North West Anglesey Survey of Possible Horse Mussel Bed Areas (2009 & 2010)

Report No: 575

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List of Acronyms

Acronym	Full term
ASML	Aquatic Survey and Monitoring Ltd.
CCW	Countryside Council for Wales
Cefas	Centre for Environment, Fisheries and Aquaculture Science
DDV	Drop Down Video
GIS	Geographic Information System
JNCC	Joint Nature Conservation Committee
MES	Marine Ecological Solutions
MBES	Multibeam Echo Sounder
NRW	Natural Resources Wales
NWA	North West Anglesey
SAC	Special Area of Conservation

Crynodeb Gweithredol

Mae'r ardal i'r gogledd a'r gorllewin o Ynys Môn (Gogledd Cymru, y DU) yn un lle y credir y mae gwelyau marchfisglen *Modiolus modiolus* i'w gweld. Yn y gorffennol, mae sawl arolwg wedi cofnodi agregau o *Modiolus* yn yr ardal hon ond yn gyffredinol nid yw dwysedd a maint *Modiolus* wedi'i fapio'n gywir. Mae gwelyau *Modiolus* yn bwysig am eu bod yn rhan o gynefinoedd Riff Atodiad I y Gyfarwyddeb Cynefinoedd creigiau, ar restr OSPAR o gynefinoedd sydd dan fygythiad ac sy'n dirywio ac maent ar restr interim adran 7 Deddf yr Amgylchedd (Cymru). Ymddengys bod gwelyau *Modiolus* yn hynod o sensitif i aflonyddwch ffisegol a chredir eu bod wedi dirywio o ran maint ac ansawdd.

Dechreuodd prosiect cydweithredol rhwng y Cyd-bwyllgor Cadwraeth Natur (JNCC) a Chyngor Cefn Gwlad Cymru (CCGC) (Cyfoeth Naturiol Cymru erbyn hyn) yn 2009 ymchwilio i bresenoldeb posibl gwelyau *Modiolus modiolus* a chynefinoedd riff eraill mewn dau leoliad i'r gogledd a'r gorllewin o Ynys Môn. Dewiswyd y lleoliadau hyn ar sail tystiolaeth hanesyddol o bresenoldeb y marchfisglen *Modiolus modiolus*. Mae Ardal NWA1-Gogledd rhwng 32 a 38 cilomedr i'r gogledd o Gaergybi ac mae ganddi arwynebedd o bron i 14cilomedr^2. Fe'i nodweddir gan ffos ddofn sy'n rhedeg i'r dwyrain - gogledd-ddwyrain drwy ardal yr astudiaeth, sydd tua 105m ar ei phwynt dyfnaf, yn fas tua'r gogledd a'r de i ddyfnder o tua 45 a 60m yn y drefn honno. Lleolir Ardal NWA2-Gorllewin rhwng 23 a 28 cilomedr i'r gorllewin - gogledd-orllewin o Gaergybi ac mae gan yr ardal arwynebedd o bron 20 cilomedr^2 yn yr ardal. Mae'r pwynt mwyaf bas yn y de-ddwyrain o ardal yr astudiaeth lle mae llwyfandir tua 50m o ddyfnder, sydd wedyn yn gostwng tuag i'r gogledd-orllewin i waelod llethr tua 90m o ddyfnder.

Arolygwyd y ddwy ardal gan ddefnyddio Seinydd Atsain Aml-belydr (MBES) a fideo a oedd yn disgyn. Cynhaliodd Canolfan Gwyddorau'r Amgylchedd, Pysgodfeydd a Dyframaethu (Cefas) arolwg MBES ym mis Gorffennaf 2009. Dehonglwyd y data a ddeilliodd o hynny gan Cefas ar gyfer creig-wely, ffurf-welyau pedeir-rhan, gwaddodion a nodweddion cynefin. Yna, bu CCGC yn arolygu meysydd diddordeb dethol gan ddefnyddio fideo a oedd yn disgyn yn ystod mis Medi 2009 a mis Ionawr 2010. Yn ogystal, arolygwyd pedwar safle mewn dŵr a oedd yn ddyfnach na 100m gan ddefnyddio camera llonydd gan y Ganolfan Astudiaethau Morol ac Arfordirol ym mis Mehefin 2010.

Roedd gan y ddwy ardal a arolygwyd gymysgrywiaeth cynefin eithaf uchel, gyda chynefinoedd a oedd yn amrywio o waddodion bras i greig-wely. Cofnodwyd y cynefinoedd canlynol:

- Gwaddod bras a chregyn gwag (gyda chyfrannau amrywiol o waddodion a chregyn, mewn rhai achosion cymaint â 100% o gregyn gwag)

- Cerrig mân a cherrig crynion gydag arfilod gwasgarog, tiwblyngyr trumiog yn bennaf *Pomatocerous (*nawr *Spirobranchus)* Sp.

- Cymysgedd o raean, cerrig mân, cerrig crynion a chlogfeini gydag arfilod talsyth (e.e. hydroidau a chwrel meddal *Alcyonium digitatum*)

- Cerrig crynion, clogfeini a chreig-wely gydag arfilod talsyth (arfilod tebyg i'r uchod ond yn tueddu i fod yn fwy dwys)

- Cynefin *Modiolus modiolus* - gwaddod bras yn bennaf gyda *Modiolus* wedi gwreiddio*,* cragen wag *Modiolus* ac arfilod, yn enwedig y cwrel meddal *Alcyonium digitatum*.

Roedd llawer o'r cynefinoedd a gofnodwyd yn debyg rhwng y ddwy ardal, er yn gyffredinol roedd gan ardal NWA1 (gogledd Ynys Môn) gyfran uwch o gynefin gwely a chlogfaen, tra bod gan ardal NWA2 (gorllewin Ynys Môn) gyfran gymharol uwch o gynefin *Modiolus modiolus*. Roedd gan y ddwy ardal gynefinoedd yn cynnwys gwaddod bras gyda chregyn gwag (yn bennaf cregyn *Modiolus modiolus*). Fodd bynnag, roedd gan ardal NWA2-Gorllewin ardaloedd hefyd lle'r oedd y gorchuddiad a chregyn gwag yn 100%, o'i gymharu ag ardal NWA1-Gogledd lle'r oedd y gorchuddiad mwyaf posibl o gregyn *Modiolus* yn 40 i 70%. Mae'n debyg mai'r cynefin amlycaf yn y ddwy ardal oedd is-haen gymysg o raean, cerrig mân, cerrig crynion a chlogfeini bach. Roedd cyfran y cerrig crynion a'r clogfeini bach yn amrywio ar draws y ddau safle a lle'r oedd y cerrig crynion a'r clogfeini bach yn fwy cyffredin roedd cymuned o arfilod talsyth (a oedd yn cynnwys yr hydroidau *Abietinaria abietina* a *Hydrallmania falcata* a'r cwrel meddal *Alcyonium digitatum*). Mewn ardaloedd lle nad oedd llawer o gerrig crynion a chlogfeini roedd cymuned arfilod gwasgarog iawn a oedd i'w gweld wedi crafu rhywfaint (e.e. rhywogaethau tiwblyngyr trumiog *Pomatocerous* (*Spirobranchus*) sp. a gwyddau môr).

Mewn sawl ardal, yn enwedig yn ardal NWA2 (gorllewin Ynys Môn) roedd rhannau o wely'r môr lle'r oedd presenoldeb *Modiolus modiolus* yn ymddangos fel pe bai'n addasu'r ffawna a oedd yn bresennol drwy ddarparu sefydlogrwydd ac arwyneb ar gyfer rhywogaethau fel *Alcyonium digitatum* i afael ynddynt.

Yn y dyfodol rydym yn argymell cynnal arolygon pellach o'r ardal i'r gogledd a'r gorllewin o Ynys Môn. Dylai'r rhain ganfod meysydd o gynefin *Modiolus*, ynghyd ag amcangyfrif o ddwysedd a maint y *Modiolus*. O ystyried yr anawsterau a gafwyd wrth nodi cynefin y *Modiolus* yn yr ardal hon o allbynnau aml-belydr, dylid hefyd ystyried defnyddio sonar ochr-sganio. Dylai unrhyw arolwg acwstig gael ei ddilyn gan arolygon biolegol gywir ar sail gwylio a mesur.

Executive Summary

The area to the north and west of the Isle of Anglesey (North Wales, UK) is one where horse mussel *Modiolus modiolus* beds are thought to occur. In the past, several surveys have recorded aggregations of *Modiolus* in this area but in general the density and extent of *Modiolus* has not been accurately mapped. *Modiolus* beds are important because they are part of the Habitats Directive Annex I Reef habitat, are on the OSPAR list of threatened and declining habitats and are on the interim Section 7 list of the Environment (Wales) Act). *Modiolus* beds appear to be extremely sensitive to physical disturbance and are thought to have declined in extent and quality.

A collaborative project between the Joint Nature Conservation Committee (JNCC) and the Countryside Council for Wales (CCW) (now Natural Resources Wales) began in 2009 to investigate the possible presence of *Modiolus modiolus* beds and other reef habitat at two locations to the north and west of Anglesey. These locations were chosen based on historical evidence of the presence of the horse mussel *Modiolus modiolus*. Area NWA1-North is between 32 and 38km north of Holyhead and has an area of almost 14km^2. It is characterised by a deep trench running ENE through the study area, which is approximately 105m at its deepest point, which shallows towards the north and south to depths of approximately 45 and 60m respectively. Area NWA2-West is located between 23 and 28km WNW of Holyhead and is almost 20km^2 in area. The shallowest point is in the SE of the study area where there is a plateau at approximately 50m depth, which then drops off towards the NW to the base of a slope at approximately 90m deep.

The two areas were surveyed using a Multibeam Echosounder (MBES) and drop down video. The Centre for Environment, Fisheries and Aquaculture Science (Cefas) carried out a MBES survey in July 2009. The resulting data was interpreted for bedrock, quaternary bedforms, sediments and habitat features by Cefas. CCW then surveyed selected areas of interest using a drop down video during September 2009 and January 2010. In addition, four sites in water deeper than 100m were surveyed using a stills camera by the Centre for Marine and Coastal Studies in June 2010.

The two areas surveyed both had quite high habitat heterogeneity, with habitats that varied from coarse sediment to bedrock. The following habitats were recorded:

- Coarse sediment and empty shell (with varying proportions of sediment and shell, in some cases as much as 100% empty shell)
- Pebbles and cobbles with sparse epifauna, mainly keel worms *Pomatocerous (*now *Spirobranchus)* sp.
- A mixture of gravel, pebbles, cobbles and boulders with erect epifauna (e.g. hydroids and soft coral *Alcyonium digitatum*)
- Cobbles, boulders and bedrock with erect epifauna (similar epifauna to above but tending to be more dense)

- *Modiolus modiolus* habitat – mainly coarse sediment with embedded *Modiolus,* empty *Modiolus* shell and epifauna, in particular the soft coral *Alcyonium digitatum*.

Many of the habitats recorded were similar between the two areas, although in general area NWA1 (north of Anglesey) had a higher proportion of bedrock and boulder habitat, whilst area NWA2 (west of Anglesey) had relatively more *Modiolus modiolus* habitat. Both areas had habitats consisting of coarse sediment with empty shell (mainly *Modiolus modiolus* shell). However, area NWA2-West also had areas where the coverage of empty shell was 100%, compared to area NWA1-North where the maximum coverage of *Modiolus* shell was 40 to 70%. The dominant habitat in both areas was probably a mixed substrata of gravel, pebbles, cobbles and small boulders. The proportion of cobbles and small boulders varied across both sites and where the cobbles and small boulders were more common there was an erect epifaunal community (which included the hydroids *Abietinaria abietina* and *Hydrallmania falcata* and the soft coral *Alcyonium digitatum*). In areas where there were few cobbles and boulders there was a very sparse epifaunal community which appeared to be fairly scoured (e.g. keel worms *Pomatocerous* (*Spirobranchus*) sp. and barnacle species).

In several areas, especially in area NWA2 (west of Anglesey) there were sections of the seabed where the presence of *Modiolus modiolus* appeared to modify the fauna present by providing stability and a surface for species like *Alcyonium digitatum* to attach to.

In the future we recommend that further surveys of the area to the north and west of Anglesey are carried out. These should identify areas of *Modiolus* habitat, plus estimate the density and extent of *Modiolus*. Given the difficulties encountered in identifying *Modiolus* habitat in this area from multibeam outputs, the use of sidescan sonar should also be considered. Any acoustic survey should be followed by biological groundtruthing surveys.

1. Introduction

1.1. General Background

A collaborative project between the Joint Nature Conservation Committee (JNCC) and the Countryside Council for Wales (CCW) (now Natural Resources Wales) began in 2009 to investigate the benthic habitats at two locations off the NW Anglesey coast. These locations were chosen based on historical evidence of the presence of the horse mussel *Modiolus modiolus*, as summarised and confirmed by a SEA6 survey carried out in 2005 which identified live *Modiolus* in the area (Rees, 2005).

Modiolus beds are important because they are part of the Habitats Directive Annex I Reef habitat, are on the OSPAR list of threatened and declining habitats and were a Biodiversity Action Plan habitat (now on the interim list for Section 7 of the Environment (Wales) Act). *Modiolus* reefs are considered to be extremely sensitive to physical impacts, such as impacts from scallop dredging (Cook et al. 2013, Holt et al. 1988, Service & Magorrian 1997). At the time of the survey the area around north and west Anglesey had been identified as a potential area for renewable energy developments, both in terms of tidal power (mainly within 12 nm) (ABPMer 2008, RPS 2011) and wind power (mainly beyond 12 nm) (DECC 2009).

1.2. Introduction to the survey area

The two survey areas are located off the NW coast of Anglesey, North Wales, UK (Figure 1). Both of the areas had previous records of *Modiolus*.

Area NWA1-North lies between 32 and 38km north of Holyhead. It covers an area of almost 14km^2 and is characterised by a deep trench running ENE through the study area, which is approximately 105m at its deepest point. This then shallows towards the north and south to depths of approximately 45 and 60m respectively. The area is characterised by Palaeozoic turbiditic sandstones overlain by quaternary submarine drumlins, with sedimentary bedforms and iceberg ploughmarks visible in the soft material overlying the bedrock (Cefas, 2009).

Area NWA2-West is located between 23 and 28km WNW of Holyhead and is almost 20km^2 in area. The shallowest point is in the SE of the study area where there is a plateau at approximately 50m depth, which then drops off towards the NW to the base of a slope at approximately 90m deep. Unlike NWA1-North, there is no evidence of bedrock exposure, and the area is overlain by quaternary sediments which could range up to 50m in depth. The main plateau is interpreted as a sub-glacial deposit of lodgement till, with the outer, rougher edge of cobbles and large boulders possibly being the remains of a terminal moraine. A series of landscape scarps trending NW lead down to the base of the slope over 100m deep (Cefas, 2009).

The tidal flow in the area is predominantly in a NE / SW direction, with maximum rates of 3.7knots at spring tides and 1.9kts at neap tides (Data taken from UKHO Chart 1411 ‘Irish Sea Western Part.’ (1992); Tidal diamond ‘N’ is in the middle of the

traffic separation lane, and the closest to the study area [see Figure 1.1]). A shipping traffic separation lane passes between the study areas and the Isle of Anglesey. The study area lies in an exposed position with the predominant wind direction from the south-west (Evans, 1995), and large swells often rolling up Saint George's channel with mean significant wave heights in winter reaching approximately 2.5m (Woolf et al., 2002).

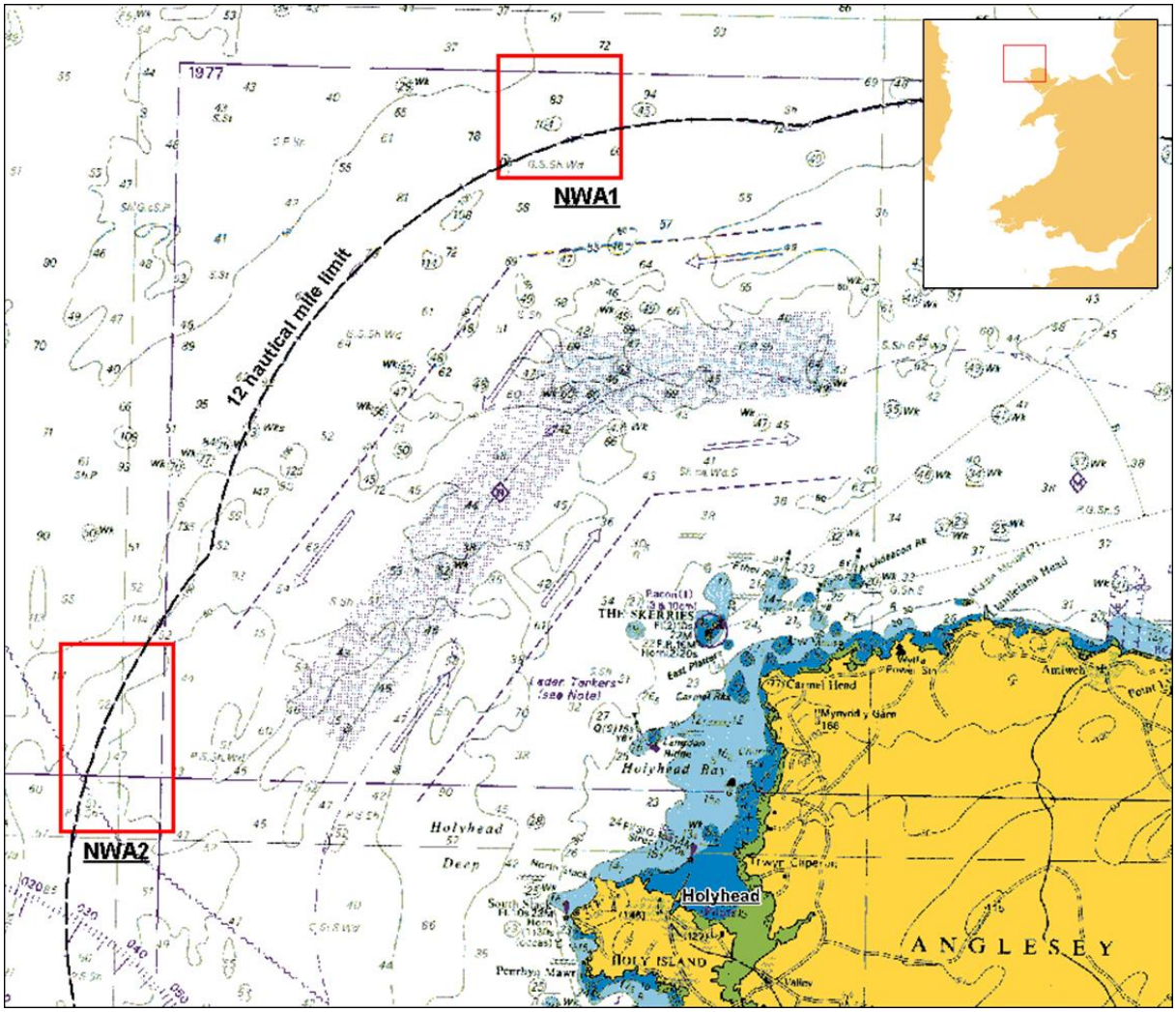


Figure 1. Location of NWA1-North and NWA2-West sites off the Anglesey coast, North Wales

1.3. Biology of *Modiolus modiolus*

Throughout this report the species *Modiolus modiolus* is often referred to simply as *Modiolus* to avoid repetition and improve the flow of the text. All references to *Modiolus* concern the specific species *Modiolus modiolus* and not any other species in the *Modiolus* genus.

Although the horse mussel *Modiolus modiolus* is a fairly common species, beds forming a distinctive habitat are much less common. In some places stabilising byssal threads help to bind the coarse seabed sediment together along with live and dead shells to create a dense bed, sometimes forming waves or mounds, parts of which may be partially or completely recessed into the seabed sediment (UK BAP, 2008). These dense beds can result in a rich associated fauna supporting hundreds of species (Holt et al., 1998), with over 200 invertebrate taxa having been recorded from a study on the north Llŷn (Rees et al., 2008). This is due to the *Modiolus* shells binding together to form a dense bed of shells, which provides a suitable surface for epifauna, as well as a complex habitat of crevices for other organisms to colonise amongst the shells and byssal threads. These crevices also provide a suitable habitat for mussel spat to colonise and provides some protection from predators such as starfish and crabs while the spat grow rapidly in the first 4-6 years (Anwar et al., 1990). Once over this age, their size becomes large enough to make it more difficult for starfish and crabs to open the shells, and they become much less vulnerable to predation (Holt et al., 1998). Most populations in a study by Anwar et al. (1990) contained individuals over 35 years old, indicating that *Modiolus* is a long-lived species. Faecal material generated as a by-product from the filter feeding of the *Modiolus* shells increases the amount of organic material within the bed itself, which can then support an abundance of infauna species (Rees et al., 2008). Holt et al. (1998) describe the more usual physical form of *Modiolus* reef in UK waters as being semi-infaunal, grading in thickness and density from continuous, dense raised reefs to scattered clumps.

Modiolus beds appear to be extremely sensitive to physical disturbance, in particular impacts from towed fishing gears such as scallop dredges and trawls (Cook et al. 2013). *Modiolus* beds are thought to have declined at various locations around the UK (e.g. Strangford Lough, Isle of Man. Scotland, north west Anglesey), with strong evidence for decline in some areas and more anecdotal evidence in others (Holt et al. 1998, Hill et al. 1999, Jones et al. 2000, Magorrian et al. 1995, Roberts 2003, Veale et al. 2000).

The byssal threads of the *Modiolus* which bind together the shells and other sediments have a stabilising effect on the seabed, and this can alter the seabed roughness, topography and acoustic reflectivity (Rees, 2009). This change in acoustic reflectivity can often be used to monitor the extent of the biogenic reef and reliably map the benthic structure using a variety of acoustic survey methods including sidescan sonar, *RoxAnn*^{TM} acoustic ground discrimination systems (AGDS), multibeam echosounder and sub-bottom profiler (Lindenbaum et al., 2008). Acoustic characteristics of biogenic reefs (where the shell aggregation is sufficiently large, and the acoustic resolution sufficiently high to discriminate the feature) depend on the acoustic survey method used. In an example from just north of the Llŷn Peninsula, N Wales, Lindenbaum et al. (2008) showed that the wavelengths and amplitudes of *Modiolus* bedform undulations differed significantly from those of surrounding sediment (lag gravel or sand) bedforms, enabling them to be reliably identified using acoustic survey methods. Additionally, a sub-bottom profiler identified *Modiolus* in thicknesses of up to 1m on top of lag gravel seabed deposits in places. These characteristic biogenic reef aggregations show up well as a characteristic ‘mottled‘ appearance on multibeam echosounder images (Figure 2).

It must be remembered that these characteristic features of the *Modiolus* beds on the north Llŷn site may be unique to this specific site. Another location with different sediment composition / sediment supply characteristics and/or a different tidal regime may lead to the *Modiolus* bed developing a different structure. Although most beds are found in current swept, fully saline conditions, some are found in sheltered bays, fjords or lochs (Rees, 2009). It is important to note that the gradation in types of *Modiolus* bed mentioned by Rees (2009) may mean that other beds with different morphology (be it due to physical conditions or degradation due to physical disturbance) may not be easy or possible to delineate using acoustic methods, highlighting the need for thorough groundtruthing.

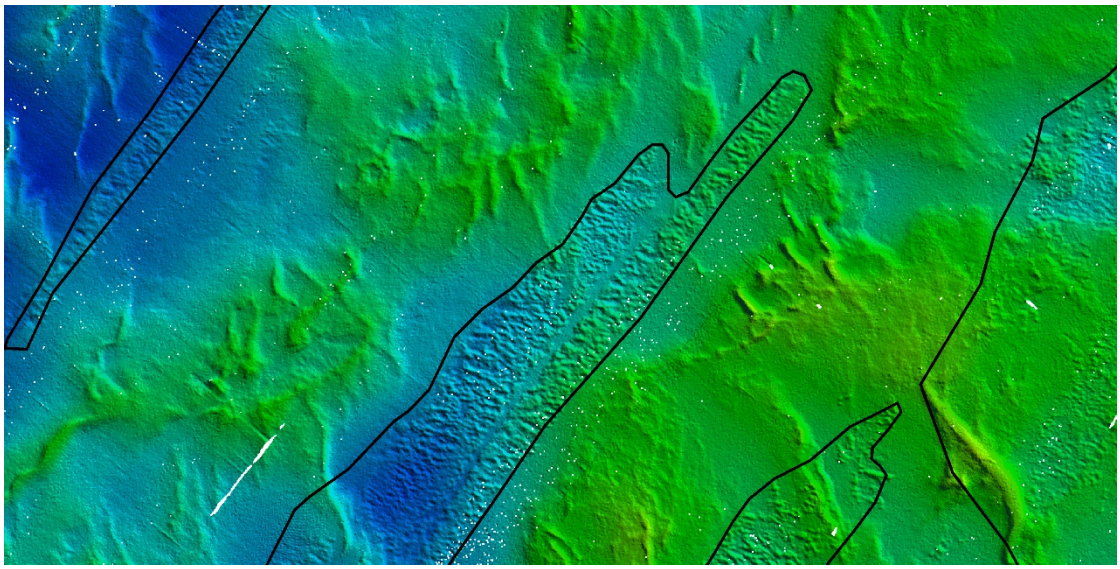


Figure 2 Characteristic mottled appearance of *Modiolus* reef on multibeam echosounder imagery. The reef delineation can be seen by the black borderline.

1.4. *Modiolus modiolus* biotopes in the Marine Habitat Classification

The marine habitat classification was developed by JNCC as a tool to aid the management and conservation of marine habitats. It provides an ecologically-based classification of seashore and seabed features, aimed primarily at classifying benthic communities in a way which is applicable to both scientific research and to the wider requirements for management of the marine environment (Connor et al. 2004). Within this classification there are six biotopes that mention *Modiolus* in their description and four that describe habitats dominated by *Modiolus* (Table 1).

Table 1. Summary of *Modiolus* biotopes identified in the 04/05 Marine Habitat Classification.

04/05 Biotope code	**Description**
SS.SMx.CMx.CIloModHo	Sparse *Modiolus modiolus*, dense *Cerianthus lloydii* and burrowing holothurians on sheltered circalittoral stones and mixed sediment
SS.SMp.KSwSS.LsacMxVS	*Laminaria saccharina (Saccharina latissima)* with *Psammechinus miliaris* and/or *Modiolus modiolus* on variable salinity infralittoral mixed sediment
SS.SBR.SMus.ModHAs	*Modiolus modiolus* beds with fine hydroids and large solitary ascidians on very sheltered circalittoral mixed substrata
SS.SBR.SMus.ModCvar	*Modiolus modiolus* beds with *Chlamys varia*, sponges, hydroids and bryozoans on slightly tide-swept very sheltered circalittoral mixed substrata
SS.SBR.SMus.ModT	*Modiolus modiolus* beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata
SS.SBR.SMus.ModMx	*Modiolus modiolus* beds on open coast circalittoral mixed sediment

The first two biotopes in Table 1, *SS.SMx.CMx.CIloModHo* and *SS.SMp.KSwSS.LsacMxVS* are not *Modiolus* bed biotopes, with the first only containing sparse *Modiolus* and describing a sheltered biotope mainly found in Scottish sea lochs. The second is again found in Scottish sealochs, in sheltered infralittoral conditions and therefore not relevant to the study area in question. The third, *SS.SBR.SMus.ModHAs* is a *Modiolus* 'bed' biotope, but is again found in very sheltered locations which would not fit with the tidal regime of the study area. *SS.SBR.SMus.ModCvar* is much more species rich than *ModHAs* with many more ascidians and hydroids growing among the *Modiolus*, as well as large numbers of the variable scallop *Chlamys varia.* Although primarily a sheltered water biotope found in Scottish sealochs, this biotope can occur in waters with moderate tidal currents and one record of this biotope exists from the *Modiolus* beds off the North Llŷn, although it is generally thought that none of the biotopes available in the classification are a perfect fit for the Modiolus beds off the North Llŷn Peninsula.

The final two biotopes in Table 1 are more suited to the open coast, occurring in environments with greater wave exposure and higher tidal velocities. *SS.SBR.SMusModMx* tends to occur in deeper water than *SS.SBR.SMusModT* with slightly lower current velocities. Less scouring in this environment means that *ModMx* is characterised by a more diverse infauna including polychaetes, venerid bivalves and brittlestars than *ModT. ModT* is characterised much more by its epifauna, which includes brittlestars, hydroids, anemones and keelworms (Connor et al., 2004). However, this may reflect differences in the sampling techniques used for the records selected as core biotope types, rather than actual differences in the infauna and epifauna.

1.5. Previous surveys in the area

SEA6

A Strategic Environmental Assessment (SEA) was carried out by the Department of Trade and Industry (now the Department for Business Energy and Industrial Strategy (BEIS)) to look at the implications of Oil and Gas exploration and other energy developments on the UK continental shelf, with the aim of balancing the pressures of economic development with the need to protect the natural environment. The UK continental shelf was divided into 8 geographical areas, with area SEA6 covering the Irish Sea.

A sub-contract technical report of the SEA6 process was written by Rees (2005) to assess the status of horse mussel *Modiolus modiolus* beds off northwest Anglesey. The main aim of this was to re-locate the *Modiolus* beds north west of Anglesey for which some patchy information was available from dredge surveys carried out in the 1960s. Using sidescan sonar over areas of previously known *Modiolus*, locations for grab and dredge sampling were identified to ground truth possible biogenic reef features.

The drift dredge samples found significant numbers of live *Modiolus* at some locations, as well as patches of clumped *Modiolus* at others, although it was not found in the abundances that previous records suggested. The *Modiolus* identified occurred in small patches and clumps and did not build up into extensive beds such as those occurring in other areas such as the north Llŷn. The physical characteristics of the area, being predominantly tide-swept and scoured are very different from the present *Modiolus* classifications in the marine habitat classification (Connor et al., 2004) which are based heavily on *Modiolus* found in more sheltered Scottish sea lochs. Rees (2005) also notes that the distinctions of present classifications are also based on differing assemblages of associates, and the SEA6 findings, with a predominance of *Balanus balanus,* doesn't fit well with any of the existing biotopes. A new *Modiolus* biotope was therefore proposed, probably at EUNIS level 5, which would more accurately reflect the conditions of the NW Anglesey site. This would be characterised by an abundance of dead shell, little evidence of recruitment, and patchy clumps of *Modiolus* in a high energy, tide scoured environment.

JNCC/MESH

In 2005 four blocks to the north and west of Anglesey were surveyed by JNCC in collaboration with the CCW and University College Cork (Blyth-Skyrme et al., 2008). There was a slight overlap between one of these blocks and the northern-most block surveyed for the current study. The survey found that the seabed in these areas was complex with a range of biological communities including large areas of mixed sediment mosaics and some boulder areas. No biogenic reef habitats were encountered during this survey.

Older data

Historically, clumps of *Modiolus* were found in dredge samples to the north and west of Anglesey during the 1960s (Ivor Rees pers comm., Moore 2002). With the survey techniques available at the time it was not possible to ascertain with certainty whether the presence of *Modiolus* in these dredge samples was indicative of *Modiolus* reef habitat, or more sparsely scattered clumps of individuals. These records came from several locations, including to the west of Holy Island (south of box NWA2-West), from Holyhead Deep, west of Langdon Ridge (north of Holyhead), sites between 2 and 8 nautical miles north west of the Skerries and sites at 1 and 7 nautical miles north of Point Lynas. The 1989-1991 Biomor survey of the southern Irish Sea also noted aggregations of *Modiolus* at two sites to the west of Anglesey (Mackie et al. 1995).

Impact assessments

More recently surveys have been carried out in the area north and west of Anglesey to assess the potential impact of various developments. Two of these have recorded possible *Modiolus* bed habitat. One of these surveys was carried out on behalf of EIRGrid and recorded a possible *Modiolus* bed habitat approx. 10 nautical miles north of Amlwch (METOC 2009). Of the area that was surveyed the possible *Modiolus* bed appeared to extend approx. 1.7 by 0.4 nautical miles and cover an area of approx. 190 hectares (with the likelihood that the Modiolus bed also extended outside of the area surveyed). In places the density of live *Modiolus* was estimated to be up to 100 individuals per m^2.

There was also an extensive survey of an area north of Anglesey as part of the Zonal Appraisal and Planning (ZAP) project for the Round 3 offshore wind energy area (Centrica Energy 2012), which is in close proximity to the area surveyed by CCW and JNCC. This survey identified an area of possible *Modiolus* habitat around 17 nautical miles north of Amlwch.

Cefas project ME3112

This project had sites between the NWA1-North and NWA2-West survey blocks. The main purpose of this project was to assess the spatial distribution of the macrofaunal assemblages currently around the coast of England, Wales and the west coast of Scotland, together with an assessment of the factors affecting such assemblages. Estimates of the benthic productivity associated with such communities were also derived, for the first time, at this large spatial scale. The data were used by JNCC as part of the re-evaluation of biotopes in offshore environments where such data have previously been relatively sparse.

1.6. Site identification

The two survey areas NWA1-North and NWA2-West were identified by JNCC based on the historic records summarised in the SEA6 report (Rees, 2005) and the subsequent data collected during the SEA6 fieldwork which suggested that *Modiolus*

beds were present in the area, albeit in patches and not on the scale of the north Llŷn example. Recommendations from this report included an acoustic survey of the areas, and a re-visit in a few years to check on the condition of the beds.

Cefas multibeam survey and report 2009

JNCC commissioned the Centre for Environment, Fisheries and Aquaculture Science (Cefas) to carry out a Multibeam Echosounder survey (MBES) within two areas of search off NW Anglesey, as part of a search for additional offshore SACs. This survey took place on 5th and 6th July 2009. The resulting data was interpreted for bedrock, quaternary bedforms, sediments and habitat features. The Cefas report to JNCC, which includes data interpretation, is reproduced in *Appendix 1*: 'NW Anglesey Reef Area of Search: Multibeam interpretation and selection of potential groundtruthing stations'.

Data formats and projections

All the coordinates in this report are in decimal degrees (unless stated otherwise), with mapping in Latitude / Longitude with the WGS84 datum.

2. Survey methodolgy

2.1. Identification of sites for drop down video

On the 19th August 2009, a meeting between JNCC, CCW and Cefas was held at the JNCC in Peterborough to discuss the results of the multibeam echosounder (MBES) survey carried out by Cefas in July 2009 within two areas of search specified by JNCC (*Appendix 1*). Cefas gave an overview of the two sites, including an interpretation of their geology and bedform characteristics. Unfortunately no habitat features that definitely indicated a biogenic origin (i.e. potential *Modiolus* reef) were readily identifiable in area NWA1-North, either due to the resolution of the imagery (approximately 2m, which is a little coarse for small reef features), the topography of the seabed or a combination of the two. As a result, sample site identification focused on topographic features in this area. Area NWA2-West was less topographically complex, with a different character to NWA1-North, and within NWA2-West possible biogenic reef features were suggested. Subsequent discussion identified a number of stations for investigation by drop down video (DDV) locations (22 stations in area NWA1-North and 27 in NWA2-West) which are listed in the Cefas report.

The DDV locations in both areas NWA1-North and NWA2-West were chosen to cover a number of different features, both for ground truthing geological features, and also to visit potential sites of biogenic reef. These potential sites had either been identified as possible biogenic reef from the MBES, where bedform features showed potential, or where there was

a historical presence of *Modiolus* in the dredge samples from the SEA6 project (Cefas, 2009) (Table 2, Table 3).

For each of the two NWA areas, the proposed DDV locations were prioritised by CCW to give a good spread of stations across a range of features and possible biogenic reef locations (Figure 3, Figure 4, Table 2, Table 3).

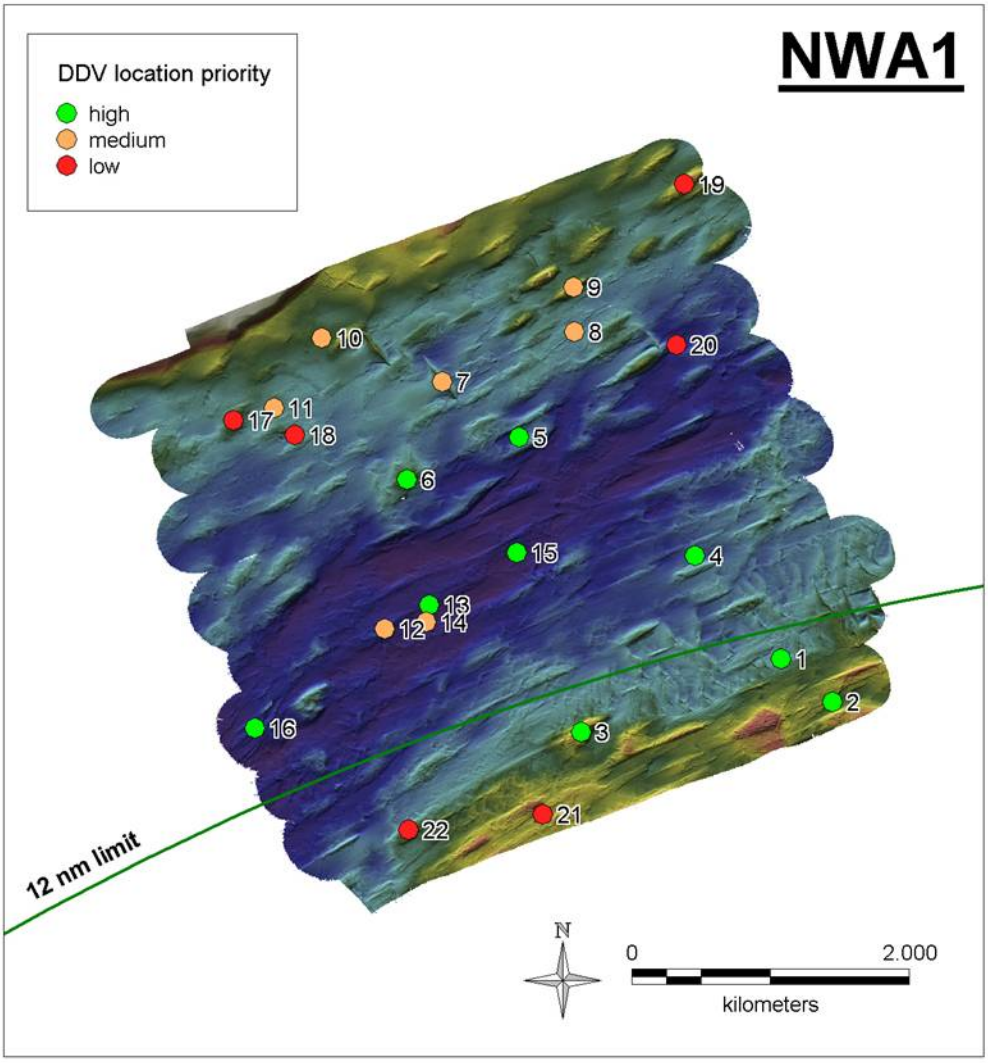


Figure 3. NWA1-North prioritised survey locations on top of the MBES bathymetry.

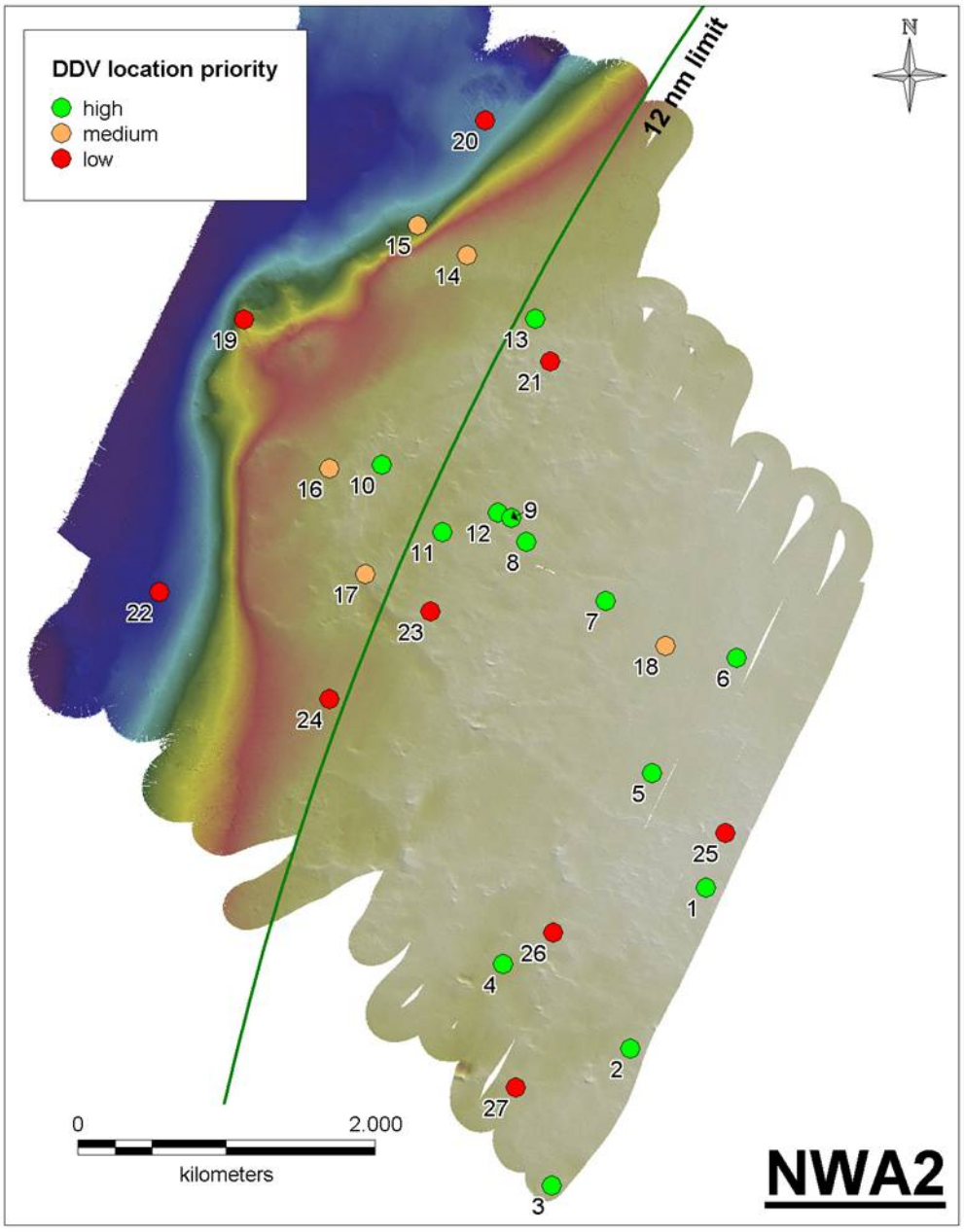


Figure 4. NWA2-West prioritised survey locations on top of the MBES bathymetry.

Table 2. NWA1-North proposed survey locations

Name	Long	Lat	Approx depth	Priority	Order	Cefas report notes
NWA1_Soft_Sediment_Waves_2	-4.69227	53.6161	75	high	1	Station to characterise the area of sediment waves in the south of the survey area. Sandy with gentle gradients – up to 6 m high
NWA1_Rocky_ledge_2	-4.68653	53.6134	70	high	2	South-eastern most example of rocky ledge, 2 ledges with up to 3 m relief.
NWA1_Drumlin_4	-4.71388	53.611	65	high	3	Well developed drumlin feature +15 m high and 65 m deep at its shallowest point.
NWA1_Sediment_Band_1	-4.70191	53.6226	89	high	4	Site of high reflected acoustic-intensity in a trough between drumlins at 89 m
R1 Few Mod + Sab crust_NWA_1	-4.72145	53.6301	90	high	5	Site of high reflected acoustic-intensity in a trough between drumlins at 90 m in the vicinity of Site R1 which recorded *Sabellaria* and *Modiolus*
NWA1_Drumlin_2	-4.73359	53.6271	75	high	6	Large mound (20 m high) on northern side of central channel, less well streamlined with possible iceberg plough mark at crest (68 m)
NWA1_Sand_Ridge_1	-4.72997	53.6335	71	medium	7	The largest of the symmetrical bedforms 6 m high with the shallowest part of the crest a 71 m water depth.
NWA1_Rocky_Ledge_5	-4.71568	53.637	80	medium	8	Two parallel ledges 1.5 m in height with a width of around 60 m part of a larger exposure
NWA1_Drumlin_7	-4.71586	53.6399	66	medium	9	Well streamlined medium sized drumlin (12 m high) shallowest depth 66 m with apparent iceberg plough mark on crest.
NWA1_Soft _Sediment_Waves_1	-4.74327	53.6361	75	medium	10	Area with low backscatter values along with smaller bedforms, from 2.5 to 0.5 m in height and less than 20 m wide.
NWA1_Featureless_1	-4.74834	53.6315	80	medium	11	Area with little seabed topography and intermediate backscatter values chosen to act as a control on the “background” seabed.

Name	Long	Lat	Approx depth	Priority	Order	Cefas report notes
NWA1_Drumlin_1	-4.73562	53.6174	95	medium	12	Smaller (7 m high) drumlin from deepest section of survey area (crest at 90 m). Close to Site R3 (previous study) which recorded *Sabellaria* and *Modiolus*
R3 Sab Crust + Mod_NWA_1	-4.73087	53.619	100	high	13	This station was occupied during a previous study which recorded *Sabellaria* and *Modiolus* present.
NWA1_Sediment_Band_2	-4.73115	53.6179	101	medium	14	Site of high reflected acoustic-intensity in a trough between drumlins at 101 m in the vicinity of Site R3 which recorded *Sabellaria* and *Modiolus*
R2 Mod+Sab Crust_NWA_1	-4.72145	53.6225	105	high	15	This station was occupied during a previous study which recorded *Sabellaria* and *Modiolus* present.
NWA1_Rocky_ledge_1	-4.7496	53.6108	105	high	16	Best example of exposed bedrock with up to 3 m relief on the ledges (outside boundary of processed data).
NWA1_Drumlin_5	-4.75278	53.6307	72	low	17	Mounded feature in far north-west of survey area, less well streamlined 6 m in height, shallowest point 72 m water depth and appears to have several iceberg plough marks
NWA1_Sand_Ridge_2	-4.74595	53.6298	80	low	18	Smallest example of these symmetrical, straight-crested bedforms. 5 m high at a depth of 80 m
NWA1_Drumlin_3	-4.70409	53.6467	75	low	19	No report notes.
NWA1_Rocky_Ledge_3	-4.70449	53.6363	90	low	20	Single large (5.5 m) rocky ledge at the upstream end of a large drumlin
NWA1_Rocky_Ledge_4	-4.71786	53.6057	70	low	21	Set of 4 small rocky ledges each less than 1 m in height at southern extent of survey area
NWA1_Drumlin_6	-4.73254	53.6044	72	low	22	Drumlin feature distinguished by being shallow (72 m) and at south-western extent of survey area

Table 3. NWA2-West proposed survey locations

Name	Long	Lat	Approx depth	Priority	Order	Cefas report notes
NWA_2_Biogenic_Reef_Test_2	-4.97776	53.3602	45	high	1	Area with possible patchy biogenic reef
NWA_2_Biogenic_Reef_1	-4.98492	53.3503	45	high	2	Good example of “pipe cleaner” type reef, likely to be patchy
NWA_2_Biogenic_Reef_2	-4.99248	53.3419	60	high	3	Good example of possible biogenic reef based on topography – should be quite continuous
NWA_2_Biogenic_Reef_Test_1	-4.99805	53.3552	55	high	4	Area with intermediate characteristics sample to test if reef present
NWA2_Biogenic_Ribbons	-4.98349	53.367	45	high	5	Very subtle low relief streamlined patches of possible biogenic reef
NWA_2_Biogenic_Reef_3	-4.97525	53.3741	45	high	6	Very subtle low relief streamlined patches of possible biogenic reef overlying slightly rougher ground
C1 Mod+Sab Crust_NWA_2	-4.98872	53.3774	50	high	7	This station was occupied during a previous study which recorded *Sabellaria* and *Modiolus* present.
NWA_2_Biogenic_Reef_4	-4.99688	53.3808	55	high	8	Pimpled texture to seabed suggests possible biogenic reef
C2 Dredge_NWA_2	-4.99847	53.3822	60	high	9	This station was occupied during a previous study
SEA6_a_NWA_2	-5.01172	53.3852	60	high	10	This station was covered during a previous study (SEA 6 Station C) with sidescan and was interpreted as having possible biogenic reef
NWA_2_Biogenic_Reef_Test_3	-5.00539	53.3813	60	high	11	Area of rougher topography - station to test for biogenic reef
SEA6_b_NWA_2	-4.99988	53.3825	60	high	12	This station was covered during a previous study (SEA 6 Station C) with sidescan and was interpreted as having boulders and Modiolus.
NWA_2_Biogenic_Reef _Test_4	-4.99662	53.3943	65	high	13	Subtle low relief streamlined patches of possible biogenic reef – likely to be patchy.
NWA_2_Ground Truth_5	-5.00371	53.398	70	medium	14	Area on edge of plateau with very low backscatter should have finer sediments.

Name	Long	Lat	Approx depth	Priority	Order	Cefas report notes
NWA_2_Ground Truth_8	-5.00877	53.3998	88	medium	15	Station at 88 m depth on slope with intermediate backscatter - characterisation
NWA2_Rough_a	-5.01705	53.3849	60	medium	16	Small 2 m high ridge running WNW-ESE part of moraine deposits
NWA_2_Ground Truth_4	-5.01308	53.3786	60	medium	17	Station on moraine ridge – possible till outcrop.
NWA_2_Shallow Ground Truth_3	-4.98254	53.3747	45	medium	18	Area close to low relief streamlined patches of possible biogenic reef – reef should be absent or lower density here
NWA2_Ridge_LP	-5.02613	53.3938	85	low	19	Ridge on edge of landslide scarp – should have sediment boundaries
NWA_2_Ground Truth_6	-5.00226	53.4062	100	low	20	Station at 100 m water depth with low backscatter – should contain mobile sediments – characterisation.
NWA2_Rough_LP_2	-4.99498	53.3918	50	low	21	Area of broken ground likely to contain boulders
NWA_2_Ground Truth_7	-5.03386	53.3771	108	low	22	Station at 108 m depth with high backscatter - characterisation
NWA_2_Shallow Ground Truth_2	-5.00638	53.3764	60	low	23	Area with lower backscatter in rougher terrain – for characterisation
NWA_2_Ground Truth_9	-5.01634	53.3709	65	low	24	Area with intermediate backscatter featureless – low priority
NWA2_Rough_b	-4.97594	53.3635	45	low	25	6.5 m high ridge running E-W and is part of moraine deposits
NWA2_Rough_LP_1	-4.9931	53.3572	40	low	26	Small 1.6m high ridge running NW-SE part of glacial deposits
NWA_2_Shallow Ground Truth_1	-4.99638	53.3478	60	low	27	Featureless area with low backscatter and should be devoid of reef

2.2. Drop down video methodology

Drop down video (DDV) was undertaken by the Countryside Council for Wales (CCW) at the selected sites during September 2009 and January 2010, aboard CCW's research vessel RV 'Pedryn' (Figure 5). The exact dates for the survey were dictated by a combination of vessel availability, equipment and personnel, weather conditions and tidal state (neap tides being preferable). Stations in the NWA2-West area (being the shallower site) were surveyed on the 25th and 28th September 2009 and the 25th January 2010. Stations in the NWA1-North survey area were visited on the 26th January 2010 and on the 17th June 2010 for stills imagery (see Section 0: Still images acquisition).

Figure 5. RV Pedryn, CCW/ NRW's research vessel. © Rohan Holt / CCW

The camera equipment used was a C-Technics subsea video system (Figure 6) consisting of a Sony TRV950E mini DV digital camcorder inside a waterproof housing rated to 100m water depth. This is obliquely mounted on a sledge accompanied by two 24V 50W lamps for illuminating the seabed, and two lasers set at a width of 10cm apart to provide a visual scale on the resulting video footage. DDV survey followed MESH (Mapping European Seabed Habitats) standard protocols (Coggan et al., 2007) as closely as possible. Even on a neap tide, given the depth of some of the survey locations and the fast running currents in the area, it was difficult to position the video tow so that it passed right through the survey location, although every effort was made to get as close as possible. In total, 8,275m of video tow was taken, with survey tows varying in length from 101m (NWA1-North, site 3(2) to over 910m (NWA2-West site 3).

Area NWA2-West had almost 2.9 times more video in terms of length than area NWA1-North (6146m and 2129m respectively), which is a reflection on the increased time spent in that survey area, and its shallower nature which made DDV deployment easier. This is also reflected in the tow length, with average tow length across both sites being 318m, but the average for NWA2-West being almost twice as long as the NWA1-North average (384 and 212m respectively). Generally speaking, a 250m tow was aimed for, but weather and tide conditions as well as equipment problems shortened some tows, while others were extended where good data was being obtained and possible *Modiolus* was visible on the wheelhouse video feed.

Figure 6. CCW/NRW drop down video sledge ready for deployment.

NWA1-North Drop down video

Eleven drop down video locations were surveyed on the 26th January 2010 (Table 4). These ranged in depth from 65 to 89m. Two sites (NWA1-North 8 and NWA1-North 21) had to be aborted due to problems with power supply to the camera, although not before some footage had been collected over the survey location at each site.

NWA2-West Drop down video

Seven survey locations were visited on the 25th September 2009, with a further two locations visited on the 28th September (NWA2-West station 8 was surveyed twice due to an unexpected change in drift direction when aiming for a tow over site 9) (Table 4). Unfortunately, technical difficulties with the camera meant that the survey then had to be abandoned for the day. A further seven stations were surveyed in the area on the 25th January 2010 with a repaired video camera. Depths at the NWA2-West survey locations ranged from 49 to 94m.

NWA1-North Still images acquisition

Given that the CCW video camera is rated to 100m depth, the equipment was not suitable for a number of survey locations in the NWA1-North area which were around, or slightly deeper than, 100m. Five high priority sites (stations 4, 5, 13, 15 and 16) remained to be surveyed, so in order to obtain imagery at these deeper sites, the Centre for Marine and Coastal Studies was contracted by CCW to do this. Stills images at these five sites were acquired on Thursday 17th June 2010 by Aquatech's survey vessel 'R/V Aquadynamic' using a "Weasel II" stills camera (Figure 7). Unfortunately, due to technical issues, the still images acquired at site NWA1-North station 4 were lost, leaving only stills from the remaining four sites surveyed at NWA1-North; 5, 13, 15 and 16.

Figure 7. Aquatech "Weasel II" stills camera.

2.3. Station logs

For each survey station visited, a station log was completed to record essential information relating to the location, video tape, water depth, locations of the start and end of line and also any notes taken by the surveyor watching the video on the vessel. These were transferred to a spreadsheet after the survey to provide the basis for mapping out the video tows, and all comments from each station were recorded to be supplied for data analysis.

Table 4. Table of sites surveyed by DDV or stills camera during the course of the survey.

Area	Approx. depth (below sea level)	Priority	Order	DDV or still images	Date
NWA1	75	high	1	DDV	26/01/2010
NWA1	70	high	2	DDV	26/01/2010
NWA1	65	high	3	DDV	26/01/2010
NWA1	89	high	4	still	17/06/2010

Area	Approx. depth (below sea level)	Priority	Order	DDV or still images	Date
NWA1	90	high	5	still	17/06/2010
NWA1	75	high	6	DDV	26/01/2010
NWA1	71	medium	7	DDV	26/01/2010
NWA1	80	medium	8	DDV	26/01/2010
NWA1	66	medium	9	DDV	26/01/2010
NWA1	75	medium	10	DDV	26/01/2010
NWA1	80	medium	11	DDV	26/01/2010
NWA1	100	high	13	still	17/06/2010
NWA1	105	high	15	still	17/06/2010
NWA1	105	high	16	still	17/06/2010
NWA2	45	high	1	DDV	25/09/2009
NWA2	45	high	2	DDV	25/09/2009
NWA2	60	high	3	DDV	25/09/2009
NWA2	55	high	4	DDV	25/09/2009
NWA2	45	high	5	DDV	25/09/2009
NWA2	45	high	6	DDV	25/09/2009
NWA2	50	high	7	DDV	28/09/2009
NWA2	55	high	8	DDV	28/09/2009
NWA2	60	high	10	DDV	25/01/2010
NWA2	60	high	11	DDV	25/01/2010
NWA2	65	high	13	DDV	25/01/2010
NWA2	70	medium	14	DDV	25/01/2010
NWA2	88	medium	15	DDV	25/01/2010
NWA2	60	medium	16	DDV	25/01/2010
NWA2	45	medium	18	DDV	25/01/2010
NWA2	50	low	21	DDV	26/01/2010
NWA2	45	low	25	DDV	25/09/2009

2.4. Vessel location and post survey GIS processing

During the survey, the vessels' position was logged every five seconds and plotted onto a trackline in the Manifold Geographical Information System (GIS) software package. After the survey, the points relating to each individual video tow line were

extracted from this position log using the recorded times and locations for the start of line and end of line. The vessel location points at each 5 second interval were then connected to create a polyline using a geospatial tool (from directionsmag.com) and plotted as towlines in MapInfo Professional GIS. These were overlain on top of the multibeam imagery and the station locations to give a visual overview of each site and which locations had been covered by camera tows (Figure 8, Figure 9). These GIS files, along with all the video and stills imagery was then provided for analysis to the contractors for each area of survey.

The equipment is not fitted with an ultra-short baseline (USBL) for underwater acoustic positioning, so it should be noted that all positions are taken as that of the surface video unit on the vessel, and no layback calculations were performed.

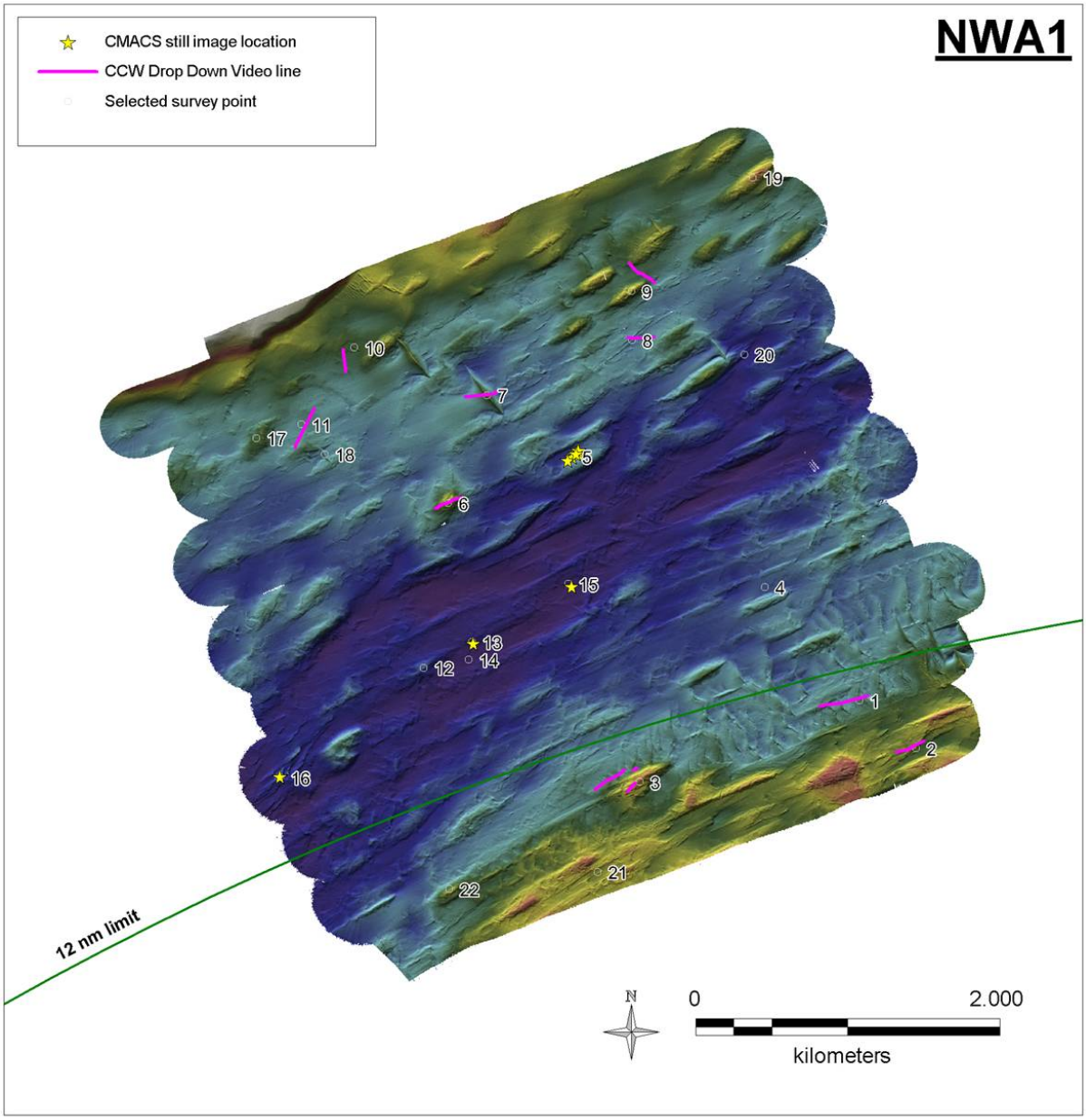


Figure 8. Site NWA1-North with proposed survey locations, overlain with DDV tracks and still image locations.

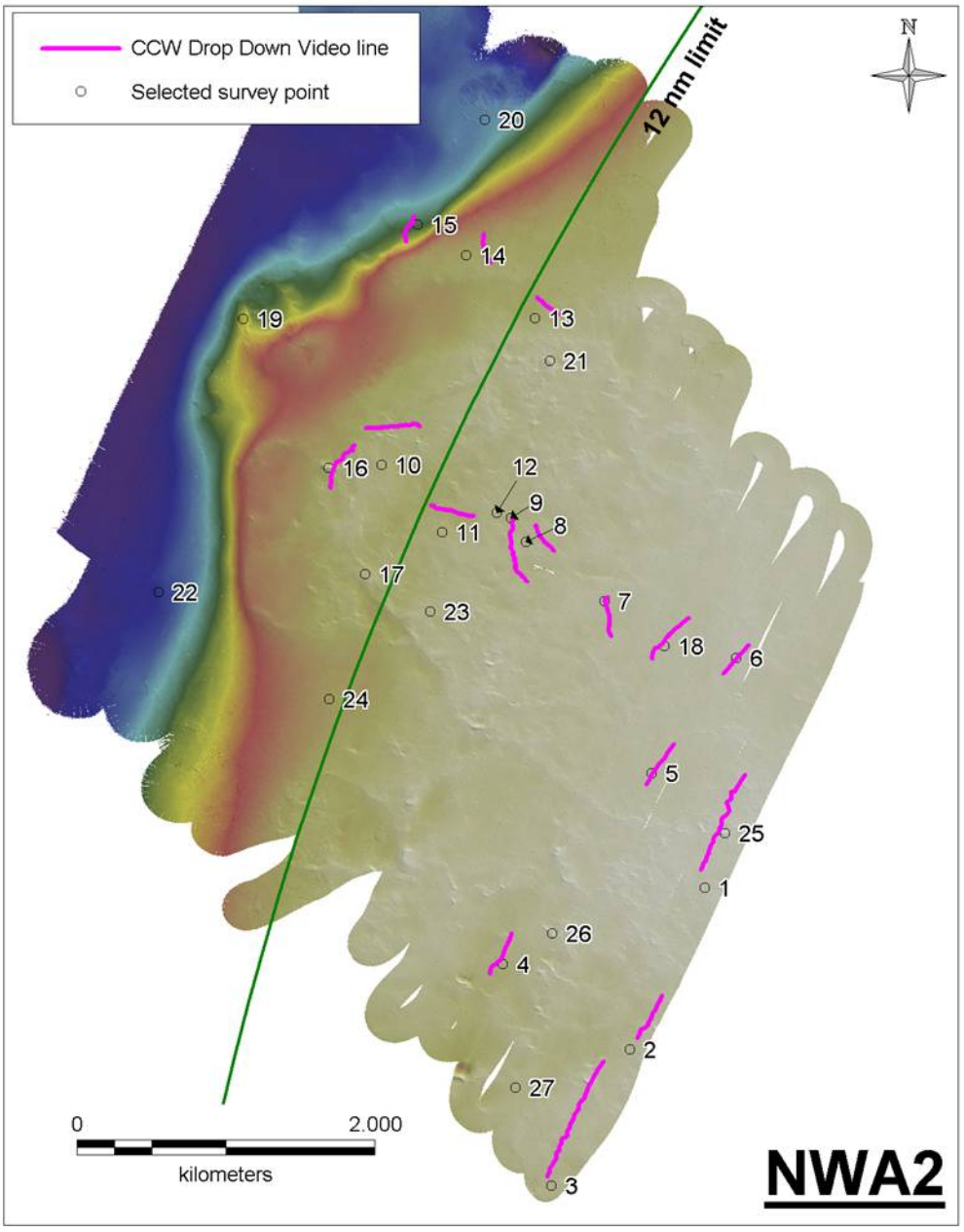


Figure 9. Site NWA2-West with proposed survey locations, overlain with DDV tracks.

3. Data analysis

3.1. Data analysis overview

The data analysis for the NWA1-North survey area was undertaken by Aquatic Survey and Monitoring Ltd (ASML) for JNCC, while Marine Ecological Solutions Ltd (MES) carried out the data analysis for the video tows in the NWA2-West survey area for CCW. MES developed a methodology for assessing areas of live *Modiolus* reef and associated epifauna, dividing the video clips into one minute sections and using the SACFOR (MNCR, 1990) scale for species abundance. In addition to this, video tows were split into sections by changes in habitat/biotope and abundances of visible species recorded for each section. In area NWA1-North however, due to much lower abundances of *Modiolus* compared to area NWA2-West, this method was not applied, and video clips were split by changes in habitat, and then assigned biotopes, noting counts of biota (including live *Modiolus*) within each section.

In total, 16 drop down video tows were obtained in area NWA2-West, and 11 video tows obtained in area NWA1-North, plus the still photos taken in Area NWA1-North by CMACS (15 stills images at 4 sites). Video quality was variable, with some clear, well illuminated images in places, while in others a combination of fast currents, high suspended sediment content and a technical problem with a loose electrical connection in the camera did cause some problems. This was especially evident on rockier / rougher ground, where, as the sledge was knocked on the rocks, this would cause the connection to fail and the display to blank for a few seconds.

3.2. NWA2-West, Marine Ecological Solutions (MES) methodology

The video footage was first split into sections based on habitat types. For each section information recorded included:

- General description of seabed type
- Percentage cover of different types of sediment, boulders and bedrock
- Abundance of species other than *Modiolus* (using the JNCC SACFOR scale)

MES were also tasked by CCW at the project outset to develop a methodology for assessing areas of live *Modiolus* reef, as opposed to just identifying areas of ‘reef’ without determining if it was still alive. This resulted in MES developing a method for *Modiolus* counts rather than percentage cover. This is not a standard video analysis technique but was developed specifically for this project due to the nature of the task.

The video footage was first split into sections based on habitat types. These sections were then further subdivided into one minute sections (if longer than this) to prevent surveyor fatigue and simplify the task of counting dense areas of *Alcyonium*

digitatum. Each video section was then analysed for *Modiolus* and other species. For analysis by count, *Modiolus* were classified as a large animal (>5cm), which to register as common on the SACFOR scale (MNCR, 1990) (Appendix 3), has a density of >1 per square metre. In addition to the *Modiolus* counts, MES incorporated the use of 'proxies' into the video analysis to account for instances where live *Modiolus* was not directly visible on the video footage but may be present and covered by other species. The presence of *Alcyonium digitatum* on potential live *Modiolus*, *Alcyonium* and barnacles with a curve between them (the curve thought to be indicative of a live shell) and the presence of large numbers of *Asterias* were all considered as proxies for live *Modiolus* (see Appendix 4: Rules to define *Modiolus* reef and APPENDIX 5: MES *MODIOLUS* VIDEO ANALYSIS METHODS).

MES assigned biotopes (Connor et al., 2004) to each section, or part section, of video tow, with the biotope SS.SBR.SMus.ModT being initially assigned to areas where *Modiolus* was identified. The biotope SS.SBR.SMus.ModMx was not assigned as it does not have *Alcyonium* listed as an identifying species, which is necessary given that this was considered an important proxy for *Modiolus* identification (See Appendix 6 'Biotope standards sheets'). However, this was later changed, mainly due to the water depths for each biotope (the deeper water depth for SS.SBR.SMus.ModMx better describes the actual water depth at the survey sites). Where the reef had a banded/hummocked nature and was therefore a mosaic of two biotopes (one being SS.SBR.SMus.ModMx) this was considered to dilute a 'common' abundance to 'occasional' over the whole tow. It should be recognised that this does not mean that good patches of live *Modiolus* reef do not exist within that area. The biotopes were assigned using expert judgement for each section, rather than on the basis of statistical analysis.

3.3. NWA1-North, Aquatic Survey and Monitoring Ltd (ASML) methodology

The video footage was first split into sections based on habitat types. For each section the following information recorded included:

- General description of seabed type
- Percentage cover of different types of sediment, boulders and bedrock
- Rock and sediment features
- Abundance of species (using the JNCC SACFOR scale)

The data were then imported into PRIMER (www.primer-e.com) and put through a series of analyses to identify, describe and interpret any patterns and groupings in the biological data. Initial analyses used complete datasets (video or stills), containing all records and taxa, to identify major groupings and individual outlying records. More detailed analyses were then carried out on various subsets of records and species, using the summary substrata types and the species habitat preferences to select data from similar habitats. Once the records had been analysed sufficiently

to differentiate clear groupings in the biological data that correlated with the available habitat data, comparisons of these groups of records were made with the biotopes in the UK Marine Habitat Classification (Connor et al. 2004). This was mainly carried out by visual inspection of the record data and the biotope descriptions from the national classification.

The methods developed by MES for recording *Modiolus*, associated epifauna and defining 'reef' were considered for use in the NWA1-North area. However, *Modiolus* abundances in NWA1-North were much less than in NWA2-West, so the MES method used for NWA2-West was not applied.

Further details of the methodology are in Moore et al. (in draft)

3.4. Mapping of video tracks and data entry into Marine Recorder

Once the video sections had been analysed and assigned a biotope, each video track section was plotted in the GIS video tracks layer and attributed by biotope (or biotopes if more than one biotope had been assigned to the video section) (Figure 10). The biotopes were originally coloured to follow as closely as possible the EUNIS colour scheme (MESH, 2007), although this was later altered where necessary to ensure that the colours were visible against the background multibeam imagery. This resulted in a map of identified biotopes throughout the two study areas (see Section 4. Results and Findings).

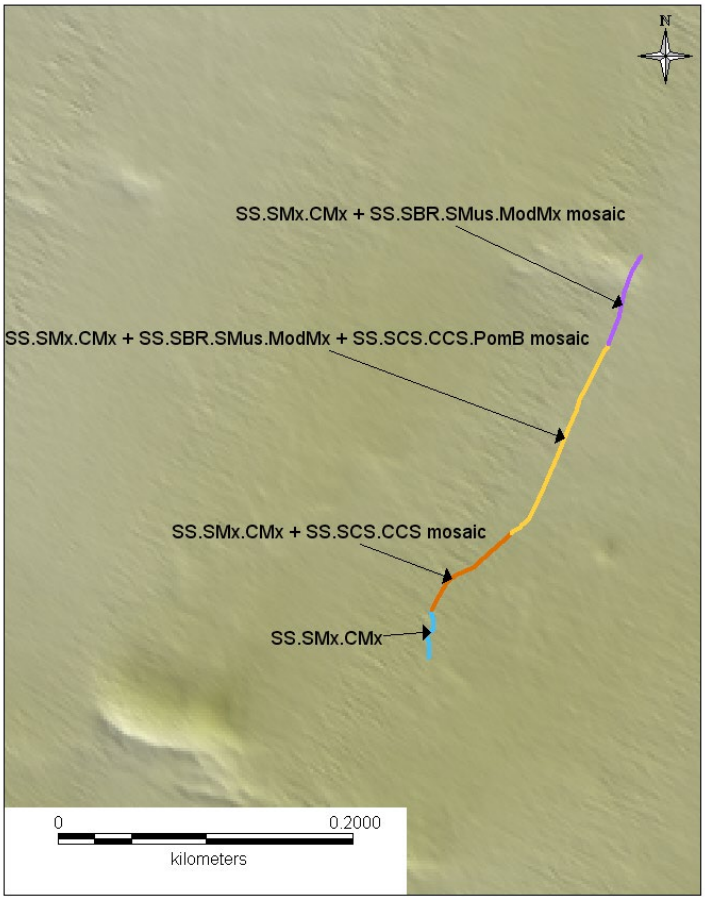


Figure 10. Close up of video track NWA2-West station 4, plotted by biotope designation on the MBES seabed imagery.

The survey data was entered into the Marine Recorder database with each video drop being entered as a survey event, and each biotope identified within that video line as a sample within the event. Data entered into Marine Recorder from the video analysis included % substratum, species abundances (SACFOR scale), counts for *Modiolus* and biotope information for each sample. The survey name was entered as "*2009-2010 CCW / JNCC North West Anglesey Modiolus drop down video survey".* In addition, collaboration between JNCC and CCW ensured that the same survey description was used for each area.

3.5. Quality Control

During video analysis, both ASML and MES carried out quality control between surveyors to ensure a robust methodology.

MES found that the short sections of video gave more consistent analysis than longer sections, and the main scoring categories were within 1 or 2 individuals. In addition, 10% of each habitat was re-analysed by surveyors to check for differences in recording and enable discussion and correction if deemed necessary. Once entered into Marine Recorder, 10% of the inputted records were checked by CCW as

an additional QC measure, with a couple of minor mistakes in data entry corrected which was considered within an acceptable margin for error.

ASML carried out a series of checks to verify data, taxa, location information and station ID codes as described in section 2.3.1 “Data verification and formatting” of their report (Moore et al. 2011). In addition, Marine Recorder data was validated by Nicola Church, JNCC.

4. Result and findings

The seabed in both areas was predominantly a mixture of coarse and mixed sediments, with some cobbles and boulders. Area NWA1-North (the northerly site) was in general more rocky than NWA2-West (the western site). In NWA1-North the seabed types included bedrock, boulders, coarse sediments and mixtures of sand, gravel, pebbles and cobbles (occasionally with boulders). In this area live *Modiolus modiolus* were sometimes observed growing on boulders and also within sediments. The rockier areas of NWA1-North seemed to be more species rich than was the case on area NWA2-West. At only one station in NWA1-North was the *Modiolus* dense enough to create a distinctive habitat. The NWA2-West site was generally more dominated by coarse and mixed sediments and also had more areas where live *Modiolus* was abundant enough to modify the habitat. In general, this area seemed quite current scoured and epifauna were sparse, with the exception of the areas modified by *Modiolus*.

4.1. Area NWA2-West

Five different habitats were identified from the video tows in the NWA2-West area and these are listed in Table 5, along with the biotope assigned to each habitat. In general, it was difficult to assign biotopes to the data, a problem which is often encountered with deeper water coarse and mixed sediments. Note that due to the hierarchical nature of the biotope classification, two of the level 4 (EUNIS Level 5) biotope complexes (SS.SCS.CCS.PomB and SS.SMx.CMx.FluHyd) are instances where the level 3 (EUNIS level 4) habitat complex can be further identified to biotope level, but are still in the same habitat at level 3. Therefore if we were to summarise the findings to habitat (level 3) we would only have three habitats (SS.SCS.CCS, SS.SMx.CMx and SS.SBR.SMus). For each biotope, a ‘standards sheet’ was provided by Marine Ecological Solutions which included information on the biotope taken from the UK Marine Habitat Classification for Britain and Ireland (Connor et al., 2004) including biotope description, the typical physical composition of the habitat and the typical species composition giving abundance on the SACFOR scale (Appendix 3). Spreadsheets showing the more detailed analysis of Modiolus habitats and displayed in Appendix 7.

Table 5. The five biotopes designated in the NWA2-West area by MES

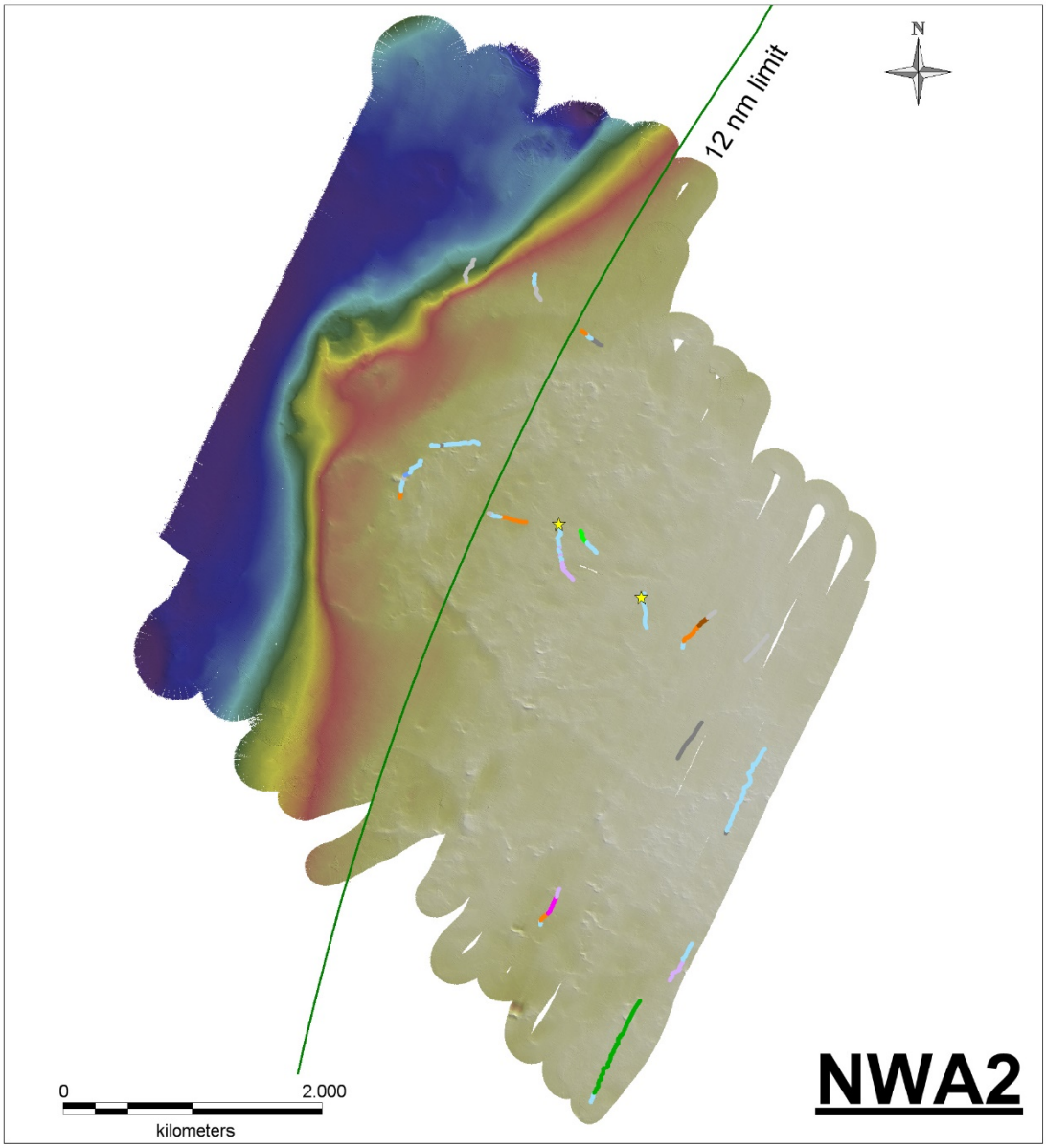
Habitat	**Best fit from UK Marine Habitat Classification (Connor et al. 2004)**	**Stations where found**
Coarse sediment and empty shell	SS.SCS.CCS Circalittoral coarse sediment	4, 5, 6, 10, 11, 13, 14, 15, 16 and 18

Habitat	Best fit from UK Marine Habitat Classification (Connor et al. 2004)	Stations where found
Pebbles and cobbles with keel worms	SS.SCS.CCS.PomB *Pomatoceros (Spirobranchus) triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	1, 4, 5, 10, 13, 15 and 18
Mixture of gravel, pebbles and cobbles with erect epifauna	SS.SMx.CMx Circalittoral mixed sediment	1, 2, 3, 4, 7, 8, 8a, 10, 11, 13, 14, 16, and 18
Mixture of gravel, pebbles, cobbles and boulders with erect epifauna	SS.SMx.CMx.FluHyd *Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment	10 and 16
Modiolus modiolus habitat	SS.SBR.SMus.ModMx *Modiolus modiolus* beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata	2,3,4,8 and 8a

The biotope most commonly assigned in this area was SS.SMx.CMx *Circalittoral mixed sediment*. This was generally a well mixed mosaic of shell, cobbles and pebbles lying in or on sand or gravel. This biotope accounted for almost 52% (3170m) of the total video tow length in area NWA2-West. Assigning biotopes to the data was difficult, as the classification for coarse and mixed sediments, especially beyond shallow inshore waters, is not that well developed.

The video tracks were coloured by biotope (Figure 11) with level 4 biotopes being the same colour but a darker shade of the level 3 habitat. Instances where a mosaic of two (or in one case three) different biotopes were identified for the same section were coloured separately to help identify them. There were four instances (three in NWA2-West station 10 and one in NWA2-West station 15) where the mosaic was made up of one habitat complex (level3) and one biotope complex (level 4) where they both shared the same level 3 habitat (eg SS.SMx.CMx and SS.SMx.CMx.FluHyd mosaic). In this case, the video track was coloured to level 3 (habitat level) in order to reduce the complexity of the map.

Also marked on the map (Figure 11) are two locations where *Modiolus* was found during the SEA6 research project (Rees 2005). These records were from dredge sampling using a small Tjarno pattern dredge which was left on the bottom for less than two minutes, until it was felt to bite a few times. Despite the fact that the vessel was drifting during the dredge, the location given is that considered to be closest to where the sample was obtained (Rees, 2005).



NWA2 area biotoped video tows

- SS.SBR.SMus.ModMx (certain)
- SS.SBR.SMus.ModMx (certain) + SS.SMx.CMx mosaic
- SS.SCS.CCS
- SS.SCS.CCS.PomB
- SS.SMx.CMx
- SS.SMx.CMx + SS.SBR.SMus.ModMx + SS.SCS.CCS.PomB mosaic
- SS.SMx.CMx + SS.SBR.SMus.ModMx mosaic
- SS.SMx.CMx + SS.SCS.CCS mosaic
- SS.SMx.CMx + SS.SCS.CCS.PomB mosaic
- SS.SMx.CMx.FluHyd

☆ SEA6 modiolus points

Figure 11. Video tracks in the NWA2-West area coloured by biotope.

Description of biotopes present

Modiolus modiolus habitat (SS.SBR.SMus.ModMx *Modiolus modiolus* beds on open coast circalittoral mixed sediment)

The *Modiolus* biotope SS.SBR.SMus.ModMx was recorded in the NWA2-West area in video tows at stations 2,3,4,8 and 8a. This was originally assigned the biotope SS.SBR.SMus.ModT (*Modiolus modiolus* beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata). This was done on the basis of the SS.SBR.SMus.ModT biotope having *Alcyonium digitatum* in the species list (a species that was commonly observed on the video tows), along with other epifauna. However, the SS.SBR.SMus.ModT includes red seaweeds in the list of characterizing species and is described as occurring in water depths of 5-50m. The biotope SS.SBR.SMus.ModMx, on the other hand, is described as occurring in water depths of 50-100m which better reflects the actual water depths at the sites surveyed here (54-60m below sea level).

This was the second most common biotope in terms of percentage of the total video distance, with 1414m (23%) of video tow length attributed to it. It should be noted that these percentages are calculated for the main biotope designated in the video section, regardless of whether it is a part (mosaic) or whole record. The *Modiolus* biotope SS.SBR.SMus.ModMx was only identified as a whole record at site 3 (the southernmost site in the study area). This was a long length of video at 837m. Other records of the *Modiolus* biotope were all part of mosaics with other biotopes.

The lack of certainty over the biotope assignation partly reflects the relatively low abundance of visible live *Modiolus*. The seabed in these areas tended to consist of a mosaic of coarse sediment and dead shell, with a few live *Modiolus* visible, along with fairly common *Alcyonium digitatum* (Figure 12, Figure 13). On other *Modiolus* beds in Welsh and Manx waters *Alcyonium digitatum* is often found associated with *Modiolus* and appears to preferentially grow on the shells of live *Modiolus* (Rohan Holt pers comm, Sanderson et al. 2008). Therefore, it is possible that the actual density of live *Modiolus* is higher than is apparent on the video and is either obscured by the *Alcyonium*, or is recessed in the sediment. Other species that were observed within this biotope or biotope complex with an abundance of frequent or higher were the hydroid *Abietinaria abietina* and the keel worm *Pomatoceros (Spirobranchus)* sp.

For a further discussion of the *Modiolus* habitat at this site see Section 4.1.2.

Figure 12. Relatively dense *Modiolus*, with large proportions of dead shell but also some live individuals. *Alcyonium digitatum* is common in this picture (station 2).

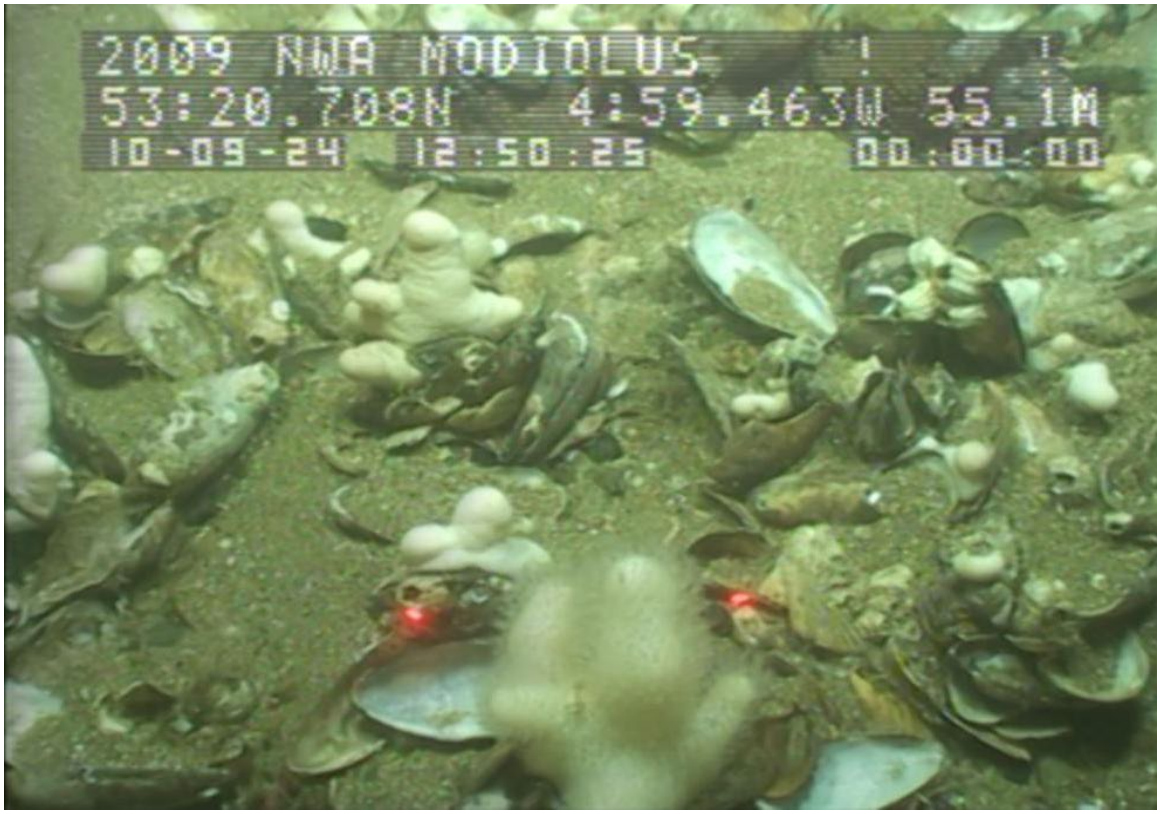


Figure 13. Less dense *Modiolus* with patches of sand (station 3).

Coarse sediment and empty shell (SS.SCS.CCS Circalittoral coarse sediment)

This habitat was identified in video tows at stations 4, 5, 6, 10, 11, 13, 14, 15, 16 and 18 and was quite variable in nature. In many cases there were large amounts of empty shell (predominantly *Modiolus*) visible (Figure 14), at other stations the seabed was comprised of a mixture of empty shell with sand and/or coarser sediments (gravel, cobbles and pebbles) (Figure 15) and in one tow the seabed was dominated by pebbles and cobbles. At some sites the empty shell was embedded into the sediment (Figure 16). This was also described in the SEA6 survey (Rees 2005) where the *Modiolus* shells sometimes became packed on edge (imbricated). There were generally few organisms visible from the video; those that were often present were hydroids (not identified to species), keel worms *Pomatoceros (Spirobranchus)* sp. and barnacles *Balanus* sp..

Figure 14. Seabed covered by empty shell (station 11).

Figure 15. Mixture of empty shell and sand (station 6).

Figure 16. Shells embedded into sediment (station 16).

Pebbles and cobbles with keel worms (SS.SCS.CCS.PomB *Pomatoceros (Spirobranchus) triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles)

This habitat was identified at stations 1, 4, 5, 10, 13, 15 and 18. The substratum generally comprised pebbles and cobbles, often with occasional empty shells and some coarse sand (Figure 17, Figure 18). The keel worm *Pomatoceros (Spirobranchus)* and barnacles *Balanus* sp. were present throughout, as is consistent with the name of the assigned biotope. Other species that were often present were the hydroids *Abietinaria abietina, Hydrallmania falcata* and other unidentified hydroids, hermit crabs and the common starfish *Asterias rubens*.

Figure 17. Substratum of pebbles and cobbles with scattered empty shell (station 4).

Figure 18. Substratum of pebbles and cobbles with increased proportion of dead shell (station 5).

Mixture of gravel, pebbles and cobbles with erect epifauna (SS.SMx.CMx Circalittoral mixed sediment)

This habitat was identified at stations 1, 2, 3, 4, 7, 8, 8a, 10, 11, 13, 14, 16, and 18 (Figure 19, Figure 20). The substratum generally comprised mixed sediments of gravel, pebbles, cobbles and small boulders, often with empty shell. In many cases it was difficult to determine whether this habitat should be assigned the SS.SMx.CMx or the SS.SCS.CCS biotope (Figure 21), with the main difference being the increased proportion of small boulders and consequently erect epifauna and the presence of finer sediments (mainly sand) and in the SS.SMx.CMx biotope. It could be argued that this habitat should be considered a mosaic of coarse sediment and rock habitats. However, no changes have been made to the biotopes assigned, as the ambiguity in the current biotope classification with respect to mixed sediment biotopes makes it difficult to confidently assign a biotope. This area of the biotope classification has been identified as needing revision and therefore it may be more appropriate to revisit the biotopes assigned to these stations once the biotope revisions have been completed. The most common organisms in this biotope were once again the keel worm *Pomatoceros (Spirobranchus)* and barnacles *Balanus* sp. However, this biotope had a higher number of other associated species visible, compared to the coarse sediment biotopes previously described. These species included the hydroids *Abietinaria abietina* and *Hydrallmania falcata*, the soft coral

Alcyonium digitatum, the dahlia anemone *Urticina felina*, hermit crabs, common starfish *Asterias rubens* and sea urchin *Echinus* sp.

Figure 19. Mixture of gravel, shell, pebbles, cobbles and small boulders with the hydroid *Abietinaria abietina* (station 1)

Figure 20. Mixture of gravel, shell, pebbles, cobbles and small boulders (station 16).

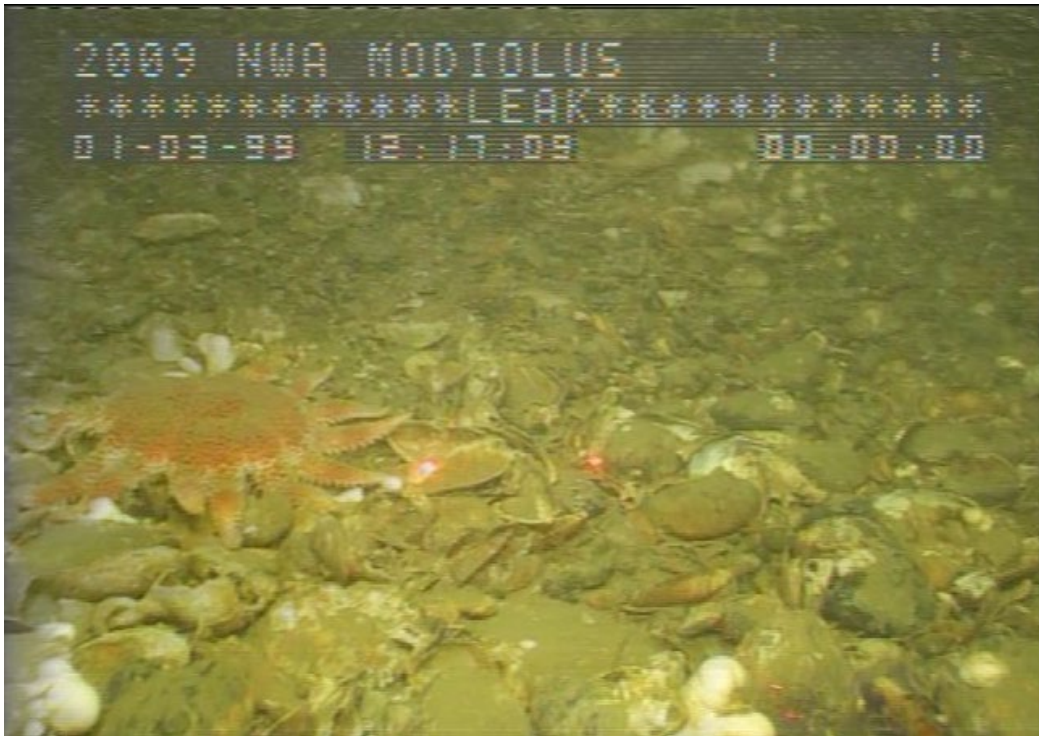


Figure 21. Picture illustrating the difficulty of distinguishing between the SS.SCS and SS.SMx biotopes.

Mixture of gravel, pebbles, cobbles and boulders with erect epifauna (SS.SMx.CMx.FluHyd *Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment)

This habitat was identified at stations 10 and 16 and was considered to be a reasonable fit with the SS.SMx.CMx.FluHyd biotope. The substratum generally comprised mixed sediments of gravel, pebbles, cobbles and small boulders (Figure 22, Figure 23). The most common organisms in this biotope were once again the keel worm *Pomatoceros (Spirobranchus)* and barnacles *Balanus* sp, along with the soft coral *Alcyonium digitatum*, unidentified hydroids and sea urchin *Echinus* sp..

The fit for this biotope was not particularly good as the bryozoan *Flustra foliacea* was not recorded. This biotope was also difficult to distinguish from the SS.SCS.CCS biotopes. The main difference was the greater proportion of finer sediments in the SS.SMx.CMx biotopes with SS.SMx.CMx.FluHyd having a greater percentage of cobbles and boulders and also a greater diversity of fauna. Again it could be argued that this habitat is a mosaic of coarse sediment and rock habitats and could be revisited once revisions to the biotope classification have taken place.

Figure 22. Mixed sediment with small boulders (station 10)

Figure 23. Mixed sediment with boulder and urchin (*Echinus* sp.) (station 10)

4.2. Area NWA1-North

Four habitats were identified in area NWA1-North (Table 6). The most common habitat was coarse sediment and empty shell (assigned a biotope of SS.SCS.OCS Offshore circalittoral coarse sediment). This also frequently occurred with cobbles and boulders that supported erect epifauna (given a biotope of CR.MCR.EcCr.FaAlCr.Flu *Flustra foliacea* on slightly scoured silty circalittoral rock). In general, area NWA1-North was much rockier than area NWA2-West and had far less *Modiolus* habitat. The *Modiolus* biotope SS.SBR.SMus.ModMx (*Modiolus modiolus* beds on open coast circalittoral mixed sediment) was only recorded at a single station.

Table 6. Habitats recorded and biotopes assigned at different video stations

Habitat	**Best fit from UK Marine Habitat Classification (Connor et al. 2004)**	**Stations where found**
Coarse sediment and empty shell	SS.SCS.OCS Offshore circalittoral coarse sediment	1, 7, 8, 9, 10, C5, C13, C15
Cobbles, boulders and bedrock with erect epifauna	CR.MCR.EcCr.FaAlCr.Flu *Flustra foliacea* on slightly scoured silty circalittoral rock	2, 8
Mixture of gravel, pebbles, cobbles and boulders with erect epifauna	Mosaic of SS.SCS.OCS and CR.MCR.EcCr.FaAlCr.Flu	1, 2, 3, 3(2), 6, 7, 8, 9, 11, C5, C13, C16
Modiolus modiolus habitat	SS.SBR.SMus.ModMx *Modiolus modiolus* beds on open coast circalittoral mixed sediment	7

There may well have been some inconsistency in the assignment of biotopes between the analyses of area NWA1-North and NWA2-West. This concerns the habitat that consists of a mixture of boulders, cobbles, pebbles, gravel and sand. In NWA2-West the habitat has been assigned the biotope SS.SMx.CMx (and SS.SMx.CMx.FluHyd), whereas in NWA1-North this habitat has been described as a mosaic of SS.SCS.OCS and CR.MCR.EcCr.FaAlCr.Flu. The biotope classification is rather ambiguous with respect to mixed substrata that include cobbles, pebbles, gravel and sand, so it is difficult to say which of these interpretations is ‘correct’. There is possibly an additional inconsistency in that in the NWA1-North area coarse sediments have been given the SS.SCS.OCS biotope and in NWA2-West coarse sediments have been given the SS.SCS.CCS biotope. However, the SS.SCS.OCS biotope occurs in deeper water than the SS.SCS.CCS biotope and the sites in area NWA1-North are generally deeper than those in area NWA2-West. Therefore no changes have been made in this respect.

A map of the biotoped video tows and still locations for NWA1-North was created (Figure 24).

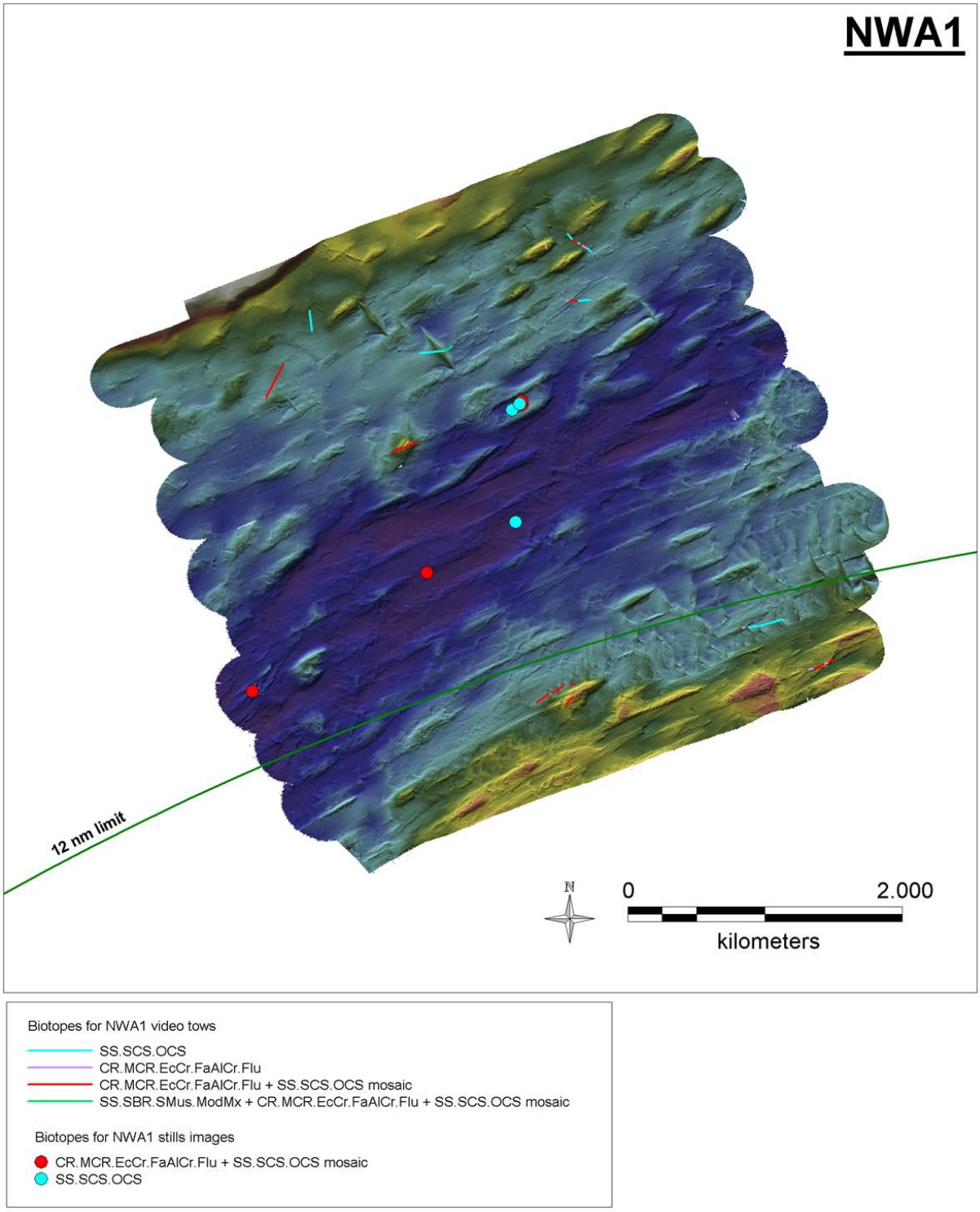


Figure 24. Video tracks and still image locations in the NWA1-North area coloured by biotope.

Description of biotopes present

Coarse sediment and empty shell (SS.SCS.OCS Offshore circalittoral coarse sediment)

This habitat was identified at stations 1, 2, 3, 3(2), 6, 7, 8, 9, 10, 11, C5, C13, C15 and C16 (Figure 25, Figure 26, Figure 27). The substratum generally consisted of coarse sand and gravel, with a high proportion of broken and unbroken *Modiolus* shell. In many cases this biotope occurred as a mosaic with CR.MCR.EcCr.FaAlCr.Flu, with the latter on cobbles and boulders. Epibiota was very sparse and included *Alcyonium digitatum, Pomatoceros (Spirobranchus),* Hermit crabs *Paguridae* and hydroids. The sediment habitat appeared to be current scoured and mobile.

Figure 25. Coarse sediment with empty shell (station C15)

Figure 26. Coarse sediment with gravel and shell (Station C5)

Figure 27. Pebbles, gravel and coarse sediment with hydroids (station C13)

Cobbles, boulders and bedrock with erect epifauna (CR.MCR.EcCr.FaAlCr.Flu *Flustra foliacea* on slightly scoured silty circalittoral rock)

This habitat generally occurred on boulders and bedrock as a mosaic with coarse sediments (discussed below) (Figure 28). However, at stations 2 and 8 the biotope occurred on mainly bedrock. The organisms most often recorded in this biotope were the soft coral *Alcyonium digitatum*, bryozoans (including *Flustra foliacea*), barnacles, hydroids, the keel worm *Pomatocerous (Spirobranchus)* sp. and the urchin *Echinus esculentus*. This biotope was not a particularly good fit to the data, possibly because the biotope in the biotope classification was described primarily from records from relatively nearshore areas of north-east England. Consequently, a suggestion has been made to create a new biotope based on these records.

Figure 28. Low lying sediment inundated bedrock with *Flustra foliacea*, *Alcyonium digitatum* barnacles and hydroids (Station 2)

Mixture of gravel, pebbles, cobbles and boulders with erect epifauna (mosaic of SS.SCS.OCS and CR.MCR.EcCr.FaAlCr.Flu)

This habitat was identified at stations 1, 2, 3, 3(2), 6, 7, 8, 9, 11, C5, C13 and C16 (Figure 29, Figure 30). The organisms most often recorded in this biotope were the soft coral *Alcyonium digitatum*, bryozoans (including *Flustra foliacea*), barnacles, hydroids, the keel worm *Pomatocerous (Spirobranchus)* sp. and the urchin *Echinus esculentus*. At some stations there were also several live *Modiolus* observed within the sediment. This habitat has similarities to the habitat assigned the biotopes SS.SMx.CMx and SS.SMx.CMx.FluHyd in area NWA2-West.

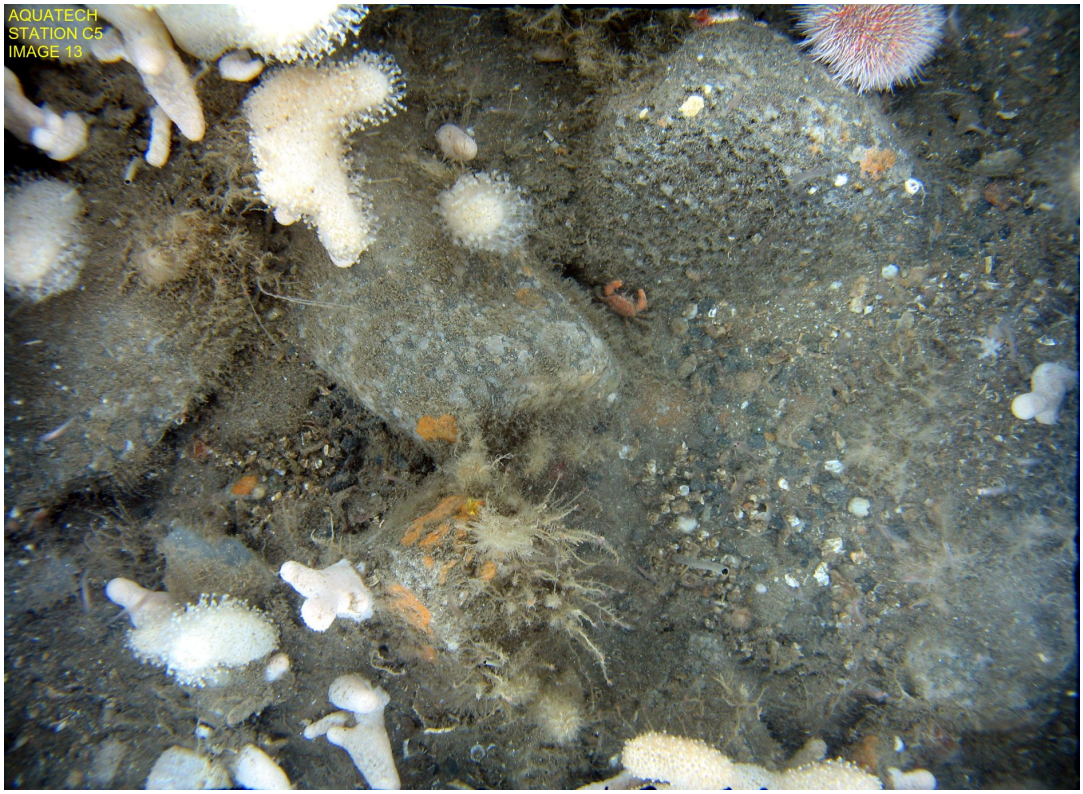


Figure 29. Hard substrata and some gravel with soft corals *Alcyonium digitatum*, hydroids and urchin *Echinus esculentus* (station C5)

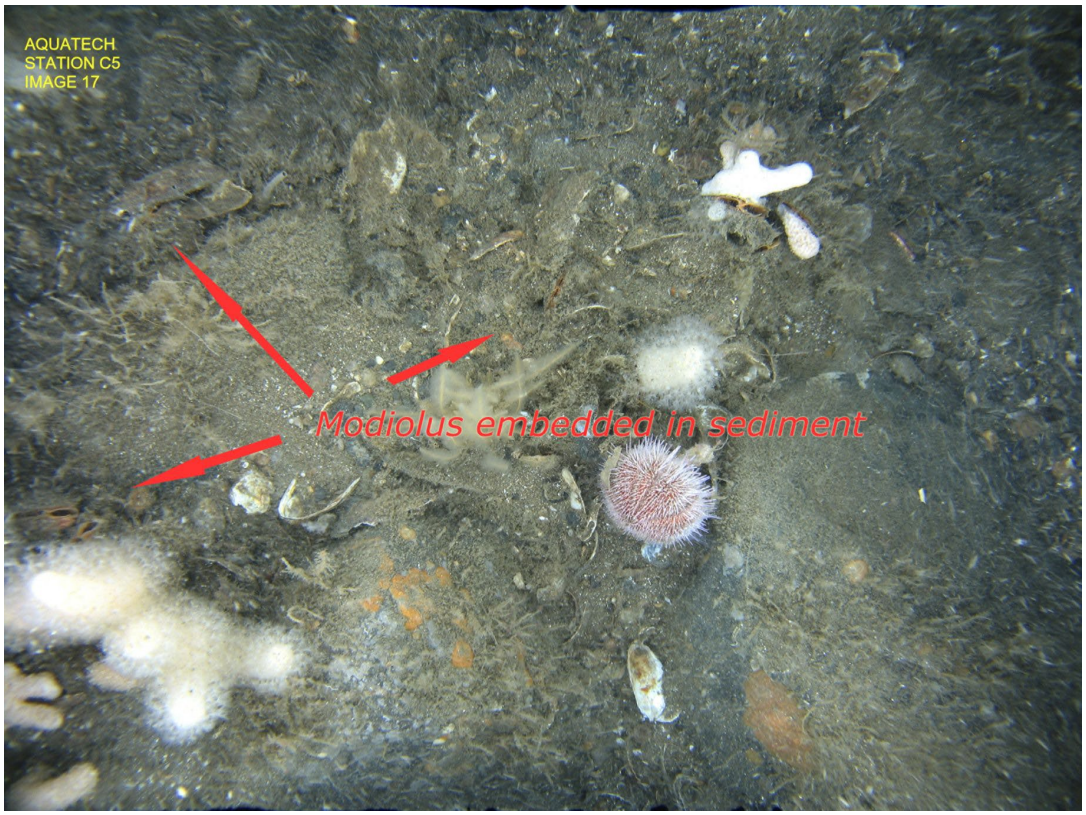


Figure 30. Hard substrata with *Modiolus* indicated (station C5). This was not assigned a *Modiolus* biotope, as the frequency of *Modiolus* was thought to be too low.

Modiolus modiolus habitat (SS.SBR.SMus.ModMx *Modiolus modiolus* beds on open coast circalittoral mixed sediment)

The *Modiolus* habitat was only recorded at the beginning of station 7 (Figure 31, Figure 32). The substratum was a mixture of cobbles, pebbles, gravel and coarse sand. It was difficult to accurately assess the abundance of live *Modiolus* in this area, as there were probably some individuals buried in sediment. However, there were relatively high numbers of live individuals visible in comparison with the NWA2-West site. In common with the *Modiolus* habitat in NWA2-West, this biotope was characterised by the soft coral *Alcyonium digitatum*, as well as *Modiolus*.

For a further discussion of the Modiolus habitat at this site see Section 4.1.2.

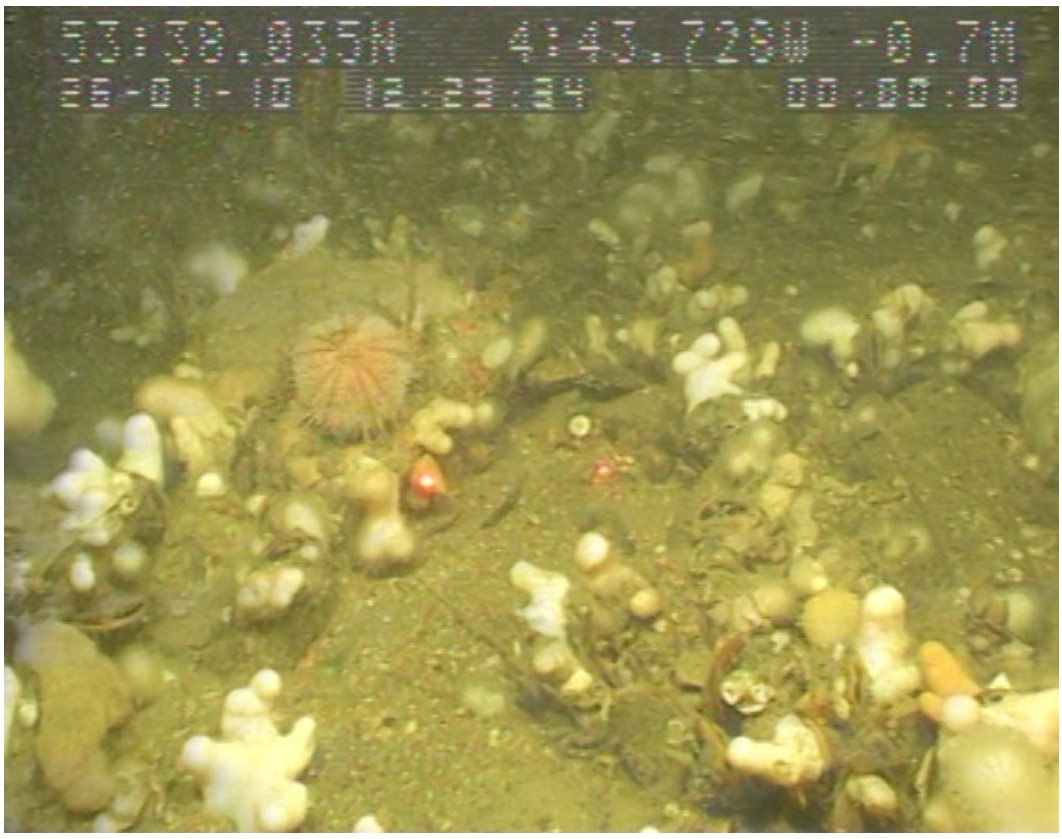


Figure 31. Pebbles and cobbles on mixed sediment with *Alcyonium digitatum* with *Modiolus* (Tow 7)

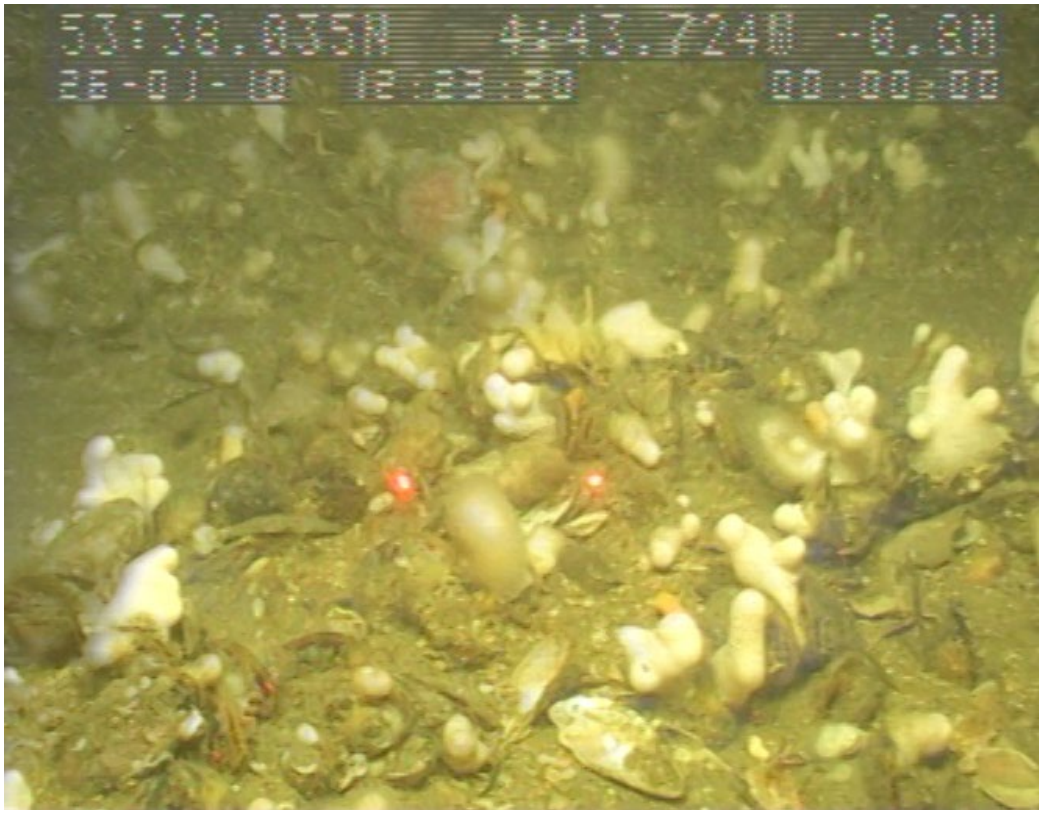


Figure 32. Pebbles and cobbles on mixed sediment with *Alcyonium digitatum* with *Modiolus* (Tow 7)

4.3. Presence of habitats of conservation importance

Presence of *Modiolus modiolus* reef

The *Modiolus* biotope SS.SBR.SMus.ModMx was recorded at five stations in area NWA2-West and one station in area NWA1-North (Figure 33).

Modiolus beds are listed as both an OSPAR threatened and/or declining habitat (OSPAR List of Threatened and/or Declining Species and Habitats (Reference Number: 2008-6)) and were a Biodiversity Action Plan habitat (now listed under Section 7 of the Environment (Wales) Act). *Modiolus* beds also form part of the Habitats Directive Annex I habitat *Reefs*. The definition of *Modiolus* bed varies slightly between each of these lists / directives.

The OSPAR working definition for *Modiolus modiolus* beds is as follows:

"*Modiolus modiolus* horse mussel beds

EUNIS Code: A5.621, A5.622, A5.623 and A5.624

National Marine Habitat Classification for UK & Ireland code: SS.SBR.SMus.ModT, SS.SBR.SMus.ModMx, SS.SBR.SMus.ModHAs and SS.SBR.SMus.ModCvar

The horse mussel *Modiolus modiolus* forms dense beds, at depths up to 70m (but may extend onto the lower shore), mostly in fully saline conditions and often in tide-swept areas. Although *M. modiolus* is a widespread and common species, horse mussel beds (with typically 30% cover or more) are more limited in their distribution. *Modiolus* beds are found on a range of substrata, from cobbles through to muddy gravels and sands, where they tend to have a stabilising effect, due to the production of byssal threads. Communities associated with *Modiolus* beds are diverse, with a wide range of epibiota and infauna being recorded, including hydroids, red seaweeds, solitary ascidians and bivalves such as *Aequipecten opercularis* and *Chlamys varia*. As *M. modiolus* is an Arctic-Boreal species, its distribution ranges from the seas around Scandinavia (including Skagerrak & Kattegat) and Iceland south to the Bay of Biscay."

(From: Descriptions of habitats on the OSPAR list of threatened and/or declining species and habitats

(Reference Number: 2008-07 http://www.ospar.org/documents/DBASE/DECRECS/Agreements/08-07e_Priority%20habitat%20definitions.doc))

An additional OSPAR document includes the following information:

"Patches extending over >10 m^2 with >30% cover by mussels should definitely be classified as "bed". However, mosaics also occur where frequent smaller clumps of mussels so influence ecosystem functioning that for conservation and management purposes lower thresholds can be accepted. Scattered populations of isolated full-grown individuals or of spat at quite high densities are not classified here as "beds"."

OSPAR Commission; Background Document for *Modiolus modiolus* beds. 2009.

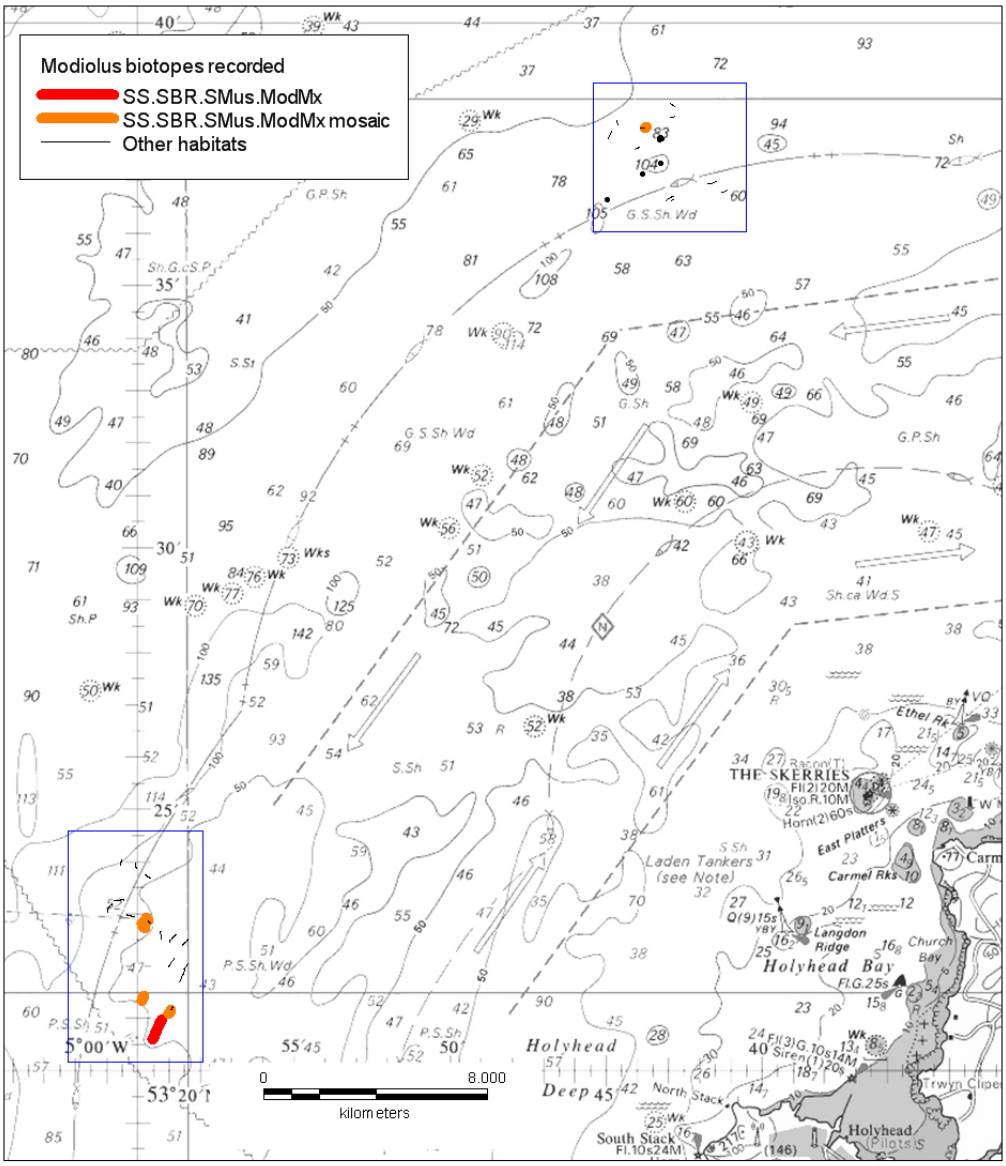


Figure 33. Areas where the *Modiolus* biotope SS.SBR.SMus.ModMx was recorded. Note that the lines have been widened to be more visible and therefore may over-represent the amount of *Modiolus* habitat present.

The UK BAP description of Horse Mussel Beds included the following:

“The horse mussel *Modiolus modiolus* forms dense beds at depths of 5-70 m in fully saline, often moderately tide-swept areas off northern and western parts of the British Isles. Although it is a widespread and common species, true beds forming a distinctive biotope are much more limited and are not known south of the Humber and Severn estuaries.” “*M. modiolus* can occur as relatively small, dense beds of epifaunal mussels carpeting steep rocky surfaces, as in some Scottish sea lochs, but is more frequently recessed at least partly into mixed or muddy sediments in a variety of tidal regimes. In some sea lochs and open sea areas, extensive expanses of seabed are covered in scattered clumps of semi-recessed *M. modiolus* on muddy gravels. In a few places in the UK, beds are more or less continuous and may be raised up to several metres above the surrounding seabed by an accumulation of shell, faeces, pseudofaeces and sand. In some areas of very strong currents extensive areas of stony and gravelly sediment are bound together by more or less completely recessed *M. modiolus*, creating waves or mounds with steep faces up to one metre high and many metres long. These areas of semi-recessed and recessed beds may in some cases extend over hundreds of hectares, and in many cases may be considered as `biogenic reefs`, though they are all referred to here as beds.”

The biotopes listed in this document are the same as those listed in the OSPAR description above.

UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008.

(Updated July 2010) http://www.jncc.gov.uk/page-5155

JNCC developed further guidance regarding the definition of *Modiolus* reef habitat (Morris 2015). A revised working definition of Annex I biogenic *Modiolus* reef habitat was agreed:

“*Modiolus modiolus* is the foundation species in biogenic reefs that are characterised by clumped mussels and shell covering more than 30% of the substrate, which may be infaunal or embedded reefs, semi-infaunal (with densities of greater than five live individuals per m^2) or form epifaunal mounds (standing clear of the substrate with more than 10 live individuals per clump), all of which support communities with high species richness (or diversity) compared to sediments of the surrounding area”.

The following parameters should be met for an area to be classified as *Modiolus* reef habitat:

- live adult *M. modiolus* individuals are present;
- the associated reef biota/communities are distinct from the surrounding habitat; and
- the distinct region containing *M. modiolus* is greater than 25m^2 in extent.

The percent cover of live *Modiolus* did not seem to reach 30% at any of the stations, although it was hard to be accurate as there may have been live individuals that

were not visible due to being partially buried in sediment, or obscured by other fauna. In general the percent cover of visible *Modiolus* was between 5 to 20%. However, in many cases, the seabed where *Modiolus* was present, even at low densities, had a very different appearance and comprised different epifauna to the seabed where live *Modiolus* were not present. For an illustration of this compare Figure 12 and Figure 13 with Figure 14, Figure 15, Figure 16, and Figure 17: Figure 12 and Figure 13 are the *Modiolus* biotopes, whilst the other figures contain large amounts of *Modiolus* shell but have very little epifauna visible. Therefore these areas can be considered *Modiolus* reef under the JNCC working definition.

It is apparent however, that the *Modiolus* habitat in this area is very different to the beds found off the North coast of the Llŷn Peninsula (Sanderson et al. 2008). The North Llŷn *Modiolus* beds are formed into distinctive ridges and troughs, with densities of live *Modiolus* on the ridges of around 100 individuals per m^2 (compared to an estimated 1-9 individuals per m^2 in the areas with the highest density in this study). In addition, species richness appears to be lower at the sites investigated in this survey, compared to the Pen Llŷn reefs. Sanderson et al. (2008) report 61 species in 20 0.25 m^2 quadrats for the north Llŷn, compared to a maximum of 27 species per tow section in this survey. It should be noted that the different survey methods will account for some of this difference; however, it seems unlikely that the difference is entirely caused by methodological differences. The lower density off Anglesey may be due to either natural or anthropogenic influences, or a combination of both. Rees (2005) notes that the Anglesey area surveyed for the SEA6 is subject to strong tides and scour from sand and gravel, which may reduce the numbers of *Modiolus* that would naturally occur. This is backed up by the relatively sparse epifauna on many of the surrounding sediment seabed areas and the prevalence of scour resistant epifauna. However, Rees (2005) also notes that historic records (e.g. from the 1840s and 1960s) suggest that *Modiolus* were previously much more abundant in this area. It is possible that this decrease in abundance over time could be due to impacts of fishing, in particular fishing with towed gears, which has caused damage to *Modiolus* beds in Strangford Lough (Service & Magorrian 1997) and the Isle of Man (Cook et al. 2013, Veale et al., 2000). Some of the points that were identified in these surveys are now protected from scallop dredging under the Scallop Fishing (Wales) Order 2010.

It will be difficult to ascertain whether the low densities of *Modiolus* in the area surveyed are due to natural or anthropogenic factors. One possibility might be to experimentally protect an area of *Modiolus* habitat from fishing impacts and to see whether or not there is an increase in density. However, it is generally believed that recovery of *Modiolus* bed habitats is likely to take a very long time (Holt et al. 1998) and indeed, there is no guarantee that recovery will happen at all.

It is unfortunate that the acoustic signal (from multibeam) of the *Modiolus* habitat in this area was not sufficiently different from the surrounding seabed to determine the extent and distribution of *Modiolus* beds in the survey boxes. This means that in order to map the *Modiolus* habitat in this area further survey will be required.

Presence of rocky and stony reef habitat

Under the Habitats Directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora) Reef habitat includes both bedrock and stony reef. Stony reef habitat is described in a report by Irving (2009) and includes areas with cobbles, boulders and some finer sediments. In terms of the biotopes recorded during this survey this can include mixed sediment biotopes (SS.SMx) and also includes circalittoral rock biotopes (CR.MCR). Therefore there is stony reef habitat present in both of the areas and bedrock reef in area NWA1-North. Table 7 shows which of the stations include sections of either bedrock or stony reef (stony reef is defined as having 10% or above of cobbles, boulders and/or bedrock) and also those stations where biogenic (*Modiolus*) reef may be present. Figure 34 shows the areas of each video tow that were recorded as stony, bedrock or biogenic reef.

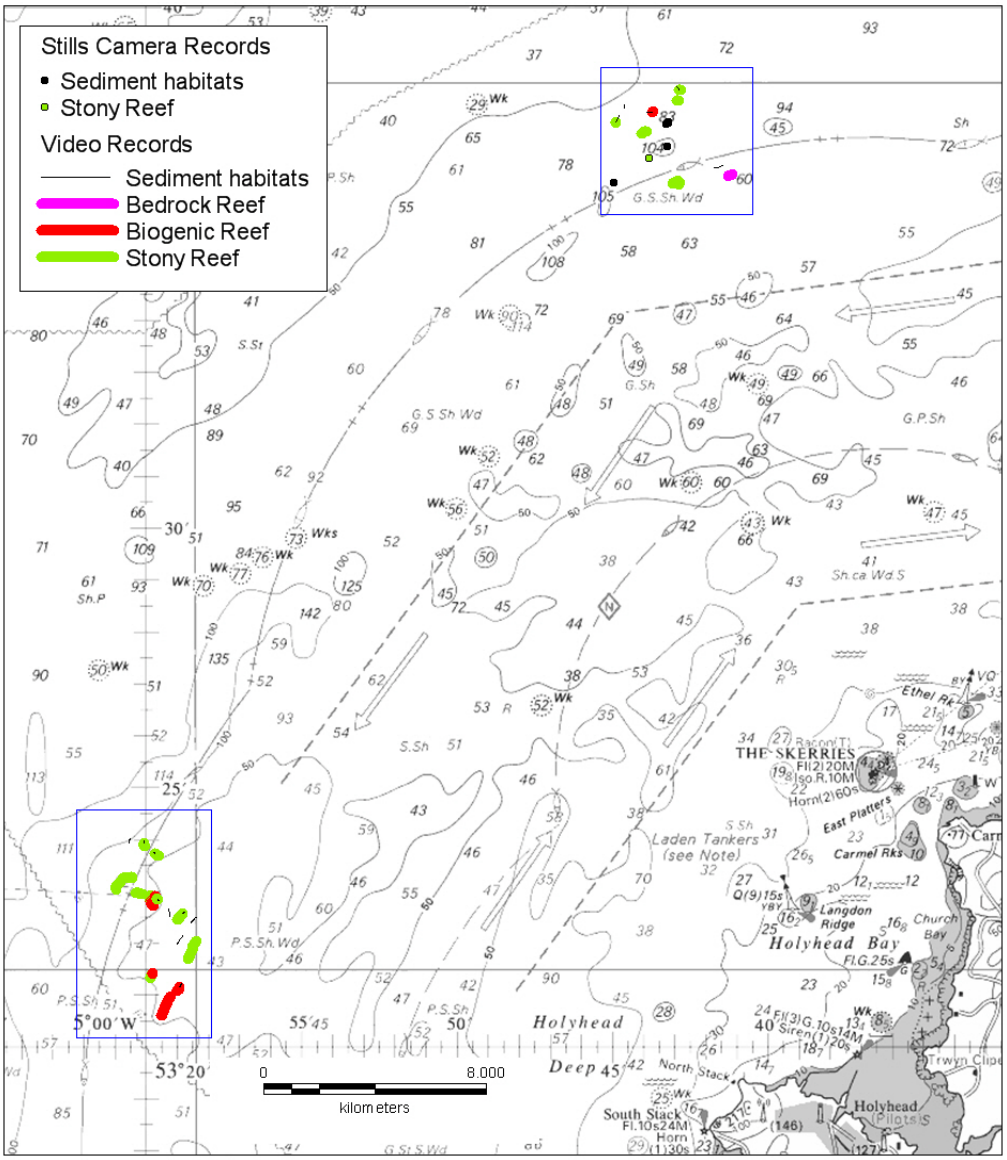


Figure 34. Areas where bedrock, stony or biogenic reef habitats were recorded. Note that the lines have been widened to be more visible and therefore may over-represent the amount of reef habitat present.

Table 7. Stations where Annex I Reef habitat was recorded.

Area	Bedrock Reef	Stony Reef	Possible Biogenic Reef
NWA1-North	2 & 8	1, 3, 3(2), 6, 8, 9, 11, C5, C13 & C16	7
NWA2-West	Blank	1, 2, 4, 6, 7, 8, 8a, 10, 11, 13, 14, 16 & 18	2,3,4,8 & 8a

New suggested biotopes

Aquatic Surveys and Monitoring Ltd prepared a new 'hard substrata biotope' suggestion for JNCC following their analysis of the video from site NWA1-North. This habitat was described as "Offshore circalittoral, scoured, slightly silty, pebbles, cobbles and boulders (and very low lying bedrock patches) on coarse sand and gravel; at 72 -108m bsl; sparsely colonised by *Alcyonium digitatum*, hydroids, encrusting bryozoa and *Flustra foliacea*". The best fit for this habitat was considered to be CR.MCR.EcCr.FaAlCr.Flu (*Flustra foliacea* on slightly scoured silty circalittoral rock). However, in comparison to the habitat at site NWA1-North this biotope is described as occurring in shallower water and as being more dominated by the bryozoan *Flustra foliacea*.

After the SEA6 survey in 2005 it was concluded that a new biotope category should be developed for the *Modiolus* habitat off NW Anglesey (Rees, 2005). It was suggested that a new biotope (probably at Level 5 in the EUNIS classification) should describe the predominance of *Balanus balanus* on the *Modiolus* beds and the highly tide swept conditions in the area, resulting in a high amount of scour from bedload transport of sand, shells and grit. This recommendation, along with the work undertaken here, should be considered during the next revision of the biotope classification.

5. Discussion and conclusions

5.1. Seabed habitats

The two areas surveyed both had quite high habitat heterogeneity, with habitats that varied from coarse sediment to bedrock. Many of the habitats recorded were similar between the two areas, although in general area NWA1-North (north of Anglesey) had a higher proportion of bedrock and boulder habitat, whilst area NWA2-West (west of Anglesey) had relatively more *Modiolus modiolus* habitat. Both areas had habitats comprising coarse sediment with empty shell (mainly *Modiolus modiolus* shell). However, area NWA2-West also had areas where the coverage of empty shell was 100%, compared to area NWA1-North where the maximum coverage of *Modiolus* shell was 40 to 70%. The dominant habitat in both areas was probably a mixed substrata with gravel, pebbles, cobbles and small boulders. The proportion of cobbles and small boulders varied across both sites and where the cobbles and small boulders were more common there was an erect epifaunal community (which included the hydroids *Abietinaria abietina* and *Hydrallmania falcata* and the soft coral *Alcyonium digitatum*). In areas where there were few cobbles and boulders there was a very sparse epifaunal community which appeared to be fairly scoured (e.g. keel worms *Pomatocerous (Spirobranchus)* sp. and barnacle species).

In several areas, especially in area NWA2-West (west of Anglesey) there were sections of the seabed where the presence of *Modiolus modiolus* appeared to modify the fauna present by providing stability and a surface for species like *Alcyonium digitatum* to attach to. It is not entirely clear whether these areas can be considered *Modiolus* beds in the context of either of the Habitats Directive, Biodiversity Action Plans or OSPAR lists. The density of *Modiolus* that could be estimated from the video or stills images was generally lower than the threshold density used for the definition of a *Modiolus* bed. However, it was difficult to accurately estimate density of live *Modiolus* as individuals were partially recessed into the sediment and some may not have been visible. In addition, it is impossible to know whether the lower density (relative to *Modiolus* beds off the north coast of the Llŷn peninsula, for example) is due to natural factors (e.g. strong tidal flows and related scour action) or previous anthropogenic impacts.

5.2. Comparison with other surveys in the area

The habitats recorded during this survey are broadly similar to those recorded in other surveys nearby, especially the JNCC North Anglesey survey (Blyth-Skyrme et al. 2008) and the SEA6 survey (Rees 2005). The JNCC North Anglesey survey covered four blocks varying in size from approximately 5 x 5 km to 9 x 9 km. Two of these blocks were to the east of area NWA1-North, one was slightly to the south east of NWA1-North (with a small overlap) and the other was between areas NWA1-North and NWA2-West. In common with the survey being reported on here, the JNCC survey recorded seabed habitats that were often a mixture of gravel, pebbles, cobbles and boulders and also empty *Modiolus* shell aggregations. However, the

JNCC North Anglesey survey also recorded areas of sandy gravel and brittlestar beds; two habitats that were not recorded in either of areas NWA1-North or NWA2-West. The SEA6 survey looked at numerous smaller areas spread to the north and west of Anglesey. Again, the habitats recorded included dense aggregations of empty shell and areas of mixed substrata. This survey however, also recorded fairly thick aggregations and also crusts of *Sabellaria spinulosa*.

5.3. Use of multibeam data

An interpretation of the multibeam echo sounder (MBES) survey data was used to identify survey sites, with the intention of targeting areas with different habitat types for survey. A comparison of the multibeam interpretation with the habitats actually found suggests only a reasonable level of correspondence (Table 8). The two areas noted to have low backscatter were coarse sediment and empty shell habitat. Of the nine stations that were interpreted from the MBES as being possible biogenic reef, 2 had *Modiolus modiolus* habitat recorded as present (with *Modiolus* habitat recorded at a total of 5 stations). However, it is important to note that the video tows did not always go over the exact target position for each site. It should also be noted that the person interpreting the multibeam data was unable to observe a very clear biogenic reef signal and the sites suggested as being possible biogenic reef were just suggestions of sites that might be more likely to be biogenic reef, not confident predictions. This demonstrates a difficulty in this area in identifying biogenic reef from MBES data, which contrasts the strong acoustic signal which can be seen on MBES (and sidescan) images of the *Modiolus* bed off the north of the Llŷn Peninsula. In the future it would be worth investigating whether sidescan or other acoustic methods might be any better for detecting *Modiolus* habitat in this area.

Table 8. Comparison of the interpretation of multibeam data with the habitats recorded at each site.

Station	Multibeam interpretation notes	Habitat recorded
NWA1-1	Station to characterise the area of sediment waves in the south of the survey area. Sandy with gentle gradients – up to 6 m high	Coarse sediment and empty shell, Mixture of gravel, pebbles, cobbles and boulders with erect epifauna
NWA1-2	South-eastern most example of rocky ledge, 2 ledges with up to 3 m relief.	Cobbles, boulders and bedrock with erect epifauna Mixture of gravel, pebbles, cobbles and boulders with erect epifauna
NWA1-3	Well-developed drumlin feature +15 m high and 65 m deep at its shallowest point.	Mixture of gravel, pebbles, cobbles and boulders with erect epifauna
NWA1-5	Site of high reflected acoustic-intensity in a trough between drumlins at 90 m in	Coarse sediment and empty shell

Station	Multibeam interpretation notes	Habitat recorded
	the vicinity of Site R1 which recorded *Sabellaria* and *Modiolus*	Mixture of gravel, pebbles, cobbles and boulders with erect epifauna
NWA1-6	Large mound (20 m high) on northern side of central channel, less well streamlined with possible iceberg plough mark at crest (68 m)	Mixture of gravel, pebbles, cobbles and boulders with erect epifauna
NWA1-7	The largest of the symmetrical bedforms 6 m high with the shallowest part of the crest a 71 m water depth.	Coarse sediment and empty shell Mixture of gravel, pebbles, cobbles and boulders with erect epifauna *Modiolus modiolus* habitat
NWA1-8	Two parallel ledges 1.5 m in height with a width of around 60 m part of a larger exposure	Coarse sediment and empty shell, Cobbles, boulders and bedrock with erect epifauna Mixture of gravel, pebbles, cobbles and boulders with erect epifauna
NWA1-9	Well streamlined medium sized drumlin (12 m high) shallowest depth 66 m with apparent iceberg plough mark on crest.	Coarse sediment and empty shell Mixture of gravel, pebbles, cobbles and boulders with erect epifauna
NWA1-10	Area with low backscatter values along with smaller bedforms, from 2.5 to 0.5 m in height and less than 20 m wide.	Coarse sediment and empty shell
NWA1-11	Area with little seabed topography and intermediate backscatter values chosen to act as a control on the “background” seabed.	Mixture of gravel, pebbles, cobbles and boulders with erect epifauna
NWA1-13	This station was occupied during a previous study which recorded *Sabellaria* and *Modiolus* present.	Coarse sediment and empty shell Mixture of gravel, pebbles, cobbles and boulders with erect epifauna
NWA1-15	This station was occupied during a previous study which recorded *Sabellaria* and *Modiolus* present.	Coarse sediment and empty shell
NWA1-16	Best example of exposed bedrock with up to 3 m relief on the ledges (outside boundary of processed data).	Mixture of gravel, pebbles, cobbles and boulders with erect epifauna
NWA2-1	Area with possible patchy biogenic reef	Pebbles and cobbles with keel worms Mixture of gravel, pebbles and cobbles with erect epifauna
NWA2-2	Good example of “pipe cleaner” type reef, likely to be patchy	Mixture of gravel, pebbles and cobbles with erect epifauna *Modiolus modiolus* habitat

Station	Multibeam interpretation notes	Habitat recorded
NWA2-3	Good example of possible biogenic reef based on topography – should be quite continuous	Mixture of gravel, pebbles and cobbles with erect epifauna *Modiolus modiolus* habitat
NWA2-4	Area with intermediate characteristics sample to test if reef present	Coarse sediment and empty shell Pebbles and cobbles with keel worms Mixture of gravel, pebbles and cobbles with erect epifauna *Modiolus modiolus* habitat
NWA2-5	Very subtle low relief streamlined patches of possible biogenic reef	Coarse sediment and empty shell Pebbles and cobbles with keel worms
NWA2-6	Very subtle low relief streamlined patches of possible biogenic reef overlying slightly rougher ground	Coarse sediment and empty shell
NWA2-7	This station was occupied during a previous study which recorded *Sabellaria* and *Modiolus* present.	Mixture of gravel, pebbles and cobbles with erect epifauna
NWA2-8	Pimpled texture to seabed suggests possible biogenic reef	Mixture of gravel, pebbles and cobbles with erect epifauna *Modiolus modiolus* habitat
NWA2-10	This station was covered during a previous study (SEA 6 Station C) with sidescan and was interpreted as having possible biogenic reef	Coarse sediment and empty shell Pebbles and cobbles with keel worms Mixture of gravel, pebbles and cobbles with erect epifauna Mixture of gravel, pebbles, cobbles and boulders with erect epifauna
NWA2-11	Area of rougher topography - station to test for biogenic reef	Coarse sediment and empty shell Mixture of gravel, pebbles and cobbles with erect epifauna
NWA2-13	Subtle low relief streamlined patches of possible biogenic reef – likely to be patchy.	Coarse sediment and empty shell Pebbles and cobbles with keel worms Mixture of gravel, pebbles and cobbles with erect epifauna
NWA2-14	Area on edge of plateau with very low backscatter should have finer sediments.	Coarse sediment and empty shell Mixture of gravel, pebbles and cobbles with erect epifauna
NWA2-15	Station at 88 m depth on slope with intermediate backscatter - characterisation	Coarse sediment and empty shell Pebbles and cobbles with keel worms

Station	Multibeam interpretation notes	Habitat recorded
NWA2-16	Small 2 m high ridge running WNW-ESE part of moraine deposits	Coarse sediment and empty shell Mixture of gravel, pebbles and cobbles with erect epifauna Mixture of gravel, pebbles, cobbles and boulders with erect epifauna
NWA2-18	Area close to low relief streamlined patches of possible biogenic reef – reef should be absent or lower density here	Coarse sediment and empty shell Pebbles and cobbles with keel worms Mixture of gravel, pebbles and cobbles with erect epifauna

5.4. Future survey recommendations

The area to the north and west of Anglesey clearly includes several habitat types protected under various legislative drivers and biodiversity commitments, for example rocky and stony reef habitat and biogenic reef including *Modiolus modiolus* reef and *Sabellaria spinulosa* reef (with the latter identified in previous surveys). *Modiolus* reef in particular is a habitat that is extremely sensitive to anthropogenic disturbance and has declined in UK waters and therefore it is important that it receives necessary levels of protection and/or management. However, in order to do this, we firstly need to know the distribution and extent of the habitat. Therefore, we recommend that a seabed survey of the waters north and west of Anglesey is carried out. At present it is not clear what the best technique for detecting and mapping *Modiolus* habitat in this area would be. As a first step it would be useful to compare the use of multibeam and sidescan for detecting *Modiolus* habitat in this area, with a view to considering whether sidescan might be more appropriate. The most appropriate acoustic survey method could then be applied, followed by targeted groundtruthing and mapping. The use of drop down video and stills images for groundtruthing is recommended; although it does have its drawbacks in that it is difficult to accurately estimate density of *Modiolus*. As the area is generally too deep for diver surveys, the only alternative quantitative method for estimating density would be the use of grabs. However, this is not ideal as it is a destructive sampling technique, which should be used with great caution on such a sensitive habitat. Further discussion would be required to decide whether a limited number of grabs could be justified in order to compare densities recorded by grabs and from video images of the same area.

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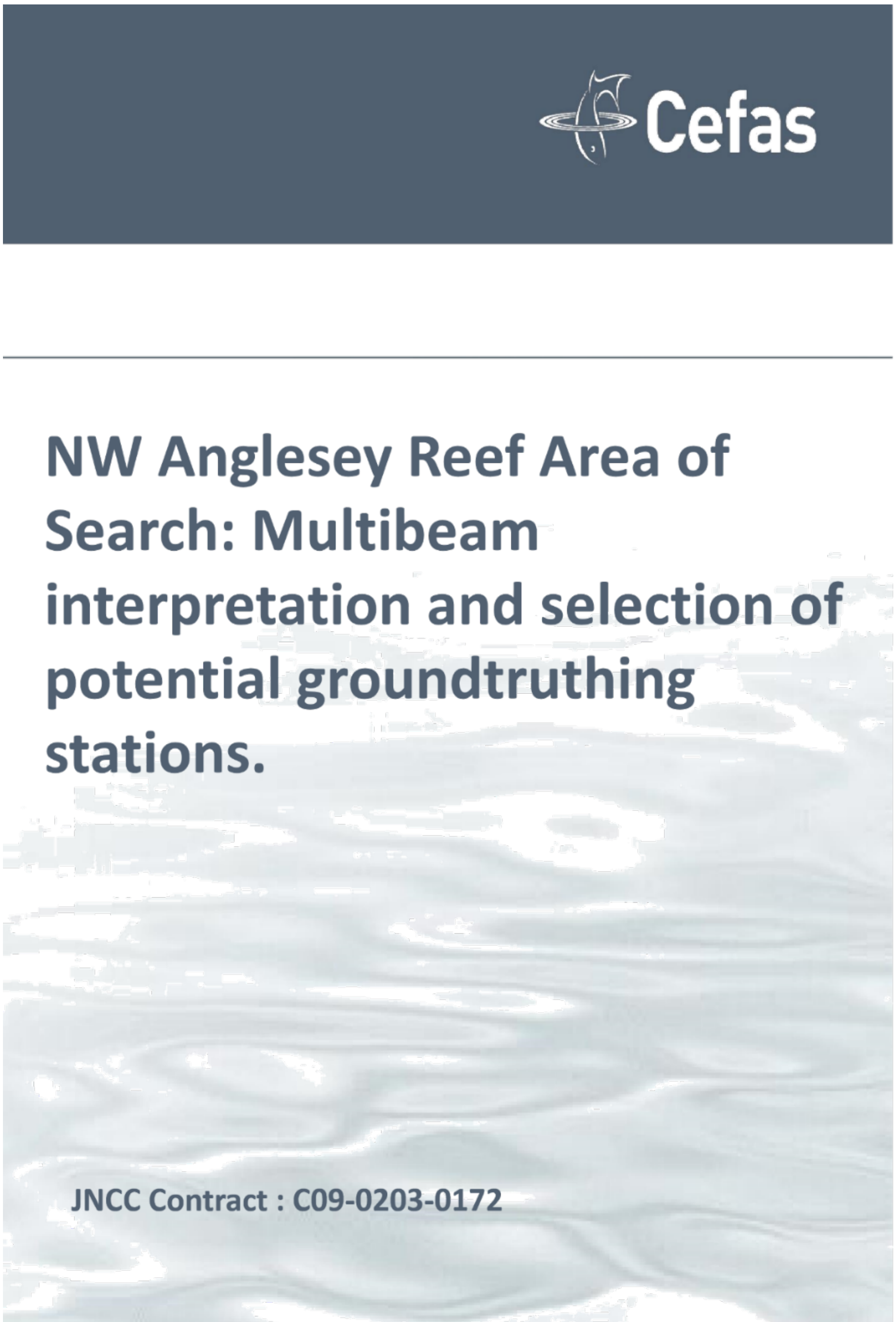
Appendices

Appendix 1: Cefas report on the multibeam survey and selection of potential groundtruthing stations


Cefas

NW Anglesey Reef Area of Search: Multibeam interpretation and selection of potential groundtruthing stations.

JNCC Contract : C09-0203-0172

Appendix 2: Station Logsheets

1. Blank survey station logsheet

N & W Anglesey Modiolus video survey

Stn number _____ Date_____

Stn code on GPS_____Stn no from spreadsheet__can leave blank

Tape number_____

Start time on tape_____End time on tape_____

Vessel speed_____

	Time	Lat/Long	Depth	Heading
Video in water				
Video stable on seabed (SOL)				
Video leaves seabed (EOL)				

Cable info (including any times significant amounts laid out or hauled in)

Time	Cable length	Water depth

Video notes:
Seabed description, anything unusual (record times)

2. Summary of station logsheets

Start/end of line	Date	Station code on GPS	Tape number	Time	Latitude (degrees, decimal minutes N)	Longitude (degrees, decimal minutes W)	Latitude (decimal degrees)	Longitude (decimal degrees)	Depth (m below sea level)	Comments noted on board
SOL	25/09/2009	NWA2 1, NWA 2 25	1	11:43	53 21.647	04 58.711	53.36078	-4.97852	52	shell and pebbles, occasional small boulders
EOL	25/09/2009	NWA2 1, NWA 2 25	1	12:02	53 21.998	04 58.467	53.36663	-4.97445	55	blank
SOL	25/09/2009	NWA2 2	1	12:17	53 21.027	04 59.072	53.35045	-4.98453	66	shelly, cobbles and pebbles and some small boulders. Possible live *Modiolus* (*Alcyonium* seen) at 12:19
EOL	25/09/2009	NWA2 2	1	12:24	53 21.170	04 58.935	53.35283	-4.98225	65	blank
SOL	25/09/2009	NWA2 3	1	12:37	53 20.503	04 59.601	53.34172	-4.99335	52	sand with pebbles and cobbles, occasional large boulders, some shells. Modiolus clumps? At 12:41.

Start/end of line	Date	Station code on GPS	Tape number	Time	Latitude (degrees, decimal minutes N)	Longitude (degrees, decimal minutes W)	Latitude (decimal degrees)	Longitude (decimal degrees)	Depth (m below sea level)	Comments noted on board
										More *Modiolus* clumps at 12:44
EOL	25/09/2009	NWA2 3	1	13:01	53 20.834	04 59.361	53.34723	-4.98935	53.3	blank
SOL	25/09/2009	NWA2 4	2	13:49	53 21.256	04 59.954	53.35427	-4.99923	60.2	Shelly, pebbles, sand/gravel. Shell gravel with Modiolus at 13:54. More at 14:04. Fish at 14:05.
EOL	25/09/2009	NWA2 4	2	14:07	53 21.407	04 59.839	53.35678	-4.99732	57.2	blank
SOL	25/09/2009	NWA2 5	2	14:17	53 21.958	04 59.062	53.36597	-4.98437	54	Shells and pebbles
EOL	25/09/2009	NWA2 5	2	14:37	53 22.094	04 58.913	53.36823	-4.98188	58	blank
SOL	25/09/2009	NWA2 6	2	14:46	53 22.374	04 58.598	53.3729	-4.97663	54	Sand with pebbles, shell. Sand and gravel by end
EOL	25/09/2009	NWA2 6	2	15:06	53 22.491	04 58.441	53.37485	-4.97402	53	blank
SOL	28/09/2009	NWA2 7	3	10:25	53 22.679	04 59.305	53.37798	-4.98842	51.7	Cobbles, pebbles, shell gravel and small boulders. 10:24 *Modiolus* shell (dead)
EOL	28/09/2009	NWA2 7	3	10:39	53 22.541	04 59.298	53.37568	-4.9883	55	blank
SOL	28/09/2009	NWA2 8	3	10:51	53 22.951	04 59.92	53.38252	-4.99867	56.8	Stones, gravel, pebbles, shell. Missed station 8 (went to west of it) but went through station 9. 11:05 live *Modiolus*? Fairly extensive lasted until end of tow
EOL	28/09/2009	NWA2 8	3	11:21	53 22.738	04 59.862	53.37897	-4.9977	57	blank
SOL	28/09/2009	NWA2 8	3	11:36	53 22.926	04 59.762	53.3821	-4.99603	56.9	Modiolus from start. 11:46 end of live *Modiolus*? (no live *Alcyonium* seen from this point)

Start/end of line	Date	Station code on GPS	Tape number	Time	Latitude (degrees, decimal minutes N)	Longitude (degrees, decimal minutes W)	Latitude (decimal degrees)	Longitude (decimal degrees)	Depth (m below sea level)	Comments noted on board
EOL	28/09/2009	NWA2 8	3	11:52	53 22.826	04 59.667	53.38043	-4.99445	56	blank
SOL	25/01/2010	NWA2 10	1	13:48	53 23.27	05 00.485	53.38783	-5.00808	54.4	Time on video incorrect. Gravel and shell with occasional boulders
EOL	25/01/2010	NWA2 10	1	14:03	53 23.24	05 00.836	53.38733	-5.01393	55.6	blank
SOL	25/01/2010	NWA2 11	1	11:41	53 22.937	05 00.164	53.38228	-5.00273	54.5	cobbles and pebbles with *Modiolus* shell
EOL	25/01/2010	NWA2 11	1	12:00	53 22.979	05 00.412	53.38298	-5.00687	blank	blank
SOL	25/01/2010	NWA2 13	1	12:10	53 23.682	04 59.66	53.3947	-4.99433	blank	shelly gravel, clumps of *Modiolus* 12:17?
EOL	25/01/2010	NWA2 13	1	12:29	53 23.797	04 59.875	53.39662	-4.99792	55.6	blank
SOL	25/01/2010	NWA2 14	2	12:39	53 23.869	05 00.088	53.39782	-5.00147	56	shell gravel, sand,cobbles and pebbles. Lost signal at 12:52ish
EOL	25/01/2010	NWA2 14	2	12:53	blank	blank	blank	blank	blank	blank
SOL	25/01/2010	NWA2 15	2	13:06	53 23.989	05 00.594	53.39982	-5.0099	83	cobbles, pebbles, gravel
EOL	25/01/2010	NWA2 15	2	13:18	53 24.049	05 00.486	53.40082	-5.0081	94	blank
SOL	25/01/2010	NWA2 16	2	13:53	53 22.997	05 01.008	53.38328	-5.0168	55	bedrock and boulders
EOL	25/01/2010	NWA2 16	2	14:05	53 23.189	05 00.869	53.38648	-5.01448	blank	blank
SOL	25/01/2010	NWA2 18	3	14:27	53 22.469	04 59.010	53.37448	-4.9835	50	shell, few cobbles
EOL	25/01/2010	NWA2 18	3	14:42	53 22.601	04 58.789	53.37668	-4.97982	50	blank
SOL	26/01/2010	NWA1 3	1	10:15	53 36.705	04 42.897	53.61175	-4.71495	83	sand cobbles and small boulders
EOL	26/01/2010	NWA1 3	1	10:28	53 36.631	04 43.106	53.61052	-4.71843	85	blank
SOL	26/01/2010	NWA1 1	1	11:07	53 36.986	04 41.493	53.61643	-4.69155	84	coarse sand waves
EOL	26/01/2010	NWA1 1	1	11:26	53 36.938	04 41.779	53.61563	-4.69632	82	blank

Start/end of line	Date	Station code on GPS	Tape number	Time	Latitude (degrees, decimal minutes N)	Longitude (degrees, decimal minutes W)	Latitude (decimal degrees)	Longitude (decimal degrees)	Depth (m below sea level)	Comments noted on board
SOL	26/01/2010	NWA1 2	1	10:44	53 36.827	04 41.161	53.61378	-4.68602	74	mixed sediment and cobbles. Modiolus at 10:45 and 10:51?
EOL	26/01/2010	NWA1 2	1	10:55	53 36.780	04 41.331	53.613	-4.68885	74	blank
SOL	26/01/2010	NWA1 6	2	11:45	53 37.652	04 43.973	53.62753	-4.73288	78	mixed sediment and boulders. Modiolus at 11:52?
EOL	26/01/2010	NWA1 6	2	11:58	53 37.601	04 44.125	53.62668	-4.73542	82	blank
SOL	26/01/2010	NWA1 7	2	12:23	53 38.036	04 47.722	53.63393	-4.79537	87	Modiolus? Gravel
EOL	26/01/2010	NWA1 7	2	12:41	53 38.010	04 47.929	53.6335	-4.79882	88	blank
SOL	26/01/2010	NWA1 8	2	12:55	53 38.231	04 42.813	53.63718	-4.71355	85	gravel and pebbles, Modiolus 13:02?
EOL	26/01/2010	NWA1 8	2	13:02	53 38.229	04 42.963	53.63715	-4.71605	85	blank
SOL	26/01/2010	NWA1 9	3	13:22	53 38.424	04 42.815	53.6404	-4.71358	85	sand cobbles and boulders
EOL	26/01/2010	NWA1 9	3	13:42	53 38.486	04 42.961	53.64143	-4.71602	77	blank
SOL	26/01/2010	NWA1 10	3	13:55	53 38.083	04 44.643	53.63472	-4.74405	82	coarse gravel and pebbles
EOL	26/01/2010	NWA1 10	3	14:06	53 38.165	04 44.652	53.63608	-4.7442	79	blank
SOL	26/01/2010	NWA1 11	3	14:19	53 37.812	04 44.931	53.6302	-4.74885	83	boulders, gravel, Modiolus 14:22?
EOL	26/01/2010	NWA1 11	3	14:36	53 37.954	04 44.824	53.63257	-4.74707	85	blank
SOL	26/01/2010	NWA 1 3(2)	4	14:54	53 36.630	04 42.895	53.6105	-4.71492	70	cobbles and boulders
EOL	26/01/2010	NWA 1 3(2)	4	14:56	53 36.675	04 42.843	53.61125	-4.71405	blank	blank
SOL	26/01/2010	NWA1 21	4	15:09	53 36.339	04 43.074	53.60565	-4.7179	74	problems with transmission of signal
EOL	26/01/2010	NWA1 21	4	15:11	53 36.339	04 43.074	53.60565	-4.7179	blank	blank

Appendix 3: Simplified SACFOR scale, developed by Seasearch

The 'SACFOR' Scale of Abundance

The Abundance scale is: **S**uper abundant **(S)**, **A**bundant **(A)**, **C**ommon **(C)**, **F**requent **(F)**, **O**ccasional **(O)**, **R**are **(R)**.

Several versions of the SACFOR abundance scale have been developed. During video analysis it is not possible to record abundance as accurately as, for instance, during the monitoring of species present within quadrats in the field. The simplified SACFOR scale, devised by 'Seasearch' (www.seasearch.org.uk/), is therefore recommended for use during video analysis:

Abundance	**Encrusting and turf species** e.g. encrusting algae/sponge, jewel anemones, hydroids, barnacles, mussels, seaweeds	**Small plants and animals (1-5cm)** e.g. worms, small sponges, anemones, cup-corals, shells, solitary sea squirts	**Large plants and animals (> 5cm)** e.g large sponges, sea fans and pens, large anemones, crabs and lobsters, starfish, fish,
Superabundant	80-100% cover	10,000 per m2	100 per m2
Abundant	40-80% cover	1000 per m2	10 per m2
Common	20-40% cover	100 per m2	1 per m2
Frequent	10-20% cover	10 per m2	1 per 10m2
Occasional	5-10% cover	1 per m2	1 per 100m2
Rare	< 5% cover	< 1 per m2	1 per 1000m2

Appendix 4: Rules to define *Modiolus* reef, used by marine ecological solutions for video analysis.

Rules used to Define live *Modiolus* Reef

SS.SBR.SMus.ModT / SS.SBR.SMus.ModMx

As a rough rule the following rules were applied to define live *Modiolus* 'reef':

1. Numbers of definite live *Modiolus* were counted in 1min subsections of video, which is thought to be a conservative underestimate when considering areas of Annex 1 subfeature of '*Modiolus* Reef'.

2. As not using % cover, the SACFOR scale for large animals (>5cm animals with more than 1/m2) was used to assign the SACFOR scale. In areas where video dropped out and we had no area data, the following rule was used: *Modiolus* counts SACFOR defined: Rare <2 *Modiolus* per 1min video, Occasional 2-5 *Modiolus* per 1 min video, Frequent 6-10 *Modiolus* per 1 min video, Common 11-15 *Modiolus* per 1min video, Abundant >15 *Modiolus* per 1 min video

3. Average SACFOR was calculated across the total tow

4 Where *Modiolus* was Common the biotope SS.SBR.SMus.ModT was assigned as certain per the attached standards sheet.

5. Where *Modiolus* was less than common, but certainly present and the reef had other proxies of live reef (i.e. blurred video and *Alcyonium* with curved edges where it is probably live and with associated epifauna including *Asterias*), the biotope was assigned as uncertain.

This should be in keeping with the OSPAR advice on reef being where *Modiolus* is 'Common' (although they use the %age scale, with a min percent cover of 30% being common).

Appendix 5: MES *Modiolus* video analysis methods.

CCW Modiolus Drop Down Video Analysis

Analysis Methodology

The contract is primarily interested in finding and quantifying live *Modiolus* beds off NW Anglesey. As a result, analysis will prioritise in the following order:

i. the counting of live *Modiolus* and *Alcyonium* colonies on **'consolidated'** *Modiolus* reef (see the categories and rules for count analysis in '*Modiolus* scoring trial.xls').

   a. 'consolidated' areas of shell gravel = empty/live shells almost imbricated, upright and, or, in hummocks, clumps or groups

ii. complete the same counts on **'unconsolidated'** areas of reef/shell gravel

   a. 'unconsolidated' areas of shell gravel = shells lying loosely/horizontally on the seabed, with little reef like form and few hummocks.

iii. Complete MNCR style habitat complex/biotope analysis on 1 and 2

iv. Complete MNCR style habitat complex/biotope analysis on other sections of transects taken.

This document guides the surveyor through the stages of analysis;

1. Choosing video sections for analysis – splitting the video into habitats/sections

2. Assessing density of *Modiolus* and *Alcyonium* on potential consolidated and unconsolidated reef.

3. Habitat classification

4. Data Entry

5. Quality Control

1. Choosing Video Sections for Analysis

As a result of the *Modiolus* priority, the video was first divided into sections. The following rules were applied to define the sections to be scored:

- The video was watched from the start and split into broad 'habitats' using time breaks. The edge of the habitats are difficult to spot, and require repeating several times to refine where the edge of the habitat is. Habitats could include

a mosaic of several biotopes. Each habitat is assigned a habitat code, and recorded in the '1 Modiolus_Metadata.xls' (listed per transect in the video transect metadata, and detailed further within Rough Habitat Metadata)

- Several habitats are possible:
    - Consolidated Modiolus reef
    - Unconsolidated shell gravel/reef
    - Other habitats (without shell gravel), to be assigned habitat numbers and defined later

2. Assessing density of *Modiolus* / *Alcyonium* on potential consolidated / unconsolidated reef

Recording proformas are provided in '2 Modiolus scoring proformas.xls', 'Count Data' worksheet.

For each habitat 'section' of suspected Modiolus habitats (using '1 Modiolus_Metadata.xls'), count the number of *Modiolus* and *Alcyonium* in the categories in Table 1. Any animal can only be counted ONCE. Additional rules for counting are provided in Table 1.

If the section is more than 1 minute long, separate the habitat 'section' into 1 minute sub-sections (1500 frames each @ 25 frames per second) until the end of the habitat. The last 'sub-section' of the habitat may be longer than 1500 frames to extend to the end of the habitat. The aim of this is to reduce surveyor fatigue and make counts on areas of lots of *Alcyonium* easier.

You may need to update *'1 Modiolus_Metadata.xls'* if changes are made to section starts / ends during the analysis. Keep a good record of habitats that have been scored using audit files in Modiolus Metadata (Habitat Progress Sheet).

Table 1. Categories used to estimate density of live Modiolus

Seabed type	***Alcyonium* features**
Alcyonium on dead *Modiolus* shells *Alcyonium* on live *Modiolus* *Alcyonium* on pebbles / cobbles / boulders *Alcyonium* on other / unknown substrata (could be live / dead shells))	To be counted, *Alcyonium* colonies must be >1cm in width / height, or have more than one large lobe / noble constituting the colony. Do not count small round single nobbles <1cm in diameter / height.
Alcyonium with a defined curved edge (could be on live *Modiolus)*	it is suspected that *Alcyonium* often grows on live *Modiolus* shells. Sometimes the live mussel itself is not evident, but instead the *Alcyonium* grows along the lip of the mussel, forming a well defined, clean 'curve'. These

Seabed type	*Alcyonium* features
	are two be counted separately, and when the colony is split with one half on each valve, the *Alcyonium* should be counted as one colony.
6…lcyonium* buried in sand	Following sand inundation / sand waves live *Alcyonium* is seen buried in sand. In an area of otherwise consolidated reef, these could be attached to live *Modiolus* and are therefore counted.
Rough *Alcyonium* count in blurred video	This is only a ROUGH count, to acknowledge that *Alcyonium* are present in large / small numbers of blurred video. The QA for this section is very rough – do surveyors agree to the same order of magnitude that Alcyonium is present in blurred sections?
All definite live *Modiolus* without *Alcyonium*.	only count if sure that it is live. Indications of live shells are two valves which may close when video is close, often with a pale yellow mantle and 2 siphons evident
Possible live *Modiolus* (without *Alcyonium,* as yet uncounted)	blank
Number of *Asterias*	blank

At the bottom of each count recording proforma, use the video QA fields to assess the quality of the sub-sections video. This will help assess the quality of recording too.

3. Habitat Classification
Use the Habitat Classification worksheet of ***'2 Modiolus scoring proformas.xls'***. Start by analysing the *Modiolus* habitats where counts have been done, and after these are complete undertake analysis of other habitats.

The aim of the habitat classification part of the survey is to ground-truth video and multi-beam data. In order to do this, the most basic data that needs be collected is that of substrate composition and the biota. Use the proforma to record this information for each section or sub-section of video (to accompany each section that has been counted).

Once this has been completed, use a combination of the JNCC Marine Habitat Classification Website (http://www.jncc.gov.uk/marine/biotopes/hierarchy.aspx), the JNCC physical and biological comparative tables to try to assign set biotopes / habitat complexes to each subsection. Due to lack of infaunal sampling, it is suspected that most habitats will only be assigned to Level 2 or 3.

4. Data Entry
Input data, plus any additional possible, into '3 Modiolus Data Entry.xls'.

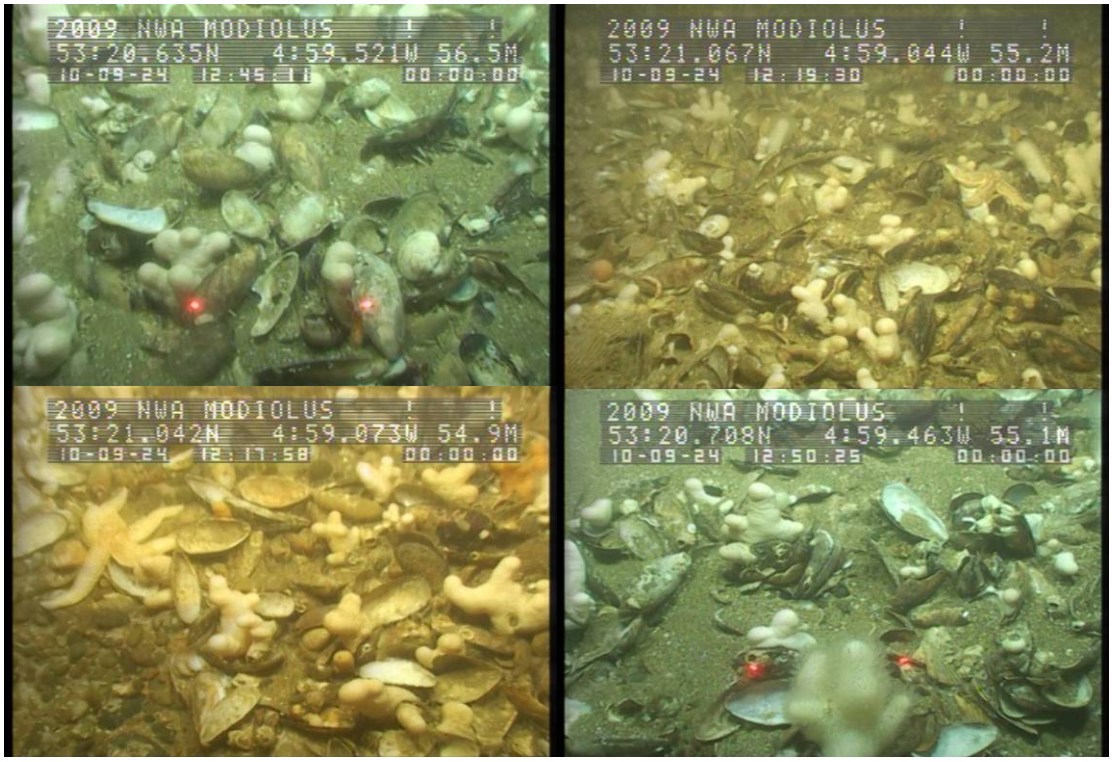
5. Quality Control

In the early stages of video scoring some QC was trialled between surveyors to ensure the method was robust and giving similar results between surveyor. It was found that short sub-sections video analysis were more consistent than longer sections, and that the main scoring categories were within 1 or 2 individuals between surveyors. Blurred video analysis was checked to ensure the same order of magnitude, as individual scores for this category were subjective and only designed to give an indication of areas not analysed by poor video.

1/10 of each habitat shall be re-analysed by surveyors. QC exercises throughout the analysis will highlight if one surveyor is consistently recording differently from another (ie: one may be consistently over estimating something). If completed regularly, the surveyor can correct / discuss their data. Overall the results of the QC will record the variability between recorders and be noted in the results prior to interpretation.

Appendix 6: Biotope standards sheets for the five biotopes identified by Marine Ecological Solutions

BIOTOPE STANDARDS SHEET
SS.SBR.SMus.ModT (changed to SS.SBR.SMus.ModMx)



Characterising features:

- *Modiolus* beds on mixed sediments.
- Stable due to binding effect of *Modiolus modiolus*.
- Rich conspicuous epifauna including *Alcyonium digitatum*.
- Biotope designated as areas with *M. modiolus* present with a consolidated sediment therefore allowing the establishment of rich epifauna.

Biotope Description (from Connor et al. 2004):

Modiolus beds on mixed substrata (cobbles, pebbles and coarse muddy sediments) in moderately strong currents or wave exposed areas, typically on the open coast but also in tide-swept channels of marine inlets. *Ophiothrix fragilis* are often common in this biotope along with the calcareous tubes of *Pomatoceros (Spirobranchus) triqueter*, anthozoans such as *Alcyonium digitatum* and *Urticina felina* and hydroids such as *Abietinaria abietina* and *Sertularia argentea*. Little information on the infaunal component is given here although it is likely that it is very rich and may highlight more

subtle differences in the *Modiolus* biotopes. This is the biotope we used to designate *Modiolus* reef.

Similar biotopes:

SS.SBR.SMus.ModMx. *Modiolus modiolus* beds on open coast circalittoral mixed sediment. There is a possibility the areas we defined as ModT could be this biotope. The main reason it was discounted is that ModMx does not have *Alcyonium* listed as a characterising species. This may just be as the biology of ModMx seems to be based more on infauna than epifauna, possibly a product of the different sampling methods used to define the two biotopes. This biotope is associated with a much more sandy environment.

SS.SMx.CMx. Similar substrates although CMx has more sand and less shells. Main difference is the biology with ModT having much greater % of *Alcyonium* and *Modiolus*.

SS.SMx.OMx. Slightly muddy gravely sand and stones or shell. No cobbles, boulder or shell (interestingly this IS noted in the description!) recorded on physical comparative tables, so generally finer sediments. This has no *Alcyonium*, *Asterias rubens* or *Echinus esculentus* but some Modiolus are noted. The biological description seems to have been based more on infauna.

SS.SCS.OCS (NB Undefined). Hard to say as no physical or biological data, but made up of coarse sands and gravel or shell. Also potentially has juvenile *Modiolus modiolus*.

SS.SBR.SMus.ModMx. *Modiolus modiolus* beds on open coast circalittoral mixed sediment. There is a possibility that it could be this biotope. The main reason it was discounted is that with this one, no *Alcyonium* is noted. This may just be as the biology of it seems to be based more on infauna than epifauna. This biotope is associated with a much more sandy environment.

Sections in which the biotope was found:

NWA2.2.1(1)
NWA2.2.1(2)
NWA2.2.1(3)
NWA2.2.1(4)
NWA2.2.2(1)
NWA2.3.2(2)
NWA2.3.2(3)
NWA2.3.2(4)
NWA2.3.2(5)
NWA2.3.2(6)
NWA2.3.2(7)
NWA2.3.2(8)
NWA2.3.2(9)
NWA2.3.2(10)
NWA2.3.2(11)

NWA2.3.2(12)
NWA2.3.2(13)
NWA2.3.2(14)
NWA2.3.2(15)
NWA2.3.2(16)
NWA2.3.2(17)
NWA2.3.2(18)
NWA2.3.2(19)
NWA2.3.2(20)
NWA2.4.3(8)
NWA2.4.3(9)
NWA2.4.4(1)
NWA2.4.4(2)
NWA2.4.4(3)
NWA2.4.4(4)
NWA2.8.6(1)
NWA2.8.8(1)
NWA2.8.8(2)
NWA2.8.8(2)
NWA2.8.8(3)
NWA2.8.8(4)
NWA2.8.8(5)
NWA2.8.8(6)
NWA2.8.8(7)
NWA2.8.8(8)
NWA2.8.8(9)
NWA2.8a.1(1)
NWA2.8a.1(2)
NWA2.8a.1(3)
NWA2.8a.1(4)
NWA2.8a.1(5)
NWA2.8a.1(6)
NWA2.8a.1(7)
NWA2.8a.1(8)
NWA2.8a.1(9)

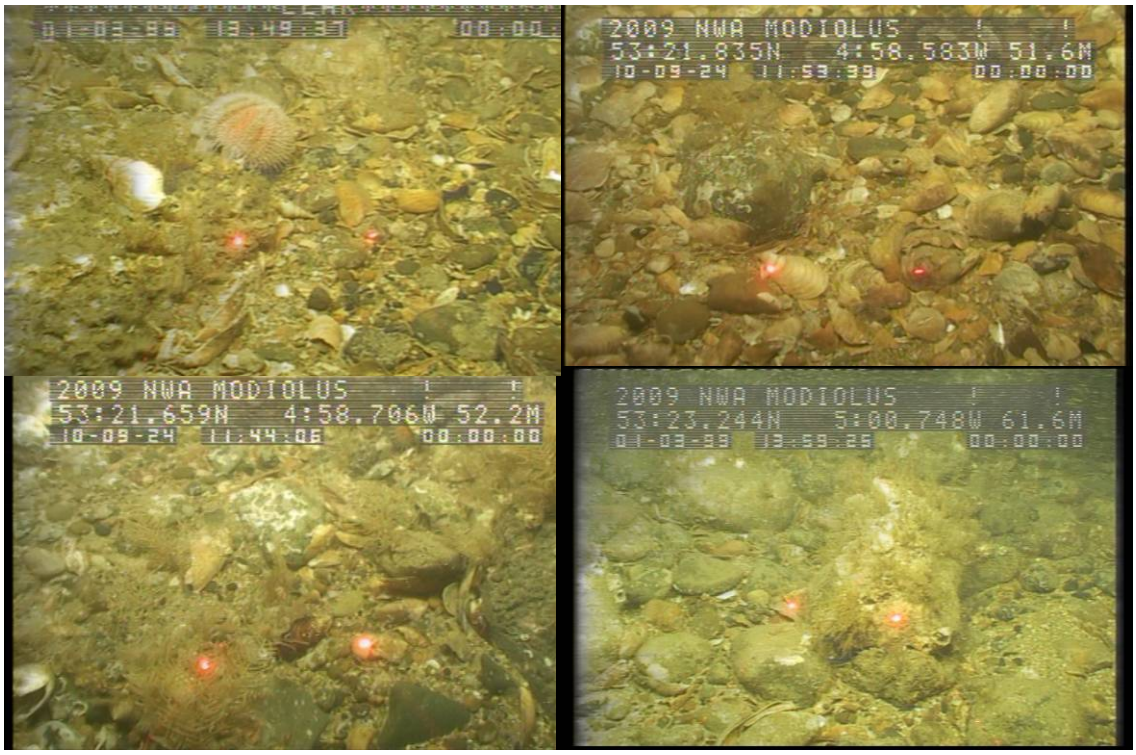
Typical Physical composition:

Physical feature	Percentage contribution to habitat
bedrock	1.33
boulders	2.91
cobbles	8.33
shells	42.12
pebbles	11.88
gravel	10.27
gravel (maerl)	0.33
sand	5.94
mud	11.88
artificial	4.24
other	0.76

Typical Species composition:

Taxa	Typical Abundance
Abietinaria abietina	F
Sertularia argentea	O
Alcyonium digitatum	C
Urticina felina	O
Pomatoceros triqueter	F
Balanus crenatus	F
Pagurus bernhardus	O
Buccinum undatum	O
Modiolus modiolus	A
Crossaster papposus	R
Asterias rubens	O
Ophiothrix fragilis	C
Ophiocomina nigra	F
Psammechinus miliaris	C
Echinus esculentus	O
Ciona intestinalis	R
Phycodrys rubens	C

BIOTOPE STANDARDS SHEET
SS.SMx.CMx



Characterising features:

- Well mixed mosaic of shell cobbles and pebbles lying in or on mud, sand or gravel.
- Hydroids present
- Species rich communities

Biotope Description:

Mixed (heterogeneous) sediment habitats including well mixed muddy gravely sands or very poorly sorted mosaics of shell, cobbles and pebbles embedded in or lying upon mud, sand or gravel. Due to the variable nature of the seabed a variety of communities can develop which are often very diverse. A wide range of infaunal polychaetes, bivalves, echinoderms and burrowing anemones are often present in such habitat and the presence of hard substrata (shells and stones) on the surface enables epifaunal species to become established, particularly hydroids such as *Nemertesia* spp and *Hydrallmania falcata*. The combination of epifauna and infauna can lead to species rich communities. This biotope was the most commonly designated in this dataset (whilst analysing areas of potential *Modiolus* reef NW of Anglesey).

Similar biotopes:

SS.SMx.OMx. Slightly muddy gravely sand and stones or shell. No cobbles, boulder or shell (interestingly this IS noted in the description!) recorded on physical comparative tables, so generally finer sediments. This has no *Alcyonium*, *Asterias rubens* or *Echinus esculentus*. The biological description seems to have been done more on infauna.

SS.SCS.OCS (NB Undefined). Hard to say as no physical or biological data, but made up of coarse sands and gravel or shell, so finer sediments. Also potentially has juvenile *Modiolus modiolus*.

SS.SCS.CCS. Coarse sands, gravel and shingle. Although physical comparative tables are similar, there is more gravel and sand – so finer sediments (also slightly less shells). The biology is similar too although there is no *Alcyonium* and generally less epifauna.

SS.SCS.CCS.PomB. Generally slightly coarser sediments mainly cobbles and pebbles rather than sand and gravel but similar. Main difference is that PomB is relatively barren of life due to scour so main species are Barnacles and *Pomatoceros (Spirobranchus)* although some (mainly mobile) epifauna noted, no *Alcyonium.*

Samples in which the biotope was found:

NWA2.1.2
NWA2.1.2.1
NWA2.1.3
NWA2.1.4
NWA2.1.4.1
NWA2.1.5(1)
NWA2.1.5(2)
NWA2.1.6
NWA2.1.7(1)
NWA2.1.7(2)
NWA2.1.8(1)
NWA2.2.2(2)
NWA2.2.2(3)
NWA2.3.1(1)
NWA2.3.1(2)
NWA2.3.1(3)
NWA2.3.2(1)
NWA2.4.1(1)
NWA2.4.1(2)
NWA2.4.2(1)
NWA2.4.2(2)
NWA2.4.3(1)
NWA2.4.3(2)
NWA2.4.3(3)
NWA2.4.3(4)
NWA2.4.3(5)
NWA2.4.3(6)
NWA2.4.3(7)

NWA2.4.3(8)
NWA2.4.3(9)
NWA2.4.4(2)
NWA2.4.4(3)
NWA2.4.4(4)
NWA2.7.1(1)
NWA2.7.1(10)
NWA2.7.1(11)
NWA2.7.1(12)
NWA2.7.1(13)
NWA2.7.1(2)
NWA2.7.1(3)
NWA2.7.1(4)
NWA2.7.1(5)
NWA2.7.1(6)
NWA2.7.1(7)
NWA2.7.1(8)
NWA2.7.1(9)
NWA2.8.1(1)
NWA2.8.2(1)
NWA2.8.2(2)
NWA2.8.2(2)
NWA2.8.3(1)
NWA2.8.3(2)
NWA2.8.3(3)
NWA2.8.3(4)
NWA2.8.3(5)
NWA2.8.3(6)
NWA2.8.3(7)
NWA2.8.3(8)
NWA2.8.3(9)
NWA2.8.4(1)
NWA2.8.5(1)
NWA2.8.5(2)
NWA2.8.6(1)
NWA2.8.7(1)
NWA2.8.7(2)
NWA2.8.7(3)
NWA2.8.8(1)
NWA2.8.8(2)
NWA2.8.8(2)
NWA2.8.8(3)
NWA2.8.8(4)
NWA2.8.8(5)
NWA2.8.8(6)
NWA2.8.8(7)
NWA2.8.8(8)
NWA2.8.8(9)
NWA2.8a.1(1)
NWA2.8a.1(2)
NWA2.8a.1(3)
NWA2.8a.1(4)
NWA2.8a.1(5)
NWA2.8a.1(6)

NWA2.8a.1(7)
NWA2.8a.1(8)
NWA2.8a.1(9)
NWA2.8a.2(1)
NWA2.8a.2(2)
NWA2.8a.2(3)
NWA2.8a.2(4)
NWA2.8a.3
NWA2.8a.4
NWA2.10.1
NWA2.10.2
NWA2.10.4
NWA2.10.5
NWA2.10.6
NWA2.10.9
NWA2.11.1
NWA2.11.2.1
NWA2.11.2.2
NWA2.11.2.3
NWA2.11.2.4
NWA2.11.2.5
NWA2.13.2.1
NWA2.13.2.2
NWA2.13.2.3
NWA2.13.3.2
NWA2.14.2
NWA2.16.1
NWA2.16.2
NWA2.16.3
NWA2.16.6
NWA2.18.1
NWA2.18.2
NWA2.18.3
NWA2.18.4

Typical Physical composition:

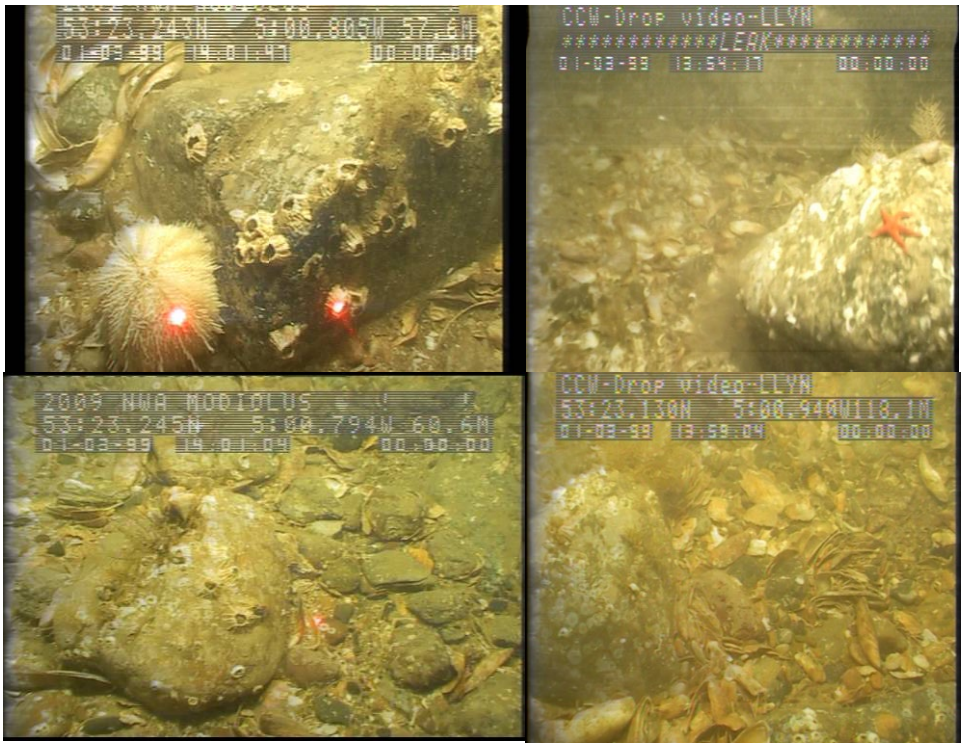
Physical feature	Percentage contribution to habitat
bedrock	0.13
boulders	4.5
cobbles	10.83
shells	5.64
pebbles	12.21
gravel	21.97
gravel (maerl)	1.18
sand	23.03
mud	19.97
artificial	0.11
other	0.42

Typical Species composition:

Taxa	Typical Abundance
Hydrallmania falcata	O
Nemertesia antennina	O
Nemertesia ramosa	O
Alcyonium digitatum	O
Cerianthus lloydii	F
Urticina felina	O
Nemertea	C
Nematoda	F
Pholoe inornata	F
Glycera alba	A
Goniada maculata	C
Nephtys	C
Nephtys hombergii	C
Lumbrineris gracilis	C
Scoloplos armiger	A
Levinsenia gracilis	C
Prionospio fallax	A
Spiophanes bombyx	F
Chaetozone setosa	C
Mediomastus fragilis	C
Scalibregma inflatum	C
Galathowenia oculata	F
Owenia fusiformis	C
Terebellides stroemi	A
Terebellidae	O
Lanice conchilega	O
Pomatoceros triqueter	O
Ampelisca tenuicornis	F

Taxa	Typical Abundance
Eudorella truncatula	A
Pagurus bernhardus	O
Liocarcinus depurator	O
Buccinum undatum	O
Modiolus modiolus	O
Pecten maximus	O
Thyasira flexuosa	C
Mysella bidentata	F
Phaxas pellucidus	C
Abra alba	C
Chamelea gallina	C
Flustra foliacea	O
Phoronis	C
Crossaster papposus	R
Asterias rubens	O
Ophiothrix fragilis	C
Ophiocomina nigra	F
Amphiura filiformis	A
Ophiura albida	F
Echinus esculentus	O
Psolus phantapus	O
Thyone fusus	O
Corallinaceae	O

BIOTOPE STANDARDS SHEET
SS.SMx.CMx.FluHyd



Characterising features:

- Hydroids such as *Flustra foliacea* common (although we didn't actually see *Flustra foliacea*.
- Can occur on coarser sediments such as boulders.
- Similar to SS.SCS.CCS.PomB but hosts more fauna.

Biotope Description:

This biotope represents part of a transition between sand-scoured circalittoral rock where the epifauna is conspicuous enough to be considered a biotope. *Flustra foliacea* (although not actually recorded in these samples) and the hydroid *Hydrallmania falcata* characterise this biotope; lesser amounts of other hydroids such as *Sertularia argentea*, *Nemertesia antennina* and occasionally *Nemertesia ramosa*, occur where suitably stable hard substrata is found. The anemone *Urticina felina* and the soft coral *Alcyonium digitatum* may also characterise this biotope. Barnacles *Balanus crenatus* and tube worms *Pomatoceros (Spirobranchus) triqueter* may be present and the robust bryozoans may appear amongst the hydroids at a few sites. This was designated on similar habitats to PomB but where there was more epifauna.

Similar biotopes:

SS.SCS.CCS.PomB. Similar coarse sediments. Main difference is that PomB is relatively barren of life due to scour so main species are Barnacles and *Pomatoceros (Spirobranchus)* although some (mainly mobile) epifauna noted, no *Alcyonium.*

SS.SMx.CMx. The FluHyd biotopes could probably also be designated as CMx. The main difference is that there is a greater amount of finer sediments in CMx with FluHyd having a greater percentage of cobbles and boulders. CMx also has a greater diversity of fauna.

Samples in which the biotope was found:

NWA2.10.2
NWA2.10.6
NWA2.10.9
NWA2.16.5

Typical Physical composition:

Physical feature	Percentage contribution to habitat
bedrock	0.3
boulders	10.12
cobbles	20.68
shells	7.12
pebbles	17.9
gravel	21.86
gravel (maerl)	0.21
sand	19.44
mud	2.22
artificial	0
other	0.14

Typical Species composition:

Taxa	Typical Abundance
Halecium halecinum	O
Hydrallmania falcata	O
Sertularia argentea	O
Nemertesia antennina	O
Nemertesia ramosa	O
Alcyonium digitatum	O
Urticina felina	O
Pomatoceros triqueter	O
Balanus crenatus	F
Pagurus bernhardus	O
Alcyonidium diaphanum	O
Vesicularia spinosa	F
Flustra foliacea	F
Crossaster papposus	O
Asterias rubens	O

BIOTOPE STANDARDS SHEET
SS.SCS.CCS

Characterising features:

- Sand, gravel, shingle or shell.
- May have bivalves and mobile crustacea.

Biotope Description:
Tide-swept circalittoral coarse sands, gravel and shingle generally in depths of over 15-20m. This habitat may be found in tidal channels of marine inlets, along exposed coasts and offshore. This habitat, as with shallower coarse sediments, may be characterised by robust infaunal polychaetes, mobile crustacea and bivalves. *Alcyonium* is not recorded. This has been designated on generally sandy areas and also on areas which are bands of empty *Modiolus* shell, both of which habitats have a sparse epifauna.

Similar biotopes:
SS.SMx.OMx. Slightly muddy gravely sand and stones or shell. No cobbles, boulder or shell (interestingly this IS noted in the description!) recorded on physical comparative tables, so generally finer sediments. This has no *Alcyonium*, *Asterias rubens* or *Echinus esculentus*. The biological description seems to have been done more on infauna. Could easily have been OMx when records biotoped as CCS, but was ruled out on the strength of there being no shell in the physical comparative table, although this could be wrong.
SS.SMx.CMx. Could probably also be designated as CMx. The main difference is that there is a greater amount of sand and gravel in CCS with CMx having coarser sediments. Probably due to these coarser sediments, CMx has a richer epifauna.
SS.SCS.OCS (NB Undefined). Hard to say as no physical or biological data, but made up of coarse sands and gravel or shell. Also potentially has juvenile *Modiolus modiolus*.
SS.SCS.CCS.PomB. Generally coarser sediments mainly cobbles and pebbles rather than sand and gravel but similar. Main difference is that PomB is relatively barren of life due to scour

so main species are Barnacles and *Pomatoceros (Spirobranchus)* although some (mainly mobile) epifauna noted, no *Alcyonium.*

Samples in which the biotope was found:

NWA2.6.1(1)
NWA2.6.1(10)
NWA2.6.1(2)
NWA2.6.1(3)
NWA2.6.1(4)
NWA2.6.1(5)
NWA2.6.1(6)
NWA2.6.1(7)
NWA2.6.1(8)
NWA2.6.1(9)
NWA2.6.2(1)
NWA2.6.2(10)
NWA2.6.2(11)
NWA2.6.2(12)
NWA2.6.2(2)
NWA2.6.2(3)
NWA2.6.2(4)
NWA2.6.2(5)
NWA2.6.2(6)
NWA2.6.2(7)
NWA2.6.2(8)
NWA2.6.2(9)
NWA2.6.1(1)
NWA2.6.1(2)
NWA2.6.1(3)
NWA2.6.1(4)
NWA2.6.1(5)
NWA2.6.1(6)
NWA2.6.1(7)
NWA2.6.1(8)
NWA2.6.1(9)
NWA2.6.1(10)
NWA2.6.2(1)
NWA2.6.2(2)
NWA2.6.2(3)
NWA2.6.2(4)
NWA2.6.2(5)
NWA2.6.2(6)
NWA2.6.2(7)
NWA2.6.2(8)
NWA2.6.2(9)
NWA2.6.2(10)
NWA2.6.2(11)
NWA2.6.2(12)
NWA2.10.3
NWA2.10.8
NWA2.11.1
NWA2.11.3
NWA2.13.3.1

NWA2.14.1
NWA2.15.1
NWA2.16.1
NWA2.16.4
NWA2.18.5
NWA2.18.2
NWA2.18.3

Typical Physical composition:

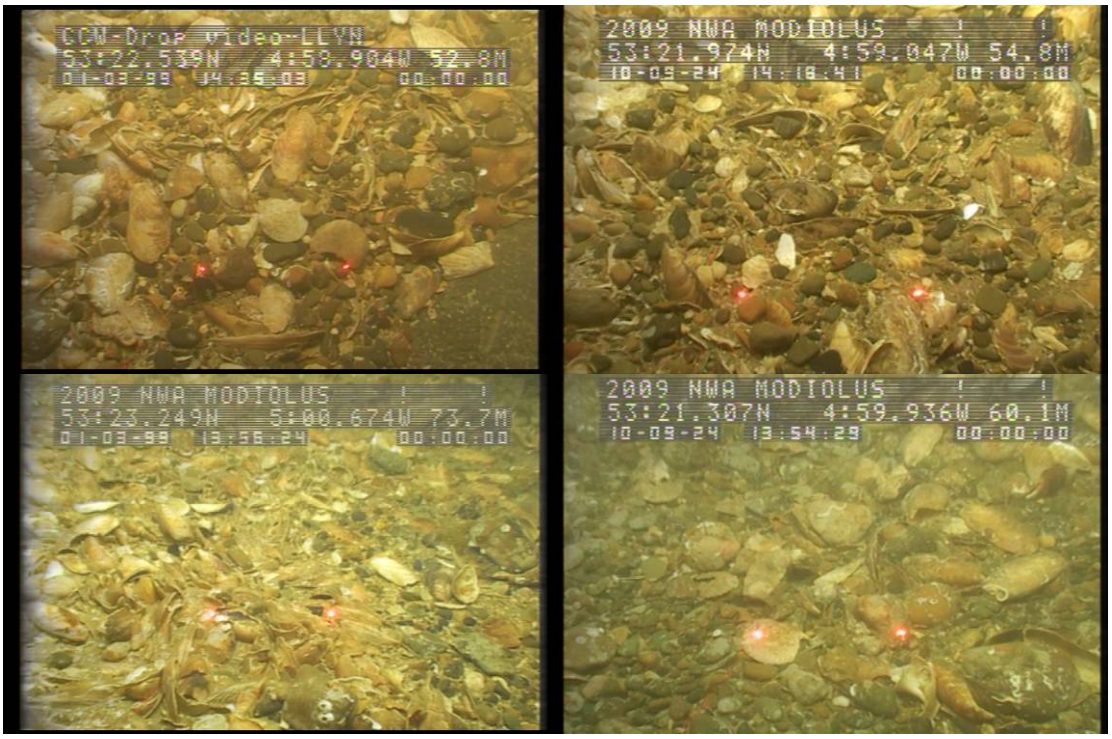
Physical feature	Percentage contribution to habitat
bedrock	0.11
boulders	3.21
cobbles	6.31
shells	2.26
pebbles	8.34
gravel	39.46
gravel (maerl)	2.66
sand	34.24
mud	2.64
artificial	0.55
other	0.22

Typical Species composition:

Taxa	Typical Abundance
Nemertesia antennina	O
Cerianthus lloydii	O
Nemertea	C
Nematoda	P
Pholoe synophthalmica	P
Hesionura elongata	P
Glycera lapidum	F
Nereis longissima	P
Lumbrineris gracilis	C
Protodorvillea kefersteini	P
Scoloplos armiger	P
Minuspio cirrifera	P
Spiophanes bombyx	F
Chaetopterus variopedatus	O
Caulleriella zetlandica	P
Mediomastus fragilis	P
Notomastus latericeus	P
Owenia fusiformis	P
Sabellaria spinulosa	P
Terebellidae	P
Lanice conchilega	O
Lanice conchilega	P
Pomatoceros triqueter	F
Ampelisca spinipes	F
Pagurus bernhardus	O
Pecten maximus	O
Abra alba	F
Asterias rubens	O
Ophiura albida	F

Taxa	Typical Abundance
Echinus esculentus	O
Echinocyamus pusillus	C
Neopentadactyla mixta	F

BIOTOPE STANDARDS SHEET
SS.SCS.CCS.PomB



Characterising features:

- Mainly cobbles and pebbles.
- Highly scoured
- No fragile species dominated by *Pomatoceros (Spirobranchus)* and *Balanus*.

Biotope Description:

This biotope is characterised by a few ubiquitous robust and/or fast growing ephemeral species which are able to colonise pebbles and unstable cobbles and slates which are regularly moved by wave and tidal action. The main cover organisms tend to be restricted to calcareous tube worms such as *Pomatoceros (Spirobranchus) triqueter*, small barnacles including *Balanus crenatus* and *Balanus balanus*, and a few bryozoan and coralline algal crusts. Scour action from the mobile substratum prevents colonisation by more delicate species. Occasionally in tide-swept conditions tufts of hydroids such as *Sertularia argentea* and *Hydrallmania falcata* are present. This biotope often grades into SMX.FluHyd which is characterised by large amounts of the above hydroids on stones also covered in *Pomatoceros (Spirobranchus)* and barnacles. The main difference here is that SMX.FluHyd, seems to develop on more stable, consolidated cobbles and pebbles or larger stones set in sediment in moderate tides. These stones may be disturbed in the winter and therefore long-lived and fragile species are not found. PomB had been designated on generally pebbly and cobbly

habitats which are occasionally embedded but in all cases have a very sparse epifauna.

Similar biotopes:

SMX.FluHyd. The main difference here is that SMX.FluHyd, seems to develop on more stable, consolidated cobbles and pebbles or larger stones set in sediment. *Flustra foliacea* and other hydroids are the characterising species and *Alcyonium* can occur.

SS.SMx.OMx. Slightly muddy gravely sand and stones or shell. No cobbles, boulder or shell (interestingly this IS noted in the description!) recorded on physical comparative tables, so generally finer sediments. OMx has richer fauna.

SS.SMx.CMx. Similar substrates although CMx is slightly finer. Main difference is the biology with CMx having more fauna.

SS.SCS.OCS (NB Undefined). Hard to say as no physical or biological data, but made up of coarse sands and gravel or shell, so finer sediments. Also potentially has juvenile *Modiolus modiolus*. OCS is likely to have a richer fauna.

SS.SCS.CCS. Coarse sands, gravel and shingle, similar but with more gravel and sand – so finer. CCS has a richer fauna.

Samples in which the biotope was found:

NWA2.1.1
NWA2.4.2(3)
NWA2.4.3(1)
NWA2.4.3(3)
NWA2.4.3(4)
NWA2.4.3(5)
NWA2.4.3(6)
NWA2.4.3(7)
NWA2.5.1(1)
NWA2.5.1(10)
NWA2.5.1(11)
NWA2.5.1(12)
NWA2.5.1(13)
NWA2.5.1(14)
NWA2.5.1(15)
NWA2.5.1(16)
NWA2.5.1(17)
NWA2.5.1(18)
NWA2.5.1(19)
NWA2.5.1(2)
NWA2.5.1(20)

NWA2.5.1(3)
NWA2.5.1(4)
NWA2.5.1(5)
NWA2.5.1(6)
NWA2.5.1(7)
NWA2.5.1(8)
NWA2.5.1(9)
NWA2.10.7
NWA2.13.1
NWA2.15.1
NWA2.18.4

Typical Physical composition:

Physical feature	Percentage contribution to habitat
bedrock	0
boulders	12.65
cobbles	22.47
shells	0.88
pebbles	27.18
gravel	18.12
gravel (maerl)	0
sand	18.71
mud	0
artificial	0
other	0

Typical Species composition:

Taxa	Typical Abundance
Lanice conchilega	O
Pomatoceros	C
Pomatoceros triqueter	F
Balanus balanus	O
Balanus crenatus	F
Bryozoa indet crusts	F
Asterias rubens	O
Echinus esculentus	O

Appendix 7: Analysis of *Modiolus* presence

Station ID	Hab Code	Video Line No.	Video Section No.	Visual quality of sample (See video quality analysis below; poor = <55% /moderate 55-75% /good = 76-100%)
NWA2.1	**NWA2.1.2**	NWA2.1	NWA2.1.2	moderate
NWA2.1	**NWA2.1.2.1**	NWA2.1	NWA2.1.2.1	moderate
NWA2.1	**NWA2.1.4**	NWA2.1	NWA2.1.4	moderate
NWA2.1	**NWA2.1.4.1**	NWA2.1	NWA2.1.4.1	moderate
NWA2.1	**NWA2.1.6**	NWA2.1	NWA2.1.6	moderate
NWA2.1	**NWA2.1.6**	NWA2.1	NWA2.1.6	moderate
NWA2.1	**NWA2.1.8 (1)**	NWA2.1	NWA2.1.8 (1)	moderate
NWA2.2	**NWA2.2.1 (1)**	NWA2.2	NWA2.2.1 (1)	moderate
NWA2.2	**NWA2.2.1 (2)**	NWA2.2	NWA2.2.1 (2)	moderate
NWA2.2	**NWA2.2.1 (3)**	NWA2.2	NWA2.2.1 (3)	moderate
NWA2.2	**NWA2.2.1 (4)**	NWA2.2	NWA2.2.1 (4)	moderate
NWA2.2	**NWA2.2.1 (4)**	NWA2.2	NWA2.2.1 (4)	moderate
NWA2.2	**NWA2.2.2 (1)**	NWA2.2	NWA2.2.2 (1)	poor
NWA2.3	**NWA2.3.2 (1)**	NWA2.3	NWA2.3.2 (1)	moderate
NWA2.3	**NWA2.3.2 (2)**	NWA2.3	NWA2.3.2 (2)	moderate
NWA2.3	**NWA2.3.2 (3)**	NWA2.3	NWA2.3.2 (3)	poor
NWA2.3	**NWA2.3.2 (4)**	NWA2.3	NWA2.3.2 (4)	poor
NWA2.3	**NWA2.3.2 (4)**	NWA2.3	NWA2.3.2 (4)	poor
NWA2.3	**NWA2.3.2 (5)**	NWA2.3	NWA2.3.2 (5)	moderate

Station ID	Hab Code	Video Line No.	Video Section No.	Visual quality of sample (See video quality analysis below; poor = <55% /moderate 55-75% /good = 76-100%)
NWA2.3	**NWA2.3.2 (6)**	NWA2.3	NWA2.3.2 (6)	moderate
NWA2.3	**NWA2.3.2 (7)**	NWA2.3	NWA2.3.2 (7)	moderate
NWA2.3	**NWA2.3.2 (8)**	NWA2.3	NWA2.3.2 (8)	moderate
NWA2.3	**NWA2.3.2 (9)**	NWA2.3	NWA2.3.2 (9)	moderate
NWA2.3	**NWA2.3.2 (10)**	NWA2.3	NWA2.3.2 (10)	moderate
NWA2.3	**NWA2.3.2 (11)**	NWA2.3	NWA2.3.2 (11)	moderate
NWA2.3	**NWA2.3.2 (11)**	NWA2.3	NWA2.3.2 (11)	moderate
NWA2.3	**NWA2.3.2 (12)**	NWA2.3	NWA2.3.2 (12)	moderate
NWA2.3	**NWA2.3.2 (13)**	NWA2.3	NWA2.3.2 (13)	moderate
NWA2.3	**NWA2.3.2 (14)**	NWA2.3	NWA2.3.2 (14)	moderate
NWA2.3	**NWA2.3.2 (15)**	NWA2.3	NWA2.3.2 (15)	moderate
NWA2.3	**NWA2.3.2 (16)**	NWA2.3	NWA2.3.2 (16)	moderate
NWA2.3	**NWA2.3.2 (17)**	NWA2.3	NWA2.3.2 (17)	moderate
NWA2.3	**NWA2.3.2 (18)**	NWA2.3	NWA2.3.2 (18)	moderate
NWA2.3	**NWA2.3.2 (19)**	NWA2.3	NWA2.3.2 (19)	moderate
NWA2.3	**NWA2.3.2 (20)**	NWA2.3	NWA2.3.2 (20)	moderate
NWA2.4	**NWA2.4.2 (1)**	NWA2.4	NWA2.4.2 (1)	good
NWA2.4	**NWA2.4.2 (2)**	NWA2.4	NWA2.4.2 (2)	good
NWA2.4	**NWA2.4.2 (3)**	NWA2.4	NWA2.4.2 (3)	good
NWA2.4	**NWA2.4.3 (1)**	NWA2.4	NWA2.4.3 (1)	good
NWA2.4	**NWA2.4.3 (2)**	NWA2.4	NWA2.4.3 (2)	good
NWA2.4	**NWA2.4.3 (3)**	NWA2.4	NWA2.4.3 (3)	good
NWA2.4	**NWA2.4.3 (4)**	NWA2.4	NWA2.4.3 (4)	good
NWA2.4	**NWA2.4.3 (5)**	NWA2.4	NWA2.4.3 (5)	good
NWA2.4	**NWA2.4.3 (6)**	NWA2.4	NWA2.4.3 (6)	good
NWA2.4	**NWA2.4.3 (7)**	NWA2.4	NWA2.4.3 (7)	good

Station ID	Hab Code	Video Line No.	Video Section No.	Visual quality of sample (See video quality analysis below; poor = <55% /moderate 55-75% /good = 76-100%)
NWA2.4	**NWA2.4.3 (7)**	NWA2.4	NWA2.4.3 (7)	blank
NWA2.4	**NWA2.4.3 (8)**	NWA2.4	NWA2.4.3 (8)	good
NWA2.4	**NWA2.4.3 (9)**	NWA2.4	NWA2.4.3 (9)	good
NWA2.4	**NWA2.4.4 (1)**	NWA2.4	NWA2.4.4 (1)	good
NWA2.4	**NWA2.4.4 (2)**	NWA2.4	NWA2.4.4 (2)	good
NWA2.4	**NWA2.4.4 (3)**	NWA2.4	NWA2.4.4 (3)	good
NWA2.4	**NWA2.4.4 (4)**	NWA2.4	NWA2.4.4 (4)	good
NWA2.5	**NWA2.5.1 (1)**	NWA2.5	NWA2.5.1 (1)	poor
NWA2.5	**NWA2.5.1 (2)**	NWA2.5	NWA2.5.1 (2)	good
NWA2.5	**NWA2.5.1 (3)**	NWA2.5	NWA2.5.1 (3)	good
NWA2.5	**NWA2.5.1 (4)**	NWA2.5	NWA2.5.1 (4)	good
NWA2.5	**NWA2.5.1 (5)**	NWA2.5	NWA2.5.1 (5)	good
NWA2.5	**NWA2.5.1 (6)**	NWA2.5	NWA2.5.1 (6)	good
NWA2.5	**NWA2.5.1 (7)**	NWA2.5	NWA2.5.1 (7)	good
NWA2.5	**NWA2.5.1 (8)**	NWA2.5	NWA2.5.1 (8)	good
NWA2.5	**NWA2.5.1 (9)**	NWA2.5	NWA2.5.1 (9)	good
NWA2.5	**NWA2.5.1 (10)**	NWA2.5	NWA2.5.1 (10)	good
NWA2.5	**NWA2.5.1 (11)**	NWA2.5	NWA2.5.1 (11)	good
NWA2.5	**NWA2.5.1 (12)**	NWA2.5	NWA2.5.1 (12)	good
NWA2.5	**NWA2.5.1 (13)**	NWA2.5	NWA2.5.1 (13)	good
NWA2.5	**NWA2.5.1 (14)**	NWA2.5	NWA2.5.1 (14)	good
NWA2.5	**NWA2.5.1 (15)**	NWA2.5	NWA2.5.1 (15)	good
NWA2.5	**NWA2.5.1 (16)**	NWA2.5	NWA2.5.1 (16)	good
NWA2.5	**NWA2.5.1 (17)**	NWA2.5	NWA2.5.1 (17)	good
NWA2.5	**NWA2.5.1 (18)**	NWA2.5	NWA2.5.1 (18)	good
NWA2.5	**NWA2.5.1 (19)**	NWA2.5	NWA2.5.1 (19)	good
NWA2.5	**NWA2.5.1 (20)**	NWA2.5	NWA2.5.1 (20)	good

Station ID	Hab Code	Video Line No.	Video Section No.	Visual quality of sample (See video quality analysis below; poor = <55% /moderate 55-75% /good = 76-100%)
NWA2.8	**NWA2.8.2 (1)**	NWA2.8	NWA2.8.2 (1)	moderate
NWA2.8	**NWA2.8.2 (2)**	NWA2.8	NWA2.8.2 (2)	moderate
NWA2.8	**NWA2.8.2 (2)**	NWA2.8	NWA2.8.2 (2)	moderate
NWA2.8	**NWA2.8.4 (1)**	NWA2.8	NWA2.8.4 (1)	moderate
NWA2.8	**NWA2.8.6 (1)**	NWA2.8	NWA2.8.6 (1)	moderate
NWA2.8	**NWA2.8.8 (1)**	NWA2.8	NWA2.8.8 (1)	moderate
NWA2.8	**NWA2.8.8 (2)**	NWA2.8	NWA2.8.8 (2)	moderate
NWA2.8	**NWA2.8.8 (2)**	NWA2.8	NWA2.8.8 (2)	moderate
NWA2.8	**NWA2.8.8 (3)**	NWA2.8	NWA2.8.8 (3)	moderate
NWA2.8	**NWA2.8.8 (4)**	NWA2.8	NWA2.8.8 (4)	moderate
NWA2.8	**NWA2.8.8 (5)**	NWA2.8	NWA2.8.8 (5)	moderate
NWA2.8	**NWA2.8.8 (6)**	NWA2.8	NWA2.8.8 (6)	moderate
NWA2.8	**NWA2.8.8 (7)**	NWA2.8	NWA2.8.8 (7)	moderate
NWA2.8	**NWA2.8.8 (8)**	NWA2.8	NWA2.8.8 (8)	moderate
NWA2.8	**NWA2.8.8 (9)**	NWA2.8	NWA2.8.8 (9)	moderate
NWA2.8a	**NWA2.8a.1 (1)**	NWA2.8a	NWA2.8a.1 (1)	good
NWA2.8a	**NWA2.8A.1 (1)**	NWA2.8a	NWA2.8A.1 (1)	Blank
NWA2.8a	**NWA2.8a.1 (2)**	NWA2.8a	NWA2.8a.1 (2)	Good
NWA2.8a	**NWA2.8A.1 (2)**	NWA2.8a	NWA2.8A.1 (2)	blank
NWA2.8a	**NWA2.8a.1 (3)**	NWA2.8a	NWA2.8a.1 (3)	good
NWA2.8a	**NWA2.8A.1 (3)**	NWA2.8a	NWA2.8A.1 (3)	Blank
NWA2.8a	**NWA2.8a.1 (4)**	NWA2.8a	NWA2.8a.1 (4)	good
NWA2.8a	**NWA2.8A.1 (4)**	NWA2.8a	NWA2.8A.1 (4)	Blank
NWA2.8a	**NWA2.8a.1 (5)**	NWA2.8a	NWA2.8a.1 (5)	good
NWA2.8a	**NWA2.8A.1 (5)**	NWA2.8a	NWA2.8A.1 (5)	
NWA2.8a	**NWA2.8a.1 (6)**	NWA2.8a	NWA2.8a.1 (6)	good
NWA2.8a	**NWA2.8a.1 (7)**	NWA2.8a	NWA2.8a.1 (7)	good

Station ID	Hab Code	Video Line No.	Video Section No.	Visual quality of sample (See video quality analysis below; poor = <55% /moderate 55-75% /good = 76-100%)
NWA2.8a	**NWA2.8a.1 (8)**	NWA2.8a	NWA2.8a.1 (8)	good
NWA2.8a	**NWA2.8a.1 (9)**	NWA2.8a	NWA2.8a.1 (9)	good
NWA2.8a	**NWA2.8a.4**	NWA2.8a	NWA2.8a.4	good

Hab code	*Alcyonium* on dead Modiolus shells	*Alcyonium* on live Modiolus	*Alcyonium* on pebbles / cobbles / boulders	*Alcyonium* on other / unknown substrata	*Alcyonium* with a defined curved edge (could be on live *Modiolus)*	*Alcyonium* buried in sand	Rough *Alcyonium* count in blurred video	All definite live *Modiolus* without *Alcyonium*.	Possible live *Modiolus* (withough *Alcyonium,* as yet uncounted)	Number of Asterias
NWA2.1.2	blank	blank	blank	blank	blank	blank	4	blank	blank	blank
NWA2.1.2.1	1	blank	8	1	blank	blank	18	blank	blank	2
NWA2.1.4	blank	blank	6	8	blank	blank	1	blank	blank	11
NWA2.1.4.1	blank	blank	3	16	blank	blank	33	blank	blank	2
NWA2.1.6	blank	blank	2	8	blank	blank	9	blank	blank	4
NWA2.1.6	blank	blank	2	5	blank	blank	15	blank	1	4
NWA2.1.8 (1)	1	blank	blank	blank	blank	blank	blank	blank	blank	1
NWA2.2.1 (1)	1	2	20	79	6	blank	90	blank	blank	7
NWA2.2.1 (2)	1	blank	blank	95	6	blank	502	blank	blank	6
NWA2.2.1 (3)	7	blank	23	144	2	blank	450	blank	blank	blank
NWA2.2.1 (4)	16	blank	42	90	2	blank	296	blank	blank	10
NWA2.2.1 (4)	3	2	12	186	8	blank	251	blank	blank	9
NWA2.2.2 (1)	blank	blank	5	blank	blank	blank	3	blank	blank	5
NWA2.3.2 (1)	blank	blank	3	26	blank	blank	31	blank	blank	blank
NWA2.3.2 (2)	blank	blank	3	25	1	1	17	blank	blank	1
NWA2.3.2 (3)	blank	blank	4	45	blank	blank	94	blank	blank	blank
NWA2.3.2 (4)	blank	2	5	96	7	6	225	blank	1	2
NWA2.3.2	3	1	4	39	3	5	78	blank	4	1

Hab code	*Alcyonium* on dead Modiolus shells	*Alcyonium* on live Modiolus	*Alcyonium* on pebbles / cobbles / boulders	*Alcyonium* on other / unknown substrata	*Alcyonium* with a defined curved edge (could be on live *Modiolus)*	*Alcyonium* buried in sand	Rough *Alcyonium* count in blurred video	All definite live *Modiolus* without *Alcyonium*.	Possible live *Modiolus* (withough *Alcyonium,* as yet uncounted)	Number of Asterias
(4)										
NWA2.3.2 (5)	4	blank	6	139	5	13	193	blank	blank	4
NWA2.3.2 (6)	1	blank	8	84	1	18	178	blank	blank	
NWA2.3.2 (7)	10	blank	5	136	1	91	190	blank	blank	3
NWA2.3.2 (8)	26	blank	4	193	blank	89	182	blank	2	1
NWA2.3.2 (9)	45	2	12	256	1	97	468	blank	blank	2
NWA2.3.2 (10)	46	4	4	114	3	6	129	blank	blank	blank
NWA2.3.2 (11)	45	6	7	167	6	4	437	3	1	1
NWA2.3.2 (11)	7	4	9	157	5	23	202	blank	2	2
NWA2.3.2 (12)	21	1	blank	167	6	9	421	blank	1	4
NWA2.3.2 (13)	18	blank	2	181	6	4	294	blank	blank	4
NWA2.3.2 (14)	38	5	7	82	12	37	283	1	1	3
NWA2.3.2 (15)	29	2	5	139	7	12	398	blank	blank	2
NWA2.3.2 (16)	40		1	201	8	14	683	blank	blank	2
NWA2.3.2 (17)	59	3	5	207	7	6	352	blank	1	6

Hab code	*Alcyonium* on dead Modiolus shells	*Alcyonium* on live Modiolus	*Alcyonium* on pebbles / cobbles / boulders	*Alcyonium* on other / unknown substrata	*Alcyonium* with a defined curved edge (could be on live *Modiolus)*	*Alcyonium* buried in sand	Rough *Alcyonium* count in blurred video	All definite live *Modiolus* without *Alcyonium*.	Possible live *Modiolus* (withough *Alcyonium,* as yet uncounted)	Number of Asterias
NWA2.3.2 (18)	33	3	blank	60	7	19	466	blank	2	4
NWA2.3.2 (19)	24	1	5	168	8	31	331	blank	1	2
NWA2.3.2 (20)	123	blank	7	112	4	27	315	blank	blank	7
NWA2.4.2 (1)	blank	blank	blank	2	blank	blank	4	blank	blank	blank
NWA2.4.2 (2)	blank	blank	blank	blank	1	blank	1	blank	1	1
NWA2.4.2 (3)	blank	blank	blank	2	blank	blank	2	blank	blank	blank
NWA2.4.3 (1)	blank	blank	blank	1	blank	blank	2	blank	blank	1
NWA2.4.3 (2)	blank	blank	blank	blank	blank	blank	blank	blank	1	blank
NWA2.4.3 (3)	blank	blank	blank	blank	blank	blank	blank	blank	1	blank
NWA2.4.3 (4)	blank	blank	blank	blank	blank	blank	blank	blank	1	blank
NWA2.4.3 (5)	blank	blank	blank	1	blank	blank	blank	blank	2	blank
NWA2.4.3 (6)	blank	blank	2	6	blank	blank	10	blank	blank	blank
NWA2.4.3 (7)	blank	2	2	9	blank	blank	28	1	1	blank
NWA2.4.3 (7)	6	blank	6	7	blank	blank	34	blank	blank	blank
NWA2.4.3 (8)	blank	1	2	5	1	blank	21	blank	3	2

Hab code	*Alcyonium* on dead Modiolus shells	*Alcyonium* on live Modiolus	*Alcyonium* on pebbles / cobbles / boulders	*Alcyonium* on other / unknown substrata	*Alcyonium* with a defined curved edge (could be on live *Modiolus)*	*Alcyonium* buried in sand	Rough *Alcyonium* count in blurred video	All definite live *Modiolus* without *Alcyonium*.	Possible live *Modiolus* (withough *Alcyonium,* as yet uncounted)	Number of Asterias
NWA2.4.3 (9)	1	blank	4	10	3	blank	29	blank	2	1
NWA2.4.4 (1)	1	blank	14	36	2	1	106	blank	6	3
NWA2.4.4 (1)	11	blank	20	58	1	blank	37	blank	blank	3
NWA2.4.4 (2)	1	blank	10	43	2	blank	36	blank	4	blank
NWA2.4.4 (3)	blank	blank	4	6	blank	blank	21	blank	2	blank
NWA2.4.4 (4)	blank	1	3	15	1	blank	31	blank	2	1
NWA2.4.4 (4)	5	blank	10	16	blank	blank	15	blank	blank	1
NWA2.5.1 (1)	blank	blank	blank	blank	blank	blank	blank	blank	blank	blank
NWA2.5.1 (2)	blank	blank	blank	blank	blank	blank	blank	blank	blank	blank
NWA2.5.1 (3)	blank	blank	blank	blank	blank	blank	blank	blank	1 (+4 potential juveniles)	blank
NWA2.5.1 (4)	blank	blank	blank	blank	blank	blank	blank	blank	(2 potential juveniles)	blank
NWA2.5.1 (5)	blank	blank	blank	blank	blank	blank	blank	blank	2 (+1 potential juvenile)	blank
NWA2.5.1 (5)	blank	blank	blank	blank	blank	blank	blank	blank	blank	blank
NWA2.5.1 (6)	blank	blank	blank	blank	blank	blank	blank	blank	blank	blank

Hab code	*Alcyonium* on dead Modiolus shells	*Alcyonium* on live Modiolus	*Alcyonium* on pebbles / cobbles / boulders	*Alcyonium* on other / unknown substrata	*Alcyonium* with a defined curved edge (could be on live *Modiolus)*	*Alcyonium* buried in sand	Rough *Alcyonium* count in blurred video	All definite live *Modiolus* without *Alcyonium*.	Possible live *Modiolus* (withough *Alcyonium,* as yet uncounted)	Number of Asterias
NWA2.5.1 (7)	blank	blank	blank	blank	blank	blank	blank	blank	1	blank
NWA2.5.1 (8)	blank	blank	blank	blank	blank	blank	blank	blank	blank	blank
NWA2.5.1 (9)	blank	blank	blank	blank	blank	blank	blank	blank	(1 potential juvenile)	blank
NWA2.5.1 (10)	blank	blank	blank	blank	blank	blank	blank	blank	1	blank
NWA2.5.1 (11)	blank	blank	blank	blank	blank	blank	blank	blank	blank	blank
NWA2.5.1 (12)	blank	blank	blank	blank	blank	blank	blank	blank	blank	blank
NWA2.5.1 (13)	blank	blank	blank	blank	blank	blank	blank	blank	(1 potential juvenile)	blank
NWA2.5.1 (14)	blank	blank	blank	blank	blank	blank	blank	blank	blank	blank
NWA2.5.1 (15)	blank	blank	blank	blank	blank	blank	blank	blank	blank	blank
NWA2.5.1 (16)	blank	blank	blank	blank	blank	blank	blank	blank	blank	blank
NWA2.5.1 (17)	blank	blank	blank	blank	blank	blank	blank	blank	blank	blank
NWA2.5.1 (18)	blank	blank	blank	blank	blank	blank	blank	blank	blank	blank
NWA2.5.1 (19)	blank	blank	blank	blank	blank	blank	blank	blank	1	blank
NWA2.5.1 (20)	blank	blank	blank	blank	blank	blank	blank	blank	blank	blank
NWA2.8.2 (1)	2	1	3	blank	blank	blank	4	blank	blank	blank

Hab code	*Alcyonium* on dead Modiolus shells	*Alcyonium* on live Modiolus	*Alcyonium* on pebbles / cobbles / boulders	*Alcyonium* on other / unknown substrata	*Alcyonium* with a defined curved edge (could be on live *Modiolus)*	*Alcyonium* buried in sand	Rough *Alcyonium* count in blurred video	All definite live *Modiolus* without *Alcyonium*.	Possible live *Modiolus* (withough *Alcyonium,* as yet uncounted)	Number of Asterias
NWA2.8.2 (2)	blank	blank	1	blank	blank	blank	blank	blank	blank	blank
NWA2.8.2 (2)	blank	blank	blank	blank	blank	blank	blank	blank	blank	blank
NWA2.8.4 (1)	blank	blank	2	blank	3	1	3	blank	blank	blank
NWA2.8.6 (1)	4	blank	3	3	1	blank	2	blank	blank	blank
NWA2.8.8 (1)	21	blank	5	11	blank	blank	28	blank	blank	1
NWA2.8.8 (2)	4	blank	14	43	blank	blank	101	blank	blank	1
NWA2.8.8 (2)	blank	blank	11	41	blank	blank	75	blank	blank	1
NWA2.8.8 (3)	15	1	32	108	2	blank	153	blank	2	1
NWA2.8.8 (4)	21	1	17	50	blank	blank	103	2	blank	3
NWA2.8.8 (5)	1	blank	33	33	2	blank	87	blank	blank	1
NWA2.8.8 (6)	blank	blank	46	23	blank	2	92	blank	1	1
NWA2.8.8 (7)	17	2	6	53	blank	blank	54	blank	blank	blank
NWA2.8.8 (8)	2	blank	32	8	blank	blank	138	1	blank	1
NWA2.8.8 (9)	6	blank	11	21	1	4	148	blank	blank	4
NWA2.8a.1 (1)	blank	1	4	89	4	blank	51	blank	1	2

Hab code	*Alcyonium* on dead Modiolus shells	*Alcyonium* on live Modiolus	*Alcyonium* on pebbles / cobbles / boulders	*Alcyonium* on other / unknown substrata	*Alcyonium* with a defined curved edge (could be on live *Modiolus)*	*Alcyonium* buried in sand	Rough *Alcyonium* count in blurred video	All definite live *Modiolus* without *Alcyonium*.	Possible live *Modiolus* (withough *Alcyonium,* as yet uncounted)	Number of Asterias
NWA2.8A.1 (1)	1	2	3	88	blank	blank	63	blank	blank	2
NWA2.8a.1 (2)	4	1	23	85	6	blank	168	blank	(1 potential juvenile)	1
NWA2.8A.1 (2)	6	1	14	130	8	blank	132	blank	blank	2
NWA2.8a.1 (3)	2	1	blank	41	3	4	71	blank	blank	2
NWA2.8A.1 (3)	4	5	1	31		1	28	blank	blank	2
NWA2.8a.1 (4)	4	3	blank	54	7	13	139	blank	1	blank
NWA2.8A.1 (4)	9	2	blank	46	8	9	129	blank	blank	blank
NWA2.8a.1 (5)	2	blank	blank	39	7	2	33	blank	blank	1
NWA2.8A.1 (5)	4	3	blank	45	2	6	27	blank	blank	1
NWA2.8a.1 (6)	2	blank	8	40	blank	blank	120	blank	1	1
NWA2.8a.1 (7)	3	blank	2	41	6	blank	93	blank	blank	blank
NWA2.8a.1 (8)	7	1	blank	33	3	2	57	blank	blank	1
NWA2.8a.1 (9)	2	2	7	84	5	1	115	blank	blank	2
NWA2.8a.4	blank	blank	blank	2	blank	blank	3	blank	blank	blank

Appendix 8: Data archive appendix

Data outputs associated with this project are archived as shown on the table below on server–based storage at Natural Resources Wales.

Media Title	Project Number	Media Number
2009 JNCC multibeam data NW Anglesey Modiolus	381	1392
2009 Drop down video North West Anglesey Surface Tape 1	268	966
2009 Drop down video North West Anglesey subsurface tape 1	268	967
2009 Drop down video North West Anglesey surface tape 2	268	968
2009 Drop down video North West Anglesey subsurface tape 2	268	969
2009 Drop down video North West Anglesey surface tape 3	268	970
2009 Drop down video North West Anglesey surface tape 3	268	971
2010 Drop down video North West Anglesey (NWA2) Surface - tape 1	268	972
2010 Drop down video North West Anglesey (NWA2) Surface - tape 2	268	973
2010 Drop down video North West Anglesey (NWA2) Surface - tape 3	268	974
2010 Drop down video North West Anglesey (NWA1) Surface - tape 1	268	975
2010 Drop down video North West Anglesey (NWA1) Surface - tape 2	268	976
2010 Drop down video North West Anglesey (NWA1) Surface - tape 3	268	977
2010 Drop down video North West Anglesey (NWA1) Surface - tape 4	268	978
2010 Drop down video North West Anglesey (NWA1) Subsurface - tape 4	268	979
2009 Drop down video survey - handheld procedural footage	268	965
2009 Aquatech/CMACSS video of still images	268	1307
CMACS still images and video grabs	268	1308
Electronic data from North West Anglesey Drop down video project	268	1309

Additionally the biological data have been entered onto the Marine Recorder database as surveys *MRCON02100000003 2009-2010 CCW / JNCC North West Anglesey*

Modiolus drop down video survey and *MRCCW31900000002 2009-2010 CCW / JNCC North West Anglesey Modiolus drop down video survey Area NWA2.*

Metadata for this project is publicly accessible through Natural Resources Wales' Library Catalogue https://libcat.naturalresources.wales (English Version) and https://catllyfr.cyfoethnaturiol.cymru (Welsh Version) by searching 'Dataset Titles'. The metadata is held as record numbers 115167 and 120063.

Further copies of this report are available from library@cyfoethnaturiolcymru.gov.uk