International Council for the Exploration of the Sea

CM 1998/OPEN:22 Poster
1997 ICES Coordinated Acoustic Survey of ICES Divisions IIIa, IVa IVb and VIa

1997 ICES COORDINATED ACOUSTIC SURVEY OF ICES DIVISIONS IIIA, IVA IVB AND VIA

E J Simmonds[1], M C Bailey[1], R Toresen[2], E Torstensen[2], B Couperous[3]
J Pedersen[4], D G Reid[1], N Hammer[5]

[1]FRS Marine Laboratory, PO Box 101, Victoria Road, Aberdeen, AB11 9DB, Scotland, UK

[2]Institute of Marine Research, Bergen, Norway

[3]RIVO, IJmuiden, Netherlands

[4]Danish Institute for Fisheries Research, Hirtshals, Denmark

[5]Hamburg, Germany

SUMMARY

Six 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 surveys. The combined survey results provide spatial distributions of herring abundance by number and biomass at age by stat rectangle.

METHODS

Six 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.

SURVEY REPORT FOR FRV *SCOTIA* IN THE NORTHERN NORTH SEA
8-28 JULY 1997

E J Simmonds, FRS Marine Laboratory, Aberdeen, Scotland

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. 1) was selected to cover the area in two levels of sampling intensity based on the limits of herring densities found in previous years, a transect spacing of 15 nautical miles 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 1°E and 4°W the ends of the tracks were positioned at ½ 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. 1) 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 1,350 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 weight including and excluding gonads, sex, maturity, stomach contents and macroscopic evidence of Ichthyophonus infection.

Data from the echo integrator were summed over quarter hour periods (2.5 nm at 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 four 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 and shallow herring schools above 50 m. For the 1997 survey 82% of the stock by number was attributable to the "herring traces" and 17% to the "probably herring traces" and 1% to the shallow herring schools. The third category which gave 9% of total fish was attributable to particularly to Norway pout in the south of the area and mixtures of herring and whiting north of Orkney. 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. 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 also contained large numbers of young Norway pout.

Two calibrations were carried out the transducer and cable systems used during the survey. Agreement between calibrations on the same systems was better than 0.05 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 48 fish. Lengths were recorded by 0.5 cm intervals to the nearest 0.5 cm below. The resulting weight-length relationship for herring was:

$$W = 1.48\ 10^{-3}\ L^{3.541}\ \text{g L measured in cm}$$

Survey Results

A total of 42 trawl hauls were carried out (Fig. 1), the results of these are shown in Table 1. Twenty-seven hauls with significant numbers of herring were used to define four survey sub areas (Fig. 1). The mean length keys, mean lengths, weights and target strengths for each haul and for each sub area are shown in Table 2, 3,691 otoliths were taken to establish the four age length keys. The numbers and biomass of fish by ICES statistical rectangle are shown in Figure 2. A total estimate of 8,020 million herring or 1,480 thousand tonnes was calculated for the survey area. 1,295 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 200 m. The survey was continued to 250 m depth for most of the western and northern edge between 0° and 4°W. Herring were generally found in similar water depths to 1996 however, the distributions were more dense to the west and north of Shetland and the west of Orkney and an absence of schools of big schools in the north of the area. The fish treaces were far more continuous in character and more mixed in size. Table 3 shows the numbers mean lengths weights and biomass of herring by sub area by age class.

In addition to the 8,020 million herring, approximately 694 million other fish were observed in mid water. Examination of the catch by species (Table 1) shows the difficulty of allocating this between species so this has not been attempted. The dominant part must be considered to be Norway pout. The proportions of mature 2 ring and 3 ring herring were estimated at 62% and 91% respectively. This is a lower proportion for 2 ring mature than those found in 1996 and lower again than 1995. The 3 ring fish are also a lower percentage mature than in previous years. Only four of the 3,691 herring examined for Icthyophonus were found with macroscopic signs of infection.

R/V *GO SARS* SURVEY REPORT
27 JUNE - 18 JULY 1997
INSTITUTE OF MARINE RESEARCH, BERGEN, NORWAY

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 08°00'E. Map the general hydrographical regime and monitor the standard profiles, Hanstholm-Aberdeen, Utsira - Start Point.

Participation

A L Johnsen, B Kvinge, S Myklevoll, H Myran, B V Svendsen, R Toresen (cr.l.), Ø Tangen, E Torstensen and E Øvretveit

Schedule

The survey started in Bergen, 27 June 1997. A call was made in Aberdeen on 30 June, in Haugesund on 11 July and in Lerwick, Shetland on 15 July. The survey was finished in Bergen on 18 July.

The survey started in south by doing systematic parallel transects in the east-west direction. south of 59°17'N the distance between the transects was 15 nm (the two southern transects 20 nm apart). North of 59°17'N the distance between the transects was 15 nm and 20 nm west and east of 3°E, respectively. In the northern survey area the investigations were carried out

by systematic parallel transects in the north-south direction with 20 nm as the distance between the transects.

Intercalibration

The survey included inter-ship calibrations of the echo sounders. In the first intercalibration R/V *GO Sars* met R/V *Walther Herwig III* on 1 July. The weather condition was rather rough but the intercalibration was carried out according to the plans north east of Aberdeen, and a total of 90 nm were sailed. A second intercalibration exercise was made with R/V *Scotia* on 16 July, north east of Shetland. During this calibration, 50 NM were sailed. The results from all the inter-ship calibrations will be presented at the next meeting in the Planning group for herring surveys (January 1998).

Survey Effort

Figure 3 shows the cruise track with fishing stations and the hydrographic profiles. Altogether 3,300 nm were surveyed and the total number of trawl hauls were 81, 77 pelagic and four on bottom. The number of CTD stations for temperature, salinity and density measures were 127.

Methods

The catches were sampled for species composition, by weight and numbers. Biological samples, ie length and weight compositions were taken of all species. Otholits 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 02°00'E.

The acoustic instruments applied for abundance estimation were a SIMRAD EK500 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	2,000 W
Angle sensitiv	21.9
2-Way beam angle	-21.0 dB
Sv transd gain	27.2 dB
TS transd gain	27.1 dB
3 dB beamwidth	7.0 deg
Alongship offset	0.01 deg
Athw ship offset	0.00 deg

Sounder: ES 38 B.

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, other pelagic fish, 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:

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

where L is total length.

The proportion of Baltic spring spawners and North Sea autumn spawners within each square were calculated by applying the observed stage of maturity, ie herring which appeared to have spawned this year were allocated to Baltic spring spawners. For immature herring, the observed mean vertebral counts for the age groups, in each square, were used to decide if it was North Sea autumn spawners or Baltic spring spawners. However, all 1-ringed herring were allocated to the North Sea stock (as confirmed by mean vertebral counts). To calculate the maturing part of the two stocks in each age group, the observed maturity stage for North Sea autumn spawners was applied for this stock while the maturity ogive as presented by the 1995 HAWG was applied for the Baltic spring spawners.

Results

Hydrography

The horizontal distributions of temperature at 5 m, 50 m and at bottom in the surveyed area are shown in Figure 4a-c. The surface water is characterized by summer heating with temperatures ranging from 10-16°C. The surface heating is most pronounced in the east. Here the temperatures measured at 5 m and 50 m depth were the highest measured in 1994-1997.

In the east-south east, where most of the herring were distributed, the surface temperatures were 3-4° higher than in 1996. This might explain the wide distribution of Baltic spring spawners along the Norwegian coast.

Distribution and Abundance of Herring and Sprat

Herring

The horizontal distribution of herring is shown in Figure 5. Herring was mostly found in the south eastern part of the surveyed area. Here immature 1-ringed autumn spawners were mixed with maturing (2-3 ringed) and adult Baltic spring spawners.

The registrations were very scattered in all regions and the herring were mainly found close to the surface. No "real" herring schools were detected.

For estimation, the survey area was divided in 3 sub areas based on biological caracteristics of the herring (length and age composition and maturity stage; see Table 4). The abundance by ICES statistical squares, divided in Baltic spring spawners and North Sea autumn spawners is shown in Table 5. 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 not presented in the table. The mean weights at age applied for biomass estimation are shown in Table 4. For the calculation of mean weights in mature/immature fish, herring >22 cm was considered as mature. The total estimated number of herring by age and length is shown

in Table 6. The total estimated biomass per age group and stock is also shown in this table. The total estimated biomass of North Sea herring in the area covered by the Norwegian vessel is at the same level as last year (130 v 150,000 t). The estimated spawning stock biomass was more than halved compared with last years estimate, from 115,000 t to 50,000 t. The estimated number of young individuals in the region surveyed by the Norwegian vessel has increased compared with last years estimate. The Norwegian vessel covered the same area in 1997 as in 1996.

Ichthyophonus

All herring samled during the survey were examined for the Ichthyophonus decease. Herring with macroscopic signs of infection were found in six trawl hauls (Table 7).

Sprat

Only a few individuals of sprat were caught. Very low Sa-values were allocated to sprat in square 47E8, based on trawl sample.

SURVEY REPORT RV *TRIDENS*
23 JUNE - 16 JULY 1997

Calibration - 23 July

The calibration was conducted in a small Norwegian fjord off Kristiansand harbour. The correction factor for the SV-gain was found without a problem. The calibration was accidently conducted with an input of 1,000 watt in the transceiver menu of the EK500. The calculated correction factor was 0.424, which is a factor two smaller than it would have been with an input of 2,000 watt. It was decided to run the the survey with 1000 Watt as input for Òmax powerÓ in the transceiver menu. The calibration report is presented in Table 8.

Survey - 1 - 16 July

Intercalibration

The planned participation in an intercalibration with the *Walter Herwig III* and *GO Sars* on 1 July had to be scratched owing to the bad weather. The *Tridens* was not able to arrive in time at meeting point (58°N-0°E/W) and the EK500-output was of very bad quality, caused by air bubbles under the hull mounted transducer.

Northern Most Rectangles

The survey start was delayed by one day owing to the weather. Since *Walter Herwig III* has been surveying the 45 and 46 ICES rectangles in the northern most area of *Tridens* shortly before the planned intercalibration, it was decided not to cover the 46 rectangles and to cover the 45 rectangles with half of the planned effort (the estimates for herring and sprat as given in this report, refer to the whole surface area of the 45 rectangles).

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 by the Bergen Integrator post processing system.

Ship's speed was 12-13 knots, and the survey was going on from 0400 UTC to 2100 UTC. During the hours of darkness, the survey was interrupted because results from previous surveys had shown that herring at this time of the day may rise close to the surface and may not be seen by the transducer. However, due to lack of time, in low density areas the survey was continued during dark until some kind of traces showed up.

Trial fishing was done with a 2,000 mesh pelagic trawl with a 20 mm cod end lining. This was the first year that a sonar was available on board the *Tridens*. In contrast to previous years it was therefore possible to track previously recorded schools during fishing. However, it was not always possible to track a school, partly because of the short range of the sonar (2 km) and possibly also because of lack of experience. In general the sonar was an improvement to the echo suvey performance on board *Tridens*.

Figure 6 shows the survey track and the trawl stations.

Results - Herring

Herring was found in the entire area in scattered small schools, mostly close to the bottom. Adult herring was mostly found in the eastern part. Most hauls (Table 9) contained a mixture of immature and adult herring. In the north-eastern part of the area, low amounts (0-20%) of adult herring were caught in large schools of Norway pout (haul 11, 12 and 13). In the western part of the area herring was found in small schools (red-green traces) some metres above the bottom at depths of 80-100 m, mixed with sprat. In the south (stratum G) immature herring and sprat were found at depths between 60 and 75 meters in thin, dense pillars at the bottom and in the midwater.

During scrutinizing the herring traces have been divided in "certainly herring", "probably herring" and "possibly herring". Results from the Tridens survey are presented in Tables 10 and 11 and Figures 7 and 8. These figures and tables provide best estimates after scrutinizing. They include SA-values which have been assigned to "certainly herring" and "probably herring". The minimum estimates ("certainly herring" only) and maximum estimates ("certainly " + "probably" + "possibly herring") by millions were similar.

Results - Sprat

Sprat was found mainly in the northwestern and the southwestern part of the area, as mentioned above. Sprat from the northern part of the area was smaller (8-14 cm) and contained more immatures than sprat from the southern part (8.5-15.0 cm).

In six out of eight hauls which contained sprat representative samples of 25 or 50 specimens were taken for the determination of sex and maturity. Samples for aging were not taken during the Tridens survey owing to a lack of manpower and unsufficient experience with the sampling of sprat.

Results on sprat are presented in Tables 12 and 13 and Figure 9.

SURVEY REPORT FOR RV *DANA*
2-13 JULY 1997

Bram Couperus, Ijmuiden and Jens Pedersen, Danish Institute for Fisheries Research, North Sea Centre, PO Box 101, DK-9850 Hirtshals, Denmark

Introduction

In several years Denmark has participated in the international acoustic survey of herring in the North Sea, Skagerrak and Kattegat. In the past five years Denmark has covered the North Sea east of 5°E, and between 57°N and 59°N, Skagerrak and Kattegat. The time effort of the Danish survey has decreased from 22 days in 1991 to 12 days in 1997.

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. 10). The area was split up into eight subareas (Fig. 11). The survey started in the west by doing parallel transects, 10-20 nautical miles apart in an north-south direction. In the easthern part of the survey area the transects were carried out westwards to the Swedish coast. The origin of the survey transect was selected "randomly". The track was then laid out with semi-systematic spacing.

Methods

Acoustic data was sampled using a Simrad EK400 and a Simrad EY500 38 kHz echo sounder with a towed body (type Es 38-29) and a hull mounted split-beam transducer (type Es 38), respectively. The towed body and the hull mounted transducer was 3.0 m and 6.0 m below the surface, respectively. The EK400 echo sounder operated in conjunction with a Simrad ES400 split-beam echo sounder and the ECHOANN analyzer 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 analyzer system for each nautical mile for each 1.0 m depth interval. Speed of the ship during acoustic sampling was 9-12 knots.

The hydroacoustic equipment was calibrated using a standard copper sphere of 60 mm in diameter at Bornö, Gullmarn fjord, Sweden in May 1996 and October 1997. The two calibrations were consistent.

Trawl hauls (Fig. 12) were carried out during the survey for length, age, maturity and weight of individual herring. 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 14). In conjunction with each trawl haul CTD profiles of temperature, salinity, density and fluoresecence were collected.

The fish caught in each trawl haul was sorted and analysed for species, length, age and weight. The fish were measured to the nearest 0.5 cm total length and weighed to the nearest 0.1 g wet weight. In each haul 10 herring were sampled per 0.5 cm length class of herring for separation of North Sea autumn spawners and Baltic spring spawners, and for determination of age and maturity. Micro-structure formed during the herring's larval period is retained as the central part of the adult otoliths and used to discriminate between North Sea autumn spawners and Baltic spring spawners. A total of 3,932 otoliths of herring were sampled and examined.

The acoustic data were judged for each nautical mile. Herring and sprat was not observed on depths below 150 meters. Layers below 150 meters was therefore excluded 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 cm. 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.

As the current maturity of North Sea autumn and Baltic spring spawning herring was below 10%. The spawning biomass of herring 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

Results

In 1997 the temperature of the water in the surface was characterised by summer heating with temperatures ranging from 16-21 which was 2-3°C higher than in 1995 and 1996. Below the thermocline at 20-25 metres depth the temperatures were ranging from 7-8°C which was inconsistant with the previous years.

Aproximately 1,600 nautical mile were surveyed (Fig. 10) and 37 trawl hauls were carried out (Table 14 and Fig. 12). The total catch was 21,723 kg with a mean catch of 587 kg. Approximately 55% of the catch was made up by herring as the total catch of herring was 12,019 kg and the mean catch of herring 353 kg. The catch of sprat was insignificant. The length frequency of herring for each trawl haul is given in Figure 13.

A total of 5.7*109 herring or 319,168 tonnes was estimated (Table 15). The estimated biomass of the North Sea autumn and the Baltic spring spawning herring was 195,918 and 123,249 tonnes, respectively (Table 16). The biomass by age was calculated using the estimated number of fish by age (Table 17) and the mean weight by age calculated from the length-weight relationship given in Table V. Approximately 50% of the spawning biomass was found in subarea IV-VI (Table 15).

Generally, the mean weight of herring by age was significant higher in subarea I-V than in subarea VI-IX (Table 18). Significant difference in length of herring between subareas was not found. However, herring caught within the 100 m line of depth show a tendency to be smaller than herring caught within the area of the 100-200 m lines of depth and above the 200 m line of depth (Fig. 14a-c).

In the Skagerrak and Kattegat the estimated total stock of herring was 542,059 and 394,147 tonnes in 1995 and 1996, respectively (Simmonds et al., 1996). In 1997 the total herring stock was 319,168 tonnes (Table 15), which was 41.1% and 18.9% lower than in 1995 and 1996, respectively. The spawning biomass decreased from 401,309 tonnes in 1995 to 166,202 tonnes in 1996 (Simmonds *et al.*, 1996) and 151,267 tonnes in 1997 (Table 16). The decrease in spawning biomass from 1995 to 1996 was higher for the Baltic spring spawners than for the North Sea autumn spawners (62% and 26%, respectively). However, the spawning biomass of the North Sea autumn spawners increased from 36,251 tonnes in 1996 to 55,415 tonnes in 1997, while the spawning biomass of the Baltic spring spawners decreased from 164,079 tonnes in 1996 to 99,852 tonnes in 1997. The total catch decreased from 1,050 kg in 1995 to 634 kg in 1996 and 587 kg in 1997 (Fig. 15), which also indicate a decrease in stock size as the effort was alike the three years.

Acknowledgements

I am grateful to Torben F Jensen (The Danish Institute for Fisheries Research) for invaluable help with computer calculations.

SURVEY REPORT FOR FRV *SCOTIA* IN ICES AREA VIA(N) 16 JUNE - 3 JULY 1997

D G Reid, Marine Laboratory, Aberdeen, Scotland

Methods

The acoustic survey on the Marine Laboratory Aberdeen vessel FRV *Scotia* (16 June to 3 July 1997) 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. 16) was selected to cover the area in three levels of sampling intensity based on herring densities found in 1991-96. Areas with highest intensity sampling had a transect spacing of 4.0 nautical miles, areas with medium intensity sampling had a transect spacing of 7.5 nautical miles and lower intensity areas a transect spacing of 15 nautical miles. The track layout was systematic, with a random start point. The ends of the tracks were positioned at ½ 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.

Twenty-nine trawl hauls (Fig. 17 and Table 20) 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, 5 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 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", "probably not herring traces", and two species mixture categories.

For the 1997 survey the total estimated stock was 238,460 tonnes. The spawning stock biomass (mature herring only) was estimated at 143,340 tonnes. 78.7% of the stock by number was attributable to the "herring traces" and 21.3% 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 28,010 tonnes, giving a maximum stock size of 266,470 tonnes.

As in previous years, in general, herring were generally found in waters where the seabed was deeper than 100 m, however, herring were also caught in reasonable quantities in shallower waters on two hauls (haul 223 and 252). Norway pout and blue whiting which were found commonly throughout the north of the survey area in previous years were relatively uncommon in 1997. Blue whiting were caught in large quantities on only two shoots (243 and 256), and very few pout were caught. The other commonly caught species during this survey was mackerel, which was ubiqitous in the catches outside the Minch. This has not been seen in previous years. It is possible that a significant part of the fish scored in category 3 were in fact herring and this would indicate a small underestimate of the true stock. It was not usually possible to make a definite assignment of these marks to species, and where doubt existed it was assumed that they were NOT herring. Similar difficulties were encountered in 1994 and 1995 but on a much larger scale.

Two sets of calibrations were carried out during the survey. One transducer was found to be faulty on the second calibration and was replaced. The new transducer was then also calibrated. The first transducer was calibrated at the start of the trip. The replacement was calibrated immediately, and also on the following survey in the North Sea. The integrator data were corrected for the deviations between the calibrations of the two transducers. 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:

$$W = 0.008191\ L^{3.001} \text{ g L measured in cm}$$

Survey Results

A total of 39 trawl hauls were carried out, the results of these are shown in Table 20. Twenty hauls contained more than 100 herring and these hauls were used to define 4 survey sub areas (Fig. 17). The sub-areas were defined as:

I. Minch
II. Barra Head
III. West Hebrides
IV. North VIa(N)

The stock estimate shows a considerable decrease from 1996 (397,580 to 238,460 tonnes). There was little evidence of change in distribution. The main concentrations were again between 4 and 5°W as in 1996. The fish appeared to be slightly more dispersed west of the Hebrides than in recent years. The importance of the Barra Head group continued to decline (Fig. 18).

There are also some indications of changes in the age and maturity structure of the stock (see Table 22). In 1995 66.3% of the two ringers were mature, in 1996 78.5% were mature, in 1997 37.5% were mature, although the survey was carried out one month earlier than previously. The proportion of older fish (4+) in the stock was also reduced from 55% in 1995 and 43% in 1996 to 16.6% in 1997. Combined with the reduced numbers, and the apparent reduction in numbers in the previously densely populated Barra Head area, this may indicate an increase in fishing pressure on this stock. Reports from fishermen indicate an increased tendency to genuinely fish in VIa(N), rather than simply misreport catches from IVa.

Large numbers of mackerel were found in the area of the shelf west of the Hebrides which have not been seen in previous years, these fish included both young fish and mature adults.

SURVEY REPORT FOR *WALTER HERWIG III* IN AREA IVB
23 JUNE - 16 JULY 1997
C Hammer, Instutut Fur Seefischerie, Hamburg, Germany

RV *Walter Herwig II* surveyed the area 54°30'N to 57'N, Danish coast to 2'E and a second area 58' to 59'N 4'E to 2'W. The cruise track and number of trawl hauls are shown in Figure 19. The survey results are given in Table 23, the number of herring in millions by stat square. The age structure by area is given in Table 24 and the mean weights are age in Table 25.

Combined Survey Report

Figure 20 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 1996 surveys (CM 1997/H:11). The stock estimates have been calculated by age and maturity stage for 30'N-S by °1E-W statistical rectangles for the survey area north of 52°N to the west of Scotland. The combined data gives estimates of immature and mature (spawning) herring for ICES areas VIa north, IVa, and IVb separately and parts of IIIa. The data from all areas have been split between Autumn spawners in the North Sea and West of Scotland and Baltic Stocks. Where the survey areas for individual vessels overlap the effort weighted mean estimates by age and maturity stage for each overlapping rectangle have been used. Stock estimates by number and biomass are shown in Tables 26 and 27 respectively for areas VIa north, IVa south, IVa and IVb separately. The mean weights at age are shown in Table 28. Stock estimates for Baltic herring by number and biomass are shown in Tables 29 and 30 respectively. The mean weights at age are for Baltic herring are shown in Table 31. Figure 21 shows the distribution of abundance (numbers and biomass) of mature autumn spawning herring for all areas surveyed. Figure 22 shows the distribution split by age of 1 ring, 2 ring and 3 ring and older herring. Estimates of "0" group have been omitted in all plots. Figure 23 shows the density distribution of numbers of adult autumn spawning herring as a contour plot and Figure 24 shows the same distribution for all 1 ring and older.

Ichthyophonus Infection

The numbers of fish with ichthyophonus was limited to four fish from *Scotia* and 0 from *Tridens* and 11 from *GO Sars*.

References

Anon. 1993. Herring assessment working group for the area south of 62°N. ICES CM 1993/Assess:15.

Anon. 1994. Report of the planning group for herring surveys. ICES CM 1994/H:3.

Anon. 1995. Report of the Herring assessment working group for the area south of 62°N. ICES CM 1995/Assess:13.

Degnbol, P., Jensen, T. F., Lundgren, B. and Vinther, M. 1990. ECHOANN - An analyser for echosounder signals. ICES CM 1990/B:10.

Simmonds, E.J., Toresen, R., Corten, A., Pedersen, J., Reid, D.G., Fernandes, P.G. and Hammer, C. 1996. 1995 ICES coordinated acoustic survey of ICES divisions IVa, IVb, VIa and VIIb. ICES CM 1996/H:8.

TABLE 1

Scotia 8 -28 July 1997, date time position and numbers of fish caught by trawl haul

Haul summary			Position		Depth	Estimated raised numbers													
Haul	Date	Time	Latitude	Longitude		Her	Mac	Sprat	Npo	Blw	A..sl	A..spy	Had	Whi	Saithe	Lum	Gur	Nha	Scad	Hake
259	9/7/97	8:0	58°39.9N	002°30.99W	67															
260	9/7/97	10:33	58°40.04N	002°21.27W	73				356				3							
261	9/7/97	16:40	58°42.13N	001°04.06W	119	6			37				9	6						
262	10/7/97	15:50	58°54.87N	000°22.96E	140	82	1		7				2							
263	10/7/97	19:0	58°55.13N	000°04.03W	110	49	2		473				1							
264	11/7/97	5:0	58°55.03N	001°23.50W	115	8660														
265	12/7/97	10:37	59°13.4N	000°45.34E	130	814			657				10	18	3	2				
266	12/7/97	15:40	59°23N	000°28.53E	70		2						5	11						
267	13/7/97	5:5	59°25.03N	001°44.50W	90															
268	13/7/97	11:40	59°40.1N	001°36.62W	90	9														
269	13/7/97	15:5	59°40.01N	001°05.51W	120	3078			686		2		101	242			20			
270	14/7/97	10:0	59°54.9N	000°10.18E	146	3200	42		118				6							
271	14/7/97	15:20	59°55N	000°44.56W	120	18	1		249			1	1	9			1	1		
272	14/7/97	18:50	59°54.12N	001°01.40W	100	149														
273	15/7/97	5:30	60°3.13N	000°06.18W	135	7			32				4	2						
274	15/7/97	11:18	60°18.04N	000°13.44E	114	1497			10621				2	76						
275	15/7/97	14:20	60°17.86N	000°39.27W	100				1143											
276	15/7/97	19:0	60°9.9N	000°31.19W	120	58200														
277	16/7/97	21:20	60°33N	000°22.00E	140	1670														
278	17/7/97	10:33	60°47.96N	000°00.16E	138	4710														
279	17/7/97	14:5	60°47.81N	000°36.22W	100	29	1	1	253					15						
280	18/7/97	8:55	60°56.57N	001°19.50E	153															
281	18/7/97	14:25	60°54.94N	000°03.20W	150	46000														
282	18/7/97	18:0	60°55.54N	000°20.63W	125	2948														
283	20/7/97	14:40	60°28.64N	000°35.26W	140	169	1	2	132			1	1							
284	20/7/97	21:15	61°9.92N	000°31.97W	150	1703														
285	21/7/97	13:0	61°26.78N	000°44.96E	170	6			6	47			1		4				9	
286	21/7/97	18:20	61°39.82N	000°08.87E	200															
287	22/7/97	8:55	61°8.32N	001°05.31W	138															
288	22/7/97	19:10	60°39.99N	002°22.72W	140	753							1							
289	23/7/97	6:0	60°47.87N	001°08.94W	90	994	7													
290	23/7/97	12:15	60°32.77N	002°10.59W	130	118			33											
291	23/7/97	15:20	60°32.8N	001°45.42W	90	14960														
292	23/7/97	19:5	60°25.16N	001°54.96W	110	6420	15		75											
293	24/7/97	7:0	60°10.94N	003°40.17W	129	669	18		3	450										
294	24/7/97	19:30	60°18.66N	002°38.45W	170	2395	10		15				5	5						
295	25/7/97	8:0	59°55.5N	001°39.22W	104	544	16							3142						
296	25/7/97	11:13	59°55.01N	002°16.61W	105	56	4		10816											
297	25/7/97	17:15	59°55.02N	003°42.21W	140	5393											40			
298	25/7/97	21:50	59°48.09N	004°01.74W	110	155	164										8			1
299	26/7/97	5:15	59°47.99N	003°23.15W	70															
300	26/7/97	9:15	59°32.9N	003°35.91W	153	1945	20													
301	26/7/97	11:45	59°33N	003°51.09W	159	4910											30			
302	27/7/97	4:30	59°25.71N	003°27.47W	100	*ca* 46000+														

Her - Herring; Mac - Mackerel; Npo - Norway pout; Blw - Blue whiting; A.si - *A. silus*; A.spy - *A. spyraena*; Had - Haddock; Whi - Whiting; Lum - Lumpsucker; Gur - Gurnard; Nha - N haddock

TABLE 2

Percentage length composition, mean weight and target strength by haul and sub area

Length/ haul	278	281	284	288	289	293	294	297	298	301	mean	262	263	265	269	270	272	274	276	277	282	283	290	291	292	mean	264	295	mean	300	mean
18.0																															
18.5																															
19.0																						0.6				0.0					
19.5																															
20.0		0.2									0.0										0.3	0.6				0.1	2.1	0.7	1.4		
20.5																0.4					0.8					0.1	13.9	1.0	7.4		
21.0															1.2	1.4		0.6	0.2	0.3	0.5	2.4		0.4	0.2	0.5	22.6	10.0	16.3		
21.5	0.2				0.5						0.1			0.2	3.0	4.8	0.7	0.8	0.9	0.3	1.8	3.5		0.4	0.9	1.2	22.6	19.6	21.1		
22.0	0.2	0.2			1.2						0.2		2.0	0.7	4.2	8.9	2.7	2.2	5.7	0.8	3.3	2.9		1.6	1.2	2.6	14.1	27.9	21.0		
22.5	0.2				1.2						0.1			0.9	7.4	6.9	2.0	2.2	7.9	0.5	4.8	5.3	1.7	1.6	1.2	3.0	5.1	21.8	13.4		
23.0	0.4	0.2		0.2	0.7					0.2	0.2	1.2		2.0	9.2	6.0	5.4	4.6	9.3	1.9	4.3	4.7	0.8	3.6	5.6	4.2	4.2	13.7	8.9	0.8	0.8
23.5	0.4			0.2	1.2						0.2	1.2	8.2	1.5	11.4	4.0	6.0	4.8	6.2	2.2	4.1	4.1		4.5	10.5	4.9	3.2	4.9	4.1	2.1	2.1
24.0	0.2	0.7		0.6	0.9					0.2	0.3	7.3		7.2	11.7	6.5	16.8	5.2	10.5	4.9	7.9	11.2	1.7	3.7	9.8	7.4	2.5		1.3	1.5	1.5
24.5	0.4	0.7		0.8	0.9				0.6		0.3	9.8	16.3	14.7	14.7	8.1	16.1	12.2	11.3	8.1	11.2	11.2	3.4	2.9	11.0	10.8	2.5	0.2	1.4	6.7	6.7
25.0	1.3	2.0		2.0	2.3				3.9	0.4	1.2	9.8	20.4	19.7	12.2	9.1	20.8	12.4	11.9	12.7	11.5	8.8	12.7	7.0	15.2	13.1	3.5		1.7	11.6	11.6
25.5	2.5	2.0		2.4	3.3		0.4		1.9	1.4	1.4	20.7	14.3	12.5	8.2	6.4	13.4	12.2	10.7	12.4	10.2	9.4	12.7	11.1	14.3	12.0	2.5		1.3	15.7	15.7
26.0	7.4	2.6		1.2	7.3			0.5	0.6	2.0	2.2	8.5	10.2	10.3	4.2	6.9	7.4	11.4	8.4	13.2	9.4	4.1	5.1	13.9	9.8	8.8	0.5		0.2	18.3	18.3
26.5	9.3	2.0	0.5	4.8	7.0		0.8	0.7	5.2	1.2	3.2	6.1	6.1	5.3	2.5	5.4	5.4	6.4	3.4	8.9	6.9	4.1	12.7	10.0	4.9	6.3	0.5		0.2	10.5	10.5
27.0	10.8	6.3	1.4	5.6	8.7	0.2	1.7	2.0	18.1	9.2	6.4	7.3	8.2	5.3	2.7	3.4		5.2	3.3	12.9	8.1	4.1	14.4	12.1	6.3	6.7				9.8	9.8
27.5	11.0	7.6	2.5	9.0	10.6	0.4	1.7	4.0	16.8	14.1	7.8	7.3	6.1	5.2	0.6	3.0	1.3	3.8	0.9	6.7	1.8	3.5	10.2	7.7	2.8	4.3				5.7	5.7
28.0	13.2	15.2	9.0	7.6	12.2	0.7	7.9	7.7	12.9	17.7	10.4	4.9	6.1	5.3	1.3	3.0	1.3	4.2	2.2	2.4	2.0	4.1	6.8	5.9	1.9	3.7	0.2		0.1	3.6	3.6
28.5	10.8	11.5	15.6	10.2	8.7	5.8	9.6	11.9	12.9	15.5	11.3	2.4		2.0	0.9	2.6	0.7	3.0	1.9	2.4	1.5	0.6	3.4	4.1	1.4	1.9				3.9	3.9
29.0	10.8	13.7	21.9	13.5	7.0	13.7	15.7	16.9	9.7	12.4	13.5	4.9		2.2	0.7	3.0		1.8	1.4	2.7	3.3	2.4	4.2	2.3	0.2	2.1				1.8	1.8
29.5	6.8	9.6	15.6	12.2	7.0	15.5	15.2	15.6	8.4	9.8	11.6	6.1	2.0	1.5	0.9	3.4		1.8	1.4	2.7	2.0	2.4	2.5	1.2	0.9	2.1				2.3	2.3
30.0	7.2	8.3	12.1	9.2	5.2	16.8	16.1	15.6	2.6	6.1	9.9	1.2		0.9	0.7	4.0		3.0	1.5	1.6	0.8	4.1	1.7	2.9	0.2	1.6				0.8	0.8
30.5	3.2	6.3	8.5	7.8	4.2	12.3	10.2	6.2	3.2	4.9	6.7			0.7	0.7	1.0		1.2	0.5	0.8	0.5	2.4	2.5	1.4	0.7	0.9				2.3	2.3
31.0	0.8	4.3	6.3	4.4	4.9	11.7	7.3	7.7	1.3	1.4	5.0			1.3	0.7	1.0		0.8	0.5	0.5	1.8	1.8	0.8	0.9	0.7	0.8				1.0	1.0
31.5	0.8	3.0	3.0	3.6	1.9	8.1	4.8	4.2	1.3	1.2	3.2			0.2	0.6	0.3			0.2	0.3	0.3	1.8	1.7	0.5	0.2	0.4				0.3	0.3
32.0	1.3	1.3	1.4	1.6	1.4	4.0	2.9	3.7	0.6	0.4	1.9	1.2			0.4	0.3				0.3	0.5		0.8	0.2		0.3				0.8	0.8
32.5	0.4	1.3	0.8	1.0	0.7	3.8	1.9	0.7		0.8	1.2					0.3					0.3					0.0				0.5	0.5
33.0		0.7	0.5	1.2	0.5	3.4	0.6	1.5		0.8	0.9			0.2		0.3				0.3						0.1					

Length/ haul	278	281	284	288	289	293	294	297	298	301	mean	262	263	265	269	270	272	274	276	277	282	283	290	291	292	mean	264	295	mean	300	mean
33.5		0.2	0.3	0.6	0.2	2.7	1.9	0.5			0.6													0.2		0.0					
34.0			0.3	0.4	0.2	0.7	0.6	0.2			0.2									0.3				0.2		0.0				0.3	0.3
34.5			0.3	0.2		0.2	0.2				0.1																			
35.0							0.2	0.2		0.2	0.1																			
35.5		0.2									0.0										0.3					0.0				
36.0																														
36.5							0.2				0.0																			
Number	471	460	365	502	426	446	479	403	155	491		82	49	543	1399	800	149	499	582	371	393	170	118	561	428		433	408		389	
Mean length	28.5	29.2	29.9	29.4	28.4	30.9	30.3	30.1	28.5	29.0	29.4	26.8	26.1	26.3	25.0	25.7	25.2	26.2	25.3	26.7	25.9	25.9	27.3	26.8	25.7	26.1	22.4	22.6	22.5	26.9	26.9
Mean weight	212	232	251	237	213	281	262	256	212	225	238	172	156	161	136	153	137	159	142	169	155	157	184	173	148	157	91	93	92	175	175
TS/ individ-ual	-42.1	-41.9	-41.7	-41.8	-42.1	-41.4	-41.6	-41.6	-42.1	-41.9	-41.8	-42.6	-42.9	-42.8	-43.2	-43.0	-43.2	-42.8	-43.1	-42.7	-42.9	-42.9	-42.5	-42.6	-43.0	-42.9	-44.2	-44.1	-44.1	-42.6	-42.6
TS/kg	-35.4	-35.5	-35.7	-35.6	-35.4	-35.9	-35.8	-35.7	-35.4	-35.5	-35.6	-35.0	-34.8	-34.9	-34.5	-34.8	-34.5	-34.8	-34.6	-34.9	-34.8	-34.8	-35.1	-35.0	-34.7	-34.8	-33.8	-33.8	-33.8	-35.0	-35.0

TABLE 3

Number*10^{-6}, Mean weight (g), mean length (cm), biomasstonnes*10^{3} of herring by area *Scotia* 8-28July

	Numbers	Length	Weight	Biomass
Area I				
1A	1.23	21.75	87.39	0.11
2I	46.90	24.38	131.76	6.18
2M	211.32	26.45	173.38	36.64
3I	16.72	26.93	188.94	3.16
3M	784.84	28.04	212.16	166.51
4A	925.20	29.21	244.37	226.09
5A	383.57	30.15	272.97	104.71
6A	114.61	30.62	288.05	33.01
7A	24.67	30.82	295.86	7.30
8A	54.18	30.59	288.54	15.63
9+	122.77	31.74	328.25	40.30
Total	2686.02	28.90	238.14	639.64
Area II				
1A	15.74	21.50	84.64	1.33
2I	587.20	23.57	116.69	68.52
2M	866.92	25.34	149.40	129.52
3I	134.10	24.94	141.23	18.94
3M	430.46	26.64	178.24	76.73
4A	235.08	28.14	216.47	50.89
5A	69.28	29.75	261.60	18.12
6A	17.32	29.45	251.90	4.36
7A	6.14	29.88	265.15	1.63
8A	2.83	31.25	309.06	0.87
9+	6.22	31.58	322.97	2.01
Total	2371.29	25.56	157.27	372.93
Area III				
1A	137.19	21.09	78.70	10.80
2I	411.73	21.96	90.65	37.32
2M	71.22	23.74	119.66	8.52
3I	1.85	24.98	141.31	0.26
3M	2.41	26.00	164.31	0.40
4A	0.00			0.00
5A	0.00			0.00
6A	0.00			0.00
7A	0.00			0.00
8A	0.00			0.00
9+	0.00			0.00
Total	624.39	21.99	91.77	57.30
Area IV				
1A	0.00			0.00
2I	257.87	24.75	137.88	35.55
2M	1203.98	25.74	157.35	189.45
3I	15.63	24.50	131.94	2.06
3M	558.31	26.96	185.04	103.31
4A	168.56	29.16	242.99	40.96
5A	71.58	30.18	273.65	19.59
6A	19.23	29.38	249.94	4.81
7A	6.01	30.50	282.60	1.70
8A	6.01	32.00	334.07	2.01
9+	31.06	31.90	334.58	10.39
Total	2338.24	26.44	175.27	409.82
Total Area				
1A	154.16	21.10	79.37	12.24
2I	1303.70	22.68	113.20	147.58
2M	2353.44	25.45	154.72	364.13
3I	168.30	25.07	145.11	24.42
3M	1776.02	27.32	195.35	346.95
4A	1328.83	29.00	232.26	317.94
5A	524.44	30.09	271.54	142.42
6A	151.16	30.30	279.06	42.18
7A	36.82	30.59	288.57	10.63
8A	63.02	30.78	293.81	18.52
9+	160.05	31.77	329.27	52.70
Total	8019.95	25.72	184.50	1479.70

TABLE 4

Estimated number of herring (10^6) in ICES stat squares divided in stocks and age groups. RV *GO Sars*, 27June - 18July 1997

1	2I	2M	3I	3M	4M	5M	6	7	8	9+	Total
43F0North Sea Autumn Spawner											
5.00	3.45	1.55		0.00	0.00	0.00					10.00
43F1North Sea Autumn Spawner											
2.00	2.76	1.24		1.00	0.00	0.00					7.00
43F5North Sea Autumn Spawner											
279.00	148.80	37.20									465.00
43F5Baltic Spring Spawner											
			35.70	66.30	12.00	2.00	1.00	3.00	5.00	0.00	125.00
43F6North Sea Autumn Spawner											
21.00	9.60	2.40									33.00
43F6Baltic Spring Spawner											
			2.80	5.20	1.00	0.00	0.00	0.00	0.00	0.00	9.00
43F7North Sea Autumn Spawner											
74.00	45.60	11.40									131.00
43F7Baltic Spring Spawner											
			9.45	17.55	4.00	0.00	0.00	0.00	0.00	0.00	31.00
44F1North Sea Autumn Spawner											
6.00	0.43	0.57		2.00	0.00						9.00
44F2North Sea Autumn Spawner											
2.00	4.00	1.00	1.75	3.25	0.00						12.00
44F3North Sea Autumn Spawner											
21.00											21.00
44F3Baltic Spring Spawner											
	13.60	3.40	4.20	7.80	2.00	0.00	0.00	0.00	0.00	0.00	31.00
44F4North Sea Autumn Spawner											
57.00	17.60	4.40									79.00
44F4Baltic Spring Spawner											
			5.95	11.05	6.00	3.00	0.00	1.00	0.00	0.00	27.00
44F5North Sea Autumn Spawner											
100.00											100.00
44F5Baltic Spring Spawner											
	94.40	23.60	27.65	51.35	13.00	5.00	7.00	2.00	1.00	0.00	225.00
44F6North Sea Autumn Spawner											
49.00											49.00
44F6Baltic Spring Spawner											
	68.80	17.20	22.75	42.25	12.00	3.00	8.00	1.00	0.00	0.00	175.00
44F7North Sea Autumn Spawner											
131.00											131.00

1	2I	2M	3I	3M	4M	5M	6	7	8	9+	Total
44F7Baltic Spring Spawner											
	91.20	22.80	18.20	33.80	13.00	4.00	7.00	0.00	0.00	0.00	190.00
45F1North Sea Autumn Spawner											
3.00	0.00	0.00									3.00
45F2North Sea Autumn Spawner											
9.00	6.40	1.60									17.00
45F2Baltic Spring Spawner											
			5.25	9.75	2.00	0.00	0.00	0.00	0.00	0.00	17.00
45F3North Sea Autumn Spawner											
12.00											12.00
45F3Baltic Spring Spawner											
	16.80	4.20	10.15	18.85	4.00	1.00	1.00	0.00	0.00	0.00	56.00
45F4North Sea Autumn Spawner											
97.00	70.40	17.60									185.00
45F4Baltic Spring Spawner											
			29.75	55.25	23.00	9.00	4.00	3.00	5.00	0.00	129.00
45F5North Sea Autumn Spawner											
25.00											25.00
45F5Baltic Spring Spawner											
	27.20	6.80	11.55	21.45	10.00	6.00	7.00	1.00	1.00	0.00	92.00
45F6North Sea Autumn Spawner											
6.00											6.00
45F6Baltic Spring Spawner											
	13.60	3.40	5.25	9.75	2.00	1.00	0.00	0.00	0.00	0.00	35.00
46F1North Sea Autumn Spawner											
59.00	10.40	2.60	0.00								72.00
46F2North Sea Autumn Spawner											
0.00											0.00
46F2Baltic Spring Spawner											
	3.20	0.20	3.50	6.50	1.00						14.40
46F3North Sea Autumn Spawner											
6.00											6.00
46F3Baltic Spring Spawner											
	14.40	3.60	10.15	18.85	3.00	0.00	3.00	0.00	0.00	0.00	53.00
46F4North Sea Autumn Spawner											
56.00											56.00
46F4Baltic Spring Spawner											
	60.80	15.20	17.50	32.50	9.00	4.00	7.00	1.00	0.00	0.00	147.00
46F5North Sea Autumn Spawner											
9.00											9.00
46F5Baltic Spring Spawner											
	11.20	2.80	2.80	5.20	0.00	1.00	0.00	0.00	0.00	0.00	23.00

1	2I	2M	3I	3M	4M	5M	6	7	8	9+	Total
47E7North Sea Autumn Spawner											
9.00	13.60	3.40		2.00	0.00						28.00
47E8North Sea Autumn Spawner											
33.00	52.80	13.20		8.00	2.00						109.00
47E9North Sea Autumn Spawner											
3.00	4.00	1.00		1.00							9.00
47F0North Sea Autumn Spawner											
11.00	2.07	0.93	0.00	0.00	0.00						14.00
47F2North Sea Autumn Spawner											
0.00	0.00	0.00	0.00	3.00	0.00						3.00
47F3North Sea Autumn Spawner											
16.00	6.46	10.54		27.00	12.00	3.00	1.00	2.00	2.00	0.00	80.00
47F4North Sea Autumn Spawner											
19.00	18.40	4.60									42.00
47F4Baltic Spring Spawner											
			10.15	18.85	9.00	3.00	1.00	2.00	0.00	0.00	44.00
48F2North Sea Autumn Spawner											
1.00	0.00	0.00	1.05	1.95	2.00						6.00
48F3North Sea Autumn Spawner											
11.00	2.56	5.44	0.00	19.00	13.00	3.00	1.00	2.00	2.00	0.00	59.00
48F4North Sea Autumn Spawner											
1.00	0.00	0.00	0.00	2.00	1.00	0.00	0.00	0.00	0.00	0.00	4.00
49F3North Sea Autumn Spawner											
6.00	3.20	6.80	0.00	17.00	7.00	2.00	1.00	1.00	1.00		45.00
49F4North Sea Autumn Spawner											
13.00	5.44	11.56	0.00	31.00	12.00	4.00	1.00	2.00	2.00		82.00
North Sea Autumn Spawner											
1152.00	427.97	139.03	2.80	118.20	49.00	12.00	4.00	7.00	7.00	0.00	1919.00
Baltic Spring Spawner											
0.00	415.20	103.20	232.75	432.25	126.00	42.00	46.00	14.00	12.00	0.00	1423.40

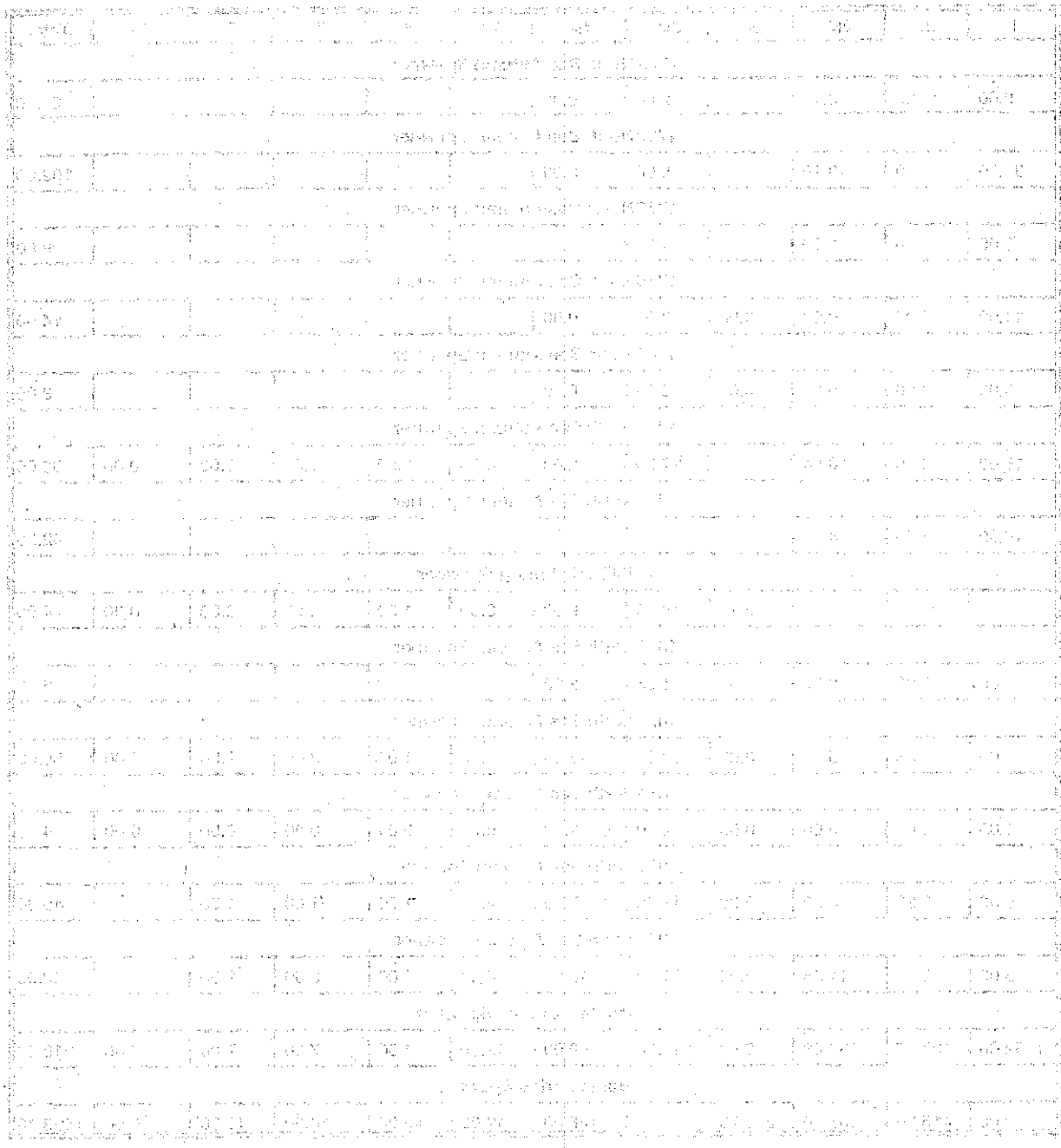


TABLE 5

Weight at age (g) for age groups and mature/immature fish in subareas. RV *GO Sars*, 27June - 18July 1997

1	2I	2M	3I	3M	4	5	6	7	8	9+	Total
Area 1											
60.1	74.4	127.3		140.8	179.8	206.5	239.6	214.0	213.0		105.9
Area 2											
53.6	76.0	123.7	84.9	135.4	169.7	201.8	213.5	219.4	218.5	117.0	101.3
Area 3											
66.3	75.6	120.1	81.6	124.3	144.5	181.1	161.6	200.4	207.8		105.9

Area 1: 43F0, 43F1, 44F1, 44F2, 45F1, 46F1, 47E7, 47E8, 47E9, 47F0, 47F2, 47F3, 48F2, 48F3, 48F4, 49F3, 49F4
Area 2: 43F5, 43F6, 43F7, 44F4, 45F2, 45F4, 46F2, 47F4
Area 3: 44F3, 44F5, 44F6, 44F7, 45F3, 45F5, 45F6, 46F3, 46F4, 46F5

TABLE 6

Estimated number and biomass of herring divided in age and length groups. Totals also divided in stocks. RV *GO Sars* 27June-18July 1997

Length (cm)	Age groups										
	1	2	3	4	5	6	7	8	9+	N (mill)	Ton (10^3)
16.0-16.9	13									13	0.4
17.0-17.9	179	26								205	8.4
18.0-18.9	355	95								450	22.9
19.0-19.9	284	88								372	22.7
20.0-20.9	176	96	10	1						283	19.9
21.0-21.9	109	238	15							362	29.0
22.0-22.9	29	208	60	4						301	27.0
23.0-23.9	4	177	128	8		6				323	33.8
24.0-24.9	3	88	201	23	1		2			318	37.0
25.0-25.9		57	172	19	3	8				259	35.1
26.0-26.9		13	113	24	7	5		1		163	24.8
27.0-27.9		1	67	30	9	8				115	20.1
28.0-28.9			16	36	26	4		3		85	17.0
29.0-29.9			4	20	4	9	11	4		52	10.8
30.0-30.9				10	5	5		2		22	5.2
31.0-31.9							1	4		5	1.2
32.0-32.9						5	4			9	2.7
N (mill)	1152	1087	786	175	55	50	18	14	0		318.0
NS herring	68.2	49.8	16.9	8.8	2.5	1.0	1.5	1.5	0		
Baltic spr	0.0	43.8	75.2	19.7	8.0	7.7	3.0	2.6	0		
								NS herring			150.2
								Baltic spr			160.0
								SSB, NS herring			49.3

TABLE 7: Herring infected with Ichtyhophonus. RV *GO Sars* 27June-18July 1997

Trawl st	Total no	Infected	Length	Maturity	Vertebrae	Age
349	100	1	23.5	2	56	2
358	36	1	23.5	2	57	2
370	50	2	28.0	3	57	4
			26.5	3	56	4
373	100	2	29.0	3	57	4
			26.5	3	56	
380	6	1	22.0			
382	5	4	29.5	8		5
			29.5	3		5
			29.0	3		3
			29.5	3		5

TABLE 8

Calibration *Tridens*

Date and time: 23 June 1997, 0800-1200 UTC	Position: off Kristiaansand harbour 58°08.13'N 007°.58.57'E
Bottom depth: 30 m	Wind: 5 BF (but in the shelter)
Salinity: 35‰	Wave height: 0.1 m
Water temperature: 14.0°C	Transducer: 38 kHz

Transceiver menu before calibration

Pulse length: medium	Bandwidth: wide
Max power: 1,000 W	Angle sensitivity: 21.9
2-way beam angle: -20.6	Sv transducer gain: 26.5
TS transducer gain: -26.5	3 dB beam width: 7.1
Alongship offset: ?	athw ship offset: ?
Ping interval: 1.0	Transmitter power: normal

Standard target:	Copper sphere, -33.6 dB
Distance transducer - target:	20.75
TS values measured:	-30.6
New transducer gain:	28.0
New TS values measured:	-33.6
SA values measured:	12588 (n=10)
SA value calculated:	5347
New Sv transducer gain:	28.4
INew SA values measured:	5343 (n=14)

TABLE 9

Length distributions herring *Tridens* 1-16July 1997

Length	Haul 1	Haul 2	Haul 3	Haul 4	Haul 5	Haul 6	Haul 7	Haul 8	Haul 9	Haul 10	Haul 11	Haul 12	Haul 13	Haul 14	Haul 15	Haul 17	Haul 18	Haul 19	Haul 20	Haul 21
13.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14.5	0	0	0	0	0	0	0	0	0	0	0	0	0.83	0	0	0	0	0	1.32	0
15	0	0	0	0	0	5.41	0	0	1.49	0	0	0	11.67	0	0	0	0	0	9.21	0
15.5	0	0.55	0	0	0.61	5.41	0	0	2.24	0	0	0	12.5	0	0	0	0	0	11.84	0.44
16	0	2.19	0	0	0.61	24.32	0	0.85	17.16	0	0	0	17.5	0	0	0	0	0	15.79	2.2
16.5	0	3.83	0	0	0.61	18.92	0	2.12	23.88	0	0	0	9.17	0	0	0	0	0	5.26	4.41
17	0	5.46	0	0	5.49	27.03	0	4.24	22.39	1.57	2.27	0	10.83	0	0	0	0	0	5.26	5.29
17.5	0.74	3.83	0	0	9.15	10.81	0.62	3.81	15.67	2.09	3.41	1.22	8.33	0	0	0	0	0.71	1.32	5.73
18	0.74	9.84	0.7	1.05	12.8	2.7	1.23	3.81	10.45	3.14	4.55	6.71	5.83	0	0	0.45	0	0	2.63	11.01
18.5	0	15.3	1.41	0	8.54	0	3.7	3.39	2.24	6.81	3.41	5.49	2.5	0	0	7.73	0	0	2.63	10.13
19	0.74	28.42	1.41	2.11	11.59	0	3.09	1.27	1.49	16.23	5.11	7.32	3.33	2.8	0	14.55	0	0.71	0	14.98
19.5	1.47	15.85	4.23	0	8.54	2.7	0	2.97	1.49	26.7	3.98	6.71	0.83	4.67	0	21.36	0	4.29	2.63	15.42
20	2.21	11.48	4.23	3.16	10.98	0	0.62	5.08	0.75	20.94	3.98	7.93	6.67	1.8	7	16.82	0	7.86	2.63	12.78
20.5	2.21	2.73	7.75	2.11	9.76	0	2.47	2.54	0	9.42	7.39	6.1	1.67	2.8	1	7.27	0	12.14	1.32	7.93
21	7.35	0.55	7.75	4.21	7.93	0	1.23	3.81	0	6.28	5.68	6.1	5	9.35	6	0.82	0	21.43	1.32	3.52
21.5	2.21	0	4.93	6.32	1.83	0	3.7	2.54	0	1.57	4.55	8.54	1.67	3.74	3	0.18	0	22.14	2.63	3.08
22	4.41	0	4.23	11.58	1.22	2.7	8.02	4.66	0.75	1.05	7.39	3.66	0	6.54	0	2.27	1.96	9.29	0	1.32
22.5	7.35	0	6.34	6.32	1.22	0	8.64	0.85	0	0	4.55	3.05	0	7.48	1	0.36	5.88	4.29	0	1.76
23	2.21	0	8.45	6.32	3.66	0	8.02	5.51	0	1.05	3.41	4.27	0	10.28	0	0.91	1.96	2.86	0	0
23.5	8.82	0	4.93	5.26	0.61	0	3.09	1.69	0	0	6.82	1.83	0	2.8	0	0.91	3.92	4.29	0	0
24	8.82	0	5.63	16.84	0	0	8.64	7.2	0	0.52	5.68	5.49	0	9.35	0	0	7.84	3.57	3.95	0
24.5	12.5	0	5.63	8.42	0.61	0	5.56	7.63	0	0	2.84	3.05	0.83	7.48	0	1.82	13.73	1.43	0	0
25	11.03	0	10.56	11.58	1.22	0	15.43	13.14	0	0.52	11.36	8.54	0	0	11.21	0.91	17.65	1.43	1.32	0
25.5	11.03	0	7.04	9.47	1.22	0	8.02	6.78	0	0	5.68	2.44	0	6.54	0	0	15.69	2.86	9.21	0

Length	Haul 1	Haul 2	Haul 3	Haul 4	Haul 5	Haul 6	Haul 7	Haul 8	Haul 9	Haul 10	Haul 11	Haul 12	Haul 13	Haul 14	Haul 15	Haul 17	Haul 18	Haul 19	Haul 20	Haul 21
26	3.68	0	6.34	3.16	0.61	0	2.47	6.36	0	1.05	2.27	4.27	0	2.8	0	0.91	17.65	0	13.16	0
26.5	3.68	0	3.52	1.05	0	0	5.56	2.54	0	0	1.14	2.44	0	1.87	0	0.45	1.96	0	0	0
27	1.47	0	1.41	0	0	0	3.09	2.97	0	0	2.27	1.22	0.83	4.67	0	0.91	7.84	0	2.63	0
27.5	0.74	0	2.11	0	0	0	2.47	1.27	0	0.52	1.14	0.61	0	1.87	0	0.45	0	0	3.95	0
28	1.47	0	1.41	0	0.61	0	2.47	0	0	0	0.57	1.22	0	0.93	0	0	0	0.71	0	0
28.5	1.47	0	0	0	0	0	1.23	0.42	0	0	0.57	0	0	0	0	0.45	1.96	0	0	0
29	1.47	0	0	1.05	0	0	0	0.42	0	0	0	0.61	0	0	0	0.45	1.96	0	0	0
29.5	1.47	0	0	0	0	0	0	0.42	0	0.52	0	1.22	0	0	0	0	0	0	0	0
30	0.74	0	0	0	0.61	0	0.62	0.85	0	0	0	0	0	0.93	0	0	0	0	0	0
30.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0.85	0	0	0	0	0	0	0	0	0	0	0	0
31.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Length	24	18.72	23.16	23.37	19.63	16.76	23.76	22.75	16.99	19.82	22.18	21	94	17.24	23.39	20.35	25.14	21.58	19.88	19.03
TS	-43.51	-45.64	-43.81	-43.73	-45.23	-46.59	-43.59	-43.97	-46.47	-45.15		-44.18	-44.28	-46.34	-43.73	-44.92	-43.11	-44.42	-45.12	-45.5
Weight	132.15	49.2	111.34	110.19	59.8	32.4	109.9	102.5	36.6	62.8	90.4	0	86.6	40	88.8	72.6	125.5	79.3	68.4	54.8

TABLE 10

Summarised results all sampling areas. *Tridens* 1July - 16July 1997 numbers in millions

	95im	94im	94ad	93im	93ad	92	91	90	89	88	87	86	85	Totals
A	375.2	26.5	25.4	0	3.5	0.9	0	0	0	0	0	0	0	431.5
B	99.6	115.2	474.2	0	261.8	39.8	3.8	8	0	0	0	0	0	1002.4
C	119.8	15.5	22.3	0	4.9	1.4	0.4	0	0	0	0	0	0	164.3
D	148.2	152.3	234.1	0	212.4	25.4	18.4	5.4	0	0	0	0	0	796.2
E	531.3	16.1	53.9	0	22.7	0	0	0	0	0	0	0	0	623.9
F	185.2	46.3	519.4	0	260.7	24	3.7	10.3	0	0	0	0	0	1049.6
G	394.7	22.5	9.9	0	27.1	0	30.5	23.7	0	6.8	0	0	0	515.2
Totals	1853.9	394.4	1339.1	0	793.1	91.5	56.8	47.4	0	6.8	0	0	0	4583.1

TABLE 11

Summary of all sample areas. *Tridens* 1July - 16July 1997 biomass in thousands of tonnes

A	17.3	1.4	2.3	0	0.5	0.2	0	0	0	0	0	0	0	21.8
B	6.3	7.9	51	0	36.5	7.3	0.7	1.8	0	0	0	0	0	111.5
C	4.9	1.1	2.6	0	0.8	0.2	0.1	0	0	0	0	0	0	9.6
D	8.2	9.3	22.4	0	25.4	4	3.4	0.9	0	0	0	0	0	73.5
E	33.1	0.9	6.2	0	2.8	0	0	0	0	0	0	0	0	42.9
F	11.7	3.3	54.4	0	33.1	4.2	0.6	1.9	0	0	0	0	0	109.2
G	18.1	1.3	0.6	0	3.3	0	4	3.2	0	1	0	0	0	31.4
Totals	99.6	25.2	139.6	0	102.2	15.9	8.7	7.8	0	1	0	0	0	400

TABLE 12

Length distribution sprat. *Tridens* 1-16 July 1997

Length	Haul 1	Haul 2	Haul 5	Haul 6	Haul 9	Haul 14	Haul 20	Haul 21
6.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.0	0.00	0.00	0.00	3.67	0.00	0.00	0.00	0.00
8.5	0.00	0.00	0.00	11.01	0.00	0.00	1.67	0.00
9.0	0.00	0.00	0.00	33.94	7.25	1.69	10.00	0.00
9.5	0.00	0.00	0.00	30.28	17.39	8.47	10.00	0.00
10.0	6.0	1.56	3.23	11.01	18.84	8.47	28.33	0.00
10.5	16.00	25.00	16.13	4.59	15.94	28.81	20.00	0.00
11.0	56.0	45.31	43.55	5.50	36.23	44.07	20.00	1.92
11.5	16.00	7.81	29.03	0.00	2.90	5.08	6.67	7.69
12.0	4.0	7.81	3.23	0.00	1.45	1.69	1.67	9.62
12.5	0.00	3.13	4.84	0.00	0.00	0.00	1.67	21.15
13.0	0.00	4.69	0.00	0.00	0.00	1.69	0.00	19.23
13.5	2.00	1.56	0.00	0.00	0.00	0.00	0.00	19.23
14.0	0.00	3.13	0.00	0.00	0.00	0.00	0.00	9.62
14.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.77
15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.77
mean length	11.0	11.3	11.1	9.3	10.4	10.7	10.3	13.0
TS mean length	-50.15	-49.99	-50.07	-51.56	-50.69	-50.42	-50.73	-48.73
mean weight	13.5	13.5	13.5	6.7	8.6	8.9	8.8	20.6

TABLE 13

Sprat - im/ad numbers in millions and weight. *Tridens* 1-16 July 1997

Length	Stratum ABCD		Stratum EFG		Totals
	im	ad	im	ad	
6.5					0
7.0					0
7.5					0
8.0	1				1
8.5	2		4		6
9.0	11		4		15
9.5	24	1	2	4	31
10.0	9	10		11	30
10.5	2	18		10	30
11.0	2	25		10	37
11.5		8		8	16
12.0		3		10	13
12.5		3		11	14
13.0		3		11	14
13.5		2		10	12
14.0		1		5	6
14.5				3	3
15.0				3	3
millions	814.3	2193.0	143.4	1768.5	4919.1
mean w	8.4	11.5	5.7	14.9	
000 tons	6.8	25.1	0.8	26.4	59.2

TABLE 14: Trawl hauls. RV *Dana* 2-13 July 1997

Date dd/mm/yy	Haul no	Time hour	ICES square	Trawl	Catch depth m	Mean depth m	Trawling speed kn	Trawling time min	Total catch kg	Main species
02 07 97	420	24.00	44F7	FOTÖ	surface	210	4.0	60	295	herring, mackerel, blue whiting
03 07 97	563	16.50	44F6	FOTÖ	130-145	182	4.0	60	480	krill, pearlsides, saithe
03 07 97	615	24.00	45F5	FOTÖ	surface	314	4.3	60	985	herring, mackerel, blue whiting
04 07 97	627	02.58	45F5	FOTÖ	surface	301	3.3	60	400	herring, mackerel, blue whiting
04 07 97	711	12.55	44F5	EXPO	bottom	137	3.4	60	953	Norway pout, saithe, cod
04 07 97	730	16.02	44F5	EXPO	bottom	102	3.1	60	1398	Norway pout, cod, saithe
04 07 97	788	23.34	43F6	FOTÖ	surface	70	4.1	60	170	mackerel, herring
05 07 97	807	02.50	43F6	FOTÖ	surface	56	3.5	60	84	jellyfish, mackerel, lumpsucker, herring
05 07 97	886	13.30	44F6	FOTÖ	235-250	295	3.4	60	55	krill, pearlsides, blue whiting
05 07 97	902	16.20	43F7	FOTÖ	140-154	204	3.6	60	76	saithe, lumpsucker, herring
05 07 97	953	00.05	43F7	FOTÖ	126-140	173	3.3	60	148	saithe, Norway pout, blue whiting
06 07 97	965	02.30	43F7	FOTÖ	17-34	132	4.4	60	150	herring, mackerel
06 07 97	1055	12.45	43F8	EXPO	bottom	28	3.2	40	150	herring, sandeel
06 07 97	1073	15.50	43F8	EXPO	bottom	55		?	106	herring
06 07 97	1137	23.47	44F8	FOTÖ	surface	435	3.8	60	400	herring, mackerel, lumpsucker, blue whiting
07 07 97	1156	02.58	44F8	FOTÖ	surface	50	4.7	60	625	herring
07 07 97	1234	13.08	45F9	FOTÖ	159-174	390	3.4	60	50	krill, blue whiting, mackerel, saithe
07 07 97	1252	16.45	45F9	FOTÖ	290-305	600	3.3	60	40	roundnose grenadier, blue whiting
07 07 97	1303	23.45	44F9	FOTÖ	surface	35	4.1	60	2730	herring
08 07 97	1321	03.03	44F9	FOTÖ	surface	90	3.6	60	1530	herring
08 07 97	1389	16.45	44G0	EXPO	bottom	146	3.1	60	1020	Norway pout, shrimps
08 07 97	1462	23.48	46F9	FOTÖ	surface	486	3.9	60	387	herring, mackerel

Date dd/mm/yy	Haul no	Time hour	ICES square	Trawl	Catch depth m	Mean depth m	Trawling speed kn	Trawling time min	Total catch kg	Main species
09 07 97	1479	02.44	46F9	FOTÖ	surface	440	2.1	60	254	herring, mackerel
09 07 97	1559	13.10	46F9	FOTÖ	250-265	445	3.9	60	7	shrimps, blue whiting
09 07 97	1577	16.00	46F9	FOTÖ	190-205	315	3.9	60	53	herring, blue whiting
09 07 97	1632	23.45	46G0	FOTÖ	surface	105	4.0	60	1275	herring, mackerel
10 07 97	1652	02.40	45G0	FOTÖ	surface	115	3.5	60	965	herring, mackerel
10 07 97	1729	12.45	44F9	EXPO	bottom	150	4.0	60	1240	Norway pout, blue whiting, haddock
10 07 97	1741	15.15	44G0	EXPO	bottom	80	4.2	60	795	herring, Norway pout
10 07 97	1803	23.45	45G1	FOTÖ	surface	150	3.2	60	685	herring, mackerel, horse mackerel, krill
11 07 97	1819	02.30	45G0	FOTÖ	surface	200	3.4	60	350	mackerel, herring
11 07 97	1900	13.35	43G1	EXPO	bottom	28	3.0	60	1782	herring
11 07 97	1913	15.10	43G1	EXPO	bottom	66	3.5	60	565	herring, jellyfish
11 07 97	1977	23.36	43G1	FOTÖ	surface	55	3.7	60	500	herring, jellyfish
12 07 97	1987	01.53	43G2	FOTÖ	surface	50	3.9	60	490	herring, jellyfish
12 07 97	2077	12.34	41G2	GOV	bottom	32	3.4	60	180	cod
12 07 97	2090	15.08	41G2	GOV	bottom	30	3.6	60	350	herring, cod, whiting
mean catch									587.1	
total				37					21723.0	

TABLE 15

RV *Dana*, 2-13 July. Biomass and number of herring

Subarea	Biomass tonnes	Number *1000000	% of biomass	% of number
I	11447.2	205.9	3.6	3.6
II	43110.7	705.6	13.5	12.4
III				
IV	88583.5	1274.7	27.7	22.4
V	12718.4	141.3	4.0	2.5
VI	55160.4	805.7	17.3	14.2
VII	10123.9	120.1	3.2	2.1
VIII	35995.9	417.0	11.3	7.3
IX	62328.2	2021.4	19.5	35.5
Total	319468.2	5691.7	100.0	100.0

TABLE 16

RV *Dana*, 2-13 July 1997. Numbers of herring at age by stock and by sub area (Fig 10)

Subarea	Age													Total biomass tonnes
	0	1	2Im	2MAT	3Im	3MAT	4	5	6	7	8	9	10	
Northe Sea autumn spawners														
I		5857.4	743.9	743.9	117.9	668.3	25.1	18.0	9.9	7.8	8.1			8200.3
II		19019.8	2865.9	2865.9	633.5	3589.7	251.7	226.8	118.0	93.9	108.9			29774.1
III														0
IV		29044.4	6666.8	6666.8	1562.9	8856.2	538.8	766.5	510.4	251.2	256.0			55120
V		1611.7	1099.2	1099.2	162.5	920.6	9.4	309.5	305.8	10.0	3.6			5531.5
VI		16397.4	3135.6	3135.6	840.7	4764.1	174.2	1120.3	1030.7	109.3	89.5			30797.4
VII	0.2	1832.7	738.4	738.4	128.5	728.2	8.0	262.7	260.0	5.8	2.7			4705.6
VIII		6250.7	2658.3	2658.3	565.9	3206.7	104.2	758.8	737.1	25.3	21.7			16987
IX	3927.8	29960.1	4381.3	4381.3	299.7	1698.6	108.7	5.3		34.3	5.3			44802.4
tonnes	3928.0	109974.2	22289.4	22289.4	4311.6	24432.4	1220.1	3467.9	2971.9	537.6	495.8	0.0	0.0	195918.3
% by age	2.0	56.1	11.4	11.4	2.2	12.5	0.6	1.8	1.5	0.3	0.3	0.0	0.0	100.0
Baltic spring spawners														
I		356.9	649.8	349.8	168.1	952.5	219.5	101.5	88.0	30.6	16.9	13.3		2946.9
II		957.8	1810.3	1810.3	749.9	4249.6	1388.7	818.7	555.1	435.0	222.4	205.6	134.3	13337.7
III														0.0
IV		1500.6	3721.4	3721.4	1910.5	10826.2	3505.0	2474.7	1655.3	2250.5	607.6	644.6	649.6	33467.4
V		56.3	935.7	935.7	250.4	1419.1	359.2	135.1	373.1	1370.4	25.5	653.5	672.0	7186.0
VI		1299.6	1757.2	1757.2	955.1	5412.2	1602.7	1128.1	1494.9	4670.1	257.7	1940.1	2087.5	24362.4
VII		77.1	596.6	596.6	175.7	995.4	263.1	94.8	308.2	1165.1	18.3	555.6	571.3	5417.8
VIII		275.8	1888.5	1888.5	733.2	4154.8	1354.2	460.9	1164.1	3722.3	94.6	1610.9	1659.5	19007.3
IX		1476.6	4331.5	4331.5	762.5	4320.6	912.5	426.8	166.4	368.9	58.1	368.9		17524.3
tonnes	0.0	6000.7	15691.0	15391.0	5705.4	32330.4	9604.9	5640.6	5805.1	14012.9	1301.1	5992.5	5774.2	123249.8
% by age	0.0	4.9	12.7	12.5	4.6	26.2	7.8	4.6	4.7	11.4	1.1	4.9	4.7	100.0

TABLE 17

RV *Dana*, 2-13 July 1997. Biomass of herring by age, stock and sub area (Fig. 10)

Subarea	Age													Total number *1000000
	0	1	2Im	2MAT	3Im	3MAT	4	5	6	7	8	9	10	
Northe Sea autumn spawners														
I		127.63	10.80	10.80	1.19	6.72	0.19	0.12	0.06	0.07	0.06			157.64
II		419.27	36.42	36.42	5.82	32.99	1.93	1.50	0.71	0.82	0.79			536.67
III														0.00
IV		630.64	78.85	78.85	13.67	77.48	4.14	4.92	3.07	2.20	1.85			895.67
V		27.80	13.52	13.52	1.41	7.97	0.07	1.87	1.84	0.09	0.03			68.12
VI		420.76	36.57	36.57	7.01	39.72	1.34	6.85	6.21	0.96	0.65			556.64
VII	0.03	38.47	9.10	9.10	1.11	6.26	0.06	1.58	1.57	0.05	0.02			67.35
VIII		127.84	31.44	31.44	4.85	27.47	0.80	4.59	4.44	0.22	0.16			233.25
IX	919.03	685.45	60.87	60.87	3.66	20.76	0.83	0.04		0.30	0.04			1751.85
number	919.1	2477.86	277.57	277.57	38.72	219.37	9.36	21.47	17.90	4.71	3.60	0.00	0.00	4267.19
% by age	21.5	58.1	6.5	6.5	0.9	5.1	0.2	0.5	0.4	0.1	0.1	0.0	0.0	100.0
Baltic spring spawners														
I		8.70	11.14	11.14	1.92	10.87	2.23	1.05	0.78	0.16	0.16	0.08		48.23
II		22.97	29.87	29.87	8.07	45.72	13.62	7.52	4.87	2.45	2.09	1.20	0.69	168.94
III														0.00
IV		35.43	58.19	58.19	19.75	112.16	34.53	21.05	14.29	12.63	5.82	3.71	3.31	379.06
V		1.17	13.94	13.94	3.08	17.48	4.17	1.53	2.94	7.44	0.26	3.65	3.56	73.16
VI		42.39	27.03	27.03	9.84	55.76	16.05	9.24	11.80	25.61	2.52	10.86	10.98	249.11
VII		1.88	8.89	8.89	2.11	11.93	2.99	1.04	2.40	6.32	0.19	3.10	3.02	52.76
VIII		6.28	27.46	27.46	8.24	46.67	14.08	4.95	9.29	20.59	0.97	8.99	8.79	183.77
IX		39.51	68.69	68.69	10.37	58.75	11.54	5.20	1.88	2.17	0.60	2.17		269.57
number	0.00	158.33	245.21	245.21	63.38	359.34	99.21	51.58	48.25	77.37	12.61	33.76	30.35	1424.60
% by age	0.0	11.1	17.2	17.2	4.4	25.2	7.0	3.6	3.4	5.4	0.9	2.4	2.1	100.0

TABLE 18

ANOVAR of linear regression

Source of variation	North Sea autumn spawning herring				Baltic spring spawning herring			
	df	SS	S^2	F	df	SS	S^2	F
Regression	1	111.159	111.159	9229.83	1	33.672	33.672	2709.03
Residual	442	5.323	0.012		280	3.480	0.012	
Total	443	116.483			281	37.152		

Linear regression

			S.E	t-value	95% confidence limits		R	number
					Lower	Upper		
North Sea herring	Slope	3.228	0.033	96.07	3.162	3.294	0.9543	444
	Intercept	0.0004	0.124	-63.03	0.0003	0.0005		
Baltic herring	Slope	3.054	0.059	52.05	2.938	3.169	0.9063	282
	Intercept	0.0007	0.223	-32.56	0.0005	0.0011		

TABLE 19

RV *Dana*, 2-13 July 1997. Mean weight at age used to convey numbers to biomass

Subarea	Age												
	0	1	2I	2M	3I	3M	4	5	6	7	8	9	10
Northe Sea autumn spawners													
I		45.89	68.88	68.88	99.08	99.45	132.11	150.00	165.00	111.43	135.00		
II		45.36	78.69	78.69	108.85	108.81	130.41	151.20	166.20	114.51	137.85		
III													
IV		46.06	84.55	84.55	114.33	114.30	130.14	155.79	166.25	114.18	138.38		
V		57.97	81.30	81.30	115.25	115.51	134.29	165.51	166.20	111.11	120.00		
VI		38.97	85.74	85.74	119.93	119.94	130.00	163.55	165.97	113.85	137.69		
VII	6.67	47.64	81.14	81.14	115.77	116.33	133.33	166.27	165.61	116.00	135.00		
VIII		48.89	84.55	84.55	116.68	116.73	130.25	165.32	166.01	115.00	135.63		
IX	4.27	43.71	71.98	71.98	81.89	81.82	130.96	132.50		114.33	132.50		
mean	4.27	44.38	80.30	80.30	111.35	111.38	130.35	161.52	166.03	114.14	137.72		
Baltic spring spawners													
I													
II		41.02	58.33	31.40	87.55	87.63	98.43	96.67	112.82	191.25	105.63	166.25	
III		41.70	60.61	60.61	92.92	92.95	101.96	108.87	113.98	177.55	106.41	171.33	194.64
IV													
V		42.35	63.95	63.95	96.73	96.52	101.51	117.56	115.84	178.19	104.40	173.75	196.25
VI		48.12	67.12	67.12	81.30	81.18	86.14	88.30	126.90	184.19	98.08	179.04	188.76
VII		30.66	65.01	65.01	97.06	97.06	99.86	122.09	126.69	182.35	102.26	178.65	190.12
VIII		41.01	67.11	67.11	83.27	83.44	87.99	91.15	128.42	184.35	96.32	179.23	189.17
IX		43.92	68.77	68.77	88.98	89.03	96.18	93.11	125.31	180.78	97.53	179.19	188.79
mean		37.37	63.06	63.06	73.53	73.54	79.07	82.08	88.51	170.00	96.83	170.00	

TABLE 20

Catch composition by trawl haul. *Scotia* (16June- 3July 1997)

Haul number	Position		Depth (m)	Numbers caught								
	Latitude (°N)	Longitude (°W)		herring	whiting	haddock	pout	mackerel	horse mackerel	blue whiting	sprat	others
229	5807.24	542.27	104		3	4	2				90	100sand eel
231	5708.07	636.64	100	394	5						377	
232	5631.67	634.98	120		3						6	
233	5610.13	651.15	80	824	28						607	
234	5609.81	723.21	110	984	116	3		85				
235	5640.27	840.04	130	10045				420				
236	5649.15	817.87	135	13360				800				
237	5650.03	810.17	130	16		3		38				
238	5702.37	817.85	140	239	12	9	5	227		2		1hake; 1pollack; 1angler
239	5703.04	916.58	420					115		79		
240	5719.35	915.34	170	32				9		4		4gurnard
242	5725.47	850.06	140	2746				567				
243	5740.30	923.90	205					4005	15	2160		
244	5755.23	840.77	130	3104				192				
245	5756.83	733.71	100					1060				
246	5810.11	716.83	120	25950								
247	5826.87	722.43	100	5				428				
248	5816.31	605.86	105	567	3	1	1			2	10	1hake; 1john dory
249	5841.67	642.25	130	674			161	112				
250	5841.31	743.20	160	1216				420				
251	5903.34	513.42	82								many meshed	sand eels and small gadoids meshed
252	5903.28	551.66	85	56				1431				180 sand eels
253	5910.19	422.18	90		95			1401				
254	5918.03	417.05	100	1			116	165				
255	5917.96	502.05	126	922	2	2	24	3080				
256	5918.42	632.10	200					420		680		4argentine
257	5924.22	506.50	144	388				119				
258	5924.79	427.65	98	10								

TABLE 21

Herring length frequency by trawl haul by sub area. *Scotia* (16June - 3July 1997) mean length - cm, mean weight - g, target strength - dB)

Haul no	Area I				Area II		Area III							Area IV					
	231	233	248	Mean	234	Mean	235	236	238	242	244	250	Mean	246	249	252	255	257	Mean
15.0	1.3	1.2		0.8															
15.5	2.8	2.3		1.7															
16.0	18.0	10.6	9.7	12.8															
16.5	21.6	21.1	14.6	19.1															
17.0	35.5	24.8	31.0	30.4	2.7	2.7											1.3		0.3
17.5	15.7	22.0	22.4	20.0	14.3	14.3											5.0		1.0
18.0	4.1	10.2	14.6	9.66	28.3	28.3								0.2			8.5	0.3	1.8
18.5	0.5	4.4	3.9	2.9	29.8	29.8									0.1		8.5		1.7
19.0		2.3	1.4	1.2	18.2	18.2											4.6		0.9
19.5		1.4	0.5	3.5	3.5									0.7			3.7	0.3	0.9
20.0		0.4		0.1	1.9	1.9								0.6			1.3		0.4
20.5		0.4		0.1	0.4	0.4									0.1		0.4		0.1
21.0					0.1	0.1					0.1		0.0		0.4		1.7		0.4
21.5		0.4		0.1											0.7	3.6	2.2	0.5	1.4
22.0				0.1							0.1		0.0		2.5		4.3	1.3	1.6
22.5			0.4	0.1	0.1	0.1								0.9	4.2		7.6	4.4	3.4
23.0			0.2	0.1							0.1		0.0	2.5	9.8	3.6	11.1	7.5	6.9
23.5	0.3		0.2	0.1	0.2	0.2					0.3		0.0	3.7	15.0	8.9	8.9	9.8	9.3
24.0					0.1	0.1					0.1		0.0	10.9	12.8	21.4	9.5	11.9	13.8
24.5					0.2	0.2								9.0	12.9	8.9	6.9	12.4	10.0
25.0					0.1	0.1		1.2	0.4	1.0			0.4	9.9	8.5	8.9	6.1	12.4	9.2
25.5					0.1	0.1		1.8	0.4	1.9	1.0		0.9	16.2	9.3	12.5	3.0	9.0	10.0
26.0								4.8	5.0	4.1	2.3	0.3	2.8	16.2	6.5	14.3	1.7	6.7	9.1
26.5							1.4	9.9	2.9	8.0	8.1		5.0	12.3	4.5	5.4	1.5	4.9	5.7
27.0							2.8	14.7	10.5	11.7	16.1	2.3	9.7	7.9	3.7	12.5	1.1	6.4	6.3
27.5							10.8	15.3	18.4	14.6	19.3	7.9	14.4	5.3	1.9		0.4	4.4	2.4
28.0							16.7	15.0	15.1	15.8	21.9	17.4	17.0	2.3	4.0			3.9	2.0
28.5			0.2	0.1			24.0	18.9	20.9	18.9	18.0	21.7	20.4	0.7	0.9			1.5	0.6

Haul no	Area I				Area II		Area III							Area IV					
	231	233	248	Mean	234	Mean	235	236	238	242	244	250	Mean	246	249	252	255	257	Mean
29.0							22.6	12.9	15.9	18.2	10.3	24.3	17.4	0.5	1.2		0.7	2.1	0.9
29.5							11.5	5.1	7.5	4.8	1.9	17.1	8.0		0.7			0.3	0.2
30.0							9.4	0.3	1.7	0.3	0.3	4.6	2.8	0.2	0.1			0.3	0.1
30.5	0.3			0.1			0.7		1.3	0.5		1.6	0.7						
31.0								0.3		0.3		1.0	0.3						
31.5												0.7	0.1						
32.0												0.7	0.1						
32.5												0.3	0.1						
33.0																			
33.5																			
34.0																			
34.5																			
Number	394	824	567		984		10045	13360	239	2746	3104	1216		25950	674	56	922	388	
mean lgt	17.3	17.6	17.8	17.6	18.9	18.9	29.1	28.3	28.6	28.4	28.2	29.3	28.6	26.0	25.2	25.4	22.5	25.5	24.9
mean wt	43	45	47	45	56	56	203	186	193	189	186	207	194	145	133	137	98	139	130
TS/ind	-46.4	-46.3	-46.2	-46.3	-45.7	-45.7	-41.9	-42.2	-42.1	-42.1	-42.2	-41.9	-42.1	-42.9	-43.2	-43.1	-44.1	-43.0	-43.2
TS/kg	-32.8	-32.8	-32.9	-32.8	-33.1	-33.1	-35.0	-34.9	-34.9	-34.9	-34.9	-35.0	-34.9	-34.5	-34.4	-34.4	-34.0	-34.5	-43.4

TABLE 22

Herring numbers and biomass by age, maturity and area. *Scotia* (16June- 3July 1997)

Category	Number x 1^{0-6}	Mean length (cm)	Mean weight (g)	Biomass (tonnes x 10^{-3})
Area I (Minch)				
1 ring	347.76	17.02	44.42	15.45
2 ring immature	1.54	22.35	98.34	0.15
2 ring mature	0.00			0.00
3 ring immature	0.00			0.00
3 ring mature	0.00			0.00
4	0.21	28.50	200.44	0.04
5	0.00			0.00
6	0.00			0.00
7	0.00			0.00
8	0.00			0.00
9+	0.30	30.50	244.86	0.07
Total	349.80	17.06	44.92	15.71
Area II (Barra Head)				
1 ring	368.50	18.33	55.04	20.28
2 ring immature	4.09	22.59	103.54	0.42
2 ring mature	0.00			0.00
3 ring immature	0.38	26.58	136.26	0.05
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	372.98	18.39	55.66	20.76
Area III (Hebrides)				
1 ring	0.00			0.00
2 ring immature	3.40	25.76	149.83	0.51
2 ring mature	1.94	25.90	151.46	0.29
3 ring immature	8.28	27.00	171.10	1.42
3 ring mature	33.29	27.00	171.55	5.71
4	110.47	27.86	187.82	20.75
5	51.06	28.37	198.05	10.11
6	39.99	28.81	207.20	8.29

Category	Number x 1^{0-6}	Mean length (cm)	Mean weight (g)	Biomass (tonnes x 10^{-3})
7	13.81	28.94	210.34	2.91
8	24.35	28.99	211.22	5.14
9+	21.64	29.18	215.25	4.66
Total	308.24	28.15	193.96	59.79
Area IV (North of Scotland)				
1 ring	80.52	18.60	57.70	4.65
2 ring immature	413.94	23.64	116.17	48.09
2 ring mature	252.31	24.83	134.02	33.82
3 ring immature	29.79	25.06	137.98	4.11
3 ring mature	225.50	26.15	155.99	35.17
4	56.16	27.22	175.29	9.84
5	14.48	27.82	187.13	2.71
6	9.65	28.04	191.43	1.85
7	2.52	28.58	202.23	0.51
8	4.71	28.96	210.35	0.99
9+	2.19	29.19	215.31	0.47
Total	1091.78	24.42	130.26	142.21
Total Area				
1 ring	796.79	17.79	50.67	40.38
2 ring immature	422.97	23.64	116.26	49.17
2 ring mature	254.25	24.84	134.16	34.11
3 ring immature	38.45	25.48	145.10	5.58
3 ring mature	258.78	26.26	157.99	40.88
4	166.83	27.64	183.62	30.63
5	65.54	28.25	195.64	12.82
6	49.65	28.66	204.13	10.13
7	16.34	28.89	209.09	3.42
8	29.06	28.89	211.08	6.13
9+	24.13	29.20	215.62	5.20
Total	2122.80	22.69	112.34	238.47

TABLE 23

Abundance of herring by stat square *Walter Herwig III*, 23 June - 16 July 1997

42F4	41.16128	40F4	11.76554	46F1	605.0341
42F5	22.01865	40F5	508.3424	46F0	879.3084
42F6	549.119	40F6	151.8426	46E9	935.9497
42F7	474.2867	39F2	51.3	46E8	255.3935
41F3	3.171798	39F3	369.5512	45F1	70.5554
42F4	4.426874	39F4	158.8512	45F0	1039.974
42F5	1359.26	39F5	160.0893	45E9	182.3937
42F6	97.02708	39F6	81.54259	45E8	106.8657
42F7	951.1488	38F5	1.013042		
40F2	295.2881	38F6	6.624921		
40F3	24.74238	38F7	727.9268		

TABLE 24

Proportion of herring by age for sub areas A north of 59'N B south of 59'N

Area	0	1	2i	2m	3i	3m	4	5	6	7	8	9+
A	0.000	0.082	0.118	0.270	0.003	0.258	0.164	0.057	0.029	0.019	0.000	0.000
B	0.156	0.804	0.021	0.013	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000

TABLE 25

Mean weights at age by area for sub areas A north of 59'N B south of 59'N

Area	0	1	2i	2m	3i	3m	4	5	6	7
A		55.03	78.93	113.8	122.5	150.8	194.3	236.9	211.2	218.9
B	4.885	36.41	69.8	86.45	117.1	117.1	142			

TABLE 26

Numbers of Autumn spawning herring in North Sea and VIaN (millions)

ICES A	IIIa	IVa	IVb	Total NS	%Mature	Total VIaN	%Mature	Total	%Mature
0	919.06	0.00	942.87	1861.93	0.00	0.00	0.00	1861.93	0
1	1444.65	1351.76	6619.38	9415.80	0.00	792.32	0.00	10208.12	0
2	322.71	4620.76	1419.13	6362.59	65.10	641.86	37.59	7004.46	62.58
3	131.61	2584.81	570.93	3287.35	94.16	286.17	87.11	3573.52	93.59
4	3.62	1641.57	50.49	1695.67	100.00	167.04	100.00	1862.71	100
5	15.55	624.16	52.42	692.12	100.00	66.10	100.00	758.22	100
6	14.44	204.95	39.76	259.16	100.00	49.52	100.00	308.68	100
7	1.90	75.96	0.78	78.63	100.00	16.28	100.00	94.91	100
8	1.13	69.72	7.48	78.33	100.00	28.99	100.00	107.32	100
9+	0.00	158.28	0.00	158.28	100.00	24.44	100.00	182.72	100
Immature	2544.82	3095.43	8050.15	13690.40		1229.81		14920.21	
Mature	309.85	8236.53	1653.08	10199.47		842.91		11042.37	
Total	2854.67	11331.96	9703.24	23889.87		2072.72		25962.58	

TABLE 27

Biomass of Autumn spawning herring in North Sea and VIaN (Thousands of tonnes)

ICES A	IIIa	IVa	IVb	Total NS	% Mature	Total VIaN	%Mature	Total	% Mature
0	3.93	0.00	4.61	8.53	0.00	0.00	0.00	8.53	0
1	64.03	74.44	271.84	410.31	0.00	40.12	0.00	450.43	0
2	25.69	600.26	127.93	753.88	72.25	78.97	41.02	832.85	69.29
3	14.62	462.09	70.14	546.85	95.18	44.92	88.06	591.78	94.64
4	0.47	376.77	8.29	385.53	100.00	30.89	100.00	416.43	100
5	2.55	165.18	7.93	175.66	100.00	13.04	100.00	188.70	100
6	2.40	53.53	6.06	61.99	100.00	10.15	100.00	72.14	100
7	0.22	19.05	0.09	19.36	100.00	3.41	100.00	22.77	100
8	0.15	19.84	1.09	21.09	100.00	6.13	100.00	27.22	100
9+	0.00	52.12	0.00	52.12	100.00	5.32	100.00	57.44	100
Immature	79.06	261.19	305.61	645.86		92.06		737.92	
Mature	31.06	1562.09	187.77	1780.93		140.91		1921.83	
Total	114.06	1823.28	497.99	2435.32		232.97		2668.29	

TABLE 28

Mean weight of Autumn spawning herring in North Sea and VIaN (g)

ICES A	IIIa	IVa	IVb	Total NS	Total VIaN	Total
0	4.27		4.89	4.58		4.58
1	44.32	55.07	41.07	43.58	50.64	44.12
2	79.61	129.90	90.15	118.49	123.04	118.90
3	111.07	178.77	122.86	166.35	156.99	165.60
4	130.44	229.52	164.26	227.36	184.96	223.56
5	164.20	264.64	151.30	253.80	197.32	248.87
6	165.98	261.18	152.41	239.19	204.95	233.70
7	114.04	250.83	114.28	246.18	209.61	239.91
8	136.84	284.56	146.25	269.22	211.60	253.65
9+		329.30		329.30	217.62	314.37
Mean (i)	31.07	84.38	37.96	47.18	74.86	49.46
Mean (m)	100.25	189.65	113.59	174.61	167.17	174.04
Mean (all)	39.95	160.90	51.32	101.94	112.40	102.77

TABLE 29

Number of Baltic Spring Spawning herring (millions) and percentage mature by number. (Four year and older are assumed 100% mature)

ICES A	IIIa	IVa	IVb	Total NS	% Mature
0	0.00	0.00	0.00	0.00	0.00
1	95.66	16.61	15.24	127.51	0.00
2	363.57	305.99	45.69	715.25	36.64
3	266.72	409.62	110.75	787.09	73.35
4	59.65	85.86	20.25	165.76	100.00
5	26.59	32.49	8.24	67.32	100.00
6	33.60	29.57	5.37	68.54	100.00
7	63.71	11.15	5.17	80.04	100.00
8	5.27	7.26	4.26	16.78	100.00
9+	56.00	1.46	2.28	59.73	100.00
Immature	339.75	383.45	67.25	790.46	
Mature	631.00	516.56	149.99	1297.56	
Total	970.75	900.01	217.25	2088.01	

TABLE 30

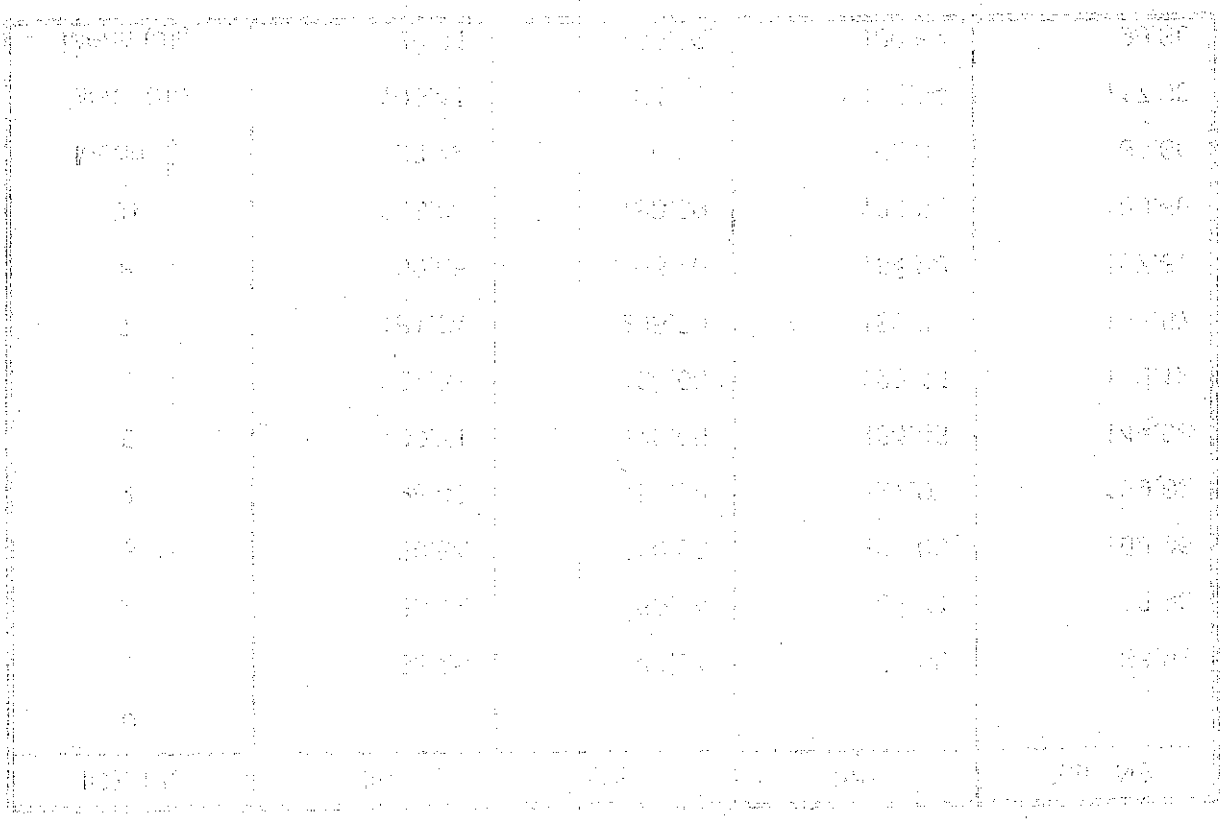
Biomass of Baltic Spring Spawning herring (thousands of tonnes) and percentage mature by weight. (Four year and older are assumed 100% mature)

ICES A	IIIa	IVa	IVb	Total NS	% Mature
0	0.00	0.00	0.00	0.00	0.00
1	3.37	0.69	0.64	4.71	0.00
2	24.77	24.55	2.87	52.18	38.64
3	23.61	45.46	11.97	81.04	78.15
4	5.87	13.03	2.59	21.49	100.00
5	2.92	5.82	1.03	9.76	100.00
6	4.28	4.87	0.66	9.81	100.00
7	11.58	2.30	0.98	14.85	100.00
8	0.53	1.42	0.70	2.65	100.00
9+	10.28	0.27	0.42	10.97	100.00
Immature	20.65	29.15	4.63	54.43	
Mature	66.56	69.24	17.23	153.02	
Total	87.21	98.39	21.85	207.46	

TABLE 31

Mean Weight of Baltic Spring Spawning herring (g)

ICES A	IIIa	IVa	IVb	Total NS
0				
1	35.26	41.64	42.08	36.91
2	68.12	80.24	62.74	72.96
3	88.54	110.98	108.08	102.96
4	98.40	151.70	127.97	129.62
5	109.71	179.05	124.45	144.98
6	127.37	164.58	123.45	143.12
7	181.74	205.99	188.73	185.57
8	100.65	195.20	164.22	157.67
9+	183.63	183.59	184.54	183.66
Mean (i)	60.79	76.02	68.81	68.86
Mean (m)	105.48	134.05	114.84	117.93
Mean (all)	89.84	109.32	100.59	99.36



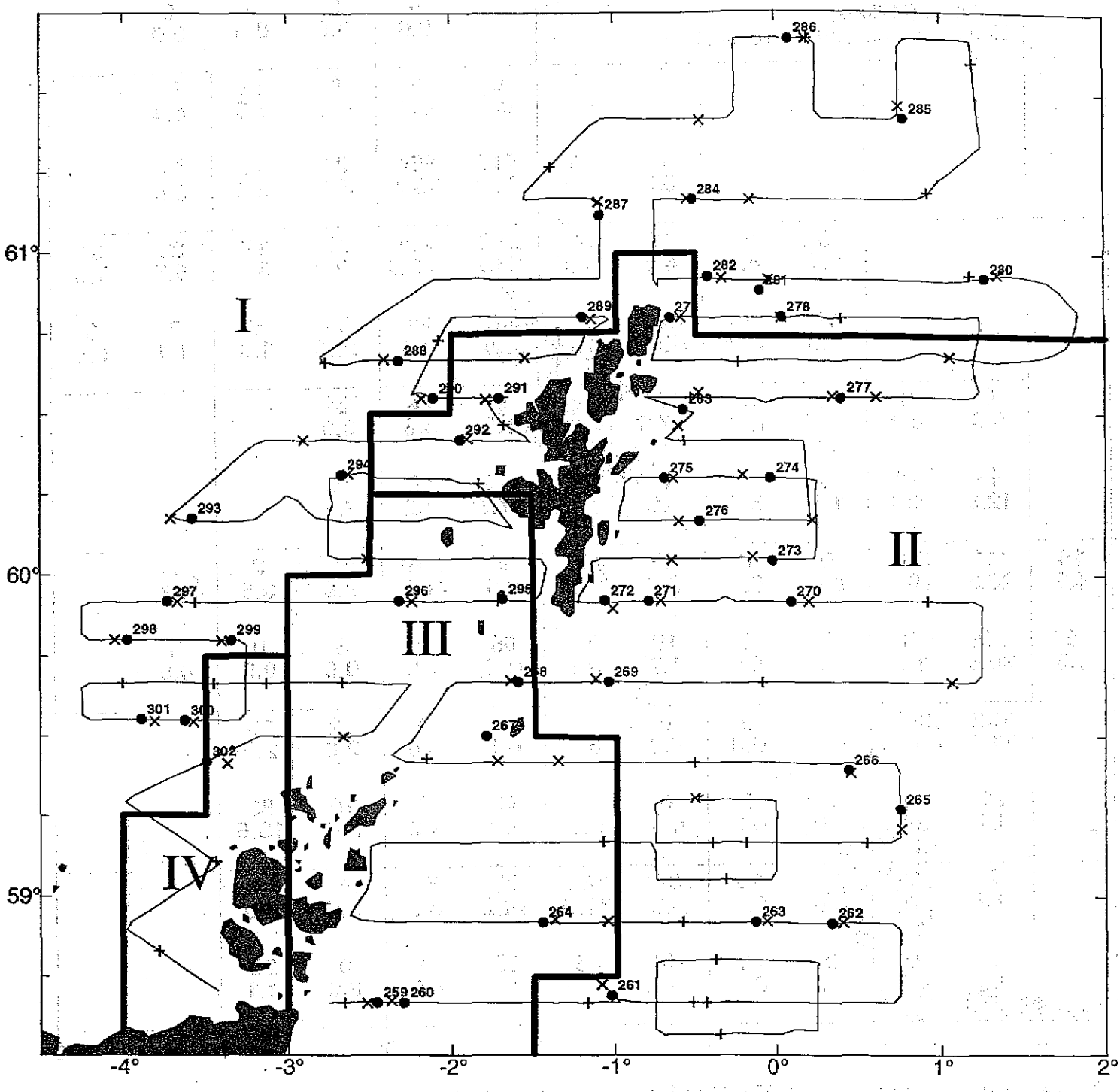


Figure 1. Scotia 8 to 28 July Cruise Track,Trawl, • CTD × and XBT + Positions. Showing boundaries of areas of homogenenious length and age composition (thick lines)

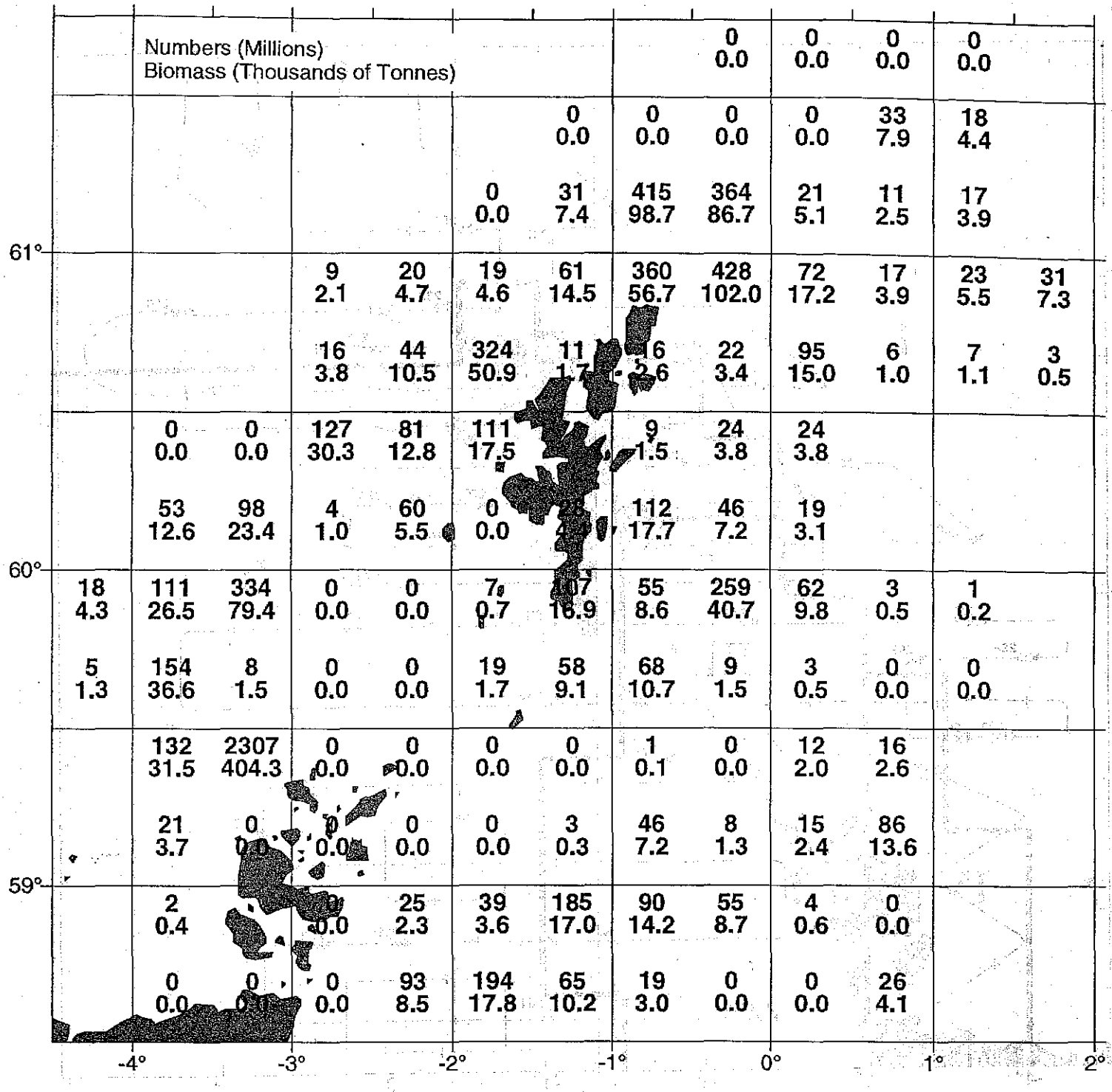


Figure 2 Scotia 8 to 28 July 1997 Numbers (millions) and Biomass (thousands of tonnes) by quater statistical rectangle.

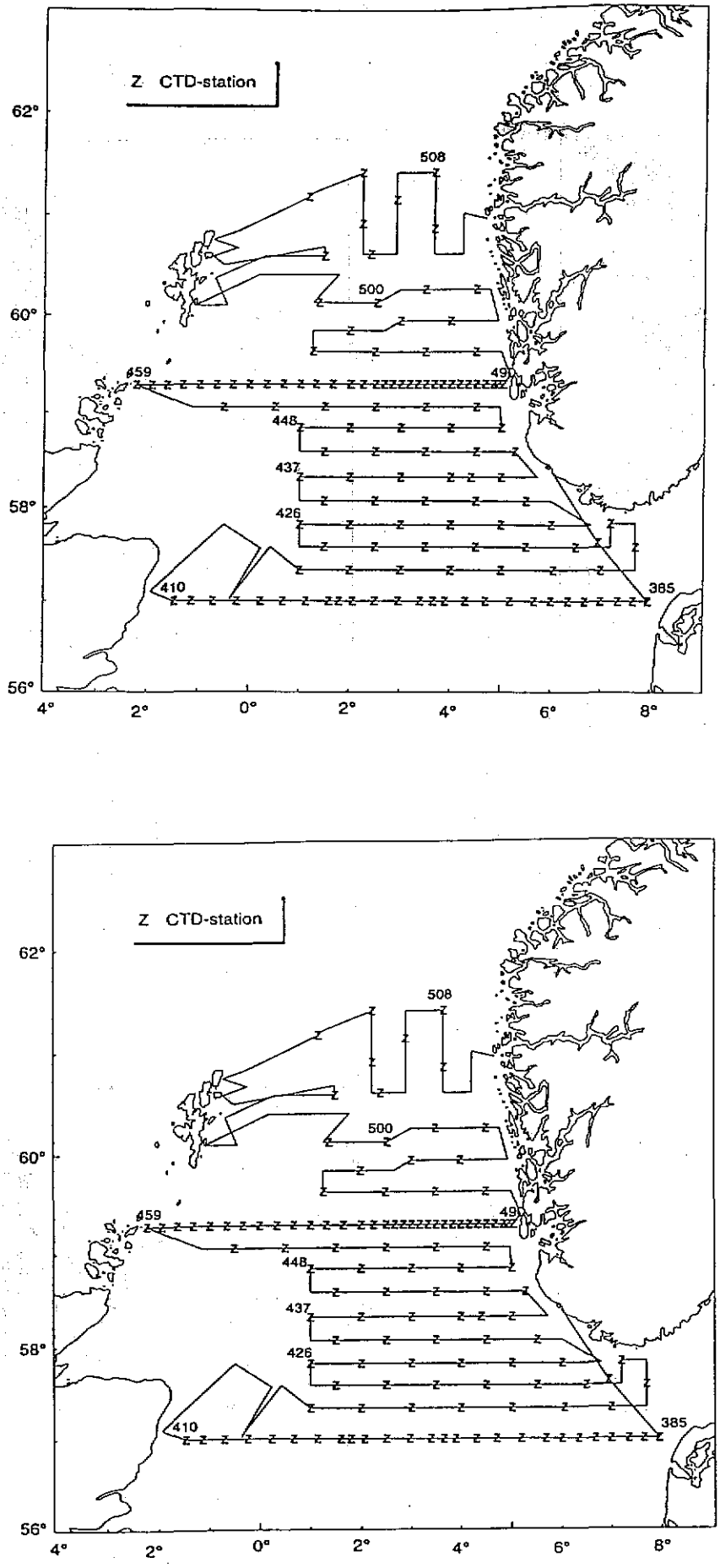
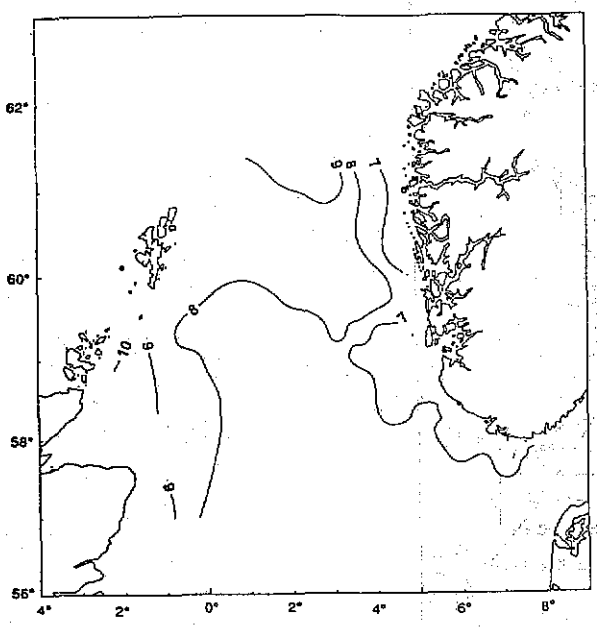
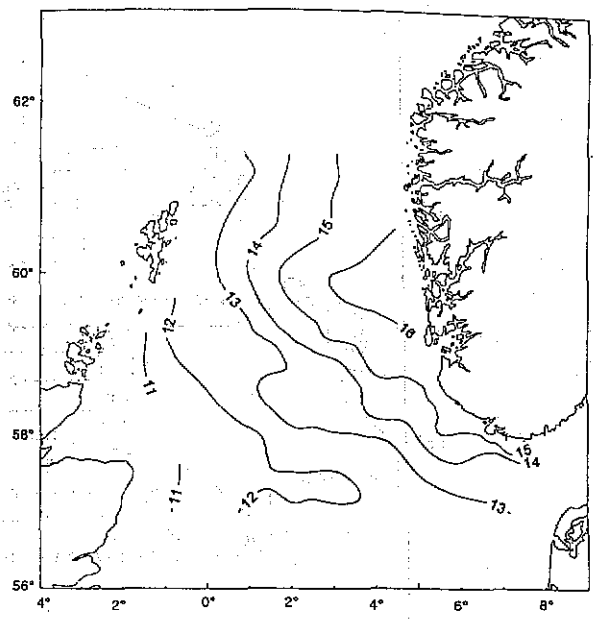


Figure 3 Course lines with CTD (Z) stations (a) and trawl stations (b) for RV GO Sars, 27 June - 18 July 1997





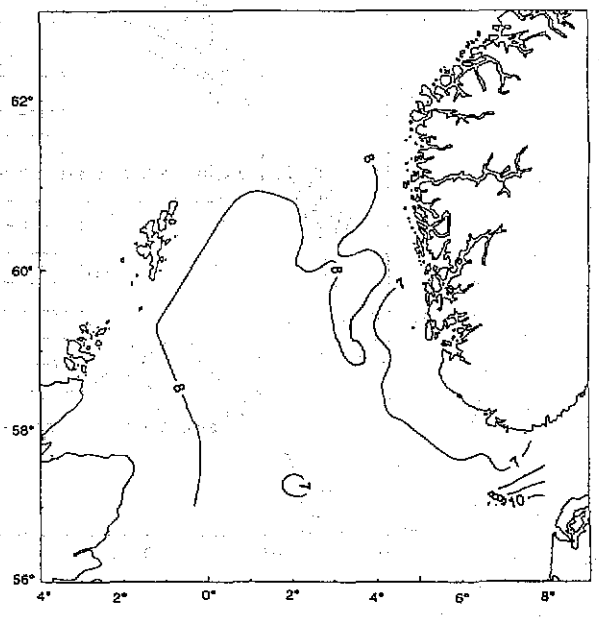


Figure 4 Distribution of temperature in 5 m (a), 50 m (b) and at bottom (c) + RV GO Sars, 27 June - 18 July 1997

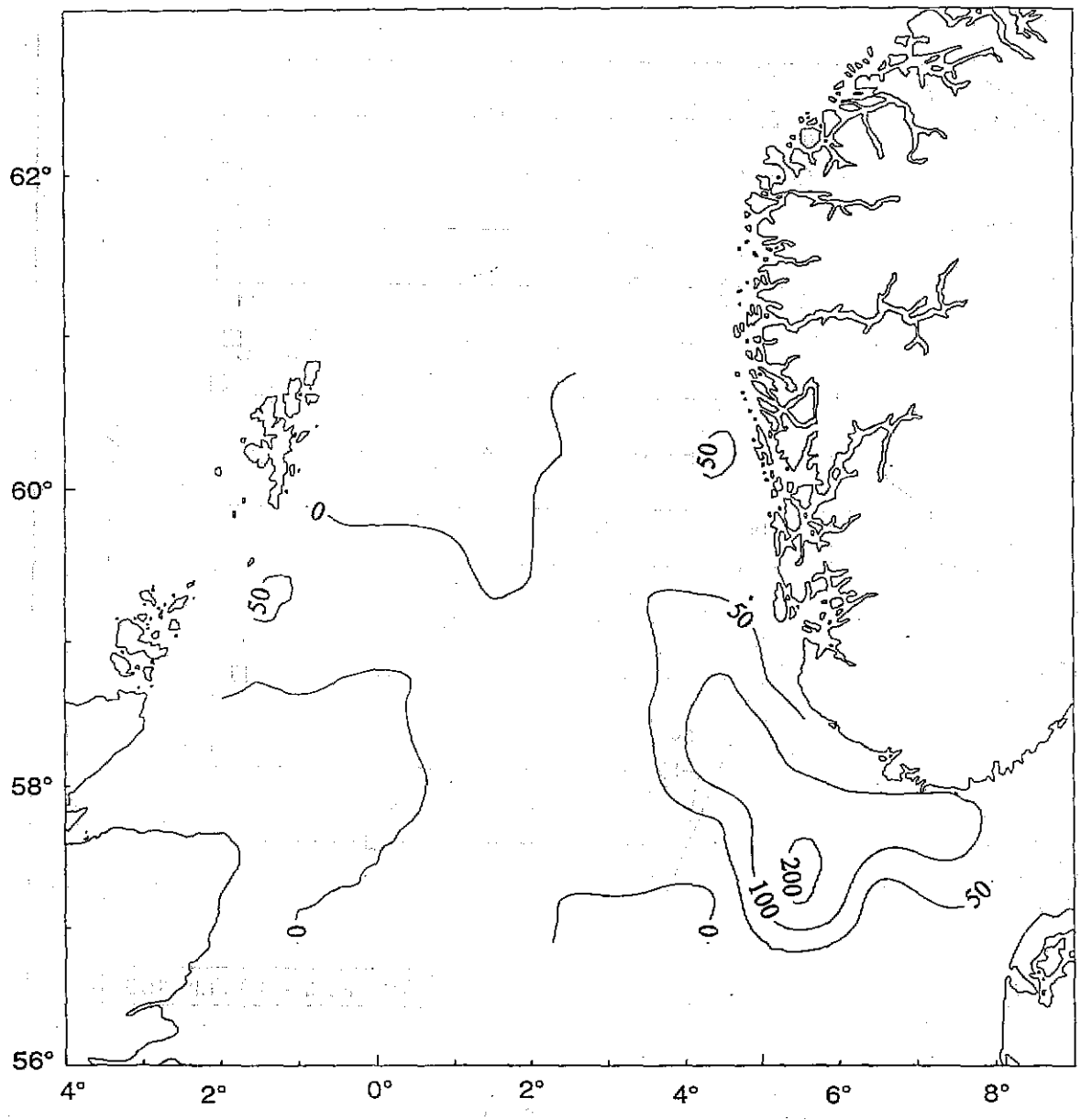


Figure 5 The horizontal distribution of herring, GO Sars, 27 June - 18 July 1997

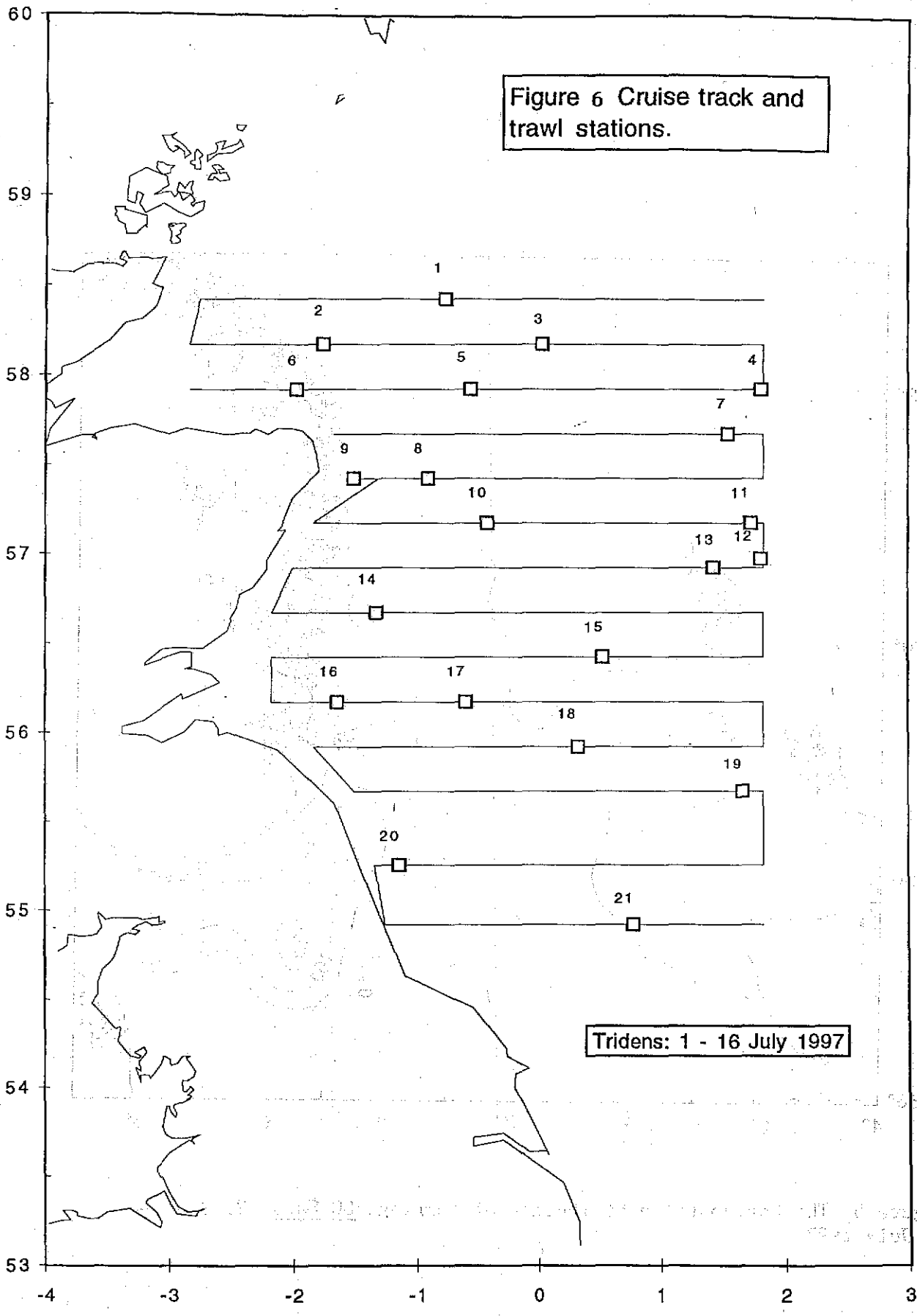


Figure 6 Cruise track and trawl stations.
Tridens: 1 - 16 July 1997
60
59
58
57
56
55
54
53
-4
-3
-2
-1
0
1
2
3
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21

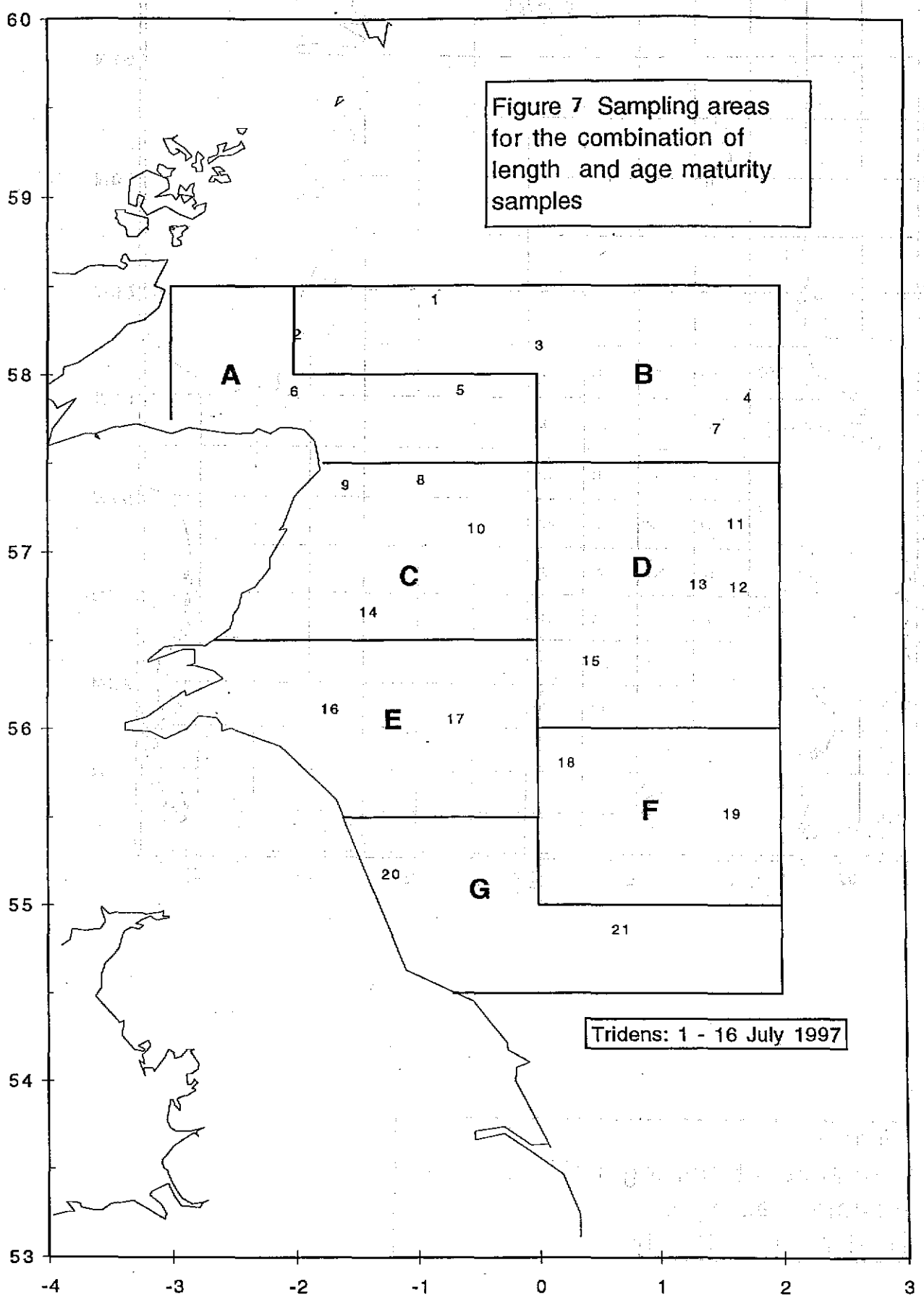


Figure 7 Sampling areas for the combination of length and age maturity samples
A
B
C
D
E
F
G
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
Tridens: 1 - 16 July 1997
60
59
58
57
56
55
54
53
-4
-3
-2
-1
0
1
2
3

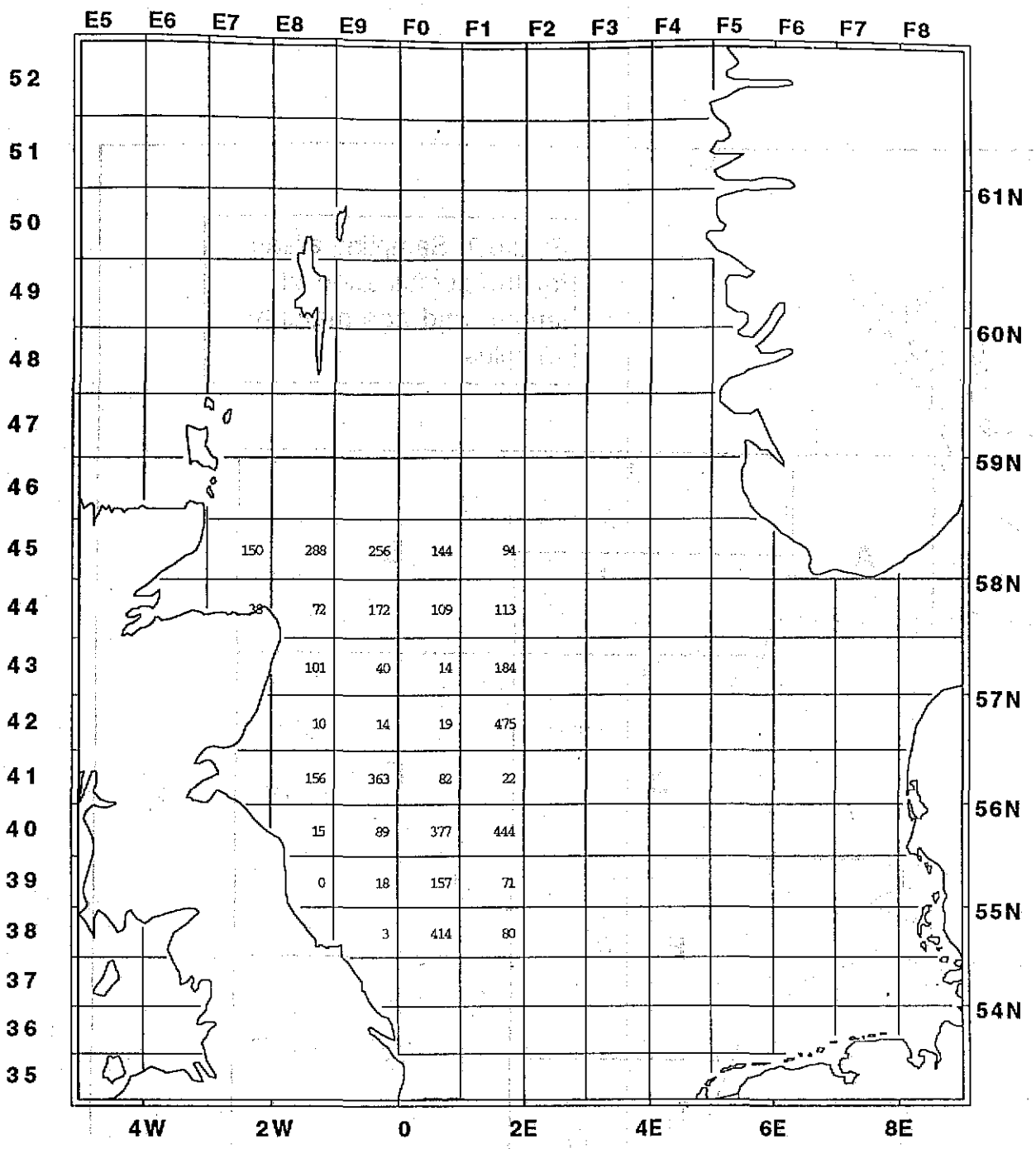


Figure 8
Numbers of herring (millions) per square - all ages.
Tridens 1 - 16 July

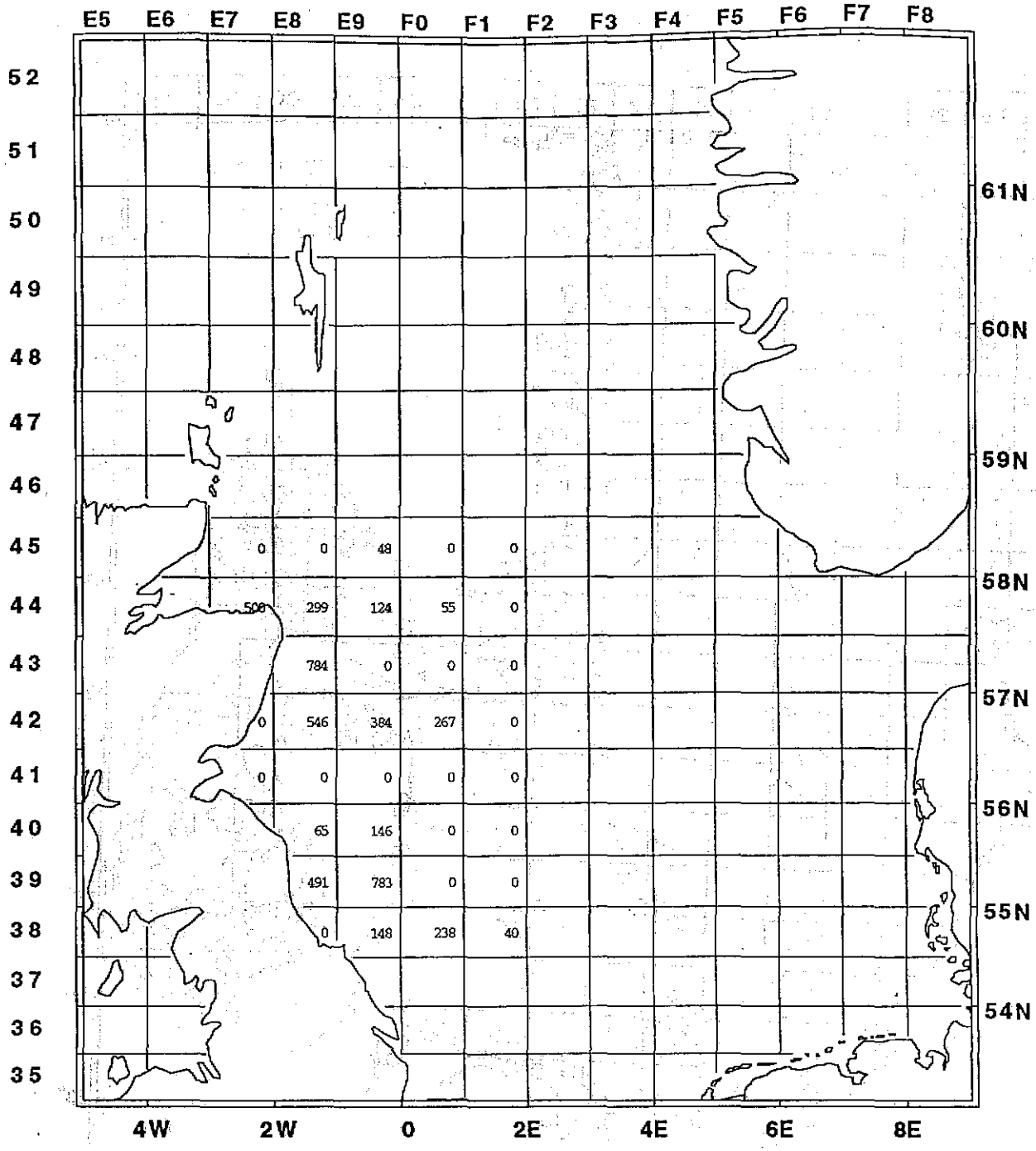


Figure 9
Numbers of sprat (millions) per square - immatures and adults
Tridens 1 - 16 July 1997

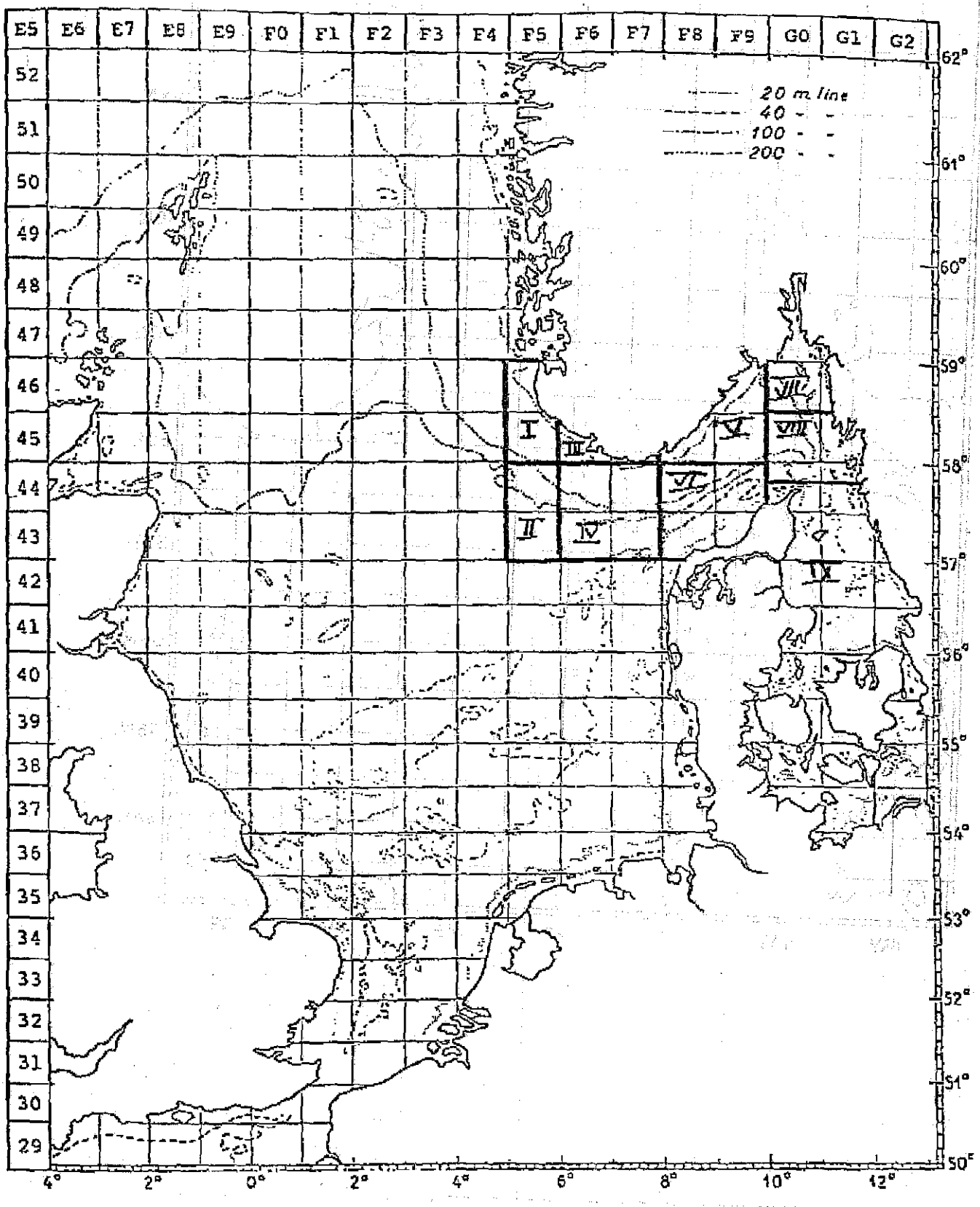


Figure 10 Subareas used during the acoustic survey of RV *Dana* in the period 2-13 July 1997.

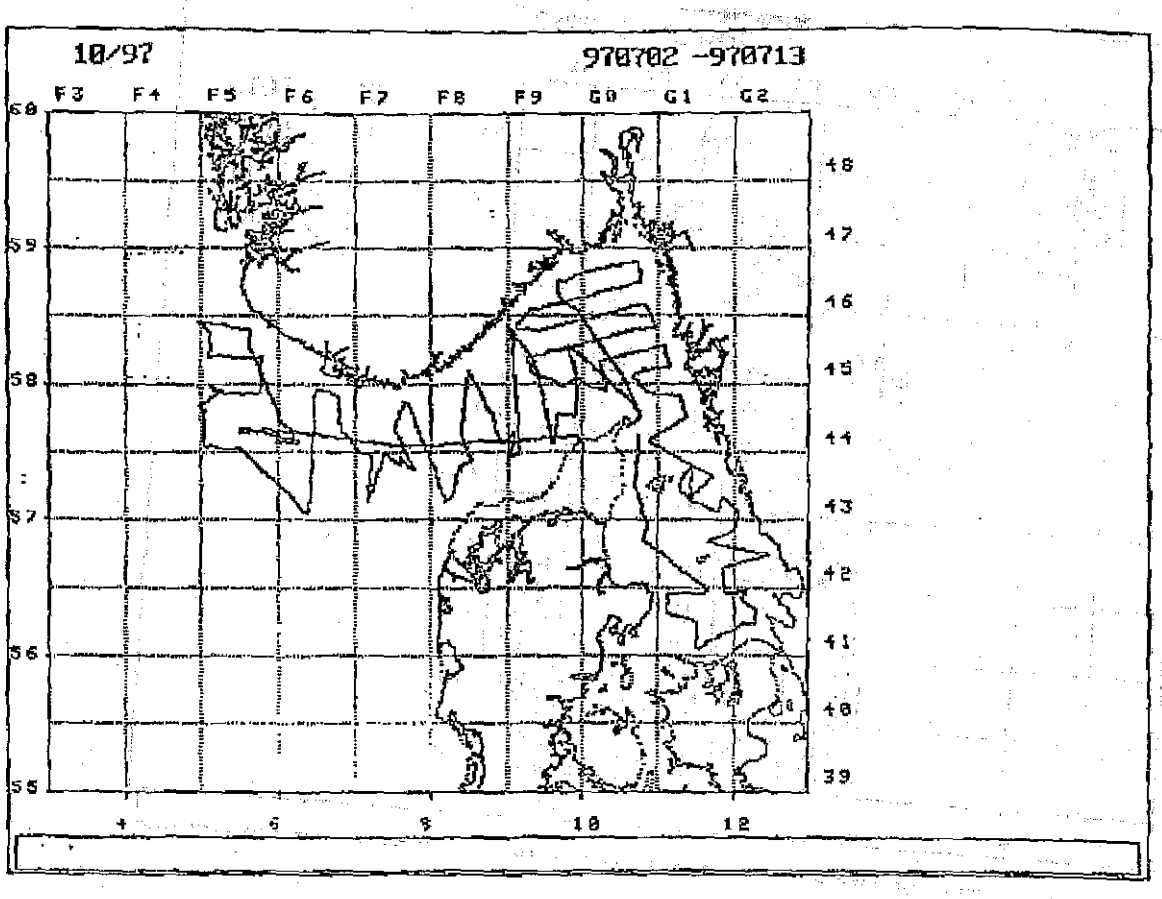


Figure 11 Cruise track during the acoustic survey of RV *Dana* in the period 2-13 July 1997.

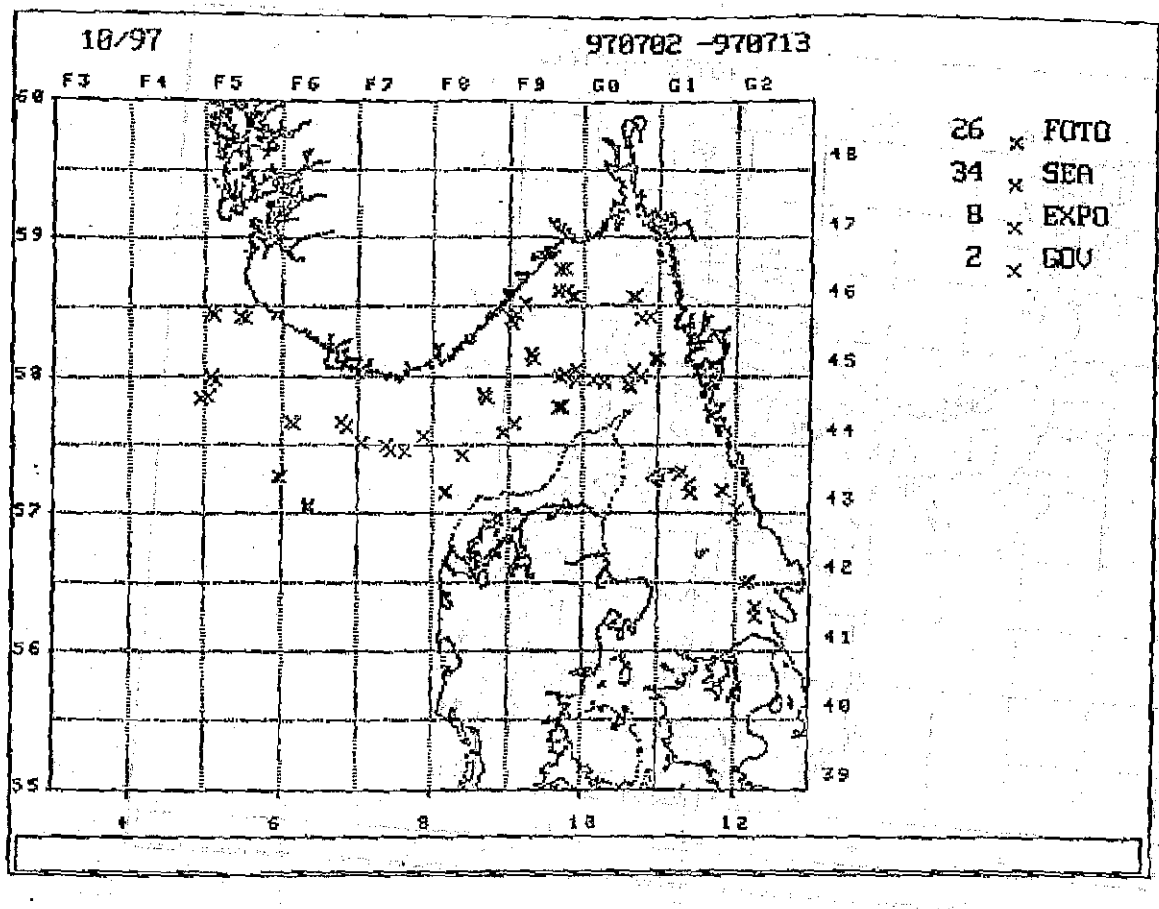


Figure 12 Trawl haul positions during the acoustic survey of RV *Dana* in the period 2-13 July 1997.

Figure 13 The length frequency of herring for each trawl haul during the acoustic survey of RV Dana in the period 2–13 July 1997

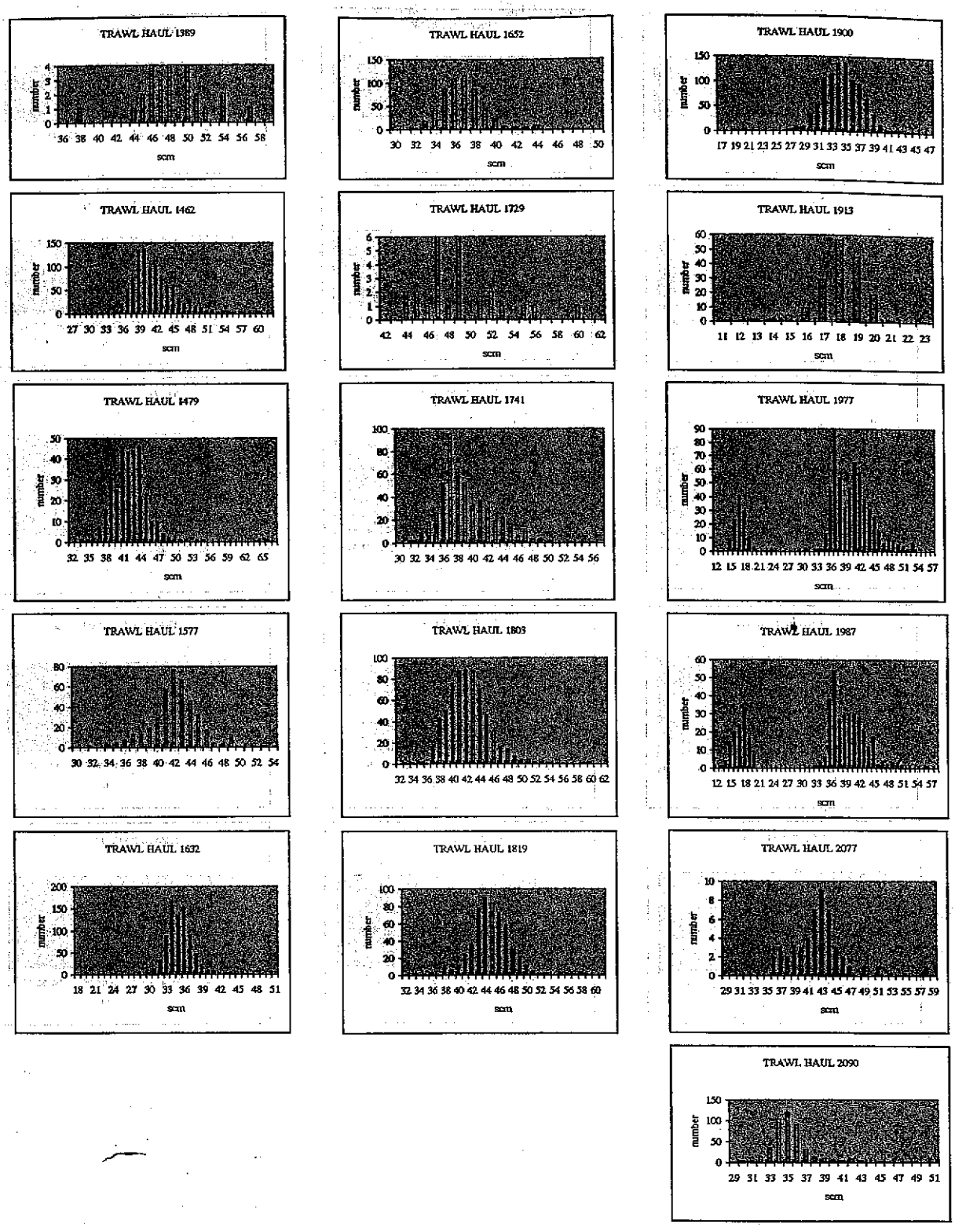


Figure 13 Continued

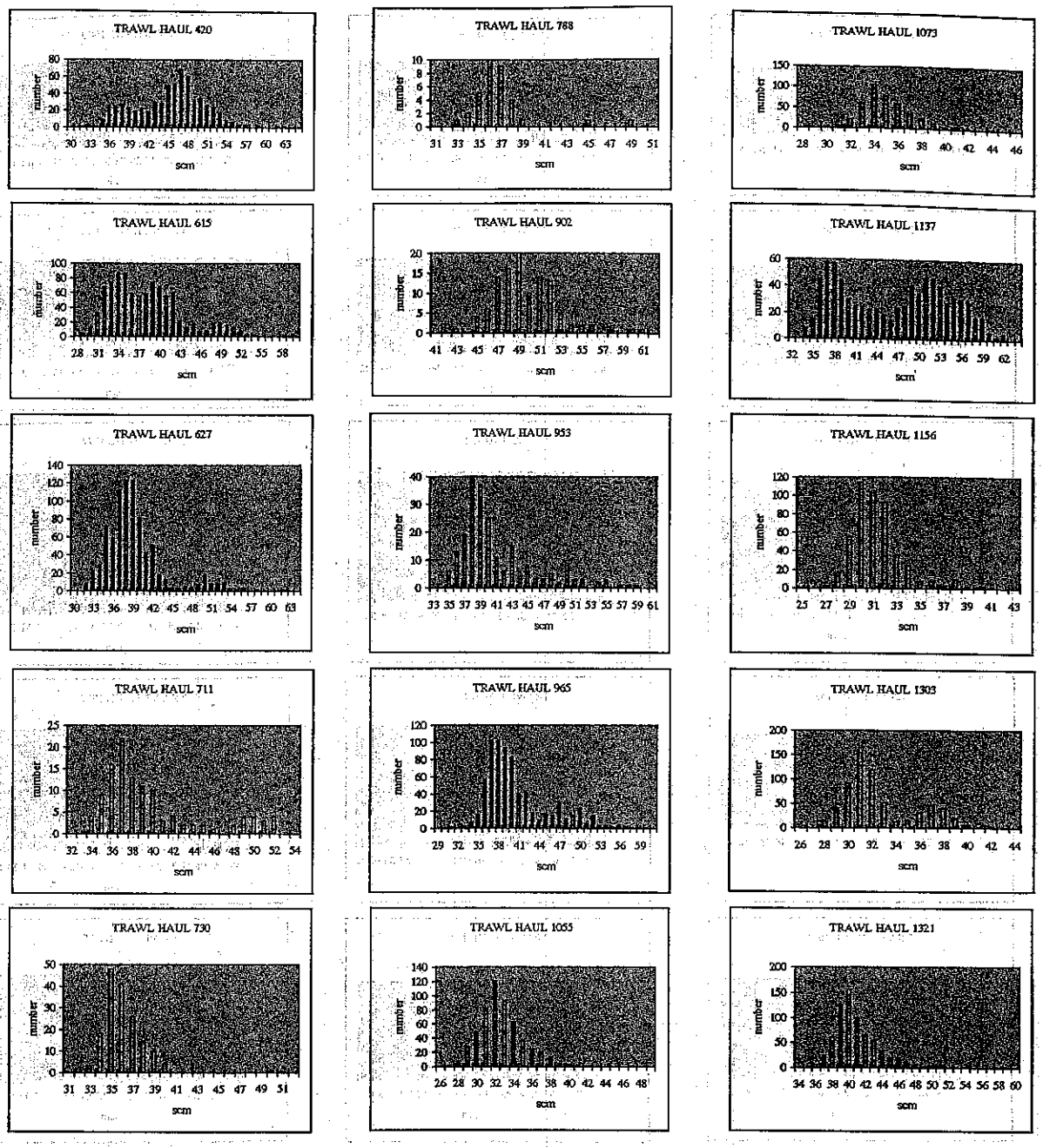


Figure 14 . The length of herring caught within the 100 m, 100-200 m and 200 m line of depth during the acoustic survey of RV Dana in the period 2-13 July 1997

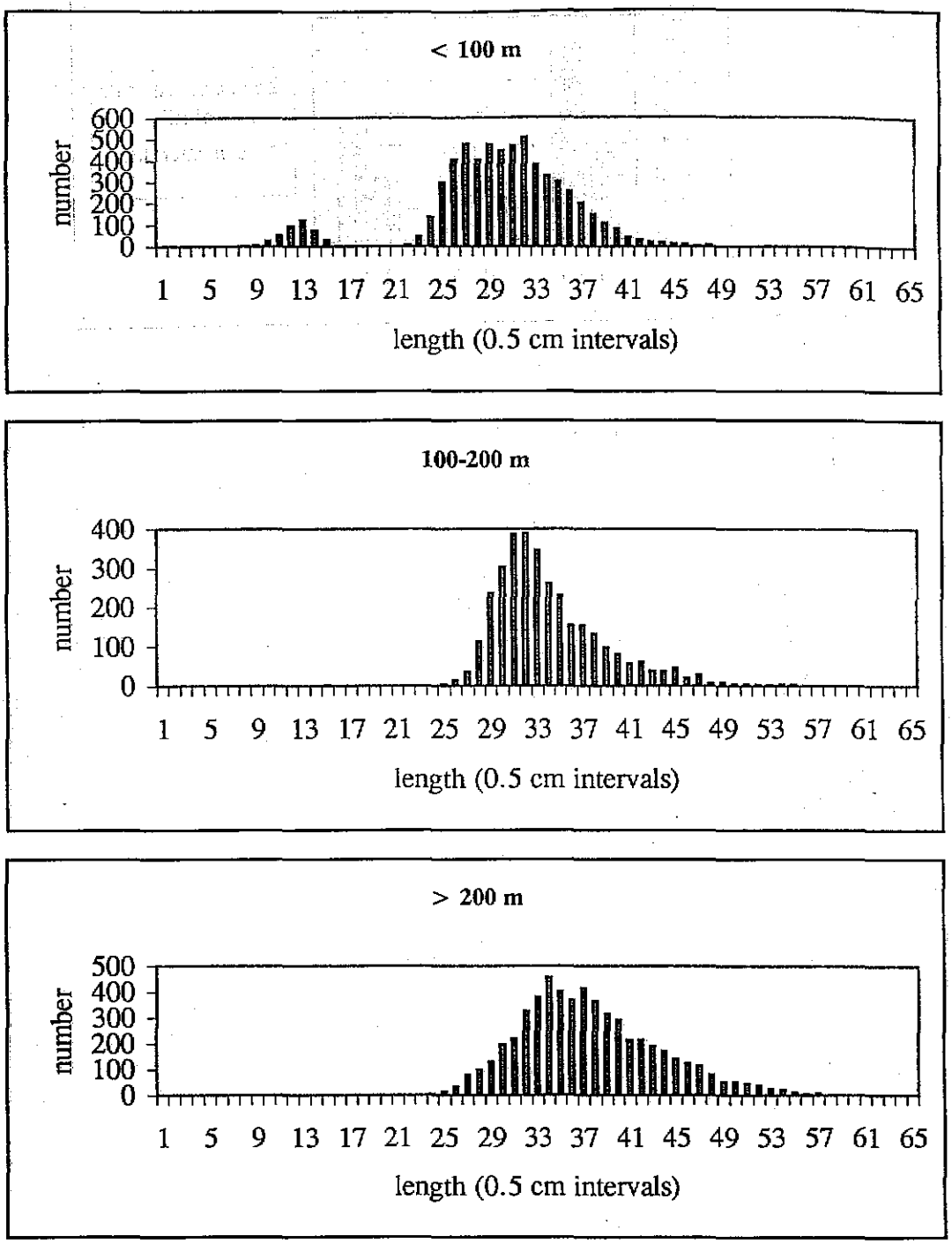


Figure 15 The mean catch and the acoustic estimate of herring during the acoustic surveys of RV Dana in the period 1995–1997

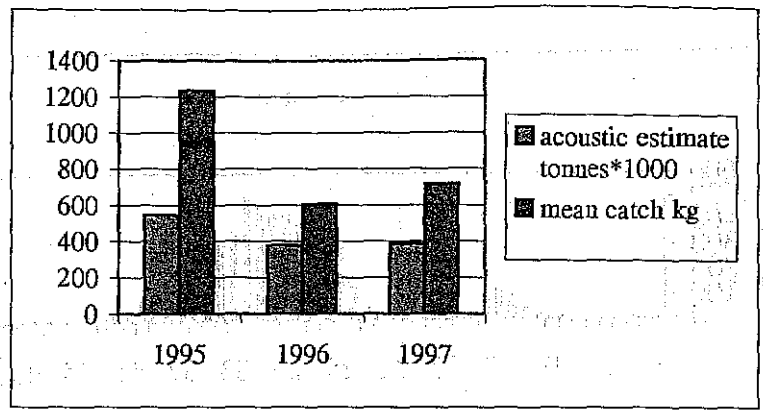


Figure 16 Survey track Scotia 17 - 30 June 1997

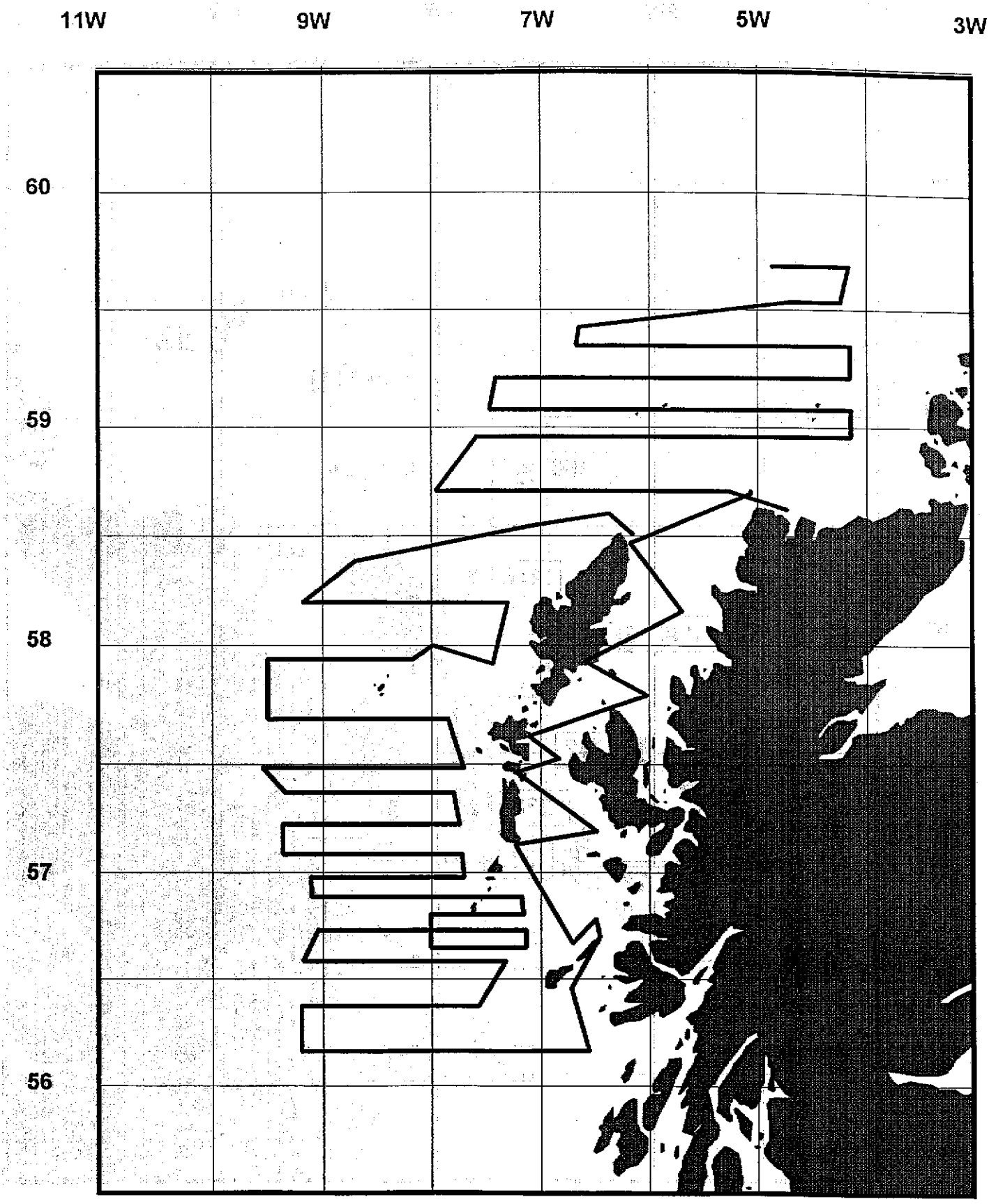


Figure 17 Herring haul positions and area subdivisions
Scotia 17 - 30 June 1997

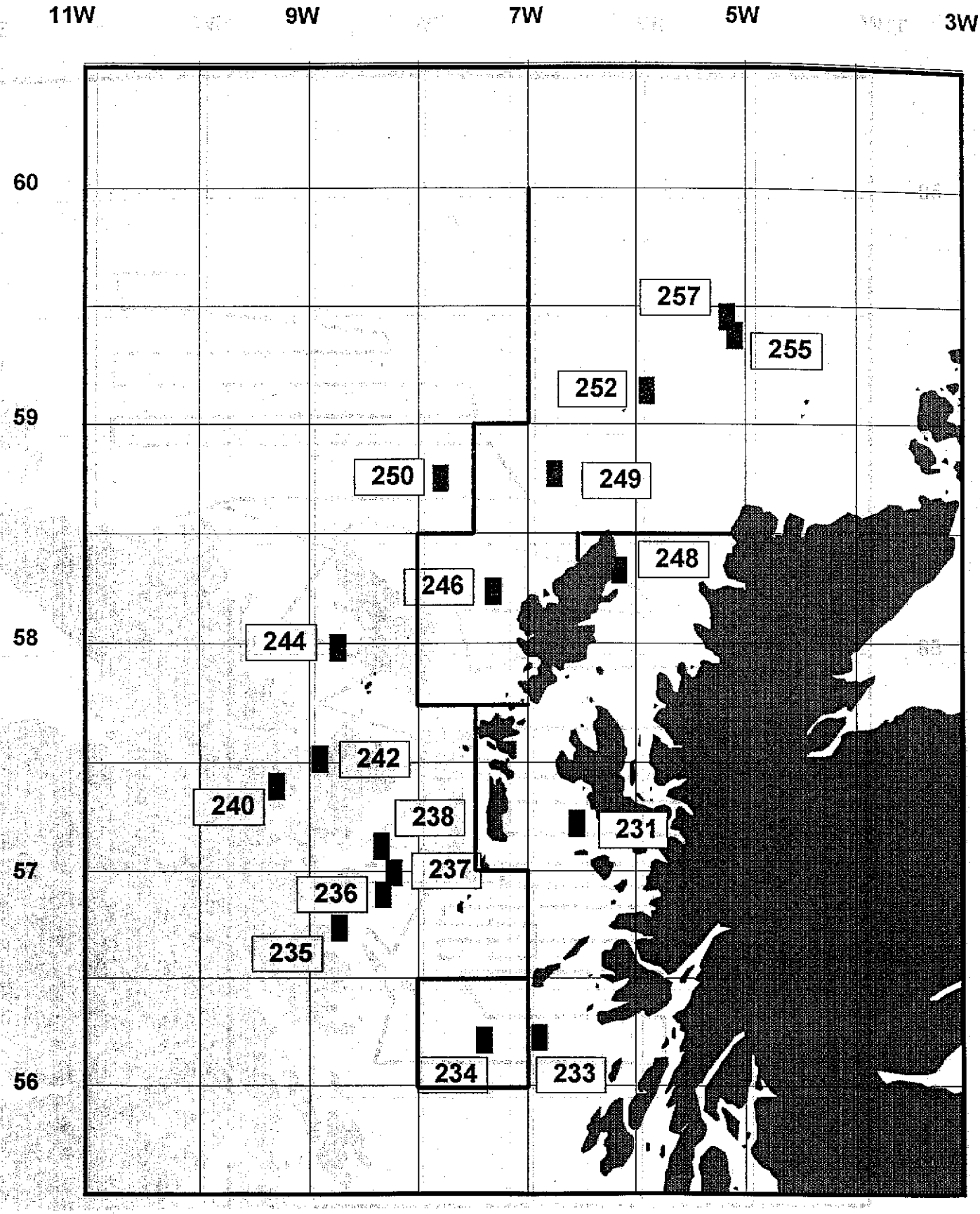


Figure 18
Herring numbers (millions) - top
Herring biomass (ktonnes) - bottom
Scotia 16 June - 3 July 1997

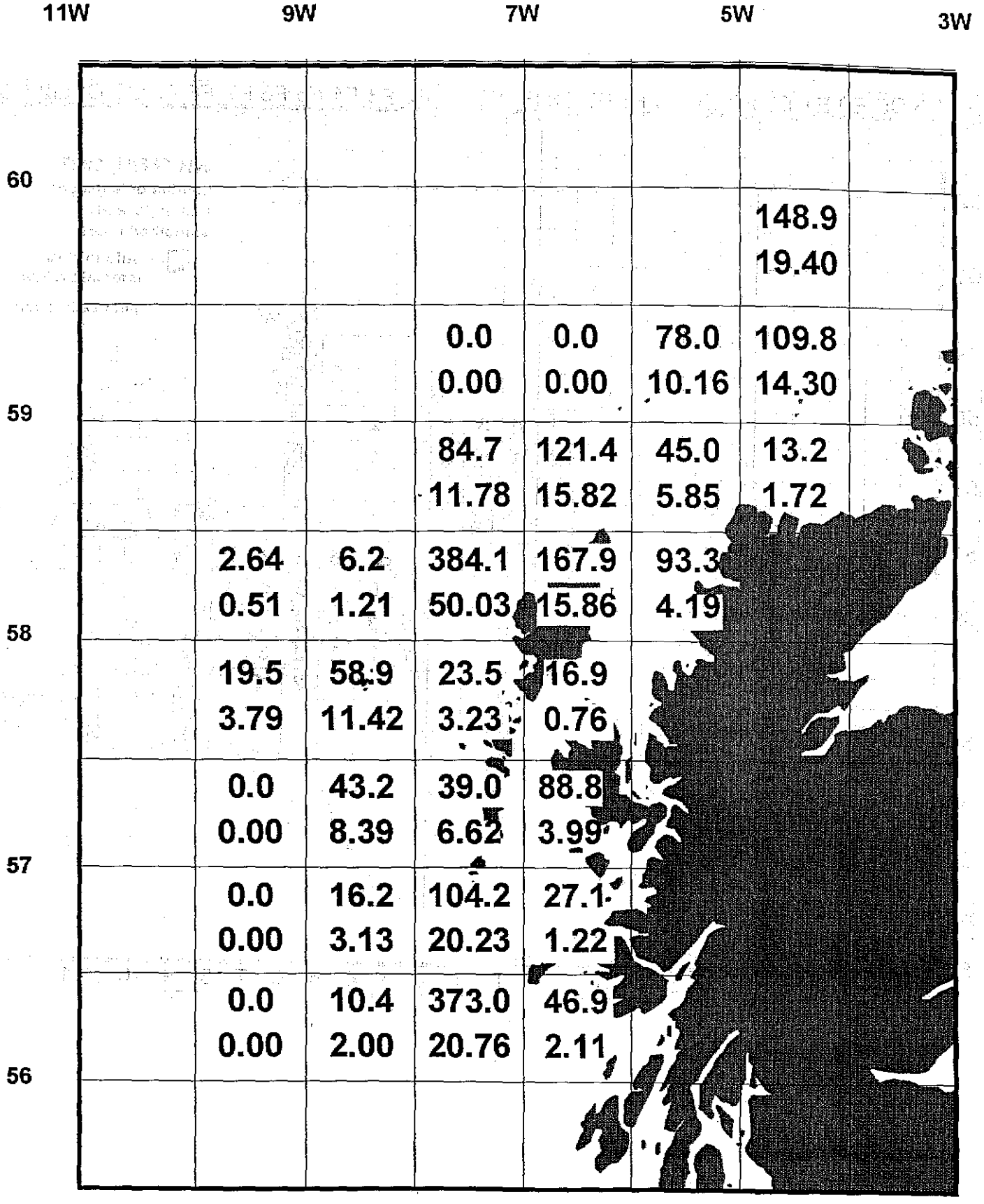
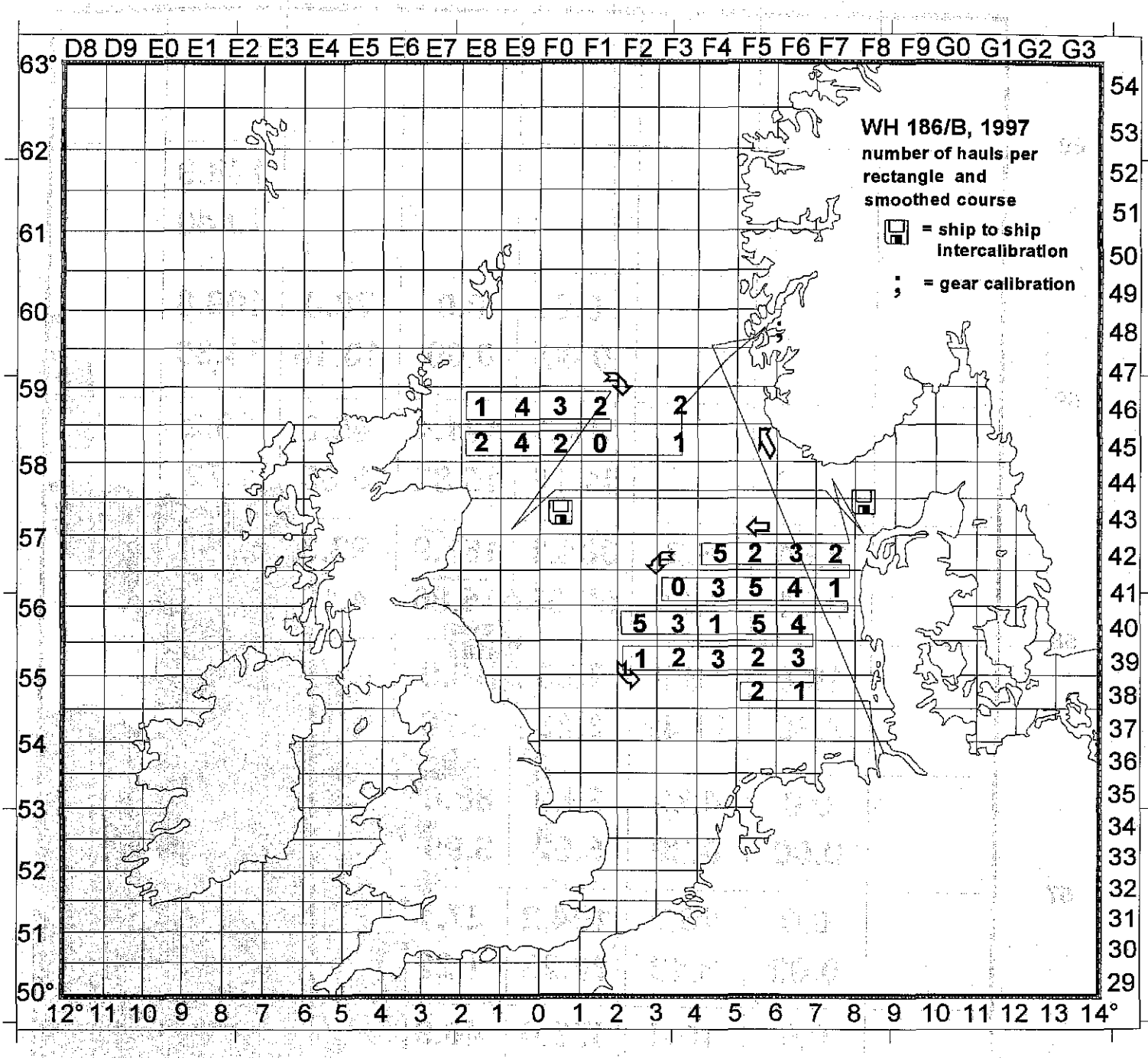


Figure 19. Cruise track *Walter Herwig III* 26 June to 16 July 1997 and number of trawl hauls per rectangle.



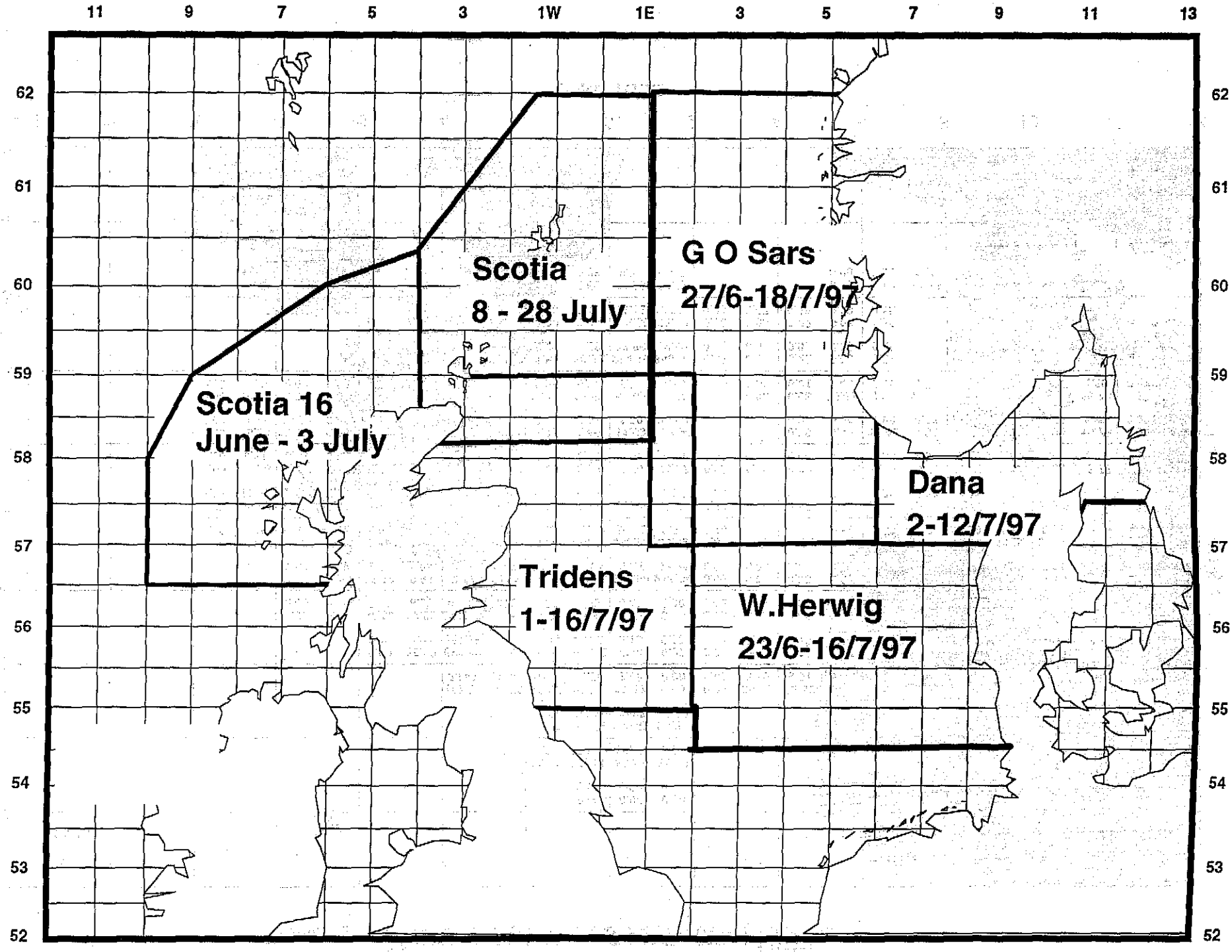


Figure 20 . Survey areas and dates for the combined acoustic herring surveys June - July 1997

FIGURE 21 **Mature autumn spawners (1997).**

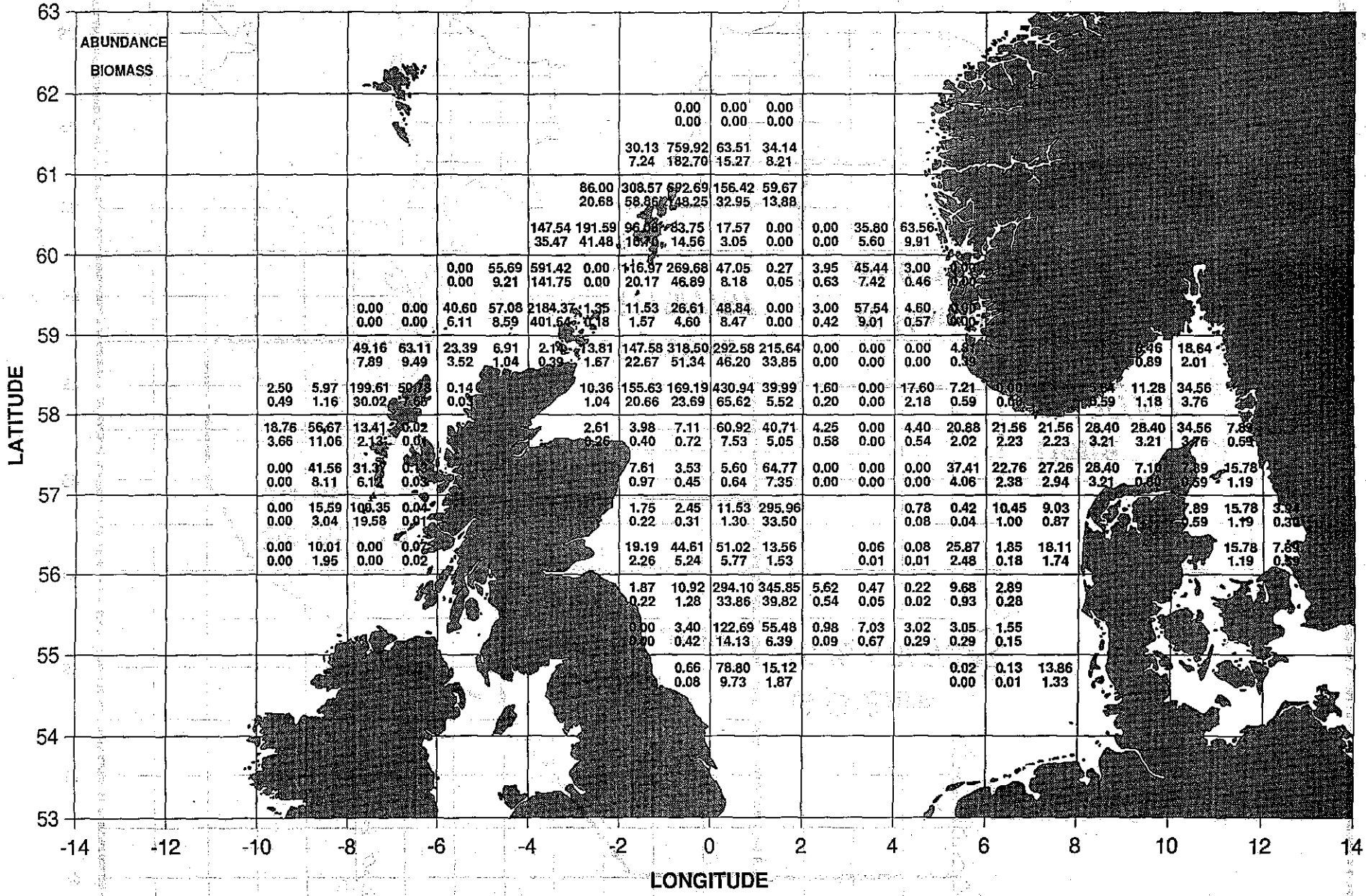


FIGURE 22

Numbers (millions) 1, 2 and 3+ group (1997).

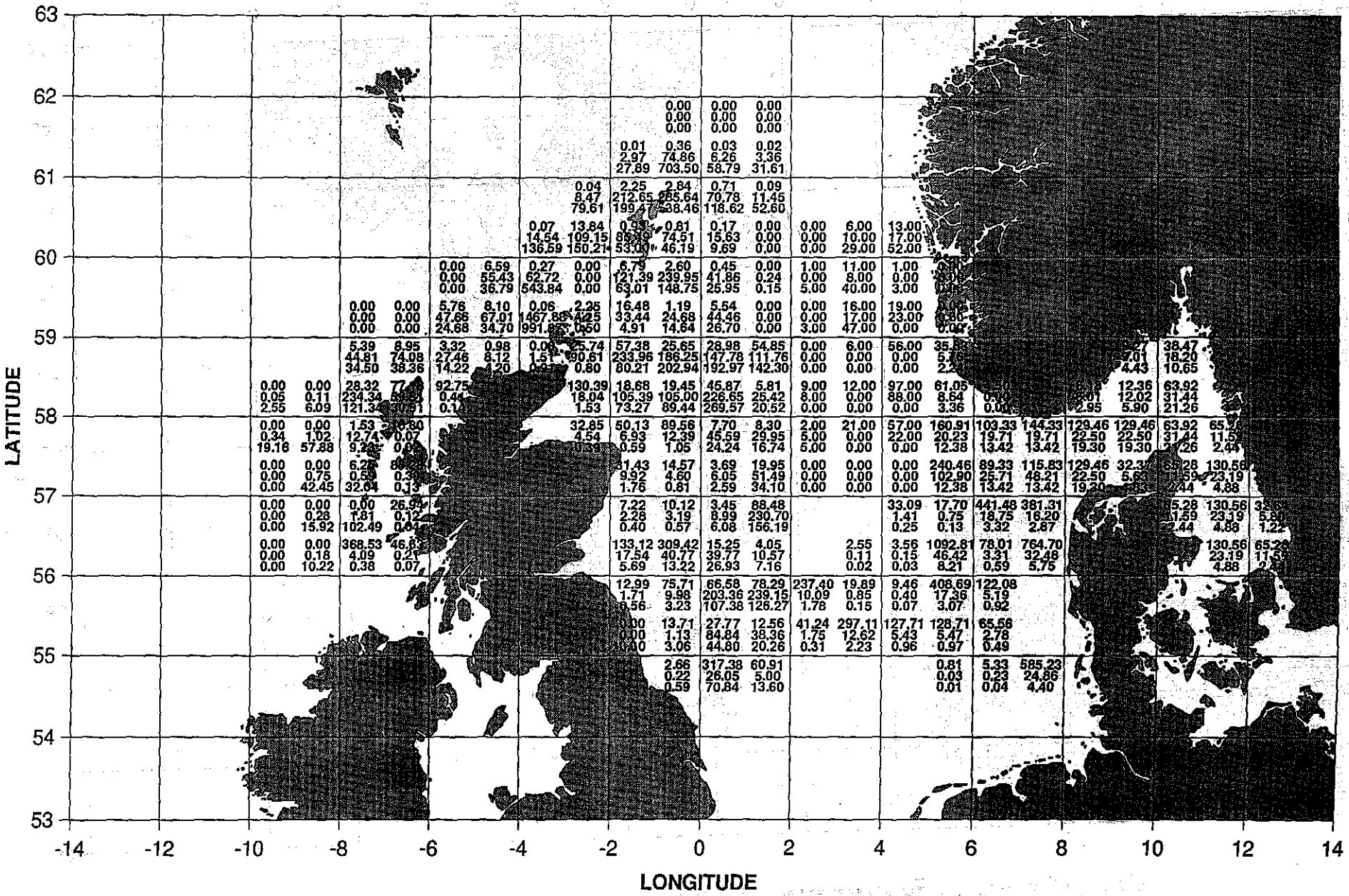


FIGURE 23 **Numbers (millions) of mature autumn spawners (1997).**

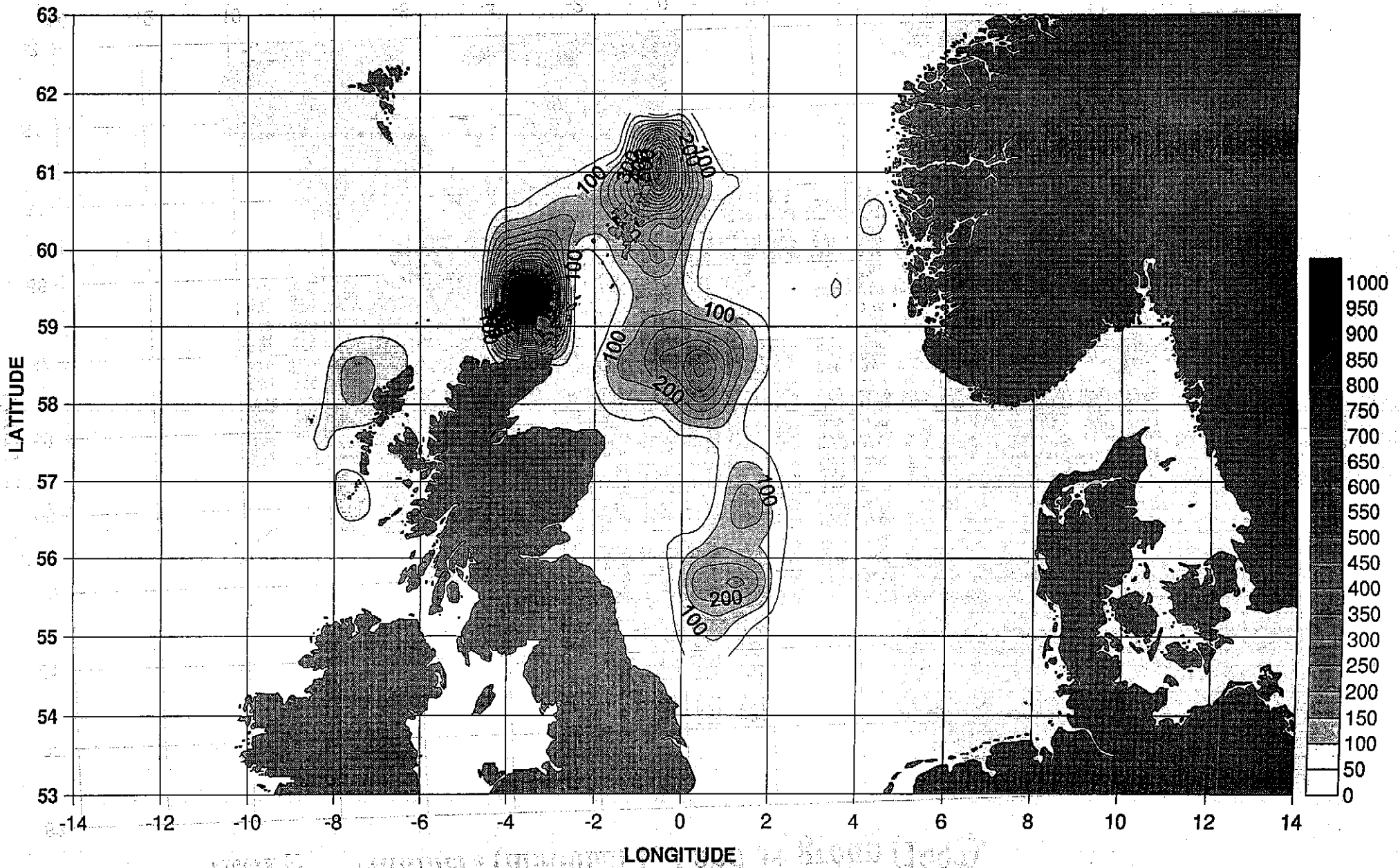
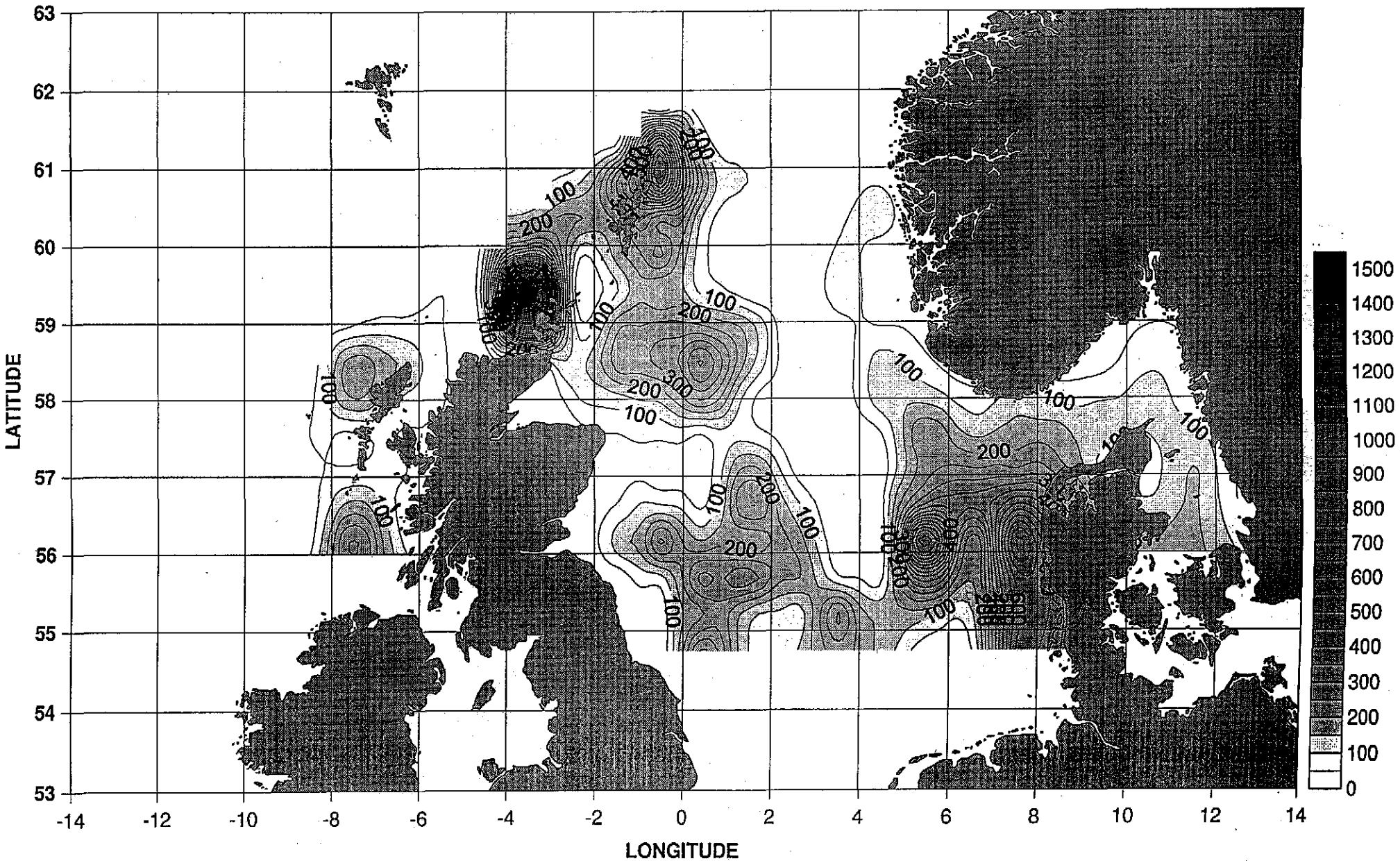


FIGURE 24 **Numbers (millions) of North Sea autumn spawning herring (1997).**



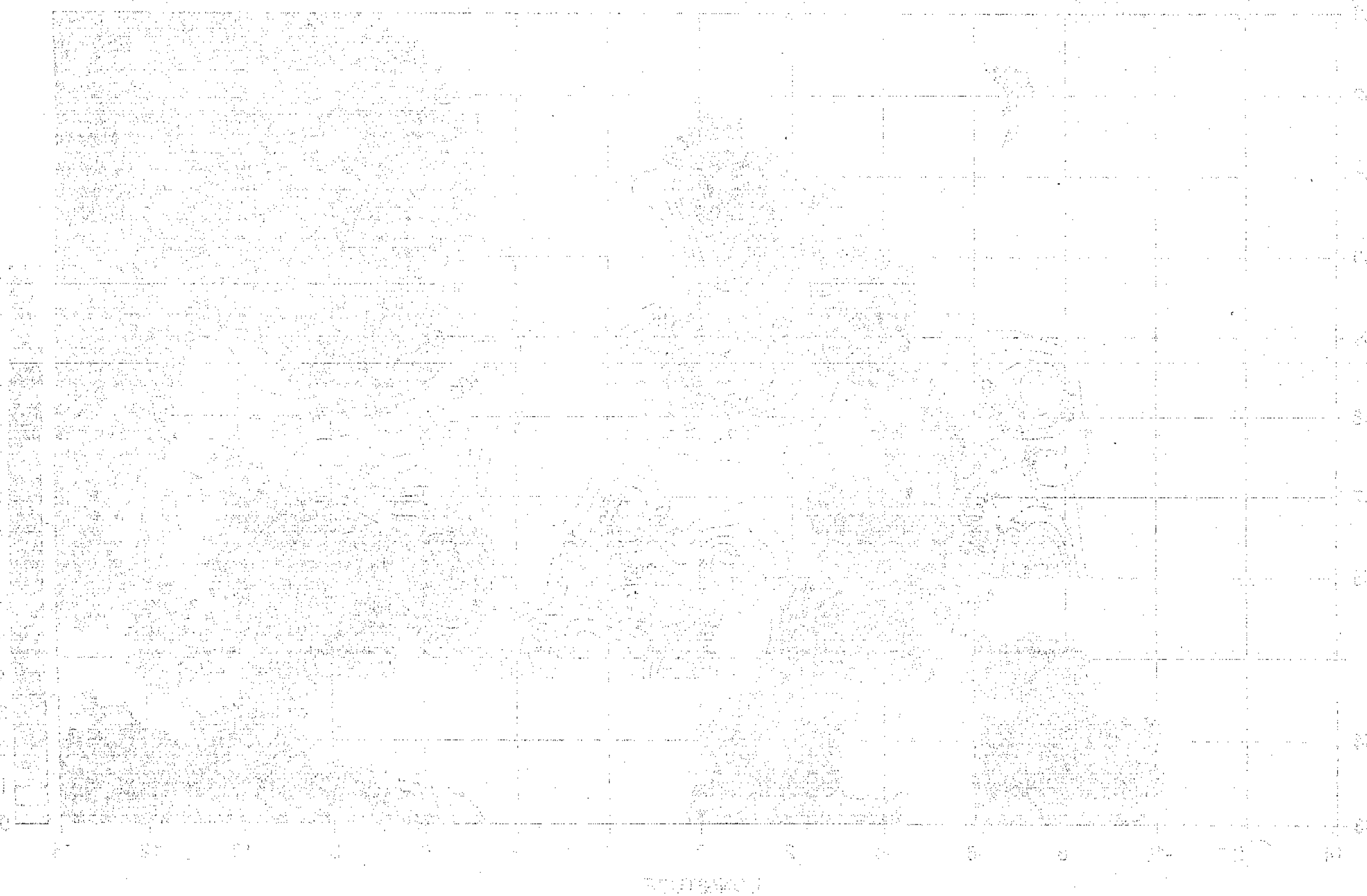


Figure [illegible]. Numbers (millions) of North Sea autumn spawning herring (1971).