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Method for creating a composite map of Annex I Submarine structures made by leaking gases for Croker Carbonate Slabs cSAC/SCI

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Summary

This report details the input data and method used to create a composite Habitats Directive Annex I feature extent map, of Submarine structures made by leaking gases for the Croker Carbonate Slabs cSAC/SCI.

Existing polygon data from three previous habitat maps was combined with groundtruthing point information, to build up a composite image of “High” and “Potential” Annex I feature within the site.

Contents

1 Introduction

1.1 Requirement

Submarine structures made by leaking gases (hereafter referred to as "submarine structures") are listed for protection under Annex I of the Habitats Directive (92/43/EEC1). This means that the UK has an obligation to provide protection for this feature through the establishment and management of Special Areas of Conservation (SACs). To aid in the protection and reporting for this feature and the designation and delineation of SACs, JNCC produces extent maps for the feature where sufficient data exist.

Figure 1. Location of Croker Carbonate Slabs cSAC/SCI.

Croker Carbonate Slabs candidate SAC (cSAC)/Site of Community Importance (SCI) has been the subject of 3 habitat mapping efforts derived from data collected across surveys in 2008 (CEND1108), 2013 (CEND0513) and 2015 (CEND2315). Polygon outputs from all three surveys have been produced describing the (potential) extent of methane-derived authigenic carbonate (MDAC, a type of submarine structure) or hard substrate across the site, however each dataset does not provide a complete picture by itself and conflicts exist between the described extents between the datasets where they overlap.

In order to provide advice based on the best available evidence on the presence and extent of submarine structures within the site we identified a need for a single composite map, including extent information from all three surveys and including consistent logic in resolving differences between the datasets.

1.2 Input datasets

1.2.1 High/Low relief MDAC from CEND1108

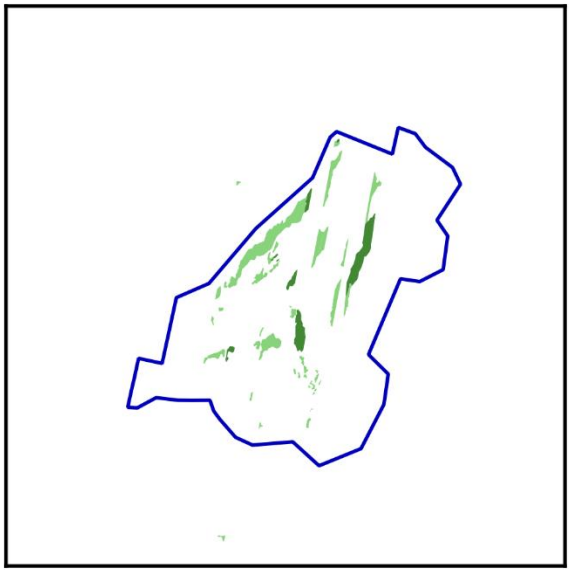

Figure 2. Extent of MDAC (High relief = dark green, Low relief = light green) from CEND1108. Croker cSAC boundary shown in blue outline.

Purpose of map: to show the likely extent of MDAC in the area to provide evidence to inform the identification of the Croker Carbonate Slabs SAC (SAD reference).

Derived from: side-scan sonar and imagery from survey CEND1108 (Whomersley *et al* 2010).

Coverage and extent: extent of side-scan sonar tracks covered by CEND1108. Mapping method: manual delineation of MDAC, split into "High" and "Low" relief.

Comparison: this has the smallest study area of the three maps. It is the only one with a distinction between high and low relief.

1.2.2 Hard substrate from CEND0513

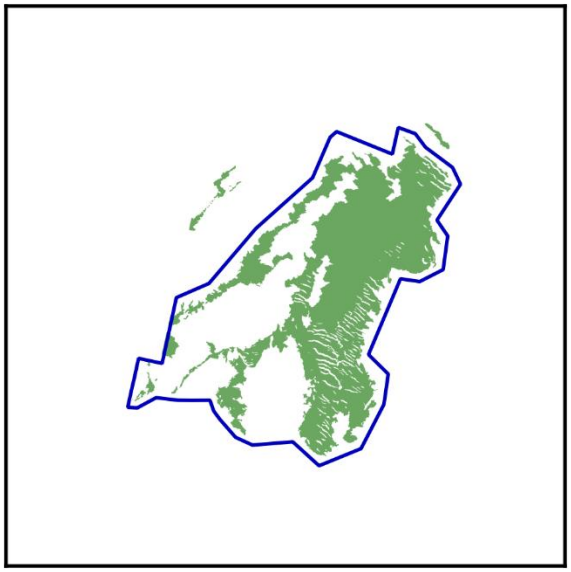

Figure 3. Extent of hard substrate (potential Annex I feature) from CEND1503. Croker cSAC boundary shown in blue outline.

Purpose of map: to show the likely extent of all broad-scale habitats within the North St George's Channel recommended Marine Conservation Zone (rMCZ) to provide evidence under Defra's MCZ Verification process.

Derived from: multi-beam echo sounder, grab samples and imagery from survey CEND0513 (Callaway *et al* 2015).

Coverage and extent: full-coverage within the boundaries of the rMCZ, which includes all of Croker Carbonate Slabs cSAC/SCI.

Mapping method: image segmentation using Object Based Image Analysis (OBIA) and subsequent classification using 'Random Forest'.

Comparison: this has the greatest coverage of the three maps; however, its primary purpose was to map all areas of hard substrate at the surface rather than MDAC alone.

1.2.3 MDAC from CEND2315

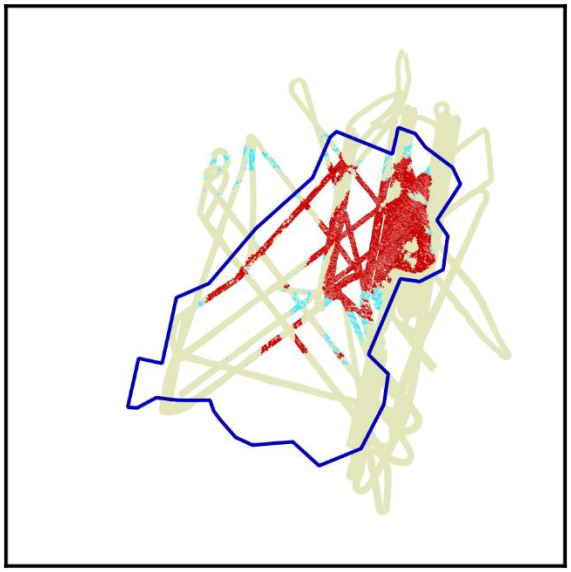

Figure 4. Extent of MDAC (High confidence = red, Low confidence = blue, not predicted = beige) from CEND2315. Croker cSAC boundary shown in blue outline.

Purpose of map: to use the most up-to-date evidence to show the likely extent of MDAC at or near the surface within Croker Carbonate Slabs cSAC/SCI.

Derived from: multi-beam echo sounder, grab sampling (with subsequent isotope analysis) and video imagery from survey CEND2315 (Noble-James *et al* 2017).

Coverage and extent: extent of multi-beam echo sounder tracks covered by CEND2315.

Mapping method: image segmentation of bathymetry, backscatter intensity and other multi-beam derivatives using OBIA. Classification using a rule-based approach, using groundtruthing describing presence of MDAC from still images or grab samples. Due to the presence-only method used in the creation of the dataset, areas where the analysis did not result in an MDAC prediction, should not be taken as evidence of a lack of MDAC. A qualitative confidence assessment was undertaken alongside the creation of the dataset, with polygons classes as increasing confidence from 0 to 4.

Comparison: this uses the most up-to-date data of the three maps, including samples that have been verified as MDAC or not using isotope analysis.

1.2.4 CEND2315 Groundtruthing data

Grab sample data collected via mini Hamon Grab during the CEND2315 survey was analysed for presence of MDAC using carbon isotope anaylsis, with 15 out of 46 samples positively identified for presence of MDAC (Noble-James *et al* 2017).

2 Method

2.1 Dataset preparation

2.1.1 CEND0513

An "extent of analysis" polygon was created for CEND0513 by dissolving the broad-scale habitat map. Within this area, polygons that were:

- determined to be hard substrate were attribute as “feature”;
- determined to be another broad-scale habitat were attributed as "not feature".

2.1.2 CEND2315

An "extent of analysis" polygon was created for CEND2315 by dissolving the the extent of the multi-beam echo sounder data used in in the model. Within this area, polygons that were:

- determined to be MDAC were attributed as “feature”, which was further subdivided by confidence score[1]:
  - confidence = 3 or 4 resulted in “high confidence feature”;
  - confidence = 0, 1 or 2 resulted in “potential feature”
- not predicted to be MDAC were attributed as “not predicted”.

2.1.3 CEND1108

Due to the manual delineation processes detecting clear and visible slabs, a lack of delineation within the area of side-scan sonar was not determined to describe a high confidence in lack of presence of MDAC. No distinction was therefore made outwith the delineated MDAC.

2.2 Dataset intersection and attribution

The three maps were used as input datasets in ArcGIS's Union tool, to produce an intersection of all possible combinations of classes. The output was then attributed confidence values based on agreement between the datasets (Table 1).

Table 1. Confidence values attributed to polygons by presence/non-presence of feature within the 3 input datasets. An asterisk (*) notes that a value was not required to determine final confidence.

CEND2315	CEND0513	CEND1108	Final confidence	Justification
High confidence feature	*	*	High	**Most up-to-date dataset shows high confidence in feature.**
Potential feature	*	Feature	High	**Low confidence in 2015 dataset supported by 2008 delineation**. 2013 dataset describes hard substrate which does not provide additional evidence as the two outputs are likely to concur due to similar methods.

[1] A value of 3 was chosen as the confidence threshold as the dataset authors state “In practice, this means that it is likely to find MDAC in areas with a total confidence of three and four” (Diesing *et al* 2017, unpublished)

Potential feature	*	Not identified	Potential	**Low confidence in 2015 data and not supported by 2008 data.** 2013 dataset describes hard substrate which does not provide additional evidence as the two outputs are likely to concur due to similar methods.
Not mapped as feature	Feature	*	Potential	**2015 dataset does not predict MDAC but, as stated by the authors, this does not provide evidence for lack of MDAC.**
Not mapped as feature	*	Feature	Potential	**2015 dataset does not predict MDAC but, as stated by the authors, this does not provide evidence for lack of MDAC.**
Not analysed	Feature	Feature	High	**Concurrence from 2013 and 2008 datasets increases likelihood of MDAC. No contradiction from 2015 dataset.**
Not analysed	Mapped as not feature	Feature	Potential	**Contradiction between 2013 and 2008 datasets with no additional evidence from 2008. 2013 modelling may have not identified all areas of MDAC.**
Not analysed	Feature	Not identified	Potential	Contradiction between 2013 and 2008 datasets with no additional evidence from 2008. 2008 delineation may have not identified all areas of MDAC.

2.3 Manual verification with groundtruthing

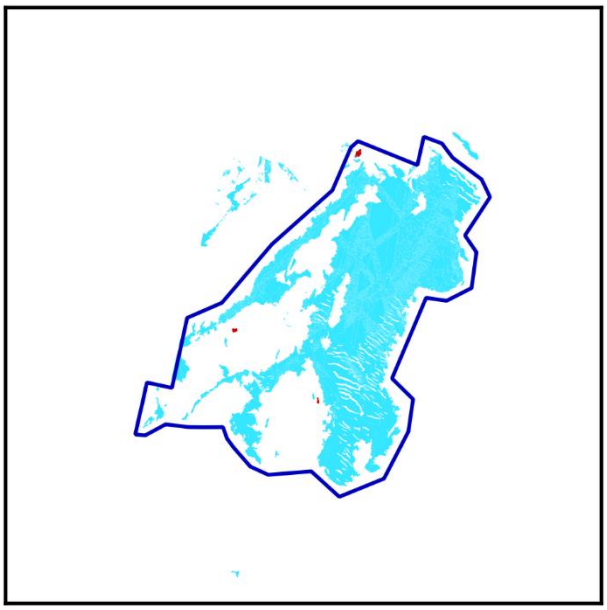

Figure 5. Extent of composite dataset in light blue. Areas in red manually attributed as "High" confidence due to presence of MDAC confirmed in grab samples.

Grab samples from CEND2315 that were tested for MDAC presence using isotope analysis were used to identify possible “high confidence” areas that were not attributed as such in the output of the intersection method (section 2.2).

The output of the intersection step was dissolved, retaining single part features, to produce an overview of contiguous areas. Point records of confirmed MDAC were then used to select underlying areas of the polygon output with additional evidence of MDAC presence by location. Polygons with an area of over 0.1km^2 (Projection – EPSG:3035) were deselected to avoid over-extrapolation from the point data.

Polygons within the three remaining selected areas were attributed as “High” final confidence, and information regarding this manual further step was included in the “VAL_COMM” (validation comments) field within the dataset.

3 Final output

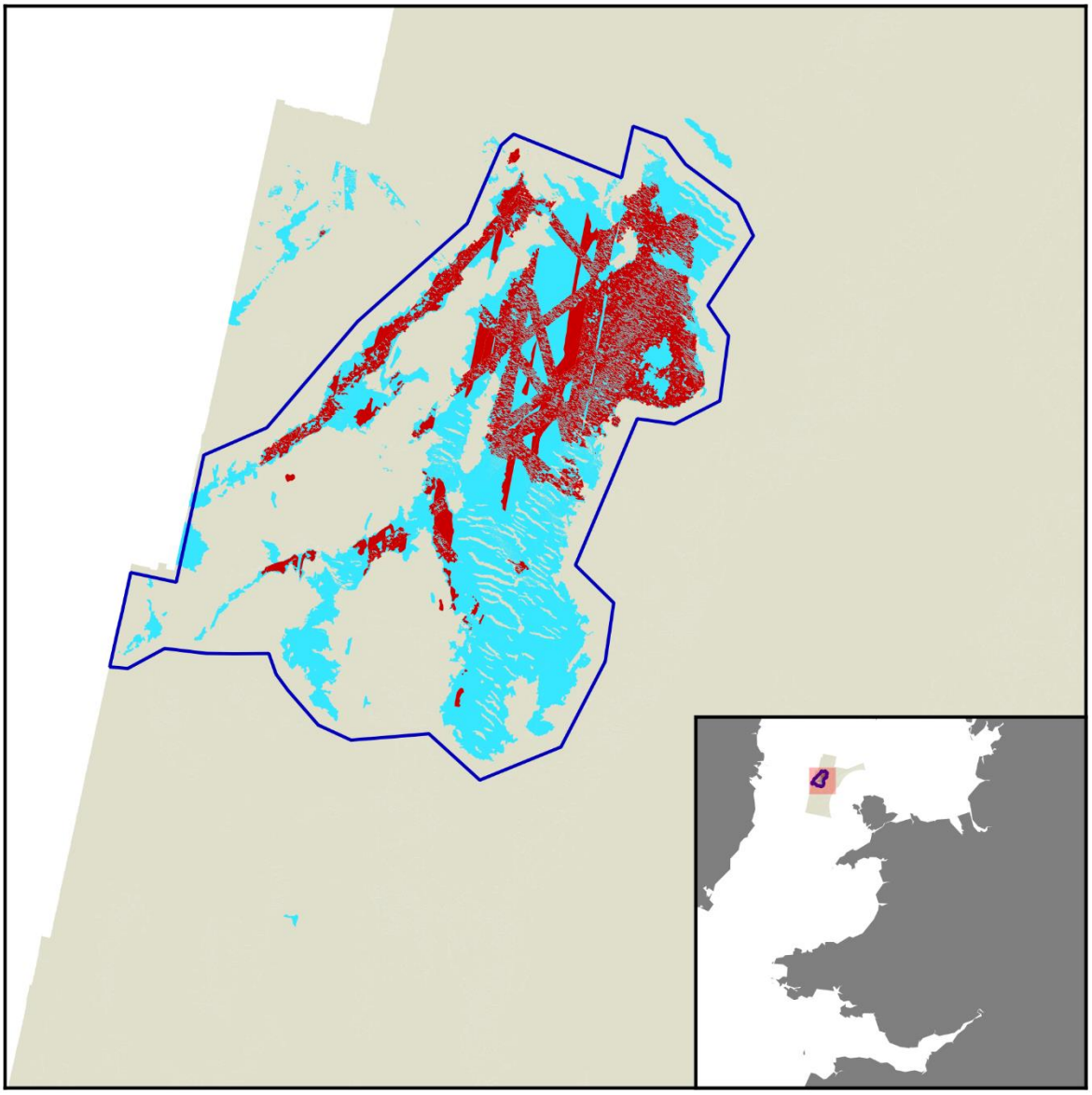

Figure 6. Final composite map. Areas of "High" confidence in red, "Potential" feature in light blue. Light grey shows the maximum extent of the analysis.

4 References

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