JNCC Report
No: 610

MRV Scotia 15/12S Cruise Report: Survey of Wyville Thomson Ridge cSAC/SCI and Faroe-Shetland Sponge Belt Proposed NCMPA

Eggett, A., Johnson, G., Johnston, C., Chaniotis, P. & Robertson, M.

February 2018
(January 2013)

ISSN 0963-8091

For further information please contact:

Joint Nature Conservation Committee
Monkstone House
City Road
Peterborough
PE1 1JY
www.jncc.defra.gov.uk

This report should be cited as:

Eggett, A., Johnson, G., Johnston, C., Chaniotis, P. & Robertson, M. 2018. MRV Scotia 15/12S Cruise Report: Survey of Wyville Thomson Ridge cSAC/SCI and Faroe-Shetland Sponge Belt Proposed NCMPA. *JNCC Report No. 610*, JNCC, Peterborough.

This report is compliant with the JNCC Evidence Quality Assurance Policy http://jncc.Defra.gov.uk/default.aspx?page=6675.

Please note that the data used in this report is from a survey conducted in 2012, therefore some information may now be out-of-date at time of publication.

Summary

The Joint Nature Conservation Committee (JNCC) and Marine Scotland Science (MSS) undertook an offshore seabed survey of Wyville Thomson Ridge candidate Special Area of Conservation (cSAC)[1]/Site of Community Importance (SCI)[2] and Faroe-Shetland Sponge Belt proposed Nature Conservation Marine Protected Area (NCMPA)[3] on the *MRV Scotia* from 25th October 2012 to 8th November 2012.

The main aim of the survey was to gather evidence to facilitate fisheries management discussions at Wyville Thomson Ridge SCI and to assist in the development of methods for future Marine Protected Sites monitoring. A secondary aim of the survey was to improve our understanding of the presence and extent of deep-sea sponge aggregations within the proposed Faroe-Shetland Sponge Belt NCMPA.

Sixty-one drop-down video camera transects, 17 side-scan sonar lines, five mini-Hamon grabs, one rock dredge and 105km^2 of multibeam echosounder (MBES) lines were successfully completed.

Please note that observations made in the Cruise Report represent preliminary field observations. These observations have not been subject to Quality Assurance procedures. This disclaimer should be included when referencing the Cruise Report.

[1] Candidate SACs (cSACs) are sites that have been submitted to the European Commission, but not yet formally adopted, http://jncc.defra.gov.uk/page-1445.
[2] Sites of Community Importance (SCIs) are sites that have been adopted by the European Commission but not yet formally designated by the government of each country.
[3] http://jncc.defra.gov.uk/page-5269.

Table of Contents

1 Introduction

The Joint Nature Conservation Committee (JNCC) and Marine Scotland Science (MSS) undertook an offshore seabed survey of Wyville Thomson Ridge candidate Special Area of Conservation (cSAC)[4]/Site of Community Importance (SCI)[5] and the Faroe-Shetland Sponge Belt proposed Nature Conservation Marine Protected Area (NCMPA)[6] on the *MRV Scotia*. The survey departed Aberdeen on 25th October 2012 and arrived back into Aberdeen on 8th November 2012.

Wyville Thomson Ridge SCI is located approximately 85nm north of the Isle of Harris. The site represents the Annex I reef sub-types 'bedrock' and 'stony' reef (JNCC 2012).

For further information on the site please see:

- Wyville Thomson Ridge MPA Site Information Centre[7]
- Offshore Special Area of Conservation: Wyville Thomson Ridge SAC Selection Assessment[8]

The Faroe-Shetland Sponge Belt proposed NCMPA lies in offshore waters to the west of the Shetland Islands. The site is located on the Scottish side of the Faroe-Shetland Channel, a large rift basin that separates the Scottish and Faroese continental shelves.

Since the survey has taken place, the site has been designated as an NCMPA by Scottish Ministers in July 2014[9].

For further information please visit the Faroe-Shetland Sponge Belt MPA Site Information Centre[10]

The Survey Plan is available on request from JNCC.

[4] Candidate SACs (cSACs) are sites that have been submitted to the European Commission, but not yet formally adopted, http://jncc.defra.gov.uk/page-1445.
[5] Sites of Community Importance (SCIs) are sites that have been adopted by the European Commission but not yet formally designated by the government of each country.
[6] http://jncc.defra.gov.uk/page-5269.
[7] http://jncc.defra.gov.uk/page-6545.
[8] http://jncc.defra.gov.uk/pdf/WTR_SACSAD_v6_0.pdf.
[9] Designation order available at http://www.gov.scot/Resource/0045/00457021.pdf.
[10] http://jncc.defra.gov.uk/page-6479.

1.1 Scientific Staff

The survey team included scientists from MSS and JNCC.

No scientific or technical content has been removed.

Original content was created pre-GDPR and has been removed as contained personal information.

1.2 Location map

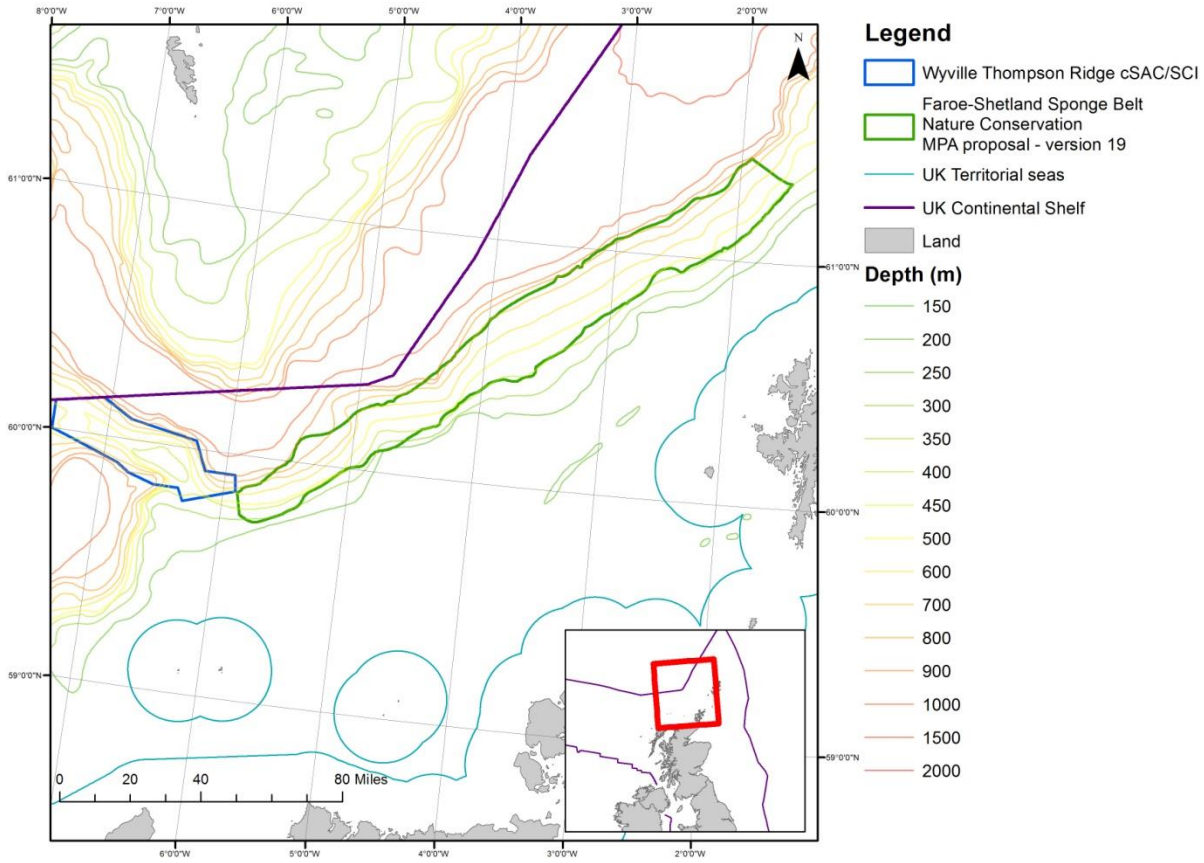


Figure 1: Wyville Thomson Ridge cSAC/SCI and Faroe-Shetland Sponge Belt proposed NCMPA location.

1.3 Existing Information Used to Inform Survey Planning

There have been a number of previous surveys dedicated to mapping and characterising Wyville Thomson Ridge. The original Special Area of Conservation (SAC[11]) boundary was drawn using survey data from the British Geological Survey (BGS) and from the Department of Trade and Industry's (DTI) oil and gas Strategic Environmental Assessments (SEAs) of UK waters in 1999 and 2000. The presence of Annex I reef was also confirmed using camera tows in a number of surveys between 1999 and 2006 (Table 1).

Table 1: Past surveys to the Wyville Thomson Ridge SCI

Project	Organisation	Ship	Cruise	Dates	Data
SEA 1\ Atlantic Margin Environmental Surveys	*SOC\NOC*	*RRS Charles Darwin*	119C Leg A	29/5/99 – 27/6/99	Towed Ocean Bottom Instrument (TOBI) side-scan
	SOC\NOC	*RRS Charles Darwin*	119C Leg B	13/8/99 – 14/9/99	TOBI side-scan Wide-angle Seabed Photography (WASP) Box cores Mega core samples
	Geotek Co., SOC\NOC & SAMS	*RV Professor Logachev*	TTR – 10	July-August 2000	TV grabs and samples
	SOC\NOC	*RRS Charles Darwin*	123C3-4	19/7/00 – 15/9/00	Box core Mega cores WASP
SEA SAC 2006		*MV Franklin*	Cruise 0406	14/9/06 - 23/9/06	Multibeam Deep-sea camera

Strategic Environmental Assessment surveys also provided some baseline information for the distribution of features within the proposed Faroe-Shetland Sponge Belt NCMPA.

[11] http://jncc.defra.gov.uk/page-1445.

2 Survey Aims and Objectives

The aim of survey 1512S was to gather seabed evidence to inform fisheries management discussions at Wyville Thomson Ridge (WTR) cSAC/SCI and to develop methods for future Marine Protected Sites monitoring.

The secondary aim was to confirm the presence and extent of deep-sea sponge aggregations within the Faroe-Shetland Sponge Belt (FSSB) proposed NCMPA.

The objectives of the survey were to:

1. Collect blocks of acoustic data from WTR
    a. Collect multibeam (MBES) (bathymetry and backscatter) data from within blocks where the water depths were shallower than 350m, and collect 100% coverage side-scan sonar data over the focused survey blocks.
2. Conduct a drop-down video survey across four different depth zones within WTR to assess Plymouth University's predicted *Lophelia pertusa* distribution model
    a. Drop-down video to be supported by mini-Hamon grab or rock dredge at each station where required.
3. Collect side-scan sonar corridors from FSSB
    a. Use side-scan outputs to aid the positioning of drop-down video camera transects to establish the upper and lower depth ranges of deep-sea sponge aggregations.
    b. Collect mini-Hamon grab or rock dredge from each drop-down video location.

Further contingency objectives in more sheltered locations were identified in the planning stage in case of a prolonged period of bad weather.

3 Methods Used

3.1 Drop-Down Video Camera Transects

A drop-down video camera frame (Figure 2) was used to collect seabed imagery along predetermined transects. As well as the seabed imagery equipment listed in Section 3.2, an experimental high-definition (HD) video camera system was also trialled (see Appendix 5). The camera frame was deployed off the stern of the *MRV Scotia* using an MSS armoured cable. Positional information was obtained through mounting a high precision acoustic positioning (HiPaP) transponder to the cable, just above the drop-frame.

Figure 2: Drop-down video camera frame used on 1512S survey.

3.1.1 Drop-Down Video Camera System

Underwater photographs and video imagery were captured using a drop-down video camera system mounted to a camera drop-frame.

The drop-down video system supported the following instruments:

- Insite Pegasus zoom video camera for primary TV observation and topside recording to mini-DV tape and DVD.
- Standard definition Kongsberg OE 14-208 digital camera (5MP) with dedicated flash unit (Kongsberg OE11-242) for still images capture (camera controlled topside, images recorded internally).
- Kongsberg 14-366 colour TV camera (backup video camera).
- Lamps x 4: Seatronics SeaLED, power 40W (max), colour white (4700k), luminous intensity 1067 Lux @ 1m, beam angle 65 degree.
- Fan laser pointers x 4: Savante projectors with beam fans, arranged in a bracket such that two pairs of parallel tracks were projected onto the sea-bed, each pair at right angles to the other, forming a 64mm square at the intersection points at a range of 1.5m from the camera face.
- Pressure sensor (Valeport miniIPS, 100bar, accuracy +/- 0.01% FS, resolution 0.001% FS).
- Stainless steel target weight (diameter 60mm), tied-off at 1.5m range from camera

face, to provide distance and size references on TV and photo images.

Set-up and operation followed the MESH 'Recommended Operating Guidelines (ROG) for underwater video and photographic imaging techniques'[12]. A video overlay was used to provide time and date from the ships GPS navigation feed.

Field notes were made during each camera deployment, noting station and sample metadata along with real-time observations of substrate and taxa.

During deployments, the vessel moved under Dynamic Positioning (DP) at a target speed of ~ 0.5-1 knots through the specified station. The height of the camera frame off the seabed was controlled by winch; the operator had sight of the video monitor.

Still images were taken at 20sec intervals, although photos were only one per minute for tows FSC8, FSC12, FSC15, FSC18, FSC19 and FSC_B1.

3.1.2 Multibeam Echo Sounder (MBES)

The Reson 7125 transducers were mounted in a Reson Hydrodynamic Fairing on the drop keel of *MRV Scotia*. The drop keel was lowered to a calibrated distance of 2m below the keel of the vessel, giving it a deployment depth of approximately 7.5m.

The following MBES parameters were routinely used during this survey:

Frequency	200Khz
Mode	256 beams Equidistant
Power	220dB
Gain	30dB
Pulse length	300 microseconds
Range	750m
Pulse rate	Range determined (Approx. 1pps)

MBES data were displayed and collected using Reson PDS 2000 survey software. No data processing was carried out on board the vessel.

A Valeport SV650 was used to obtain Sound Velocity Profiles (SVPs) of the water column to calibrate the multibeam system.

Swathe data were collected only at 200KHz due to the site depth. All surveying carried out with the 200KHz transducer was in 256 beam equidistant mode.

Visualisation of data used a cell size of 15 x 15m, however raw data were collected at maximum system resolution.

Weather conditions were generally poor during the survey period. Multibeam data acquisition was carried out when no other sampling could be conducted. Survey speed varied from 3-5 knots depending on weather conditions. Survey tracks were planned to ensure 100% coverage of the area with an overlap factor, which resulted in sequential swathes overlapping by 50%. This meant that initial data density was doubled in all areas resulting in 20-40 'hits' per cell.

[12] Coggan, R., Mitchell, A., White, J. and Golding, N. (2007) Recommended operating guidelines (ROG) for underwater video and photographic imaging techniques. MESH Project guideline document. Online: http://www.searchmesh.net/pdf/GMHM3_Video_ROG.pdf.

Data quality was classified as being either acceptable or low as a direct result of the weather conditions.

The survey of the target area covered 70km^2 at a track spacing of 400m. Depths within the area varied from 320 - 380m. In addition to that carried out in the target area, opportunistic surveying took place during side-scan deployments where the water depth allowed. This resulted in an additional area of 35km^2 in deeper water depths being surveyed. Usable (albeit poor quality) data was collected down to depths beyond 500m.

3.1.3 Side-scan Sonar

An Edgetech 4200 towfish system operating at frequencies of 300 and 600kHz along with Edgetech Discover software were used to undertake this element of the survey.

Seventeen lines were surveyed using the Edgetech side-scan sonar however the limited cable length available resulted in the survey being conducted at lower speeds than planned and over a more limited depth range. Generally, data were collected simultaneously at 300 and 600kHz but initially some areas were surveyed at only 300kHz. The scanning frequency was finally limited to 300kHz, which was shown to collect data of the optimum quality possible.

Accurate position fixing of the towfish was carried out using a Simrad HiPaP system with an acoustic transponder mounted on the tow cable above the sonar fish. Towfish position data were collected from the HiPaP during each deployment for use in mosaicing of the side-scan output.

Side-scan data were generally adequate but poorer than might have been expected due to the instability of the towfish. Various modifications to the towfish assembly were made to try to reduce the occurrence of striations across the echogram but these proved only partially successful. Nevertheless, features and possible trawl tracks could be distinguished in the data set which allowed camera deployments to be directed to areas of interest.

A Simrad EK60 sounder, operating at 18Khz, was used to provide an echogram for operators during side-scan deployments.

3.1.4 Mini-Hamon Grab and Rock Dredge

A 0.1m^2 mini-Hamon grab (Figure 3) and rock dredge (Figure 4) were loaned from Cefas and used to sample the stony substrate and epifauna surrounding Wyville Thomson Ridge SCI and the Scottish Marine Protected Area (SMPA) search locations.

In total two successful mini-Hamon grabs were recovered of four attempts, within the proposed Faroe-Shetland Channel NCMPA, along with a single rock dredge towed for a distance of ~260m.

Samples collected were sieved through a 1mm mesh and then preserved in buffered formaldehyde. One particle size analysis (PSA) sample was collected from station FSC5G at Faroe Shetland Channel.

Additional mini-Hamon grab samples were taken at the Noss Head contingency site. Four stations were sampled, of which three achieved successful samples, with the fourth site failing to achieve a valid sample: two attempts were made, neither of which was successful.

Figure 3: 0.1m^2 Mini-Hamon grab.

Figure 4: Rock dredge.

4 Planned Sampling Design

4.1 Evidence Gathering to Inform Fisheries Management

For the purposes of this survey, blocks of specific interest were identified *a priori* over areas of high demersal fishing pressure recognised from VMS data, this provided a focus for acoustic surveying and groundtruthing (Figure 5):

- Block A (central): approx. 6km x 25km (150km^2); from <350m to 825m depth; this block has been extended widthways across the site to take a representative slice of the depth range on the northern and southern aspect.
- Block B (marginal): approx. 2km x 10km (20km^2); from 790 to 820m depth.

To undertake this design, a large number of short side-scan survey lines will be required. However, there are advantages to running along isobaths to reduce hauling and to improve quality of side-scan data.

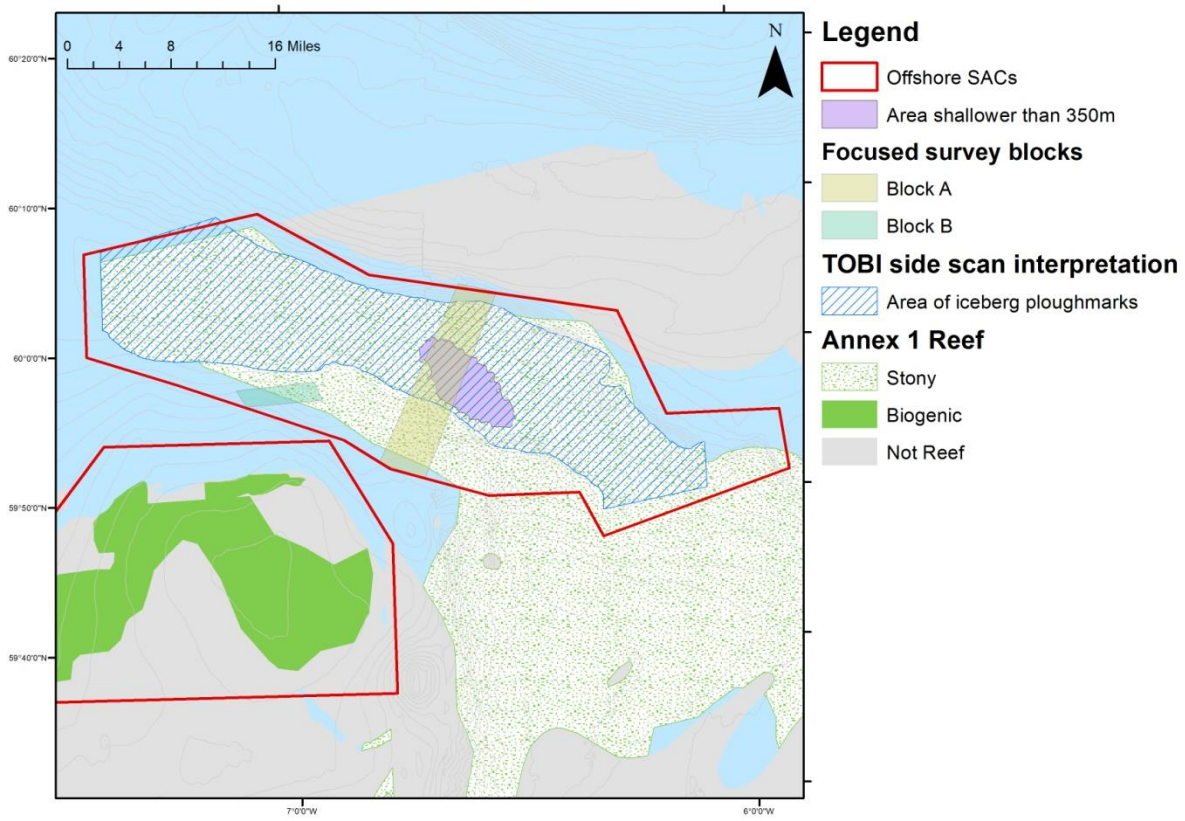


Figure 5: Blocks of survey focus within the WTR SCI boundary.

At each of these blocks, 100% side-scan coverage was planned. For the central block, a portion of the area is shallower than 350m depth (approx 25km^2) and so the use of RESON Seabat 7125 multibeam equipment[13] was possible here. Elsewhere, deeper waters meant that only side-scan would be achievable. A USBL transponder was used on the side-scan to give positional information. Calibration of RESON Seabat 7125 would take an estimated 6 hours at the Southern Trench prior to the survey starting.

[13] More information available at: http://www.teledyne-reson.com/products/echo-sounder-seabat/multibeam-seabat-7125/.

Four, one-kilometre-long camera transects were planned to be run at four depth zones perpendicular to repeat trawl lines identified from VMS (Figure 6). Camera transects within the central block also coincided with Plymouth University's predictive *Lophelia pertusa* model at different probabilities. At each of these camera tows, samples were to be taken with either the mini-Hamon grab or rock dredge, depending on substrate, to aid species identification from video and in order to help characterise the habitat.

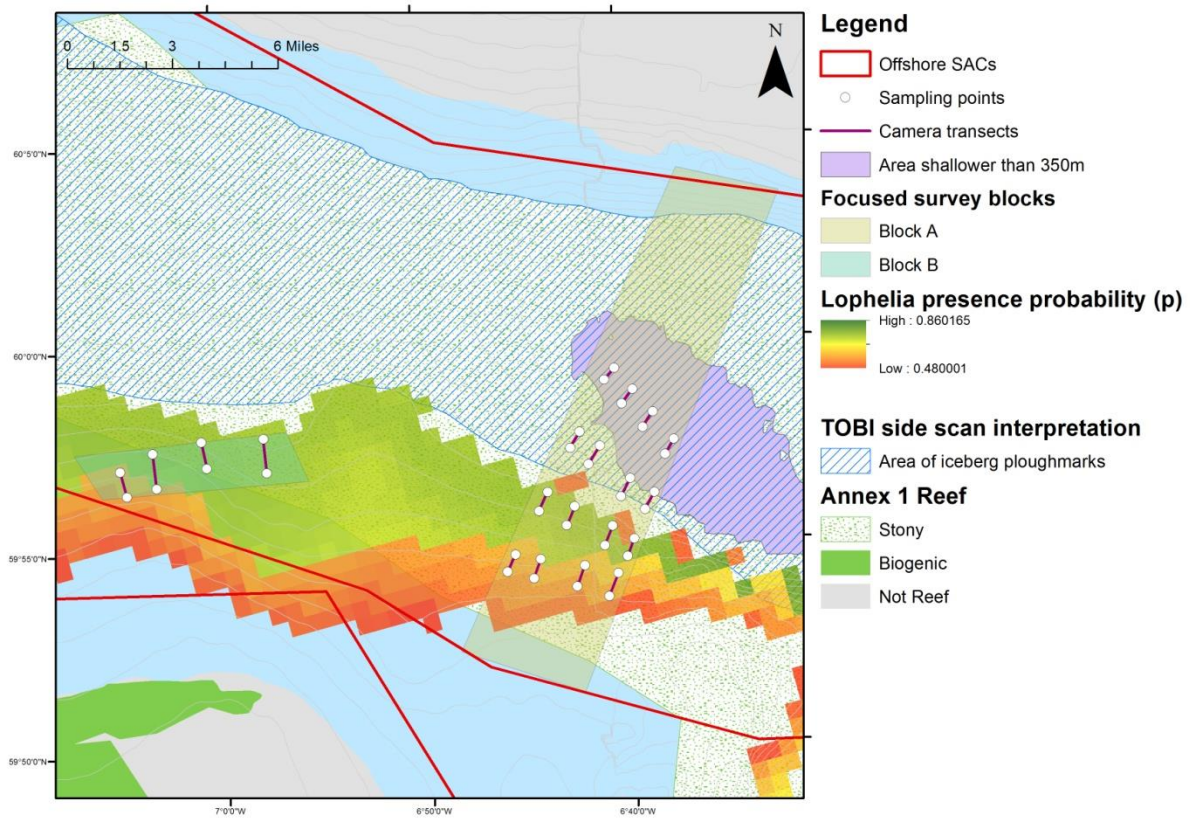


Figure 6: Detail of planned camera tows over areas of highest fishing effort and coinciding with predicted *Lophelia pertusa* reef.

In addition, based on raw MBES collected and side-scan data processed on board, additional groundtruthing stations were to be chosen within Block A and stratified. Stations could be stratified by depth (e.g. <400m, 400-600m, 600-800m and >800m) or by interpreted habitats from previous surveys (e.g. iceberg ploughmarks, stony reef, *Lophelia pertusa* reef and no reef). It was suggested that two or three groundtruthing stations should be chosen per stratum, giving an estimated total of 16 or 24 samples respectively. At each station, sampling was to consist of drop-camera work (500m tows) and biological sampling (mini-Hamon grab or rock dredge). As rock dredge samples were intended only to aid species identification, quantitative samples did not need to be retained, with only representatives of each species kept.

4.2 Develop Future Site Monitoring Methods

As part of the sampling programme, *MRV Scotia* would repeat a number of camera tows carried out during the 2006 SEA SAC surveys to the south-east of the site (Figure 7). This would investigate the feasibility of time-series monitoring using towed camera systems. Additional camera transects were undertaken in the same area and with increased frequency of stills in order to investigate sampling power and create species-area curves for the habitats. Still images were planned to be taken every 20 seconds, instead of the usual 1 minute, to investigate ideal frequency of sampling.

These camera tows also correspond to an SMPA area of search for deep-sea sponge aggregations. If deemed necessary, to aid identification of sponge species, further biological sampling may be required using the mini-Hamon grab or rock dredge.

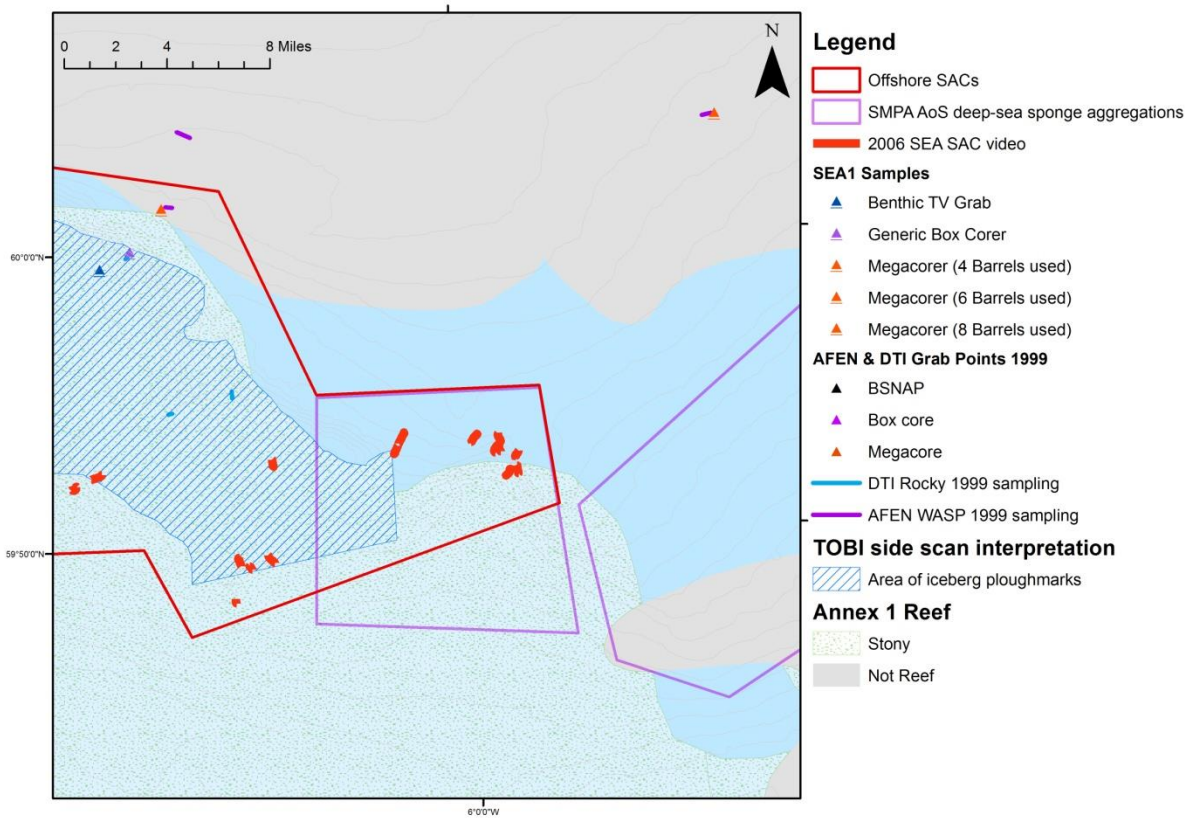


Figure 7: Locations of SAC SEA 2006 camera tows targeted for repeat sampling and corresponding with the SMPA Area of Search (AoS).

4.3 Proposed NCMPA: Faroe-Shetland Sponge Belt

The proposed Faroe-Shetland Sponge Belt NCMPA spans the 400-800m depth contours on the Scottish side of the Faroe-Shetland Channel. The objective of this part of the survey was to further verify the presence and extent of deep-sea sponge aggregations within the proposed MPA (Figure 8).

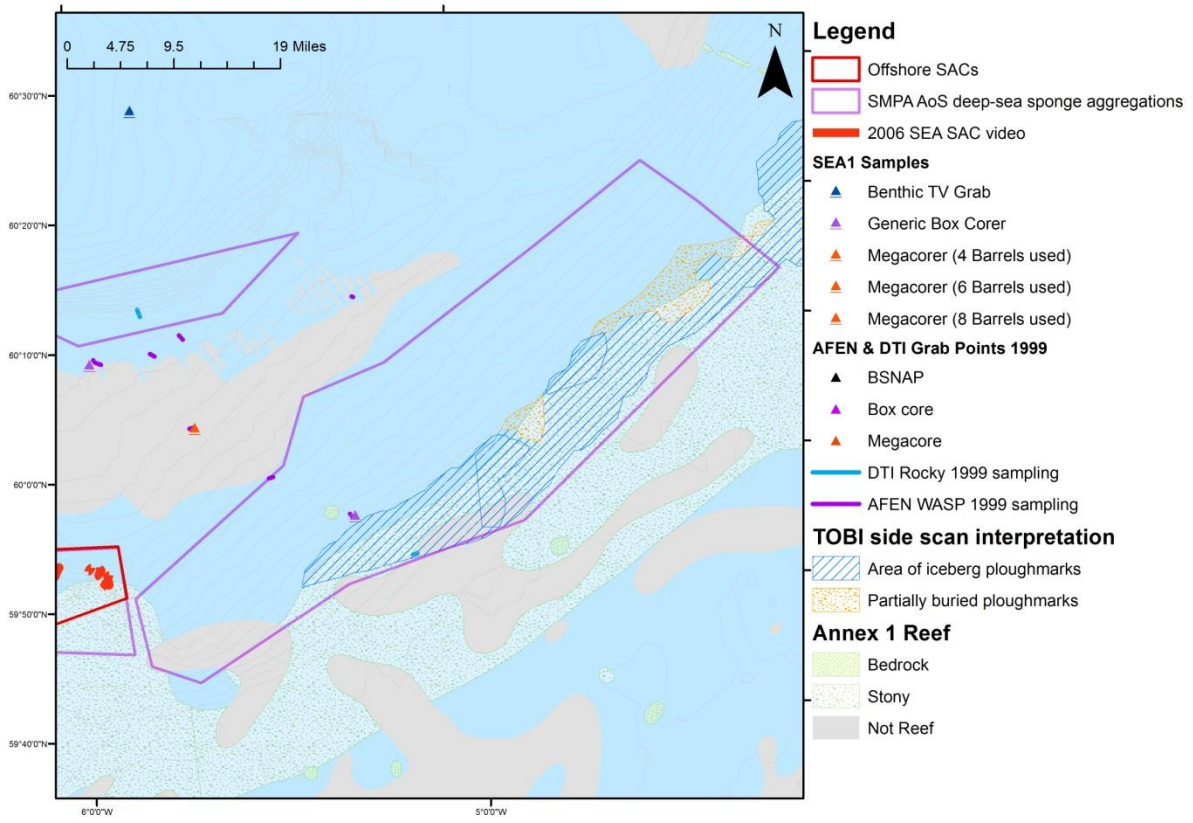


Figure 8: SMPA Area of Search (AoS) for deep-sea sponge aggregations in the region of the Faroe-Shetland Channel.

Side-scan data collection was initially planned from discrete corridors along the survey area, in parallel with the depth contours. The side-scan would focus on areas of over 450-500m deep where most of the sponge records originate in order to delineate broadscale habitats. A drop-camera would then be used in order to identify deep sea sponge aggregations Representative samples taken of the fauna using the rock dredge and mini-Hamon would also be collected in order to enable species identification.

As the area of search (AoS) was so vast (approximately 80km long and 11km Wide) there would be time only to complete between three and five acoustic lines. In conjunction with this task, a series of video transects (between six and ten depending on time) would be run perpendicular to the depth contours in order to confirm the presence of the deep-sea sponge aggregations and investigate the upper and lower depth boundaries of their distribution. Groundtruthing would again be used to aid species identification and habitat characterisation.

- Side-scan corridors (3-5 of *c*.75km)
- Groundtruthing (6-10 camera tows and corresponding mini-Hamon/rock dredge samples).

5 Variations to Survey Plan

It was not possible to complete all stations identified in the Survey Plan.

This was due primarily to weather conditions and operational constraints that only became apparent once the survey was underway. The major constraint was focused on a shorter than expected coaxial towing cable, which meant planned sampling and acoustic work at the deepest locations was not possible. This problem occurred because of the gradual cutback of the cable over time as a result of wear and tear and damage during use. The winch monitoring system had not been updated to reflect the shortened cable length. Station running order was adapted *ad hoc* by the JNCC Lead, to maximise sampling efficiency and site coverage in the time available.

The Objectives set out in the Survey Plan were continuously assessed against the time available on survey, resulting in variations to the original Survey Plan.

Wyville Thomson Ridge

MBES started in the north-west of the site over the region identified as being above 350m in depth.

The side-scan sonar system was constrained by the limited length of cable available onboard the vessel. Efforts were made to increase the depth range of the system through the addition of weights to the cable above the towfish; this was used to good effect in some of the deeper side-scan sonar lines.

Longer side-scan lines were run parallel to the depth contours on the south side of Wyville Thomson Ridge extending to around 800m. These side-scan lines were much longer than originally planned in order to maximise the data collected on site within the achievable depth range.

Survey time was also lost due to the towfish becoming unstable when the stability fins attached to its side repeatedly detached, resulting in the need to retrieve and refit before deployment and continuation of the survey line.

Whilst on site at Wyville Thomson Ridge, there was a significant amount of time where it was not possible to deploy any equipment over the side of the vessel due because of weather. However, this provided the opportunity for further MBES acquisition over the area of water depth less than 350m and enabled a far greater amount of MBES to be collected than was originally planned, acquiring 100% of the site in less than 350m and deeper areas surrounding it.

Despite the ability of the MBES to acquire data in sea states, 12hrs of survey time were lost on the 28th October 2012 because of inclement weather conditions, thus impacting the completion of the survey objectives.

It was not possible to process the acquired MBES onboard the vessel as the required software licence was not available at the time of departure. However, the raw data were reviewed and informed the selection of targeted video tows over features of interest. Side-scan data processed onboard the vessel was used to assist in the positioning of groundtruthing samples. However, due to the limitations in the depths achievable with the side-scan tow-fish, decisions on the placement of the deeper video tows were informed by fisheries effort, modelled location of sponge aggregations and bathymetry. This enabled a

representative selection of samples to be achieved from a range of depths on the south side of WTR.

Problems were experienced onboard *MRV Scotia* with the processing of the raw side-scan data, due to the HiPaP layback corrections that had to be applied to the tow-fish positional data. This caused delays to data processing and required consultation with colleagues ashore to resolve the issues experienced. Poor weather conditions experienced during acquisition, presented difficulties in maintaining the towfish at a steady height above the seabed thereby affecting data quality.

Sampling at WTR was cut short because of the weather forecast which indicated that sampling would be severely limited in Faroe-Shetland Channel (FSC). The decision was therefore taken to cut short sampling at WTR in order to sample within the FSC before a forecast weather system arrived, with the aim that there would be time to return to WTR after the inclement weather had passed. However, having completed operations in FSC, weather conditions had not improved enough and so prevented a return to WTR. The more sheltered Noss Head contingency site was therefore sampled at this time.

Faroe-Shetland Channel / Faroe-Shetland Sponge Belt MPA Search Location

Justification for sampling strategy change in the FSC search area:
Six tows were planned per depth zone (split between fished and un-fished), each of ~500m, with the aim to cover areas of predicted *Lophelia*. The depth zones were 400 - 500m; 500 - 600m; 600 - 700m; 700 - 800+m.

For shallow areas, side-scan was used to inform sample locations while VMS data were used to inform sample locations in waters beyond the depths achievable by the side-scan tow-fish. Camera transects were extended further to the north-east than originally planned in order to assess the northern extent of the sponge field and to gain valuable additional information regarding the Faroe-Shetland Sponge Belt search location.

Further north-east locations were chosen within the 400 - 600m depth range where sponges are associated with iceberg ploughmark features and where Bett *et al* (2012) reported suitable conditions for the aggregation of sponges. Towed Ocean Bottom Instrument (TOBI) side-scan data were also used to inform the selection of locations.

Shorter side-scan lines were run over 20km, rather than the originally planned 75km lengths to allow more time for camera tows to be completed within the Faroe-Shetland Channel. Side-scan data quality was likely to have been affected for the later tows undertaken within the Faroe-Shetland Channel, due to the towfish making contact with the seabed. Investigations undertaken after the survey was completed suggested the damage was more substantial than had been initially observed onboard the ship.

The survey area was extended beyond the original site boundary in order to investigate the north extent of sponge distributions in the FSC. This enabled investigation into the possibly better environmental conditions for sponges towards the north east of the FSC. Video tow spacing's were increased to conduct survey operations across a greater geographical area within the FSC

Contingency

Due to inclement weather conditions experienced once sampling at FSC was completed, combined with a poor forecast for the following 36hrs, the decision was made to sample a contingency site suggested by Scottish Natural Heritage at Noss Head.

The objective was to conduct MBES and grab sampling to establish the extent of the horse mussel (*Modiolus modiolus*) community within the site. This aim was completed successfully.

5.1 Adaptations to Running Order

As noted in Daily Progress Reports located in Appendix 6.

25/10/12
Calibration of equipment not able to be undertaken en-route due to poor weather conditions.

2/11/12
Decided not to proceed with side-scan sonar at the Faroe-Shetland Channel because of difficulty with georeferencing side-scan to correct survey location at WTR. Also, Brian Bett's SEA4 report delivered a data layer of iceberg ploughmark terrain from side-scan data and so this has been used to feed directly into camera work.

3/11/12
Move from camera work to completing grab samples and side-scan sonar work along 500m contour of the Faroe-Shetland Channel.

4/11/12
Faulty connection between camera connection and cable fixed temporarily with epoxy resin adhesive. If temporary camera fix continues to work, plan to complete video tows along a series of transects situated in a second block of interest around existing sponge records. This is to check condition and build up a better picture of extent within the area. The plan is to continue with these tows for the next 24 hours and then switch to grab sampling on the way back down the channel for the last 12 hours of operational survey.

6 Cruise Narrative

The planned survey duration was for fourteen days (including one day transit each way). Calibration and testing of equipment was planned for the Southern Trench (off Fraserburgh) en route to the survey area. Survey was planned to be completed running 24hr operations, with Marine Scotland Science leading the survey (Mike Robertson as Scientist in Charge), with JNCC providing a client representative (Charlotte Johnston) and three other survey scientists to assist with biological sample preparation/camera tow data loggers.

Phil Copeland led on the acquisition of multibeam and side-scan sonar data along with Mike Robertson (bathymetry and backscatter). Gillian Horner led on processing side-scan to be used to identify groundtruthing locations. Multibeam data acquisition using the *Scotia* system was possible only over the shallower portion of Wyville Thomson Ridge (<350m).

Thurs 25th Oct
Due to leave Aberdeen harbour 09:00, but delayed until 14:30 due to fault with Reson multibeam system (components replaced by Reson). Testing of multibeam, side-scan and camera systems at Southern Trench cancelled due to high winds and swell making deployment of instruments over the side of the vessel dangerous. Continued transiting to survey area, around the north of Orkney, due to arrive at WTR survey area 22:00 on 26th Oct.

Fri 26th Oct
In transit to survey area all day, weather conditions poor.

Sat 27th Oct
Arrived at survey area 01:00, later than planned due to poor weather. Not possible to deploy Sound Velocity Profiler (SVP) over the side of vessel due to rough weather and high winds at time of arrival, postponed to 07:00 when lull in swell and winds was due. SVP successfully deployed, and drop camera tested – all working properly. Started multibeam lines at 10:30. Adjusted planned multibeam area due to limited weather window and needed to collect lines heading into weather. Revised area was north-west section of Box A, see Figure 9, showing original planned MBES area. Once MBES acquisition in north-west of Box A was completed, plan was to complete camera transects on features of interest identified from MBES data. MBES acquisition would then move to south-eastern end of Box A, followed by groundtruthing. However, weather deteriorated again from 15:00 onwards, so it was not possible to deploy camera or side-scan, so continued with MBES, despite the quality of data being affected by the sea state. MBES acquisition continued all night.

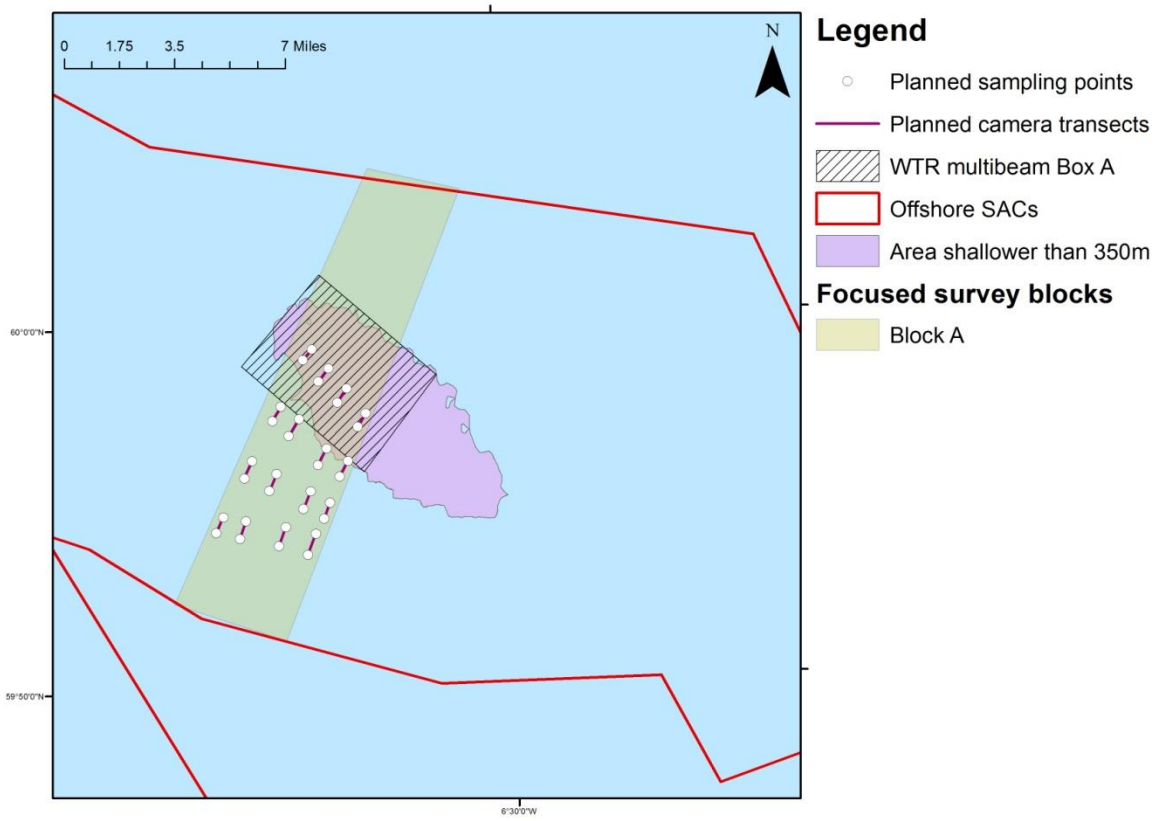


Figure 9: Wyville Thomson Ridge (WTR) northern multibeam (Box A) situated on the north side of the 350m plateau on WTR, together with proposed side-scan area and camera tows.

Sun 28th Oct

Multibeam acquisition from Box A North continued until 07:30, at which point operations swapped to camera tows as there was a short window of good weather for a few hours. Three camera tows were carried out over trench/ploughmark features identified from multibeam. The seabed was consolidated cobbles and boulders with areas of finer-grained gravels, with sparse fauna of squat lobsters, pencil urchins, a few ling – and not much else. Weather deteriorated rapidly so camera tows and multibeam were both abandoned at 14:30 due to high winds and swell. The next likely opportunity for survey was expected to be 06:00 tomorrow. Weather improved so re-started multibeam tracks at approx. 03:00.

Mon 29th Oct

Continued multibeam until 08:00, with Box A almost completed. Weather remained relatively calm, with a possible weather window of 24hrs, so side-scan equipment was mobilised. Tested side-scan in water (two test runs) until 13:00, then started side-scan lines, running parallel to southern edge of Box A and overlapping with the last multibeam line. Side-scan lines were approx. 15km long with swath width approx. 200m, towfish 10% of depth above seabed, speed ~3-4kn. Each line took ~4-5hrs. Moved onto 6hr watches and continued side-scan overnight.

Tuesday 30th Oct

Continued use of side-scan sonar from 00:00 until 07:00 hours, with an hour delay at 02:00 hours to re-attach fins, which had detached from the towfish. A second delay between 07:00 and 09:18 hours to re-attach the fins again before continuing side-scan lines approx 15km long, with swath set at approx 200m with and towfish flown at height of 10% of swathe (20m) above seabed; continued until 00:00.

Wednesday 31st Oct

Continued use of side-scan sonar for 24 hours, but 5 hours' equipment downtime during this period to add additional weight to the towfish and to re-attach fins. Side-scan lines approx 15km long, swathe 200m and towfish flown at height of 10% of swathe (20m) above seabed. During operations, the side-scan made contact with the seabed, while the system was still able to collect data the extent of damage sustained internally was not clear.

Thursday 1st Nov

Sea state and winds too high to continue survey operation between 00:00 and 09:00 hours. At 09:30 cables were changed to begin drop-down camera tows. Drop-down camera tows were undertaken at various locations south-west of the Wyville Thomson Ridge 350m plateau. Sampling was set up to run 500m video tows, six tows per 100m depth band; three of which sampled locations where VMS data support fishing activity, and three that do not. Pictures were taken every 20 seconds and each run lasted approximately 12 minutes. Ten tows were completed, adding to three previously undertaken on 28th October on the 350m plateau. Stations were all relatively similar, comprising stones, pebbles, boulders interspersed with sandy sediments with some erect and encrusting sponges, anemones, squat lobsters and pencil urchins.

Friday 2nd Nov

23 hours were spent completing planned drop-down video tows at various locations south-west of the Wyville Thomson Ridge. In total, 16 additional camera tows were completed at the Wyville Thomson Ridge. This included two repeat camera tows over previous SEA7 sampling locations where cold-water corals, feather stars, cup corals and sponges were present. The other 14 tows were largely similar to those tows undertaken on Thursday 1st November. One hour was spent transiting east to the Faroe-Shetland Channel study site. The sampling strategy within the Faroe-Shetland Channel was initially to undertake 3-5 lines of side-scan sonar c. 75km in length running along the depth contours between the 450-500m depth contours where most of the sponges are recorded. The side-scan sonar data would then be processed on board and used to inform the position of video tows based on the identification of suitable deep-sea sponge aggregation habitat (most notably iceberg ploughmark zones). Based on difficulties with onboard processing and matching of the side-scan sonar mosaics to the HiPaP navigation files at the Wyville Thomson Ridge, we decided to start with video tows at the area of interest from the outset.

We used the coarse shapefiles of probable and actual iceberg ploughmark zones delivered by Bett (2012), and the depth zone at which sponges are known to occur (between 400 and 500m), to guide the random depth positioning of 1km camera tows from the western extent of the area of interest to the eastern extent at approximately 5km intervals. The camera tow lines were set perpendicular to the depth contours to sample across a greater depth range. The first of these planned camera tows was undertaken before midnight at the western extent of the area of interest. Fauna here included occasional sponges on sandy/gravelly sediments. Occasional boulders were also present and were often host to white and yellow encrusting sponges.

Saturday 3rd Nov

00:00 – 06:00 hours were spent continuing 1km camera tows at 5km intervals moving west to east along the area of interest perpendicular to the depth contours. Six video tows were undertaken in total. All tows except for the first (FSC2) were largely similar, comprising coarse, shelly and sandy sediments amongst areas of cobbles and pebbles with occasional boulders. Typical fauna included encrusting sponges, occasional lamellate sponges, and pencil urchins.

Some tows (most notably FSC2 and FSC5) had clay/mud clumps present in places, and FSC2 appeared to be more characteristic of stony reef habitat present on the Wyville

Thomson Ridge, with fauna including very dense numbers of feather stars, urchins and anemones.

Following FSC7 at 06:00 hours, the cable became wrapped around the transponder resulting in cable damage. This was repaired but the camera still wasn't working. The cable termination was re-done three times but the problem was found not to be with the camera but the connection between the camera and the cable. Whilst it continued to be investigated, the mini-Hamon grab was prepared for deployment to collect samples for analysis at video stations FSC5 – FSC7. Grab samples were successfully collected at FSC5 and FSC7, consisting of sand, pebbles, and some clay in FSC7. Despite trying twice, no grab sample was successfully acquired at FSC6. The grab samples were preserved in formaldehyde and samples taken for Particle Size Analysis. Rock dredging at the location was going to be attempted, but the equipment needed repairing before deployment and so it was not attempted at this time in the survey.

Whilst undertaking grab samples, problems with setting the navigation files to the HiPaP were resolved, and so at 17:30 hours a decision was made to set up the side-scan sonar equipment to run lines between 450 and 500m depth contours in the area between the next batch of video tow survey locations. The purpose of this was to better inform the position of subsequent video tows. One hour of setting up time was required and between 18:30 and 24:00 hours side-scan tows were undertaken, totalling two lines c. 20km in length, swath width approximately 200m, fish 10% of swathe width above seabed, speed c. 3-4kn. Staff moved onto 3-hour watches from 12 hours, which was used for video tows.

Sunday 4th Nov

Side-scan sonar ran until 22:00 hours on Sunday 4th November, by which time an additional ~20km lines were acquired, totalling seven lines for the Faroe-Shetland Channel. This information was processed and used to inform the alteration of video sampling points in the area to correspond with features of interest. In total, processed side-scan sonar data informed the placement of three video tow lines. The justification behind this was that side-scan sonar initial processing showed three distinct types of seabed: swirling patches of mounds and ridges that may correlate to harder ground, several wavy vertical lines that gave a 'crinkled' appearance to the seabed that may correspond to sediment ripples, and vertical parallel lines that may correspond to areas of fishing activity. A representative tow line for each was undertaken, representing FSC14 for potentially harder ground, FSC15 for potential trawl marks, and FSC16 for wavy vertical lines with a 'crinkled' appearance.

Between 23:00 and 00:00, video tows re-commenced with Araldite being used to seal a faulty connection between the camera and the cable.

Monday 5th Nov

The repair on the camera held, and video tows continued throughout the 24 hour period. The 12 video tow stations remaining in the block of 20 for the area of interest were completed. As with previous tow locations, the seabed largely consisted of coarse and shelly sediments, with occasional boulders. Fauna included starfish, encrusting sponges, occasional lamellate and foliose sponges, some potential *Geodia* sponges and pencil urchins. Red banded fish, ling and chimera were also recorded.

Once camera tow work in the area of interest had been completed, the survey team evaluated the most sensible course of action for completing further survey work at the Faroe-Shetland sponge belt proposed NCMPA. Provisionally, previous video tows in the area of interest had not identified what would likely be classified as deep-sea sponge aggregations. On considering the value of further grab sampling, the SEA4 data processing contract completed by Bett (2012) provided a fair picture of the biotopes associated with sand and

gravel habitats of the Faroe-Shetland Channel, and Particle Size Analysis data provided by the British Geological Survey are fairly well distributed throughout the area.

As the primary objective of survey work in the Faroe-Shetland Channel was to collect further information on the distribution and extent of deep-sea sponge aggregations, we decided to continue with 5km interval, 1km long camera tows perpendicular to the contour lines and randomly distributed between 400 and 500m depth. An interval of approximately 15km was required between the original area of interest and the new area of interest 'FSC_B' because of the presence of oil fields and associated infrastructure. The 20 additional video tow locations selected included five repeat tows of verified deep sea sponge aggregation records from the original AFEN surveys to aid the development of condition monitoring.

Before the end of the day, the first four video tows in FSC_B (FSC_B1 - FSC_B4) were completed. The seabed was largely made up of gravelly sand with pebbles, cobbles and occasional boulders. Fauna included moderate numbers of lamellate and encrusting sponges, pencil urchins and star fish.

Tuesday 6th Nov

Video tows continued, completing FSC_B5 at 00:30. FSC_B5 consisted of gravelly sand with pebbles, cobbles and occasional boulders. Of all stations surveyed previously, this has notably greater densities of sponges, including lobose, lamellate and encrusting. After FSC_B5 a kink was noticed in the camera tow cable. Repair work was undertaken between 00:30 and 02:30, but a subsequent spell of bad weather meant no further work could be carried out until 12:30. At 12:30, we decided that completing a further 15 video tows before the next spell of bad weather (due at approximately 03:00 hours on 7th November) was too ambitious to complete, and so a sub-set of seven of the remaining 15 were selected based on covering the entirety of FSC_B but including two of the planned five repeat tows from the AFEN deep sea sponge aggregation data. Five of the sub-set of seven video tows were completed on 6th November, all comprising relatively large numbers of what are likely to be deep-sea sponge aggregations.

Wednesday 7th Nov

The two remaining planned video tows were completed by 02:30 hours. The rock dredge, which was previously broken, was repaired and used to take a sample from FSC_B 11. Unfortunately, taking the sample broke the rock dredge again and so only one sample could be taken. With bad weather coming in as planned at 03:00 hours, only one sample could be collected in the time available. The sample included some sponges, most probably *Phakellia*.

Bad weather was forecast to continue from 03:00 hours on 7th November until we were due to leave site at 24:00hours on 7th November. As such, a decision was made to begin transiting back to Aberdeen but with the option to conduct some survey work focussed on the horse mussel beds at Noss Head (one of SNH's bad weather alternative survey sites) weather permitting. We arrived at Noss Head at 22:30 hours and began undertaking multibeam work over the extent of the Noss Head proposed NCMPA just after midnight.

Thursday 8th Nov

Multibeam continued from just after midnight on 7th November until 7:30 hours. In total, eight lines were collected, each approximately 6.5km in length. All were reported as high quality. At 07:30 we set up the mini-Hamon grab to sample the horse mussel bed community at Noss Head as advised by SNH. We began grab sampling at 08:15 hours and in total five grab samples were attempted (two at the same site), of which three were successful. Contents of the successful grabs were largely similar, with shelly and coarse sands. Fauna included clams, rag worms and tube worms. However, no horse mussels were collected. This may be due to positioning problems with the ship. Grab sampling finished at 09:30 hours and we

began transiting back to Aberdeen via the Southern Trench where multibeam equipment was calibrated between 14:30 and 16:30 hours. We arrived into Aberdeen at 21:00 hours to complete the cruise.

7 Results

7.1 Overview

Sixty-one drop-frame camera transects, 17 side-scan sonar lines, five mini-Hamon grabs, one rock dredge and 105 km^2 of multibeam data were collected (Figure 10).

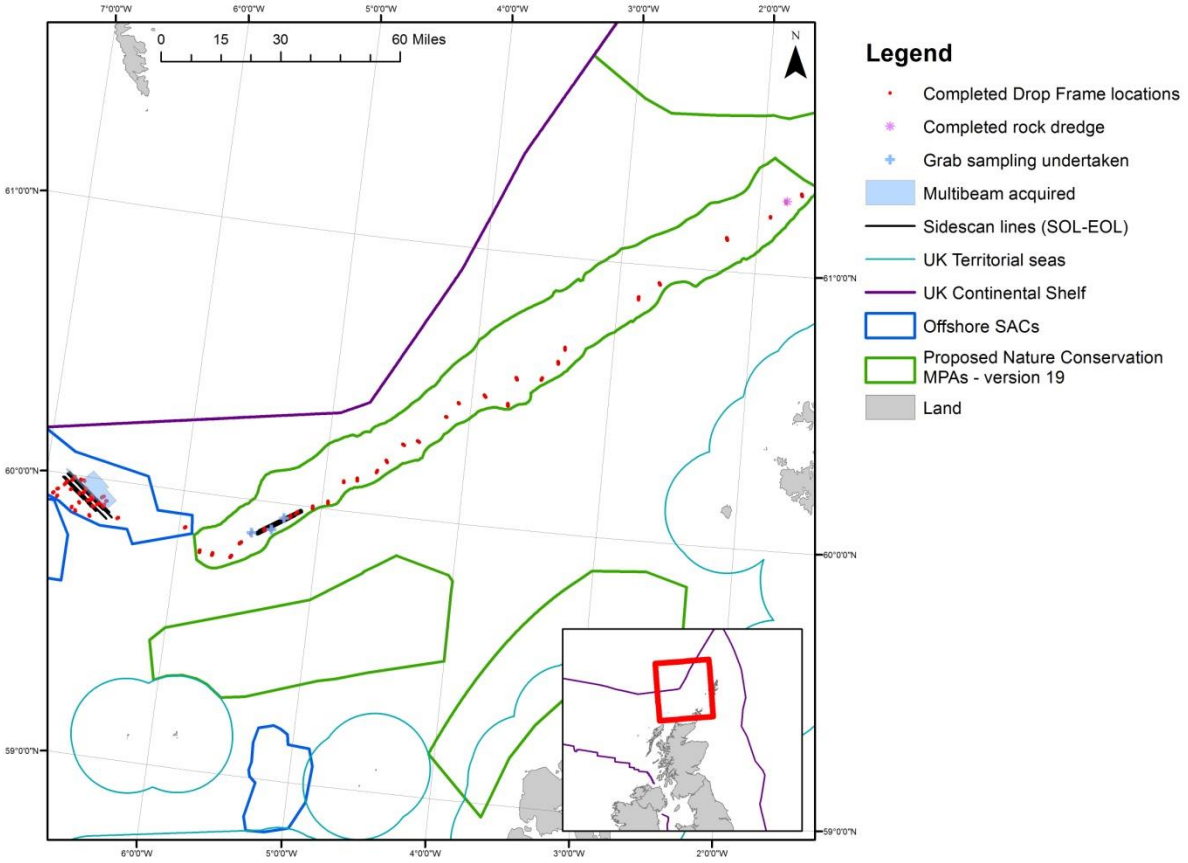


Figure 10: Summary of stations successfully sampled.

7.2 Data collected

7.2.1 Multibeam Coverage Acquired on Wyville Thomson Ridge

105km^2 of multibeam data were acquired over the shallowest section of Wyville Thomson Ridge (Figure 11).

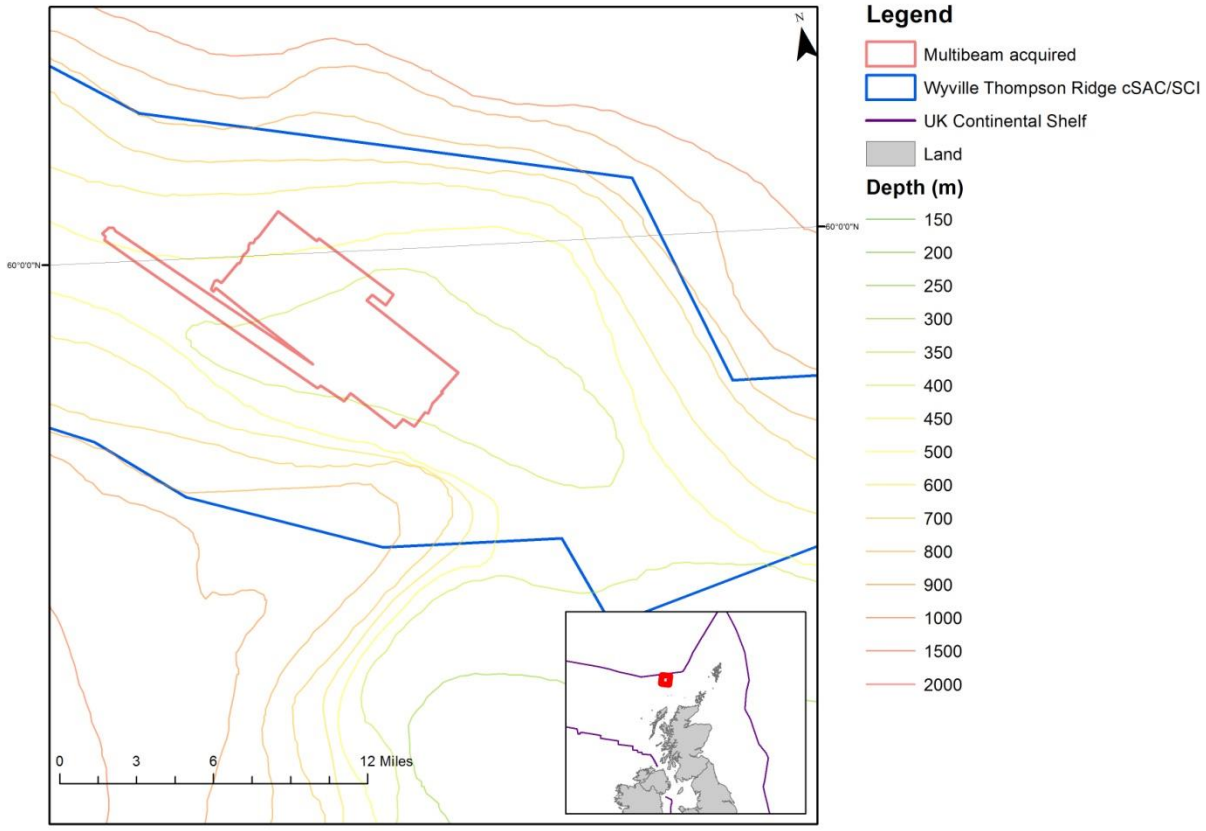


Figure 11: Extent of multibeam data acquired within Wyville Thomson Ridge cSAC/SCI.

7.2.2 Completed Video Tows on Wyville Thomson Ridge

Video and stills imagery data were successfully collected at 29 locations (Figure 12).

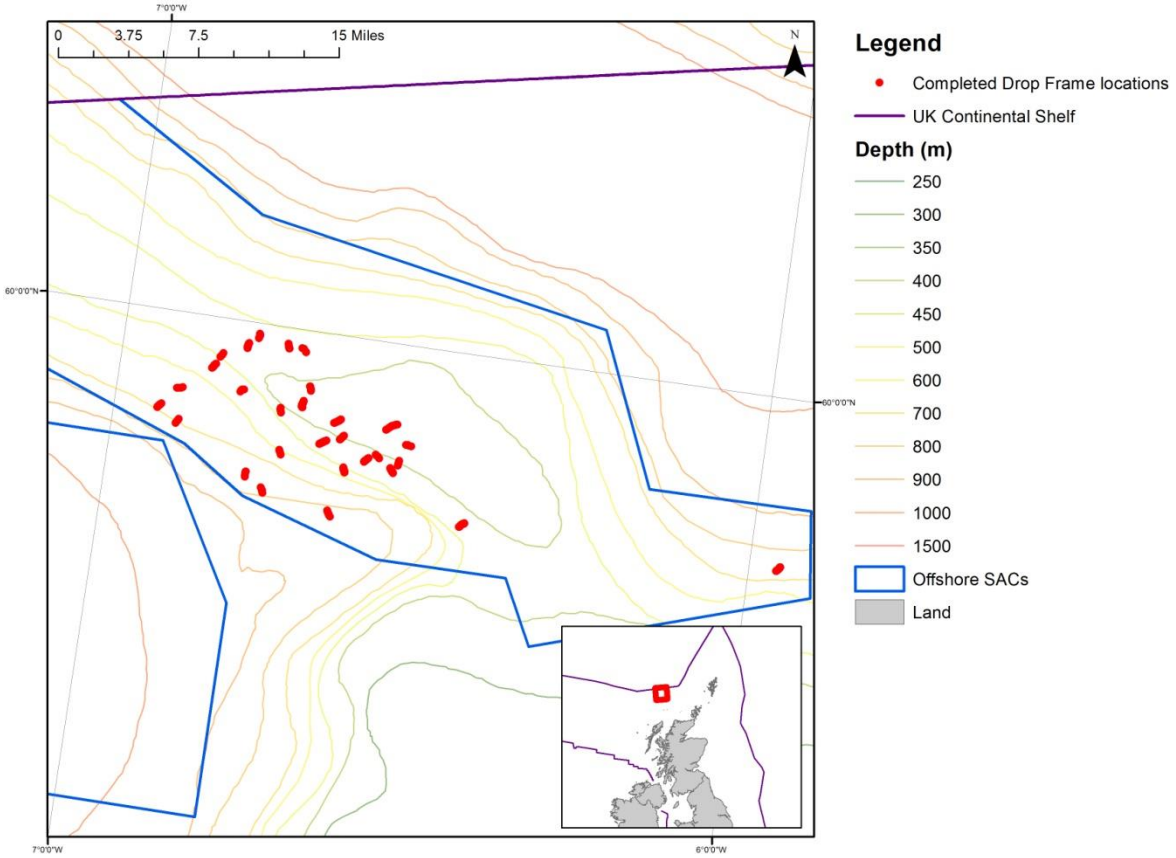


Figure 12: Completed drop-frame locations with Wyville Thomson Ridge cSAC/SCI.

7.2.3 Completed Video Tows in Faroe-Shetland Sponge Belt Proposed NCMPA

Video and stills imagery data were successfully collected from 32 stations within the Faroe-Shetland Sponge Belt (FSSB) proposed NCMPA (Figure 13).

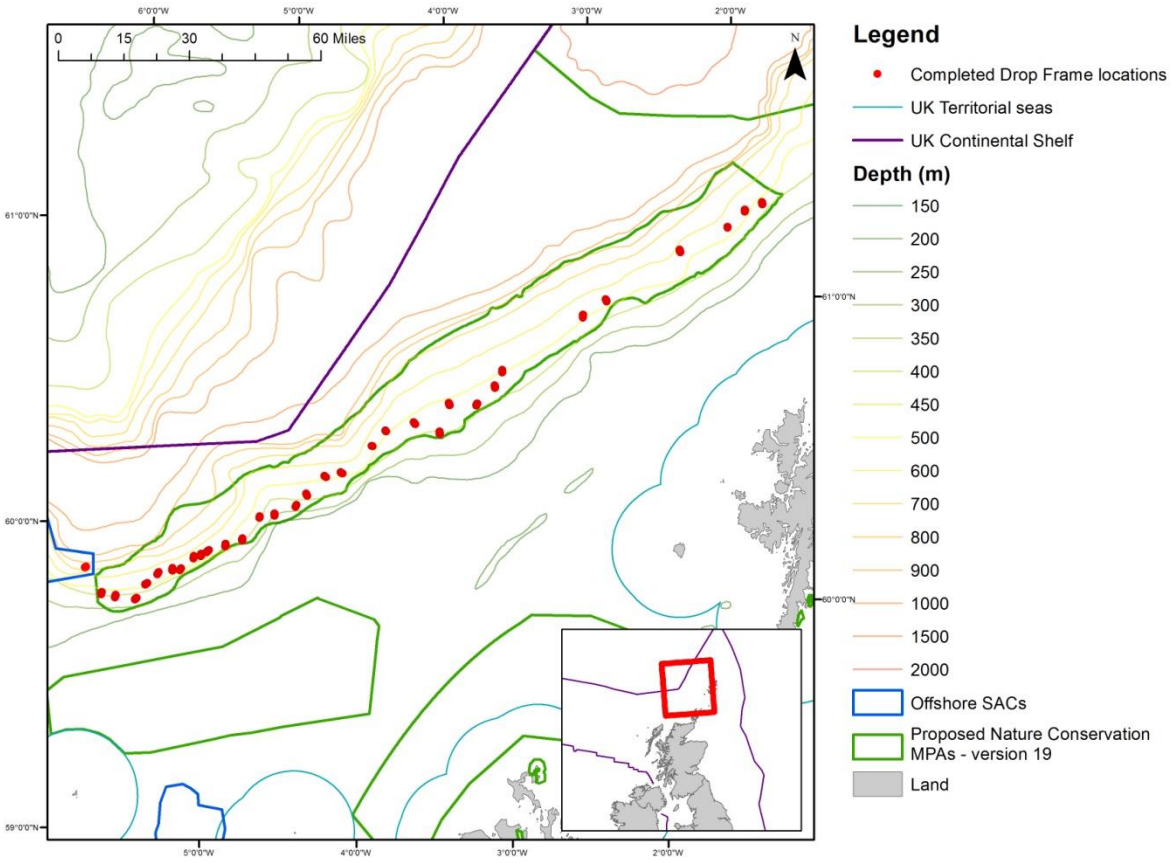


Figure 13: Completed drop-frame stations within FSSB proposed NCMPA.

7.2.4 Completed Side-scan Sonar Lines on Wyville Thomson Ridge

Ten side-scan sonar lines were obtained within the Wyville Thomson Ridge cSAC/SCI boundary (Figure 14).

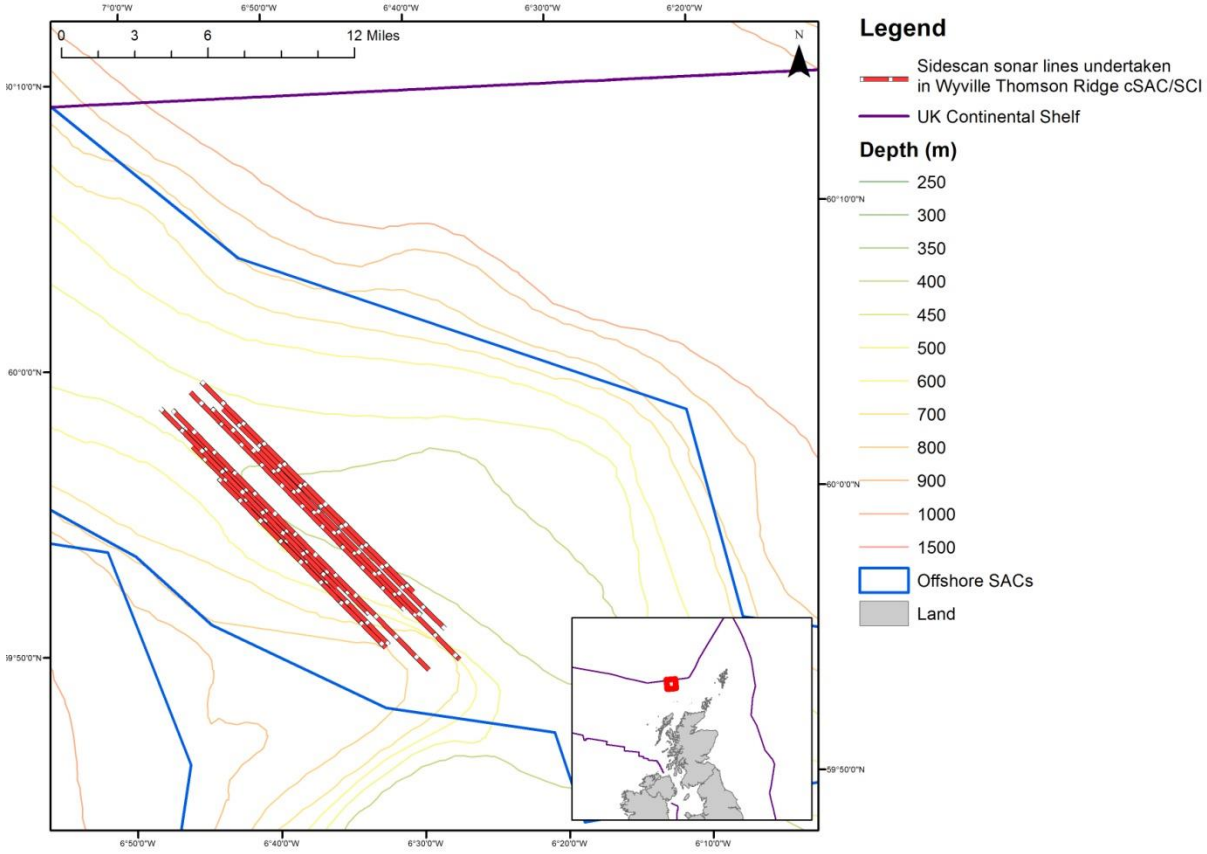


Figure14: Side-scan sonar lines undertaken in Wyville Thomson Ridge cSAC/SCI.

7.2.5 Completed Side-scan Sonar Lines in Faroe-Shetland Sponge Belt Proposed NCMPA

Seven side-scan sonar lines were completed within the Faroe-Shetland Sponge Belt (FSSB) proposed NCMPA (Figure 15).

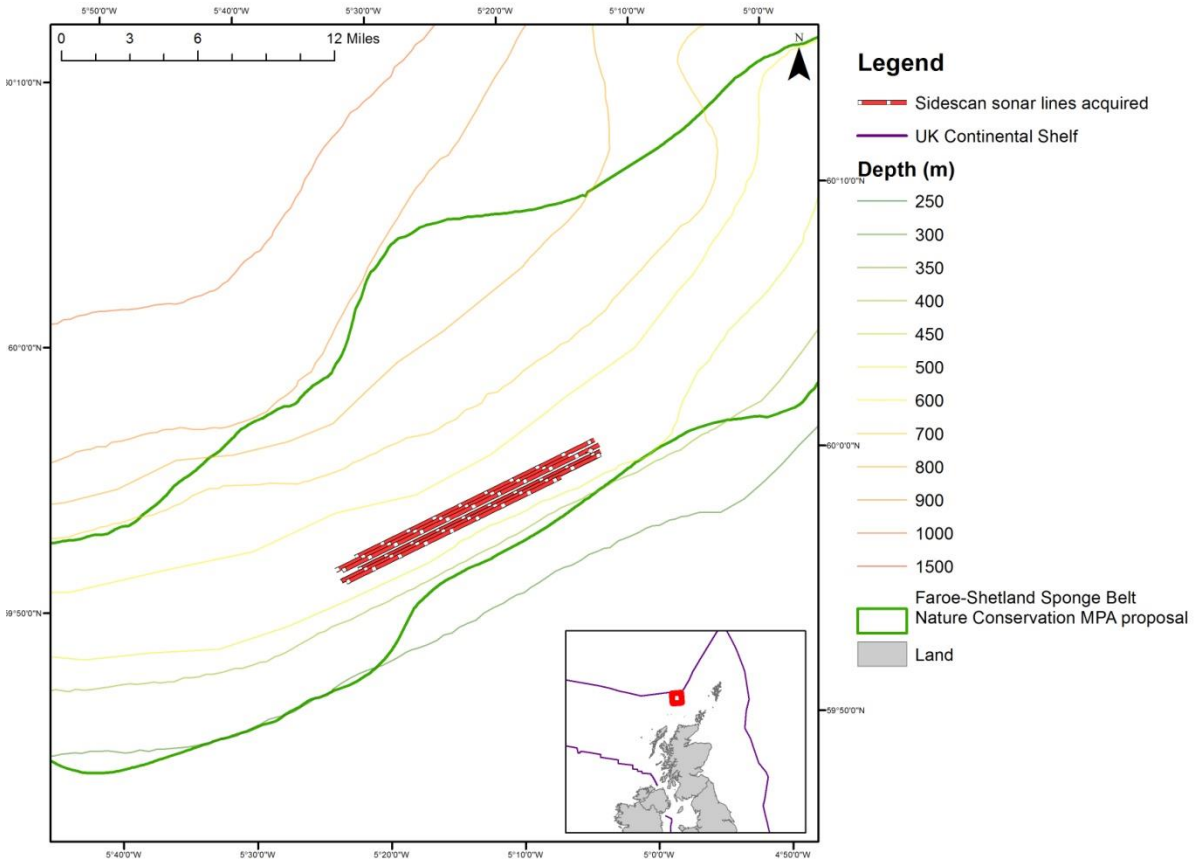


Figure 15: Side-scan sonar lines obtained within the FSSB proposed NCMPA.

7.2.6 Completed Mini-Hamon Grab Sampling and Rock Dredge in Faroe-Shetland Sponge Belt Proposed NCMPA

Three grab samples and one rock dredge sample were obtained within the FSSB proposed NCMPA (Figure 16).

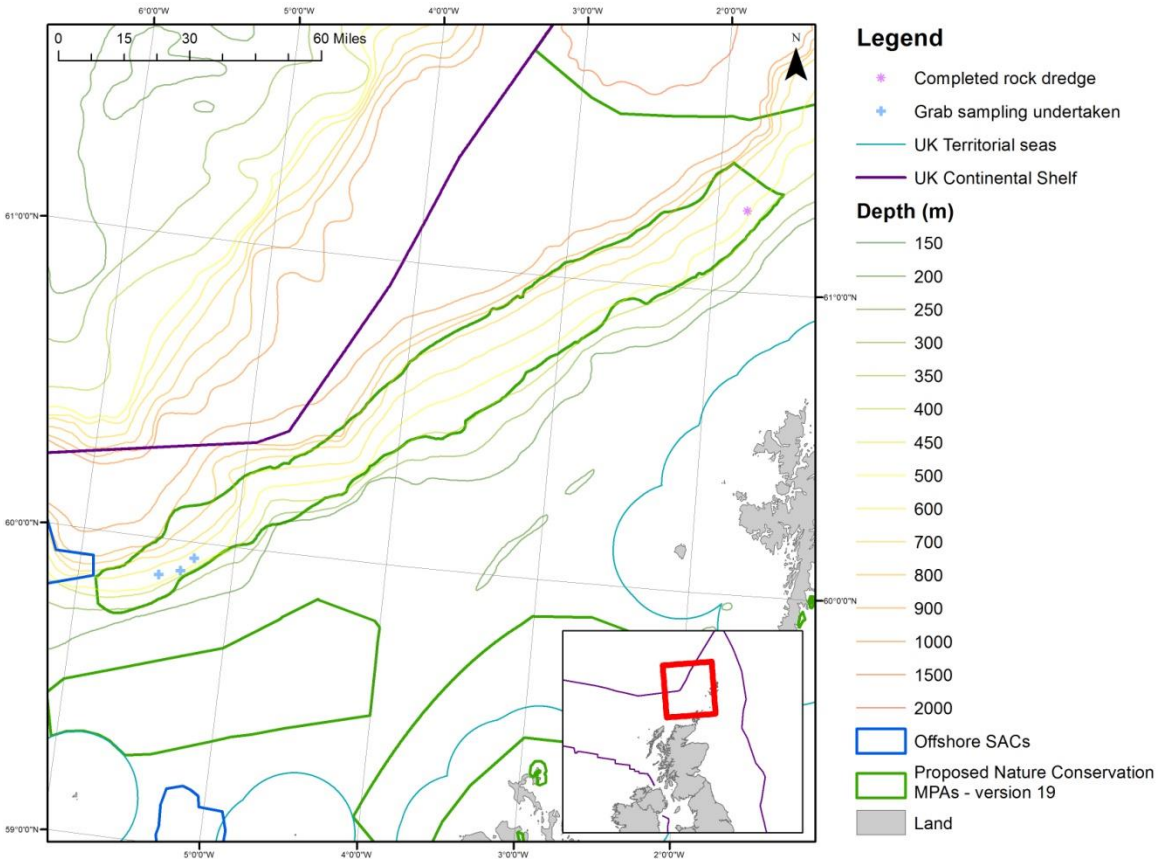


Figure 16: Mini-Hamon grab and rock dredge samples acquired in the FSSB proposed NCMPA.

7.2.7 Completed Grab Sampling at Noss Head

Three mini-Hamon grab samples were undertaken adjacent to the Noss Head proposed NCMPA (Figure 17).

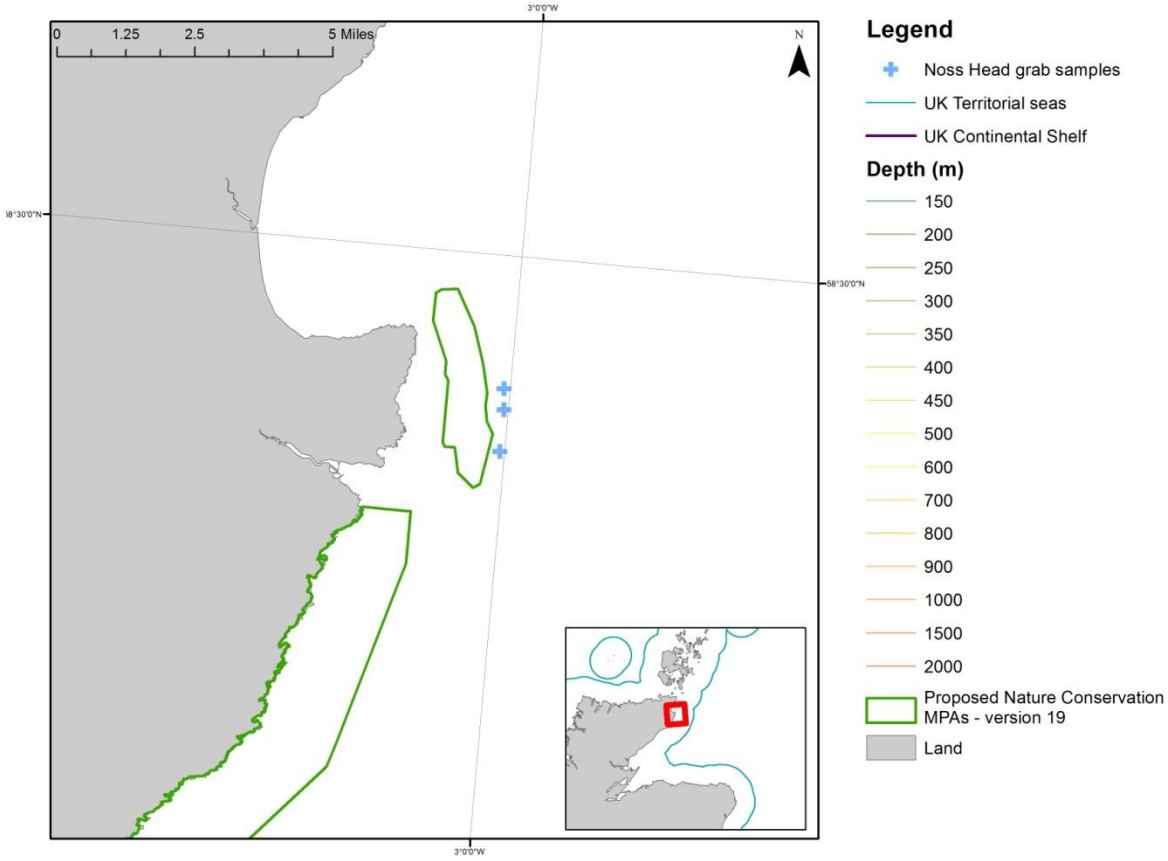


Figure 17: Mini-Hamon grab sample locations off Noss Head.

8 Data Formats

Data Type	Raw Format	Converted To	Saved
High Definition Video UoP HD camera	.mp4	n/a	Electronically
Standard Definition Video	.vob	.avi	DVD, mini DV tape
Stills	.jpeg	n/a	Electronically
Sound Velocity Profile	.svp	n/a	Electronically
HiPaP	.txt	.xls	Electronically
Metadata	.xml	n/a	Electronically

9 Quality Control (QC)

9.1 Positioning

A USB-Comms adaptor was used to link ArcGIS to the ship's dGPS feed to record ship's position.

'Fixes' were recorded in ArcGIS for each still image taken by the camera.

Length of cable paid out, seabed and towfish depths were logged regularly during side-scan operations to enable layback to be used in case of HiPaP failure. The start and end locations, plus depth, were recorded during drop-frame video transects.

A HiPaP system with acoustic transponders was employed to obtain accurate drop-frame and side-scan positioning.

The ship's positioning was linked to the HiPaP log positioning using time stamps recorded.

During the cruise, there were a number of problems experienced with the recording of data from the HiPaP system. These issues occurred due to a combination of system, transponder and human error. A log of HiPaP numbers used during drop frame and side-scan operations can be found in Appendixes 7 and 10.

10 Human Activity

10.1 Wyville Thomson Ridge

At the Wyville Thomson Ridge, camera video tows supported the presence of possible trawl marks from stations VTR2, VTR4, VTR22 and VTR24. An example is shown in Figure 19. In addition, rope is visible on the seafloor in VTR1, VTR6, VTR14 and VTR28 and there is possibly a plastic bottle in VTR23. Examples are provided in Figure 20. An overview of the locations where potential anthropogenic impacts were observed is shown in Table 2 and Figure 18.

Table 2: Potential anthropogenic impacts observed.

Station No.	Date	Anthropogenic impact
VTR1	28/10/2012	Rope visible on seafloor
VTR2	28/10/2012	Possible trawl scar
VTR4	01/11/2012	Possible trawl scar
VTR6	01/11/2012	Rope visible on seafloor
VTR14	02/11/2012	Rope visible on seafloor
VTR22	02/11/2012	Possible trawl scar
VTR23	02/11/2012	Possible plastic bottle
VTR24	02/11/2012	Possible trawl scar
VTR28	02/11/2012	Rope visible on seafloor

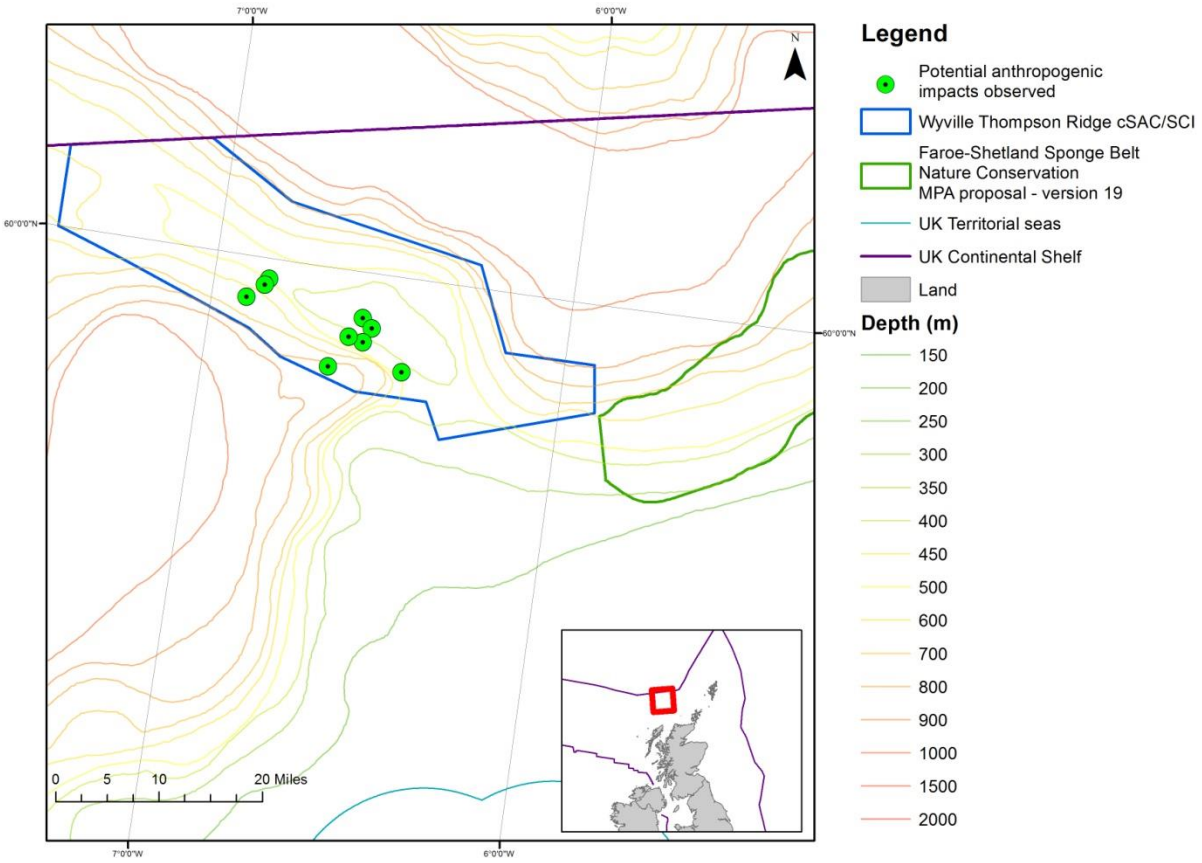


Figure 18: Potential and observed anthropogenic impacts within Wyville Thomson Ridge cSAC/SCI.

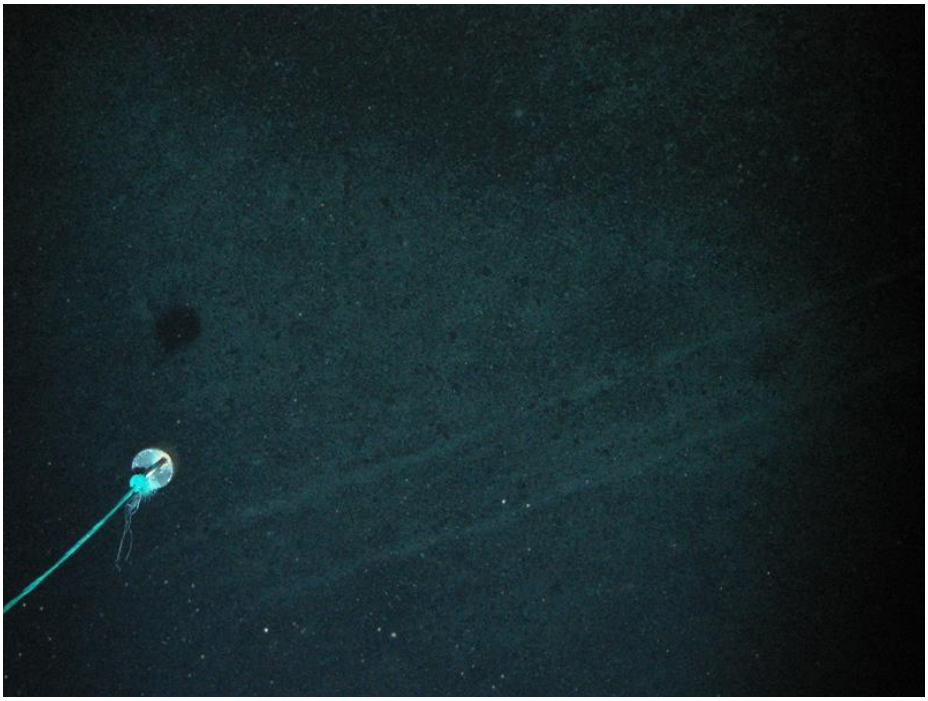


Figure 19: Example trawl track from south-west of the Wyville Thomson Ridge cSAC/SCI.

Figure 20: Various anthropogenic debris on the seabed identified within the Wyville Thomson Ridge cSAC/SCI.

10.2 Faroe-Shetland Channel

At the Faroe-Shetland Channel, camera video tows supported the presence of possible trawl marks from stations FSC9, FSC10, FSC15 and FSC18. In addition, rope is visible on the seafloor in FSC_B4, rusted cable in FSC17 and what appears to be a piece of pipe in FSC15 (all pictured in Figure 22). An overview of the locations where potential anthropogenic impacts were observed is shown in Table 3 and Figure 21.

Side-scan sonar of the Faroe-Shetland Channel slope between 460-510m supported the presence of possible trawl marks in all seven transect lines. However, this is very uncertain as they may represent sediment ripples or another type of natural feature on the seabed. It is notable however that FSC15 (a camera transect selected from an area of side-scan sonar data containing possible trawl scars) did appear to show trawl marks on the video footage.

Table 3: Potential anthropogenic impacts observed.

Station No.	Date	Anthropogenic impact
FSC9	05/11/2012	Possible trawl scar
FSC10	05/11/2012	Possible trawl scar
FSC15	05/11/2012	Possible trawl scar
FSC15	05/11/2012	Discarded piece of pipe
FSC17	05/11/2012	Rusted cable on seafloor
FSC18	05/11/2012	Possible trawl scar
FSC_B4	05/11/2012	Rope visible on seafloor

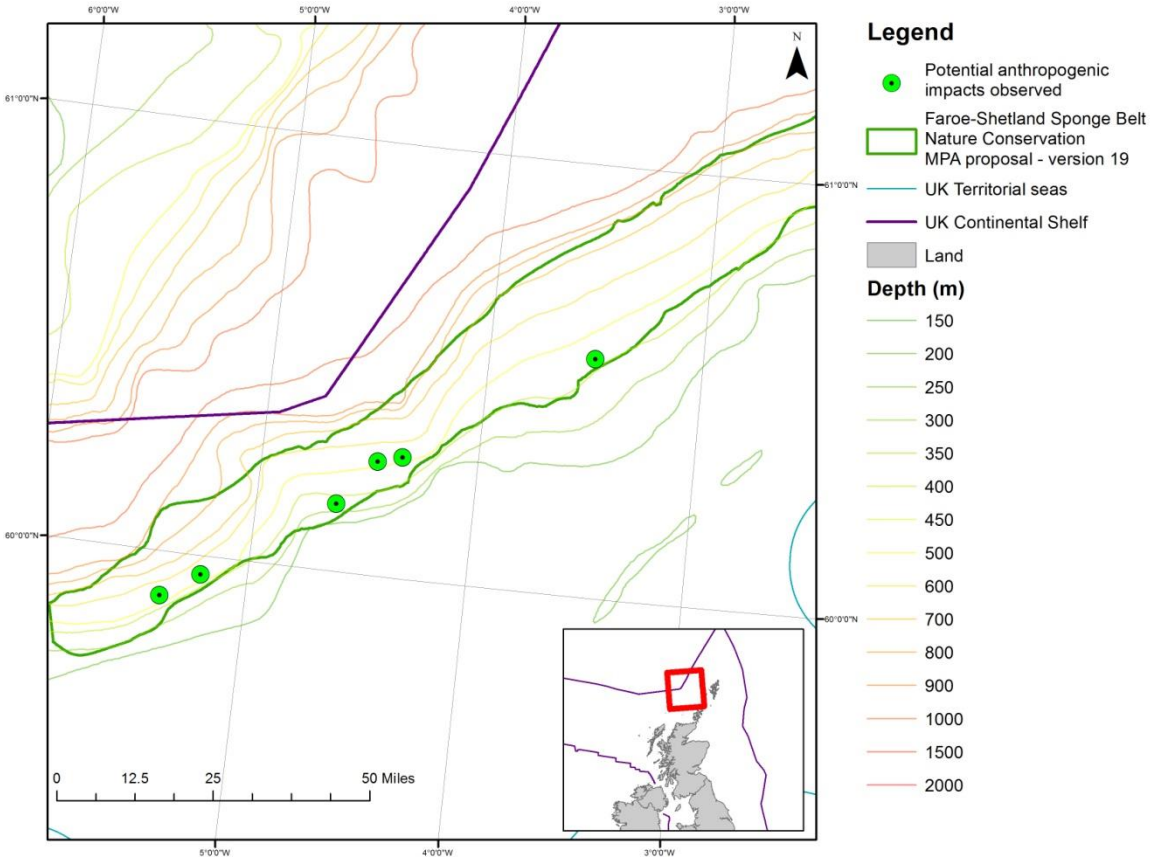


Figure 21: Location of potential and observed anthropogenic impacts within the FSC proposed NCMPA.

Figure 22: Various anthropogenic debris on the seabed identified within the Faroe-Shetland Sponge Belt proposed NCMPA.

11 H&S Events

No unplanned H&S incidents occurred.

One safety drill was undertaken.

A ‘general muster’ was held at 15:00 on 25th October 2012.

12 Intellectual Property and confidentiality

Rights to all knowledge (including but not limited to data, information, know-how, designs, drawings and specifications) brought to the project by either party (JNCC or MSS) will remain with that party, and such knowledge is to be used solely for the purposes of conducting this project. Rights to knowledge jointly generated within the project will be jointly owned by JNCC and MSS.

The project is publicly funded and all knowledge generated within the project will be made publicly available under Open Government Licence (http://www.nationalarchives.gov.uk/doc/open-government-licence/version/2/).

Data must be accompanied by the following statement:
“Contains Joint Nature Conservation Committee and Marine Scotland Science materials ©JNCC/MSS 2012/2013”

13 References

Bett, B.J. 2000. Benthic ecology of the Faeroe-Shetland Channel. Section 4.3.1 in Environmental Surveys of the Seafloor of the UK Atlantic Margin, Atlantic Frontier Environmental Network [CD-ROM]. ISBN 09538399-0-7. Available from Geotek Limited, Daventry, UK.

Bett, B.J. 2012. Seafloor biotope analysis of the deep waters of the SEA4 region of Scotland's seas. *JNCC Report No. 472*, JNCC, Peterborough.

Coggan, R., Mitchell, A., White, J. & Golding, N. 2007. Recommended operating guidelines (ROG) for underwater video and photographic imaging techniques. MESH. http://www.searchmesh.net/PDF/GMHM3_Video_ROG.pdf.

Henry, L-A. & Roberts, J.M. 2004. The biodiversity, characteristics and distinguishing features of deep-water epifaunal communities from the Wyville Thomson Ridge, Darwin Mounds and Faeroes Plateau. Draft Final Report to the Atlantic Frontier Environmental Network, AFEN, UK.

Howell, K.L., Davies, J.S., Hughes, D.J. & Narayanaswamy, B.E. (2007) Strategic Environmental Assessment / Special Area for Conservation Photographic Analysis Report. Department of Trade and Industry, Strategic Environmental Assessment Report, UK

JNCC. 2004b. UK Guidance on defining boundaries for marine SACs for Annex I habitat sites fully detached from the coast [online]. JNCC, Peterborough. Available from: http://www.jncc.gov.uk/pdf/SACHabBoundaryGuidanceFinal.pdf.

JNCC, 2010. Wyville Thomson Ridge SAC Selection Assessment: Version 6.0. http://jncc.defra.gov.uk/PDF/WTR_SACSAD_v6_0.pdf

Masson, D., Bett, B.J. & Jacobs, C.J. 2000. White Zone DTI marine surveys 1999. Preliminary Report. Commercial in Confidence.

APPENDIX 1: Vessel and Equipment Used - Additional Information

Vessel

For more information on MRV Scotia, please see:
http://www.scotland.gov.uk/Topics/marine/science/scienceops/vessels-technology/vessels/scotia

Kongsberg HiPaP Acoustic Transponder

For information on the HiPaP system used, please see:
http://www.km.kongsberg.com/ks/web/nokbg0240.nsf/AllWeb/FF57C18363FAD917C1256A7E002B9F2F?OpenDocument

APPENDIX 2: Equipment Configuration and Calibration

Camera

Camera	Viewing angle (nominal) deg	Viewing angle Horizontal (deg)	Viewing angle Vertical (deg)	Aspect Ratio	Field width (mm) at range 1.5m	Field height (mm) at range 1.5m
Insite Pegasus zoom **(TV)**	63 (diagonal)	Not recorded	Not Recorded	4:3	Not Recorded	Not Recorded
Kongsberg DSC OE14-208 **(Digital Stills)**	62 (diagonal)	50.5	38	4:3	1350	1044

Digital Stills Camera configuration	
Focus	1.5m (fixed)
Aperture	f5.6
Mode	Aperture Priority
ISO	200
Flash	1/8 +1
Resolution	“Superfine” JPEG

Other

- Application of cruise calibrations to conductivity, temperature and depth sensor data is not required as manufacturers calibration coefficients are applied as the data is recorded.
- HiPaP system did not require calibration.

APPENDIX 3: Navigation Data

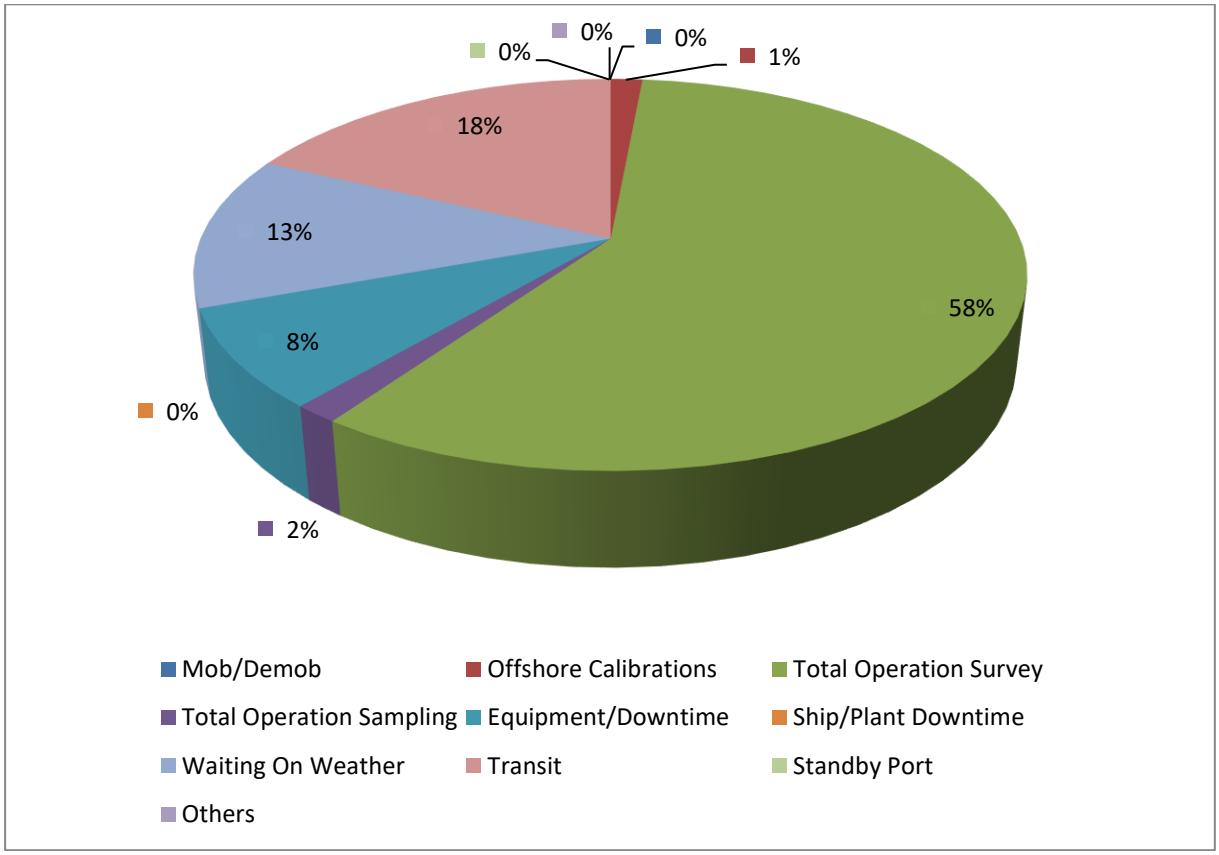
Navigation data (ships position) is from the vessels main system (VMS). Offsets were not applied.

Positional data for the side-scan and drop frame was supplied from the HiPaP system and used to correct the navigational data from the ship for the drop-down instrument.

Vessel heading was supplied from the ships navigational system.

APPENDIX 4: Breakdown of Survey Operation Time

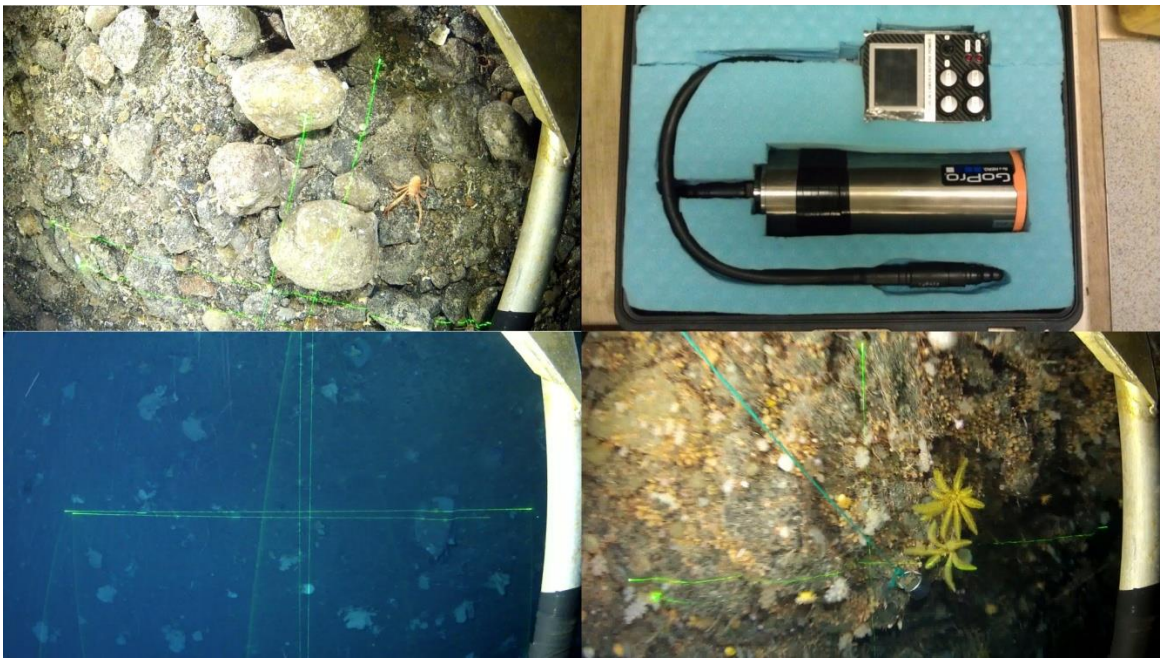
Activity	Hours Spent
Mob/Demob	00:00
Offshore Calibrations	05:09
Total Operation Survey	204:37
Total Operation Sampling	05:15
Equipment/Downtime	28:33
Ship/Plant Downtime	00:00
Waiting On Weather	44:26
Transit	63:00
Standby Port	00:00
Others	00:00
Total:	351:00



APPENDIX 5: Plymouth University Experimental HD Camera

An experimental low-cost HD camera developed by Marcus Shirley and Kerry Howell of Plymouth University was deployed along with the standard drop-frame equipment on 10 tows. The HD camera comprised a modified GoPro HeroCam v2 within a reclaimed 2000m rated housing cylinder. The system was modified with an added heating element, secondary battery supply and a 10-pin output with waterproof cap allowing the control of the camera and download of footage via USB to be performed using a handset without opening the housing.

This trial deployment was considered a success, producing high-quality wide-angle footage, although it should be noted that the drop-frame is probably not the ideal mount for this camera, as it would perform better at slower speeds or oblique angle mounting, and with additional lighting.



Clockwise from top right: The HD Camera and the controller handset; frame grab from WTR_VTR29 (repeat of SEA7 transect WTR_4) detailing the point focus on the *Helimotera glacialis* and surrounding blur that occurred with the drop frame system motion which could not be avoided with this setup; frame grab from FSC_B7 showing the benefits of a wide angle lens in assessing density, here of lamellate sponges cf *Phakellia* sp., and providing context to the close up images; frame grab from the first dive WTR_VTR1, showing the quality of a single frame if the drop frame is landed and stays still long enough.

The HD camera was deployed on Wyville Thomson Ridge transects VTR1, VTR3, VTR4, VTR5, VTR7, VTR9 (although footage of this dive may be corrupt), VTR28 (repeat of SEA7 2006 transect WTR2), VTR29 (repeat of SEA7 2006 transect WTR4) and Faroe-Shetland Channel transects FSC_B2 and FSC_B7.

Original content was created pre-GDPR and has been removed as contained personal information. No scientific or technical content has been removed.

APPENDIX 7: Survey Metadata - Summary Version

Table 4: Summary of camera tows undertaken at the Wyville Thomson Ridge plateau (<350m). Start/end latitude and longitude recorded as ships position.

Tow reference	HiPaP no.	Tow length (m)	Depth range (m)	Tow length (mins)	Start (Lat/Long)	End (Lat/Long)	Brief summary	Frequency of photos	Number of photos[14]
VTR1	2	1000	334-338	72	59.938696, -6.561045	59.933054, -6.579769	Targeted channel/iceberg ploughmark feature from multibeam. Boulders/cobbles grading to coarse gravel and pebbles, little fauna, mostly squat lobsters, pencil urchins, a few sponges and ling.	20 secs	218
VTR2	3	500	345-350	17	59.923172, -6.537827	59.923961, -6.548344	Targeted channel/iceberg ploughmark feature from multibeam. Habitat as above, but with more pebbles and gravel and less visible fauna.	20 secs	59
VTR3	4	500	339-347	13	59.983128, -6.718548	59.986674, -6.7257	X shaped channel/ploughmark feature targeted from multibeam. Habitat very similar to VTR2.	20 secs	43

[14] Excludes clapper board photo.

Table 5: Summary of camera tows undertaken south-west of the Wyville Thomson Ridge. Start/end latitude and longitude recorded as ships position.

Tow reference	HiPaP no.	Tow length (m)	Depth range (m)	Tow length (mins)	Start (Lat/Long)	End (Lat/Long)	Brief summary	Frequency of photos	Number of photos[15]
VTR4	23	500	902-903	27	59.864827, -6.65132	59.860545, -6.645577	Mixed gravelly and sandy sediments with occasional cobbles and boulders. Fauna include urchins, sponges and crustaceans	20 secs	79
VTR5	24	500	355-377	15	59.911534, -6.553347	59.906917, -6.553974	Mixed gravelly and sandy sediments with occasional cobbles and boulders. Fauna include pencil urchins and ling	20 secs	47
VTR6	25[16]	500	428-469	15	59.904545, -6.565243	59.900779, -6.559676	Gravelly sand with common cobbles and boulders. Fauna include encrusting sponges and pencil urchins	20 secs	45
VTR7	26	500	395-407	17	59.913212, -6.591266	59.910448, -6.583124	Gravelly sand with common cobbles and boulders. Fauna include pencil urchins and rabbit fish	20 secs	45
VTR8	27	500	624-694	18	59.90002, -6.636823	59.895884, -6.633593	Pebbly sand with cobbles and boulders and encrusting sponges. Other fauna include ling and pencil urchins	20 secs	51
VTR9	28	500	86-88	19	59.875384, -6.757293	59.870949, -6.753188	Pebbly sand with occasional cobbles and boulders. Fauna include squat lobsters and occasional sponges.	20 secs	51
VTR10	29	500	820-847	18	59.885872, -6.783582	59.881038, -6.78388	Pebbly sand with occasional cobbles and boulders. Fauna include pencil urchins and a black urchin.	20 secs	47
VTR11	30	500	625-683	19	59.906009, -6.738005	59.902031, -6.734257	Fine sand with cobbles and occasional boulders. Fauna include occasional squat lobsters and sponges.	20 secs	35
VTR12	31	500	459-483	22	59.946984, -6.711272	59.940833, -6.712233	Coarse pebbly and cobbly seabed with common boulders, interspersed with patches of sandy and mixed sediments. Fauna include many	20 secs	66

[15] Excludes clapper board photo.
[16] VTR6 - HiPaP recording had to be restarted approx 7 mins into deployment.

							encrusting sponges, anemones and pencil urchins. Possible patch of *Lophelia*.		
VTR13	32	500	356-412	19	59.936011, -6.650808	59.932581, -6.660145	Coarse pebbly and cobbly seabed with common boulders, interspersed with patches of sandy and mixed sediments. Fauna include encrusting sponges, anemones and pencil urchins.	20 secs	47
VTR14	33	500	492-585	18	59.909545, -6.600362	59.906261, -6.606495	Coarse pebbly and cobbly seabed with common boulders. Fauna include many encrusting sponges, anemones and pencil urchins.	20 secs	58
VTR15	34[17]	500	443-487	17	59.923848, -6.642586	59.92053, -6.647815	Coarse pebbly and cobbly seabed with common boulders. Fauna include many encrusting sponges, anemones and pencil urchins	20 secs	51
VTR16	35	500	547-599	24	59.918193, -6.668094	59.914959, -6.678103	Coarse pebbly and sandy sediment with occasional boulders. Fauna include leather corals, encrusting sponges, anemones and pencil urchins	20 secs	75
VTR17	36	500	554-568	15	59.938359, -6.744889	59.933105, -6.743774	Coarse sandy sediments with occasional boulders and cobbles. Sparse fauna of occasional sponges and pencil urchins	20 secs	49
VTR18	37	500	350-358	15	59.954121, -6.702449	59.95816, -6.705345	Pebbly and cobbly sediments with occasional boulders. Fauna include crabs, squat lobsters, sponges and pencil urchins	20 secs	48
VTR19	38	500	373 only	17	59.983959, -6.744703	59.988387, -6.74736	Coarse sandy sediments with occasional boulders and cobbles. Sparse fauna of squat lobsters, pencil urchins and anemones. Several ling	20 secs	55
VTR20	39	500	429-433	14	59.98815, -6.793692	59.992651, -6.793348	Pebbly and cobbly sediments with occasional boulders. Fauna include encrusting sponges, squat lobsters, anemones and pencil urchins	20 secs	41
VTR21	40	500	462-487	12	59.979447, -6.808756	59.983738, -6.807445	Cobbly, pebbly and sandy sediments with common boulders. Fauna include red urchins and anemones and sponges on and between	20 secs	39

[17] VTR15 - on corrupted floppy, not recovered.

							boulders and cobbles. A number of starfish also present.		
VTR22	41	500	610-614	15	59.969075, -6.847956	59.973716, -6.843968	Sandy sediments with occasional cobbles and boulders. Sparse fauna include encrusting sponges and squat lobsters.	20 secs	46
VTR23	42	500	605 only	15	59.96456, -6.852554	59.960654, -6.858151	Sandy sediments with occasional cobbles and boulders. Sparse fauna include pencil urchins	20 secs	41
VTR24	43	500	682-696	19	59.942675, -6.898124	59.941461, -6.907235	Sandy sediments with occasional cobbles and boulders. Sparse fauna include pencil urchins and encrusting sponges.	20 secs	53
VTR25	44	500	775-789	20	59.918571, -6.896561	59.914394, -6.901178	Sandy sediments with occasional pebbles and boulders. Fauna includes white sponges of *Phakellia* and pencil urchins	20 secs	58
VTR26	45	500	747-760	20	59.927992, -6.926674	59.924461, -6.932397	Sandy and pebbly sediments with occasional cobbles and boulders. Fauna includes what may be *Lophelia* and gorgonians on boulders, encrusting sponges, massive sponges and pencil urchins	20 secs	52
VTR27B[18]	47	500	579-596	13	59.998483, -6.811017	59.948133, -6.8029	Sandy and pebbly sediments with occasional cobbles and boulders. Fauna includes pencil urchins and encrusting sponges	20 secs	51

Table 6: Summary of repeat SEA7 camera tows undertaken east of the Wyville Thomson Ridge. Start/end latitude and longitude recorded as ships position.

Tow reference	HiPaP no.	Tow length (m)	Depth range (m)	Tow length (mins)	Start (Lat/Long)	End (Lat/Long)	Brief summary	Frequency of photos	Number of photos[19]
VTR28	48	500	668-712	21	59.87068, -6.440074	59.867171, -6.447439	Cobbly seabed with patches of sand and numerous boulders, Fauna include *Lophelia* and *Madrepora*, lobose sponges, encrusting sponges, anemones and pencil urchins	20 secs	60

[18] VTR27A was aborted due to a technical issue with the stills camera. The drop frame was recovered before being deployed again at the same station.
[19] Excludes clapper board photo.

VTR29	49	500	632 only	20	59.870796, -5.951444	59.867114, -5.957295	Rocky sediments with many soft corals, hydroids, brittlestars, feather stars and *Lophelia*	20 secs	58

Table 7: Summary of camera tows undertaken south-west of the Faroe-Shetland Sponge Belt proposed NCMPA. Start/end latitude and longitude recorded as ships position.

Tow reference	HiPaP no.	Tow length (m)	Depth range (m)	Tow length (mins)	Start (Lat/Long)	End (Lat/Long)	Brief summary	Frequency of photos	Number of photos[20]
FSC1	50	1000	491-537	19	59.794206, -5.8277	59.785715, -5.828254	Occasional feather stars and yellow encrusting sponges on dense cobbles with occasional sand patches. Occasional lamellate and lobose sponges	20 secs	44
FSC2	51[21]	1000	552-565	32	59.790933, -5.73394	59.781976, -5.737232	Common feather stars on dense cobbles with occasional sand patches. Occasional massive lobose sponges	20 secs	60
FSC3	52	1000	443-445	17	59.783319, -5.606127	59.790081, -5.59667	Sandy to coarse sediments with pebbles and occasional boulders with encrusting sponges	20 secs	37
FSC4	53	1000	498-513	24	59.83613, -5.551679	59.8433, -5.539973	Sandy to coarse sediments with pebbles and occasional boulders with encrusting sponges. Occasional sediment ripples	20 secs	48
FSC5	54	1000	519-530	25	59.875688, -5.481212	59.883971, -5.474138	Sandy to coarse sediments with pebbles and occasional boulders with encrusting sponges. Occasional lamellate sponges	20 secs	40
FSC6	55	1000	450-455	16	59.897304, -5.337868	59.905507, -5.330359	Sandy and coarse sediments, occasional squat lobsters and pencil urchins	20 secs	44
FSC7	56	1000	481-509	28	59.94233, -5.259001	59.951564, -5.258904	Sandy to coarse sediments with pebbles and occasional boulders with encrusting sponges. Occasional squat lobsters and pencil urchins	20 secs	44
FSC8	67	1000	503-489	24	59.976808, -5.164407	59.968404, -5.178197	Ripples in compacted fine sand, pencil urchins and occasional encrusting sponges on rocks	1 per min	25

[20] Excludes clapper board photo.
[21] FSC2 - Not recorded. Only short data set at point of recovery. May be able to use as general offset for the whole deployment.

FSC9	68	1000	479-498	30	59.961763, -5.211812	59.952838, -5.211834	Rippled sand with pebbles and occasional boulders with lamellate and encrusting sponges. Possible trawl marks	20 secs	80
FSC10	69	1000	483-508	26	59.903295, -5.387763	59.894092, -5.386107	Fine sand with pebbles and occasional boulders with lamellate and encrusting sponges. Possible trawl marks	20 secs	71
FSC11	70	1000	454-477	24	60.004234, -5.060948	59.995223, -5.06018	Rippled sand in places with pebbles, cobbles and occasional boulders with encrusting sponges	20 secs	74
FSC12	71	1000	424-447	20	60.028989, -4.955813	60.020444, -4.953679	Fine sand with pebbles, occasional boulders with unidentified sponges and encrusting sponges	1 per min	39
FSC13	72	500	523-534	15	60.10274, -4.859193	60.107681, -4.859684	Rippled fine sand with occasional cobbles and boulders encrusted with some sponges	20 secs	48
FSC14	73	1000	462-475	25	60.114027, -4.762276	60.123405, -4.764962	Fine sand with pebbles and occasional boulders with encrusting sponges	20 secs	75
FSC15	74	1000	436-445	30	60.151819, -4.631073	60.16018, -4.623636	Gravelly sand with cobbles and occasional boulders. Some lamellate and lobose sponges on cobbles and boulders.	1 per min	38
FSC16	75[22]	1000	467-489	29	60.192918, -4.561324	60.20035, -4.571282	Gravelly sand with cobbles and occasional boulders. Some lamellate and lobose sponges on cobbles and boulders. Occasional *Geodia*	20 secs	64
FSC17	76	1000	510-532	27	60.261023, -4.450759	60.265557, -4.466085	Sand with occasional patches of gravel, cobbles and boulders. Encrusting sponges with occasional lamellate sponges.	20 secs	40
FSC18	77	1000	463-488	35	60.279125, -4.34483	60.283158, -4.361196	Gravelly sand with occasional cobbles and boulders. Lamellate and encrusting sponges	1 per min	38
FSC19	78	500	469-477	12	60.38006, -4.166101	60.380474, -4.174827	Occasional lamellate and *Geodia* sponges on sandy gravel with some sponge encrusted boulders	1 per min	19

[22] FSC16 Transponder returns erratic, transponder to be changed prior to next deployment.

FSC20	79	500	498-503	11	60.433161, -4.08779	60.436426, -4.093917	Occasional lamellate and *Geodia* sponges on sandy gravel with some sponge encrusted boulders	20 secs	22

Table 8: Summary of camera tows undertaken north-east of the Faroe-Shetland Channel in FSCB area of interest. Start/end latitude and longitude recorded as ships position.

Tow reference	HiPaP no.	Tow length (m)	Depth range (m)	Tow length (mins)	Start (Lat/Long)	End (Lat/Long)	Brief summary	Frequency of photos	Number of photos[23]
FSCB 1	80	1000	470-477	22	60.467037, -3.898565	60.473727, -3.910337	Coarse gravelly sediments with occasional sand patches and boulders with encrusting sponges. Occasional lobose and lamellate sponges	1 per min	21
FSCB 2	81	1000	415-419	25	60.443294, -3.729207	60.451614, -3.731625		20 secs	70
FSCB 3	82	1000	492-502	22	60.540909, -3.682518	60.548822, -3.691091	Coarse gravelly sediments with common sand patches and occasional small lamellate sponges	20 secs	65
FSCB 4	83	1000	431-434	24	60.548422, -3.504914	60.55695, -3.499387	Coarse gravelly sediments with occasional lobose and lamellate sponges. Other fauna includes sea cucumbers and squat lobsters	20 secs	66
FSCB 5	85	1000	457-469	23	60.62146, -3.395077	60.612677, -3.391716	Coarse gravelly sediments with common lobose and lamellate sponges, with occasional *Geodia* sponges. Other fauna includes sea cucumbers and pencil urchins.	20 secs	68
FSCB 6	86[24]	1000	491-500	25	60.674771, -3.35454	60.665563, -3.352892	Coarse gravelly sediments with occasional boulders. Common lobose and lamellate sponges and *Geodia* sponges. Other fauna includes common numbers of pencil urchins.	20 secs	76
FSCB 7	87	1000	484-494	24	60.88167, -2.845442	60.871563, -2.844372		20 secs	61
FSCB 8	88	1000	496-509	25	60.931542, -2.693169	60.939762, -2.701872	Coarse gravelly sediments with occasional sand patches and boulders with encrusting sponges. Common lobose and lamellate sponges and *Geodia* sponges. Other fauna includes common numbers of pencil urchins.	20 secs	74

[23] Excludes clapper board photo.
[24] Due to technical issues no data was recorded.

FSCB 9	89	1000	548-568	26	61.113563, -2.220712	61.122672, -2.227117	Fine sandy sediments with occasional patches of gravel. Common lobose, lamellate and foliose sponges. Occasional *Geodia* sponges.	20 secs	69
FSCB 10	90	c700	496-502	16	61.205813, -1.912109	61.210696, -1.911836		20 secs	35
FSCB 11	91	1000	497-509	25	61.262907, -1.802322	61.272033, -1.802537	Fine sandy sediments with occasional patches of gravel. Common numbers of different sponge forms	20 secs	70
FSCB 12	92	1000	463-480	25	61.291449, -1.683726	61.300206, -1.689039	Fine sandy sediments with occasional patches of gravel. Common numbers of different sponge forms	20 secs	75

APPENDIX 8: Faroe Shetland Channel grab and rock dredge samples

Metadata for grab and rock dredge sampling, within the Faroe-Shetland Sponge Belt proposed NCMPA. Latitude and longitude recorded as ships position.

Station	Grab number	Date	Time	Lat	Long	Depth (m)	Valid	Photo	PSA	Sed_Type	Sed_depth	No_contain	Grab_Type	Extra_Info
FSC7G	1	03/11/2012	14:30	59.947833	-5.256333	493	Y	Y	N	Sand and pebbles clay	2L	1	Mini-Hamon	Sieve size 1mm
FSC6G	1	03/11/2012	15:34	59.901667	-5.336667	452	N			No sample			Mini-Hamon	Grab failed. Likely rocky ground
FSC6G	2	03/11/2012	15:59	59.901667	-5.336667	452	N			No sample			Mini-Hamon	Grab failed. Likely rocky ground
FSC5G	1	03/11/2012	17:01	59.880833	-5.476167	522	Y	Y	Y	Sand and pebbles clay	2L	1	Mini-Hamon	Sieve size 1mm
FSC_RD	0	07/11/2012	03:20	61.269830	-1.793667	500	Y	Y	N	Muddy sand and stone with Phakellia sponge		1	Rock dredge	10min tow. 260m distance

APPENDIX 9: Noss Head grab samples

Metadata for grab samples obtained at Noss Head contingency site. Latitude and longitude recorded as ships position.

Station	Grab number	Date	Time	Lat	Long	Depth (m)	Valid	Photo	PSA	Sed_Type	Sed_depth	No_contain	Grab_Type	Extra_Info
NH1	1	08/11/2012	08:15	58.448833	-3.002	57.9	Y	Y	N	Shelly sands	4L	1	Mini-Hamon	
NH2	1	08/11/2012	08:32	58.459833	-3.001833	53.0	Y	Y	Y	Shelly sands	5L	1	Mini-Hamon	
NH3	1	08/11/2012	08:44	58.465333	-3.002833	52.1	Y	Y	Y	Shelly sands	3L	1	Mini-Hamon	
NH4	1	08/11/2012	08:59	58.481333	-3.003167	55.5	N			No sample			Mini-Hamon	Grab failed
NH4	2	08/11/2012	09:03	58.4815	-3.003167	55.5	N			No sample			Mini-Hamon	Grab failed

APPENDIX 10: Side-scan sonar lines collected

Side-scan lines collected within Wyville Thomson Ridge cSAC/SCI. Start/end latitude and longitude recorded as ships position, unless otherwise stated.

Tow No.	HiPaP no.	Date	Start time	End time	Start Lat Long	End Lat long	Depth (m)	kHz	Notes
SS1	7	29/10/2012	13:26	17:21	59.884833, -6.509833	60.0085, -6.839333	363-640	300	
SS2	8	29/10/2012	18:18	20:56	59.994333, -6.808833	59.903, -6.554*	367-438	300	Line stopped due to towfish instability *End of line recorded as towfish position - ship position was not recorded
SS3	9	29/10/2012 & 30/10/2012	22:47	01:59	59.890833, -6.543333	59.999735, -6.835802*	381-582	300	*End of line recorded as towfish position - ship position was not recorded
SS4	N/A*	30/10/2012	02:53	06:49	59.994333, -6.824	59.867333, -6.488	405-760	300	*Data not stored due to corrupted file
SS5	N/A*	30/10/2012	09:53	13:31	59.891166, -6.559166	60.001666, -6.850333	430-610	300	*Data not stored due to corrupted file
SS6	15	30/10/2012	18:15 – deployment time	22:48	59.859666, -6.524833 – deployment position	59.989, -6.867333	481-778	Dual	Start of recording position/ time not recorded.
SS7	16	30/10/2012 & 31/10/2012	23:48	02:43	59.980833, -6.850666	59.88666, -6.601333	554-809	Dual	

SS8	17	31/10/2012	04:44	07:21	59.899833, -6.646166	59.987666, -6.8785	505-813	Not recorded	
SS9-1	18	31/10/2012	09:48	11:02	59.9695, -6.837166	59.933833, -6.740833	526-587	Dual	Line stopped due to suspect HiPaP readings
SS9-2	19	31/10/2012	12:47	13:17	59.914666, -6.691666	59.899333, -6.651333	621-666	Dual	Line stopped due to lack of HiPaP readings
SS9-3	20	31/10/2012	15:38 – deployment time	16:22 – recovery time	59.9055, -6.674666 deployment position	59.8825, -6.607333 recovery position	656-852		Fish retrieved before data acquisition could begin due to insufficient cable length to reach depth
SS10-1	21	31/10/2012	18:00	18:52	59.895333, -6.649	59.922333, -6.703833	695-595	Dual	Line stopped due to towfish instability
SS10-2	22	31/10/2012	21:01	22:19	59.917666, -6.707666	59.953166, -6.802333	571-625	Dual	Line stopped 3nm early due to rough weather

Side-scan lines collected within the Faroe-Shetland Sponge Belt proposed NCMPA. Start/end latitude and longitude recorded as ships position, unless otherwise stated.

Tow No.	HiPaP No.	Date	Start time	End time	Start Lat Long	End Lat long	Depth (m)	kHz	Notes
SS11	59	03/11/2012	18:37	21:42	59.893666, -5.424333	59.9865, -5.143166	509-512		
SS12	60	03/11/2012 & 04/11/2012	22:23	01:22	59.9755, -5.168666	59.884, -5.446166	492-506		
SS13	61	04/11/2012	02:27	05:38	59.884333, -5.438166	59.983833, -5.136	490-500		
SS14	62	04/11/2012	06:35	09:53	59.9795, -5.143	59.979287, -5.152787*	450-500		*End of line recorded as towfish position - ship

									position was not recorded
SS15	63*	04/11/2012	10:56	14:04	59.886166, -5.417833	59.979833, -5.133333	460-490		*HiPaP pole not deployed resulting in large error in dataset
SS16	64	04/11/2012	14:55	18:12	59.977833, -5.133	59.877666, -5.437333	460-485		
SS17	65	04/11/2012	19:01	21:46	59.877333, -5.431166	59.9605, -5.179166	460-486		