

CENTRE FOR ENVIRONMENT, FISHERIES AND AQUACULTURE SCIENCE,
LOWESTOFT, SUFFOLK, ENGLAND

2007 RESEARCH VESSEL PROGRAMME

Report RV Cefas Endeavour: CRUISE 3

STAFF:

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|-------------------------|--|
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| Dr Rodney Forster | Ms Laura Bristow (UEA) |
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| Mrs Annie Brown | |

DURATION: Tuesday 20th February – Tuesday 27th February
Sailed 22:00 GMT (HW 23:20 GMT)

Docked 07:00 GMT on 27th (HW 06:00 GMT)

LOCALITY: Southern Bight, Oyster Grounds and Central North Sea, Dogger Bank region

Background: This is the first cruise of a series, an essential part of a project addressing the source, cycling and fate of nutrients (i.e. carbon, nitrogen, silicon, oxygen) in UK Shelf Seas, specifically the North Sea. It will examine the relative importance of the various ecosystem components, their degree of connectivity and their susceptibility to change due to environmental or human pressures. The project combines an intensive observational programme in the North Sea, with model development and operation. Three representative sites have been selected for detailed process studies (5 cruises per year for 2 years) of pelagic (water column) and benthic (seabed) food webs, with horizontal and vertical spatial sampling over a broader area being achieved using a variety of towed instruments, and the temporal range being extended using autonomous buoys and bottom landers. *In situ* observations will be supplemented by satellite imagery and data from other sources, such as the continuous plankton recorder (CPR) and Ferryboxes™.

The overall aims of this series of cruises are to investigate:

1. Pelagic food webs, water column measurements
2. Hydrography and seawater chemistry
3. Community structure
4. Phytoplankton and microbial production
5. Grazing impacts
6. Mesozooplankton secondary production
7. Vertical flux and budgets of carbon
8. Benthic food webs, sediment processes, exchanges across the interface
9. Sediment Profile Imagery
10. Advection in coarse sediments
11. Resuspension events

Specific cruise AIMS (not in priority order)

1. Deploy Landers and Smartbouys are required at the three primary sites.
2. Sampling at frequent intervals (approx hourly) using CTD rosette at the 3 sites with LISST
3. CTD casts for primary productivity estimates and deck incubations using ^{15}N uptake.
4. Underway measurements for isotopic ratio work from continuous supply.
5. Trial the use of the plankton multinet.
6. Collect plankton samples for species composition using vertical nets.
7. Deployment of SPI camera over a wide range of sites to characterize inter-site variability
8. Undertake assessment of benthic flora/fauna assemblage using Jennings beam trawls
9. Collect samples for isotope analysis of fish, fauna and flora using 2m beam
10. Collect core profiles of nutrients, oxygen, chl-a. (NIOZ corer) and sediment profiles.

Cruise Narrative.

Cefas Endeavour sailed on time (20/2/07) and transited down to Gabbard, with samples for isotope analysis taken off Lowestoft, and the Gabbard and a site on transit up to the Sean gas field. Zooplankton hauls were also performed at these stations. The following morning (21/3/07) a CTD was performed followed by a lander mooring, SPI camera, further CTDs then NIOZ cores. The swath bathymetry survey was conducted with further CTDs, following further SPI camera sites and CTD at 06:00 (22/3/07) for productivity followed by some trawling with a 2m beam. Following further CTDs and plankton nets for Ben Kurten a transect line was undertaken across the East Anglian plume from 35.3 salinity to a minimum of 34.3 just north of the main site.

After transit to the Oyster grounds (23/3/07) the day started with a SPI camera survey, which covered 4 sites. CTDs were then performed for bottom waters and coring commenced at 07:00. Following continuation of coring until lunch, a lander?? mooring was then deployed, with more coring until tea. A third coring site was completed after tea. CTDs commenced every hour with full water column samples for taken at 18:00, 24:00, and 06:00 (24/3/07). CTD profiles were taken until 10:00, followed by sampling with the 2m-beam trawl, NIOZ coring was then undertaken at the remaining sites, until tea. After tea the remaining SPI sites were sampled. Coring finished at around 22:30 followed by a trawl for Ben using the 3m beam. The Swath bathy survey finished at about 02:30 (25/3/07) with transit up to the Dogger site with arrival at 09:30 (7hrs). On arrival NIOZ coring started at 10:30 which continued after lunch. Following this the mooring consisting of a lander with ADCP and a smart buoy with sub-surface ESM2 logger at 25m was deployed. Subsequently, a SPI camera survey of 7 sites was performed, and hourly CTDs were taken through the night with full samples at 20:30 and 00:30 (26/3/07). The CTD failed at 05:00 but the casts were continued through a brief spell of bad weather (Force 7). Bottle casts were performed for analysis and incubation experiments performed. 2m beam trawls were undertaken and on completion of a 3m beam trawl we departed for Lowestoft, taking some samples from the continuous supply, on passage through a potential phytoplankton bloom.

Objectives and Preliminary Results.

All primary objectives have been met either in part or in full. Sampling locations are shown in Fig. 1a Cruise map, 1b, The Sean Gas field A1221 site, 1c The Oyster grounds and 1d, the North Dogger site.

In total 33 CTDs 20 net hauls, 122 NIOZ cores, 172 SPI camera drops, xx beam trawls, 3 mooring sites and 3 swath bathymetry surveys were completed in 6 days. Preliminary results indicate excellent data has been collected.

Water Column Results

Particle size distribution results from the LISST are shown in Fig 2. Apparent is a clear tidal signal. CTD profiles indicated that all three sites were relatively well mixed, with a small vertical salinity difference at the North Dogger site. Zooplankton abundance derived from Net Hauls was relatively sparse across the three sites.

Samples were taken for PON/POC DOC/DON, viruses, DNA, picoplankton, HPLC, suspended load, nutrients, Chlorophyll, oxygen and Ph at the three sites.

Experiments for the calculation of primary production were performed daily with high quality irradiance profiles being used to derive in-water production. The contrasting results between the three sites are apparent in Fig 3. Grazing experiments were conducted at two of the sites and gave consistent results Fig 4.

A bloom was observed on top of the Dogger during the cruise, detected using the underway fluorometer. Fig 5 shows the satellite-derived Chl-a with continuous fluorometer data superimposed.

Benthic work:

The benthic work examined the main sites and scoped the sediment characteristics and wider substrate context (via multibeam, SPI spatial survey) with baseline state and rate measurements at the 3 main sites and with additional spatial sampling at the Oyster Ground. Key measures taken were sediment characteristics (PSA, porosity, sediment chlorophyll, C/N), nutrient and oxygen/redox profiles, and nutrient fluxes and rate measurements (oxygen uptake, sulphate reduction and nitrification/denitrification) from core incubations. These biogeochemical measures were combined with measurements of benthic ecology (micro-, meio- and macrofauna) to enable biological contribution to C and N cycling processes to be ascertained.

Fig 6 shows three example images from SPI surveys around the main sites.

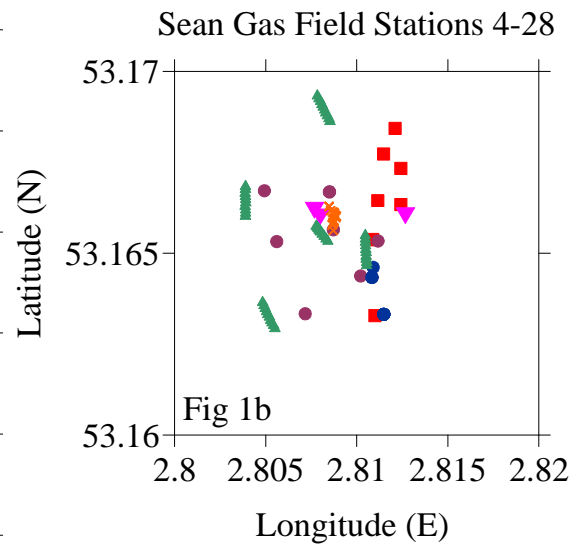
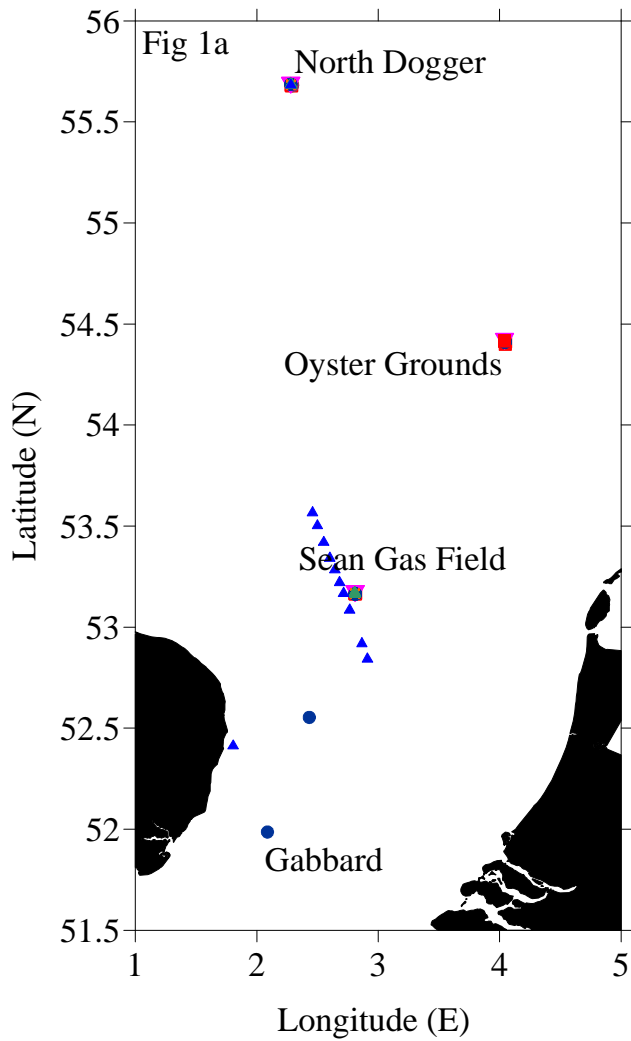
Penetration of the SPI is variable depending on substrate and there are clear sediment type and redox/biological mixed depth changes between the sites. The SPI also allows observation of macrofauna in-situ, for example tube worms in the Dogger which grabbing/NIOZ sampling cannot maintain.

Fig 7 shows the MDS plots from the trawling for benthos which demonstrates that the sites are locally homogenous and distinct from each other.

Acknowledgments

The success of the cruise was considerably aided to by the experience and good humour of the officers and crew. Special mention must be given to both deck watches for the help given when coring.

Site Map Cefas Endeavour 3 20/2/2007 - 27/2/2007



- Beam
- CTD
- ▲ Surface
- ▲ SPI
- ✕ NIOZ
- NET
- ▼ Mooring

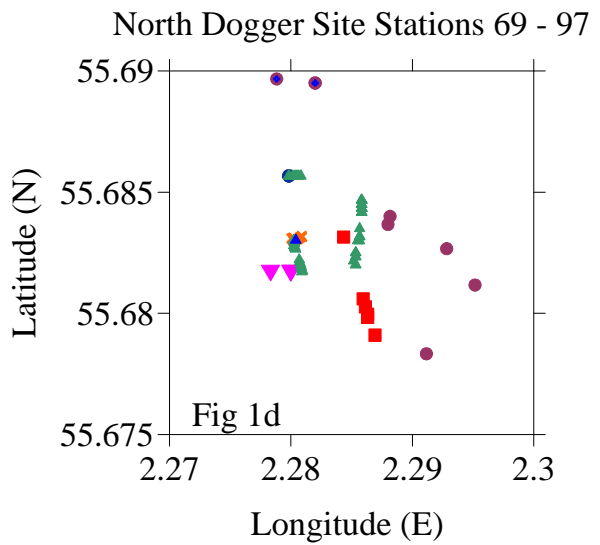
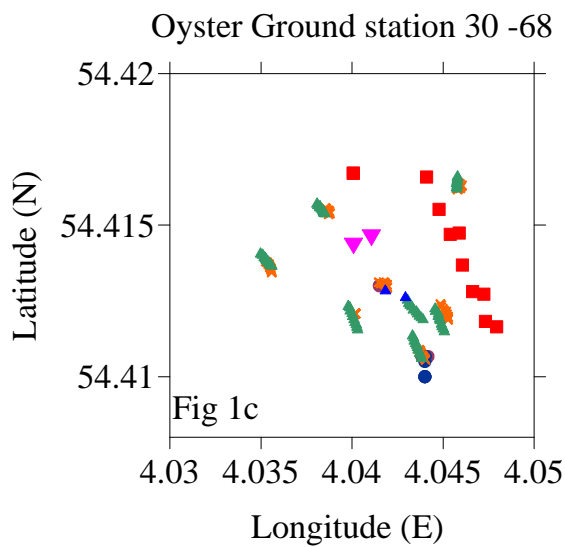


Figure 2 Vertical variability in volume concentration (mm³ L⁻¹) and particle size (μm) at Oyster Ground. Concentration in the 32 size classes from the LISST-100. Median particle size (heavy black line) is varies around 80-100 μm throughout each profile and during the stay on station. The size spectra are mainly unimodal and generally poorly sorted (compared to AE1221; data not shown), suggesting only little flocculation

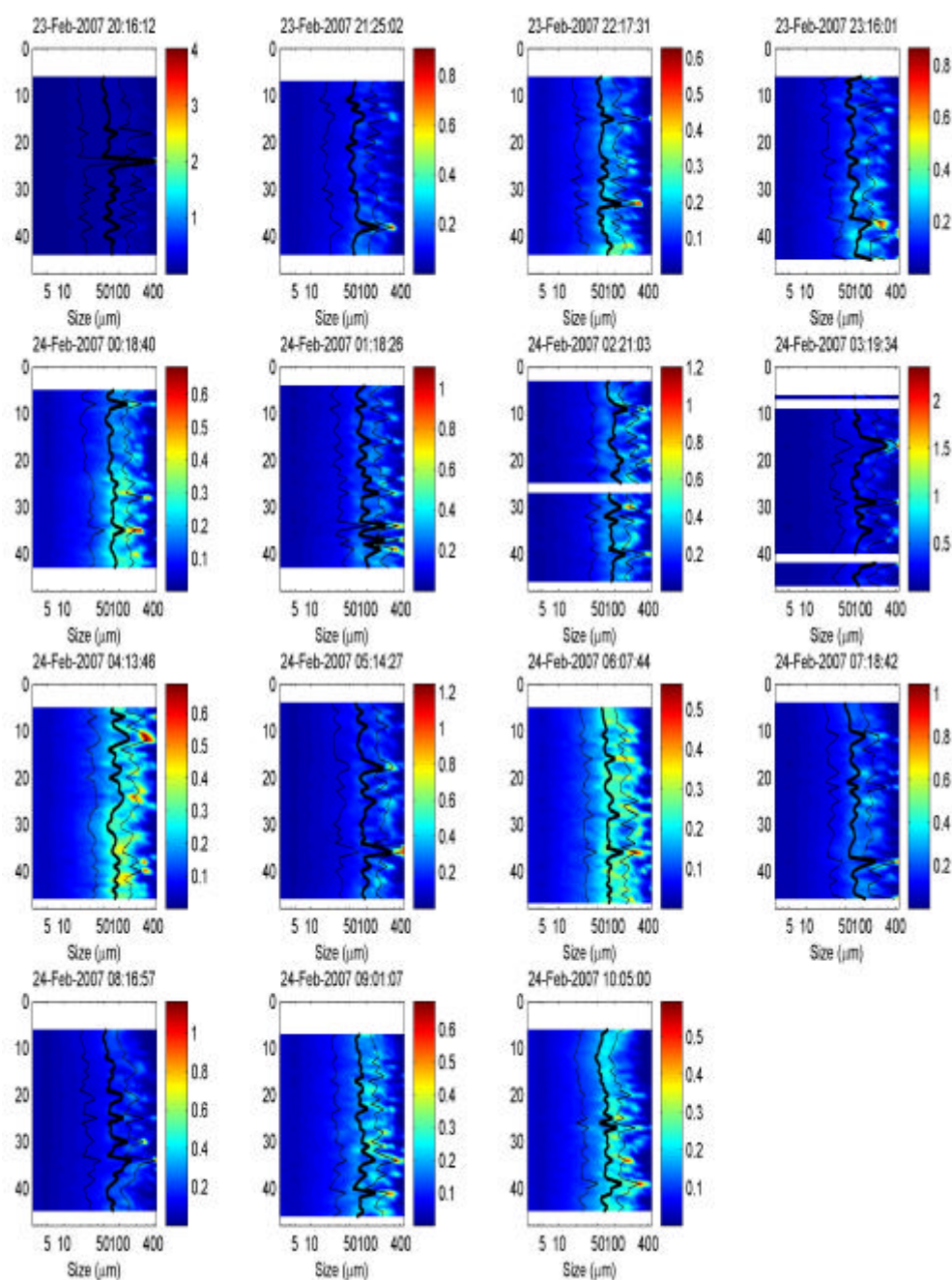


Fig 3 Daily net primary production calculated at the three Ecosystem connections sites. Only the North Dogger site shows a potential for phytoplankton growth at this time of year.

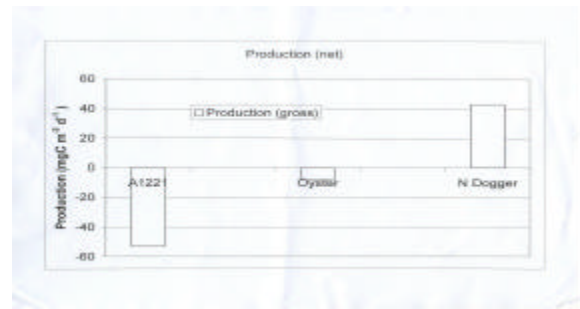


Fig 4 24-h Dilution experiment at Site A1221. Estimated phytoplankton growth rate 0.06 d⁻¹, grazing rate 0.45 d⁻¹.

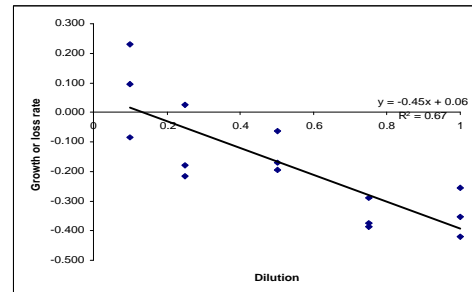
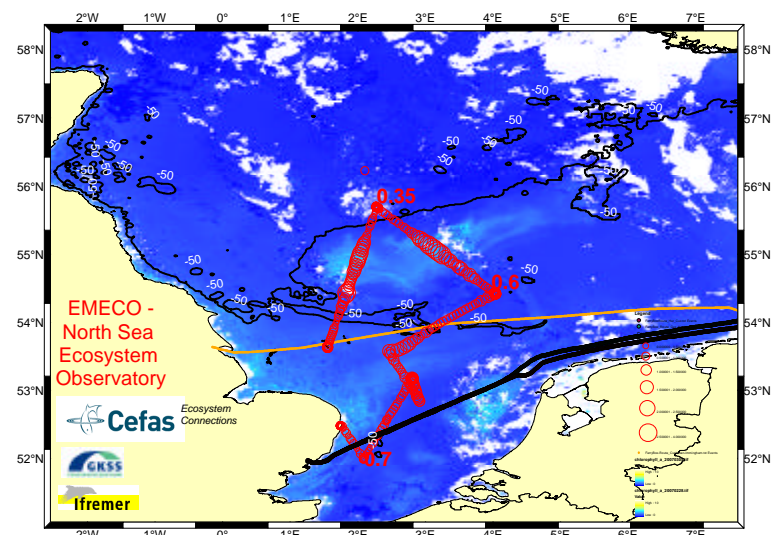


Fig 5 –“North Sea Ecosystem Observatory” consisting of Ifremer chlorophyll image composite 28 February to 5 March 2007, Cefas Smartbuoy mean chlorophyll fluorescence values in this period, Cefas cruise track chlorophyll fluorescence for cruise Cend 0307 (22 February-28 February), and GKSS ferrybox route (data to be added).

The chlorophyll bloom which was observed over the Dogger Bank region at the beginning of the month has expanded, and now covers the whole of the shallow area bounded by the 50 m contour line (black). High chlorophyll values in the bloom locations were confirmed by Cefas cruise

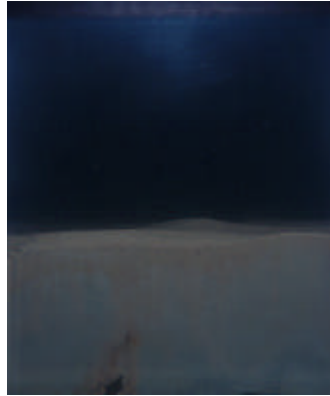


Cend0307 using a logging chlorophyll fluorometer, and by extraction of water samples with acetone. Cefas buoys are presently located outside of the bloom and are still recording low (winter) values. GKSS ferry route lies to the south of the bloom, and is not yet showing increased chlorophyll (ferrydata.gkss.de).

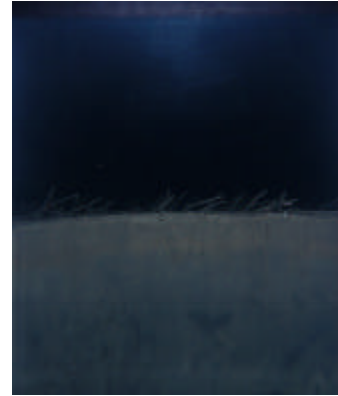
Fig 6 Spi camera Images



Sean Gas field
Coarse deep redox
transition BMD 10 –13cm



Oyster Grounds
Muddy Sand BMD 5cm



North Dogger
Muddy sand less
bioturbation 2-3 cm

Fig 7 MDS from 2 m beam trawl, by benthic fauna by weight. It indicates that trawls within the site are more similar to each other than they are to those at other sites.

