Cefas

C5291B

Mapping Annex 1 reef habitat present in specific areas within the Lyme Bay and Torbay cSAC

Authors: Koen Vanstaen and Jacqueline Eggleton

Issue date: 8th April 2011

Cefas Document Control

Title: Mapping Annex 1 reef habitat present in specific areas within the Lyme Bay and Torbay cSAC

Submitted to:	Gavin Black, Natural England
Date submitted:	8th April 2011
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Quality control by:	Paul Whomersley 18/03/2011
Approved by & date:	Ed McManus 21/3/11
Version:	2

Version Control History			
Author	**Date**	**Comment**	**Version**
Koen Vanstaen & Jacqueline Eggleton	18/03/2011	Draft	0.1
Koen Vanstaen	20/03/2011	Address internal QC comments	0.2
Koen Vanstaen	21/03/2011	Final Draft	1.0
Koen Vanstaen	08/04/2011	Final	2.0

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Executive Summary

Under the Memorandum of Agreement between Cefas and Natural England, Cefas were tasked by Natural England to identify and delineate Annex I reef features from available survey data in the Lyme Bay and Torbay candidate Special Area of Conservation (cSAC). Recently acquired high resolution multibeam bathymetry and backscatter data, supplemented with recent and historic sampling data, were used to delineate and characterise potential Annex I reef habitats in the area. No targeted sampling of features recognised from the acoustic data was undertaken as part of this project.

The outcome of this work is a map showing the distribution of rocky and stony reef habitats with the area of interest. Rocky reef habitats could easily be identified from the multibeam echosounder data. Stony reef habitats on the other hand did not reveal a unique acoustic signature and mapping their presence was heavily reliant on available sampling evidence.

Reef habitats were widespread within the Lyme Bay region and mainly consist of rocky reef habitats, with locally stony reef habitat. A large area south of Lyme Regis was identified as an area of mixed rocky and stony reef habitat.

Within the central part of the Torbay cSAC region, reef habitat was less extensive and restricted around a few headlands. Surrounding the rocky reefs, locally stony reef habitat was identified.

Where biological sample data were available, an attempt was made at attributing EUNIS Habitat Types to each of the areas identified as reef habitat.

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1 Introduction

Under the framework of the Memorandum of Agreement between Cefas and Natural England, Cefas were tasked with a desk-based piece of work that will, using existing data, create a refined map of Annex 1 reef features (where possible differentiating between exposed bedrock, stony reef and biogenic reef) in the Lyme bay and Torbay sections of the Lyme Bay and Torbay cSAC (Figure 1). This biotope map will provide a baseline for the extent, distribution and location of the different types of Annex 1 reef in the cSAC, however, more urgently it will provide relevant authorities such as the Devon Sea Fisheries Committee (DSFC), Southern Sea Fisheries Committee (SSFC) and Marine Management Organisation (MMO) with the necessary information to be able to introduce appropriate management measures to conserve the features at risk from detrimental practices. The biotope map will also provide further information regarding presence, distribution and extent of notable and characterising biotopes and is anticipated will feed into a wider understanding of the ecology of the area.
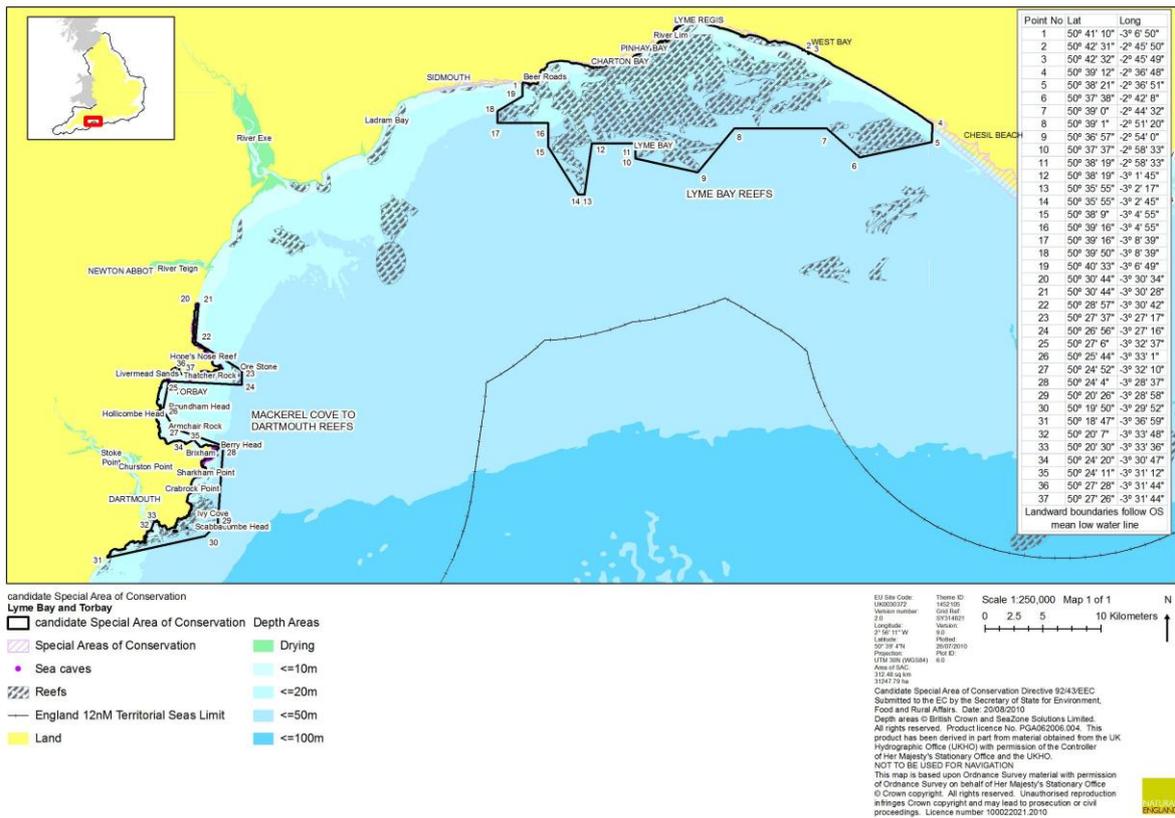

Figure 1: Location of the Lyme Bay and Torbay candidate SAC area

2 Available data

Due to the short time span available to deliver this work, it was agreed at the beginning of the project that only readily available data in processed or interpreted form would be used by Cefas. Natural England supplied all data holdings for the area and an assessment was undertaken by Cefas whether or not the data would be used during the data interpretation stage. The main datasets using in this project are listed below.

2.1   Acoustic seabed data

2.1.1   Lyme Bay - Channel Coastal Observatory multibeam echosounder data

Between 16th June and 18th September 2007 the Channel Coastal Observatory (CCO), with support from the Maritime and Coastguard Agency, collected multibeam bathymetry data between Portland Bill, Dorset, and Petit Tor Point, Devon. Data was generally collected from Mean Low Water out to 1 kilometre from shore (Figure 2, Figure 3). The majority of the data was collected by Halcrow from their survey vessel Sir William Halcrow, using a GeoSwath swath bathymetry echosounder and a limited amount of Reson 8101 multibeam echosounder data. In addition, some data was collected by the Remote Sensor survey vessel using a Kongsberg EM3002 multibeam echosounder.

Processed data were provided to Cefas as GSF (Generic Sensor Format) files including bathymetry and backscatter data. Sun illuminated colour images at 1m resolution were derived from the bathymetry data using the IVS3D Fledermaus software suite. Backscatter intensity mosaics at 1m resolution were derived from the backscatter data using the IVS3D GeoCoder software.

The data quality was generally found to be poor to moderate.

2.1.2   Lyme Bay - Maritime and Coastguard Agency/Natural England multibeam echosounder data

In June and July 2010 the Maritime and Coastguard Agency and Natural England commissioned a survey of the Lyme Bay cSAC area (Figure 2, Figure 3). The survey was undertaken by Marin Mätteknik using the survey vessels Icebeam and Triad, both equipped with a Kongsberg EM3002D multibeam echosounder.

Processed data were provided to Cefas as GSF (Generic Sensor Format) files including bathymetry data. Sun illuminated colour images at 1m resolution were derived from the bathymetry data using the IVS3D Fledermaus software suite. Backscatter intensity mosaics at 1m resolution were derived from the backscatter data using the IVS3D GeoCoder software.

The data quality was generally found to be very good.

2.1.3   Torbay - Natural England multibeam echosounder data

In December and January 2011 Natural England commissioned a survey of the Torbay part of the Lyme Bay and Torbay cSAC area. The survey was managed by the Maritime and Coastguard Agency and undertaken by Marine Mätteknik using survey vessels Triad and Seabeam, both equipped with a Kongsberg EM3002D multibeam echosounder. Within the time available, data collection was only possible in the area between Hope's Nose and Berry Head (Figure 4, Figure 5). No new data collection was possible in the area north of Hope's Nose and south of Berry Head.

At the time this work was undertaken, fully processed data were not available. To allow data interpretation of the recently acquired data, Marin Mätteknik provided preliminary bathymetry and backscatter outputs. Since no XYZ data or processed data files were available, no further data analysis could be undertaken on the data for this area.
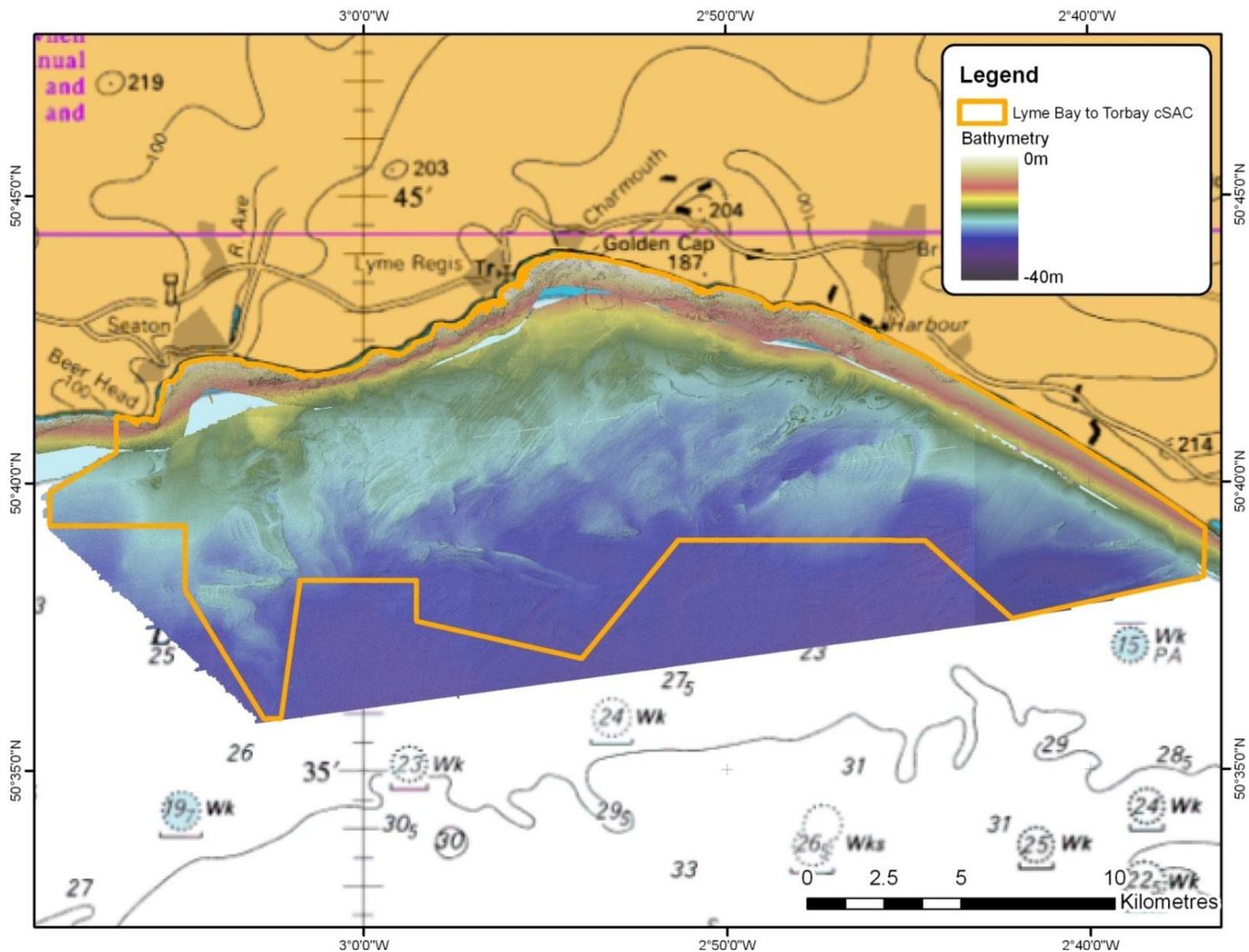
Figure 2: Multibeam bathymetry coverage in the Lyme Bay area. Chart 2656 © British Crown and SeaZone Solutions Limited. All rights reserved. Product licence No. PGA062006.004. This product has been derived in part from material obtained from the UK Hydrographic Office (UKHO) with permission of the Controller of Her Majesty's Stationary Office and the UKHO. NOT TO BE USED FOR NAVIGATION. Bathymetry © British Crown and Maritime and Coastguard Agency and © British Crown, Maritime and Coastguard Agency and Channel Coast Observatory. NOT TO BE USED FOR NAVIGATION. This map is based upon Ordnance Survey material with permission of Ordnance Survey on behalf of Her Majesty's Stationary Office © Crown copyright. All rights reserved. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Licence number 100022021.2011.
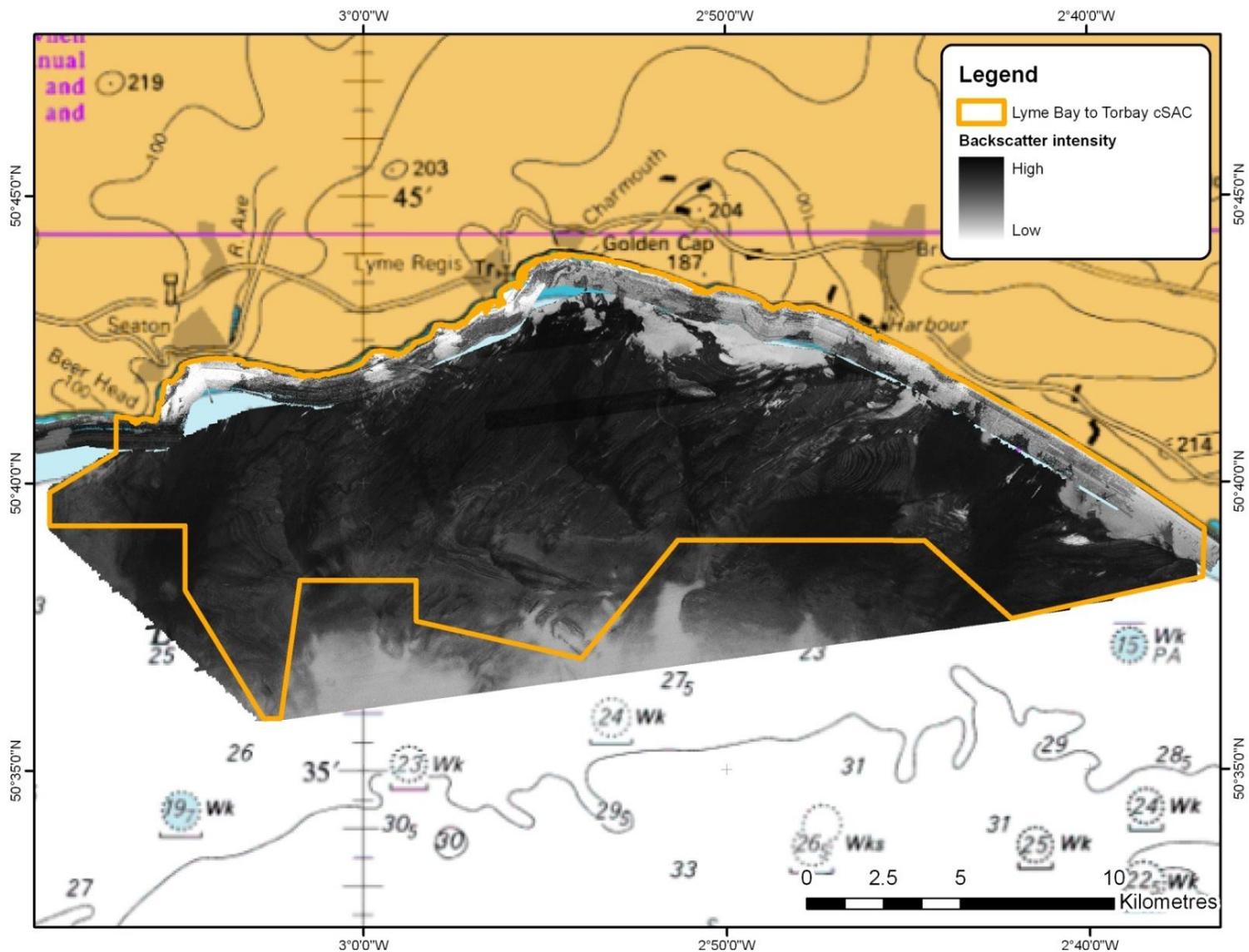
Figure 3: Multibeam backscatter coverage in the Lyme Bay area. Chart 2656 © British Crown and SeaZone Solutions Limited. All rights reserved. Product licence No. PGA062006.004. This product has been derived in part from material obtained from the UK Hydrographic Office (UKHO) with permission of the Controller of Her Majesty's Stationary Office and the UKHO. NOT TO BE USED FOR NAVIGATION. Backscatter data © British Crown and Maritime and Coastguard Agency and © British Crown, Maritime and Coastguard Agency and Channel Coast Observatory. This map is based upon Ordnance Survey material with permission of Ordnance Survey on behalf of Her Majesty's Stationary Office © Crown copyright. All rights reserved. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Licence number 100022021.2011.
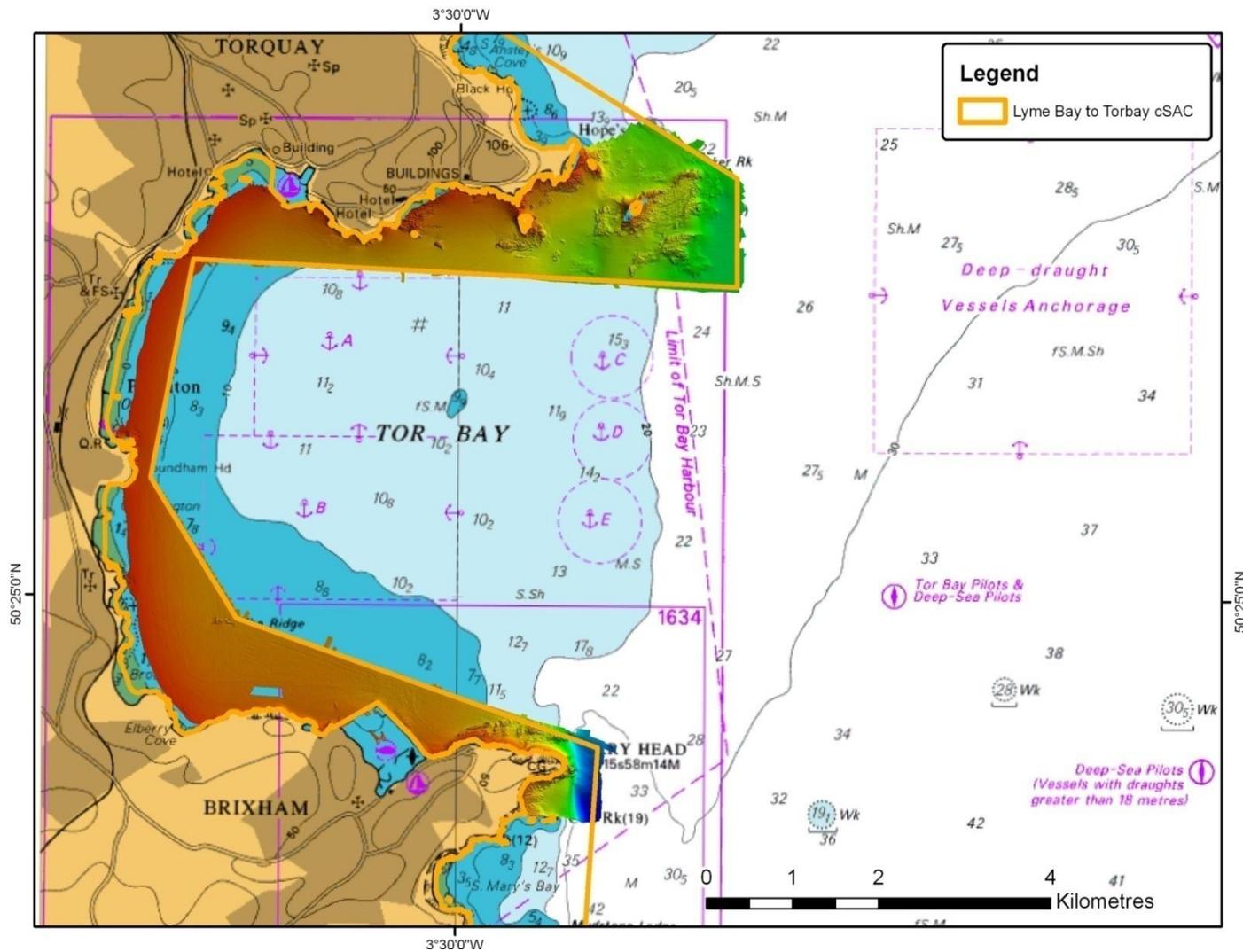
Figure 4: Multibeam bathymetry coverage in the Torbay area. Chart 2454 © British Crown and SeaZone Solutions Limited. All rights reserved. Product licence No. PGA062006.004. This product has been derived in part from material obtained from the UK Hydrographic Office (UKHO) with permission of the Controller of Her Majesty's Stationary Office and the UKHO. NOT TO BE USED FOR NAVIGATION. Bathymetry © Natural England. NOT TO BE USED FOR NAVIGATION. This map is based upon Ordnance Survey material with permission of Ordnance Survey on behalf of Her Majesty's Stationary Office © Crown copyright. All rights reserved. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Licence number 100022021.2011.
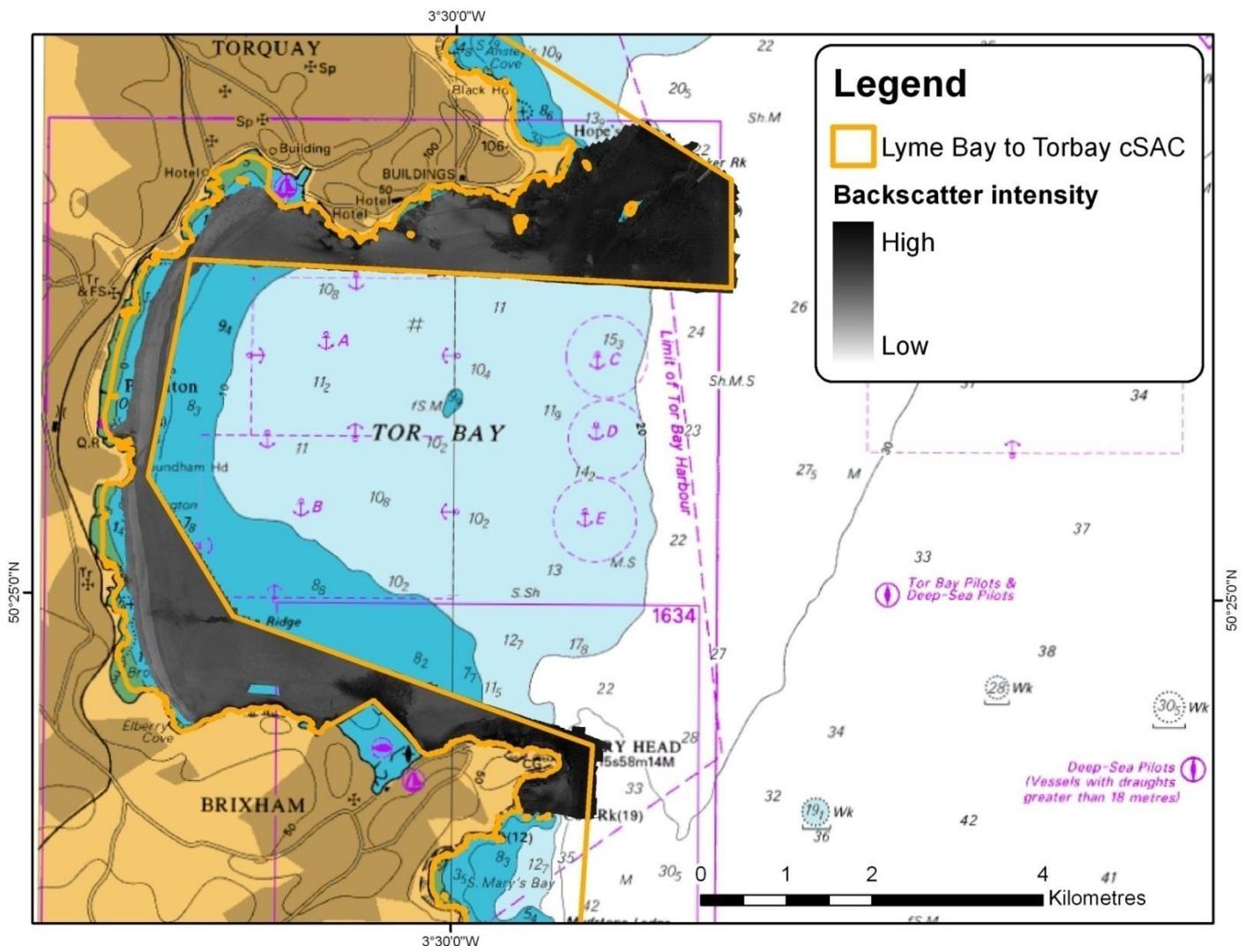
Figure 5: Multibeam backscatter coverage in the Torbay area. Chart 2454 © British Crown and SeaZone Solutions Limited. All rights reserved. Product licence No. PGA062006.004. This product has been derived in part from material obtained from the UK Hydrographic Office (UKHO) with permission of the Controller of Her Majesty's Stationary Office and the UKHO. NOT TO BE USED FOR NAVIGATION. Backscatter data © Natural England. NOT TO BE USED FOR NAVIGATION. This map is based upon Ordnance Survey material with permission of Ordnance Survey on behalf of Her Majesty's Stationary Office © Crown copyright. All rights reserved. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Licence number 100022021.2011.

2.2 Seabed sampling data

Natural England provided all historic and recent sampling data to Cefas for review. In addition to the datasets made available by Natural England, Cefas also reviewed its biological sample databases DigiLog and UNICORN, but did not yield any samples within the area of interest. An assessment was undertaken to identify those datasets which could be incorporated in the data analysis. A number of datasets only provided information on sample positions, without any readily available descriptive information on the nature of the sample. Within the timeframe of this project, only datasets with sample descriptions or analysis results were used during the data interpretation.

Those datasets that were incorporated in the data interpretation undertaken under this task are listed in Table 1 and their distribution shown in Figure 6. Table 1 also indicates whether biological and/or physical data are associated.

Table 1: List of sample datasets used for ground-truthing of acoustic seabed data

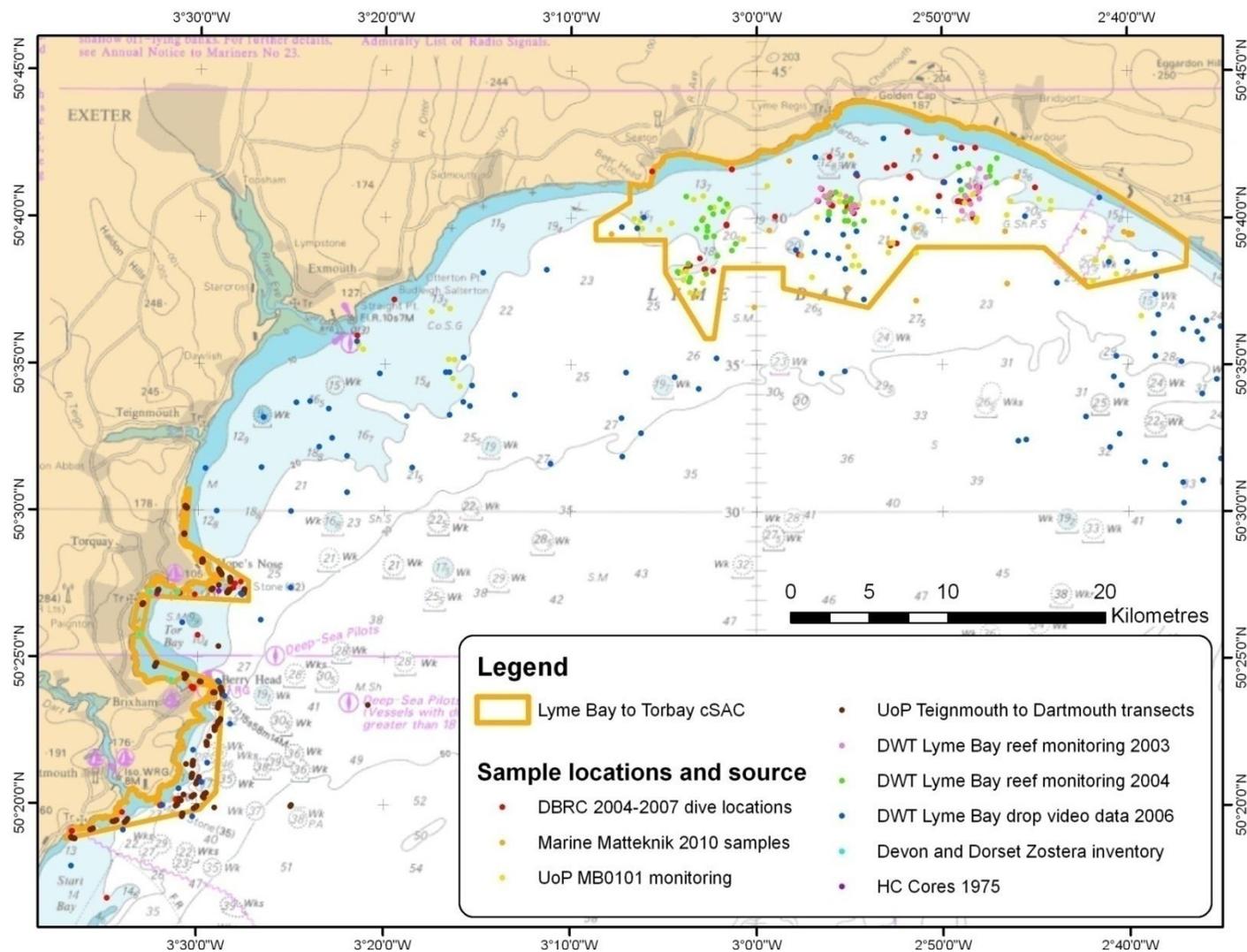| Source	Description	Physical	Biological
Devon Biodiversity Record Centre (DBRC)	Extract from Marine Recorder database for period **2004 - 2007**. Diver survey observations.	✔	✔
Marin Mätteknik	Samples collected during the **2010** Lyme Bay multibeam echosounder survey.	✔	
University of Plymouth	Video transect within the Lyme Bay region collected as part of Defra funded contract MB0101 in **2010**. Although biological data was collected, this was not available at the time this work was undertaken.	✔	
University of Plymouth	Video transects between Teignmouth and Dartmouth undertaken on behalf of Natural England in **2010**. Although biological data was collected, this was not available at the time this work was undertaken.	✔	
Devon Wildlife Trust	Video monitoring of reef sites in Lyme Bay region in **2003 and 2004**	✔	✔
Devon Wildlife Trust	Video transects within the Lyme Bay and Torbay cSAC area collected during **2006**	✔	✔
English Nature, Environment Agency, Devon Biodiversity Records Centre and Dorset Environmental Records Centre	Inventory of *Zostera* communities along the Devon and Dorset coast in **2004**.		✔
HC cores	Location and description of cores taken within Torbay area in **1975**	✔	

Figure 6: Distribution of samples within the Lyme Bay and Torbay cSAC area. Chart 2656 © British Crown and SeaZone Solutions Limited. All rights reserved. Product licence No. PGA062006.004. This product has been derived in part from material obtained from the UK Hydrographic Office (UKHO) with permission of the Controller of Her Majesty's Stationary Office and the UKHO. NOT TO BE USED FOR NAVIGATION. This map is based upon Ordnance Survey material with permission of Ordnance Survey on behalf of Her Majesty's Stationary Office © Crown copyright. All rights reserved. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Licence number 100022021.2011.

3 Results

3.1 Acoustic seabed data interpretation

The multibeam bathymetry and backscatter data were subjected to expert interpretation to delineate potential areas of Annex I reef habitat, including exposed bedrock, stony reef or biogenic reef. The definitions of reef habitats used in the "Interpretation manual or European Union habitats"[1] were adopted in this report. Exposed bedrock reefs were defined as those areas where bedrock was present at the surface. These reefs could be upstanding from the seabed or could be present as flat bedrock platforms. The stony reef definition used in this report was adopted from JNCC Stony Reef guidance document (Irving, 2008[2]). Biogenic reefs were defined as those hard compact substrata from dead or living animals arising from the seabed.

During the interpretation phase the ground-truth sampling dataset were used extensively. The majority of samples with physical descriptions of the nature of the seabed were reviewed and classified as reef habitat, not reef habitat or unknown (no physical data available or insufficient detail available). Whereas for the majority of stations this was a subjective assessment, the data collected by the University of Plymouth allowed a quantitative assessment to be carried out building on the stony reef definition (Irving, 2008). In line with the guidance, transects were only considered to be stony reef habitat if more than 10% of the 30 stills images showed cobble or boulder habitat.

The acoustic seabed data allowed the identification of rocky reef exposures. However, no characteristic signature could be associated with the occurrence of stony reef. This is very much in line with the findings of other research (Limpenny *et al.*, 2010[3]). Therefore it was not possible to delineate stony reef habitats from the acoustic seabed data alone. To be able to attribute an area as stony reef sample evidence was required confirming the presence of cobbles or boulders.

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[1] European Commission (2007) Interpretation Manual of European Union Habitats. European Commission, DG Environment, Nature and Biodiversity, 142p.

[2] Irving, R, (2009), The identification of the main characteristics of stony reef habitats under the Habitats Directive, JNCC Report 432, ISSN 0963 8091

[3] Limpenny, D.S., Foster-Smith, R.L., Edwards, T.M., Hendrick, V.J., Diesing, M., Eggleton, J.D., Meadows, W.J., Crutchfield, Z., Pfeifer, S., and Reach, I.S. (2010). Best methods for identifying and evaluating *Sabellaria spinulosa* and cobble reef. Aggregate Levy Sustainability Fund Project MAL0008. Joint Nature Conservation Committee, Peterborough, 134 pp., ISBN - 978 0 907545 33 0

This sample evidence was used to validate the observations from the acoustic data. As such this provided a measure of confidence in the resulting data interpretation as summarised in Table 2. Where confidence is considered low, it is strongly recommended that further work is undertaken by collecting additional samples to better characterise the nature of the seabed in those areas.

Table 2: Confidence scoring for reef interpretation

Confidence score	Summary
1 (low)	Unclear reef expression from acoustic seabed data
	No reef evidence from samples or lack of samples
2 (moderate)	Clear reef expression from acoustic seabed data
	No reef evidence from samples or lack of samples
3 (high)	Clear reef expression from acoustic seabed data
	Reef presence confirmed by one or more samples

The result of the reef assessment for the Lyme Bay and Torbay region is presented in Figure 8 and Figure 9 respectively.
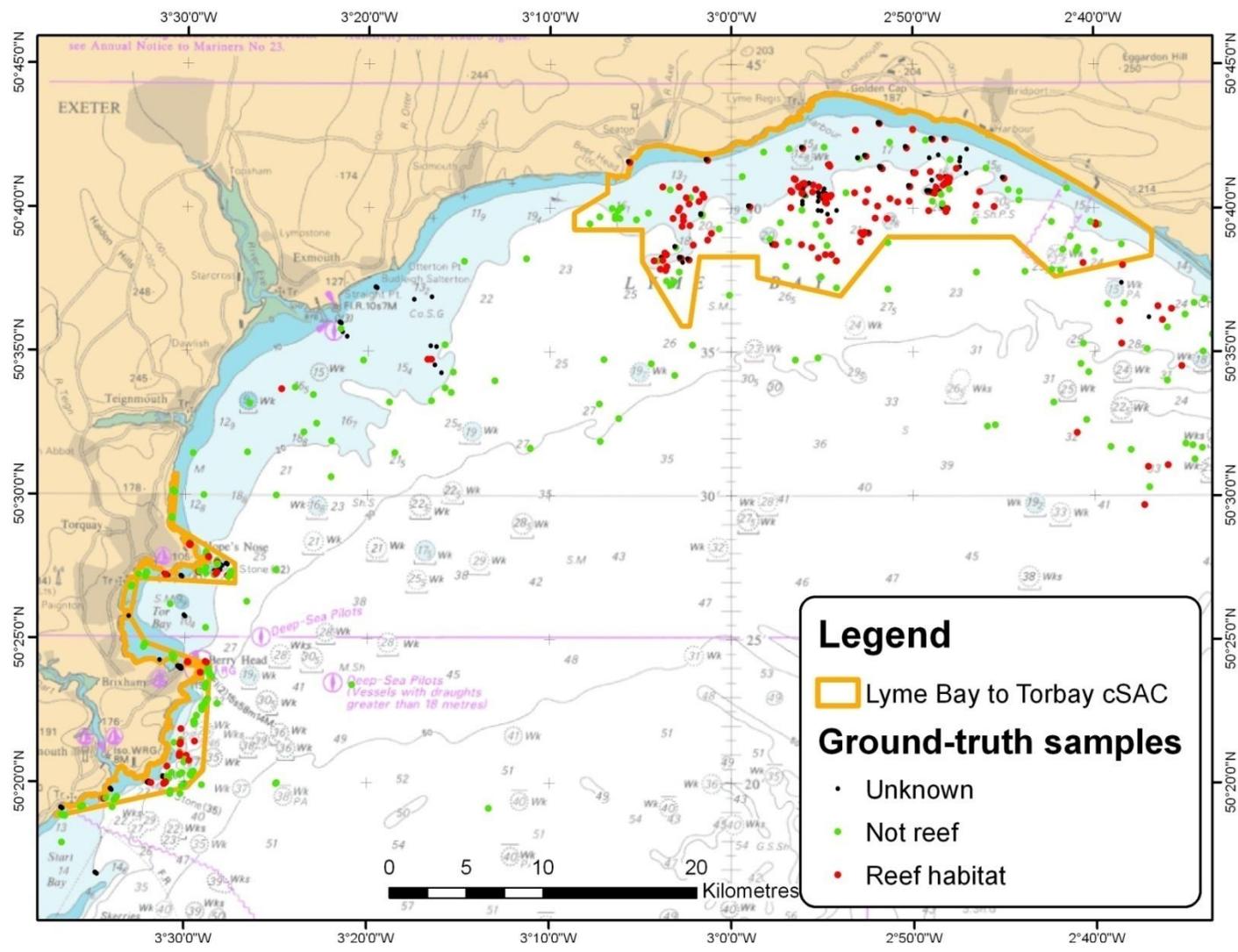
Figure 7: Classification of ground-truthing samples. Chart 2656 © British Crown and SeaZone Solutions Limited. All rights reserved. Product licence No. PGA062006.004. This product has been derived in part from material obtained from the UK Hydrographic Office (UKHO) with permission of the Controller of Her Majesty's Stationary Office and the UKHO. NOT TO BE USED FOR NAVIGATION. This map is based upon Ordnance Survey material with permission of Ordnance Survey on behalf of Her Majesty's Stationary Office © Crown copyright. All rights reserved. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Licence number 100022021.2011.
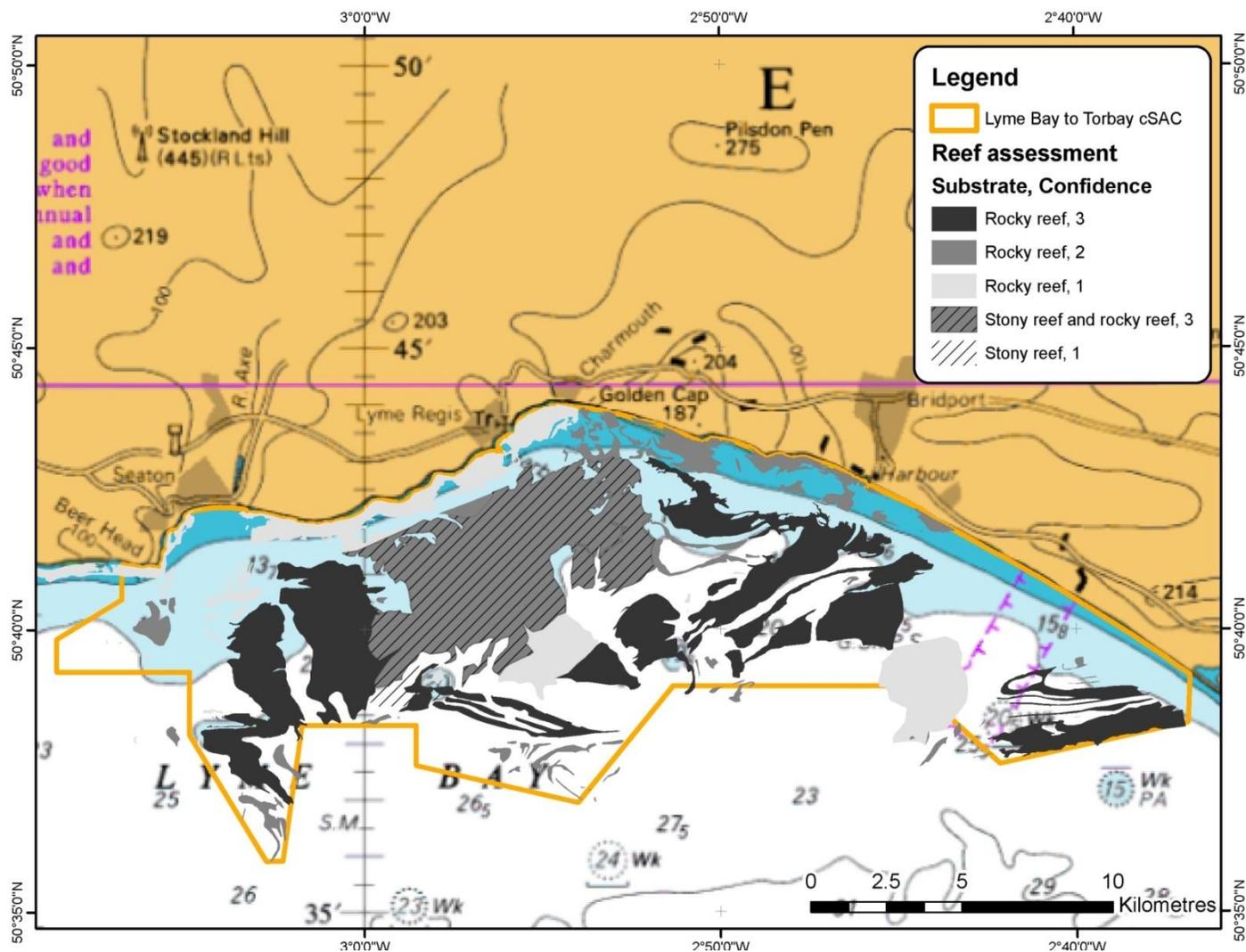
Figure 8: Distribution of Annex I reef habitats within the Lyme Bay region and associated confidence. Chart 2656 © British Crown and SeaZone Solutions Limited. All rights reserved. Product licence No. PGA062006.004. This product has been derived in part from material obtained from the UK Hydrographic Office (UKHO) with permission of the Controller of Her Majesty's Stationary Office and the UKHO. NOT TO BE USED FOR NAVIGATION. This map is based upon Ordnance Survey material with permission of Ordnance Survey on behalf of Her Majesty's Stationary Office © Crown copyright. All rights reserved. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Licence number 100022021.2011.
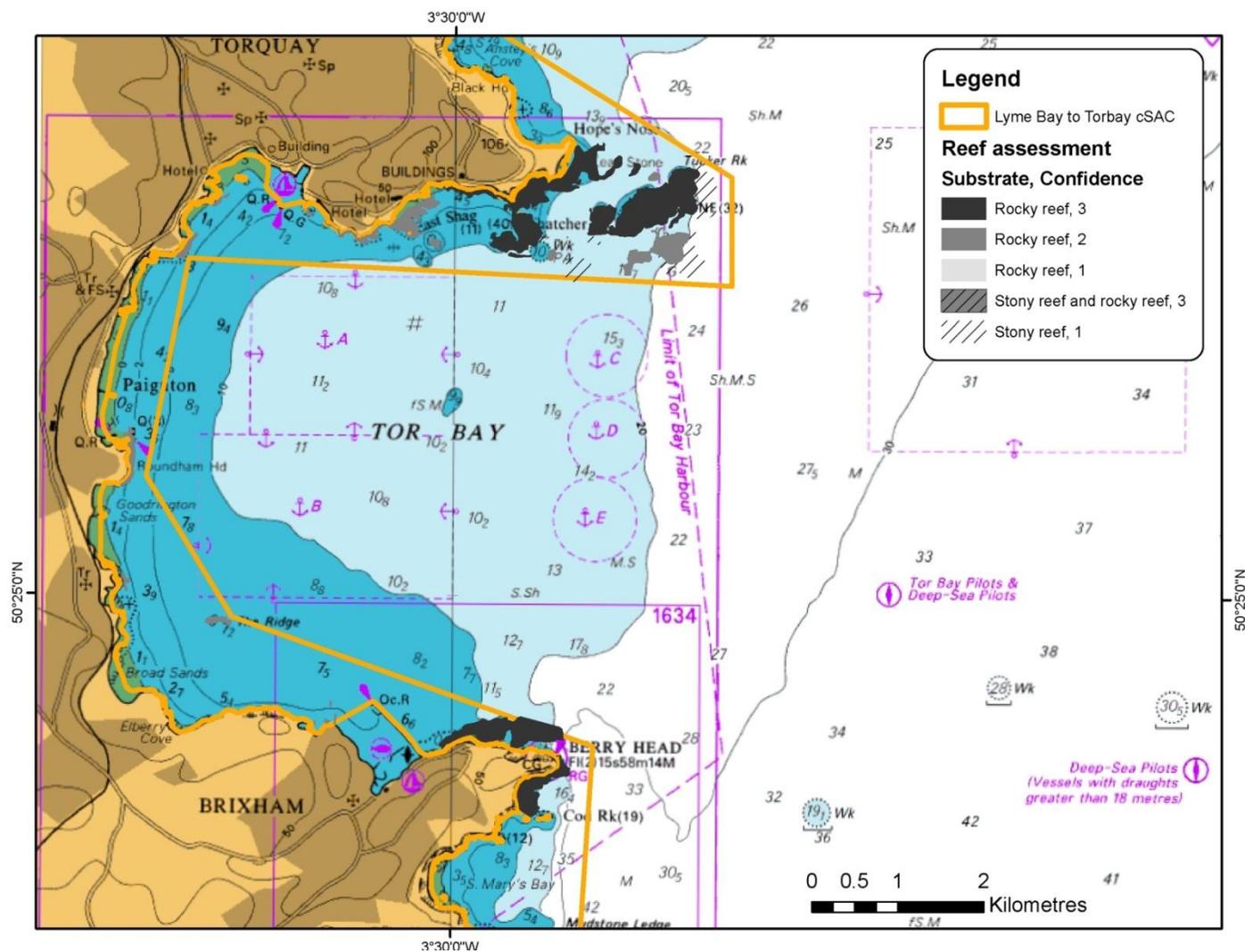
Figure 9: Distribution of Annex I reef habitats within the Torbay region and associated confidence. Note, no data was collected north of Hope's Nose and south of Cod Rock. Chart 2454 © British Crown and SeaZone Solutions Limited. All rights reserved. Product licence No. PGA062006.004. This product has been derived in part from material obtained from the UK Hydrographic Office (UKHO) with permission of the Controller of Her Majesty's Stationary Office and the UKHO. NOT TO BE USED FOR NAVIGATION. This map is based upon Ordnance Survey material with permission of Ordnance Survey on behalf of Her Majesty's Stationary Office © Crown copyright. All rights reserved. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Licence number 100022021.2011.

The results show the widespread presence of reef habitat in the Lyme Bay region. Rocky reef was the predominant type of reef identified throughout the area. Stony reef was found to be less widespread and found to occur alongside rocky reef. Furthermore, samples often reported stony reef habitats in areas with clear bedrock exposures on the acoustic data. It can therefore be expected that in many areas identified as rocky reef, locally stony reef may also be present. South of Lyme Regis, a large area of flat bedrock reef was observed from the acoustic seabed data. Ground truthing samples revealed a combination of rocky reef and stony reef habitats in this area, although samples were unevenly distributed over the area. Between Lyme Regis and Beer Head, the rocky reef area was given low confidence, due to the poor multibeam bathymetry and backscatter data within the inshore area (Figure 10). Although confidence is high that rocky reef is present in these areas, the outline of the reef area could not be mapped with the same confidence as in other areas.
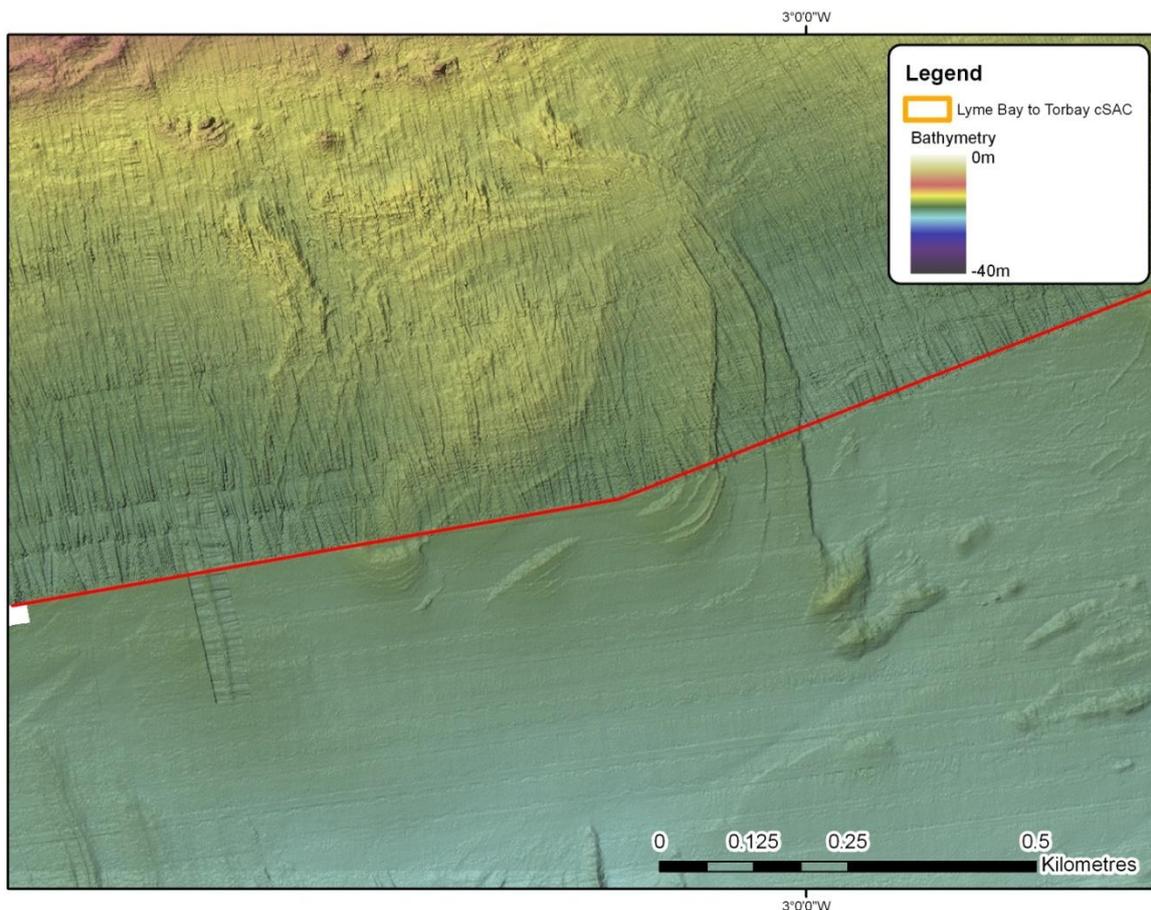

Figure 10: Difference between the CCO (north of red line) and MCA/NE (south of red line) multibeam bathymetry data illustrating the difficulty in delineating the rock reef in areas of poor data quality. Bathymetry © British Crown and Maritime and Coastguard Agency and © British Crown, Maritime and Coastguard Agency and Channel Coast Observatory. NOT TO BE USED FOR NAVIGATION.

Within the area mapped by multibeam echosounder of the Torbay part of the cSAC area, reef habitats were mainly limited to the headlands around Hope's Nose and Berry head. Rocky reef habitats were mainly identified in this area, although locally stony reef was found adjacent to bedrock reef habitats.

Generally good correspondence was found between the interpretations from the acoustic seabed data and the evidence available from sampling surveys, as illustrated in Figure 11.

Figure 11: Sample locations in relation to an area identified as potential rocky reef habitat. Red dots indicated several samples confirm the presence of reef within the area identified from acoustic data. Yellow dots outside the area identified from acoustic data confirm no reef habitat is present in these areas. Bathymetry © British Crown and Maritime and Coastguard Agency and © British Crown, Maritime and Coastguard Agency and Channel Coast Observatory. NOT TO BE USED FOR NAVIGATION.

The areas identified as reef are to be made available to Natural England as an ESRI Shapefile. The file contains four columns related to the physical characterisation of the seabed:

- Substrate: Defines the nature of the seabed: rocky reef or stony reef;

- Source: Lists the datasets used in defining the substrate type;

- Subst_Conf: Scores the confidence in the substrate assessment, 3 = High and 1 = Low; and

- Comments: Includes any additional information in support of the confidence assessment or relevant to the substrate classification.

4 EUNIS Classification

Following the review of the acoustic data for potential Annex I reef habitats, a further assessment was undertaken of the benthic habitats associated with these areas. Where species data were available for the sampling stations within the potential reef habitat, an attempt was made to assign a EUNIS (European Nature Information System) Level 5 habitat type. Species records from Seasearch diver surveys were found to be the best source for confidently assigning biotopes to level 5 and occasionally level 6 due to the spread of the data and extensive species lists. Where no species data were available, a predictive EUNIS modelling approach was adopted using the data layers available from UKSeaMap2010. The majority of the Lyme Bay region was found to be situated in the infralittoral zone, and subject to high energy. Hence EUNIS Habitat Type A3.1 was attributed to the reefs in this area. However, the majority of biological samples in this region contained species more closely aligned with circalittoral habitat descriptions and species lists. The reefs may therefore be situated in a transitional zone.

4.1 Biotope classifications

Where extensive species lists existed, a search for potential biotopes, using the Marine Habitat Classification hierarchy (Connor *et al*., 2004), was undertaken for the most commonly found species. The characterising species of resulting biotopes were then compared with the species lists from the survey area. This was then supplemented with descriptive information from the Lyme Bay drop down video survey and species data (top 5 most sensitive species to trawling) from the temporal Lyme Bay reef monitoring surveys.

Details on each of the EUNIS Habitat Types can be found in the Appendices to this report.

4.1.1 Lyme Bay (Figure 12)

The survey data relating to the Lyme Bay reefs were animal dominated with the occasional foliose red algae recorded and no records of kelp, therefore the biotopes were assigned within the

circalittoral classification. The majority of reefs with biological data were assigned to biotopes A4.13: Mixed faunal turf communities on circalittoral rock (Level 4), A4.131: Bryozoan turf and erect sponges on tide-swept circalittoral rock (Level 5) or depending on the occurrence of *Eunicella verrucosa* and *Pentapora foliacea,* A4.1311: [Eunicella verrucosa] and [Pentapora foliacea] on wave-exposed circalittoral rock (Level 6). Discrete patches of maerl (*Phymatolithon calcareum*) and maerl gravel were identified within the large central reef (Lyme Maerl Bed and Lanes Ground) and could potentially be assigned to (e.g. A5.51: Maerl Beds), however the majority of the reef was more characteristic of A4.131. Patches of bored mudstone were also evident, although species data were lacking, therefore a separate biotope classification was not applied to these areas. On the North east fringes of the Saw-tooth Ledges, red and brown algae became more prominent (A3.116: Foliose red seaweeds on exposed lower infralittoral), representing a transitional zone between the infralittoral and circalittoral biotopes as classified by Connor et al, 2004.

4.1.2   Torbay (Figure 13)

Survey data (containing species information) that corresponded with the reef locations was limited in the Torbay cSAC region. The majority of reefs could therefore only be assigned to EUNIS level 3, either A3.2: **Atlantic and Mediterranean moderate energy infralittoral rock** or A3.3: **Atlantic and Mediterranean low energy infralittoral rock,** depending on the predicted wave energy from UKSeaMap2010. Only one reef (Ore Stone) could be confidently assigned to EUNIS level 5: A3.212 **[Laminaria hyperborea] on tide-swept, infralittoral rock, due to the existence of comprehensive species records from Seasearch surveys.**
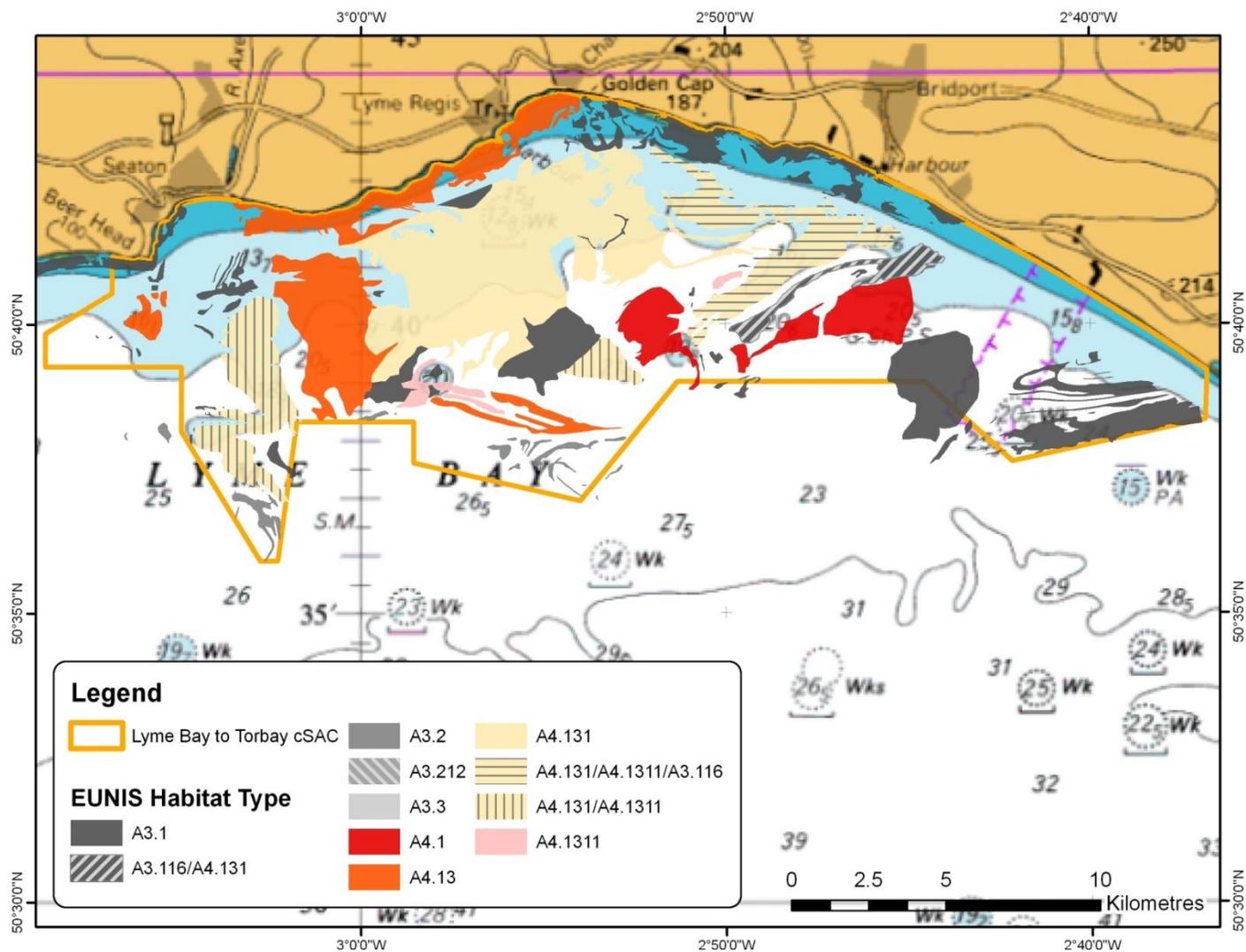
Figure 12: Distribution of EUNIS Habitat Types within the Lyme Bay region. Chart 2656 © British Crown and SeaZone Solutions Limited. All rights reserved. Product licence No. PGA062006.004. This product has been derived in part from material obtained from the UK Hydrographic Office (UKHO) with permission of the Controller of Her Majesty's Stationary Office and the UKHO. NOT TO BE USED FOR NAVIGATION. This map is based upon Ordnance Survey material with permission of Ordnance Survey on behalf of Her Majesty's Stationary Office © Crown copyright. All rights reserved. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Licence number 100022021.2011.

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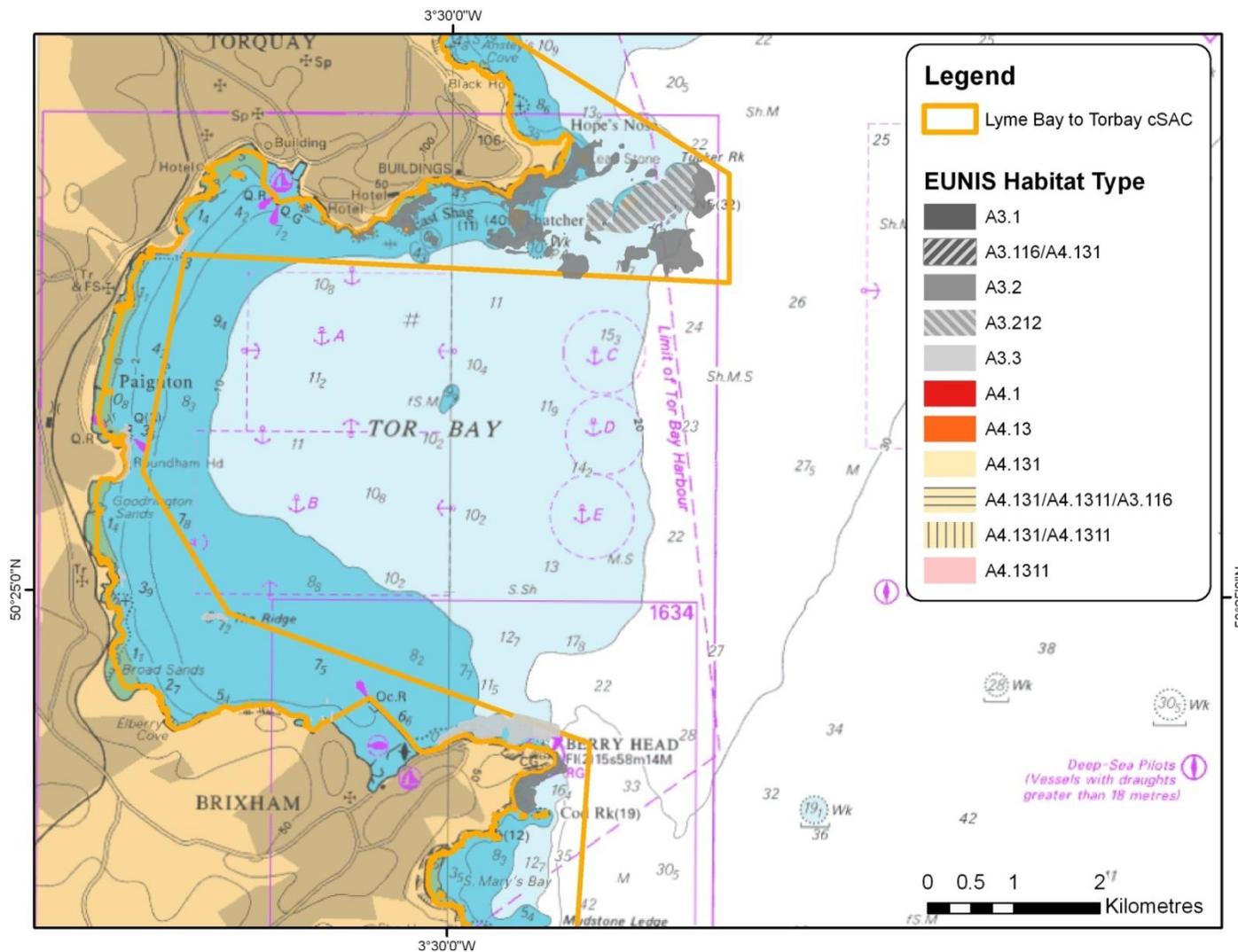
Figure 13: Distribution of EUNIS Habitat Types within the Torbay region. Chart 2656 © British Crown and SeaZone Solutions Limited. All rights reserved. Product licence No. PGA062006.004. This product has been derived in part from material obtained from the UK Hydrographic Office (UKHO) with permission of the Controller of Her Majesty's Stationary Office and the UKHO. NOT TO BE USED FOR NAVIGATION. This map is based upon Ordnance Survey material with permission of Ordnance Survey on behalf of Her Majesty's Stationary Office © Crown copyright. All rights reserved. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Licence number 100022021.2011.

5 Conclusions

Recently acquired high resolution multibeam bathymetry and backscatter data, supplemented with recent and historic sample data, were used to delineate and characterise potential Annex I reef habitats in the Lyme Bay and Torbay cSAC.

The outcome of this work is a map showing the distribution of rocky and stony reef habitats within the area of interest. Rocky reef habitats were confidently identified from the multibeam echosounder data. Stony reef habitats on the other hand did not reveal a unique acoustic signature and mapping their presence was heavily reliant on available evidence from associated ground truthing samples. Additional ground-truth samples across the area would benefit the identification of stony reef habitats, especially in those areas attributed a low confidence in the reef classification.

Reef habitats were widespread within the Lyme Bay region and mainly consist of rocky reef habitats, with locally stony reef habitat. A large area south of Lyme Regis was identified as an area of mixed rocky and stony reef habitat. Although the habitat in this area is often a flat bedrock platform, the biological communities associated were typical of reef habitats.

Within the central part of the Torbay cSAC region, reef habitat was less extensive and restricted around a few headlands. Surrounding the rocky reefs, locally stony reef habitat was identified.

An attempt was made to attribute EUNIS habitat types to the areas identified as reef habitat. Although a large number of samples were available, these were often concentrated in small areas. Hence many areas are only attributed a EUNIS Level 3 habitat type, not taking into account any of the biological characteristics of the site.

6 Annexes: EUNIS Habitat Types details

A3.1: Atlantic and Mediterranean high energy infralittoral rock
Rocky habitats in the infralittoral zone subject to exposed to extremely exposed wave action or strong tidal streams. Typically the rock supports a community of kelp [Laminaria hyperborea] with foliose seaweeds and animals, the latter tending to become more prominent in areas of strongest water movement. The depth to which the kelp extends varies according to water clarity, exceptionally (e.g. St Kilda) reaching 45 m. The sublittoral fringe is characterised by dabberlocks [Alaria esculenta].

A3.2: Atlantic and Mediterranean moderate energy infralittoral rock
Predominantly moderately wave-exposed bedrock and boulders, subject to moderately strong to weak tidal streams. On the bedrock and stable boulders there is typically a narrow band of kelp [Laminaria digitata] in the sublittoral fringe which lies above a [Laminaria hyperborea] forest and park. Associated with the kelp are communities of seaweeds, predominantly reds and including a greater variety of more delicate filamentous types than found on more exposed coasts (cf. A3.11).

A3.3: Atlantic and Mediterranean low energy infralittoral rock
Infralittoral rock in wave and tide-sheltered conditions, supporting silty communities with [Laminaria hyperborea] and/or [Laminaria saccharina] (A3.31). Associated seaweeds are typically silt-tolerant and include a high proportion of delicate filamentous types. In turbid-water estuarine areas, the kelp and seaweeds (A3.32) may be replaced by animal-dominated communities (A3.36) whilst stable hard substrata in lagoons support distinctive communities (A3.34).

A4.1: Atlantic and Mediterranean high energy circalittoral rock
Occurs on extremely wave-exposed to exposed circalittoral bedrock and boulders subject to tidal streams ranging from strong to very strong. Typically found in tidal straits and narrows. The high energy levels found within this habitat complex are reflected in the fauna recorded. Sponges such as [Pachymatisma johnstonia], [Halichondria panicea], [Esperiopsis fucorum] and [Myxilla incrustans] may all be recorded. Characteristic of this habitat complex is the dense 'carpet' of the hydroid [Tubularia indivisa]. The barnacle [Balanus crenatus] is recorded in high abundance on the rocky substrata. On rocky outcrops, [Alcyonium digitatum] is often present.

A3.116: Foliose red seaweeds on exposed lower infralittoral rock

A dense turf of foliose red seaweeds on exposed or moderately exposed lower infralittoral rock, generally, at or below the lower limit of the kelp. Most of the red seaweeds are common to the kelp zone above, while the faunal component of the biotope is made up of species that are found either in the kelp zone or the animal-dominated upper circalittoral below. Foliose species commonly present include [Dilsea carnosa], [Hypoglossum hypoglossoides, Schottera nicaeensis], [Cryptopleura ramosa] and [Delesseria sanguinea]. The red seaweed species composition varies considerably; at some sites a single species may dominate (particularly [Plocamium cartilagineum]). Small filamentous red seaweeds can be found here as well. These include species such as [Heterosiphonia plumosa, Brongniartella byssoides]. As well as a varied red seaweed component, this biotope may also contain occasional kelp plants and patches of the brown foliose seaweed [Dictyota dichotoma]. Coralline crusts covers the bedrock beneath the seaweeds. The fauna generally comprises low-encrusting forms such as the tubeworms [Pomatoceros] spp., anthozoans including [Alcyonium digitatum], [Urticina felina] and [Caryophyllia smithii]) and occasional sponge crusts such as [Cliona celata, Esperiopsis fucorum], [Scypha ciliata] and [Dysidea fragilis]. More mobile fauna include the gastropod [Calliostoma zizyphinum], the echinoderms [Echinus esculentus] as well as the starfish [Asterias rubens] and [Marthasterias glacialis] and lastly, the crab [Cancer pagurus]. Bryozoan crusts such as [Electra pilosa] can be found fronds on the foliose red seaweeds while scattered hydroids such as [Nemertesia antennina] form colonies on shells, cobbles and available rock. At some sites erect bryozoans [Crisia] spp. and [Bugula] spp. are present. Ascidians such as [Clavelina lepadiformis] and [Clavelina lepadiformis] may also be common. In the north the foliose red seaweed [Callophyllis laciniata] may occur.

Situation: This biotope is generally found at or below the lower limit of the kelp, below either kelp forest or park (LhypR.Ft and LhypR.Pk).

Temporal variation: Many of the red seaweeds, which occur in this biotope, have annual fronds, which tend to die back in the autumn and regenerate again in the spring. This produces a seasonal change in the density of the seaweed cover, which is substantially reduced over winter months and reaches its most dense between April to September.

A3.212: **[Laminaria hyperborea] on tide-swept, infralittoral rock**

Wave exposed to moderately wave exposed, tide-swept bedrock and boulders with [Laminaria hyperborea], characterised by a rich under-storey and stipe flora of foliose seaweeds including the brown seaweed [Dictyota dichotoma]. The kelp stipes support epiphytes such as [Cryptopleura ramosa] and [Phycodrys rubens]. At some sites, instead of being covered by red seaweeds, the kelp stipes are heavily encrusted by the ascidian [Botryllus schlosseri]. Epilithic seaweeds [Delesseria sanguinea], [Plocamium cartilagineum] [Heterosiphonia plumosa, Hypoglossum hypoglossoides], [Callophyllis laciniata], [Kallymenia reniformis], [Brongniartella byssoides] and crustose seaweeds commonly occur beneath the kelp. The kelp fronds are often covered with growth of the hydroid [Obelia geniculata] or the bryozoan [Membranipora membranacea]. On the rock surface, a rich fauna comprising the bryozoan [Electra pilosa], the sponge [Pachymatisma johnstonia], anthozoans such as [Alcyonium digitatum], [Sagartia elegans] and [Urticina felina], colonial ascidians such as [Clavelina lepadiformis], the calcareous tubeworm [Pomatoceros triqueter] and the barnacle [Balanus crenatus] occur. More mobile species include the gastropod [Calliostoma zizyphinum], the crab [Cancer pagurus] and the echinoderms [Asterias rubens] and [Echinus esculentus]. Two variants have been described: Tide-swept kelp forest (LhypT.Ft) and tide-swept kelp park (LhypT.Pk).

Situation: This biotope occurs below [Alaria esculenta] (Ala) at exposed sites or [L. digitata] (Ldig.Ldig) at moderately exposed locations. With increasing depth the kelp density diminishes to become tide-swept kelp park (LhypT.Pk).

A4.13: Mixed faunal turf communities on circalittoral rock

This habitat type occurs on wave-exposed circalittoral bedrock and boulders, subject to tidal streams ranging from strong to moderately strong. This complex is characterised by its diverse range of hydroids ([Halecium halecinum], [Nemertesia antennina] and [Nemertesia ramosa]), bryozoans ([Alcyonidium diaphanum], [Flustra foliacea], [Bugula flabellata] and [Bugula plumosa]) and sponges ([Scypha ciliata], [Pachymatisma johnstonia], [Cliona celeta], [Raspailia ramosa], [Esperiopsis fucorum], [Hemimycale columella] and [Dysidea fragilis]) forming an often dense, mixed faunal turf. Other species found within this complex are [Alcyonium digitatum], [Urticina felina], [Sagartia elegans], [Actinothoe sphyrodeta], [Caryophyllia smithii], [Pomatoceros triqueter], [Balanus crenatus], [Cancer pagurus], [Necora puber], [Asterias rubens], [Echinus esculentus] and [Clavelina lepadiformis].

A4.131: Bryozoan turf and erect sponges on tide-swept circalittoral rock

This biotope is typically found on wave-exposed circalittoral bedrock or boulders subject to tidal streams ranging from moderately strong to strong. It often has a thin layer of silt covering the seabed, and is characterised by a bryozoan/hydroid turf with erect sponges. Typical bryozoans to be found include crisiids, [Alcyonidium diaphanum], [Flustra foliacea], [Pentapora foliacea], [Bugula plumosa] and [Bugula flabellata], while typical hydroids include [Nemertesia antennina], [Nemertesia ramosa] and [Halecium halecinum]. The soft coral [Alcyonium digitatum] is frequently recorded on the tops of boulders and rocky outcrops. Characteristic erect sponges include [Raspailia ramosa], [Stelligera stuposa] and [Stelligera rigida]; other sponges present include [Cliona celata], [Dysidea fragilis], [Pachymatisma johnstonia], [Polymastia boletiformis], [Hemimycale columella], [Esperiopsis fucorum], [Polymastia mamillaris] and [Tethya aurantium]. Other species present include [Caryophylia smithii], [Actinothoe sphyrodeta], [Corynactis viridis], [Urticina felina], [Balanus crenatus], [Asterias rubens], [Marthasterias glacialis], [Henricia oculata], [Echinus esculentus], [Clavelina lepadiformis], [Calliostoma zizyphinum] and [Necora puber]. Three variants of this biotope have been described, but all are characterised by a bryozoan turf with erect sponges. ByErSp.Eun is found primarily on circalittoral bedrock and is dominated by the seafan [Eunicella verrucosa]. ByErSp.DysAct is found under slightly stronger tide-swept conditions, and is characterised particularly by the sponge [D. fragilis] and the anemone [A. sphyrodeta]. Finally ByErSp.Sag is characterised by the anemone [Sagartia elegans].

A4.1311: [Eunicella verrucosa] and [Pentapora foliacea] on wave-exposed circalittoral rock

This variant typically occurs on wave-exposed, steep, circalittoral bedrock, boulder slopes and outcrops, subject to varying tidal streams. This silty variant contains a diverse faunal community, dominated by the seafan [Eunicella verrucosa], the bryozoan [Pentapora foliacea] and the cup coral [Caryophyllia smithii]. There are frequently numerous [Alcyonium digitatum], and these may become locally abundant under more tide-swept conditions. [Alcyonium glomeratum] may also be present. A diverse sponge community is usually present, including numerous erect sponges; species present include [Cliona celata], [Raspailia ramosa], [Raspailia hispida], [Axinella dissimilis], [Stelligera stuposa], [Dysidea fragilis] and [Polymastia boletiformis]. [Homaxinella subdola] may be present in the south west. A hydroid/bryozoan turf may develop in the understorey of this rich sponge assemblage, with species such as [Nemertesia antennina], [Nemertesia ramosa], crisiids, [Alcyonidium diaphanum] and [Bugula plumosa]. The sea cucumber [Holothuria forskali] may be locally abundant, feeding on the silty deposits on the rock surface. Other echinoderms encountered include the starfish [Marthasterias glacialis] and the urchin [Echinus esculentus]. Other fauna includes aggregations of colonial ascidians [Clavelina lepadiformis] and [Stolonica socialis]. Anemones such as [Actinothoe sphyrodeta] and [Parazoanthus axinellae] may be seen dotted across the rock surface. This biotope is present in south west England and Wales.

Situation: This biotope is commonly found on rocky outcrops, surrounded by coarse sediment. This may be in the form of shelly gravel or muddy gravel, supporting [Urticina felina], [Cerianthus lloydi] and [Neopentadactyla mixta]. Above ByErSp.Eun, dense kelp forest containing [Saccorhiza polyschides] is usually found.

A5.51: Maerl beds

Beds of maerl in coarse clean sediments of gravels and clean sands, which occur either on the open coast or in tide-swept channels of marine inlets (the latter often stony). In fully marine conditions the dominant maerl is typically [Phymatolithon calcareum] (A5.511), whilst under variable salinity conditions in some sealochs beds of [Lithothamnion glaciale] (A5.512) may develop.

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