

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
FISHERIES LABORATORY, LOWESTOFT, SUFFOLK NR33 0HT, UK

1990 RESEARCH VESSEL PROGRAMME

REPORT: RV CIROLANA : CRUISE 7 (JONUS 2)

STAFF:

D S Woodhead	11-25 July
S J Malcolm	6-20 July
J M Rees	6-11, 19-20 July
R J Chapman	13-25 July
A Reeve	
D B Sivyer	
P Burgess	6-20 July
S R Jones	
D C Denoon	6-19 July
D McCubbin	19-25 July
R Fichez (UEA)	11-19 July
C Law (PML)	19-25 July

DURATION:

6-25 July 1990

LOCATION:

Wash, Humber and southern North Sea

AIMS:

To identify and quantify the fate of river-borne nutrients entering the Wash and the Humber Estuary, examining nutrient distributions and critical processes from the river inputs through to the North Sea in intertidal and subtidal sediments and in the water column.

NARRATIVE:

CIROLANA sailed from Lowestoft at 2000 (GMT) on 6 July and proceeded overnight to the Bull Anchorage at the mouth of the Humber Estuary. She remained at anchor from 0600 on 7 July to 0700 on 9 July.

On 7 July hourly CTD stations were worked over a full tidal cycle and water samples (surface and bottom) taken for the determination of nutrient concentrations, salinity and suspended load. Water samples were collected from a searider on transects from the Bull to Buoy 63 (North Channel), from the Bull to Buoy 6B (South Channel) and across the mouth of the Humber from Spurn Head to Haile Sand Fort on 8 July. At each sampling station temperature and salinity profiles were measured with a mini STD probe (an instrument which proved invaluable throughout the cruise). The water samples have been analysed for nutrients and partly processed for determination of suspended load, particulate chemistry and salinity.

The Zodiac was used to collect sediment samples from the Spurn-Bight on 7 July and Cleethorpes Sands on 8 July. Pore water samples were collected using the in situ sipper system (although still developing, the present version worked well throughout the cruise) for the determination of nutrient and redox profiles. Core samples were collected for nutrient flux and oxygen consumption experiments and for denitrification assay.

On 9 July CIROLANA moved up the Estuary to anchor off the Killingholme Jetty, remaining at this position until 0700 on 12 July.

Box core sediment samples were collected 9-10 July for studies of processes affecting nutrient behaviour and on each day hourly CTD stations were worked to cover a full tidal cycle with

water samples being collected for nutrient, salinity and suspended load analysis. Transects of water stations were worked from seariders from Buoy 12 to Buoy 6B on 9 July, from Buoy 12 to Buoy 27 in Hull Roads on 10 July, and to both Blacktoft Jetty and Trent Falls on 11 July. At each station, water samples were collected for the determination of nutrient concentration, suspended load and salinity and STD profiles measured. On 11 July an exchange of scientific staff took place.

At 0700 on 12 July the CIROLANA staff left the Humber en route for the Wash. CTD stations were worked during the day and two CTD transects made across the mouth and the inner part of the Wash before anchoring in Boston Deep at 2200 h. During the passage, estuarine mixing experiments were carried out with water samples previously collected at the Bull Anchorage and in the River Trent and the River Ouse.

A Zodiac survey of the sediments adjacent to the channels leading to Boston was undertaken on 13 July to identify sites for future studies of sediment processes. A transect of stations was worked from a searider between Freddie Grays and Buoy Echo on the Witham to collect water for nutrient, suspended load and salinity analyses with temperature and salinity profiles determined with the STD at each station. Hourly CTD and water stations were worked from the anchored ship over a full tidal cycle. R Chapman joined the ship to reinforce the nutrient analysis team and a replacement gas chromatograph column arrived to provide a cure for a stability problem which had troubled the denitrification analyses of the Humber sediment samples.

At 2000 on 13 July CIROLANA left the Boston Deep to anchor at 2300 at the Roaring Middle. During the morning of 14 July Box core sediment samples were collected for studies of denitrification rate, nutrient flux oxygen consumption and pore water chemistry. At 1300 on 14 July moved to re-anchor a Bar Flat Buoy. Hourly CTD and water sample stations were worked for the remainder of the day and on 15 July the series was continued to give coverage of a complete tidal cycle. Box core samples were collected for sediment process studies. A searider made a transect between Wisbech No 1 Buoy and Sutton Bridge on the River Nene collecting water samples and measuring salinity and temperature profiles at six stations. These measurements were timed to overlap with a similar series being made further up-river by NRA staff. All stations were resampled on the return journey to the ship.

At 0800 h on 16 July, CIROLANA had moved to re-anchor at Sunk Sand Buoy. Hourly CTD and water sampling commenced immediately and was continued to give full coverage of a complete tidal cycle; the series of observations was repeated on 17 July. Weather conditions on 16 July prevented the use of the Zodiac for the sampling of inter-tidal sediments but the seariders were used to make a water sample and STD profile transect between Buoy no 2 and Kings Lynn main quay (8 stations), and to put a crewman ashore for medical treatment. On 17 July two sites on Bulldog Sand were sampled, one for the full range of sediment process investigations, and the other, due to a rapidly rising tide, only for denitrification samples. The first of these sites was resampled for denitrification measurements on 18 July together with an additional site on Peter Black Sand. The water sample transect in the Great Ouse was repeated.

CIROLANA moved to anchor at Bar Flat Buoy at 1900 on 18 July. On 19 and 20 July a seatruck ("Seeker") from Boston Port Authority was used, with the aid of a Honda ATV, to sample sediments on the Breast Sands for process studies CTD and water sample stations were worked over a tidal cycle on 19 July although the hourly frequency was disrupted due to an electrical fault (repaired) in the control box of the hydrographic winch. An exchange of scientists took place. Box core sediment samples were collected for denitrification studies on 20 July (PML). At 1800 on 20 July CIROLANA weighed anchor and repeated the transect of CTD stations across the mouth of the Wash before moving offshore in readiness for sediment sampling for denitrification studies (PML).

A series of sites had been identified on earlier RV CHALLENGER cruises as having mud or sandy mud sediments suitable for these studies. Over the period 21-24 July, however, numerous attempts to obtain samples at these, and other, sites in the area between the Humber and the

Wash were unsuccessful. In the majority of cases, sediments with a significant mud content either could not be located or could not be adequately sampled with the equipment (a Calvert Box corer) available; penetration into any except the softest sediments was poor and even quite small (4 cm diameter) stones could prevent the correct closure of the jaws, resulting in the loss of sample. In all, five sites were successfully sampled.

The failure of the switch gear on the main engine on the afternoon of 21 July did not lead to any loss of working time as samples were in hand for processing. No significant working time was lost due to adverse weather.

CIROLANA set course for Lowestoft at 1600 on 24 July and docked at 0015 on 25 July.

RESULTS:

Water Column

CTD profiles were measured at 136 stations and, in addition, provided water samples for nutrient, suspended load and salinity measurement. Apart from the preliminary processing of the samples no further evaluation of the results has been possible.

STD profiles were measured at 78 stations on 6 transects into estuaries. The data have been entered into Excel spreadsheet files and plots produced. These generally show the expected pattern of lower salinity, higher temperature water in the upper part of the water column. Preliminary nutrient concentration data are available but have not yet been correlated with the temperature and salinity data.

Approximately 600 samples have been analysed for the nutrients - nitrate plus nitrite, phosphate and ammonia, and the majority also for nitrite alone. The results from anchor stations show higher nitrate + nitrite concentrations on the ebb tide than the flood; the data also show higher concentrations in the rivers than in the offshore waters. For the CTD anchor stations the bottom water samples generally show lower nitrate + nitrite concentrations than those from the surface, and the difference is proportionately greater on the ebb than the flood tide. Fuller analysis will show whether these data show the expected correlation with salinity.

Sediments

Much more time will be required to interpret and correlate the data obtained for sediments. At present it appears that the oxygen consumption rate and the denitrification rate show wide variations which are not entirely related to sediment type. Nutrient data are available in preliminary form for sediment pore waters as are nutrient flux rate measurements. Pore waters from Humber sediments show much higher concentrations of iron and manganese than those from the Wash; data will also become available from offshore samples. As expected the redox boundary is nearer to the sediment-water interface in the muddy sediments than in the coarser, sandy sediments.

General

The continued development of sampling techniques is yielding dividends. Improvements made to the pore water "sipper" equipment have produced larger and more consistent samples. The STD probe has proved invaluable on the river transects.

The Calvert Box corer will require considerable refurbishment before JONUS 3: replacement of the wire strops is necessary (plus a spare set) and the lower set of jaws require adjustment. As this is the work-horse of the sub-tidal sediment sampling programme, it is disappointing that it does not produce better, and more consistent samples.

The tests of the Seatruck as a means of gaining access to the large inter-tidal sand and mud flats of the Wash was a real success. If demountable analytical facilities could be fitted into the

available space it should be possible to much more reliably sample and process the sediments in this area. This approach appears likely to be much more efficient and cost-effective than the present Zodiac-CIROLANA combination, particularly for the autumn and winter sampling periods.

D S Woodhead

SEEN IN DRAFT

G S
J H

INITIALLED:

C E P

DISTRIBUTION:

Basic List +
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