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1995 ICES COORDINATED ACOUSTIC SURVEY OF ICES DIVISIONS IVa IVb, VIa AND VIIb

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SUMMARY

Seven surveys were carried out during late June and July covering most of the continental shelf North of 54°N in the North Sea and Ireland to the west of Scotland to a northern limit of 62°N. The eastern edge of the survey area is bounded by the Norwegian and Danish coasts, and to the west by the shelf edge between 200 and 400 m depth. The surveys are reported individually, and a combined report has been prepared from the data from all seven surveys.

METHODS

Seven surveys were carried out during late June and July covering most of the continental shelf North of 54°N in the North Sea and 52°30'N west of Ireland west of Scotland to a northern limit of 62°N. The eastern edge of the survey area is bounded by the Norwegian and Danish coasts, and to the west by the Shelf edge between 200 and 400 m depth. The surveys are reported individually, and a combined report has been prepared from the data from all seven surveys.

SURVEY REPORT FOR FRV *SCOTIA* IN THE NORTHERN NORTH SEA 8-27 JULY 1995

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Methods

The acoustic survey on FRV *Scotia* was carried out using a Simrad EK500 38 kHz sounder echo-integrator. Further data analysis was carried out using Simrad BI500 and Marine Laboratory Analysis systems. The survey track (Fig. A1) was selected to cover the area in

one levels of sampling intensity based on the limits of herring densities found in previous years, a transect spacing of 15 nm was used in most parts of the area with the exception of a section east and west of Shetland where short additional transects were carried out at 7.5 nm spacing. On the administrative boundaries of 2°E and 4°W the ends of the tracks were positioned at 1/2 the actual track spacing from the area boundary, giving equal track length in any rectangle within the area. The between-track data could then be included in the data analysis. Transects at the coast and shelf break were continued to the limits of the stock and the transect ends omitted from the analysis. The origin of the survey grid was selected randomly with a 15 nm interval the track was then laid out with systematic spacing from the random origin. Where 7.5 nm spacing was used the same random origin was used.

Trawl hauls (positions shown in Fig. A1) were carried out during the survey on the denser echo traces. Each haul was sampled for length, age, maturity and weight of individual herring. Up to 350 fish were measured at 0.5 cm intervals from each haul. Otoliths were collected with five per 0.5 cm class below 24 cm, and 10 per 0.5 cm class for 25 cm and above. The same fish were sampled for sex maturity and macroscopic evidence of Ichthyophonus infection. Fish weights were collected at sea from a random sample of 50 fish per haul.

Data from the echo integrator were summed over quarter hour periods (2.5 nm at knots). Echo integrator data was collected from 9 metres below the surface (transducer at 5 m depth) to 1 m above the seabed. The data were divided into five categories, by visual inspection of the echo-sounder paper record and the integrator cumulative output; "herring traces", "probably herring traces" and "probably not herring traces" all below 50 m, shallow herring schools and shallow schools probably not herring both from above 50 m. For the 1995 survey 64% of the stock by number was attributable to the "herring traces" and 23% to the "probably herring traces" and 18% to the shallow herring schools. The third category which gave 63% of total fish was attributable to particularly to Norway pout in the south of the area and schools of young blue whiting on the shelf break. Apart from these two locations the rest of the fish species in the area were either easily recognisable from the echo-sounder record or did not appear to occupy the same area as the herring. The final category of surface schools not allocated to herring constituted 13% of the total fish biomass. Generally herring were found in waters where the seabed was deeper than 100 m, except close to Orkney. The area to the east of Orkney between 1°W and 1°E contained large numbers of young Norway pout.

Two calibrations were carried out during the survey. Agreement between these was better than 0.07 dB. To calculate integrator conversion factors the target strength of herring was estimated using the TS/length relationship recommended by the acoustic survey planning group (Anon, 1982):

$$TS = 20\log_{10}L - 71.2 \text{ dB per individual}$$

The weight of fish at length was determined by weighing fish from each trawl haul which contained more than 50 fish. Lengths were recorded by 0.5 cm intervals to the nearest 0.5 cm below. The resulting weight-length relationship for herring was:

$$W = 0.662\ 10^{-3}\ L^{3.79} \text{ g L measured in cm}$$

Survey Results

A total of 37 trawl hauls were carried out (Fig. A1), the results of these are shown in Table A1. Twenty-two hauls with significant numbers of herring were used to define three survey sub areas (Fig. A2). The mean length keys, mean lengths, weights and target strengths for each haul and for each sub area are shown in Table 2. 2,721 otoliths were taken to establish the three age length keys. The numbers and weights of fish by ICES statistical rectangle are shown in Figure 2. A total estimate of 3,662 million herring or 741 thousand tonnes was calculated for the survey area. 735 thousand tonnes of these were mature. Herring were found mostly in water with the seabed deeper than 100 m, with traces being found in waters with depths of up to 250 m. The survey was continued to 400 m depth for most of the western and northern edge between 0° and 4°W. Herring were generally found in similar water depths to 1993 however, the distributions were more dense to the west of Shetland and less dense to the east and an absence of large schools in the north of the area. Table A3 shows the numbers, mean lengths weights and biomass of herring by sub area by age class.

In addition to the 3,662 of herring, approximately 4,700 million other fish were observed in mid water. Examination of the catch by species (Table A1) shows the difficulty of allocating this between species so this has not been attempted. The dominant part must be considered to be Norway pout and blue whiting. The proportions of mature 2 ring and 3 ring herring were estimated at 95% and 99.5% respectively. This is a very similar proportion for mature fish than those found in 1994.

SURVEY REPORT RV *GO SARS*
26 JUNE - 16 JULY 1995

Objectives

Abundance estimation of herring and sprat in the area between latitudes, 57°00'N and 62°00'N and between longitudes 01°00'E and 07°00'E. Map the general hydrographical regime and monitor the standard profiles, Utsira - Start Point, Feie - Shetland.

Participation

A L Johnsen, H Myran, K Strømsnes, B V Svendsen, R Toresen (crl), E Torstensen, R Pedersen, J A Vågenes.

Schedule

The survey started in Bergen, 26 June 1995. A calibration of the echo sounder was done in a nearby fjord the same day. A call was made in Aberdeen on 30 June and in Lerwick, Shetland on 3 July. The survey was finished in Bergen on 16 July. It was good weather conditions during the whole survey period.

The survey started in south by doing systematic parallel transects, 15 nm apart, east-west. In the southern and northern part of the survey area the investigations were carried out westwards to the Scottish coast.

Survey Effort

Figure B1 shows the cruise track with fishing stations and the hydrographic profiles. Altogether 3,000 nm were surveyed and the total number of trawl hauls were 100, 94 pelagic and six on bottom. The number of CTD stations where temperature, salinity, density and fluorescence were recorded were 126.

Methods

The catches were sampled for species composition, by weight and numbers. Biological samples, ie length and weight compositions were taken of all species. Otoliths were taken of herring, sprat and mackerel for age determination. Herring were also examined for fat content and maturity stage in the whole area, and vertebral counts for the separation of autumn spawning herring and Baltic spring spawners in the area to the east of 03°00'E.

The acoustic instruments applied for abundance estimation were a SIMRAD EK-500 echo sounder and the Bergen Echo Integrator system (BEI). The setting of the instruments were as follows:

Absorption coeff	10 dB/km
Pulse length	medium
Bandwidth	wide
Max power	4,000 W
Angle sensitiv	21.9
2-way beam angle	-21.0 dB
Sv transd gain	25.3 dB
TS transd gain	25.3 dB
3 dB beamwidth	6.7°
Alongship offset	-0.17°
Athw ship offset	0.16°

Sounder: ES 38 B

A summary of the results form the calibration of the acoustic instruments is given in Annex 1.

The S_A-values were divided between the following categories on the basis of trawl catches and characteristics on the echo recording paper:

Herring	Sprat
Mackerel	Sandeel
Norway pout	Blue whiting
Other demersal fish	Plankton

The following target strength (TS) function was applied to convert S_A-values of herring and sprat to number of fish:

$$TS = 20 \log L - 71.2 \text{ dB} \quad (1)$$

or on the form:

$$C_F = 1.05 - 10^6 - L^{-2} \qquad (2)$$

where L is total length. The following formula was programmed into Excel (4.0) sheets to calculate the number of fish (herring and sprat) in length groups (1/2 cm) in ICES statistical squares (Annex 2):

$$N_i = A \cdot S_A \cdot \frac{p_i}{\sum_{i=1}^{n} \frac{p_i}{C_{Fi}}}$$

where N_i = number of fish in length group i
A = area in nm^2
S_A = mean integrator value in the area
p_i = proportion of fish in length group i in samples from the area
C_{Fi} = fish conversion factor (Eqn 2) applying the length of fish in length group i

The number per length group were then divided in age groups according to the observed age distribution per length group observed in the samples representing the square. The number in each length category and age group were then summed and the total number of fish obtained. The proportion of Baltic spring spawners and North Sea autumn spawners within each square were calculated by applying the mean vertebral counts per age group in the samples representing the square, and calculating the proportion of the stocks as described by the HAWG in its reports. To calculate the maturing part of the two stocks in each length group, the observed maturity stage for North Sea autumn spawners was applied for this tock while the maturity ogive as presented by last year's HAWG was applied for the Baltic spring spawners.

The biomass of fish was calculated applying observed mean weights per age group multiplied by number of fish in the same group.

Results

Hydrography

The horizontal distributions of temperature at 5 m, 50 m and at bottom in the surveyed area are shown in Figures B2a-c. The surface water is characterised by summer heating with temperatures ranging from 10-14°C. In 50 m depth, the overall level of the temperature is significantly lower showing that the thermocline is found in the upper layers of the water column. The overall temperature regime in the surface (where most of the herring were found) is significantly colder (2-3°) this year than in 1994.

Distribution and Abundance of Herring and Sprat

Herring

The horizontal distribution of herring is shown in Figure B3. In the southeastern part of the survey area, small North Sea autumn spawners were predominating (1-ringers) while along the Norwegian coast, older and mature Baltic spring spawners mixed with the younger autumn spawners. In central parts of the North Sea adult autumn spawners predominated. In the whole area the herring were distributed in the upper 30 m of the water column. The registrations were very scattered and real herring schools were not found.

For estimation, the survey area was divided in six sub areas based on biological characteristics of the herring (length at age and vertebral counts) as shown in Figure B4. The abundance by ICES statistical squares, divided in Baltic spring spawners and North Sea autumn spawners is shown in Table B1. The numbers are given age disaggregated and the numbers in age groups 2 and 3 are split in mature/immature parts. The surveyed squares where no herring were recorded are also presented in the table. The mean weights at age applied for biomass estimation are shown in Table B2. The total estimated number of herring by age and length is shown in Table B3. The total estimated biomass per age group and stock is also shown in this table. The total estimated biomass in the area covered by the Norwegian vessel has decreased severely from last year (360 v 220,000 t). The estimated part of the spawning stock biomass is about halved from 320,000 t in 1994 to 160,000 t in 1995. The Norwegian vessel has covered a somewhat larger area in 1995 than in 1994.

Ichthyophonus

All herring sampled during the survey were examined for the Ichthyophonus decrease. Table B4 shows a record of the stations on which herring were examined. The number of herring investigated and the number of infected fish on each station are given, and in addition, the length, maturity, stage, vertebral counts and age of the infected fish are also presented. Very few infected fish were found this year.

Sprat

Sprat was observed scattered distributed in the western part of the surveyed area, in the ICES statistical squares 43E9, 49E9 and 50E9. Sprat in age group 1 and 2 were predominating.

The estimated number by age groups and total, and the biomass are shown in Table B5. The mean weights at age applied for the biomass estimations, are given in Table B6. Age group 1 is split into immature/mature, while age group 2 and older were all mature.

No Ichthyophones infection was observed in the 230 sprat examined.

SURVEY REPORT RV *TRIDENS*
3-21 JULY 1995

Calibration

The planned calibration of the EK-500 in a Norwegian fjord had to be cancelled because of problems with the necessary permit. Norwegian authorities issued the permit not until the ship was already at sea, and then calibration was allowed only in one specific location (far north of the survey area) for which no detailed maps were on board. Therefore, it was decided to abandon the calibration along the Norwegian coast, and to try and calibrate the equipment in the open sea under calm weather conditions. On two occasions the weather was calm enough for a calibration of the TS-gain, and on one occasion the SV-gain could also be calibrated. Although theoretically the correction for SV-gain may be calculated on the basis of the correction for TS-gain, in practice the correction factor for SV-gain is different from the theoretical value. It may be useful to include specific instructions for calibration of SV-gain in the survey manual, since this calibration is rather sensitive to errors, and the results have a large effect in the survey estimate.

During the present survey, the default settings of 26.5 dB were used for TS-gain and SV-gain. Based on the results of the calibration in open sea, all SA-measurements collected during the survey were corrected by a factor 1.37.

Survey Methods

The methods used were similar to those in previous years. A SIMRAD EK-500 system was used with a 38 kHz hull mounted transducer. Integration of echo recordings was done both by the EK-500 system and by the BI post processing system.

Ship's speed was 12-13 knots, and the survey was conducted from 0300 UTC to 2100 UTC. During the hours of darkness, the survey was interrupted because results from previous survey had shown that herring at this time may rise close to the surface, and may not be seen by the transducer.

Trial fishing was done with a 2,000 mesh pelagic trawl with a 20 mm cod-end lining.

Results

Figure C1 shows the survey track and the relative densities of herring traces by 5 mile intervals.

The main concentration of herring was found between 58° and 59°N at a bottom depth of 120 m. Some freezer trawlers were also fishing for herring in this area. To the east of the area with bottom schools, herring was seen in dense schools very close to the surface (10-20 m). These schools were encountered in positions 58°25'N 00°45'W and 58°10'N 00°35'E. Two successful trawl sets were made at these surface schools by fishing the pelagic trawl with the trawl doors at the surface. The surface schools appeared to consist of the same type of mature herring as was found in the bottom schools further west. most of these herring were 3- and 4-ringers, with a small proportion of 5-ringers. Therefore, the areas with both bottom schools and surface schools were combined into one stratum (B). Of all mature herring encountered in this strata, about half the total amount occurred in surface schools. Since strata B was by far the most important strata in the entire survey, the surface schools

made up a significant proportion of the total quantity of herring found during the survey. The herring caught during daytime at the surface had empty stomachs; they seemed to be migrating rather than feeding.

Between 57°30'N and 55°30'N very few pelagic fish were found, except for one concentration of surface schools of 1-ringed herring at 56°40'N 01°00'E. Most of these waters were characterised by very dense plankton layers. Pelagic fish seemed to avoid these plankton concentrations, and were found mainly on the outskirts of the areas with plankton blooms.

Most of the pelagic fish south of 55°30'N consisted of 1-ringed herring. Only the deeper troughs at 55°10'N contained some older and maturing herring, obviously preparing to spawning along the English coast. These herring showed a larger variety in age groups than the mature herring found further north, with herring of 5-7 rings occurring in reasonable numbers.

Results from the *Tridens* survey are presented in Tables C1-C4 and Figure C2.

SURVEY REPORT FOR MFV *KINGS CROSS* IN ICES AREA VIA(N) 8-28 JULY 1995

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Methods

The acoustic survey on the charter vessel MFV *Kings Cross* (8 to 28 July 1995) was carried out using a Simrad EK500 38 kHz sounder echo-integrator. Further data analysis was carried out using Simrad BI500 and Marine Laboratory Analysis systems. The survey track (Fig. D1) was selected to cover the area in three levels of sampling intensity based on herring densities found in 1991-94. Areas with highest intensity sampling had a transect spacing of 4.0 nm, areas with medium intensity sampling had a transect spacing of 7.5 nm and lower intensity areas a transect spacing of 15 nm. The track layout was systematic, with a random start point. The ends of the tracks were positioned at 1/2 the actual track spacing from the area boundary, giving equal track length in any rectangle within each intensity area. Where appropriate the between-track data could then be included in the data analysis. Between track data were abandoned at the westward end of all transects, and on the eastward ends between 56° 45' and 58° 00'N, along the coast of the Outer Hebrides.

Forty-three trawl hauls (Table D1) were carried out during the survey on the denser echo traces. Each haul was sampled for length, age, maturity and weight of individual herring. Up to 350 fish were measured at 0.5 cm intervals from each haul. Otoliths were collected with two per 0.5 cm class below 22 cm, five per 0.5 cm class from 20 to 27 cm and 10 per 0.5 cm class for 27.5 cm and above. Fish weights were collected at sea from a random sample of 50 fish per haul.

Data from the echo integrator were summed over quarter hour periods (2.5 nm at 10 knots). Echo integrator data was collected from 9 m below the surface (transducer at 5 m depth) to 1 m above the seabed. The data were divided into five categories, by visual inspection of the echo-sounder paper record and the integrator cumulative output; "herring traces", "probably herring traces", "probably not herring traces", and two species mixture categories.

For the 1995 survey the total estimated stock was 597,400 tonnes. The spawning stock biomass (mature herring only) is 451,920 tonnes. 79.2% of the stock by number was attributable to the "herring traces" and 21.8% to the "probably herring traces". Fish schools scored in category 3 (probably not herring) were identified from the echogram and trawling exercises, and were probably mostly pout, and other small gadoids. If all these traces were scored as herring they would total 33,220 tonnes, adding 5.5% to the stock and giving a maximum stock size of 631.100 tonnes.

As in previous years, in general, herring were found in waters where the seabed was deeper than 100 m, however, herring were also caught in reasonable quantities in shallower waters on one haul (haul 9). Norway pout were found irregularly throughout the north of the survey area, and often in deeper waters. There was no major difficulty experienced in 1995 in assigning marks to species as was the case in 1994. Hauls 38, 40 and 41 caught many small "0" group blue whiting, these were found very close to hauls 37 and 39 containing mostly herring. It was possible to separate the marks for each species from the echogram (see Fig. D2).

Two calibrations were carried out during the survey. To calculate integrator conversion factors the target strength of herring was estimated using the TS/length relationship recommended by the acoustic survey planning group (Anon 1982) for clupeoids:

$$TS = 20\log_{10}L - 71.2 \text{ dB per individual}$$

The weight of herring at length was determined by weighing fish from each trawl haul which contained more than 50 fish. Lengths were recorded by 0.5 cm intervals to the nearest 0.5 cm below. The resulting weight-length relationship for herring was:

$$W = 0.0015903\ L^{3.516} \text{ g L measured in cm}$$

Survey Results

A total of 43 trawl hauls were carried out, the results of these are shown in Table D1. Sixteen hauls contained more than 100 herring and these hauls were used to define seven survey sub areas (Fig. D3). The sub-areas were defined as:

I. South Minch
II. South Barra Head
III. Barra Head
IV. South West Hebrides
V. Shelf break (NW of Lewis)
VI. North Minch
VII. North VIa(N)

The stock estimate shows a slight decrease from 1994 (600,430 to 597,900 tonnes). The stock distribution is largely as in previous surveys (Fig. D4). Large numbers of fish were found south- west of the Hebrides. A slight uncertainty must attach to the very large biomass in a single rectangle in the north-east of the survey area. There is no doubt that these fish were herring as they were successfully fished. However, the survey was being conducted at low intensity in this area (15 nm transect spacing). As has been commented on before for this survey, the stock displays a highly contagious distribution, which requires

closer tracks. This area has been largely barren in previous years and therefore was given low priority. This may have to change in 1996.

The only other notable points were that large numbers of apparently "0" group herring were found in the south Minch, and large numbers of "0" group blue whiting in the shelf-break sub-area.

The mean length keys, mean lengths, weights and target strengths for each haul and for each sub area are shown in Table D2. 1684 otoliths were taken to establish the seven age length keys. The numbers and weights of fish by quarter statistical rectangle are shown in Figure D3. A total estimate of 3,415.3 million herring or 597,400 tonnes was calculated for the survey area. 451,920 tonnes of these were mature. Herring were found mostly in water with the seabed deeper than 100 m, with traces being found in waters with depths of up to 250 m. The survey was continued over the shelf break for most of the western edge of the survey area. Herring were generally found in similar areas and water depths as 1994. Table D3 shows the numbers and weights of herring by sub area by age class.

There is no dominant year class, in 1994 the stock was dominated by 3 and 7 ring fish. These are still apparent as reasonably strong groups of 4 and 8 ring fish. As in 1994, the bulk of the 1 ring fish (99%) were found in the Minch. There was a very high number of 2 ring fish, most of these (55%) were found in the area north of Scotland, discussed above. The remainder were mostly found in the southern areas (II, III and IV). If these are all genuine VIa(N) herring this may represent a new good year class. Sub-area IV (South west Hebrides) and sub-areas II and III (Barra Head) again contained just over 50% of the stock. Sub-area V (Shelf Break) was agin dominated by the older age classes. Fishing appeared to be successful and trace identification was straight forward.

SURVEY REPORT FOR *RV DANA*
28 JUNE - 12 JULY 1995

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Introduction

In several years Denmark has participated in the International acoustic survey of herring in the North Sea, Skagerrak and Kattegat. In the past four to five years Denmark has covered the North Sea east of 4°E and between 57°N and 59°N, Skagerrak and Kattegat. The effort of the Danish survey has decreased from 22 days in 1991 to 15 days in 1995.

Survey Area

The survey was carried out in the North Sea east of 5°E and between 57°N and 59°N, Skagerrak and Kattegat (Fig. E1). The survey started in the west by doing parallel transects, 10-15 nm apart in an north-south direction. In the eastern part of the survey area the transects were carried out westwards to the Swedish coast. The survey area was split up into eight subareas (Fig. E1).

Methods

Acoustic data were sampled during 24 hours a day. Speed of the ship during acoustic sampling was 9-10 knots. A Simrad EK400 38 kHz echo sounder with a towed body mounted split-beam transducer (type Es 38-29) was used. The echo sounder operated in conjunction with a Simrad ES400 split-beam echo sounder and the ECHOANN analyser system, with the EK400 sounder serving as the transmitter (Degnbol *et al.,* 1990). The pulse duration was 1 ms and the receiver bandwidth 1 kHz between -3 dB point during the survey. The integration data was stored by the ECHOANN analyser system for each nautical mile for each 1.0 m depth interval. The hydroacoustic equipment was calibrated using a standard copper sphere of 60 mm in diameter at Bornö, Gullmarn fjord, Sweden immediately prior to the survey (Table E1).

The towed body used is made of reinforced fibre glass and is partly filled with polyurethane foam, to be slightly positively buoyant. An adjustable hydrofoil fin is mounted in the nose. By tilting the fin and adjusting the wire length and speed of the vessel the towed body can be positioned at various depths between 1 and 5 m (Stæhr *et al.,* 1986).

Pelagic trawling was carried out using a Fotö trawl (16 mm in cod-end), while benthic trawling was carried out using an Expo trawl (16 mm in cod-end). Trawling was carried out in the time interval 1200-1800 h and 2300-0500 h (Table E2). Each trawl haul was analysed for species, length, age and weight. Fish were measured to the nearest 0.5 cm total length and weighed to the nearest 0.1 g wet weight. In each subarea 10 otoliths were sampled per 0.5 cm length class of herring above 15 cm for determination of age. A total of 1,852 otoliths were sampled from herring, which also was examined for maturity stage and vertebral counts for the separation of North Sea autumn spawners from Baltic spring spawners in Skagerrak and Kattegat. Immediately after trawl hauls CTD profiles were collected, where temperature, salinity, density and fluorescence were recorded.

The acoustic data were judged for each nautical mile. Herring was not observed on depths below 150 m. Layers below 150 m was therefore skipped during the acoustic judging. The contribution from plankton, air, bubbles, bottom echoes and noise were removed. When fish echoes were mixed with plankton echoes the contribution from plankton was estimated by comparing the integration values with values obtained at other close sampling positions with similar plankton recordings not containing fish. Significant contribution from air bubbles, bottom echoes and noise were removed by skipping those layers.

For each subarea the mean back-scattering cross section was estimated for herring, sprat, gadoids and mackerel by the TS-length relationship recommended by The Planning Group for Herring Surveys (Anon, 1994):

herring TS = 20 log L - 71.2 dB
sprat TS = 20 log L - 71.2 dB
gadoids TS = 20 log L - 67.5 dB
mackerel TS = 21.7 log L - 84.9 dB

where L is the total fish length in scm. The number of each fish species was assumed to be in proportion to their contribution in trawl hauls. The density of a particular fish species was therefore estimated by subarea using the contribution of the species in trawl hauls. The nearest trawl hauls was allocated to subareas with uniform depth strata. Allocation

to length-age for each species was assumed to be in accordance with the length-age distribution in the allocated trawl hauls.

The spawning biomass was estimated using the maturity key:

age 0 and 1: no mature individuals
age 2: 50% mature individuals
age 3: 85% mature individuals
age 4+: 100% mature individuals

The maturity of North Sea autumn and Baltic spring spawning herring observed during the survey is shown in Table 10.

Results

The temperature of the water in the surface was characterised by summer heating with temperatures ranging from 15-18°C. Below the thermocline which was found in 14-18 m depth the temperatures were ranging from 5-8°C.

A total of 1549 nautical mile were surveyed (Table E3) and 35 trawl hauls were carried out (Table E2). The mean Sa was between $4.51*10^{-6}$ to $1.94*10^{-5}$ and the mean TS estimated was between $1.22*10^{-5}$ to $5.36*10^{-5}$ (Table E3). A total estimate of $605*10^{7}$ herring (Table E4) or 542,000 tonnes (Table E5) was estimated for the subarea I-VII. The spawning biomass of North Sea autumn and Baltic spring spawning herring was estimated to 42,051 and 359,258 tonnes respectively (Table E5). Subarea VIII was not included in the calculations due to very high densities of jellyfish. The main densities of herring was found in subarea I-IV, which contributed with about 70% of the total biomass (Table E4). The mean weight of herring by age was significant higher in subarea I-V than in subarea VI-VIII (Table E6). Significant difference in length of herring by subarea was not found (Table E7). However, herring in subarea VIII show a tendency to be smaller than herring in subarea I-VII. The length-weight relationship between North Sea autumn and Baltic spring spawning herring was found not to be significant different (Table E8). The fraction of Baltic spring spawning herring was nearly 100% for the age classes 4+ (Table E9). The faction of Baltic herring had however a tendency to decrease in subarea IV-V (Table E10). Furthermore, for the year class 1 and 2 the fraction of Baltic herring in subarea I-IV was smaller than in subarea V-VII (Table E10). The current maturity of North Sea autumn and Baltic spring spawning herring was found to be 8.7% and 8.9% respectively (Table E11). All herring sampled for determination of age during the survey were examined for Ichthyophonus. No infected herring was found.

The total stock estimate for 1995 was in the same order of magnitude as the estimate for 1994 (515,000 tonnes). The spawning biomass for Baltic spring spawning herring was however a factor 1.5 higher for 1995 than for 1994 (359,258 and about 200,000 tonnes respectively).

Acknowledgements

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SURVEY REPORT FOR THE RV *LOUGH FOYLE*
17 JULY - 3 AUGUST 1995

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Methods

The survey was carried out in the north east Atlantic Ocean off the north and west coasts of Ireland, extending from the Isle of Islay off Scotland, to Dingle Bay, Ireland. The cruise track (Fig. F1), proceeding west from Islay, consisted of 21 systematic parallel transects, of variable length (30-90 nm), spaced 10 nm apart giving three transects per ICES statistical rectangle. The start point of the survey was randomised within 10 minutes of latitude, with a 1 nmile buffer on each side (ie 1-8 nmile start point). The transects extended from close inshore at the 20 m contour, to the limit of the continental shelf (200 m contour) up to 80 nm (148 km) offshore. In Galway Bay, the cruise track was modified to sample the area more intensely. Zig-zag transects dividing the bay into equal segments were undertaken. The total cruise track length excluding inter-transect data was 1,489 nm (2,754.2 km) and the area covered was 16,210 nmile^2 (55,480 km^2); this gave a degree of coverage of 11.7.

Acoustic data were collected with a Simrad "EK500" scientific echo-sounder interfaced to a personal computer running version 5.0 of Simrad's "EP500" software. A Simrad ES-38D (38 kHz) transducer was used, mounted in a towed body. The equipment was calibrated using a tungsten carbide standard target. Data from the echo-integrator were summed over 15 minute periods using a constant ping rate of 0.8 seconds and a "ping based" log option set to 1,125 pings. Unlike previous cruises, the S_A values derived from the EK500 and EP500 were the same; this vindicates the use of the ping based log option. In accordance with the other coordinated surveys, the data obtained between 1200 hrs and 0400 hrs was not used for integration.

Fishing was carried out using a 25 x 30 m rectangular pelagic trawl. Fish samples were broken into species composition by weights. Measurements of lengths were taken to the nearest 0.5 cm, and in the case of herring, samples were taken for maturity, age (otolith extraction), and weight.

The S_A values from each log interval were partitioned by inspection of the echogram into the following categories: 1) Definitely herring; 2) Probably herring; 3) Herring in a mixture. Allocated integrator counts (S_A values) from these categories were used to calculate herring numbers using the "Marine Laboratory echo integrator survey logging and analysis programme" (MILAP). The TS/length relationship used was that recommended by the acoustic survey planning group (Anon, 1994):

Herring $\quad TS = 20 \log L - 71.2$ dB per individual (L = length in cm)

Herring biomass was calculated from numbers using the length-weight relationship determined from the trawl samples taken during the cruise:

Herring weight (grams) $\quad = 0.002723 * L^{3.374}$ (L = length in cm)

Results

A total of 631 data samples were taken, of which 74 had at least one of the three categories assigned to them (and consequently a total of 557 zero values). A total of 39 trawl hauls were taken. The positions of these hauls are indicated in Figure F1. Herring was present in nine of the 39 trawl hauls, of which five captured sufficient numbers to provide adequate samples to qualify the acoustic data. The sampled area was sub-divided into four areas according to similar length distributions: Offshore North (represented by trawl 2); Inshore North (trawl 11); Offshore South (trawl 30); and Inshore South (a weighted average of trawls 25 and 26). The borders of these sub-divisions and the length frequency histograms are illustrated in Figure F2.

The total biomass estimates for the survey area were:

Definitely herring	75,440 tonnes	55%
Probably herring	55,530 tonnes	40%
Herring in a mixture	6,700 tonnes	5%
Total herring	**137,670 tonnes**	

A breakdown of the biomass estimate by area, is given in Figure F3. The biomass estimates by age and maturity are given in Table F1. 2-ring fish comprise the dominant year class (38 % of the biomass); this may suggest good recruitment. The 3-ring and 4-ring fish comprise 28% and 11% of the biomass respectively. The 1985 year class (9+) which has been the dominant one in this fishery (Anon, 1993) is still evident making up 9.5% of the biomass.

The herring stock off the west coast of Ireland continues to be highly contagiously distributed with the whole stock being contained in just 12% of the acoustic records; zero values accounted for the vast majority (88%) of records. The situation has somewhat improved from last year however, when over 94% of records were zeros. In addition, the fishing success has been significantly improved upon due in part to the use of a larger trawl. Despite the improved fishing success there is a major cause for concern with regard to the substantial drop in the biomass estimate from 353,000 tonnes to 137,670. Due to the lack of catches, last years acoustic data was qualified using commercial catches. These catches gave a length frequency distribution and length-weight relationship quite similar to that obtained this year. The location of acoustic records was also very similar. The biggest and most notable difference between the two years is the presence in 1994 of two exceptionally large schools which registered extremely high S_A values of 12,124 and 10,297. These values effectively pushed up the mean S_A value to 50.2 - without them the mean would be 20.8, which is very close to this years mean value of 20.7. The reduction in this years estimate relative to 1994 is, therefore, most likely due to 1994's estimate being exceptionally high due to the detection of unrepresentatively large numbers of large schools. The current estimate is closer to tentative VPA estimates of between 150,000-200,000 tonnes (Anon, 1995); this, and the improved fish sampling in this years survey implies that the current estimate is closer to the actual value.

Due to the extremely contagious distribution of the stock, stratification of effort may be advantageous next year. It is clear from the two surveys carried out to date, that the bulk of the biomass occurs in large schools, located offshore. It may therefore be prudent in future to put more effort into offshore transects.

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SURVEY REPORT FOR FRV *WALTHER HERWIG*, NORTHERN NORTH SEA

General Comments

The 1995 echo-survey was performed as scheduled and carried out without major or unexpected problems. As in the previous year, the abundance of plankton and other fish species hampered the identification of herring schools severely. In particular, small mackerel and horse mackerel schools were found in the area, and especially sprat schools partly seemed to mix with juvenile herring. These factors hampered severely the appropriate identification of herring schools.

In the German sector herring were found to be most abundant in a stretch of north/south direction in the ICES rectangles 39-41/F5-F6.

The total biomass was calculated to be 422,711 t. Of these were 48,000 t 0-ringer, 232,000 t immature I-ringer (55%), 47,000 t mature 1-ringer (12%), 62,000 t immature II-ringer (15%), 31,000 t mature II-ringers, and some 2,000 t of III-ringers and minor quantities of IV-ringers. Thus, in total, 342,000 t were immature fish (81%) and correspondingly 81,000 t mature (19%).

All the herring were found to be autumn-spawners.

Specific Comments

The analysis of the samples was strongly delayed due to difficulties in reading and correctly interpreting the otoliths, especially of the I- and II-ringers. As the distribution of the average weights per age class shows, are the II-ringers on average only slightly heavier than the I-ringer. The same can be seen of course by comparing the average lengths. The I-ringers were found to be in the range of about 17-20 cm, and the II-ringers in the respective rectangle were only about 1 cm longer, if at all. However, since it was expected that either the I-ringers were smaller and/or the II-ringers larger, the otoliths were re-examined, also

by the help of the Dutch colleagues. Many of the otoliths had double rings, and it was eventually only a matter of decision whether to regard these fish as I- or II-ringers. Fish with conspicuous double rings were regarded as II-ringers, while others not. This decision may have been wrong. If so, the majority of the II-ringers are as a matter of fact one year younger, leaving a complete gap in the age-frequency distribution. A total lack of II-ringers is on the one hand not regarded as realistic. II-ringers, on the other hand, that are not really bigger than I-ringers is a scenario not regarded to be realistic either. As a result, the data should be treated with care.

Another problem was encountered during the process of weighing on board of the vessel. Chiefly the weights of the small individuals were found to be unreliable due to a proportionally too large weighing error on the relatively insensitive balance. The problem has been addressed and will be improved in the future. As a consequence, the average weights of the 0-ringers appear partly unlikely. This was also a result of insufficient numbers per length group in the catches. So, the weights of the 0-ringers should partly also be treated with care.

COMBINED SURVEY REPORT

Figure G1 shows survey areas for each vessel. The results for the six surveys have been combined. Procedures and TS values are the same as for the 1994 surveys (CM1995/H:15). The stock estimates have been calculated by age and maturity stage for 30'N-S by 1°E-W statistical rectangles for the survey area north of 52°N to the west of Scotland. The combined data give estimates of immature and mature (spawning) herring for ICES areas VIa north, VIa south, IVa and IVb separately. The region east of 6°E is presented separately and the data from all areas have been split between North Sea and Baltic Stocks. Where the survey areas for individual vessels overlap the mean estimates by age and maturity stage for each overlapping rectangle have been used. Stock estimates by number and weight are shown in Tables G1 and G2 respectively for areas VIa north, IVa south, IVa and IVb separately, for area IVab combined and for the area east of 6°E for North Sea autumn spawning herring. The mean weights at age are shown in table G3. Stock estimates by number and weight are shown in Table G4 for Baltic herring. Figure G2 shows the distribution of abundance (numbers and biomass) of all one ring and older herring for all areas surveyed. Figure G3 shows the distribution split by age of one ring, 2 rings and 3 rings and older herring, omitting "O" group estimates in all areas. Figures G4 and G5 show the density distribution of numbers and biomass of all one ring and older herring as contour plots.

Ichthyophonus Infection

The numbers of fish with ichthyophonus was limited to four fish from 1,704 on the Norwegian survey, five fish from 2,721 from *Scotia* and 0 from 400 from *Tridens* giving a total of nine from 4,825 or 0.2%. The level of sampling was insufficient to establish either a proportion or an age distribution. The prevalence of ichthyophonus at about 0.2% compares with 0.8% in 1994 3.6% in 1993 and 5% in 1992. These results show again lower prevalence of infection than in previous years, suggesting the influence of the disease on the population has declined to a negligible level.

Table A1 Trawl Haul Summary Scotia July 1995

HAUL No	Latitude			Longitude			DEPTH	HERR	WHIT	HADD	POUT	MACK	SPRAT	M.POUT	COMMENTS
212	58	40.46	N	0	38.64	E	143	7448		117					
213	58	55.00	N	0	9.00	W	120	1215	3			5			
214	58	55.00	N	1	5.60	W	126		1		121	2			
215	59	10.00	N	0	0.50	W	140			4		88			1 LUMPSUCKER
216	59	10.00	N	0	22.25	E	148		20	5	755				
217	59	10.08	N	0	34.22	E	80				168				
218	59	10.21	N	0	41.69	E	121	9	27	3		3			2 COD 1 SAITHE
219	59	24.10	N	1	34.10	W	84	24075			1559				
220	59	25.12	N	1	51.22	W	105	373	561	209	7				
221	59	47.86	N	1	45.10	E	117				20				
222	59	54.81	N	1	3.82	W	103	1445			436				
223	60	2.98	N	0	55.45	W	110								MISSED MARK
224	60	2.96	N	0	14.55	W	134	215		7	40				
225	60	24.30	N	0	35.70	W	130	383	6	5	2				
226	60	33.04	N	0	31.46	W	151	248	6	2					2 PEARLSIDES
227	60	47.90	N	0	5.84	E	140	6285							
228	60	38.89	N	0	37.36	W	106	6903		13	40		67		
229	60	54.97	N	0	17.22	W	150	184							1 GURNARD
230	61	7.10	N	0	49.71	W	152	3080				450			
231	61	10.07	N	0	37.93	W	157								MISSED MARK
232	60	37.47	N	2	12.56	W	140	12		2	15				1 LUMPSUCKER
233	60	33.83	N	1	39.48	W	86		1		121				
234	60	39.90	N	2	16.50	W	140	67		1				118	
235	60	40.00	N	2	37.00	W	140							150	1 SCAD
236	60	25.00	N	2	15.16	N	148	439	3	5	130				1 COD

HAUL No	Latitude			Longitude			DEPTH	HERR	WHIT	HADD	POUT	MACK	SPRAT	M.POUT	COMMENTS
237	60	25.46	N	2	2.18	W	111	15147							
238	60	3.92	N	1	28.10	W	120	401	8		35				
239	60	9.71	N	2	53.11	W	143	454							2 GURNARDS
240	60	10.20	N	3	6.50	W	200		1					161	4 GURNARDS
241	60	10.08	N	3	10.99	W	158	1						206	
242	59	54.74	N	2	44.66	W	91	81		2	23				1 GURNARD
243	59	56.27	N	1	29.76	W	105	150	825		390				1 SCAD
244	59	40.13	N	3	48.75	W	135	3	45	15					
245	59	33.40	N	3	44.20	W	150	4814							
246	59	27.10	N	3	52.44	W	140	32750	100				100		1 COD
247	59	25.10	N	2	57.22	W	46								SURFACE TOW SANDEELS AND SPRATS MESHED
248	58	53.69	N	3	44.40	W	95								SURFACE TOW SPRATS MESHED

Table A2 Length Keys, mean weights, lengths and targets strengths by haul and sub area Scotia 1995

Length	224	227	228	229	230	234	236	239	242	246	mean	212	213	220	222	225	226	237	238	245	mean	219	243	mean
19.5																			0.2		0.0			
20.0																								
20.5	0.5										0.0			1.2					0.5		0.2	0.2		0.1
21.0														2.5					0.5		0.3	0.4		0.2
21.5														1.2	0.2					0.2	0.2	1.1	4.0	2.5
22.0														0.6							0.1	1.3	4.0	2.6
22.5														4.3					0.5	0.3	0.6	4.0	2.0	3.0
23.0													0.4	4.3		0.5			0.2		0.6	6.7	6.0	6.3
23.5	0.5									0.2	0.1	0.2	0.9	2.5	0.2	0.3		0.2	2.2	1.6	0.9	7.6	14.0	10.8
24.0	0.9	0.2			0.2		0.2			0.6	0.2	0.4	1.1	1.2	0.2	3.4	0.8	0.4	3.0	4.5	1.7	12.8	14.0	13.4
24.5	0.9	0.2			0.3					1.4	0.3	2.2	6.9	8.0	1.1	5.5	0.8	1.1	6.5	5.9	4.2	11.3	18.0	14.7
25.0	0.5	0.2	1.0		1.5			0.4		2.9	0.6	5.2	18.7	11.1	1.8	9.1	1.6	3.1	13.5	11.0	8.3	11.7	12.0	11.8
25.5	1.9	0.7	1.2		1.3			1.3		2.7	0.9	10.3	18.7	9.9	2.5	8.6	3.2	5.4	14.0	9.7	9.1	10.8	10.0	10.4
26.0	4.2	1.4	1.0	2.2	3.6		1.6	0.4	2.5	3.8	2.1	13.9	19.3	9.3	8.7	15.9	7.3	8.7	16.0	11.9	12.3	10.3	6.0	8.1
26.5	4.7	3.8	4.6	1.6	5.8		1.6	2.0	4.9	3.8	3.3	14.8	16.4	12.3	14.6	12.8	11.3	8.5	15.5	9.7	12.9	9.4	6.0	7.7
27.0	8.4	7.4	6.9	4.3	7.8	1.5	1.6	4.0	4.9	3.5	5.0	10.5	9.1	9.9	16.4	14.1	14.9	13.3	11.2	9.3	12.1	5.6	2.0	3.8
27.5	5.1	8.1	8.7	1.1	8.1	1.5	3.0	4.4	7.4	4.3	5.2	11.7	4.2	9.3	13.7	11.0	11.3	11.8	7.7	4.7	9.5	3.2		1.6
28.0	6.0	9.8	12.3	4.3	9.6	6.0	7.3	7.7	4.9	4.4	7.2	9.0	2.2	3.1	11.6	5.5	10.1	12.4	2.7	5.9	6.9	1.6	2.0	1.8
28.5	13.5	11.2	10.2	8.2	9.1	1.5	7.5	9.0	7.4	6.4	8.4	8.1	0.7	4.3	9.1	4.4	14.1	7.4	2.5	4.7	6.1	0.2		0.1
29.0	14.0	13.1	12.1	14.1	8.8	10.4	10.3	12.3	17.3	8.4	12.1	5.6		1.2	7.1	3.7	9.3	7.2	1.5	4.1	4.4	0.7		0.4
29.5	9.8	11.7	10.6	11.4	8.9	16.4	11.6	12.3	12.3	8.5	11.4	2.9	0.7	0.6	5.5	1.6	5.2	7.4	0.7	4.0	3.2	0.9		0.4
30.0	8.8	9.1	9.2	11.4	9.6	22.4	15.9	13.2	6.2	10.4	11.6	1.8	0.4	1.9	3.4	1.0	2.8	5.0		3.1	2.2	0.4		0.2
30.5	4.7	6.4	6.6	10.3	6.0	10.4	9.1	10.4	2.5	7.8	7.4	1.1		0.6	1.1	1.0	2.0	3.5	0.2	2.2	1.3	0.2		0.1
31.0	6.5	6.2	6.4	10.3	5.7	11.9	6.4	6.4	4.9	7.2	7.2	0.7			1.1	0.8	2.4	1.3	0.5	1.9	1.0			
31.5	5.1	4.8	4.0	8.2	2.8	4.5	7.5	4.4	8.6	6.3	5.6	0.4			0.9	0.8	0.8	1.3		1.2	0.6			
32.0	3.3	3.8	2.7	3.8	2.9	1.5	5.2	3.3	3.7	6.3	3.6	0.4	0.2		0.2		2.0	0.2	0.2	1.6	0.5			
32.5		1.0	1.2	3.8	3.2	7.5	3.9	2.6	7.4	4.1	3.5	0.2			0.2			0.9		0.7	0.2			
33.0	0.5	0.5		2.2	1.8	1.5	3.2	3.1	1.2	3.8	1.8							0.9		1.6	0.3			
33.5	0.5	0.2	0.6	1.6	1.5	1.5	1.6	1.5	2.5	1.5	1.3			0.6						0.2	0.1			
34.0			0.8	1.1	1.0		0.9	0.4	1.2	1.1	0.6	0.2								0.2	0.0			
34.5					0.5	1.5	1.4	0.4		0.5	0.4	0.2								0.2	0.0			
35.0					0.2		0.2	0.2		0.2	0.1													
Number Measured	215	419	519	184	616	67	439	454	81	655		446	450	162	438	383	248	459	401	580		556	50	
mean length (cm)	29.3	29.5	29.5	30.4	29.5	30.7	30.5	30.1	30.1	30.0	30.0	27.6	26.4	26.3	28.1	27.1	28.3	28.3	26.5	27.5	27.3	25.5	24.9	25.2
mean weight (g)	244	252	250	281	254	290	285	272	271	270	267	195	163	164	207	182	214	214	167	195	189	145	132	139
TS/individual (dB)	-41.9	-41.8	-41.8	-41.5	-41.8	-41.4	-41.5	-41.6	-41.6	-41.6	-41.7	-42.4	-42.8	-42.8	-42.2	-42.5	-42.1	-42.1	-42.7	-42.4	-42.4	-43.0	-43.3	-43.1
TS/kilogramme (dB)	-35.7	-35.8	-35.8	-36.0	-35.8	-36.1	-36.0	-35.9	-35.9	-35.9	-35.9	-35.3	-34.9	-34.9	-35.4	-35.1	-35.5	-35.5	-34.9	-35.3	-35.2	-34.7	-34.5	-34.6

Table A3 Numbers, mean lengths mean weights and biomass of North Sea herring Scotia July 1995

Age/Maturity	Numbers (*10^6)	Mean Length (cm)	Mean Weight (g)	Biomass (Tonnes 10^{-3})
Area Area I				
1A	0.64	20.50	67.93	0.04
2I	9.38	25.16	146.21	1.37
2M	196.32	26.93	188.33	36.97
3I	3.86	27.62	209.13	0.81
3M	573.77	28.95	246.45	141.40
4A	226.98	29.85	275.94	62.63
5A	56.94	30.56	301.52	17.17
6A	55.24	31.35	330.92	18.28
7A	76.95	31.50	336.70	25.91
8A	89.59	31.75	348.38	31.21
9+	87.68	32.04	360.36	31.59
Total	1377.36	29.46	266.74	367.40
Area II				
1A	14.54	21.00	74.70	1.09
2I	114.99	24.29	129.01	14.84
2M	1157.74	26.16	169.15	195.83
3I	13.39	25.89	163.33	2.19
3M	642.58	27.64	208.57	134.02
4A	152.72	28.45	232.98	35.58
5A	76.35	28.79	242.12	18.49
6A	19.35	30.60	303.67	5.88
7A	21.16	31.09	321.83	6.81
8A	14.71	31.48	336.55	4.95
9+	10.02	32.07	360.24	3.61
Total	2237.53	26.84	189.17	423.27
Area III				
1A	3.26	22.56	97.60	0.32
2I	13.45	23.72	117.61	1.58
2M	26.24	25.21	147.75	3.88
3I	0.00			0.00
3M	3.50	26.62	181.20	0.64
4A	0.13	29.83	274.09	0.03
5A	0.00			0.00
6A	0.08	29.75	271.00	0.02
7A	0.00			0.00
8A	0.00			0.00
9+	0.00			0.00
Total	46.66	24.72	138.64	6.47
All Areas				
1A	18.43	21.26	78.51	1.45
2I	137.82	24.30	129.07	17.79
2M	1380.30	26.25	171.47	236.68
3I	17.25	26.28	173.58	2.99
3M	1219.85	28.25	226.31	276.06
4A	379.83	29.29	258.67	98.25
5A	133.29	29.54	267.50	35.66
6A	74.68	31.16	323.79	24.18
7A	98.11	31.41	333.49	32.72
8A	104.30	31.71	346.71	36.16
9+	97.69	32.04	360.35	35.20
Total	3661.55	27.80	217.70	797.14

Table B1

Table 1. Estimated number of herring in ICES stat squares divided in stocks and agegroups.											
	R/V 'G.O. Sars', 26 June - 16 July 1995.										
43-E9	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
20,02	18,41	58,30	0,30	14,65	5,36	5,08	1,41	0,28	0,56	0,28	124,66
43F0	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
8,58	7,89	24,99	0,13	6,28	2,30	2,18	0,60	0,12	0,24	0,12	53,43
43F3	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
0,51	0,13	0,50	0,01	0,12	0,04	0,02	0,02	0,00	0,00	0,00	1,37
	Baltic Spring Spawners										
0,00	0,08	0,02	0,03	0,10	0,07	0,03	0,03	0,00	0,01	0,00	0,38
43F4	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
1,01	0,27	1,01	0,02	0,24	0,09	0,04	0,04	0,00	0,01	0,00	2,73
	Baltic Spring Spawners										
0,00	0,08	0,04	0,07	0,20	0,13	0,07	0,06	0,01	0,01	0,00	0,68
43F5	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
5,49	1,08	1,27	0,11	0,44	0,56	0,16	0,12	0,09	0,02	0,02	9,39
	Baltic Spring Spawners										
0,00	1,88	0,47	0,55	1,65	2,26	0,66	0,47	0,38	0,09	0,09	8,51
43F6	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
13,73	2,71	3,18	0,27	1,10	1,41	0,41	0,29	0,24	0,06	0,06	23,46
	Baltic Spring Spawners										
0,00	4,71	1,18	1,37	4,12	5,65	1,65	1,18	0,94	0,24	0,24	21,27
44F0	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
14,88	13,68	43,33	0,22	10,89	3,98	3,77	1,05	0,21	0,42	0,21	92,65
44F1	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
14,37	13,21	41,84	0,21	10,51	3,85	3,64	1,01	0,20	0,40	0,20	89,45
44F2	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
13,86	12,74	40,34	0,21	10,14	3,71	3,51	0,98	0,20	0,39	0,20	86,26
44F3	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
6,48	1,72	6,45	0,13	1,54	0,58	0,29	0,26	0,03	0,05	0,00	17,53
	Baltic Spring Spawners										
0,00	1,06	0,27	0,43	1,30	0,86	0,43	0,39	0,04	0,08	0,00	4,87

Table B1 (continued)

44F4	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
5,49	1,45	5,46	0,11	1,30	0,49	0,24	0,22	0,02	0,04	0,00	14,83
	Baltic Spring Spawners										
0,00	0,90	0,23	0,37	1,10	0,73	0,37	0,33	0,03	0,07	0,00	4,12
44F5	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
20,59	4,06	4,77	0,41	1,65	2,12	0,62	0,44	0,35	0,09	0,09	35,19
	Baltic Spring Spawners										
0,00	7,06	1,77	2,06	6,18	8,47	2,47	1,77	1,41	0,35	0,35	31,89
44F6	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
8,67	1,71	2,01	0,17	0,69	0,89	0,26	0,19	0,15	0,04	0,04	14,82
	Baltic Spring Spawners										
0,00	2,97	0,74	0,87	2,60	3,57	1,04	0,74	0,59	0,15	0,15	13,43
45F1	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
6,57	6,04	19,14	0,10	4,81	1,76	1,67	0,46	0,09	0,19	0,09	40,93
45F2	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
0,51	0,46	1,47	0,01	0,37	0,14	0,13	0,04	0,01	0,01	0,01	3,15
45F3	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
30,47	8,06	30,32	0,63	7,22	2,71	1,35	1,23	0,12	0,25	0,00	82,37
	Baltic Spring Spawners										
0,00	5,00	1,25	2,04	6,12	4,06	2,03	1,85	0,18	0,37	0,00	22,91
45F4	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
13,76	3,64	13,69	0,28	3,26	1,22	0,61	0,56	0,06	0,11	0,00	37,20
	Baltic Spring Spawners										
0,00	2,26	0,56	0,92	2,77	1,83	0,92	0,83	0,08	0,17	0,00	10,35
45F5	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
28,64	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	28,64
	Baltic Spring Spawners										
6,29	47,66	11,92	19,52	58,55	12,33	2,05	0,00	2,05	0,00	0,00	160,37
45F6	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
16,56	3,26	3,83	0,33	1,32	1,70	0,50	0,35	0,28	0,07	0,07	28,29
	Baltic Spring Spawners										
0,00	5,68	1,42	1,66	4,97	6,81	1,99	1,42	1,14	0,28	6,00	31,35
46F1	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
7,73	7,11	22,51	0,12	5,66	2,07	1,96	0,54	0,11	0,22	0,11	48,13

Table B1 (continued)

46F2	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
9,23	8,48	26,86	0,14	6,75	2,47	2,34	0,65	0,13	0,26	0,13	57,44
46F3	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
10,18	2,69	10,13	0,21	2,41	0,90	0,45	0,41	0,04	0,08	0,00	27,52
	Baltic Spring Spawners										
0,00	1,67	0,42	0,68	2,05	1,36	0,68	0,62	0,06	0,12	0,00	7,65
47E7	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
0,37	2,31	20,77	0,00	2,03	0,55	0,00	0,00	0,00	0,00	0,00	26,04
47E8	North Sea Autumn spawners										
1	2I	2M.	3I	3M	4	5	6	7	8	9+	Total
2,28	14,26	128,30	0,00	12,55	3,42	0,00	0,00	0,00	0,00	0,00	160,81
47E9	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
1,72	10,73	96,53	0,00	9,44	2,57	0,00	0,00	0,00	0,00	0,00	120,99
47F3	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
7,17	1,90	7,14	0,15	1,70	0,64	0,32	0,29	0,03	0,06	0,00	19,38
	Baltic Spring Spawners										
0,00	1,18	0,29	0,48	1,44	0,96	0,48	0,43	0,04	0,09	0,00	5,39
48F3	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
0,94	0,25	0,94	0,02	0,22	0,08	0,04	0,04	0,00	0,01	0,00	2,54
	Baltic Spring Spawners										
0,00	0,15	0,04	0,06	0,19	0,13	0,06	0,06	0,01	0,01	0,00	0,71
48F4	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
0,00	0,27	0,95	0,09	0,61	0,45	0,20	0,09	0,02	0,04	0,00	2,71
	Baltic Spring Spawners										
0,00	0,00	0,00	0,65	1,96	2,98	1,35	0,62	0,14	0,24	0,00	7,95
49E9	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
0,00	2,27	73,41	0,00	27,42	2,19	3,29	0,00	0,00	0,00	0,00	108,59
49F4	North Sea Autumn spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
0,00	0,06	0,21	0,02	0,13	0,10	0,04	0,02	0,00	0,01	0,00	0,59
	Baltic Spring Spawners										
0,00	0,00	0,00	0,14	0,43	0,65	0,29	0,14	0,03	0,05	0,00	1,74
50E9	North Sea Autumn Spawners										
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
0,00	1,81	58,56	0,00	21,88	1,75	2,63	0,00	0,00	0,00	0,00	86,63

Table B1 (continued)

50F0 North Sea Autumn Spawners											
1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
0,00	1,54	49,95	0,00	18,66	1,49	2,24	0,00	0,00	0,00	0,00	73,89
In the following squares, no herring were recorded:						43E8, 43F1, 43F2, 45F5,					
						46F4, 46F5, 47F0, 47F1, 47F2,					
						47F4, 48F1, 48F2, 49F1, 49F2,					
						49F3, 50F1, 50F2, 50F3,					
						51F1, 51F2, 51F3, 51F4					

Table B2

Table 2. Herring. Weight at age (g) for age groups and mature/immature fish in sub areas.										
Area 1										
1	2I	2M	3I	3M	4	5	6	7	8	9+
48.00	95.80	165.70	92.78	209.70	152.20	176.90	194.10	189.30	235.30	175.70
Area 2										
1	2I	2M	3I	3M	4	5	6	7	8	9+
54.90	99.60	178.08	88.50	214.80	187.10	185.80	196.40	214.00	244.00	0.00
Area 3										
1	2I	2M	3I	3M	4	5	6	7	8	9+
65.70	91.70	139.50	155.60	155.80	179.60	183.20	223.40	264.00	231.50	211.00
Area 4										
1	2I	2M	3I	3M	4	5	6	7	8	9+
52.50	106.20	126.60	0.00	140.80	142.30	0.00	0.00	0.00	0.00	0.00
Area 5										
1	2I	2M	3I	3M	4	5	6	7	8	9+
0.00	126.00	187.60	160.20	206.90	200.70	220.80	228.30	245.70	268.20	245.00
Area 6										
1	2I	2M	3I	3M	4	5	6	7	8	9+
0.00	102.50	161.40	0.00	182.10	199.00	181.70	0.00	0.00	0.00	0.00

Table B3

Table 3. Estimated number and biomass of herring divided in age- and lengthgroups. Totals also divided in stocks. R/V 'G.O. Sars' 26 June - 16 July 1995											
					Agegroups						
Length (cm)	1	2	3	4	5	6	7	8	9+	N (mill)	W (ton 6-9)
15	2,50									2,50	0,07
15,5	1,73									1,73	0,05
16	8,81									8,81	0,29
16,5	11,34									11,34	0,44
17	22,64									22,64	0,92
17,5	22,78									22,78	1,05
18	23,83									23,83	1,18
18,5	13,11									13,11	0,68
19	13,61									13,61	0,78
19,5	18,75	1,35								20,10	1,21
20	23,92									23,92	1,51
20,5	16,64	4,18		1,04						21,84	1,45
21	11,32	3,08	1,46	0,69						16,56	1,23
21,5	12,48	19,90	1,46	1,04						34,88	2,77
22	6,27	21,67	2,57	0,69						31,21	2,70
22,5	11,31	39,86	2,15	1,73	0,35					55,41	5,17
23	2,23	28,47	1,46	0,35						32,51	3,30
23,5	1,35	62,64	0,35	0,35	0,35					65,03	6,93
24		66,83	7,95	1,11						75,69	8,55
24,5		124,48	11,05							135,54	16,42
25		133,33	14,05	3,36	2,46					153,21	19,98
25,5		141,69	31,35	0,84						173,87	23,96
26		100,18	25,54	3,36						129,07	19,36
26,5		80,47	13,05	8,06	0,07	0,35				102,00	18,41
27		84,91	35,87	11,03	10,76	0,35	0,69			143,61	24,32
27,5		47,89	19,20	12,31	8,63	2,78	0,35			91,16	18,46
28		9,29	18,43	17,98	3,80	3,16	0,35	0,77	0,35	54,10	10,51
28,5		5,42	26,04	5,79	10,35	1,74	0,35			49,67	10,05
29		1,42	7,40	7,44	8,35	2,88	1,11	0,35	1,69	30,63	6,41
29,5		3,47	8,02	3,82	3,48	2,94	0,76	0,00	0,00	22,49	4,99
30			1,55	0,27	0,83	5,82	1,11	0,48	0,35	10,41	2,43
30,5			1,35	2,04	0,07		1,69	2,76		7,92	1,92
31		1,35	1,35		0,35	0,41	0,07	0,07		3,59	1,04
31,5				0,20	0,07					0,27	0,08
32				0,07	0,07	0,07				0,20	0,06
32,5								1,11		1,11	0,31
33										0,00	0,00
33,5				0,07				0,07		0,13	0,04
34					0,07					0,07	0,02
34,5											
35											
35,5											
36											
Tot. number:	224,62	981,65	231,66	83,61	50,03	20,49	6,47	5,61	21,24		221,98
NS herring:	224,62	945,28	188,71	49,90	37,51	10,97	2,51	3,56	1,56		
Baltic spring:	0,00	36,37	42,95	33,72	12,53	9,52	3,96	2,05	19,69		
										NS-herring (1000 t):	193,97
										Baltic spring " :	28,00
										SSB, NS herring " :	165,97

Table B4: Record of observations of Ichthyophonus in herring

Station	Investigated	Infected	Length	Maturity	Vertebrate	Age
364	57	0				
367	29	0				
382	100	0				
384	100	0				
386	100	0				
392	97	1	24.5	2		2
394	49	1	18	1		1
395	100	0				
398	100	2	27.5	3	56	3
			28.5	3		3
399	100	0				
400	33	0				
402	50	0				
406	100	0				
414	47	0				
416	100	0				
426	100	0				
427	42	0				
440	100	0				
442	100	0				
449	100	0				

Table B5

Table 5. Sprat. Estimated number per age group and mature/immature fish, and biomass.							
43-E9			Agegroups				
	1	2	3	4	5+	Total N	W (ton E-3)
N-S Sprat	19.93	100.68	19.93	2.10	0.00	142.63	2.04
NS-Immature	0	0	0	0	0	0	0
49-E9			Agegroups				
	1	2	3	4	5+	Total N	W (ton E-3)
N-S Sprat	18.25	4.76	0.00	0.00	0.00	23.01	0.22
NS-Immature	5.48	0.00	0.00	0.00	0.00	5.48	0.01
NS-Mature	12.78	4.76	0.00	0.00	0.00	17.54	0.22
50-E9			Agegroups				
	1	2	3	4	5+	Total N	W (ton E-3)
N-S Sprat	23.98	6.26	0	0	0	30.23	0.29
NS-Immature	7.19	0.00	0	0	0	7.19	0.01
NS-Mature	16.79	6.26	0	0	0	23.04	0.28

Table B6

Table 6 Sprat. Weight at age (g) in ICES stat. squares for age groups and mature/immature fish.									
43E9									
1I	1M	2I	2M	3	4	5+			
0.00	12.00	0.00	14.30	16.50	15.50	0.00			
49E9									
1I	1M	2I	2M	3M	4	5+			
8.42	9.19	0.00	10.00	0.00	0.00	0.00			
50E9									
1I	1M	2I	2M	3M	4	5+			
8.42	9.19	0.00	10.00	0.00	0.00	0.00			

Table C1: *Tridens* 3-21 July 1995. Numbers of herring investigated for Ichthyophonus

Haul	Latitude	Longitude	No investigated	No infected
1	58.55	01.28W	50	0
3	58.39	01.08W	25	0
4	58.25	00.44W	50	0
5	58.25	01.13W	50	0
6	58.10	01.41W	25	0
7	58.10	01.28W	25	0
9	58.09	00.38E	50	0
12	56.40	00.40E	25	0
15	55.04	01.34E	50	0
18	55.26	00.53W	50	0

length	haul 1	haul 3	haul 4	haul 5	haul 6	haul 7	haul 9	haul 12	haul 15	haul 16	haul 17	haul 18	haul 19	haul 20
15.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.00	0.00	0.00	0.00	0.00	0.00
15.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.00	0.00	0.00	0.00	0.00	0.00
16.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.56	0.00	0.00	0.00	0.00	0.00	0.00
16.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.56	0.00	0.00	0.00	0.00	0.00	0.00
17.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.56	0.00	0.57	0.00	0.00	0.00	0.00
17.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.47	1.59	2.86	3.39	0.00	0.00	0.00
18.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.38	0.00	5.71	4.24	1.25	0.00	0.81
18.5	0.00	0.00	0.00	0.00	0.32	0.00	0.00	17.19	4.76	13.14	1.69	0.00	0.00	1.63
19.0	0.00	0.00	0.00	0.00	1.59	0.00	0.00	11.72	2.38	21.14	12.71	1.25	0.00	3.25
19.5	0.00	0.00	0.00	0.00	2.55	0.00	0.00	20.31	8.73	15.43	10.17	0.00	0.90	6.50
20.0	0.00	0.00	0.00	0.00	8.60	3.81	0.00	15.63	18.25	16.57	11.02	1.25	1.80	8.13
20.5	0.00	0.00	0.00	0.00	13.38	0.00	0.00	6.25	24.60	14.29	12.71	1.25	0.00	18.70
21.0	0.00	0.00	0.00	0.00	13.38	0.00	0.81	3.91	14.29	4.57	18.64	1.25	1.80	23.58
21.5	0.00	0.00	0.00	0.00	18.79	0.00	0.00	1.56	7.94	1.71	11.02	1.25	1.80	22.76
22.0	0.00	0.00	0.00	0.00	13.06	4.76	0.40	0.78	3.17	3.43	2.54	1.25	0.90	5.69
22.5	0.00	0.00	1.25	0.00	10.51	11.43	2.82	0.00	2.38	0.57	5.93	0.00	2.70	4.88
23.0	1.12	0.00	2.08	2.86	7.96	12.38	4.03	0.00	2.38	0.00	5.08	1.25	2.70	2.44
23.5	5.58	1.37	4.17	5.14	4.78	18.10	5.24	0.00	1.59	0.00	0.00	7.50	6.31	1.63
24.0	5.58	4.79	3.75	7.43	1.91	10.48	4.03	0.00	3.17	0.00	0.85	5.00	4.50	0.00
24.5	10.41	4.79	5.42	1.14	2.55	14.29	7.66	0.00	2.38	0.00	0.00	8.75	7.21	0.00
25.0	12.27	6.16	8.75	8.57	0.32	9.52	5.24	0.00	0.00	0.00	0.00	15.00	9.91	0.00
25.5	13.75	15.07	10.00	8.00	0.32	3.81	8.47	0.00	0.00	0.00	0.00	15.00	11.71	0.00
26.0	13.38	17.81	7.92	18.86	0.00	3.81	4.03	0.00	1.59	0.00	0.00	20.00	18.02	0.00
26.5	13.75	21.23	16.25	12.00	0.00	3.81	13.31	0.78	0.00	0.00	0.00	13.75	18.02	0.00
27.0	7.06	8.22	11.25	10.86	0.00	0.95	13.71	0.00	0.00	0.00	0.00	3.75	3.60	0.00
27.5	7.81	5.48	7.50	12.00	0.00	1.90	9.27	0.00	0.79	0.00	0.00	1.25	6.31	0.00
28.0	4.09	4.79	5.00	4.57	0.00	0.95	6.45	0.78	0.00	0.00	0.00	0.00	0.90	0.00
28.5	1.86	3.42	5.00	3.43	0.00	0.00	4.44	0.00	0.00	0.00	0.00	0.00	0.90	0.00
29.0	0.37	2.74	3.33	1.14	0.00	0.00	1.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29.5	2.23	3.42	2.50	2.86	0.00	0.00	2.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30.0	0.37	0.00	1.67	0.57	0.00	0.00	1.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30.5	0.00	0.00	0.42	0.57	0.00	0.00	1.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31.0	0.00	0.68	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31.5	0.37	0.00	1.67	0.00	0.00	0.00	2.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32.0	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32.5	0.00	0.00	0.83	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
mean length	25.88	26.35	26.52	26.20	21.60	23.90	26.32	19.18	20.85	19.54	20.43	24.94	25.20	20.93
TS mean length	-42.86	-42.70	-42.65	-42.75	-44.41	-43.54	-42.71	-45.43	-44.72	-45.27	-44.89	-43.17	-43.09	-44.68
mean weigth	134	123	146	154	75	108	153	58	75	52	69	134	136	69

Table C2 Tridens 3-21 July 1995. Length distribution and mean weight of herring per haul

haul	date	time UTC	latitude	longitude	depth meters	duration min.	herring	N. pout	other gadoids	mackerel	sprat	others	remarks
1	5.7	06.38	58.55	01.28W	100	23	3250	43	4	4	0	1	
2	5.7	12.00	58.40	02.12W	67	40	0	434	282	0	0	0	
3	5.7	16.50	58.39	01.08W	98	25	117	595	26	3	0	1	
4	6.7	15.30	58.25	00.44W	122	60	568	0	0	5	0	11	surface haul
5	6.7	19.00	58.25	01.13W	93	20	1904	559	4	12	0	0	
6	7.7	09.15	58.10	01.41W	94	15	212	68	13	4	0	0	
7	7.7	12.00	58.10	01.28W	100	30	340	144	2	0	0	0	
8	8.7	09.15	57.45	01.50W	60	25	0	0	0	0	1	1	surface haul
9	10.7	11.55	58.09	00.38E	149	35	1950	0	0	3	0	0	surface haul
10	11.7	07.54	57.40	00.42E	107	28	5	225	10	0	0	0	
11	12.7	17.10	56.55	01.37E	98	25	3	32	14	0	0	0	
12	13.7	19.00	56.40	00.40E	83	45	646	0	0	10	2	0	surface haul
13	17.7	12.30	55.55	01.15E	77	45	0	0	2	210	0	10	
14	17.7	17.24	55.55	00.03E	80	51	0	0	0	4	902	0	
15	18.7	15.30	55.40	01.34E	74	75	6686	0	0	0	952	3	
16	18.7	19.37	55.30	01.49E	75	33	925	0	0	0	407	5	
17	19.7	06.18	55.25	01.19E	85	15	170	1	0	5	0	6	
18	19.7	12.45	55.26	00.53W	95	30	535	10	8	0	1050	0	
19	19.7	17.42	55.09	01.01W	98	33	2356	117	218	0	218	0	
20	20.7	06.21	55.07	00.30E	80	12	1292	0	7	0	0	2	

Table C3

Tridens 3 - 21 July 1995 trawl catches in kg

Table C4

TRIDENS 3 - 21 July 1995

Age composition by strata and mean weights by age

numbers by age in millions														
autumn spawners													spr.sp	
rings	1	2I	2M	3I	3M	4	5	6	7	8	9	9+	all ages	totals
A	423	462	241	0	0	0	0	0	0	0	0	0	0	1126
B	0	174	872	44	827	308	53	40	26	16	0	0	0	2360
C	1121	0	0	0	18	0	0	0	0	0	0	0	0	1139
D	48	0	71	21	55	48	103	71	14	0	0	0	0	431
E	1437	38	29	0	14	3	0	0	0	0	0	0	0	1521

numbers by age in fractions														
autumn spawners													spr.sp	
rings	1	2I	2M	3I	3M	4	5	6	7	8	9	9+	all ages	totals
A	0.376	0.410	0.214	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
B	0.000	0.074	0.369	0.019	0.350	0.131	0.022	0.017	0.011	0.007	0.000	0.000	0.000	1.000
C	0.984	0.000	0.000	0.000	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
D	0.111	0.000	0.165	0.049	0.128	0.111	0.239	0.165	0.032	0.000	0.000	0.000	0.000	1.000
E	0.945	0.025	0.019	0.000	0.009	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

mean weight by age													
autumn spawners												spr.sp	
rings	1	2I	2M	3I	3M	4	5	6	7	8	9	9+	all ages
A	66.7	90.8	129.8										
B		95.2	146.0	115.5	157.5	164.3	190.2	258.6	204.0	280.5			
C	52.1				190.0								
D	79.8		137.6	115.3	135.2	149.8	137.9	154.5	158.5				
E	66.7	105.0	118.3		144.5	184.0							

Table C4 (continued)

total weight by age group in '000 tonnes														
autumn spawners													spr.sp	
rings	1	2I	2M	3I	3M	4	5	6	7	8	9	9+	all ages	totals
A	28	42	31	0	0	0	0	0	0	0	0	0	0	101
B	0	17	127	5	130	51	10	10	5	4	0	0	0	360
C	58	0	0	0	3	0	0	0	0	0	0	0	0	62
D	4	0	10	2	7	7	14	11	2	0	0	0	0	58
E	96	4	3	0	2	1	0	0	0	0	0	0	0	106
totals	186	63	172	8	143	58	24	21	8	4	0	0	0	687

total mature	431
total immature	256
total spr.sp.	0
grand total	687

Table D1 Catch composition by trawl haul. *Kings Cross* 8 - 28 July 1995

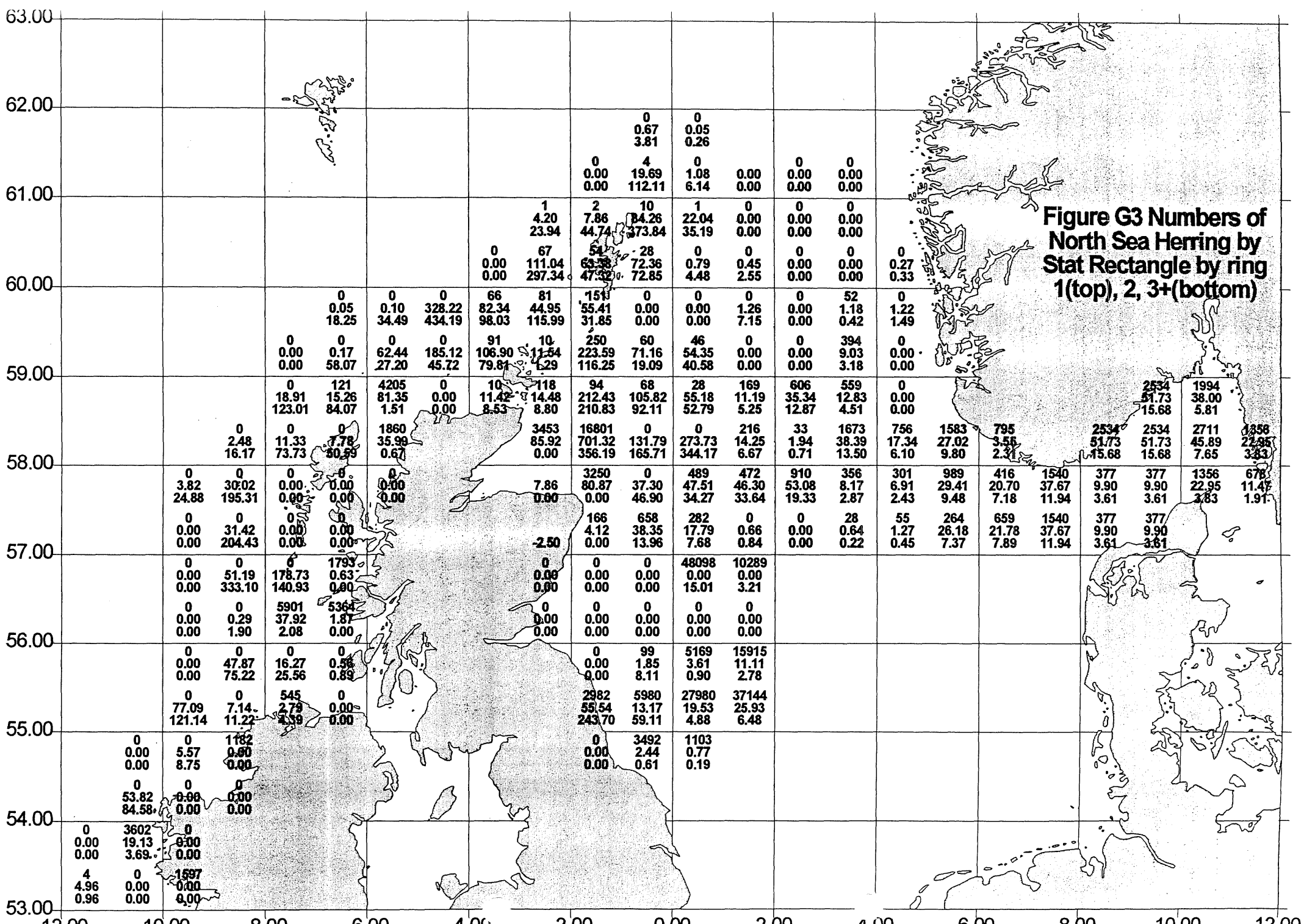
Haul number	Position		Depth (m)	Numbers caught								
	Latitude (°N)	Longitude (°W)		herring	whiting	haddock	pout	mackerel	horse mackerel	blue whiting	sprat	others
1	58 21.00	6 05.66	70					2			215	
2	58 15.44	6 04.44	110	5			1			2	780	78 spurdog
3	58 16.40	6 06.06	100									
4	58 12.64	6 03.87	125	10	6			1		1	1239	278 spurdog
5	57 43.00	6 33.82	60									2 spurdog
6	57 29.32	6 48.78	120									sand eels
7	56 49.18	6 38.20	167	small "o" group	39	1						
8	56 03.97	7 31.28	125		1			2	1			1 spurdog 1 hake
9	56 17.62	7 03.50	80	334	2			1718			4702	
10	56 28.46	7 33.70	125	216	8	3	203	12	1			3 hake
11	56 34.24	8 10.51	160	46625								
12	56 33.85	8 50.81	138						17			
13	56 41.70	8 49.40	125	24750								
14	56 40.96	7 34.42	200	22480								
15	56 37.50	7 38.00	120	23100								
16	56 48.89	8 17.35	140	365		3		27				1 hake
17	56 49.10	8 51.05	135	254	1			14	6			
18	56 56.30	8 32.81	135	604								
19	57 04.15	8 28.88	140	51		2						1 gurnard
20	57 11.51	8 00.51	100		1		2					meshed pout
21	57 26.67	8 38.71	160	756	10							
22	57 41.47	8 44.84	160	256			6			62		

Table D1 (continued) Catch composition by trawl haul. *Kings Cross* 8 - 28 July 1995

Haul number	Position		Depth (m)	Numbers caught								
	Latitude (°N)	Longitude (°W)		herring	whiting	haddock	pout	mackerel	horse mackerel	blue whiting	sprat	others
23	57 49.09	8 55.95	140	2	2		810		1	212		4 Sebastes viviparus
24	58 17.35	5 27.71	35				23					Many small meshed pout
26	58 34.05	5 54.11	110	104		4	2				4	
27	58 41.24	5 45.41	115	1	1	9	45					1 spurdog 1 gurnard 1 sole 1 angler
29	58 35.29	6 40.97	95				many meshed					many small meshed pout
30	58 41.38	7 30.15	115	2516								
32	58 10.49	5 42.56	80		1							
33	58 48.35	6 48.30	150	1				5		1	8	
34	59 04.10	7 12.82	190									many meshed pearlside
35	59 11.54	5 57.00	110	1			8					some meshed pout
36	59 11.54	6 00.40	110	1			many meshed					
37	59 26.16	6 04.27	150	5425				148		169		
38	59 33.79	6 02.20	150	5				1		many meshed		
39	59 33.90	5 49.80	130	8625				303				
40	59 42.90	5 07.72	150							many meshed		
41	60 01.86	4 14.30	160							many meshed		
42	59 34.89	4 19.15	100				many meshed					1 gurnard
43	59 31.39	4 06.04	110	8816	756	14	14300					

Table D2 . Herring length frequency by trawl haul by sub area. Kings Cross 9 - 29 July1 9 9 5mean length - cm, mean weight - g, target strength - dB)

Haul No	Area I		Area II		Area III			Area IV									
	9	mean	10	Mean	14	15	mean	11	13	16	17	18	19	21	22	30	mean
15.0																	
15.5	12.7	12.7															
16.0	24.1	24.1															
16.5	21.2	21.2															
17.0	13.6	13.6															
17.5	10.8	10.8															
18.0	4.2	4.2															
18.5	4.2	4.2	0.5	0.5													
19.0	1.4	1.4	1.4	1.4													
19.5	2.3	2.3	2.8	2.8													
20.0	2.3	2.3															
20.5	0.8	0.8	0.5	0.5													
21.0	1.4	1.4	1.9	1.9													
21.5			4.2	4.2													
22.0			1.6	1.6				0.3									0.0
22.5			19.9	19.9	0.4	0.5	0.4			0.3							0.0
23.0			16.7	16.7	0.4	0.3	0.3	0.8		0.3				0.3			0.1
23.5			15.7	15.7	1.1	0.5	0.8	1.6		2.5							0.5
24.0			13.9	13.9	3.9	1.8	2.9	1.9		3.6			2.0	1.1	0.4		1.0
24.5			7.9	7.9	5.7	8.8	7.3	1.9		4.9			2.0	2.1	0.4		1.3
25.0	0.8	0.8	5.6	5.6	11.0	11.4	11.2	4.3		3.8		1.0	3.9	0.8		0.9	1.6
25.5			0.9	0.9	14.9	19.0	17.0	10.5		5.2		1.3		8.7	0.8	1.5	3.1
26.0					11.4	16.9	14.1	8.3		6.3		3.3	5.9	14.0	0.8	2.7	4.6
26.5			0.5	0.5	7.8	10.4	9.1	13.4		6.0	0.8	7.3	9.8	14.6	4.7	10.7	7.5
27.0			0.9	0.9	8.5	8.1	8.3	13.7	1.2	12.1	2.4	16.2	19.6	18.8	15.2	18.5	13.1
27.5			0.5	0.5	8.2	8.3	8.2	11.5	4.2	19.2	12.2	25.8	21.6	16.1	23.0	19.4	17.0
28.0			0.5	0.5	8.9	5.2	7.0	15.8	13.6	16.4	26.4	25.8	19.6	12.4	28.5	19.4	19.8
28.5					7.8	3.9	5.9	9.7	28.8	11.0	23.2	13.2	11.8	7.9	15.6	13.4	15.0
29.0			0.5	0.5	6.0	2.9	4.5	3.8	29.4	4.9	21.7	5.0	3.9	2.1	7.4	7.8	9.5
29.5			0.5	0.5	3.9	1.0	2.5	1.9	14.8	2.7	11.4	1.0		1.1	2.3	4.8	4.4
30.0			0.5	0.5		1.0	0.5	0.8	6.4	0.8	1.2				0.8	0.3	1.1
30.5									1.2		0.8					0.3	0.3
31.0									0.3								0.0
31.5																0.3	0.0
32.0																	
32.5																	
33.0																	
33.5																	
34.0																	
34.5																	
Number	353		216		22480	23100		46625	24750	365	254	604	51	756	256	2516	
mean lgt	17.4	17.4	23.7	23.7	27.0	26.7	29.9	27.4	29.3	27.5	29.0	28.1	27.8	27.4	28.3	28.2	28.1
mean wt	38	38	111	111	175	167	171	183	229	186	220	198	190	183	203	200	199
TS/ind	-46.3	-46.3	-43.7	-43.7	-42.5	-42.7	-42.6	-42.4	-41.9	-42.4	-42.0	-42.2	-42.3	-42.4	-42.2	-42.2	-42.2
TS/kg	-32.1	-32.1	-34.1	-34.1	-35.0	-34.9	-34.9	-35.1	-35.5	-35.1	-35.4	-35.2	-35.1	-35.0	-35.2	-35.2	-35.2


63.00
62.00
61.00
60.00
59.00
58.00
57.00
56.00
55.00
54.00
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-10.00
-8.00
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
Figure G3 Numbers of North Sea Herring by Stat Rectangle by ring 1(top), 2, 3+(bottom)

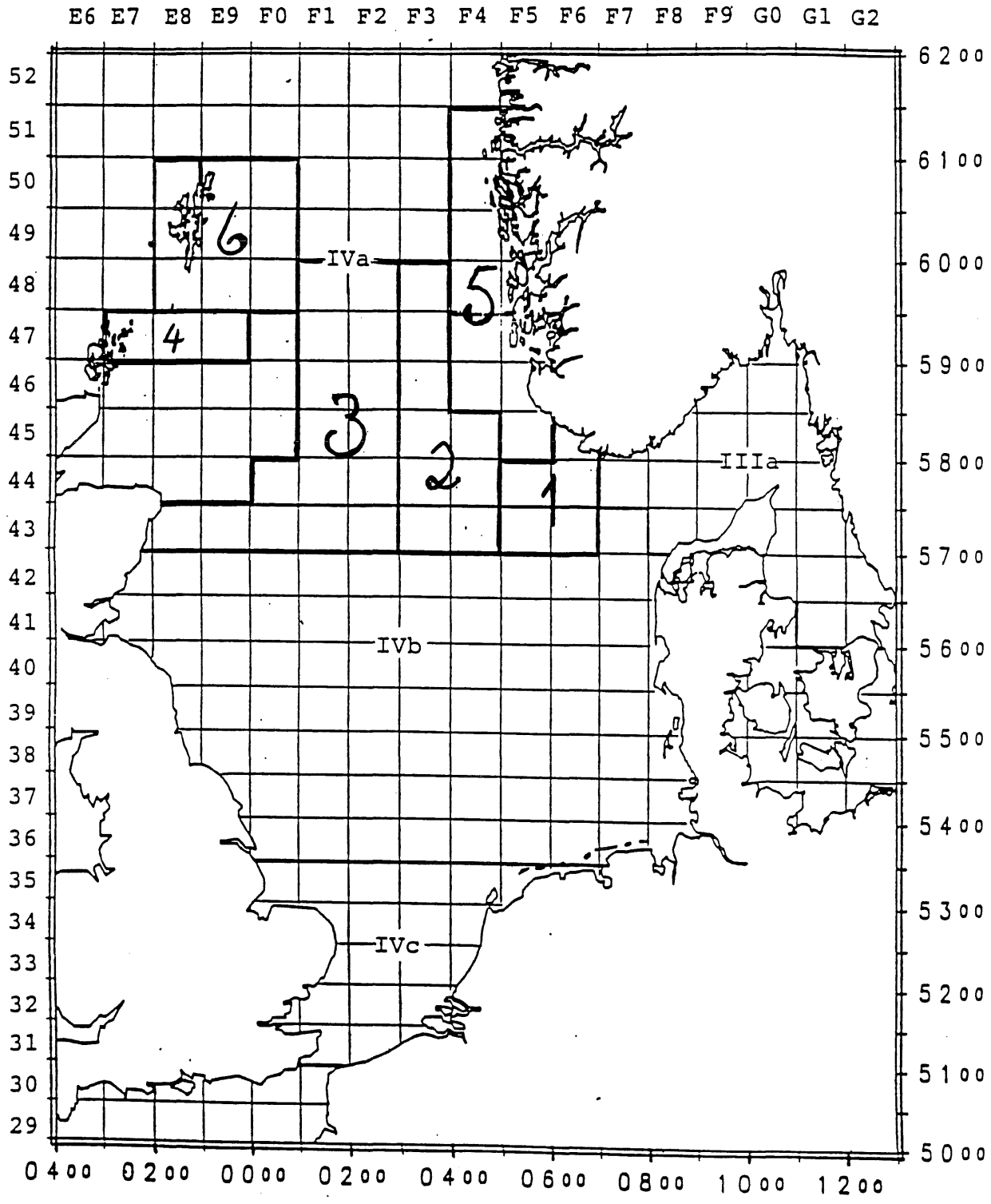

E6 E7 E8 E9 F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 G0 G1 G2
52 51 50 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29
6200 6100 6000 5900 5800 5700 5600 5500 5400 5300 5200 5100 5000
0400 0200 0000 0200 0400 0600 0800 1000 1200
IVa
IVb
IVc
IIIa
1
2
3
4
5
6

Figure B4

Annex I

CALIBRATION SHEET EK-500
RV " G. O. SARS "

Date: 26.06.1995	Location: Uggdalseidet
Sphere type: CU 60	Target strength: -33,6
Sea Temp: 6.5 °C (At sphere depth)	Sound speed 1496 ms. (mean transducer to sphere)
Responsible / personel:	H P Knudsen, I Svellingen, R Toresen, R Pedersen, J A Vågenes.

PARAMETER	OLD SETTING	NEW SETTING
TRANSCEIVER / FREQUENCY	1 / 38 kHz	1 / 38 kHz
TRANSDUCER DEPTH (MUST BE 0.0 M DURING CALIBRATION)	5,00 m.	5,00 m.
ABSORPTION COEFFICIENT	10 dB/km	10 dB/km
PULSE LENGTH	Medium	Medium
BAND WIDTH	Wide	Wide
MAXIMUM POWER	4000 W.	4000 W.
ANGLE SENSITIVITY	21.9	21.9
2 WAY BEAM ANGLE	-21.0 dB	-21.0 dB
SV TRANSDUCER GAIN	24.9 dB	25.3 dB
TS TRANSDUCER GAIN	24.9 dB	25.3 dB
3 dB BEAMWIDTH	6.7 deg.	6.7 deg.
ALONGSHIP OFFSET	-0.07 deg.	-0,17 deg.
ATHWARDSHIP OFFSET	0.11 deg	0,16 deg.
RANGE TO SPHERE DURING INTEGRATION: (REF. SOUND SPEED SETTING)		23.1
THEORETICAL SA		4112
MEASURED SA AFTER CAL.		4057

COMMENTS:

Figure C1

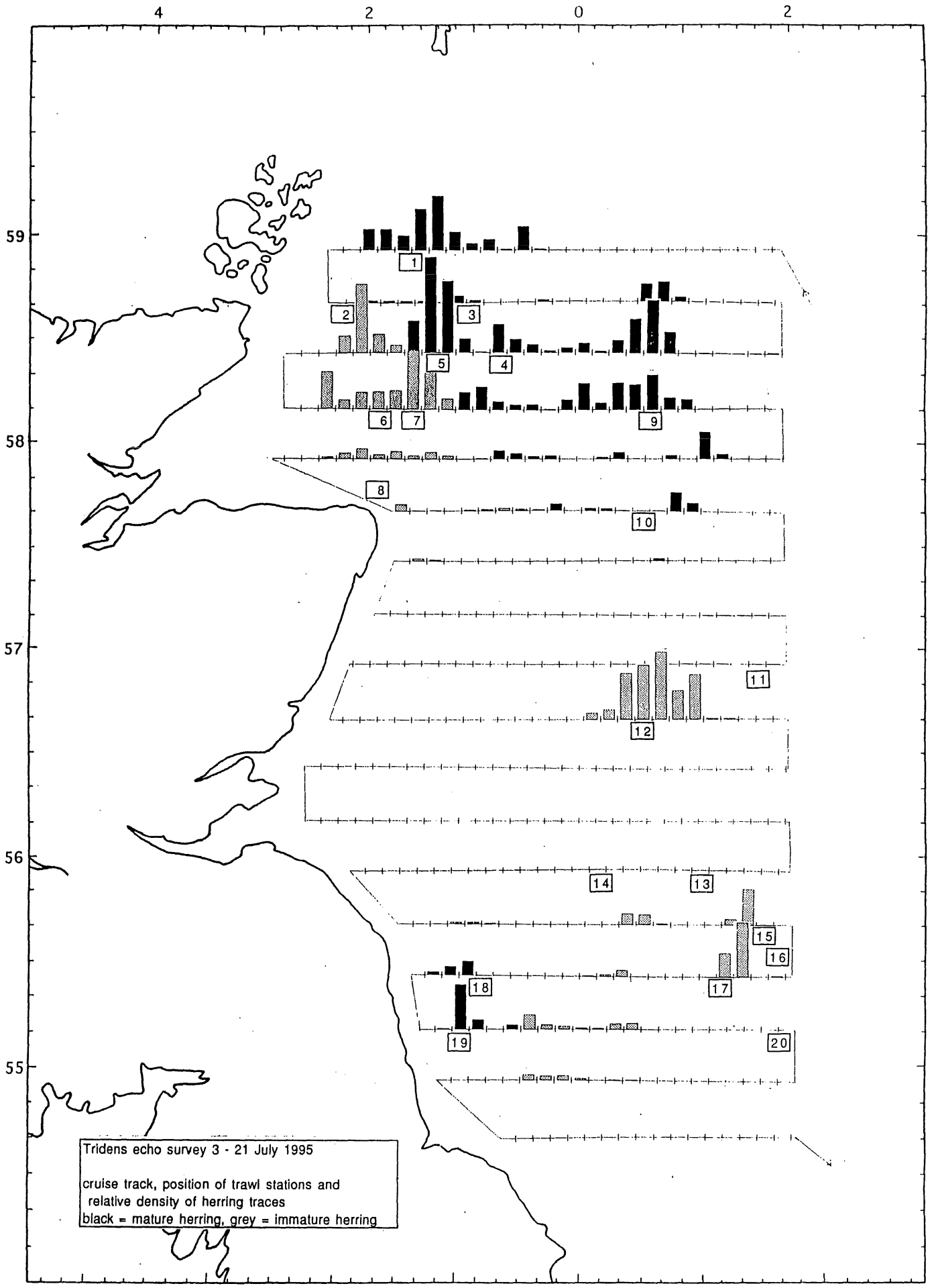
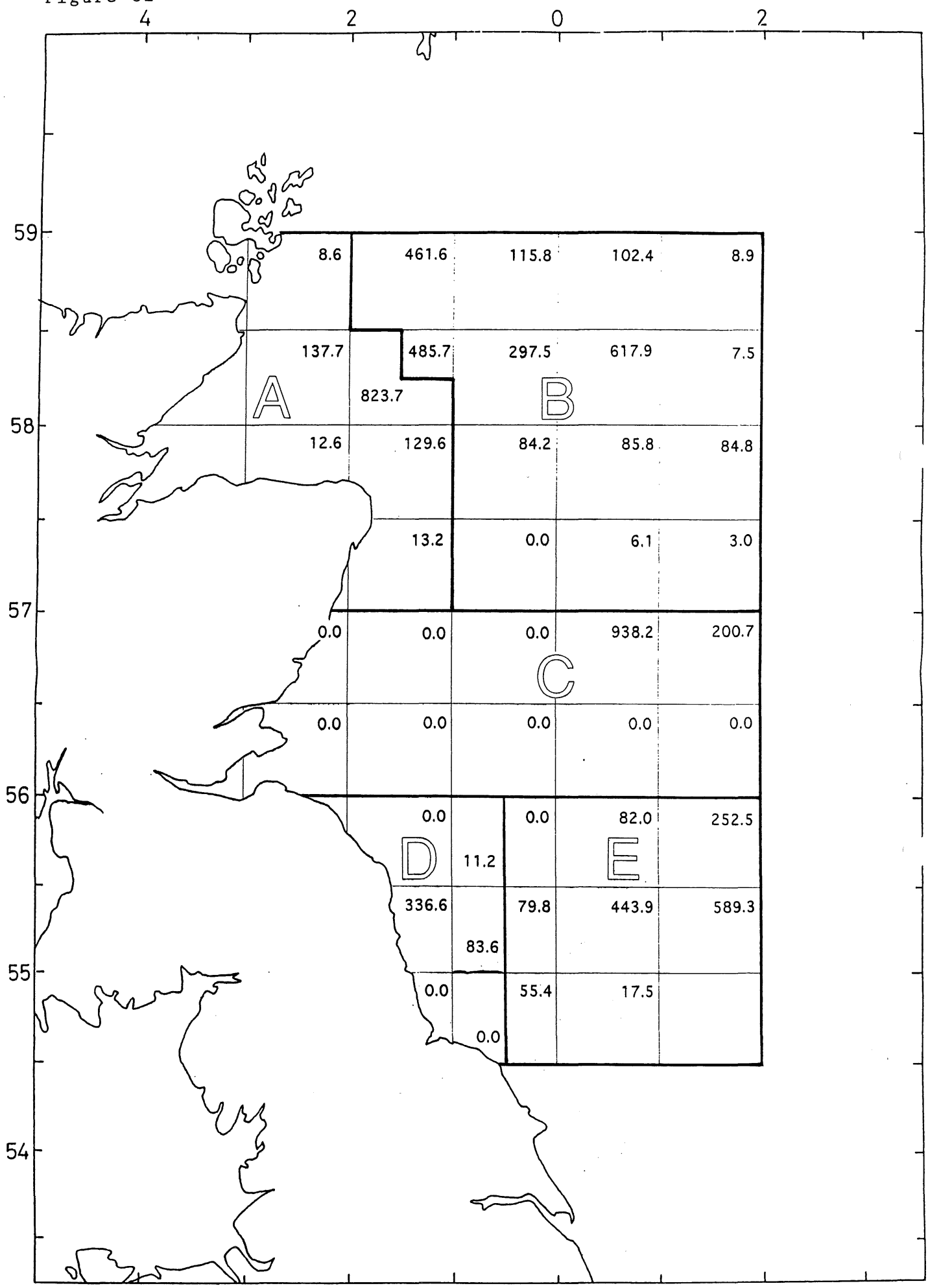

4
2
0
2
59
58
57
56
55
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Tridens echo survey 3 - 21 July 1995
cruise track, position of trawl stations and
relative density of herring traces
black = mature herring, grey = immature herring

Figure C2



TRIDENS 3 - 21 July 1995

Numbers of herring (millions) per rectangle and stratification for length distributions and ALKs

Figure D1

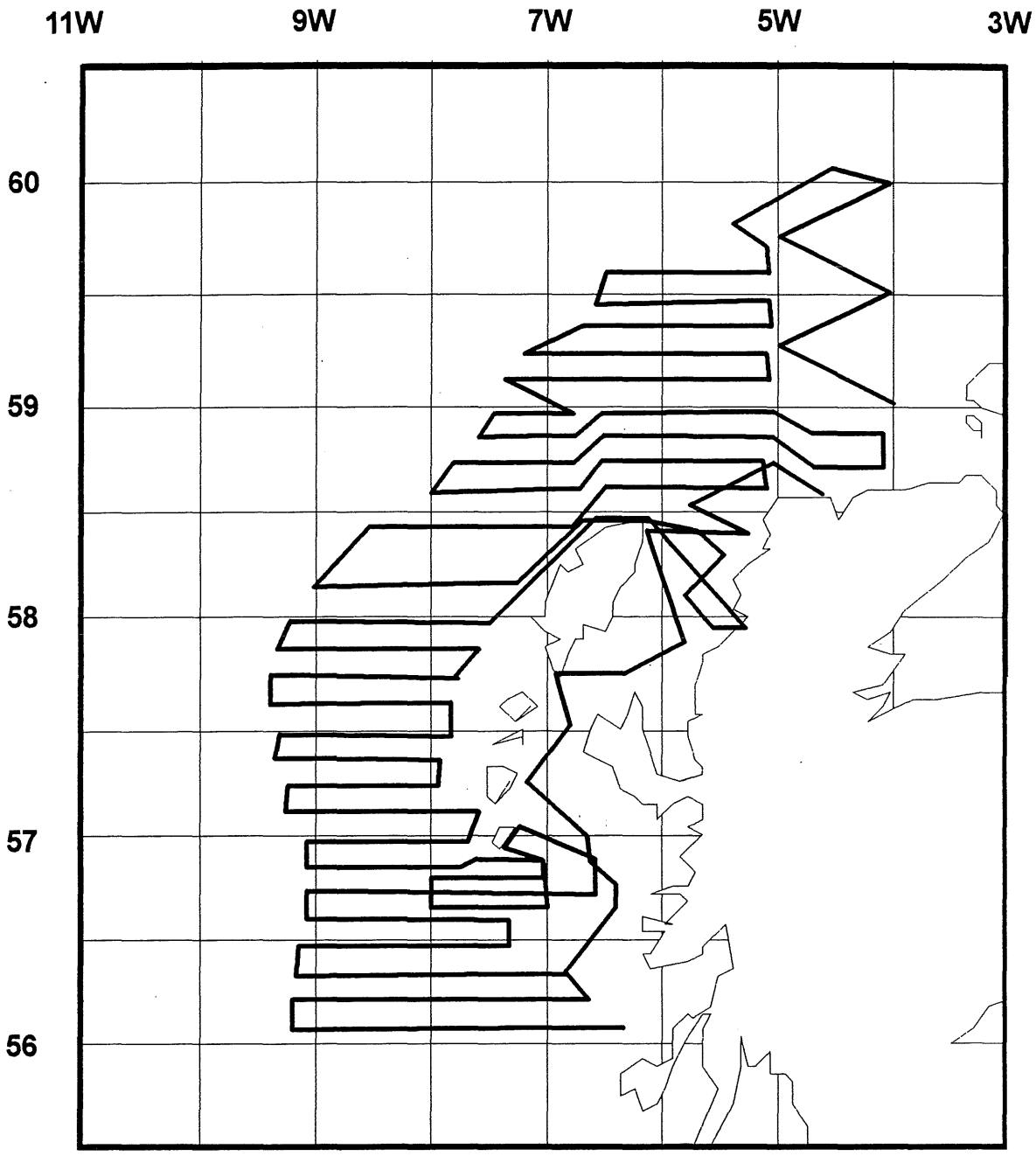
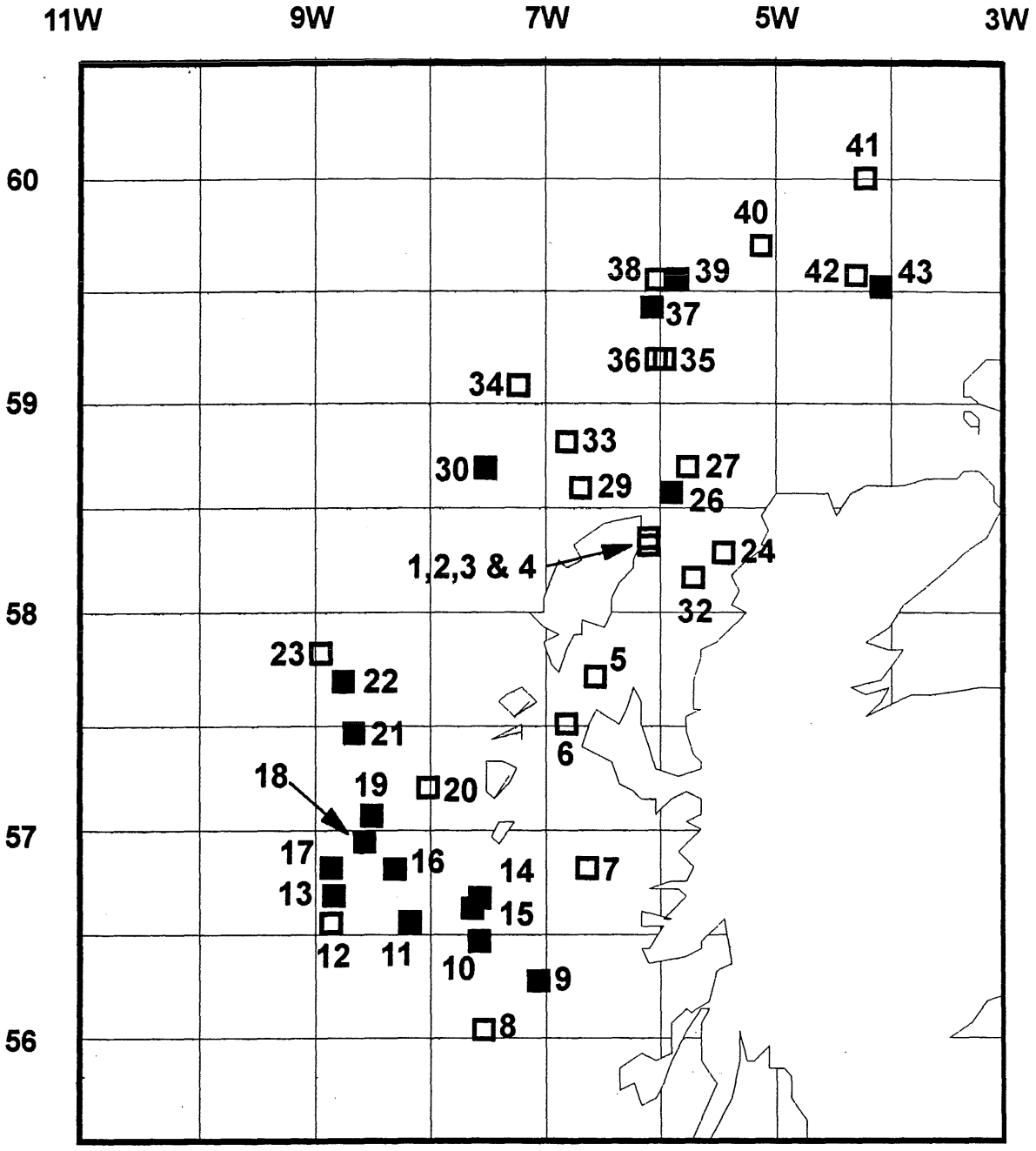

Survey Track: Kings Cross 8 - 28 July 1995
11W
9W
7W
5W
3W
60
59
58
57
56

Figure D2

Haul Positions: Kings Cross 8 - 28 July 1995



■ Hauls with > 50 herring

□ Hauls with < 50 herring

Figure D3

Analysis Areas: Kings Cross 8 - 28 July 1995

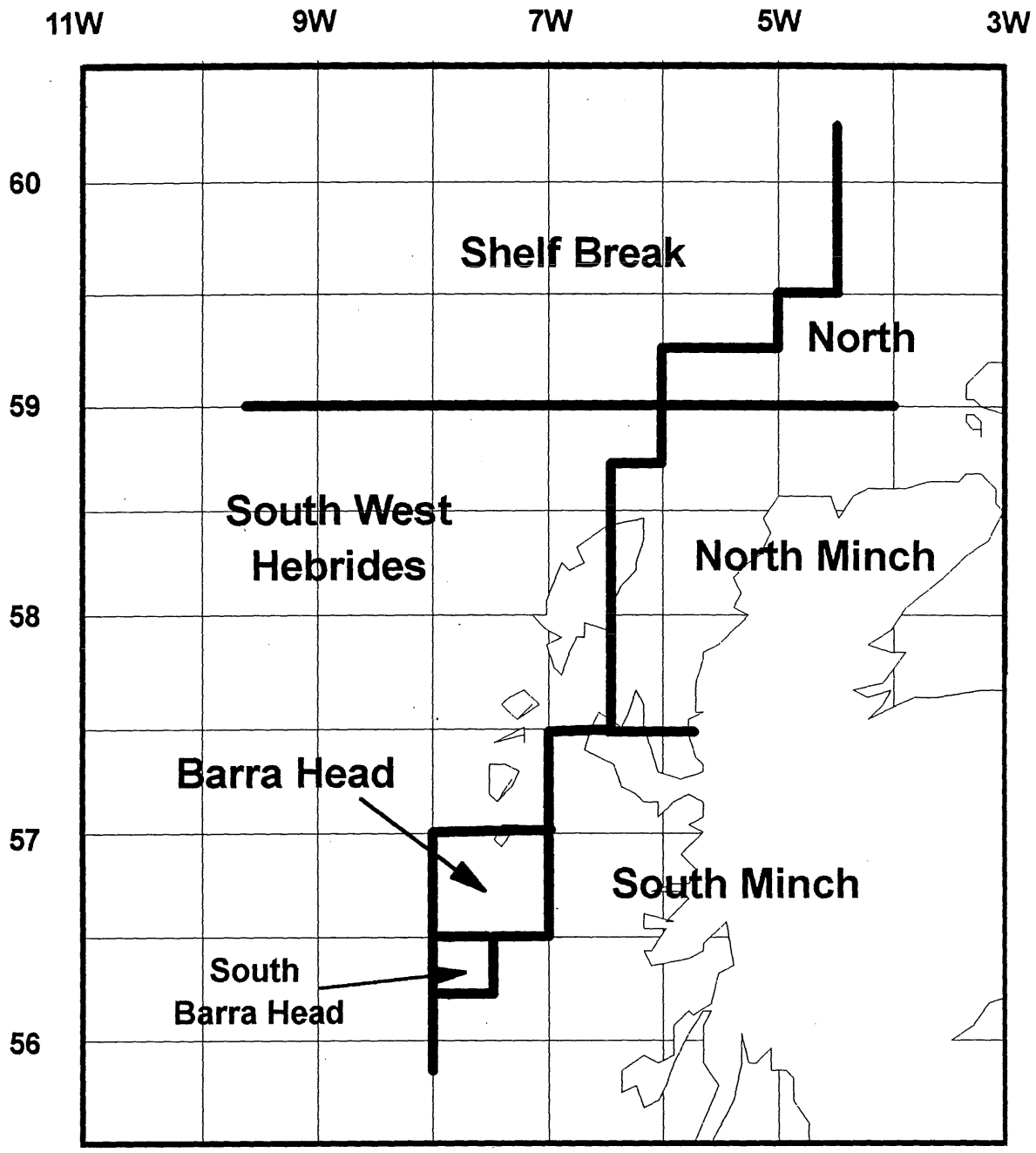


Figure D4

Herring numbers (millions) - top
Herring Biomass (thousand tonnes) - bottom
Kings Cross 8 - 28 July 1995

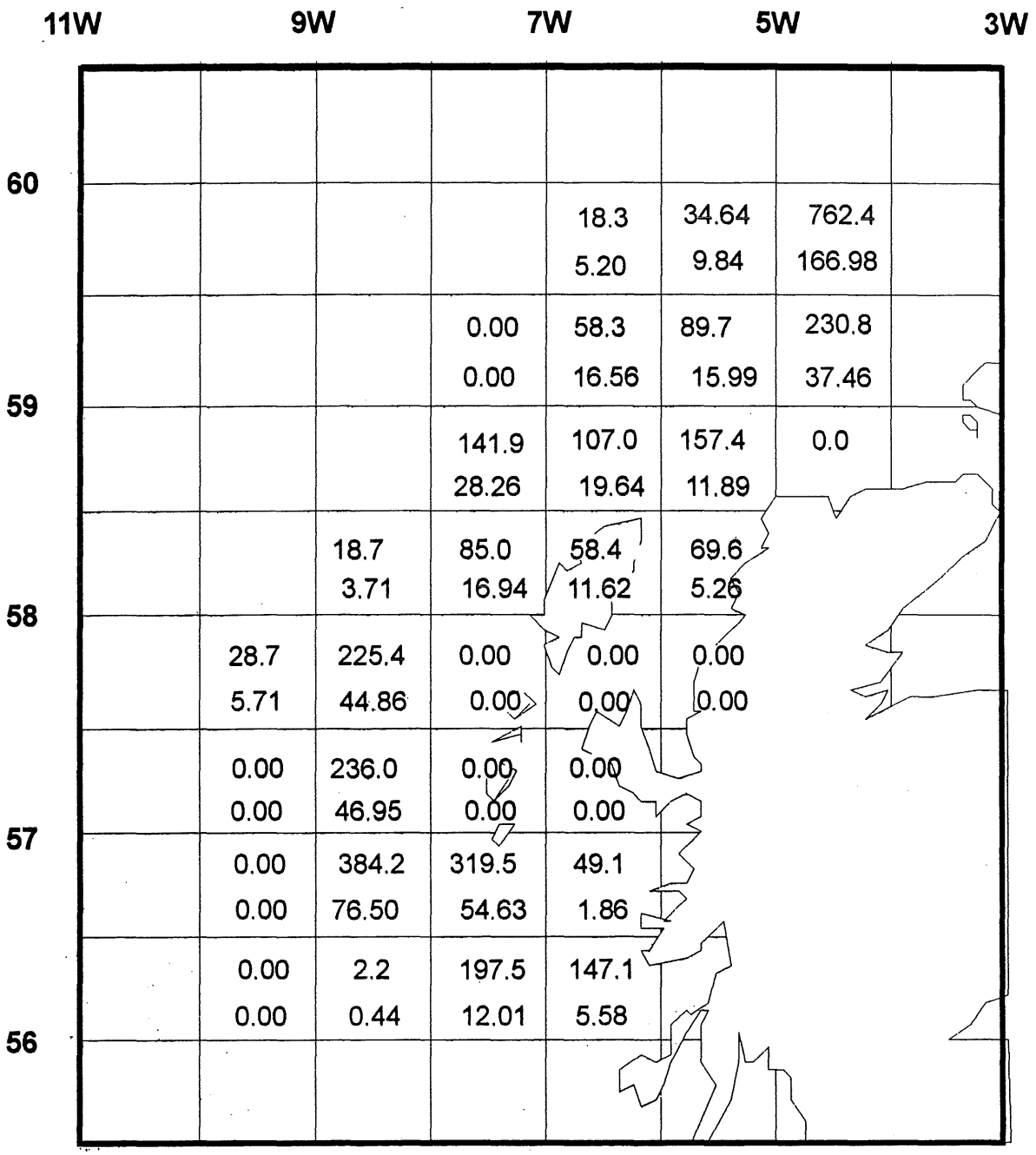
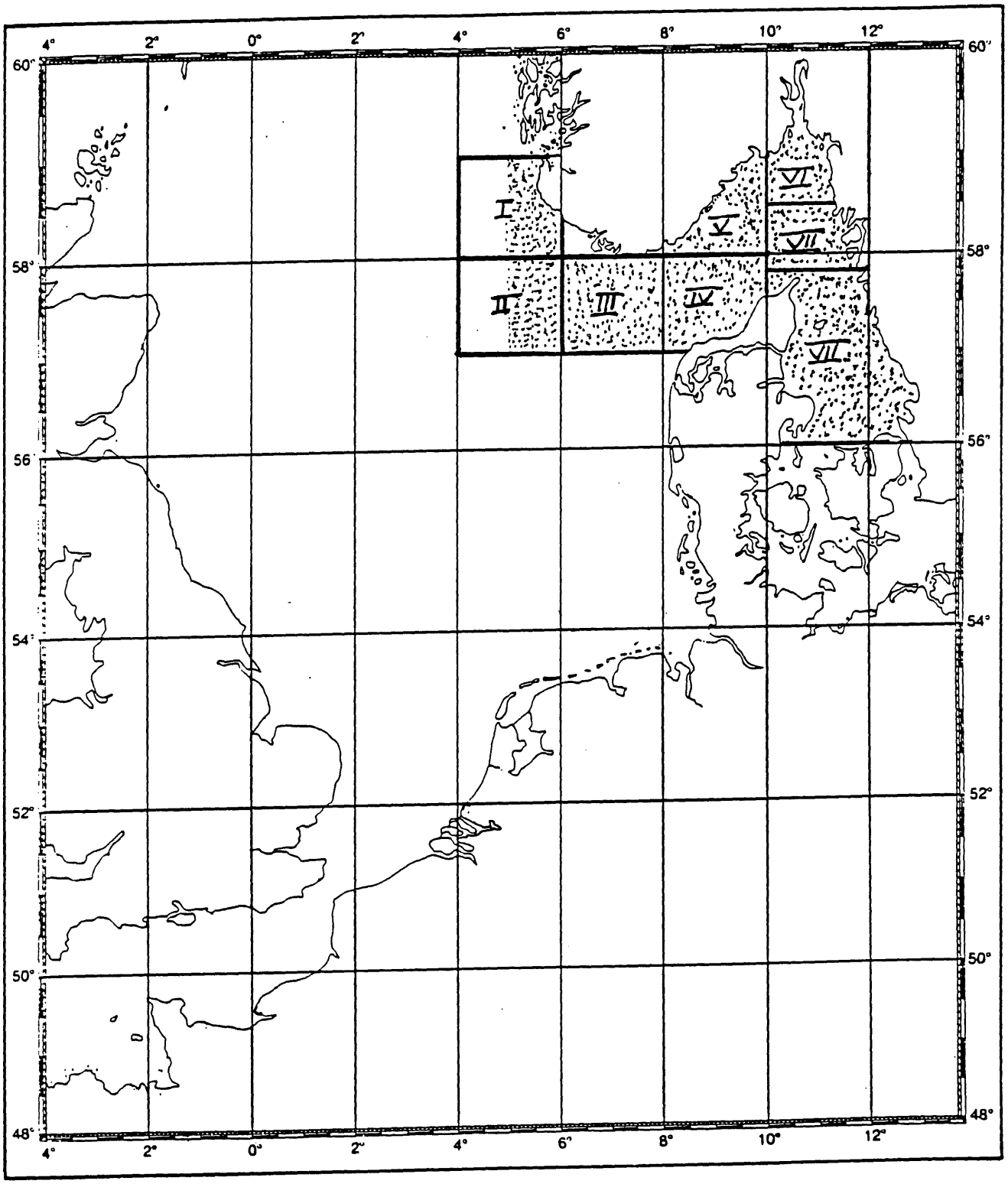


Figure E1 Area and subarea surveyed of R/V DANA during the acoustic survey 28. June - 12 July 1995.



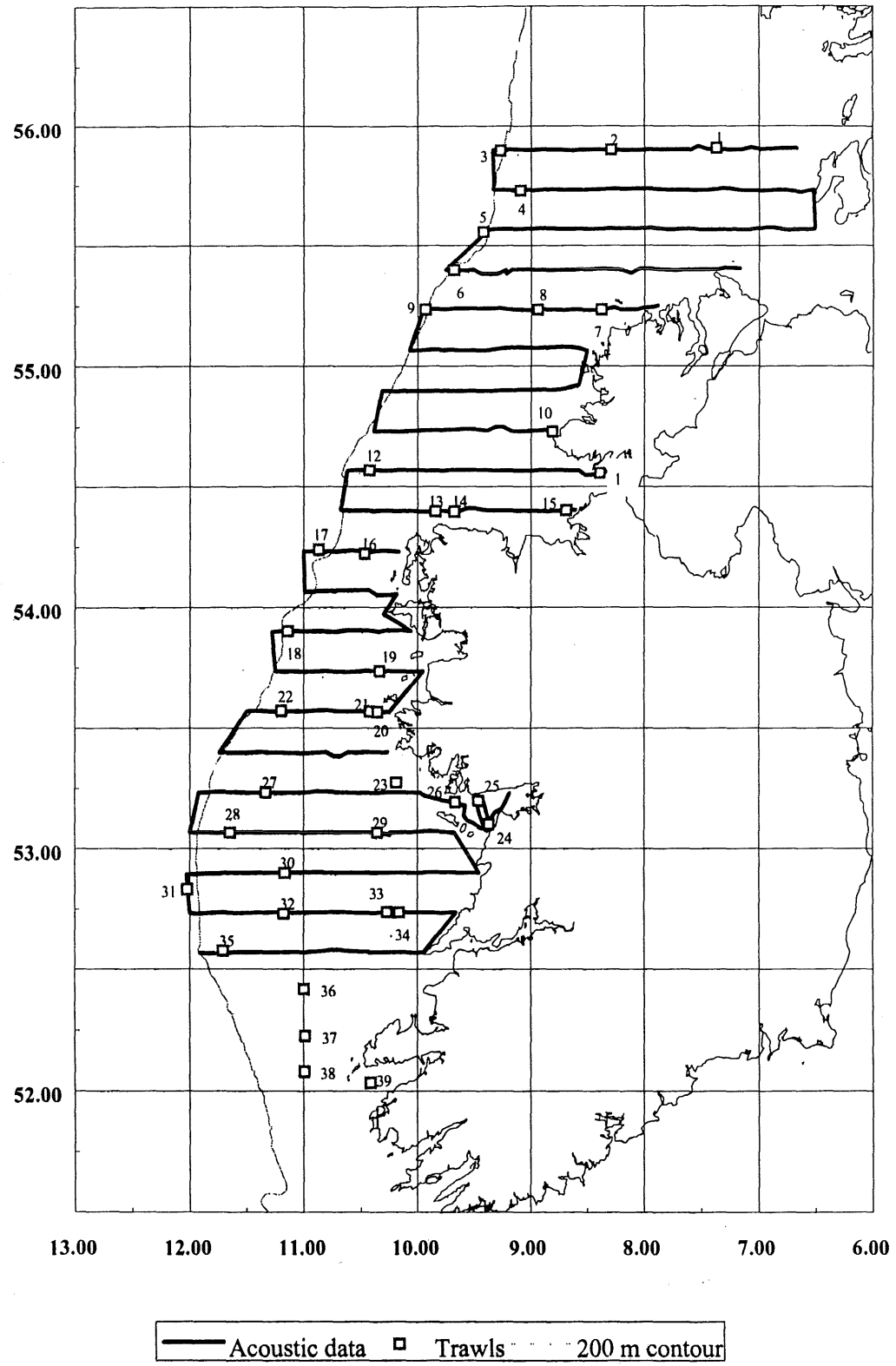


Figure F1 . Map of the west coast of Ireland, showing cruise track and positions of fishing trawls during the July/August '95 herring acoustic cruise.

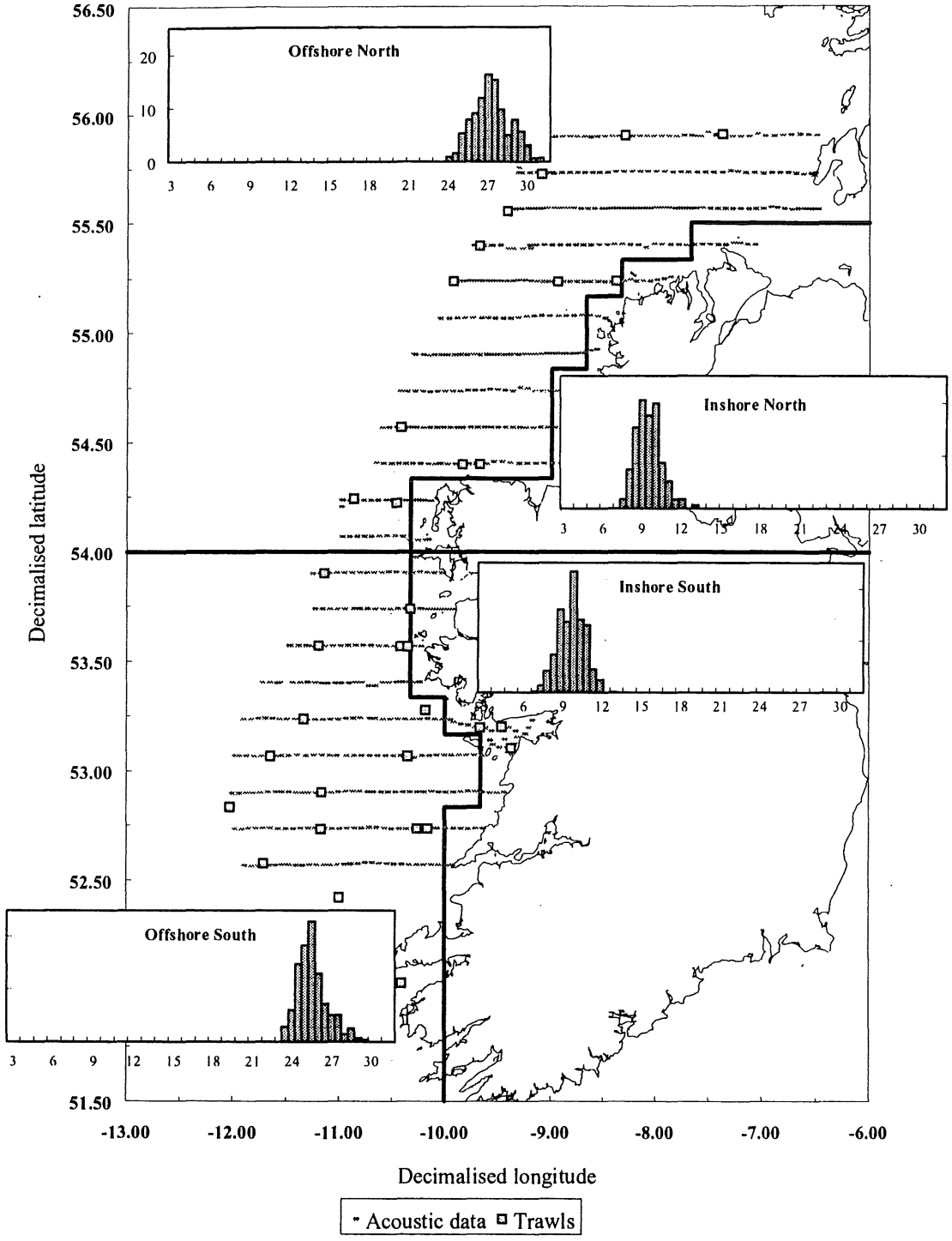


Figure F2 Map of the west coast of Ireland showing the area sub-divisions for trawl allocations used to qualify the acoustic data on the July/August '95 herring acoustic cruise; length frequency distributions of herring are on the same scale.

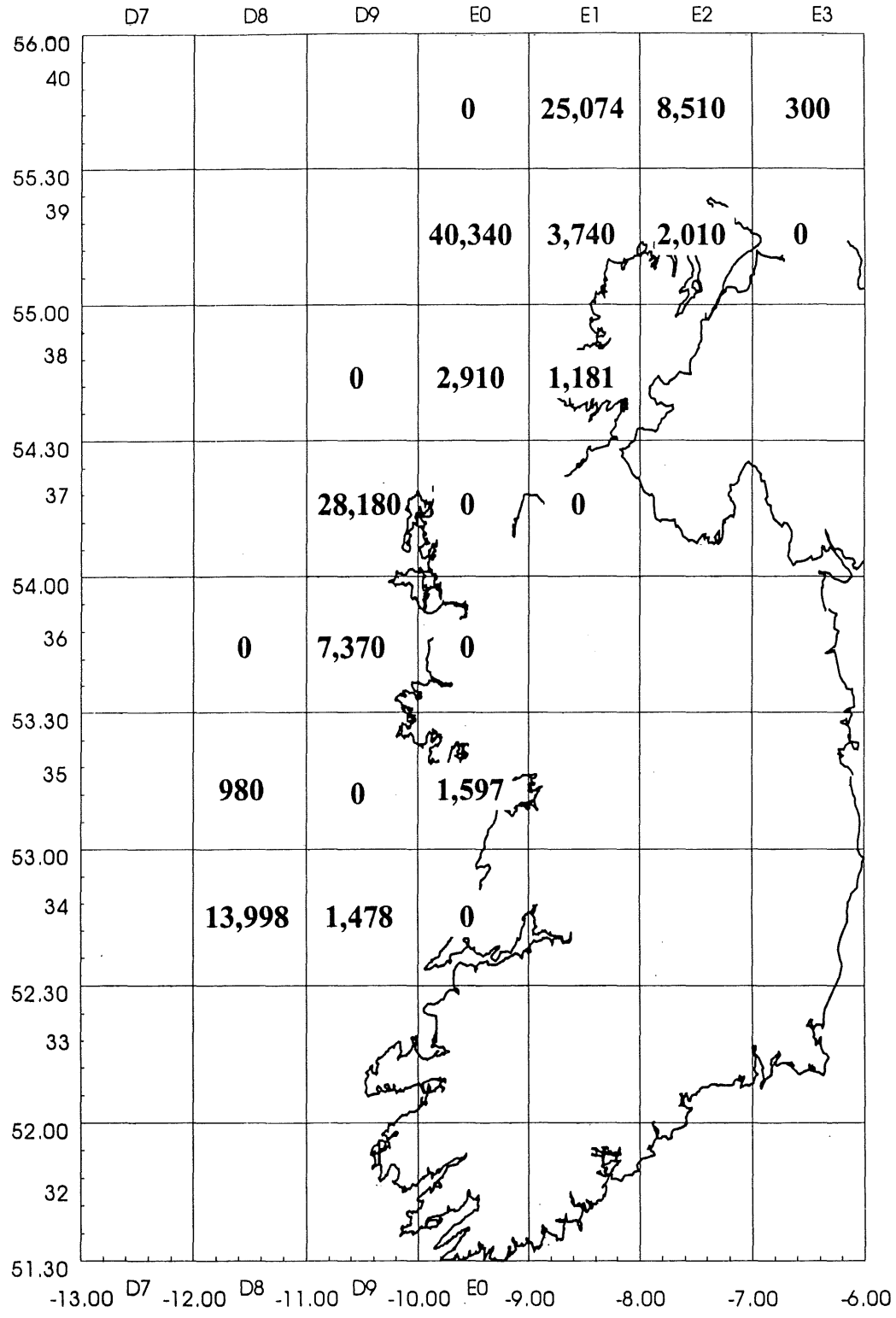
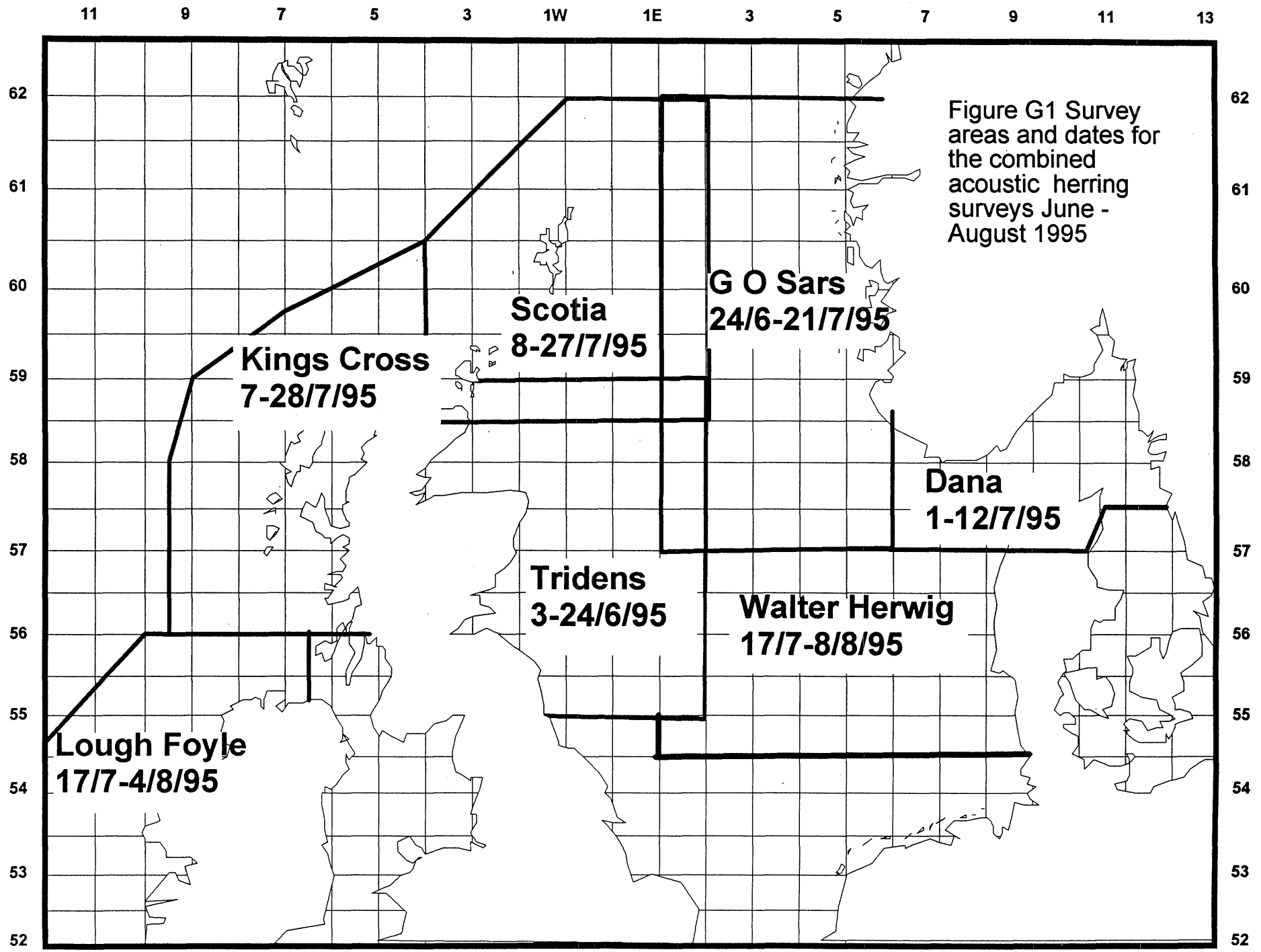


Figure F3 Estimates of probable herring biomass (tonnes) by ICES statistical rectangle for the July/August '95 herring acoustic cruise.


11
9
7
5
3
1W
1E
3
5
7
9
11
13
62
61
60
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57
56
55
54
53
52
Figure G1 Survey areas and dates for the combined acoustic herring surveys June - August 1995
Kings Cross
7-28/7/95
Scotia
8-27/7/95
G O Sars
24/6-21/7/95
Dana
1-12/7/95
Tridens
3-24/6/95
Walter Herwig
17/7-8/8/95
Lough Foyle
17/7-4/8/95

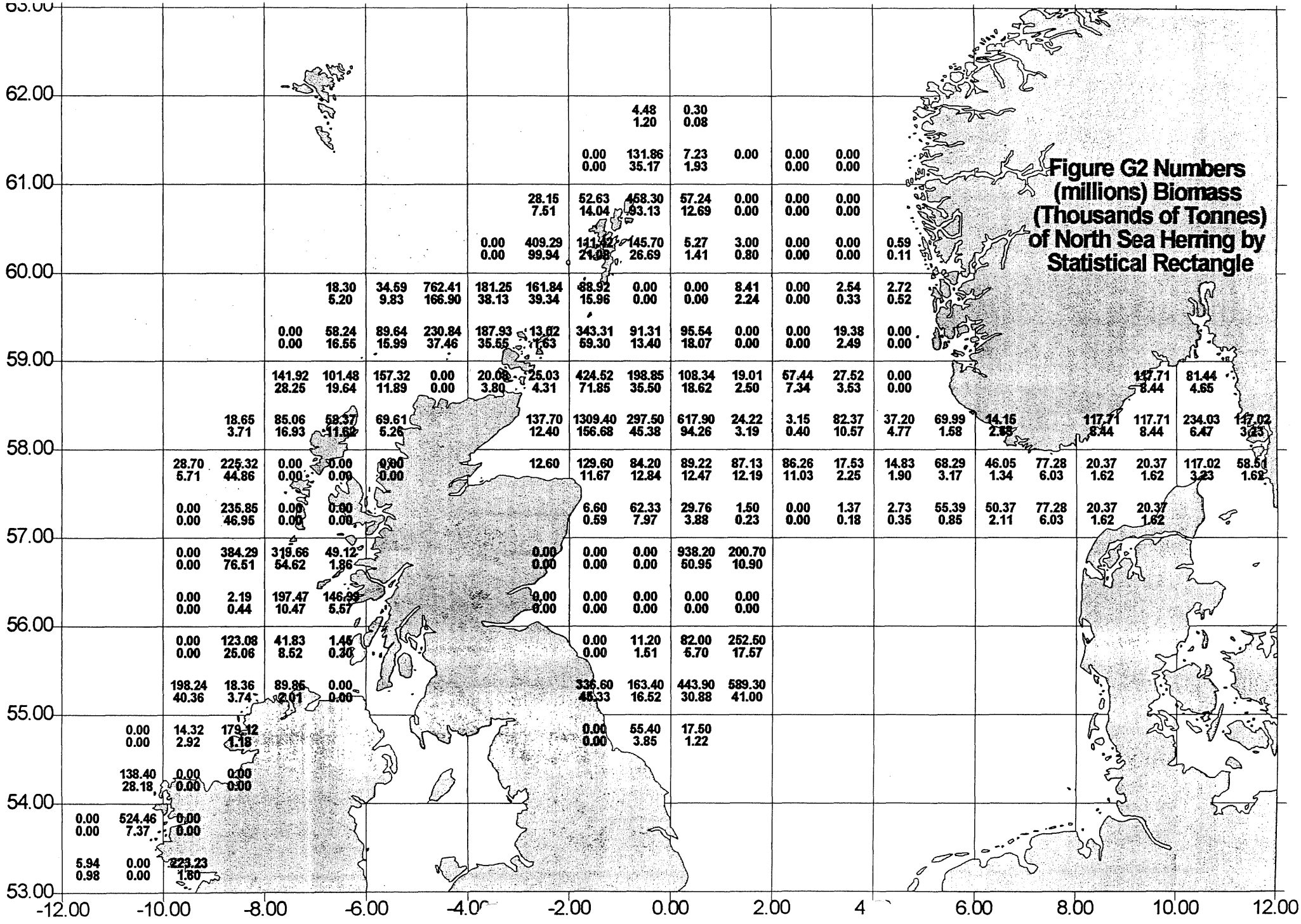
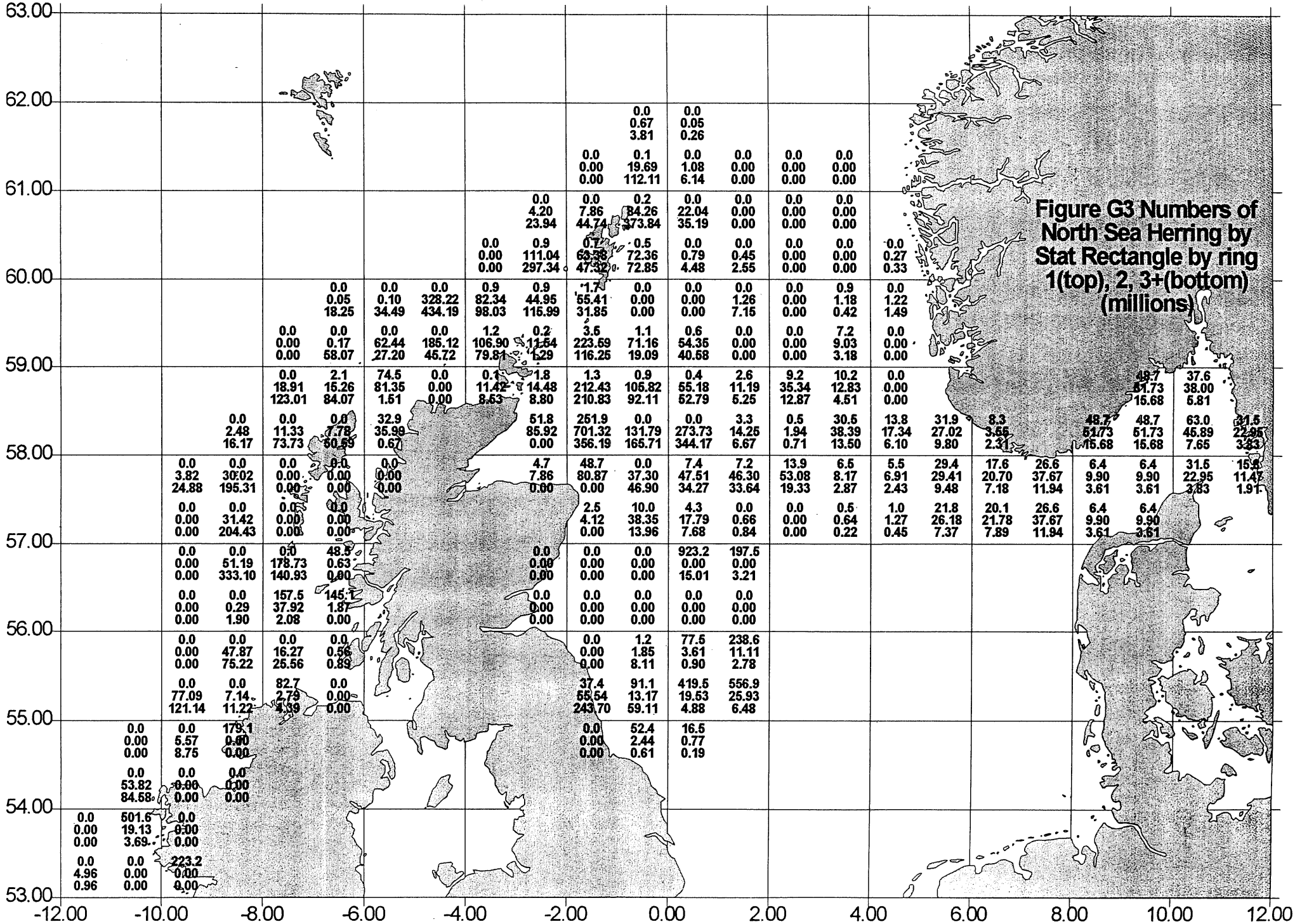


Figure G2 Numbers (millions) Biomass (Thousands of Tonnes) of North Sea Herring by Statistical Rectangle
63.00
62.00
61.00
60.00
59.00
58.00
57.00
56.00
55.00
54.00
53.00
-12.00
-10.00
-8.00
-6.00
-4.00
-2.00
0.00
2.00
4
6.00
8.00
10.00
12.00


63.00
62.00
61.00
60.00
59.00
58.00
57.00
56.00
55.00
54.00
53.00
-12.00
-10.00
-8.00
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
Figure G3 Numbers of North Sea Herring by Stat Rectangle by ring 1(top), 2, 3+(bottom) (millions)

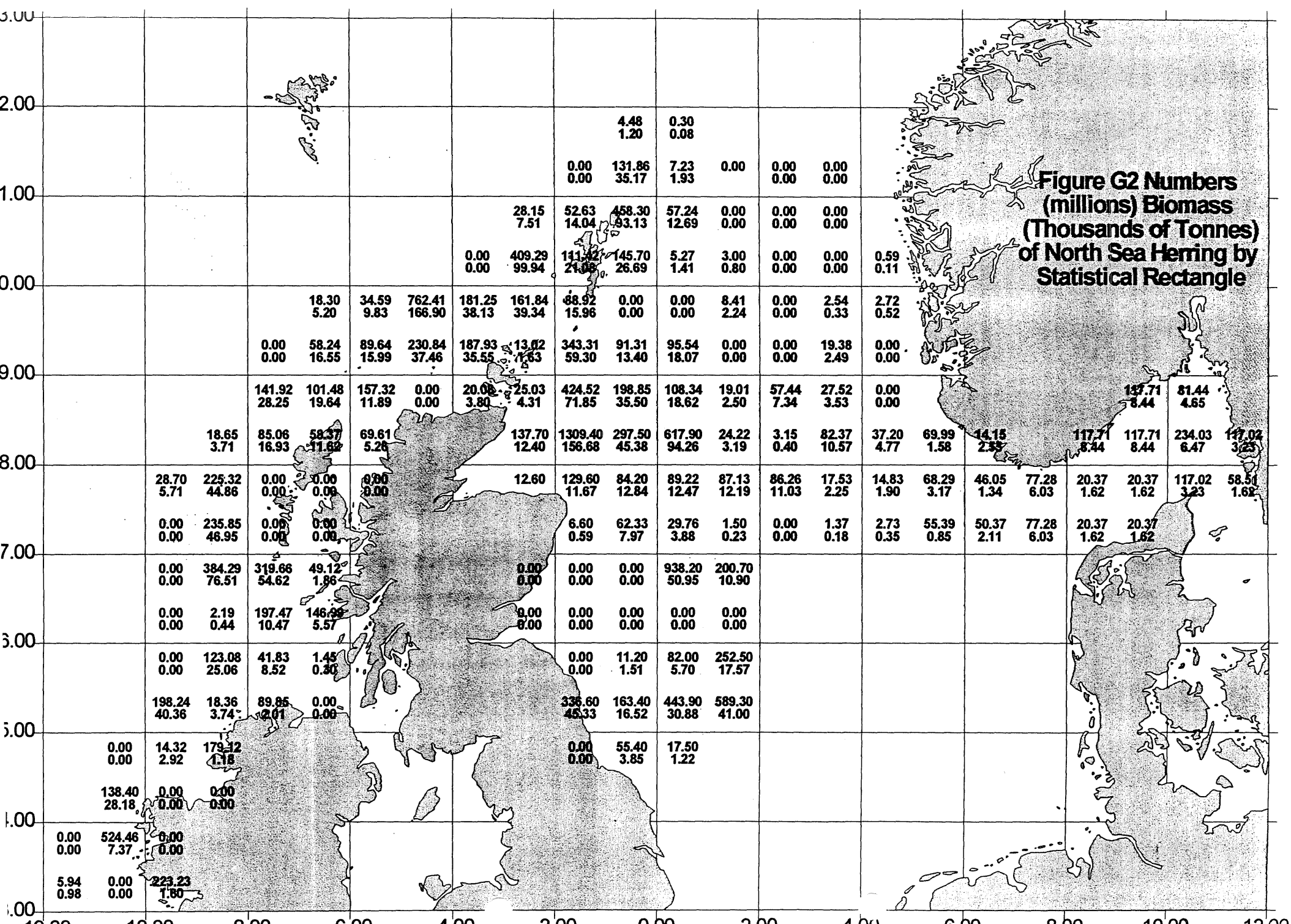


Figure G2 Numbers (millions) Biomass (Thousands of Tonnes) of North Sea Herring by Statistical Rectangle
3.00
2.00
1.00
0.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
-12.00
-10.00
-8.00
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00

Table D2 (cont.) Herring length frequency by trawl haul by sub area. Kings Cross 9 - 29 July 1995 (mean length - cm, mean weight - g, target strength - dB)

Haul No	Area V			Area VI		Area VII	
	37	39	mean	26	mean	42	mean
15.5							
16.0							
16.5							
17.0							
17.5				1.9	1.9		
18.0				1.9	1.9		
18.5				9.6	9.6		
19.0				14.4	14.4		
19.5				9.6	9.6		
20.0				8.7	8.7		
20.5				11.5	11.5		
21.0				9.6	9.6		
21.5				9.6	9.6		
22.0				7.7	7.7		
22.5						0.2	0.2
23.0				2.9	2.9	0.3	0.3
23.5				2.9	2.9	2.0	2.0
24.0				3.8	3.8	2.8	2.8
24.5				3.8	3.8	9.5	9.5
25.0						17.5	17.5
25.5				1.0	1.0	14.7	14.7
26.0	0.2	0.3	0.3			15.3	15.3
26.5						12.5	12.5
27.0	1.1	0.3	0.7			10.4	10.4
27.5	1.6	4.3	3.0	1.0	1.0	5.3	5.3
28.0	3.9	5.8	4.9			4.4	4.4
28.5	8.1	6.4	7.2			1.7	1.7
29.0	9.0	7.2	8.1			1.1	1.1
29.5	8.3	8.4	8.4			0.6	0.6
30.0	10.8	11.6	11.2			0.9	0.9
30.5	9.2	8.7	9.0			0.3	0.3
31.0	8.1	9.9	9.0			0.2	0.2
31.5	10.4	11.0	10.7			0.3	0.3
32.0	12.4	8.7	10.6				
32.5	8.1	8.1	8.1				
33.0	4.8	5.5	5.2				
33.5	3.0	2.9	2.9				
34.0	0.7	0.6	0.6				
34.5	0.2		0.1				
35.0		0.3	0.1				
Number	5425	8625		104		8816	
mean lgt	31.1	31.0	31.1	21.2	21.2	26.5	26.5
mean wt	285	283	284	76	76	162	162
TS/ind	-41.3	-41.4	-41.3	-44.7	-44.7	-42.7	-42.7
TS/kg	-35.9	-35.9	-35.9	-33.4	-33.4	-34.8	-34.8

Table D3

Herring numbers and biomass by age, maturity and area. *Kings Cross* 8 - 28 July 1995

Category	Number x 10^{-6}	Mean Length (cm)	Mean weight (g)	Biomass (tonnes x10^{-3})
Area I (South Minch)				
1 ring	327.38	16.84	36.96	12.10
2 ring immature	4.23	23.17	110.83	0.47
2 ring mature	0.00			0.00
3 ring immature	0.00			0.00
3 ring mature	0.00			0.00
4	0.00			0.00
5	0.00			0.00
6	0.00			0.00
7	0.00			0.00
8	0.00			0.00
9+	0.00			0.00
Total	331.61	16.92	37.91	12.57
Area II (South Barra Head)				
1 ring	4.30	19.93	65.12	0.28
2 ring immature	33.91	22.96	105.29	3.57
2 ring mature	20.60	23.78	118.60	2.44
3 ring immature	0.00			0.00
3 ring mature	1.72	25.42	150.46	0.26
4	0.29	27.50	194.84	0.06
5	0.00			0.00
6	0.29	28.00	207.35	0.06
7	0.00			0.00
8	0.29	29.00	234.08	0.07
9+	0.57	29.75	255.76	0.15
Total	61.96	23.23	111.06	6.88
Area III (Barra Head)				
1 ring	0.00			0.00
2 ring immature	107.06	25.26	145.95	15.63
2 ring mature	71.67	25.45	149.86	10.74
3 ring immature	2.77	26.98	182.57	0.51
3 ring mature	55.92	26.94	182.11	10.18
4	32.63	27.61	198.15	6.47
5	9.87	28.42	218.78	2.16
6	14.64	28.38	217.57	3.19
7	8.52	28.54	221.87	1.89
8	10.26	28.80	229.11	2.35
9+	6.32	29.22	240.35	1.52
Total	319.66	26.37	170.88	54.62

Table D3 (continued)

Herring numbers and biomass by age, maturity and area. *Kings Cross* 8 - 28 July 1995

Category	Number x 10^{-6}	Mean Length (cm)	Mean weight (g)	Biomass (tonnes x10^{-3})
Area IV (South West Hebrides)				
1 ring	0.00			0.00
2 ring immature	57.87	25.39	148.97	8.62
2 ring mature	112.29	25.74	156.18	17.54
3 ring immature	8.89	27.13	186.10	1.65
3 ring mature	245.62	27.12	186.44	45.79
4	326.61	27.57	197.16	64.40
5	119.06	28.57	222.95	26.54
6	134.27	28.34	216.51	29.07
7	90.29	28.45	219.49	19.82
8	129.51	28.52	221.57	28.69
9+	52.88	28.83	230.08	12.17
Total	1277.29	27.61	099.09	254.30
Area V (Shelf Break)				
1 ring	0.00			0.00
2 ring immature	0.00			0.00
2 ring mature	1.37	27.00	182.88	0.25
3 ring immature	0.00			0.00
3 ring mature	55.97	28.80	230.09	12.88
4	53.66	28.86	231.24	12.41
5	24.04	29.04	235.97	5.67
6	36.76	30.05	266.22	9.79
7	69.13	30.63	284.46	19.66
8	94.02	31.56	315.02	29.62
9+	141.73	31.64	318.56	45.15
Total	476.67	30.52	283.70	135.23
Area VI (North Minch)				
1 ring	109.55	19.15	56.47	6.19
2 ring immature	92.74	21.44	83.52	7.74
2 ring mature	26.96	23.77	119.92	3.23
3 ring immature	0.00			0.00
3 ring mature	2.23	25.50	150.15	0.33
4	0.00			0.00
5	0.00			0.00
6	0.00			0.00
7	0.00			0.00
8	0.00			0.00
9+	0.00			0.00
Total	231.47	20.67	75.59	17.50

Table D3 (continued)

Herring numbers and biomass by age, maturity and area. *Kings Cross* 8 - 28 July 1995

Category	Number x 10^{-4}	Mean Length (cm)	Mean weight (g)	Biomass (tonnes x10^{-3})
Area VII (North of Scotland)				
1 ring	0.00			0.00
2 ring immature	574.72	25.65	154.36	88.72
2 ring mature	0.00			0.00
3 ring immature	0.00			0.00
3 ring mature	100.10	27.14	187.92	18.81
4	37.099	27.62	200.36	7.43
5	0.00			0.00
6	1.14	30.50	278.68	0.32
7	1.14	30.50	278.68	0.32
8	2.47	30.69	285.48	0.71
9+	0.00			0.00
Total	716.650	26.00	162.28	116.30
Total Area				
1 ring	441.24	17.45	42.08	18.57
2 ring immature	870.52	25.02	143.30	124.75
2 ring mature	232.88	25.26	146.87	34.20
3 ring immature	11.67	27.10	185.26	2.16
3 ring mature	461.55	27.29	191.22	88.26
4	450.27	27.73	201.56	90.75
5	152.97	28.64	224.72	34.38
6	187.10	28.69	226.73	42.42
7	169.08	29.36	246.57	41.69
8	236.54	29.76	259.72	61.44
9+	201.50	30.82	292.71	58.98
Total	3415.31	25.97	174.92	597.40

Table E1: Settings and calibration data of the towed body at Bornö, Gullmarn Fjord, Sweden July 1995

Echo sounder	EK/ES 400, 38 kHz
Transducer	Simrad ceramic 38-29/25
SL + VR (dB)	129.6
10 Log psi	-20.2
TVG	64.6
Sound velocity (m/s)	1,498
Pulse length (s)	0.001

Table E2 Catch information by trawl haul during the acoustic survey of R/V DANA in Skagerrak and Kattegat in the period 28 June - 12 July 1995.

Date	Haul no	Time	ICES square	Trawl	Catch depth m	Mean depth m	Speed kn	Trawling time min	Total catch kg	Main species
300695	4849	23.23	44F8	FOTÖ	surface	510	4	60	1632	mackerel, herring
10795	4875	1.22	44F7	FOTÖ	surface	475	3.8	60	430	herring, mackerel
10795	4948	12.36	45F5	FOTÖ	118-135	315	3.5	60	168	saithe, pearlsides
10795	4966	15.51	45F5	FOTÖ	220-240	337	3.7	60	19	pearlsides
10795	5017	23.22	44F5	FOTÖ	surface	120	3.5	60	1900	Norway pout, herring, mackerel
20795	5039	2.57	45F5	FOTÖ	surface	310	3.5	60	1140	herring
20795	5133	13.55	43F5	EXPO	bottom	60	3.5	60	1560	sandeel, haddock, cod
20795	5208	23.22	43F6	FOTÖ	surface	150	3.5	60	1800	herring, Norway pout, mackerel
30795	5229	2.49	43F6	FOTÖ	surface	75	3.7	60	190	herring, mackerel
30795	5309	12.29	44F7	FOTÖ	140-150	270	3.7	60	190	pearlsides, krill, saithe
30795	5316	14.26	44F7	FOTÖ	115-130	250	3.6	60	470	blue whiting, saithe, krill
30795	5384	23.22	43F7	FOTÖ	surface	60	3.6	60	1140	herring, mackerel
40795	5403	2.49	44F8	FOTÖ	surface	160	3.5	60	574	herring, blue whiting, mackerel
40795	5486	13.3	43F9	EXPO	bottom	30	3.1	60	1500	whiting
40795	5570	23.3	44G1	FOTÖ	surface	70	3.6	60	2100	herring, sprat
50795	5589	2.48	44G1	FOTÖ	surface	45	3.6	60	740	herring, sprat
50795	5696	15.54	44G0	EXPO	bottom	25	3.4	60	1500	herring, sprat, whiting
50795	5748	11.16	45G0	FOTÖ	surface	90	2.9	60	1350	herring, lumpsucker
60795	5770	2.46	45F9	FOTÖ	surface	320	3.6	60	1100	herring, mackerel
60795	5879	16.23	44G0	EXPO	bottom	180	3.2	60	465	blue whiting, shrimp
60795	5928	23.21	46F9	FOTÖ	surface	500	3.6	60	1000	mackerel, herring
70795	5948	2.49	46F9	FOTÖ	surface	415	3.9	60	400	herring, mackerel
70795	6033	12.45	45G0	FOTÖ	180-190	250	3.7	60	400	krill
70795	6050	15.49	46G0	EXPO	bottom	90	3.5	60	650	haddock, cod, whiting
70795	6108	23.24	45G0	FOTÖ	surface	190	3.7	60	1800	herring, garfish
80795	6130	2.45	44G0	FOTÖ	surface	65	3.7	60	1050	herring, sprat
80795	6224	12.39	43G1	EXPO	bottom	40	3.2	60	1410	herring, sprat
80795	6322	23.19	42G2	FOTÖ	surface	40	3.7	60	811	herring, sprat
90795	6337	2.07	42G1	FOTÖ	surface	60	3.9	60	2000	herring, sprat
90795	6424	13.31	42G1	EXPO	bottom	35	3.4	60	600	herring, sprat
90795	6523	23.19	41G0	FOTÖ	surface	20	3.5	60	2500	jellyfish, herring, sprat
100795	6551	3.16	41G0	FOTÖ	surface	25	3.7	30	1000	jellyfish
100795	6608	10.16	41G2	EXPO	bottom	25	3.3	60	575	herring, cod
100795	6633	14.52	40G2	EXPO	bottom	28	3.2	30	4000	cod, herring
100795	6662	17.5	40G2	EXPO	bottom	15	3.2	15	1100	cod, sprat
TOTAL									39264	

Table E3: The area of subareas, number of nm surveyed by subarea, mean Sa and mean TS estimated by subarea are indicated for the survey area covered by R/V *Dana* during the acoustic survey July 1995

Subarea	Area nm^2	No nm surveyed	Number trawl hauls	Mean Sa	Mean TS
I	1,479	64	10	8.15E-06	2.75E-05
II	2,333	114	6	9.00E-06	3.16E-05
III	3,600	285	16	1.10E-05	2.85E-05
IV	3,406	133	17	1.42E-05	2.92E-05
V	1,822	78	10	4.51E-06	2.57E-05
VI	988	88	4	1.94E-05	5.36E-05
VII	1,837	200	8	1.64E-05	3.50E-05
VIII	5,228	587	12	1.13E-05	1.22E-05
Total	20,693	1,549			

Table E4: The total number (*1,000) of herring by age and subarea observed in Skagerrak and Kattegat during the acoustic survey of R/V *Dana* in the period 28 June - 12 July 1995

	Age										
Sub-area	0	1	2	3	4	5	6	7	8	9+	Total
I	2541	74803	136121	108916	135123	38107	26666	8375	3747	1681	536080
II	0	162482	251871	141022	159240	45872	36812	12050	8667	4451	822467
III	4453	225983	379588	261859	313659	88873	65060	20762	11496	5502	1377235
IV	4693	311105	390893	259350	312067	87062	65770	19687	11234	5485	1467346
V	1872	54406	99760	80570	100368	27941	20245	5952	2741	1254	395109
VI	0	80063	95712	37923	88089	3952	741	108	108	0	306696
VII	264250	301819	260083	109751	189501	14624	3867	1543	520	0	1145958
VIII	2396364	2741316	1280659	367339	271260	26776	16856	7140	1981	0	7109691
Total	2674173	3951977	2894687	1366730	1569307	333207	236017	75617	40494	18373	13160582
Total-VIII	277809	1210661	1614028	999391	1298047	306431	219161	68477	38513	18373	6050891

Table E5: The total biomass and the spawning biomass of North Sea autumn and Baltic spring spawning herring in Skagerrak and Kattegat estimated during the acoustic survey of R/V *Dana* in the period 28 June - 12 July 1995

North Sea herring											
Age	0	1	2	3	4	5	6	7	8	9+	Total
Total biomass (tonnes)	1123	29571	48282	15726	0	0	0	3336	1207	0	99425
Spawning biomass (tonnes)	0	0	24141	13367	0	0	0	3336	1207	0	42051

Baltic herring											
Age	0	1	2	3	4	5	6	7	8	9+	Total
Total biomass (tonnes)	0	33549	73334	87735	153223	41273	35696	8329	5651	3844	442634
Spawning biomass (tonnes)	0	0	36667	74575	153223	41273	35696	8329	5651	3844	359258

Table E6: The mean weight (g) of herring by age and subarea observed in Skagerrak and Kattegat during the acoustic survey of R/V *Dana* in the period 28 June - 12 July 1995

	Age										
Subarea	0	1	2	3	4	5	6	7	8	9	10+
I	7	60	83	111	124	138	163	168	156	191	222
II		57	79	106	120	140	169	175	200	213	224
III	7	58	81	108	123	139	165	171	178	201	224
IV	6	52	78	108	122	137	164	171	178	200	222
V	6	59	82	110	124	137	162	168	156	191	220
VI		53	59	70	106	76	79	111	111		
VII	4	43	59	74	100	80	79	144	111		
VIII	5	31	45	77	82	89	79	147	116		

Table E7 Length and weight of herring measured in catch by subareas in Skagerrak and Kattegat during the acoustic survey of R/V DANA in the period 28. June - 12 July 1995.

length	subarea I		subarea II		subarea III		subarea IV		subarea V		subarea VI		subarea VII		subarea VIII	
scm	number	weight (g)	number	weight (g)	number	weight (g)	number	weight (g)	number	weight (g)	number	weight (g)	number	weight (g)	number	weight (g)
20																
21																
22																
23																
24															5	12
25							2	18					2	15	10	14
26							4	20					1	15	27	15
27							5	23					3	17	73	15
28							5	29					20	20	100	21
29							6	26					38	23	142	24
30					1	75	8	26					44	25	200	25
31					4	42	12	32					52	28	223	27
32	2	33	4	33	12	37	31	38					46	28	274	29
33	1	35	3	37	15	38	18	40					44	33	373	32
34	2	40	10	40	23	41	15	43	1	40			35	35	583	34
35	3	43	3	45	34	46	10	45	1	45	2	43	47	38	688	37
36	3	52	3	47	59	49	20	47	5	44	11	45	62	42	418	41
37			4	55	91	53	37	50	27	48	10	49	77	46	175	47
38	3	65	3	195	96	57	16	42	42	53	19	54	87	52	85	48
39	3	62			95	63	6	58	46	58	19	58	84	57	51	54
40	3	78	2	75	116	67	22	63	41	63	20	60	87	61	52	54
41	5	79			173	72	27	70	47	64	27	62	99	66	58	59
42	29	72	2	73	195	76	56	79	47	68	26	70	134	72	60	63
43	44	76	8	79	217	80	109	79	73	77	17	74	120	77	37	67
44	85	80	8	85	171	81	113	83	72	77	12	77	120	80	26	72
45	70	100	11	90	111	90	79	87	72	84	12	80	67	85	17	80
46	62	108	5	95	76	100	46	91	68	92	8	84	53	91	6	83
47	43	112	10	100	53	109	23	95	59	98	3	102	28	100	3	82
48	28	125	1	115	45	115	26	101	54	101	1	115	17	107	2	90
49	28	134	5	117	33	126	23	107	60	110			13	110	1	110
50	33	116	12	94	39	135	16	100	69	114	1	100	7	114	2	120
51	25	121	11	127	36	146	20	123	87	122			6	133		
52	32	125	16	144	39	138	23	118	87	133	1	150	7	134		
53	31	138	22	147	45	157	28	135	89	139			1	165		
54	16	148	29	159	37	164	20	147	98	152						
55	7	159	14	174	33	176	21	162	72	159			2	153		
56	6	225	14	183	21	183	8	166	68	174						
57	4	260	7	194	15	202	9	192	52	181			2	230		
58	1	180	13	194	7	203	8	186	26	194						
59			15	210	7	218	5	188	12	209						
60			12	223	3	243	3	195	19	205			1	265		
61			6	255	4	244	2	190	6	225						
62			2	265	1	240	1	200	1	230						
63			5	259			1	155	2	243						
64																
65			2	298												
66			2	305												
total	569	60654	264	38436	1907	168503	884	75648	1403	160110	189	12378	1406	85761	3691	132581

Table E8: Statistical information of length-weight relationship of Baltic spring and North Sea autumn spawning herring in Skagerrak and Kattegat during the acoustic survey of R/V *Dana* in the period 28 June - 12 July 1995

ANOVAR of Linear Regression

Source of variation	Baltic spring spawning herring				North Sea autumn spawing herring			
	df	SS	S^2	F	df	SS	S^2	F
Regression	1	182.019	182.019	10477.54	1	204.318	204.318	7881.708
Residual	494	8.582	0.017		458	11.709	0.026	
Total	495	180.601			459	216.028		

Linear Regression

			S.E	t-value	95% confidence limits		R	Number
					Lower	Upper		
Spring spawning herring	Slope	3.230	0.032	102.36	3.168	3.292	0.977	496
	Intercept	-7.768	0.119	-65.397	-8.002	-7.535		
Autumn spawning herring	Slope	3.192	0.036	89.396	3.122	3.263	0.973	460
	Intercept	-7.588	0.133	-57.087	-7.849	-7.327		

Table E9: The number of fish examined, the mean number of vertebrae by age, variance and the percent Baltic herring by age observed in skagerrak and Kattegat during the acoustic survey of R/V *Dana* July 1995.

Age	Number of fish	mean vs	Variance S^2	Percent Baltic
1	543	56.12891	0.706598	53.0
2	450	56.07778	0.731131	60.3
3	277	55.90614	0.759274	84.8
4	312	55.70192	0.820832	100.0
5	89	55.76404	0.659602	100.0
6	47	55.65957	0.707678	100.0
7	23	56	0.454545	71.4
8	13	55.92308	0.410256	82.4
9+	5	55.6	1.3	100.0

Table E10: Fraction (%) of Baltic spring spawning herring by subarea and age in Skagerrak and Kattegat during the acoustic survey of R/V *Dana* in the period 28 June - 12 July 1995

Age	Subarea							
	I	II	III	IV	V	VI	VII	VIII
1	21.4	10.9	67.3	22.4	51.6	63.9	55.0	72.7
2	74.6	43.4	59.3	31.3	62.0	41.1	81.1	98.3
3	85.4	40.6	100.0	78.4	100.0	89.3	71.4	83.9
4	96.9	79.1	100.0	100.0	99.4	100.0	100.0	61.3
5	100.0	65.4	100.0	79.4	100.0	71.4	100.0	71.4
6		100.0	100.0	85.7	100.0		100.0	
7		71.4	71.4	71.4	71.4		100.0	
8	23.9	0.0		100.0	100.0			
9+		100.0		0.0	71.4			

Table E11: Percent mature North Sea autumn and Baltic spring spawning herring observed in Skagerrak and Kattegat during the acoustic survey of R/V *Dana* in the period 28 June - 12 July 1995

Age	North Sea autumn spawners				Baltic spring spawners			
	No	Immature	Mature	Percent mature	No	Immature	Mature	Percent mature
0								
1	178	177	1	0.6	111	110	1	0.9
2	135	122	13	9.6	102	101	1	1.0
3	66	55	11	16.7	88	81	7	8.0
4	52	42	10	19.2	132	105	27	20.5
5	13	11	2	15.4	32	29	3	9.4
6	8	7	1	12.5	21	17	4	19.0
7	5	4	1	20.0	5	4	1	20.0
8	2	2		0.0	3	3		0.0
9	1		1	100.0	1	1		0.0
10+					1	1		0.0
Total	460	420	40	8.7	496	452	44	8.9

Table F1: Numbers (millions of fish) and biomass (thousands of tonnes) at age for the July/August 1995 herring acoustic cruise

Age	Mean length (cm)	Mean weight (g)	Number x 10^6	%	Biomass x 10^3 T	%
0+1	9.65	7.08	987.12	59.74	6.99	5.08
2I	25.91	170.95	19.31	1.17	3.30	2.40
2M	25.72	167.23	294.28	17.81	49.21	35.74
3I	27.50	207.85	7.61	0.46	1.58	1.15
3M	27.43	206.77	175.69	10.63	36.33	26.39
4A	27.74	214.48	71.54	4.33	15.34	11.14
5A	28.17	225.44	7.76	0.47	1.75	1.27
6A	29.99	277.43	19.79	1.20	5.49	3.99
7A	29.55	263.95	10.69	0.65	2.82	2.05
8A	29.78	270.70	6.50	0.39	1.76	1.28
9+	29.15	252.26	51.94	3.14	13.10	9.52
Total	16.99	83.33	1,652.23	100.00	137.67	100.00
Immature			1,014.04	61.37	11.87	8.62
Mature			638.19	38.63	125.80	91.38

Table F2

Stratum	Herring 1995, average weight per age group (g/ind)				
	0-ringer	I-ringer	II-ringer	III-ringer	IV-ringer
42F6	7.5	43.3	43.4	-	-
42F5	10.8	62.9	83.3	-	-
41F7	11.3	62.5	50.9	-	-
41F6	7.5	43.3	43.4	-	-
41F5	10.8	62.9	83.3	-	-
41F4	-	77.0	164.2	-	-
41F6	6.7	82.5	80.8	140.0	-
40F5	5.9	60.0	81.4	-	-
40F4	-	77.0	164.2	-	112.5
40F3	-	77.0	164.2	208.0	-
39F6	15.8	75.0	89.7	-	-
39F5	8.2	30.0	66.4	-	200.0
39F3	-	77.0	164.2	208.0	-
39F2	4.6	-	-	-	-
39F1	4.6	-	-	-	-
38F6	20.0	60.0	95.0	-	-
38F5	10.0	38.2	-	-	-
38F4	20.0	-	-	-	-
38F3	4.6	-	-	-	-
38F2	4.6	-	-	-	-
38F1	4.6	-	-	-	-

Table F3

Stratum	Herring 1995, average length per age group (cm)				
	0-ringer	I-ringer	II-ringer	III-ringer	IV-ringer
42F6	11.1	15.7	17.3	-	-
42F5	9.1	17.4	18.0	-	-
41F7	11.9	17.0	17.8	-	-
41F6	11.1	15.7	17.3	-	-
41F5	9.1	17.4	18.0	-	-
41F4	-	19.4	20.8	-	-
41F6	9.7	18.5	20.5	23.3	-
40F5	9.2	17.5	18.4	-	-
40F4	-	19.4	20.8	23.2	24.8
40F3	-	19.4	20.8	-	-
39F6	9.6	17.9	19.9	-	-
39F5	9.1	20.5	21.1	-	26.8
39F3	10.8	19.4	20.8	23.2	-
39F2	10.3	-	-	-	-
39F1	10.3	-	-	-	-
38F6	13.4	17.5	20.3	-	-
38F5	11.8	16.6	-	-	-
38F4	11.8	-	-	-	-
38F3	10.3	-	-	-	-
38F2	10.3	-	-	-	-
38F1	10.3	-	-	-	-

Table F4

Stratum	Herring, number per stratum and age group (n x 10^6)					
	0-ringer	I-ringer (l)	I-ringer (m)	II-ringer (l)	II-ringer (m)	III-ringer
42F6	3	240	3	10	3	-
42F5	57	7	7	4	3	-
41F7	18	907	302	22	35	-
41F6	13	1,189	12	51	7	-
41F5	1,319	173	141	84	75	-
41F4	-	38	1	20	4	-
41F6	39	326	106	158	14	13
40F5	3,778	257	5	101	16	-
40F4	-	129	25	39	55	2
40F3	-	11	2	6	1	-
39F6	402	419	47	55	82	-
39F5	58	29	84	8	32	-
39F3	3	151	2	81	5	2
39F2	3	-	-	-	-	-
39F1	2	-	-	-	-	-
38F6	10	35	6	1	1	-
38F5	1	15	4	-	-	-
38F4	1	-	-	-	-	-
38F3	7	-	-	-	-	-
38F2	51	-	-	-	-	-
38F1	113	-	-	-	-	-

Quantities under 1 are omitted

Table F5

Stratum	Herring, biomass per stratum and age group (t)					
	0-ringer	I-ringer (l)	I-ringer (m)	II-ringer (l)	II-ringer (m)	III-ringer
42F6	23	10,392	130	434	130	-
42F5	616	440	440	333	250	-
41F7	203	56,688	18,875	1,120	1,782	-
41F6	98	51,484	520	2,213	304	-
41F5	14,245	10,882	8,869	6,997	6,248	-
41F4	-	2,926	77	3,284	657	-
41F6	2,613	26,895	8,745	12,766	1,131	1,820
40F5	22,290	15,420	300	8,221	1,302	-
40F4	-	9,933	1,925	6,404	9,031	416
40F3	-	847	154	985	164	-
39F6	6,352	31,452	3,525	4,934	7,355	-
39F5	476	870	2,520	531	2,125	-
39F3	-	11,627	154	13,300	821	416
39F2	14	-	-	-	-	-
39F1	9	-	-	-	-	-
38F6	200	2,100	360	95	95	-
38F5	10	423	153	-	-	-
38F4	20	-	-	-	-	-
38F3	32	-	-	-	-	-
38F2	235	-	-	-	-	-
38F1	520	-	-	-	-	-

Quantities under 1 are omitted

Table G1 Numbers ($*10^{-6}$) of North Sea Autumn Spawning Herring (Millions) by ICES area for 1995

Numbers (Millions)	IVa	IVb	IVa&b	East of 6°E	Total North Sea
0	1.27	0.00	1.27	274.15	275.43
1	553.89	2651.91	3205.80	100.93	4201.96
2I	746.29	65.65	811.94	228.37	1040.31
2M	2372.59	157.31	2529.90	229.04	2758.94
3I	56.48	22.14	78.63	15.98	94.61
3M	1766.97	104.45	1871.42	89.93	1961.35
4	599.10	55.19	654.29	2.00	656.29
5	165.43	106.07	271.50	0.58	272.09
6	104.29	70.55	174.84	0.42	175.26
7	107.44	14.85	122.29	12.59	134.88
8	105.17	0.84	106.01	4.17	110.18
9	83.79	0.21	84.01	0.08	84.09
Tot	6662.72	3249.18	9911.89	1307.75	11219.64
Immature	1357.93	2739.70	4097.64	968.93	5066.57
Mature	5304.78	509.47	5814.25	338.82	6153.07

Table G2 Biomass($t*10^{-3}$) of North Sea Autumn Spawning Herring (Millions) by ICES area for 1995

Biomass (Tonnes $*10^{-3}$)	IVa	IVb	IVa&b	East of 6°E	North Sea
0	0.01	0.00	0.01	1.12	1.13
1	35.16	160.66	195.82	50.01	247.03
2I	72.10	0.00	78.45	16.79	95.24
2M	365.37	20.55	385.92	17.17	403.09
3I	7.16	2.55	9.71	1.61	11.32
3M	334.36	15.73	350.09	9.25	359.34
4	122.26	8.49	130.75	0.30	131.06
5	38.14	14.80	52.94	0.10	53.04
6	28.92	10.90	39.82	0.08	39.90
7	30.08	2.39	32.48	2.14	34.62
8	32.34	0.18	32.52	0.73	33.25
9	27.21	0.04	27.25	0.01	27.27
Tot	1093.12	236.31	1335.77	72.07	1407.84
Immature	114.43	163.21	283.99	42.28	326.27
Mature	978.68	73.09	1051.78	29.79	1081.56

Table G3 Mean Weight(g) of North Sea Autumn Spawning Herring (Millions) by ICES area for 1995

Weight (g)	IVa	IVb	IVa&b	East of 6°E	North Sea
0	7.00	0.00	7.00	4.08	4.10
1	63.48	60.58	61.08	51.02	57.78
2I	96.62	0.00	96.62	73.51	91.55
2M	154.00	130.61	152.54	74.95	146.10
3I	126.78	115.26	123.53	100.76	119.69
3M	189.23	150.58	187.07	102.84	183.21
4	204.07	153.91	199.84	152.20	199.69
5	230.54	139.56	195.00	176.90	194.96
6	275.37	157.40	228.13	194.10	228.05
7	280.03	161.16	265.59	169.98	256.67
8	307.47	219.28	306.77	174.83	301.77
9	324.70	209.04	324.41	175.70	324.26
Tot	164.06	72.73	134.76	55.11	125.48
Immature	84.27	59.57	69.31	43.64	64.40
Mature	184.49	143.47	180.90	87.92	175.78

Table G4 Numbers (millions), Biomass (Thousands of Tonnes) and Mean Weights (g) for Baltic Spring Spawners.

	Numbers (Millions)	Biomass (Thousand Ton)	Mean Wt. (g)
2I	446.96	31.95	71.49
2M	411.40	30.66	74.53
3I	121.78	11.38	93.46
3M	639.79	65.34	102.13
4	1105.76	130.33	117.87
5	253.86	34.33	135.21
6	179.31	29.38	163.87
7	41.77	7.00	167.62
8	26.03	4.71	181.06
9	14.49	2.90	200.05
Tot	3793.11	376.42	99.24
Immature	1120.71	71.76	64.03
Mature	2672.40	304.66	114.00

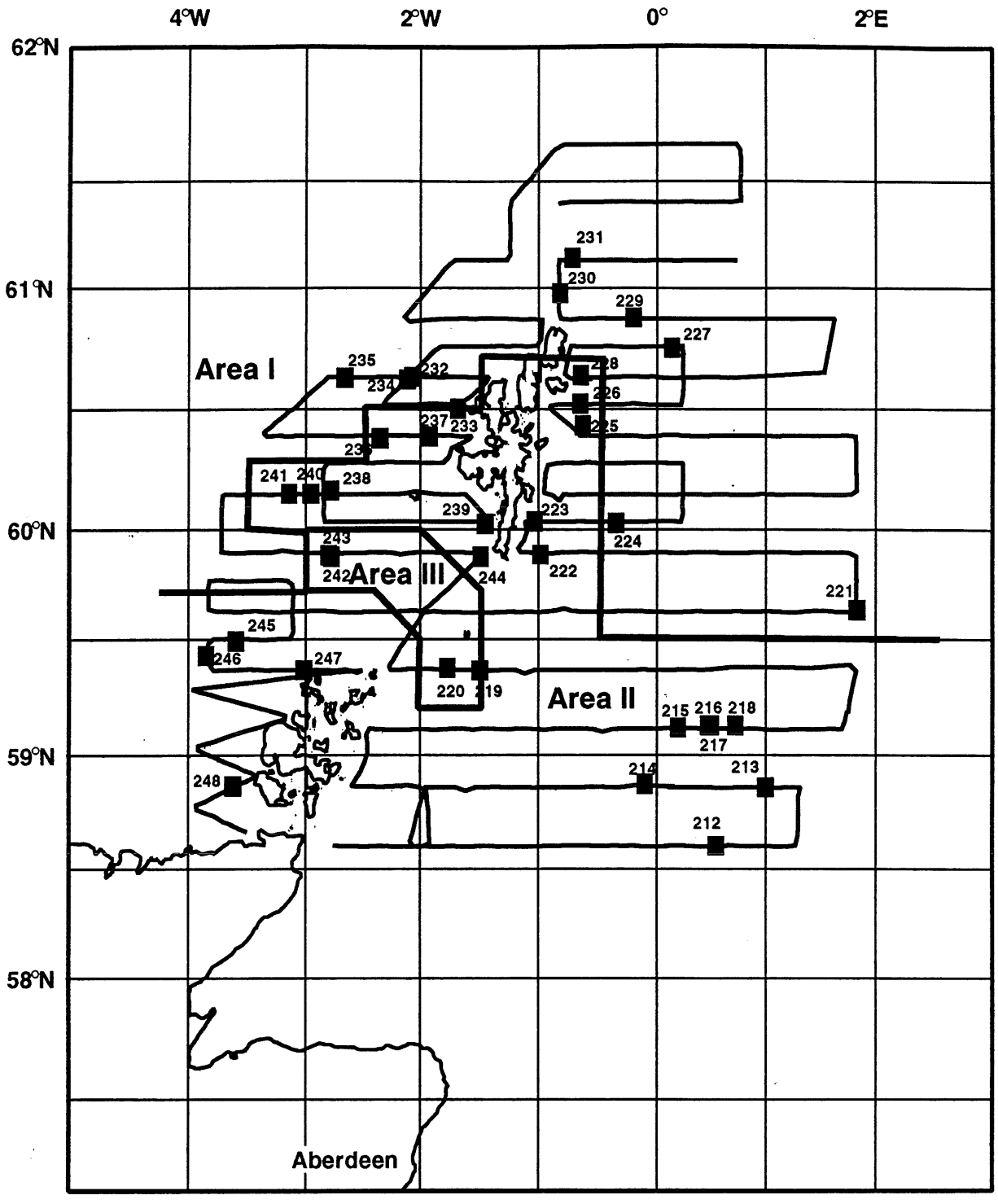


Figure A1 Cruise Track and Trawl Positions for Scotia Survey 8-27 July 1995

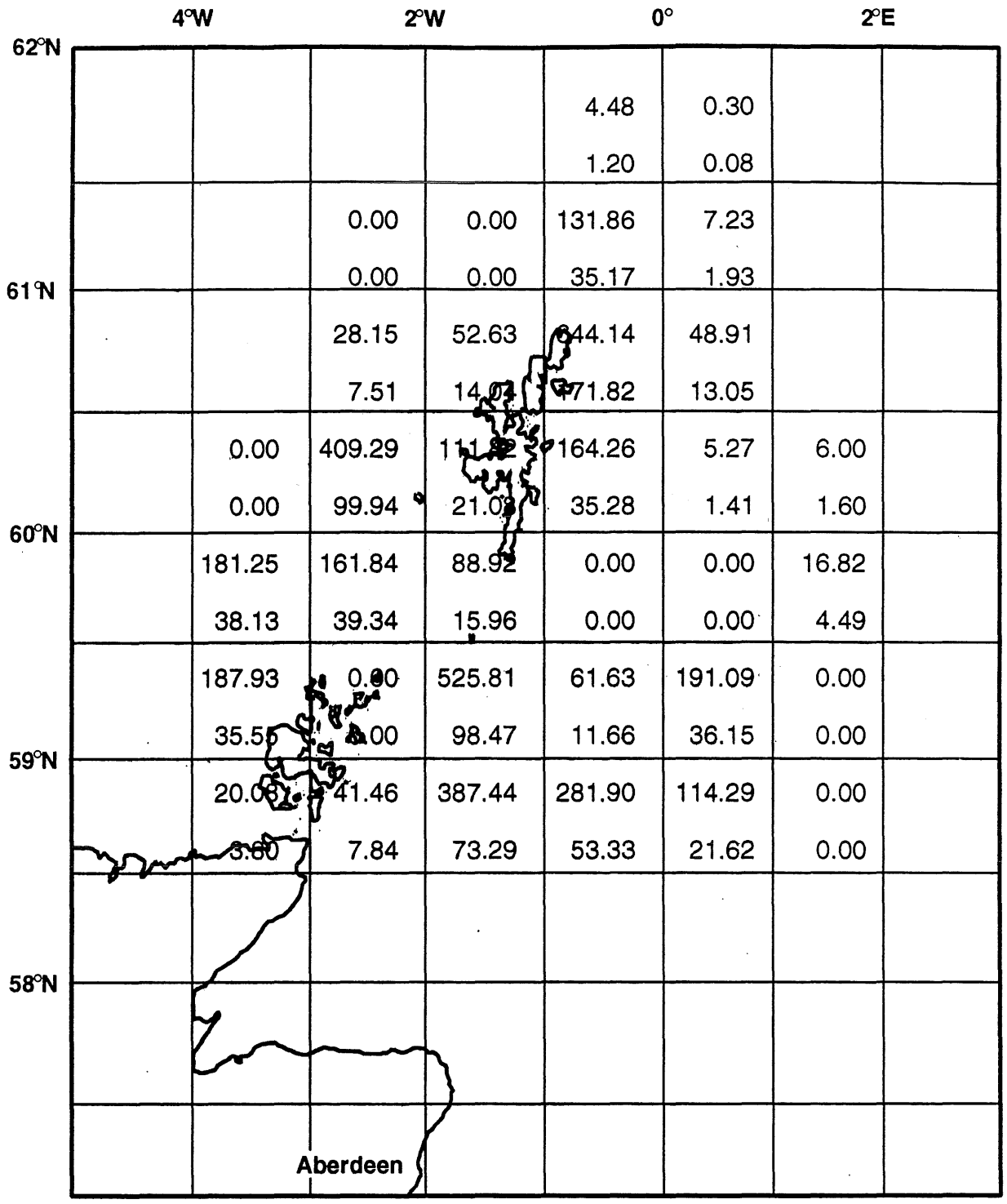


Figure A2 Scotia 1995 Numbers (millions) and Biomass (Thousands of tonnes)

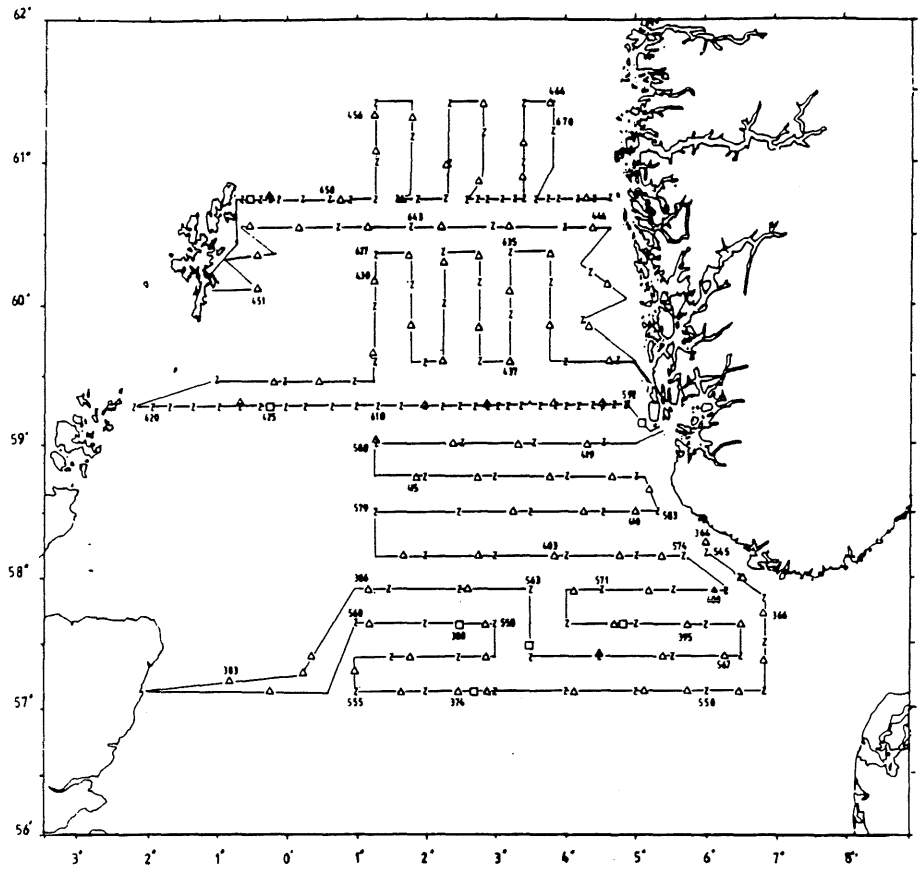


Figure B1. Course lines with CTD (Z) stations and trawl stations for R/V "G.O. Sars", 26 June - 26 July 1995.

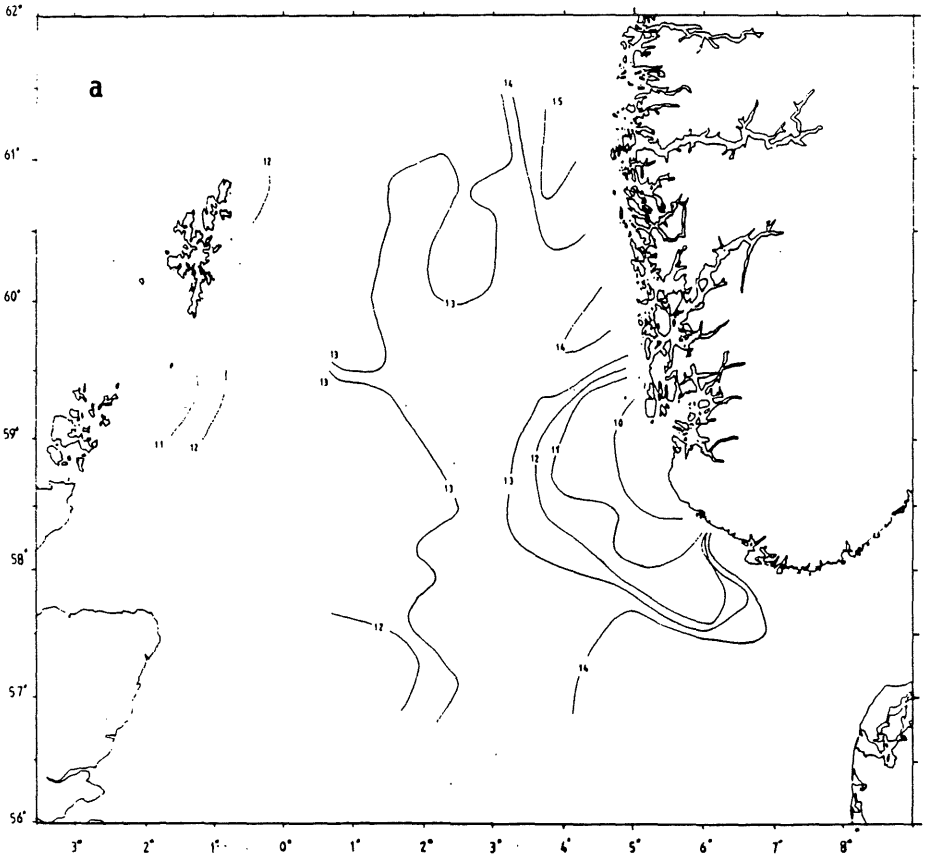
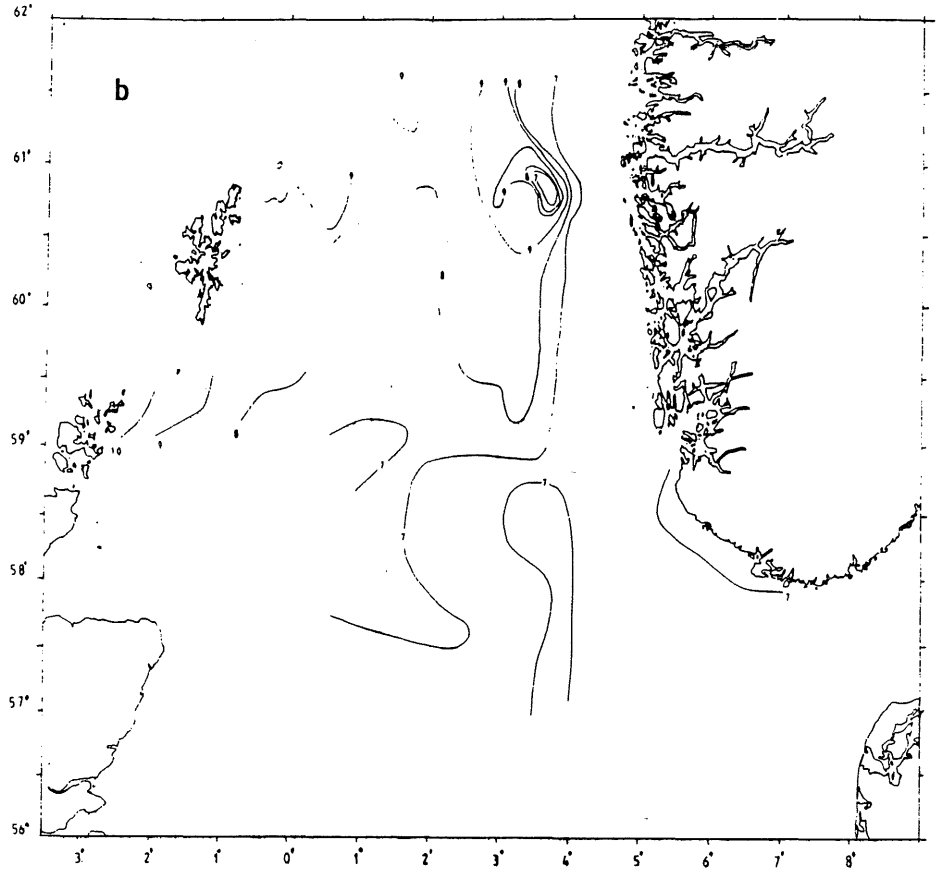


Figure B2. Distribution of temperature in 5m (a), 50m (b) and at bottom (c).



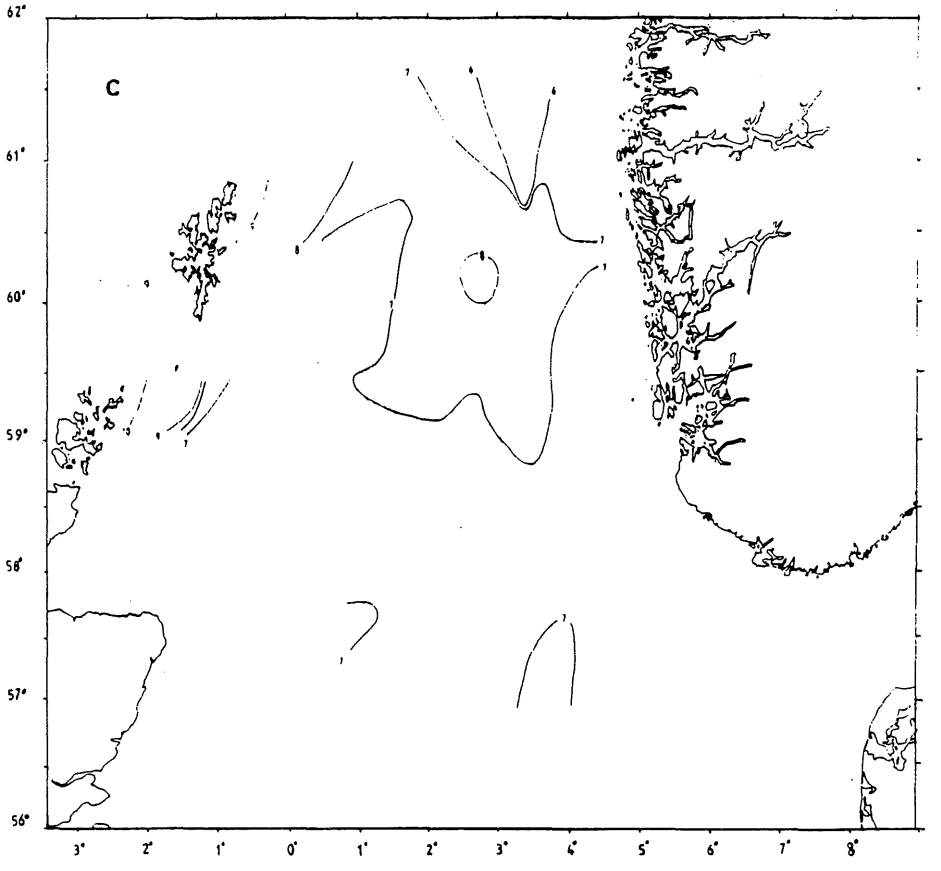


Figure B2 **continued.**

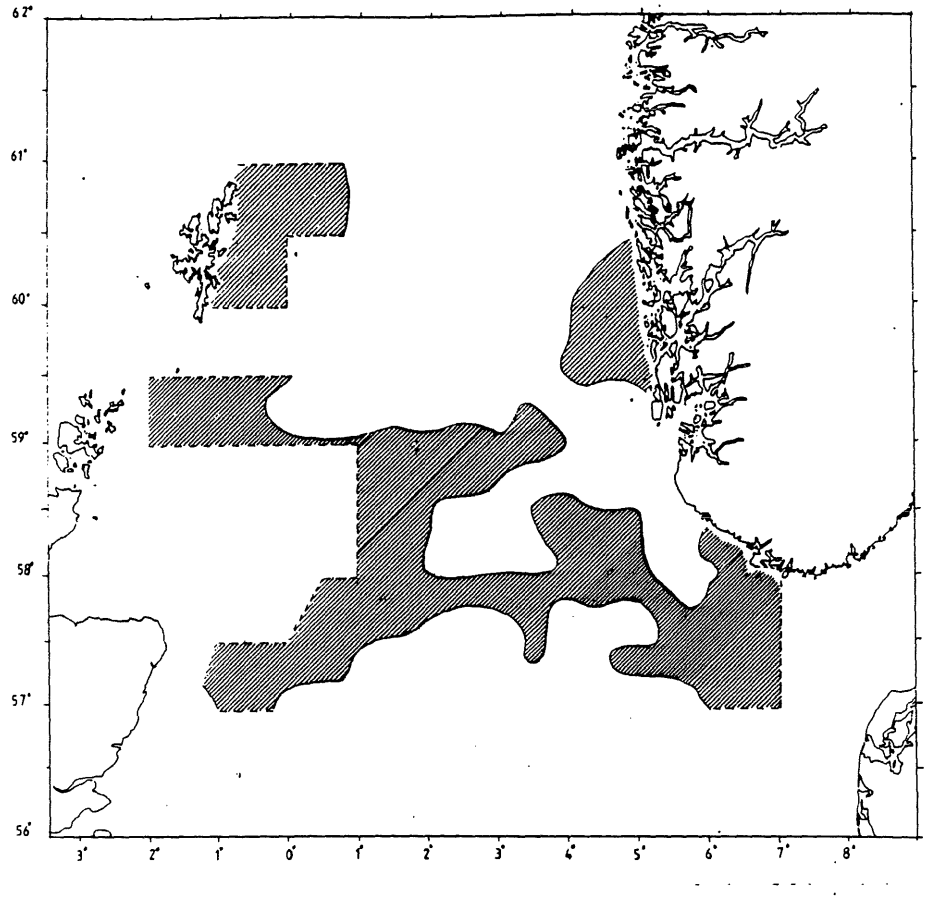


Figure B3 **The horizontal distribution of herring, 26 June - 16 July 1995.**