JNCC/Cefas Partnership Report Series

Report No. 39

Cromer Shoal Chalk Beds MCZ, Orford Inshore MCZ, West of Wight-Barfleur MCZ and East of Start Point MCZ Survey Report 2021

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February 2023

ISSN 2051-6711

CEND0121

Cromer Shoal Chalk Beds MCZ, Orford Inshore MCZ, West of Wight-Barfleur MCZ and East of Start Point MCZ

2021 Survey Report

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February 2023

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This report should be cited as:
Stones, S., Bullimore, R., T. Noble-James & Lake, I. (2023). Cromer Shoal Chalk Beds MCZ, Orford Inshore MCZ, West of Wight-Barfleur MCZ and East of Start Point MCZ Survey Report 2021. JNCC/Cefas Partnership Report No. 39. JNCC, Peterborough, ISSN 2051-6711, © Cefas, JNCC, Natural England 2022.
https://hub.jncc.gov.uk/assets/ff943b46-7d27-4dd0-bbf8-d0bf4ace7623

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Funded by:
Department for Environment, Food and Rural Affairs (Defra)
Marine and Fisheries Directorate
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Abbreviations

2IC	Deputy Scientist in Charge
ASLF	Aggregate Levy Sustainability Fund
BACI	Before-After-Control-Impact
BSH	Broadscale Habitats
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CSCB	Cromer Shoal Chalk Beds MCZ
CTD	Conductivity, Temperature and Depth
Defra	Department for Environment, Food and Rural Affairs
DC	Drop Camera
EA	Environment Agency
EOL	End of Line
EOSP	East of Start Point MCZ
EUNIS	European Nature Information System
GIS	Geographic Information System
GPS	Global Positioning System
HiPAP	High Precision Acoustic Positioning
IHO	International Hydrographic Organisation
JNCC	Joint Nature Conservation Committee
MBES	Multibeam echosounder
MCZ	Marine Conservation Zone
MHM	Mini Hamon Grab
MPA	Marine Protected Area
NE	Natural England
NIS	Non-Indigenous Species
ORIN	Orford Inshore MCZ
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
PSA	Particle Size Analysis
QA	Quality Assurance
ROG	Recommended Operating Guidelines
RV	Research Vessel
SAC	Special Area of Conservation
SIC	Scientist in Charge
SNCB	Statutory Nature Conservation Body
SOL	Start of Line
SPA	Special Protected Area

STR	Subsea Technology & Rentals
T0	First point in a monitoring time series
T1	Second point in a monitoring time series
UTC	Coordinated Universal Time
WWBF	West of Wight-Barfleur MCZ

1 Background and introduction

Marine Conservation Zones (MCZs) are designed to meet conservation objectives under the Marine and Coastal Access Act (2009). These sites also contribute to an ecologically coherent network of Marine Protected Areas (MPAs) across the North-east Atlantic, as agreed under the Oslo Paris (OSPAR) Convention and other international commitments to which the UK is a signatory.

MCZ monitoring is carried out by the Statutory Nature Conservation Bodies (SNCBs) to meet the requirements of the Marine and Coastal Access Act (2009). SNCBs are responsible for assessing the degree to which conservation objectives for sites are being achieved, Natural England (NE) is the SNCB responsible for inshore nature conservation (i.e. up to 12 nm (22 km) from the coast), whilst the Joint Nature Conservation Committee (JNCC) is responsible for the offshore area (i.e. between 12 nm and 200 nm (370 km) from the coast).

The CEND0121 survey was delivered by Cefas in partnership with Natural England and JNCC, visiting sites within both inshore and offshore areas. These sites are briefly described in Sections 1.1 to 1.4, with the features for which the sites have been designated listed in Table 1. The site locations are presented in Figure 1.

The CEND0121 survey was conducted onboard the Research Vessel (RV) *Cefas Endeavour*, between 9 and 30 January 2021. The survey visited four MCZs; Cromer Shoal Chalk Beds (CSCB), Orford Inshore (ORIN), West of Wight-Barfleur (WWBF) and East of Start Point (EOSP), acquiring data to support monitoring of the designated features of these MCZs (as briefly described in the following sections). This report presents information on the survey design and methodology, the events of the survey and the data collected.

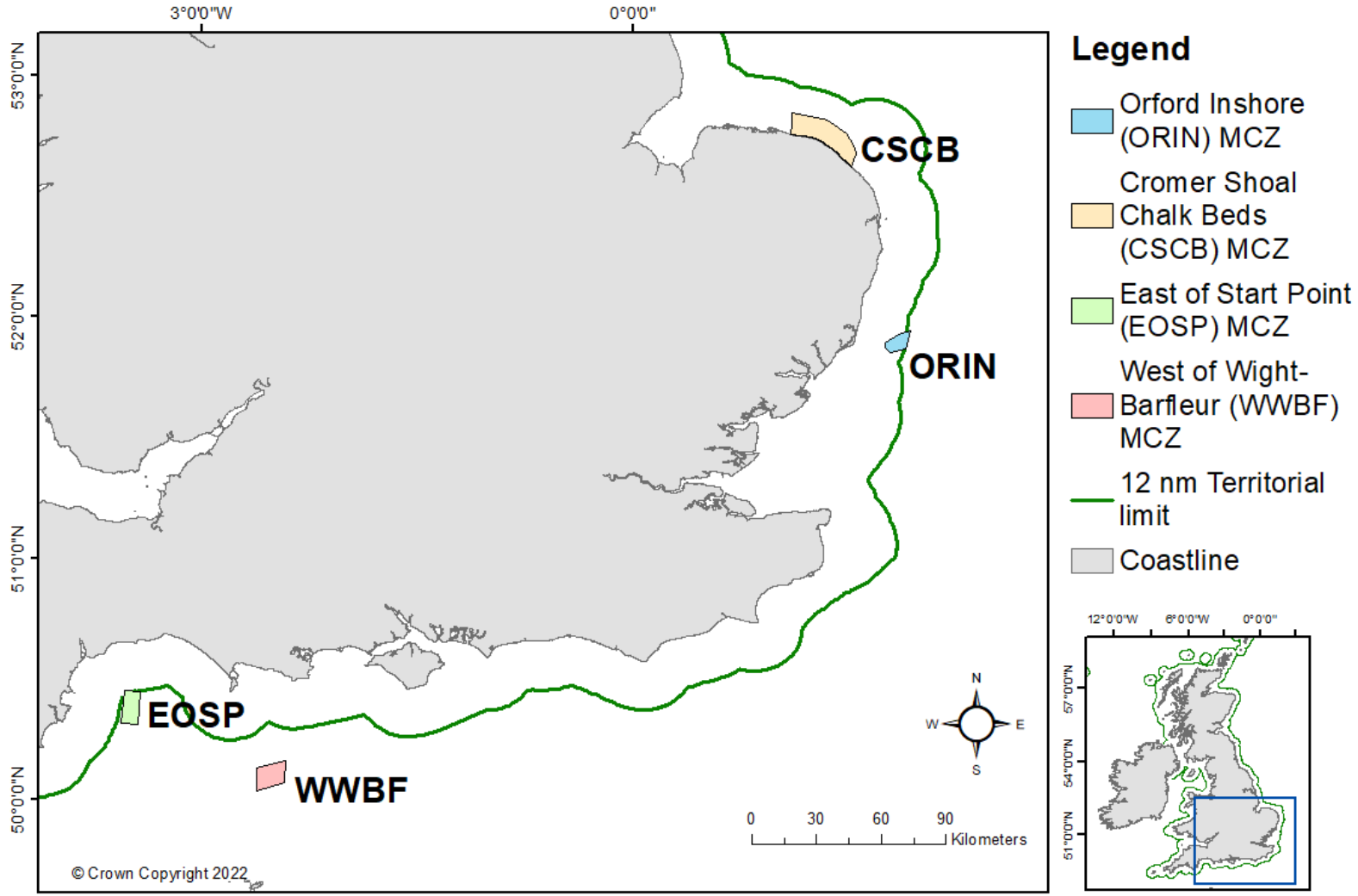

Figure 1. Map showing the locations of East of Start Point (EOSP), West of Wight-Barfleur (WWBF), Orford Inshore (ORIN) and Cromer Shoal Chalk Beds (CSCB) MCZs, visited on the CEND0121 survey in January 2021.

1.1 Cromer Shoal Chalk Beds (CSCB) MCZ

Cromer Shoal Chalk Beds (CSCB) MCZ was designated in January 2016 for a range of subtidal sediment and rock features, including 'Subtidal chalk' and 'Peat and clay exposures'. Its inshore boundary lies 200 m off the North Norfolk coastline. The northern boundary of the MCZ is located west of Weybourne and the southern boundary west of Happisburgh. The site extends up to 10 km out to sea and covers an area of 321 km^2. The MCZ overlaps with the Greater Wash Special Protected Area (SPA), designated for non-breeding red-throated diver, common scoter and little gull, and three species of breeding tern.

1.2 Orford Inshore (ORIN) MCZ

Orford Inshore (ORIN) MCZ was designated in May 2019 for subtidal mixed sediments. It is an inshore site that extends into offshore waters, covering a total area of approximately 72 km². The site is located off the Suffolk coast in the Southern North Sea, approximately 14 km offshore from the Alde Ore Estuary. As the majority of the site is located within inshore waters less than 12 nm from the coast, Natural England is the leading SNCB responsible for the site. However, ORIN MCZ is a joint site for NE and JNCC, as the eastern section of the site intersects the 12 nm inshore-offshore boundary and a small proportion of it is located within offshore waters. The site overlaps with the Southern North Sea Special Area of Conservation (SAC), designated for harbour porpoise.

Although ORIN MCZ mainly consists of mixed sediments, subtidal sand and coarse sediments are also present. These subtidal sediments form important nursery grounds for various fish species and provide habitat for infaunal invertebrates and burrowing megafauna.

1.3 East of Start Point (EOSP) MCZ

Designated in May 2019, East of Start Point (EOSP) MCZ is located in the Eastern Channel region, approximately 25 km East of Torbay and 30 km southwest from Lyme Bay. The site covers 116 km^2 of seabed and depths within the site range from 25 to 50 m. Existing data indicate the site is predominantly composed of subtidal sand.

1.4 West of Wight-Barfleur (WWBF) MCZ

Designated in May 2019, West of Wight-Barfleur (WWBF) MCZ is located within the English Channel region. This site protects 138 km^2 of seabed and depths within the site range from 50 to 100 m. The seabed within WWBF is predominately composed of subtidal coarse and mixed sediments.

Table 1. Features for which the MCZs covered in this survey report have been designated.

MCZ	Designated Feature	Feature Type
Cromer Shoal Chalk Beds	Moderate energy infralittoral rock	Broadscale Habitat
	High energy infralittoral rock	Broadscale Habitat
	Moderate energy circalittoral rock	Broadscale Habitat
	High energy circalittoral rock	Broadscale Habitat
	Subtidal chalk	Broadscale Habitat
	Subtidal coarse sediment	Broadscale Habitat
	Subtidal mixed sediments	Broadscale Habitat
	Subtidal sand	Broadscale Habitat
	Peat and clay exposures	Habitat FOCI
	North Norfolk Coast (subtidal)	Geological feature

MCZ	Designated Feature	Feature Type
Orford Inshore	Subtidal mixed sediments	Broadscale Habitat
East of Start Point	Subtidal sand	Broadscale Habitat
West of Wight-Barfleur	Subtidal coarse sediment	Broadscale Habitat
	Subtidal mixed sediments	Broadscale Habitat

2 Survey objectives

The vessel departure was delayed from the original schedule (detailed in Section 4), therefore it was necessary to re-prioritise the survey objectives. The original objectives are shown in Figure 2, with de-prioritised objectives crossed out. Operations displayed below were listed in order of anticipated survey activity, with the relative priority detailed. The original detailed monitoring objectives and sub-objectives for the survey are supplied in Annex 2 (Table 6 to Table 9), however it should be noted that they could not all be addressed in the final re-prioritised survey plan.

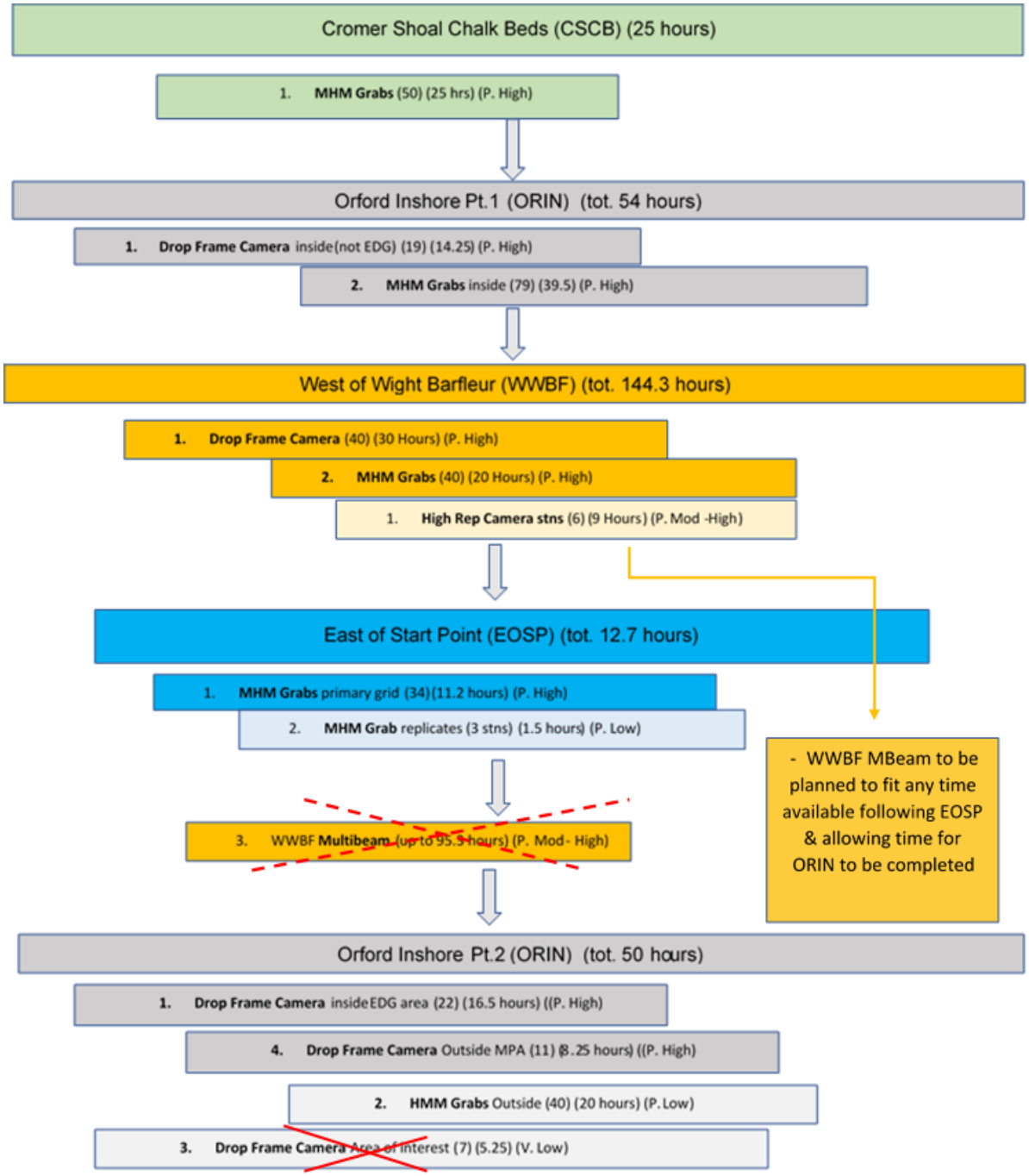

Figure 2. Decision tree detailing operational survey objectives, listed in order of priority. MHM = mini Hamon grab, P = priority. Solid line = dropped, Dashed line = contingency. Colours indicate different sites; paler boxes indicate lower priority.

Please note the survey Plan of Action document, which details the full rationale for undertaking the survey and for the planned survey design, is available on request from JNCC.

3 Survey design and methods

3.1 Survey design

Individual survey designs were developed for each MCZ, to target the designated biodiversity features of interest (Sections 3.1.1 to 3.1.4).

3.1.1 Cromer Shoal Chalk Beds (CSCB) MCZ

The primary aim of the CSCB survey was to collect biological and physical data to inform condition assessment of the feature attributes of the designated sediment features (extent, distribution, structure, function and supporting processes). Drop camera data had been previously collected to inform on hard substrate features and were therefore not part of the objectives for this survey. The monitoring survey objectives are presented in Annex 2 (Table 6).

The survey design was split into deeper and shallower sections (with the split falling along the 15 m depth contour), to be delivered by Cefas and Environment Agency (EA), respectively (Figure 3). A total of 80 grab stations (0.1 m^2 mini Hamon grab) were chosen to groundtruth acoustic data already existing for the site. Thirty stations were selected to be surveyed by the EA, with 50 being surveyed onboard RV *Cefas Endeavour* during CEND0121. These stations only are shown in Figure 3.

In the east of the site, a 2 km triangular grid was used to position the grab sampling stations. However, many of the locations had to be moved from the triangular grid to avoid seabed cable obstructions. In the west of the site, stations were selected to fill in areas with no previous data and also as repeats of sampling locations where both Particle Size Analysis (PSA) and biological data had been successfully acquired in 2014. Twenty-one stations were selected as repeat stations across the site[1].

The final planned survey design is presented in Figure 3.

[1] Stations 2, 7, 9, 11, 14, 15, 18, 19, 20, 30, 32, 33, 34, 36, 38, 41, 42, 61, 68, 72, 73

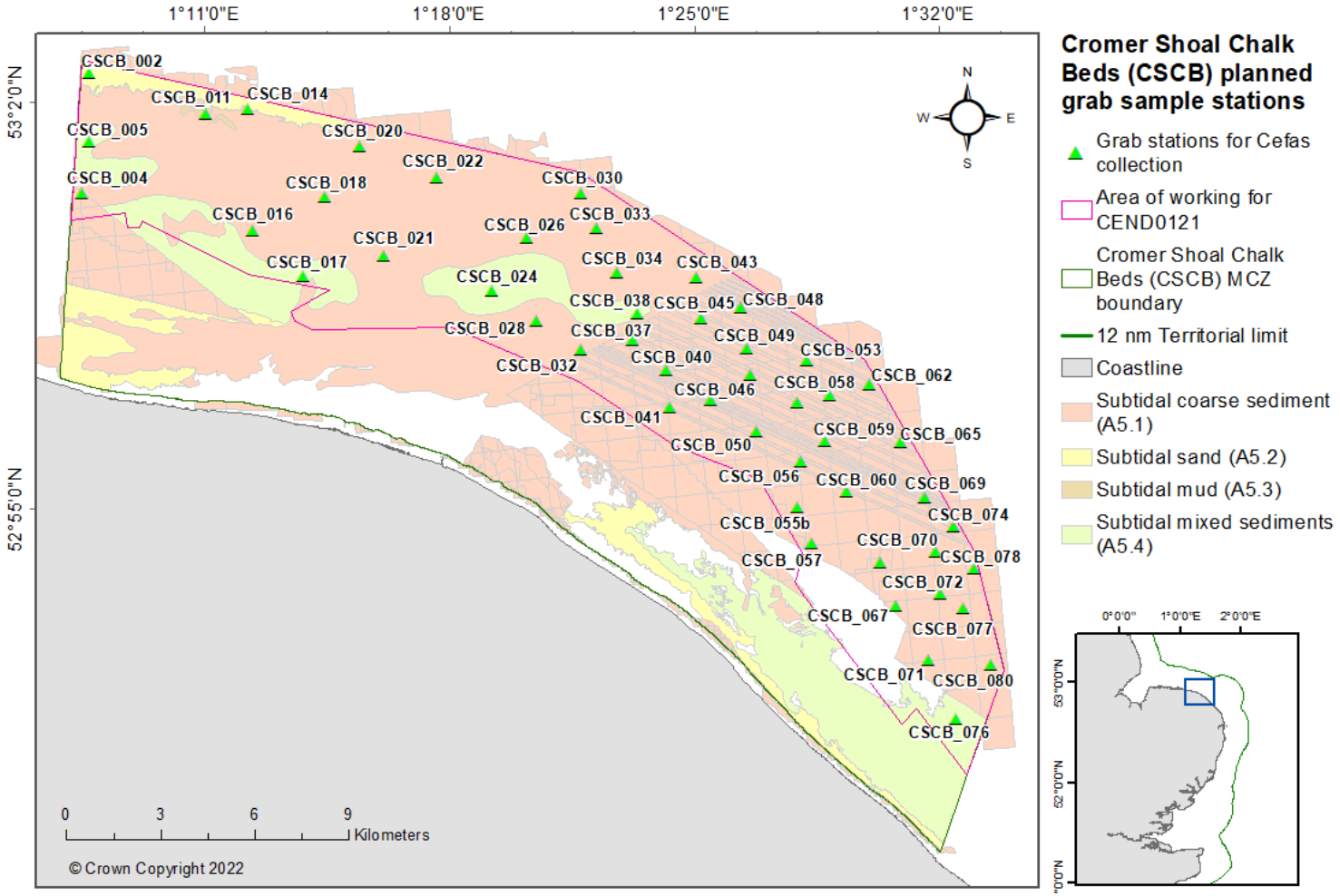

Figure 3. Map showing the locations of Cromer Shoal Chalk Beds (CSCB) MCZ Mini Hamon grab sample stations to be collected by Cefas survey CEND0121. Broadscale habitats shown from Natural England Marine Evidence Base. (Figure layers © Crown Copyright, Broadscale Habitat Layers © Natural England).

3.1.2 Orford Inshore (ORIN) MCZ

The primary aim of the ORIN survey was to collect biological and physical data to inform condition assessment of the feature attributes of the designated subtidal mixed sediments (extent, distribution, structure, function and supporting processes).

To fulfil the survey objectives (Annex 2; Table 7), the sampling design included more intensive sampling within 500 m x 500 m survey boxes, to reduce the inherent sample variability within the mobile mixed sediments feature, as well as wider sampling within the mixed sediments and other subtidal habitat types present within the site. Long camera tows (150 m) with frequent still imagery acquisition were planned to give sufficient coverage for characterisation of the seabed and the epifaunal communities.

The 0.1 m^2 mini Hamon grab stations were chosen based on a Broadscale Habitat map generated from a previous survey in 2012. Within the MCZ boundary, the grab station locations were chosen through a combination of random selection and re-sampling of a subset of grab stations sampled in 2012. Care was taken to avoid placing grab stations near any existing wrecks or cable installations.

In the north east of the site there is an area designated on the navigation charts as ‘Explosives/Ordnance Disposal Ground – disused’. In line with unexploded ordnance risk assessments for conducting seabed sampling, grab sampling was excluded from this area. Drop camera sampling within this area remained as planned.

The two 500 m x 500 m survey boxes, each with five grab stations with triplicate sampling, were positioned randomly within the ‘Subtidal mixed sediments’ habitat feature inside the MCZ boundary (Figure 4). Further grab stations (with no replicate sampling) were randomly placed within the ‘Subtidal mixed sediments’ and other habitat types (‘Subtidal sand’ and ‘Subtidal coarse sediment’) to provide sufficient coverage across the entire MCZ. Altogether, 28 grab stations (to collect 48 samples, including the triplicate sampling) were placed within the mixed sediments feature inside the MCZ, and an additional 17 stations were placed within the other habitat types present within the MCZ.

To enable future evaluation of management effectiveness, an additional survey box with five triplicate grab stations was placed outside the MCZ, based on a Before-After-Control-Impact (BACI) type survey design. A further 25 grab stations were also placed randomly outside the MCZ boundary for a wider characterisation and BACI assessment, however this was a lower priority.

The final planned survey design is presented in Figure 4 and 5.

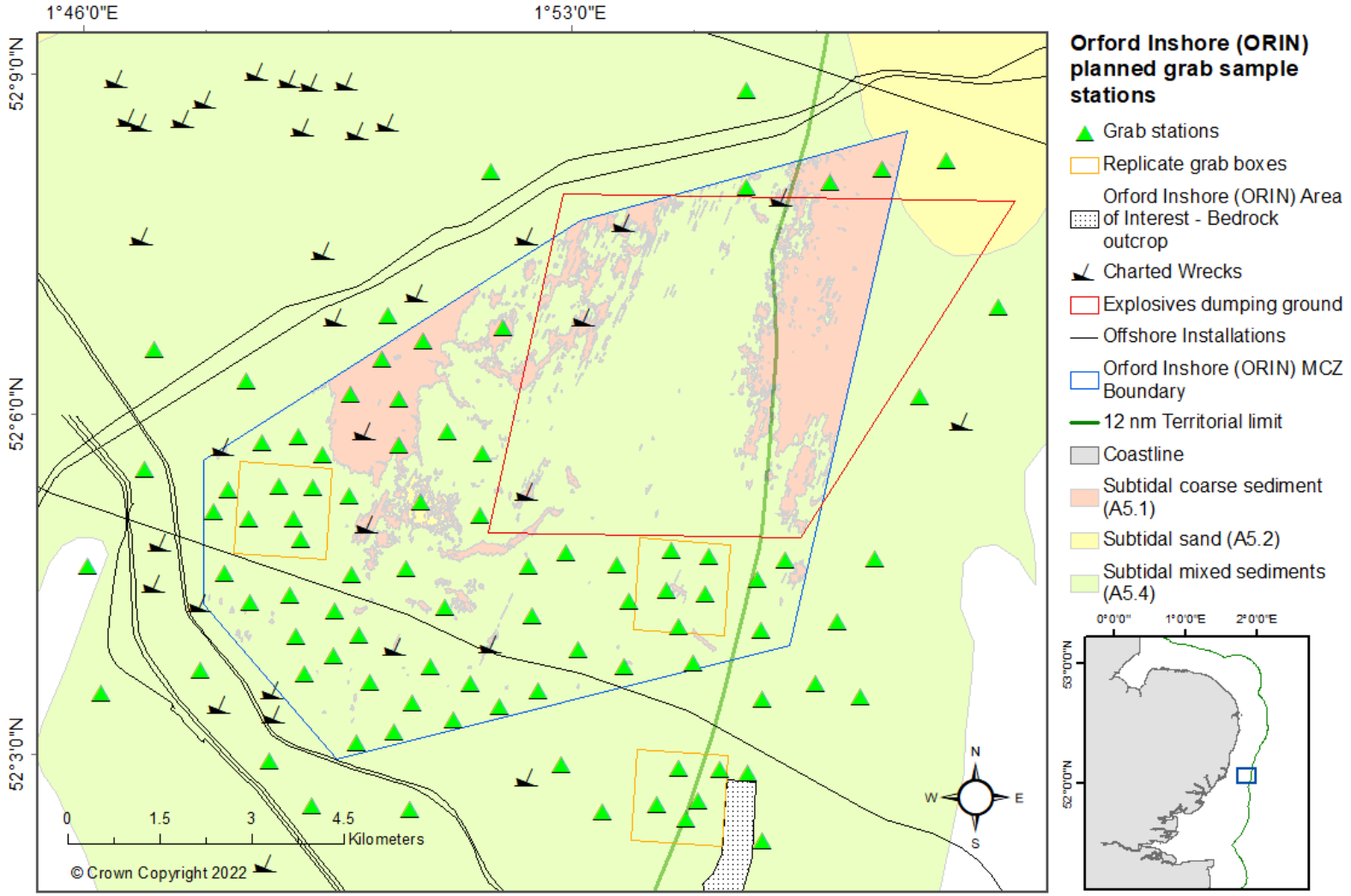

Figure 4. Map showing planned mini Hamon grab station locations for Orford Inshore (ORIN) MCZ (Figure layers © Crown Copyright, Broadscale Habitat Layers © Natural England).

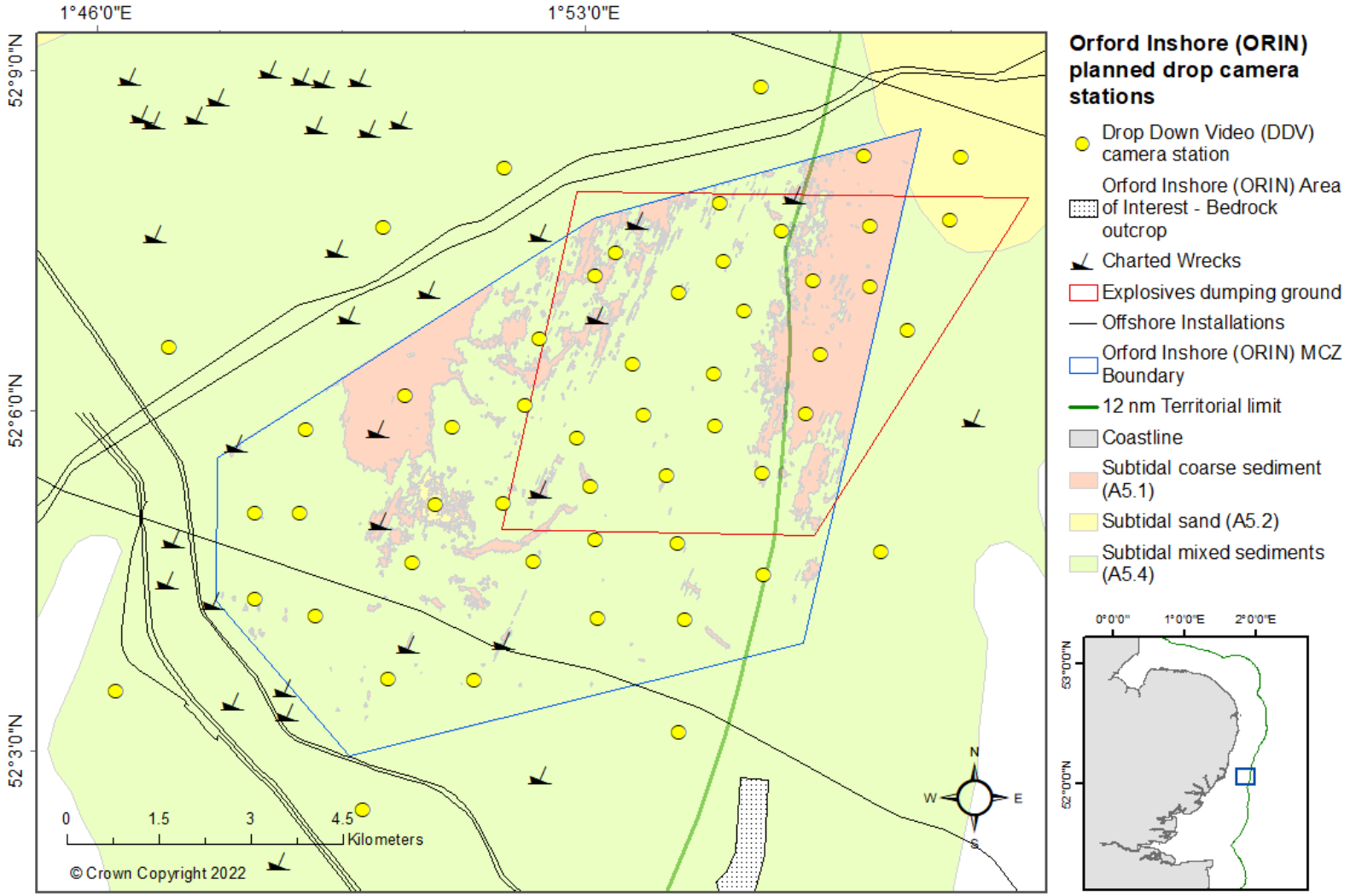

Figure 5. Map showing planned drop camera station locations for Orford Inshore (ORIN) MCZ. (Figure layers © Crown Copyright, Broadscale Habitat Layers © Natural England).

3.1.3 East of Start Point (EOSP) MCZ

The survey at EOSP was designed to gather the data for the first point in a monitoring time series. Monitoring survey objectives are presented in Annex 2 (Table 8).

A random sampling design, with stations placed across the entire MCZ, was selected after assessment of available data and following guidance given in Noble-James *et al*. (2018).

High replication grab samples (three mini Hamon grab replicates at three stations) were planned to be collected within the site from a subset of stations, to better understand the within-station variability of the habitat and communities. These data will be used to better understand whether single replicate sampling is the most effective approach for this MCZ.

Thirty-five grab stations were randomly generated using ArcGIS with a 1 km minimum distance between points, to reduce the probability of spatial autocorrelation (Olea 1984). A 500 m buffer from the edge of the MCZ was used to ensure stations were not close to its boundary. The number of grab stations was decided based on time available and achieving enough stations to provide good coverage across the site.

The final planned survey design is presented in Figure 6.

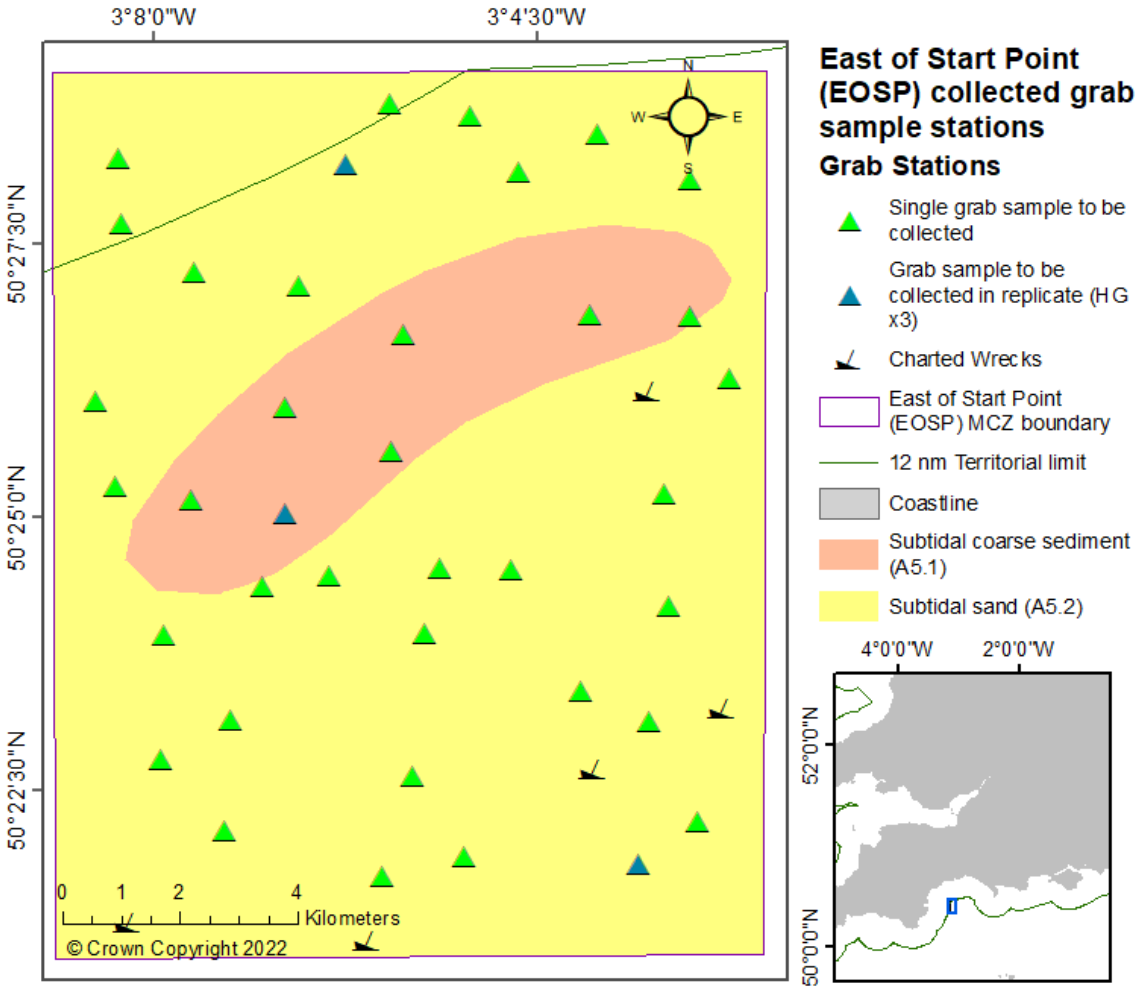

Figure 6. Map showing the planned station locations for Mini Hamon Grab (HG) sampling in East of Start Point (EOSP) MCZ, as created using random point generation with a minimum distance between points of 1 km (0.54 nm) (Figure layers © Crown Copyright and Broadscale Habitat Layers © JNCC/EU SeaMap).

3.1.4 West of Wight-Barfleur (WWBF) MCZ

The survey at WWBF was designed to gather data to form the first point in a monitoring time series and enable long-term monitoring. Monitoring survey objectives are presented in Annex 2 (Table 9).

Forty stations were positioned within WWBF using a 2 km triangular grid, which was selected to maximise coverage across the site and avoid pseudo-replication (Hurlbert 1984). These stations were to be sampled with a 100 m drop camera imagery transect and the mini Hamon grab if possible. Camera work was planned for completion first, to assess the benthic habitats present and determine whether a station could be effectively sampled using a grab. Where the imagery from the drop-frame camera indicated that grabbing at a given station would not be possible, grabbing would not be attempted.

Multibeam bathymetry and backscatter data were also planned to be acquired from WWBF, with survey coverage extending across as much of the site as possible (if available survey time permitted).

Six higher replication camera stations were selected to improve understanding of the small-scale variability within a single station. At the higher replication stations four camera transects were planned to bisect a 50 m bullring surrounding the station, with the aim to collect four parallel transects across the bullring (Figure 7). These higher replication imagery stations form part of the triangular grid system (Figure 8) and were the lowest priority sampling approach for the site.

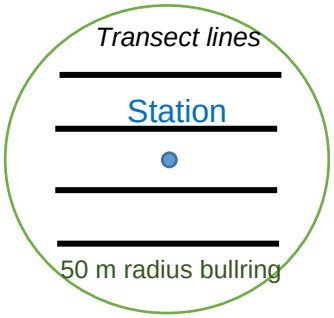

Figure 7. Diagram showing the higher replication bullring sampling methodology.

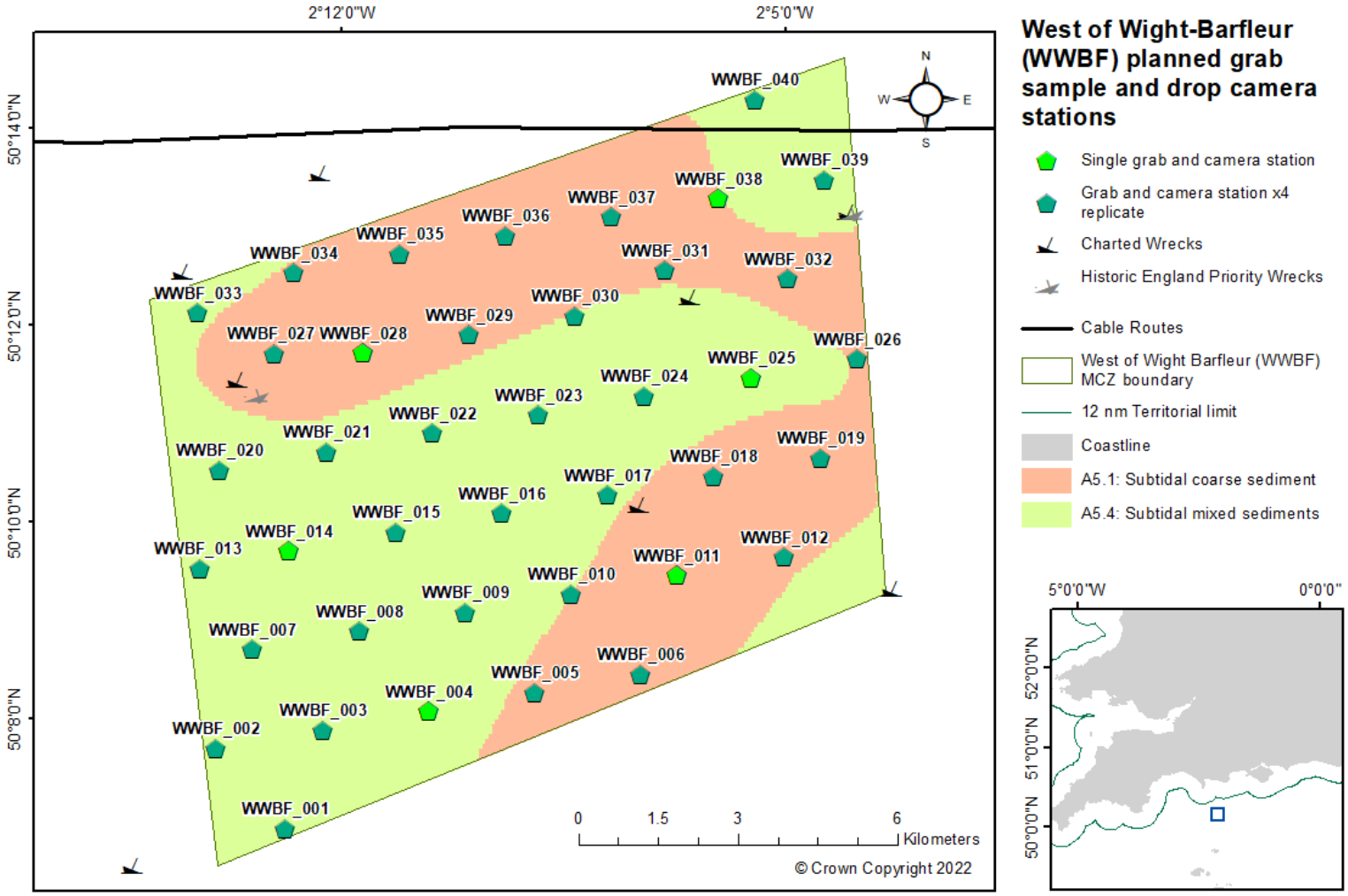

Figure 8. Map showing planned sampling locations for drop camera and mini Hamon grab samples at West of Wight-Barfleur (WWBF) MCZ, as positioned using a 2 km triangular grid. Higher replication imagery stations are also indicated (Figure layers © Crown Copyright and Broadscale Habitat Layers © JNCC/EU SeaMap).

3.2 Methods

The methods and equipment used on the CEND0121 survey are summarised below, with more detailed information provided in Annex 3.

3.2.1 Drop camera imagery sampling approach

Imagery data were acquired using a STR Seaspyder Telemetry still image camera and an STR SP-HDC-3000aw video camera, attached to a drop frame (see Annex 3 for a detailed specification).

The drop camera stations comprised single replicates of 100 m length (WWBF), limited replicate short 50 m transects (WWBF) and 150 m transects (ORIN) of simultaneously acquired still and video imagery data. Each station location was circled by a bullring of appropriate radius and the camera was deployed within the bullring to bisect the centre of the station. Still images were acquired using a downward facing camera with altimeter and taken on the downswing of the camera, aiming for an altitude of as close to 1 m off the seabed as practicable (as gauged from live altimetry readings). Still images were taken as frequently as possible, when a suitable altitude was reached, to ensure a data set of sufficient size. The vessel speed over ground was approximately 0.3 knots.

Camera settings and image quality were reviewed at the start of each tow at a new location or any tow where conditions were observed to have changed since the previous tow (e.g. visibility and availability of natural light, as varying by depth and time of day). Test images were taken, reviewed and camera settings adjusted accordingly to ensure image focus and exposure before data collection commenced.

Additional environmental data (ESM2 attached to camera system) was collected, with turbidity data being used (alongside altimetry) to help automate and standardise image categorisation (poor, moderate and good) prior to analysis.

3.2.2 Grab sampling approach

A 0.1 m^2 mini Hamon grab was used to sample the seabed for PSA and benthic macrofauna. Three grab attempts were completed at each station before moving on to the next station if sampling was unsuccessful. The samples were processed onboard with a subsample taken for PSA and the remainder of the sample sieved over a 1 mm sieve for macrofauna, as described in Annex 3.

The Aggregate Levy Sustainability Fund (ASLF) guidelines for sample volumes of greater than 5 L were adhered to where possible. However, where multiple attempts were made (and smaller samples consistently returned) valid samples of a smaller volume were retained at the discretion of the Scientist in Charge (SIC). Sample details and volumes are provided in Annex 4 (Table 11).

3.2.3 Multibeam echosounder

A calibration was performed on 27 January 2021 over the wreck of the SS Stanmount, located in the Southern North Sea. The UKHO wrecks database lists the known position of the Stanmount as; 52° 39.793' N, 02° 01.456' E. As the wreck location was known, a set of calibration lines were prepared, and data collected over the wreck. This allowed the angular offsets of the MBES system to be checked. This ensures that the RV Cefas Endeavour will collect MBES data to the standard as defined by the International Hydrographic Organization (IHO) s-44 order 1a, 6th edition (IHO 2020). A full calibration report is given in Annex 5.

3.2.4 Water sampling

Water samples were taken every 1 hour during transit and filtered on board for determination of chlorophyll and suspended particulate matter. These samples were acquired for analysis and reporting under existing projects, providing ground truthing data to calibrate SmartBuoy, Ferrybox and ocean colour space-borne data (for the EU FP7 project HIGHROC, C5878) and collectively informing policy reporting requirements for water quality and environmental impacts (eutrophication) from anthropogenic activities.

3.3 Survey project team

The survey team for the duration of CEND0121 included Cefas marine ecologists, marine surveyors, habitat mappers and a data manager. Table 2 details the assigned roles and responsibilities of staff onboard CEND0121.

Table 2. Roles across the 12 hour working shifts.

Shift Pattern	Role
0600-1800	SIC
0600-1800	2IC
0600-1800	Data Manager
1200-0000	Day Shift Lead
0000-1200	Night Shift Lead
1200-0000	Hydrographer
1200-0000	Marine Operations
0000-1200	Marine Operations
0000-1200	GIS
0000-1200	Survey Scientist
0000-1200	Survey Scientist
1200-0000	Survey Scientist
1200-0000	Survey Scientist

4 Operational summary and survey narrative

A summary of the CEND0121 survey dates is provided for individual MCZs in Table 3.

Table 3. Summary of CEND0121 survey dates and locations.

Marine Conservation Zone (MCZ)	Code	Survey Dates
Cromer Shoal Chalk Beds	CSCB	16 – 18 January 2021
Orford Inshore	ORIN	18 – 20 & 26 – 27 January 2021
East of Start Point	EOSP	22 – 23 January 2021
West of Wight-Barfleur	WWBF	22 – 25 January 2021

Across the entire survey window the below time was lost from anticipated operational time:

- Operational time lost due to COVID19 protocols was 4 days
- Operational time lost to weather was 29 hours.

A narrative of the CEND0121 survey onboard RV *Cefas Endeavour* is provided below. All times are UTC. Survey equipment and consumables were mobilised in advance of sailing.

Saturday 09 January: Scientists joined the vessel following COVID-secure procedures. A PCR test was taken by all vessel personnel, followed by an isolation period in cabins until negative results were received by all.

Saturday 16 January: A vessel familiarisation induction was held at 09:30 for all Cefas staff, the vessel held an Abandon Ship Drill at 10:30.

The vessel left port at 12:00. During the transit to Cromer Shoal Chalk Beds (CSCB) a toolbox safety talk was carried out with the day shift on the use of the Hamon Grab. The first grab sample was collected at 17:50.

Sunday 17 January Work continued at CSCB throughout Sunday 17 January.

Monday 18 January: By 08:00 48 of 50 stations had been visited. The second half of the survey at CSCB was quicker than the earlier stations, mostly due to the closer spacing and the higher occurrence of ‘no-samples’. There was a minor delay during the night shift due to a fire alarm (false alarm) and some remedial maintenance work to the Hamon Grab. At this point the survey aims, as revised on departure, remained on target.

Tuesday 19 January: Having finished the last station at CSCB the vessel made transit to Orford Inshore (ORIN). On arrival the drop camera was deployed, and a single tow was completed. Several issues with logging were detected after the data check and work-around plans were made. A second camera station was aborted due to poor visibility. The decision was made to wait for an hour to determine whether the slackening tide would improve the visibility, but this proved not to be the case. As the weather was forecast to worsen throughout the night, operations switched to the Hamon grab and the survey continued. Grabbing overnight was largely successful, with 17 stations visited. At approximately 06:00 the increasing wind and sea state caused the cessation of deck activities. After sampling ceased at 06:00 on the 19th Endeavour waited inshore for 3 hours for the forecasted easing of the wave height and wind speed. As the tide turned, the conditions improved, and operations recommenced at around 10:30 and continued throughout the day.

Wednesday 20 January: Grabbing routinely proceeded faster than sample processing and at 06:00 on the 20th a short break was called with only 5 more stations (of 74) remaining at ORIN. At 10:25 the final grab sample inside ORIN MCZ was collected and the vessel headed south towards East of Start Point (EOSP). The vessel sheltered from Storm Christophe overnight off Margate, Kent.

Thursday 21 January: The vessel upped anchor at 08:30 and moved slowly into the Dover Straits to transit to EOSP. Underway water samples were collected for salinity and nutrients on an hourly basis throughout.

Friday 22 January: The vessel arrived at EOSP at around 10:30 and grabbing operations commenced. Grabbing continued smoothly throughout both shifts.

Saturday 23 January: Grab operations at EOSP were completed at around 05:00 and the vessel made transit to West of Wight-Barfleur (WWBF). On arrival at WWBF the drop camera was deployed at 10:30. The first drop demonstrated that the visibility was suitable for acquiring good images. After a brief testing phase, the remainder of the day was spent collecting imagery.

Sunday 24 January: By 06:00 on the 24 half of the planned stations had been completed (20 of 40) with all stations sampled at that point having hard substrate not suitable for grabbing. The vessel continued with drop camera work at WWBF. At approximately 18:00 the weather and tide had increased to the point the ship was unable to hold position without the drop camera wire leading under the hull, so operations were ceased.

Monday 25 January: After waiting for the tide to turn, the drop camera was deployed again at 02:00. After the first camera dip following the break for weather and tide, there was a further delay as the data retrieval system for the cameras failed. A work-around was tested and implemented, and operations recommenced at 06:00. The final camera tow was completed at 12:45. The vessel then returned to ORIN, to make the most of the weather window predicted. A timed arrival was planned for 08:00.

Tuesday 26 January: The vessel arrived at ORIN at 08:00 and the drop camera was deployed. Poor visibility was observed at the first station but the transect was run. The second station was attempted at slack water when the tidal resuspension of sediments should have been at a minimum. As the visibility was even worse camera operations were suspended. The wind was forecast to increase for 24hrs, so operations switched to lower priority Hamon grabs and repeating those stations where previous sediment volumes were low.

Wednesday 27 January: Hamon grabbing continued into the morning of the 27. Once the grabbing was completed several more attempts were made using the drop camera, but the visibility was consistently too poor. The vessel moved to a wreck ~35 miles north and completed a multibeam calibration exercise before transiting to Lowestoft.

Thursday 28 January: The vessel docked in Lowestoft at approximately 08:00 and the survey demobilised.

5 Data acquired

All survey objectives planned upon vessel departure (Section 2 and Figure 2) were completed as planned, with the exception of ORIN video tows due to poor visibility conditions encountered. A summary of all samples collected is given in Table 4 and Table 5. Site specific summaries of samples collected are then given in the following sections.

5.1 Grab sampling and imagery data summary

Table 4. Summary of all sediment grab sampling on CEND0121.

Site	Sediment Sampling				Overall number of deployments
	Mini Hamon Grab				
	Successful Samples		No Samples (Sediment)		
	PSA	Biota/Infauna	No sample - (stations)	Total number of no sample deployments	
Cromer Shoal Chalk Beds MCZ	39	37	11	65	104
Orford Inshore MCZ	118	118	3	43	161
East of Start Point MCZ	44	44	0	1	45
West of Wight-Barfleur MCZ	-	-	-	-	-
Totals	**201**	**199**	**14**	**109**	**310**

Table 5. Summary of all Drop Camera imagery sampling on CEND0121.

Site	Imagery Sampling		
	Drop-Camera		
	Still Images (Stations / transects / number of stills)	Video (Stations / transects)	No. Sample deployments
Cromer Shoal Chalk Beds MCZ	-	-	-
Orford Inshore MCZ	2 / 2 / 134	2	7
East of Start Point MCZ	-	-	-
West of Wight-Barfleur MCZ	40 / 59 / 2274	40 / 59	-
Totals	**42 / 61 / 2408**	**42 / 61**	**7**

5.2 Cromer Shoal Chalk Beds (CSCB) MCZ

Of the 50 sediment sampling stations planned at CSCB, 37 stations were successfully sampled. Two stations returned samples only sufficient to be retained for Particle Size Analysis and no samples were retained from 11 stations (Table 4 and Figure 9).

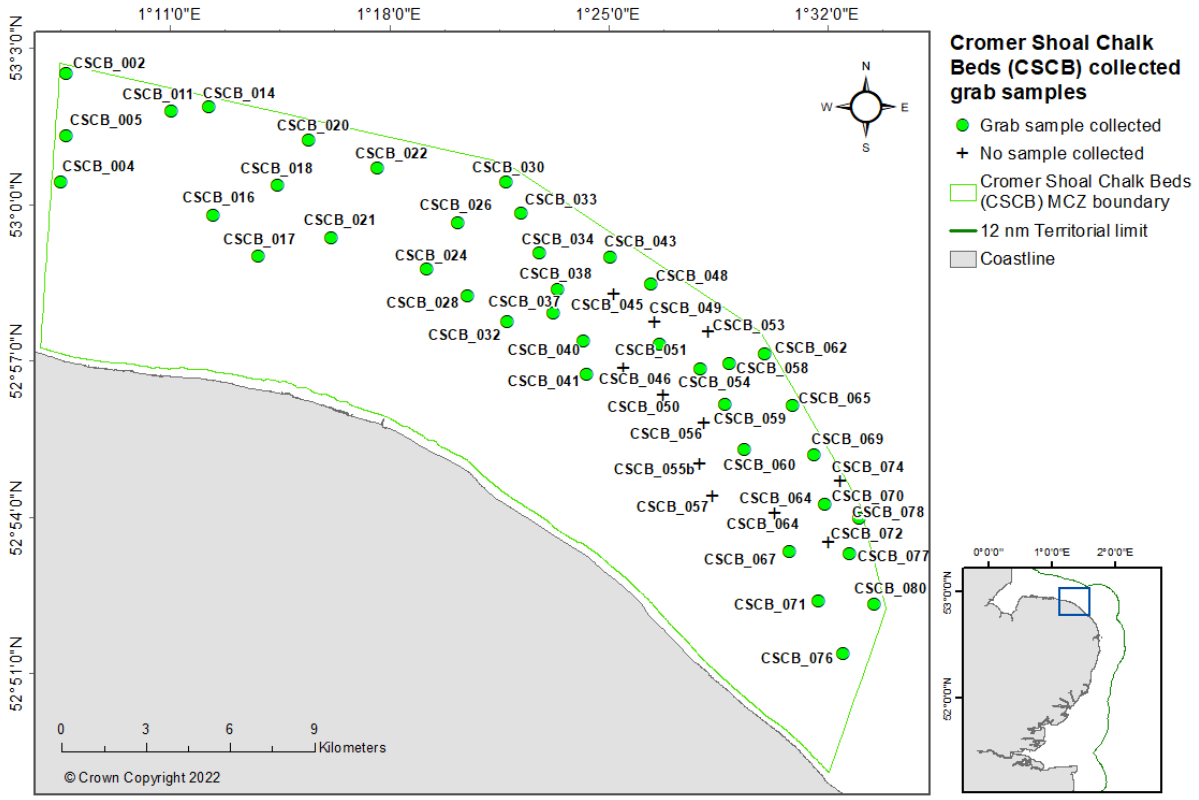

Figure 9. Map showing locations of single grab samples acquired (green circle) and grab samples attempted (but not acquired) at Cromer Shoal Chalk Beds (CSCB) MCZ on survey CEND0121.

5.3 Orford Inshore (ORIN) MCZ

All grab stations at ORIN were visited, with all being successfully sampled except three 'no sample' stations (due to insufficient sample volumes or cobbles preventing the Hamon grab jaw from closing).

Grab samples were acquired in triplicate from inside the planned replicate sampling boxes at ten sampling locations inside the MCZ and 5 stations outside the MCZ (Section 3.1.2, Figure 4 and Figure 10).

Drop camera tows were attempted at several locations (Figure 11) and during different tidal states, however these were not completed due to zero visibility making it unsafe to tow the camera system when the seabed and any possible obstructions could not be observed on the live video feeds. Video data and still images were recorded from two stations, however these similarly suffered from extremely poor visibility and could be used only for an indication of Broadscale Habitat.

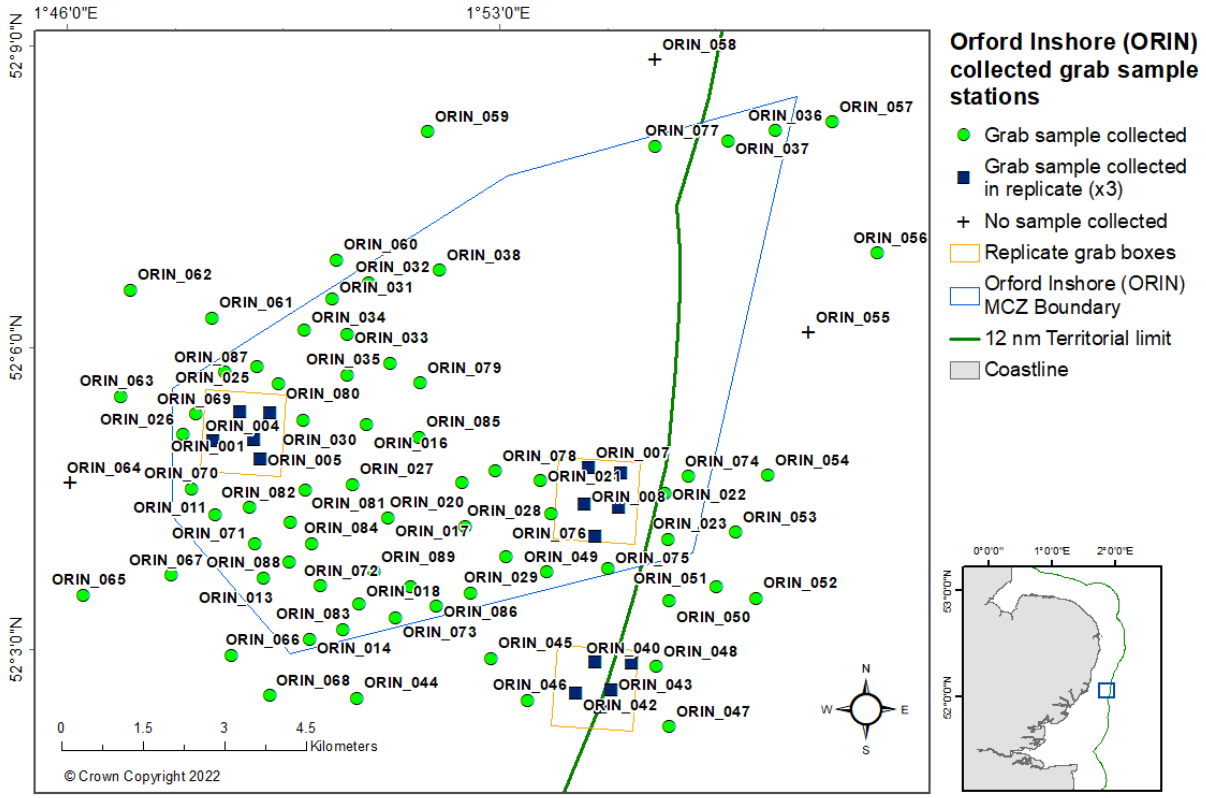

Figure 10. Map showing locations of single (green circle) and replicate (blue square) grab samples acquired, and grab samples attempted (but not acquired) at Orford Inshore (ORIN) MCZ on survey CEND0121.

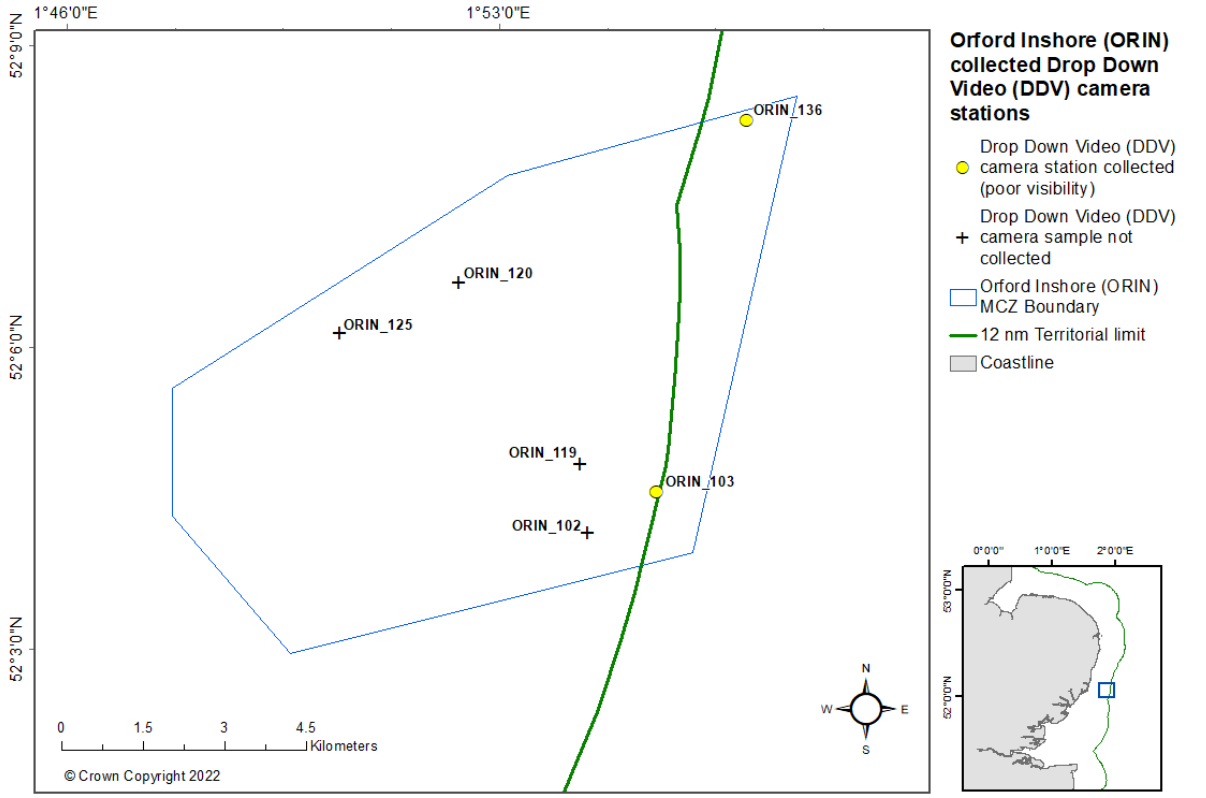

Figure 11. Map showing locations of a) successful but poor quality (yellow circle) and b) attempted but unsuccessful (black cross) drop camera stations at Orford Inshore (ORIN) MCZ on survey CEND0121.

5.4 East of Start Point (EOSP) MCZ

All planned grab samples (44 samples, 38 stations) were successfully collected at EOSP (Table 4 and Figure 12). Grab samples were acquired in triplicate from three locations.

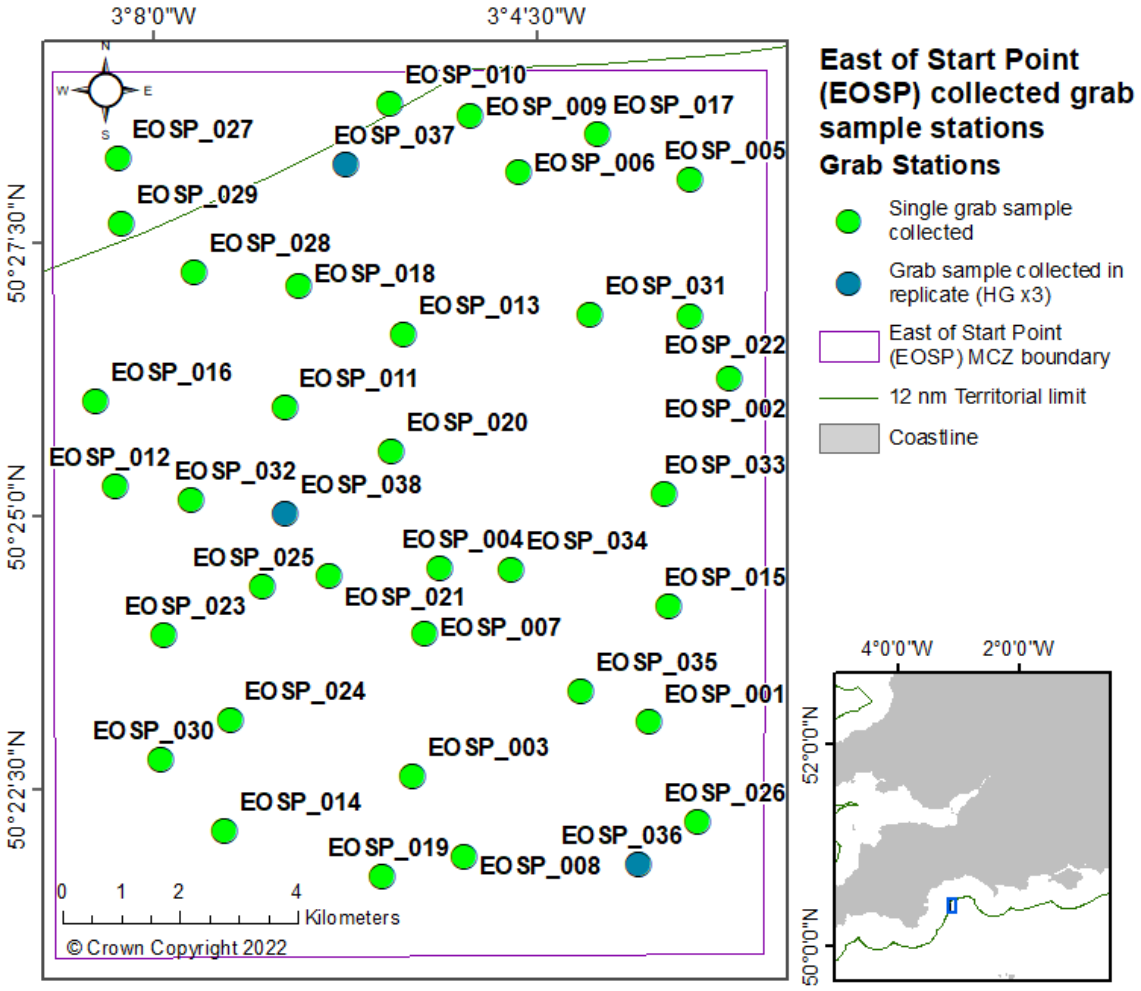

Figure 12. Map showing locations of single (green circle) and replicate (blue circle) grab samples acquired at East of Start Point (EOSP) MCZ on survey CEND0121.

5.5 West of Wight-Barfleur (WWBF) MCZ

All planned drop camera stations (40 stations, 58 transects) were surveyed at WWBF (Table 5 and Figure 13). One transect was run twice to better position the vessel and camera system for longer tows. The camera survey at WWBF revealed the presence of rocky seabed which was unsuitable for Hamon grabbing at all stations. Four replicate transects were completed at six locations across the MCZ.

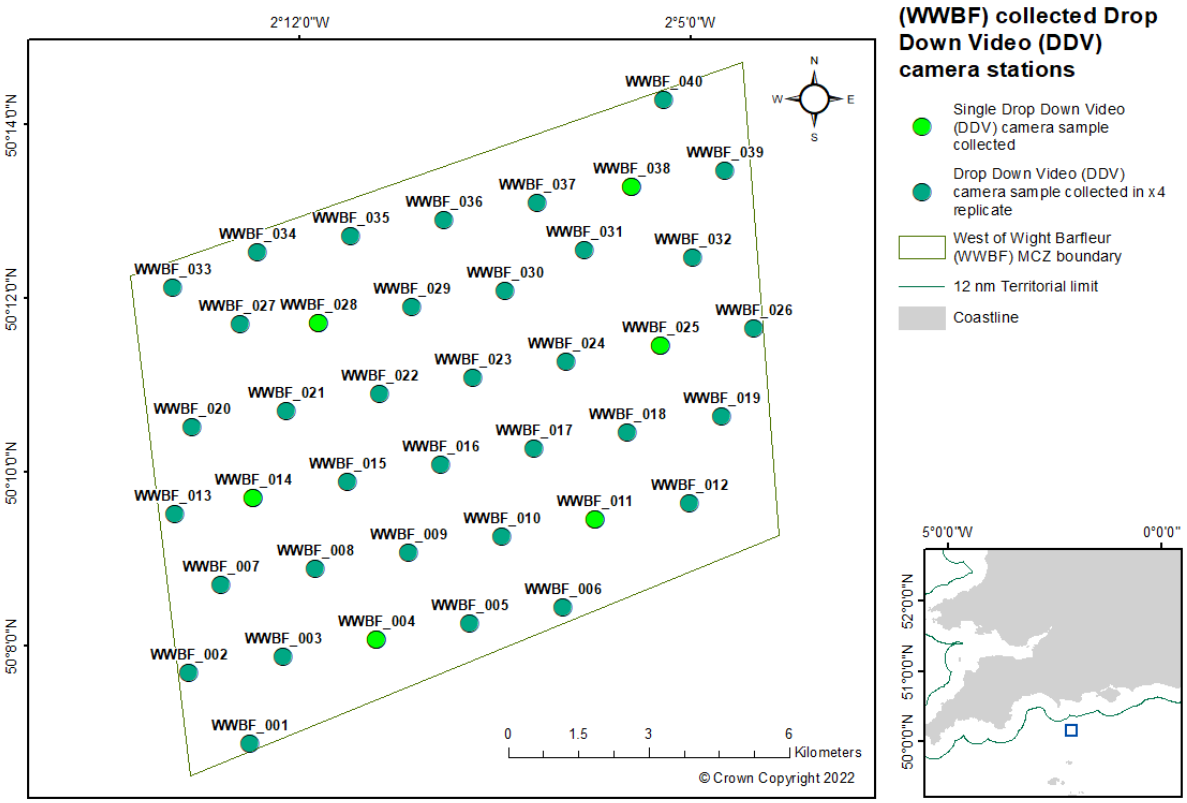

Figure 13. Map showing locations of drop camera stations surveyed at West of Wight-Barfleur (WWBF) MCZ on survey CEND0121.

5.6 Multibeam echosounder

No acoustic data were acquired to fulfil the survey objectives. However, an opportunistic MBES calibration exercise was carried out on 27 January over the wreck of the SS Stanmount, located in the Southern North Sea. A full calibration report is given in Annex 5.

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Annex 1. Glossary

Definitions signified by an asterisk (*) have been sourced from Natural England and JNCC Ecological Network Guidance (Natural England & JNCC 2010).

Activity	A human action which may have an effect on the marine environment; e.g. fishing, energy production (Robinson *et al*. 2008).*
Assemblage	A collection of plants and/or animals characteristically associated with a particular environment that can be used as an indicator of that environment. The term has a neutral connotation and does not imply any specific relationship between the component organisms, whereas terms such as 'community' imply interactions (Allaby 2015).
Benthic	A description for animals, plants and habitats associated with the seabed. All plants and animals that live in, on or near the seabed are benthos (e.g. sponges, crabs, seagrass beds).*
Biotope	The physical habitat with its associated, distinctive biological communities. A biotope is the smallest unit of a habitat that can be delineated conveniently and is characterised by the community of plants and animals living there.*
Broadscale Habitats	Habitats which have been broadly categorised based on a shared set of ecological requirements, aligning with level 3 of the EUNIS habitat classification. Examples of Broadscale Habitats are protected across the MCZ network.
Community	A general term applied to any grouping of populations of different organisms found living together in a particular environment; essentially the biotic component of an ecosystem. The organisms interact and give the community a structure (Allaby 2015).
Conservation Objective	A statement of the nature conservation aspirations for the feature(s) of interest within a site, and an assessment of those human pressures likely to affect the feature(s).*
Epifauna	Fauna living on the seabed surface.
EUNIS	A European habitat classification system, covering all types of habitats from natural to artificial, terrestrial to freshwater and marine.*
Favourable Condition	When the ecological condition of a species or habitat is in line with the conservation objectives for that feature. The term 'favourable' encompasses a range of ecological conditions depending on the objectives for individual features.*
Feature	A species, habitat, geological or geomorphological entity for which an MPA is identified and managed.*
Feature Attributes	Ecological characteristics defined for each feature within site-specific Supplementary Advice on Conservation Objectives (SACO). Feature Attributes are monitored to determine whether condition is favourable.

Impact	The consequence of pressures (e.g. habitat degradation) where a change occurs that is different to that expected under natural conditions (Robinson *et al*. 2008)
Infauna	Fauna living within the seabed sediment.
Joint Nature Conservation Committee (JNCC)	JNCC is the public body that advises the UK Government and devolved administrations on UK-wide and international nature conservation. JNCC has responsibility for nature conservation in the offshore marine environment, which begins at the edge of territorial waters and extends to the UK Continental Shelf (UKCS).
Marine Conservation Zone (MCZ)	MPAs designated under the Marine and Coastal Access Act (2009). MCZs protect nationally important marine wildlife, habitats, geology and geomorphology, and can be designated anywhere in English and Welsh inshore and UK offshore waters.*
Marine Protected Area (MPA)	A generic term to cover all marine areas that are 'A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values' (Dudley 2008).*
Natural England	The statutory conservation advisor to Government, with a remit for England out to 12 nautical miles offshore.
Non-indigenous Species	A species that has been introduced directly or indirectly by human agency (deliberately or otherwise) to an area where it has not occurred in historical times and which is separate from and lies outside the area where natural range extension could be expected (Eno *et al*. 1997).*
Pressure	The mechanism through which an activity has an effect on any part of the ecosystem (e.g. physical abrasion caused by trawling). Pressures can be physical, chemical or biological, and the same pressure can be caused by a number of different activities (Robinson *et al*. 2008).*

Annex 2. Monitoring objectives

Table 6. Original Cromer Shoal Chalk Beds (CSCB) MCZ Monitoring Objectives.

Monitoring Objective	Sub-objectives	Rationale/Justification	Hypotheses (to be tested after a second monitoring survey (T1))	Proposed analysis and metrics (if relevant)
1. Conduct T0 monitoring of the biological structure and function within the 'Subtidal coarse sediment', 'Subtidal mixed sediment', and 'Subtidal sand' features (sedimentary habitats hereafter) associated with the Cromer Shoal Chalk Beds (CSCB) MCZ.	1.1 Acquire quantitative infaunal data by collecting physical samples from each sedimentary habitat within CSCB.	Grab sampling will allow us to identify the infauna present in each sedimentary habitat and allow quantitative assessments to be carried out.	There is no difference/change in infaunal communities associated with designated habitats within the site between T0 and T1.	Analyses to consider: • Community composition and structure; • Biotope identification; • Abundance of species; • Number of species; • Taxonomic distinctness • Diversity indices (e.g. Shannon, Pielou)
2. Conduct Type 1 (sentinel) monitoring of the extent, distribution and physical structure of the sedimentary habitat features of CSCB.	2.1 Acquire sediment particle size data across sedimentary habitat features within CSCB.	Grab sampling will allow us to quantify in detail what sediment type is located where.	There is no difference/change in the Broadscale Habitats between T0 and T1.	• Particle size analysis
3. Collect evidence to improve our understanding of the extent and distribution of marine litter and non-indigenous species (NIS) within CSCB.	3.1. Analyse samples collected for the presence litter and NIS.	Acquiring data on litter and NIS will improve our understanding of how widely dispersed and where litter is found within the site, allowing us to better inform and advise on this feature.	N/A	• Quantify abundance and extent of marine litter and NIS • Quantify and classify microplastics in sediment samples using the NE/EA methodology

Table 7. Original Orford Inshore (ORIN) MCZ Monitoring Objectives.

Monitoring Objective	Sub-objectives	Rationale/Justification	Hypotheses (to be tested after a second monitoring survey (T1))	Proposed analysis and metrics (if relevant)
1. Provide T0 data for a monitoring time series of the biological structure and function within the 'Subtidal mixed sediment' feature associated with Orford Inshore (ORIN) MCZ.	1.1 Acquire quantitative infaunal data by collecting physical samples from the 'Subtidal mixed sediment' feature inside and outside the MCZ.	Grab sampling will allow us to identify the infauna (present in each sedimentary habitat) and allow quantitative assessments to be carried out.	There is no difference/change in infaunal communities associated with designated habitats within the site between T0 and T1.	Analyses to consider: • Community composition and structure; • Biotope identification; • Abundance of species; • Number of species; • Taxonomic distinctness • Diversity indices (e.g. Shannon, Pielou) • Infaunal function: secondary productivity
	1.2. Acquire semi-quantitative epifaunal data using stills and video imagery inside and outside the MCZ.	Imagery will allow us to enumerate and identify what epifauna (including key and characteristic epifauna) are present on the 'Subtidal mixed sediment' feature using non-damaging techniques.	There is no difference/change in infaunal communities associated with designated habitats within the site between T0 and T1.	Analyses to consider: • Community composition and structure; • Biotope identification; • Abundance/density of species; • Number of species; • Taxonomic distinctness • Functional attributes
2. Provide T0 data for a monitoring time series of the extent, distribution and physical structure of the 'Subtidal mixed sediment' habitat feature of ORIN MCZ.	2.1. Acquire sediment particle size data inside and outside the MCZ	Grab sampling will allow us to quantify in detail what sediment type is located where.	There is no difference/change in infaunal communities associated with designated habitats within the site between T0 and T1.	• Particle size analysis

Monitoring Objective	Sub-objectives	Rationale/Justification	Hypotheses (to be tested after a second monitoring survey (T1))	Proposed analysis and metrics (if relevant)
	2.2 Acquire semi-quantitative physical data using stills and video imagery within the MCZ	Imagery will allow us to identify the spatial distribution of each sedimentary habitat more broadly than grab sampling.	N/A	• Analyse distribution of Broadscale Habitats from video data
3. Collect evidence to improve our understanding of the extent and distribution of marine litter and non-indigenous species (NIS) within ORIN MCZ.	3.1. Analyse imagery data and samples for the presence litter and NIS.	Acquiring data on litter and NIS will improve our understanding of how widely dispersed and where litter is found within the site, allowing us to better inform and advise on this feature.	N/A	• Quantify abundance and extent of marine litter and NIS • Quantify and classify microplastics in sediment samples using the NE/EA methodology
4. Provide T0 data in the supporting processes relating to the sedimentary habitat features of ORIN MCZ	4.1. Acquire CTD and turbidity data within sedimentary habitat features of ORIN 4.2 Acquire Ferrybox data continuously during survey	Quantitative environmental data (e.g., temperature, salinity and turbidity) will improve our understanding of natural, supporting processes at the seabed within the site and form part of critical time series data.	N/A	• Supporting processes data will contextualise and support analysis of the data.

Table 8. Original East of Start Point (EOSP) MCZ Monitoring Objectives.

Monitoring Objective	Sub-objectives	Rationale/Justification	Hypotheses (to be tested after a second monitoring survey (T1))	Proposed analysis and metrics (if relevant)
1. Conduct Type 1 (sentinel) monitoring of the biological extent and distribution, structure and function within the 'Subtidal sand' (sedimentary habitat(s)) features associated with the East of Start Point (EOSP) MCZ	1.1 Acquire quantitative infaunal data by collecting physical samples from the sedimentary habitat within EOSP.	Grab sampling will allow for the identification, enumeration and biomass, of the infaunal communities associated with the site including the biological assemblages, key and influential species and characteristic communities in a spatially discrete manner.	There is no difference/change in infaunal communities associated between T0 and T1.	Analyses to consider: • Community composition and structure; • Biotope identification • Abundance of species; • Number of species; • Taxonomic distinctness • Diversity indices (e.g. Shannon, Pielou)
	1.2 Acquire semi-quantitative epifaunal data by collecting imagery from the sedimentary habitat within EOSP.	Imagery will allow us to identify and enumerate the epifauna (including key and characteristic epifauna) associated with the site and each sedimentary habitat using non-damaging techniques. This will develop understanding on the distribution of species as well as the epifaunal assemblages and structure.	There is no difference/change in epifaunal communities associated between T0 and T1.	Analyses to consider: • Community composition and structure; • Biotope identification • Abundance/density of species; • Number of species; • Taxonomic distinctness • Biological traits
2. Conduct Type 1 (sentinel) monitoring of the physical extent and distribution, structure and function within the 'Subtidal	2.1 Acquire sediment particle size data across sedimentary habitat features within EOSP.	Grab sampling will allow us to quantify what sediment type is located where. This will develop understanding on the extent and distribution, sediment composition and structure at the site.	There is no difference/change in the measured PSA between T0 and T1.	• Particle size analysis

Monitoring Objective	Sub-objectives	Rationale/Justification	Hypotheses (to be tested after a second monitoring survey (T1))	Proposed analysis and metrics (if relevant)
sand' (sedimentary habitat(s)) features associated with the EOSP MCZ	2.2 Acquire semi-quantitative physical data using still and video imagery within the sedimentary habitat features of EOSP.	Imagery will allow us to identify the spatial distribution of each sedimentary habitat more broadly than grab sampling. This will develop understanding on the extent and distribution at the site, and aid biotope assignment.	There is no difference/change in the broad scale habitats identified measured PSA between T0 and T1.	• Analyse distribution of broad scale habitats from video data
3. Conduct Type 1 (sentinel) monitoring of supporting processes relating to the sedimentary habitat features of EOSP MCZ.	3.1 Acquire CTD and ESM logger transmissometer data within sedimentary habitat features of EOSP.	Quantitative environmental data (e.g., temperature, salinity and turbidity) will improve our understanding of natural, supporting processes at the seabed within the site and form part of critical time series data.	N/A	Supporting processes data will contextualise and support analysis of the data.

Table 9. Original West of Wight-Barfleur (WWBF) MCZ Monitoring Objectives.

Monitoring Objective	Sub-objectives	Rationale/Justification	Hypotheses (to be tested after a second monitoring survey (T1))	Proposed analysis and metrics (if relevant)
1. Conduct Type 1 (sentinel) monitoring of the physical extent and distribution, structure and function within the 'Subtidal coarse' and 'Subtidal mixed sediment' (sedimentary habitat(s)) features associated with the West of Wight-Barfleur (WWBF) MCZ	1.1 Acquire multibeam bathymetry data to determine the extent of all the broad scale habitats. This information may also be used to create an updated habitat map of the WWBF MCZ.	The survey aims to collect multibeam data to inform imagery and grab sampling locations and replication. The multibeam will be used to collect ground-truthing data to enable the production of a higher resolution habitat map which will determine the extent of the broad-scale habitats in the MCZ.	There is no difference/change to the predicted extent of broad-scale habitats in the site.	• Analysis of multibeam data to locate the ground-truthing stations • Production of a new habitat map for WWBF
	1.2 Acquire sediment particle size data across sedimentary habitat features within WWBF.	Grab sampling will allow us to quantify what sediment type is located where. This will develop understanding on the extent and distribution, sediment composition and structure at the site.	There is no difference/change in the measured PSA between T0 and T1.	• Particle size analysis
	1.3 Acquire semi-quantitative physical data using still and video imagery within the sedimentary habitat features of WWBF.	Imagery will allow us to identify the spatial distribution of each sedimentary habitat more broadly than grab sampling. This will develop understanding on the extent and distribution at the site, and aid biotope assignment.	There is no difference/change in the measured PSA between T0 and T1.	• Analyse distribution of broad scale habitats from video data

Monitoring Objective	Sub-objectives	Rationale/Justification	Hypotheses (to be tested after a second monitoring survey (T1))	Proposed analysis and metrics (if relevant)
2. Conduct Type 1 (sentinel) monitoring of the biological extent and distribution, structure and function within the 'Subtidal coarse' and 'Subtidal mixed sediment' (sedimentary habitat(s)) features associated with the WWBF MCZ	2.1 Acquire semi-quantitative epifaunal data by collecting still and video data from the sedimentary habitat within WWBF.	Imagery will allow us to identify and enumerate epifauna (including key and characteristic epifauna) associated with the site and each sedimentary habitat using non-damaging techniques.	There is no difference/change in epifaunal communities associated between T0 and T1.	Analyses to consider: • Community composition and structure; • Biotope identification • Abundance/density of species; • Number of species; • Taxonomic distinctness • Biological traits
	2.2 Acquire quantitative infaunal data by collecting physical samples from the sedimentary habitat within WWBF.	Grab sampling (pending imagery overview) will allow for the identification and enumeration of the infaunal communities associated with the site including the biological assemblages, key and influential species and characteristic communities in a spatially discrete manner.	There is no difference/change in infaunal communities associated between T0 and T1.	Analyses to consider: • Community composition and structure; • Biotope identification • Abundance of species; • Number of species; • Taxonomic distinctness • Diversity indices (e.g. Shannon, Pielou)
3. Conduct Type 1 (sentinel) monitoring of supporting processes relating to the sedimentary habitat features within the WWBF MCZ	3.1 Acquire CTD (dependant on MBES), ESM2 (attached to camera) and Ferry-Box, logger transmissometer data within sedimentary habitat features of WWBF	Quantitative environmental data (e.g., temperature, salinity and turbidity) will improve our understanding of natural, supporting processes at the seabed within the site and form part of critical time series data.	N/A	• Supporting processes data will contextualise and support analysis of the data.

Annex 3. Survey equipment and sample processing

Grab sampling

The grab system used during the survey was a 0.1 m^2 mini Hamon grab (Figure 14). Samples were collected from anywhere within a 50 m radius bullring centred on the target location. On recovery, the grab was emptied into a large plastic bin and a representative sub-sample of sediment (approx. 0.5 litres) taken for Particle Size Analysis (PSA). The sample was stored in a labelled plastic container and frozen ready for transfer to a laboratory ashore. The remaining sample was photographed, and the volume of sediment measured and recorded. Benthic fauna were collected by washing the sample with seawater over a 1 mm sieve. The retained >1 mm fraction was transferred to a labelled container and preserved in buffered 4 % formaldehyde for later analysis ashore. For each grab, a preliminary visual assessment of sediment type was performed on board the vessel and noted on the field records. The assessment assigned the sample to a Folk class and its equivalent EUNIS and Broadscale Habitat sediment classes.

Figure 14: 0.1 m^2 mini Hamon grab.

Camera (drop frame) sampling

The stills camera fitted to the drop frame (see Figure 15 for illustrative image of system) was an STR Seaspyder Telemetry (Canon EOS) 18 megapixel digital stills camera with flat lens and STR MP-F through-the-lens-controlled flash. It was controlled through a dual role copper/fibre multiplexor custom built to Cefas specification.

The video footage was shot using an STR SP-HDC-3000aw 1080p video camera with a 1 Lux colour 2 megapixel sensor. It was run at 1080p (25 frames per second) video resolution along with all other control signals over a dual fibre optic cable. The digital stream was captured by the surface PC and recorded direct to MP4 format video files. Lighting was provided by four STR MP-3 LED lights running at 1500 Lumens light intensity per unit. Laser scaling was provided by two green dot class 3r laser pointers providing a reference width of 22 cm on the seabed. The drop frame was also fitted with a digital heading/pitch/roll sensor, altimeter and water temperature sensor. This was recorded in real time along with GPS time and position using a video overlay.

The system was set up with both video and stills cameras set up in vertical orientation to optimise the system for collection of quantitative data. See Hitchin *et al.* (2015) for general operational recommendations. Particular attention was paid to the lighting, exposure and focus of the stills camera to maximise the quality of images recorded. Following guidance provided by Cefas specialists settings for the still camera and flash were altered to suit environmental conditions and changed as necessary throughout the survey to suit the seabed features encountered and variations in environmental conditions.

Figure 15. STR drop frame with video and still imaging system.

Field notes were made during each camera deployment, noting station and sample metadata, real-time observations of substrate and taxa, and an initial assessment of the range of Broadscale Habitats that had been seen.

Multibeam echosounder

A calibration was performed on 27/01/2021 over the wreck of the SS Stanmount located in the Southern North Sea. The UKHO wrecks database lists the known position of the Stanmount as; 52° 39.793' N, 02° 01.456' E. As the wreck location was known a set of calibration lines were prepared and data collected over the wreck. This allowed the angular offsets of the MBES system to be checked. This ensures that the RV Cefas Endeavour will collect MBES data to the standard as defined by the International Hydrographic Organization (IHO) s-44 order 1a, 6th edition (IHO, 2020).

A full calibration report is given in Annex 5.

Water sampling

Water samples was taken every 1 hour during transit and filtered on board for determination of chlorophyll and suspended particulate matter. These samples will be used to calibrate SmartBuoy, Ferrybox and ocean colour space-borne data (for the EU FP7 project HIGHROC, C5878).

GPS positions and corrections

GPS fixes were recorded using the Tower Navigation system. This records the Lat/Long position of the gantry from which the sampling equipment is being deployed, automatically compensating for the offset between these gantries and the GPS antenna. Prior to this survey an updated version of Tower had been installed on the vessel (due to technical issues with the system), the offsets had not been set up correctly and this could not be resolved by the personnel onboard the vessel.

Fixes for grab samples were taken at the instant the grab contacted the seabed. The grab was always deployed from the side gantry, however the position recorded was most likely the GPS antenna. This difference has not been accounted for in the data as the difference is similar to the influence of strong tides on positional accuracy, up to about 10 metres.

Manual fixes were taken approximately every 10 seconds and at the start and end of camera survey line. As for the grab deployments, the GPS fix positions recorded were most likely for the GPS antenna rather than the side gantry. The HiPAP beacon was attached to the drop camera frame and the telemetry files, that include positional data, were obtained from the camera system.

RV Cefas Endeavour

Full details of the RV Cefas Endeavour can be found on the Cefas website: https://www.cefas.co.uk/about-us/facilities/rv-cefas-endeavour/

Annex 4. Survey metadata

Table 10. Metadata for drop camera samples taken at West of Wight-Barfleur MCZ and Orford Inshore MCZ on CEND0121. SOL = Start of Line, EOL = End of Line.

Event	Station Code	Replicate	Depth	SOL Time	Latitude	Longitude	EOL Time	Latitude	Longitude	Notes
52	ORIN136	A1	37.8	14:43	52.13975	1.951027	14:58	52.13872	1.949846	Poor visibility
53	ORIN120	A1	34	17:38	52.11242	1.874085	17:43	52.11207	1.873664	No Sample
53	ORIN120	A2	34	N/A	N/A	N/A	N/A	N/A	N/A	No Sample
153	WWBF033	A1	59	10:42	50.20152	-2.23933	10:58	50.20198	-2.23739	
154	WWBF034	A1	59	12:52	50.20776	-2.21316	13:02	50.2085	-2.2138	
155	WWBF035	A1	59	13:40	50.21074	-2.18473	13:50	50.2114	-2.18557	
156	WWBF036	A1	59	14:25	50.2139	-2.15642	14:36	50.21444	-2.15745	
157	WWBF037	A1	59	15:11	50.21676	-2.12848	15:21	50.21713	-2.1297	
158	WWBF038	A1	58	15:57	50.2202	-2.10086	16:03	50.22031	-2.10152	
158	WWBF038	B1	58	16:14	50.22022	-2.10161	16:19	50.22011	-2.10098	
158	WWBF038	C1	58	17:34	50.21995	-2.10109	17:40	50.22007	-2.10172	
158	WWBF038	D1	58	17:45	50.21998	-2.10169	17:50	50.21987	-2.10104	
159	WWBF040	A1	58	18:16	50.23656	-2.09059	18:26	50.23677	-2.09188	
160	WWBF039	A1	57	18:48	50.22284	-2.07254	18:58	50.22309	-2.07383	
161	WWBF032	A1	58	19:21	50.20621	-2.08253	19:31	50.20643	-2.08379	
162	WWBF031	A1	59	19:53	50.20776	-2.11486	20:03	50.20809	-2.11607	
163	WWBF030	A1	63	20:28	50.20015	-2.13877	20:38	50.20077	-2.1397	
164	WWBF029	A1	58	21:03	50.19737	-2.16799	21:13	50.19767	-2.16674	
165	WWBF028	A1	58	21:52	50.19453	-2.19578	21:58	50.1947	-2.19505	
165	WWBF028	B1	58	22:04	50.19463	-2.19491	22:09	50.19449	-2.19556	
165	WWBF028	C1	59	22:15	50.19443	-2.19548	22:20	50.19456	-2.19484	
165	WWBF028	D1	58	22:26	50.19447	-2.19478	22:31	50.19437	-2.1953	
166	WWBF027	A1	59	23:00	50.19468	-2.21914	23:10	50.19486	-2.21784	
167	WWBF020	A1	60	00:31	50.17473	-2.23401	00:41	50.1751	-2.23282	

Event	Station Code	Replicate	Depth	SOL Time	Latitude	Longitude	EOL Time	Latitude	Longitude	Notes
168	WWBF021	A1	60	01:20	50.17833	-2.20443	01:31	50.1778	-2.20543	
169	WWBF022	A1	59	02:10	50.18117	-2.17649	02:25	50.18048	-2.17829	
170	WWBF023	A1	60	03:01	50.18408	-2.14838	03:17	50.18341	-2.15019	
171	WWBF024	A1	59	04:02	50.18703	-2.12037	04:12	50.18668	-2.12165	
172	WWBF025	A1	59	05:11	50.19003	-2.0927	05:16	50.18977	-2.09336	
172	WWBF025	B1	60	05:26	50.18972	-2.09321	05:31	50.1899	-2.09255	
172	WWBF025	C1	60	05:41	50.1898	-2.09238	05:46	50.18959	-2.09303	
172	WWBF025	D1	61	06:03	50.18939	-2.09308	06:08	50.18908	-2.09359	
173	WWBF026	A1	59	06:38	50.19306	-2.06487	06:48	50.19245	-2.06562	
174	WWBF019	A1	62	07:50	50.17611	-2.07482	08:01	50.17568	-2.07612	
175	WWBF018	A1	60	08:27	50.17319	-2.10279	08:38	50.17288	-2.10403	
176	WWBF017	A1	59	09:06	50.17007	-2.13079	09:16	50.17011	-2.1321	
177	WWBF016	A1	60	09:49	50.16706	-2.1587	10:00	50.16733	-2.16006	
178	WWBF015	A1	60	12:43	50.16414	-2.18662	12:53	50.16429	-2.18794	
179	WWBF014	A1	62	13:26	50.16104	-2.21455	13:31	50.1611	-2.21521	
179	WWBF014	B1	62	13:40	50.16115	-2.21473	13:46	50.16122	-2.21545	
179	WWBF014	C1	63	13:55	50.16125	-2.2148	14:01	50.16133	-2.21547	
179	WWBF014	D1	63	14:10	50.16134	-2.21468	14:15	50.16144	-2.21532	
180	WWBF013	A1	62	14:38	50.15837	-2.23764	14:49	50.15828	-2.239	
181	WWBF007	A1	61	15:25	50.14466	-2.22392	15:35	50.14463	-2.2253	
182	WWBF008	A1	63	16:10	50.1478	-2.19643	16:20	50.14764	-2.19779	
183	WWBF009	A1	60	20:34	50.15022	-2.1685	20:49	50.15113	-2.16982	
184	WWBF010	A1	60	02:24	50.15286	-2.14125	02:34	50.15372	-2.14129	
185	WWBF011	A1	60	04:11	50.15637	-2.11284	04:22	50.15723	-2.1132	
185	WWBF011	A2	60	05:01	50.15655	-2.11294	05:07	50.15673	-2.11364	
185	WWBF011	B1	60	05:15	50.15662	-2.11365	05:20	50.15646	-2.11296	
185	WWBF011	C1	61	05:28	50.15637	-2.113	05:33	50.15657	-2.11369	
185	WWBF011	D1	60	05:47	50.15642	-2.11351	05:53	50.15621	-2.11279	

Event	Station Code	Replicate	Depth	SOL Time	Latitude	Longitude	EOL Time	Latitude	Longitude	Notes
186	WWBF012	A1	63	06:27	50.15917	-2.0848	06:37	50.15966	-2.086	
187	WWBF006	A1	60	08:00	50.14015	-2.12334	08:10	50.13933	-2.1228	
188	WWBF005	A1	60	08:39	50.13728	-2.15082	08:54	50.13601	-2.15154	
189	WWBF004	A1	62	09:27	50.1337	-2.17924	09:32	50.13412	-2.1789	
189	WWBF004	B1	62	09:41	50.13411	-2.17882	09:47	50.13365	-2.17907	
189	WWBF004	C1	61	09:54	50.1337	-2.17962	10:00	50.13411	-2.17929	
189	WWBF004	D1	60	10:07	50.1342	-2.1794	10:13	50.13379	-2.17972	
190	WWBF003	A1	60	10:43	50.13091	-2.20738	10:54	50.13124	-2.20616	
191	WWBF002	A1	60	11:26	50.12793	-2.23539	11:37	50.12832	-2.23417	
192	WWBF001	A1	60	12:27	50.11411	-2.21729	12:42	50.11434	-2.21537	
193	ORIN103	A1	30	08:42	52.07731	1.928135	08:58	52.0783	1.926739	Poor visibility
194	ORIN119	A1	31	09:41	52.08164	1.906618	09:57	52.08288	1.907435	Poor visibility
198	ORIN102	A1	27	13:07	52.0714	1.909601	13:08	52.07135	1.909728	No Sample
198	ORIN102	A2	26	13:55	52.07122	1.909842	N/A	N/A	N/A	No Sample
233	ORIN125	A1	34	13:15	52.10324	1.841811	N/A	N/A	N/A	No Sample
233	ORIN125	A3	34	14:54	52.10324	1.841839	N/A	N/A	N/A	No Sample

Table 11. Metadata for Hamon grab stations sampled (including failed attempts) at Cromer Shoal Chalk Beds MCZ, Orford Inshore MCZ, and East of Start Point MCZ during CEND0121.

Event	Station Code	Sample	Replicate Attempt	Sample Volume	Water Depth (m)	Date	Time	Latitude	Longitude	Notes
001	CSCB002	Macrofauna, PSA	A1	10.5	21.5	16/01/2021	17:48:55	53.0420677	1.1287031	
002	CSCB014	Macrofauna, PSA	A1	9.5	25.7	16/01/2021	18:50:00	53.0328106	1.2049955	
003	CSCB011	Macrofauna, PSA	A1	8.5	31.7	16/01/2021	19:16:15	53.0310667	1.1850188	
004	CSCB005	No sample	A1		22.6	16/01/2021	19:48:00	53.0221678	1.1295900	
004	CSCB005	Macrofauna, PSA	A2	5	22.6	16/01/2021	19:53:30	53.0221609	1.1295834	
005	CSCB004	Macrofauna, PSA	A1	8	21.4	16/01/2021	20:21:26	53.0073787	1.1271300	
006	CSCB016	Macrofauna, PSA	A1	6.5	22.2	16/01/2021	20:59:31	52.9979628	1.2088026	
007	CSCB017	Macrofauna, PSA	A1	8	21.2	16/01/2021	21:49:50	52.9852409	1.2333477	
008	CSCB021	Macrofauna, PSA	A1	5	22.6	16/01/2021	22:31:53	52.9917042	1.2714605	
009	CSCB018	Macrofauna, PSA	A1	4.5	20	17/01/2021	04:27:20	53.0081216	1.2424262	
010	CSCB020	No sample	A1		27	17/01/2021	05:44:28	53.0228829	1.2586311	
010	CSCB020	No sample	A2		27	17/01/2021	05:53:46	53.0229429	1.2587239	
011	CSCB022	No sample	A1		22	17/01/2021	06:23:00	53.0142376	1.2954698	
011	CSCB022	Macrofauna, PSA	A2	13	22	17/01/2021	06:29:36	53.0144761	1.2955467	
012	CSCB020	Macrofauna, PSA	A1	6.5	28	17/01/2021	07:02:00	53.022776	1.2586407	Revisit to station
013	CSCB030	No sample	A1		27	17/01/2021	07:55:00	53.0109894	1.3641332	
013	CSCB030	Macrofauna, PSA	A2	5.5	27	17/01/2021	08:00:11	53.0110273	1.3641773	
014	CSCB033	No sample	A1		27	17/01/2021	08:21:00	53.0011519	1.3723832	
014	CSCB033	Macrofauna, PSA	A2	6.5	27	17/01/2021	08:27:00	53.0012386	1.3722773	
015	CSCB026	Macrofauna, PSA	A1	8	26	17/01/2021	08:53:08	52.9977166	1.3386666	
016	CSCB024	No sample	A1		23	17/01/2021	09:22:00	52.9825537	1.3227179	
016	CSCB024	No sample	A2		23	17/01/2021	09:27:00	52.9825151	1.3226876	
016	CSCB024	Macrofauna, PSA	A3	8.5	23	17/01/2021	09:32:37	52.9825402	1.3226298	
017	CSCB028	Macrofauna, PSA	A1	7.5	23	17/01/2021	10:13:11	52.97417	1.3443471	
018	CSCB032	No sample	A1		23	17/01/2021	10:47:00	52.966116	1.3657466	

Event	Station Code	Sample	Replicate Attempt	Sample Volume	Water Depth (m)	Date	Time	Latitude	Longitude	Notes
018	CSCB032	Macrofauna, PSA	A2	8.5	23	17/01/2021	10:53:08	52.9661805	1.3656721	
019	CSCB037	Macrofauna, PSA	A1	4	23	17/01/2021	11:22:10	52.9692171	1.3902774	
020	CSCB038	Macrofauna, PSA	A1	5	23	17/01/2021	12:40:00	52.9767938	1.3924545	All small samples for each attempt at this station.
020	CSCB038	No sample	A2		23	17/01/2021	12:44:34	52.9768332	1.3923830	All small samples for each attempt at this station.
020	CSCB038	No sample	A3		23	17/01/2021	12:48:54	52.9768508	1.3923224	All small samples for each attempt at this station.
021	CSCB034	Macrofauna, PSA	A1	5	23	17/01/2021	13:09:01	52.9885563	1.3823224	All small samples for each attempt at this station.
021	CSCB034	No sample	A2		23	17/01/2021	13:13:14	52.9886006	1.3822617	All small samples for each attempt at this station.
021	CSCB034	No sample	A3		23	17/01/2021	13:17:13	52.9886358	1.3822175	All small samples for each attempt at this station.
022	CSCB043	Macrofauna, PSA	A1	5.5	24	17/01/2021	13:43:36	52.9875541	1.4198795	
023	CSCB048	Macrofauna, PSA	A1	5	23	17/01/2021	14:13:24	52.9791653	1.4416234	
024	CSCB045	No sample	A1		22	17/01/2021	14:33:13	52.9758375	1.4227395	
024	CSCB045	Macrofauna, PSA	A2	4	22	17/01/2021	14:37:39	52.9758695	1.4226493	
025	CSCB040	PSA	A1	3	20	17/01/2021	15:15:49	52.9607711	1.4066945	All small samples for each attempt at this station.
025	CSCB040	No sample	A2		20	17/01/2021	15:20:31	52.9608082	1.4066146	All small samples for each attempt at this station.
025	CSCB040	No sample	A3		20	17/01/2021	15:25:18	52.9607667	1.4065933	All small samples for each attempt at this station.
026	CSCB041	No sample	A1		18	17/01/2021	16:09:58	52.9500666	1.4090988	
026	CSCB041	No sample	A2		18	17/01/2021	16:14:19	52.9500999	1.4091315	
026	CSCB041	Macrofauna, PSA	A3	4	18	17/01/2021	16:19:00	52.950146	1.4091811	
026	CSCB041	No sample	A4		18	17/01/2021	16:23:38	52.9501748	1.4092411	
027	CSCB046	Macrofauna, PSA	A1	5	21	17/01/2021	17:39:58	52.9523663	1.4285673	
028	CSCB051	No sample	A1		22	17/01/2021	18:21:03	52.9600207	1.4469134	
028	CSCB051	No sample	A2		22	17/01/2021	18:25:15	52.9600834	1.4468924	
028	CSCB051	No sample	A3		22	17/01/2021	18:29:11	52.9600229	1.4468379	
029	CSCB049	No sample	A1		24	17/01/2021	18:43:40	52.9673812	1.4444891	

Event	Station Code	Sample	Replicate Attempt	Sample Volume	Water Depth (m)	Date	Time	Latitude	Longitude	Notes
029	CSCB049	No sample	A2		24	17/01/2021	18:47:19	52.9674818	1.4447089	
029	CSCB049	No sample	A3		24	17/01/2021	18:51:04	52.9674616	1.4447542	
030	CSCB053	No sample	A1		24	17/01/2021	19:10:10	52.9643604	1.4731473	
030	CSCB053	No sample	A2		24	17/01/2021	19:14:35	52.9645897	1.4731092	
030	CSCB053	No sample	A3		24	17/01/2021	19:17:08	52.9645267	1.4730738	
031	CSCB062	No sample	A1		24	17/01/2021	19:41:13	52.9577111	1.5030849	
031	CSCB062	No sample	A2		24	17/01/2021	19:44:13	52.9578864	1.5031173	
031	CSCB062	Macrofauna, PSA	A3	5	24	17/01/2021	19:47:15	52.957881	1.5031374	
032	CSCB058	Macrofauna, PSA	A1	5	25.6	17/01/2021	20:05:30	52.954466	1.4843594	
032	CSCB058	No sample	A2		25.6	17/01/2021	20:08:30	52.9545096	1.4843861	
033	CSCB054	No sample	A1		25.1	17/01/2021	20:26:10	52.9522811	1.4690732	
033	CSCB054	PSA	A2	3.5	25.1	17/01/2021	20:29:39	52.9523099	1.4690205	
034	CSCB050	No sample	A1		25.2	17/01/2021	20:58:22	52.9438366	1.4501279	
034	CSCB050	No sample	A2		25.2	17/01/2021	21:02:07	52.9438871	1.4500529	
034	CSCB050	No sample	A3		25.2	17/01/2021	21:07:18	52.9438722	1.4501687	
035	CSCB056	No sample	A1		25	17/01/2021	21:38:30	52.9352428	1.4715826	
035	CSCB056	No sample	A2		25	17/01/2021	21:42:32	52.935377	1.4715519	
035	CSCB056	No sample	A3		25	17/01/2021	22:03:00	52.9353824	1.4715331	
036	CSCB059	Macrofauna, PSA	A1	8	24.7	17/01/2021	22:32:25	52.9412277	1.4826846	
037	CSCB065	No sample	A1		23.8	17/01/2021	23:33:24	52.9413434	1.5183984	
037	CSCB065	No sample	A2		23.8	17/01/2021	23:37:30	52.9413791	1.5183446	
037	CSCB065	No sample	A3		23.8	17/01/2021	23:41:28	52.9414019	1.5182667	
038	CSCB069	Macrofauna, PSA	A1	2.5	23	18/01/2021	00:20:29	52.9259389	1.5303964	
039	CSCB060	No sample	A1		20.7	18/01/2021	00:45:51	52.9269224	1.4932466	
039	CSCB060	No sample	A2		20.7	18/01/2021	00:50:37	52.9269416	1.4931559	
039	CSCB060	Macrofauna, PSA	A3	4.5	20.7	18/01/2021	00:55:43	52.9269454	1.4930868	
040	CSCB055b	No sample	A1		20	18/01/2021	01:20:05	52.9221637	1.4700740	

Event	Station Code	Sample	Replicate Attempt	Sample Volume	Water Depth (m)	Date	Time	Latitude	Longitude	Notes
040	CSCB055b	Macrofauna, PSA	A2	2.5	20	18/01/2021	01:25:17	52.9221879	1.4700012	
041	CSCB057	No sample	A1		17.5	18/01/2021	02:13:15	52.9119495	1.4775530	
041	CSCB057	No sample	A2		17.5	18/01/2021	02:19:43	52.9119013	1.4775716	
041	CSCB057	No sample	A3		17.5	18/01/2021	02:24:25	52.91208	1.4775220	
042	CSCB064	No sample	A1		18.2	18/01/2021	03:01:17	52.907028	1.5105714	
042	CSCB064	No sample	A2		18.2	18/01/2021	03:07:30	52.9069816	1.5105943	
042	CSCB064	No sample	A3		18.2	18/01/2021	03:13:15	52.9069466	1.5106218	
043	CSCB070	No sample	A1		18.2	18/01/2021	03:51:41	52.9102221	1.5368110	
043	CSCB070	No sample	A2		18.2	18/01/2021	03:57:07	52.9101775	1.5368698	
043	CSCB070	No sample	A3		18.2	18/01/2021	04:03:09	52.9101293	1.5368719	
044	CSCB074	No sample	A1		21	18/01/2021	04:47:01	52.9177313	1.5448171	
044	CSCB074	Macrofauna, PSA	A2	9.5	21	18/01/2021	04:52:27	52.9176997	1.5448371	
045	CSCB078	No sample	A1		19.6	18/01/2021	05:18:35	52.9057208	1.5550334	
045	CSCB078	No sample	A2		19.6	18/01/2021	05:25:09	52.9056942	1.5550668	
045	CSCB078	No sample	A3		19.6	18/01/2021	05:32:48	52.9056247	1.5550777	
046	CSCB077	No sample	A1		23.5	18/01/2021	06:01:01	52.8942329	1.5502789	
046	CSCB077	No sample	A2		23.5	18/01/2021	06:05:39	52.8942712	1.5503134	
046	CSCB077	No sample	A3		23.5	18/01/2021	06:10:09	52.8942798	1.5504041	
047	CSCB072	No sample	A1		20.2	18/01/2021	06:27:14	52.8980339	1.5391597	
047	CSCB072	No sample	A2		20.2	18/01/2021	06:32:01	52.8981469	1.5393787	
047	CSCB072	Macrofauna, PSA	A3	4.5	20.2	18/01/2021	06:38:20	52.8981193	1.5394760	
048	CSCB067	Macrofauna, PSA	A1	4.5	22.3	18/01/2021	06:55:58	52.8945508	1.5181790	
049	CSCB071	No sample	A1		21.3	18/01/2021	07:45:40	52.879092	1.5342374	
049	CSCB071	Macrofauna, PSA	A2	5	21.3	18/01/2021	07:49:55	52.8791247	1.5342956	
050	CSCB080	No sample	A1		24	18/01/2021	08:13:29	52.8782231	1.5640528	
050	CSCB080	No sample	A2		24	18/01/2021	08:17:49	52.8782431	1.5639864	
050	CSCB080	Macrofauna, PSA	A3	3	24	18/01/2021	08:21:58	52.878292	1.5639388	

Event	Station Code	Sample	Replicate Attempt	Sample Volume	Water Depth (m)	Date	Time	Latitude	Longitude	Notes
051	CSCB076	Macrofauna, PSA	A1	5	21.3	18/01/2021	08:50:17	52.8623488	1.5479352	
054	ORIN038	Macrofauna, PSA	A1	6	33	18/01/2021	19:43:42	52.1139149	1.8682189	Depth on Tower frozen
055	ORIN032	Macrofauna, PSA	A1	6	33	18/01/2021	20:10:52	52.1116673	1.8491769	
056	ORIN031	Macrofauna, PSA	A1	10	30	18/01/2021	20:36:05	52.1089357	1.8392816	
057	ORIN034	Macrofauna, PSA	A1	8.5	31	18/01/2021	20:50:58	52.1037019	1.8318765	
058	ORIN033	Macrofauna, PSA	A1	5	33	18/01/2021	21:09:40	52.1028889	1.8436679	
059	ORIN035	No sample	A1		31	18/01/2021	21:26:57	52.0962017	1.8437369	
059	ORIN035	Macrofauna, PSA	A2	6	31	18/01/2021	21:30:58	52.0961625	1.8436833	
060	ORIN024	Macrofauna, PSA	A1	6	31	18/01/2021	21:55:30	52.0982005	1.8554211	
061	ORIN079	Macrofauna, PSA	A1	5	33	18/01/2021	22:13:45	52.0950813	1.8634447	
062	ORIN085	Macrofauna, PSA	A1	9.5	32	18/01/2021	22:58:15	52.0861303	1.8631275	
063	ORIN016	Macrofauna, PSA	A1	7.5	28	19/01/2021	00:36:33	52.0880083	1.8491342	
064	ORIN030	Macrofauna, PSA	A1	9.5	31	19/01/2021	01:02:26	52.0885534	1.8321996	
065	ORIN080	Macrofauna, PSA	A1	8	31	19/01/2021	01:31:01	52.0945273	1.8254139	
066	ORIN025	Macrofauna, PSA	A1	8	30	19/01/2021	01:50:36	52.0973045	1.8195936	
067	ORIN087	Macrofauna, PSA	A1	8.5	29	19/01/2021	02:05:19	52.096338	1.8110771	
068	ORIN003	Macrofauna, PSA	A1	10	28	19/01/2021	02:28:17	52.0899168	1.8150538	
068	ORIN003	Macrofauna, PSA	B1	4.5	28	19/01/2021	02:35:32	52.0898506	1.8152182	
068	ORIN003	Macrofauna, PSA	C1	5.5	28	19/01/2021	02:43:18	52.0898076	1.8153604	
069	ORIN002	Macrofauna, PSA	A1	8	30	19/01/2021	03:50:02	52.0899257	1.8233591	
069	ORIN002	Macrofauna, PSA	B1	8	30	19/01/2021	03:54:05	52.0898797	1.8233000	
069	ORIN002	Macrofauna, PSA	C1	7.5	30	19/01/2021	03:59:29	52.0897521	1.8232530	
070	ORIN001	Macrofauna, PSA	A1	8	29	19/01/2021	04:49:00	52.0853868	1.8190692	
070	ORIN001	Macrofauna, PSA	B1	9.5	29	19/01/2021	04:56:55	52.0853191	1.8190727	
070	ORIN001	Macrofauna, PSA	C1	7.5	29	19/01/2021	05:03:38	52.0852109	1.8188989	
071	ORIN005	Macrofauna, PSA	A1	6.5	29	19/01/2021	06:15:19	52.0822017	1.8207960	
071	ORIN005	Macrofauna, PSA	B1	8.5	Unknown	19/01/2021	10:18:28	52.0821922	1.8205353	Depth on Tower frozen

Event	Station Code	Sample	Replicate Attempt	Sample Volume	Water Depth (m)	Date	Time	Latitude	Longitude	Notes
071	ORIN005	Macrofauna, PSA	C1	7.5	Unknown	19/01/2021	10:23:32	52.0821952	1.8203843	Depth on Tower frozen
072	ORIN004	Macrofauna, PSA	A1	4.5	Unknown	19/01/2021	10:40:07	52.0849654	1.8084196	Depth on Tower frozen
072	ORIN004	No sample	B1		Unknown	19/01/2021	10:47:05	52.0848771	1.8084225	Depth on Tower frozen
072	ORIN004	Macrofauna, PSA	B2	7	Unknown	19/01/2021	10:53:42	52.084846	1.8082672	Depth on Tower frozen
072	ORIN004	Macrofauna, PSA	C1	4.5	Unknown	19/01/2021	11:00:25	52.0850046	1.8082099	Depth on Tower frozen
073	ORIN069	Macrofauna, PSA	A1	8	28	19/01/2021	12:36:07	52.0893588	1.8032305	
074	ORIN026	Macrofauna, PSA	A1	7	28	19/01/2021	12:53:22	52.0858512	1.7999746	
075	ORIN070	No sample	A1		26	19/01/2021	13:15:41	52.0770008	1.8026535	
075	ORIN070	Macrofauna, PSA	A2	5	26	19/01/2021	13:20:27	52.0769341	1.8026571	
075	ORIN070	No sample	A3		26	19/01/2021	13:25:44	52.0769039	1.8026043	
076	ORIN011	Macrofauna, PSA	A1	10	27	19/01/2021	13:48:21	52.0727861	1.8090644	
077	ORIN082	No sample	A1		28	19/01/2021	14:08:10	52.0739232	1.8183256	
077	ORIN082	Macrofauna, PSA	A2	5	28	19/01/2021	14:14:20	52.073866	1.8183417	
078	ORIN081	Macrofauna, PSA	A1	7	29	19/01/2021	14:41:16	52.0770911	1.8329723	
079	ORIN027	Macrofauna, PSA	A1	7	31	19/01/2021	15:01:35	52.0781615	1.8459019	
080	ORIN017	No sample	A1		32	19/01/2021	15:22:54	52.0726595	1.8555685	
080	ORIN017	Macrofauna, PSA	A2	5	32	19/01/2021	15:27:20	52.0726039	1.8554741	
081	ORIN012	Macrofauna, PSA	A1	5	30	19/01/2021	15:58:05	52.0717397	1.8291010	
082	ORIN071	Macrofauna, PSA	A1	8	29	19/01/2021	16:25:31	52.0681227	1.8199048	
083	ORIN013	Macrofauna, PSA	A1	6	27.5	19/01/2021	17:32:49	52.0624364	1.8221160	
084	ORIN088	Macrofauna, PSA	A1	5	30	19/01/2021	18:02:17	52.0650742	1.8290126	
085	ORIN084	No sample	A1		27	19/01/2021	18:22:13	52.0683091	1.8349071	
085	ORIN084	Macrofauna, PSA	A2	9	27	19/01/2021	18:26:06	52.0682712	1.8348711	
086	ORIN072	Macrofauna, PSA	A1	9	27	19/01/2021	18:42:19	52.0613404	1.8375470	
087	ORIN014	Macrofauna, PSA	A1	5	27.8	19/01/2021	19:02:19	52.0525586	1.8347174	
088	ORIN083	Macrofauna, PSA	A1	7	26.5	19/01/2021	19:20:33	52.0541849	1.8438806	
089	ORIN018	Macrofauna, PSA	A1	7	28.2	19/01/2021	19:35:01	52.0583617	1.8478501	

Event	Station Code	Sample	Replicate Attempt	Sample Volume	Water Depth (m)	Date	Time	Latitude	Longitude	Notes
090	ORIN089	Macrofauna, PSA	A1	9.5	29.4	19/01/2021	19:47:31	52.0637824	1.8518307	
091	ORIN015	Macrofauna, PSA	A1	6.5	29.3	19/01/2021	20:02:46	52.0612671	1.8617672	
092	ORIN073	No sample	A1		27.4	19/01/2021	20:17:35	52.0561001	1.8579050	
092	ORIN073	Macrofauna, PSA	A2	4.5	27.4	19/01/2021	20:21:38	52.0561291	1.8579462	
093	ORIN086	No sample	A1		29.6	19/01/2021	20:39:30	52.0581076	1.8687951	
093	ORIN086	No sample	A2		29.6	19/01/2021	20:42:25	52.0581514	1.8687828	
093	ORIN086	Macrofauna, PSA	A3	5	29.6	19/01/2021	20:45:22	52.058191	1.8688373	
094	ORIN029	Macrofauna, PSA	A1	8	29	19/01/2021	21:01:22	52.0604894	1.8778116	
095	ORIN028	Macrofauna, PSA	A1	6	31	19/01/2021	21:37:30	52.0714286	1.8762193	
096	ORIN020	Macrofauna, PSA	A1	5.5	34	19/01/2021	22:04:02	52.0787286	1.8752750	
097	ORIN078	Macrofauna, PSA	A1	7.0	34	19/01/2021	22:23:38	52.0807686	1.8840835	
098	ORIN019	Macrofauna, PSA	A1	5.5	35	19/01/2021	22:57:42	52.0667283	1.8872337	
099	ORIN049	Macrofauna, PSA	A1	7.5	33.3	19/01/2021	22:33:30	52.0640495	1.8985030	
100	ORIN075	Macrofauna, PSA	A1	8.5	30	20/01/2021	00:41:30	52.0647876	1.9148518	
101	ORIN023	Macrofauna, PSA	A1	9.5	29	20/01/2021	01:28:19	52.0698491	1.9309462	
102	ORIN022	Macrofauna, PSA	A1	7.5	30	20/01/2021	02:05:38	52.0773447	1.9297287	
103	ORIN074	Macrofauna, PSA	A1	6.5	31	20/01/2021	02:25:06	52.0803322	1.9364637	
104	ORIN006	Macrofauna, PSA	A1	7.5	32	20/01/2021	02:49:50	52.0807327	1.9181884	
104	ORIN006	Macrofauna, PSA	B1	6.5	32	20/01/2021	02:57:25	52.0806016	1.9181058	
104	ORIN006	Macrofauna, PSA	C1	8	32	20/01/2021	03:03:10	52.0805567	1.9180610	
105	ORIN009	Macrofauna, PSA	A1	7	28	20/01/2021	03:36:05	52.0752279	1.9174011	
105	ORIN009	Macrofauna, PSA	B1	7.5	28	20/01/2021	03:40:56	52.0751274	1.9173608	
105	ORIN009	Macrofauna, PSA	C1	9	28	20/01/2021	03:46:56	52.0750912	1.9173091	
106	ORIN010	Macrofauna, PSA	A1	8	27	20/01/2021	04:48:20	52.0703754	1.9112608	
106	ORIN010	Macrofauna, PSA	B1	8	27	20/01/2021	04:53:58	52.070269	1.9111630	
106	ORIN010	Macrofauna, PSA	C1	8	27	20/01/2021	04:59:45	52.0702033	1.9111227	
107	ORIN008	Macrofauna, PSA	A1	9	27	20/01/2021	05:34:37	52.0755899	1.9082067	

Event	Station Code	Sample	Replicate Attempt	Sample Volume	Water Depth (m)	Date	Time	Latitude	Longitude	Notes
107	ORIN008	Macrofauna, PSA	B1	10	27	20/01/2021	05:40:15	52.0755375	1.9081508	
107	ORIN008	No sample	C1		27	20/01/2021	05:46:26	52.0754234	1.9080648	
107	ORIN008	Macrofauna, PSA	C2	7	27	20/01/2021	05:55:16	52.0754578	1.9080568	
108	ORIN007	Macrofauna, PSA	A1	6.5	28	20/01/2021	07:59:17	52.0813239	1.9091779	
108	ORIN007	Macrofauna, PSA	B1	5	28	20/01/2021	08:04:39	52.0813966	1.9092287	
108	ORIN007	Macrofauna, PSA	C1	6.5	28	20/01/2021	08:09:28	52.0814982	1.9092597	
109	ORIN021	Macrofauna, PSA	A1	9	31	20/01/2021	08:24:30	52.0793289	1.8962241	
110	ORIN076	Macrofauna, PSA	A1	7	32	20/01/2021	08:37:40	52.0738962	1.8994917	
111	ORIN077	Macrofauna, PSA	A1	9	34	20/01/2021	09:30:52	52.134967	1.9258475	
112	ORIN037	Macrofauna, PSA	A1	6.5	36	20/01/2021	10:01:26	52.1358624	1.9456743	
113	ORIN036	Macrofauna, PSA	A1	8	34	20/01/2021	10:25:45	52.1378264	1.9583044	
114	EOSP010	Macrofauna, PSA	A1	8	45	22/01/2021	11:42:45	50.4794513	-3.0974689	
115	EOSP009	Macrofauna, PSA	A1	7	46	22/01/2021	12:17:50	50.4777536	-3.0852377	
116	EOSP017	Macrofauna, PSA	A1	9	47	22/01/2021	12:42:45	50.4749724	-3.0658371	
117	EOSP005	Macrofauna, PSA	A1	5	49	22/01/2021	13:03:26	50.4680113	-3.0518559	
118	EOSP006	Macrofauna, PSA	A1	8	48	22/01/2021	13:25:20	50.4689486	-3.0777408	
119	EOSP037	Macrofauna, PSA	A1	9	47	22/01/2021	13:44:45	50.4704175	-3.1039511	
119	EOSP037	Macrofauna, PSA	B1	9	47	22/01/2021	13:48:52	50.4703981	-3.1040234	
119	EOSP037	Macrofauna, PSA	C1	9	47	22/01/2021	13:53:33	50.470403	-3.1041080	
120	EOSP027	Macrofauna, PSA	A1	11	45	22/01/2021	14:18:45	50.4713175	-3.1389862	
121	EOSP029	Macrofauna, PSA	A1	10	47	22/01/2021	14:39:03	50.461244	-3.1383098	
122	EOSP028	Macrofauna, PSA	A1	9	49	22/01/2021	14:57:29	50.453897	-3.1273280	
123	EOSP018	Macrofauna, PSA	A1	8	49	22/01/2021	15:23:16	50.4517627	-3.1112772	
124	EOSP013	Macrofauna, PSA	A1	7	50	22/01/2021	15:46:43	50.4445323	-3.0952173	
125	EOSP031	Macrofauna, PSA	A1	6.5	51	22/01/2021	16:13:28	50.4473781	-3.0669036	
126	EOSP022	Macrofauna, PSA	A1	7	50	22/01/2021	17:28:54	50.4473348	-3.0517097	
127	EOSP002	Macrofauna, PSA	A1	8	51	22/01/2021	18:01:27	50.4377383	-3.0454858	

Event	Station Code	Sample	Replicate Attempt	Sample Volume	Water Depth (m)	Date	Time	Latitude	Longitude	Notes
128	EOSP033	Macrofauna, PSA	A1	8	53	22/01/2021	18:22:10	50.4202036	-3.0555196	
129	EOSP020	Macrofauna, PSA	A1	9	51	22/01/2021	18:51:41	50.426815	-3.0969813	
130	EOSP011	Macrofauna, PSA	A1	9	51	22/01/2021	19:06:08	50.4334593	-3.1136236	
131	EOSP016	Macrofauna, PSA	A1	7	50	22/01/2021	19:24:47	50.4341599	-3.1422887	
132	EOSP012	Macrofauna, PSA	A1	8	51	22/01/2021	19:41:40	50.4213976	-3.1394278	
133	EOSP032	Macrofauna, PSA	A1	9	53	22/01/2021	20:02:33	50.4193409	-3.1278614	
134	EOSP038	Macrofauna, PSA	A1	6	53	22/01/2021	20:22:00	50.4171204	-3.1134650	
134	EOSP038	Macrofauna, PSA	B1	7	53	22/01/2021	20:25:56	50.4172214	-3.1134059	
134	EOSP038	Macrofauna, PSA	C1	7	53	22/01/2021	20:29:52	50.4173186	-3.1133830	
135	EOSP023	Macrofauna, PSA	A1	7	54	22/01/2021	20:51:24	50.3986194	-3.1318803	
136	EOSP025	Macrofauna, PSA	A1	7.5	54	22/01/2021	21:19:28	50.4058592	-3.1170928	
137	EOSP021	Macrofauna, PSA	A1	7	54	22/01/2021	21:44:24	50.4077274	-3.1066654	
138	EOSP004	Macrofauna, PSA	A1	7.5	54	22/01/2021	22:06:29	50.4089008	-3.0898655	
139	EOSP034	Macrofauna, PSA	A1	7.5	55	22/01/2021	22:24:34	50.4085208	-3.0789193	
140	EOSP015	Macrofauna, PSA	A1	7.5	55	22/01/2021	22:52:10	50.4030348	-3.0548670	
141	EOSP001	Macrofauna, PSA	A1	5.5	56	22/01/2021	23:33:22	50.3853305	-3.0580468	
142	EOSP035	Macrofauna, PSA	A1	9.5	56	23/01/2021	00:19:56	50.3900196	-3.0683496	
143	EOSP007	Macrofauna, PSA	A1	8	56	23/01/2021	00:43:34	50.398953	-3.0921306	
144	EOSP024	Macrofauna, PSA	A1	7	56	23/01/2021	01:10:47	50.3856398	-3.1217948	
145	EOSP030	Macrofauna, PSA	A1	9.5	57	23/01/2021	01:27:30	50.3796609	-3.1322376	
146	EOSP014	Macrofauna, PSA	A1	9	57	23/01/2021	01:49:22	50.3687419	-3.1224936	
147	EOSP003	No sample	A1		56	23/01/2021	02:14:15	50.3771992	-3.0938789	
148	EOSP019	Macrofauna, PSA	A1	6.5	58	23/01/2021	02:38:12	50.3617067	-3.0986070	
149	EOSP008	Macrofauna, PSA	A1	9.5	58	23/01/2021	02:59:46	50.3647284	-3.0860542	
150	EOSP003	Macrofauna, PSA	A1	10	58	23/01/2021	03:30:21	50.3772835	-3.0938454	Revisit to station.
151	EOSP036	Macrofauna, PSA	A1	9.5	57	23/01/2021	04:32:32	50.3638888	-3.0591367	
151	EOSP036	Macrofauna, PSA	B1	7.5	57	23/01/2021	04:36:58	50.3638542	-3.0592599	

Event	Station Code	Sample	Replicate Attempt	Sample Volume	Water Depth (m)	Date	Time	Latitude	Longitude	Notes
151	EOSP036	Macrofauna, PSA	C1	7	57	23/01/2021	04:41:04	50.3638198	-3.0593890	
152	EOSP026	Macrofauna, PSA	A1	6.5	57	23/01/2021	05:30:40	50.3703239	-3.0504803	
195	ORIN054	Macrofauna, PSA	A1	6	36	26/01/2021	10:53:20	52.0805878	1.9577572	
196	ORIN053	Macrofauna, PSA	A1	8.5	29	26/01/2021	11:25:53	52.071117	1.9491289	
197	ORIN052	Macrofauna, PSA	A1	4.5	26	26/01/2021	12:22:20	52.0602073	1.9547892	
199	ORIN051	Macrofauna, PSA	A1	5.5	26	26/01/2021	14:28:28	52.0620323	1.9441780	
200	ORIN050	Macrofauna, PSA	A1	7	23	26/01/2021	14:44:50	52.05958	1.9316266	
201	ORIN048	Macrofauna, PSA	A1	6.5	27	26/01/2021	15:05:31	52.048713	1.9283494	
202	ORIN047	Macrofauna, PSA	A1	6.5	23	26/01/2021	15:29:12	52.038856	1.9319182	
203	ORIN040	Macrofauna, PSA	A1	9	36	26/01/2021	15:53:59	52.04928	1.9215494	
203	ORIN040	Macrofauna, PSA	B1	9	36	26/01/2021	15:58:02	52.0492695	1.9214876	
203	ORIN040	Macrofauna, PSA	C1	9	36	26/01/2021	16:01:38	52.0492395	1.9214287	
204	ORIN039	Macrofauna, PSA	A1	5	29	26/01/2021	16:19:26	52.0494804	1.9116530	
204	ORIN039	Macrofauna, PSA	B1	4	29	26/01/2021	16:23:18	52.0494465	1.9116029	
204	ORIN039	Macrofauna, PSA	C1	4	29	26/01/2021	16:26:44	52.0494126	1.9115580	
205	ORIN043	Macrofauna, PSA	A1	7	30	26/01/2021	17:38:44	52.0447133	1.9163079	
205	ORIN043	No sample	B1		30	26/01/2021	17:43:33	52.0447358	1.9163202	
205	ORIN043	Macrofauna, PSA	B2	7.5	30	26/01/2021	17:46:41	52.0447369	1.9163161	
205	ORIN043	Macrofauna, PSA	C1	8.5	30	26/01/2021	17:51:13	52.0447934	1.9163652	
206	ORIN041	Macrofauna, PSA	A1	9	32	26/01/2021	18:17:08	52.0419139	1.9132484	
206	ORIN041	No sample	B1		32	26/01/2021	18:19:56	52.0418804	1.9133454	
206	ORIN041	Macrofauna, PSA	B2	8	32	26/01/2021	18:22:27	52.041857	1.9134064	
206	ORIN041	Macrofauna, PSA	C1	7.5	32	26/01/2021	18:25:12	52.0417961	1.9135141	
207	ORIN042	No sample	A1		28	26/01/2021	18:47:46	52.0440707	1.9064281	
207	ORIN042	No sample	A2		28	26/01/2021	18:50:28	52.0440366	1.9064884	
207	ORIN042	Macrofauna, PSA	B1	8	28	26/01/2021	18:53:09	52.04402	1.9065537	
207	ORIN042	Macrofauna, PSA	C1	7.5	28	26/01/2021	18:55:42	52.0439751	1.9066215	

Event	Station Code	Sample	Replicate Attempt	Sample Volume	Water Depth (m)	Date	Time	Latitude	Longitude	Notes
207	ORIN042	Macrofauna, PSA	A3	9	28	26/01/2021	18:58:03	52.0439378	1.9066812	
208	ORIN046	Macrofauna, PSA	A1	5	20	26/01/2021	19:22:07	52.0429735	1.8937580	
209	ORIN045	No sample	A1		29	26/01/2021	19:58:10	52.0497554	1.8835500	
209	ORIN045	Macrofauna, PSA	A2	4.5	29	26/01/2021	20:01:30	52.0497402	1.8836291	
210	ORIN044	Macrofauna, PSA	A1	5	29	26/01/2021	20:30:30	52.0428133	1.8473769	
211	ORIN068	Macrofauna, PSA	A1	7.5	27	26/01/2021	21:08:55	52.0427962	1.8242559	
212	ORIN066	Macrofauna, PSA	A1	4.5	30	26/01/2021	21:40:21	52.0494316	1.8140002	
213	ORIN067	No sample	A1		25	26/01/2021	22:14:13	52.0625457	1.7973614	
213	ORIN067	Macrofauna, PSA	A2	4.5	25	26/01/2021	22:18:01	52.0625591	1.7973811	
214	ORIN065	Macrofauna, PSA	A1	5	27	26/01/2021	22:56:44	52.0590003	1.7737739	
215	ORIN064	No sample	A1		38	26/01/2021	23:31:13	52.0776647	1.7698426	All small samples for each attempt at this station.
215	ORIN064	No sample	A2		38	26/01/2021	23:35:17	52.0777086	1.7698863	All small samples for each attempt at this station.
215	ORIN064	No sample	A3		38	26/01/2021	23:39:24	52.0776989	1.7699230	All small samples for each attempt at this station.
216	ORIN063	Macrofauna, PSA	A1	9.5	31	27/01/2021	00:23:18	52.0920184	1.7830914	
217	ORIN062	No sample	A1		32	27/01/2021	00:56:27	52.1096954	1.7849740	
217	ORIN062	Macrofauna, PSA	A2	6.5	32	27/01/2021	01:04:23	52.1096684	1.7849578	
218	ORIN061	Macrofauna, PSA	A1	7	29	27/01/2021	01:40:04	52.1052699	1.8071419	
219	ORIN060	Macrofauna, PSA	A1	10	32	27/01/2021	02:10:06	52.1152307	1.8405842	
220	ORIN059	No sample	A1		32	27/01/2021	02:35:58	52.1366767	1.8646840	
220	ORIN059	Macrofauna, PSA	A2	10.5	32	27/01/2021	02:42:19	52.1366342	1.8646667	
221	ORIN058	No sample	A1		36	27/01/2021	03:25:49	52.1493627	1.9254033	All small samples for each attempt at this station.
221	ORIN058	No sample	A2		36	27/01/2021	03:31:31	52.1493517	1.9253479	All small samples for each attempt at this station.
221	ORIN058	No sample	A3		36	27/01/2021	03:37:34	52.1493116	1.9252956	All small samples for each attempt at this station.
222	ORIN057	Macrofauna, PSA	A1	9	35	27/01/2021	04:46:24	52.1394411	1.9734245	
223	ORIN056	Macrofauna, PSA	A1	11.5	27	27/01/2021	05:14:48	52.1178706	1.9862694	

Event	Station Code	Sample	Replicate Attempt	Sample Volume	Water Depth (m)	Date	Time	Latitude	Longitude	Notes
224	ORIN055	No sample	A1		28	27/01/2021	05:36:07	52.1046212	1.9679103	All small samples for each attempt at this station.
224	ORIN055	No sample	A2		28	27/01/2021	05:41:10	52.1046037	1.9678478	All small samples for each attempt at this station.
224	ORIN055	No sample	A3		28	27/01/2021	05:45:18	52.1045703	1.9678037	All small samples for each attempt at this station.
225	ORIN052	No sample	A2		27	27/01/2021	06:42:33	52.060204	1.9547560	Revisit to station.
225	ORIN052	No sample	A3		27	27/01/2021	07:06:30	52.0602434	1.9546391	Revisit to station.
226	ORIN039	No sample	B2		30	27/01/2021	07:54:00	52.0494941	1.9116637	Revisit to station.
226	ORIN039	No sample	B3		30	27/01/2021	07:58:00	52.0494906	1.9117504	Revisit to station.
226	ORIN039	No sample	C2		30	27/01/2021	08:02:00	52.0494877	1.9118307	Revisit to station.
226	ORIN039	No sample	C3		30	27/01/2021	08:06:00	52.0494563	1.9119068	Revisit to station.
227	ORIN045	No sample	A3		29	27/01/2021	08:31:50	52.0498084	1.8835957	Revisit to station.
228	ORIN073	Macrofauna, PSA	A3	11.5	28	27/01/2021	08:56:40	52.0560734	1.8577471	Revisit to station.
229	ORIN066	No sample	A2		29	27/01/2021	09:32:39	52.0497042	1.8138411	Revisit to station.
229	ORIN066	Macrofauna, PSA	A3	7	29	27/01/2021	09:37:50	52.04974	1.8138868	Revisit to station.
230	ORIN067	No sample	A3		25	27/01/2021	10:05:20	52.0627765	1.7972055	Revisit to station.
231	ORIN004	No sample	A2		30	27/01/2021	10:30:11	52.0852385	1.8079846	Revisit to station.
231	ORIN004	No sample	A3		30	27/01/2021	10:34:27	52.0852822	1.8080437	Revisit to station.
231	ORIN004	No sample	C2		30	27/01/2021	10:38:31	52.0853168	1.8080855	Revisit to station.
231	ORIN004	No sample	C3		30	27/01/2021	10:42:30	52.0852936	1.8081512	Revisit to station.
232	ORIN003	No sample	B2		28	27/01/2021	10:59:44	52.0898085	1.8151351	Revisit to station.
232	ORIN003	No sample	B3		28	27/01/2021	11:04:48	52.0897736	1.8150828	Revisit to station.

Annex 5. MBES Calibration Report

Survey	CEND0121
Calibration Date	27-JAN-2021
Vessel	SS Stanmount
Latitude	52°39.793'N
Longitude	02°01.456'E

Background

Stanmount was built 1914 by Gray & Co; ex-Ricardo A Mestres, ex-Anerley; ex-Wyneric; ex-Bratton; Stanmount was mined and sunk, 1 mile off the No.6 buoy, Yarmouth, on 24th December 1941, while en route from London to Grimsby with creosote. Figure 16 shows the layout of the Stanmount.

Multibeam Calibration

A calibration was performed on 27/01/2021 over the wreck of the Stanmount, located in the Southern North Sea. The UKHO wrecks database lists the known position of the Stanmount as: 52° 39.793' N, 02° 01.456' E

Due to bathymetric data being collected in 2014 (HI 1428) an initial survey line was compiled and is presented in Figure 17. The purpose of the calibration was to further validate the new angular offsets after the 0.4° TX transducer was replaced in Nov 2020. In effect this calibration can be viewed as a confirmation of the calibration and repeatability tests conducted in November 2020. This will ensure that the RV Cefas Endeavour will collect MBES data to International Hydrographic Organization (IHO) s-44 order 1a, 6th edition (IHO 2020).

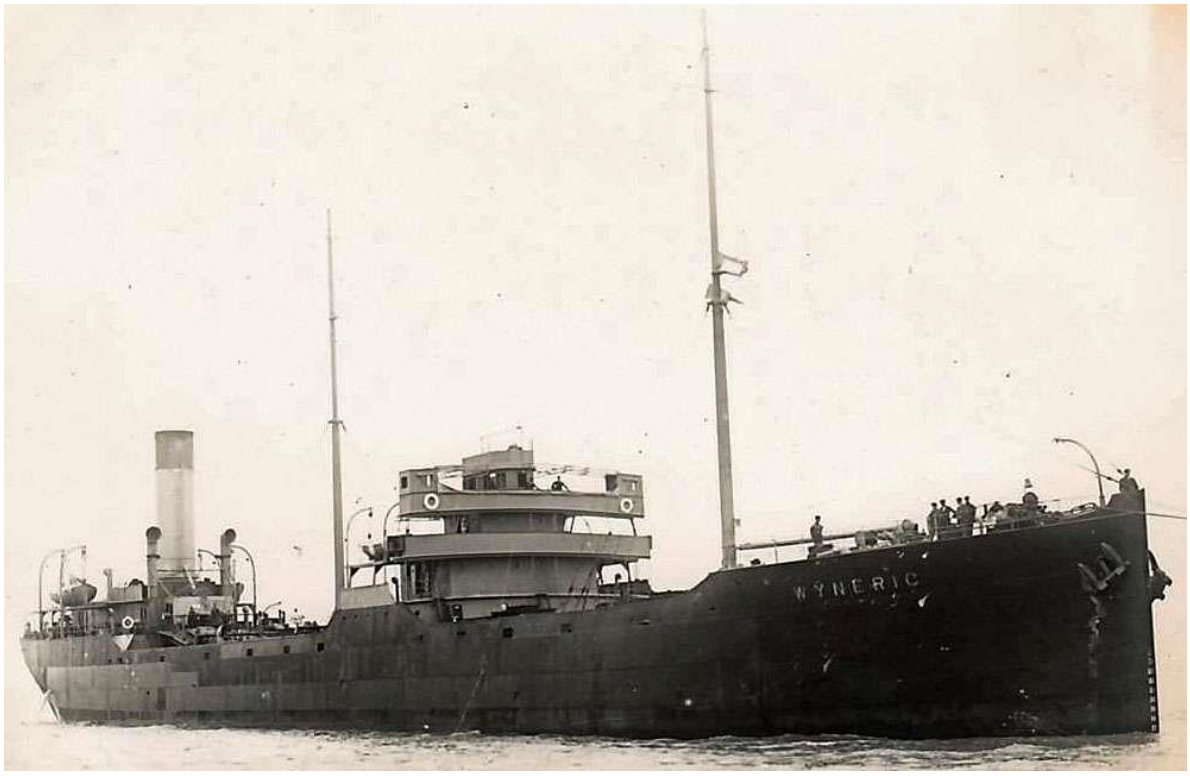


Figure 16. SS Stanmount as Wyneric.

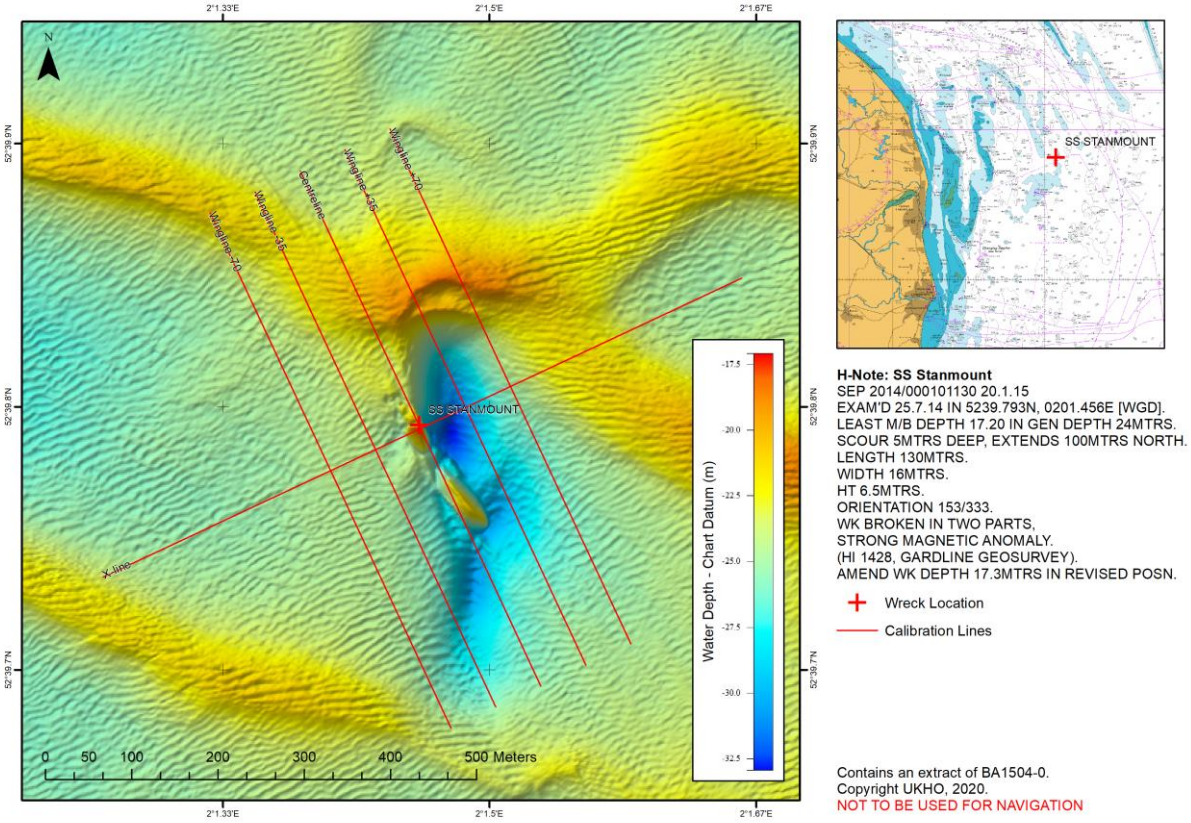


Figure 17. Initial line planning.

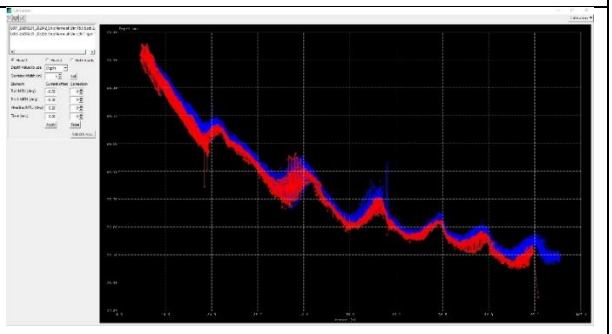
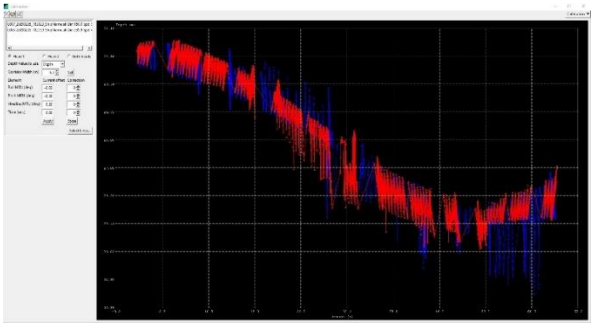
Data acquisition

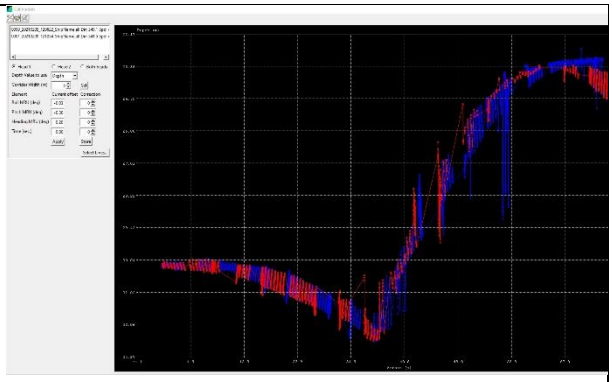
During the acquisition of data several issues arose. These were:

- New autopilot had been fitted which meant that the initial line keeping was of poor quality.
- Old version of survey navigation software had been installed, which meant that the helmsman had poor DCC (Distance Cross Course) values to steer by.
- Due to the calibration being the last item on the survey schedule meant that the lines were run at peak tidal flows, which meant that the cross-line was run in both directions and served for the roll calibration.
- Grid engine failed in SIS, so calibration lines had to be replayed in simulation mode.

Although these factors were present for acquisition an acceptable set of data were collected, which enabled the calibration to be completed.

Table 12. MBES calibration factors.

Parameter	Line file name	Previous value	Change value	Online image
Roll	0012_20210127_202839.all 0014_20210127_203931.all	-0.03	-0.03	
Pitch	0004_20210127_192937.all 0008_20210127_195819.all	-0.30	-0.30	

Yaw	0004_20210127_192937.all 0006_20210127_194603.all 0010_20210127_201344.all	0.20	0.20	

The calibration factors were also checked when the data had been loaded into Caris. Graphical representations of the Stanmount are presented in Figure 18 and Figure 19.

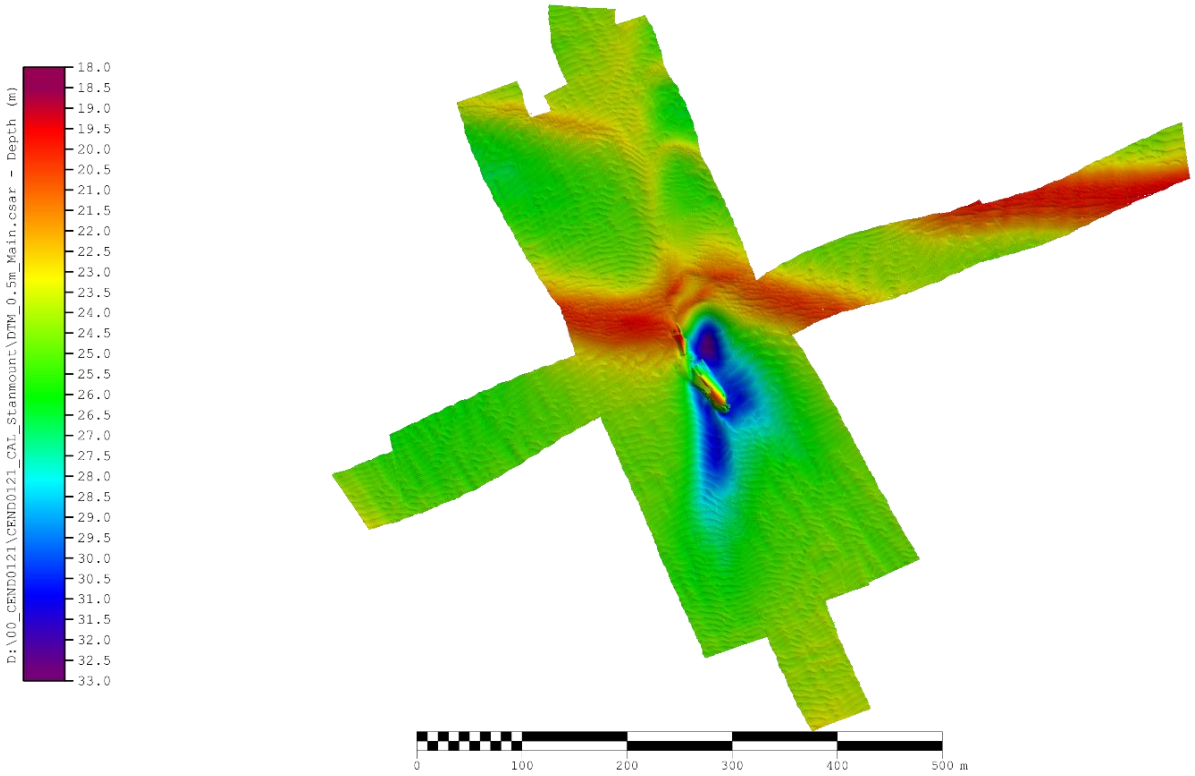


Figure 18. 2D view of the SS Stanmount.

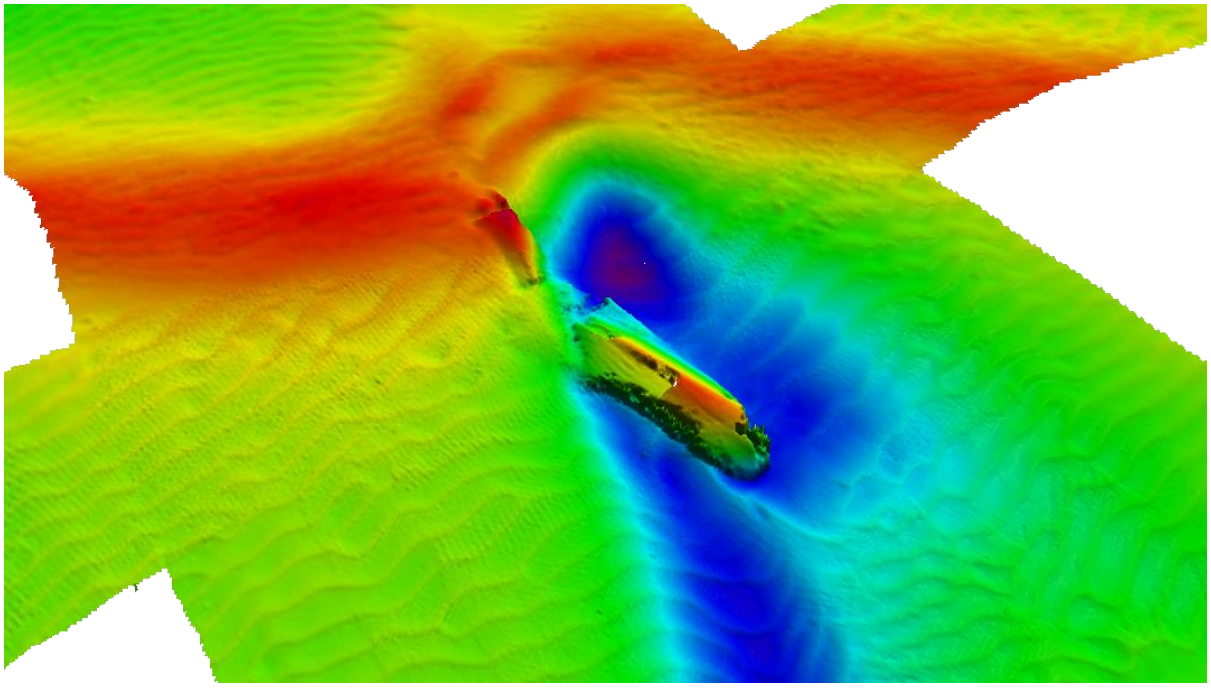


Figure 19. 3D view of the SS Stanmount.

Spatio-temporal Analysis

It was possible to conduct further analysis using data collected by the Civil Hydrography Programme in 2014. Figure 20 shows the calibration data collected in 2021 overlain on the 2014 data, and Figure 21 demonstrates the surficial change that has occurred between the two datasets. As the figures show, there has been significant mass transport of sediment around the wreck and the scour pit extended to the south has undergone scour / sediment erosion.

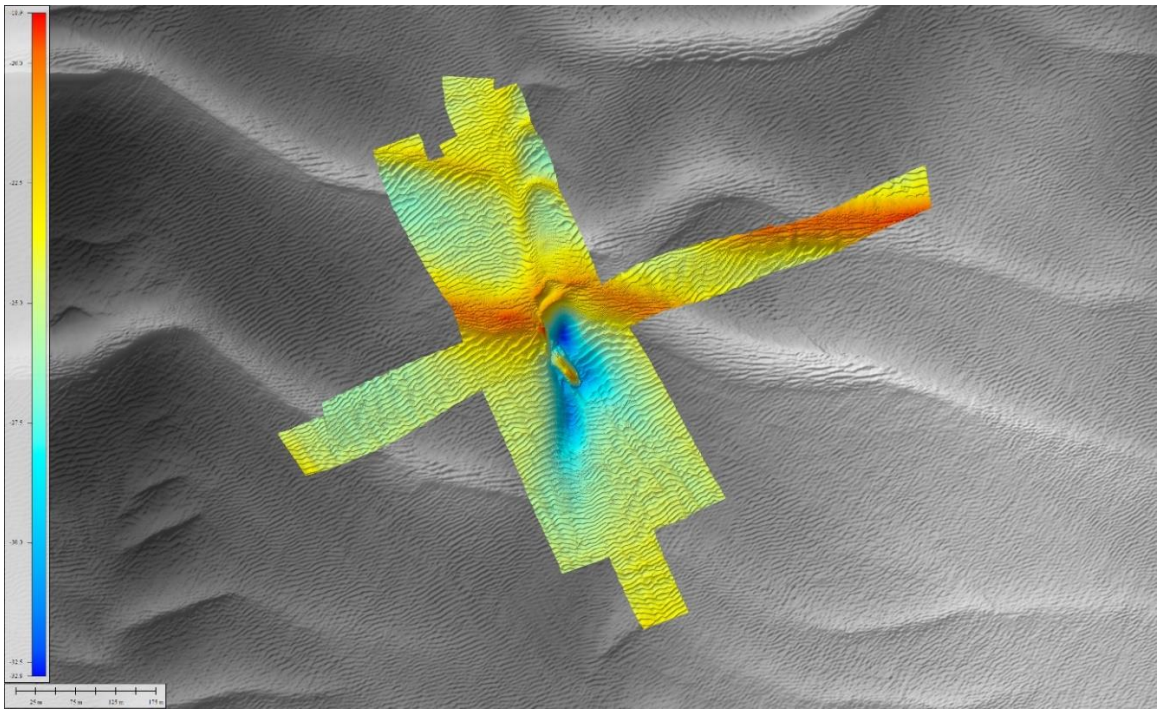


Figure 20. Civil Hydrography Programme 2014 multibeam bathymetry data (greyscale) of the SS Stanmount, overlain with CEND1921 calibration data (multicoloured).

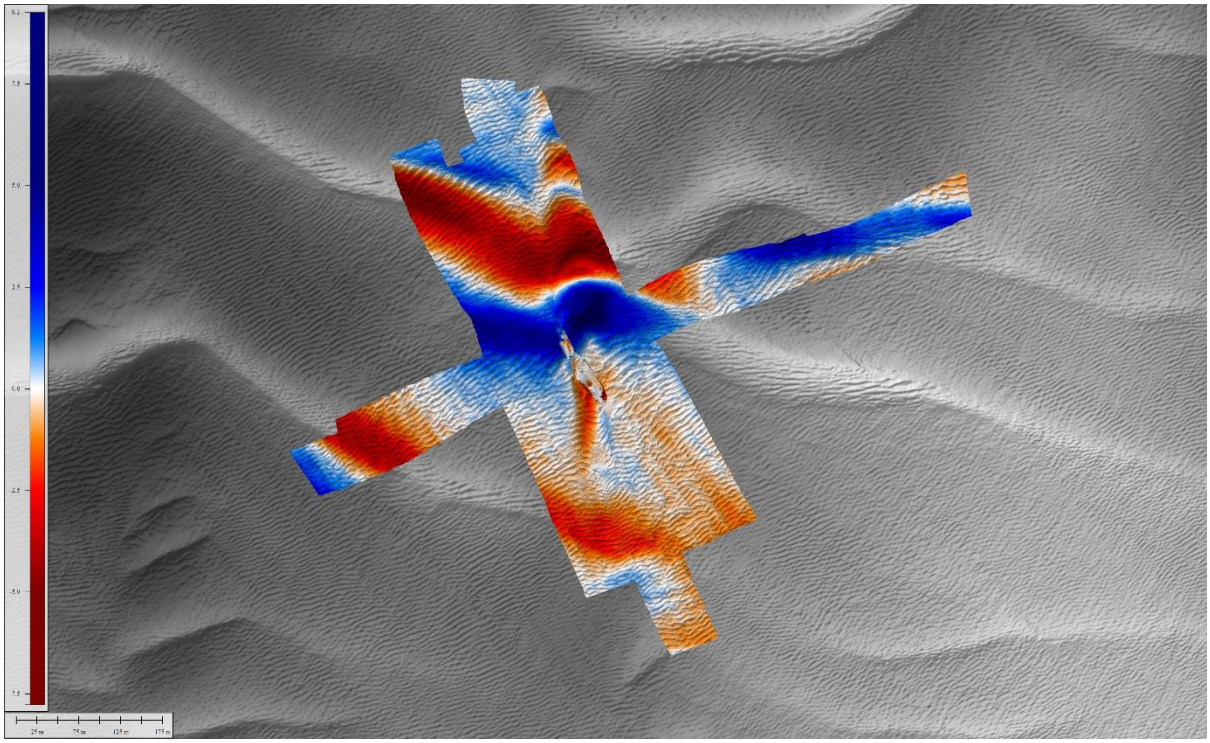


Figure 21. Temporal change in CEND1921 multibeam calibration data (multicoloured) compared with Civil Hydrography Programme 2014 data (greyscale) at the SS Stanmount. Difference in metres (blue = positive change / deposition, red = negative change / erosion).

Stones, S., Bullimore, R., T. Noble-James & Lake, I. (2022). Cromer Shoal Chalk Beds MCZ, Orford Inshore MCZ, West of Wight-Barfleur MCZ and East of Start Point MCZ Survey Report 2021. JNCC/Cefas Partnership Report No. 39. JNCC, Peterborough, ISSN 2051-6711, © Cefas, JNCC, Natural England 2022.