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

1999 RESEARCH VESSEL PROGRAMME

REPORT: RV CORYSTES: CRUISE 7

STAFF: Dr J Brown, Miss J Taylor, Dr E Young, Mr A Young, Mr D Sivyer, Mr L Fernand, Mr J Read, Mr K Medler, Dr C Whalley

DURATION: 19 July – 4 August

LOCALITY: North Sea

AIMS:

The work is directed at a better understanding of the dynamics of the circulation processes fringing the north east coast of England, between the Firth of Forth and Flamborough Head, and in vicinity of the Dogger Bank. It is intended to characterise the extent and nature of the density driven and seasonal jet like circulation which acts as a direct and rapid pathway for transport of material from the coastal region to the central North Sea. Subsequently, the knowledge will be viewed with respect to concerns that elevated levels of contaminants on the Dogger Bank have originated in the near coastal region. Additionally, work includes an examination of whether nutrients derived from the UK coast region are being advected rapidly into the central North Sea via secondary circulations at the margins between mixed and stratified waters. The main sampling aims of the cruise were:

1. To recover five acoustic Doppler current profiler (ADCP) moorings laid in the vicinity of the western Dogger Bank during Corystes 5/99.
2. Recover free floating satellite tracked buoys deployed during Corystes 5/99. A number may be deployed and recovered during this cruise.
3. To undertake Scanfish, CTD and grab surveys of the north-east coast and Dogger Bank to collect information on nutrients, suspended sediment and metals.
4. Conduct experiments to examine the near-bed cross frontal circulation.

Supplementary aims:

5. Collect low nutrient sea water for use in the laboratory as a standard.
6. Undertake a series of grab samples at NMMP station 285 (western Dogger), a site not sampled during Cirolana 3/99.

NARRATIVE (all times GMT):

RV CORYSTES sailed at 1245 for the region of Flamborough Head and the first Scanfish line, which commenced at 0100 20 July (Fig. 1). Following this, an Argos buoy, that had

apparently lost its drogue soon after deployment, was recovered (2045 20 July). A second Scanfish line (203) was started toward the Dogger Bank, but this was ended prematurely (0400 21 July) in worsening weather conditions when a flap motor on the instrument failed. The latter was soon replaced, but deteriorating weather prevented further work. With the prospect of poor weather for at least 36 hours it was decided to steam slowly for Tees Bay to put Mr Carrol ashore (09:30 22 July), thereby mitigating against the potential for considerable lost downtime later in the cruise if he was required to get off, as was probable. However, whilst in Tees Bay the Sercel DGPS (navigation) unit, which had been causing concern for a number of cruises, failed. Despite valiant efforts by Captain Chapman and Mr Fernand it was not possible to effect a repair. To compound this, the junction box outputting navigation information to the laboratory and bridge instruments was found to be faulty in respect of the DECCA data stream. As the precautionary measure of carrying the spare navigation unit had not been taken, we were forced to sail for the Humber to collect replacement parts (1000 23 July), thereby loosing further time. On collection of the spares, the aerial and the bridge console were replaced and we sailed for the Outer Silver Pit and two Scanfish legs (204 & 205).

The following day (24 July) the sea state was much improved, with two satellite tracked Argos buoys recovered and a CTD line and Scanfish leg (209) undertaken to the north and west of the Dogger Bank. The work was punctuated by a visual examination of a nearby Met. Office data buoy. Subsequently (25 July), seven Argos buoys were recovered and a series of CTD stations (217 – 234) occupied from the vicinity of the Outer Silver Pit to the central Dogger Bank. On completion, Scanfish line 205 was repeated (236) before recovery of the ADCP moorings (27 July). At site E (Fig. 2) the recovery line failed to appear following the acoustic command and the mooring had to be recovered by 'dragging' for the ground wire. Noteworthy, was the considerable skill shown by the crew in the rigging of the trawl block for the recovery operation. Whilst in the vicinity of this position, approximately 300 litres of low nutrient seawater were collected.

Overnight (27 – 28 July) a CTD section (243 – 253) was occupied along the line of Scanfish section 236 in order to examine the nutrient distribution in relation to the physical structure and phytoplankton distribution within the water column. This was followed by a series of day grabs at NMMP station 285 (Position ~ 54° 50'N 1° 20.0'). The next few days (28 July – 3 August) were occupied with a series of Scanfish lines (263 – 296; Fig. 1) and Argos buoy recoveries in excellent weather. In the interim, we endeavoured to cure niggling instrumental problems, the most irksome of which centred on the rhodamine fluorometer and GMI CTD in the Scanfish, which prevented the dye release experiment. There was also a limited CTD section (277, 284 – 290; Fig. ?) to again examine nutrient, phytoplankton distribution in relation to the physical processes. The final Scanfish leg was finished at 14:00, whereupon CORYSTES returned to Lowestoft, docking at 1400 4 August.

RESULTS (Preliminary):

1) Full data sets were recorded at four of the ADCP moorings. At the fifth (D), the instrument had recorded for only 10 days. The cause of this remains to be determined. Full analysis of the data awaits return to the laboratory.

2) All satellite tracked drifters deployed during Corystes 5/99 were recovered. In conjunction with the Scanfish surveys, the trajectories of those deployed to the west of the

Dogger Bank provided conclusive evidence of the persistence and repeatability of the strong jet-like circulations associated with the margins of the cold pool waters isolated below the seasonal thermocline of the central North Sea. At two locations, drifters deployed at 30 and 15 m and followed broadly the same pathway, demonstrating that the jet-like density driven flow dominates the majority of the water column. However, on an instrument where the drogue had been cut there was a reassuringly close relationship between the instruments trajectory and wind forcing.

The drifters deployed at the eastern end of the Dogger Bank and drogued at 15 m described a previously unreported anti-clockwise flow to the south of the Bank about an isolated dome of relatively warm, as compared to that north of the Bank, bottom water.

The strong westerly and north-westerly winds of 21 – 23 July had a marked effect on the drifters, particularly those drogued at 15 m on the eastern side of the Dogger Bank. During the wind event the majority of the trajectories moved east and south-east. However, on relaxation of the wind forcing there was a distinctive shift in the paths of many of the instruments to the west and north-west. Although not conclusive, this perhaps suggests a re-adjustment of the water in the southern North Sea following increased sea-level in the German Bight during the period if wind.

3) The series of Scanfish legs showed the majority of the region to be stratified, with pronounced bottom fronts fringing the Dogger Bank. In the days immediately following the strong wind event the gradient of the thermocline was strong and the surface mixed layer was comparatively deep. During section 205 a region of high turbidity was concentrated below the thermocline in the vicinity of the bottom fronts (Fig. ?). This, combined with the comparatively horizontal attitude of the isotherms, suggests that increased water velocities induced by wave action at the sea bed acts as an effective mixing agent for eroding stratification and perhaps transporting nutrient rich deeper waters onto the Bank.

As the cruise progressed in calm and sunny weather a secondary near surface thermocline developed, producing an intermediate mixed layer isolated between two thermoclines.

Associated with the bottom fronts were enhanced levels of chlorophyll, whilst on the shallower Dogger Bank fluorescence was highest near the bed. In the deeper water to the north and west of the Bank, sharp gradients of fluorescence were associated with the base of the thermocline. However, in the shallower south eastern region chlorophyll peaked below the thermocline despite low nutrient concentrations.

Data from the single CTD line for metal concentrations will be available after laboratory analysis later in the year.

4) The combination of poor weather, instrument malfunction and operational difficulties prevented attempts at direct measurement of the cross frontal circulation. However, analysis of CTD, Scanfish, nutrient, biological and ADCP data will provide a valuable grounding for work next year.

5) Approximately 300 litres of low nutrient sea water was collected from the central Dogger Bank for use as a standard in the laboratory.

6) Nine surface samples were collected at NMMP station for subsequent analysis at Burnham.

Unfortunately, time lost to poor weather and operational difficulties resulted in the loss of approximately 15% of the scheduled cruise time. There was a consequential impact on the cruise aims, which combined with instrument problems, prevented the dye release work (aim 4). However, the hard work, enthusiasm and good humour of the ships officers and crew was a significant factor in the success of the remainder of the programme.

Juan Brown
(Scientist-in-Charge)
4 August 1999

SEEN IN DRAFT:

B Chapman (Master)
A Lincoln (Senior Fishing Skipper)

DISTRIBUTION:
BASIC LIST+

Dr J Brown x 10
Miss J Taylor
Dr E Young
Mr A Young
Dr C Whalley
Mr L Fernand
Mr J Read
Mr K Medler
Mr D Sivyer

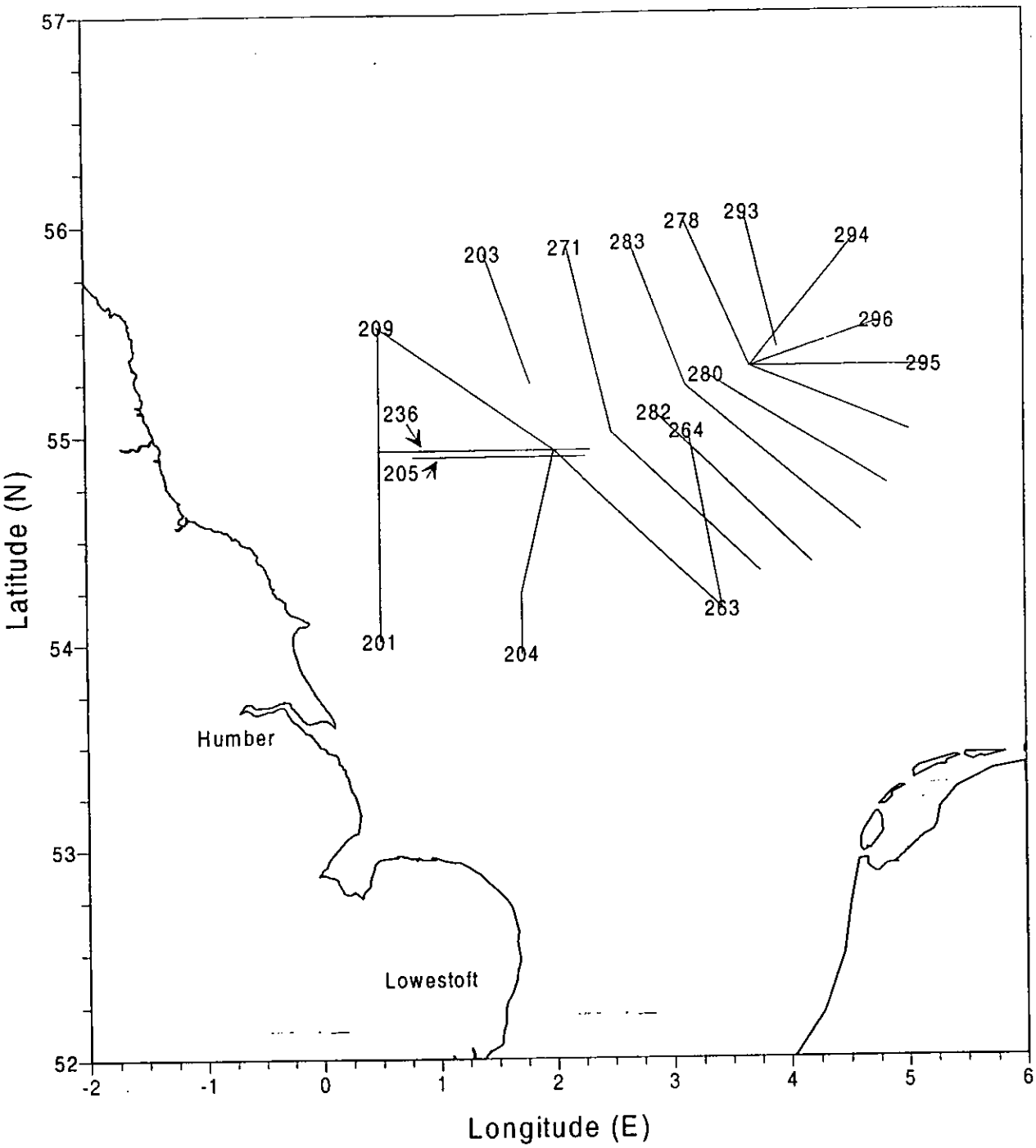

Figure 1 Locations of Scanfish sections Corystes 7/99

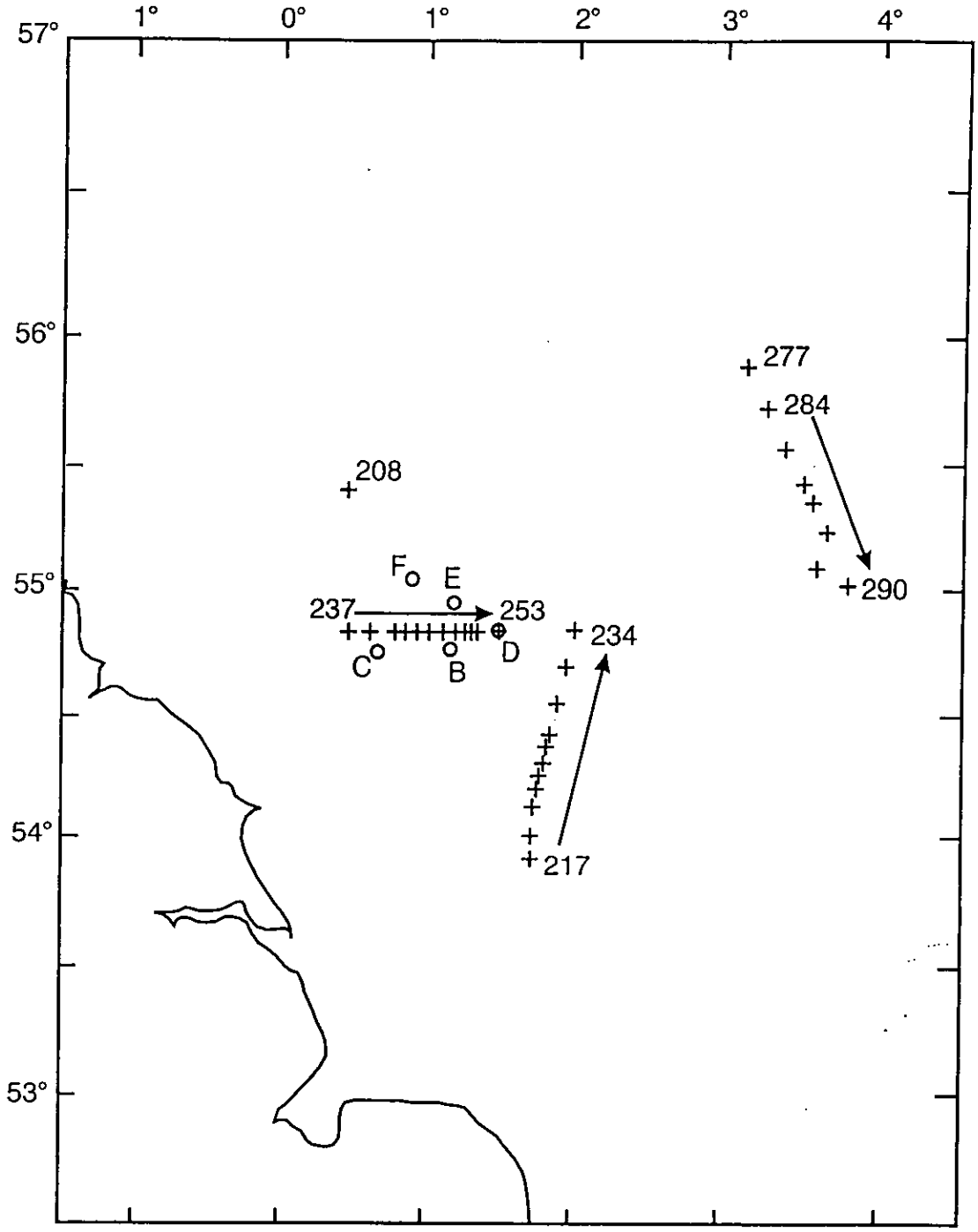

Figure 2. Locations of CTD stations (+) and mooring positions(o).