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NATURAL ENVIRONMENT RESEARCH COUNCIL
INSTITUTE FOR MARINE ENVIRONMENTAL RESEARCH

CHALLENGER 13/87

CRUISE REPORT

IMER 2/87 (VES 2.1)
RVS Ref. No. P12/13/87

VESSEL RRS CHALLENGER

CRUISE PERIOD 29 March to 19 April 1987

PERSONNEL
R Williams (Principal Scientist)
I R Joint
D V P Conway
N R Collins
M Jordan
A Pomroy
N Halliday
R Howland
S Milligan (MAFF, Lowestoft)
RVS Barry (3 staff)
Irish Observer (Katherine Horstman, University of Galway)

ITINERARY

28 March		Equipment and personnel to Barry
29 March		Joined ship and set up equipment
	0800	Departed Barry and set course for Irish Sea
	1000	Reverse course to Barry to pick up computer spares following computer breakdown
	1645	Set course for Irish Sea.
30 March	0630	Commenced UOR tow (Fig 1)
1 April	1000	Finished UOR grid (Fig 1) together with associated CTD profiles (Fig 2 Table 1) Change over of personnel at Holyhead and embark samples of fish eggs for UCNW Menai Bridge.
	1430	Set course for Irish Coastal Station (southern)
	1830	Commenced Station work, CTD, water bottles, LHPR, RMT1, Lowestoft sampler, ^{14}C in situ incubation experiments, light measurements etc
4 April	0645	Easterly gale, Station work stopped proceeding to shelter.
	1200	Hove to off west coast of Isle of Man
5 April	1226	Commenced work on Northern Station
	2000	Completed Station work, deployed UOR on course for Central Station
	2356	Recovered UOR (Fig 3)
6 April	0515	Commenced Station work (Fig 4, Table 2)

	2300	Completed Station work. Lowestoft net sampler transect towards Irish coast (Table 3, Fig 4)
7 April	0330	Completed transect, return to Central Station
	0520	Commenced Station work
	1816	Completed Station work
	2027	UOR tows (4) to southern Coastal Station (Fig 3)
8 April	0200	UOR tows completed.
	0500	Commence Station work
	1744	Station work completed, Lowestoft net sampler transect parallel to Irish coast
	2322	Transect completed.
9 April	0500	Station work commenced (southern Coastal Station, LHPR etc
	1836	Station work completed (Fig 5)
	1857-2208	Lowestoft net sampler survey
	2230	Station work
10 April	1348	Station work stopped, hove to heavy weather
	2144 - 2251	Lowestoft net sampler survey.
11 April	0627	Commenced work at Central Station.
12 April	2349	Completed Station work.
13 April	0507	Commenced work at Coastal Station (Central)
	1837	Completed Station work, Lowestoft net survey
14 April	0046	Survey completed
	0508	Commenced work at Coastal Station (northern)
	2159	Completed Station work
	2212	UOR deployed
15 April	0616	UOR recovered
	0635	Commenced work on eastern Station (north of Anglesey).
	2156	Completed Station work.
16 April	0500	Proceeded to Holyhead
	0800	Hove to off Holyhead to disembark two scientists and 2 containers with sprat eggs for UCNW (Menai Bridge)
	1001	Commenced UOR survey (Fig 6).
17 April	2031	UOR inboard
18 April	0645	Commenced UOR transect south through Irish Sea (Fig 5)
	1753	Completed UOR transect, set course for Barry.
19 April	0630	Docked Barry, unloaded equipment, personnel and equipment to Plymouth.

OBJECTIVES

To quantify the rates of primary and secondary production in the Irish Sea and to relate these rates to the biomass and distribution of phytoplankton, zooplankton and fish larvae. The hydrographic origin of differences in regional production will be investigated and its consequence to the feeding of early larval fish examined. The results will be compared with equivalent data available for the North Sea.

SPECIFIC OBJECTIVES

1. To determine size fractionated rates of phytoplankton production in different light regimes and bacterial production - to relate these to the production and flux of organic matter by various components of the pelagic ecosystem.

2. To relate primary production, phytoplankton biomass and species composition to the vertical structure, behaviour and feeding of the herbivorous zooplankton; to determine the availability of suitable phytoplankton as a diet for first-feeding larvae.

3. To determine the horizontal and vertical distribution of zooplankton, including fish eggs and larvae, in relation to hydrographic conditions and the availability of suitable food for fish larvae.

4. To determine the dissolved free amino acids, vitamins,a nd polyunsaturated fatty acids present in various zooplankton species and their developmental stages and in fish larvae and eggs: larvae of sprat will be collected for determination of RNA/DNA and histology.

METHODS

1. a. Primary production will be measured by in situ incubations with ^{14}C; samples will be taken from 10 depths in the water column, inoculated with ^{14}C and returned to the depth from which the samples were taken. The incubation rig will be free-floating and marked with a radio beacon; incubations will last for 24h. At the end of the incubation period the samples will be fractionated through Nuclepore filters of varying pore-size to estimate the production by different sizes of phytoplankton. Dissolved organic carbon production by phytoplankton will be measured on the same samples.

   b. The photosynthetic characteristics of the different phytoplankton populations will also be determined by incubating samples in a light gradient with ^{14}C for 3-4h. The maximum rate of photosynthesis (P_m^B), efficiency of photosynthesis (α) and susceptibility to photoinhibition (β) of the populations will be determined from these photosynthesis/irradiance curves.

   c. Bacterial production will be estimated from the incorporation of ^{3}H thymidine into bacterial nucleic acid. Numbers and biomass of heterotrophic bacteria will be determined by epifluorescence microscopy on samples stained with fluorochrome. Number of cyanobacteria will be determined by epifluorescence microscopy based on the autofluorescence of the accessory pigment, phycoerythrin.

2. a. Phytoplankton biomass and species composition will be determined in preserved samples at the end of the cruise. High-precision image analysis will be used to obtain measurements of cell dimensions of the in individual phytoplankton species and these

measurements will be used to estimate phytoplankton biomass.

b. Night and day oblique profiles will be taken with the Double LHPR (20µm and 200µm mesh nets) at the selected sites. Samples will be processed onboard - the fine mesh samples will be washed off the gauze immediately onto pre-ashed GFC papers and the filters frozen for subsequent analysis of carbon and nitrogen and chlorophyll a. The fish eggs and larvae from the coarse (200µm) net will be removed from the samples and identified onboard and the remainder of the zooplankton washed off. The samples will be divided in 2 aliquots, half for dry weight C/N determinations and the other half for identification of species composition. It is hoped to carry out this identification at sea using the voice recognition system developed at IMER.

3. The UOR, Lowestoft sampler, LHPR and RMT1 nets will be used on grid surveys together with the CTD system to define the plankton composition in the different hydrographic regions of the area under study (Fig 1). The fish eggs and larvae will be identified onboard and the gut contents of larvae examined for comparison with locally observed concentrations of zooplankton.

4. Samples will be collected, sorted, frozen and maintained in liquid nitrogen for despatch to France (ROSCOFF and VILLEFRANCHE) and FRG (KIEL) to our collaborators in this project.

5. Collection of sprat eggs for R Shields (Menai Bridge). Collection of Metridia for Professor E Naylor.

RESULTS

1. a. Primary production measurements

A total of 11 in situ primary production incubations were done during the cruise. Samples were incubated at 9 depths from a free-floating buoy and after 24h incubations the samples were filtered to give size fractions of >5µm, <5 to 1µm and <1µm. These incubations will give estimates of the primary production rates of picoplankton, as well as the nano- and microplankton. The numbers of cyanobacteria in the surface waters were also determined; at the beginning of the cruise, there were about 4500 cyanobacteria/ml and this increased to 7500 cells/ml in those stations where thermal stratification was developing. A total of 10 in situ light meter array recordings were taken along with water samples from nine depths to study the absorption characteristics of the water. Data from the light sensors was recovered on eight of these deployments. Water samples were analysed onboard using the spectrophotometer and it was apparent that absorption by soluble material was very low even though the effects of river run-off were expected to be observed in the samples.

b. Photosynthetic characteristics of natural phytoplankton populations

Values of maximum rate of photosynthetic carbon fixation (P_m) and initial slope of the photosynthesis/irradiance curve (α) can be used to indicate the potential for the phytoplankton population to respond to different light and mixing regimes. A total of 14 experiments were done to determine values of P_m, α and photoinhibition parameters. In addition, samples were taken to determine dissolved organic carbon production.

c. Heterotrophic bacterial production

The production of heterotrophic bacteria was measured from the incorporation of ^3H thymidine. Measurements were made on every occasion when phytoplankton production was measured. Samples were also preserved for the subsequent analysis of bacterial numbers.

2. a. Chlorophyll concentration

Throughout the cruise, chlorophyll samples were taken and size fractionated to determine the relative abundance of picoplankton and nanoplankton. At the beginning of the cruise, chlorophyll a concentrations were ca 1µg/l, with 60% of the chlorophyll in the >5µm fraction. By the end of the cruise, the spring bloom was developing in the surface waters at some stations and chlorophyll a concentrations were >2µg/l; 50% of the total chlorophyll was due to phytoplankton >5µm, 30% from small nanoplankton (<5 to >1µm) and 20% from picoplankton. However, these values were only found at those stations where the water column was well mixed, chlorophyll a concentrations were less than 1·µg/l

b. Longhurst Hardy Plankton Recorder Hauls

Nine DLHPR hauls were taken at selected stations (Northern, Central, Coastal and Eastern; Fig 5)with the 20µm fine mesh and the 200µm coarse mesh cod-ends. Fish eggs and larvae were sorted from the 204 samples and identified following 12h preservation in 3% formaldehyde. The larger organisms in the major taxonomic groups (Chaetognathes, Euphausiids, Decapods) were removed from the samples, identified and preserved separately for estimation of dry weight and carbon content. The remainder of the samples was preserved and a full taxonomic identification carried out in approx half (~100) of these samples onboard using the voice recognition technique; with data input into an IBM.PC. [It is intended to use this technique on future cruises whenever there is time in the sampling programme ie; periods of heavy weather, steaming between stations etc].

The 190 fine mesh samples were washed off the nylon gauzes and divided into 2 aliquots, one for chlorophyll, carbon and nitrogen analysis, the other for counts of micro-organisms including eggs and nauplii. All chlorophyll analysis, including 184 samples from water bottle profiles have been analysed. The samples (1116) for C.N. analyses have yet to be started.

3. A number of grids and transects were completed using the

Lowestoft sampler with a total of 44 oblique or horizontal tows. Large concentrations of sprat eggs were found near the central coastal stations off the Irish coast. Samples of these eggs ~5000 - 10,000 were bought back to Holyhead for transfer to Menai Bridge. All fish eggs and larvae from the UOR, LHPR and Lowestoft sampler were counted and identified onboard by S Milligan (MAFF).

c. Undulator Tows

Thirty Undulator tows were taken along the four standard survey legs together with nine additional tows. Valid temperature, depth, chlorophyll a fluorescence and flow data were obtained from 37 of these tows. Plankton samples for fish eggs and larvae were also taken on these tows. Complementary sampling of water pumped from 3m was also carried out along the UOR transects for particle size analysis (Coulter counts, chlorophyll a, carbon and nitrogen measurements and on line filtration of particles in the following size categories (>200, >100, >22μm)). Continuous measurements of salinity, temperature, nitrate, nitrite, phosphate and silicate were taken along the transects. There was little variation in the values of the nutrients over the cruise period. Typical values were 8.5μmol l^{-1} for nitrate and 0.7μmol l^{-1} for phosphate.

Prior to each deployment and after recovery of the Undulator the CTD was deployed to the maximum depth possible. The CTD worked very well and was deployed on ~170 occasions. Calibration of the salinity and fluorescence sensors was carried out onboard which enabled the data to be plotted in a final form using the plotting routine on the BBC Micro.

4. Few sprat larvae were found in these hauls, therefore there was no material preserved for estimates of nutritional status of larvae.

5. Ample fish eggs were collected but no Metridia lucens were found in the net hauls in any quantity sufficient to despatch back to Bangor (UCNW).

6. Samples of plankton, fine particulates and sediments were taken during the cruise for radioactivity studies.

EQUIPMENT AND OPERATIONAL PROBLEMS

1) UOR. Contact was made with the sea-bed on one transect which resulted in damage to the fibre glass body, and data was lost in two tows due to failure of the data logger.

2) LHPR The gauze transport of the fine mesh net system in haul IS/3 was intermittent, therefore,the haul was repeated - successfully.

3) CTD Worked exceptionally well, but the O_2 sensor failed during the cruise.

4) 7.1 Water bottles - One bottle was lost during recovery in heavy weather when the ship drifted over the wire.

5) Ship's main stern gantry was very slow in moving out - a fault which I believe is now rectified. Similarly the problem with the meter wheel and change over of winches on the starboard winch and gantry I believe has now been attended to.

6) Ship's communications were very poor between laboratories and bridge - again I understand this is receiving attention.

7) The Schatt davit was a tremendous improvement allowing us to deploy and recover the UOR easily and safely from the starboard quarter. The winch had no mechanical spooling arrangement so the wire had to be hand spooled during recovery of the UOR.

8) Lowestoft sampler A net was torn when the sampler made contact with the sea-bed.

9) Light profiling equipment Data was lost from 2 of the 8 profiles because of problems with the particular solid state logger being used with this equipment. This unit is the early prototype and there is a persistent fault in the 'start' 'stop' 'reset' circuitry - this older unit should be replaced by the new version of this logger. One of the light sensors (0.5m depth) was taken out of the array after developing a slight leak.

10) Ship's computer This was down for approximately half of the cruise although all plotting requirements were fulfilled by the end of the cruise.

Prepared by: R Williams

Approved by: B. C. Bayne.

Date : 3 August 1987

Circulation: Director, Williams, Coombs, Joint, Conway, Collins, Jordan, Pomroy, Halliday, Howland. Notice board, File. VES 2.1
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NERC Swindon: D Pugh, S White
IOS Wormley: M Angel, Library
Bidston: Director, Library
Wormley,
MIAS: P Edwards
RVS Barry: L Skinner (x2)

Table 1

CTD Stations Challenger 13/87

Station	Date	Day	Time	Latitude		Longitude	
C 1/1	30.3.87	Mon	05.59	52	00.6N	05	44.7W
C 1/2	"	"	12.21	52	45.6N	05	17.6W
C 6/1	"	"	18.43	53	16.1N	04	59.5W
C 7/1	"	"	23.14	53	30.0N	03	59.5W
C 8/1	31.3.87	Tues	01.14	53	34.3N	04	20.7W
C 9/1	"	"	02.58	53	38.0N	04	39.7W
C 10/1	"	"	05.05	53	42.5N	05	01.2W
C 11/1	"	"	07.02	53	46.8N	05	19.9W
C 12/1	"	"	08.59	53	51.0N	05	40.4W
C 12/2	"	"	09.21	53	51.0N	05	40.5W
C 13/1	"	"	11.10	53	54.8N	05	59.8W
C 14/1	"	"	13.17	53	43.0N	05	55.2W
C 15/1	"	"	15.00	53	30.2N	05	50.1W
C 15/2	"	"	15.40	53	31.3N	05	50.9W
C 15/3	"	"	16.19	53	33.6N	05	51.6W
C 15/4	"	"	16.58	53	35.4N	05	52.7W
C 15/5	1.4.87	Wed	04.29	53	29.8N	05	50.3W
C 16/1	"	"	07.34	53	30.0N	05	14.9W
C 17/1	"	"	10.40	53	22.8N	04	43.9W
C 18/1	"	"	18.41	53	29.8N	05	50.3W
C 19/1	"	"	19.24	53	32.0N	05	50.2W
C 20/1	"	"	19.57	53	34.0N	05	49.9W
C 21/1	2.4.87	Thurs	07.32	53	30.8N	05	51.5W
C 22/1	"	"	08.12	53	30.9N	05	51.8W
C 23/1	"	"	08.50	53	31.3N	05	52.3W
C 24/1	"	"	09.26	53	31.9N	05	52.6W
C 25/1	"	"	09.59	53	32.5N	05	53.1W
C 26/1	"	"	10.48	53	33.2N	05	53.3W
C 27/1	"	"	11.29	53	34.1N	05	53.6W
C 28/1	"	"	13.51	53	34.6N	05	54.5W
C 29/1	"	"	18.49	53	34.5N	05	54.4W
C 30/1	"	"	20.03	53	34.7N	05	54.6W
C 31/1	"	"	20.43	53	36.6N	05	54.7W
C 32/1	"	"	21.38	53	39.7N	05	54.7W
C 33/1	5.4.87	Sun	12.50	54	15.1N	05	06.1W
C 34/1	"	"	16.00	54	20.3N	05	09.2W
C 35/1	"	"	18.18	55	18.6N	05	08.2W
C 36/1	"	"	19.47	54	17.2N	05	08.4W
C 37/1	6.4.87	Mon	07.51	53	50.0N	05	33.3W
C 38/1	"	"	08.36	53	50.1N	05	34.0W
C 39/1	"	"	09.19	53	50.3N	05	34.6W
C 40/1	"	"	10.01	53	50.3N	05	35.0W
C 41/1	"	"	10.49	53	50.5N	05	35.4W
C 42/1	"	"	11.33	53	50.6N	05	35.7W
C 43/1	"	"	12.19	53	50.9N	05	36.3W
C 44/1	"	"	14.47	53	52.2N	05	37.7W
C 45/1	"	"	15.49	53	52.6N	05	38.3W
C 46/1	"	"	18.26	53	50.0N	05	32.0N

C.T.D. Stations CH 13/87

C 47/1	6.4.87	Mon	19.22	53	51.2N	05	36.8W
C 48/1	"	"	20.07	53	53.0N	05	41.4W
C 49/1	"	"	20.58	53	54.7N	05	45.8W
C 50/1	"	"	21.35	53	56.0N	05	50.1W
C 51/1	"	"	22.11	53	57.5N	05	54.4W
C 52/1	"	"	22.47	53	57.6N	05	54.0W
C 53/1	7.4.87	Tues	08.08	53	50.2N	05	33.1W
C 54/1	"	"	09.30	53	49.6N	05	32.7W
C 55/1	"	"	11.02	53	49.3N	05	33.8W
C 56/1	"	"	12.02	53	49.5N	05	34.5W
C 57/1	"	"	13.03	53	49.9N	05	34.6W
C 58/1	"	"	17.49	53	51.6N	05	34.1W
C 59/1	"	"	20.07	54	05.4N	05	40.7W
C 60/1	8.4.87	Wed	07.32	53	33.0N	05	50.4W
C 61/1	"	"	08.18	53	32.5N	05	50.1W
C 62/1	"	"	08.58	53	32.1N	05	49.6W
C 63/1	"	"	11.01	53	30.9N	05	48.8W
C 64/1	"	"	12.05	53	30.0N	05	48.5W
C 65/1	"	"	13.05	53	29.6N	05	48.1W
C 66/1	"	"	15.01	53	29.7N	05	48.0W
C 67/1	"	"	17.04	53	29.1N	05	47.5W
C 67/1up	"	"	17.10				
C 68/1	9.4.87	Thurs	07.41	53	54.6N	05	58.1W
C 69/1	"	"	08.03	53	54.5N	05	58.4W
C 70/1	"	"	08.59	53	54.6N	05	58.0W
C 71/1	"	"	10.03	53	54.5N	05	58.0W
C 72/1	"	"	11.03	53	54.2N	05	58.1W
C 73/1	"	"	12.04	53	53.2N	05	57.6W
C 74/1	"	"	13.27	53	54.8N	05	56.9W
C 75/1	"	"	14.36	53	53.5N	05	56.6W
C 76/1	"	"	15.38	53	53.0N	05	55.4W
C 77/1	"	"	17.02	53	53.4N	05	55.2W
C 78/1	"	"	22.29	53	53.2N	05	57.3W
C 79/1	"	"	23.45	53	54.7N	05	57.4W
C 80/1	10.4.87	Fri	07.34	53	51.5N	05	29.7W
C 81/1	"	"	08.33	53	52.2N	05	28.8W
C 82/1	"	"	09.34	53	52.4N	05	28.2W
C 83/1	"	"	11.03	53	52.7N	05	28.0W
C 84/1	"	"	12.05	53	52.1N	05	27.4W
C 85/1	"	"	13.07	53	52.1N	05	27.1W
C 86/1	11.4.87	Sat	07.59	53	50.5N	05	31.2W
C 87/1	"	"	09.02	53	50.9N	05	29.0W
C 88/1	"	"	09.58	53	50.8N	05	28.0W
C 89/1	"	"	11.02	53	50.4N	05	27.4W
C 90/1	"	"	13.12	53	49.9N	05	33.2W
C 90/2	"	"	13.27	53	49.7N	05	33.3W
C 91/1	"	"	14.21	53	47.8N	05	28.4W
C 92/1	"	"	15.34	53	46.6N	05	28.5W
C 93/1	"	"	17.07	53	46.1N	05	29.3W
C 94/1	"	"	18.07	53	46.5N	05	29.5W
C 95/1	"	"	19.15	53	50.1N	05	32.1W
C 96/1	"	"	23.07	53	49.6N	05	28.7W
C 97/1	12.4.87	Sun	00.34	53	49.8N	05	32.6W

C.T.D. Stations CH 13/87

C 98/1	12.4.87	Sun	01.05	53	49.9N	05	32.0W
C 99/1	"	"	08.10	53	51.2N	05	30.7W
C100/1	"	"	09.00	53	51.6N	05	30.1W
C101/1	"	"	09.59	53	52.5N	05	30.0W
C102/1	"	"	11.02	53	53.0N	05	29.3W
C103/1	"	"	12.01	53	55.4N	05	29.0W
C104/1	"	"	12.34	53	55.4N	05	29.6W
C105/1	"	"	14.03	53	55.6N	05	26.8W
C106/1	"	"	14.44	53	55.6N	05	21.3W
C107/1	"	"	15.18	53	54.3N	05	20.9W
C108/1	"	"	15.50	53	53.3N	05	20.7W
C109/1	"	"	19.33	53	52.7N	05	21.8W
C110/1	"	"	20.21	53	50.5N	05	22.7W
C111/1	"	"	21.07	53	49.2N	05	25.4W
C112/1	"	"	21.58	53	46.7N	05	25.4W
C113/1	13.4.87	Mon	07.55	53	44.6N	05	55.0W
C114/1	"	"	09.09	53	45.2N	05	54.7W
C115/1	"	"	10.05	53	45.3N	05	55.1W
C116/1	"	"	11.03	53	44.9N	05	56.1W
C117/1	"	"	12.02	53	45.0N	05	55.1W
C118/1	"	"	13.03	53	44.6N	05	54.0W
C119/1	"	"	13.50	53	45.8N	05	60.0W
C120/1	"	"	16.03	53	41.5N	05	51.9W
C121/1	"	"	17.05	53	41.1N	05	52.7W
C122/1	"	"	18.05	53	41.2N	05	53.2W
C123/1	14.4.87	Tue	07.34	53	57.7N	05	52.8W
C124/1	"	"	08.39	53	58.0N	05	53.0W
C125/1	"	"	09.50	53	58.7N	05	53.1W
C126/1	"	"	11.05	53	58.9N	05	53.1W
C127/1	"	"	12.06	53	58.8N	05	53.0W
C128/1	"	"	12.59	53	58.5N	05	53.0W
C129/1	"	"	14.03	53	58.6N	05	53.3W
C130/1	"	"	18.11	53	58.1N	05	52.0W
C131/1	"	"	18.50	53	57.9N	05	52.5W
C132/1	"	"	19.46	53	58.2N	05	55.9W
C133/1	"	"	21.55	53	39.9N	05	59.8W
C134/1	15.4.87	Wed	01.50	53	39.7N	05	07.8W
C135/1	"	"	07.21	53	40.1N	04	13.2W
C136/1	"	"	08.35	53	40.5N	04	07.4W
C137/1	"	"	09.32	53	40.4N	04	03.8W
C138/1	"	"	11.16	53	40.4N	03	59.1W
C139/1	"	"	12.08	53	40.3N	03	58.7W
C140/1	"	"	13.08	53	40.1N	04	01.7W
C141/1	"	"	15.52	53	40.7N	04	10.7W
C142/1	"	"	17.04	53	40.0N	04	11.5W
C143/1	"	"	18.02	53	40.3N	04	12.6W
C144/1	"	"	19.51	53	42.7N	04	10.7W
C145/1	"	"	20.38	53	45.3N	04	08.1W
C146/1	"	"	21.32	53	48.0N	04	03.5W
C147/1	16.4.87	Thurs	09.45	53	30.1N	03	59.2W
C148/1	"	"	12.02	53	34.2N	04	20.0W
C149/1	"	"	13.46	53	38.4N	04	40.3W
C150/1	"	"	15.24	53	42.6N	05	01.1W

C.T.D. Stations CH 13/87

C151/1	16.4.87	Thurs	17.[illegible]1	53	46.6N	05	20.1W
C152/1	"	"	18.47	53	50.9N	05	41.0W
C153/1	"	"	20.30	53	55.3N	06	00.8W
C154/1	"	"	21.03	53	54.7N	05	57.4W
C155/1	"	"	21.32	53	54.2N	05	54.2W
C156/1	"	"	22.01	53	53.6N	05	50.8W
C157/1	"	"	22.28	53	53.0N	05	47.6W
C158/1	"	"	22.55	53	52.2N	05	44.4W
C159/1	"	"	23.26	53	51.2N	05	41.5W
C160/1	17.4.87	Fri	00.04	53	50.5N	05	38.4W
C161/1	"	"	06.33	53	55.0N	06	00.3W
C162/1	"	"	08.28	53	42.3N	05	42.9W
C163/1	"	"	10.56	53	28.5N	05	49.1W
C164/1	"	"	12.13	53	40.0N	05	54.1W
C165/1	"	"	13.57	53	40.0N	05	33.0W
C166/1	"	"	15.58	53	29.4N	05	50.2W
C167/1	"	"	18.40	53	30.1N	05	14.9W
C168/1	"	"	20.37	53	30.3N	04	51.6W
C169/1	18.4.87	Sat	06.44	53	15.0N	04	59.8W
C170/1	"	"	14.08	52	29.7N	05	26.8W
C171/1	"	"	16.04	52	14.4N	05	35.9W
C172/1	"	"	18.01	51	59.1N	05	44.7W

Table 2. 'Challenger' IMER 2/87 Irish Sea

Double Longhurst Hardy Plankton Recorder Haul
(Mesh size 20 and 200 µm)

Haul No.	Date	Time (GMT)	Position (Start of tour)	Water depth	Max. Depth of Sampler	No. of Samples Coarse	Fine
IS/3	2-4-87	12.28	53°35'N 05°56'W	52	50	22	12*
4	5-4-87	17.18	54°21'N 05°10'W	132	124	36	33
5	6-4-87	13.35	53°52'N 05°40'W	101	92	31	31
6	9-4-87	12.38	53°53'N 05°58'W	41	35	13	13
7	9-4-87	23.05	53°53'N 05°57'W	41	39	13	13
8	11-4-87	12.10	53°50'N 05°28'W	130	115	33	33
9	11-4-87	23.46	53°50'N 05°28'W	130	120	32	32
10	14-4-87	19.06	53°58'N 05°53'W	35	32	12	12
11	15-4-87	12.34	53°40'N 03°59'W	46	42	12	11
						204	190

* The fine mesh cod-end in the first deployment jammed and therefore the haul was repeated using the fine net system only.

The course mesh samples were preserved in buffered formaldehyde and the fine mesh samples were washed off the gauze, through a 200 µm mesh and split into two aliquots - one was preserved in formaldehyde the other was filtered onto pre-ashed, pre-weighed filters (GFC) and frozen (-20°C) for determination of chlorophyll a, carbon and nitrogen.

Challenger 29 March - 19 April 1987

Table 3. Lowestoft Sampler horizontal and oblique hauls

Haul No	Position				Flow m^3	Max Depth
	Start		Finish			
	Lat	Long	Lat	Long		
1	53°40.1'N	06°00.2'W	53°41.2'N	06°00.3'W	121.0	20
2	53°42.3'N	06°00.2'W	53°43.0'N	06°00.1'W	115.5	20
3	53°44.2'N	06°00.2'W	53°44.9'N	06°00.3'W	118.5	20
4	53°46.3'N	06°00.3'W	53°47.0'N	06°00.0'W	106.3	20
5	53°48.2'N	05°59.9'W	53°48.9'N	05°59.8'W	91.4	20
6	53°50.2N	05°59.8'W	53°50.8'N	05°59.9'W	102.0	20
7	53°52.1'N	05°59.9'W	53°52.7'N	05°59.9'W	103.7	20
8	53°54.1'N	06°00.1'W	53°54.6'W	06°00.1'W	86.4	20
9	53°56.0'zn	06°00.1'W	53°56.6'N	06°00.2'W	95.6	20
10	NO SAMPLE					
11	53°56.7'N	06°06.6'W	53°56.0'N	06°07.1'W	115.7	13
12	53°55.8'N	06°07.2'W	53°55.0'N	06°07.4'W	105.8	17
13	53°54.9'N	06°07.4'W	53°54.3'N	06°07.8'W	111.2	14
14	53°54.1'N	06°08.1'W	53°53.4'N	06°08.4'W	114.8	20
15	53°53.3'N	06°08.3'W	53°54.0'N	06°07.5'W	122.7	21
16	53°55.6'N	06°05.1'W	53°56.2'N	06°04.2'W	116.7	15
17	53°57.4'N	06°02.4'W	53°58.0'N	06°01.3'W	98.5	15
18	53°57.6'N	06°00.7'W	53°56.9'N	06°00.2'W	109.4	15
19	53°55.7'N	05°59.2'W	53°54.9'N	05°58.3'W	112.0	15
20	54°09.0'N	05°46.3'W	54°09.5'N	05°45.5'W	91.5	17
21	54°09.6'N	05°45.1'W	54°10.1'N	05°44.3'W	97.5	17
22	54°10.2'N	05°44.1'W	54°10.8'N	05°43.3'W	102.1	18
23	54°11.0'N	05°43.1'W	54°11.6'N	05°42.3'W	103.5	17

24	54°11.7'N	05°42.1'W	54°12.4'N	05°41.0'W	131.2	20
25	53°58.7'N	05°53.4'W	53°58.9'N	05°51.1'W	187.0	10
26	53°58.9'N	05°50.8'W	53°59.1'N	05°47.7'W	267.1	10
27	53°57.9'N	05°48.2'W	53°57.9'N	05°51.0'W	240.9	10
28	53°57.9'N	05°51.2'W	53°57.6'N	05°54.4'W	273.0	10
29	53°57.7'N	05°54.4'W	53°56.2'N	05°54.3'W	211.2	10
30	53°56.1'N	05°54.4'W	53°56.3'N	05°50.9'W	263.6	10
31	53°56.2'N	05°50.8'W	53°56.2'N	05°47.6'W	237.7	10
32	53°59.0'N	05°52.8'W	53°59.0'N	05°55.3'W	223.2	5
33	53°59.0'N	05°56.0'W	53°59.0'N	05°54.7'W	87.9	5
34	53°58.9'N	05°53.4'W	53°58.8'N	05°51.8'W	118.0	5
35	53°58.4'N	05°51.9'W	53°57.7'N	05°52.9'W	124.3	10
36	53°58.1'N	05°52.5'W	53°58.1'N	05°53.9'W	106.6	10
37	53°58.2'N	05°54.1'W	53°58.2'N	05°52.6'W	108.9	10
38	53°58.1'N	05°52.6'W	53°58.1'N	05°53.8'W	111.5	10
39	53°58.1'N	05°53.8'W	53°58.1'N	05°52.4'W	121.2	10
40	53°39.9'N	04°06.6'W	53°40.7'N	04°10.0'W	233.7	10
41	53°40.2'N	04°12.6'W	53°39.4'N	04°12.7'W	119.3	10
42	53°40.9'N	04°12.0'W	53°42.5'N	04°11.1'W	203.5	30
43	53°42.9'N	04°09.9'W	53°45.1'N	04°08.6'W	282.9	30
44	53°45.5'N	04°06.9'W	53°47.7'N	04°04.6'W	298.9	30

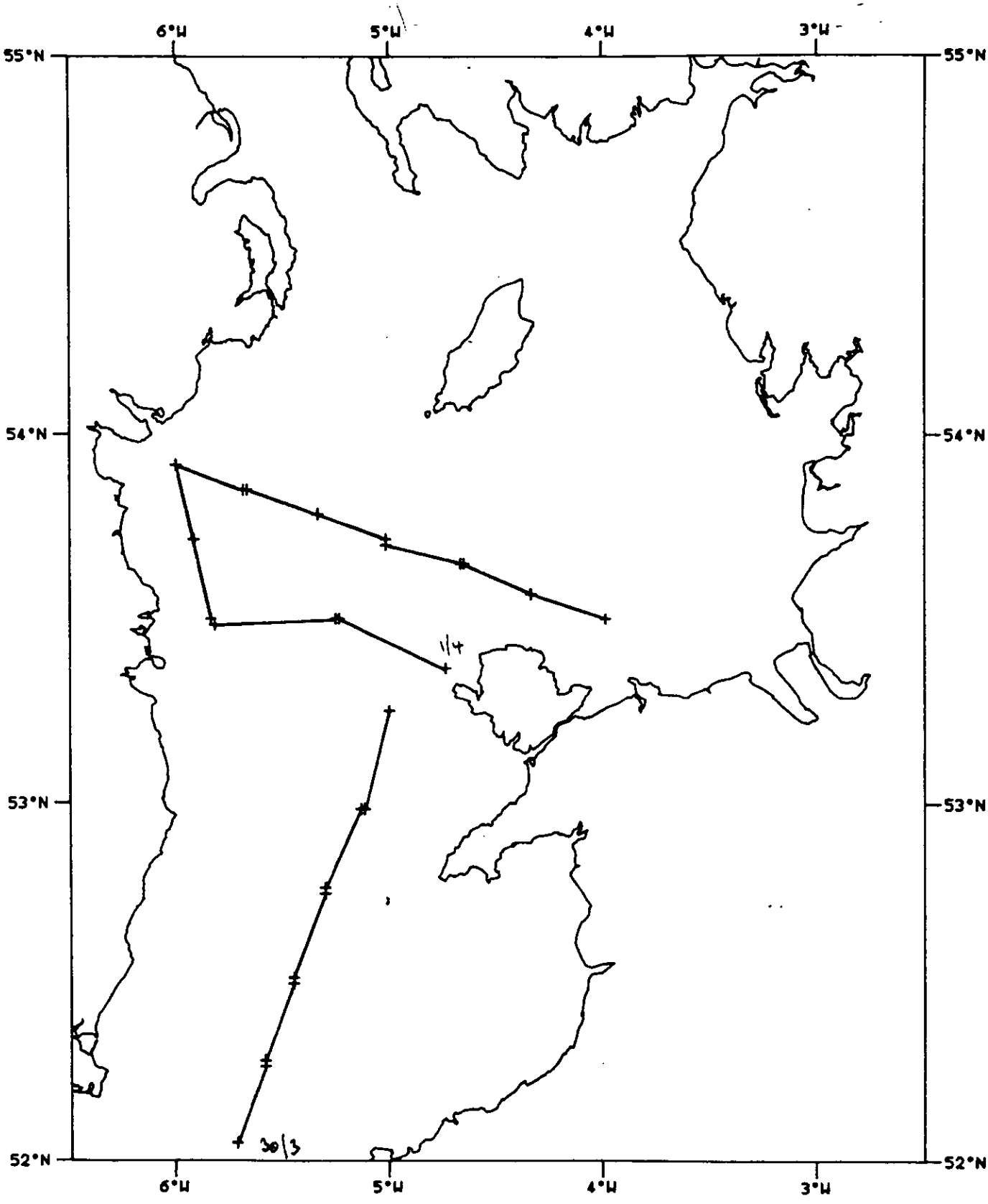

Fig. 1 CHALLENGER 87 UOR TOWS (1)

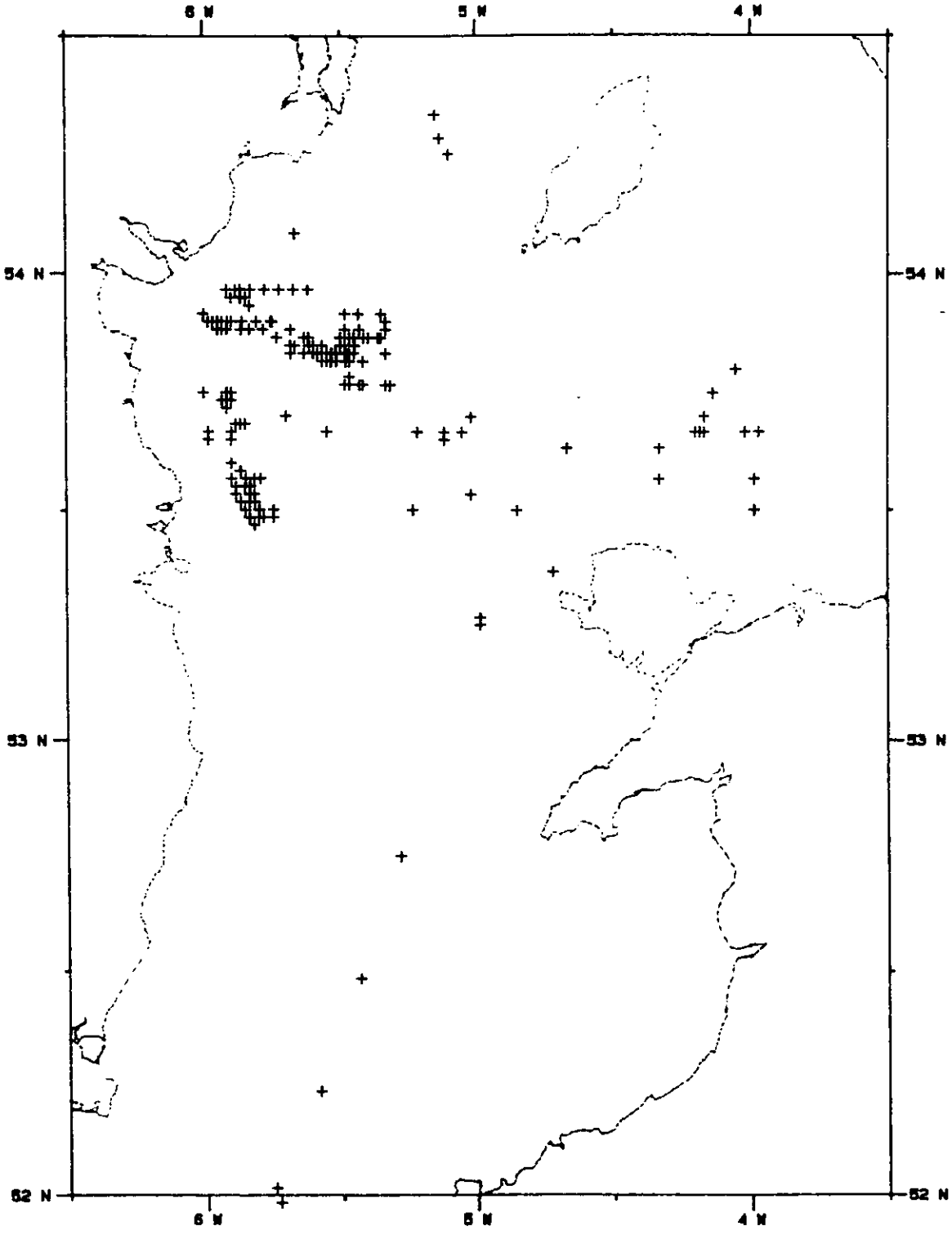

Fig. 2 CTD POSITIONS CHALLENGER 1987

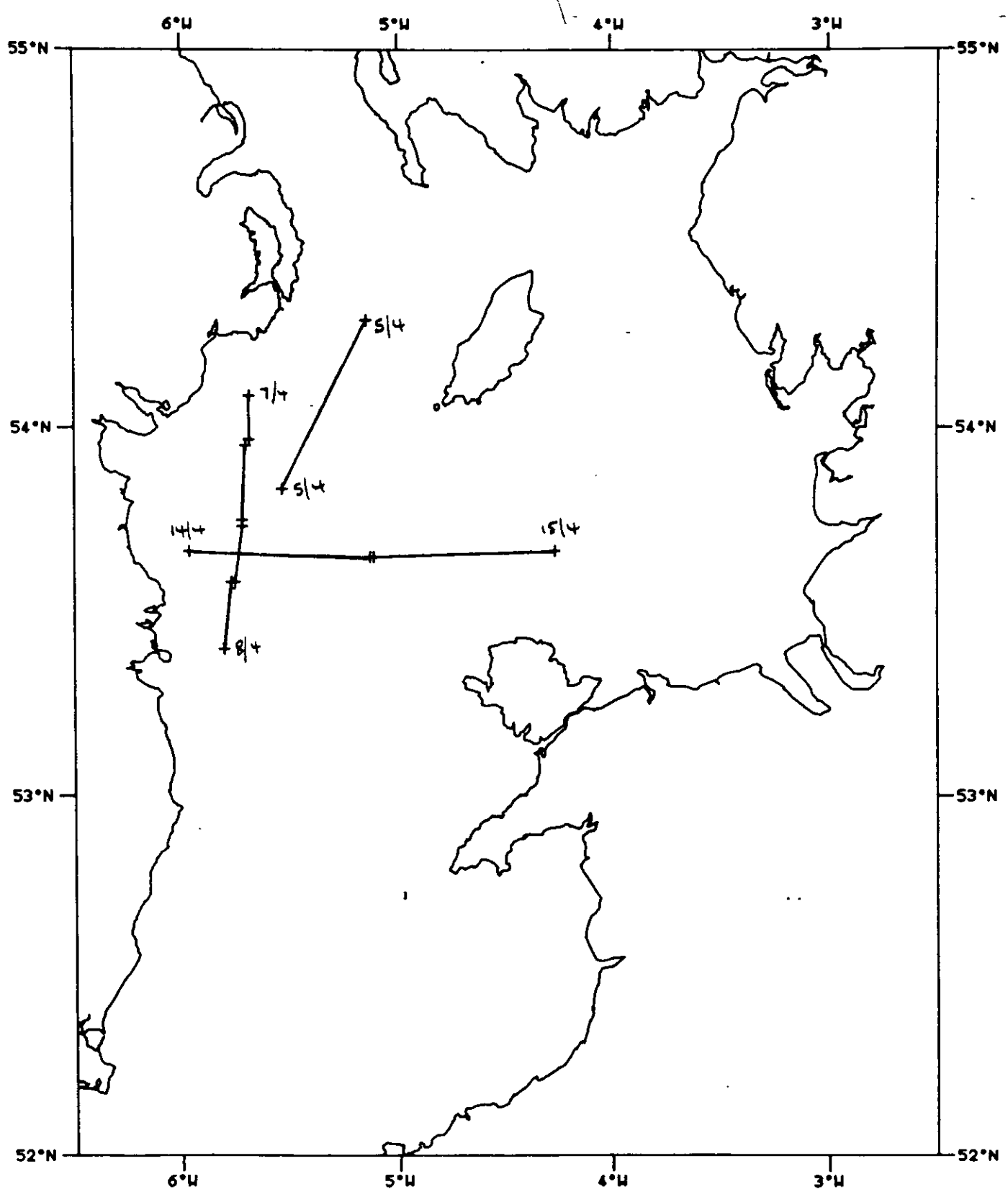

Fig. 3. CHALLENGER 87 UOR TOWS (2)

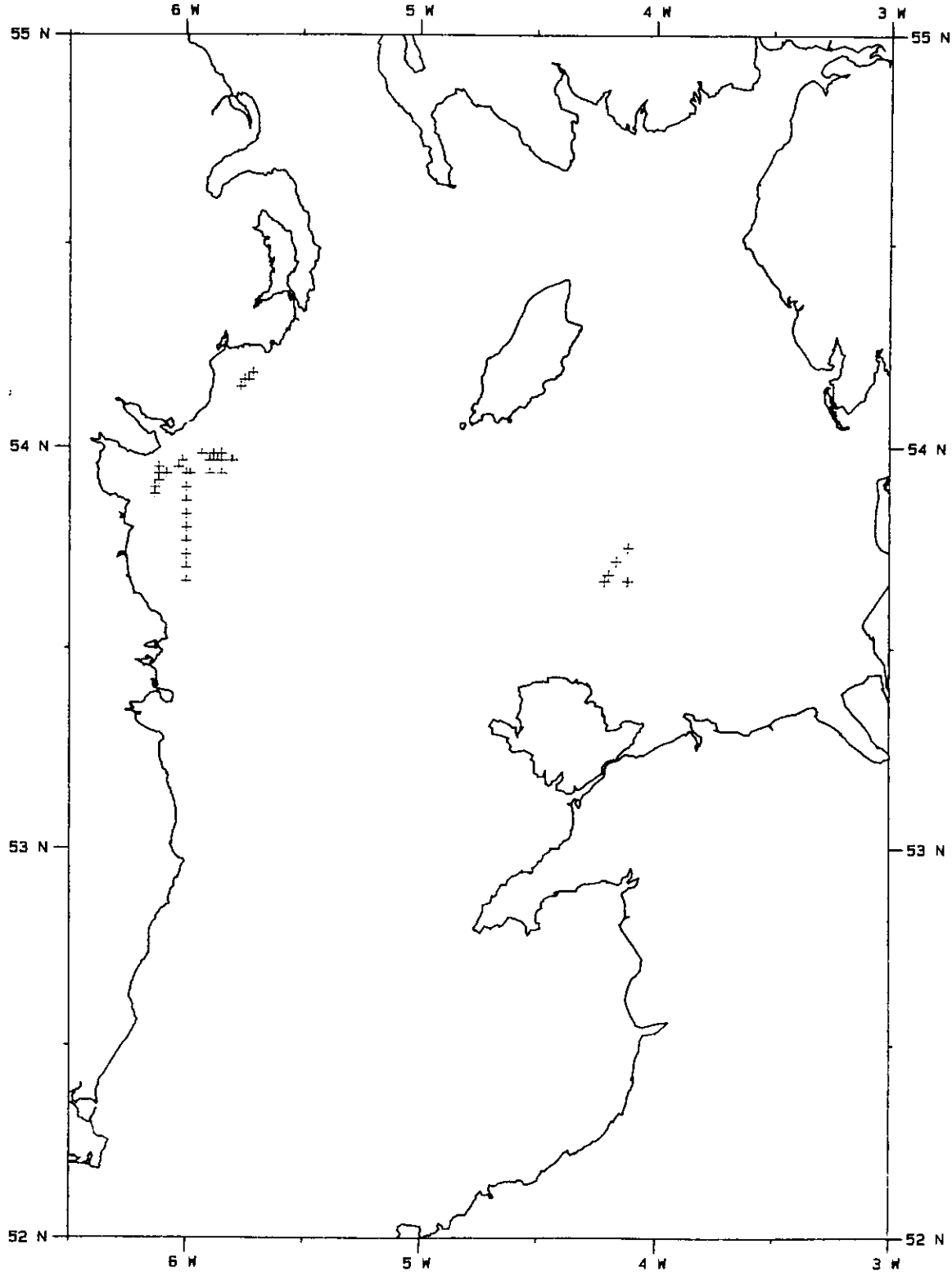

Fig. 4 LOWESTOFT SAMPLER CHALLENGER 87

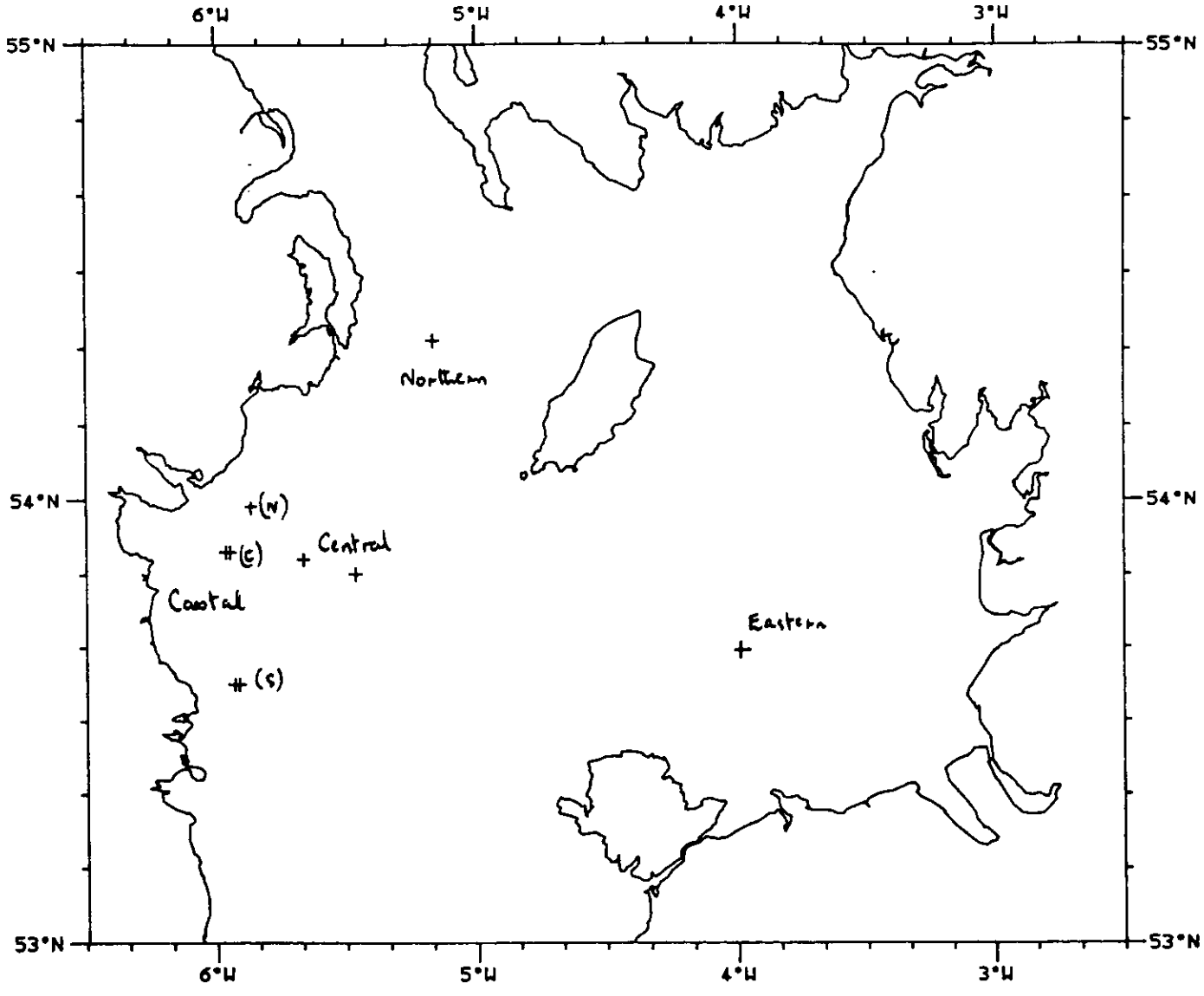

Fig. 5 LHPR TOWS CHALLENGER 1987

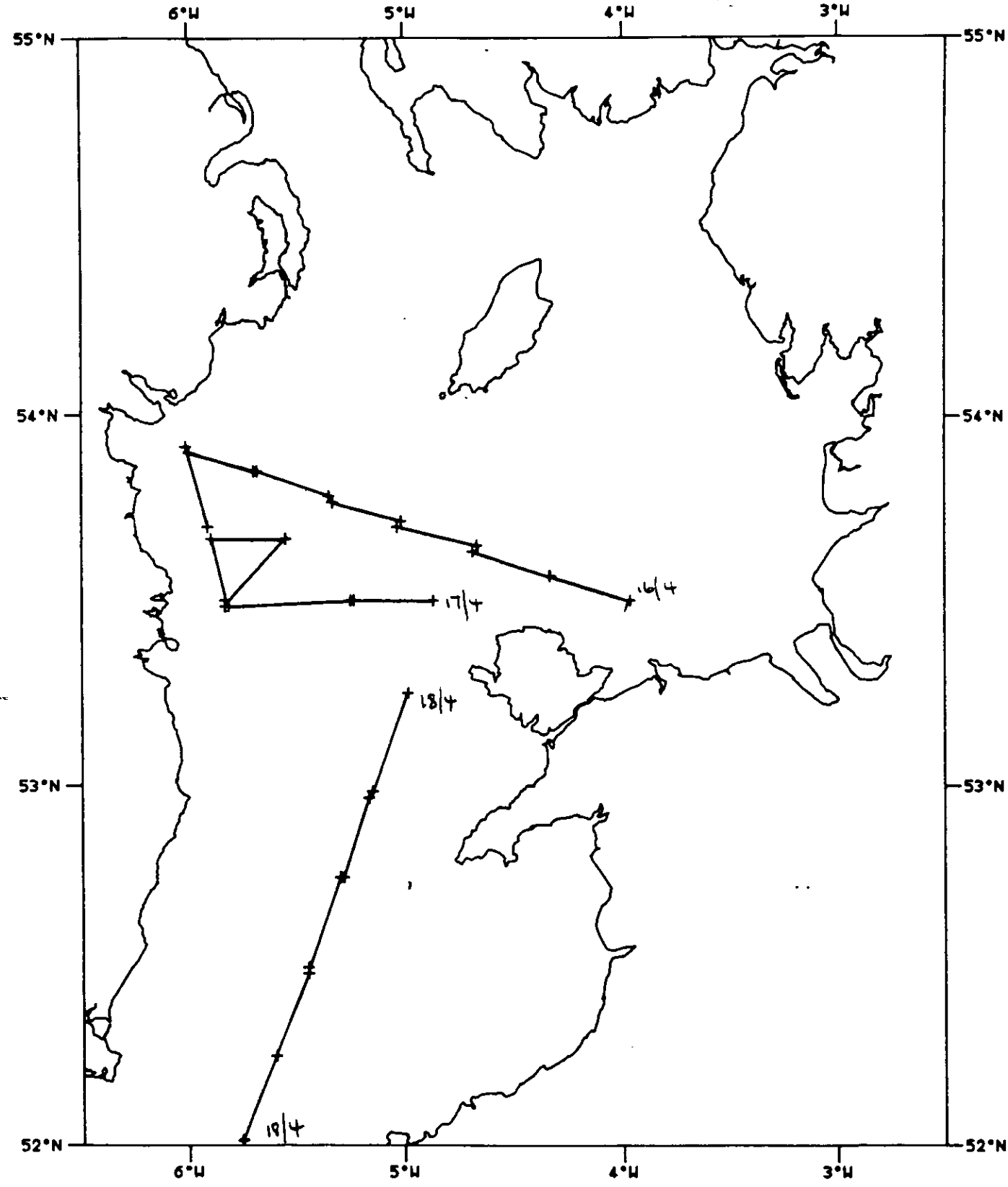

Fig 6. CHALLENGER 87 UOR TOWS (3)