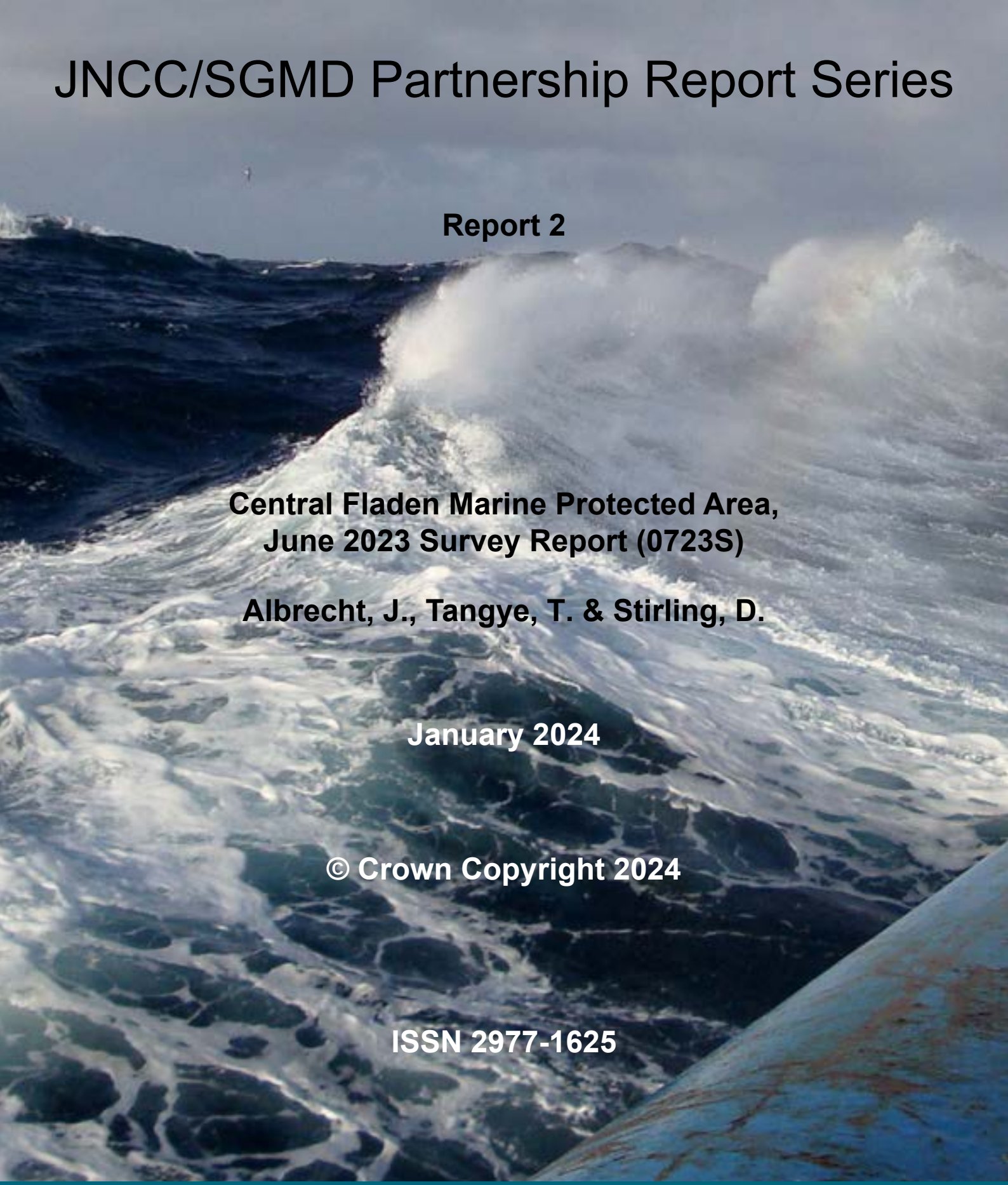
JNCC/SGMD Partnership Report Series



Report 2

Central Fladen Marine Protected Area, June 2023 Survey Report (0723S)

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January 2024

ISSN 2977-1625

Scottish Government
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This report should be cited as:
Albrecht, J., Tangye, T & Stirling, D. (2024). Central Fladen Marine Protected Area, June 2023 Survey Report (0723S). JNCC/SGMD Partnership Report 2. JNCC, Peterborough, ISSN 2977-1625.

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Acknowledgements
We thank the captain, crew, and scientists of the MRV *Scotia* cruise 0723S.

JNCC EQA Statement:
This report is compliant with the JNCC **Evidence Quality Assurance Policy** https://jncc.gov.uk/about-jncc/corporate-information/evidence-quality-assurance/ and was reviewed by Scottish Government's Marine Directorate (SGMD) and JNCC.

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Abbreviations

EMODNet	European Marine Observation and Data Network
GT	Ground-truthing
JNCC	Joint Nature Conservation Committee
NMBAQC	North East Atlantic Marine Biological Analytical Quality Control Scheme
SGMD	Scottish Government's Marine Directorate (formerly known as Marine Scotland Science (MSS))
MBES	Multibeam Echosounder
MPA	Marine Protected Area
PSA	Particle Size Analysis
MRV	Marine Research Vessel
SIC	Scientist In Charge
SVP	Sound Velocity Profile

1 Background and introduction

The survey at Central Fladen Nature Conservation Marine Protected Area (MPA) was carried out between 19 and 26 June 2023 on the Marine Research Vessel (MRV) *Scotia* (survey code 0723S). The survey was conducted by staff from the Joint Nature Conservation Committee (JNCC) and Scottish Government's Marine Directorate (hereafter referred to as the Marine Directorate). 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 on separately.

1.1 Central Fladen Nature Conservation MPA

Central Fladen Nature Conservation MPA was designated in July 2014 to protect the Burrowed mud (sea-pens and burrowing megafauna and tall sea-pen components) habitat feature and Sub-Glacial Tunnel Valley (representative of the Fladen Deeps key geodiversity area) geomorphological feature.

The Central Fladen Nature Conservation MPA is in the northern North Sea (Figure 1) and lies within the Fladen Grounds, a large area of mud named after the German word "fladen" meaning "flat cake". The MPA includes a particular type of mud habitat that is characterised by feather-like soft corals called sea-pens, and the burrows made by crustaceans such as mud shrimp and the Norway lobster (*Nephrops norvegicus*). The site has an area of 925 km^2 and a depth range of 100–280 m.

For up-to-date background information on Central Fladen MPA, see the Site Information Centre.

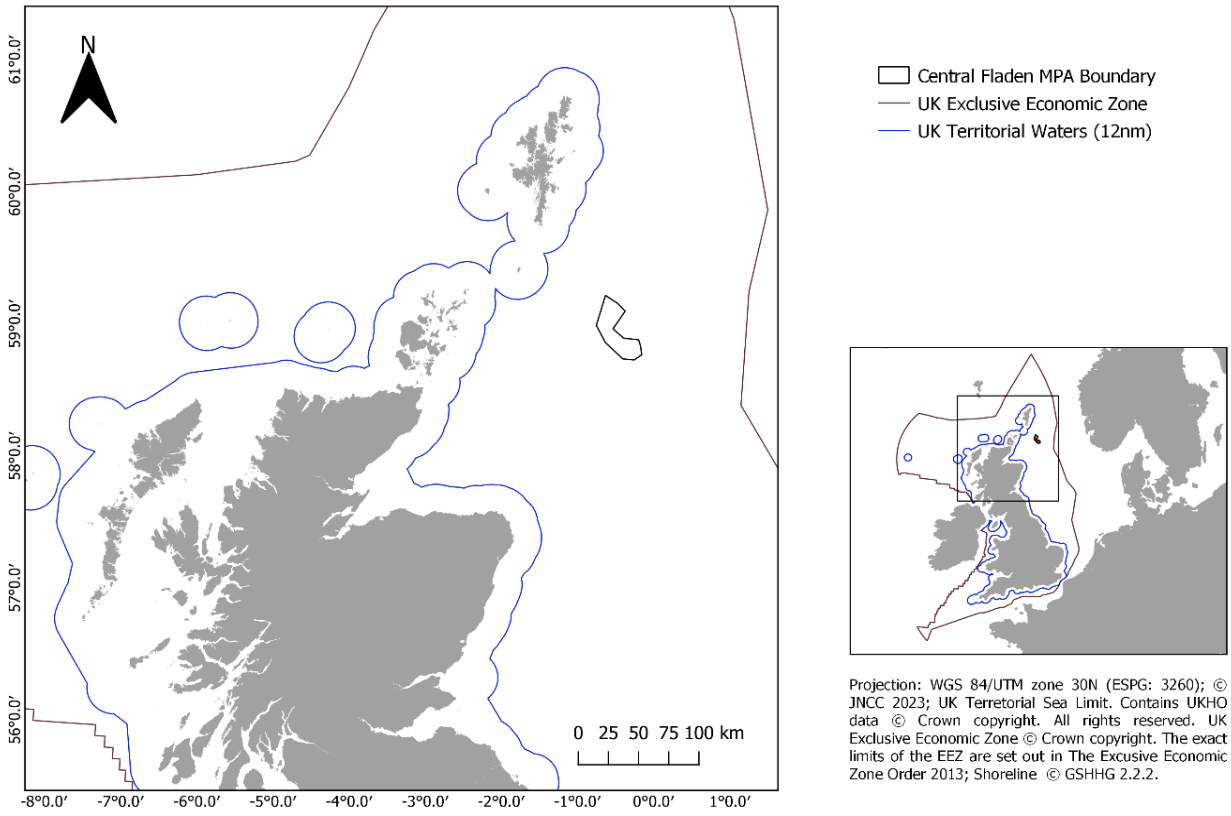

Figure 1. Map showing the location and boundary of the Central Fladen Nature Conservation MPA.

1.2 Aims and objectives

The aim of the 0723S survey was to acquire a robust infauna community dataset from the burrowed mud feature inside the Central Fladen Nature Conservation MPA, before any fisheries management measures are implemented. This will contribute to the development of a sentinel monitoring (Type 1) time series for Central Fladen Nature Conservation MPA. This will monitor change in infaunal communities over time and before and after fisheries management measures are put in place in the MPA features.

An additional aim, should time allow, was to acquire infauna datasets from areas of the Fladen ground outside of the MPA before any fisheries management measures are implemented at Central Fladen Nature Conservation MPA. This will contribute to the development of an investigative monitoring (Type 3) time series for Central Fladen Nature Conservation MPA. This will monitor change in infaunal communities over time from before until after fisheries management measures are put in place inside and outside the MPA features.

Data from this survey will form part of a monitoring time series, and future 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.

Data was gathered to inform assessment of:

Burrowed Mud (Sea-pens and Burrowing Megafauna and Tall Sea-pen Components):

- Physical extent and distribution of the sedimentary habitats that can support the burrowed mud (sea-pens and burrowing megafauna and tall sea-pen components) feature.
- Biological community extent, distribution, and function of the burrowed mud (sea-pens and burrowing megafauna and tall sea-pen components) feature.
- Physical and biological structure of the burrowed mud (sea-pens and burrowing megafauna and tall sea-pen components) feature.

Sub-Glacial Tunnel Valley:

- Physical extent and distribution of the Sub-Glacial Tunnel Valley sediment feature.
- Biological community extent, distribution, and function of the Sub-Glacial Tunnel Valley sediment feature.
- Physical and biological structure of the Sub-Glacial Tunnel Valley sediment feature.

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

- **Monitoring Objective 1:** Monitor change in infaunal communities over time and before/after fisheries management measures are put in place.
- **Monitoring Objective 2:** Monitor change in infaunal communities over time at control sites from outside Central Fladen Nature Conservation MPA.
- **Monitoring Objective 3:** Mapping and ground-truthing of the Fladen Deeps Sub-Glacial Tunnel Valley.

The monitoring objectives were used to create more specific survey objectives which also include contingency activities (Table 1).

Table 1. Prioritised survey objectives for survey 0723S, with details of the monitoring objectives that they address, the equipment required to address them, and a summary of the extent to which they were progressed during the survey.

Priority	Survey objective	Monitoring objective	Equipment	Summary of progress
1	Acquire 125 grab and PSA samples from inside Central Fladen Nature Conservation MPA	1	0.1 m^2 Day Grab	Complete
2	Acquire 10 grab and PSA samples from the Sub-Glacial Tunnel Valley floor	3	0.1 m^2 Day Grab	Complete
3	Acquire 40 grab and PSA samples from outside Central Fladen Nature Conservation MPA, Box A	2	0.1 m^2 Day Grab	Not addressed
4	Acquire 40 grab and PSA samples from outside Central Fladen Nature Conservation MPA, Box B	2	0.1 m^2 Day Grab	Not addressed
5	Acquire multibeam data from the Sub-Glacial Tunnel Valley	3	Multibeam system	Partially 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 the Marine Directorate.

2 Survey design and methods

An equidistant triangular grid of stations was plotted within Central Fladen Nature Conservation MPA to address Survey Objective 1 (see Table 1, Figure 2). Stations within the Fladen Deeps Sub-Glacial Tunnel Valley and those too close to seabed obstructions, such as wrecks and pipelines, were removed; this resulted in 125 stations.

The EModnet Bathymetry layer was used to manually select 10 ground-truthing stations within the Fladen Deeps Sub-Glacial Tunnel Vally feature. This was to address Survey Objective 2 (see Table 1, Figure 2).

To address survey objectives 3 and 4 (see Table 1, Figure 2), a further 80 stations were plotted using an equidistant triangular grid in two survey boxes (40 stations each) outside the Nature Conservation MPA.

To address Survey Objective 5, a multibeam survey box was plotted over the Fladen Deeps Sub-Glacial Tunnel Valley (see Table 1, Figure 2).

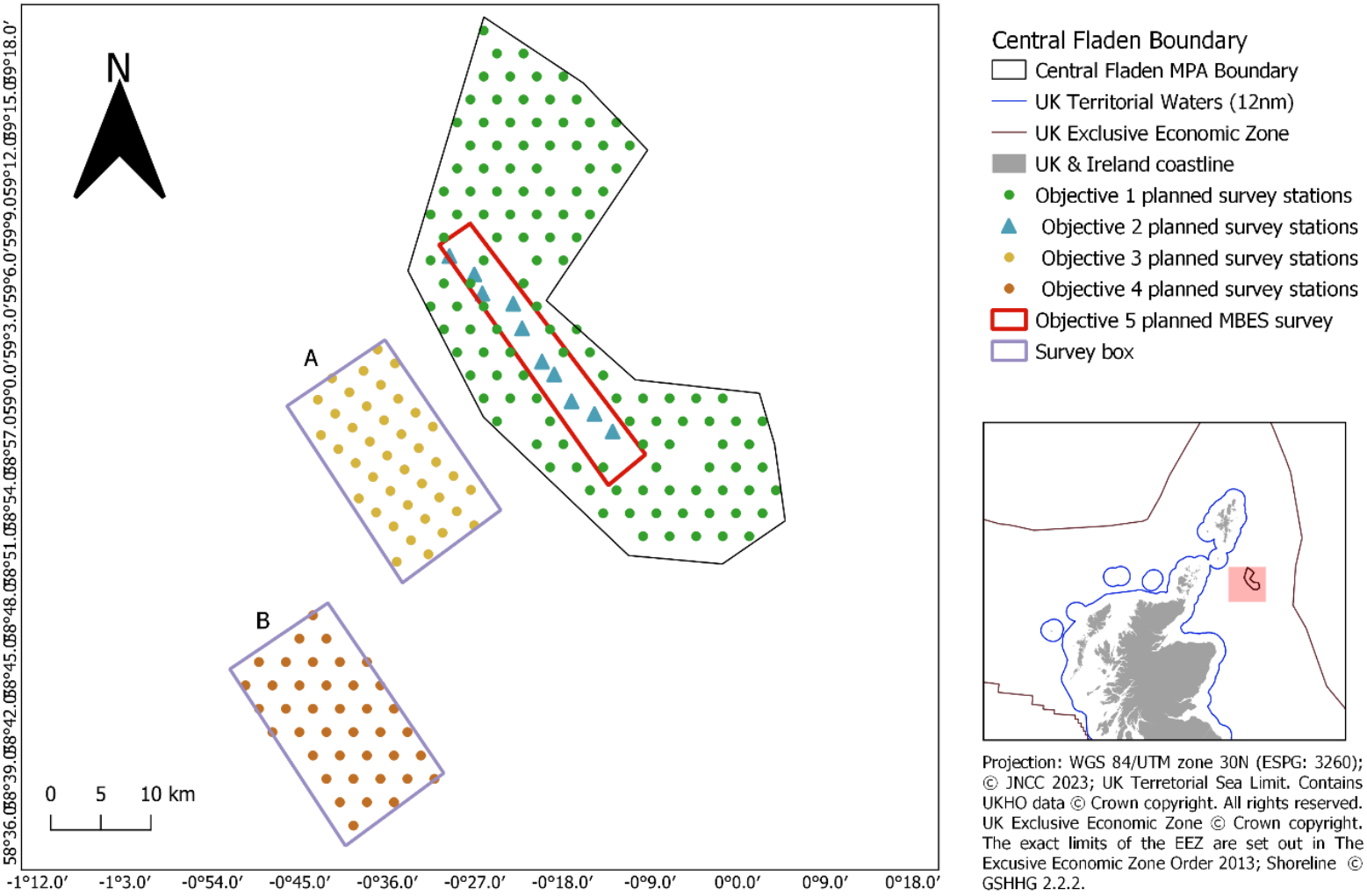

Figure 2. Schematic map showing planned sampling design of survey objectives for survey 0723S, including sampling stations planned inside and outside the MPA. The planned area of multibeam echosounder (MBES) acquisition is also shown (objective 4, red box).

2.1 Methods

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

- 0.1 m^2 Day grab (infauna and particle size distribution).
- Multibeam echosounder (bathymetry and backscatter).

See “Appendix 1. Survey equipment and processing” for more details.

2.2 Survey project team

The survey team for the duration of the fieldwork included JNCC survey scientists, Marine Directorate technicians, and a Marine Directorate Scientist in Charge (SIC). Shift assignments are shown in Table 2 below.

Table 2. Roles across the working shifts.

Shift	**Roles assigned**
Cross-shifts (06:00 – 18:00)	Marine Directorate SIC JNCC survey planning lead Marine Directorate multibeam technician
Night Shift (00:00 – 12:00	JNCC shift lead JNCC survey scientist
Day Shift (12:00 – 24:00)	JNCC shift lead JNCC survey scientist

3 Survey narrative

The survey at Central Fladen Nature Conservation MPA was carried out between 19 – 26 June 2023 on the MRV *Scotia* survey 0723S.

All times are UTC (Coordinated Universal Time) +0 and to the nearest 15 minutes. Survey equipment and consumables were loaded onto the survey vessel in advance of sailing.

3.1 Monday 19 June

MRV *Scotia* sailed from Aberdeen at 15:30 and began transit to Stonehaven for a multibeam patch test. A muster stations safety drill and risk assessment review was completed on route. The multibeam patch test started at 17:30 and was completed by 22:30, at which time the transit to Central Fladen Nature Conservation MPA began.

3.2 Tuesday 20 June

Vessel arrived at the northern end of the Central Fladen Nature Conservation MPA and began collecting Day grabs for Survey Objective 1 at 12:15. By midnight 16 of the 125 Survey Objective 1 stations had been sampled.

3.3 Wednesday 21 June

Vessel continued collecting Day grab samples for Survey Objective 1 all day. Weather downtime between 8:45 and 9:45 due to a lightning storm passing over, making it unsafe to operate the crane which deploys the grab. By midnight 49 of the 125 Survey Objective 1 stations had been sampled.

3.4 Thursday 22 June

Vessel continued collecting Day grab samples for Survey Objective 1 all day. Encountered an issue with the wires of the Day grab fouling and preventing the jaws closing fully. Switching to a spare Day grab avoided further issues. By midnight 81 of the 125 Survey Objective 1 stations had been sampled.

3.5 Friday 23 June

Vessel continued collecting Day grab samples for Survey Objective 1 all day. By midnight 115 of the 125 Survey Objective 1 stations had been sampled.

3.6 Saturday 24 June

Vessel continued collecting Day grab samples for Survey Objective 1 and by 07:30 all 125 Survey Objective 1 sample stations had been visited. At this time work began on Survey Objective 2, collecting ground-truthing samples from the Sub-Glacial Tunnel Valley using the Day grab. By 16:10 all of the 10 Survey Objective 2 stations had been sampled. As there was not enough survey time remaining to complete a whole survey box for survey objectives 3 or 4, the decision was made to start Survey Objective 5. At 16:10 vessel started a short transit to a nearby location to collect a sound velocity profile and begin the multibeam survey

of the Fladen Deeps Sub-Glacial Tunnel Valley feature. The multibeam survey continued through to midnight.

3.7 Sunday 25 June

Vessel continued the multibeam survey until 10:00, at which point there was an issue with the multibeam transmitter. At 11:00 it was advised that resolving this issue would require returning to port and raising the drop keel. At this point, multibeam data had been acquired from approximately one quarter of the Fladen Deeps Sub-Glacial Tunnel Valley.

As there were only a few hours of survey time left and it would not be possible to address survey objectives 3 and 4 in the time available, a decision was made to return to Aberdeen early. Transit continued for the rest of the day.

3.8 Monday 26 June

Vessel continued transit and arrived in Aberdeen at 07:45, bringing the survey to a close.

For a summary of all time allocation during 0723S operations see Appendix 2 (Survey timings). This shows the time breakdown between different operations of the survey, transit, and weather downtime through to sampling operations.

4 Data acquired

4.1 Infauna and sediment samples

In total ,135 0.1 m^2 Day grab sampling stations were visited during the survey, 125 for Survey Objective 1 and 10 for Survey Objective 2. Infauna and PSA samples were collected from a total of 133 sampling stations. Two stations (F036 and GT03) were not suitable for Day grab sampling, with no successful sample after three attempts (Figure 3). Metadata for each of the samples collected is shown in Appendix 3 (Survey metadata).

No data were acquired for survey objectives 3 and 4.

4.2 Multibeam

There was not enough time to acquire multibeam for the entire Sub-Glacial Tunnel Valley feature. Instead multibeam bathymetry and back scatter was acquired from two smaller boxes (A and B). These boxes were plotted during the survey and positioned within the planned multibeam box (Figure 4). Coordinates of the box vertices are shown in Appendix 3 (Survey metadata). Box A at the north of the trench was fully surveyed. Box B, directly south of Box A, had two and a half (2.5) lines of multibeam collected before issues with the equipment ended the multibeam survey (Figure 5). Coordinates of the survey boxes are shown in Table 4.

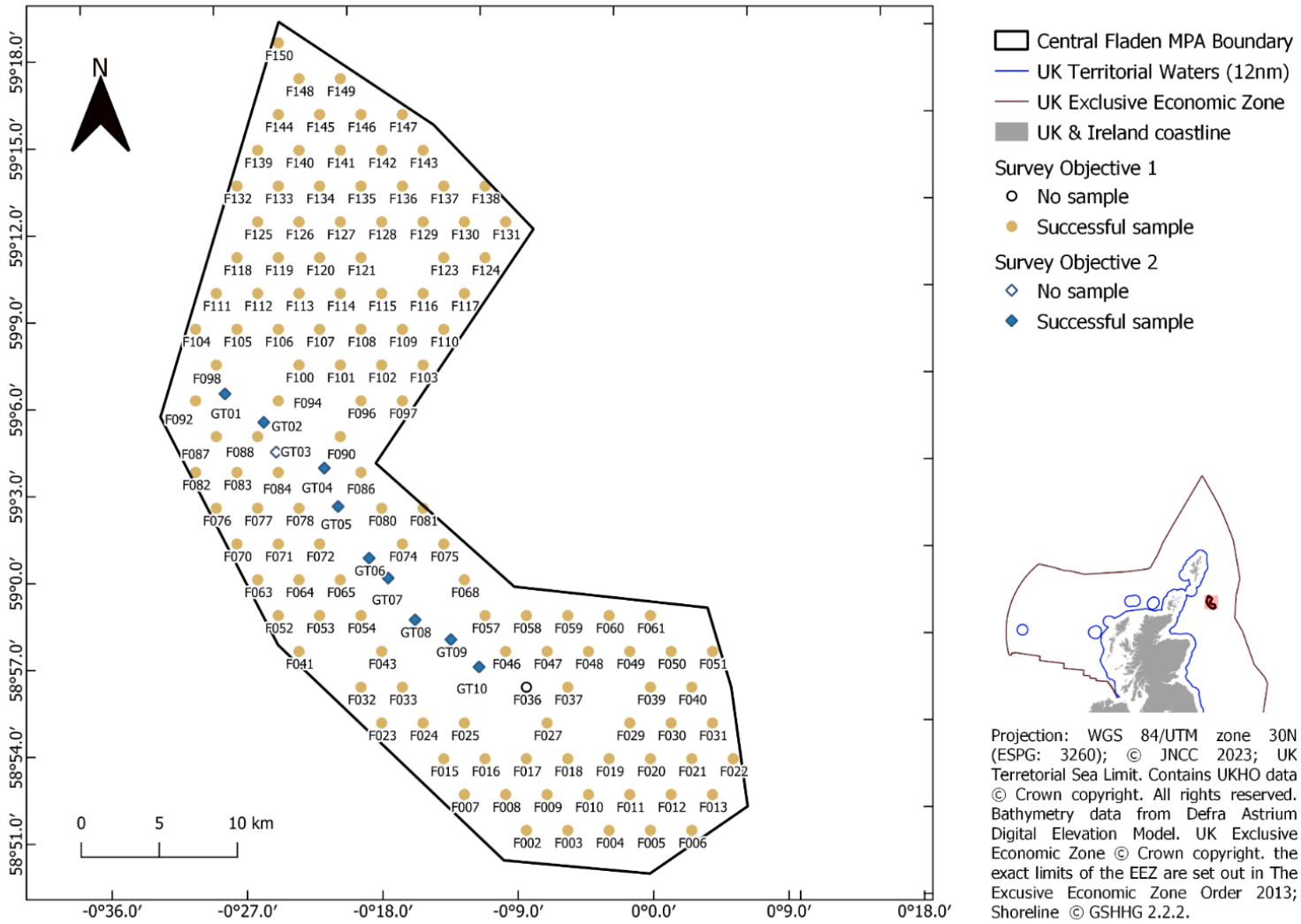

Figure 3. Schematic map showing all stations visited with the 0.1 m^2 Day grab during the 0723S survey of Central Fladen Nature Conservation MPA. Sampling station codes for survey objectives 1 and 2 have the prefix “F”, for Fladen, and “GT”, for ground-truthing, respectively.

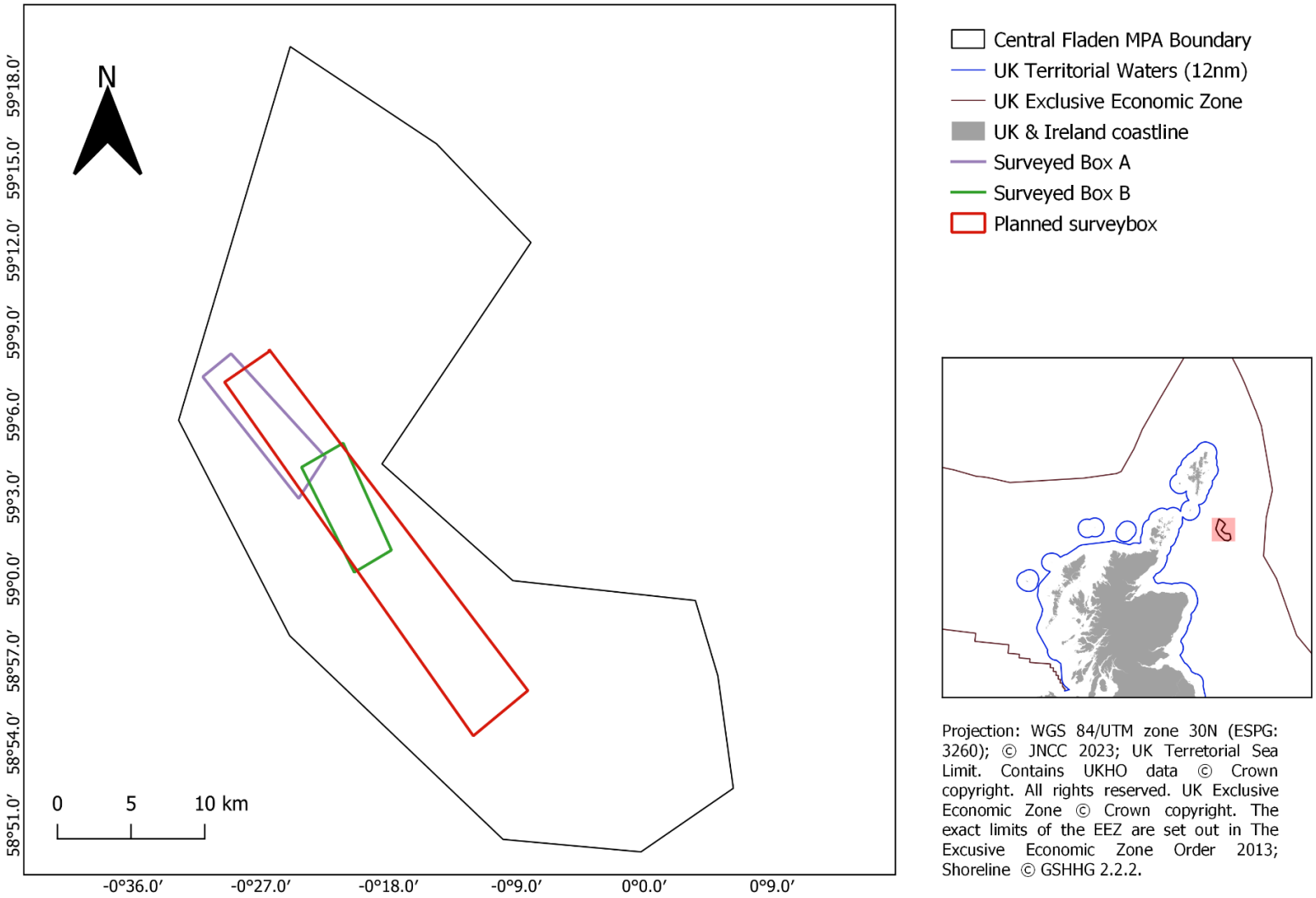

Figure 4. Map showing the planned multibeam survey box, and the smaller boxes that were visited to collect multibeam bathymetry and backscatter data during the 0723S survey of Central Fladen Nature Conservation MPA.

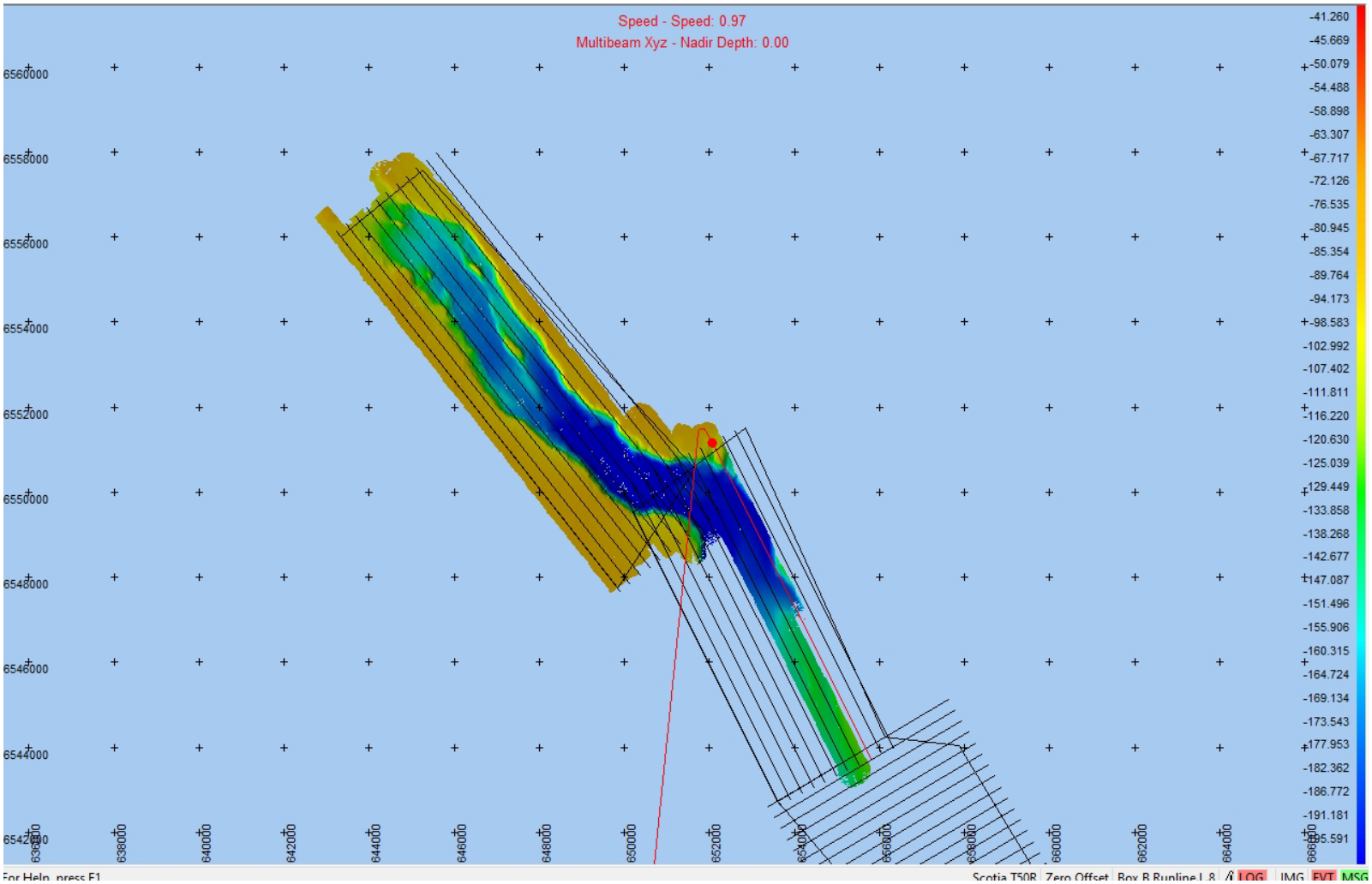

Figure 5. Screenshot taken from the multibeam acquisition system showing the extent of the unprocessed multibeam and backscatter collected during the 0723S survey of Central Fladen Nature Conservation MPA.

5 References

Mason, C. 2016. NMBAQC's Best Practice Guidance. Particle Size Analysis (PSA) for Supporting Biological Analysis. National Marine Biological AQC Coordinating Committee, 84pp, first published 2011, updated March 2022.

McIlwaine, P. 2015. CEND 5/14 Fladen Grounds Survey Cruise Report, *JNCC/Cefas Partnership Report* Series 2, JNCC, Peterborough, ISSN 2051-6711. https://hub.jncc.gov.uk/assets/63bf8971-c14a-4150-bb17-9f92b6ecdd26

Noble-James, T., Jesus, A. & McBreen, F. 2018. Monitoring guidance for marine benthic habitats (Revised 2018). *JNCC Report 598*. JNCC, Peterborough, ISSN 0963-809. https://hub.jncc.gov.uk/assets/9ade4be8-63dd-4bbc-afd0-aefe71af0849

Glossary

Term	Description
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.
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).
Scottish Government's Marine Directorate (formerly Marine Scotland Science (MSS))	Scottish Government's Marine Directorate is the marine division of Scottish Government. 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.

Appendix 1. Survey equipment and processing

A single 0.1 m^2 Day grab (Figure 6) was collected from each survey station, following guidance in Section 7.2 of the monitoring guidance for marine benthic habitats (Noble-James *et al*. 2018). Up to three attempts, where the grab fired correctly, were made at each station. If a successful grab was not acquired after three attempts, the station was abandoned. Each grab was used to collect an infauna sample and a sediment sub-sample for Particle Size Analysis (PSA).

PSA sub-sample

NMBAQC guidelines (Mason 2016) were followed for acquiring a PSA sub-sample. It should be noted that separate grabs for PSA and infauna were not collected in order to maintain compatibility with previous surveys of Central Fladen Nature Conservation MPA (McIlwaine 2015).

Once the grab was recovered the viewing door was opened, a visual sediment description was recorded, and a photograph of the sediment surface within the grab was taken.

The depth of the sediment in the grab was measured with a stainless-steel ruler and rejected if less than 5 cm.

Samples suffering from washout or unequal bite were also rejected.

To collect the sub-sample, a scoop was inserted vertically into the sediment as far as the grab base and rotated to create a core-like plug. A minimum on 100 ml of sediment was retained for the sub-sample.

Any large/conspicuous (greater than 2 cm) live marine fauna were removed from the PSA sub-sample, but shell debris were left.

All PSA sample containers were labelled internally and externally. The samples were stored in a freezer.

Infauna sample

The grab was emptied and washed into a fish box with seawater and a photograph was taken. The volume of the sample was measured and recorded to the nearest 0.5 L. A minimum size of 4 L was preferred, however the sample with the greatest volume was kept if a 4 L sample was not acquired after three attempts.

The infauna sample was passed through a 1 mm sieve. A photograph was taken of everything retained on the sieve. The sieve was then decanted into a sample pot, the mesh picked through with forceps, and the sample fixed in buffered 4% formalin solution. All sample pots were labelled internally and externally.

Figure 6. Photograph of the 0.1 m^2 Day grab used on the 0723S survey of Central Fladen Nature Conservation MPA.

Multibeam

Multibeam bathymetry and backscatter data were acquired using the RESON Seabat T50R multibeam system deployed to the drop keel of MRV *Scotia*. This was used to acquire bathymetry and backscatter data during the survey, set between 300 and 200 KHz (lower frequency used in deeper water) with the drop keel lowered 7 m below the water surface (2 m below the MRV *Scotia*'s hull).

Survey lines were spaced 300 m apart, providing approximately 50 m overlap between multibeam swaths.

Variations of sound velocity with water depth were determined using a Valeport Sound Velocity Profile (SVP) probe and applied during multibeam data acquisition. SVPs were collected at the start of the multibeam survey and every 12 hours afterwards.

Motion and time data were collected from an SBG systems APOGEE using SBG software.

GPS positions and corrections

GPS fixes were recorded using the MRV *Scotia's* data management system, and a backup 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 0923S. One was a 180º omnidirectional and the other a 40º vertical beam transponder. The position of these transponders under water was recorded based on offsets from the ships GPS antenna.

Positional data for the camera systems will be obtained using a Sonardyne Ranger Ultra Short Baseline (USBL) system and equipment mounted Sonardyne Omni-directional Transponder. USB-Comms adaptor will be used to link QGIS to ship's GPS feed to allow 'fixes' of the ship's position to be recorded; these can then be linked to USBL positions using the time stamps.

Layback will be used in case of USBL system not being available. Cable out and depth must be logged for each deployment regardless of USBL availability.

MRV Scotia

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

For a breakdown of survey operations and time sampled during the survey see Appendix 2.

Appendix 2. Survey timings

Table 3. Summary of the time sent on different survey activities during survey 0723S.

Activity	Time spent (hh:mm)
Mob/Demob	31:45
Offshore Calibrations	05:00
Total Operation Acoustic Survey	17:50
Total Operation Sampling	98:55
Equipment/Downtime	01:00
Waiting On Weather	01:00
Transit	36:30

Appendix 3. Survey metadata

Day grab metadata

A summary of Day grab metadata is shown in Table 4.

Table 4. Summary of 0.1 m^2 Day grab samples collected from Central Fladen Nature Conservation MPA during survey 0723S. Coordinates (decimal degrees, date, time (UTC + 0), and sample type collected are shown for each successful deployment.

Sample ID	Latitude	Longitude	Date	Time	Sample type
0723S_CFL_F150_001_A1	59.30574	-0.37876	20/06/2023	12:30:39	Infauna and PSA
0723S_CFL_F150_001_A3	59.30573	-0.37877	20/06/2023	13:15:29	Infauna and PSA
0723S_CFL_F148_002_A1	59.28481	-0.35706	20/06/2023	13:55:16	Infauna and PSA
0723S_CFL_F149_003_A1	59.28348	-0.31102	20/06/2023	14:33:45	Infauna and PSA
0723S_CFL_F147_004_A1	59.26165	-0.24319	20/06/2023	15:19:05	Infauna and PSA
0723S_CFL_F146_005_A1	59.26228	-0.29029	20/06/2023	15:58:03	Infauna and PSA
0723S_CFL_F145_006_A1	59.2638	-0.33592	20/06/2023	17:09:42	Infauna and PSA
0723S_CFL_F144_007_A1	59.26538	-0.38283	20/06/2023	17:55:48	Infauna and PSA
0723S_CFL_F139_008_A1	59.24482	-0.40611	20/06/2023	18:39:30	Infauna and PSA
0723S_CFL_F140_009_A1	59.24391	-0.36083	20/06/2023	19:17:02	Infauna and PSA
0723S_CFL_F141_010_A1	59.24312	-0.31353	20/06/2023	19:59:28	Infauna and PSA
0723S_CFL_F142_011_A1	59.24172	-0.26762	20/06/2023	20:34:31	Infauna and PSA
0723S_CFL_F143_012_A1	59.24087	-0.22126	20/06/2023	21:14:01	Infauna and PSA
0723S_CFL_F138_013_A1	59.21863	-0.15337	20/06/2023	21:56:47	Infauna and PSA
0723S_CFL_F137_014_A1	59.21988	-0.19977	20/06/2023	22:34:56	Infauna and PSA
0723S_CFL_F136_015_A1	59.22071	-0.2458	20/06/2023	23:13:48	Infauna and PSA
0723S_CFL_F135_016_A1	59.22135	-0.29244	20/06/2023	23:50:36	Infauna and PSA

Sample ID	Latitude	Longitude	Date	Time	Sample type
0723S_CFL_F134_017_A1	59.22207	-0.3397	21/06/2023	00:26:42	Infauna and PSA
0723S_CFL_F133_018_A3	59.22271	-0.38312	21/06/2023	01:19:11	Infauna and PSA
0723S_CFL_F132_019_A1	59.22316	-0.43121	21/06/2023	01:56:17	Infauna and PSA
0723S_CFL_F125_020_A1	59.2032	-0.41005	21/06/2023	02:27:06	Infauna and PSA
0723S_CFL_F126_021_A1	59.20233	-0.3639	21/06/2023	03:05:58	Infauna and PSA
0723S_CFL_F127_022_A1	59.20143	-0.31733	21/06/2023	03:44:42	Infauna and PSA
0723S_CFL_F128_023_A2	59.20046	-0.27109	21/06/2023	04:30:46	Infauna and PSA
0723S_CFL_F129_024_A1	59.19949	-0.22456	21/06/2023	05:10:06	Infauna and PSA
0723S_CFL_F130_025_A1	59.19862	-0.17823	21/06/2023	05:51:32	Infauna and PSA
0723S_CFL_F131_026_A1	59.19808	-0.13226	21/06/2023	06:40:16	Infauna and PSA
0723S_CFL_F124_027_A1	59.1778	-0.15748	21/06/2023	07:20:43	Infauna and PSA
0723S_CFL_F123_028_A1	59.1786	-0.20204	21/06/2023	07:59:40	Infauna and PSA
0723S_CFL_F121_029_A1	59.18047	-0.29526	21/06/2023	10:01:17	Infauna and PSA
0723S_CFL_F120_030_A1	59.18132	-0.34144	21/06/2023	10:38:09	PSA only
0723S_CFL_F120_030_A2	59.18134	-0.34138	21/06/2023	10:49:17	Infauna and PSA
0723S_CFL_F119_031_A1	59.18223	-0.38797	21/06/2023	11:22:02	Infauna and PSA
0723S_CFL_F118_032_A1	59.18253	-0.43403	21/06/2023	11:59:15	Infauna and PSA
0723S_CFL_F111_033_A1	59.1611	-0.45858	21/06/2023	12:34:06	Infauna and PSA
0723S_CFL_F112_034_A1	59.16219	-0.41288	21/06/2023	13:12:32	Infauna and PSA
0723S_CFL_F113_035_A1	59.16065	-0.36652	21/06/2023	13:56:07	Infauna and PSA
0723S_CFL_F114_036_A1	59.16017	-0.32079	21/06/2023	14:31:47	Infauna and PSA

Sample ID	Latitude	Longitude	Date	Time	Sample type
0723S_CFL_F115_037_A1	59.15944	-0.27337	21/06/2023	15:19:23	Infauna and PSA
0723S_CFL_F116_038_A1	59.15765	-0.22713	21/06/2023	16:02:26	Infauna and PSA
0723S_CFL_F117_039_A1	59.15716	-0.18146	21/06/2023	17:15:47	Infauna and PSA
0723S_CFL_F110_040_A1	59.13767	-0.20651	21/06/2023	17:49:21	Infauna and PSA
0723S_CFL_F109_041_A1	59.13893	-0.25229	21/06/2023	18:31:58	Infauna and PSA
0723S_CFL_F108_042_A1	59.13942	-0.29934	21/06/2023	19:10:59	Infauna and PSA
0723S_CFL_F107_043_A1	59.1404	-0.34447	21/06/2023	19:41:32	Infauna and PSA
0723S_CFL_F106_044_A1	59.14113	-0.39111	21/06/2023	20:14:11	Infauna and PSA
0723S_CFL_F105_045_A1	59.14224	-0.43733	21/06/2023	20:46:56	Infauna and PSA
0723S_CFL_F104_046_A1	59.14294	-0.48361	21/06/2023	21:26:16	Infauna and PSA
0723S_CFL_F098_047_A3	59.12213	-0.46115	21/06/2023	22:22:29	Infauna and PSA
0723S_CFL_F100_048_A1	59.12017	-0.3691	21/06/2023	23:12:44	Infauna and PSA
0723S_CFL_F101_049_A1	59.11911	-0.32268	21/06/2023	23:48:45	Infauna and PSA
0723S_CFL_F102_050_A1	59.11806	-0.27703	22/06/2023	00:26:46	Infauna and PSA
0723S_CFL_F103_051_A1	59.11671	-0.22998	22/06/2023	01:01:49	Infauna and PSA
0723S_CFL_F097_052_A1	59.09581	-0.25473	22/06/2023	01:34:33	Infauna and PSA
0723S_CFL_F096_053_A1	59.0978	-0.30184	22/06/2023	02:09:36	Infauna and PSA
0723S_CFL_F094_054_A1	59.09925	-0.39291	22/06/2023	02:48:52	Infauna and PSA
0723S_CFL_F092_055_A1	59.10166	-0.48635	22/06/2023	03:37:57	Infauna and PSA
0723S_CFL_F087_056_A1	59.08084	-0.46498	22/06/2023	04:14:45	Infauna and PSA
0723S_CFL_F088_057_A1	59.08008	-0.41906	22/06/2023	04:50:43	Infauna and PSA

Sample ID	Latitude	Longitude	Date	Time	Sample type
0723S_CFL_F090_058_A1	59.07769	-0.32682	22/06/2023	05:40:22	Infauna and PSA
0723S_CFL_F086_059_A1	59.05702	-0.3049	22/06/2023	06:16:46	Infauna and PSA
0723S_CFL_F084_060_A1	59.05881	-0.39721	22/06/2023	07:03:22	Infauna and PSA
0723S_CFL_F083_061_A1	59.05963	-0.44346	22/06/2023	07:37:18	Infauna and PSA
0723S_CFL_F082_062_A1	59.06082	-0.4893	22/06/2023	08:18:02	Infauna and PSA
0723S_CFL_F076_063_A1	59.03999	-0.46786	22/06/2023	08:58:25	Infauna and PSA
0723S_CFL_F077_064_A1	59.03874	-0.42194	22/06/2023	09:35:30	Infauna and PSA
0723S_CFL_F078_065_A3	59.03762	-0.37585	22/06/2023	10:39:58	Infauna and PSA
0723S_CFL_F080_066_A2	59.03601	-0.28339	22/06/2023	11:32:03	Infauna and PSA
0723S_CFL_F081_067_A3	59.03488	-0.23728	22/06/2023	12:40:36	Infauna and PSA
0723S_CFL_F075_068_A1	59.01395	-0.21615	22/06/2023	13:16:16	Infauna and PSA
0723S_CFL_F074_069_A1	59.01376	-0.26196	22/06/2023	13:48:45	Infauna and PSA
0723S_CFL_F072_070_A1	59.0162	-0.35461	22/06/2023	14:31:19	Infauna and PSA
0723S_CFL_F071_071_A1	59.01747	-0.40039	22/06/2023	15:16:51	Infauna and PSA
0723S_CFL_F070_072_A1	59.0183	-0.44631	22/06/2023	16:00:20	Infauna and PSA
0723S_CFL_F063_073_A1	58.99758	-0.42521	22/06/2023	17:03:41	Infauna and PSA
0723S_CFL_F064_074_A1	58.99673	-0.37874	22/06/2023	17:46:35	Infauna and PSA
0723S_CFL_F065_075_A1	58.9954	-0.33251	22/06/2023	18:28:24	Infauna and PSA
0723S_CFL_F068_076_A1	58.99254	-0.1948	22/06/2023	19:22:27	Infauna and PSA
0723S_CFL_F061_077_A1	58.96743	0.010272	22/06/2023	20:59:03	Infauna and PSA
0723S_CFL_F060_078_A1	58.96847	-0.03473	22/06/2023	21:26:44	Infauna and PSA

Sample ID	Latitude	Longitude	Date	Time	Sample type
0723S_CFL_F059_079_A1	58.9698	-0.0814	22/06/2023	21:58:38	Infauna and PSA
0723S_CFL_F058_080_A1	58.97085	-0.1273	22/06/2023	22:31:23	Infauna and PSA
0723S_CFL_F057_081_A2	58.97192	-0.17378	22/06/2023	23:12:38	Infauna and PSA
0723S_CFL_F054_082_A1	58.97456	-0.31137	23/06/2023	00:06:45	Infauna and PSA
0723S_CFL_F053_083_A1	58.97574	-0.3572	23/06/2023	00:45:02	Infauna and PSA
0723S_CFL_F052_084_A1	58.97643	-0.40377	23/06/2023	01:19:19	Infauna and PSA
0723S_CFL_F041_085_A1	58.95527	-0.38187	23/06/2023	01:51:28	Infauna and PSA
0723S_CFL_F043_086_A1	58.9534	-0.28998	23/06/2023	02:35:24	Infauna and PSA
0723S_CFL_F046_087_A1	58.95045	-0.15235	23/06/2023	03:31:07	Infauna and PSA
0723S_CFL_F047_088_A1	58.94941	-0.10638	23/06/2023	04:02:57	Infauna and PSA
0723S_CFL_F048_089_A1	58.94843	-0.06022	23/06/2023	04:37:24	Infauna and PSA
0723S_CFL_F049_090_A1	58.94753	-0.01432	23/06/2023	05:11:03	Infauna and PSA
0723S_CFL_F050_091_A1	58.94621	0.031153	23/06/2023	05:43:35	Infauna and PSA
0723S_CFL_F051_092_A1	58.94515	0.07752	23/06/2023	06:15:08	Infauna and PSA
0723S_CFL_F040_093_A2	58.92539	0.052988	23/06/2023	07:02:15	Infauna and PSA
0723S_CFL_F039_094_A3	58.9262	0.00721	23/06/2023	07:53:56	Infauna and PSA
0723S_CFL_F037_095_A3	58.92828	-0.08407	23/06/2023	08:55:01	Infauna and PSA
0723S_CFL_F033_097_A1	58.9324	-0.26869	23/06/2023	10:42:55	Infauna and PSA
0723S_CFL_F032_098_A1	58.93362	-0.31553	23/06/2023	11:15:46	Infauna and PSA
0723S_CFL_F023_099_A1	58.91234	-0.29341	23/06/2023	11:47:35	Infauna and PSA
0723S_CFL_F024_100_A1	58.9115	-0.24684	24/06/2023	12:20:15	Infauna and PSA

Sample ID	Latitude	Longitude	Date	Time	Sample type
0723S_CFL_F025_101_A3	58.91036	-0.20151	24/06/2023	13:01:24	PSA only
0723S_CFL_F025_101_A4	58.91035	-0.20151	24/06/2023	13:09:34	Infauna and PSA
0723S_CFL_F027_102_A2	58.90844	-0.10978	24/06/2023	13:53:18	Infauna and PSA
0723S_CFL_F029_103_A1	58.90641	-0.0173	24/06/2023	15:00:06	Infauna and PSA
0723S_CFL_F030_104_A1	58.90529	0.02777	24/06/2023	15:36:44	Infauna and PSA
0723S_CFL_F031_105_A1	58.90418	0.074565	24/06/2023	16:14:16	Infauna and PSA
0723S_CFL_F022_106_A1	58.88293	0.09499	24/06/2023	17:07:49	Infauna and PSA
0723S_CFL_F021_107_A1	58.88422	0.049575	24/06/2023	17:46:15	Infauna and PSA
0723S_CFL_F020_108_A1	58.88525	0.003868	24/06/2023	18:24:56	Infauna and PSA
0723S_CFL_F019_109_A3	58.8863	-0.04229	24/06/2023	19:29:06	Infauna and PSA
0723S_CFL_F018_110_A3	58.88737	-0.08796	24/06/2023	20:26:55	Infauna and PSA
0723S_CFL_F017_111_A3	58.8882	-0.13196	24/06/2023	21:22:19	Infauna and PSA
0723S_CFL_F016_112_A1	58.88928	-0.18003	24/06/2023	21:53:43	Infauna and PSA
0723S_CFL_F015_113_A1	58.89057	-0.22613	24/06/2023	22:29:17	Infauna and PSA
0723S_CFL_F007_114_A1	58.86922	-0.20503	24/06/2023	23:10:24	Infauna and PSA
0723S_CFL_F008_115_A1	58.86832	-0.15866	24/06/2023	23:48:21	Infauna and PSA
0723S_CFL_F009_116_A2	58.86726	-0.11289	24/06/2023	00:29:29	Infauna and PSA
0723S_CFL_F010_117_A2	58.86615	-0.06709	24/06/2023	01:13:20	Infauna and PSA
0723S_CFL_F011_118_A1	58.8651	-0.02112	24/06/2023	01:49:24	Infauna and PSA
0723S_CFL_F012_119_A1	58.86406	0.024597	24/06/2023	02:40:42	PSA only
0723S_CFL_F012_119_A2	58.86403	0.024612	24/06/2023	02:49:32	Infauna and PSA
0723S_CFL_F013_120_A3	58.86293	0.070467	24/06/2023	03:36:25	Infauna and PSA

Sample ID	Latitude	Longitude	Date	Time	Sample type
0723S_CFL_F006_121_A2	58.843	0.045857	24/06/2023	04:20:13	Infauna and PSA
0723S_CFL_F005_122_A1	58.84404	-0.00002	24/06/2023	05:02:28	PSA only
0723S_CFL_F005_122_A3	58.84403	-0.00002	24/06/2023	05:18:48	Infauna and PSA
0723S_CFL_F004_123_A1	58.84498	-0.04602	24/06/2023	05:50:30	Infauna and PSA
0723S_CFL_F003_124_A2	58.84611	-0.09132	24/06/2023	06:27:12	Infauna and PSA
0723S_CFL_F002_125_A2	58.84703	-0.13709	24/06/2023	07:07:08	Infauna and PSA
0723S_CFL_GT10_126_A1	58.9423	-0.18239	24/06/2023	08:33:51	PSA only
0723S_CFL_GT10_126_A2	58.9423	-0.18239	24/06/2023	08:23:27	Infauna and PSA
0723S_CFL_GT09_127_A3	58.95872	-0.21199	24/06/2023	09:12:36	Infauna and PSA
0723S_CFL_GT08_128_A1	58.97098	-0.2513	24/06/2023	10:29:33	Infauna and PSA
0723S_CFL_GT07_129_A1	58.99542	-0.27951	24/06/2023	11:23:41	Infauna and PSA
0723S_CFL_GT06_130_A1	59.00743	-0.29985	24/06/2023	12:01:40	Infauna and PSA
0723S_CFL_GT05_131_A1	59.03777	-0.3324	24/06/2023	12:47:14	Infauna and PSA
0723S_CFL_GT04_132_A1	59.06026	-0.34588	24/06/2023	13:35:12	Infauna and PSA
0723S_CFL_GT02_134_A1	59.0878	-0.4119	24/06/2023	15:13:45	Infauna and PSA
0723S_CFL_GT01_135_A1	59.1051	-0.45359	24/06/2023	15:58:44	Infauna and PSA

Multibeam

Acoustic survey box locations are provided in Table 5.

Table 5. Vertex coordinates (decimal degrees) of the acoustic survey boxes sampled at Central Fladen Nature Conservation MPA during survey 0723S.

Survey box	Vertex order	Latitude	Longitude
Box A	0	59.119064	-0.496297
Box A	1	59.132497	-0.461731
Box A	2	59.067347	-0.354683
Box A	3	59.042825	-0.388328
Box B	0	59.061744	-0.383572
Box B	1	59.075422	-0.333133
Box B	2	59.009081	-0.281247
Box B	3	58.996533	-0.326178

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