South West of England Regional Development Agency

Wave Hub
Appendix H to the Environmental Statement

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Halcrow

South West of England
Regional Development Agency

HALCROW GROUP LTD.
WAVE HUB PROJECT
ENVIRONMENTAL BASELINE SURVEY

Report No: 68-8695

VOLUME II
(ENVIRONMENTAL BIOTOPE CLASSIFICATION REPORT)

Final Report

Client:	Halcrow Group Limited Ash House Falcoln Road Sowton Exeter Devon EX2 7LB
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1 INTRODUCTION

1.1 Scope of Work

Alluvial Mining Limited (AML) were commissioned by Halcrow Group Limited to provide Geotechnical/ Environmental Survey Services in association with the "Wave Hub – offshore survey stage 2" in NW Cornwall. The Environmental Department of Fugro Survey Limited (FSLTD) was subcontracted by AML to perform the offshore environmental field operations and subsequent analysis and interpretation.

The environmental baseline survey was required to provide baseline data relating to the physico-chemical and macrofaunal benthic environment. The survey comprised grab sampling using a $0.1m^2$ Hamon grab for physico-chemical and biological analysis of the sediment, 2m beam trawls for epibenthic fauna and high resolution stills photography with video framing capability along transects.

Due to the adverse weather conditions experienced, the environmental survey was completed in two Phases. Phase I was performed using the survey vessel VOS Baltic with the cruise dates between 18/10/2005 and 31/10/2005 and involved acquisition of all grab samples, beam trawls and camera transects 1 and 2. Phase II was performed using the survey vessel Portree II with the cruise dates between 18/11/2005 and 24/11/2005 and involved the acquisition of the remaining camera transects (see Appendix A for details of personnel).

This volume, Volume II, focuses on the discussion of the benthic biotopes of the Wave Hub survey area. The hierarchical biotope analysis, used for biotope classification by Connor *et al* (1997 and 2004), was used to characterise biotopes in terms of their bathymetric, granulometric and biotic characteristics. Where possible, biotopes were classified in accordance with 'The marine habitat classification for Britain and Ireland version 04.05' (Connor *et al*, 2004).

The sampling and analytical methodology, results and data analysis are detailed in Volume I - Environmental Baseline Survey Report.

1.1.1 Survey Regions

The field survey was split into four sections:

- Offshore Regional Area – survey of area surrounding original Wave Hub deployment area location (9.5km x 8.5km).
- Original Wave Hub Deployment Area – survey at original Wave Hub deployment area footprint (2km x 4km).
- Offshore Cable Route – survey of the 500m wide cable corridor running approximately 28km between St. Ives bay (from area of exposed bedrock) and original Wave Hub proposed location.
- Nearshore Cable Route – survey of the St. Ives Bay section of the cable route (from exposed bed rock area to the most nearshore station).

It should be noted that during the reporting process, the original Wave Hub deployment area was revised and relocated to the east of the regional offshore area.

1.1.2 Sediment Sampling

A total of 30 grab sampling stations were positioned by the FSL Environmental Department using geophysical data from a previous survey obtained in July 2005 by EGS Ltd. Grab samples were initially located in areas which were expected, from geophysical survey data, to comprise surficial sediments, thereby avoiding areas of bedrock. Stations were then positioned to give sufficient geographical and bathymetric coverage of the area to represent the diverse range of sediment types present within the survey area.

Stations 1 to 8 and 16 were located within the original Wave Hub Deployment Area. Stations 9 and stations 12 to 20 (excluding station 16) were located around the regional offshore area (outside the original Wave Hub deployment area). Stations 10 and 11 were located along the offshore cable route, whilst stations 24 to 30 were located along the nearshore cable route. Station 24 was only sampled for two samples, FA and FB. Samples FC and PC (physico-chemical) were not sampled due to the coarse nature of the sediment. Station 30 was repositioned for safety reasons due to shallow water depth at this station. Stations 20 to 23 were not sampled due to the coarse nature of the substrate.

1.1.3 Beam Trawl Sampling

A total of 20 beam trawl transects were also positioned by FSL using the geophysical data. Trawls 1 to 3 and 8 were positioned within the Wave Hub deployment area. Trawls 5 to 14 (excluding trawl 8) were located around the regional offshore area, trawl 4 was located along the offshore cable route and trawls 15 to 20 were located along the nearshore cable route.

Midline coordinates for beam trawls corresponded to particular grab stations, so that both infauna and epifauna communities could be investigated at these locations.

1.1.4 Underwater Photography

A total of 18 camera transects were positioned after preliminary review of grab and beam trawl data. Transects 14 to 17 were located within the original Wave Hub deployment area. Transects 8 to 13 were located around the regional offshore area, transects 5 to 7 and transect 18 were located along the offshore cable route and transects 1 to 4 were located along the nearshore cable route.

Camera transects were reoriented according to tidal conditions, to facilitate the effective survey of transects. At the request of the client, a drop-down camera deployment was undertaken to investigate a magnetic anomaly located along the cable route, which was subsequently identified as a wreck.

2 DATA ANALYSIS METHODOLOGY AND RATIONALE

2.1 Introduction

A biotope can be defined as a habitat with which a specific biological community is associated. Although habitat is used here in its accepted scientific sense (i.e. as an area defined solely by its abiotic characteristics), in common usage, for example in the EC Habitats Directive, biota tends to be included in its definition; used in this way the term habitat can be considered synonymous with the term biotope (Connor *et al*, 1997).

Although in a theoretical sense a biotope can be defined at any spatial scale, this report follows recent biotope classifications (Connor *et al*, 1997 and 2004) by adopting a minimum biotope area of 25m^2; it should be noted that this minimum area can be made up of two or more smaller patches distributed over the site. Theoretically biotopes can also be defined on different temporal scales, for example the composition of a rocky shore community may show seasonal variation dependent on its biota's susceptibility to cold, desiccation or wave exposure. Classification systems generally attempt to 'filter out' small temporal variation (e.g. seasonal or tidal). As a consequence of this filtered approach, longer term changes, such as those resulting from population growth and decline, can be more difficult to detect.

A marine biotope classification system for British waters has been developed by Connor *et al* (1997 and 2004) from data acquired during the Joint Nature Conservation Committee (JNCC) Marine Nature Conservation Review (MNCR). The classification system has been developed to be compatible with the European Nature Information Service (EUNIS), which has compiled habitat information from across Europe into a single database. The classification systems developed by EUNIS and Connor *et al* (1997) are both based around the same hierarchical analysis. Initially abiotic habitats are defined at three levels, biological communities are then linked to these (at two lower levels) to produce a biotope classification; this hierarchy is summarised in Table 2.1 with a coding system developed on the same principle (Connor *et al,* 2004).

Table 2.1 The Biotope Classification Hierarchy (Adapted from Connor *et al*, 2004)

Level	Number of Types Defined*	Example (Biotope Classification Code*)
1. Environment	1	Marine Environment
2. Broad habitat types	5	Circalittoral Rock (CR)
3. Main habitats	24	High energy circalittoral rock (CR.HCR)
4. Biotope complexes	75	Very tide-swept faunal communities (CR.HCR.FaT)
5 & 6. Biotopes and sub-biotopes	370	*Balanus crenatus* and *Tubularia indivisa* on tide-swept circalittoral rock (CR.HCR.FaT.BalTub)

**In 'The marine habitat classification for Britain and Ireland Version 04.05 (Connor et al, 2004).*

2.2 Habitat Classification

This analysis classifies habitat characteristics in accordance with 'The Marine Habitat Classification for Britain and Ireland Version 04.05 (Connor *et al*, 2004). The survey area was initially divided into different abiotic habitats defined by (in hierarchical order):

1) Substrate type

2) Bathymetry

3) Hydrodynamic energy

Other abiotic factors considered during the habitat analysis included salinity, light penetration and temperature. As none of these factors were quantified during the survey campaign, their contribution was inferred from community structure. Several of the factors mentioned are interdependent to a great degree. For example, sediment type is largely the product of hydrodynamic regime which may in turn vary with depth.

The hierarchical habitat classification is summarised in Table 2.3, whilst Table 3.3 details the corresponding habitat classification matrix for the current survey.

2.2.1 Substrate Type

Seabed features data from the geophysical survey were analysed in order to place substrata around the survey area into two broad categories, rock or sediment. Groundtruthing in the form of video/ stills photography was used to confirm and, in some areas, descriptively refine this classification.

The substrate composition of sediment areas was quantitatively sampled as part of the grab sampling campaign. Multivariate statistical analysis of particle size distribution (PSD) data was used to group stations in terms of their sediment composition; further details of the multivariate techniques used are provided in Section 2.4.

2.2.2 Bathymetry

Bathymetric data from the geophysical survey were used to further subdivide the substrate classifications. In accordance with Connor *et al* (2004), three zones were considered when applying this classification; the summary characteristics of these are presented in Table 2.2.

Table 2.2 Characteristics of Bathymetric Zones (Adapted from Connor *et al*, 2004)

Bathymetric Zone	Typical Upper Boundary (Above/Below LAT)	Immersion	Salinity	Temperature	Light Level	Wave Energy
Littoral	+10m to +6m	Regularly immersed and emmersed	Variable	Highly variable	Full (when emmersed) to slightly reduced	Highly variable
Infralittoral	+1m to 0m (MLWS)	Immersed	Intermediate to full salinity	Variable	Variably reduced	Variable
Circalittoral	-5m to -20m	Immersed	Full salinity	Moderately variable to stable	Low to none	Moderately variable to stable

The infralittoral zone is defined as the zone in which, given suitable substrate, algae will dominate the epibiota. Circalittoral zone communities are animal dominated, although sparse filamentous and coralline algal growth may occur (Hartnoll, 1998). In this assessment the extent of the infralittoral zone was determined by examination of the biological communities of ROCK and COBBLE habitats.

2.2.3 Energy

The hydrodynamic energy to which habitats are exposed is very difficult to quantify and can be subject to extreme temporal variation. To overcome these problems a simple three point scale (low, moderate and high energy) was adopted.

The level of wave exposure of a habitat was assessed by consideration of the following factors:

1) Geographical location: the orientation of the survey area to the prevailing wind (and therefore wave) direction and the fetch (i.e. distance over which the waves travel without obstruction) will largely determine the wave exposure of a particular habitat.

2) Depth: the shallower the habitat the more exposed it will be to wave action. Habitats at depths of greater than 40m are unlikely to be subject to significant wave action except during gale conditions (Hiscock, 1983).

Seabed topography can reduce, or in some cases increase, wave and current exposure. Topographic features running perpendicularly to wave/ current direction can provide some protection from wave / current energy; those running parallel to it (e.g. wave-surge channels) are subjected to greater energy.

Sediment type is largely determined by hydrodynamic conditions and provided a useful indication of energy exposure. Intertidal areas subject to high wave energy typically comprise coarse SAND; the finer SAND, SILT and CLAY are scoured away by wave action. In lower energy intertidal areas, seabed scour is reduced and increased deposition occurs. The sediment of these areas is therefore likely to comprise fine SAND and/or SILT. Biological communities may also be indicative of energy exposure and were used as part of the assessment of habitat energy. High energy rock and COBBLE substrates often have a characteristic epifauna composed of cnidarian and bryozoan species tolerant of wave or current exposure. Sediment communities in high energy areas are often dominated by a small number of opportunistic polychaete and crustacean species that quickly colonise disturbed sediment.

Table 2.3 Habitat Classification Matrix Showing Biotope Classification Prefixes (Adapted from Connor *et al*, 2004)

<table>
<tr><th colspan="3"></th><th colspan="10">SUBSTRATUM</th></tr>
<tr><th colspan="3"></th><th colspan="4">ROCK</th><th colspan="6">SEDIMENT</th></tr>
<tr><th colspan="3"></th><th>High Energy Rock
(HR)</th><th>Moderate Energy Rock
(MR)</th><th>Low Energy Rock
(LR)</th><th>Features on Rock
(FR)</th><th>Coarse Sediment
(CS)</th><th>Sand
(Sa)</th><th>Mud
(Mu)</th><th>Mixed Sediment
(Mx)</th><th>Macrophyte-Dominated Sediment
(Mp)</th><th>Biogenic Reefs
(BR)</th></tr>
<tr><td rowspan="3">BATHYMETRIC ZONE</td><td>LITTORAL</td><td>Littoral
(*L*)</td><td>High energy littoral rock
(HLR)</td><td>Moderate energy littoral rock
(MLR)</td><td>Low energy littoral rock
(LLR)</td><td>Features on littoral rock
(FLR)</td><td>Littoral coarse sediment
(LCS)</td><td>Littoral sand
(LSa)</td><td>Littoral mud
(LMu)</td><td>Littoral mixed sediment
(LMx)</td><td>Littoral macrophyte-dominated sediment
(LMp)</td><td>Littoral biogenic reefs
(LBR)</td></tr>
<tr><td rowspan="2">SUBLITTORAL</td><td>Infralittoral
(*I*)</td><td>High energy infralittoral rock
(HIR)</td><td>Moderate energy infralittoral rock
(MIR)</td><td>Low energy infralittoral rock
(LIR)</td><td>Features on infralittoral rock
(FIR)</td><td rowspan="2">Sublittoral coarse sediment
(SCS)</td><td rowspan="2">Sublittoral sand
(SSa)</td><td rowspan="2">Sublittoral mud
(SMu)</td><td rowspan="2">Sublittoral mixed sediment
(SMx)</td><td rowspan="2">Sublittoral macrophyte-dominated sediment
(SMp)</td><td rowspan="2">Sublittoral biogenic reefs
(SBR)</td></tr>
<tr><td>Circalittoral
(*C*)</td><td>High energy circalittoral rock
(HCR)</td><td>Moderate energy circalittoral rock
(MCR)</td><td>Low energy circalittoral rock
(LCR)</td><td>Features on circalittoral rock
(FCR)</td></tr>
</table>

Letters in parenthesis represent biotope classification prefixes

2.3 Community Classification

Biotic communities were identified from the analysis of data acquired during the survey campaign; sample acquisition and analysis methodologies are detailed in the Environmental Baseline Survey Report (Volume I). The current volume has focussed on the analytical techniques used in the determination of biological community structure.

2.3.1 Rock Communities

The community structure of rock habitats was defined by analysis of the underwater video/ stills photography data. Changes in substrate and epibiota were logged for all of the footage acquired and stills or sections of video pertaining to specific communities were noted. The position of each community was determined from the stills fixes and the navigation string overlay on the video.

A selection of stills and/ or sections of video that were considered characteristic of each biotope identified were selected for more detailed analysis. The taxa present in each photograph or video segment were identified to the lowest possible taxonomic level and then semi-quantified using the SACFOR scale, in which they were classed as superabundant, abundant, common, frequent, occasional or rare dependent on percentage substrate coverage. The SACFOR scale splits taxa into two broad groups, those that form extensive (and often aggregated) colonies that cover the substrate and those in which smaller discrete colonies are evident. Taxa which form large colonies are further split into two growth forms, encrusting and massive, while taxa which form smaller colonies are subdivided by colony size.

The SACFOR scale utilised during this assessment was adapted from that used in the Marine Nature Conservation Review (Hiscock (ed.), 1996). As the majority of biotopes within 'The Marine Habitat Classification for Britain and Ireland' (Connor *et* al, 2004) were classified under this scheme, direct comparison could be made to the biotope characterising data detailed therein. Examples of SACFOR scale use include *Pentapora fascialis*, a bryozoan with a massive growth form, which was found to cover 10 to 15% of the substrate at 150 288mE, 43 421mN (camera transect 4, still 174) and was therefore classed as common. At the same location, the erect bryozoan *Crisia* sp. accounted for between 1 and 5% cover; colonies of this genus grow to around 10cm high and were therefore classed as frequent. Table 2.3 summarises the SACFOR scale used, while Table 2.4 gives examples of genera that fit the six growth classifications.

2.3.2 Sediment Communities

Sediment community structure was determined by analysis of grab and beam trawl sample data. As all of the beam trawl transects corresponded to grab stations it was possible to link the epifauna and infauna of much of the survey area. This avoids the bias towards one or other sampling methodologies inherent in less balanced sampling programmes. Data relating to all free-living taxa were analysed using multivariate statistical analysis (see Section 3); this allowed groupings of significantly similar communities to be recognised and the characterising taxa identified. Colonial taxa taken by beam trawl were semi-quantified using the SACFOR scale (Table 2.3), percentage of sample volume was used in place of percentage cover. While this data could not be analysed statistically, it was considered when explaining trends in the other macrofaunal data.

Table 2.4 SACFOR Scale (adapted from Hiscock (ed.), 1996)

Cover / Volume (%)	Growth Form		Size of Colonies / Individuals				Density (num / m^2)
	Encrusting	Massive	<1cm	1-3cm	3-15cm	>15cm	
>80%	S		S				>10 000
40-79%	A	S	A	S			1000-9999
20-39%	C	A	C	A	S		100-999
10-19%	F	C	F	C	A	S	10-99
5-9%	O	F	O	F	C	A	1-9
1-5%	R	O	R	O	F	C	0.1-0.99
<1%		R		R	O	F	0.01-0.099

S = superabundant, A = abundant, C = common, F = frequent, O = occasional, R = rare.

Table 2.5 Growth Form of Genera Encountered

Phylum	Growth Form		Colony Size			
	Encrusting	Massive	<1cm	1-3cm	3-15cm	>15cm
PORIFERA	*Halichondria*			*Tethya*	*Stelligera*	
ANTHOZOA		*Alcyonium*			*Nemertesia* *Sertularia* *Hydrallmania*	
BRYOZOA	*Schizomavella* *Aetea*	*Pentapora* *Flustra*			*Cellaria* *Amathia*	
CHORDATA	*Botryllus*					
RHODOPHYCOTA		*Gelidium*				
CHLOROPHYCOTA	*Ulva*					

2.4 Multivariate Statistical Analysis

Multivariate statistical analysis was used to identify groupings in the community and PSD data that corresponded to specific sediment biotopes. The analysis was undertaken using the widely used statistical package, Plymouth Routines in Multivariate Ecological Research (PRIMER) v6.0 (Clarke & Gorley, 2006). Multivariate statistical techniques have been shown to be effective for biotope identification in a study conducted by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) (Brown *et al*, 2001). These analyses are also an important component of the biotope classification methodology used by Connor *et al* (1997 and 2004).

A more detailed description of the statistical methods used is presented, along with the results of the analyses, in the Environmental Baseline Survey Report (Volume I).

Pre-treatment of data

The macrofaunal dataset was fourth root transformed so that the analysis took account of all components of the community but retained some quantitative information. This transformation effectively reduced the data to a 6 point scale (0 = absent, 1 = one individual, 2 = handful, 3 = sizeable number, 4 = abundant, ≥5 = very abundant).

Data for percentage of sediment composition within 0.5 phi size classes were normalised by ranking.

Creating Similarity Matrices

A triangular similarity matrix was then produced from the transformed data, by calculating the similarity between every sample within the dataset. For the macrofaunal data the Bray-Curtis similarity coefficient was used (Bray & Curtis, 1957), this is widely considered to be the most suitable similarity measure for community data (Clarke & Warwick, 2001). For the PSD data the Euclidean distance similarity measure was utilised.

Hierarchical Agglomerative Clustering (CLUSTER) and Similarity Profile Testing (SIMPROF)

The CLUSTER programme uses the similarity matrix to successively fuse samples into groups and the groups into clusters according to their level of similarity. The end point of this process is a single cluster containing all the samples, which is displayed by means of a dendrogram with similarity displayed on one axis and samples on the other.

A series of similarity profile permutation tests (SIMPROF) were also performed, these look for statistically significant evidence of genuine clusters in samples. By combining this significance testing with the CLUSTER function, dendrograms were produced indicating those clusters which were statistically significant.

Non-Metric Multidimensional Scaling (nMDS)

N-MDS also uses the similarity matrix, but unlike hierarchical agglomerative clustering nMDS simultaneously displays the similarity between all pairs of samples on 2 or 3 dimensional ordinations.

Similarity Percentages Analysis (SIMPER)

This programme was used to calculate the individual contribution of different variables (taxa or sediment size classes) to both the similarity of samples within a cluster group and the dissimilarity between different cluster groups. SIMPER was used to identify the taxa and size classes of sediment that characterised each sediment biotope.

2.5 Presentation of Biotope Classifications

For each broad habitat type (rock or sediment) biotopes are presented in order of increasing depth. The following information is provided for each listed biotope:

1) Biotope complex and biotope name and code as listed in Connor *et al*, 2004. Where no existing classification exists a new biotope name has been designated.

2) A summary of habitat characteristics showing substratum and topography, bathymetric zone, depth (range), tidal stream strength and wave exposure.

3) A description of the biotope's characteristics, including justification for its classification and details of its ecology.

4) A description of the biotope's distribution.

5) Photograph(s) considered typical of the biotope.

6) Summary table(s) displaying the characterising taxa for the biotope and their typical SACFOR abundance in the biotope. For sediment biotopes the density of individuals of each taxon is also provided as is their percentage contribution to cluster similarity, as calculated by SIMPER.

   Where comparable data from Connor *et al* (2004) are available these are also presented in this table. Connor *et al* (2004) present a frequency of occurrence symbol for the characterising taxa of each biotope within their classification and this data is also provided in the form of the following scoring system:

   1 – Occurs in < 21% of records
   2 – Occurs in 21 - 40% of records
   3 – Occurs in 41 - 60% of records
   4 – Occurs in 61 - 80% of records
   5 – Occurs in 81 - 100% of records

All depths given in the classifications are tide reduced i.e. expressed as metres below lowest astronomical tide (m below LAT); they were derived from the bathymetric data provided by EGS Ltd.

2.6 Assessing Biotope Closeness of Fit

The closeness of fit of the biotopes classified in this study to those classified by Connor *et* al (2004) was primarily assessed by comparison of the data relating to characterising taxa for the biotopes. Habitat characteristics were also considered.

Direct comparison was made between the identities of taxa present, their SACFOR abundance and, for sediment biotopes, their density. When these comparisons were being made it was important to remember that the data provided by Connor *et al* (2004) were, in most instances, derived from large numbers of samples taken from a wide range of locations. As a result of this taxa that may be abundant in a biotope in a particular area may be 'filtered out' of the classification because of their absence from other sites. Density of individuals can vary significantly between different areas where a biotope occurs, the logarithmic SACFOR scale was designed to mitigate this problem to some degree by classifying taxa within discrete abundance ranges according to size (see Table 2.3); comparisons of SACFOR abundance are therefore considered preferable to comparisons of absolute abundance (Hiscock (ed.), 1994).

The percentage contributions to similarity listed by Connor *et al* (2004) were calculated by SIMPER analysis of community data for sites where specific biotopes have been identified. They cannot be directly compared to the contributions to similarity calculated in this study, as these quantify relationships between samples from a single location. These data do however, provide a useful indication of how important taxa are for the characterisation of a biotope and also give some idea of the biotope's typical biodiversity. A very speciose biotope would for example, be characterised by many taxa that each make a low contribution to similarity (e.g. SS.SMX.OMx – see page X). A species poor biotope would be characterised by a few species that each make a large contribution to similarity (e.g. SS.SSA.IFiSaNCirBat – see page X).

Another measure provided by Connor *et al* (2004) that indicates the importance of characterising taxa is their frequency of occurrence range. Biotopes identified from this study that contain several taxa with high frequency of occurrence ranges (e.g. CR.HCR.DpSp – see page X), can be said to closely fit the Connor *et al* (2004) classification of the biotope.

2.7 Biotope Mapping

The contouring and 3D surface mapping software package, Surfer, Version 8, was utilised to aid interpretation and visual representation of environmental data. By interpolating irregularly spaced geographical information (XYZ data) regularly spaced grid data may be produced. These grids may then be displayed in a number of forms, including contour, shaded relief and wireframe maps.

Interpolation of bathymetry and environmental variables (discrete values for sampling stations) was undertaken according to the following criteria:

Bathymetry Interpolation	
Gridding Method	Kriging
Search Radius	3m
Contour Scaling	Coded on each figure
Grid Line Spacing	10m

3 RESULTS

3.1 Habitat Classification

3.1.1 Substrate

Rock habitats were identified throughout the survey area, the shallowest occurred at around 20m depth in the nearshore cable route area and the deepest was found at approximately 60m depth in the northerly original Wave Hub deployment area.

Multivariate statistical analysis of the PSD data identified four clusters. Cluster a corresponded to the moderately well to well sorted fine to medium SAND substrate of the shallower areas of the inshore cable route (< 20m below LAT). Clusters b and c corresponded to variants of the very poorly sorted PEBBLE substrate that extended from the deeper areas of the nearshore cable route area (> 20m below LAT) to the southern halves of the regional offshore and original Wave Hub deployment areas. Cluster d corresponded to a poorly to moderately sorted coarse SAND substrate in the northern regional offshore and original Wave Hub deployment areas.

3.1.2 Bathymetry

The seaweed dominated communities typical of the infralittoral zone were not apparent in this study and as such all rock habitats were, for the sake of classification, considered circalittoral. This is consistent with Connor *et al* (2004), who define all infralittoral rock biotopes by their flora.

As no defined infralittoral zone was evident, both infralittoral and circalittoral sediment biotopes (from Connor *et al*, 2004) were considered in this biotope classification.

3.1.3 Hydrodynamic Energy

Uninterrupted fetch during westerly and south-westerly winds means that large waves are commonplace in the survey area and 2.5 to 3m waves were frequently recorded during Phase I of the survey. The medium SAND sediment of the shallow sublittoral is characteristic of a wave exposed coast and the paucity of fauna found at station G30 suggests mobile, wave disturbed sediment. Hiscock (1983) showed the relationship between water velocity and depth under gale conditions (force 8 to 9 winds): at 20m depth bottom velocity exceeded 200cm.s^{-1} (7.2km.h^{-1}); at 40m it was reduced to 60cm.s^{-1} (2.1km.h^{-1}); and at 80m it was just 9cm.s^{-1} (0.3km.h^{-1}). Habitats of the nearshore cable route area (below ~ 30m depth) are therefore likely to be subjected to considerable energy during gale and storm force winds.

Surface tidal velocity was logged throughout the Phase I sampling campaign, the greatest tidal flow recorded was approximately 4.5 knots (8.5km.h^{-1}) although it was more typically around 1.5 to 2 knots (2.8 to 3.8km.h^{-1}). In the context of the Connor *et al* (2004) classification current speeds of this magnitude are considered weak to moderate, tidal flows of up to 8 knots (15km.h^{-1}) have been recorded for straits between land masses and entrances to sea loughs and rias (Hartnoll, 1998). Areas with extremely strong tidal streams often have communities dominated by characteristic species, notably the hydroid *Tubularia indivisa*; these communities were not recorded in the current study.

The Connor *et al* (2004) classification does not clearly differentiate between what constitutes a high, moderate or low energy habitat. This problem appears to arise from difficulty in characterising the combined effect of wave and tidal action, wave energy is known to negate tidal flow in shallow water, but in deeper water the two forces interact in a manner that is hard to quantify. The problem is compounded by the classification's broad geographic coverage; communities recorded in a set of hydrodynamic conditions in one area may occur under different hydrodynamic conditions elsewhere.

The habitats of the survey area were defined as being of moderate to high energy. This definition was consistent with the biological community classifications of Connor *et al* (2004), but may understate the importance of wave energy in the shaping of shallower rock communities.

3.1.4 Other Abiotic Factors

As no significant freshwater input was evident, the entire site was assumed to be fully marine. The absence of any fauna characteristic of reduced salinity conditions validated this assumption.

As all of the rock habitats were found circalittorally they are probably fairly thermostable, experiencing only slight seasonal variations in temperature. The infralittoral sediment habitats are likely to be subject to slight diurnal and seasonal temperature variation.

3.2 Biotope Classification

3.2.1 General Description

A total of fifteen biotopes were identified within the survey area, of these nine were identified from rock habitats and six from sediment habitats. The biotopes were classified within six biotope complexes, three pertaining to rock substrata and three to sediments. Table 3.1 shows the number of types defined at each level of the biotope classification hierarchy

The majority of the biotopes classified in this study fitted, with varying accuracy, biotopes listed in the Connor *et al* (2004) classification. Of the previously unclassified biotopes all were assigned to a biotope complex and all but two were allied to biotopes within the Connor *et al* (2004) classification; this should allow data broadly relevant to their ecology and sensitivity to be accessed.

Table 3.2 presents a summary of the biotopes found along with brief details of their habitat and biota; this also effectively provides a key to the abbreviations used in Section 3.2.2. A reduced habitat classification matrix in which the biotopes identified in this study are displayed is presented in Table 3.3.

Section 3.2.2 briefly describes the spatial distribution of the biotopes over the survey area as a whole. Although only limited data were available for the revised Wave Hub deployment area, a prediction of biotope distribution within this has been made by extrapolation of data from adjacent areas. Detailed descriptions of each of the biotopes found within each biotope complex are provided in sections 3.2.3 to 3.2.8. Within each complex the biotopes are presented in order of increasing bathymetry.

Table 3.1 The Biotope Classification Hierarchy (Adapted from Connor *et al* 2004)

Level	Number of Types Defined*	Type (Classification Code*)
1. Environment	1	Marine Environment
2. Broad habitat types	2	Circalittoral Rock (CR) Sublittoral Sediment (SS)
3. Main habitats	4	High Energy Circalittoral Rock (CR.HCR) Moderate Energy Circa Littoral Rock (CR.MCR) Sublittoral Sand (SS.SSA) Sublittoral Mixed Sediment (SS.SMX)
4. Biotope complexes	6	Deep Sponge Communities (CR.HCR.Dpsp) Mixed Faunal Turf Communities (CR.HCR.Xfa) Echinoderms And Crustose Communities (CR.MCR.Eccr) Infraliitorral Fine Sand (SS.SSA.Ifisa) Cicalittoral Mixed Sediment (SS.SMX.CMx) Offshore Circalittoral Mixed Sediment (SS.SMX.OMx)
5 & 6. Biotopes and sub-biotopes	15	See Table 3.2

**In 'The Marine Habitat Classification for Britain and Ireland Version 04.05' (Connor et al, 2004).*

Table 3.2 Summary Table Showing the Biotopes Identified in this Study

Habitat Type		Biotope Complex		Biotope	
Code	Name	Code	Name	Code	Name
CR	Circalittoral Rock	CR.HCR.DpSp	Deep Sponge Communities	CR.HCR.DpSp	Deep Sponge Communities
CR	Circalittoral Rock	CR.HCR.Xfa	Mixed Faunal turf Communities	N/A	Flustra foliacea and encrusting sponges on wave-exposed circalittoral boulders
CR	Circalittoral Rock	CR.HCR.Xfa	Mixed Faunal turf Communities	CR.HCR.XFa.ByErSp	Bryozoan turf and erect sponges on tide swept circalittoral rock
CR	Circalittoral Rock	CR.HCR.Xfa	Mixed Faunal turf Communities	N/A	*Corynactis viridis* on wave-exposed circalittoral rock
CR	Circalittoral Rock	CR.MCR.Eccr	Echinoderms and Crustose Communities	N/A	*Pentapora fascialis,* solitary ascidians, *Halichondria panicea* and red algae on wave-exposed circalittoral rock
CR	Circalittoral Rock	CR.MCR.Eccr	Echinoderms and Crustose Communities	CR.MCR.EcCr.CarSp.PenPcom	Caryophyllia smithii and sponges with *Pentapora fascialis*, *Porella compressa* and crustose communities on wave-exposed circalittoral rock
CR	Circalittoral Rock	CR.MCR.Eccr	Echinoderms and Crustose Communities	CR.MCR.EcCr.FaAlCr.Bri	Brittlestar beds on faunal and algal encrusted, exposed to moderately exposed circalittoral rock
CR	Circalittoral Rock	CR.MCR.Eccr	Echinoderms and Crustose Communities	N/A	*Antedon bifida* on moderately exposed bedrock outcrops
CR	Circalittoral Rock	CR.MCR.Eccr	Echinoderms and Crustose Communities	CR.MCR.EcCr.CarSp.Bri	Brittlestar bed overlying coralline crusts, *Parasmittina trispinosa* and *Caryophyllia smithii* on wave-exposed circalittoral rock
SS	Subtidal Sediment	SS.SSA.IFiSa	Infralittoral Fine Sand	SS.SSA.IFiSa.IMoSa	Infralittoral mobile clean sand with sparse fauna
SS	Subtidal Sediment	SS.SSA.IFiSa	Infralittoral Fine Sand	SS.SSA.IFiSaNCirBat	*Nephtys cirrosa* and *Bathyporeia* spp. in Infralittoral Sand
SS	Subtidal Sediment	SS.SMX.CMx	Circalittoral mixed sediment	SS.SMX.OMx overlain by SS.SCS.CCS.PomB	Offshore circalittoral mixed sediment overlain by Pomatoceros triqueter with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles
SS	Subtidal Sediment	SS.SMX.CMx	Circalittoral mixed sediment	SS.SMX.CMx.OphMx	*Ophiothrix fragilis* and / or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment
SS	Subtidal Sediment	SS.SMX.CMx	Circalittoral mixed sediment	N/A	*Antedon bifida* beds with *Ophiothrix fragilis* on circalittoral mixed sediment
SS	Subtidal Sediment	SS.SMX.OMx	Offshore circalittoral mixed sediment	SS.SMX.OMx overlain by SS.SCS.CCS.Blan	Offshore circalittoral mixed sediment overlain by *Branchiostoma lanceolatum* in circalittoral coarse sand with shell gravel

Table 3.3 Habitat Classification Matrix Showing the Biotopes Identified in this Study (Adapted from Connor *et al*, 2004)

		ROCK HABITATS		SEDIMENT HABITATS	
		High Energy Rock (HR)	**Moderate Energy Rock (MR)**	**Sand (Sa)**	**Mixed Sediment (Mx)**
BATHYMERTRIC ZONE	Infralittoral			Infralittoral mobile clean sand with sparse fauna	
BATHYMERTRIC ZONE	Infralittoral			*Nephtys cirrosa* and *Bathyporeia* spp. in Infralittoral Sand	
BATHYMERTRIC ZONE	Circalittoral	Deep Sponge Communities	*Pentapora fascialis,* solitary ascidians, *Halichondria panicea* and red algae on wave-exposed circalittoral rock		Offshore circalittoral mixed sediment overlain by Pomatoceros triqueter with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles
BATHYMERTRIC ZONE	Circalittoral	Flustra foliacea and encrusting sponges on wave-exposed circalittoral boulders	Caryophyllia smithii and sponges with *Pentapora fascialis*, *Porella compressa* and crustose communities on wave-exposed circalittoral rock		*Ophiothrix fragilis* and / or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment
BATHYMERTRIC ZONE	Circalittoral	Bryozoan turf and erect sponges on tide swept circalittoral rock	Brittlestar beds on faunal and algal encrusted, exposed to moderately exposed circalittoral rock		*Antedon bifida* beds with *Ophiothrix fragilis* on circalittoral mixed sediment
BATHYMERTRIC ZONE	Circalittoral	*Corynactis viridis* on wave-exposed circalittoral rock	*Antedon bifida* on moderately exposed bedrock outcrops		Offshore circalittoral mixed sediment overlain by *Branchiostoma lanceolatum* in circalittoral coarse sand with shell gravel
BATHYMERTRIC ZONE	Circalittoral		Brittlestar bed overlying coralline crusts, *Parasmittina trispinosa* and *Caryophyllia smithii* on wave-exposed circalittoral rock		

3.2.2 Biotope Distribution

Nearshore Cable Route Area (~5m to 32m below LAT)

The very exposed SAND substrate of the shallow circalittoral (~5m below LAT) was found to have a community consistent with SS.SSA. IFiSa.IMoSa. This biotope grades into the SS.SSA.IFiSa.NCirBat variants characteristic of the finer, more stable SAND substrates associated with the deeper infralittoral zone (14 to 20m below LAT). The *Pentapora fascialis*, *Halichondria panicea* and red algae on wave-exposed circalittoral rock biotope was identified from an isolated rock outcrop at around 20m depth; although this biotope was only seen once in the current study it may occur on the other shallow outcrops evident from the geophysical data. The PEBBLE sediment of the deepest section of the nearshore cable route area was found to have a community consistent with SS.SMX.OMx overlain by SS.SCS.CCS.PomB.

Offshore Cable Route (18m to 52m below LAT)

The habitat of the offshore cable route was predominantly bedrock and boulder, although isolated patches of PEBBLE substrate were also present.

Bedrock topography was apparently the main determinant of biotope distribution within the rock habitats. Raised outcrops were colonised by communities consistent with CR.MCR.EcCr.CarSp.PenPCom or the more diverse variant of CR.HCR.DpSp. The flat bedrock plateaus had the dense brittlestar aggregations typical of CR.MCR.EcCr.FaAlCr.Bri, low diversity variants of CR.HCR.DpSp or CR.HCR.XFa.ByErSp. Boulder biotopes adjacent to bedrock outcrops were classified as either CR.HCR.DpSp, CR.HCR.XFa.ByErSp or *Flustra foliacea* and encrusting sponges on wave-exposed circalittoral boulders.

Southern Regional Offshore and Original Wave Hub Deployment Areas (32m to 58m below LAT)

The dominant biotope of the southern halves of these areas was SS.SMX.OMx overlain by SS.SCS.CCS.PomB. In places SS.SMx.CMx.OphMx and *Antedon bifida* beds and *Ophiothrix fragilis* on circalittoral mixed sediment were identified.

The distribution of rock biotopes again appeared to be determined by topography. The biotopes of steep rock outcrops were either the diverse variant of CR.HCR.DpSp, CR.HCR.XFa.ByErSp or *A. bifida* on moderately exposed bedrock outcrops. Bedrock plateaus were dominated by CR.HCR.XFa.ByErSp, CR.MCR.EcCr.CarSp.Bri and the *Ophiocomina nigra* bed variant of CR.MCR.EcCr.FaAlCr.Bri; *Corynactis viridis* on wave-exposed circalittoral rock was identified from one outcrop in the south western regional offshore area.

Northern Regional Offshore and Original Wave Hub Deployment Areas (50m to 64m below LAT)

The dominant biotope of these areas was SS.SMx.OMx overlain by SS.SCS.CCS.Blan. The *O. fragilis* dominated variant of CR.MCR.EcCr.FaAlCr.Bri was identified from a bedrock outcrop in the north eastern regional offshore area and CR.HCR.XFa.ByErSp was found in the northern original Wave Hub deployment area.

Revised Wave Hub Deployment Area (50m to 60m below LAT)

As only limited data are available for this area the following discussion of distribution is largely based on findings from bathymetrically comparable adjacent areas.

The dominant sediment biotope is likely to be SS.SMX.OMx overlain by SS.SCS.CCS.PomB. Grab sample G18, taken on the northern edge of the area, identified occurrence of SS.SMx.OMx overlain by SS.SCS.CCS.Blan, this biotope may occur in other deeper sections of this area. The epifauna sampled by trawl T11, taken on the western edge of the Wave Hub deployment area, suggests that *A. bifida* beds and *O. fragilis* on circalittoral mixed sediment is likely to occur. SS.SMx.CMx.OphMx may also be found.

The distribution of rock biotopes is, as in other areas, likely to be topography dependent. *A. bifida* on moderately exposed bedrock outcrops is likely to occur on steeper rock substrata and the brittlestar-dominated CR.MCR.EcCr.FaAlCr.Bri and CR.MCR.EcCr.CarSp.Bri may be present.

3.2.3 Rock Habitats: Biotope Complex CR.HCR.DpSp - Deep Sponge Communities

BIOTOPE COMPLEX: **CR.HCR.DpSp Deep Sponge Communities**

Habitat:	Moderate to high energy circalittoral rock
Substrate and Topography:	Flat to topographically complex bedrock
Depth Range:	26 to 60m
Bathymetric Zone:	Circalittoral
Tidal Streams:	Weak to moderate
Wave Exposure:	Exposed to very exposed

Biotope Description

This biotope complex was characterised by sponges typical of wave exposed bedrock habitats. The most frequently encountered sponge taxa were *Cliona celata*, *Polymastia boletiformis* and encrusting sponges of the family Microcionidae; *Tethya aurantium*, *Hemimycale columella* and *Haliclona viscosa* were also recorded. Other sessile epifauna found in association with the sponges included the cup coral *Caryophyllia smithii*, the soft coral *Alcyonium digitatum*, tube worms of the genus *Pomatoceros* and red seaweeds. The sea urchins *Echinus esculentus* and starfish *Marthasterias glacialis* and *Henricia oculata* were found in moderate densities in some areas.

The diversity of the sponge community appears to vary with the topographic complexity of the substrate. The raised bedrock and boulder formations found within the biotope complex (Plate 3.1) tend to harbour higher sponge species diversity than flat bedrock substrates (Plate 3.2). As filter feeders sponges are susceptible to smothering by sediment, encrusting forms (e.g. Microcionidae and *Hemimycale columella*) are likely to be especially vulnerable; the higher sponge diversity of rock outcrops can probably be attributed to the protection they provide from sand deposition.

The most frequently encountered taxa from the deep sponge biotope complex identified in the current study are listed in Table 3.4. Their frequency of occurrence and typical abundance in the deep sponge complex classified by Connor *et* al (2004) is also presented; as most of the taxa were recorded at a frequency of at least 61%, it was concluded that the complex found was a close match to that defined by Connor *et al* (2004). Only one biotope has currently been described within the deep sponge community complex, CR.HCR.DpSp.PhaAxi – *Phakelia ventilabrum* and axinellid sponges on deep, wave-exposed cicalittoral rock. As the deep sponge biotopes identified in this study lacked the characteristic *P. ventilabrum* and axinellids, they appear unlikely to be sub-biotopes of CR.HCR.DpSp.PhaAxi.

Distribution

The biotope complex appeared to largely be restricted to the wave exposed bedrock and boulder substrates of the offshore cable route area (camera transects 5, 6 and 7) in depths ranging from 18 to 44m. Small patches of the community were also seen at a depth of around 44m in the western regional offshore area (camera transect 8) and at around 60m in the original Wavehub Deployment area (camera transect 15) (see Figure 3.1).

Plate 3.1 A Diverse Deep Sponge Community on a Steep Bedrock Outcrop

Plate 3.2 A Low Diversity Deep Sponge Community on a Bedrock Plateau

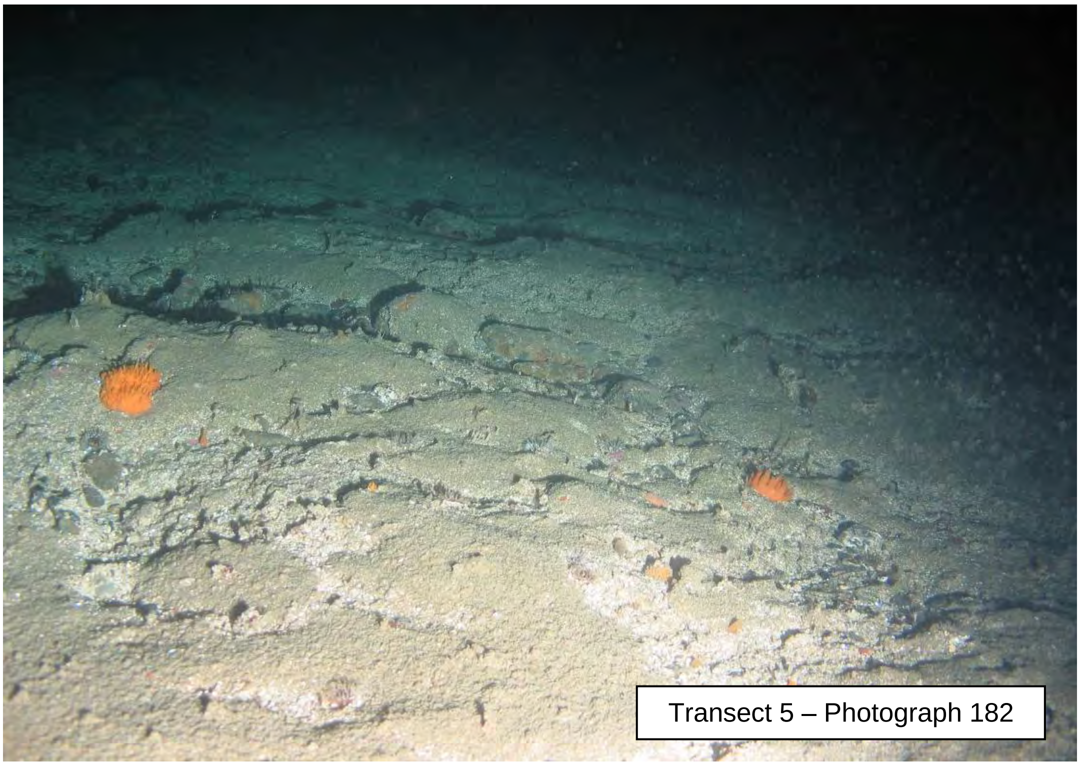


Table 3.4 Characterising Taxa for CR.HCR.DpSp

Taxon	Current Study	Connor *et al* (2004)	
	SACFOR Abundance	SACFOR Abundance	Frequency
Cliona celata	Frequent	Frequent	5
Henricia oculata	Frequent	Occasional	5
Asterias rubens	Frequent	-	-
Marthasterias glacialis	Frequent	Ocassional	4
Echinus esculentus	Frequent	Ocassional	5
Tethya aurantium	Occasional	Occasional	4
Polymastia boletiformis	Occasional	Frequent	5
Stelligera stuposa	Occasional	Frequent	5
Ciocalypta penicillus	Occasional	-	-
Haliclona viscisa	Occasional	Frequent	4
Nemertesia antennina	Occasional	Occasional	4
Hemimycale columella	Rare	Occasional	4
Microcionidae	Rare	-	-
Alcyonium digitatum	Rare	Frequent	5
Caryophyllia smithii	Rare	Frequent	5
ASCIDIACEA	Rare	-	-

Blue highlighted taxa characterise the biotope in the present study and in Connor et al (2004)

Figure 3.1 Distribution of Cr.Mcr.Dp.Sp - Deep Sponge Communities

3.2.4 Rock Habitats: Biotope Complex CR.HCR.Xfa - Mixed Faunal Turf Communities

BIOTOPE:	**Flustra foliacea and encrusting sponges on wave-exposed circalittoral boulders**
	Similar to:
	CR.HCR.XFa.FluCoAs – Flustra foliacea and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock
Habitat:	High energy circalittoral rock
Substrate and Topography:	Boulders
Depth Range:	26 to 38m
Bathymetric Zone:	Circalittoral
Tidal Streams:	Weak to moderate
Wave Exposure:	Exposed to very exposed

<u>Biotope description</u>

This bryozoan turf dominated biotope occurred on boulder habitats close to bedrock formations. Encrusting sponge species, such as Microcionidae and *Hemimycale columella*, were found in varying abundance alongside *Flustra foliacea* and tube worms, *Pomatoceros* sp. and barnacles, *Balanus* sp. were always present. Discrete colonies of the hydroid *Nemertesia antennina* were frequently evident and crisiid and cellariid bryozoans were sometimes seen within the *F. foliacea* turf. The starfish *Henricia oculata* and *Marthasterias glacialis* were occasionally present.

Where found in shallow water (~26m) the *F. foliacea* and encrusting sponge biotope probably represents a transitional area between the circalittoral mixed sediment biotope (to be confirmed) of the nearshore cable route and the deep sponge biotope complex (CR.HCR.DpSp). Despite similarities in encrusting sponge composition the community appears to represent a biotope distinct from CR.HCR.DpSp; the extensive colonies of *F. foliacea* were exclusive to it and the massive sponge species characteristic of CR.HCR.DpSp were largely absent. A higher proportion of *N. antennina,* Crisiids and *Cellaria* sp. were evident where the *F. foliacea* and encrusting sponge biotope occurs on deeper sections of the cable route, these communities probably represent a transition into the bryozoan turf and erect sponges on tide-swept circalittoral rock biotope (CR.HCR.XFa.ByErSp).

Although this biotope superficially resembles CR.HCR.XFa.FluCoAs and its sub-biotopes, the absence, or at least inconspicuousness, of an ascidian (sea-squirt) component suggested that it should be differentiated from them. Table 3.5 lists the prominent taxa in the biotope and shows, for sake of comparison, their frequency and typical abundance in CR.HCR.XFa.FluCoAs.

<u>Distribution</u>

The biotope occurred between the mixed sediment and bedrock substrates of the nearshore cable route (camera transects 4 and 5). Depths in this area ranged from 26 to 28m below LAT. The biotope was also recorded further along the cable route at a depth of around 38m below LAT (camera transect 7) (see Figure 3.2).

Plate 3.3 ***Flustra foliacea*** **and Encrusting Sponges on Wave-Exposed Circalittoral Boulders**

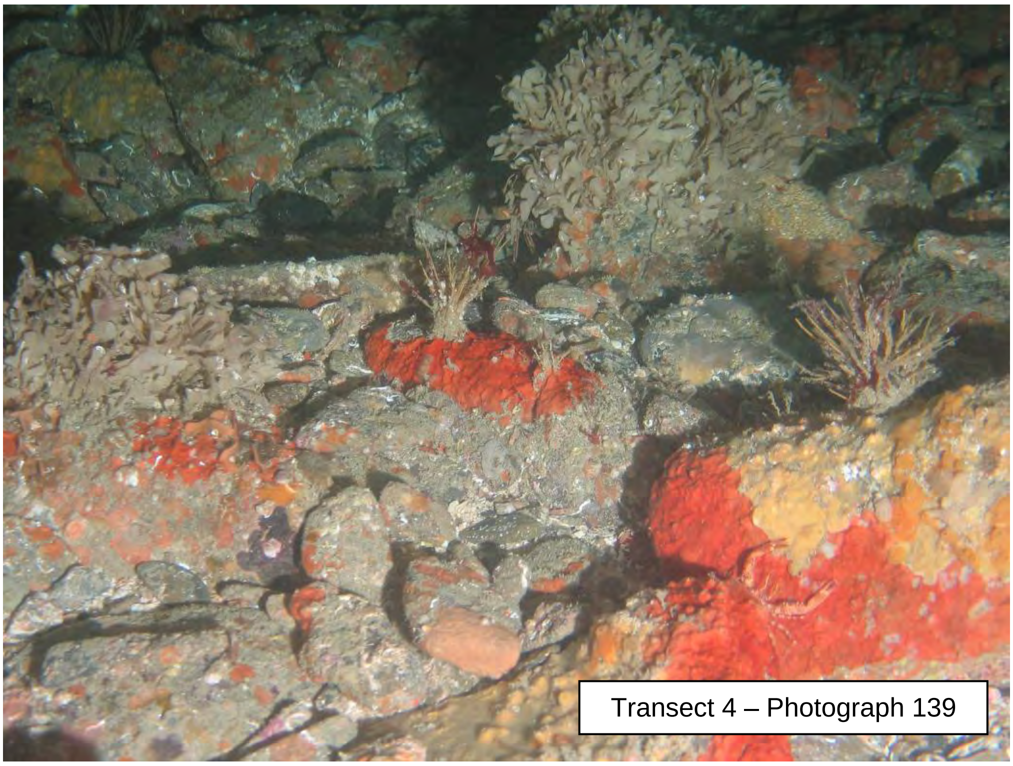


Table 3.5 **Characterising Taxa for *Flustra foliacea* and Encrusting Sponges on Wave-Exposed Circalittoral Boulders**

Taxon	Current Study	Connor *et al* (2004)	
	Typical Abundance	Typical Abundance	Frequency
Flustra foliacea	Abundant	Frequent	5
Nemertesia antennina	Frequent	Frequent	5
Pomatoceros sp.	Frequent	Frequent	5
BRYOZOA (encrusting)	Frequent	-	-
Microcionidae	Occasional	-	-
Balanus sp.	Occasional	Occasional	4
Cellaria sp.	Occasional	-	-
Hemimycale columella	Rare	Occasional	4
Caryophyllia smithii	Rare	-	-
Crisiidae	Rare	Frequent	3

Blue highlighted taxa characterise the biotope in the present study and in Connor et al (2004)

Figure3.2 Distribution of *Flustra foliacea* and Encrusting Sponges on Wave-Exposed Circalittoral Boulders

BIOTOPE:	**CR.HCR.XFa.ByErSp – Bryozoan turf and erect sponges on tide swept circalittoral rock**
Habitat:	Moderate to high energy circalittoral rock
Substrate and Topography:	Bedrock; Bedrock with overlying sand
Depth Range:	30 to 38m
Bathymetric Zone:	Circalittoral
Tidal Streams:	Weak to moderate
Wave Exposure:	Exposed

Biotope description

This biotope was characterised by its dense turf of crisiid and cellariid bryozoans and a diverse range of erect and massive sponges, these included *Stelligera stuposa*, *Raspailia ramosa* and *Polymastia boletiformis*. Colonies of the hydroid *Nemertesia antennina* were present throughout the biotope and the bryozoans *Pentapora fascialis* and *Flustra foliacea* were found where it occurred in shallower water (30 to 34m below LAT). The crinoid *Antedon bifida* was commonly found where the crisiids and cellariids had colonised raised outcrops.

The density of the bryozoan turf varied considerably throughout the biotope. Where it occurred in shallower water scour is likely to have suppressed the growth of the crisiids and *Cellaria* sp., allowing more robust species such as *P. foliacea* and *F. foliacea* to colonise. The reduced hydrodynamic energy of the deeper water areas (greater than 38m below LAT) mean that a much denser turf may develop, although on flatter bedrock areas this turf may be smothered under deposited sand.

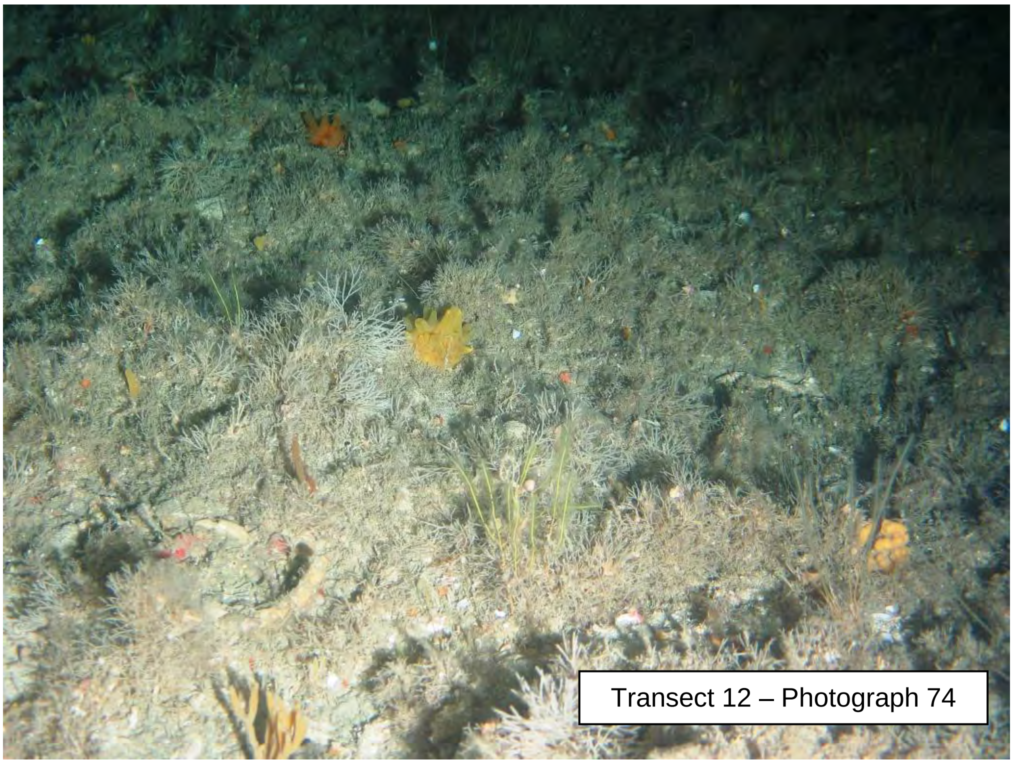
A reasonable degree of crossover was evident between CR.HCR.XFa.ByErSp and the *F. foliacea* and encrusting sponge biotope. For the purposes of this analysis the two biotopes were primarily differentiated by habitat; CR.HCR.XFa.ByErSp occurred on bedrock outcrops and the *F. foliacea* and encrusting sponge biotope occurred on boulders.

The dominant taxa for CR.HCR.XFa.ByErSp are listed in Table 3.6, their frequency of occurrence and typical abundance in the Connor *et al* (2004) classification of the biotope is also provided. The Connor *et al* (2004) classification suggests considerable variation in the biotopes turf composition; all of the bryozoan species except *Alcyonidium diaphanum* occurred with just 61 to 80% frequency. Surprisingly *Cellaria* sp., the co-dominant turf forming species in this study, is not listed as a characterising taxon by Connor *et al* (2004).

Distribution

This biotope was found on the offshore cable route area in a depth range of 30 to 52m below LAT (camera transects 6 and 7). The biotope was also evident at depths of around 52 to 62m below LAT in the western regional offshore (camera transects 9, 10 and 11) and at a depth of approximately 52m in the eastern regional offshore area (camera transect 12) (see Figure 3.3).

Plate 3.4 Bryozoan Turf and Erect Sponges on Tide Swept Circalittoral Rock



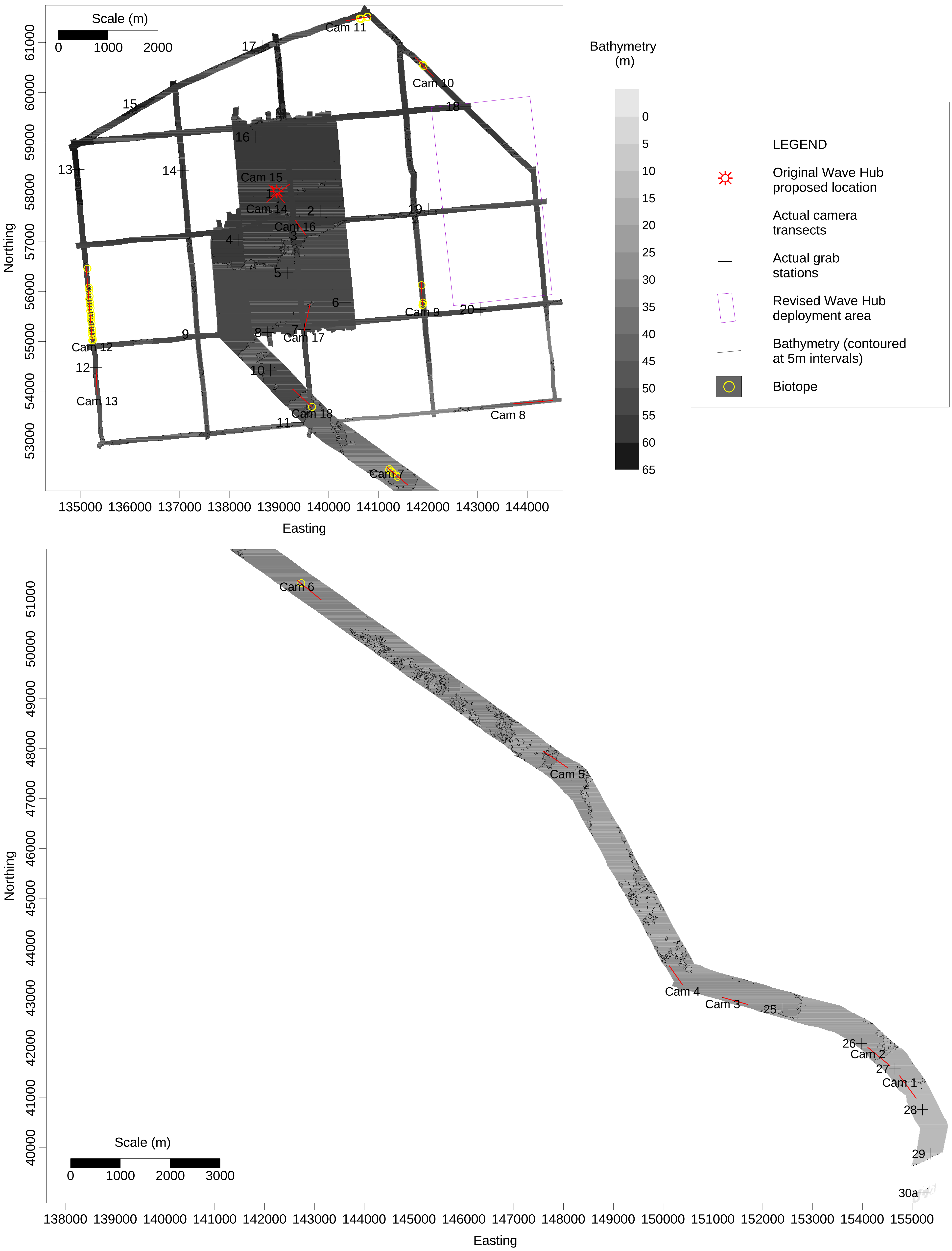
Transect 12 – Photograph 74

Table 3.6 Characterising Taxa in CR.HCR.XFa.ByErSp

Taxon	Current Study	Connor *et al* (2004)	
	Typical Abundance	Typical Abundance	Frequency
Crisiidae	Abundant	Frequent	3
Cellaria sp.	Abundant	-	-
Antedon bifida	Common	-	-
Flustra foliacea	Frequent	Frequent	3
Pentapora fascialis	Frequent	Occasional	3
Stelligera stuposa	Occasional	Occasional	3
Cliona celata	Occasional	Occasional	4
Microcionidae	Occasional	-	-
Raspailia ramosa	Occasional	Occasional	4
HYDROZOA	Occasional	-	-
Nemertesia antennina	Occasional	Frequent	5
Pomatoceros sp.	Occasional	-	-
Polymastia boletiformis	Rare	Occasional	4
Alcyonium digitatum	Rare	Frequent	5
Caryophyllia smithii	Rare	Frequent	4
Alcyonidium diaphanum	Rare	Frequent	4

Blue highlighted taxa characterise the biotope in the present study and in Connor et al (2004)

Figure 3.3 Distribution of CR.HCR.Xfa.ByErSp - Bryozoan Turf and Erect Sponges on Tide-Swept Circalittoral Rock



BIOTOPE:	***Corynactis viridis* on wave-exposed circalittoral rock**
	Similar to:
	CR.HCR.XFa.CvirCri – *Corynactis viridis* and a mixed turf of crisiids, *Bugula*, *Scrupocellaria* and *Cellaria* on moderately tide-swept exposed circalittoral rock
Habitat:	Moderate to high energy circalittoral rock
Substrate and Topography:	Raised bedrock outcrop
Depth Range:	~50m
Bathymetric Zone:	Circalittoral
Tidal Streams:	Weak to moderate
Wave Exposure:	Exposed

<u>Biotope Description</u>

This biotope was characterised by its high density of the jewel anemone *Corynactis viridis*. The variation in colour seen in the *C. viridis* aggregations is the product of their asexual reproduction; specimens in a patch of a particular colour are all descended from a common ancestor. The only other fauna recorded for the biotope were the soft coral *Alcyonium digitatum*, tube worms of the genus *Pomatocerus* and a lone specimen of the sea urchin *Echinus esculentus*.

Although the biotope identified in this study and CR.HCR.XFa.CvirCri are both characterised by dense aggregations of *C. viridis*, significant differences in community composition were apparent. The biotope classified in this study was less diverse than CR.HCR.XFa.CvirCri and lacked its characteristic bryozoan turf, the cup coral *Caryophyllia smithii*, a species frequently recorded in CR.HCR.XFa.CvirCri, also appeared to be absent. Connor *et al* (2004) stated that CR.HCR.XFa.CvirCri typically occurs on steep or vertical rock at depths of 10 to 30m. The biotope identified in this study may represent a sub-biotope of CR.HCR.XFa.CvirCri that is associated with deeper water and/ or a flat bedrock habitat.

Table 3.7 lists the characterising taxa for the *Corynactis viridis* biotope, comparative data for CR.HCR.XFa.CvirCri from Connor *et al* (2004) are also presented.

<u>Distribution</u>

This biotope was recorded at a depth of around 50m in the southern original Wave Hub area (camera transect 17) (see Figure 3.4).

Plate 3.5 ***Corynactis viridis*** **on Wave-Exposed Circalittoral Rock**

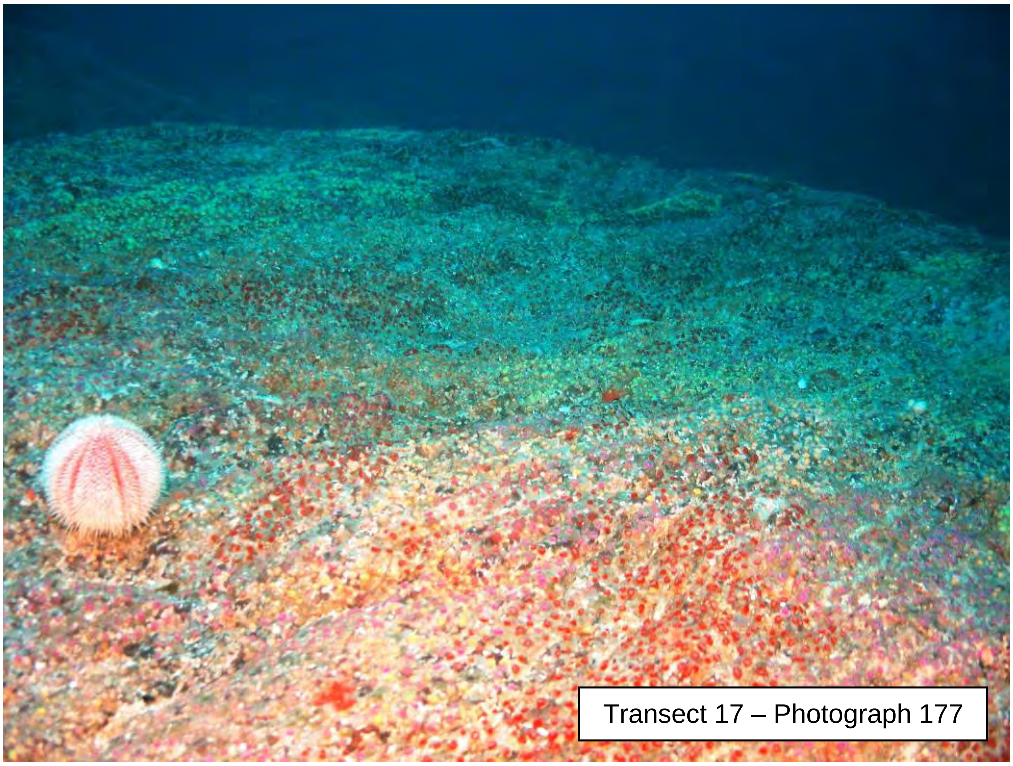
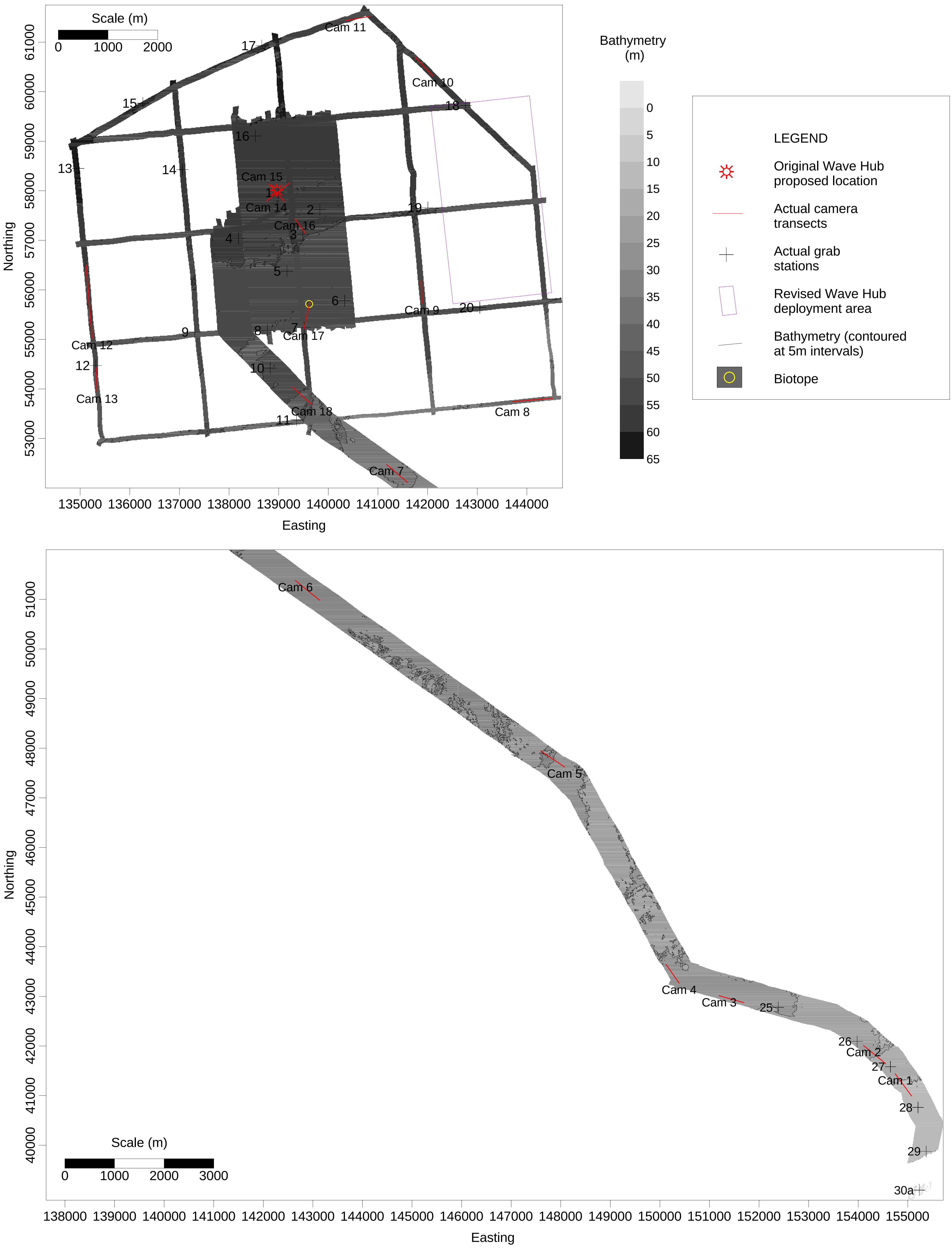

Transect 17 – Photograph 177

Table 3.7 **Charcterising Taxa in *Corynactis viridis* on Wave-Exposed Circalittoral Rock**

Taxon	**Current Study**	**Connor *et al* (2004)**	
	Typical Abundance	**Typical Abundance**	**Frequency**
Corynactis viridis	Superabundant	Common	5
Echinus esculentus	Frequent	Occasional	4
Alcyonium digitatum	Rare	Common	5
Pomatoceros sp.	Rare	-	-

Blue highlighted taxa characterise the biotope in the present study and in Connor et al (2004)

Figure 3.4 Distribution of *Corynactis viridis* on Wave-Exposed Circalittoral Rock



3.2.5 Rock Habitats: Biotope Complex CR.MCR.Eccr - Echinoderms and Crustose Communities

BIOTOPE:	***Pentapora fascialis,* solitary ascidians, *Halichondria panicea* and red algae on wave-exposed circalittoral rock**
	Similar to:
	CR.MCR.EcCr.CarSp.PenPcom – *Caryophyllia smithii* and sponges with *Pentapora fascialis*, *Porella compressa* and crustose communities on wave-exposed circalittoral rock.
Habitat:	Moderate to high energy circalittoral rock
Substrate and Topography:	Raised bedrock outcrops
Depth Range:	~20m
Bathymetric Zone:	Circalittoral
Tidal Streams:	Weak to moderate
Wave Exposure:	Exposed to very exposed

Biotope Description

This *Pentapora fascialis* dominated biotope was restricted in distribution to an isolated rock outcrop surrounded by a well-sorted SAND sediment. After *P. foliacea* the most prominent components of the biotic community were red algae, solitary ascidians and the breadcrumb sponge *Halichondria panicea*, a low abundance of anemones and epiphytic bryozoans was also recorded.

Although tentatively classified as a separate biotope here, this community may in fact represent a sub-biotope of CR.MCR.EcCr.CarSp.PenPcom that is restricted to shallower, more energetic areas. The increased light level at this depth appears to promote significant macrophyte growth; differences in faunal community can perhaps be attributed to the habitat's greater wave exposure. This biotope has been classified within the CR.MCR.EcCr complex because of its similarity to CR.MCR.EcCr.CarSp.PenPcom, it could however be part of the mixed faunal turf communities complex (CR.HCR.XFa).

The dominant taxa for the *Pentapora fascialis,* solitary ascidians, *Halichondria panicea* and red algae biotope are listed in Table 3.8, no comparable data for CR.MCR.EcCr.CarSp.PenPcom were provided in Connor *et al* (2004).

Distribution

This biotope was found at a depth of around 20m at a single location on the nearshore cable route (camera transect 2) (see Figure 3.5).

Plate 3.6 ***Pentapora fascialis,*** **Solitary Ascidians,** ***Halichondria Panicea*** **and Red Algae on Wave-Exposed Circalittoral Rock**

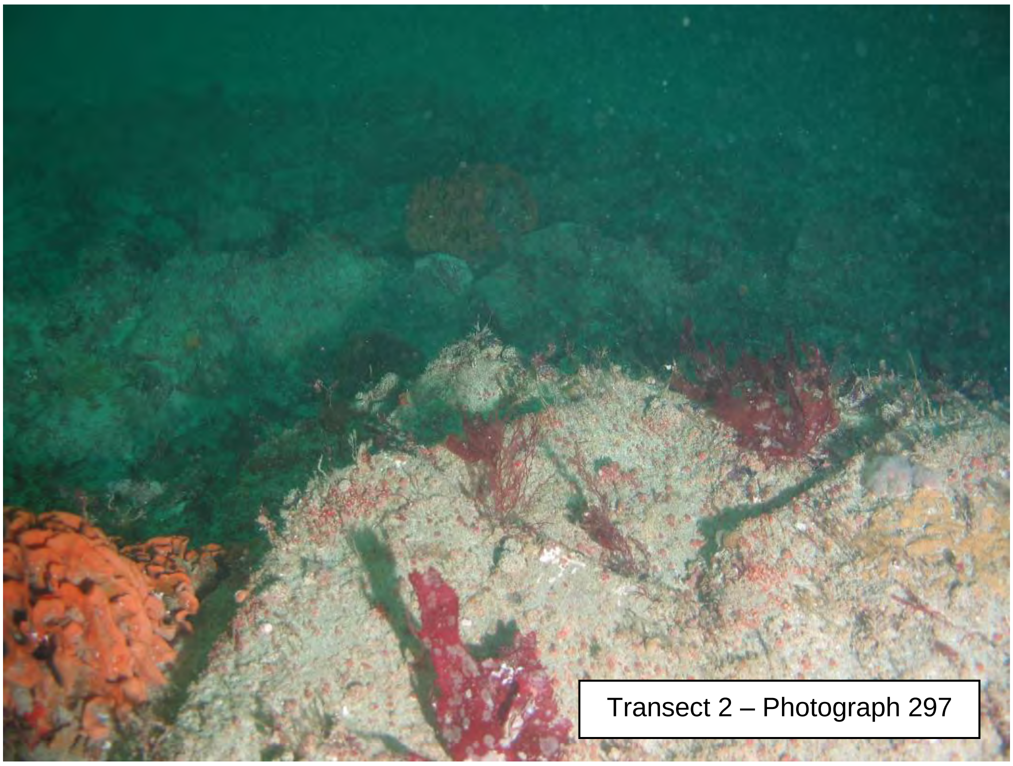


Table 3.8 **Dominant Taxa in** ***Pentapora fascialis,*** **Solitary Ascidians,** ***Halichondria Panicea*** **and Red Algae on Wave-Exposed Circalittoral Rock**

Taxon	Typical Abundance
ASCIDIACEA	Abundant
RHODOPHYCOTA	Common
Halichondria panicea	Frequent
Pentapora fascialis	Frequent
ACTINIARIA	Occasional
BRYOZOA	Rare

Figure 3.5 Distribution of *Pentapora foliacea* , Solitary Ascidians, *Halichondria panicea* and Red Algae on Wave-Exposed Circalittoral Rock.

BIOTOPE:	**CR.MCR.EcCr.CarSp.PenPcom – *Caryophyllia smithii* and sponges with *Pentapora fascialis*, *Porella compressa* and crustose communities on wave-exposed circalittoral rock.**
Habitat:	Moderate to high energy circalittoral rock
Substrate and Topography:	Raised bedrock outcrops
Depth Range:	26 to 34m
Bathymetric Zone:	Circalittoral
Tidal Streams:	Weak to moderate
Wave Exposure:	Exposed to very exposed

<u>Biotope Description</u>

The most conspicuous element in this biotope was the massive bryozoan *Pentapora fascialis*; the biotope characterising cup coral *Caryophtllia smithii* was always present alongside this, although its density was typically low. Significant variation was evident in community structure throughout the biotope, in two of the areas where it was found a conspicuous hydroid and bryozoan turf was evident alongside anemones and the soft coral *Alcyonium digitatum*. In another area a similar community was recorded alongside the solitary ascidians characteristic of the *Pentapora fascialis,* solitary ascidians, *Halichondria panicea* and red algae biotope (see page 23). The other areas where the biotope was identified had a much sparser epifauna.

The variation in community structure evident for this biotope and the presence of another *P. folicaea* dominated biotope suggest that revision of CR.MCR.EcCr.CarSp.PenPcom may be necessary. Connor *et al* (2004) say that the biotope has been most frequently recorded from the west coast of Ireland; it appears likely that the communities identified in this study represent sub-biotopes of CR.MCR.EcCr.CarSp.PenPcom or should be classified as separate biotopes in a broader biotope complex.

Table 3.9 lists the characterising taxa for the variant of CR.MCR.EcCr.CarSp.PenPcom identified in this study, the typical abundance and frequency of occurrence of these taxa in the Connor *et al* (2004) classification are also presented. Connor *et al* (2004) did not include *P. foliacea* in their summary data for the biotope. As this species is included in the biotope name it is possible that this is an accidental omission by the authors.

<u>Distribution</u>

This biotope was restricted in distribution to the nearshore section of the cable route (camera transects 4 and 5) (see Figure 3.6).

Plate 3.7 ***Caryophyllia smithii*** **and Sponges with** ***Pentapora fascialis*****,** ***Porella compressa*** **and Crustose Communities on Wave-Exposed Circalittoral Rock**

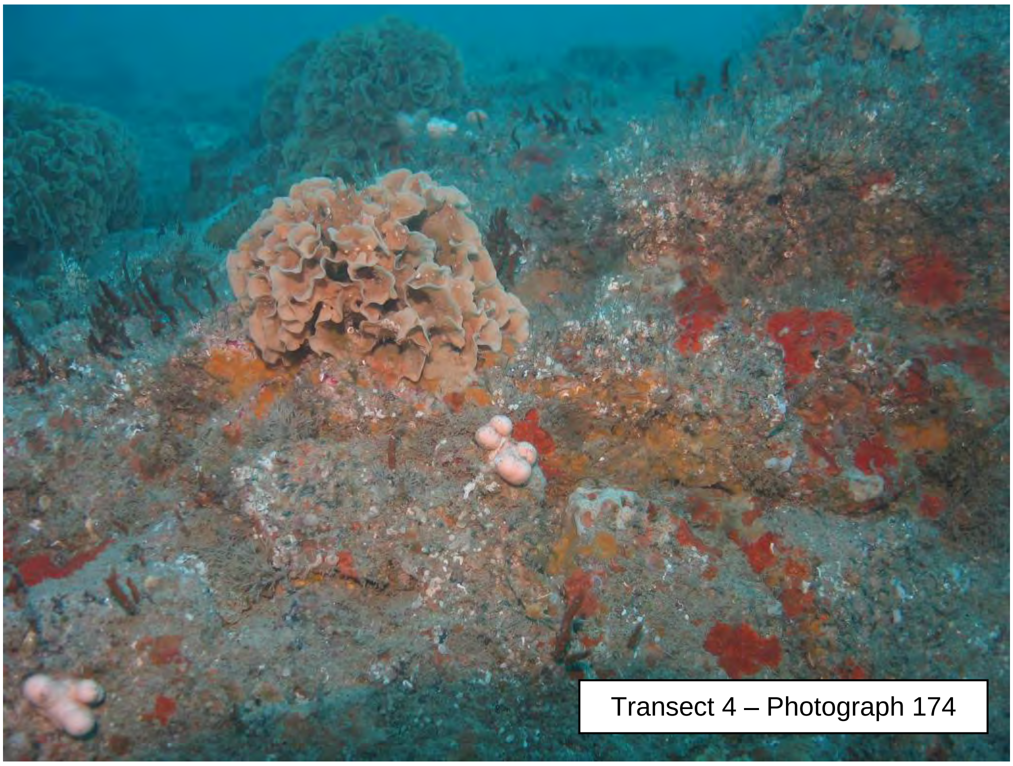


Table 3.9 **Characterising Taxa in CR.MCR.EcCr.CarSp.PenPcom**

Taxon	Current Study	Connor *et al* (2004)	
	Typical Abundance	Typical Abundance	Frequency
Pentapora fascialis	Common	-	-
Marthasterias glacialis	Frequent	Occasional	5
Alcyonium digitatum	Occasional	Frequent	5
Crisiidae	Occasional	-	-
Clathrinidae	Rare	-	-
Caryophyllia smithii	Rare	Common	5
Corallinaceae	Rare	Frequent	3

Blue highlighted taxa characterise the biotope in the present study and in Connor et al (2004)

Figure 3.6 Distribution of CR.MCR.EcCr.CarSp.PenPcom - *Caryophyllia smithii* and Sponges with *Pentapora foliacea* , *Porella compressa* and Crustose Communities on Wave-Exposed Circalittoral Rock.

BIOTOPE:	**CR.MCR.EcCr.FaAlCr.Bri – Brittlestar beds on faunal and algal encrusted, exposed to moderately exposed circalittoral rock**
Habitat:	Moderate to high energy circalittoral rock
Substrate and Topography:	Flat bedrock
Depth Range:	32 to 52m
Bathymetric Zone:	Circalittoral
Tidal Streams:	Weak to moderate
Wave Exposure:	Exposed

Biotope Description

This biotope was characterised by extremely high densities of the brittlestars *Ophiocomina nigra* and *Ophiothrix fragilis*, the small number of other taxa found were sparsely distributed throughout the biotope. At each location where this biotope was found one of these brittlestar species was conspicuously dominant, no areas were identified where the two species were co-dominant.

In brittlestar beds where *O. fragilis* was found to dominate, low densities of *O. nigra* were also typically recorded; beds of similar composition have been identified in Strangford Lough, Northern Ireland and Torbay, South Devon (Hughes, 1998). In the brittlestar beds in which *O. nigra* was the dominant species, *O. fragilis* appeared to be completely absent. The density of individuals in *O. fragilis* dominated beds was high in comparison to those formed by *O. nigra*, this supports the findings of Hughes (1998) who suggests that *O. fragilis* is more tolerant of close proximity to conspecific individuals than *O.* nigra.

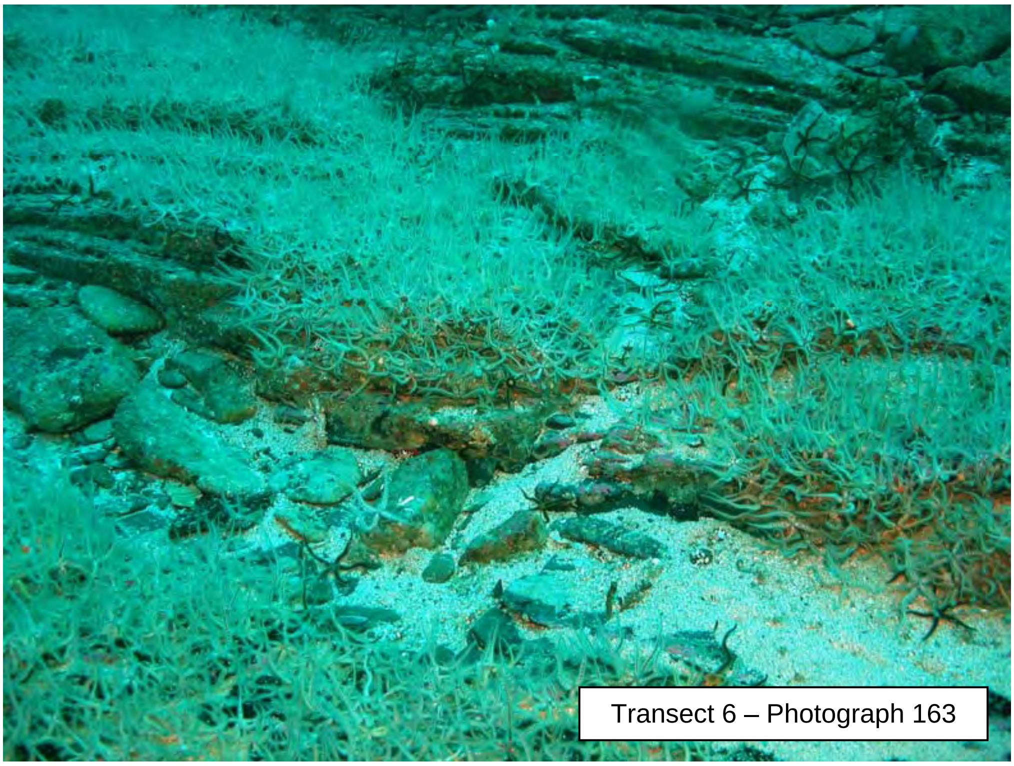
Connor *et al* (1997) suggested that *O. nigra* beds were restricted to deeper habitats than *O. fragilis* beds. This pattern of distribution could possibly be explained by the comparatively high density of *O. fragilis* beds, Hughes (1998) suggests this may ensure their stability in shallower, high energy areas. While this study broadly concurs with the findings of Connor *et al* (1997) one isolated *O. fragilis* bed was found at a depth of 54m, deeper than any of the *O. nigra* beds.

The dominant taxa for CR.MCR.EcCr.FaAlCr.Bri are listed in Table 3.10, along with their frequency of occurrence and typical abundance in the Connor *et al* (2004) classification of the biotope.

Distribution

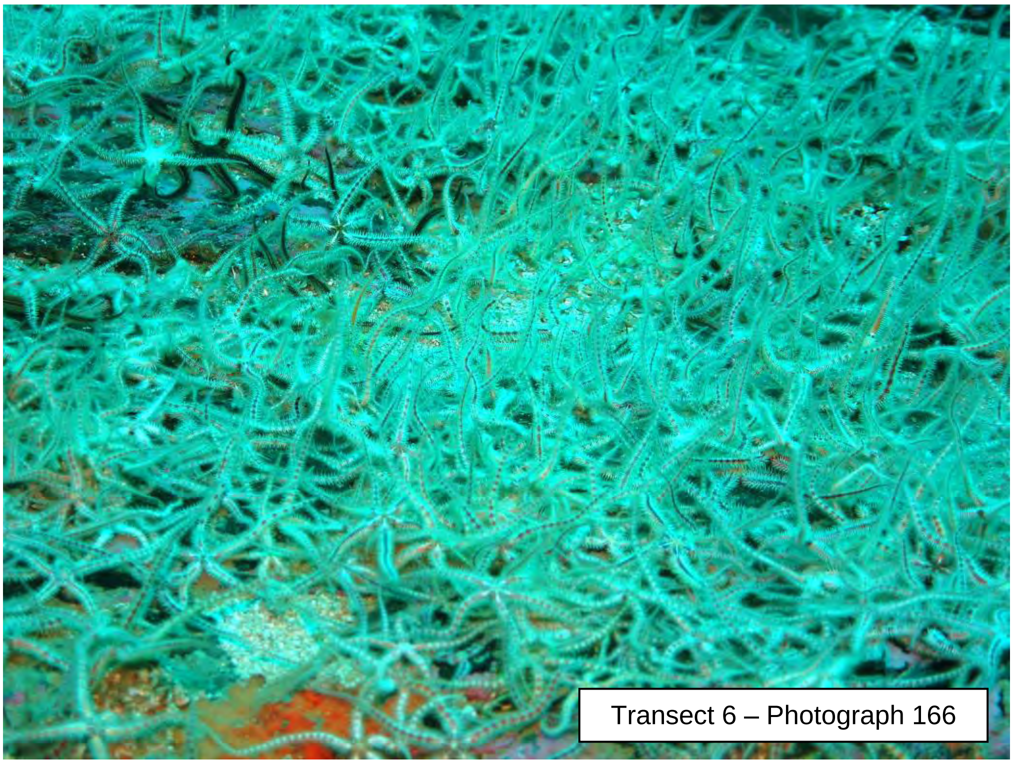
The majority of the *O. fragilis* dominated brittlestar beds were found at a depth of 32 to 36m in the offshore cable route area (camera transect 6), one isolated bed was however, identified at a depth of around 54m in the regional offshore area (camera transect 10). The two *O. nigra* dominated beds were found in the offshore cable route area at depths of 34 and 52m (camera transects 6 and 18, respectively) (see Figure 3.7).

Plate 3.8 An *Ophiothrix fragilis* Dominated Brittlestar Bed



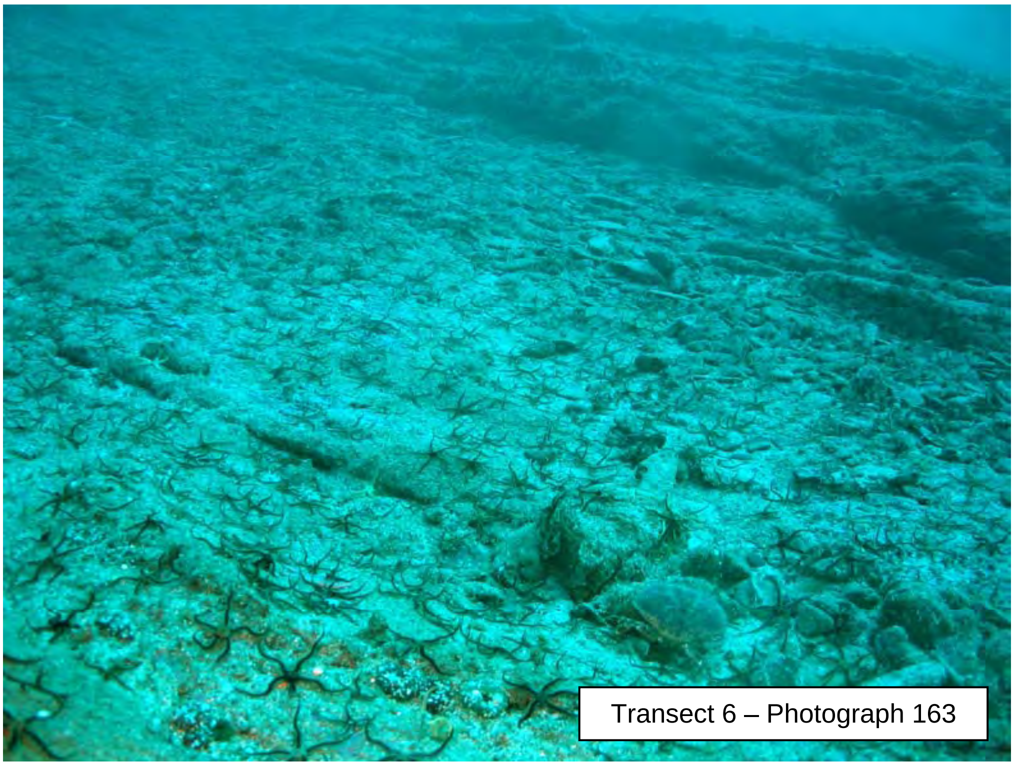
Transect 6 – Photograph 163

Plate 3.9 Zoom Photograph of an *Ophiothrix fragilis* Dominated Brittlestar Bed



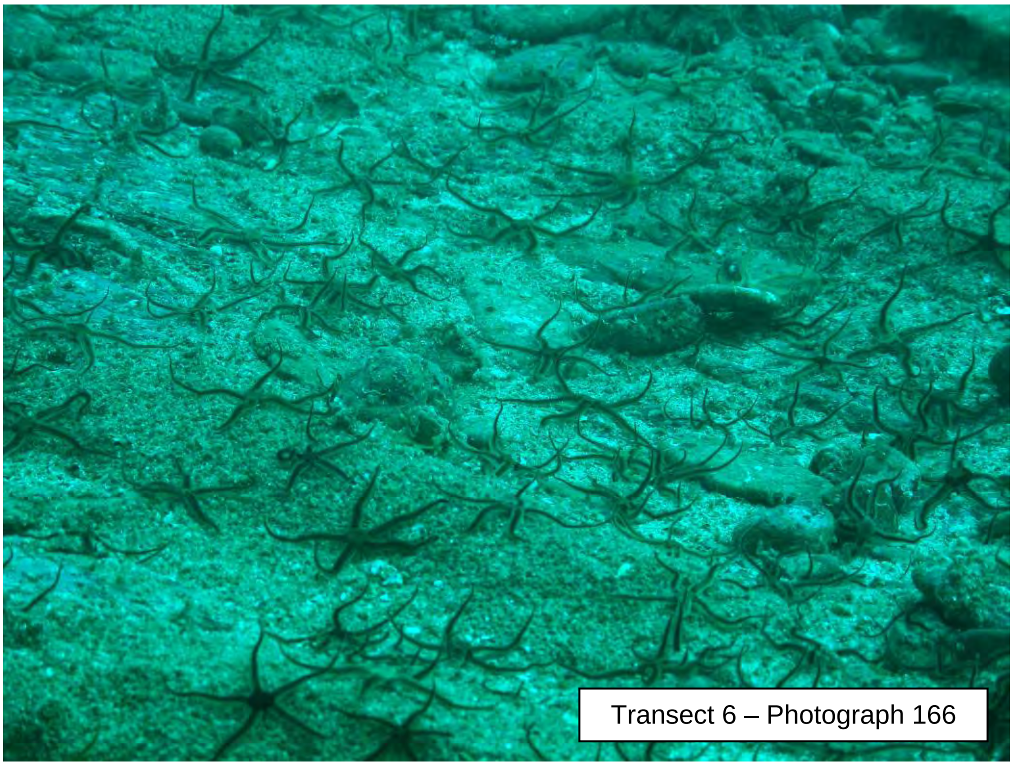
Transect 6 – Photograph 166

Plate 3.10 An *Ophiocomina nigra* Brittlestar Bed



Transcect 6 – Photograph 163

Plate 3.11 Zoom Photograph of an *Ophiocomina nigra* Brittlestar Bed



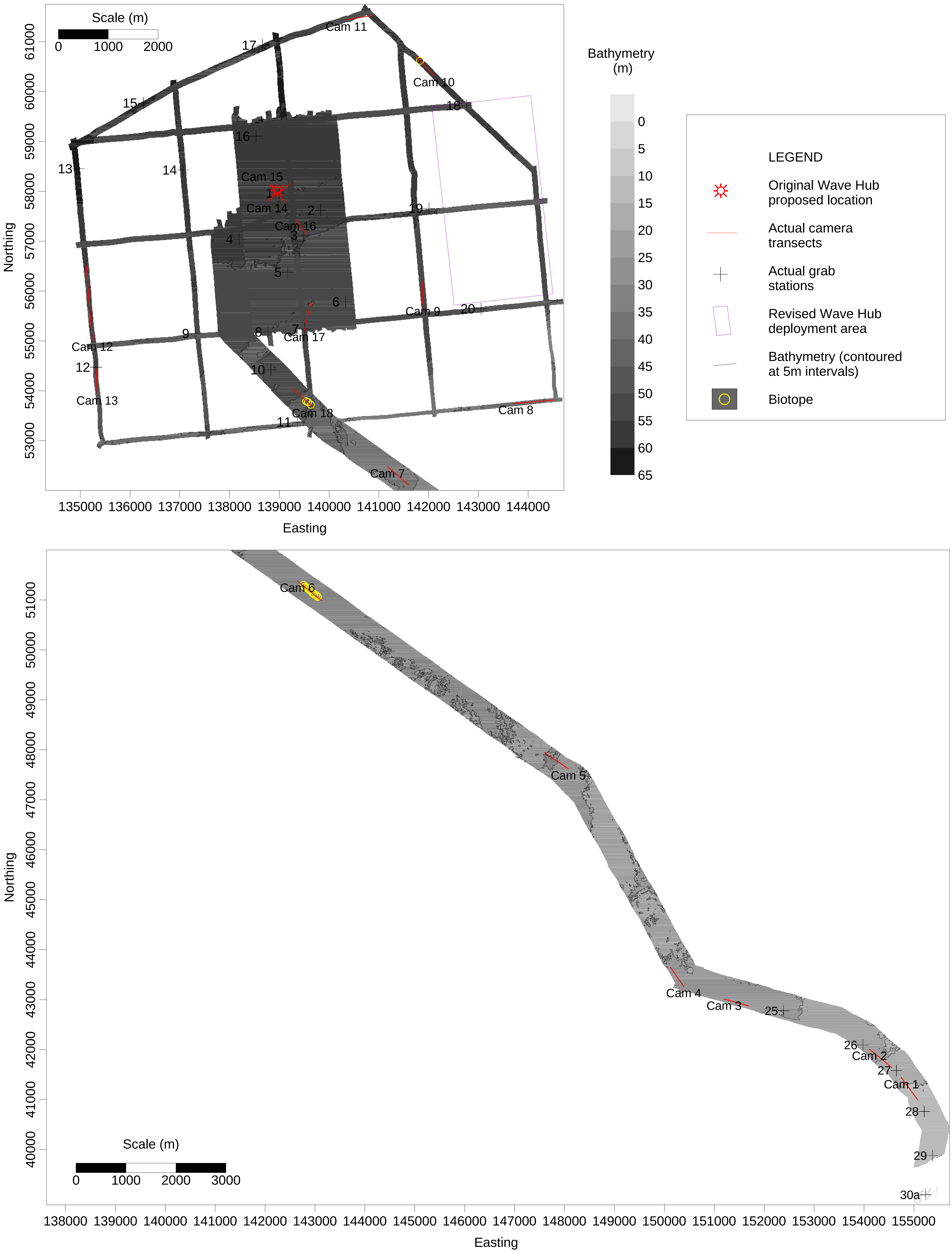
Transect 6 – Photograph 166

Table 3.10 Characterising Taxa in CR.MCR.EcCr.FaAlCr.Bri

Taxon	Current Study	Connor *et al* (2004)	
	Typical Abundance	Typical Abundance	Frequency
Ophiothrix fragilis	Superabundant	Abundant	5
Ophiocomina nigra	Abundant	Common	4
Echinus esculentus	Frequent	Frequent	5
Cellaria spp.	Frequent	-	-
Marthasterias glacialis	Frequent	-	-
Stelligera stuposa	Occasional	-	-
Cliona celata	Occasional	-	-

Blue highlighted taxa characterise the biotope in the present study and in Connor et al (2004)

Figure 3.7 Distribution of CR.MCR.EcCr.FaAlCr.Bri - Brittlestar Beds on Faunal and Algal Encrusted, Exposed to Moderately Exposed Circalittoral Rock.



BIOTOPE: ***Antedon bifida*** **on moderately exposed bedrock outcrops**

Habitat:	Moderate to high energy circalittoral rock
Substrate and Topography:	Raised bedrock outcrops and boulders
Depth Range:	44 to 60m
Bathymetric Zone:	Circalittoral
Tidal Streams:	Weak to moderate
Wave Exposure:	Moderately exposed

Biotope Description

This biotope was characterised by an abundance of the feather star *Antedon bifida*. In addition, the massive form of the sponge *Cliona celata* and encrusting sponges of the family Microcionidae were frequently present and colonies of the soft coral *Alcyonium digitatum* and encrusting bryozoa were sometimes recorded. The biotope was typically associated with steep rock outcrop habitats, although in some areas the *A. bifida* population spread into the adjacent CR.HCR.XFa.ByErSp biotope or the CR.HCR.DpSp biotope complex.

Connor *et al* (2004) only recognised a single crinoid characterised biotope, CR.LCR.BrAs.AntAsH – *Antedon* spp., solitary ascidians and fine hydroids on sheltered circalittoral rock. As this biotope is typically associated with sheltered, SILT covered rock habitats in sea loughs, ecological comparison to the biotope identified in this study seems inappropriate. *C. celata* and *A. digitatum* were both absent from the list of characterising taxa for CR.LCR.BrAs.AntAsH.

The most frequently recorded taxa for the *Antedon bifida* biotope are listed in Table 3.11.

Distribution

This biotope was recorded at a depth of approximately 52m in the offshore cable route area and in the western regional offshore area (camera transects 18 and 12, respectively). It was also recorded from the original Wave Hub deployment area in depths of 50m and 60m (camera transects 17 and 15, respectively) (see Figure 3.8).

Plate 3.12 ***Antedon bifida*** **on Moderately Exposed Bedrock Outcrops**

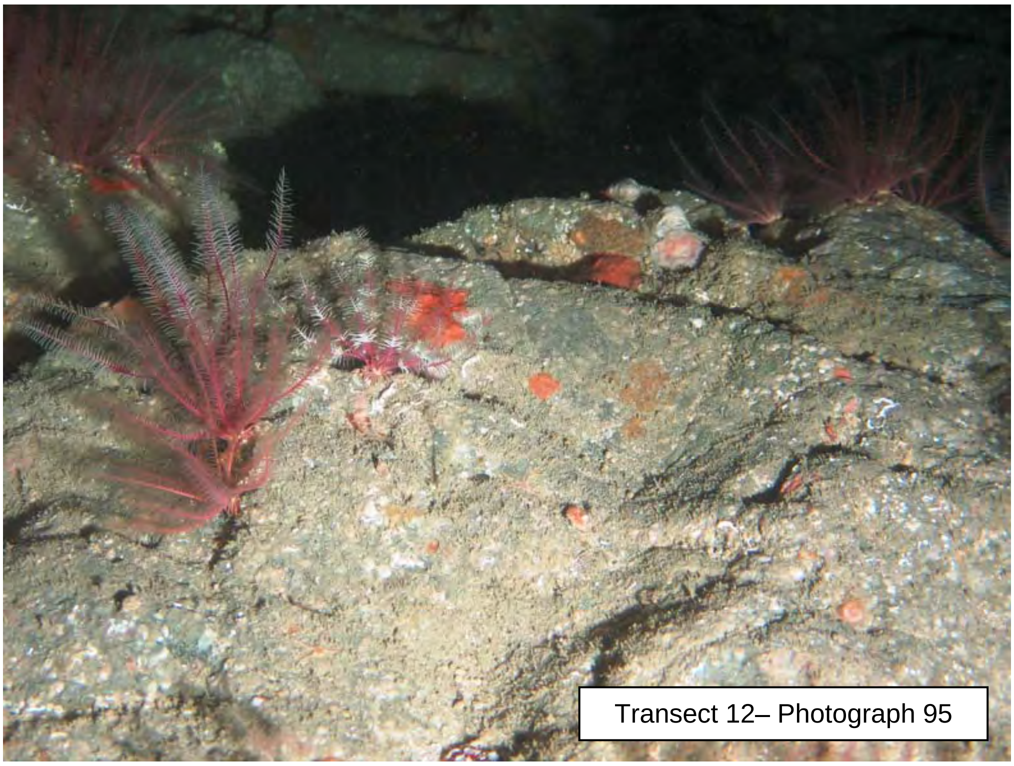
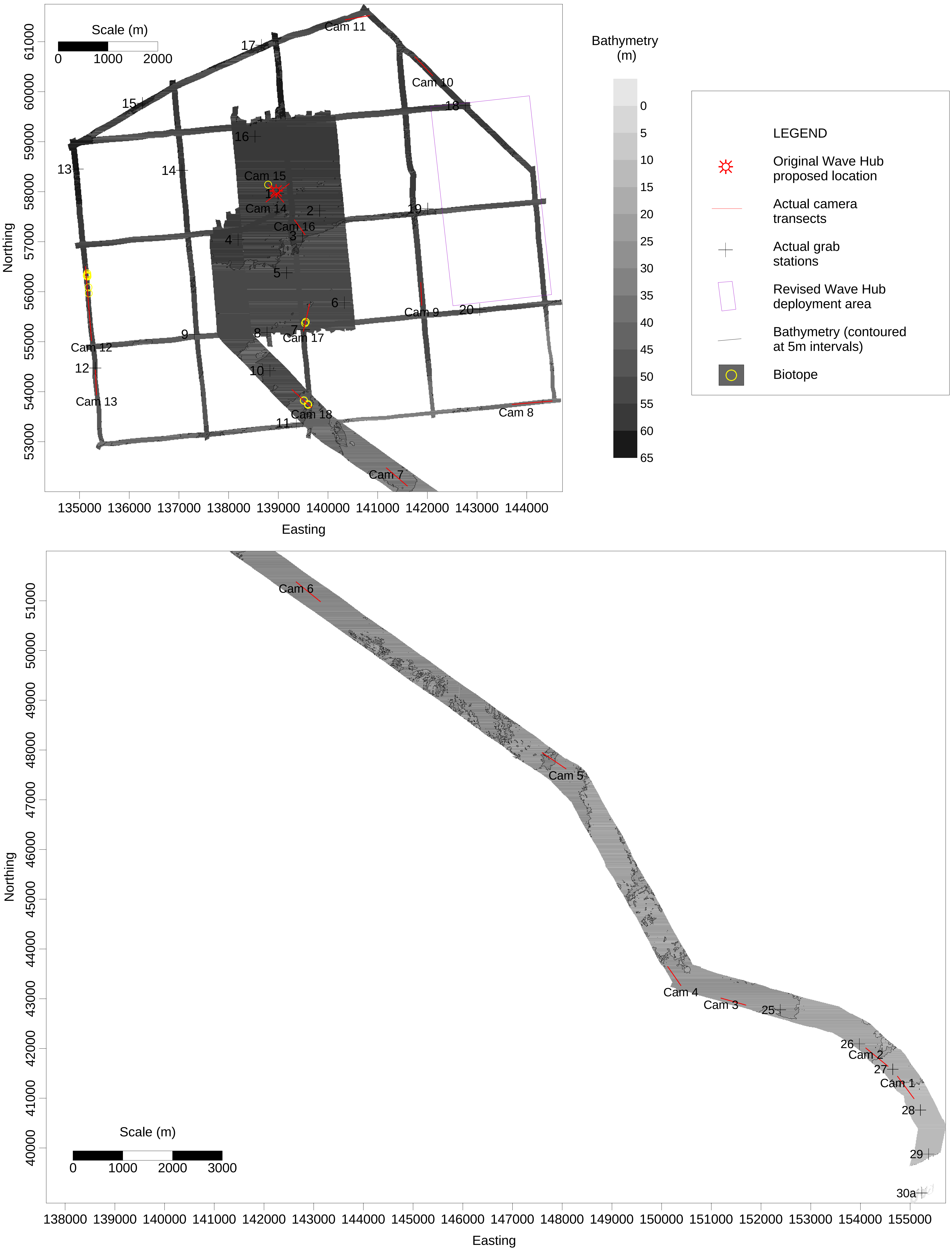


Table 3.11 **Characterising Taxa in *Antedon bifida* on Moderately Exposed Bedrock Outcrops**

Taxon	Typical Abundance
Antedon bifida	Abundant
Microcionidae	Occasional
BRYOZOA (encrusting)	Occasional
Alcyonium digitatum	Rare
Antedon bifida	Abundant

Figure 3.8 Distribution of *Antedon bifida* on Wave-Exposed Bedrock Outcrops



BIOTOPE:	**CR.MCR.EcCr.CarSp.Bri – Brittlestar bed overlying coralline crusts, *Parasmittina trispinosa* and *Caryophyllia smithii* on wave-exposed circalittoral rock**
Habitat:	Moderate to high energy circalittoral rock
Substrate and Topography:	Flat bedrock
Depth Range:	~50m
Bathymetric Zone:	Circalittoral
Tidal Streams:	Weak to moderate
Wave Exposure:	Exposed

<u>Biotope Description</u>

This biotope is dominated by the brittle star *Ophiocomina nigra*, a bed of this species partially overlies a crustose community of principally made up of the cup coral *Caryophyllia smithii* and the tube worm *Pomatocerus* sp. The soft coral *Alcyonium digitatum* and encrusting sponges of the family Microcionidae are present at low density and the urchin *Echinus esculentus* and sea cucumber *Holothuria forskali* were also recorded.

The biotope recorded in this study closely fits the Connor *et al* (2004) description of CR.MCR.EcCr.CarSp.Bri. The dominant taxa for CR.MCR.EcCr.CarSp.Bri are listed in Table 3.12, along with their frequency of occurrence and typical abundance in the Connor *et al* (2004) classification of the biotope.

<u>Distribution</u>

This biotope was recorded at a depth of around 50m on a bedrock outcrop in the southern original Wave Hub area (camera transect 17) (see Figure 3.9).

Plate 3.13 Brittlestar Bed Overlying Coralline Crusts, *Parasmittina trispinosa* and *Caryophyllia smithii* on Wave-Exposed Circalittoral Rock

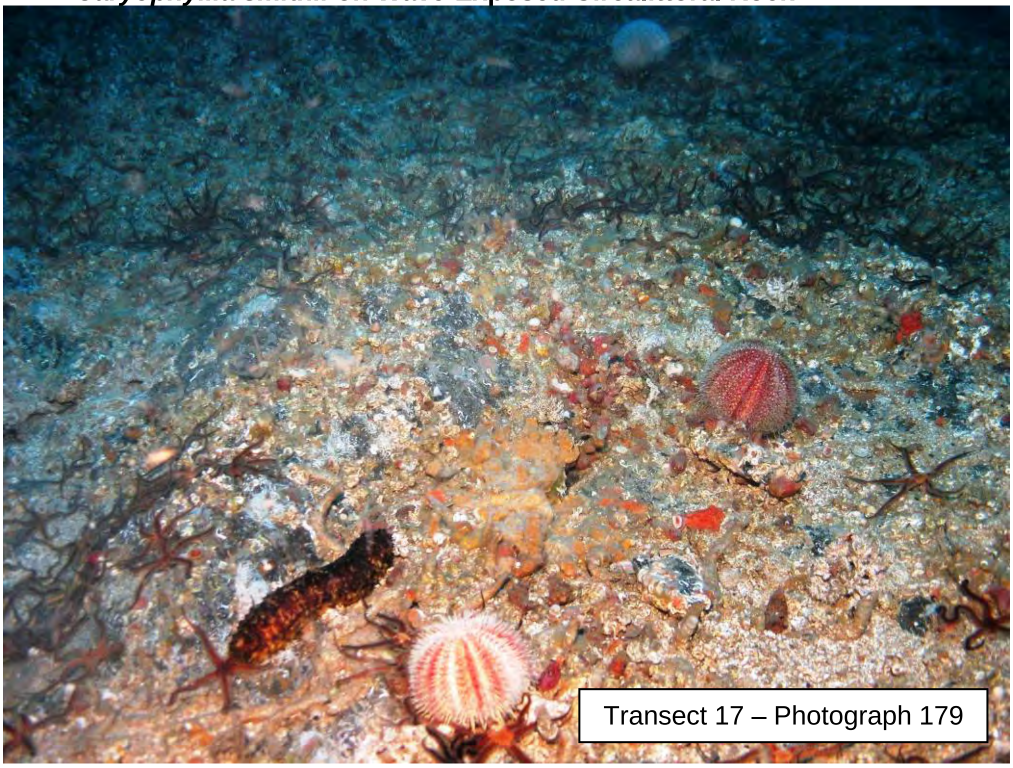
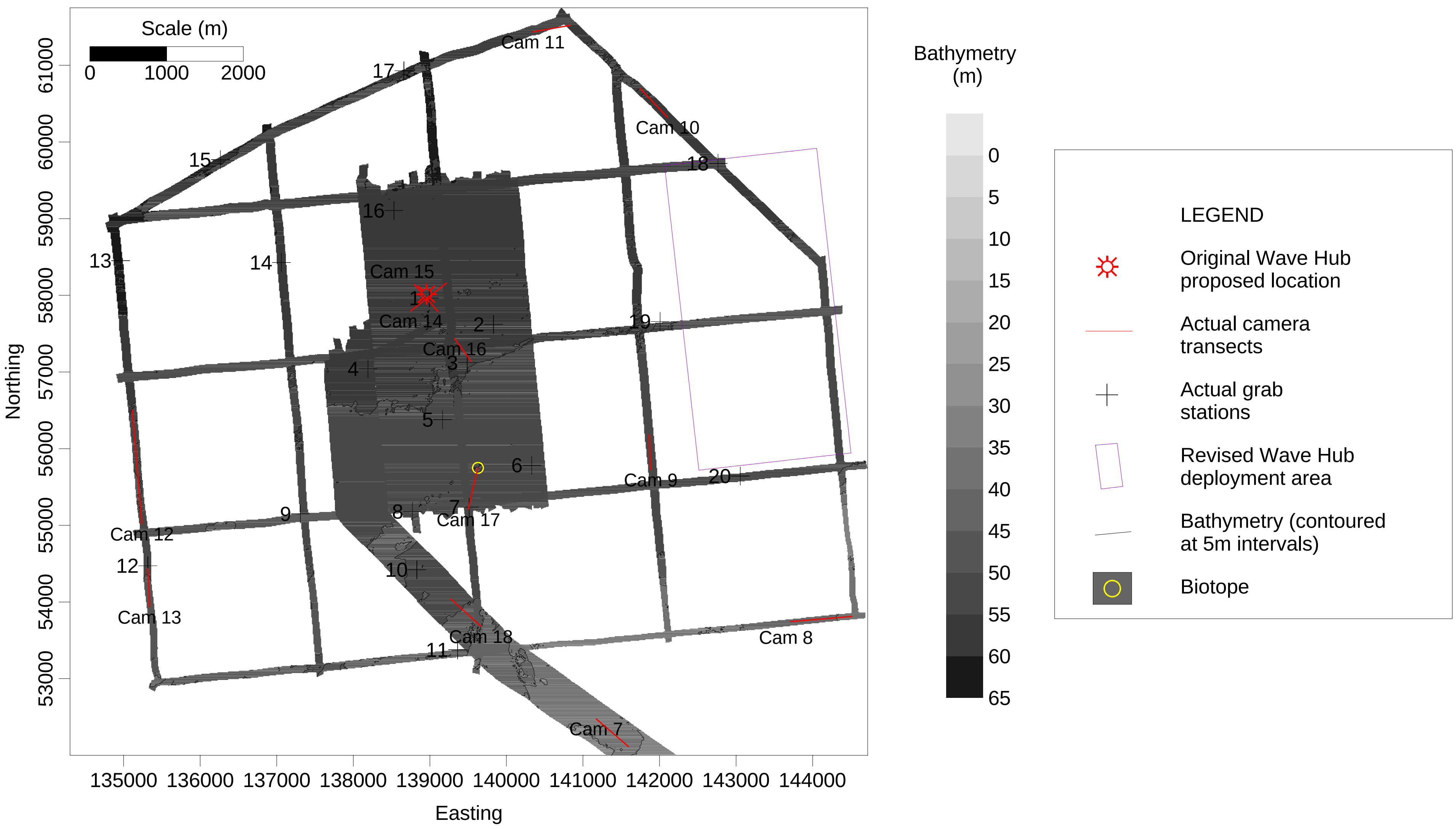


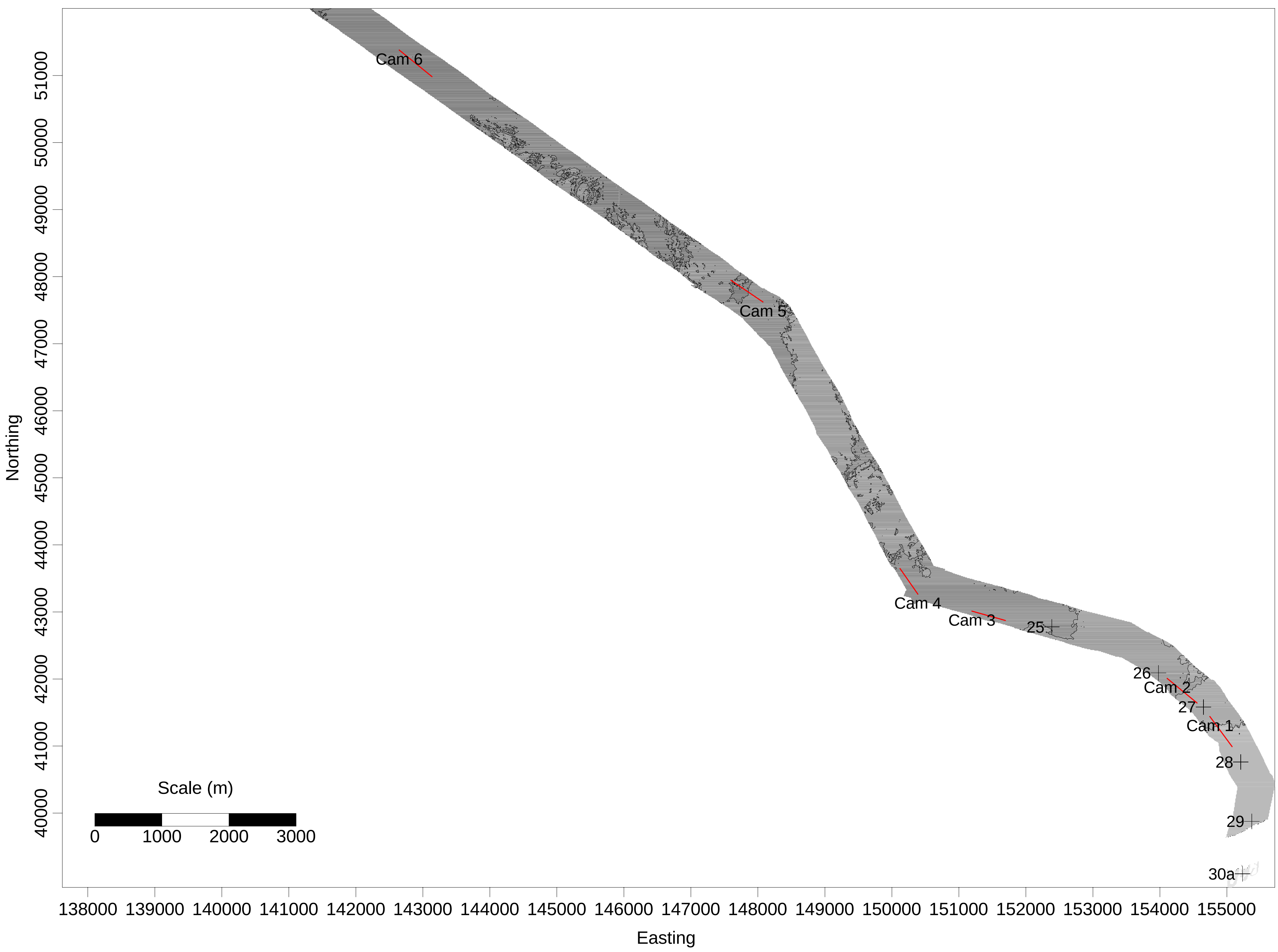
Table 3.12 Characterising Taxa in CR.MCR.EcCr.CarSp.Bri

Taxon	Current Study	Connor *et al* (2004)	
	Typical Abundance	Typical Abundance	Frequency
Ophiocomina nigra	Abundant	Common	5
Pomatoceros sp.	Common	Occasional	3
Echinus esculentus	Frequent	Occasional	4
Holothuria forskali	Frequent	-	-
Caryophyllia smithii	Occasional	Occasional	4
Microcionidae	Rare	-	-
Alcyonium digitatum	Rare	Occasional	5

Blue highlighted taxa characterise the biotope in the present study and in Connor et al (2004)

Figure 3.9 Distribution of CR.MCR.EcCr.CarSp.Bri - Brittlestar Bed Overlying Coralline Crusts, *Parasmittina trispinosa* and *Caryophyllia smitii* on Wave-Exposed Circalittoral Rock





3.2.6 Sediment Biotopes: Biotope Complex SS.SSA.IFiSa – Infralittoral Fine Sand

BIOTOPE: **SS.SSA.IFiSa.IMoSa – Infralittoral mobile clean sand with sparse fauna**

Habitat: Infralittoral medium sand

Substrate and Topography: Moderately well-sorted medium sand

Depth Range: ~5m

Bathymetric Zone: Infralittoral

Tidal Streams: Weak to moderate

Wave Exposure: Very exposed

<u>Biotope Description</u>

This biotope was characterised by a low diversity faunal community comprising the polychaetes *Nephtys cirrosa*, *Paraonis fulgens* and *Magelona filiformis*, the amphipod *Urothoe brevicornis* and the bivalve *Angulus tenuis.* The macrofaunal data for this community were shown by the multivariate ordinations to represent an outlying data point (see the Environmental Baseline Survey Report (Volume I)).

The highly disturbed nature of the sediment associated with the SS.SSA.IFiSa.IMoSa biotope means that considerable variation in community structure could be expected within it. The presence of *M. filiformis* and the atypically high density of *N. cirrosa*, both of which were seen from only one of the two samples analysed, suggests an area of transition exists between SS.SSA.IFiSa.IMoSa and the deeper SS.SSA.IFiSaNCirBat biotope (discussed on page 50). *P. fulgens* and *A. tenuis* are species typically found in fine intertidal sand (Strelzov, 1979; Tebble, 1966); their presence suggests that a biotope such as LS.LSa.FiSa.Po.Ncir (*Nephtys cirrosa* dominated fine sand) or LS.LSa.FiSa.Po.Aten (Polychaetes and *A. tenuis* in fine sand) may occur in the littoral zone.

Table 3.13 lists the fauna found in SS.SSA.IFiSa.IMoSa, as the biotope was identified using data from a single station, percentage contributions to similarity could not be calculated. Comparative data for the species from Connor *et al* (2004) are also shown although SACFOR abundances were not provided in their classification.

<u>Distribution</u>

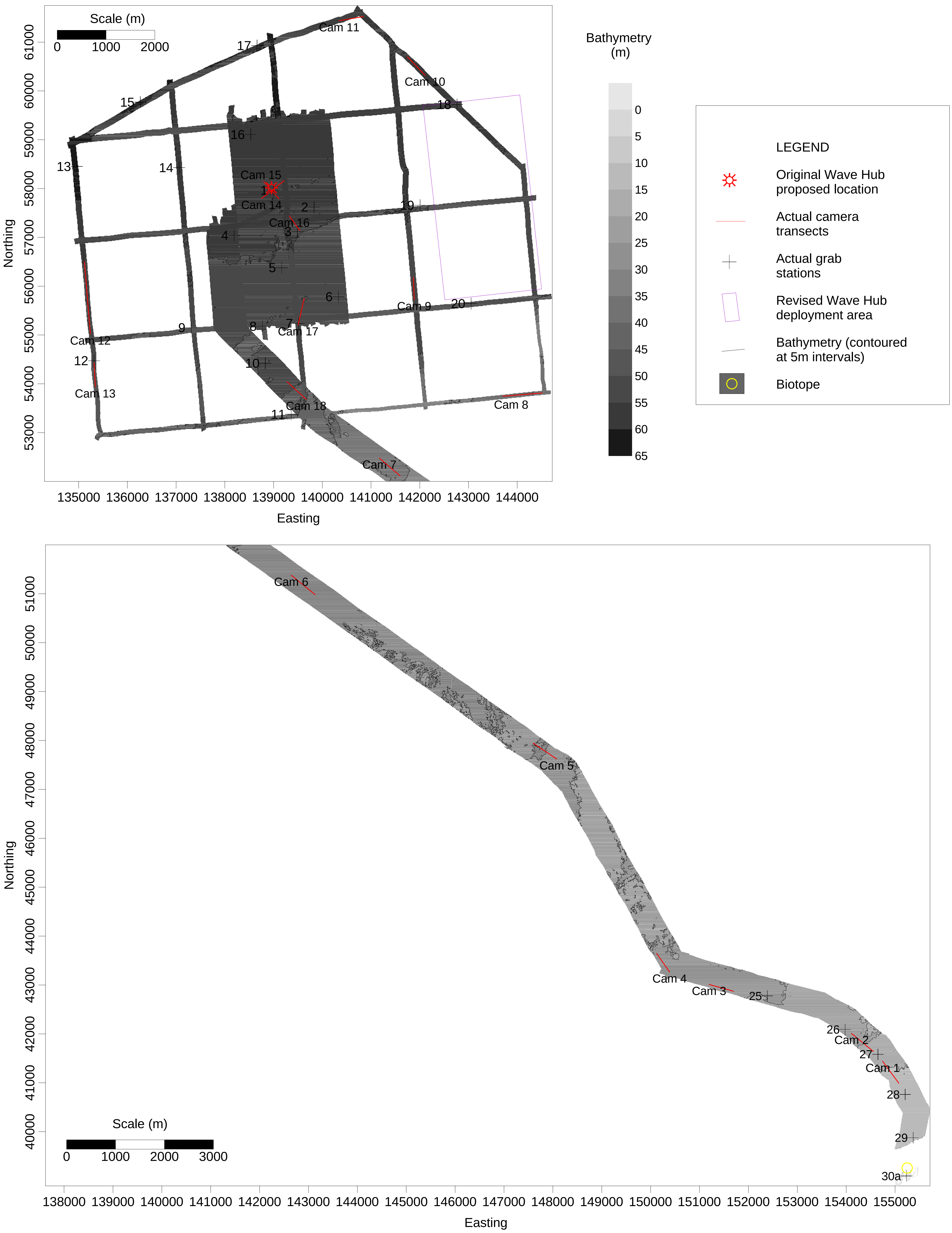
This biotope was found at the most nearshore grab sampling location (G30) at a depth of approximately 5m below LAT (see Figure 3.10).

Table 3.13 Characterising Infauna of SS.SSA.IFiSa.IMoSa

Species	Current Study		Conner *et al* (2004)	
	Typical Abundance	Density (per m^2)	Density (per m^2)	Contribution to Similarity (%)
Nephtys cirrosa	C	10	2	11
Magelona filiformis	C	10	-	-
Angulus tenuis	R	10	-	-
Paraonis fulgens	F	5	-	-
Urothoe brevicornis	R	5	2	15

Blue highlighted taxa characterise the biotope in the present study and in Connor et al (2004)

Figure 3.10 Distribution of SS.SSA.IFiSa.IMoSa - Infralittoral Mobile Clean Sand with Sparse Fauna



BIOTOPE:	**SS.SSA.IFiSaNCirBat – Nephtys cirrosa and Bathyporeia spp. in Infralittoral Sand**
Habitat:	Infralittoral medium to very fine sand
Substrate and Topography:	Moderately well to well sorted fine sand, often formed into waves or ripples
Depth Range:	14-20m
Bathymetric Zone:	Infralittoral
Tidal Streams:	Weak to moderate
Wave Exposure:	Exposed to very exposed

Biotope description

This biotope was characterised by sparse infaunal communities dominated by the amphipods *Urothoe poseidonis* and *Bathyporeia* spp. and polychaetes of the genus *Magelona*. The epifauna community associated with the biotope was dominated by sand gobies of the genus *Pomatoschistus* and sole, *Solea solea.* These communities correspond to Cluster a in the multivariate analyses of particle size, grab and trawl data (see Volume I - Environmental Baseline Survey).

The biotope was identified from a fine SAND habitat subject to considerable disturbance from wave action; differences in the level of disturbance experienced by different areas within the habitat influence both sediment and faunal composition. The substrates of the areas that have apparently been subjected to high levels of disturbance had a lower proportion of very fine SAND and were dominated by motile, opportunistic taxa such as *Urothoe poseidonis, Bathyporeia* spp. and *Nephtys cirrosa* (G27 and G29). In more stable areas a greater proportion of very fine SAND was recorded and sedentary polychaetes such as *Magelona* spp. and *Chaetozone setosa* were more prevalent (G28).

The community composition of the biotope identified in this study fitted the Connor *et al* (2004) description of SS.SSA.IFiSaNCirBat reasonably well. The more stable area of the biotope was reminiscent of the *Magelona* spp. dominated SS.SSA.IMuSa.FfabMag in some ways, but the absence of the bivalves that also characterise this biotope suggested that the area was in fact a variant within SS.SSA.IFiSaNCirBat.

Tables 3.14 and 3.15 list the characterising infaunal and epifaunal species for the biotope, their abundances and percentage contributions to similarity in the Connor *et al* (2004) description of SS.SSA.IFiSaNCirBat are also shown. Two of the species listed by Connor *et al* (2004) have been included in Table 3.X despite their absence from the biotope identified in this study. *Magelona mirabilis* has been the cause of considerable taxonomic confusion in the past (Fiege, 2000) and has now been differentiated into two separate species, one of these, *Magelona johnstoni*, was reasonably abundant in the community seen in this study. *Bathyporeia elegans* has also been included in the table as prior to the publication of the most recent revision of *Bathyporeia* (d'Udekem d'Acoz, 2004) species within the genus were frequently misidentified.

Distribution

This biotope was found on the nearshore section of the cable route in depths of 14 to 20m below LAT (G27-29, T17-20 and camera transect 1) (see Figure 3.11).

Plate 3.14 ***Nephtys cirrosa*** **and** ***Bathyporeia*** **spp. in Infralittoral Sand**

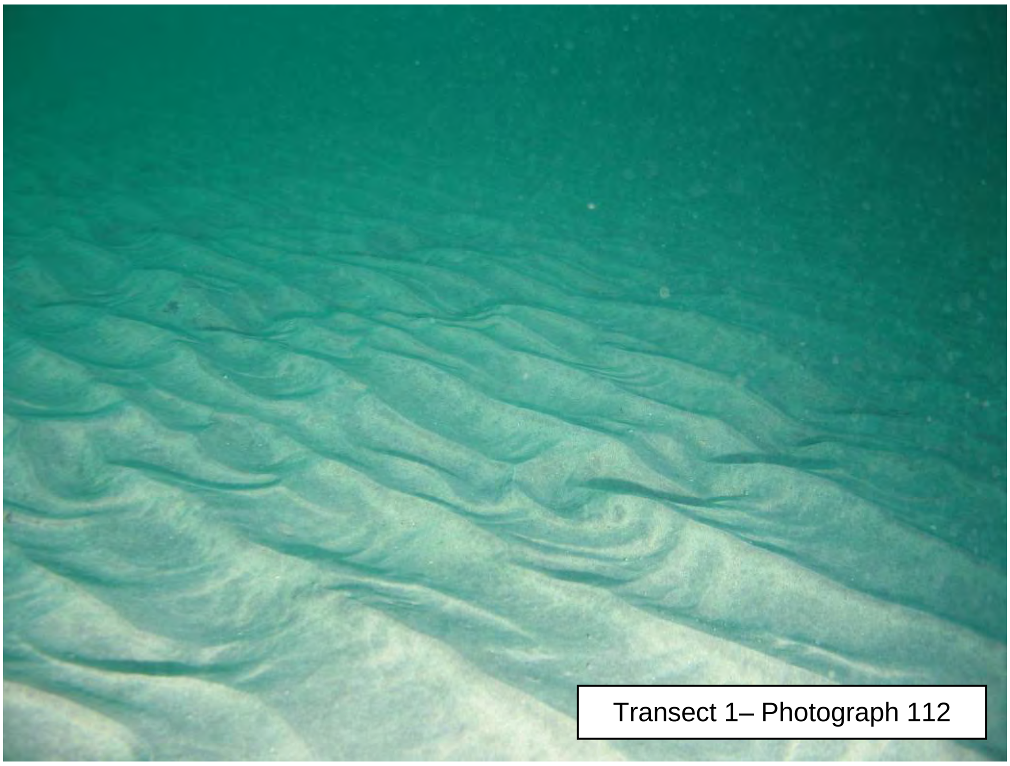


Table 3.14 Characterising epifaunal species in SS.SSA.IFiSaNCirBat

Taxon	Current Study			Conner *et al* (2004)		
	Typical Abundance	Density (per m^2)	Contribution to Similarity (%)	Typical Abundance	Density (per m^2)	Contribution to Similarity (%)
Solea solea	O	1	22	-	-	-
Pomatoschistus sp.	R	5	27	O	-	8
Ophiothrix fragilis	R	2	8	-	-	-

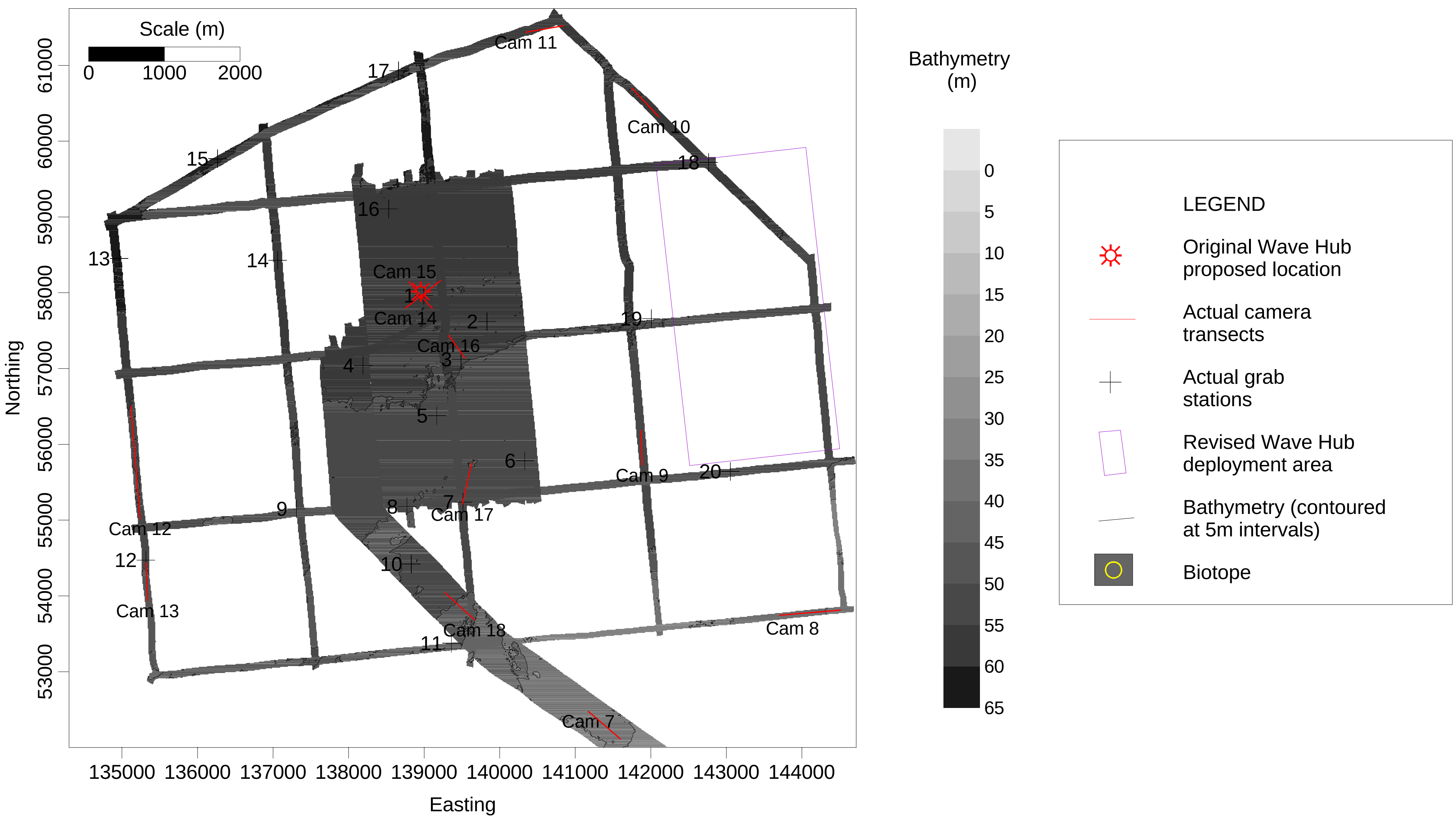
Blue highlighted taxa characterise the biotope in the present study and in Connor et al (2004)

Table 3.15 Characterising infaunal species in SS.SSA.IFiSaNCirBat

Species	Current Study			Conner *et al* (2004)		
	Typical Abundance	Density (per m^2)	Contribution to Similarity (%)	Typical Abundance	Density (per m^2)	Contribution to Similarity (%)
M.agelona filiformis	C	110	15	**-**	**-**	**-**
Magelona johnstoni	**F**	**47**	**12**	**-**	**-**	**-**
Magelona mirabilis	**-**	**-**	**-**	**F**	**38**	**15**
Chaetozone setosa	C	67	6	C	16	5
Urothoe poseidonis	F	47	16	-	-	-
Bathyporeia elegans	**-**	**-**	**-**	**F**	**140**	**14**
B. guilliamsoniana	**F**	**42**	**13**	**F**	**18**	**5**
B. tenuipes	**F**	**15**	**5**	**-**	**-**	**-**
Tellimya ferruginosa	F	15	11	-	-	-
Nephtys cirrosa	F	8	5	C	40	43
Myrtea spinifera	F	3	3	-	-	-
Owenia fusiformis	O	8	10	-	-	-

Blue highlighted taxa characterise the biotope in the present study and in Connor et al (2004)
Species in bold have previously been taxonomically confused or may be partially synonymous - see Page 50

Figure 3.11 Distribution of SS.SSA.IFiSaNCirBat - *Nephtys cirrosa* and *Bathyporeia* spp. in Infralittoral Sand



3.2.7 Sediment Habitats: Biotope Complex SS.SMX.CMx - Circalittoral mixed sediment

BIOTOPE:	**SS.SMX.OMx – Offshore circalittoral mixed sediment**
	Overlain by:
	SS.SCS.CCS.PomB - *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles
Habitat:	Sublittoral mixed sediment
Substrate and Topography:	Very poorly sorted PEBBLE, often with considerable amounts of shell
Depth Range:	22 – 58m
Bathymetric Zone:	Circalittoral
Tidal Streams:	Weak to moderate
Wave Exposure:	Moderately exposed to very exposed

<u>Biotope Description</u>

This biotope was characterised by very high densities of the porcelain 'crab' *Pisidia longicornis* and of epilithic tube-building polychaetes of the family serpulidae (mainly *Pomatoceros triqueter*). Other taxa found in abundance included the polychaetes *Typosyllis* spp., *Harmothoe* spp. and *Polydora* caeca agg. and the amphipods *Corophium sextonae* and *Leptocheirus tricristatus*. The epifauna recorded from the trawl samples was dominated by *P. longicornis* and the brittle star *Ophiothrix fragilis*, although the sea urchin *Psammechinus miliaris,* queen scallop *Aequipecten opercularis* and spider crab *Inachus phalangium* were also regularly recorded. Colonial epifauna in the form of encrusting bryozoa were a prominent feature of the biotope, with the most frequently encountered bryozoan species comprising *Schizomavella cristata, Microporella ciliata, Escharella immersa* and *Rhynchozoon bispinosum*. This biotope relates to clusters b and c in the multivariate analyses of macrofaunal grab and PSD data and to cluster b in the trawl data analyses. Grab samples G5, G7, G10, G11, G19 and G25 and trawl sample T15, all of which were identified as outliers by statistical analysis, also appear to belong within this biotope.

Densities of *P.longicornis* and serpulids varied considerably within the biotope, both species were more abundant in the less coarse shell dominated substrates (cluster c) than in the coarser predominantly COBBLE and PEBBLE substrates (cluster b). *P. longicornis* is an epifaunal filter feeder that frequents crevices between and underneath rocks and shells (Ingle and Christiansen, 2004); the less coarse shell-dominated substrate will provide more microhabitat of this type than the coarser COBBLE and PEBBLE substrate. The elevated serpulid density on the shell substrate can probably be attributed to the greater surface area available for tube-building. Where higher numbers of serpulids occurred greater abundances of *Typosyllis* spp. and *C. sextonae* were also recorded, these species were frequently found occupying empty serpulid tubes.

Although this biotope has been tentatively classified as SS.SMX.OMx overlain by SS.SCS.CCS.PomB, it may represent a distinct biotope within SS.SMX.CMx that has not been identified prior to this study. No *P. longicornis* and serpulid dominated biotopes are listed by Connor *et al* (2004), but the similarities between the biotope identified here and SS.SMX.OMx and SS.SCS.CCS.PomB should be sufficient to ensure reasonable comparability of ecological and sensitivity data. *P. triqueter* and bryozoan encrustation is characteristic of SS.SCS.CCS.PomB and another species characteristic of this biotope, the barnacle *Balanus crenatus,* was evident from the grab sample data and underwater photography; another barnacle species, *Verruca stroemia*, was a characterising taxon in cluster b. The infaunal composition of the biotope identified in this study was most comparable to that of the offshore circalittoral mixed sediment complex (SS.SMX.OMx), although the abundances of the constituent taxa were distinctly different.

It appeared to be reasonable to treat SS.SCS.CCS.PomB as an epibiotic overlay as no infaunal taxa are listed within its characterisation data. This biotope is likely to have been classified from dive or underwater photography surveys as opposed to quantitative benthic data.

Underwater video / stills showed significant variation in sediment type within SS.SMX.OMx overlain by SS.SCS.CCS.PomB. In shallower areas adjacent to bedrock outcrops the biotope was PEBBLE and COBBLE dominated whereas in deeper water shell was more prominent; this difference may be the cause of cluster differentiation in the multivariate analysis of the macrofaunal data. Despite this, subdivision of this biotope appeared inappropriate as the three most dominant taxa for both clusters were identical.

Tables 3.16 and 3.17 shows the top twenty characterising taxa for SS.SMX.OMx overlain by SS.SCS.CCS.PomB, comparative data for SS.SMX.OMx from Connor *et al* (2004) are also shown. *Syllis* spp., a characterising taxon for SS.SMX.OMx, has been included in Table 3.17 as both *Ehlersia cornuta* agg. and *Typosyllis* spp. were included in this genus in the past. Another charactersing species of SS.SMX.OMx, the serpulid *Hydroides norvegica*, was also included in the table as this was occasionally recorded from the *P. longicornis* and polychaetes biotope. Due to the high proportion of damaged (and therefore unidentifiable) serpulid specimens found in the current study these animals had to be grouped at family level for the purposes of statistical analysis.

Distribution

This biotope was found at depths ranging from 22 to 28m in the nearshore cable route (G24 to G26), on the southern half of the regional offshore area (44 to 54m) and on the southern half of the original Wave Hub deployment area (52 to 58m). It corresponds to grab stations G3 to G12, G19, G20 and G24 to G26 and trawl stations T3, T4 and T11 to T17. The *P. longicornis* and polychaetes biotope dominated the sediment habitats seen in camera transects 2 to 5, 8, 9, 13 and 16 to 18, it also appeared to have a limited distribution in transects 10 and 12 (see Figure 3.12).

Plate 3.15 Offshore Circalittoral Mixed Sediment Overlain by *Pomatoceros Triqueter* with Barnacles and Bryozoan Crusts on Unstable Circalittoral Cobbles and Pebbles

Transect 9– Photograph 105

Table 3.16 Dominant Epifauna in SS.SMX.OMx Overlain by SS.SCS.CCS.PomB

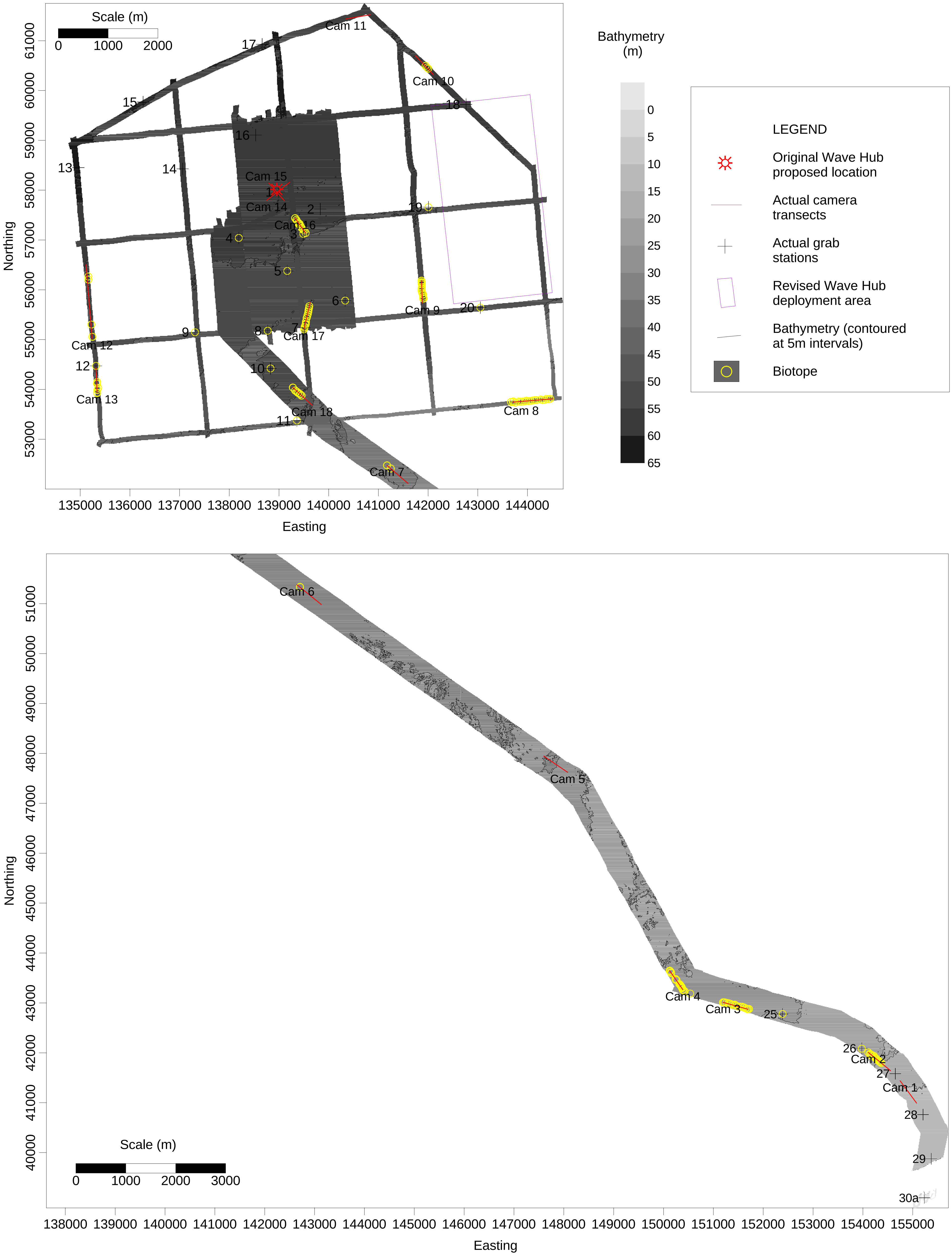
Taxon	Typical Abundance	Density (per 1000m^2)	Contribution to Similarity (%)
Pisidia longicornis	R	26.6	13.9
Ophiothrix fragilis	R	18.8	12.9
Psammechinus miliaris	R	2.00	8.77
Aequipecten opercularis	R	9.25	8.75
Inachus phalangium	R	2.50	7.10

Table 3.17 Characterising Infauna in SS.SMX.OMx Overlain by SS.SCS.CCS.PomB

Taxon	Current study- Cluster C			SS.SMX.OMx (Connor *et al*, 2004)		
	Typical Abundance	Density (per m^2)	Contribution to Similarity (%)	Typical Abundance	Density (per m^2)	Contribution to Similarity (%)
Serpulidae	**A**	**282**	**4**	**-**	**-**	**-**
Hydroides norvegica	**-**	**-**	**-**	**F**	**24**	**1**
***Typosyllis* spp.**	**A**	**181**	**4**	-	-	-
***Syllis* spp.**	-	-	-	-	**25**	**1**
***Ehlersia cornuta* agg.**	**F**	**15**	**2**	-	-	-
Harmothoe spp.	A	130	3	A	78	2
NEMERTEA	A	39	2	A	91	3
Corophium sextonae	C	265	4	-	-	-
Polydora caeca agg.	C	95	3	-	-	-
Notomastus sp.	C	61	3	-	-	-
Galathea intermedia	C	55	3	-	-	-
Lumbrineris gracilis	C	24	2	C	86	2
Aonides paucibranchiata	C	21	2	C	241	5
Scalibregma celticum	C	20	2	-	-	-
Leptocheirus tricristatus	F	91	2	-	-	-
Janira maculosa	F	66	3	-	-	-
Ceradocus semiserratus	F	42	3	-	-	-
Xantho pilipes	F	6	2	-	-	-
Timoclea ovata	F	6	2	C	59	2
Onchidorididae	O	6	2	-	-	-
Lanice conchilega	O	5	2	-	-	-

Blue highlighted taxa characterise the biotope in the present study and in Connor et al (2004)
Taxa in bold type may be at least partially synonymous – see Page 54

Figure 3.12 Distribution of SS.SMX.OMx - Offshore Circalittoral Mixed Sediment Overlain by: SS.SCS.CCS.PomB - *Pomatoceros triqueter* with Barnacles and Bryozoan Crusts on Unstable circalittoral Cobbles and Pebbles



BIOTOPE:	**SS.SMx.CMx.OphMx – *Ophiothrix fragilis* and / or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment**
Habitat:	Sublittoral mixed sediment
Substrate and Topography:	Very poorly sorted shelly PEBBLE
Depth Range:	40 to 50m
Bathymetric Zone:	Circalittoral
Tidal Streams:	Weak to moderate
Wave Exposure:	Moderately exposed to very exposed

<u>Biotope Description</u>

This community associated with this biotope was characterised by a sparse bed of *Ophiothrix fragilis* and *Ophiocomina nigra*, while *Marthasterias* glacialis, a starfish that that feeds on brittlestars was also recorded in the biotope. An encrusting epifauna of serpulid polychaetes and bryozoa, as found in the *Pisidia longicornis* and polychaetes biotope, was evident.

The SS.SMx.CMx.OphMx brittlestar bed identified in this study was considerably less extensive and contained a lower density of individuals than the CR.MCR.EcCr.CarSp.Bri and CR.MCR.EcCr.FaAlCr.Bri beds seen.

As this biotope was identified from camera footage, quantitative infaunal data are not available for it. Connor *et al* (2004) cite a study which showed that the presence of epifaunal brittlestars did not reduce the biomass of the underlying infauna; as the biotope occurs on the same shelly PEBBLE substrate as SS.SMX.OMx overlain by SS.SCS.CCS.PomB, it was presumed to have a similar infaunal community.

The characterising taxa for SS.SMx.CMx.OphMx are listed in Table 3.18, along with comparative data from Connor *et al* (2004) are also provided.

<u>Distribution</u>

SS.SMx.CMx.OphMx was identified at a depth of approximately 50m in the south western regional offshore area (camera transect 13) and at a depth of approximately 40m in the south eastern regional offshore area (camera transect 8) (see Figure 3.13).

Plate 3.16 ***Ophiothrix fragilis*** **and** ***Ophiocomina nigra*** **Brittlestar Beds on Sublittoral Mixed Sediment**

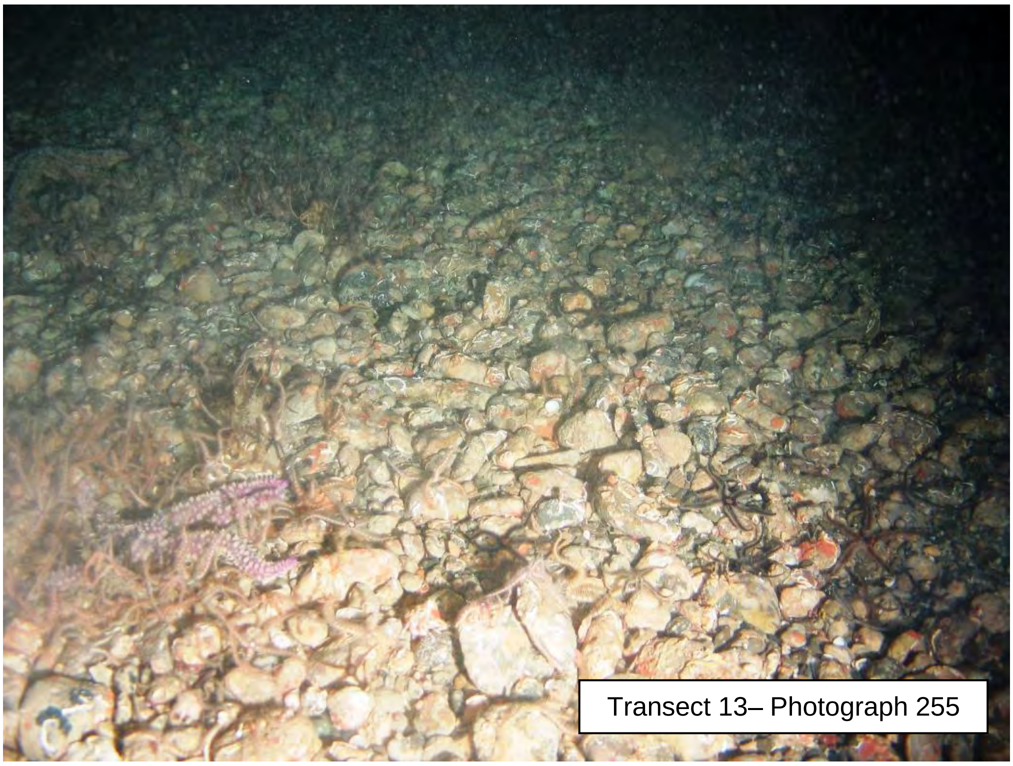


Table 3.18 Characterising Taxa in SS.SMx.CMx.OphMx

Taxon	Current Study	CR.HCR.XFa.CvirCri	
	Typical Abundance	Typical Abundance	Frequency
Ophiothrix fragilis	Abundant	Abundant	5
Pomatoceros sp.	Abundant	Common	2
Ophiocomina nigra	Frequent	Frequent	3
BRYOZOA	Frequent	-	-
Marthasterias glacialis	Frequent	-	-

Blue highlighted taxa characterise the biotope in the present study and in Connor et al (2004)

Figure 3.13 Distribution of SS.SMx.CMx.OphMx - *Ophiothrix fragilis* and / or *Ophiocomina nigra* Brittlestar Beds on Sublittoral Mixed Sediment

BIOTOPE:	***Antedon bifida* beds with *Ophiothrix fragilis* on circalittoral mixed sediment**
Habitat:	Sublittoral mixed sediment
Substrate and Topography:	Very poorly sorted shelly PEBBLE
Depth Range:	~50m
Bathymetric Zone:	Circalittoral
Tidal Streams:	Weak to moderate
Wave Exposure:	Moderately exposed to very exposed

<u>Biotope Description</u>

This biotope was characterised by an abundance of the feather star *Antedon bifida* on a shelly PEBBLE substrate, the brittle star *Ophiothrix fragilis* was also present in moderate density. A similar encrusting epifauna to that seen in the *Pisidia longicornis* and polychaetes biotope and SS.SMx.CMx.OphMx was recorded.

Like SS.SMx.CMx.OphMx this biotope was identified from underwater video / stills and trawl sample data. No quantitative infaunal data is available for it but the community was assumed to be similar to that found in the *Pisidia longicornis* and polychaetes biotope.

No sediment biotopes characterised by a high crinoid density are listed by Connor *et al* (2004). Although this biotope could be considered a sub-biotope of the *P. longicornis* and polychaetes biotope, its differentiation was considered consistent with the separate classification of SS.SMx.CMx.OphMx.

The characterising taxa for the *Antedon bifida* beds with *Ophiothrix fragilis* on circalittoral rocks biotope are listed in Table 3.19.

<u>Distribution</u>

This biotope was identified at a depth of approximately 50m in the southern and south western regional offshore area (camera transects 18 and 13, respectively). The high number of *A. bifida* and moderate abundance of *O. fragilis* recorded from trawl sample T11 suggested that this biotope may also have been found in the eastern regional offshore area (see Figure 3.14).

Plate 3.17 ***Antedon bifida*** **Beds with** ***Ophiothrix fragilis*** **on Circalittoral Mixed Sediment**

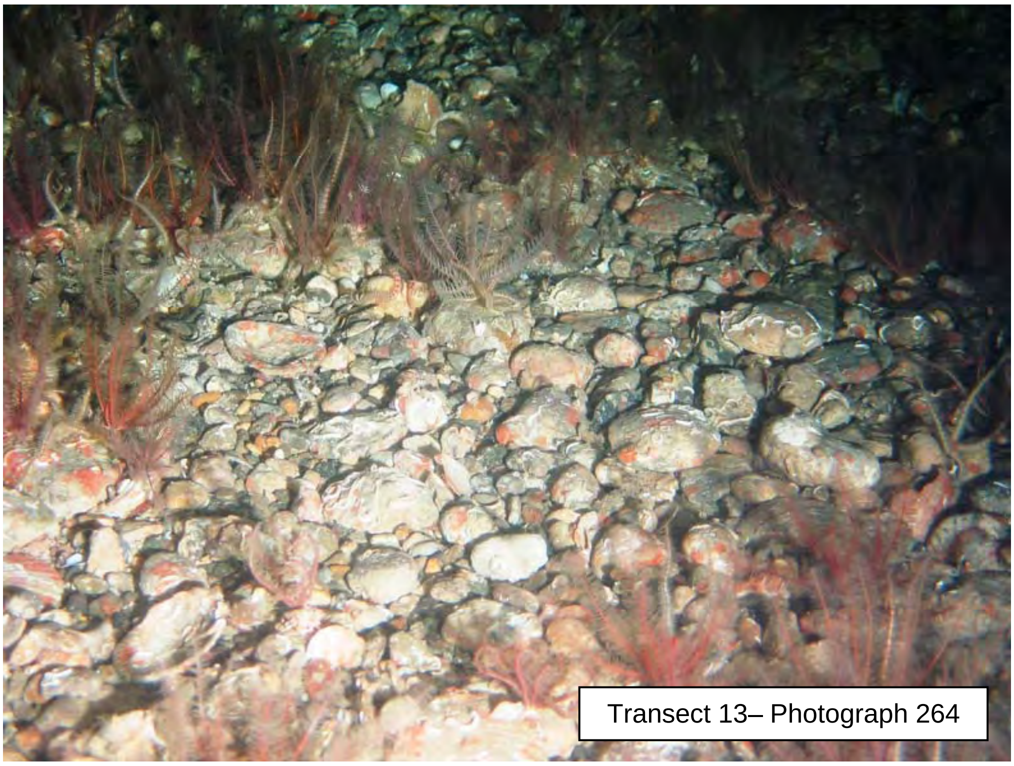
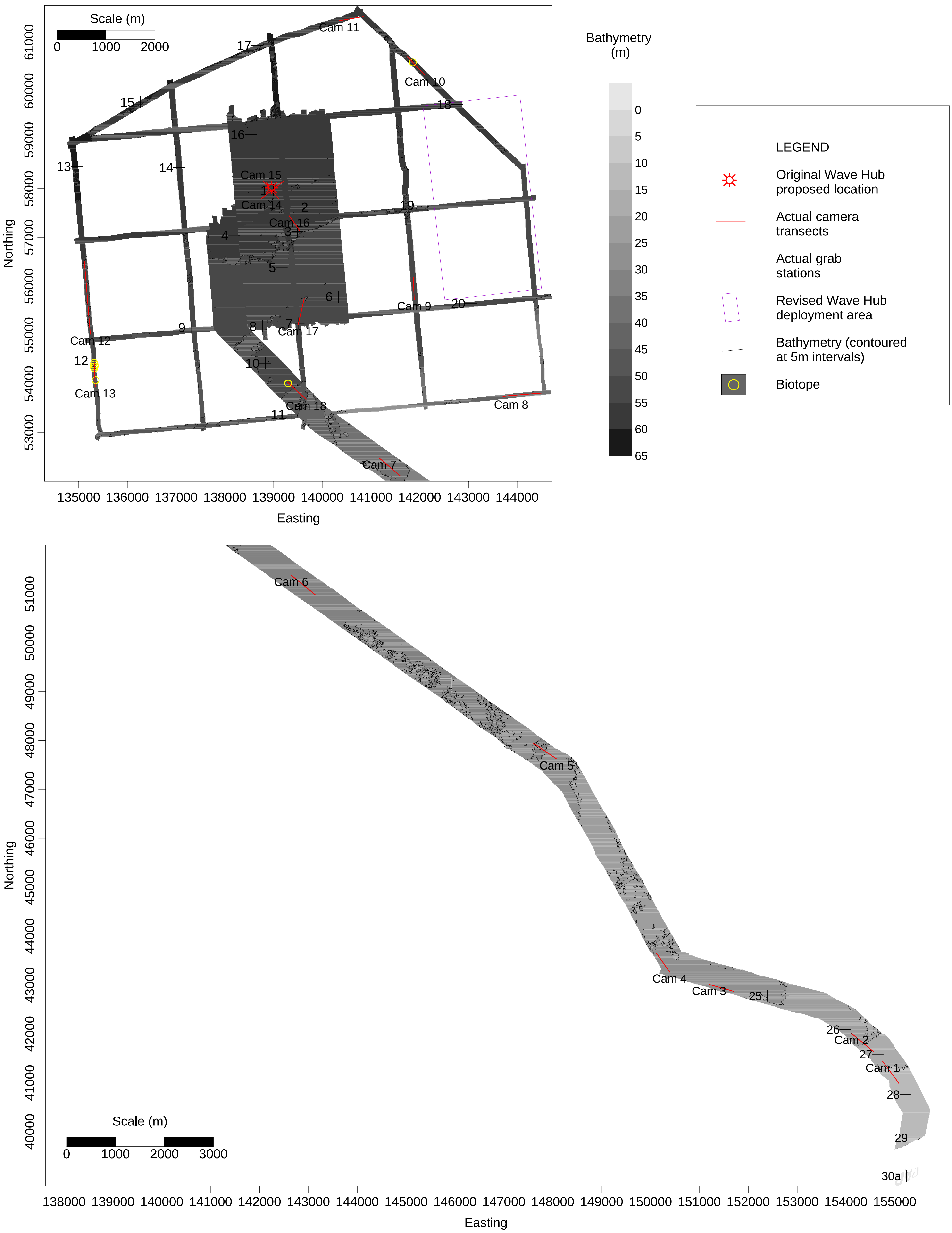


Table 3.19 **Characterising Epifauna of** ***Antedon bifida*** **Beds with** ***Ophiothrix fragilis*** **on Circalittoral Mixed Sediment**

Taxon	Typical Abundance
Antedon bifida	Abundant
Pomatoceros sp.	Abundant
Ophiothrix fragilis	Frequent
BRYOZOA	Frequent

Figure 3.14 Distribution of *Antedon bifida* Beds with *Ophiothrix fragilis* on Circalittoral Mixed Sediment



3.2.8 Sediment Biotopes: Biotope Complex SSSMX.OMx – Offshore Circalittoral Mixed Sediment

BIOTOPE COMPLEX:	**SS.SMX.OMx – Offshore circalittoral mixed sediment**
	Overlain by:
BIOTOPE:	**SS.SCS.CCS.Blan – *Branchiostoma lanceolatum* in circalittoral coarse sand with shell gravel**

Habitat:	Circalittoral mixed sediment
Substrate and Topography:	Moderately to poorly sorted coarse to very coarse SAND with pebbles, gravel and shell aggregations
Depth Range:	58 – 63m
Bathymetric Zone:	Circalittoral
Tidal Streams:	Weak to moderate
Wave Exposure:	Sheltered

<u>Biotope description</u>

The infaunal community of this biotope was characterised by moderate densities of the polychaetes *Polygordius* spp. and *Glycera lapidum* agg., the green sea urchin *Echinocyamus pusillus* and dog cockle *Glycymeris glycymeris*; several other polychaete species were present at low density, as were lancelets of the genus *Branchiostoma*. The biotope's motile epifauna was dominated by the queen scallop *Aequipecten opercularis*, the hermit crab *Pagurus prideaux* and sea urchin *Echinus esculentus*. The most frequently occurring colonial epifaunal species were the erect bryozoan *Amathia lendigera* and the encrusting bryozoans *Schizomavella cristata*, *Micropora coriacea* and *Microporella ciliata*; colonial epifaunal diversity and cover was significantly less than in SS.SMX.OMx. overlain by SS.SCS.CCS. PomB. The biotope relates to cluster d in the multivariate analyses of the macrofaunal grab and PSD data and to cluster c in the analyses of the trawl sample data (see the Environmental Baseline Survey Report (Volume I)).

Although four of the species that characterise SS.SCS.CCS.Blan in the Connor *et al* (2004) classification were recorded at significant density in this biotope, they were not found to be as dominant as in SS.SCS.CCS.Blan because of the diversity of other taxa present. As much of this diversity was contributed by taxa typical of SS.SMX.OMx, the biotope appears likely to belong within this complex.

Connor *et al* (2004) suggest that SS.SCS.CCS.Blan may represent an epibiotic overlay of another biotope (i.e. a sediment surface community that exists above a different community). This may explain the coexistence of taxa associated with the SS.SCS.CCS.Blan and SS.SMX.OMx in the biotope found in this study.

The lack of motile epifauna in the characterising taxa listed by Connor *et* al (2004) for SS.SCS.CCS.Blan and SS.SMX.OMx suggests that trawl and / or dredge sample data were not available for these biotopes. This is likely to explain the absence of biotope characterising taxa from the trawl sample data.

The characterising epifauna and infauna for the biotope are presented in Tables 3.20 and 3.21, respectively, comparative infaunal data from Connor *et al* (2004) are provided for both SS.SCS.CCS.Blan and SS.SMX.OMx. *Syllis* spp., a characterising taxon for SS.SMX.OMx, has been included in the Table 3.21 (bold type) as both *Ehlersia cornuta* agg. and *Typosyllis* spp. were included in this genus in the past.

<u>Distribution</u>

This biotope was found in the northern offshore regional area and the northern half of the original Wave Hub deployment area in depths ranging from 56 to 63m. It corresponds to grab stations G1, G2 and G13 to G18 and trawl samples T3, T4 and T11 to T16 and is the dominant biotope in the video/ stills footage acquired from camera transects 10, 11, 14 and 15 (see Figure 3.15).

Plate 3.18 **Offshore Circalittoral Mixed Sediment Overlain by *Branchiostoma lanceolatum* in Circalittoral Coarse Sand with Shell Gravel**

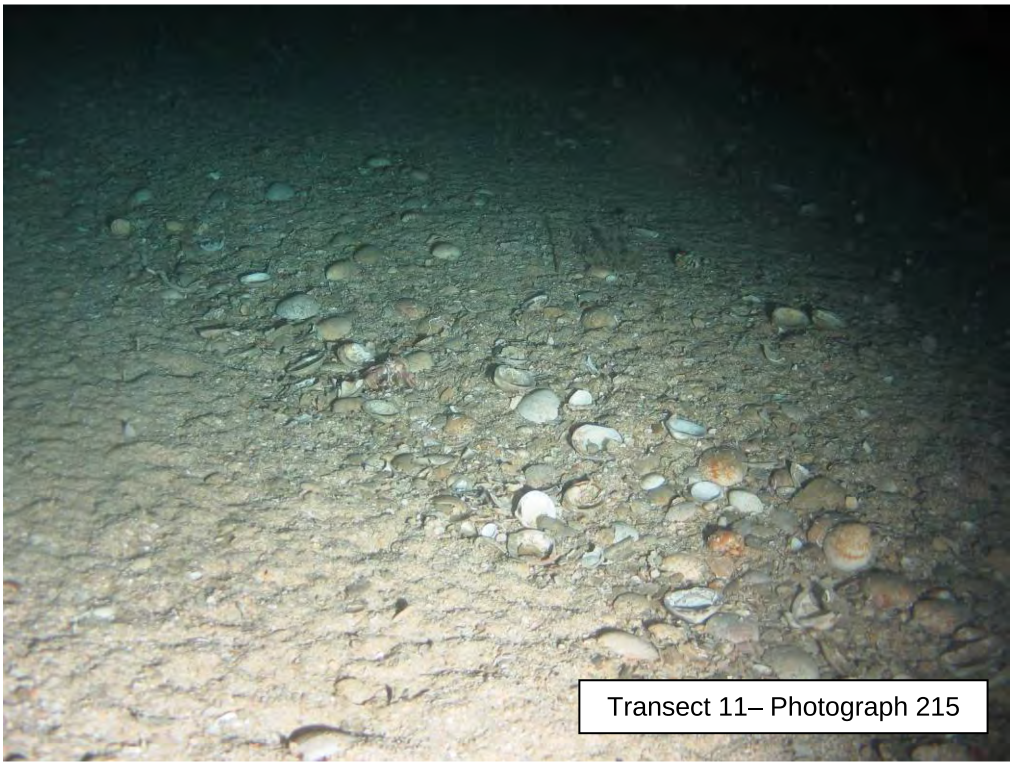


Table 3.20 **Characterising Epifaunal Species in SS.SMX.OMx overlain by SS.SCS.CCS.Blan**

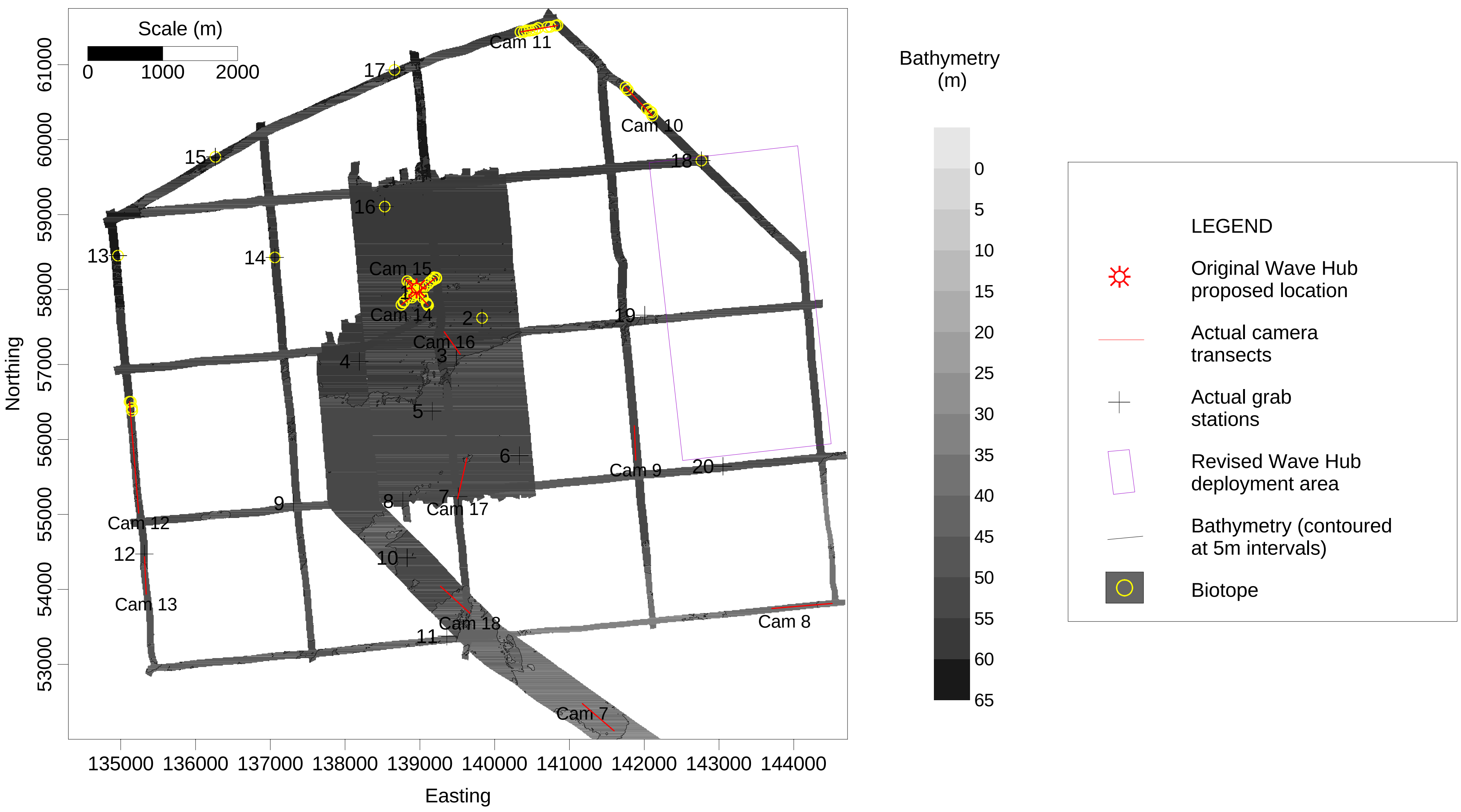
Taxon	SACFOR	Density (per m^2)	Contribution to Similarity (%)
Aequipecten opercularis	R	8.92	52.7
Pagurus prideaux	R	8.37	26.1
Echinus esculentus	R	7.64	17.1
Asterias rubens	R	7.21	8.38
Macropodia tenuirostris	R	6.42	5.63

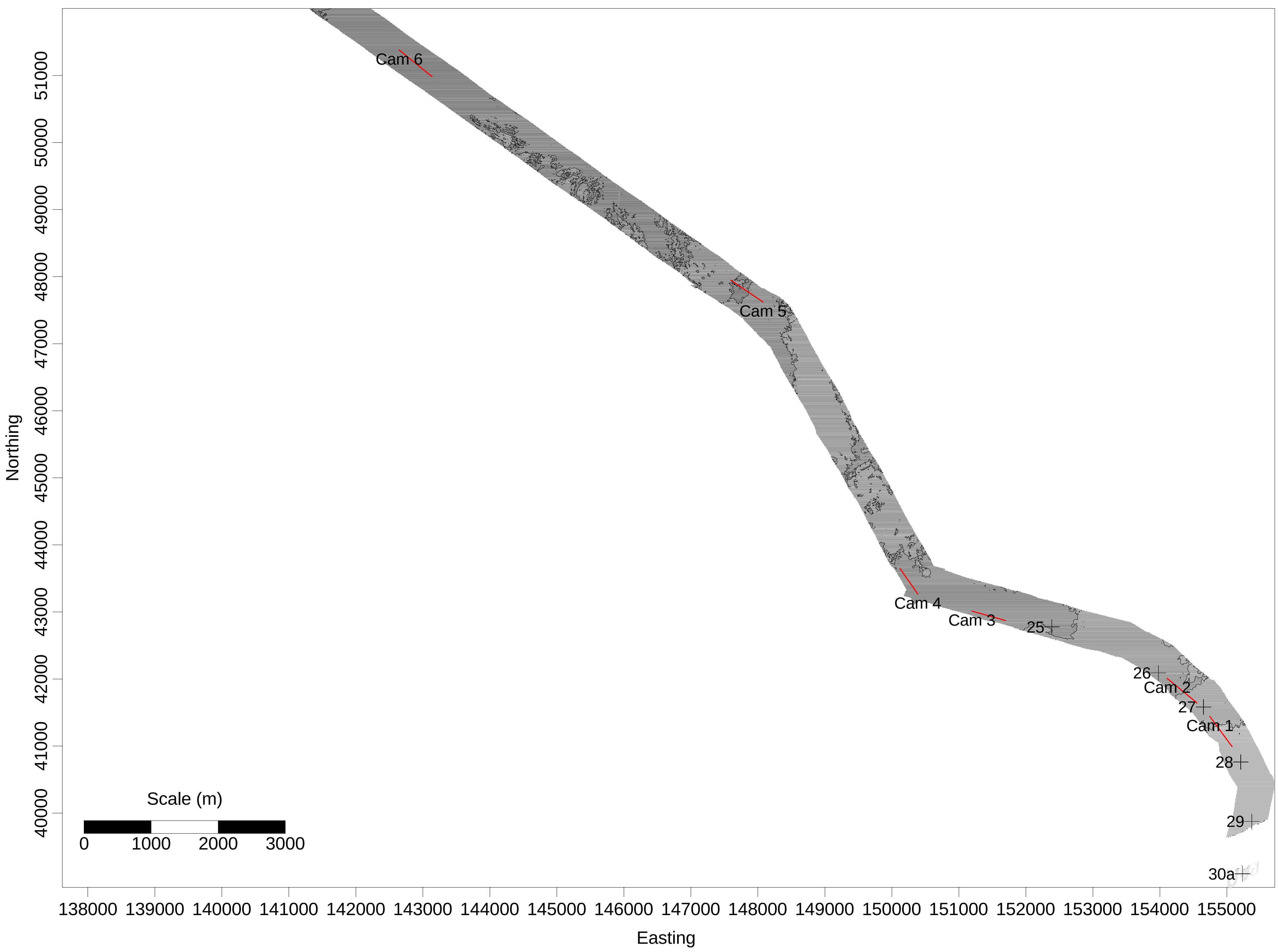
Table 3.21 Characterising Infauna in SS.SMX.OMx Overlain by SS.SCS.CCS.Blan

Taxon	Current Study			Connor *et al* (2004)					
				SS.SCS.CCS.Blan			SS.SMX.OMX		
	SACFOR	Density (per m^2)	Contribution to Similarity (%)	SACFOR	Density (per m^2)	Contribution to Similarity (%)	SACFOR	Density (per m^2)	Contribution to Similarity (%)
Glycymeris glycymeris	A	56	5	-	-	-	A	30	1
Eunice sp.	A	43	5	-	-	-	-	-	-
Polygordius spp.	C	81	6	F	53	13	-	-	-
Glycera lapidum agg.	C	54	5	C	70	20	C	92	2
***Typosyllis* sp.**	**C**	**40**	**5**	-	-	-	-	-	-
***Ehlersia cornuta* agg.**	**C**	**22**	**4**	-	-	-	-	-	-
***Syllis* spp.**	-	-	-	-	-	-	-	**25**	**1**
Protodorvillea kefersteini	C	26	3	-	-	-	-	-	-
Branchiostoma lanceolatum	C	23	3	C	70	20	-	-	-
Serpulidae	**C**	**21**	**3**	-	-	-	-	-	-
Hydroides norvegica	-	-	-	-	-	-	**1**	**24**	**F**
Harmothoe spp.	C	19	3	-	-	-	C	78	2
Malmgrenia spp.	C	15	3	-	-	-	-	-	-
Kefersteinia cirrata	C	12	4	-	-	-	-	-	-
Timoclea ovata	C	11	3	-	-	-	C	59	2
Echinocyamus pusillus	F	53	5	A	170	25	-	-	-
Aonides paucibranchiata	F	9	3	-	-	-	C	241	5
Goniadella sp.	F	6	3	-	-	-	-	-	-
Lumbrineris gracilis	F	6	2	-	-	-	C	86	2
Sphaerosyllis bulbosa	O	6	2	-	-	-	F	59	1

Blue highlighted taxa characterise the biotope in the present study and in Connor et al (2004)

Figure 3.15 Distribution of SS.SMX.OMx - Offshore Circalittoral Mixed Sediment Overlain by: SS.SCS.CCS.Blan - *Branchiostoma lanceolatum* in Circalittoral Coarse Sand with Shell Gravel





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