Report of Survey: DY099

# Marine biodiversity of South Georgia and the South Sandwich Islands 2019

**Reference: CR146**

**15th February – 10th March 2019**

**Authors: Paul McIlwaine, Chris Darby, Gemma Kiff,**

**Rui Vieira, Marta Soeffker.**

**Issue date: June 2019**

# Cefas Document Control

# Title: Marine biodiversity of South Georgia and the South Sandwich Islands 2019

| | |
|---|---|
| **Submitted to:** | |
| **Date submitted:** | |
| **Portfolio Leads:** | |
| **Project Manager:** | Ed McManus |
| **Principal Investigators:** | Chris Darby |
| **Report compiled by:** | Paul McIlwaine et al. |
| **Quality control by:** | Chris Darby |
| **Approved by & date:** | 14/06/2019 |
| **Version:** | CR146 v1.5 |

| **Version Control History** | | | |
|---|---|---|---|
| **Author** | **Date** | **Comment** | **Version** |
| Paul McIlwaine et al. | March 2019 | Initial Draft (Cefas QA) | 1.1 |
| Rui Vieira | 19/03/2019 | Comments and update initial draft | 1.2 |
| M Soeffker | 28/03/2019 | Update of version 1.2 | 1.2.1 |
| C Darby | 15/5/2019 | Submitted to GSGSSI for comment | 1.4 |
| C Darby | 14/6/2019 | Final | 1.5 |

# Marine biodiversity of South Georgia and the South Sandwich Islands 2019

**Issue date: June 2019**

**Head office**

Centre for Environment, Fisheries & Aquaculture Science

Pakefield Road, Lowestoft, Suffolk NR33 0HT, UK

Tel +44 (0) 1502 56 2244  Fax +44 (0) 1502 51 3865

www.cefas.defra.gov.uk

Cefas is an executive agency of Defra

## GLOSSARY

| | |
|---|---|
| **BB** | Blue Belt |
| **Cefas** | Centre for Environment, Fisheries and Aquaculture science |
| **UTC** | Coordinated Universal Time |
| **SGSSI** | South Georgia and the South Sandwich Islands |
| **CRP** | Central Reference Point |
| **USBL** | Ultra Short Base Length |
| **MMO** | Marine Mammal Observation |
| **GPS** | Global Positioning System |
| **NMF** | National Marine Facilities |
| **RRS** | Royal Research Ship |
| **DC** | Drop Camera |
| **AT** | Agassiz Trawl |
| **MBES** | Multibeam Echosounder |
| **ADCP** | Acoustic Doppler Current Profiler |
| **SBP** | Sub-bottom Profiler |
| **KEP** | King Edward Point |
| **MIS** | Marine Instrument Surveys |
| **MPA** | Marine Protected Area |

# Table of contents

# Figures

# Tables

# 1 Background and Introduction

### *1.1 The Blue Belt Programme*

The UK's Overseas Territories are home to over 90% of the UK's biodiversity and are of fundamental importance to regional and international marine conservation. The Blue Belt Programme supports the delivery of the UK Governments commitment to enhance marine protection of over four million square kilometres of marine environment across UK Overseas Territories. As part of the project Cefas are undertaking several multidisciplinary offshore expeditions, collecting information and data to aid in the design, designation and management of Marine Protected Areas.

### *1.2 Survey Area: South Georgia and the South Sandwich Islands*

In 2012 the Government of South Georgia & the South Sandwich Islands (GSGSSI) declared a sustainable use Marine Protected Area across more than 1 million $km^2$ of the Scotia Sea within its maritime zone (MZ), which was further enhanced in 2013 and 2019 (Figure 1). The GSGSSI MPA monitoring and development requires scientific information that will describe the benthic ecological processes in several key sites; including the data poor area around the South Sandwich Islands.

Consequently, in 2019 Cefas, chartered the RRS *Discovery* to undertake a survey around the South Sandwich Islands examining the biodiversity and distribution of benthic invertebrate species and their potential vulnerability to impacts of the licensed longline research fisheries.

The Blue Belt programme also took the opportunity to reach out to other academic UK research teams, with less access to resources, by sharing the capabilities of that the *Discovery* offers as a research platform. Cefas therefore teamed up with colleagues from the Universities of Essex, Bristol and Oxford during the expedition.

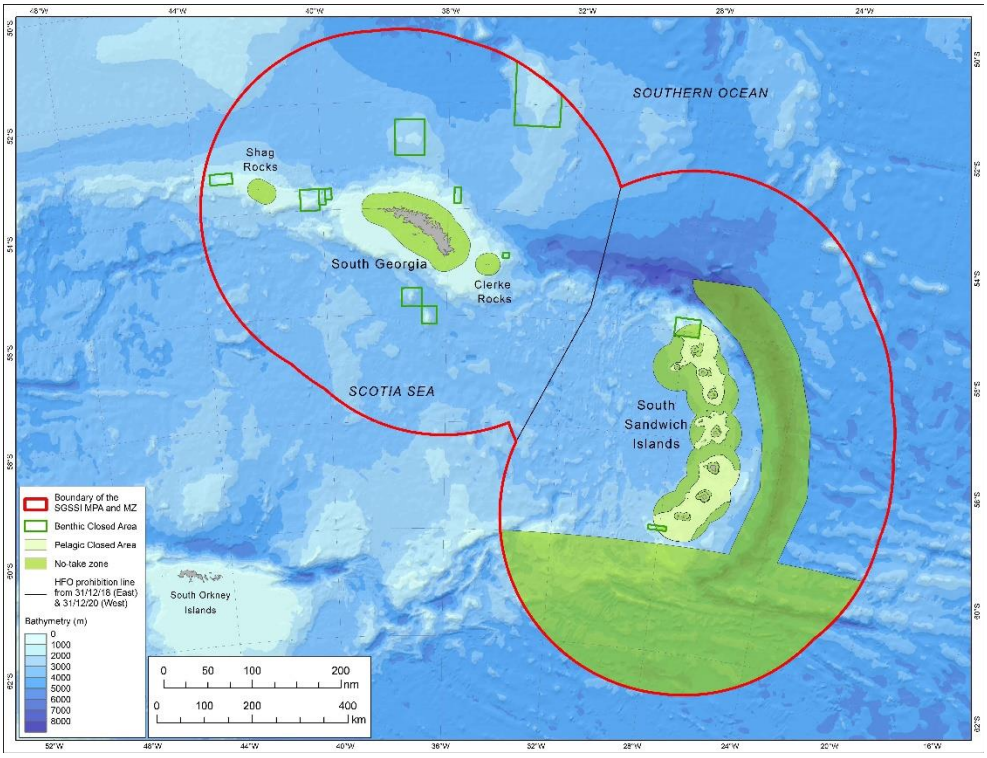


Figure 1. The South Georgia & the South Sandwich Islands Marine Protected Area management areas

### *1.3 Aims and operation objectives*

**Overall aim:** To gain a wider understanding of the regional ecosystem and thereby provide advice to the Government of South Georgia & the South Sandwich Islands that will enable it to determine the effectiveness of current management measures and to further develop its management of the region.

| Objective | Sub-Objective | Rationale | Gear |
|---|---|---|---|
| 1.Collect evidence to inform the assessment of the benthic biodiversity | 1.1 Acquire (semi-) quantitative epifaunal camera data from each survey area. | Supply initial data for assessment of the benthic community and create a baseline for future assessments. | STR Deep-Sea Drop-Camera |
| | 1.2 Acquire quantitative epifaunal data across the extent of the feature (the entire site). | Supply initial data for assessment of the benthic community. The data will allow characterisation of the different communities and biological traits associated with depth and topography. | Agassiz trawl<br>Benthic dredge |
| | 1.3 Analyse community connectivity across the survey sites and across the wider region | DNA samples from benthic epifauna collected to investigate the genetic connectivity of the benthic communities across the MPA. | Agassiz trawl<br>Benthic dredge |

| | | | |
|---|---|---|---|
| 2. Collect evidence of the impact of the Long-line fishery on the benthic community. | 2.1 Acquire (semi-) quantitative epifaunal camera data from areas and depths where fishing occurs. | Comparisons can be made against the benthic communities of areas and depths where fishing occurs to determine the potential impact of the fishery on the benthic environment. | STR Deep-Sea Drop-Camera |
| | 2.2 Acquire images of the impact of long line fishing on the seabed. | Targeting of known long line fishing locations to determine the footprint and potential impact on the benthic community. | STR Deep-Sea Drop-Camera |

### *1.3.1 Seabed imagery (Priority 1)*

Collect high-resolution seabed imagery of the benthos at the South Sandwich Islands various depth contours of representative islands to the north and south of the polar front.

### *1.3.2 Acoustic data collection-(Priority 2)*

Acquire acoustic data throughout the survey and from areas of interest around the South Sandwich Islands to improve information on bathymetry, and in the biomass (unidentified and uncalibrated) present in the water column during the survey.

### *1.3.3 Specimen collection-(Priority 2)*

Deploy the Agassiz trawl and / or benthic dredge, where the deep water camera had been deployed, to enable species identification and collection of samples to determine the genetic connectivity of the region's benthic species and to conduct geochemical analysis of coral's skeletons to examine past ocean conditions, growth and biomineralization rates.

### *1.3.4 Marine mammal observations (Priority 3)*

Collect information during scheduled observation effort on location and abundance of marine mammals to gain understanding of their distribution during the time period of the survey and improve knowledge of marine mammal distribution and presence throughout South Georgia and the South Sandwich Islands.

## *1.4 Survey Project Team*

The survey was carried out between 14$^{th}$ February – 10$^{th}$ March 2019 on the RRS *Discovery* (survey code: DY099) with the aid of a multidisciplinary survey team comprising Cefas scientists and instrument technicians, scientists from University of Oxford, University of Essex and University of Bristol and National Marine Facilities officers, crew and technicians (Table 1).

**Table 1. Survey team comprising scientific survey staff, showing details of their primary roles and shift pattern, and ship's crew and rank.**

| **Scientific staff** | **Floating shift (07:00-19:00)** | **Day shift (08:00-20:00)** | **Night shift (12:00-24:00)** |
|---|---|---|---|
| | Paul McIlwaine **Senior Scientist (Cefas)** | Anna Downie **Survey scientist (Cefas)** | Rodney Brash **Marine instrument technician (Cefas)** |
| | Chris Darby **Principle Scientific Officer (Cefas)** | Marta Soffker **Survey scientist (Cefas)** | Rui Vieira **Survey scientist and camera operator (Cefas)** |
| | Gemma Kiff **Data manager (Cefas)** | Christopher N. Roterman **Survey scientist (University of Oxford, on behalf of University of Essex)** | **Day shift (12:00-24:00)** |
| | | Georgia Robson **Survey scientist (Cefas)** | Bill Meadows **Marine instrument technician (Cefas)** |
| | | Jessica Gordon **Survey scientist (University of Essex)** | Clement Garcia **Survey scientist and camera operator (Cefas)** |
| | | Maria Luiza De Carvalho Ferreira **Survey scientist (University of Bristol)** | |
| | | Ramon Benedet **Survey scientist (Cefas)** | |

| **Ship's crew** | **Name** | **Rank** |
|---|---|---|
| | Antonio Gatti | Master |
| | Stewart Mackay | Master |
| | Robert Ovenden | Chief Officer |
| | Colin Leggett | 2nd Officer |
| | Benjamin Lawrence | 3rd Officer |
| | James Bills | Chief Engineer |
| | Christopher Kemp | 2nd Engineer |
| | Daniel Evans | 3rd Engineer |
| | Mitchell Hamber | 3rd Engineer |
| | Charles Fisher | Electronic Technical Officer |
| | Valerija Forbes-Simpson | Purser |
| | John Macdonald | Chief petty officer science |
| | Andrew Maclean | Chief petty officer deck |
| | Craigjames Lapsley | Petty officer deck |
| | Andrew Dwyer | Able bodied seaman |
| | Craigross Gilfillan | Able bodied seaman |
| | Christopher Devitt | Able bodied seaman |
| | Emlyn Williams | Engine room petty officer |
| | Mark Ashfield | Head Chef |
| | Michael Leigh | Chef |
| | Carl Piper | Steward |
| | Denzil Williams | Assistant steward |
| | Philip Keating | Medic |
| | Jason Scott | Technical support |
| | William Richardson | Technical support |
| | Mark Maltby | Technical support |

# 2 Survey Design and Methods

## *2.1 Survey planning and design*

## *2.2 Survey methods and sample processing*

All survey activities were permitted by the Government of South Georgia & the South Sandwich Islands through Restricted Activity Permit (RAP 2019/003), including sampling within the no take zones of the MPA.

### *2.2.1 Seabed imagery: Drop frame camera*

Video observations were made with a deep-water capable drop frame camera system (STR Telemetry), which has a separate video camera and still images system. Illumination was provided by four high powered light emitting diodes (LED) and a separate high-powered synchronised flash. The high definition 1080p/25/30fps subsea video camera and 18 megapixels digital stills camera was oriented to provide a forward oblique view of the seabed. The frame also comprised an integrated 250 khz precision altimeter, combined compass and depth sensor, and was fitted with 4x dual scaling lasers spaced at 215 mm.

Set-up and operation followed the 'Mapping European Seabed Habitats' (MESH) 'Recommended Operating Guidelines (ROG) for underwater video and photographic imaging techniques' ((Populus et al., 2015)). Video and stills data were collected along a 30 to 45 min transect with the vessel moving at a velocity of 0.3-0.5 knots. The transect was centred on the proposed sampling station.

Video was recorded simultaneously to two video capture top side units; one logging USBL position (back up) and one logging Central Reference Point (CRP) (main), and telemetry data. Recording commenced when the altimeter showed the camera was 30 m from the sea bed and continued until the end of the tow and arrival back at 30 m altitude.

Still images were acquired every 30 seconds, or as close as possible, with the camera being no more than 2 m off the seafloor., maximising the number of high quality images available for subsequent analysis, after focusing the stills camera while on or as close as possible to the seabed at the beginning of each tow.

A video overlay was used to provide station metadata, time and position (CRP) in the main recorded video footage. Positional data, in addition to values from the altimeter, combined compass and depth sensors, were recorded (as a single ".txt" file per recording). Telemetry data were not available to display on the back up video overlay nor were they recorded in the associated ".txt" files.

The subsea computer clock was synchronised with GPS time and all still images taken during video footage capture will be available to “time-match” with USBL and/or CRP position and telemetry data. Any deviation from GPS time will be accounted for during subsequent image georeferencing.


**Figure 2. Deployment of the drop camera frame from the aft starboard crane of the RRS *Discovery***

### *2.2.2 Specimen collection: Agassiz trawl and benthic dredge*

The Agassiz trawl is a benthic sampler designed to collect benthic invertebrates and is suitable for application in deep water environments as the orientation of the gear as it lands on the seabed is not critical for successful specimen collection. The Agassiz trawl comprised 2m x 5mm inner and 40mm outer netting, wire sling bridle and a 5-tonne weak link in case of fouling.

The benthic dredge construction was based on the “Hein” dredge design. This more robust sampler is intended for use on coarse sediments and areas of flat bedrock where damage to other towed gears would limit haul success. The benthic dredge comprised a 1m x 2m box frame with steel mesh top and base.

The operation of both the Agassiz and dredge involved deployment from a stationary vessel. A 500 m pennant wire was used (in water greater than 500 m) and the sampler deployed to the seabed. Winch wire was payed out while the vessel manoeuvred to a location between 200 m and 500 m from the starting location. The gear was recovered to the stationary vessel using the winch wire and the catch assessed and processed accordingly.

Specimens were collected from the sampler (muddy samples were sieved over a 5 mm mesh to facilitate extraction) and brought into a constant temperature environment (4 degrees) and stored in ambient (sea surface temperature) seawater. Individuals were sorted, counted and identified to the lowest possible taxonomic level, provided a unique identification code and ordered for processing. A representative image of each taxon was taken, and tissue subsamples were collected for subsequent genetic analysis, storing subsamples in both 100 % ethanol and RNA later. Samples (subsampled individuals, specimens sorted into major groups from the total catch and unsorted material comprising specimens not yet extracted from the substratum) were fixed in 4 % formaldehyde and later (after 24 hours) preserved in 70 % ethanol.

Live corals, with a calcium carbonate skeleton and suitable for geochemical analysis, were rinsed in fresh water and placed in a 10% bleach solution for approximately 24 hours before further rinsing to remove bleach and tissue residues. Fossil / historic corals did not require bleaching. Specimens were then air dried, placed in labelled containers and catalogued.

**Figure 3. Recovery of the Agassiz trawl (left) and dredge (right) from the aft deck of the RSS *Discovery* during cruise code DY099 showing the bridles, weak links and recovery bridle (dredge).**

### *2.2.3 Selection of sampling locations*

One (or more) survey run lines were orientated, at each of the South Sandwich Islands visited, to maximise the depth profile achieved while minimising the distance of the area of interest (e.g. Figure 4). The vessel acquired acoustic data at speeds no greater than 6 knots (1-6 knots) while manoeuvring toward shallower water. Bathymetry was reviewed following preliminary processing and several stations were identified and selected to incorporate at least five depth contours; 250 m, 500 m, 750 m, 1000 m and 1500 m. Stations were selected with the operational capability of the vessel in prevailing conditions, seabed imagery requirement and trawl/dredge deployments in mind. Drop camera

deployments were either along prescribed run lines, orientated and acquired down slope, or within regions of topographically similar seabed, allowing acquisition in any direction, as the weather and bathymetry permitted.

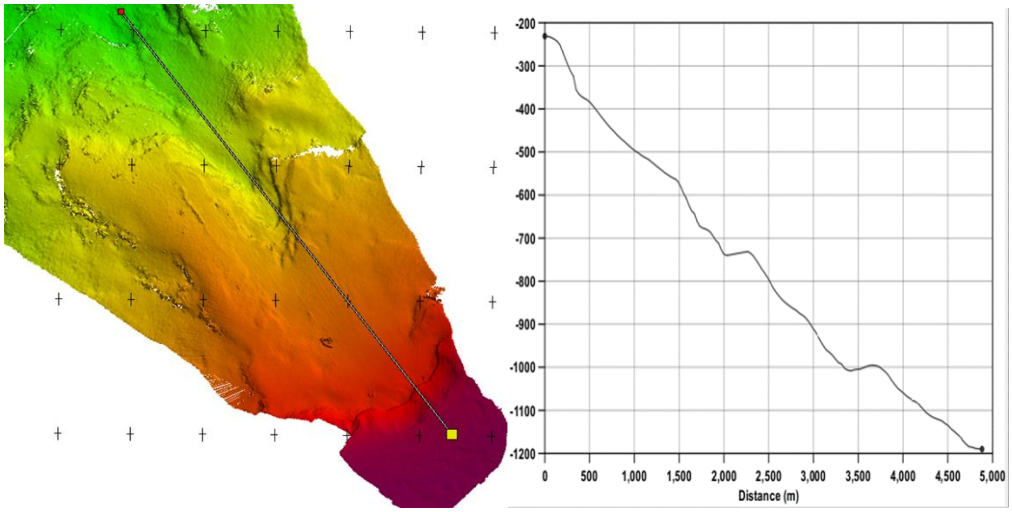


**Figure 4. Bathymetry of the Saunders Island (west) area of interest, showing the depth profile between two points, generated from the preliminarily cleaned acoustic data from the acoustic processing software, CARIS.**

### *2.2.4 Opportunistic* surface sightings of any marine mammals

Marine mammal observations were carried out in two modes. Firstly, vessel transit was used as the basis for transects with observation effort using distance sampling with two observers with separate viewing points on a single vessel (Buckland et al. 2001). Observers were located on the bridge deck on the port and starboard side, and during observation effort periods, observations were made from -10 degrees to 90 degrees on the starboard side, and from -90 degrees to 10 degrees on the port side, thus ensuring a 20 degree overlap in observation sector at the bow of the ship. Distance sampling is part of a group of data collection methods for estimating animal densities or abundances, based on the assumption that (in most cases) detection probability decreases with increasing distance from the observation transect (Buckland et al. 1993). In addition to conventional presence (number)/absence data, the method relies also on collecting information on the height of the observation position, the distance, the angle to the observed target, and factors that may affect detectability, such as weather or sea conditions (Figure 5). This allows a detection function to be calculated, which models the probability of detecting a target depending on its distance from the observation point.

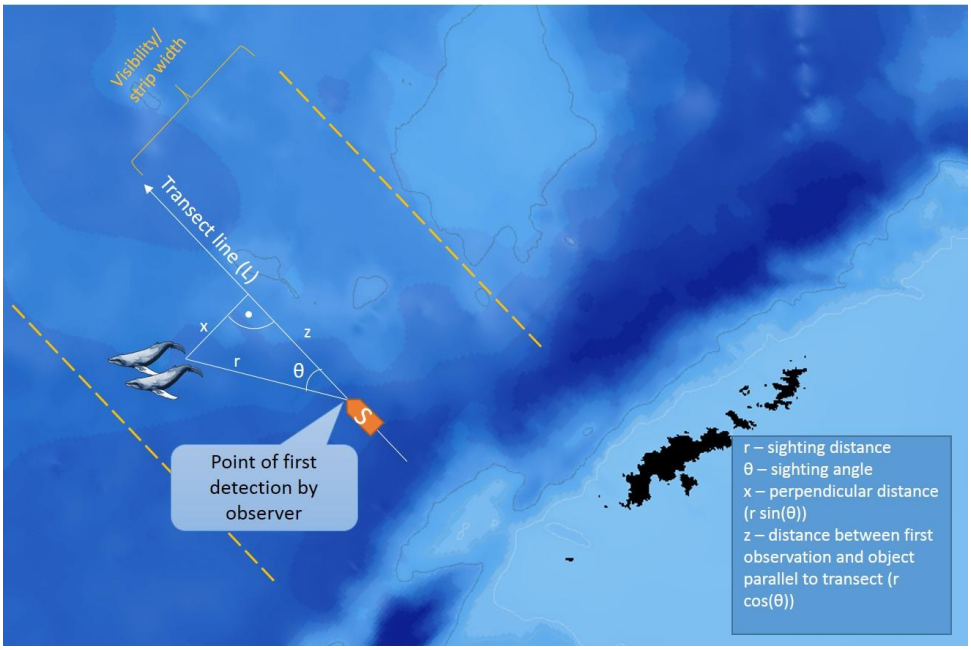


**Figure 5 - schematic representation of data collection under distance sampling**

Secondly, outside of scheduled observation periods, marine mammals were recorded opportunistically when observed, either by observers or by bridge crew. These data were presence-only records, treated as supplemental information of species occurrence to the distance sampling dataset.

### *2.2.5 Global Position System and Corrections*

Position fixes were recorded on all paper log sheets using the ship-based display, noting both time (UTC) and CRP position as a minimum.

The drop camera was deployed from the aft starboard crane. During camera operations, the position of the gear on the seabed was recorded using an Ultra Short Base Length (USBL) positioning beacon. An offset of up to ~10 m may occur and the USBL position can be lost entirely in deep water and when the vessel is operating using Dynamic Positioning. Comparison of the USBL position and the Central Reference Position will allow for UBSL accuracy to be determined and a decision made on which is preferable / available for use with georeferencing seabed imagery. Positional data were recorded every second between the start and end of each tow on the top side acquisition suite. Still images were matched, based on embedded “EXIF” time stamp within the renamed “.jpg” file, to the corrected positional data to provide geo-referenced still images. The position of the dredge and the Agassi trawl deployments were determined using the vessel position (CRP) at the time of deployment and recovery.

# 3 Survey Narrative

All scientific staff, participating in RRS *Discovery* DY099, joined the vessel at 10:30 (Falkland Island local time, -3 UTC) on the 14th February 2019, alongside in Stanley Harbour, Falkland Islands, and completed a brief vessel induction.

The Cefas deep water camera system (including dedicated winch) and several items of survey equipment and consumables were mobilised, with the aid of the ships' crew, and stored securely. Set up of the laboratory spaces, the drop camera system and survey specific information technology infrastructure commenced on the 15th February and was completed in advance of subsequent test deployments.

Following a short delay while awaiting ships' crew change and unavailable pilotage during darkness, the vessel sailed to bunker at Mare Harbour, leaving Stanley at 06:00 on the 16th February. Strong winds prevented the pilot transfer which was attempted at approximately 09:30 – 10:00. Bunkering was unable to be completed at Mare harbour due to an issue with the pipeline (failure of communication of planned maintenance at the Mare Harbour facility to the vessel). However, as a container of vessel stores that required mobilisation from Mare Harbour, the vessel stood by until the pilot could board, in safer conditions, at approximately 19:00. Following successful transfer of the container, the vessel returned to Stanley Harbour to bunker in preparation for DY099.

At approximately 18:00 on the 16th February, the vessel sailed again from Stanley Harbour on route to King Edward Point (KEP), South Georgia to collect a calico of survey equipment which had been inadvertently collected from Mount Pleasant and transported to the field station at KEP. Opportunistic marine mammal observations were carried out during the three-day transit to KEP and the acoustic gears (multibeam echosounder, sub-bottom profiler, echo sounder and acoustic doppler current profiler) were set to record continuously for the duration of DY099. A general muster and life boat familiarisation was carried out at 10:30 on the 18th February (Falkland Island local time, -3 UTC) 2019.

A camera deployment was carried out in Cumberland Bay, South Georgia at 06:00 (South Georgia local time, -2 UTC) on the 21st February 2019 following a toolbox talk of the safe deployment, operation and recovery procedure developed in collaboration with the National Marine Facilities technical leads, ships bosun and Cefas Marine Instrument Technician staff. The remaining survey equipment was successfully transferred following the two "familiarisation" deployments. Amendments to the LED positions and laser mounts were completed while on route to the first drop camera station.

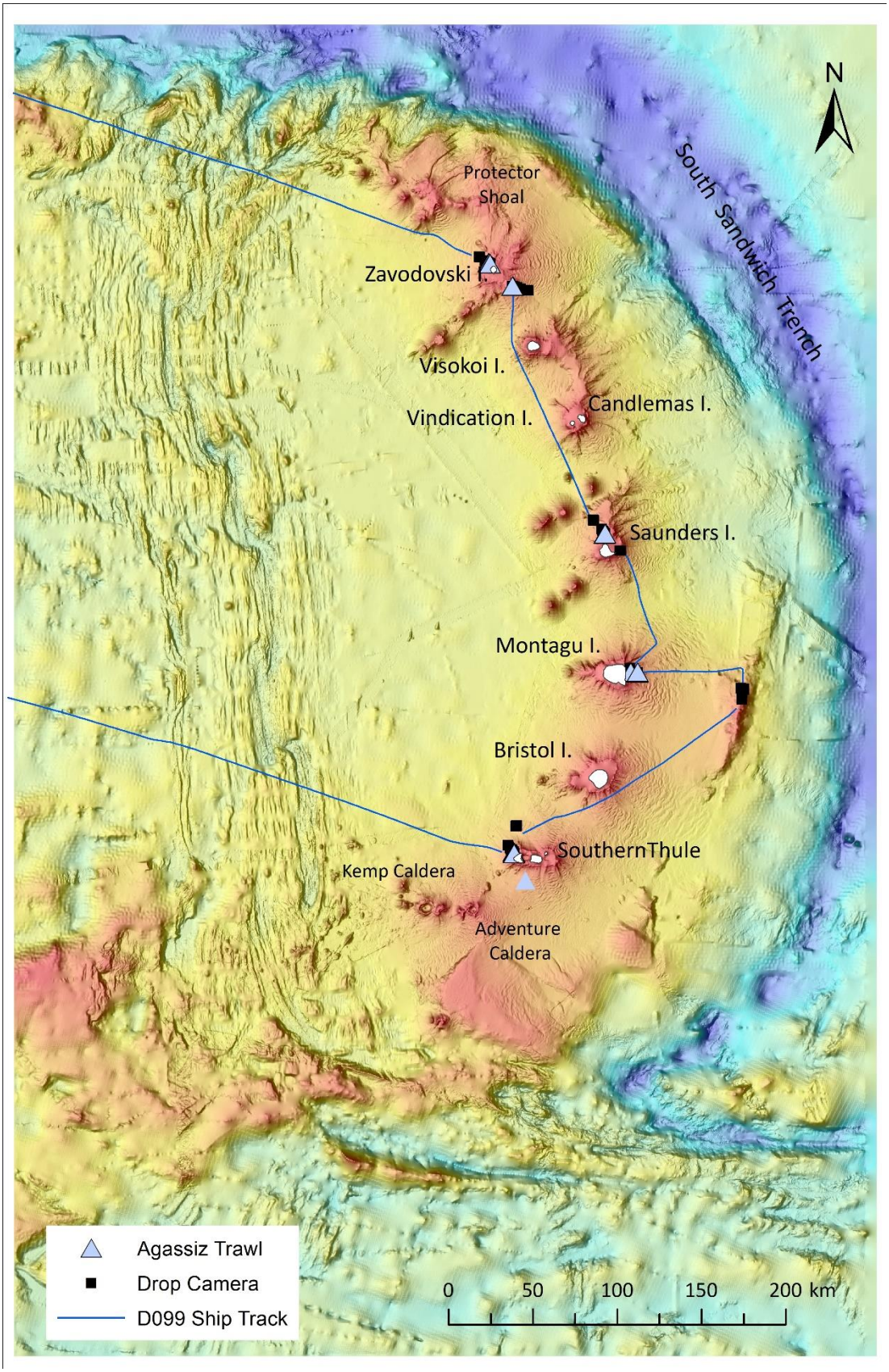


**Figure 6. The DY99 survey track and sampling locations at the South Sandwich Islands**

Upon arrival, to the west of Zavodovski Island, South Sandwich Islands, on the 23rd February 2019, an assessment of the preliminary bathymetry data was used to inform the placement of target stations. Seabed imagery was successfully collected from five depth contours and an additional station coinciding with a feature of interest on the bathymetry was also surveyed. Operations commenced to the east of Zavodovski Island at 04:00 (South Georgia local time, -2 UTC) on the 24th February 2019 and were completed by 19:30 (South Georgia local time, -2 UTC). Test deployments of the dredge and the Agassi trawl resulted in the collection of several specimens from the east of Zavodovski Island, which were processed during the transit to the west of Saunders Island, where operations commenced at approximately 06:00 (South Georgia local time, -2 UTC) on the 25th February. Following successful collection of seabed imagery from each of the five depth contours the drop camera was deployed at the east of Saunders Island at 10:30 (South Georgia local time, -2 UTC) on the 26th February 2019.

A full re-termination of the fibre optic cable was required, after a single deployment of the drop camera system at the east of Saunders Island, which was completed during the transit to the east of Montagu Island (MONT). Drop camera deployments were carried out while sheltering from the weather behind Montagu Island throughout the 27th February 2019 and continued until 06:00 (South Georgia local time, -2 UTC) on the 28th February 2019 when the winch wire was found to have fouled on protruding bolts and a full cable re-termination was required. The Agassiz trawl was deployed twice at MONT07 to collect specimens from the 250 m depth contour (wire fouled on frame during first deployment). Another successful Agassiz trawl deployment was carried out at MONT13, recovered on deck at 15:30 (South Georgia local time, -2 UTC), before transiting to Montague Bank (MOBA), approximately 33 nautical miles east of Montague Island. Four drop camera stations were successfully surveyed and operations at MOBA were completed at approximately 09:30 (South Georgia local time, -2 UTC) on the 1st March.

The vessel arrived at the Southern Thule site (SOTH) at approximately 18:40 (South Georgia local time, -2 UTC) on the 1st March. Following acquisition and preliminary processing of a single line of MBES data, four sampling stations were identified that covered the required depth contours. Seabed imagery was collected from four stations and two suitable stations, SOTH01 & SOTH02, were identified for specimen collection. Poor weather prevented the successful collection of seabed imagery from the 1500 m contour. The Agassiz trawl was deployed at SOTH02 at 07:00 (South Georgia local time, -2 UTC) on the 2nd March 2019 and the specimens processed accordingly. A small sample was collected at SOTH02, using the dredge, and fully processed before a deployment of the Agassiz trawl at the same station. This catch comprised mostly soft mud and was processed once the fauna were rinsed and extracted. MBES data were acquired parallel to the SOTH run line, in the sheltered area north west of SOTH and several drop camera stations identified for subsequent survey.

Following a drop camera deployment in approximately 2100 m, water was observed in the stills camera housing. The spare drop camera frame was readied and deployed. However, there was water ingress into the stills camera housing and survey operations stopped at 03:00 (South Georgia local time, -2 UTC) 3rd March.

At first light, the vessel entered the caldera at Southern Thule / Cook Island, then commenced transit back to Stanley Harbour, Falklands Islands at 08:00 (South Georgia local time, -2 UTC). Survey data were checked and finalised; equipment packed, and the vessel cleaned in preparation for demobilisation during the return journey. A general muster was held on the 6th March and the ships crew carried out fire drills.

The vessel arrived outside of Stanley Harbour at 08:30 (Falkland Island local time, -3 UTC) on 8th March 2019 following a five-day transit. A small boat transfer was carried out at 12:00 (Falkland Island local time, -3 UTC) on the 9th March 2019 and the vessel came alongside at 07:00 (Falkland Island local time, -3 UTC) on the 10th March 2019. Survey equipment and samples from DY099 were stowed securely and handovers were made with the oncoming DY100 scientist in charge. DY099 survey staff disembarked the vessel at 13:30 (Falkland Island local time, -3 UTC).

| Date | | Location or Activity |
|---|---|---|
| From | To | |
| | | **Mobilisation, transit and camera trials** |
| 13/02/2019 | 14/02/2019 | Mobilisation of scientific equipment and staff in Stanley, Falkland Islands |
| 15/02/2019 | 16/02/2019 | Crew change, bunkering and taking on of stores in Stanley Harbour and Mare Harbour |
| 16/02/2019 | 21/02/2019 | Transit to South Georgia to collect survey equipment and conduct trial camera deployment |
| | | **Benthic survey** |
| 21/02/2019 | 23/02/2019 | Transit to Zavodovski Island |
| 23/02/2019 | 24/02/2019 | Survey operations |
| 24/02/2019 | | Arrive at Saunders Island |
| 25/02/2019 | 26/02/2019 | Survey operations |
| 27/02/2019 | | Arrive at Montagu Island |
| 27/02/2019 | 28/02/2019 | Survey operations |
| 28/02/2019 | | Arrive at Montagu Bank |
| 28/02/2019 | 01/03/2019 | Survey operations |
| 01/03/2019 | | Arrive at Southern Thule |
| 01/03/2019 | 03/03/2019 | Survey operations |
| | | **Transit and demobilisation** |
| 03/03/2019 | 08/03/2019 | Transit to Stanley Harbour, Falkland Islands |
| 09/03/2019 | | Outside of Stanley Harbour for personnel transfer |
| 10/03/2019 | | Alongside in Stanley Harbour for demobilisation |

# 4 Sample Acquisition

### *4.1 Station and data summary*

Seabed imagery was acquired from a total of 36 stations and six survey areas during 38 deployments. Operations were curtailed at two stations due to poor weather and equipment failure, resulting in shorter tows and fewer stills images (MONT06 and SOTH09 respectively). MOBA03 was abandoned, due to deteriorating weather conditions, prior to the collection of any imagery. The drop camera was deployed twice at a camera trial station (surveyed previously in 2018) in Cumberland Bay, KEP, South Georgia.

In total, 4124 images were acquired during the collection of 30 hours and 10 minutes of video footage. A summary of the deployments, showing the duration and number of stills from each survey area is provided in Table 2.

Over 500 specimens were collected from six stations at four survey areas in the South Sandwich Island chain from a total of ten successful hauls from 12 deployments (four dredge and eight Agassiz trawls), (Table 3). A single specimen (*Umbellula* sp., Cnidarian) was recovered from the drop camera following a video tow at MOBA03.

Marine mammal observation transects and summary

Observers completed 67 hours marine mammal observation in total, covering a total of 1,486 kilometres or 803 nautical miles. The black lines in Figure 7 show the locations of observation effort. A total of 567 marine mammals were counted during these observation effort sessions. The most frequent marine mammals were fur seals, seen in abundance approaching South Georgia and towards the South Sandwich Islands. Humpback whales were also seen frequently and throughout the entire survey, followed by hourglass dolphins, groups of pilot whales, and fin whales. Other less frequently sighted species included blue whales, sei whales, minke whales, sperm whales, and beaked whales. Closer to the Falkland Islands several dolphin species were recorded, including dusky dolphins, hourglass dolphins, Comerson's dolphins, and Peale's dolphins. A total of 15 species were identified, in addition to unidentified records of seals, whales, and dolphins.

In addition to observations during scheduled effort periods, an estimated 156 marine mammals were recorded as opportunistic sightings outside of scheduled effort periods. These included fur seals, humpback whales, hourglass dolphins, minke whales, and fin whales.

Table 2. Total duration of video footage and number of stills collected from drop camera deployments at each of the surveyed areas.

| Survey area | Duration of video footage hh:mm:ss | Total number of stills | Number of deployments | Notes |
|---|---|---|---|---|
| **Cumberland Bay** | 00:58:00 | 110 | 2 | Camera trial station in Cumberland Bay. Repeat of station visited in 2018. |
| **Montagu bank** | 03:15:00 | 633 | 5 | One tow abandoned during deployment. |
| **Montagu Island** | 05:11:00 | 760 | 8 | One station abandoned due to deteriorating weather. Stations on the east side of the island. |
| **Saunders Island** | 05:50:00 | 743 | 6 | Five stations on the west and one on the east side of the island. |
| **Southern Thule (Cooks Island)** | 04:43:00 | 715 | 6 | One deployment shortened due to equipment failure. Stations to the west of the Island. |
| **Zavodovski Island** | 10:13:00 | 1163 | 11 | Six stations west of and five stations east of the island. |
| **Totals** | **31:10:00** | **4124** | **38** | |

Table 3. Agassiz and dredge deployments at each of the survey areas surveyed during DY099.

| Survey area | East | West |
|---|---|---|
| **Montagu Island** | 3 x Agassiz at 2 stations | |
| **Saunders Island** | | 1 x Agassiz |
| **Southern Thule (Cooks Island)** | | 1 x Dredge (small sample), 2 x Agassiz at 2 stations |
| **Zavodovski Island** | 1 x Dredge (small sample), 1 x Agassi (no sample), 1 x Agassiz (small sample) | 2 x Dredge (unsuccessful) |

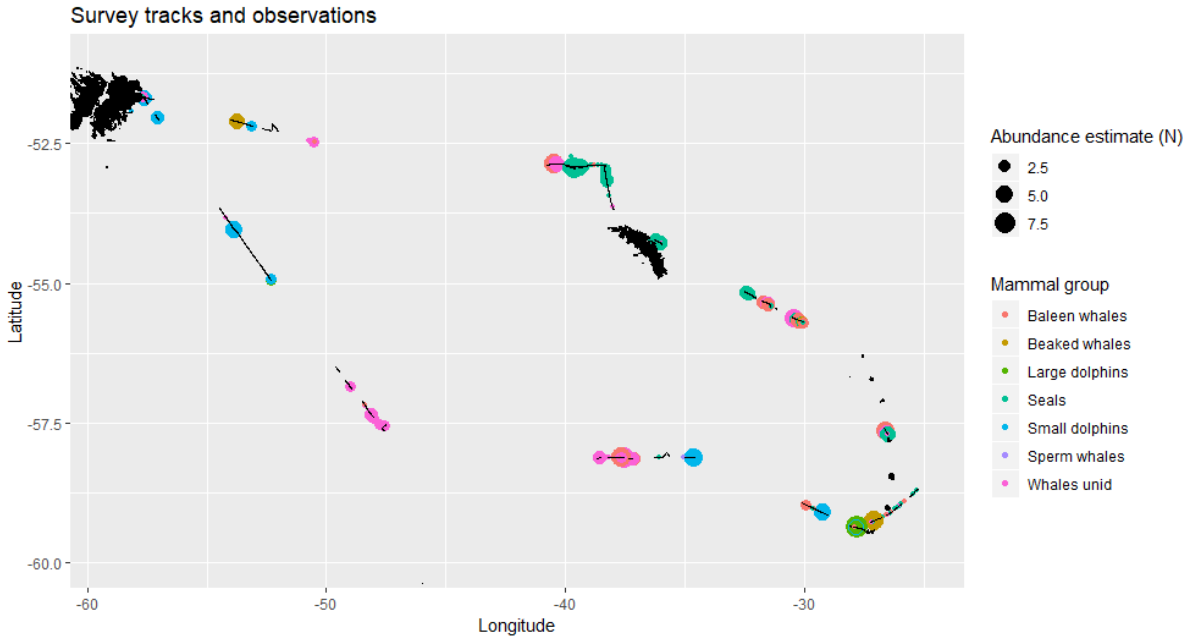


Figure 7 -Scheduled effort marine mammal observations around South Georgia & South Sandwich Islands. Observation effort tracks are shown as black lines. Species groups are shown as centroids on the line (not at angle/distance), with the point size indicating sighting abundance.

# 5 References

Populus, J., Rodrigues, A. M., Freitas, R., Quintino, V., McGrath, F., Tempera, F., … Alonso, J. L. S. (2015, June 1). Preface to “MeshAtlantic: Mapping Atlantic area seabed habitats for better marine management.” *Journal of Sea Research*, *100*, 1. https://doi.org/10.1016/j.seares.2015.06.007

# 6 Annexes

## *6.1 Annex 1:* RRS *Discovery*


https://nerc.ukri.org/research/sites/facilities/marine/ships/discovery-info-spec/

| | |
|---|---|
| **Name of vessel** | **DISCOVERY** |
| **IMO number** | **9588029** |
| **Official number** | **919206** |
| **Type of vessel** | **RESEARCH VESSEL** |
| *(include details of any special features)* | |
| **Previous name(s)** | **N/A** |
| **Vessel Owner** | **NATURAL ENVIRONMENT RESEARCH COUNCIL** |
| Address | **POLARIS HOUSE**<br>**NORTH STAR AVENUE**<br>**SWINDON. SN2 IEU** |
| Telephone | |
| Fax | |
| e-mail | |
| **Vessel operator** | |
| Name | **NMF-SEA SYSTEMS** |
| Address | **NATIONAL OCEANOGRAPHY CENTRE**<br>**EUROPEAN WAY**<br>**SOUTHAMPTON. SO14 3ZH** |
| Telephone | **+44 (0)2380 596286** |
| Fax | **+44 (0)2380 635130** |
| e-mail | **rxp@noc.ac.uk** |
| IMO Database Number | **0010877** |
| **Date current vessel operator assumed responsibility for vessel** | **08 JULY 2013** |
| **Manning agent** | **N/A** |
| Address | |

| | |
|---|---|
| Telephone | |
| Fax | |
| e-mail | |
| **Flag** | **UNITED KINGDOOM** |
| **Port of registry** | **SOUTHAMPTON** |
| **Classification society** | **LLOYDS REGISTER**<br>**Lloyd's +100A1 Oceanographic Research Vessel, *IWS, Ice Class 1D, EP +LMC, UMS, DP(AM), Green Passport, Shipwright (SERS)** |
| **Class ID number** | **9588029** |
| Hull type | **STEEL** |
| LOA | **99.70m** |
| Beam | **18.00m** |
| Maximum draft | **6.60m** |
| Deadweight tonnage | **1840T** |
| Gross tonnage | **5952T** |
| Net Tonnage | **1785T** |
| Main engine horsepower and manufacturer | **5760kW** |
| Number of engines | **DIESEL ELECTRIC** |
| Number and type of main propellers | **2 x Wartsila Azimuth Thrusters with 5-bladed, fixed pitch, 3.6m diameter (Outward turning)** |
| Number of rudders | **N/A** |
| Number of generators | **4 X Wartsila 8L20 (1770kW/1000RPM)** |
| Kort nozzles fitted? | **NO** |
| Bow thrusters fitted (number and type)? | **WARTSILA – AZIMUTH 1350Kw**<br>**TEES GILL – WATER JET (1700kW)** |
| Stern thrusters fitted (number and type)? | **NONE** |
| Other propulsions fitted (number and type)? | **2 x Wartsila DC Propulsion Motors (2,200kW, 3x690v, 50Hz)**<br>**4 x Warstila LLC (low Loss Concept) Transformers each 2500/1250kVA** |
| Rated bollard pull (as applicable) | **N/A** |
| Type of bunkers | **MARINE GAS OIL** |
| Bunker capacity | **596m3 approx** |
| Daily fuel consumption | **9m3 on 2 generators** |
| Potable water capacity | **310m3 approx** |
| Can vessel make potable water? | **YES** |
| Water ballast capacity | **1375m3** |
| Inmarsat number (MMSI) | **235091165** |
| Call sign | **2FGX5** |
| Name of the vessel's P&I club | **BRITISH MARINE** |
| Name and contact details for designated person ashore (DPA) | **GERAINT WEST**<br>**HEAD NMF-SEA SYSTEMS**<br>**+44 (0)2380 596147**<br>**geraint.west@noc.ac.uk** |
| DEEP WATER CORING TRACTION SYSTEM<br>SWL 30 T | **Cable length: 8000m Diameter: 30 mm**<br>**Minimum Breaking Load of the cable (MBL): 75 tonnes** |
| FIBRE OPTIC DEEP TOW TRACTION SYSTEM<br>SWL 11 T | **Cable length: 10, 000m Diameter: 17.3mm**<br>**MBL: 18.4 t**<br>**Note: Deep Water Coring and the Optical Fibre Deep Tow Cable use same traction winch.** |

| | |
|---|---|
| TRAWL TRACTION WINCH – TAPERED<br>SWL 12.5T 8 T @ inboard end, 11.5 T @ outboard end | **Wire rope length: 15, 000m**<br>**Outer length: 8, 300m Diameter: 14.5mm MBL: 13 T**<br>**Middle length: 4, 350m Diameter: 16.5mm MBL: 18.1 T**<br>**Inner length: 2, 350m Diameter: 18mm MBL: 20.9 T** |
| CTD TRACTION WINCH – FIBRE OPTIC CABLE<br>SWL 5 T | **Rope Length: 8000m Diameter: 11.43mm**<br>**MBL 8.39 T** |
| AFT 'A' FRAME | **SWL 20t static, 10t luffing**<br>**Outreach 3.0m**<br>**Inboard reach 3.8m**<br>**Height above deck 5.8m**<br>**Width 6.0m**<br>**Pennant winch 1t SWL** |
| MIDSHIP 'A' FRAME | **SWL 15t static, 8t luffing**<br>**Outreach 2.8m**<br>**Inboard reach 1.8m**<br>**Height above deck 3.9m**<br>**Pennant winches 2 x 2t SWL** |

### *6.2 Vessel offsets*

The approximate deployment location for the camera stations was be obtained from the vessel location data. Actual camera position was obtained from a beacon located on the camera and was logged on the video and data files recorded by the vessel.

### *6.3 Annex 2: Survey Metadata*

Station metadata for DY099 is provided below. “Station number” is a sequential event number for the cruise, so changes each time a new gear is used, or a new location is sampled. Station code identifies the sampling location.

| Station number | Station code | Date | Gear | Sample acquired | Replicate Attempt | Start of line Latitude (D M.M) | | Start of line Longitude (D M.M) | | Number of stills | Duration of video footage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CUBA01 | 21/02/2019 | Drop Camera | TRUE | A1 | 54 | 16.0176 | 36 | 26.1356 | 84 | 01:02 |
| 1 | CUBA01 | 21/02/2019 | Drop Camera | TRUE | A2 | 54 | 15.8995 | 36 | 25.872 | 26 | 00:33 |
| 2 | ZAVO01 | 23/02/2019 | Drop Camera | TRUE | A1 | 56 | 15.931 | 27 | 36.275 | 127 | 00:53 |
| 3 | ZAVO02 | 23/02/2019 | Drop Camera | TRUE | A1 | 56 | 15.65 | 27 | 37.115 | 115 | 01:16 |
| 4 | ZAVO03 | 23/02/2019 | Drop Camera | TRUE | A1 | 56 | 15.387 | 27 | 37.837 | 116 | 02:02 |
| 5 | ZAVO04 | 23/02/2019 | Drop Camera | TRUE | A1 | 56 | 14.998 | 27 | 38.946 | 95 | 01:21 |

| Station number | Station code | Date | Gear | Sample acquired | Replicate Attempt | Start of line Latitude (D M.M) | | Start of line Longitude (D M.M) | | Number of stills | Duration of video footage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | ZAVO05 | 23/02/2019 | Drop Camera | TRUE | A1 | 56 | 13.918 | 27 | 42.099 | 146 | 01:31 |
| 7 | ZAVO02 | 23/02/2019 | 1.5m Benthic Dredge | FALSE | A1 | 56 | 15.588 | 27 | 37.28 | - | N/A |
| 8 | ZAVO01 | 23/02/2019 | 1.5m Benthic Dredge | FALSE | A1 | 56 | 15.959 | 27 | 36.646 | - | N/A |
| 9 | ZAVO06 | 23/02/2019 | Drop Camera | TRUE | A1 | 56 | 16.1148 | 27 | 36.672 | 91 | 01:03 |
| 10 | ZAVO07 | 24/02/2019 | Drop Camera | TRUE | A1 | 56 | 23.138 | 27 | 23.674 | 100 | 00:57 |
| 11 | ZAVO08 | 24/02/2019 | Drop Camera | TRUE | A1 | 56 | 23.303 | 27 | 22.739 | 66 | 01:04 |
| 12 | ZAVO09 | 24/02/2019 | Drop Camera | TRUE | A1 | 56 | 23.565 | 27 | 21.38 | 93 | 01:28 |
| 13 | ZAVO10 | 24/02/2019 | Drop Camera | TRUE | A1 | 56 | 23.935 | 27 | 19.283 | 81 | 01:08 |
| 14 | ZAVO11 | 24/02/2019 | Drop Camera | TRUE | A1 | 56 | 24.556 | 27 | 14.588 | 133 | 01:30 |
| 15 | ZAVO07 | 24/02/2019 | 2m Agassiz Trawl | TRUE | A1 | 56 | 23.137 | 27 | 23.67 | - | N/A |
| 15 | ZAVO07 | 24/02/2019 | 2m Agassiz Trawl | TRUE | A2 | 56 | 23.169 | 27 | 23.344 | - | N/A |

| Station number | Station code | Date | Gear | Sample acquired | Replicate Attempt | Start of line Latitude (D M.M) | | Start of line Longitude (D M.M) | | Number of stills | Duration of video footage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | ZAVO07 | 24/02/2019 | 1.5m Benthic Dredge | TRUE | A1 | 56 | 23.138 | 27 | 23.266 | - | N/A |
| 17 | SAUN01 | 25/02/2019 | Drop Camera | TRUE | A1 | 57 | 42.347 | 26 | 29.311 | 210 | 01:47 |
| 18 | SAUN01 | 25/02/2019 | 2m Agassiz Trawl | TRUE | A1 | 57 | 42.457 | 26 | 29.457 | - | N/A |
| 19 | SAUN02 | 25/02/2019 | Drop Camera | TRUE | A1 | 57 | 42.0052 | 26 | 30.095 | 87 | 01:05 |
| 20 | SAUN03 | 25/02/2019 | Drop Camera | TRUE | A1 | 57 | 41.5189 | 26 | 30.4605 | 126 | 01:12 |
| 21 | SAUN04 | 25/02/2019 | Drop Camera | TRUE | A1 | 57 | 40.8213 | 26 | 31.2339 | 60 | 01:00 |
| 22 | SAUN05 | 25/02/2019 | Drop Camera | TRUE | A1 | 57 | 38.1253 | 26 | 36.0142 | 117 | 01:36 |
| 23 | SAUN06 | 26/02/2019 | Drop Camera | TRUE | A1 | 57 | 47.685 | 26 | 20.319 | 143 | 01:34 |
| 24 | MONT08 | 27/02/2019 | Drop Camera | TRUE | A1 | 58 | 26.702 | 26 | 12.658 | 77 | 01:19 |
| 25 | MONT07 | 27/02/2019 | Drop Camera | TRUE | A1 | 58 | 26.5138 | 26 | 12.7426 | 57 | 00:34 |
| 26 | MONT06 | 27/02/2019 | Drop Camera | FALSE | A1 | 58 | 25.2137 | 26 | 13.581 | 8 | 00:17 |

| Station number | Station code | Date | Gear | Sample acquired | Replicate Attempt | Start of line Latitude (D M.M) | | Start of line Longitude (D M.M) | | Number of stills | Duration of video footage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | MONT10 | 27/02/2019 | Drop Camera | TRUE | A1 | 58 | 27.392 | 26 | 11.6971 | 79 | 00:46 |
| 28 | MONT09 | 27/02/2019 | Drop Camera | TRUE | A1 | 58 | 26.5684 | 26 | 11.5701 | 138 | 01:04 |
| 29 | MONT11 | 27/02/2019 | Drop Camera | TRUE | A1 | 58 | 25.7973 | 26 | 11.5347 | 96 | 00:55 |
| 30 | MONT12 | 28/02/2019 | Drop Camera | TRUE | A1 | 58 | 27.156 | 26 | 9.069 | 147 | 01:26 |
| 31 | MONT13 | 28/02/2019 | Drop Camera | TRUE | A1 | 58 | 26.51 | 26 | 8.669 | 158 | 00:26 |
| 32 | MONT07 | 28/02/2019 | 2m Agassiz Trawl | TRUE | A1 | 58 | 26.572 | 26 | 12.734 | | N/A |
| 32 | MONT07 | 28/02/2019 | 2m Agassiz Trawl | TRUE | A2 | 58 | 26.584 | 26 | 12.711 | | N/A |
| 33 | MONT13 | 28/02/2019 | 2m Agassiz Trawl | TRUE | A1 | 58 | 26.774 | 26 | 8.705 | | N/A |
| 34 | MOBA02 | 01/03/2019 | Drop Camera | TRUE | A1 | 58 | 31.0919 | 25 | 5.547 | 116 | 01:24 |
| 35 | MOBA01 | 01/03/2019 | Drop Camera | TRUE | A1 | 58 | 31.396 | 25 | 3.77 | 145 | 01:26 |
| 36 | MOBA05 | 01/03/2019 | Drop Camera | TRUE | A1 | 58 | 32.457 | 25 | 4.63 | 196 | 01:28 |

| Station number | Station code | Date | Gear | Sample acquired | Replicate Attempt | Start of line Latitude (D M.M) | | Start of line Longitude (D M.M) | | Number of stills | Duration of video footage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 37 | MOBA04 | 01/03/2019 | Drop Camera | TRUE | A1 | 58 | 34.471 | 25 | 4.854 | 176 | 01:34 |
| 38 | MOBA03 | 01/03/2019 | Drop Camera | FALSE | A1 | | | | | | 00:00 |
| 39 | SOTH01 | 01/03/2019 | Drop Camera | TRUE | A1 | 59 | 24.6585 | 27 | 24.5412 | 90 | 00:59 |
| 40 | SOTH02 | 02/03/2019 | Drop Camera | TRUE | A1 | 59 | 24.0833 | 27 | 24.9565 | 124 | 01:02 |
| 41 | SOTH03 | 02/03/2019 | Drop Camera | TRUE | A1 | 59 | 23.481 | 27 | 26.024 | 178 | 01:26 |
| 42 | SOTH04 | 02/03/2019 | Drop Camera | TRUE | A1 | 59 | 22.063 | 27 | 28.341 | 89 | 01:18 |
| 43 | SOTH02 | 02/03/2019 | 2m Agassiz Trawl | TRUE | A1 | 59 | 24.07 | 27 | 24.91 | | N/A |
| 44 | SOTH01 | 02/03/2019 | 1.5m Benthic Dredge | TRUE | A1 | 59 | 24.515 | 27 | 24.796 | | N/A |
| 45 | SOTH01 | 02/03/2019 | 2m Agassiz Trawl | TRUE | A1 | 59 | 24.508 | 27 | 24.796 | | N/A |
| 46 | SOTH05 | 02/03/2019 | Drop Camera | TRUE | A1 | 59 | 15.865 | 27 | 23.4853 | 156 | 01:43 |
| 47 | SOTH09 | 02/03/2019 | Drop Camera | TRUE | A1 | 59 | 23.247 | 27 | 22.12 | 78 | 00:43 |

## About us

Cefas is a multi-disciplinary scientific research and consultancy centre providing a comprehensive range of services in fisheries management, environmental monitoring and assessment, and aquaculture to a large number of clients worldwide.

We have more than 500 staff based in 2 laboratories, our own ocean-going research vessel, and over 100 years of fisheries experience.

We have a long and successful track record in delivering high-quality services to clients in a confidential and impartial manner.
(www.cefas.defra.gov.uk)

Cefas Technology Limited (CTL) is a wholly owned subsidiary of Cefas specialising in the application of Cefas technology to specific customer needs in a cost-effective and focussed manner.

CTL systems and services are developed by teams that are experienced in fisheries, environmental management and aquaculture, and in working closely with clients to ensure that their needs are fully met. (www.cefastechnology.co.uk)

.

## Customer focus

With our unique facilities and our breadth of expertise in environmental and fisheries management, we can rapidly put together a multi-disciplinary team of experienced specialists, fully supported by our comprehensive in-house resources.

Our existing customers are drawn from a broad spectrum with wide ranging interests. Clients include:

- international and UK government departments
- the European Commission
- the World Bank
- Food and Agriculture Organisation of the United Nations (FAO)
- oil, water, chemical, pharmaceutical, agro-chemical, aggregate and marine industries
- non-governmental and environmental organisations
- regulators and enforcement agencies
- local authorities and other public bodies

We also work successfully in partnership with other organisations, operate in international consortia and have several joint ventures commercialising our intellectual property

**Head office**

**Centre for Environment, Fisheries & Aquaculture Science**

**Pakefield Road, Lowestoft,**

**Suffolk NR33 0HT UK**

**Tel +44 (0) 1502 56 2244**
**Fax +44 (0) 1502 51 3865**

**Web www.cefasdefra.gov.uk**

**Centre for Environment, Fisheries & Aquaculture Science**

**Barrack Road, The Nothe**

**Weymouth, DT4 8UB**

**Tel +44 (0) 1305 206600**
**Fax +44 (0) 1305 206601**