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FRV *Clupea*

Cruise 0701C

REPORT

22 May - 11 June 2001

Personnel

S P R Greenstreet	(SIC)	
H M Emmerson		
M Robertson		(22 May to 4 June)
G Holland		(24 May to 11 June)
O Ross	Visitor	(22-23 May and 31 May to 11 June)
F Armstrong		(5-9 June)
F Kennedy		(31 May to 4 June)
J Dunn		(22-23 May and 10-11 June)
C Hall		(22-23 May)

Cruise Objectives

1. To service three hydrographic monitoring moorings, one near the Stonehaven transect, and two in the Wee Bankie/Marr Bank study area.
2. To investigate the density distribution of sandeels buried in the sediment by carrying out a nocturnal stratified random Day grab survey across the Wee Bankie/Marr Bank study area. All sandeels caught will be measured, weighed and have their otoliths collected for age assessment.
3. To investigate variation in sandeel population age structure at different locations on the Wee Bankie and Marr Bank from samples collected using the Sandeel dredge.
4. To carry out a demersal trawl survey to determine the abundance and distribution of whiting, haddock and cod, the main fish predators of sandeels. At each trawl station the length frequency of all fish species caught will be determined. Sub-samples of the three gadoids will be weighed to determine length-weight relationships. Otoliths will be taken to determine age composition. Stomach samples will be collected to establish diet and food consumption rates, and livers and gonads will be removed to determine Hepato- and Gonado- Somatic Indices. (Any sandeels and clupeid fish caught during the demersal trawling will be worked up to determine length frequency distributions, length-weight relationships and age composition.)
5. To determine spatial variation in water temperature and salinity across the Wee Bankie/Marr Bank study area using a Seabird CTD sampler. Approximately 40 vertical dip stations will be sampled utilising the demersal trawl stations and additional locations mid-way between the trawl stations. The dual Bongo net may be deployed with the CTD to collect Zoo- and Phyto-plankton samples.

6. To undertake an acoustic survey of sandeels and clupeid fish in the water column using 38 and 120 kHz. Concentrations of fish will be sampled using the pelagic trawl. Species composition and length frequency distributions of fish caught will be determined. Sub samples will be weighed and their otoliths removed to establish length-weight relationships and age composition.
7. During the acoustic survey, Expendible Bathy-thermographs (XBTs) will be deployed to determine more precisely the locations of the boundaries between mixed and stratified water.
8. To conduct a RoxAnn survey of the substrate in the study area to investigate variation in the sandbank structure between this and previous cruises.
9. To conduct a survey of seabirds using the study area, to determine their abundance and distribution, using standard census methods.
10. To record all sightings of marine mammals (number of animals, species if possible, and their location) observed during the course of the cruise.
11. To conduct a hydrographic survey along a transect offshore of Stonehaven. At pre-selected locations the Seabird CTD sampler and the dual Bongo net will be deployed using a vertical dip. Water samples will be collected for salinity, nutrient and phytoplankton analysis. The 1 m plankton net will be deployed using a double oblique tow between selected stations along the transect.

Out-turn days per project: C683 16 days; MF0463 5 days.

Narrative

The scientific equipment was loaded on board *Clupea* on 19 May. Scientists joined *Clupea* at Fraserburgh at 0940 hours BST on the morning of 22 May 2001 and the vessel sailed at 1000 hours. Equipment in the laboratory was set up whilst the vessel was on route to the hydrographic instrument mooring off Stonehaven. *Clupea* arrived at the mooring at 1430 hours. On inspection it was apparent that the mooring had been tampered with; the top current meter and flurometer were wrapped around one another and both instruments had suffered damage. All the instruments were replaced. The mini-logger mooring was then serviced and all the mini-loggers downloaded. After completing servicing of the instrument moorings a deployment of the CTD and flurometer was made and salinity and chlorophyll calibration samples collected at the water surface, seabed and at a depth of 25 m, the depth of the flurometer on the instrument mooring. Work was completed by 1700 hours and the vessel sailed for anchorage in Lunan Bay, arriving at 2100 hours.

The following day *Clupea* sailed at 0600 hours to service the two instrument moorings in the main study area, arriving on station at the Marr Bank mooring at 1100 hours. The mini-logger mooring was immediately recovered to allow downloading of the mini-loggers whilst work was carried out on the main instrument line. This was successfully recovered and the flurometer and two current meters were replaced. Both moorings were re-deployed and a CTD dip was made. Again three lots of calibration samples were collected. Work at this station was completed by 1230 hours and *Clupea* sailed for the instrument mooring on the Wee Bankie. On arrival at 1500 hours, no sign of the mini-logger mooring could be seen. The current meter and flurometer mooring was serviced successfully, although problems with the flurometer were apparent. A replacement mini-logger line, consisting of four loggers instead of the original eight, was set up and deployed. A CTD dip was made and calibration samples collected. Figure 1 shows the location of the three CTD dips at the instrument mooring locations. Work at the Wee Bankie mooring site was completed by 1620 hours and *Clupea* then sailed for Montrose, arriving at

1945 hours. John Dunn, Oliver Ross and Chris Hall left the vessel and Gayle Holland joined.

Clupea remained at Montrose through the day on 24 May, sailing at 1800 hours to commence nocturnal grab sampling. Over the following three nights 133 stations were sampled for a total catch of 17 sandeels (Figure 2). These were measured to the 1/2 cm, below, weighed to 0.1 g, and had their otoliths removed for age determination. During the days of 24, 25 and 26 May *Clupea* anchored at Pease Bay.

Whilst carrying out this work numerous shoals of sandeels were observed in the water column on the echo sounder. It was concluded that the sandeels were spending most of the night in the water column, rather than returning to the sediments during the hours of darkness. Since this particular cruise was approximately four weeks earlier in the year than the four previous summer cruises, this could reflect seasonal variation in sandeel emergence behaviour. It was clear that continuing the grab sampling was pointless. On 27 May therefore, *Clupea* set off at 1830 hours to carry out some dredge sampling in an effort to catch sufficient sandeels for age and length composition analysis, and to compare the age and length composition of sandeels caught on different banks. Stations on Berwick's Bank and on the Wee Bankie were sampled during this first night (Figure 3). *Clupea* anchored in St Andrews Bay during the day on 28 May. During the night of 28 May, a further station off St Andrews Bay was sampled, but gale force winds prevented any additional work further offshore. *Clupea* therefore sailed for Montrose to make the next personnel and equipment changes. On 29 May, the mooring equipment, sandeel dredges and Day grabs were taken off the boat and the demersal Jackson Rockhopper fishing gear was loaded. Fiona Kennedy and Oliver Ross joined the vessel.

Clupea departed Montrose at 0400 hours on 30 May to commence demersal fishing operations and to sample the grid of CTD stations. This work continued over the next five days with the vessel anchoring at St Abbs on the nights of 30 and 31 May, south of Dunbar on 1 June and off Carnoustie on 2 June. A total of 19 demersal stations were fished (Figure 4). The total numbers at length (to the 1/2 cm below for herring, sprats and sandeels, and to the cm below for all other species) of all species in each catch was determined. Samples of herring, sprats and sandeels were weighed to the nearest 0.1 g to determine length-weight relationships and otoliths were collected to determine age at length keys. Samples of whiting, haddock and cod were weighed to the nearest 0.2 g to determine length-weight relationships and otoliths were collected to determine age at length keys. Stomach samples were also taken to determine diet and daily food consumption rates. Livers and gonads were extracted to establish Hepato-Somatic and Gonado-Somatic indices.

At each demersal fishing station, and at locations approximately mid-way between the fishing stations, the CTD and flurometer was deployed. In all 44 deployments were made (Figure 5). At certain stations the dual bongo net was set up to sample zoo- and phyto-plankton as the CTD was deployed (Figure 6). Water samples were also collected at some stations, at variable depths, to obtain chlorophyll (Figure 7) and salinity (Figure 8) samples to calibrate the flurometer and CTD.

Demersal fishing and CTD sampling work was completed by the morning of 3 of June and *Clupea* sailed for Montrose for the second equipment and personnel exchange. Fiona Kennedy left the vessel on 3 June. On 4 June the demersal fishing gear was exchanged for pelagic gear. Mike Robertson left the vessel and Eric Armstrong joined.

Clupea departed Montrose at 1130 hours on 4 June to commence acoustic survey of sandeels and clupeids in the water column, and survey of seabirds and marine mammals at sea in the study area. This work continued over the following five days during which time the vessel anchored at night at St Andrews on 4 and 8 June, St Abbs on 5 June, off Dunbar on 6 June, and off Pittenweem on 7 June. Concentrations of fish in the water column were sampled by pelagic trawl to determine species and length composition (Figure 9). The total catch of each species

at length was determined. Clupeids and sandeels were measured to the 1/2 cm below and, as previously, length stratified samples of each species were weighed (to 0.1 g) to establish weight-length distributions. Otoliths were also taken from these length stratified samples to determine age at length. Acoustic data were integrated over five minute periods. The centre points of all such periods of acoustic survey are shown in figure 10.

Survey of seabirds at sea was undertaken over nearly all the track shown in figure 9. Data were aggregated over the same five-minute periods of acoustic integration to allow direct comparison of predator abundance and prey density. Standard survey techniques were employed, incorporating as far as possible, recent developments to allow greater description of bird behaviour at sea. On 8 June a mini acoustic fish and seabird survey, focused on the sea area around the Isle of May, was undertaken to try and relate seabird distributions at sea more directly to radio-tracking data in the area. During this mini-survey the acoustic data continued to be integrated over five minute periods. However, in order to try and provide fine resolution of the seabird at sea distribution on the much shorter transects, the seabird data were aggregated over one-minute intervals (Figure 11).

RoxAnn data were also routinely collected throughout the entire duration of the acoustic survey. These data were averaged in 10 s time-bins over the track indicated in figures 10 and 11. These data will be used to generate maps of seabed characteristics for comparison with previous maps. These data will help to determine the distribution and location of suitable sandeel habitat, and to examine the stability of such habitats.

Over the course of the acoustic survey, Expendable Bathy-Thermographs (XBTs) were deployed to explore, in finer resolution, variation in the thermal profile of the water column. The aim here was to define the locations of fronts between mixed and stratified water more precisely. Figure 12 indicates where these XBTs were deployed.

Acoustic survey, seabird survey, Roxann survey and XBT depolyments were all completed by early afternoon on 9 June and *Clupea* sailed once again for Montrose. Eric Armstrong and Oliver Ross left the vessel and John Dunn rejoined it. *Clupea* sailed at 0400 hours to carry out four hours of hydrographic and plankton sampling along a transect off Stonehaven. Figure 13 shows the location of the stations sampled and indicates the type of sampling carried out at each station.

At 1030 hours, *Clupea* broke off this work and sailed for Fraserburgh, arriving at 1630 hours. The scientific equipment was unloaded during the morning of 11 June and scientists left the ship at 1100 hours.

S P R Greenstreet
13 July 2001

Seen in draft: A Simpson (OIC)

Figure 1. Location of the CTD dups made at the three instrument mooring sites.

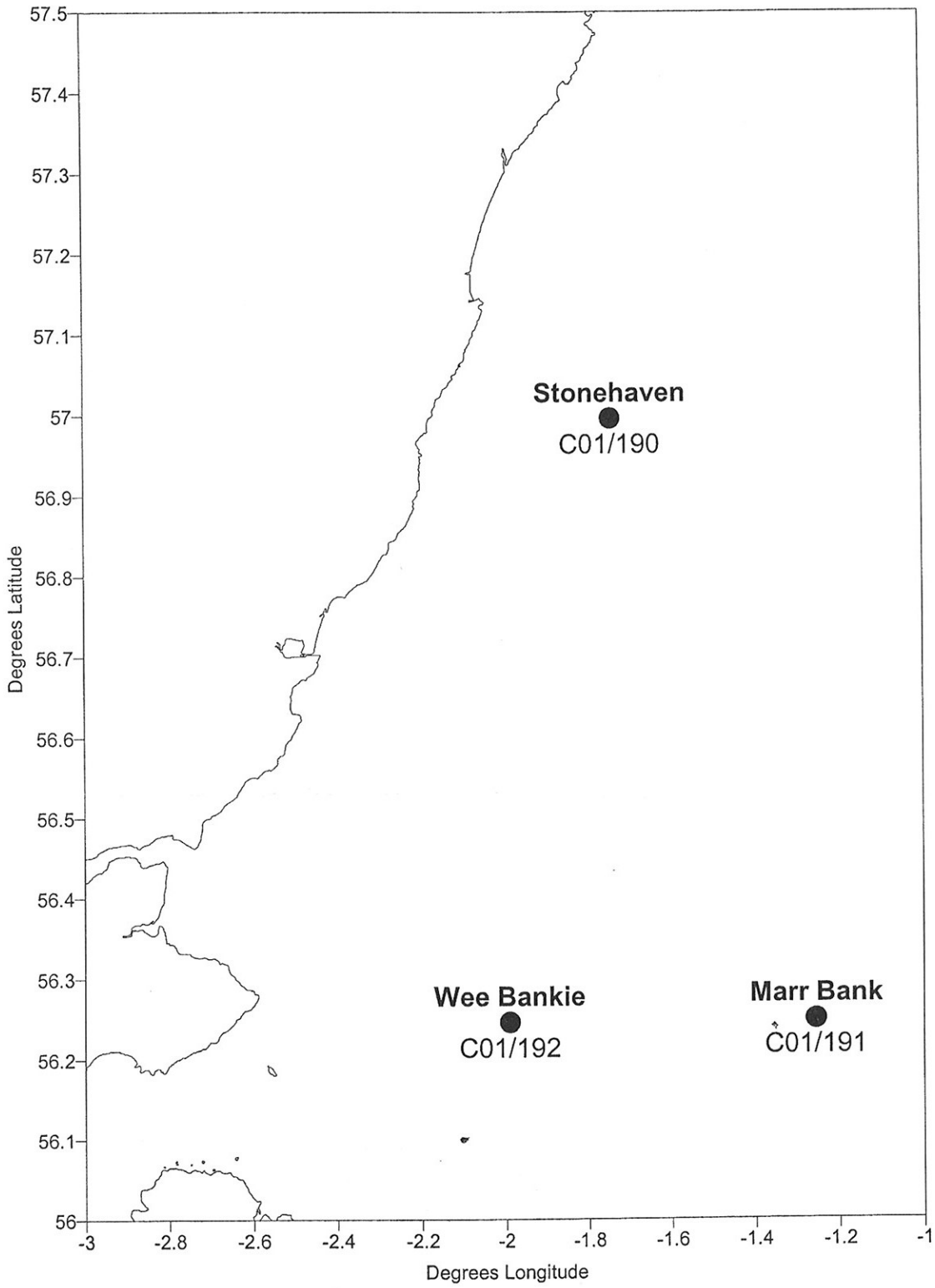


Figure 2. Location of the grab sample stations actually sampled.

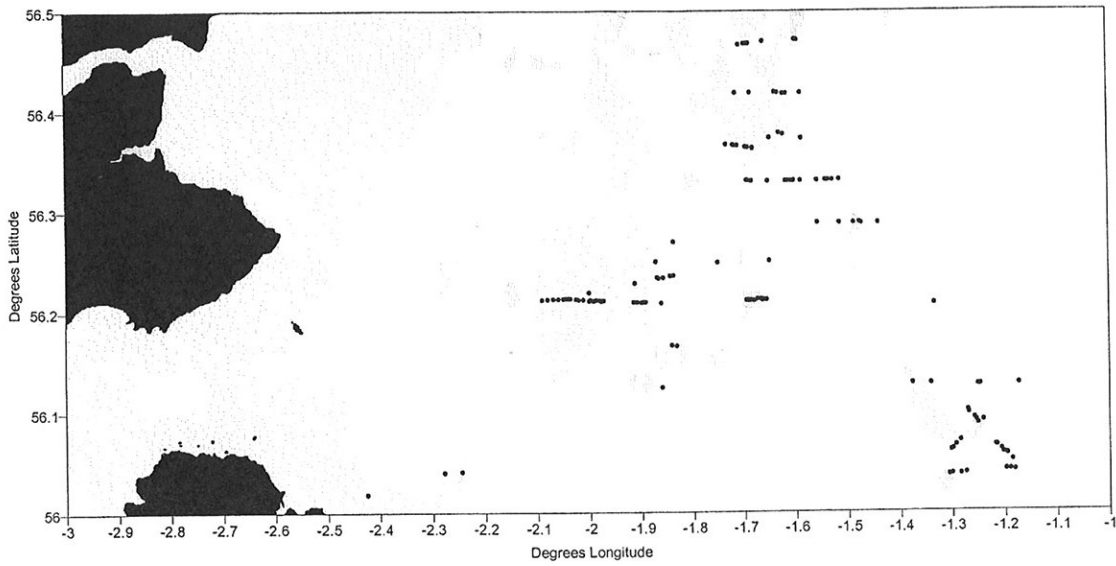


Figure 3. Position of Sandeel Dredge samples.

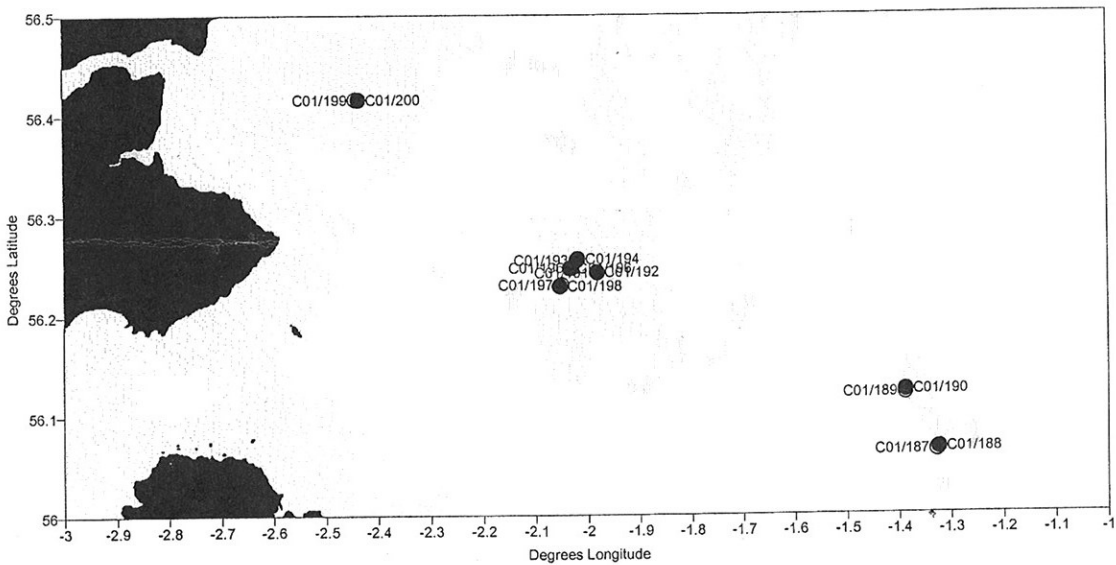


Figure 4. Locations of demersal trawling stations.

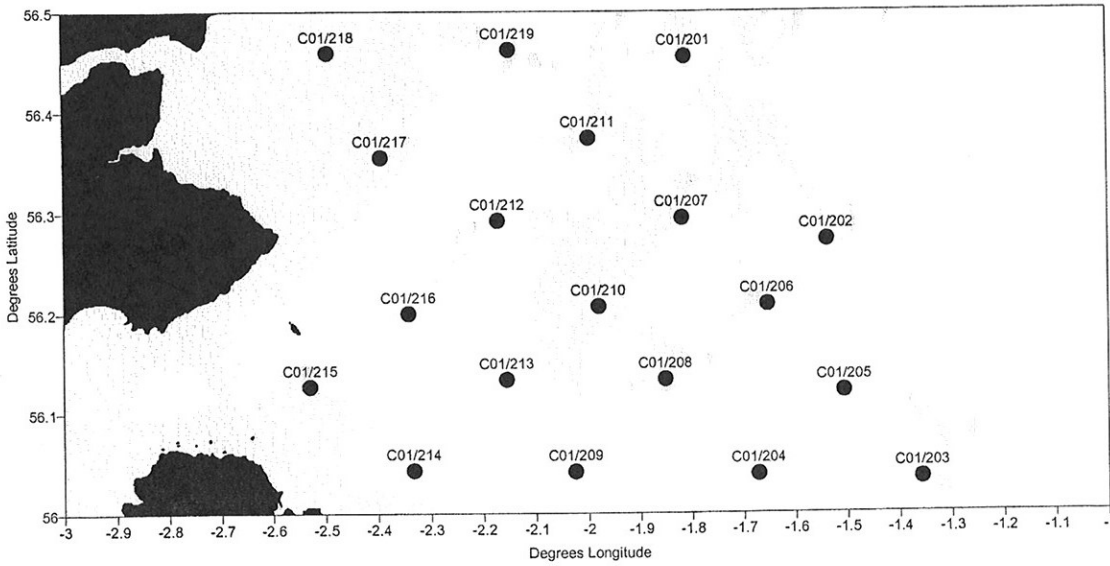


Figure 5. Location of CTD/Flurometer dips.

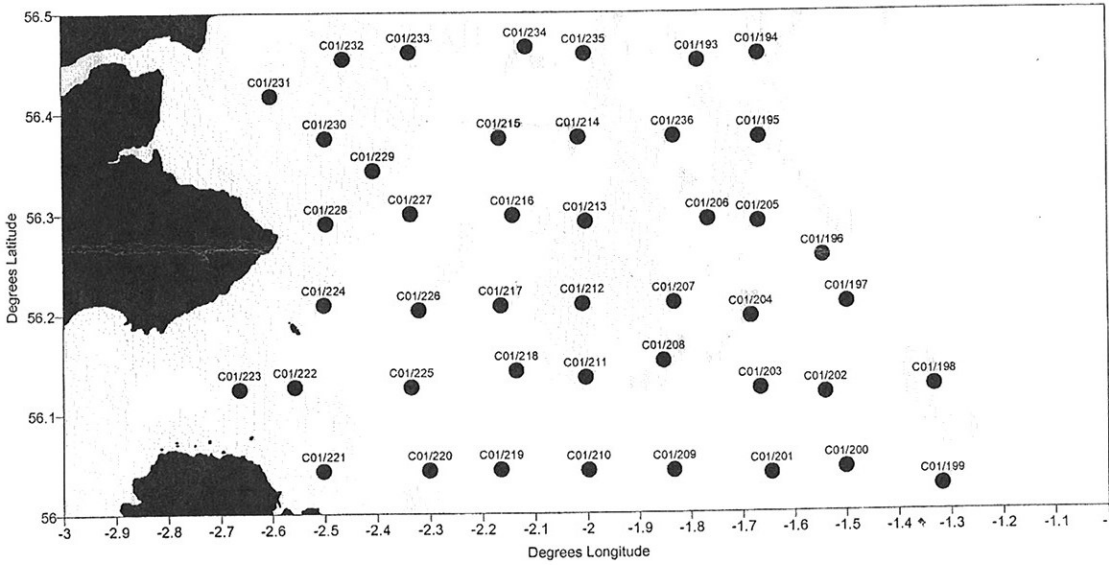


Figure 6. Locations where vertical Bongo net plankton sampling was undertaken (circles = zooplankton samples, crosses = phytoplankton samples).

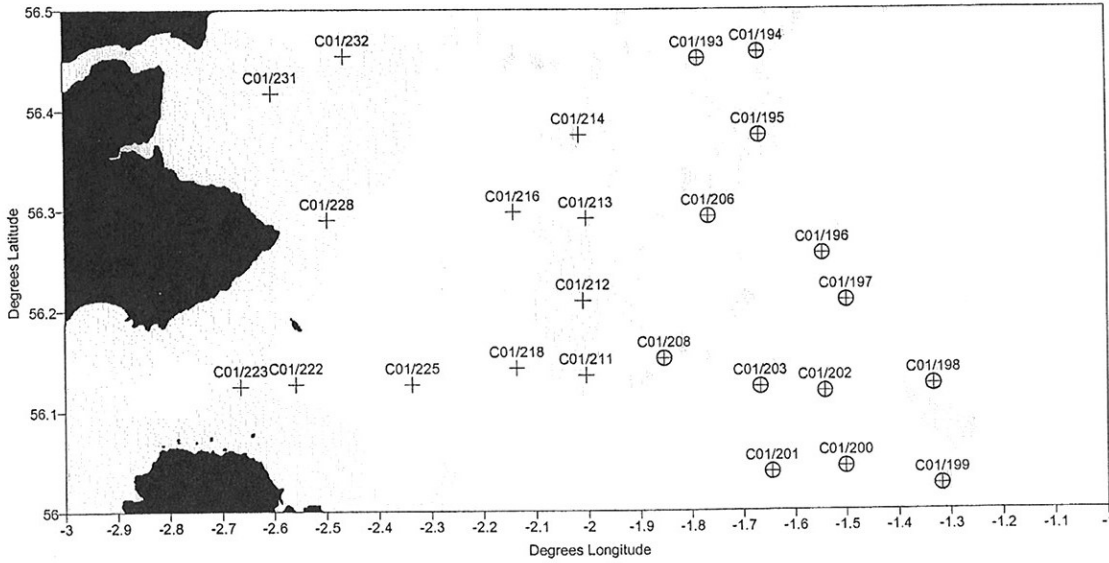


Figure 7. Locations where chlorophyll samples were collected to calibrate the flurometer. Numbers indicate the depth of the sample.

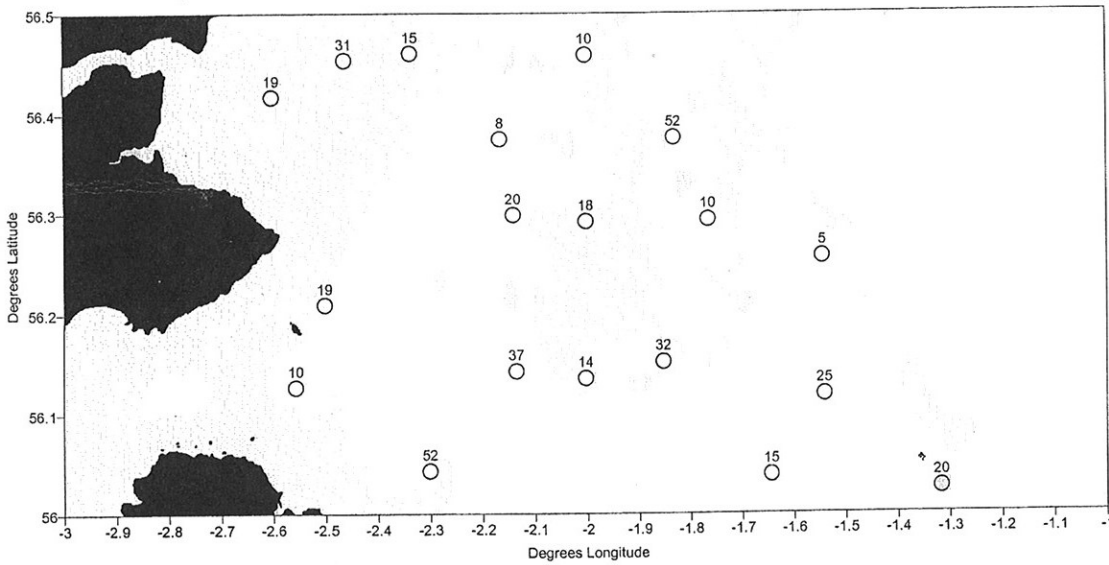


Figure 8. Locations where salinity samples were taken to calibrate the CTD. Numbers indicate the depth of the sample.

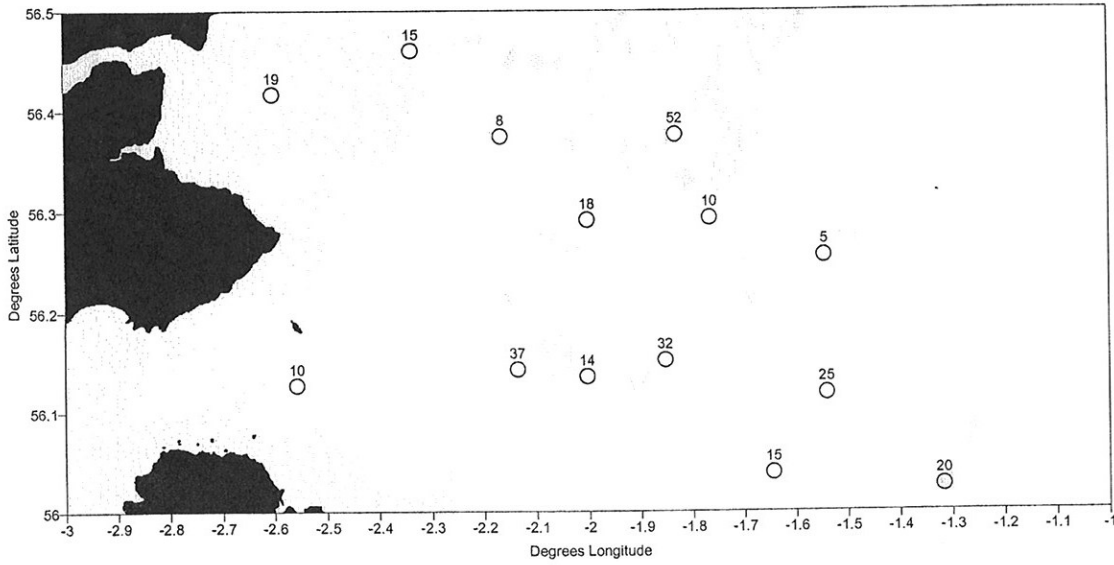


Figure 9. Locations of the pelagic trawl samples.

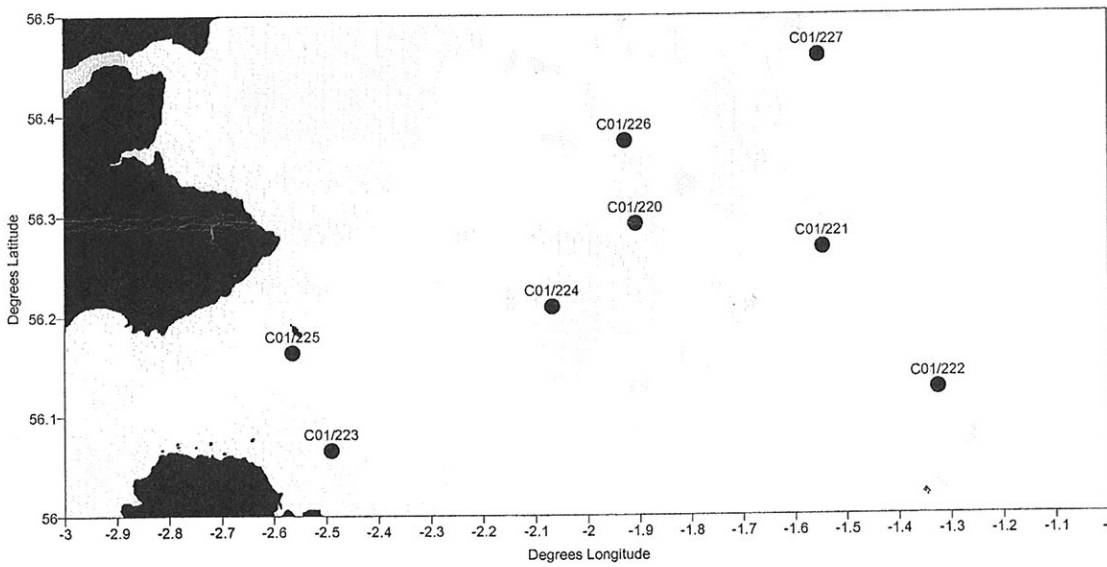


Figure 10. Acoustic survey and seabird survey track. Circles indicate the centre points of the five-minute acoustic integration periods. Filled circles show where seabird survey was undertaken.

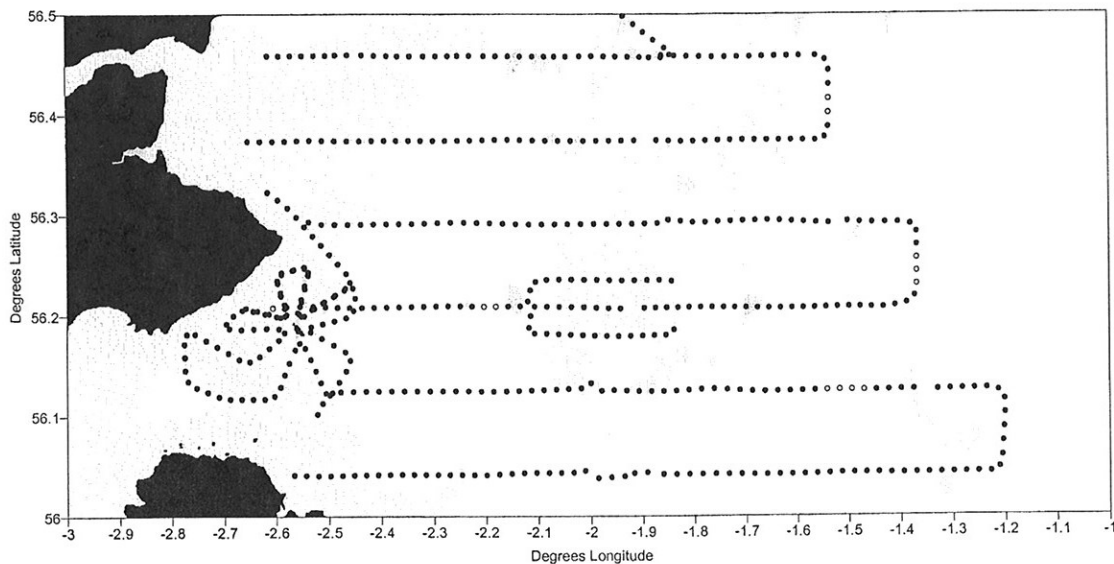


Figure 11. Detail of the mini acoustic and seabird survey undertaken around the Isle of May. Circles indicate centre points of one-minute seabird survey periods.

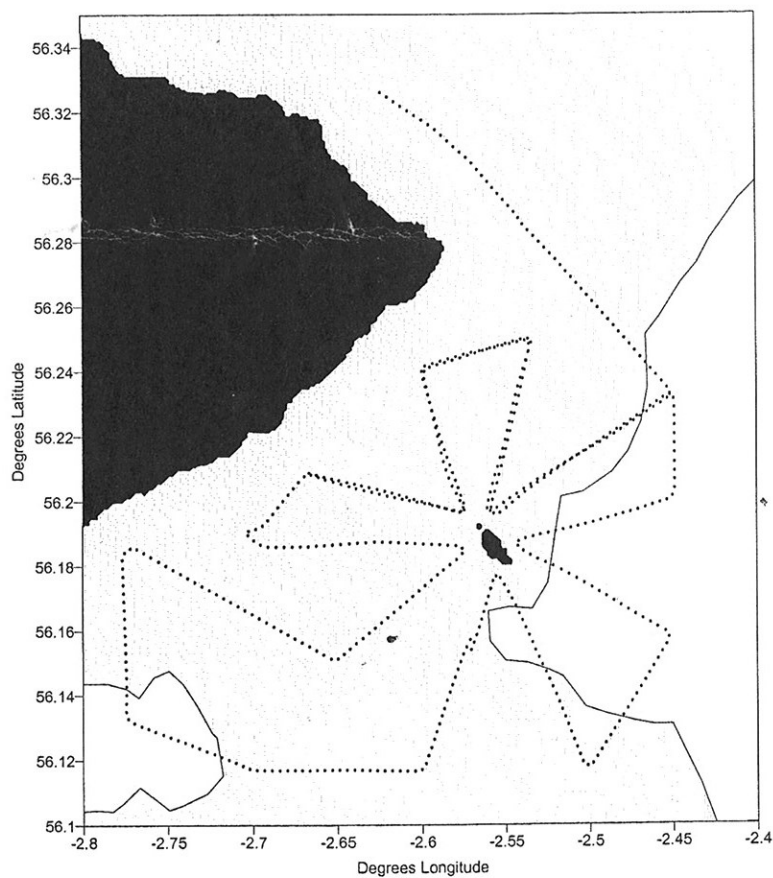


Figure 12. Locations of XBT deployments.

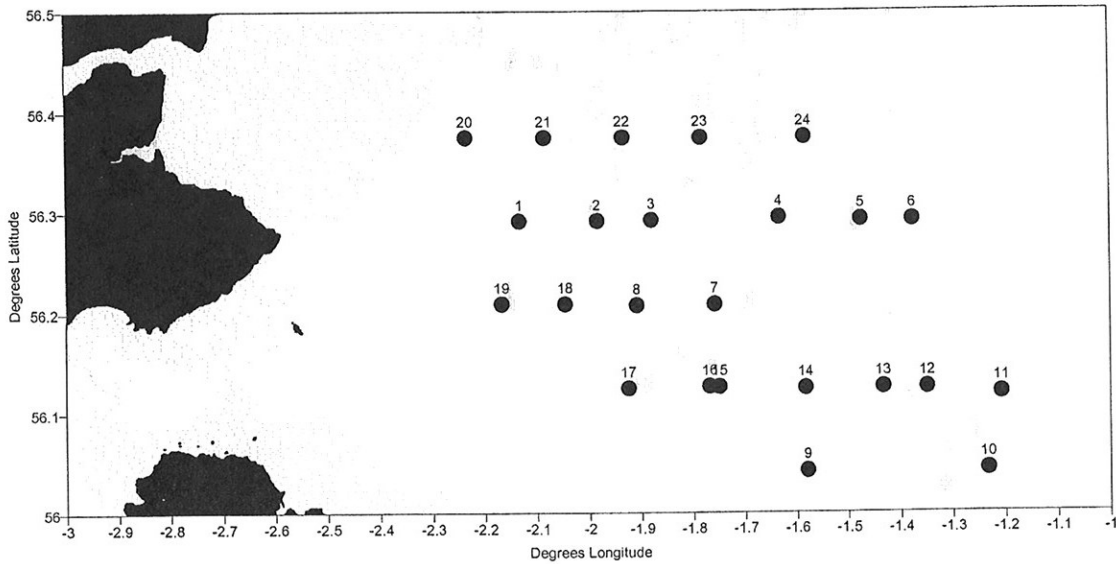


Figure 13. Hydrographic and plankton sample locations along a transect off Stonehaven. Filled circles indicate stations where the CTD/fluorometer was deployed and where a hose sample from the surface 10m of water was obtained for chlorophyll, phytoplankton and ciliates analysis. Open circles indicate stations where Van Doorn bottles were used to obtain samples for salinity, chlorophyll, nitrate and silicate analysis (except station indicated by 1, where only chlorophyll samples were taken). Dual Bongo nets were deployed at stations marked by + for zooplankton and phytoplankton analysis. Zooplankton samples were also collected using a 1m net at stations marked by X. Water turbidity was examined using a secci disc at stations marked by a square.

