Natural England

St Austell Bay Maerl Survey

Acoustic and Video Analysis

Citation:

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Summary

Background

In July 2012, as part of a larger survey of maerl beds in Cornwall, Seasearch divers identified a previously undocumented area of the Biodiversity Action Plan (BAP) Habitat Maerl Beds (Gall 2012) in the east of St Austell Bay, South East Cornwall. In response to the findings of Gall (2012) Natural England in conjunction with Cornwall Inshore Fisheries and Conservation Authority (CIFCA) undertook acoustic and drop-down video surveys within the bay in order to identify areas of maerl. Seastar Survey Ltd. were contracted by Natural England to conduct analysis of the drop-down video and sidescan sonar data collected.

Main findings

- Sidescan sonar data were reprocessed by Seastar Survey and imported into ArcGIS in order to facilitate interpretation. Four major substrata types were identified; gravel with bedforms, gravel without bedforms, rock, and sand / mixed sediments.
- All ten video transects run were analysed, with HD video utilised in preference to the VideoRay due to quality reasons.
- Maerl was observed on 9 out of 10 video transects, although the majority of maerl observed was determined to be dead.
- Other habitats observed included bedrock outcrops dominated by kelp and foliose red algae. The most common epifauna observed included the echinoderms *Asterias rubens*, *Marthasterias glacialis*, *Ophiothrix fragilis* and *Ophiocomina nigra*; anemones such as *Anemonia viridis*, *Cereus pedunculatus* and *Urticina* sp.; and encrusting fauna including sponges, bryozoans and the keel worm *Spirobranchus* sp..
- Maerl was most commonly observed as maerl gravel in large waves mixed with gravel and shell.
- The highest fraction of live maerl was observed on transect Tow_5, with large nodules observed on gravelly sediments and in gullies between bedrock outcrops, with the species *Lithothamnion corallioides* tentatively identified.
- The distribution, extent, percentage cover and health of the maerl observed has been assessed and discussed.
- The survey limitations and knock-on effects on the data analysis and habitat mapping are discussed, with confidence assessments assigned to the data.
- It is recommended that the analyses presented here are used primarily to inform a further, more thorough and robust survey of the area, with greater coverage by acoustic and ground-truthing techniques required for the creation of reliable and accurate habitat maps and for maerl assessment.

Contents

List of Figures

List of Tables

1 INTRODUCTION

In July 2012, as part of a larger survey of maerl beds in Cornwall, Seasearch divers identified a previously undocumented area of the Biodiversity Action Plan (BAP) Habitat Maerl Beds (Gall 2012) in the east of St Austell Bay, South East Cornwall.

Maerl is a collective term used to describe living and dead accumulations of several species of calcified red algae. Maerl grows as unattached nodules or 'rhodoliths' on the seabed, especially in coarse clean gravel or sand or on muddy mixed sediment (Hall-Spencer *et al.*, 2008), and can form extensive beds in favourable conditions (JNCC, 2007). Maerl is slow-growing, but over long periods its dead calcareous skeleton can accumulate into deep deposits or beds overlain by a thin layer of pink, living maerl, forming an important habitat in its own right. Maerl has been found at depths from the lower shore down to 30 m depth. The depth is determined by water turbidity, since maerl requires light to photosynthesise (Hall-Spencer *et al.*, 2008). Therefore maerl usually occurs in areas with clear water and strong currents (Axelsson *et al.*, 2008).

Maerl beds have a high biodiversity, primarily due to the complex three-dimensional nature of the habitat. A wide range of species live within the interstitial spaces of the maerl bed, and some, such as the tanaid *Leptognathia paramanca*, have specific associations with maerl beds (Bamber, pers. comm.). This complex structure is also important because it provides feeding areas for juvenile fish, such as Atlantic cod *Gadus morhua*, and acts as a nursery area for commercially important species including *Pecten maximus*, *Venus verrucosa* and *Ensis* spp. (Kamenos *et al.*, 2004). In addition to the fauna living in the interstitial spaces, a variety of epifauna grows on the heterogeneous hard surface of the maerl (Howson *et al.*, 2004). Rich algal communities are present on maerl beds, which show distinct seasonal variation (JNCC, 2001).

The maerl bed in St Austell Bay observed by Gall (2012) was thought to be predominantly composed of *Lithothamnion corallioides*, which is nationally scarce, however nearby maerl beds – for example, at St Mawes Bank and Castle Point – are known to consist of both *L. corallioides* and *Phymatolithon calcareum* (Allen *et al.*, 2014). Exceptionally diverse biological communities are associated with maerl; over fifty species of seaweed and many animal species are associated with the St Mawes Bank live maerl bed, including many nationally rare species such as *Gracilaria multipartita*, *Halymenia* spp. and Couch's goby *Gobius couchi*. More common species associated with maerl beds include the burrowing anemone *Cerianthus lloydii*, other anemones, crabs, polychaetes, fish and crustaceans. These sediments are also rich in species and provide an important habitat for, amongst others, deep burrowing species, attached seaweed, bivalves and crustaceans (Hall-Spencer *et al.*, 2008).

In response to the findings of Gall (2012) Natural England in conjunction with Cornwall Inshore Fisheries and Conservation Authority (CIFCA) undertook acoustic and drop-down video surveys within the bay in order to identify areas of maerl. Seastar Survey Ltd. were contracted by Natural England to conduct analysis of the drop-down video and sidescan sonar data collected.

The principal aim of the data analysis was to provide baseline information on the extent and distribution of maerl habitats within St Austell Bay. In order to achieve this aim, a robust methodology for the assessment of maerl bed health and percentage cover was devised. The objectives of the work were to interpret the acoustic survey data and ground-truthing data and to use these data to produce biotope maps for the survey area to inform both initial assessment of any maerl bed present (distribution, extent, species composition and percentage cover of any maerl observed) and further sampling plans of the area.

2 METHODOLOGY

2.1 Survey summary

2.1.1 Acquisition acoustic data

Sidescan sonar data was collected by CIFCA from St Austell Bay on the 29th October 2012 aboard SV *Kerwyn*. Nine lines of varying lengths were positioned by members of CIFCA across St Austell Bay at orientations and locations where it was thought, based on prior knowledge and experience, maerl habitats were likely to occur given the shape and bathymetry of St Austell Bay. The lines were located so as to, where possible, follow the depth contours of the bay.

The equipment used was a Tritech Starfish 450F (450Khz) sidescan sonar system set to 50 m range and a gain of 22 %. The data acquired were in a proprietary format (Scanline), and delivered to Seastar Survey as .XTF files and as processed GeoTiff files (created using Geosurvey 6.1.0 software from CodaOctopus). These GeoTiff files were used to inform the subsequent camera survey.

2.1.2 Acquisition of video footage

The drop-down camera survey was undertaken by CIFCA in one day on the 14^{th} March 2013 aboard *Saint Piran* using a VideoRay ROV with overlay in a drop camera frame to collect video data from the area. In addition, a GoPro Hero 2 video camera in waterproof housing was attached to the frame to provide 1080 HD video footage.

Drop-down camera deployments were conducted as transects of around 15 minutes (250 – 500 m in length). Camera transects were positioned with the aim of ground-truthing the acoustic data, with transects crossing habitat boundaries identified during initial sidescan interpretation, with particular attention paid to the areas surveyed by Seasearch in 2012 and to those areas with acoustic signatures similar to those verified as maerl beds in the nearby Falmouth Bay. A total of ten transects were conducted.

2.1.3 Horizontal Control

The sidescan sonar survey used the Starfish GPS antenna, designed specifically to work with the Tritech Starfish sidescan sonar system being used. All positions were recorded in WGS84 geographic coordinates and incorporated with the raw data outputs. No raw navigational data for this aspect of the survey was available.

Positional data acquired during the drop-down camera survey were intended to be provided solely in the form of the VideoRay Smart Tether system, using a dedicated GPS antenna which relayed positional data to the surface control unit of the ROV. The system then employed the Smart Tether function, as well as unit depth, to compute the exact location of the ROV whilst deployed. This position was then fed directly into the video overlay along with time (of surface computer). No raw navigation data were recorded.

The vessel navigation system used was a Transas NaviSailor 3000 ECS, and was logging vessel position throughout the camera survey.

2.2 Sidescan sonar data processing and interpretation

The GeoTiff images of the sidescan sonar data acquired showed good quality acoustic data, however the water column, inherent in any raw acoustic dataset, had not been processed out and there was some indication of variation in the gain values during lines. In order to attempt to provide the highest quality dataset from which to work, the raw .XTF files provided were re-processed by Seastar Survey.

In order to reprocess the raw .XTF files, the files were incorporated into Hypack 2011 Survey management Software. The files were opened individually using the Sidescan Survey Targeting and Mosaicking function within Hypack 2011. This function allowed for a post processed bottom tracking to be applied to the dataset (set in this instance at a medium-to-high sensitivity of 6). The bottom tracking is then visually scanned and edited manually. The data were then passed into a waterfall function and the gain of the lines altered manually (with consistent settings then used for the following lines) to best analyse the data. The data were processed using an inverted greyscale colour pallet. The water column was then removed and each line inspected. This was done as the pre-mosaicked (processed) data show the most detail with respect to the acoustic signatures acquired. An experienced ecologist recorded the likely substrate types and any unusual or anthropogenic targets seen on each line and any bedform features observed. Following this initial analysis the data were individually mosaicked into GeoTiff files, at 0.25 m resolution.

The completed GeoTiff files were then incorporated into an ArcGIS 10.2 project for closer inspection and substrate interpretation. The data were then analysed again in context with other lines, allowing for an overall understanding of the substrata within St Austell Bay to be achieved. The colour pallet used was an inverted greyscale and the classification of substrate was based on intensity of return according to this pallet. Acoustic returns which were displayed as light grey to white indicated a harder substrate, whereas darker grey to black was indicative of relatively soft substrate, or of shadows caused by objects protruding from the seabed. Bedforms noted during the initial analysis were then observed in context with the surrounding data and described.

Following this initial large scale analysis of the acoustic data the drop-down video navigation lines were incorporated into the GIS. Where these lines intersected sidescan sonar data the footage was used to ground-truth and inform the assignment of substrate types to specific acoustic signatures. The classification of notable bedforms was also used to help assign these signatures.

2.3 Analysis of video records

The video analysis of each deployment was primarily conducted using the HD video as the footage from the onboard camera of the VideoRay was considered to be of poor quality and unsuitable for species identification. Analysis started with an initial assessment to gain a broad understanding of the substratum, flora and fauna present, as well as the identification of any different habitats / biotopes on the seabed. The analysis was carried out 'blind' without any prior knowledge of the sites, using a personal computer and software that allowed slow-motion, freeze frame and standard play analysis. During the initial assessment video footage was viewed at 4x normal speed in order to divide the footage into segments representing different substrata. The start and end time of each segment were recorded. Brief changes in substratum type (usually considered to be less than thirty seconds in duration) were treated as incidental patches and were not recorded as separate segments. Further, more detailed analysis of the video footage was then undertaken.

Detailed video analysis consisted of a description of the seabed and the identification of flora and fauna to the lowest practical taxonomic level. The abundance data were recorded using the SACFOR scale, though percentage cover of maerl was also recorded where appropriate. Sediment categories were assigned based on the Folk Trigon and Wentworth scale (see Leeder, 1982), with boulders and cobbles being described within 'gravel', and 'rock' referring to bedrock. A broadscale habitat (BSH) type was subsequently assigned to each video segment and observed sediment fractions were recorded as percentages. If applicable a Habitat Features of Conservation Importance (FOCI) category was also assigned. The presence of any Annex I habitats and associated sub-features, including reef sub-types, were recorded. Any other features of interest, such as trawl marks or litter, were also noted. A list of the encountered fauna was produced for each site using species reference numbers as cited in the Marine Conservation Society Species Directory (Howson and Picton, 1997) with additional reference to the World Register of Marine Species (WoRMS Editorial Board, 2014) to avoid problems in species nomenclature. Video segments were designated a biotope according to Marine Biotope Classification for Britain and Ireland (Connor *et al.*, 2004).

Special attention was paid to the amount of maerl observed in each video segment. The amount of dead and live maerl visible was estimated as a percentage and converted to SACFOR abundance. The live maerl was then examined in further detail in an attempt to ascertain the species identity and where possible the percentage cover and SACFOR abundance estimated for each species present. A maerl assessment category was also assigned to each video segment.

2.3.1 Maerl Assessment Classification Scheme

There are no currently published guidelines as to what characterises a 'healthy' maerl bed. Areas where dead maerl retain some of the spatial complexity of live maerl beds still offer fauna some of the potential benefits associated with maerl (e.g. crevices for juveniles etc.). Therefore during the analysis of the video footage the presence of any maerl was recorded, whether dead or alive. The percentage cover of dead and live maerl was estimated for each video segment.

Depending on the percentage cover of dead and live maerl, one of five broad categories was assigned to each video segment as per Table 2.1. These five categories, in increasing order of maerl 'health', were:

- Sparse maerl gravel
- Maerl gravel
- Sparse live maerl
- Covered maerl
- Healthy maerl bed

A sixth category, 'No maerl', was used for those areas without dead or live maerl. Covered maerl beds (usually by algae, but also by dense ophiuroid beds etc.) were deemed to be less healthy than uncovered maerl as any cover would prevent light from reaching the maerl underneath. Modifications to some biotopes of the Marine Biotope Classification for Britain and Ireland (Connor *et al.*, 2004) were made to reflect the focus on maerl for this study. Examples of biotopes used for each of the five categories are also shown in Table 2.1. This categorization system has been developed over the course of several maerl extent and distribution based projects conducted by Seastar Survey over the past two years.

Table 2.1: Showing the example images of the Maerl Assessment Classification Scheme

Category Name	Sparse maerl gravel	Maerl gravel	Sparse live maerl	Covered maerl	Healthy maerl bed
Example Image					
Dead maerl (%)	5 – 15 %	15 – 95 %	15 – 40 %	15 – 40 %	<5 %
Live maerl (%)	-	-	5 – 15 %	5 – 70 %	>70 %
Description / Comments	Background sediment with sparse maerl gravel.	Dead maerl gravel dominating the sediment	Mixture of both dead and live maerl, with the dead gravel still more common	Dead or live maerl with a cover by red or brown algae or dense fauna e.g. brittlestars	Healthy maerl bed with sparse algae cover
Designated Biotopes	Assigned a biotope based on background sediment, and **.Mrl** added e.g. **SS.SCS.CCS.Mrl** or **SS.SMx.CMx.Mrl** etc.	**SS.SMp.Mrl**	**SS.SMp.Mrl.(Lcor)**	Biotope assigned accorded to level of dead or live maerl seen, and **.R** added, e.g. **SS.SMp.Mrl.Lcor.R**	**SS.SMp.Mrl.Lcor**

2.3.2 Quality control

The Quality Control (QC) process involved an ongoing element and a post-analysis element. A principal analyst examined all the data to ensure a level consistency, with ongoing collaboration with other Seastar Survey staff to check species identification, sediment classification and biotope classifications during the process of analysis. A senior member of staff also checked any uncertain identification to ensure the highest possible level of quality in the data. The post-analysis QC process involved a re-assessment of 10 % of the data, checking the faunal / floral identification, habitat / biotope classification and data entry. Any discrepancies were discussed between analysts and agreed on prior to finalisation of the results.

2.4 Processing of Video Navigation Data

The positional data available were that of the vessel's Transas NaviSailor 3000 ECS system (see section 4.3). This system used a separate GPS antenna and records raw WGS84 data every 10 seconds, together with GPS time (UTC). A .txt file of the .trk data was produced. The track data were imported into the GIS in X and Y (UTM 30 N) format and found to be a complete track plot for the whole survey day. The data were then split according to the SOL and EOL times for each line (to the nearest 10 second recorded point) and re-imported. This process indicated that the video overlay clock was not been synchronised with UTC / Transas navigation time. No exact offset between the two clocks could be calculated (see section 4.3) and exact positional information for the camera transects was therefore unavailable.

In order to generate approximate positional information for the camera transects, the track data were split into ten sections where the vessel slowed down (taken as the location where the number of data points exceeded two per 5 m) and then sped up. The video tows were assumed, with a good degree of certainty, to have taken place between these two points. These sections were then analysed for their duration (using the time stamp within the data). These durations were then compared with the time on seabed duration (i.e. the duration of the video tows). The discrepancy between the two values was assumed to be deployment and recovery time. This discrepancy was divided by two (as it is impossible to know whether the deployment or the recovery time was longer) and this value was removed from the front and the end of the positional data for each line, resulting in a theoretical positional data file for each video tow.

This methodology is inherently inaccurate and the confidences are discussed in Section 4.4. The theoretical navigational files agree roughly (to within an average of ~63 m) with the VideoRay Smart Tether GPS overlay positions. However, as these positions were considered to be unreliable (see section 4.3), a method of ensuring 90 % confidence in the mapped location of the video data was developed.

3 RESULTS

3.1 Interpretation of sidescan sonar data

The interpretation of the reprocessed sidescan sonar data comprised an initial analysis of substrata and bed form features observed during the processing stages. The locations of the sidescan lines conducted are given in Figure 3.1. Example high resolution images of the acoustic data and bedforms used to classify the substrate type are shown in Figure 3.2.

Figure 3.2 A shows both the higher (lighter) and lower (darker) reflectivity sediments that are prominent throughout the dataset. The higher reflectivity sediment has an acoustic return consistent with what would be expected from coarse sediment and was interpreted to be well sorted. No obvious medium to large sized contacts can be seen within the areas of this substrate type. This indicates that the sediment is likely to be composed of coarse particles uniformly distributed. Figure 3.2 B shows large wave-like bedforms composed of a substrate with a very similar acoustic return to the coarse sediment observed in image A. This is indicative of a fine to medium gravel.

The second substrate seen in Figure 3.2 A, with a lower acoustic return, was not observed anywhere within the dataset to possess any bedform features. The lower strength of the return combined with the lack of bedform features indicates a likely sandy or mixed substrate. Figure 3.2 C shows the possible gravel substrate alongside a ribbon of gravel bedforms, with a patch of probable sand towards the bottom of the image. The image shown is approximately 40 m in length, demonstrating the heterogeneity of the seabed on this line. Figure 3.2 E shows an example of some of the largest probable gravel waves seen in the dataset, with heights of 1- 1.5 m and a distance of 2 and 3 m between the crests (wavelength). These dimensions are indicative of large gravel waves. Figure 3.2 D shows a prominent rocky outcrop also seen on camera transect Tow 2. The obvious strong returns combined with prominent and measurable shadows are very characteristic of rocky outcrops. Such outcrops occur throughout the dataset but are concentrated to the east of the survey area, on camera tows 1, 2, 3, 4 and 5. Figure 3.2 F shows an example of a rocky outcrop alongside a gravel substrate with small ‘fingers’ of possible gravel waves in between rock spurs.

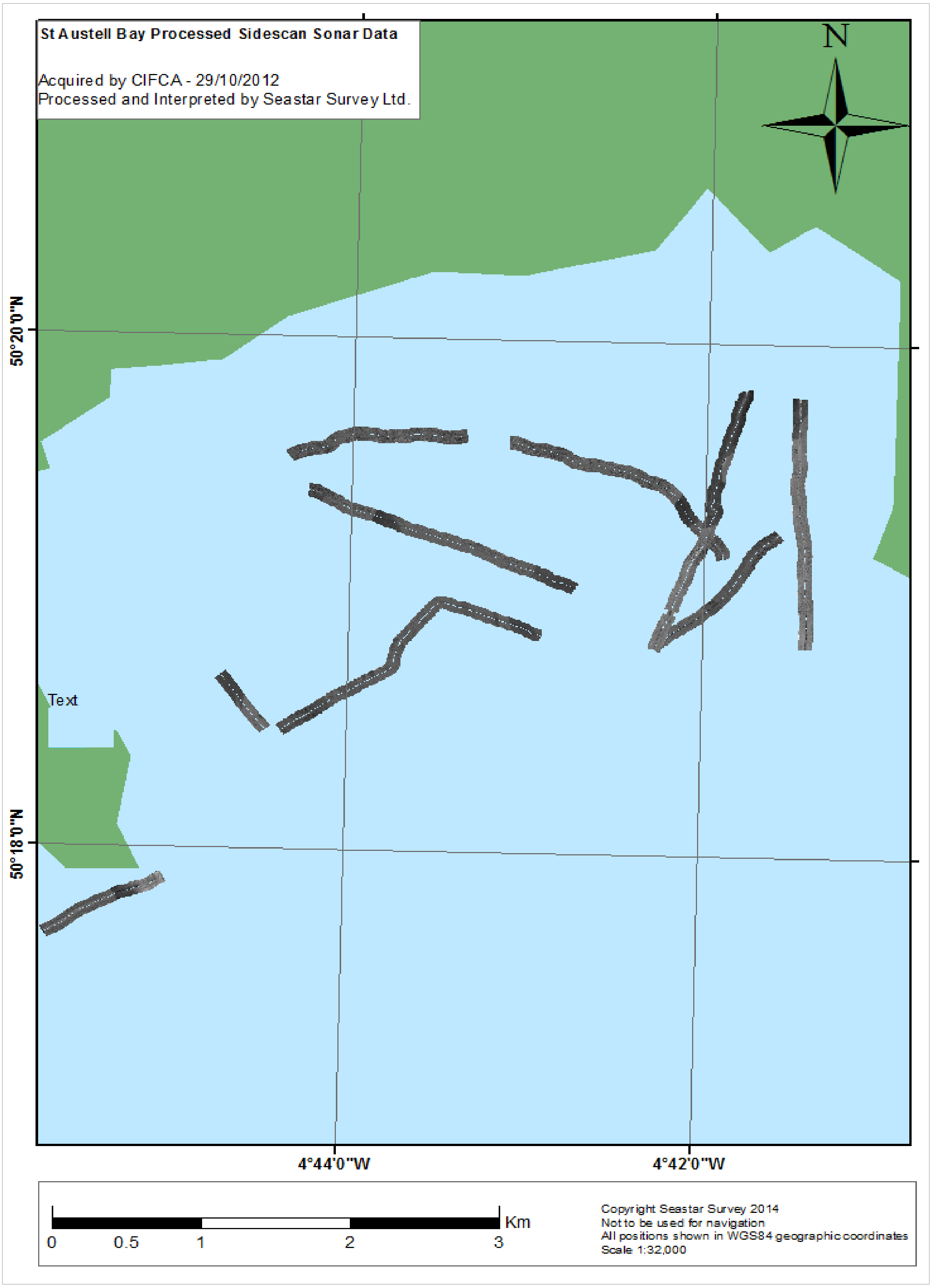

Figure 3.1: Map of the survey area with the processed sidescan survey data incorporated.

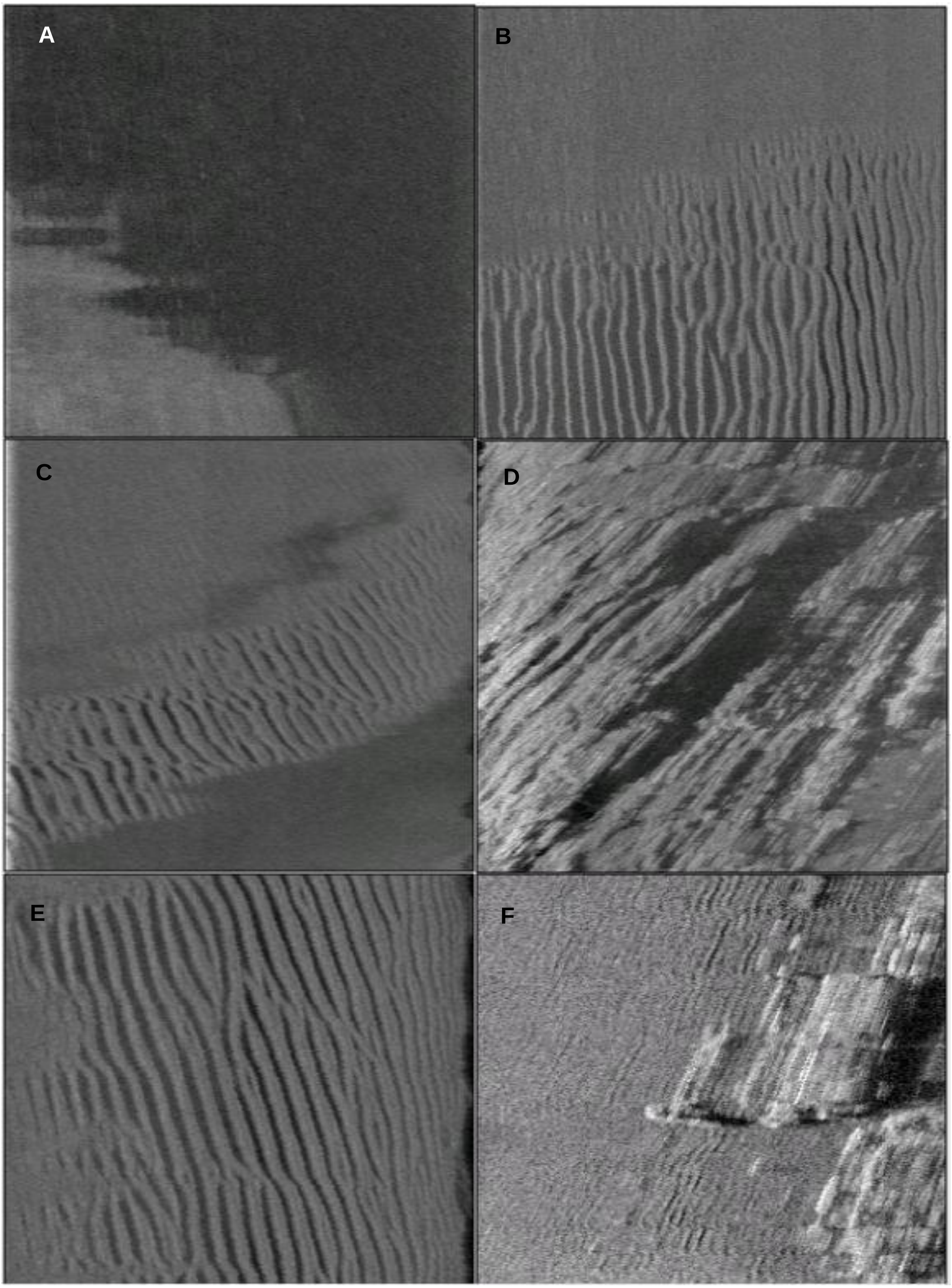

Figure 3.2: High resolution example types of acoustic return used to classify the substrate types observed

A: NE TOW 2 291112 – Example high reflectivity (lighter return) and low reflectivity transition indicative of gravel and sand / muddy sand.
B: NE TOW 6 291112 – Example gravel bedforms and gravel transition – bedforms are approx. 0.5 m high and 1.5 – 2 m apart, indicative of gravel waves.
C: NE TOW 7 291112 – Example gravel bedforms, gravel and sand transition.
D: NE TOW 2 291112 – Example rock outcrop with heights of ~ 1- 2 m.
E: NE TOW 4 291112 – Example of large gravel bedforms of ~1 to 1.5 m in height and 2 - 3 m separation – indicative of large waves.
F: NE TOW 9 291112 - Example of large rock outcrop with gravel waves in gullies and surrounding, poorer quality data acquired on this line.

3.2 Analysis of video footage

A total of approximately 3 hours and 22 minutes of HD video footage from the Go Pro Hero 2 camera was analysed by Seastar Survey. Table 3.1 gives details of each video tow undertaken during the survey. Tow 7 was aborted due to a malfunction and then restarted along the same azimuth. Tow 8 only contains 3:47 of HD video due to a malfunction.

Table 3.1: Showing the tow numbers, SOL and EOL times (GMT, derived from the overlay) and duration of HD video

Transect	SOL Time (Overlay)	EOL Time (Overlay)	Duration
NE_StA_140313_Tow_1	10:09:33	10:32:52	00:23:19
NE_StA_140313_Tow_2	14:53:42	15:13:32	00:19:50
NE_StA_140313_Tow_3	12:28:19	13:08:26	00:40:07
NE_StA_140313_Tow_4	14:21:57	14:37:04	00:15:07
NE_StA_140313_Tow_5	13:19:30	13:40:00	00:20:30
NE_StA_140313_Tow_6	11:19:37	11:38:36	00:18:59
NE_StA_140313_Tow_7a	10:45:36	10:47:20	00:01:44
NE_StA_140313_Tow_7b	10:51:47	11:06:34	00:14:47
NE_StA_140313_Tow_8	15:36:49	15:49:09	00:03:47
NE_StA_140313_Tow_9	16:01:15	16:27:15	00:26:00
NE_StA_140313_Tow_10	16:42:01	16:59:42	00:17:41

Tow 7a was not analysed as Tow 7b was used. Video tow speed appeared to vary between the video transects, with Tow 1 running at too great a speed to acquire quality footage.

The theoretical positions of the video tows (discussed in section 2.4) were mapped in the GIS. Figure 3.3 shows a map of the St Austell Bay survey area with the processed sidescan sonar lines and the theoretical video tow positions.

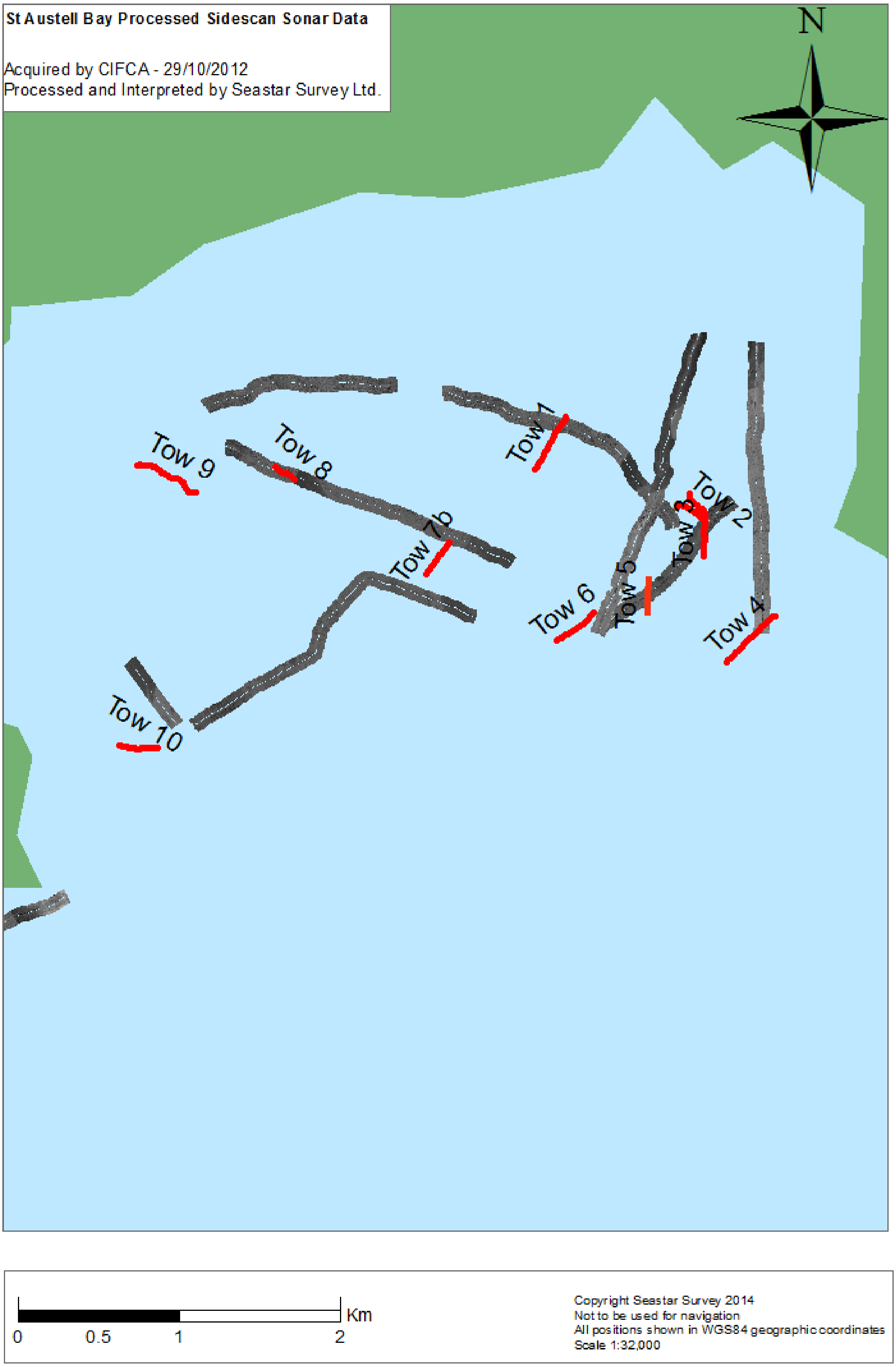

Figure 3.3: Estimated location of the video tows as taken from the Transas navigation data

3.2.1 General description of the habitats and biotopes observed

Table 3.2 gives a summary of the biota and sediment observed during each video tow, including a full list of the biotopes / biotope complexes recorded. Further details of the biotopes / biotope complexes / biotope matrices observed are given in Table 3.3.

Table 3.2: summary of the results of the analysis of the HD video.

Tow	Habitat Description	Maerl Assessment	Biotope(s) assigned	Comments
1	Waves of maerl gravel and coarse gravel interspersed with exposed scoured rock outcrops featuring kelps and red algae; brittlestars on maerl gravel also present	Sparse maerl gravel Maerl gravel	**IR.HIR.KSed.XKScrR IR.HIR.KFaR.FoR SS.SMx.IMx.Mrl SS.SMx.CMx.OphMx.Mrl SS.SMp.Mrl**	dead maerl up to 60 % coverage; very little live maerl
2	Mixed kelps and red algae on sand-scoured bedrock with maerl gravel infill; brittlestars on maerl gravel also present	Maerl gravel	**IR.HIR.KSed.XKScrR SS.SMp.Mrl**	dead maerl up to 80 % coverage; very little live maerl
3	Mixed kelps and red algae on sand-scoured bedrock with maerl gravel infill. Maerl gravel in waves at times	Sparse live maerl Sparse maerl gravel	**IR.HIR.KSed.XKScrR SS.SMp.Mrl**	dead maerl up to 60 % coverage; up to 10 % live maerl
4	Brittlestars and foliose red algae on faunal and algal encrusted bedrock; Ophiothrix fragilis brittlestar beds on sediment; waves of maerl gravel and coarse gravel near EOL	Maerl gravel	**IR.HIR.KFaR.FoR CR.MCR.EcCr.FaAlCr.Bri SS.SMx.CMx.OphMx SS.SMp.Mrl**	dead maerl up to 50 % coverage but only at EOL; very little live maerl
5	Rock outcrops and cobbles with healthy (up to 50 % live) maerl bed infill. Boulder reef at EOL	Maerl bed Sparse live maerl Sparse maerl gravel	**SS.SMx.CMx.OphMx SS.SMp.Mrl.Lcor**	live maerl up to 50 % coverage
6	Slightly silty bedrock with maerl gravel infill; brittlestar beds on maerl	Sparse live maerl Sparse maerl gravel	**IR.HIR.KFaR.FoR IR.MIR.KR.XFoR.Mrl SS.SMx.CMx.OphMx.Mrl**	dead maerl up to 50 % coverage; up to 10 % live maerl
7b	Patchy maerl gravel in coarse or mixed sediment; patch of exposed rock with foliose red algae	Maerl gravel Sparse maerl gravel	**IR.MIR.KR.XFoR SS.SCS.ICS.Mrl SS.SMx.IMx.Mrl**	dead maerl up to 20 % coverage; very little live maerl
8	Waves of maerl gravel and coarse gravel	Maerl gravel	**SS.SMp.Mrl**	dead maerl up to 60 % coverage; very little live maerl
9	Mixed kelps and red algae on sand-scoured bedrock with some maerl gravel infill	Maerl gravel Sparse maerl gravel	**IR.HIR.KSed.XKScrR.Mrl SS.SCS.ICS.Mrl SS.SMx.CMx.OphMx.Mrl**	no HD video available
10	Maerl gravel, gravel, cobbles and sand, in waves at times; silty bedrock towards EOL	Maerl gravel	**IR.MIR.KR.XFoR SS.SMx.IMx.Mrl SS.SMp.Mrl**	dead maerl up to 55 % coverage; very little live maerl

Table 3.3: Details of the biotopes and biotope complexes observed during the video analysis of the HD video data

Biotope	Biotope Code	Number of Observations
Infralittoral coarse sediment	SS.SCS.ICS	1
Infralittoral coarse sediment / poor quality maerl beds on infralittoral coarse sediment.	SS.SCS.ICS / SS.SMp.Mrl	2
Poor quality maerl beds with indeterminable species composition	SS.SMp.Mrl	11
Ophiothrix fragilis and/or *Ophiocomina nigra* brittlestar beds on circalittoral mixed sediment	SS.SMx.CMx.OphMx	2
Poor quality maerl beds overlying *Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment	SS.SMp.Mrl / SS.SMx.CMx.OphMx	5
Ophiothrix fragilis and/or *Ophiocomina nigra* brittlestar beds on circalittoral mixed sediment/ Poor quality *Lithothamnion corallioides* maerl beds on infralittoral muddy gravel	SS.SMx.CMx.OphMx / SS.SMp.Mrl.Lcor	1
Infralittoral mixed sediment with poor quality maerl beds overlying	SS.SMx.IMx / SS.SMp.Mrl	1
Foliose red seaweeds on exposed lower infralittoral rock	IR.HIR.KFaR.FoR	4
Foliose red seaweeds on exposed infralittoral rock / with poor quality maerl beds	IR.HIR.KFaR.FoR / SS.SMp.Mrl	4
Mixed kelp with kelps and red algae on sparse sand-scoured bedrock outcrops	IR.HIR.KSed.XKScrR	
Waves of maerl gravel and gravel with mixed kelp with kelps and red algae on sparse sand-scoured bedrock outcrops	IR.HIR.KSed.XKScrR / SS.SMp.Mrl	8
Brittlestar bed on faunal and algal encrusted, exposed to moderately wave-exposed circalittoral rock / Brittlestar bed on faunal and algal encrusted, exposed to moderately wave-exposed circalittoral rock	IR.HIR.KFaR.FoR / CR.MCR.EcCr.FaAlCr.Bri	2
Foliose red algae and echinoderms on scoured, slightly silty bedrock and boulders with sparse gravel and maerl gravel infill	IR.MIR.KR.XFoR	4

The biotope complex most frequently observed was **SS.SMp.Mrl** (maerl beds in coarse clean sediments of gravels and clean sands). During this survey these beds were often encountered as a fine gravel substrate being mainly composed of dead maerl. The maerl species encountered could not be determined from the video data in most instances. For these reasons the biotope description is given as “poor quality maerl beds with indeterminable species composition.”

Where the above biotope complex was found to be dominated by a substantial bed of ophiuroids, the section was assigned the biotope matrix **SS.SMp.Mrl /SS.SMx.CMx.OphMx** (brittlestar beds on circalittoral mixed sediment). This biotope matrix was observed five times during the analysis, on transects Tow_1 Tow_5 Tow_6 (two segments) and Tow_9. On two occasions the ophiuroid bed was recorded as being too dense to determine the underlying substrate. One example of the biotope matrix **SS.SMx.IMx / SS.SMp.Mrl** (infralittoral mixed sediment with poor quality maerl beds overlying) was identified on Tow_10.

The second most common biotope observed was a matrix of the biotope **IR.HIR.KSed.XKScrR** and the biotope complex **SS.SMp.Mrl**. These two descriptors were taken together as a matrix biotope due to the frequency of observed waves of the **SS.SMp.Mrl** biotope complex occurring in between outcrops of bedrock, characterized by the biotope **IR.HIR.KSed.XKScrR** (mixed kelp and red algae on sparse sand-scoured bedrock outcrops). The characterizing fauna of this matrix were again the echinoderms *Asterias rubens* and *Mathasterias glacialis*.

The remaining biotopes encountered were mainly of the infralittoral rock (IR) broad habitat type (most often within the main habitat of High Energy Infralittoral Rock). These include 21 video segments which were assigned biotopes indicative of the EU Habitats Directive Annex I habitat; Reefs. The reef types observed were all rocky reef, mostly composed of bedrock outcrops with occasional large boulders overlaying. These reef types were encountered on every line apart from Tow_7b and the HD video of Tow_8. The video transects where these reef biotopes were most commonly encountered were Tows 2, 3, 4 and 5, all located in the east of the survey area.

3.2.2 Maerl habitats observed

Figure 3.4 shows representative images of six biotopes commonly encountered which contained maerl. These images are screen grabs taken from the HD video during analysis and form part of the image reference collection for this survey. Together these images give a good representation of the majority of substrata identified during the video analysis.

The majority of maerl habitats observed were classified as the biotope complex **SS.SMp.Mrl**, primarily due to the quality of the video footage preventing identification of the maerl observed to species level. This biotope complex was encountered (either as itself or within a matrix) on every transect apart from Tow_8, and only for a brief amount of time at the end of Tow_4. The prevailing substrate seen within the **SS.SMp.Mrl** biotope complex is a fine gravel mainly composed of dead maerl fragments (species indeterminable). The complex is seen throughout the video footage with frequent large bedforms which have been described a gravel waves, as they are between 0.5 and 1 m high and with a wavelength of 1 - 2 m. The faunal composition of this biotope is best described as impoverished, with very few epifaunal species observed. The dominating epifauna observed within this biotope complex were the asteroids *Asterias rubens* and *Mathasterias glacialis,* which were frequently present in large numbers (up to and including the Abundant SACFOR category). The ophiuroids *Ophiopthrix fragilis* and *Ophiocoma nigra* were also frequently observed.

The biotope matrix **IR.HIR.KSed.XKScrR / SS.SMp.Mrl** was observed on Video Tow_1, Tow_2, Tow_9 and frequently on Tow_3. The faunal composition of this biotope matrix is comparatively diverse and dominated by kelp species such as *Laminaria hyperborea* and *Laminaria ochroleuca* as well as various red algae, sponges and anemones such as *Anemonia viridis*. The **SS.SMp.Mrl** component of the biotope matrix was most frequently observed as waves of maerl gravel in between rocky outcrops.

The biotope matrix **SS.SMx.CMx.OphMx / SS.SMp.Mrl.Lcor** was encountered once during the analysis, this was during Tow_5. Tow_5 was also the only instance where the species of the live maerl observed – *Lithothamnion corallioides* – could be identified. Live maerl, also tentatively identified as *Lithothamnion corallioides*, was observed at various points on Tow_5, on a variety of substrata and with a variety of associated species communities. Most prominently, the biotope matrix **IR.HIR.KFaR.FoR / SS.SMp.Mrl** was encountered. This biotope matrix was composed of patches of live and dead maerl, often featuring comparatively large rhodoliths, in between outcrops of bedrock. The bedrock outcrops were found to be dominated by foliose red algae with a species-rich sponge and hydroid community with often dense aggregations of the starfish *Mathasterias glacialis* and the anemone *Cereus pedunculatus*.

The matrix of **SS.SMp.Mrl / SS.SMx.CMx.OphMx** was observed on four occasions and was observed to be composed of patchy ophiuroid beds overlying a fine gravel substrate with a large degree of dead maerl fragments. These sections also included occasional squat lobsters and occasional polychaete species such as *Chaetopterus* sp.. This biotope was observed in three of the nine sections of Tow_5, where high fractions of living maerl were observed (up to 50 %). It is likely, given the assessment of other sections of Tow_5, that the maerl observed was also *Lithothamnion corallioides*, however given the level of cover by brittlestars this was difficult to confirm.

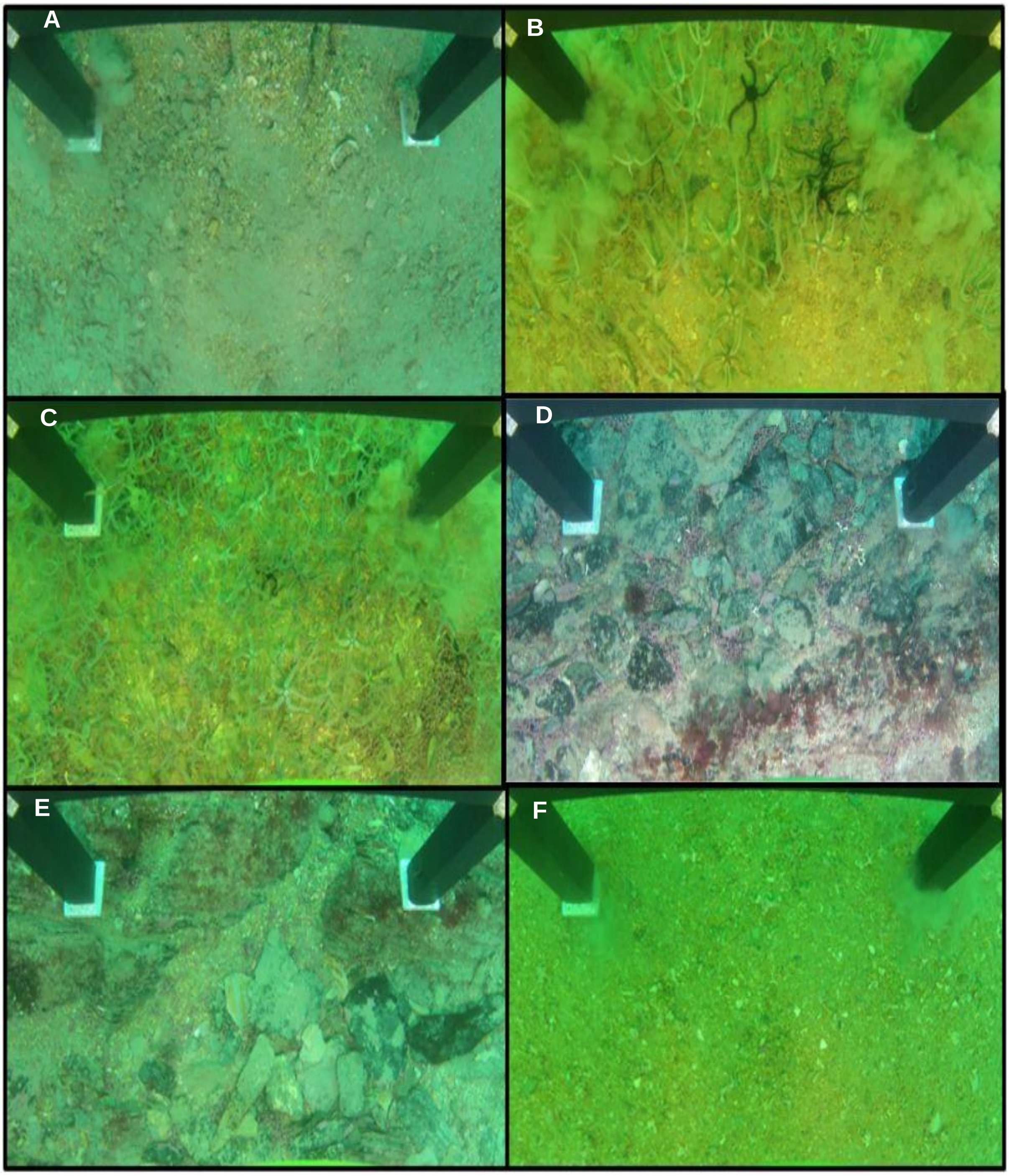

Figure 3.4: Screen grabs from the HD video showing examples of the various maerl habitats

A: Tow 7b – ***SS.SMx.IMx(.Mrl)***
B: Tow 6 - ***SS.SMp.Mrl /SS.SMx.CMx.OphMx***
*C**:** Tow 5 -* ***SS.SMx.CMx.OphMx.Mrl.Lcor***
D: Tow 5 - ***IR.HIR.KFaR.FoR / SS.SMp.Mrl***
E: Tow 5 ***- SS.SMp.Mrl.Lcor***
F: Tow 1 - ***SS.SMp.Mrl***

3.2.2.1 Distribution and extent

Without accurate and reliable navigation data or complete sidescan sonar coverage, calculating and mapping the complete distribution and extent of maerl coverage within St Austell bay is not possible. What has been achieved is the mapping of the areas wherein the camera transects are highly likely (with 90 % confidence) to have taken place in the form of ellipsoids. The ellipsoids have a radius equal to the average discrepancy between the calculated SOL and EOL points derived from the Transas data and the SOL and EOL positions taken from the overlay (Smart Tether GPS) data. The average discrepancy calculated by this method is 63 m, and the resulting ellipsoids all have radii of 63 m. Figure 3.5 shows the ellipsoids created for all ten video tows. The following five figures (Figures 3.6 to 3.10 – Maerl Biotopes by Transect) show on which tows the five maerl habitats described above are located. It can be said with 90 % confidence that the maerl habitats discussed in the previous section are located within these ellipsoids.

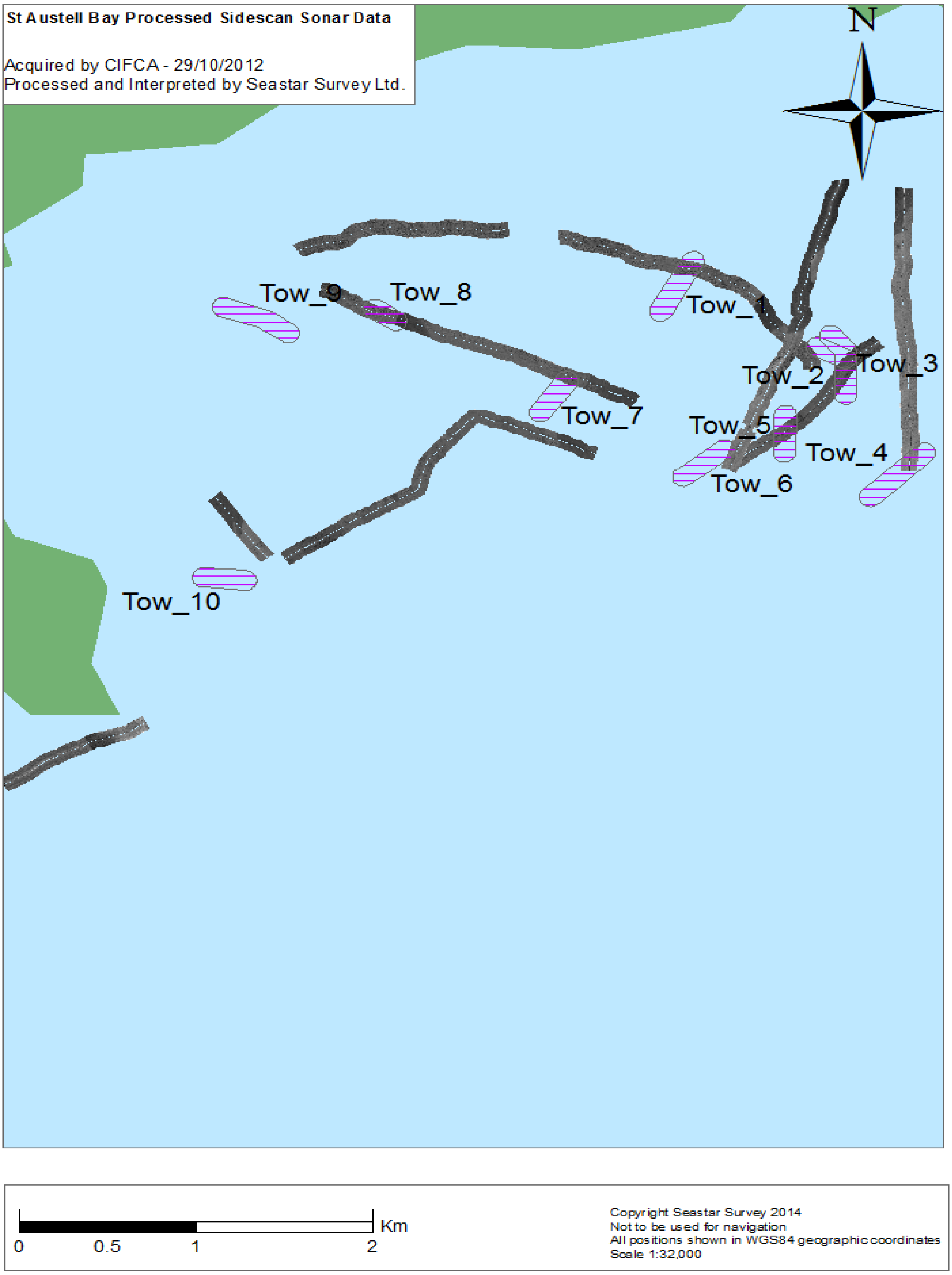

Figure 3.5: Map showing the camera tows in the form of ellipsoids – incorporating the uncertainty of position due to lack of reliable navigation data.

Figure 3.6: Map showing the transects (camera tows) on which the maerl biotope matrix SS.SMx.CMx.OphMx / SS.SMp.Mrl.Lcor was observed – incorporating the uncertainty of position due to lack of reliable navigation data.

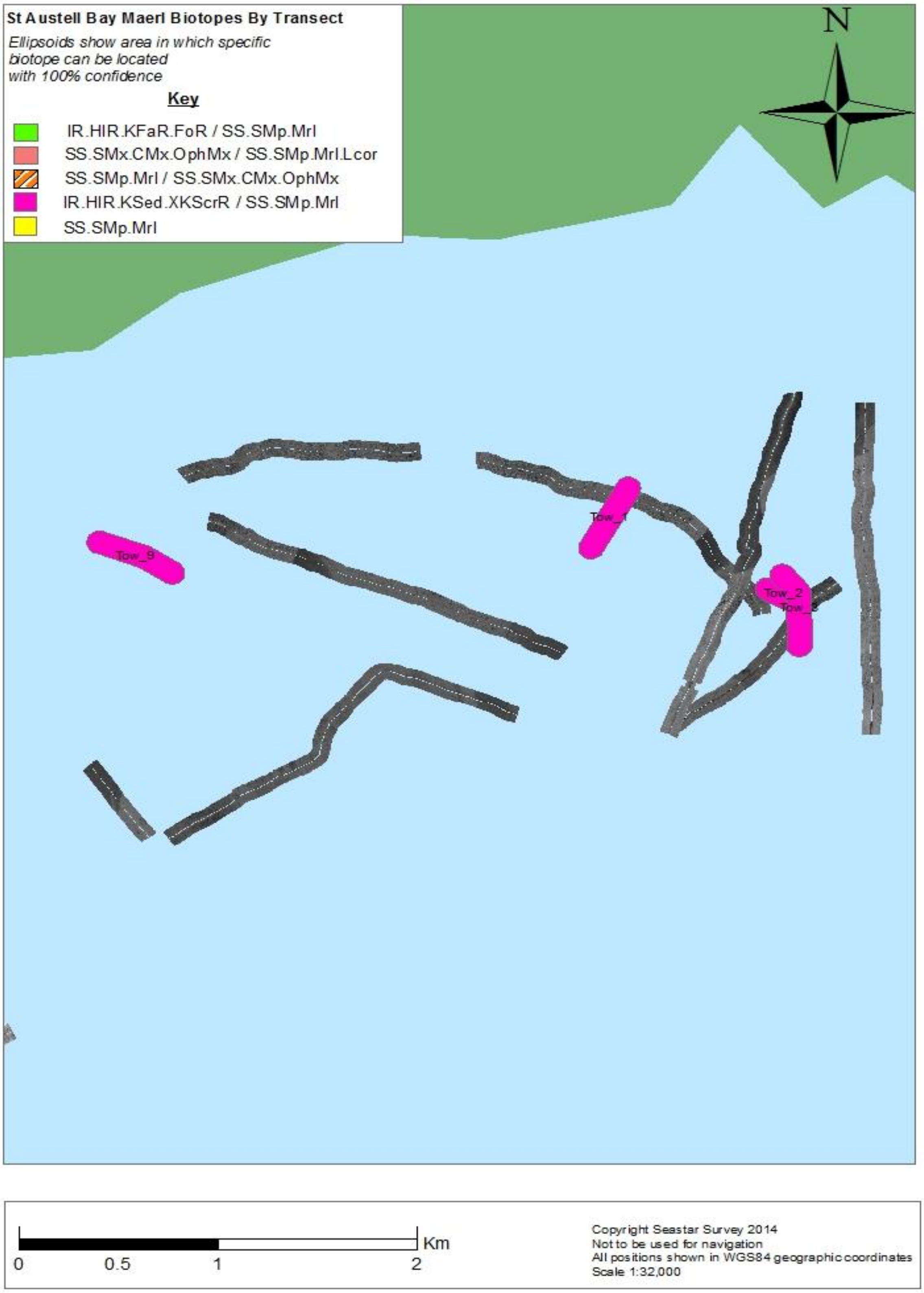

Figure 3.7: Map showing the transects (camera tows) on which the maerl biotope matrix IR.HIR.KSed.XKScrR / SS.SMp.Mrl was observed – incorporating the uncertainty of position due to lack of reliable navigation data.

Figure 3.8: Map showing the transects (camera tows) on which the maerl biotope matrix IR.HIR.KFaR.FoR / SS.SMp.Mrl was observed – incorporating the uncertainty of position due to lack of reliable navigation data.

Figure 3.9: Map showing the transects (camera tows) on which the maerl biotope complex SS.SMp.Mrl was observed – incorporating the uncertainty of position due to lack of reliable navigation data.

Figure 3.10: Map showing the transects (camera tows) on which the maerl biotope matrix SS.SMp.Mrl / SS.SMx.CMx.OphMx was observed – incorporating the uncertainty of position due to lack of reliable navigation data.

3.2.2.2 Maerl Assessment

Under the Maerl Assessment Categorisation Scheme outlined in section 2.3.1, seven sections of video data were assigned the category of Sparse *Maerl Gravel*. Fifteen of the observed sections were classified as *Maerl Gravel*. Six sections were designated as areas of *Sparse Live Maerl* and four sections were considered *Maerl Beds.* The *Maerl Bed* category has been used in place of the *Covered Maerl* and the *Healthy Maerl* categories displayed in Table 2.1, due to the lack of useable still images resulting in identification of maerl species proving impossible. The remaining eleven analysed sections of video data did not contain any indication of maerl, alive or dead. In order to assess the extent of the categorised maerl habitats, the total duration for which these habitats were observed during the analysis of all the video tows has been calculated and shown in Table 3.3. An estimation of the extent (in metres) of these observed maerl habitats has also been calculated, based upon the estimated average tow speed of the camera frame – 0.32 m/s. These extent values are estimated, and cannot be considered as accurate values.

The total estimated extent of the video footage was approximately 3823 m. The maerl habitat class which was found the cover the largest estimated extent was that of the Maerl Gravel Category – covering up to approximately 1480 m. Over half of the total estimated extent of the video footage showed habitats which were judged to be either Sparse Maerl or Maerl Gravel.

3.2.2.3 Health and percentage cover

The percentage cover of both live and dead maerl observed during the video analysis was documented along with the assigned biotope and abundance of observed benthic fauna and flora. Health of maerl beds is based upon the maerl assessment classification category the observed habitat falls under.

Dead maerl was encountered within the fine gravel substrate seen in every video transect other than the aborted Tow 7a. Tow_4 has the least amount of maerl gravel seen in any complete line. The species composition of this dead maerl gravel could not be confirmed. Tows 10, 9, 8, 3, 2 and 1 each had at least one section of habitat where over 50 % of the substrate was composed of dead maerl. This value increased to 80 % (the maximum percentage cover of dead maerl seen within these data) during section 3 of Tow_2. Tows 4, 5 and 7b had a smaller dead maerl component in the substrate observed. The majority of the sections within Tow_4 contained no dead maerl and Tow_5 had an average of 7 % dead maerl within the substrate.

As illustrated in Table 3.4, the most commonly observed category of maerl habitat was *maerl gravel* with 1 hour 17 minutes and 7 seconds of video footage being classified as this. This category is characterised by large quantities of dead maerl, constituting 15 – 95 % of the substrate. Sparse Maerl Gravel, the category denoting the maerl habitat of lowest quality / poorest health, was observed for a total of 55 minutes and 47 seconds, and as such is the second most commonly observed maerl habitat class. This time yields an estimated extent of 1071 m for this class of maerl habitat.

The percentage cover of live maerl recorded during the analyses of the video tow was also recorded. Table 3.4 illustrates that approximately 602 m (31 minutes 20 seconds) of maerl habitat which can be considered of moderate to good health (the classifications of *Maerl Bed* and *Sparse Live Maerl*) was observed. However some small patches of live maerl were also observed within the biotopes which fell under the *Maerl Gravel* and *Sparse Maerl Gravel* categories.

Table 3.4: Showing the total times and estimated extent of each maerl habitat category observed.

Category Under the Maerl Assessment Categorisation Scheme	Total Duration of Category (hs.mm.ss)	Estimated Extent (m) Based on Estimated Average Camera Tow Speed (0.32 m/s)
Maerl bed	00:03:09	60.48
Maerl gravel	01:17:07	1480.64
Sparse Live Maerl	00:28:11	541.12
Sparse maerl gravel	00:55:47	1071.04
No Maerl	00:34:59	671.68
Total Video Time	**03:19:13**	**3823.68**

Below is a summary of the prevalence of live maerl within the five biotopes in which maerl was observed.

SS.SMp.Mrl - This biotope contained very little live maerl (not more than ~ 8 %), with the exception of sections 5 and 7 on Tow_5 (25 % and 35 % respectively).

IR.HIR.KSed.XKScrR / SS.SMp.Mrl - Very little live maerl was associated with this biotope matrix aside from Tow_3 section 2 which was found to be composed of ~ 10 % live maerl.

SS.SMp.Mrl / SS.SMx.CMx.OphMx - The fractions of live maerl seen within this biotope matrix varied between 10 % and 50 %, making it the habitat associated with the highest percentage cover of live maerl.

SS.SMx.CMx.OphMx / SS.SMp.Mrl.Lcor - This biotope matrix occurred only once throughout the survey, on Tow_5 Section 1 and had a live maerl content of 25 %.

IR.HIR.KFaR.FoR / SS.SMp.Mrl - Of the four occurrences of this biotope matrix, three fell on Tow 5 and had 10 – 15 % live maerl.

3.3 Substrate Mapping

The results of the sidescan sonar data interpretation are polygons outlining the four substrate types thought to be present in the area covered by the sidescan sonar lines. These four substrate types include gravel, gravel with bedforms (the prominent wave features described in section 3.1), rock and a probable sand or mixed sediment. Figure 3.11 shows these polygons overlaying the processed sidescan sonar data, mapping the predicted distribution of the four substrate types.

The most commonly observed substrate is gravel with apparent bedforms (green polygons in Figure 3.11). Some rock outcrops (yellow polygons) are seen on each of the nine lines, with rock dominating the substrata on the sidescan tows in the east of St Austell Bay (Tow_1 and Tow_3). Sand or mixed sediment (red polygons) was observed throughout the area and was interpreted to be the dominant substrate type on Tow_2, however was absent from Tow_3 and Tow_4. The substrate type least common throughout the sidescan sonar data is that of gravel without obvious bedforms (blue polygons).

Figure 3.11: Map showing the mapping of the substrate types from the interpretation of the sidescan sonar data.

4 DISCUSSION

4.1 Assessment of observed maerl

Where maerl has been observed during these analyses, percentage cover of maerl – assessed within the context of the video segment in question - has been assigned. This percentage cover has been further sub-divided into percentage live and percentage dead. These values are used as an indicator of maerl habitat health, and have been used in conjunction with biotope mapping to categorise each video segment containing maerl habitat.

The most prevalent maerl habitat observed during the video analysis was that of *Maerl Gravel*, described as habitat where dead maerl gravel dominates the sediment. This maerl habitat covered over 38 % of the seabed observed from the video. The second most prevalent category was *Sparse Maerl Gravel*, covering approximately 28 % of the extent of the video transects. The *Maerl Gravel* category, as shown in Table 4.1, contained an average percentage living maerl value of 3 %, and an average percentage dead maerl value of 43 %. The *Sparse Maerl Gravel* category contained an average of 2 % (approximately) living maerl, and approximately 17 % dead maerl. From the values shown in Table 4.1, and under the proposed Maerl Assessment Categorization Scheme, these two dominant categories are considered maerl habitats of poor health.

Table 4.1: Average approximate percentages of living and dead maerl seen within the five maerl habitat classes observed during the video analysis.

Maerl Assessment Category	Average % living	Average % dead
Maerl bed	33.8	11.3
Maerl gravel	3.0	43.1
Sparse live maerl	10.8	25.4
Sparse maerl gravel	1.8	16.6
No maerl	N/A	N/A

The healthiest maerl habitat category is *Maerl Bed*. This category was observed for a very brief period during the analysis of the video data and is shown to cover approximately 1.5% of the seabed observed. This category was only observed as patches on video Tow_5, and was interspersed with sections of *Sparse Live Maerl*. The *Maerl Bed* category was composed an average of 34 % live maerl and 11 % dead maerl. The *Sparse Live Maerl* category was observed to be composed of an average of ~11 % living maerl and 25 % dead maerl. These two categories together are considered of moderate to good health (the *Covered Maerl* category in the Maerl Assessment Classification Scheme).

Approximately 15 % of the seabed observed was found to comprise maerl habitat of moderate to good health. Maerl habitat considered in poor health comprised approximately 66 % of the video footage analysed.

4.2 Ground-truthing and comparison with sidescan sonar data

As described previously, an accurate map of the extent of the maerl habitats observed was not possible due to the lack of navigation data available. However, some ground-truthing of the substrate types assigned to specific acoustic signatures can be established from analysis of the video tows which are highly likely to have crossed the sidescan sonar lines. Once these acoustic signatures have been ground-truthed, the substrate type most associated with the various maerl habitat classes can be proposed.

The transects which are known to cross, at least in part, a sidescan sonar line are; Tow_1, Tow_2, Tow_3, Tow_4, Tow_5 and Tow_8. The remaining transects either fall very far from any sidescan sonar data (e.g. Tow_9 and Tow_10), or are located further than half the 63 m (21.5 m) radius of confidence from sidescan sonar data (as in the case of Tow_6 and Tow_7). With respect to Tows 6 and 7, the confidence that these camera transects cross the processed sidescan sonar data is too low to use for ground-truthing.

Camera Tow_1 is highly likely to have crossed sidescan sonar Tow_4. The large majority of the maerl habitat class identified from the video footage is that of *Maerl Gravel* (with one section of video classed as *Sparse Maerl Gravel*). Figure 4.1 shows a screen grab from the HD video footage of Tow_1, compared with a high resolution screen grab of the bedforms seen on sidescan sonar Tow_4. The footage analysed definitively shows the camera moving over large bedforms composed of a fine gravel, dominated by dead maerl. Unfortunately the location of the footage cannot be exactly matched up with the sidescan sonar data due to the lack of navigation data.

It is possible, however, to compare the sidescan sonar data with that if the video. Approximately 100 m (at least 20 % of the video tow) of the camera transect line is over sidescan sonar data showing the prominent large bed form features described as gravel waves (based on the ellipsoid created for this camera tow). Maerl gravel and gravel was observed in large waves on Tow_1 (Figure 4.1 A). Figure 4.1 B shows the acoustic return seen on the starboard transducer of the sidescan sonar (i.e. the southern part of the line) at approximately half way through the elapsed duration. The video Tow_1 is highly likely to have crossed the sidescan line somewhere within this vicinity; it can therefore be suggested that the areas of 'gravel with bedforms' mapped in Figure 3.11 (green polygons) are composed of maerl gravel and gravel. If this is the case, the extent of the Maerl gravel classification type extends throughout the survey area, and would be worthy of further investigation.

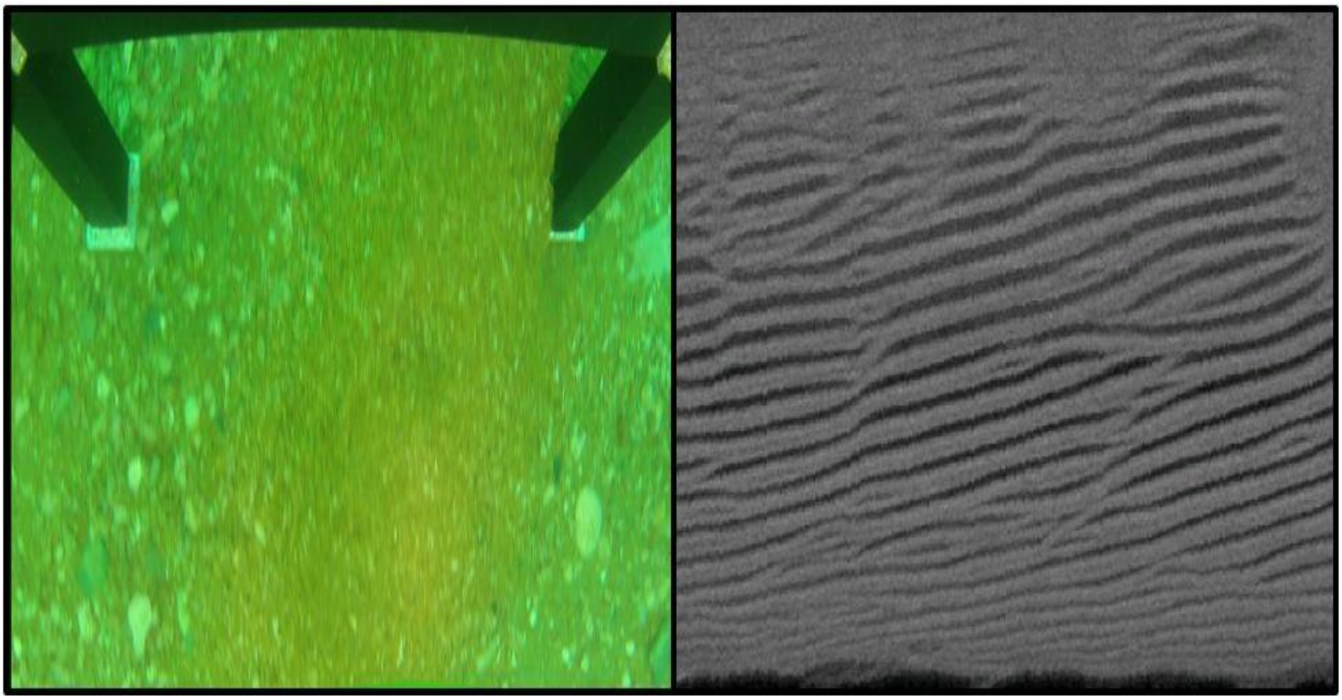

Figure 4.1: Showing both the screen grab of the HD video footage (A) from Tow_1 with gravel bedform – and the high resolution screen grab from the processed sidescan sonar data acquired from Tow_4.

Camera Tow_5 is highly likely to have crossed sidescan sonar Tow_3. The section of the sidescan sonar data where camera Tow_5 is likely to cross is observed to be a variation of the least common interpreted substrate types; **gravel** (without bedforms) and **rock** substrata. The maerl habitat (*Maerl Bed)* with the largest percentage (up to 50 %) of live maerl was located 5 minutes and 50 seconds into the video footage of Tow_5. As the acoustic return varies across the portion of sidescan sonar data thought to be covered by the video footage, any ground-truthing method must attempt to first estimate the position of the image used. Assuming an approximate average towing speed of 0.30 m/s the estimated position of a single point, for example the screen grab seen in Figure 4.2 A, can be calculated. This is however inherently inaccurate and has only been done for areas of special importance, such as the comparatively high densities of live maerl observed on Tow_5.

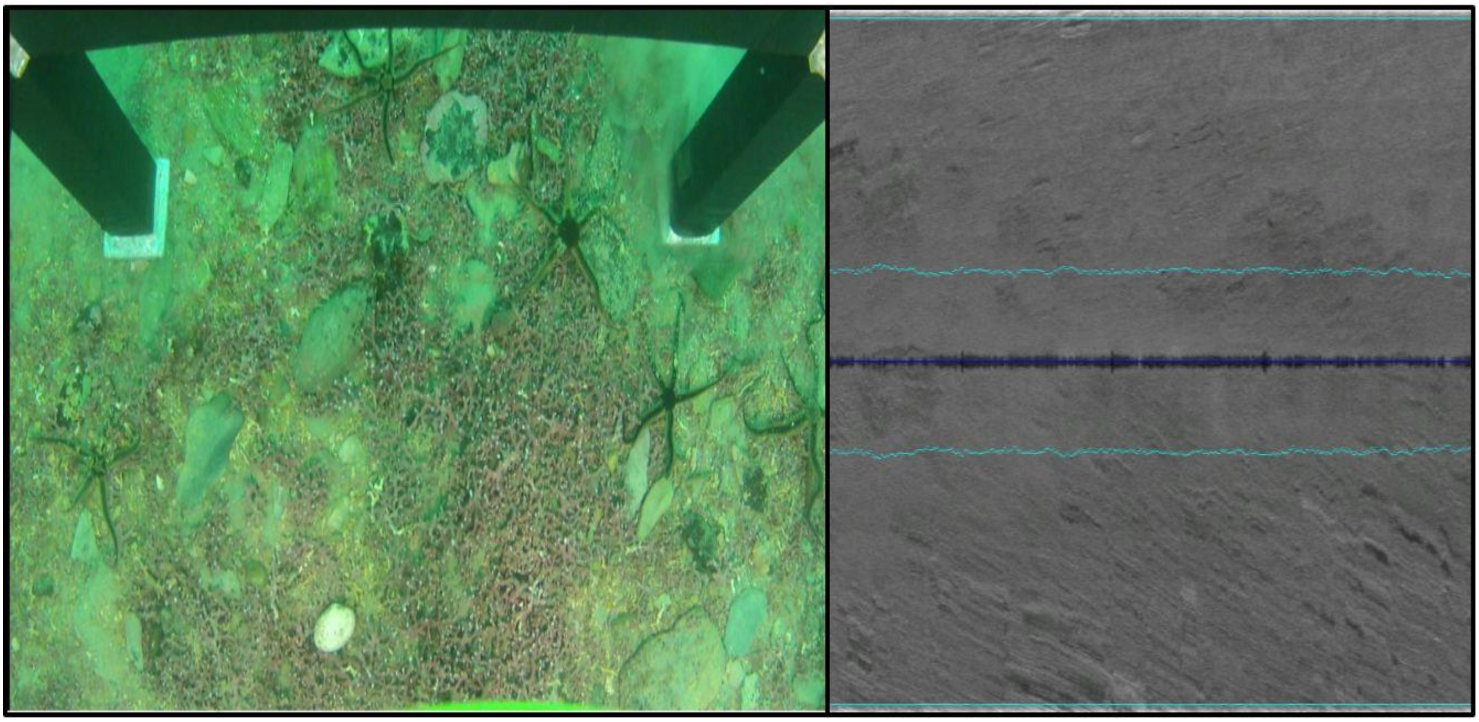

Figure 4.2: **A**: A screen grab taken 6 minutes and 16 seconds into the seabed footage taken on video Tow_5. **B:** A high resolution screen grab showing the area of sidescan sonar Tow_3 where Camera Tow_5 is likely to have crossed

Figure 4.2 A shows an example screen grab from the HD video of Tow_5 (section 3). This image shows the ~ 50 % density of live maerl associated with this video segment, and is classified as *Maerl Bed*. Figure 4.2 B shows a high resolution image taken from the processed sidescan sonar data of Tow_3 (from the analysis software, not the mosaic image). The section viewed is the area of the sidescan sonar line where video Tow_5 is highly likely to have crossed. Rocky substrate can be seen toward the bottom of the image, with a likely small outcrop in the top right. The remaining return is likely to be gravel, with no bedform features. This is consistent with what was observed during analysis of the video footage for Tow_5, with sections of coarse sediment (a mixture of fine gravel and pebbles) interspersed with rocky outcrops.

By using the above described method, an estimated position of this screen grab can be calculated, shown in Figure 4.3. This position has been calculated based on the time into seabed footage (00:06:16) giving a position along line of 112 m from SOL, taken as straight line from the start of the ellipsoid. From this figure it can be shown that the location of this screen grab is, with approximately 50 % confidence, on the transition between the mapped rock and gravel substrata. This is supported by the fact that Tow_5 Section 2 (immediately prior to Section 3) was observed to be composed primarily of rocky outcrops – indicating that the likely acoustic return associated with the *Maerl Bed* habitat shown in figure 4.2A is what has been interpreted as gravel (with no bedforms).

As no other video tow crossed an area interpreted as 'gravel with no bedforms', further ground-truthing of this possible association cannot be undertaken here.

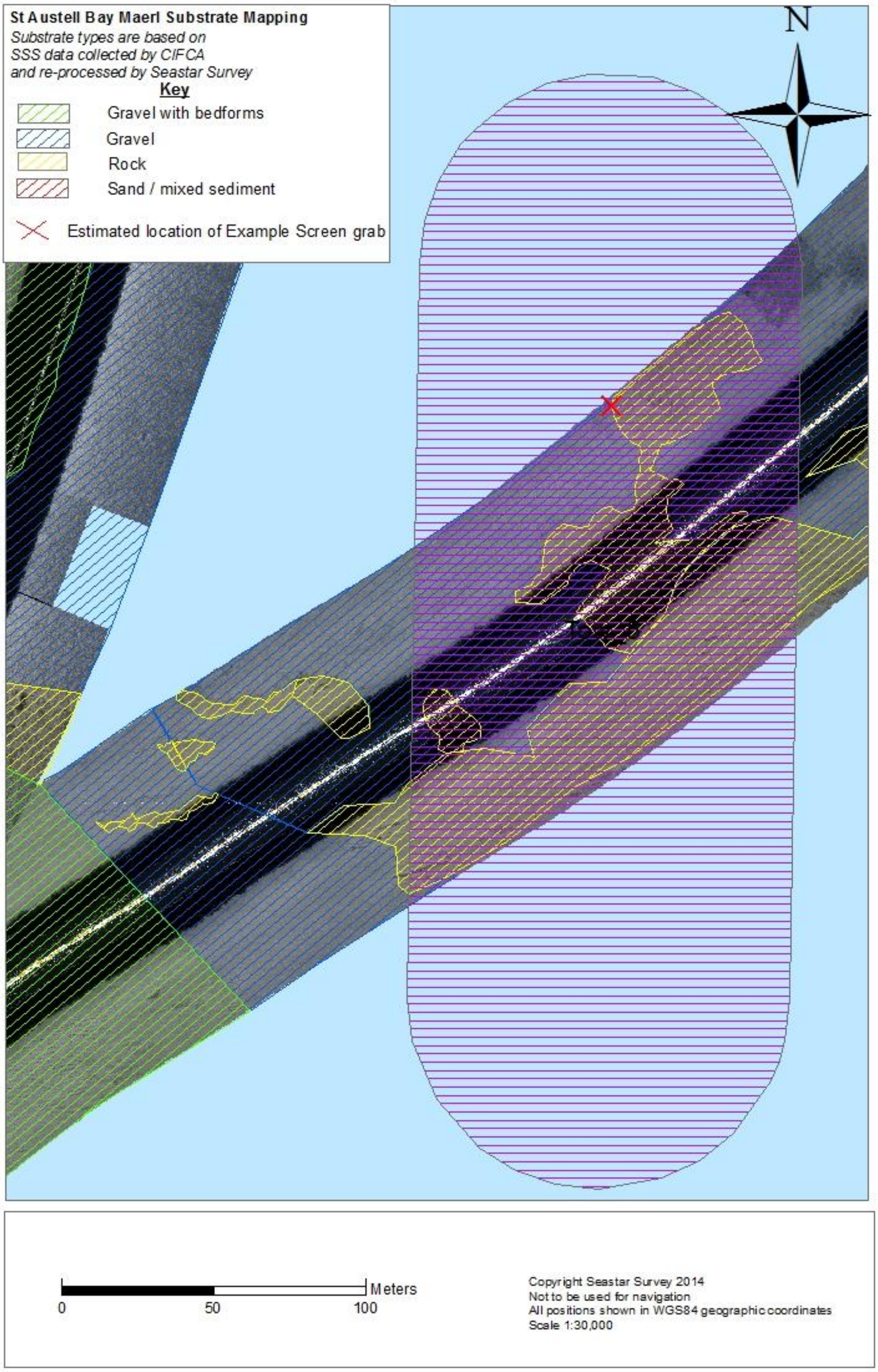

Figure 4.3: Map showing the interpreted substrata over the raw sidescan sonar data, overlaid by the ellipsoid of uncertainty for camera Tow_5. The estimated position along Tow_5 of the example screen grab, shown in Figure 4.2A, is displayed as a red cross.

4.3 Survey limitations

The major limitations of this survey concern the lack of positional information for the video data. The original survey methodology envisaged the use of the VideoRay Smart Tether GPS antenna to display the exact position of the ROV (and hence the camera frame) on the video overlay. Due to a malfunction with the antenna this position was found to be 'stuck' throughout large sections of the video transects, making the overlay position unusable in further analysis and extent / distribution mapping.

Furthermore, no accurate survey logs were provided. The start of line (SOL, taken at first sighting of the seabed rather than start of recording) and end of line (EOL) times taken from the overlay did not correspond with the geographic coordinates provided in the field report (assumed to be vessel position written down as the vessel began to deploy the instrument, rather than when the seabed was first viewed). This has resulted in a requirement for an alternative source of positional data, as no mapping can be accomplished without definitive SOL and EOL locations.

As discussed in section 2.4, the positional data available was the vessel's Transas NaviSailor 3000 ECS system. Initially the files containing this data (the .trk file for the camera survey day) were corrupted and so could not be exported by the usual Transas Data Management Tool. Additionally, when a .txt file of the .trk data was produced, corruption had altered the degree and minute values. Once the correct degree and minute values were substituted into the dataset the data corresponded with the expected track the vessel took during the survey day.

As discussed in section 2.4, importing the track data from Transas revealed an inconsistency between video overlay clock and UTC time. The lack of synchronisation between the VideoRay overlay clock and GPS time (i.e. the Transas NaviSailor 3000 system) proved to be a substantial limitation with the data acquired from this survey, meaning that even with exhaustive processing the Navigation data acquired from the Transas system could not be utilised to its full extent.

The VideoRay onboard video camera provided footage which was deemed insufficient for the identification of biota and therefore the assignment of biotopes / habitats. Equally, none of the screen grabs taken from the VideoRay on-board camera were deemed suitable for analysis. The HD video, whilst usable for the identification of biota and the assignment of biotopes, was not specifically designed to acquire high resolution underwater imagery, and a distinct colour imbalance (resulting in a washed green hue on all video files) was evident on all footage. This hampered the ability of the assessor to identify certain species and, more importnantly, determine whether any observed maerl was alive or dead.

The survey design (coupled with the navigation data issues) did not allow for either effective ground-truthing of interpreted sidescan sonar data, or for a methodical approach in assessing the maerl habitat parameters required. This was due to a lack of video tows which could be confidently stated as bisecting sidescan sonar tows; furthermore not all acoustic return signals were investigated. The approach of siting sidescan sonar transects along depth contours and not in a regularly distributed fashion has resulted in a patchy understanding of the maerl extent and distribution within St Austell Bay.

4.4 Limitations of data analysis

The above described limitations have an expected knock down effect on the video and acoustic data analysis presented here. The major limitation is in regard to the mapping of the transects within a GIS project. Without accurate and reliable navigation data or complete sidescan sonar coverage, calculating and mapping the complete distribution and extent of maerl coverage within St Austell bay is not possible. What has been achieved is the mapping of the areas wherein the camera transects are highly likely (with 90 % confidence) to have taken place in the form of ellipsoids. The method of presenting the video tow transects as ellipsoids allows for the uncertainty of vessel position and the lack of information regarding camera frame layback to be factored into analysis. As such these positions are far less accurate than would usually be considered acceptable for habitat mapping. For this reason, and due to the limitations discussed, no definitive indication of the extent of the maerl habitats observed has been calculated and presented. What has been achieved in this work is the indication of the likely extent of certain habitats, the distribution of these habitats within the limits of the data acquired, and a broadscale indication of the health of the maerl habitats observed.

The application of the Maerl Assessment Classification Scheme is of use in the present survey, however it will provide a more robust method of classifying maerl habitats when applied to data collected from a full habitat mapping survey.

The sidescan sonar interpretation and subsequent substrate mapping undertaken within this contract are limited by the nature of the .XTF files provided. Hypack 2011 Sidescan Targeting and Mosaicking software could not determine the navigation method used for the sidescan tow-fish. This resulted in processing artefacts being generated within the processed sidescan sonar lines meaning that, although these lines were very useful in so far as the gain control and display enabled more seabed features to be interpreted, there was a discrepancy between the swath widths seen in the raw and the processed sidescan sonar data. Therefore both raw and processed datasets were used to interpret the substrata and generate the polygons shown in Figure 3.11.

The results obtained from the ground-truthing survey, carried out to confirm the nature of the substrata interpreted from the acoustic data, are to be treated with caution and have been only tentatively described. This is especially true for the possible association of the gravel (without obvious bedforms) substrate type and the observed maerl bed class habitats seen on Tow_5. These analyses have been carried out to inform further investigation only.

4.5 Confidence assessment

In this study, attempts have been made to minimise interpolation of the data as much as possible. However, as previously discussed, the ground-truthing coverage was not as extensive as perhaps desired. In order to illustrate the quality and interpretation of the data, confidence ratings have been assigned to the shapefiles produced.

The confidence assessments for each shapefile created have been made using the MESH confidence assessment tool which allows the user to take into account the in the level of certainty of the interpretation of the seabed environment from the acoustic data, the level of confidence in the ground-truth coverage and the general confidence in the accuracy of the habitat maps produced. Confidence in the remote sensing undertaken was hampered in this case by the coverage, i.e. the lack of evenly spaced sidescan sonar lines, causing large gaps in the dataset. Biological ground-truthing assessment is deemed to be in the form of video analysis for this survey and at point source (i.e. a video file) it is estimated at 90 – 100 % accurate. However the confidence in this section is greatly reduced by the lack of recorded navigational data.

While the substratum was found to be dominated by gravel with bedform features, frequent outcrops of rock, patches of gravel without bedforms and assumed mixed sediment were identified throughout. Due to the limited amount of ground-truthing data the actual extent and boundaries of the biotopes are not fully clear; the creation of detailed biotope classification maps in the St Austell Bay area has therefore been deemed inappropriate at this stage.

5 REFERENCES

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