

NATURAL ENVIRONMENT RESEARCH COUNCIL  
INSTITUTE FOR MARINE ENVIRONMENTAL RESEARCH

CRUISE REPORT  
IMER C4/84  
RVS REF FR 22/83

VESSEL RRS FREDRICK RUSSELL

CRUISE PERIOD 7 - 15 December 1983

PERSONNEL  
R WILLIAMS  
N J P OWENS  
D V P CONWAY  
D B ROBINS  
N R COLLINS  
E M WOODWARD  
A POMROY  
C M HOYLE (Ms)

ITINERARY

Tuesday 6 December	Loaded equipment
Wednesday 7 December	Departed Plymouth. Set course for CS4. (See chart).
8 December	0830 Arrive CS4. 0945 RMT 1 haul 1. 1045 Water bottle cast. 1200 LHPR haul 1. 1320 Water bottle cast. 1500 RMT 1 haul 2. 1700 Water bottle cast. 1900 RMT 1 haul 3. 2000 Stopped work due to weather deteriorating. Hove to.
9 December	
10 December	0830 Water bottle cast. 0915 LHPR haul 2. 1200 Water bottle cast. 1312 LHPR haul 3. 1539 RMT 1 haul 4. 1629 RMT 1 haul 5. 1962 RMT 1 haul 6. 1956 RMT 1 haul 7. 2117 RMT 1 haul 8. 2305 LHPR haul 4.
11 December	0125 Completed overside operations, set course back to CS4. 0647 Water bottle cast. 0945 Station work abandoned due to deteriorating weather, set course for CS2. 1318 Hove to, bad weather.
12 December	0330 Weather marginally improved. Set course for Scillies.
13 December	0600 Arrived off Falmouth. 0815 Docked Falmouth.
14 December	1300 Terminated cruise.
15 December	1300 Unloaded equipment and returned to Plymouth.

OBJECTIVES

1) To determine the presence or absence of a diapause condition in the two congeneric species of copepod (Calanus helgolandicus and C. finmarchicus) from the shelf area and open ocean during winter.

a) To compare the vertical distribution and stage composition of the overwintering Calanus spp. in the shallow shelf-sea (100m) with those in the deep water (2000m) at the shelf-edge.

- b) To collect live material to determine whether or not the Calanus from the shelf are in a different chemical and physiological state from those of the deep ocean.
  - c) To obtain living material for length (dry weight, gut content, carbon, nitrogen, ash, lipid and protein contents).
  - d) To measure the assimilation rate and absorption efficiency by Calanus using radioactive tracer and gut enzyme analysis techniques.
- 2) a. To measure in situ and on deck primary production and to partition production into different size classes of phytoplankton.
- b. To measure the abundance and vertical distribution of phytoplankton, bacteria and flagellates.
- c. To measure bacterial production throughout the water column.
- 3) To investigate size-related re-mineralization of  $\text{NH}_4^+$  in relation to measurements of trace concentrations of  $\text{NH}_4^+$ .
- 4) a. To investigate the variations in the natural abundance of  $^{15}\text{N}$  in suspended particulate matter at CS2 and CS4 sites.
- b. To investigate the variation in the natural abundance of  $^{15}\text{N}$  in operationally defined trophic levels.
- 5) To investigate the biotic conditions (chlorophyll, particulate carbon, organic matter particle size) and hydrography at each of the stations.

#### PROCEDURES AND METHODS

- 1a. Day and night oblique profiles will be obtained at CS2 and CS4 using the Double Lowestoft Longhurst sampling system fitted with 53 $\mu\text{m}$  and 280 $\mu\text{m}$  mesh nets for sampling two size fractions of the zooplankton.
- 1b. Live Calanus will be collected, using a N10 RMT 1 net with acoustic release gear, for experiments and freezing.
- 1c. Experiments will be carried out using the plankton wheels and samples will be taken from the incubation bottles over a time series for  $\text{NH}_3$  and  $\text{PO}_4$  excretion and respiration ( $\text{O}_2$  analyses).
- 1d. Feeding experiments will be carried out with Calanus using radioactive  $^{14}\text{C}$  labelled diatom cultures. Samples will be preserved for analyses back at IMER.
- 2a. At CS2 and CS4 the in situ  $^{14}\text{C}$  incubation rig will be deployed at dawn and recovered at dusk; on deck incubations will be carried out in parallel.
- 2b. Water bottles casts, 9 depths at dawn each day on station.
- 2c. Bacterial production will be measured each day with H-thymidine uptake techniques.
3. Size related remineralization experiments will be carried out using isotope dilution techniques in association with measurements of trace  $\text{NH}_4^+$  concentrations.

4a. The  $^{15}\text{N}$  transect will involve collecting surface water samples for filtration (non-toxic supply adequate) at intervals between CS2 and CS4.

4b. The investigation of  $^{15}\text{N}$  in various trophic levels will involve the collection of surface water samples for size fractionation of the particulate material and subsequent filtration. Zooplankton will be collected with  $\frac{1}{2}\text{m}$  nets deployed in the surface layers and RMT 1 for sampling at depth at CS2 and CS4.

5. Profiling with large water bottles for water samples at CS4 and CS2.

#### EQUIPMENT AND OPERATIONAL PROCESSES

Bad weather conditions prevented the comparative study taking place between the shelf and the open ocean sites (CS2 and CS4). Work was only carried out at the deep water station (CS4). After docking in Falmouth (13 Dec) the cruise was eventually terminated on the 14 Dec due to prevailing and forecast weather conditions.

Heavy sea conditions were responsible for damage and loss of RVS equipment. The PES III fish was lost when the cable parted (see separate loss report). The cable of the fish taken off the ship in Plymouth had been severely jammed between the cheeks of the block during transfer. Although the cable did not part at the block it is a fault which has occurred before. The MUFAX recorder was damaged when the mountings and pallet broke away from the bench tracks. This is a RVS installed piece of equipment which is secured prior to sailing. Two NIO water bottles were washed out of their racks and were lost overboard. The sea-state which prevailed throughout the cruise made experimental work very difficult.

The acoustic opening and closing system of the RMT1 only worked in 3 out of the 8 hauls. The faults were in the acoustic monitors - see separate IMER report. One of the four LHPR hauls was discarded because of poor transport of the filtering gauze in the cod-end system.

#### RESULTS

A thermocline of  $1^{\circ}\text{C}$  was observed at station CS4 ( $10^{\circ} 30'\text{W}$ ) at a depth of 80m which progressively deepened to 110m by the time we reached  $12^{\circ} 00'\text{W}$ . Temperature above the thermocline was  $13.0$  to  $13.3^{\circ}\text{C}$  while below the thermocline the temperature decreased from  $12^{\circ}\text{C}$  to  $10.5^{\circ}\text{C}$  at 500m. The surface chlorophyll a values were  $0.3$ – $0.4 \text{ mg Chla m}^{-3}$  which are typical winter values for this region. Nitrite values were similar down the profile (0–800m) while nitrate values increased fourfold below the thermocline (80–110m); phosphate and silicate values below the thermocline were twice those above.

Two vertical profiles were taken (nine depths from 1 to 800m) and samples collected for salinity, nutrients, chlorophyll a, bacteria, microflagellates, phytoplankton, particulate sizes and particulate carbon determinations.

No significant production by heterotrophic bacteria was measured in the two  $^3\text{H}$  thymidine experiments (nine depths, 1 to 300m). Two  $^{14}\text{C}$  on deck incubation experiments were completed at 5 simulated light levels. Preliminary estimates of primary production are 18%, 68% and 14% in the particulate size fractions  $>5\mu\text{m}$ ,  $5$ – $1\mu\text{m}$  and  $1$ – $0.2\mu\text{m}$  respectively. Extracts from the size fractionated chlorophyll a samples gave similar results.

Three LHPR hauls were successful (Table 1), haul 1 was frozen for chemical and biological analysis and haul 3 and 4 were preserved in formalin. A total of 97 samples were collected.

The RMT 1 was used to sample the deep overwintering population of Calanus. It was only after a number of hauls that their depth of maximum abundance was established and the final haul gave an excellent catch of stage V copepodites in good condition. Stage V copepodites were sorted and used in a time-course excretion experiment (0, 6, 12, 18, 24 and 42 hours). Nitrate, Nitrite, silicate, phosphate and ammonia levels were measured. Only barely detectable levels of ammonia were released by the copepods over the duration of the experiment. Samples were stored from the experiment for determination of oxygen.

100 Calanus stage V copepodites were measured, dried and stored for subsequent determination of carbon and nitrogen contents.

Prepared by: R. Williams

Approved by:

Date:

B. L. Bayne  
10 Jan. 1964.

Circulation:

Internal:

B L Bayne  
G A Robinson  
F Mantoura  
All Cruise Personnel  
Notice Board  
File

External:

NERC Foxton (Swindon)  
RVS Skinner (Barry)  
IOS M Angel  
Mrs Edwards (MIAS)  
MBA Denton  
DAFS McIntyre  
MAFF Harden-Jones

Table 1

a) Rectangular mid-water trawl (RMT 1) hauls

<u>Haul No</u>	<u>Date</u>	<u>Time GMT</u>	<u>Position</u>		<u>Depth of trawling</u>	<u>Status</u>
			<u>Lat. N</u>	<u>Long W</u>		
1	8 December	0946	48° 20'	10° 27'	690-600	good open and close
2	"	1459	48° 15'	10° 37'	518-518	"
3	"	1903	48° 13'	10° 41'	620	failed to open
4	10 December	1539	48° 57'	12° 00'	200-200	good open and close
5	"	1629	48° 58'	12° 00'	700	failed to open
6	"	1902	49° 01'	12° 00'	650	failed to open
7	"	1956	49° 02'	11° 59'	750-0	shot open failed to close
8	"	2117	49° 03'	12° 00'	750-0	shot open failed to close

b) Water-bottle cast (7.1 litre bottles)

<u>No</u>	<u>Date</u>	<u>Time GMT</u>	<u>Position</u>		<u>Depth of Bottles</u>
			<u>Lat. N</u>	<u>Long W</u>	
1	8 December	1046	48° 18'	10° 29'	⊗ 1,10,25,50,100,150,200,250 & 300m
2	"	1320	48° 15'	10° 35'	1,20,40,70,100,200,400,600 & 800m
3	"	1657	48° 14'	10° 39'	⊗ 1,10,25,50,100,150,200,250 & 300m
4	10 December	0831	48° 41'	11° 51'	* 1,2,5,7,10,15,20,25 & 30m
5	"	1200	48° 49'	11° 55'	1,20,40,70,100,200,400,600 & 800m
6	"	1809	49° 00'	12° 01'	10m
7	11 December	0647	48° 36'	11° 21'	* 1,2,5,7,10,15,20,25 and 30m

\* Samples for <sup>14</sup>C experiments, ⊗ Samples for <sup>3</sup>H thymidine experiments

c) Longhurst Hardy Plankton Recorder (LHPR) hauls

<u>No</u>	<u>Date</u>	<u>Time (GMT)</u>		<u>Position (Start)</u>		<u>Max. Depth</u>	<u>Samples/ haul</u>
		<u>Start</u>	<u>Finish</u>	<u>Lat. N</u>	<u>Long W</u>		
1	8 December	1200	1307	48° 18'	10° 31'	900	25
2	10 December	0923	1120	48° 42'	11° 51'	815	Discarded
3	"	1312	1455	48° 50'	11° 56'	750	35
4	"	2305	0125	49° 01'	12° 00'	582	37

RAS Fredrick Russell

7 - 13 December 1983

INER C4/83

FR 22/53

