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Faroe-Shetland Sponge Belt MPA Survey Report (1121S)

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Executive Summary

The Joint Nature Conservation Committee (JNCC) and Marine Scotland Science (MSS) undertook a seabed monitoring survey of Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Area (hereafter referred to as FSSB) and adjacent areas between the 20 August and 6 September 2021, aboard the MRV Scotia.

The aim of the 1121S survey was to acquire a robust initial monitoring dataset that will contribute to the development of a monitoring time-series for FSSB, against which the rate and direction of any change in the condition of the MPA features can be assessed. Repeated surveys will allow the long-term variability in any parameters measured to be quantified over time. Further, this dataset will help to determine the effectiveness of any management measures that may be implemented. Data from this survey will form part of a monitoring time series, and future repeated monitoring and evidence gathering will be required to fully investigate and understand the long-term variability in any parameters measured.

In total 184 drop-camera transects (still images and video footage), five 0.1 m^2 Hamon grab samples (for eDNA protocol testing), were collected on the survey.

Please note: observations made in this Survey Report represent preliminary field observations. These observations have not been subject to JNCC's Evidence Quality Assurance procedures. Please refer to the Final Report for this survey for Quality Assured evidence. This disclaimer should be included when referencing this Survey Report.

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Abbreviations

DSSA	Deep-sea Sponge Aggregations
EOL	End of Line
FIM	Fair Isle - Munken Line
FSSB	Faroe-Shetland Sponge Belt
JNCC	Joint Nature Conservation Committee
MPA	Marine Protected Area
MRV	Marine Research Vessel
MSS	Marine Scotland Science
NCMPA	Nature Conservation Marine Protected Area
NOL	Nolso-Flugga Line
OSSG	Offshore Subtidal Sands and Gravels
SIC	Scientist in Charge
SOL	Start of Line
UTC	Co-ordinated Universal Time

1 Background and introduction

The survey of Faroe-Shetland Sponge Belt (FSSB hereafter) Nature Conservation Marine Protected Area (NCMPA) was carried out between 20 August and 6 September 2021 on the MRV *Scotia* (cruise code 1121S). This report describes the survey design and methodology, the events of the survey and the data collected. Results of analyses of the data collected will be reported separately.

1.1 Faroe-Shetland Sponge Belt NCMPA

The FSSB is positioned in UK offshore waters on the Scottish side of the Faroe-Shetland Channel (Figure 1), a large rift basin that separates the Scottish and Faroese continental shelves (Figure 3). FSSB NCMPA is part of a wider network of offshore MPAs in Scottish waters with Wyville Thomson Ridge located close by and at a similar depth gradient (Figure 2).

Five different water masses meet in the Faroe-Shetland Channel, which interact with each other and the continental slope to generate ideal conditions for the boreal 'ostur' type of deep-sea sponge to settle (JNCC 2018). Deep-sea Sponge Aggregations (DSSA hereafter) occur between 400 and 600 m depth at FSSB (Bett 2001; Kazanidis *et al.* 2019; Davison *et al.* 2019). Iceberg ploughmarks on the upper continental slope (reaching a depth of 450 to 500 m, Masson 2001) may also provide ridges of coarse sediment where sponges can aggregate. Offshore Subtidal Sands and Gravels (OSSG) are present within much of the site, supporting a diversity of polychaete worms and the slow-growing bivalve mollusc, the ocean quahog (*Arctica islandica*, Linnaeus 1767).

DSSA, OSSG, and ocean quahog are all protected features of FSSB NCMPA, along with the large-scale feature of the continental slope, and geomorphological features that have been previously identified within the MPA (Table 1).

Table 1. Site designations at Faroe-Shetland Sponge Belt NCMPA.

Designated Feature	Feature type
Deep-sea Sponge Aggregations	**Habitat**
Offshore Subtidal Sands and Gravels	**Habitat**
Ocean quahog aggregations	Low or limited mobility species
Continental slope	Large-scale feature
Continental slope channels, iceberg ploughmarks, prograding wedges and slide deposits representative of the West Shetland Margin paleo-depositional system Key Geodiversity Area	Geomorphological
Sand wave fields and sediment wave fields representative of the West Shetland Margin contourite deposits Key Geodiversity Area	Geomorphological

Please note only the **habitat features** were targeted for monitoring on the 1121S survey.

FSSB has an area of 5,278 km^2 and a depth range of approximately 300 m to 1,000 m below sea-level, although most of the site ranges in depth from 400 m to 800 m (Figure 3). For more information on FSSB NCMPA see the Site Information Centre[1].

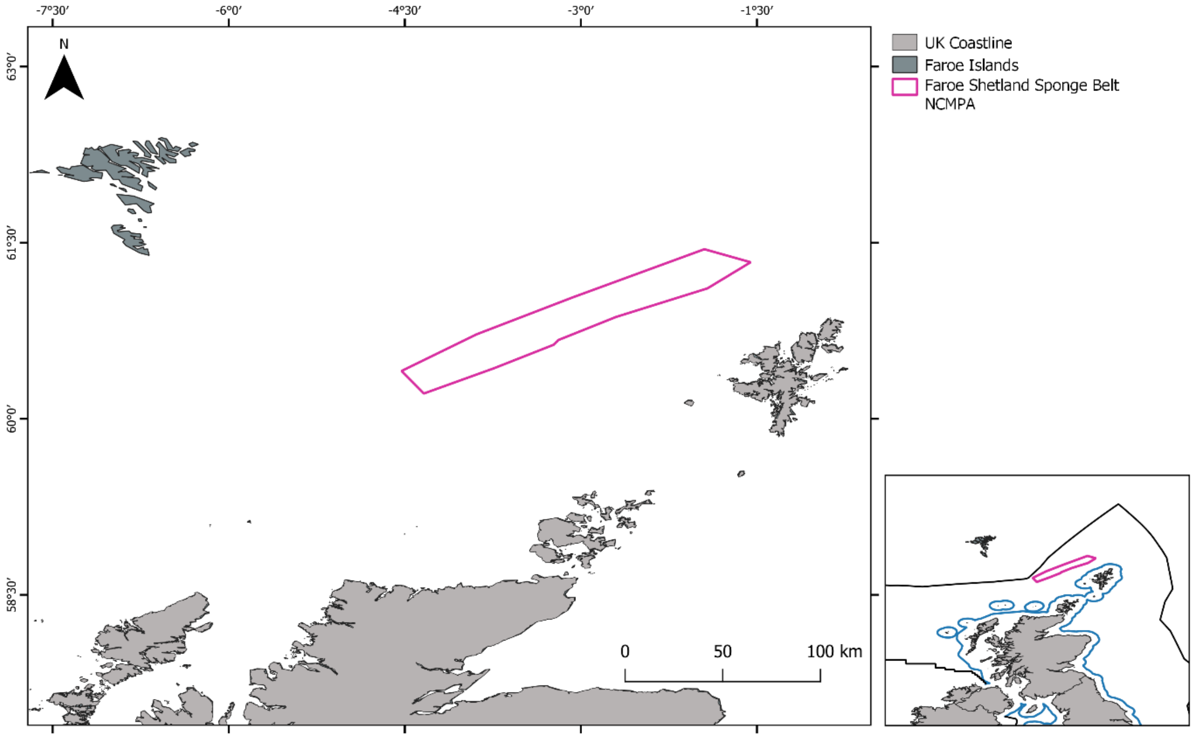
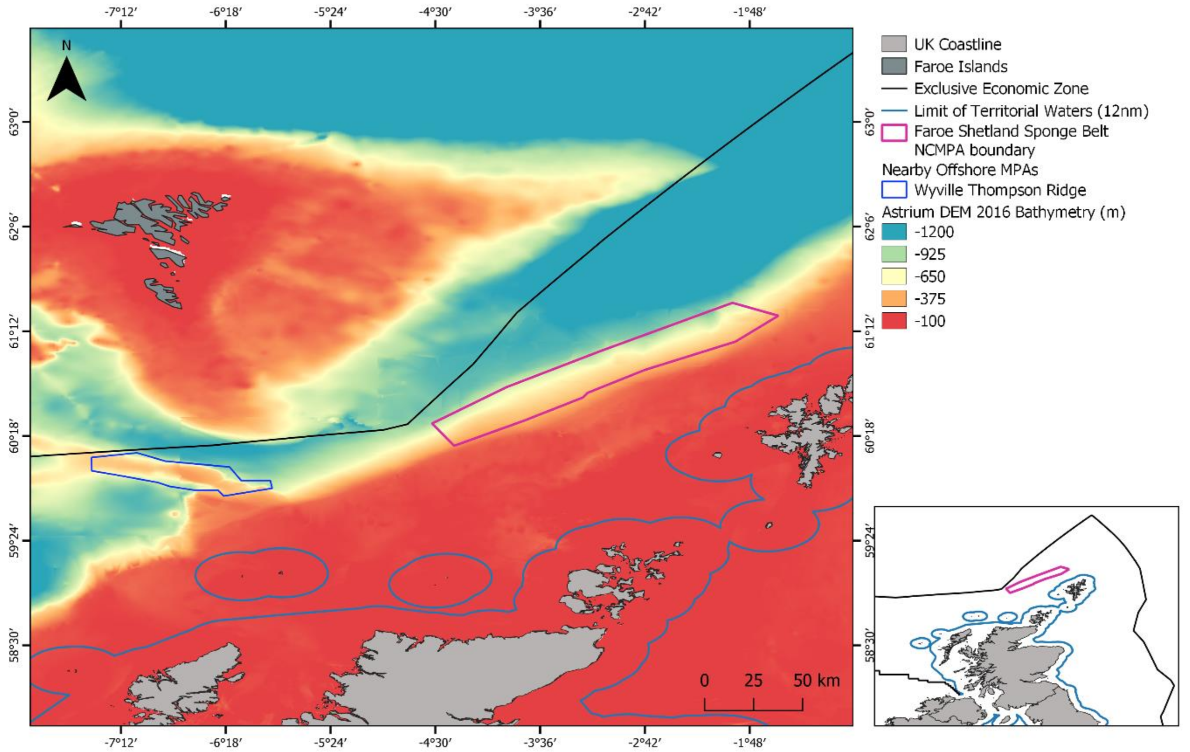


Figure 1. The Faroe-Shetland Sponge Belt NCMPA is in UK offshore waters on the Scottish side of the Faroe-Shetland Channel.

[1] Faroe-Shetland Sponge Belt NCMPA Site Information Centre. Accessed January 2022: https://jncc.gov.uk/our-work/faroe-shetland-sponge-belt-mpa/



Projection: WGS 84 / UTM zone 30N (EPSG: 32630); © JNCC 2021; UK Territorial Sea Limit. Contains UKHO data © Crown copyright. All rights reserved. UK Exclusive Economic Zone © Crown copyright, The exact limits of the EEZ are set out in The Exclusive Economic Zone Order 2013; Shoreline © GSHHG 2.2.2. Bathymetry data fromDEFRA Astrium Digital Elevuation Model.

Figure 2. Bathymetry of the Faroe Shetland Sponge Belt NCMPA and Faroe-Shetland Channel. The Faroe-Shetland Channel is a large rift basin that separates the Scottish and Faroese continental shelves.

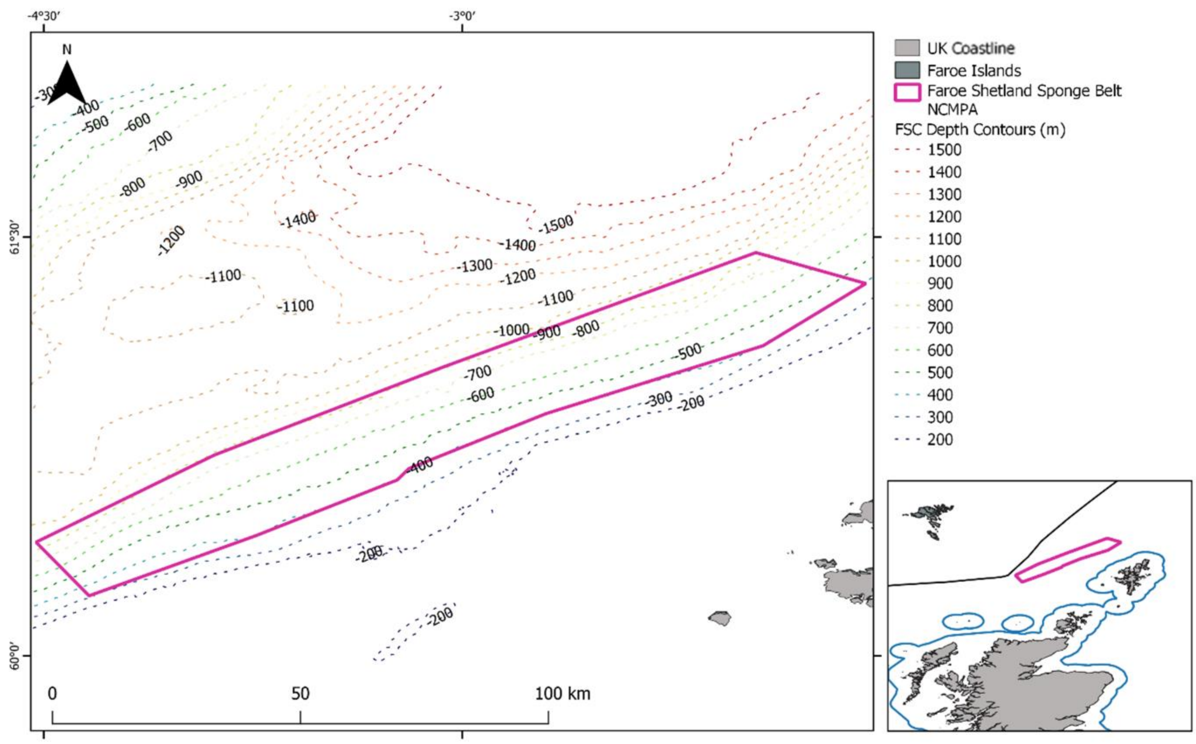


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Figure 3. Faroe Shetland Sponge Belt NCMPA depth range.

1.2 Aims and objectives

The aim of the 1121S survey was to acquire a robust initial sentinel monitoring dataset ('Type One' monitoring), within FSSB NCMPA to contribute to the development of a monitoring time-series against which the rate and direction of change in the condition of this MPA's features can be inferred in the long term.

Definition of Type One monitoring see Kröger & Johnston 2016:

> *"**Sentinel monitoring of long-term trends (Type One monitoring) – Monitoring designed to assess the condition of a protected feature at a site***
>
> ***Objective:** To measure rate and direction of long-term change.*
>
> *Description: Type One monitoring data are quantitative (for example, density data or data that allow assessment of the status of populations of mobile species e.g., photo-ID) and statistically robust, allowing the rate and direction of change in the feature of interest over time to be quantified. The design of Type One monitoring should include consideration of known activities / pressures. The use of reference areas outside of MPAs may be considered to provide context for any changes observed. This monitoring provides data that are appropriate for the assessment of status against MPA feature conservation objectives - recovery (trajectory) and / or maintenance - informing management action and reporting obligations."*

Data from this survey will form part of a monitoring time series, with future repeated monitoring and evidence gathering will be required to fully investigate and understand the long-term variability in any parameters measured. Future monitoring must collect comparable data to that collected by this survey, though over time it is anticipated that there may be a phased change in the methods of monitoring as technology and practices are developed.

The two designated habitat features, Deep-sea Sponge Aggregations and Offshore Subtidal Sands and Gravels (DSSA and OSSG respectively), have been targeted for monitoring. In addition, data gathered will provide information on the oceanographic conditions in the Faroe-Shetland Channel.

The monitoring objectives of the survey were as follows (listed in order of priority).

- **Monitoring Objective 1**: Collect evidence to inform the extent, distribution, sponge composition, sponge abundance and characteristic communities of the Deep-sea Sponge Aggregations of FSSB.

- **Monitoring Objective 2**: Collect evidence to inform the extent, distribution, key and influential species, characteristic communities and function of the Offshore Subtidal Sands and Gravels of FSSB.

- **Monitoring Objective 3**: Collect evidence to monitor changes in environmental conditions within FSSB.

The monitoring objectives listed above were used to create more specific survey objectives (Table 2).

Table 2. Survey objectives in priority order. The equipment used to complete each survey objective, the monitoring objective the survey objective addresses, and a summary of the extent to which each survey objective was completed during 1121S are also shown.

Priority	Survey objective	Monitoring objective	Equipment	Summary of progress
1	Acquire imagery samples from chariot transects at 600, 650 and 700 m	1	Chariot	Completed
2	Target isobath in central sponge belt (500 m)	1	Drop-camera	Completed
3	Target isobath at shallow margin of sponge belt (400 m)	1	Drop-camera	Completed
4	Target isobath at deep margin of sponge belt (600/650 m)	1	Drop-camera	Completed at 550 m
5	Target more isobaths in central sponge belt (e.g., 450, 550, 600, or 650 m)	1	Drop-camera	Completed at 450 m
6	Acquire sediment samples from areas of OSSG outside the sponge belt (800 m stations)	2	Grab	See section 4.1.2
7	Acquire CTD samples from the NOL and FIM line	3	CTD	Completed
8	Acquire sediment samples from areas of OSSG outside the sponge belt (700 m stations)	2	Grab	Not addressed
9	Acquire imagery samples from chariot transects at 350 and 300 m	1	Chariot	Completed

Please note: the Survey Plan document, which details the rationale for undertaking the survey and for the planned survey design, is available on request from JNCC and MSS.

2 Survey design and methods

2.1 Sampling Methodology

Video footage was collected using a high-speed towed ‘chariot’ camera system (see annex 2) to gather information on the distribution and extent of habitat types along transects.

Still images and video were collected from drop-frame camera transects. Each transect was 15 minutes in length and acquired 60 images.

The still imagery analysis will be conducted on a habitat observed per transect basis, with images of comparable field of view pooled to form a standardised sample area per transect.

The results of this analysis will be used to determine appropriate sampling units for each observed habitat type for future monitoring.

2.1.1 Number of Stations

A power analysis was conducted prior to the survey to identify the number of camera stations required to detect change within the sponge belt. However, the results from this analysis were inconclusive due to the limited amount of data available for FSSB (details of the power analysis are available on request from JNCC).

The camera sampling design for 1121S therefore aimed to oversample the sponge belt with between n = 40 and 50 stations per depth band identified. This would allow for a post-hoc power analysis to determine the number of camera sample stations required per parameter on future surveys to FSSB (see Section 2.3.1 for more details).

2.1.2 Monitoring stations

Depth contours (initially derived from the Astrium and later the EMODnet bathymetry layer) were used (see Figure 4) to plot stations within FSSB. During the survey the EMODnet bathymetry contours were found to be more accurate than the Astrium contours, especially in the northeast of the MPA (see Figure 3). As such stations were moved during the survey to align with EMODnet bathymetry.

A semi-random transect design was used to position monitoring stations at FSSB. The transects were positioned parallel to each other and approximately perpendicular to the depth contours within the site. To cover the whole survey area, 2000 parallel transects, 100 m apart, were generated in QGIS. Transects 1737 to 1867 were removed from the study area as they cross the Schiehallion and Foinaven oil fields, where oil and gas infrastructure would prevent safe ship operations and deployment of the sampling equipment. A random number generator was used to sequentially produce 50 random numbers between 1 and 2000. If a transect was less than 1 km from a previously selected transect, that transect was rejected and another random number would be generated. In this way 50 parallel transects with a minimum separation distance of 1 km between them were chosen for 1121S. The minimum 1 km spacing was applied as a reasonable threshold distance across an area of this size.

Each planned transect intersects a 50 m depth contour between 400 and 800 m (see Annex 3). This resulted in 50 transects intersecting nine depth contours, producing 450 monitoring stations. It was not anticipated that all these stations would be visited but instead specific depth contours would be prioritised for sampling (aiming for the target depth +/- 10 m) with different equipment types (see Table 2 and Annex 2).

All stations were given a station code consisting of the transect number (T01 - T50) and the target depth (D400 - D800). For example, a station on the 10th transect targeting 500 m would have the code T10_D500.

By prioritising depth contours, a high level of replication at each depth visited could be ensured even if poor weather reduced the available sampling time during the survey. A total of 50 sampling stations per depth band were planned (Figure 5), but this could be reduced to 40 based on progress during the survey (with stations selected using a random number generator to avoid bias).

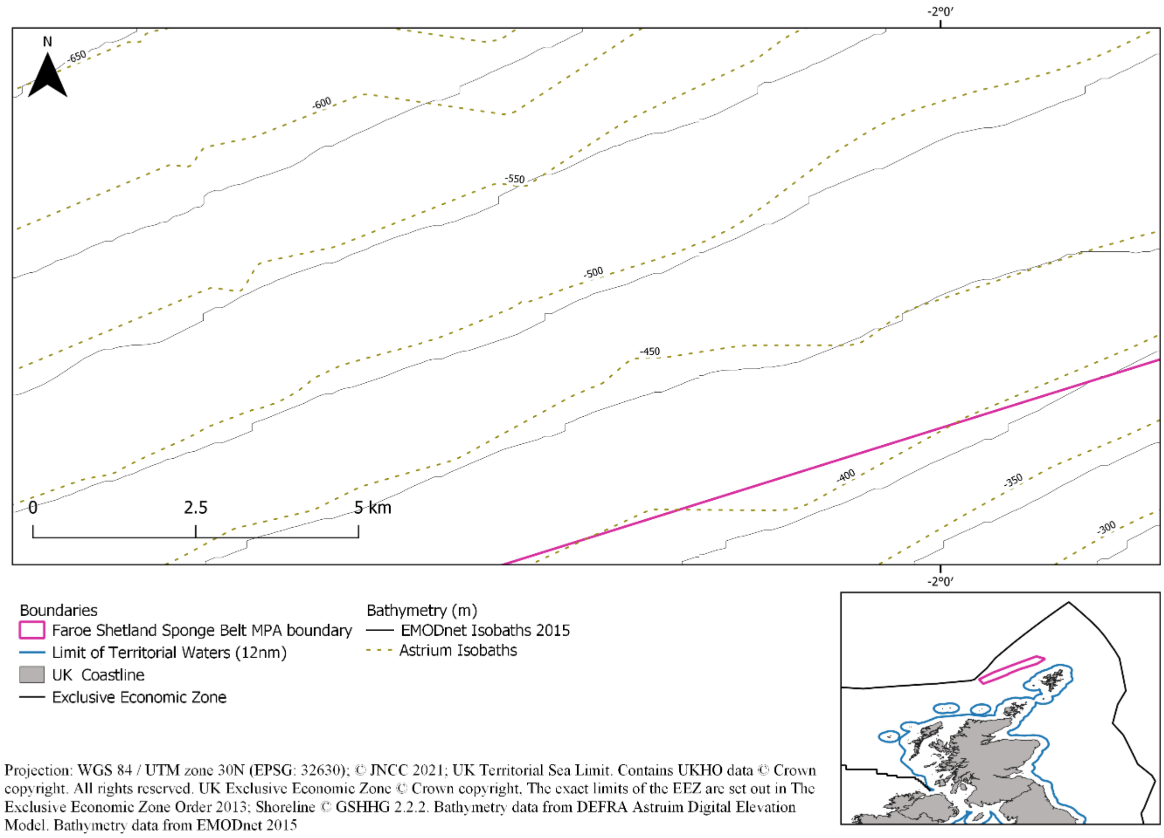

Figure 4. Showing the discrepancy between the Astrium and EMODnet bathymetry contours.

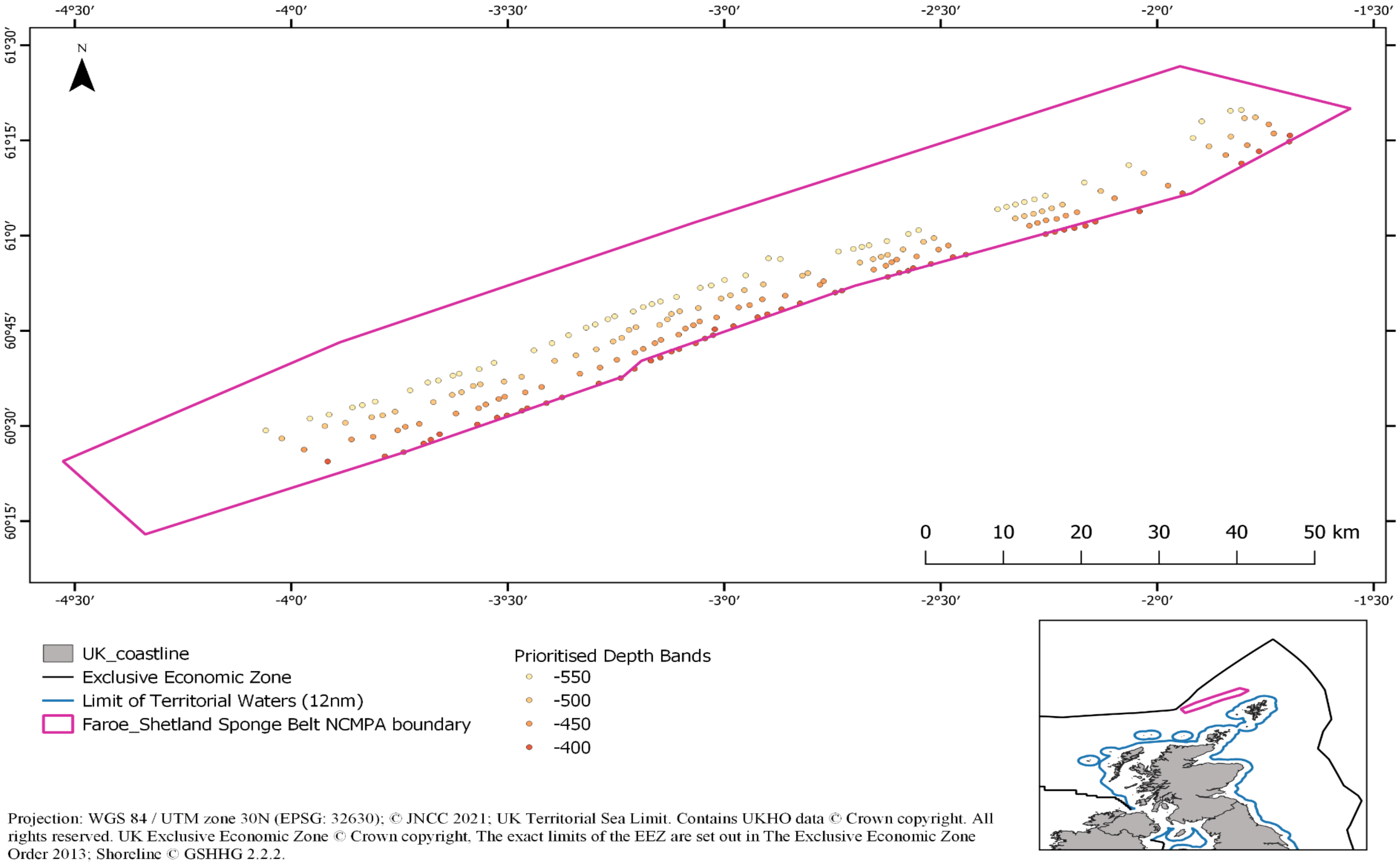

Figure 5. The 1121S planned sampling stations along the four priority depth bands for drop-camera sampling. Transects were not placed over the Schiehallion and Foinaven oilfields in the southwest of the MPA.

2.1.3 Drop-camera stations

In order to address monitoring Objective 1, drop-camera stations were selected based on the reported depth range of DSSA. Where OSSG is present, these stations will be used to address monitoring Objective 2.

The DSSA has been estimated to occur between 400 m to 600 m and 450 m to 530 m respectively by Davison *et al.* (2019) and Kazanidis *et al.* (2019), though this may vary across the site. Depth bands of 500 m and 400 m were selected as priority as Kazinidis *et al.* (2009) found the highest densities of sponges can be found from 500 to 550 m. The 400 m contour has also been prioritised as it is the shallowest continuous contour that runs the length of FSSB (survey Objectives 2 and 3 respectively, Table 2). Two further depth bands of 450 m and 550 m were selected for drop-camera sampling (survey Objectives 4 and 5, Table 2) on survey to target DSSA based on review of camera chariot data collected (Figure 5).

2.1.4 Camera chariot transects

Chariot transects were orientated parallel to the isobaths to help identify the extent of DSSA in the Faroe-Shetland Channel. Transects varied in length and were up to 7 km long. Before the survey, planned transects were located in the northeast end of the MPA based on existing data which indicated that sponge aggregations were present in this part of the site. During the survey extra chariot transects were added (see Table 3 for reasoning). Chariot transects CT1, CT2 and CT3 targeted the 700 m, 650 m, and 600 m depth contours respectively (Figure 6) to identify the deepest range of the DSSA. Review of imagery collected from these three transects was used to inform which depth band was chosen for drop-camera sampling of the deepest part of the sponge belt. As such, completing these transects was the first priority for the survey (survey objective 1, Table 2) to allow time for the footage to be reviewed whilst at sea. CT1 and CT2 were positioned to cross the boundary between predicted areas of sandy mud and muddy sand and mixed sediment to better understand this boundary and possible differences in epifaunal communities associated with the different substrate types.

Chariot transects CT4 and CT5 targeted the 350 m and 300 m depth contours respectively (Figure 5). These transects were placed outside the MPA to help identify if DSSA are associated with iceberg ploughmark features present at these shallower depths. As these transects do not directly address the monitoring objectives, they were given a lower priority (survey objective 9, Table 2).

An additional nine chariot transects added during the survey were included as part of survey objective 9 with co-ordinates and rationale for transect positions provided in Table 3.

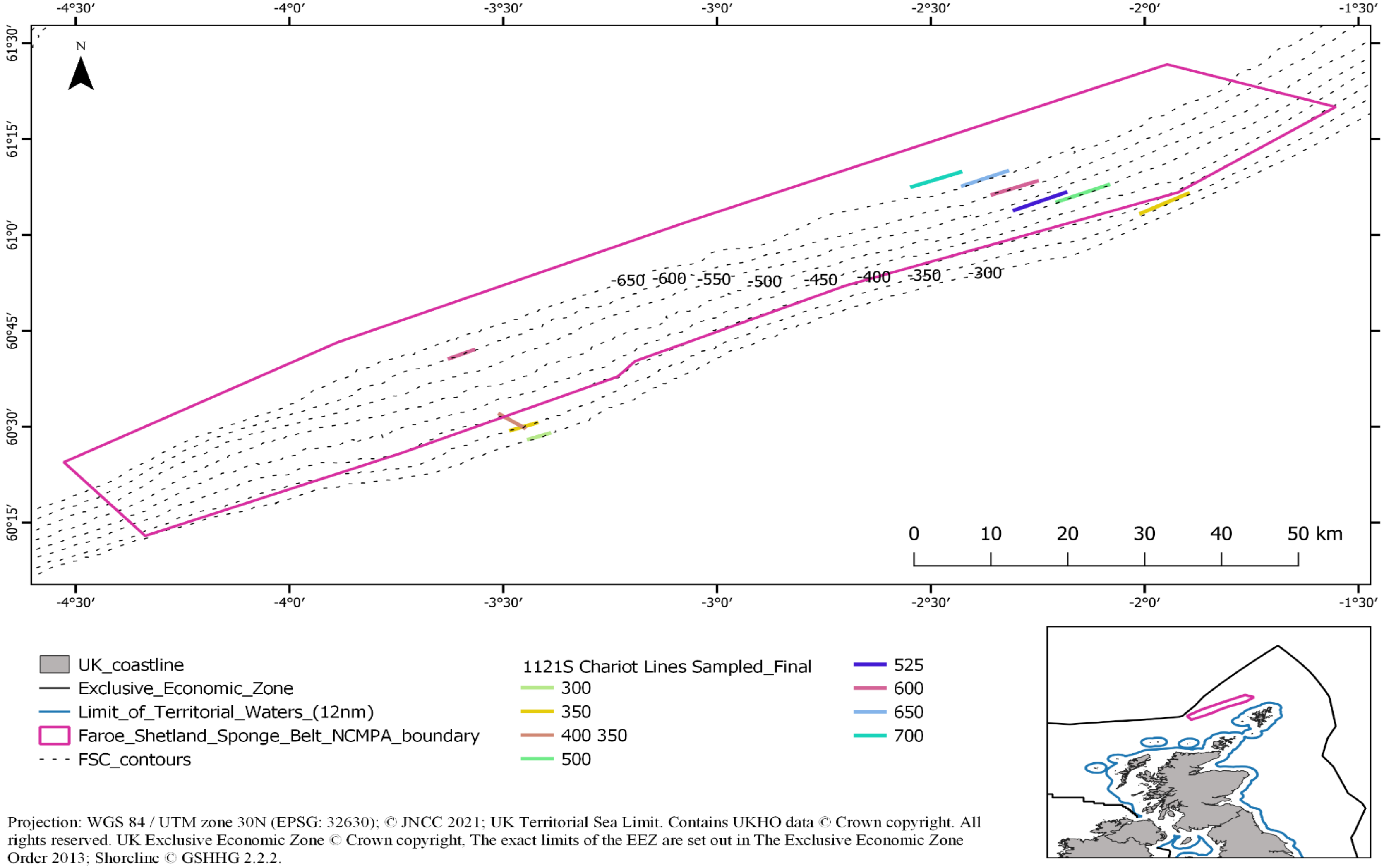

Figure 6. Planned and completed locations of chariot tow transects, during the survey are shown.

Table 3. Chariot transect start / end point co-ordinates (NE = northeast, SW = southwest). Showing the target depth of each point, when the transect was added to the survey plan and the rationale behind the placement of each transect.

Station Code	Target Depth	When	Rationale	Status
CT1	700	Pre-survey	Target a depth contour beyond the expected depth limit of the sponge belt, to confirm the presence/absence of sponge aggregations in the area.	Completed
CT2	650	Pre-survey	Target a depth contour beyond the expected depth limit of the sponge belt, to confirm the presence/absence of sponge aggregations in the area.	Completed
CT3	600	Pre-survey	Target a depth contour at the expected depth limit of the sponge belt, to confirm the presence/absence of sponge aggregations in the area.	Completed
CT4	350	Pre-survey	Target a depth contour outside the MPA to confirm the presence/absence of sponge aggregations	Completed
CT5	300	Pre-survey	Target a depth contour outside the MPA to confirm the presence/absence of sponge aggregations	Not completed
CT6	800	Survey	Target the 800 m contour near the NOL section	Not completed
CT7	525	Survey	Revisit of chariot transect run on the 2014 MOREDEEP Survey transect	Completed
CT8	500	Survey	Revisit of the chariot transect run on the 2014 MOREDEEP Survey transect	Completed
CT9	700	Survey	Target the 700 m contour in the south of the MPA	Not completed
CT10	600	Survey	Target the 600 m contour in the south of the MPA	Completed
CT11	350	Survey	Target a depth contour outside the MPA to confirm the presence/absence of sponge aggregations	Completed
CT12	300	Survey	Target a depth contour outside the MPA to confirm the presence/absence of sponge aggregations	Completed
CT13	350	Survey	Transect intersects the 400 and 350 m contour, to identify where sponge aggregations start/stop.	Completed
CT14	350	Survey	Transect intersects the 350 and 300 m contour, to identify where sponge aggregations start/stop.	Not completed

2.2 Grab survey

Stations to address monitoring objective 2 were sampled with the 0.1 m^2 Hamon grab. These were chosen based on the depth range where DSSA were not expected to occur in order to avoid destructive sampling of this habitat. Priority depth bands of 700 m and 800 m were chosen as they represent isobaths that are broadly continuous along the length of FSSB. OSSG were predicted to be present across most of FSSB though sands and muddy sands have been found in the northeast of the site, particularly the “black hole” contourite[2] and the sand wave features (Masson 2001).

Due to extremely favourable weather conditions during the cruise, there was a change in the survey objectives. With the main priority for the 1121S survey being to collect imagery, the time allocated on the lower priority Hamon grab sampling was transferred to drop-frame camera sampling. This enabled a large imagery dataset collected at FSSB (see Section 4).

2.3 Oceanographic survey

2.3.1 CTD stations

Twelve CTD stations were planned for sampling from the Nolso- Flugga Line (NOL) and the Fair Isle Munken Line (FIM) to acquire two sections through FSSB. Targeting the NOL and FIM stations were survey objective 7 (Table 2). These station codes are listed below in Table 4 and shown in Figure 7.

Table 4. Planned NOL and FIM sampling stations for 1121S.

Station	Line
NOL-04	NOL
NOL-3a	NOL
SEFN4	NOL
NOL-03	NOL
SEFN3	NOL
NOL-02	NOL
FIM-05	FIM
FIM-04	FIM
FIM-03	FIM
SEFOS-2	FIM
FIM-02	FIM
SEFOS-1	FIM

[2] A contourite is a sedimentary deposit commonly formed on continental rise to lower slope settings, although they may occur anywhere that is below storm wave base. Contourites are produced by thermohaline-induced deep-water bottom currents and may be influenced by wind or tidal forces.

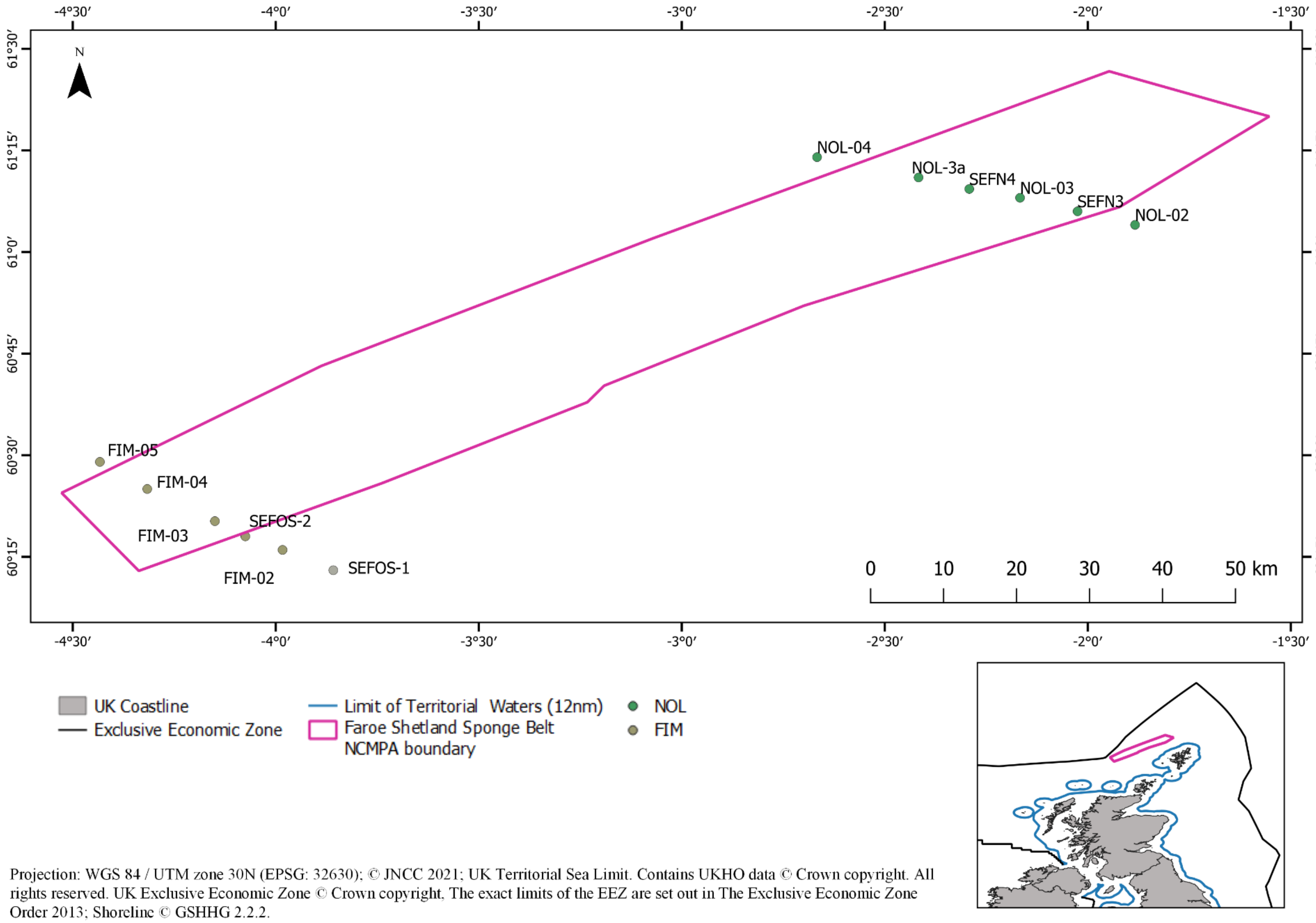

Figure 7. NOL and FIM stations that intersect Faroe-Shetland Sponge Belt NCMPA, which were planned during 1121S

2.4 Methods

The following sampling equipment was used on the survey (data type collected given in brackets):

- Drop-frame camera (still and video imagery);
- Camera chariot (video imagery);
- Deep-sea Hamon grab (infauna, particle size distribution, and environmental DNA);
- CTD probe (conductivity, temperature, depth with Niskin bottle for water sampling).

Further details of equipment used, and procedures followed are provided in Annex 2.

2.5 Survey project team

The survey team for the duration of the fieldwork included JNCC survey scientists, MSS engineers/technicians, and an MSS Scientist in Charge (SIC).

Roles across the 12 hour working shifts were assigned as follows:

Cross-shifts (06:00 – 18:00)

- MSS scientist in charge
- MSS camera engineer
- JNCC survey planning lead
- JNCC data manager

Night Shift (00:00 – 12:00

- JNCC survey scientist (x 2)
- MSS camera engineer

Day Shift (12:00 – 24:00)

- JNCC survey scientist
- MSS camera engineer

3 Survey Narrative

The survey at FSSB NCMPA was carried out between 20 August – 6 September 2021.

All times are UTC and to the nearest 15 minutes. Survey equipment and consumables were loaded onto the survey vessel in advance of sailing.

Friday 20 August: All science staff aboard MRV *Scotia* in Aberdeen. An induction and safety briefing were held at 08:00 followed by a muster drill at 08:30. The planned sailing time of 07:00 was delayed until 12:00 while waiting for the final crew member to join.

MRV *Scotia* sailed at 12:00 to a location near Fraserburgh where a wet test of the camera chariot was conducted at 15:45. Having successfully completed the wet test, transit to FSSB began at 16:30.

Saturday 21 August: MRV *Scotia* arrived at chariot station CT03 at 09:00 and began chariot operations. These continued until 19:30 when chariot tows for the 600, 650, and 700 m depth contours were completed (completing survey objective 1). At this time transit began towards the first drop-camera station (T01_D500) and the camera equipment was moved from the chariot to the drop-frame.

Sunday 22 August: After the equipment change and camera download, a drop-camera test deployment was conducted at 02:00. This was used as an opportunity for survey scientists to practice taking images before sampling began at monitoring stations and familiarise themselves with its performance. The camera images were downloaded, and images were reviewed. The decision was made following the review of images to take a minimum of 60 images per tow and run each camera tow for a minimum of 15 minutes (i.e., if the tow had been running for 15 minutes but there had been less than 60 images, the tow continued until 60 images had been taken). By 05:15 the testing and image review were complete and drop-camera operations began at the first monitoring station (T01_D500). Drop-camera operations continued for the rest of the day and by midnight 10 stations on the 500 m depth contour had been sampled.

Monday 23 August: Drop-camera operation continued for the whole day and by midnight 17 more stations had been completed.

Tuesday 24 August: Drop-camera operation continued for the whole day and by midnight 20 more stations had been completed.

Wednesday 25 August: Drop-camera operations continued for the whole day. By 03:00 the final 3 stations on the 500 m depth contour had been sampled, completing survey objective 2. Camera operations began at the 400 m depth contour (survey objective 3) immediately thereafter. As more time had been used to complete the 500 m depth contour sampling than had been estimated before the survey, the number of stations on the 400 m contour was reduced from 50 to 45, as had been agreed before the survey if sampling was slower than expected. By midnight 16 more stations had been completed.

Thursday 26 August: Camera operations continued until 03:45, when they were stopped as a kink was seen in the cable. 10 m of cable was removed, and the cable was re-terminated, tested, and ready to use again by 08:30, when camera operations restarted.

Although wind and swell were generally low, occasional larger swells caused the vessel to pitch, risking damage to the camera or cable. At 12:00 camera operations were stopped, and alternative options were looked at. One option was to fly the camera higher (2 m off the seabed); this was tested, but when the images were reviewed, it was clear they were too dark and too high to be comparable with the data already collected, so this option was not chosen. In this time the swell conditions had started improving and it was decided to try a camera deployment with the vessel broadside on to the swell and the camera flying 1 m above the seabed. The camera operations restarted at 13:30, and this method was successful and was continued for the rest of the day. Station T16_D400 was not attempted due to proximity to a seabed pipeline.

Friday 27 August: Drop-camera operations continued for the whole day. Another station (T07_D400) on the 400 m contour was not attempted due to proximity to a seabed pipeline. By 16:30 the final 13 stations on the 400 m depth contour had been sampled, completing survey objective 3. Camera operations began at the 550 m depth contour (survey objective 4) immediately after.

Saturday 28 August: Drop-camera operations continued for the whole day. By midnight 18 more stations had been completed. This brought the total number of stations completed on the 550 m contour to 22.

Sunday 29 August: Drop-camera operations continued for the whole day. By midnight 21 more stations had been completed. This brought the total number of stations completed on the 550 m contour to 43.

Monday 30 August: At 00:30 the drop-camera was recovered from a tow with a kink in the cable. 7 m of cable was removed, and the cable was re-terminated. At 02:20 the camera was deployed again but it was noted that it was not facing directly downwards. It was recovered before starting the station and the cable had kinked again. A further 7 m of cable was removed, and the cable was re-terminated a second time. The camera was deployed at 05:00 successfully with no further issues.

Drop-camera operations continued for the rest of the day. By 06:00 the final 2 stations on the 550 m contour were completed (survey objective 4). Drop-camera operations then began on the 450 m depth contour (survey objective 5) and by midnight 12 more stations had been completed.

Tuesday 31 August: Drop-camera operations continued for the whole day. By midnight 20 more stations had been completed.

Wednesday 01 September: Drop-camera operations continued for most of the day before changing to CTD sampling. One station (T18_D450) was skipped due to proximity to a seabed pipeline. By 16:00 all remaining drop-camera stations at the 450 m depth contour had been sampled. After this, station T01_D500 was revisited with the drop-camera as less than 30 good quality images had been collected in the first visit; this was completed by 17:00.

Transit began to the first of six CTD stations on the NOL section, and CTD operations were undertaken between 18:30 and midnight, by which time five stations had been sampled.

Thursday 02 September: CTD operations continued until 03:00, when the final NOL section station was sampled.

After transiting to the 450 m contour line, three drop-camera stations that had fewer than 30 required good quality images taken on their first attempt were revisited. These stations were T05_D450, T06_D450, and T09_D450. Drop-camera operations started at 04:00 and were finished by 08:45, completing survey objective 5.

Grab samples were then collected. The scope of the grab sampling objective was reduced to allow more time for camera work and the remaining grabs focussed on testing the deep-sea Hamon grab in deep water and testing the eDNA protocol at five stations. Transit began to the 800 m depth contour and five stations were sampled using the deep-sea Hamon grab between 11:15 and 17:00. The grab was tested to find the correct cable out to depth ratio and worked well without any misfires. Only eDNA sub-samples were collected from these stations.

Additional chariot transects were placed within and adjacent to the sponge belt in areas that had previously been less well sampled. Two chariot transects from the MOREDEEP survey were selected for revisiting.

Chariot operations began at 18:30 and by midnight two chariot transects had been visited, although one was aborted due to poor visibility in the water.

Friday 03 September: Chariot operations continued for the whole day. Two transects were visited in the north of the site by 09:00. One of these was a revisit of a MOREDEEP chariot transect and the other was in an area outside the MPA. After this transit began towards the south of the MPA and the FIM section. Chariot transects began in the south of the site at 14:00 and continued until midnight.

Saturday 04 September: Chariot operations continued until 01:00 when transit began to the first CTD station on the FIM line. CTD sampling began at 03:30 and by 09:30 the five FIM stations within/adjacent to the MPA had been sampled. The sixth CTD station was shallower and further from the MPA and was removed to allow more time for drop-camera sampling. Transit began to station T50_D500, which had not achieved 30 or more good quality images. Drop-camera operations began at 12:00 and after T50_D500, two stations which had been skipped on the 450 m contour were visited (T39_D450 and T30_D450). This continued until 17:45 when the vessel departed site for the transit back to Aberdeen.

Sunday 05 September: Day was spent transiting back to Aberdeen and completing data management tasks. Alongside in Aberdeen Harbour at 15:00 to complete survey.

Monday 06 September: End of survey, demobilisation of equipment and samples and science staff departed vessel.

4 Data acquired

Imagery data were acquired to address monitoring objective 1, this being the highest priority. With conditions being favourable during survey, changes were made to the survey plan (see section 4.1) to focus efforts on imagery data collection. A total of 184 transects were completed for drop-camera operations with a total of approx.16,000 still images and approx. 50 hours of high-definition video footage was collected at FSSB during the 1121S survey.

4.1 Changes to survey plan

4.1.1 Imagery

Of the 50 stations per depth contour planned (Figure 5) five monitoring stations were removed randomly at 550 m, 450 m and 400 m depth contours due to longer than expected operational times when completing drop-camera operations at the first depth contour visited (500 m). The randomly removed stations where T23, T25, T30, T39 and T48. This took the total number of stations to 45 for the remaining depth contours.

Additional stations were removed due to being too close to seabed pipelines. These stations were T07_D400, T16_D400 and T18_D450.

Despite their initial removal, stations T30_D450 and T39_D450 were sampled on the last day due to additional available time.

For a summary of all drop-camera stations completed, see Table 5. See Figure 8 for the location of the 184 drop-camera stations sampled.

Table 5. Summary table of drop-camera stations

Target Depth Contour	Number of Transect stations completed	Comments
400	43	T07 and T16 not attempted due to pipeline T23, T25, T30, T39 and T48 not attempted
450	46	T18 not attempted due to pipeline T23, T25, and T48 not attempted
500	50	All transect stations completed
550	45	T23, T25, T30, T39 and T48 not attempted
Total number of stations	**184**	

4.1.2 Grabs

The pre-survey plan was for each grab sample to be sieved to collect infauna samples after being sub-sampled for PSA and eDNA. Due to the unexpectedly favourable weather conditions, camera operations were prioritised and time available for grabbing was reduced. The remaining efforts were focussed on testing the deep-sea Hamon grab in deep water (800 m) and testing the eDNA protocol at five stations. Therefore, infauna and PSA samples were not collected. See Figure 8 for the location of the five grab stations sampled.

4.1.3 CTD

The pre-survey plan was to collect 12 CTD stations (six from NOL and six from FIM, see Figure 7). One FIM CTD sampling station was not sampled (SEFOS-1), as this station was shallower and further from the MPA and so was not sampled in order to prioritise time for additional drop-camera sampling. Therefore, six NOL stations and five FIM stations were sampled (see Table 3 and Figure 9).

For a summary of all time allocation during 1121S operations see Annex 4. This shows the time breakdown between different operations of the survey, transit and weather downtime through to sampling operations.

4.2 Data Collected

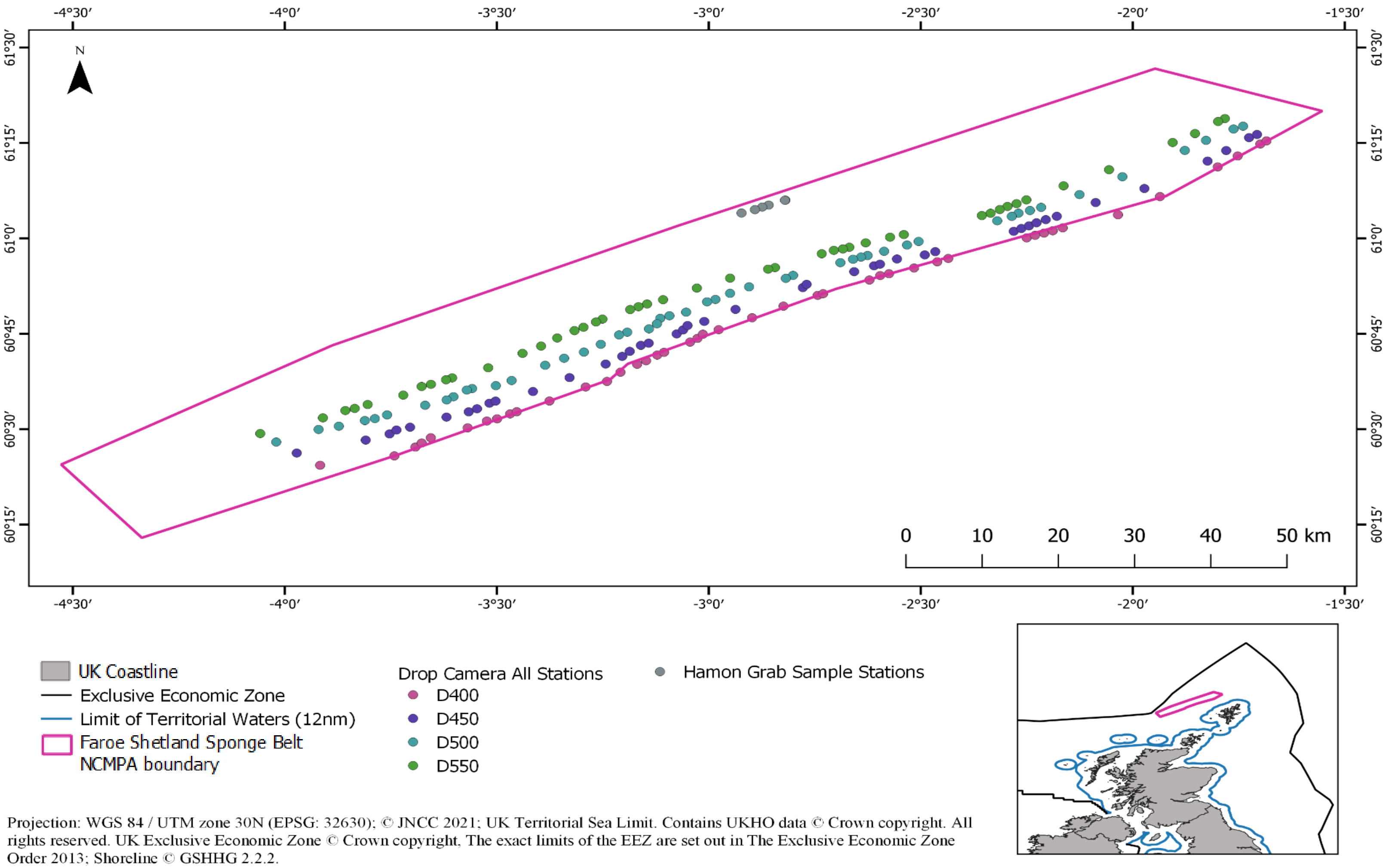

Figure 8. Summary map showing all sampling stations visited with the drop-camera and the Hamon grab.

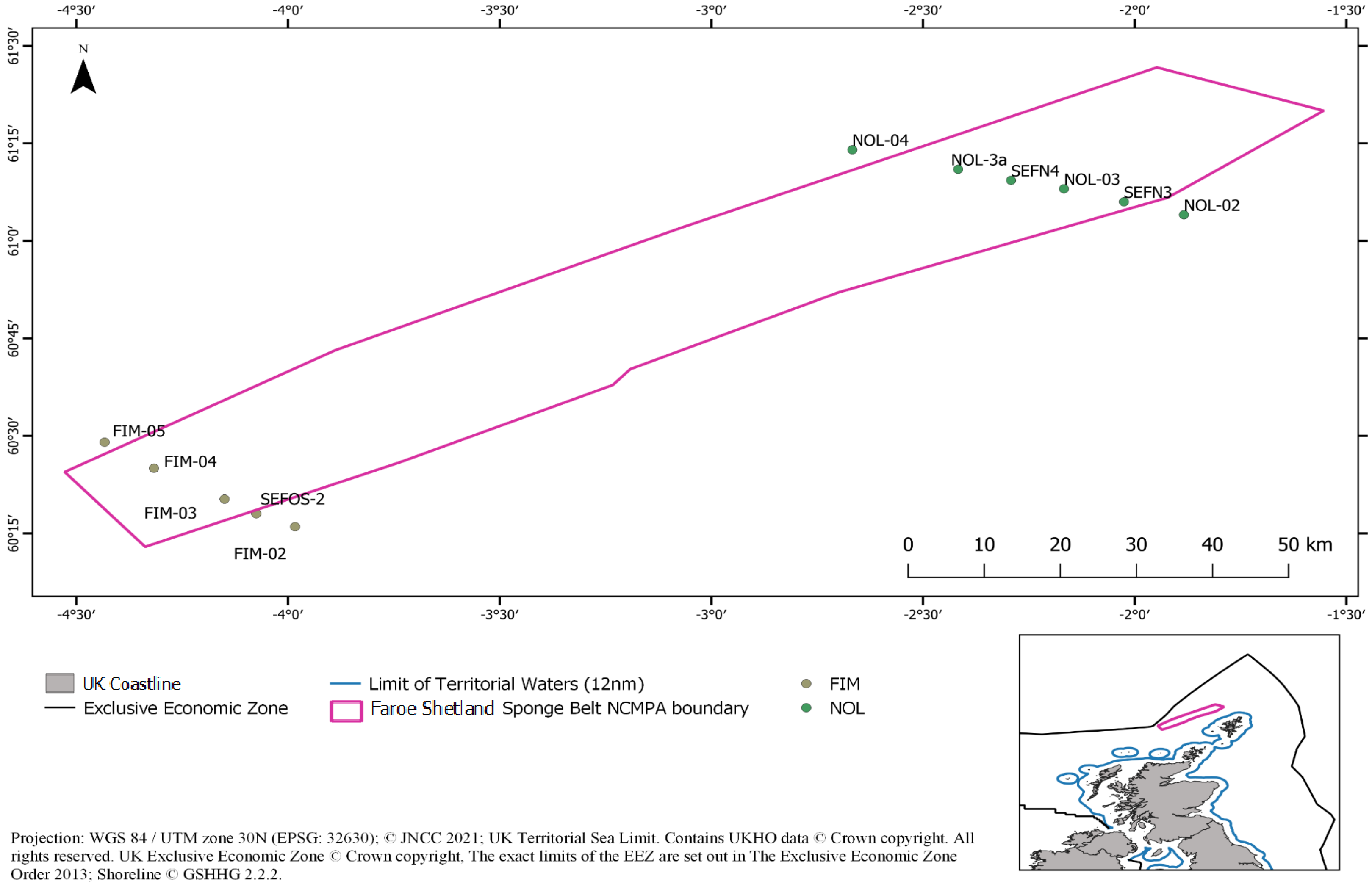

Figure 9. Showing the six NOL and six FIM CTD stations sampled at Faroe-Shetland Sponge Belt NCMPA

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Annex 1. Glossary

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	The European Commission (2012) defines conservation objectives as 'the specification of the overall target for the species and/or habitat types for which a site is designated, in order for it to contribute to maintaining or reaching favourable conservation status / condition of the habitats and species concerned at the national, the bio-geographical or the European level'. Conservation objectives set out the broad ecological aims of a site.
EC Habitats Directive	The EC Habitats Directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora) requires Member States to take measures to maintain natural habitats and wild species of European importance at, or restore them to, favourable conservation status.
Marine (Scotland) Act	Marine (Scotland) Act safeguards the future of Scotland's seas and laying the foundations for a more simplified marine planning and licensing system.
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.
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 Scotland Science (MSS)	Marine Scotland Science is the scientific division of the Marine Scotland Directorate. Its purpose is to provide expert scientific and technical advice on marine and freshwater fisheries, aquaculture, and the protection of the aquatic environment and its wildlife. This advice informs the policies and regulatory activities of the Scottish Government.

Annex 2. Survey equipment and sample processing

Drop-frame camera sampling

The drop-frame used for 1121S is shown in Figure 10.

Figure 10. Drop-frame with video and still imaging system.

The stills camera fitted to the drop-frame was a standard definition Kongsberg OE 14-408 digital camera (10MP) with dedicated flash unit for still images capture. The stills camera was mounted on the frame to provide a planar (downward facing) view of the seabed. Camera settings are summarised in Table 6. The stills camera was controlled topside with images (.CR2 and .JPG) recorded internally and downloaded twice daily. The camera downloads typically took 2 hours and was considered a standard part of the sampling procedure for this piece of equipment (i.e. the download time was included in the "total operations sampling").

Table 6. Summary of stills camera settings used during 1121S.

Setting	Value
Manual focus	1 meter
Shutter speed	1/400
Aperture	F5.6
ISO	100
Flash power output	1/8

The video footage was shot using a SubC 1 Alpha video camera. HD video was recorded internally and downloaded twice daily. The video camera was also mounted to provide a planar view of the seabed. SD video was sent up the line and recorded on DVD as a back-up. The digital stream was captured by the surface PC and recorded direct to MP4 format video files.

Lighting was provided by four SeaLED lamps.

Laser scaling was provided by two red dot laser pointers set to 120 mm spacing, these are visible in both the Still and video imagery (Figure 10). The video camera has two additional, built in, red point lasers set to 64 mm spacing. These are weaker and do not show up in the still imagery as they are washed out by the camera flash.

The drop-frame was also fitted with an altimeter, which recorded the altitude of the frame and GPS time. Additionally, a weight suspended 1 m below the still's camera lens was used as a guide for survey scientists to take in focus images at a consistent altitude.

Figure 11. Video frame of laser scaling used on 1121S drop-frame. Red point lasers (centre) 64 mm spacing, note that these will not be visible on still images. Red point lasers (bottom) 120 mm spacing.

A Valeport CTD was mounted on the frame to record salinity, temperature, and depth.

A HiPAP transponder (see GPS positions and corrections section for more details) was attached to the frame to record its position.

Field notes were made during each camera deployment, noting station and sample metadata, brief descriptions of substrate, and an assessment of whether the station is suitable for grab sampling.

During drop-camera deployments, the vessel executed a controlled drift at a target speed of 0.5 knots through the specified station. The plan had been to collect 150 m video transects; however, this was changed to a minimum time of 15 minutes and a minimum number of 60 still images taken during the transect. This decision was made, as it was easier for a single survey scientist to monitor time rather than distance, along with the rest of the data collection, and to ensure enough suitable still images are taken to cover a representative area of seabed at each station. Stills were captured as frequently as possible during the transect, whenever the following criteria were met:

1. The seabed is clearly visible (no sediment plumes)
2. The camera is at the correct altitude (1 m above the seabed) and in focus
3. The flash has had an opportunity to charge

4. The camera's field of view has changed since the last image (to avoid pseudo replication)

Chariot camera sampling

The camera chariot used on 1121S is a towed camera system shown in Figure 11.

Figure 11. Towed camera chariot system used on 1121S.

Video was recorded using a SubC 1 Alpha video camera. HD video was recorded internally and downloaded twice daily. The video camera was mounted to provide a planar view of the seabed. SD video was sent up the line and recorded on DVD as a back-up. The digital stream was captured by the surface PC and recorded direct to MP4 format video files.

Lighting was provided by four SeaLED lamps.

Laser scaling was provided by two red dot laser pointers set to 310 mm spacing, the video camera has two additional, built in, red point lasers set to 64 mm spacing.

A Valeport CTD was mounted on the frame to record conductivity, temperature, and depth.

A HiPAP transponder (see GPS positions and corrections section for more details) was attached to the frame to record its position.

Field notes were made during each camera chariot deployment, noting station and sample metadata, brief descriptions of substrate, and an assessment of whether a transect section contained DSSA. The video was reviewed during the survey to identify potential sponge aggregations and inform the depth contours sampled for survey objectives 4 and 5 (Table 2).

During deployments, the vessel towed the chariot at a target speed of 2 knots for up 7 km at an altitude above the seabed of approximately 3 m.

0.1 m^2 Hamon grab

JNCC's deep-sea Hamon grab was used for collecting benthic samples during 1121S (Figure 12). This grab is designed to have increased weight to improve its success rate when operating in deep water (where a long length of cable out can lead to misfires in the water column). The grab was deployed fully loaded with 20 weight blocks. The grab was fitted with a 0.1 m^2 bucket.

1121S was used to test the grabs operation at a depth of 800 m and to test the eDNA protocol for Hamon grab sub-samples.

Sediment samples were only collected for eDNA analysis to test and inform further:

- Development of marine benthic eDNA sample collection and processing methods; and,
- Investigation of applicability of eDNA sampling for marine habitats and species monitoring

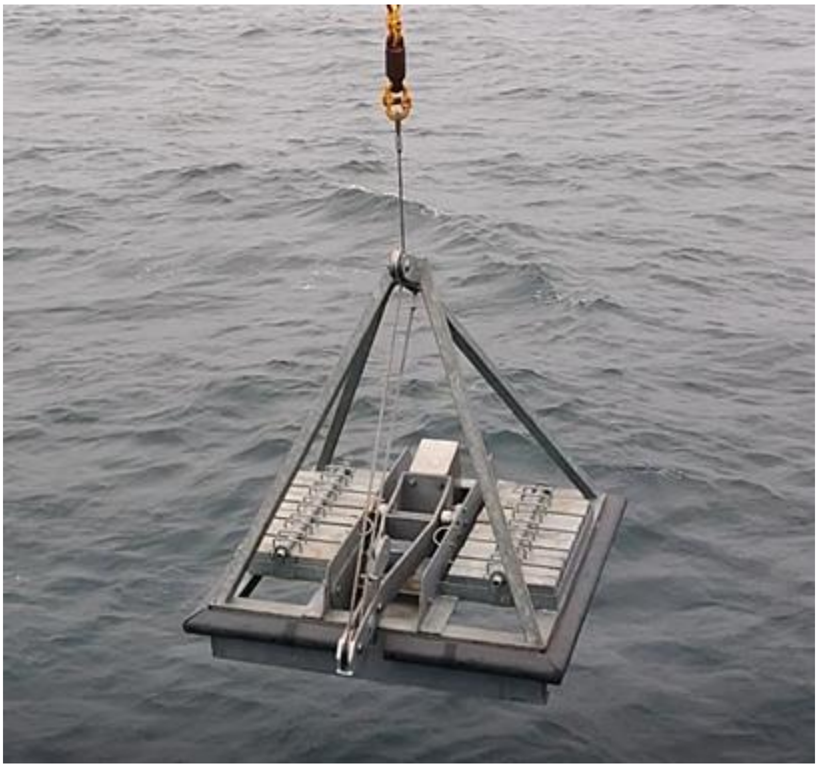

Figure 12. Deep-sea Hamon grab with 0.1m^2 bucket used on 1121S.

eDNA sampling Protocol

1. Empty the grab sample into a sufficiently large plastic crate with clean plastic over the top.
2. Put on a fresh pair of nitrile gloves.
3. Label two snaplock bags with a unique ID using a permanent marker on the write on panel.
4. Open one of the labelled snaplock bags, hold it over the scales, and use the scoop to collect sediment from several different locations around the sample until approximately 30 grams has been collected into the bag.

5. Carefully pour off any excess water that was scooped into the bag, close the seal, then mix the sediment within the bag. This can be done by “massaging” the outside of the bag with your hands and some careful shaking.
6. Once homogenised, push/shake the sample to the bottom of the bag, slightly open the bag seal, roll the bag around the sample to expel excess air from the bag, and then reseal.
7. Place the sample bag into the second labelled snaplock bag, push out excess air, and seal. This is to minimise cross contamination in the event of water leakage or split sample bag.
8. Immediately place sample into a fridge or freezer. Alternatively, samples can be kept in a closed cool box with ice packs for a few hours before transferring to a fridge or freezer. Samples can be stored in a fridge for a couple of days. If storage time will be longer, samples should be transferred to a -20ºC freezer as soon as possible after sampling. If samples are frozen, they must be kept frozen until arrival at the laboratory because repeat freeze/thaw samples will affect the results. For transportation to the laboratory, samples should be packed in a cool box with ice packs leaving minimal headspace. For long term storage (several months), it may be advisable to store samples at -80°C, although this is unnecessary for short term storage (several weeks).

CTD (conductivity, temperature, depth) probe

An RBR Concerto[3] CTD was attached to a cable along with a Niskin water bottle and a weight (Figure 13). At each CTD sampling station this was deployed and held at 5 m below the surface for 2 minutes before the downcast. The CTD descended at a maximum rate of 30 m per minute to a maximum cable out of 600 m or 5 m less than the depth to seabed, whichever was reached first. A messenger weight was then sent down the cable to trigger the Niskin water bottle.

Once the equipment was recovered the CTD data was downloaded.

The following variables are recorded by the CTD;

1. Conductivity
2. Temperature
3. Pressure
4. Chlorophyll a (fluorescence)
5. Dissolved O_2
6. Pressure
7. Depth
8. Salinity
9. Speed of sound
10. Specific conductivity
11. Dissolved O_2
12. Density anomaly

Surface water temperature, salinity, and fluorescence were also recorded from MRV *Scotia’s* ferry box. Surface water samples were taken using a seawater hose. This was left to run for one minute before collecting samples.

Surface and bottom water samples were stored in labelled glass bottles after being rinsed three times with sample water before collection.

Figure 13. RBR Concerto[3] CTD with a Niskin water bottle and weight used on 1121S.

GPS positions and corrections

GPS fixes were recorded using the MRV *Scotia's* data management system, and a back-up of each camera tow's position was made using QGIS. These systems recorded the Lat/Long position of the ships GPS antenna.

Two Kongsberg cNODE miniS model 34 High Precision Acoustic Positioning (HiPAP) transponders were available to mount on equipment during 1121S. One was a 180º omnidirectional and the other a 40º vertical beam transponder. The position of these transponders underwater was recorded based on offsets from the ships GPS antenna.

MRV Scotia

Full details of the MRV *Scotia* can be found on the MSS website: https://www.gov.scot/publications/marine-science-research-vessels-and-technology/

Annex 3. A workflow for selecting random transects at FSSB

Transects were made in QGIS using the following workflow.

1. Project, input, and output layers all projected as **WGS84 UTM 30N**
2. A rectangle with dimensions of 40,000 x 200,000 meters was placed over FSSB boundary using the "**QRectangle Creator**" plug in.
3. The two parallel lines making the length of the rectangle were extracted from this box (lines referred to as north and south line) and the lines were split into 100 m segments using the "**v.split**" tool (GRASS).
4. The "**Extract vertices**" tool (QGIS) was then used to create points every 100 m along each line.
5. Each point has a corresponding point along the two lines i.e., there is a point at 500 m along the north and south line.
6. The two lines were merged into one shapefile and a field was added to show if the point is from the north or south line.
7. The "**Points to path**" tool (QGIS) was used to create the transects (grouped by distance along the line and ordered by north/south line).
8. This resulted in 2000 parallel transects running perpendicular to the continental slope. Each transect is numbered ("T_no").
9. A random number generator (selecting numbers between 1 and 2000) was used to identify transect numbers that would be visited on survey. The shapefile is filtered to show only the selected transects using a statement in the query builder (e.g., *"T_no" IN ('100','200','300')*)
10. Once transects were selected, the "**Line intersections**" tool (QGIS) was used to create points where the transect lines cross isobaths from the Astrium bathymetry layer (isobaths were every 50 m of depth, starting at 300 m and ending at 1000 m).
11. Stations would then be chosen for sampling based on their depth and the survey priorities.

Annex 4. Survey timing calculations

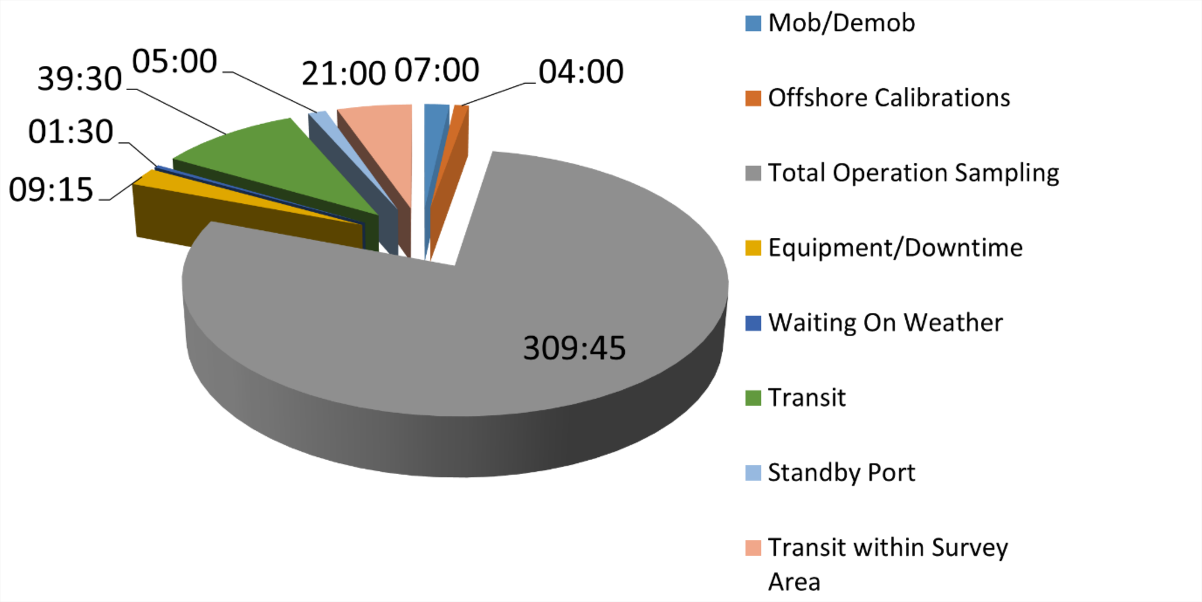

Figure 14. Showing the summary of how where time was used during 1121S.

Annex 5. Survey metadata

Station metadata

Table 7. Drop-camera samples taken at FSSB NCMPA on 1121S. Failed attempts not included. SOL = Start of Line, EOL = End of Line. Latitude and longitude recorded from ship's GPS.

Drop-camera sampling stations	Lat	Lon	Start of Line (SOL)/ End of Line (EOL)
T01_D500_S005_A1	61.29370	-1.74113	SOL
T01_D500_S005_A1	61.29311	-1.73711	EOL
T02_D500_S006_A1	61.28644	-1.76194	SOL
T02_D500_S006_A1	61.28570	-1.75760	EOL
T03_D500_S007_A1	61.25677	-1.82698	SOL
T03_D500_S007_A1	61.25511	-1.82309	EOL
T04_D500_S008_A1	61.23031	-1.87697	SOL
T04_D500_S008_A1	61.22901	-1.87376	EOL
T05_D500_S009_A1	61.16133	-2.02413	SOL
T05_D500_S009_A1	61.15988	-2.02087	EOL
T06_D500_S010_A1	61.11455	-2.12541	SOL
T06_D500_S010_A1	61.11227	-2.12412	EOL
T07_D500_S011_A1	61.08109	-2.21588	SOL
T07_D500_S011_A1	61.07842	-2.21427	EOL
T08_D500_S012_A1	61.07282	-2.24230	SOL
T08_D500_S012_A1	61.07070	-2.23925	EOL
T09_D500_S013_A1	61.06589	-2.26940	SOL
T09_D500_S013_A1	61.06376	-2.26600	EOL
T10_D500_S014_A1	61.05753	-2.28652	SOL
T10_D500_S014_A1	61.05640	-2.28350	EOL
T10_D500_S014_A2	61.06008	-2.27998	SOL
T10_D500_S014_A2	61.06008	-2.28000	EOL
T10_D500_S014_A3	61.05744	-2.28512	SOL
T10_D500_S014_A3	61.05503	-2.28829	EOL
T11_D500_S015_A1	61.05230	-2.30500	SOL
T11_D500_S015_A1	61.05000	-2.30800	EOL
T12_D500_S016_A1	61.04587	-2.31946	SOL
T12_D500_S016_A1	61.04293	-2.32329	EOL
T13_D500_S017_A1	60.99177	-2.50489	SOL
T13_D500_S017_A1	60.98980	-2.50835	EOL
T14_D500_S018_A1	60.98239	-2.53225	SOL
T14_D500_S018_A1	60.98066	-2.53594	EOL
T15_D500_S019_A1	60.96597	-2.58634	SOL
T15_D500_S019_A1	60.96338	-2.58937	EOL
T16_D500_S020_A1	60.95485	-2.62525	SOL
T16_D500_S020_A1	60.95396	-2.63015	EOL
T17_D500_S021_A1	60.95074	-2.64081	SOL
T17_D500_S021_A1	60.94941	-2.64472	EOL

Drop-camera sampling stations	**Lat**	**Lon**	**Start of Line (SOL)/ End of Line (EOL)**
T18_D500_S022_A1	60.94512	-2.65958	SOL
T18_D500_S022_A1	60.94394	-2.66321	EOL
T19_D500_S023_A1	60.93613	-2.68950	SOL
T19_D500_S023_A1	60.93476	-2.69294	EOL
T20_D500_S024_A1	60.90287	-2.80111	SOL
T20_D500_S024_A1	60.90160	-2.80529	EOL
T21_D500_S025_A1	60.89508	-2.81818	SOL
T21_D500_S025_A1	60.89365	-2.82174	EOL
T22_D500_S026_A1	60.87280	-2.90488	SOL
T22_D500_S026_A1	60.87163	-2.90999	EOL
T23_D500_S027_A1	60.85578	-2.94982	SOL
T23_D500_S027_A1	60.85391	-2.95360	EOL
T24_D500_S028_A1	60.83977	-2.98425	SOL
T24_D500_S028_A1	60.83831	-2.98761	EOL
T25_D500_S029_A1	60.83351	-3.00395	SOL
T25_D500_S029_A1	60.83206	-3.00733	EOL
T26_D500_S030_A1	60.80648	-3.05339	SOL
T26_D500_S030_A1	60.80498	-3.05664	EOL
T27_D500_S031_A1	60.79699	-3.09276	SOL
T27_D500_S031_A1	60.79601	-3.09668	EOL
T28_D500_S032_A1	60.79032	-3.11434	SOL
T28_D500_S032_A1	60.78917	-3.11800	EOL
T29_D500_S033_A1	60.79032	-3.11434	SOL
T29_D500_S033_A1	60.77380	-3.12378	EOL
T30_D500_S034_A1	60.76265	-3.14097	SOL
T30_D500_S034_A1	60.76124	-3.14405	EOL
T31_D500_S035_A1	60.75391	-3.19231	SOL
T31_D500_S035_A1	60.75299	-3.19749	EOL
T32_D500_S036_A1	60.74676	-3.21155	SOL
T32_D500_S036_A1	60.74508	-3.21563	EOL
T33_D500_S037_A1	60.73100	-3.23553	SOL
T33_D500_S037_A1	60.72940	-3.23884	EOL
T34_D500_S038_A1	60.72223	-3.25469	SOL
T34_D500_S038_A1	60.72111	-3.25840	EOL
T35_D500_S039_A1	60.70178	-3.29452	SOL
T35_D500_S039_A1	60.70022	-3.29784	EOL
T36_D500_S040_A1	60.68563	-3.34121	SOL
T36_D500_S040_A1	60.68472	-3.34486	EOL
T37_D500_S041_A1	60.66725	-3.38592	SOL
T37_D500_S041_A1	60.66584	-3.39051	EOL
T38_D500_S042_A1	60.62725	-3.46505	SOL
T38_D500_S042_A1	60.62620	-3.46897	EOL
T39_D500_S043_A1	60.61387	-3.50226	SOL
T39_D500_S043_A1	60.61278	-3.50639	EOL

Drop-camera sampling stations	**Lat**	**Lon**	**Start of Line (SOL)/ End of Line (EOL)**
T40_D500_S044_A1	60.60620	-3.55824	SOL
T40_D500_S044_A1	60.60566	-3.56251	EOL
T41_D500_S045_A1	60.60232	-3.57078	SOL
T41_D500_S045_A1	60.60113	-3.57542	EOL
T42_D500_S046_A1	60.58475	-3.60229	SOL
T42_D500_S046_A1	60.58471	-3.60770	EOL
T43_D500_S047_A1	60.57643	-3.61831	SOL
T43_D500_S047_A1	60.57647	-3.62377	EOL
T44_D500_S048_A1	60.56243	-3.66907	SOL
T44_D500_S048_A1	60.56312	-3.67471	EOL
T45_D500_S049_A1	60.53714	-3.75896	SOL
T45_D500_S049_A1	60.53783	-3.76419	EOL
T46_D500_S050_A1	60.52746	-3.78768	SOL
T46_D500_S050_A1	60.52800	-3.79284	EOL
T47_D500_S051_A1	60.52232	-3.81123	SOL
T47_D500_S051_A1	60.52312	-3.81526	EOL
T48_D500_S052_A1	60.50751	-3.87265	SOL
T48_D500_S052_A1	60.50846	-3.87661	EOL
T49_D500_S053_A1	60.49897	-3.92045	SOL
T49_D500_S053_A1	60.49991	-3.92433	EOL
T50_D500_S054_A1	60.46600	-4.02034	SOL
T50_D500_S054_A1	60.46770	-4.02303	EOL
T50_D400_S055_A1	60.40517	-3.91679	SOL
T50_D400_S055_A1	60.40769	-3.91733	EOL
T48_D400_S056_A1	60.42973	-3.74170	SOL
T48_D400_S056_A1	60.43223	-3.74317	EOL
T47_D400_S057_A1	60.45288	-3.69199	SOL
T47_D400_S057_A1	60.45505	-3.69532	EOL
T46_D400_S058_A1	60.46346	-3.67719	SOL
T46_D400_S058_A1	60.46552	-3.68035	EOL
T45_D400_S059_A1	60.47725	-3.65563	SOL
T45_D400_S059_A1	60.47916	-3.65920	EOL
T44_D400_S060_A1	60.50318	-3.56878	SOL
T44_D400_S060_A1	60.50490	-3.57265	EOL
T43_D400_S061_A1	60.52098	-3.52346	SOL
T43_D400_S061_A1	60.52278	-3.52605	EOL
T42_D400_S062_A1	60.52688	-3.49927	SOL
T42_D400_S062_A1	60.52831	-3.50295	EOL
T41_D400_S063_A1	60.53980	-3.46860	SOL
T41_D400_S063_A1	60.54008	-3.47305	EOL
T40_D400_S064_A1	60.54548	-3.45289	SOL
T40_D400_S064_A1	60.54740	-3.45664	EOL
T38_D400_S065_A1	60.57350	-3.37581	SOL
T38_D400_S065_A1	60.57612	-3.37503	EOL

Drop-camera sampling stations	**Lat**	**Lon**	**Start of Line (SOL)/ End of Line (EOL)**
T37_D400_S066_A1	60.61037	-3.29042	SOL
T37_D400_S066_A1	60.61242	-3.28805	EOL
T36_D400_S067_A1	60.62489	-3.24007	SOL
T36_D400_S067_A1	60.62717	-3.23825	EOL
T35_D400_S068_A1	60.64908	-3.20828	SOL
T35_D400_S068_A1	60.65112	-3.20500	EOL
T34_D400_S069_A1	60.66988	-3.16896	SOL
T34_D400_S069_A1	60.67251	-3.16729	EOL
T33_D400_S070_A1	60.67913	-3.14785	SOL
T33_D400_S070_A1	60.68106	-3.14341	EOL
T32_D400_S071_A1	60.69395	-3.12164	SOL
T32_D400_S071_A1	60.69660	-3.12155	EOL
T31_D400_S072_A1	60.70117	-3.10538	SOL
T31_D400_S072_A1	60.70320	-3.10107	EOL
T29_D400_S073_A1	60.72793	-3.04410	SOL
T29_D400_S073_A1	60.73046	-3.04248	EOL
T28_D400_S074_A1	60.73762	-3.02679	SOL
T28_D400_S074_A1	60.73931	-3.02253	EOL
T27_D400_S075_A1	60.74860	-3.01380	SOL
T27_D400_S075_A1	60.75120	-3.01257	EOL
T26_D400_S076_A1	60.76051	-2.97661	SOL
T26_D400_S076_A1	60.76304	-2.97519	EOL
T24_D400_S077_A1	60.79224	-2.89707	SOL
T24_D400_S077_A1	60.79444	-2.89441	EOL
T24_D400_S077_A2	60.79176	-2.89769	SOL
T24_D400_S077_A2	60.79174	-2.90316	EOL
T22_D400_S078_A1	60.82218	-2.82373	SOL
T22_D400_S078_A1	60.82216	-2.82924	EOL
T21_D400_S079_A1	60.85048	-2.74304	SOL
T21_D400_S079_A1	60.85101	-2.73750	EOL
T20_D400_S080_A1	60.85487	-2.73022	SOL
T20_D400_S080_A1	60.85436	-2.72476	EOL
T19_D400_S081_A1	60.89064	-2.62092	SOL
T19_D400_S081_A1	60.88974	-2.61650	EOL
T18_D400_S082_A1	60.90234	-2.59546	SOL
T18_D400_S082_A1	60.90107	-2.59045	EOL
T17_D400_S083_A1	60.90716	-2.57476	SOL
T17_D400_S083_A1	60.90836	-2.57970	EOL
T15_D400_S084_A1	60.92216	-2.51558	SOL
T15_D400_S084_A1	60.92227	-2.52105	EOL
T14_D400_S085_A1	60.93836	-2.46100	SOL
T14_D400_S085_A1	60.93781	-2.46618	EOL
T13_D400_S086_A1	60.94723	-2.43495	SOL
T13_D400_S086_A1	60.94635	-2.44004	EOL

Drop-camera sampling stations	Lat	Lon	Start of Line (SOL)/ End of Line (EOL)
T12_D400_S087_A1	61.00102	-2.24998	SOL
T12_D400_S087_A1	61.00003	-2.25482	EOL
T11_D400_S088_A1	61.00782	-2.23023	SOL
T11_D400_S088_A1	61.00642	-2.23482	EOL
T10_D400_S089_A1	61.01368	-2.20907	SOL
T10_D400_S089_A1	61.01258	-2.21331	EOL
T09_D400_S090_A1	61.01977	-2.18845	SOL
T09_D400_S090_A1	61.01820	-2.19249	EOL
T08_D400_S091_A1	61.02731	-2.16498	SOL
T08_D400_S091_A1	61.02602	-2.16852	EOL
T06_D400_S092_A1	61.06165	-2.03457	SOL
T06_D400_S092_A1	61.06066	-2.03857	EOL
T05_D400_S093_A1	61.10936	-1.93548	SOL
T05_D400_S093_A1	61.10846	-1.93953	EOL
T04_D400_S094_A1	61.18702	-1.79933	SOL
T04_D400_S094_A1	61.18537	-1.80257	EOL
T03_D400_S095_A1	61.21574	-1.75213	SOL
T03_D400_S095_A1	61.21407	-1.75494	EOL
T02_D400_S096_A1	61.24716	-1.69889	SOL
T02_D400_S096_A1	61.24873	-1.69567	EOL
T01_D400_S097_A1	61.25530	-1.68422	SOL
T01_D400_S097_A1	61.25754	-1.68101	EOL
T01_D550_S098_A1	61.31378	-1.78237	SOL
T01_D550_S098_A1	61.31552	-1.77933	EOL
T02_D550_S099_A1	61.30611	-1.79836	SOL
T02_D550_S099_A1	61.30496	-1.79333	EOL
T03_D550_S100_A1	61.27446	-1.85287	SOL
T03_D550_S100_A1	61.27286	-1.85610	EOL
T04_D550_S101_A1	61.25110	-1.90564	SOL
T04_D550_S101_A1	61.24933	-1.90851	EOL
T05_D550_S102_A1	61.17977	-2.05571	SOL
T05_D550_S102_A1	61.17834	-2.05893	EOL
T06_D550_S103_A1	61.13759	-2.16296	SOL
T06_D550_S103_A1	61.13614	-2.16683	EOL
T07_D550_S104_A1	61.10076	-2.25074	SOL
T07_D550_S104_A1	61.09968	-2.25465	EOL
T08_D550_S105_A1	61.09086	-2.27387	SOL
T08_D550_S105_A1	61.09019	-2.27820	EOL
T09_D550_S106_A1	61.08343	-2.29539	SOL
T09_D550_S106_A1	61.08276	-2.29954	EOL
T10_D550_S107_A1	61.07534	-2.31346	SOL
T10_D550_S107_A1	61.07454	-2.31772	EOL
T11_D550_S108_A1	61.06574	-2.33513	SOL
T11_D550_S108_A1	61.06496	-2.33955	EOL

Drop-camera sampling stations	**Lat**	**Lon**	**Start of Line (SOL)/ End of Line (EOL)**
T12_D550_S109_A1	61.05960	-2.35579	SOL
T12_D550_S109_A1	61.05924	-2.36018	EOL
T13_D550_S110_A1	61.00977	-2.53979	SOL
T13_D550_S110_A1	61.00860	-2.54434	EOL
T14_D550_S111_A1	61.00289	-2.57230	SOL
T14_D550_S111_A1	61.00196	-2.57628	EOL
T15_D550_S112_A1	60.98806	-2.62968	SOL
T15_D550_S112_A1	60.98717	-2.63359	EOL
T16_D550_S113_A1	60.97652	-2.66839	SOL
T16_D550_S113_A1	60.97524	-2.67219	EOL
T17_D550_S114_A1	60.97207	-2.68359	SOL
T17_D550_S114_A1	60.97083	-2.68731	EOL
T18_D550_S115_A1	60.96841	-2.70492	SOL
T18_D550_S115_A1	60.96733	-2.70887	EOL
T19_D550_S116_A1	60.95951	-2.73345	SOL
T19_D550_S116_A1	60.95812	-2.73755	EOL
T20_D550_S117_A1	60.92326	-2.84375	SOL
T20_D550_S117_A1	60.92210	-2.84771	EOL
T21_D550_S118_A1	60.91916	-2.85997	SOL
T21_D550_S118_A1	60.91796	-2.86394	EOL
T22_D550_S119_A1	60.89553	-2.94971	SOL
T22_D550_S119_A1	60.89456	-2.95410	EOL
T24_D550_S120_A1	60.86959	-3.02804	SOL
T24_D550_S120_A1	60.86828	-3.03201	EOL
T26_D550_S121_A1	60.83910	-3.10778	SOL
T26_D550_S121_A1	60.83837	-3.11256	EOL
T27_D550_S122_A1	60.82782	-3.14550	SOL
T27_D550_S122_A1	60.82609	-3.14859	EOL
T28_D550_S123_A1	60.82068	-3.16579	SOL
T28_D550_S123_A1	60.81917	-3.16885	EOL
T29_D550_S124_A1	60.81326	-3.18541	SOL
T29_D550_S124_A1	60.81207	-3.19052	EOL
T31_D550_S125_A1	60.78821	-3.25081	SOL
T31_D550_S125_A1	60.78620	-3.25388	EOL
T32_D550_S126_A1	60.78069	-3.26606	SOL
T32_D550_S126_A1	60.78006	-3.27118	EOL
T33_D550_S127_A1	60.76695	-3.29551	SOL
T33_D550_S127_A1	60.76630	-3.30029	EOL
T34_D550_S128_A1	60.75808	-3.31674	SOL
T34_D550_S128_A1	60.75751	-3.32184	EOL
T35_D550_S129_A1	60.73870	-3.35749	SOL
T35_D550_S129_A1	60.73776	-3.36244	EOL
T36_D550_S130_A1	60.71754	-3.39556	SOL
T36_D550_S130_A1	60.71702	-3.40074	EOL

Drop-camera sampling stations	**Lat**	**Lon**	**Start of Line (SOL)/ End of Line (EOL)**
T37_D550_S131_A1	60.69848	-3.43927	SOL
T37_D550_S131_A1	60.69715	-3.44413	EOL
T38_D550_S132_A1	60.66065	-3.52030	SOL
T38_D550_S132_A1	60.65963	-3.52418	EOL
T40_D550_S133_A1	60.63415	-3.60535	SOL
T40_D550_S133_A1	60.63320	-3.60951	EOL
T41_D550_S134_A1	60.62915	-3.61987	SOL
T41_D550_S134_A1	60.62742	-3.62420	EOL
T42_D550_S135_A1	60.61732	-3.65531	SOL
T42_D550_S135_A1	60.61581	-3.65952	EOL
T43_D550_S136_A1	60.61159	-3.67738	SOL
T43_D550_S136_A1	60.61011	-3.68141	EOL
T44_D550_S137_A1	60.58896	-3.72067	SOL
T44_D550_S137_A1	60.58743	-3.72439	EOL
T45_D550_S138_A1	60.56436	-3.80462	SOL
T45_D550_S138_A1	60.56263	-3.80910	EOL
T46_D550_S139_A1	60.55412	-3.83517	SOL
T46_D550_S139_A1	60.55612	-3.83926	EOL
T47_D550_S140_A1	60.54852	-3.85733	SOL
T47_D550_S140_A1	60.54785	-3.86259	EOL
T48_D550_S141_A1	60.52938	-3.91023	SOL
T48_D550_S141_A1	60.52982	-3.91450	EOL
T50_D550_S142_A1	60.48830	-4.05809	SOL
T50_D550_S142_A1	60.48668	-4.06137	EOL
T50_D450_S143_A1	60.43717	-3.97197	SOL
T50_D450_S143_A1	60.43868	-3.96888	EOL
T48_D450_S144_A1	60.47086	-3.81257	SOL
T48_D450_S144_A1	60.47109	-3.81180	EOL
T48_D450_S144_A2	60.47113	-3.80928	SOL
T48_D450_S144_A2	60.47149	-3.81377	EOL
T47_D450_S145_A1	60.48728	-3.75302	SOL
T47_D450_S145_A1	60.48920	-3.75503	EOL
T46_D450_S146_A1	60.49749	-3.73670	SOL
T46_D450_S146_A1	60.49959	-3.73555	EOL
T45_D450_S147_A1	60.50489	-3.70457	SOL
T45_D450_S147_A1	60.50704	-3.70376	EOL
T44_D450_S148_A1	60.53135	-3.61866	SOL
T44_D450_S148_A1	60.53390	-3.61749	EOL
T43_D450_S149_A1	60.54519	-3.56629	SOL
T43_D450_S149_A1	60.54765	-3.56515	EOL
T42_D450_S150_A1	60.55324	-3.54661	SOL
T42_D450_S150_A1	60.55574	-3.54549	EOL
T41_D450_S151_A1	60.56784	-3.51739	SOL
T41_D450_S151_A1	60.57056	-3.51733	EOL

Drop-camera sampling stations	**Lat**	**Lon**	**Start of Line (SOL)/ End of Line (EOL)**
T40_D450_S152_A1	60.57334	-3.50281	SOL
T40_D450_S152_A1	60.57565	-3.50007	EOL
T38_D450_S153_A1	60.59847	-3.41470	SOL
T38_D450_S153_A1	60.60071	-3.41165	EOL
T37_D450_S154_A1	60.63485	-3.32839	SOL
T37_D450_S154_A1	60.63748	-3.32709	EOL
T36_D450_S155_A1	60.64698	-3.28082	SOL
T36_D450_S155_A1	60.65002	-3.27859	EOL
T35_D450_S156_A1	60.67045	-3.24326	SOL
T35_D450_S156_A1	60.67245	-3.23980	EOL
T34_D450_S157_A1	60.69048	-3.20416	SOL
T34_D450_S157_A1	60.69294	-3.20287	EOL
T33_D450_S158_A1	60.70372	-3.18642	SOL
T33_D450_S158_A1	60.70169	-3.18954	EOL
T32_D450_S159_A1	60.71938	-3.16019	SOL
T32_D450_S159_A1	60.71739	-3.16342	EOL
T31_D450_S160_A1	60.72514	-3.14169	SOL
T31_D450_S160_A1	60.72310	-3.14490	EOL
T29_D450_S161_A1	60.74947	-3.07567	SOL
T29_D450_S161_A1	60.74863	-3.08061	EOL
T28_D450_S162_A1	60.75995	-3.06051	SOL
T28_D450_S162_A1	60.75890	-3.06526	EOL
T27_D450_S163_A1	60.77145	-3.05006	SOL
T27_D450_S163_A1	60.77092	-3.05515	EOL
T26_D450_S164_A1	60.78221	-3.01055	SOL
T26_D450_S164_A1	60.78164	-3.01569	EOL
T24_D450_S165_A1	60.81365	-2.93685	SOL
T24_D450_S165_A1	60.81242	-2.94178	EOL
T22_D450_S166_A1	60.84187	-2.85783	SOL
T22_D450_S166_A1	60.84220	-2.86337	EOL
T21_D450_S167_A1	60.87074	-2.77813	SOL
T21_D450_S167_A1	60.87075	-2.78430	EOL
T20_D450_S168_A1	60.87934	-2.76911	SOL
T20_D450_S168_A1	60.87892	-2.77458	EOL
T19_D450_S169_A1	60.91258	-2.65692	SOL
T19_D450_S169_A1	60.91095	-2.66005	EOL
T17_D450_S170_A1	60.92796	-2.61001	SOL
T17_D450_S170_A1	60.92617	-2.61288	EOL
T16_D450_S171_A1	60.93216	-2.59598	SOL
T16_D450_S171_A1	60.93072	-2.59986	EOL
T15_D450_S172_A1	60.94583	-2.55598	SOL
T15_D450_S172_A1	60.94533	-2.56053	EOL
T14_D450_S173_A1	60.95647	-2.49034	SOL
T14_D450_S173_A1	60.95610	-2.49467	EOL

Drop-camera sampling stations	Lat	Lon	Start of Line (SOL)/ End of Line (EOL)
T13_D450_S174_A1	60.96504	-2.46561	SOL
T13_D450_S174_A1	60.96500	-2.46999	EOL
T12_D450_S175_A1	61.01831	-2.28051	SOL
T12_D450_S175_A1	61.01904	-2.28471	EOL
T11_D450_S176_A1	61.02573	-2.26256	SOL
T11_D450_S176_A1	61.02685	-2.26635	EOL
T10_D450_S177_A1	61.03264	-2.24451	SOL
T10_D450_S177_A1	61.03439	-2.24820	EOL
T09_D450_S178_A1	61.03972	-2.22452	SOL
T09_D450_S178_A1	61.04154	-2.22826	EOL
T08_D450_S179_A1	61.04891	-2.20486	SOL
T08_D450_S179_A1	61.05052	-2.20943	EOL
T07_D450_S180_A1	61.05768	-2.17889	SOL
T07_D450_S180_A1	61.06010	-2.18076	EOL
T06_D450_S181_A1	61.09553	-2.09188	SOL
T06_D450_S181_A1	61.09796	-2.09373	EOL
T05_D450_S182_A1	61.13265	-1.97592	SOL
T05_D450_S182_A1	61.13497	-1.97794	EOL
T04_D450_S183_A1	61.20233	-1.82327	SOL
T04_D450_S183_A1	61.20529	-1.82562	EOL
T03_D450_S184_A1	61.23001	-1.77929	SOL
T03_D450_S184_A1	61.23164	-1.78397	EOL
T02_D450_S185_A1	61.26386	-1.72538	SOL
T02_D450_S185_A1	61.26578	-1.73201	EOL
T01_D450_S186_A1	61.27209	-1.70666	SOL
T01_D450_S186_A1	61.27035	-1.70970	EOL
T01_D500_S005_A2	61.29385	-1.73950	SOL
T01_D500_S005_A2	61.29226	-1.74408	EOL
T05_D450_S182_A2	61.13052	-1.97236	SOL
T05_D450_S182_A2	61.13073	-1.97787	EOL
T06_D450_S181_A2	61.09366	-2.08724	SOL
T06_D450_S181_A2	61.09485	-2.09201	EOL
T09_D450_S178_A2	61.04074	-2.22678	SOL
T09_D450_S178_A2	61.04280	-2.23018	EOL
T50_D500_S054_A2	60.46718	-4.02092	SOL
T50_D500_S054_A2	60.46609	-4.02635	EOL
T39_D450_S200_A1	60.58499	-3.45467	SOL
T39_D450_S200_A1	60.58310	-3.45866	EOL
T30_D450_S201_A1	60.74289	-3.10775	SOL
T30_D450_S201_A1	60.74112	-3.11082	EOL

Table 8. TD and water samples taken at FSSB MPA on 1121S. Latitude and longitude recorded from ship's GPS.

Station	Location	Latitude	Longitude
376	NOL_02	61.06628	-1.88293
377	SEFN_3	61.0998	-2.02443
378	NOL_03	61.13357	-2.1662
379	SEFN_4	61.15485	-2.29115
380	NOL_3A	61.18325	-2.42473
381	NOL_04	61.2337	-2.66643
382	FIM-05	60.48285	-4.43363
383	FIM-04	60.4164	-4.31555
384	FIM-03	60.32403	-4.18212
385	SEFOS-2	60.30052	-4.07488
386	FIM-02	60.26692	-3.98308

Table 9. Hamon grab samples taken at FSSB MPA on 1121S. Latitude and longitude recorded from ship's GPS.

Station	Lat	Long
T19_D800_S191_A1	61.06622	-2.92272
T18_D800_S190_A1	61.07505	-2.89109
T17_D800_S189_A1	61.08186	-2.87387
T16_D800_S188_A1	61.08701	-2.85863
T15_D800_S187_A3	61.09985	-2.82029

Table 10. Chariot camera samples taken at FSSB MPA on 1121S. SOL = Start of Line, EOL = End of Line. Latitude and longitude recorded from ship's GPS.

Chariot camera sampling stations	Latitude	Longitude	Start of Line (SOL)/ End of Line (EOL)
CT01_D700	61.12565	-2.54333	SOL
CT01_D700	61.16368	-2.43069	EOL
CT02_D650	61.12801	-2.42489	SOL
CT02_D650	61.16635	-2.32144	EOL
CT03_D600	61.10562	-2.35483	SOL
CT03_D600	61.14007	-2.25193	EOL
CT04_D350	61.10041	-1.91302	SOL
CT04_D350	61.05661	-2.00788	EOL
CT07_D530	61.11049	-2.18517	SOL
CT07_D530	61.06464	-2.30374	EOL
CT08_D500	61.13040	-2.08505	SOL
CT08_D500	61.08630	-2.20351	EOL
CT10_D600	60.69487	-3.58272	SOL
CT10_D600	60.67778	-3.62522	EOL
CT11_D350	60.50942	-3.42237	SOL
CT11_D350	60.49048	-3.48146	EOL
CT12_D300	60.48311	-3.39281	SOL
CT12_D300	60.46687	-3.44012	EOL
CT13_D400_D350	60.52383	-3.49474	SOL
CT13_D400_D350	60.49679	-3.45085	EOL
CT13_D400_D350	60.53189	-3.50785	SOL
CT13_D400_D350	60.52097	-3.49009	EOL

Table 11. eDNA Hamon grab samples taken at FSSB MPA on 1121S. Latitude and longitude recorded from ship's GPS.

Grab Station	Latitude	Longitude	Seabed Depth	Substrate type
T15_D800_S187_3	61.09985	-2.82029	811	Sandy mud
T16_D800_S188_1	61.08701	-2.85863	807	Sandy mud
T17_D800_S189_1	61.08186	-2.87387	806	Sandy mud
T18_D800_S190_1	61.07505	-2.89109	800	Sandy mud
T19_D800_S191_1	61.06623	-2.92272	800	Sandy mud

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