VESSEL R R S JOHN MURRAY

CRUISE PERIOD 9 May - 24 May 1978

PERSONNEL

R Williams	PSO (Senior Scientist)
F Mantoura	SSO
D V P Conway	HSO
R J M Howland	SO
T F Kendall	SO
Miss S Gent	SO
Mrs M Brinsley	ASO
H Langworthy	ASO
P Armitage	(RVB-MSES)

ITINERARY

8 May		Equipment and personnel to Barry.
9 May	10.40	Departed Barry.
	13.00	Flygt pumps and hydrophone pole fitted and secured.
	17.26	Arrived Station I Carmarthen Bay (CB) site and deployed side scan sonar fish.
	21.00	Completed familiarisation with EG and G side scan sonar.
	21.28	Commenced grid at Station 1.
10 May	06.44	Completion of CB. Grid 1 at Station 29.
	08.00	Commenced side scan sonar grid.
	10.44	Dahn buoy launched at 'best' position.
	11.00	Williams transferred to HMS INSTOW. J: MURRAY sailed to Tenby to transfer Armitage and collect Langworthy.
	15.30	Williams transferred from INSTOW.
	15.50	Live plankton collections.
	18.20	Side scan sonar work to relate position of the lost sampler to the Dahn buoy.
	18.45	Started feeding experiments.
	19.40	Live plankton collections.
11 May	09.00	Side scan soner work.
	10.00	Williams transferred to HMS INSTOW.
	10.16	Vertical profiles at Station 1.
	13.06	Williams transferred from HMS INSTOW.
	13.30	Feeding experiments commenced.
	14.08	Vertical profiles at Station 5.
	15.05	Vertical profiles at Station 31.
	16.38	Vertical profiles at Station 28.
	17.40	Vertical profiles at Station 25.
	18.45	Completed first feeding experiment.
	18.45	Live plankton collections.
12 May	01.43	Completed plankton collections.
	08.27	Live plankton collections.
	13.30	Finished feeding experiment 2.
	15.30	3rd feeding experiment started.
	21.45	4th feeding experiment started.
	21.46	Plankton collections completed.

13 May	09.21	Commenced 13 hour anchor station sampling every hour - 42 vertical casts.
	22.30	Station CB DZ 1 completed.
14 May	11.06	Side scan sonar deployed.
	21.42	Side scan sonar fish inboard.
	23.41	Started CB grid 2 at Station 29.
15 May	08.42	Completed CB grid 2.
	09.41	Side scan sonar fish deployed.
	16.01	Completed 19 positive runs of side scan sonar work.
	18.00	Moved pellet float to estimated position of sampler.
	18.30	Set course for Celtic Sea site.
	22.50	Arrived Celtic Sea site at Station 30.
	22.52	Commenced Celtic Sea grid, CS1.
16 May	09.11	Completed Celtic Sea grid, CS1.
	12.00	1st feeding experiment started.
	12.53	Vertical profiles at Station 31.
	14.53	Vertical profiles at Station 30.
	17.25	Vertical profiles at Station 25.
	19.25	Vertical profiles at Station 1.
	21.25	Vertical profiles at Station 6.
	22.38	Completed vertical profiling.
17 May	08.27	Live plankton collections.
	11.15	2nd feeding experiment started.
	12.00	1st feeding experiment completed.
	13.26	Live plankton collections.
	18.04	LHPR haul 1.
	18.23	Commenced 13 hour central station, sampling approximately every hour.
	22.47	LHPR haul 2.
18 May	04.41	LHPR haul 3.
	07.02	Completed 13 hour station work.
	09.30	Set course for Milford Haven.
	11.15	2nd feeding experiment completed.
	14.15	Docked Milford Haven.
19 May	15.30	Sailed Milford Haven.
	19.10	On Station 31 of Celtic Sea site, Flygt pumps fitted and secured.
	19.35	Live plankton collections.
	22.41	Ceased operations.
20 May	06.18	Live plankton collections.
	09.20	Started feeding experiment 3.
	13.40	Started experiment to determine development time of *Calanus* eggs.
	18.05	Started feeding experiment 4.
	24.00	Live plankton collections.
21 May	00.00	Live plankton collections.
	01.45	Feeding experiment 5 started.
	08.11	Live plankton collections.
	09.20	Feeding experiment 3 completed.
	10.42	Completed net work.
	11.03	LHPR haul 4.
	13.26	Live plankton collections.
	18.05	Feeding experiment 4 completed.

	23.10	LHPR haul 5.
	23.39	Completed net work.
22 May	01.45	Feeding experiment 5 completed.
	09.05	Vertical profiles at Station 31.
	10.50	" " " Station 1.
	12.59	" " " Station 6.
	14.50	" " " Station 30.
	17.59	" " " Station 25.
	18.33	Completed vertical profiles.
23 May	02.02	Started Celtic Sea grid 2 at Station 1.
	11.56	Completed Celtic Sea grid at Station 30.
	12.30	Horizontal profiling for temperature, salinity, nutrients and chlorophyll.
24 May	00.00	Profiling Flatholm to Avonmouth.
	04.21	Arrived Avonmouth, N. pier.
	09.00	Off Barry awaiting pilot.
	10.20	Docked Barry.

OBJECTIVES

Programme Objectives

1. To compare the rates and processes which control the seasonal development of two species of copepod at two contrasting sites; one a near-shore embayment (Carmarthen Bay), the other, offshore with a seasonally stratified water column (Celtic Sea site).

2. To compare seasonal differences in the rates of nutrient turnover at the two sites with emphasis on sediment-water column interactions at the Carmarthen Bay site.

Cruise Objectives

1. To measure levels of nutrients, chlorophyll, total suspended matter, organic matter and the zooplankton and phytoplankton populations.

2. To characterise the hydrographic conditions at the two sites.

3. To measure the feeding rates and development times of two species of copepods at the two sites.

4. To measure uptake and release of nutrients by micro-organisms.

5. To measure the release of nutrients by zooplankton.

PROCEDURES AND METHODS

As outlined in the Cruise Programme. The grids and station positions were amended to suit the prevailing conditions (Appendix I and II).

EQUIPMENT AND OTHER FAILURES

1. The ship put into Milford Haven for a 24 hr. period to repair damage to the main engine coupling. This break in the cruise programme caused the premature termination of the copepod development work at the Celtic Sea site.

2. Both of IMERs MC 5 salinity, temperature bridges malfunctioned. RVB, on request, sent a replacement unit to Milford.

3. Two water bottle reversing thermometers and holders (Nos. 6099 and 6091) were lost after contact with the ship's side.

RESULTS

The weather condtions allowed a complete sampling programme to be carried out at each sampling site.

Problems were encountered at the Celtic Sea site with the Lowestoft 20" nets clogging with a dense bloom of Phaeocystis in the euphotic zone.

Five LHPR oblique hauls were taken at the Celtic Sea site giving 132 separate samples, although, because of the dense phytoplankton, there will be difficulty in interpreting these samples.

Two grids were completed at each site (Appendix I a, b, c and II a, b, c) and a series of vertical stations worked. (Appendix Id, e and II d, e and g). A series of feeding experiments were carried out at Carmarthen Bay and at the Celtic Sea sites (Appendix If and II h) with Calanus copepodite stages V and adults and small copepods under ambient conditions of temperature and food, using the Coulter Counter and ^{14}C labelled phytoplankton. Growth rate and exudation experiments were successfully carried out on the major copepod species (Appendix I g and II i). The temporal and spatial distributions of dissolved organic carbon, dissolved organic nitrogen, dissolved organic phosphorus, nitrate, nitrite, reactive phosphate, reactive silicate, phytoplankton species, chlorophyll, particle sizes, microseston and net zooplankton, at the Carmarthen Bay and Celtic Sea sites, as well as tracks between the two sites and up the estuary to Avonmouth were investigated.

Four experiments were carried out using the new Multiple Exudation (MULEX) system. The respiration and exudation of organic and inorganic compounds (ammonia, urea, dissolved organic carbon, amino acids, phosphate and nitrate) by Mysids and Calanus were measured as well as oxygen utilization.

One experiment was successfully completed at the Celtic Sea site to measure the exudation of ^{14}C - DOC from Calanus pre-fed on Phaeodactylum.

A new technique for the direct fluorometric assay of "combined" and "free" form of amino acids in seawater was successfully applied to water samples recovered from a selection of vertical profiles in the Carmarthen Bay and Celtic Sea sites. The "combined" amino acids included peptide, polypeptide, protein and amino sugar residues, while the "free" acids included glycine, leucine and alanine. Preliminary results indicate very low

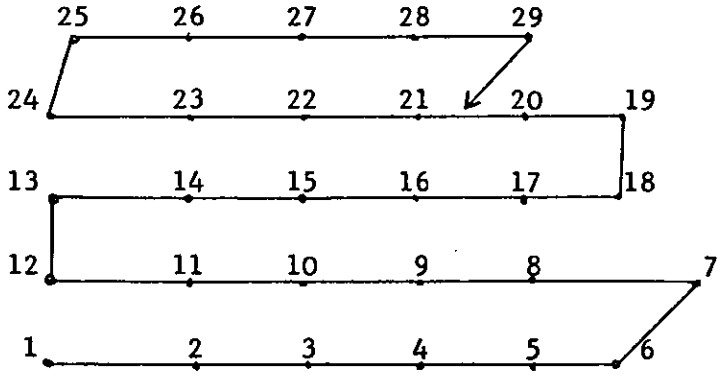
concentrations from 0.1 - 1.0 nanno moles m l^{-1}) of "free" amino acids with slightly greater concentrations of "combined" species. Productive waters supporting the Phaeocystis bloom contained five times the concentration of amino acids than the less productive waters of Carmarthen Bay.

Prepared by: R Williams
Approved by: R S Glover
Date: 1 June 1978

APPENDIX 1a

Carmarthen Bay Site - Cruise Track and Station Positions

9-10 May 1978



Station Positions

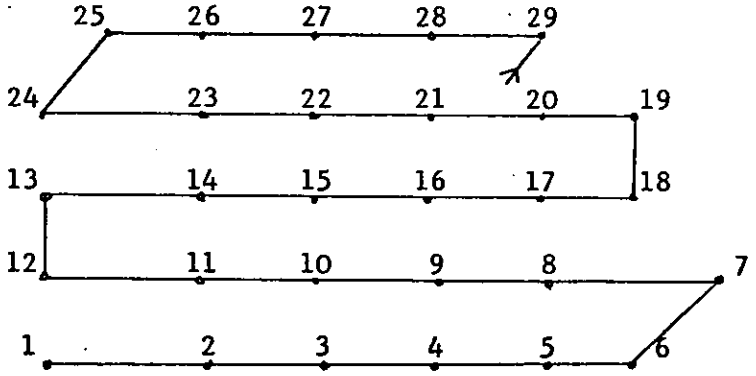
Station	Time (BST)	Decca Positions		Station	Time	Decca Positions	
1	21.28	F42.00	J67.77	15	02.17	F37.13	A52.0
2	21.46	F39.55	J70.50	16	02.42	F34.3	A56.3
3	22.07	F36.90	J73.36	17	03.01	F31.8	A59.3
4	22.38	F33.48	J78.21	18	03.11	F30.35	A61.15
5	23.05	F31.00	A52.41	19	03.33	F31.08	A64.8
6	23.32	E46.45	A55.95	20	03.44	F32.3	A63.04
7	23.50	E47.48	A59.01	21	04.05	F34.8	A59.45
8	00.07	F31.9	A55.6	22	04.33	F38.2	A55.4
9	00.19	F31.92	A52.5	23	04.52	F40.3	A52.27
10	00.41	F37.27	J77.15	24	05.18	F43.2	J79.75
11	00.56	F39.85	J73.8	25	05.35	F42.8	A53.85
12	01.12	F42.5	J71.6	26	05.48	F40.9	A56.5
13	01.36	F42.8	J75.5	27	06.09	F38.55	A59.5
14	01.57	F40.23	J78.8	28	06.26	F35.4	A63.35
				29	06.44	F33.5	A65.9

Nutrients, Chlorophyll, Salinity, Temperature, POC, DOC, microseston, particle size analysis were measured at all stations; DON at alternate stations and selected samples were taken for salinity checks (1/4I-9/4I) and phytoplankton species counts (CB1/1-CB1/27).

APPENDIX Ib

Carmarthen Bay Site - Cruise Track and Station Positions

14-15 May 1978



Station Positions

Station	Time (BST)	Decca Positions		Station	Time	Decca Positions	
29	23.41	F33.06	A66.42	14	04.26	F40.2	J78.3
28	23.59	F35.40	A63.26	13	04.38	F42.78	J75.40
27	00.19	F38.40	A59.0	12	04.59	F42.5	J71.4
26	00.34	F40.65	A55.8	11	05.20	F39.9	J74.6
25	00.46	F42.65	A53.6	10	05.37	F37.4	J77.8
24	01.04	F43.15	J79.1	9	05.59	F34.0	A52.15
23	0.123	F40.5	A52.1	8	06.17	F31.3	A55.7
22	0.140	F38.1	A54.4	7	06.33	E46.8	A59.0
21	02.05	F34.8	A59.4	6	06.52	E46.15	A55.0
20	02.29	F32.35	A62.93	5	07.13	F30.8	A51.4
19	02.43	F31.0	A64.7	4	07.33	F33.4	J78.05
18	03.10	F30.45	A61.2	3	07.59	F36.9	J73.5
17	03.21	F31.75	A59.4	2	08.20	F39.55	J70.41
16	03.42	F34.3	A56.0	1	08.42	F42.30	J67.22
15	04.06	F37.7	A51.7				

Nutrients, Chlorophyll, Salinity, Temperature, POC, DOC, microseston, particle size analysis were measured at all stations; DON at alternate stations and selected samples were taken for salinity checks (1/4I-9/4I) and phytoplankton species counts (CB1/1-CB1/27).

Appendix Ic

Carmarthen Bay Site - 9-10 May 1978 CB1

Lowestoft 20" net

Haul No.	TIME (BST) Shoot	Recovered	Decca Positions Shoot		Recovered	
1	21.31	21.51	F41.51	J68.33	F38.40	J71.73
2	22.07	22.27	F36.90	J73.36	F34.29	J76.82
3	22.55	23.19	F31.84	A51.08	E47.58	A54.40
4	23.27	23.52	E46.80	A55.38	E47.48	A59.01
5	00.03	00.33	F31.39	A56.66	F36.1	J78.9
6	00.48	01.30	F38.0	J75.5	F42.95	J74.55
7	01.45	02.15	F41.7	J76.85	F37.82	A51.85
8	02.29	03.00	F36.1	A54.15	F31.8	A59.3
9	03.10	03.38	F30.45	A61.05	F31.5	A64.27
10	04.24	04.56	F37.3	A56.60	F40.3	A52.27
11	05.20	05.50	F43.3	A50.3	F40.9	A56.5
12	06.09	06.39	F37.9	A60.2	F33.5	A65.9

Carmarthen Bay Site - 14-15 May 1978 CB2

Haul No.	TIME (BST) Shoot	Recovered	Decca Positions Shoot		Recovered	
1	23.41	00.13	F33.20	A66.32	F37.7	A60.1
2	00.26	00.46	F39.38	A57.6	F42.65	A53.6
3	00.56	01.20	F42.8	A51.2	F41.0	A51.5
4	01.30	02.01	F39.7	A53.2	F35.4	A58.75
5	02.11	02.40	F34.35	A60.3	F31.2	A64.2
6	02.52	03.19	F30.8	A63.9	F31.5	A59.8
7	03.31	04.01	F32.9	A57.8	F37.0	A52.9
8	04.13	04.42	F38.73	A50.0	F42.8	J75.0
9	04.48	05.16	F42.77	J73.25	F40.5	J73.85
10	05.23	05.50	F39.55	J75.0	F34.45	A51.5
11	06.03	06.33	F33.5	A52.7	E47.25	A58.4
12	06.39	07.12	E46.6	A58.1	F30.25	A52.0
13	07.19	07.55	F31.5	A50.5	F36.3	J74.3
14	08.05	08.43	F37.80	J72.42	F41.90	J67.37

APPENDIX Id

Carmarthen Bay - Vertical Profiles

RRS JOHN MURRAY (9-24 May 1978) 11 May 1978

Station	CB1	CB5	CB31	CB28	CB26
CAST 1	MC5 (41 m)	MC5 (19 m)	MC5 (25 m)	MC5 (12 m)	MC5 (15 m)
Time start	10.16	14.10	15.06	16.40	17.41
finish	10.20	14.14	15.12	16.43	17.47
Salinity	✓	✓	✓	✓	✓
Salinity bot		18/4I	19/4I	20/4I	21/4I
Temperature	✓	✓	✓	✓	✓
HYDROCAST I	Water botts 6 depths	Water botts 6 depths	Water botts 6 depths	Water botts 6 depths	Water botts 6 depths
Time start	10.36	14.16	15.12	16.45	17.49
finish	10.40	14.20	15.16	16.49	17.52
Coulter Counter	✓	✓	✓	✓	✓
Chloro. a	✓	✓	✓	✓	✓
Phytoplankton	✓	✓	✓	✓	✓
HYDROCAST II	Water botts 6 depths	Water botts 6 depths	Water botts 6 depths	Water botts 6 depths	Water botts 6 depths
Time start	10.45	14.22	15.18	16.50	17.54
finish	10.50	14.28	15.22	16.52	17.57
Nutrients	✓	✓	✓	✓	✓
DOC	✓	✓	✓	✓	✓
POC	✓	✓	✓	✓	✓
Microseston	✓	✓	✓	✓	✓
Salinity	12/4I-17/4I	-	-	-	-
Depths	1,5,10,15, 20 & 40 m	1,3,6,9,12 and 15 m	1,5,9,13,17 and 21 m	1,3,5,7,9 and 11 m	1,3,5,7,9 and 11 m
Sample Codes	CB/1-1 - CM/1-40	CB/5-1 - CB/5-15	CB/31-1 CB/31-21	CB/28-1 - CB/28-11	CB/26-1 - CB/26-11
Position CI	F42.72 J67.26	F30.9 A51.48	F36.05 A53.85	F35.1 A63.20	F42.6 A53.95
HI	F42.80 J67.03	F31.07 A51.48	F35.98 A53.96	F35.1 A63.20	F42.5 A54.3
HII	F42.82 J66.90	F31.23 A51.41	F35.92 A54.13	F34.9 A63.5	F42.4 A54.6

IMER C3/78 Cruise Report

APPENDIX Ie

Anchor Station Carmarthen Bay (CBD21 Depths 1, 5, 10, 15, 20 and 32 m) 51°34.8'N 04°29.9'W

RRS JOHN MURRAY (9-24 May 1978) Sounding 36.5 m 13 May 1978 Time BST

Station No.	Hydrocast 1 MC5 (17 depths)					Hydrocast 2 (6 depths)						Hydrocast 3 (6 depths)						Decca Positions	
	Start	Finish	S°/oo	T°C	Salinity bottle	Start	Finish	C.C	Chl.a	Phyto	Sest	Start	Finish	Nut	DOC	POC	A.Acid	Start	Finish
CBD2 1	09.20	09.26	✓	✓	22/4I	09.26	09.31	✓	✓	✓	✓	09.32	09.37	✓	✓	✓	✓	F35.84 A51.72	F35.85 A51.72
2	10.23	10.25	✓	✓	23/4I	10.25	10.29	✓	✓	✓	✓	10.30	10.35	✓	-	✓	✓	F35.84 A51.70	F35.84 A51.70
3	11.18	11.22	✓	✓	24/4I	11.23	11.27	✓	✓	✓	✓	11.28	11.33	✓	✓	✓	✓	F35.88 A51.65	F35.88 A51.65
4	12.22	12.27	✓	✓	25/4I	12.28	12.33	✓	✓	✓	✓	12.34	12.39	✓	-	✓	✓	F35.88 A51.65	F36.9 A51.65
5	13.17	13.21	✓	✓	26/4I	13.24	13.27	✓	✓	✓	✓	13.27	13.31	✓	✓	✓	✓	F36.92 A51.67	F36.92 A51.67
6	14.18	14.20	✓	✓	27/4I	14.21	14.25	✓	✓	✓	✓	14.25	14.28	✓	-	✓	✓	F36.91 A51.66	F36.92 A51.66
7	15.16	15.21	✓	✓	28/4I	15.22	15.25	✓	✓	✓	✓	15.25	15.30	✓	✓	✓	✓	F36.92 A51.67	F36.9 A51.66
8	16.17	16.21	✓	✓	29/4I	16.23	16.26	✓	✓	✓	✓	16.27	16.31	✓	-	✓	✓	F35.85 A51.70	F35.85 A51.70
9	17.16	17.21	✓	✓	30/4I	17.21	17.25	✓	✓	✓	✓	17.26	17.30	✓	✓	✓	✓	F35.81 A51.80	F35.80 A51.80
10	18.16	18.20	✓	✓	S1	18.20	18.23	✓	✓	✓	✓	18.25	18.29	✓	-	✓	✓	F35.82 A51.78	F35.82 A51.79
11	19.16	19.20	✓	✓	S2	19.20	19.24	✓	✓	✓	✓	19.25	19.28	✓	✓	✓	✓	F35.84 A51.81	F35.84 A51.80
12	20.17	20.20	✓	✓	S3	20.20	20.23	✓	✓	✓	✓	20.24	20.28	✓	-	✓	✓	F35.84 A51.80	F35.84 A51.80
13	21.16	21.19	✓	✓	S4	21.20	21.23	✓	✓	✓	✓	21.23	21.29	✓	✓	✓	✓	F35.81 A51.85	F35.81 A51.85
14	22.14	22.19	✓	✓	S5	22.19	22.24	✓	✓	✓	✓	22.25	22.32	✓	-	✓	✓	F35.86 A51.74	F35.88 A51.79

Salinity bottles taken at 1 m for check of MC5.

APPENDIX 1f

Feeding experiments Times

Carmarthen Bay 5 ✓ = 24 hours after start of experiment

Experiment	Date & Time Started	Date & Time Finished	Initial Seawater Count	Controls				Feeding Bottles								
				1	2	3	4	1	2	3	4	5	6	7	8	9
CBF (1)	10/5/78 18.45	11/5/78 18.45	18.45	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓
CBF (2)	11/5/78 13.30	12/5/78 13.30	13.30	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓
CBF (3)	12/5/78 15.50	13/5/78 15.50	15.50	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓
CBF (4)	12/5/78 21.45	13/5/78 21.45	21.45	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓

Copepods used: Calanus stages C5 and C6, small copepods of mixed species including younger stages of Calanus.

APPENDIX 1g

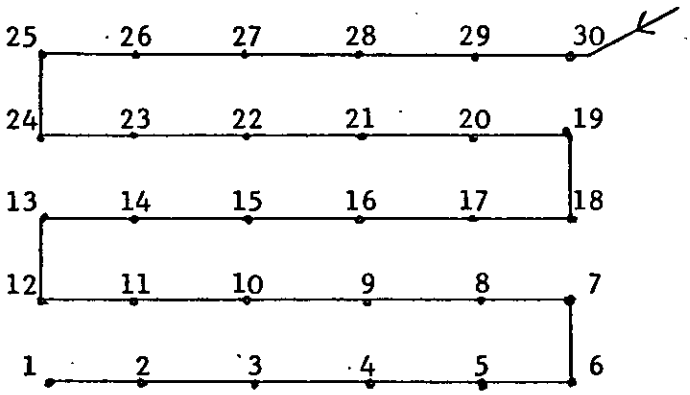
Carmarthen Bay Site

Date	Experiment	Organisms used	Result
10/5/78-14/5/78	Copepod growth rate determination	Calanus helgolandicus Acartia clausi Acartia bifilosa Centropages hamatus Temora longicornis	Moulting rates of copepodites of these species obtained using ca. 100 organisms.
11/5/78	"MULEX" trials	Schistomysis ornata	Successful testing of new apparatus for investigation exudation.
13/5/78	"MULEX" experiments to investigate respiration and exudation of plankton in closed system.	Temora longicornis Calanus helgolandicus	Rates of O_2 uptake and release of DOC, CO_2, PO_4, NO_3^-, NO_2^-, NH_3 and Primary Amines measured.

APPENDIX IIa

Celtic Sea Site - Cruise Track and Station Positions

15-16 May 1978



Station Positions

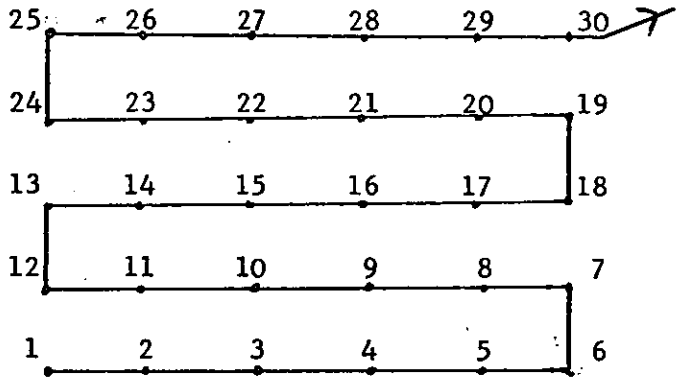
Station	Time (BST)	Decca Positions		Station	Time	Decca Positions	
CS1/30	22.52	I30.85	I52.14	14	04.33	J43.8	H69:0
29	23.11	J33.46	I50.78	13	04.54	J46.4	H68.0
28	23.28	J36.05	H79.33	12	05.19	J47.5	H64.5
27	23.51	J39.40	H77.33	11	05.41	J44.75	H65.75
26	00.13	J42.0	H75.92	10	06.00	J42.25	H67.05
25	00.33	J44.5	H74.72	9	06.26	J38.6	H69.1
24	00.57	J45.5	H71.3	8	06.46	J35.9	H70.3
23	01.15	J42.92	H72.6	7	07.04	J33.25	H71.55
22	01.39	J40.3	H73.98	6	07.24	J34.0	H68.2
21	02.07	J36.8	H75.75	5	07.44	J36.75	H66.75
20	02.27	J34.28	H77.4	4	08.04	J39.50	H65.29
19	02.47	J31.6	H78.75	3	08.34	J43.29	H63.51
18	03.10	J32.45	H75.5	2	08.51	J45.7	H62.25
17	03.28	J35.1	H73.8	1	09.11	A30.44	H60.97
16	03.47	J37.7	H72.4				
15	04.10	J41.1	H70.3				

Nutrients, Chlorophyll, Salinity, Temperature, Microseston, particle size analysis, DOC and POC were measured at all stations and selected samples were taken for salinity checks (S/15-S/18) and phytoplankton species counts (CS1/26-CS1/2).

APPENDIX IIb

Celtic Sea Site - Cruise Track and Station Positions

23 May 1978



Station Positions

Station	Time (BST)	Decca Positions		Station	Time	Decca Positions	
CS2/1	02.02	A30.4	H61.0	16	07.23	J37.7	H72.55
2	02.24	J45.7	H62.25	17	07.41	J35.0	H74.1
3	02.43	J43.2	H63.5	18	08.01	J32.3	H75.3
4	03.10	J39.5	H63.45	19	08.19	J31.68	H78.83
5	03.29	J36.8	H66.8	20	08.35	J34.25	H77.36
6	03.46	J34.0	H68.0	21	08.51	J36.85	H75.81
7	04.18	J33.28	H71.57	22	09.12	J40.29	H73.93
8	04.40	J36.0	H70.28	23	09.29	J42.90	H72.56
9	04.56	J38.2	H68.8	24	09.45	J45.46	H71.22
10	05.28	J42.30	H67.23	25	10.03	J44.55	H74.55
11	05.45	J44.8	H65.70	26	10.24	J.42.00	H76.02
12	06.07	J47.5	H64.43	27	10.47	J39.39	H77.27
13	06.24	J46.45	H68.0	28	11.16	J36.00	H79.30
14	06.42	J43.8	H69.4	29	11.35	J33.40	I50.88
15	06.59	J41.3	H70.6	30	11.56	J30.80	I52.26

Nutrients, Chlorophyll, Salinity, Temperature, particle size analysis were measured at all stations and microseston and POC at alternate stations. Selected samples were taken for phytoplankton species counts (30/18-40/18, 2/26-8/26) and salinity checks (A/20-A/23).

APPENDIX IIc

Celtic Sea Site - 15/16 May 1978 CS1

Lowestoft 20" net

Haul No.	TIME (BST)		Decca Positions			
	Shoot	Recovered	Shoot		Recovered	
1	23.00	23.35	J32.06	I51.36	J36.48	H79.02
2	23.40	00.16	J37.69	H78.30	J42.3	H75.83
3	00.26	01.00	J43.4	H75.4	J45.45	H71.3
4	01.00	01.33	J43.7	H72.1	J41.35	H73.65
5	01.40	02.08	J40.18	H74.0	J36.75	H75.8
6	02.20	02.41	J35.03	H76.8	J32.05	H78.35
7	03.12	03.42	J32.78	H75.3	J36.3	H73.22
8	04.18	04.43	J42.08	H69.6	J45.08	H68.78
9	05.00	05.24	J46.77	H67.22	J46.9	H64.8
10	05.39	05.59	J45.0	H65.7	J42.35	H66.90
11	06.14	06.32	J40.3	H68.1	J37.75	H69.60
12	06.45	07.04	J35.9	H70.3	J33.23	H71.55
13	07.26	07.52	J34.25	H68.0	J37.9	H66.13
14	08.06	08.32	J39.64	H65.24	J43.00	H63.64

Celtic Sea Site - 23 May 1978 CS2

Haul No.	Time (BST)		Decca Positions			
	Shoot	Recovered	Shoot		Recovered	
1	02.08	02.41	J47.93	H61.22	J43.5	H63.3
2	02.51	03.28	J42.18	H64.07	J37.13	H66.7
3	03.46	04.08	J34.23	H67.9	J33.5	H70.6
4	04.21	04.54	J33.60	H71.35	J38.2	H68.8
5	05.12	05.44	J40.20	H68.0	J44.6	H65.82
6	05.59	06.19	J46.53	H64.57	J46.93	H67.10
7	06.32	06.52	J45.35	H68.65	J42.45	H70.15
8	07.07	07.34	J39.9	H71.3	J36.0	H73.65
9	07.46	08.18	J34.5	H74.3	J31.80	H78.18
10	08.22	08.42	J32.09	H78.74	J35.52	H76.61
11	08.52	09.27	J37.21	H75.52	J41.34	H73.40
12	09.30	09.58	J43.41	H72.20	J45.16	H72.44
13	10.04	10.30	J44.42	H74.68	J41.26	H76.36
14	10.48	11.28	J39.43	H77.51	J35.69	H79.46

APPENDIX IId

Celtic Sea - Vertical Profiles

RRS JOHN MURRAY (9-24 May 1978) 16 May 1978

Station	CS31	CS30	CS25	CS1	C36
CAST 1	MC5 (44 m)	MC5 (64 m)	MC5 (95 m)	MC5 (93 m)	
Time start	12.58	14.35	17.32	19.26	
finish	13.05	14.52	17.44	19.44	-
Salinity	✓	✓	✓	-	
(1 m) Salinity bott	S8	S19	S20	S21	S22
Temperature	✓	✓	✓	✓	
HYDROCAST I	Water bott 5 depths	Water bott 5 depths	Water bott 5 depths	Water bott 5 depths	Water bott 5 depths
Time start	13.13	14.53	17.46	19.45	21.43
finish	13.16	14.57	17.48	19.52	21.47
Coulter Counter	✓	✓	✓	✓	✓
Chloro. a	✓	✓	✓	✓	✓
Phytoplankton	✓	✓	✓	✓	✓
Microseston	✓	✓	✓	✓	✓
HYDROCAST II	Water bott 5 depths	Water bott 5 depths	Water bott 5 depths	Water bott 5 depths	Water bott 5 depths
Time start	13.17	14 15.59	17.48	19.52	21.50
finish	13.22	15 16.03	17.52	19.56	21.58
Nutrients	✓	✓	✓	✓	✓
DOC	✓	✓	✓	✓	✓
DON	✓	✓	✓	✓	✓
POC	✓	✓	✓	✓	✓
St. Amines	✓	✓	✓	✓	✓
HYDROCAST III	Water bott 4 depths	Water bott 4 depths	Water bott 4 depths	Water bott 4 depths	Water bott 4 depths
Time start	13.35	15.15	18.01	20.03	22.14
finish	13.38	15.19	18.06	20.07	20.20
Coulter Counter	✓	✓	✓	✓	✓
Chloro. a	✓	✓	✓	✓	✓
Phytoplankton	✓	✓	✓	✓	✓
Microseston	✓	✓	✓	✓	✓
HYDROCAST IV	Water bott 4 depths	Water bott 4 depths	Water bott 4 depths	Water bott 4 depths	Water bott 4 depths
Time start	13.45	15.20	18.14	20.10	22.27
finish	13.48	15.29	18.23	20.20	22.39
Nutrients	✓	✓	✓	✓	✓
DOC	✓	✓	✓	✓	✓
DON	✓	✓	✓	✓	✓
POC	✓	✓	✓	✓	✓
Amines	✓	✓	✓	✓	✓
HYDROCAST IV Temperature	-	Thermometers 4 depths	Thermometers 4 depths	Thermometers 4 depths	Thermometers 4 depths
Sample Codes	CS/31-1 - CS/31-91	CS/30-1 - CS/30-91	CS/25-1 - CS/25-102	CS/1-1 - CS/1-98	CS/6-1 - CS/6-82
Positions CI	J39.5 H71.42	J30.8 I52.28	J44.5 H74.45	A30.46 H61.20	-
HI	J39.55H71.55	J30.6 I52.77	J44.35H74.65	A30.55 H61.05	J34.34 H67.77
HII	J39.65H71.48	J30.63I52.8	J44.38H74.60	A30.55 H61.00	J34.47 H67.41
HIII	J39.65H71.72	J30.63I53.15	J44.45H74.60	A30.73 H60.85	J34.61 H67.28
HIV	J39.62H71.8	J30.16I53.33	J44.35H74.73	A30.81 H60.87	J34.47 H67.49

APPENDIX IIe

Celtic Sea Site - Longhurst Hardy Plankton Recorder Hauls, RRS JOHN MURRAY, 9-24 May 1978

Haul No.	Date	Time (BST)	Shooting Position	Hauling Position	Number of Samples	Maximum Depth (m)
LHPR 1	17/5/78	18.04	J39.23 H71.55	J39.23 H71.55	17	85
2	17/5/78	22.47	J39.45 H70.62	J39.42 H72.06	26	64
3	18/5/78	04.41	J39.45 H71.66	J39.85 H70.90	29	91
4	21/5/78	11.03	J38.98 H67.57	J39.69 H64.20	38	81
5	21/5/78	23.15	J38.27 H70.53	J37.94 H69.12	22	80

IMER C3/78 Cruise Report

APPENDIX IIf

Celtic Sea Central Station CSDZ1-11 17-18 May 1978

Station No.	Time Start	Time Finish	C.C	Chl.a	Phyto	Micro Sest	Time Start	Time Finish	Nut	DOC	POC	S°/oo	T°C	Time Start	Time Finish	C.C	Chl.a	Phyto	Micro Sest	Time Start	Time Finish	DOC	Nut	POC	T°C	S°/oo	Start	Finish
CSDZ 1	18.38	18.45	✓	✓	✓	✓	18.48	18.58	✓	✓	✓	✓	✓	19.13	19.18	✓	✓	-	✓	19.20	19.31	✓	✓	✓	✓	✓	J39.5 H71.8	J39.9OH72.10
2	19.44	19.49	✓	✓	✓	✓	19.50	19.58	✓	✓	✓	✓	✓	20.11	20.18	✓	✓	-	✓	20.21	20.30	✓	✓	✓	✓	✓	J39.5OH71.50	J40.29H71.31
3	21.04	21.08	✓	✓	✓	✓	21.10	21.13	✓	X	✓	✓	-	21.25	21.30	✓	✓	-	✓	21.34	21.43	X	✓	✓	✓	✓	J39.48H71.48	J39.55H70.96
4	21.57	21.01	✓	✓	✓	✓	22.04	22.13	✓	✓	✓	✓	✓	22.27	22.32	✓	✓	-	✓	22.33	22.43	✓	✓	✓	✓	✓	J39.52H71.48	J39.3OH70.56
5	23.28	23.33	✓	✓	✓	✓	23.34	23.42	✓	✓	✓	✓	✓	23.57	00.02	✓	✓	-	✓	00.04	00.13	✓	✓	✓	✓	✓	J39.6OH71.42	J39.57H71.75
6	00.25	00.32	✓	✓	✓	✓	00.33	00.41	✓	X	✓	✓	✓	00.54	00.58	✓	✓	-	✓	01.00	01.12	X	✓	✓	✓	✓	J39.45H71.25	J39.98H71.45
7	01.23	01.27	✓	✓	✓	✓	01.30	01.38	✓	✓	✓	✓	✓	01.50	01.58	✓	✓	-	✓	02.03	02.15	✓	✓	✓	✓	✓	J39.63H71.5	J39.93H72.24
8	02.28	02.34	✓	✓	✓	✓	02.35	02.45	✓	✓	✓	✓	✓	02.58	03.02	✓	✓	-	✓	03.03	03.14	✓	✓	✓	✓	✓	J39.4 H71.64	J39.35H72.48
9	03.30	03.36	✓	✓	✓	✓	03.38	03.48	✓	X	✓	✓	✓	04.04	04.08	✓	✓	-	✓	04.09	04.19	X	✓	✓	✓	✓	J39.35H71.41	J38.8OH73.10
10	05.17	05.22	✓	✓	✓	✓	05.23	05.31	✓	✓	✓	✓	✓	05.45	05.50	✓	✓	-	✓	05.52	06.01	✓	✓	✓	✓	✓	J39.47H71.51	J39.2OH72.50
11	06.18	06.22	✓	✓	✓	✓	06.26	06.35	✓	✓	✓	✓	✓	06.46	06.50	✓	✓	-	✓	06.51	07.03	✓	✓	✓	✓	✓	J39.45H71.55	J39.47H72.02
	Depths 1, 5, 10, 15 and 20 m						Depths 1, 5, 10, 15 and 20 m							Depths 25, 40, 60 and 93 m						Depths 25, 40, 60 and 93 m							

APPENDIX IIg

Celtic Sea - Vertical Profiles

RRS JOHN MURRAY (9-24 May 1978) 22 May 1978

Station	CS2/31	CS2/1	CS2/6	CS2/30	CS2/25
CAST 1	MC5 (22 m)	MC5 (25 m)	MC5 (25 m)	MC5 (25 m)	MC5 (25 m)
Time start	09.05	10.50	12.59	14.50	17.59
finish	09.21	10.56	13.07	15.02	18.02
Salinity	✓	✓	✓	✓	✓
(1 m) Salinity bott	30 1I	A4	A8	A12	A16
Temperature	✓	✓	✓	✓	✓
HYDROCAST I	Water bott 5 depths	Water bott 5 depths	Water bott 5 depths	Water bott 5 depths	Water bott 5 depths
Time start	09.22	10.56	13.09	15.02	18.04
finish	09.25	10.59	13.12	15.04	18.07
Coulter Counter	✓	✓	✓	✓	✓
Chlorophyll a	✓	✓	✓	✓	✓
Phytoplankton	✓	✓	✓	✓	✓
Microseston	5 m	5 m	5 m	5 m	5 m
HYDROCAST II	Water bott 5 depths	Water bott 5 depths	Water bott 5 depths	Water bott 5 depths	Water bott 5 depths
Time start	09.26	11.04	13.14	15.05	18.07
finish	09.32	11.07	13.17	15.08	18.11
POC	✓	✓	✓	✓	✓
Nutrients	✓	✓	✓	✓	✓
HYDROCAST III	Water bott 4 depths	Water bott 4 depths	Water bott 4 depths	Water bott 4 depths	Water bott 4 depths
Time start	09.40	11.16	13.26	15.17	18.18
finish	09.45	11.20	13.30	15.23	18.24
Coulter Counter	✓	✓	✓	✓	✓
Chlorophyll a	✓	✓	✓	✓	✓
Phytoplankton	✓	✓	✓	✓	✓
POC	✓	✓	✓	✓	-
HYDROCAST IV	Water bott 4 depths	Water bott 4 depths	Water bott 4 depths	Water bott 4 depths	Water bott 4 depths
Time start	09.48	11.23	13.32	15.25	18.24
finish	09.58	11.32	13.41	15.34	18.33
Nutrients	✓	✓	✓	✓	✓
Salinity	✓	✓	✓	✓	✓
Temperature	✓	✓	✓	✓	✓
Sample Codes	CS2/31-1 -CS2/31-93	CS2/11-1 CS2/1-93	CS2/6-1 CS2/6-82	CS2/30-1 CS2/30-90	CS2/25-1 CS2/25-102

Positions CI	J32.40 H71.65	A30.61 H60.76	J34.2 H68.23	J31.05 I52.32	J44.40 H64.50	
HI	J39.47 H71.72	A30.86 H60.51	J34.4 H67.8	J31.01 I51.95	J44.30 H74.50	
HII	J39.50 H71.80	A31.01 H60.32	J34.5 H67.7	J31.01 I51.83	J44.27 H74.51	
HIII	J39.70 H71.88	A31.28 H60.02	J34.73 H67.28	J30.88 I51.43	J44.18 H74.65	
HIV	J39.80 H71.90	A31.43 H59.80	J34.79 H67.02	J30.8 I51.2	J44.05 H74.80	

IMER C3/78 Cruise Report RRS JOHN MURRAY

APPENDIX IIh

Feeding Experiments Times

Celtic Sea ✓ = 24 hours after start of experiment

Experiment	Date & Time Started	Date & Time Finished	Initial Seawater Count	Controls				Feeding Bottles											
				1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12
CSF (1)	16/5/78 12.00	17/5/78 12.00	16/5/78 12.00	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	-
CSF (2)	17/5/78 11.15	18/5/78 11.15	17/5/78 11.15	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-
CSF (3)	20/5/78 09.20	21/5/78 09.20	20/5/78 09.20	11.20	15.20	21.20	09.20	11.20	11.20	11.20	15.20	15.20	15.20	21.20	21.20	21.20	09.20	09.20	09.20
CSF (4)	20/5/78 18.05	21/5/78 18.05	20/5/78 18.05	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	-
CSF (5)	21/5/78 01.45	22/5/78 01.45	21/5/78 01.45	03.45	07.45	13.45	01.45	03.45	03.45	03.45	07.45	07.45	07.45	13.45	13.45	13.45	01.45	01.45	01.45

Copepods used: Calanus helgolandicus stages C5 and C6

Egg laying and development times of Calanus eggs: 20 May 1978 Started 13.40 17 development pots
23 May 1978 Finished 15.00

IMER C3/78 Cruise Report

APPENDIX IIi

Celtic Sea Site

Date	Experiment	Organisms used	Result
17/5/78-23/5/78	Copepod growth rate determination	Calanus helgolandicus Acartia clausi Temora longicornis	Moulting rates obtained for most copepodite stages of these species.
21/5/78 23/5/78	Feeding experiments using labelled phytoplankton.	Calanus ♀♀ Calanus V	Samples to be Liquid Scintillation counted at Plymouth.
22/5/78	Measurement of release rate of incorporated ^{14}C from copepods fed with labelled Phaeodactylum culture.	Calanus ♀♀	Samples frozen and taken to Plymouth for Liquid Scintillation counting.
22/5/78	Feeding time and food preference of copepods.	All species present	Animals frozen and taken to Plymouth for Gut Content Analysis.

CIRCULATION LIST - BRISTOL CHANNEL

Internal

Glover
Hamilton
Robinson
Fay
File
Notice Board - (Brown)

External

NERC

Foxton
Director STS - NERC-London

IOS

Mrs Edwards (BODS)
Cartwright (Bidston)
Charnock (Wormley)
Tucker (Taunton)

IGS

Moore

MBA

Denton

SMBA

Currie

MAFF

Lee
Cushing
Wood

DAFS

Parrish

RVB

Stobie - (2)

DOE

Graham, London

WRC

Eden, Stevenage

Welsh Office

Naylor Firth - (4)

ICI

Pearson

BRISTOL UNIVERSITY

Dineley
Eglinton

UNIVERSITY COLLEGE CARDIFF

Bellamy
Hammond

UWIST CARDIFF

Davies

UNIVERSITY COLLEGE SWANSEA

Knight-Jones (3)

IMPERIAL COLLEGE OF SCIENCE & TECHNOLOGY

Webb

UNIVERSITY OF LIVERPOOL

Abdullah

WATER AUTHORITY

Welsh National
Severn-Trent
Wessex
South West