

Holyhead Harbour

**MARINE ECOLOGICAL SURVEYS –
SEPTEMBER / OCTOBER 2009**



PREPARED BY

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AQUATIC ENVIRONMENTS

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Summary

- An intertidal mapping survey was carried out in October 2009 and the littoral biotope map was updated, having been last surveyed in 1996.
- The intertidal biotopes complement was found to be relatively diverse.
- The intertidal infauna were also studied at two sites and both the muddy gravel in the southwest corner of the site and the gravel shore adjacent to the Yacht club were found to be depauperate.
- In the sublittoral, a drop-down video survey and a diving survey were carried out. The video survey showed the sublittoral sediment biotopes to be limited to a muddy gravel, a barren mud and a version of the '*Philine aperta* and *Virgularia mirabilis* in soft stable infralittoral mud' biotope.
- The *Virgularia mirabilis* biotope is located in the southern half of the harbour, throughout the area of moorings.
- The video survey also showed the dominant reef biotope to be dominated by the 'sugar kelp' *Saccharina latissima* and a common ascidian *Ascidella aspersa*.
- Further diving surveys recorded a diverse assemblage of red algae in the understory and foliose algal sward amongst the 'sugar kelp' and obtained infaunal macrobenthic cores from the *Virgularia* biotope, confirming the classification of the biotope even with the absence of *Philine aperta*.

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1. Introduction

The Holyhead Waterfront Regeneration Scheme is a mixed-use regeneration project that is centred on a new leisure marina. The development encompasses: residential; hotel; leisure; retail and commercial development; and associated infrastructure. A significant part of the built development will be constructed on land reclaimed from the sea, within the confines of the harbour. The existing harbour is illustrated in the Figure 1 and a sketch of the proposed development is shown on Figure 2

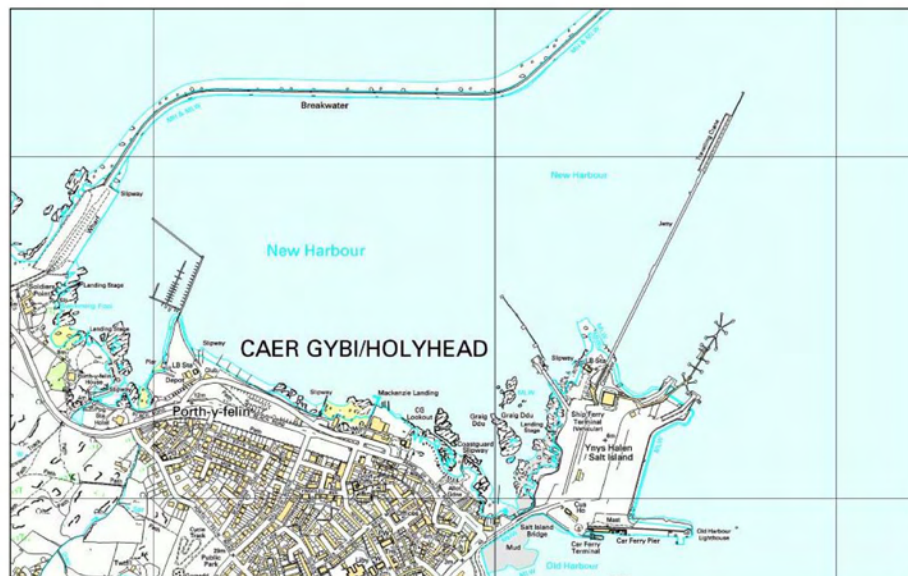


Figure 1 Map of Holyhead harbour and the survey area.



Figure 2 Sketch of Holyhead harbour proposed development

Given the potential impact of the development on the existing intertidal and subtidal environments of the western side of Holyhead harbour, a literature review and consultation exercise was performed in May/June 2009, following a request from the Countryside Council for Wales (CCW) for up to date information on the marine ecology of the Harbour area.

2. Aims

Consequently the following marine ecological surveys were then proposed and carried out in September/October 2009:-

2.1 Intertidal:

- 1) Given the age of the existing CCW littoral biotope map and the fact that the national biotope classification has changed at least twice since their map was produced, it was proposed that an intertidal mapping survey be carried out to update the littoral biotope information.
- 2) Similarly as little or no data appeared to exist on the infaunal communities of the intertidal sediment environments within the harbour, two sites were also proposed for an infaunal study.

2.2 Subtidal:

- 1) A drop-down video survey was proposed, in order to locate and document the dominant sublittoral biotopes present within the footprint of the harbour development. This would then inform further targeted diving studies.
- 2) A series of MNCR Phase II level diving surveys were proposed to target key biotopes noted during the video survey. A priority biotope for this targeted diving study element, noted during the consultation, was to be the bed of Slender seapens (*Virgularia mirabilis*) which are characteristic of the Biodiversity Action Plan habitat, 'Deep Mud'.
- 3) Finally the divers were also required to survey two sites by coring, to investigate the dominant sublittoral infaunal communities found within the Harbour.

3 Methods

3.1 Littoral biotope map

Field maps of the intertidal were prepared prior to the survey. These were based on the aerial photographs of the harbour. The photographs were printed on waterproof paper and carried in the field. Surveyors then used GPS information and waterproof pens, to geo-reference notes, photographs and information on the maps *in situ*.

Two surveyors working in the field as a pair carried out the mapping of the intertidal biotopes, with each surveyor carrying a GPS receiver, a base-map and recording forms. The boundaries of the biotopes identified were walked, whilst the surveyors took photographs and made contemporaneous notes. Waypoints were entered into the GPS receivers, as features of interest were encountered. The surveyors generally walk opposite boundaries of each biotope, in order to cover the ground quickly and efficiently.

The GPS receivers store the entered waypoints in a pre-determined format (Grid References or Latitude and Longitude) and also store the track walked in a similar format. Both these data sets were then uploaded from the GPS receivers to the *Mapinfo* GIS programme. This allows the boundaries of the biotopes to be immediately viewed in relation to the Landline map data and subsequently digitised into polygons, producing accurate maps of the biotopes' sizes and locations.

The photographs taken during the survey were also geo-referenced with the recorded waypoints and the biotope description data, along with target notes. The resulting maps and photographs are included in the report of the survey.

3.2 Littoral infaunal survey



Figure 3 Intertidal beach cores

The intertidal sediments were sampled at two locations, in each case taking five replicates within the selected biotope, with a 0.01m² beach corer as shown in Figure 3. The target biotopes were the muddy mixed sediment at

low water in the southwest corner of the harbour (Figure 8) and the coarse beach material found at mid-tide level in front of the Yacht Club on the southern shore. Both these biotopes will be lost when the marina development is built. An accompanying sediment particle size distribution (PSA) and organic content sample was also taken from the surface 50mm of the sediment biotope at each site sampled. The analysis of these physical and chemical sediment properties are shown in Appendix 1.

The biological intertidal core samples were sieved in seawater in the field over a 0.5mm mesh, to remove the fine sediment and the residue was fixed with a 10% formaldehyde solution and sealed in an airtight bucket. These residues were then returned to Aquatic Environments' laboratory for infaunal taxonomic analysis and reporting following the survey.

In the laboratory the infaunal sediment cores, were individually removed from their buckets and thoroughly washed over a 0.5mm sieve with freshwater to remove all traces of preservative and fine sediment. The sample residues were then further elutriated to float off the lighter components of the fauna. This and the heavy fraction were individually transferred to gridded, white trays and then sorted under a 'long-arm' dissecting microscope to remove all visible fauna. The elutriate sample and the 'heavy fraction' faunas were then re-united and preserved in 70% Industrial Methylated Spirit (IMS).

All organisms were then identified, by means of low and high powered microscope and the latest taxonomic keys, to species level according to the nomenclature of Howson & Picton (1997). Unless otherwise specified, colonial and encrusting organisms were recorded as present. Sewage related indicators such as tomato seeds and *Rubus* spp. pips were also recorded by presence alone.

Final species and abundance results' figures for the benthic macrofauna removed from the cores are presented in the results section

3.3 Drop-down video survey

The Aquatic Environments survey used a drop-down video system based on a 3CCD Sony DRV 950 digital video camera in an aluminium housing rated to 130m. The system is controlled (camera and lights) from the surface via 110 m multi-core umbilical. The digital video footage was recorded on the surface on a Sony mini digital VCR (GV-D1000E). The lights are powered

by an independent surface 110v system (generator or vessel supplied) and so do not rely on battery power. The video system was deployed from a 7m RIB and is hand hauled as it is exceedingly light.

The deployment technique for the video is one where the system is, if possible 'drifted' just above the seabed **not** dragged along it. This mode of operation is deemed to be more appropriate to a nature conservation assessment role, because a 'drifted' system is benign and will not damage fragile seabed biotopes such as 'Slender seapens'.

The video footage captured was used to determine both the substrate type and sublittoral biotope present on the seabed as the video drifts over it. The video transects ranged from stationary spot drops to drifts of 70m in length, depending on the speed of the boat drift in the strong wind or the limited amount of available and accessible seabed in the shallows amongst reefs, whilst considering the safety of the vessel and crew.

Notes were made on the standard recording sheets for drop-down video records. The data was organised into biotopes and or habitat types where the characterising epifauna/flora could not be identified or were absent. GPS receivers were used to note the start and end point of each video drop.

Multiple drops were undertaken to cover as much of the harbour area as possible, in order to define and map the sublittoral biotopes. Thirty-four drops were carried out during the day's fieldwork.

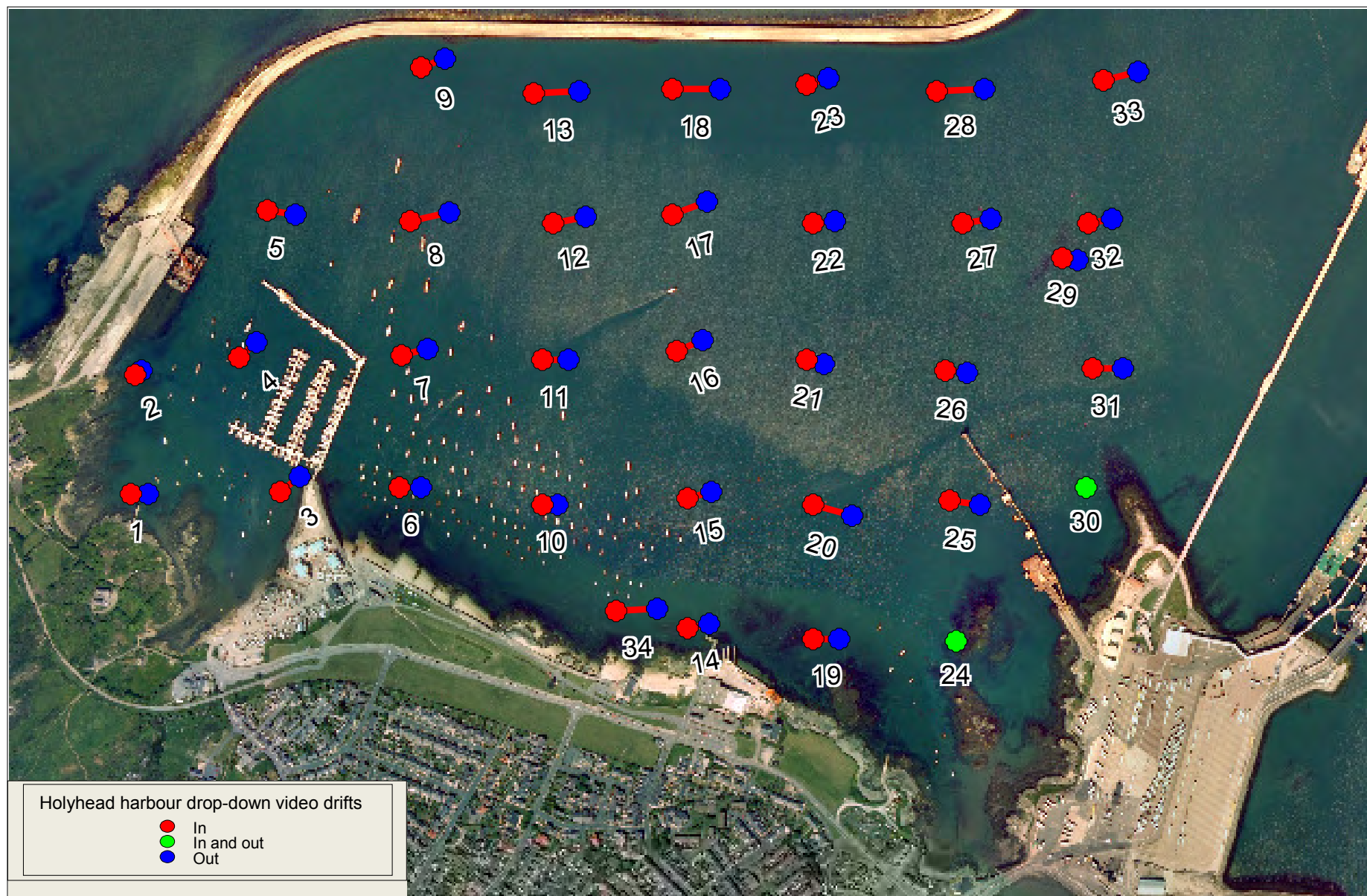


Figure 4 Drop-down video transect drifts made within the harbour

3.4 Diving surveys

An MNCR Phase II level diving survey was conducted to help map the biotopes of the bed of the harbour and to survey the Slender seapen biotope. Slender seapens a pennatulid anthozoan, are characteristic of the BAP habitat, 'Deep Mud', and a large bed is known to exist in the vicinity of the proposed marina extension. The diving was also used to target any sublittoral hard substrata biotopes that may have been present.

The diving was carried out from the MCA coded RIB Domino whilst she was anchored. All dives were carried out as 'single roped diver' with a permanently 'kitted up' standby diver as back-up in the boat at all times. All divers used through-water communications with full facemasks and breathed air with scuba equipment and so the Diving Supervisor was able to keep in contact with the diver for the duration of each dive. The diving was carried out under the Approved Code of Practice for scientific diving projects (Health and Safety Commission 1998) and with the permission of Holyhead Harbour Authority.

During the dive the divers recorded the biotopes in their vicinity, the species complement and the SACFOR abundances of these species. Twenty-five dives were carried out throughout the harbour and two of these dives were used to collect diver cores ($5 \times 0.01 \text{m}^2$ at each site) from the sublittoral sediments. This was undertaken in order to assist in the characterisation of the sublittoral sediment biotopes and their infaunal communities.



Figure 5 Holyhead harbour dive survey locations

4 Results

4.1 Littoral biotope map

The mapping survey notes, waypoints, photographs and field maps were combined and analysed to update the existing CCW biotope map which was originally completed in 1996. The current map is shown on Figures 7-9 and is broadly similar to the previous map. This is in-part due to the sheltered nature of the harbour and so there are few forces of natural change at work and so stability prevails. Even though the national biotope classification has changed at least twice since it was first mapped zonation patterns remain constant.



The maps should be read in conjunction with the key below (Figure 6), which labels each biotope or group of biotopes according to the Marine Habitat Classification of Britain and Ireland (Connor *et al.*). Please note that the colours of the biotopes do not follow convention, in order to fully differentiate between each entity i.e. similar or closely related biotopes are **not** coloured similarly in this map.

Figure 6 Littoral biotope map key (codes from Connor *et al.* 2004)

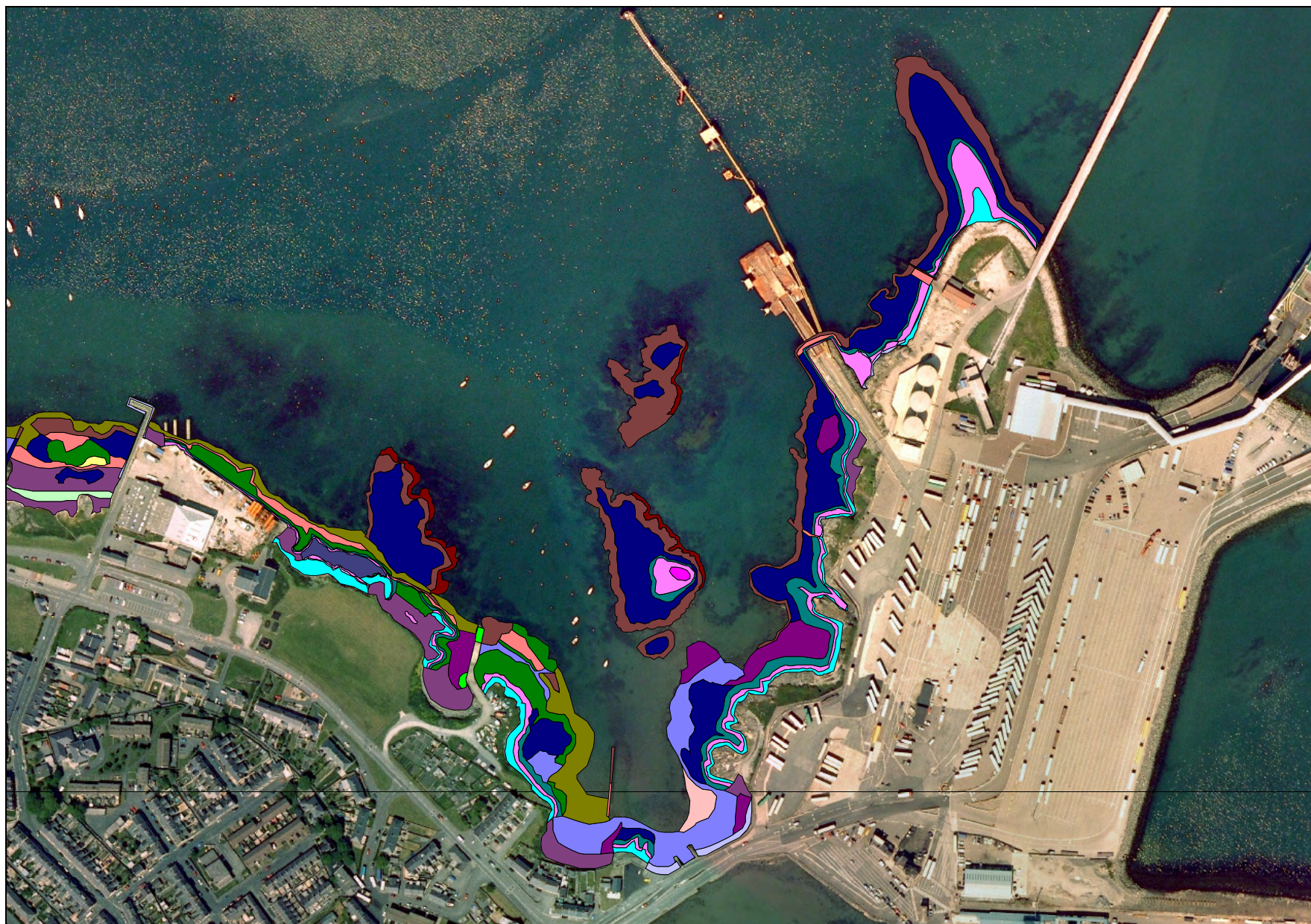


Figure 7 Holyhead Harbour littoral biotopes - Southeast quadrant

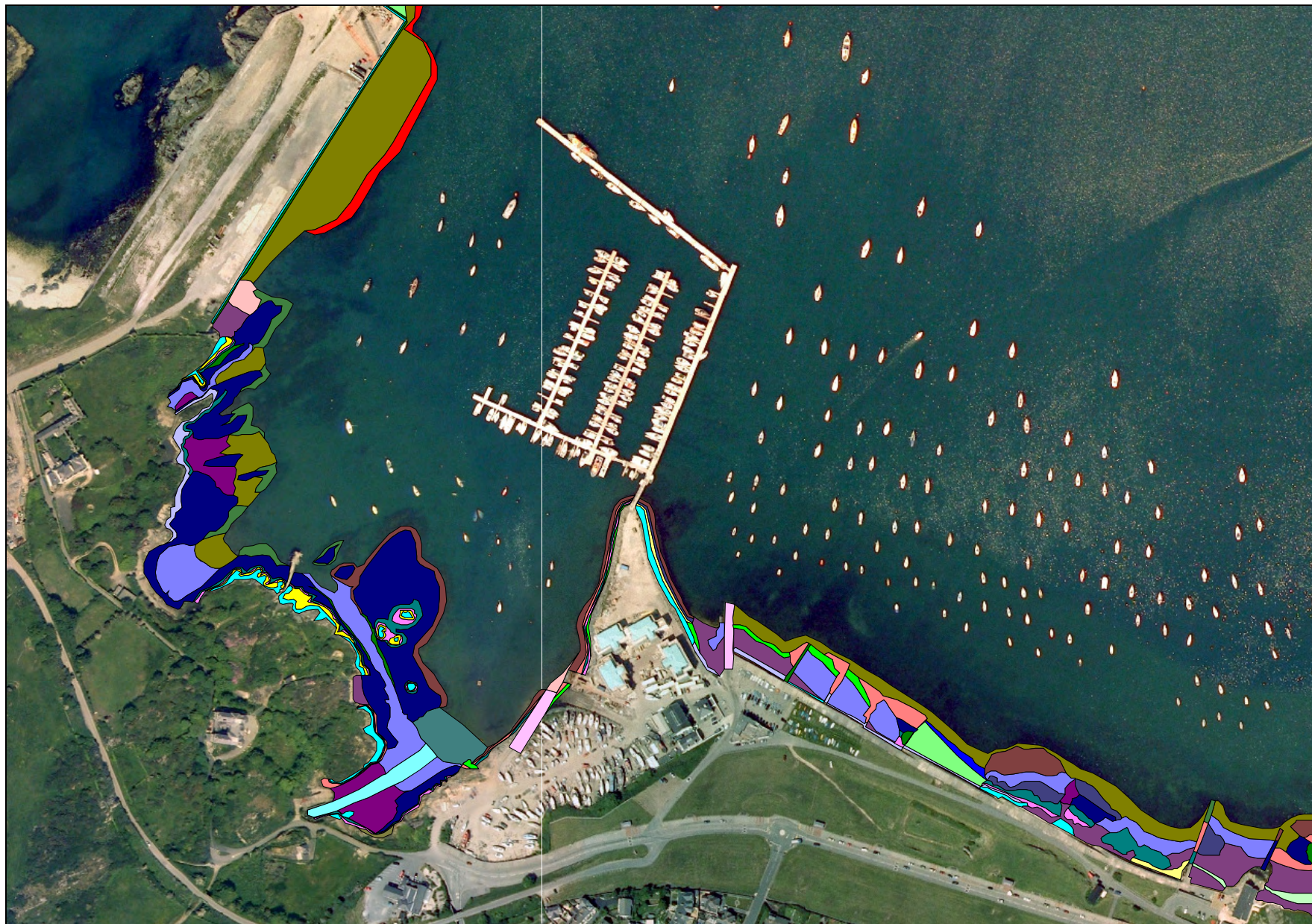


Figure 8 Holyhead Harbour littoral biotopes - Southwest quadrant

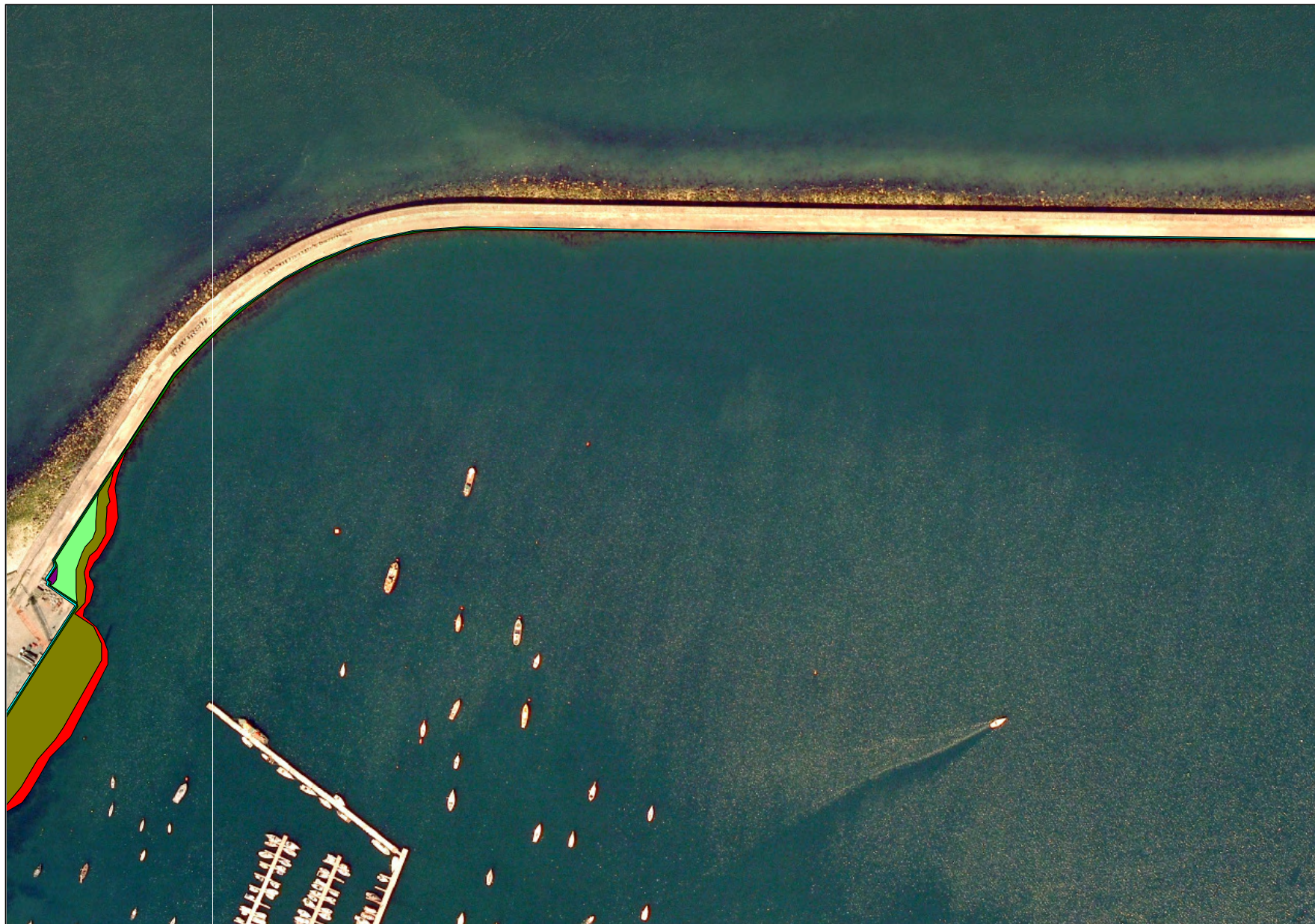


Figure 9 Holyhead Harbour littoral biotopes – northern half



Figure 10 CCW's 1996 littoral biotope map

The maps show a broadly similar picture to the earlier CCW map (Figure 10). Some extra detail is visible on the October 2009 map, which will in part be due to the extra human resources that were deployed during the survey, allowing a slightly more detailed survey to be undertaken.

The main physical changes noted on the map can be seen in the Marina's boat park region, where land claim has progressed since 1996, with a loss of approximately 0.4ha of intertidal area and the location of the marina slipway has moved to the west.

No rare or endangered biotopes were noted during the survey, but the extra human mapping effort did improve the detail of the knowledge of the intertidal biotopes in the vicinity of the harbour, particularly to the west of the Marina. Here the extra resources have improved the detailed locations of the lichen zones, the mixed sediment biotopes and noted the presence of the more faunally dominated biotopes such as LR.HLR.MusB.Sem.Sem. This was not recorded in 1996. Of note within this biotope, adjacent to Porth Y Felin, is the presence of Pacific oysters, an alien species growing on the rocks in the midshore.



Figure 11 LR.HLR.MusB.Sem.Sem with Pacific oysters growing on the rock surface

Also noted on the lower shore north of Soldiers Point, is the change from a limpet/barnacle dominated biotope (ELR.MB.BPat.Sem) in 1996, to a fucoid dominated biotope LR.LLR.F.Fserr.X in 2009. This however is likely to be due to a continual, natural cycling of biotopes, from faunal dominance to floral dominance and back again, that occurs on shores of this nature.

4.2 Littoral infauna

The two sets of beach cores were analysed at Aquatic Environments' laboratory and the invertebrate communities were identified. The tables below show the infaunal makeup of the biotope in each case.

Table 1 Porth Y Felin - Invertebrate core sample analysis

MCS	Station	Porth Y Felin				
		PyF1	PyF2	PyF3	PyF4	PyF5
	Taxon					
G00001	<i>Nemertean sp. B Indet.</i>				1	
P02050	<i>Eteone longa</i>			1		
P02570	<i>Anaitides mucosa</i>			1		
P05680	<i>Ophiodromus flexuosus</i>		1			
P08280	<i>Neanthes virens</i>		1	1		
P08710	<i>Nephtys hombergii</i>					1
P12780	<i>Polydora ciliata</i>			9		
P14040	<i>Chaetozone gibber</i>		7	2		
P14230	<i>Tharyx A</i>	5		26	47	45
P14300	<i>Monticellina cf. dorsibranchialis</i>	1	13			
P15580	<i>Mediomastus fragilis</i>		4	21	2	
P15630	<i>Notomastus latericeus</i>			1		
P18860	<i>Melinna palmata</i>			1		
P24870	<i>Tubificoides benedii</i>			1	1	1
P24890	<i>Tubificoides pseudogaster</i>		4	2	1	
W02720	<i>Hydrobia ulvae</i>	1	18		16	4
W19910	<i>Cerastoderma edule</i>			1		1
	<i>Rubus pips</i>	p	p	p	p	p
	<i>Tomato pips</i>			p	p	
	No. Species/Taxa	3	6	12	6	4
	No. Individuals	7	41	67	68	51
	Biotope Version 04.05- Littoral Sediments	LS.LMx.Mx.CirCer				
	Description	Cirratulids and Cerastoderma edule in littoral mixed sediment?				

The Porth Y Felin samples were dominated by the three species of the cirratulid polychaete family recorded; *Chaetozone gibber*, *Tharyx A* and *Monticellina cf. dorsibranchialis*. This muddy mixed sediment is exposed to slight salinity variations at low water, due to the stream that flows down across the shore in this bay. Also of note in the samples are the specimens of the 'King Ragworm' (*Neanthes virens*), which is obviously a frequent target for bait diggers in this vicinity.

Much of the mixed sediment in this area of the harbour was noticeably 'pockmarked' with previously-dug holes and in fact bait diggers were observed trenching for 'King Ragworm' whilst these intertidal surveys were underway (See Figure 12).

The Yacht Club shores are almost certainly artificial in origin, having being formed from a crushed angular limestone at some point in the recent past. The invertebrate community recovered from the beach cores taken at this location, consequently does not fit easily into the littoral biotope classification and unsurprisingly the dominant species, *Malacoceros fuliginosus*, is characteristic of disturbed environments.



Figure 12 Bait diggers below Porth Y Felin

Table 2 Yacht Club beach - Invertebrate core sample analysis

MCS	Taxon	Station	Yacht Club Beach				
			YC1	YC2	YC3	YC4	YC5
HD00001	<i>Nematoda</i>		5	1	1	3	2
F00010	<i>Turbellaria indet.</i>				1		
G00001	<i>Nemertean sp. A Indet.</i>		3	3	5	5	5
G00790	<i>Lineus sp.</i>				6	1	1
N00160	<i>Nephasoma minutum</i>		8	15	4	18	14
P07530	<i>Sphaerosyllis hystrix</i>		2	4		1	1
P12270	<i>Aonides oxycephala</i>					1	
P12570	<i>Malacoceros fuliginosus</i>		37	10	24	18	26
P16920	<i>Ophelia limacina</i>		21	18	16	8	11
P21520	<i>Amphiglena mediterranea</i>					1	
P23030	<i>Pomatoceros lamarcki</i>			1	1		
P25760	<i>Enchytraeidae</i>		10	4	3	20	4
W03400	<i>Onoba semicostata</i>			2			
	<i>No. Species/Taxa</i>		7	9	9	10	8
	<i>No. Individuals</i>		86	58	61	76	64
	<i>Biotope Version 04.05- Littoral Sediments</i>		LS.LCS				
	<i>Description</i>		Littoral coarse sediments				

No rare or endangered species were recorded from the ten core samples collected from the two littoral sites within the harbour.

4.3 Drop-down video survey

The results of the drop-down video survey are shown in table 3 below

Table 3 Drop-down video analysis

ID	Length (m)	Easting	Northing	Notes
1	26	223816.1	383502.4	Epipellic diatoms on a level soft mud plain. Possible small polychaete tubes.
2	11	223813.2	383679.4	A shallow reef in the lower littoral zone with a dense growth of <i>Fucus serratus</i> encrusted with spirorbids and occasional <i>Ulva</i> sp. A dense turf of very silty foliose red algae beneath the <i>Fucus</i> . Below the fucoid zone a bed of silty <i>Saccharina latissima</i> with numerous <i>Carcinus maenas</i> , <i>Ascidia mentula</i> and Two-spot gobies was noted
3	34	224034.6	383516.8	Epipellic diatoms on a level soft mud plain with occasional <i>Ascidiella aspersa</i> . Small patch of <i>Saccharina latissima</i> , Dragonets, worm tubes and <i>Liocarcinus depurator</i> .
4	34	223973.7	383712.9	Epipellic diatoms on a level soft mud plain. Solitary boulders with encrusting fauna. The mud is covered with the tracks of fish and crabs
5	41	224022.9	383915	Epipellic diatoms on a level soft mud plain. Occasional fish and <i>Virgularia mirabilis</i> .
6	34	224211.1	383510.7	Epipellic diatoms on a level soft mud plain but with occasional eroding piles of mud!! Dragonets and worm tubes common. A diffuse bed of <i>Virgularia mirabilis</i> and occasional fish and crabs. Evidence of infaunal bioturbation.
7	39	224218.1	383711	A thick film of epipellic diatoms(?) on a level soft mud plain with occasional Dragonets and worm tubes. Patches of a diffuse bed of <i>Virgularia mirabilis</i> and patches of dense <i>Virgularia mirabilis</i> . Occasional fish and crabs. Evidence of infaunal bioturbation.
8	60	224239.2	383907.1	Epipellic diatoms on a level soft mud plain with occasional Dragonets and worm tubes. A diffuse bed of <i>Virgularia mirabilis</i> and occasional fish and crabs. Evidence of infaunal bioturbation.
9	37	224243	384132.8	Epipellic diatoms on a level soft mud plain with occasional <i>Ascidiella aspersa</i> , <i>Saccharina latissima</i> , Dragonets, worm tubes and <i>Liocarcinus depurator</i> .
10	24	224415	383487.9	Epipellic diatoms on a level soft mud plain with numerous infaunal burrows. Occasional fish and <i>Virgularia mirabilis</i> . Occasional <i>Liocarcinus depurator</i> and Dragonets noted.
11	37	224422.4	383699.9	Epipellic diatoms on a level soft mud plain. Occasional fish and a dense bed of <i>Virgularia mirabilis</i> .
12	48	224442.3	383902.7	Epipellic diatoms on a level soft mud plain. The mud is covered with the tracks of fish and crabs
13	66	224424.8	384090.4	Epipellic diatoms on a level soft mud plain with occasional Dragonets and worm tubes.
14	30	224632.2	383309.9	A mosaic of cobbles and silty gravel. The hard surfaces are colonised by occasional <i>Saccharina latissima</i> and a dense foliose red algal turf. <i>Ascidiella aspersa</i> dominates the faunal component

ID	Length (m)	Easting	Northing	Notes
				of the biotope.
15	37	224634.1	383500.6	Epipellic diatoms on a level soft mud plain. Occasional fish and a dense bed of <i>Virgularia mirabilis</i> .
16	41	224619.2	383720.1	A barren mud plain with infaunal burrows and bioturbation evidence. Occasional crabs and fish, notably dragonets, and clumps of drift algae
17	54	224619.8	383919.3	A barren mud plain with infaunal burrows and bioturbation evidence. Occasional crabs and fish, notably dragonets
18	71	224628.8	384094.2	Epipellic diatoms on a level soft mud plain. Possible small polychaete tubes. Occasional fish.
19	35	224818.5	383290.4	A plain of cobbles and boulders with tongues of silty gravel in between the outcrops. The hard surfaces are colonised by occasional <i>Saccharina latissima</i> and a dense foliose red algal turf. Clumps of <i>Ascidiella aspersa</i> and occasional large <i>Ascidia mentula</i> colonise the rock surface.
20	57	224827.9	383478.8	A level soft mud plain with burrows. Occasional <i>Virgularia mirabilis</i> and occasional crabs and fish, notably dragonets. One small reef colonised with sparse <i>Saccharina latissima</i> .
21	25	224803.1	383694.5	A barren mud plain with infaunal burrows and bioturbation evidence. Occasional crabs and fish, notably dragonets
22	32	224815.1	383899.1	A barren mud plain with infaunal burrows and bioturbation evidence. Occasional crabs and fish, notably dragonets
23	31	224806.1	384104.8	A barren mud plain with infaunal burrows and bioturbation evidence. Occasional crabs and fish, notably dragonets
24	0	225007.2	383289	Silty bedrock reef and muddy gravel deposits with <i>Ascidiella aspersa</i> , <i>Saccharina latissima</i> , a turf of foliose red algae including <i>Polyides rotundus</i> , <i>Phyllophora pseudoceranoides</i> and <i>Dilsea carnosa</i> . Two-spot gobies <i>Ulva</i> sp. and coralline crusts also noted.
25	46	225021.5	383490	Soft mud plain with abundant burrows, fish and the occasional <i>Virgularia mirabilis</i> and on to a silty cobble/ boulder area with <i>Ascidiella aspersa</i> , <i>Saccharina latissima</i> , <i>Desmarestia viridis</i> and a scrap/rubbish accumulation
26	31	225008.4	383681.2	A barren mud plain with infaunal burrows and bioturbation evidence. Occasional crabs and fish, notably dragonets
27	42	225037.6	383901.2	A barren mud plain with infaunal burrows and bioturbation evidence. Occasional crabs and fish, notably dragonets. Several small clumps of <i>Ascidiella aspersa</i> and some drift <i>Saccharina latissima</i> and foliose red algae.
28	70	225013.9	384093.5	Soft mud plain with abundant burrows, fish and the occasional <i>Cerianthus lloydii</i>
29	24	225175.1	383846.4	Silty bedrock reef with <i>Ascidiella aspersa</i> , <i>Saccharina latissima</i> , <i>Desmarestia aculeata</i> , <i>Desmarestia viridis</i> , <i>Polysiphonia</i> sp., <i>Polyides rotundus</i> and Two-spot gobies, <i>Phyllophora pseudoceranoides</i> , <i>Anemonia viridis</i> and onto a soft mud plain with abundant burrows and

ID	Length (m)	Easting	Northing	Notes
				epipellic algae.
30	0	225199.8	383512.2	Silty bedrock reef with <i>Saccharina latissima</i> , <i>Polysiphonia</i> sp. <i>Desmarestis</i> sp. and on to a soft mud plain with burrows and occasional Sabellid polychaete tubes?
31	44	225230.1	383685.9	Soft mud plain with abundant burrows.
32	35	225219.4	383901.6	Soft mud plain with abundant burrows and occasional <i>Liocarcinus depurator</i> . Foliose red algae on few cobbles.
33	52	225250	384113.7	Soft mud plain with burrows and occasional <i>Cerianthus lloydii</i>
34	61	224542.4	383334.2	A soft mud plain with burrows and occasional polychaete tubes? Briefly on to a silty bedrock reef with <i>Saccharina latissima</i> and foliose red algae interspersed with clumps of <i>Ascidiella aspersa</i> . Then on to the mud again with a diffuse bed of <i>Virgularia mirabilis</i> and finally on to a mosaic of mud and cobbles with more <i>Saccharina latissima</i> , ascidians, foliose red algae and <i>Liocarcinus depurator</i> .

The video survey confirmed the presence of hard substrata on the north, west and southern boundaries of the harbour, in the form of silty cobbles, boulders and bedrock reef. The majority of this sublittoral fringing reef was found to be colonised by *Saccharina latissima*, a sward of understorey red algae, (see section 4.4 for species lists) large ascidians, in particular *Ascidia aspersa*. The majority of the eastern side of the harbour, the entrance channel, was found to be a mud plain with the exception of one patch of reef surveyed at site 29. This reef which is visible on the aerial photograph was also dived (site 11), and it is described in more detail in the section 4.4.

The remainder of the harbour area was a relatively sterile mud plain with very little epifaunal life, barring the common benthic fish, the Dragonet and the common swimming crab, *Liocarcinus depurator*. The only interest within this biotope is the presence of the Slender seapen *Virgularia mirabilis*, which was recorded at 10 sites as shown on figure 13 below.



Figure 13 Locations where *Virgularia mirabilis* was recorded on the drop-down video

4.4 Diving surveys

The habitat and biotope descriptions of the twenty five Phase II dives undertaken in the harbour are presented in Table 4 and the SACFOR abundances of the species recorded during the dives are presented in Tables 5 and 6. Dives on which significant levels of hard substrata biotopes were recorded, are indicated by the highlighted columns in Tables 5 and 6 in order to allow a greater degree of interpretation by eye.

Hard substrata were found only as a fringe around all boundaries of the harbour, without exception, even on the eastern boundary where the outcrop at site 11 can be seen on the aerial photograph.



Generally the diving was performed in 1-2m underwater visibility, yet the surveys returned a relatively healthy species list. The shallow sublittoral reef in particular held a rich algal and faunal community. These were relatively diverse, with 50 algae and 48 faunal epibenthic species recorded on the reefs sites. This out of a total of 53 algal species and 58 faunal species recorded on all dives.

Figure 14 Sites dived in Holyhead Harbour

Table 4 Phase II diving survey habitat and biotope descriptions

Dive site	Way Pt	Date	Diver	East	North	Description
1	252	30-Sep-09	FB	224211.4	383446.2	Dense <i>Saccharina latissima</i> on cobbles with pebbles gravel and fine sand at 1.6 m (bcd). Foliose algae and <i>Pomatoceros</i> on the pebbles with a few small patches of encrusting bryozoa, <i>Pomatoceros</i> and <i>Porifera</i> crusts. Dominant algae included <i>Antithamnionella ternifolia</i> on the <i>Saccharina</i> fronds and also <i>Gracilariopsis gracilis</i> and <i>Polyides rotundus</i> .
2	253	30-Sep-09	FB	224423	383708.2	Deep flocculent mud at 6.7 m (bcd) with sea pens <i>Virgularia mirabilis</i> at a density of 3 to 4 per m ² . Many tracks on the sediment made by <i>Pagurus bernhardus</i> , also burrows from crustacea. A few <i>Liocarcinus depurator</i> crabs scuttled around.
3	255	30-Sep-09	JJM	224625	383491.4	Soft mud at 10m bsl with <i>Virgularia mirabilis</i> (3 to 5 per m ²), gobies, <i>Liocarcinus depurator</i> and frequent holes/burrows.
4	257	30-Sep-09	JJM	224818.2	383291.4	Shelly mud with frequent medium sized boulders and anchor blocks. All very silty. Much of sediment and rock covered in mat of <i>Heterosiphonia japonica</i> . Boulders dominated by <i>Saccharina latissima</i> (long broad fronds) and <i>Asciidiella aspersa</i> . Common <i>Gibbula cineraria</i> on <i>Saccharina latissima</i> fronds. Occasional <i>Pecten maximus</i> .
5	263	30-Sep-09	TM	224203.4	383893.4	Plain of soft mud with a surface covering of epipellic diatoms and some small polychaete tubes, much tracked by the movement of crabs (<i>Liocarcinus depurator</i>) and small fish (Dragonets, juvenile flatfish and Common gobies). Sparse burrows with megafaunal bivalves were noted. <i>Virgularia mirabilis</i> were observed in the low densities (1m-2) protruding from the mud and <i>Sagarteogeton undatus</i> were rare.
6	265	30-Sep-09	TM	223802.6	383709.4	A shallow slope of muddy gravel and angular cobbles. Dominated by very silty <i>Saccharina latissima</i> , <i>Chorda filum</i> , <i>Ulva</i> sp. and <i>Fucus serratus</i> plants. <i>Carcinus maenas</i> were abundant as were the tunicate <i>Asciidiella aspersa</i> , Common gobies and Two spotted gobies. Occasional <i>Balanus crenatus</i> were noted on the cobbles with <i>Pomatoceros</i> sp.
7	266	30-Sep-09	CH	225168.6	383835.8	Plain of very soft mud at 8m bsl with numerous burrows, including at least one <i>Nephrops</i> -like. One small patch of silty <i>Saccharina latissima</i> on bedrock.
8	267	30-Sep-09	CH	225015	383492.2	Scattered small boulders on mud, very silty. Boulders covered with <i>Asciidiella aspersa</i> and <i>Styela clava</i> . Some <i>Saccharina latissima</i> . Scatted <i>Sabella pavonina</i> tubes amongst the ascidians. Megafaunal burrows and one <i>Pecten maximus</i> on the sediment.
9	268	30-Sep-09	JJM	224425.4	383498.2	Soft mud at 8m bsl with <i>Virgularia mirabilis</i> (3 to 5 per m ²) and gobies, but very little else. A few small isolated boulders with <i>Asciidiella aspersa</i> and <i>Balanus crenatus</i> . Mostly all level mud seabed, but a slope of mud present.

Dive site	Way Pt	Date	Diver	East	North	Description
10	269	30-Sep-09	JJM	224595	383337	Soft mud at 6m bsl with <i>Virgularia mirabilis</i> (2 to 3 m ⁻²), gobies, <i>Liocarcinus depurator</i> and some holes/burrows. A few small stones with <i>Ascidella aspersa</i> and a large bent metal plate harbouring numerous prawns and dominated by more <i>Ascidella aspersa</i> . Occasional <i>Pagurus bernhardus</i> making tracks across the mud. Diatoms often covering the mud surface.
11	270	30-Sep-09	FB	225191.4	383893.4	Bedrock adjacent to sediment at 1 m (bcd) with dense <i>Saccharina latissima</i> and clumps of <i>Ascidella aspersa</i> with much <i>Heterosiphonia japonica</i> . A variety of other algae were present including <i>Plocamium cartilagineum</i> , <i>Polyides rotundus</i> , <i>Phyllophora pseudoceratoides</i> , <i>Palmaria palmata</i> and <i>Antithamnionella ternifolia</i> .
12	271	30-Sep-09	FB	224774.6	384155.8	Deep soft mud sloping up towards harbour wall at 8.0 m (bcd). Visibility was practically 0 m. One drift plant of <i>Saccharina latissima</i> and an <i>Ascidella aspersa</i> noted.
13	272	30-Sep-09	TM	224367.4	383609.8	Plain of soft mud with a surface covering of epipellic diatoms and some small polychaete tubes, much tracked by the movement of crabs and small fish. This site was cored (5 x 0.01m ²) by divers and then sieved over a 0.5mm mesh sieve. A particle size distribution sample was also taken.
14	272	01-Oct-09	CH	224700.6	383343	Silty bedrock at 6 m covered with cape <i>Saccharina latissima</i> , foliose red algae and occasional coralline crusts. <i>Ascidella aspersa</i> was abundant with occasional <i>Ascidia mentula</i> . Small patches of <i>Halichondria panicea</i> and <i>Esperiopsis fucorum</i> . Rock was bordered by shelly mud.
15	273	01-Oct-09	CH	224517.8	383404.6	Soft burrowed mud at 10 m with <i>Virgularia mirabilis</i> and <i>Liocarcinus depurator</i> .
16	274	01-Oct-09	CH	224505	383561.4	Soft burrowed mud at 11m with <i>Virgularia mirabilis</i> and <i>Liocarcinus depurator</i> .
17	275	01-Oct-09	JJM	224264.2	383580.6	Soft level mud with frequent holes / burrows, but very little surface life, except for gobies and patchy diatom cover. A couple of <i>Sagartia troglodytes</i> . Sediment obviously well bioturbated (more than at other sites seen on previous days diving)
18	276	01-Oct-09	JJM	224307	383466.6	Fairly featureless bedrock platform covered in layer (1 to 3cm) of soft mud. Common <i>Ascidella aspersa</i> , Frequent <i>Saccharina latissima</i> and Frequent patches of <i>Heterosiphonia japonica</i> turf; but not much else. Occasional <i>Ciona intestinalis</i> amongst the <i>Ascidella</i> (on <i>Saccharina latissima</i>) and a few <i>Cerianthus lloydii</i> in deeper patches of mud.
19	277	01-Oct-09	JJM	224399	383346.2	Mixed substrata of boulders, cobbles, pebbles, gravel and muddy sand. Dominated by canopy of <i>Saccharina latissima</i> and a turf of mixed red algae on the boulders and cobbles. Patches of fairly dense <i>Chorda filum</i> . All very silty. Underboulder communities including <i>Balanus crenatus</i> , <i>Anomiidae</i> , <i>Terrebellidae</i> and encrusting sponges.
20	278	01-Oct-09	FB	223903.4	383811.4	Mud with epipellic diatoms and <i>Pecten maximus</i> at 2.1 m (bcd). No other conspicuous epibiota were recorded.

Dive site	Way Pt	Date	Diver	East	North	Description
21	279	01-Oct-09	FB	224291.4	384174.6	Steep slope of small boulders and cobbles on sediment with <i>Saccharina latissima</i> from 0.5 to 1.5 m (bcd), <i>Ascidiella aspersa</i> and filamentous red algae, especially <i>Heterosiphonia japonica</i> .
22	280	01-Oct-09	FB	224135	383514.2	Mud with diatoms at 3.1 m (bcd) and no other conspicuous macrobiota noted apart from gobies and juvenile flat fish.
23	281	01-Oct-09	TM	223835	383626.6	Gravelly mud with occasional boulders protruding. Film of epipellic diatoms on the surface of the mud. The boulders had silty plants of <i>Saccharina latissima</i> draped over them and were surrounded by shoals of Two-spot gobies. Much of the hard surfaces were colonised by <i>Ascidiella aspersa</i> , <i>Ciona intestinalis</i> and foliose and filamentous red algae (<i>Furcellaria lumbricoides</i> , <i>Heterosiphonia japonica</i> , <i>Ulva</i> sp. and <i>Chondrus crispus</i>). Occasional <i>Pecten maximus</i> dotted the mud and the crabs <i>Carcinus maenas</i> and <i>Liocarcinus depurator</i> and other small fish were also numerous.
24	282	01-Oct-09	TM	223895	383522.6	Bedrock outcrops of reef rising out of a soft muddy plain in the shallow sublittoral. The mud was colonised by diatoms, gobies and <i>Carcinus maenas</i> and <i>Liocarcinus depurator</i> crab species. The rock and other hard substrata were again covered with <i>Ascidiella aspersa</i> and <i>Ciona intestinalis</i> ascidians and a sward of small foliose red algae and <i>Saccharina latissima</i> . Encrusting coralline red algae were also present beneath the silt. Sparse sponge species, (<i>Himeniacidon perleve</i> and <i>Suberites domuncula</i>) were noted on the rock, along with <i>Urticina felina</i> and <i>Sagartiogeton undatus</i> anemones. A single specimen of <i>Antedon bifida</i> was also noted.
25	284	01-Oct-09	TM	223965.4	383442.6	A soft level mud plain with an active but depauperate crab and fish fauna and only epipellic algae representing the floral component of the biotope. This site was cored (5 x 0.01m ²) by divers and then sieved over a 0.5mm mesh sieve. A particle size distribution sample was also taken.

Table 5 Species abundances (SACFOR) noted at the Holyhead Harbour dive sites

[illegible]

[illegible]

Dive site	1	2	3	4	5	6	7	8	9	10	11	12	13
Dendrodoa grossularia								O					
Dragonet					C	R							F
Electra pilosa								F					
Gibbula cineraria				C						R			
Gobiidae indet.													
Halichondria panicea													
Harmothoe sp													
Hinia reticulata													
Hymeniacion perleve													
Lacuna vineta													
Liocarcinus depurator		O	F		O		R	O		O			O
Macropodia rostrata											R		
Maia squinado										x1			
Modiolarca tumida								F					
Myoxocephalus scorpius	R												
Necora puber	R							R					
Nymphon gracile								R					
Onchidoris muricata								R					
Pagurus bernhardus										O			
Palaemon serratus	R												
Pecten maximus				F				R		R	R		
Pleuronectes platessa				x1	R								R
Polynoidae indet													
Pomatoceros sp.	F					R							
Pomatoschistus sp.	O		C	O	F	O		O	F	C			F
Porifera indet. Crusts	R												
Rissoa parva								F					
Sabella pavonina						R		F					
Sagartia troglodytes													
Sagartiogeton undatus			R		R								
Scrupocellaria reptans													
Scypha ciliata													
Spirorbidae indet	O										F		
Styela clava								F					
Suberites ficus													
Terrebellidae indet	R												
Trivia monacha								R					
Urticina felina													
Verruca stroemia								R					
Virgularia mirabilis		F	C		C				C	C			O

Table 6 Species abundances (SACFOR) noted at the Holyhead Harbour dive sites

[illegible]

Dive site	14	15	16	17	18	19	20	21	22	23	24	25
Erythroglossum laciniata	R											
Fucus serratus						R				F	R	
Gelidium spinosum								R				
Gracilariopsis gracilis												
Griffithsia corallioides								R				
Halurus flosculus							R	O				
Heterosiphonia japonica					F	F		C	R	O	R	
Hypoglossum hypoglossoides	O											
Lomentaria clavellosa	R					P		R		R		
Monosporus pedicellatus												
Nitophyllum punctatum	F					O		R				
Palmaria palmata						F				R	R	
Peyssonellia cf squamaria												
Phyllophora crispa										R	O	
Phyllophora pseudoceranioides						F				R	R	
Phyophyceae indet. Crusts												
Plocamium cartilagineum	R											
Polyides rotundus	O					F				O	R	
Polysiphonia elongata	O					F	R	R				
Polysiphonia harveyi	O					P		R				
Pterothamnion pluma								R				
Rhodomela confervoides						P						
Rhodymenia pseudopalmata	O					P				R		
Saccharina latissima	A				F	S	O	F	R	O	F	
Schottera niccaeensis	R											
Seiriospora interrupta								R				
Sphacelaria sp.	R					P		R				
Ulva sp.	O					O		R		R	R	
Animals												
Obelia dichotoma									O			
Palaemon serratus												
Two-spot goby										O	F	
Amphilectus fucorum	O											
Anomiidae indet.						R						
Antedon bifida											P	
Ascidia mentula	F									O	O	
Asciidiella aspersa	A				C	C	F	C	O	F	C	
Asciidiella scabra						R		R		R	R	
Balanus crenatus	O					O		O		R	O	
Botryllus schlosseri	R											
Bryozoa indet. Crusts						R		R				
Bugula flabellata	O											
Burrows	R	O	F	F								

Dive site	14	15	16	17	18	19	20	21	22	23	24	25
<i>Carcinus maenas</i>					O	O				F	F	O
<i>Cerianthus lloydii</i>		R			O							
<i>Ciona intestinalis</i>					O	O		R		F	O	
<i>Clavelina lepadiformis</i>												
<i>Corophium</i> sp.												
<i>Dendrodoa grossularia</i>								O				
Dragonet							R			R	R	
<i>Electra pilosa</i>												
<i>Gibbula cineraria</i>						F						
Gobiidae indet.				F	O				O	C	F	F
<i>Halichondria panicea</i>	O					O						
<i>Harmothoe</i> sp								R				
<i>Hinia reticulata</i>										R		
<i>Hymeniacion perleve</i>											R	
<i>Lacuna vincta</i>	R											
<i>Liocarcinus depurator</i>	O		O							R	R	R
<i>Macropodia rostrata</i>									R			
<i>Maia squinado</i>						x1						
<i>Modiolarca tumida</i>	F											
<i>Myoxocephalus scorpius</i>												
<i>Necora puber</i>	R											
<i>Nymphon gracile</i>												
<i>Onchidoris muricata</i>												
<i>Pagurus bernhardus</i>		O	R							R	R	F
<i>Palaemon serratus</i>												
<i>Pecten maximus</i>						0	F			F		
<i>Pleuronectes platessa</i>												R
Polynoidae indet						P						
<i>Pomatoceros</i> sp.	O					F		R		R	R	
<i>Pomatoschistus</i> sp.		F	F									
Porifera indet. Crusts						O						
<i>Rissoa parva</i>	F					C		O			C	
<i>Sabella pavonina</i>												
<i>Sagartia troglodytes</i>				R					R			
<i>Sagartiogeton undatus</i>											R	
<i>Scrupocellaria reptans</i>	R											
<i>Scypha ciliata</i>	R											
Spirorbidae indet	O					F						
<i>Styela clava</i>	R					R						
<i>Suberites ficus</i>	R										R	
Terrebellidae indet		O				O				R	R	
<i>Trivia monacha</i>												
<i>Urticina felina</i>	R										R	
<i>Verruca stroemia</i>												
<i>Virgularia mirabilis</i>		C	C	R								

The algologists in the survey team were of the opinion that the shallow sublittoral reef in the harbour may have returned a slightly greater species list, if the survey had been carried out in June/July before significant grazing by herbivorous invertebrates and some of the seasonal senescence had occurred. The algal community in the shallow sublittoral is dominated in terms of biomass by the large 'sugar kelp' (*Saccharina latissima*) and in terms of diversity by numerous small foliose red algal species. The invertebrate fauna of the shallow reef areas are dominated by the ascidian fauna and in particular by *Ascidiella aspersa*, *Ascidiella scabra*, *Ascidia mentula* and *Ciona intestinalis*. No particularly rare or endangered species were recorded on the reef habitat during the diving survey.

The remaining 14 dive sites were targeted at the sublittoral sediment community, which proved to be relatively sterile in terms of the epibenthic algae and invertebrates. Generally the biotope was characterised by a surface film of epipelagic diatoms, a mobile crab and fish fauna and very little else. However at 9 of these sites, the Slender seapen (*Virgularia mirabilis*) was recorded a species which is characteristic of the 'Deep Mud' Biodiversity Action Plan (BAP) habitat. The biotope also appears to fit the shallow stable mud biotope - *Philine aperta* and *Virgularia mirabilis* in soft stable infralittoral mud, even though the Opisthobranch, *Philine aperta* was not recorded.

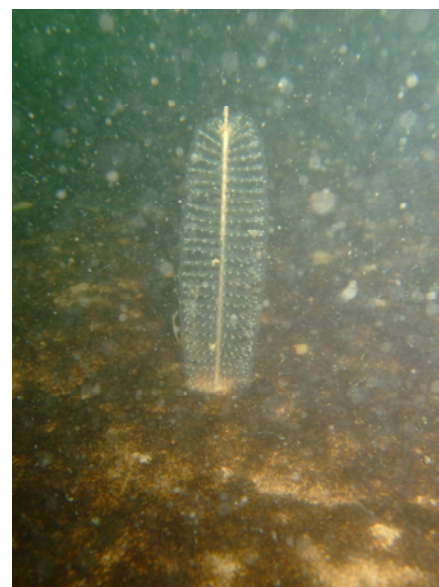


Figure 15 *Virgularia mirabilis* emerging from the sediment.

At dive sites 13 and 25, five x 0.01m² diver cores were taken and processed to extract the invertebrate infauna. This data is shown below. An accompanying sediment particle size distribution (PSA) and organic content sample was also taken from the surface 50mm of the sediment biotope at each of the dive sites sampled by diver coring. The analysis of these physical and chemical sediment properties are also shown in Appendix 1 with the intertidal sediment data..

Table 7 Sublittoral diver cores - Invertebrate infaunal analysis

MCS	Station	West of the Marina					North Moorings				
		25.1	25.2	25.3	25.4	25.5	13.1	13.2	13.3	13.4	13.5
	Taxon										
P08710	<i>Nephtys hombergii</i>								2		1
P13980	<i>Caulleriella zetlandica</i>						8	3		2	
P14040	<i>Chaetozone gibber</i>						43	34	25	37	40
P14230	<i>Tharyx A</i>	21	35	6	15	9					
P14240	<i>Aphelocheata marioni</i>						56	68	41	49	64
P18860	<i>Melinna palmata</i>						6	15	8	16	11
P24890	<i>Tubificoides pseudogaster</i>	23	22	7	5	39					
W02720	<i>Hydrobia ulvae</i>	28	13	26	12	13		1	1		
W16180	<i>Nucula nitidosa</i>						15	22	6	8	13
W16500	<i>Mytilus edulis</i>		1	1		1					
W18520	<i>Thyasira flexuosa</i>						1	2		1	
	No. Species/Taxa	3	4	4	3	4	6	7	6	6	5
	No. Individuals	72	71	40	32	62	129	145	83	113	129
	Biotope Version 97.07-Littoral Sediments	SS.SMU.SMuVS.AphTubi					SS.SMU.SMuVS.AphTubi				
	Description	Aphelocheata marioni and Tubificoides spp. in variable salinity infralittoral mud					Aphelocheata marioni and Tubificoides spp. in variable salinity infralittoral mud				

The 'North moorings' site cores were found to be dominated by the cirratulid family of polychaetes, *Chaetozone gibber*, *Aphelocheata marioni* and *Caulleriella zetlandica* and the species assemblage fits well with the description of the biotope *Aphelocheata marioni* and *Tubificoides* spp. in variable salinity infralittoral mud. This invertebrate assemblage coupled with the recorded epifauna, such as *Sagarteogeton* also fits well with the *Philine aperta* and *Virgularia mirabilis* in soft stable infralittoral mud biotope. The 'West of the Marina' site also fits the former description of this infaunal biotope even though cirratulid species *Aphelocheata marioni* has been replaced by *Tharyx A.* at this site, as this is allowed for in the National Biotope Classification. Again no rare or endangered species were recorded in the diver cores taken within the harbour.

5 Discussion

This suite of surveys has updated the state of knowledge of the marine ecology of the Holyhead harbour area. The intertidal area has been shown to have a high diversity of biotopes. This is due to the mixture of sediments types and reef areas at all tidal levels, which particularly in terms of the reef, allows all littoral zones to be colonised by the naturally occurring flora and fauna, producing some classic zonation patterns.

The natural sediments of the intertidal zone are without doubt highly impacted by bait digging activities within the harbour and in particular the muddy gravels at mid and lowershore levels. The infaunal cores taken from the muddy gravel and analysed for this survey, reflected this in terms of their low diversity.

Several alien species were recorded during the survey and in the intertidal zone the most notable of these was the Pacific oyster, whilst in the subtidal zone *Heterosiphonia japonica* and *Styela clava* were also recorded, the former in some considerable abundance.

In the sublittoral zone the occurrence of the 'Slender seapen' in the shallow waters of the harbour area in the southern half is of particular interest (Figures 13 and 14). This species is characteristic of the BAP habitat 'Deep mud'. However this is not a 'Deep mud' environment and the species assemblage also appears to resemble the '*Philine aperta* and *Virgularia mirabilis* in soft stable infralittoral mud', only the *Philine aperta* appears to be missing.

The presence of the 'Slender seapen' should not be totally unexpected in this location, as this species does seem to frequently occur in shallow muddy harbours. One theory behind which is that it is due to the long-term presence of fishing boats which are thought to have introduced the 'Slender seapen' in many places through the action of cleaning their decks and nets in the vicinity and thus introducing some live specimens accidentally. The infauna of the 'Slender seapen' biotope was shown to be depauperate, but similar to that described in the '*Philine aperta* and *Virgularia mirabilis* in soft stable infralittoral mud', in the National marine habitat classification.

The shallow sublittoral and littoral fringe reef in the western quadrant of the survey area, was also shown to hold an algal community of high diversity, which may warrant further study.

With the exception of the 'Slender seapen' biotope, no rare or endangered biotopes or species were recorded in the harbour area during this survey.

6 References

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Appendix 1 Particle size distribution and loss on ignition data for the infaunal samples

Sediment category	Size	Phi	Porth Y Felin	Yacht Club Beach	West of Marina	North Moorings
Medium pebble (gravel)	> 8 mm	< -3	1.71	51.33	0	0
Small pebble (gravel)	4-8 mm	-2 to -3	2.82	14.92	0	0
Granule	2-4 mm	-1 to -2	4.44	13.38	0	0.09
Sand - very coarse	1-2000 µm	0 to -1	4.56	17.99	0.02	0.33
Sand - coarse	500-1000 µm	1 to 0	3.04	2.15	0.09	0.27
Sand - medium	250-500 µm	2 to 1	5.30	0.07	0.47	0.64
Sand - fine	125-250 µm	3 to 2	14.34	0.05	2.02	1.17
Sand - very fine	63-125 µm	4 to 3	13.77	0.02	4.50	1.76
Silt & Clay	< 63 µm	>4	50.02	0.09	92.89	95.75
Loss on ignition			6.96%	0.58%	11.18%	9.55%