Natural England Commissioned Report NECR299

Bideford to Foreland Point MCZ 2019 Survey Report

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Foreword

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Background

Following designation, Natural England started a baseline monitoring programme across all marine protected areas.

This report was commissioned as part of an inshore benthic marine survey of the Bideford to Foreland Point MCZ.

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Bideford to Foreland Point MCZ 2019 Survey Report

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Bideford to Foreland Point MCZ 2019 Survey Report

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C. Miller	Natural England/Environment Agency Marine Technical Specialist
L. Parkhouse	Devon and Severn Inshore Fisheries and Conservation Authority Environment Officer

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1. Introduction

Following the introduction of the Marine and Coastal Access Act in 2009, the UK Government is creating an ecologically coherent network of Marine Conservation Zones (MCZs) in British waters. The MCZ network will exist alongside other Marine Protected Areas (MPAs), including Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Sites of Special Scientific Interest (SSSIs) and Ramsar sites to help conserve marine biodiversity, in particular habitats and species of national importance.

Forming part of this network, the Bideford to Foreland Point MCZ was formally designated on the 17th January 2016[1]. The site protects 14 Broadscale Habitats, four habitat Features of Conservation Interest (FOCI) and two species FOCI (Table 1). Following designation, Natural England* have started a programme of monitoring and the initial datasets gathered will be used, along with all other available information, to assess the condition of the features in the site using Natural England marine condition assessment methodology. The method uses attributes set out in the sites supplementary advice on conservation objectives to form an overall decision about the condition of the features, and this work will inform the assessment of specific attributes (Section 1.2). The results from the condition assessment will inform future monitoring planning and management of the site.

*inshore Statutory Nature Conservation Body

1.1 Site Description

The Bideford to Foreland Point MCZ is located on the north coast of Devon in the south west of England (Natural England, 2016) (Figure 1). The inshore site covers an area of 104 km² and is overlapped by two pre-existing designated sites; Braunton Burrows SSSI and SAC, and Northam Burrows SSSI, both of which extend into the intertidal zone of the Bideford to Foreland Point MCZ. The site also sits within the Bristol Channel Outer South and Barnstaple Bay coastal Water Framework Directive (WFD) water bodies, where monthly water quality monitoring is undertaken for temperature, salinity, dissolved oxygen, dissolved inorganic nutrients, phytoplankton community composition and chlorophyll.

[1] This report was produced before the Tranche 3 designation announcement on the 31st May 2019 and as such all content was correct at the time of writing.

The Bideford to Foreland Point MCZ protects a wide range of Broadscale Habitats (BSH), Species and Habitat FOCI. These include subtidal sediment and rock habitats which are permanently submerged, as well as beaches of intertidal sand, which are exposed to air at low tide and below water at high tide (Natural England, 2016). This MCZ helps fill a gap in the network for Honeycomb worm reefs. Created by the closely-packed sand tubes constructed by the Honeycomb worm (*Sabellaria alveolata*), these support a wide range of shore-dwelling species including anemones, molluscs, shore crabs and seaweeds (Natural England, 2016).

This site also protects a range of important and vulnerable species such as the Pink sea-fan (*Eunicella verrucosa*), which provides a home to other species including the Celtic sea slug (*Onchidella celtica*) and Policeman anemone (*Mesacmaea mitchellii)* (The Wildlife Trust, 2019). Finally, the European spiny lobster (*Palinurus elephas)* which is protected with the aim to recover to favourable condition (Natural England, 2016).

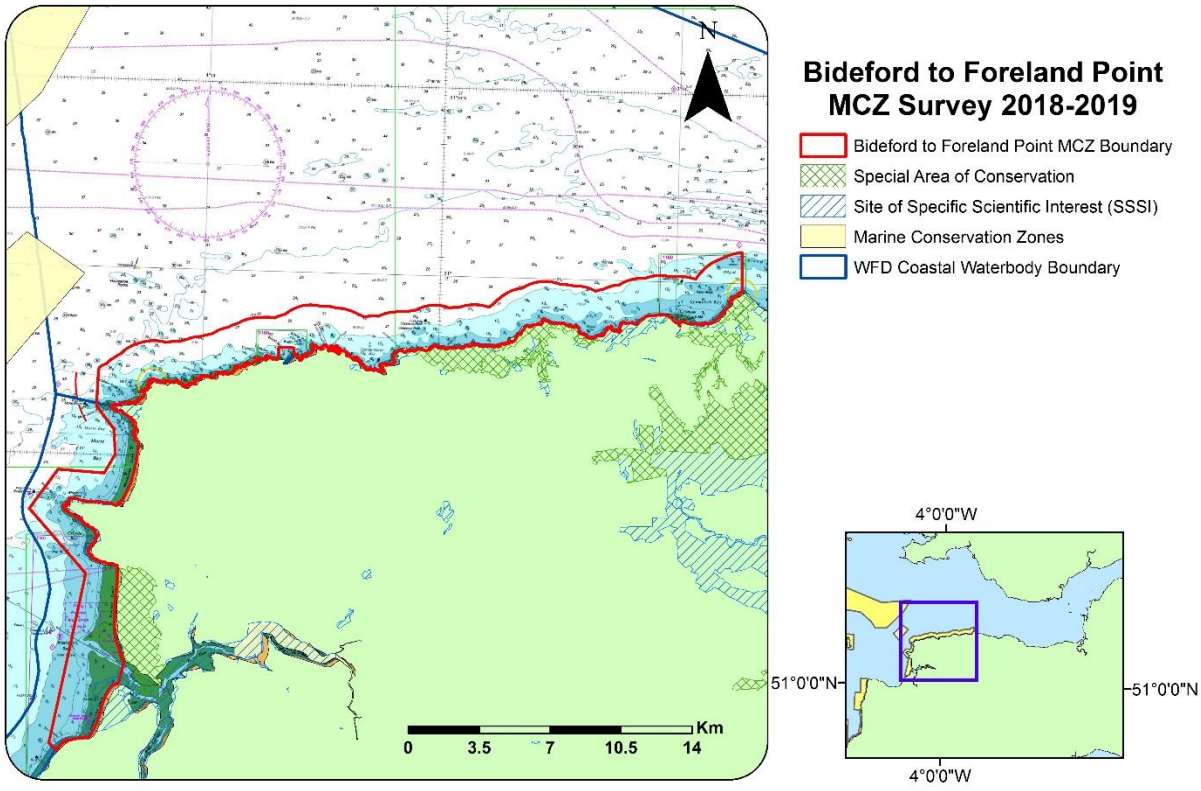

Figure 1. Location of the Bideford to Foreland Point Marine Conservation Zone (MCZ) in the context of other MCZs off the South West of England.

The features protected under the MCZ designation order are presented in Table 1 alongside the general management approach. The survey planned here will focus on those features indicated by blue shading (Table 1).

Current Devon and Severn Inshore Fisheries and Conservation Authority (DSIFCA) management measures for the Bideford to Foreland Point MCZ include the prohibition of the removal of the European spiny lobster (*Palinurus elephas*) via towed gear, potting, netting and diving, listed under DSIFCA Mobile Fishing Permit Byelaw and Netting Permit Byelaw. Additional management measures for this species FOCI in the form of byelaws (Potting Permit and Diving Permit) are also currently under review by the DSIFCA (L. Parkhouse, DSIFCA, pers. comm.).

Areas of the MCZ, near the Taw and Torridge rivers are not permitted to use nets other than a seine net in accordance with paragraph 3.2 of the Netting Permit Conditions. Further information can be found on the DSIFCA website: https://www.devonandsevernifca.gov.uk/Enforcement-Legislation/Current-Permit-Byelaws-Permit-Conditions

Table 1. Designation status and the current General Management Approach (GMA) for the features of conservation importance present in the Bideford to Foreland Point Marine Conservation Zone. The survey planned here will focus on those features indicated by blue shading.

Feature Type	Features Present	Designated	GMA
Broadscale Habitat (BSH)	Low energy intertidal rock	✓	**Maintain**
	Moderate energy intertidal rock	✓	**Maintain**
	High energy intertidal rock	✓	**Maintain**
	Intertidal coarse sediment	✓	**Maintain**
	Intertidal sand and muddy sand	✓	**Maintain**
	Intertidal mixed sediments	✓	**Maintain**
	Low energy infralittoral rock	✓	**Maintain**
	Moderate energy infralittoral rock	✓	**Maintain**
	High energy infralittoral rock	✓	**Maintain**
	High energy circalittoral rock	✓	**Maintain**
	Moderate energy circalittoral rock	✓	**Maintain**
	Subtidal coarse sediment	✓	**Maintain**
	Subtidal mixed sediments	✓	**Maintain**
	Subtidal sand	✓	**Recover**
Habitat Feature of Conservation Importance	Fragile sponge and anthozoan communities on subtidal rocky habitats	✓	**Maintain**
	Honeycomb worm (*Sabellaria alveolata*) reefs	✓	**Maintain**
	Intertidal underboulder communities	✓	**Maintain**
	Littoral chalk communities	✓	**Maintain**
Species Feature of Conservation Importance	Pink sea-fan (*Eunicella verrucosa*)	✓	**Maintain**
	Spiny lobster (*Palinurus elephas*)	✓	**Recover**

1.2 Survey Aim and Objectives

To undertake a survey of Bideford to Foreland Point MCZ designated features (Table 1) to obtain new evidence which can be used by Natural England, alongside all other relevant information, to detect change over time and ascribe condition to inform future monitoring and management measures.

Objective 1:

Benthic grab and underwater camera survey of subtidal sediment and rock features along the western side of the site (Ilfracombe to Westward Ho!).

Objective 2:

Benthic grab and underwater camera survey of subtidal sediment and rock features mapped following the 2014-2015 MCZ verification survey along the northern part of the site (Foreland Point to Ilfracombe).

Objective 3:

Underwater camera survey of the Pink sea-fan (*Eunicella verrucosa*) species FOCI to assess the following attributes from Natural England's Supplementary Advice on Conservation Objectives (Natural England, 2017):

1) Population structure – Population size is the number of individuals within a population that are able to contribute to the species viability at a local, national and bio-geographic scale. Population size relates to the abundance of a species. It should include all the populations of a species within the site.

2) Population: recruitment and reproductive capability - Recruitment and reproductive capability reflect the health and success of the population in terms of maintaining and / or restoring numbers. A reduction in the availability of individuals able to successfully reproduce, and survival rates, may impact the overall size and age-structure of the population

3) Presence and spatial distribution of the species - The presence describes the species occurrence, with the spatial distribution providing a more detailed overview of the location(s) and pattern of occurrence within a site. It's important to consider the various life stages of a species as this may influence its distribution. Disturbance caused by human activities should not adversely affect the species.

4) Supporting Processes: physico-chemical properties and water quality (dissolved oxygen, turbidity) - The physico-chemical properties that influence the species include salinity, pH and temperature. These abiotic factors can affect the species in different ways depending on species-specific tolerances. Temperature and salinity are closely linked and can act either alone or in combination and can ultimately

determine the success of a population, most notably in coastal habitats. Changes in any of these properties, as a result of human activity, may also impact the supporting habitats and the food favoured by the species.

Dissolved Oxygen (DO) levels affect the condition and health of species. A reduction in oxygen concentration may cause some individuals of a Pink Sea-Fan population to die (Readman and Hiscock, 2017).

Water turbidity is a result of material suspended in the water, including sediment, plankton, pollution or other matter washed into the sea from land sources. In coastal environments turbidity levels can rise and fall rapidly as a result of biological (e.g. plankton blooms), physical (e.g. storm events) or human (e.g. coastal development) factors. Prolonged increases in turbidity could affect the ability of the species to feed and respire (Readman and Hiscock, 2017).

Incidental information may be gathered on the Sea-fan anemone (*Amphianthus dohrnii*), which occurs in association with Pink sea-fans (the Sea-fan anemone is extremely difficult to observe from video and still images).

Objective 4:

Underwater camera survey of the 'Fragile Sponge and Anthozoan Communities on Subtidal Rocky Habitats' to assess the following attributes from the Supplementary Advice:

1) Extent and distribution - The extent describes the presence and area of the habitat. The distribution describes the more detailed location(s) and pattern of habitat across the site. The distribution will influence the component communities present, and also help increase the health and resilience of the feature. The extent of subtidal rock is important as it provides the platform for the fragile sponge and anthozoan community.

2) Structure and function: presence and abundance of key structural and influential species - Structural species are those that form part of the habitat structure or help to define a key biotope. Influential species are those that are likely to have a key role affecting the structure and function of the habitat (such as bioturbators (mixers of sediment), grazers, surface borers, predators or other species with a significant functional role linked to the habitat).

3) Structure: species composition of component communities - Species composition of communities includes a consideration of both the overall range of species present within the community, as well as their relative abundance. Species considered need not be restricted to sessile benthic species but could include mobile species associated with the benthos. Species composition could be altered by human activities without changing the overall community type.

4) Structure: non-native species - Non-native species may become invasive and displace native organisms by preying on them or out-competing them for resources such as food, space or both.

5) Structure: physical structure of rocky substrate - The physical structure of the subtidal rock will influence the marine life that's likely to be present within a site. Structural and surface complexity, the spaces between rocks, fissures and crevices are all examples of aspects that should be considered. Fragile sponge and anthozoan communities are found at the top of large depressions on exposed rock ledges and a flat or gently sloping boulder - strewn platform. Within these structures there are holes and crevices which provide a good substrate for these communities to establish.

6) Supporting Processes: physico-chemical properties and water quality (dissolved oxygen, turbidity) - The physico-chemical properties that influence habitats include salinity, pH and temperature. They can act alone or in combination to affect habitats and their communities in different ways, depending on species-specific tolerances. In coastal habitats they can vary widely and can influence the abundance, distribution and composition of communities at relatively local scales.

Water turbidity is a result of material suspended in the water, including sediment, plankton, pollution or other matter washed into the sea from land sources. Prolonged changes in turbidity may influence the amount of light reaching the seabed, affecting the primary production and nutrient levels of the habitat's associated communities.

Dissolved Oxygen (DO) levels affect the condition and health of features. Excessive nutrients and / or high turbidity can lead to a drop in DO, especially in warmer months.

1.3 Survey Team

The Bideford to Foreland Point MCZ survey took place between the 1st September, 2018 and 9th April, 2019. The survey team comprised of marine monitoring specialists from the Environment Agency. The coastal survey vessel *Severn Guardian,* staffed and operated by Briggs Marine (Figure 2, Annex 7.1) was used to conduct the survey work reported here.

Figure 2. Coastal survey vessel *Severn Guardian* operated by Briggs Marine.

2. Survey Design and Methods

2.1 Survey Design and Planning Phase

Objective 1: Benthic grab and underwater camera survey of subtidal sediment and rock features along the western side of the site (Ilfracombe to Westward Ho!).

During the MCZ verification survey in 2014-2015 (Davies *et al*., 2015), the west of the site had limited spatial coverage of Drop Camera (DC) and grab stations and there was no backscatter or multibeam data collected. Therefore no broadscale habitat map was available to aid survey planning for this section of the MCZ (Archer and Murray, 2018). Power analysis to aid survey design was not used to determine sample numbers due to the incomplete broadscale habitat map to aid placement of sample stations and spatial differences in benthic communities due to the prominent headland at Morte Point.

A detailed survey of this western section of the MCZ was deemed appropriate to provide as much data about the features present as possible. No further multibeam surveys were planned for the 2018 survey due to the shallow nature of this section of the MCZ.

To ensure comparability with verification survey data, Thirty Mini-Hamon Grab (MHM) stations were selected along the western side of the site using a 1 km triangular grid, avoiding areas deemed to be subtidal rock on Admiralty Charts, to gather data on the sediment features for Objective 1 (Figure 3). Nine stations sampled in the 2014-2015 MCZ verification survey in the western half of the site (Stations BTFP33, 35, 37, 39, 40, 42, 45, 49 and 57) were reselected to allow direct temporal comparisons to previous historical data.

Nineteen Drop Camera (DC) stations (stations BTFP01-19) were selected to provide a broad spatial distribution across this section of the MCZ and fill in data gaps from the MCZ verification survey to meet Objective 1 (Figure 4). A triangular grid was not used to aid DC station selection due to the shallow nature and strong currents of the subtidal area within this section of the site. Instead expert judgement and local knowledge was used to place stations with a broad geographic spread across features and in locations which could be safely surveyed. Admiralty Charts were also used to guide station placement around rock and sediment features due to the lack of BSH map.

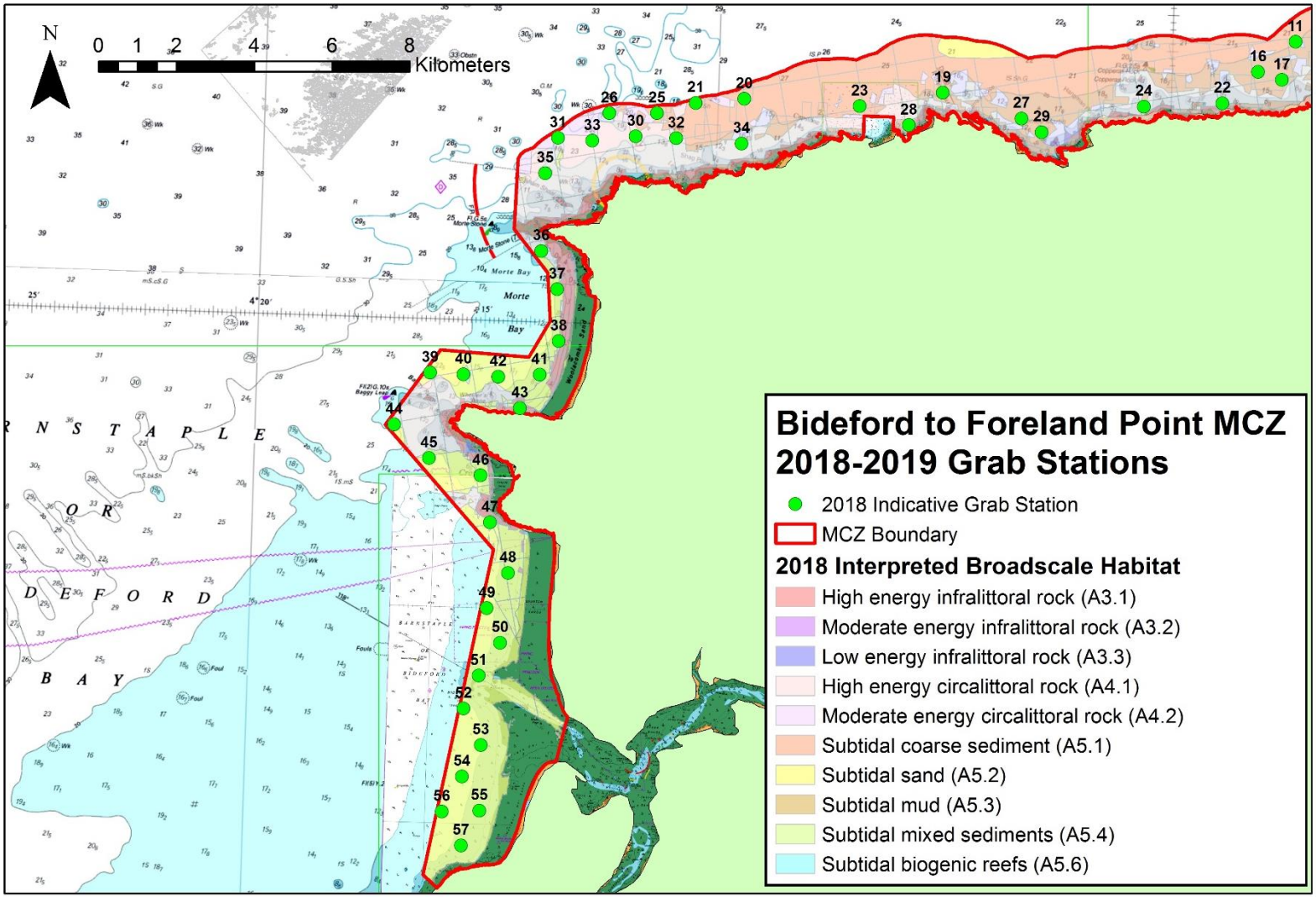

Figure 3. Bideford to Foreland Point Marine Conservation Zone (MCZ) survey plan showing target Mini-Hamon Grab (MHM) sampling stations (Ilfracombe to Westward Ho!) mapped over interpreted Broadscale habitat data (Archer and Murray, 2018, Natural England 2019).

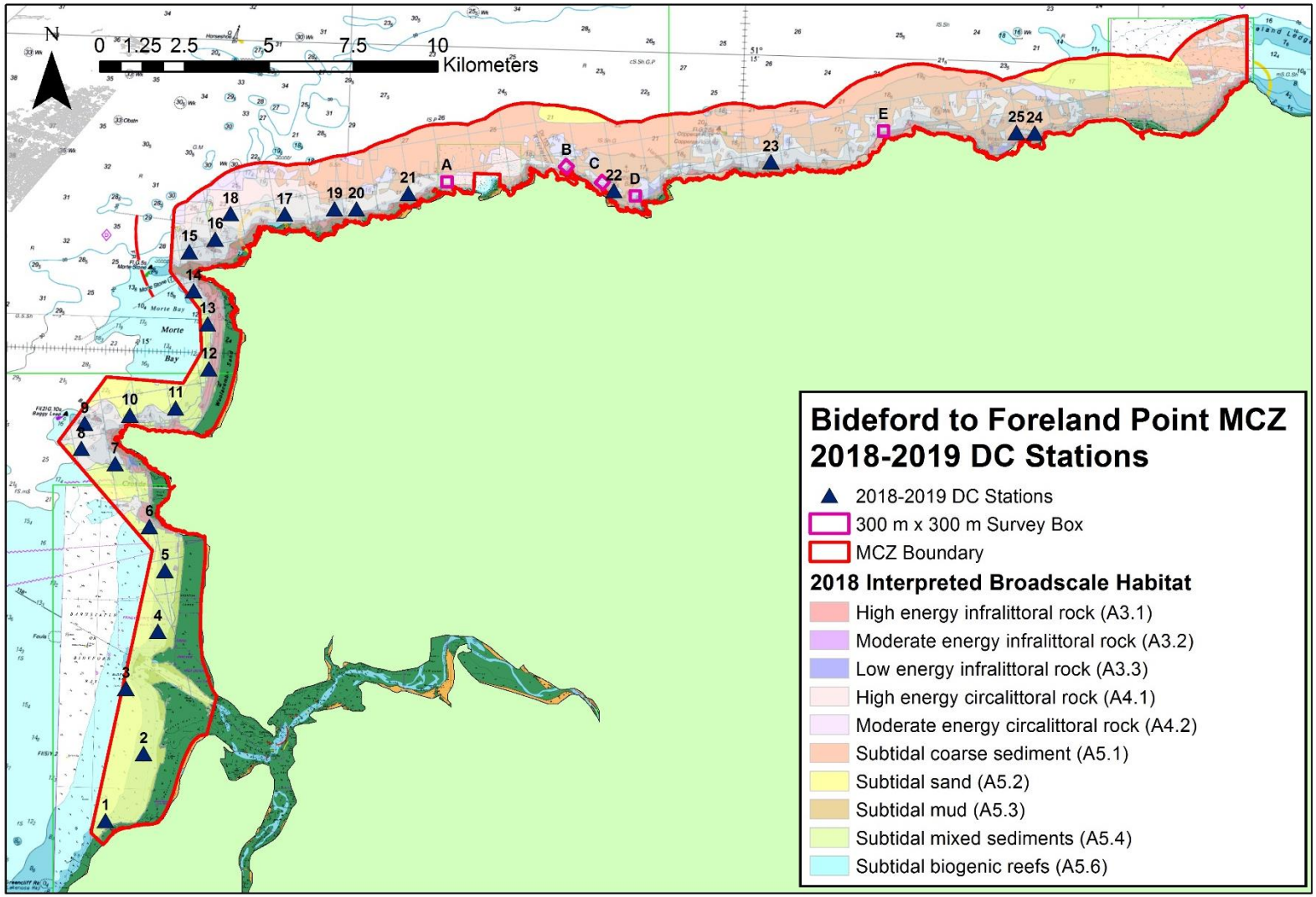

Figure 4. Bideford to Foreland Point Marine Conservation Zone (MCZ) 2018 Drop Camera (DC) stations, mapped over interpreted Broadscale Habitat data (Archer and Murray, 2018, Natural England 2019).

Objective 2: Survey of sediment and rock communities mapped following 2014-2015 MCZ verification survey along the northern part of the site (Foreland Point to Ilfracombe).

To ensure comparability with verification survey data, Twenty-seven MHM stations were selected for the northern part of the site using the 2017 Broadscale Habitat map produced following the MCZ verification survey (Archer and Murray, 2018). Sampling stations were placed within the interpreted 'A5.1 Subtidal coarse sediment' and 'A5.2 Subtidal sand' features (Figure 5). Areas mapped as 'A5.6 Biogenic reef' were avoided to ensure there was no damage to this habitat. Six stations were repeats of stations sampled in the 2014-2015 verification survey in the north section of the MCZ (Stations BTFP04, 05, 17, 18, 27 and 28) to allow comparisons to previous data.

Three of these stations (BTFP05, 15 and 23) along the north of the MCZ were selected for contaminants sampling (heavy metals, TBT, PAHs, PCBs) using a Day Grab. Contaminants sampling normally targets subtidal sediments with a mud fraction e.g. 'A5.3 Subtidal mud' or 'A5.4 Subtidal mixed sediments' (Environment Agency, 2007) however these BSH were not found during the MCZ verification survey. Other surveys in the Bristol Channel have shown high levels of sediment contaminants so Natural England were keen to obtain further data from the northern section of the MCZ (B.Green pers. comm.*).* Therefore sampling of contaminants would be confirmed if stations previously grabbed using a Mini-Hamon grab for Objective 1 and 2 contained a visible mud fraction. No contaminants sampling stations were selected in the west of the MCZ due to the predominance of 'A5.2 Subtidal sand' indicated by the 2014-2015 survey.

Objective 3: Underwater camera survey of the Pink sea-fan (*Eunicella verrucosa*) feature.

No records of Pink sea-fans (*Eunicella verrucosa*) were found during the MCZ verification survey (Archer and Murray, 2018). Instead, records within the MCZ were obtained from the SeaSearch datasets extracted from the National Biodiversity Network Database (NBN, 2018). These records were mapped across the MCZ and four fixed-position 300 m x 300 m survey boxes (B - E) were selected for the 2018 survey, along the north of the MCZ (Figures 6 and 7) to meet Objective 3.

These sample boxes were located over historical records of Pink sea fan presence from between 2008 and 2018. Records of Pink sea-fans older than 10 years, or those found at wreck sites, were disregarded from the selection process due to reduced data confidence or safety concerns around wrecks. Further methodology details are available in Annex 7.6

Measurements were also taken within each sample box for near-seabed salinity, dissolved oxygen, sea temperature and turbidity using an Idronaut probe.

Objective 4: Underwater camera survey of the 'Fragile sponge and anthozoan communities on subtidal rocky habitats' feature

No records of the 'Fragile sponge and anthozoan communities on subtidal rocky habitats' feature were found in the MCZ verification survey (Archer and Murray, 2018). Instead, records of the Marine Nature Conservation Review (MNCR) biotope 'Bryozoan turf and erect sponges on tide-swept circalittoral rock' (CR.HCR.XFa.ByErSp) were used as an indicator of the MCZ feature to aid survey planning. This biotope was mapped across the MCZ and two fixed-position 300 m x 300 m boxes (A and E) were placed within the MCZ boundary to encompass historical stations which had over 5 stills noting the presence of this biotope (Figures 6 and 7). Survey box E also contained records of Pink sea-fans for Objective 3.

Measurements were also taken within each sample box for near-seabed salinity, dissolved oxygen, sea temperature and turbidity using an Idronaut probe.

Historical stations which had fewer than 5 stills recording the 'Bryozoan turf and erect sponges on tide-swept circalittoral rock' biotope (stations BTFP20-25), had a single DC point placed on the station instead of a 300 m x 300 m fixed-position survey box (Figures 6 and 7). Further methodology details are available in Annex 7.6.

Marine specialists from the Environment Agency and Natural England reviewed the plan. The following hazards were identified from the UKHO Admiralty charts; pipeline, subsea cables, underwater obstructions and charted wrecks. Sampling stations were checked to ensure these hazards were avoided. A 'Notification of an exempt activity form' to cover 'samples and investigations' was submitted to the Marine Management Organisation prior to the survey being carried out.

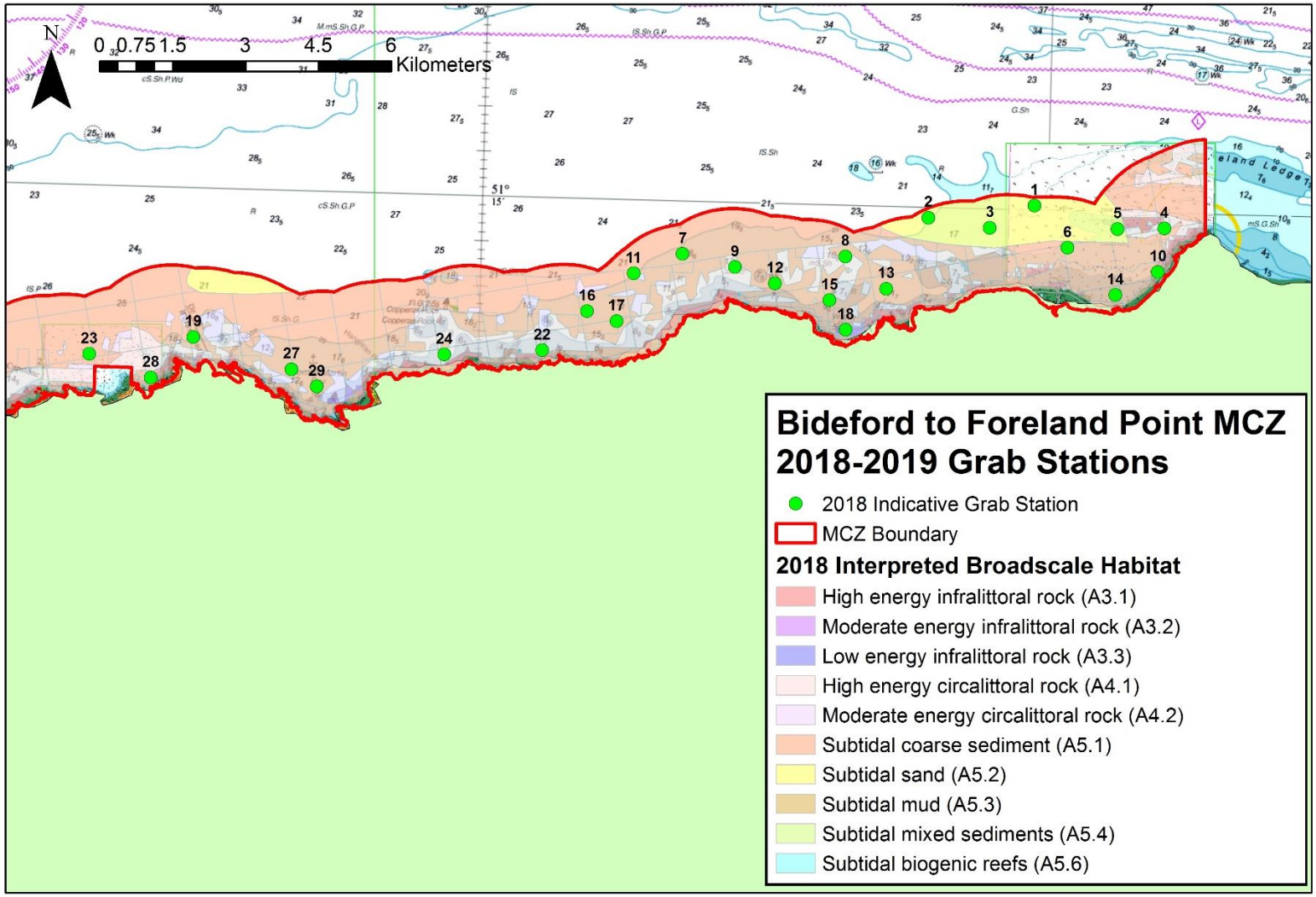

Figure 5. Bideford to Foreland Point Marine Conservation Zone (MCZ) survey plan showing target Mini-Hamon Grab (MHM) sampling stations (Foreland Point to Ilfracombe), mapped over interpreted Broadscale Habitat data (Archer and Murray, 2018).

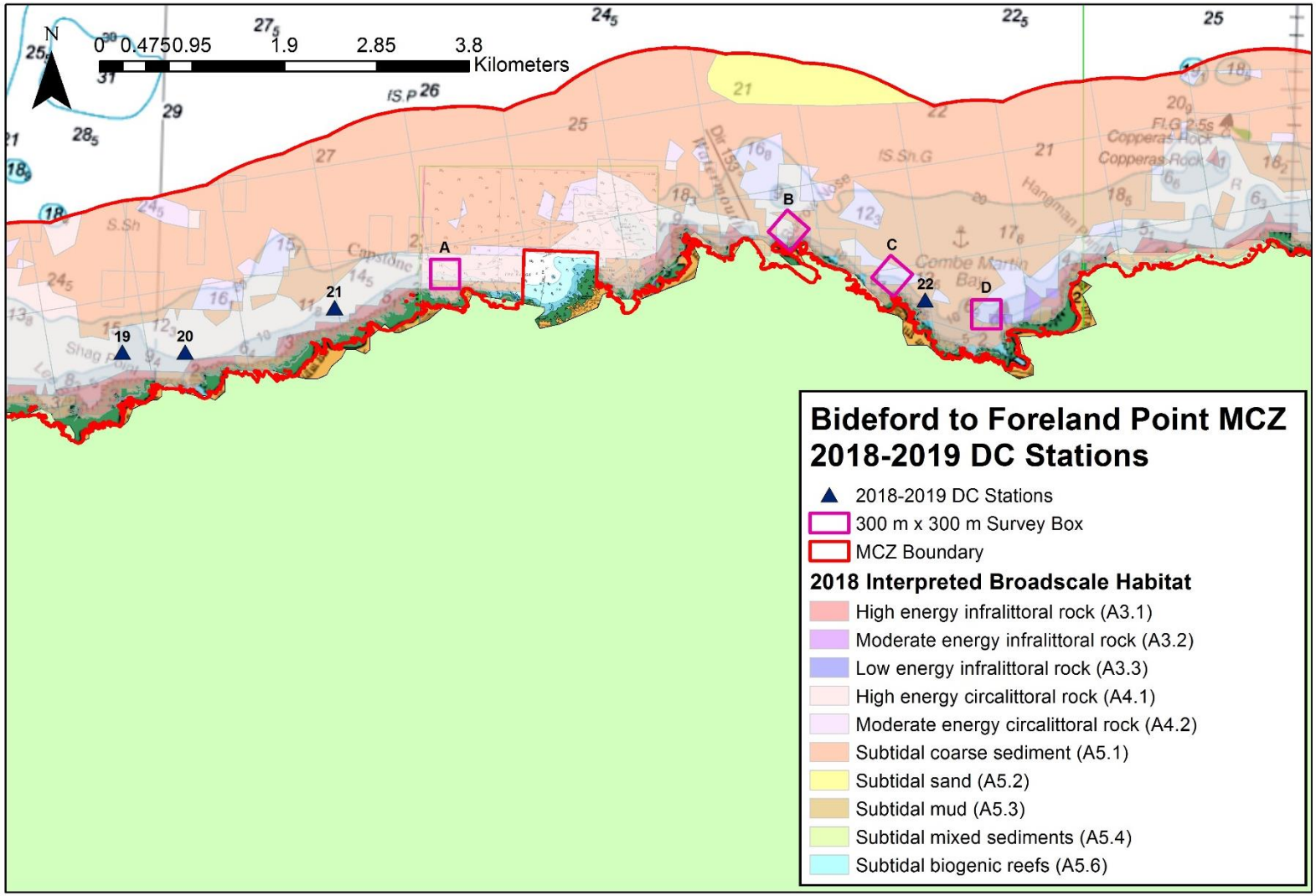

Figure 6. Bideford to Foreland Point Marine Conservation Zone (MCZ) survey plan showing target Drop Camera (DC) sampling stations and 300 m x 300 m survey boxes (Foreland Point to Ilfracombe), mapped over interpreted Broadscale Habitat data (Archer and Murray, 2018).

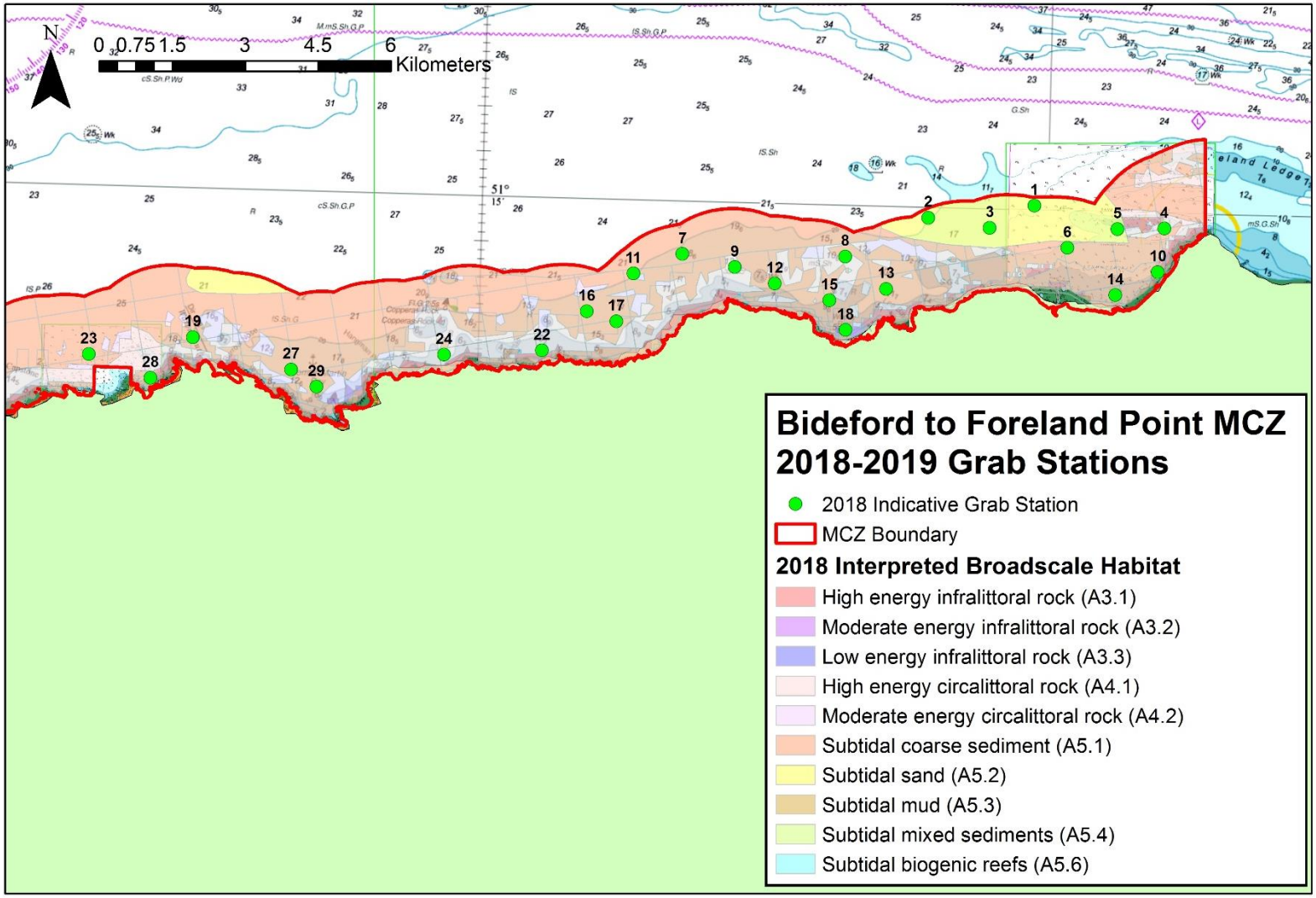

Figure 7. Bideford to Foreland Point Marine Conservation Zone (MCZ) survey plan showing target Drop Camera (DC) sampling stations and 300 m x 300 m survey boxes (Ilfracombe to Westward Ho!), mapped over interpreted Broadscale Habitat data (Archer and Murray, 2018).

2.2 Sample Collection Methodology

2.2.1 Habitat Characterisation

Drop video camera equipment (Annex 7.2.2 and 7.2.3) was deployed in accordance with the MESH 'recommended operating guidelines (ROG) for underwater video and photographic imaging techniques' (Coggan *et al*., 2007). The Subsea Technology & Rentals (STR) SeaSpyder camera system was deployed from the stern of the survey vessel, as shown in Figure 8. Real time navigation data acquisition and manual position fixing when the gear contacted the seabed was captured via Trimble® HYDRO*pro*™ software and logged by the survey officer. The mid-point of the vessel's stern gantry was used as the default offset for position fixing (see Annex 7.2.1 for further details). Video files and digital still images were transmitted via the sea cable to be captured and saved directly to a computer in the survey cabin. The video footage was annotated with time and position using a GPS (SIMRAD MX512 DGPS) referenced video overlay (uncorrected position data). Images of the seabed were captured approximately every 10 to 15 metres over a distance of > 150 metres. Extra photographs were taken in heterogeneous areas of BSH and if particular habitat/species FOCI were observed. If a BSH habitat boundary was detected towards the end of a tow, the camera deployment was extended to confirm the change. The drop frame depth was controlled via a winch operator receiving instructions from the survey cabin. For further deployment details please see the 'EA underwater video procedure_version 2.4' in Annex 7.3.

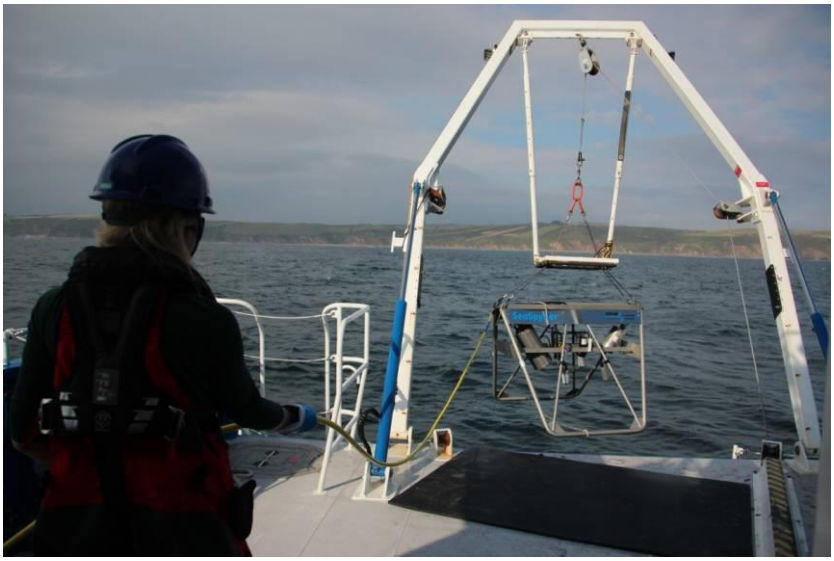

Figure 8. STR SeaSpyder drop camera system being deployed from the stern of the coastal survey vessel.

During each drop camera deployment, a member of the survey team continuously monitored the real-time video feed, recording general station notes, underwater visibility (Annex 7.4), habitat information and fauna observations. Please see Annex 7.5 for a worked example of the video logsheet.

The procedure for surveying Pink sea-fans and Fragile Sponge and Anthozoan Communities involved completing five randomly distributed video tows within a 300 m x 300 m pre-selected survey box. The video tows were undertaken across the survey box, with a minimum tow length of 150 m (as per MESH guidance, Coggan *et al*., 2007). Every effort was made to ensure video tows did not cross one another. Video was recording for the duration of the tow, with images taken every five seconds. The camera system was towed at a maximum speed over ground of 1.5 knots and hovered at a maximum height of 50 cm above the seabed. The drop frame depth was controlled via a winch operator receiving instructions from the survey cabin. For further procedure details please see the 'Pink sea-fan (*Eunicella verrucosa*) and Fragile Sponge and Anthozoan Communities DC Survey Guidance' in Annex 7.6.

2.2.2 Broadscale Habitat Groundtruthing

A Mini-Hamon Grab (Figure 9), with a sampling area of 0.1 m^2, was deployed from the stern gantry of the vessel to collect sediment from the seabed, as described by Ware and Kenny (2011). Sampling positions were recorded (fixed) using Hydropro data acquisition software when the gear contacted the seabed, with the mid-point of the vessel's stern gantry being used as the default offset for position fixing (see Annex 7.2.1 for further details).

Once recovered, the sample was emptied into a suitable container, photographed, and the sample volume measured. A minimum of three attempts was made at each station to obtain a valid grab sample before the station was abandoned. A sample volume of 5 litres was required to qualify as a valid sample. Samples of <5 litres were ordinarily discarded. However, when it was difficult to obtain a valid sample, a sample with <5 litres of material was retained at the discretion of the lead scientist if it was deemed representative across all attempts made at that station. For valid samples, a small scoop was used to remove a sub-sample (approx. 500 ml) of sediment for particle size analysis (PSA). The remaining sample was washed over a 1mm sieve to retain the faunal fraction (Figure 9), photographed and preserved with a buffered 4% formaldehyde solution for transfer ashore to a specialist laboratory for analysis.

If the volume of sediment collected was insufficient for faunal analysis in each grab attempt made at a particular station, a photograph was taken and, if sufficient material was present, a subsample was removed for PSA. The station was then abandoned.

Sediment descriptions were recorded for each sample collected. For consistency across all the MCZ benthic habitat surveys, these were based on a pictorial field guide produced by Cefas marine sedimentologists, a modified Folk seabed sediment classification system (Long, 2006) (Figure 10) and the Wentworth Scale (Table 2).

Figure 9. Mini-Hamon Grab (left), and equipment for sieving benthic fauna samples (right)

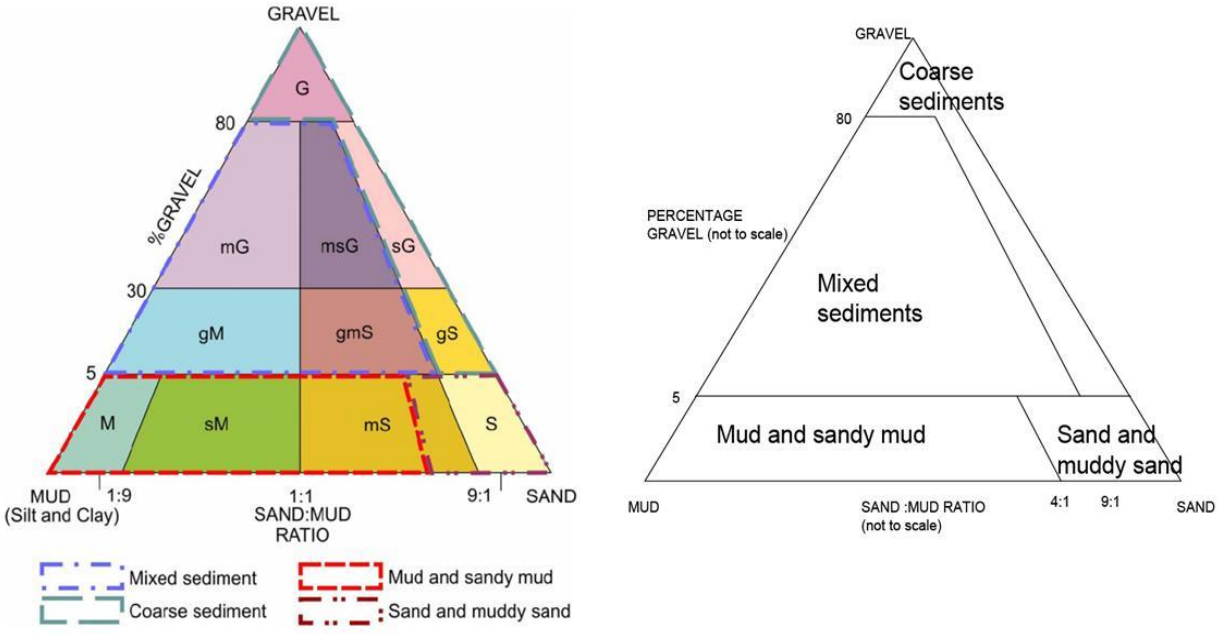

Figure 10. Simplified sediment classification of the Folk triangle for UK SeaMap (Long, 2006).

Table 2. Sediment grade terms and size limits (Wentworth, 1922).

Size	Grade Terms
> 256 mm	Boulder
> 64 - 256 mm	Cobble
4 - 64 mm	Pebble

3. Survey Narrative

Between the 1st September 2018 and 10th April 2019, the Bideford to Foreland Point MCZ survey took four 'on-task' days to complete (Table 3). Daily progress reports for each survey day are available from the Environment Agency on request.

Table 3. Summary of equipment deployments during the 2019 Bideford to Foreland Point Marine Conservation Zone survey.

Equipment	Dates	Duration
Camera deployments	1st September 2018	1 day
Mini-Hamon Grab deployments	21st–22nd March, 9th April 2019	3 days

On Friday 31st August, survey personnel mobilised to the survey vessel *Severn Guardian* berthed in Ilfracombe. They prepared survey equipment and assembled the STR SeaSpyder camera system. On Saturday 1st September 2018, survey personnel mobilised to the vessel and completed a safety briefing for the scientific staff. The vessel departed the marina at 08:00 UTC and headed out towards the Bideford side of the MCZ survey area. The sea state was slight, with a 0.6 m swell (Bideford Bay Waverider Buoy) and visibility was good making the conditions suitable for the survey to commence. After a one hour transit the vessel arrived at the first station at 09:00 UTC. Repeat of camera tows were completed at four single DC stations; at BTFP09 the camera frame was brought to the surface due to its instability in the water column. BTFP16 was repeated as the data cable became twisted during deployment. Poor visibility was encountered at BTFP13 and BTFP14, so both stations were repeated during the return passage in the afternoon. Poor visibility was encountered at stations BTFP02, BTFP03, BTFP04, BTFP05, BTFP06 and BTFP07. Camera survey operations ceased at 17:47 UTC and the vessel returned to Ilfracombe, arriving alongside at 19:30 UTC. In total twenty-one out of fifty target stations were surveyed. Nineteen of these stations met Objective 1 and two stations met Objective 4.

The following day, survey staff demobilised and *Severn Guardian* passaged to Penarth to complete routine water quality work.

Multiple attempts at resuming the survey that autumn were hampered by poor weather conditions due to the exposed location of the site. Following discussion with Natural England, survey operations within the Bideford to Foreland Point MCZ were halted over the winter (see Section 4.1 for further details).

Grabbing survey operations restarted at the Bideford to Foreland Point MCZ on Thursday 21st March 2019. The CSV *Severn Guardian* departed Padstow Harbour at

06:15 UTC with a team of Environment Agency survey officers. Following a grabbing safety briefing, survey operations began at 12:33 UTC at station BTFP57. Overall, 14 stations were surveyed, collecting a total of 13 biota and PSA samples, and 13 PSA-only samples. No samples were collected from station BTFP44 as cobbles obstructed the grab jaws leading to significant sediment loss. Survey operations ceased at 15:55 UTC due to tidal constraints and CSV *Severn Guardian* arrived alongside in Ilfracombe Harbour at 16:30 UTC.

The following day, the CSV *Severn Guardian* left Ilfracombe Harbour at 07:00 UTC and undertook a 45 minute transit to the first station, BTFP39. Following a grabbing and vessel safety brief for the new survey officer, survey operations commenced at 07:45 UTC. In total 15 stations were surveyed, collecting seven biota and PSA samples, and nine PSA-only samples. At two stations, BTFP27 and BTFP34 PSA samples were obtained but no biota samples were retained due to an insufficient volume of sediment. No samples were collected from six stations, primarily due to cobbles obstructing the grab jaws. Grab survey operations ceased at 12:10 UTC and the vessel headed back to Ilfracombe. The Environment Agency survey officers demobilised from the boat at Ilfracombe.

On Tuesday 9th April 2019, the grab survey recommenced with CSV *Severn Guardian* departing from Ilfracombe at 07:00 UTC. With a moderate sea state and 0.6 m swell (Minehead Waverider Buoy), conditions were suitable to carry out the grab survey. Sampling commenced at 07:28 UTC at station BTFP35. A total of 28 stations were surveyed, collecting 15 biota and PSA samples, and nine PSA-only samples. No samples were collected from four stations, BTFP02, BTFP03, BTFP07 and BTFP14 again due to a lack of suitable sediment. All stations were surveyed by 14:45 UTC and the CSV *Severn Guardian* arrived alongside at Ilfracombe harbour at 17:30 UTC. On Wednesday 10th April, survey staff demobilised from the vessel. A summary of the samples collected is presented in Section 4 of this report.

4. Data Acquisition

4.1 Survey plan changes

Repeated attempts to survey the MCZ with the DC equipment in autumn 2019 were hampered by poor weather. Following discussions with Natural England the decision was made to halt the camera work as the seasonal dieback of macroalgae would affect habitat characterisation. Digital still images and video footage were therefore only obtained from 21 of the 25 single DC stations. Nineteen stations were surveyed to meet Objective 1, and two stations were surveyed to meet Objective 4. No video footage was captured in the five survey boxes for Objectives 3 and 4.

4.2 Sample collection summary

Samples collected during the 2018-19 Bideford to Foreland Point MCZ survey are summarised in Table 4.

Table 4. Summary of samples collected during the 2019 Bideford to Foreland Point Marine Conservation Zone survey.

Equipment	Data Type	No. of samples
Drop Camera	Video and still images	25 videos and 674 stills
Mini-Hamon Grab	Biota and PSA	35
	PSA only	11

Video footage and digital photographs of the seabed were captured at 21 stations (Figure 11). Four single DC stations were resampled; BTFP09, 13, 14 and 16, giving a total of 25 videos.

Nineteen of these stations were surveyed to assess the subtidal sediment and rock features for Objective 1, and two stations (BTFP20 and 21) were surveyed to assess the Fragile sponges and anthozoan communities for Objective 4 (Figure 11). EUNIS Level 3 BSH classifications and species identifications will be assigned to each station following detailed independent analysis of the usable video footage and stills.

Viable grab samples to assess the subtidal sediment features were successfully recovered across the survey area to meet Objectives 1 and 2. Samples for both infaunal and particle size analyses were collected at 35 stations, using the Mini-Hamon Grab. At 11 stations, the quantity of sediment collected was only sufficient for particle size analysis. (Figure 12).

11 stations (BTFP02, 03, 07, 14, 19, 23, 24, 36, 39, 43 and 44) selected for ground truthing were discarded due to insufficient volumes of sediment recovered across multiple attempts (please refer to metadata in Annex 7.8). Definitive classification of

habitat features present was not possible prior to the results of the more detailed sample analyses carried out in the laboratory being available.

Objective 2 required contaminants sampling (heavy metals, TBT, PAHs, PCBs) using a 0.1 m^2 Day Grab at three stations, (BTFP05, 15 and 23), however, no samples were collected as no sediment with high mud content was identified. These stations were not relocated as suitable sediment was not found at any of the 57 MHM stations sampled.

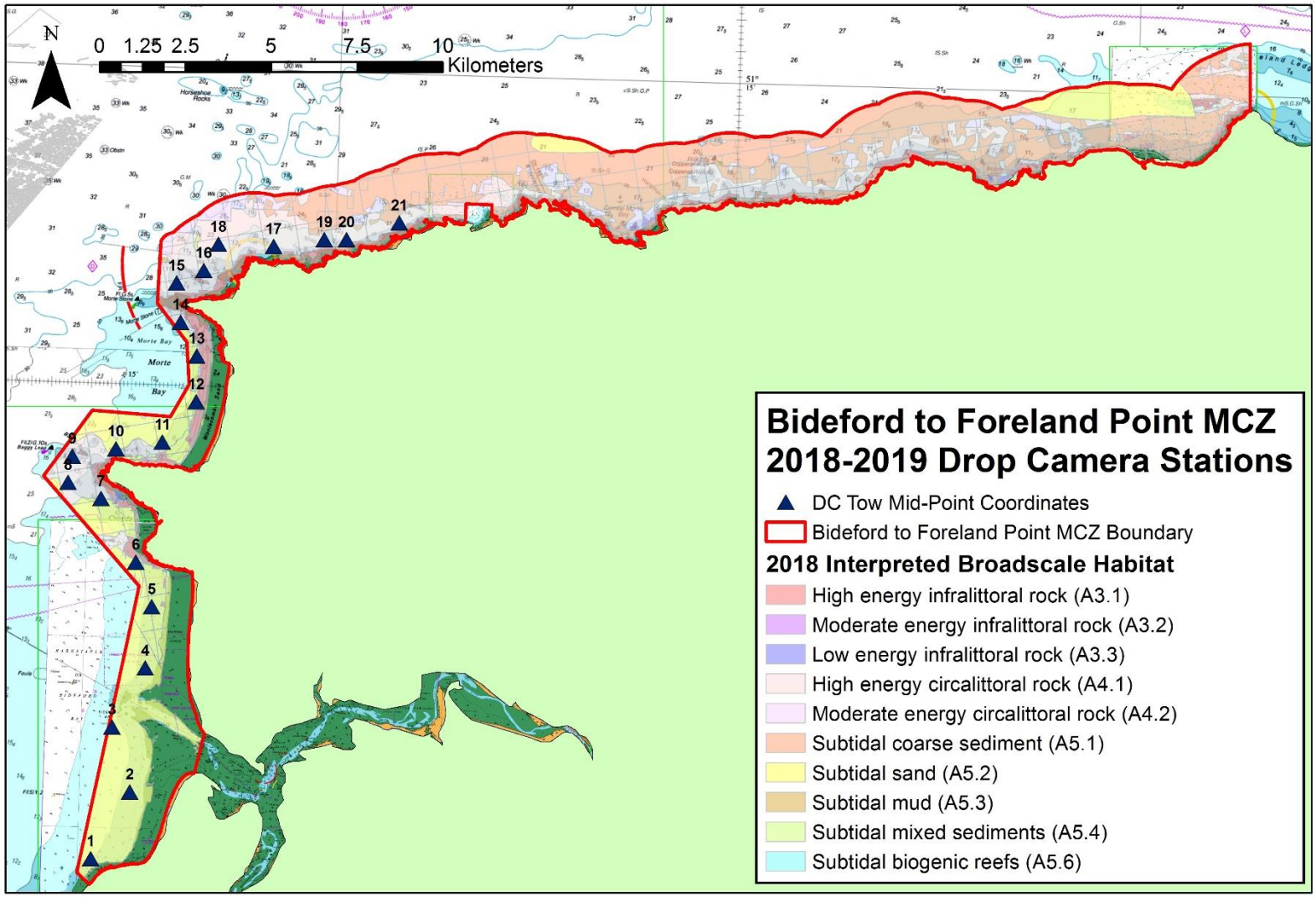

Figure 11. Locations of video data capture during the Bideford to Foreland Point Marine Conservation Zone (MCZ) summer 2018 survey, mapped over interpreted Broadscale Habitat data (Archer and Murray, 2018, Natural England 2019).

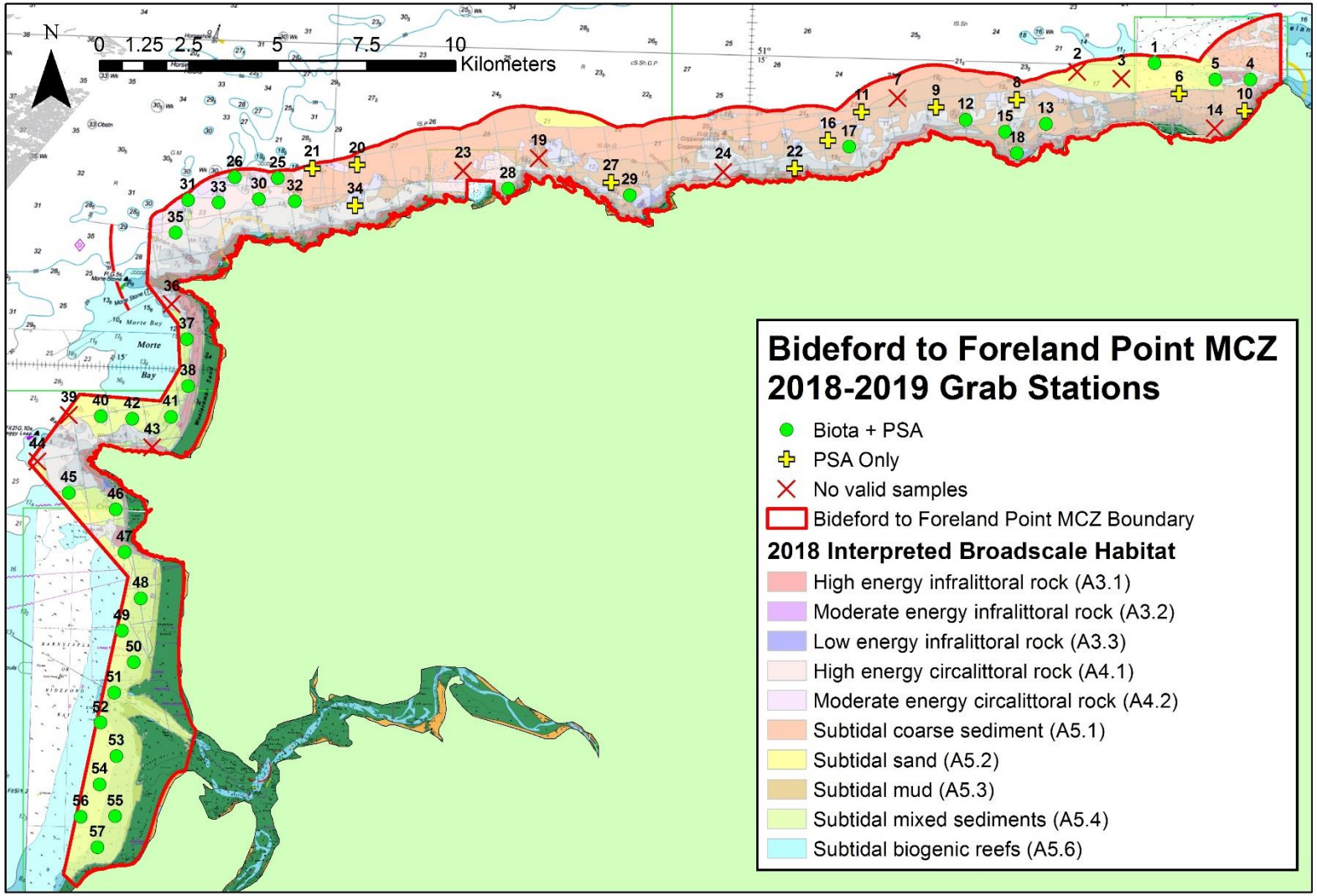

Figure 12. Bideford to Foreland Point Marine Conservation Zone (MCZ) spring 2019 Mini-Hamon Grab survey results, mapped over interpreted Broadscale Habitat data (Archer and Murray, 2018, Natural England 2019).

4.3 Evidence of anthropogenic activities

A lobster pot containing Brown crabs (*Cancer pagurus*) was observed at station BTFP08; this had no impact on the sampling and the survey continued as planned.

5. References

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6. General List of Abbreviations

BSH	Broadscale Habitat
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CHP	Civil Hydrography Programme
CS	Camera Sledge
CSV	Coastal Survey Vessel
DC	Drop Video Camera
Defra	Department for Environment, Food and Rural Affairs
DG	Day Grab
DC	Drop Camera
EA	Environment Agency
ECMAS	Estuarine and Coastal Monitoring & Assessment Service
ENG	Ecological Network Guidance
FOCI	Features Of Conservation Importance
IFCA	Inshore Fisheries and Conservation Authority
MCZ	Marine Conservation Zone
MESH	Mapping European Seabed Habitats
MHM	Mini-Hamon Grab
PSA	Particle Size Analysis
REC	Regional Environmental Characterisation
RSG	Regional Stakeholder Group
SAC	Special Area of Conservation
SAD	Site Assessment Document
SNCB	Statutory Nature Conservation Body
SOP	Standard Operating Procedure
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
STR	Subsea Technology and Rentals
UTC	Coordinated Universal Time

7. Annexes

7.1 Coastal Survey Vessel General Information

Briggs Marine and Environmental Services Ltd.
Seaforth House, Seaforth Place, Burtisland, Fife, KY3 9AX.
Tel: +44(0)1592 872939
Email: marketing@briggsmarine.com
Website: www.briggsmarine.com

Severn Guardian

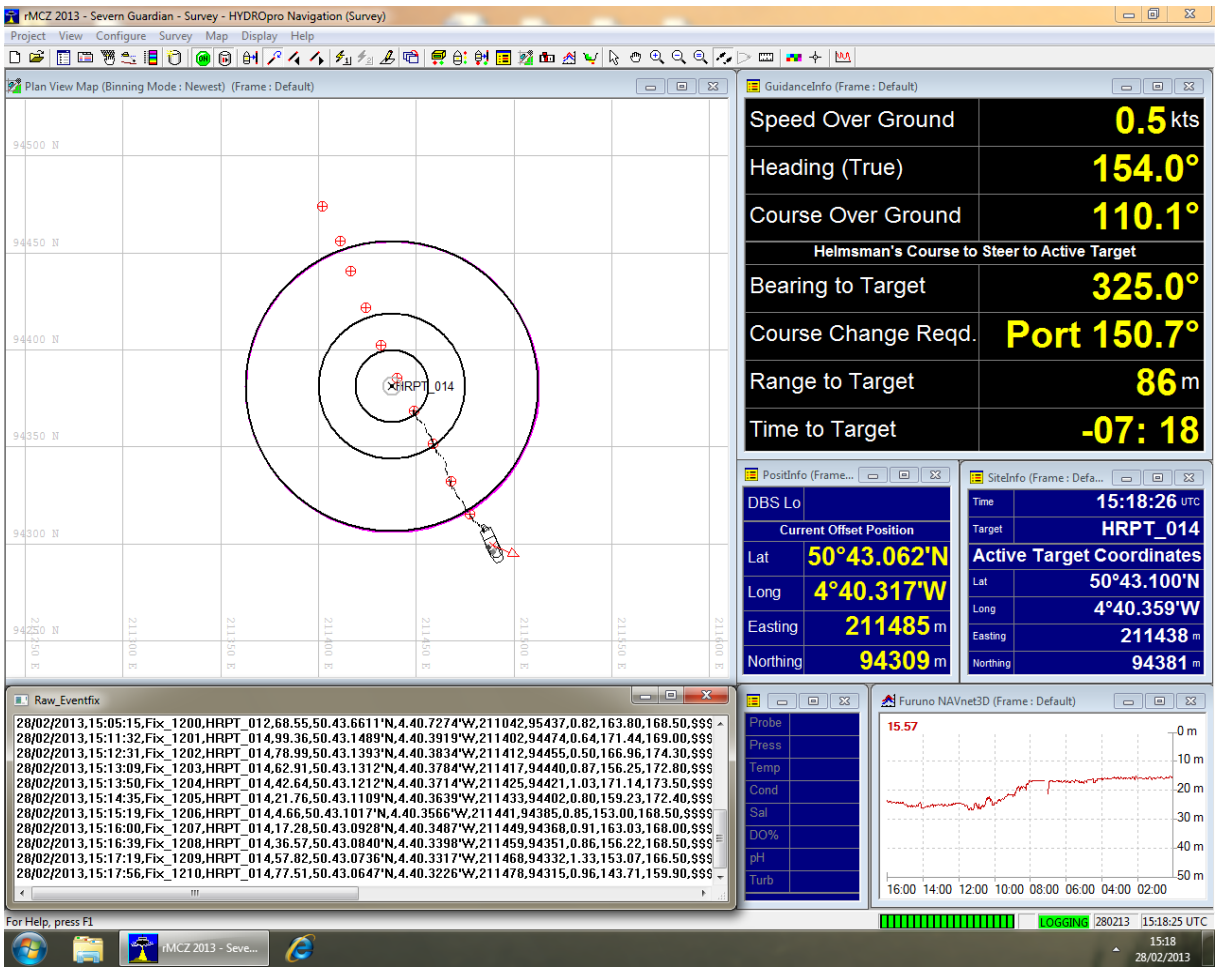
General Information
Length: 18.3 m
Beam: 6.3 m
Draft (baseline): 1.15 m
Draught (skegs): 1.65 m
Displacement (light ship): 22 T
Displacement (full load): 30 T
Service Speed: 16 knots
Maximum Speed: 18 knots

Main Equipment
Main Engines: 2 x Volvo D9-MH 261 bkW @ 2200 rpm. Twin Disc MGX-5075 integral vee-drive
Crew: 2
Scientific Officers: Up to 10
Accommodation: 3 x twin cabins and mess
Data network to share information around vessel
Wet lab/bench for processing water, sediment and ecology samples
Fridge/freezer for sample storage
Dry lab space for two computers and data processing
Large aft deck working area
A frame – 2 T SWL
Double Independent Drum Trawl Winch – 2 T SWL
Hydraulic crane

7.2 Survey Equipment

7.2.1 Navigation and Positioning

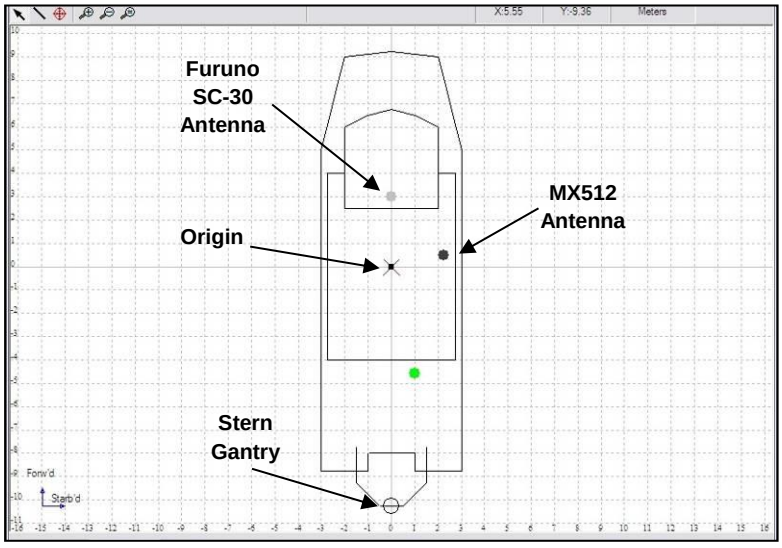
Trimble® HYDRO*pro*™ software is utilised for real-time navigation and survey data acquisition.



Trimble® HYDRO*pro*™ software screen grab displaying real-time navigation and survey data acquisition for a MCZ drop camera survey line.

Navigational and survey equipment offsets on the Coastal Survey Vessel *Severn Guardian* (Environment Agency Estuarine and Coastal Monitoring & Assessment Service).

NMEA Device	Make/Model	Offset Name	Offset (m) X (Starb'd)	Y (Forw'd)	Z +ve (Up)
Gyrocompass	Simrad Robertson RGC50	n/a	-	-	-
Navigation Echosounder	Furuno DFF1, 525ST-MSD transducer	n/a	-	-	-
Survey Echosounder	Kongsberg EA400	n/a	-	-	-
Origin	n/a	Origin	0.0	0.0	0.0
Navigation GPS (Secondary)	Furuno SC-30 DGPS	Furuno SC-30 Antenna	0.0	3.0	0.0
Survey GPS (Primary)	SIMRAD MX512 DGPS	MX512 Antenna	2.25	0.5	0.0
n/a	n/a	Sediment Grab (Stern Gantry)	0.0	-10.25	0.0



Trimble® HYDROpro™ vessel editor screen showing survey equipment offsets from the origin (Environment Agency Estuarine and Coastal Monitoring & Assessment Service).

7.2.2 SeaSpyder Drop Camera System

STR
SUBSEA TECHNOLOGY & RENTALS

SEASPYDER DROP CAMERA SYSTEM


Surface Control Unit & Processor

The SeaSpyder Underwater Drop Camera System is part of a family of field proven camera systems manufactured by STR for the marine survey and environmental communities. The SeaSpyder is ideally suited for operation in shallow-medium water depths with the standard system having a working depth range of 500m. For applications demanding a deeper rating, a "telemetry" model is offered which operates over longer cable lengths for operation down to 1000m. Both models are fitted with a new generation digital SLR Camera offering high resolution digital stills and HD Video for the highest imagery detail. The high specification digital SLR Camera offers an impressive 18.0 mega pixels resolution and both manual and automatic focus for achieving the sharpest images. The captured digital stills are framed with the aid of dedicated real-time video and can be transferred to the topside 'on the fly' for rapid online review.

A 19" rack mount Surface Control Unit and powerful topside processor give full remote control of the camera via the easy to use SeaView GUI software. As standard, the purpose designed camera deployment frame is fitted with a subsea electronics and camera housing, high power underwater flash, an array of four high intensity LED lamps and dual scaling laser pointers to provide accurate imagery scaling. There is the option to install additional sensors with the availability of three user defined serial interfaces with optional power.

SYSTEM FEATURES

- Latest generation 18 Mega Pixels Digital SLR Camera
- Full remote control of camera functions including automatic and manual focus control
- 'On-the-fly' image download
- Real time HD Video
- High intensity LED Lamps
- Dual lasers for precise imagery scaling
- High speed digital telemetry link to camera and sensors
- Additional user defined RS232 ports and 24VDC power interfaces

SEASPYDER SHALLOW WATER CAMERA SYSTEM

SEASPYDER RACK MOUNT PROCESSOR

Hardware: Standard 19" Rack Mountable
Processor: Intel I5 3.1GHz Quad-Core
Memory: 4GB DDR3 RAM
Storage: 500GB hard drive
Interface: DVD-RW, 2 x 1 GigE, 6 x USB, 4 x RS232
Display: 2 x 22" LED HDMI Monitor
Power: 110/240 VAC, 50 Hz (900W)
Dimensions: 19" 3U rack mountable 550 mm (L) x 485 mm (W) x 132mm (H)

SEASPYDER SEAVIEW SOFTWARE

Key Features:

- Remote control of SeaSpyder Digital Stills Camera
- Digital stills and video capture
- "On-the-fly" image download
- External overlay functions
- Realtime composite video
- HD video capture
- Remote control of lights, scaling lasers and additional sensors

SEASPYDER SURFACE CONTROL UNIT

ELECTRICAL

Power Input: 85 – 264 VAC (47 – 63 Hz) ≈ 500 W max
Cable Power: +/- 48VDC Nominal (≈ 400W max.)
with built in electrical leakage detector

SIGNAL INTERFACE

Cable Interface #1: High bandwidth VDSL2
Cable Interface #2: Differential Colour Composite Video with automatic cable length compensation

MECHANICAL

Dimensions: 19" 2U rack mountable 550 mm (L) 485 mm (W), 88 mm (H)

SEASPYDER SUBSEA ELECTRONICS

ELECTRICAL

Power Output: 24VDC Output (200 W Max Subsea Power)
Interface: 1 x SeaSpyder Camera & Underwater Flash
4 x 24VDC LED Lamps
2 x RS232 Ports with 24VDC
1 x RS232 Port with 12 VDC/ 24VDC
1 x Dual Scaling Lasers

MECHANICAL

Diameter: 200mm
Length: 409mm
Standard Housing: Hard Anodised Aluminium
Depth Rating: 500m

SEASPYDER 18 MEGA PIXELS UNDERWATER DIGITAL STILLS CAMERA

ELECTRICAL

Image Size: JPEG (720 x 480) to (5184 x 3456)
Image Size: RAW (5184 x 3456)
Video: Full HD (1920 x 1080)
ISO Sensitivity: Auto (100 – 6400), 100 – 12800
Sensor Type: 22.3 x 14.9mm CMOS
Aspect Ratio: 3:2
Shutter Speed: 30 – 1/4000 Sec
Interface: Ethernet

OPTICAL

Standard Lens: 10 – 24mm
Macro Mode: F/3.5 – 4.5
Zoom: Fixed
Focus: Manual & Automatic mode
Angle of View: ≈65° in water
Vertical View: ≈1m²@ 80cm in water

SEASPYDER COLOUR VIDEO CAMERA

ELECTRICAL

Image Resolution: 600 TV lines
Video Format: PAL Composite Colour Video
Sensitivity: 0.01 Lux
Sensor Type: 1/3 Sony Super HAD CCD
Frame Rate: 50 FPS
Video Output: ≈1.3Vpp into 75Ω

OPTICAL

Lens Type: 3.6 mm Wide Angle

SEASPYDER HIGH POWER CAMERA FLASH

ELECTRICAL

Control: TTL control via digital stills camera
Power Input: Power supply via stills camera

MECHANICAL

Diameter: 150mm
Length: 230mm
Weight in Air: 7.6kg
Weight in Water: 3.54kg
Standard Housing: Hard Anodised Aluminium
Depth Rating: 3000 m

SEASPYDER 20W LED LIGHT

ELECTRICAL

Lighting: LED Lamp
Luminous Flux: 1500Lm
Wavelength: Neutral White
Power Input: 24 VDC @ 1.1 A (Built in thermal protection)

MECHANICAL

Diameter: 70mm
Length: 110mm
Weight in Air: 1kg
Weight in Water: 0.58kg
Standard Housing: Hard Anodised Aluminium
Depth Rating: 3000m

SEASPYDER DUAL SCALING SUBSEA LASERS

ELECTRICAL

Power Input: 8 V – 30VDC; 60 m A @ 24VDC

LASER

Type: 2 X Class II Safety Classification (<1 milliwatt output)
Beam Shape: Elliptical (Approx 6 mm Red Dot output)
Beam Divergence: - 0.75mrad
Wavelength: 650nm
Temperature Range: -10°C to 40°C

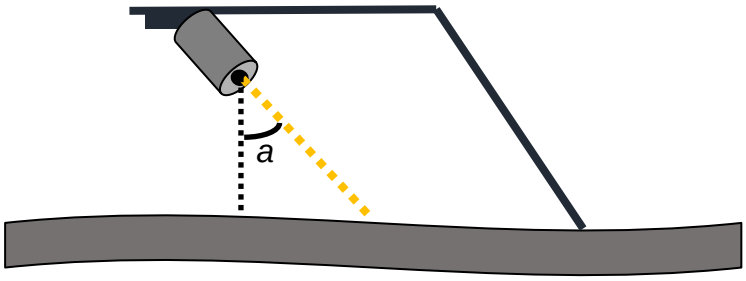
SEASPYDER DROP CAMERA FRAME

MECHANICAL

Length: 2.21m
Width: 1.43m
Height: 1.40m
Weight in Air: 125kg (Inc sensors)

7.2.3 Camera Setup

Manufacturer	Subsea Technology Rentals
Model	**Sea Spyder Drop camera**
Survey Vessel	**Severn Guardian**
Separate video/stills camera	Yes (in same housing)
Approximate video/stills camera line of sight angle (a)	45º
distance of video/stills camera above seabed	60 cm
Flash unit angle relative to the seabed (approx.)	45º
no. of lights (dimmable?)	4 x LED spotlights – non-dimmable
FOV scaling lasers distance apart	**O 20cm O** **FIN----19cm 19cm** **O 19cm O**
Comments: N/A	



Camera settings	
Date	**01/09/2018**
Image quality	Large Normal
Flash setup	Auto
Shutter speed	Adjusted to quicker speed, see log sheet
Aperture size	F7.1
ISO setting	AUTO
White balance	AWB
Light metering mode	
Focus	Auto

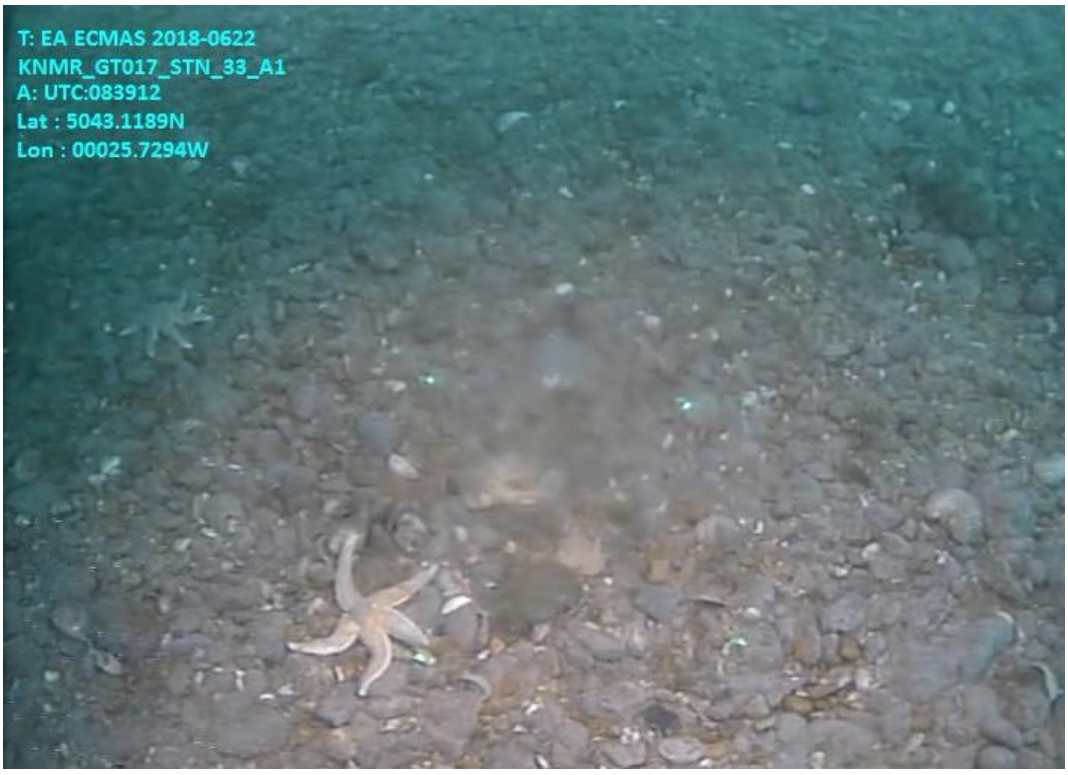
7.3 EA underwater video procedure_version 2.5 (STR Systems)

The procedure outlined below has developed through a series of discussions involving the Environment Agency, Cefas and Natural England. Due to the heterogeneous nature of the inshore coastal seabed habitat, strong tidal streams, various underwater hazards and no dynamic positioning system, a flexible approach is recommended for the underwater video camera deployment. The procedure must be used in accordance with the MESH 'recommended operating guidelines (ROG) for underwater video and photographic imaging techniques' (Coggan et al., 2007).

Important points to remember:

- Select stern gantry offset in Hydropro
- Synchronise all survey equipment (camera, laptops, etc.) with primary survey GPS time (UTC).
- Ensure the correct date, station code, STN number, time and position are displayed on the video overlay and clapperboard (if used).

Overlay Example:
EA ECMAS_2018-0622
KNMR_GT017_STN_33_A1 (annotate if station has been attempted on a previous occasion)
UTC: 083912 (real time feed from survey GPS)
Lat: 5043.1189N (real time feed from survey GPS – **uncorrected**)
Lon: 00025.7294W (real time feed from survey GPS – **uncorrected**)



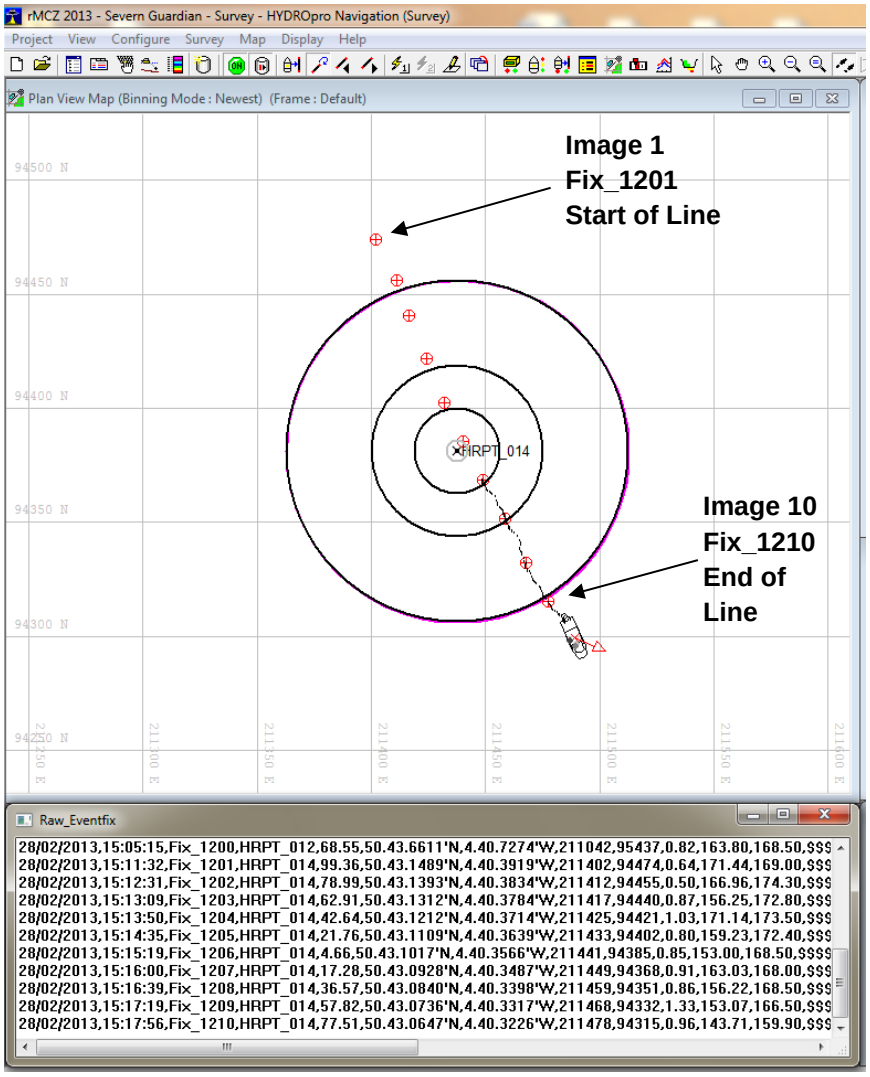
Clapperboard Example:

- Alter the stills prefix to the correct station code.

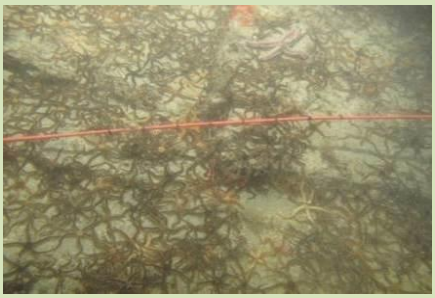
- The field of view scale bar/laser points should be set up/calibrated prior to the survey commencing. Laser pointers are ineffective in moderate/poor visibility conditions; a rope with a visible scale will be required as a replacement
- Set the image resolution to Large Normal (14.7 Mega Pixels, 18 sec upload time)
- Check the camera settings are appropriate for the conditions; the LED lights are on if required and ensure the video is recording throughout the deployment.

- If a broad-scale habitat (BSH) boundary is detected extend the deployment to gather as much information on habitat extent as possible.
- Take extra stills if habitat/species FOCI are observed – note these in the survey log.
- If possible, work a downhill seabed profile to avoid slack cable during deployment.
- Beware of sudden depth changes when surveying rocky areas.
- Abandon the station if survey conditions are hazardous.

Video Camera Type	Survey Conditions	Deployment
Drop Down	Good visibility SOG <1.5 knots	*Deploy camera initially working across the Hydropro 75 m radius target area, as shown in the diagram below. Hover/rest camera above/on the seabed; take a still every 15 m. If tide/wind conditions do not allow a survey line to be followed across the bull ring, use the outer circle as a guide to ensure a distance of 150 m is covered (minimum) nearby.
	Poor visibility SOG >1.5 knots	Hover/rest camera above/on the seabed, take a still every 15 m. If the visibility is very poor, retrieve the equipment after taking 3-4 stills.



7.4 Underwater Visibility Scale

Example image	Scale	Definition
	Excellent	clear, sharp images - no suspended particulate matter
	Good	seabed features and epifauna clearly discernible
	Moderate	seabed features discernible - epifauna difficult to discern
	Poor	both seabed features and epifauna difficult to discern, low confidence in preliminary habitat assessment
	Very Poor	no seabed features or epifauna visible

7.5 MCZ Video logsheet

MCZ Video Logsheet (v1)

Station data

Contract Code: C5433 Vessel: Solent Guardian Date: 09/04/2016

MCZ Name: Mounts Bay Station Code: MNTB071

Nav-Log filename: SW 2016-0409 SL_log Sampling Gear: DC Water Depth: 10·5 m

Cable Out: _____ (metres). Speed Over Ground (SOG): 1·0 (knots)

Notes on Station:
(including any times & adjustments to Cable Out)

Position Reference Point: Stern gantry

Sample data

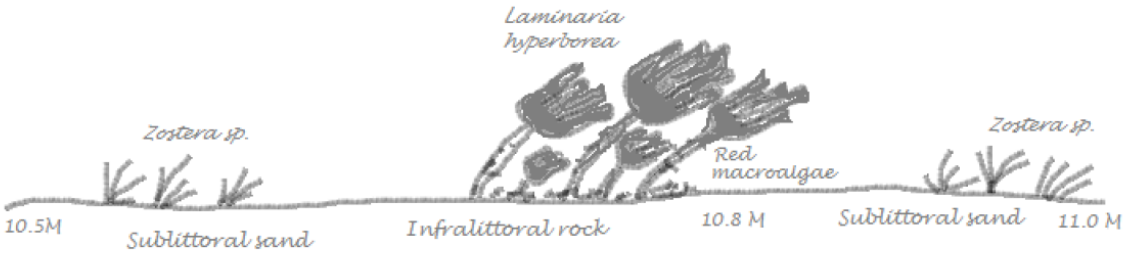
Digital Video Tape label: n/a

Filename on Hard-Drive: MNTB_2GDK70416_GT071_STN_1_AI_153751

No. of camera stills: 14 Stills folder name: GT071_STN_1

	GPS Time hh:mm		Fix No	Position in Lat/Long (WGS84)	DV tape counter Mins	Secs
Start of Video (SOV)	15	40	3862	50° 06·3266' N; 5° 32·2924' W	n/a	n/a
End of Video (EOV)	15	45	3875	50° 06·3893' N; 5° 32·2093' W	n/a	n/a

Visual / Video notes: (ground-type, terrain, visibility, species, FOCI, sketch of transect)



Broad-scale habitats observed

Infralittoral Rock ✓		Circalittoral Rock		Sediment habitats		Others	
high energy		high energy		subtidal mixed		macrophyte dominated sed's	✓
mod.energy		mod.energy		subtidal coarse			
low energy		low energy		subtidal mud		biogenic reef	
				subtidal sand	✓	deep-sea bed	

Completed by: K· Arnold Checked by: N· Godsell Entered by: K· Arnold

7.6 Pink Sea-Fan (*Eunicella verrucosa*) and Fragile Sponge and Anthozoan Communities DC Survey Guidance

The procedure outlined below has been developed through a series of discussions involving the Environment Agency, Cefas and Natural England. Due to the heterogeneous nature of the inshore coastal seabed habitat, strong tidal streams, various underwater hazards and lack of dynamic positioning system, a flexible approach is recommended.

The following guidance should be adhered to when undertaking monitoring of these features using the survey box method **only**.

Before Survey

- 300 m x 300 m survey boxes have been selected based on historical Pink Sea-Fan and Fragile Sponge and Anthozoan Community records. The co-ordinates of the four corners of these boxes will be provided to you prior to the start of survey.

- No co-ordinates for the camera tows have been provided prior for the survey, as the tow direction and location will depend on conditions at sea. Survey box co-ordinates should be uploaded to your navigation system (e.g. HydroPro) to aid camera tow placement.

- Deployment of the video / stills camera (including stills camera mounted on video frame) will comply with guidance developed by MESH: 'Recommended operating guidelines (ROG) for underwater video and photographic imaging techniques (http://webarchive.nationalarchives.gov.uk/20101014084033/http://www.searchmesh.net/Default.aspx?page=1739 and http://webarchive.nationalarchives.gov.uk/20101014084849/http://www.searchmesh.net/PDF/GMHM3_Video_ROG.pdf).

- Four (two pairs) of green scaling lasers should be used and the distance between each point measured before the survey. These details should be recorded on the 'camera equipment configuration' sheet.

- Deployment of the camera system and set up should also comply with EA underwater video procedure version 2.4 (STR Systems).

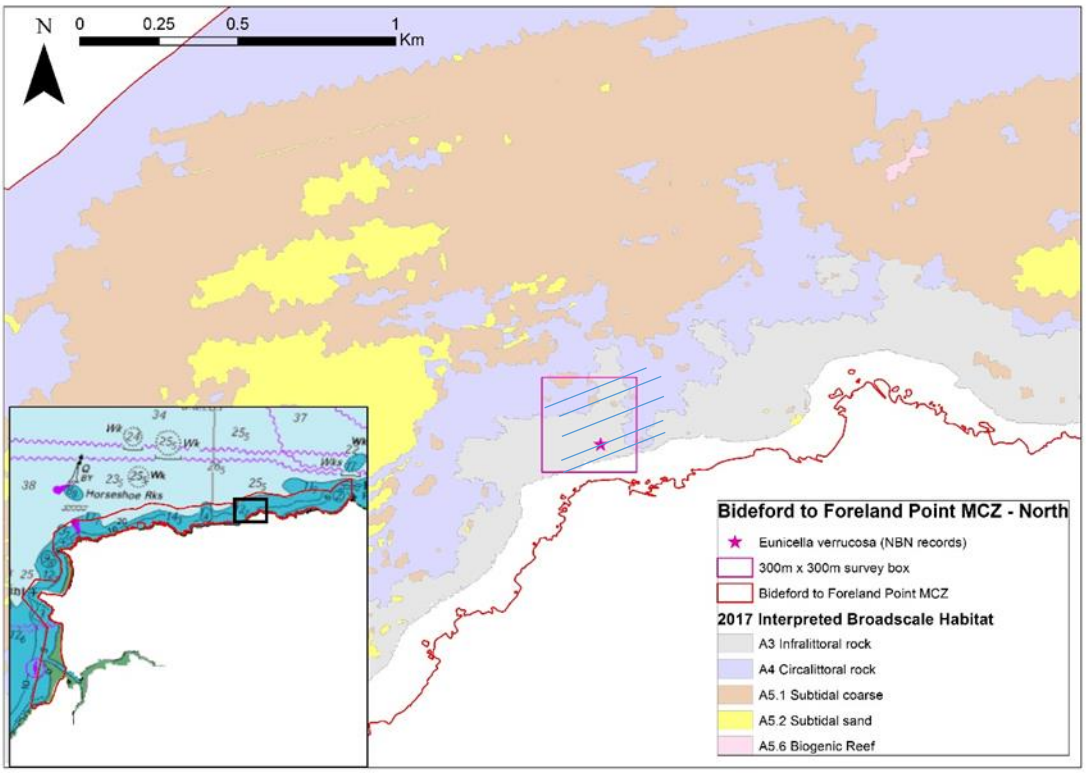
- For the purposes of MCZ naming conventions, each survey box is considered a station (GT number) and each tow a replicate (STN number). Therefore, one station should have five camera tow replicates. Follow Cefas guidance 'MPA work – File naming convention – all sample types. Version 2.1 (11 Jan 2013)'.

E.g. CBSL_2GDK70718_GT008_STN_038

Box number Tow number

During Survey

- 5 x randomly distributed video tows should be undertaken across the survey box, with a minimum tow length of 150 m (as per standard tow length) (see example below). Ideally, video tows should not cross each other.



- Position of MCZ features, human activities (e.g. fishing gear) or damage (e.g. broken Pink Sea-Fans) should be noted on the survey log and locations also recorded using the navigation software (Hpro 'fix').

- The Seaspyder camera should hover just above the seabed at a maximum height of 50 cm. The system should be towed at approximately 1 knot or less, up to maximum 1.5 knots speed over ground (SOG). The camera system should be deployed with the tail fin, buoy and line to facilitate towing.

The video/stills data are used for counts of colonies / individuals of Pink Sea-Fan so the slower and more stable the tow, the better the data quality.

- The video should be recording for the entire tow.

- Still images should also be taken every 5 seconds during the tow.

- One Idronaut reading for near seabed turbidity, O_2, temperature and salinity measurements should be taken within each survey box. Take care with deployment due to the presence of rocky reef and follow EA Idronaut deployment procedure. Contact your Team Leader if unsure on the correct Idronaut procedure.

- Good visibility is vital for video/still analysis. Do not undertake the survey if visibility is less than ‘moderate

7.7 Video Survey Metadata

7.8 Grab Survey Metadata

Date	Time UTC	Station Code	WGS84 Latitude DD.DDDDD	WGS84 Longitude DD.DDDDD	STN no.	Hpro fix no.	Water depth (m)	Sediment vol. (litres) calculated	Sediment use
Sampling gear = Mini-Hamon Grab, sieve mesh = 1 mm									
21/03/2019	12:33	BTFP_57	51.04504	-4.25340	26	Fix_5651	2.95	1.8	Biota + PSA
21/03/2019	12:36	BTFP_57	51.04494	-4.25306	26	Fix_5652	3.52	1.5	Discarded
21/03/2019	12:38	BTFP_57	51.04492	-4.25299	26	Fix_5653	3.13	1.3	Discarded
21/03/2019	12:52	BTFP_56	51.05275	-4.26054	27	Fix_5655	6.40	1.5	Discarded
21/03/2019	12:55	BTFP_56	51.05277	-4.26064	27	Fix_5656	6.18	1.2	Discarded
21/03/2019	12:57	BTFP_56	51.05265	-4.26047	27	Fix_5657	6.11	1.9	Biota + PSA
21/03/2019	13:07	BTFP_55	51.05306	-4.24669	28	Fix_5658	2.37	2.8	Biota + PSA
21/03/2019	13:10	BTFP_55	51.05319	-4.24695	28	Fix_5659	2.72	2.8	Discarded
21/03/2019	13:13	BTFP_55	51.05306	-4.24669	28	Fix_5660	3.19	1.5	Discarded
21/03/2019	13:21	BTFP_54	51.06097	-4.25334	29	Fix_5661	5.54	1.5	Biota + PSA
21/03/2019	13:23	BTFP_54	51.06104	-4.25340	29	Fix_5662	5.62	0.7	Discarded
21/03/2019	13:25	BTFP_54	51.06094	-4.25361	29	Fix_5664	5.80	0.8	Discarded
21/03/2019	13:34	BTFP_53	51.06826	-4.24700	30	Fix_5665	4.74	2.5	Biota + PSA
21/03/2019	13:36	BTFP_53	51.06834	-4.24711	30	Fix_5666	4.73	1.8	Discarded
21/03/2019	13:38	BTFP_53	51.06849	-4.24692	30	Fix_5667	4.66	1.3	Discarded
21/03/2019	13:46	BTFP_52	51.07676	-4.25351	31	Fix_5668	6.35	2.0	Discarded
21/03/2019	13:48	BTFP_52	51.07671	-4.25359	31	Fix_5669	6.57	1.8	Discarded
21/03/2019	13:51	BTFP_52	51.07661	-4.25369	31	Fix_5670	7.00	2.3	Biota + PSA
21/03/2019	13:59	BTFP_51	51.08429	-4.24852	32	Fix_5671	3.40	3.5	Biota + PSA
21/03/2019	14:07	BTFP_50	51.09208	-4.24111	33	Fix_5672	3.97	2.5	Biota + PSA
21/03/2019	14:11	BTFP_50	51.09209	-4.24100	33	Fix_5673	4.87	1.5	Discarded
21/03/2019	14:13	BTFP_50	51.09228	-4.24112	33	Fix_5674	4.21	1.1	Discarded
21/03/2019	14:20	BTFP_49	51.10002	-4.24608	34	Fix_5675	6.99	1.5	Discarded
21/03/2019	14:23	BTFP_49	51.09995	-4.24625	34	Fix_5676	7.25	2.5	Biota + PSA
21/03/2019	14:25	BTFP_49	51.10010	-4.24608	34	Fix_5677	6.90	2.0	Discarded
21/03/2019	14:33	BTFP_48	51.10824	-4.23920	35	Fix_5678	5.54	2.0	Discarded
21/03/2019	14:35	BTFP_48	51.10818	-4.23877	35	Fix_5679	5.30	2.8	Discarded
21/03/2019	14:37	BTFP_48	51.10828	-4.23907	35	Fix_5680	5.12	2.9	Biota + PSA

Date	Time UTC	Station Code	WGS84 Latitude DD.DDDDD	WGS84 Longitude DD.DDDDD	STN no.	Hpro fix no.	Water depth (m)	Sediment vol. (litres) calculated	Sediment use
Sampling gear = Mini-Hamon Grab, sieve mesh = 1 mm									
21/03/2019	14:45	BTFP_47	51.11994	-4.24607	36	Fix_5681	7.65	2.0	Discarded
21/03/2019	14:49	BTFP_47	51.11983	-4.24618	36	Fix_5682	7.43	2.3	Biota + PSA
21/03/2019	14:51	BTFP_47	51.11983	-4.24611	36	Fix_5683	7.69	2.1	Discarded
21/03/2019	14:59	BTFP_46	51.13055	-4.25017	37	Fix_5684	8.11	2.5	Biota + PSA
21/03/2019	15:01	BTFP_46	51.13063	-4.25014	37	Fix_5685	7.64	2.5	Discarded
21/03/2019	15:03	BTFP_46	51.13062	-4.25007	37	Fix_5686	7.94	1.0	Discarded
21/03/2019	15:12	BTFP_45	51.13439	-4.26897	38	Fix_5687	14.80	2.0	Discarded
21/03/2019	15:14	BTFP_45	51.13443	-4.26892	38	Fix_5688	15.02	1.8	Discarded
21/03/2019	15:17	BTFP_45	51.13439	-4.26932	38	Fix_5689	15.40	3.5	Biota + PSA
21/03/2019	15:27	BTFP_44	51.14206	-4.28221	39	Fix_5690	23.00	-	Discarded
21/03/2019	15:30	BTFP_44	51.14185	-4.28220	39	Fix_5691	23.93	-	Discarded
21/03/2019	15:33	BTFP_44	51.14197	-4.28232	39	Fix_5692	24.43	-	Empty
21/03/2019	15:35	BTFP_44	51.14186	-4.28238	39	Fix_5693	24.54	-	Discarded
22/03/2019	07:52	BTFP_39	51.15402	-4.27014	40	Fix_5695	Echosounder off	1.0	Discarded
22/03/2019	07:55	BTFP_39	51.15409	-4.26971	40	Fix_5696	Echosounder off	-	Discarded
22/03/2019	07:57	BTFP_39	51.15407	-4.26980	40	Fix_5697	Echosounder off	-	Discarded
22/03/2019	08:00	BTFP_39	51.15402	-4.26961	40	Fix_5698	Echosounder off	-	Discarded
22/03/2019	08:08	BTFP_40	51.15400	-4.25738	41	Fix_5699	Echosounder off	3.7	Biota + PSA
22/03/2019	08:18	BTFP_42	51.15359	-4.24470	42	Fix_5700	Echosounder off	2.0	Biota + PSA
22/03/2019	08:21	BTFP_42	51.15363	-4.24469	42	Fix_5701	Echosounder off	1.5	Discarded
22/03/2019	08:23	BTFP_42	51.15371	-4.24479	42	Fix_5702	Echosounder off	1.5	Discarded
22/03/2019	08:32	BTFP_43	51.14643	-4.23644	43	Fix_5703	Echosounder off	-	Misfire
22/03/2019	08:32	BTFP_43	51.14639	-4.23627	43	Fix_5704	Echosounder off	-	Empty
22/03/2019	08:34	BTFP_43	51.14650	-4.23628	43	Fix_5705	Echosounder off	-	Empty
22/03/2019	08:36	BTFP_43	51.14652	-4.23625	43	Fix_5706	Echosounder off	-	Discarded
22/03/2019	08:49	BTFP_41	51.15438	-4.22924	44	Fix_5707	Echosounder off	2.0	Biota + PSA
22/03/2019	08:51	BTFP_41	51.15453	-4.22957	44	Fix_5708	Echosounder off	1.0	Discarded
22/03/2019	08:53	BTFP_41	51.15440	-4.22941	44	Fix_5709	Echosounder off	1.0	Discarded
22/03/2019	09:01	BTFP_38	51.16245	-4.22293	45	Fix_5710	Echosounder off	1.5	Discarded
22/03/2019	09:04	BTFP_38	51.16242	-4.22286	45	Fix_5711	Echosounder off	1.0	Discarded
22/03/2019	09:07	BTFP_38	51.16227	-4.22274	45	Fix_5712	Echosounder off	2.5	Biota + PSA
22/03/2019	09:15	BTFP_37	51.17422	-4.22370	46	Fix_5713	Echosounder off	1.5	Discarded
22/03/2019	09:19	BTFP_37	51.17411	-4.22399	46	Fix_5714	Echosounder off	1.1	Discarded
22/03/2019	09:21	BTFP_37	51.17411	-4.22376	46	Fix_5715	Echosounder off	2.0	Biota + PSA
22/03/2019	09:30	BTFP_36	51.18285	-4.23014	47	Fix_5716	Echosounder off	-	Discarded
22/03/2019	09:32	BTFP_36	51.18285	-4.23014	47	Fix_5717	Echosounder off	-	Empty

Date	Time UTC	Station Code	WGS84 Latitude DD.DDDDD	WGS84 Longitude DD.DDDDD	STN no.	Hpro fix no.	Water depth (m)	Sediment vol. (litres) calculated	Sediment use
Sampling gear = Mini-Hamon Grab, sieve mesh = 1 mm									
22/03/2019	09:34	BTFP_36	51.18283	-4.23023	47	Fix_5718	Echosounder off	-	Discarded
22/03/2019	10:23	BTFP_34	51.20909	-4.15769	48	Fix_5719	23.68	1.0	PSA
22/03/2019	10:26	BTFP_34	51.20932	-4.15787	48	Fix_5720	23.99	-	Discarded
22/03/2019	10:30	BTFP_34	51.20922	-4.15783	48	Fix_5721	23.50	-	Discarded
22/03/2019	10:47	BTFP_23	51.21867	-4.11472	49	Fix_5722	25.46	-	Discarded
22/03/2019	10:53	BTFP_23	51.21867	-4.11482	49	Fix_5723	25.02	-	Discarded
22/03/2019	10:55	BTFP_23	51.21873	-4.11470	49	Fix_5724	25.01	-	Discarded
22/03/2019	11:02	BTFP_28	51.21457	-4.09636	50	Fix_5725	7.06	3.5	Biota + PSA
22/03/2019	11:11	BTFP_19	51.22236	-4.08440	51	Fix_5726	22.97	-	Discarded
22/03/2019	11:13	BTFP_19	51.22232	-4.08439	51	Fix_5727	22.82	-	Discarded
22/03/2019	11:16	BTFP_19	51.22239	-4.08429	51	Fix_5728	22.95	-	Discarded
22/03/2019	11:27	BTFP_27	51.21681	-4.05501	52	Fix_5729	17.20	1.0	PSA
22/03/2019	11:30	BTFP_27	51.21685	-4.05511	52	Fix_5730	17.43	0.5	Discarded
22/03/2019	11:32	BTFP_27	51.21678	-4.05508	52	Fix_5731	17.14	1.0	Discarded
22/03/2019	11:39	BTFP_29	51.21378	-4.04744	53	Fix_5732	14.88	-	Discarded
22/03/2019	11:41	BTFP_29	51.21367	-4.04743	53	Fix_5733	14.86	1.0	Discarded
22/03/2019	11:43	BTFP_29	51.21375	-4.04741	53	Fix_5734	14.80	2.8	Biota + PSA
22/03/2019	11:57	BTFP_24	51.22029	-4.00999	54	Fix_5735	11.51	-	Discarded
22/03/2019	11:59	BTFP_24	51.22041	-4.01016	54	Fix_5736	11.72	-	Discarded
22/03/2019	12:01	BTFP_24	51.22034	-4.00998	54	Fix_5737	11.62	-	Discarded
09/04/2019	07:28	BTFP35_	51.20091	-4.22963	55	Fix_5843	21.79	6.5	Biota & PSA
09/04/2019	07:36	BTFP31_	51.20930	-4.22489	56	Fix_5844	39.66	4.0	Biota & PSA
09/04/2019	07:44	BTFP33_	51.20888	-4.21268	57	Fix_5845	34.81	6.0	Biota & PSA
09/04/2019	07:51	BTFP26_	51.21539	-4.20642	58	Fix_5846	39.80	3.5	Biota & PSA
09/04/2019	08:00	BTFP30_	51.21001	-4.19648	59	Fix_5871	33.63	3.0	Biota & PSA
09/04/2019	08:09	BTFP32_	51.20978	-4.18202	60	Fix_5872	30.76	2.7	Biota & PSA
09/04/2019	08:16	BTFP25_	51.21547	-4.18913	61	Fix_5873	37.79	3.5	Biota & PSA
09/04/2019	08:24	BTFP21	51.21813	-4.17517	62	Fix_5874	37.08	0.5	Discarded
09/04/2019	08:30	BTFP21	51.21825	-4.17496	62	Fix_5875	37.05	0.5	Discarded
09/04/2019	08:34	BTFP21_	51.21815	-4.17533	62	Fix_5876	37.06	0.5	PSA
09/04/2019	08:42	BTFP20_	51.21939	-4.15734	63	Fix_5877	37.83	1.0	PSA
09/04/2019	08:46	BTFP20	51.21955	-4.15783	63	Fix_5878	37.73	0.5	Discarded
09/04/2019	10:44	BTFP4_	51.24707	-3.79887	64	Fix_5879	15.59	4.5	Biota & PSA
09/04/2019	10:50	BTFP10	51.23906	-3.80044	65	Fix_5880	9.95	-	Empty
09/04/2019	10:53	BTFP10	51.23912	-3.80057	65	Fix_5881	10.42	-	Empty
09/04/2019	10:55	BTFP10_	51.23907	-3.80081	65	Fix_5882	10.51	1.0	PSA

Date	Time UTC	Station Code	WGS84 Latitude DD.DDDDD	WGS84 Longitude DD.DDDDD	STN no.	Hpro fix no.	Water depth (m)	Sediment vol. (litres) calculated	Sediment use
Sampling gear = Mini-Hamon Grab, sieve mesh = 1 mm									
09/04/2019	11:01	BTFP14	51.23448	-3.81271	66	Fix_5883	8.79	-	Discarded
09/04/2019	11:04	BTFP14	51.23452	-3.81259	66	Fix_5884	9.04	-	Empty
09/04/2019	11:07	BTFP14	51.23465	-3.81268	66	Fix_5885	8.48	-	Empty
09/04/2019	11:14	BTFP5_	51.24685	-3.81302	67	Fix_5886	11.79	4.5	Biota & PSA
09/04/2019	11:21	BTFP6	51.24311	-3.82737	68	Fix_5887	14.71	-	Empty
09/04/2019	11:23	BTFP6	51.24305	-3.82741	68	Fix_5888	14.22	-	Empty
09/04/2019	11:26	BTFP6_	51.24301	-3.82739	68	Fix_5889	14.46	1.8	PSA
09/04/2019	11:34	BTFP1_	51.25063	-3.83770	69	Fix_5890	19.96	2.0	Biota & PSA
09/04/2019	11:37	BTFP1	51.25079	-3.83782	69	Fix_5891	20.00	2.0	Discarded
09/04/2019	11:44	BTFP1	51.25076	-3.83740	69	Fix_5892	20.23	1.5	Discarded
09/04/2019	11:51	BTFP3	51.24647	-3.85072	70	Fix_5893	19.08	-	Discarded
09/04/2019	11:54	BTFP3	51.24638	-3.85055	70	Fix_5894	18.67	-	Empty
09/04/2019	11:57	BTFP3	51.24660	-3.85058	70	Fix_5895	18.67	-	Empty
09/04/2019	12:04	BTFP2	51.24780	-3.86877	71	Fix_5896	24.16	0.1	Discarded
09/04/2019	12:09	BTFP2	51.24807	-3.86873	71	Fix_5897	23.98	0.2	Discarded
09/04/2019	12:11	BTFP2	51.24790	-3.86867	71	Fix_5898	23.72	0.2	Discarded
09/04/2019	12:21	BTFP13_	51.23462	-3.88069	72	Fix_5899	16.07	3.5	Biota & PSA
09/04/2019	12:28	BTFP8_	51.24044	-3.89268	73	Fix_5900	15.64	1.0	PSA
09/04/2019	12:30	BTFP8	51.24058	-3.89275	73	Fix_5901	15.90	-	Discarded
09/04/2019	12:33	BTFP8	51.24044	-3.89266	73	Fix_5902	15.42	0.1	Discarded
09/04/2019	12:41	BTFP18_	51.22698	-3.89211	74	Fix_5903	9.94	2.2	Biota & PSA
09/04/2019	12:45	BTFP18	51.22696	-3.89190	74	Fix_5904	9.55	2.2	Discarded
09/04/2019	12:48	BTFP18	51.22692	-3.89178	74	Fix_5905	9.61	2.4	Discarded
09/04/2019	13:13	BTFP15_	51.23231	-3.89707	75	Fix_5906	11.49	3.3	Biota & PSA
09/04/2019	13:22	BTFP12	51.23511	-3.91339	76	Fix_5907	13.46	2.5	Discarded
09/04/2019	13:24	BTFP12	51.23507	-3.91324	76	Fix_5908	13.10	2.6	Discarded
09/04/2019	13:27	BTFP12_	51.23510	-3.91307	76	Fix_5909	13.54	4.2	Biota & PSA
09/04/2019	13:34	BTFP9	51.23800	-3.92532	77	Fix_5910	16.69	0.2	Discarded
09/04/2019	13:36	BTFP9	51.23798	-3.92509	77	Fix_5911	16.82	0.1	Discarded
09/04/2019	13:39	BTFP9_	51.23800	-3.92509	77	Fix_5912	16.57	1.0	PSA
09/04/2019	13:47	BTFP7	51.24010	-3.94072	78	Fix_5913	20.96	-	Discarded
09/04/2019	13:50	BTFP7	51.24018	-3.94069	78	Fix_5914	20.95	-	Misfire
09/04/2019	13:52	BTFP7	51.24007	-3.94075	78	Fix_5915	20.79	0.5	Discarded
09/04/2019	14:01	BTFP11	51.23631	-3.95530	79	Fix_5916	21.84	1.0	Discarded
09/04/2019	14:04	BTFP11	51.23631	-3.95496	79	Fix_5918	21.57	0.5	Discarded
09/04/2019	14:06	BTFP11_	51.23632	-3.95500	79	Fix_5919	21.75	1.0	PSA

Date	Time UTC	Station Code	WGS84 Latitude DD.DDDDD	WGS84 Longitude DD.DDDDD	STN no.	Hpro fix no.	Water depth (m)	Sediment vol. (litres) calculated	Sediment use
Sampling gear = Mini-Hamon Grab, sieve mesh = 1 mm									
09/04/2019	14:12	BTFP17	51.22743	-3.95950	80	Fix_5920	18.68	0.3	Discarded
09/04/2019	14:15	BTFP17_	51.22749	-3.95966	80	Fix_5921	18.53	3.0	Biota & PSA
09/04/2019	14:19	BTFP17	51.22726	-3.95932	80	Fix_5922	18.27	1.0	Discarded
09/04/2019	14:27	BTFP16_	51.22892	-3.96825	81	Fix_5923	19.86	0.3	PSA
09/04/2019	14:29	BTFP16	51.22895	-3.96824	81	Fix_5924	19.88	0.3	Discarded
09/04/2019	14:32	BTFP16	51.22891	-3.96831	81	Fix_5925	19.60	0.3	Discarded
09/04/2019	14:39	BTFP22	51.22171	-3.98138	82	Fix_5926	10.52	0.2	Discarded
09/04/2019	14:41	BTFP22_	51.22159	-3.98129	82	Fix_5927	10.41	1.5	PSA
09/04/2019	14:43	BTFP22	51.22164	-3.98128	82	Fix_5928	10.64	0.5	Discarded

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