Assessment of Outer Ards *Modiolus modiolus* biogenic reefs against Special Area of Conservation (SAC) criteria

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A report from the Fisheries and Aquatic Ecosystems Branch,
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to
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Table of Contents

Table of Figures

1. Introduction

In order to meet Northern Ireland's obligations under the EC Habitats Directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora), Strangford Lough was designated as a Special Area of Conservation under the Conservation (Natural Habitats, etc.) Regulations (Northern Ireland),1995. One of the reasons for this designation was the *Modiolus modiolus* biogenic reef; however this feature is currently in unfavourable condition. A '*Modiolus* Restoration Plan' was developed with the overall aim of restoring Strangford Lough to favourable condition. Implementation of the *Modiolus* Restoration Plan is overseen by the *Modiolus* Restoration Plan Working Group. This group includes DAERA and the key stakeholders associated with the restoration plan. The restoration plan is periodically reviewed and a 2nd revision was agreed by the *Modiolus* Restoration Plan Working Group in July 2015. In this review it was identified that there was a need to protect the *Modiolus* reefs along the Outer Ards, in particular at Craigbrain and Burial Island (Figure 1.1), as examples of Annex I biogenic reef and which may, through larval dispersion, support the gradual recovery of *Modiolus* beds within Strangford Lough. The presence of *Modiolus* reefs at these two sites was first recorded by the Ulster Museum Dive Team in the 1980s. Further commissioned survey work such as The Sub-littoral Survey of NI and various seed mussel surveys by DOE, DARD and AFBI confirmed the presence of two distinct areas which form the basis of this particular study.

To assess whether the *Modiolus* reefs located off the Ards Peninsula may be considered as Annex I biogenic reefs under the Habitats Directive, and to assess the extent of such reef areas, this project was commissioned by DAERA (DOE Marine Division at the time of commissioning) to collate existing/historical data and, where deemed necessary, supplement these with additional surveys, to define the extent of potential Annex I *Modiolus modiolus* reefs at Craigbrain and Burial Island. In particular, the criteria as developed by a workshop in 2014 hosted by the Joint Nature Conservation Committee (JNCC), reported by Morris (2014), were applied to all available data, and this process is described within this report.

Morris (2014) surmises the guidance for positive assignment of Annex I *Modiolus* reef through a two stage process, in which all criteria in stage one must be met prior to evaluation of criteria at stage two. Crucially, stage one requires that:

1. There is presence of live *M. modiolus* individuals;
2. The biota in the area of interest associated with live *M. modiolus* are distinct from the surrounding habitats;
3. This distinct region is in excess of 25m^2 in extent.

In stage two, a number of factors must be considered which differ slightly between Open Coast and Sheltered/semi-enclosed settings (see Box 4.2 of Morris (2014)). In the case of Outer Ards, the Open Coast setting applies, with stage two criteria including:

- The percentage cover of the suspected biogenic reef;
- The number of live individuals per m^2;
- Potentially distinct acoustic signature and elevation.

Confidence in assignment of “biogenic reef” status is also determined based on the stage two criteria. The process of assessing data according to these criteria are detailed within this report, with final recommendations made on extent of biogenic reef and the confidence of assignment of biogenic reef. Finally, further recommendations are made for condition monitoring of biogenic *Modiolus* reef features in this region.

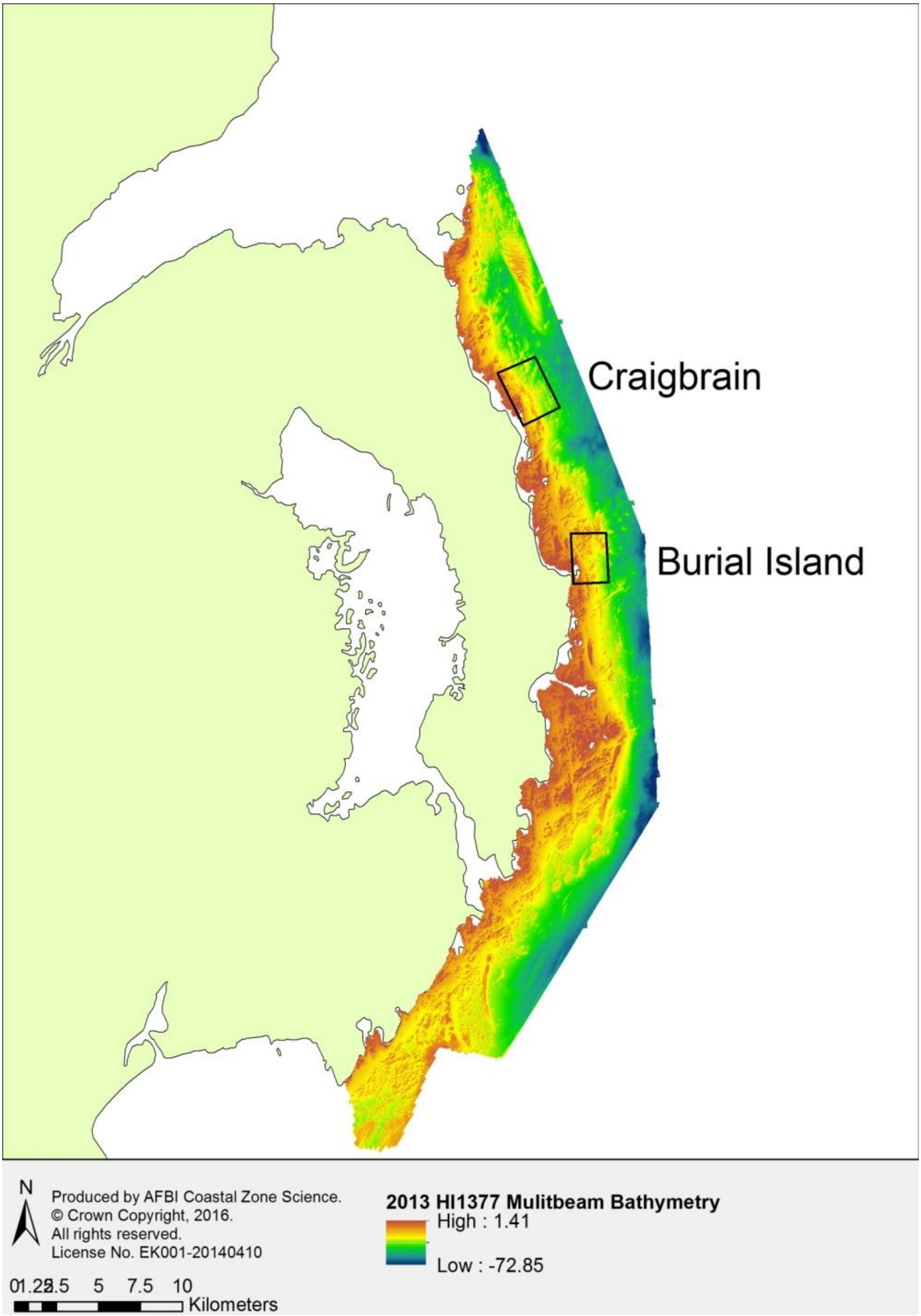


Figure 1.1. The initial survey areas of Craigbrain and Burial Island on the Outer Ards Peninsula.

2. Methodology

2.1. Multibeam echosounder (MBES) data

The UK Hydrographic Office (UKHO) under the Civil Hydrography Programme (CHP) commissioned an IHO Order 1a bathymetric survey of an area extending from outer Belfast Lough to St. John's Point, adjacent to the Ards Peninsula. 'HI1377' was completed in 2013 by UKHO contractors using a Reson SeaBat multibeam echosounder system, and data were cleaned and tidally corrected according to CHP standards, with bathymetric data were exported as a 32-bit floating point Bathymetric Attributed Grid (BAG), with a 2m horizontal spatial resolution. These data were made available via the UKHO's Data Archive Centre (DAC), and have been used within this project. Raw data was also provided upon request to UKHO, however due to issues snippets (fragments of backscatter data that surround bottom detection information for each individual beam) having not been recorded in the raw survey data files, backscatter data could not be mosaiced.

AFBI completed small areas of multibeam using the Kongsberg EM3002 within the Outer Ards area in 2012, with overlap on some of the areas of interest, which have backscatter data available. Investigation of these data are ongoing and will be reported as a supplementary annex.

2.2. Multibeam data post-processing

The HI1377 bathymetric data were post-processed to yield the following derivatives using the Spatial Analyst toolset in ArcGIS 10.3 and Benthic Terrain Modeller (Wright *et al.,* 2012) extension:

1. Slope angle
2. Aspect – northness and eastness
3. Terrain ruggedness

Due to the very large file sizes of the HI1377 dataset, the BAG file was first split into tiles prior to post-processing. Symbology of the resulting data layers were consistent between tiles.

2.3. Ground-truthing data collation

2.3.1. Historic data collation

A variety of data sources were made available to this project:

1. Historic diver records within Marine Recorder, including Northern Ireland Sublittoral Survey dives and recent dives by the DAERA dive team;
2. DAERA grab sample data (2012) including full infaunal species abundance and biomass matrices, and particle size analysis data;
3. QUB grab sample data (2014) indicating number of live *Modiolus* per grab sample;
4. AFBI grab sample data from 2010, 2013 and 2014 including full infaunal species abundance and biomass matrices and particle size analysis data;

5. AFBI annual seed mussel survey data, including dredge survey data and video footage.

These data were examined within ArcGIS 10.3 to ascertain spatial coverage and to examine records within these of living *Modiolus*, and how these may relate to potential acoustic signatures within the multibeam data.

The grab sample infaunal abundance data matrices from 1mm sieved samples were checked against WoRMS (World online Register of Marine Species) to ensure all taxonomic nomenclature was correct and all colonial species and juveniles were removed. Samples were renamed to ensure traceability upon merging different datasets.

From examination of existing video footage it is clear that presence of living *Modiolus* is difficult to ascertain due to the often dense coverage of brittlestars (mostly *Ophiothrix fragilis*, and also *Ophiocomina nigra*) making the visibility of *Modiolus* valves very hard to see. This is coupled with the frequently poor visibility and footage having been taken on a sledge moving faster than optimal speeds due to the strong currents in this area. Conspicuous epifauna (e.g. presence of *Alcyonium digitatum,* starfish, urchins etc.) could be described in addition to substratum descriptions, and provide useful context for the finer scale grab samples and diver data.

In order to ensure the areas of interest (Craigbrain and Burial Island) had an appropriate coverage of samples which could be used for community analysis and quantitative assessment of living *Modiolus*, a gaps analysis was undertaken and a sampling campaign designed to fulfil the project objectives. This additional survey work was completed aboard the R.V. *Corystes* on cruise number CO0516 on 1-4 February 2016.

2.3.4. Sediment grab sampling

Sediment samples were taken from aboard the R.V. *Corystes* using a 0.1m^2 Day grab. The depth of sample retained by the grab was noted, the samples were photographed, described, and sorted to determine how many living *Modiolus* were contained within the sample. For a subset of samples, a sub-sample from each grab was retained for particle size analysis (PSA) and a further sub-sample for sediment nutrients (carbon and nitrogen). The remainder of the sample was sieved using a 1mm sieve, and the residue stored in buffered formalin for processing of infauna. 26 samples had PSA and CN samples processed, while only 22 of the samples collected were processed for infauna due to cost constraints.

PSA data were processed for PSA and the results analysed through Gradistat to help identify textural group and Folk category (which bears relation to the EUNIS biotope classification).
The infaunal data (and epifauna where samples contained shells and pebbles or cobbles) were supplied as a species abundance matrix and total biomass for each sample. These data were subjected to the same checks and pre-treatment as the historic grab data, before being merged in PRIMER statistical package for statistical analysis. These data were fourth root transformed and used to build a resemblance matrix and this was subjected to cluster analysis. Within the cluster analysis, the SIMPROF routine (with a 5% significance level) was used to identify factors which in turn were plotted using multi-dimensional scaling to examine grouping of the infaunal communities from the samples. SIMPER was then used to extract the species responsible for the similarity of each community group. Each sample's group identity was plotted within ArcGIS and information

used to extract potential biotope complex identity. In addition, the resulting community clusters were examined in relation to the presence or absence of living *Modiolus*.

2.3.5. Additional video data collection

Further video data were collected using a towed camera sledge to provide a platform at a constant height above the seabed, using a Sub-C high definition camera, Go Pro camera, lasers (for scale) and appropriate lighting, with an Ultra Short Baseline (USBL) acoustic tracking device to allow high precision positioning of the sledge on the seabed. Unfortunately, conditions were very poor during the field campaign, and in spite of the swell settling enough to permit deployment of the camera sledge the visibility was very poor. Five tows were completed in the Outer Ards area, with conspicuous epifauna visible along with an impression of the structure/elevation of potential living *Modiolus* clumps, which provides valuable context for the grab sample data and how these may relate to potential acoustic signatures. *Modiolus* percentage cover, substratum type, epifauna (with SACFOR abundances) were noted per minute (approx. 30m^2) for each video tow. Biotopes or biotope complexes were assigned to each section of video based on the substratum type and epifauna, according to the MNCR classification (Connor et al., 2004) along with the translation to EUNIS habitat codes.

2.4. Data integration

All data (historic and new survey data) were collated within ArcGIS 10.3 and used to examine relationships between grab sample community data, number of living *Modiolus*, biotope distribution from video and potential acoustic signatures. Together, these data were assessed according to the criteria published in Morris (2014) and biogenic reef extent drawn within the ArcGIS environment based upon the evidence collated.

3. Results

3.1. Multibeam data

The HI1377 reveal complex topographic patterns over both areas of interest, with fringing bedrock and boulder reefs to the west adjacent to the shoreline, and clearly visible mobile bedforms (sand waves and ripples) in much of the area. These features vary from horizontal scales of a few meters (crest to crest) to tens of meters. Such bedforms are typical of tidally swept areas, with larger bedforms also resulting from glacial retreat.

Figures 3.1 to 3.6 below show the bathymetry and bathymetry-derived features for each of the sites (Craigbrain and Burial Island). Attention is drawn to the slope angle and rugosity layers, which show distinctive finer-scale, non-linear ripples over a defined area. Further discussion of potential Annex I *Modiolus* reef acoustic signatures is provided in section 3.3.3 below.

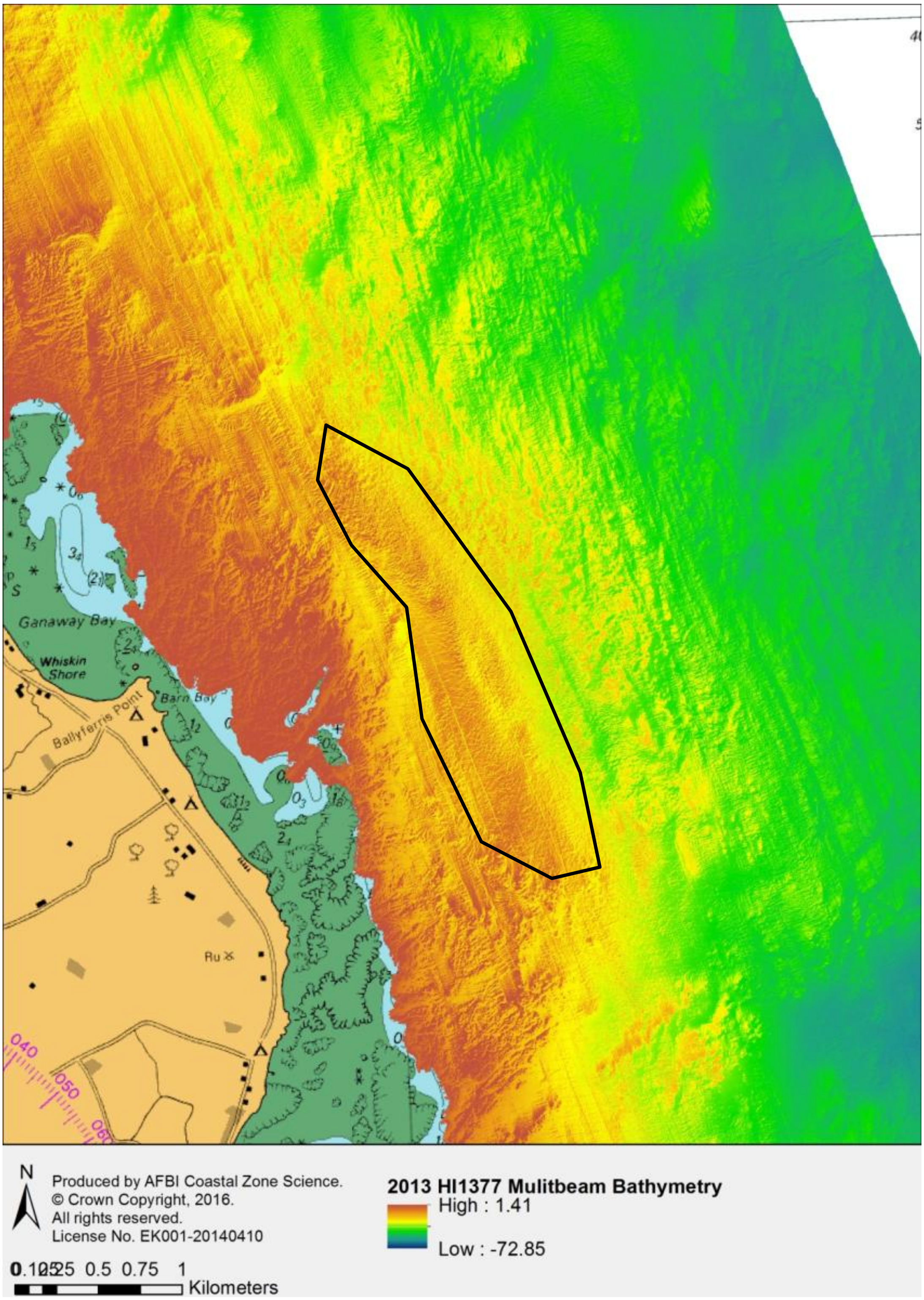
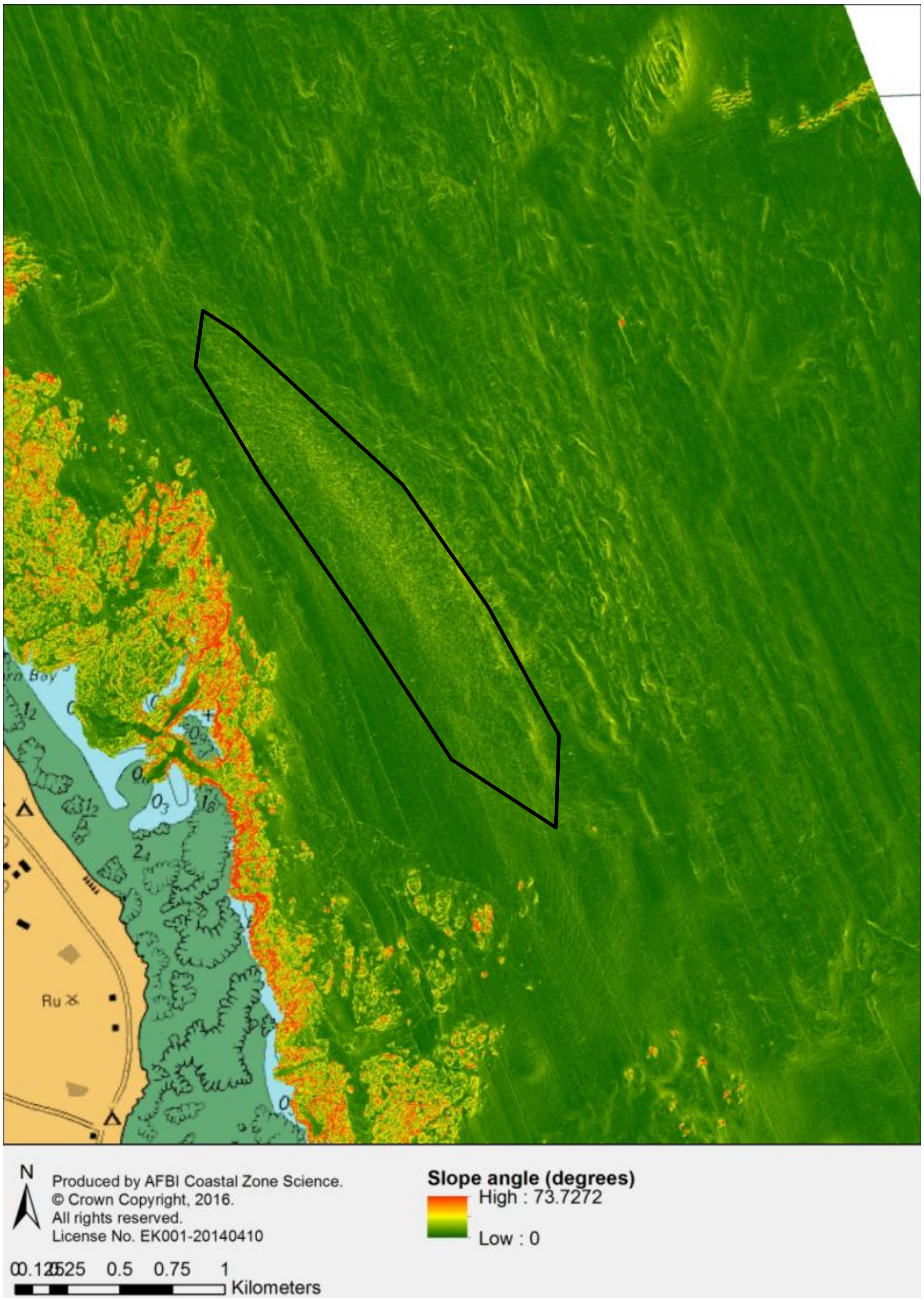


Figure 3.1. Multibeam bathymetry for Craigbrain, with black line highlighting the distinctive finer-scale, non-linear ripples.



. Figure 3.2. Multibeam slope angle (in degrees) for Craigbrain, with black line highlighting the distinctive finer-scale, non-linear ripples.

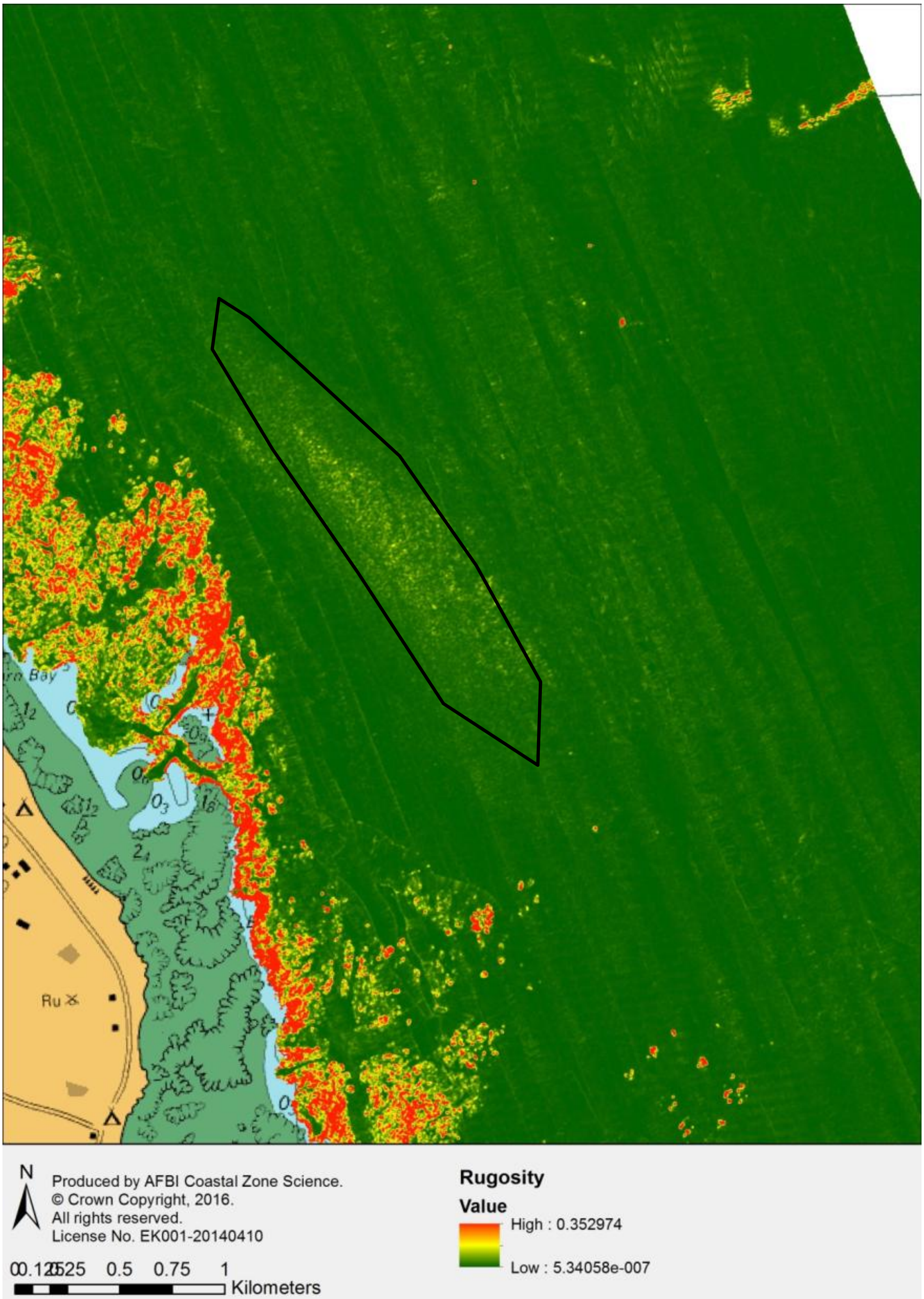


Figure 3.3. Multibeam bathymetry derived rugosity for Craigbrain, with black line highlighting the distinctive finer-scale, non-linear ripples.

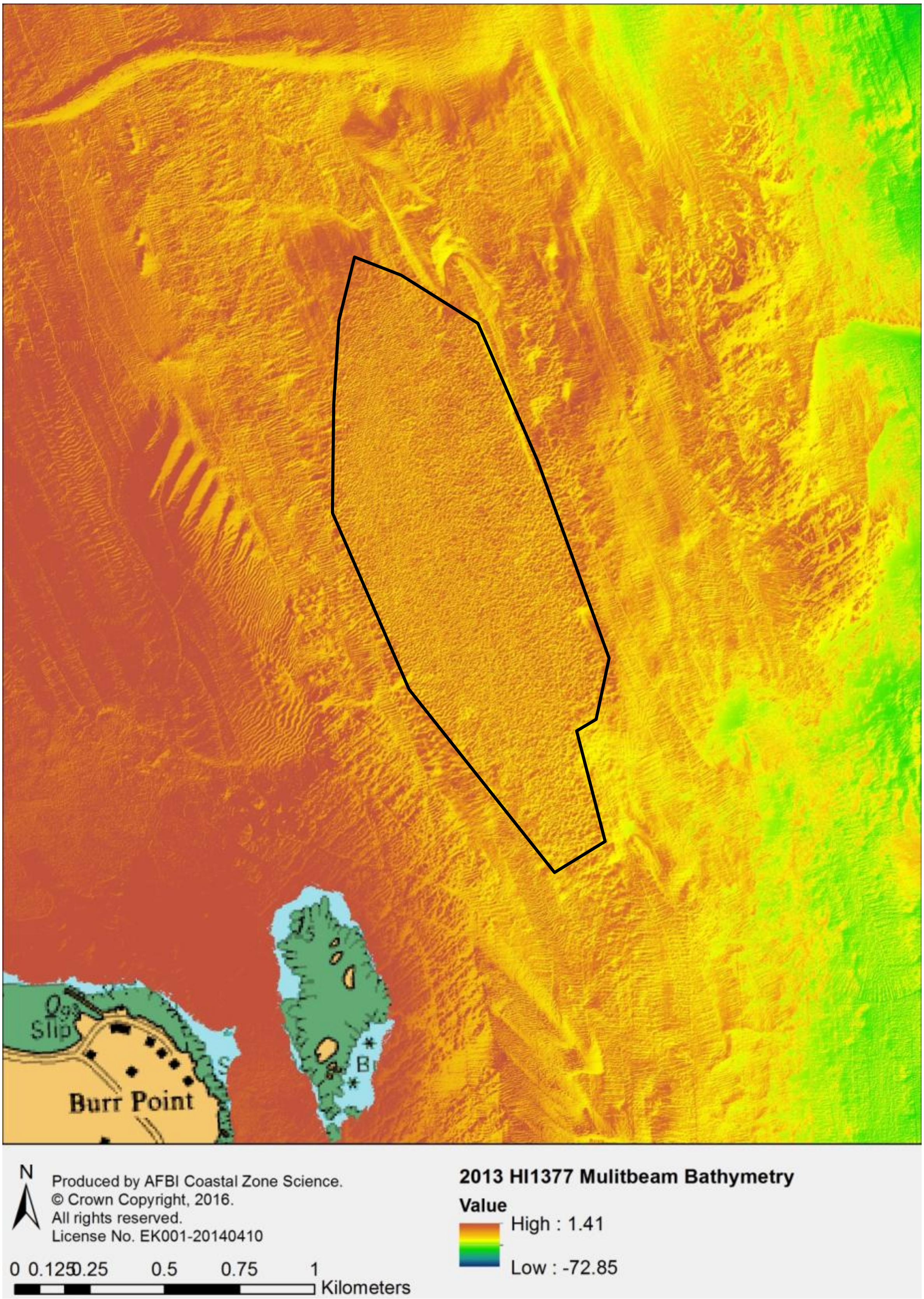


Figure 3.4. Multibeam bathymetry for Burial Island, with black line highlighting the distinctive finer-scale, non-linear ripples.

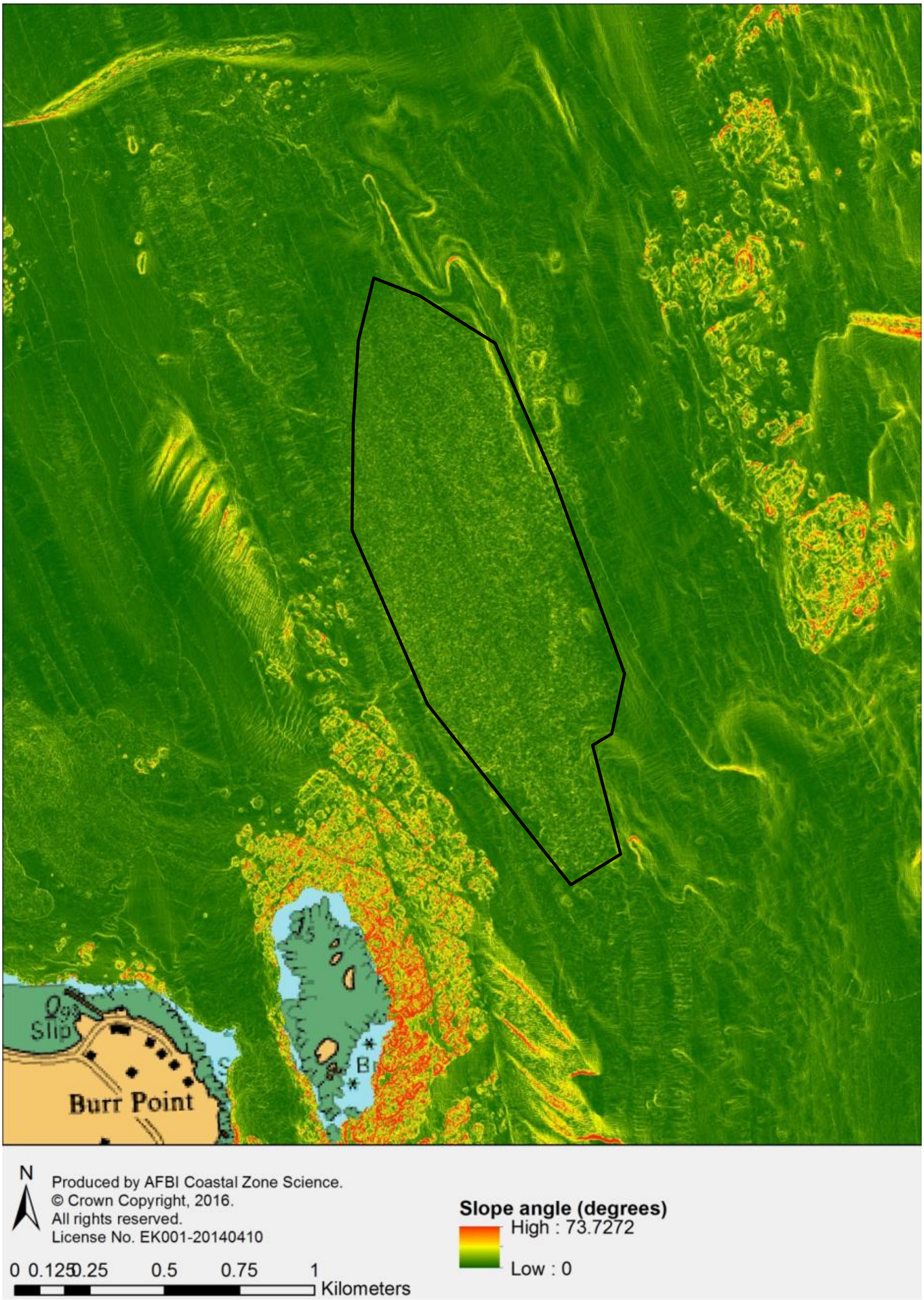


Figure 3.5. Multibeam slope angle (in degrees) for Burial Island, with black line highlighting the distinctive finer-scale, non-linear ripples.

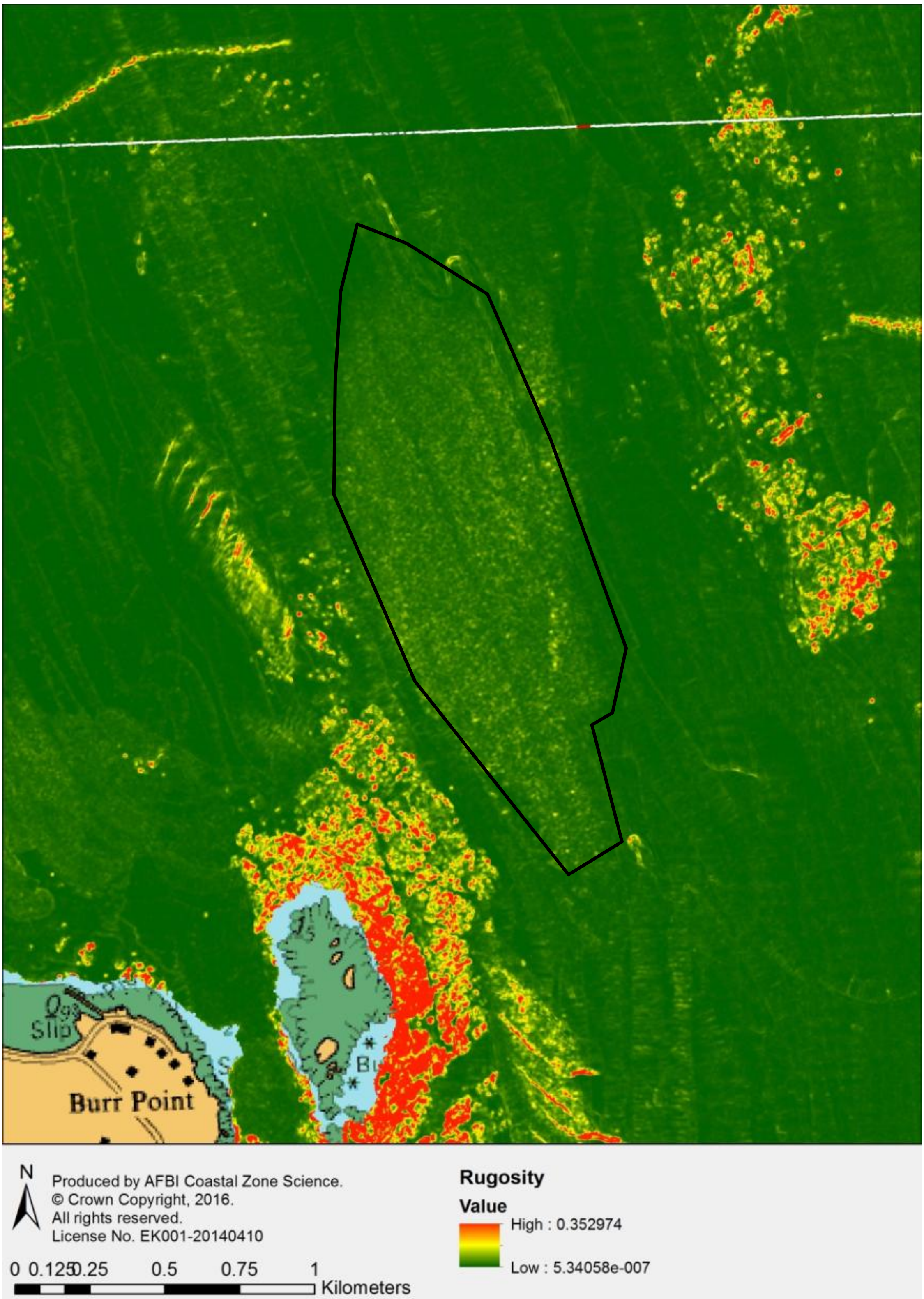


Figure 3.6. Multibeam-derived rugosity for Burial Island, with black line highlighting the distinctive finer-scale, non-linear ripples.

3.2. Sample and video data

The collation of historic and new ground-truthing data is presented by area of interest below (Figures 3.7 – 3.10), with presence of live *Modiolus* plotted and, where available, number of live *Modiolus* per grab sample. Historic video data suffered from the same issues as the new video footage, namely that due to dense coverage of brittlestars, identification and enumeration of live

Modiolus was not possible. Instead, presence of epifaunal species and elevation of potential living *Modiolus* clumps were used to map potential reef extent.

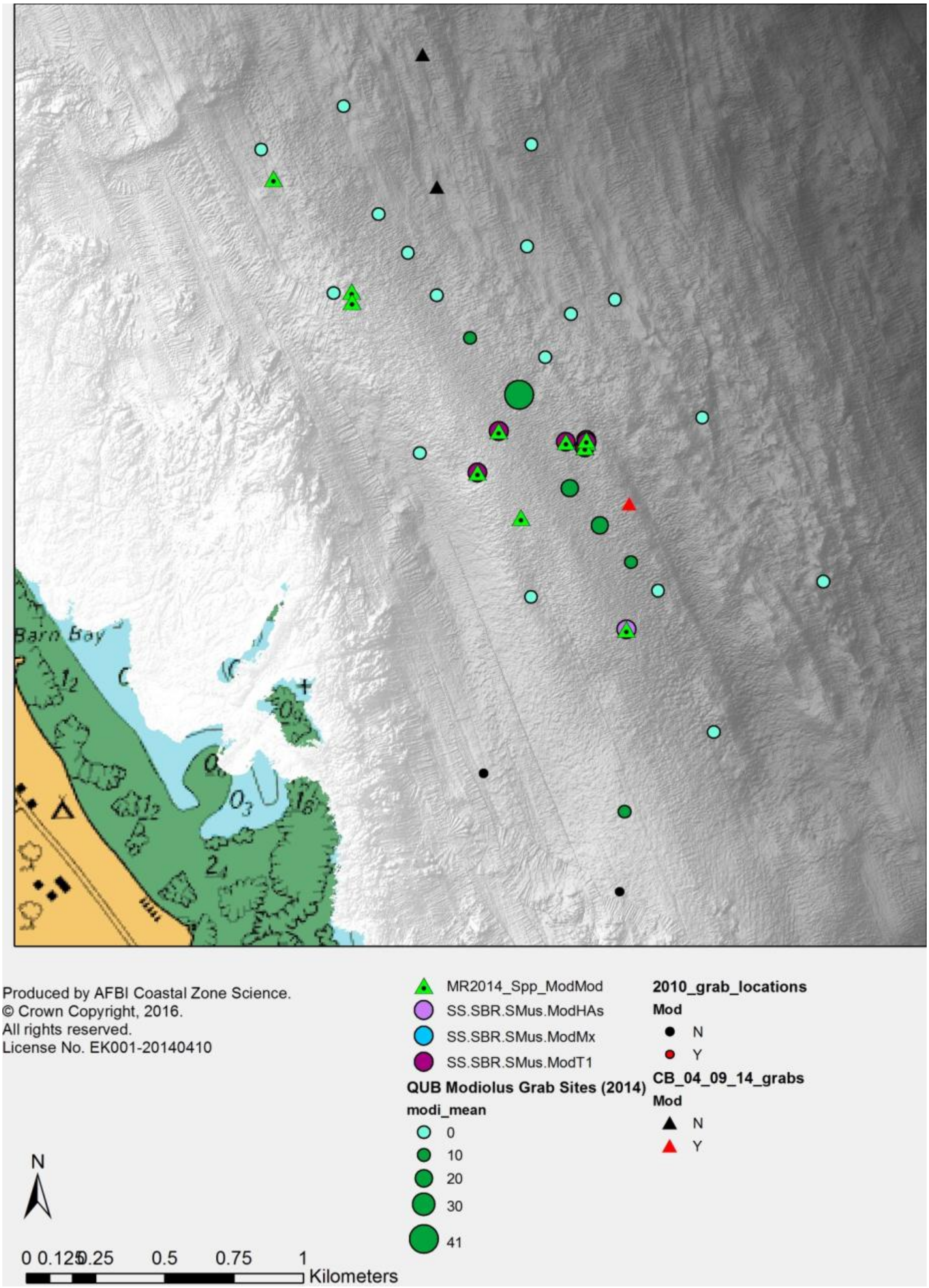


Figure 3.7. Historic sample data for Craigbrain (diver records classified as biotopes where recorded in Marine Recorder). Note QUB grabs are number of live *Modiolus* per grab (not per m^2).

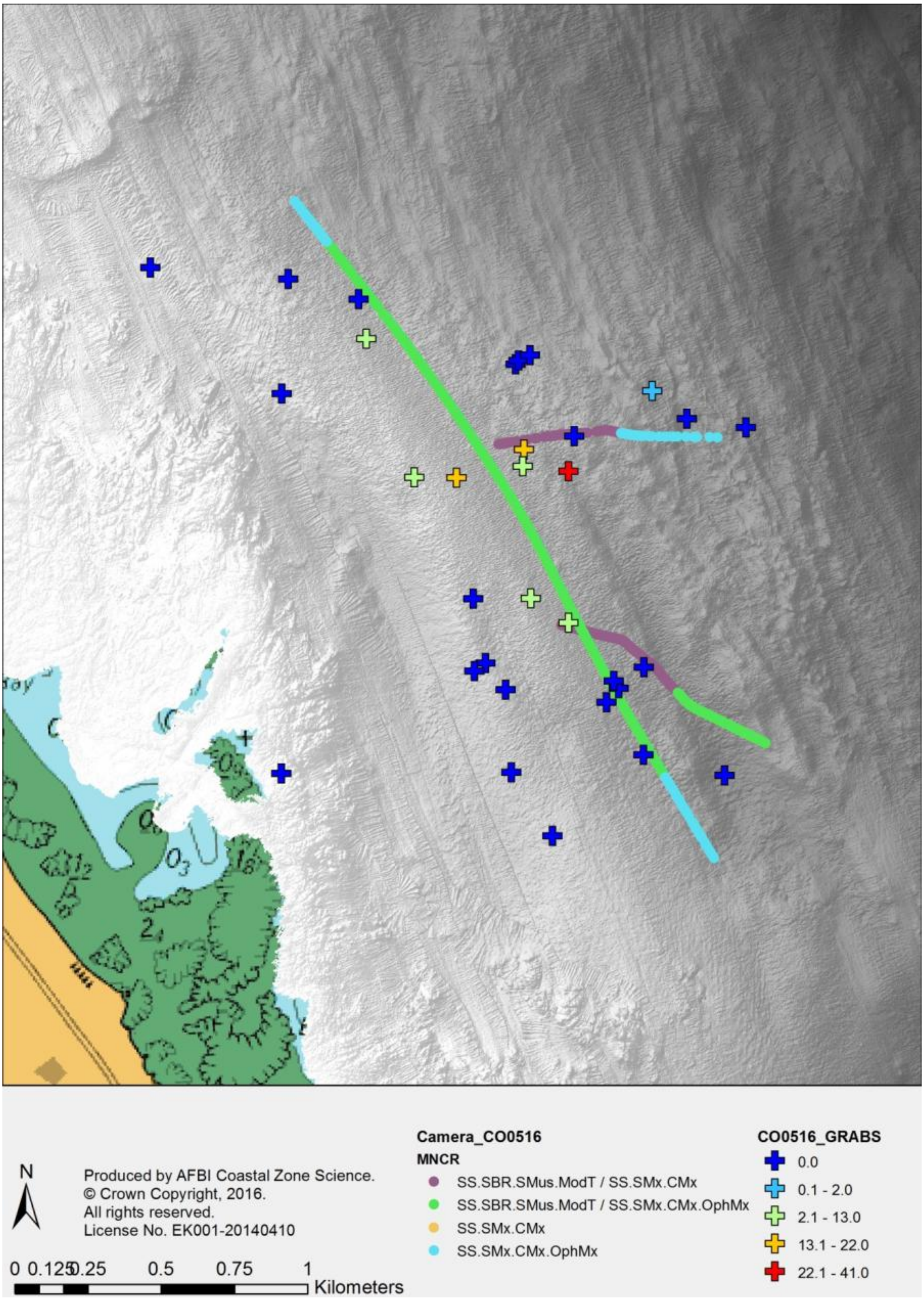


Figure 3.8. Additional sampling (grabs and video) collected on cruise CO0516. Note grab sites are coded according to number of live *Modiolus* within each grab (not per m^2).

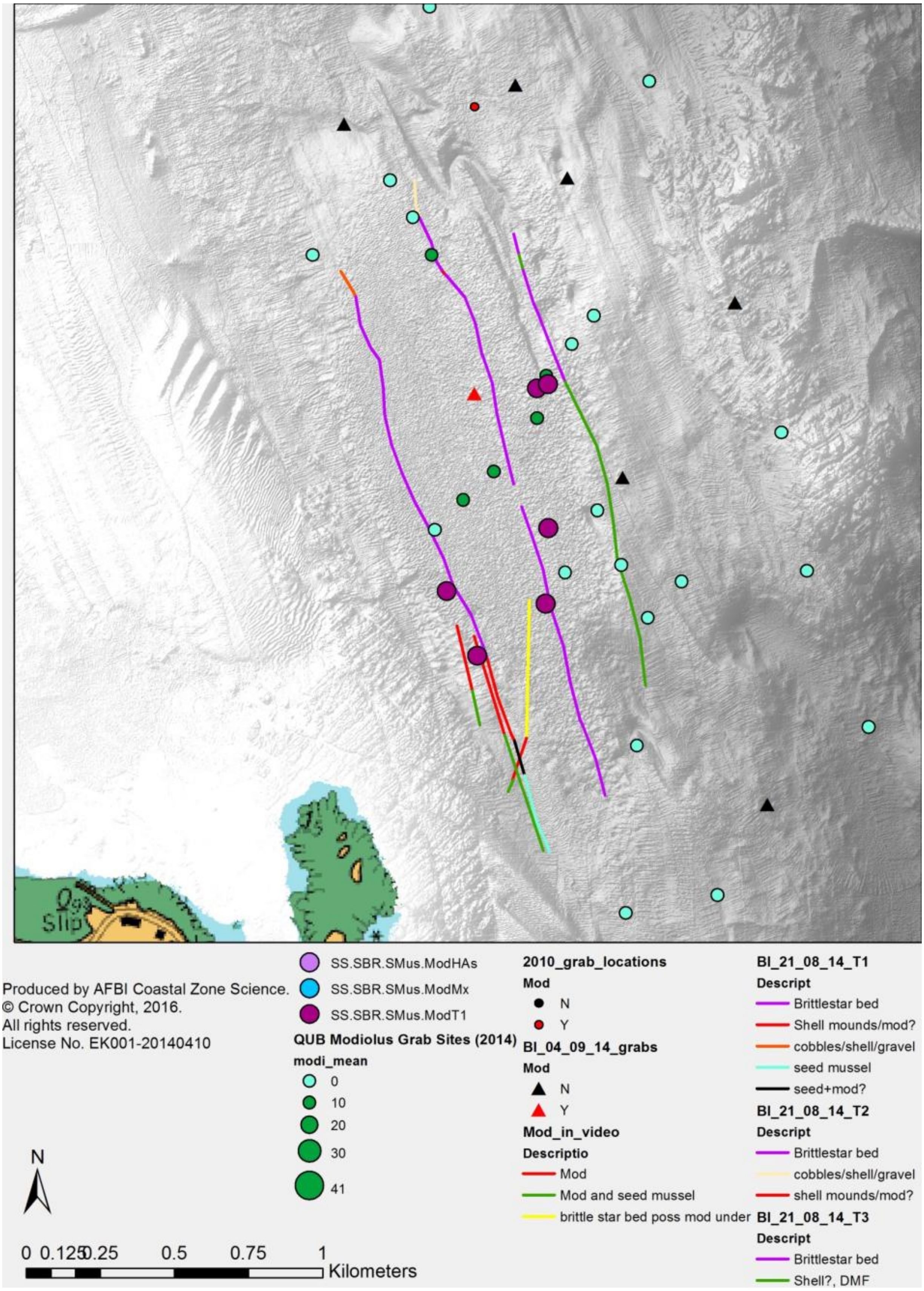


Figure 3.9. Historic sample data for Burial Island (diver records classified as biotopes where recorded in Marine Recorder). Note “BI xx Tx” refer to AFBI video tows. Note QUB grabs are number of live *Modiolus* per grab (not per m^2).

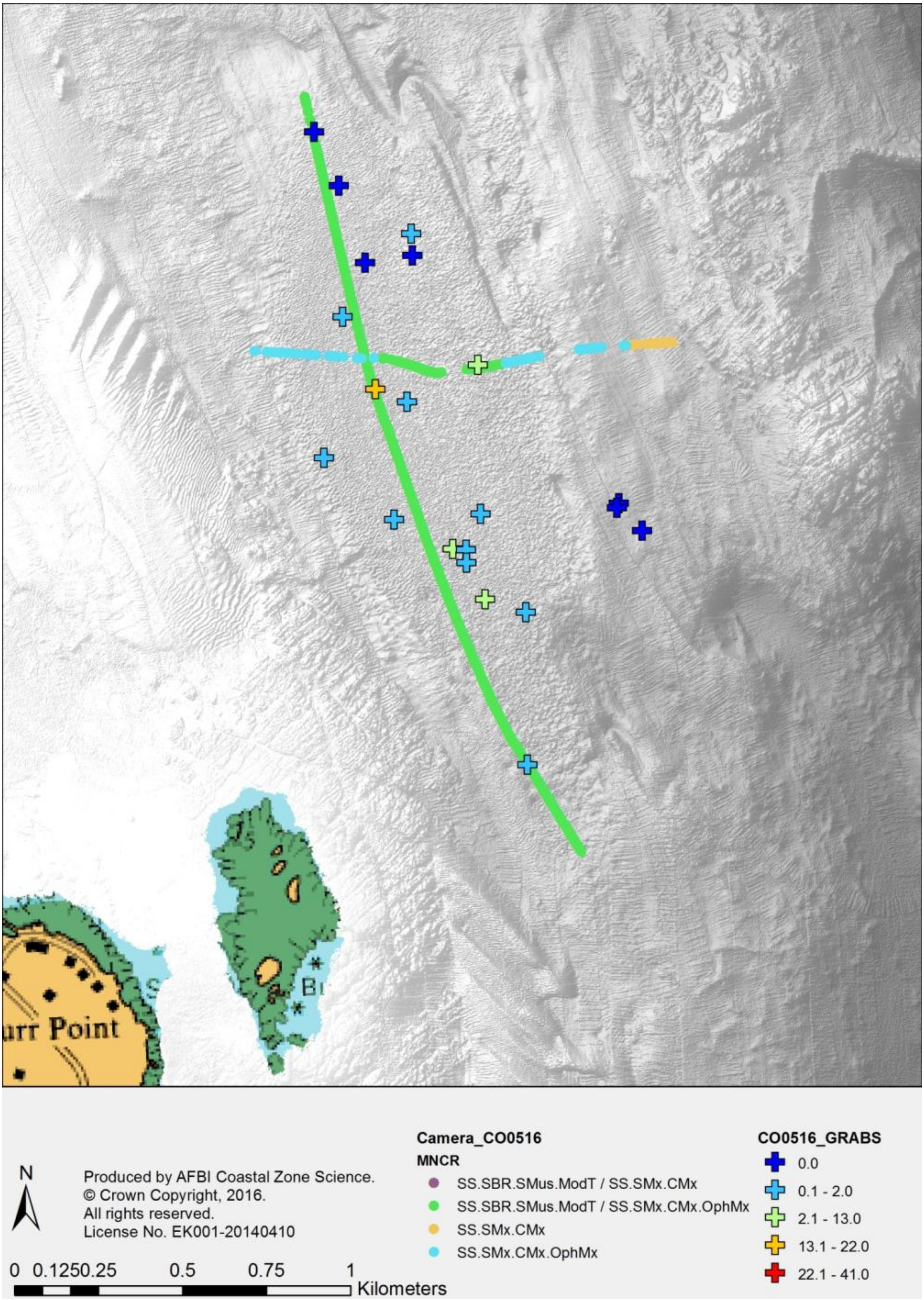


Figure 3.10. Additional sampling (grabs and video) collected on cruise CO0516. Note grab sites are coded according to number of live *Modiolus* within each grab (not per m^2).

All grab sample data from historic and new surveys with quantitative species data (species abundance matrices) were successfully merged and processed within PRIMER. The numbers of live *Modiolus* per m^2 were calculated based on grab sampling areas of $0.1m^2$. These data are summarised in Figure 3.11 below. Note that the threshold for high confidence in *Modiolus* biogenic reef presence requires more than 9 living *Modiolus* per m^2 (Morris, 2014).

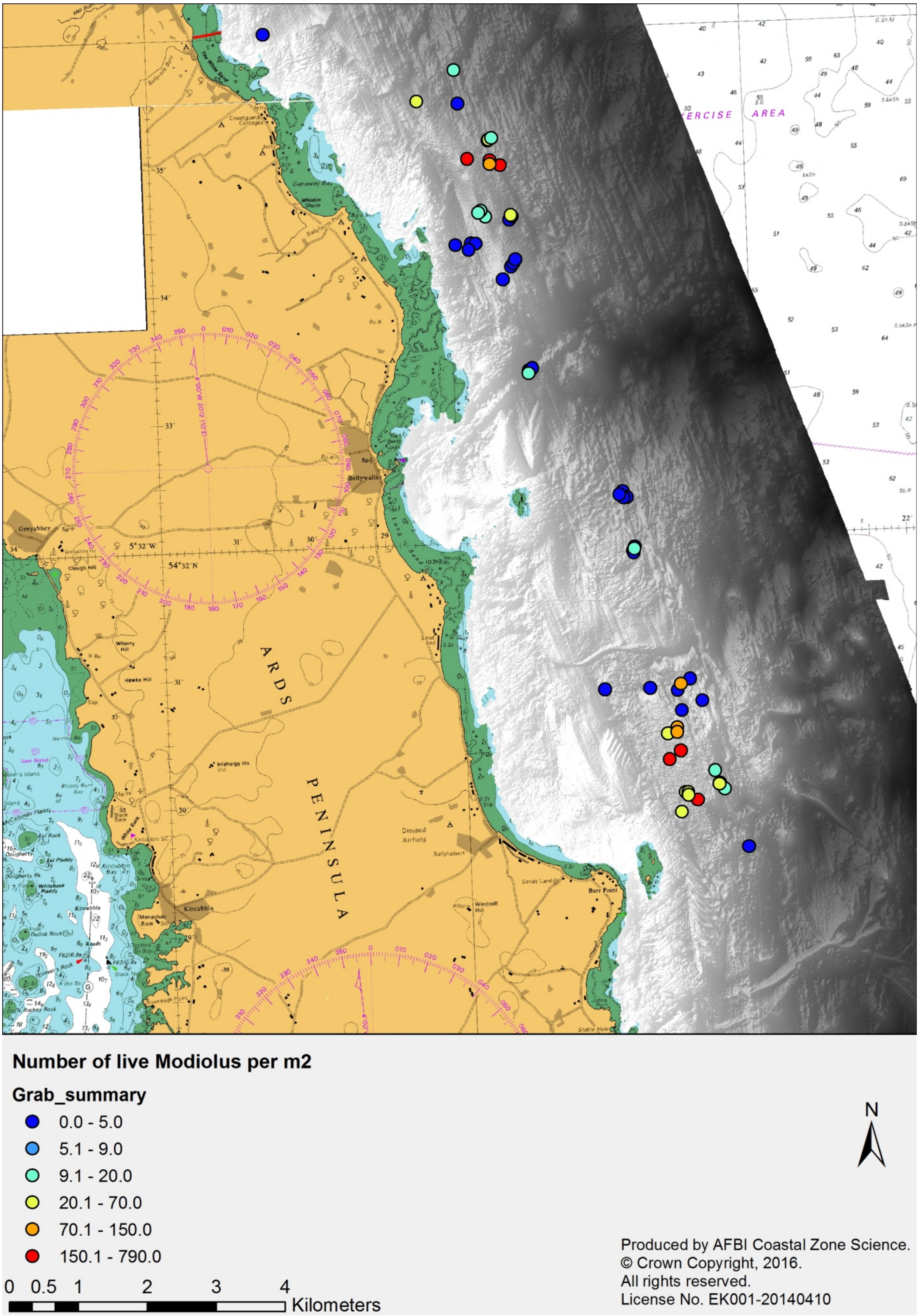


Figure 3.11. All combined grab sample data (historic and new) where infauna were fully enumerated, symbolised by the number of live *Modiolus* per m^2.

3.3. Annex I Biogenic Reef extent mapping

3.3.1. Comparison of biological communities on biogenic reef areas and adjacent areas

Infaunal community analysis of all samples available for the Outer Ards area revealed some 693 taxa (excluding colonial and juvenile species, or fish records) which were processed first at species level (where available) and secondly at family level (to remove issues arising from laboratory differences in identification). The community clusters resulting from the family level analysis are presented below in Figures 3.12 and 3.13. These are presented in multi-dimensional scaling (MDS) plots with cluster similarities overlain. The numbers of live *Modiolus* per sample (not per m^2) were overlain in the MDS which clearly are associated with a subset of the communities identified by the analysis.

Figure 3.12. Multi-dimensional scaling plot of community clusters (“SIMPROF2”) from all combined grab sample data (historic and new) from the Outer Ards. Labels are sample IDs which include survey year.

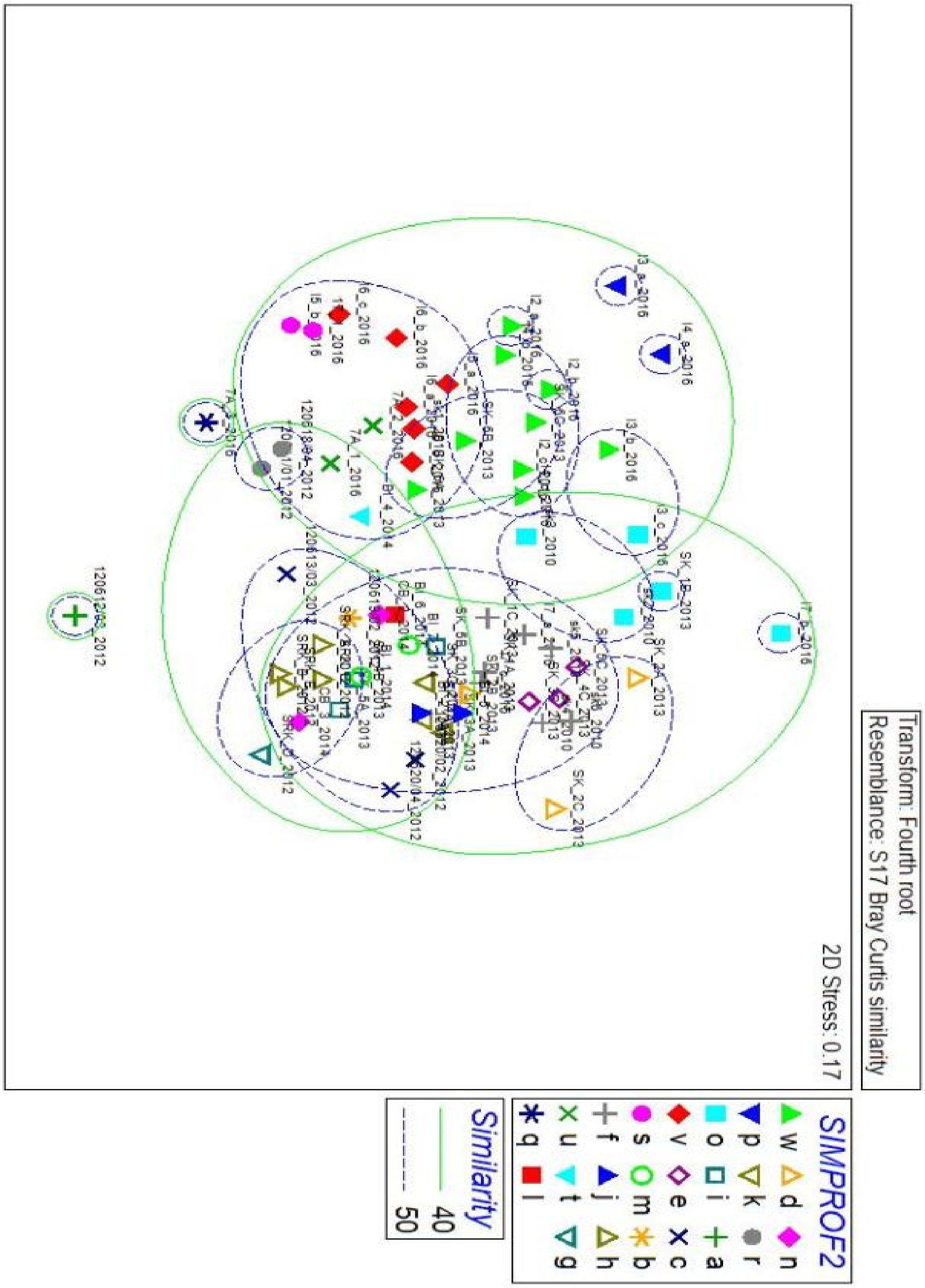
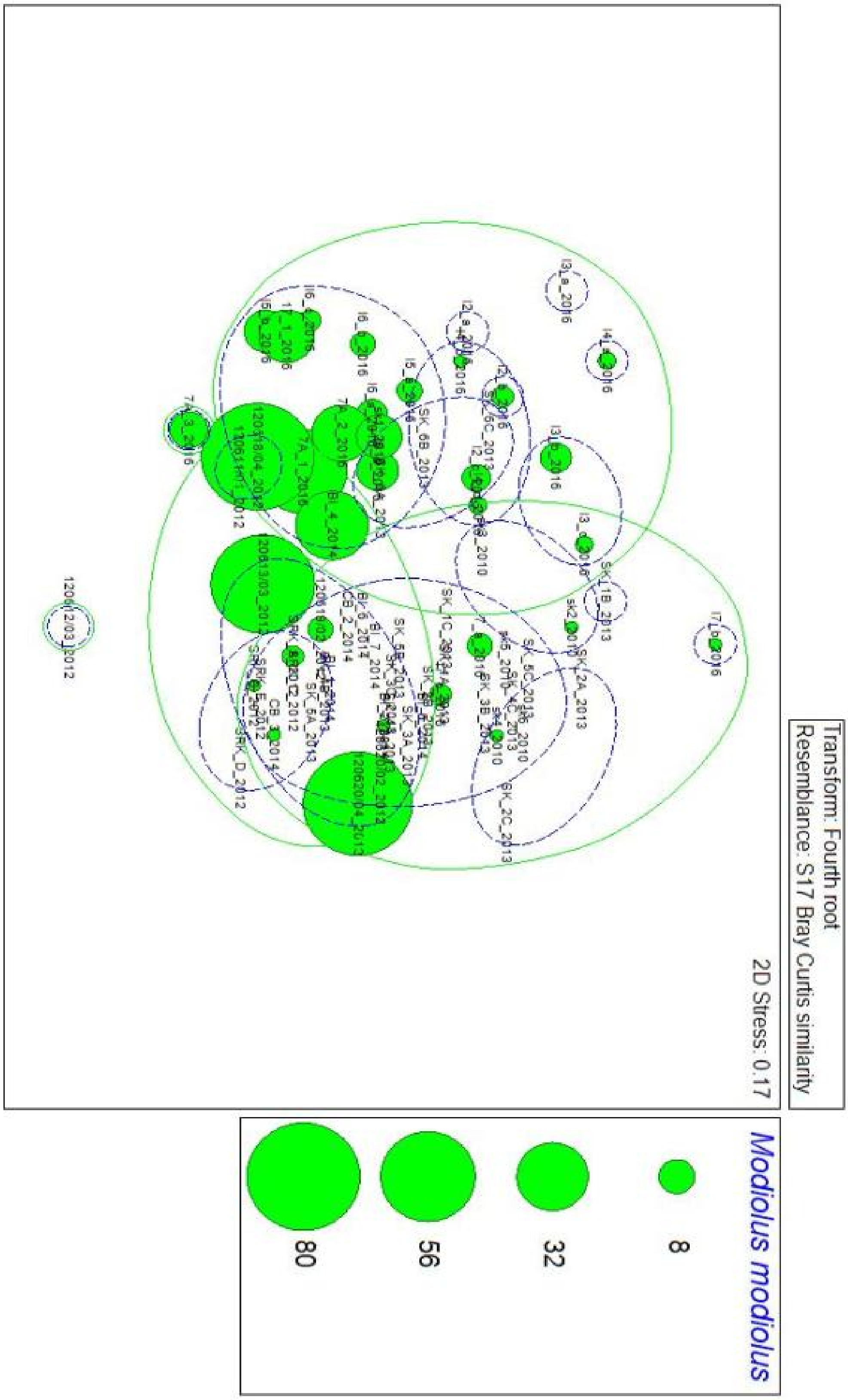


Figure 3.13. Multi-dimensional scaling plot of all combined grab sample data (historic and new) from the Outer Ards, with number of live *Modiolus* overlain (per grab abundance, not per m^2). Labels are sample IDs which include survey year.



To facilitate interpretation, the samples which are located over each area of interest (Craigbrain and Burial Island) were processed separately to look at finer scale community distribution (Figures 3.14 and 3.15). These indicate that both sites harbour overlapping community types, with a clear associated between *Modiolus* numbers and community type.

Diversity indices were also calculated for all samples, and over areas harbouring more than 9 live *Modiolus* per m^2 these showed numbers of taxa per sample ranging from 31 to 161, Shannon-Weiner diversity indices of between 2.0 and 4.3, and Pielou's evenness index ranging from 0.52 to 0.95, which are all comparable to figures from similar open coast *Modiolus* reefs (Fariñas-Franco *et al.,* 2014).

Based on the **infaunal** records (not epifauna, or coupled with video), the following biotopes could potentially be assigned to records:

- In non *Modiolus* areas where gravels and sands predominate with low mud content: SS.SCS.CCS.MedLumVen (EUNIS A5.142)
- In non *Modiolus* areas where there is a notable proportion of mud in addition to sands and gravels:
  SS.SSA.CMuSa.AalbNuc (EUNIS A5.261)
- In *Modiolus* areas the most likely fit is:
  SS.SBR.SMus.ModT (EUNIS A5.621)

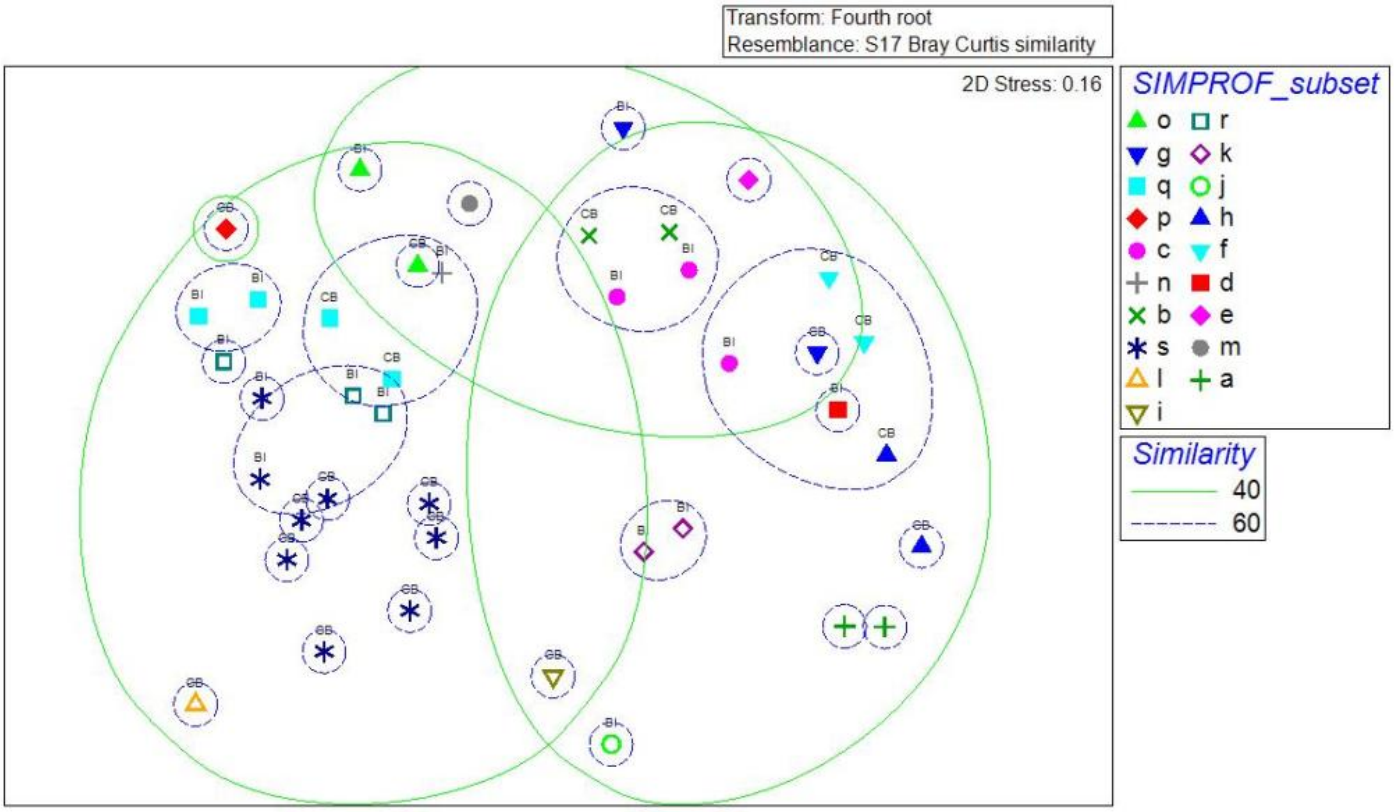


Figure 3.14. Multi-dimensional scaling plot of a subset of samples which fall in the areas of search of Craigbrain and Burial Island, symbolised by community clusters ("SIMPROF_subset"). Labels indicate site (CB = Craigbrain, BI = Burial Island).

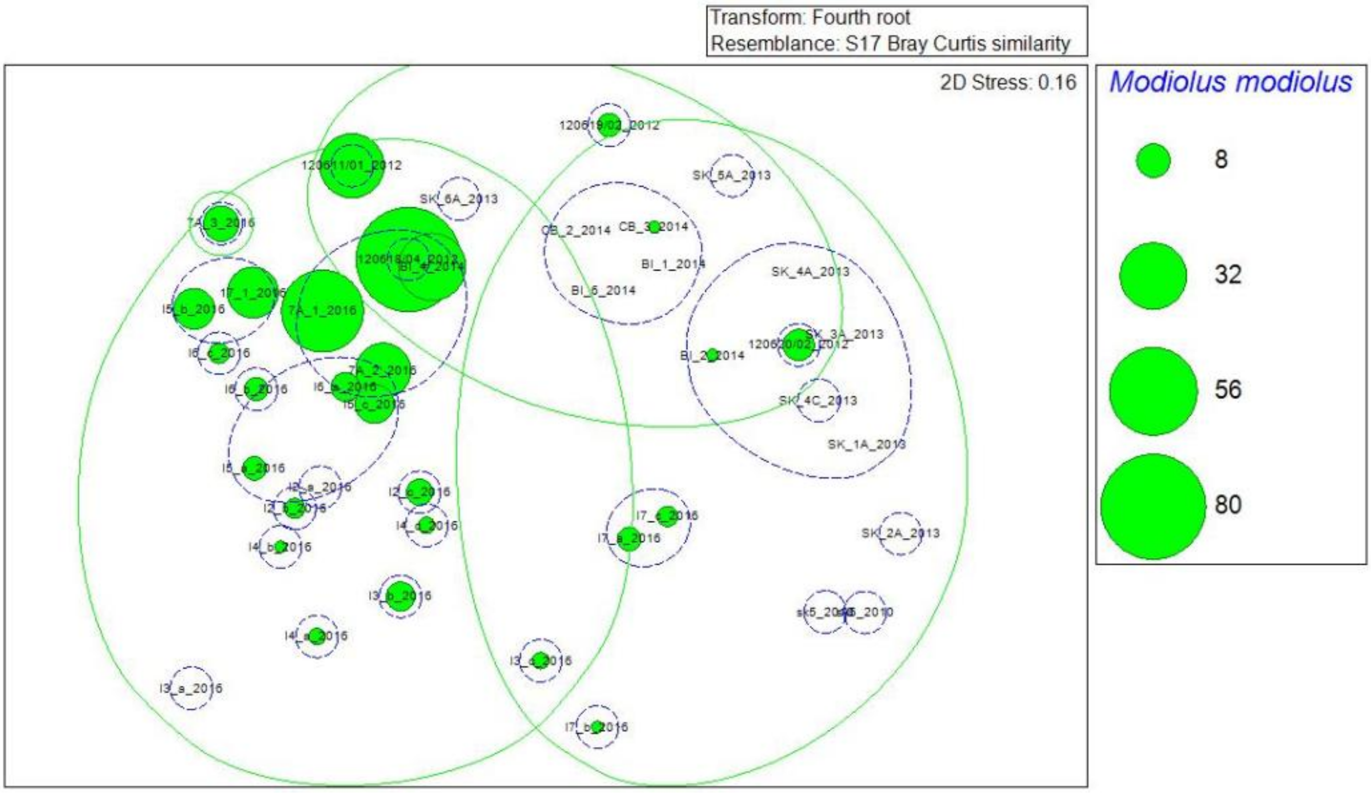


Figure 3.15. Multi-dimensional scaling plot of a subset of samples which fall in the areas of search of Craigbrain and Burial Island, with number of live *Modiolus* overlain (per grab, not per m^2) symbolised by grab sample ID.

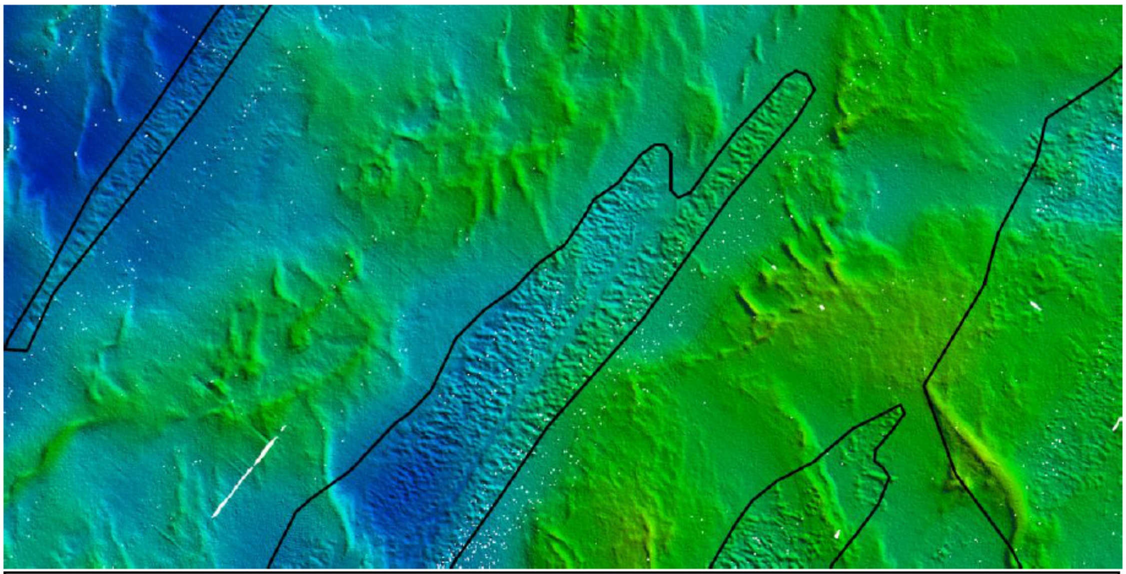
3.3.2. Analysis of video data and its use in determining Annex I biogenic reef

The video footage collected in 2016 had records of substratum type and conspicuous epifauna which could be reliably identified in spite of the poor visibility. Where possible notes of potential biogenic reef cover were also made, based on distinctively elevated "clumps" or ridges, and presence of certain epifauna in spite of few cobbles (e.g. presence of *Alcyonium digitatum*). These records were then translated into biotopes, with the following identified:

1. Where biogenic reef cover was 20% or more: SS.SBR.SMus.ModT (EUNIS A5.621). 'Reef' is made up on patches or ridges of clumps, slightly elevated from the surrounding seabed, often with dense dead *Modiolus* shell between the ridges, along with occasional cobbles.
2. Many such sites overlapped brittlestar beds, and as clumps/ridges appear patchy there could be a mosaic of the biogenic reef biotope with SS.SMX.CMx.OphMx (EUNIS A5.445)
3. In some cases, no evidence of distinctive ridges or clumps was seen but dense brittlestars persisted, and therefore this biotope could be considered in a non-mosaiced form. Dense empty *Modiolus* shell was common in these areas.
4. Mixed sediments without brittlestars were also identified, with muddy gravels and a high shell content plus occasional cobbles and boulders. These were assigned to SS.SMX.CMx (EUNIS A5.44) biotope complex.

3.3.3. Investigation of biogenic reef acoustic signatures and reef elevation

As indicated by the multibeam bathymetry images in Figures 3.1 to 3.6 above, a distinctive pattern of fine scale ripples is evident over the Craigbrain and Burial Island areas of interest. These appear closely related to the presence of living *Modiolus* in densities above 9 individuals per m^2, and the presence of the video mapped biotope SS.SBR.SMus.ModT.
For context, examples of other open coast biogenic reef multibeam bathymetric imagery are provided in Figures 3.16 and 3.17 below.



Ramsay, K., Walker, P., Bayley, D., Golding, N., Robson, L. 2013. *North West Anglesey Survey of Possible Horse Mussel Bed Areas.* CCW Staff Science Report No: 2, 122pp, Natural Resources Wales, Bangor. Figure 1.2.

Figure 3.16. Example of multibeam acoustic signature from bathymetry off Northwest Wales

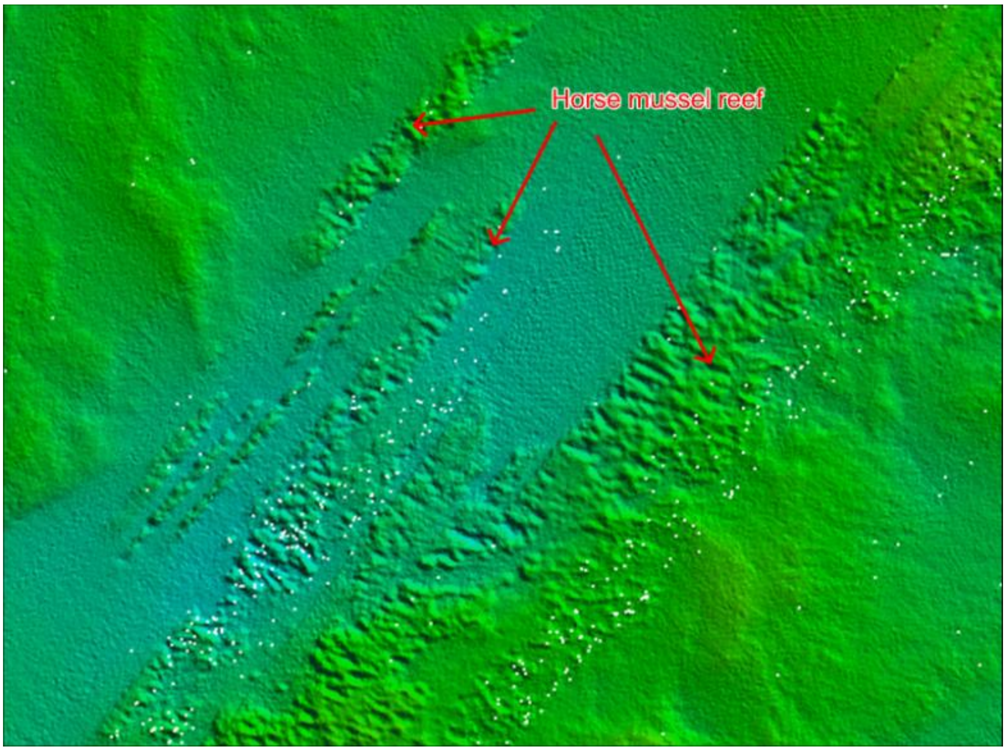


Figure 3.17. Second example of multibeam acoustic signature from bathymetry off Northwest Wales (courtesy of C. Lindenbaum, pers. comm.).

Close ups of the bathymetric pattern (not vertically exaggerated) at Craigbrain and Burial Island are shown in Figures 3.18 and 3.20 below, which show a similar non-linear, fine scale rippled pattern which is spatially constrained and differs from surrounding areas. These patterns are further investigated in Figures 3.19 and 3.21 through the use of bathymetric profiles, which show the ripples are approximately 20cm high (elevation), and extend between 2 and 5m in length. This information is consistent with the ridges seen on video footage.

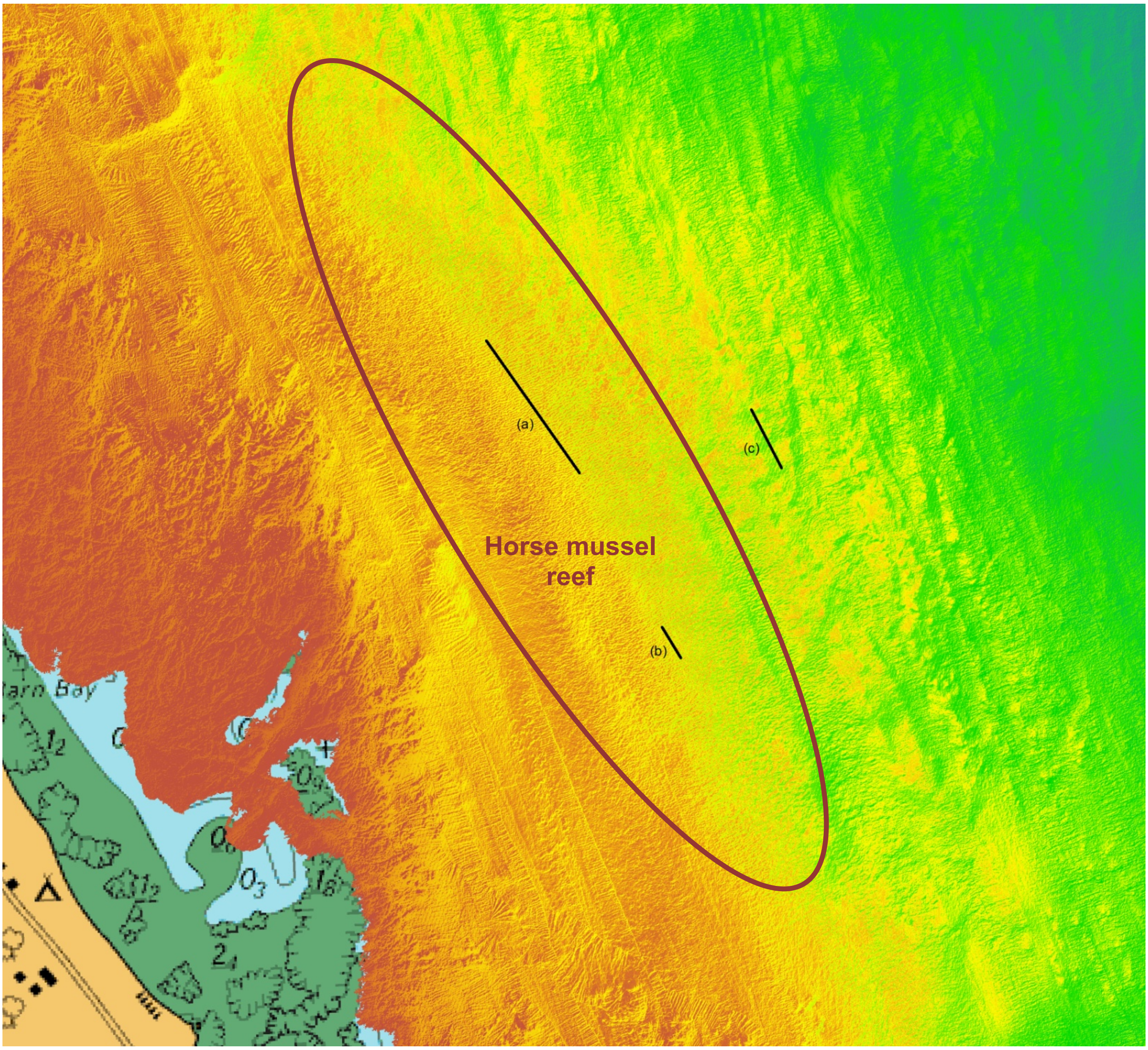


Figure 3.18. Distinctive “rippled” bathymetric signature from 2m horizontal resolution multibeam off Craigbrain. Bathymetric profile positions indicated by black lines.

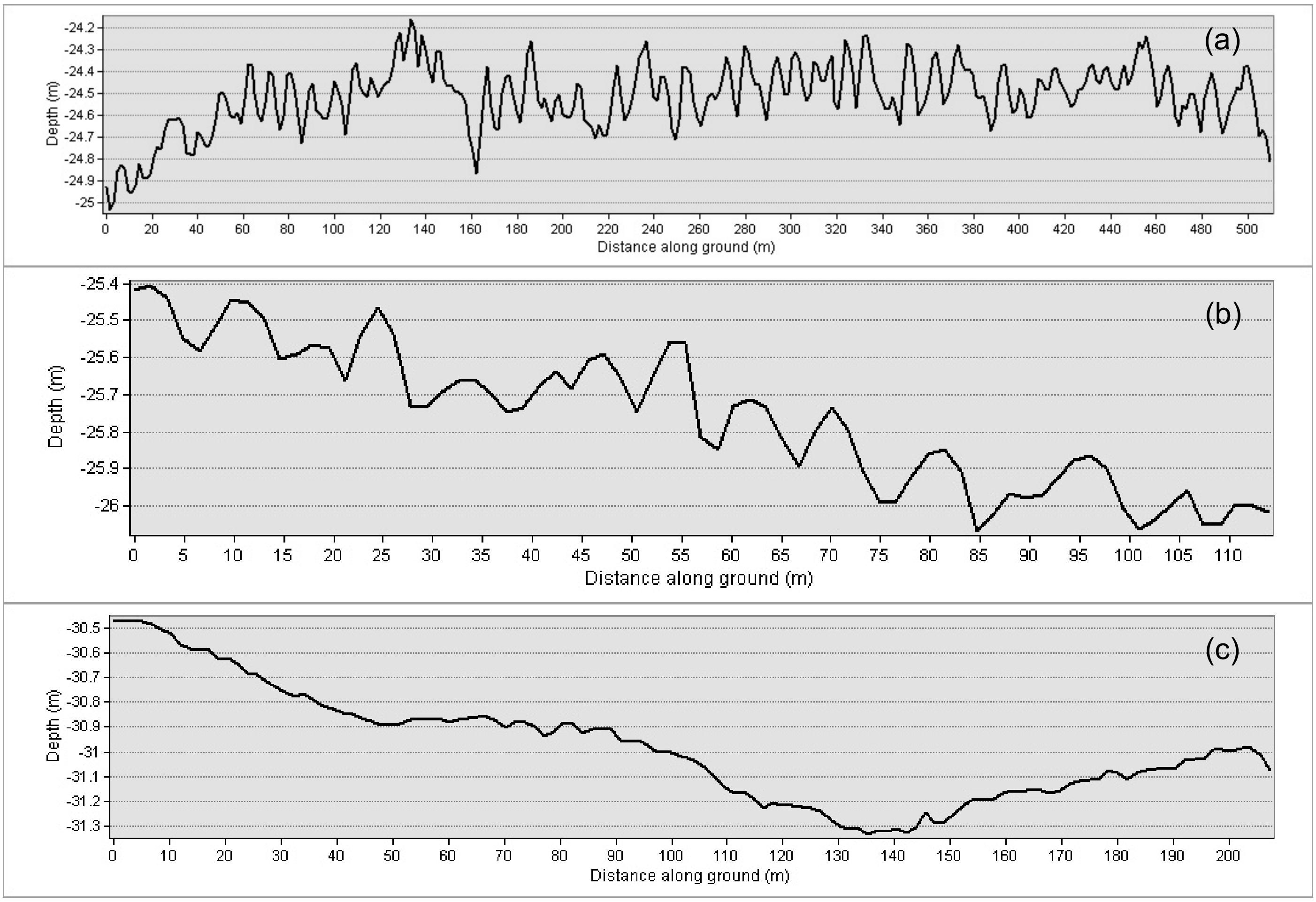


Figure 3.19. (a) and (b): Bathymetric profiles across known *Modiolus* reef area at Craigbrain, showing rippled structure, and (c) Bathymetric profile in area adjacent to *Modiolus* reef (all profiles in NNW to SSE orientation, with profiles marked on Figure 3.18 above).

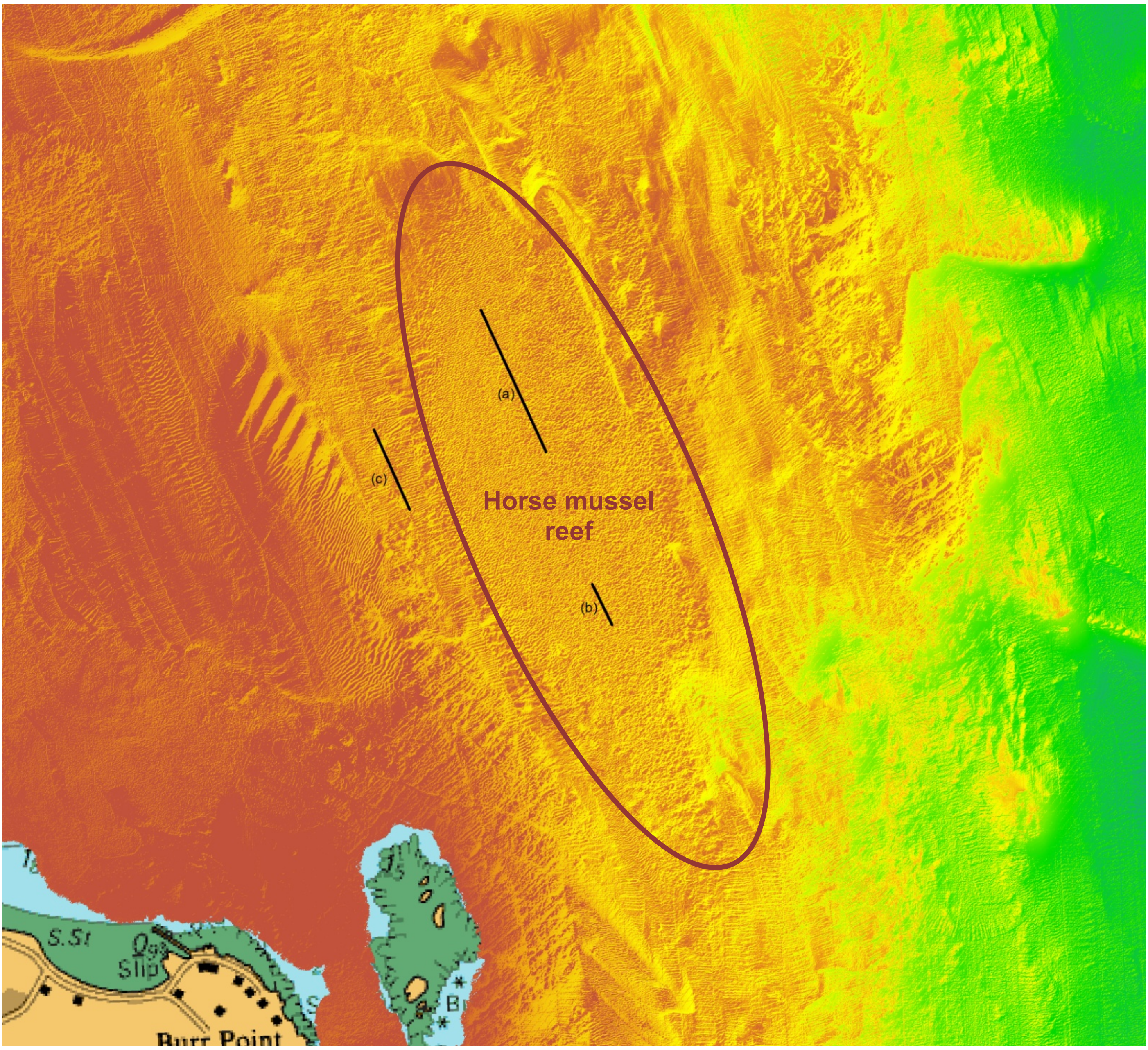


Figure 3.20. Distinctive “rippled” bathymetric signature from 2m horizontal resolution multibeam off Burial Island. Bathymetric profile positions indicated by black lines.

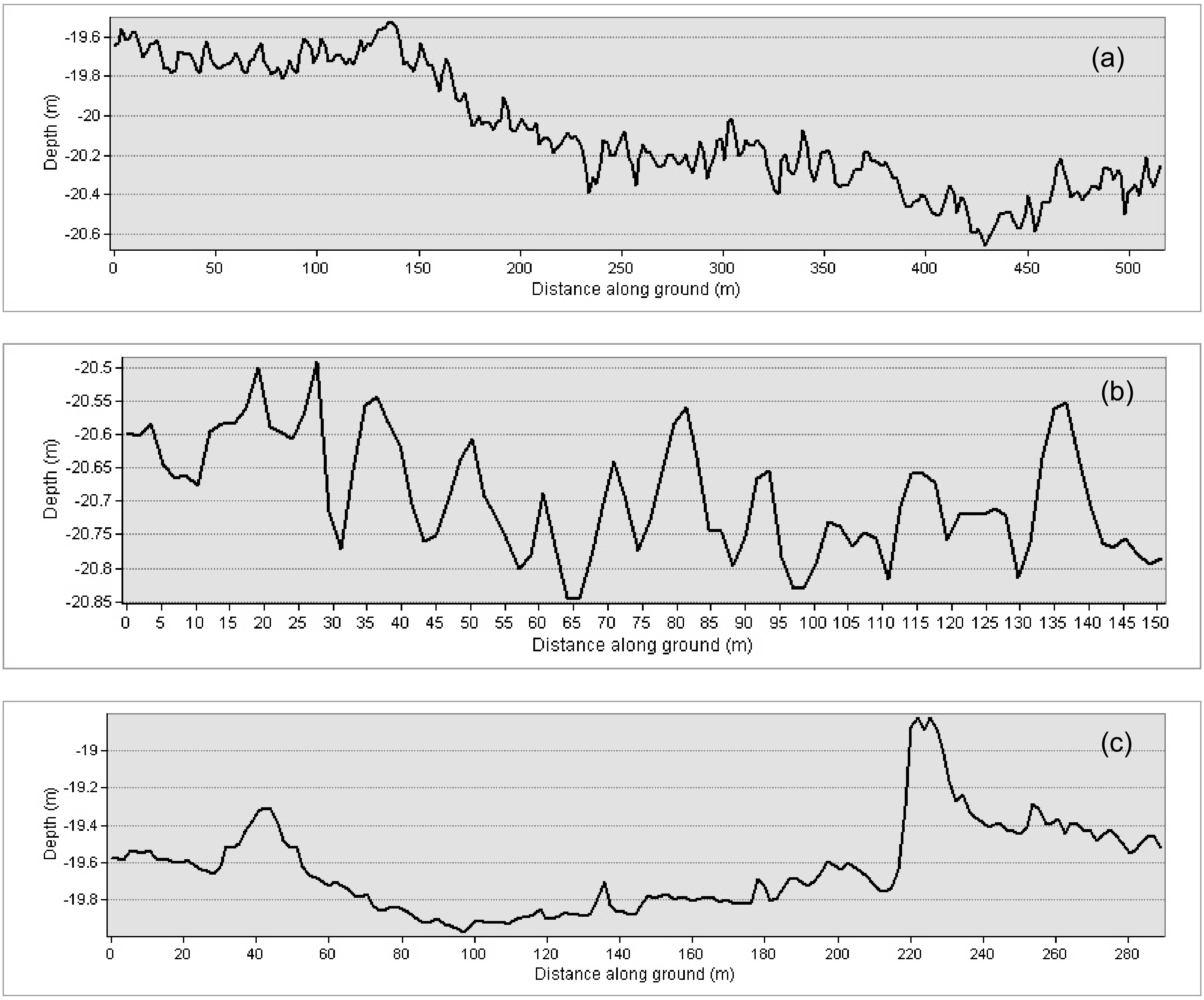


Figure 3.21. (a) and (b): Bathymetric profiles across known *Modiolus* reef area at Burial Island, showing rippled structure, and (c) Bathymetric profile in area adjacent to *Modiolus* reef (all profiles in NNW to SSE orientation, with profiles marked on Figure 3.20 above).

3.3.4. Mapped extent of *Modiolus modiolus* biogenic reef

The sample and video information was combined with the multibeam imagery and detail of potential acoustic signatures as discussed in section 3.3.3 above to manually interpret an extent of Annex I biogenic *Modiolus* reef at both Craigbrain and Burial Island, and this is presented along with the areas of these reefs in Figures 3.22 and 3.23 below.

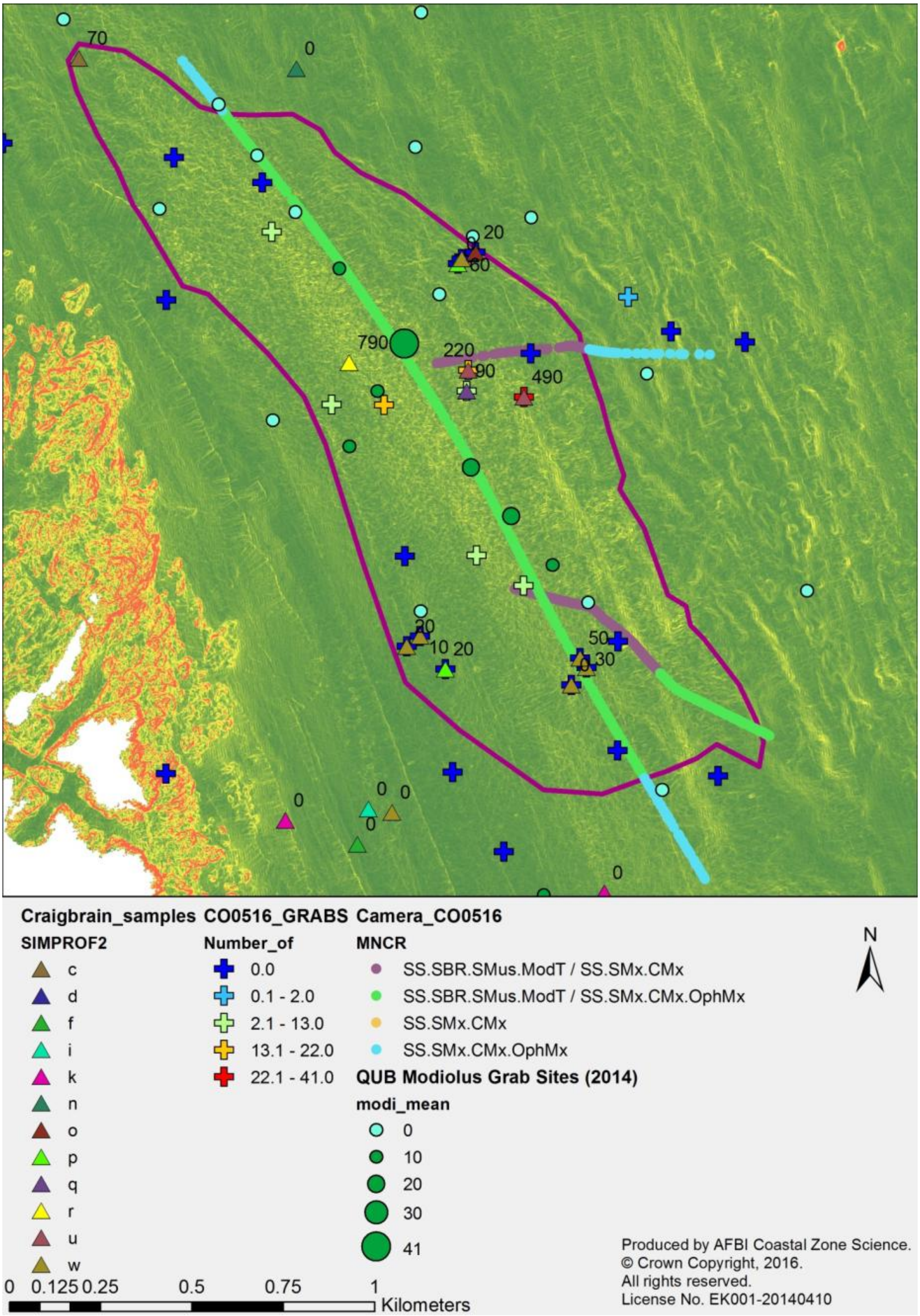


Figure 3.22. Delineation of Annex I biogenic *Modiolus* reef extent (purple line) at Craigbrain based upon quantitative grab sample data, video biotope data and acoustic signature. Reef extent: 1.51 km^2.

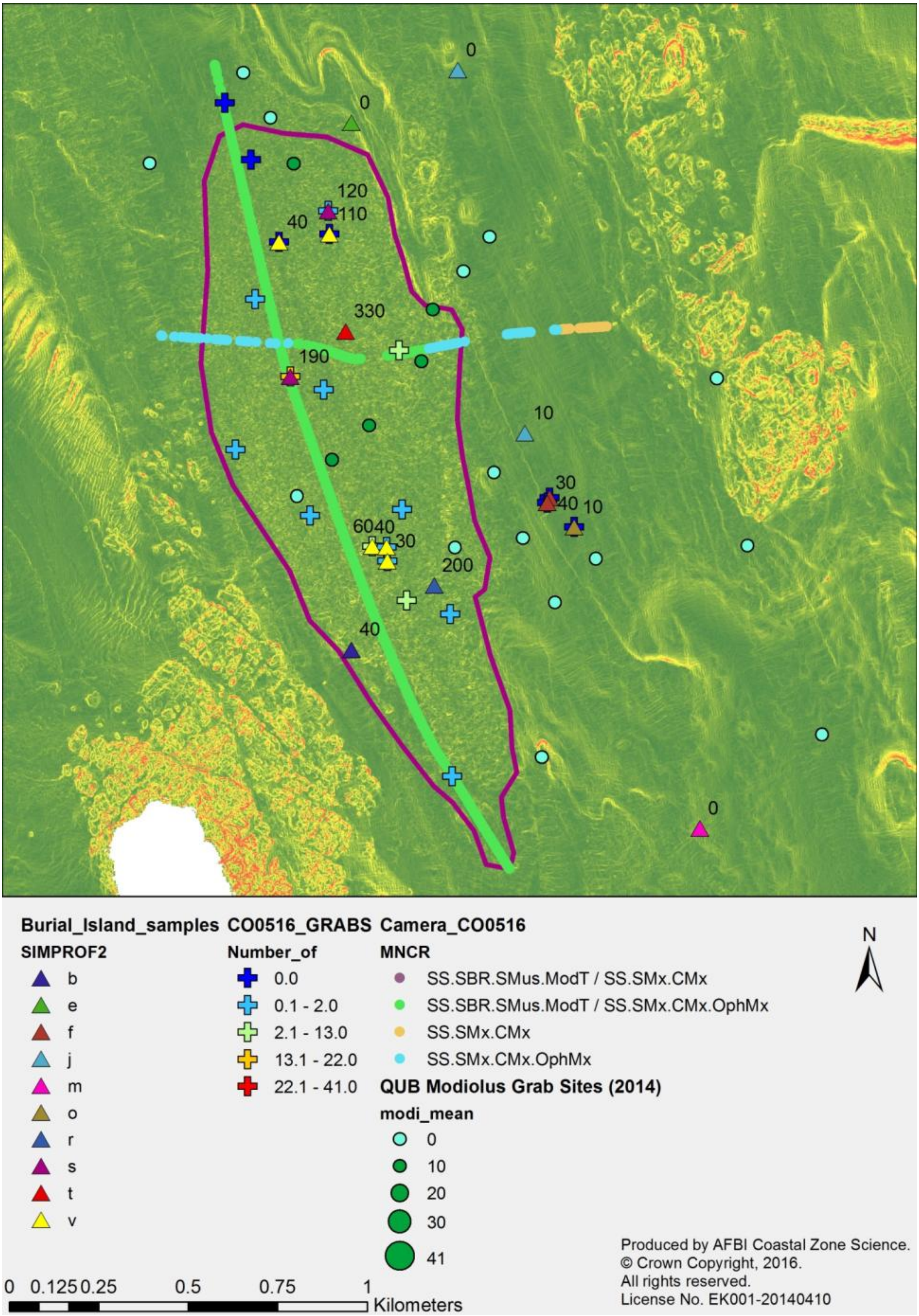


Figure 3.23. Delineation of Annex I biogenic *Modiolus* reef extent (purple line) at Burial Island based upon quantitative grab sample data, video biotope data and acoustic signature. Reef extent: 1.00 km^2.

4. Discussion

4.1. Annex I biogenic reef extent

According to the criteria detailed in Morris (2014), there is good evidence of the presence of live adult *Modiolus* at the potential reef areas, with distinctive communities as shown through infaunal cluster analysis at areas of living *Modiolus* versus surrounding habitats. Each reef area extends well over the 25m^2 threshold and is made up of acoustically distinguishable “ridges” which elevate by approximately 20cm above the surrounding seabed and extend up to 5m across, and are surrounded by dead *Modiolus* shell and muddy sands (with comminuted shell). Over the acoustically distinct ridged areas, live *Modiolus* per m^2 is above 9 per m^2. Percentage cover is more difficult to assess based on the quality of the video footage, and potentially ranges from 20% to over 50% at a scale of 25m^2. Together, this information provides medium to high confidence in Annex I biogenic reef assignment, as per the method detailed in Morris (2014).

4.1.1. Comparisons to other open coast *Modiolus* reefs

M. modiolus is a widely distributed boreal species extending from southern parts of the White Sea (Russia), Norway and Iceland as far south as the Bay of Biscay (Brown, 1984; Hayward and Ryland, 1990). Although it is widespread and common, actual horse mussel beds or “reefs” are limited in their distribution (JNCC, 2008). Individuals have been recorded to depths of 280m (Brown, 1984; Hayward and Ryland, 1990), and in Northern Ireland aggregations of *M. modiolus* have been observed off Rathlin Island in waters exceeding 200m depth (AFBI, 2015). *M. modiolus* reefs can be semi-infaunal or infaunal extending from the lower shore to over 100 m depth (Holt *et al.*, 1998; Tendal and Dinesen, 2005), with such dense aggregations reaching their southerly limit in the southern Irish Sea (Rees, 2009). Figure 4.1 presents the 2013 known *Modiolus* bed records across the UK and the predicted distribution of this species (from Gormley *et al.,* 2013). Figures 4.2 - 4.3 present the known distribution of this species (not necessarily as beds) in the Irish Sea (Figure 4.2) and around Northern Ireland (Figure 4.3). With climate change and increasing water tempetature, this northern species may be pushed further north; the predictive modelling based on a 4°C sea temperature rise within 100 years by Gormley *et al.* (2013) predicted 100% loss of the ‘most suitable’ habitat by 2080.

It has been noted by Rees (2009) that individual *M. modiolus* beds usually extend over only a few square kilometres and often the area of a bed measures only a few hectares or less; several semi-discrete beds may occur within a limited area and frequently beds are termed “patchy”. In this study, the two beds are indeed patchy and each ‘reef’ extends only just over 1km^2, but within each reef area the patches appear to form a regular series of “bioherms” similar to open coast beds in other parts of the UK and Isle of Man (Morris, 2014), with living clumped *Modiolus* separated by troughs of thick dead *Modiolus* shell and shell gravel.

The reefs at Burial Island and Craigbrain appear to show an undulating pattern with an elevation of between 15 and 25cm, which is comparable to the North Llŷn beds off Wales, as reported by Lindenbaum *et al.* (2008) “The mussels form an undulating surface, orientated perpendicular to the current, with an average wavelength of 11.7 m and amplitude of 0.24 m that is significantly different from the surrounding seabed. Reef deposits reach a thickness of 1 m on top of the underlying lag gravels."   In the case of the Burial Island and Craigbrain beds the thickness of the reefs cannot be fully determined from the methods and data available to date – potentially sub-bottom profile information would yield the thickness of these deposits.

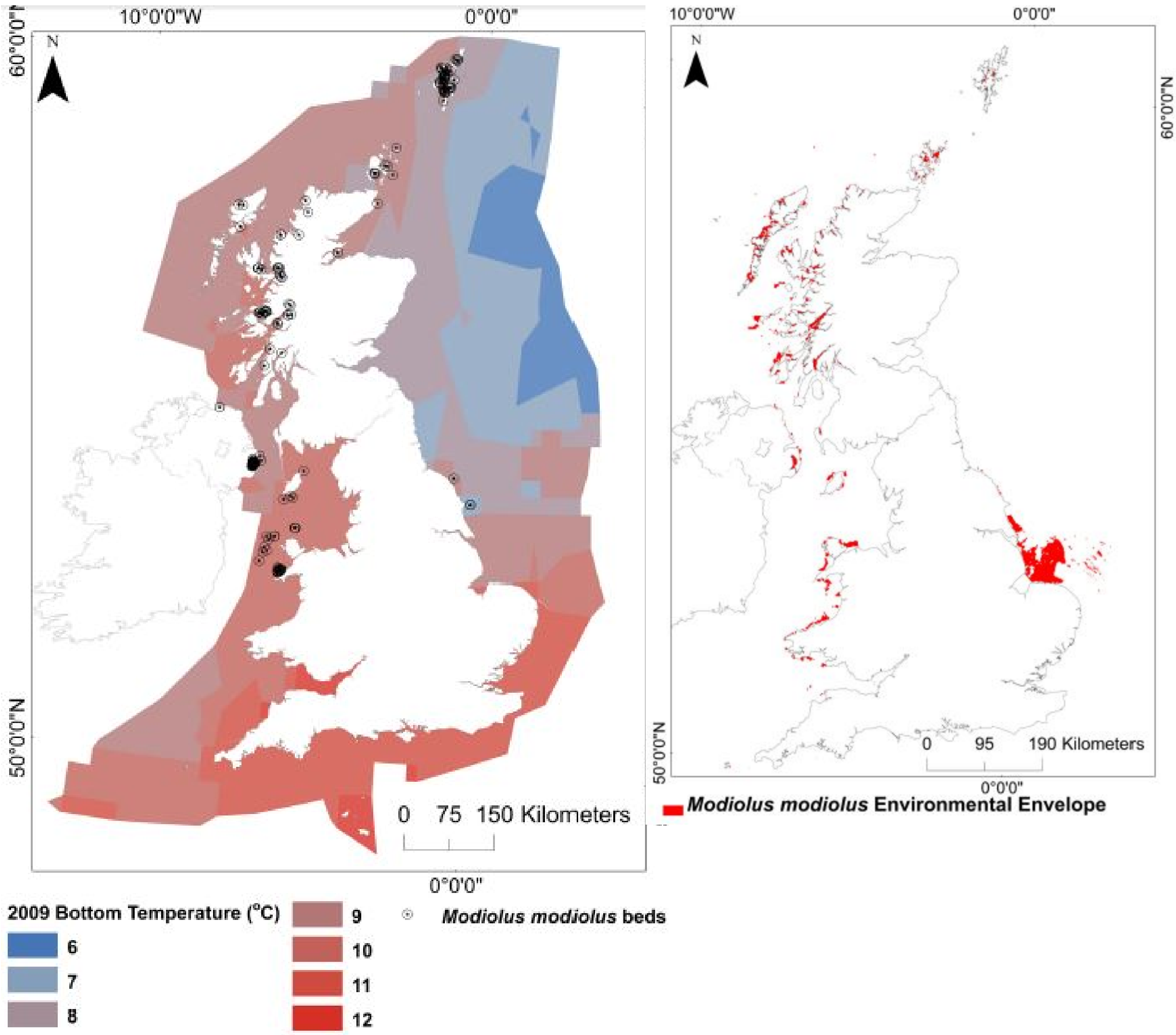


Figure 4.1. (L) 2013 UK known *M. modiolus* bed distribution and (R) *M. modiolus* species distribution model, from Gormley *et al.* (2013).

Figure 4.2. Records of *M. modiolus* distribution at a 2km grid resolution (presence only) throughout the Irish Sea (up to 2016) as reported through the UK National Biodiversity Network. Note that this also includes older records of *M. modiolus* where currently living individuals are not found.

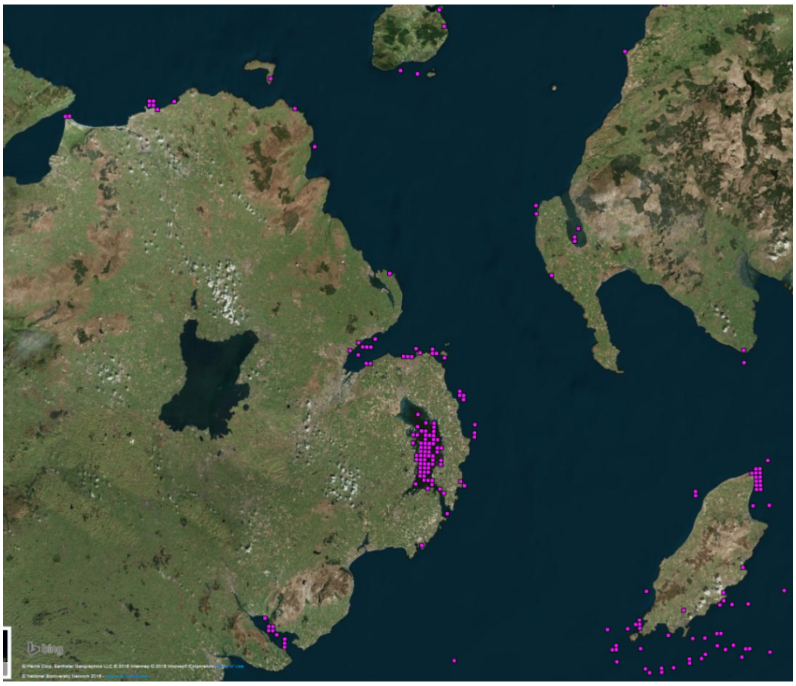


Figure 4.3. Records of M. *Modiolus* distribution at a 2km grid resolution (presence) across Northern Ireland (up to 2016) as reported through the UK National Biodiversity Network. Note that this also includes older records of *M. modiolus* where currently living individuals are not found.

The *Modiolus* reefs off the Ards Peninsula are the only mapped open coast *Modiolus* reefs in Northern Ireland. There may also be similar reefs near the Skerries based on historic data, but recent evidence of reef structures in this area is currently lacking. There is evidence of clumped *Modiolus* in deeper water north of Rathlin Island, but further data are required to assess this area against the criteria of Morris (2014). There is evidence of connectivity between the Ards reefs and those remaining *Modiolus* populations in Strangford Lough based on larval transport modeling (Gormley *et al*., 2015), and potential connectivity between the Ards reefs and those off the Isle of Man (Point of Ayre) given the correct hydrodynamic conditions. Connectivity between the Ards Peninsula reefs and Strangford Lough *Modiolus* populations was also shown through the hydrodynamic modeling undertaken for the Sustainable Mariculture in northern Irish Sea Loughs (SMILE) project (Ferreira *et al.,* 2007), as shown in Figure 4.4 below. However, there is only weak genetic differentiation noted between *Modiolus* from the eastern and western Irish Sea regions (Gormley *et al.*, 2015) which suggests that there has been little restriction in gene flow and therefore some degree of connectivity between these popultations, and it is likely that small *Modiolus* beds (potentially not "reefs") act as "stepping stones" for gene flow between the reef areas. In terms of their geographical location, the Ards Peninsula *Modiolus* reefs are near the southern most extent of *Modiolus* reefs in the UK and Europe, with only the reefs off Wales and the Isle of Man being further south, and as noted above (Gormley *et al.*, 2014) these reefs may become vulnerable to warming seas ahead of their more northern or deeper water counterparts.

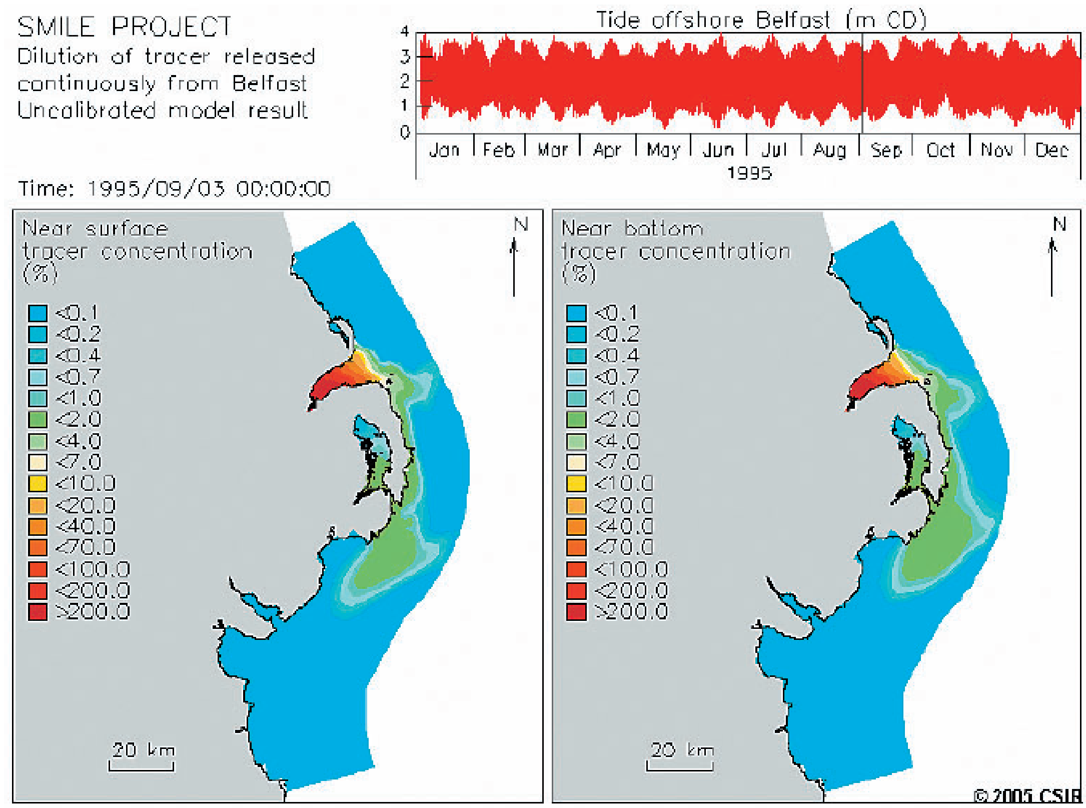


Figure 4.4. Linkages between Ards Peninsula and Strangford Lough as shown through tracer release modeling from Belfast Lough (taken from Ferreira *et al.,* 2007).

4.1.2. Information available on structure and function of the mapped reefs

It is widely recognised that *M. modiolus* reefs represent biodiversity 'hotspots' (e.g. Rees et al., 2008). In the Craigbrain and Burial Island *Modiolus* reefs, diversity indices from samples containing more than 9 live *Modiolus* per m^2 showed numbers of taxa per sample ranging from 31 to 161, Shannon-Weiner diversity indices of between 2.0 and 4.3, and Pielou's evenness index ranging from 0.52 to 0.95, which are all comparable to figures from similar open coast *Modiolus* reefs such as those of North Llŷn and sites in Loch Alsh (see Fariñas-Franco *et al.,* 2014). The diversity indices did not differ markedly from the surrounding area which is characterised by muddy sandy gravels with high shell content (mostly dead *Modiolus* shell), however the infaunal communities were significantly different between "*Modiolus* reef" and "surrounding sediments" (as determined through multivariate community analysis, including cluster analysis and ANOSIM routines). Due to inconsistencies in recording of epifaunal species from the grab samples, the epifaunal communities could not be statistically examined; however it was clear that there is a marked increase in the number of epifaunal species over the reef areas.

Density of living *Modiolus* ranged from zero to 530 per m^2. These numbers are similar to those in other open coast reefs, such as the North Llŷn beds (Fariñas-Franco *et al.,* 2014), and the variation in numbers per m^2 is indicative of the patchy nature of the reefs. The Craigbrain site appears to show the highest numbers of living *Modiolus* per m^2, however due to the limited number of samples and small areal coverage of grab samples it cannot be concluded that this reef site is markedly different from the Burial Island reef site, and the infaunal community analysis does not show statistically significant differences between the Craigbrain and Burial Island reef sites.

It has been noted by Fariñas-Franco *et al.* (2014) that living *Modiolus* density is a useful indicator of site condition, with reduced density linked to physical impacts, however due to the natural patchiness of the reefs a large number of samples are required to establish a suitable baseline against which change could be measured.

4.2. Recommendations for future condition assessment

As noted above, grab samples are able to provide useful indicators that could be used for condition monitoring, notably the number of live *Modiolus* per m^2, and infaunal community data. Furthermore, such sampling techniques can also be used to examine the epifaunal community which is known to vary between reef and non-reef substrata. However, grab sampling is a destructive sampling method and also required high levels of replication due to the small area sampled by each grab, and the patchiness of the reef areas. Furthermore, the cost of fully processing infauna from grab samples may be prohibitive for regular monitoring campaigns. In addition, large *Modiolus* shells and the occasional cobble act often to partially jam open the grab jaws, which means that there is loss of sample from the grab and the grab is rarely more than 2/3 full (and may disproportionately lose small polychaetes, amphipods and fine sediments). In spite of these limitations, grab sampling may play an important role in monitoring the reefs in this area due to the issue of dense brittlestar *Ophiothrix fragilis* and (to a lesser extent) *Ophiocomina nigra* coverage of the reefs making remote visual assessments of living *Modiolus* per m^2 from video or stills problematic (see Figue 4.5 for an example). Diver surveys are an alternative that could overcome the issues of brittlestar coverage obscuring vision of *Modiolus* valves, and suggestions of best *in situ* methods for measuring *Modiolus* density are outlined in Fariñas-Franco *et al.* (2014). However, issues of strong currents and related health and safety risks and the cost of undertaking diver surveys with adequate replication/coverage must be borne in mind in future monitoring survey plans.

Figure 4.5. Diver taken still photograph of Craigbrain *Modiolus* reef, courtesy of Joe Breen, DAERA.

If grab samples are to be used to examine the infaunal community as a measure of reef condition, the following species/taxa were found to represent the greatest community differences between ‘on reef’ and ‘off reef’ sites, as determined by SIMPER statistical routine (Table 4.1).

Table 4.1. Characterising species/taxa from ‘off reef’ and ‘on reef’ grab sample stations at Craigbrain and Burial Island.

Habitat type	Phylum	Class	Order	Family	Scientific Name
Off reef	Annelida	Polychaeta	Spionida	Spionidae	*Dipolydora coeca*
	Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera lapidum*
	Annelida	Polychaeta	Phyllodocida	Polynoidae	*Harmothoe*
	Annelida	Polychaeta	Spionida	Spionidae	*Laonice bahusiensis*
	Annelida	Polychaeta	Phyllodocida	Polynoidae	*Lepidonotus squamatus*
	Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris cingulata*
	Annelida	Polychaeta	Terebellida	Terebellidae	*Pista maculata*
	Annelida	Polychaeta	Sabellida	Sabellariidae	*Sabellaria spinulosa*
	Annelida	Polychaeta	Sabellida	Serpulidae	*Spirobranchus triqueter*
	Arthropoda	Malacostraca	Amphipoda	Cressidae	*Cressa dubia*
	Arthropoda	Malacostraca	Decapoda	Oregoniidae	*Hyas coarctatus*
	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	*Amphipholis squamata*
	Mollusca	Bivalvia	Pectinida	Anomiidae	*Anomiidae*
	Mollusca	Polyplacophora	Lepidopleurida	Leptochitonidae	*Leptochiton asellus*
	Mollusca	Bivalvia	Myida	Myidae	*Sphenia binghami*
On reef	Annelida	Polychaeta	Sabellida	Serpulidae	*Circeis spirillum*
	Annelida	Polychaeta	Spionida	Spionidae	*Dipolydora coeca*
	Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris cingulata*
	Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nephtys*
	Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Nephtys kersivalensis*
	Annelida	Polychaeta	Terebellida	Flabelligeridae	*Pherusa plumosa*
	Annelida	Polychaeta	Phyllodocida	Pholoidae	*Pholoe baltica*
	Annelida	Polychaeta	Phyllodocida	Polynoidae	*Polynoidae*
	Annelida	Polychaeta	Sabellida	Serpulidae	*Spirobranchus triqueter*
	Annelida	Polychaeta	Phyllodocida	Polynoidae	*Subadyte pellucida*
	Annelida	Clitellata	Haplotaxida	Tubificidae	*Tubificoides amplivasatus*
	Echinodermata	Ophiuroidea	Ophiurida	Ophiotrichidae	*Ophiothrix fragilis*
	Mollusca	Bivalvia	Cardiida	Semelidae	*Abra alba*
	Mollusca	Bivalvia	Mytilida	Mytilidae	*Modiolus modiolus*
	Mollusca	Bivalvia	Nuculida	Nuculidae	*Nucula nucleus*

Grab samples could be used without full infaunal work-up to enumerate *Modiolus* density and could also be used to identify key epifaunal species. Equally, some epifaunal species that appear to be characteristic of *Modiolus* reefs may also be reliably identified from remote video and stills imagery. A list of epifaunal species that are regularly found in grab samples from reef areas at Craigbrain and Burial Island is provided below in Table 4.2.

Table 4.2. Characterising epifaunal species/taxa from grab sample stations over >9/m^2 living *Modiolus* stations at Craigbrain and Burial Island. The asterisks indicate taxa that may be visible and reliably identified from high quality towed underwater video/stills.

Phylum	Family	Scientific Name
Bryozoa	Alcyonidiidae	*Alcyonidium diaphanum**
Bryozoa	Crisiidae	*Crisia**
Bryozoa	Crisiidae	*Crisia aculeata*
Bryozoa	Crisiidae	*Crisia eburnea*
Bryozoa	Lichenoporidae	*Disporella hispida*
Bryozoa	Electridae	*Electra pilosa*
Bryozoa	Romancheinidae	*Escharella immersa*
Bryozoa	Romancheinidae	*Escharella ventricosa*
Bryozoa	Hippothoidae	*Hippothoa flagellum*
Bryozoa	Microporellidae	*Microporella ciliata*
Bryozoa	Plagioeciidae	*Plagioecia*
Bryozoa	Tubuliporidae	*Tubulipora lilacea*
Cnidaria	Sertulariidae	*Abietinaria abietina**
Cnidaria	Alcyoniidae	*Alcyonium digitatum**

From the grab samples analysed within this report, key areas near the centre of each reef areas appear to have high living *Modiolus* density and characterising species as shown in Tables 4.1 & 4.2 above.

Part of the contract specified identifying locations that could be targeted for repeat monitoring (within a 50m radius) and are as follows (in degrees and decimal minutes, WGS 1984 datum):

- For Craigbrain reef area: 54° 34.942' N, 005° 27.216' W
- For Burial Island reef area: 54° 30.322' N, 005° 25.084' W

Acoustic methods producing high resolution bathymetry have revealed a distinctive signature in terms of topography relating to an undulating reef pattern with an elevation of 15-25cm at the ridges. Furthermore there is evidence that RoxAnn acoustic ground discrimination system also shows a distinctive signature over the reefs at Burial Island, as documented from seed mussel surveys. Use of such methods to monitor reef extent and examination of high resolution backscatter (whether from multibeam or sidescan) to ascertain seafloor integrity impacts from fishing gears are recommended. An example of sidecan imagery is provided from the North Llŷn open coast *Modiolus* reefs in Figure 4.6 below. The ripples of the bioherm-type reef structures are clearly visible and relate closely to those seen on multibeam sonar in the same area – it is likely that sidescan towed close to the seafloor over the Craigbrain and Burial Island reefs would show a very similar pattern which, with good image georeferencing (preferably with the use of a USBL on the sidecan towfish), could be used for monitoring extent of the reefs in addition to monitoring any fishing gear impacts. An example of an unsupervised classification of interpolated RoxAnn data is provided in Figure 4.7 below. The classification was optimised for seed mussel bed extent estimation inshore of the *Modiolus* reef, but it is clear that a signature relates closely to the extent of the reef at Burial Island and as a low cost and quick seabed mapping tool this may warrant further research to see whether a method could be optimised and developed for extent mapping of the *Modiolus* reef areas.

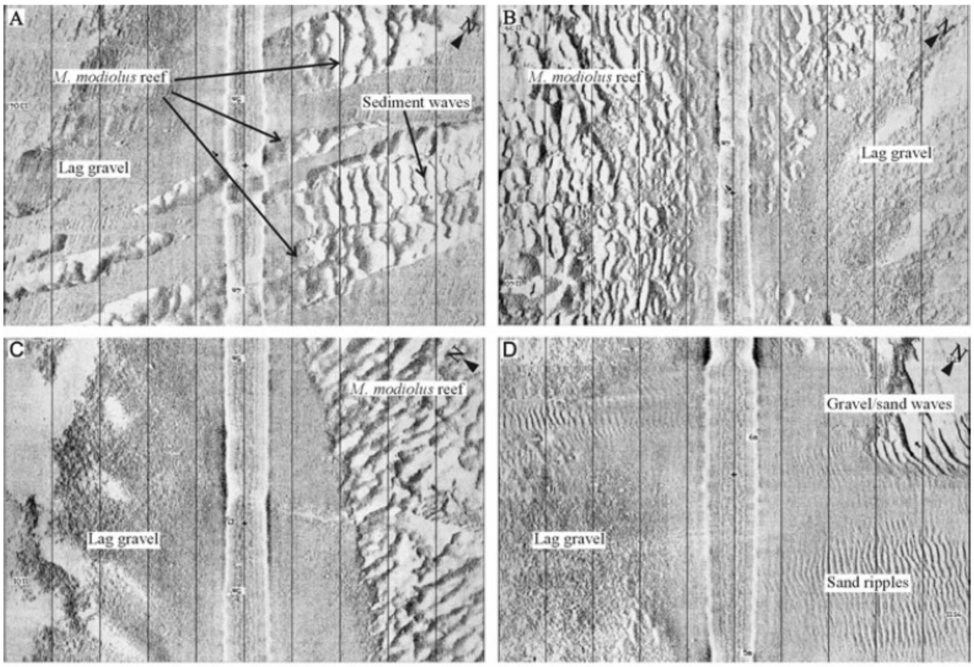


Figure 4.6. From Lindenbaum *et al.,* (2008): Side-scan sonar images of horse mussel reef from the north Pen Llŷn using a Cmax 800. (A) Thin ribbon/finger-like structures at the north-eastern extremity of the reef; (B) fragmented reef edge; (C) definitive reef edge; (D) bedforms recorded in the vicinity of the *Modiolus Modiolus* reef using side-scan sonar.

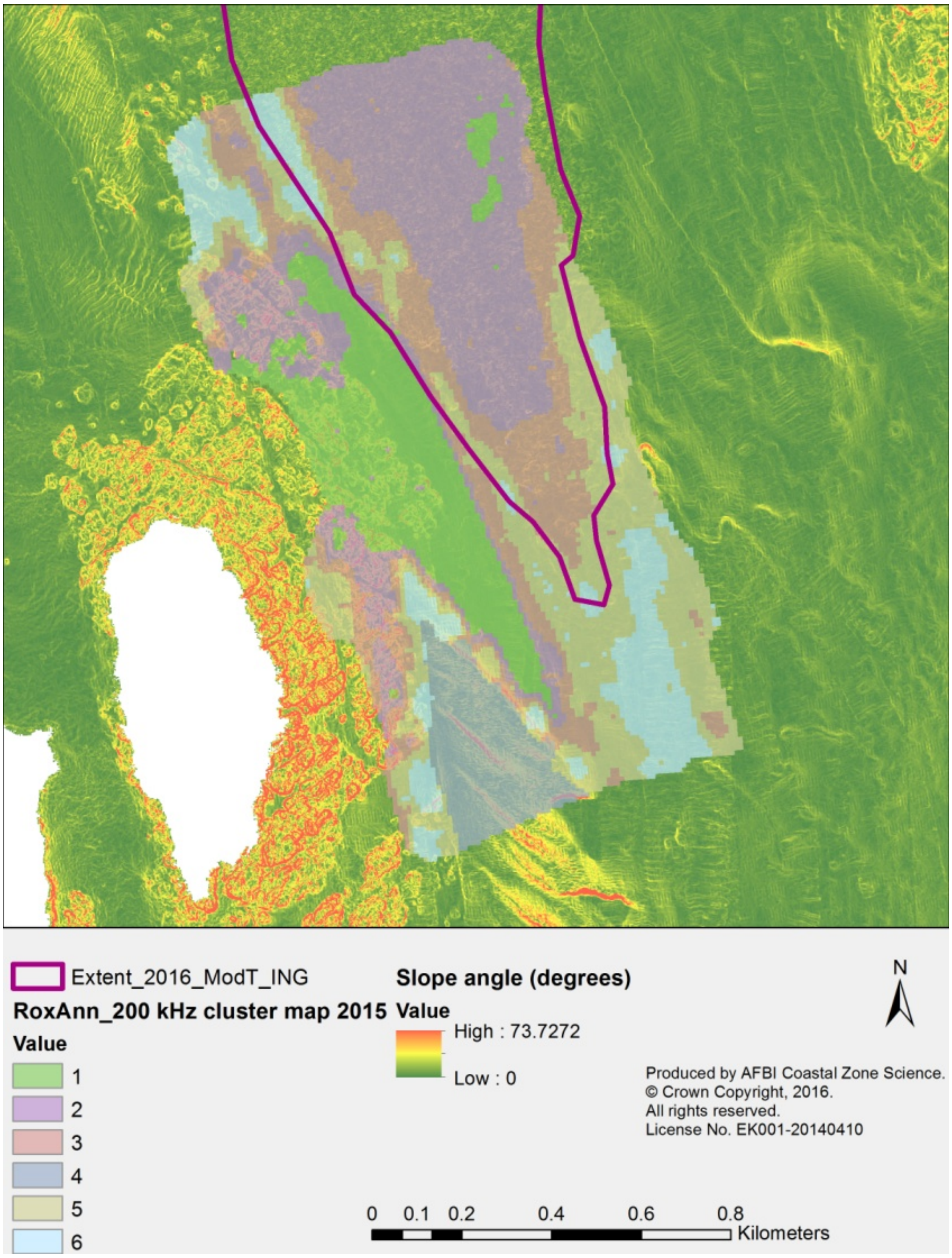


Figure 4.7. RoxAnn (200kHz) unsupervised cluster map (30% transparent) overlaid on multibeam slope angle data and *Modiolus* reef extent at Burial Island.

DAERA will need give consideration to merits of each methodology when developing a monitoring programme to assess the condition of the *Modiolus* reefs that have been identified in this report.

5. Conclusion

The evidence provided in this report regarding the extent and condition of the Craigbrain and Burial Island *M. modiolus* reefs has shown that these reefs meet the criteria for Annex I Biogenic Reefs, with a medium-high confidence in the areas being reef habitat (according to the criteria published in Morris (2014)). The multibeam echosounder data shows a distinctive bathymetric signature of fine scale non-linear ripples which relate well to the presence of *Modiolus* 'bioherms' where clumped, semi-infaunal *Modiolus* individuals form "ridges" separated by troughs of empty shell and mixed sediments (muddy sands and gravels). A combination of the acoustic data and ground-truthing from grab samples and underwater video has allowed the delineation of the two reef areas where there is medium-high confidence in the reef habitats, and it is recommended that these two areas are considered for designation under the EC Habitats Directive accordingly.

The grab samples allowed an evaluation of the number of living *Modiolus* per m^2, and proved more reliable than remote video due to issues of (a) visibility, and (b) dense brittlestars obscuring sight of *Modiolus* valves. In addition, a multivariate statistical comparison of the infaunal communities from the grab samples showed clear differences in these between reef areas and off-reef areas. Characterising infaunal and epifaunal species were also noted from the grab samples with potential application to monitoring reef health discussed. Diversity and species richness did not show a clear difference between on-reef and off-reef areas, and therefore such metrics were not useful in isolation in defining the reef extent and further research would be required before such metrics could be considered in a monitoring programme.

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Annex I: CO0516 Grab sample notes and summary results from CN and PSA analyses

Station	Date	Depth	Lat_decdeg	Long_decde	Proportion Full	Grab Area (m2)	Total area	Notes_samp	Number of Modi counted	Number of living Modi/m2	Dead_Modio	Gravel %	Sand %	Mud %	Folk	Mean phi	Mean sorting	Nitrogen	Tot Carbon	Org Carbon	% Org C	% stones
1_1	01/02/2016	28	54.571267	-5.456167	0.5	0.1	0.05	Photos, notes	0	0.00	Y											
10_1	01/02/2016	24	54.58235	-5.46055	0.67	0.1	0.067	Photos, notes	19	283.58	Y											
10_b	01/02/2016	25	54.5824	-5.462767	0.5	0.1	0.05	Photos, notes	5	100.00	Y											
11_1	01/02/2016	26	54.573483	-5.470333	0.75	0.1	0.075	Photos, notes	0	0.00	Y											
11_A	02/02/2016	27	54.588617	-5.46905	0.67	0.1	0.067	Photos, notes	0	0.00	Y											
12_1	01/02/2016	26	54.5867	-5.465033	0.67	0.1	0.067	Photos, notes	6	89.55	Y											
12_b	01/02/2016	40	54.587917	-5.465367	0.5	0.1	0.05	PSA, CN	0	0.00	Y	22.48	38.99	38.53	Gravelly muddy sand	1.94	4.81	0.09	5.82	0.86	14.76	0.00
13_1	02/02/2016	22	54.504017	-5.420067	0.67	0.1	0.067	Photos, notes	1	14.93	Y											
14_1	02/02/2016	22	54.5113	-5.423867	0.67	0.1	0.067	Photos, notes	0	0.00	Y											
14_a	02/02/2016	21	54.50985	-5.422833	0.67	0.1	0.067	Photos, notes	0	0.00	Y											
15_a	02/02/2016	21	54.498667	-5.416817	0.67	0.1	0.067		7	104.48	Y											
16_1	02/02/2016	22	54.50635	-5.422867	0.75	0.1	0.075	Photos, notes	1	13.33	Y											
17_1	02/02/2016	22	54.504383	-5.421483	0.67	0.1	0.067	PSA, CN, Infauna	19	283.58	Y	19.84	46.38	33.78	Gravelly muddy sand	1.40	4.69	0.08	4.41	0.49	11.04	0.00
18_1	02/02/2016	22	54.500883	-5.42085	0.5	0.1	0.05	Photos, notes	1	20.00	Y											
19_1	02/02/2016	22	54.504933	-5.41675	0.5	0.1	0.05	Photos, notes	7	140.00	Y											
2_1	01/02/2016	34	54.576333	-5.451033	0.33	0.1	0.033	Photos, notes	0	0.00	Y											
20_1	02/02/2016	22	54.50095	-5.416883	0.5	0.1	0.05	Photos, notes	2	40.00	Y											
21_1	02/02/2016	23	54.498283	-5.414967	0.67	0.1	0.067	Photos, notes	2	29.85	Y											
22_1	02/02/2016	21	54.494217	-5.41515	0.5	0.1	0.05	Photos, notes	1	20.00	Y											
23_1	01/02/2016	23	54.585117	-5.4696	0.5	0.1	0.05	Photos, notes	0	0.00	Y											
3_1	01/02/2016	22	54.589117	-5.476283	0.5	0.1	0.05	Photos, notes	0	0.00	Y											
4_1	01/02/2016	28	54.573267	-5.458217	0.75	0.1	0.075	Photos, notes	0	0.00	Y											
5_1	01/02/2016	38	54.572933	-5.447	0.75	0.1	0.075	Photos, notes	0	0.00	Y											
6_1	01/02/2016	26	54.578617	-5.4599	0.75	0.1	0.075	Photos, notes	0	0.00	Y											
7_1	01/02/2016	34	54.583483	-5.454267	0.75	0.1	0.075	Photos, notes	0	0.00	Y											
7A_1	02/02/2016	29	54.582417	-5.454633	0.75	0.1	0.075	PSA, CN, Infauna	41	546.67	Y	30.21	35.78	34.01	Muddy sandy gravel	1.57	4.53	0.10	4.47	0.82	18.35	0.00
7A_2	02/02/2016	29	54.583133	-5.45695	0.5	0.1	0.05	PSA, CN, Infauna	22	440.00	Y	18.03	46.67	35.30	Gravelly muddy sand	2.19	4.36	0.09	4.61	1.73	37.59	0.00
7A_3	02/02/2016	29	54.582617	-5.457033	0.25	0.1	0.025	Infauna only as small sample	7	280.00	Y											
9_1	01/02/2016	30	54.577783	-5.454933	0.33	0.1	0.033	Photos, notes	13	393.94	Y											
9_b	01/02/2016	38	54.578567	-5.456867	0.67	0.1	0.067	Photos, notes	9	134.33	Y											
I1_a	01/02/2016	36	54.583567	-5.4452	0.125	0.1	0.0125	PSA, CN, Infauna	0	0.00	N	34.61	49.88	15.50	Muddy sandy gravel	-0.01	3.51	0.07	3.48	0.68	19.62	51.06
I1_b	01/02/2016	34	54.584783	-5.450067	0.67	0.1	0.067	PSA, CN, Infauna	1	14.93	Y	48.59	37.71	13.70	Muddy sandy gravel	-1.00	3.47	0.05	5.86	0.71	12.16	28.60
I1_c	01/02/2016	35	54.5839	-5.4483	0.5	0.1	0.05	PSA, CN, Infauna	0	0.00	Y	50.90	41.99	7.11	Muddy sandy gravel	-1.54	3.10	0.03	4.61	0.42	9.20	23.39
I2_a	01/02/2016	30	54.5753	-5.453067	0.5	0.1	0.05	PSA, CN, Infauna	0	0.00	Y	34.60	45.28	20.11	Muddy sandy gravel	0.42	4.15	0.08	6.55	0.71	10.90	0.00
I2_b	01/02/2016	32	54.575717	-5.4524	0.75	0.1	0.075	PSA, CN, Infauna	0	0.00	Y	20.04	47.12	32.84	Gravelly muddy sand	2.14	4.03	0.07	7.00	0.47	6.72	0.00
I2_c	01/02/2016	32	54.57595	-5.45265	0.5	0.1	0.05	PSA, CN, Infauna	0	0.00	Y	36.39	45.71	17.90	Muddy sandy gravel	0.19	3.92	0.07	7.13	0.44	6.11	0.00
I3_a	01/02/2016	30	54.58575	-5.457217	0.75	0.1	0.075	PSA, CN, Infauna	0	0.00	Y	9.10	51.33	39.58	Gravelly muddy sand	3.37	3.44	0.07	4.63	1.16	25.01	0.00
I3_b	01/02/2016	30	54.585867	-5.45705	0.5	0.1	0.05	PSA, CN, Infauna	0	0.00	Y	37.62	41.26	21.11	Muddy sandy gravel	0.49	4.13	0.09	6.34	1.32	20.84	0.00
I3_c	01/02/2016	30	54.586017	-5.45645	0.33	0.1	0.033	PSA, CN, Infauna	0	0.00	Y	45.04	37.66	17.31	Muddy sandy gravel	-0.31	3.71	0.06	7.12	0.90	12.65	0.00
I4_a	01/02/2016	27	54.5758	-5.458367	0.67	0.1	0.067	PSA, CN, Infauna	0	0.00	Y	28.16	37.97	33.87	Gravelly muddy sand	1.79	4.48	0.09	5.37	0.97	18.02	0.00
I4_b	01/02/2016	27	54.576633	-5.459383	0.67	0.1	0.067	PSA, CN, Infauna	0	0.00	Y	32.22	45.75	22.03	Muddy sandy gravel	0.77	4.16	0.09	5.33	0.71	13.22	0.00
I4_c	01/02/2016	27	54.5764	-5.459967	0.25	0.1	0.025	PSA, CN, Infauna	0	0.00	Y	20.04	48.52	31.44	Gravelly muddy sand	1.72	4.06	0.10	6.89	0.85	12.35	0.00
I5_a	02/02/2016	20	54.507767	-5.42175	0.67	0.1	0.067	PSA, CN, Infauna	0	0.00	Y	33.32	41.46	25.22	Muddy sandy gravel	1.17	4.18	0.07	6.45	0.80	12.45	0.00
I5_b	02/02/2016	20	54.5085	-5.419583	0.33	0.1	0.033	PSA, CN, Infauna	2	60.61	Y	19.24	51.59	29.17	Gravelly muddy sand	1.79	4.28	0.08	5.17	0.57	11.11	0.00
I5_c	02/02/2016	20	54.507917	-5.419567	0.67	0.1	0.067	PSA, CN, Infauna	0	0.00	Y	24.03	48.38	27.59	Gravelly muddy sand	1.23	4.61	0.08	5.09	0.57	11.12	0.00
I6_a	02/02/2016	22	54.50005	-5.418217	0.67	0.1	0.067	PSA, CN, Infauna	5	74.63	Y	29.99	47.87	22.14	Gravelly muddy sand	0.98	4.08	0.07	3.83	0.71	18.55	0.00
I6_b	02/02/2016	23	54.500017	-5.4176	0.75	0.1	0.075	PSA, CN, Infauna	1	13.33	Y	16.13	48.01	35.86	Gravelly muddy sand	2.46	3.94	0.09	4.43	0.86	19.36	0.00
I6_c	02/02/2016	23	54.499667	-5.4176	0.75	0.1	0.075	PSA, CN, Infauna	1	13.33	Y	10.22	54.82	34.96	Gravelly muddy sand	3.02	3.67	0.07	4.00	1.00	24.87	0.00
I7_a	02/02/2016	24	54.5011	-5.410517	0.67	0.1	0.067	PSA, CN, Infauna	0	0.00	Y	18.97	72.80	8.23	Gravelly muddy sand	-0.20	2.20	0.03	9.68	0.58	5.98	0.00
I7_b	02/02/2016	24	54.50035	-5.4095	0.33	0.1	0.033	PSA, CN, Infauna	0	0.00	Y	42.61	51.75	5.64	Sandy gravel	-1.02	2.40	0.03	7.77	0.31	3.95	6.93
I7_c	02/02/2016	24	54.500983	-5.410617	0.33	0.1	0.033	PSA, CN, Infauna	0	0.00	Y	42.90	53.05	4.05	Sandy gravel	-1.32	2.11	0.04	8.88	2.20	24.74	27.74
X1_1	02/02/2016	21	54.5026	-5.423967	0.33	0.1	0.033	Photos, notes	1	30.30	Y											
X2_1	02/02/2016	22	54.5082	-5.44055	0.67	0.1	0.067	Photos, notes	0	0.00	Y											
X3_1	02/02/2016	31	54.57365	-5.451217	0.67	0.1	0.067	Photos, notes	0	0.00	Y											