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

1993 RESEARCH VESSEL PROGRAMME

REPORT: RV CIROLANA: CRUISE 11
(PROVISIONAL: Not to be quoted without prior reference to the author)

DURATION: 23 November - 21 December
(Planned 23 November - 22 December)

STAFF:

K S Leonard (SIC)	
M B Lovett	23-29 November
R D Ibbett	
D McCubbin	
P Blowers	
H S Emerson	23 November-3 December
R Bonfield	
B Taylor	23-29 November
A J Poole	30 November-3 December
D J Allington	29 November-3 December
A K Young	29 November-3 December
N D Pearson	3-8 December
J M Rees	3-8 December
P Murray (U Cambridge)	3-8 December
J F Knowles	8-21 December
L N Greenwood	8-21 December
T Brooks	8-21 December
I T McMeekan	8-21 December
A Downes (U C Dublin)	8-21 December
L Leon (U C Dublin)	8-21 December
H Fjelldal (NLH, U Norway)	8-21 December

AIMS:

1. To collect and process surface water from UK coastal waters for the analysis of Tc, Cs, Sb and transuranic radionuclides as part of the Enhanced Actinide Removal Plant survey (AE0114A, Nuclear Fission Safety Programme).

2. To compare the spatial distribution of the present oxidation state of transuranium elements discharges into the Irish Sea from Sellafield with discharges into the Channel from Cap de La Hague (AE0114A).

3. To collect a large volume sample of surface Atlantic water for low level radionuclide intercomparison purposes (AE0114A).

4. To study the surface sediment and water concentrations of U, Th, Ra, Po and Pb radionuclides and nutrients in the immediate vicinity of the Marchon outfall and further

offshore in the eastern Irish Sea. Part of this work is to be done in conjunction with a small charter vessel (AE0115A).

5. To recover tetrapod and quadrapod from west of Barrow and current meters from the North Channel (AE0207A, AE0128A, U Cambridge).

6. To conduct further studies to determine changes in the actinide colloidal distributions in both surface and bottom waters using a variety of innovative techniques at a number of key sites (AE0114A, U C Dublin, U Norway).

7. To collect live Dab from a contaminated region of Liverpool Bay and a relatively clean region of Cardigan Bay for an ongoing study of the effects of pollutants on Dab chromosomes (AE0116A).

NARRATIVE:

RV CIROLANA sailed from Lowestoft at 1745h on 23 November 1993. A short delay (1-2 hrs) was necessary prior to departure to enable a fault in the ship's gyro compass to be repaired. The ship proceeded south (see figure 1) and during the period 24-26 November a grid of surface water stations was worked along the French coast of the English Channel, including a cross-Channel transect. Water samples were processed for a range of radionuclide analyses and duplicate samples (0.45µm filtered) were taken on behalf of IPSN/CEA for intercomparison purposes - these conditions were imposed to allow sampling in certain French territorial waters. Unfortunately, upon arriving at a station in the vicinity of Cherbourg, on the 25 November permission to collect samples around the Cap de La Hague nuclear installation was withdrawn by the French authorities. Prior to departure from Lowestoft, permission had been granted subject to a number of conditions. As a consequence some of the proposed sampling stations were moved outside the restricted area and two important stations around the Cap de La Hague were removed from the work programme.

The ship then proceeded to the Scilly Isles and during the period 27-28 November a further grid of surface water stations was carried out for radionuclide analyses in the Celtic Sea. Despite deteriorating weather conditions CIROLANA proceeded slowly to the Irish Sea carrying out further sampling en route. Figure 2 provides station locations for subsequent work (excluding the Marchon survey) carried out in the Irish Sea.

On Wednesday 29 November, although the weather conditions were not favourable, an exchange of scientific staff took place off Whitehaven between CIROLANA and the charter vessel LADY EMMA. Inshore samples collected using the charter vessel were also transferred to CIROLANA for processing. During mid morning CIROLANA commenced the Marchon survey extending from the Saltom Bay area (as shown in figure 3) collecting both water and surface sediment samples for natural radionuclide and nutrients analyses. A further planned rendezvous between the charter vessel and CIROLANA was abandoned because of poor weather conditions but a scientist and further inshore samples were successfully brought aboard CIROLANA on 30 November. The remainder of the Marchon work programme was successfully completed by the 3 December. Also during the period 29 November-3 December the opportunity was taken to complete the majority of stations for artificial radionuclide determinations in the N E Irish Sea.

A further transfer of scientists took place on the afternoon of 3 December by pilot boat from Workington in poor weather and CIROLANA proceeded to the North Channel. On the morning of 4 December, in strong winds, recovery of MAFF and POL (Proudman Oceanographic Laboratory) current meters was carried out. Afterwards CIROLANA sailed to the west of Barrow and recovered the tetrapod, quadrapod and guard buoys on 5 December, again in poor weather. The ship then returned to the North Channel, via a route along the east coast of Ireland, completing water stations for radionuclide determinations in the western Irish Sea. Overnight of 6/7 December a CTD section (8 stations) was carried out across the North Channel along the line of current meter moorings. With the work programme completed on schedule and time in hand, a number of sediment samples using the NIOZ corer were collected around the Sellafield area. This work, originally planned for later in the cruise, was brought forward.

To avoid forthcoming poor weather, CIROLANA docked at Barrow-in-Furness on the evening tide of Tuesday 7 December for the mid-cruise break. The following day an exchange of scientists and gear took place. Because of prolonged bad weather CIROLANA was unable to depart from Barrow until the evening tide on 9 December. An attempt to proceed to Cardigan Bay to commence fishing for dab in a relatively uncontaminated area, was aborted because of poor weather and CIROLANA sheltered off Anglesey overnight. CIROLANA anchored briefly and the proceeded to Liverpool Bay on the morning 10 December. En route two surface water sample were collected to compare the colloidal distributions of plutonium inside and outside the bay area. Trawling for dab in the contaminated area of Liverpool Bay commenced at midday.

After 3 trawls in Liverpool Bay the main trawl winch failed. An attempt to repair the winch was aborted because of bad weather and an anchor was lost shortly afterwards. Later, attempts to retrieve the anchor were also unsuccessful. CIROLANA proceeded to the east coast of the Isle of Man to shelter and to take the opportunity to repair the winch. The ship then sailed to the Sellafield outfall and on the evening of 11 December large volume water samples (surface and bottom) were collected for radiocolloid experiments to be carried out. CIROLANA returned to Liverpool Bay and on the 12 December two further trawls were taken by which time adequate numbers of dabs had been caught. Further attempts failed to recover the lost anchor.

Prior to proceeding to Cardigan Bay one final visit to Sellafield was made, on the evening of 12 December to collect fresh surface water to continue radiocolloid studies. Unfortunately without a bow thruster it was not possible to collect bottom waters using the CTD array. Trawling in Cardigan Bay commenced in the early hours of 13 December and continued throughout the day (9 trawls).

CIROLANA proceeded to the North Channel and on the morning of 14 December collection of surface water samples for the analyses of artificial radionuclides from UK coastal waters recommenced. The remainder of the scheduled water sampling stations were visited en route including the Mull of Kintyre, through to the north Scottish coast, north of the Shetlands and a grid in the North Sea as indicated in figure 1. The schedule was timed to allow the chemical processing to be completed between sampling stations. However, because of extremely poor weather and a large volume spill (seawater sample) in one of the laboratories some processing could not be completed prior to docking.

CIROLANA docked at Lowestoft at 0100h on 21 December. Although extremely unfavourable weather conditions were experienced for long periods of the cruise damage to the scientific programme was quite small. Our success was undoubtedly helped considerably by the enthusiasm and first class support provided by the Master, the ship's officers and crew for which we record our gratitude.

RESULTS

1. Samples of 50 litres x 2 surface seawater were collected from 72 locations around the UK coast and passed through ion exchange columns to extract ^{99}Tc and Cs radionuclides. At 50 sites, 50 litres surface seawater samples were collected and ^{125}Sb was extracted by co-precipitation methods. Further radiochemical purification and radiometric assay will take place at the Lowestoft laboratory. The primary purpose of this survey is to establish the baseline and elevated concentrations for key radionuclides from the new BNF Enhanced Actinide Removal Plant (EARP). In addition small volume samples (100 ml) were taken at 26 locations for ^{3}H analysis by UCD.

2. Samples of 50 or 100 litres of surface seawater, collected from 25 locations, were subjected to preliminary chemical separation procedures to isolate ^{241}Am, and the higher and lower oxidation states of plutonium and ^{60}Co. The information will provide a basis to compare the spatial distribution of transuranic elements discharged from Sellafield and Cap de La Hague. Although some of the sampling sites from the latter location were not permitted an attempt will be made to have the required samples collected by our French colleagues.

3. A large volume of Atlantic seawater was collected for laboratory experiments.

4. Samples of surface water and sediments for natural radionuclide, nutrient and suspended particulate matter determinations were collected at a total of 57 stations extending from the Saltom Bay area. A background Ra water sample was also collected to the south-east of the Isle of Man (54.00.00N 04.25.00W). Preliminary separation of U, Th, Pb and Po radionuclides, and the initial filtration of water samples for Ra, took place on board. Nutrient samples were filtered and preserved with $HgCl_2$ and taken ashore for further analysis at Lowestoft. Surface sediment samples were collected in Whitehaven and Harrington Harbours for natural radionuclide, grain size and geochemical analysis. This programme of work undertaken 18 months after the Albright & Wilson Marchon works ceased processing phosphate ore forms part of a down-run study of the environmental changes in concentrations of natural radionuclides and nutrients as a consequence of this change. Samples have previously been collected: prior to cessation of ore processing, 6 months later (December 1992) and 1 year later (May 1993).

5. The tetrapod, quadrapod and guard Buoys were successfully recovered from their long deployment (laid on CIRO 9/93). The tetrapod and Acoustic Backscatter Sensor (ABS) loggers were full with 700 and 137 bursts, respectively. The Benthic Acoustic Stress Sensor (BASS) logger had only 59 instead of 534 bursts. The cause is suspected to be a hard disc error handling fault. Five of the 12 syringes on the quadrapod

operated successfully. Data will be worked up at the Lowestoft laboratory. Current meter mooring site A was recovered intact. Although mooring site C was recovered only one of the three current meters was retrieved. The POL mooring in Belfast Loch, reported as moved, was recovered with neither of its two current meters attached. Dragging operation to recover the POL current meters and mooring site B were unsuccessful. Initial results from the CTD section across the North Channel show a horizontal temperature gradient - decreasing from west to east. There are also indications of a 'slug' of warm salty water in the bottom of the North Channel.

6. Samples of 250 litres of seawater (surface and bottom) were collected at three carefully selected locations in the Irish Sea for the study of radiocolloids. Samples were fractionated using 0.45μm membrane filters and 1k Dalton (MWCO) ultrafilters. Aliquots (totals, permeates and retentates) were taken for transuranic and oxidation state determinations with initial chemical separations being carried out on ship. Water samples (200 litres) were also collected by UCD and NLH at the locations and fractionated through 0.45μm 3k and 1k filters. Aliquots collected by UCD were also passed though a series of Al_2O_3 beds as an alternative means of colloid fractionation. Similar analyses to those carried out by MAFF will be undertaken and the results compared. Hollow fibre ultrafiltration, using 0.45μm, 100k, 30k, 10k and 3k filters, was carried out by MAFF to fractionate a bottom water sample. Particle size determinations on the different fractions using scanning electron microscopy will be carried out in Norway.

7. From the trawls in Liverpool Bay a total of 37 female dab were successfully processed board to give cytological preparations. Ovaries from 15 dab were fixed in formalin for future analysis of atresia. In addition, a sample of 20 dab of mixed sex was frozen for A Franklin at Burnham. Samples of small whiting also requested by A Franklin were collected from Liverpool Bay. From Cardigan Bay only 20 female dab were available for processing and only 6 survived to give cytological preparations. The high mortality rate almost certainly resulted from rough sea conditions. No fish were available to provide fixed ovaries.

K S Leonard (SIC)
17 February 1994

SEEN IN DRAFT

R J (Captain)
M R (Fishing Skipper)

INITIALLED: PGS

DISTRIBUTION:

Basic List +
Staff on cruise

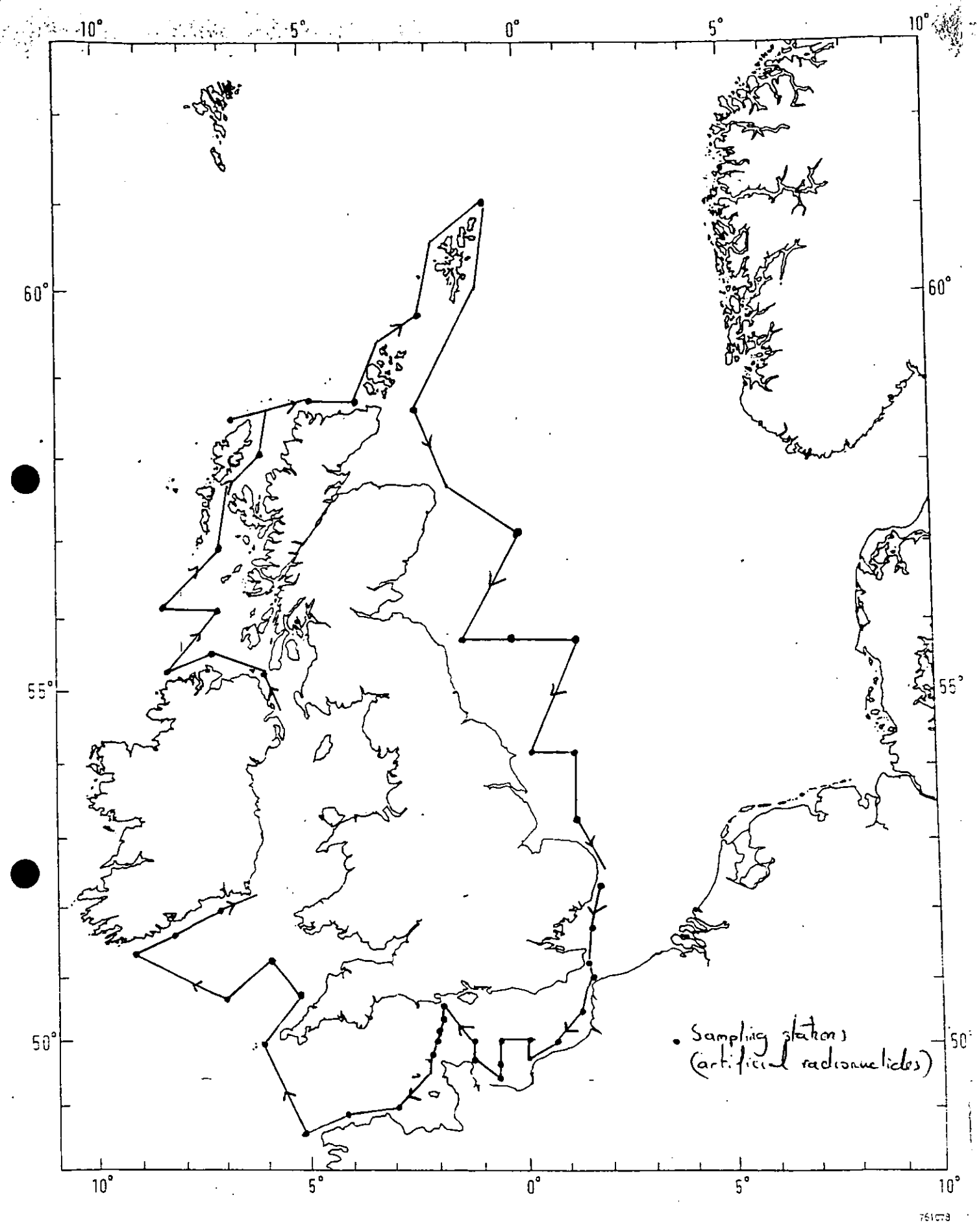


FIGURE 1

CIROLANA 11/93

23 NOVEMBER – 21 DECEMBER 93

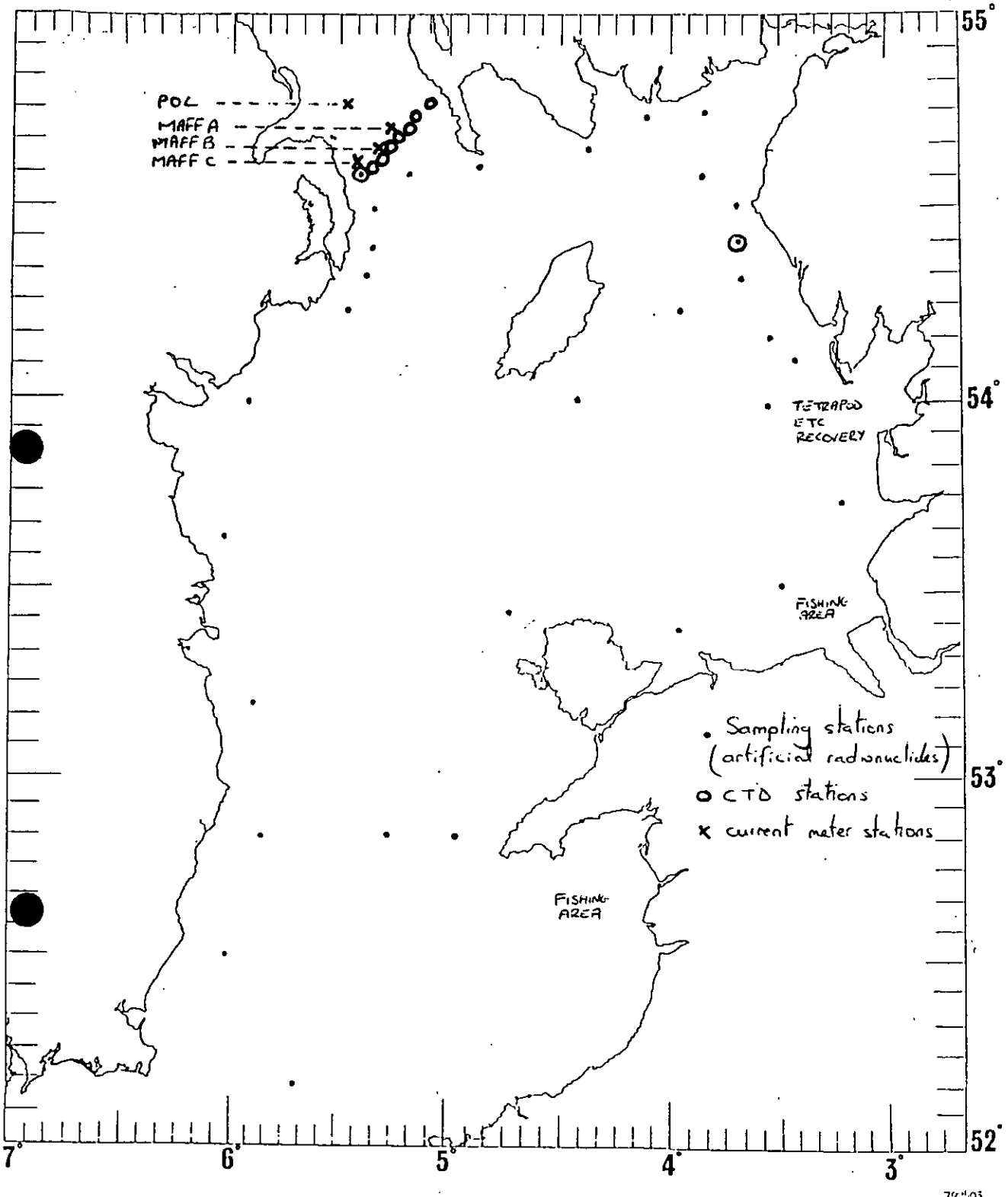


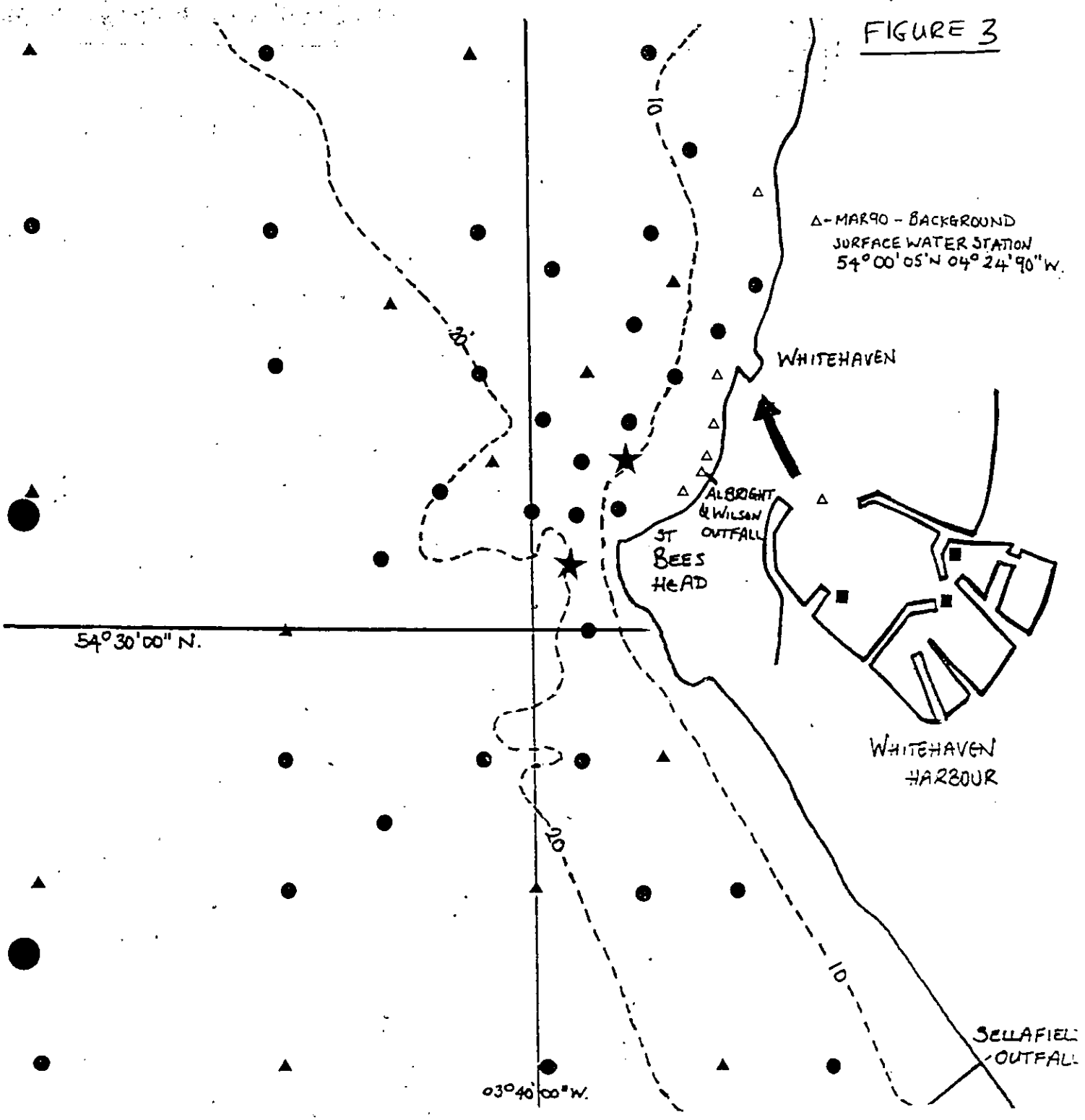
FIGURE 2.

CIROCANA 11/93

28 NOVEMBER - 13 DECEMBER 93

MARCHON V - CIROLANA 11/93 (29th NOVEMBER - 3rd DECEMBER 1993)

FIGURE 3



★ - Surface waters for Ra, Pb, Po, Th and U radionuclide, nutrient, suspended load and salinity analysis plus sediments for geochemical, grainsize and Ra, Pb, Po, Th and U radionuclide analysis

■ - Sediment samples for geochemical, grainsize and Ra, Pb, Po, Th and U radionuclide analysis

▲ - Surface waters for dissolved ^{226}Ra determination and nutrient, suspended load and salinity analysis and sediments for geochemical, grainsize and Ra, Pb, Po, Th and U radionuclide analysis

△ - Surface waters for dissolved ^{226}Ra determination and nutrient, suspended load and salinity analysis

● - Surface water samples for nutrient, suspended load and salinity analysis