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

1989 RESEARCH VESSEL PROGRAMME

REPORT: RV CIROLANA : CRUISE 4/89

STAFF:

Part 1.
J H Nichols (SIC to 26 April)
A B Thompson (SIC 26-29 April)
B F Riches
L E Woolner
S P Milligan
R T Harrop
J Evans — PML
D V P Conway — " — from 15 April
M Jordan — "
A Pomroy — "
N Halliday — "
C Morales — "
D Kirkwood — 14-15 April
R Chapman — 14-15 April

Part 2.
K Brander (SIC)
R B Mitson
N D Pearson
C R Hood
B F Riches
S P Milligan
D V P Conway PML
D S Conway
D V Holliday, Tracor Applied Sciences
R J Pieper, USC
C Greenlaw, Tracor Applied Sciences
J Dawson, USC
G Kleppel (9-11 May)

(All times are Greenwich Mean Time)

DURATION:
14 April-29 April, part 1
30 April-11 May, part 2

LOCALITY:
Irish Sea

AIMS: Part 1.

1. To determine the rates and processes of primary and secondary production in different hydrographic regions of the Irish Sea.

2. To construct a C/N budget of the production transformation and fate of biogenic particulates.

3. To assess the vertical and horizontal availability of food for fish larvae and particle distribution in relation to hydrographic features.

4. To determine the nutritional status of fish larvae in relation to feeding conditions.

5. To study predation on the larvae of fish.

Part 2.

1. To compare profiles of particle size distributions obtained with MAPS, with those from pump and net samples in order to identify components.

2. To identify the food particle size range for available species of fish larvae and to relate the distribution and condition of the larvae to the concentrations of suitable particles.

3. To survey the distribution of suitable sized particles in the western Irish Sea in relation to different hydrographic and biological regimes, using MAPS and the Lowestoft integrator system.

NARRATIVE: (Part 1)

RV CIROLANA sailed from Lowestoft at 0500 h 14 April and proceeded to Plymouth arriving there at 0830 h on the following day. Gear and staff from the Plymouth Marine Laboratories were taken on board and the ship sailed at 1400 h. Messrs Kirkwood and Chapman returned by road to Lowestoft from Plymouth. An attempt to calibrate the ships log after leaving Plymouth had to be abandoned in an easterly gale. The vessel made a good passage to the Irish Sea and started a plankton sampling survey at 1350 h on 16 April. During this survey one CTD/Niskin cast was made during which two 30 litre Niskins were destroyed by implosion having been deployed un-cocked. The plankton survey was completed at 0630 h, 18 April and a UOR/CTD transect from Dundalk Bay to the North Wales coast was started. The transect was completed in Liverpool Bay at 2350 h. At 0500 h, 19 April the primary production and light profiling 'rig' was deployed ca. 10 nml north of Llandudno. Because of heavy fishing activity in this area it was deemed wise to remain close to the 'rig' all day. Further sampling was confined to CTD/Niskin casts, vertical plankton net tows for copepods and LHPR deployments at 1200 h and 2330 h. The 'rig' was recovered at 1930 h and a mini-grid of eight standard sampler stations started. These were completed by 0400 h on the following day when the 'rig' was re-deployed at the previous days position. Further plankton sampling and collection tows including some Methot and Lowestoft frame trawl hauls were done during the day. The 'rig' was recovered at 1830 h and after two further hauls with the Methot trawl (MIK), the vessel steamed overnight towards the Irish coast off Clogher Head. The 'rig' was deployed at 53°50'N; 06°02.5'W at 0600 h, 21 April recovered in the evening and deployed again for the daylight hours on the following day. The remaining time in that area was spent collecting samples of fish larvae, copepods and selected-depth water for particle counts. LHPR tows were made at 1230 h and 2300 h, 21 April. Sampling was completed off Clogher Head at 2025 h, 22 April and restarted in a new, deep water area, at 2310 h (53°45'N; 05°30'W) with CTD and LHPR deployments. The 'rig' was deployed at this position by 0630 h, 23 April. A second LHPR deployment was made at 1245 h. Collection tows with the TTN, ring nets and MIK net revealed a dearth of plankton and no fish larvae in this area and an alternative site 10 nml to the west was selected for the following day. After a grid of ten TTN stations en-route to the new site the 'rig' was redeployed at 0600 h 24 April (53°53'N; 05°47'W). A series of larvae collection tows, CTD's, MIK net tows and one LHPR were done in this area until the 'rig' was recovered at 1840 h. After further collection tows the vessel steamed 42 nml to the east to the final designated sampling site for primary and secondary production measurements. The 'rig' was deployed at 53°40'N; 04°45'W by 0600 h, 25 April. Sampling in the vicinity and up to 15 nml from the rig showed that there were few larvae in the area. LHPR tows were done at 1330 h and 2330 h and further collection tows for bulk plankton and sandeel larvae during the evening. Production in this area was very low and it was decided to move to an area 12 nml SE of the Isle of Man for the following day. Two TTN stations were sampled en-route and the 'rig' was deployed at 54°00'N; 04°15'W by 0600 h, 26 April for an extra location where cod larvae were found in 1988. RV CIROLANA left the 'rig' at 0930 h to steam to Douglas, Isle

of Man, where Mr Nichols was disembarked to return to Lowestoft at 1230 h. The 'rig' was re-located at 1730 h and after recovery at 1900 h a grid of seven TTN stations was worked in the same area.

Three MIK stations were taken whilst steaming to Dundalk Bay, for the start of the second UOR/CTD transect at 0500 h, 27 April. This transect, a repeat of the first, was completed in Liverpool Bay at 2030 h on the same day. After an overnight steam a small grid of seven TTN stations was worked east of the Isle of Man commencing at 54°09'N; 03°38'W and finishing near Workington. Suitable numbers of cod larvae for collection were found only on the last station at 54°30'N; 03°50'W. Collection tows with the ring net were very successful, and about 90 small cod, less than 7 mm in length, were collected. Scientific sampling finished at 1130 h on 28 April, and RV CIROLANA docked in Workington at 1800 h on the same day.

RESULTS: (Part 1)

1. A standard TTN grid of 37 stations with 'V' profiles of salinity temperature and chlorophyll 'a' was completed between 16-18 April (Figure 1). A transect of Undulating Oceanographic Recorder (UOR) tows and CTD casts was run from the Dundalk area to the North Wales coast (Figure 2). These observations formed the basis of choice for the subsequent detailed study sites. Fish larvae abundance was generally low over the western Irish Sea with the exception of the Irish coastal belt where sprat larvae and late stage cod larvae were found. Chlorophyll levels were also low at less than 1-3 mg m^{-3} and no dramatic peaks were observed on the UOR transect. The second transect had higher chlorophyll levels towards Liverpool Bay reading greater than 5 mg m^{-3}. No significant thermal or salinity differences vertically were observed and the values of the stratification parameter Ø were generally less than 2 $J.m^{-3}$. The only exception to this was found at one station in Liverpool Bay where a thermohalocline generated a stratification parameter of 23 $J.m^{-3}$.

The PML free floating rig for measuring primary production rates and insolation over the photosynthetically active range down to 30 metres depth, was deployed in six different areas (Figure 2). Continuous measurements were made during daylight hours on each day from 19-26 April. Successful primary production incubations were achieved each day at depths of 1,2,5,7,10,15,20,25, & 30 metres, and there was complete recovery of logged data from the light measuring rig. Concurrent measurements of solar radiation were made throughout the cruise at deck level.

2. Vertical profiles of particulate matter were taken twice daily at each of the study sites and from the CTD casts on the UOR transects. Samples from the Niskin bottles were analysed on board for particle size and abundance, and size partitioned filtrates taken for subsequent analysis of carbon and nitrogen.

3. A total of nine triple LHPR deployments were made within the study sites, nominally at midday and midnight in each area. Fish larvae and large zooplankters were sampled in the 270 micron net and potential food organisims in the 50 and 20 micron nets from approximately 5 metre depth bands. Samples from the fine mesh nets were partitioned for subsequent carbon and nitrogen analysis.

4. Samples of cod and sprat larvae were obtained from two of the six sites studied. Cod and sprat larvae were readily available at the Irish coastal site but more difficult to obtain at the other sites. However, some 90 small cod larvae were obtained from east of the Isle of Man. Samples of both species were either dried, or fixed in IMS or liquid nitrogen for subsequent analysis of nutritional status. Some samples of other larvae were fixed in formalin for comparative feeding studies.

4. CTD profiles and rosette samples

41 stations were sampled and at most of these nutrient and particle count analyses were carried out. The nutrients included nitrate, phosphate and silicate. Particle counts were made with the PML Coulter and the MAFF Elzone, covering the size range from about 5 to 150 microns ESR. Both instruments appeared to function well and were checked against standards on several occasions, but there are some discrepancies between their results, which need to be investigated. The Elzone calibration apparently failed or drifted during the last two days of operation. Since the Coulter was overlapping most of the size range this should not result in any significant loss of data. A very brief look at particles retained by the fine mesh (53μ) LHPR at one station indicated that in the central mixed region of the Irish Sea a large proportion of particles in the 5-100 μ ESR range may be detritus. This backs up previous studies.

The nutrient analysis showed very high levels during the first transect from Gt Ormes to Dundalk Bay on 1/2 May, but by 8/9 May, when the same transect was repeated, the levels of nitrate close to the front in the western Irish Sea had declined to $<$ .2 μmols/l, which is an indication of the rapid bloom conditions that developed during the cruise.

5. Plankton sampling using MIK and LHPR

25 MIK and 13 LHPR stations were carried out to estimate size composition of organisms being profiled by the MAPS gear and to collect samples of fish larvae for gut content analysis. The LHPR system operated with the MAFF deck controlled coarse mesh unit (280μ) and the PML internal logging fine mesh unit (53μ). At most stations samples were taken in 2 m intervals in the upper part of the water column and at 5 m intervals lower down, which usually gave about 20 depth strata. There were only minor gear problems and the system can now be regarded as a routine sampling tool, although it requires expertise to set up and run. Since each haul could, if required, produce up to 70 samples from each of two mesh sizes, care is needed to keep the analytical load manageable.

As on previous occasions, it was difficult to locate adequate concentrations of larvae for regular sampling and so it was not possible to collect material for growth and condition studies. However a number of ring net tows produced a large variety of larvae in good condition and a start has been made in examining their gut contents, in order to relate these to the availability of small plankton in the area where they were caught.

Samples from several LHPR and MIK net tows were photographed using silhouette photography in order to provide a quick record of the larger plankton organisms for comparison with MAPS profile results. One LHPR tow was analysed rapidly on board in order to provide a profile of the biomass of plankton through the water column for comparison with a MAPS profile and to give a broad taxonomic breakdown within each of the 27 depths sampled.

6. During the cruise the TRANSECT program was modified to plot rosette CTD data and named CTDPLOT.

SMSPLOT was modified to plot LHPR data and named LHPRPLOT.

CONTRACK was written to plot out continuous temperature, salinity and fluorometer values from the continuous surface recordings.

7. A separate report has been prepared by Drs Kleppel and Nash on their work on zooplankton dynamics and bio-acoustic distributional studies off the Isle of Man.

K Brander
19 May 1989

SEEN IN DRAFT:
R G
M J W

INITIALLED:
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J G S

DISTRIBUTION:

Basic List+

Staff on cruise

CIROLANA 4/89 GRID 1

Figure. 1.

SHOWING :
STATION POSITION
STATION NUMBER
COASTLINE

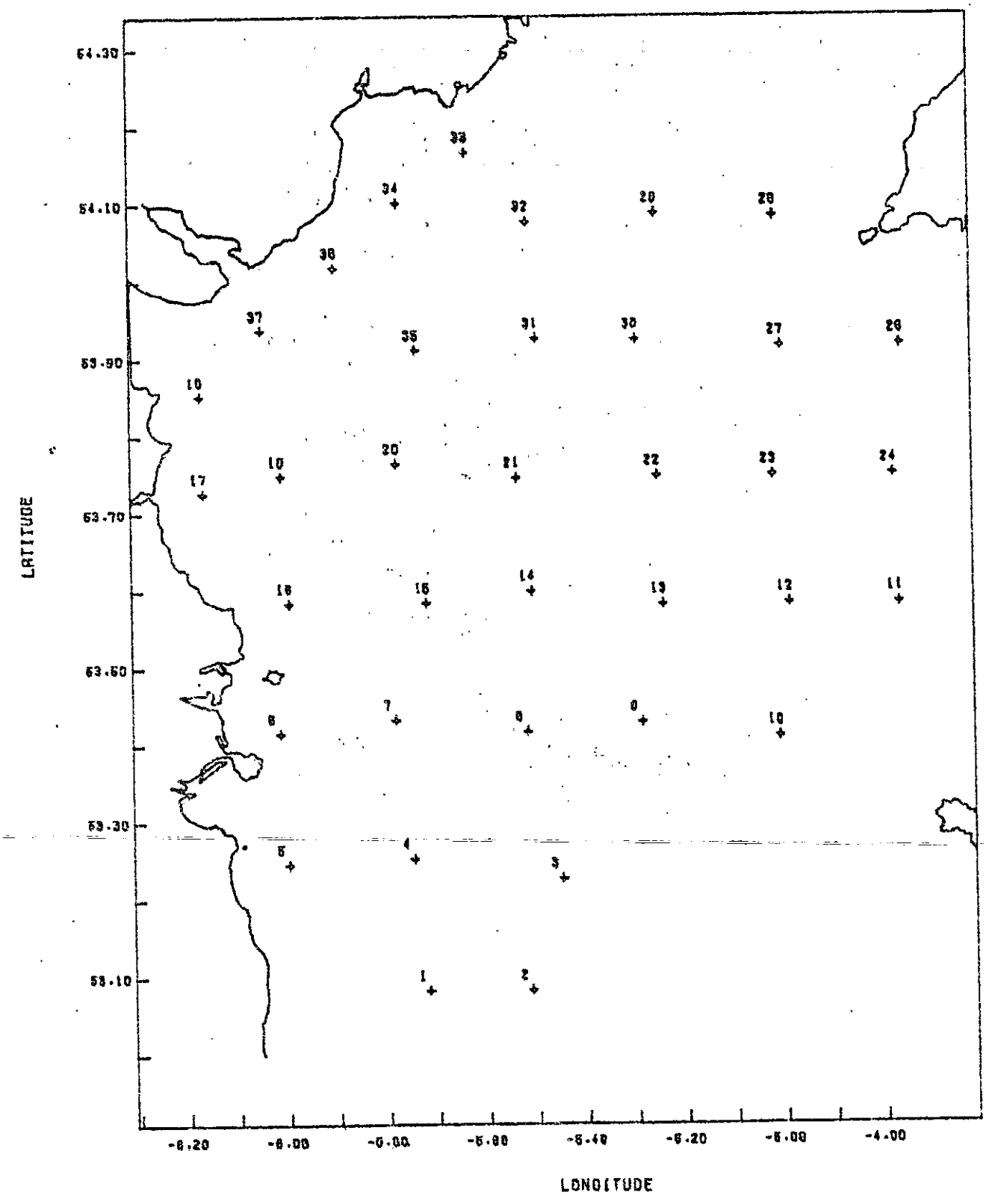

FIG I

CIROLANA 4/89 UOR AND LIGHT RIG DEPLOYMENTS

Figure. 2.

SHOWING :
STATION POSITION
STATION NUMBER
COASTLINE

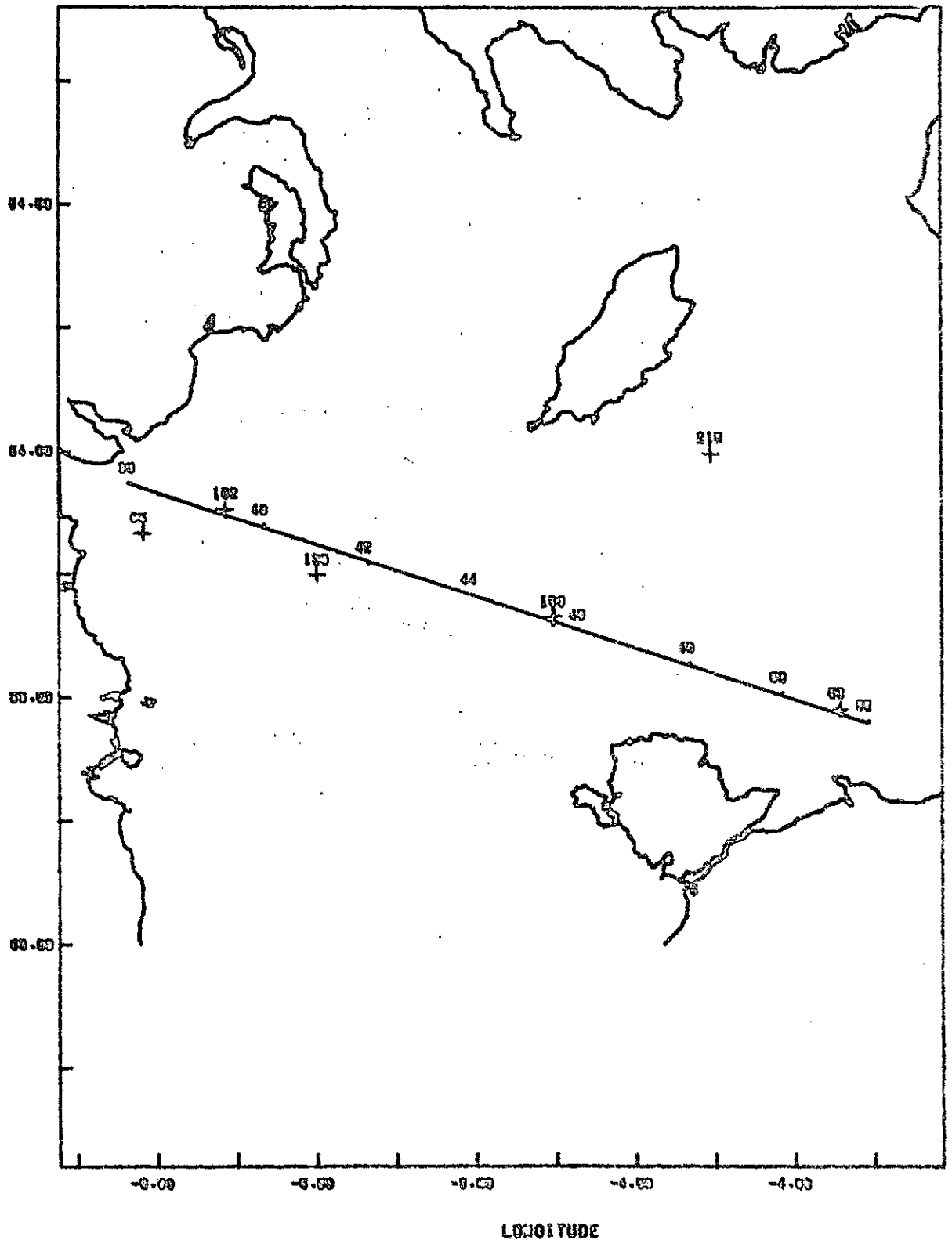

FIG 2.

Plymouth Marine Laboratory
United Kingdom

Cruise Report - PML/MAFF/1/89

Vessel - R V Cirolana

Cruise Period - 14-29 April 1989

Personnel -

PML	D Conway	MAFF	J Nichols (SIC)
	M Jordan		A Thompson
	A Pomroy		L Woolner
	N Halliday		B Riches
	C Morales		S Milligan
	J Evans		R Harrap

Itinerary:

15 April	0900 GMT	Cirolana docked Plymouth. PML equipment loaded and secured.
	1400	Departed Plymouth and set course for Irish Sea.
16 April	1150	UOR depth calibration trials.
	1300	Commenced tin tow net (TTN) grid in western Irish Sea.
18 April	0634	Completed TTN grid.
	0758	Commenced CTD and Undulating Oceanographic Recorder (UOR) transect from Dundalk Bay to Liverpool Bay.
	2346	Completed transect.
19 April	0503	Coastal area off Anglesey. CTD then production and light rig deployed. Triple Longhurst Hardy Plankton Recorder (TLHPR) sampling. Ring netting and TTN sampling for fish larvae.
20 April	0504	CTD then production and light rig deployed. MIK net, TTN and ring net sampling for fish larvae and sprat eggs.
	2046	Steamed overnight to Irish Coast.
21 April	0505	Dundalk Bay. CTD then production and light rigs deployed. TLHPR, TTN, MIK and ring net sampling for fish larvae.
22 April	0037	TTN grid overnight.
	0534	CTD then production and light rig deployed.
	0747	Mini TTN grid. TLHPR sampling. MIK and Ring net sampling for copepods and fish larvae.
	2022	Moved to position 53°45'N 05°30'W which becomes seasonally temperature stratified.
	2236	CTD followed by TLHPR sampling.
23 April	0021	Overnight ring and MIK net sampling for large fish larvae.
	0505	CTD then production and light rig deployed. TLHPR

		and ring net sampling. Mini TTN grid overnight as moved to position 53°53'N 05°47'W an area where higher production was indicated by the initial UOR transect.
24 April	0502	CTD then production and light rig deployed. TLHPR, TTN, MIK and ring net sampling for copepods and fish larvae.
	2312	Moved overnight to position 54°40'N 04°45'W, NW of Anglesey.
25 April	0509	CTD then production and light rig deployed. TLHPR, TTN, MIK and ring net sampling.
26 April	0228	Steamed to position 54°00'N 04°15'W.
	0500	CTD then production and light rig deployed. TTN and ring net sampling for copepods and fish larvae.
	0944	Steamed to Douglas, Isle of Man to disembark J. Nichols, then returned to rig position.
	1440	TTN and MIK net sampling back towards Ireland.
27 April	0511	Commenced CTD and UOR transect from Dundalk Bay to Liverpool Bay.
	1847	Completed transect.
	1910	Commenced TTN survey east of the Isle of Man for cod larvae.
28 April	1009	Completed sampling. Packed equipment.
	1500	Docked Workington.
29 April	1430	PML staff departed Workington for Plymouth with equipment.

Objectives - (1) To determine the rates and processes of primary and secondary production in different hydrographic regions of the Irish Sea.

(2) To construct a C/N budget of the production, transformation and fate of biogenic particulates.

(3) To assess the vertical and horizontal availability of food for fish larvae and particle distribution in relation to hydrographic conditions.

(4) To determine the nutritional status of fish larvae in relation to feeding conditions.

Methods - (1) Complete a grid of TTN plankton station in the western Irish Sea.

(2) UOR tows along the standard transect (with extensions into shallow water at each end) near the beginning and towards the end of the cruise.

(3) On the basis of the TTN grid, UOR and Coulter results to identify 4 coastal and deeper water mixed and stratified sites for more detailed sampling. Provisionally N. Anglesey, central mixed, central stratified, Dundalk Bay.

(4) Additional UOR tows as required for surveys around areas of detailed sampling.

(5) CTD profiles at detailed sampling sites and at intervals along UOR transect.

(6) Particle sampling using Coulter counter, vertically stratified at detailed stations and from surface samples along the UOR tows.

(7) Primary production measurements for assessment of regional productivity in relation to different light regimes and hydrographic conditions.

(8) Collection of cod and sprat larvae for gut contents analysis, histological examinations, CHN determination, length/weight measurement, and vitamin analysis.

(9) Collection of sprat eggs for vitamin analysis.

(10) Secondary production determinations at each detailed site based on egg production of large and small copepods fed on ambient food.

(11) Sampling for fish eggs and larvae (cod + sprat) in a grid around each main station (say 20 stations) to collect material for nutritional analyses (30" Lowestoft sampler).

(12) Concurrent fine mesh (53 μm) net samples taken with zooplankton samples to determine abundance of microplankton suitable for larval feeding.

(13) Day/night TLHPR sampling at each site with 200, 53 and 20 μm systems to determine vertical distribution of zooplankton, fish larvae and suitable food.

Results -

1) From the initial TTN (280 μm main net, 53 μm mesh pup net) survey (Fig.1) and subsequent TTN, UOR and CTD sampling, the whole Irish Sea was established as being largely isothermal (8-9°C) and isohaline (~33.5°/oo). Water was being kept mixed and cool by frequent strong cold northerly winds and low solar heat input. Greatest primary and secondary production was in the coastal areas. Phytoplankton levels were initially highest off the Irish coast, while in the central Irish Sea small particles were mainly silt. Off the welsh coast over 90% of small material was organic debris.

2) The standard UOR transect (Fig. 2) was completed twice. Fourteen individual tows were taken (Table 1) which included depth integrated plankton sampling. Rosette casts were taken before and after each tow. Salinity temperature and turbidity were measured and water samples taken for chlorophyll and carbon analysis and particle counting. Only small volumes of water (generally 0.5 l) could be filtered because of the high particulate loading. Surface fluorescence, temperature and nutrients (nitrate, phosphate and silicate) were measured continuously on the transects.

3) Nine LHPR hauls (Table 2) with the new triple system (200, 53 and 20 μm)

which operated well and towed very stable and level. Rosette casts for environmental information were taken before and after each haul.

4) Samples of mainly sprat but also cod larvae were collected by TTN, MIK and ring nets for length/dry weight/CHN determinations (99 sprat and 15 cod), gut content (25 samples) and histological analysis (24 sprat and 13 cod). The only area where sprat larvae were found in any number was along the Irish coast. Samples of sprat eggs were also collected for vitamin analysis.

5) 15 litre samples of 200 μm pre-filtered sea water from two sites in each of six different areas was filtered onto 5 μm gauze and re-suspended with addition of 10% DMSO then stored in liquid N_2 for analytical flow cytometer analysis.

6) Samples of micro-zooplankton were collected at the beginning, mid point and end of each UOR tow and more detailed vertical profiles in each of six different areas by gently filtering 20 litre water bottle samples through 53 μm gauze and then preserving in formaldehyde.

7) The free floating buoy system supporting the recording light meter array and primary production experiments was deployed on eight days at six different sites. The light rig logger worked well apart from two occasions when some difficulty was encountered dumping the data. Incident irradiation was high on most days so good information on the sub-surface light regime was achieved. The value of the VHF beacon on the rig for relocation was reinforced when it was necessary to leave the rig intended for a long period in an area of strong tidal movement in poor visibility.

   On the same eight days water samples were taken from nine depths to study rates of absorption by various light-absorbing parameters. The new spectrophotometer worked well giving vastly increased precision. The micro-drive permitted immediate data manipulation. This year again the absorption by detritus greatly exceeded the absorption by pigments by some 15-20 times. A signal from the latter was however still achieved. The only station where a strong pigment signal to detritus was obtained was on the last deployment south of the Isle of Man.

   Size fractionated primary production measurements at nine depths were successfully carried out on the eight days.

Operational problems -

1) The UOR undulated erratically on one tow due to a servo fault, though data was collected. On one haul the logger failed to operate.

2) On two of the triple LHPR hauls one of the sets of samples was not collected due to jams in the cod end.

Prepared by: D V P Conway

Approved by: I.R. Joint

Date: 25.5.89

Circulation: Internal - Cruise personnel, Bayne, Williams, Coombs, Joint.

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Notice board, File VES 1.1

Table 1. UOR shooting and hauling information.

Number	Date	Shooting Position	Time (GMT)	Hauling Position	Time (GMT)
1	18/4/89	53°56'N 06°05'W	0821	53°51'N 05°41'W	1012
2	18/4/89	53°51'N 05°40'W	1056	53°46'N 05°20'W	1220
3	18/4/89	53°46'N 05°20'W	1254	53°42'N 05°01'W	1422
4	18/4/89	53°42'N 05°00'W	1455	53°38'N 04°39'W	1635
5	18/4/89	53°38'N 04°39'W	1825	53°34'N 04°19'W	1937
6	18/4/89	53°34'N 04°20'W	2018	53°31'N 04°03'W	2123
7	18/4/89	53°31'N 04°03'W	2158	53°27'N 03°46'W	2314
8	27/4/89	53°56'N 06°05'W	0534	53°51'N 05°41'W	0725
9	27/4/89	53°51'N 05°40'W	0812	53°47'N 05°21'W	0944
10	27/4/89	53°46'N 05°20'W	1010	53°43'N 05°00'W	1136
11	27/4/89	53°42'N 05°00'W	1202	53°38'N 04°41'W	1317
12	27/4/89	53°38'N 04°40'W	1343	53°34'N 04°21'W	1502
13	27/4/89	53°34'N 04°20'W	1525	53°31'N 04°04'W	1645
14	27/4/89	53° 30'N 04°03'W	1700	53°27'N 03°45'W	1833

Table 2. Triple LHPR haul information.

Haul Number	Station Number	Date	Time	Position	Profile depth (m)	Bottom depth (m)	Number of samples 20μm	53μm	200μm
IS32	57	19/4/89	1305	53°29'N 03°45'W	34	36	12	13	12
33	66	19/4/89	2344	53°28'N 03°53'W	32	37	-	14	14
34	91	21/4/89	1229	53°50'N 06°06'W	28	31	8	-	9
35	104	21/4/89	2301	53°48'N 06°05'W	28	31	10	11	11
36	130	22/4/89	2309	53°45'N 05°29'W	100	102	25	25	25
37	143	23/4/89	1242	53°45'N 05°30'W	99	105	24	24	22
38	168	24/4/89	1209	53°53'N 05°45'W	67	69	17	17	16
39	197	25/4/89	1256	53°41'N 04°35'W	62	71	17	17	18
40	210	25/4/89	2254	52°38'N 04°40'W	85	92	20	19	18

Fig. 1 Cirolana April 1989 initial TTN survey grid

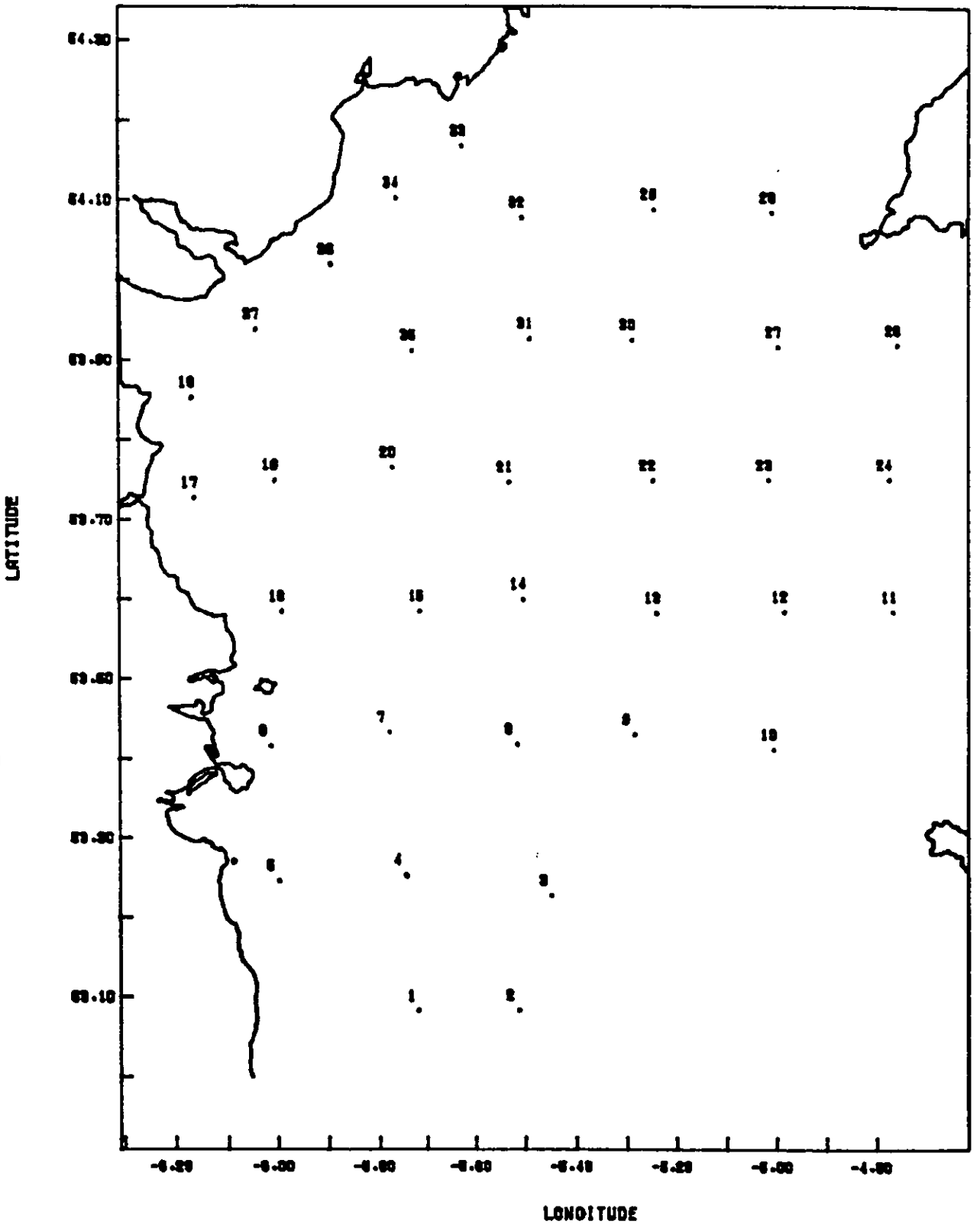

Fig. 2 Cirolana April 1989 UOR transect and TLHPR positions