R1/6

Not to be cited without prior reference to the Marine Laboratory, Aberdeen

FRV *Clupea*

Cruise 1595C

REPORT

26 September - 9 October 1995

Ports

Loading	Fraserburgh
Unloading	Fraserburgh
Working	Granton 29/30 September, 1 October and 3/4/5 October

Personnel

D Saward	SSO	26 September - 9 October (in charge)
J McKie	HSO	26 September - 9 October
L Goodwin	SO	26 September - 9 October
E Armstrong	SO	26-30 September
S Forsyth	SO	29 September - 5 October
D Moore	SSO	1-4 October
C Hall	SSO	4-9 October
S Mathieson	SNH	6 October (Scottish Natural Heritage visitor)
A Virtue	TRPB	6 October (Tweed River Purification Board visitor)

Fishing Gear

BT116 *Clupea* wing trawl

Objectives

1. To collect seabed sediment samples from dredge spoil disposal sites off Peterhead, Aberdeen and Stonehaven, for particle size and heavy metal analyses in the Marine Laboratory, Aberdeen.

2. To map the seabed at the Bell Rock and St Abb's Head sewage sludge disposal sites, using RoxAnn©.

3. To undertake trawl surveys at the Bell Rock and St Abb's Head sewage sludge disposal sites, to collect samples of representative species for chemical analysis in the Marine Laboratory, Aberdeen.

4. To collect seawater samples from the Bell Rock and St Abb's Head sewage sludge disposal sites, for microbiological analysis on FRV *Clupea*.

5. To collect seawater samples from the Bell Rock and St Abb's Head sewage sludge disposal sites, for measurement of suspended solid levels in the Marine Laboratory, Aberdeen.

6. To collect seabed sediment samples from the Bell Rock and St Abb's Head sewage sludge disposal sites, and from areas adjacent to the disposal sites, for microbiological analysis on FRV *Clupea*.

7. To collect seabed sediment samples from the Bell Rock and St Abb's Head sewage sludge disposal sites, and from areas adjacent to the disposal sites, for particle size and heavy metal analyses in the Marine Laboratory, Aberdeen.

8. To map the seabed in the vicinity of the St Abb's Head Voluntary Marine Nature Reserve, using RoxAnn©.

9. To undertake a transmissometer survey in the vicinity of the St Abb's Head Voluntary Marine Nature Reserve, to investigate the levels of turbidity in the water column.

10. To collect seawater samples in the vicinity of the St Abb's Head Voluntary Marine Nature Reserve, for measurement of suspended solid levels in the Marine Laboratory, Aberdeen.

11. To collect seawater samples in the vicinity of the St Abb's Head Voluntary Marine Nature Reserve, for phytoplankton analysis in the Marine Laboratory, Aberdeen.

12. To collect seabed sediment samples in the vicinity of the St Abb's Head Voluntary Marine Nature Reserve, to obtain samples of surface material for phytoplankton analysis in the Marine Laboratory, Aberdeen.

13. To collect seabed sediment samples in the vicinity of the St Abb's Head Voluntary Marine Nature Reserve, for particle size and heavy metal analyses in the Marine Laboratory, Aberdeen.

14. To collect seabed sediment samples from munitions and dredge spoil disposal sites in the Firth of Forth, for particle size and heavy metal analyses in the Marine Laboratory, Aberdeen.

15. To map the seabed in Stonehaven Bay, using RoxAnn©.

Out-turn Days Per Project: Four days, BEA1; 10 days, BEB1.

Narrative

Scientific staff joined the vessel at Fraserburgh at 1015 hours on 26 September, and completed the loading of scientific equipment. The vessel departed Fraserburgh at 1330 hours, and proceeded to the Peterhead dredge spoil disposal sites to undertake the seabed sediment sampling outlined in Objective 1. The Peterhead grab survey commenced at 1445 hours on 26 September and was completed at 1745 hours. The vessel then proceeded to the Aberdeen dredge spoil disposal site to continue the Objective 1 sampling. The Aberdeen grab survey commenced at 2030 hours and was completed at 2200 hours. Objective 1 sampling at the Stonehaven dredge spoil disposal sites was postponed. The vessel then proceeded to the Bell Rock sewage sludge disposal site to undertake the RoxAnn© survey outlined in Objective 2. The Bell Rock RoxAnn© survey commenced at 0200 hours on 27 September and was completed at 1520 hours. The vessel then commenced transit to the St Abb's Head sewage sludge disposal site to undertake a similar RoxAnn© survey. During transit, weather and sea conditions deteriorated and further survey work was not possible. Programmed operations were suspended at 1620 hours on 27 September, and the vessel proceeded to shelter in Largo Bay. The vessel remained at anchor in Largo Bay from 1945 hours on 27 September until 0630 hours on 28 September. On leaving Largo Bay, the vessel proceeded to the St Abb's Head sewage sludge disposal site to undertake the RoxAnn© survey outlined in Objective 2. The St Abb's Head RoxAnn© survey commenced at 0850 hours on 28 September and was completed at 1800 hours. The vessel then proceeded to the St Abb's Head Voluntary Marine Nature Reserve to undertake the RoxAnn© survey outlined in Objective 8. The vessel anchored in Coldingham Bay at 1945 hours on 28 September, and remained at anchor until 0630 hours on 29 September. The RoxAnn© survey of the St Abb's Head Voluntary Marine Nature Reserve commenced at 0645 hours on 29 September and was completed at 1245 hours. The vessel then

proceeded to Granton, to allow S Forsyth to join the vessel and E Armstrong to disembark. The vessel berthed at Granton at 1745 hours on 29 September, and S Forsyth joined the vessel immediately. E Armstrong disembarked at 0645 hours on 30 September, and the vessel departed Granton at 0700 hours to return to the St Abb's Head sewage sludge disposal site to undertake the seabed sediment sampling outlined in Objectives 6 and 7. The St Abb's Head grab survey commenced at 1030 hours on 30 September 1995 and was completed at 1645 hours. The vessel then proceeded to anchor in the Musselburgh Road small vessel anchorage. The vessel remained at anchor in Musselburgh Road from 2000 hours on 30 September until 0630 hours on 1 October. During this period, weather and sea conditions deteriorated, and programmed operations were suspended. The vessel therefore returned to Granton to allow D Moore to join the vessel. The vessel berthed at Granton at 0730 hours on 1 October, and remained there to await an improvement in the weather. Whilst at Granton, the St Abb's Head seabed sediment samples were processed for enumeration of faecal coliforms and faecal streptococci. D Moore joined the vessel at 1700 hours on 1 October, and the vessel departed Granton at 1800 hours to proceed to anchor off Fidra. The vessel remained at anchor off Fidra from 1930 hours on 1 October until 0700 hours on 2 October. On leaving the Fidra anchorage, the vessel returned to the St Abb's Head sewage sludge disposal site to undertake the trawl survey and seawater sampling outlined in Objectives 3, 4 and 5. The St Abb's Head seawater sampling commenced at 0900 hours on 2 October and was completed at 1045 hours. The St Abb's Head trawl survey commenced at 1100 hours on 2 October and was completed at 1215 hours. The vessel then proceeded to the Bell Rock sewage sludge disposal site to undertake a similar trawl survey and seawater sampling programme. During transit to the Bell Rock sewage sludge disposal site, the St Abb's Head seawater samples were processed for enumeration of faecal coliforms and faecal streptococci, and the St Abb's Head trawl catch was partially sorted. The Bell Rock seawater sampling commenced at 1445 hours on 2 October and was completed at 1615 hours. The Bell Rock trawl survey commenced at 1645 hours on 2 October, but had to be suspended at 1830 hours following damage to the trawl gear. The vessel therefore proceeded to anchor in St Andrew's Bay. During transit to St Andrew's Bay, the Bell Rock seawater samples were processed for enumeration of faecal coliforms and faecal streptococci, and the St Abb's Head and Bell Rock trawl catches were sorted. The vessel remained at anchor in St Andrew's Bay from 2045 hours on 2 October until 0630 hours on 3 October. Whilst at anchor, the St Abb's Head and Bell Rock seawater samples were processed for determination of suspended solid levels, and the St Abb's Head and Bell Rock trawl catches were sampled and prepared for chemical analysis. On leaving St Andrew's Bay, the vessel returned to the Bell Rock sewage sludge disposal site, to complete the trawl survey outlined in Objective 3 and to undertake the seabed sediment sampling outlined in Objectives 6 and 7. The Bell Rock grab survey commenced at 0830 hours on 3 October and was completed at 1545 hours. The Bell Rock trawl survey recommenced at 1600 hours on 3 October and was completed at 1730 hours. The vessel then returned to Granton to allow C Hall to join the vessel and D Moore and S Forsyth to disembark. During transit to Granton, the Bell Rock trawl catch was sorted, sampled and prepared for chemical analysis. The vessel berthed at Granton at 2145 hours on 3 October, and remained there until 1045 hours on 5 October. S Mathieson (SNH) visited the vessel during the morning of 4 October, to discuss the results of the RoxAnn© survey of the St Abb's Head Voluntary Marine Nature Reserve and to make arrangements for joining the vessel later in the cruise. Following the visit, D Moore disembarked at 1100 hours. C Hall joined the vessel at 2030 hours on 4 October, and S Forsyth disembarked at 1030 hours on 5 October. Whilst at Granton, the Bell Rock seabed sediment samples were processed for enumeration of faecal coliforms and faecal streptococci, and sampling equipment was prepared for the remainder of the cruise. On leaving Granton, the vessel returned to the St Abb's Head Voluntary Marine Nature Reserve to undertake the transmissometer survey and seawater sampling outlined in Objectives 9, 10 and 11. During transit to the St Abb's Head Voluntary Marine Nature Reserve, seawater samples were collected at two locations in the Firth of Forth, east of Inchkeith and off Bass Rock, for phytoplankton analysis. The transmissometer survey and seawater sampling at the St Abb's Head Voluntary Marine Nature Reserve commenced at 1430 hours and were suspended at 2015 hours. The vessel then proceeded to anchor in Coldingham Bay. The vessel remained at anchor in Coldingham Bay from 2030 hours on 5 October until 0615 hours on 6 October. Whilst at anchor, the St Abb's Head Voluntary Marine Nature Reserve seawater samples were processed for

determination of suspended solid levels. Selected seawater samples were also preserved for phytoplankton analysis, and processed for enumeration of faecal coliforms and faecal streptococci. The transmissometer survey and seawater sampling at the St Abb's Head Voluntary Marine Nature Reserve recommenced at 0815 hours on 6 October, and the transmissometer vertical profiles and the seawater sampling were completed at 1345 hours. Seabed sediment sampling at the St Abb's Head Voluntary Marine Nature Reserve, outlined in Objectives 12 and 13, commenced at 1350 hours on 6 October and was completed at 2015 hours. S Mathieson (SNH) and A Virtue (TRPB) joined the vessel at 0945 hours on 6 October, to observe and assist with the sampling programme, and remained on board until 1545 hours. On completion of the seabed sediment sampling, the vessel proceeded to anchor in Pease Bay. The vessel remained at anchor in Pease Bay from 2100 hours on 6 October until 0930 hours on 7 October. Whilst at anchor, the remainder of the seawater samples from the St Abb's Head Voluntary Marine Nature Reserve were processed for determination of suspended solid levels. Selected seawater and seabed sediment samples were also preserved for phytoplankton analysis, and processed for enumeration of faecal coliforms and faecal streptococci. On leaving Pease Bay, the vessel returned to the St Abb's Head Voluntary Marine Nature Reserve to complete the transmissometer survey. Towed transmissometer deployments commenced at 0950 hours on 7 October and were completed at 1530 hours. The vessel then proceeded to the Isle of May munitions disposal sites to undertake the seabed sediment sampling outlined in Objective 14. During transit to the Isle of May munitions disposal sites, the sampling trawl was streamed for approximately one hour to remove any material collected at the sewage sludge disposal sites, and a seawater sample was collected in the outer Firth of Forth for phytoplankton analysis. The Isle of May grab survey commenced at 1800 hours on 7 October and was completed at 2015 hours. The vessel then proceeded to the Stonehaven dredge spoil disposal sites to undertake the seabed sediment sampling outlined in Objective 1. During transit to the Stonehaven dredge spoil disposal sites, a seawater sample was collected off Montrose for phytoplankton analysis. The Stonehaven grab survey commenced at 0100 hours on 8 October and was completed at 0400 hours. The vessel then proceeded to Fraserburgh. During transit to Fraserburgh, seawater samples were collected off Aberdeen and off Rattray Head for phytoplankton analysis. The vessel docked at Fraserburgh at 1000 hours on 8 October, and scientific staff completed the processing of scientific samples and prepared for unloading on 9 October. Unloading was completed at 0930 hours on 9 October, and scientific staff disembarked at 1000 hours to return to Aberdeen.

Results

1. Grab sampling was undertaken at a total of 40 sampling stations at the Peterhead, Aberdeen and Stonehaven dredge spoil disposal sites. Sixty one grab deployments were made, and 36 seabed sediment samples collected. The seabed sediment samples were sub-sampled for particle size and heavy metal size analyses. Thirty five core sub-samples were taken for particle size analysis; and 36 surface scoop sub-samples were taken for heavy metal analysis. The sub-samples were deep frozen for analysis in the Marine Laboratory, Aberdeen. Particle size and heavy metal analyses will be undertaken during 1995.

2. RoxAnn© surveys were completed at the Bell Rock and St Abb's Head sewage sludge disposal sites, and seabed sediment maps produced to support the grab sampling programme. The maps will be refined in the Marine Laboratory Aberdeen, incorporating the particle size analysis data, and used to interpret the results of the seabed sediment analyses.

3. Two trawls were undertaken at the Bell Rock sewage sludge disposal site. The total catch of 15 baskets was sorted and counted. Samples of four fish species, cod, haddock, whiting and plaice, were measured and sub-sampled. One trawl was undertaken at the St Abb's Head sewage sludge disposal site. The total catch of 12 baskets was sorted and counted. Samples of four fish species, cod, haddock, whiting and mackerel, were measured and

sub-sampled. Flesh and liver sub-samples were deep frozen for chemical analysis in the Marine Laboratory Aberdeen. Chemical analyses will be undertaken during 1995/96.

4. Five seawater sampling stations were occupied at both the Bell Rock and St Abb's Head sewage sludge disposal sites, and one water sampler (Rosie) deployment was undertaken at each sampling station. Three duplicated seawater samples were collected at each sampling station, near sea surface (-1 metre), mid-water and near sea bed (<5 metres from sea bed). The duplicated seawater samples were pooled prior to sub-sampling and processing. All the seawater samples were sub-sampled for microbiological analysis. The sub-samples were processed on board the vessel, and faecal coliforms and faecal streptococci enumerated. Faecal coliforms and faecal streptococci were not detected in any of the seawater samples.

5. All the seawater samples from the Bell Rock and St Abb's Head sewage sludge disposal sites were sub-sampled for determination of suspended solids. The sub-samples were filtered on board the vessel, for measurement of suspended solid levels in the Marine Laboratory Aberdeen. Suspended solid levels will be measured during October 1995.

6. Grab sampling was undertaken at 30 sampling stations at the Bell Rock sewage sludge disposal site, and at one adjacent control location. Thirty nine grab deployments were made, and 30 seabed sediment samples collected. Grab sampling was undertaken at 31 sampling stations at the St Abb's Head sewage sludge disposal site, and at one adjacent control location. Thirty four grab deployments were made, and 31 seabed sediment samples collected. All the seabed sediment samples were sub-sampled for microbiological analysis. Sub-samples were removed from the surface of the grab samples using a sterile spatula. The sub-samples were processed on board the vessel, and faecal coliforms and faecal streptococci enumerated. Processed sub-samples were also stored in a refrigerator, for enumeration of *Clostridium perfringens* spores in the Marine Laboratory Aberdeen. The spore analyses will be undertaken during October 1995. Faecal coliforms were detected in 21 of the seabed sediment samples taken from the Bell Rock sewage sludge disposal site. Faecal streptococci were also detected in 21 of the samples. Faecal coliforms or faecal streptococci were detected in a total of 25 of the 29 samples. The patterns of distribution of faecal coliforms and faecal streptococci were similar, but not identical. The levels of faecal coliforms were low. The levels of faecal streptococci were also low in 20 of the 21 positive samples. The single high level was detected in the sample taken from the centre of the Bell Rock sewage sludge disposal site. Faecal coliforms were not detected in any of the seabed sediment samples taken from the St Abb's Head sewage sludge disposal site. Faecal streptococci were detected in only four of the 30 samples. The levels of faecal streptococci were low. Faecal coliforms and faecal streptococci were not detected in the seabed sediment samples taken from the Bell Rock or St Abb's Head control locations. At the time of the survey, sewage sludge disposal operations were confined to the Bell Rock disposal site, and the St Abb's Head disposal site had not been used since May 1995.

7. All the seabed sediment samples from the Bell Rock and St Abb's Head sewage sludge disposal sites, and the adjacent control locations, were sub-sampled for particle size and heavy metal analyses. Thirty core sub-samples were taken from the Bell Rock area for particle size analysis; and 30 surface scoop sub-samples were taken for heavy metal analysis. Thirty one core sub-samples were taken from the St Abb's Head area for particle size analysis; and 31 duplicated surface scoop sub-samples were taken for heavy metal analysis. The sub-samples were deep frozen for analysis in the Marine Laboratory Aberdeen. Particle size and heavy metal analyses will be undertaken during 1995.

8. A RoxAnn© survey was completed at the St Abb's Head Voluntary Marine Nature Reserve, and a seabed sediment map produced to support the grab sampling programme. The map will be refined in the Marine Laboratory Aberdeen, incorporating the particle size analysis data.

9. Twenty five combined transmissometer and seawater sampling stations were occupied at the St Abb's Head Voluntary Marine Nature Reserve. One vertical profile transmissometer and CTD (Conductivity, Temperature and Depth) deployment was undertaken at each sampling station. Temperature, salinity and transmission data (descent and ascent) were plotted against water depth, to characterise the water column. The water column appeared to be well mixed, although there were indications of a weak thermocline and helicline at some of the sampling stations. Transmission levels were significantly reduced in the near seabed water layer at a number of sampling stations, and also appeared to be reduced throughout the water column at some of the offshore sampling stations. At the offshore locations, the reduction in transmission appeared to increase with water depth. Additional towed transmissometer deployments were undertaken throughout the survey area, and the results appeared to confirm the observations made during the vertical profile survey. It is possible that some of the observed reductions in transmission were related to the very poor weather conditions on the second day of the survey. The transmission data will be calibrated using the suspended solids data, and the results compared with the results of the seawater analyses.

10. One water sampler (Rosie) deployment was undertaken at each of the St Abb's Head Voluntary Marine Nature Reserve seawater sampling stations. Wherever possible, three duplicated seawater samples were collected at each sampling station, near sea surface (-1 metre), mid-water and near sea bed (<5 metres from sea bed). The duplicated seawater samples were pooled prior to sub-sampling and processing. All the seawater samples were sub-sampled for determination of suspended solids. The sub-samples were filtered on board the vessel, for measurement of suspended solid levels in the Marine Laboratory Aberdeen. Suspended solid levels will be measured during October 1995.

11. Selected seawater samples from the St Abb's Head Voluntary Marine Nature Reserve were sub-sampled for phytoplankton analysis in the Marine Laboratory Aberdeen. Seven sampling stations were selected for phytoplankton analysis. The sub-samples were preserved with Lugol's solution and stored in the dark in insulated containers. Phytoplankton analyses will be undertaken during October/November 1995. The selected seawater samples were also sub-sampled for microbiological analysis. The sub-samples were processed on board the vessel, and faecal coliforms and faecal streptococci enumerated. The microbiological sampling was not included in programmed operations, but might have indicated a connection between water quality and coastal discharges of sewage. Faecal coliforms were detected in four of the seven near surface seawater samples, five of the six mid-water samples and six of the seven near sea bed samples. Faecal coliforms were detected at one or more depths at all the sampling stations. Faecal streptococci were detected in one of the near surface seawater samples, and two of the mid-water samples. Faecal streptococci were detected at three of the seven water sampling stations. There was no apparent relationship between the distributions of faecal coliforms and faecal streptococci. The levels of faecal coliforms and faecal streptococci were low. Nevertheless, it is interesting to note that microbiological contamination of the water column is more extensive at the St Abb's Head Voluntary Marine Nature Reserve than at either of the sewage sludge disposal sites.

12. Grab sampling was undertaken at the 25 St Abb's Head Voluntary Marine Nature Reserve combined transmissometer and seawater sampling stations. Thirty six grab deployments were made, and 22 seabed sediment samples collected. Selected seabed sediment samples were sub-sampled for phytoplankton analysis. Seven sampling stations were selected for phytoplankton analysis. Core sub-samples were dispersed in a small volume of filtered seawater, and stored in the dark in insulated containers. Phytoplankton analyses, to identify settled planktonic material and the resting stages of phytoplankton species, will be undertaken during October/November 1995. The selected seabed sediment samples were also sub-sampled for microbiological analysis. Sub-samples were removed from the surface of the grab samples using a sterile spatula. The sub-samples were processed on

board the vessel, and faecal coliforms and faecal streptococci enumerated. Processed sub-samples were also stored in a refrigerator, for enumeration of *Clostridium perfringens* spores in the Marine Laboratory Aberdeen. The spore analyses will be undertaken during October 1995. The microbiological sampling was not included in programmed operations, but might have indicated a connection between settled material and coastal discharges of sewage. Faecal coliforms were detected in three of the seven seabed sediment samples. Faecal streptococci were detected in only one sample. There appeared to be a relationship between the distribution of faecal coliforms and faecal streptococci in the near sea bed seawater samples and the seabed sediment samples. The levels of faecal coliforms and faecal streptococci were low.

13. All the seabed sediment samples from the St Abb's Head Voluntary Marine Nature Reserve were sub-sampled for particle size and heavy metal size analyses. Twenty two core sub-samples were taken for particle size analysis; and 22 surface scoop sub-samples were taken for heavy metal analysis. The sub-samples were deep frozen for analysis in the Marine Laboratory Aberdeen. Particle size and heavy metal analyses will be undertaken during 1995.

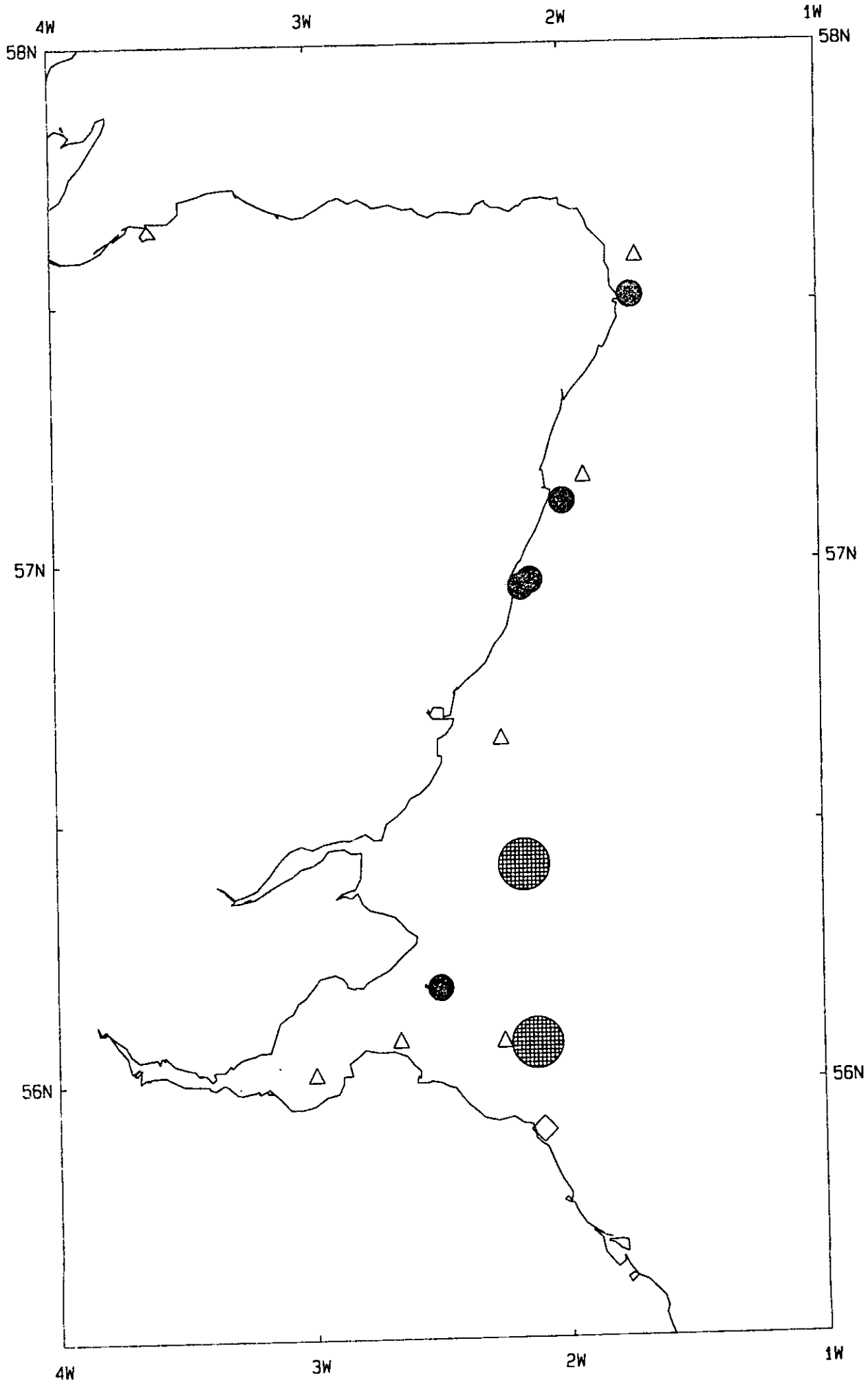
14. Grab sampling was undertaken at 16 sampling stations at the Isle of May munitions disposal sites. Sixteen grab deployments were made, and 16 seabed sediment samples collected. All the seabed sediment samples were sub-sampled for particle size and heavy metal analyses. Sixteen core sub-samples were taken for particle size analysis; and 16 surface scoop sub-samples were taken for heavy metal analysis. The sub-samples were deep frozen for analysis in the Marine Laboratory Aberdeen. Particle size and heavy metal analyses will be undertaken during 1995. The contingency seabed sediment sampling programme for the Firth of Forth dredge spoil disposal sites was cancelled.

15. The contingency RoxAnn© survey of Stonehaven Bay was cancelled, because storms during September dispersed the silts and clays that had been relocated into the bay following the dredging campaigns at Stonehaven and Aberdeen harbours.

16. Six seawater sampling stations were occupied at locations in the inner Firth of Forth, off Bass Rock, in the outer Firth of Forth, off Montrose, off Aberdeen and off Rattray Head, to obtain seawater samples for phytoplankton analysis in the Marine Laboratory Aberdeen. One water sampler (Rosie) deployment was undertaken at each sampling station. Duplicated near sea surface (-1 metre) seawater samples were collected at each sampling station, and the duplicated samples were pooled prior to sub-sampling for phytoplankton analysis. The sub-samples were preserved with Lugol's solution and stored in the dark in insulated containers. This work was not included in programmed operations, and was undertaken at the request of the Oceanography Section (M Kelpy).

Derek Saward
19 October 1995

CRUISE 1595C - SAMPLING STATIONS



KEY

● 52 sediment samples collected for heavy metal and particle size analyses (Day Grab)

△ 6 water samples collected for phytoplankton analysis (Rosette Water Sampler)

⊕ 61 sediment samples collected for heavy metal, microbiological and particle size analyses (Day Grab)
30 water samples collected for microbiological analyses and suspended solids measurements (Rosette Water Sampler)
Samples of representative fish species collected from 3 trawls (BT 116)
Surveys undertaken to support grab programme (RoxAnn©)

□ 22 sediment samples collected for heavy metal, and particle size analyses. 21 samples selected for microbiological analyses (Day Grab)
75 water samples collected for suspended solids measurements. 21 water samples selected for phytoplankton analysis (Rosette Water Sampler)
25 vertical transmissometer and CTD dips (Transmission, Conductivity, Temperature and Depth)
Towed transmissometer survey undertaken to support programme
Survey undertaken to support grab programme (RoxAnn©)