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CRUISE REPORT
FRV EXPLORER

11 May - 4 June 1976

OBJECTIVES

To continue and complete the joint IMER/DAFS/MAFF contribution to the Fladen Ground Experiment (FLEX). This contribution had three main objectives:

- (i) To describe the horizontal variability of the physical, chemical and biological processes over the FLEX box by making a number of passes over the seven legs of the grid.
- (ii) To describe the vertical variability of the physical, chemical and biological processes at stations 1-9.
- (iii) To measure the rates of selected processes (primary productivity, sedimentation etc.)

NARRATIVE

Part I EXPLORER sailed from Aberdeen at 1930 on 11 May and worked a line jointly with CIROLANA to the FLEX area. The first survey of the FLEX box (90 km square) was carried out from 12 to 15 May using the UOR and CPR for plankton sampling; an intercalibration station was then worked with METEOR about noon of 16 May. The second survey with the High Speed Loch Ewe net took place from 16 to 18 May. On the basis of temperature, salinity, nitrate and chlorophyll data obtained during these surveys and in co-operation with FREDREICH HEINCKE, a small grid (15 km square) was worked 3 times within the FLEX box to elucidate features of the patchiness. On completion of these surveys and a further intercalibration station on 23 May EXPLORER returned to Aberdeen, docking at 0900 on 24 May.

Part II EXPLORER left Aberdeen again at 1030 on 26 May and towed the UOR and CPR towards the FLEX box. Having occupied Station 1 during the late evening of the 26th, the third survey of the FLEX box commenced early on 27 May using the UOR and CPR for plankton sampling and was completed on 29 May; the fourth survey of the box was then carried out during 29 May to 2 June using the High Speed Loch Ewe net. On completion of this survey EXPLORER proceeded once more to the small grid to work a fourth survey which was completed late on 2 June. An extension of the small grid was then worked until 0530 when EXPLORER proceeded to join METEOR for an intercalibration exercise. EXPLORER left METEOR at 1100 and set course for the mooring at which the sedimentation traps were anchored. Having lifted the jars EXPLORER returned to Aberdeen where she docked at 0630 on 4 June.

RESULTS

This was a highly successful cruise which achieved much of its programme of work. A considerable quantity of data was obtained and although much of it is already processed the full significance of the results can only be appreciated when they are considered along with those obtained by other vessels taking part in the FLEX exercise. When all the data are combined it should be possible to describe, in much more detail than previously, the development in time and space of the spring phytoplankton bloom and the associated increase of small herbivorous zooplankters which are of such importance as food for larval fish. Here the results will only be dealt with briefly as far as they relate to the main objectives of the DAFS contribution to FLEX.

Horizontal variability

Observations made in April 1974 suggested that when dealing with the spatial variability of phytoplankton (measured as chlorophyll) one is dealing with variability at a wide range of spatial scales best described as 'patchiness'. However the FLEX 76 data suggest that there were actual patches of phytoplankton with dimensions of the order of 10-20 km and that they persisted for at least a few days. These two sets of observations give rise to the interesting hypothesis that early in the seasonal cycle physical factors produce a 'patchiness' while later in the season biological factors (zooplankton grazing) become dominant resulting in fairly large patches.

Vertical variability

Calm weather at the start of the cruise resulted in a shallow thermocline (10-20 m) at stations occupied on 12 May but subsequent strong winds had resulted in a mixed layer depth of between 50 to 60 metres by late on 13 May. This situation was observed at most positions occupied during the rest of Part I of the cruise, but by 26 May when EXPLORER returned to the FLEX box, calm weather had allowed a second thermocline to develop with a depth of 20 to 30 m.

The chlorophyll a vertical profiles varied considerably from station to station. Some stations showed less than 0.5 mg/m^3 at all depths while some (eg the central station on 23 May) had a peak of about 5 mg/m^3 at 10 m; others had a peak of 0.5 - 1.5 at 20 or 30 m depth, particularly those occupied from 29 May onwards. At one of the latter stations a Longhurst-Hardy Plankton Recorder was deployed and the results obtained suggested that the chlorophyll peak coincided with a marked decrease in the abundance of Calanus, the principal herbivore.

Rate of processes

Sedimentation of organic material

During the cruise sets of five settlement traps were successfully deployed and recovered eight times. The material which had been collected in the traps in the earlier FLEX cruises had been predominantly large faecal pellets, probably Euphausiid in origin, and, judging from the relatively large amount of inorganic material collected, there had been considerable resuspension of the bottom sediment up to at least 40 m above the bottom. The collections obtained by EXPLORER during the spring bloom showed that a considerable amount of primary production may settle onto the bottom as ungrazed diatoms but that this diminishes as the zooplankton population increases. A feature of the collections in late May and early June was the very large numbers of zooplankters trapped (perhaps during vertical migration) in the settlement collectors situated about 60 and 100 m above the bottom ie in traps at depths of about 35 and 70 m.

Since it is difficult to differentiate between freshly settled and resuspended material, except by the indirect means described above, only approximate values for the organic input to the bottom can be made. However, prior to the spring bloom the organic input would appear to have been about $60-80 \text{ mgC/m}^2/\text{day}$ and during the bloom between $250-400 \text{ mgC/m}^2/\text{day}$ although both these estimates may be on the high side.

Primary productivity

Preliminary calculations suggest that the nett particulate primary productivity was of the order of $660 \text{ mgC/m}^2/\text{day}$ (range $400-800 \text{ mgC/m}^2/\text{day}$) and that nett soluble plus particulate primary productivity about $960 \text{ mgC/m}^2/\text{day}$ (range $500-1430 \text{ mgC/m}^2/\text{day}$).

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