MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
FISHERIES LABORATORY, LOWESTOFT, SUFFOLK

1996 RESEARCH VESSEL PROGRAMME

REPORT: RV CIROLANA: CRUISE 5a

STAFF:

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M Finch	SOC	3/5-13/5
S Kratzer	UWB	
P Tett	NU	13/5-19/5
A Hammerstein	NU	13/5-19/5

DURATION: 3 May - 19 May 1996

LOCALITY: North Sea, Thames Estuary, Irish Sea

AIMS:

1. To undertake process measurements at sites in the Thames estuary and southern North Sea to determine the impact of land derived nutrients on the marine ecosystem (AE0529A0 and C956J168)
2. To undertake spatial surveys to determine the distribution of nutrients, phytoplankton indicators and other relevant parameters using CTD and underway sampling in the outer Thames estuary (AE0529A0 and C956J168)
3. To undertake process measurements at sites in Dundalk Bay, the Western 'Gyre'region and in Liverpool Bay in the Irish Sea. (AE0529A0 and C956J168)
4. To undertake spatial surveys to determine the distribution of nutrients, phytoplankton indicators and other relevant parameters using CTD and underway sampling in the Irish Sea (AE0529A0 and C956J168)
5. To make bio-optical measurements at sites in the Irish Sea in support of JoNuS and the Smart Biophysical Mooring programme (CSG extra-mural).
6. To conduct trials of an Optical Nitrate Sensor (Southampton Oceanography Centre)

NARRATIVE: [note all times in GMT]

Cirolana departed from Lowestoft on the evening tide of Friday 3 May 1996 and went directly to the Warp anchorge in the Thames estuary. Work started on Saturday 4 May 1996 at 0400h with a pre-dawn sampling using the CTD-rossete system to provid water samples for the

primary production and grazing measurements. The rest of the day Cirolana remained at anchor to collect water samples over the tidal cycle and sediment samples using the NIOZ corer for measurements of nutrient cycling and oxygen consumption. Cirolana moved to a position near Long Sand Head where further measurements of production, grazing, sediment proceses and the tidal cycle were undertaken on 5 May 1996. A final station was worked at the Outer Gabbard National Monitoring Programme site on 6 May 1996, completing the estuary to offshore transect for the Thames. In addition to the standard suite of measurements, samples at this site were size fractionated for production and respiration rates. A grid of stations around the Outer Gabbard was sampled on 7 May 1996 but the grid had to be abandonned later in the day due to deteriorating sea conditions under the north east wind. Cirolana went directly to the Irish Sea via Dover, Lands End and Cardigan Bay. During the passage surface water samples were collected to calibrate sensors including the Southampton Oceanography Centre's new Optical Nitrate Sensor.

The first site visited in the Irish Sea was south of Dundalk Bay where size fractionated production, respiration and grazing measurements were made on Friday 10 May 1996 and sediment process measurements and a survey in the area were carried out on 11 May 1996. Overnight Cirolana transferred east to commence the Liverpool Bay grid survey. Half of the survey was completed on 13 May 1996 and the remainder on Monday 13 May 1996 following an exchange of staff at Holyhead. Dr Finch left and Dr Tett and Ms Hammerstein joined the ship.

A UWB four colour optical sensor was deployed by Ms Kratzer at each of the production measurement stations to measure both up and down-welling light (this work is supported by a MAFF CSG extra-mural commission to UWB). The arrival of Dr Tett and Ms Hammerstein augmented the bio-optics work to include deployments of a spectroradiometer and a 'solar-induced' fluorometer. The University of Dundee and Cray Systems Ltd contacted Cirolana to arrange an overflight with remote sensing equipment but there was no sign of an aircraft at the appointed time.

Cirolana anchored in Liverpool Bay on 14 May 1996 to conduct further production and grazing measurements followed by sediemnt sampling on the 15 May 1996. The front between the stratified waters and unstratified waters was sampled for bio-optical properties before the ship took up position next to the DANI/MAFF moorings at Station 45 in the western Irish Sea Gyre. Observations were made over a 24 hour period and the complete suite of production, loss and sediment process measurements were made. Optical profiles were determined during the course of the day and on 17 May 1996 a survey was conducted in the area before passage back to Liverpool Bay. Surface water samples were collected along a transect running into Liverpool Bay on 18 May 1996 and Cirolana re-occupied the anchor site to make optical and CTD profile measurements. The final work of the cruise was to complete a survey along the coast from the Dee to Morecambe Bay.

The ship lay overnight and docked in Barrow-in-Furness at h on Sunday 19 May 1996. Scientific personnel disembarked and returned to Lowestoft or their own institutions.

RESULTS

The exceptionally good weather and the teamwork of the scientific staff, a mix of DFR people and staff from other institutions, and ships officers and crew all contributed to the successful completion of the cruise aims.

Aim 1. Unfractionated and size fractionated (unfiltered, <20, <5 and <2 μm) primary production, respiration and chlorophyll biomass determinations will allow calculation of water

column production and respiration at 3 sites associated with the Thames part of the study. Initial calculations of photosynthetic parameters have been made and show considerable variability between sites and between the size fractions. In the outer Thames high chlorophyll concentrations (up to 35µg/l) were associated with a diatom dominated phytoplankton assemblage consisting of large Rhizosolenia sp. and Thalassiosira sp.. Offshore at the Outer Gabbard a Phaeocystis sp. bloom was encountered but with lower chlorophyll levels (about 5 µg/l).
Zooplankton in the Thames was dominated by Temora sp. and the Larvacean Oikioplura sp. was prominant. Experiments were conducted to measure micro-plankton grazing, meso-plankton grazing and faecal pellet production and samples collected to measure faecal pellet carbon and particulate carbon. Preliminary estimates of grazing pressure were made.
The sediments sampled ranged from muddy sand in the inner Thames to medium/coarse sand at the Outer Gabbard. Measurements of oxygen uptake and sediment/water interface fluxes of nutrients.

Aim 2. The tidal cycle sampling at the station in the Warp clearly indicated the higher nutrient concentrations around low water as a result of discharge from the estuary and lower concentrations around high water when water from offshore was sampled. A significant diatom bloom was underway at this site. The same temporal pattern characterised the site off Long Sand Head also with evidence of significant diatom activity. At the Outer Gabbard site the water was depleted of nutrients and a Phaeocystis bloom was in progress.

Aim 3. In Liverpool Bay both diatom and joint diatom/Phaeocystis sp. dominated phytoplankton communities were found together with a range of different flagellate species. In Dundalk Bay and the western gyre region diatoms dominated but the chlorophyll concentrations were low. Size fractionated (as before Aim 1) primary production, rspiration and chlorophyll biomass were determined and photosynthetic parameters were calculated. Considerable variation was noted between sites and between the size fractions.
Grazing experiments were conducted as for the thames/North Sea sites and grazing pressures estimated. Liverpool Bay and Dundalk Bay zooplankton samples were dominated by Temora sp. but in contrast the western gyre region was dominated by Pseudocalanus sp. with greater diversity and less abundance than the coastal sites.
The sediments sampled ranged form inhomogeneous sands and clays in Liverpool Bay through muddy sand at Dundalk Bay to very fine silt in the western Gyre. Oxygen uptake and sediment/water interface fluxes of nutrients were determined.

Aim 4. Dundalk Bay showed a gradient in nutrient and chlorophyll concentrations with higher concentrations offshore. The same distribution occurred in Liverpool Bay with higher nutrient concentrations offshore and depletion in the shallow inner areas where a diatom and Phaeocystis sp. bloom was in progress. There was significant stratification at the western Irish Sea Gyre site but the biomass was relatively low and chlorophyll concentrations low compared to the shallow coastal sites and the nutrient concentrations were relatively high.

Aim 5. UWB designed four colour sensors were deployed at all process measurement sites to detect the pigment compsition of the predominant phytoplankton group and, where Phaeocystis ocurred, to investigate the optical properties of the bloom. Supporting measurements were made and samples collected for further analysis at UWB.

The optical work in the Irish Sea established that, on the basis of the two areas sampled, that the waters were of Optical Type 2. That is waters in which inorganic suspended particulate matter absorbs and scatters a large proportion of submarine light. The measurements contrasted the sites in Liverpool Bay with those in the western stratified area.

Aim 6. The Optical Nitrate Sensor sampled water from the pumped non-toxic seawater supply throughout the cruise. Samples were collected from the cell effluent at frequent intervals and will be used to calibrate and validate the optical measurements. Preliminary evidence suggests that the instrument works well in the waters sampled.

Further working up of the data will be undertaken together with data collected on subsequent JoNuS II programme cruises.

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S J Malcolm
19 May 1996

SEEN IN DRAFT: **D McD** Master

MR Senior Fishing Mate

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