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Broad-scale biotope mapping of potential reefs in the Irish Sea (north-west of Anglesey)

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4. Integrated assessment

The results of the acoustic and biological data analysis and interpretation were integrated in order to provide an overview of each of the areas surveyed. The biological results of the North Anglesey survey work were also compared with those from other studies in the region surrounding the four survey areas in order to give a more complete environmental overview of the region. Relatively little data from other studies was located directly within the four areas surveyed during the current project, though data points pertaining to grab samples and images were found within a few kilometres of the blocks. These originated from the Irish Sea Pilot survey (ERT Ltd. 1995), and from an investigation into the distribution of *Modiolus modiolus*, carried out as part of the Strategic Environmental Assessment (SEA6) (Rees 2005). In addition to previous survey data, the results were also examined in relation to modelled biotope maps generated during the HABMAP project (Robinson *et al.*, 2007). However, it should be noted that modelled habitat predictions in the four survey areas were based on physical data of unknown confidence, and BGS sediment data of low confidence (as reported in Robinson *et al.*, 2007).

4.1 Area 1

Survey Area 1 was the most north-easterly of the four survey areas. It was characterised by the presence of ribbed moraines, which were visible as parallel ridges on the multibeam bathymetry. These moraines, oriented NW–SE, ranged in depth from 40–70m and were surrounded by deeper areas from which the moraines arose. The moraines were commonly 200–250m in length, 100–120m wide, and in places were found to be up to 9m high, although heights of 2–3m were more common. The moraines were not clearly visible in the backscatter data, however, thin lineations of lighter backscatter were observed, running across the area in a roughly E–W direction, approximately aligned to the dominant current. These streaks could be associated with the movement of modern fine sediments across the area along the direction of the predominant currents. The stronger currents could also prevent the bedform features from being buried or eroded.

The ground-truthing data obtained from video and grabs showed a substrate that ranged from coarse sand and gravel to coarser pebbles and cobbles with occasional boulders. The alternating pattern of dark and light backscatter streaks appeared to be reflected in changes in substrate type observed on the video footage; a number of tows running across these streaks showed an alternating pattern of shell, gravel and coarse sand substrata with boulder and cobble substrata. The substrate was also moderately shelly, with scatterings of empty *Modiolus modiolus* shells. Where grabs were obtained, the sediment tended to be gravelly and sandy.

Due to the variety and scale of the features imaged by the multibeam, it was to be expected that the habitats would similarly show a very complex distribution, with small-scale changes.

Eight grab samples were obtained within Area 1. Samples obtained from the tops of moraines and lower slopes of the rocky outcrops demonstrated variations of the SS.SCS.CCS.MedLumVen biotope, with some samples containing abundant *Mytilus edulis* (cluster c) and some samples being relatively impoverished (cluster b). The one sample taken from a deeper area in between seabed features contained a very sparse infaunal community

(sample 35.2). Due to the low number of samples taken it was not possible to determine any relationships between the infaunal community and the underlying acoustic data.

All but one of the eight biotopes determined from the video analysis were present within Area 1. The impoverished biotope SS.SCS.CCS.1 was not recorded. The biotopes associated with coarser sediment (CR.MCR.EcCr.FaAlCr.Adig, CR.MCR.EcCr.FaAlCr.Bri, CR.MCR.EcCr.FaAlCr.Flu and SS.SMx.CMx.FlyHyd.1) were generally found associated with the tops and slopes of the rocky moraines, whereas SS.SMx.CMx.FlyHyd.2, which is characterised by finer sediment, tended to be on the slopes of the moraines. The brittlestar dominated biotope, SS.SMx.CMx.OphMx was also present on the slopes of moraines, however brittlestar beds are known to move over time, so this pattern of distribution could alter. Areas dominated by empty *Modiolus modiolus* shells (biotope SS.SMx.CMx.1) were found on both the slopes of moraines and the top of a rock outcrop, however no live adult *M. modiolus* were recorded anywhere in the area either within video footage or grab samples, although one grab sample (41.1) did contain significant numbers of live juvenile *M. modiolus*.

Very little Annex I reef habitat was recorded in Area 1. Only three small patches of reef were observed on the video footage (max 12m length of tow), and these were essentially patches of boulders that occurred in an otherwise gravel dominated habitat.

The faunal and substrate observations made throughout survey Area 1 are moderately comparable to those observed in other studies nearby, as well as with some of the biotope predictions made by the HABMAP project. All of these data sources indicate that the area is highly complex, with mixed sediments and mosaics of different biotopes occurring within small areas that cannot be easily discerned without fine scale ground-truthing work.

HABMAP predicted biotope maps for survey area 1 were based mainly on underlying BGS seabed sediment designations in this area, since little additional survey data was available on which to base modelled outputs. The biotope SS.SSa.IMuSa was predicted in the north and east of Area 1, with a low confidence score (only scoring 3.98 out of a maximum value of 8.00). In contrast, video tows from the same location obtained during the current study (tows 1.33 and 1.34), recorded biotopes SS.SMx.CMx.FlyHyd.2 on pebbles and gravel and CR.MCR.EcCr.FaAlCr.Bri and CR.MCR.EcCr.FaAlCr.Flu on boulders and cobbles, while results of infaunal analyses on grabs from the same location indicated communities belonged to the SS.SCS.CCS.MedLumVen biotope. This comparison clearly indicated that the HABMAP prediction did not accurately reflect the nature of the benthic community in the north / north-west of Area 1.

The remainder of survey Area 1 was predicted by the HABMAP project to contain the tide swept mixed sediment biotope SS.SMx.CMx.FluHyd (with a confidence value of 6.04 out of 8.00), possibly as a mosaic with other rock and sediment biotopes, which corresponded with the mixed nature of the sediments observed in the current study. Grab samples taken during this project in the southern and central regions of Area 1 were identified as the biotope SS.SCS.CCS.MedLumVen. This same biotope was also predicted by the HABMAP model in the east of the survey area, though this had a lower confidence score, and was predicted in combination with other biotopes such as SS.SMx.CMx.FluHyd and SS.SCS.CCS.PomB (*Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles) with low confidence.

Video tows from the centre and south of Area 1 showed the substrate to be mixed, with frequent patches of cobbles and boulders. Visible epifauna was mostly assigned to the biotopes CR.MCR.EcCr.FaAlCr.Bri, SS.SMx.CMx.FlyHyd, CR.MCR.EcCr.FaAlCr.Flu, and CR.MCR.EcCr.FaAlCr.Adig with a patch of SS.SMx.CMx.1 (*M. modiolus*) being observed at the southern end of the survey area. In general the results showed some similarities with the HABMAP predictions for mixed sediment biotopes in the area, though indicated that boulders, cobbles and associated rock biotopes were more likely to occur than predicted during the HABMAP modelling work. This is likely due to the fact that the sediment map used for this area did not accurately reflect the sediment types observed during the North Anglesey survey work, adversely affecting the quality of the model's outputs.

No other survey data records were available for comparative purposes within Area 1. However, grab sample data collated during the Irish Sea Pilot (ERT Ltd. 1995) from approximately 11.3km North East of the study area had recorded the biotope SS.SCS.CCS.MedLumVen (as predicted by the HABMAP study in the east of area 1). Still images taken approximately 7.6km south of the area by Ivor Rees (as ground-truthing for a survey carried out as part of SEA6) showed the seabed was composed of lag gravel with overlying linear features and mounds, possibly with *M. modiolus* shells (Rees 2005). This tied in with the substrate types observed throughout parts of Survey Area 1, along with the observation of *M. modiolus* shells in the southern most video tow (1.38).

4.2 Area 2

Area 2 lay to the west of Area 1, and was slightly deeper, with a depth range of 50–100m. Area 2 was characterised by a series of around 200 drumlins, 100m–400m in length, which were present throughout the study area. Associated with the drumlins were long flutes forming tails of up to 1400m in length. Other glacial features were also abundant in the area. The drumlin and flute features were visible in both the bathymetry and backscatter data. Video footage revealed the substrate was generally characterised by gravel, pebbles and cobbles with occasional areas of boulder piles from the glacial till forming the drumlins.

In some locations, lower backscatter intensity values were associated with sediment waves, which ran perpendicular to the dominant tidal current. Video footage indicated these sediment waves were formed by coarse sand, which contrasted with the surrounding diamicton and lag deposits. In general the substratum was not very shelly, and where grabs were obtained these indicated the sediment to be very poorly sorted coarse sand and very fine gravel.

As with Area 1, it was anticipated that the complex topography of the area would result in a similarly complex distribution of habitats. This was indeed found to be the case, with frequent changes in biotopes recorded along the video tows. These changes in biotopes occurred on a very fine scale (often tens of metres), which meant that it was not possible to confidently determine any relationships between the distribution of biotopes and changes in the acoustic properties of the seafloor, which were mapped on a similar scale (10m resolution), although some patterns could be observed. The alternating pattern of light and dark backscatter, aligned to the direction of the dominant current, appeared to be reflected in the alternating habitats observed on the video footage. Where video tows crossed changes in backscatter, the observed habitat appeared to alternate between finer gravel, cobble and sand habitat and coarser boulder habitat. However, due to the resolution, and the small number of

video tows that actually crossed changes in backscatter, the specific location of changes in the backscatter and biotope could not be matched (e.g., Video 2.28, see Figure 60).

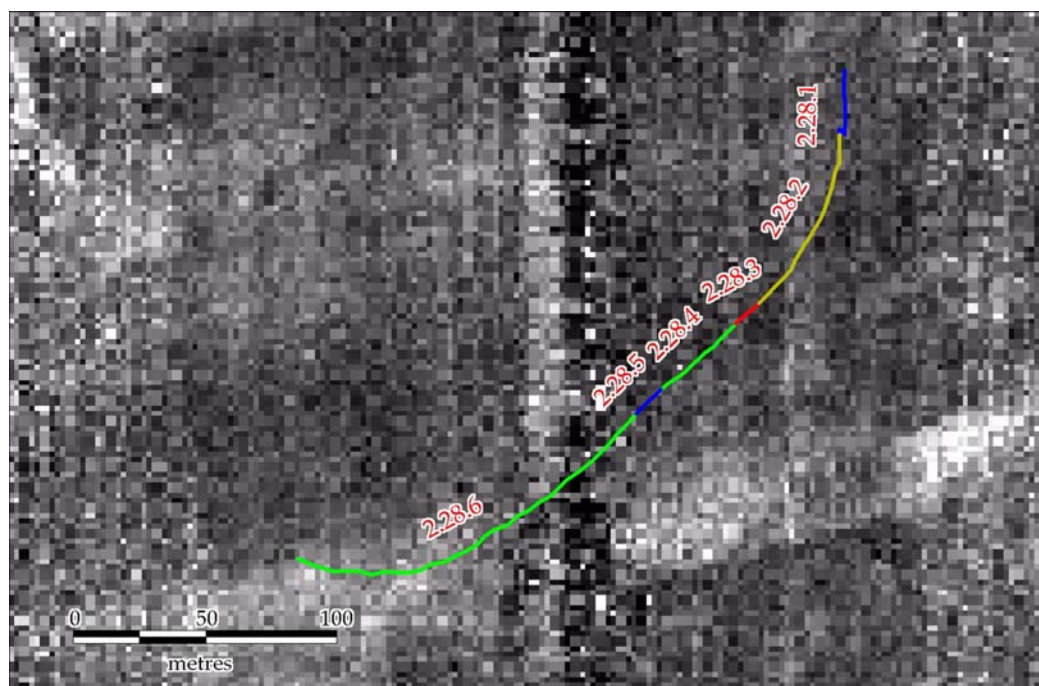


Figure 60. Video tow 2.28 symbolised according to biotope, draped over backscatter

In Area 2, five of the eight biotopes identified from the videos were present, representing typically scour-tolerant communities. The most commonly occurring of these was CR.MCR.EcCr.FaAlCr.Flu, which was present throughout the area, although SS.SMx.CMx.FlyHyd.1, SS.SMx.CMx.FlyHyd.2 and SS.SCS.CCS.1 were also common. SS.SMx.CMx.FlyHyd.1 seemed to occur mainly on the larger rock features and on the tops of drumlins, whilst the other biotopes present, which were characterised by more gravelly substrata, were associated with the slopes and flatter areas in between bedform features. No dense beds of brittlestars were observed in this area, nor were there any areas with high abundance of empty *M. modiolus* shells that were common in other study areas.

The observed biotopes were compared to those predicted by the HABMAP project. The HABMAP project predicted three different biotopes in Area 2, with results being very similar to Area 1. The biotope SS.SSa.IMuSa was again predicted with low confidence in the north and west of the survey area, while SS.SMx.CMx.FluHyd was predicted in the central, south and eastern parts of the survey area with reasonable confidence (scoring 6.04 out of 8), along with the less likely SS.SMu.CSaMu.LkorPpel biotope (which was predicted with a lower confidence score of 4.79). Again, these predictions were based on original BGS sediment data, which was found to be inconsistent with the actual sediment types recorded in many areas sampled during the current study. Biotopes recorded during video work were similar to those in Area 1, with SS.SMx.CMx.FlyHyd being observed on mixed sediment in the centre and north of the survey area (as predicted by HABMAP) along with three further biotopes that were not predicted by HABMAP; CR.MCR.EcCr.FaAlCr.Adig and CR.MCR.EcCr.FaAlCr.Flu on cobbles, pebbles and boulders, and SS.SCS.CCS (barren gravel). Videos in the south of the survey area similarly reported a mix of biotopes and substrates, again with SS.SMx.CMx.FlyHyd being commonly observed (matching the FluHyd HABMAP prediction), along with the additional biotopes (not predicted by

HABMAP) SS.SCS.CCS, CR.MCR.EcCr.FaAlCr.Adig and CR.MCR.EcCr.FaAlCr.Flu in areas where boulders, pebbles and cobbles were more predominant.

Only four grab samples were obtained in this area, all of which represented the same characteristic circalittoral coarse sand biotope, SS.SCS.CCS.MedLumVen. All of the samples were obtained from the top of drumlin flutes. No other grab data from other studies was available for comparative purposes within Area 2.

As in Area 1, results from Area 2 showed this to be composed of complex mixed substrates that were home to both infaunal and epifaunal communities. Further detailed ground-truthing survey work would be required to map habitats in more detail in this area.

Area 2 had a number of patches of Annex I reef that were identified through the video analysis. In general these were moderately small patches of reef (average length 29m) which occurred within the area of drumlins, and which tended to be found alternating with other non-reef habitats. For example, patches of Annex I reef of biotopes CR.MCR.EcCr.FaAlCr.Adig and CR.MCR.EcCr.FaAlCr.Flu tended to be found alternating with patches of SS.SMx.CMx.FlyHyd.1 which was not Annex I reef. The areas of reef did not appear to follow any pattern that could be correlated with the interpreted acoustic data, or any other pre-existing data that was reviewed, and so it was not possible to delineate an area of Annex I reef. However, due to the close association with the drumlins, and the fact that the drumlin field appeared to continue beyond the boundaries of the study area, it is likely that occurrences of Annex I reef would also be found in the immediate area outside the boundaries of Area 2.

4.3 Area 3

Area 3 was dominated by an extensive shallow plateau at about 30m water depth, clearly visible on the bathymetry, with steep slopes along the plateau edge. In common with Areas 1 and 2, the backscatter image for this area showed streaks running along the direction of the dominant tidal current, which could result from the effects of tidal scour, leaving behind lines of coarser gravelly sediment. The majority of video tows in this area did not cross any marked changes in backscatter amplitude. However, one tow in this area (3.3) ran across dark streaks in the backscatter, and appeared to show a correlation, whereby patches of SS.SMx.CMx.FlyHyd.1 corresponded to darker streaks on the backscatter, whereas elsewhere the sediment was more shelly, and represented by lighter backscatter (Figure 61).

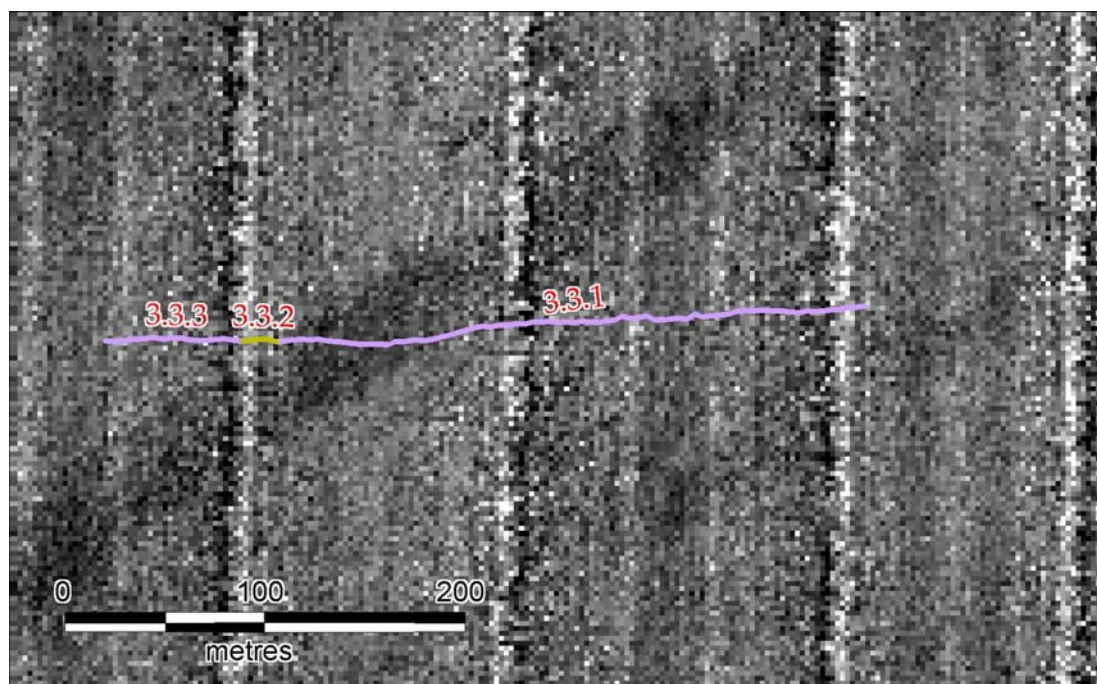


Figure 61. Video tow 3.3 overlain on backscatter

In other parts of Area 3 the changes in backscatter observed were more complex and varied on a finer scale. For example video tow 3.4 passed over an area of more complex backscatter with darker streaks. Frequent changes in the substrate were observed, however, spatially, the changes in biotope did not seem to match the changes in backscatter, perhaps due to the degree of error in positioning exceeding the resolution of the observed changes.

No grabs were taken within Area 3, but analysis of the video footage indicated that the sediment was predominantly compact gravel and sand with loose empty *Modiolus modiolus* shells scattered on the surface. The average abundance of shells in this area was the highest of all four study areas (average 22% cover by visual assessment). Occasional patches of coarser cobble and gravel substrate with boulders also occurred.

A feature of interest within Area 3 was the presence of large isolated sediment waves, up to 12m high. These sediment waves were trochoidal type, nearly symmetrical in cross section and transverse to the tidal flow. These features have also been recorded elsewhere in the Irish Sea during the HABMAP project, but have not been previously described and their origin is unknown. No ground-truthing samples were obtained over this feature within Area 3.

Modelled biotope predictions from the HABMAP project within Area 3 reflected the underlying BGS sediment designations, with predicted rock, pebble and cobble biotopes dominating the raised shelf area. As in Areas 1 and 2, some discrepancy was noted in Area 3 between the BGS sediment maps and the observed sediments, with BGS delineating the raised shelf area that dominated the region as diamicton, as opposed to the mixed gravelly sediments observed during video tows in the area. This naturally led to some discrepancies between biotopes predicted by the HABMAP project and biotopes observed within the current study.

Biotopes predicted with reasonable confidence in Area 3 included CR.HCR.XFa.FluCoAs, CR.HCR.XFa.SpNemAdia (Sparse sponges, *Nemertesia* spp., and *Alcyonidium diaphanum*

on circalittoral mixed substrata) and CR.HCR.XFa.CvirCri (*Corynactis viridis* and a mixed turf of crisiids, *Bugula*, *Scrupocellaria*, and *Cellaria* on moderately tide-swept exposed circalittoral rock) (all with confidence scores between 5.00 and 6.00), with SS.SCS.CCS.PomB being predicted with lower confidence. However, actual video and grab results from five locations on the raised shelf showed the sediment to be mixed, with embedded boulders, gravel and shell. Biotopes observed during video tows generally reflected this type of substrate, with SS.SMx.CMx being the most commonly observed biotope, in contrast to the biotopes predicted by the HABMAP study. However, a patch of CR.MCR.EcCr.FaAlCr.Flu was observed on the southern edge of the shelf, suggesting that rock biotopes did occur in the survey area, albeit less frequently than predicted by the HABMAP study. It is likely that patches of underlying rock and or boulders were also present elsewhere in the survey area.

Surrounding the raised shelf, HABMAP biotope predictions of reasonably good confidence included SS.SCS.CCS.MedLumVen and SS.SMx.CMx.FluHyd in the north, east and southwest, along with a small area of SS.SSa.IMuSa of low confidence in the southeast. These were a reasonable match with video results in the north east of Area 3 where a mixed sediment biotope was observed.

No grab data from other studies, either within or around survey Area 3 were available. However, *Modiolus* shells were abundant in Area 3, along with other areas designated with the biotope CR.MCR.EcCr.FaAlCr.Adig that could be associated with live *Modiolus* (Sanderson *et al.*, 2008); this population could potentially be linked to others noted during the BIOMOR survey and by Ivor Rees off the North and West coast of Anglesey as observed during the SEA6 surveys (Rees 2005).

Within Area 3, only one small patch of Annex I reef was found (23m in length). This patch was in a video tow that was otherwise dominated by *M. modiolus* shells (SS.SMx.CMx.1) and SS.SMx.CMx.FlyHyd.1. There was no distinct acoustic signature that corresponded to the reef patch. The multibeam appeared to indicate rougher ground, but other areas with a similar appearance on the multibeam were revealed to be mainly the shelly SS.SMx.CMx.1. Thus, overall it is unlikely that this study area would contain more than small isolated patches of Annex I reef.

4.4 Area 4

The main seabed features visible in Area 4 were bedrock outcrops, which were streamlined by glacial scour. The outcrops were frequently accompanied by scour marks from present day tides.

Variations in backscatter were observed across the survey, but in contrast to the other three survey areas, changes in backscatter amplitude did not appear to correspond to dominant tidal current direction. In the eastern side of the study area, patches of lighter backscatter appeared to correspond to the flatter areas in between topographic highs. Areas of bedrock outcrop were associated with a mottled pattern in backscatter intensity, perhaps reflecting patterns in the overlying sediment.

The nature of the seafloor, as revealed by grab samples and video analysis, was one with areas of coarse sand waves over cobbles and boulders, areas of cobble and pebble substrate with occasionally boulders, and some areas where small boulders and cobbles appeared to

form a more stable substrate. Very little shell was observed in the area in comparison to some of the other study areas. Bedrock was only observed in one video tow. Where grabs were obtained the sediment was very poorly sorted coarse and very coarse sand.

Throughout Area 4, a number of high, symmetrical sediment waves were present, with similar dimensions as the sediment waves in Area 3. A video tow across one of these features indicated the substrate to be moderately scoured gravel and pebbles with coarse sand (tow 4.19.1), supporting a scour-tolerant epifaunal community.

Within this study area four of the eight biotopes defined using the video data were observed, all reasonably frequently. Despite the changes in backscatter, slope, rugosity and aspect that were observed in this area, there did not appear to be any strong correlation between any of these parameters and the biotopes. The clearest patterns could be seen when comparing the distribution of biotopes and the seabed features observed on the bathymetry. CR.MCR.EcCr.FaAlCr.Adig and CR.MCR.EcCr.FaAlCr.Flu tended to be observed with the larger rocky outcrops that were visible, on the slopes and tops of the outcrops as well as on the rocky ridges. SS.SMx.CMx.FlyHyd.1 was most frequently observed on the flatter, deeper areas, such as the crater of the rock feature, the base of rocky outcrops and on the rocky slopes. Finally, SS.SMx.CMx.FlyHyd.2 was also observed within the rocky crater and also on the flatter areas in between the rock outcrops.

Predictive biotope maps from the HABMAP study suggested Area 4 was dominated by mixed sediment biotopes (as in the other survey areas), with SS.SMx.CMx.FluHyd being predicted with relatively good confidence (6.04 out of 8) and SS.SCS.CCS.MedLumVen being predicted with lower confidence (4.70 out of 8). Both of these biotopes were observed in grab and video samples from Area 4 in the current study. A few small patches of SS.SMu.CSaMu.LkorPpel were also predicted with lower confidence in Area 4, though no ground-truthing data was available to confirm or refute these. In general, video tows and bathymetric data revealed a complex mix of topographies, substrates and biotopes throughout Area 4; biotopes observed in video footage changed frequently in some areas in accordance with the changing nature of the seabed. This heterogeneity was not shown in the HABMAP modelled outputs.

As with Area 3, no additional data was available for comparative purposes from within Area 4. However, grab sample data collected during the Irish Sea Pilot survey 3–4km east and west of Area 4 reported the occurrence of biotopes SS.SCS.CCS.MedLumVen and SS.SMx.OMx.PoVen, suggesting that (as for the other survey areas), coarse and mixed circalittoral sediment biotopes were common in the region (Rees 2003). Grab samples taken as part of the current study in the southeast of survey Area 4 contained abundant *S. spinulosa*. It should be noted that *S. spinulosa* crusts are known to be present throughout this part of the Irish Sea, though were only specifically found in high numbers in Area 4 (e.g., Rees 2005).

Several patches of Annex I reef were observed in Area 4 (7 sections, total length 747m). These were on average 106m in length, and some covered the length of entire tows. The reef patches were correlated with the large rocky features (e.g., outcrops or craters) that were visible on the multibeam bathymetry. The rock outcrop visible in the south-west of the study area corresponds with a topographic feature identified in the UKSeaMap project as a ‘shelf mound or pinnacle’ that was defined on the basis of slope and bathymetry (Figure 62) (Connor *et al.*, 2006). The feature follows the 80m bathymetric contour and clearly extends beyond the boundaries of the study area. It is therefore likely that Annex I reef, associated

with this rocky feature, would also extend beyond the study area, although it would be difficult to determine with any confidence the likely abundance of reef within the feature as a whole, as only a small area of this topographic feature has been ground-truthed within this study.

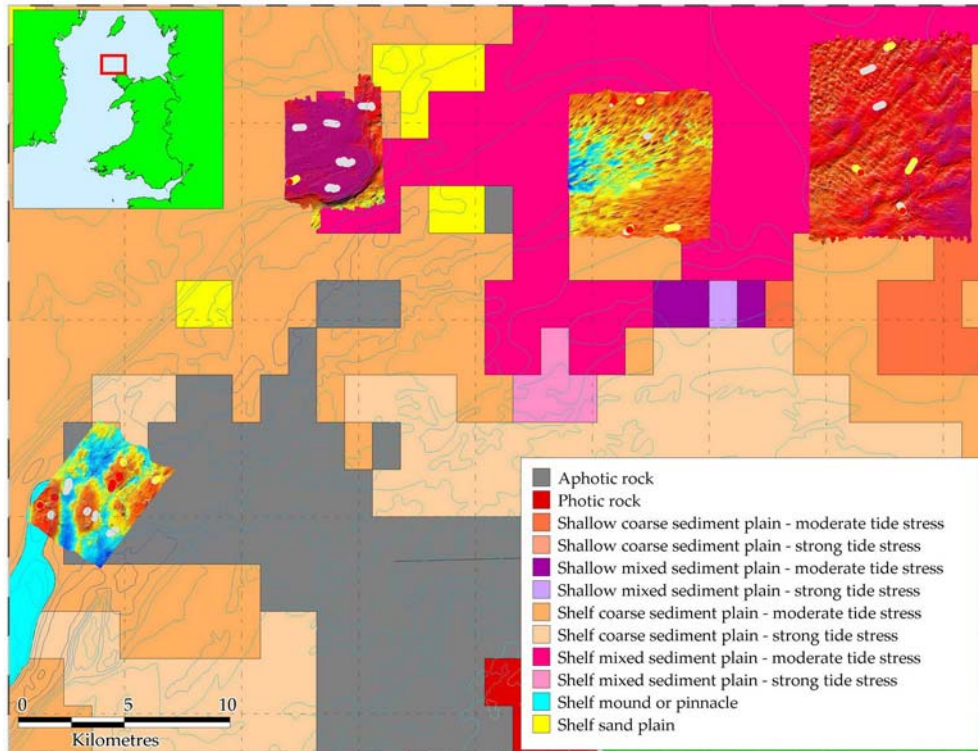


Figure 62. Annex I reef identified by video analysis, overlain on features identified by UKSeaMap (Connor *et al.*, 2006).