:23:58	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_805_ST3_Q7_b.JPG	22/08/13 18:24:16	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_806_ST3_Q8_a.JPG	22/08/13 18:25:02	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_807_ST3_Q8_b.JPG	22/08/13 18:29:20	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_808_ST3_Q2_a.JPG	22/08/13 18:29:34	PB CJ	WAD		WAD 3	Full Quadrat Count
20130822_DPB_WAD_809_ST3_Q2_b.JPG	22/08/13 18:30:08	PB CJ	WAD		WAD 3	Full Quadrat Count
20130822_DPB_WAD_810_ST3_Q9_a.JPG	22/08/13 18:30:38	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_812_ST3_Q9_b.JPG	22/08/13 18:32:10	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_813_ST3_Q3_a.JPG	22/08/13 18:35:58	PB CJ	WAD		WAD 3	Full Quadrat Count
20130822_DPB_WAD_814_ST3_Q3_b.JPG	22/08/13 18:36:22	PB CJ	WAD		WAD 3	Full Quadrat Count
20130822_DPB_WAD_815_ST3_Q10_a.JPG	22/08/13 18:37:12	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_816_ST3_Q10_b.JPG	22/08/13 18:37:42	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_817_ST3_Q11_a.JPG	22/08/13 18:38:18	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_818_ST3_Q11_b.JPG	22/08/13 18:39:16	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_819_ST3_Q12_a.JPG	22/08/13 18:40:04	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_820_ST3_Q12_b.JPG	22/08/13 18:47:18	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_822_ST3_Q13_a.JPG	22/08/13 18:48:38	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_823_ST3_Q13_b.JPG	22/08/13 18:50:38	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_825_ST3_Q4_a.JPG	22/08/13 17:54:50	PB CJ	WAD		WAD 3	Full Quadrat Count
20130822_DPB_WAD_826_ST3_Q4_b.JPG	22/08/13 17:55:54	PB CJ	WAD		WAD 3	Full Quadrat Count
20130822_DPB_WAD_827_ST3_a.JPG	22/08/13 17:56:36	PB CJ	WAD		WAD 3	Action Shots
20130822_DPB_WAD_828_ST3_b.JPG	23/08/13 11:33:34	PB CJ	WAD		WAD 3	Action Shots
20130822_DPB_WAD_829_ST3_c.JPG	23/08/13 10:15:20	PB CJ	WAD		WAD 3	Action Shots

Filename	Time	Photographer	Site	Zone	Stn	Notes
20130822_DPB_WAD_830_ST3_Q14_a.JPG	22/08/13 18:02:26	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_831_ST3_Q14_b.JPG	22/08/13 18:03:20	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_832_ST3_Q5_a.JPG	22/08/13 18:03:44	PB CJ	WAD		WAD 3	Full Quadrat Count
20130822_DPB_WAD_833_ST3_Q5_b.JPG	22/08/13 18:10:52	PB CJ	WAD		WAD 3	Full Quadrat Count
20130822_DPB_WAD_834_ST3_Q15_a.JPG	22/08/13 18:15:48	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_836_ST3_Q15_b.JPG	22/08/13 18:16:40	PB CJ	WAD		WAD 3	Sabellaria Checks
20130822_DPB_WAD_837_ST1_Q1_a.JPG	22/08/13 18:17:04	PB CJ	WAD		WAD 1	Full Quadrat Count
20130822_DPB_WAD_838_ST1_Q1_b.JPG	22/08/13 18:21:44	PB CJ	WAD		WAD 1	Full Quadrat Count
20130822_DPB_WAD_839_ST1_Q6_a.JPG	22/08/13 18:21:58	PB CJ	WAD		WAD 1	Sabellaria Checks
20130822_DPB_WAD_840_ST1_Q6_b.JPG	22/08/13 18:22:58	PB CJ	WAD		WAD 1	Sabellaria Checks
20130822_DPB_WAD_841_ST1_Q7_a.JPG	22/08/13 18:23:58	PB CJ	WAD		WAD 1	Sabellaria Checks
20130822_DPB_WAD_842_ST1_Q7_b.JPG	22/08/13 18:24:16	PB CJ	WAD		WAD 1	Sabellaria Checks
20130822_DPB_WAD_843_ST1_Q2_a.JPG	22/08/13 18:25:02	PB CJ	WAD		WAD 1	Full Quadrat Count
20130822_DPB_WAD_844_ST1_Q2_b.JPG	22/08/13 18:29:20	PB CJ	WAD		WAD 1	Full Quadrat Count
20130822_DPB_WAD_845_ST1_Q8_a.JPG	22/08/13 18:29:34	PB CJ	WAD		WAD 1	Sabellaria Checks
20130822_DPB_WAD_846_ST1_Q8_b.JPG	22/08/13 18:30:08	PB CJ	WAD		WAD 1	Sabellaria Checks
20130822_DPB_WAD_847_ST1_Q3_a.JPG	22/08/13 18:30:38	PB CJ	WAD		WAD 1	Full Quadrat Count
20130822_DPB_WAD_848_ST1_Q3_b.JPG	22/08/13 18:32:10	PB CJ	WAD		WAD 1	Full Quadrat Count
20130822_DPB_WAD_849_ST1_Q9_a.JPG	22/08/13 18:35:58	PB CJ	WAD		WAD 1	Sabellaria Checks
20130822_DPB_WAD_850_ST1_Q9_b.JPG	22/08/13 18:36:22	PB CJ	WAD		WAD 1	Sabellaria Checks
20130822_DPB_WAD_852_ST1_Q10_a.JPG	22/08/13 18:37:12	PB CJ	WAD		WAD 1	Sabellaria Checks
20130822_DPB_WAD_853_ST1_Q10_b.JPG	22/08/13 18:37:42	PB CJ	WAD		WAD 1	Sabellaria Checks
20130822_DPB_WAD_854_ST1_Q11_a.JPG	22/08/13 18:38:18	PB CJ	WAD		WAD 1	Sabellaria Checks
20130822_DPB_WAD_855_ST1_Q11_b.JPG	22/08/13 18:39:16	PB CJ	WAD		WAD 1	Sabellaria Checks
20130822_DPB_WAD_856_ST1_Q4_a.JPG	22/08/13 18:40:04	PB CJ	WAD		WAD 1	Full Quadrat Count
20130822_DPB_WAD_857_ST1_Q4_b.JPG	22/08/13 18:47:18	PB CJ	WAD		WAD 1	Full Quadrat Count
20130822_DPB_WAD_858_ST1_Q5_a.JPG	22/08/13 18:48:38	PB CJ	WAD		WAD 1	Full Quadrat Count
20130822_DPB_WAD_859_ST1_Q5_b.JPG	22/08/13 18:50:38	PB CJ	WAD		WAD 1	Full Quadrat Count

Appendix 10 Data Archive Appendix

Citation: Mercer, T.S. 2016. Intertidal monitoring, Pen Llyn a'r Sarnau SAC August 2013. NRW Evidence Report No. 58, pp 67 + x, Natural Resources Wales, Bangor.

Data outputs associated with this project are archived as Project No 411, Media No 1525 and metadata No 116508 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 spreadsheets of data and NBNDATA file for Marine Recorder

[C] 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

[D] A full set of images produced in [jpg/tiff] format.

Metadata for this project is publicly accessible through Natural Resources Wales' Library Catalogue http://libcat.naturalresources.wales (English), http://catllyfr.cyfoethnaturiol.cymru (Welsh), by searching 'Dataset Titles'

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