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Report

Survey CEND 07/12
North Sea (FU5)

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INTRODUCTION

The Norway lobster (*Nephrops norvegicus*) is common throughout the North Sea and supports a very important fishery for the UK. The present survey focuses on the Botney Gut / Silver Pit (FU5), an offshore ground comprising UK and Dutch national waters (Figure 1) and where the total landings in 2010 were 960 tonnes. This area is predominantly 50 to 80 m deep, with a muddy-sand substratum, and is surrounded by shallower sandy areas.

Currently the assessment on *Nephrops* stocks in the North Sea is based on underwater television surveys (UWTV) which provides a fishery independent estimate of stock size, exploitation status and catch advice (ICES, 2008). This assessment method is already being used in two other areas the Farn Deeps and the East Irish Sea.

The *Nephrops* stock assessments are run annually and these are the scientific basis on which the annual TACs for this species are set. So far for the Botney Gut/Silver Pit area there is no analytical assessment method established. In autumn 2010 for the first time a UWTV survey was conducted on this ground providing a starting point for using UWTV surveys to assess the *Nephrops* populations in this area. In 2011 due to bad weather none of the stations were completed, and so the present survey aims to replicate the experimental design planned for 2011.

The specific objectives of this survey are listed below:

1. To carry out the second year of a preliminary survey of the Botney Gut Silver Pit grounds, 54° 20' - 53° 40' N and 1° 20' - 3° 15' E, to evaluate *Nephrops* abundance and define the edges of *Nephrops* distribution on the ground.
 2. To characterise the benthic community. A 2 m beam and/or 3 m beam trawl will be used in some stations, to identify the occurrence of other burrowing species and determine the *Nephrops* length frequency distribution on this ground.
 3. To characterise sediment features at and between TV survey stations using swathe bathymetry.
 4. If time allows, burrow occupancy experiments will be carried out by using a zipper sledge, which discharges electric pulses into the sea bottom.
 5. To collect juvenile *Nephrops* hepatopancreas from beam trawl tows to send to the Weymouth CEFAS laboratory (contact: Kelly Bateman). This will be used to conduct a small scale study of juvenile *Nephrops norvegicus* to see if the disease profile in juvenile differs from that of adults. In particular the lab in Weymouth is looking for an intranuclear bacilliform virus (IBV) which is known to infect other juvenile crustacean species such as *Cancer pagurus*. After the survey the hepatopancreas will be sampled from juvenile *Nephrops norvegicus* for histology and electron microscopy.
 6. To collect water samples for analysis of phytoplankton communities.
- Aim 1: water from the vessel's continuous supply will be analysed via flow cytometry. Samples will be filtered to provide pigment and DNA data. Sub-samples will be concentrated and preserved in order to undergo DNA staining and further flow cytometric analysis. This will provide data which can be related to the carbon content of cells.

Aim 2: Calibration of the Turner Phytoflash instrument on the Ferrybox system of Endeavour. Water samples will be collected and used to compare variable fluorescence measurements from the Phytoflash system installed permanently in the Ferrybox against independent results from a Chelsea Instruments Fastracka-II.

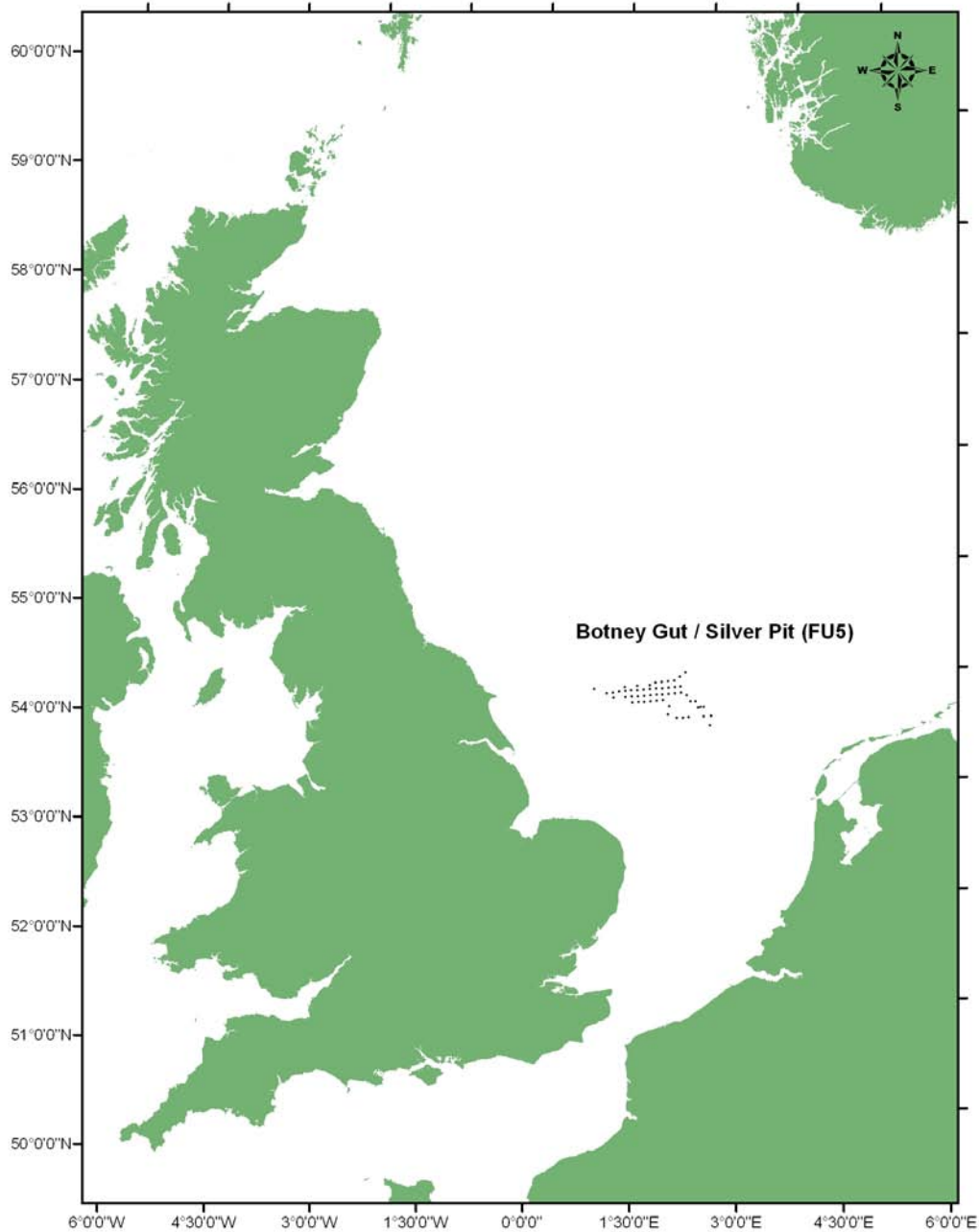


Figure 1 – Map showing the location of Botney Gut/Silver Pit grounds.

MATERIAL AND METHODS

The 2012 North Sea *Nephrops* UWTV survey covering the Botney Gut/Silver Pit area took place on RV Endeavour between 9th to 14st April. The departure and arrival port was Lowestoft.

Survey design

The survey design for the main area of the Botney Gut / Silver Pit grounds is based on a fixed grid with approximate 3 nautical miles distance in-between stations. The initial ground perimeter has been delimited by the combination of VMS data and BGS sediment maps. Based on 2010 survey results for the Botney Gut area another 15 new stations were added to ensure a better definition of the *Nephrops* ground limits, especially in the Dutch national waters which were not covered in 2010.

At each station a sledge mounted TV camera was deployed and a clear 10 minute tow was recorded onto DVD and DVT and HD DVT (only a subset of stations were recorded on HD). Once back in the lab the HD recordings will be compared with the standard definition at different visibility scenarios; this will allow us to make the decision on moving to HD in the future.

Vessel position (DGPS) and position of sledge (using a USBL transponder) were recorded every 1 second.

The sledge was equipped with:

- An HD camera at an oblique angle to the sea bed, sighted towards the front of the sled (Annex 1);
- The sledge was firstly mounted with to 2 sets of lights connected to 2 different power supplies to allow independent regulation of the light intensity: 4 LED lights on the side (the intensity was set to 100 “units” each, and had to be manually set up inside the lab) plus 2 LED lights on the top (intensity controlled remotely by the power supply) to fully illuminate the field of view. The top lights proved to be better in most stations, although the combination of 2 top lights plus 2 side lights (reduced to 50 “units” of intensity) also proved to be a good option.
- 2 fan lasers to delimit the field of view (**field of view 71 cm**). This year the new set of green fan lasers were used, although they did not offer any improvement over the original red lasers.
- A transponder so that the sledge could be retrieved if lost;
- The ESM2 logger unit was unavailable so no turbidity data were recorded.

The Dynamic Positioning system (DP) was used throughout the survey to provide a controlled towing speed of around 0.7 knot.

Swathe data were collected on the survey between and over TV stations (approximately 20 stns; due to time constraints the run through the stations was cut down to the new stations not included in the 2010 grid).

Recounts

In line with SGNEPS recommendations all scientists were trained/re-familiarised using training material and reference sets for this ground. On completion of this process, all CEND 07/12 recounts were conducted as blind counts, by two persons during the survey. Here, the number of *Nephrops* burrow systems and the activity in and out of the burrows were counted by each minute block (for 7 clear minutes). All minute blocks with more than 20 seconds obscured by sediment clouds were rejected. Back in the lab the Linn's CCC will be applied to check which stations will need to be revisited and where a 3rd and 4th counter need to be added.

Whilst reviewing the videos, the visibility, ground type, trawl marks, occurrence of bio-fauna, ground contact of the sledge, cloud and any other interference was recorded during each one-minute intervals, using a classification key.

For post-analysis, counts of burrow systems are converted into densities at each station using the width of view and the length of the tow. Each system is assumed to represent one adult *Nephrops* and occupancy is assumed to be 100%. Overall abundance is estimated by raising the mean density to the appropriate strata area. Total survey abundance, variance and confidence limits are then calculated. To estimate the spatial structure of *Nephrops* densities a geo-statistical analysis is carried out.

Beam trawl

Two types of beam trawls were tested, a 3m beam and a 2 m beam, both with metal frames.

- 2m Jennings beam with a 20mm mesh in 210/24 (6z) nylon twine (with a 10mm mesh liner). Included a chain mat (Figure 2). Extra weight was added in the shoes (~ 5 Kg in each shoe) and also an extra chain was added around the foot-rope of the net. The tickler chain was removed because this made the beam too heavy.
- The 3m Jennings type was only similar as regards the steelwork, the netting itself was very different. The square, wings and top belly were all 100mm mesh in 4mm polypropylene. Lower belly was 75mm mesh in 4mm polypropylene. The codend was 40mm mesh in black twisted nylon, with the lower codend lined with 10mm soft white nylon. This trawl also had a light chain mat.

After testing both beams, the 2 m beam trawl perceived to be a more suitable fishing gear to the survey purposes, catching more prawns and more burrowing megafauna. The 2m beam showed to have a better performance when towed at a speed of 1 knot (1.85 Km/h) with a warp length:water depth ratio of 3:1, for 15 minutes. Each tow was timed from the moment that the net contacted the seabed until the moment of hauling from the seabed (Annex 2).

The tows were conducted across the Botney Gut / Silver Pit ground, in areas identified by the underwater TV camera as having a high density of small burrows. The tows intended just to be qualitative with the aim of indentifying the macro fauna associated with these small burrow grounds and also to identify the length frequency distribution of *Nephrops* living in these areas.

A total of 6 TVID stations were towed to cover at least the same area that was previously TV surveyed. The mud was washed out through a 1m² sieve stand with 5mm and 1mm sieves and the catch was sorted afterwards. All *Nephrops* caught were sorted by sex and measured to the lowest millimetre carapace length and individual weight (g) was also recorded. The benthic catch was sorted by species and sampled by weight (g) and number.



Figure 2 - 2m Jennings beam, showing the chain matt and the extra chain on the shoes and around the foot-rope. Photo by Robin Masefield (Cefas).

Hepatopancreas sampling – juvenile *Nephrops*

Hepatopancreas sampling of juvenile *Nephrops norvegicus* was undertaken on behalf of the “Aquatic Health and Hygiene groups” Pathology & Molecular Systematics team. This will enable a small scale study to evaluate if the infectious disease profile in juvenile *Nephrops* differs to that of adults. In particular, identification of an intranuclear bacilliform virus (IBV) observed in adult specimens will be profiled. Fifty *Nephrops* under 30mm carapace length were measured, sexed and examined for deformities, shell fouling, shell disease, missing appendages and claws. Following dispatch, sections of hepatopancreas were excised and preserved in Davidson’s solution and glutaraldehyde for later histological examination using molecular biological techniques and electron microscopy.

Flow cytometry

A total of 17 stations distributed across the cruise path were analysed by the Cytosense flow cytometer. At each station, analyses were performed at low (10 mV) and high (26mV) red

fluorescence trigger levels, at flow speeds of 4.2 and 9.7 microlitres/second respectively. At 8 of these stations, water was filtered for pigment and DNA analysis, and concentrated for preservation and DNA staining. Samples were fixed using methanol, and incubated at 37 °C with the DNA fluorochrome PicoGreen for 1 hour. Replicates were analysed using multiple yellow fluorescence trigger levels (from 10-140 mV) at a variety of flow rates dependent on cell density.

Fastracka

42 stations distributed across the cruise path were analysed by the Fastracka. Adjustments to the gain settings were made in accordance with the fluorescence emitted by the phytoplankton communities in each area. At every station 3 samples were collected from the ferry box overflow. Analysis comprised a number of single acquisitions, followed by a rapid light curve. Samples were filtered through 0.2µm filter to provide a blank and once every 24hrs a blank of deionised water was analysed of these blanks comprised 3 single acquisition measurements.

Health and Safety

As required all staff had a valid ENG1 health certificate and a Personal Sea Survival Certificate.

Also the following risk assessments were acknowledged (where applicable to work activities):

HS26 CORP-GOV-HSEQ-RA-G01 Access to and Work in Laboratories & Workshops

HS26 CORP-GOV-HSEQ-RA-G03 Access to and Work on RV Cefas Endeavour

HS26 AHH-AAD-PAMS-RA-13 Crustaceans dissection

HS26 AHH-ADD-PAMS-CRA-20 Fixative used on research vessels and in the field

HS26 AHH-GEN-RA-21 Using Sharps

HS26 FD-C&F-SHELL-RA-09 MB001 *Nephrops* TV Cruise

HS26 FD-C&F-SHELL-SOP-01 MB001 NEPTV Burrow Count SOP

SOP 2014 *Nephrops* tissue sampling

Note: Marine Instrumentation and Surveys Team documentation (SOP and RA) for the zapper sledge requires updating for use in the next *Nephrops* survey.

RESULTS

Technical aspects

During this survey no major technical issues were identified, although a recurrent problem was raised regarding the HD camera focusing. The battery did not maintain charge for more than a few hours. The loss of charge resulted in all camera settings reverting to the defaults which included the focus reverting from manual to auto focus. This was a problem in some stations and to solve this issue the camera was left on continuously during the nights to full charge the battery.

The overall performance of the LED lights was very good but minor issues were also identified. Two of the new set of strip side lights had a communication fault and one of the top right lights were flickering in some stations. This was not crucial but repair/replacement of lights is required for the next survey.

Some problems were also identified regarding the multibeam. The CTD needs reconfiguration to be able to communicate to the multibeam system and also the Multibeam GPS system needs to be checked.

The use of Ferrybox fluorescence data could be greatly enhanced if light measurements from the PAR sensor on the bridge of Endeavour were being recorded, as was the case with the previous met pack. This problem is being addressed at present (R. Forster, N. Lyman).

TV survey

In this survey the poor visibility hampered many stations and despite repeated attempts at over 23 sites (TVID) only 7 were successfully redone providing better footage when compared the first run.

This survey reached a total of 98 stations and footage was recorded in 46 sites (TVID).

TVID stn - footage recorded	46
TVID stn - no footage recorded	8
TV stn - revisited	29
Beam Trawl	9
Water sample (Niskin bottle)	2
CTD (multibeam calibration)	4

The surveyed area is shown in Figure 4 giving the survey stations and the correspondent station rating, from good to poor, which decreased towards the east side of the grid. Bottom water was sampled in 2 of the very poor visibility stations and analysed by flow cytometry. Results showed average numbers of phytoplankton cell counts, lower than bloom levels, although higher abundance than in surface waters. Figure 3 shows the results for the flow cytometry. There was an average concentration of 4.6 cells/ μ l in sample B, 31.6 cells/ μ l in sample C, while just 2.1 cells/ μ l in the water surface sample in the same area. Sediment particles recorded by the flow cytometer are indicated by the blue grouping, and can be seen to be higher in the two bottom water samples than at the

surface. This suggests that the main cause of poor visibility might have been suspended sediment (very soft mud) combined with some phytoplankton.

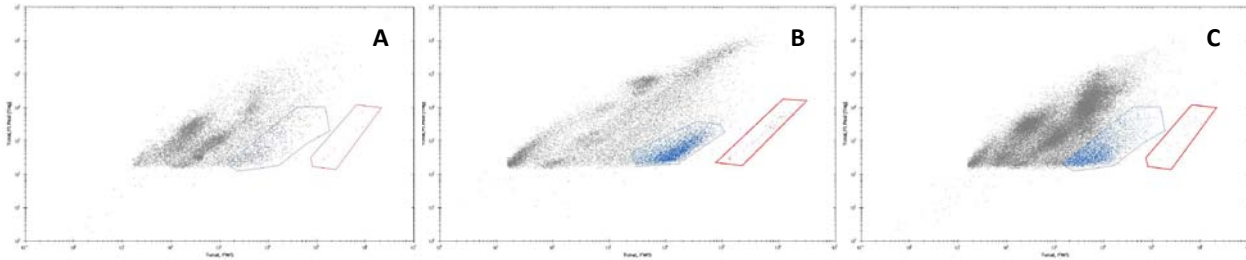


Figure 3 - Flow cytometry data for the surface water sample (A), Niskin sample for 5-V (B) and Niskin sample for 5-AM (C). The X axis (Total FWS) can be interpreted as a proxy for cell size, whilst the Y axis (Total FL Red (Trig)) represents chlorophyll *a*. The largest cells (e.g. diatoms) are found at the top right, and cyanobacteria, e.g. *Synechococcus* are found at the bottom left. The dots within the boxes are noise: the red box contains bubbles and blue box is general dirt, debris, and dead cells.

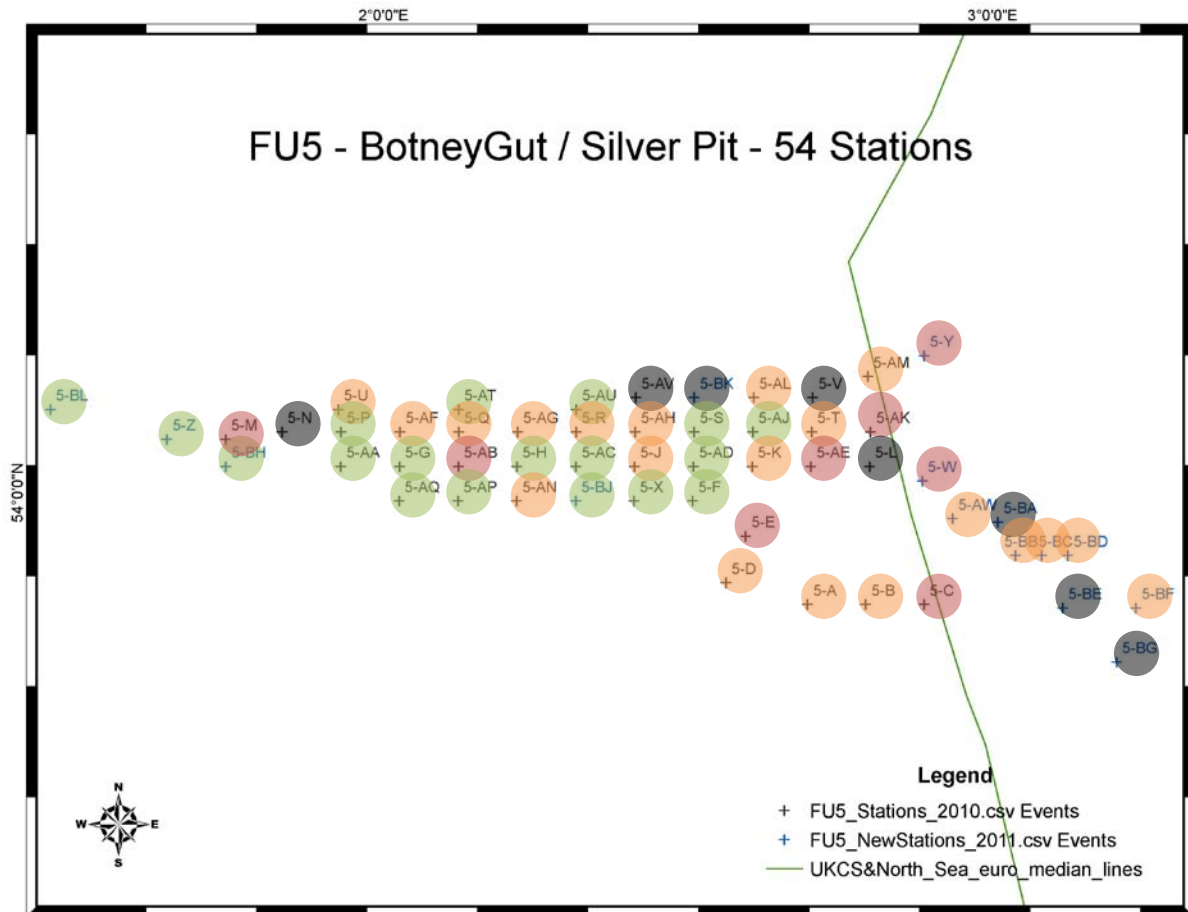


Figure 4 – CEND 07/12 station rating of all surveyed stations. Green = good; Orange = medium, Red = poor; and Black = stations that were aborted and no footage was recorded (green line represents the border between the UK and Dutch national waters; blue stations stand for the new stations added this year).

Nephrops burrow live-counts were made over a 10-minute tow, which were recorded on DVD, DVT and HD tape. All recordings were then recounted under controlled conditions; burrows were counted

by each minute block for 7 clear minutes. This ground proved to be very different compared with the Farn Deeps area. The same issues were raised from the 2010 survey, high density of small burrows appear to be common throughout the ground making the identification of *Nephrops* burrows very difficult. The first counts at sea varied greatly between counters necessitating additional review. More training is required before a second run of counts. Figure 5 shows the preliminary results of the average burrow counts per station, for a total of 43 valid stations were the other stations were discarded or due to poor visibility or due to incongruence in the burrow counts among counters. It is noticeable a higher abundance in the central part of the ground as well towards the east side.

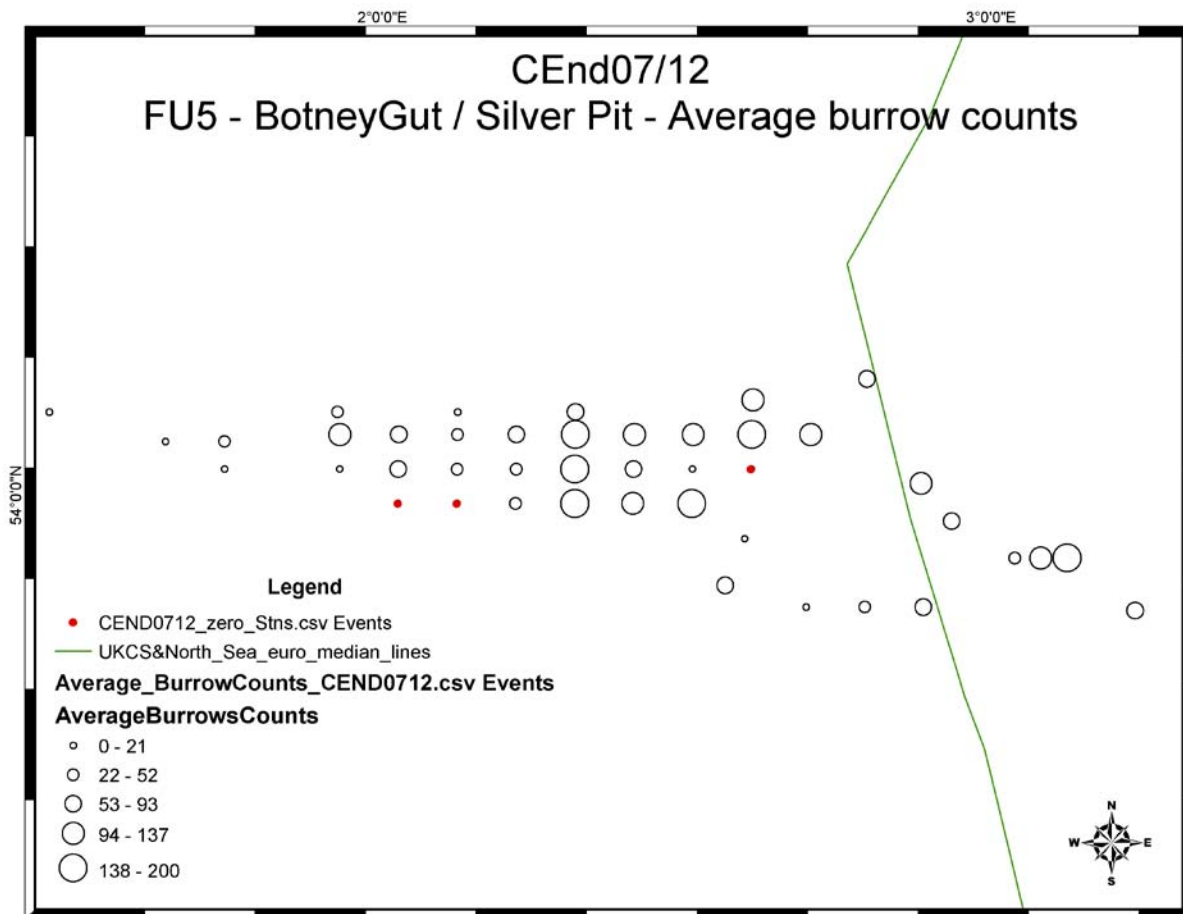


Figure 5 – CEND 07/12 average burrow counts per station.

Beam trawling

In 2010, underwater camera work identified areas with a high abundance of very small burrows systems exhibiting *Nephrops* “signatures” (central-eastern side of the ground) (Figure 6). Again this year the central-eastern side of the ground seems to be dominated by high densities of small burrows, although this characteristic is common to the entire ground. Burrow identification in the Botney Gut / Silver Pit was notoriously difficult due to the high small burrow densities and poor visibility (soft mud). Thus, this year an important objective of beam trawling these areas was to identify the size distribution of *Nephrops* and also identify other burrowing organisms.

Conversations with fishermen suggest a high abundance of small *Nephrops* in this part of the ground, although the occurrence of other burrowing organisms can also lead to misidentification of the burrow systems. Accurate identification of *Nephrops* burrows gets more difficult with small burrow sizes where the signatures are usually more difficult to recognise.

These data should help us on the identification of small burrow systems.

A total of 9 tows were made along 6 different stations (Figure 6). The *Nephrops* size ranges from 10 mm CL to 35 mm CL, with 36% below the minimum landing size (MLS) of 24 mm CL (Figure 7).

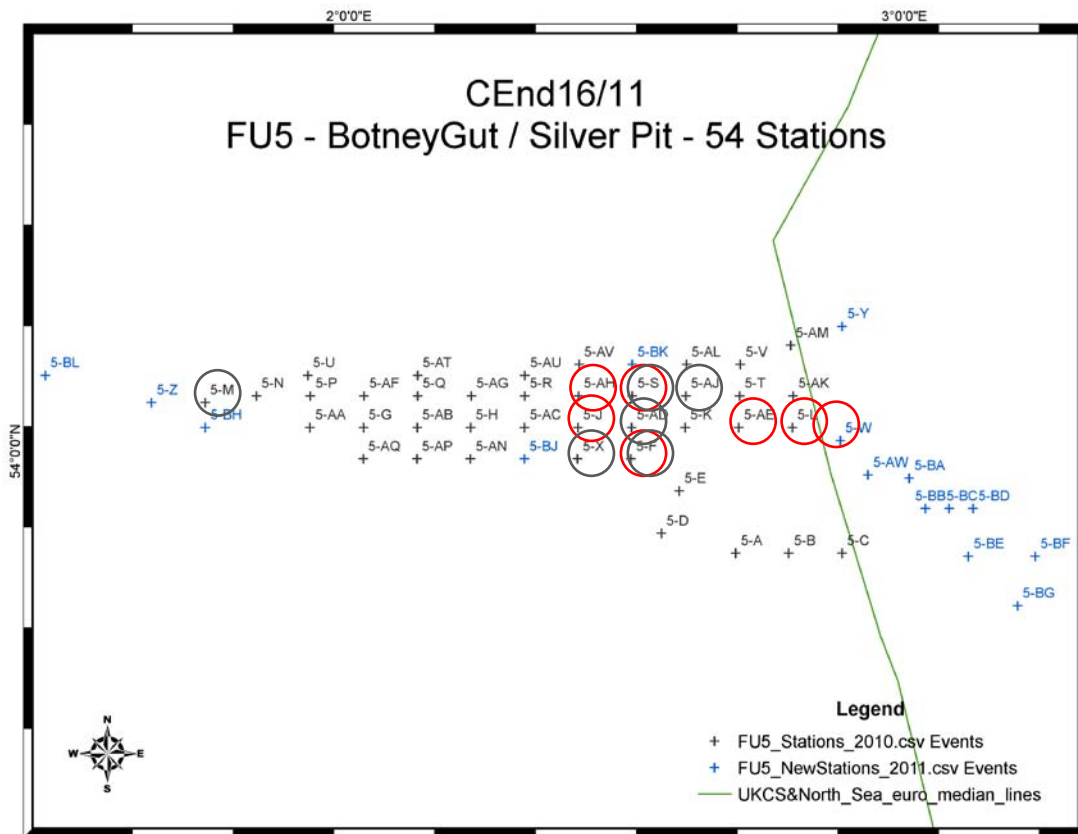


Figure 6– Beam trawl stations completed in the Botney Gut / Silver Pit area, for 2010 (red) and 2012 (grey).

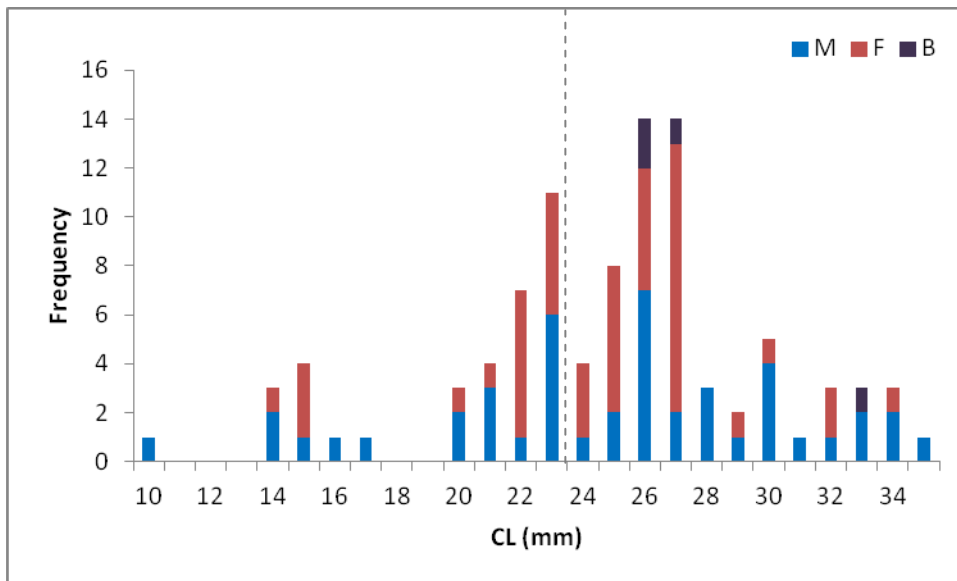


Figure 7 – *Nephrops norvegicus* length distribution by sex. M = male; F = female, B= berried female. Lines marks minimum landing size (MLS).

Table 1 shows a list of the total benthic megafauna species caught for the Botney Gut / Silver Pit area. Although in low numbers, species like *Callianassa subterranea* and *Goneplax rhomboids* were present; this highlights to the fact that the presence of these species might lead to misidentification of *Nephrops* burrows.

Table 1 – List of total megafaunal species caught for the Botney Gut / Silver Pit area.

Species	Total Number	Total Weight (g)
<i>Abra alba</i>	29	5.9
<i>Agonus cataphractus</i>	1	4
<i>Alycyonium digitatum</i>	2	99.1
<i>Amphipoda</i>	14	3.7
<i>Anapagurus in epizoanthus</i>	3	16.2
<i>Anemone</i>	1	23.9
<i>Antalis entails</i>	41	6
<i>Aphrodite aculeata</i>	25	850.3
<i>Arnoglossus laterna</i>	10	65.2
<i>Asterias rubens</i>	45	457.5
<i>Asteroidea</i>	3	10.6
<i>Astropecten irregularis</i>	61	339
<i>Buccinum undatum</i>	1	1
<i>Buglossidium luteum</i>	2	16.2
<i>Callianassa subterranea</i>	4	2.3
<i>Camilia galiana</i>	2	8.5
<i>Chamelea gallina</i>	1	4
<i>Corystes cassivelaunus</i>	42	258.6
<i>Crangon allmani</i>	313	241.2

<i>Dosinia exolata</i>	5	17.9
<i>Echinocardium chordatum</i>	373	7054.3
<i>Enchelyopus cimbrius</i>	31	423.8
<i>Flustra folicea</i>	-	10.2
<i>Gari fervensis</i>	1	6.4
Gobiidae	5	4.8
<i>Goneplax rhomboides</i>	2	23.1
<i>Hippoglossoides platessoides</i>	2	39.1
Isopoda	1	1
<i>Limanda limanda</i>	13	565.7
<i>Liocarcinus depurator</i>	8	96.4
<i>Liocarcinus holsatus</i>	11	87.9
<i>Luidia sarsi</i>	3	7.7
<i>Macropodia spp.</i>	4	2.9
<i>Merlangius merlangus</i>	7	472.5
<i>Microchirus variegatus</i>	3	50.7
<i>Microstomus kitt</i>	1	79.5
<i>Nephrops norvegicus</i>	97	1262.5
<i>Nucula nitidosa</i>	21	3.7
<i>Nucula nucleus</i>	25	6.2
<i>Ophiothrix fragilis</i>	10	8.3
Ophiuroida	308	113.9
<i>Pagurus bernardus</i>	59	1407.9
<i>Phaxas pellucidus</i>	61	4.8
Platyhelminthes	6	1.6
<i>Pleuronectes platessa</i>	1	70.9
Polychaeta	38	34.6
<i>Pomatoschistus spp.</i>	12	9.2
<i>Processa canaliculata</i>	31	7.7
<i>Psammechinus miliaris</i>	2	6
<i>Solea solea</i>	1	95.3
<i>Turritella communis</i>	4	5.8
Grand Total	1746	14395.5

Although the 2 m beam did catch *Nephrops* and other burrowing species further sampling needs to be taken in this ground, using different sampling techniques. The use of grabs is recommended for the next survey, to sample into the sediment at greater depth and provide more representative samples of what can be seen by the UWTV surveys. Several studies reveal that burrowing megafauna are difficult to sample using a single technique (Atkinson, 1986; Hughes, D.J. 1998). Most of the studies have used a combination of different sampling techniques: trawls/grabs, scuba diving and underwater video/still pictures (Marrs *et al.*, 1996).

Hepatopancreas sampling – juvenile *Nephrops*

All samples were taken to meet the requirements for Weymouth lab. Further analysis will take over in Weymouth lab.

Flow cytometry

The Cytosense flow cytometry operated without issue for the duration of this cruise, allowing acquisition of detailed data sets on live phytoplankton communities within the survey area (see figure 8). The DNA staining component of this work was less successful, for reasons yet to be fully understood, although which may be related to cell wall permeabilisation. This is an experimental protocol undergoing field tests for the first time: further laboratory work should resolve the issues experienced.

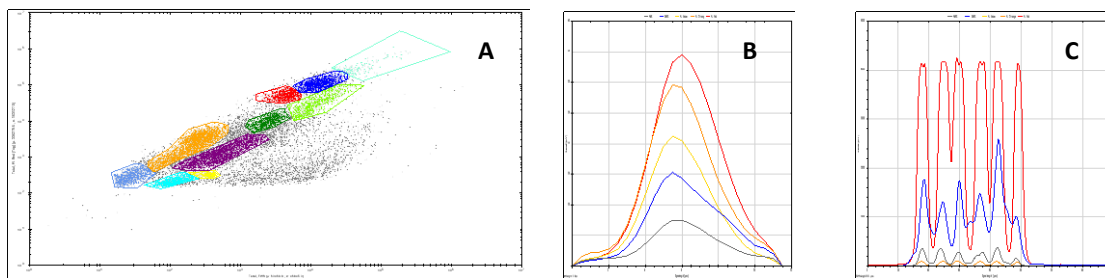


Figure 8 – Cytoplot acquired by flow cytometry of a typical phytoplankton community observed during the cruise (A). Each coloured cluster represents a different group cells, varying in size (X-axis) and red fluorescence (Y-axis). Cluster identification is reinforced through the use of pigment profiling: the small size and high orange fluorescence of the cyanobacteria *Synechococcus* can be clearly seen (B), in contrast the multiple chloroplasts observed within each cell of a diatom chain (C).

Fastracka

The Ferrybox system on RV Cefas Endeavour is fitted with an instrument, the Turner Phytoflash, which measures fluorescence of phytoplankton. Standard fluorometers such as the one used on the ESM2 logger and SmartBuoys only measure the baseline fluorescence of cells, thus giving an indirect measure of chlorophyll. In contrast, the Phytoflash is able to resolve the amount of chlorophyll AND the photosynthetic efficiency of the sample using the “variable fluorescence” technique. This is a very useful extra measurement as we have very few measurements of photosynthesis or primary productivity in our seas. The aim of the present work is to quantify what exactly the Phytoflash measures in comparison to our laboratory instruments. This opens the way for the automated mapping of primary production on fisheries cruises (funded by the EU FP7 project ‘ProTool’).

The route of Cend 0712 through the southern North Sea was chosen for this work because this area shows a high natural variability in phytoplankton concentration during late Spring (Schratzberger *et al.* 2008). The phytoplankton spring bloom in the Silver Pit provides the main food supply for the benthic system, and years with strong blooms show high concentrations of benthic chlorophyll as algal cells sink to the seafloor (Schratzberger *et al.* 2008).

Weather conditions were good throughout the cruise and several satellite remote sensing scenes were obtained during the week. A particular good image was obtained on Day 2 (Tuesday 10th April), shown below with an overlay of the cruise track (Figure 9). An algal bloom can be seen to the east of the Botney Gut / Silver Pit on the UK/Netherlands border, where the cruise was track was located on

Days 2 and 3. The Ferrybox and the Fastracka both recorded high concentrations of chlorophyll here, in good agreement with the satellite data. The western end of the grid, sampled on days 3 and 4, had clearer water with much lower chlorophyll.

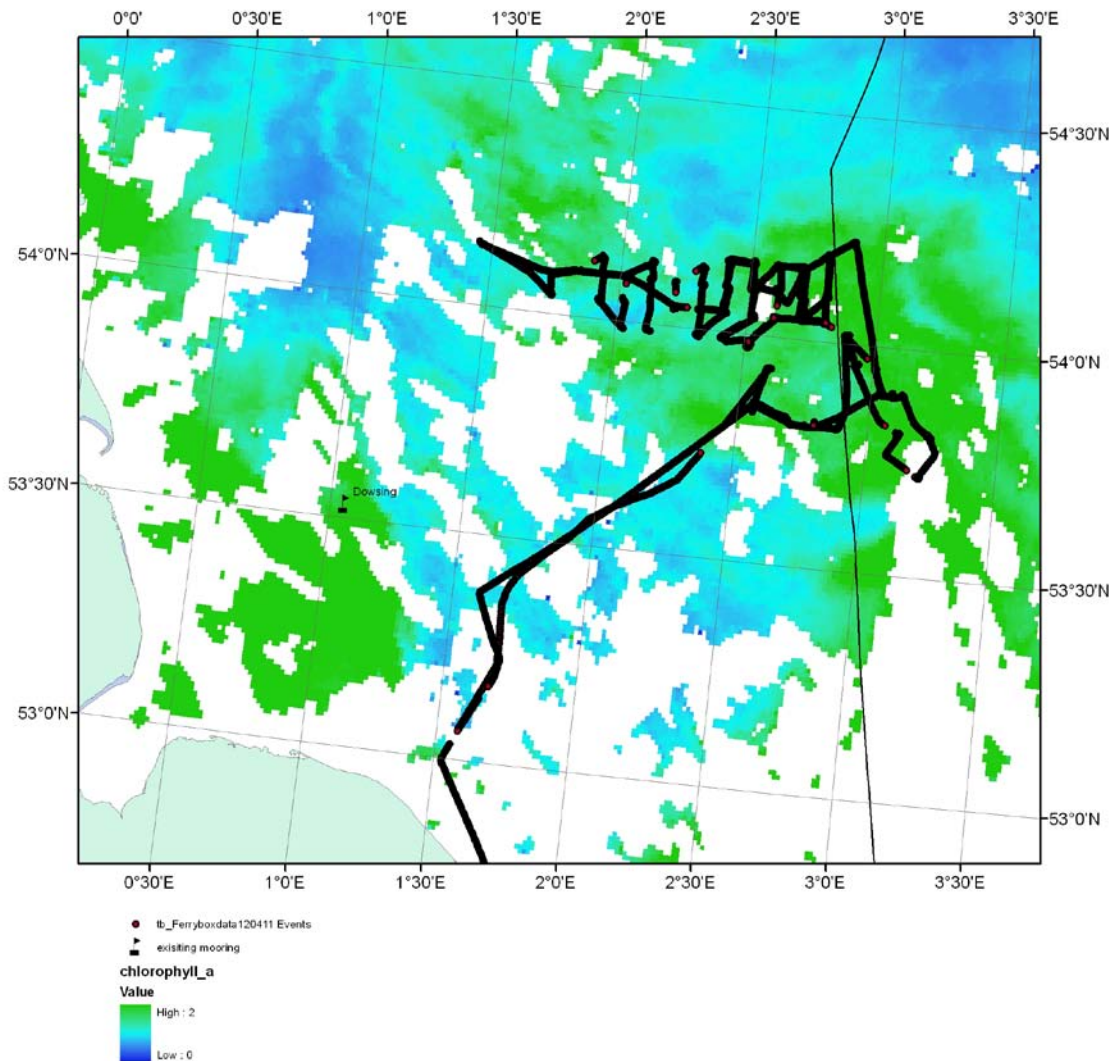


Figure 9 – Overlay of cruise track from Ferrybox on an ocean colour image of the North Sea from Tuesday 10th April, showing surface chlorophyll concentrations in the region.

The Ferrybox failed to record fluorescence data from 09:37 on 13/04/2011 onwards, making data for comparisons after this point unavailable; this may be due to the Ferrybox having been re-set at this point. Otherwise the Fastracka provided a very promising validation of the Phytoflash (Figure 10). There was a much better agreement between these two instruments than when an alternative PAM fluorometer was used in 2011. A photosynthetic efficiency of 0.5 to 0.55 was recorded in the night between day 1 and day 2 (eastern end of the grid) by both instruments. This value is at the upper end of the range measured by the Phytoflash and indicates that algae in this area are in the rapidly-growing phase of a bloom. The western end of the grid showed lower photosynthetic efficiency, being in the range 0.2 to 0.4 for both instruments. These are low values for the North Sea and can preliminary interpretation of this could be in terms of a strong nutrient limitation of cells in this region, which has caused the bloom to end (and sink?) prematurely.

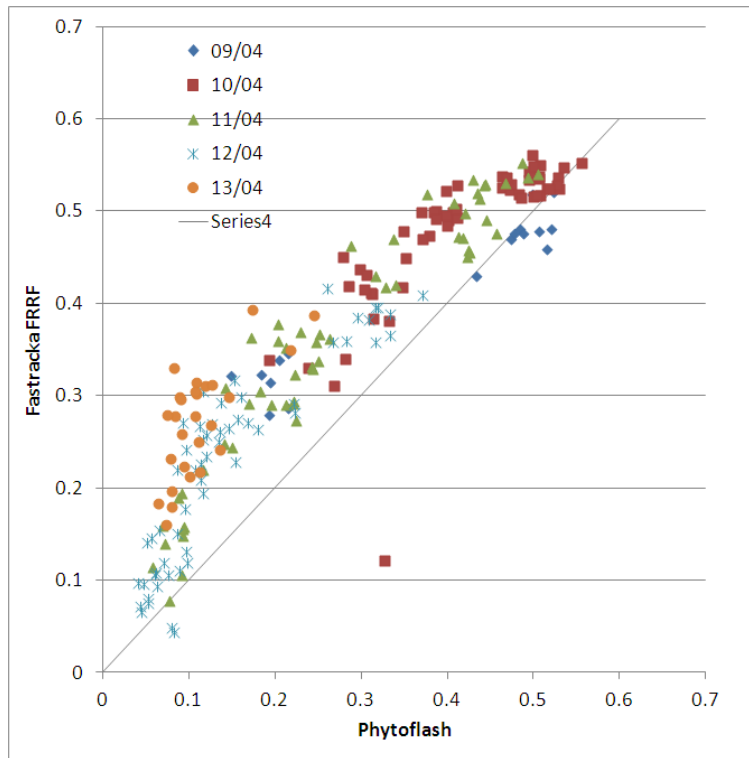


Figure 10 – Comparison of Fastracka and Phytoflash (Ferrybox) FRRF photosynthetic efficiency values obtained throughout the cruise. Sample time was recorded when sampling from the Ferrybox overflow, so that Fastracka samples could be related to Phytoflash readings recorded by the Ferrybox.

FINAL CONSIDERATIONS

This survey was of a multidisciplinary nature and the main objectives were met with minimal technical difficulties.

The UWTV coverage was of 85% of the overall grid, although poor visibility in many stations will exclude those from any analysis. The data collected so far for this area does not yet allow a robust assessment using the UWTV surveys. However, this survey provided useful information for the preliminary assessment for this ground and the boundary of *Nephrops* distribution was more defined compared with the 2010 survey. Further surveys need to be done in this area before the validation of this UWTV surveys as a standard assessment method for the Botney Gut/Silver Pit grounds.

Results from the beam trawl survey revealed a high density of small *Nephrops*. Although, new gear types should be tested to get better catchability and thus improve the description of the size component of *Nephrops* and the identification of other burrowing species.

ACKNOWLEDGMENTS

We would like to express our thanks and gratitude to the Captain and crew of RV Endeavour for their good will and professionalism during the survey. Also thanks to P&O Maritime for handling all gear and sort any technical difficulties. Finally, thanks to all CEFAS staffs onboard for their hard work and enthusiasm in making this survey a success.

Well done shellfishers...



Ana Leocadio (SIC), 16/04/2012

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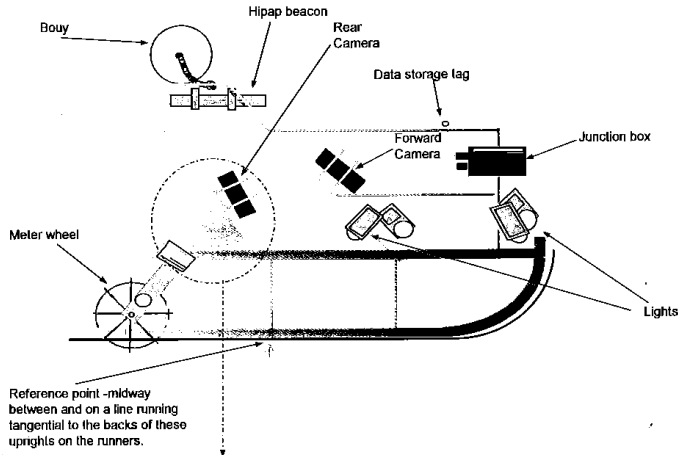
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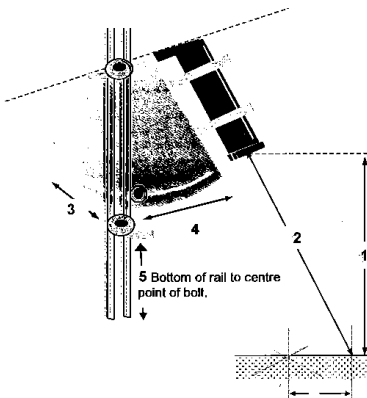
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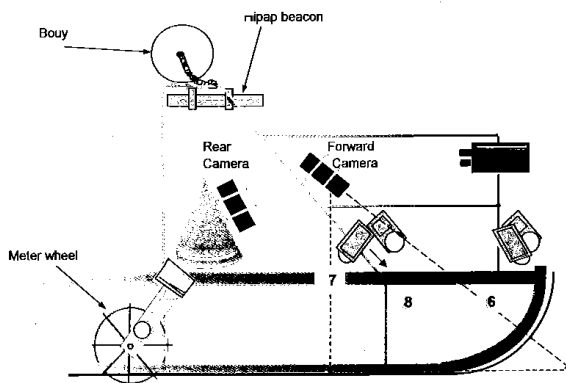
ANNEXE 1



Cefas Endeavour 7/12
Date: 9-4-12



Rear Camera	
No.	cm
1	127
2	171
3	65
4	285
5	463



Forward camera	
No.	cm
6	
7	

Lights	
No.	cm
8 port	
8 starbrd	

FAN LASERS.
23.5cm * 18cm from ends of rails.
distance between fan lasers on deck 78cm.
71cm

Camera lasers
8.6cm between.

File: SledgeSetUp_Template.xls Tab: Side

ANNEXE 2

TVID	Stn	Beam	Shot/Hauled	Time	SOG (kn)	Heading	Dlat	Dlong
5-M	58	2m	SHOT	16:44:26	1	113.3	54.08862	1.737167
5-M	58	2m	HAULED	16:54:26	1.1	112.3	54.08758	1.741817
5-M	59	3m	SHOT	17:19:05	1.1	113.9	54.08883	1.73595
5-M	59	3m	HAULED	17:29:06	1	112.5	54.08783	1.7406
5-M	60	2m	SHOT	18:19:15	1	112.3	54.0895	1.733233
5-M	60	2m	HAULED	18:29:17	1.1	111.7	54.08848	1.737917
5-F	80	2m	SHOT	11:42:42	0.4	308.8	53.98462	2.512
5-F	80	2m	HAULED	11:52:42	1	307.1	53.98625	2.508133
5-X	81	2m	SHOT	12:33:25	1	302.5	53.98523	2.415117
5-X	81	2m	HAULED	12:43:25	0.9	303.9	53.98677	2.41115
5-X	82	2m	SHOT	13:04:00	0.7	300.3	53.9853	2.415717
5-X	82	2m	HAULED	13:19:00	0.7	314.7	53.98682	2.411133
5-AD	83	2m	SHOT	14:11:24	0.7	312.4	54.04172	2.520983
5-AD	83	2m	HAULED	14:26	1	312.6	54.04465	2.5155
5-S	84	2m	SHOT	15:09:26	1.1	321.4	54.09873	2.512833
5-S	84	2m	HAULED	15:27:02	1.1	321.6	54.10263	2.50715
5-AJ	85	2m	SHOT	16:41:28	0.9	144.3	54.10083	2.605933
5-AJ	85	2m	HAULED	16:56:28	1	145	54.09733	2.61035