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BIOLOGICAL OCENAOGRAPHY CRUISE : LF1795

(August 7-18 1995)

Personnel

R. Gowen (SIC),	SSO	DANI
P. Elliott	SO	DANI
S. Bloomfield	ASO	DANI
D. Mills	HSO	MAFF
J. Morrison		Postgraduate student UCNW
C. Burkart		Postgraduate student Nova University, Florida USA

Cruise Objectives

1. To undertake a preliminary investigation of microplankton community structure and dynamics in the western Irish Sea.

2. To service the particle trap and current meter mooring at station 38.

3. To determine rates of copepod egg production and viability (see annex I).

4. To make sub-surface optical measurements (see annex II).

Cruise narrative

1. General

R.V. Lough Foyle departed Belfast at 1930 h on Monday August 7 and sailed overnight to station 38 (see Figure 1). During the cruise three stations (38, 41 and 47) were worked and experimental work was repeated at station 38. Lough Foyle returned to Belfast on Friday August 11 to off-load mooring gear and for a mid-cruise break. The ship departed Belfast for the second leg of the cruise at 1800 h on Saturday, August 12 and the cruise was completed on Friday August 18 when Lough Foyle docked in Belfast at 0800 h.

2. Experimental work carried out at each station

The following timetable of sampling and experimental work was followed:

0400 : collection of water (from the fluorescence maximum or the upper 10 m of the water column) and set up of size fractionated (unfiltered, <20μm, <5μm and <2μm) phytoplankton photosynthesis and microplankton respiration incubations using a micro-Winkler technique. For photosynthesis, samples were incubated in a temperature controlled light gradient incubator. Twelve hour incubations were carried out.

0530 : collection of water for microplankton grazing experiments using a serial dilution method.

0600 : collection of copepods for egg production and viability (stations 38 and 47 only) and copepod grazing experiments.

1000 : collection of water for ^{14}C simulated *in situ* phytoplankton production incubations.

1100 : collection of water from selected depths for ^{14}C *in situ* phytoplankton production incubations. During these incubations a natural fluorometer was deployed over the side of the ship.

During each day, vertical profiles of temperature, conductivity, *in vivo* fluorescence and sub-surface PAR were recorded and water samples were collected from selected depths for the estimation of phytoplankton chlorophyll and dissolved inorganic nutrients (phosphate, nitrate, silicate and ammonia). Each day of experiments was followed by a day of sample and data analysis.

Summary of Results

The particle trap and current meter mooring at station 38 was serviced on August 9.

As expected, the water column at station 38 was thermally stratified with a surface to bottom temperature difference of ≈ 5.7 °C. Thermal stratification was also observed at the shallow coastal station 47. In previous years the water column at station 47 has remained vertically mixed during the summer, and stratification in August 1995 is attributed to the unusually warm, calm weather. The water column at station 41 was isothermal and cooler (≈ 14.5 °C) than surface waters at the other two stations.

The vertical distribution of dissolved inorganic nutrients and phytoplankton biomass (measured as chlorophyll) reflected the vertical structure of the water column. Thus, at station 38, there was evidence of surface depletion of nutrients. For example, in near surface waters, concentrations of nitrate ranging from 0.7 - 1.4 mmol m^{-3}, compared to concentrations of 5.8 - 7.5 mmol m^{-3} in water below 65 m. There was less evidence of near-surface depletion of nitrate at station 47. At station 41, nitrate was uniformly distributed throughout the water column and the concentration in near surface waters (≈ 2.5 mmol m^{-3}) was higher than at the other two stations.

Maximum concentrations of chlorophyll at stations 38 and 47 were similar (3.8 mg m^{-3}) and higher than the maximum concentration (2.4 mg m^{-3}) at station 41. The vertical distribution of chlorophyll exhibited a pronounced sub-surface maximum at station 38, with the peak associated with the thermocline. There was no obvious sub-surface maximum at station 47 and at station 41, chlorophyll was uniformly distributed throughout the water column.

All of the samples from the productivity experiments have been processed and initial work up of the data has been carried out. Examples are shown in Figures 2 and 3. Figure 2 (A) shows a plot of photosynthesis versus irradiance for one of the ^{14}C *in situ* incubations and Figure 2B shows a vertical profile of photosynthesis. From the latter, daily production can be estimated as 454.1 mg C m^{-2}. Figure 3 shows photosynthesis (derived from the micro-Winkler method) versus irradiance plots for the < 5.0μm size fraction of the microplankton population at stations 38 and 41.

Problems encountered

The cruise took place during a period of fine, calm weather. No serious problems were encountered and all of the planned work was completed satisfactorily. Four of the rosette, sample bottle firing mechanisms failed and on several occasions this made it necessary to do a repeat deployment of the rosette to collect the required number of water samples.

Acknowledgements

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R.J. Gowen

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ANNEX I

C. Burkart, Nova University, Florida USA

Microplankton and copepod grazing

Water was collected from the upper mixed layer by rosette or Niskin bottle. Water for microplankton grazing was pre-screened through a 202 µm mesh net to remove large zooplankton and mixed with GF/F filtered seawater (obtained from the ships clean seawater supply) to make up dilutions of 100%, 75%, 50% and 33% unfiltered seawater. Dilutions were mixed in 10 l containers and then dispensed into three, 1 l bottles for incubation. Incubations were conducted for 24 h at ambient (4 m) seawater temperature and a near ambient light/dark cycle. Three initial samples of each dilution were retained for chlorophyll estimation. Triplicate samples were also taken from the unfiltered sample and fixed with lugol's iodine for microscopic analysis. At the end of the incubation period, the chlorophyll concentration in each of the incubated samples was estimated. An aliquot was removed from the unfiltered, incubated sample and fixed with Lugol's iodine for microscopic analysis.

The water used for copepod grazing was the same as that collected for the microplankton grazing experiments. For copepod grazing, water was pre-screened through a 100 µm mesh net to remove large zooplankton. Initial samples were retained for chlorophyll estimation. Five, 1 l bottles were filled with pre-screened water, and 5 - 10 copepods of the same species and developmental stage were added to three of the bottles. The remaining two were used as controls. Animals were collected by vertical tow using a 60 cm diameter Bongo net with a 200 µm mesh and non draining cod end. Experimental and control bottles were incubated for 24 h at ambient (4 m) seawater temperature and

a near ambient light/dark cycle. At the end of the incubation, the concentration of chlorophyll in each bottle was determined.

Copepod egg production

Water collected by rosette water bottles was pre-screened (100 μm mesh net) and used to fill four, 1 l bottles. The contents of one bottle was filtered onto a 35 μm mesh net and preserved with Lugol's iodine as a control. Copepods were collected (as described above) and five, adult females placed into the three remaining bottles and incubated for 24 hours. After the incubation the entire contents of each bottle was filtered onto 35 μm mesh net and fixed with Lugol's iodine. The control was used to determine the number of eggs which may have been in the seawater used to fill the experimental bottles.

Egg viability experiments

These experiments formed part of the research towards my PhD. Egg viability experiments were conducted with *Acartia clausi* at stations 38 and 47. Data collected during this cruise form part of a survey of hatching success (% eggs that hatch / eggs produced) of the eggs produced by species from various latitudes (polar to sub-tropical) and systems (coastal to offshore).

Individual female copepods were sorted into specially designed containers which allow the eggs to be incubated and monitored. The containers were filled with pre-screened water to remove eggs and zooplankton. The females were incubated for 24 h and then removed. Eggs were counted using a dissecting microscope and returned to the incubator, and the number of eggs hatching was monitored on a daily basis. Once nauplii were observed in the chambers the incubation was continued for a further 24 h before being filtered onto a 35 μm mesh net and preserved with Lugol's iodine. Final counts of the number of eggs present in the experimental chamber are made using an inverted microscope (X100 magnification).

ANNEX II

J Morrison, School of Ocean Sciences, University College of North Wales

Optically important measurements were made at each of the stations visited. These measurements included the underwater light field, particle absorption spectrum, chlorophyll concentration, suspended particulate material and dissolved organic material, DOM, (aka yellow substance and gelbstoff).

A Bioshperical Instruments, Integrating Natural Fluorometer (INF-300) was used to measure the underwater light field. This instrument measures the scalar, downwelling photosynthetically active radiation E_o (PAR), upwelling radiance centred at 683 nm, I_u (683), temperature, T and depth, Z. The natural fluorescence signal can, in theory, be used to determine chlorophyll concentration and rates of photosynthesis. Deployments during the ^{14}C *in situ* incubations included constant depth (≈10 m) measurements and hourly profiles. Typical PAR attenuation coefficients were 0.18, 0.21 and 0.28 m^{-1} for station 38, 41 and 47.

A Shimadzu UV-1201 spectrophotometer was used to determine the particulate absorption spectrum and the DOM. Particulate spectra were measured on filters against a filtered seawater soaked filter blank. Absorbances were corrected using specific algorithms. The concentration of DOM was ascertained from the spectrum of filtered seawater in a 10 cm cuvette with a distilled water blank. All spectra were measured between 350 and 750 mn.

Figure 1

A map of the western Irish Sea showing the location of the three stations worked.

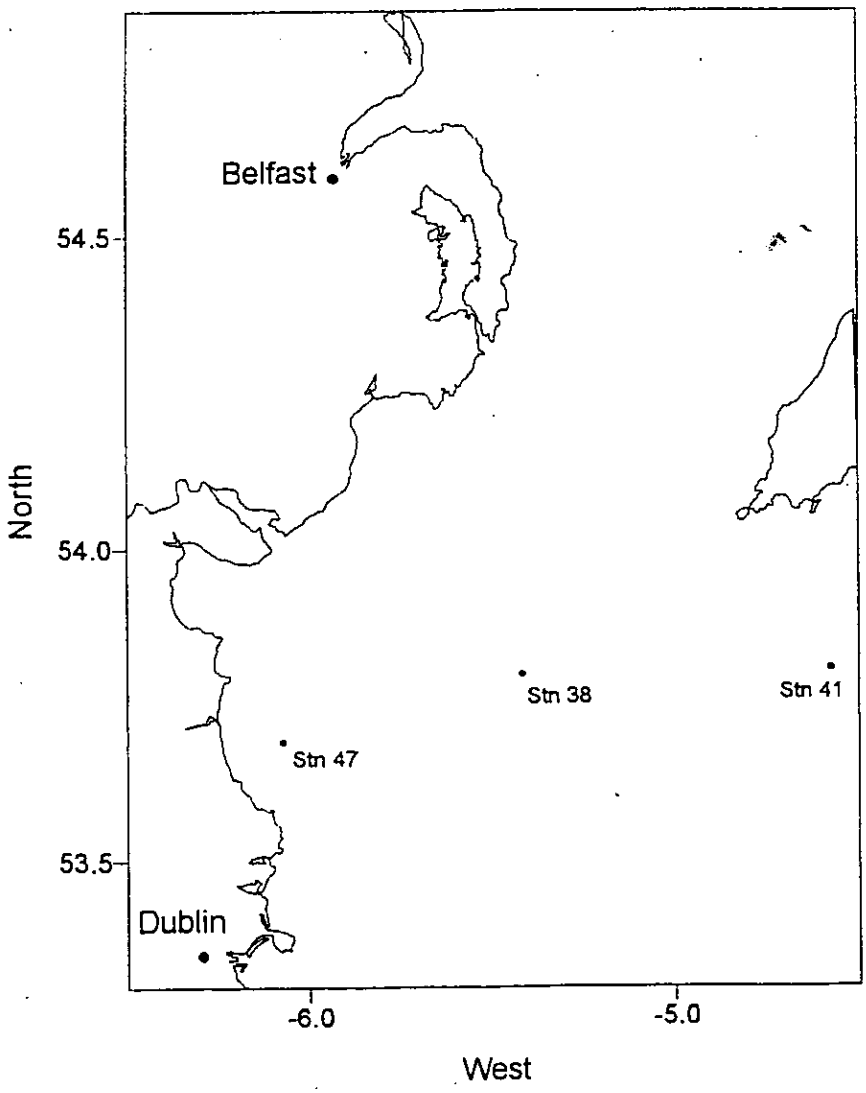

Figure 2

Results from one of the in situ experiments carried out at station 38.
A, Photosynthesis versus irradiance cruve; B, a vertical profile of production

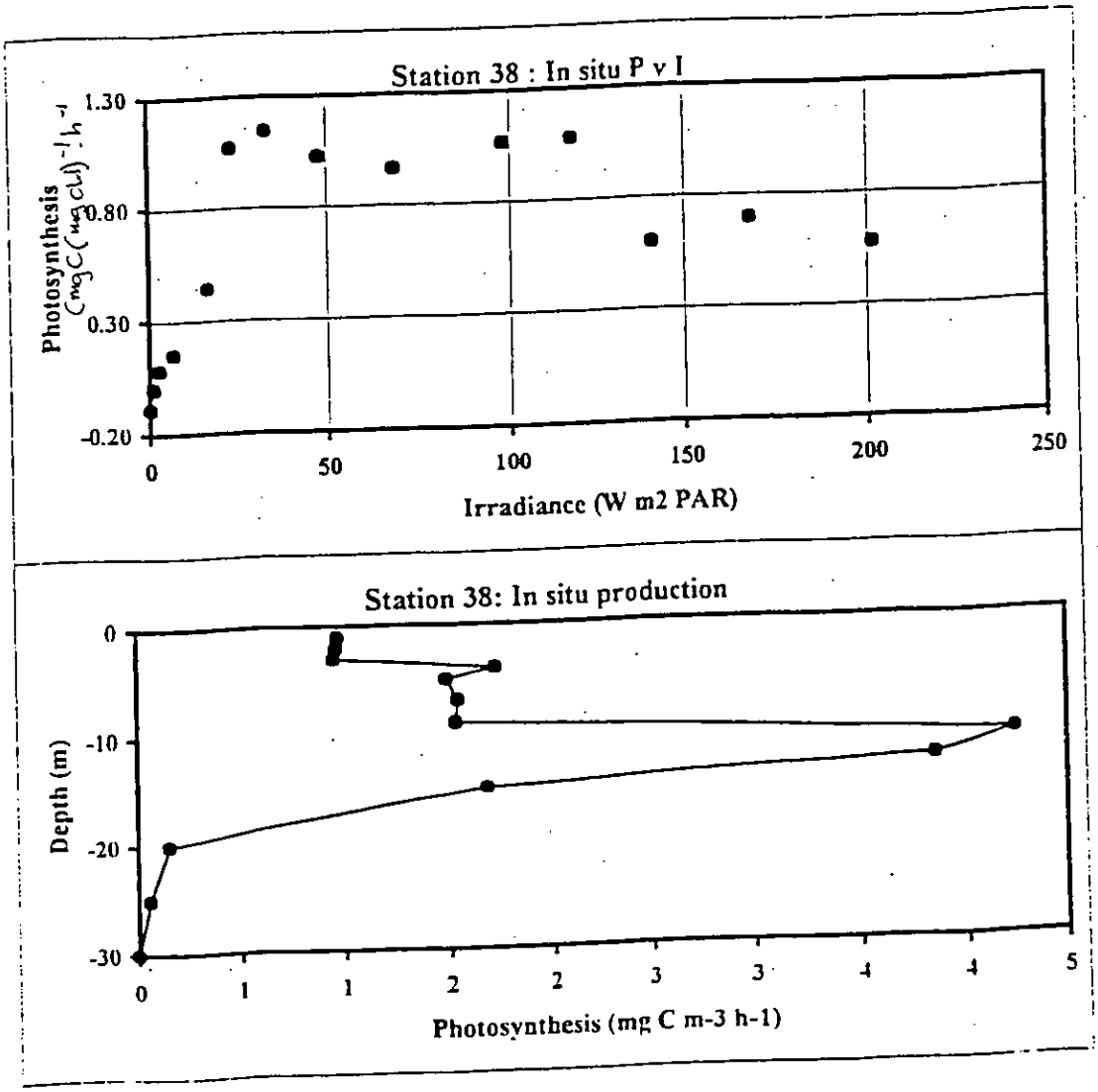

Figure 3

Examples of photosyntheis versus irradiance curves (based on the micro-Winkler method) for the < 5 micron phytoplankton size fraction at station 38 and 41.