Centre for Environment Fisheries & Aquaculture Science

Cefas

CEND 12/16 Nephrops TV Survey Final Report - 2016

Title: Farn Deeps Nephrops Grounds (FU6) 2016 UWTV Survey Report.

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Abstract: This report provides the main results and findings of the 20th annual underwater television survey on the 'Farn Deeps grounds' ICES assessment area, Functional Unit 6. The survey was multi-disciplinary in nature collecting UWTV, backscatter data and other ecosystem data. The survey design consists of a randomised fixed grid of 110 stations where at each station a sledge mounted TV camera is deployed and a clear 10 minute tow is recorded onto DVD and DVT. In June 2015, 110 stations (TVID) were successfully surveyed in the Farn Deeps area with the TV sledge and multibeam, from 21 Jun to 28 Jun. No time was lost due to weather conditions and additionally the water clarity was very good to excellent throughout the footage recorded. Burrows were counted by each minute block for 7 clear minutes. The counting performance of the 2016 counters was generally very high, with a Linn's CCC scored average of 0.74. The data from the present survey will be analysed in preparation for the 2016 WGNEP.

1. Introduction

The Norway lobster (*Nephrops norvegicus* L. 1758) has a wide area of distribution across European waters (from Iceland to the southern coast of Portugal, Morocco and the Mediterranean) and are managed within the scope of the International Council for the Exploration of the Sea (ICES). The *Nephrops* stock assessments are run annually, where catch options are defined for each functional unit (FU) and accordingly on advice from ICES the European Commission sets annual total allowable catches (TAC's) for this species at an ICES sub-area level.

The lack of age-structured data in addition to uncertain historic landings for a number of stocks makes the use of standard stock assessments and forecasting methods, based on commercial catch data, very difficult to apply and unreliable. Additionally, *Nephrops* spend a great deal of time in their burrows and their emergence behaviour is influenced by several factors: time of year, light intensity, tidal strength, etc. So, over the last 20 years, assessments for *Nephrops* have become progressively more reliant upon Underwater TV (UWTV) surveys which have enabled the development of fishery independent indicators of stock size, exploitation status and catch advice. This method was firstly implemented in 1992 by Marine Scotland on the Fladen ground, and has subsequently been put into practice by other countries such as Ireland, England, Denmark and Sweden. The UWTV surveys are now listed regularly in 15 ICES Functional Units, being widely used in the North Sea.

The standard methodology involves the use of a sledge mounted camera to film the seabed at a grid of stations conducting TV tows for 10 minutes. Each country has adopted different sampling designs, from random stratifications of the stations up to fix grids, which better fits the grounds. The aim is to identify and count the number of *Nephrops* burrow systems falling within a fixed field of view, along transects of known length. 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* with occupancy assumed to be 100%. Overall abundance is then estimated by raising the mean density to the appropriate strata area or by using geostatistical methods, and total survey abundance, variance and confidence limits are then calculated.

In deep waters the UWTV surveys are still not being used as a standard assessment procedure, due to the complexity of running a sledge at those depths. Alternatives to sledges have been experimented for example by IPMA in Portugal by fitting a camera to the trawl cable; disadvantages of this method are the speed of recording and the angle of the camera, making the visual identification of burrow systems very challenging.

Although this assessment method has been improved over the years there are still some constrains associated with this method. Misidentification of *Nephrops* burrows, high density of burrows, edge effects, clarity, variability of the counters are some of the sources of bias that have been identified in the past and addressed in specialized ICES study groups for *Nephrops* TV surveys. Progress was made in 2009 ICES Benchmark were the main sources of bias were estimated for each functional unit and an overall bias correction factor introduced adjusting the estimates of abundance.

The present survey focuses in the North Sea at the Farn Deeps (FU6) area, in the NE coast of England (Figure 1).

CEFAS has performed annual UWTV surveys in the Farn Deeps area since 1996 (Table 1).

Table 1 – Summary of the UWTV results for the autumn season, since 1997, showing number of valid stations, mean density per meter square, abundance, confidence interval and the method used to estimate the abundance. Analysis of the 2016 survey data will be carried out in preparation for the 2016 WGNEP.

Year	Stations	Season	Mean density (burrows/m²)	Absolute Abundance (millions)	95%CI (millions)	Method
1997	87	Autumn	0.46	1500	125	Box
1998	91	Autumn	0.33	1090	89	Box
1999	-	Autumn	No survey	Box		
2000	-	Autumn	No survey	Box		
2001	180	Autumn	0.56	1685	67	Box
2002	37	Autumn	0.33	1048	112	Box
2003	73	Autumn	0.33	1085	90	Box
2004	76	Autumn	0.43	1377	101	Box
2005	105	Autumn	0.49	1657	148	Box
2006	105	Autumn*	0.37	1244	114	Box
2007	105	Autumn*	0.28	858	23	Geostatistics
2008	95	Autumn*	0.31	987	39	Geostatistics
2009	76	Autumn*	0.22	682	38	Geostatistics
2010	95	Autumn*	0.25	785	21	Geostatistics
2011	97	Autumn*	0.28	878	17	Geostatistics
2012	97	Autumn*	0.24	758	13	Geostatistics
2013	110	Summer	0.23	706	18	Geostatistics
2014	110	Summer	0.24	755	18	Geostatistics
2015	110	Summer	0.18	568	13	Geostatistics

The specific objectives of the 2016 survey are listed below:

1. To conduct a standard underwater TV survey of *Nephrops* burrow densities on the Farn Deeps grounds, 55° 35′ - 54° 45′ N and 1° 30′ - 0° 40′ W, and to evaluate *Nephrops* abundance (110 stations).
2. To conduct a seabed multibeam survey (at each TV survey station).
3. To visit 20 additional TV stations, surveyed by NEIFCA as part of their annual autumn TV survey of inshore grounds, to compare burrow densities between early summer and autumn.
4. To analyse the phytoplankton diversity using on line flow cytometry. This is a study which is required for the Work packages 3 and 4 of the H2020 EU project: Jerico-next and have for main deliverables the comparability of different automatic instruments on RV and the collaboration between countries for a harmonization of the assessment for phytoplankton.

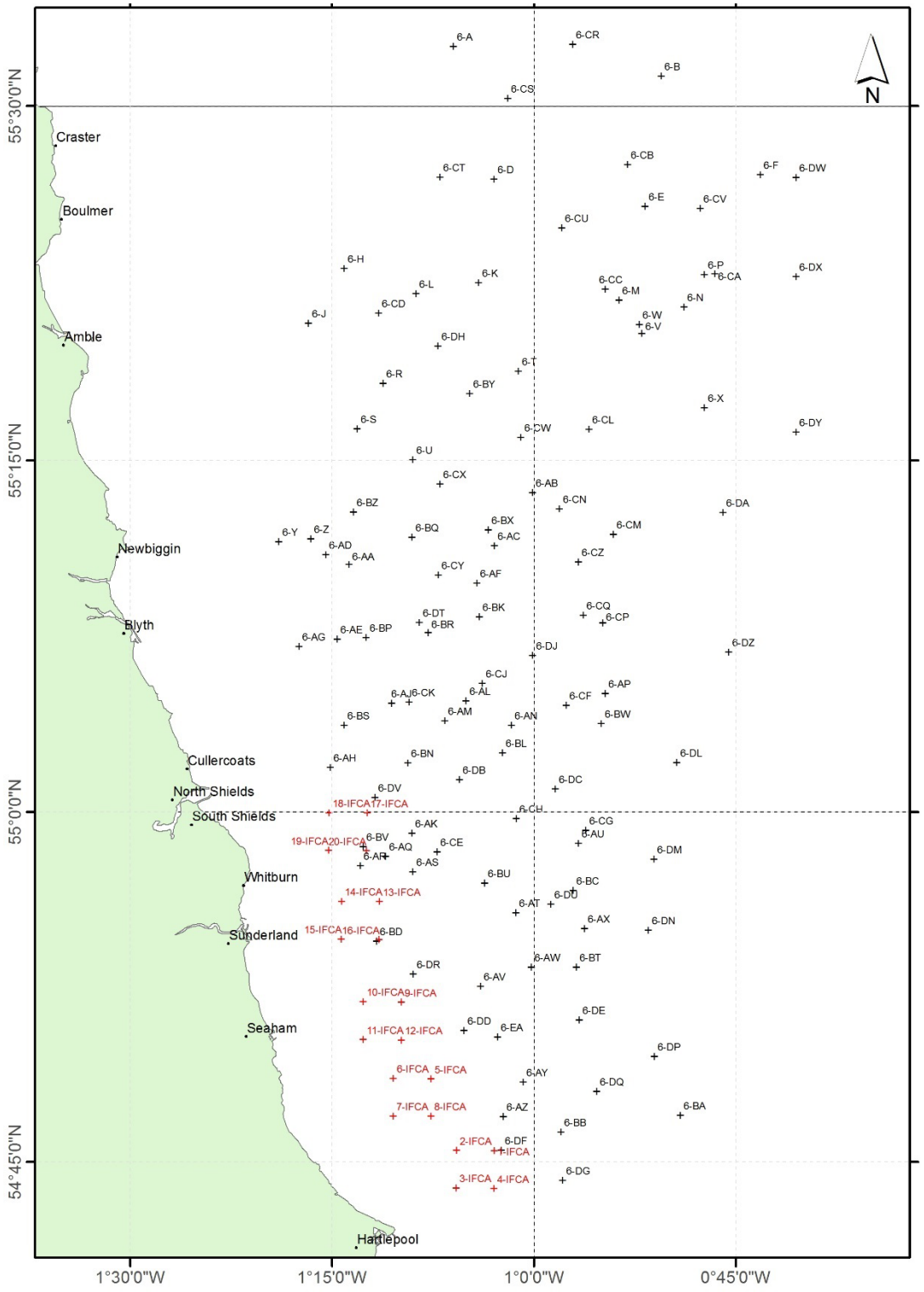


Figure 1 – Map showing the location of the surveyed area in the Function Unit 6 area (110 stations) and the 20 additional NEIFCA stations.

2. Material and Methods

The 2016 North Sea *Nephrops* UWTV survey took place on RV Endeavour between 21st to 28th June. The departure and arrival port was Lowestoft.

TV survey – Survey design

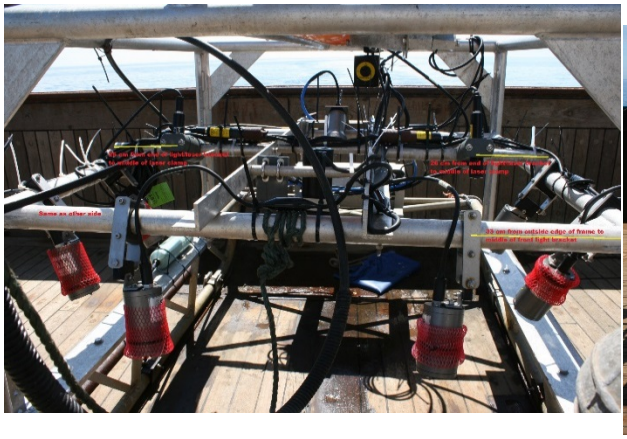
For the Farn Deeps the survey design is based on a randomised fixed grid and includes a total of 110 stations. The initial ground perimeter has been delimited by the combination of VMS data and BGS sediment maps.

At each station a sledge mounted TV camera was deployed and a clear 10 minute tow was recorded to MP4 video files, recorded directly to two separate drives to provide a backup. Vessel position (DGPS) and position of sledge (using a USBL transponder) were recorded every 1 to 2 seconds.

This year a new sledge setup was used along with a new camera system, lights, lasers, altimeter and compass, all manufactured by STR. The camera, lights and lasers were controlled by an onboard mux box, which communicated with a mux box on board. Camera cable B (coax) was used to receive the live footage from the video camera. The new camera offered better video quality than the SIMRAD camera used in previous years, although there were the occasional issues with jerky footage. This is likely to be resolved when the fibre optic cable is in place for the TV survey next year.

The sledge was equipped with (Figure 2):

- An IP camera (720p) at an oblique angle to the sea bed, sighted towards the front of the sled.
- The sledge was mounted with 6 LED lights: 2 LED lights on either side plus 2 LED lights at the front to fully illuminate the field of view.
- Two green fan lasers to delimit the field of view (field of view 81.5 cm);
- A transponder so that the sledge can be retrieved if lost;
- The ESM2 logger, to record turbidity readings, depth and salinity, was not used this year
- With the new system, an altimeter and compass are used, which log to a txt file.



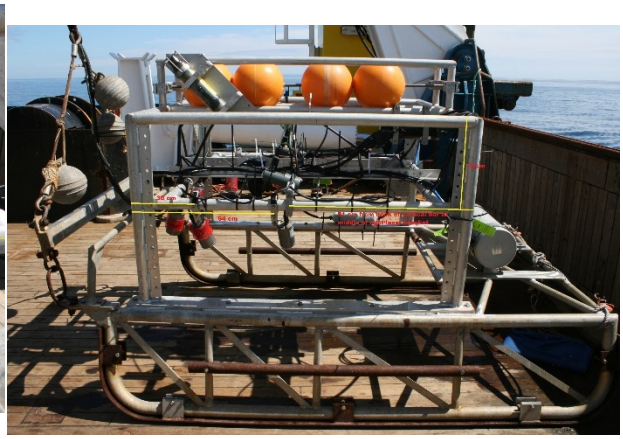


Figure 2 – Sledge used during CEnd 12/16, showing the equipment setup. *Photos by Robin Masefield (Cefas).*

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

Recounts

In line with SGNEPS recommendations all scientists were trained/re-familiarised using training material and validated using reference footage (measured by Linn's concordance correlation coefficient (CCC)) prior to recounting June 2015 footage. A limit of 0.5 was used to identify counters who need further training. On completion of this process, all CEND 12/16 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). In case the field of view became obscured by cloud the seconds obscured were recorded and all minute blocks with more than 20 minutes obscured were rejected. After all counts completed again the Linn's CCC (with a threshold of 0.5) was applied to check which stations needed to be revisited and were a 3rd or 4th counter needed 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 posterior analysis, counts of burrow systems are converted into densities at each station using the width of view (81.5 cm) and the length of the tow (extracted from tower position vessel logging). Each system is assumed to represent one adult *Nephrops* and occupancy is assumed to be 100%. To estimate the spatial structure of *Nephrops* densities a geo-statistical analysis is carried out in the whole area and the total survey abundance, variance and confidence limits are then calculated.

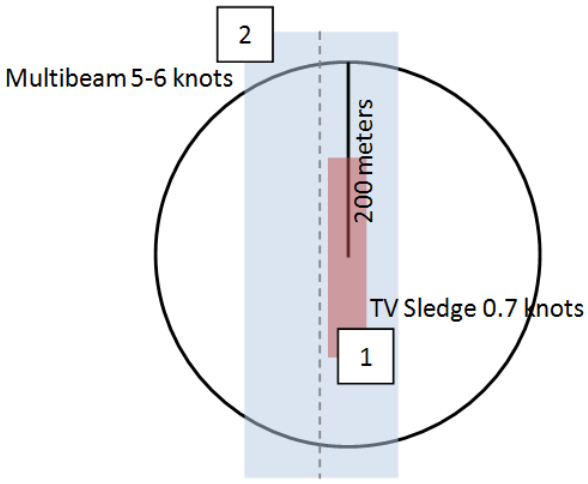
Multibeam survey

Swathe data were collected over each TV station. The equipment used was an EM2040 (300 KHZ), with a Multibeam angle of 60 degrees for each head.

Before deploying the sledge a run through was done slightly offset of the centre of the station (approx. 40m) covering the direction of the eventual sledge run. The offset was to ensure the sledge track avoided the nadir, the point directly below the ship where the data from the two Multibeam sensors overlap. The processing package used to analyse these data re-interprets the backscatter data from either side of the nadir much more easily.

1. Multibeam through station slightly offset the centre of the station (~ 40m). Tower data recorded using CRP.

2. TV sledge through the centre of the stn – Stern gantry. Tower data recorded using stern gantry.



The multibeam data will be analysed at a later date and added to the burrow density analysis.

Phytoplankton flow cytometry analysis

Water samples from the ferrybox sample outlet were analysed daily for the phytoplankton diversity using the on line flow cytometry. This is a study which is required for the Work packages 3 and 4 of the H2020 EU project: Jerico-next and have for main deliverables the comparability of different automatic instruments on RV and the collaboration between countries for a harmonization of the assessment for phytoplankton.

Health and Safety

As required all staff had a valid ENG1 health certificate, Personal Sea Survival Certificate and a valid 'working near water' safety course.

Also the following risk assessments were acknowledged:

✓ FD-C&F-SHELL-SOP-01 MB001 NEPTVBurrowCount SOP V1.3.DOC (updated during the survey).

✓ G02 – Travelling while on official duty in Official or private vehicles, including loading and unloading equipment, baggage, etc, but excluding the carriage of dangerous chemicals, the use of HGV or specialised vehicles;

✓ G03 – Participation in research cruises on CEFAS owned and managed ships. The collection of samples and data all subsequent processing whilst on-board, including the use of the ships sea-rider.

✓ FD-CF-SHELL-RA-09-MB001 – *Nephrops* TV cruise activities

Technical aspects/failures

- Some teething issues with the camera for the first two days, including:

    - Some video footage being truncated on writing to file, cutting the first few minutes of footage in some cases. This was resolved by setting the codec to 'xvid MPEG -4 Codec'.

- The altimeter was causing the system to crash when turned on during sledge deployment. This was fixed by leaving the altimeter running at all times.
- The video footage was on occasion jerky, something which did not impact on the survey and will likely be resolved with the installation of the fibre optic cable next year.
- In total, 3 hours survey time were lost on the first day due to the above issues.

- The ESM2 logger was not on board and was not checked for by the SIC prior to sailing, as such it wasn't used on the survey. This was followed up in the debriefing to ensure it is on board next year.

3. Results and Final Considerations

In June 2016, all 110 stations (TVID) of the standard survey grid, as well as an additional 19 stations of the NEIFCA survey grid, were successfully surveyed in the Farn Deeps (FU6) with the TV sledge and Multibeam, from 21 Jun (09:30 BST) to 28 Jun (15:00 BST). No time was lost due to weather conditions; weather was in fact very good throughout the survey and additionally the water clarity was very good to excellent. The visibility was, as with the previous two years, very good, 47% of footage was classed as "Excellent", 45% as "Good", and 8% as "Moderate". This time of the year proved to be ideal to do the survey as all conditions are more favourable to run a more efficient survey and it proved also to save time as much less stations needed to be revisited due to bad weather conditions and/or poor water clarity.

CTD dips were carried out to calibrate the Multibeam.

	Excellent	Good	Moderate	Poor	None
2011 – Autumn	5%	44%	48%	2%	0%
2012 – Autumn	17%	57%	22%	4%	0%
2013	27%	68%	5%	0%	0%
2014	28%	63%	9%	0%	0%
2015	80%	19%	1%	0%	0%
2016	47%	45%	8%	0%	0%

Primary objective - TV survey

Nephrops burrow live-counts were made over a 10-minute tow, which was recorded on mp4 files and backed up on two external hard drives. All recordings were then recounted under controlled conditions and the CCC code was used to validate stations and to identify which stations required a 3rd counter, for this propose a threshold of 0.5 was used.

Burrows were counted by each minute block for 7 clear minutes. The counting performance of the 2015 counters was generally very high, with a Linn's CCC scored average of 0.74. The results of the Nephrops assessment will be produced in preparation for the 2016 WGNEP.

The primarily objective was fully achieved as all TVID stations were successfully surveyed with the TV sledge, all data was inputted and quality checked while onboard and additionally all analysis was made to calculate the final abundance estimation for the ground.

Additionally, 16 of the 20 NEIFCA stations were surveyed. Two were abandoned due to the substrate type being unsuitable for the camera sledge and the remaining two were abandoned due to proximity to a cable. These data will be compared with the footage collected by NEIFCA during their annual TV survey which is due to be completed in Autumn 2016.

Secondary objectives

Multibeam data collection

Multibeam data were collected for 59 of the 110 stations, this objective was dropped after the first two days to ensure that there was sufficient time to visit the additional 20 IFCA stations. Data retrieved from the Multibeam (backscatter data) will be processed and analysed later on and integrated with the burrow counts densities. Preliminary results form 2013 survey show a relationship between the decibel values and the burrow densities, although these data needs to be further analysed and incorporated in the geospatial model along with the other variables, like the sediment type and the redox layer.

Flow cytometry

Within the EU-project Jerico-Next (H2020) one of the objectives is to combine and improve the use of innovative (semi)-automated observation techniques like flow cytometry for addressing phytoplankton dynamics in several European coastal and shelf seas, at high resolution, in (near) real-time. Flow cytometry is a technique by which (phytoplankton) particles can be rapidly counted based on their optical properties. Every particle is scanned by a laser and will auto fluoresce depending on their specific pigments and scatter light depending on their shape . By clustering the data the phytoplankton will be characterized in optical groups.

A member of the Ministry of Infrastructure and Environment, RWS-CIV-laboratory (Netherlands) joined the Endeavour for the Nephrops survey to test the flow cytometer in a remote on-line environment coupled to the Ferrybox and to compare and couple to other devices (like FRRF, PhytoPam, Multibeam Fluorescence sensors) used by different partners involved. The Flowcytometer data of RWS and those of CEFAS were compared. Every half hour (RWS-machine) and every hour (CEFAS) machine were automatically counting a sample provided via the Ferrybox water inflow. Several parameters of the Ferrybox will be used to understand the phytoplankton dynamics. An important issue to achieve was to upload the (near) real time data from both flow cytometers automatically to the website www.fytoplankton.nl. Due to the limited internet capacity in the CTD Annexe this was not possible. The only way to achieve this was to put data on a memory stick and send the data from another laptop at the ship.

Besides these data will be used by RWS to determine biodiversity of phytoplankton based on flow cytometry in several parts of the North Sea.

Final considerations

The main objective of the survey (*Nephrops* abundance estimation) was successfully met for this year in the Farn Deeps. The UWTV coverage was excellent (100% stations done with the TV sledge) and the overall footage quality was very good to excellent in the Farn Deeps grounds due to favourable weather

conditions and minimal technical difficulties. Data retrieved from the multibeam (backscatter data) will be processed and analysed later on and integrated with the burrow counts densities. The collection of these data was successful in 59 of the 110 stations and was dropped to ensure there was sufficient time to visit the IFCA stations. The incorporation of the multibeam data might be used to increase confidence in the *Nephrops* abundance estimates and be used as predictors in the model to estimate geospatial abundance. The data will be analysed in preparation for the 2016 WGNEP.

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.

Robin Masefield (SIC)